

Navian Marketing Report

Mid-term outlook for the Front End Module and high-frequency component market

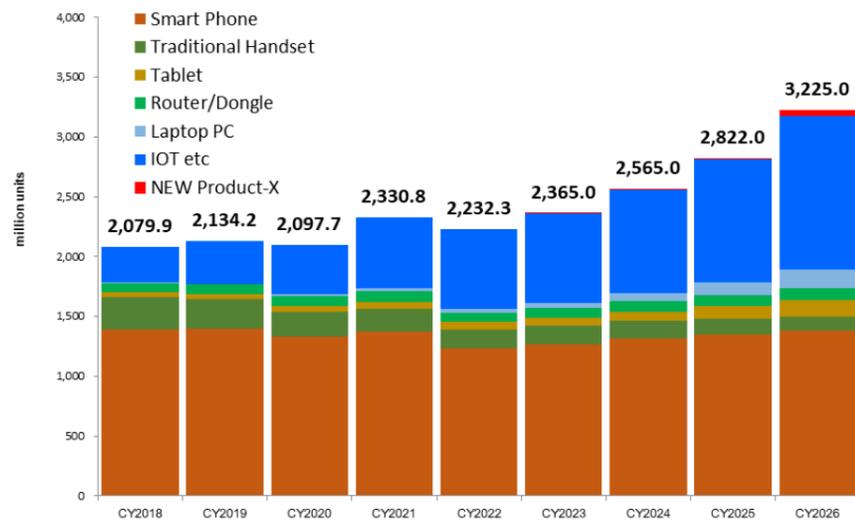
RF Devices/Modules for Cellular 2022-2023

Released on March 31, 2023

Front End Modules & RF Components in this report

- ① Front end Module (ASM・RX Module・TX Module・PAiD・PAMiD・FEMiD・Multiplexer・Antenna Multiplexer・5G TX Module/PAMiF・AIP・mmW Module) ② Antenna Switch (For Main RF・For RX Diversity) ③ Power Amplifier Module ④ Duplexer (SAW/BAW/IHP) ⑤ Band Pass Filter (SAW/BAW/IHP/LTCC for Sub 6GHz/IPD for Sub 6GHz) ⑥ TCXO

Cellular Terminal Shipment Forecast by Standard



New Product X
Expecting a completely new kind of gadget with completely groundbreaking display and input-output style different from existing mobile gadgets, and it will be the engine of 5G era.



Cellular LPWA IOT
It is one of the highlights of 5G, but NR-IOT of 5G standard is likely to take a while. IOT market will expand mainly in 4G-based NB-IOT for now.



Cellular V2X
LTE adoption would be the next step for Cellular V2X. Because of competition with WiFi-based 802.11p, demand size would be limited.



Cellular PC/Tablet
Cellular adoption in Tablet and Notebook PC will become full scale as 5G becomes widely used. It should become the adrenaline shot which will stimulate the Tablet and Notebook PC market.



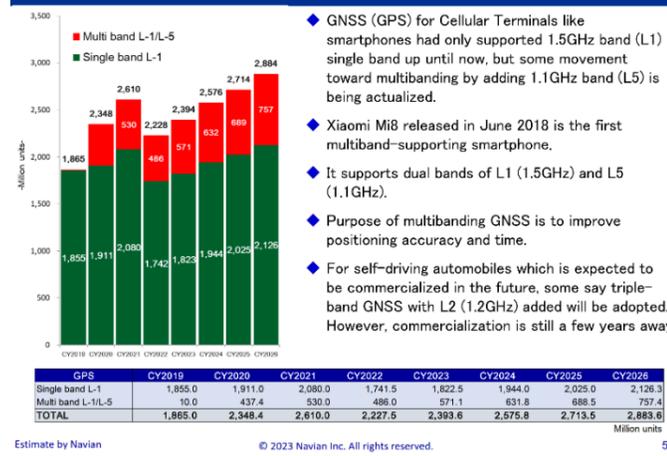
Smart phone
Product which would most likely adopt 5G. However, as for milli-waves, it is strongly thought that adoption would be limited due to issues with space, cost, and power consumption.



Traditional Handset
Would be the last to adopt 5G. Also, it will only adopt either Sub 3GHz or Sub 6GHz, and not milli-waves.

Report Sample

Multi-band GNSS Forecast



◆ GNSS (GPS) for Cellular Terminals like smartphones had only supported 1.5GHz band (L1) single band up until now, but some movement toward multiband by adding 1.1GHz band (L5) is being actualized.

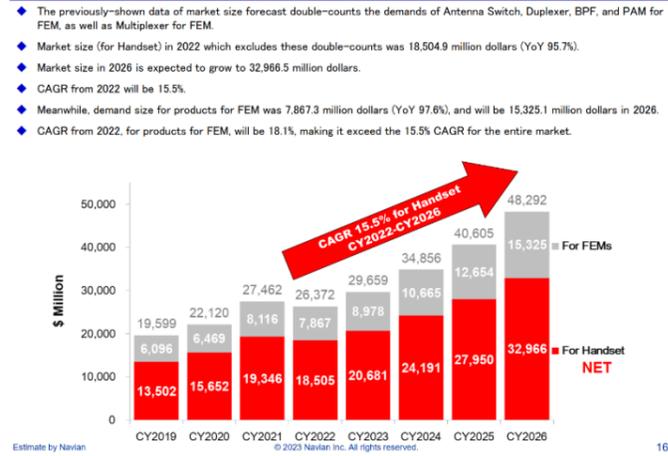
◆ Xiaomi Mi8 released in June 2018 is the first multiband-supporting smartphone.

◆ It supports dual bands of L1 (1.5GHz) and L5 (1.1GHz).

◆ Purpose of multiband GNSS is to improve positioning accuracy and time.

◆ For self-driving automobiles which is expected to be commercialized in the future, some say triple-band GNSS with L2 (1.2GHz) added will be adopted. However, commercialization is still a few years away.

RF Devices / Modules Market Forecast - For FEMs / For COB -



◆ The previously-shown data of market size forecast double-counts the demands of Antenna Switch, Duplexer, BPF, and PAM for FEM, as well as Multiplexer for FEM.

◆ Market size (for Handset) in 2022 which excludes these double-counts was 18,504.9 million dollars (YoY 95.7%).

◆ Market size in 2026 is expected to grow to 32,966.5 million dollars.

◆ CAGR from 2022 will be 15.5%.

◆ Meanwhile, demand size for products for FEM was 7,867.3 million dollars (YoY 97.6%), and will be 15,325.1 million dollars in 2026.

◆ CAGR from 2022, for products for FEM, will be 18.1%, making it exceed the 15.5% CAGR for the entire market.

Multiplexer Market Size Trend & Forecast by Duplexer Type



◆ BAW now accounts for majority of component type Quadplexer.

◆ Aside from this, there are IHP type (bonding thin film substrates) which are commercialized by MURATA, RF360, and Tayo Yuden, and also the type that use TC-SAW.

◆ For usages requiring even better characteristics like Hexaplexer, BAW Duplexers are more superior.

◆ Currently, most Hexaplexers are supplied by Broadcom only, and majority of their demand is Apple.

◆ Although IHP is said to be as good as Broadcom's BAW (FBAR) when it comes to characteristics as single filter or Duplexer, some say it has issues when constructing composite components like Multiplexer.

◆ However, cases of its practical application in Quadplexer is increasing, and IHP is especially adopted in Qualcomm (RF390)'s Quadplexer-mounted PAMiD, supplied through cross-selling with Qualcomm chipsets.

◆ Also, MURATA's IHP mainly was for FEMiD and COB until recently, but from late 2022, they seem to have partly started supplying PAMiD with IHP Quadplexer mounted.

◆ Unlike Hexaplexer that requires BAW spec, it is expected that for Quadplexer, an IHP-type Duplexer should become widely adopted considering the cost aspects.

◆ Meanwhile, aside from Broadcom, Skyworks is also commercializing BAW Duplexer to mount in their inhouse FEM. They are both supplied as Multiplexer for FEMiD and COB for Apple.

◆ Multiplexer demand will depend on the competitiveness as a FEM manufacturer and the technology used, as well as the superiority of each technology.

◆ MURATA plans to enter the BAW market in 2022 with its acquisition of Resonant's XBAR, and Skyworks and others are reportedly planning to enter the IHP type in addition to BAW.

iPhone14Pro MAX A2651 USA Model RF Block diagram



◆ iPhone14Pro MAX USA版のRF回路図を左記に示す。

◆ iPhone14 日本版との違いは、ミキサ回路の有無。

◆ iPhone13と同様に、AIPx1, Antennax1, mmW Module1の構成となっている。

◆ ただ、サブキャリアは4G/5Gの両方で採用された。

◆ その他の回路は基本同じで、注目の衛星通信機能も利用可能かどうかは別として日本版もUSA版もハード的には備えていると推定した。

◆ iPhoneが利用するGlobalstarの衛星通信周波数は、下り2.4GHz、上り1.6GHzとなっている。

◆ 2.4GHzはWiFiと共用、1.6GHzはMiddle/High-band PAMiDにBAW Filterを内蔵している模様だ。

◆ 1.6GHz用のPAiAは、PAMiD内のMulti-band PAを利用していると推定。

◆ GPSの測位性能の向上を狙ってBroadcomのGPS receiverを単独で採用している。

◆ この辺り、mmWのハイブリッドでTCXOも採用された。

◆ TCXOのメーカーは不明。

◆ この仕様は、USA版のみで、日本版は別モデルではなく、Pro及びPro MAXといった上位機種で採用されている。

◆ iPhone14 日本版とサプライヤーが異なる部品が3種類ある。

◆ 2.4GHzのWiFi FEMはSkyworks (iPhone14 日本版では村田製作所)、Sub 6GHzの5G FEMはBroadcom (iPhone14 日本版ではQorvo)、mmW ModuleはQorvoのChippac (iPhone14 日本版ではUS)となっている。

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Phase1. Cellular Terminal Shipment Forecast**I. Cellular Terminal Shipment AND Update**

1. Cellular Terminal Variation & Definition
2. Cellular Terminal Annual Shipment History CY2001-CY2022
3. Annual Cellular Terminal Shipment Trend by Product Type
4. Annual Cellular Terminal Shipment Trend by Cellular Standard
5. Annual Cellular Terminal Market Share Trend
6. Key Terminal Manufacturer Annual Shipment History CY2019-CY2022
7. Cellular Terminal Shipment by Maker & Cellular Standard History CY2019-CY2022

II. 5G Situation & Topics

1. Cellular Terminals Classification For 5G
2. 5G Specifications Comparison to LTE
3. Detailed 5G Specifications
4. 5G Application Trend
5. 5G standardization History & Schedule
6. 5G standardization Release15 & Release16
7. Cellular IOT vs Non Cellular IOT
8. 5G Frequency Band Plan
9. Wireless Frequency Band Standard Organization
10. 5G Frequency Band Plan
11. Detailed Sub 6GHz Frequency Band Plan
12. 5G Smartphone Shipment CY2019-CY2022
13. Outline of 5G Smartphone Venders
14. 5G Smartphone Shipment by destination
15. 5G Shipment CY2019-CY2022 by Brand
16. 5G Product Shipment by Platform
17. 5G RF Front End Circuit
18. Conventional FEM for Sub 6GHz
19. Main Players FEM and Main RF components for Sub 6GHz

III. Cellular Terminal Shipment Forecast –CY2026

1. Cellular Terminal Forecast by Product
2. Cellular Terminal Forecast by Standard
3. 5G Cellular Terminal Forecast by Band Group
4. Forecast of Sub 6GHz Band Combination
5. Increasing FDD bands for EN-DC
6. 3G/4G/5G Band Plan Update
7. Diversity Forecast
8. Multi-band GNSS(GPS) for High-end Smartphone
9. Multi-band GNSS Forecast
10. Cellular Terminal Forecast by Product & Standard
11. Cellular Terminal Forecast by Standard & Frequency
12. Cellular Terminal Forecast in Detail
13. Future Market Opportunities by Standard in CY2026
14. How will Sub 6GHz RFFE Change from 4G to 5G?
15. 5G RFFE ESTIMATION by Platform
16. Detailed 5G NR RFFE Estimation for Full Specification
17. 5G RFFE ESTIMATION EN-DC Combination Examples
18. Sub 6GHz Co-Existence with WIFI
19. What's Dual Uplink?

Phase 2. 3G/4G/5G RF Platform Analysis**I. RF Platform Trend & Forecast**

1. 5G RF Platform share Trend
2. 5G Platform Forecast
3. 3G/4G/5G Total Platform Forecast

II. iPhone14 Teardown Analysis

1. iPhone12-13-14 History

2. iPhone14 Japan model VS. iPhone14Pro MAX USA
3. Detailed Table of RF Components and FEMs in iPhone14
4. Teardown of iPhone 14 Japan Model
 - a. RF block diagram
 - b. Teardown pictures
5. Teardown of iPhone 14Pro USA Model
 - a. RF block diagram
 - b. Teardown pictures

III. SAMSUNG Galaxy S22 5G SC-51C Teardown

- Latest GALAXY S series compatible with mmW & Sub 6GHz-
- 1. iPhone14Pro MAX A2651 vs. SAMSUNG Galaxy S22 SC-51C
- 2. Teardown of iPhone 14Pro USA Model
 - a. RF block diagram
 - b. Teardown pictures

Non-Smartphone Products Teardown

1. Summary
2. Foxconn T99W175 5G Module
 - a. RF block diagram
 - b. Teardown pictures
3. Foxconn T99W175 5G Module
 - a. RF block diagram
 - b. Teardown pictures
4. Quectel RM500Q-GL
 - a. RF block diagram
 - b. Teardown pictures
5. Quectel RM500U-CN
 - a. RF block diagram
 - b. Teardown pictures
6. Fibocom FM650-CN
 - a. RF block diagram
 - b. Teardown pictures
7. CHUWI HiPad X
 - a. RF block diagram
 - b. Teardown pictures
8. TCU for BMW 3 SERIES 2018-2022
 - a. RF block diagram
 - b. Teardown pictures

IV. Sub 6GHz RFFE Examples and Analysis

1. Sub 6GHz RFFE of SAMSUNG GALAXY S10 5G SM-G977N
2. Sub 6GHz RFFE of Huawei MATE20X5 EVR-AN00
3. Sub 6GHz RFFE of Xiaomi Mi Mix 3 5G M1810E5GG
4. Sub 6GHz RFFE of OPPO Reno3 5G
5. Sub 6GHz RFFE of SAMSUNG GALAXY S20+ 5G SC-52A
6. Sub 6GHz RFFE of Apple iPhone12Pro A2406
7. Sub 6GHz RFFE of SAMSUNG GALAXY S21 Ultra SC-52B docomo
8. Sub 6GHz RFFE of Apple iPhone13Pro A2483
9. Sub 6GHz RFFE of iPhone14 Pro MAX USA
10. Sub 6GHz RFFE of Fibocom FM650-CN (5G IOT Module)

Phase3. RF Devices / Modules Market Status & Forecast**I. RF Devices / Modules Total Market Forecast CY2019-CY2026**

1. RF Devices / Modules in This Report
2. RF Devices / Modules Total Market Forecast Detail Data
3. RF Devices / Modules Total Market Forecast - For FEMs / For COB -
4. RF Devices / Modules Total Market Forecast - Except overlap -
5. RF Devices / Modules Total Market Forecast Detail Data - Except overlap -
6. RF Devices / Modules For Cellular Market Share Breakdown -CY2019-CY2022

II. Front End Module & Sub Front End Module Market Forecast CY2026

1. Front End Module/ Sub Front End Module Variation & Circuit Examples
 - a. Outline of PAMiD
 - b. Multiplexer:Quadplexer Example & Outline
 - c. Antenna Multiplexer Outline
 - d. Front End Module & Sub Front End Module Variation & Outline
 - e. Front End Module & Sub Front End Module Usage
 - f. FEM Trend & Future Estimation
 - g. Usage of Front End Module by Customer
 - h. Enter the RFFE market one after another
2. FEM Market Forecast
 - a. FEM Supply-chain
 - b. Front End Module Market Trend & Forecast by Product Type
 - c. Front End Module Market Trend & Forecast by Product Type: Detail Data
 - d. Front End Module Market Trend & Forecast by For Apple/For Others 1/2
 - e. Sub Front End Module Market Trend & Forecast by Product Type
 - f. Sub Front End Module Market Forecast: Detailed Data
3. Antenna Switch Module
 - a. Antenna Switch Module Market Size Trend & Forecast by Product Type
 - b. Antenna Switch Module Market Forecast: Detailed Data
 - c. ASM Market Share Trend
4. TX Module
 - a. TX Module Market Size Trend & Forecast by Product Type
 - b. TX Module Market Share Trend
5. FEMiD
 - a. FEMiD Module Market Size Trend & Forecast by Product Type
 - b. FEMiD Market Forecast: Detailed Data
 - c. FEMiD Market Share Trend
 - d. FEMiD Market Share Breakdown per Product Type
6. PAMiD
 - a. PAMiD Market Size Trend & Forecast by Product Type
 - b. PAMiD Market Forecast DATA
 - c. PAMiD Market Share Trend 1/2
 - d. PAMiD Supply chain
 - e. PAMiD Suppliers Outline
 - f. PAMiD Market Share Breakdown per Product Type
7. 5G TXM(PAMiF)
 - a. Outline of 5G TX Module
 - b. 5G TXM(PAMiF) Market Forecast
 - c. 5G TXM(PAMiF) Market Share Trend
 - d. 5G TXM(PAMiF) Market Forecast DATA
8. AIP (Antenna In Package) for Millimeter Wave
 - a. Motorola 5G Moto Mods mmWave Antenna Location
 - b. Motorola 5G Moto Mods mmWave AIP
 - c. Motorola 5G Moto Mods mmWave Antenna Modules
 - d. AIP(Antenna In Package) Market Forecast
9. mmW Module
 - a. mmW Module Market Forecast
 - b. mmW Module Market Share Trend
10. FEM for NB-IOT/5G-IOT
 - a. FEM for NB-IOT/5G-IOT Market Forecast
 - b. FEM for NB-IOT/5G-IOT Market Share Trend
11. Diversity FEM
 - a. Diversity FEM Market Size Trend & Forecast by Product Type
 - b. Diversity FEM Market Forecast: Detailed Data
 - c. Diversity FEM Market Share Trend

- d. Diversity FEM Supply chain
12. Multiplexer
 - a. Multiplexer Market Size Trend & Forecast by Band Combination
 - b. Multiplexer Market Size Trend & Forecast by Product Type
 - a. Multiplexer Market Size Trend & Forecast for COB or For FEMs
 - b. Multiplexer Market Size Trend & Forecast by Duplexer Type
 - c. Multiplexer Market share Trend
 - d. Market Share Breakdown per Product Type
13. Antenna Multiplexer
 - a. Antenna Multiplexer Outline
 - b. Antenna Multiplexer Market Size Trend & Forecast by Product Type
 - c. Antenna-Multiplexer Market Forecast: Detailed Data
 - d. Antenna-Multiplexer Market Share Trend
 - e. Antenna-Multiplexer Market Share Breakdown per Product Type

III. Antenna Switch

1. Total Market Size Trend & Forecast
2. Antenna Switch for Main RF Market Size Trend & Forecast
3. Antenna Switch for Diversity Market Size Trend & Forecast
4. Antenna Switch for Main RF Market Share Trend
5. Antenna Switch for RX Diversity Market Share Trend
6. Annual Antenna Switch for Main RF Market Share Breakdown per Product Type
7. Annual Antenna Switch for Diversity Market Share Breakdown per Product Type

IV. Power Amplifier Module

1. Market Size Trend & Forecast by Product Type
2. M/M PAM Type & Outline
3. Multi-band/Multi-mode PAM Market Size Trend & Forecast by Product Type
4. Power Amplifier Module Market Forecast Detailed Data -Quantity-
5. Power Amplifier Module Market Forecast Detailed Data -Quantity-
6. PAM TOTAL Market Share Trend
7. Single PAM Market Share Trend
8. Multi-band/Multi-mode PAM Market Share Trend
9. Power Amplifier Module Market Share Breakdown per Product Type

V. Duplexer

1. Duplexer Market Size Trend & Forecast by Product Type
2. Duplexer Market Size Trend & Forecast for FEMs
3. Duplexer for FEMs
4. Duplexer usage by Band Duplexer
5. Market Size Trend & Forecast by Band
6. Duplexer Market Forecast Data table
7. Duplexer Market Share Trend
8. Duplexer Supply chain
9. Duplexer Market Share Breakdown per Product Type CY2017-CY2020

VI. Band Pass Filter

1. Application & Classification
2. Band Pass Filter Market Size Trend & Forecast by Application
3. Band Pass Filter Market Size Trend & Forecast by Product Type
4. Band Pass Filter Market Size Trend & Forecast for FEMs
5. Band Pass Filter Market Size Forecast by Application/Technology
6. Band Pass Filter Market Size Forecast by Technology/Application
7. BPF Market Share Trend
8. Filter (Duplexer & BPF) Suppliers Outline
9. Low Performance Filter (IPD/LTCC) manufacturers
10. Filter market Analysis -for FEM/for COB-

VII. TCXO

1. Market Size Trend & Forecast by Application TCXO
2. Market Size Trend & Forecast: Detailed Data TCXO

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