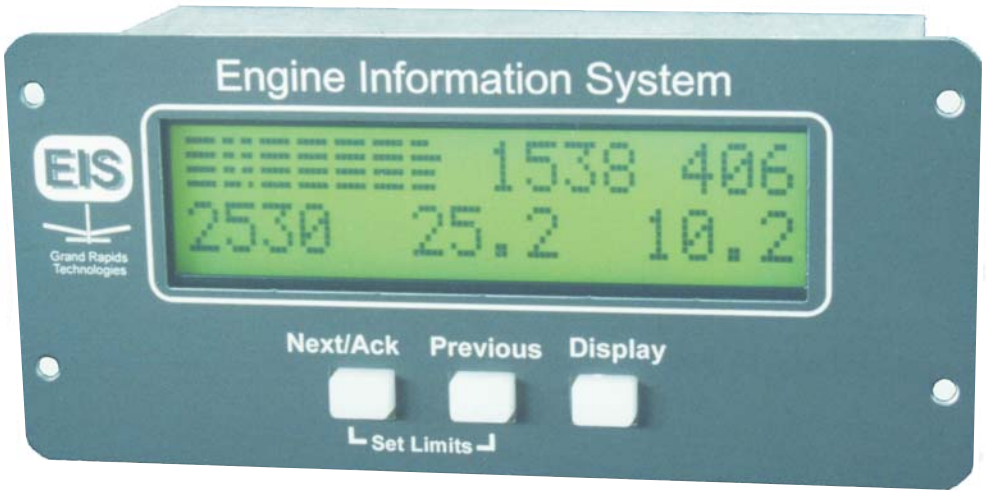
Automated Engine Monitoring for Aircraft Engines



A complete engine monitoring system at an affordable price -- The EIS Model 4000 & 6000 features start with the most comprehensive EGT/CHT monitor available anywhere, and then adds every other engine monitoring function you need, and more! Utilizing a back-lit, sunlight readable display, the EIS provides user-programmable graphical and digital displays in a compact package. A host of other useful features, and the scrutiny of the 62 alarms, add the final touches to make your flying a safe, satisfying, and enjoyable experience.

Features:

Comprehensive Leaning Functions – The best available at any price.
Graphical and Digital Displays of EGT & CHT for all cylinders
EGT Tracking Function – detects changes undetectable by human senses
Alarms on all functions, most with upper and lower limits
User-Defined Digital & Bar Graph pages.
Label/Data flip-flop identifies all data on combination pages
User-Defined labels for auxiliary inputs
User-Selectable Units (Fahrenheit/Celsius & Gallons/Liters)
Landing Checklist/Gear Reminder
Serial Output – Allows data recording using a laptop PC
Serial Input – Provide for growth to interface with other systems

Functions:

4 or 6 Exhaust Gas Temperatures
4 or 6 Cylinder Head Temperatures
Tachometer
Oil Temperature
Oil Pressure
6 Auxiliary Inputs user configurable can provide:
- Manifold Pressure (normally aspirated or turbo)
- Fuel Pressure
- Fuel Level(s) (using capacitive or float-type sending units)
- Ammeter, Coolant Pressure & more!

Outside Air Temperature
Voltmeter
Carburetor Temperature
Hourmeter
Flight Timer with Interval Timer
Options include: Fuel Flow System, Altimeter/VSI, Airspeed

$995

4-cylinder package price complete with most probes and pre-wired cables.

Now Available...

Add the EFIS Series I Display Unit for Color Graphical Engine Monitoring! See our website at www.GRTavionics.com for details.

EIS

Grand Rapids Technologies

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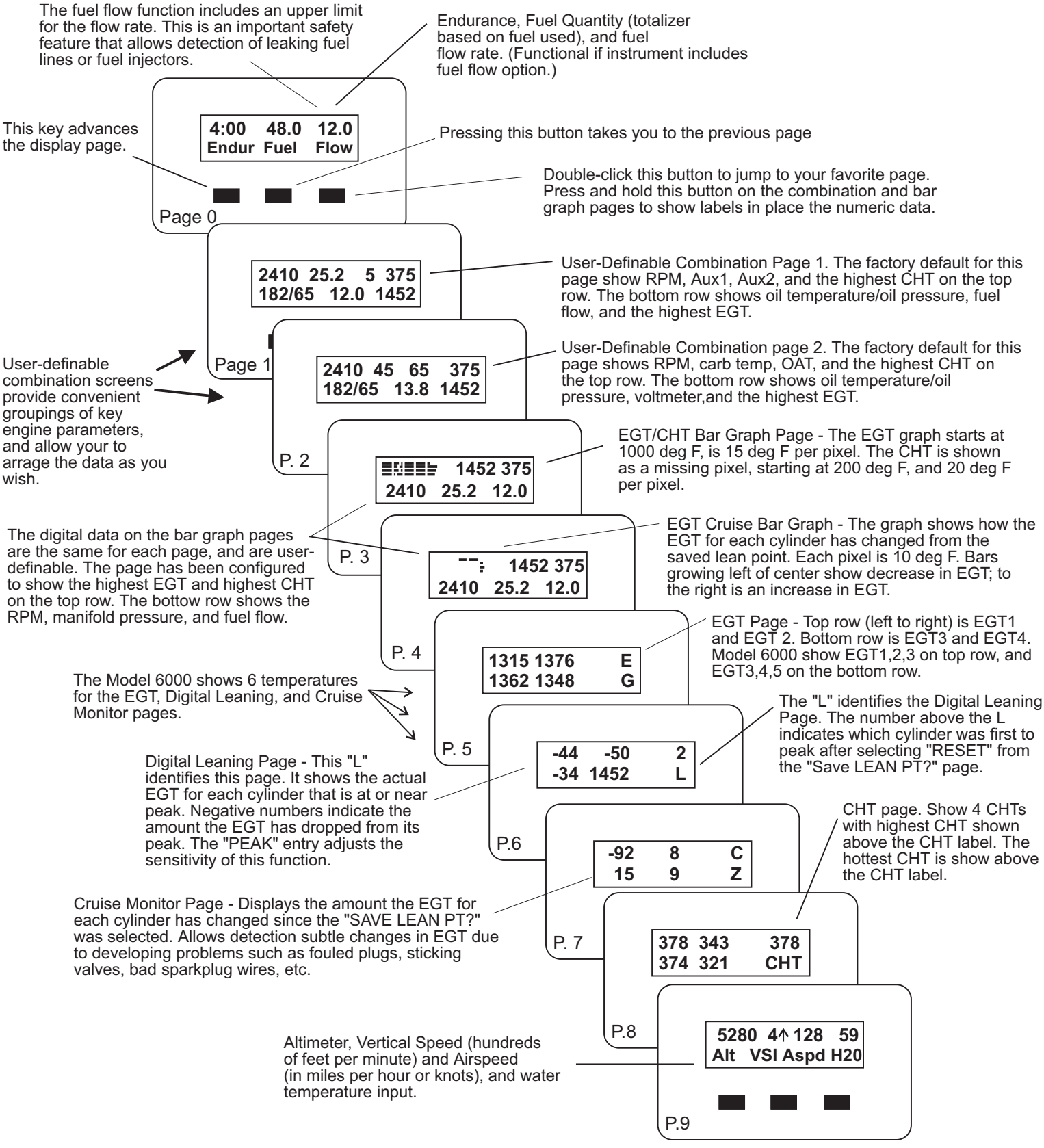
Byron Center, MI 49315

(616) 583-8000 Fax (616) 583-8001
www.GRTavionics.com

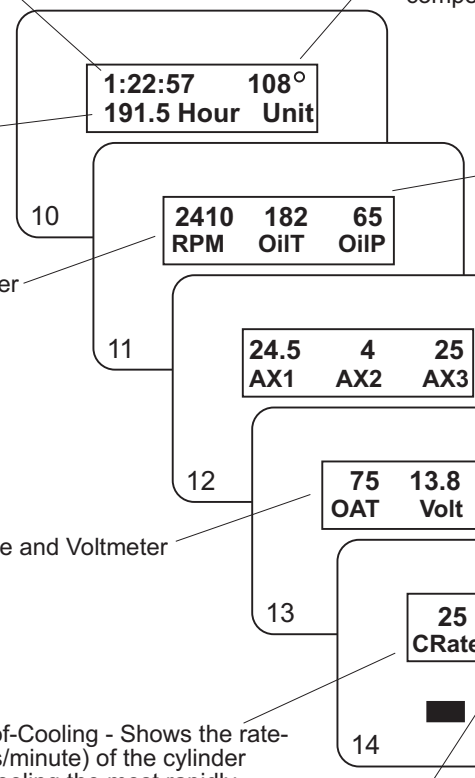
The following two pages illustrate much about the functionality of the EIS. At Grand Rapids Technologies we often here a tone of surprise in our customer's voice when they describe how happy they are with their EIS. This may come from the inherent difficulty in evaluating the suitability of an device like this, without the benefit of practical use. Often, it is only when our customers put the EIS to use that they begin to fully appreciate the functionality of the instrument. It is then that the influence of the designer's 16 years experience in the aerospace industry, with his particular interest in cockpit automation, becomes apparent. Seemingly small details, like the ability to easily select your favorite page, the operation of the alarms, the non-glare texture on the window, and so many others, combine into a system that truly fills the engine instrumentation needs of the aviator.



The flight timer runs when the RPM is above the TIM-RPM entry. It shows the last flight time at power-up, and until 3 minutes into the next flight. This timer shows hours:minutes:seconds.

Internal Instrument Temperature (Used by the EIS to temperature compensate the EGT and CHT Inputs.)

Engine Hours - Accumulates when RPM is above the TIM-RPM entry.



Oil Temperature and Oil Pressure

Tachometer

Auxiliary Inputs - User definable inputs that may be used for fuel level, fuel pressure, manifold pressure, coolant pressure or a variety of other uses. The scaling and labels are user-selectable, allowing you to change the AX1 label to MAP for instance.

Outside Air Temperature and Voltmeter

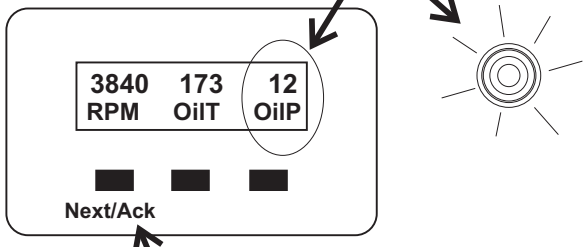
Carb Temperature

Cylinder Head Rate-of-Cooling - Shows the rate-of-cooling (in degrees/minute) of the cylinder head temp which is cooling the most rapidly. Allows for detection of shock cooling.

EGT Span - This shows the difference between the hottest and coolest EGT. It is especially useful to help characterize your engine, allowing easy detection unusual EGT readings.

A flashing light will alert you to a new alarm. At the same time the EIS will automatically switch to a labeled page, and will flash the offending item to clearly identify the problem.

If the pilot's corrective action solves the problem, the warning light will stop flashing, and the instrument will return to the page it was previously on.



If the problem can not be solved, the pilot acknowleges the alarm with the Next/Ack (acknowledge) button. The warning light will stop flashing, but will remain illuminated until the problem goes away. The display page will return to the page it was previously on after the alarm is acknowledged.

Annunciation of Alarms

By far, this is the most important function of the EIS. Without alarms, it is the engine that alerts the pilot.

Note how the warning light makes the alarm obvious, and the labeled page and blinking display clearly identify the problem so that the proper

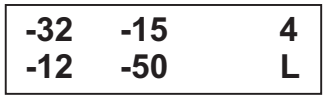
Q. How do you lean using the EIS?

Ans. Any way you want! I like to lean until a cylinder is 50 degrees past peak EGT, as this offers very economical operation. To do this, use either the digital or graphical leaning page, and lean until the EIS has detected the first cylinder to reach peak and continue leaning until this cylinder is 50 degrees past peak. I prefer to use the leaning page, but the first cylinder to peak and the leaning status of the first cylinder to peak can be displayed on any of the programmable pages, including the bar graph pages.

Have your own method? No problem. The flexibility of the leaning pages allow you to easily lean, no matter how you do it!

The "L" identifies this as the Leaning page. The "4" indicates cylinder 4 was the first to peak. Note that in the bottom display, only one cylinder has reached peak, while the uppper display shows that all cylinders have peaked.

The digital versions of the leaning page, and cruise monitor page have proven to be very popular. The 1 degree resolution allow you to easily determine if a temperature is increasing, decreasing, or not changing. This is excellent for determining if the engine has reached steady-state after changing the mixture, or for detecting subtle problems with one cylinder using the cruise monitor page.



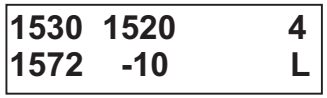
This page makes it easy to lean, no matter what your leaning style preference.

This page makes it easy to see changes to the EGTs during the cruise segment of the flight.

Digital Leaning Pages

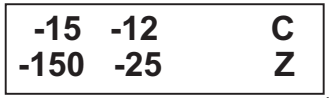
Absolute EGT Page

This page displays the actual temperatures for each cylinder, and could be used to lean, but this page is not really suited for this task. Its best to use the "Leaning Page". Note that the EG on the right side of the page



Leaning Page

The leaning pages starts by showing the EGT of each cylinder. As you lean, the EGTs will increase to their peak EGT, and then begin dropping. The EIS detects each cylinder's peak, and changes the display to show how far each cylinder is from its peak.



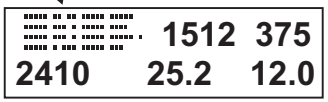
Cruise Monitor Page

The change in EGT since the EGT tracking function was activated for each cylinder is displayed here. This shows that that cylinder 3 has developed a problem. Even a mis-firing plug becomes obvious with the one-degree resolution of the EGT tracking function. The "CZ" identifies this page.

Missing pixels display CHT temperatures.

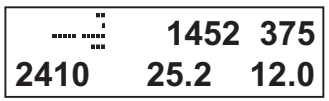
All digital data user selectable. In this example the top row includes the highest EGT and CHT, and the bottom row displays RPM, Manifold Pressure, and fuel flow.

Graphical Leaning Pages



Absolute EGT Graph

The bars represent each EGT. Range 1000-1800 F. Resolution is 20 degrees



Cruise Monitor Graph

Each bar represents a cylinder. It grows to the left when EGTs drop, and to the right when they increase, from the temperature they were at when the cuise monitor function was activated. Each pixel represents 10 deg F.

Pressing the DISPLAY button replaces numeric data with labels.

Options to Complete your EIS....

...any or all of these options can be added to your EIS...

Fuel Flow -- $375

The fuel flow option includes a FloScan fuel flow sensor to provide fuel flow rate, total fuel remaining, and the endurance (time until empty at the current flow rate). The endurance display is especially useful, as it eliminates the mental calculations required to convert a fuel level indication into gallons, and gallons into time remaining. The Fuel Flow function also includes a user programmable calibration factor that allows you achieve an accuracy of 0.5% or better for all of these functions. This accuracy is unattainable with traditional fuel level sensing techniques.

2:30	13.0	5.2
ENDUR	FUEL	FLOW

The fuel flow option is ideally suited for:

- Those who often fly cross-country flights, especially those who fly to the limits of their airplane's range, where the precision of the total fuel remaining and endurance calculation become very useful.
- For airplanes with fuel tanks which are difficult to instrument accurately. The shape of the fuel tank does not affect the accuracy of the fuel flow's totalizer, overcoming the accuracy problems of fuel level probes in such tanks.
- For fuel injected engines. The higher fuel pressure of fuel injected engines increases the likelyhood of fuel leaks that could go undetected. The max flow rate alarm provides additional safety in detecting these leaks.

- Fuel Flow Rate (0.6-60 gallons/hour)
- Total Fuel Remaining
- Time Until Empty
- Low Fuel Warning
- Max Flow Limit
- 0.5% Accuracy
- User-selectable units of Gallons or Liters
- Adjustable Scale Factor
- Includes FloScan Brand Fuel Flow Sensor

Altimeter/VSI Option -- $149

This option provides low-cost means of adding a second altimeter, or as your primary altimeter. The altimeter display is steady (does not toggle back and forth between readings), is accurate to better than 10' per 1000', is practically unaffected by temperature, and requires no warm-up. The vertical speed function is sensitive enough to detect 10' changes in altitude, and updates once per second. The altimeter is adjustable to field elevation, and to a barometric pressure (altimeter) setting.

5410	14↑	131	134
Alt	VSI	MPH	H20

The Altimeter Option is ideally suited for:

Primary or Backup Source of Altitude

Recording of altitude and engine data via serial data output.

- Altimeter - 10' resolution updated 2 times per second.
- Vertical Speed - 100 fpm resolution - 1 sec update.
- Adjustable to field elevation or barometric pressure (altimeter) setting.
- -1000 to +40,000 foot range
- Unaffected by vibration
- Excellent as a backup or as a primary altimeter. Altimeter data is available on the serial data output.

Airspeed Option -- $195

The airspeed option provides low-cost means adding airspeed to your EIS. Using pitot/static pressure sensing, airspeed is provided over a range of 30-300 mph. As with the altimeter function, the airspeed sensor is unaffected by vibration, making it highly reliable. Although typically used as a back-up, the easy-to-read display of the EIS makes it suitable as your primary source of airspeed data. (Power loss to the EIS would result in loss of airspeed data however.) Calibration may be ordered in knots or mph.

The Airspeed Option is ideally suited for

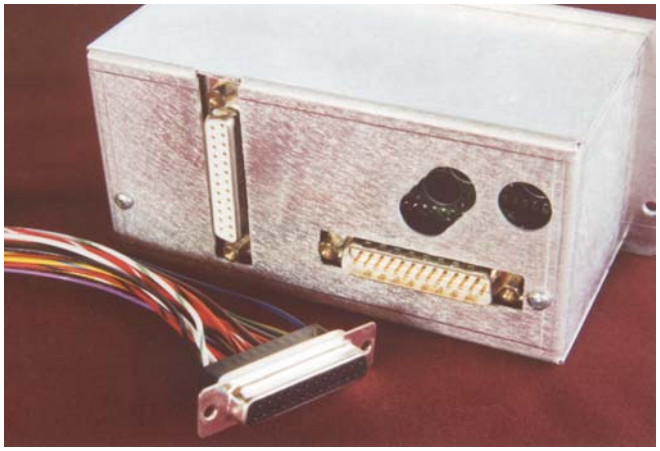
- Primary or Backup Source of Airspeed Data
- Recording of and engine data via serial data output
- The landing checklist/gear reminder function can be activated by airspeed to generate a reminder. Great insurance for retractable and amphibious airplanes.

- ▶ Airspeed range of 30-300 mph or 26-275 knots
- ▶ Airspeed display updates 2 times per second
- ▶ Landing Checklist/Gear reminder can be triggered by airspeed.
- ▶ Airspeed is available on the serial data output.
- ▶ Typical accuracy of +/-2 mph at 100 mph

Tefzel Insulated Cable A Upgrade -- $28

Two cables provide all electrical connections to the EIS. Of these two cables, cable A, the cable which include all signals *except* the thermocouple extension wire connections to the EGT and CHT probes, is available with Tefzel insulation as an upgrade. The PVC insulation normally supplied on this cable has served us well for years, and is accepted by the FAA. While the PVC insulation has excellent abrasion resistance, aging characteristics, and tolerance of chemicals, Tefzel insulation, a type required by the military, is superior in these categories, and is safer in the event of fire.

At this time cable B, the EGT/CHT cable, is available only with PVC insulation. We are researching other insulation options for this cable, so feel free to contact us regarding other insulation options.

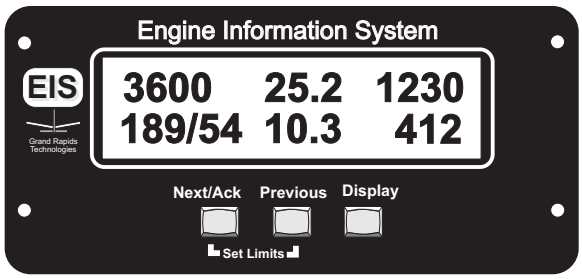


Slave Unit -- $350

The slave unit provides a low-cost means of adding a second EIS to your airplane. Requiring only 3 electrical connections, the slave unit receives serial data from the primary instrument, operating otherwise as an independent instrument. Alarms may be set, programmable pages may be arranged as desired, and a warning light may be controlled by this instrument. A great solution to airplanes with tandem seating, and is especially popular with biplanes. Altimeter setting and fuel flow totalizer data is also transmitted to the slave instrument, making in unnecessary to enter this data twice..

The Slave Unit ideally suited for:

- Airplanes with Tandem Seating or Biplanes
- Displaying serial data received over a downlink
- Although not necessary, the slave unit can be used to effectively double the amount of data available to the pilot without requiring any page changes for single cockpit airplanes.



- ▶ Low-Cost means of adding a second EIS
- ▶ Instant data update -- no latancy in data
- ▶ Only 3 wires to connect

Why monitor every cylinder for EGT and CHT? Safety and Cost -- Monitoring all cylinders makes it unlikely a developing engine problem will go undetected, enhancing safety. It makes clear if a problem is unique to a cylinder, in which case you know exactly which cylinder, or common to the engine (like a carburetor problem), thereby reducing maintenance costs considerably.

What can EGT tell you? Besides the obvious improvement in fuel economy achieved through precise leaning with the leaning function, and the corresponding reduction in engine deposits which result from an overly rich mixture**,** EGT also gives you an excellent picture of the health of your engine. Here is a brief summary of some of the problems it can detect. Note that it is often the change in EGT that signifies a problem. The EGT tracking function, with its alarms, is perfect for effortless detection of such conditions. The 1 degree resolution of the digital cruise monitor page provides sensitivity previously unavailable in any instrument. It allows detection of developing engine problems too subtle to be detected by human senses, or the coarse resolution of most other instrument's bar graphs.

Condition	Typical Problem
EGT rises more than 100 degrees	Pre-ignition -
EGT increase in one cylinder by 50-100 degrees F	Fouled spark plug or faulty ignition Intake manifold leak
EGT increase in all cylinders	Magneto failure or incorrect (overly retarded) ignition timing.
EGT decrease in all cylinders	Air filter restriction Carburetor ice Overly advanced ignition timing
EGT decrease in one cylinder	Intake or Exhaust valve Low compression
Very low EGT in one cylinder during Mag Check	Fouled spark plug or faulty ignition
Hard to find peak EGT	Detonation due to low fuel octane Low energy ignition or wrong spark plugs or gap

Probes & Accessories

EGT Probes - EGT probes include 4' of matching extension wire and connector accessories They are constructed with an Inconol 600 protection tube, compacted mineral insulation, and a water-proof transition joint with 2' long stranded leads with stainless steel overbraid. Type-K calibration. Aircraft quality--not the low cost wire-in-a-tube type. (6' total length.)

Part No. EGT-HC-01 Features a traditional hose clamp type attachment. Suitable for engines with large manifolds.

Part No. EGT-HCS-01 Smaller hose clamp for 1-2" diameter pipes. Most popular size. Fits most engines.

Part No. EGT-CF-01 Features Rotax Standard compression fitting

EGT Extension Wire - PVC insulated dual conductor stranded type-K thermocouple extension wire.

CHT Probes - CHT probes include 4' of matching extension wire and connector accessories. Double fibrous glass braid insulation is used with these spark plug gasket-type probes.

Part No CHT-14 - 14 mm diameter

Part No CHT-18 - 18 mm diameter (for Lycoming and Continental)

CHT Bayonet Style Probe - Spring loaded push and turn type probe for Lycoming and Continental engines with 1-1 3/4 inch deep wells for measuring cylinder head temperature. These probes are superior to spark plug gasket type probes because they are not subject to the wear or inconvenience of spark plug gasket types. Bayonet adapter required

Part No CHT-BAY-01 Bayonet-style CHT probe

Part No CHT- ADPT-01 threaded bayonet adapter

CHT Extension Wire - PVC insulated dual conductor stranded type-J thermocouple extension wire.

Use of EGT & CHT Extension Wire

Matching EGT and CHT extension wire, or the temperature compensating terminal strip should be used when it is necessary to extend lead lengths for these probes. The matching wire allows the EIS to compensate correctly for ambient temperature fluctuations, and thus assures maximum instrument accuracy.

Fluid Temperature Probes

Part No FT-1827-02 1/8-27 pipe threads type.

Part No. FT-LC-01 A 5/8" threaded probe complete with gasket for sensing oil temperature for Lycoming and Continental engines.

Outside Air Temperature Probe -- Accurate from -30 to 120 degrees F for air temperature measurements. (Part No. OAT-02)

Manifold Pressure Sensors - Used with the auxiliary input of the advanced EIS to display manifold pressure in inches of mercury.

Part MAP-01 Range of 0-31 inches of Hg for normally aspirated engines.

Part MAP-02 Range of 0-51 inches of Hg for turbo-charged engines.

Fuel/Oil/Coolant Pressure Senders - Using the auxiliary input, these senders allow the EIS to display the following pressures.

Part LPS-02 Suitable for fuel and coolant pressures over a range of 0-28 psi

Part HPS-01 Suitable for oil and coolant pressure over a range of 0-99 psi.

Part Number	Description	Price
EIS-4000P (Advanced EIS Model-4000 package)	Save $145. Package for Lycoming/Continental 4-cylinder engines includes EIS Model 4000 Instrument, 4 EGT probes, 4 CHT bayonet-type CHT probes with adapters, Oil Temperature Sensor, Oil Pressure Sensor, and pre-wired cables	$995.
EIS-4000P9	Save $145. Package for Rotax 912 Engine includes EIS Model 4000 Instrument, 4 EGT probes, 2 10mm CHT probes and pre-wired cables.	$795.
EIS-4000PJ	Save $145. Package for Jabiru 2200 Engine includes EIS Model 4000 Instrument, 4 EGT probes, 4 12mm CHT probes, and pre-wired cables.	$823.
EIS-6000P (Package)	Save $163. Package for Lycoming/Continetal 6-cylinder engines includes EIS Model 6000 Instrument, 6 EGT probes, 6 CHT bayonet-type CHT probes with adapters, Oil Temperature Sensor, Oil Pressure Sensor, and pre-wired cables.	$1185.
EIS-6000J	Save $163. Package for Jabiru 3300 engine includes EIS Model 6000, 6 EGT probes, 6 12mm CHT probes, and pre-wired cables.	$956.
Opt-FF-01	Fuel Flow Option – Includes sending unit	$375.
Opt-IntAlt	Altimeter/VSI Option	$149.
Opt-AS	Airspeed Option	$195.
EGT-HC-01	EGT Probe - Hose clamp type	$36.
EGT-CF-01	EGT Probe - Compression Fitting Type	$36.
EGT-HCS-01	EGT Probe - Small Hose Clamp	$36.
EGT-EXT-01	EGT Extension Wire	$0.80/ft
CHT-18-01	CHT Probe - 18 mm	$16.
CHT-14-01	CHT Probe - 14 mm	$14.
CHT-EXT-01	CHT Extension Wire	$0.65/ft
CHT-BAY-01	Bayonet Style CHT probe	$38.
CHT-ADAT-01	Threaded bayonet style adapter	$5.
FT-1827-01	Fluid Temperature Probe - 1/8-27 threads	$18.
FT-LC-01	Oil Temp Probe - for Lycoming & Continental	$20.
OAT-01	Outside Air Temperature Probe	$24.
CARB-01	Carburetor Air Temperature Probe	$28.
MAP-01	Manifold Pressure Sensor 0-31 in Hg	$60.
MAP-02	Manifold Pressure Sensor 0-51 in Hg	$60.
LPS-02	0-28 psi fuel/coolant pressure sender	$35.
CS-01	Current Sensor +/- 100 AMP	$60.
HPS-01	0-99 psi oil/coolant pressure sender	$35.
FL-PE-01	Capacitive Fuel Level Probe – Easy Calibrate	$95.

Instruments include connectors, auxiliary warning light, and detailed manual.

Mastercard, Visa, and Discover cards accepted. COD available to US addresses for $6.00 COD charge. Cashiers check or money order required for COD payment. For orders pre-paid with personal checks, allow 2 weeks for checks to clear.

Orders from outside the US must be pre-paid by certified funds in US dollars or via personal or company check drawn in US dollars on a US bank. Cashiers check, money order, or similar certified funds, or Mastercard, Visa or Discover cards are recommended for orders outside the US.

Shipping & Insurance to Alaska, Hawaii, or Canada is $16. Continental US. $10 Foreign orders are can be shipped via U.S. Airmail, UPS, Burlington Air Express or DHL. (Call for rate.)
Prices effective 1/2002

1-Year Satisfaction Guarantee. If for any reason you are unhappy with the EIS, you may return it for a full refund anytime in the first year you own it. All products include a 2-year warranty starting on the day the instrument is put into service (or 3-years after purchase, whichever comes first.) The EIS Instrument has a lifetime warranty for the original owner.

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