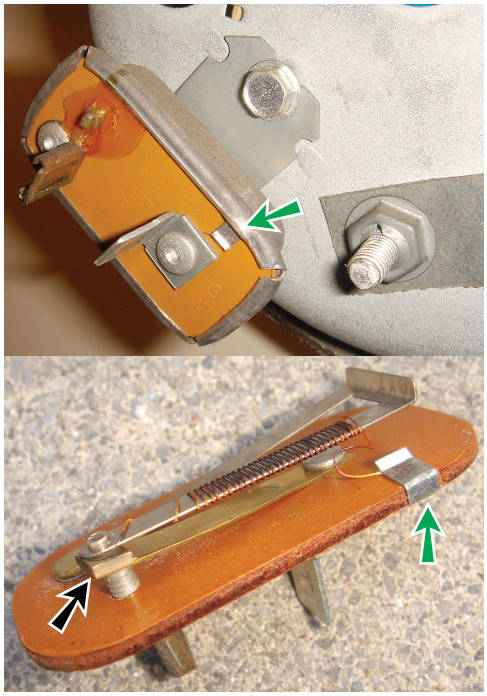
# Improving Fuel Sender Accuracy

*MeterMatch by TechnoVersions*

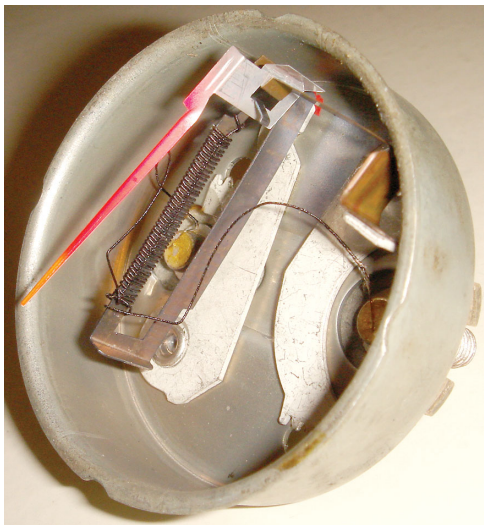
**by Bob Mannel**

The fuel gauge system in the Fairlane, like most Fords of that day, is electro-mechanically driven. Power from the battery or generator/alternator passes through the ignition switch, 5-volt regulator, gas gauge, and fuel tank sender before being grounded to the chassis and completing the circuit. The 5-volt regulator is an oscillating mechanical contact, pulsing between zero and about 10 volts to produce a 5-volt average. It functions by using a heating coil to cause a bi-metal strip to bow and break a set of points. When the points open, current flow stops. The bi-metal strip unbows as it cools, bringing the points in contact once again. The cycle time is about half a second on, and a half a second off.



This is what is inside of the 5-volt oscillating regulator case. The wire coil heats and bows the metal away from the contact (*black arrow*). The double ramp allows temperature compensation. The case is mounted to the instrument panel for grounding of the heating coil (*see green arrows*).

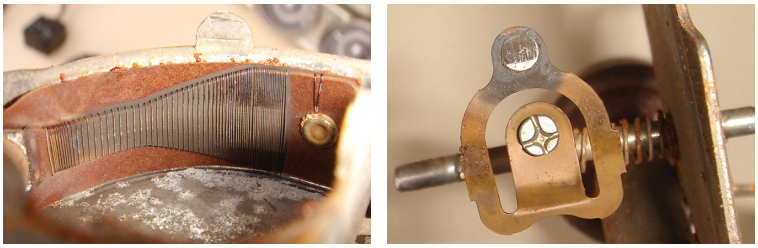
When current flows through the gauge, it is through another heating coil. This time, the bowing of its bi-metal strip rotates the gauge needle. The amount of heating is related to the current flow, which is controlled by the fuel sender.



Delicate, but effective. Gauges were factory calibrated through small access holes. Moving the lever teeth rotates the cams to alter gauge range.

The fuel sender uses a float to determine fuel level. The float is attached to a rod which pivots a contact across resistance wire. The resistance varies from about 10 (tank full) to 60 ohms (tank empty).

Since movement of the gas gauge needle depends on a heating coil wrapped around a bi-metal strip, the gauge is well dampened from the pulsing 5-volt regulator and the fast changing float in the tank. But, with so many variables, seldom does any particular fuel gauge system read the same as any other with the same quantity of fuel in the tank. Ford specifies the range of "Fuel Level vs Gauge Reading" starting in its 1963 Fairlane/Meteor Shop Manual Supplement and continuing in the 1964 Fairlane Shop Manual Supplement. As can be seen in the table below, the acceptable variation in reading actual fuel in the tank can be as high as 3½ gallons.



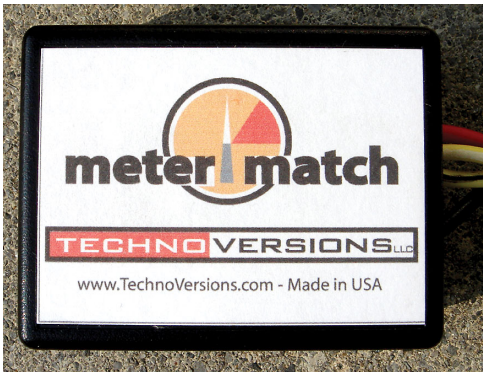
The sender uses a wrapped wire that varies the electrical resistance as a contact (right) slides across the wires. This is the critical part of the tank sender in determining accuracy. MeterMatch can improve this accuracy.

| Gauge Reading | Theoretical Gallons in Tank | Sedan/Hardtop Approximate Gallons in Tank | Wagon Approximate Gallons in Tank |
|---|---|---|---|
| **E (empty)** | 0 | ½ - 2½ | 1 - 3 |
| **¼** | 4 | 3 - 6 | 3½ - 6 |
| **½** | 8 | 6 - 9½ | 6 - 9 |
| **¾** | 12 | 9½ - 12½ | 9 - 12 |
| **F (full)** | 16 | 13 - 16 | 12½ - 15½ |

I find it interesting that in spite of the significant range given in the table, the word "approximate" is used. So, actual amounts might be even higher or lower than indicated.

As was covered in previous articles, some of the reproduction senders have an incorrect resistance profile and throw the range even further from those Ford published. I have encountered senders that keep the gas gauge near full too long while fuel levels drop, then cause the gauge to drop rapidly to empty while as much as a quarter tank of fuel remains. And, like snowflakes, no two systems are likely to match each other perfectly.

In our club forums, Tom Lewis identified a possible solution to inaccurate gas gauges by a company called *TechnoVersions*. I contacted the company and spoke with Brian Laine. He sent me one of the devices called "MeterMatch" (allows analog gauges to use senders that were not originally designed for that gauge and provide for an alarm indicator if normal readings are exceeded).




Since our Fairlane application is a little

different (the Fairlane reproduction sender is designed to work with our gauge), Brian was interested in seeing if his device would work. Because our system draws more current than is typical in an electronic system, Brian made an adjustment to the circuitry that got us up and running on my test system.

For testing, I used an old Fairlane tank that has been sectioned so I could access the sender float and position it wherever I wanted. An actual 1963 instrument cluster was used for the gauge. Electrical power was from a computer power supply. Once we confirmed that the readings on the gauge could be adjusted from those the sender was providing, we checked to see if the device would work with the OEM 5-volt regulator. It would not. The oscillations between zero and 10 volts were effectively turning the device's input on and off.

Brian designed a small electronic 5-volt regulator to convert a 12-volt battery or generator/alternator output into a steady 5 volts and the system worked perfectly.

Once all the connections have been made, the MeterMatch can be calibrated. This should be done after you have installed the sender in the tank and installed the tank in the car and the car is on reasonably level ground. Also, it is best to establish the low fuel and high fuel settings first. If you have just installed the tank, have a 2-gallon gas container nearby (or one filled with 2-gallons of fuel). Fill the tank with 2 gallons of gas and set your low calibration point to indicate empty. This will insure that at least 2 gallons remain as the needle touches the empty mark.

Keep in mind that this does not mean that you have 2 gallons of useable fuel remaining when on empty. The amount of useable fuel remaining will depend on how close to the bottom of the tank your pickup tube is. It can never be right on the bottom due to the mesh screen surrounding the end of the tube, so at least one-half gallon is probably never useable. But with empty indicating with 2 gallons in the tank, you should not run out of fuel before empty. (I personally don't like to get below one-eighth tank before refueling.)

If you are calibrating a gauge when the tank has already been fueled, you will have to determine where approximately 2 gallons remaining is by a series of refillings. For example, drive the car until you have a one-eighth gauge reading, then completely fill the tank and record the number of refill gallons. Subtract that from 16 (or whatever your tank's capacity is) to get the fuel remaining at one-eighth gauge reading. You can repeat the process with slightly lower gauge readings until you find what reading is on the gauge with 2 gallons remaining.

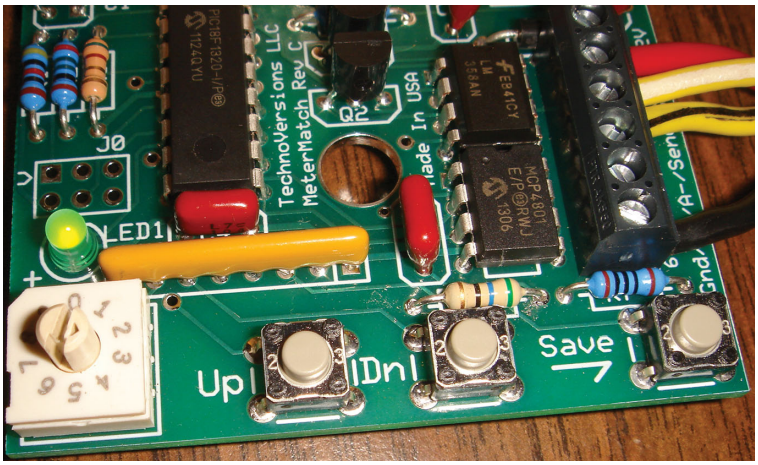
As an alternative, you can get down to an eighth tank and siphon out the remaining fuel. I would have two 5-gallon containers standing by. Some tanks might be nearly a half-full of fuel at one-eighth gauge reading. I have often siphoned fuel from a Fairlane tank using a clear plastic tube. The tube had a natural curve to it from being stored in a loop. By judging how far to insert the tube to be at the lowest part of the tank and keeping the natural curve of the tube downward, you can get at least all but the last half-gallon out of the tank, maybe more. I can say that once after doing this siphoning, I ran out of gas before I got to the gas station just three miles away!

When calibrating, give the gauge plenty of time to settle down. Because the gauge deflects from the heating of a bi-metal strip, it takes a minute or two to get a truly steady reading. I would also have the engine running at high idle (1,000 rpms would be sufficient) to insure you are running off the generator or alternator. This simulates driving which is when you want the most accurate gauge readings.

One more thing about the low point setting—some of the reproduction senders have a flat spot in the resistance profile. What I mean by that is that when the float drops to a certain level in the tank, the resistance is maxed out and does not change as the float continues to drop with decreasing fuel levels. These senders will always have more than the 2 gallons of fuel remaining when the gauge first reads empty. Depending on how you calibrate your MeterMatch, the gauge readings for the last half of the tank might seem to drop rather quickly. If so, the nice thing about the MeterMatch is that you can adjust mid-calibration points to get a smoother drop of the gauge reading. More on that below.

Once you have the low calibration point, I recommend filling the tank and calibrating the high point to get the gauge to read on the full mark. You can go slightly above full if you want.

MeterMatch will now interpolate between the low and high calibration for all other gauge readings. However, I recommend using the options which allow two mid-calibration points.




Rotator switch is used to select calibration points and alarms. Currently, I am calibrating #3 which is the "mid-low" calibration point. The Up button will increase the gas gauge reading and Dn will decrease the reading. Be sure to depress the Save button when satisfied, or calibration will revert to the previous one when the rotator switch is set back to zero for operation.

The points I chose were one-quarter tank and half tank. The reason is that I am less concerned with the gauge accuracy in the first half tank, but much more so for the lower half. Unlike the OEM setup where you get what you get, MeterMatch allows you to choose the settings. For example, you can choose 8 gallons to give you a one-half tank gauge reading. For one-quarter tank, you can use 4 or 5 gallons. Four gallons might seem like the logical choice, but keep in mind that in the case I am using, empty has 2 gallons remaining. So, halfway between empty with 2 gallons and half with 8 gallons would be 5 gallons at the quarter reading. If 4 is chosen, the drop between one-quarter gauge reading and empty (a 2 gallon difference) will be twice as fast as between half and one quarter (a 4 gallon difference). Using 5 gallons makes the difference 3 gallons for both for a smoother drop. In this scenario, the first half tank would go down more slowly than the last half. But, once again, you can change that by adjusting the half gauge indication for 9 gallons. That is the beauty of MeterMatch. You can set it up to do what you want, even for an OEM tank sender. And, you can change the calibration anytime you want as a new calibration simply overwrites the previous one for that point.

MeterMatch also allows for two alarm (alert) points on your fuel gauge. You can ignore this feature, or use just one of them. For example, you might want to be alerted at one-eighth tank gauge reading. As your gauge gets to that reading, MeterMatch

will illuminate an LED light you can install on your dash. TechnoVersions sells the LED alarm indicators for $6 each.

Full instructions come with the MeterMatch and are well written. You can also download the 8-page instructions in PDF form from *www.technoversions.com*. The PDF graphics are in color. The procedures for calibration are straightforward. When you like your calibration, just be sure to depress the "Save" button. Otherwise, the calibration reverts to the previous one when you rotate the rotary switch.

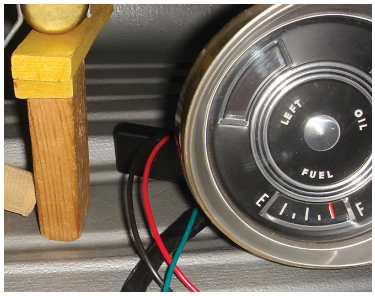
You can approximate the number of clicks you will need for the "Up" and "Dn" (down) buttons to correct your gauge reading by using this rule of thumb: one depression of either button will move the needle approximately half a needle's width (approximately 1/32 tank reading or about 1/2 gallon). So, if you are calibrating for one-half tank reading and the gauge shows 5/16 tank (3/16 tank low), you can depress the Up button six times. After the needle settles down, you are probably within one up or down click of the reading you want. I found this rule of thumb worked well for all four calibration points.

MeterMatch has six terminals for wiring. Four must be used. The others are optional if the alerts are desired. The terminals are screw type and require a small (large jeweler's size) slotted screwdriver. The terminals accept up to #16 AWG wire size. The #1 pin is for 12-volt power. You can use an eyelet terminal to connect to the accessory post of the ignition switch. This post has power when the ignition switch is in the 'Accessory' or 'On' positions. I would recommend a small 2-amp in-line fuse (like the one Ford used for the Fairlane instrument panel illumination lights) just to be on the safe side. Pin #6 is for ground. Any convenient chassis connection will do. Pin #2 is connected to the gas gauge terminal. It does not matter which terminal (the gauge will work with current flow in either direction), but for convenience, use the one that the yellow/white wire connects to. Pin #3 connects to the yellow/white wire which goes to the fuel tank sender.

If you want to maintain reversibility and happen to have some spare connectors and wires from other Fairlanes, you can make a MeterMatch harness to use OEM style connectors for the gas gauge and round pin connectors to attach to the original gas gauge wiring connectors.

The 5-volt electronic voltage regulator can get its 12-volt power from the same accessory post on the ignition switch, or you can make up one eyelet terminal with two wires attached. Another alternative is to use a jumper between the MeterMatch and the regulator. One of the two remaining regulator wires is for ground. The third wire is to connect the regulated 5-volts to the other gas gauge terminal.

In this sequence of pictures, I have calibrated my low and high points (top two pictures at right). For this exercise, I chose to set the needle on the marks. You might prefer something else, such as the low mark being a little below empty or the high mark being a little above full. Then I used the blocks of wood that I had used previously with an NOS sender that gave me ¼ and ½ gauge readings. You will want to use known quantities of fuel in the tank to make these calibrations. Note on the two pictures below, the needle is reading high. Five to six down button clicks on MeterMatch brought the needle right on the marks I wanted. (Remember to Save your new setting!)

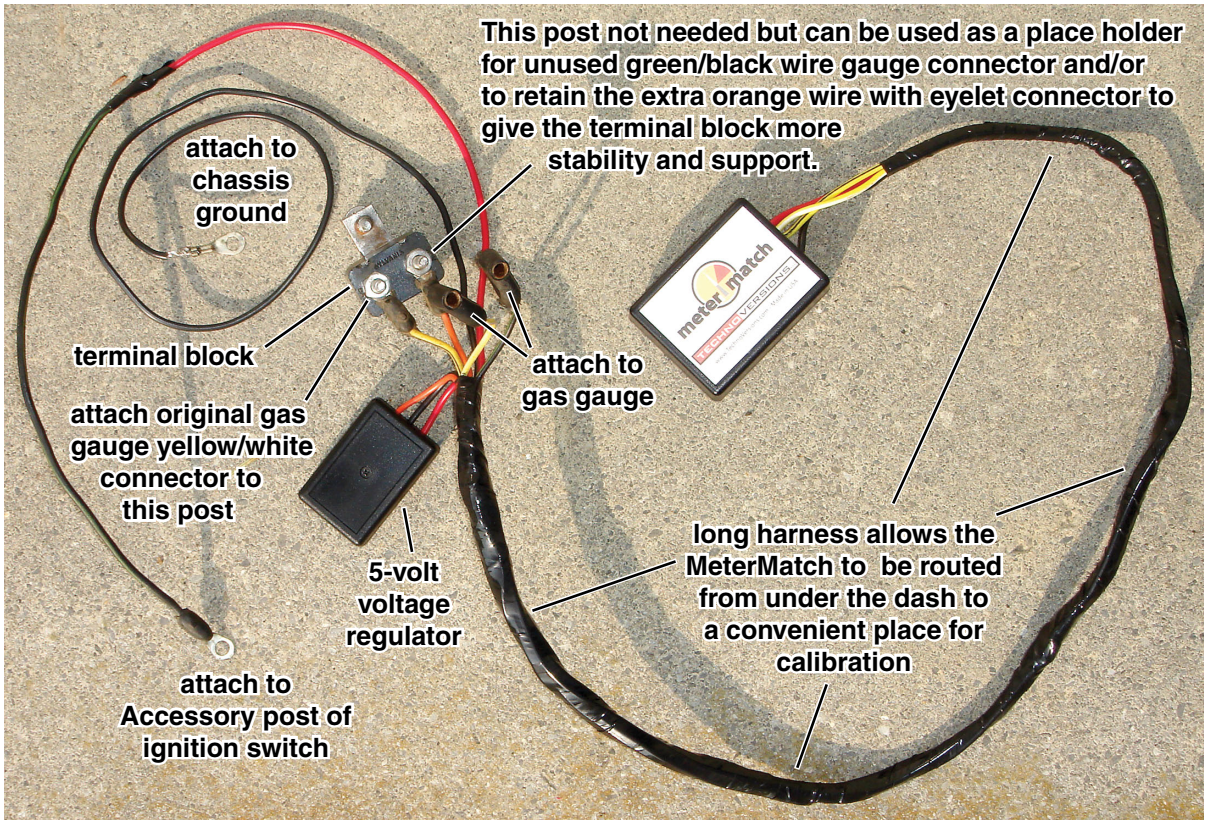




¼ tank before calibration

¼ tank after calibration

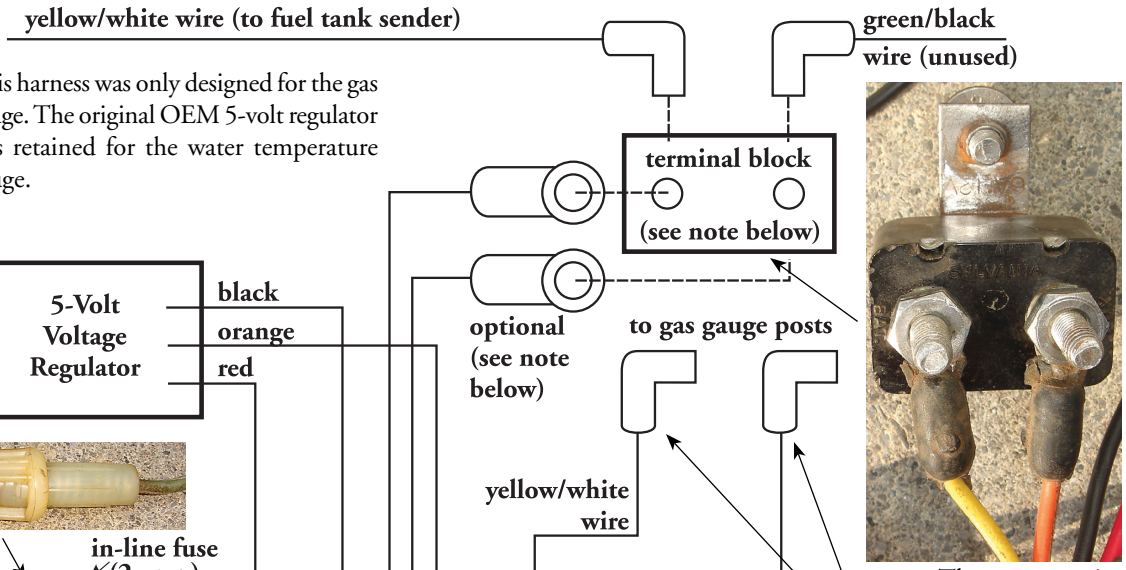
½ tank before calibration

½ tank after calibration



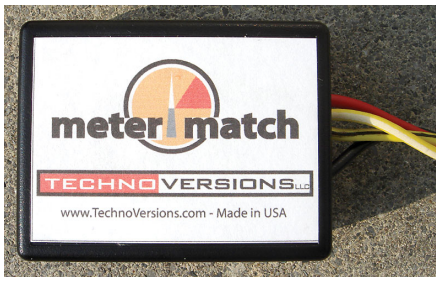

My harness for quickly installing MeterMatch.

This harness was only designed for the gas gauge. The original OEM 5-volt regulator was retained for the water temperature gauge.




The orange wire is not connected to anything—it ends in the wiring harness—and is used to help stabilize the terminal block if it can't be mounted. Also, I will use the post to attach the original—now unused—gas gauge connector from the original 5-volt voltage regulator.

**Note: The terminal block was used to retain the stock connectors originally attached to the gas gauge. The green/black wire does not need to be connected to the terminal block, but can be to eliminate a loose connector. Likewise, the second eyelet connection is not necessary, but can help stabilize and support the terminal block. The terminal block is an old wiper system circuit breaker that has been modified by removing the breaker points. Each post is now independent from the other.**




Costs:
MeterMatch.....$44.99
5-Volt Regulator.....$20.00
*(be sure to ask for the Fairlane-specific configuration so Brian can modify MeterMatch to work with our system. Also, please keep in mind that this is not a high volume operation. These are made up as needed by a one-man operation. He is only charging a small percentage above what it takes him to put these together.)*

Plan your wiring lengths to allow the MeterMatch to be accessible from the driver's seat. That way you can easily make the calibration adjustments anytime you feel they need to be changed.

In conclusion, for the first time we have a viable solution to improve the accuracy of reproduction fuel tank senders. We can even adjust OEM senders or compensate for variations in gas gauge readings. I also like the fact that I can do this without permanently altering the car. Reverting back to the OEM configuration is as simple as reconnecting the OEM connectors to the gas gauge and disconnecting the harness' power and ground wires.

The MeterMatch assembly can also be moved to another Fairlane, if I choose, and installed very quickly. However, whenever changing to a new vehicle, be sure to recalibrate all four points before depending on gas gauge accuracy.

TechnoVersions is web/email based, no phone number.

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