Navian Marketing Report

~The engine of the market shifting from smartphones to non-voice devices like IOT~

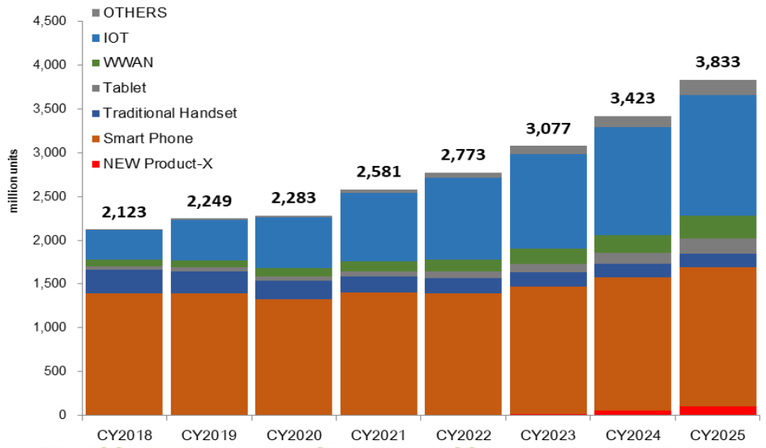
RF Devices/Modules for Cellular 2021-2022

Released on January 7, 2022

Front End Modules & RF Components in this report

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

Cellular Terminal Shipment Forecast by Standard



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.

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.

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

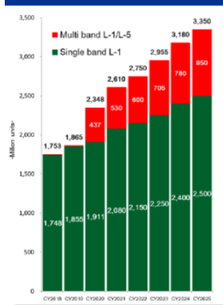
Cellular adoption in Tablet and Notebook PC will become full scale as 5G becomes widely used. It should become the adrenaline shot which will stimulate the Tablet and Notebook PC market.

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.

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

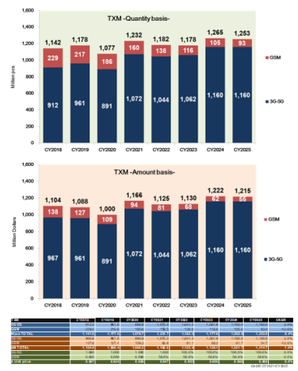


- GNSS (GPS) for Cellular Terminals like smartphones had only supported 1.5GHz band (L1) single band up until now, but some movement toward multibanding by adding 1.1GHz band (L5) is being actualized.
- Xiaomi Mi8 released in June 2018 is the first multiband-supporting smartphone.
- It supports dual bands of L1 (1.5GHz) and L5 (1.1GHz).
- Purpose of multibanding 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.

GPS	CY2018	CY2019	CY2020	CY2021	CY2022	CY2023	CY2024	CY2025
Single band L-1	1,747.9	1,855.0	1,911.0	2,080.0	2,150.0	2,250.0	2,400.0	2,500.0
Multi band L-1/L-5	5.0	10.0	437.4	530.0	600.0	705.0	780.0	850.0
TOTAL	1,752.9	1,865.0	2,348.4	2,610.0	2,750.0	2,955.0	3,180.0	3,350.0

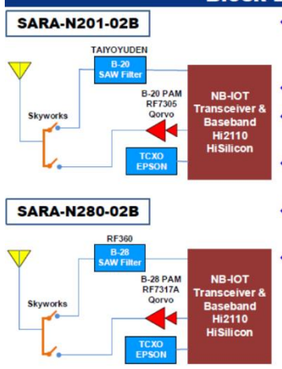
Million units

TX Module
Market Size Trend & Forecast by Product Type



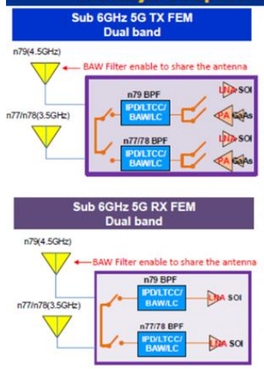
- On top of the decrease in shipment of Cellular Terminal in 2020 affected by COVID pandemic, the increase in 5G smartphones adopting PAMD and FEMD resulted in demand shrinkage for TX Module.
- Market size of TX Module in 2020 was 1,076.7 million pcs (YoY 91.4%, quantity) and 1,000.2 million dollars (YoY 91.9%, amount).]
- Meanwhile, increase is expected for adoption of Low-end Platform from companies like Media Tek which adopt TX Module in middle/low-end 5G smartphones, and also for IOT Module market. Such increase should contribute to growth in TX Module demands.
- Market size of TX Module in 2021 is expected to reach 1,231.7 million pcs (YoY 114.4%, quantity) and 1,166.0 million dollars (YoY 116.6%, amount).
- Although PAMD adoption is expected to increase in IOT and low-end smartphones in the future, there may be cases where the market returns to TX Module for lower cost in 5G smartphones where PAMD is the standard.
- TX Module market is expected to maintain the current level of demand, and market size in 2025 is expected to be 1,253.0 million pcs based on quantity and 1,214.7 million dollars based on amount.

U-Blox SARA-N201-02B/SARA-N280-02B Block Diagram



- U-Blox SARA-N201-02B and SARA-N280-02B are IOT Modules that support NB-IOT.
- Each supports only 1 band of LTE FDD.
- SARA-N201-02B supports Band-20 and adopts Taiyo Yuden's SAW Filter.
- SARA-N280-02B supports Band-28 and adopts RF360's SAW Filter.
- Chipset is HiSilicon's Hi2110, that integrates Transceiver and Baseband.
- It does not support GSM, and uses a discrete Antenna Switch on Front End, combined with Qorvo's single band PAM.

Conventional FEM for Sub 6GHz
~The major components are Switch, Filter, and PA~



- There are 2 basic types of FEMs for Sub 6GHz: TX Module (often called PAMiF in the market) for transmitting and receiving, and RX Module (called 5G RX Module here at Navian) for receiving.
- As for the materials of the main components, Antenna Switch and LNA are SOI, and Power Amplifier is GaAs-HBT.
- Sub 6GHz (n77/n78/n79) for 5G is TDD (Time Division Duplex) Band, so no Duplexer is used.
- Band Pass Filter, aside from the ones Apple makes with BAW Filter, is LTCC (laminated ceramic) or IPD (integrated passive device).
- In cases where BAW filter with high attenuation characteristics is used, it lets a single antenna share 3.5GHz (n77/n78) and 4.5GHz (n79), and also avoids interference with adjacent 5GHz of Wi-Fi.
- However, the BAW filter is more expensive than other filters, so manufacturers other than Apple use inexpensive IPD and LTCC.
- Also, Skyworks creates its original Filter circuit on the FEM substrate, using a combination of inductor and capacitor.

RF Devices/Modules For Cellular 2021 2022 English version
-CD-ROM (PDF file & Excel file)-

○Release Schedule　December 15 2022

○Report format　322 SLIDES（PDF file）
PDF file of report/Excel data

○Price
① 220,000JPN for Year's subscribers of Navian quarterly report'
② 270,000JPN Customers who have purchased Navian quarterly report within 1year
③ 320,000JPN Customers who have not purchased Navian quarterly report within 1year
＊Additional notes for companies with more than 10,000 employees on a consolidated basis.
If you will share our reports between different departments or subsidiaries and affiliated companies, you need to purchase the corporate license. Please contact us.

■Method of order
○BY Attached FAX　ORDER FORM Fax.+81-3-5303-1304
○BY Email　order@navian.co.jp with your information as same as FAX ORDER FORM

■PAYMENT
Please Bank Transfer in Japanese Yen to the bank account of the Navian, Inc.
The report's bill will be sent with the report.
Payment term is within 1 month after you receive the report.

■PUBLISHER
Navian Inc.　http://www.navian.co.jp
mailto:info@navian.co.jp
2-18-2,Zenpukuji, Suginami-ku, Tokyo 167-0041 JAPAN
Tel.+81-3-5303-1303/Fax. +81-3-5303-1304

— CONTENTS —

Phase1. Cellular Terminal Shipment Forecast

I. Cellular Terminal Shipment AND Update
1. Cellular Terminal Variation & Definition
2. Cellular Terminal Annual Shipment History CY2001-CY2021
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 CY2015-CY2021
7. Cellular Terminal Shipment by Maker & Cellular Standard History CY2015-CY2021

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-CY2020
13. Outline of 5G Smartphone Venders
14. 5G Smartphone Shipment by destination
15. 5G Shipment CY2019-CY2020 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
20. Consideration of Antennas & Filters for Sub 7GHz

III. Cellular Terminal Shipment Forecast –CY2025
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 1/2
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 CY2025
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. iPhone13 Pro Analysys
1. iPhone13 Pro vs. GALAXY S21+in mmW Part
2. mmW in iPhone 12 Pro for USA
3. RF Components and FEMs in iPhone12 & 13
4. Detailed Table of RF Components and FEMs in iPhone12 pro & 13 pro
5. Teardown of iPhone 13Pro USA Model

III. SAMSUNG Galaxy S21 Ultra 5G SC-52B Teardown
- Latest GALAXY S series compatible with mmW & Sub 6GHz-
1. RF Circuit Diagram
2. RFFE of GALAXY S21 Series by model
3. SAMSUNG Galaxy S21 Ultra 5G SC-52B Teardown

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. RF Market Potential in 4.5G-5G

V. IOT Modules Teardown
1. Teardown Summary of 21 IOT modules
a. Outline of 21 IOT Modules
b. Teardown of 21 IOT Modules
c. Outline of Cellular IOT Standard
d. RF band count of 21 IOT Modules
e. Chipset Share of 21 IOT Modules
f. RF Components/Modules in 21 IOT Modules
g. Filters & TCXO in 21 IOT Modules
h. Share of FEM & PAM in 21 IOT Modules
i. Share of PAM in 21 IOT Modules
j. Share of Dupelxer in 21 IOT Modules
k. Share of SAW/IHP Filter in 21 IOT Modules
l. Share of TCXO/XTAL UNIT in 21 IOT Modules
m. 21 IOT Module list

2.FEMs and Filters in RF Section of Low-end Smartphones
-Picture/RF Block Diagram/FEMs/Filters/Chipset/XTALs-
a. Quectel-BC95-B5-NB-IOT
b. Quectel-BC95-G-NB-IoT
c. Quectel-BC28-NB-IOT
d. U-Blox-SARA-N280-02B-NB-IOT
e. U-Blox-SARA-N201-02B-NB-IOT
f. SIMCom-SIM7000G -CAT M1/NB-IoT
g. SIMCom-SIM7000E -CAT M1/NB-IoT
h. NimbeLink"-NL-SW-LTE-QBG96-B-CAT M1/NB-IoT
i. Sequans Communications"-GM01Q-CAT M1/NB-IoT
j. Sierra Wireless-AirPrime WP7702-CAT M1/NB-IoT
k. Sierra Wireless-AirPrime HL7800-CAT M1/NB-IoT
l. Telit-ME910C1-NV-CAT M1/NB-IoT
m. SIMCom-SIM7600E mini-LTE CAT1
n. SIMCom-SIM7600G-LTE CAT1
o. SIMCom-SIM7600E L1C-LTE CAT1
p. Thales DIS-ELS61-US REL.2-LTE CAT1
q. Telit-LN930-AP DW5814e-LTE CAT4
r. Huawei-ME909s-821A V2-LTE CAT4
s. Quectel-EC25-E-LTE CAT4
t. Quectel-EC25-AU-LTE CAT4
u. Quectel-EC25 -AF-LTE CAT4

Phase3. RF Devices / Modules Market Status & Forecast

I. RF Devices / Modules Total Market Forecast CY2018-CY2025
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 -CY2018-CY2021

II. Front End Module & Sub Front End Module Market Forecast CY2025
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
v. FEM Supply-chain
w. Front End Module Market Trend & Forecast by Product Type
x. Front End Module Market Trend & Forecast by Product Type: Detail Data
y. Front End Module Market Trend & Forecast by For Apple/For Others 1/2
z. Sub Front End Module Market Trend & Forecast by Product Type
aa. 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. All-in-One FEM
a. All-in-One FEM Market Size Trend & Forecast
b. All-in-One Market Share Trend
8. 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
9. 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
10. mmW Module
a. mmW Module Market Forecast
b. mmW Module Market Share Trend
11. FEM for NB-IOT/5G-IOT
c. FEM for NB-IOT/5G-IOT Market Forecast
d. FEM for NB-IOT/5G-IOT Market Share Trend
12. 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
13. 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
14. 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

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

ORDER FORM

ATTN: NAVIAN INC.
Fax : +81-3-5303-1304

RF Devices/Modules For Cellular 2021-2022 English version

Division license	Price	Initial
For Year's subscribers of Navian **quarterly report**	JPY220,000	
For Customers who have purchased Navian **quarterly report** within 1year	JPY270,000	
For Customers who have **not** purchased Navian **quarterly report** within 1year	JPY320,000	

If you will share our reports between different departments or subsidiaries and affiliated companies, you need to purchase the corporate license. Please contact us.

Corporate license	Price	Initial
For Year's subscribers of Navian **quarterly report**	JPY352,000	
For Customers who have purchased Navian **quarterly report** within 1year	JPY432,000	
For Customers who have not purchased Navian **quarterly report** within 1year	JPY512,000	

YOUR P.O. NUMBER	*For our invoice referencing purpose.*

Date of order	(YYYY) / (MM) / (DD)				
First name		Last name			
Company					
Job title		Department			
Address					
State/Province		Zip code		Country	
Contact Phone		FAX			
E-mail	@				

Authorizing Signature Signature Date

CONTACT

ATTN: Yoshiyasu Andoh
E-mail: andoh@navian.co.jp
Navian Inc.
2-18-2, Zenpukuji, Suginami-ku, Tokyo 167-0041, Japan
Phone: +81-3-5303-1303
Fax: +81-3-5303-1304