3MS Mass Movement Sensor

Operating Description

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Document Change Record

Issue	Date	Pages Affected	Reason(s) for change
1	12 /-07/2004	All	First Issue
2	14/12/2005	1,2,5,6	Reflect organisation change, the sensitivity threshold is now set by a programming word and removal of standalone EEPROM from block diagram

Distribution

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1 Introduction

The e2v technologies 3MS alarm sensor is a volumetric microwave Doppler radar sensor that operates at 2.45 GHz in the ISM band.

The design is ideal for use in vehicle security systems and is compatible with existing alarm systems that incorporate a volumetric sensor input. The sensor is supplied as a fully assembled and tested unit, designed for housing in the customer's own case following e2v technologies guidelines. The sensor is initiated when the vehicle is locked.

2 Functionality

A block diagram of the sensor is shown in Figure 1. The sensor utilises the Doppler effect principle. For a Doppler system, the received frequency difference is found from:

$$\Delta f = f_r - f_o = \frac{2vf_o}{C}$$

where:

f_o	Carrier frequency (Hz)
f_r	Received frequency (Hz)
Δf	Baseband frequency difference (Hz)
v	velocity (m/s)
C	3×10^8 (m/s)

so that:

$$v = \frac{C(f_r - f_o)}{2f_o}$$

This gives a velocity sensing range of 0.03 m/s to 1.6 m/s.

The alarm sensor employs an autodyne radar, based on a ceramic resonator stabilised transistor oscillator and balanced mixer, coupled to a planar patch antenna structure embedded into the design of the printed circuit board. This produces a free space RF beam pattern approximating to a hemispherical ellipse. Temperature compensation of the oscillator is incorporated to reduce the frequency excursion with temperature to within design limits.

The output of the mixer is the low amplitude base band Doppler signal, which is fed for analogue signal processing. The signal is filtered and amplified and then fed to a microcontroller for further signal processing.

The microcontroller performs analogue-to-digital conversion of the Doppler signal, an output pulse of approximately 1 second duration being generated dependant upon a threshold crossing from a digital "charge pump" simulator. During power on a programming word is sent to the sensor that selects the sensitivity of the sensor by adjusting the thresholds.

The microcontroller also provides the controlling waveform to enable duty cycling of the RF power.

The RF beam shape within a vehicle will be modified due to internal reflections and resonances particular to the vehicle and its internal structure.

The size and material of a target determines the amplitude of the received Doppler signal, the velocity of a target determines the Doppler frequency.

Reflections within the vehicle from stationary objects such as the seats and steering column produce no Doppler shift and therefore do not trigger the sensor. However, movement within the defined sensor range will be detected and generate an alarm event which will be recognised by the Alarm Control Unit (ACU), the ACU then initiating an audible alarm.

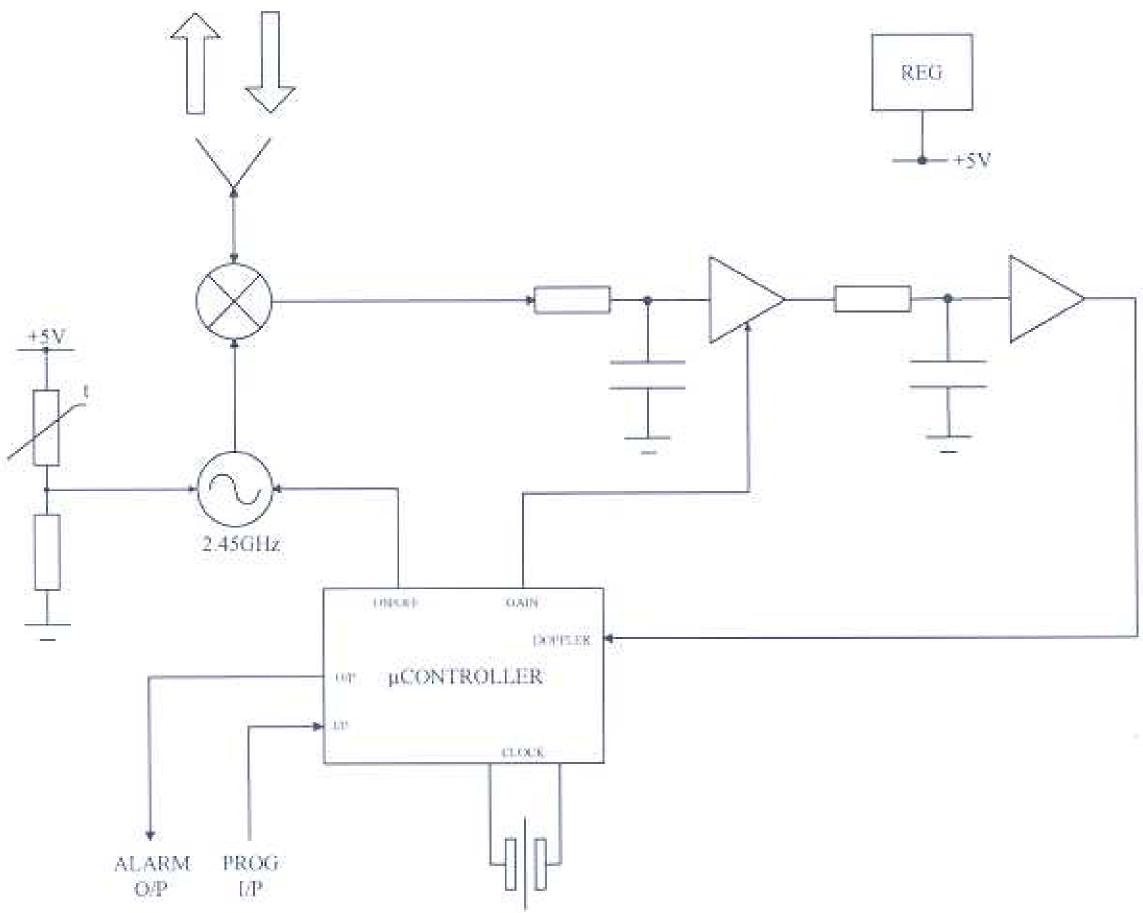

Figure 1: 3MS Block Diagram