A Wearable Textile Dipole for Search and Rescue Application

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***Abstract*—A wearable textile antenna for search and rescue application is presented in this work. It is designed based on the dipole topology to operate at 406 MHz for the Cospas-Sarsat application and fabricated fully using textile materials. The meanderline miniaturization technique is chosen to compact the proposed dipole due to its expected large size and wavelength at 406 MHz. The antenna evaluated in planar and bent forms indicated satisfactory performance when evaluated in terms of reflection coefficients, gain and radiation patterns.**

***Keywords*—Textile antenna; Ultra High Frequency (UHF) antenna; meanderline antenna; dipole antenna; search and rescue application.**

I. INTRODUCTION

Cospas-Sarsat is an international satellite system for search and rescue which is available to many countries. The system consist of a network of earth stations and constellation of satellites in the polar orbit which provide distress alert and location information to appropriate rescue authorities for users in maritime, aviation and land [1]. The Cospas-Sarsat system contains radio components which enable the alert and initiation of a search and rescue operation. Distress radio beacons vary in size and capability depending on the intended applications. For example, an Emergency Locator Transmitter (ELTs) is designated for use in aviation, Emergency Position Indicating Radio Beacons (EPIRBs) for use in maritime and Personal Locator Beacons (PLBs) for personal use. These beacons referred to as Local Users Terminals (LUTs) transmit signals during distress to satellites in geostationary and low earth orbits (LEO) orbits. This signal will then be relayed back to ground stations known as Mission Control Centers (MCCs), which will then alert Rescue Coordination Centers (RCCs) or other MCCs [2][8].

In the case of a PLB, they are disadvantageous to the victims in real emergency situations due to several factors. The beacon itself requires the victim to act to setup the antenna and activate the beacon before the transmission of signal can be sent to the satellite that allows location of the victims. Wearable antennas are extremely advantageous as they provide rescuers and victims are flexibility in movement in emergency situations [4].

In this paper, a wearable antenna operating at 406 MHz for Cospas-Sarsat application based on the meandered dipole topology is investigated via simulations and measurements. It is intended to be used for mobile location tracking devices such as PLBs for efficient and effective search and rescue activities in emergency. Section II presents the detailed antenna design strategies. The results of the investigations are presented in Section III prior to its conclusion in Section IV.

II. ANTENNA DESIGN

In general, two antennas have been designed by using the same types of textiles materials. Two textile materials were used; the first is a 3 mm thick non-conductive Felt textile used as the antenna substrate. Its relative permittivity (ε_r) is 1.44, with a loss tangent (tanδ) of 0.044. The other textile used to form the conductive elements of the antenna is ShieldIt Super. It is a 0.17 mm thick textile with conductivity of 1.18 x 10^5 S/m. It also features an adhesive reverse side and this enables ease of attachment onto the substrate.

Initially, two different antenna designs resonating at 406 MHz was designed using CST Microwave Studio. The concept of meander line antenna are chosen for both based on its potential to result in a miniaturized antenna [5],[6]. This is due to the relatively longer intrinsic electrical length resulting from the use of 406 MHz frequency for Cospas-Sarsat application. The first design, denoted as Design 1 is shown in Figure 1(a). The dipole is 414 mm long and 2 mm wide. Each arm of the dipole consists of an initial part of 10

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