MLX^{TM} Mobile Platform Communication System

User's Manual

**RESTRICTIVE COVENANT
AND
DISCLAIMER**

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All rights reserved.**

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by Modular Mining Systems could void the user's authority to operate this equipment.

MANDATORY SAFETY INSTRUCTIONS TO INSTALLERS AND USERS

Use only antennas supplied by Modular Mining Systems or dealer.

Antenna Minimum Safe Distance: 20 cm

Antenna Gain: dBi referenced to a perfect isotropic radiator.

The Federal Communications Commission has adopted a safety standard for human exposure to RF (Radio Frequency) energy which is below the OSHA (Occupational Safety and Health Act) limits.

Antenna Mounting: The antenna supplied by Modular Mining Systems or dealer must not be mounted at a location such that during radio transmission, any person or persons can come closer than the above minimum safe distance to the antenna, i.e. 20cm.

To comply with current FCC RF exposure limits, the antenna must be installed at or exceeding the minimum safe distance shown above, and in accordance with the requirements of Modular Mining Systems.

Antenna substitution: Do not substitute any antenna for the one supplied or recommended by Modular Mining Systems. You may be exposing person or persons to harmful radio frequency radiation. You may contact Modular Mining Systems for further instructions.

WARNING: Maintain a separation distance from the antenna to person(s) of at least 20cm.

You, as the qualified end -user of this radio device must control the exposure conditions of bystanders to ensure the minimum separation distance (above) is maintained between the antenna and nearby persons for satisfying RF Exposure compliance. The operation of this transmitter must satisfy the requirements of Occupational / Controlled Exposure Environment, for work-related use. Transmit only when person(s) are a least the minimum distance from the properly installed, externally mounted antenna.

Professional Installation: This device must be professionally installed.

About This Manual

This manual contains a description of the MLX^{TM} Mobile Platform's Communication System designed by Modular Mining Systems (MMS). Its use is intended for MMS personnel and clients who may be responsible for the system's operation.

System Description

The MLX^{TM} Mobile Platform's Communication System is based in two components:

- MLX^{TM} Mobile Hub
- Bi-directional Amplifier and Cavity Filter
- Omni-directional Antenna

MLX^{TM} Mobile Hub

Internally the MLX^{TM} Mobile Hub contains a radio that operates with the standard IEEE 802.11g in the ISM 2.412 to 2.484 GHz frequency band. The modulation schemes used are OFDM for data rates 6, 9, 12, 18, 24, 36, 48 and 54 Mbps, reverts to CCK for 5.5 and 11 Mbps and to DBPSK/DQPSK for 1 and 2 Mbps. The radio has two ports (Primary and Auxiliary) configured to operate in diversity antenna mode. The diversity antenna mode scans the SNR of each port until one is found to be above a predetermine threshold. Then the radio receives and transmits only for this port (antenna) until it falls below the SNR threshold and the scanning process is again initiated. In other words, the MLX^{TM} Mobile Hub only receives and transmits for one antenna at time.
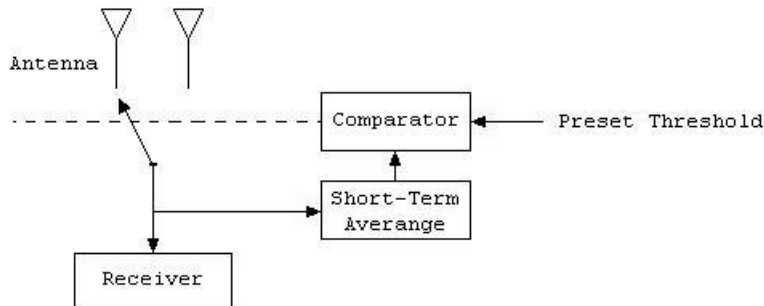
Basic form of scanning diversity

Bi-directional Amplifier

The Bidirectional Amplifier is designed to be used for IEEE 802.11g standard, providing up to 1W of AGC compensated transmit power and giving low noise amplification in receive mode. It provides spectrally clean power amplification in transmit mode.
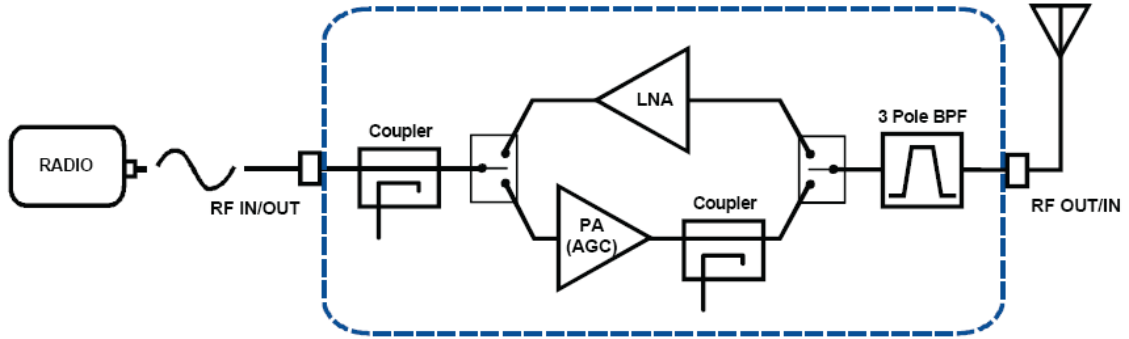
Bidirectional Amplifier Block Diagram

Omni Directional Antenna

Antenna diversity is an option and not a requirement. If the omni is positioned such that it is the highest point on the vehicle, then multipath is not a problem and a single omni performs 98-99% as good a dual configuration. The disadvantage with omni antennas on many mine vehicles is that they are prone to being knocked off during normal mining operations.

Neglecting losses between the amplifier and the antenna (some minimal cable run is unavoidable), the radiated output power from a 6dB antenna would be 36dBm (4Watts). However, actual output power will be slightly less due to unavoidable losses (cables, connectors, etc).

Block Diagram

Omni Directional Antenna Configuration
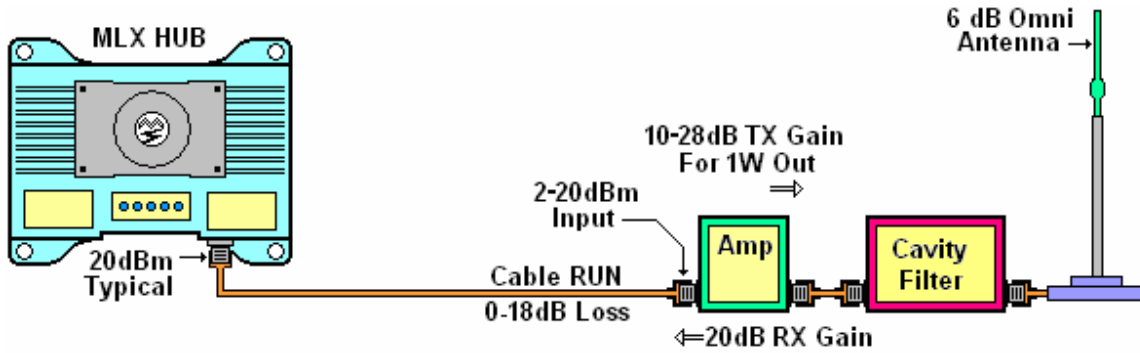
Tune Up Information

No tuning procedure is required by the end user since the RF power that is put in the entry of the amplifier is controlled by firmware (driver) being this less than 20 dBm, limit that permits to the Automatic Gain Control operates correctly in the range 2-20 dBm to obtain 30dBm RF power output as maximum.
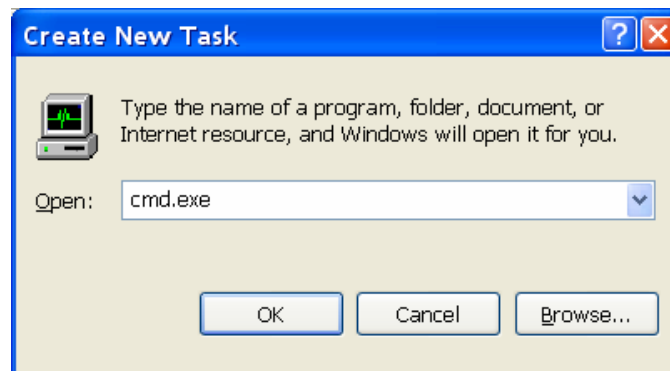
Wireless Network Configuration

The Wireless Ethernet adapter will obtain its IP address from the DHCP service. Make sure that the MLX^{TM} Mobile Hub is being covered by the desired RF Wireless Access Point signal.
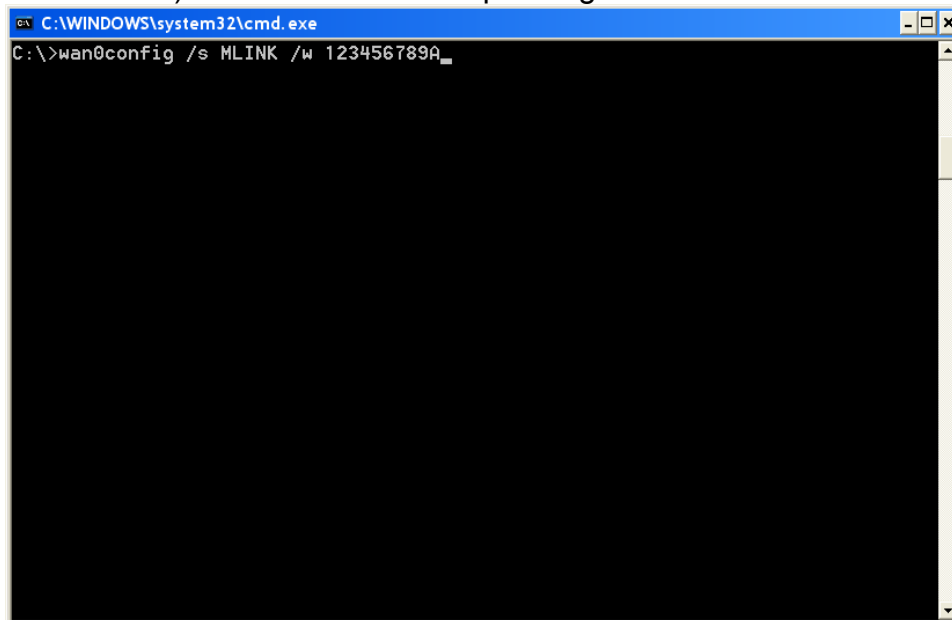
1. Press Ctrl-Alt-Del to open the "Windows Task Manager"

2. Press Alt-F
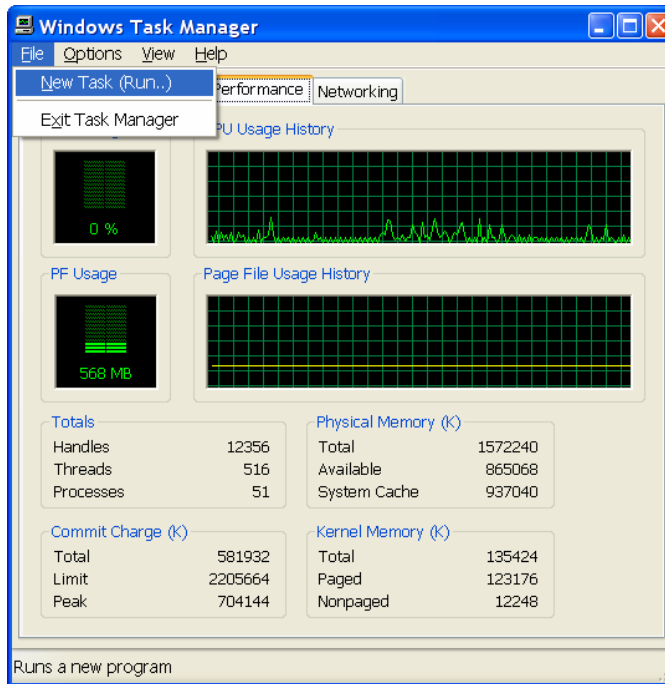
3. Press Enter to open a "Create New Task" window and type "**cmd.exe**" and **Enter.**

4. A shell command window will appear, type "**wan0config /s MLINK /w 123456789A**" and press **Enter.** Note that the SSID (MLINK) and Wepkey (123456789A) could be different depending of each installation.
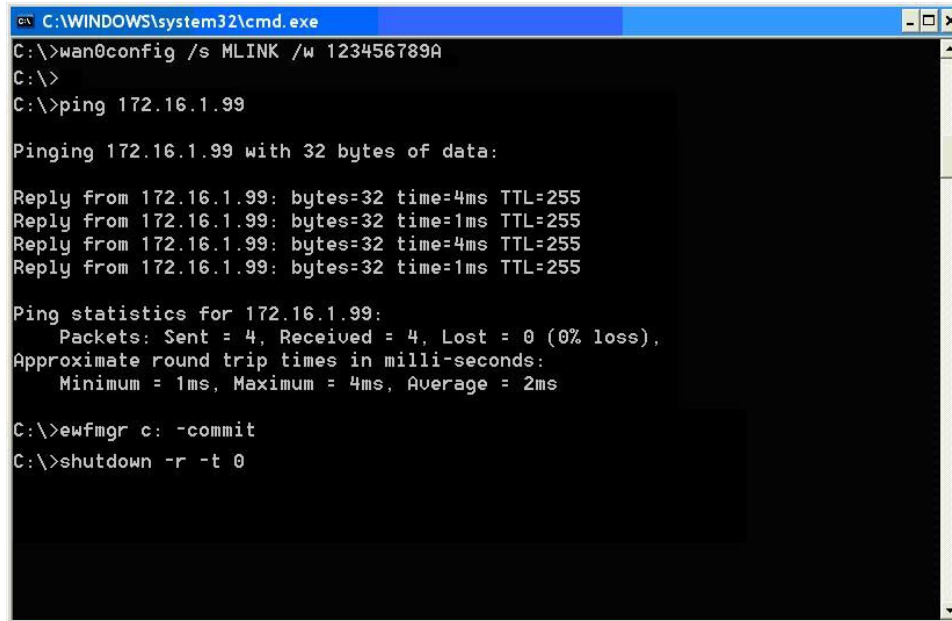
5. Type "**ping 172.16.1.99**" and press "**Enter**" to do pings to the central server. Note that the central server IP address could be different depending of each installation.

6. If the ping is successful type "**ewfmgr c: -commit**" and press **Enter.**
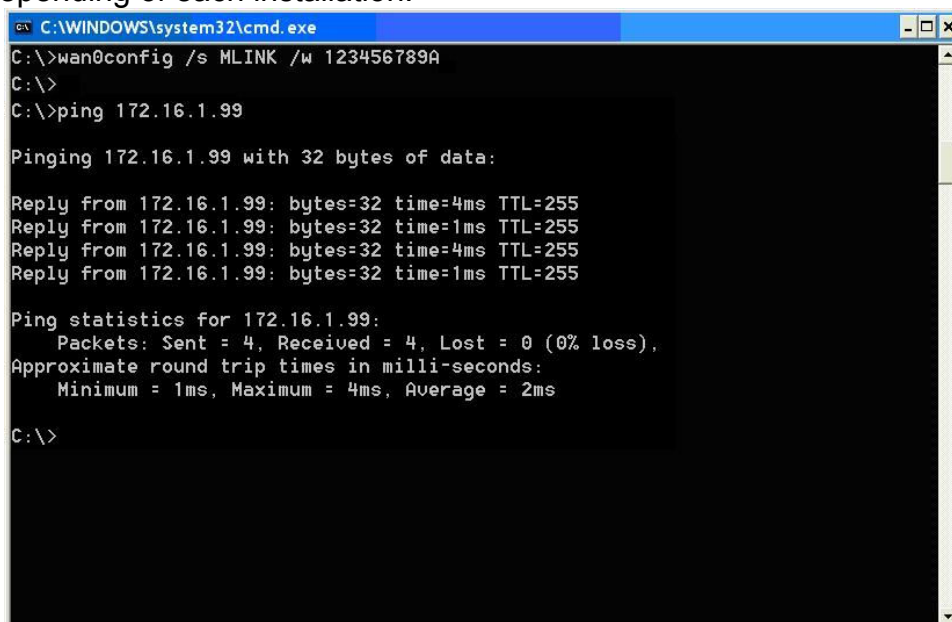
7. Type "**shutdown –r –t 0**" and press **Enter** to shutdown the MLX^{TM} Mobile Hub.
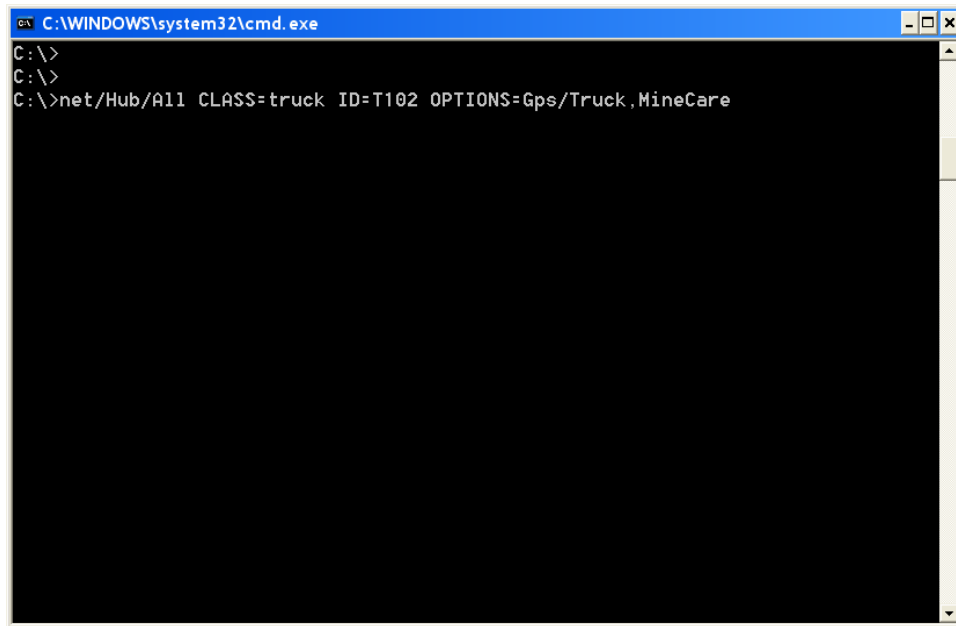
8. Turn ON the MLX^{TM} Mobile Hub again.

9. Repeat steps 1, 2, 3 and 5.

10. If everything is successful, the MLX^{TM} Mobile Hub has been configured correctly. If not, please send it to the MMS office to be repaired.

Application Loading

1. Open a "**cmd.exe**" shell window command.

2. Type "**net/Hub/All CLASS=truck ID=<*name of equipment*>
   OPTIONS=Gps,Truck,MineCare**" and press "**Enter**"

Example:

3. To run the application type "**resetme**" and press "**Enter**"

4. To reload the application, type "**bootme**", press "**Enter**" and repeat the
   steps 1, 2 and 3.

Hardware Installation and Specifications

MLX^{TM} Mobile Hub

The MLX^{TM} Mobile Hub consists of a rugged case to support and base plate made of cast aluminum, which has been anodized and enameled to provide maximum protection from harsh environments. Its physical dimensions are approximately 33.0 by 26.2 by 8.9 centimeters (13 by 10.3 by 3.5 inches), and it weighs 4.7 kilograms (10.4 pounds).

The MLX^{TM} Mobile Hub is installed inside the mining vehicle's cab usually mounted to the wall or on an upright bracket attached to the floor or rear dash.

Mounted to the wall	Mounted on an upright bracket

Important note: *The pictures are not showing the MLX^{TM} Mobile Hub. The device that is being showed is the MasterLink® Mobile hub as reference, since both have the same mounting pattern.*

MLX^{TM} Mobile Hub – Specifications

Required Supply Voltage	+12 VDC ISOLATED (11.0-14.0)	Provided by the MLX™ Power Subsystem
Over voltage Turn-Off	14.0-14.5 VDC	Protected to 40V
Reverse Polarity	Protection built in	Protected to -40V
Operating System	Windows XPe	
Standard Base Model Processor	Celeron 600MHz	
Standard CF (Compact Flash)	1GB	
Standard SDRAM	1GB	
PC Card Slot	Type II	
Mini-PCI Slot	Type IIIA	

Automatic Self Heat & Boot	Heats to -20ºC and then boots	
Automatic Cooling	Waterproof fan on at +45ºC	Short circuit protected fan monitored for current and tachometer
Temp Sensor	±2ºC from -40º to +125ºC	
Internal GPS	Trimble SKII	12-channel differential GPS

MLX^{TM} Mobile Hub Display Indicators

| *LED*	*ON*	*Blink Rate*	*Off*
Power	Power good	--	--
Radio	Radio good	Indicates time from last received packet	No radio detected
Radio Assoc	Associated with network	Indicates time from last association 5 quick flashes = Change of assoc.	No association > 2 minutes
GPS	--	- 4Hz=Differential solution (with # blinks = # satellites in use) - 1Hz=Autonomous solution (with # blinks = # satellites in use) - Once every 5 seconds = No GPS solution	No comms with receiver
Heater	Heat cycle ON	--	Heatters OFF
Fan	Fan ON	--	Fan OFF

MLX^{TM} Mobile Hub Connectors
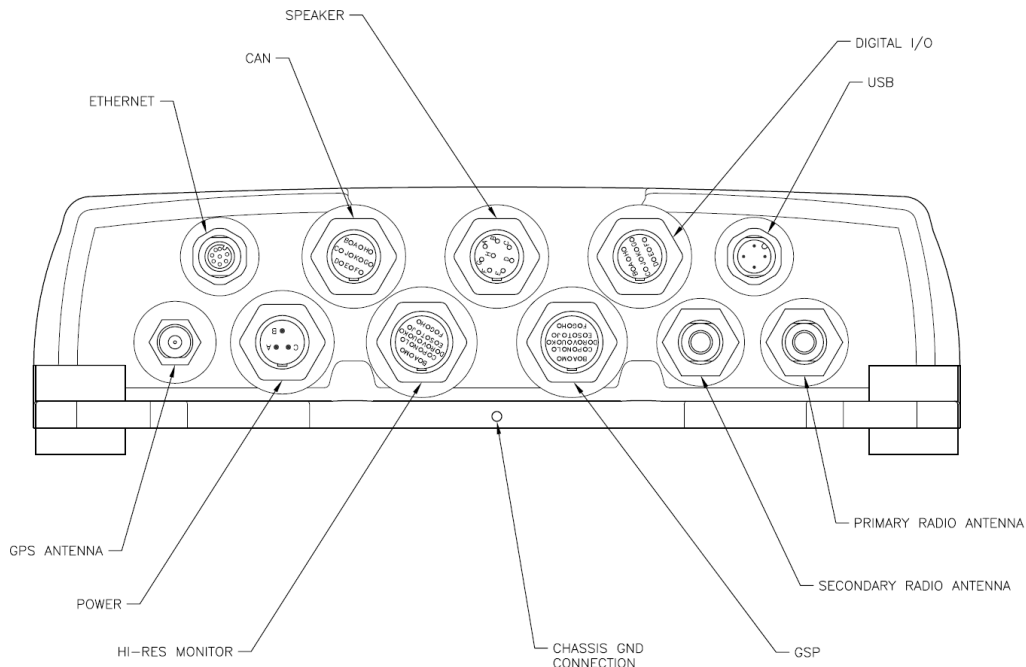
Connector	Description
Ethernet	Standard 10/100Base-T network connection
CAN	Provides power output to and data communications with standard CAN devices.
Speaker	Standard PC Stereo out left & Right signals, Beeper, and Mic In. For future use only
Digital I/O	Provides two digital inputs for contactclosure-type devices such as foot switches. Also contains standard Keyboard and Mouse signals.
USB	Universal Serial Bus. Supports ver 2.0
GPS Antenna	Type TNC coaxial cable connector for GPS antenna.
Power	Receives source power
Hi-Res Monitor	For optional LVDS Digital Interface for 18-Bit LCD panels and RS232 touchscreen interface.
GSP	Provides 15-V isolated power to the communications port for serial devices. The port contains two RS-232 or one RS-485 ports.
Primary Radio Antenna	Provides 12VDC power and RF signal to the external Bi-directional.
Secondary Radio Antenna	Provides 12VDC power and RF signal to the external Bi-directional amplifier through coaxial cable.

Bi-directional Amplifier, Cavity Filter and Antenna

The antenna have to be positioned such that it is the highest point on the vehicle, then multipath is not a problem and a single omni performs 98-99% as good a dual configuration, providing 360-degree coverage. The antennas brackets are typically mounted on the front left and right deck or handrails as follows:

(Front right side)

(Front left side)
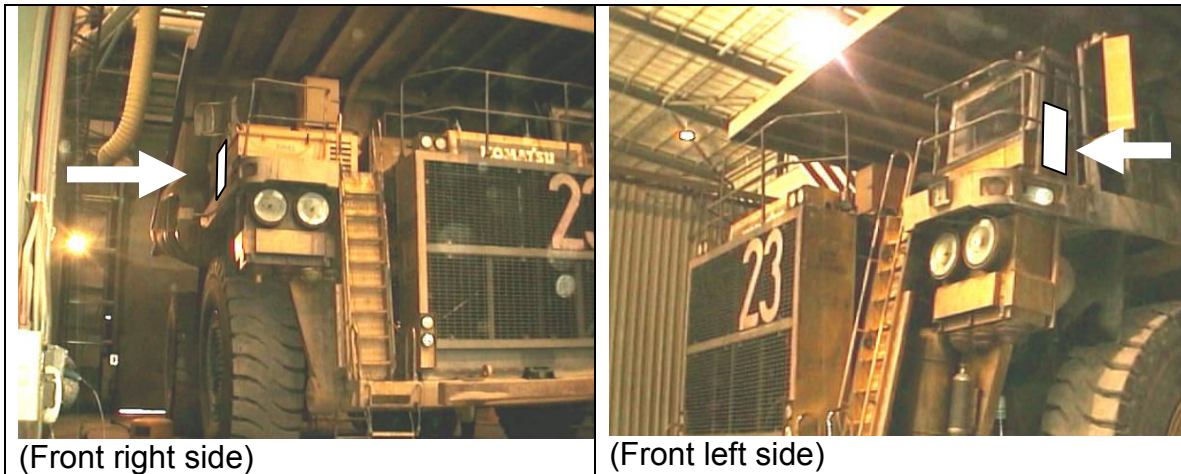
Bi-directional Amplifier, Filter and Antenna – Specifications

Horizontal Pattern	360 degrees	
Vertical Pattern	35 degrees	
Antenna Gain	6dBi	
Frequency Operation	2400- to 2484-MHz	
Supply Voltage	+12VDC +/- 5%	Provided by the MLX^{TM} Mobile Hub
Power Usage	2.6 watts 3.2 watts	Typical 100% duty
Receive (RX)		
Gain	20dB (amplifier) + 6dBi of antenna gain +/- 2dB	
Supply Current	<250mA	
TX to RX Switching	2 uSec	Typical
Transmit (TX)		
AGC Gain	Wide RF power input	2-20 dBm
Maximum Amplifier Output	1 watt (30 dBm)	
Supply Current	<800mA	
RX to TX Switching	2 uSec	Typical

Omni Directional Antennas – *Radiating Patterns*

1. Omni-directional Antenna 6dBi Gain

Frequency:	2.4-2.485 GHz
Gain:	6dBi
Manufacturer:	Mobile Mark
Model:	OD6-2400
Vertical:	25 degrees
Horizontal:	360 degrees

2. Omni-directional Antenna 2dBi Gain

Frequency:	2.4-2.485 GHz
Gain:	2dBi
Manufacturer:	Modular Mining Systems, Inc.
Model:	303300
Vertical:	70 degrees
Horizontal:	360 degrees

Revision History

Revision	Date	Comments
-------------	December 2006	First issue
A	May 2007	Release