PILOT'S GUIDE

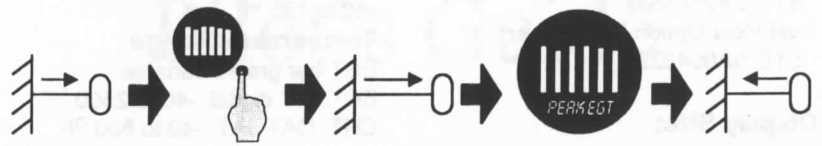
EDM - 700
EDM - 800

J.P. INSTRUMENTS

Leaders in Engine
Data Management

EDM-700 Quick Reference Guide

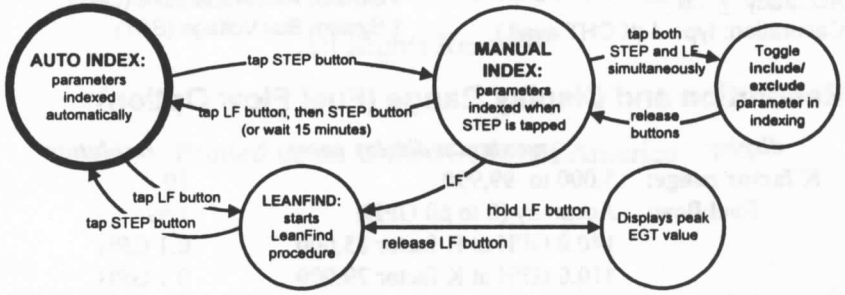
How to use LeanFind™ (page 14)



Pre-lean the mixture | Tap LF button | Lean the mixture | Stop at peak | Enrich to peak or 100° rich of peak

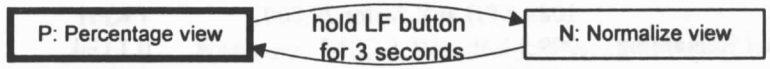
How to Change Modes (page 8)

EDM-700 enters Automatic mode two minutes after power up



How to Change Views (page 5)

To toggle between Normalize and Percentage view:



How to ...

Specifications

FAA Approved
EDM-700 EGT/CHT:
STC SA2586NM
Fuel Flow Option Transducer:
STC SA00432SE

Display Size:
2 1/4 in panel mount
2.6 in. sq., 7.1 in. deep

Common Mode Range:
± 4v, rejection > 80db

Analog Thermocouples
Response curve: All Linearized.
Resolution: 1.0 °F
Accuracy: ± 1.0 °F
Calibration: type J (K CHT avail.)

Operating Temperature Range:
-40 to 195 °F

Temperature Range:
EGT bar graph: variable
EGT, TIT digital: -40 to 2500 °F
CHT, OAT, IAT: -40 to 800 °F

Analog input channels:
6 Exhaust Gas Temperature (EGT)
6 Cylinder Head Temperature (CHT).
2 Turbine Inlet Temperature (TIT)
1 Oil temperature (OIL)
1 Carburetor Temperature (CRB)
1 Induction Air Temperature (IAT)
1 Compress. Discharge Temp. (CDT)
1 Outside Air Temperature (OAT)
1 System Bus Voltage (BAT)

Resolution and Display Range (Fuel Flow Option)

display	*maximum display value*	*resolution*
K factor range:	5,000 to 99,990	10
Fuel flow:	Accuracy (8 to 60 GPH)	1 %
	140.0 GPH at K factor 85,000	0.1 GPH
	410.0 GPH at K factor 29,000	0.1 GPH
	820 PPH at K factor 85,000	1 PPH
	2400 PPH at K factor 29,000	1 PPH
	560 LPH at K factor 85,000	1 LPH
	1640 LPH at K factor 29,000	1 LPH
	372 KPH at K factor 85,000	1 KPH
	1088 KPH at K factor 29,000	1 KPH
Fuel Remaining:	999.9 Gal	0.1 Gal
	999 Lbs., L, or Kg	1 Lb., L, or Kg
Fuel Used:	999.9 Gal.	0.1 Gal
	9999 Lbs., L, or Kg	1 Lb., L, or Kg
Time to Empty:	50 hours	1 minute

EZREC® Long Term Memory Option

Data capacity: up to 70 hours
Recording rate: every 6 seconds

Pilot's Guide

EDM-700

Copyright © 1998 J.P. Instruments, Inc.
All Rights Reserved

Printed in the United States of America

J.P.INSTRUMENTS

Information: P. O. Box 7033
Huntington Beach, CA 92646

Factory: 3402-I West Mac Arthur
Santa Ana, CA 92704

(714) 557-5434 Fax (714) 557-9840

http://www.jpinstruments.com

Rev H 2/99

Table of Contents

Section 1 - Introduction

Product Features

EDM-700 Standard Instrument:

- Hands-free, automatic scanning
- Bar graph
- LeanFind™ mode
- Battery voltage
- Normalize view
- DIF low to high EGT spread
- Shows largest EGT variance
- Oil temperature option
- EGTs to 1°F resolution
- Shock cooling monitoring
- Outside air temperature (OAT) option
- User selectable index rate
- Alarm "red line" limits
- Fast response probes
- Real-time serial data port

Fuel Flow Option:

- Solid-state pulse generating rotor fuel flow transducer
- Fuel quantity measured in gallons, kilograms, liters, or pounds
- Low fuel quantity alarm
- Low fuel time alarm
- GPS interface
- Instantaneous fuel flow rate,
- Total amount of fuel consumed,
- Total fuel remaining, and
- Time to empty at the current fuel flow rate.

Long Term Memory Option:

- Records and stores data
- Non-volatile memory
- Post-flight data retrieval
- Data retrieval software

Engine Data Management

The EDM-700 Engine Data Management system is the most advanced and accurate piston engine monitoring instrument on the market. Using the latest microprocessor technology, the EDM-700 will monitor up to twenty-four critical parameters in your engine, three times a second, with a linearized thermocouple accuracy of better than 0.1 percent or 2°F.

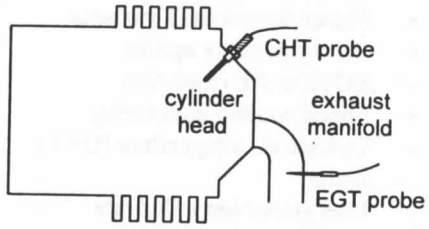
As your built-in flight engineer, the EDM-700 is constantly "red line" checking: all critical parameters are automatically checked several times a second, regardless of the current display status. Leaning is accomplished quickly and automatically using the LeanFind™ procedure. With the EDM-700 it is now possible to have substantially more diagnostic information available to you in a timely and usable manner.

The real-time serial data port—a standard feature—permits you to record scanned parameters in real-time using a user-supplied palmtop or laptop PC.

Benefits of Proper Mixture Control

- Improved engine efficiency
- Greater fuel economy
- Smoother engine operation
- Longer spark plug life
- Reduced maintenance costs
- Reduced operating costs
- Proper engine temperatures
- Reduced engine vibration

JPI Probes



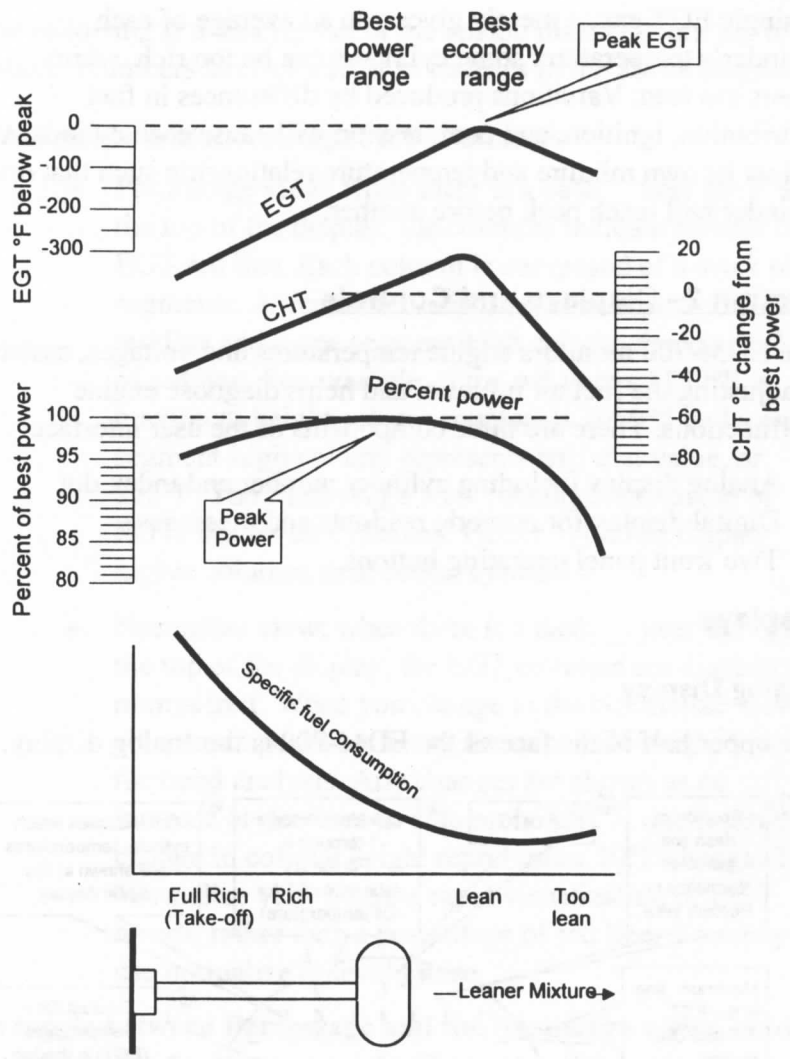
Temperature information processed by the EDM-700 is captured by **fast response**, grounded ***JPI*** temperature probes, that accurately measure the small temperature changes—as small as 1°F—that occur during mixture adjustment.

Temperature and Mixture

In a piston engine only a small portion of the energy from combustion produces movement of the piston during the power stroke. The majority of energy passes into the exhaust pipe as hot gasses. By monitoring the temperature of these exhaust gasses you will have an indication of the quality of the combustion process. Low compression, non-uniform fuel distribution, faulty ignition, and clogged injectors diminish the efficiency of the combustion process that generates power.

From the cockpit you can adjust the fuel/air ratio by a process called *leaning*. Retarding the mixture control changes the fuel/air ratio and hence the resulting Exhaust Gas Temperature (EGT).

The following figure depicts the mixture and temperature relationship.



As the mixture is leaned, *EGT* rises to a peak temperature, and then drops as the mixture is further leaned. Peak *power* occurs at a mixture using more fuel than at peak EGT. Best *economy* occurs at peak EGT. Accurate leaning yields optimal engine temperatures. By being able to precisely adjust the mixture, your engine can produce either the highest fuel economy or maximum power, whichever you choose.

A single EGT gauge merely gives you an average of each cylinder's temperature: some cylinders can be too rich, while others too lean. Variations produced by differences in fuel distribution, ignition, and compression will cause each cylinder to follow its own mixture and temperature relationship such that one cylinder will reach peak before another.

Section 2 - Displays and Controls

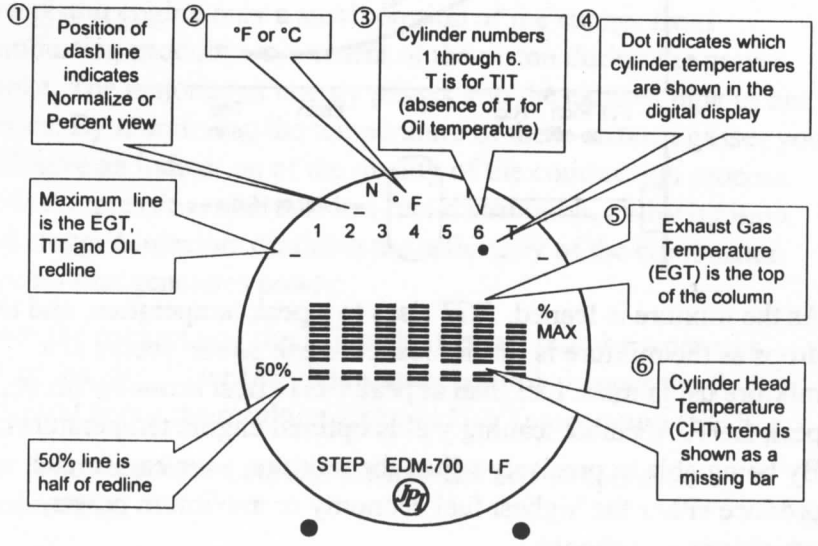
The EDM-700 monitors engine temperatures and voltages, assists in adjusting the fuel/air mixture, and helps diagnose engine malfunctions. There are three components of the user interface:

- Analog display including cylinder number and index dot
- Digital display for numeric readouts and messages
- Two front panel operating buttons.

Displays

Analog Display

The upper half of the face of the EDM-700 is the analog display.



The following is a description of the analog display, from top to bottom. Numbers in circles refer to features in the above diagram.

①Normalize and Percentage View Indicators

- Percentage view: when there is a dash _ near the **P** at the top of the display, the columns indicate percent of EGT red line. Each column is composed of a stack of segments. A maximum height column depicts 100 % of red line and a one segment-high column depicts 50 % of red line. For example, if the red line is 1650°F, a maximum height column represents 1650°F and a one segment-high column represents half that value, or 825°F. The *Percentage view* permits comparison of EGTs *across all* cylinders. Hotter cylinders display higher columns than cooler cylinders.
- Normalize view: when there is a dash _ near the **N** at the top of the display, the EGT columns are displayed normalized. When you change to the Normalize view, all column peaks are set to the same half-height level for trend analysis. Any changes are shown as an increase or decrease in column height. A one-segment change in column height represents a 10°F change. The Normalize view permits rapid visualization of EGT *trends*, rather than a percentage of red line. You may use normalize in level cruise.

To toggle between Percentage and the Normalize views, hold the LF button for three seconds. The analog display becomes half height and the display changes to the Normalize view. Selecting the Normalize view does not affect the digital display nor alter the parameter sequence. The CHT display—described later—is not affected by the Normalize or Percentage view.

You may select the Normalize view in either the Manual or Automatic mode. Normalize view is most helpful for engine trend monitoring of each cylinder's operation. For example using the

Normalize view during engine run-up, a fouled spark plug will appear as a higher column.

A common mistake is to be in the Normalize view and then change your power setting, causing all columns to go off scale, high or low. Set to the Percentage view before adding or reducing power. Always set Percentage View when beginning your descent.

②*Temperature Units (°F or °C)*

- °F temperatures in the digital display are in Fahrenheit degrees.
- °C temperatures in the digital display are in Celsius degrees.

To change the display of engine temperatures see "Pilot Programming" on page 36. To change the display of OAT see "Changing the Alarm Limits" on page 43.

③④*Cylinder Numbers and Dot Index*

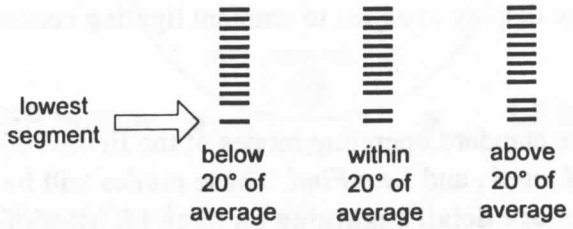
A row of numbers 1 through 6 and the letter T are the column labels for the analog display. The 1 through 6 are the cylinder numbers. If the TIT option is installed, the T denotes the last column is displaying Turbine Input Temperature (TIT). If the T is absent and the Oil temperature option is installed, the last column displays Oil temperature. If both TIT and Oil temperature options are installed, the last column displays TIT. A round dot under the numbers 1 through 6 indicates that particular column is shown numerically in the EGT and CHT digital display.

⑤⑥*Bar Graph EGT and CHT*

Each column in the bar graph is composed of a stack of segments. The total height of each column represents the EGT and the missing segment in the column represents the CHT trend.

- In the Percentage view, the EGT and TIT (or Oil temperature) columns' resolutions depend on the programmed red line limits

- CHT trend is displayed by a missing segment and should be interpreted as follows:



The cylinder with the hottest CHT cylinder will have a missing segment one segment higher than the highest segment of the other cylinders.

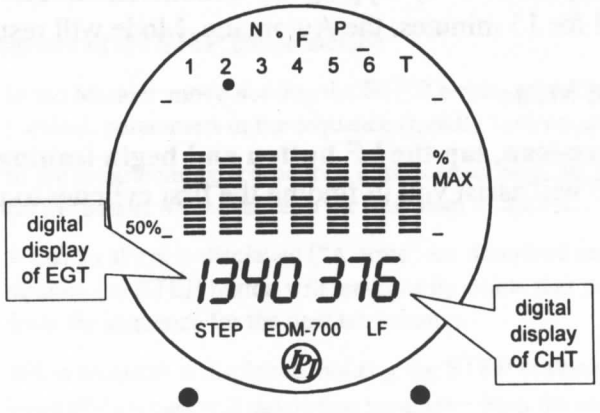
The CHT display is the not affected by mode or view.

Digital Display

Beneath the bar graph is the 9-segment alphanumeric display.

EGT and CHT

When the dot index is beneath a cylinder number, 1 through 6, the digital display shows the EGT on the left (four digits) and the CHT on the right (three digits). Other parameters are displayed in the digital display as described in the subsection "Parameter " on page 11.



Display Dimming

The entire display panel features automatic dimming. Allow ten seconds for the display to adjust to ambient lighting conditions.

Modes

There are three standard operating modes of the EDM-700: *Automatic* , *Manual* , and *LeanFind*. **These modes will be described in more detail beginning on page 14.** Most of the time you will operate the EDM-700 in the Automatic mode. When you first turn on the power the EDM-700 starts in the Manual mode, but will enter the Automatic mode after two minutes. The three modes affect primarily the digital display.

Automatic Mode

Just tap the LF button, then tap the STEP button. No user intervention is required to use this mode. Each cylinder and each parameter value is automatically sequenced and shown in the digital display for a few seconds.

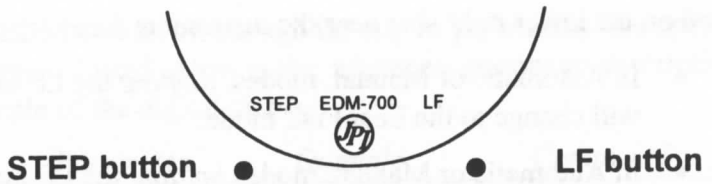
Manual Mode

Just tap the STEP button. Automatic stops. Each indexed parameter is frozen in the digital display until you manually index to the next parameter by tapping the STEP button. If no button is depressed for 15 minutes, the Automatic Mode will resume.

LeanFind Mode

Simply pre-lean, tap the LF button and begin leaning. The EDM-700 will assist you in finding the first cylinder to peak.

Buttons



Buttons, Front Panel

Two operating buttons control all functions of the EDM-700.

The term ***tap*** will be used to denote pressing a button momentarily. The term ***hold*** will be used to denote pressing and holding a button for five seconds or longer.

STEP Button

Located on the lower left side near the instrument face.

- In the Automatic mode, *tapping* the STEP button will stop and change to the Manual mode. Then each *tap* of the STEP button will display the next parameter in the sequence.
- In the LeanFind mode *tapping* the STEP button will terminate the LeanFind mode and change to the Automatic mode.

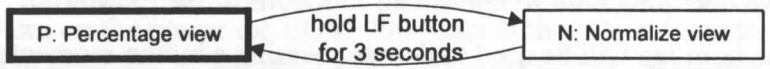
Secondary functions of the STEP button include:

- In the Manual mode *holding* the STEP button will display the previous parameters in the sequence (rapidly backwards).
- In the programming procedures, described on page 36, *tapping* the STEP button will advance to the next item in the list.
- When an alarm is displayed ("Alarms" are described on page 42), *tapping* the STEP button will temporarily delete that parameter from the sequence for the next ten minutes.
- When an alarm is displayed, *holding* the STEP button until the word *OFF* appears will delete that parameter from the sequence for the remainder of the flight.

LF Button

Located on the lower right side near the instrument face.

- In Automatic or Manual modes, *tapping* the LF button will change to the LeanFind mode.
- In Automatic or Manual modes *holding* the LF button for three seconds will toggle between Percentage and Normalize views.



- In the LF mode *holding* the LF button after peak EGT is found will display peak EGT.
- EZREC® Memory Option only: in the LF mode *tapping* the LF button will mark a data record in memory.

Secondary functions of the LF button include:

- In the pilot programming procedure, *holding* or *tapping* the LF button is used to increment or decrement parameter values and toggle between yes and no answers to questions.

STEP and LF Buttons

- Holding both the STEP and LF buttons simultaneously for five seconds changes to the pilot programming procedure.
- Tapping both the STEP and LF buttons simultaneously in Manual mode toggles to include or exclude the displayed parameter from the Automatic mode. It has no affect on the displayed parameters in the Manual mode.

Parameter —without Fuel Flow Option

The EDM-700 steps through the engine parameters in a specific sequence. Listed below is the sequence, parameter description and example of the digital display.

Parameter	*Example*	*Comments*
Voltage, System Bus	14.2 BAT	Battery voltage
Outside Air Temperature	81 OAT	°F or °C
Induction Air Temperature	125 IAT	Out of the intercooler
Compressor Discharge Temperature	300 CDT	Into the intercooler
Carburetor Temperature	-22 CRB	Not available when CDT is installed
Difference between hottest and coolest EGT	80 DIF	Dot indicates most widely deviating cylinder
EGT, CHT	1340 376	EGT, left, CHT, right. Dot indicates cylinder
TIT, Turbine Inlet Temperature	1370 TIT 1370 TI2	Turbine #1, left Turbine #2, right
Oil Temperature	177 OIL	
Shock Cooling	-30 CLD	Dot indicates fastest cooling cylinder

The display will pause at each parameter for four seconds in the Automatic mode. (The four second rate can be changed. See "Pilot Programming" on page 36.) In the Manual mode, tap the STEP button to advance to next parameter. Only the parameters for the options that are installed will be displayed; uninstalled parameters will not appear.

Section 3 - Operating Procedures

Diagnostic Testing on Startup and During Flight

When your EDM-700 is first turned on, all digits light up for a few seconds, permitting you to check for non-functional segments. Then each column is self-tested in sequence while the EDM-700 tests internal components, calibration and integrity of the probes. If a problem is found, it will be displayed as OPEN PRB or CAL ERR, followed by the name of the probe or channel.

Display	*Channel*	*Display*	*Channel*	*Display*	*Channel*
EGT 1	EGT #1	CHT 1	CHT #1	OIL	Oil
EGT 2	EGT #2	CHT 2	CHT #2	TIT1	TIT #1
EGT 3	EGT #3	CHT 3	CHT #3	TIT2	TIT #2
EGT 4	EGT #4	CHT 4	CHT #4	CDT CRB	CDT carb
EGT 5	EGT #5	CHT 5	CHT #5	IND	IAT
EGT 6	EGT #6	CHT 6	CHT #6	OAT	OAT

During flight, probes are constantly checked for inconsistent or intermittent signals. A faulty channel or probe encountered during start-up or during flight will be deleted from the sequence, producing a missing column or blank digital data.

Modes

The EDM-700 has three different operating modes: *Automatic* , *Manual* and *LeanFind*. When you first turn on the power the EDM-700 starts in the Manual mode, but will enter the Automatic mode after a few minutes. The Automatic mode provides you with engine monitoring information for the majority of flight conditions. To adjust the mixture, use the LeanFind mode. And to display specific parameters, use the Manual mode. In both the Automatic and Manual modes the analog display shows a bar graph of EGT and CHT for each cylinder and the TIT, if installed (or Oil temperature, if it is installed and TIT is not installed).

Automatic Mode

Just tap the LF button, then tap the STEP button. No user intervention is required to use this mode. In the Automatic mode the EDM-700 displays the parameter sequence at a user-selected rate (see "Personalizing" on page 36).

Individual parameters can be excluded from the *Automatic mode*: tap STEP to enter the Manual mode. Tap STEP to index to the parameter you want to exclude. Then tap both the STEP and LF buttons simultaneously. Excluded parameters display a decimal point before the parameter name. For example:

Included 184 OIL Excluded 184 .OIL

Tapping the STEP and LF buttons simultaneously will toggle back and forth between *include* and *exclude*.

- Every time you turn on the EDM-700, it will remember which parameters were excluded.
- *All* installed parameters are always displayed in the Manual mode. Exclusion only applies to the Automatic mode.
- All parameters are checked for alarm conditions every second *regardless of their included or excluded status*.

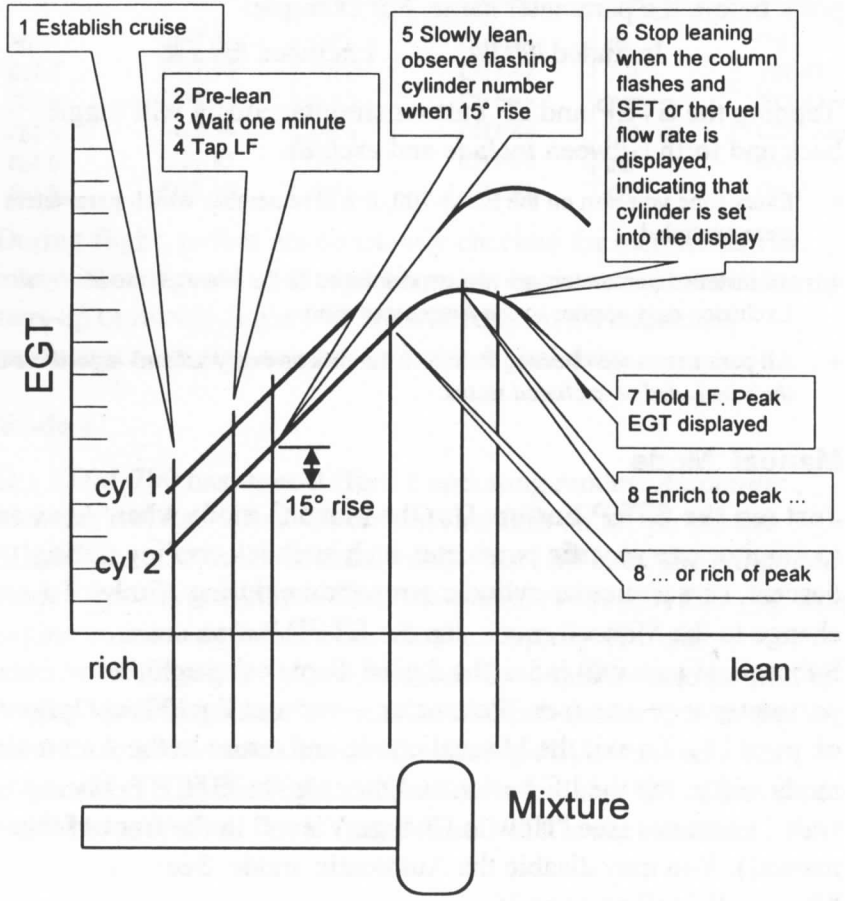
Manual Mode

Just tap the STEP button. Use the Manual mode when you want to monitor one specific parameter such as shock cooling during descent, or a particular cylinder temperature during climbs. To change to the Manual mode, tap the STEP button once. Subsequent taps will index the digital display through the parameter sequence (see "Parameter —without Fuel Flow Option" on page 11). To exit the Manual mode and return to the Automatic mode, either tap the LF button and then tap the STEP button or wait 15 minutes (see "How to Change Views" in the front of this manual). You may disable the Automatic mode. See "Personalizing" on page 36.

LeanFind Mode

Simply pre-lean, tap the LF button and begin leaning. Upon reaching cruise configuration, you will use the LeanFind mode to identify the first cylinder to reach peak EGT.

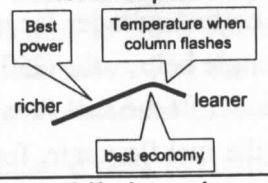
In the example diagram below only two cylinders are depicted for clarity. The numbers in the boxes on the diagram correspond to the numbered list shown on the LeanFind Procedure—Step-by-step—shown on the opposite page. *It is important to realize that the hottest cylinder is not necessarily the first cylinder to peak.*



A more detailed explanation of the LeanFind procedure follows this step-by-step procedure.

LeanFind Procedure—Step-by-Step

	Procedure	Example	Comments
1	Establish cruise at approx. 65 to 75% power.		
2	Pre-lean the mixture to 50°F on the rich side of the estimated peak EGT on any cylinder: _____ °	1490 370	*For your *first flight* with the EDM-700, use the method shown below.
3	Wait one minute		Let engine stabilize.
4	Tap the LF button	1490 LF	Start the LeanFind mode.
5	Slowly lean the mixture—approx. 4°/second—while observing the display. When there is a 15°F rise in EGT, LeanFind mode becomes active.	1520 LF (Fuel Flow Option shows flow on the right	Flashing cylinder number indicates hottest cylinder and that LeanFind mode is active.
6	Stop leaning when a column begins flashing. You will see PEAK EGT for two seconds, followed by:	1550 SET or with Fuel Flow 1550 12.4	Flashing cylinder number & column indicates leanest cylinder. (SET means that the peaked cylinder is "set" into the display.) Due to thermal inertia this will usually be about 10°F lean of peak.
7	If you hold LF, peak EGT will be displayed while the LF button is held down.	1560 PK	Captured peak EGT value is displayed.
8	Slowly enrich the mixture. the temperature will increase, returning to peak. Stop enriching at the desired EGT.	1560 SET	• Peak EGT for best economy • 100° cooler than peak for best power
	Best economy	1560 SET	
	Best power	1460 SET	



*Here is how to determine the pre-lean value: while in cruise at under 65 percent power, choose any cylinder and lean that cylinder

to peak EGT in the Manual mode or to engine roughness, whichever occurs first. Note the peak, subtract 50° and write the resulting number in the space provided in step 2.

LeanFind Procedure—General Explanation

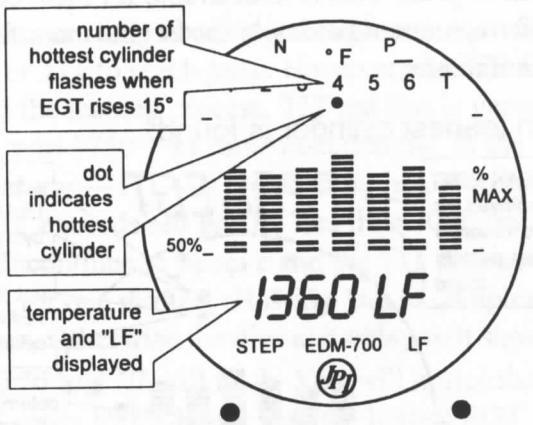
> Lycoming and Continental engines have established specific restrictions on leaning that must be followed, such as percentage of power, climb leaning, and TIT limits. Lycoming recommends operation at peak EGT for power settings of 75% or lower, while Continental recommends operation at peak EGT for power settings of 65% or lower. This guide is not meant to supersede any specific recommendations of the engine manufacturer or airframe manufacturer.
>
> **It is your responsibility to know your aircraft's limitations.**

Pre-lean the mixture to about 50° below peak. After pre-leaning, wait for one minute for the temperatures to stabilize. Next, begin the leaning process by tapping the LF button. This tells the EDM-700 to begin looking for a 15° rise in EGT for any cylinder. Begin leaning the mixture. When a 15° rise occurs, the LeanFind mode becomes activated, shown when the cylinder number above the column of the hottest cylinder begins flashing. LeanFind is not active if a cylinder number is not blinking.

> With the Fuel Flow Option, instead of seeing the word *LF* in the display, you will see numerical fuel flow rate during the leaning process on the right side of the digital display. This allows you to observe the EGT rise and at the same time watch the fuel flow rate decrease.

To show the progress of the leaning process, the EDM-700 selects the hottest cylinder for reference in the digital display. In the example below, the *1360* is the current temperature of the hottest cylinder. If the fuel flow option in installed, instead of *LF* you will see the fuel flow rate, for example *12.4*.

When LF is activated:



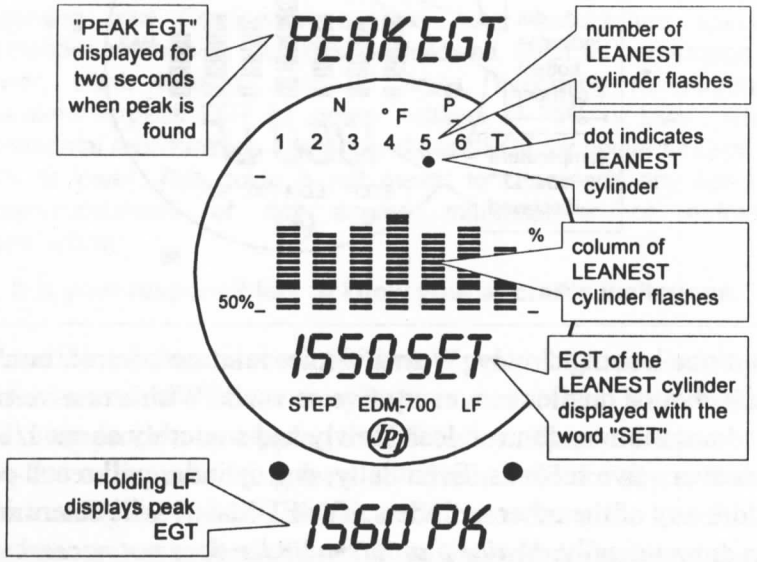
Continue leaning slowly. With a vernier mixture control, turn the knob about a quarter turn every five seconds. With a non-vernier or quadrant mixture control, lean slowly and smoothly about 1/16 inch every five seconds. Eventually, one cylinder will reach peak before any of the other cylinders. The EDM-700 will determine this automatically. *Notice that this cylinder does not necessarily have the hottest EGT.*

The EDM-700 will indicate success in finding a peak by displaying the words *PEAK EGT* for two seconds, followed by flashing the column of—and displaying the value of—the EGT of the cylinder that peaked first. The word *SET* will also be displayed. (With the Fuel Flow Option the current fuel flow rate will be displayed on the right side of the digital display instead of the word *SET*.) The flashing cylinder will be locked —or set—into the digital display during the remainder of the LeanFind procedure to allow you to set the final mixture. The peak EGT value is remembered by the EDM-700 and will be displayed as long as you hold the LF button.

You may now enrichen the mixture to operate at peak or continue enriching to 100° rich of peak, or a value of your choice, consistent with the procedures defined in your aircraft engine manual.

If you lean too much, the EGT will drop and the engine will be operating lean of peak. This is undesirable for most engines. Refer to the specific recommendations of the engine manufacturer or airframe manufacturer.

When leanest cylinder is found:



Fine Tuning the Mixture

Fuel flow is the critical issue in the leaning process. Uniform fuel distribution to all cylinders results in the best economy and smooth operation. Estimate the uniform fuel distribution by the heights of the EGT columns on the analog display. Uniform fuel balance among all cylinders occurs when the heights of the columns, displayed in Percentage view, are uniform. Minor adjustments in throttle position, RPM, and mixture settings can dramatically improve uniformity of the fuel distribution. In fuel injected engines, interchanging injector nozzles between high and low EGT cylinders will improve fuel distribution in many cases.

Turbocharged Engines

The leaning process for turbocharged engines is by reference to the first cylinder or TIT to reach peak. However, the TIT *factory red line* may limit the leaning process. TIT red line is generally 1650°F, and up to 1750°F in some installations. In the LeanFind mode the T column—TIT—is included in the procedure. If during leaning the TIT exceeds red line by less than 100°, the LeanFind procedure will continue to operate and the TIT redline alarm will be suppressed for one minute, allowing you to complete the leaning process. Otherwise the digital display will show, for example, *1650 TIT* and *TIT* will flash. You will notice that in some cases the TIT reads 100°F hotter than the hottest EGT. This is caused by unburned fuel in the exhaust igniting at the turbine inlet.

The reduced size of the ***JPI*** Hastaloy-X-tip probes produces faster response and more accurate than the massive factory installed probe. Therefore ***JPI*** probes may read as much as 100°F higher than the factory installed probe. However, note that the engine was certified with the factory installed probe and gauge, and this gauge reading is the limiting factor when adjusting your engine.

Never exceed red line on the factory installed instruments.

Common Misapplications

Some of the more common misapplications made by first-time EDM-700 users are presented here in an attempt to help you avoid similar problems.

Problem	*Situation*	*Correction*
May find a premature "false" peak. LeanFind finds a "peak" too soon.	Failure to pre-lean before performing LeanFind.	Follow the pre-lean procedure in the section "LeanFind Mode" on page 14.
	Leaning too slowly.	Lean more quickly.
Peak not found	Leaning too quickly.	Lean at the speed of approximately 10°F per second.
Off-scale EGT bars, too high or low	You forgot that you set the EDM-700 in the Normalize view and later observe off-scale EGT bar readings.	The higher sensitivity of the Normalize view can quickly go too high or low off-scale with only small changes in EGT.
First cylinder to peak is not the hottest	This is normal. The first to cylinder peak is unrelated to the hottest.	
EGTs rise during single magneto check	This is normal, due to incomplete combustion persisting longer.	
EGTs not uniform during low power operation	This is normal. Fuel and air distribution is not optimal at low power settings.	

Section 4 - Diagnosing Engine Problems

Normal Engine Limits

The follow chart lists typical *normal* parameter values that you will observe for most general aircraft engines.

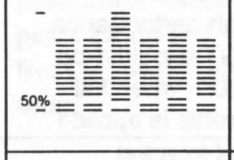
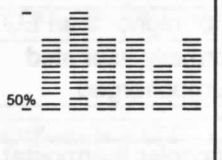
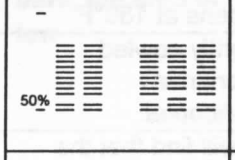
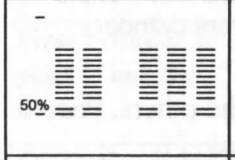
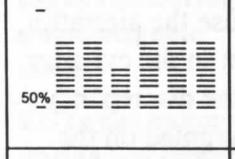
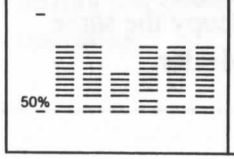
Parameter	*Normal range*	*Comments*
EGTs in Cruise	1350°F 1550°F	• under 200 HP • high performance • EGT should drop 200°F when full throttle is applied
EGT span (DIF)	70 to 90°F 120 to 150°F	• fuel injected • carbureted
TIT	1600°F average	• 100° higher than EGT
CHTs	350°F (OAT 60°F) 410°F	• normally aspirated • Turbocharged
CHT span	50 to 70°F	
OIL	200°F	• oil cooler thermostat opens at 180°F
Shock cooling*	-40°/minute -55°/minute -200°/minute	• tightly cowled • Bonanza • helicopter

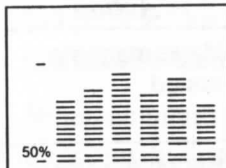
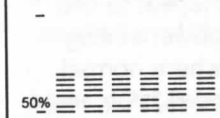
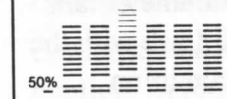
* Maintain a cooling rate of less than -60°/minute. You will find that the cylinder with the greatest shock cooling will shift from front cylinders (during climb out) to the rear cylinders (during descent).

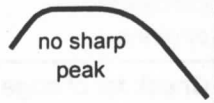
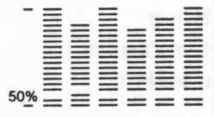
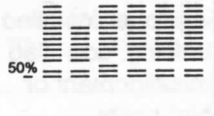
If one CHT is reading 20° to 50° above or below the others, this may be due to that cylinder having a spark plug gasket probe instead of a bayonet probe. This is necessary because the aircraft's factory original CHT probe is occupying the socket in the cylinder head rather than the EDM-700. This is normal. If the discrepancy is greater, be sure the spark plug gasket probe is mounted on the *top* spark plug. An adapter probe is available to occupy the same socket as the factory original probe. Contact your dealer.

Engine Diagnosis Chart

The following chart will help you diagnose engine problems in your aircraft. (Views are Percentage views). Notice that there is always one CHT that is shown hotter than the others.

Display	*Symptom*	*Probable Cause*	*Recommended Action*
	75° to 100° rise for one cylinder during flight	Spark plug not firing due to fouling, faulty plug, lead or distributor.	Enrich mixture to return EGT to normal. Have plugs checked.
	Increase or decrease after ignition system maintenance	Improper timing: high EGT → retarded ignition; low EGT → advanced ignition.	Check EGT for each mag to determine any uneven timing.
	Loss of EGT for one cylinder. Engine rough	Stuck valve. Other cylinders are okay.	Have valve train checked.
	Loss of EGT for one cylinder; no digital EGT	Failed probe or failed wire harness.	Swap probes to determine if probe or wire harness is bad.
	Decrease in EGT for one cylinder	Intake valve not opening fully; faulty valve lifter.	Have valve lifter or rocker arm checked.
	Decrease in EGT for one cylinder at low RPM	Low compression.	Check compression.

Display	*Symptom*	*Probable Cause*	*Recommended Action*
	EGT and CHT not uniform	Dirty fuel injectors or fouled plugs.	Check injectors and plugs. Non-uniformity is normal for carbureted engines
	Decrease in EGT for all cylinders	Decrease in airflow into the induction system. Carb or induction ice. Engine units set to Celsius	Check for change in manifold pressure. Set alarm limits to Celsius degrees
	Slow rise in EGT. Low CHT	Burned exhaust valve. CHT is low due to low power output.	Have compression checked.
	High CHT on cylinders on one side of engine	Obstruction under cowling.	Check for improper installed baffling, cowl flap misalignment or bird nests.
	EGT on one cylinder jumps up and down 100°	Spark plug fouling at higher temperatures.	Check spark plug.
	Sudden off scale rise for any or all cylinders	Pre-ignition . or Normalize view. or failed probe	Full rich and reduce power. Change to Percentage view. Check probe

Display	*Symptom*	*Probable Cause*	*Recommended Action*
	Loss of peak EGT	Poor ignition or vapor in fuel injection system.	Have magneto tested.
	Decrease in peak or flat EGT response to leaning process	Detonation. Usually the result of 80 Octane fuel in 100 Octane engine.	Enrich mixture, reduce power and relean mixture. Repeat to find power setting where normal peak is obtained or run rich.
	Below 10,000 ft. full throttle causes EGTs to rise	Weak or defective mechanical fuel pump.	Apply booster pump. If EGTs drop, replace fuel pump.
	CHT more than 500°, EGT normal. Adjacent EGT may be low	Leaking exhaust gasket blowing on CHT probe.	Look for white powder around cylinder to determine leak area.

Alarms

The EDM-700 has programmable alarms. When a parameter falls outside of its normal limit(s), the digital display will flash with the value and abbreviation of the alarming item. If the condition triggering the alarm returns to within normal limit(s), the display will stop flashing the alarm. If your installation includes a separate panel mounted alarm warning enunciator light or audible warning, it too will be activated.

There is no alarm for the individual EGTs because the temperature values can assume different ranges depending on the flight configuration (run up, climb, cruise). There *is* an alarm on the DIF

parameter, the difference between the hottest and coolest EGTs. DIF—or span—is the important parameter for monitoring the EGTs. See "Factory Set Default Limits" on page 42 for a list of the alarms and their factory default settings.

When an alarm is displayed, *tapping* the STEP button will temporarily disable the alarm indication for the next ten minutes.

When an alarm is displayed, *holding* the STEP button until the word *OFF* appears will disable that alarm indication for the remainder of the flight. See Alarm Limits" on page 42.

Alarm Priority

If multiple alarms occur simultaneously, the higher priority alarm will temporarily "hide" the lower priority alarm(s). When an alarm occurs, note the cause of the alarm and tap the STEP button to clear the alarm indication so that you will be notified of any other alarm that might have occurred. The alarm priorities are as follows:

Highest priority	*CLD*	CHT cooling rate
	CHT	CHT over temperature
	OIL	OIL temperature
	TIT	TIT over temperature
	DIF	EGT span
	BAT	Battery voltage
	LO FUEL	Fuel remaining low
Lowest priority	*LO TIME*	Fuel endurance low

Pre-Ignition and Detonation

Combustion that is too rapid leads to detonation and possibly pre-ignition. *Detonation* is abnormally rapid combustion where the fuel-air mixture explodes instead of burning uniformly. It causes the EGT to decrease and the CHT to increase, and can appear during the leaning process. It occurs under high compression from fuel with too low an octane rating, or from avgas contaminated by jet fuel. Fuel additives, such as lead, boost the octane rating and slow down the combustion process, producing an even pressure to the piston.

Pre-ignition is caused by hot spots in the cylinder. Ignition occurs prior to the spark plug firing. The EDM-700 depicts pre-ignition as a sudden red line of the EGT on the analog display. This may occur in one or more cylinders. The affected cylinder column(s) will flash while the digital display will show an EGT higher than 2000°F. **At this temperature pre-ignition will destroy your engine in less than a minute unless you take immediate corrective action.**

Logging Data Manually

On monthly intervals, you may choose to jot down peak EGT, parameter sequence values, and cruise engine settings on a *data logging worksheet* in the back of this book. Look for trends as well as absolute values. DIF is a good indicator of the overall health of the engine. Typical values are less than 80°F for a factory new fuel injected engine, and less than 150°F for a carbureted engine. If you discover a DIF spread greater than this, identify the effected cylinder and initiate preventive maintenance.

Trend data for EGT and CHT is also of value. Any departure from a cylinder's baseline requires investigation. Refer to the "Engine Diagnosis Chart" on page 24. Data logging as a means of identifying trends is of considerable value in preventative engine maintenance.

EDM-700 Data Worksheet

This is an example of an entry into the worksheet. A blank worksheet is provided in the back of this guide for you to use.

			EGT / CHT								RPM
Date	Tach	Alt	#1	#2	#3	#4	#5	#6	TIT	DIF	MP
21231 96	453	95	350 378	360 382	390 365	370 385	380 369	370 385	450	40	2350 28

Standard Real-Time Serial Data Port (standard with instrument, optional EZREC® available)

The EDM-700 is equipped with a standard real-time serial data output port. Every six seconds all measured parameters are sent to the serial port. A computer connected to the serial port through a standard RS-232 serial link can collect and store these parameters, which can then be analyzed in real-time or at a future time. If the EDM-700 is equipped with the EZREC® Long Term Memory Option (you can select to output in real-time, or to record, but not both). Refer to the section on "Real-Time Serial Data Port" on page 46 for details of the data protocol and format. **Do not connect a power source to the serial port connector.**

Section 5 - Fuel Flow Option Operation

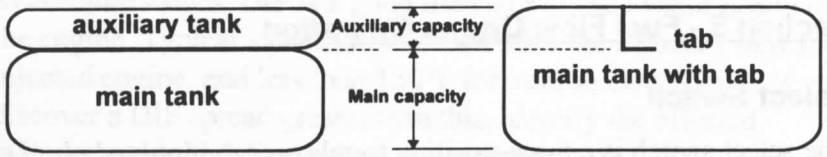
Select Switch

The select switch is a three-position toggle switch mounted on your instrument panel near the display of the EDM-700. Any alarm warning will appear regardless of the select switch setting.

- In the **EGT** (**T***emperature)* position only the installed temperature (and battery voltage) parameters are displayed in the digital display in either the Automatic or Manual modes or during the pilot programming procedure.
- In the **FF** (**F***uel Flow)* position only fuel flow parameters are displayed in the digital display in either the Automatic or Manual modes or during the pilot programming procedure.
- In the **ALL** (**A***ll*) position, the EDM-700 both installed temperature and fuel flow parameters are displayed in the digital display in either the Automatic or Manual modes or during the *pilot* procedure.

Start Up Fuel

After initial self-test, you will be asked to inform the EDM-700 of start up fuel. The EDM-700 will display *FUEL* for one second, and then flash *FILLPN* until any button is pressed. If your aircraft has tank fill tabs and no auxiliary tanks, you can use the auxiliary tank feature to select either filling to the tank tabs or topping the tank. See "Main Tank Capacity" and "Auxiliary Tanks" beginning on page 45 to program the EDM-700 for this feature. The EDM-700 does not differentiate fuel flow between the main and auxiliary tanks; it considers only *total* fuel in the aircraft. **During flight you may also inform the EDM-700 of startup fuel using the pilot program mode, page 36, if you forgot to do so at start up.**



Refer to the column in the chart below corresponding to your fuel tank configuration. Tap the LF button to select one of the four following fueling choices on the left column of the chart.

LF to choose ⇓	*Main tanks only, no tabs*	*Main tanks with tabs*	*Main & Auxiliary tanks*
FILLPN	Did not add any fuel since last shutdown.		
FILL 75	Topped the main tanks.	Filled only to the tabs.	Topped the main tanks. If some additional fuel is added to the auxiliary tanks, you will input this next when *.0GAL* is displayed
FILL 120	(not available)	Topped the main tanks.	Topped both the main and auxiliary tanks.
FILL +	Did not top, but added additional fuel to the aircraft, or removed fuel from the aircraft.		

Then tap the STEP button to complete the entry and advance to the Manual mode.

Adding Fuel and Auxiliary Tanks

If you either

a) added less than full fuel to only the main tanks, or
b) topped the main tanks but have some fuel remaining in the auxiliary tanks,

then select *FILL +* and the next display will ask you how much you added: *.0GAL* (or selected units). Hold the LF button to count up, tap the LF button to count down. The count up will stop at full tanks, since you cannot add more fuel than would top the tanks.

If you added fuel to only the main tanks, then input how much you added.

If you topped the main tanks, but have some fuel remaining in the auxiliary tanks, input how much is now in the auxiliary tanks.

You can "add" a negative amount of fuel if you remove fuel from the aircraft or wish to correct the total quantity of fuel on board.

Accumulate Total—Trip Total

You may either display total fuel *used* since the last time you informed the EDM-700 that the aircraft was refueled, or for an extended trip with multiple fuel stops. This selection affects only the *USD* parameter. How to select whether to accumulate or reset is described in "Pilot Programming" beginning on page 36.

Resetting "USED"

Every time you inform the EDM-700 that the aircraft is refueled, the amount of fuel *used* is set to zero, unless the instrument is programmed to accumulate. The display of fuel *used* pertains only to the fuel used since the last time you informed the EDM-700 that the aircraft was refueled.

To reset to zero the amount of fuel *used* at any point in time, manually step to display USD and hold both buttons for five seconds until the display shows .0 USD.

Fuel Management

Without a means of measuring fuel flow, you must rely on the aircraft fuel gauges or total time of flight. Aircraft fuel gauges are notoriously inaccurate (they are only required by the FAA to read accurately when displaying *empty)*. And measuring time of flight is only an approximation, and assumes a constant fuel flow rate for each phase of flight.

The EDM-700 Fuel Flow Option uses a small turbine transducer that measures the fuel flowing into the engine. Higher fuel flow causes the transducer turbine to rotate faster which generates a faster pulse rate. Because the transducer turbine generates thousands of pulses per gallon of fuel, it can measure with high resolution the amount of fuel that the engine has consumed. Prior to engine start you inform the EDM-700 Fuel Flow Option of the known quantity of fuel aboard, and it will keep track of all fuel consumed.

For fuel calculations to be accurate, it is imperative that you inform the EDM-700 of the correct amount of fuel aboard the aircraft. Do not rely on fuel flow instruments to determine fuel levels in tanks. Refer to original fuel flow instrumentation for primary information

Parameter —with Fuel Flow Option

The EDM-700 steps through the engine parameters in a specific sequence. Listed below is the sequence, parameter description and example of the digital display. The display will pause at each parameter for a few seconds in the Automatic mode. In the Manual mode, tap the STEP button to advance to next parameter.

Parameter Start Up Sequence with Fuel Flow Option

Select	*Parameter*	*Example*	*Comments*
T, A	**Voltage**, System Bus	14.2 BAT	Battery voltage
T, A	**Outside Air** Temperature	81 OAT	°F or °C
T, A	**Induction** Air Temperature	125 IAT	Out of intercooler
T, A	**Compressor Discharge** Temperature	300 CDT	Into intercooler
T, A	**Carburetor** Temperature	22 CRB	Not available when CDT is installed
T, A	**Difference** between hottest and coldest EGT	80 DIF	Dot indicates most widely deviating cylinder
F, A	**Fuel Remaining**	37.2 REM	In gallons, liters or pounds or kilograms
F, A	**Fuel required to next GPS WPT or Destination**	25.9 REQ	Present with GPS interface Valid signal and way point
F, A	**Fuel Reserve at next GPS Waypoint or Destination**	11.3 RES	Present with GPS interface Valid signal and way point
F, A	**Nautical Miles per Gal**	13.0 MPG	Present with GPS interface and valid signal or MPK, MPL, MPP
F, A	**Time to Empty**	02.45 H.M.	Hours . Minutes Remaining at current fuel burn
F, A	**Fuel Flow Rate**	13.5 GPH	Or KPH, LPH, PPH
F, A	**Total Fuel Used**	38 USD	Since last refueling or trip total.
T, A	**EGT, CHT**	1340 376	EGT, left, CHT, right. Dot indicates cylinder
T, A	**TIT**, Turbine Inlet Temperature	1370 13.5 1370 T12	Turbine #1, left and fuel flow Turbine #2, right
T, A	**Oil** Temperature	177 OIL	
T, A	**Shock Cooling**	-30 CLD	Dot indicates fastest cooling cylinder

The first column indicates what position the select switch must be in to display that particular parameter. T is EGT, F is FF and A is ALL.

Section 6 - Long Term Memory Option

The EDM-700 Long Term Memory Option will record and store all displayed parameters once every six seconds and, at a later time, transfer them to a palmtop or laptop PC. You can select to *record*, or to output in *real-time*, but not both. (To turn on or turn off the recording feature, see "Changing the Alarm Limits" on page 43.)

If you select to output in real-time, refer to the description in the section, "Real-Time Serial Data Port" on page 46.

When you retrieve recorded data to your laptop PC you can choose to retrieve *all* the data in stored in the EDM-700, or only the *new* data recorded since your last retrieval. In either case, no data in the EDM-700 is erased. The data will be saved in the PC in a file in a compressed format. The PC program supplied with the Long Term Memory Option will decompress the data for display and use by other programs, such a MS Excel or Lotus 123.

The amount of total data that the EDM-700 can store will vary depending on how rapidly the measured temperatures change. The typical storage is 70 hours, but may vary depending on which options are installed. When the memory becomes full, the oldest data will be discarded to make room for the newest. You may place a mark at the next data record by tapping the LF button twice. You will see the word SNAP within the next six seconds, indicating a data record has been marked. Tap the STEP button to return to the Automatic mode. Recording begins when EGTs are greater than 500°F or "snap" is requested.

All data are time-stamped. The EDM-700 Long Term Memory Option contains a real-time clock that may be reset to local time when you initially program your instrument. You may also program an *aircraft id* that will appear in the output data file. The aircraft id can be your aircraft registration number or your name. Initially the *aircraft id* is set to the EDM-760's serial number.

At power on, the EDM-700 will execute its self test and then display the date (e.g., 11.12.99), the time (13.26), the percentage of memory filled since the last save (FULL 24), and the Aircraft ID.

Transferring Recorded Data

To transfer recorded data to your palmtop or laptop PC, proceed as follows:

1. Connect the computer to the serial port using the serial cable. Insert the small round plug into the data connector on your aircraft instrument panel, and the other end into the computer serial port.
2. Start running the download program in the PC, referring to the instructions supplied with that program.
3. Simultaneously hold the STEP and LF buttons for five seconds. You will see the word PROGRAM for two seconds. Tap the STEP button until you see the question DUMP? N.
4. Tap the LF button to select either NEW or ALL.
   - NEW will transfer only data *newly* recorded since you last saved your data.
   - ALL will transfer *all* the data that is in the EDM-700 memory.

   In either case, no data will be erased from the EDM-700.
5. Tap the STEP button to begin the transfer process. The display shows the percentage of memory remaining to be transferred. When this number reaches zero, the transfer is complete. If you want to terminate the transfer before it is complete, simultaneously hold the STEP and LF buttons for five seconds.
6. The EDM-700 display will show SAVE DPN.

- If you have successfully dumped the data to your PC, tap the LF button to display SAVE DPY and then tap STEP. This will reset to zero the percentage of memory filled since the last save. No data will be erased.
- If you did not dump the data to your PC and wish to do so later, leave the message SAVE DPN and tap STEP. You will asked if you are finished using the program mode by the message: END Y. Tap STEP if done. Tap LF to change the message to END N and stay in the program mode. Tap STEP to continue.

Section 7 - Personalizing

Pilot Programming

You can program the automatic rate (1-9 seconds or 0 = don't auto-index), the temperature display (°F or °C) and the EGT resolution (1 or 10°). To start the Pilot Programming Procedure, simultaneously hold the STEP and LF buttons for five seconds. You will see the word PROGRAM for two seconds and then the sequence shown in the chart below. Tap the STEP button to advance to the next item in the list. Tap the LF button to select alternate values of that item. The shaded areas in the chart below pertain only to the Fuel Flow Option.

Select switch	*Tap* STEP *to advance to the next item*	*Tap* LF *to sequence through these values*	*Comments*
T, F, A	PROGRAM		Stays on for two seconds.
T, F, A	FUEL? N	N⇔Y	Y—Yes—to change fuel status (see page 30)
T, A	RATE 4	0⇒9	rate in the Automatic Mode. Selecting 0, disables the Automatic Mode.
T, A	OATF	OAT F⇔ OAT C	To calibrate the OAT ±10°, hold both the STEP and LF buttons simultaneously for five seconds, which will proceed to the next step. Otherwise the next step will be skipped.
T, A	OAT+0	OAT-10⇒ OAT+10	This step will be normally be skipped. Adjust the indicated temperature up or down by up to 10°. For example, OAT+3 adjust the OAT upward 3°.
T, A	EGT 1?N	EGT 1?N⇔ EGT 1?Y	Y—Yes—sets the digital display to one degree resolution; N—No—sets 10°. (10° is easier to see.)
F, A	KF-SET	29.00=KF	Used to set and fine tune the K factor. See text below.
F, A		ACCUM?N⇔ ACCUM?Y	N—No—Upon informing the EDM-700 that you refueled the aircraft, reset total fuel used to 0. Y—Yes—accumulate total fuel used rather than reset to 0.
F, A		GPS-C=0	GPS Com Format.
T, F, A	DUMP? N	N⇒NEW⇒ ALL⇒	(Long Term Memory Option only.) Select to transfers ALL or only NEW data. (Next step is bypassed for a Long Term Memory Option DUMP.)
T, F, A	END Y	END Y⇔ END N	Y—Yes to exit; N—No to review list again.

Using a Factory Original TIT Probe

If your aircraft is using the factory original TIT probe and gauge, you will be required to calibrate the EDM-700 for that probe. The factory original TIT probe must be a type K and the leads must be wired red-to-red and yellow-to-yellow. Both the EDM-700 and factory original gauge may be used concurrently. Due to the high input impedance of the EDM-700 instrument, it will not affect the accuracy of the factory installed probe or gauge.

In normal cruise flight, record the difference between the factory installed TIT gauge and the EDM-700 TIT reading.

TIT gauge _____ EDM _____.

If you haven't already done so, start the pilot programming procedure, by simultaneously holding the STEP and LF buttons for five seconds. You will see the word *PROGRAM* for two seconds.

Tap* STEP *to advance to the next item	***Tap the* LF *button to sequence through these values***	***Comments***
PROGRAM		Stays on for two seconds.
RATE 4	RATE 4	hold both STEP and LF buttons simultaneously for five seconds to begin the next sequence.
ORIG TIT	ORIG T-N ⇔ ORIG T-Y	Y—Yes—selects factory original TIT probe and proceeds to the next step.
CAL TIT	TIT+0 ⇒ TIT-5 ⇒ TIT-10 ⇒ ... TIT-975 ⇒ TIT+975 ⇒ TIT+970 ⇒ ...	Tap the LF button to lower the correction; hold the LF button to raise the correction. For example, if the EDM-700 reads 100 less than the aircraft's TIT gauge, set the display to read TIT+100.
		Tap STEP button to exit the procedure.

Fuel Flow Option Programming

Fuel Flow Parameters

Three additional parameters may be set by the pilot when the Fuel Flow Option is installed:

- K Factor—the fuel flow transducer calibration constant.
- Accumulate—default is OFF: reset the fuel *used* to 0 every time you inform the EDM-700 that the aircraft was refueled. With accumulate ON fuel *used* will not be reset to 0 when you inform the EDM-700 that the aircraft was refueled.
- GPS Communications fuel data format.

K Factor

The K factor is shown on the fuel flow transducer as a four digit number, which is the number of pulses generated per gallon of fuel flow. **Before installing the transducer, write down the K factor here _____.** To enter the number, move the decimal point three places to the left. For example if the K factor on the fuel flow transducer is 29,123, enter 29.12 in the K factor parameter.

The K factor can be changed in the pilot programming procedure. *When the K factor is changed during a trip, calculations of fuel used, fuel remaining and time to empty are not retroactively recalculated.*

Fine Tuning the K Factor

The K factor shown on the fuel flow transducer does not take into account your aircraft's particular installation. Fuel hose diameters and lengths, elbows, fittings and routing can cause the true K factor to be different from that shown on the fuel flow transducer.

You must use the following procedure to fine tune the K factor.

1. Make at least three flights of about two to three hours each. Note the actual fuel used (as determined by topping the tanks)

and the EDM-700 calculation of the fuel consumed for each flight = (total tank capacity) - (fuel remaining).

Flight	*Fuel USED shown by EDM-700 (total tank - REM)*	*Actual fuel used by topping tanks*
1		
2		
3		
4		
Total	❶	❷

2. Total ❶ the EDM-700 fuel used and ❷ the actual fuel used.
3. Record the current K factor here ❸_____ and in the table below.
4. Calculate the New K Factor as follows:

New K Factor = (❶EDM-700 fuel used) x (❸Current K factor)
(❷actual fuel used)

New K Factor = (❶) x (❸)
(❷)

Every time you fine tune the K factor, record the measurements here:

Date	❶*EDM-700 fuel used*	❷*actual fuel used*	❸*Current K factor*	*New K factor = ❶x❸/❷*	*Pilot's initials*

Fuel Flow Option Programming Procedure

Setting the K factor

This procedure is different than for setting other parameters. Place the select switch in the FF position. If you haven't already done so, start the pilot programming procedure, simultaneously hold the STEP and LF buttons for five seconds. You will see the word *PROGRAM* for two seconds.

1. Tap STEP button to advance to the KF-SET screen *29.00=KF*
2. Hold both the STEP and LF buttons simultaneously for five seconds. First digit blinks: *29.00*
3. Tap or Hold the LF button to change flashing digit: *19.00*
4. Tap STEP button for next digit: *19.00*
5. Tap or Hold the LF button to change flashing digit: *18.00*
6. Tap STEP button for next digit: *18.00*
7. Repeat items 5 and 6 for the remaining two digits.
8. Hold STEP and LF buttons simultaneously for five seconds to exit.

Accumulate Total—Trip Total

Select "no" if you wish to display total fuel used since the last time you informed the EDM-700 that the aircraft was refueled. Select "yes" to display total fuel used for an extended trip with multiple fuel stops. This selection affects only the *USD* parameter.

GPS-C Comm settings

The GPS-C setting selects the format of the *fuel data* output of the EDM-700. See "Setting GPS-C Fuel Flow Communications Format" on page 50.

Setting Long Term Memory Option Parameters

If you haven't already done so, start the pilot programming procedure, simultaneously hold the STEP and LF buttons for five seconds. You will see the word *PROGRAM* for two seconds. To

change the date, time and user id for the Long Term Memory Option, tap the STEP button until the display shows DUMP? N. Next, simultaneously hold the STEP and LF buttons for five seconds. Then set the date and time as show below:

Tap **STEP** *advances to next item*	*Tap the* **LF** *button to sequence*	*Comments*
MNTH	1⇒12	Month
DAY	1⇒31	Day
YEAR	80⇒79	Year (note: represents 1980 through 2079)
HOUR	00⇒23	24 hour time. We suggest you set Zulu time
MIN	00⇒59	This also zeros the seconds
N-----	N123456	Displays current Aircraft ID. To *change* Aircraft ID, hold both STEP and LF buttons simultaneously until the first character flashes. Use LF to select the first character. STEP moves to the next character. To *Save* the Aircraft ID, Hold both STEP and LF for 5 sec.
FAST ?	Y⇔N	Y: 19200 baud, N: 9600 baud
END Y		Tap STEP button to exit the procedure.

Alarm Limits

Factory Set Default Limits

JPI conservatively sets the default alarm limits below Lycoming and Continental recommendations.

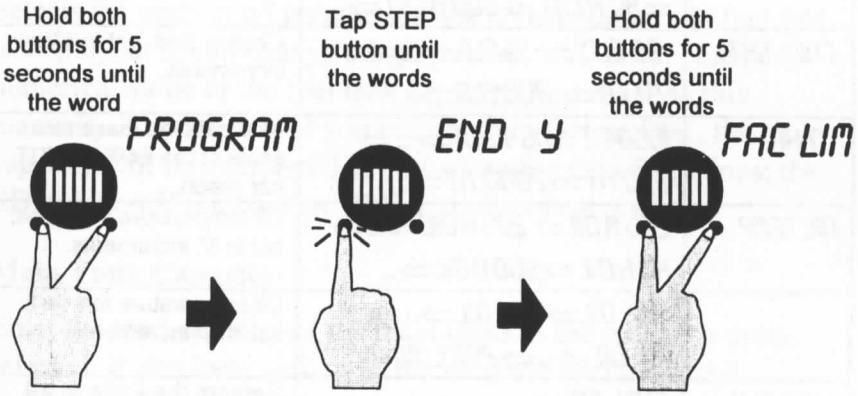
Parameter	*Default Low Limit*	*Default High Limit*	*Example*
DIF		500°F 280°C	525 DIF
CHT		450°F 230°C	465 CHT
CLD		-60°F/min. -33°C/min.	-65 CLD
OIL	90°F 32°C	230°F 110°C	280 OIL
BAT, 24 V	24V	32V	22.4 BAT
BAT, 12 V	12V	16V	17.6 BAT
TIT		1650°F 900°C	1720 TIT
LO FUEL	45 min		00.20 H.M
LO TIME	10 gal, kg, ltr, lbs		7.2 REM

If you change the display to Celsius, be sure to change the alarm limits to Celsius degrees. This is not done for you automatically. When an alarm is displayed, *tapping* the STEP button will temporarily delete that parameter from the sequence for the next ten minutes. When an alarm is displayed, *holding* the STEP button until the word OFF appears will delete that parameter from the sequence for the remainder of the flight.

Changing the Alarm Limits

You may prefer to set your own alarm limits Follow the procedure outlined below to change any of the factory default settings.

To start the alarm limit procedure, after power up, wait until the EDM-700 completes its self test and is in the Automatic or Manual mode. If in doubt, tap the STEP button a few times. Then follow the steps depicted here:



The display will then sequence as shown in the chart below. Tap the STEP button to advance to the next item in the list. Tap the LF button to select alternate values of that item. *Hold* the LF button to increase a numerical value; *tap* the LF button to decrease a numerical value. The shaded areas in the chart below pertain to the Fuel Flow Option only.

Changing the Alarm Limits Procedure:

Tap **STEP** *to next item*	**LF** *sequences through these values*	*Description*
FAC LIM	FAC? N⇔FAC? Y	Restore factory defaults?
REV X.XX		Firmware rev. number.
EGT-CHT	ENG F⇔ENG C	Select F or C degrees for all engine temps. You must also change the alarm limits to °F or °C.
BATTERY	16.0 H BAT⇒15.5 H BAT⇒...⇒ 10.0 H BAT⇒35.0 H BAT⇒...	Battery high voltage limit, set in 0.5 volt increments.
	12.0 L BAT⇒11.5 L BAT⇒...⇒ 8.5 L BAT⇒30.0 L BAT⇒...	Battery low voltage limit.
EGT DIF	500 DIF⇒490 DIF⇒480 DIF ⇒...⇒30 DIF⇒990 DIF⇒...	EGT difference limit, set in 10° increments.
CHT HI	450 H CHT⇒445 H CHT⇒... ⇒90 H CHT⇒500 H CHT⇒...	CHT high limit, set in 5° increments.
COOL CHT	-60 CLD⇒-55 CLD⇒...⇒ -5 CLD⇒-200 CLD⇒...	Cooling limit, set in 5°/min. increments.
TIT HI	1650 TIT⇒1640 TIT⇒...⇒ 650 TIT⇒2000 TIT⇒...	Also sets the maximum scale of the EGT and TIT bar graph.
OIL TEMP	230 H OIL⇒225 H OIL⇒...⇒ 40 H OIL⇒500 H OIL⇒...	Oil temperature high limit, set in 5° increments.
	90 L OIL⇒85 L OIL⇒...⇒ 10 L OIL⇒...⇒250 L OIL⇒...	Oil temperature low limit set in 5° increments
FUEL FLW	FUEL GAL⇒ FUEL KGS⇒ FUEL LTR⇒ FUEL LBS⇒	Selects the units in **all** parameters where fuel quantity or fuel rate is displayed
MAIN TK	MAIN=50	Main tank capacity, in units selected
AUX TNK	AUX? N⇔AUX? Y	Y—Yes—aircraft has auxiliary tanks
	AUX=0	Auxiliary tank capacity

LO TIME	MIN=45	Alarm limit in minutes for low time in tanks
LO FUEL	REM=10	Alarm limit for low fuel quantity in tanks, in units selected
	CARB? N⇔ CARB? Y	Y—Yes—carbureted engine
RECRD?	RECRD? Y⇔ RECRD? N	Long Term Memory Option. Y—only data recording. N—only real-time data output.
	END Y⇔END N	Y—Yes to exit; N—No to review list again

Fuel Flow Alarm Limits, Units, Fuel Capacity

Fuel Flow Units

Selects the units in *all* parameters where fuel quantity or fuel rate is displayed. If you change this parameter, it does *not* change the numerical value of the fuel tank capacity. You must do this manually. For example if you change from Gal. to Lbs., the tank capacity will be interpreted as 50 Lbs. rather than 50 gallons; the EDM-700 will not convert 50 Gal to equivalent pounds.

Main Tank Capacity

Enter the total capacity of the main tanks in the fuel flow units selected. If you have tank tabs (but no auxiliary tanks) and sometimes fill only to the tabs, set the main tank capacity to the capacity up to the tabs.

Auxiliary Tanks

If you do not have auxiliary tanks or tank tabs, answer "No." If you answer "Yes," you will be asked to input the capacity of the auxiliary tanks in the fuel flow units selected. If you have tank tabs and sometimes fill only to the tabs, set the auxiliary tank capacity

to the difference between full tank capacity and tab capacity. The EDM-700 does not differentiate fuel flow between the main and auxiliary tanks; it tracks only *total* fuel in the aircraft.

Low Time Alarm Limit

Select the value of the time remaining, in minutes, that triggers the alarm. Time remaining is calculated at the current fuel flow rate.

Low Fuel Alarm Limit

Select the value of the fuel remaining, in the selected fuel flow units, that triggers the alarm. Fuel remaining is calculated at the current fuel flow rate.

Carburetor?

Different response filters are used depending on whether your engine is carbureted or fuel injected. The filter for a carbureted engine has a slower response time to reduce sudden fluctuations in readings.

Section 8 - Real-Time Serial Data Port

Serial Data Output Port Configuration

The RS-232 port on your computer should be configured as follows: 9600 baud, 1 stop bit, 8 data bits, no parity. The connector is 2.5 mm ID, 5.5 mm OD. **Do not connect a power source to the serial output port connector.**

Real-time Serial Data Output Format

Every six seconds a data block is transmitted, formatted as comma delimited ASCII text. Every 60 lines a header line is transmitted. Note: the format for the *recorded data* when using the Long Term Memory Option is compressed binary and not compatible with the text format shown here.

Table of header names for parameters:

header name	*parameter*	*header name*	*parameter*
"E1"	EGT cyl 1	"C3"	CHT cyl 3
"E2"	EGT cyl 2	"C4"	CHT cyl 4
"E3"	EGT cyl 3	"C5"	CHT cyl 5
"E4"	EGT cyl 4	"C6"	CHT cyl 6
"E5"	EGT cyl 5	"OIL"	oil temp
"E6"	EGT cyl 6	"DIF"	EGT span
"T1"	TIT #1	"CLD"	shock cooling
"T2"	TIT #2	"OATF"	outside air temp.
"C1"	CHT cyl 1	"BAT"	battery voltage
"C2"	CHT cyl 2	"GPH"	fuel flow
		"REM"	remaining fuel

Header line example:

"E1", "E2", "E3", "E4", "E5", "E6", "T1", "T2", "C1", "C2", "C3", "C4", "C5", "C6", "OIL", "DIF", "CLD", "OATF", "BAT","GPH","REM"*<CR><LF>*

In the examples shown here, separate lines are shown for clarity only. Each line is output as a single string with no imbedded carriage returns or line feeds, and is terminated with a single carriage return *<CR>* and line feed *<LF>*. If a parameter is not in the sequence it will be omitted from both the descriptor line and the data line. Outside air temperature header is either "OATF" or "OATC" depending on the temperature units displayed.

Data line example:

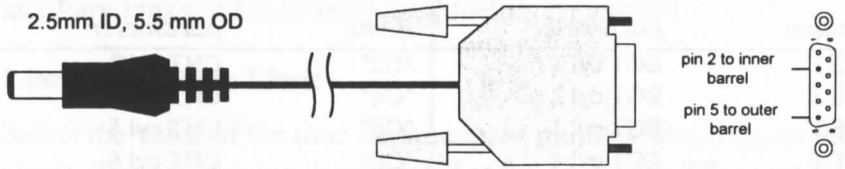
1390,1340,1390,1360,1420,1340,1450,1460,365,380,334,
359,344,365,196,90,-30,76,28.2,14.2,43*<CR><LF>*

If a parameter is removed from the sequence due to a disabled probe, that parameter will be output as the string "NA" with the quotation marks included in the string.

Capturing real-time data with a PC Compatible Laptop

Any laptop computer can be used to capture and analyze the real-time serial data from your EDM-700. J. P. Instruments provides an

optional connector to interface to a standard 9 pin D serial data port of a PC, or you may construct your own as shown here:



2.5mm ID 5.5mm OD plug	9 pin D subminiature female	Signal
Outer barrel	Pin 5	ground
Inner barrel	Pin 2	signal

J. P. Instruments provides an optional data capture computer program for the PC called EzRec™. Or you may use terminal emulator software for display and data capture, such as HyperTerminal, supplied with MS Windows.

Capturing real-time data with the HP-100LX or 200LX

The examples shown here are specifically for the Hewlett Packard HP-100LX or 200LX Palm Top computer only. J. P. Instruments provides an optional connector to interface to the HP-100LX or 200LX Palm Top computer. J. P. Instruments provides an optional real-time data capture computer program for the HP series called EzRec™.

Real-Time Data Capture & Import

With the HP-100LX or 200LX you can capture the real-time data lines into a file and then later import the data into a Lotus 123 spreadsheet. Here are the steps used to perform these two operations. Refer to the **HP 100LX or 200LX User's Guide** for specific details on using the HP 100LX or 200LX. The steps shown below will get you started in capturing data and starting Lotus 123.

Collect the real-time data in a file

Follow these steps to collect real-time data into a file for later analysis using Lotus 123 or another software tool.

- Start Datacomm by pressing [&...] [C] from the application manager.
- In Datacomm enter the settings dialog box by pressing [menu] [C] [S]

  Set the choices as follows:

  Baud: 9600 Parity: None
  Interface: Com1 Data Bits: 8
  Stop Bits: 1.

  Press [enter] when done.

- Press [F5] (Capture) to enter the Capture File dialog box.
- In the File name box, type the name of the file to capture the data. For example `FLT1025.PRN`. Use .PRN as the file extension. Press [F10] when your are done.

Data will now be captured in the file you named until you press [F5] to stop the capturing. Data will continue to be displayed on the screen even though data is no longer being captured in the data file.

Import the real-time data into Lotus 123

- Start Lotus 123 by pressing [123]
- Import the data in the capture file to the spreadsheet by pressing [/] [F] [I] [N]. Select the file name and press [enter] when done.

The data will be imported into the spreadsheet and may be analyzed and graphed as required.

Section 9 - Fuel Flow Option—Formats, Diagnostics

Navigation Data Formats

Output of GPS; input to EDM-700. The EDM-700 automatically configures itself for one of three industry standard data formats:

Format	*Baud rate*	
NMEA-183 (Marine Navigation Data Format)	4,800 (non-standard 9,600 also supported)	This is the format for most handheld GPS receivers. Loran must have sentences RMA & RMB. GPS must have sentences RMB & RMC.
Aviation Data Format	9,600	"Output sentence type 1" Required sentences are: A, B, C, D, E, I and L first character identifier byte. Sentence terminator may be either <CR><LF> or <CR> alone.
Northstar (Northstar binary)	1,200	M1 setup select "NO EXTENDED", "NAV ONLY"

Setting GPS-C Fuel Flow Communications Format

GPS-C	Input to GPS; output of EDM-700	*string length*
0	No fuel data output	
1	Select for Garmin (Shadin Miniflow format)	55 byte
2	Select for Allied Signal (format B)	52 byte
3	Select for Arnav/EI fuel data	13 byte
4	Allied Signal (format C) *	108 byte
5	Garmin fuel/air data	139 byte
6	Apollo Fuel/Air data	155 byte

Diagnostic Messages, Fuel Flow

The following displays indicate a malfunction in the Fuel Flow Option transducer or associated electrical connections:

0.0 GPH	Zero's indicate Fuel flow is too low to register
--- GPH	Dashes indicate No fuel flow transducer signals
--- H.M	Dashes indicate No fuel flow transducer signals

GPS Interface Diagnostics

Parameters REQ, RES, & MPG are all missing from the scan.	No communications from GPS receiver to EDM-700. Possibly no connection or aircraft GPS is off.
NO-COM message and parameters REQ, RES, & MPG are missing.	Communications are received by EDM-700 and the Auto-Protocol setup is in process. Verify correct output format setup in GPS receiver; check GPS connections.
NO-SIG message and parameters REQ, RES, & MPG are missing.	GPS receiver has insufficient signal for valid data.
NO-WPT message and parameters REQ & RES, are missing.	No waypoints are programmed into the aircraft GPS receiver.
---REQ or ---RES message	Your ground track is more than ±70° from your course to the next GPS waypoint.

Navigation Data Ports for GPS Comm

(These ports are completely independent of the EDM-700 serial data output port.)

Navigation Data (output of GPS; input to EDM-700)

Space $+2.4 < V_{in} < +30$ **Mark** $-30 < V_{in} < +1.0$

Compatible with RS-232, TTL, RS-423, RS-422 SDA.

Serial data format 8 data, 1 start, no parity. Baud rates: 1,200, 4,800, or 9,600 depending on the GPS data output format. The EDM-700 automatically detects the GPS data output format and is independent of the GPS-C setting.

Fuel Data (input to GPS; output of EDM-700)

Space > +5 V **Mark** < -5 V

Serial data format 8 data, 1 start, no parity. Baud rate: 9,600.

Output format is determined by the GPS-C setting, but may be over-ridden by the GPS navigation format: If the EDM-700 senses Northstar or NMEA-183 navigation data input, there will be no fuel data output.

Section 10 - Option Connector Pin Assignments

P1(upper) 25-pin connector for 4 or 6 cylinder engines. See installation manual for 7, 8, 9 cylinder instruments

Pin no.	*Pin no.*	*Probe or function*
yellow 1	red 2	OIL
yellow 3	red 4	IAT
yellow 5	red 6	CARB (or CDT)
yellow 14	red 15	OAT
yellow 16	red 17	TIT
yellow 18	red 19	TIT-2 (2nd TIT)
gray 12		Remote alarm
red 13		+ Power
White 24		RS-232 data port
black 25		Engine ground

Fuel Flow Option 15-pin connector

Pin no.	*Function*
white 1	RS-232 out
white 2	RS-232 in
white 4	FF signal
red 5	FF power (+)
black 6	FF Ground (-)
white 7	Switch com
white 8	Switch EGT
white 9	Switch FF
white11	Remote alarm

Section 11 - Reference Reading

You may wish to know more about the effect of engine operations on EGT and CHT. The reading list below provides general overviews as well as original references on topics that may be of interest.

General Overview

These references are readily available to pilots and provide a readable source of general technical information.

- Teledyne Continental Motors, *Engine Operation for Pilots*, from the FAA Accident Prevention Program, FAA-P-8740-13.
- Editors of *Light Plane Maintenance* Magazine, *EGT Systems*, Belvoir Publications Inc., Greenwich, CT 06836. 1989.
- *Lycoming Flyer* Issue 53 dated January 93.

Technical Reviews and Original References

For those pilots who have engineering backgrounds, the references listed below present the original research on the combustion process and represent the source documents for those with technical interests.

- A. Hundere, "Autogas for Avgas," *AOPA Pilot*, October, 1969.
- A. Hundere and J. Bert, "Pre-ignition and Its Deleterious Effects in Aircraft Engines," *SAE Quarterly Transactions*, Vol. 2, No. 4, pages 547-562, October 1948.

Section 12 - Technical Support

JPI offers both e-mail and telephone technical support. Have your model and serial number ready when you call. Call ***JPI*** for a return authorization number before returning any equipment.

J.P.INSTRUMENTS

3402-I West Mac Arthur Blvd.
Santa Ana, CA 92704

714 557-3805

800 345-4574

jpi_tech@compuserve.com

www.jpinstruments.com

Limited Warranty

J.P. Instruments, Inc. (JPI), warrants all parts in your new EDM-700 to be free from defects in material and workmanship under normal use. Our obligation under this warranty is limited to repair or exchange of any defective part of this unit if the part is returned, shipping prepaid, within two years for electronics and one year for probes from the date of original purchase. Installation labor is the responsibility of the aircraft owner. Homebuilt aircraft warranty starts when the aircraft is certified for flight. Replacement parts carry a warranty for the balance of the warranty period.

Under this warranty, JPI is not responsible for any service charges, including removal, installation, nor any other consequential damages. JPI incurs no obligation under this warranty unless a Warranty Registration Certificate describing the warranted product has been completed and mailed to JPI with all information requested.

This warranty is void on any product which has been subject to misuse, accident, damage caused by negligence, damage in transit, handling or modification which, in the opinion of JPI, has altered or repaired the product in any way that effects the reliability or detracts from the performance of the product, or any product whereon the serial number has been altered, defaced, effaced or destroyed.

This warranty is in lieu of all other warranties expressed or implied and other obligations of liability on JPI's part, and it neither assumes nor authorizes any other person to assume for JPI any other liability in connection with the sale of JPI products.

To initiate this warranty, the aircraft owner must submit a completed Data Logging Worksheet to JPI. Upon receiving a completed worksheet, JPI will initiate the warranty from the date of original purchase. Any replacement parts carry a warranty that extends for the balance of the period of the original warranty. For homebuilt aircraft the warranty starts when the aircraft is certificated for flight and noted on the warranty card.

Index

E

F

G

H

I

K

L

M

EDM-700 Logging Data manually Worksheet

A/C N _____ Make _____ Model _____ Engine _____

Date	Tach	Alt	EGT / CHT #1	#2	#3	#4	#5	#6	TIT	DIF	RPM / MAP

J.P. INSTRUMENTS

1-800-345-4574

P.O. Box 7033
Huntington Beach CA 92615
Office:(714) 557- 3805
Fax:(714) 557-9840
http://www.jpinstruments.com