Model 2000G

ENGINE INFORMATION SYSTEM

With GPS Interface

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Introduction - The Importance of the Engine Information System

Two-stroke engines are lightweight and powerful, making them ideally suited for ultralight aircraft. Their only potential weakness is their intolerance for operating outside their strict temperature limits. Exceeding these limits can cause engine damage in as little as tens of seconds. The EIS greatly overcomes this weakness by continuously monitoring all critical engine parameters, and alerting you with a bright red flashing light should damaging engine conditions develop. With this close monitoring it is nearly impossible to knowingly exceed these limits, making the two-stroke engine well suited as an ultralight aircraft engine.

Understanding EGT and CHT - Why they are critical to safe engine operation.

The need for monitoring engine RPM and coolant temperatures (water-cooled engines) is obvious to most pilots. The tachometer gives you a measure of the power being produced, and allows you to keep RPM within limits to prevent damage from mechanical stresses that result from high RPM. The coolant temperature allows detection of high engine temperatures that could result in thermally induced mechanical damage due to insufficient cooling. But often EGT and CHT measurements are often misunderstood. They perform very separate and distinct roles.

Why monitor Exhaust Gas Temperature (EGT)?

- EGT reflects the ratio of fuel to air being provided to the cylinder. The leaner the mixture, the higher the EGT.
- EGT does not provide any indication of how well the engine is being cooled. (This is the job of coolant and CHT.)
- Internal parts (such as the piston) of all two-stroke engines will be damaged if they are operated with an EGT that is too high. ***Damage can occur in a matter of tens of seconds or less if EGT limits are exceeded.***

What causes a high EGT?

A lean fuel/air mixture will cause high EGT. This can be caused by:

- Misadjusted, or a problem with, the carburetor
- Too little load on the engine, such as an under pitched propeller. (This also results in unusually high engine RPM).
- A problem with fuel delivery to the engine, such as a clogged fuel line or filter, a malfunctioning fuel pump, etc.
- Unbalanced (unequally opening) carburetors will cause one cylinder to operate with a higher EGT.
- Cooler ambient temperatures and lower altitudes. An engine set up for operation in Denver (5000 feet above sea level) will operate at higher EGTs when operated at sea level.

What do you do when you get a high EGT alarm.

- If possible, reduce engine power. If high EGTs persist, be prepared for the possibility of sudden engine stoppage!
- If not possible to reduce power, try going to full power. The carburetor provides the leanest mixture (and highest EGTs) around mid power. Going to full power will normally reduce the EGTs, assuming the engine is otherwise functioning normally.

Why monitor Cylinder Head Temperature (CHT) and Coolant Temperature?

- Both CHT and coolant temperature reflect how well the engine is being cooled.
- They revel problems association with insufficient cooling, such as poor airflow over the engine and/or radiator, lack of coolant, loose fan belts, etc.
- They do not provide any indication of the mixture being too lean, and thus can not give any warning about excessive internal engine temperatures. (This is the job of EGT.)
- For air-cooled engines, CHT is the only means to measure how well the engine is being cooled.
- For water-cooled engines, CHT allows detection of uneven coolant flow, and provides earlier warning to loss of coolant than water-temperature.
- Exceeding these limit may result in damage, but not nearly as quickly as exceeding EGT limits.

What causes high CHT and Coolant Temperatures?

- High power settings and high ambient temperatures.
- Problems with the engine's cooling system.

What to do when you get a high CHT and/or Coolant alarm?

- Reduce engine power as soon as practical.
- Reduce the load on the engine by reducing the climb rate.
- If normal temperatures can not be achieved with these actions, land as soon as practical and safe and investigate.

Can only EGT or CHT/Coolant Temperature be monitored?

No. Remember that EGT reflects the fuel/air ratio, and the internal temperatures of the engine. The CHT and coolant reflect how well the engine is being cooled, and the overall temperature of the engine. When an engine is damaged due to high EGT (lean mixture), it is typical for the CHT or coolant temperature to remain normal. When an engine is damaged due to high CHT and/or coolant (lack of cooling), it is typical for the EGT to remain normal. They measure different aspects of the engine that do not necessarily react together.

Operating Instructions for the EIS Model 2000G

The Model 2000 is specifically designed for the powered-parachute type aircraft, requires very little input from the pilot.

Before using the Model 2000 for the first time:

1. Set the units for temperature, altitude, and fuel quantity (if used) as desired. The instruments are set at the factory to Fahrenheit, Feet and Gallons for temperature, altitude, and fuel respectively.
2. Read the section on "Automatic Altimeter" operation. Set this as desired.
3. Engine limits are pre-set at the factory. You may review these limits, and change them at any time if you desire.
4. All settings in the instrument may be set back to the initial factory settings by holding the right button ("Display") when turning on the instrument.

Before Each Flight:

1. If the altimeter is operated in the Manual mode, set the altimeter appropriately. If the altimeter is set to the automatic mode, no action is required.

Detailed Description of the Features:

Automatic/Manual Altimeter Setting.

The altimeter can be set manually by the pilot, or automatically the by the instrument. This option is selected on the "SET LIMITS" pages.

Automatic Altimeter Operation -

In this mode the altimeter will automatically be set to zero at 45 and 75 seconds after the instrument is turned on, if the engine is running and has not exceeded 4100 RPM. If the RPM goes above 4100, the instrument assumes the airplane is in the air, thus does not alter the altimeter setting.

The intent of this logic is to allow the instrument to automatically zero the altimeter when the engine is being warmed up on the ground, but hopefully not cause the instrument to reset the altimeter when the instrument is turned on and off in the air. The automatic mode of the altimeter should not be used when:

- You wish to set the altimeter to the airport's elevation. This is often done when flying to another airport, especially when the airports are at different elevations.

- If you anticipate turning off the instrument in flight, and then turning it back on when the engine RPM is below 4100. This could be the case when stopping the engine in flight, and restarting.

Manual Altimeter Operation –

Use the "SET LIMITS" pages to set the altimeter as desired.

Flight Timer

The flight timer shows you how long your flight has lasted. It resets at power up, and starts counting when the engine is running (based on the tachometer). It displays the previous flight time until the current flight time reaches 3 minutes, allowing you to easily recall the length of the previous flight. A warning can be set when the timer exceeds your preset limit to remind you to check your fuel.

Favorite Page

The instrument will automatically select your favorite page when the checklist is ended, or the right button is double-clicked, or when leaving the "Set Pages". Your favorite display page is entered under the "DISPLAY" setting in the "Set Limits" pages. It is the last setting on these pages.

Press-to-See Labels

Pressing the right button ("Display") when on a combination page (that is, a page with no labels), will replace the numeric data with labels to identify the data. Releasing the button returns the numeric data to the page.

Double-clicking the "Display" button immediately takes you to your favorite page. Normally a combination page is used as your favorite.

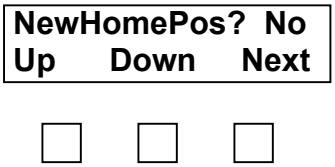
GPS Page

The GPS page gives you easy-to-read and easy-to-understand steering information to get you home. It also provides groundspeed, as well as the distance and magnetic bearing to home. This function requires the connection of a GPS to the EIS to perform these functions. Using the GPS page provided on the EIS has several advantages over that of a stand-alone GPS, namely:

- Automatic Operation – A GPS requires the creation of a waypoint for each location you fly from, and also requires that you manually select the correct waypoint as the "Goto" in order to get steering information to it. The EIS does this automatically.
- Large, Readable Display – The EIS display is much larger and more easily read than any of the low-cost GPS units available today.
- Easy-to-Understand Steering – All handheld GPS receivers reviewed to date provide steering information that is sometimes invalid, and often hard to interpret. The EIS provides simple steering information, and provides it only when it is valid.
- Convenient Grouping of Information – The GPS pages shows all relevant GPS data, as well as altitude and tachometer on one screen. (Although engine temperatures are not shown, they are being monitored by the EIS alarms.)

Saving your Home Position

At power-up, the EIS will determine if you are on the ground. If you are, and the GPS is providing data to the EIS, it will determine if you at the same location you flew from last time. If the EIS determines you are at a new location, it will prompt you to see if you would like to save this as your new home position. If you are at the same place you flew from your last flight, it will not issue this prompt.



If valid GPS position data is lost, the No/Yes prompt will be replaced with dashes, indicating no position is available for saving as your home position.

Normally, you will use the "Up" or "Down" button to select "Yes" and then press the right button to update your home position. Selecting "No" will retain the last home position, and is normally done only when on a cross-country flight. This page can also be manually accessed on the "Set Limits" pages, to allow you to save the current position as your home position at any time.

Note: The EIS assumes you are on the ground if the engine RPM has not exceeded 4100 RPM since the EIS was turned on, and the GPS indicates you are not moving.

Using the GPS Page

The GPS page is described in detail in figure 2. This page provide steering information to direct you to your home position, as well as RPM, altitude, groundspeed, distance and bearing to home. When data can not be calculated, or is unavailable, it will be replaced with dashes to indicate that no valid data is available.

Connecting a GPS and Setting up the GPS Function.

1. Only 2 electrical connections are required to a GPS. These are the serial data output line and ground. Refer to the "Cable Assembly" diagram for an illustration of how these connections are made.
2. Go to the "Configuration Set Pages" and make the following selections: (See the section "Configuration Set Pages" for more details on how this is done.)
    - GPS Page - ON
    - GPS Baud - 4800
    - GPS Units – Miles or Kilometers, as desired.

3. Turn on the GPS. Refer to its user's manual to select NMEA 0183 serial out on. Select a baud rate of 4800. If necessary, make any selection required to enable the GPRMC output sentence. (Most GPS receivers will transmit the GPRMC sentence automatically when the NMEA 0183 selection is made.)
4. Verify the EIS is receiving GPS data by checking the GPS page on the EIS. If data is being received, the "X" on this screen will disappear. When the GPS locks onto the satellites, a groundspeed of 0 will be displayed on the EIS. (Note: Magellan brand GPS receivers do not activate the data output until they have locked onto satellites and are able to provide a valid position. Garmin brand GPS receivers typically activate data output as soon as they are turned on, even before any position data is available.)

If no data is received by the EIS, double check your electrical connections, verify the GPS setup to transmit NMEA 0183 at 4800 baud, and verify the EIS is set to a baud rate of 4800. A fluctuating voltage of a couple of volts can be measured between the GPS serial output line and ground to verify it is providing data output.

Peak Recording

The EIS records the peaks (maximums) for 9 parameters during the flight. The recording of these items begins when 3 minutes has elapsed on the flight timer, at which time the peaks from the last flight are erased.

Since the peaks are recorded in non-volatile memory, the EIS is able to show you the peaks from the previous flight, even if the EIS has been turned off since the end of the last flight. (These peaks will not be erased until 3 minutes into the next flight.) This can be very useful for evaluating the highest RPM generated by your engine, peak engine temperatures, as well as your maximum altitude and your maximum distance from your home position.

The peaks that are recorded are as follows:

- Tachometer
- Cylinder Head Temperature #1 & #2
- Exhaust Gas Temperature #1 & #2

- Coolant Temperature
- Voltmeter
- Altimeter
- GPS Range (from your home position)

To view the peaks, select the "Set Limits" pages, and page down to the "Show Peaks" page. Use the UP/DOWN to select "YES". Press and hold the right button to leave the set pages. The peak values for the above items will replace their current values on the various display pages. The EIS will alternately flash the symbol "PK" and the peak data to identify the peaks.

The "Show Peaks" function can be turned off by returning to the "Show Peaks" page and selecting "NO". This function is also automatically turned off at power-up, or whenever the RPM exceeds 4100. The "Show Peaks" function is disabled when the RPM is above 4100.

Warning System Operation

The alarm system is the most important part of the system. It allows you to enjoy flying without the need to constantly monitor your instrument. Damaging engine conditions are made immediately obvious.

All alarms cause the warning light to flash, and the page to change automatically to a labeled screen which includes the out-of-limit parameter. The offending parameter is flashed on the display, along with the warning light until the problem goes away, or until it is acknowledged by pressing the "Next/Ack" button. Acknowledged alarms cause the warning light to stay on steady until the condition ends, and does not inhibit other alarms.

Set Limit Pages

The settings on these pages are accessed by pressing the left and center buttons together. This will immediately bring up the set pages, displaying each item listed, one at a time. While on the set pages, the bottom row of the display will show "UP Down Next", indicating the function of the buttons while on these pages. As such, the left and center buttons allow you to change the setting, and the right button takes you to successive settings. To leave these pages, repeatedly press the right button, or press and hold the right button, until the normal display pages return. The items that can are set on these pages are, in order, as follows:

- **Contrast** defaults to the best setting at power-up. It may be altered if desired to enhance readability.
- **Alt-Set** allow you to select Auto or Manual for the altimeter setting function.
- **Alt** shows the current altimeter setting. Altitude is manually set here.
- **New Home Pos?** This setting is only available it the GPS page is turned on. Selecting "Yes" and pressing the right button stores the current position as your home position. Dashes will be displayed when no valid GPS position has been received in the last 60 seconds.
- **Show Peaks** allows you to display the peak values in place of the current values on the various display pages. This function is inhibited while the RPM is greater than 4100. See the "Show Peaks" section for more information.
- **Max Timer** gives you the maximum time before the flight timer will issue an alarm. The limit is entered in minutes. If you exceed this limit, it can be increased easily in flight.
- **Max Cool** is the maximum coolant temperature.
- **Max RPM** is the maximum RPM. This limit is set in 30 RPM increments.
- **Min Fuel** applies to the optional fuel level input.
- **Max Volt** is used to warn of overcharging due to a failed regulator. A good limit for this is 15.0 volts. If a battery is not used, this alarm is not required.
- **Min Volt** is used to warn of battery discharging. A good setting for this is 12.0 - 12.8 volts.
- **Max EGT** is a very critical alarm, as high EGT can destroy an engine in seconds to minutes. It reflects the fuel/air mixture being burned by the engine. A typical limit is 1200-1250 degrees F.
- **Max CHT** warns of inadequate cooling.
- **Display** is used to enter your favorite display page.

Configuration Set Pages

These pages contain information that configures the instrument to your engine, and selects various options.. These pages are accessed by pressing and holding the **right** and center buttons for several seconds, until the bottom row of the screen displays "Up Down Next". While on the configuration set pages, the bottom row of the display will show "UP Down Next", indicating the function of the buttons while on these pages. As such, the left and center buttons allow you to change the setting, and the right button takes you to successive settings. To leave these pages, repeatedly press the right button, or press and hold the right button, until the normal display pages return. The items that can are set on these pages are, in order, as follows:

- **Fuel , Temp. and Altitude** show the units they are using. The units for the vertical speed (climb rate) indicator are feet per minute (in increment of 100 feet per minute), or meters per second, corresponding to the selection for the altimeter.
- **GPS_Page** – When "On" enables the GPS page. This page appears after the second combination page. See the section "GPS Page" for a complete description.
- **GPS_Units** – Selects whether miles or kilometers will be used as the units on the GPS pages. Has no effect if GPS_Page is off.
- **GPS_Baud** – Selects the baud rate for receiving data from the GPS. Most GPS receivers transmit data at 4800 baud, and this setting should be used.
- **EGT_Toggle** – When "Off", the highest EGT is displayed on combination screen 1. When "On", this display will toggle between the two EGTs every 2 seconds, allowing you to observed both EGTs without switching pages.
- **CHT_Toggle** – When "Off", the highest CHT is displayed on combination screen 1. When "On", this display will toggle between the two CHTs every 2 seconds, allowing you to observed both CHTs without switching pages.
- **Combo_Page** – Selects whether coolant temperature (Cool) or outside air temperature (OAT) is displayed on the combination pages. The OAT selection is useful when coolant temperature is not being monitored.
- **TachP/R** - Indicates the number of pulses per revolution of the engine for tachometer sensing. Rotax CDI engines require a setting of 6. The Rotax 912 requires a setting of 1.
- **Fuel-SF, Fuel-Off, FuelSens** - Fuel level input scaling. Normal settings are 5, 0, and Forward, respectively. When using a Princeton Electronics fuel level probe, set the Fuel-SF to half of the desired full tank reading. (For example, if you want to display the fuel level as 0-100%, set the Fuel-SF to 50).

Messages at Power-Up

- **Non Rotax-Tach Setting** – This indicates the TachP/R setting is not standard for a Rotax engine. This is a reminder that it may be set wrong. The instrument will not change the TachP/R setting however.
- **Limits Reset!** – This indicates that a limit may have been altered unintentionally. The instrument will reset all limits the initial factory setting.

Troubleshooting Common Problems

One EGT or CHT is erratic.	One of the two wires is unconnected between the instrument and the probe. Most commonly, a crimp connection on the quick disconnect on the probe, or the cable it plugs into, is loose. A visual inspection will usually be enough to find the problem. Another simple test is to use a continuity tester, and verify each pin at the instrument end of the cable has good continuity to the engine case, since each probe is grounded to the engine. The pins numbers are listed on the wiring diagram in the back of this manual.
All EGT and CHT are erratic.	This is caused by an open ground connection to the case of the engine on engines which do not include an electric starter.
Coolant Temperature shows 59 deg F all the time.	The connection to the coolant temperature probe is open, or the case of the coolant temperature sensor is not grounded. A quick test is to touch the coolant temperature sensor lead to ground. If the EIS show a high temperature, the connection to the instrument is good. If it does not change, check the wire between the instrument, and the coolant temperature sensor, especially the crimp on the quick-disconnect that plugs onto the coolant temperature sensor.
Tach Reading is erratic or zero when one mag is turned off.	This is normal, as the tach signal is generated by one of the mags. Sometimes it is possible to get a good reading if the mag test is performed at higher RPM (3500 or so).
Tach reading is steady, but too low or too high.	TachP/R is incorrectly set. See "Configuration Set Pages" section.
Instrument turns off by itself.	The battery or capacitor is not connected to the output of the regulator/rectifier. (Does not apply to Key West regulator/rectifiers.)

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