

Testing Tomorrow's Technology
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October 9, 2012

Felix Ambrosetti
WaterSignal, LLC
510 Staghorn Ct.
Alpharetta, GA 30004

Dear Mr. Ambrosetti:

Following is your test report for performance testing of the WaterSignal Model Generation 4. Testing was completed by US Tech to determine whether or not this product interferes with the operation of water meters used in utility metering. In our opinion, when tested as reported herein, the Intelligent Sensor product has no affect on the operation of water meters used in utility metering.

We appreciate the opportunity to be of service to your company. If you have any questions about the enclosed report please do not hesitate to call one of our engineers.

Sincerely,

A handwritten signature in black ink, appearing to read "Alan Ghasiani", is written over a light gray rectangular background.

Alan Ghasiani
Consulting Engineer - President

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Report of
Performance Testing
For
WaterSignal LLC

Model: Generation 4

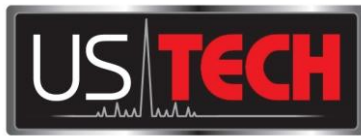
Test Date(s): September 25 – October 9, 2012

Issue Date: October 9, 2012

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I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: Compliance Engineer – President

Date: October 9, 2012

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US Tech Test Report:
Report Number:
Issue Date:
Model:

Interference Test
12-0397
October 9, 2012
Generation 4

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1 General Information

1.1 Purpose of Test

The purpose of the test is to determine if the WaterSignal LLC Generation 4 in any way interferes with the operation or recording functions of the water meters next to which the device is installed.

For the purpose of this report, US Tech assumes all information provided by WaterSignal, including schematics, drawings, and product manual are accurate and representative of the equipment under test (EUT).

1.2 Characterization of Test Sample

Three samples of the EUT and associated water meters and other processing equipment were received on September 20, 2012 in good condition.

1.3 Product Description

The Equipment Under Test (EUT) is a sensor and processing unit that continually monitors a water meter and sends data about water usage to a remote computer for analysis and early detection of potential water leaks. The Generation 4 is placed on the exterior of the water meter and senses movement of the water meter's coupling magnets to determine the flow of water without affecting the water meter itself. The Generation 4 can send digital signals to a processing unit which stores data over time and sends the data to a remote computer at predetermined times.

1.4 Test Facility

US Tech is an FCC Recognized (Designation Number US5117) and NVLAP Accredited (Lab Code 200162-0) privately owned, independent testing laboratory located at 3505 Francis Circle, Alpharetta, GA 30004. All testing described in this test report was completed at this location.

2 Engineering Analysis and Test Methodology

Two parallel approaches have been used to carry out this investigative project; engineering analysis and experimental testing. The experimental approach was designed to test interference by using three types of widely available and commonly used meters in the water utility market, working in a typical environment with the product under test. All the data was recorded; photos and test diagram collected, and the results are reported herein.

2.1 Engineering Analysis

From engineering analysis, potential causes of interference with the water meter operation from the EUT are:

1. Electrical

The sensor does not electrically connect to any water meter. In addition, there are no electrical or active electronic components in water meters. Therefore, no electrical interference is expected.

2. Magnetic

In order to analytically show that the sensor cannot interfere magnetically, a worst case scenario is considered, where the sensor is positioned in such a way that the meter receives the maximum magnetic interference. This is the case where the meter is situated along the centerline axis of the current carrying circular loop whose area is at an optimum:

$$B_z = \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{(Z^2 + R^2)^{3/2}}$$

Where:

B_z is the z-axial component of the magnetic field generated by the loop in Tesla

μ_0 is permeability of free space = $4\pi \times 10^{-7}$ T m / A

R is the radius of the loop in m

I is the current in amperes

Z is the distance from the center of the loop

According to the sensor's specifications and the system manufacturer's declaration, the maximum current flowing in the device is only 350 uA. Assuming a reasonable distance of 1.5 cm from the sensor to the nearest active part of the meter, the largest calculated magnetic field is only 60 uGauss. For the purpose of comparison, the maximum earth magnetic field is about 500 mGauss.

Therefore, beyond a reasonable doubt, it can be concluded that the magnetic interference is nonexistent.

3. Mechanical

Since there are no motors, moving parts, or vibrating parts in the EUT, mechanical interference between the EUT and the water meter is not possible as long as the installer does not inadvertently cause physical damage to the meter while installing the EUT.

4. Temperature

With the maximum electric current in the sensor being 350 uA, and resistance of 850, the I^2R heat would be miniscule. There are no other sources of heat generation in EUT to cause any rise in temperature surrounding the device.

5. Chemical

There are no gases or liquids emanating from the EUT; nor are there any explosive materials used in the EUT. Therefore, no chemical interference is expected.

6. Others

No other sources of potential interfering factors are identified.

2.2 Test Methodology

A test table consisting of three parallel water lines, each using two identical meters, one meter with the EUT installed and one control meter, with no EUT, was used. The meters on the water lines consisted of three different models, commonly used by water utilities. Water was pumped from a large tank through the lines at a typical water pressure and then recycled back into the tank. The EUT was connected to only one of the meters in each line, and turned on for the duration of the tests. The objective was to show that meters in each parallel line would read exactly the same numbers (within their specified error range) after running a large water volume of water through the system over time.

A block diagram of the test configuration is shown in Figure 1 and a photograph of the test configuration is shown in Figure 2.

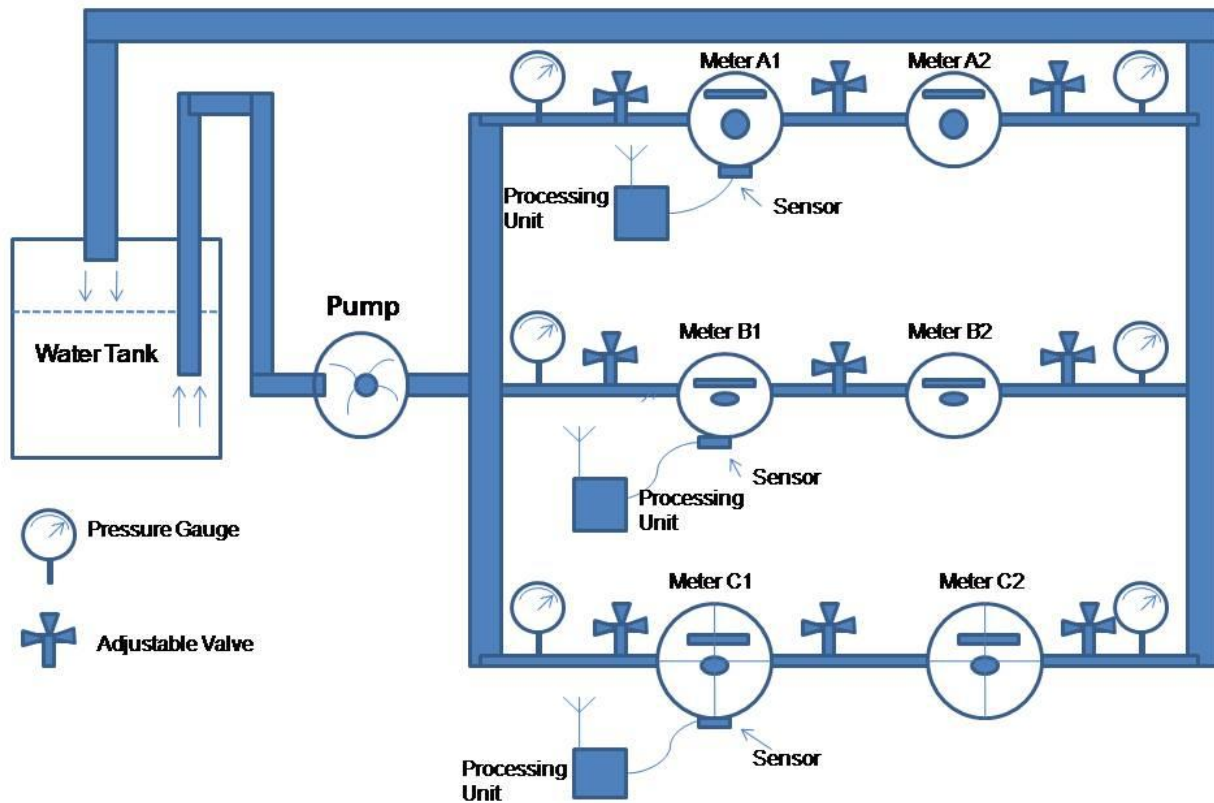


Figure 1 Test Configuration Block Diagram



Figure 2 Photograph of Test Setup

2.3 Test Equipment

A list of test equipment used for these measurements is found in Table 1, following.

Table 1 Test Instruments and Accessories Used

INSTRUMENT	MANUFACTURER	MODEL	SERIAL NUMBER
Test Table	Custom Built	N/A	N/A
Infrared Thermo Meter	MA-Line	MA-16510	02078709
Pressure Gauge	Wats	DP IWTG	None
Pump	Dayton	5UXH8	None
Valves (x 9)	Mueller Industries	Proline Boiler Drain	None
Water Meter A1 (with EUT)	Neptune	T-10	92363462
Water Meter A2	Neptune	T-10	92077980
Water Meter B3 (with EUT)	MasterMeter	BL05	8747639
Water Meter B4	MasterMeter	BL05	8747640
Water Meter C5 (with EUT)	Badger Meter	25 Recordall	41771149
Water Meter C6	Badger Meter	25 Recordall	41771150

3 Test Results

The following photographs show the initial meter readings of each meter and the final (after test completion) meter reading of each meter.

Table 2 summarizes the reading of each meter before and after the test. The total water each meter and each branch carried was calculated and is shown in the table. The error percentage, which is the percentage of the difference between the identical meters in each branch, is also computed and presented. All three error percentages were within the meter manufacturers' specified tolerance of $\pm 1.5\%$.



Figure 3 Meter A1 Initial Reading



Figure 4 Meter A1 Final Reading



Figure 5 Meter A2 Initial Reading



Figure 6 Meter A2 Final Reading



Figure 7 Meter B3 Initial Reading



Figure 8 Meter B3 Final Reading



Figure 9 Meter B4 Initial Reading



Figure 10 Meter B4 Final Reading



Figure 11 Meter C5 Initial Reading



Figure 12 Meter C5 Final Reading



Figure 13 Meter C6 Initial Reading



Figure 14 Meter C6 Final Reading

Table 2 Comparison of Initial Meter Readings and Final Meter Readings

Date	Time	A1 Reading	A2 Reading	Δ	B3 Reading	B4 Reading	Δ	C5 Reading	C6 Reading	Δ
9/26/2012	10:49 AM	226680.0	227290.0	610.0	23064.0	23214.0	150.0	167940.2	168160.4	220.2
10/8/2012	6:30 PM	439170.0	439870.0	700.0	447360.0	450060.0	2700.0	327020.0	327670.0	650.0
Total		212490.0	212580.0	90.0	424296.0	426846.0	2550.0	159079.8	159509.6	429.8
Error %				0.04 %			0.60%			0.27 %
Total Volume		795865.80	Gal							

Error % < ±1.5%

Note: All reading numbers are in gallons.

4 Summary Conclusion

It is our engineering judgment and opinion that the product under test, the WaterSignal LLC Model Generation 4 does not interfere with the typical water meters on the market. This conclusion is based on all the arguments and data described in this report.