BlueWaveTel's Products and Technologies

BlueWaveTel
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- R&D Key Members
- Patents
- Customers
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BlueWaveTel's Mission

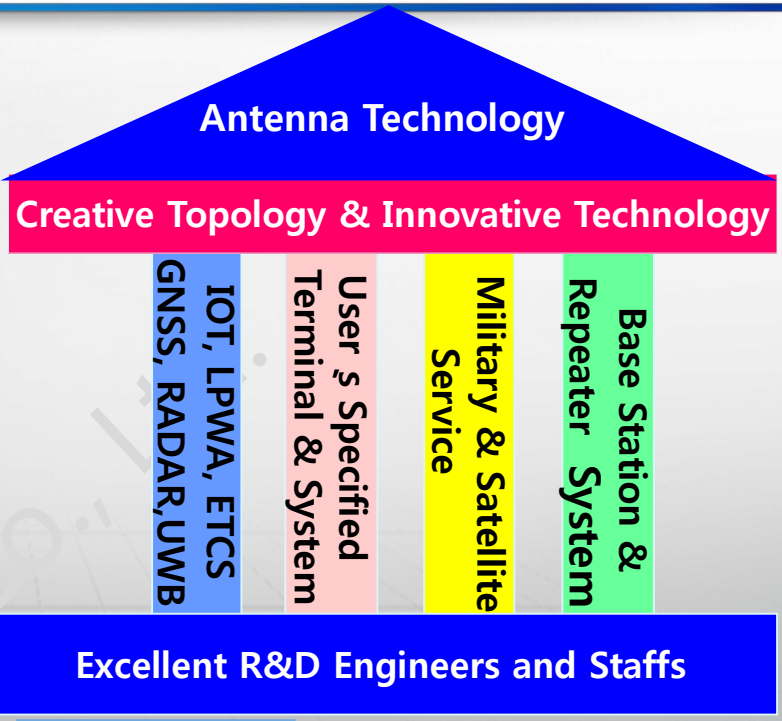
BWT BlueWaveTel Co., Ltd.

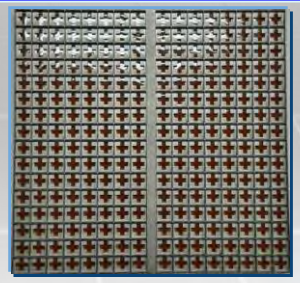
- Blue : Blue Ocean & Blue Chip
  Hopeful Expectation
- Wave : Wireless Components
- Tel : Telecommunication Service

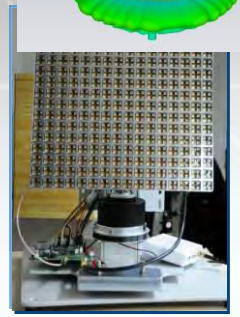
BlueWaveTel's Mission

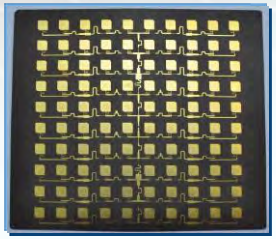
Provide competitiveness in industry-leading wireless system technologies and services through cutting edge antenna technology.

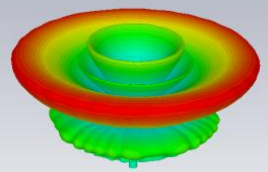
Paradigm Shift by IOT System on the Chip(SOC) System in the Antenna(SIA)

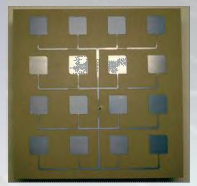












BlueWaveTel's Business Field

Business Field

- Customized Antenna Module
- Beam Forming/Shaping Antenna Technology
- Array Antennas for 5G Repeater and BS
- Advanced Antenna Technologies for IOT, WiFi, LPWA, ETCS, GNSS, UWB
- Flat Plate Array Antenna for Satellite Service & RADAR System,
- Broadcast Reception Antenna
- Multi-Band/Wide Band Antenna

Head Office & R&D Center : in Daejeon City

Assembly Line in : Gumi City

Strength

- Innovative Technology
- Performance Quality
- Cost

Certificates

◆ 10 Patents in recent 3 Years

◆ ISO 9001 and ISO 14001 since 2005

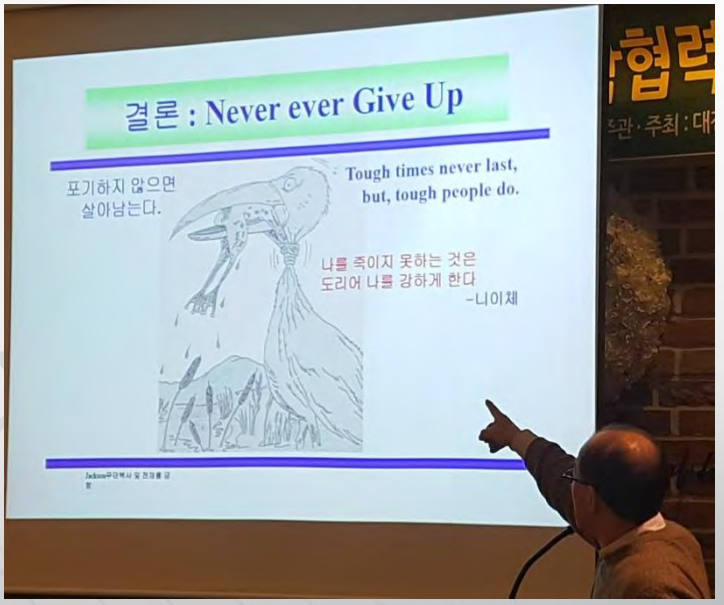
◆ Company R&D Center

◆ More than 15 Papers in recent 3 years

BlueWaveTel is a Social Enterprise

◆ Providing Internship for University Students

- Theory, Design, Fabrication, and Measurement of a patch antenna



◆ International Cooperations for Developing Countries

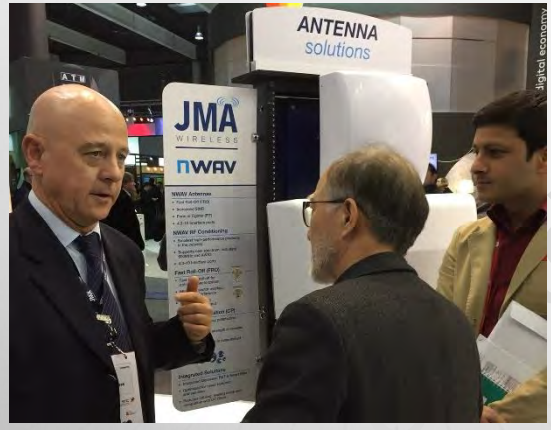
- We can provide our advanced antenna technologies for future wireless world.

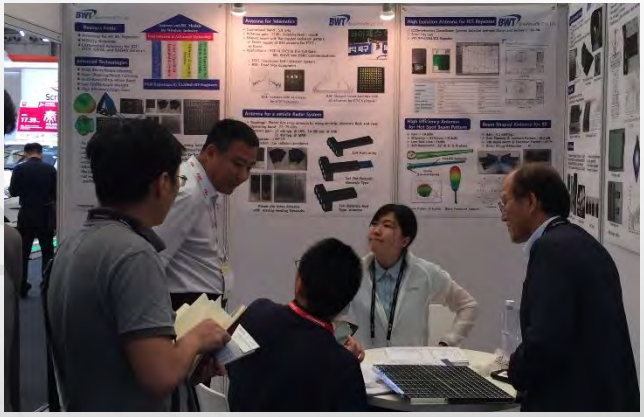
- Special Lecture : How to survive in this field.

BlueWaveTel's Trials for Global Market

International ICT Exhibitions

- MWC Booth Exhibition in Spain Barcelona, 2016, 2017, and 2018
- MWC Booth Exhibition in China Shanghai(2017) and in USA LA(2018)

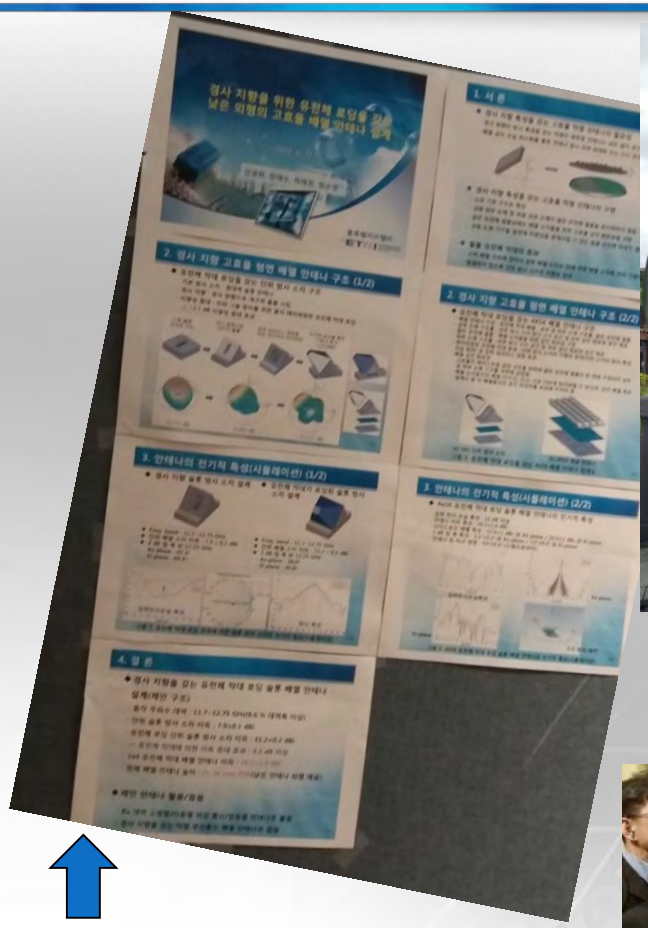




- 2016 AIRTEC Booth Exhibition
(German Munich, 10. 25 ~ 27, 2016)

- 2018 ISE Booth Exhibition
(Holland Amsterdam, Feb.,6 ~ 9, 2018)

Motivations for the staffs



More than 15 papers and 10 patents in recent 3 years

BWT'S Workshop in Jeju Island('15~'17)

International Exhibition with BWT's staffs('15~'18)

BlueWaveTel's Key Members

Name	Major (Degree)	Fields	Remarks
J.K. Ha	Electronics(Ph.D.)	Antenna and System Engineering in BWT for 17 years Telecommunication and antenna in ETRI for 18 years	CEO
G.L. Park	Physics(Ph.D.)	System Engineering in IT Company for 17 years Telecommunication and Semiconductor in ETRI for 13 years	CTO
Y. W. Koo	Electronics	LIG Nex1 for 25 years IT System and Marketing Engineer 8 Years	Senior Managing Director
I.Y. Chung	Computer	QC in BWT/IT Companies for 29 years	Managing Director
J.S. Jang	Electronics (Ph.D. Course)	Antenna/Microwave Circuits Development for 12 years	PE
M. Sazard Ahmad	Electronics(Ph.D.)	Antenna/Microwave Circuits Development for 3 years	SE
N.H. Jo	Electronics	Digital and Analog Circuits Design for 8 years	SE
N.H. Kang	Electronics (MS Course)	Antenna/Microwave Circuits Development for 6 years	SE
J.N. Choi	Electronics	S/W and Firmware Development for 3 years	E
H.H. Kim	Microwave (MS Course)	Microwave Circuits in BWT	E

BlueWaveTel's Papers

Organizer	Title	Year
KIEE	E-band 4x4 Butler matrix circuit design	KIEE Summer General Conference 2017. 8. 24~26
KIEE	Multi beam antenna design using E-band 4x4 Butler matrix	KIEE Summer General Conference 2017. 8. 24~26
KIEE	E-band high gain multi-beam lens antenna design	KIEE Summer General Conference 2017. 8. 24~26
KIEE	Ku-band Transmit/Receive high gain array antenna design	KIEE Summer General Conference 2017. 8. 24~26
KIEE	Multi-Beam Array antenna for 78GHz Automotive Applications	KIEE Summer General Conference 2017. 8. 24~26
KIEE	Design of Dielectric Bar Array Antenna for 78GHz Band LRR	KIEE Summer General Conference Vol. 4, No. 1 2016. 6. 16~18
KIEE	Design of cross slot antenna for ku-band satellite communication	KIEE Summer General Conference Vol. 4, No. 1 2016. 6. 16~18
KIEE	HIGH EFFICIENT PLANAR ARRAY ANTENNA WITH PROTRUSION DIELE CTRIC LOADING STRUCTURE FOR TILTED BEAM DIRECTION	KIEE Summer General Conference Vol. 4, No. 1 2016. 6. 16~18
KIEE	Design and manufacture of intrusion detection radar system using microwave	KIEE Summer General Conference Vol. 4, No. 1 2016. 6. 16~18
KIEE	Study on High Efficiency High-gain Antenna by Low-speed Parasitic Elements Arra y	KIEE Summer General Conference 2015.8.19-22
KIEE	Beamforming characteristics of omni-directional antennas	KIEE Summer General Conference 2015.8.19-22
KIEE	Study of azimuth beam forming characteristics of omni-directional excitation device	KIEE Summer General Conference 2015.8.19-22
KIEE	Design of 24GHz band multi-beam antenna	KIEE Summer General Conference 2015.8.19-22
KIEE	Dual-fed Small Repeater Antenna with High Isolation	2012.06. KIEE Journal 23(6)
2013 APMC Conference	Planar Array Antenna Design with Beam Shaping for ETCS-RSE	2013.11.05~11.08

BlueWaveTel's Patents

Year	Title	Number	Type
(2017.9.26)	Wireless Communication Antenna	30-2017-0045369	Design application
(2017.9.7)	A Wideband Planar Modified Bow Tie Antenna For UHDTV/DTV, And a Picture Frame Embedding thereof	10-2017-0114765	Patent application
2017.09.21. (2016.02.03)	HIGH-EFFICIENT RF TRANSMISSION LINE STRUCTURE AND ITS TRX ARRAY ANTENNA WITH DUAL ORTHOGONAL DUAL POLARIZATION USING THE STRUCTURE	10-2016-0013249 10-1784501-00-00	Patent registration
2017.04.06. (2016.02.03)	HIGH EFFICIENT PLANAR ARRAY ANTENNA WITH PROTRUSION DIELECTRIC LOADING STRUCTURE FOR TILTED BEAM DIRECTION	10-2016-0013213 10-1739889-00-00	Patent registration
2016.07.08. (2015.11.04)	BEAM SHAPING ANTENNA EQUIPMENT WITH OMNDIRECTIONAL RADIATOR	10-2015-0154391 10-1639601-00-00	Patent registration
2016.09.29. (2015.02.25)	RF TRANSMISSION LINE ARRAY ANTENNA	10-2015-0026290 10-1663139-00-00	Patent registration
2016.11.01. (2015.01.06)	MICROSTRIP PATCH ARRAY RADAR ANTENNA FOR HEAVY EQUIPMENT VEHICLE	10-2015-0001008 10-1673200-00-00	Patent registration
2015.05.07. (2013.08.30)	MICROSTRIP PATCH ARRAY ANTENNA WITH FLAT-TOP AND LOW SIDE LOBE BEAM PATTERN	10-1519875 10-2013-0103673	Patent registration
2013.12.16. (2012.11.22)	ANTENNA DESIGN SYSTEM BY USING FOOTPRINT SIMULATION	10-1343991 10-2012-0132712	Patent registration
2013.10.10. (2012.06.11)	DUAL-BAND ANTENNA FOR WIRELESS REPEATER WITH HIGH ISOLATION	10-1318660 10-2012-0062171	Patent registration
2010.05.06. (2007.12.03)	Broadband stack patch array antenna for wireless repeater with high isolation	10-0957852 10-2007-0124154	Patent registration

BlueWaveTel's Customers

- Electronic Toll Collection
- Installed in Every & each " hi-pass " Toll Gate
- Precision and Accuracy with Very Low Side Lobe Pattern

- Interference Cancellation Repeater System
- High Isolation (-70dB)
- Multiple Bands
- Over 220K units deployed since 2012

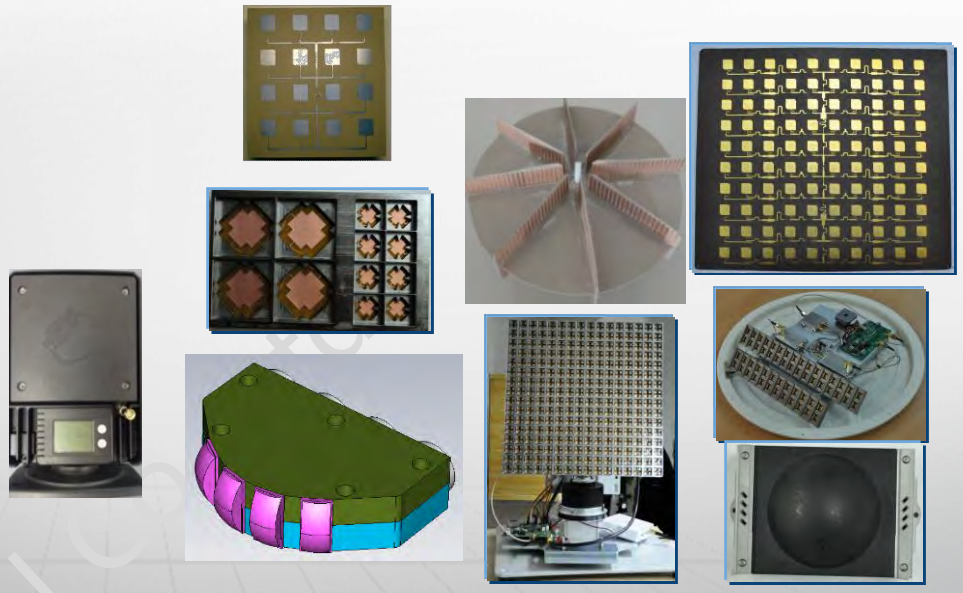
Products and Technologies

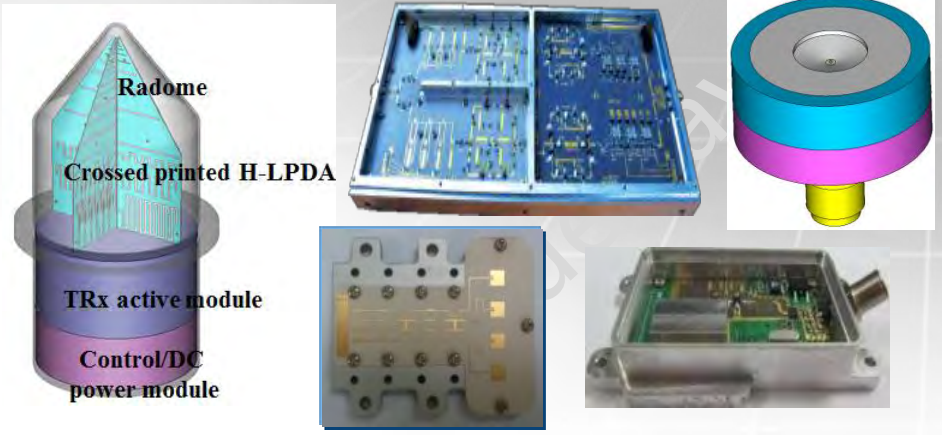
1. Antennas for Mobile communications(4G LTE, 5G)

2. Multi-beams & beam-shaping antennas

3. Military Antennas

4. Antennas for Satellite communications & DBS reception





5. Vehicle Application Antennas

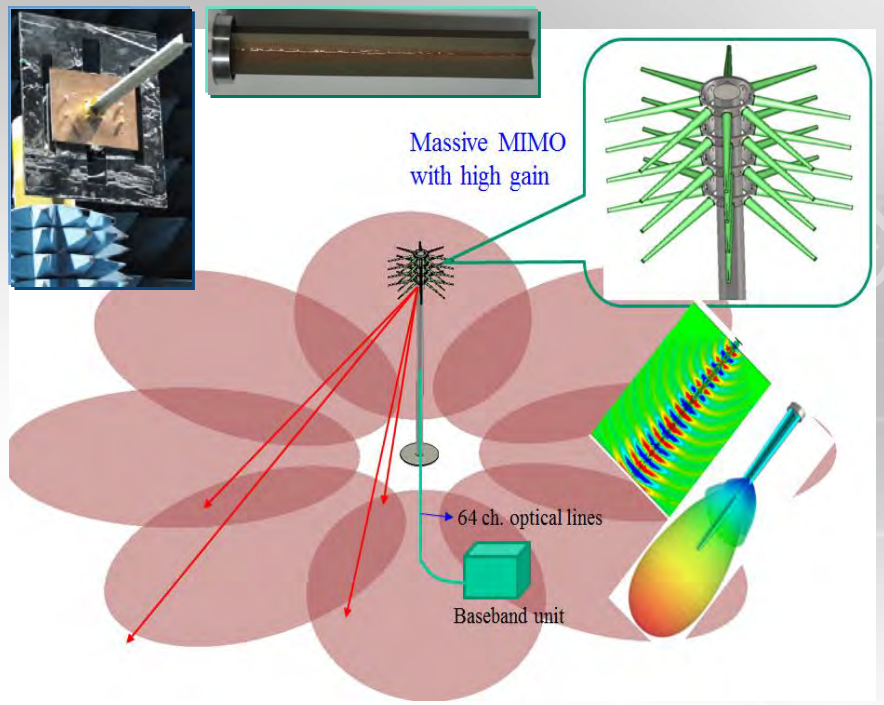
6. Various customized antennas

7. Active RF modules

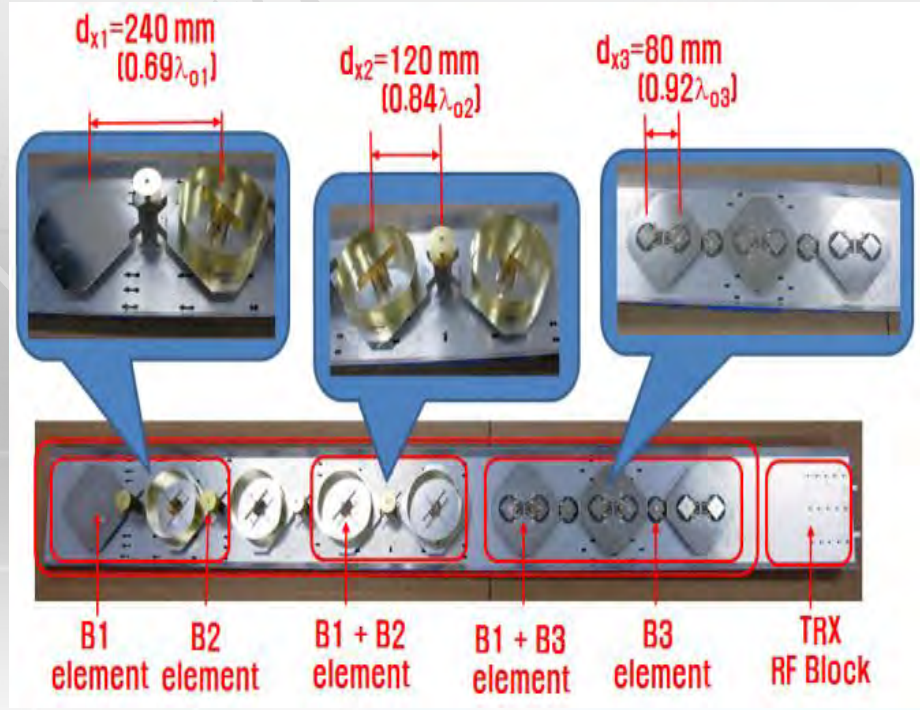
Antennas for Future Mobile Networks

- **Massive MIMO array using HE_HD CDP**
  - Compact massive MIMO structure for high data rate(64 CH./3.5GHz)
  - Multi-sector operation(> 8-sector)
  - High gain(>18 dBi)/High efficiency(>90%)

- **Multi-band antenna for repeater & BS**
  - Operating bands of 860MHz/2GHz/3.5GHz
  - Independent array spacing between elements
  - 3 kinds antenna elements



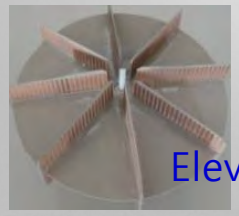
Massive MIMO Array Antenna

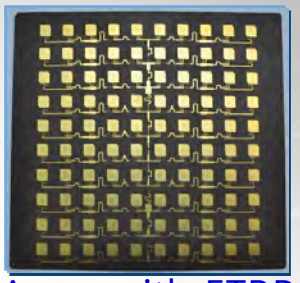


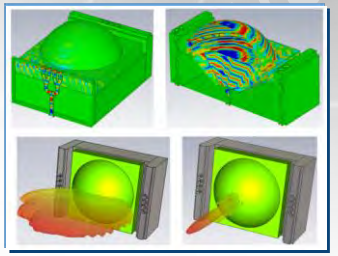
Multi-band antenna for repeater & BS

Radiator Elements/Topologies for Future 5G Service

◆ **Various beam shaping antenna**
- Beam shaping at azimuth or elevation plane using SWS(5 GHz)
- Beam shaping using tapered aperture distribution
- Beam shaping using dielectric lens

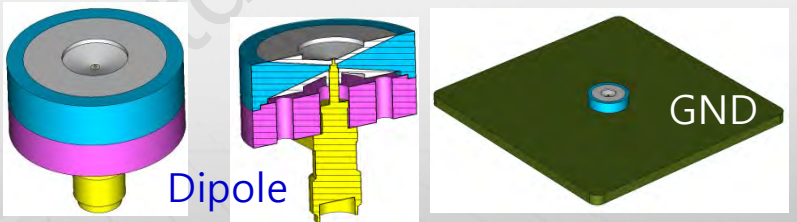


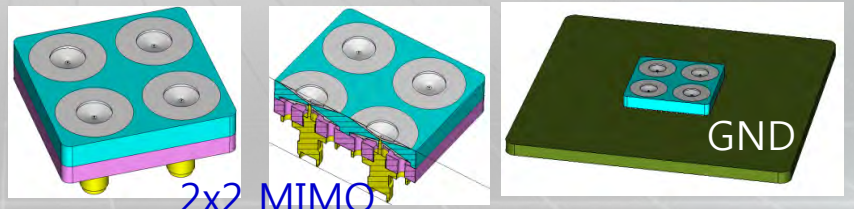


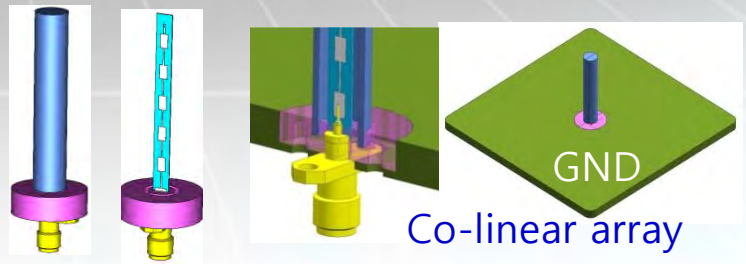


Various beam shaping antenna

◆ **28 GHz various antennas for 5G**
- Dipole antenna embedded into dielectric material
- 2x2 MIMO antenna embedded into dielectric material
- Co-linear array antenna for high gain

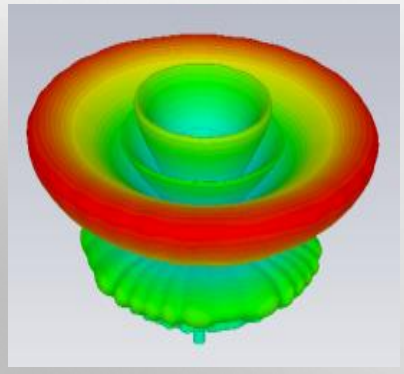




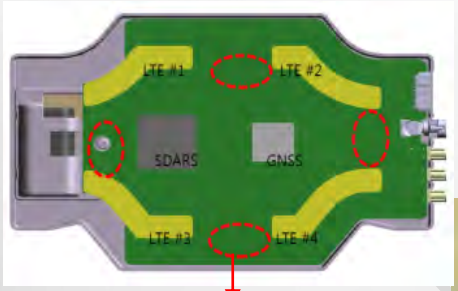


28 GHz various antennas for 5G

28GHz Antenna for V2X



Dipole Element



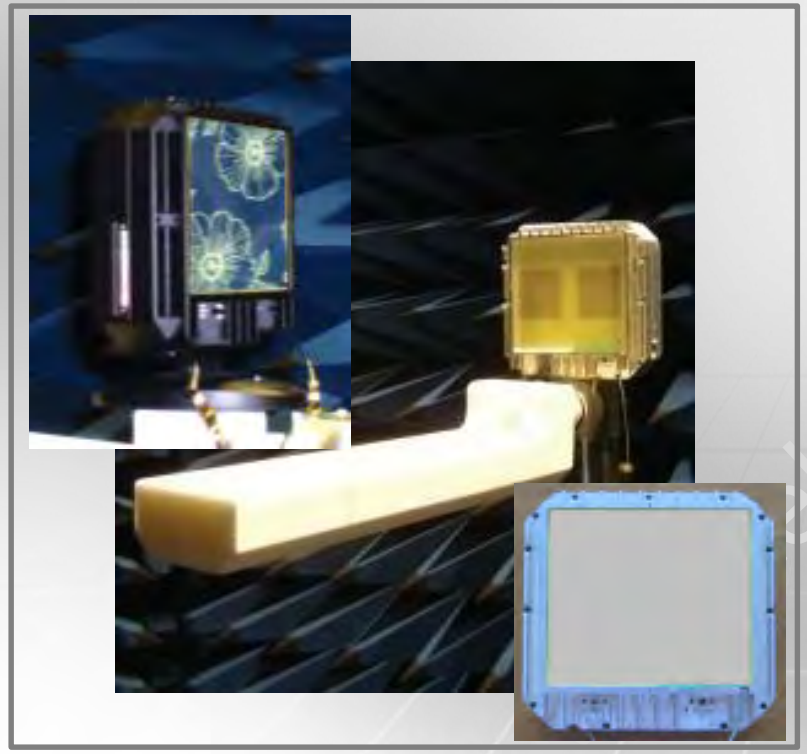
2x2 MIMO Dipole

Item	2X2 MIMO Dipole	Co-Linear Array Antenna
Frequency	28.0 GHz	25.0 GHz ~ 27.0 GHz
Gain (Typical)	7 dBi	9.0 dBi
Polarization	LP	LP
3dB Beam Width	Omni Directional @Az. 16° @ El.	Omni Directional @Az. 13° ± 5° @ El.
Size (mm)	40(W) × 40(L) × 5(H)	Ø20 ,52

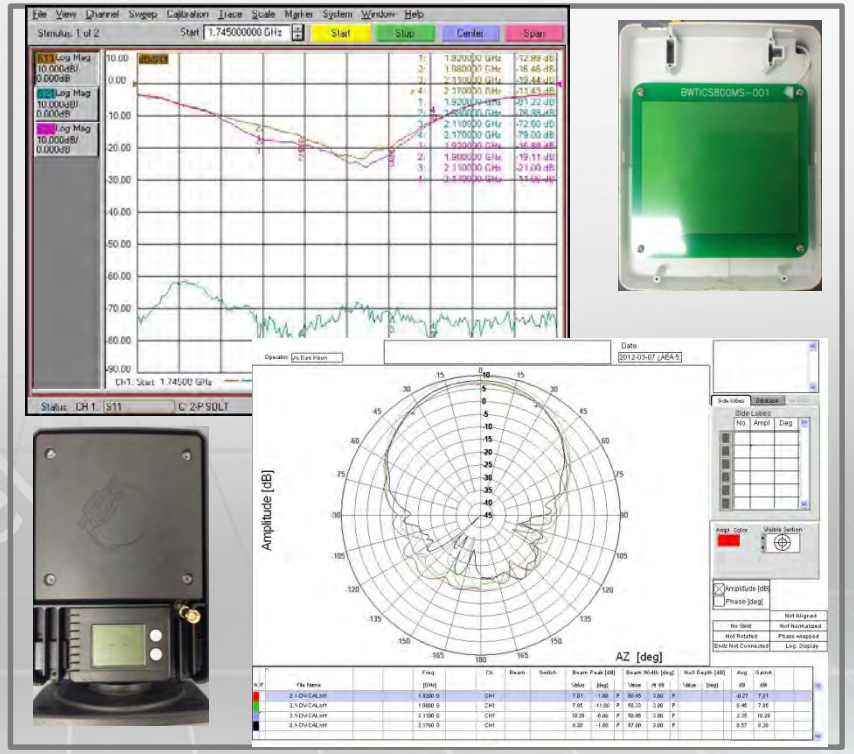
Co-linear Array Antenna

High Isolation Antenna for ICS Repeater

*** ICS : Interference Cancellation System**

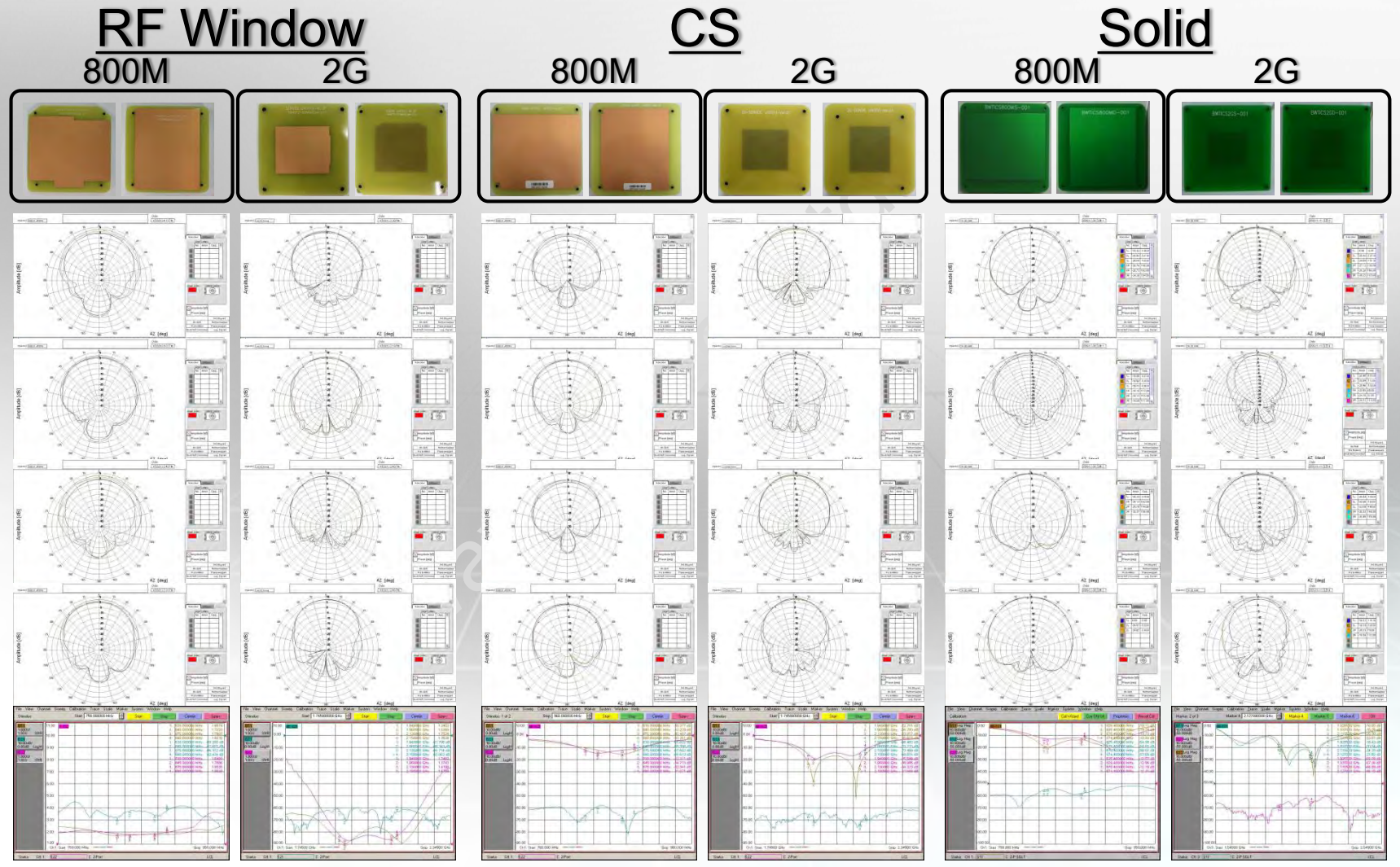


Antenna of ICS for NTT DOCOMO/KDDI



Return Loss and Beam Pattern

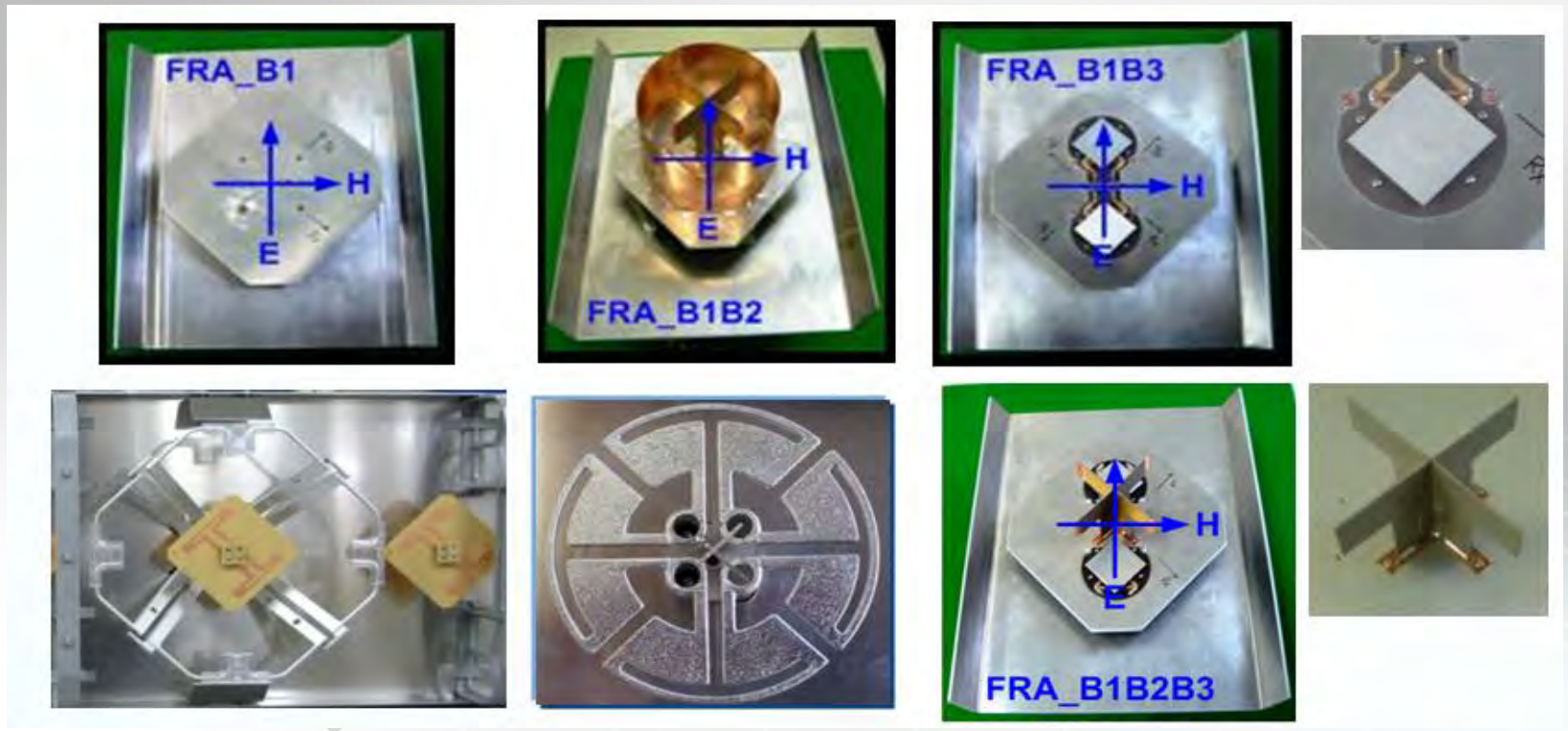
Beam Patterns and Isolations of ICS Antennas



Antennas for BS and Repeater Service

◆ **Single- & Multi-band array antennas**

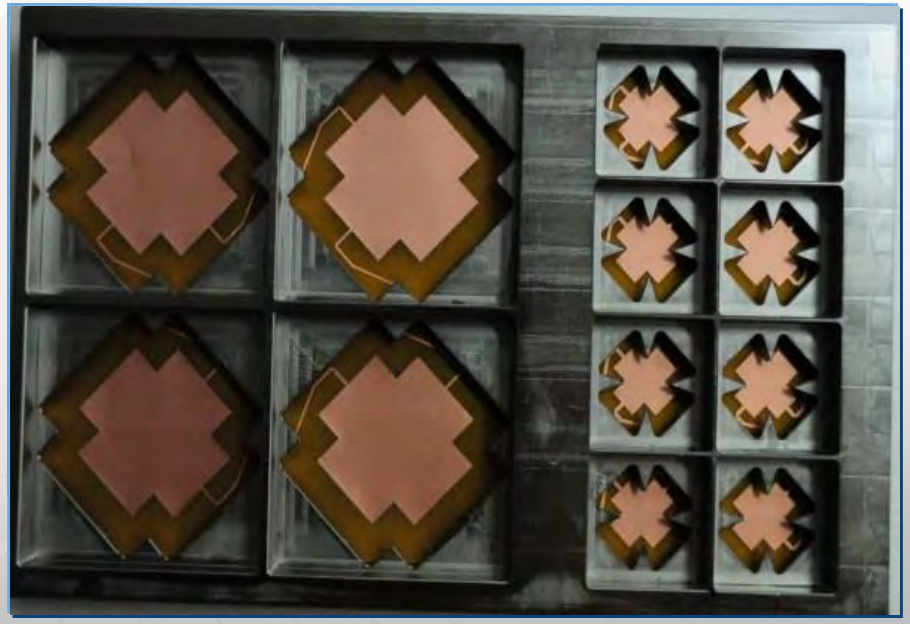
- Multi-band array spacing between elements
- Feeder Network realization by airstrip transmission lines
- Broadband DAS application



Radiation element for Multi-Band

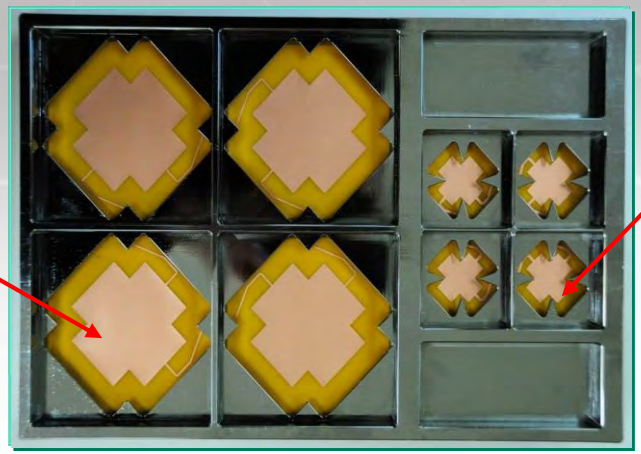
Dual Band WiFi Antennas for Access Point

Items	Description
Frequency	2.40Ghz~2.4835GHz 5.15GHz~5.825GHz
Gain	13.89 dBi (2.4GHz) 15.30 dBi (5.0GHz)
Polarization	Dual linear(+45°/ −45°)
Impedance	50ohm
Isolation between ports(Max)	-25.6 dB (2.4GHz) -40.5 dB (5GHz)
Return Loss	12 dB min.
Size	350 x 218 x27
Input Connector	SMA type



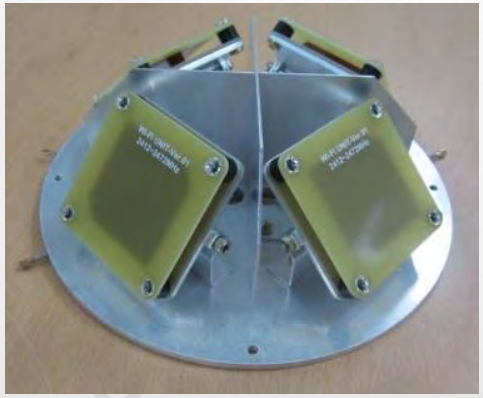
◆ Features
Air-strip patch antenna with slot

◆ Applications
- WiFi/WLAN
- Back Haul Communication

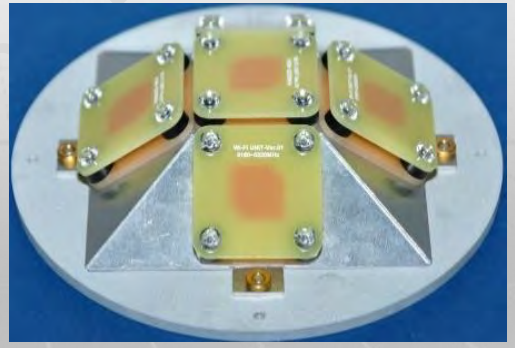


Omni-Directional Wi-Fi Antennas for AP

Items	2.4GHz	5.8GHz
Antenna Type	Patch Antenna	Patch Antenna
Frequency	2.412GHz ~ 2.472GHz	5.18 GHz ~ 5.32 GHz
Gain	> 3.0 dBi	> 3.0 dBi
Beam Width	Az : 80° ± 10° El : 80° ± 10°	Az : 80° ± 10° El : 80° ± 10°
Radiation Pattern	RHCP	RHCP
Impedance	50Ω	50Ω
VSWR	2.0 : 1	2.0 : 1
Isolation	-30 dB	-30 dB
Front to Back Ratio	> 10 dB	> 10 dB
Power Capability	< 5Watt	< 5Watt
Beam Tilting	45° ± 15°	45° ± 15°
Size	160Ø x 53mm	160Ø x 53mm
Input Connector	UFL(F)	UFL(F)



2.4 GHz Stack Patch Antenna



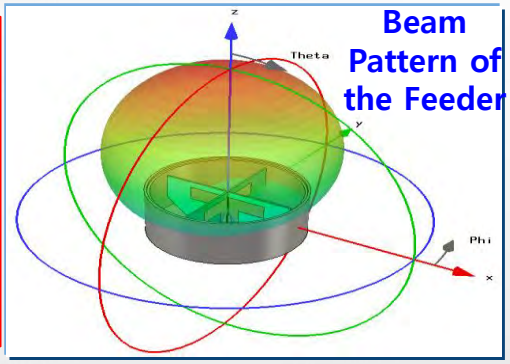
5 GHz Stack Patch Antenna

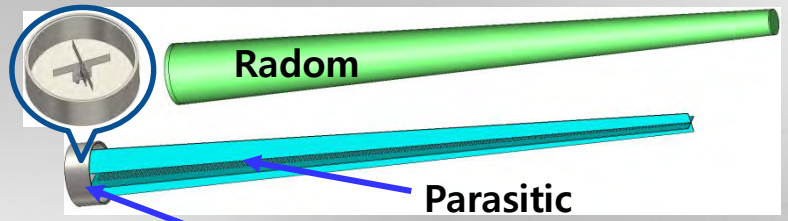
◆ Features
- Stacked patch antenna
- Omni-Directional Pattern

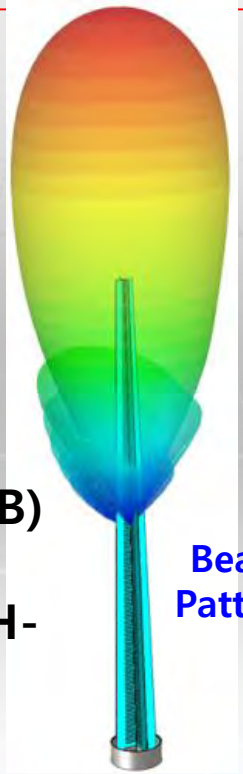
◆ Applications
- Wi-Fi Access Point
- Repeater System

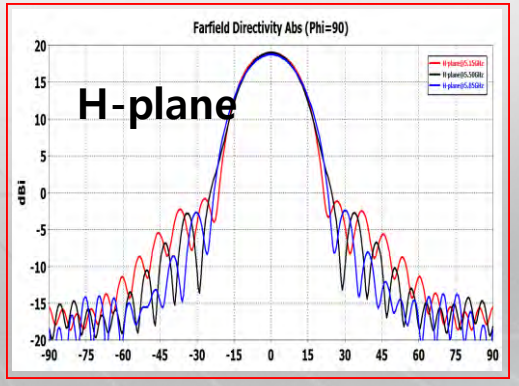
Spot Beam Antenna for a Future Repeater/BS

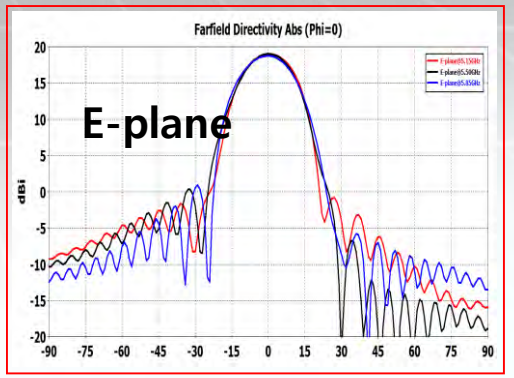
- Freq. band : XXX~YYYY GHz
- Gain of the Feeder : 9.7 dBi @ XXX GHz
- 3 dB Beamwidth @ XXXGHz
  - E-plane : 59.1°
  - H-plane : 58.3°







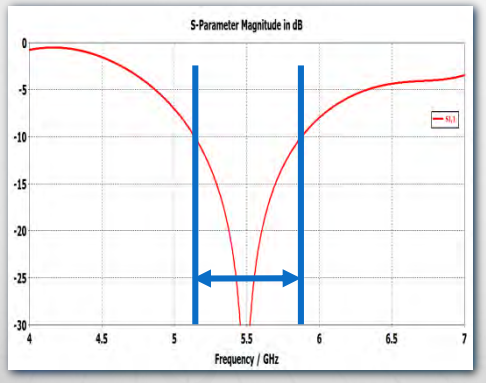




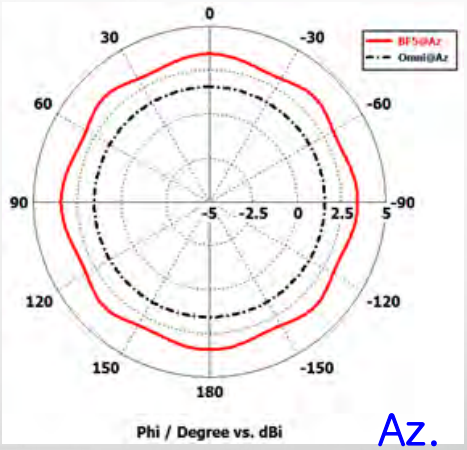
- Gain : >18.8 dBi
- Efficiency : > 91 %(Loss < -0.4 dB)
- Side Lobe Level : >18 dBc
- 3 dB Beam width : 22° @ E- & H-plane(Circular Pol, Directional Beam)

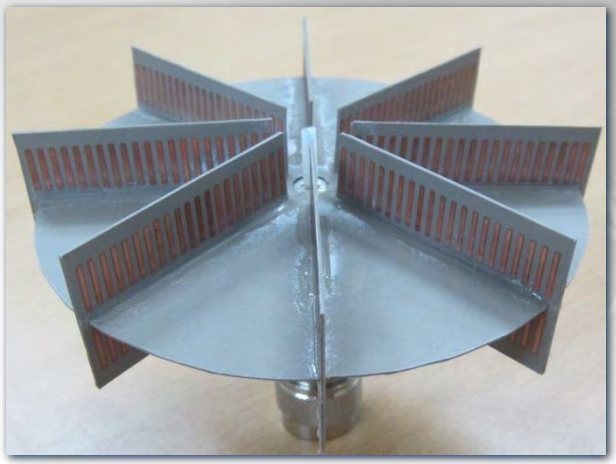
Beam Shaping Antenna : Parasitic slow-wave structures(I)

- Beam forming direction : El. direction(-6°, down-tilting)
- Az. gain ripple : ±0.2 dB
- Directivity increase effect : > 2.6 dB
- Reduction of 3dB beam width in El. direction
- Input Return Loss : > 10 dB
- Antenna Gain : 4.1 dBi (Typ.)
- 3 dB Beam width - 45.7° @ El.

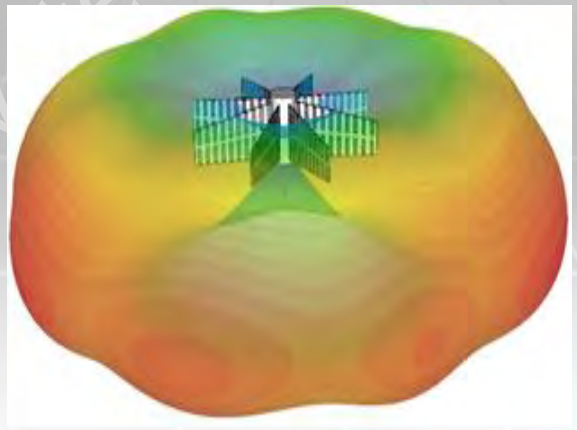


Return Loss

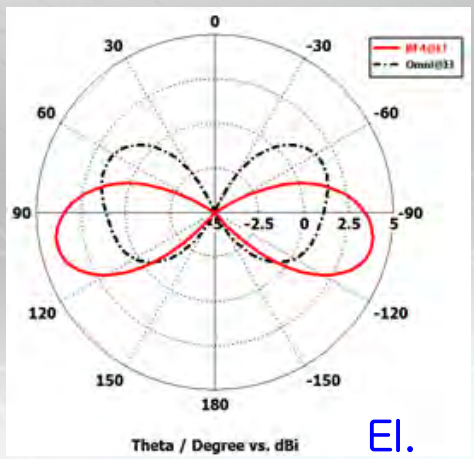




Antenna prototype



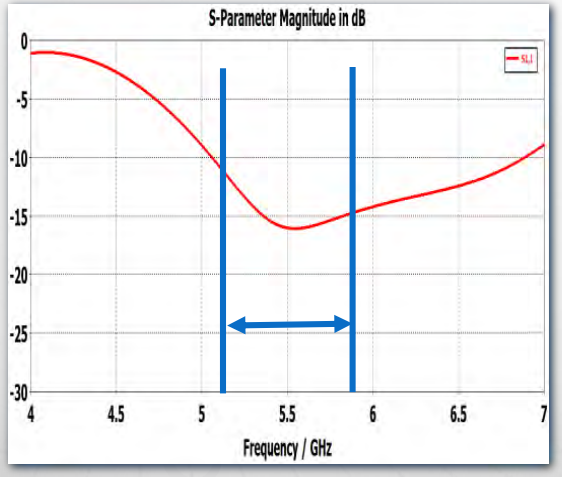
Azimuth direction(Simulation)



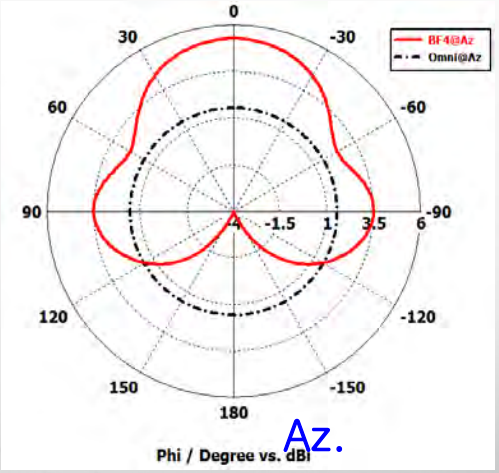
2-D Radation pattern

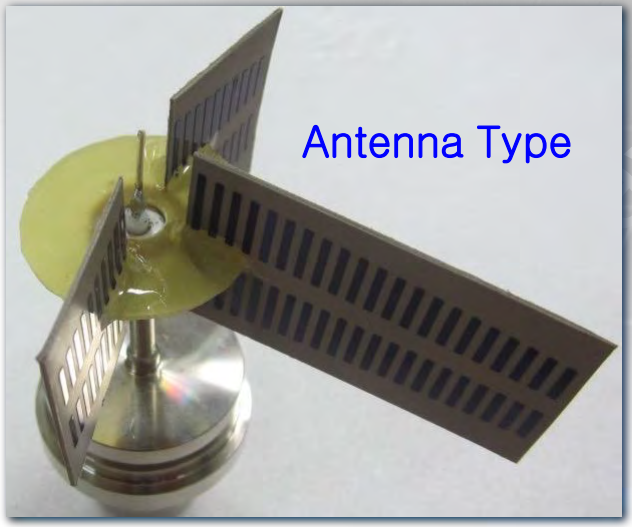
Beam Shaping Antenna : Parasitic slow-wave structures(II)

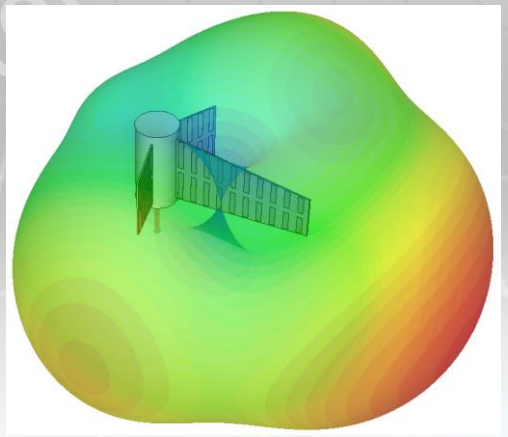
- Beam forming direction : Main orientation direction(0°)
- Directivity increase effect : > 3.5 dB
- Backward emission reduction effect
- Reduction of 3dB beam width in Az. and El. directions
- Return Loss : > 12 dB
- Antenna Gain : 5.0 dBi (Typ.)
- 3 dB Beam Width
  - 223° @ Az.
  - 63° @ El.



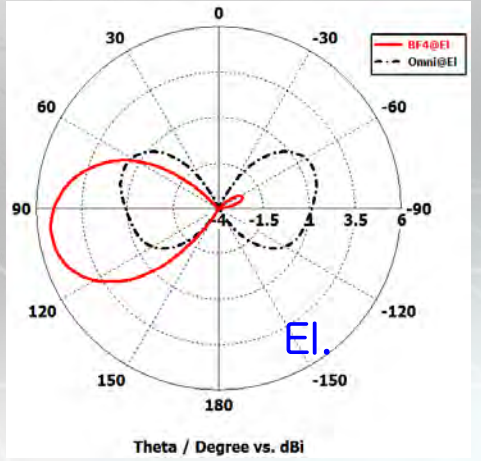
Return Loss







Azimuth direction(Simulation)



2-D Radation pattern

Active Antennas for Global Navigation Services

◆ **Active antennas for GPS, BeiDou, GNSS**

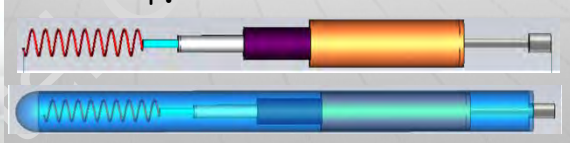
- Antenna structure : Corner-truncated Microstrip antenna realized on ceramic material
- Operational band : 1.56 ~ 1.61 GHz
- Antenna gain : 2.0 dBi typ.
- Polarization : RHCP
- Axial ratio : 3.0 Max.
- LNA linear gain : 33.4 dB Min.
- Noise figure : 1.0 dB Max.
- DC supply : DC +5 ~ 12 V, 6mA typ.
- Output return loss : 14 dB Min.

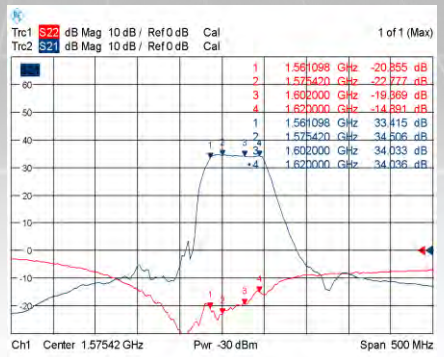
Indoor Active antennas for GPS

◆ **Outdoor Active antennas for GPS, BeiDou, GNSS**

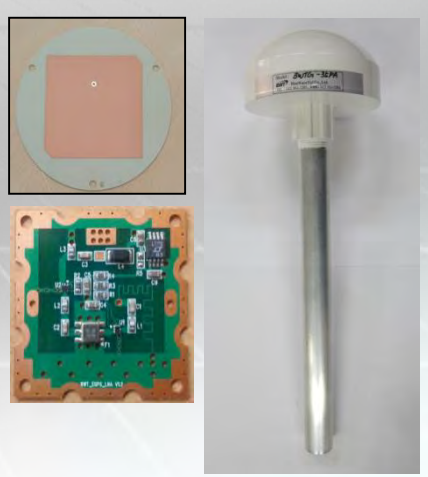
- Antenna structure : Corner-truncated microstrip antenna using teflon substrate
- Operational band : 1.56 ~ 1.61 GHz
- Antenna gain : 5.5 dBi typ.
- Polarization : RHCP
- Axial ratio : 2.0 Max.
- LNA linear gain : 33.4 dB Min.
- Noise figure : 1.0 dB Max.
- DC supply : DC +5 ~ 12 V, 6mA typ.
- Output return loss : 14 dB Min.

나.





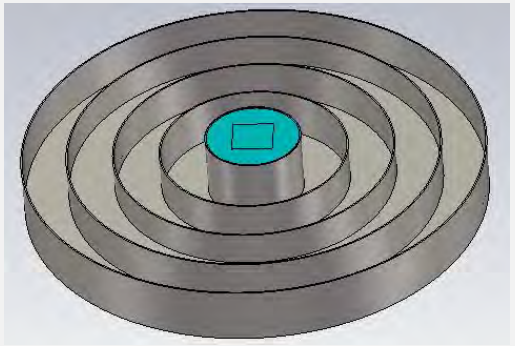
L-band LNA for GPS



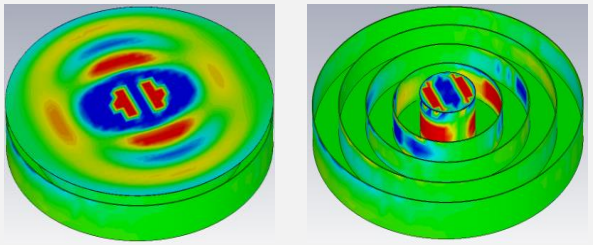
Outdoor Active antenna for GPS

Choke Ring Antenna for Anti-Jamming GNSS

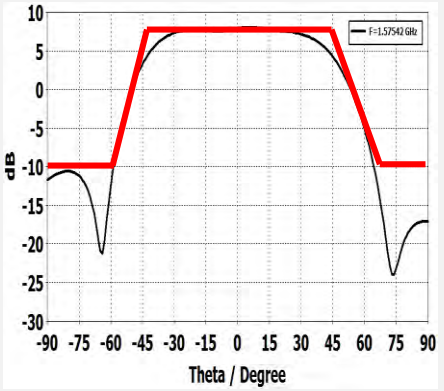
- **Key Technologies**
  - Beam Shaping in the Low Orbit
  - Small Size, Light Weight
- **Applications**
  - Anti-Jamming GNSS
  - Multi-Band Active Antenna for GNSS



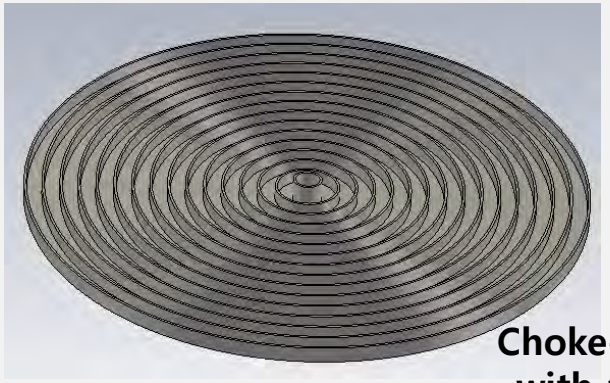
Choke-ring GNSS Antenna with four rings



Electric field distribution of choke-ring GNSS antenna



Flat-topped radiation pattern(FTRP)



Choke-ring GNSS Antenna with more than 10 rings

Military Antennas

Dual Band Antenna (Bomb)

- **Munitions Flight Control**
- **GPS/GLONASS, Telemetry**

Wide Band Antenna (Radio Set)

Onboard Antenna (Helicopter)

Telemetry Antenna (Guided Bomb)

- **Bomb Guidance & Telemetry**

Blade Antenna (Aircraft)

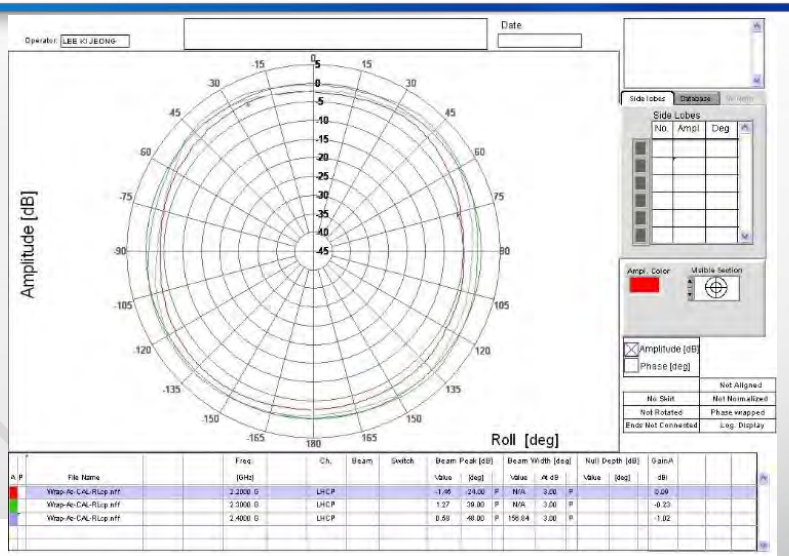
- **F-5 E/F**
- **UHF & IFF**

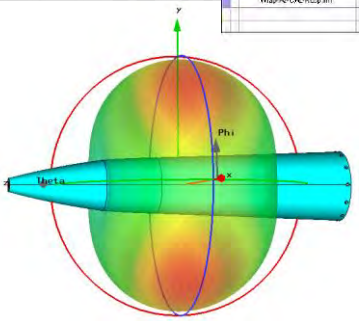
Telemetry Antenna (UAV)

Type	Blade Antenna (Aircraft)	Telemetry Antenna (UAV)	Dual Band Antenna (Bomb)	Telematry Antenna (Guided Bomb)
Frequency	UHF, L Band	UHF, L Band	GPS,GLONASS,L Band	UHF, L Band
Beam Pattern	Omni, Cardioid	Omni, Directional	Directional	Backward pattern
Polarization	LP	LP	LP, CP	LP, CP
VSWR	<2.0	<2.0	<2.5&3	<2.0
Gain(dBi)	1.9 / 3.6	2.0	0	3.0+ / -1.0
Remarks	IFF for Aircraft	Set up at wing / body of UAV	Antenna for Fuse /Dual Band	Inverted F Type

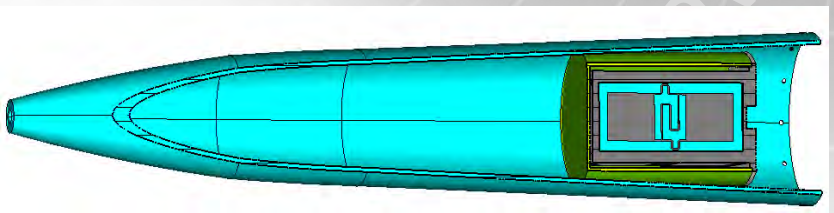
Omni-Directional Antenna for UAV/DRONE

Items	Description
Antenna Type	Patch Antenna
Frequency	2.20GHz ~ 2.40GHz
Gain	> 0.0 dBi
Beam Width	Az : Om-ni El : $100^\circ \pm 10^\circ$
Radiation Pattern	LHCP
Impedance	50Ω
VSWR	2.0 : 1
Size	$90\emptyset \times 75mm$
Input Connector	SMA(F)

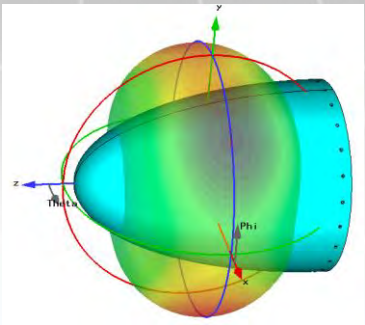




(AIM 9 radom



Omni-directional antenna
with CP installed into POD 1

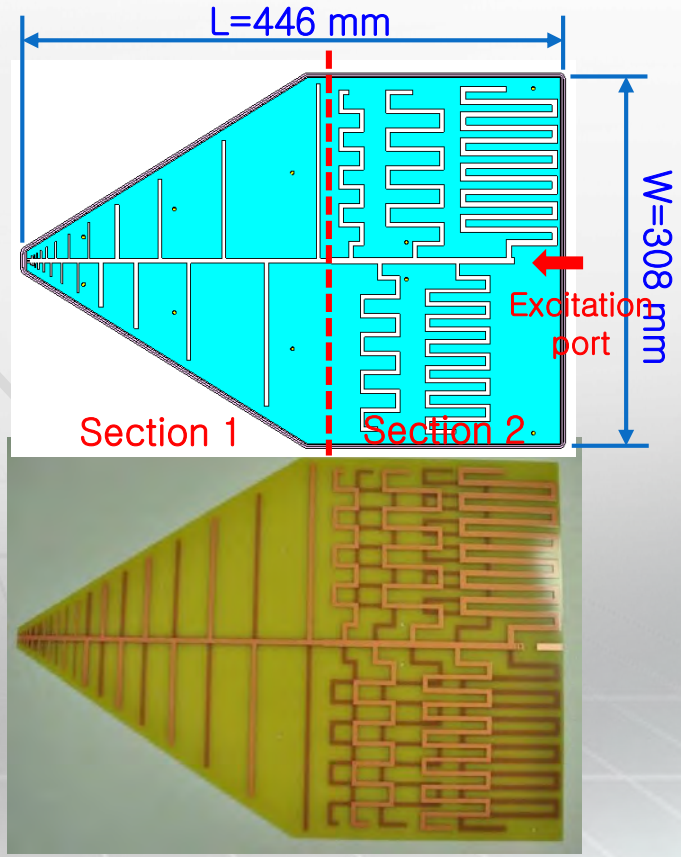


POD 2(CFT-radome)

Omni-directional wrap-around
antenna with CP
(1x2 array, high gain)

Hybrid LPDA Antenna

Items	Description
Antenna Type	Printed Hybrid LPDA
Frequency Range	130MHz ~ 6,000MHz
Polarization	Linear (Vertical)
Radiation Pattern	Directional
Gain	5.0 dBi (max.) - 130 MHz : -18 dBi typ. (SIM) - 200 MHz : -13 dBi typ. (SIM) - 500 MHz : 4.3 dBi typ. (MEA) - 1,000 MHz : 3.3 dBi typ. (MEA) - 2,000 MHz : 6.2 dBi typ. (MEA) - 3,000 MHz : 5.5 dBi typ. (MEA) - 4,000 MHz : 5.6 dBi typ. (MEA) - 5,000 MHz : 6.7 dBi typ. (MEA) - 6,000 MHz : 5.9 dBi typ. (MEA)
V. S. W. R	3.0 : 1 @ 130~250MHz 2.0 : 1 @ 250~6,000MHz
Impedance	50 Ω
Dimension	L=446mm이하 H=308mm이하
Input Connector	SMA(F)

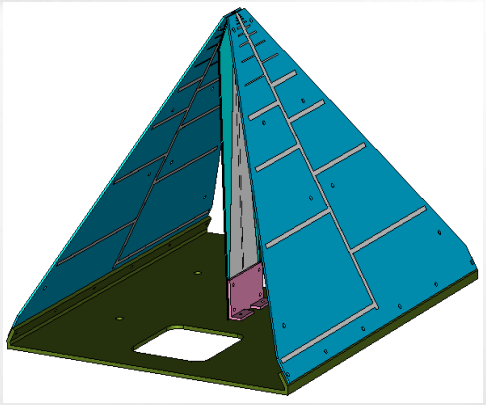


- Input return loss over frequency
  - 130 ~ 250 MHz : < 6.0 dB typ.
  - 250~6,000 MHz : < 10.0 dB typ.

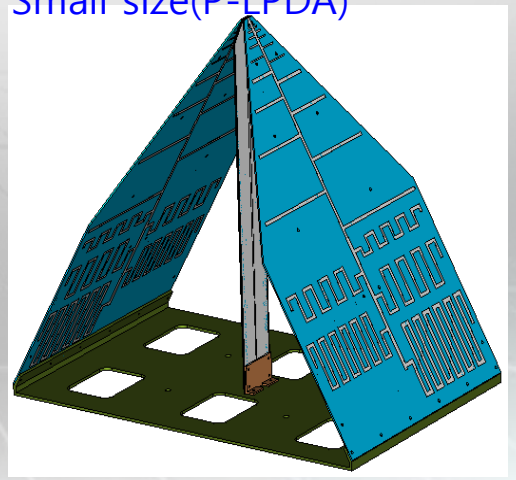
- Hybrid LPDA structure
  - Section 1 for 350~6,000 MHz
  - Section 2 for 130~350 MHz
  - Miniaturization design using meander-line in Section 2

LPDA Antenna Structure for Direction Finding

- Antenna structure : Printed hybrid log-periodic dipole array antenna
- Operating band : 130 ~ 6,000 MHz
- Antenna gain : 5.0 dBi typ.
- Polarization : Vertical linear
- 3 dB beamwidth : 65° ~ 100° @ Az.
  70° typ. @ El.
- Input return loss : 6.0 dB Max. @ 130~350 MHz
  10.0 dB Max. @ 350~ 6,000 MHz
- Input impedance : 50 ohm
- Antenna size : L=450 mm, H=300 mm

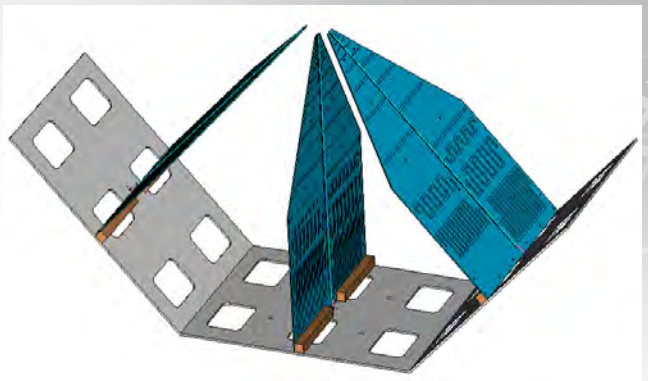


Small size(P-LPDA)

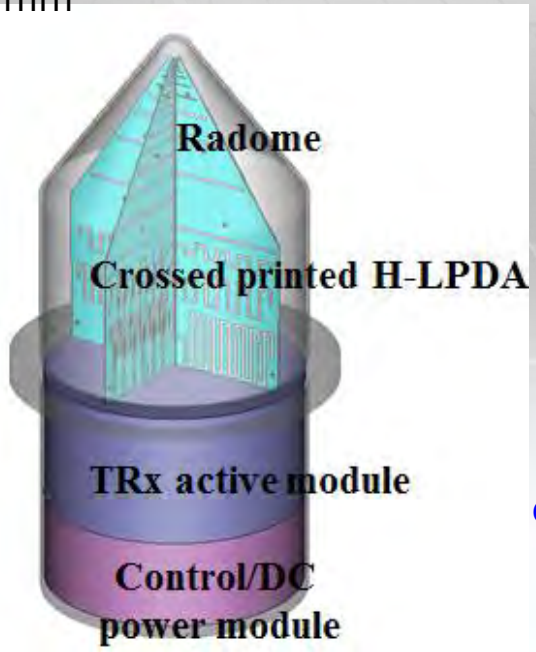


Large size(PH-LPDA)

Two antennas combined to decrease antenna beamwidth at Azimuth direction



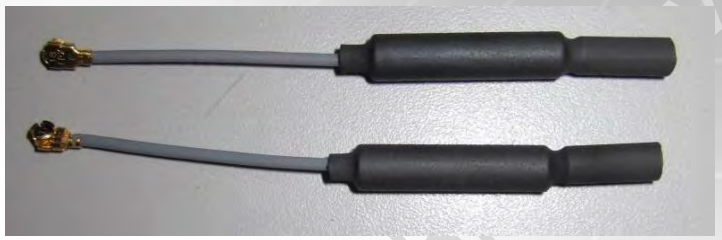
3-sector structure with reflector



UWB Antennas & Ultra-Broadband Antennas

◆ Various ultra-wideband antennas for WLAN/Bluetooth

- Antenna structure : Printed monopole antenna
- Operating band : 3.1~10.6 GHz
- Antenna gain : 1.0~3.5 dBi
- Polarization : Linear
- Radiation : omnidirectional @ Az.
- Input return loss : 14 dB Max.

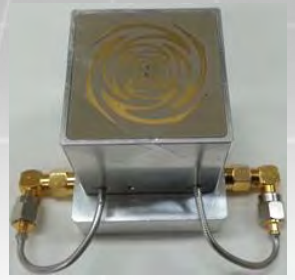


Various ultra-wideband antennas

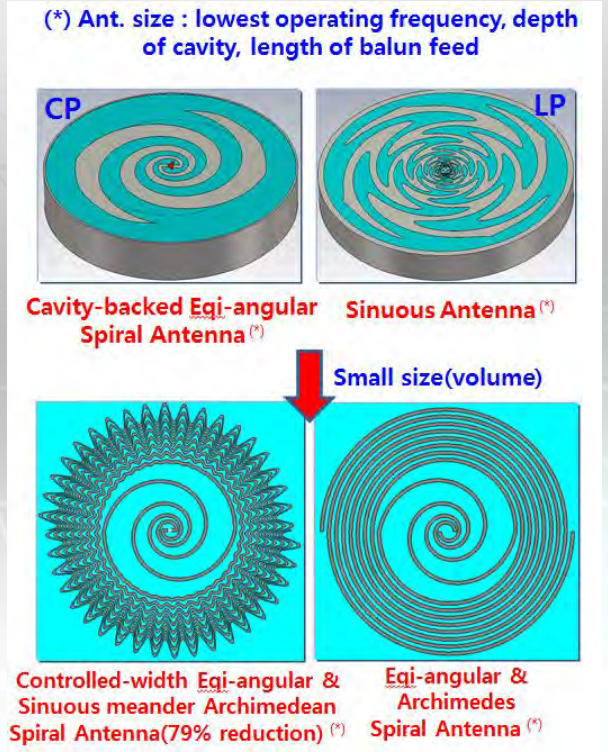
◆ Ultra broadband antennas for military app.

- Ultra-broadband operation(> 200%)
- Frequency-independent antenna characteristics
  ⇒ angle dependency, self-complementary, thick metal, self-scaling
- Constant phase center with frequency
- Different radiating position by frequency
- Constant 3dB beam-width & gain over frequency

Two sinuous antennas



Radar module with sinuous ant.



Antennas for DTV/UHD TV Reception

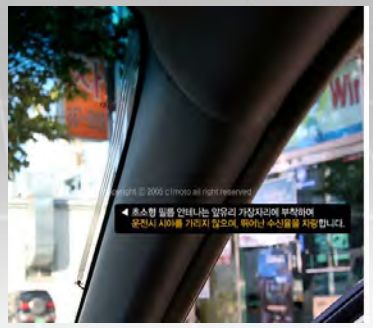
Electric Features

Operation Freq.	470MHz~806MHz
Input Voltage	DC 5V
Gain	2dBi(Antenna) 17dB(Max., LNA)
Current	20mA(Typ.)
Output Imp.	75ohm
Connector Type	Antenna : MCX (F) Cable : MCX(M) to F type(M)
Noise Figure	2.0dB (Max)

Physical Features

Size	226mm X 178mm X 10mm
Cable length	Depend on Models and Specifications

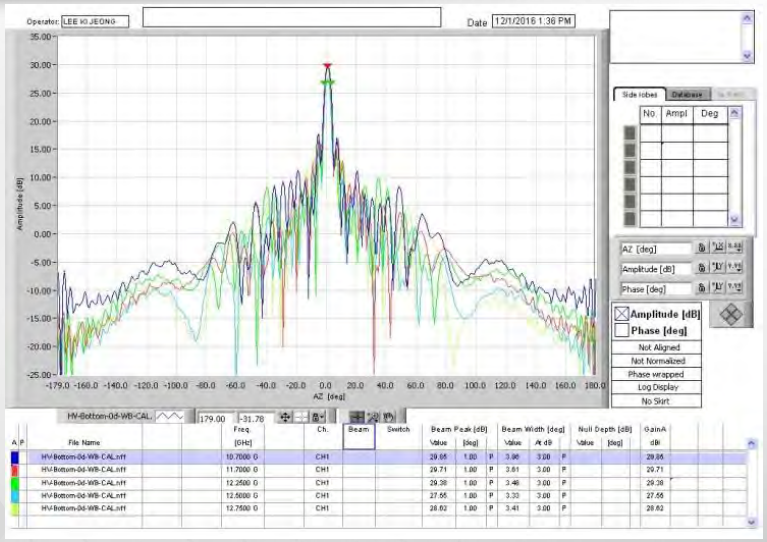
Frame Antennas for DTV/UHD TV

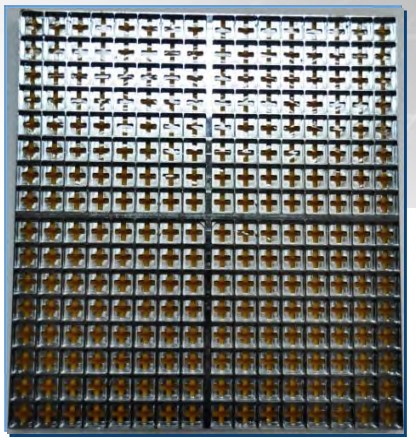


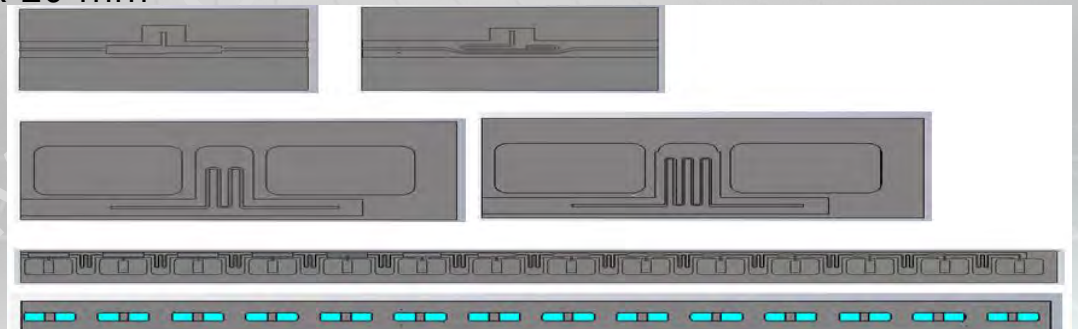
Film Etched Antenna for DTV Reception

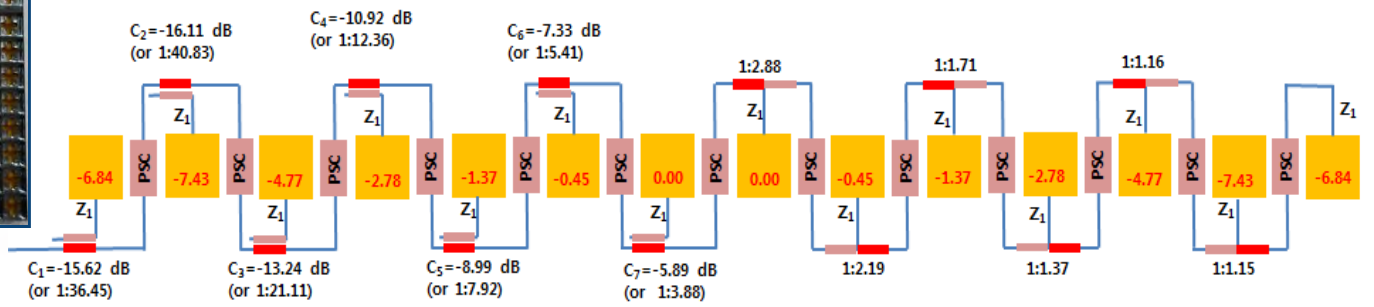
TRx LP Planar Array Antennas for Satellite Service

- Antenna structure : Broadband planar slot array antenna with high-efficient air-strip feed network
- Operating band : 14.0~14.5 GHz @ Tx
  11.7~12.75 GHz @ Rx
- Antenna gain : 32 dBi typ. @ 16x16 array
  32 dBi typ. @ 16x16 array
- Antenna efficiency : 70 % typ.
- Polarization : Dual orthogonal LP
- Port isolation : 40 dB Min.
- Port type : WR75 Waveguide
- Dual I/O ports : Input(Tx), Output(Rx)
- Antenna size : 355 mm x 355 mm x 20 mm
- Weight : 1.9 Kg
- Sat. Service : TRx Communication

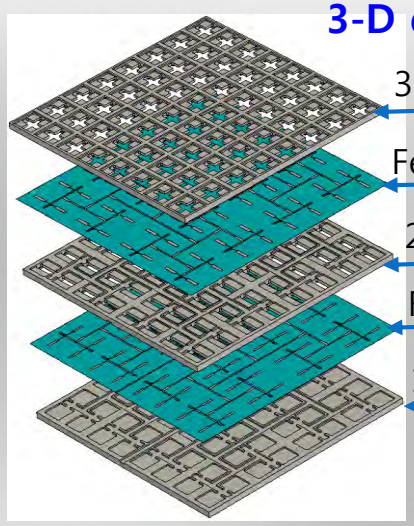


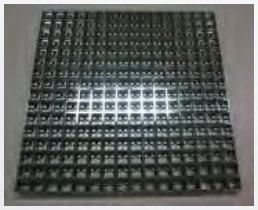


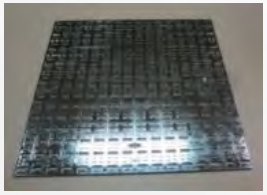


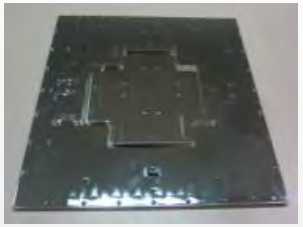


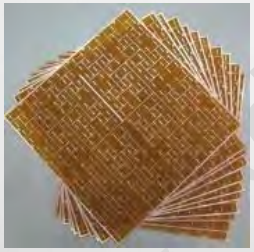
Flat Array Antenna with Dual Polarization/TRX

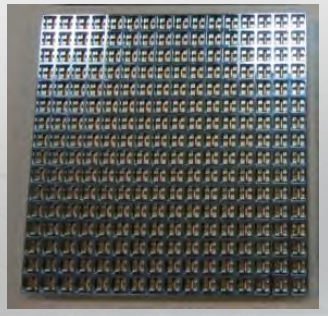








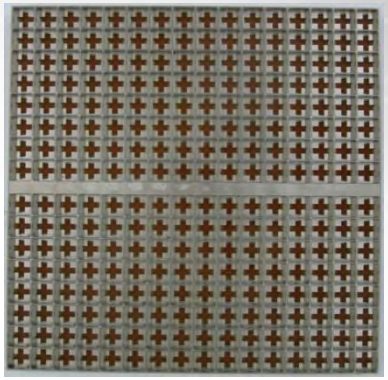




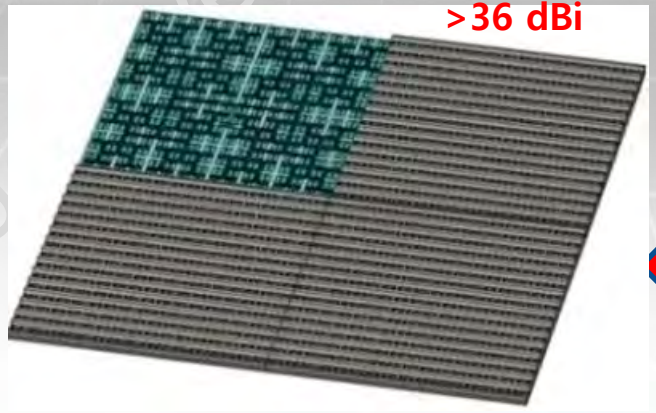
16x16 array
(V/H, Tx/Rx)

4x16 array(RHCP)

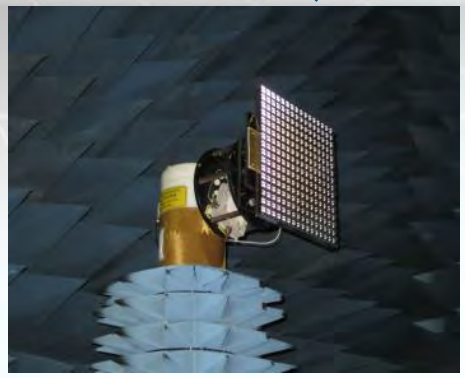
16x16 array(LHCP)



High Gain
>36 dBi



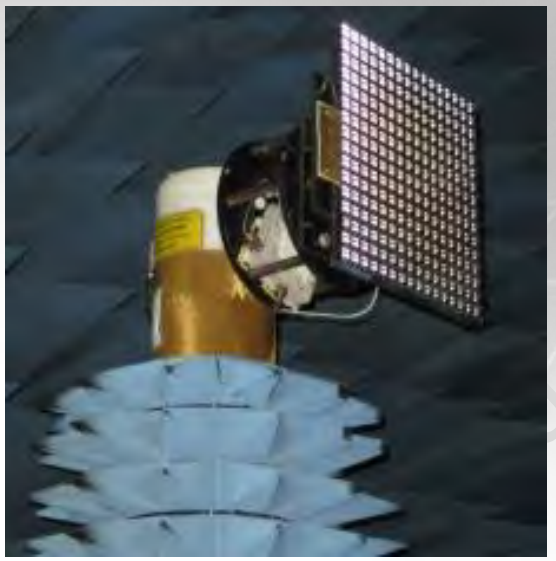
Dual Linear Pol.

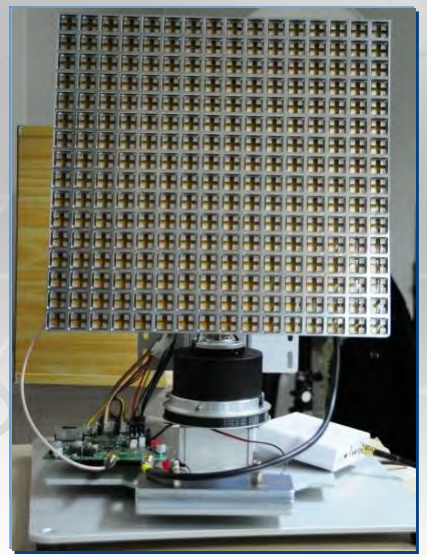


Planar Array Antenna with Satellite Tracking

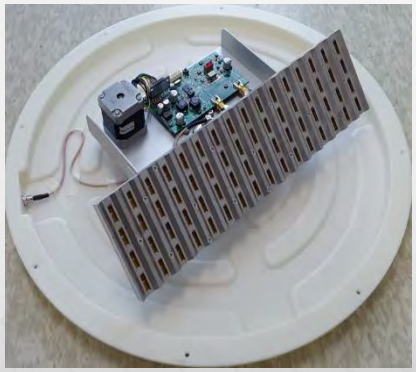
◆ 2-Axis Controlled Automatic Satellite Tracking System

- 16X16 Array Module
- Operating band : 14.0~14.5 GHz @ Tx, 11.7~12.75 GHz @ Rx
- Antenna gain : 27 dBi typ. @ 4x16 array
  32 dBi typ. @ 16x16 array
- Polarization : LP/CP/Dual LP
- Applications : DBS reception(Rx only), Communication(TRx)



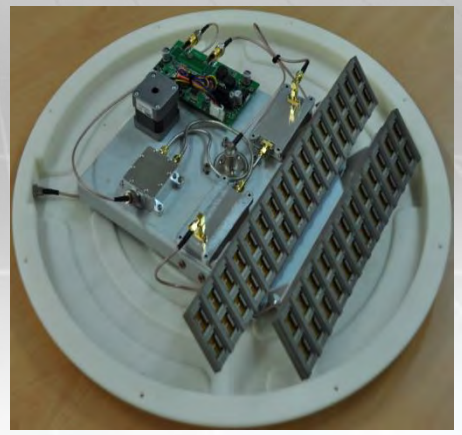


◆ 1-Axis Controlled Automatic Satellite Tracking System



4X16 Array

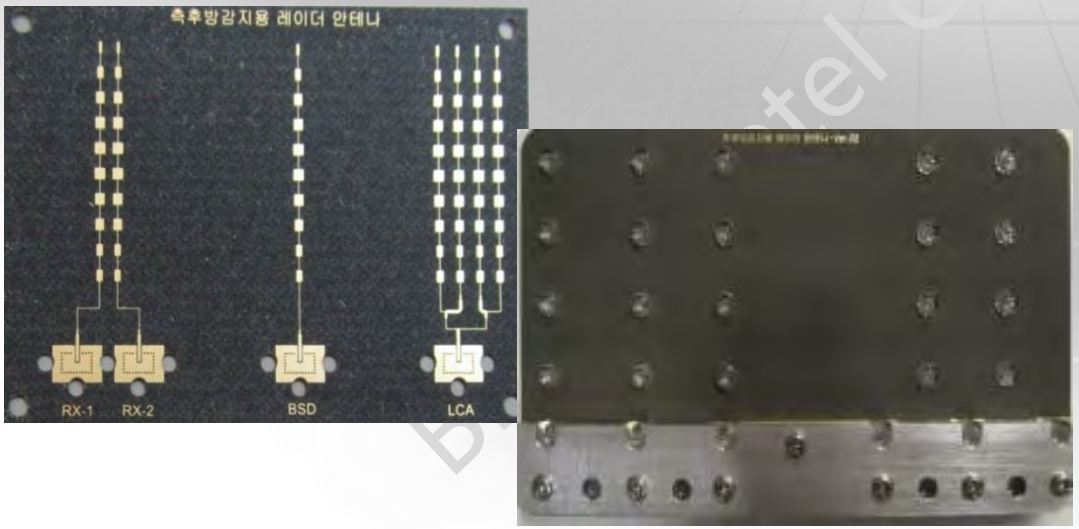
Circular Radiation Module with Tilted beam



- 2X16 and 2X12 Array for low profile
- 2 LNA + Down Converter

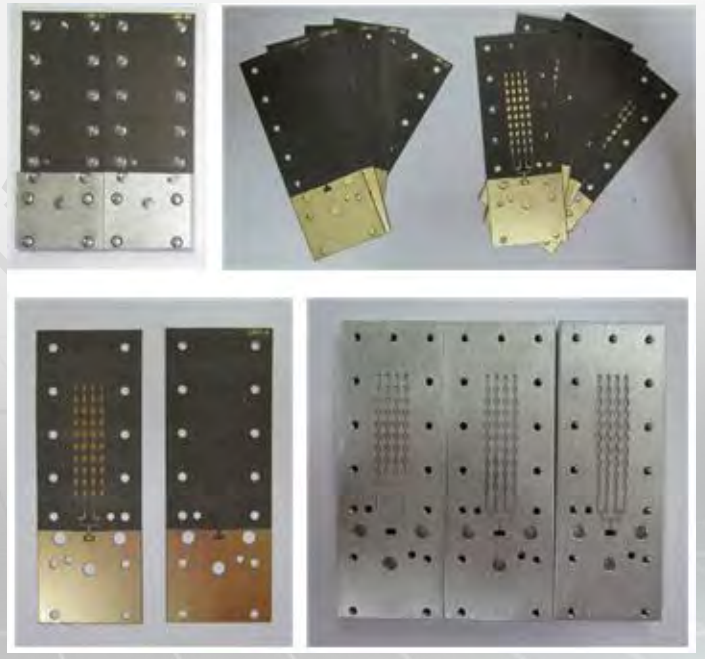
Antennas for Collision Protection RADAR System(I) (1)

- Antenna structure : Airstrip planar array antenna with series-feed and waveguide transition
- Operating band : 77~79 GHz
- No. of array : 1x10 array @ BSD
  4x10 array @ LCA
- Antenna gain : 16 dBi typ. @ BSD
  15 dBi typ. @ LCA
- Beam peak direction : 0° (bore-sight) @ BSD
  40° off-set @ LCA
- Polarization : Vertical Linear
- Application : Collision Protection RADAR System



BSD & LCA module

Various airstrip planar array antenna with series-feed and waveguide transition



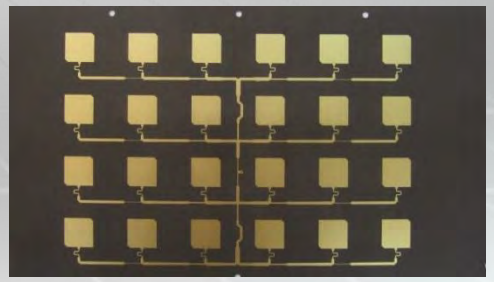
LRR : Long-range radar
MRR : Middle-range radar
SRR : Short-range radar
BSD : Blind-spot detection
LCA : Lane-change assist

RSE Antennas for ETCS Service

◆ RSE(*) Planar Array Antenna for ITS(BIS, ETCS(*), etc), WAVE and DSRC/Advanced ETCS

⇒ Sole supplier of RSE antenna for ETCS in Korea

Items	4X4 Patch Array Type	4X6 Patch Array Type
Frequency	5.795GHz ~ 5.875GHz	5.790GHz ~ 5.850GHz
Az. 3dB Beam Width	> 22°	>17 °
El. 3dB Beam Width	> 22°	>22 °
Gain	14.0dBi	19dBi
Polarization	Circular (RHCP)	Circular (RHCP)
Impedance	50Ω	50Ω
VSWR	2 : 1	2.0 : 1
First Side Lobe Level	< -20dB	< -26dB
Power	< 5Watt	< 5Watt
Size	160 X 160 X 0.5mm	300 X 160 X 0.508mm
Connector	SMA(F)	SMA(F)

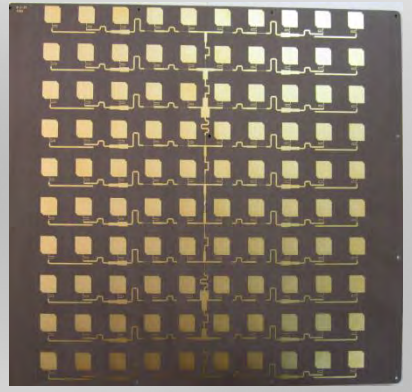


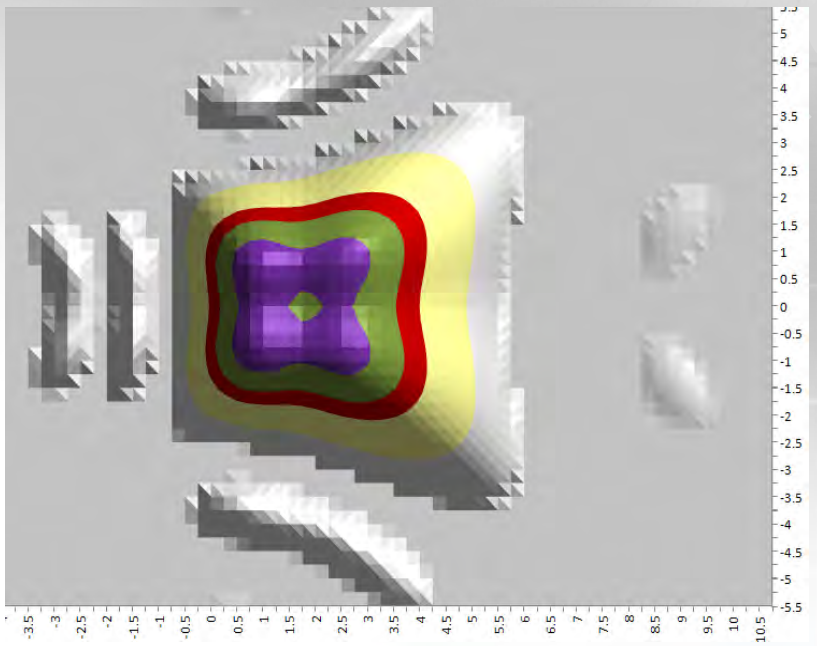
RSE Antennas for ETCS (Korea)

* ETCS : Electronic Toll Collection System
* RSE : Road Side Equipment

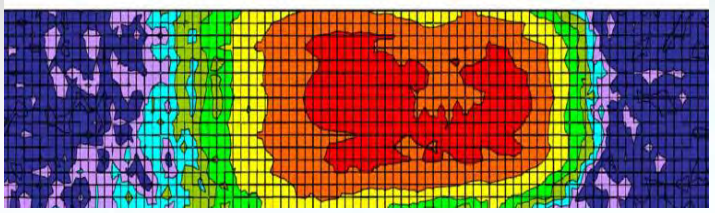
RSE Antenna with Flat Top Beam for ETCS

Antenna Topology and Footprints for ETCS in Japan





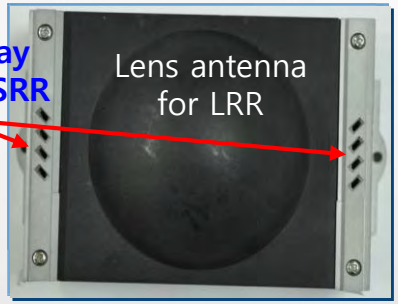
Items	Description
Antenna Type	!0X10 Patch Array Type
Frequency	5.790GHz ~ 5.850GHz
Az. 3dB Beam Width	> 32°
El. 3dB Beam Width	> 32°
Gain	14dBi
Polarization	Circular (RHCP)
Axial ratio	Less then 3
VSWR	2.0 : 1
First Side Lobe Level	< -26dB
Size	390 X 340 X 1.58mm



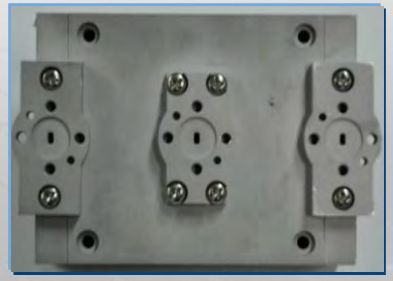
Antennas for Collision Protection RADAR System(II)

- **Waveguide array & Lens antenna for Multi-mode(LRR(*) & SRR(*)) operated at 78 GHz**
  - Antenna structure : Broadband planar slot array antenna with high-efficient air-strip feed network
  - Operating band : 77~79 GHz
  - Antenna gain : 27 dBi typ. @ LRR
    14 dBi typ. @ SRR
    23 dBi typ. @ MRR
  - Polarization : +45° LP
  - Application : Car collision avoidance

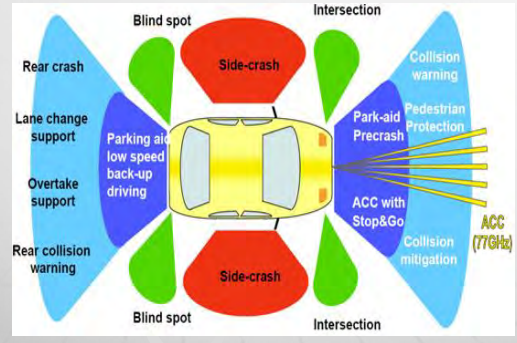
Multi-mode(LRR/SRR) antenna



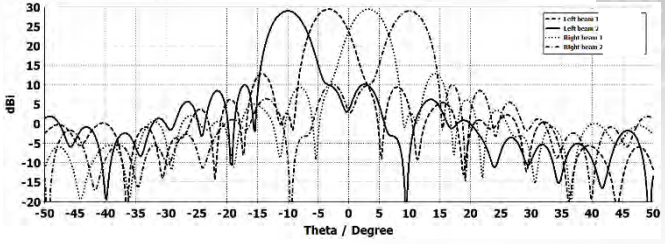
Front-side view



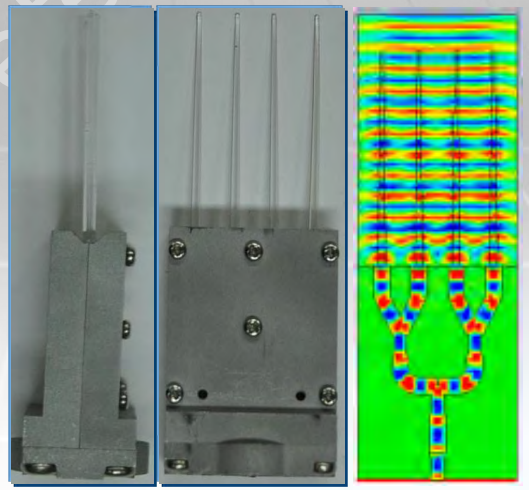
Back-side view

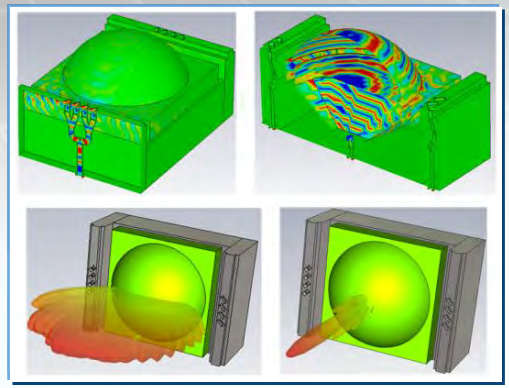


Multi-beam generation by four exciters



1x4 WG array antenna with protruding dielectric rod(for MRR)

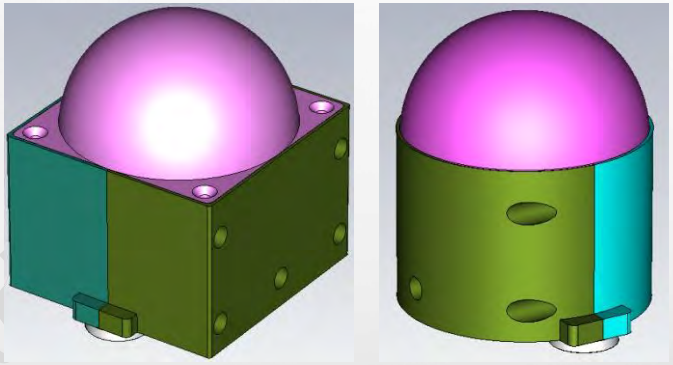




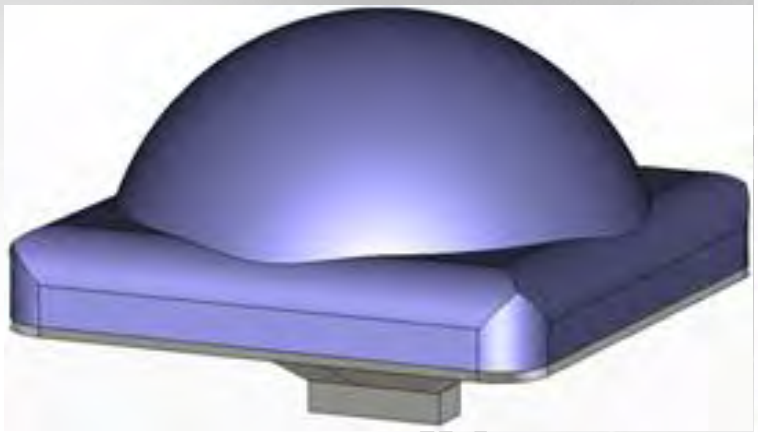
* LRR : Long Range Radar * MRR : Middle Range Radar
* SRR : Short Range Radar

High-Gain Lens Antenna with Multi-Beams

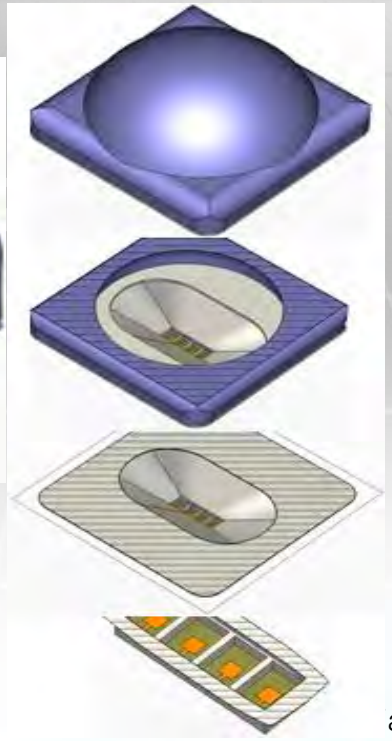
- **High-gain lens antenna with multi-beam generations**
- Operating band : 77~79 GHz
- Composition : four exciters + Flare horn + Lens
- No. of beams : 4
- Dielectric material for Lens : Rexolite
- Antenna gain : 32.0 dBi typ.
- 3 dB beam-width : 3.6° typ. @ Az., 3.2° typ.@ El.
- Side-lobe level : 16 dBc typ. @ Az., 17 dBc typ. @ El.
- Size : 70mm(W) x 70mm(L) x 80mm(H)

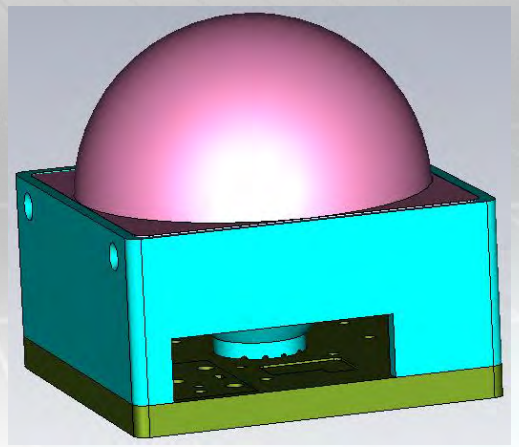


Lens antenna with 4-beams
(WR10 interface)



Multi-beam generation
by four microstrip patch exciters

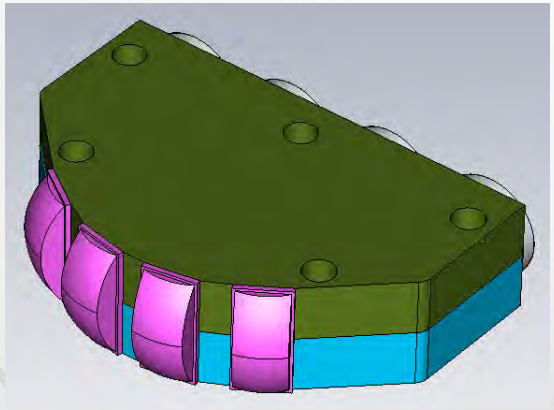


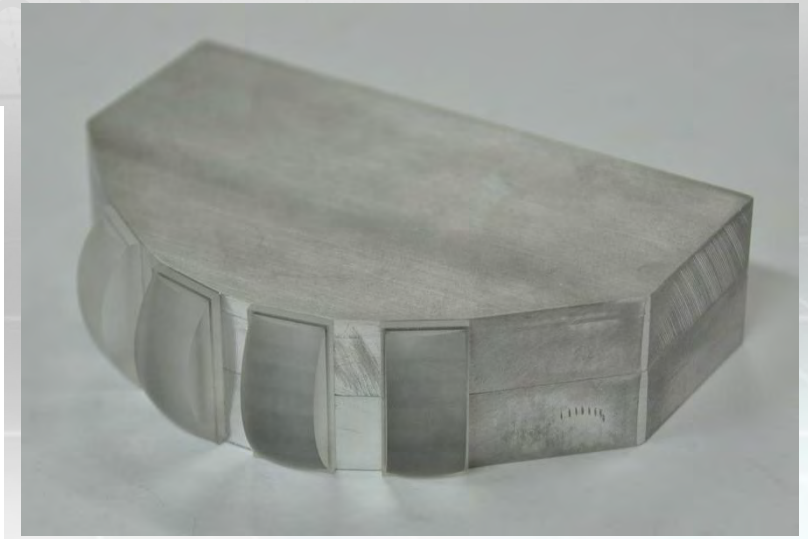


Lens antenna with 4-beams
(integrated RF switching
module)

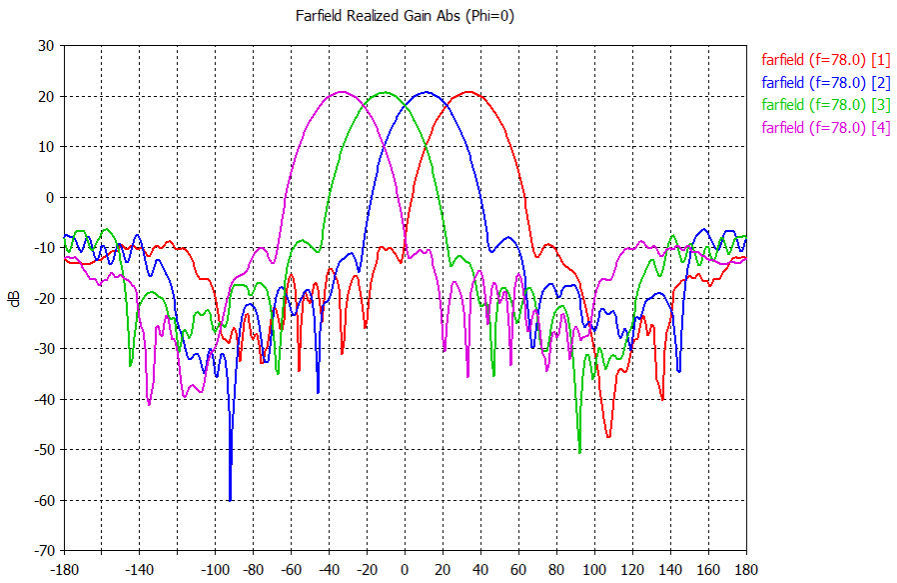
Lens Array with Multi-Beam in Wide-Range

Items	Description
Antenna Type	Waveguide Horn type
Frequency	77GHz ~ 79GHz
Az. 3dB Beam Width	> 31°
Gain	18.0 dBi ± 1dBi
Polarization	Linear (Vertical)
Impedance	50Ω
VSWR	< 2.0:1
Size	82 X 52.5X10.5



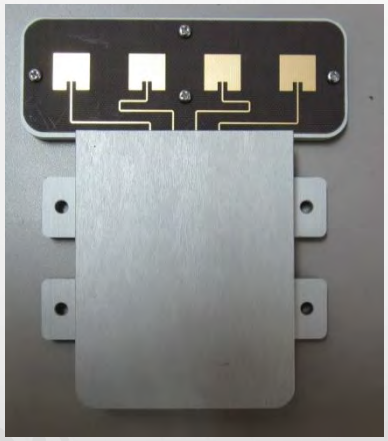


Lens array with multi-beam
in wide-range

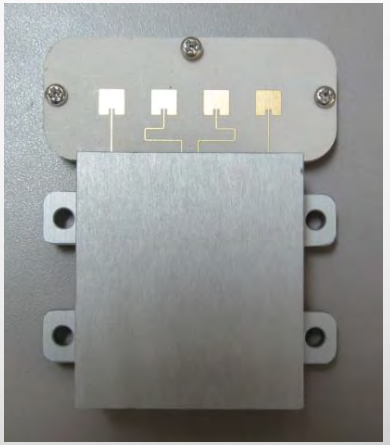


Beam Steering Antenna

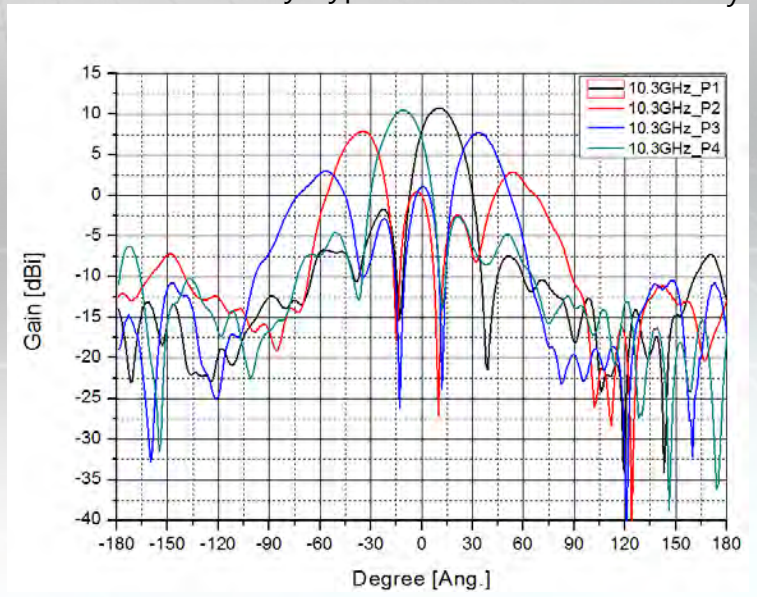
Items	Description	
Antenna Type	Patch Array Type	Patch Array Type
Frequency	10.30GHz ~ 10.50GHz	24GHz ~ 24.25GHz
Az. 3dB Beam Width	> 20°	> 20°
El. 3dB Beam Width	> 90°	> 90°
Gain	9.0 dBi ± 2dBi	9.0 dBi ± 2dBi
Polarization	Linear (Vertical)	Linear (Vertical)
Impedance	50Ω	50Ω
VSWR	< 2.0:1	< 2.0:1
Max. Power	10mW	10mW
Size	< 90 x 100 x 0.5mm	< 50 x 60 x 0.5mm



10GHz Patch Array Type

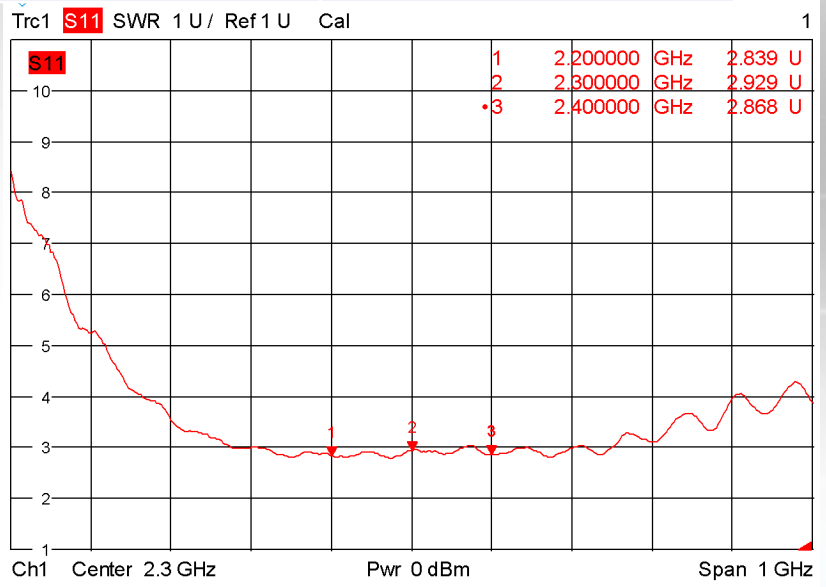


24GHz Patch Array Type

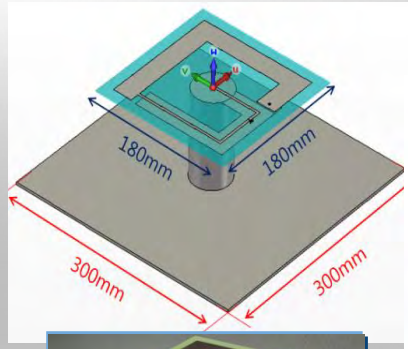


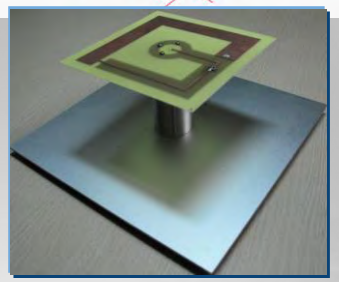
Dipole Antenna for WiFi Services

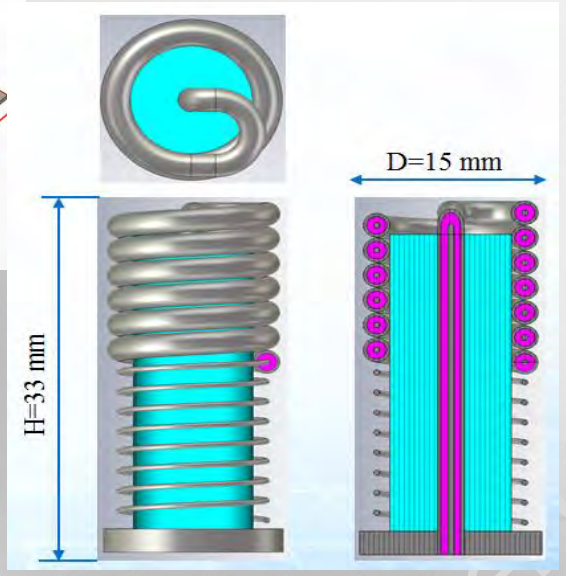
Items	Description
Antenna Type	Dipole Antenna
Frequency	2.2GHz ~ 2.4GHz
Gain	0 dBi
Beam pattern	Omni-Directional
Impedance	50ohm
VSWR	3.5 : 1
Size	190mm, ,Φ70
Input Connector	N type(M)



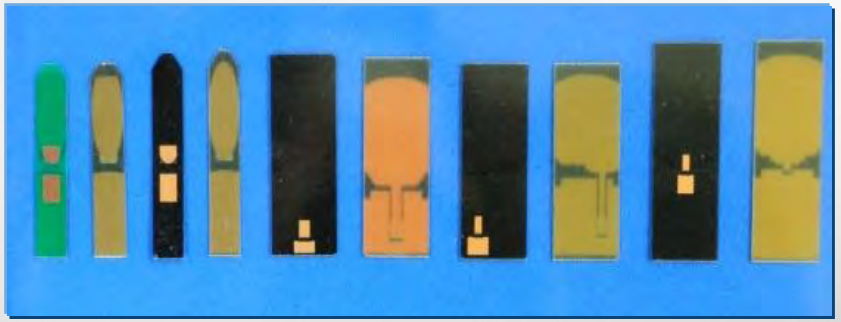
Antenna Topologies for IOT Applications



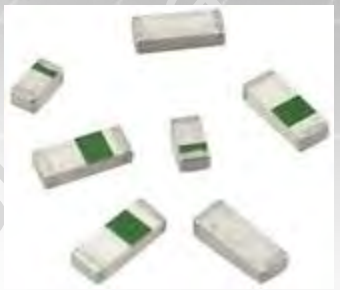




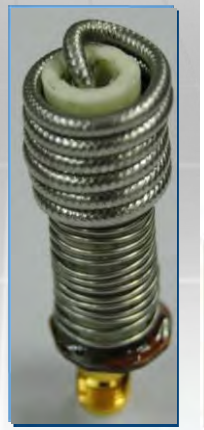
Helical Type

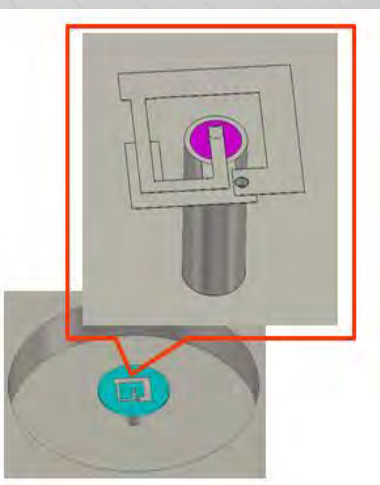


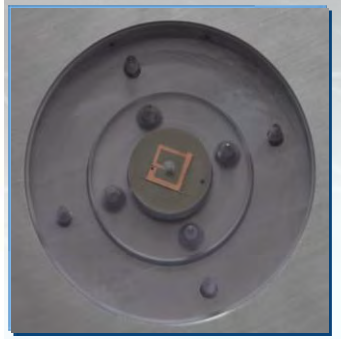
Ultra-wide Band Antennas



LTCC Chip Antennas (Future Business)



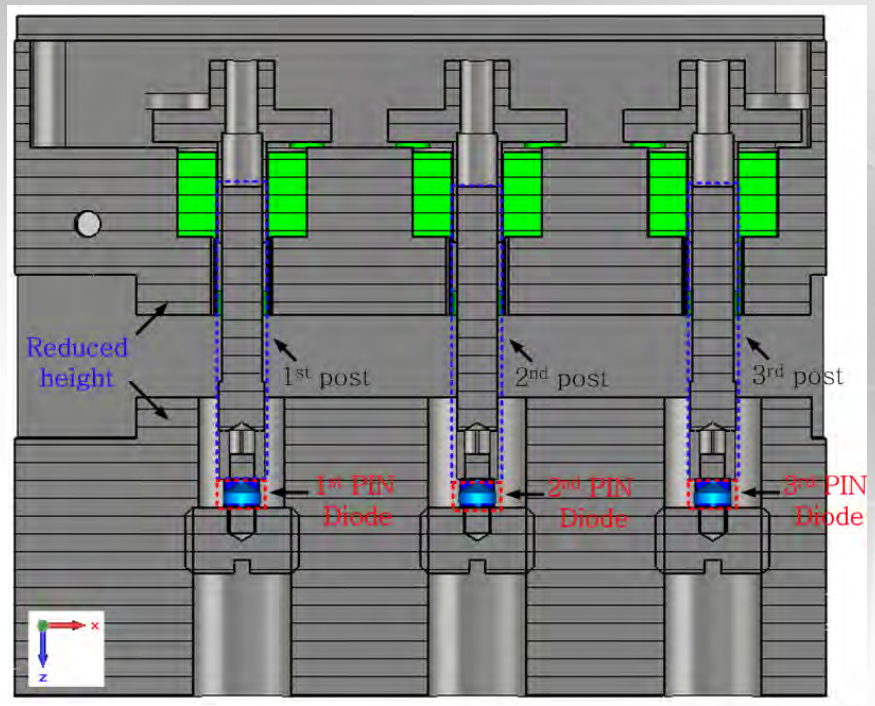


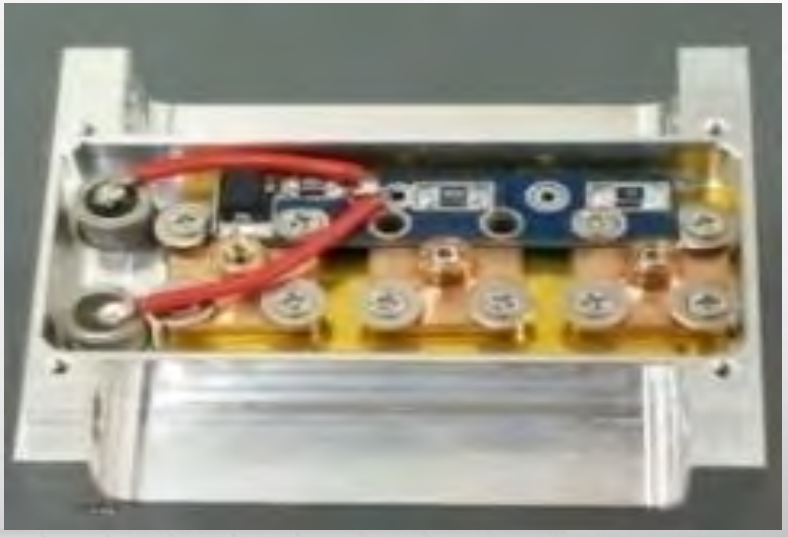


Small Antenna embedded into Manhole Cover

TR Limiter

- Operation Frequency : X-Band
- VSWR : < 1.4 :1
- Insertion Loss : < 0.7 dB
- Size (L x W x H) : 42 x 50 x 40 (mm)
- Applications : TR Limiters are used in radar systems to protect the radar receiver from unwanted and potentially damaging high power signals.

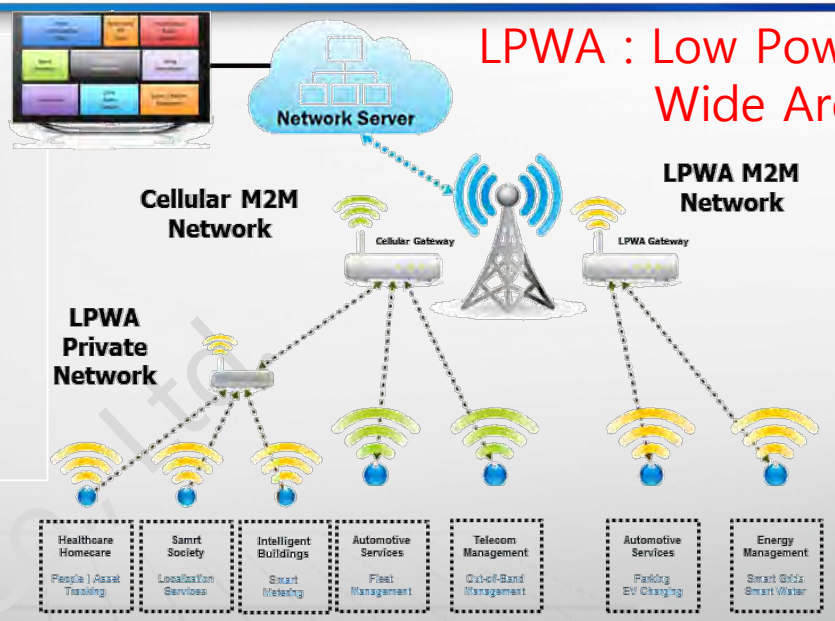




Waveguide Type TR Limiter

2.4GHz RF Transceiver Module for LPWA

- Operating band : 2.401~2.4835 GHz
- Linear gain @ Tx channel : 8 dB typ.
- Linear gain @ Rx channel : 25 dB typ.
- Noise figure @ Rx channel : 2 dB typ.
- Isolation between TRx channel : 60 dB typ.
- Digital circuit(ATMEGA 128A)
  . TDD Tx/Rx Timing signal generation
  . RF Tx signal monitoring(level detection)

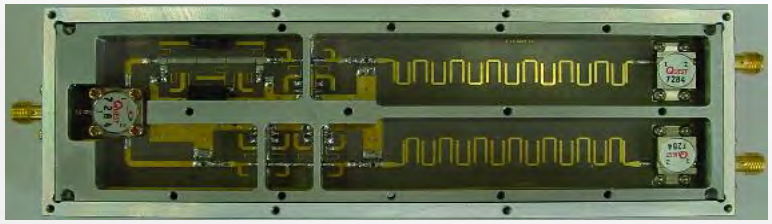


RF Transceiver Part (front-side)

Digital timing generation Part (back-side)

Active & Passive RF Module

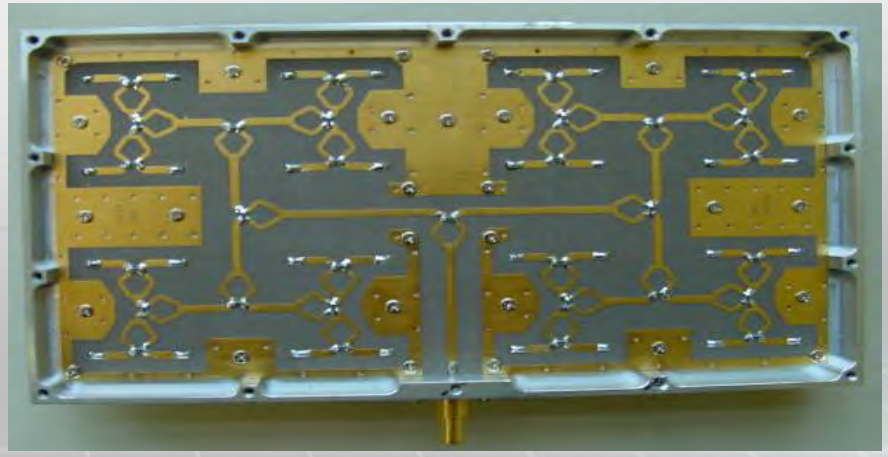
- Design frequency band : 0.5~70 GHz
- Microwave Integrated Circuit(MIC) design
  → Microstrip & Air-strip design
- Components : Transceiver, PLL-LNB, Power divider/combiner, various filters



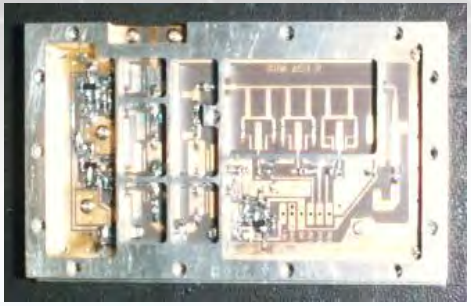
TRx Duplexer with Tx switch

X-band Transceiver (Tx, front-side)
- 3-stages SSPA(4W)
- Tx Attenuator
- Tx HMIC PS

X-band Transceiver (Tx, front-side)
- 3-stages LNA
- Rx BPF
- Rx HMIC PS



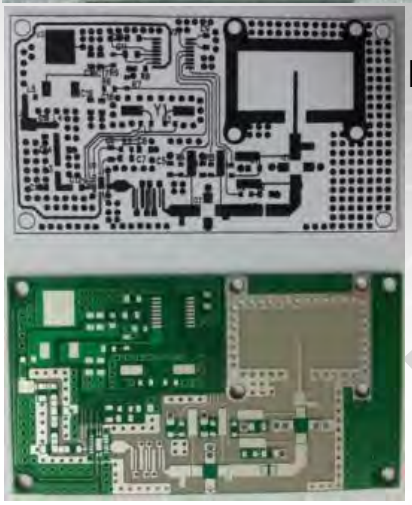
1-32 way power divider/combiner

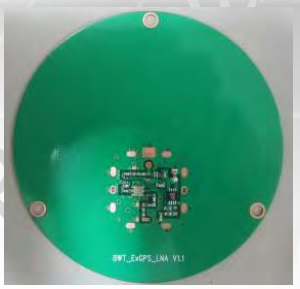


Ku-band Low-noise amplifiers and 3-bit Phase shifter

LNB for Satellite Service

Ku-Band
LNB module





LNA module
for GPS

Input Frequency	10.7~12.75
Noise Figure(@25℃)	0.8 to 1.2dB max.
Input VSWR	2.5:1 typ.
Image Rejection	40dB min.
Output Frequency	950~2000MHz
Conversion Gain	30dB typ.
Output VSWR	2:1 typ.
Gain Flatness	6dB p-p max.
Gain Ripple(@per channel)	±1.0dB max.
P1dB Gain Compression Point	5dBm typ.
Output Impedance	75 Ohms
Local Oscillator Frequency	10.75 GHz
Stability(@25℃)	±1.0MHz
Stability(@-30℃ to +60℃) Leakage(@Input port)	±2.0 MHz, -60dBm max
Phase Noise	-50dBc/Hz(1kHz)
	-75dBc/Hz(10kHz)
	-95dBc/Hz(100kHz)
DC Power Supply	+13 to +24V DC
Required Current	100mA max.
Operating Temperature	-30℃ to +60℃
Storeage Temperature	-40℃ to +80℃
Relative Humidity	0% to 95% RH
Input Waveguide Flange	WR-75
IF Output Connector	F-type Female

BlueWaveTel's Technologies

	Applications	BWT's Technology options
Antenna Design & Development	User Requirements Analysis and RF Solution	Over 20 years experience with Expertise (Doctors and Masters)
	Radiation material & structure	Half loop, Inverted F, Laminated, Patch, Dipole, Monopole, Whip and Blade Types
	Feeding	Coupling, Coaxial, Micro-strip, Air-strip
	Wideband and Multiplexing	Impedance Matching and Balun, Laminated, Multi-resonator
	Interference Cancellation	Filter Design, Mechanical Isolation, Orthogonal Polarization, Parasitic Design
	Design for low frequency	Impedance Matching, Top Loading, Agility Circuit
	Lighting Protection	Discharging Circuit and Structure Design
	Filter & Diplexer Design	Circuit Design and Test
	Mechanical parts	Radome design & material selection per RF characteristics
Production	Manufacturing	In-House manufacturing & QA in Gumi Factory
	QA	ISO 9001 & 14001 certified
Testing	Functional Test	As per customer's spec. with advanced testing equipment
	Environmental Test	As per MIL Spec.

Conclusions : BWT's competitiveness

- Company specializing in customized antenna development : RF Link Budget and Specification Analysis
- Ability to develop antenna topology with various functions/performance
  - Achieved ultra-thin/high efficiency/high gain antenna technology
  - Beam forming/shaping/steering/tilting technology
  - Spot beam antenna for radar system(anti-collision radar : 77~80GHz)
  - Multi-band/multi-beam Antenna
  - High isolation antenna
- Developed military antenna: Blade type antenna for fighter aircraft, Communication antenna for robot and UAV/DRONE, UAV antenna, Smart Bomb/Missile antenna, Satellite array antenna
- GNSS(Global Navigation Satellite System) antenna for DGPS, anti-Jamming/ GPS/GLONASS/Galileo/Beidou Navigation Satellite System
- Over 25 years of experience in antenna technology development, experience in various field tests, superior wireless system engineering capability, and quick technical response
- Small but strong Company, BlueWavetel : provide customers with price competitiveness and technology competitiveness