Faculty of Electronics and Computer Engineering

RETURN LOSS ENHANCEMENT OF RADIAL LINE SLOT ARRAY ANTENNA USING CLOSED RING RESONATOR STRUCTURE AT 28 GHz

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A thesis submitted
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DECLARATION

I declare that this thesis entitled "Return Loss Enhancement of Radial Line Slot Array Antenna Using Closed Ring Resonator Structure At 28 GHz" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : ……………………………………………………………

Name : RABIATUL ADAWIYAH BINTI AZIAN KAMARUDDIN

Date : ……………………………………………………………

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Electronic Engineering.

Signature : ....

Supervisor Name: : DR. IMRAN BIN MOHD IBRAHIM

Date : 29 Nov 2018

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Electronic Engineering.

Signature	:	....
Supervisor Name:	:	DR. IMRAN BIN MOHD IBRAHIM
Date	:	....

DEDICATION

To my beloved mother and father, Mrs Hazizah binti Che' Ros and Mr. Azian Kamaruddin bin Talha and siblings, Muhammad Zulhilmi, Siti Darwisyah and Muhammad Uzair. This thesis is merely the reflection of your tireless support and sacrifice. I dedicate this all to you. May Allah bless you guys.

ABSTRACT

Nowadays, a wireless communication technology are moving towards fifth generation (5G) which consist all the previous generation technologies. Radial line slot array (RLSA) antenna became very popular since the weight is light and ease of installation besides the ability to carry high speed signal with high directivity characteristic and the potential of beam steering and beam shaping. Furthermore, this RLSA antenna can perform three polarizations such as linear, elliptical and circular. The aim of this project is to design, simulate and fabricate the new closed ring resonator (CRR) structure which operating at 28 GHz frequency. The objectives of this research are to study different characteristic of FR4 and RT Duroid 5880 materials and enhanced the return loss (RL), S_{11} of the hybrid RLSA antenna air gap with RT Duroid 5880 performances at 28 GHz by introducing the CRR structure. Besides, to study the performance of hybrid air gap with RT Duroid 5880 RLSA antennas with and without the presence of a layer of the superstrate CRR structure. Those designs were simulated and assist by Computer Simulation Technology (CST) Microwave Studio Software and tested with the network analyzer. The result for a gap λ / 4 of hybrid air gap with RT Duroid 5880 with a layer of the superstrate of cicumference CRR structure at 28 GHz had 19.430 dBi of gain and -15.044 dB reflection coefficient. The gap value of a layer superstrate had been increased to λ / 2 and the reflection coefficient improved to -17.191 dB with gain increased to 20.020 dBi. The hybrid air gap with RT Duroid 5880 RLSA at λ / 2 shows a good for 5G point to point communication system.

ABSTRAK

Pada masa kini, teknologi komunikasi tanpa wayar menuju kearah 5G yang merangkumi kesemua teknologi generasi terdahulu. Antena RLSA telah menjadi sangat popular kerana ringan dan memudahkan pemasangan. Selain mempunyai keupayaan untuk membawa isyarat berkelajuan tinggi pada pemboleh laras yang tinggi serta mengubah bentuk lebar alur dan arah radiasi. Tambahan pula, antenna RLSA ini boleh melakukan tiga polarisasi seperti melurus, membujur dan membulat. Projek ini dilakukan bertujuan untuk mereka bentuk, mensimulasi dan membina struktur pengayun lingkaran tertutup (CRR) yang boleh dikendalikan pada frekuensi 28 GHz. Objektif projek ini adalah bertujuan untuk mengkaji ciri-ciri yang berbeza pada bahan FR4 and RT Duroid 5880 serta meningkatkan kehilangan balikan (RL), S_{11} untuk mengkaji prestasi jurang udara hibrid dengan ruas RT Duroid 5880 antena RLSA pada 28 GHz dengan kehadiran struktur CRR. Selain itu, bertujuan untuk mengkaji prestasi jurang udara hibrid dengan antenna RLSA sama ada menggunakan atau tidak menggunakan lapisan super-substratum struktur CRR. Reka bentuk tersebut telah disimulasikan dengan menggunakan Perisian Studio Gelombang Micro Teknologi Simulasi Komputer (CST) dan diuji dengan penganalisis rangkaian. Keputusan bagi ruas $\lambda / 4$ jurang udara hibrid dengan RT Duroid 5880 antena RLSA dengan lapisan 'superstrate' lilitan struktur CRR pada 28 GHz memberikan gandaan 19.430 dBi dan permalar pembalikan -15.044 dB. Nilai jurang lapisan super-substratum telah meningkat kepada $\lambda / 2$ dan menurun kepada -17.191 dB dengan gandaan meningkat kepada 20.020 dBi. Jurang udara hibrid dengan RT Duroid 5880 antena RLSA pada ruas $\lambda / 2$ menunjukkan potensi yang baik untuk sistem komunikasi titik ke titik 5G.

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LIST OF ABBREVIATIONS

1G	-	First generation
2G	-	Second generation
3G	-	Third generation
4G	-	Fourth generation
5G	-	Fifth generation
3D	-	Three dimensional
2D	-	Two dimensional
IoT	-	Internet of things
BD	-	Big data
RLSA	-	Radial line slot array
FR4	-	Flame retardant
CRR	-	Closed ring resonator
RL	-	Return loss
RP	-	Radiation pattern
FSS	-	Frequency selective surface
LMCS	-	Local multipoint communication system
SRSP	-	Standard radio system plan
LMDS	-	Local multipoint distribution system
F	-	Fixed system

PCB	-	Printed circuit board
LTCC	-	Low temperature cofired ceramic
SIW	-	Substrate integrated waveguide
PIFA	-	Planar inverted F antenna
CPW	-	Coplanar waveguide
CRLH	-	Composite right/left handed
DD	-	Dense dielectric
EBG	-	Electromagnetic band gap
RCA	-	Resonant cavity antenna
PRS	-	Partially reflective surface
FBR	-	Fabry perot resonator
PMC	-	Perfect magnetic conductor
PEC	-	Perfect electric conductor
EM	-	Electromagnetic
FP	-	Fabry perot
LAN	-	Local area network
WLAN	-	Wireless local area network
CP	-	Circular polarization
AUT	-	Antenna under test
NF	-	Near field
PWS	-	Plane wave spectrum
DFT	-	Discrete fourier transform
FFT	-	Fourier transforms
G-P	-	Gerchberg-Papoulis

OAM	-	Orbital angular momentum
DSN	-	Deep space network
SRR	-	Split ring resonator
ELC	-	Electric field couple
ERR	-	Electric ring resonator
MTM	-	Metamaterial
RF	-	Radio frequency
EC-SRR	-	Edge couple-split ring resonator
BC-SRR	-	Broadside couple-split ring resonator
NC-SRR	-	Nonbianistropic couple –split ring resonator
T(ω)	-	Transmittance
R(ω)	-	Reflectance
A(ω)	-	Absorbance
LP RLSA	-	Linear polarization radial line slot array
HIS	-	High imedance surface
VNA	-	Visual basic application
UV	-	Ultraviolet
NaOH	-	Sodium hydroxide
SMA	-	SubMiniature version A connector
CST	-	Computer simulation technology
HFSS	-	High frequency electromagnetic field simulation

LIST OF PUBLICATIONS

R.A.A.Kamaruddin, I.M.Ibrahim, M.A.A.Rahim, Z.Zakaria, N.A.Shairi and T.A.Rahman, 2017. Radial line slot array (RLSA) antenna design at 28 GHz using Air Gap Cavity Structure. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 9(2-8), pp.133-136.

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