MiMOMax Radio Installation and Operation Guide
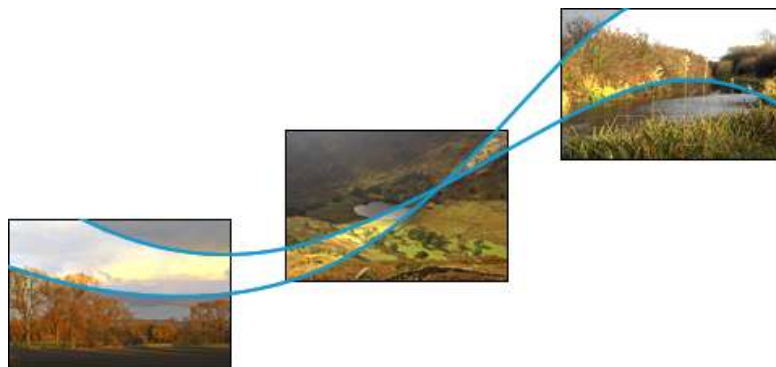
TABLE OF CONTENTS

1   INTRODUCTION

This manual is intended for use by experienced technicians familiar with installation and operation of radio frequency linking equipment. It includes a description of the equipment, general recommendations for site engineering, and instructions for installing and configuring the MiMOMax radio. A basic maintenance and troubleshooting guide is also included in the last section of this manual.

2   OVERVIEW OF THE MIMOMAX RADIO UNIT

The MiMOMax radio products are a family of software flexible, ultra low latency, digital radio links designed for mission critical data linking and backhaul applications. The product family includes the Network Digital Link (NDL), Optimised Protection Variant (OPV), Multipoint Digital Link (MDL) and Rural Digital Link (RDL).

The radios utilise licensed narrow band radio channels and MIMO technology 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 in the OPV version) in 25kHz licensed channels.

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 ($<1\times10^{-7}$ bit error rate).

For data linking applications the radio provides a number of industry standard data interfaces at link end points.

2.1   MIMO DIGITAL LINK GENERAL SPECIFICATIONS

Supply Voltage	10.5V to 32V DC
Maximum Power Consumption	<92W at 13.8V
Ambient Temperature Range	-25ºC to +60ºC
Mounting	2U high rack mount Also available as wall mount or pole mount unit
Dimensions (W x L x D)	262 x 393 x 86.5mm, Base Radio Unit
Weight	6.8kg (pole mount excluding mounting bracket)
Gross Data Rate	Up to 320kbps

2.2 MECHANICAL DIMENSIONS

2.2.1 Base Radio Unit
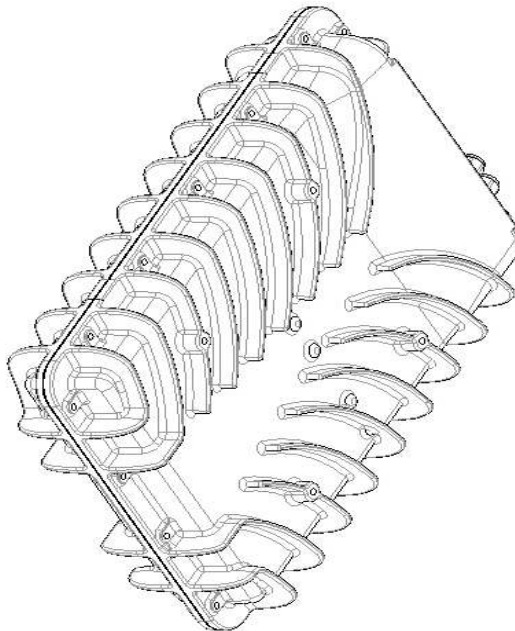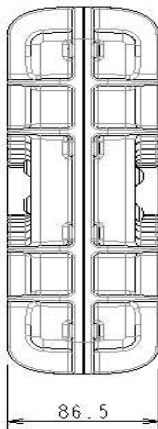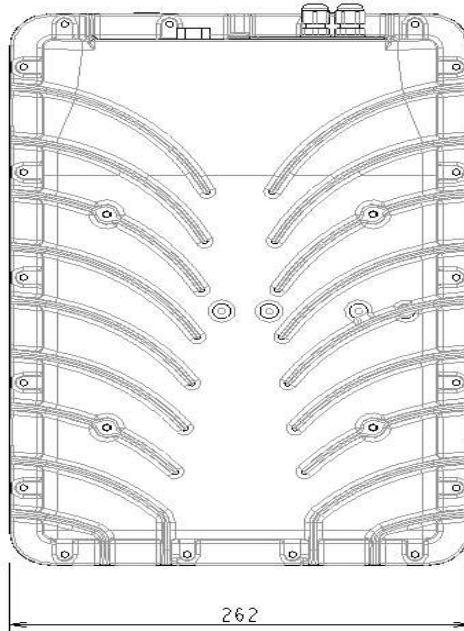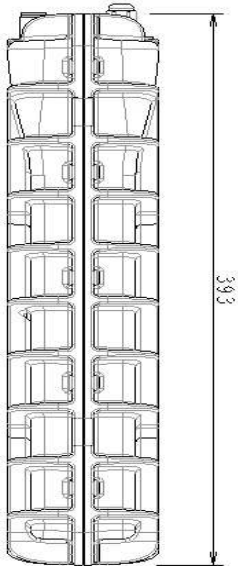
2.2.2   Rack mount option

2.2.3   Pole mount option
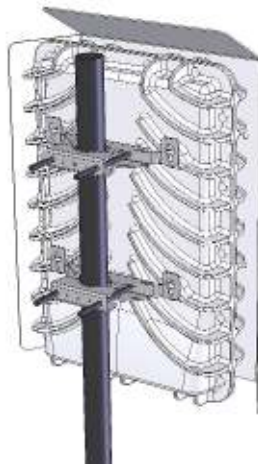
2.2.4   Wall mount option
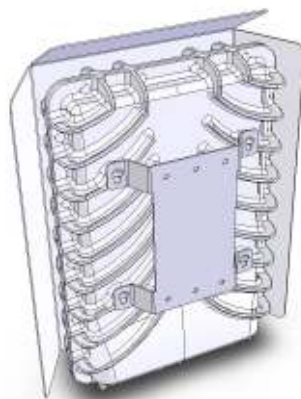
3   INSTALLATION ON SITE

3.1   SITE ENGINEERING AND RECOMMENDATIONS

Prior to commissioning any fixed radio link of this nature, a full evaluation of the site and link path characteristics **must** be carried out to ensure reliable operation of the radio link under all environmental conditions. Important factors to consider and allow for include the following:

- expected path loss and link budget;
- multipath propagation and fading effects, including those caused by moving objects such as vehicles and aircraft in or near the link path;
- obstructions (high ground, trees, buildings and structures etc.) in or near the link path (note that weather conditions can significantly affect losses caused by trees and other foliage);
- potential interference from nearby radio frequency sources (these include both narrowband sources such as other radio transmitters, and wideband sources such as noise generated by other electrical equipment in the vicinity);
- potential interference to other nearby radio receiving equipment as a result of normal transmitted emissions from the radio link being commissioned.

A comprehensive source of information and guidance on general site engineering issues has been published by ETSI: EG 200 053 v1.5.1, 2004/06 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radio site engineering for radio equipment and systems". It is highly recommended that this freely available ETSI document be studied in detail, in conjunction with this manual.

3.2   INSTALLING ANTENNA

3.2.1   Bi Quad Diversity Directional – Loop Yagi Antenna

Antenna overview:

The loop Yagi is a directional dual-polarised antenna containing both vertical and horizontal radiating elements in the same structure. The antenna is made of aluminium and fibreglass with stainless steel mounting brackets and bolts. It is weather resistant and designed for use in outdoor situations. Mounting brackets are included to fit poles from 20mm to 50mm in diameter. The antenna is equipped with two 2m coax "tails" and connectors for interfacing to the radio equipment or intermediate coaxial feeders.
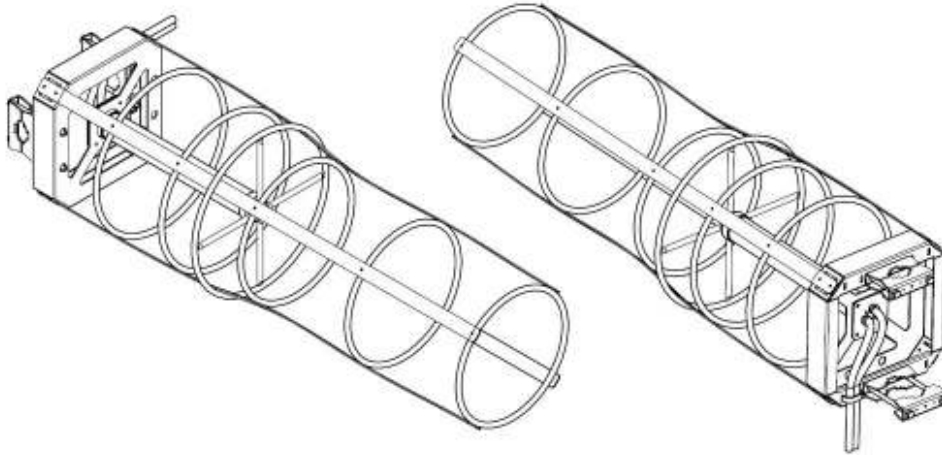
Technical specification:

Polarisation	Horizontal and vertical with separate feeds
Antenna gain	>10dBi (typically 11.5dBi)
Beamwidth, -3dB (parallel to polarisation plane) (perpendicular to polarisation plane)	50° nominal 50° nominal
Front-to-back ratio	>15dB
Frequency bandwidth (>15dB return loss)	>20MHz
Connector arrangement	2 x female type N connector on 1.5m tails of RG214 coaxial cable
Mounting (pole)	Twin vertically spaced clamps for attachment to 20-50 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

Package contents:

1x loop Yagi antenna with 2 mounting brackets and 2x 2m coax
2x removable mounting brackets
4x stainless steel mounting bolts

Installation guidelines:

Mounting location: The antenna is designed to create a directional radiation pattern. To achieve the expected pattern and gain it should be mounted clear of any local obstructions to the front or close to the sides. Generally the higher an antenna is above

the ground the better it performs. A minimum of 2m above the roof line and away from all power lines and obstructions is a good general rule.

Pole installation: The antenna is designed to mount on a pole of 20–50mm diameter. The pole must be weatherproof and strong enough to support the antenna during wind gusts. Generally, the antenna and pole should be located as close to the radio equipment as possible - long cable runs increase the signal loss. If the radio equipment is located indoors, extension coax cables will be required for the cable run from the radio equipment to the antenna.

Orientation: The Yagi antenna is directional. To achieve best performance, it must be oriented such that the central axis points directly towards the antenna at the other end of the radio link path.

Direction of Radio Energy

Loop Yagi Antenna
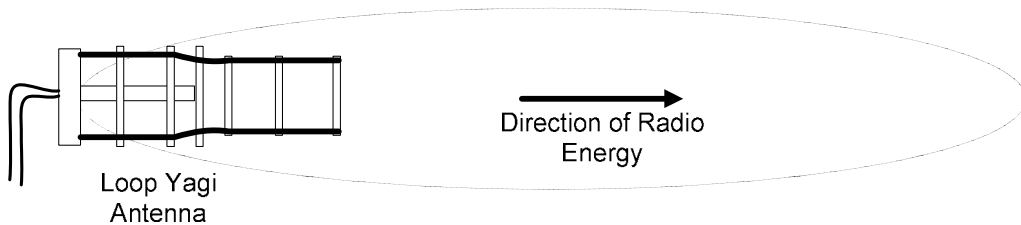
Antenna installation:
Tools and equipment required
-   10mm spanner or socket
-   self vulcanising rubber tape

Step 1 Remove the 4x mounting bolts and 2x removable brackets from the antenna.
Step 2 Place antenna on pole and reattach mounting brackets and bolts. Note the "this side down" label - this is to ensure the drain holes are located downwards and the coax cables exit at the bottom of the antenna.
Step 3 Move the antenna to the correct height on the pole so that it has line of sight to the antenna at the other end of the link, and with its central axis aligned to the other antenna preferably to within ±5º. if the other antenna isn't visible use a map & compass (**note:** be aware that nearby large ferrous objects such as antenna towers can cause erroneous compass readings) or find a landmark in the foreground that is on the signal path and point it towards that. Tighten mounting bolts equally so the mounting bracket clamps evenly.
Step 4 Once the connections to the cable feeds have been made it is highly recommended that they are waterproofed using self-vulcanising rubber tape or similar. Follow the manufacturer's instructions for applying the tape.

Note: **Do not** cut the cable ties holding the coax to the antenna frame - it is required for cable strain relief.

3.3   ENVIRONMENTAL AND SAFETY

3.3.1   Grounding

On site ground networks must be created in accordance with ITU-T recommendation K.27: Protection against Interference; Bonding Configuration and Earthing inside a telecommunications building.

3.3.2   Lightning protection

This aspect is very important to assure the protection of the tower, antennae and the radio equipment hardware.

The following diagrams show the techniques recommended for tower protection, antennae, feeder and RF hardware protection.

Adequate lightning protection is dependent on the effectiveness of the station earth point.

Lightning
rod

45º cone of
protection

antenna

16mm earth
conductor

16mm

Station earth mat
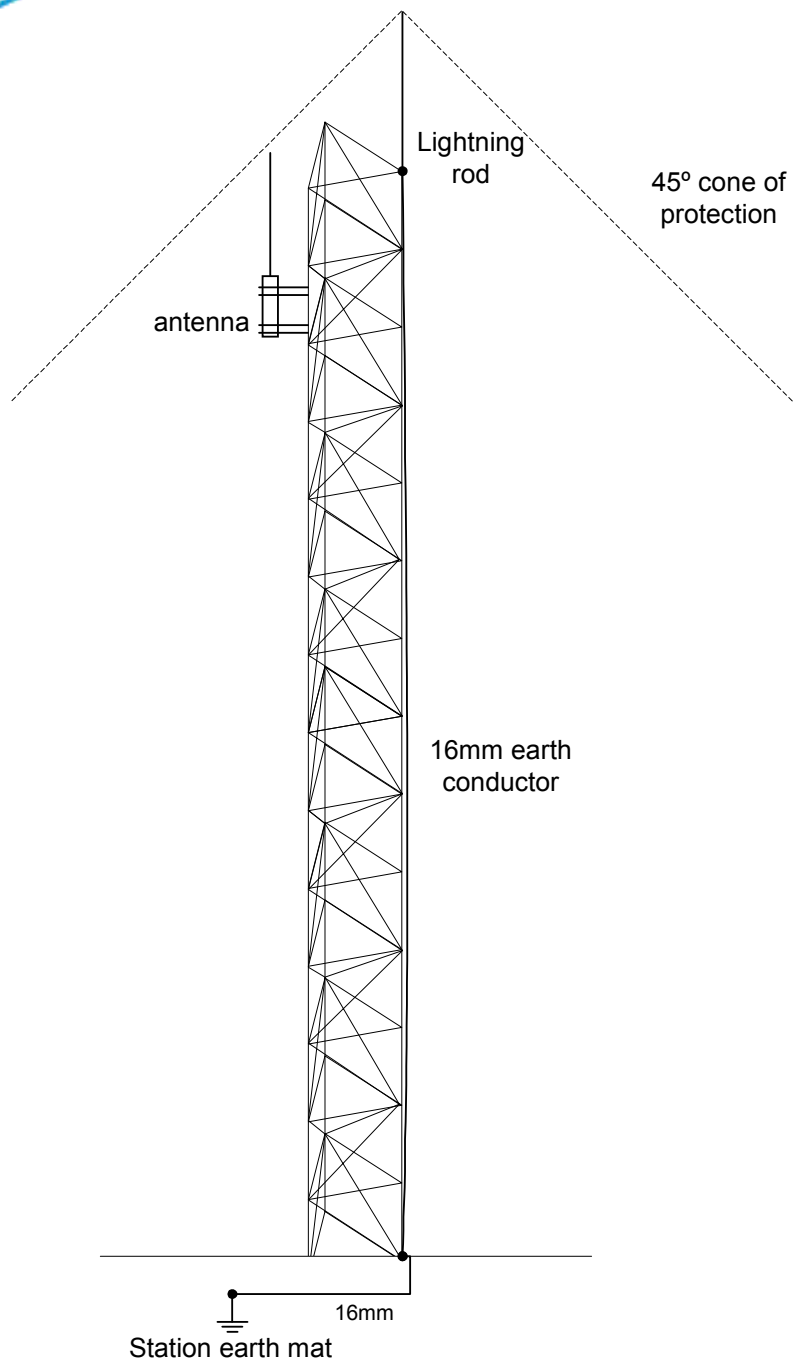
This diagram shows a typical tower protection arrangement. The site earth point is wired
to the tower base with a conductor of no less than 16mm square area. This conductor
then is taken to the tower top and bonded to the tower and a lightning conductor rod. The
rod is typically about 2 metres long. The 45-degree cone of protection profile then defines
where protected plant can be mounted.

45º cone of protection

Antenna also acts as a lightning rod

16mm earth conductor

16mm

Station earth mat
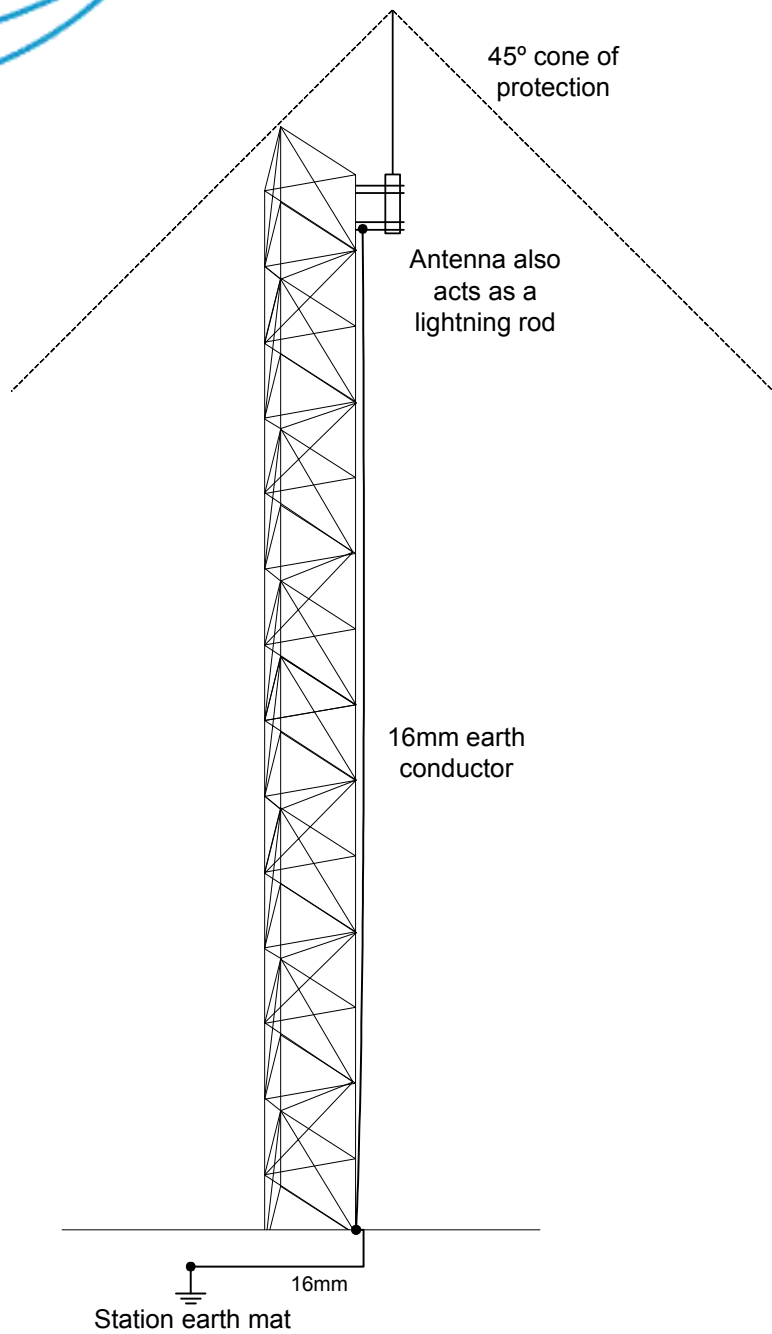
This example shows where the top antenna serves a dual role as receive antenna and lightning rod. Most collinear style antennae are designed to have the active elements placed at ground potential such that this dual role is possible.

When this example is used it is important that the heliax feeder sheath is also bonded to the tower adjacent to the antenna connection.

45º cone of protection

Earthing kit

RG214 to cabinet

Polyphase discharge unit

1/2" heliax cable
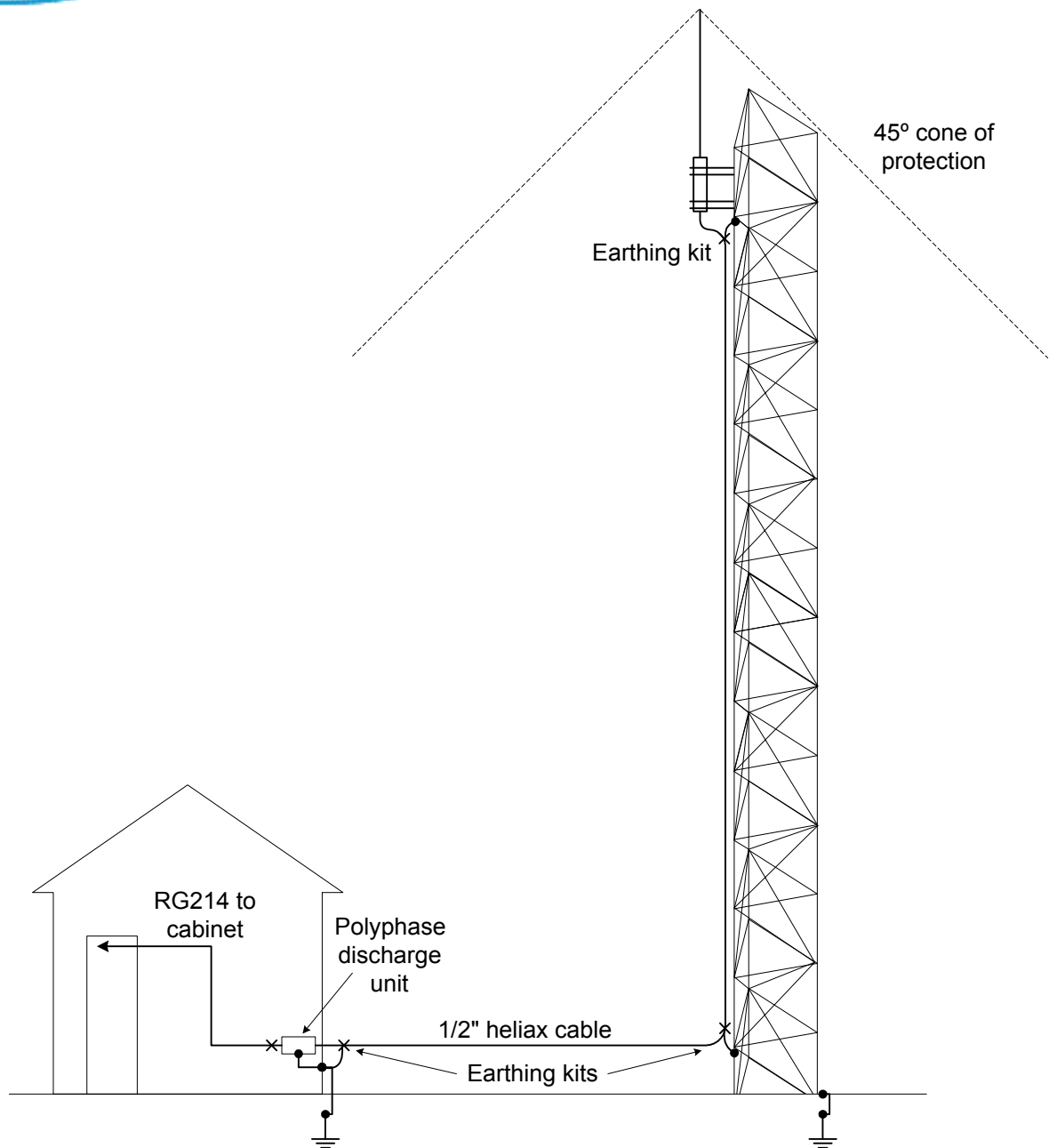
Earthing kits

This diagram shows a recommended feeder earthing and discharge protection scenario. Feeder earthing kits are placed at the antenna adjacent to the feeder connector, where the feeder leaves the base if the tower and where the feeder enters the building structure. This is a 3 point earthing concept. If earthing kits supplies are limited or connection to an earth point is difficult, the order of importance of the earthing locations is:

For a top mounted antenna acting for lightning protection.

1. At antenna connection point.
2. At the tower base.
3. At the entry to the building.

For a general mounted antenna.

1. At the entry to the building.
2. At the tower base.
3. At the antenna connector.

The polyphaser discharge unit is very important to release high voltage charges developed between the cable inner and outer. There are two types supplied, a transmitting and a receiving variant. The transmitting is the larger. It is very important that these function do no become confused because the lower discharge potential rating for the receiver unit will be triggered by transmitting voltages. This will cause a high VSWR and poor coverage.

3.3.3   Equipment ventilation

The radio (rack mount option) should be installed preferably in a dry, dust-free room. It is recommended that a thermal study be carried out for each site to check and ensure that thermal conditions within the cabinets do not raise the ambient temperature of the radio above its operating limit. If the temperature of the site can range beyond the operating limits, the site enclosure must have air conditioning or a forced air system installed to stabilise these excursions.

Note: Equipment cooling in the rack mount configuration relies on the front panel cooling fan. It is important to ensure that the panel fan inlet is unobstructed and that the fan is operating correctly.

3.4 CONNECTING UP THE RADIO

3.4.1 Connecting the Data Cables and Termination

Overview
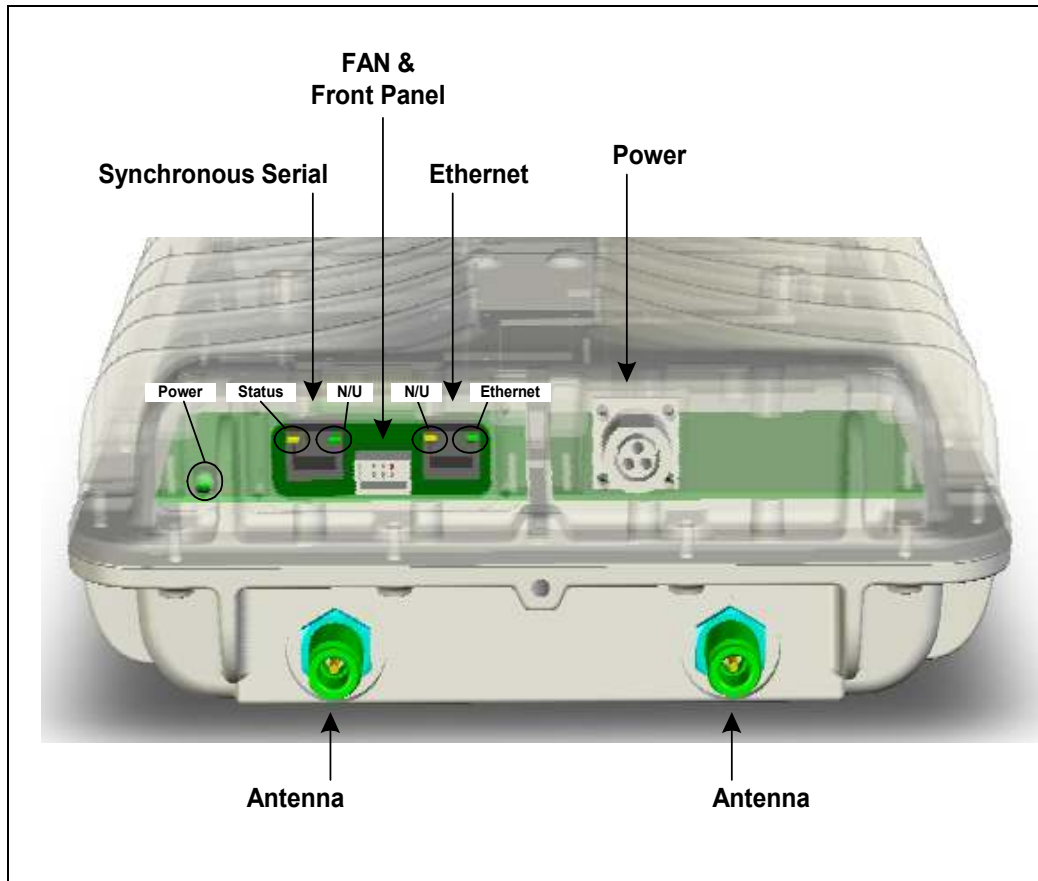
Radio Unit Connector and LED layout

Ethernet

A single shielded RJ45 socket provides connectivity. Shielded cable is not normally required. The green LED of the connector indicates Ethernet traffic while the yellow LED is NOT used.

Synchronous serial

The Synchronous Serial sub system as provided by the 'DIF version 2' PCB supports two main standards RS422 and G.703 (64 kbps only). For best performance in noisy environments, these interfaces are optically isolated. The RS422 implementation also supports connection to compatible standards such as X.21 (64 kbps only) and V.35. Connection to RS323 is also possible under certain circumstances.

Connection to the Radio Unit is through a single shielded RJ45 socket. The yellow LED of the connector is a status indicator while the green LED is NOT used.

All signals are named with respect to connected equipment. Transmit data is an input to the Radio Unit while receive data is an output.

Except for X.21 clocking for transmit and receive paths is independent and for RS422 co-directional and contra-directional transmit clocking is supported.

The G.703 implementation is of the 64 kbps co-directional (4 wire) version and as such utilizes a symbol rate of 256 kHz where bit and byte timing are embedded.

Synchronous Serial Signal Characteristics

Standard	Output Signal Voltage	Input Threshold
G.703	Mark: 1V ±0.1V Space: 0V ±0.1V	NA
RS-422	±5 V	±200 mV

RS-422 compatible standards		
Standard	**Output Signal Voltage**	**Input Threshold**
V-35	±500 mV	±200 mV
V-11	±5 V	±300 mV
X-21	±5 V	±300 mV

Synchronous serial Cabling

The recommended cable is shielded twisted pair similar to Belden 1868E fitted with a shielded RJ-45 plug as shown in the following images.
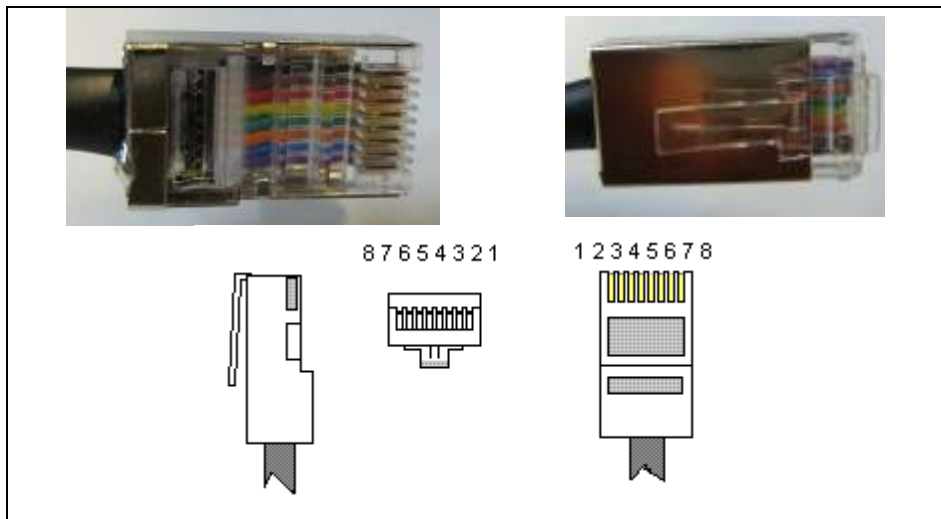
Shielded RJ-45 plug

Termination

Although operation will not normally be prevented if the connecting cable is incorrectly terminated at the user equipment, proper termination is strongly advised. As well as ensuring maximum signal integrity over longer cables, correct termination is necessary to ensure that compliance with CISPR22/EN55022 EMC standards is maintained.
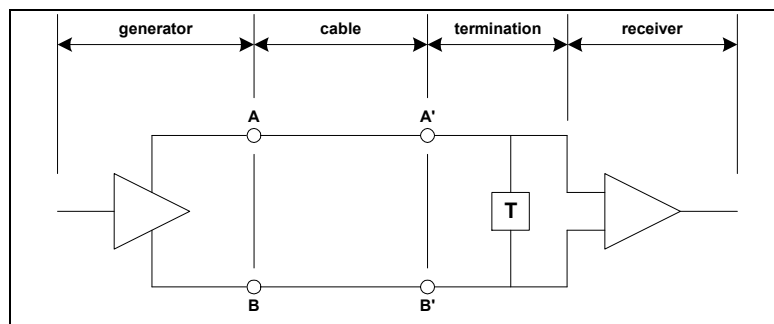
Differential Signal Path Overview (T indicates point of termination)

RS422 / X.21 / V.11
Termination is generally a single resistor across the inputs of the receiver of a value no less than 100 ohms and generally between 100 and 150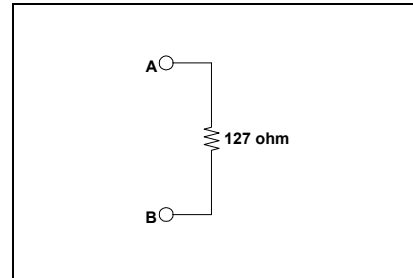 ohms. Multiple receivers may be connected to a single driver in which case only the receiver furthest from the generator shall be terminated.

A ○
127 ohm
B ○

V.35
Termination is a resistor network providing a load of 100 ±10 ohms and a path to ground of 150 ±15 ohms.
Note: The Radio Unit provides RS422 type termination only.

A ○
52 ohm
127 ohm
52 ohm
B ○
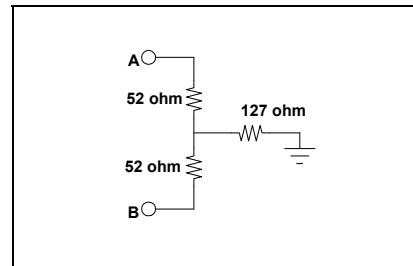
G.703
The nominal impedance for termination is 120 ohm.

Grounding

The Synchronous Serial drive circuitry and corresponding ground are isolated from chassis ground (to 1500 VRMS). Isolation is provided to prevent the possibility of ground loops. There is therefore the need to ground any shield at the user equipment (DTE) to prevent the shield/ground from floating.
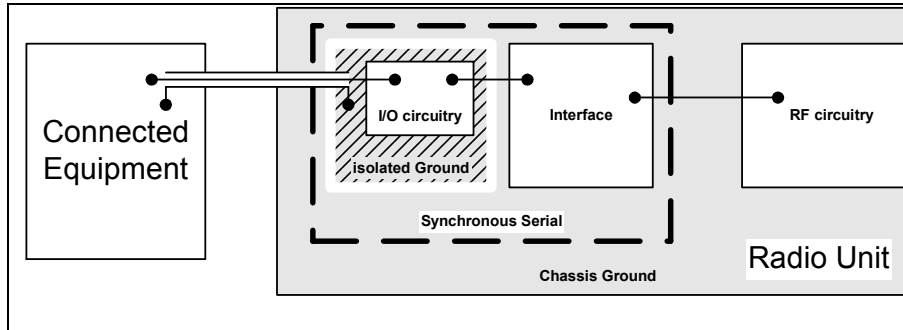
Alternatively provision has been made to place a shorting link between the Synchronous Serial and chassis grounds. Under NO circumstances should there be grounding at both ends (ie. The shorting link placed and a ground connection at the connected equipment).
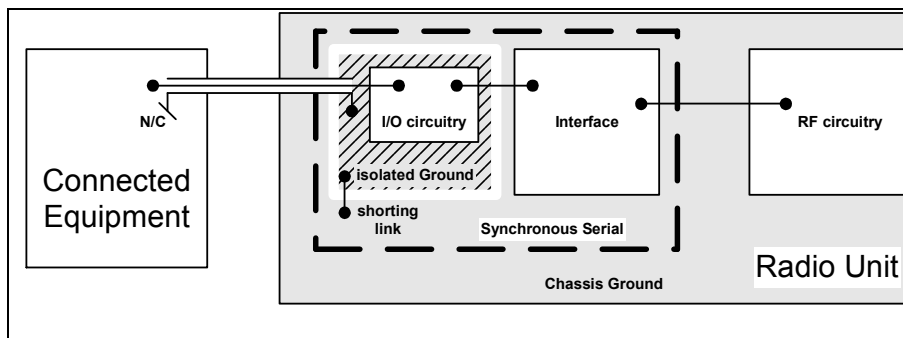
Synchronous Serial Physical

RS422

The following table outlines the OPV SII Synchronous Serial RS422 signals that are provided on the RJ45 connector.

Connected Equipment Interface		OPV SII		
Termination (ohm)	Signal	Pin – RJ45 (male)	Signal	In / Out
none	Tx Data (non inverted)	2	Tx Data A	I
	Tx Data (inverted)	1	Tx Data B	
100 - 150	Rx Timing (non inverted)	6	Rx Clock A	O
	Rx Timing (inverted)	3	Rx Clock B	
100 - 150	Rx Data (non inverted)	5	Rx Data A	O
	Rx Data (inverted)	4	Rx Data B	
100 – 150 [1]	Tx Timing (non inverted)	8	Tx Clock A	I/O
	Tx Timing (inverted)	7	Tx Clock B	
N/A	Shield	Body	Shield / GND [2]	N/A

NOTE (1): Termination is for co-directional mode only.
NOTE (2): GND is isolated from chassis ground.

Circuit Overview

The opposite diagram (RS422 circuit outline) shows the basic functional blocks that form the RS422 sub system and corresponding data paths.
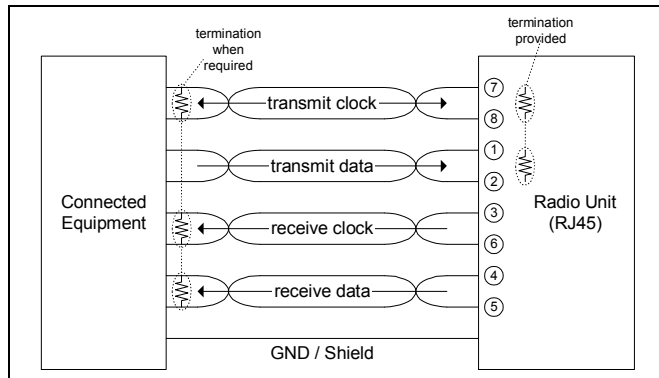Transmit and receive paths including their clocks are totally independent of each other.
The transmit clock is internally selectable as co-directional or contra-directional.
The receive clock driver may be disabled such that a static state exists on it's outputs.
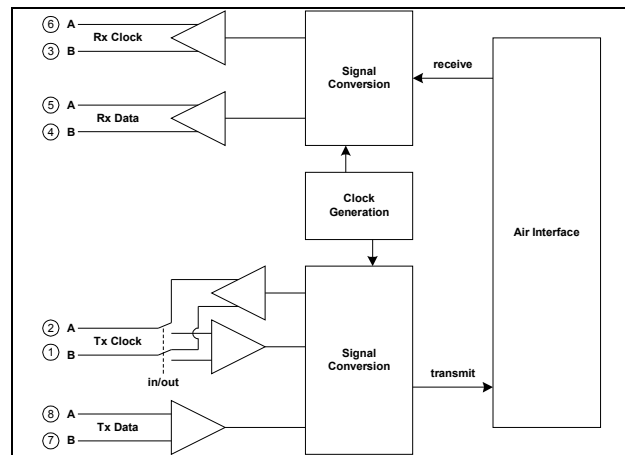
RS422 circuit outline

Cable Termination

RS422 Connections and Termination

Either the connected equipment shall provide internal termination or external termination at the locations shown in 'RS422 Connections and Termination'. The termination shall be within the 100 to 150 ohm range.

V.35 Considerations

Signal Levels: Although the generator drive levels (±5 volts for RS-422 and ±0.5 volts for V.35) are different the receiver decision levels (±0.2 volts for RS-422 and V.35) are the same meaning the two standards are compatible.

Termination for RS-422 and V.35 is somewhat different however this alone will not prevent operation.

As with RS-422, connection of the cables shield to ground is required and should be made at the connected equipment.

Termination comparison
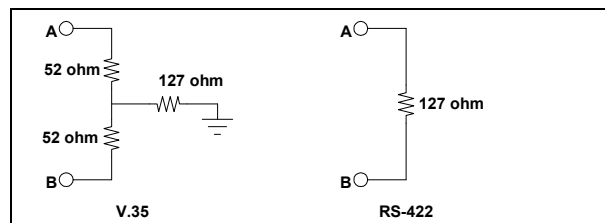
X.21

The following table outlines the OPV SII Synchronous Serial signals that are provided on a RJ45 connector.

Connected Equipment Interface		OPV SII		
Termination (ohm)	Signal	Pin – RJ45 (male)	Signal	In / Out
none	Tx Data (non inverted)	2	Tx Data A	I

	Tx Data (inverted)	1	Tx Data B	
100 - 150	Timing (non inverted)	6	Rx Clock A	O
	Timing (inverted)	3	Rx Clock B	
100 - 150	Rx Data (non inverted)	5	Rx Data A	O
	Rx Data (inverted)	4	Rx Data B	
N/A		8	N/U	I
		7	N/U	
N/A	Shield	Body	Shield / GND (1)	N/A

NOTE (1): GND is isolated from chassis ground and is accessible through the shield of the socket.

Circuit overview

X.21 circuit outline

The opposite diagram (X.21 circuit outline) shows the basic functional blocks that form the X.21 sub system and corresponding data paths.
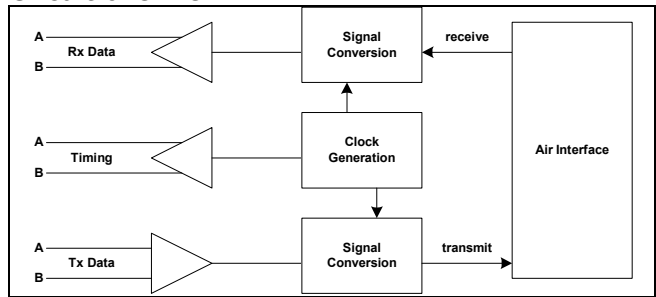
Cable Termination

Either the connected equipment shall provide internal termination or external termination shall be provided at the locations shown in the opposite diagram (X.21 Connections and Termination). The termination shall be within the 100 to 150 ohm range.
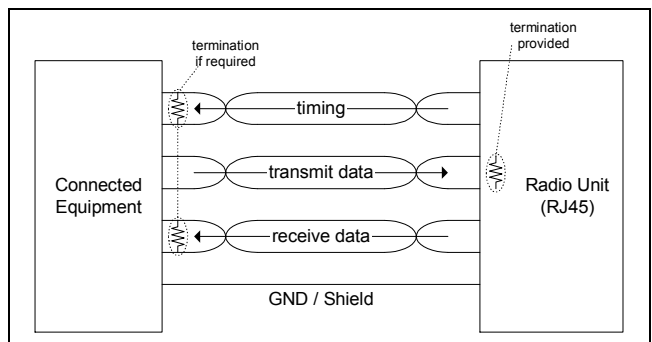
X.21 Connections and Termination

G.703

The following table outlines the OPV SII Synchronous Serial connections and the corresponding for connected equipment.

Connected Equipment Interface		OPV SII		
Termination (ohm)	Signal	Pin – RJ45 (male)	Signal	In / Out
none	Tx Data (non inverted)	2	Tx Data A	I
	Tx Data (inverted)	1	Tx Data B	
N/A	GND	6	GND[1]	N/A
	GND	3	GND[1]	
none	Rx Data (non inverted)	5	Rx Data A	O
	Rx Data (inverted)	4	Rx Data B	
N/A	NO CONNECT	8	NO CONNECT	N/A
		7	NO CONNECT	
N/A	Shield	Body	Shield / GND[1]	N/A

NOTE (1): GND is isolated from chassis ground.

Cabling

Some installations may require an alternate cable with individually screened twisted pairs. In which case pins 3 and 6 of the RJ45 socket provide for the connection of the individual screens to the Radio Unit.

Circuit overview
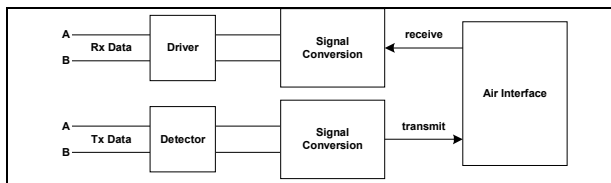
G.703 circuit outline

The opposite diagram (G.703 circuit outline) shows the basic functional blocks that form the G.703 sub system.

Termination and Grounding

It is expected that equipment requiring a G.703 interface will have internal termination.
It is the responsibility of the installer to ensure the correct termination is provided.
Termination is expected to have a nominal value of 120 ohms.
In the event that cable with individually screened pairs is used, connection of those shields to ground is possible through the connector as shown.
A connection of the cables shield to ground is required and should be made at the connected equipment.
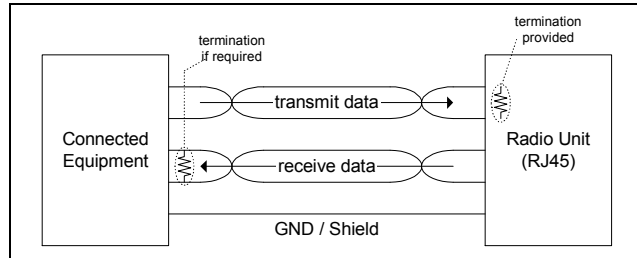
G.703 Connections and Termination

4   RADIO CONFIGURATION

4.1   CCMS SETUP

MiMOMax radios use a built in web configuration package called CCMS. To access the
CCMS, point a web browser to the radio's IP address (see Figure 1).   MiMOMax radios
are often preconfigured with an IP address specified by the customer when the radio is
ordered. If no IP address has been assigned, the default is 192.168.0.1/24. Additionally
MiMOMax radios will broadcast 3 gratuitous ARPs to advertise the IP address when the
radio boots up.

Figure 1: MiMOMax logon

To logon to the radio, press the "log into System" button. MiMOMax radios have two levels of access (user and tech). The default login credentials are:

Username	Default password
user	user
tech	tech

Figure 2: Default login credentials

See section 4.7 on changing the default passwords.

4.2 SYSTEM INFORMATION AND CONFIGURATION

The System configuration page (see Figure 3) is where one can set the system related items.   Most of these will have been set in the factory prior to shipping.

Figure 3: System configuration page

To configure a radio, one should set the following items:

1. Give the system a descriptive name that can be used to identify the radio for example, "SS test radio 1" in Figure 3.

2. Set the desired modulation order and whether adaptive modulation (MCAM) is enabled or not. Note that the M-CAM and QAM256 features are software add-ons, see Software Feature Enable (section 5.5).

   The adaptive modulation (M-CAM) feature, when enabled, allows the RF modulation logic to step up or down depending on the quality of the received signal. It traverses from QPSK through to the maximum modulation order and visa versa depending on RF channel conditions.

   If this feature is disabled, the RF modulation logic will stay on the set maximum modulation independent of signal quality. M-CAM typically allows for better utilisation of the channel as the modulation order is adapted as channel conditions change. In some circumstances this may not be desirable (e.g. differential line protection, where fixed bandwidth and latency is required).

   QPSK will provide 64kbit/sec, QAM16 128kbit/sec, QAM64 197kbit/sec and QAM256 256kbit/sec user data rates in 25kHz licensed channels.

3. The link retry timeout is set to 6 for a slave unit or 200 for a master unit. It does not matter which end of a link is slave or master as long as each end is different – this is usually set in the factory.

4. Set the low voltage notification level. An SNMP trap can be sent if the input voltage dips below this value. MiMOMax radios can operate down to 10.5V DC. A value of 11V for a 12V system or 22V for a 24V system may be appropriate. Note that the SNMP features are software add-ons; see Software Feature Enable (section 5.5).

5. Set the low signal threshold which can be used to trigger an SNMP trap to be sent.

6. Set the high temperature level which can be used to trigger an SNMP trap to be sent.

7. The "Auto refresh" feature refers to web pages in the CCMS auto refreshing. For example, the monitoring page can refresh every few seconds if enabled. On low bandwidth links or busy networks, this option is best disabled.

8. Press the "Save" button to save the changes. "Cancel" will revert to the original settings. Once the settings are saved, they can be activated by clicking on "Apply changes" on the Control Panel page.

4.3 SYSTEM INFORMATION

The system information page (see Figure 4) shows various version numbers of software and hardware. The most notable items are the software version and the backup (Inactive partition) software version.

Figure 4: System information

4.4 NETWORKING

MiMOMax linking radios can run in two network configurations:
- Layer II Ethernet bridge
- Layer III router

Layer II networking makes for easy network setup, but can be problematic in larger networks where broadcast traffic needs to be isolated.

To setup IP networking, click on "Network" (see Figure 5). Firstly setup the desired IP address, subnet mask and default gateway. Be sure to note the IP address down if it is changed. All MiMOMax radios broadcast 3 gratuitous ARPs when booting up to

advertise the IP address, this can be used in conjunction with a packet capturing program to find the IP address should it be unknown.

MiMOMax radios have a real-time clock that can be synchronised with a Network Time Protocol (NTP) server. Time is used for logging purposes only. To use an NTP server, enter the NTP server's IP address in the NTP server field.

Next, select if the radio should function as a layer II bridge or layer III router. To enable layer III router mode, disable "Network bridge"(see Figure 5). When running in router mode, an IP address for the air interface needs to be specified. The air IP addresses should be on completely different subnet (for example 192.168.x.x). If running in layer III mode, the default gateway address could be the air interface of the remote radio.

MiMOMax radios have an optional built in SNMPv3 service that can allow various parameters to be read from the radio. For details of what can be read from your radio, click on "SNMP base MIB" and "SNMP MIB" in the control panel. Note that the SNMP service is an optional "software feature enable" (SFE), to enable this feature see Section 5.5.

The following traps (notifications) can be sent by the radio if SNMP is enabled.

1. Low input voltage notification
This notification is sent if the system detects that the input voltage goes below a set threshold.

2. Low signal level notification
This notification is sent if the system detects that the RSSI (Received Signal Strength Indicator) has gone below a set level.

3. High temperature notification
This notification is sent if the system detects that the temperature on the radio has exceeded a set threshold.

The thresholds for these traps are set on the System configuration page, see section 4.2.

The SNMP service can be enabled by selecting "Enabled" from the drop down menu. A username and password also needs to be provided that will be used for authenticating SNMP clients connecting to the radio. The various traps can also be enabled / disabled.

Once the networking options have been entered, click "Save", this will save the options to the radio's internal database. To activate the changes, click on "Apply changes" in the control panel. If the radio's IP address has been changed, you may need to change you computer's IP address to match the radio's new subnet.

Figure 5: Network configuration page

Static routes can be added to the radio should the radio need to communicate with routers other than the default gateway. These can be added on the static routes configuration page (See Figure 6). Enter the destination network, netmask and gateway address and then click "Save". To delete a route, check the "Del" checkbox and then click "Save". To activate the route changes, click on "Apply changes" in the control panel.

Figure 6: Static routing page

4.5 RF SETTINGS

MiMOMax radios feature internal duplexers for full duplex low latency communication on a frequency pair. The duplexers are factory tuned for a specific frequency range, therefore the transmit and receive frequencies are factory set. These frequencies can be viewed on the transmit (see Figure 7) and receive (see Figure 8) pages. Additionally the receive page also allows for internal 20dB receive attenuators to be enabled should they be needed due to very high receive levels or for interference trouble shooting. As with all options, to save changes press the "Save" button and then to activate the changes, click "Apply changes" in the control panel.

Figure 7: Transmitter configuration page

Figure 8: Receiver configuration page

4.6 SYNCHRONOUS SERIAL SETTINGS (OPV)

OPV (Optimised Protection Variant) versions of the NDL (Network Digital Link) family of products contain a synchronous serial port that supports the following standards:

- RS422
- X.21
- V.35
- G.703

The desired serial standard is usually specified when the radio is ordered and set in the hardware and software in the factory

Should any changes need to be made to the synchronous serial setting, click on "Sync Serial" (See Figure 10). The signals listed on this page are defined from the perspective of the connected equipment, see Figure 9.

Signal	Direction
Transmit data	input
Transmit clock	input/output
Receive data	output
Receive clock	output
Timing (X-21)	output

Figure 9: Synchronous serial signals

1.   Synch Serial Mode
Selects the desired mode for the interface. Note: G-703 requires a hardware change. Selecting "Disabled" will disable the synchronous serial hardware and allow the full bandwidth to be used for Ethernet traffic.
2.   Desired Bit Rate
User defined bit rate.
3.   Actual Bit Rate
Actual achieved bit rate. Note: Desired and actual values my differ. Only exact multiples of the internal clock will result in a one to one relationship.
4.   Configuration
Pre-defined settings (remaining fields are inaccessible) or manual (all fields are accessible)
5.   Rx Clock Mode
When disabled no receive clock signal will be available.
6.   Rx Phase
Defines which clock edge receive data is valid on.
7.   Tx Clock Mode
Selects clock direction. Co-Directional sets as an input, Contra-Directional sets as an output.
8.   Tx Phase
Defines which clock edge transmit data will be read on.

It is advised to consult the MiMOMax application notes for details on interfacing various synchronous serial products to the OPV radios.

Figure 10: Synchronous serial page

4.7   CHANGING PASSWORDS

Passwords are used to secure access for the "user" and "tech" logins. In addition to "tech" being able to change the "tech" password, "tech" may also change the "user" password.

To change a password, click on "Change Passwords" under System and then do the following (see Figure 11):

1. Type the intended password into the column labelled "Password" and retype the password into the column labelled "Retype Password".
2. Click "Save" to save the changes
3. Click on "Apply Changes" in the Control Panel to activate the new passwords.

Figure 11: Password page

5   ADVANCED TOPICS

5.1   MONITORING AND DIAGNOSTICS

This section is aimed at diagnosing poor radio link performance on a link that was previously known to be good. A radio link may perform badly due to poor signal or a fault. The following set of steps will endeavour to discover and solve the source of the problem.

Step 1
The first thing to check is if one can logon to the radio:
Point a web browser to the radio's IP address. This can be done remotely or locally with a laptop (ensure that the laptop has an IP address on the same subnet as the radio).
If the radio is online, one should be presented with a logon screen (See Figure 12).

Figure 12: Logon page

- Logon as user "tech" (The default password is "tech").
- If one can't logon to the radio then:
  - Ensure that power is on and verifying that the power LED is on.
  - Verify that the Ethernet LED flashes in the presence of network traffic.
  - Ensure that there is IP connectivity to the previous router in the network or logon to the radio locally.
  - The status LED will be on if there is an RF link to the remote end of the link.
  - If one can't login locally then please contact MiMOMax for service.

5.1.1 Step 2

- Click on the monitoring menu item. One should see a screen similar to the one in Figure 13.

Figure 13: System monitoring page

- Items to check are:
    - Link state (in the banner at the top of the page). "Not active", indicates that there is no communication with the radio on the other end of the link.
    - **Signal Quality** (Should be higher than 50%). Signal quality is a measure of how much noise is on the channel. A 70% signal quality will not usually result in any more bit errors than a 90% signal. It is purely a measure of channel performance. A very low signal quality is usually an indication of interference.
    - **RSSI** (Should not be below -97dBm). For OPV or greater (see product data sheet)
    - **Errors on the air interface** (Errors are to be expected on a radio channel, but a high error rate indicates a problem, probably related to poor RF conditions).
    - **Uptime** (A unexpectedly short uptime indicates an unexpected reboot).
    - **High transmitter temperature (90°C+)**
    - **Low input voltage** (less than 10.5VDC)

If signal levels are bad on one end only, it either indicates a faulty transmitter at the far end or a faulty receiver at the near end. If the signal levels are bad at both ends, check the antennas and antenna feeds.

Errors on a synchronous serial connection with good signal level, good signal quality and few air interface errors could be a result of noise on the synchronous serial cable or missing terminators on the connected equipment on long cable runs.

5.2   LONG TERM MONITORING

MiMOMax radios store various engineering parameters for 48 hours at a 1 minute sample resolution. These can be downloaded in CSV format from the control panel, by clicking on "Data log".

5.3   SOFTWARE UPGRADE

A software upgrade is usually done locally via the wired Ethernet connection to the radio device. However, if the optional Over-The-Air Programming (OTAP) feature is enabled, the process can also be done remotely via the MiMOMax link.

The following steps described here are common to the following products: OPV, LRU, BRU and RRU. The screen-shots were taken during an RRU software upgrade.

1.   MiMOMax will have provided the user with a file whose filename resembles: mdl_rru_software_5.bz2. This file is for an RRU product and is version 5 of the software. The file is securely compressed and encrypted and can not be used on any other products other than an RRU.

2.   The user needs to login to CCMS as Technician (username "tech") and navigate to the Control Panel page (see Figure 14).

Figure 14: Control Panel

3.   The user clicks on the browse button next to the "File to be uploaded: " text box to find the software image (see Figure 15).
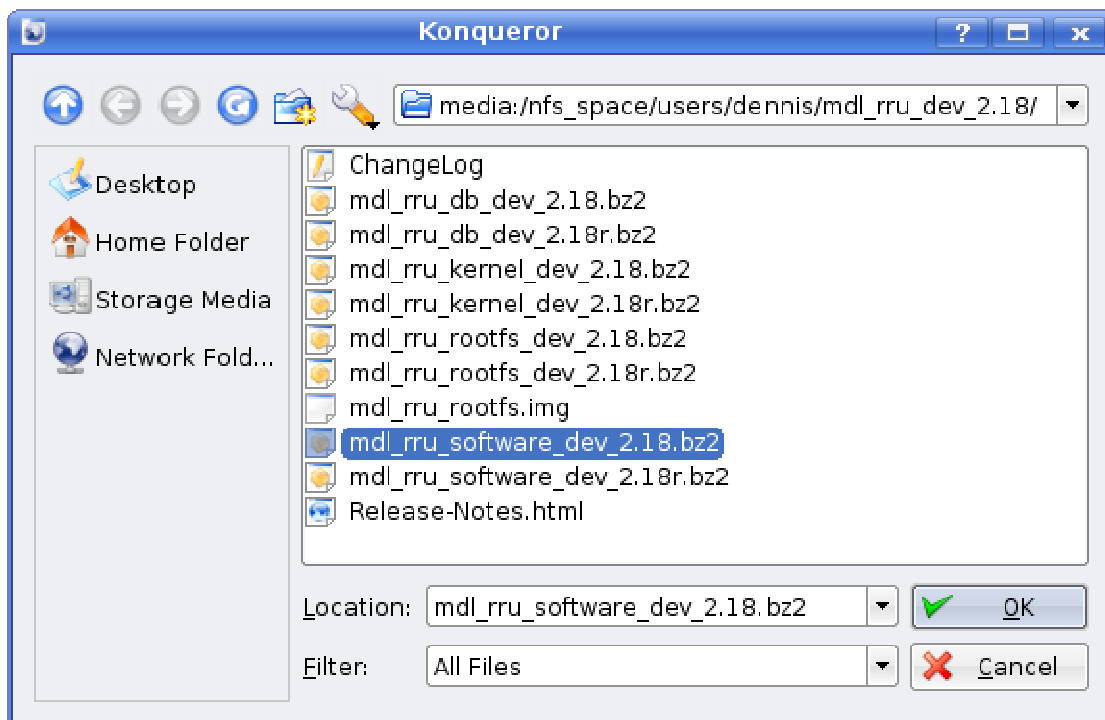
Figure 15: Selection of file to upload

4.   Once the file is selected, a confirmation box will popup prompting the user to continue the process or not.
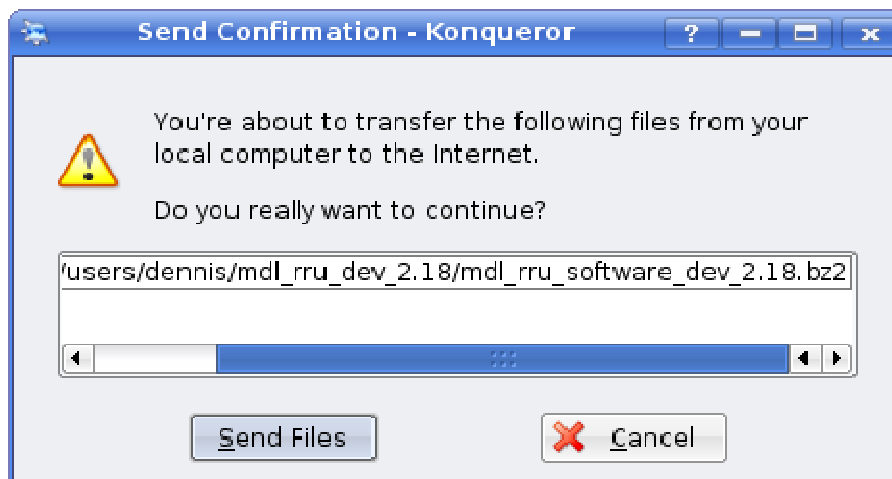

Figure 16: Send confirmation

5.   Click the "Upload File" button to upload the file. A pop-up message window (see Figure 17) will then inform the user whether the upload was successful or not.

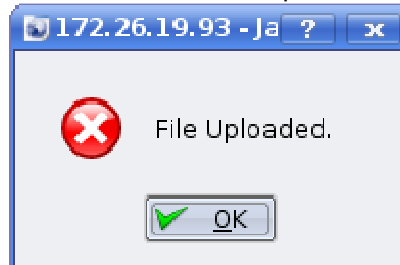**Figure 17: File upload confirmation**

6.   The user will need to scroll down to the "System Upgrade Operations" section of the Control Panel page and click on the "Upgrade Software" button (see Figure 18).
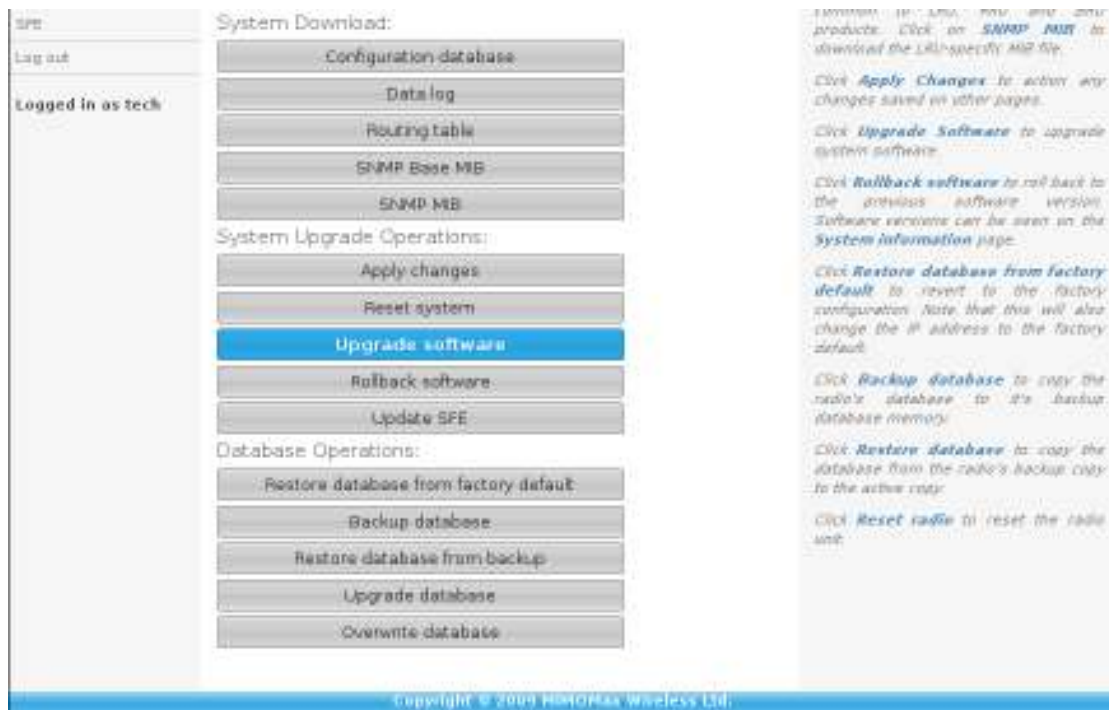

Figure 18: Control Panel

7.   Once the upgrade process is started, the user will be redirected to a self-reloading page that shows the process status. It reloads every 5 seconds. See Figure 19.

Figure 19: Software update progress page

8. The system will automatically reboot when the upgrade is done and the system should be back up in about 1.5 minutes.

The upgrade process takes about 3 minutes to complete plus 1.5 minutes for reboot for a total of 4.5 minutes downtime.

This same process can be used to downgrade the running software. Use the software image with the older version and follow the steps as outlined above.

5.4 SOFTWARE ROLLBACK

The system stores two independent copies of the software image. When the software is upgraded, the new software is copied to the inactive memory partition. In other words, the currently running software is kept intact. After the software upgrade process, the memory banks are swapped such that the previous active partition becomes the inactive partition and vice versa.

If the user needs to go back to the previously running version of the software, the button called "Rollback software" under the Control Panel page is used for this purpose.

When the "Rollback software" button is pressed, the radio immediately shuts down and reboots using the other memory bank.

5.5 SFE (SOFTWARE FEATURES ENABLER)

Figure 20: Software Feature Enable (SFE) page

5.5.1 Software Feature Enablers

The SFE page (see Figure 20) shows the features enabled or disabled in the currently running software. The following features can be found:

1. Adaptive Modulation (M-CAM, MiMOMax Cognitive Adaptive Modulation)

This feature, when enabled, allows the RF modulation logic to step up or down depending on the quality of the received signal. It traverses from QPSK through to the maximum modulation order and visa versa depending on RF channel conditions.

If this feature is disabled, the RF modulation logic will stay on the set maximum modulation independent of signal quality. M-CAM typically allows for better utilisation of the channel as the modulation order is adapted as channel conditions change. In some circumstances this may be not be desirable (e.g. differential line protection, where fixed bandwidth and latency is required).

2. Nitro QAM Boost

This feature allows the RF modulation logic to go up to the full QAM256 giving a boost in data throughput, to reach a user data rate of up to 256kbit/sec (320kbit/sec air speed).

3. Over-The-Air Configuration (OTAC)

Normally the CCMS web application is only accessible via the local Ethernet port of the radio and not via the link over the air. With this feature enabled, CCMS can then be

accessible via both the local Ethernet port and over the air link, thus allowing remote configuration.

4. Over-The-Air Programming

This feature allows the user to perform software and database updates or upgrades remotely via the RF link. Without this feature, the software and database on the radio can only be updated or upgraded locally via the wired Ethernet port.

5. SNMP Support

MiMOMax radios can be accessed via SNMP (Simple Network Management Protocol) for network monitoring purposes. The radio can also send various traps or notifications via SNMP to a configured SNMP manager on the network.

6. Data Logging

This feature can be used for monitoring the system performance over the previous 48-hour period. With this feature, a CSV (Comma-Separated Values) data file will be available for download on the Control Panel page that can be downloaded for a more detailed performance monitoring.

5.5.2 Software Feature Request

The SFE page allows the user to request that additional features are enabled. See Figure 21. This process is described below:

1. The user clicks on the drop-down selection menu opposite to a particular feature or features and sets it to "Enabled".

2. The user then clicks the "Submit" button in order to create a file containing the request. The SFE page will reload and will then display a message that the process is complete and an instruction to the user about what to do next.

3. A new button called "Download SFE" also appears at the bottom of the page. The user must click this button in order to download the generated file and then send it to the nearest MiMOMax Business Center.

4. Once the features are purchased, MiMOMax Wireless will send the customer an SFE update file in order to enable the features on the radio. Please see the next section (5.5.3 SFE Update) for details on how to do this.

Figure 21: Software feature request page

5.5.3 SFE Update

When a customer is given an SFE update file from MiMOMax Wireless, an SFE update process needs to be done in order to apply the SFE changes. This process is described below:

1. The SFE file needs to be uploaded to the specific radio it is meant for. This SFE file can not be used on other radio units. The file upload facility is found on the Control Panel page.

2. Once the file is uploaded, the user needs to click on "Update SFE" button on the Control Panel page in order to apply the SFE changes. The process takes a few seconds to complete and once done, the features requested should then be "Enabled" as shown on the SFE page. See Figure 22.

Figure 22: Software feature update status page

5.6 DATABASE OPERATIONS

The database on a MiMOMax radio stores all configuration parameters for the radio. The database is separated from the software so that configuration settings will survive a software upgrade. In other words, even if the radio's software is upgraded or changed multiple times, the configuration settings remain intact.

The user can also download the database file for backup purposes. Additionally, the radio can also keep a backup of the database internally.

The usual time when the user will need to upgrade the database is when a previous software upgrade requires it. It is important for the software and the database to be synchronized for correct operation.

A Technician can choose from among the different database operation options:

1.   Restore database from factory default
This operation will reload the factory-set configuration and reboot the radio.

2.   Backup database
This operation signals the radio to create a backup of the current configuration internally. The backup database is stored in non-volatile memory and is persistent when the radio is rebooted or powered down.

3.   Restore database from backup

This operation will reload the configuration from the backup stored internally in the radio. This also causes the radio to reboot so that the new settings are applied.

4.   Upgrade database

This operation will upgrade the current database. It is important to note that a database upgrade does not necessarily affect the current configuration settings. It only means that the database version or schema is upgraded and the relevant values are retained.

5.   Overwrite database

This operation will overwrite the database on the radio which means that all the values are overwritten with new ones. The database file used in this operation should be a database file that is specific to the radio, otherwise the operation will fail. This file is usually the result of downloading the database file from the radio by clicking on the "Configuration database" button under the "System Download" section of the "Control Panel" page.

5.6.1   Upgrading the database

The database upgrade process is similar to the software upgrade process.

1. MiMOMax will have provided the user with the appropriate database upgrade file where the filename resembles: ndl_opv2_db_1.3.bz2. It is a securely compressed and encrypted file and can only be used for the appropriate product range. In this case, this applies to any OPV series 2 (OPV2) product.

2. Login as Technician (username "tech") in CCMS and navigate to the "Control Panel" page.

3. Upload the file by clicking on the browse button next to the "File to be uploaded:" text box. Select the file provided (See Figure 23).
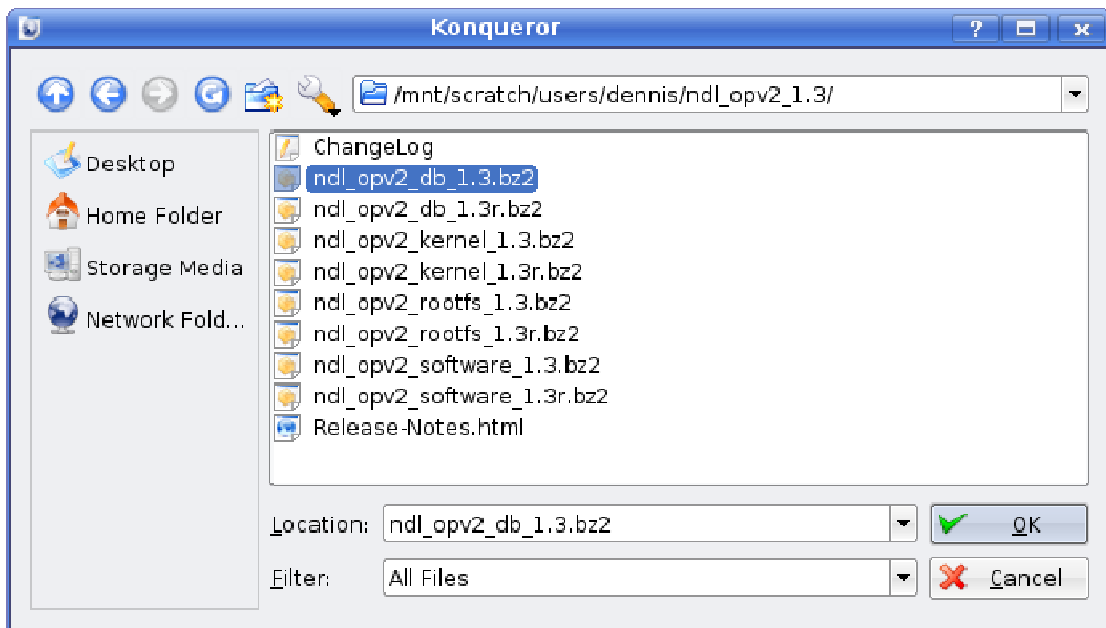
Figure 23: Database file selection

4. Click on the "Upload file" button. Once the upload is complete, a message prompt will pop-up with the appropriate message (see Figure 24).
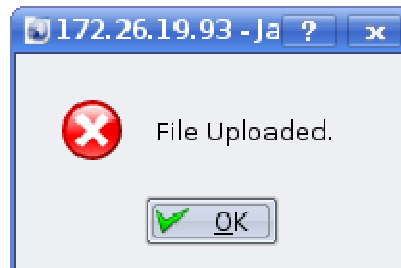

Figure 24: File upload confirmation message

5. Scroll down to the "Database operations" section of the "Control Panel" page and then click on "Upgrade database". Once the radio has verified the file it will then apply the upgrade and reboot the radio. This process is a very quick process such that the browser may not have the chance to load the upgrade status page. This is normal and any HTML errors on the page as a result of a sudden loss of connection to the radio can be safely ignored. The radio should be back up after 1.5 minutes.