1. INTRODUCTION

The Dynex Semiconductor 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 a customer's own case following the Dynex Semiconductor 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 x 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.

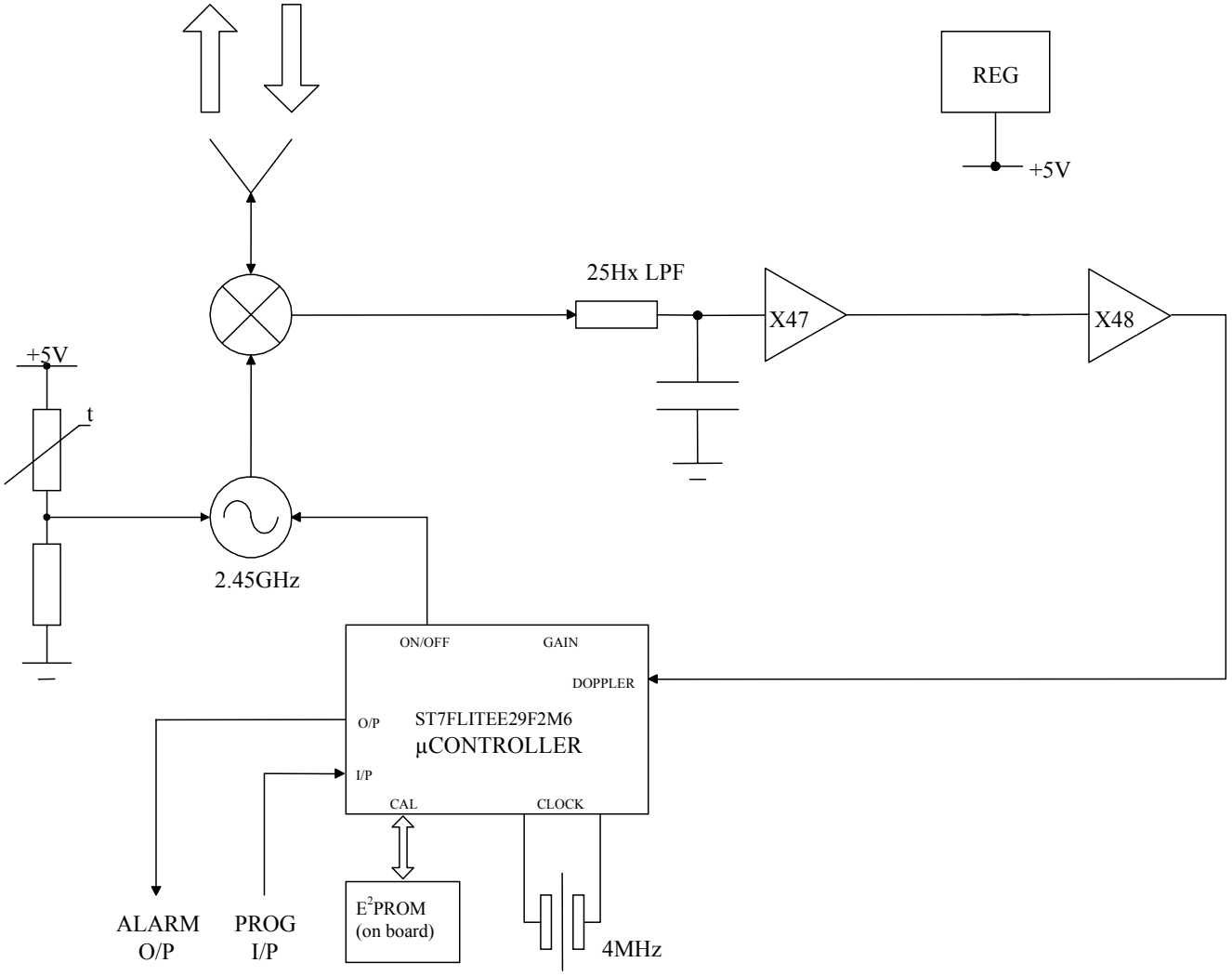

FIGURE 1: 3MS Block Diagram

The microcontroller performs an analogue-to-digital conversion on the Doppler signal, an output pulse being generated (of approximately 1 second duration) dependant upon a threshold crossing from a digital “charge pump” simulator.

The microcontroller provides high gain setting resolution by use of a 10-bit ADC. Analogue gain of the baseband signal is fixed and the thresholds adjusted accordingly to set the sensitivity of the sensor. 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.