MUW II

Microwave sensor
for
volumetric protection.

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1   Introduction

1.1   Document Scope

The purpose of this document is to provide technical information about the microwave sensor used for volumetric protection of the cars.

1.2   Field of Application

This document is applicable to the project and to explain the base functionality of the module integrate in the complete alarm system.

1.3   Installation and manual

The product is OEM product then the fitting is during production process of the vehicle and not in charge at Meta System. then no manual e no installation instruction will be provided with the product.
The car manufacturer will be write on the vehicle manual the information for the user.

2   Project Description

2.1   Project overview

The project is a part of the BMW project, for a complete alarm system for convertible vehicles. The complete alarm is system is named CAN Sine and contains all the function required from the alarm system to fulfil the requirements of the regulations (95/56/EC, ECE Reg.116)

It's also requested to weather-seal the case of each sensor and to use a weather-sealed connector.
MUW II are volumetric intrusion sensors, based on a microwave technology.
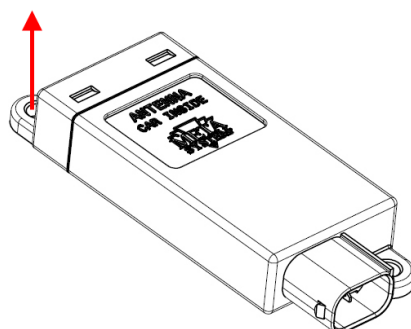

Fig. 2.1   MUW II

2.2   System Overview

MUW II is a volumetric intrusion sensors system for convertible cars, based on a microwave technology: this sensor system has to signal an intrusion or an attempt of intrusion to the central unit (DWA) of the vehicle alarm system, CAN-SiNe.
The sensors are devices for the OEM market (on vehicle installation during assembly phases), customised on the requirements of a specific customer.

Each sensor is connected to CAN-SiNe II through a serial bus, LIN-bus: components and communication protocols have to follow the technical specifications of LIN-bus [N4, N7]. On the LIN network, CAN-SiNe II is the master node and MUW II sensors are the slave nodes. The communication protocol is made of functional messages (arming, disarming, alarm on/off, ...) and coding / memory access messages (alarms memory read, defects memory read, ...).

The number of MUW II sensors connected in a network can be 1 to 5, typically 4.
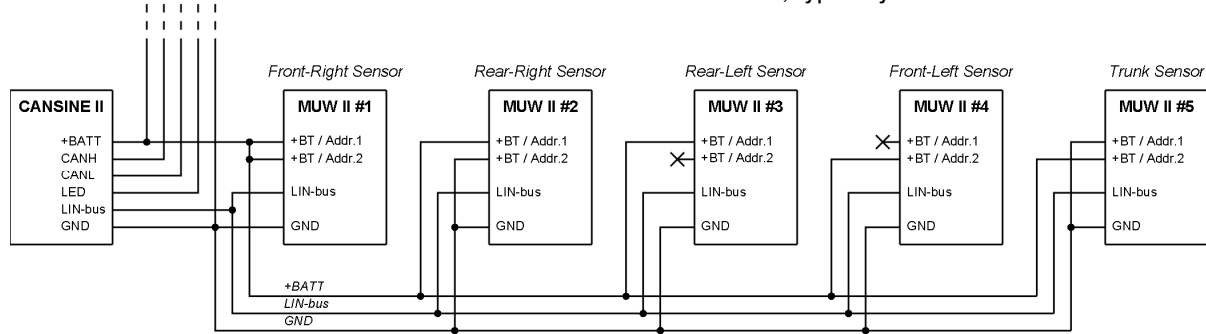

Fig. 2.2   MUW II connection scheme

The connection of system allow to single part to know its own position to manage the different set up parameters to be use. This self address is obtained via hardware because any parts is addressed from the previous one present in the chain.

2.3   Operative environment description

The volumetric protection is oriented at the convertible cars, then the protection against intrusion is needed also for the closed version. In additional could be placed an additional sensor in the luggage compartment to protect the rear part of the vehicle behind the rear seat.
In the picture are showed some typical positioning of the sensors.
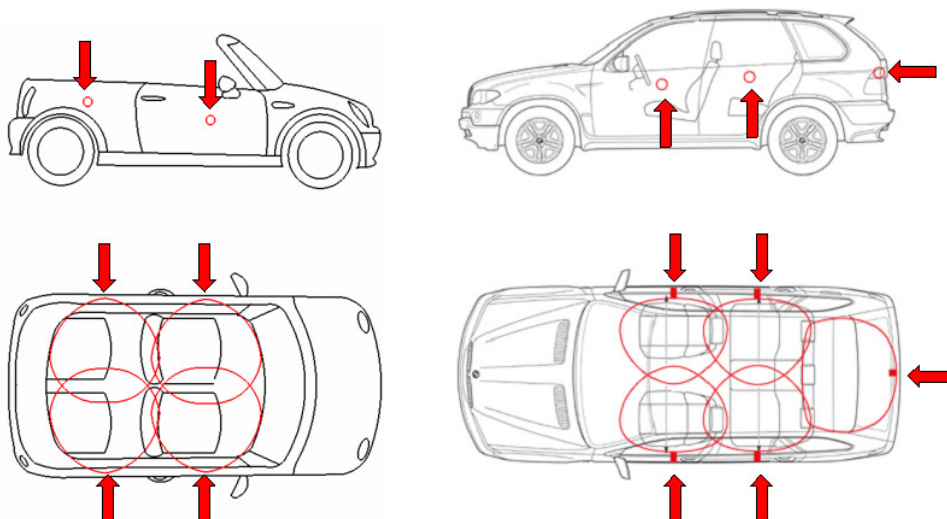
 All the sensors are placed in the doors and the antenna, then the RF transmission is towards the centre of the vehicle.

2.4   Product description

The module (sensor) used are based on Doppler effect to detect the possible movement in the protected area, to verify intrusion or theft of object in the vehicle.
The RF signal is generate by microwave oscillator, this signal is reflected from the object in movement and the amplitude and frequency of the received signal is correlated at the shape of the object and at its speed. By means the analysis of two Doppler signal 90° degrees rotated is also possible to know the direction of the movement.
The transmission of the each sensors is one by one and not simultaneously to avoid interference between two sensor facing.
The alarm unit CANSine is the manager of the activity of the sensors, its timing activation, and the responsible of the analysis of the signal received before to send an alarm.
Any module has an internal microprocessor with 8 MHz resonator, Any parts is provide with its internal power supply regulator , EEPROM to store the set up data and working parameters, all the block of the sensor are equipped with a diagnostic circuit to inform the CANSine about possible fault.
The product operability and functionality must be guarantee in the automotive temperature range, from -40°C to + 85°C. With the voltage limit from 8 to 16 Volts.
The module are closed in a plastic housing, with 4 pins connector build in.
In any module is present a temperature sensor to compensate environmental effect. The communication between module and CANSine is based on LIN 2.0 protocol.

2.5   Technical data

The sensor transmit the RF signal and the analysis of the reflection is used in order to verify the intrusion with the analysis of Doppler effect.
The received signal is demodulated and compared with the transmitted signal for a limited window period, During this limited period if the demodulated signal is around 20 Hz and intrusion signal is generated.

Current consumption:
-   Not insert   < 0.2 mA
-   Insert without activity (no movement detected) < 1.1 mA
-   Insert with activity (movement detected)   < 3.3 mA
-   Maximum current consumption   < 6   mA

Not insert means the alarm system is disarmed the module is in weak up mode for the diagnostic function. Not insert is used when the volumetric protection is voluntary, temporary, excluded. This situation is used in transport mode when the vehicle is moved with other transport vehicle, by boat for example.
Insert without activity means that the sensor in its periodically transmission and at any analysis the signal do not contains information that could be related to an intrusion, any reflection is stable.
Insert with activity means that a specific circuit detect a perturbation of the received signal and the microprocessor is completely wreaked up to allow a deep analysis of the signal, then the increasing of power consumption is due at the full functionality of the microprocessor, the transmitted signal is not changed.
Maximum current is when a intrusion is detected and a full communication on the network is present.

Radio characteristics:

Central Frequency: 5.784 GHz
Frequency Band: 5725 – 5875 MHz, 150 MHz
Pulsed Transmission, Pulse Width = 150 ns,
Duty Cycle = 11%
Antenna: Printed Patch Antenna

The module is used to detect the movement in very small area, 80 cm form the module. This distance is fixed from the 5.9 ns window analysis, then the second microwave sensor is activated. Any sensor is activated one by one and non simultaneously activation is allowed to avoid interference between the different modules. The CANSine can be change the scanning activation of the modules in relation to movement detection.

2.6   Installation

The modules are installed in the door in hidden positioning with the antenna directed toward the interior of the vehicle.

The position need to create a housing with IP 67 to avoid water penetration in the modules caused from the humidity and condensation.

In the picture below an example for the positioning of the sensor.