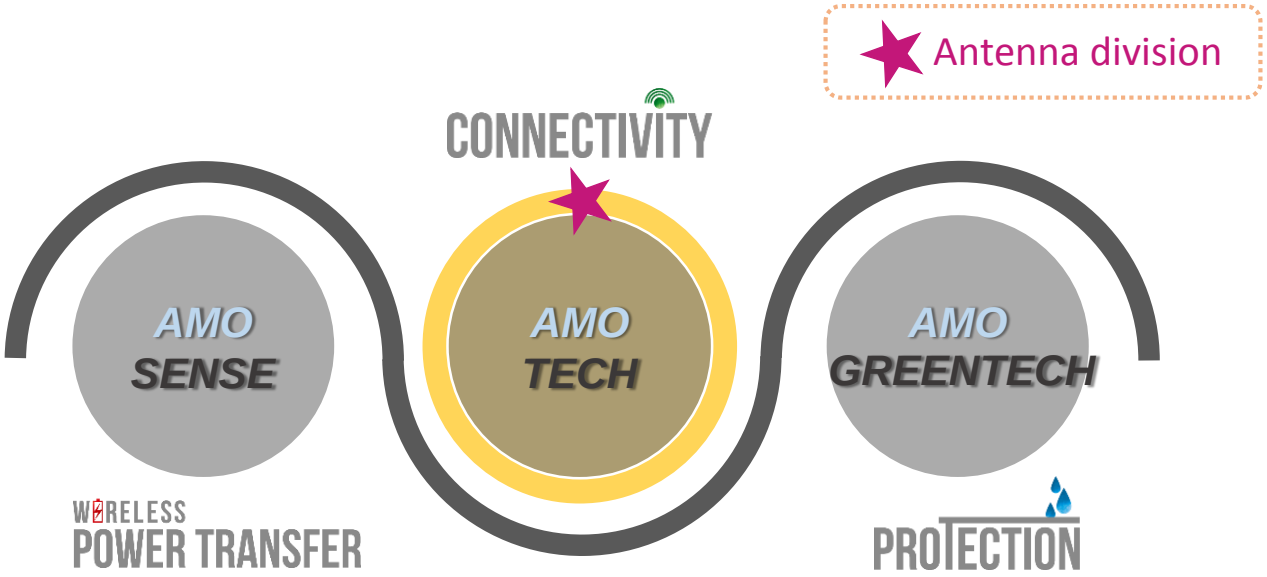
AMOTECH

SOLUTION FOR
AUTOMOTIVE

AMO GROUP



Head office	Incheon, South Korea
Factory	8 sites (5 in Korea & 2 in China & 1 in Vietnam)
Sales office	11 locations in worldwide
R&D center	6 centers (3 in Korea & 3 in China)
Type	KOSDAQ-published in 2003 (Established in 1994)
Sales revenue	$180M(2014) → $320M(2015) → $330M(2016) → $360M(2017)

FACTORY

INCHEON

- Antenna
- Passive Components

HASUNG

- Amorphous core

SUCHAM

- HTF
- Nano fiber membrane
- Air vent

POSEUNG

- Shielding sheet
- WPC
- BLDC motor

CHOENAN

- LED substrate
- Module
- Lightening

ISO/TS 16949 ISO 14001

RoHS COMPLIANT REACH COMPLIANT HF Halogen Free CONFLICT MINERALS COMPLIANCE

QINGDAO

- Motor

SHANDONG

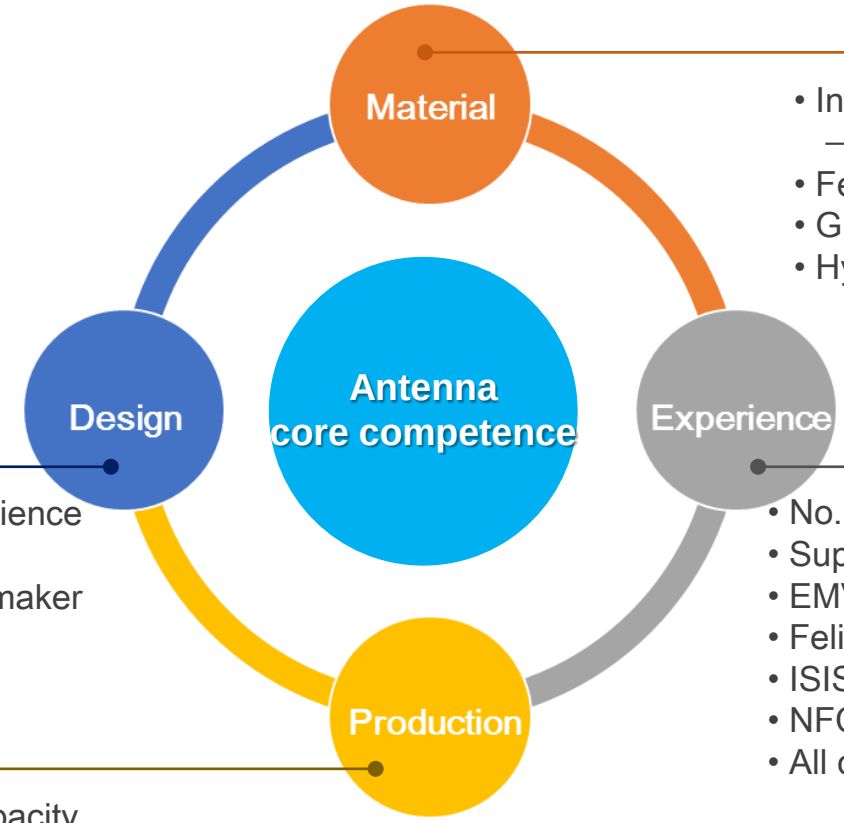
- Antenna (GPS)
- WPC

VINHYEN

- Antenna (NFC)

COMPETITIVENESS

- Chipset
- Certificate



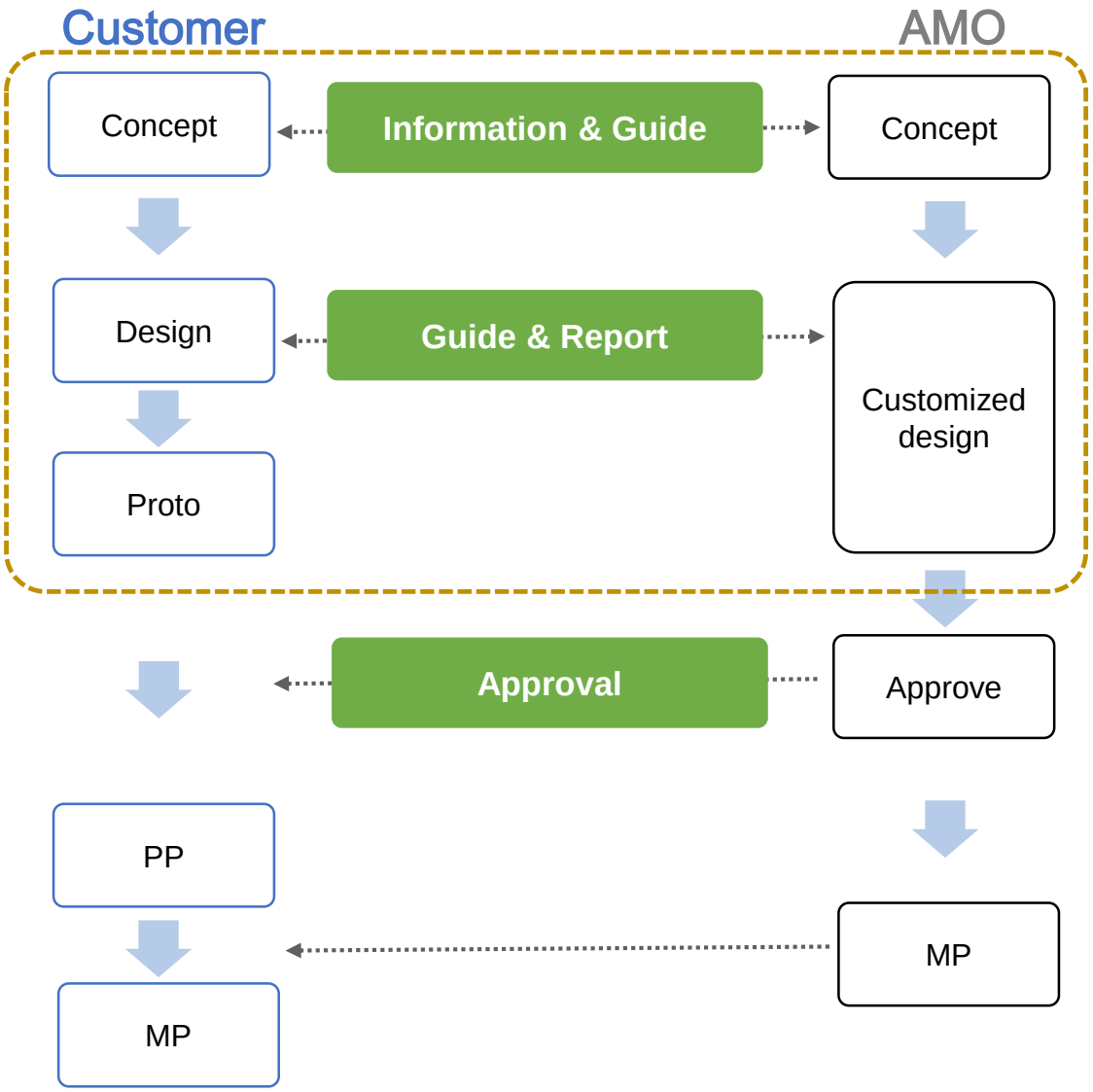
- In-house material
  → Flexibility in material composition
- Ferrite sheet
- Glass metal sheet
- Hybrid sheet

- Various certificate experience
- Customized design
- Co-design with chipset maker
- R&D manpower : 12%

- No. 1 market share : NFC antenna
- Support customers to pass certificate
- EMVCo / ISO (for European market)
- Felica (for Japanese market)
- ISIS (for USA market)
- NFC forum, ISO (for Chinese market)
- All credit card (Visa, Master, Discover)

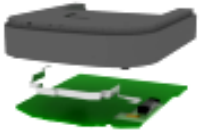
- Biggest capacity
- Fully equipped test bench
- Automation measuring machine

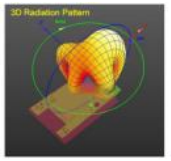
CUSTOMIZED DESIGN

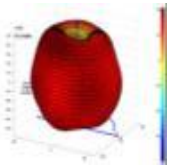


Major Process

- Design guide
- Simulation
- Optimization
- Measurement
  - Gain & Efficiency
  - Isolation
  - Radiation pattern
  - OTA (TRP/TIS)







Simulation Tools

Items	Tool
EM simulation	HFSS
	CST
	SEMCAD
PCB design	CADSTAR
	ALTIUM
Mechanical design	AUTOCAD
	SOLIDWORKS
	RHINO

KEY TOOLS

Equipment

Item	Equipment
Center frequency & Return-loss	Network Analyzer
2D/3D Anechoic Chamber	8x4x4(2D) / 6x3x3(3D) / 2.8x1.6x1.8(3D)
GPS signal generator	Spirent STR4500
NFC EMVCo	3 sets of EMVCo full test bench
Bluetooth tester	TC3000C (Tescom)
WiFi tester	MT9960C R&S PTW70 (Anritsu)
Cellular TRP/TIS	E5515C 8960 (Agilent), MT8820C(LTE)

Design simulation

CST

SolidWorks

SEMCAD X

ANSOFT
ANSYS Product Suite

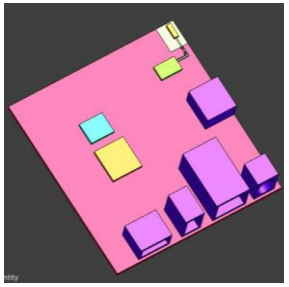
CADSTAR™

Altium

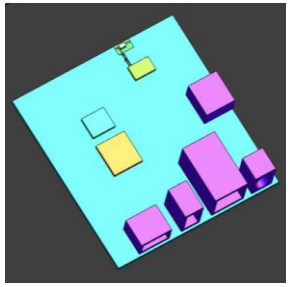
DESIGN SERVICE

1.

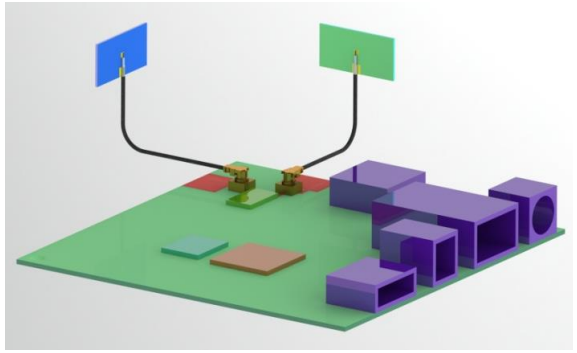
Custom antenna design & Device layout optimization



▲ Monopole



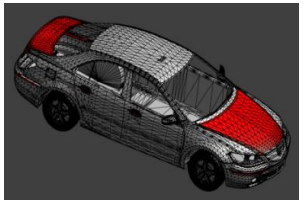
▲ PIFA

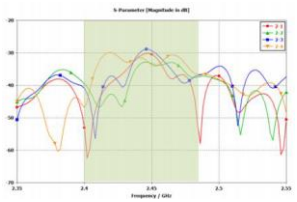


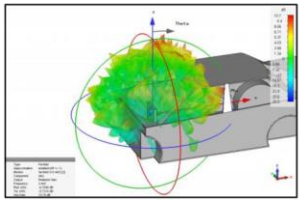
▲ cable assembly

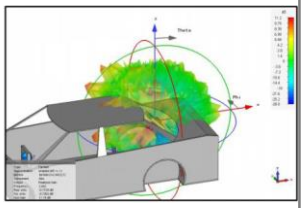
2.

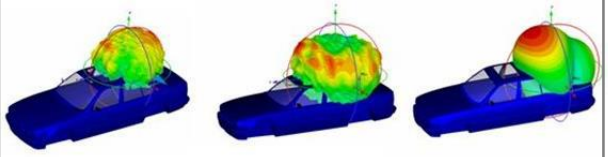
Capability of electro magnetic simulation





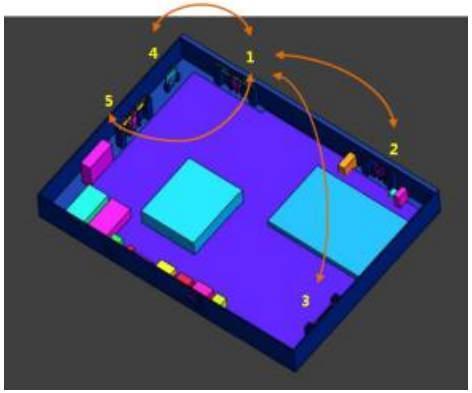


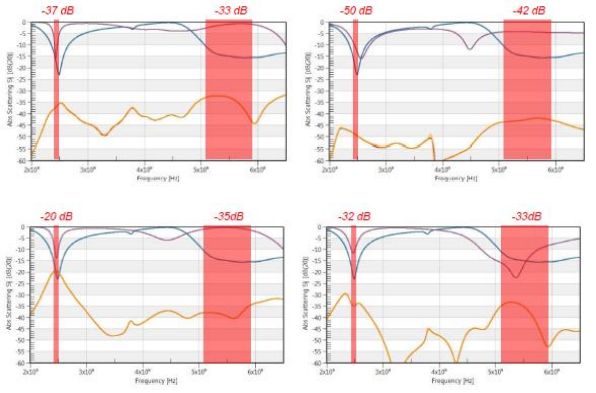




3.

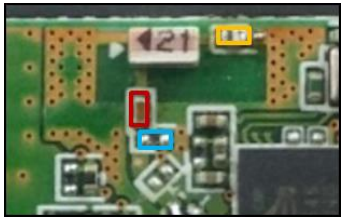
Antenna co-existence test





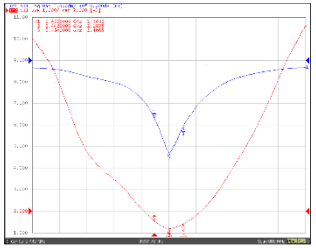
MEASUREMENT

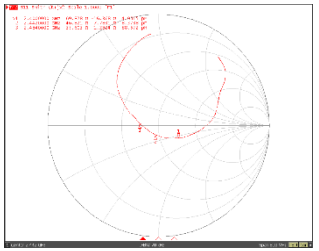
1. Matching information



Test No.	#1-1
Antenna	AMAN301512ST01
Series	1.8nH
Shunt	N/C
GND	1.0nH

2. Passive result : VSWR / Smith chart

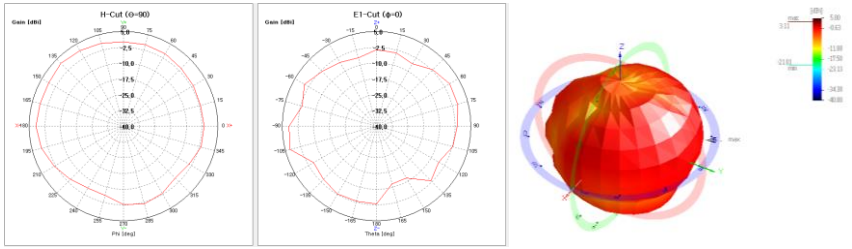




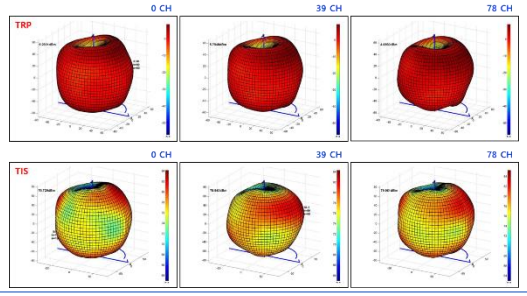
3. Passive antenna gain

Freq. (MHz)	Efficiency (%)	Avg. gain (dBi)	Peak gain (dBi)
2400 MHz	65.21	-1.86	3.15
2442 MHz	69.58	-1.58	3.11
2485 MHz	61.22	-2.13	2.97

4. Passive antenna 2D / 3D radiation pattern



5. Active measurement



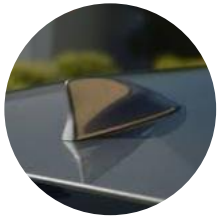
※ AMOTECH measurement

√ To provide test report including No. 1 ~ 5

√ To ensure the customer achieve target spec.

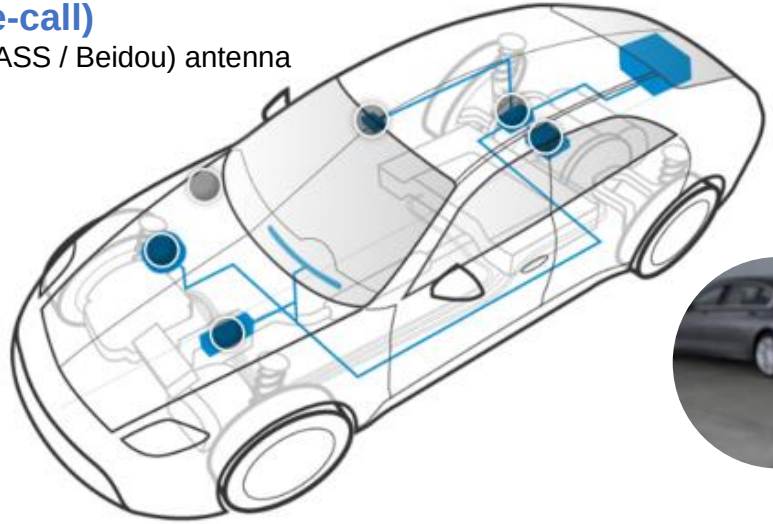
TOTAL SOLUTION

For AVN / Infotainment
- Bluetooth antenna
- WiFi antenna
- NFC antenna



For Shark antenna
- GNSS (GPS / GLONASS / Beidou) antenna
- SDARS antenna

For Telematics (e-call)
- GNSS(GPS / GLONASS / Beidou) antenna
- WiFi antenna
- Bluetooth antenna
- 3G/4G antenna



For V2X
- 5.9GHz antenna

For Smart entry / Key fob
- LF antenna
- 433MHz antenna
- NFC antenna

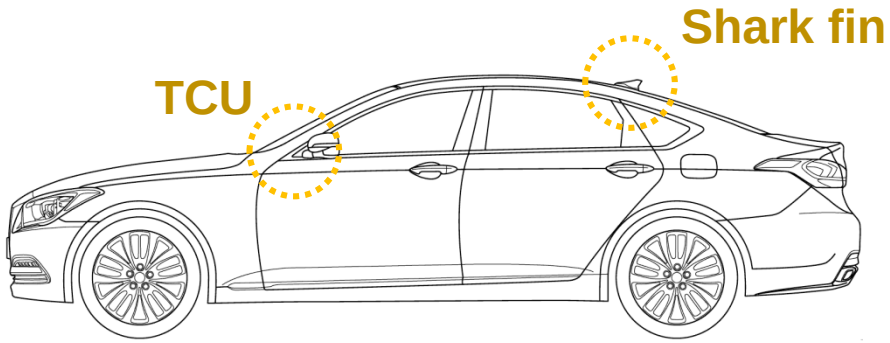
For car sharing
- NFC antenna
- GPS antenna

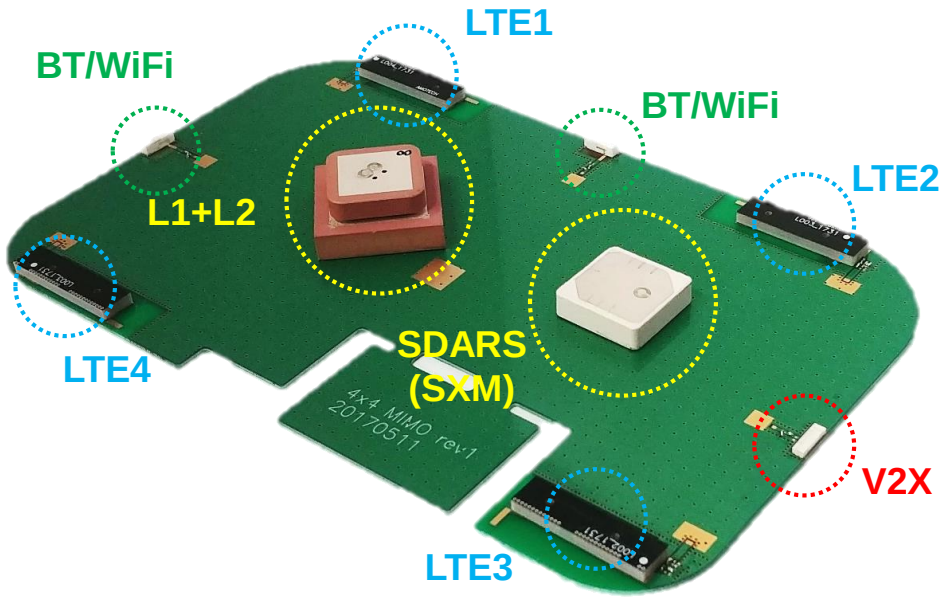
For BCM / SMK / IBU
- 433MHz antenna

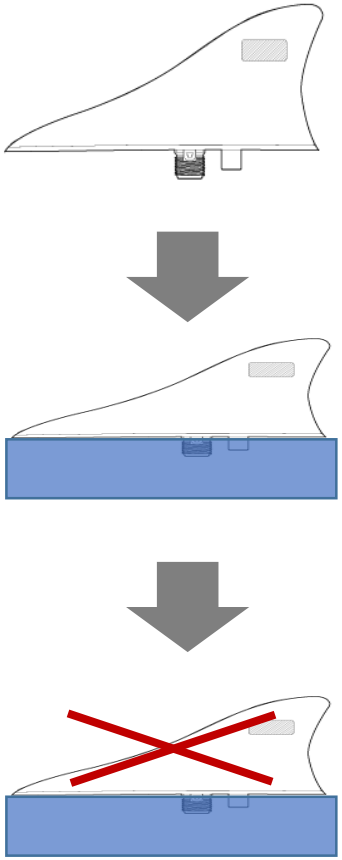
For Wireless charging
- Coil + sheet
- Thermal sheet

ANTENNA TREND

- **Shark fin**







- Conventional type
- New type_1
  - Shark fin + TCU
- New type_2
  - No shark fin

ANTENNA TREND

▪ Navigation transition

Audio → **AV (Audio + Video)** → **AVN (AV + Navigation)** → **CID/AVN**

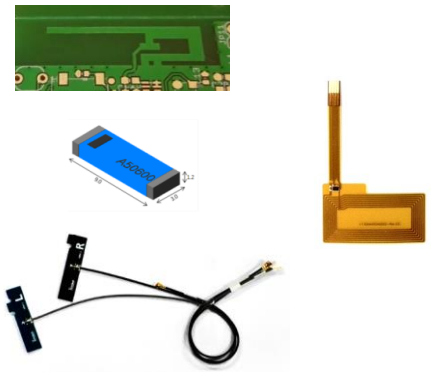
· Bluetooth

· Bluetooth
* Chip / PCB pattern

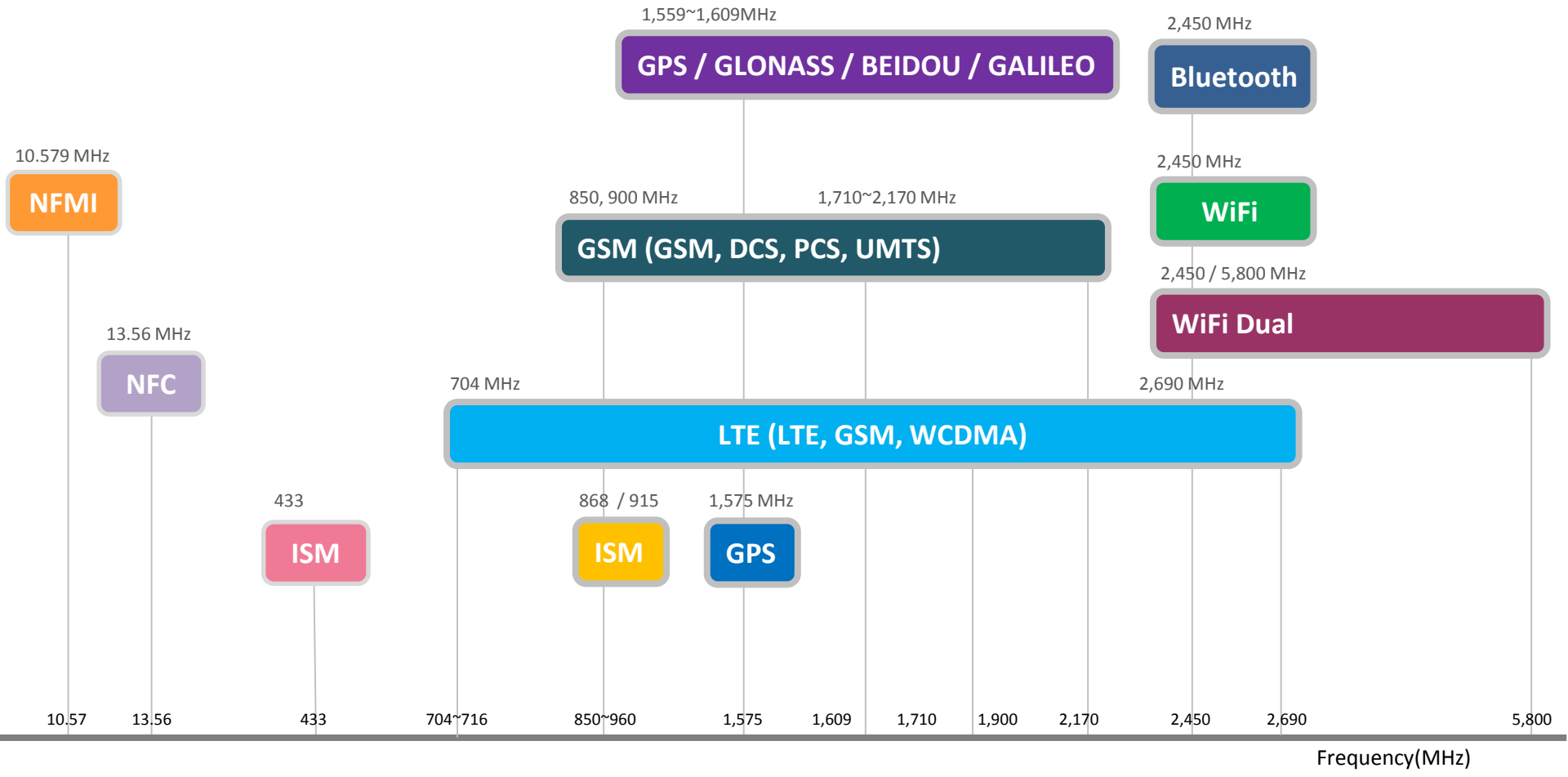
· BT / WiFi / MIMO
* Chip / PCB pattern
· Display : 7~8inch

· BT / WiFi / MIMO / NFC
* Cable assembly
· Display : Over 12inch

▪ NFC embedded technology

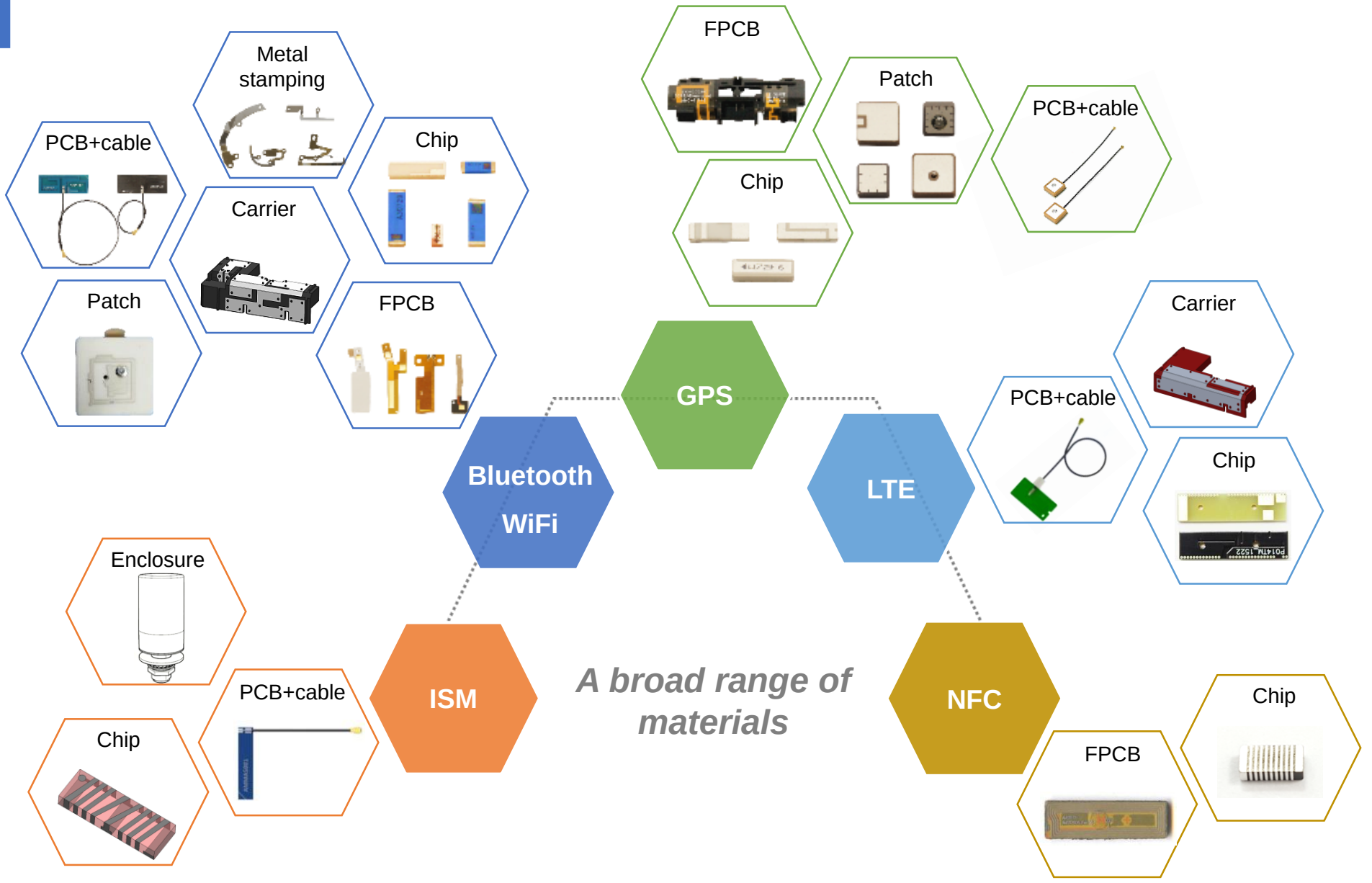


ANTENNA LINE-UP



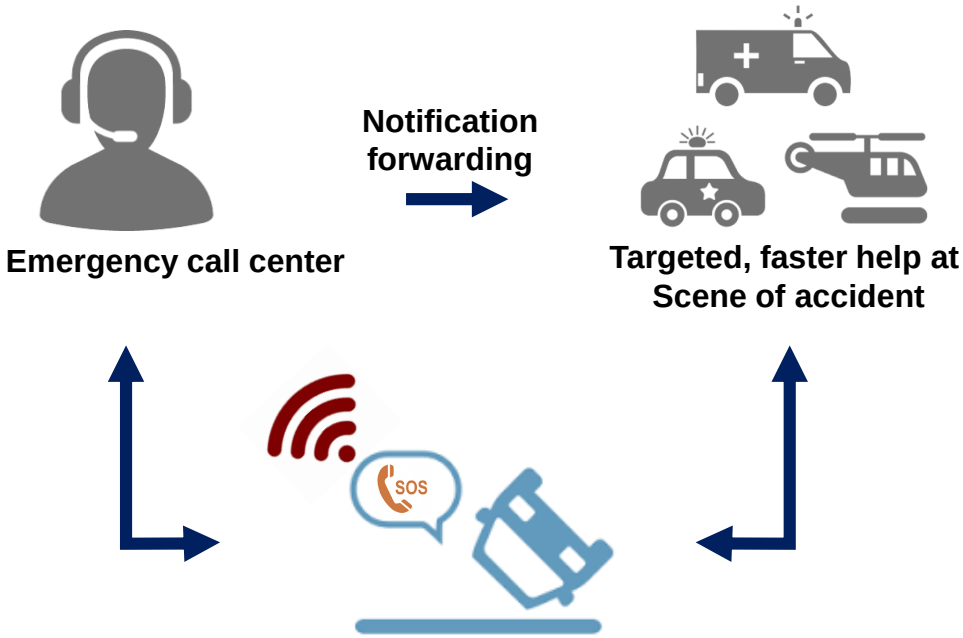
VARIOUS TYPES OF ANTENNAS

AMO
AMOTECH



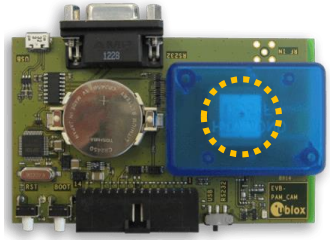
TELEMATICS / E-CALL

eCall system mandatory for all cars sold in the EU from Mar. 31, 2018.



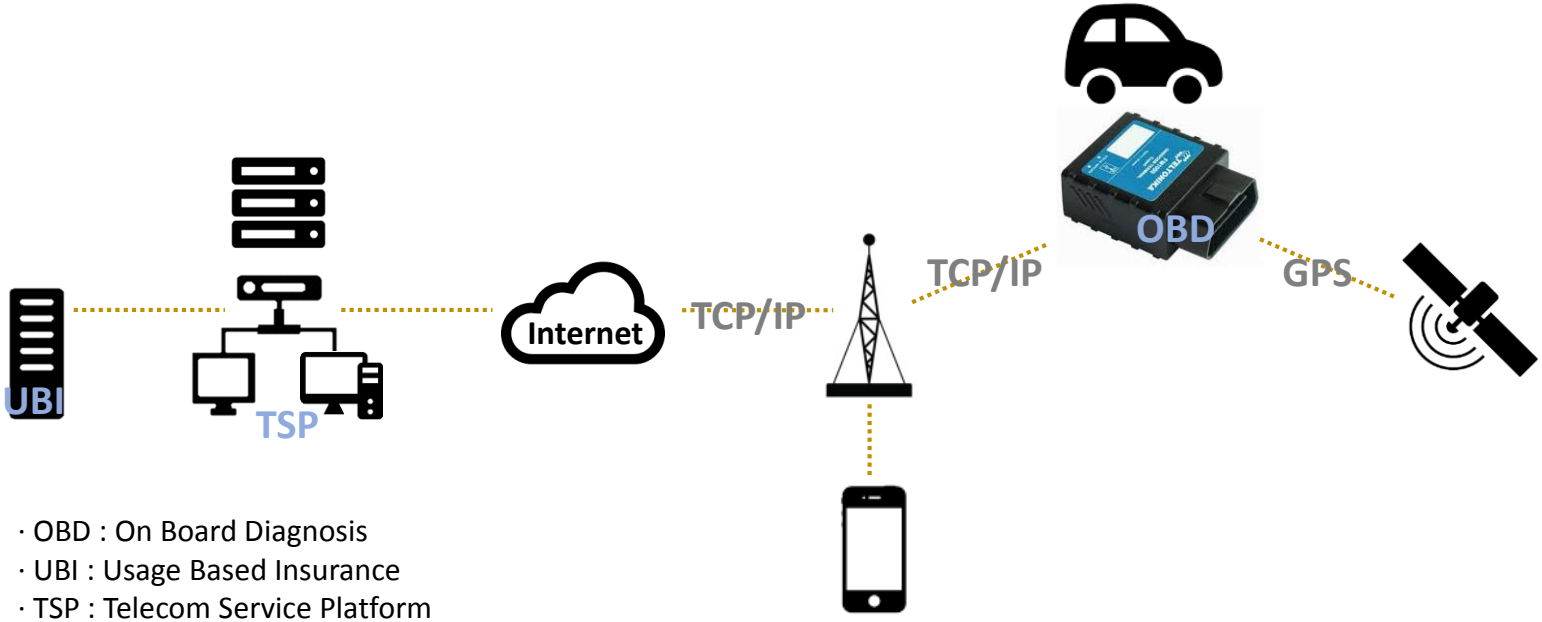
Cellular :
Chip / PCB + cable assembly

GNSS :
GPS / GLONASS / BEIDOU / GALILEO



Bluetooth & WiFi :
SMD chip

OBD / UBI



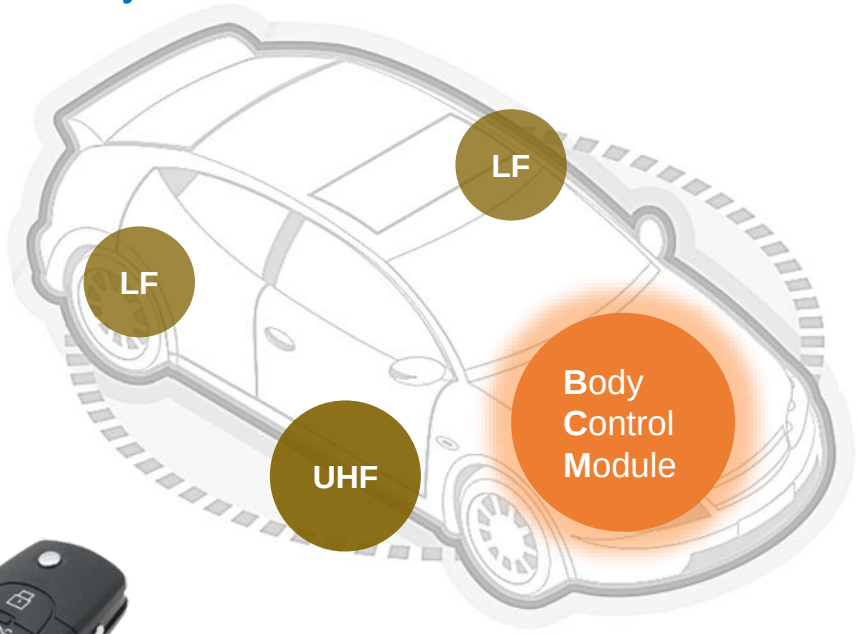
· OBD : On Board Diagnosis
· UBI : Usage Based Insurance
· TSP : Telecom Service Platform

Cellular :
Chip / PCB + cable assembly

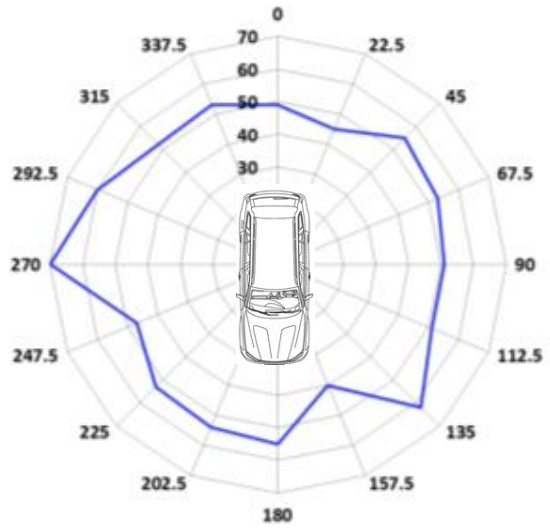
GNSS :
GPS / GLONASS

Bluetooth & WiFi :
SMD chip

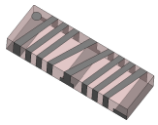
BCM - Body Control Module



- LF antenna
- UHF antenna



▲ Vehicle test_AMOTECH chip antenna

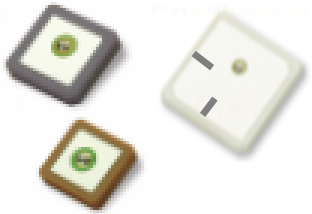
Conventional	AMOTECH
	 • Competitive price • SMT • Equivalent performance 

PATCH ANTENNA DESIGNS

GNSS / SDARS

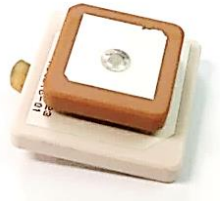
01
E-call

02
Shark fin

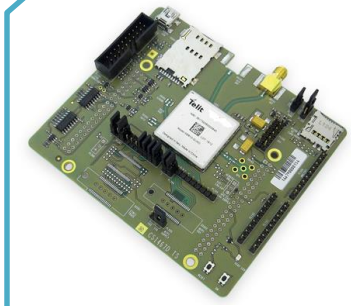


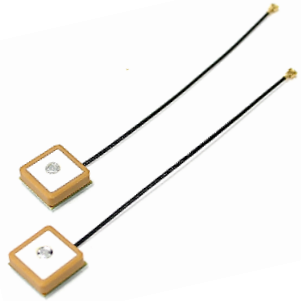
03
GNSS module

04
Shark fin



15
GNSS module





PATCH

Passive antenna overview

GPS L1 + Glonass

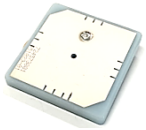
With single feed

GNSS (GPS L1 / Glonass/ Galileo / Beidou)

With dual feed
25x25-6T
Dia.42-6T

SDARS (SXM)

34x34-3T



GPS + SXM

25x25 + 34x34

GNSS + SXM

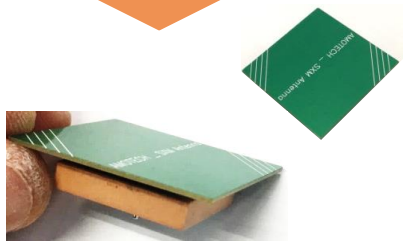
GPS L1 + GPS L2

GPS L1 + GPS L2 + GPS L5

SXM with air gap

35x33-6T

SXM with 2nd radiator



GPS + SXM

18x18 + 25x25

PATCH

Stacked Patch Antenna GNSS L1 + L2 Solutions

High perform 42x13mm
ASPA-A35A

- **GNSS L1 (1559~1608MHz)**

Peak Gain [dBic]	3.2~4.4
Axial Ratio [dB]	0.7~1.3
Isolation [dB]	Min. 23.50

- **GNSS L2 (1215~1255MHz)**

Peak Gain [dBic]	2.2~4.3
Axial Ratio [dB]	1.2~1.5
Isolation [dB]	Min. 22.23

- **Size : Dia. 42-13T**
  - GNSS L1 (Dia. 42-4T)
  - GNSS L2 (Dia. 42-8T)

Slim 42x8mm
ASPA-A36A

- **GNSS L1 (1559~1608MHz)**

Peak Gain [dBic]	3.2~4.4
Axial Ratio [dB]	1.0~1.5
Isolation [dB]	Min. 33.96

- **GNSS L2 (1215~1255MHz)**

Peak Gain [dBic]	-1.5~1.0
Axial Ratio [dB]	1.8~3.2
Isolation [dB]	Min. 20.63

- **Size : Dia. 42-8T**
  - GNSS L1 (Dia. 42-3T)
  - GNSS L2 (Dia.42-4T)

Small 33x15mm
ASPA-A37A

- **GNSS L1 (1559~1608MHz)**

Peak Gain [dBic]	3.1~5.0
Axial Ratio [dB]	1.2~1.8
Isolation [dB]	Min. 17.9

- **GNSS L2 (1215~1255MHz)**

Peak Gain [dBic]	0.7~4.0
Axial Ratio [dB]	0.9~2.7
Isolation [dB]	Min. 23.4

- **Size**
  - GNSS L1 (25x25-6T)
  - GNSS L2 (33x33-8T)

PATCH

Stacked Patch Antenna GNSS L1 + L2 + L5

▪ Requirement check :

GNSS L1 :
L1 : 4dBic @1565.42~1585.42MHz
G1 : 2.5dBic @1599~1619MHz
B1 : ?dBic @1559.098~1563.098MHz
E1 : 4dBic @1609MHz and 1558~1592MHz

GNSS L2 :
L2 : 4dBic @1217.6~1237.6MHz
G2 : 2.5dBic @1242~1262MHz
B2 : 2.5dBic @1197.14~1217.14MHz

GNSS L5 :
L5 : -1.5dBic @1166.45~1186.45MHz
E5 : -1.5dBic @1177~1207MHz

• Case1 : GNSS L1(Dia.42-6T) / GNSS L2&L5(50x50-4.8T)

Band	Performance	G/P 1,000mm	G/P 150mm
GNSS L1 1525~1608M	Zenith Gain [dBic]	0.5~4.2	3.5~5.4
	Axial Ratio [dB]	1.5~2.5	1.6~2.5
GNSS L2/l5 1164~1255M	Zenith Gain [dBic]	-3.7~1.2	0~4.5
	Axial Ratio [dB]	1.5~2.0	1.4~2.0

▲ GNSS L1 : Dia.42-6T
GNSS L2/L5 : 50x50-4.8T

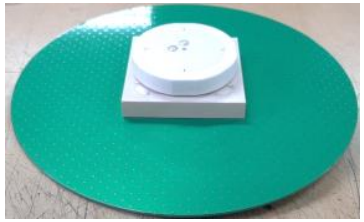
• Case2 : GNSS L1(Dia.42-4T) / GNSS L2/L5 (Dia. 42-8T)

Band	Performance	G/P 1,000mm	G/P 150mm
GNSS L1 1558~1619M	Zenith Gain [dBic]	-	3.2~4.9
	Axial Ratio [dB]	-	Max. 2.5
GNSS L2/l5 1166~1262M	Zenith Gain [dBic]	-	-2.4~4.0
	Axial Ratio [dB]	-	Max. 2.5

▲ GNSS L1 : Dia.42-4T)
GNSS L2/L5 : Dia. 42-8T

PATCH

GNSS L1+L2+Inmarsat SBAS(ASPA-A57A) - High Performance 50x17mm



- GNSS L1+Inmarsat (Dia. 46-8T) / GNSS L2 (50x50x8mm)
- Ground plane dia. : 150mm

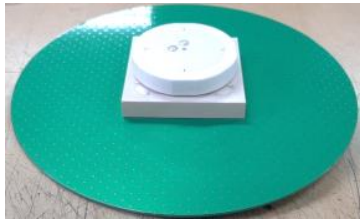
GNSS L1 1559~1608MHz	Peak Gain [dBic]	5.3~5.9
	Axial Ratio [dB]	Max. 1.4
GNSS L2 1194~1255MHz	Peak Gain [dBic]	2.5~5.6
	Axial Ratio [dB]	Max. 2.9
INMARSAT 1525~1550MHz	Peak Gain [dBic]	4.5~5.5
	Axial Ratio [dB]	Max. 2.3

Theta(Θ)	Gain @ GNSS L1 + Inmarsat																	
	1525	1535	1540	1545	1550	1559	1561	1563	1565	1570	1575	1580	1585	1592	1595	1599	1608	1610
0	4.50	4.90	5.02	5.55	5.55	5.54	5.52	5.51	5.59	5.63	5.63	5.63	5.76	5.85	5.90	5.77	5.51	5.33
10	4.35	4.74	4.87	5.30	5.31	5.28	5.25	5.26	5.33	5.42	5.43	5.45	5.59	5.65	5.72	5.54	5.27	5.08
20	3.82	4.25	4.35	4.84	4.84	4.81	4.77	4.78	4.85	4.89	4.91	4.91	5.00	5.04	5.06	4.87	4.59	4.41
30	3.00	3.49	3.62	4.11	4.09	4.09	4.06	4.05	4.10	4.14	4.14	4.10	4.17	4.23	4.20	4.02	3.66	3.47
40	1.99	2.46	2.61	3.12	3.10	3.08	3.05	3.04	3.11	3.17	3.18	3.15	3.24	3.29	3.27	3.03	2.62	2.41
50	0.56	1.12	1.30	1.74	1.75	1.74	1.67	1.68	1.74	1.81	1.80	1.80	1.85	1.87	1.87	1.63	1.29	1.09
60	-0.97	-0.45	-0.29	0.22	0.19	0.22	0.18	0.16	0.27	0.26	0.32	0.31	0.39	0.42	0.42	0.20	-0.23	-0.43
70	-2.61	-2.04	-1.94	-1.42	-1.42	-1.46	-1.49	-1.53	-1.45	-1.41	-1.37	-1.41	-1.34	-1.26	-1.30	-1.55	-1.91	-2.17
80	-4.38	-3.81	-3.58	-3.06	-3.02	-3.09	-3.09	-3.10	-2.96	-2.85	-2.84	-2.81	-2.71	-2.69	-2.70	-2.93	-3.34	-3.56

Theta(Θ)	Gain @ GNSS L2											
	1194	1197	1207	1215	1217	1227	1237	1240	1242	1245	1250	1255
0	2.51	3.03	4.51	5.26	5.41	5.68	5.09	4.76	4.59	4.28	3.80	3.20
10	2.23	2.77	4.24	4.97	5.12	5.38	4.80	4.48	4.32	4.01	3.53	2.93
20	1.56	2.05	3.53	4.24	4.39	4.66	4.07	3.75	3.58	3.29	2.82	2.24
30	0.74	1.20	2.57	3.17	3.29	3.50	2.87	2.54	2.35	2.08	1.60	1.05
40	-0.02	0.42	1.60	2.12	2.21	2.27	1.53	1.20	0.98	0.68	0.20	-0.39
50	-1.13	-0.70	0.51	1.00	1.08	1.06	0.22	-0.13	-0.33	-0.70	-1.18	-1.81
60	-3.01	-2.54	-1.33	-0.88	-0.77	-0.80	-1.63	-1.98	-2.22	-2.52	-3.05	-3.63
70	-4.50	-4.11	-3.00	-2.58	-2.52	-2.69	-3.72	-4.13	-4.39	-4.70	-5.31	-5.94
80	-6.22	-5.74	-4.56	-4.06	-4.06	-4.24	-5.39	-5.81	-6.03	-6.46	-7.08	-7.74

PATCH

GNSS L1+L5+Inmarsat SBAS(ASPA-A58A) - High Performance 50x17mm



- GNSS L1+Inmarsat (Dia. 46-8T) / GNSS L2 (50x50x8mm)
- Ground plane dia. : 150mm

GNSS L1 1559~1608MHz	Peak Gain [dBic]	4.2~5.3
	Axial Ratio [dB]	Max. 1.2
GNSS L5 1166~1192MHz	Peak Gain [dBic]	5.3~6.2
	Axial Ratio [dB]	Max. 2.5
INMARSAT 1525~1550MHz	Peak Gain [dBic]	4.2~4.9
	Axial Ratio [dB]	Max. 2.3

Theta(Θ)	Gain @ GNSS L1 + Inmarsat																		
	1525	1530	1535	1540	1545	1550	1559	1561	1563	156	1570	1575	1580	1585	1592	1595	1599	1608	1610
0	4.24	4.50	4.58	4.70	4.86	4.99	5.26	5.29	5.28	5.25	5.36	5.36	5.24	5.11	4.99	4.86	4.70	4.26	4.24
10	4.18	4.41	4.51	4.64	4.79	4.90	5.12	5.14	5.08	5.05	5.14	5.14	5.03	4.93	4.82	4.69	4.51	4.03	3.98
20	3.73	4.00	4.06	4.21	4.34	4.45	4.67	4.69	4.60	4.59	4.65	4.63	4.52	4.44	4.27	4.15	3.91	3.39	3.37
30	2.95	3.22	3.33	3.42	3.59	3.72	3.94	3.91	3.87	3.83	3.89	3.85	3.77	3.63	3.47	3.34	3.08	2.54	2.51
40	2.01	2.24	2.30	2.45	2.56	2.69	2.97	2.92	2.90	2.87	2.90	2.86	2.72	2.62	2.44	2.33	2.14	1.64	1.58
50	0.69	0.91	0.96	1.07	1.28	1.40	1.62	1.59	1.54	1.47	1.50	1.46	1.29	1.24	1.11	1.01	0.84	0.32	0.28
60	-0.72	-0.52	-0.54	-0.46	-0.29	-0.17	0.03	0.02	-0.06	-0.07	-0.05	-0.11	-0.22	-0.32	-0.51	-0.60	-0.76	-1.32	-1.38
70	-2.37	-2.10	-2.06	-1.93	-1.76	-1.72	-1.65	-1.53	-1.65	-1.74	-1.71	-1.79	-1.93	-2.07	-2.22	-2.33	-2.61	-3.14	-3.20
80	-4.01	-3.80	-3.75	-3.62	-3.44	-3.31	-3.13	-3.22	-3.30	-3.33	-3.34	-3.40	-3.51	-3.66	-3.83	-3.96	-4.22	-4.87	-4.85

Theta(Θ)	Gain @ GNSS L5						
	1166.45	1171.45	1176.45	1177.00	1181.45	1185.45	1192.00
0	5.30	5.70	6.17	6.28	6.18	5.78	5.39
10	5.09	5.50	5.98	6.04	5.95	5.52	5.15
20	4.62	4.99	5.44	5.48	5.35	4.92	4.49
30	4.00	4.34	4.75	4.77	4.61	4.14	3.68
40	3.10	3.46	3.88	3.92	3.73	3.25	2.80
50	1.63	2.03	2.51	2.57	2.41	1.95	1.53
60	-0.19	0.24	0.61	0.68	0.52	0.10	-0.33
70	-1.40	-1.07	-0.66	-0.70	-0.83	-1.39	-1.89
80	-3.37	-3.00	-2.54	-2.48	-2.67	-3.15	-3.63

PATCH

Stacked Patch L1 + L2 + L5 42x13mm

- ➔ GNSS L1 (Dia.42-4T) / GNSS L2&L5 (Dia. 42-8T)
- ➔ Ground plane dia. : 150mm

Band	Performance	G/P 1,000mm	G/P 150mm
GNSS L1 1558~1619M	Zenith Gain [dBic]	-	3.2~4.9
	Axial Ratio [dB]	-	Max. 2.5
GNSS L2 1197~1262M	Zenith Gain [dBic]	-	0~4.0
	Axial Ratio [dB]	-	Max. 2.5
GNSS L5 1166~1207M	Zenith Gain [dBic]	-	-2.4~3.4
	Axial Ratio [dB]	-	Max. 2.5

ASPA-A35A _ High performance Antenna (Dia.42mm-4T + Dia.42mm-8T Stacked Antenna) _ L1 Band RHCP Gain Table

Theta(Θ)	Frequency [MHz]															
	1558	1559	1561	1563	1565	1570	1575	1580	1585	1592	1595	1599	1608	1609	1610	1619
0	3.60	3.61	3.68	3.74	3.84	4.04	4.25	4.38	4.66	4.90	4.84	4.66	4.00	3.87	3.83	3.23
10	3.44	3.50	3.56	3.63	3.73	4.00	4.22	4.30	4.52	4.70	4.63	4.44	3.73	3.66	3.55	3.02
20	2.95	2.98	3.06	3.13	3.23	3.50	3.78	3.84	4.06	4.22	4.13	3.91	3.23	3.13	3.07	2.49
30	2.13	2.17	2.21	2.31	2.42	2.68	2.93	3.01	3.23	3.37	3.31	3.06	2.42	2.32	2.25	1.66
40	0.98	1.04	1.10	1.16	1.27	1.54	1.82	1.88	2.11	2.29	2.20	1.98	1.28	1.19	1.12	0.58
50	-0.33	-0.32	-0.25	-0.15	-0.06	0.24	0.47	0.50	0.71	0.85	0.69	0.51	-0.19	-0.25	-0.38	-0.88
60	-1.79	-1.77	-1.72	-1.67	-1.59	-1.30	-1.11	-1.06	-0.90	-0.83	-0.93	-1.18	-1.93	-2.02	-2.03	-2.61
70	-3.51	-3.45	-3.34	-3.30	-3.24	-3.00	-2.78	-2.76	-2.55	-2.46	-2.62	-2.84	-3.52	-3.61	-3.76	-4.39
80	-5.26	-5.14	-5.17	-5.11	-5.06	-4.78	-4.51	-4.40	-4.24	-4.19	-4.28	-4.54	-5.20	-5.33	-5.45	-6.12

ASPA-A35A _ High performance Antenna (Dia.42mm-4T + Dia.42mm-8T Stacked Antenna) _ L2+L5 Band RHCP Gain Table

Theta(Θ)	Frequency [MHz]												
	1166	1176	1177	1185	1192	1197	1207	1217	1227	1237	1242	1252	1262
0	-2.44	-1.19	-1.15	0.02	1.14	1.93	3.46	4.01	3.73	2.72	2.24	1.16	0.13
10	-2.57	-1.38	-1.33	-0.16	0.96	1.73	3.22	3.76	3.48	2.52	2.00	0.91	-0.07
20	-2.85	-1.74	-1.64	-0.54	0.57	1.31	2.77	3.27	2.91	1.90	1.36	0.26	-0.70
30	-3.45	-2.27	-2.22	-1.08	-0.01	0.76	2.15	2.58	2.17	1.11	0.56	-0.59	-1.62
40	-4.57	-3.27	-3.26	-2.02	-0.95	-0.15	1.28	1.71	1.32	0.19	-0.36	-1.48	-2.52
50	-6.23	-4.93	-4.88	-3.67	-2.52	-1.72	-0.25	0.26	-0.10	-1.16	-1.66	-2.76	-3.78
60	-7.77	-6.69	-6.57	-5.41	-4.34	-3.63	-2.18	-1.80	-2.21	-3.21	-3.77	-4.81	-5.72
70	-8.96	-7.86	-7.80	-6.67	-5.61	-4.96	-3.64	-3.33	-3.87	-5.02	-5.60	-6.76	-7.71
80	-11.02	-9.83	-9.79	-8.59	-7.55	-6.74	-5.38	-5.10	-5.71	-6.86	-7.40	-8.51	-9.39

PATCH

GNSS L1+L2+L5(ASPA-A59A) - Gain data

- GNSS L1 (Dia.46-8T) / GNSS L2&L5 (50x50x8mm)
- Ground plane dia. : 150mm

Band	Performance	Spec.	G/P 150mm
GNSS L1 1558~1619M	Zenith Gain [dBic]	2~4dBic	5.1~5.8
	Axial Ratio [dB]	Max. 3	Max. 1.5
GNSS L2 1197~1262M	Zenith Gain [dBic]	Min. 2.5dBic	2.7~5.9
	Axial Ratio [dB]	Max. 3	Max. 1.1
GNSS L5 1166~1207M	Zenith Gain [dBic]	Min. -1.5dBic	-1.0~5.0
	Axial Ratio [dB]	Max. 3	Max. 1.1

Theta(Θ)	Gain @ GNSS L1															
	1558	1559	1561	1563	1565.42	1570	1575.42	1580	1585.42	1592	1595	1599	1608	1609	1610	1619
0	5.15	5.18	5.27	5.34	5.39	5.55	5.69	5.69	5.73	5.85	5.89	5.84	5.64	5.60	5.58	5.59
10	5.03	5.03	5.13	5.17	5.19	5.36	5.47	5.48	5.54	5.72	5.72	5.67	5.39	5.35	5.30	5.29
20	4.56	4.61	4.66	4.69	4.72	4.87	4.97	4.96	5.05	5.20	5.17	5.09	4.80	4.74	4.71	4.71
30	3.83	3.86	3.90	3.95	3.98	4.11	4.21	4.22	4.26	4.36	4.36	4.27	3.96	3.91	3.86	3.79
40	2.81	2.86	2.90	2.96	2.98	3.11	3.19	3.18	3.25	3.36	3.37	3.32	3.02	2.99	2.92	2.82
50	1.50	1.54	1.57	1.59	1.63	1.70	1.76	1.79	1.88	1.99	2.01	1.98	1.69	1.62	1.58	1.57
60	-0.11	-0.06	-0.02	0.00	0.05	0.16	0.21	0.23	0.30	0.44	0.45	0.43	0.02	0.02	-0.07	-0.17
70	-1.67	-1.61	-1.59	-1.58	-1.57	-1.48	-1.45	-1.43	-1.38	-1.33	-1.33	-1.42	-1.80	-1.78	-1.91	-1.94
80	-3.39	-3.29	-3.23	-3.22	-3.26	-3.14	-3.01	-3.08	-3.02	-2.91	-2.87	-3.02	-3.40	-3.44	-3.45	-3.59

Theta(Θ)	Gain @ GNSS L2/L5															
	1166	1171	1176	1177	1181	1185	1192	1197	1207	1217	1227	1237	1242	1247	1252	1257	1262
0	-1.01	-0.36	0.29	0.31	0.86	1.50	2.58	3.48	5.00	5.86	5.97	5.29	4.85	4.37	3.82	3.24	2.75
10	-1.22	-0.55	0.02	0.09	0.62	1.24	2.31	3.21	4.72	5.59	5.71	5.00	4.59	4.11	3.62	3.03	2.55
20	-1.69	-1.05	-0.47	-0.46	0.07	0.64	1.71	2.55	4.04	4.89	5.01	4.33	3.91	3.50	3.01	2.43	1.95
30	-2.31	-1.74	-1.20	-1.15	-0.64	-0.12	0.90	1.75	3.16	3.93	4.01	3.33	2.89	2.46	1.93	1.41	0.97
40	-3.16	-2.55	-2.05	-2.00	-1.52	-0.96	0.04	0.86	2.20	2.89	2.95	2.22	1.81	1.33	0.80	0.24	-0.21
50	-4.56	-3.97	-3.40	-3.33	-2.80	-2.25	-1.20	-0.36	1.01	1.72	1.80	1.10	0.66	0.22	-0.26	-0.83	-1.27
60	-6.27	-5.73	-5.16	-5.06	-4.62	-4.06	-2.96	-2.20	-0.79	-0.07	0.04	-0.64	-1.03	-1.43	-1.88	-2.37	-2.81
70	-7.46	-6.93	-6.37	-6.38	-5.89	-5.34	-4.47	-3.64	-2.40	-1.78	-1.77	-2.54	-2.94	-3.37	-3.85	-4.34	-4.83
80	-9.27	-8.73	-8.12	-8.01	-7.68	-7.05	-6.11	-5.33	-4.10	-3.54	-3.46	-4.24	-4.65	-5.06	-5.47	-6.00	-6.41

PATCH

GNSS L1+L2+L5(ASPA-A59A) - AR data

- GNSS L1 (Dia.46-8T) / GNSS L2&L5 (50x50x8mm)
- Ground plane dia. : 150mm

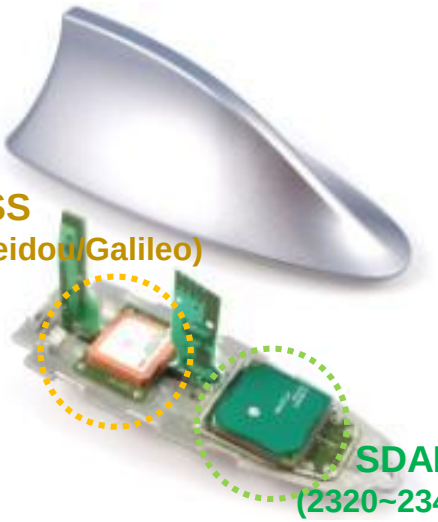
Band	Performance	Spec.	G/P 150mm
GNSS L1 1558~1619M	Zenith Gain [dBic]	2~4dBic	5.1~5.8
	Axial Ratio [dB]	Max. 3	Max. 1.5
GNSS L2 1197~1262M	Zenith Gain [dBic]	Min. 2.5dBic	2.7~5.9
	Axial Ratio [dB]	Max. 3	Max. 1.1
GNSS L5 1166~1207M	Zenith Gain [dBic]	Min. -1.5dBic	-1.0~5.0
	Axial Ratio [dB]	Max. 3	Max. 1.1

Theta(Θ)	Axial ratio @ GNSS L1															
	1558	1559	1561	1563	1565	1570	1575	1580	1585	1592	1595	1599	1608	1609	1610	1619
0	1.47	1.46	1.41	1.47	1.43	1.37	1.40	1.38	1.39	1.42	1.44	1.52	1.47	1.48	1.50	1.57
10	1.46	1.46	1.46	1.46	1.43	1.40	1.40	1.48	1.47	1.47	1.46	1.53	1.56	1.57	1.52	1.66
20	1.55	1.52	1.47	1.49	1.41	1.45	1.45	1.46	1.51	1.57	1.62	1.60	1.69	1.68	1.74	1.83
30	1.53	1.52	1.55	1.50	1.52	1.52	1.57	1.63	1.63	1.70	1.77	1.82	2.01	1.96	1.98	2.25
40	1.82	1.80	1.86	1.81	1.84	1.89	1.98	2.01	2.09	2.23	2.25	2.33	2.59	2.56	2.58	2.89
50	2.26	2.25	2.28	2.33	2.36	2.42	2.52	2.68	2.76	2.90	2.90	3.05	3.20	3.25	3.28	3.54
60	3.18	3.16	3.23	3.16	3.15	3.28	3.39	3.52	3.48	3.55	3.72	3.67	3.95	3.96	3.94	4.34
70	4.33	4.37	4.43	4.41	4.44	4.54	4.54	4.70	4.61	4.88	4.89	4.86	5.06	4.98	5.03	5.37
80	5.42	5.30	5.52	5.46	5.58	5.52	5.66	5.80	5.87	5.58	5.73	5.77	5.69	5.87	5.92	6.19

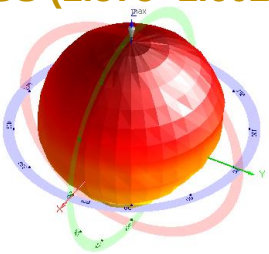
Theta(Θ)	Axial ratio @ GNSS L2/L5															
	1166	1171	1176	1177	1181	1185	1192	1197	1207	1217	1227	1237	1242	1247	1252	1257	1262
0	0.97	0.99	0.98	0.98	1.02	0.98	0.96	0.94	0.95	1.06	1.05	0.99	0.96	0.92	0.90	0.77	0.77
10	1.13	1.10	1.11	1.10	1.09	1.05	1.05	1.02	0.99	1.07	1.07	1.03	0.96	0.94	0.86	0.89	0.79
20	1.44	1.39	1.41	1.36	1.39	1.38	1.31	1.32	1.23	1.25	1.17	1.07	1.09	1.07	1.05	0.95	0.88
30	2.04	1.96	1.95	2.00	1.90	1.88	1.78	1.73	1.51	1.48	1.36	1.24	1.17	1.11	1.17	1.05	1.00
40	3.03	2.80	2.70	2.72	2.61	2.38	2.26	2.14	1.90	1.74	1.54	1.33	1.26	1.16	1.09	0.99	0.96
50	3.93	3.75	3.64	3.54	3.47	3.23	2.99	2.68	2.36	2.15	1.84	1.52	1.36	1.16	1.06	0.81	0.75
60	4.41	4.18	4.14	4.19	4.17	3.96	3.66	3.64	3.20	2.87	2.36	1.89	1.77	1.50	1.30	1.02	0.91
70	5.83	5.60	5.36	5.29	4.93	4.78	4.43	4.27	3.85	3.41	2.97	2.56	2.28	1.96	1.80	1.73	1.53
80	6.69	6.46	6.19	6.04	5.91	5.48	5.16	4.80	4.28	3.67	3.03	2.44	2.26	2.01	1.86	1.77	1.80

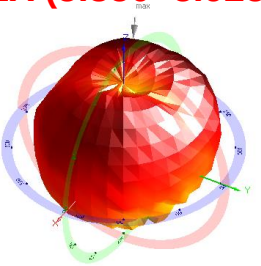
PATCH

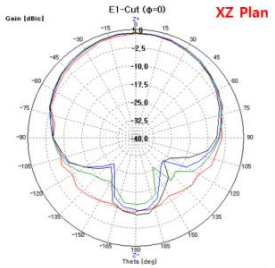
V2X solution in the shark antenna

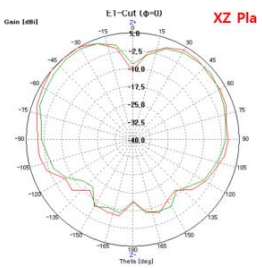


GNSS (1.575~1.602G) + **V2X (5.850~5.925G)**









V2X (5.850~5.925GHz)	GNSS (1.575~1.602GHz)
▪ Omni directional ▪ Linear polarization	▪ Directional ▪ RHCP

Freq. [MHz]	Peak [dBic]	Zenith [dBic]
1575	3.4	3.2
1602	3.87	3.5

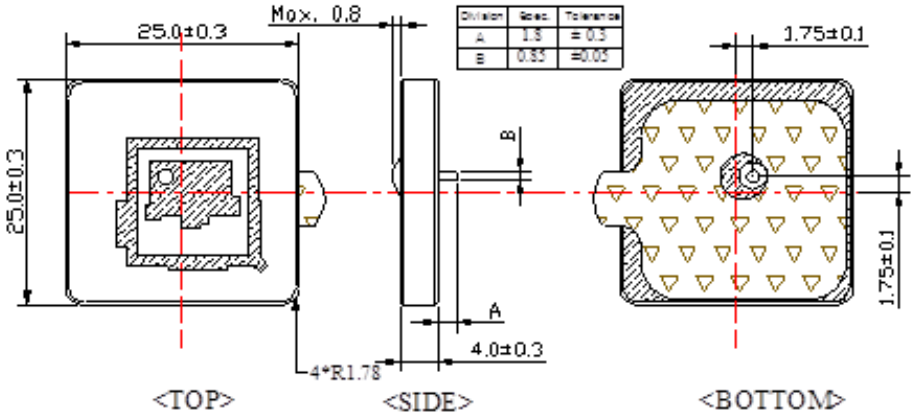
Freq. [MHz]	Eff. [%]	Avg. [dBi]	Peak [dBi]
5850	79	-1.0	5.5
5925	69	-1.6	4.6

• V2X

	Application	AMOTECH solution	Part No.
Omni Directional	Car to Car	√ 5.9G chip √ 2.4G/5G dual patch	AMAN1003015ST04 A25-410M870-AMT31
Directional	Car to Infrastructure	√ Patch	G12-4559870-AMT28

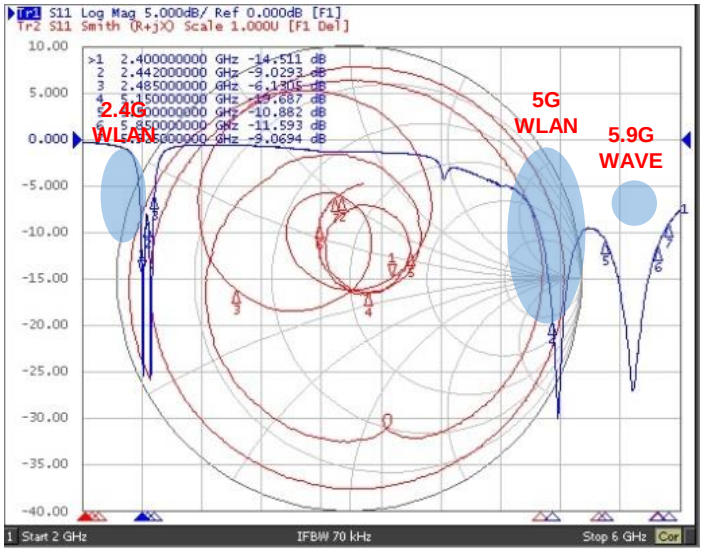
PATCH

Dual WiFi 2.4GHz and 5GHz & 5.9GHz(Wave)

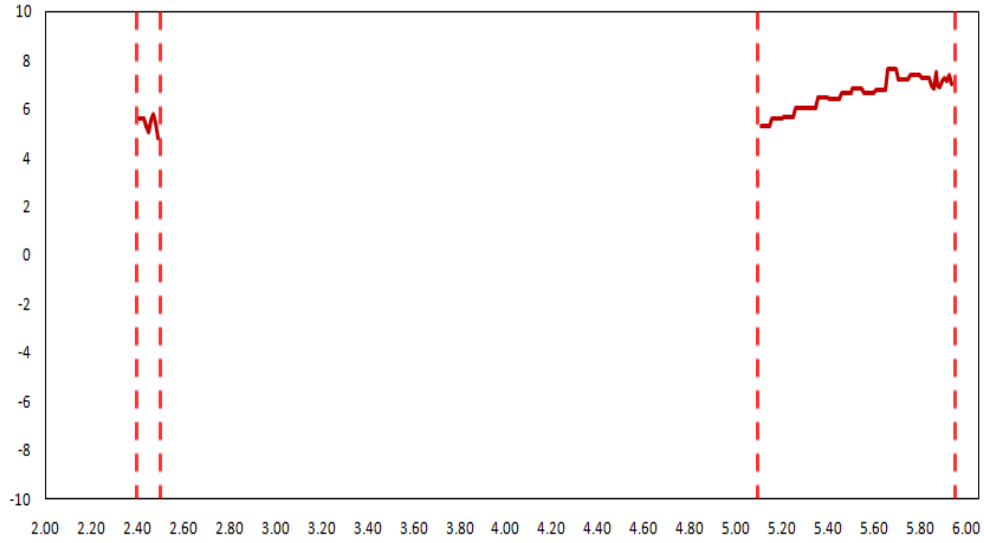


▲ 25x25-4T

- **S11**



- **Peak gain**



▲ Frequency [GHz]

GNSS

GPS / SDARS Line-Up (passive patch)

Type	Part number	Size (mm)	Frequency (MHz)	Gain@Zenith (dBic)	Axial Ratio (dB)	Polarization	G/P Size (mm)
Pin type	**A9-4T**	9x9x4	GPS L1	-4.5	Typ. 4.0	RHCP	30x30
	D12-2T	12x12x2		-4.5	3.0	RHCP	12x12
	D12-4T	12x12x4		-2.0	3.0	RHCP	12x12
	YDRA-A15-1575	15x15x4		0.9	Typ.2.0	RHCP	30x30
	YDRA-A18-1575	18x18x4		3.4	Typ.2.0	RHCP	50x50
	A20-4565753-STD60	20x20x4		4.8	Typ.2.0	RHCP	60x60
	YDRA-A25-1575	25x25x4		5.8	Typ.2.0	RHCP	70x70
	B35-3452753-STD35	35x35x3		2.4	Typ.2.0	RHCP	35x35
SMD type	**B9**	9x9x4	GPS L1	-4.5	Typ. 4.0	RHCP	30x30
	E12-4T	12x12x4		-3.3	3.0	RHCP	About 14x17
	B18-4T	18x18x4		4.0	Typ.2.0	RHCP	70x70
	G25-4T	25x25x4		5.8	Typ.2.0	RHCP	70x70
Pin type	**S25,SB25,SG25,SH25-STD70**	25x25x4	SDARS (SXM)	5.0	2.0	LHCP	70x70
	SB34-STD70	34x34x3.2		5.0	2.0	LHCP	70x70

GNSS

GPS / GLONASS / BEIDOU / GALILEO Line-Up (passive patch)

Type	Part number	Size (mm)	Frequency (MHz)	Gain@Zenith (dBic)	Axial Ratio (dB)	Polarization	G/P Size (mm)
Pin type	**A13-4T**	13x13x4	GPSL1/Glonass	1.0	Typ. 20	RHEP	70x70
	A15-4T	15x15x4	GPSL1/Glonass	2.0	Typ. 15	RHEP	70x70
	A18-4T	18x18x4	GPSL1/Glonass	2.8	Typ. 12.0	RHEP	70x70
	A18-4T	18x18x4	GPSL1/Beidou	3.0	Typ. 10.0	RHEP	70x70
	A25-4102920-AMT02	25x25x4	GPSL1/Glonass	3.7	Typ. 8	RHCP	70x70
	A25-4T	25x25x4	GPSL1/Beidou	4.5	Typ. 6	RHCP	70x70
	A25-6B02920-AMT15	25x25x4	GPSL1/Glonass	4.0	Typ. 8	RHCP	70x70
	A25-6T	25x25x6	GPSL1/Beidou	5.0	Typ. 4	RHCP	70x70
	N25-4102820-GNS5	25x25x4	GPS/Glonass/ Galileo/Beidou	2.0	2.0	RHCP	70x70
	N25-6B02920-GNS6	25x25x6		3.0	2.0	RHCP	70x70
SMD type	**E12-4T**	12x12x4T	GPSL1/Glonass	-6.5	Typ. 10	RHEP	About 14x17
	B18-4T(Glonass)	18x18x4	GPSL1/Glonass	2.7	Typ. 2.0	RHEP	70x70
	B18-4T(Beidou)	18x18x4	GPSL1/Beidou	8.0	Typ. 2.0	RHEP	70x70

GNSS

GPS / GLONASS / BEIDOU Line-Up (active embedded or external)

Type	Part number	Size (mm)	Frequency (MHz)	LNA gain (dB)	NF (dB)	Current (mA)	Cable(mm)/connector
Embedded type	**AGA090904-S0-A1**	10x10-6.8T	GPS	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=0.81, L=30 / U.FL Equivalence
	AGA250602-S0-A1	39x5.7-3T	GPS	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=62 / U.FL Equivalence
	AGA121202-S0-A3	12x12-4.8T	GPS	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA121204-S0-A11	12x12-6.8T	GPS/Glonass	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA151502-S0-A1	15x15-4.8T	GPS	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA151504-S0-A8	15x15-6.8T	GPS/Glonass	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA181802-S0-A3	18x18-4.8T	GPS	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA181804-S0-A8	18x18-6.8T	GPS/Glonass	Typ. 19	Typ. 1.2	Typ. 4.0 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA252502-S0-A6	25x25-6.5T	GPS/Glonass	Typ. 30	Typ. 1.5	Typ. 11 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
	AGA252504-S0-A7	25x25-8.5T	GPS/Glonass	Typ. 30	Typ. 1.5	Typ. 11 @ 3V	Φ=1.13, L=100 / U.FL Equivalence
External type	**AGA363913-S0-A1**	36x39-13T	GPS/Glonass/Beidou	Typ. 30	Typ. 1.5	Typ. 14 @ 5V	RG174 Φ2.8, L=3,000/ SMA
	AGA363914-S0-A5 (New, Pre-LNA)	36x39-14T	GPS/Glonass/Beidou	Typ. 30	Typ. 1.5	Typ. 14 @ 5V	RG174 Φ2.8, L=3,000/ SMA
	AGA393914-S0-A2 (New, IP66)	39x39-14T	GPS/Glonass/Beidou	Typ. 30	Typ. 1.5	Typ. 14 @ 5V	RG174 Φ2.8, L=3,000/ SMA

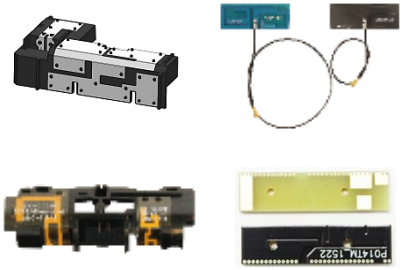
GNSS

GPS chip

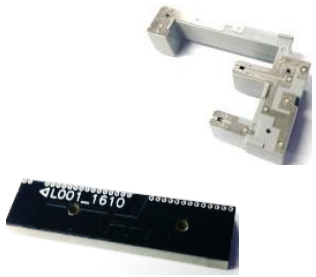
Type	Part number	Size (mm)	Frequency (MHz)	VSWR	Gain	
					Average	Peak
PIFA type	**AMAN1003030ST01**	10x3.0x3.0	GPS	3.0:1	-0.3	3.7
	AMAN1003015ST01	10x3.0x1.5	GPS	3.0:1	-1.1	1.0
	AMAN1003015ST02		Glonass	3.0:1	-1.1	2.3
	AMAN1003015ST03		GPS+Glonass	3.0:1	-0.7~-0.1	2.8, 2.2

CELLULAR ANTENNA

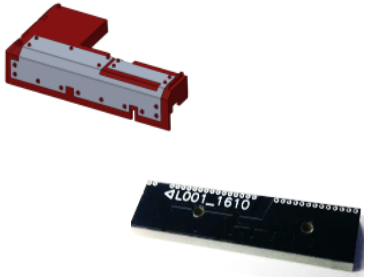
2G



3G



US
LTE



EU
LTE

GLOBAL
LTE

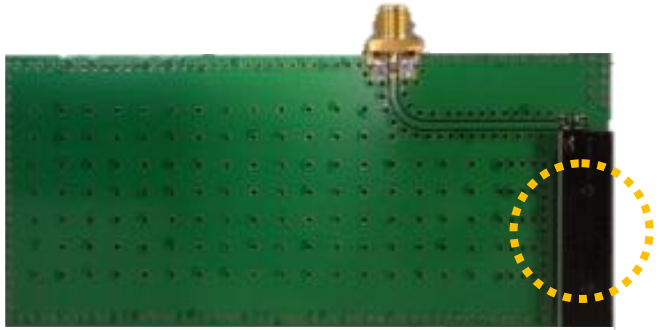
CELLULAR

Type	Part Number	Size (mm)	Frequency	VSWR	Gain (dBi)		EVB Size (mm)
					Average	Peak	
PCB + cable	AMMAP007(FPCB)	40.0x15.0x0.55	GSM850 GSM900 DCS1800 PCS1900 WCDMA UMTS	3:1	-1.0	3.0	-
	AMMAP008(PR4)	40.0x15.0x0.14		3:1	-3.0	4.0	-
	AMMAP009	40.0x15.0x0.14		3:1	Min. -4.5	-	-
Customizing	Press or FPCB with carrier	Optional		-	-	-	-
Cellular Chip (SMD)	AMMAP017	20x8-3.2T		3:1	Min. -3.5	3.4	114x50
	AMMAP003(F)	24.0x5.5x4.4		3.5:1	Min. -3.7	4	114x45
	AMMAP005(R)	24.0x5.5x4.4		3.5:1	Min. -3.7	4	114x45
	AMMAQ002	22.0x5.5x4.4		3.5:1	Min. -3.3	3	114x45
	AMMAP014	35.0x9.0x3.2		2.7:1	Min. -3.3	3	110x50
	AMMAL001	35.0x9.0x3.2	US LTE	2.7:1	Min. -2.6	3	120x50
	AMMAL002	35.0x9.0x3.2	EU LTE (791~2690MHz)	3.0:1	Min. -3.4	3	120x50
	AMMAL004	35.0x9.0x3.2	Global LTE	3.8:1	Min. -3.6	3	141X50

CELLULAR 3G

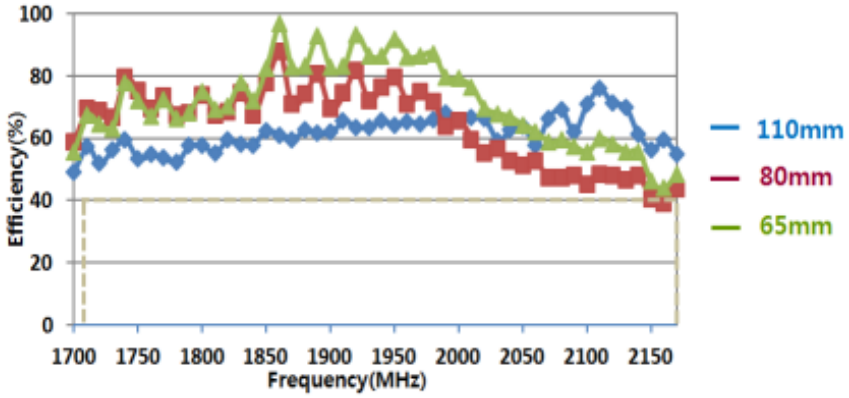
AMMAP014TM (824~960, 1710~2170MHz)]

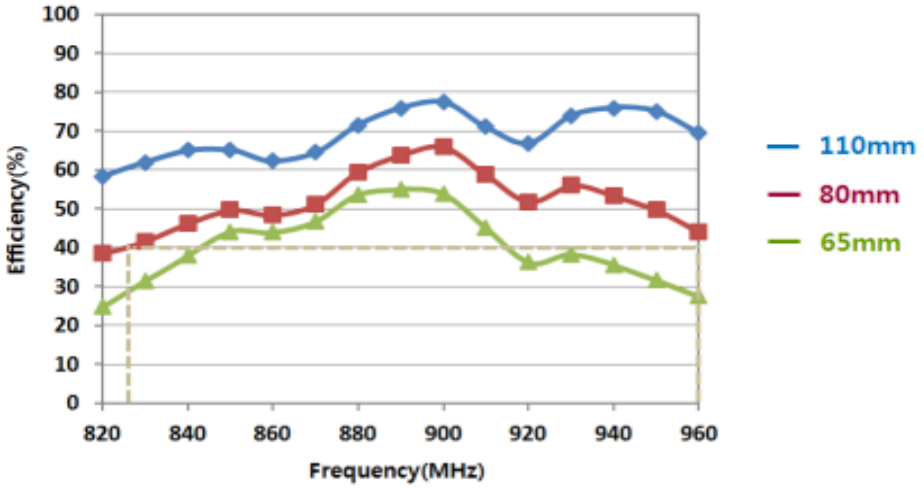
Item	GSM850	GSM900	DCS	PCS	UMTS
Frequency [MHz]	824~894	880~960	1710~1880	1850~1990	1920~2170
Peak gain [dBi]	1.13	0.89	1.87	2.39	2.99
Average eff. [%]	69.13%		61.98 %		
VSWR	2.7 : 1 max				



- Antenna size : 35 * 9 * 3.2T (mm)
- Board size : 110 * 50 * 0.8T (mm)

▪ Efficiency @ different EVB size





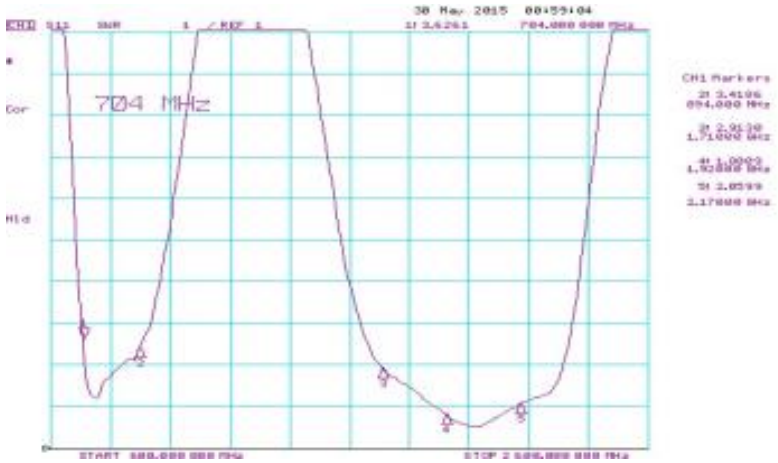
CELLULAR US LTE

AMMAL001 (704~894, 1710~2155MHz)

Item	LTE17	GSM850/LTE5/WCDMA5	LTE2/WCDMA2	WCDMA4
Frequency [MHz]	704~716 734~746	824~894	1850~1990	1710~1755 2110~2155
Peak gain [dBi]	0.59	0.29	2.82	1.96 (1710~1755) 2.78 (2110~2155)
Average eff. [%]	60.3 %	52.26 %	68.02 %	53.32% (1710~1755) 77.42% (2110~2155)
VSWR	3.62 : 1			

- **Antenna size : 35 * 9 * 3.2T (mm)**
- **Board size : 120 * 50 * 1.6T (mm)**

▪ VSWR / Efficiency @ EVB



Band	Frequency (MHz)	EFF. (%)	Avg. (dB)	Peak (dB)
LTC17	704	51.83	-2.85	-0.64
	716	53.53	-2.71	-0.57
	734	63.72	-1.96	0.09
	746	72.12	-1.42	0.59
GSM850 LTE5 WCDMA5	824	60.45	-2.19	0.29
	849	55.84	-2.53	0.23
	869	49.44	-3.06	-0.11
	894	46.58	-3.32	-0.12
LTE2 WCDMA2	1850	68.12	-1.67	2.25
	1910	71.43	-1.46	2.8
	1930	64.33	-1.92	2.48
	1990	70.05	-1.55	2.38
WCDMA4	1710	51.67	-2.87	1.67
	1755	54.97	-2.6	1.96
	2110	78.7	-1.04	2.16
	2155	76.15	-1.18	2.62

CELLULAR EU LTE

AMMAL002 (791~960, 1710~2690MHz)

Item	LTE20	LTE23	LTE 40	LTE7/LTE41	GSM900	DCS	PCS	WCDMA
Frequency [MHz]	791~821 832~862	2000~2020 2180~2200	2300~2400	2500~2690	880~960	1710~1880	1850~1990	1920~2170
Peak gain [dBi]	2.11	2.02	0.96	1.81	1.8	1.72	2.57	3.54
Average eff. [%]	61.9 %	59.0 %	51.6 %	52.2 %	52.26 %	57.91 %	65.81 %	69.29 %
VSWR	3.0 : 1							

- **Antenna size : 35 * 9 * 3.2T (mm)**
- **Board size : 120 * 50 * 1.6T (mm)**

▪ Efficiency @ EVB

Band	Frequency (MHz)	EFF. (%)	Avg. (dB)	Peak (dB)
LTE20	791	50.79	-2.94	0.57
	821	59.84	-2.23	1.25
	832	66.53	-1.77	1.78
	862	70.56	-1.51	2.11
GSM900	880	73.92	-1.31	2.34
	960	68.04	-1.67	2.7
DCS	1710	51.16	-2.91	0.57
	1785	50.76	-2.95	0.88
	1805	58.89	-2.30	1.71
	1880	59.6	-2.25	1.7
PCS	1850	69.18	-1.6	2.57
	1910	68.21	-1.66	2.29
	1930	69.57	-1.58	2.32
	1990	63.59	-1.97	1.82
WCDMA	1920	71.86	-1.44	2.32
	1980	64.05	-1.93	1.91

Band	Frequency (MHz)	EFF. (%)	Avg. (dB)	Peak (dB)
WCDMA	2140	76.44	-1.17	3.54
	2170	70.27	-1.53	3.44
	2000	63.40	-1.98	1.85
LTE23	2020	53.11	-2.75	0.91
	2180	62.91	-2.01	2.02
	2200	56.62	-2.47	1.76
LTE40	2300	49.04	-3.09	0.51
	2400	54.26	-2.65	0.96
LTE7	2500	59.74	-2.24	1.6
	2570	45.42	-3.43	0.86
	2620	56.09	-2.51	1.81
	2690	47.48	-3.23	1.58
LTE41	2555	63.58	-1.97	1.06
	2575	65.76	-1.82	1.29
	2635	51.39	-2.89	0.25
	2655	55.54	-2.55	0.49

CELLULAR GLOBAL LTE

AMMAL004 (704~960, 1710~2690MHz)

Item	LTE17	LTE20	LTE23	LTE 40	LTE7/LTE41	GSM850 LTE5	GSM900 LTE8	DCS LTE3	PCS LTE2	WCDMA1 LTE1
Frequency [MHz]	704~716 734~746	791~821 832~862	2000~2020 2180~2200	2300~2400	2500~2690	824~849 869~894	880~960	1710~1785 1805~1880	1850~1910 1930~1990	1920~1980 2110~2170
Peak gain [dBi]	1.97	2.09	3.12	1.85	1.46	1.94	1.31	3.14	2.98	3.01
Average eff. [%]	65.48 %	64.40 %	73.71 %	71.38 %	58.28 %	61.11 %	49.08 %	71.95 %	74.08 %	76.96 %
VSWR	4.0 : 1									

- Antenna size : 35 * 9 * 3.2T (mm)
- Board size : 141 * 50 * 1.6T (mm)

▪ Efficiency @ EVB

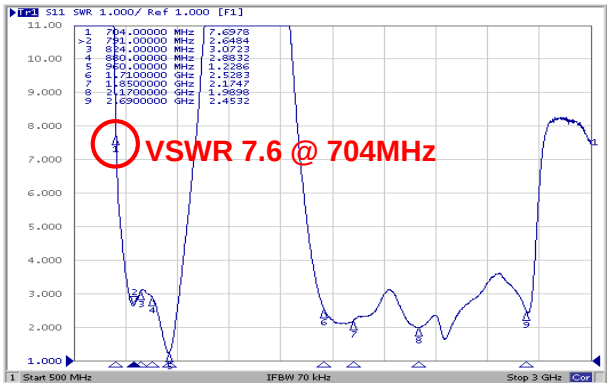
Band	Frequency (MHz)	EFF. (%)	Avg. (dB)	Peak (dB)
LTE17	704	47.72	-3.21	-0.77
	716	60.14	-2.21	0.4
	734	72.98	-1.37	1.45
	746	81.1	-0.91	1.97
LTE20	791	77.29	-1.12	1.87
	821	54.37	-2.65	0.72
	832	58.62	-2.32	1.13
	862	67.34	-1.72	2.09
GSM850 LTE5	824	54.36	-2.65	0.7
	849	66.1	-1.8	1.84
	869	63.8	-1.95	1.94
	894	60.18	-2.21	1.64
GSM900 LTE8	880	55.22	-2.58	1.31
	960	42.95	-3.67	0.15
DCS LTE3	1710	58.66	-2.32	1.32
	1785	77.95	-1.08	3.03
	1805	69.83	-1.56	2.73
	1880	81.38	-0.89	3.14

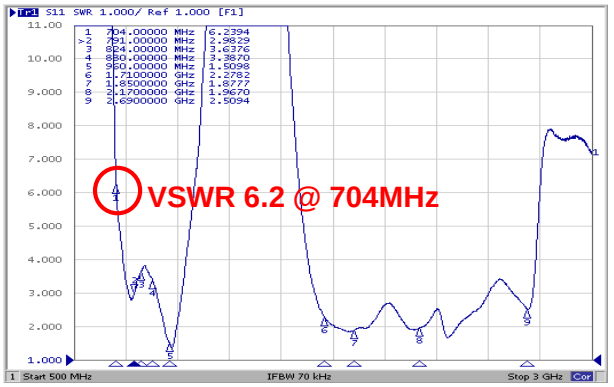
Band	Frequency (MHz)	EFF. (%)	Avg. (dB)	Peak (dB)
PCS LTE2	1910	79.65	-0.99	2.88
	1930	70.77	-1.5	2.42
	1990	68.89	-1.62	2.21
WCDMA1 LTE1	1920	76.33	-1.17	2.63
	1980	70.31	-1.53	2.12
	2110	79.87	-0.98	2.79
	2170	81.36	-0.9	3.01
LTE23	2000	67.01	-1.74	2.04
	2020	71.69	-1.45	2.64
	2180	71.73	-1.44	2.48
	2200	84.42	-0.74	3.12
LTE40	2300	67.71	-1.69	1.85
	2400	75.05	-1.25	1.48
LTE7 LTE41	2500	63.49	-1.97	1.33
	2570	63.78	-1.95	1.46
	2620	60.09	-2.21	1.14
	2690	45.78	-3.39	0.08

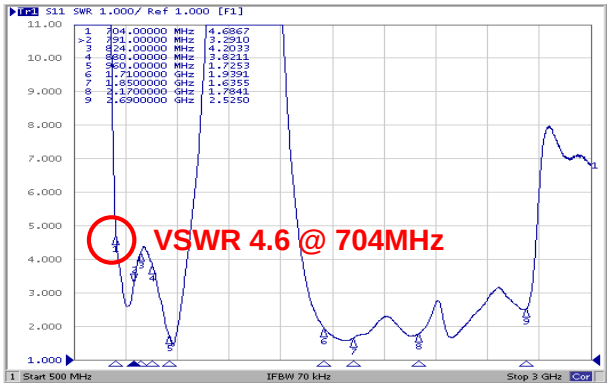
CELLULAR GLOBAL LTE

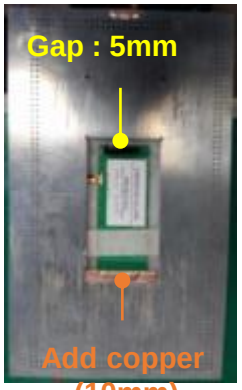
AMMAL004 (704~960, 1710~2690MHz)

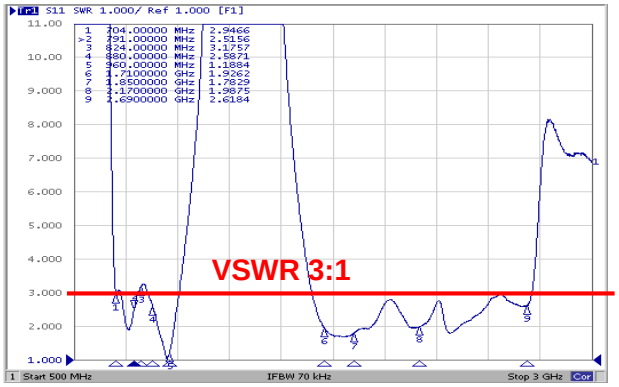
- Roof dimensions : 342 x 207 mm







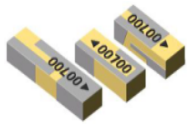




BLUETOOTH / WIFI DESIGNS

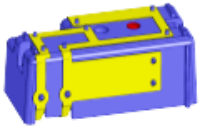
AMO
AMOTECH

01
AVN

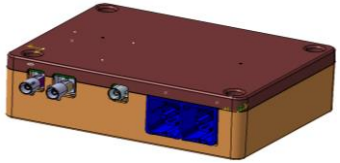


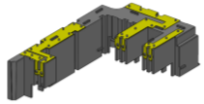
02
AVN

03
AVN



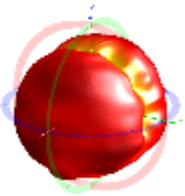
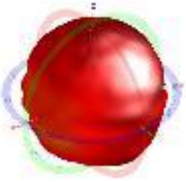
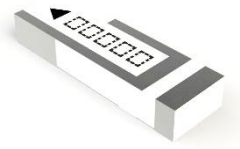
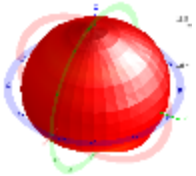
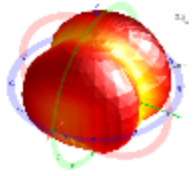
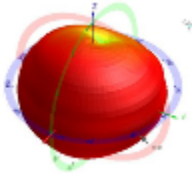
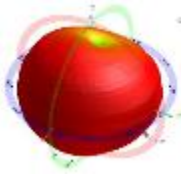
04
Telematics



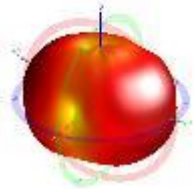
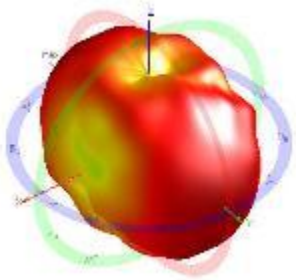


05
Telematics

BLUETOOTH / WIFI NEW ANTENNAS

Frequency	Part No.	Image	Type	Bandwidth	Radiation pattern
WLAN 5GHz (5150~5850 MHz) for IEEE 802.11 a / ac	AMAN103015ST04		SMD chip (10*3*1.5)	Wide bandwidth	 ▲ @5500MHz
WLAN 5GHz (5150~5850 MHz) for IEEE 802.11 a / ac	AMAN103015ST05		SMD chip (10*3*1.5)	Wide bandwidth	 ▲ @5500MHz
Dual WLAN (2.4+5GHz) for IEEE 802.11 n	AMAN103015ST07		SMD chip (10*3*1.5)	PIFA	 ▲ @2442MHz  ▲ @5500MHz
GPS (1575.42 MHz) + GNSS (1592~1610 MHz)	1003015ST03		SMD chip (10*3*1.5)	PIFA	 ▲ @1575MHz  ▲ @1600MHz

BLUETOOTH / WIFI NEW ANTENNAS

	Image	Details	Radiation pattern
Dual-port external antenna		√ Port 1: 2.4 GHz Port 2 : 5 GHz for Access Point (AP) √ Cable Ø1.37 mm, length 180 mm (Cable length changeable) √ Mini PCI connector (U.FL Compatible)	 ▲ @2480MHz  ▲ @5500MHz
WAVE system antenna		√ PCB slot antenna with cable √ Cable : RG178 500mm (Cable length changeable) √ V2X wave system (5850~5925MHz)	 ▲ @5850MHz

BLUETOOTH / WIFI Line-Up

Type	Part number	Size (mm)	Frequency (MHz)	VSWR	Gain (dBi)	
					Average	Peak
Chip (Helical)	ALA321C3	3.2x1.6x1.2	2400~2485	3.0:1	-1.6	2.3
	ALA621C4	6.0x2.0x1.2		2.5:1	-1.0	3.5
	ALA621C5	6.0x2.0x1.0		2.5:1	-1.0	3.5
	ALA931C5	9.0x3.0x1.2		2.5:1	-0.5	3.5
	ALA131C3	11.0x3.0x1.2		2.5:1	-0.5	4.0
Chip (Mono-Pole)	AMAN402012MS01	4.0x2.0x1.2	2400~2485	3.0:1	-1.6	2.6
	AMAN802012MS02	8.0x2.0x1.2		2.5:1	-0.5	3.5
	AMAN1003015ST04	10.0x3.0x1.5	5150~5850	2.0:1	-1.4	-
	AMAN1003015ST05	10.0x3.0x1.5		2.0:1	-1.6	-
Chip (PIFA)	AMAN201510ST01	2.0x1.5x1.0	2400~2485	3.0:1	-1.0	3.0
	AMAN301512ST01	3.0x1.5x1.2		3.0:1	-1.0	3.0
	AMAN402012ST01	4.0x2.0x1.2		3.0:1	-1.0	3.0
	AMAN1003030ST02 [Dual band]	10.0x3.0x3.0	2400~2485 5150~5850	2.5:1	-2.0	-
	AMAN1003030ST03	10.0x3.0x3.0	2400~2485	3.0:1	-1.0	3.0
	AMAN1003015ST06 [Dual band]	10.0x3.0x1.5	2400~2485 5150~5850	2.5:1	-1.2	-
Patch (On ground)	F12(SMD)	12x12x4	2400~2485	3.0:1	-1.4	3.8
	SM25-4552250-STD70 [Dual band]	25x25x5	2400~2485 5150~5850	3.0:1	Max.-1.4, -2.7 at edge Max.-4.2, -1.4 at edge	5.4 6.5

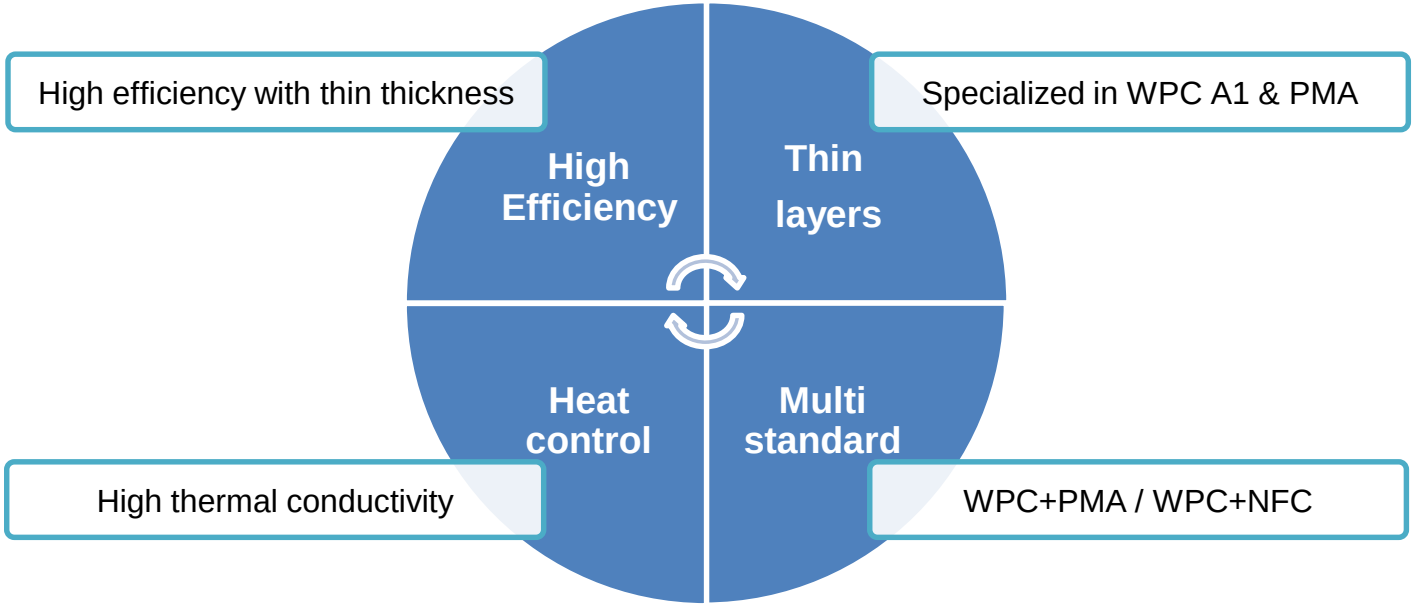
GSM & ISM Line-Up

Type	Part Number	Size (mm)	Frequency	VSWR	Gain (dBi)		EVB Size (mm)
					Average	Peak	
PCB + cable	AMMAP007(FPCB)	40.0x15.0x0.55	GSM850 GSM900 DCS1800 PCS1900 WCDMA UMTS	3:1	-1.0	3.0	-
	AMMAP008(PR4)	40.0x15.0x0.14		3:1	-3.0	4.0	-
	AMMAP009	40.0x15.0x0.14		3:1	Min. -4.5	-	-
Customizing	Press or FPCB with carrier	Optional		-	-	-	-
Main chip (SMD)	AMMAP003(F)	24.0x5.5x4.4		3.5:1	Min. -3.7	4	114x45
	AMMAP005(R)	24.0x5.5x4.4		3.5:1	Min. -3.7	4	114x45
	AMMAQ002	22.0x5.5x4.4		3.5:1	Min. -3.3	3	114x45
	AMMAP014	35.0x9.0x3.2		2.7:1	Min. -3.3	3	110x50
	AMMAL001	35.0x9.0x3.2	US LTE	2.7:1	Min. -2.6	3	120x50
	AMMAL002	35.0x9.0x3.2	EU LTE (791~2690MHz)	3.0:1	Min. -3.4	3	120x50
	AMMAL004	35.0x9.0x3.2	Global LTE	3.8:1	Min. -3.6	3	141X50
Helical type (Mono-pole)	AMAN903012ST05	9.0x3.0x1.2	868MHz	2:1	-7	-3.4	-
		9.0x3.0x1.2	915MHz	2:1	-4	-1.3	-

NFC SHIELDING SHEET

★ **In-house material**

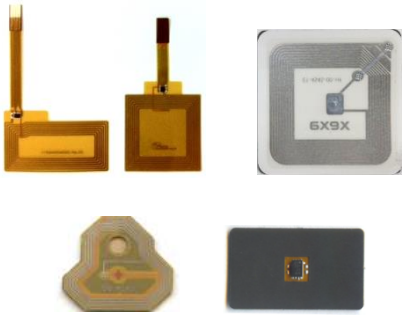
AWS	AFS	AWFS
√ Metal sheet	√ Ni/Zn, Mn/Zn basis	√ Hybrid type sheet
√ High permeability	√ High μ & low μ'	√ Specialized in WPC+PMA+NFC
√ High flux density	√ Specialized in NFC antenna	
√ Specialized in WPC or PMA Rx	√ Specialized in WPC & PMA	
	√ Specialized in A4WP	



NFC

NFC / NFC tag

- Convenient wireless paring
- User setting & S/W update available with paring
- Dynamic data exchange with mobile having NFC
- Information long download with I2C, SPI, UART
- Suitable for home appliance application

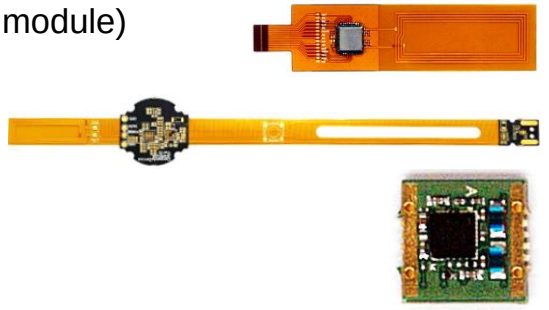


NFC+WLC combo

- Thin thickness but high antenna performance
- Having special shielding sheet for NFC and WLC antenna
- Payment & Wireless power charging
- Suitable for mobile or home appliance application

NFC full module

- Tag & R/W & Peer-to-peer NFC full support (active module)
- Payment available
- All type of NFC tag support (Type A, B, A/B, F)
- Compact size
- Suitable for mobile or wearable application



NFC DESIGNS

AMO
AMOTECH

01 AVN

02 Key fob

03 Door

04 Car payment

05 WLC armrest

WIRELESS POWER CHARGING - WPC

AMOTECH Competitiveness

- Quick turn-around for custom design
- Value added product with unique materials
- Total solution from material to module

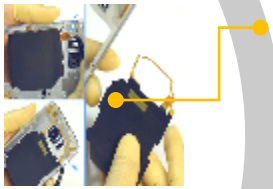
Follow up market demand and industrial standard

◦ Close cooperation with IC maker

AirFuel™Alliance

Design & Development

◦ Rx / Tx
◦ Circuitry design for module
◦ Combo solution



NFC+WPC/PMA+MST
√ World's 1st technology
√ Total thickness < 0.3 (mm)

Production technology

◦ Design own process from development stage
◦ No. 1 in WPT market share

Various materials in house

◦ Metal glass sheet
◦ Ferrite sheet
◦ Hybrid sheet

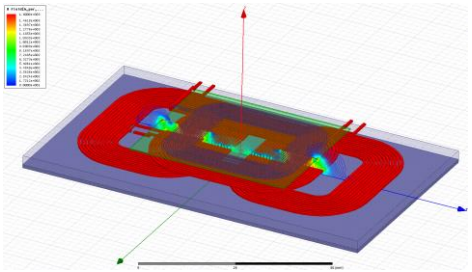
WPC CAPABILITIES

Various shielding sheet

- NiZn ferrite sheet with flexibility, low loss and various shape
- Available hybrid sheet for NFC & WLC
- Having high permeability

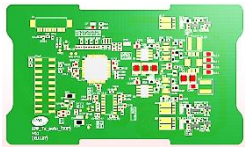
Simulation

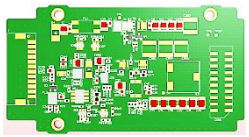
- HFSS simulation



Circuit design & Programming

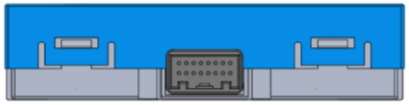
- TI / NXP / IDT reference design
- ARM, AVR, K-line, LIN, vector can





Mechanical design

- 2D & 3D



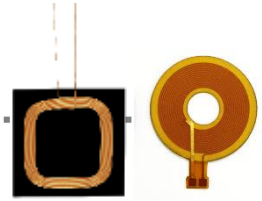
WPC RX SOLUTIONS

AMO WPT Rx

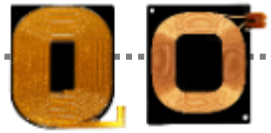
" Wide Product Line-up"

- Ultra thin profile
- Compatible industrial standard [Inductive / Resonant]
- Working with major IC suppliers

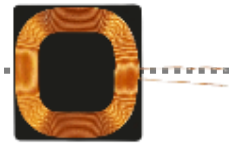
SINGLE MODE



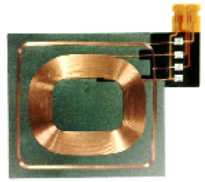
▲ 2.5 W



▲ 5 W

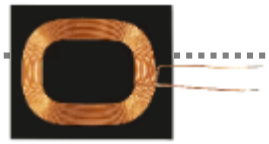


▲ 10 W

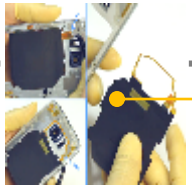


▲ NFC+WLC combo

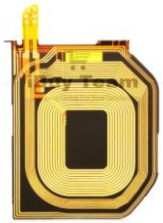
DUAL MODE



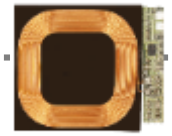
▲ WPC+PMA



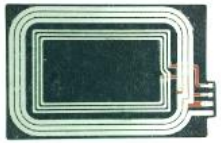
NFC+WPC/PMA+MST
√ World's 1st technology
√ Total thickness < 0.3 (mm)



MODULE



RESONANT



▲ A4WP

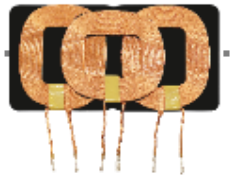
▲ PRU category 3

WPC TX SOLUTIONS

AMO WPC Tx

- Customized design available
- Compatible industrial standard [Inductive / Resonant]

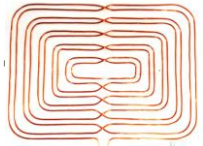
A6

A11



Resonant

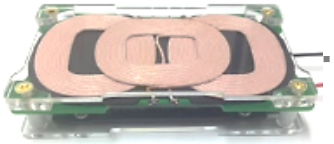


▲ PTU class 4

Wearable



Medium power (15W)


ESD / EMI SOLUTIONS

AMO AMOTECH

- EMI / ESD Solution

Category	EMI / ESD filter	EMI single filter
Series	ADF	ASF
Size (mm)	1210 / 2012	1608

Category	CMF	DMF (Dual)
Series	AHFE	ADMF
Size (mm)	1210 / 2012	1210 / 2012

- ESD / Surge solution

Category	Chip varistor	ESD suppressor
Series	AVMC	AIES
Size (mm)	1005 / 1608 / 2012 / 2520	1015 / 1608

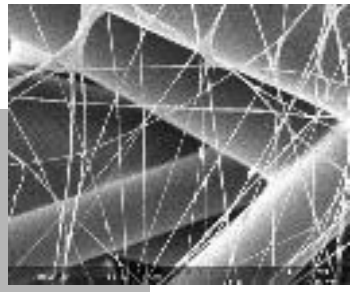
Compliant with ***AEC-Q200***

		ESD/EOS		EMI/ESD			
		AVMC	AIES	ADF	ASF	ADMF	AHF
Car audio	RGB			●	●		
	I/O	●	●				
AVN	LVDS					●	●
	SD card			●		●	
	HDMI		●				●
Cluster	RGB			●			
	RMII (ethernet)			●	●		
Telematics	RMII (ethernet)			●	●		
Multi-jack	USB 2.0		●				●
	Aux	●					
RSES CID	RGB			●	●		
	LVDS					●	●
Camera AVM ADAA	RGB			●	●		
	LVDS					●	●
BCM	CAN	●					

MEMBRANE

AMOVentMems™ Electric Vent Membrane is **“Ultra Thin Fiber”** in the form of nonwovens.

AMOventmems™ creates 3D open pore structure by nm level control of fiber diameter.



1. High air permeability

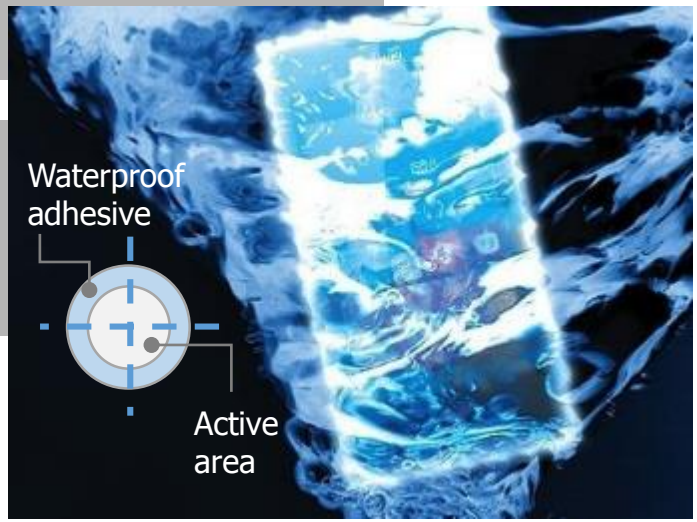
- High porosity & Uniform pore size
- Minimal acoustic transmission loss & impedance

2. Special treatment

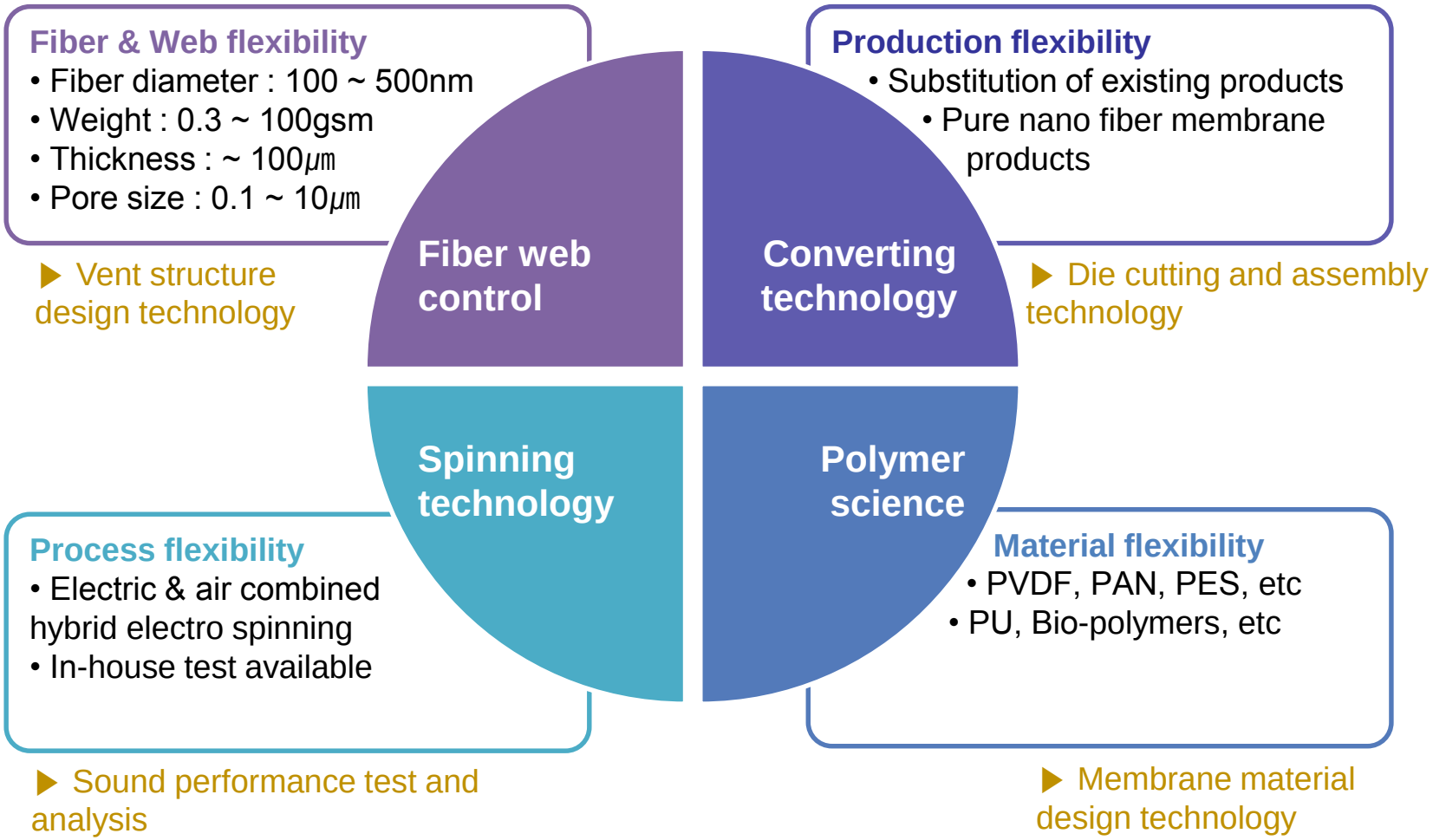
- Quick recovery after liquid immersion

3. Customized membrane

- Flexibility of membrane design upon the customer’s request
- IPX4 / IPX7 / IPX8 / 3 ATM / 5 ATM



MEMBRANE


Fiber & Web flexibility
• Fiber diameter : 100 ~ 500nm
• Weight : 0.3 ~ 100gsm
• Thickness : ~ 100㎛
• Pore size : 0.1 ~ 10㎛
▶ Vent structure design technology
Fiber web control
Converting technology
Production flexibility
• Substitution of existing products
• Pure nano fiber membrane products
▶ Die cutting and assembly technology
Spinning technology
Polymer science
Process flexibility
• Electric & air combined hybrid electro spinning
• In-house test available
▶ Sound performance test and analysis
Material flexibility
• PVDF, PAN, PES, etc
• PU, Bio-polymers, etc
▶ Membrane material design technology

Your Contact in Europe:

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