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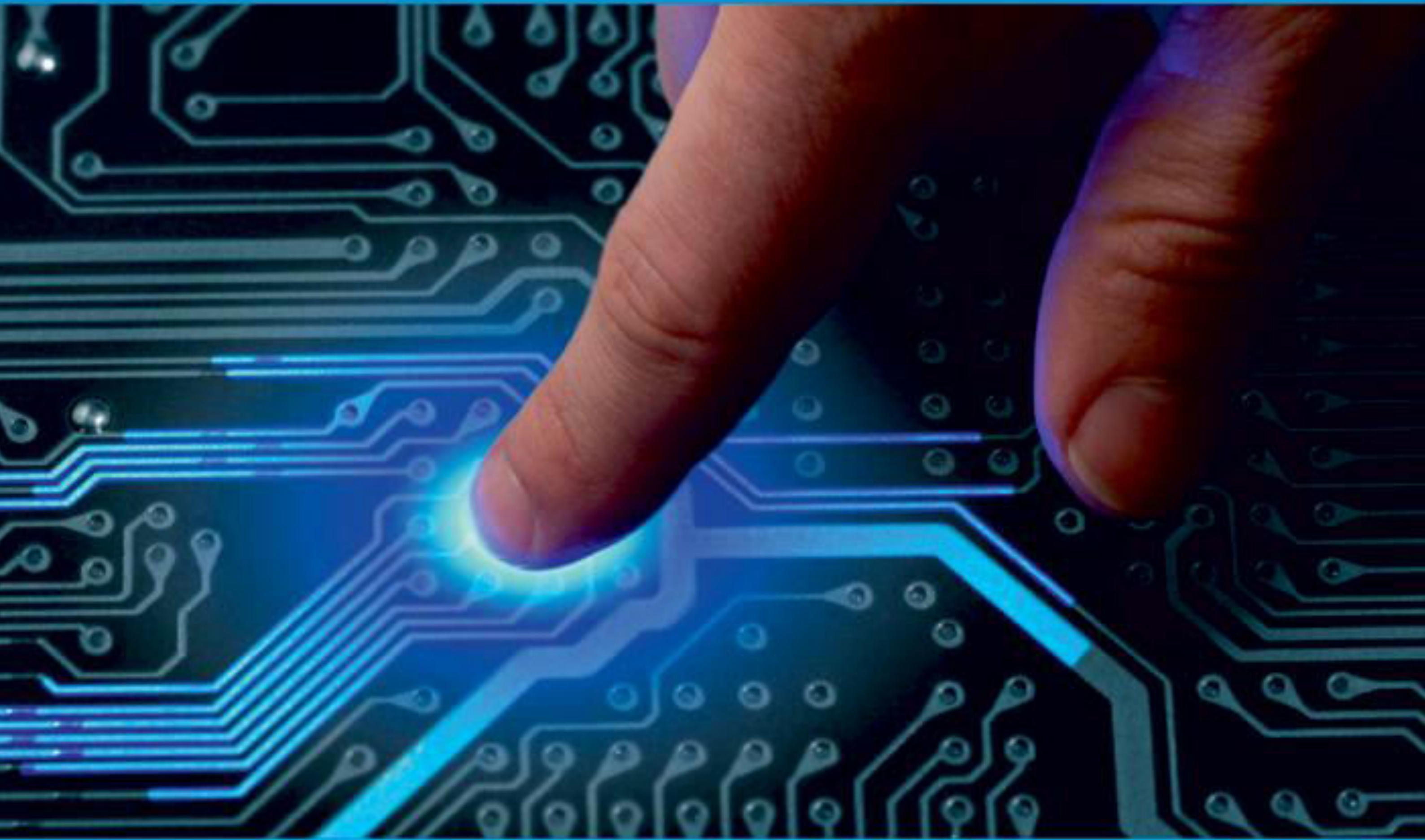

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Design and Analysis of L Band Microstrip Patch Antenna for Global Navigation Satellite System

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ABSTRACT: In the recent year's antenna configuration shows up as a develop field of research. It truly isn't the reality on the grounds that as the innovation develops with new thoughts, fitting desires in the antenna configuration are continually coming up. In this paper L-band patch antenna stacked with scores and cut has been structured and mimicked utilizing CST studio device. Single frequency band operation is gotten from the proposed microstrip antenna. The structure was done utilizing air as the substrate and copper as antenna material. The planned antennas reverberate at 1.567GHz with return loss over - 12dB and VSWR 1.66. Such planned band is utilized in the satellite application for Global Navigation Satellite System (GNSS), non-geostationary circle (NGSO) and settled satellite administrations (FSS) suppliers to work in different fragments of the L-band.

KEYWORDS: L-Band, CST, GNSS, VSWR, Return loss.

I. INTRODUCTION

GNSS (Global Navigation Satellite System) is a satellite system that is utilized to pinpoint the geographic area of a client's beneficiary anyplace on the planet. Two GNSS systems are as of now in operation: the Assembled States' Global Situating System (GPS) and the Russian Federation's Global Circling Navigation Satellite System (GLONASS). An assortment of types of antenna can be utilized for transmitting to and accepting from satellites. The most widely recognized sort of satellite antenna is the allegorical reflector, anyway this isn't the main kind of antenna that can be utilized. The real sort of antenna will rely on what the general application and the necessities. The separations over which signals travel to a few satellites is extensive. Geostationary ones are a specific case. This implies way losses are high and as needs be flag levels are low. Notwithstanding this the power levels that can be transmitted by satellites are constrained by the way that all the power has be produced from sunlight based boards. Therefore the antennas that are utilized are frequently high increase directional assortments. The microstrip patch antenna is a standout amongst the most mainstream.

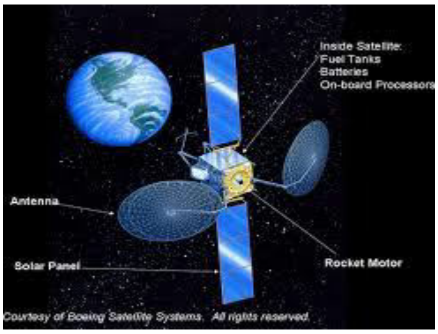

Figure 1: Antenna for satellite communication

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A. Satellite Frequency Bands

Because of lower frequencies, L-Band is most effortless to execute for marine satellite settled systems. There isn't much L-Band bandwidth accessible. The higher you go in frequency, the more bandwidth is accessible, yet the hardware should be progressively complex.

L C Ku Ka

On the off chance that one could liken the expense and accessibility of L-Band space section to state, city land, C-Band may be suburbia, Ku band the wide open, and Ka-Band the prairies of the Wild West. Possibly somewhat harder to get to, yet a great deal of it accessible at a sensible cost.

L-Band (1-2 GHz) | C-Band (4-8 GHz) | Ku-Band (12-18 GHz) | Ka-Band (26.5-40 GHz)|

L-Band (1-2 GHz)

Being a generally low frequency, L-band is less demanding to process, requiring less complex and more affordable RF hardware, and because of a more extensive bar width, the pointing precision of the antenna does not need to be as exact as the higher bands.

Just a little part (1.3-1.7GHz) of L-Band is allotted to satellite interchanges on Inmarsat. Inmarsat utilizes L-band for their Armada Broadband, Inmarsat-B and C. The more seasoned Inmarsat An and B antennas were commonly 1 meter in distance across, be that as it may, with the dispatch of all the more incredible satellites and the utilization of steerable spot shafts, the new Armada broadband antennas are down to under 30cm (12 inches).

L-Band is likewise utilized for low earth circle satellites, military satellites, and earthbound remote associations like GSM cell phones. It is likewise utilized as a moderate frequency for satellite television where the Ku or Ka band signals are down-changed over to L-Band at the antenna LNB, to make it less demanding to transport from the antenna to the beneath deck, or indoor gear.

B. Utilization of L and S Band

L band - Global Situating System (GPS) transporters and furthermore satellite cell phones, for example, Iridium; Inmarsat giving interchanges adrift, land and air; World Space satellite radio.

S-band (2– 4 GHz)- Climate radar, surface ship radar, and a few correspondences satellites, particularly those of NASA for correspondence with ISS and Space Transport. In May 2009, Inmarsat and Solaris versatile (a joint endeavor among Eutelsat and Astra) were granted each a 2×15 MHz segment of the S-band by the European Commission.

II. RELATED WORK

C. Sun, Z. Wu and B. Bai [1] he bandwidth of antenna will diminish with the decline of antenna size and this component confines the structure of reduced Global Navigation Satellite System (GNSS) patch antenna (1.1-1.6 GHz). In this correspondence, a novel wideband method dependent on the mode examination on the shorting load patch antenna is proposed. By altering the position and the span of the shorting load structure, the overwhelming resounding method of patch antenna(TM 10) is separated into two optional modes and these two modes are consolidated together to shape a wide working band. It is demonstrated this new technique has preferable bandwidth upgrade impact over the customary strategies. By using this proposed strategy, a reduced circularly polarization wideband patch antenna is intended for GNSS application, which has a little electrical size of just $0.2\lambda_0 \times 0.2\lambda_0 \times 0.05\lambda_0$.(λ_0 is the wavelength of low band in free space.) The reproduced and estimated results demonstrate that the proposed antenna has great and stable execution over the entire working band, which implies that it is a significant perfect minimized antenna utilized for GNSS satellite navigation applications.

A. S. W. Ghattas and E. E. M. Khaled [2] A closeness feed ultra-wide band (UWB) patch antennas with a reduced size (millimeters measure) for Ku/K band applications is exhibited. Surrendered ground structure (DGS) strategy is utilized to extend the bandwidth of the antenna. The proposed antenna presents UWB execution in the frequency scope of 16 GHz to 29 GHz with a reduced size of 7×10 mm ^{2} , which is appropriate for some applications. The examination and structure of the proposed antenna are researched with the monetarily accessible programming CST microwave studio (MWS) test system. The proposed plan is manufactured and tried. The deliberate information of the created antenna shows a decent concurrence with the reproduced outcomes. The proposed antenna indicates omnidirectional radiation design with a normal gain of 3.5 dBi and great radiation proficiency over the working band.

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K. K. Thus, K. M. Luk and C. H. Chan [3] Patch antennas are broadly connected in present day remote correspondence systems. Be that as it may, traditional patch antennas have the inconvenience of limited bandwidth and are not appropriate for Ku-band satellite communicate gathering. Numerous specialists have proposed different systems to upgrade the bandwidth of test sustained patch antennas, e.g., utilizing thick substrate, including parasitic patches either in a similar layer (coplanar) or in another layer (stacked) , and utilizing capacitor-stacked patches. With the principal strategy, the substrate thickness increments and incites the excitation of surface waves. Aside from diminishing the radiation effectiveness, these surface waves diffract at the substrate edges and crumble the radiation designs. The nearness of coplanar and stacked geometry has the disservice of expanding the zone and thickness of the antenna, individually. Extra capacitors cause antenna gain decrease on account of the ohmic loss of the stacking chip resistor.

H. Al-Saedi, W. M. Abdel-Wahab [4] This letter introduces the plan of a wideband circularly enraptured antenna, working at Ka band. The proposed antenna includes a round microstrip patch antenna that is coupled to a microstrip feedline through an adjusted L-molded gap space. The antenna emanates a wideband right-hand circularly energized wave with high polarization virtue and a wide pivotal ratio (AR) precise beamwidth. A 4 × 4 antenna subarray has been planned, manufactured, and estimated to approve the proposed idea. The cluster displays a reflection coefficient S11 <; - 10 dB over the frequency band 27-31 GHz. In addition, the 4 × 4 antenna subarray yields an abnormal state of polarization virtue, and additionally a level estimated AR ⩽ 1.15 dB over the frequency go 27.55-30.45 GHz (10% bandwidth).

L. Wang, Z. Weng, Y. Jiao, W. Zhang [5] A position of safety broadband circularly enraptured (CP) microstrip antenna with a wide beamwidth is proposed for a global navigation satellite system. Four paw formed parasitic branches are put on the sides of the ground to broaden the impedance bandwidth (IBW) and half-control beamwidth (HPBW) at the same time. A few openings are carved on the radiation patch to get impedance coordinating. The proposed antenna is created and estimated. The test results demonstrate that the IBW for VSWR ⩽ 2 is 72.5% from 1.02 to 2.18 GHz, and the 3 dB hub ratio bandwidth is 54% from 1.15 to 2 GHz. The HPBW is past 100° by and large CP bandwidth. Its measurements are 70 mm × 70 mm × 12 mm, (0.35 × 0.35 × 0.06) λ 0 3 , where λ 0 is the wavelength of the middle frequency.

III. PROPOSED DESIGN AND SIMULATION RESULTS

Microstrip antenna comprise of a thin (h<<λ0, where λ0 is the free-space wavelength and f0 is the working frequency) metallic strip (patch) set on a little division of a wavelength over a ground plane. The microstrip patch is planned so its example most extreme is typical to the patch (broadside radiator).

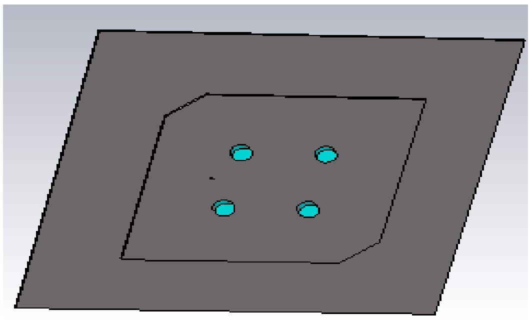

Figure 2: Top view of Proposed antenna

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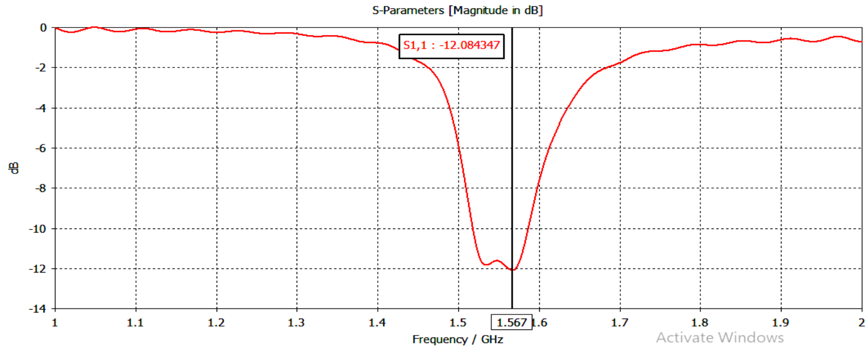

Figure 3: S 11 calculation

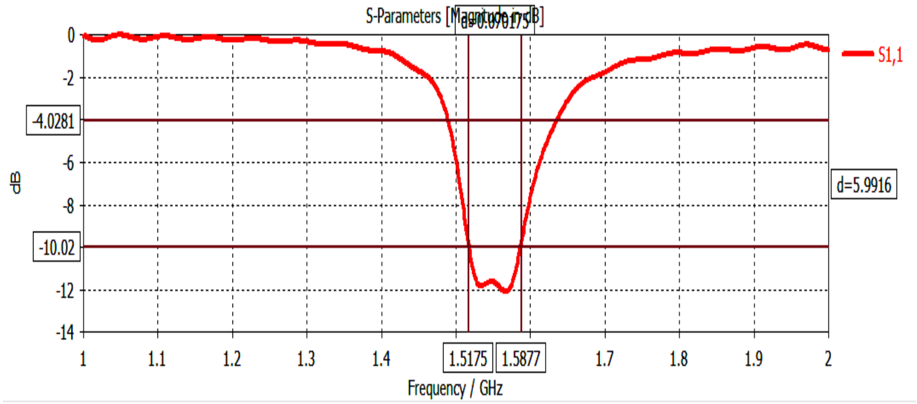

Figure 4: Bandwidth

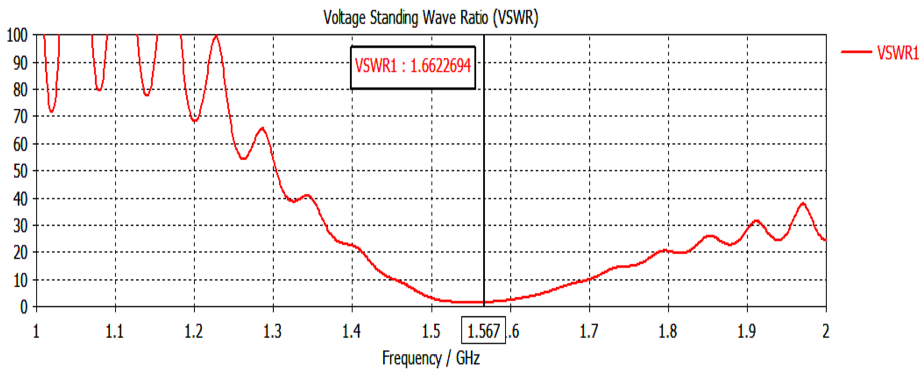

Figure 5: VSWR of proposed antenna

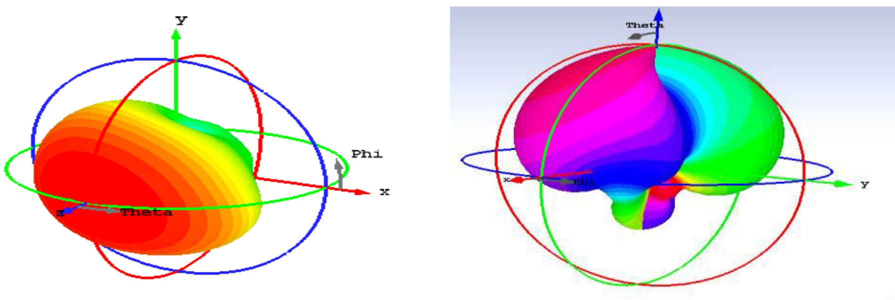

Figure 6: SAR calculation of antenna field

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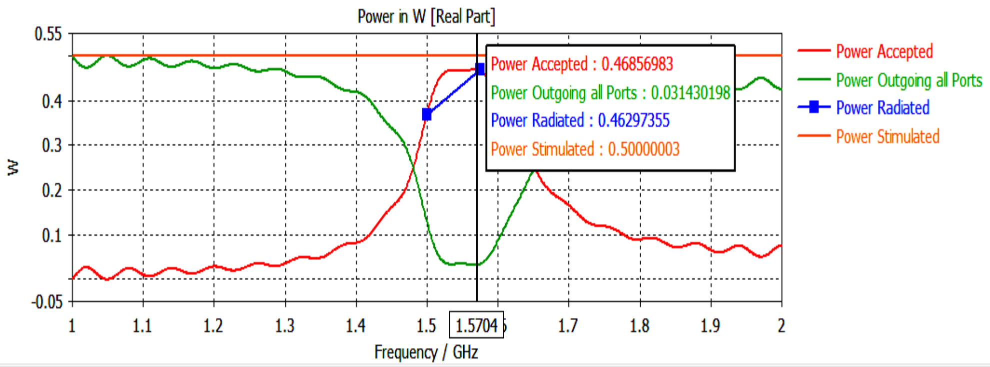

Figure 7: Power calculation of proposed antenna

Table 1: Design parameters

Frequency(f_r)	1.7 GHz
Dielectric constant(ε_r)	4.4 /Air
Substrate Height(h)	1.6 mm
Line Impedance	50 Ω
Ground Plane	140 x 180 mm^2
Tangent Loss	0.06

Table 2: Comparison of proposed design results with previous results

Parameter	Previous work [1]	Proposed Work
Bandwidth	25MHz	70.2MHz
Return Loss	-11db	-12.08db
Resonant Frequency	1.35GHz	1.567GHz
VSWR	>1	1.662
No of Band	Single	Single
Application	GNSS	GNSS

IV. CONCLUSION

In this work, we proposed a changed single frequency microstrip antenna which works productively in satellite correspondence. As aftereffects of proposed antenna was reproduced with fitting parameters for better working antenna. The cutting of rectangular opening brought about wide single band microstrip antenna for GNSS applications. The last outcomes fulfill every one of the parameters of an effective antenna. The structured antenna works productively under all conditions with great return loss and appropriate impedance coordinating. Frequency extend from 1-7 GHz utilized in remote correspondence can be accomplished by utilizing planned antenna. Further streamlining should likewise be possible with various dielectric substrates and in addition on geometry.

REFERENCES

1. C. Sun, Z. Wu and B. Bai, "A Novel Compact Wideband Patch Antenna for GNSS Application," in IEEE Transactions on Antennas and Propagation, vol. 65, no. 12, pp. 7334-7339, Dec. 2017.
2. S. W. Ghattas and E. E. M. Khaled, "A compact ultra-wide band microstrip patch antenna designed for Ku/K bands applications," 2017 Japan-Africa Conference on Electronics, Communications and Computers (JAC-ECC), Alexandria, 2017, pp. 61-64.

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3. K. K. So, K. M. Luk and C. H. Chan, "A High-Gain Circularly Polarized U-Slot Patch Antenna Array [Antenna Designers Notebook]," in IEEE Antennas and Propagation Magazine, vol. 60, no. 5, pp. 147-153, Oct. 2018.
4. H. Al-Saedi, W. M. Abdel-Wahab, S. Gigoyan, R. Mittra and S. Safavi-Naeini, "Ka-Band Antenna With High Circular Polarization Purity and Wide AR Beamwidth," in IEEE Antennas and Wireless Propagation Letters, vol. 17, no. 9, pp. 1697-1701, Sept. 2018.
5. L. Wang, Z. Weng, Y. Jiao, W. Zhang and C. Zhang, "A Low-Profile Broadband Circularly Polarized Microstrip Antenna With Wide Beamwidth," in IEEE Antennas and Wireless Propagation Letters, vol. 17, no. 7, pp. 1213-1217, July 2018.
6. Zhang, R. Li, L. Wu, H. Sun and Y. Guo, "A Highly Integrated 3-D Printed MetallicK-Band Passive Front End as the Unit Cell in a Large Array for Satellite Communication," in IEEE Antennas and Wireless Propagation Letters, vol. 17, no. 11, pp. 2046-2050, Nov. 2018.
7. S. Kharche, G. S. Reddy, R. K. Gupta and J. Mukherjee, "Wide band circularly polarised diversity antenna for satellite and mobile communication," in IET Microwaves, Antennas & Propagation, vol. 11, no. 13, pp. 1861-1867, 20 10 2017.
8. Mao, S. Gao, Y. Wang, Q. Chu and X. Yang, "Dual-Band Circularly Polarized Shared-Aperture Array for C -/ X -Band Satellite Communications," in IEEE Transactions on Antennas and Propagation, vol. 65, no. 10, pp. 5171-5178, Oct. 2017.
9. S. Mener, R. Gillard and L. Roy, "A Dual-Band Dual-Circular-Polarization Antenna for Ka-Band Satellite Communications," in IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 274-277, 2017.
10. Z. Yang, K. C. Browning and K. F. Warnick, "High-Efficiency Stacked Shorted Annular Patch Antenna Feed for Ku-Band Satellite Communications," in IEEE Transactions on Antennas and Propagation, vol. 64, no. 6, pp. 2568-2572, June 2016.
11. K. K. So, H. Wong, K. M. Luk and C. H. Chan, "Miniaturized Circularly Polarized Patch Antenna With Low Back Radiation for GPS Satellite Communications," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 12, pp. 5934-5938, Dec. 2015.
12. P. R. Prajapati, G. G. K. Murthy, A. Patnaik and M. V. Kartikeyan, "Design and testing of a compact circularly polarised microstrip antenna with fractal defected ground structure for L-band applications," in IET Microwaves, Antennas & Propagation, vol. 9, no. 11, pp. 1179-1185, 20 8 2015.
13. H. Huang, J. Lu and P. Hsu, "A Compact Dual-Band Printed Yagi-Uda Antenna for GNSS and CMMB Applications," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 5, pp. 2342-2348, May 2015.
14. K. Ng, C. H. Chan and K. Luk, "Low-Cost Vertical Patch Antenna With Wide Axial-Ratio Beamwidth for Handheld Satellite Communications Terminals," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 4, pp. 1417-1424, April 2015.
15. K. K. Karnati, Y. Shen, M. E. Trampler, S. Ebadi, P. F. Wahid and X. Gong, "A BST-Integrated Capacitively Loaded Patch for${K_a}$- and${X}$-band Beamsteerable Reflectarray Antennas in Satellite Communications," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 4, pp. 1324-1333, April 2015.

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