

Antenna in Package (AiP/AoP)

Patent Landscape Analysis

June 2021

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- Geographic coverage of main players' AiP patent portfolio
- Time evolution of patent publications for main players
- Newcomers in the AiP patent landscape
- IP leadership of main players
- Patent segmentation per AiP technical approach:
 - WLP, Fan-Out WLP, 3D stacking, Other*
 - Main patent assignees per AiP approach
 - Fan-Out packaging: IP players vs. Market players
 - Time evolution of patent publications per AiP approach

- Patent segmentation per package-integrated antenna structures:
 - Patch antenna, Dipole antenna, Monopole antenna, Microstrip antenna, Yagi antenna, Vivaldi antenna, Slot antenna*
 - Main patent assignees per package-integrated antenna structures
- Air cavity related patents
- Stacked antenna related patents
- Main IP collaborations (co-owned patents and IP transfers)

IP PROFILE OF KEY PLAYERS **47**

Patent portfolio overview, key patents, and recent patenting activity

- *SMIC / SJSemi*
- *TSMC*
- *Samsung Electro-Mechanics*
- *Huawei*
- *MediaTek*
- *IBM*
- *ASE*
- *SPIL*
- *NCAP*
- *Qualcomm*
- *Murata*

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KNOWMADE PRESENTATION **85**



Knowmade is a Technology Intelligence and IP Strategy consulting company specialized in analysis of patents and scientific information. The company helps innovative companies and R&D organizations to understand their competitive landscape, follow technology trends, and find out opportunities and threats in terms of technology and patents.

Knowmade's analysts combine their strong technology expertise and in-depth knowledge of patents with powerful analytics tools and methodologies to turn patents and scientific information into business-oriented report for decision makers working in R&D, Innovation Strategy, Intellectual Property, and Marketing. Our experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence and freedom-to-operate analysis. In parallel the company proposes litigation/licensing support, technology scouting and IP/technology watch service.

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SCOPE OF THE REPORT

- This report provides a detailed picture of the patent landscape related to **antenna integrated in package**, covering **antenna in package (AiP)** and **antenna on package (AoP)**.
- We have selected and analyzed more than **1,560 patents and patent applications** published **worldwide** up to **February 2021**, representing more than **660 patent families** (inventions) relevant to the scope of this report.

Yours needs are out of scope of this report?
 You want a deeper analysis on technologies or companies
 Contact us for a custom report

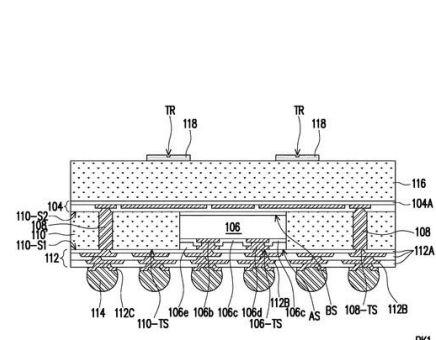


Included

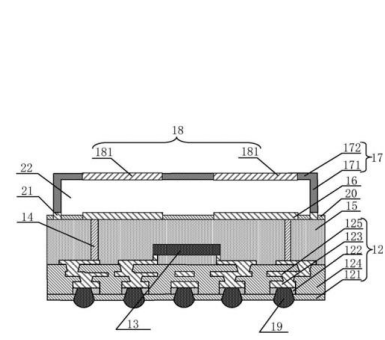
- **Antenna and antenna array** integrated into the package with ICs.
- **Antenna in package (AiP), antenna on package (AoP)**
- **Flip-chip based AiP** (organic laminates, glass-based substrates, etc.), **molding-compound based AiP** (Fan-Out WLP/PLP, InFO, eWLB, IC-embedding, etc), **antenna-integrated modules (AiP modules)**.

Excluded

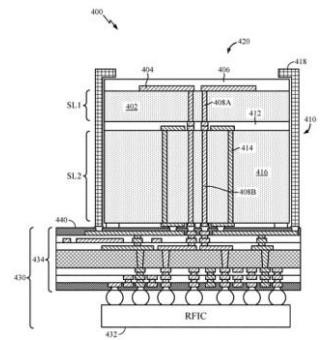
- **Antenna which are not integrated with ICs**
- **System-in-Package (SiP) for RF front-end modules**



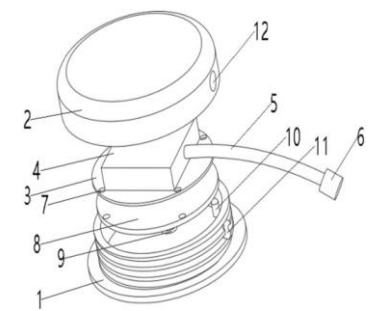
TSMC (US20200313278)



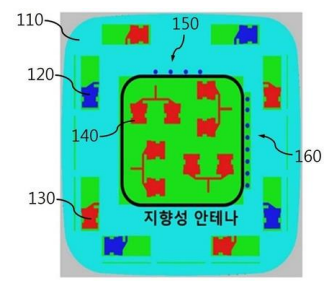
SMIC (CN112038327)



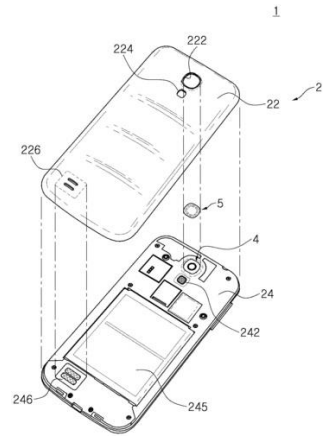
Qualcomm (US20200006846)



Zhongshen Xinhua Precision Technology Shenzhen (CN212303905)



2.4 GHz 대역 안테나 : ■
 5 GHz 대역 안테나 : ■
 KETI (KR10-2020-0137656)



SEMCO (CN104423123)

KEY FEATURES OF THE REPORT

- The report provides **essential patent data** for **Antenna-in-Package** published up to February 2021.
- It provides **in-depth patent analyses** of **key technologies** and **key players** including:
 - Main IP dynamics and key trends.
 - IP leaders, most active players and newcomers.
 - IP portfolio strength of key players, and their technology/application focus.
 - Time evolution of patents filings by company, countries, and technology.
 - Current legal status of patents.
 - Joint developments, IP collaborations and IP transfers between key organizations.
 - Insights into the status of technologies, identifying trends for each technology/application.
 - Key patents.
- This report also includes an extensive **Excel database** with the **660+ patent families** analyzed in this study. This useful patent database allows for **multi-criteria searches** and includes patent publication numbers, hyperlinks to the original documents, priority date, title, abstract, patent assignees, patent's current legal status, and **segments** (Air cavity AiP, Wafer Level Packaging, Fan Out WLP, etc.)



Disclaimer: This report **does not provide** any insight **analyses or counsel regarding legal aspects** or the **validity** of any individual patent. Knowmade is a research firm that provides technical analysis and technical opinions. Knowmade is not a law firm. The research, technical analysis and/or work proposed or provided by Knowmade and contained herein is not a legal opinion and should not be construed as such.

WHY STUDY THE PATENT LANDSCAPE

Understanding the **competitive landscape** and **technology developments** from a **patent perspective**

- **Key IP players** (key patents, IP strategy, technology roadmap)
- **Newcomers** (technology and markets of interest)
- **Technology trends & Emerging technologies**
- **Benchmark patent portfolios** (competitors' strength & weakness)
- **Key patents** (blocking, valuable)
- **Key technical solutions**
- **Risks** (patent infringement, new entrants, etc.)
- **Opportunities** (partnership, technology acquisition, licensing, etc.)



Very complementary to market research

Give another point of view of the competitors, technologies and markets

Links between patents and

- Key market players
- Supply chain
- Technology Readiness Levels (TRL)
- Market product
- Emerging technologies/applications
- Forecast

IP PROFILE OF KEY PLAYERS

IP portfolio summary, Description of key patents

SAMPLE

A focus on key IP players is provided in a dedicated section. For each patent assignee, the **AiP patent portfolio** is statistically analyzed to provide an overview of its **strengths, weaknesses and level of IP activity**. Most **notable patents** are described in light of the main AiP challenges.



ORDER FORM

Antenna in Package

Patent Landscape Analysis – June 2021

Ref.:KM21004



SHIP TO

Name (Mr/Ms/Dr/Pr):

Job Title:

Company:

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FRANCE

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IBAN: FR76 1460 7003 6360 6214 5695 139
BIC/SWIFT: CCBPFRPPMAR

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For French customer, add 20% for VAT.

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“Seller”: Based in Sophia Antipolis (France headquarters), Knowmade is a technology intelligence company specialized in the research and analysis of scientific and technical information. We provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

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2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be

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BIC or SWIFT code: CCBPFRPPMAR

IBAN: : FR76 1460 7003 6360 6214 5695 139

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3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

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4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

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b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

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- Recordings and re-transmittals over any network (including any local area network);

- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;

- Posting any Product to any other online service (including bulletin boards or the Internet);

- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

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Competitive landscape | Technology trends | Opportunities / Risks | R&D and IP strategy



Intellectual Property

Patent your inventions
Assert your patents and defend your position in case of licensing/litigation
Evaluate the risks to infringe patents

Prior art search, Freedom-to-operate analysis, Patent invalidation, Evidence of use, Patent valuation

Understand, anticipate and evaluate the competitive landscape and current technology developments

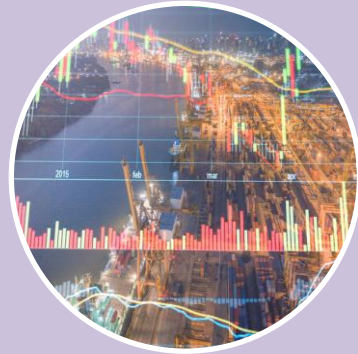
Patent landscape, Monitoring service, IP due diligence

Innovation Strategy

Improve your R&D and IP strategy
Identify and get access to external innovation

Technology scouting, Scientific literature analysis

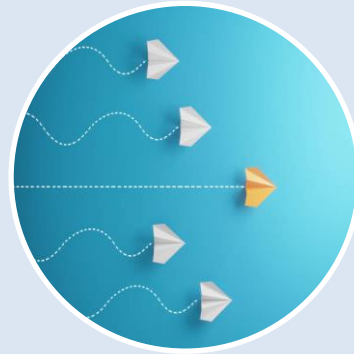
WHAT INFORMATION CAN YOU GET?



Market

Business developer, strategy

- *Compare the IP with the market position*
- *Evaluate the level of investment*
- *Future products and targeted markets?*
- *Identify the competitors*



Technology

R&D

- *Technological roadmap*
- *Position on the supply chain*
- *R&D activities*



Intellectual property

IP teams, attorney, law firms

- *Patent evaluation (key patents)*
- *Link between patents and products*
- *Risks and opportunities (licensing, litigations, FTO, etc.)*

KNOWMADE OFFER



Patent Landscape Analysis
to give an overview on
IP dynamics, IP trends and
IP players



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analyses**

Meet customer's
business needs and
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Patent Monitoring Service
to track current R&D activity and
early detect weak signals,
opportunities and risks

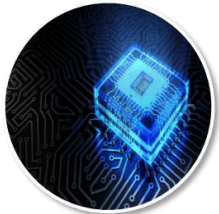


Monthly IP database | Quarterly report
Access to IP analysts

MAIN FIELDS OF EXPERTISE

Communication

- RF, Microwaves, mm-Waves
- RF Front End Module
- Antenna & Networks
- Digital Optic Communication (datacom, telecom, photonics)



Advanced Packaging
Innovative Materials
AI & Computing

Energy Mgt & Storage

- Power electronics
- Batteries & Fuel-cell
- Power management
- PV



MEMS, Sensors & Optoelectronics

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- Sensors & Imaging
- Lighting & Display

Life Sciences & Healthcare

- MedTech
- Microfluidics
- Biotech & Pharmaceuticals
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