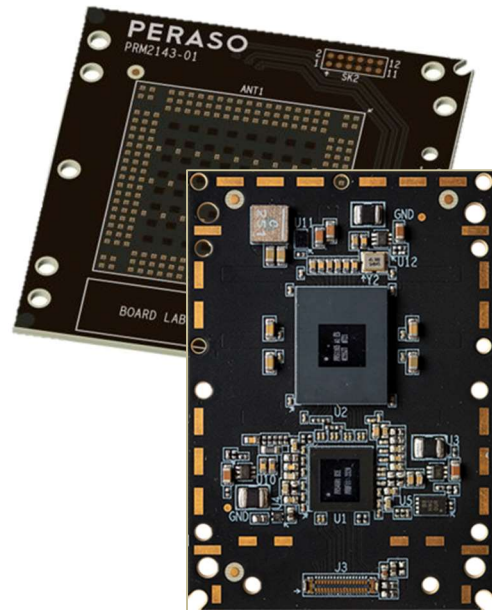


mmWave Products for FWA

Peraso is a global leader in the development and high-volume deployment of semiconductor solutions for the unlicensed 60 GHz (mmWave) spectrum. With a focus on high-performance, scalable wireless technologies, Peraso serves a diverse range of markets, including fixed wireless access (FWA), tactical communications, wireless video and transportation. 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.



60GHz Modules Overview

Peraso's mmWave modules provide complete USB 3.0 to IEEE 802.11ad solutions for high-speed wireless applications. 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

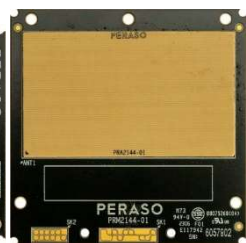
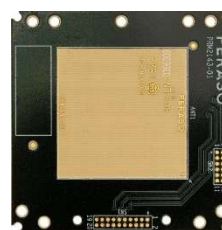
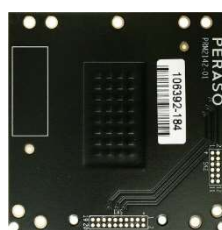
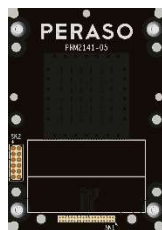
- Point-to-multipoint Fixed Wireless Access Networks
- Tactical communications
- Point-to-Point Backhaul / Fiber alternative
- Transportation

Features

- 57-71 GHz, Channels 1-6
- ½ Channel capability
- High-power 16 RF chains
- 16 to 128 element antenna arrays
- MCS 1 (BPSK) to MCS 12 (16QAM) support
- Total user data capacity 3.5 Gbps
- Multi-user support up to 48 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-V	PRM2142X-V	PRM2143X-V	PRM2144X-V
Antenna Array	16-element patch	32-element patch	64-element patch	128-element patch
Polarization	Vertical	Vertical	Vertical	Vertical
Max EIRP (CH4, MCS9)	38 dBm	40 dBm	44 dBm	47.5 dBm
Antenna Gain (Av.)	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 25° 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: 4.25 to 11.75 W Rx: 3.3 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	50mm × 50mm	55mm × 55mm
Additional information	Dish (reflector) antenna supported	Highest coverage in PtMP configuration	Balanced gain and coverage	Highest gain in PtMP configuration



Notes:

- EIRP may be limited for regulatory compliance.

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

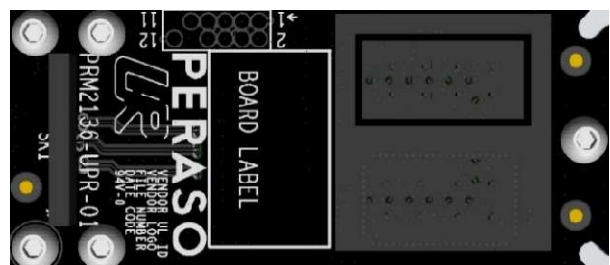
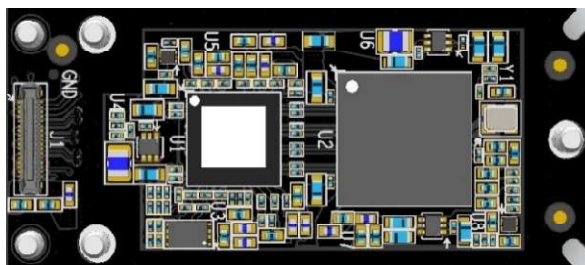
- Enterprise networking
- Industrial automation
- Multi-AP and STA networks with fast roaming
- Wireless display
- Untethered AR/VR
- Secure communications

Module Features

- 57-66 GHz, Channels 1-4
- 8 active RF chains
- Wide field-of-view beam-steering range
- Automatic polarization switching
- MCS0 (BPSK) to MCS 12 (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	PRM2132X	PRM2137X
Status	In production	Contact Factory	Contact Factory
Baseband		PRS4601 (802.11ad)	
RFIC		PRS1145	PRS1165
Antenna Array	8+8 element dual polarized patch	16 element hybrid	8+8 element dual polarized patch
Max EIRP	29 dBm	20dBm	31 dBm (estimated)
Antenna Gain	13 dBi	8 dBi	12 dBi (estimated)
Scan range	±45° azimuth ±40° elevation	360° azimuth > 120° elevation	>90° azimuth (target) >80° elevation
Digital Interface	USB 3.0 data and control. 2.5V CMOS 1PPS Sync and GPIO.		
Power consumption	Tx: 3.2 W; Rx: 2.9 W	Tx: 2.8 W; Rx: 2.7 W	Tx: 9 W; Rx: 4.5 W
Size	22mm × 45mm	22mm × 45mm (target)	35mm × 45mm (target)
Additional information	Available with EMI shield or fence		



PRM2136X Component and Antenna sides

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 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