# mmWave Products for FWA

Peraso Inc. develops semiconductors and modules for the millimeter-wave markets. It is focused on 5G FR2 licensed bands and the 60GHz license-free band. Peraso has been a leader in providing RF solutions for more than 10 years, has made essential contributions to the IEEE 802.11ad/ay standard and holds several patents in the field.

The company's IC products include baseband ICs and various mmWave RFICs. When combined with its patented antenna technology, the result is two compelling families of module products. Peraso offers its *Perspectus 60* and *Versatus 60* module series for the 60GHz band.

These modules offer low latency, high reliability, multi-gigabit throughput and can be configured to support Fixed Peraso's unique capabilities enable point-to-point and point-to-multipoint Fixed Wireless applications with link ranges exceeding 25 kilometers. Enterprise and consumer applications, such as wireless UHD video streaming, untethered augmented reality and virtual reality can also be supported.
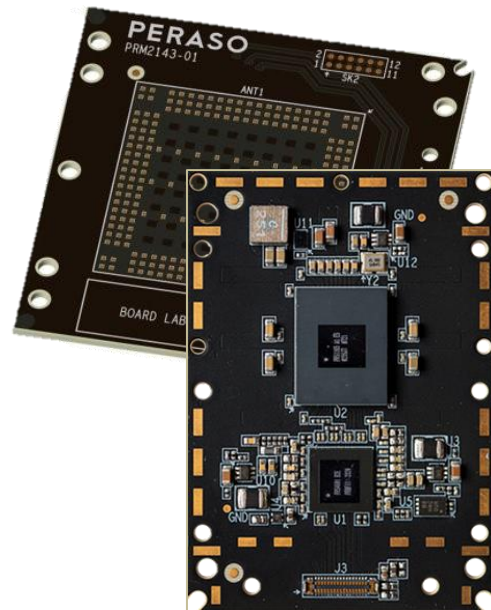
60GHz Modules Overview

Peraso's mmWave modules provide complete USB 3.0 to 802.11ad solutions for high-speed wireless applications including Fixed Wireless and Enterprise data networking infrastructure. The modules utilize the Peraso X720 and X130 60 GHz phased-array chipsets which include a baseband processor and mmWave beamforming transceiver RFICs.

The modules incorporate phased array antennas which offer a variety of gain and field-of-view options. The antenna is integrated into the PCB and provides uniform performance over the entire license-free 60GHz band.

The Baseband processor, the PRS4601-B2E, provides MAC and PHY layer functionality necessary for IEEE 802.11ad operation and supports point-to-point or point-to-multipoint capability. Peraso offers a variety of software/firmware versions which are optimized for common applications.

Common Module Features

- Operates in the license-free 60 GHz band
- IEEE 802.11ad MAC and PHY compliance
- Integrated phased-array antenna
- Dynamic beamforming
- Up to 3.5 Gbps user throughput
- Extremely low (< 1ms) link latency
- USB 3.0 data and control interface
- Automatic rate adaptation
- Automatic calibrations

- AES 128-bit data encryption
- Network synchronization support
- A- MSDU, A-MPDU data aggregation
- Integrated power management
- -40°C to 85°C operation
- Single 5V power supply input
- Application Software Modules
- Scanned for FCC compliance

Perspectus 60 Series

The Perspectus series of modules utilize Peraso's high power X720 chipset. The modules are supported by Peraso's Perspectus Infrastructure software and firmware packages.

The PRS1165 RFIC provides 16 RF chains with high transmit power levels and supports all 6 of the IEEE 802.11ad/ay defined channels. Channels 5 and 6 are outside the oxygen absorption band thereby allowing for long range operation. Selectable RF filters allow it to also support ½ bandwidth channels.

With a variety of integrated antenna options, and the ability to add a high gain parabolic reflector, the Perspectus system can achieve gigabit data rates at ranges exceeding 20km.
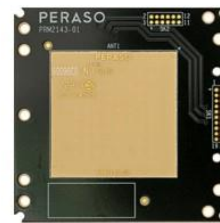
Target Applications

- Point-to-multipoint Fixed Wireless Access Networks
- Secure communication networks
- Point-to-Point Backhaul / Fiber alternative
- Industrial Automation

Features

- 57-71 GHz, Channels 1-6
- ½ Channel capability
- High-power 16 RF chains
- 16 to 64 element antenna arrays
- MCS 1-12
- Total user data capacity up to 3Gbps*
- Multi-user support up to 32 STA
- Peraso Directional Beam Scan and Connect (DBSC) for establishing long-range Fixed Wireless links
- Peraso STA Focus for long-range Fixed Wireless Access point-to-multipoint systems
- EDCA tuning to optimize channel utilization
- -40°C to 85°C operation
- 5VDC power input
- Scanned for FCC compliance

Perspectus 60 Module Comparison Table

	PRM2141X	PRM2142X	PRM2143X	PRM2144X
Antenna Array	16-element patch	32-element patch	64-element patch	128-element patch
Max EIRP	37 dBm	40 dBm	44 dBm	47.5 dBm
Antenna Gain	15 dBi	18 dBi	22 dBi	25.5 dBi
Scan range	±45° azimuth ±45° elevation	±45° azimuth ±20° elevation	±15° azimuth ±20° elevation	±10° azimuth ±20° elevation
Boresight Beamwidth (-3dB)	25° azimuth 20° elevation	22° azimuth 12° elevation	11° azimuth 11° elevation	7° azimuth 11° elevation
Maximum Boresight Side Lobe	-15 dB azimuth -15 dB elevation	-12.5 dB azimuth -13.5 dB elevation	-14.5 dB azimuth -13.5 dB elevation	-19 dB azimuth -13.5 dB elevation
Coverage (-6dB)	±45° azimuth ±45° elevation	±50° azimuth ±30° elevation	±30° azimuth ±30° elevation	±15° azimuth ±25° elevation
Power consumption	Tx: 5 to 11.5 W Rx: 3.5 to 4.5 W	Tx: 11.5 W Rx: 4.5 W	Tx: 11.5 W Rx: 4.5 W	Tx: 11.5 W Rx: 4.5 W
Size	35mm × 50mm	50mm × 50mm		55mm × 55mm
Additional information	Dish (reflector) antenna supported	Highest coverage in PtMP configuration	Balanced gain and coverage	Highest gain in PtMP configuration

Versatus 60 Series

Versatus 60 series modules are targeted for enterprise, industrial and consumer applications which demand reliable, low latency, multi-gigabit data rates.

The modules incorporate antenna arrays which can switch between vertical and horizontal polarizations to match any installation or operational scenario.

The modules are supported by Peraso's Software and Firmware packages which include features such as roaming and the ability to service up to 32 associated and active STA.

Target Applications

- Enterprise networking
- Industrial automation
- Multi-AP and STA networks with fast roaming
- Wireless display
- Untethered AR/VR
- Secure communications

Module Features

- 57-66 GHz, Channels 1-4
- 8 active RF chains
- Wide field-of-view beam-steering range
- Automatic polarization switching
- π/2-BPSK, π/2-QPSK, π/2-16QAM modulations
- Total user data capacity up to 3.5 Gbps
- Multi-user support up to 32 STA
- Fast roaming between APs
- 0°C to 50°C operation
- Scanned for FCC compliance

Versatus 60 Module Comparison Table

	PRM2136X
Status	In Production
Application	AP and direction STA
Antenna Array	8+8 dual polarized patch
Max EIRP	29 dBm
Antenna Gain	13 dBi
Scan range	±45° azimuth ±40° elevation
Boresight Beamwidth (-3dB)	40° azimuth 25° elevation
Maximum Boresight Side Lobe	-15 dB azimuth -15 dB elevation
Coverage (-6dB)	±60° azimuth ±60° elevation
Power consumption	Tx: 2.5 to 3.2 W Rx: 2.4 to 2.9 W Idle: <1 W (<500 mW planned)
Size	22mm × 45mm
Interface	36-pin Hirose board-to-board

PRM2131X	PRM2132X	PRM2138X
Under Development	Under Development	Under Development
USB adapter client	USB adapter client	High performance AP
6-4-6 end-fire array	4-4-4-4 end-fire + patch array	8+8 dual polarized patch
23 dBm	23 dBm	33 dBm
12 dBi	12 dBi	13 dBi
290° azimuth 0° elevation	290° azimuth (target) 0° to 120° elevation (target)	±45° azimuth ±45° elevation
25° to 35° azimuth 120° elevation	35° azimuth 60° to 120° elevation	40° azimuth 25° elevation
-15 dB azimuth -20 dB elevation	-15 dB azimuth -15 dB elevation	-15 dB azimuth -15 dB elevation
310° azimuth 120° elevation	310° azimuth (target) 140° elevation (target)	±70° azimuth ±60° elevation
Tx: 2.5 to 3.0 W Rx: 2.4 to 2.8 W Idle: <1 W (<500 mW planned)	Tx: 2.5 to 2.8 W Rx: 2.4 to 2.8 W Idle: <1 W (<500 mW planned)	Tx: 5 to 9 W Rx: 3.5 to 4.5 W
16mm × 51mm (existing) 20mm × 45mm (target)	20mm × 45mm (target)	35mm × 45mm (target)
USB 3.0 Type-A Plug	USB 3.1 Type-C Plug	36-pin Hirose board-to-board

PERASO

Module Total Solution: Eliminates Risk - Shortens Time to Market

Peraso's Module solutions focus on _eliminating the time and_ cost of designing a module that must be manufactured in high volume and is of high quality and reliability. Modules allow system companies to focus on their competitive advantage with the confidence of using a proven RF module. The Result: _Short Time to Revenue_.

Peraso modules benefits are:
- Matched set of components from one supplier (RFIC, Baseband IC, Integrated Antenna)
- Single supplier, single point of support
- Eliminates High frequency board design challenges
- Proven Manufacturability for quality, reliability and volume
- Operating test coverage and testing time
- Pre-scanned for compliance with FCC regulations
- Allow customers for focus on the application not the RF connectivity

And, when the 5G RF market, application or configuration requirements change, that can be solved by selecting a different module. No need to go back to the design drawing board.

The competitive advantage of a Peraso Module, in addition to meeting stringent FCC qualification:
- Integrated antenna
  - Patented technology
  - Reduces transition losses
  - Eliminated costly LTCC component
- RF
  - Antenna and RFIC were co-designed to optimize performance over wide frequency band
  - Field-proven beamforming with selective antenna matching to provide a range of performance
  - Multiple application specific software offering for point-to-point and point-to-multipoint
- Baseband
  - Co-designed to work with Peraso RFIC
  - Highly programmable for complex beamforming
  - Easy to use USB 3.0 interface
- Module
  - Eliminates design risks in the mmWave frequency range which require specialized skills
  - Solves the difficult issues of high-volume module manufacturing
  - Eliminates a requirement to build complex RF testing systems
  - Golden units and automated test systems available for in-house testing

SUMMARY

Peraso's modules eliminate the RF design concerns that come with using different component suppliers, component matching, trying to minimize power transition losses, board reliability and quality, difficulty of testing to specific RF power and beamforming performance, etc. Peraso modules allow you to focus on what you do best, delivering on your system and product's Value Propositions.

The module's antenna, RFIC, Baseband IC, board (substrate) are all from Peraso, providing a single source for all key elements. _Module designs utilize the technology, design techniques, and manufacturing flows of modules that are already in production at Tier 1 customers._

Modules Eliminates Risks and Shorten your Time to Revenue
Peraso Modules can help you quickly create compelling 5G Products