



mimo | max
wireless

maximising the potential of advanced wireless communications

MiMOMax Linking Products

General

The MiMOMax Optimised Protection Variant (OPV) is a software flexible, ultra low latency, digital radio link designed for mission critical data linking and back-haul type applications.

The OPV product family utilises licensed narrow band radio channels and 2x2 MiMO technologies to provide industry leading spectral efficiencies of up to 12.8 bits/Hz/s or greater, enabling raw data rates of up to 320kb/s including link overhead (160kb/s for standard 25kHz OPV at 16QAM).

Utilising licensed spectrum ensures that the link operates in an interference free environment and is capable under the right conditions of providing a reliable low-error data transport service ($<1 \times 10^{-7}$ bit error rate).

For Power Line Protection applications the OPV will provide a number of industry standard data interfaces at link end points.

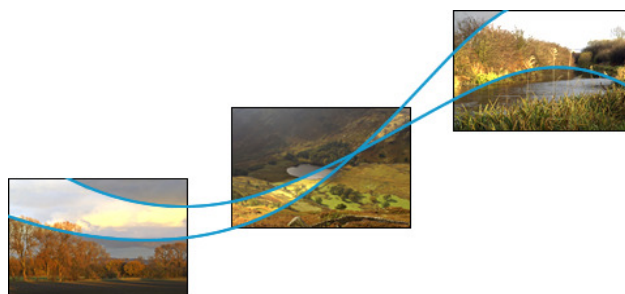
OPV

The OPV (Optimised Protection Variant) is designed to support a pair of power line protection relays (e.g. General Electric L90). The relays typically use the radio link to exchange data packets at 64 kb/s, containing power system voltage and current magnitude and phase angle information. This information is used to determine whether there is an unexpected event or power loss on the line, and to transmit information used to trip circuit breakers when a line fault is detected. Up to three OPV protection circuit links may be cascaded in order to handle longer ranges and difficult terrain.

The interface required for the protection relays is typically synchronous serial using V.11 (RS422) X21 or G703 signalling, at a 64 kb/s transmission rate. However, a number of other synchronous serial interfaces can be accommodated.

The total link latency must not be greater than 2 power system cycles (i.e. 40 milliseconds in each direction), and the jitter must not be greater than 130 microseconds. Since up to three protection circuit links may be cascaded, the latency of each link must be less than 13ms (typically <6 ms). Similarly the combined jitter of these links must not exceed 130 microseconds.

It is intended that the link radio paths will be engineered to provide sufficient signal strength at the equipment antenna terminals, to allow sufficient margin for signal fading. A single dual-polarised MiMO antenna is used at each end of the link.



1 PRELIMINARY PRODUCT FEATURES

1.1.1 Spectral Efficiency

The OPV utilises 2x2 MiMO and 16QAM technologies, to reliably achieve industry-leading spectral efficiency of 160 kb/s raw data rate in a 25 kHz (or 80 kb/s in 12.5 kHz) radio channel.

1.1.2 Built-in Multiplexer

The OPV has a built-in multiplexer, supporting a mix of traffic from synchronous serial and Ethernet interfaces. The synchronous serial connection takes service priority, with any remaining link bandwidth being used for IP data transport via the Ethernet port.

1.1.3 Built-in Duplexers

For full duplex multi-antenna operation whilst maintaining a small overall size, the OPV has built-in antenna duplexers.

1.1.4 Form Factor & Installation

The OPV is pole, wall or rack mountable (forced-air cooling when rack mounted). Occupying just 2U in a standard 19in rack, it can be installed by installers with the usual industry skills.

1.1.5 Alarms

The OPV offers an optional external alarm on the synchronous serial interface port. This alarm uses the interface lines normally used by the receive clock signal, and is therefore only available where the receive clock signal is not required.

1.2 ENVIRONMENTAL SPECIFICATIONS

1.2.1 Operating Temperature Range

Maximum ambient temperature range -25°C to +60°C

(Where the radio unit is exposed to direct sunlight a suitable solar shield is required to prevent solar temperature gain)

1.2.2 Humidity

4% to 100% (per EN 300 019 sec. 3.3 & 4.2H)

1.2.3 Environmental Protection

IP67 for outdoor wall or pole mount. IP20 for indoor rack-mount unit.

1.2.4 Operating Altitude

Up to 3000m

1.3 EXTERNAL COMPLIANCES

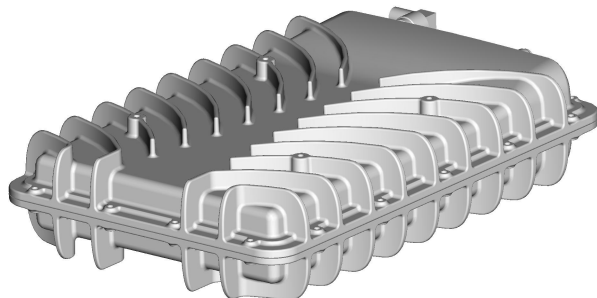
The product is designed to comply with the following standards:

Radio performance:

- AS/NZS 4768
- EN 302 217
- FCC 47CFR part 90
- RSS-Gen, RSS-119

EMC:

- AS/NZS/CISPR22
- EN 301 489
- FCC 47CFR part 15
- ICES-003



Optimised Protection Variant (OPV)

Environmental:

- EN 300 019 sections 3.3 & 4.2H

Safety:

- EN 60950

1.4 INTERFACES

The OPV provides both Ethernet and a range of 64 kb/s synchronous serial interfaces.

Customer/App.	Interfaces	Data Service Policy	Comment
Protection Circuit	Synchronous serial, various <i>Interfaces Include:</i> RS422, V11, V35 and X21 (between 32 & 128kb/s) Ethernet	Synchronous serial is serviced first, remaining bandwidth is used for Ethernet transport	Low latency required, <6ms for Cat I. Jitter must be compatible with three cascaded L90 links - <130µs.

Table 1: Protection Circuit Link Interface Configuration

1.4.1 Ethernet Interface

Ethernet connectivity is via an RJ45 socket, configurable to provide connectivity to other IP enabled networked devices. The network connectivity provided by the OPV is at layer 2 (IP). Layer 3 is also optionally available. Bandwidth not used by the synchronous serial interface will be available for IP traffic.

1.4.2 Synchronous Serial Interface and Connection

The synchronous serial data interface operates in one of two formats. Format one supports RS422, V11, V35 and X21 between 32 and 128kb/s. For RS422 and V35, transmit and receive paths are independent, where the transmit clock may be configured as either co-directional (clock defined from the user equipment) or contra-directional (clock generated from an internal reference). The receive clock is internally sourced and synchronised with the receive data stream, and may also be configured as an alarm output where its operation is software definable. For X21 the timing source may be internal or external. Format two is G703 at a user rate of 64kb/s where the clocking is co-directional and combined with user data as defined by ITU-T Recommendation G.703.

The connector type is RJ45; the maximum cable length is 100m.

1.4.3 Power Interface

The OPV operates on an external DC supply over a range of 10.5V to 32V. An optional AC supply is available for mains operation.



MiMO Multi Port Nib

1.5 PERFORMANCE

1.5.1 Raw Link Data Rate

MiMO 16QAM with a symbol rate of 20(10) kilosymbols/second, resulting in a raw data rate of 160(80) kb/s for a 25 kHz(12.5kHz) channel.

Note: 64QAM can be implemented for 12.5 kHz OPVs where suitable propagation paths are available, to enable additional data capacity for monitoring purposes and/or reduced latency. Where extra capacity or reduced latency is not required it is recommended that 16QAM be used.

1.5.2 Transmission Frequency Range & Bandwidth

The OPV operates on 12.5 kHz or 25 kHz PMR paired channels within the 420-470MHz band (other options on request).

1.5.3 Transmission Power

The OPV transmits a maximum power of 1W average per transmitter (total 2W average for 2x2 MIMO).

1.5.4 Synchronous Serial Interface Performance

1.5.4.1 Data Rate (Sync Serial)

The synchronous serial interface is nominally 64 kilobits per second.

1.5.4.2 Bit Error Rate

The BER in the user data for a 16QAM OPV is typically less than 1×10^{-7} for ≥ -98 dBm input RF level in a 25 kHz channel.

1.5.4.3 Data Delay

The latency for a 25 kHz OPV is typically less than 6ms (5.05ms), supporting Cat I, II & III Protection circuits. Latency for a 12.5 kHz OPV is not more than 10ms, which meets Cat II & III protection requirements.

1.5.4.4 Co-directional Transmit Clock Frequency Error

When in co-directional mode, the error in the frequency of the transmit clock will not exceed 1%.

1.5.4.5 M-RAP – Routing Adaptation Protocols

M-RAP is a suite of protocols that provide dynamic re-routing in the event of a path failure, where multiple paths are available. M-RAP is able to learn the topology of the network and therefore reroute paths as the topology changes (links lost or added). The OSPF (Open Shortest Path First) routing protocol is used to determine which path to take to achieve this re-routing functionality in a MiMOMax system. Where networking equipment is set to use a radio as the “default gateway”, there is a risk that the entire subnet could become unreachable in the event of the gateway going offline. MiMOMax uses VRRP (Virtual Router Redundancy Protocol) to dynamically assign a virtual IP address, so that any MiMOMax radio in the subnet can perform the role of default gateway. OSPF routers only communicate their state with the other routers in that “area”. GRE (Generic Routing Encapsulation) protocol may be used to pipe this monitoring information from the “areas” to a monitoring system in the core of the customer’s network.

1.5.5 Ethernet Interface Performance

1.5.5.1 Ethernet Physical Layer

The physical layer of the Ethernet interface is 10BaseT.

1.5.5.2 Bit Error Rate

The bit error rate provided by the IP transport (via Ethernet) service under appropriate link conditions is typically less than 1×10^{-7} .

MIMO DIGITAL LINK PRELIMINARY SPECIFICATIONS

1.6 GENERAL

Supply Voltage	10.5V DC to 32V DC
Maximum Power Consumption	92 W at 13.8V
Ambient Temperature Range	-25°C to +60°C
Mounting	2U high rack mount Also available as pole/wall mount unit
Dimensions (W x H x D), Rack mount option	440 x 84.5 x 382 mm (box size) 481 x 86 x 392 mm (including protrusions)
Dimensions (W x H x D), Wall/pole mount option	262 x 393 x 86.5 mm (radio unit only, excluding mounting)
Weight	6.8kg (radio unit only, excluding mounting)
Gross Data Rate (25 kHz, 16QAM)	160kb/s
Gross Data Rate (12.5 kHz, 16QAM)	80kb/s
Gross Data Rate (12.5 kHz, 64QAM)	120kb/s

1.7 TRANSMITTER

Number of MIMO Transmitters	2
Modulation	16/64QAM
RF Power Output **	2 x +30dBm (1 Watt) average
RF Power Control Range	10dB
RF Power Tolerance	+/- 1dB
Frequency Range	420 to 470 MHz ***
Frequency Step Size	6.25 kHz
Frequency Accuracy and Stability	≤ 2 ppm
Nominal Channel Bandwidth	12.5 kHz or 25 kHz
RF & EMC Standards Compliance	See section 1.3

1.8 RECEIVER

Number of MIMO Receivers	2	
Modulation	16/64QAM	
Typical RF Sensitivity for 10^{-4} BER (16QAM)	25 kHz	≤ -99 dBm
	12.5 kHz	≤ -102 dBm
Typical RF Sensitivity for 10^{-7} BER	25 kHz	≤ -98 dBm
	12.5 kHz	≤ -101 dBm
Frequency Range	420 to 470 MHz	
Frequency Step Size	6.25 kHz	
Frequency Accuracy and Stability	≤ 2 ppm	
Nominal Channel Bandwidth	12.5 kHz or 25 kHz	
RF & EMC Standards Compliance	See section 1.3	

1.9 DUPLEXER (INTERNAL)

Frequency	420 to 470 MHz (In three frequency splits)
Tx / Rx split	5 MHz minimum
Stop Band Attenuation	> 70 dB
Stop Band Bandwidth	> 500 kHz
Insertion Loss	< 2 dB

1.10 DATA INTERFACE (DIF II)

Synchronous serial	
Format	RS422, V11, V35, X21, G703 (64kbps)
Connector	RJ45
Input clock* (transmit clock)	Internal or external
Supported bit rates	32 to 128 kb/s ***
Maximum internal clock error	± 20 ns
Supported external clock error	$\pm 3\%$
Output clock** (receive clock)	Internal (synchronised to data stream)
Nominal inter-symbol jitter	< 54 ns
Ethernet	
Format	10BaseT
Connector	RJ45
Throughput	Up to 128 kb/s ***

* Input from connected equipment

** Output to connected equipment.

*** 128 kb/s is the maximum total data rate, shared between Serial and Ethernet ports.
Note: Clocks are defined from the perspective of the connected equipment, i.e. Tx Clock is an input.

2 ANTENNAS

2.1 DUAL-POLARISED COMPACT YAGI

Polarisation	Horizontal and vertical with separate feeds
Antenna Gain	>10dBi across the band
Beam width, -3dB (parallel to polarisation plane) (perpendicular to polarisation plane)	48° nominal 52° nominal
Front-to-back ratio	>15dB
Frequency bandwidth (15dB return loss)	>20 MHz
Connector arrangement	2 x male type N connector on 1.5m tails of RG214 coaxial cable.
Mounting (pole)	Twin vertically spaced clamps for attachment to 25 - 55 mm mounting pipe.
Dimensions W x H x L (direction of propagation)	250 x 250 x 850 mm
Weight	2.5 kg including coax tails and mounting brackets

2.2 QUAD ARRAY DUAL POLARISED LOOP YAGI

Polarisation	Horizontal and Vertical with separate feeds
Antenna Gain	> 16dBi
Beam width, -3dB (parallel to polarisation plane) (perpendicular to polarisation plane)	24 degrees (nominal) 24 degrees (nominal)
Front-to-back ratio	>20 dB
Frequency bandwidth (15dB return loss)	20 MHz
Connector arrangement	2 x Female type n connectors on combining Harness (Optional 1.5m tails of RG213 terminated in 2 x Male type n connectors)
Mounting	4 vertically spaced clamps for attachment to 25 to 55 mm mounting pipe. >= 50mm pipe recommended
Number required per link end	1 for 2 receiver MIMO, 2 for 4 Receiver MIMO
Dimensions W x H x L (direction of propagation)	910 x 910 x 860 mm
Weight	13kg including coax tails and mounting brackets

2.3 PANEL MIMO ANTENNA (HIGH WIND AND ICE TOLERANT)

Polarisation	Horizontal and vertical with separate feeds
Antenna Gain	>10dBi (typically 11.5dBi)
Beam width (horizontal, vertical)	75° nominal, 32° nominal
Front-to-back ratio	>20 dB
Frequency bandwidth (15dB return loss)	80 MHz
Connector arrangement	2 x female 7/16 connectors
Maximum Gust Withstand Speed	250 kph
Wind loading	660N (at 150kph)
Mounting	Twin vertically spaced clamps for attachment to 48 - 114 mm mounting pipe. Provision for additional stabilising struts (up to 4)
Dimensions W x H x T (direction of propagation)	500 x 1100 x 120 mm (+ mounting bracket)

ANTENNAS

Dual- Polarised Compact Yagi

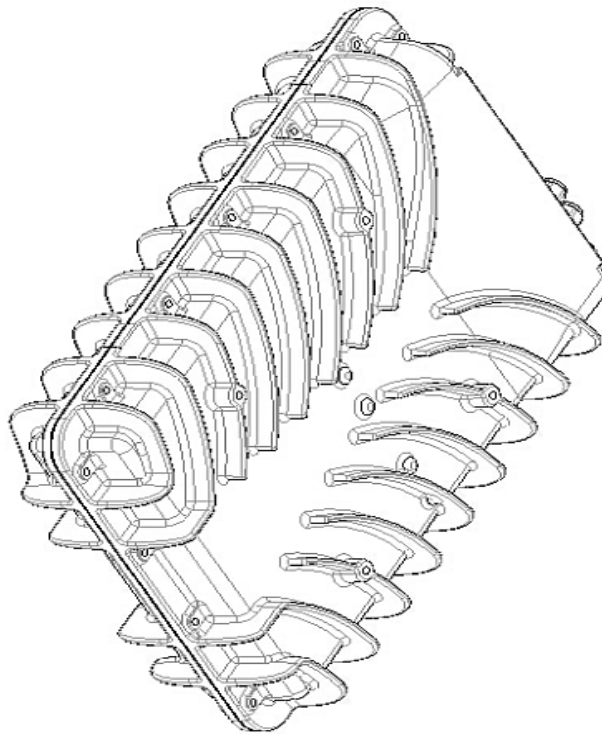
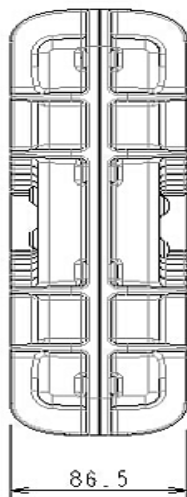
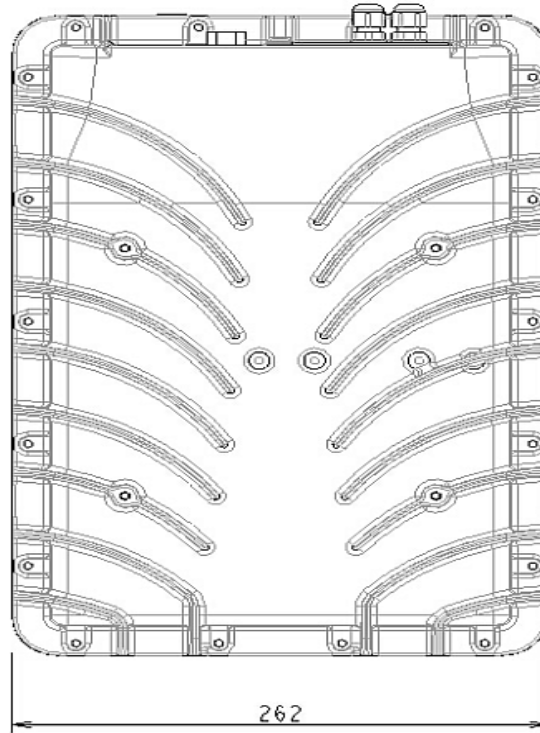
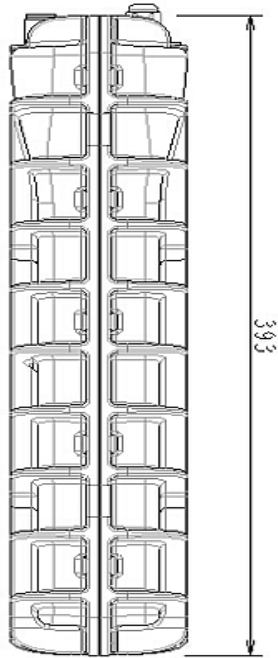


Panel MiMO Antenna



Quad- Array Dual Polarised Compact Yagi

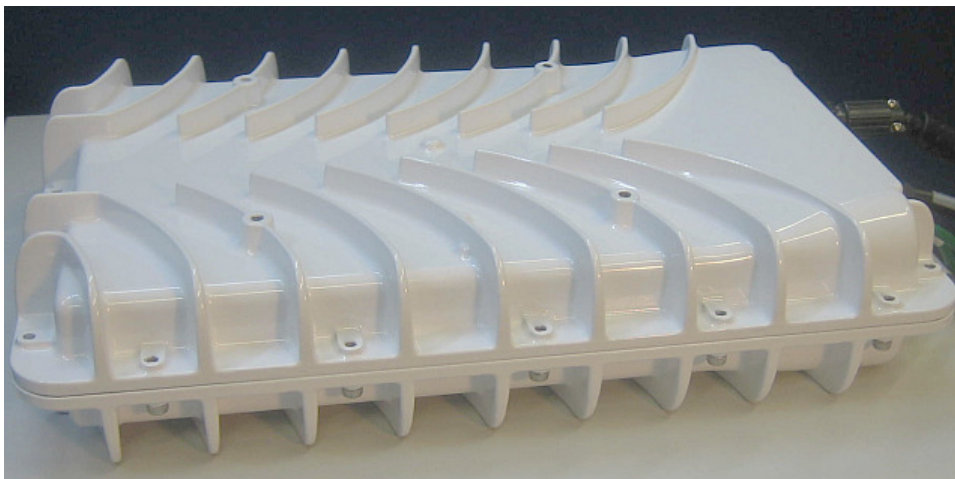
MECHANICAL DIMENSIONS



RACK MOUNT MIMOMAX OPTIMISED PROTECTION VARIANT (OPV)



POLE OR WALL MOUNT OPTIMISED PROTECTION VARIANT

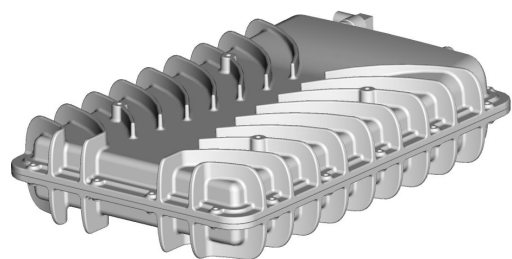


DISCLAIMER:

Whilst every precaution has been taken in the preparation of this literature and it is believed to be correct at time of issue, MiMOMax Wireless Ltd assumes no liability for errors or omissions or for any damages resulting from the use of this information. Due to a policy of continuous technical improvement the contents of this document and any specifications contained therein are subject to revision and may change without notice.



4 NOTES



mimo | max
wireless

MiMOMax Wireless Ltd
535 Wairakei Rd
Christchurch New Zealand
Ph +643-358-3399
www.mimomax.com