mimo max wireless

maximising the potential of advanced wireless communications

Ultra High Spectral Efficiency, Very Low Latency
UHF Radio for Mission Critical Applications

NETWORK DIGITAL LINK (NDL)

DATA SHEET

FCS Awards 2010 FINALIST Gerald David OBE Innovation in Business Radio Award

UTC UTILITIES TELECOM COUNCIL *The Voice of Critical Infrastructure Communications* Product Award 2010 Best Wireless Equipment

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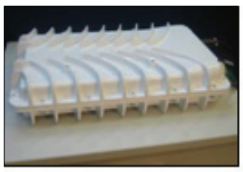
Radio spectrum is finite and therefore should be preserved through high-performing, ultra spectrally efficient linking solutions. Public safety, transport, utilities and government organizations all require efficient and low latency backhaul communication links in order to connect network locations and to have Faster Access, Increased Reliability and Spectral Efficiency.

With this in mind, the MiMOMax team has designed a seriously smart, point-to-point, ultra spectrally efficient, very low latency digital radio for depolyment in critical network infrastructure. **Network Digital Link (NDL)** by MiMOMax aims to provide intelligent wireless linking solutions for SCADA and backhaul applications.



Award-Winning Solutions

Industry-Leading Range Throughput Latency

Seriously Smart

SCADA & Backhaul Linking

Benefits

Preserves Valuable Spectrum
- Industry-Leading Spectral Efficiency

Very Fast Access
- Very Low Latency
- Very Low Jitter

Very High Data Throughput
- Full Duplex
- Digital Cartesian Loop Supports High Level Modulations
- Data Acceleration Protocols for Increased Throughput

Highly Secure
- Comprehensive Range of Industry Standard Security Options

Future Defensive
- Flexible Architecture (Powerful Linux Engine)
- Utilises Packet Based IP Data
- Sophisticated Software Features

Industry Compatible
- Native IP
- Ease of Implementation; “Plug & Play”
- Wide Range of Internal & External Interfaces

Adaptable
- Adaptive Modulation Protocols
- User Settable Frequency
- User Programmable Power
- Software Feature Enablers

Robust
- Multiple Routing Options
- Rugged IP67 Options
- Extensive Path Redundancy Options

Economical
- High Level of Integration Reduces Hardware Needs
- Low Installation & Set-up Costs

Low Maintenance
- Internal Micro-Duplexers Eliminate Installation of Additional Hardware, Wiring, Co-axial Cabling and Connectors
- Digital Cartesian Loop Dramatically Reduces the Need for Ongoing Calibration & Adjustment

System Overview

The MiMOMax NDL is a long range point-to-point wireless linking solution for backhaul and SCADA applications. Utilizing the Multiple Input Multiple Output (MiMO) technology and operating in full-duplex mode, the NDL maximizes system throughput by enabling raw data rates of up to 320 kb/s in 25 kHz channel and up to 160 kb/s raw data rate in 12.5 kHz channel.

The NDL is designed to provide high reliability, fixed linking solutions to a number of mission critical industries. Apart from servicing SCADA applications primarily, the NDL can also be used for linking conventional and trunked and digital and radio sites. Multiple links can be cascaded to cope with difficult terrain and very long paths. Mounting options (including wall, pole and rack) provide much-needed flexibility for varied network requirements.

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 ($<10^{-7}$ bit error rate). Very high system gains and good receive sensitivity makes it possible to achieve industry-leading long range in excess of 100kms from high radio sites at full throughput.

A number of internal interfaces are available to support various SCADA applications and also multichannel, conventional, analogue, simulcast, MPT, P25 or TETRA digital networks in trunked and simulcast configurations.
For PMR applications, a separate high quality Network Interface Box (NIB) with up to 6 x 32 k ADPCM audio channels plus a 9k6 RS232 signalling channel, supports analogue networks.

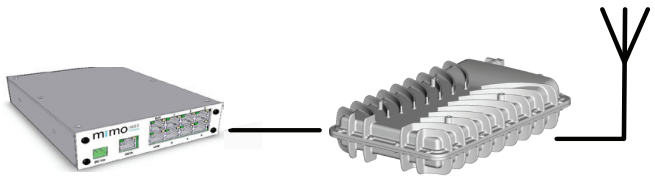
Optional MiMOMax proprietary protocols including software feature enablers support network robustness, integrity, security and faster transmission while overcoming adverse environmental challenges. These protocols include MiMOMax Data Acceleration Protocol (M-DAP), MiMOMax Routing Adaptation Protocol (M-RAP), MiMOMax Cognizant Adaptive Modulation (M-CAM) & MiMOMax Power on Demad (M-PoD).

Furthermore, sophisticated network management, monitoring and over-the-air configuration options enable remote monitoring, diagnostics, configuration and software upgrades. The MiMOMax NDL also supports the generic system management standard, Simple Network Management Protocol (SNMP) & DNP3. A comprehensive suite of security options further ensures that mission critical operations remain highly secure.

Being fully compatible with the rest of the MiMOMax products, NDL can be incorporated into MiMOMax point-to-multipoint Multiple Digital Link (MDL)[1].

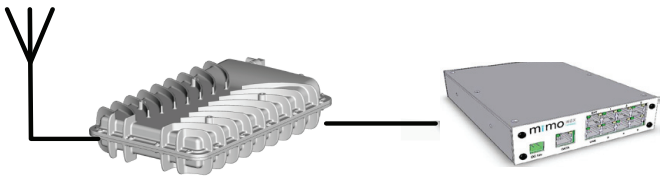
1. *For more information regarding MDL, please visit the "products" section of our website: www.mimomax.com.*
2. *For more information regarding 4 Wire Audio Interface Box, please visit "products" section of our website: www.mimomax.com.*

Four Wire Audio Interface connected to MiMOMax NDL



MiMOMax Four Wire Audio

MiMOMax Link-End Radio Unit



PRODUCT PERFORMANCE

~ ULTRA HIGH SPECTRAL EFFICIENCY

MiMOMax NDL is capable of achieving up to 16b/s/Hz in both 25 kHz and 12.5 kHz channels.

~ VERY HIGH DATA THROUGHPUTS

The NDL utilises MiMO technoloy to achieve industry leading spectral efficiency of up to 320 kb/s raw data rate in a 25 kHz channel & up to 160 kb/s in a 12.5 kHz channel. Additionally, optional proprietary Data Acceleration Protocol can boost the effective data rate even higher.

~VERY LOW LATENCY

In X-21 mode, 16 QAM, the MiMOMax NDL offers very low latency of 5.05 ms in 25 kHz and 9.8 ms in 12.5 kHz channels respectively and even lower latency when using higher available modulations.

~ VERY LOW JITTER

The nominal inter-symbol jitter rate for MiMOMax NDL is typically <50ns in X-21 mode.

~ ADAPTIVE MODULATION

The MiMOMax NDL supports an optional, intelligent adaptive modulation protocol (M-CAM), which enables the system to always optimise the modulation modes for maximum data throughput even in fading environments. Supported modulations include QPSK/16/64/256 QAM.

~ LOW ERROR RATE

The MiMOMax NDL has a very low bit error rate of less than 10^{-7} (signal level dependant on modulation rate). This is provided by the IP transport service (via Ethernet) under appropriate link conditions.

~ HIGH LEVELS OF SECURITY[1]

The MiMOMax NDL supports a range of advanced, industry compliant, security features that prevent both deliberate and inadvertent attacks on the network.

~ RF PERFORMANCE

High system gain enables the MiMOMax NDL to transmit data over paths spanning up to 100 kilometers in length from high sites with some non-line-of-sight and near-line-of-sight capability over shorter distances.

~ BUILT-IN MICRO-DUPLEXERS

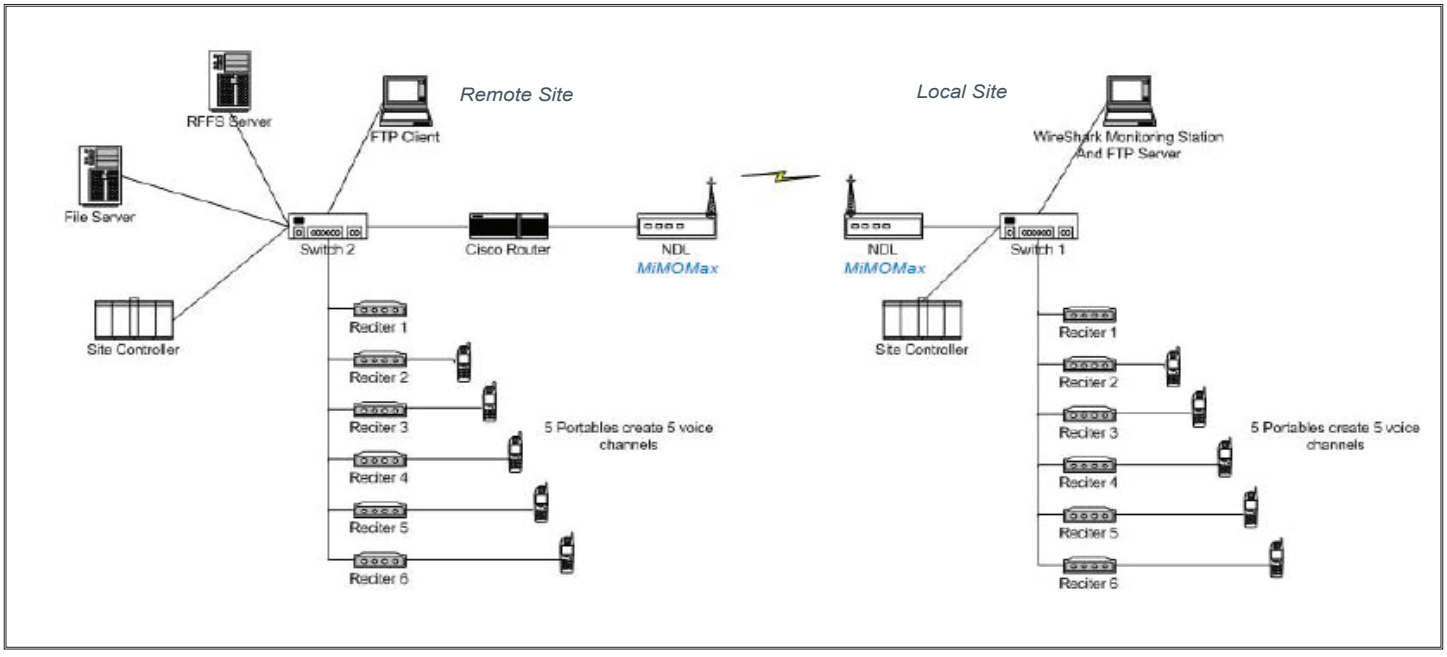
The NDL transmits an average power of 1W average per transmitter (for 2x2 MiMO). The receive sensitivities and transmit powers are measured at the output of the duplexers.

~ POWER CONSUMPTION

The typical active power consumption for the MiMOMax NDL is 72 W with a standby power consumption of <10 W when using optional Power on Demand (PoD).
Optional low power radios are also available which reduce power consumption to <55 W @ +26 dBm & <40 W @ +23 dBm.

1 For complete details on security features, please view both "Product Features" and "Product Options" sections.

MiMOMax Linking in a 5 + 1 Channel P25 Trunking System



PRODUCT FEATURES

MiMO
In true MiMO format, each MiMOMax radio unit has 2 internal transmitters and 2 internal receivers. This enables a single radio link to produce high performance, pattern-diverse MiMO signals and to increase both signal quality and path resilience.

Data Throughput
The MiMOMax NDL utilises true 2 x 2 MiMO technology-which is capable of operating in QPSK/16/64/256QAM to achieve industry-leading full-duplex data throughputs of 80/160/240/320 kb/s (raw data rates) in a 25 kHz channel bandwidth (40/80/120/160 kb/s in a 12.5 kHz channel).

Operating Frequencies
The MiMOMax NDL operates in a range of licensed UHF frequency bands including 369-390MHz, 420-470MHz and 806-960MHz and operates in both 12.5 kHz and 25 kHz narrowband channels[1]. Please refer to the "Product Specifications" section for details on specific frequency band splits.

Internal Micro-Duplexers
Each MiMOMax NDL radio unit has sets of internal micro-duplexers that provide full-duplex operation, maintain an overall small size and reduce the cost and time of installing additional equipment.

Interfaces
The MiMOMax NDL is a fully integrated solution that transmits both packet-based IP and serial data (RS232, V24, RS422, V11, V35 and X21 between 32 & 128kb/s) via internal Ethernet.

~ Ethernet Interface
Ethernet connectivity is provided via RJ45 socket, configurable to provide connectivity to other IP enabled networked devices. The network connectivity provided by the NDL is at layer II (IP). Layer III is also available as an option. Bandwidth not used by the synchronous serial interface will be available for IP traffic.

Built-in Multiplexer
The NDL has a built-in multiplexer, supporting a mix of traffic from synchronous & asynchronous 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. Additionally, optional M-DAP and QoS can be utilized for efficient Ethernet traffic management.

MiMOMax Configuration, Control & Monitoring Software (CCMS)
The MiMOMax NDL supports connection of an HTTP type web browser which allows customers to have access to a field level of configuration, control, monitoring and alarm functions[2].
The CCMS has two access options including:

~Local CCMS
This allows local access to the CCMS web application via the Ethernet port of the local radio modem link. It enables restricted control of the local radio modem.

~Remote CCMS (Over-The-Air Configuration--OTAC & Over-The-Air Programming--OTAP)
Optional remote CCMS enables the CCMS web application to be accessible via local Ethernet port and over-the-air link. This allows remote configuration (OTAC) and programming (OTAP) of the remote radio unit (RRU) and often replaces the need for the user to travel to radio sites, saving both time and cost.

Standard Security[3]
The MiMOMax NDL system has the capability of protecting the wider SCADA network from either deliberate or accidental breach or denial of service. The following security features are included in the NDL radio unit:

~ Licensed Spectrum: ensures that the spectrum licensee is the only authorised user for that channel.
~ Proprietary MiMO Protocol: avoids any over-the-air interception or manipulation of data, as only MiMOMax radios can reassemble the coded MiMO data.
~ Software Image Protection: prevents determined interceptors from making unauthorised software changes or mimicking MiMOMax radio software.
~ Directed Traffic Control: only MiMOMax radios registered on the system will be recognised by the system. Radios must be either paired or part of a system to participate in that system. Prevents "Man in the Middle" intercepts.
~ Transparent Payload Encryption: transparent to Encrypted packets for all data types. Supports "end to end" encryption schemes.
~ Management Interface Protection: SSL/TLS & AES 256 provide "end to end" management system interface protection for both directly connected and over-the-air CCMS.
~ Audit Logging: CCMS user passwords are logged so that past history of system CCMS users can be interrogated.

Digital Cartesian Loop
The MiMOMax NDL has a Digital Cartesian Loop that provides very high linearity and low distortion and enables high order modulation. Hence, it helps to achieve very high data throughputs and dramatically reduces the need for regular and ongoing calibration and adjustment.

User Programmable Frequencies
The MiMOMax NDL Tx frequencies can be electronically tuned by the user provided they are within the duplexer tuning range. The programmable frequency step size is 5 kHz or 6.25 kHz. Duplexers will need to be manually tuned if the desired frequency is outside the duplexer bandwidth.

User Programmable Power
The MiMOMax NDL has transmitter power output that is user configurable to suit specific path requirements. Users can choose either dBm or mW via the CCMS. The programmable power range is greater than 20 dB and includes 10 mW to 1 W power levels.

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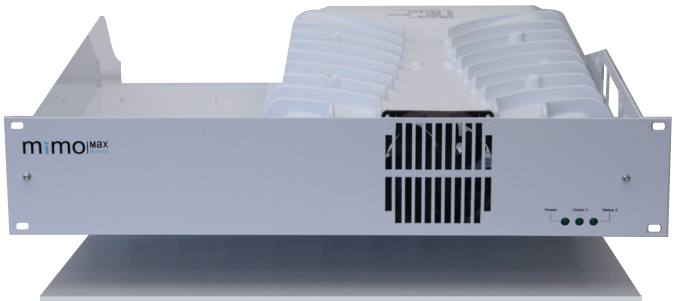
1 For information on alternative operational channel bandwidths, please contact MiMOMax Wireless directly.

2 MiMOMax offers a pre-ship configuration service, which will configure a radio unit to a user's documented requirements, prior to shipping, to expedite implementation.

3 For details on further optional protection and security features, please refer to the "Product Options" section.



Internal Power Supplies

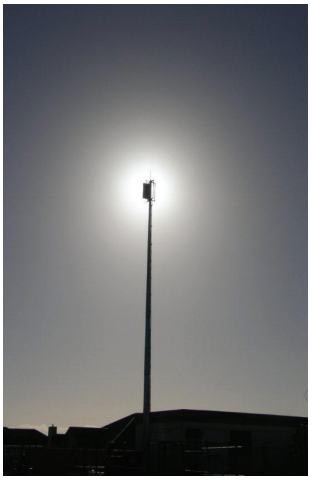
The MiMOMax NDL contains an internal switched mode power supply with an input range of 10.5 VDC to 32 VDC. An optional internal isolated (10-64 VDC) power supply is also available. This option eliminates the need for an external isolated power supply.

Form, Factor & Installation (Physical Structure)

All MiMOMax radio units can be pole, wall or rack mounted. Pole and wall mounts come with sunshades and the rack mount option comes with a fan that provides forced-air cooling. In a standard 19in rack, occupying only a 2U panel, rack mount radio units can be installed by technicians with normal industry competency. Additionally, MiMOMax pole or wall mount radio units are designed to meet IP67 waterproofing when deployed outdoors.

Compliances

The MiMOMax NDL conforms to a broad range of international compliances which are detailed in the "Product Specifications" section of this document.



PRODUCT OPTIONS

Additional Security Options

While the MiMOMax NDL has a comprehensive security suite, additional protection options are available to further enhance network robustness and reliability. These include:

~ SNMP V3: Management interfaces are password protected and have optional SNMP V3 (Authentication and encryption).

~ Firewall: Optional Stateful Packet Inspection provides high level of security to any element on the network by isolating network zones.

Software Feature Enablers (SFEs)[1]

MiMOMax has developed a wide portfolio of SFEs to optimise network performance and meet unique customer requirements. The MiMOMax SFEs that are compatible with the MiMOMax NDL include:

~ MiMOMax Cognizant Adaptive Modulation (M-CAM)
~ MiMOMax Data Acceleration Protocol (M-DAP)
~ MiMOMax Routing Adaptation Protocol (M-RAP)
~ MiMOMax Enhanced Security Options (M-SEC)
~ Over-The-Air Configuration (OTAC)
~ Over-The-Air Programming (OTAP)
~ SNMP Support
~ Diversity Enabled (2x4 MiMO) (Future)
~ Terminal Server Software
~ Redundancy Enabled

PRODUCT ACCESSORIES

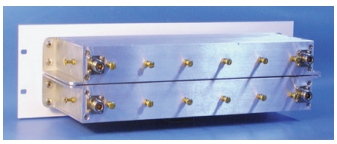
Antennas[2]

MiMOMax has developed a range of unique, high performing MiMO antennas that can be connected directly to MiMOMax radio units. All MiMOMax antennas transmit and receive both vertically and horizontally polarized signals. They produce pattern diverse MiMO signals for links that span up to 100 kms (high site) with some near-line-of-sight and non-line-of-sight capability over shorter distances. The MiMOMax NDL is compatible with the complete range of MiMOMax antennas. These include:

~ MiMOMax Dual Polarised Loop Yagi Antenna
(Single, Dual & Quad Array Variants)
~ MiMOMax Ruggardised Panel Antenna
~ MiMOMax Collinear Omni Directional Antenna
~ MiMOMax 13 dBi Wide Band Antenna

Radio Filters[3]

To ensure high quality and interference-free data transmission, MiMOMax offers two radio filter options specifically for MiMOMax radio units. These include Band Pass Filter and Band Reject Filter. Various configuration options are available to suit specific application requirements.



2 Band Pass Filters on a 3U Panel

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1 For comprehensive information on the complete portfolio of MiMOMax SFEs, please refer to the MiMOMax SFE Specification Sheet, located on the MiMOMax website, www.mimomax.com/products/specs-at-a-glance
2 For comprehensive information and specifications on the complete MiMOMax antenna range, please refer to the MiMOMax Antenna Specification sheets, which are available on the MiMOMax website; www.mimomax.com/products/antenna-range
3 For further information on MiMOMax's Radio Filter options, please refer the MiMOMax Radio Filter Specification Sheets, which are available on the MiMOMax website; www.mimomax.com/products/specs-at-a-glance

NDL Product Specifications

RF General			
RF Bands		400MHz	900MHz
RF Frequency Range		369 to 470MHz(1)	806 to 960MHz(1)
RF Frequency Band Splits		369-390MHz 420-430MHz 440-450MHz 450-470MHz	806-869MHz 852-933MHz 896-960MHz
Configuration		2 x 2 MIMO 2 x 4 MIMO	2 x 2 MIMO
Supply Voltage		(Non-Isolated) 10.5V DC to 32V DC	(Isolated) 10.5V DC to 64V DC
Nominal Channel Bandwidth		12.5 kHz & 25 kHz (50kHz future)	
Modulation Options *(Software Configurable)*		QPSK/16/64/256QAM	
Gross Data Rates	25 kHz	80/160/240/320kb/s	
	12.5 kHz	40/80/120/160kb/s	
Maximum Power Consumption		92W Max (at 13.8V) 72W Typical	
Standby Power Consumption (2)		8W Typicial	
Ambient Temp Range		-25ºC to +60ºC	
Symbol Rate		2 x 20 k symbols / second	
Mounting		2U high Rack Mount	
		Pole Mount Unit	
		Wall Mount Unit	
Dimensions (W x H x D)	Rack mount option	440 x 84.5 x 382mm *box size* 481 x 86 x 392mm *incl. protrusions*	
	Wall/pole mount option	262 x 393 x 86.5mm, *radio unit only, excl. mounting*	

Transmitter		
Modulation		QPSK/16/64/256QAM
RF Power Output		2 x +30dBm (1 Watt) average
RF Power Control Range		>20dB
Frequency Step Size		5kHz & 6.25kHz Adjustable
Frequency Accuracy and Stability		≤2ppm

Receiver / Diversity Receiver		
Modulation		QPSK/16/64/256QAM
Typical RF Sensitivity for 10-4 BER	25 kHz	<-102/-99/-94/-87dBm
	12.5 kHz	<-106/-102/-97/-90dBm
Typical RF Sensitivity for 10-7 BER	25 kHz	<-101/-98/-92/-85dBm
	12.5 kHz	<-105/-101/-95/-88dBm
Frequency Step Size		5kHz & 6.25kHz Adjustable
Frequency Accuracy and Stability		≤2ppm

Duplexer (Internal)		
RF Bands	400MHz	900MHz
Bandwidth	>500kHz *(Stop Band)*	>4MHz *(Pass Band)*
Tx / Rx Split	5MHz minimum	24-76MHz
Stop Band Attenuation	>70dB	

(1) Other frequencies available on request
(2) NDL configured with MiMOMax Power on Demand software

Internal Digital Interfaces (Data & Analogue)	
ETHERNET	
Format	10BaseT (400MHz)
	10/100BaseT (900MHz)
Connector	RJ45
Supported Bit Rates	Up to 280 kb/s(3)
FIBRE	
Format	Fibre Ethernet (Future)
Connector	ST
ASYNCHRONOUS SERIAL	
Format	Single & Dual(4) RS232
Connector	RJ45
Baud Rate	300 - 115,200 baud
SYNCHRONOUS SERIAL	
Format	RS422. V.35, X.21, HSSI, V.11 OR G.703
Connector	RJ45
Baud Rate	64 000 baud

External Network Interfaces via Interface Hardware	
FOUR WIRE AUDIO	
Format	6 x 4 wire 600Ω ports *incl. E & M Signalling*
Coding	32kbps ADPCM(5)
Connector	RJ45
Signalling	Via RS232 serial port *9600 Baud Rate*
SUB MUX	
Format	2 x RS422, V.35, X.21 4 x V.24 (RS232) 1 x C37.94

Compliances		
RF Bands	400MHz	900MHz(6)
Radio Performance	ACMA *AS/NZS 4768 & AS/NZS 4295-2004*	ACMA *AS/NZS 4768 & EN 300 113*
	FCC 47CFR part 90 *FCC: XMK-MMXRUDHB002*	FCC 47CFR part 101
	RSS-Gen *RSS-119*	RSS-Gen *RSS-119*
	IC Canada *8587A-RUBFDHB2*	
	EN 302 217 *EN302 217-2-2 V1.2.3 & EN302 326-2 V1.2.2*	
	EN 302-113 *EN 300-113-2 V1.4.1*	
EMC	AS/NZS/CISPR22	
	EN 301 489 *EN 301 489-1 V1.8.1 & EN301 489-4 V1.3.1*	
	FCC 47CFR part 15	
	ICES-003	
Environmental	EN 300 019 *Sections 3.3 & 4.2H*	
Safety	EN 60950 (2006)	

(3) Total aggregate Data Rate is 70, 140, 210, 280 kbp/s, depending on configuration and path signal
(4) The Dual RS232 does not include hardware flow control
(5) Other CODECS also available on request
(6) Designed to be compliant with listed standards

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