

**Multi Point Digital Link
(MDL)
Series II**

mimo | max
wireless
maximising the potential of advanced wireless communications

MiMOMax Linking Products

General

The MiMOMax Network Digital Link (NDL) and Multipoint Digital Link (MDL) is a family of software flexible, low latency, digital radio links designed to provide mission critical linking for data, telemetry, SCADA and back-haul type applications.

The MDL product family utilises licensed narrow band radio channels and MiMO technologies in 2x2 and 2x4 configurations to provide industry leading spectral efficiencies of up to 16 bits/Hz/s or greater, enabling raw data rates (including link overhead) of up to 320kbps.

Utilising licensed spectrum ensures that the equipment 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), with coverage diameters of up to 130km dependent on site location and height.

For data and voice linking applications the MDL will provide a number of industry standard data interfaces at link end points.

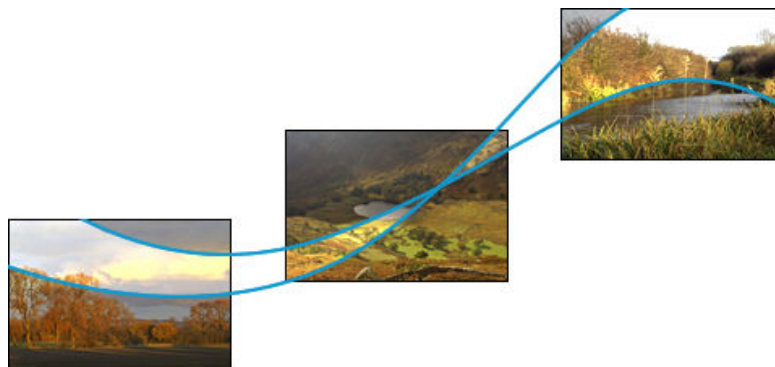
MDL

The MiMOMax MDL solution describes a radio network comprising one or more base stations providing reliable duplex communications with a number of outstations throughout the intended coverage area. A high performance random multi-access protocol allows each outstation rapid access to the system.

Each station uses a MiMO antenna (or antennas) to produce both vertically and horizontally polarized signals, allowing a high performance pattern diverse MiMO link of up to 64km with near-line-of-sight capability and non-line-of-sight over shorter distances. A second optional MiMO antenna and receiver operating in a 2x4 configuration may be used to further enhance spatial diversity and link robustness.

A number of interfaces support various applications, and the system can simultaneously support outstations on different modulation schemes to accommodate varying path characteristics. A separate high quality interface card with up to 6 x 32k ADPCM audio channels and a signalling channel supports analogue interface requirements.

With these applications in mind the MDL is designed to have ultra low latency and low jitter whilst fitting into the usual channel allocations allocated to fixed radio links. Multiple links can be cascaded or combined with NDLs to cope with difficult terrains or very long paths.



1 MULTI-POINT SYSTEM OVERVIEW



The basic Multipoint Digital Link (MDL) system consists of a Base Radio Unit (BRU) communicating with multiple Remote Radio Units (RRUs) on a pair of 25kHz radio channels f_1 and f_2 , such that f_1 is used for RF transmit and f_2 for RF receive functionality by the BRU.

Each RRU conversely uses f_2 for transmit and f_1 for receive. The BRU connects to the customer's network and the RRUs extend this network to remote outstations. Linking between the BRU and the customer's network is via 10BaseT Ethernet. In cases where wired Ethernet is not available, this network connection can be extended by Link Radio Units (LRUs)¹, using another pair of frequencies f_3 and f_4 . The system currently operates in the UHF band. A basic system level diagram is shown in Figure 1.

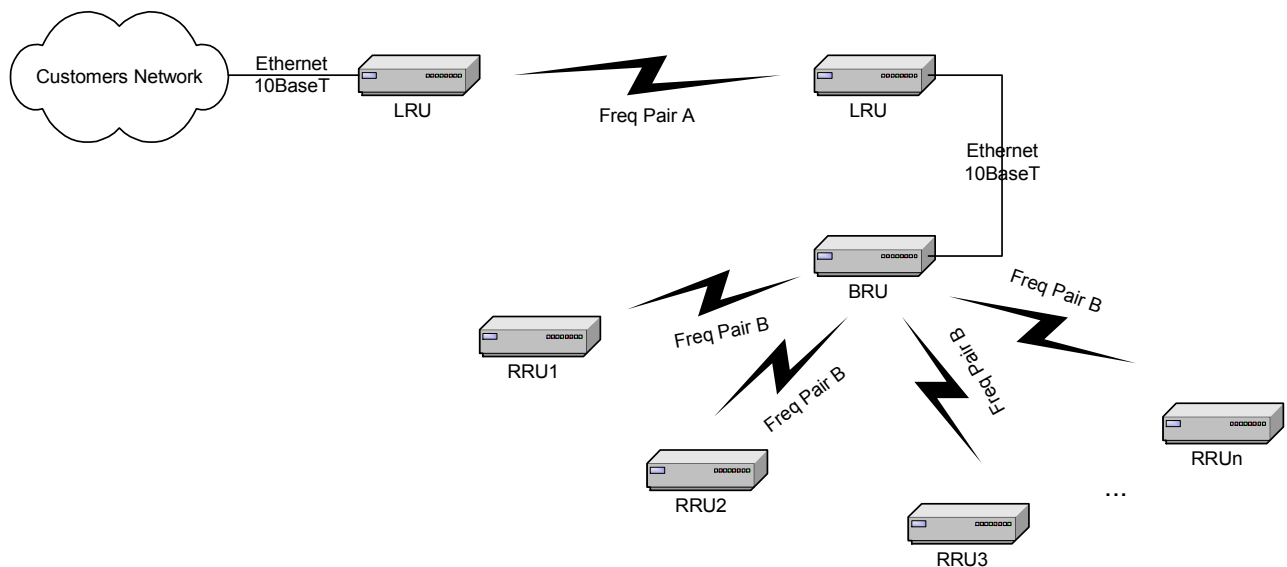


Figure 1 - System Diagram MDL Linking Network

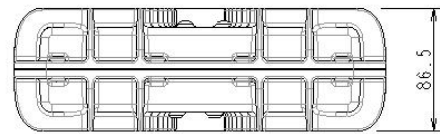
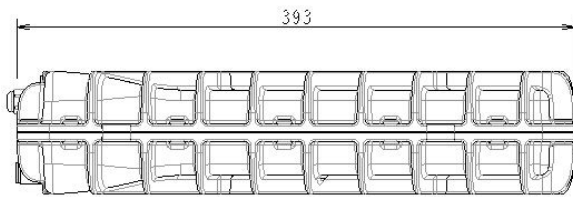
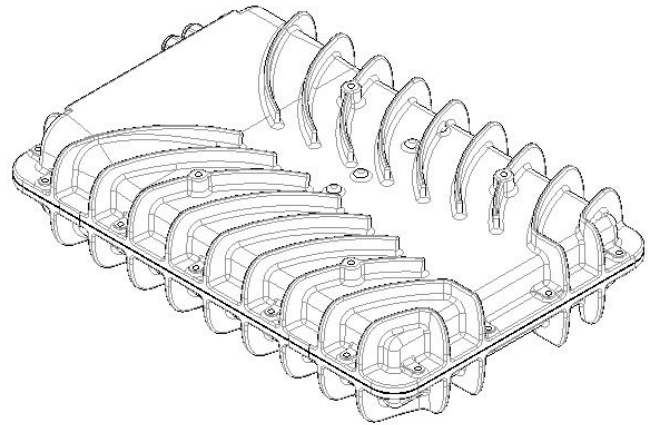
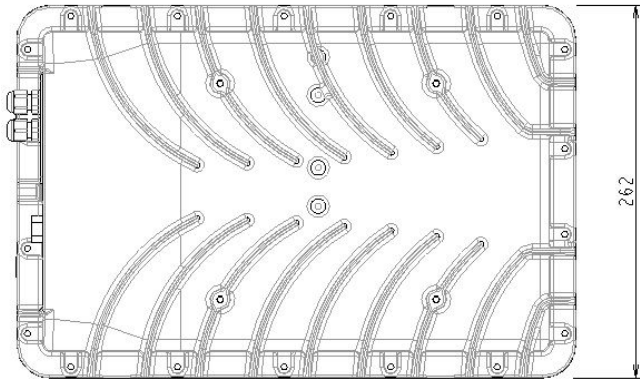
1.1 MDL CUSTOMER APPLICATION REQUIREMENTS

The MDL is capable of carrying IP data including DNP3 (TCIP encapsulated SCADA) information across all elements of the network. MDLs may be used to configure and download data from a variety of customer equipment types e.g. protection equipment, SCADA RTUs and security equipment. The latency of SCADA response time, including multi-access protocol, is typically less than 1 second.

¹ A LRU is an NDLP point to point Linking Radio Unit used to provide point to point linking. LRUs can be used to extend the customer's network to a BRU or beyond the RRUs.

1.1.1 Mechanical Dimensions

Radio Modem



Rack Mount Options



2 PRELIMINARY PRODUCT FEATURES

1.1.2 Spectral Efficiency

The MDL utilises 2x2 or 2x4 MiMO QPSK/16/64/256QAM technologies to achieve industry-leading spectral efficiency of up to 320kbps raw data rate in a 25kHz radio channel. MiMOMax Cognizant Adaptive Modulation (M-CAM) is applied to improve system reliability and throughput.

1.1.3 Built-in Multiplexer

The MDL has a built-in data multiplexer, supporting a mix of traffic from serial or Ethernet interfaces depending on interface option chosen. A number of external interface options, including analogue, are also available and in special cases interfaces may be designed for a specific application.

1.1.4 Built-in Duplexer

For full duplex multi-antenna operation while maintaining a small overall size, the MDL has built-in antenna duplexers. No external antenna duplexers are required for most installations saving considerable installation time, space and costs.

1.1.5 Form Factor & Installation

The MDL is optionally wall, pole or rack mountable (with forced-air cooling for rack mount), occupying just 2U in a standard 19in rack, and can be installed by installers with the usual competency and industry skills. In outdoor configuration the MDL is designed to meet IP67 waterproofing.

1.1.6 Configuration, Monitoring & Alarms

The MDL offers a range of comprehensive configuration and monitoring packages which enables both local and optional remote configuration and monitoring of the system. The configuration tool can be accessed locally or over the air or remotely via an internet/intranet connection. SNMP is also optionally available. A range of alarms can be configured in a number of ways depending on the application.

1.2 ENVIRONMENTAL SPECIFICATIONS

1.2.1 Operating Temperature Range

Ambient maximum temperature range -20°C to +60°C

1.2.2 Humidity

20% to 75% non-condensing

1.2.3 Environmental Protection

Designed to meet IP67 for outdoor mounting and IP20 for indoor rack-mount unit

1.2.4 Operating Altitude

Up to 2000m

1.3 EXTERNAL COMPLIANCES

EMC: The product is designed to comply with AS/NZS/CISPR22 Information technology equipment, Radio disturbance characteristics, Limits and methods of measurement (Class A limits).

1.4 INTERFACES

1.4.1 Ethernet Interface

Ethernet connectivity is presented via an RJ45 socket and is also configurable to provide connectivity to other IP enabled networked devices. The network connectivity provided by the MDL is at layer 2 or 3 (IP). In the layer 3 mode the MDL will function as a router as opposed to an Ethernet bridge or switch. Data rates of up to 256kbps can be achieved in the appropriate configuration and conditions.

1.4.2 Analogue and Serial Interface and Connection

An optional audio interface card provides up to 6 high quality 32k ADPCM audio channels plus an asynchronous 9600bd RS232 serial data interface. This enables the direct support of up to 6 analogue channels with site signalling over one MiMOMax MDL link, for example supporting a 6 channel MPT site over one MDL 25 kHz link. Other codecs may be supported on request.

1.4.3 Power Interface

The MDL operates on an external DC supply over a range of 10.5V to 32V. Optional external AC or DC power supplies are available for mains or higher voltage operation.

1.5 PERFORMANCE

1.5.1 Raw Link Data Rate

MiMO MDL operates with QPSK or 16/64/256QAM at a symbol rate of 20 kilosymbols/second, resulting in raw data rates of 80/160/240/320 kbps (Under MiMOMax M-CAM).

1.5.2 Transmission Frequency

The MDL operates on 25kHz PMR paired channels within the 420-470MHz band (12.5kHz future).

1.5.3 Transmission Power

The MDL transmits a maximum power of 1 Watt average per transmitter (total 2 Watts average for 2x2 MIMO).

1.5.4 Transmission Bandwidth

The MDL meets the limits of EN 300 113 and EN 302 326 for frequency error, conducted carrier power, adjacent channel power, and conducted spurious emissions.

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} .

MDL SPECIFICATIONS (PRELIMINARY)

1.6 GENERAL

Configuration	2 x 2 MIMO	2 x 4 MIMO
Supply Voltage	10.5V DC to 32V DC	
Maximum Power Consumption	92W at 13.8V	
Ambient Temperature Range	-20°C to +60°C	
Mounting	2U high rack mount Also available as wall mount unit	
Dimensions (W x H x D)	440 x 84.5 x 382 mm (box size) 481 x 86 x 392 mm (including protrusions)	
Weight	6.8kg (radio only excluding mounting bracket)	
Gross Data Rate	80/160/240/320kbps	320 kbps

1.7 TRANSMITTER

Number of MIMO transmitters	2	
Modulation	QPSK, 16/64/256QAM	256QAM
Symbol Rate	2 x 20 k symbols / second	
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	≤2ppm	
Nominal Channel Bandwidth	25kHz (12.5kHz future option)	
Emission mask	Meets ETSI EN300 113 & EN302 326	
Adjacent Channel Power*	Meets EN 300 113 & (AS/NZS/4768) & EN 302 326	
Spurious Outputs: Conducted	< -40dBm (AS/NZS4768) & EN302 326	

1.8 RECEIVER / DIVERSITY RECEIVER

Number of MIMO receivers	2	4
Modulation	QPSK, 16/64/256QAM	256 QAM
Symbol Rate	2 x 20 k symbols / second	
RF Sensitivity **	<-104/-97/-91/-85dBm for 10 ⁻⁴ BER	<-85dBm for 10 ⁻⁴ BER
Frequency Range	420 to 470 MHz ***	
Frequency Step Size	6.25 kHz	
Frequency Accuracy and Stability	≤2ppm	
Nominal Channel Bandwidth	25 kHz (12.5kHz option)	

* ETSI EN300-113 test method

** Measured at antenna port (through duplexer)

*** Other frequency variants available

1.9 DUPLEXER (INTERNAL)

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

1.10 ANALOGUE AND DATA INTERFACE

Ethernet	
Format	10BaseT
Connector	RJ45
Supported Bit Rates	Up to 256 kbps *
Serial (optional)	
Format	RS232
Connector	DB9 female
Rate	9600 baud
Audio (optional)	
Format	6 x 4 wire 600Ω ports
Coding	32kbps ADPCM **
Connector	6 x RJ45
Signalling	Via RS232 serial port

* The total aggregate data rate is 80, 160, or 320 kbps dependent on configuration and signal path.

** Other CODECS also available on request

2 ANTENNAS

2.1 CROSS - POLARISED COMPACT YAGI

Polarisation	Horizontal and vertical with separate feeds
Antenna Gain	>10dBi
Beam width, -3dB (parallel to polarisation plane)	48° nominal
(perpendicular to polarisation plane)	52° nominal
Front-to-back ratio	>15dB
Frequency bandwidth (15dB return loss)	20 MHz
Connector arrangement	2 x female Type N connectors on 1.5m tails of RG214 coaxial cable.
Mounting	Twin vertically spaced clamps for attachment to 25 - 55 mm mounting pipe.
Number required per link end	1 for 2 receiver MIMO, 2 for 4 receiver MIMO
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 PANEL MIMO ANTENNA (HIGH WIND AND ICE TOLERANT)

Polarisation	Horizontal and vertical with separate feeds
Antenna gain	>10dBi
Beam width (horizontal, vertical)	75° nominal, 32° nominal
Front-to-back ratio	>20dB
Frequency bandwidth (15dB return loss)	80 MHz
Connector arrangement	2 x female 7/16 connectors
Maximum wind speed	250 kph (TBC)
Wind loading	660N (at 150kph) (TBC)
Mounting	Twin vertically spaced clamps for attachment to 50 to 77 mm mounting pipe. Provision for additional stabilising struts (up to 4)
Number required per link end	1 for 2-receiver MIMO, 2 for 4-receiver MIMO
Dimensions W x H x T (direction of propagation)	500 x 1100 x 120 mm (+ mounting bracket)



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