Design and Fabrication of GSM Based Antenna

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***Abstract*—** Antennas plays an vital role in communication and used for many applications since many decadesago. An Antenna is a electrical device , which converts electrical power into electromagnetic waves and vice versa. An antenna is required to radiate and receive the signals and therefore their performance is key to the operation of the overall radio system. Antenna has the capability of sending or receiving the electromagnetic waves for the communication purpose. In this project, analysis and design of GSM based antenna is focused. Antenna design is a function of frequency, application, broad area, range, and costs. Whether the application requires the absolute minimum costs or minimization of broad area or maximum range, it is important to understand the critical parameters so that the proper trade-offs can be chosen. The parameters that are required in selecting the correct antenna are antenna tuning, matching, gain/loss, and required radiation pattern. In this project, a smart SMD antenna is selected on the basis of its gain factor and efficiency to interface with GSM module for tracking applications. M66 is a Quad-band GSM engine that works at Penta band frequency range. By studying this GSM module and preferring the suitable antenna by its gain in order to interface with this module. The proposed work is design and fabrication of efficient antenna that is employed in M66 GSM module for the purpose of various applications like GPS-GSM tracking, anti-theft security and personal security system. The case study is made on different GSM antenna like Reflexus, Calvus and an alternate antenna called Meanderline has been designed using Altium software. To choose the efficient antenna, properties of antenna such as feed point, impedance matching, return loss, directivity have to be compared and studied. The comparative analysis of all these antenna has been summarized and demonstrated with GSM module. The respective results are shown using Docklight monitoring software.

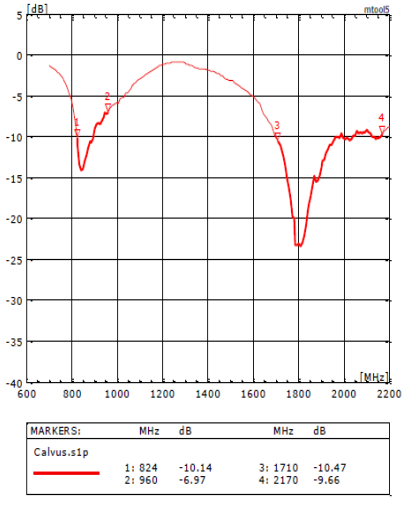
***Keywords*—** *Antennas ; formatting; environmental monitoring system; Android application; Arduino; sensor.*

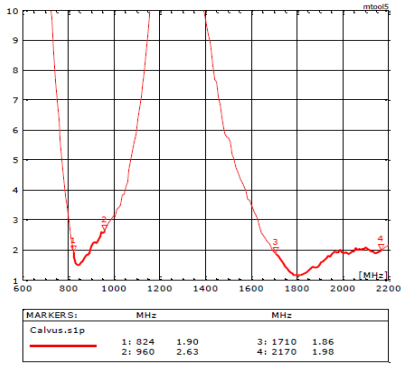
I. INTRODUCTION

This paper represents the parametric analysis of two different types of antenna in terms of gain, loss and efficiency and thereby employingin GSM module. Three antennas named calvus,reflexus, are chosen which are penta band frequencies operated SMD antenna.The antenna operations are analysed in Altium software and the antenna implementation in GSM module are analysed using Docklight software.

II. CALVUS PENTA BAND SMD ANTENNA

Calvus operates in the frequency range of 824MHz-960MHz Calvus uses a ground plane in order to radiate efficiently, but the ground plane must not be present underneath the antenna itself. To achieve optimized results,the antenna uses a matching circuit for the specific frequency bands that are required. This product specification describes the performance of the antenna when optimized to cover a typical penta-band reception:GSM850/900/1800/1900 and WCDMA. Higher efficiencies are possible,if the antenna is used for ffewer than 5 bands.Calvus antenna offers average gain of -1.6dBi with return loss of -6dB and an efficiency factor of 69%.The maximum VSWR is 3:1.The return loss is shown in figure2.1.The VSWR is shown in figure2.2





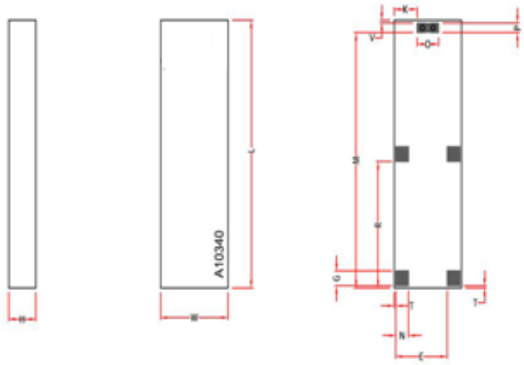


Fig 1 ; The antenna schematic

The antenna dimension is tabulated below:

L	W	H	E	N		T
LENGTH	WIDTH	HEIGHT				
27	7.92	3.2	6.22	1.5		0.2
G	R	M	V	O	K	P
1.5	12.76	25.76	0.25	2.5	2.7	1

Unit: mm

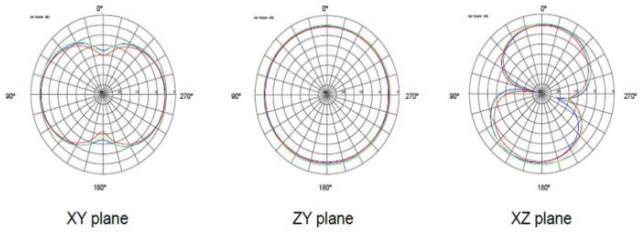
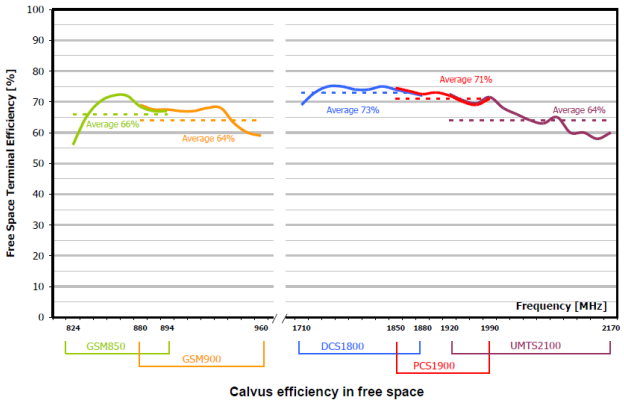


Fig 2 ; The antenna radiation pattern is each two axes

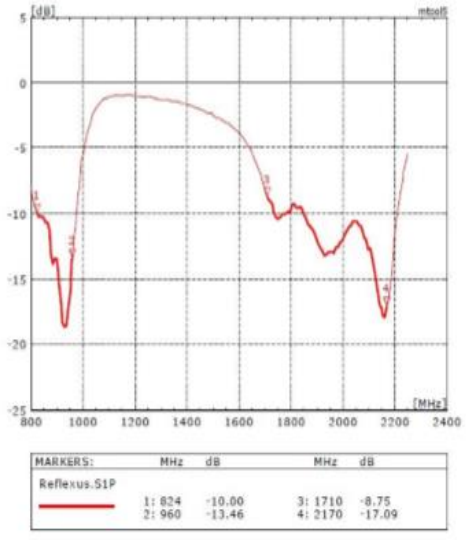
The antenna efficiency under different frequency range are highlighted in below graph:



III. REFLEXUS PENTA BAND SMD ANTENNA

In order to radiate efficiently, Reflexes uses a ground plane. But this ground plane must not extend underneath the antenna itself. Matching circuit are used by antenna to achieve optimized results for the specific frequency bands that are required. This product specification describes the performance of the antenna when optimized to cover a typical penta-band reception: GSM850/900/1800/1900 and WCDMA.

Reflexus antenna offers average gain of -1.3 dBi with return loss of -8dB and an efficiency factor of 70%.The maximum VSWR is 3:1.The return loss is shown in figure3.1.The VSWR is shown in figure3.2



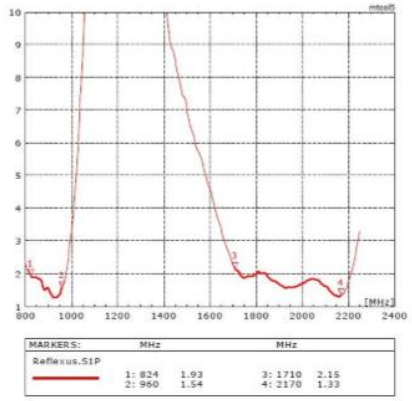
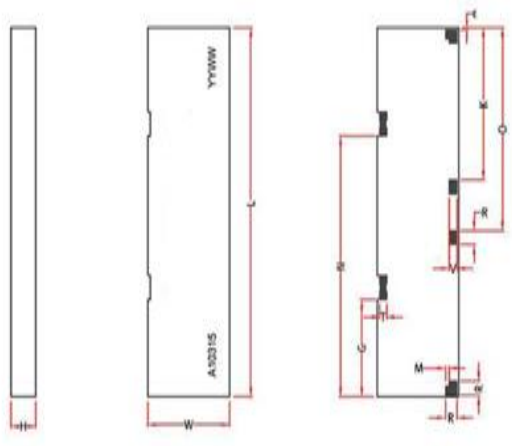


Fig 3 ; The antenna schematic

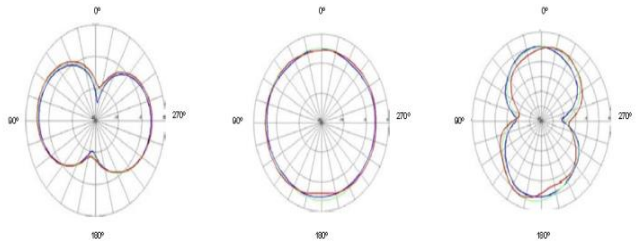


The antenna dimension is tabulated below:

L	W	H	E	N	T
LENGTH	WIDTH	HEIGHT			
40.0	10.4	3.2	0.2	28.28	0.9
G	R	M	V	O	K
10.56	1.5	0.2	1.0	22	16.5

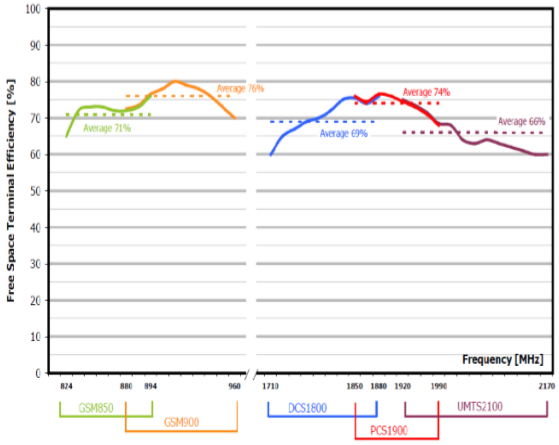
Unit:mm

Reflexus antenna offers average gain of -1.3 dBi with return loss of -8dB and an efficiency factor of 70%.The maximum VSWR is 3:1.The return loss is shown in figure3.1.The VSWR is shown in figure3.2The antenna schematic is shown in figure 3.2. The antenna radiation pattern is each two axes as shown below in figure 3.3



XY plane ZY plane XZ plane

The antenna efficiency under different frequency range are highlighted in below graph:

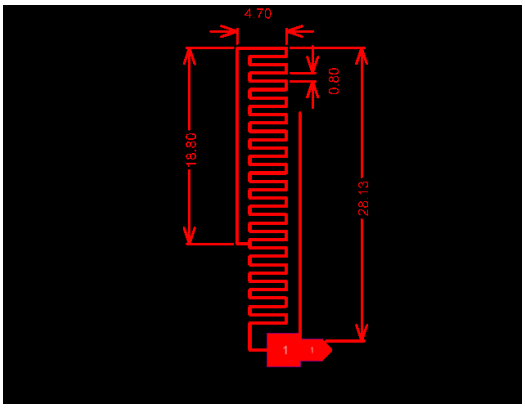


IV. PROPOSED ANTENNA

The co-operates in the frequency range of 824MHz-960MHz.Wireless sensor nodes are expected to be extremely small and battery operated.

Design of protocol for these network must be in such a way that the limited power in the sensor nodes should be used in the most efficient manner. The ageing population in many developed countries highlights the importance of novel technology-driven enhancements to current health care practices. Technological developments in the fields of sensing, actuation, processing, wireless communication, and information management. Meander line antenna (MLA) is electrically small antenna. The meander line antenna is described as slow wave circuit which consists vertical and horizontal lines uniformly space and connected each other. The meander line antenna is designed with a set of horizontal and vertical lines. Meander line antenna is type of the micro strip antennas. Combination of horizontal and vertical lines forms turns in the antenna. Small size antenna and wideband performance are obtained by meander line technology. Antenna the size of the dipole at given frequency is reduced in meander line by a factor that is proportional to the number of turns. The adjacent horizontal segments of the meander line case of meander line if meander spacing is increase resonant frequency decreases. Antenna have opposite phase. Number of turns increases efficiency increases. The Resonant frequency of meander line antenna as a function of meander separation and meander spacing. Meander spacing increase resonant frequency decrease. The extension of the basic folded antenna is the meander antenna and frequencies much lower than resonances of a single element antenna of equal length. Radiation efficiency of meander line antenna is good to compare with conventional antennas.

V. STRUCTURE OF AN ANTENNA



Relative permittivity is 4.4, the substrate height is 1.59mm and ground of size 13.33 mm x 10.04 mm. PCB area is about 14.5mm×26.6mm. MLA is electrically small antenna so total length of antenna is 10 / λ Quarter Wave Transformer is used for impedance matching Purpose impedance of antenna is 50 ohm. There are total eight turns are present in proposed meander line antenna structure. Ground is back side of the antenna and dimension should be λ/4 OR λ/2.

Lumped inductance

LA=Ll/2-1

Lumped capacitance

CB=Cl

Where Linductance per unit length is, C is capacitance per unit length and l is length of line segment

Total length of antenna is given by

N X S = λ/10

Where N number of turns, S is spacing between two meander lines. Where d is the monopole wire diameter. The characteristic impedance of each meander section given as:

Zo=276 log(2S/d)

VI. RESULTS

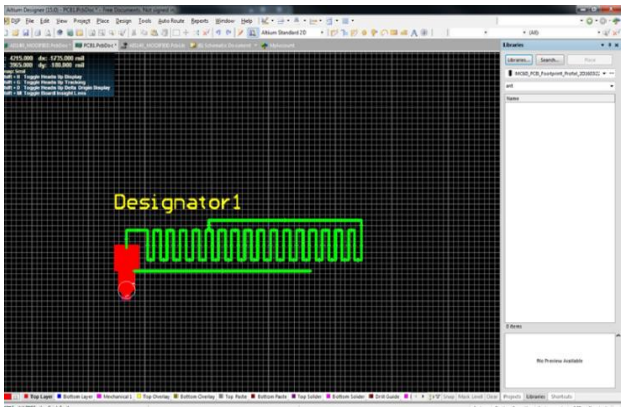


Fig 4 ; Design for Meander Line Antenna

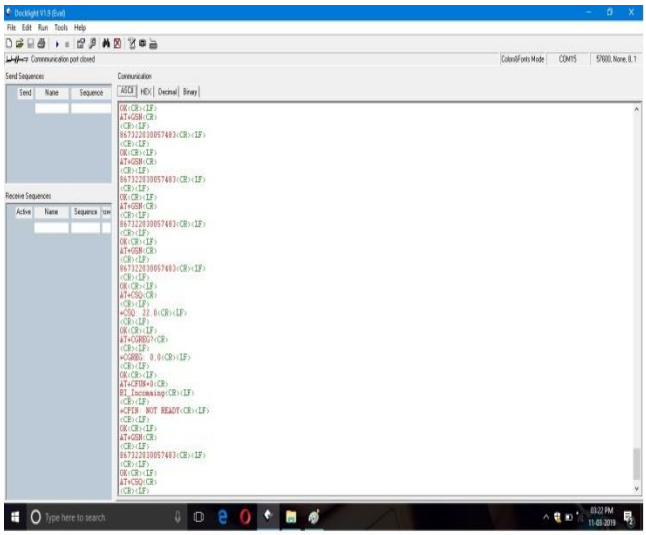


Fig 5 ; CSQ Value Output

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Fig 6 ; Meander Line Antenna Insulated With GSM Module

VII. CONCLUSION

The GSM antenna with wide bandwidth is presented in this project. Compared to the established performance characteristics of older GSM antennas, the presented antennas have a novel feature of achieving high gain and good efficiency, with a simple design and small in their dimensions, when printed in circuit boards. This shows that the proposed antennas have all the capabilities to get interfaced with GSM modules and can be efficiently used for tracking applications. Inserting suitable slots in radiating patch is also a common technique in reducing the dimensions of patch antenna.

Meander line antenna (MLA) is one type of the micro strip antennas. The antenna is designed to operate on 50 ohm impedance.

Added to the note, out of two GSM antennas, MEANDER LINE ANTENNA has delivered the best gain and good efficiency in terms of CSQ value. MEANDER LINE antenna has achieved a higher CSQ value which is much recommended to use in a GSM module than the other two antennas.

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