

# SilverLeaf Electronics and Kavlico Analog Sensors

This is a simple trouble-shooting document for the Kavlico tank sensors used with the SilverLeaf Electronics TM-102.

## The Background

The Kavlico sensor used is the p4050-3g, which has a range of 0-3 pounds per square inch (PSI). This type of sensor can be used to detect up to 40 inches of vertical height in a tank of liquid. The TM-102 sends a 5V supply voltage and then measures the return voltage from the sensor, which is varied by the pressure against the diaphragm of the sensor. This voltage is read as a simple numerical value called a “raw count”. The TM-102 reads the raw counts from the Kavlico sensor and converts that first to a percentage, and then to number of gallons. If the raw counts aren't correct, the percentage and gallons won't be correct.

The SilverLeaf Electronics TM-102 module uses a 10-Bit analog-to-digital converter (ADC), which gives it a reporting range of 0 to 1023 Counts, independent of what kind of analog sensor is used. A new Kavlico sensor with correct cabling connected to the TM-102 will report a count of 97, plus or minus 2 (that is a range of 95-99 counts), with no pressure on the sensor. For each vertical inch of liquid added to the tank, the Kavlico will increase its counts by 10.

## What to Look For

By knowing this, you can perform a “Sanity Check” on the tank system by looking at the raw counts being reported, and knowing how tall and how full the tank is. For Instance, if you have a 10 Inch Tank, and it is  $\frac{3}{4}$  Full, (7.5 Inches), your raw counts should be around 172 (10 counts per inch x 7.5 inches + 97 counts for the dry sensors = 172 Counts). You can then determine if the tank percentage and gallons are correct.

## Dry Calibration

Sometimes the starting value of the Kavlico is NOT around 97 Counts, plus or minus 2 counts. You can perform a dry calibration, defining the current value of the Kavlico sensor as the dry point. If you perform the dry calibration while the tank is full, the system will most likely report empty, no matter what the actual tank level is. You will then need to drain the tank and perform the dry calibrate again.

## Sensor Failures

When the Kavlico sensor fails, it usually reports a low value, like 56, or a high value, like 870. Very rarely does it fail with a Value of 0 or 1023.

## Finding the Bad Component

When you have a bad tank sensor reading, how do you know which part is bad? The failure points of a kavlico tank sensor with the TM-102 are as follows:

- 1) The sensor (This is brass and plastic)
- 2) The sensor harness (This is about 1 foot long and has three wires)
- 3) The MS703 (wrapped adapter circuit board)
- 4) The phone cable (This is a rolled-over 4 or 6-wire phone cable)
- 5) The TM102 port (RJ14/RJ25 port)

If you have a working sensor and port on the TM-102, you know that the above 5 points are good. You can exchange or swap the known good components above with the suspect components to locate the bad component(s). We DO NOT recommend swapping the black or gray tank sensor into the fresh tank. Contamination will occur! The easiest swap is right at the TM-102.

Lets say that the Gray Tank is reporting 87 counts, and the counts never change when the tank is filled or drained. If the Gray and the Black Tanks are switched right at the TM-102, and the Black Tank now reads 87 counts and the Gray Tank reports what the Black Tank did, we can assume that the TM-102 is fine. The failure is somewhere in the sensor or wiring to the TM-102 for the Gray Tank. Switch the Gray and Black back to their previous locations, and then switch the Gray and Black Tank cables at the Kavlico sensors. Lets say that the Black Tank (now connected to the Gray sensor) is now reporting 87 counts, and the Gray Tank is now reporting 115. Since we already know the Black Tank components are good, we can surmise that:

- 1) The Gray Tank has 1.5 Inches of Liquid in the Tank and
- 2) The failure is the sensor harness, the MS703 (wrapped adapter board) or the phone cable. Since the MS703 is a possible failure point when corrosion occurs, it is the most likely culprit. Switch the Gray Tank and Black Tank cables back at the Kavlico sensors, then mark and switch the MS703s between the Gray Tank and Black Tank. If the MS703 is the failure, the Gray Tank will report 115 counts and the Black Tank will report 87 counts. At this point, you would need to order an

MS703 from SilverLeaf to replace the bad one on the Gray Tank.