



Calibrating Resistive Float-Type Fuel Senders with the Horizon EFIS



Revision A1

11-Jul-2013

Supplement Revision Notes

Revision	Date	Change Description
A	9-Jul-2013	Initial Release
A1	11-Jul-2013	Corrected table of contents

Table of Contents

Section 1: Introduction

1.1 About Float-Type Resistive Fuel Senders.....	4
1.2 Data Port and Hardware Requirements.....	4

Section 2: Installation and Wiring

2.1 Mechanical Installation.....	6
2.2 Assign Analog Inputs in the Horizon EFIS.....	6
2.3 Wire Fuel Senders to the Horizon EFIS.....	6

Section 3: Programming & Calibration

3.1 Configure the Analog Functions.....	7
3.2 Calibration of Fuel Senders.....	8
3.3 Configure Fuel Quantity Bar Graphs.....	10
3.4 Configure Horizon EFIS Fuel Dials.....	10

Section 1: Introduction

1.1 About Resistive Float Senders

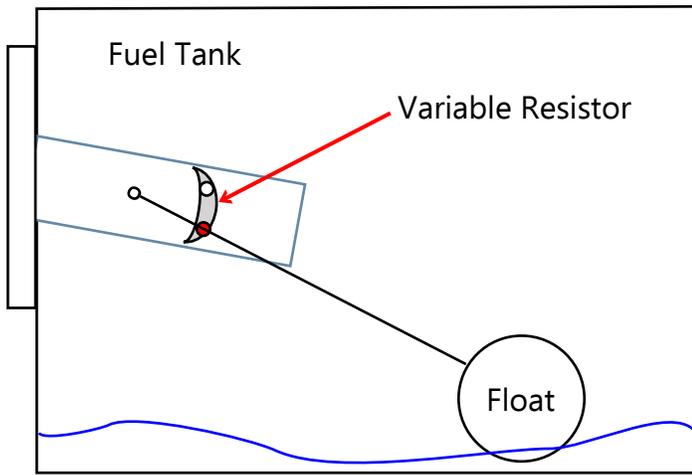
When aviation was new, fuel gauges consisted of a cork float connected to a wire shaped like an upside down L that ran up and out through a fuel cap visible to the pilot. The concept was simple: The cork floated on top of the fuel. As the fuel tank went from full to empty, the cork descended with the fuel level, causing the wire to slide down. When the upside down L rested on the cap, the cork was at its lowest, and tank was presumably empty.

Resistive float senders are an electronic upgrade to this concept. The float is still there, but its rise or fall causes tiny changes in voltage which drive a fuel gauge instrument—In this case, your Horizon EFIS display.

The Horizon EFIS display unit measures the voltage that comes out of the sender unit. A metered voltage level enters the sender unit from the EFIS as an “excitation” current. As the float moves up and down along a slide contact, the electrical current flows through a variable resistor that further changes the voltage. The Horizon then reads the voltage levels flowing from the senders. The EFIS must be calibrated so that the float position voltage readings can be converted into pilot-friendly readings of gallons or liters.

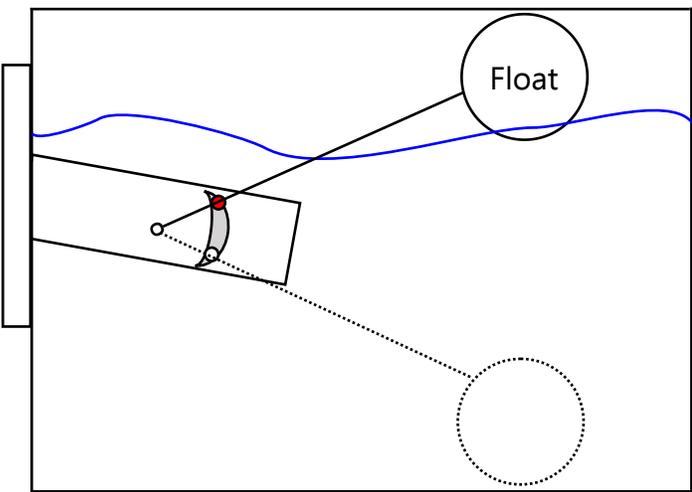
1.2 Data Port and Hardware Requirements

EFIS Data Port	Requires (1) Analog Function per fuel tank sender.
Power Connections	Power is provided from the EFIS display unit.
Hardware Required	(1) float sender per fuel tank



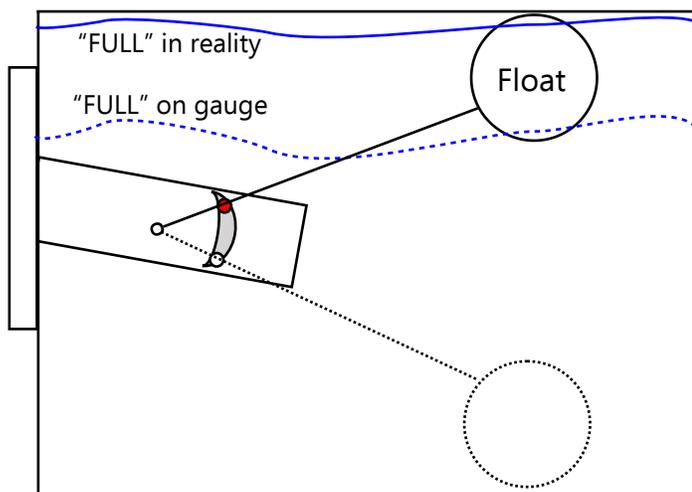
How Does It Work?

The Variable Resistor and float stem are wired to send a signal to the fuel gauge in the form of a precise level of voltage that depends on the position of the float. As the float rises, the voltage of the signal changes. Most of the time, the signal voltage is the lowest when the tank is empty, and the highest when it is full. (Not always-sometimes the opposite is true. This is where the Forward/Reverse Sensing adjustment will come into play later in this process.)



Converting Voltage to Gauge Readings

The voltage level created by the float position is sensed by the EIS. But we don't care about voltage levels, we care about gallons (or litres) in the tank. This is where Scale Factor comes in. The voltage range is somewhere between 0 and 5. If the EIS senses 1 volt, where is the float position? How many gallons does 1 volt represent? **Scale factor** converts raw voltage to a value we can use on the EIS. This is done by calibrating the system. Horizon EFIS users can take advantage of automatic calculations by the EFIS to simplify the calibration process.



Float Sender Limitations

Sometimes the float hits the top of the fuel tank before the tank is full. This causes the gauge to read FULL when the tank is not truly full. Airplanes with dihedral run into this problem often because there is much more fuel uphill from the float. The same is true when it reads empty. Usually there is a small amount of fuel that remains in the tank when the float is at its lowest position. Irregularly-shaped tanks provide unique calibration challenges because the relationship of quantity to float position is not linear- The tank may contain more or less fuel at certain float levels. That's why it's important to add fuel in many small increments while calibrating the fuel senders to get a more accurate picture of reality.

Section 2: Installation & Wiring

2.1 Mechanical Installation

Every airplane is different, so mechanical installation of senders is not covered in this Supplement. Use the airplane kit and/or sender instructions to properly install each sender.

2.2 Assign Analog Inputs in the EFIS

Fuel senders wired to the Horizon EFIS utilize the analog functions. These are user-configurable inputs that sense voltage levels from wide variety of things including flap & trim sensors, VOR/ILS deviations, and fuel senders. They are programmed on the General Setup page of the Set Menu. Start your installation by deciding which analog inputs you will use for your fuel senders. You may fill in the My System table below to record the analog functions and other information for each sender to aid in creating your wiring diagram or schematic for your airplane. Refer to the Horizon Connector Definitions on the GRT Avionics website or the pinout diagram in the Appendix of the HXR manual to find pin assignments for the analog inputs.

My System- Fuel Sender Wiring Information

Fuel Tank	Analog Input	Display Unit Pin	Wire Color	Notes
Left				
Center				
Right				

2.3 Wire the Senders

Using the EFIS connector pinout diagram provided in the Horizon Installation Manual or on the GRT Avionics website, wire the senders to the D-sub connector using standard aircraft wiring practices. Follow the instructions for the senders to ensure that they are properly grounded. External resistors are not required because you will use the EFIS programmable internal pull-up resistors instead.

Section 3: Programming & Calibration

NOTE: To access EFIS configuration menu: Press NEXT or MORE (HXr) until you see the Set Menu softkey label. Press the Set Menu softkey. Turn the right knob to highlight the General Setup page and press the knob to access it.

3.1 Configure Analog Functions

In this step, you will program the EFIS Analog functions that are wired to the fuel tank senders. This step enables the EFIS to display the fuel quantity indicators on the screen.

1. Choose one tank to begin. Verify which Analog function you wired to each sender. In our example, we have wired Analog Function 1 to the Left Tank sender, so the table below shows the values required to configure Analog 1 for the left tank.
2. Access the EFIS Setup Menu > General Setup page. Turn the right knob to scroll down to the Analog setup section. Configure each setting below as shown.
3. Repeat for the other fuel tank(s). **SAVE SETTINGS!**

Setting	Value	Notes
Analog 1 Function	Aux (EIS compatible)	Enter this value first.
Analog 1 Internal Pull-Up	On	Activates the programmable resistor that replaces the external resistor normally used on float fuel senders
Analog 1 Scale Factor	100	
Analog 1 Offset	0	
Analog 1 Sensing	Forward	Starting value- Set to "Reverse" if gauge indication decreases as fuel quantity increases.
Analog 1 Integer/Decimal	Integer	Whole numbers; "Decimal" displays in 0.1 increments
Analog 1 Aux Function	Left Fuel	Choose a label for the gauge (Left/Right/Center Fuel)

3.2 Calibration of Fuel Senders

1. **Preparation:** Begin with empty fuel tanks. This operation is easiest to accomplish with a helper to watch the EFIS fuel gauge readout. Level the aircraft so that it sits on the ground at an angle close to a **straight & level cruise flight attitude** to provide the most accurate fuel level reading in flight.

NOTE: Due to the limitations of float senders described in Section 1.1 of this manual, it is not recommended to use the tank capacity as the "FULL" indication. The EFIS should read the actual fuel level at the upper range limit of the float sender. For example, in a 15 gallon tank, the float sender may reach its upper limit at 12 gallons. When more than 12 gallons are in the tank, the EFIS will display 12; however, the gauge will read more accurately below 12 gallons, where sharper accuracy is most desired.

2. Use Worksheet 2 on Page 9 to record the correlation between the actual amount of fuel in the tank and the readout provided by the fuel sender. You will add up to 10 small, measured increments of fuel. With every addition of fuel, write the indication on the gauge in the "Probe" column and the actual amount of fuel in the tank in the "Actual" column.

NOTE! Until the float begins to move off the bottom of the tank, Actual Fuel entered should be "0". PAY ATTENTION to the moment the float comes off the lower stop, indicated by the first change in the fuel level indication on the EFIS. As soon as the gauge begins to move, record the actual amount of fuel at that point. The gauge should read "0" below this point and, most importantly, when the tank is empty.

3. If the quantity on the gauge decreases as fuel is added, repeat Step 3.1 and set Analog 1 Sensing to "Reverse."
4. When the fuel gauge stops moving, this means the sender float is at its highest level. To provide an accurate spread of data, this should be the highest quantity entered in the Actual column.
5. Repeat for the other tank(s).
6. When all fuel levels are entered, access the Set Menu > Engine Limits > Fuel Data Scale page. Enter your values into the chart by highlighting each box and turning the knob. Scroll through the entire spreadsheet by turning the knob.
7. Press SAVE and exit the Set Menu.
8. Monitor actual fuel quantities carefully and readjust calibration as necessary if errors are found.

3.3 Configure Fuel Quantity Bar Graphs

1. Go to the Graphical Engine Display page in the Set Menu. Scroll down until you see the following:

Setting	Value	Notes
Left Fuel Graph Min Level	3	For best results, enter the gallons in the tank at the minimum and maximum float levels as recorded in Worksheet 1, Section 3.
Left Fuel Graph Max Level	12	

2. Repeat for the other fuel tank(s). SAVE SETTINGS!

3.4 Configure Horizon EFIS Fuel Dials

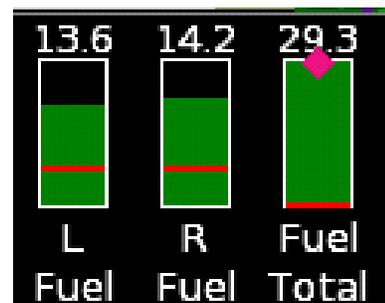
Fuel quantity may be set up as an option on one of the four round engine dials on the ENG pages. Access these settings on the Graphical Engine Display set menu page.

NOTE: The Fuel Total value shown below (magenta reading on the dial gauge and magenta diamond on the Fuel Total bar graph) does not come from the fuel tank quantity senders. It is available as part of the optional Fuel Flow package. Fuel total must be manually entered by the pilot and is affected by the fuel flow rate. Therefore, it is a totally separate system of sensing fuel quantity.

Setting	Value	Notes
Dial #1 Source	Fuel (Combined)	Combination gauge that includes each tank and a total quantity
Dial #1 Scale	1	Integer. If using a decimal, set Scale to the appropriate decimal reading.
Dial #1 Start		Qty at minimum float level.
Dial #1 End		Qty at maximum float level.
Dial #1 Green Start...		The rest of the Dial settings are to establish custom limits for the colored arc markings on the edge of the gauge.



HXR Fuel Combination Dial (left) and Left/Right Bar Graphs (right) showing integer quantities.



Fuel quantity bar graphs (left) showing decimal quantities. Fuel Total (right) is reset by the pilot and derived from Fuel Flow data, NOT from the float senders.