# Pilot's Guide

# Fuel Scan
# FS-450M  TWIN

Printed in the United States of America

## **Table of Contents**

# Section 1 - <u>Introduction</u>

## Product Features

- Fuel quantity measured in gallons, liters, or pounds
- Low fuel quantity alarm
- Low fuel time alarm
- GPS interface—bi-directional serial interface
- Solid-state pulse generating rotor fuel flow transducers
- Instantaneous fuel flow rate
- Total amount of fuel consumed
- Fuel consumed by each engine
- Total fuel remaining
- Time to empty at the current fuel flow rate
- Fuel required to next waypoint
- Fuel reserve at next waypoint
- Nautical miles per gallon

## 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.
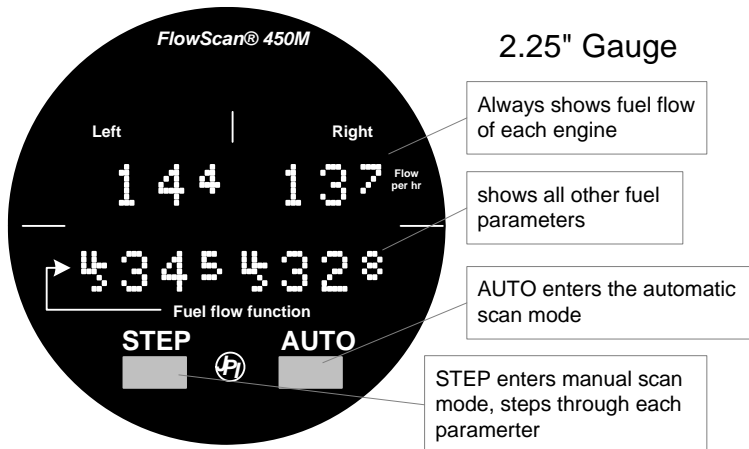
The FS-450M Fuel Scan uses small turbine transducers that measure the fuel flowing into each engine. Higher fuel flow causes the transducer turbine to rotate faster which generates a faster pulse rate. Because the transducer turbine generates thousands of pulses per gallon of fuel, it can measure with high resolution the amount of fuel that the engines have consumed. Prior to engine start you inform the FS-450M Fuel Scan of the known quantity of fuel aboard, and it will keep track of all fuel used.

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**For fuel calculations to be accurate, it is imperative that you inform the FS-450M 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.**

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## Section 2 - <u>Displays and Controls</u>

The FS-450M helps you manage your fuel. There are two components of the user interface:

- Digital display for numeric readouts and messages: top display is fuel flow per hour and the lower display for all other parameters.
- Two front panel operating buttons: STEP and AUTO



2.25" Gauge

Always shows fuel flow of each engine

shows all other fuel parameters

AUTO enters the automatic scan mode

STEP enters manual scan mode, steps through each paramerter

Two operating buttons control all functions of the FS-450M.

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.

- Tapping the STEP button will stop Automatic Indexing and change to the Manual indexing mode. Then each

tap of the STEP button will display the next parameter in the sequence.

- Holding the STEP button will display the previous parameters in the sequence (rapidly backwards).

- In the programming procedures, described on page 8, tapping the STEP button will advance to the next item in the list.

- When an alarm is displayed, tapping the STEP button will temporarily delete that alarm from appearing for the next ten minutes.

- When an alarm is displayed, holding the STEP button until the word OFF appears will delete that alarm from appearing for the remainder of the flight.

## AUTO button

Located on the lower right side near the instrument face.

- The AUTO button will begin the Automatic Indexing Mode.

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

## STEP and AUTO buttons

- Holding both the STEP and AUTO buttons simultaneously for five seconds changes to the pilot programming procedure.

## Section 3 - <u>Modes and Alarms</u>

### Modes

There are two standard operating modes of the FS-450M:
**Automatic Indexing**, and **Manual Indexing**. Most of the time you will operate the FS-450M in the Automatic indexing mode. When you first turn on the power the FS-450M starts in the Manual indexing mode, but will enter the Automatic indexing mode after a minute. Tapping the AUTO button will begin the Automatic Indexing Mode.

### Alarms

The FS-450M has programmable alarms. When the remaining amount of fuel falls below the alarm limit the lower display will show the amount of fuel REMaining and REM will flash on the lower right display.

When the remaining time falls below the alarm limit the lower display will show the MINutes of fuel remaining and HR<sup>MN</sup> will flash on the lower right display.

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.

## Section 4 - <u>Operation</u>

### Diagnostic Testing on Startup and During Flight

When your FS-450M is first turned on, all digits light up in each display for a short time, permitting you to check for non-functional segments. Then the FS-450M tests internal components, and integrity of the system.

**Start Up Fuel**

After initial self-test, you will be asked to inform the FS-450M of start up fuel. The FS-450M will display `FUEL IN GALLONS` (or LITERS or POUNDS) for one second, and then flash `FILL? NONE`.

During flight you may also inform the FS-450M of startup fuel using the pilot program mode, beginning on page 8, 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 AUTO button to select one of the four following fueling choices on the left column of the chart.

| AUTO to choose⇓ | Main tanks only, no tabs | Main tanks with tabs | Main & Auxiliary tanks |
|---|---|---|---|
| `FILL? NONE` | Did not add any fuel since last shutdown. | | |
| ∗ `FILL 75` | Topped the main tanks. | Filled only to the tabs. | Topped the main tanks. The auxiliary tanks are empty. |
| ∗ `FILL 125` | (not applicable) | Topped the main tanks. | Topped both the main and auxiliary tanks. |
| `FILL ADD` | Did not top, but added additional fuel to the aircraft, or removed fuel from the aircraft. | | |

* These values are examples and will be customized for your aircraft.

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

**Adding Fuel and Auxiliary Tanks**
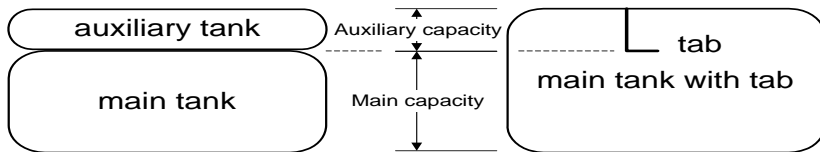


If your aircraft has tank fill tabs and no auxiliary tanks, you can use the auxiliary tank feature to select either filling to the tank tabs or topping the tank. See "Main Tank Capacity" and "Auxiliary Tanks" beginning on page 15 to program the FS-450M for this feature. The FS-450M does not differentiate fuel flow between the main and auxiliary tanks; it considers only total fuel in the aircraft.

If you added less than full fuel, then tap AUTO to select FILL ADD. Then tap STEP. The next display will ask you how much you added: ADD ⁰GALS (or selected units). Hold the AUTO button to count up, tap the AUTO button to count down. The count up will stop at full tanks, since you cannot add more fuel than would top the tanks. Tap STEP to complete the entry and advance to the Manual indexing mode.

If you removed fuel from the aircraft or wish to correct the total quantity of fuel on board, you can "add" a negative amount of fuel.

**Accumulate Total—Trip Total**

You may either display total fuel used

- since the last time you informed the FS-450M that the aircraft was refueled, or

- for an extended trip with multiple fuel stops.

This selection affects only the USed parameter, $\frac{4}{5}$. How to select whether to accumulate for a extended trip or reset at each refueling is described in "Pilot Programming" beginning on page 8.

**Resetting "USed"**

Every time you inform the FS-450M that the aircraft is refueled, the amount of fuel used is set to zero, unless the instrument is programmed to accumulate for an extended trip. The display of fuel used pertains only to the fuel used since the last time you informed the FS-450M that the aircraft was refueled.

In the manual mode with left and right engine USed displayed, holding the AUTO button for three seconds will reset the left, right and total used to 0.

## Parameter Indexing

The FS-450M steps through the engine parameters in a specific sequence. Listed below is the indexing sequence, parameter description and example of the digital display. The display will pause at each parameter for a few seconds in the Automatic indexing mode. In the Manual indexing mode, tap the STEP button to advance to next parameter. Holding the STEP button will display the previous parameters in the sequence (rapidly backwards).

**Parameter Indexing Sequence**

Fuel flow rate is always shown on the top display.

| | | |
|---|---|---|
| **Fuel Flow Rate** | `144 137` | GPH (or LPH, or PPH) |

The lower display shows the following parameters in this sequence.

| Parameter Description | Example | Comments |
|---|---|---|
| Total fuel used | `673 TOTL` | Total used by both engines |
| Fuel USed by each engine | `4345 4328` | Left and right engines shown separately. |
| Time to Empty | `0245 HRMN` | Hours$^{Minutes}$ Remaining at current fuel burn |
| Fuel required to next GPS WPT or Destination | `258 REQ` | Present with GPS interface Valid signal and way point |
| Fuel Reserve at next GPS WPT or Destination | `319 RES` | Present with GPS interface Valid signal and way point |
| Nautical Miles per Gal | `203 MPG` | Present with GPS interface and valid signal or MPL, MPP |
| Fuel Remaining | `577 REM` | In gallons, liters or pounds |

Note that liter and pound parameters are displayed as whole numbers without the decimal fraction.

## Section 5 - Personalizing

## Pilot Programming

You can program the Automatic Indexing rate (1 to 9 second wait periods or 0 for no Automatic Indexing), the K-factor, and whether to accumulated fuel used or reset at each refueling.

To start the Pilot Programming Procedure, simultaneously hold the STEP and AUTO buttons for five seconds. You will see the words

**PROGRAM MODE** 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 AUTO button to select alternate values of that item.

| Tap STEP to advance to the next item | Tap AUTO to sequence | Comments |
|---|---|---|
| FUEL?   N | N ⇔ Y | Y—Yes—to change fuel status (see page 5 |
| RATE=   4 | 0 ... 9 | Indexing rate in the Automatic Indexing Mode. Selecting 0, disables the Automatic Indexing Mode. |
| 2900=KF LEFT | | Used to set and fine tune the K factors. To adjust the K-factors, hold both STEP and AUTO buttons for five seconds. See "Setting the K-factors" below. |
| 2900=KF RIGHT | | |
| TRIP ? N | N ⇔ Y | N—No—Upon informing the FS-450M that you refueled the aircraft, reset total fuel used to 0. Y—Yes—accumulate total fuel used rather than reset to 0. |
| GPS C= 2 | 0 ... 6 | GPS Com Format. |
| END      Y | N ⇔ Y | Y—Yes to exit; N—No to review list again. |

**Start Up Fuel** FUEL?   N

During flight you may also inform the FS-450M of startup fuel using the pilot program mode. See page 5 for the steps to take to set the start up fuel if you did not set it during power up.

**Indexing Rate** RATE=   4

In the automatic mode the display will automatically index through each parameter and pause for a period of time. The pause time can be set from between 1 and 9 seconds. Set the rate to 0 to inhibit the automatic indexing mode.

**Fuel Flow Parameters**

The pilot may set three parameters:
- K Factors—the fuel flow transducers calibration constants.
- Accumulate for extended trip—default is OFF: reset the fuel used to 0 every time you inform the FS-450M that the aircraft was refueled. With accumulate ON fuel used will not be reset to 0 when you inform the FS-450M that the aircraft was refueled.
- GPS Communications fuel data format.

**K Factors**

The K factor is shown on each 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 factors here: Left_____   Right_____.** 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 Factors

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.

## Setting the K factors

## Use the following procedure to determine the new K factors.

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 FS-450M calculation of the fuel consumed for each flight = USD L and USD R.

| Flight | Fuel USED shown by FS-450M | | Actual fuel used by topping tanks | |
|:---:|:---:|:---:|:---:|:---:|
| | USed L | USed R | filled left | filled right |
| 1 | ❶ | | ❷ | |
| 2 | | | | |
| 3 | | | | |
| Total | | | | |

2. Total ❶ the FS-450M fuel used and ❷ the actual fuel used for each tank.

3. Record the current K factor here ❸ left_____ right_____ and in the table below.

4. Calculate the New K Factor as follows:

New K Factor = (❶FS-450M fuel used) x (❸Current K factor)
                      (❷actual fuel used)

New K Factor (L) = (❶(L)_____ ) x (❸(L)_____ )

$$\text{New K Factor (R)} = \frac{(\mathbf{❶}(R) \qquad) \times (\mathbf{❸}(R) \qquad)}{(\mathbf{❷}(L) \qquad) \; (\mathbf{❷}(R) \qquad)}$$

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

| Date | ❶FS-450M fuel used | ❷actual fuel used | ❸Current K factor | | New K factor = ❶x❸/❷ | |
|------|------|------|------|------|------|------|
| | | | Left | Right | Left | Right |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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

1. Tap STEP button twice to advance to the display
   2900=KF
   LEFT
2. Hold STEP and AUTO buttons simultaneously for five seconds.
3. Press STEP button. First digit blinks: 29.00
4. Tap or Hold the AUTO button to change flashing digit: 19.00
5. Tap STEP button for next digit: 19.00
6. Tap or Hold the AUTO button to change flashing digit: 18.00
7. Tap STEP button for next digit: 18.00
8. Repeat items 6 and 7 for the remaining digit.
9. To exit, hold STEP and AUTO buttons simultaneously for five seconds.
10. See
    2900=KF
    RIGHT
11. Repeat steps 1 through 8 for the right engine K factor.

**Setting the GPS-C Comm settings** `GPS C= 2`

The GPS-C setting selects the format of the fuel data output of the FS-450M.

GPS-C                              Input to GPS; output of FS-450M

| 0 | No fuel data output |
|---|---|
| 1 * | Garmin (Shadin Miniflow format) |
| 2 * | Allied Signal (format B) |
| 3 | Arnav/EI fuel data |
| 4 | Allied Signal (format C) |
| 5 | (Not used) |
| 6 * | UPS fuel/air data |

      * Recommended formats.

## FS-450M Set Up

### Factory Default Set Up

The factory default fuel measurement units are gallons and the alarm limits are 45 minutes for the low time alarm, and 10 gallons for the low fuel alarm. The K-factor defaults are K=29.00 (29,000).

### Changing the FS-450M Set Up

You may need to change the fuel measurement units, the fuel tank capacity, and may prefer to set your own alarm limits. Follow the procedure outlined below to change any of the factory default settings.

To start the Set Up procedure, after power up, wait until the FS-450M completes its self test and is in the Automatic or Manual indexing mode. If in doubt, tap the STEP button a few times. Then follow the steps illustrated below. 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 AUTO button to select alternate values of that item. Hold AUTO button to increase a numerical value; tap the AUTO button to decrease a numerical value.

**Procedure—Changing the Set Up:**

| | | |
|---|---|---|
| Hold both buttons for 5 seconds until the words | Tap STEP button until the words | Hold both buttons for 5 seconds until the words |

PROGRAM MODE  →  END   Y  →  SETUP
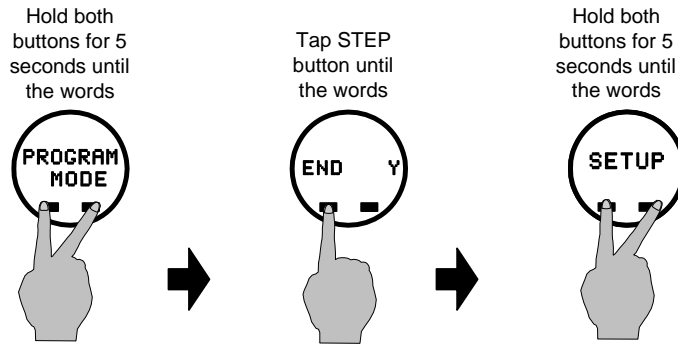
| **Tap STEP to next item** | **Hold or tap AUTO to sequence through these values** | **Description** |
|---|---|---|
| FUEL GALLONS | GALLONS ⇒ POUNDS ⇒ LITERS | Selects fuel units |
| MAIN= 50 | Hold or tap AUTO to select | Main tank capacity, in units selected |
| AUX?     N | N⇔Y | Y—Yes—aircraft has auxiliary tanks (next step) |
| AUX = 0 | Hold or tap AUTO to select | Auxiliary tank capacity (skipped if AUX? is no) |
| MIN = 45 | Hold or tap AUTO to select low time limit | Alarm limit in minutes for low time in tanks |
| REM = 10 | Hold or tap AUTO to select low quantity limit | Alarm limit for low fuel quantity in tanks, in units selected |
| CARB ? N | N⇔Y | Y—Yes—carbureted advances to next step |
| FILTR= 1 CARB | FILTR = 1, 2 or 3 | Higher is smoother filter |
| END     Y | N⇔Y | Y—Yes to exit; N—No to review list again |

**Fuel Measurement Units, Fuel Capacity, Alarm Limits**

### Fuel Measurement 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 gallons to pounds, the tank capacity will be interpreted as 50 pounds rather than 50 gallons; the FS-450M will not convert 50 gallons 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 FS-450M 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 engines are carbureted or fuel injected. The filters for a carbureted engine have a slower response time to reduce sudden fluctuations in readings. Select FILTR=1, 2 or 3 where higher number is more smoothing. Pick the lowest number that gives steady readings.

**Flow Only**

If you want to display only fuel flow, TOTaL and USed without any alarms and without displaying HR$^{MN}$, REQ, RES, MPG and REM, enable the *flow only* setting. To do this, when you see END Y at the completion of the setup procedure, simultaneously hold the STEP and AUTO buttons for five seconds. You will see FLOW ONLY?  N. Change the N to a Y by tapping AUTO. Then tap SET to exit.

## Section 6 - Data Formats, Diagnostics

### Navigation Data Input Formats

Output of GPS; input to FS-450M. The FS-450M automatically configures itself for one of three industry standard data formats:

| Format | Baud rate | |
|---|---|---|
| NMEA-183 (Marine Navigation Data Format) | 4,800 | 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 Communications Output Format

GPS-C                  Input to GPS; output of FS-450M

| | |
|---|---|
| 0 | No fuel data output |
| 1 * | Garmin (Shadin Miniflow format) |
| 2 * | Allied Signal (format B) |
| 3 | Arnav/EI fuel data |
| 4 | Allied Signal (format C) |
| 5 | (Not used) |
| 6 * | UPS fuel/air data |

     * Recommended formats.

## GPS Interface Diagnostic Messages

| | |
|---|---|
| Parameters REQ - RES - MPG are all missing from the scan. | No communications from GPS receiver to FS-450M. Possibly no connection or aircraft GPS is off, or GPS not enabled to output data. |
| **GPS -COM** message and parameters REQ - RES - MPG are missing from scan. | Communications are received by FS-450M and the Auto-Protocol setup is in process. Verify correct output format setup in GPS receiver; check GPS connections. |
| **GPS -SIG** message and parameters REQ - RES - MPG are missing from scan. | GPS receiver has insufficient signal for valid data. |
| **GPS -WPT** message and parameters REQ - RES are missing from scan. | No waypoints are programmed into the aircraft GPS receiver. |
| **— — —** replaces REQ or RES | Number is larger than can be displayed. |

## Navigation Data (output of GPS; input to FS-450M)

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 FS-450M automatically detects the GPS data output format and is independent of the GPS-C setting.

### *Fuel Data (input to GPS; output of FS-450M)*

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 FS-450M senses Northstar or NMEA-183 navigation data input, there will be no fuel data output.

## Section 7 - <u>Rear Panel Connector Pin Assignments</u>

Rear Fuel Flow 9-pin connector

| Pin no. | Function |
|---|---|
| 1 | Power 12-28VDC (red) |
| 2 | Ground (black) |
| 3 | FF transducer power (red) |
| 4 | Remote alarm |
| 5 | FF transducer ground (black) |
| 6 | RS-232 out (to GPS) |
| 7 | Left FF transducer signal (white) |
| 8 | Right FF transducer signal (white) |
| 9 | RS-232 in (from GPS) |

Interface connections to selected GPS models

| EDM | P4 conn Pin 1 | P4 conn Pin 2 |
|---|---|---|
| Arnav 5000 | Pin 4 | Pin 5 |
| Garmin 195 | (nc) | Pin 4 |
| Garmin 430 / 430 | Pin 57 | Pin 56 |
| Northstar M3P | (nc) | Pin 6 (leave pin 11 open) |
| UPS GX50 / 60 | Pin 4 | Pin 5 |

## Section 8 - <u>Technical Support</u>

**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**
3185B Airway, Costa Mesa, CA 92626
800 345-4574
714 557-3805
www.jpinstruments.com

# Limited Warranty

J.P. Instruments, Inc. (JPI), warrants all parts in your new FS-450M 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 period begins when the aircraft is certificated for flight and noted on the warranty card.

## Index

# FS-450M Specifications
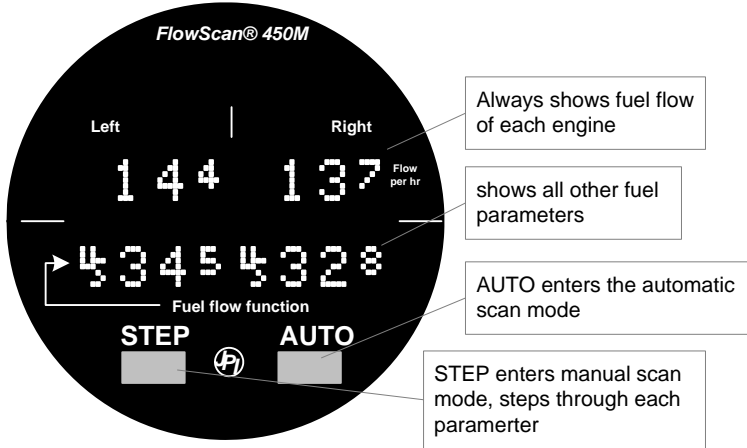
**FAA Approved**
Fuel Flow Transducer:
 STC SA00432SE

**Operating Temperature Range:**
-40 to 195 <sup>o</sup>F

**Display Size:**
2 1/4 in panel mount
2.6 in. sq., 2.5 in. deep incl. conn.

**FlowScan® 450M**

Left | Right

$1\,4\,4$    $1\,3\,7$ **Flow per hr**

$4\,3\,4\,5\,4\,3\,2\,8$

**Fuel flow function**

**STEP**    **AUTO**

Always shows fuel flow of each engine

shows all other fuel parameters

AUTO enters the automatic scan mode

STEP enters manual scan mode, steps through each paramerter

## Resolution and Display Range

| 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 |
| **Fuel Remaining:** | 999.9 gal | 0.1 gallons |
| | 999 pounds., liters | 1 pound., liter |
| **Fuel Used:** | 999.9 gal. | 0.1 gallons |
| | 9999 pounds., liters | 1 pound., liter |
| **Time to Empty:** | 50 hours | 1 minute |

# FS-450M Quick Reference Card

## Reset Alarm

Temporary reset (next 10 minutes): tap STEP.

Reset for remainder of flight: hold STEP until the word OFF appears.

## Reset Fuel Used

1. Tap STEP until USD indicator lights up.

2. Hold AUTO for 3 seconds to reset fuel used to 0.

## No Fuel Added

1. On initial power up see:

   FILL?

   NONE

2. Tap STEP to exit.

## Totalize Fuel Used

1. Hold both STEP and AUTO until you see:

   PROGRAM
   MODE

immediately followed by:

   FUEL?   N

2. Tap STEP four times and see:

   TRIP ? N

3. If you want to accumulate the fuel used, tap AUTO and see:

   TRIP ? Y

4. Tap STEP a few times to exit.

# FS-450M Quick Reference Card

## Filled Tanks

In flight do steps 1, 2, 3 first (on power up skip to step 4)

1. Hold both STEP and AUTO until you see:

### PROGRAM MODE

immediately followed by:

### FUEL?  N

2. Tap AUTO and see:

### FUEL?  Y

3. Tap STEP.

4. See:

### FUEL IN GALLONS

immediately followed by:

### FILL? NONE

5. Tap AUTO and see:

### FILL 75*

(with aux tanks or tabs, Tap AUTO again and see:

### FILL 125*

6. Tap STEP to exit.

(* Your tank capacity)

## Added or Removed Fuel

In flight do steps 1, 2, 3 first (on power up skip to step 4)

1. Hold both STEP and AUTO until you see:

### PROGRAM MODE

immediately followed by:

### FUEL?  N

2. Tap AUTO and see:

### FUEL?  Y

3. Tap STEP.

4. See:

### FUEL IN GALLONS

immediately followed by:

### FILL? NONE

5. Tap AUTO 2 or 3 times, see:

### FILL ADD

6. Tap STEP and see:

### ADD  ⁰GALS

Hold AUTO to increase;
Tap AUTO to decrease.

7. Tap STEP to exit.