

## **A Novel AMC Loaded CPW Fed Wide Band Antenna for 5G Applications**

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### **Abstract**

With the touchy development of mobile traffic request, the logical inconsistency occurs in between capacity prerequisites and spectrum range deficiency turns out to be progressively eminent. The congestion of wireless bandwidth turns into a major issue of the fifth era (5G) remote systems. In this research work, a CPW antenna with AMC for the frequency range of 18GHz to 30GHz is planned which can cover applications in K band (Satellite communication) and 5G applications. The structure of the Patch can be altered (like a star, circle, bloom and so on) to enhance the transmission capacity. The reflector is made of an electric ground plane, a dielectric substrate, and artificial magnetic conductor (AMC) which shows an effective operational bandwidth. Then, the closely spaced AMC reflector is employed under the CPW for performance improvement including unidirectional radiation, low profile, gain enhancement. The plan of a Co-Planar Waveguide antenna encompassed by a polarization subordinate Artificial Magnetic Conductor has been introduced and its highlights, regarding reflectance and present dissemination, have been examined. AMC structures for transmission capacity improvement have been utilized with CPW antennas. The deliberate information demonstrates that whole Artificial Magnetic Conductor surfaces go about as great ground planes for a low profile antenna, yet the bandwidth and gain of the structure like a star, circle, blossom and so forth are more extensive and bigger, individually than those of alternate structures. Thus the result shows that the first band is obtained at 25.2 GHz to 28.2GHz and the second wideband is 30.5 GHz to 50 GHz. Hence this antenna can be used for K, Ka, Q& U band of microwave applications. It also provides a gain of 2.9dBi. The utilization of AMC in CPW antenna thereby, conceivable to fabricate an antenna to promptly conceal the K Band recurrence band and 5G applications.

**Keywords:** CPW antenna, AMC, bandwidth, K Band, 5G.

### **1.0 Introduction**

In Recent Years , CPW Antennas has been used as an great part of ideal opportunity for versatile communication and its applications. A CPW antenna is portrayed by its limited wide transmission by its weight, minimal size and manufacture of creation . In any case on account by designing the radiator and the ground plane on a solitary side of the substrate the vitality will be excluded bi-directionally , which prompts a low band antenna to gain[3]. This makes it adequately sufficient immerse to meet the necessities of wide band applications. The fundamental requirements are high gain and unidirectional radiation .

A Coplanar waveguide reception mechanical FED is an kind of strip transmission line portrayed as planar transmission in structure for microwave signals transmissions. I contains no shorter depends on the level of conductive piece of little thickness , and conductive ground planes . A Structure of CPW which incorporates a middle metallic segment of securing the dielectric substrate fragment with two thin openings in which ground cathodes runs coterminous and are

parallel to the similarity of strip surface. Nearly the small micro strip line, the CPW is in dynamic use as planar transmission line in RF/Microwave combined circuits. It can be viewed as double coupled open lines. Thusly, similar properties of a slot line may be typical.

Artificial magnetic Conductors are remarkable by their ability capacity of in stage reflection at a specific frequency range. By placing a well being structure, the impedance organizing transfer speed is upgraded. More researchers has been fixated on using antennas stacked with segments of AMC. This paper proposed an another receiving antenna of AMC, which gets fused with a clear CPW structure and the effect of this AMC structure for enhancing the gain and directivity at mm-wave groups is attained.

The Disadvantage of wireless data transfer limit speed changes into key issue for the 5G wireless frameworks. Then again with gigantic transfer speed in the millimetre wave (mm-Wave) band from 30 GHz to 300 GHz millimetre wave communication is proposed to give multi gigabit communications (mm-Wave) communications is proposed as a essential piece of 5G convenient frameworks for example, High Definition TV (HDTV) and ultra-t indent video (UHDV) [1][2].

Most of Exploration is centred on the 28 GHz band, the 38 GHz band, the 60 GHz band, and the E-band (71-76 GHz and 81-86 GHz). Smart advance in reciprocal metal-oxide-semiconductor (CMOS) radio rehash (RF) melded circuits bearing the way for electronic things in the mm-Wave band [3], [4], [5]. There is an beginning for two or three models depicted for indoor or wireless individual critical structures (WPAN) or remote neighbourhood (WLAN), for instance, ECMA-387 [6],[7], IEEE 802.15.3c [8], and IEEE 802.11ad [9], which is to reproduce the inner and outside cell frameworks plans in the mm-Wave bands [11] [12] [13] [14].

The surface of AMC structures are expected to have an in-structure reflection property for a plane rush of customary recurrence in the locale of 2.45 GHz. The interior arrange reflection for AMC surface and return misfortunes, radiation patterns and gain level or even receiving antennas o the AMC ground planes are estimated and different in appearance in coordination with each other. The Data showed that all the AMC surfaces about extraordinary ground planes for a position of safety radio wire and the transfer speed and gain of the antenna structure like star, circle, bloom et cetera are wide broad and independently greater than the structure exchange research has been centred on utilizing antennas stacked with AMC components. This paper proposes another receiving antenna of AMC, which incorporates with a straightforward structure of CPW to consider the impact of this AMC structure for enhancing the directivity and gain at mm-wave groups.

The bottleneck of wireless data transfer capacity speed transforms into a key issue for the fifth time (5G) remote systems. On the other hand, with gigantic transfer speed in the millimetre wave (mm-Wave) band from 30 GHz to 300 GHz, millimetre wave (mm-Wave) correspondence have been proposed to be an essential piece of the 5G portable system to give multi-gigabit correspondence administrations, for instance, High Definition TV (HDTV) and ultra-t notch video (UHDV) [1][2].

Most of the exploration is centred on the 28 GHz band, the 38 GHz band, the 60 GHz band, and the E-band (71– 76 GHz and 81– 86 GHz). Snappy progress in complementary metal-oxide-semiconductor (CMOS) radio repeat (RF) fused circuits enduring the path for electronic things in the mm-Wave band [3], [4], [5]. There are starting at now a couple of models described for indoor remote individual area frameworks (WPAN) or remote neighbourhood (WLAN), for example, ECMA-387 [6],[7], IEEE 802.15.3c [8], and IEEE 802.11ad [9], which recreates the creating interests in cell systems or outside work systems masterminds in the mm-Wave band [10], [11], [12], [13], [14].

The AMC surface structures are expected to have an in-organize reflection property for a plane rush of customary recurrence in the locale of 2.45 GHz. The transfer speed of the in-arrange reflection for the AMC surfaces and return misfortunes, radiation illustrations, and pick up of the level or even wire receiving wire on the AMC ground planes are through and through estimated and appeared differently in relation to each other. The ponder data show that all the AMC surfaces go about as extraordinary ground planes for a position of safety radio wire yet the transfer speed and pick up of the structure like a star, circle, bloom et cetera are more broad and greater, independently than those of exchange structures.

In this manner the CPW antennas with AMC has been incited and the deliberate information demonstrate that all the AMC surfaces go about as great ground planes for a position of safety antenna are shown in Fig 5, yet the transfer speed and pick up the structure like star, circle, bloom and so on are more extensive and bigger, separately, than those of alternate structures.

## **2.0 Problem definition**

Despite the fact that with the explosive improvement over mobile traffic congestion call for incidence, The restrict conditions and range lack seems to be steadily conspicuous which also results in inconsistency . The wireless bandwidth ability range turns out to be an key issue of the fifth generation 5G systems . Alternatively with large bandwidth variety from 30 GHz to three hundred GHz millimetre wave (mm-Wave) communication is an essential piece for 5G cellular machine which offers an multi gigabit communication administrations , for instance, pinnacle- notch television (HDTV) and ultra-top quality video (UHDV) [1][2].

Many Exploration on 28 GHz band , 38GHz band , the 60 GHz band , and the E-band (seventy one-seventy six GHz and eighty one- 86 GHz ) is focused. The Snappy progress in complementary metallic -oxide-semiconductor (CMOS) radio frequency (RF) fused circuits which endures path for electronic matters in the mm-Wave band [3], [4], [5]. There exists an beginning models of couples which describes an indoor wireless personal area frameworks (WPAN) or neighbourhood (WLAN), For instance ECMA -387 [6] , [7] , IEEE 802.15.3c [8] and IEEE 802.11ad [9], which recreates the interests in cellular systems or outside paintings structures mastermind in mm-Wave band [10], [11], [12], [13],[14].

The call for smaller size antenna having broadband attributes activates enlargement of constructing up the high information rates Wi-Fi communication. In this improved statistics wireless communication framework the necessity of antenna ought to be made out of littler in length, with less down strength usage, high-facts fee transmission restriction, with effortlessness fabrication, wideband capacities and cost effective fee. For Wi-Fi carrier requirements, with double or multiband assumes a essential component to accomplish exceptional outcomes. Aside from existing single band, double band multiband UWB antennas are ending up extensively more unpredictable. Outcomes, Other than present unmarried band, double band multiband UWB antennas are finishing up considerably more unpredictable.

## **3.0 Related works**

In this work, Ghada Hussain Elzwawi et al proposed an 30 GHz AMC for 5G applications . The CPW structure primarily based antenna as reflector enhances the benefit and directivity at mm Wave companies . With respectable coordination , the switch speed from 24.3GHz to forty one.4Ghz

is displayed as antenna configuration. It incorporates the desired 5G wi-fi band as an in depth variety . A trendy antenna gain improve of round four dB is achieved.

An antenna structure accommodates of high-quality receiving twine of 3 layers and AMC ground aircraft is proposed by way of Imad Ali et al. To start with each LTCC-and LCP-based totally substrates are composed of any other and 3 layer minimized AMC .

The composed AMC is decreased and gives 37.Five% better in-degree transmission capacity and then contrasted with a high-quality magnificence plan. At that factor , repair receiving antenna is out layered and streamlined on LTCC and LCP construct substrates is made by way of 3 layer recommended CPW which results in mild of satisfactory of the 3- layer AMC ground plane of a similar material.

It performs out a advantage facts transmission limit relative examination of radio wires on multilayer LTCC-and LCP based substrates with AMC/percent ground planes for 60 GHz. Henceforth it's been watched that radio wires on LCP-broaden substrate beat the ones as for LTCC-based substrate with recognize to consist of impedance switch velocity limit, furthermore, pick out up on both AMC and p.C floor planes, even as getting wires on LTCC-based substrate have littler receiving twine and AMC estimations.

Om Pandey et al, displayed an AMC stacked FSA working at the frequency of 1.82 GHz. CPW-fed FSA is first composed. This FSA is stacked with PEC at a separation of  $d=4$  to make design uni-directional. A fore said antenna(FSA alone) again stacked with AMC for minimization. At that point PEC and AMC stacked FSA are looked at and on that premise of final design is exhibited.

In this work outline of coplanar waveguide (CPW) bolstered reception apparatus joined with a polarization subordinate manufactured attractive conductor (AMC) is introduced by R.C. Hotopan et al. The gain and directivity of the antenna structure, assessed through an investigation apparatus in light of strategy for minutes (MoM), are enhanced as for the reception apparatus without AMC. The present disseminations of the antenna alone and of the antenna encompassed by the AMC are contrasted with break down the impact of the artificial material.

In this work, a polarization-insensitive double band artificial magnetic conductor (AMC) structure is planned and tentatively confirmed by Pooja Prakash et al. It comprises of a planar cluster of annular ring-space loaded rectangular patches. Subtle elements of the proposed structure and origin of the two groups are talked about. Through recreations and estimations, it is demonstrated that the structure is obtuse to the polarization of the episode wave. The tuning of the higher AMC band is exhibited by shifting the capacitance of the annular opening through its width variety. The planned AMC is utilized as a reflector for a wideband monopole fix radio wire. It is demonstrated tentatively at the antenna frequencies in the AMC band that the gain of the receiving wire enhances by right around 10 dB and front-to-back proportion is enhanced by 15 dB.

#### **4.0 Proposed system**

As of late, CPW antennas have been used at most as regularly as conceivable portable communication applications . A CPW receiving antennas are depicted by its wide information exchange limit, insignificant exertion, light weight, minimal size, and effortlessness of manufacture. As a Result in any case by printing radiator and ground plane on one side substrate , which prompts an low gain receiving antenna due to its bidirectional transmission. The gain and the unidirectional

radiation are essential necessities and it is not immense adequately to meet the wide band applications requirements. The impedance planning transmission limits and gets place of wellbeing structure . Much Researches has been centred by using receiving antennas stacked with AMC parts . This paper proposes an another AMC antenna structure , which is used to facilitate with CPW structure and consider the AMC structure effect for improving the directivity and gain at mm wave groups.

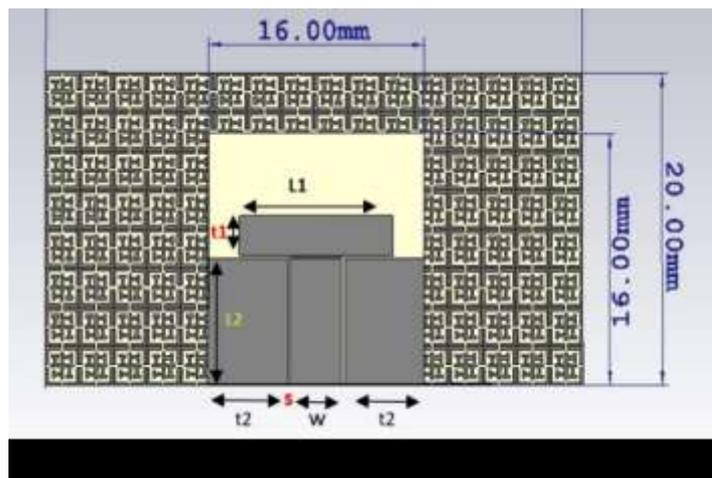


Fig. 1. The configuration of the CPW integrated with the AMC reflector

### 5.0 Novel CPW fed antenna structure

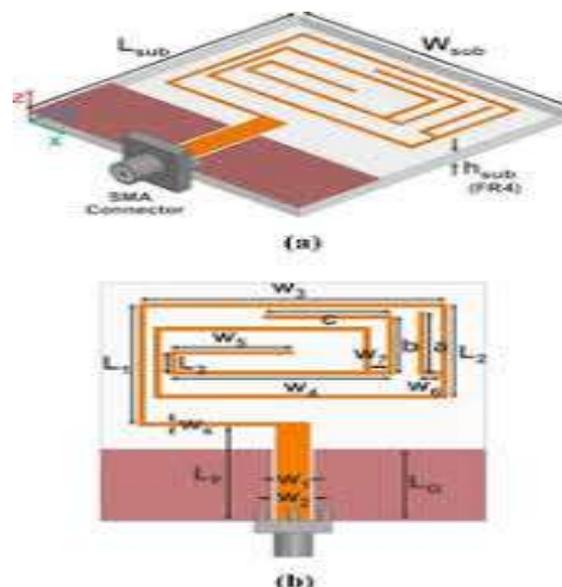


Fig. 2. Structure of CPW FED Antenna

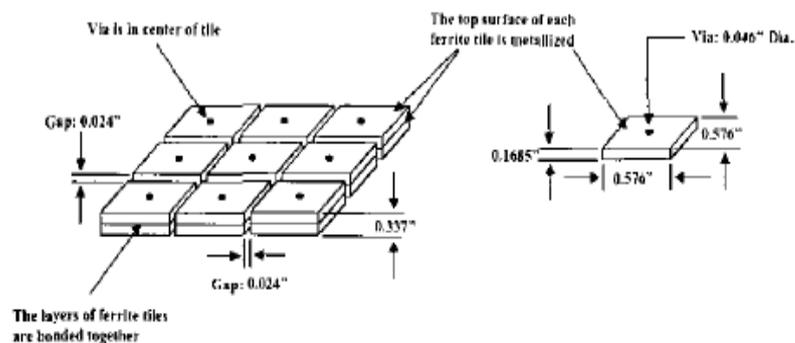
**6.0 Design of active artificial magnetic conductor**

In this work, a novel arrangement is displayed by Elena de Cos to join a basic broadband antenna as a CPW-fed Bow-tie [1][2] with a conservative double band Artificial Magnetic Conductor (AMC) without reflector. Thus, a double band conservative minimal effort radio wire appropriate to be utilized on metallic objects is obtained. A CPW-fed bow tie antenna for operation at 5.8GHz is intended to be joined with the antenna, planning to acquire a double – band antenna and to protect the antenna from metallic objects.

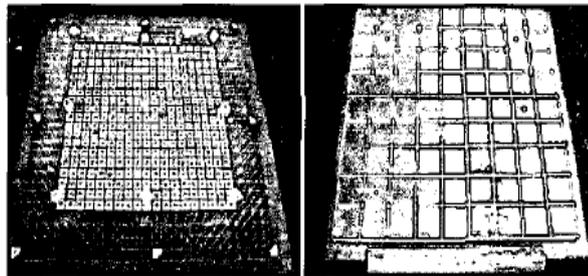
The AMC (magazine-AMC) turned into determine to paintings with a band recognition at 315 MHz and have an effect on records move confine in an I" thick shape thing. A portrayal of the AMC is appeared in Fig. I and a close-by with the aid of the appealing material geometry is seemed in Fig. 2. The distinctive idea of the game plan turned into simple to accomplish a surface wave band gap over the entire excessive-impedance repeat band of the AMC ~ depicted as the +/- 90" mirrored image sort out a band.

As portrayed similarly below, certain particular edges design bend confined adversity and reap the proper high impedance band at the same time as others are basically associated with TM floor wave cut off, and still, others basically effect the TE floor wave cut off [3,4]. The TM floor wave cut off is overseen by using the strategies for dispersing in the higher and decrease spacer layer zones. For the upper district containing the Rohacell froth, the reflectors are set at the purpose of joining of each 1/3 FSS unit cell. Regardless, within the lower quarter containing the femte tiles an on a very simple level nearer by strategies for disengaging is required via righteousness of the excessive transverse permittivity and piousness acknowledging via set at the reason of joining of each ferrite tile. Inside the closing shape, the via are scattered 9 times nearer collectively within the ferrite tile location than in the Roha cell region.

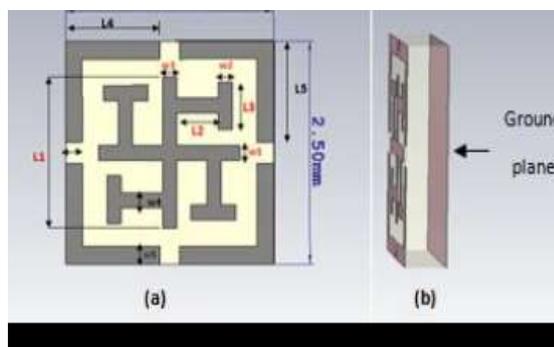
The high vulnerability of the Co2Z penurbs the attractive field sections of the TE surface wave near the capacitive FSS layer and urges imperativeness to wind up detectably bound to the surface. To check this effect, the appealing material should be past what many would consider conceivable from the FSS layer, and its common vulnerability should be restricted. This is showed up in the improvement photo and last frame photo of the Magnetic -AMC Figs. 3 and 4, separately. The AMC showed up in Fig. 4 has a shape factor of 16.2" ~16.2" ~1.3" and measures 18 lbs.



**Fig. 3. Ferrite Tile Geometry**



**Fig. 4.**Construction and Completed Photo of Magnetic AMC Ferrite Tile Geometry



**Fig. 5.**(a) AMC Top view, (b) AMC side view of the AMC.

## 7.0 Proposed design of CPW antenna structure

### A. The Simple CPW Antenna Geometry

As determined already, in this work a fundamental structure of CPW radio wire is used as a sort of reference receiving wire. The CPW is engraved on a (Rogers RO 4003C) substrate with permittivity of 3.38 and a misfortune deviation of 0.0027. The data impedance is facilitated to a 50 $\Omega$  transmission line, and the information exchange limit of activity extends from 23.8GHz to 43.5GHz.

### B. The Enhanced gain CPW Antenna

To achieve a higher gain and better directivity of the radiation execution of the accepting wire, the proposed AMC is used as a reflector under the CPW are appeared in Fig6. The division between the base of the receiving antenna and the most noteworthy purpose of the reflector AMC structure is 3mm. AMC reflectors with different estimations were attempted, and the best results were gotten by using the one with 40 x 20 mm<sup>2</sup>. The Figure 7 demonstrates the structure of the receiving antenna with the AMC structure. The propelled estimations of the CPW antenna are recorded in Table I.

## 8.0 Proposed antenna design

### A. Proposed AMC design

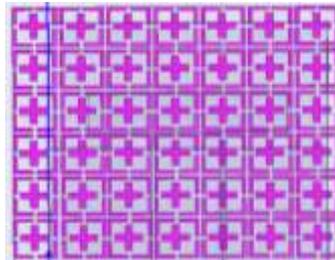


Fig. 6. AMC Design

### B. Proposed CPW antenna with AMC

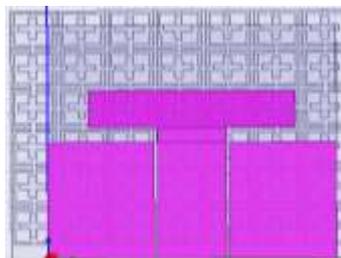


Fig. 7. CPW Antenna with AMC

## 9.0 Results

The first band is obtained at 25.2 GHz to 28.2GHz and the second wideband is 30.5 GHz to 50 GHz. Hence this antenna can be used for K, Ka, Q& U band of microwave applications. It provides a gain of 2.9dBi.as shown in Fig 8a.Thus the other results obtained from the Proposed AMC Loaded CPW Fed Wide Band Antenna are illustrated in Fig 8b, Fig8c and 8d.

### Gain



Fig 8(a) Gain

Return loss

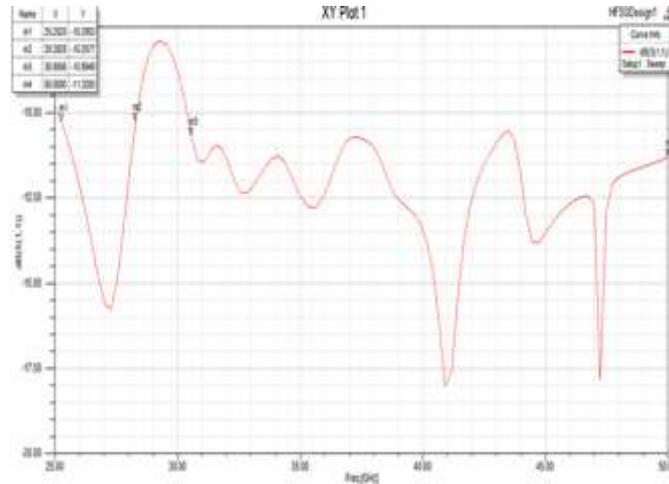


Fig 8(b) Return Loss

Directivity



Fig 8(c) Directivity

Radiation pattern

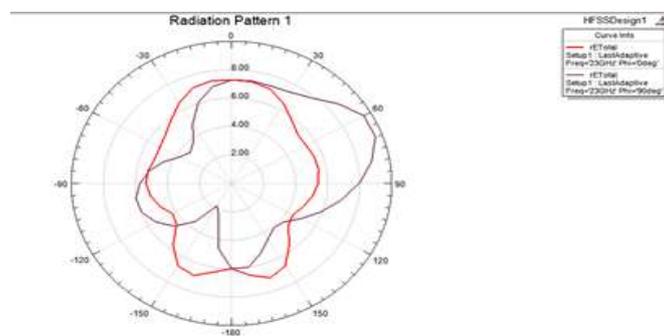


Fig 8(d) Radiation Pattern

**Table 1 : Comparisons of Various Wide Band width Antennas**

Reference	Antenna Type	CPW	Operating Frequency	Bandwidth	Gain
Ref[1]	Chip Package Antenna	No	311.6 – 315.5 GHz	3.9 GHz	4 dB
Ref [2]	AMC Loaded Planar Antenna	Yes	1.77 – 1.93 GHz	0.21 GHz	3.2 dB
Ref [3]	Fractal Antenna	Yes	1.9 – 2.48 GHz	0.58 GHz	-
Ref[4]	Dual Band AMC	Yes	5.8 GHz , 8.3 GHz	Narrow Bandwidth	2.48 dB 3.57 dB
Ref[5]	Monopole Antenna	Yes	3.16 – 6.0 GHz	2.48 GHz	6.0 dBi
Ref[6]	AMC	Yes	24.3 – 41.4 GHz	17.1 GHz	4 dB
Ref[7]	Fractal	Yes	5.8 GHz	Narrow Bandwidth	1.43 dB
This work	AMC with CPW fed	Yes	25.8 GHz – 33.3 GHz and 37.4 GHz – 42.7 GHz	20 GHz , 25 GHz	2.9 dBi

## 10. Conclusion

This paper showed the essential part of the AMC reflector for enhancing the pickup and directivity of CPW radio wire. A basic coplanar receiving wire has been incorporated with the novel AMC reflector. By incorporating CPW antenna with AMC, the deliberate information demonstrates that all the AMC surfaces go about as great ground planes for a position of low profile antenna, yet the transmission capacity and pickup the structure like star, circle, and bloom and so on are more extensive and bigger, separately, than those of alternate structures.

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