OPERATING INFORMATION

W072491

The Ultimate Scanner is easy to operate. You can learn the basic operation of this unit in the first few minutes of hands-on operation. Although the Ultimate Scanner is simple to operate, its capabilities are numerous. The following section will describe the operating features of the Ultimate Scanner and some of its capabilities.

1. MULTI-FUNCTION CAPABILITY:

The Ultimate Scanner has 8-channel capability for each of the displays. For a 6-cylinder single-engine aircraft, the first 6-channels on the left display should be used for EGT and the first 6 channels on the right display should be used for CHT. For a twin-engine aircraft the first 6 channels should be left EGT and right EGT. These channels are designated as analyzer channels. The Peak Locate, Hottest Cylinder Indicator and Differential Warning features are only functional on the analyzer channels. The number of analyzer channels is independently programmable from 1 to 8 for each display. The Over-Temp and Low-Temp features are functional on all channels and any channel may be used to measure any temperature (TIT, Oil, EGT, CHT, OAT, Carb, Induction Air, Cabin Air, Cowling Air, etc.).

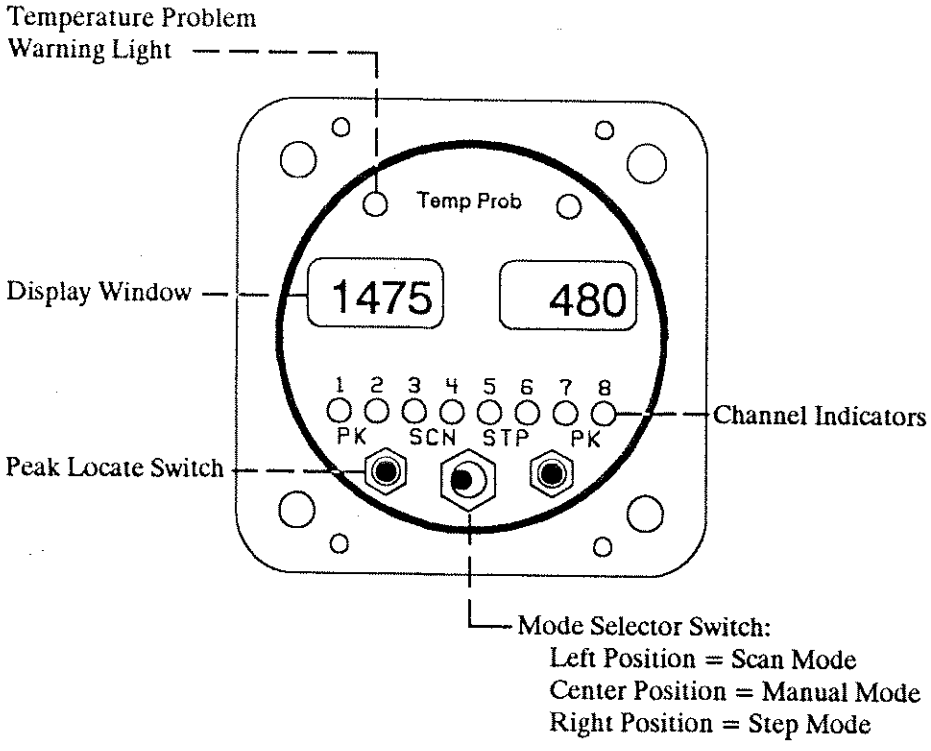
2. MODE SELECT SWITCH:

A) **Manual Mode** - With the Mode Select Switch in the center position, the Ultimate Scanner will display the temperatures on the channel designated by the green Channel Indicators.

B) **Step Mode** - Each time the Mode Select Switch is pressed to the right, the Ultimate Scanner will advance to the next channel. When this switch is released, it will return to the center position (Manual Mode). The Ultimate Scanner can be programmed to step through any number of channels from 2 through 8 from the front panel.

C) **Scan Mode** - In the Scan Mode, the Ultimate Scanner will automatically scan through the channels. When the unit is first placed into the Scan Mode, it will switch to Channel One to start its scan. This is done to establish a reference for the automatic engine analysis features.

The Ultimate Scanner may be placed in the Scan Mode during run up, takeoff, climb or cruise, as long as the engine temperatures are increasing or stable. This unique operating characteristic allows the Ultimate Scanner to stand watch over your engine during most phases of a flight. But if the engine temperatures are decreasing, the Ultimate Scanner should be set in the Manual Mode of operation to eliminate any false Differential Condition problems it may find and to enable the automatic Shock-Cooling Detection feature.



3. PEAK LOCATE SWITCH:

There are two Peak Locate Switches, one for the left display and one for the right. The Peak Locate feature may be used in the Manual or Scan Mode of operation. Its purpose is to eliminate all of the mental calculations and time to find the hottest cylinder. This can be a real asset in leaning or locating a possible problem. When used for (EGT) leaning, it should be noted that the leanest cylinder is not always the hottest; but in most cases, it is. For those few engines in which the hottest cylinder is not the leanest, most pilots have found little difference when leaning with either cylinder. In any case, the Ultimate Scanner will help you check out your engine for its unique operating characteristics.

A) Manual Mode - To find the hottest analyzer cylinder in the Manual Mode, press the "Peak" button. The Ultimate Scanner will automatically switch to Channel One and start a fast scan (one second per channel). It will only scan through the analyzer channels and remain on the hottest channel when done.

B) Scan Mode - You may also use the Peak Locate feature in the Scan Mode. The Ultimate Scanner will operate the same as in the Manual Mode. After it has found the hottest analyzer channel it will continue scanning at the programmed scan rate.

4. HOTTEST CYLINDER INDICATOR:

In the Scan Mode, the Ultimate Scanner will light a bar high in the left hand corner of the display any time it is displaying the hottest analyzer cylinder. This feature allows you to determine if the leanest cylinder has changed. If this happens, you may need to readjust your mixture.

5. "TEMP PROB" WARNING LIGHTS (Automatic Engine Analysis):

A) Over-Temp Problem (Scan and Manual Modes) - If the temperature being displayed exceeds the programmed limit, the "Temp Prob" warning light over the appropriate display will come on. Also, a bar high in the left hand corner of the display will light. If you are in the scan mode, the scan will stop on the problem channel.

B) Under-Temp Problem (Scan Mode only) - If the temperature being displayed is less than the programmed Low Limit, the "Temp Prob" warning light over the appropriate display will come on. Also, a bar low in the left hand corner of the display will light and the scan will stop on the problem channel.

C) Differential Temp Problem (Scan Mode only) - Any time the temperature difference between the hottest and coldest channel exceeds the programmed limit the "Temp Prob" warning light over the appropriate display will come on. Also, the high and low bar in the left hand corner of the display will alternately blink and the Ultimate Scanner will stop on the coldest cylinder. In this case, the problem may be the coldest cylinder or it may be the hottest cylinder. By comparing temperatures with adjacent cylinders the problem cylinder will become apparent. To quickly find the hottest cylinder, press the "PEAK" button on the front panel.

D) Shock-Cooling Temp Problem (Manual Mode only) - Any time you are on a channel on which the High Limit is programmed between 300'F and 600'F (this indicates a CHT channel) and the temperature being monitored is between 300'F and 600'F (this is the critical range of cylinder head temperatures) and the temperature is decreasing faster than the programmed limit, the appropriate "Temp Prob" warning light will blink.

NOTE: The Ultimate Scanner will stop on the first channel on which it finds a problem and light the appropriate "Temp Prob" warning light. If the problem corrects itself, the "Temp Prob" warning light will go out and the Ultimate Scanner will continue its scan.

6. BACK LIGHT and CHANNEL INDICATOR INTENSITY:

The Ultimate Scanner comes with 12 and 24 volt back light control lines. If the appropriate line is connected to your panel light rheostat, the display back light can be controlled during night operation. As the back light intensity increases, the Channel Indicators will dim. If you find the Channel Indicators to be too bright during daytime operation, turn the panel light rheostat up slightly to control the intensity of the Channel Indicators to suit your requirements.

PROGRAMMING INFORMATION

Although programming may be new to some of you, programming the Ultimate Scanner is simple. After a few tries, you should have the hang of it. No matter which buttons you push or limits you set, you cannot hurt the Ultimate Scanner and any limit can be reset.

1. MANUAL PROGRAMMING MODE:

There are two programming modes: Manual and Scan. In the Manual Mode you can program the High Limits, Low Limits, Differential Limits and Shock-Cooling Limits for both the left and right displays. Before setting your limits it may be helpful to read the Application Information section of this manual to get an idea where the limit should be set.

To enter the Manual Programming Mode, select the channel you would like to program using the Step position on the Mode Selector Switch. Then with the Mode Selector Switch in the center position, push both Peak buttons at the same time.

A) Programming a High Limit - High in the far left hand corner of the left and right Display Windows will be a bar. This bar indicates you are programming the High Limit. The blinking digit is the only digit you can program at this time.

1) **Advance a Digits Count** - Use the Step position on the Mode Selector Switch to advance the digit to the desired limit you would like. Programming all digits to "000" will disable the High Limit.

2) **Select a Digit** - The left and right Peak Locate Switch can be used to select the desired digit in the left or right Display Window you would like to program. Set one digit, then the next untill all digits for that limit are set, then move on to the next limit.

3) **Changing Functions** - If you are done programming the High Limits for this channel and would like to program the Low limits, place the Mode Selector Switch in the Scan position. In this manner the Mode Selector Switch will call up the different programmable limits (for the channel selected) in the following sequence:

   High Limit (set on each channel)
   Low Limit (set on each channel)
   Differential Limit (set once on any channel)
   Shock-Cooling Limit (set once on any channel)

4) **Leaving the Programming Mode** - You may leave the programming mode at any time by pushing both Peak Buttons at the same time. When this is done, the programmed information is stored in memory for life. The Ultimate Scanner does not use any internal batteries and the information will not be lost if the unit is disconnected from power or removed from the aircraft.

B) **Programming the Low Limit** - Low in the far left hand corner of the left and right Display Windows will be a bar. This bar indicates you are programming the Low Limit. The Low Limit may be programed as shown in steps A-1 and A-2.

To program the Differential Limit, place the Mode Selector Switch in the Scan position. If the Differential limits and Shock-Cooling limits have already been set, you may want to leave the programming mode at this time (see step A-4).

C) **Programming the Differential Limit** - There will be NO bars in the far left hand corner of the left and right Display Windows. This indicates you are programming the Differential Limit. The Differential Limit sets the maximum allowed difference between the hottest cylinder and the coolest cylinder for the analyzer channels only. Analyzer channels would be EGT's or CHT's and always start with channel one. There is only one Differential limit for each Display Window. This limit can be set on any channel but only needs to be set once. The Differential Limit may be programed as shown in steps A-1 and A-2.

To program the Shock-Cooling Limit, place the Mode Selector Switch in the Scan position.

D) **Programming the Shock-Cooling Limit** - The Shock-Cooling limit will be preceded by an "Sc" in the left and right Display Windows. The limit is displayed in seconds per one degree change. The Shock-Cooling Limit may be programed as shown in steps A-1 and A-2. To program the High Limit, place the Mode Selector Switch in the Scan position and go to step A. To leave the programming mode, see step A-4.

2. SCAN PROGRAMMING MODE:

There are two programming modes: Manual and Scan. In the Scan Mode you can program the following functions in the sequence listed below:

Scan Rate
Last Channel
Analyzer Channels

To enter the Scan Programming Mode, place the Mode Selector Switch in the Scan position and push both Peak buttons at the same time. It does not matter which channel is being displayed when you do this.

A) **Programming the Scan Rate** - In the left display will be the letters "Scn," indicating you are programming the Scan Rate. In the right display will be the Scan Rate displayed in seconds. This number indicates the time the Ultimate Scanner will display a channel before stepping to the next channel. The Scan Rate may be programed from 2 to 9 seconds by using the Step position on the Mode Selector Switch.

To program the Last Channel, place the Mode Selector Switch in the Scan position.

B) **Programming the Last Channel** - In the left display will be the letters "Ch," indicating you are programming the Last Channel to be used (the last channel on which you've connected probes and cables). In the right display will be the last channel the Ultimate Scanner will display before resetting to channel one. The Last Channel may be set by using the Step position on the Mode Selector Switch.

To program the Analyzer Channels, place the Mode Selector Switch in the Scan position.

C) **Programming the Analyzer Channels** - In the left and right display will be "1-?", indicating you are programming the Analyzer Channels. The ? will be a number between 1 and 8 and is programmable. If you have a 6-cylinder single-engine aircraft and have the left display channels 1 through 6 connected to EGT's and the right display channels 1 through 6 connected to CHT's, you would program the left and right display for "1-6." This would set up the first six channels to be analyzed against the Differential Limit and these channels are the only ones looked at when the Peak Button is pressed. Channels 7 and 8 may be used for any other temperature measurement without interfering with the Differential or Peak Locate features.

To program the Analyzer Channels use the Step position on the Mode Selector Switch to advance the count. The Peak Buttons may be used to select the left or right digit. To leave the programming mode, press both Peak Buttons at the same time.

APPLICATION INFORMATION

1. LEANING:

A rich running engine wastes fuel needlessly and tends to run on the rough side, thereby creating vibration, which causes deterioration of engine accessories and engine mounts. Also, proper leaning at cruise and during descent means less spark plug fouling, longer life for the plugs, reduced maintenance costs and a considerable fuel savings. Furthermore, good leaning techniques result in cleaner combustion chambers with fewer lead salt deposits on the pistons and exhaust valves. Under certain conditions, these deposits invite preignition and higher maintenance costs. 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.

A) Rough Adjustment: During cruise, slowly adjust the mixture control from the full rich position to a leaner setting that results in a slight drop in engine RPM or a rough running engine. Then enrichen the mixture slightly from this position. The mixture control should be left at this setting until the EGT's stabilize. It will take about 30 seconds for the temperature to stabilize within 1'F. This lag is due to the combustion walls and piston domes increasing in temperature and, therefore, affecting the combustion and exhaust gas temperatures. To correctly lean an engine you must wait for the engine to thermally stabilize. Less sensitive gauges will not pick up these subtle changes, which are important in leaning and diagnosing problems.

B) Precision Adjustment: Press the "Peak" button on the Ultimate Scanner to find the hottest EGT cylinder. Again, start leaning, only this time making very small adjustments to your mixture control. The 1`F resolution of the digital display will react instantly, telling you whether your engine is on the rich or lean side of peak EGT. Our unique stable display allows you to lean precisly to peak EGT or to a specific temperature below peak for most engines. Peak EGT with a float-type carbureted engine is frequently a vague point because of the fuel/air distribution problems in these lower horsepower engines. As a result, these engines tend to operate smoother at 25`F on the rich side of peak EGT. The fuel-injected engines will provide a more precise peak. Most engines normally operate within an EGT range of 1200`F to 1600`F at cruise power.

Some engine manufacturers allow leaning to peak EGT at 75% power and below on their direct drive normally aspirated engines. For your engine, check the engine manufacturer's recommended procedures. It is not recommended to lean for peak EGT above 75% power settings. The richer mixture is needed to cool the combustion temperatures and keep the anti-knock capability of the fuel high enough to prevent detonation from occurring at the higher power settings.

2. EGT's:

The Exhaust Gas Temperatures are directly related to your engine's ability to produce power. If any cylinder has a problem producing power (fouled pluged, burned or stuck valve, broken ring, intake leak, plugged injector, timing problem,

bad mag, etc.) the EGT's for that cylinder will be abnormally high or low depending on the problem. Each cylinder on your engine operates differently and has a normal operating temperature of its own. The Ultimate Scanner is capable of being programmed to match each cylinder on your engine. When selecting the following limits, it is assumed your engine does not have a problem and is operating properly.

A) 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.

B) Selecting the Lower EGT Limits: Set your aircraft up in a normal cruise power condition. Adjust the mixture full rich and wait for the EGT's to stabilize. Once the EGT's have stabilized, record the EGT readings for each cylinder. Program the Lower Limit for each cylinder 50'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.

C) Selecting the Differential EGT Limit: Your engine's EGT's will vary for different power, altitude and mixture settings . To further enhance the Ultimate Scanner's ability to detect a problem, set up your aircraft in a normal cruise power condition. Record the EGT's for each cylinder at peak EGT. Set the Differential Limit for 50% higher than the difference between the hottest and coldest EGT readings (i.e., Hottest EGT - Coldest EGT = Diff. X 1.5 = Setting). 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.

2. TIT:

Running your engine with Turbine Inlet Temperatures (TIT) above 1650'F can cause hairline thermal stress cracks in the turbine housing. Also, it can cause detonation and preignition, which will lead to burned valves, bent valve stems, broken rings and cracked exhaust systems. Controlling your TIT temperatures is essential for turbocharged aircraft.

The Ultimate Scanner will continuously monitor your TIT in the scan mode. If the TIT exceeds the programmed High Limit, the Ultimate Scanner will stop and light a bright red warning light over the display, immediately alerting the pilot of an over-temperature condition. This is an important feature for turbocharged aircraft since Turbine Inlet Temperatures can easily creep above limit after a change in power or mixture settings.

Another advantage of the Ultimate Scanner over conventional gauges is its extreme accuracy and linearity. This assures you of accurate TIT readings.

Turbine housing life is also affected by sudden changes in temperature. Thermal shock can occur during abrupt changes of the mixture or power settings. Make gentle changes in the mixture and power settings when transitioning from a higher TIT to a lower temperature.

The Ultimate Scanner's 1'F resolution will help in assuring that the proper transitioning of the TIT is taking place.

A) Selecting the High TIT Limit: Set your High TIT Limit for the maximum limit allowed (or lower) for your aircraft. For most aircraft this limit will be 1650'F. 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.

B) Selecting the Lower TIT Limit: Set up your aircraft in a normal cruise power condition. Adjust the mixture full rich and wait for the TIT to stabilize. Once the TIT has stabilized, record the TIT reading. Program the Lower TIT Limit 50'F below the recorded reading. 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.

3. CHT's:

The Ultimate Scanner helps you protect your engine against the threat of excessive heat. Most general aviation aircraft take the CHT off the hottest cylinder determined by extensive flight tests. Minimum in-flight CHT should be 150'F, and maximum in most direct drive normally aspirated Avco Lycoming engines is 500'F. Some of the higher-powered, more complex engines have a limit of 475'F. Although these are minimum and maximum limits, the pilot should operate the engine at more reasonable temperatures in order to achieve the expected overhaul life of the powerplant. It would be normal during all-year operations in climb and cruise to see head temperatures in the range of 350'F to 435'F.

Sudden cooling of the CHT (known as Shock-Cooling) is a problem that is common with aircraft engines. This is caused by fast descents with little or no power and rich mixtures. This may 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. To avoid these problems, do not allow the CHT to cool more rapidly than 1'F every 3 seconds during in-flight operation. The Ultimate Scanner will automatically detect a Shock-Cooling condition in the normal mode of operation for the cylinder being displayed. When it detects a CHT descending too rapidly the red light over the CHT display will blink.

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

The 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 CHT for that cylinder will be abnormally high or low depending on the extent of the problem. Each cylinder on your engine operates differently and has a normal operating temperature of its own. The Ultimate Scanner is capable of being programmed to match each cylinder on your engine. When selecting the following limits, it is assumed your engine does not have a problem and is operating properly.

A) Selecting the High CHT Limits: On a hot day with your engine set to 75% power, lean your engine to peak EGT. Record the CHT readings for each cylinder with the cowl flaps closed. Program the High Limit for each cylinder 40'F above the recorded reading for that cylinder. This limit should not be set higher than the maximum limit allowed for your aircraft. 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.

B) Selecting the Lower CHT Limits: Set your aircraft up in a normal cruise power condition. Adjust the mixture full rich and wait for the CHT to stabilize. Once the CHT has stabilized, record the CHT readings for each cylinder. Program the Lower CHT Limit 50'F below the recorded reading 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.

C) Selecting the Shock-Cooling Limit: Set the Shock-Cooling Limit for 3 seconds for a 1'F change. 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.

4. OIL TEMPERATURE:

As the oil passes through the engine, it is heated. It then passes through the oil cooler and reaches a stable temperature, depending on internal engine temperatures, oil flow (pressure, etc.) and oil cooler efficiency (airspeed, etc.). A change in any of these parameters will cause the oil temperature to increase or decrease. With the 1'F resolution of the Ultimate Scanner, oil temperature changes can be detected at a glance. This allows the pilot to diagnose many problems that may never be noticed with a less sensitive gauge. Also, with the 1'F resolution of the Ultimate Scanner some of our customers are attempting to detect excessive wear in the engine bearings. All of the data is not in as of this writing.

Maintaining your oil temperatures within operating limits is essential. If the oil exceeds its maximum operating temperature or if it is operated at excessively high temperatures for a long period of time, the oil will break down and it will not possess the necessary lubricating properties to protect your engine. The formula for long engine life is to change your oil at regular intervals and watch your oil temperatures with an accurate gauge that can give you rate and trend information at a glance.

A) Selecting the High Oil Limit: On a hot day with your engine set to 75% power, lean your engine to peak EGT. Record the Oil Temperature reading with the cowl flaps closed. Program the High Limit for 20'F above the recorded reading. This limit should not be set higher than the maximum limit allowed for your aircraft. 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.

B) Selecting the Lower Oil Limit: At cold temperatures the viscosity of oil increases. Although synthetic oils will operate at relatively cold temperatures, most oils will not flow well below 50'F. Set the Lower Oil Limit

to the minimum allowed operating temperature limit for your aircraft. 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.

5. OUTSIDE AIR TEMPERATURE:

The Ultimate Scanner has two features that make it a valuable tool when measuring Outside Air Temperatures. First is its superior accuracy and linearity over conventional gauges. Outside Air Temperatures have a big effect on your aircraft's ability to lift and on engine horsepower. Accurate OAT readings are essential if you are looking for maximum performance from your aircraft.

Second is the Ultimate Scanner's ability to detect small temperature changes (1'F). This gives the pilot rate and trend information (in what direction and how fast the temperatures are changing) at a glance. This is valuable for detecting changing atmospheric conditions and avoiding thunderstorms and icing conditions. It can also help in warm weather to find cooler flying conditions.

Selecting the Higher and Lower OAT limits: If the High or Low OAT Limits are exceeded, the scan will stop and the appropriate "Temp Prob" light will come on. For this reason you may want to disable the Higher and Lower OAT Limits.

6. CARBURETOR TEMPERATURE:

Venturi effect and atomization of fuel can cause temperatures in the carburetor to drop 25'F or more. When the atmospheric conditions are right, this temperature drop will cause icing in the carburetor. As icing starts to form, the Ultimate Scanner will display a temperature near 32'F. To avoid carburetor icing, apply partial carburetor heat to bring the carb temp between 39'F and 49'F. Outside air temperatures below 10'F usually will not cause carb icing due to the lack of moisture in the air.

A) Selecting the High Carb Temp Limit: The High Carb Temp Limit can be used as a fire detector or detonation deterrent. Many aircraft engines can detonate at high throttle settings if the Carb Temp exceeds 150'F. This is normally only a problem for turbo-charged aircraft.

   It is not uncommon for an aircraft engine to backfire on start. This is especially true when the battery is low. If this happens and a fire starts in the carburetor, it can cause extensive damage before the problem is noticed. The Ultimate Scanner can detect this problem almost immediately.

   Set the High Carb Temp Limit for 150'F. 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.

B) Selecting the Lower Carb Temp Limit: You may want to set the Lower Carb Temp Limit for 37'F. This is just above the temperature where ice will form. There is, however, a disadvantage to setting the High Limit for 37'F. If you fly in very cold weather where ice cannot form, the Ultimate Scanner will show a "Temp Prob" until the Carb Temp is increased above 37'F. If this is the case, you may want to disable the Lower Carb Temp Limit.

INSTALLATION INSTRUCTIONS

W072091

You should have no trouble installing the Ultimate Scanner in your aircraft. The instrument, probes and cables simply plug together to make hookup easy. Probe and instrument installation is standard and straightforward. The Ultimate Scanner does not require any programming before installation. Also, it does not use any internal batteries, so once installed the US-8 does not have to be removed. If you run into trouble or have a question, please call 503-640-9797 and we will be glad to help.

Perform only the following steps that apply to your configuration:

1. CHT PROBE INSTALLATION:

A single CHT probe should be placed on the hottest cylinder. In many aircraft, this is the cylinder furthest downstream--which would be cylinder 3 or 4 on a 4-cylinder engine; or cylinder 5 or 6 on a 6-cylinder engine. Most engines have a port just below the lower spark plug for the CHT probe.

2. EGT PROBE INSTALLATION:

A single EGT probe should be installed in the exhaust stack of the leanest cylinder. This information is available from the airframe dealer's service department. However, as a general rule, the leanest cylinder is the hottest cylinder. This would be cylinder 3 or 4 on a 4-cylinder engine and cylinder 5 or 6 on a 6-cylinder engine.

IMPORTANT NOTE: For Cessna 210's or any aircraft using a slip joint in the exhaust system, install the EGT probes BELOW THE SLIP JOINT. This is approximately 5" to 6" down from the exhaust port. The ideal location is 1 1/2", but ease of installation should prevail. Look at each exhaust stack and determine the best location for all the EGT probes. Each probe should be installed the same distance down from the exhaust port. Drill a 13/64" diameter hole in each exhaust stack. Insert the probe and tighten the hose clamp. As the hose clamp is heated and cooled, it will become loose as it conforms to the exhaust stack. After the first 10 hours of operation, each hose clamp should be retightened.

3. OIL TEMPERATURE PROBE INSTALLATION:

LYCOMING
IO 320, IO 360 and IO 540

Remove the 5/8" - 18 plug located on the rear engine accessory case above and forward of the oil filter adaptor or oil screen as applicable. Install E.I.'s P-120 Oil Probe with a new oil seal and torque to Lycoming's specifications. Check for oil leaks after the first flight.

All Other Engines
Equipped with a 5/8"-18 Oil Drain Plug

Remove the 5/8" - 18 oil drain plug located on the bottom of the engine. Install E.I.'s P-120 Oil Probe with a new oil seal and torque to specifications. Check for oil leaks after the first flight.

4. CARB TEMP PROBE INSTALLATION:

Remove the threaded plug located in the carburetor housing just below the throttle valve. Install the carburetor temperature probe in this hole using a lock washer. Care should be taken to not over-tighten the probe and strip the threads in the carburetor housing.

NOTE: A carb temp probe must be connected through a precision extension cable to a precision channel on the back of the Ultimate Scanner. Check that the Ultimate Scanner has a precision channel (a yellow connector) to accept the signal from the carb temp probe. A precision channel must be specified when ordering the Ultimate Scanner.

5. OAT PROBE INSTALLATION:

Mount the OAT probe in an appropriate location on the aircraft, using the hardware supplied. The OAT probe is sensitive to air temperature changes. For this reason, do not mount the OAT probe in the path of the cowl or engine exhaust exiting air flow.

NOTE: An OAT probe must be connected through a precision extension cable to a precision channel on the back of the Ultimate Scanner. Check that the Ultimate Scanner has a precision channel (a yellow connector) to accept the signal from the OAT probe. A precision channel must be specified when ordering the Ultimate Scanner.

6. EXTENSION CABLE INSTALLATION:

Mark both ends of each cable with the appropriate cylinder number and/or probe type. Plug each probe into its associated extension cable. Be sure the connectors mate properly. When tie wrapping these cables down, be sure there is no strain or pull on the cable against the probe or connectors. Dress each cable up to the instrument keeping them away from any hot areas such as exhaust stacks, cylinder heads, etc.

When connecting EGT and/or CHT cables start with channel one on the Ultimate Scanner. The Ultimate Scanner uses the first channels as analyzer channels. See your Operating Instructions for further information on analyzer channels.

You may decide to use your existing type K thermocouple extension cables. In this case, install E.I's slip-on connectors as follows:

A) Strip each wire and double the wires over.

B) Place a male connector on the red wire and a female connector the yellow wire. Double crimp these connectors. A good crimp is very important.

Tie off any excess cable under the instrument panel. Be sure these cables do not obstruct the freedom of travel of any controls. Cable length does not affect the accuracy of the Ultimate Scanner, so cables of any length may be used.

7. INSTALLATION OF CONNECTING WIRES:

Connect the red wire from the accessory kit to the 12 or 24 volt bus via a 1 amp fuse (see Wiring Instructions). Connect the black wire to ground. Connect the white wire to the panel rheostat. Tie wrap wires as needed.

8. INSTRUMENT INSTALLATION:

Connect the extension cables and other leads from the accessory kit to the Ultimate Scanner as shown in the following Wiring Instructions. Be sure the connectors mate properly. Install the unit from behind the instrument panel using 6 x 32 screws supplied in the accessory kit. DO NOT USE SCREWS LONGER THAN 1/2". Tie wrap cables as needed.

WIRING INSTRUCTIONS

The following wires are from the center grommet:

Wires from the back of the unit:	Connects to:
Red and Black pair:	
Red	12/24 Volt Bus.
Black	Ground.
Brown and Red striped pair:	
Brown striped	12 Volt back light rheostat.
Red striped	24 Volt back light rheostat. (Connect to ground for a 12V system.)

There are two groups of the following wires on the back of the US-8, one for the left display and one for the right display:

Brown pair	Channel 1.
Red pair	Channel 2.
Orange pair	Channel 3.
Yellow pair	Channel 4.
Green pair	Channel 5.
Blue pair	Channel 6.
Violet striped pair	Channel 7.
Gray striped pair	Channel 8.

TROUBLESHOOTING SUGGESTIONS

Because high reliability is designed into Electronics International's equipment, there is no reason to put up with poor operation. We have few problems with our probes, cables and units and installation is simple. Usually fixing a problem is a simple matter of inspecting the installation at a few key points.

Strategy:

If you have more than one problem, FIX ONE PROBLEM AT A TIME. Trying to fix all of them at once can be confusing and misleading. In many cases fixing one problem first will lead you to the solution for fixing all of the problems. Therefore, take one problem on one channel and proceed with the following:

1. Instrument Check Out:

If there is an identical symptom on each channel, then the Instrument may be the problem. However, before suspecting the instrument, recheck the power and ground connections.

NOTE: Few problems turn out to be the instrument.

Fixing One Problem On One Channel

2. Poor Connections:

When plugging the instrument or probe into the extension cable it is possible to get the tab on the male connector to wedge between the nylon and receptacle on the female connector. This connection may work for a few weeks or even months and then you will start to see jumpy readings. Disturbing the connection, without actually fixing it, will get it to work for a short time and then the problem will reappear. Check your connections at the back of the instrument and at the probe for a proper connection.

3. Loose Connections:

The female connector can become loose if the connector has been used many times. A good connection is difficult to pull apart. If your connector is loose it can be tightened using a pair of needle nose pliers. Check your connections at the back of the instrument and at the probe for a good tight connection.

4. Poor Crimp:

This is usually only a problem if the customer has removed the connectors and replaced them. The symptoms for this problem are the same as in step 2. To check a crimp, give a sharp pull on the wire and connector. The wire should be tight in the crimp (no movement). When putting a new connector on a wire,

double the wire over and put two tight crimps on the connector. Check your crimps at the back of the instrument and at the probe.

5. Defective Probe:

A probe can be tested with an ohmmeter. When checking between the connectors, the probe should measure a "short" (less than 5 ohms). When measuring from one lead (either lead) to the probe sheath (metal tip), there should be an "open" (10k or greater).

Another method of checking a probe is to plug the probe into a channel which is displaying correct readings. If the problem follows the probe, you may have a defective probe.

6. Defective Cable:

It is very rare to have a defective cable. To check a cable, plug a good probe into the suspected bad cable and plug the cable into a channel which is displaying correct readings. If the problem follows the cable, you have a defective cable. Ordinarily, the only problem with a cable would be a sharp bend (kink) in it. This can break one of the wires in the cable. Check over your cable for kinks.

SPECIFICATIONS and OPERATING FEATURES

Model: US-8

Weight: 19 oz.

Environmental: Meets TSO C43a

Power Requirements: 7.5 to 30 Volts, 1/10 Amp.

Display: LCD's (viewable in direct sunlight), with 12 and 24 volt back light control wires for night operation (channel indicators dim when back light is on).

Display Temperature Range: 1999'F to -1999'F

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

Resolution: 1'F (with enhanced stability and response circuits).

Power-up Test: Flashes red Temp Prob lights during power-up.

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

Extension Cables: Type K, any length or size (you may use your existing type K cables to reduce cost and installation time).

Channels: Maximum of 16 Channels, 8 for each display. The number of channels to be used is programmable (2 to 8) from the from the front panel.

Analyzer Channels: Programmable from 1 to 8 from the front panel (EGT and/or CHT).

Scan Rate: Programmable from the front panel from 2 to 9 seconds.

Peak Locate: Finds hottest analyzer channel within 1'F for the right and left displays.

Hottest Cylinder Indicator: Indicates hottest analyzer channel during scan within 1'F (lights a bar in the display).

High Limits: Programmable in 1'F increments from 1'F to 1999'F. Each channel for each display may be programmed individually from the front panel.

Low Limits: Programmable in 1'F increments from 1'F to 1999'F. Each channel for each display may be Programmed individually from the front panel.

Differential Limit: Programmable in 1'F increments from 1'F to 1999'F from the front panel.

Shock-Cooling: Programmable from 1 to 9 Seconds per 'F).

"Temp Prob" Warning Lights: Lights for the following conditions:

A. Any channel over the High Limit. Also exhibits a high bar in the display.

B. Any channel under the Low Limit (in the scan mode only). Also exhibits a low bar in the display.

C. Any time the difference between the hottest and coldest analyzer channel exceeds the differential limit (in the scan mode only). Also flashes a high and low bar in the display.

D. Flashes the Temp Prob light any time the displayed channel cools faster than the Shock-Cooling limit (in normal mode only, not scan mode). This problem is only displayed for channels with a High Limit programmed between 300'F to 600'F and displaying a temperature between 300'F and 600'F.

WARRANTY

Electronics International Inc. warrants this unit 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. This Warranty does not apply if the item has been damaged by misuse or incorrect installation. This Warranty is made only to the original user. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS: EXPRESS OR IMPLIED. MANUFACTURER EX PRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. PURCHASER AGREES THAT IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS OR LOSS OF USE OR OTHER ECONOMIC LOSS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, MANUFACTURER DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSON IN CONNECTION WITH THE USE OR PERFORMANCE OF MANUFACTURER'S PRODUCTS, INCLUDING SPECIFICALLY LIABILITY IN TORT.

United States of America
Department of Transportation — Federal Aviation Administration

Supplemental Type Certificate

Number SA4302NM

This certificate issued to Electronics International, Inc.

certifies that the change in the type design for the following product with the limitations and conditions thereof as specified hereon meets the airworthiness requirements of Part * *of the* * *Regulations.*

Original Product—Type Certificate Number: * *Make:* * *Model:* * *See attached Approved Model List (AML) No. SA4302NM for list of approved airplane models and applicable airworthiness regulations.

Description of Type Design Change: Installation of Electronics International, Inc. Model SR-8 or Model US-8 Digital Automatic Engine Analyzer (THE SMART SCANNER) in accordance with Electronics International, Inc. Installation Instructions No. II 01288l, dated 1/28/88 (for SR-8), or Installation Instructions No. II 072091, dated July 20, 1989 (for US-8), or later FAA approved revisions.

NOTE: The Model SR-8 and Model US-8 listed here are designed as engine analyzers and are not primary instruments.

Limitations and Conditions: Approval of this change in type design applies to the above model aircraft only. This approval should not be extended to other aircraft of this model on which other previously approved modifications are incorporated unless it is determined that the relationship between this change and any of those other previously approved modifications, including changes in type design, will introduce no adverse effect upon the airworthiness of that aircraft. A copy of this Certificate, AML No. SA4302NM, and the above mentioned Installation Instructions must be maintained as part of the permanent records for the modified aircraft.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: February 25, 1988 *Date issued:*

Date of issuance: April 21, 1988 *Date amended:* October 13,1989

By direction of the Administrator

(Signature)

Assistant Manager, Seattle
Aircraft Certification Office
(Title)

Any alteration of this certificate is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years, or both.

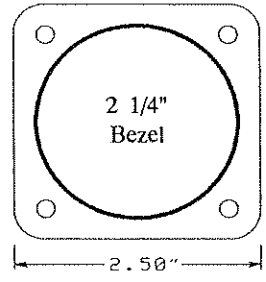
This certificate may be transferred in accordance with FAR 21.47.

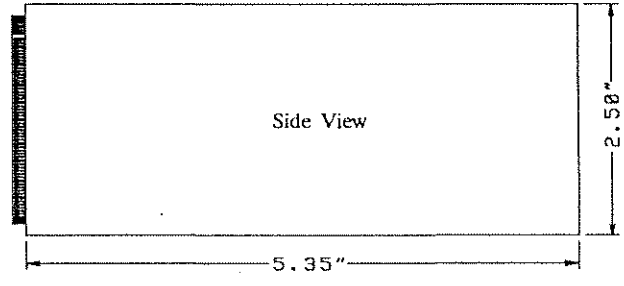
FAA Form 8110-2 (10-68)

Installation Instructions

II 072091 7/20/89

Ultimate Scanner
US-8





Electronics International Inc.

US-8 WIRING DIAGRAM

Wires for the back of the unit:	Connects to:
Red and Black Pair:	
Red	12/24 Volt Bus
Black	Ground
Brown and Red striped pair:	
Brown striped	12 Volt back light rheostat
Red striped	24 Volt back light rheostat
Brown Pair	Channel 1
Red pair	Channel 2
Orange pair	Channel 3
Yellow pair	Channel 4
Green pair	Channel 5
Blue pair	Channel 6
Violet striped pair	Channel 7
Gray striped pair	Channel 8

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