



FullMAX Cobalt-Plus Installation Manual

Version 1.2

June 2017

Warning: Never power on a FullMAX radio without a load on the RF connector.

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.

NOTE: The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

FCC Compliance Statement:

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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must be at **least 180 cm** from the user and must not be co-located or operating in conjunction with any other antenna or transmitter.

The maximum allowable antenna gain for this device is 23.5 dBi and 9.5 dBi at 757.5 MHz and 787.5 MHz respectively

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1 System Overview

FullMAX is a multi-cell, Point-to-Multipoint (PtMP) broadband wireless system based on the IEEE 802.16e (Mobile WiMAX) standard with modifications to enable its operation in a wide range of frequencies below 1 GHz and a wide range of channel sizes. The system is used to establish a private, broadband wireless service for electrical utilities and other mission critical industries. It supports both fixed and mobile applications.

The main characteristics of the FullMAX System include the following:

FullMAX employs TDD framing to provide greater flexibility and to maximize spectrum utilization.

FullMAX is capable of operating in any frequency band between 40 MHz and 958 MHz and in any channel size between 100 KHz and 5 MHz. FullMAX can be configured to operate in a downlink to uplink ratio to support symmetrical, asymmetrical and reverse asymmetrical applications.

The FullMAX system offers the private system operator wide area coverage by leveraging the following:

- High transmit power from both the Base Station and Remote Stations
- Exceptional receiver sensitivity
- Superior propagation due to the operation in narrower channel sizes and low band frequencies

The FullMAX system offers excellent frequency utilization through the following capabilities:

- Adaptive Modulation and Coding per link in both the downlink and uplink
- Optimization of the downlink and uplink ratio for the user's main applications. For example, in the case of SCADA applications, the FullMAX frame is configured as reverse asymmetrical, i.e., more bandwidth is allocated to the uplink than to the downlink.
- Modifications to the standard air interface protocol to minimize MAC layer overhead.
- Employ Band-AMC subcarrier allocation scheme in both uplink and downlink direction to maximize the percentage of data transport subcarriers.
- Packet Header Suppression (PHS) with the following characteristics:
 - Compressible header field values are learned automatically with no need for manual configurations.
 - Support for multiple compressible values for the same header fields. As a result, PHS can be used even when the header fields are not constant.

FullMAX includes a versatile set of Quality of Service (QoS) tools that can optimize traffic performance for each application and prioritize access to the available bandwidth according to the operator's requirements. QoS tools include various scheduling methods (e.g., Best Efforts and Unsolicited Grant Service), service flows with various QoS parameters such as priority level, minimum and maximum traffic rates, guaranteed delay, jitter, etc.

FullMAX provides secure connections with strong encryption (AES-128), strong authentication (EAP after RSA with X.509 certificates) and advanced key management protocol (PKMv2).

FullMAX supports various frequency reuse methods including:

- Traditional full channel based frequency reuse
- OFDMA based Band-AMC sub-channel reuse with up to 6 sub-channels in both uplink and downlink. Any combination of sub-channels can be used in each sector in both downlink and uplink.

FullMAX Remote Stations support a pre-configured channel acquisition plan, i.e., a preconfigured list of channel alternatives, characterized by center frequency, bandwidth, sub-channels and other parameters. During channel acquisition, the Remote Station goes through the list and evaluates the best alternative.

FullMAX has an advanced remote management system that enables the system operator to monitor, configure, manage, detect failures and diagnose problems. The FullMAX system configuration and FullMAX system provisioning support centralized management profiles.

The FullMAX system architecture consists of Base Stations, Fixed Remote Stations and Mobile Stations. Backhaul networking equipment connects the Base Stations to the customer's Network Operations Center (NOC) and the FullMAX Network Management System (NMS).

FullMAX Base Stations are typically installed in the existing Private Land Mobile Radio (PLMR) towers serving their respective cells.

The FullMAX Base Station is designed as a single sector device. Any number of sectors can be designed per tower, however the most common configuration is a three sector design with a Base Station unit per sector.

The sector configuration dictates the type of antenna that should be used. Typically a router is used at the tower to connect all Base Stations to the NOC via backhaul facilities. FullMAX Fixed Remote and Mobile Stations are deployed throughout the tower's serving area.

2 Physical Installation

2.1 Introduction

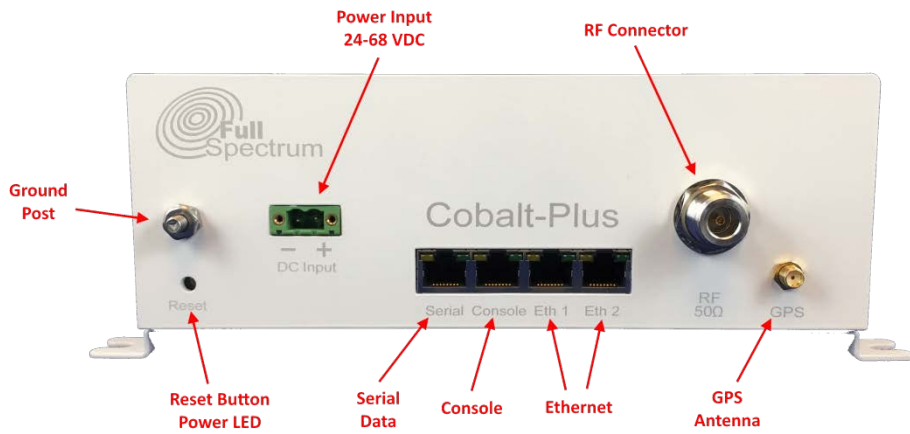
A FullMAX Cobalt-Plus Remote Station is comprised of software and hardware which is packaged in an indoor enclosure.

2.2 Cobalt-Plus Enclosure

2.2.1 Specifications

Enclosure Material	Aluminum Alloy
Dimensions (W x D x H)	8.5" x 4.85" x 2.95" (216mm x 123mm x 75mm)
Operating Temperature	-40° F to 158° F (-40° C to 70° C)
DC Input Power Range	24 to 68 VDC
Power Consumption	No load : 13.1 watts @ 48 VDC Peak load : 23.4 watts @ 48 VDC

2.2.2 Product Overview

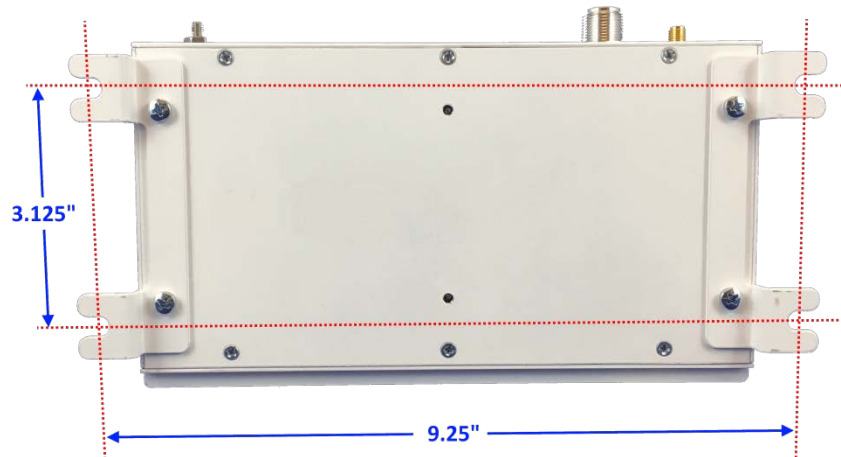


2.2.3 Connection Descriptions

Connector	Application
GPS Antenna	SMA female connector for optional GPS antenna.
RF Out	50Ω N-Type female connector for RF input from antenna
DC Input	DC power input 24-68 volts. Warning: Ensure Correct Polarity
Ethernet	2 x RJ45 connector for Ethernet 10/100 Base-T interface
Console (Serial)	RJ45 8-pin connector wired using the Cisco interface specification for console access
Serial Data	RJ45 8-pin connector wired using the Cisco interface specification for serial data
Ground Post	Connection to building ground

2.2.4 Mounting Guidelines

- A mounting bracket is provided for attaching the Cobalt-Plus enclosure to a vertical flat surface.



3 Operation and Configuration CLI Instructions

CLI show command		
show ms bsid	it should display the mac address of the BS.	cross checked with HW addr in BS.
show ms version	it should display the mac and phy load currently used. HW version, mac FW and phy FW version given in the msconfig should be displayed.	phy and mac load is fine. Others needs clarification
show ms ipconfig	ip configurations set in the msconfig should be displayed irrespective of STATIC_IP_CONFIG enabled or disabled in the config file.	cross checked with config file
show ms sysconfig	it should display all the configurations in the ms config file except for ip config.	cross checked with config file
show ms radioconfig	it should display radio configurations set in the ms config file.	cross checked with config file
show ms scanconfig	it should display scan configurations set in the ms config file.	cross checked with config file and changes are reflected upon soft reboot.
show ms phyconfig	it should display phy configurations set in the ms config file.	cross checked with config file
show ms state	it should display the current state of the MS. When NE is happened MS_OPERATION and DCD_UCD acquired state is verified. When BS is switched off it shows DCD_UCD acquired.	MS_OPERATION and DCD_UCD acquired state is verified.
show ms capabilities	it should display all the basic capabilities supported by the MS.	
show ms con statistics	upon giving this command consecutively the number of sdus in and out should keep increasing when the NE is successful.	
show ms dcd	it should display the dcd configurations set in the ucddcd config file for BS EIRP, EIRxPirmax, TTG, RTG, BSID.	BSID needs to be clarified
show ms info		clarified ms state, ms mac addr, ms ip addr, ms peer addr others needs to be clarified.
show ms l1if statistics	it should display all the l1if statistics like number of DL Burst received from l1if, UL burst sent to l1if.	
show ms memory statistics	it should display maximum buffer available, used and freed and also number of enqueued, dequeued, totally available and free msgs in a msg queue.	
show ms rf statistics	it should display rf antenna statistics.	
show ms sdu pool statistics	it should display maximum sdu nodes available, used and freed	
show ms sinfo	it should display informations of each service flows like: phs rule supporting a SF, cid of a SF	
show ms statistics	it should display the number of sdus received, sent, dropped, memory allocated, errors occurred in the system.	
show ms timer statistics	it should display the numbers of timers created, started, deleted, expired.	
show ms ucd	it should display ucd configurations :number of init ranging codes, periodic ranging codes, BW ranging codes, HO ranging codes from the UCDDCD config file.	cross checked with config file
show ms measurement report	it should display CINR, Rx Gain, RSSI, fec code used values.	
show ms ulmap burst <count>		
show ms ulmap error <count>		
show ms ulmap rcvd <count>		
show ms csm statistics		
show ms timing		
show ms transmitted packet		
show ms trigger metrics		
show ms tx power	it should display MS tx power to the serving BS	
show ms sainfo		
show ms dlmap error <count>		
show ms dlmap rcvd <count>		
show ms decoded burst <count>		
show ms encoded burst <count>		
show ms received packet <count>		

Config CLI command

CLI Command	Description	Parameter range	How To Verify
config ms profile dl symbols <numOfSymbols>	Used to configure dl symbols	19 to 169	show ms phyconfig & show ms sysconfig
config ms profile ul symbols <numOfSymbols>	Used to configure ul symbols	19 to 169	show ms phyconfig & show ms sysconfig
config ms profile frame duration code	Used to configure frame duration by setting a value which corresponds to certain frame duration	7 (fixed value)	show ms phyconfig & show ms sysconfig
config ms profile channel bw <kHz>	Used to set channel bandwidth	500 to 1000	show ms phyconfig & show ms sysconfig
config ms profile dl zone	Used to set number of DL zones	1	show ms phyconfig & show ms sysconfig
config ms radio antenna <num>	Used to configure number of radio antenna used	1 to 3	show ms phyconfig & show ms sysconfig
config ms radio agc enable	Used to set automatic gain control	1	show ms radioconfig & show ms sysconfig
config ms radio agc disable	Used to reset automatic gain control	0	show ms radioconfig & show ms sysconfig
config ms radio rxgain <gainIndB>	Used to set receiver gain level	0-78	show ms radioconfig & show ms sysconfig
config ms radio txpcmode open	Used to set transmission power control to open loop mode	4	show ms measurement report
config ms radio txpcmode closed	Used to set transmission power control to closed mode	1	show ms measurement report
config ms radio txpcmode fixed	Used to set transmission power control to disabled mode	0	show ms measurement report
config ms radio maxtxpower <pwrlndB>	Used to set maximum transmission power level	-45 to 43 db	show ms radioconfig & show ms sysconfig
config ms radio mintxpower <pwrlndB>	Used to set minimum transmission power level	-45 to 43 db	show ms radioconfig & show ms sysconfig
config ms radio filterfile <filename>	Used to set filter characteristics		show ms sysconfig
config ms radio samplingclock	Used to set samplingClock; if ChannelBW=500 & samplingClock=0, then samplingClock=560; else if ChannelBW=1000 & samplingClock=0, then samplingClock=1120	0 or 1120 khz	show ms radioconfig & show ms sysconfig
config ms scan numbands <numbands>	Used to set the number of bands to be scanned	1 to 8	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> bandid <bandid>	Used to set the band number & corresponding band ID to be scanned	BandNo:1-8; BandId:0-7	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> bandrowstatus <0/1>	Used to set the band number & corresponding band status to be scanned	BandNo:1-8; Bandrowstatus:0/1	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> frequency <freqinkHz>	Used to set the band number & corresponding frequency to be scanned	BandNo:1-8; Frequency:600000-800000	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> preamble <preambleId>	Used to set the band number & corresponding preamble to be scanned	BandNo:1-8; Preamble:0-113	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> sectorid <sectorId>	Used to set the band number & corresponding sector ID to be scanned	BandNo:1-8; SectorId:0-3	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> cellid <cellId>	Used to set the band number & corresponding cell ID to be scanned	BandNo:1-8; CellId:0-31	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> dlamcbm <dLAmcBitmap>	Used to set the band number & corresponding DL AMC Bitmap to be scanned	BandNo:1-8; DL AMC Bitmap:0-63	show ms scanconfig & show ms sysconfig
config ms scan band <bandno> ulamcbm <uLAmcBitmap>	Used to set the band number & corresponding UL AMC Bitmap to be scanned	BandNo:1-8; UL AMC Bitmap:0-63	show ms scanconfig & show ms sysconfig
config ms phy tx power max bpsk <db>	Used to set max transmission power for BPSK modulation scheme	-39 to +43	show ms phyconfig & show ms sysconfig
config ms phy tx power max qpsk <db>	Used to set max transmission power for QPSK modulation scheme	-39 to +43	show ms phyconfig & show ms sysconfig

Config CLI command			
CLI Command	Description	Parameter range	How To Verify
config ms phy tx power max 16qam <db>	Used to set max transmission power for 16QAM modulation scheme	-39 to +43	show ms phyconfig & show ms sysconfig
config ms phy tx power max 64qam <db>	Used to set max transmission power for 64QAM modulation scheme	-39 to +43	show ms phyconfig & show ms sysconfig
config ms phy fixed timing adjust	Used to enable or disable fixed timing	0/1	show ms phyconfig & show ms sysconfig
config ms phy initial timing adjust	Used to set initial timing of the MS to the amount of internal fixed delay	0 to 65535	show ms sysconfig
config ms phy gps enable <1/0>	Used to enable or disable gps	0/1	show ms phyconfig & show ms sysconfig
config ms phy gps delay	Used to set gps delay	0 to 1024	show ms phyconfig & show ms sysconfig
config ms mac max fec dl <fec>	Used to indicate the maximum DL modulation that can be configured	0 to 6 where: 0->QPSK Convolutional Code1/2; 1->QPSK CC3/4; 2->QAM16 CC1/2; 3->QAM16 CC3/4; 4->QAM64 CC1/2; (3 & 4 Same); 5->QAM64 CC2/3; 6->QAM64 CC3/4	show ms sysconfig
config ms mac max fec ul <fec>	Used to indicate the maximum UL modulation that can be configured	0 to 6 (Same as above)	show ms sysconfig
config ms mac arq enable <1/0>	Used to enable or disable ARQ	0/1	show ms sysconfig
config ms mac auth type <noauth=0/rsa=1/eap-ttls+chapv0=2/eap-ttls+mschapv2=3>	Used to set authentication type	0 to 3	show ms sysconfig
config ms mac encryption enable <1/0>	Used to enable or disable Encryption	0/1	show ms sysconfig
config ms system timers lost dlmap intvl <ms>	Used to set the timer with lost DL Map interval in ms. Waits for such time before MS moves to next band.	200 to 655000	show ms sysconfig
config ms system timers lost ulmap intvl <ms>	Used to set the timer with lost UL Map interval in ms. Waits for such time before MS moves to next band.	200 to 655000	show ms sysconfig
config ms system timers dcd timeout <ms>	Used to set the timer with DCD timeout value	500 to 50000	show ms sysconfig
config ms system timers ucd timeout <ms>	Used to set the timer with UCD timeout value	500 to 50000	show ms sysconfig
config ms system timers broadcast ranging timeout	Used to set T2 timeout	30 to 6000	show ms sysconfig
config ms system timers t3 timeout <ms>	Used to set T3 RNG-RSP timeout	30 to 200	show ms sysconfig
config ms system timers periodic ranging timer <s>	Used to set T4 Periodic ranging timer	500 to 60000	show ms sysconfig
config ms system timers t6 timeout	Used to set T6 REG-RSP timeout	30 to 6000	show ms sysconfig
config ms system timers t7 timeout	Used to set T7 DSX-RSP timeout	30 to 2000	show ms sysconfig
config ms system timers t8 timeout	Used to set T8 DSX-ACK timeout	30 to 1000	show ms sysconfig
config ms system timers t10 timeout	Used to set T10 DSX transaction timeout	30 to 6000	show ms sysconfig
config ms system timers t14 timeout	Used to set T14 DSX RVD timeout	30 to 2000	show ms sysconfig
config ms system timers t18 timeout	Used to set T18 SBC-RSP timeout	30 to 2000	show ms sysconfig
config ms system timers t42 timeout	Used to set T42 MOB-HO-IND timeout	30 to 2000	show ms sysconfig
config ms system timers t43 timeout	Used to set T43 MOB-SLP-RSP timeout	30 to 2000	show ms sysconfig
config ms system timers t44 timeout	Used to set T44 MOB-SCN-RSP timeout	30 to 2000	show ms sysconfig
config ms system timers t45 timeout	Used to set T45 DREG CMD Timeout	30 to 500	show ms sysconfig
config ms system timers traffic monitoring timeout <s>	Used to set traffic monitoring timeout of the frames. If idle mode is enabled, MS triggers idle mode entry after this amount of idle time.	30 to 3000000	show ms sysconfig

