# Specification

## Technical parameters

| Parameter | 10 GHz | | 11 GHz | | 17 GHz / 24 GHz | | 18 GHz | |
|---|---|---|---|---|---|---|---|---|
| Frequency range (approx.) | 10.300 – 10.600 GHz | | 10.700 – 11.700 GHz | | License-free band | | 17.700 – 19.700 GHz | |
| | 10.100 – 10.700 GHz | | | | 17.1 – 17.3 / 24.0 – 24.25 GHz | | | |
| Sub-band | Lower (GHz) | Upper (GHz) | Lower (GHz) | Upper (GHz) | no sub-bands | | Lower (GHz) | Upper (GHz) |
| sub-band A | 10.300-10.420 | 10.476-10.588 | 10.695-10.970 | 11.185-11.460 | 17.1 – 17.3 / 24.0 – 24.25 | | 17.700-18.209 | 18.710-19.219 |
| sub-band B | 10.125-10.325 | 10.475-10.675 | 10.935-11.195 | 11.425-11.695 | | | 18.167-18.690 | 19.177-19.700 |
| sub-band C | | | | | | | 17.700-18.300 | 19.300-19.700 |
| Channel spacing | 1.75 – 56 MHz | | 1.75 – 56 MHz | | 3.5 – 56 MHz | | 1.75 – 55 MHz | |
| Channel duplex spacing | min. 56 MHz | | 490, 530 MHz | | min. 60 Mhz | | 1008, 1010, 1560 MHz | |
| Modulation | QPSK, 16, 32, 64, 128, 256 QAM, hitless ACM | | | | | | | |
| User data speed | 1.4 – 360 Mbps | | 1.4 – 360 Mbps | | 4.9 – 360 Mbps | | 2.5 – 360 Mbps | |
| Forward Error Correction | LDPC | | | | | | | |
| Data sensitivity @BER $10e^{-6}$ | CS 1.75 MHz | CS 56 MHz | CS 1.75 MHz | CS 56 MHz | CS 3.5 MHz | CS 56 MHz | CS 1.75 MHz | CS 55 MHz |
| QPSK | -103 | -86 | -102 | -87 | -97 / -96 | -87 / -86 | -97 | -84 |
| 16 QAM | -97 | -79 | -97 | -80 | -90 / -89 | -80 / -79 | -91 | -75 |
| 32 QAM | -94 | -75 | -94 | -76 | -87 / -86 | -76 / -75 | -88 | -72.5 |
| 64 QAM | -91 | -72 | -91 | -73 | -84 / -83 | -73 / -72 | -85 | -70 |
| 128 QAM | -88 | -68 | -88 | -69 | -83 / -79 | -69 / -68 | -82.5 | -67 |
| 256 QAM | | -66 | | -67 | -81 / -77 | -66 / -65 | | -64 |
| Output power | -10 to +13 dBm | | -15 to +24 dBm | | -25 to +5 dBm / -30 to +10 dBm | | -10 to +24 dBm | |
| ATPC | YES | | YES | | YES | | YES | |
| Latency (RFC 2544) | typ. 81µs (64 B/360 Mbps); 234 µs (1518 B/360 Mbps) | | | | | | | |
| User interface RJ45 | 1 Gb Eth. (10/100/1000) (IEEE 802.3ac 1000BASE-T), MTU 10240 B, recommended cable S/FTP CAT7 | | | | | | | |
| User interface SFP | 1000BASE-SX / 1000BASE-LX, MTU 10240 B, user exchangable SFP, power consumption max. 1.25 W | | | | | | | |
| Service interface | USB-A: USB / ETH a USB / WiFi | | | | | | | |
| Power supply | PoE (40 - 60 VDC, IEEE 802.3at to 100m. max. 25 W), 20 - 60 VDC, floating | | | | | | | |
| Power consumption | 21 W | | 21 - 29 W | | 21 W / 23 W | | 21 - 28 W | |
| Operating temperature range | - 30 to + 55°C (ETSI EN 300019-1-4, class 4.1.) | | | | | | | |
| Mechanical design | FOD (Full Outdoor) | | | | | | | |
| Size | 245 × 245 × 150 mm | | | | | | | |
| Weight | 2.8 kg | | 2.8 kg | | 2.5 kg | | 2.8 kg | |

## Management

| | |
|---|---|
| Configuration & management | HTTPS, SSH, Telnet |
| Real time monitoring | RSS, SNR, BER |
| Diagnostic tools | spectrum analyzer, pinger, constellation diagram |
| History charts | temperature, power supply, RSS, SNR, BER, data rate, output power |
| Statistics | RMON counters for all interfaces |
| Installation | RSS voltage output |
| Network management | SNMP ver.2c including configurable TRAPs |

## Antennas

| | |
|---|---|
| Various suppliers | Class 2,3; Direct mounting to 30 – 120 cm parabolic antennas, mounting via flexible waveguide also possible |

## Standards

| | | | | |
|---|---|---|---|---|
| Radio parameters | ETSI EN 302 217-2-2 V2.1.1 | | ETSI EN 300 440-2 V 1.4.1 | ETSI EN 302 217-2-2 V2.1.1 |
| | limits for ACCP/CCDP | | | limits for ACCP/CCDP |
| EMC | ETSI EN 301 489-4 V 2.1.1, ETSI EN 301 489-1 V1.9.2 | | | |
| Safety | EN 60 950-1:2006 | | | |
| FCC | | CFR 47 part 101 | RAy2-24: CFR 47 part 15 | CFR 47 part 101 |

Technical parameters are subject to change without prior notification.

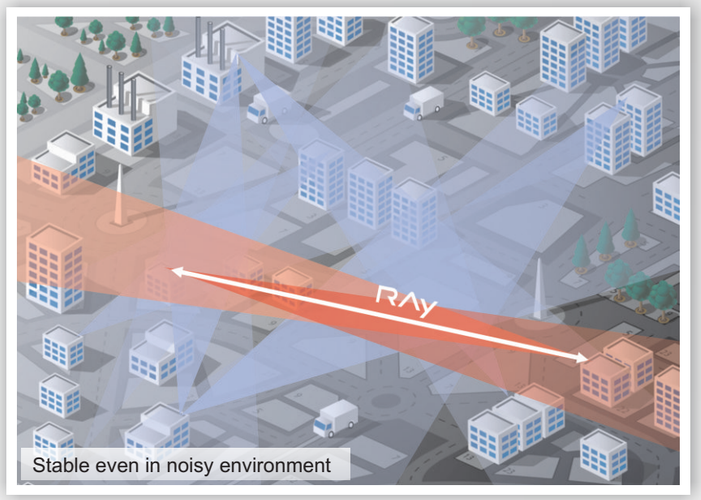
ver. 1.6


## General

**RAy** is the **high-speed point-to-point microwave link** developed and completely manufactured by RACOM, a global leader in the development and production of high performance, industrial grade wireless equipment. Benefiting from customer feedback, collected from thousands of units sold, **RAy** is continually being enhanced and further improved.

The concept of **RAy** technology, based on excellent sensitivity and interference resistance, allows the user to build links with **high capacity over long distances**, whilst maintaining **maximum link availability**.

Supporting a broad range of options and with an excellent reliability and price/performance ratio, **RAy** is your perfect **product of choice** for every application.



Stable even in noisy environment

# RAy

10 GHz | 11 GHz | 18 GHz
17 GHz | 24 GHz

## Microwave link

- **FREE & licensed bands**
- **Interference & obstacle tolerant**
- **Maximum distances & reliability**
- **Narrow channels from 1.75 MHz**
- **ACM, ATPC**
- **Optical + metallic Ethernet**
- **IPTV optimized**
- **PoE or DC (20 - 60 V)**
- **Low power consumption**
- **Climate chamber tested**

## Applications

- **LAN Extension**
- **Internet providers**
- **SCADA**

RACOM
www.racom.eu

# Microwave link

RAy

## Radio parameters

- High radio receiver **robustness** against unwanted interference
- Narrow channels (from **1.75 MHz**)
- SW selectable modulation: QPSK, 16, 32, 64, 128, 256 QAM
- Hitless ACM (Adaptive Coding and Modulation)
- ATPC (Automatic Transmit Power Control)

## Reliability

- **Heavy-duty** industrial components
- Built-in surge protection
- Operating temperature range from **-30 to +55 °C** certified
- Every single unit is thoroughly **tested** in a **climatic chamber**
- Quality manufacturing results in **exceptional reliability**
- **Rugged** input **filter** with no adjustable components

## Interfaces

- **Ethernet**: 1x optical, 1x metallic port configurable as:
  2 independent user ports, in-band management
  1 user + 1 management port
- **Power**: PoE, DC (**20 – 60 V**)
- **USB:** Management via USB / ETH or USB / WiFi

## FREE & licensed bands

- Supports both **FREE & LICENSED** bands
- **17 & 24 GHz: Fulfilling SRD standards.** Identical unit type at both ends of link offers **lower distribution and storage costs**
- Widely **configurable** channel **duplex spacing** eases sourcing of available channels

## Solution for any application

- High sensitivity together with wide channel width and modulation enables optimized links for **distance** and **performance**.
- MTU **10240 B**, MPLS transparent
- Packet buffer & QoS optimized for IPTV (multicasts, unicasts)

## Instalation in minutes

- Full outdoor unit with aluminium casing
- **HW reset button** for factory and customers settings
- Simple signal polarization change by unit's rotation
- RSS voltage output for antenna alignment
- Direct mounting to parabolic antennas

## Security & Standards

- Configuration via HTTPS and SSH for secured access
- Compliance to all relevant international standards
- Key parameters measured and confirmed by certified laboratory
- SFP modules, NMS and power supplies have no proprietary restrictions

## Advanced diagnostics

- Intuitive **web interface**
- Temperature, power supply, RSS, SNR, BER, data rate, output power status and history avail. as text or charts
- SNMP (Including generation of TRAPs)
- Built-in spectrum analyzer for free channel search
- Automatic detection of unit polarization
- Constellation diagram of the received signal

## References

### RACOM – solution of choice

**RAy** microwave links are successfully installed in all types of environmental and climatic conditions in **dozens of countries** from Europe through Middle East to Tropical areas.

The excellent **reliability** of **RACOM´s** microwave link is appreciated by numerous types of clients:

- global mobile operators: **Vodafone, O2**
- corporate networks operators
- cable TV providers: **UPC**
- government authorities: **Czech National Customs Office**

Based on RACOM's experience in the field of **SCADA and Telemetry**, RAy microwave links are also used in SCADA networks, both as a backhaul solution or as a link for surveillance IP cameras.

## Typical Applications

### LAN extension

- Corporate clients
- Fiber line replacement
- Building to building interconnectivity

RAy:

- Low and constant latency < 0.1 ms
- Two user ports available
- Ethernet, layer L2 transparent
- Excellent resistance to interference

### Internet providers

- Backbone and hi-priority last-mile
- Heavy traffic with multiple TCP streams

RAy:

- Free & licensed bands
- Both optical and metallic port
- IPTV proven solution
- Web interface including diagnostics
- Standard SNMP + SNMP traps, VLAN management

### SCADA

- Maximise emphasis on reliability and response time requirements
- High speed backbone
- Small data packets have to be processed as fast as possible

RAy:

- High reliability
- **24 VDC** powering with off-grid capability
- Long range links, narrow channels
- Low OPEX costs