automotive engineering specialists

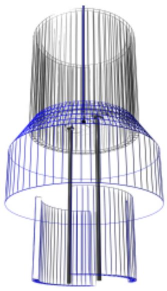
Airbag RF Robustness – Confidence Testing

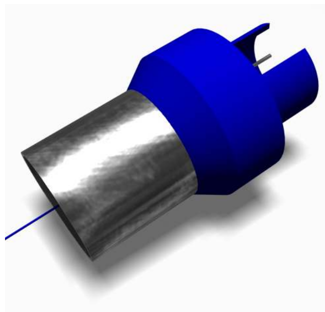
MIRA has considerable experience in the measurement of RF immunity robustness of vehicle restraint systems, at both vehicle and component level.

Services aimed at providing a complete solution for all your compliance and safety assessment needs

Services Include

- Unobtrusive Measurements (Fibre Optic Probe)
- Accurate Bridgewire Current Analysis
- Onboard Transmitter Confidence Testing
- Cost Effective Vehicle Test Methodologies
- Suppression Component Design and Validation
- Cost Save Risk Assessments
- System Integration for Reduced EMC Risks
- Electrostatic and Electromagnetic Simulations





All modern vehicles are supplied with supplementary restraint systems of varying complexity. However, all restraint systems use the same basic components - an electronic control module connected to an Electro-Explosive Device (EED) via a length of harness. When a wire is subjected to a sufficiently strong RF field, current is induced in the wire connected to the EED, and inadvertent airbag deployment can occur.

Whilst EED's have been used in vehicles for many years, relatively little information is known about the true impact of electromagnetic energy on these devices. Furthermore, the precise characteristics of RF filter devices used to suppress the electromagnetic energy coupled into the EED wires are relatively unknown.

Historically, electrical measurements have been used in an attempt to analyse the inherent characteristics of airbag systems under RF conditions. However, these methods are prone to some inherent inaccuracy due to loading and unseen coupling mechanisms between test harness wires. It is to this end that MIRA has built upon existing electrical measurement test procedures to produce a highly accurate airbag test method. The Fibre Optic Probe (FOP) method is capable of assessing the true nature of EED's under RF conditions and the performance characteristic of any type of suppression component used in modern restraints systems.

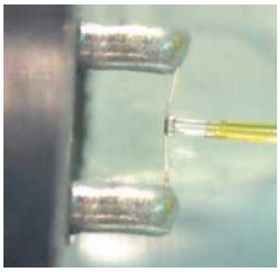
The FOP method

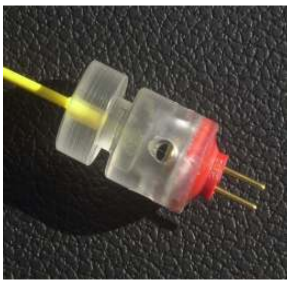
The Fibre Optic Probe (FOP) measurement method developed by MIRA is to date the most accurate and fastest method of assessing the true performance of suppression devices both at a component and full vehicle or system level.

The method is based on monitoring actual EED bridgewire currents, using a state-of-the-art unobtrusive fibre optic probe. As information is obtained from the most critical part of the airbag system – the EED bridgewire – the true characteristic of an airbag system can be assessed.

This information is vital for component suppliers who must assess the true characteristic of the filter devices they design, and is of paramount importance for vehicle manufacturers who must select filter components which will adequately suppress induced electromagnetic energy at full vehicle level.

The vehicle level airbag RF robustness test is treated as an extension to standard immunity tests currently carried out by all vehicle manufacturers. This invariably reduces the costs associated with evaluating the RF robustness of airbag systems, providing vehicle manufacturers with a cost efficient means of extracting information regarding the immunity of airbags fitted to their vehicles.





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MIRA

Airbag RF Robustness Testing

MIRA, as well as using conventional techniques, has developed a test method, which directly monitors EED bridgewire temperatures. At vehicle level this method quantifies any risk of inadvertent airbag deployment due to RF fields, giving a measured level of confidence in the airbag system. At component level the suppression performance of filters can accurately be assessed, allowing filter designs to be validated with confidence. The measurement method is also aimed at EED manufacturers who wish to ensure that unfiltered EED devices are not susceptible to low levels of RF energy, due to unintentional interactions between the constituent parts of an EED.

The Fibre Optic Probe (FOP) Test Method

MIRA's Electrical Group have developed an accurate test method based on monitoring EED bridgewire temperatures using an unobtrusive fibre optic temperature probe, and a minimum test harness length. Temperature measurements obtained during an assessment are converted to equivalent DC bridgewire currents using calibration data. The component and vehicle level test method eliminates the inaccuracies inherent in electrical measurements, extends the range of filter types that can be assessed, and provides vital bridgewire current measurements for confidence. The FOP system allows measurements to be made to an accuracy of 0.025°C, at an acquisition frequency of 1000Hz.

Bridgewire Measurement

The impact of electromagnetic energy coupled into the airbag system and the influence of any filter component is measured directly at the bridgewire of an actual EED itself. This enhances the data obtained from the test method developed by MIRA, and accurately assesses the filters influence at the critical point of the system using a real world load (EED). The extremely small dimension of the probe, $100\mu m^2$, and its low thermal mass ensures that the bridgewire temperature can be obtained with an exceptionally high degree of precision.

One Test Method For All Filter Types

All types of filtered or unfiltered airbag connectors can be assessed using the FOP test method, whereas existing electrical measurement methods only allow the assessment of symmetrical, inline filter components. Filtering provided by between-pin filters, e.g. capacitor connected between the EED pins, can readily be assessed with no additional change to the FOP test method.

Unsymmetrical Filters

Unsymmetrical filters can be assessed accurately using the FOP test method. The filtering provided by an unsymmetrical filter is highly dependent upon which wire RF energy is injected. MIRA's FOP test method can be used to determine the effect of the filter at the bridgewire when RF is injected on either wire, allowing the worst case filtering to be determined. If an electrical test method is used to measure an unsymmetrical filter, the result indicates best case filtering, whereas in practice this level of filtering may not be achieved.

Common and Differential Mode Energy

The FOP test method can be used to determine the filter performance for both common mode and differential mode coupling. Existing methods only consider differential mode, where RF energy is injected into a single wire. As MIRA's test method measures filter performance at the bridgewire, it is possible to accurately determine common mode filter performance, by combining the two airbag wires and simultaneously injecting RF into both wires.

Component Level Testing

The length of wire used to connect the airbag connector to the RF measurement equipment has been shown to significantly affect the measured performance of a filter. It is therefore recommended that the minimum required wire length, to connect the airbag connector to the RF equipment, is used. The FOP test method (minimal wire length) developed by MIRA reduces problems due to coupling, which in all existing test specifications introduces a significant amount of inaccuracy in airbag performance measurements.

Vehicle Level Testing

It is not possible to accurately predict EED performance within a vehicle structure without undertaking full vehicle tests, due to the influence of vehicle wiring harnesses, screening and resonant cavity effects within the vehicle. An equivalent DC current profile for the EED is obtained for the incident field strength across the complete frequency range of interest. Due to the unobtrusive nature of the fibre optic probe the measurements can be performed during routine immunity tests.

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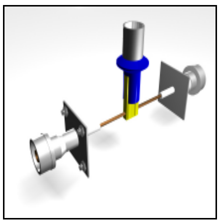
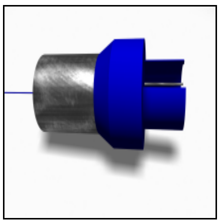

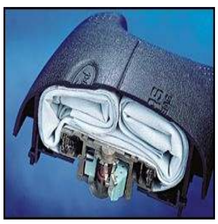

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