



Automotive Water Intrusion Detection with Smart Passive Sensors™

KEYWORDS

water intrusion leak detection quality control on metal sensor battery-free low-cost

ESSENTIAL POINTS reduces missed leaks

detects 0.2 ml leak

easy to deploy

improves data analytics

self adhesive

OVERVIEW

RFMicron's moisture sensing technology addresses one of the most serious warranty issues facing the automotive industry - water intrusion. Despite proactive efforts by automotive manufacturers to address this problem in design, engineering and manufacturing, namely subjecting every finished vehicle to an extended water bath and costly manual inspection, numerous vehicles continue to escape the production line and are delivered to customers with leaks. RFMicron's passive, wireless OnMetal Moisture Sensor can reliably detect water leakage, which would normally be missed by today's manual inspection techniques, and can result in significant cost savings to automotive manufacturers.

BENEFITS

- Wirelessly and accurately detect water intrusion during factory test
- Harvests RF energy eliminating the need for batteries
- Operates in a harsh metalized vehicle chassis environment
- Rapidly detects water leakage and alerts personnel of a problem
- Reliably detects 0.2 ml of water, 0.05 ml in certain conditions
- Automatically documents the event data analysis purposes
- Cost-effective, scalable, and easy to deploy
- Self adhesive moisture sensors quickly attach to chassis



KEY Points

Recent recall incurred \$9M to repair 19,000 leak prone vehicles -- almost \$500 per vehicle

Manual leak detection misses many leaks that are too small to be seen or felt

Production line trials have been highly reliable and detected leaks that were missed in manual inspection

A car presents a harsh metal envionrment that is challienging for RF solutions.

The Problem: Water Intrusion

Water leakage inside a vehicle reflects very poorly on the quality of the vehicle and creates significant consumer dissatisfaction. Stains, odors, mildew, electronics damage and structural issues associated with rust are only a few of the problems stemming from water leakage. In light of such a competitive automotive industry, water intrusion into a vehicle can do irreparable damage to a manufacturer's reputation.

Window seals, weather stripping and body seams are the primary causes of factory water leakage. Current manual inspection techniques are costly, labor intensive, error prone and become a considerable liability when vehicles escape detection. For example, the estimated rework costs for a recent recall involving 19,000 vehicles for leakage was in excess of nine million US dollars (\$9,000,000), conservatively assuming that each vehicle costs \$500 to inspect and repair under warranty. To make matters worse, as hybrid and electric vehicle manufacturing expands, traditional manual water intrusion inspection becomes much more difficult, and damage due to leakage become even more severe. Needless to say, a new water intrusion detection approach that reduces test time and errors is beneficial to manufacturers and consumers.

A new solution for water intrusion detection comes with significant challenges. It must be reliable and easily deployed on the assembly line. It must also be able to rapidly detect and pinpoint water leakage during the vehicle's water bath, alert personnel of a problem, and automatically document the event for quality tracking and trending purposes. It must be cost effective to automotive manufacturers, both from operational and capital expenditures perspectives. Because electrical and hybrid vehicles have more batteries and associated electronics housed in semisealed chassis compartments that must be shielded from the elements, a wireless sensor solution that can remotely detect water intrusion is the ideal way to ensure vehicle quality control.

RFMicron's On-Metal Moisture Sensor

RFMicron's passive, wireless On-Metal QC (Quality Control) Water Intrusion Sensor enables automotive manufacturers with the capability to reliably detect 0.2 milliliters of water (a very small drop) and as little as 0.05 milliliters in certain conditions in difficult to inspect locations which would normally be missed by traditional manual inspection techniques. RFMicron's solution includes a self adhesive moisture sensor tags that quickly attach to a vehicle chassis and a handheld or fixed sensor reader. An automated, cost-effective, scalable, detection of water intrusion is now possible by RFMicron's On-Metal QC Water Intrusion Sensor solution.

A fully functional wireless, passive On-Metal QC Water Intrusion Sensor consists of nothing more than a Magnus® Smart Passive Sensor™ IC (integrated circuit) cconnected to specially designed antenna with adhesive backing, making it cost effective and easy to deploy. The Magnus® IC incorporates RF energy harvesting to power sensing and communication





circuits eliminating the need for batteries. Communication is based upon open industry-standard UHF RFID protocol (ISO 18000-6C, commonly known as "Gen 2").

One of the biggest challenges of implementing a wireless sensor solution is that the automobile is a highly metalized environment making wireless communication and sensing difficult. However, the RFMicron chip incorporates patented Chameleon[™] technology that both facilitates sensing and optimizes RF communications for moisture sensing within the difficult metal environment of an automotive chassis. The Chameleon[™] engine automatically adjusts to keep the chip electrically matched to the antenna. The amount of adjustment needed changes when moisture is present and is what allows the detection of moisture.

Moisture Sensor Tag Placement

Tag placement should be customized for each individual vehicle platform. Tag placement and the number of tags allocated to a vehicle platform are affected by vehicle size, chassis, historical data, severity of leakage, water collection points, and the ability of the sensor to communicate with the reader. Once placement has been determined, each location is assigned a tag location number. The tag location number is then stored in the on-chip memory. For example, the Front Left Floor tag could be named "FLF" and be designated as the tag location 1. From then on all "FLF" tags will be assigned a tag value of 1.

As shown in the diagram above, RFMicron's QC Water Intrusion Sensor can detect water on multiple edges, so tag placement and orientation in proximity to locations prone to moisture collection within a vehicle chassis can be optimized to ensure detection. Additionally, a "tail" can be added to wick water from locations difficult to place the tag.

RFMicron's moisture sensor solution is easily integrated into the vehicle manufacturing flow because the self adhesive QC sensor tags can be quickly attached to predetermined leak locations within a vehicle. Water intrusion testing is performed by reading all sensors prior to the water bath and again after the water bath. The before and after mea-

Smart Passive Sensors™

Wireless Battery Free Detects 0.2 ml Low cost Disposable Easy to apply

Capabilities

Wet vs. Dry Moisture Temperature Easy to apply



surements are compared and a significant difference between the two measurements indicates the presence of as little as 0.2 ml (0.05 ml in some conditions) of water at which point the vehicle is flagged for rework.

Recent "Real World" Results from Automotive Production Line Testing

RFMicron's wireless OnMetal Moisture Sensor solution has undergone months of production line testing at automotive manufacturers with thousands of tags deployed. These tests have proven the RFMicron solution to be highly reliable and has resulted in the ability to detect very small leaks that would typically go undetected by manual inspection.

Conclusion

RFMicron's new low-cost, passive wireless moisture sensors is enabling a more reliable automotive QC water intrusion testing capability. RFMicron's On-Metal QC Water Intrusion Moisture Sensor Tag provides a reliable alternative to today's manual, error prone water intrusion testing process. During production line testing, RFMicron moisture sensor tags were placed in locations that are known to be prone to leaks resulting in the ability to sense water intrusion in that could not be inspected or detected by today's manual visual inspections.

Leaky vehicles that escape factory water intrusion inspection are costly to the manufacturer in terms of repair costs and reflect poorly on overall vehicle quality resulting in damage to a manufacturer's reputation and brand. RFMicron's technology provides a cost-effective and scalable solution, making automated water intrusion detection possible.



To learn more about RFMicron's incontinence management solutions or other Smart Passive Sensor solutions, contact RFMicron at <u>www.RFMicron.com/QC</u>

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