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UWB Antennas

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Abstract : *The Demand Of Compact And Low Profile Antennas Has Increased With The Advancement In Wireless Communication System. Ultra Wideband Antennas Are Widely Used For The Same. A Variety Of Structures Are Analyzed And Designed To Obtain Ultra Wideband Response. This Paper Explains Printed Monopole Antennas And Discusses Various Modified Circular And Rectangular Structures To Obtain Ultra Wideband Characteristics. The Discussed Configurations Yield Operating Bandwidth From Less Than 2 Ghz To More Than 10 Ghz With Co-Polar Gain Of Around 1 To 2 Dbi Over Complete Bandwidth. Due To The Realized Bandwidth And Gain, The Configurations Can Find Applications In Personal Mobile Communication, Blue-Tooth And Wi-Fi Wi-Max Applications In 3 To 10 Ghz Frequency Range.*
Keywords *- UWB Antenna, Printed Monopole Antenna, Impedance Bandwidth.*

I. INTRODUCTION

The Advancement Of Modern Wireless Communication Systems Are Motivating And Demanding The Need Of Compact And Low Profile Antennas. This Modern Trend In Miniaturization Of Wireless Devices Has Triggered The Evolution Of Microstrip Antenna (MSA) Technology. It Is One Type Of Antenna That Possesses Most Of The Desirable Features For Today's Modern Trend. The Advancement In The Microstrip Technology Over The Last Decades Has Resulted In Increase Of Information Transmitted And Higher Data Rates [1]. Ultra-Wideband (UWB) Antenna Technology Is Used For Transmitting Large Amounts Of Digital Data Over A Wide Frequency Spectrum Using Short-Pulse, Low Powered Radio Signals. The Term UWB Was Introduced By The U.S. Department Of Defense (DOD) Around 1989 And Was Authorized By The U.S. Federal Communications Commission (FCC) In 2002 For Unlicensed Range 3.1 Ghz To 10.6 Ghz. The Power Emission For UWB Is Limited To 1.5mw And Power Spectral Density Is 6.7×10^{-8} W/Mhz. UWB Signals Are Impulse-Type Signals Which Are Localized In Time Domain But Spread Out In Frequency Domain.

UWB Antennas Should Be Electrically Small, Low Profile. Also It Should Be Integral With Other Subsystems/Components [2]. Realization Of UWB Antennas Is Done By Using Basic Planar Monopole Antenna And The Variations Of The Same Resulting In Different Shapes Like Triangular, Crescent, Bowtie Etc. [12-18]. They Are Also Realized By Modifying The Feeding Strip Shape Or By Cutting The Slot Inside The Radiator, Feed Line And Ground Plane Of The Regular Shaped Monopole Antenna. The UWB Antenna Technology Is Used For Various Applications Such As Radar Imaging Of Objects Buried Under The Ground And Behind Walls, Surveillance Systems And Military Systems, In Medical Monitoring Like Patient Motion Monitoring, Vital Signs Monitoring Of Human Body, Monitoring Of Medicine Storage, Cardiology Imaging, ENT Imaging Etc. The UWB Technology Finds Its Application In Blue-Tooth, Wi-Fi, Wi-Max And Personal Mobile Communication System Applications In 3 To 10 Ghz Frequency Range [3, 4].

II. ULTRA WIDEBAND ANTENNAS

2.1 PRINTED MONOPOLE ANTENNAS (PMA'S)

The MSA Suspended Above Air Substrate Of Thickness 'H' Is Shown In Figure 2-1(A). Here The Larger BW Is Realized Due To Thicker Substrate And By Feeding The Microstrip Patch With An Edge Feed. The Edge Feed Is Supported By Orthogonal Ground Plane Which Helps In Achieving Input Impedance Matching For Thicker Substrate. For Very Large Value Of Substrate Thickness, The Bottom Ground Plane Will Have Negligible Effects And Hence It Is Removed. This Leads To Microstrip Variation Of Printed Monopole Antenna (PMA) As Shown In Figure 2-1(B).

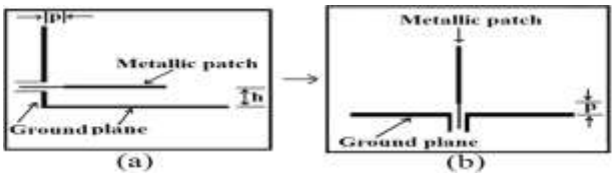

Fig. 2-1: (A) Rectangular MSA Suspended Above Air Substrate Of Thickness 'H' And (B) Planar Monopole Antenna

This Planar Structure Allows flexibility To Integrate Various Discrete Components On A Compact Printed Circuit Board Which Reduces The Overall Volume. Various Structures For Planar Monopole Antennas Are Reported To Yield Large Bandwidth Such As Rectangular, Square, Triangular, Hexagonal, Circular, Oval, Elliptical Monopole Etc [2].

2.2 MODIFIED CIRCULAR PMA's

A Novel Modified Circular Structure Shown In Fig. 2-2(A) Is Realized By Combining A Rectangular Section With Two Semicircles. To Achieve Optimum Impedance Bandwidth For UWB Antennas Dimensions Of The Radiating Element And Ground Plane And Feed Line Are Adjusted. These Antenna Design Parameters Are Designed Using Simulation Electromagnetic Solver. The Simulated And Measured Return Loss Curves For The Antenna Are Shown In Figure 2-2(B). It Is Seen That The Return Loss Is Better Between 3 And 14 Ghz Frequency Range. The Antenna Generates Three Resonances That Overlap With Each Other To Extend The Bandwidth. However, The Effect Of Combined Structure On UWB Realization With Respect To Modal Frequencies Is Not Provided [5].

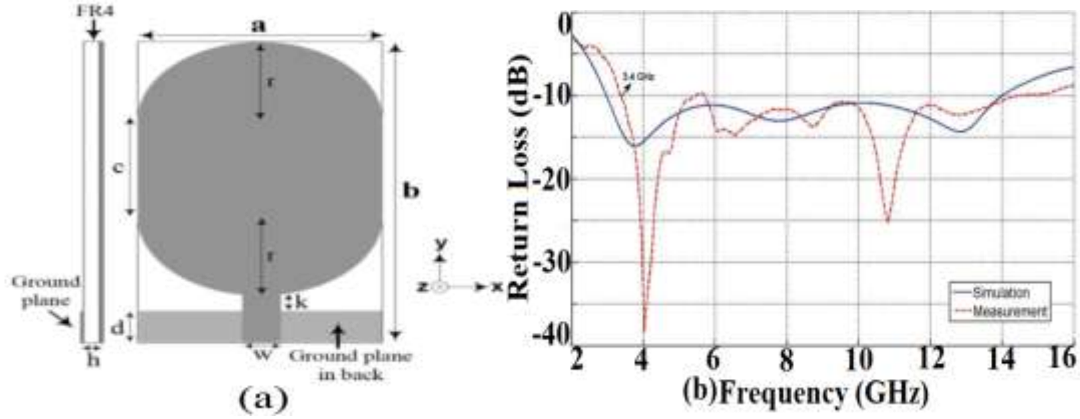

Fig. 0-2: (A) A Modified Circle Planar UWB Antenna And (B) Its Measured And Simulated Return Loss Plots Against Frequency [5]

The U Shape Antenna Is Realized By Cutting Circular Slot Inside Circular Shaped Printed Monopole Antenna And Adding Two Rectangular Sections In The Radiating Element As Shown In Fig. 2.2(C). The Spiral Stub In The Radiating Patch Is Used To Reject The Frequency Band Limited By Wi-Max And C-Band Systems While The Symmetrical L-Shaped Slot On The Ground Plane Is Used To Reject The Frequency Band Limited By HIPERLAN/2 And WLAN Systems. At 3.8 Ghz Frequency The Current Mainly flows In The Stub, Which Acts As Short Circuit Resonator And There Is Negligible Current In The Radiating Patch Making It Non-Radiate. Similarly, At 5.6 Ghz The Surface Current Is Concentrated Around The L-Shaped Slots In The Ground Plane Which Causes The Antenna To Be Non-Responsive At That Frequency. Thus, The Impedance Of The Structure Is Not Well Matched And These Large Reflections Result In Increased Return Loss, Decrease Radiation Efficiency And Gain In The Stop Bands. The Proposed Antenna Has A Large Bandwidth Over The Frequency Band From 2.75 Ghz To 10.6 Ghz Except 3.27–4.26 Ghz And 5.01–5.99 Ghz Frequency Bands As Seen In The VSWR Curve Shown In Figure 2-2(D). [6]

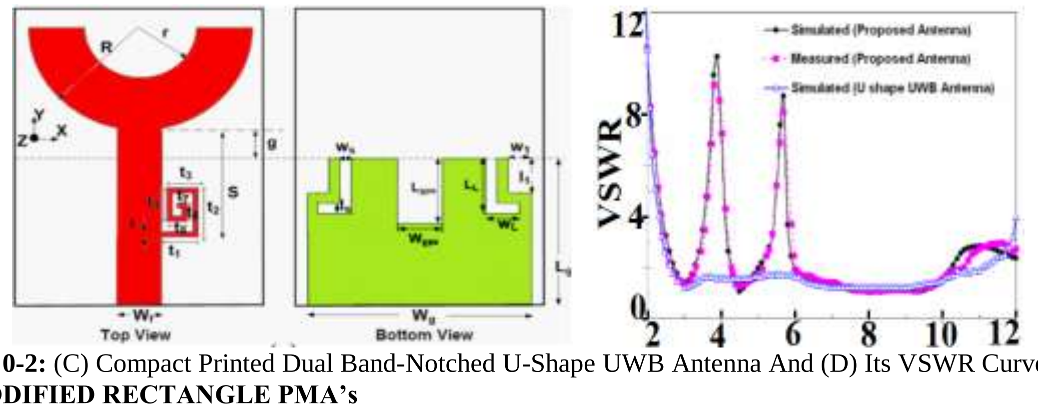

Fig. 0-2: (C) Compact Printed Dual Band-Notched U-Shape UWB Antenna And (D) Its VSWR Curve [6]

2.3 MODIFIED RECTANGLE PMA's

A Modified Rectangular Dual Wideband Antenna Is Formed By Combining Rectangular Ring Monopole And A Rectangular Monopole As Shown In Fig. 2-3(A). The Resonant Mode Of Ring Monopole At About 2.9 Ghz Whereas, Resonant Mode Of Rectangular Monopole At About 5.2 Ghz Are Successfully Excited With Good Impedance Matching To Cover The 2.4/5.2/5.8 Ghz WLAN Bands And The 2.5/3.5/5.5 Wi-Max Bands As Seen From The Return Loss Plot Shown In Figure 2-3(B). The Width Of The Monopole Antenna Controls The Impedance Bandwidth Of The Lower And Upper Bands For The Proposed Antenna. [7]

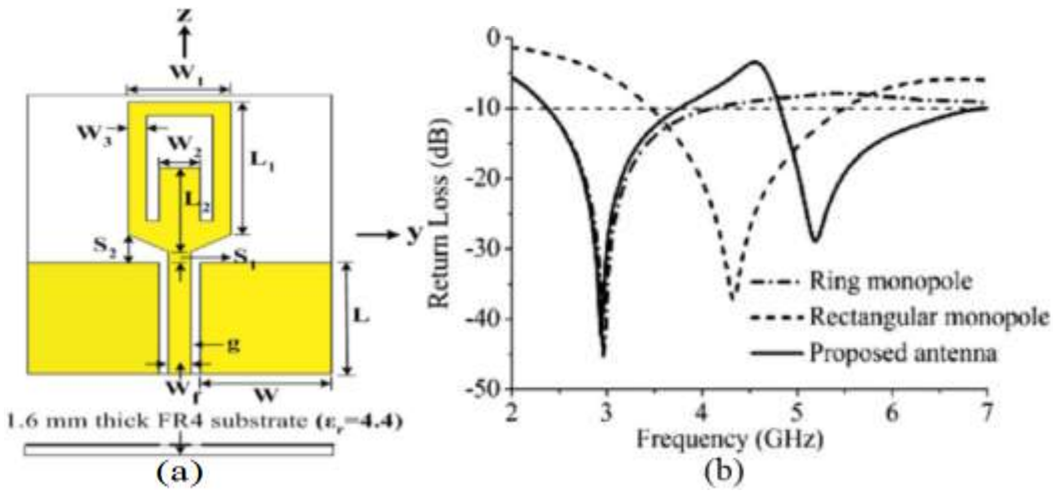

Fig. 0-2: (A) Geometry Of Compact Dual-Wideband Antenna And (B) Return Loss Plot Of The Proposed Antenna [7]

III. Conclusion

The UWB Technology Will Therefore Be The Solution For The Future Wireless Communication Antenna Systems. The Ability To Achieve High Data Rates Which Results From The Large Frequency Spectrum Occupied Makes It Flexible To Be Used Widely. The Extremely Low Power Emission Level Prevents These Antenna Systems From Causing Interference With Other Wireless Systems. Various Antenna Designs With Notch Analysis For UWB Systems Are Carried Out Extensively. Rectangular, Circular And Triangular Planar Monopole Antennas Are Used As Conventional Structures Due To A Simple Structure, Low Profile, Easy To Fabricate Having UWB Characteristics With Nearly Omni-Directional Radiation Patterns. Various Antenna Configurations With Modification Structures, Slot Cuts And Microstrip Offset Feed-Line Have Been Analyzed In Order To Form The Novel Structure For Optimum UWB Impedance Bandwidth.

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