CM1

COMTECH MOBILE DATACOM CORPORATION

Comtech Messaging System (CMS)
MTM-203 Transceiver Module
End User Manual

Document Version:	B
Document Number:	CMDC-DOC-0138
Author:	Kerry Keksz
Date:	November 1, 2006
Privilege Level:	Customer
Transceiver Host Firmware:	3.4T
Transceiver DSP Firmware:	Altera 0.227

CM1

REVISION HISTORY

Revision Date	Revision	By Whom	Description of the Changes
11/1/06	**B**	**Lajuana Johnson**	**Modified page 34 the Regulatory Compliance section of the document to include regulatory information as required by the FCC.**

CM1

Notices

Throughout this manual, a user will see: **WARNINGS**, **CAUTIONS**, **NOTES**, and **TIPS**.

WARNINGS are for procedures that, if not followed, may result in personal injury or death.

CAUTIONS are for procedures that, if not followed, may result in hardware or software damage or failure.

NOTES are included to provide the operator with additional information intended to simplify a step or entire procedure.

TIPS are included for the operator detailing useful information about using the equipment and software.

CM1

Safety steps to follow if someone is the victim of electrical shock

1. Do not try to pull or grab the individual.

2. If possible, turn off the electrical power.

3. If you cannot turn off the electrical power, pull, push or lift the person to safety using a dry wooden pole, or dry rope or some other insulated material, send for help as soon as possible.

4. After the injured person is free of contact with the source of electrical shock, move the person a short distance away and immediately render first aid, as applicable.

WARNING: If nuclear, biological, or chemical (NBC) exposure is suspected, all air filter media will be handled by personnel wearing full NBC protective equipment.

CM1

Table of Contents

CM1

CM1

1. About this Manual

1.1. Purpose of this Section

The purpose of this section is to introduce the user to the terminology and layout of this manual.

1.2. Intent of this Document

This document is intended for users who are seeking a general overview of Comtech's transceivers. This document provides a general introduction and understanding of:

- transceiver functions
- transceiver integration and connectivity
- transceiver diagnostics
- common errors and troubleshooting

Comtech's transceivers support multiple privilege levels. This document is intended for users with "Customer" level access to a transceiver.

1.3. Terminology Clarification

Throughout this document the term "transceiver" refers to the MTM-203 transceiver (satellite antenna). The term "Agent" refers to the program that allows users to connect to the terrestrial component of the Comtech network.

1.4. Conventions Used in this Document

To distinguish between API commands entered by a user or application and various API outputs. This document uses two different font formats.

`Commands`	All interface commands are in `10 Point Black Bold Courier Font`. Commands are case sensitive. All commands must be entered in lower case.
Responses	All interface responses and outputs are in 10 Point Blue Verdana Font.

1.5. Description of Document Contents

This document is organized into functional sections described in Table 1. Some sections of the document are targeted for users who know very little about the Comtech network, other sections are for more experienced users who are interested in configuring the MTM-203 transceiver.

CM1

Table 1: Document Structure

Section #	Description	Target Audience
Chapter 2: Introduction to the Comtech Network	This section provides a brief overview of the Comtech network, and introduces the reader to the major components of the network.	Users who are unfamiliar with the Comtech Network.
Chapter 3: Integrating the MTM203 into a Device Appendix A: Specifications and Appendix B: Mechanical Description	These sections provide an understanding of the transceiver interface and how to physically integrate the transceiver into a device. Appendix A and B include specifications and mechanical drawings that detail the transceiver's physical description.	Users and organizations who intend to build their own cable sets (rather than using cables provided by Comtech) and/or users who are integrating the transceiver into a device for the first time.
Chapter 4: Indicators and Diagnostics	This section describes the LEDs (Light Emitted Devices) and their functions.	Users who want to verify transceiver operations when integrating the transceiver into a device. This section is also used for diagnostics.
Chapter 5: Troubleshooting	This section describes error messages, including "Bad command" message, and describes troubleshooting techniques.	Users who want to understand error messages and troubleshoot problems.
Chapter 6: Customer Solutions	This section provides contact information for Customer Solutions.	Users who are unable to resolve problems after referring to Diagnostics and Troubleshooting sections.

2. Introduction to the Comtech Network

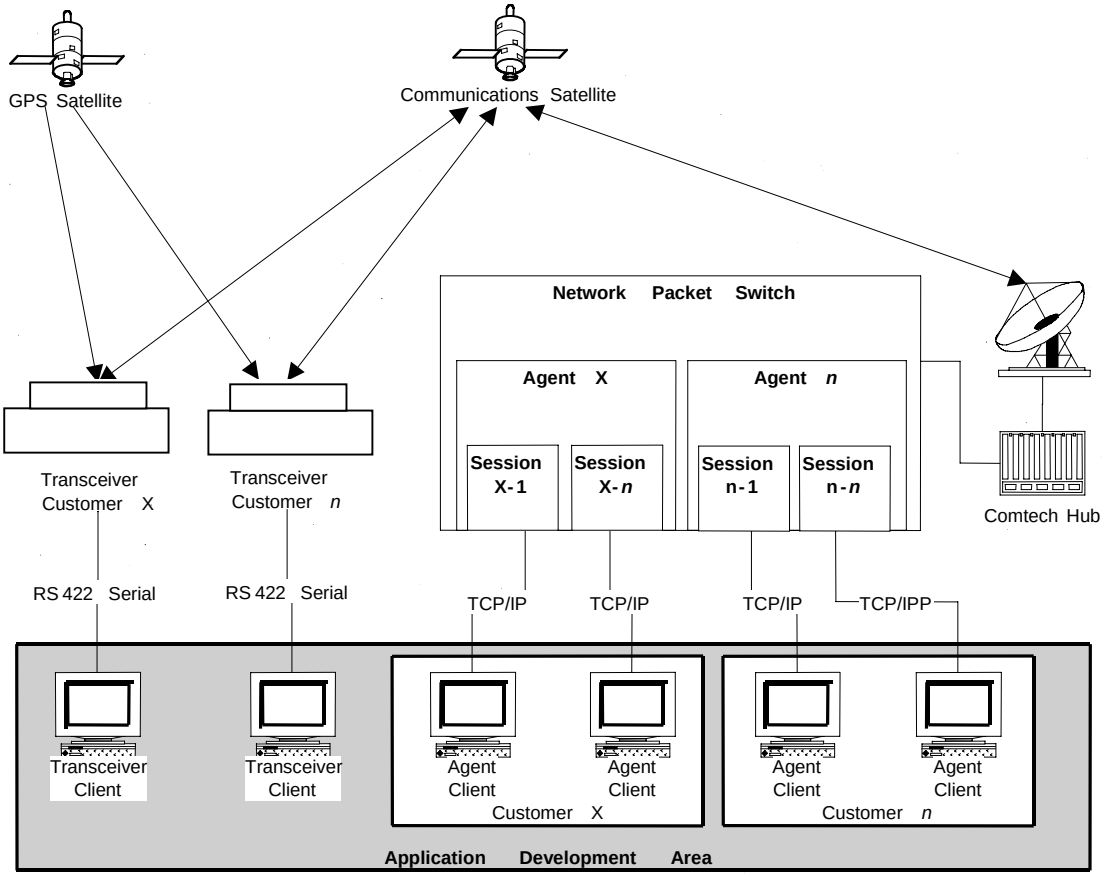
2.1. Purpose of this Section

This section provides a brief overview of the Comtech network, and introduces the major components of the network. The focus of this section is to introduce the Agent and the Transceiver.

2.2. Components of the Network

The following figure illustrates the Comtech Network Architecture and is followed by a description of the network components.

Figure 1: Comtech Network Architecture.



The Comtech Mobile Datacom Network consists of three main components:

- Network Packet Switch
- Hub
- Transceiver

CM1

The Network Packet Switch (or Switch) is a set of ground station computers through which all network traffic is routed. The Switch can support many different types of connections:

- VSAT
- Internet
- Leased line
- Dialup

The Switch's primary function is to handle the routing of network traffic. The Switch has several processes to support this function. Of the processes running on the Switch, the Agent process is the most important process to a customer. An Agent is one of the access points a customer can use to send messages via the CMS. Section 2.3 describes the functions and workings of an Agent in more detail. For security purposes, the Switches, and therefore the Agents, are protected via a firewall.

The Comtech Hub is connected to the Switch. The Hub contains radio frequency (RF) modulation and demodulation equipment. The Hub's primary function is to transform data into a radio frequency signal and a radio frequency signal into data. The Hub takes outgoing TCP/IP packets from the Switch and transforms them into signals that are then transmitted up to the satellite and down to a transceiver. The Hub also takes the incoming signals sent from a transceiver via satellite and transforms them into TCP/IP packets that can be processed by the Switch.

The transceiver is a customer's other access point into the Comtech Network. A transceiver's primary function is to act as an antenna. A transceiver sends and receives messages as directed by the client application that is connected to it. A transceiver also has some on-board processing capabilities that allow it to send messages autonomously. Section 2.4 describes the functions and workings of a transceiver in more detail.

2.3. Agent

An Agent is a process that runs on the Network Packet Switch. An Agent's main function is to manage message traffic for a given customer. Typically, each customer is assigned a separate agent, thereby creating a VPN (Virtual Private Network) for each customer. Customers cannot access each other's Agents, unless the customer instructs Comtech to permit such access.

The Agent performs the following functions to incoming messages:

- Accepts messages from transceiver or client connections
- Decrypts messages
- Delivers messages to their intended recipients

CM1

The Agent performs the following functions to outgoing messages:

- Accepts messages from a client connections
- Encrypts the outgoing messages
- Sends messages through the Comtech network

Customers with specific processing requirements often have applications that connect to the Agent. Each Agent has a process focused on listening on a specific TCP/IP port for incoming client connections. Once an Agent receives an incoming connection, the Agent forks (spawns) a child dedicated to servicing the client. This child process will continue to service the client until the client application closes the TCP/IP connection. An Agent can service up to 64 separate connections.

2.4. Transceiver

The MTM-203 Transceiver is a compact module that can easily be integrated into a device. The transceiver's primary function is to allow users and applications the ability to send and receive messages via satellite. Using the GPS receiver, a transceiver can "piggyback" location information on each message. A transceiver can also transmit its location automatically.

The MTM-203 Transceiver module provides the following features:

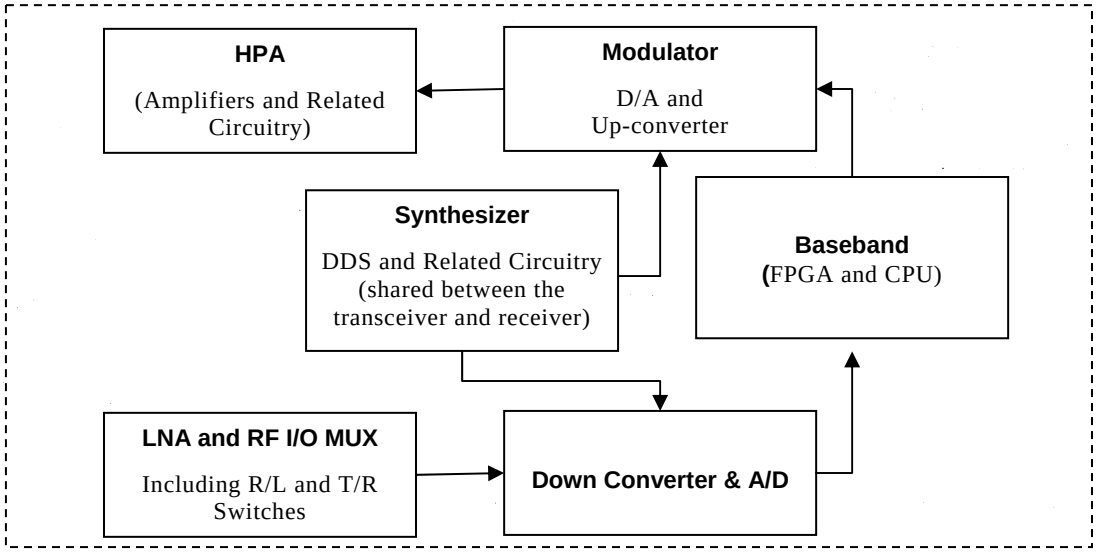
- Small, two-sided board to easily integrate into a device
- Includes a single serial interface, at TTL levels
- Supports API commands using the serial interface
- Contains internal GPS device with capability to connect to an external GPS device. The internal GPS pass-through model provides an RF signal to the external GPS for both L1 and L2 frequencies
- Low power operation to minimize battery consumption and can connect to an external power supply
- Ensures GPS receiver can receive RHCP signal, regardless of communication channel polarization
- Allows for dual polarization antenna use
- Provides overload protection on the receive channel to prevent LNA burn-out for large signals
- Allows for FPGA code loading via an external serial port at rates higher than normal API rates
- Ensures a short power on to operational period, including less than 1 sec FPGA load times

CM1

2.4.1. Transceiver Subsystems

The following figure illustrates the MTM-203 Transceiver subsystems. A description of each subsystem follows.

Figure 2: MTM-203 Block Diagram of Subsystems.



2.4.2. High Power Amplifier (HPA) Subsystem

The HPA subsystem is comprised of amplifiers and converter circuitry to boost signal sufficiently for transmissions.

2.4.3. Modulator Subsystem

The Modulator subsystem processes the signal from the baseband subsystem for amplification by the HPA.

2.4.4. Synthesizer Subsystem

The Synthesizer subsystem provides the timing signals to synchronize the other subsystems.

2.4.5. Baseband Subsystem

The Baseband subsystem is comprised of a Field Programmable Gate Array (FPGA) and Central Processing Unit (CPU), which process the received and transmitted signals.

2.4.6. Low Noise Amplifier (LNA) and R/F I/O Mux Subsystem

The LNA, R/F, and I/O Mux subsystem processes the receive signal for use by the down converter.

CM1

2.4.7. Down Conversion and A/D Subsystem

The down converter and A/D subsystem processes the received signal for use by the baseband.

2.5. Transceiver Operational Considerations

The transceiver enables satellite communications via an external antenna. Therefore, the external antenna must be able to "see" the satellite in order to function properly. The transceiver is designed to operate outdoors with an unobstructed view of the southern sky. Some obstacles that can block the transceiver include tall buildings, tunnels, parking garages, and dense forests. The transceiver may operate inside of a building provided the antenna is positioned in a window with a view of the satellite, and provided the window is not coated with a reflective material.

In addition to large visible obstacles, multi-path interference may hinder a transceiver from receiving optimally. Multi-path interference occurs when multiple signals arrive at an antenna having traversed different paths. Multi-path is due to reflections from objects (surfaces) located near the transceiver. In most cases, moving the transceiver a few feet (sometimes inches) in one direction or another will alleviate the interference caused by multiple signals.

NOTE: Since the communications receiver and the GPS receiver are two separate receivers, each performs (receives its signal) independently. A partition of the front-end receiver is common between the GPS path and the message receiver path. Therefore, it is possible for the antenna to receive messages but not have a valid GPS fix. The reverse is also true.

NOTE: Comtech's transceivers are designed to operate in the United States of America in accordance with Federal Communications Commission (FCC) regulations (authorization pending as of 05/16/06). To operate in the U.S., the MTM-203 transceiver must adhere to FCC regulations regarding mobile radio transmitters which use L-Band. By regulation, a transceiver operating in the U.S. must be configured so that it will not transmit if its receiver is not in lock (locked onto the satellite signal). Therefore, any Comtech transceiver operating in the U.S. is configured not to transmit if the transceiver's receiver is out-of-lock. Transceivers may be configured differently in other countries.

CAUTION: External antennas should not be positioned within six feet of each other. Antennas that are too close together may result in equipment damage.

CAUTION: Do not place equipment directly on wet ground, snow, or ice for operations.

2.6. Client API and Command Set (Agent and Transceiver)

As previously stated, the CMS provides two basic access points, the Agent and the transceiver. Each access point has its own Application Programming Interfaces (APIs). These APIs allow external applications to use the platform as a conduit for application

CM1

message exchange and for other supported functions (such as mobile GPS tracking). The APIs may be engaged directly by users or by application programs.

In the spirit of the traditional client-server model, this document will use the general terms ‘client’ and ‘server’ when referring to components of a Comtech messaging implementation. In this context, a client will generally refer to any external entity that engages an Agent or Transceiver API. This may include any of the following variations:

- A user accessing the API directly (typically via a terminal communications utility such as TELNET).
- A user interface application that bridges between the API and a user.
- An automated application.

The term ‘server’ will generally refer to a specific instance of an Agent or Transceiver API.

The Agent and Transceiver components each provide an API for external clients. Both APIs consist of an interactive command line interpreter (CLI) that is generally activated when a client establishes a connection.

The CLI presents a command prompt and allows the client to issue specific commands to the server process of the respective Agent or Transceiver. The server will generally respond to client commands with action (such as changing a session setting), data output (such as displaying current settings), or both. Certain commands may prompt the client for additional input.

The CLI operates synchronously. It issues a new command prompt only after it completes execution of the previous command. The client must wait for a prompt before submitting subsequent commands (i.e., the CLI does not support type-ahead).

In certain situations, the CLI may present unsolicited information to the client while the client is issuing commands (primarily in the case of message arrival). However, this behavior can be suppressed and/or controlled in most cases.

Interaction between client and API will usually be discussed in the context of a ‘session’. In the case of an Agent, a session is generally defined as the period of the TCP/IP connection between client and Agent. In the case of a Transceiver, a session is best described as the operational period of the transceiver following boot-up.

The session concept implies a period in which the configuration of the Agent or Transceiver (with respect to commands issued by the client) is retained. In the case of an Agent, all session contexts are lost when the TCP/IP connection is broken. In the case of the Transceiver, session context is generally retained as long as the transceiver is continuously operating – whether or not the client is actively engaging the serial interface. (Note: The CMDC concept of session may not necessarily apply to that of a particular client application.)

CM1

3. Integrating the MTM-203 into a Device

3.1. Purpose of this Section

The purpose of this section is to provide guidance for integrating the Comtech Mobile Datacom MTM-203 Transceiver Module into a device. The focus of this section is to describe transceiver integration, including material requirements and a detailed description of the MTM-203 transceiver interface and connectors.

3.2. Needed Materials for Integration

The following materials are needed to integrate the MTM-203 Transceiver Module into a device:

- Antenna, cable, and connectors
- Power supply
- Optional Military GPS Receiver

3.2.1. MTM-203 Interface Requirement

Required Performance Characteristics for Antenna	
Gain	+1dBiC minimum for elevation angles between 20 degrees and 60 degrees
Impedance	50 ohms
Polarization for use in the USA	Right-hand circularly polarized (RHCP). The transceiver can be operated with a single RHCP antenna connected to the RHCP port or a dual pole antenna with both RHCP and LHCP ports connected.
Polarization for use outside the USA	RHCP is required as a minimum. LHCP can be added for additional satellite coverage options.
Connector Type	Cable connectors must be compatible with the type SSMB coaxial connectors on the MTM-203 module antenna ports. Manufacturer and part number used for these parts are AEP p/n 7209-1511-050 (alternate supplier is COAXICOM p/n 6M230SL-1).
Max Loss	Total combined loss for cable and connections should be no more than .5dB at 1.6 GHz
Tx Modulation	BPSK DS-SS
Tx Frequency	1626.5 – 1660.5 MHz
Tx Level	36.9 dBm Max

CM1

Rx Modulation	BPSK DS-SS
Rx Frequency	1525 – 1559 MHz – Communication Channel 1575.42 +/- 13 MHz - GPS L1 1227.60 +/- 13 MHz - GPS L2
Rx Level	-131 dBm
GPS Rx Modulation	BPSK DS-SS
GPS Rx Frequency	1525 – 1559 MHz – Communication Channel 1575.42 +/- 13 MHz - GPS L1 1227.60 +/- 13 MHz - GPS L2
GPS Rx Level	-107 dBm
Approvals	Must pass Comtech System/Network Compliance Approval Process to be fielded outside of test/development environment.

The wire gauge should be 20 AWG for the cable connection to the MTM-203's 24 position control interface connector (P1) (Molex, Part Number 87831-2420).

3.2.2. External Power Supply Requirements

The VBAT input to the MTM-203 Transceiver module must be between 6.5V to 15 VDC.

3.2.3. External GPS Requirements

An external GPS RF 50 ohm, -107 dBM (see Table 4) device may be connected to the MTM-203 transceiver. The cable from the External GPS Input port should have an SSMB connector.

3.3. Physical Interface Description

There are two hardware interface points on the MTM-203 Transceiver Module (Figure 3): the Control Interface and the Antenna Interface.

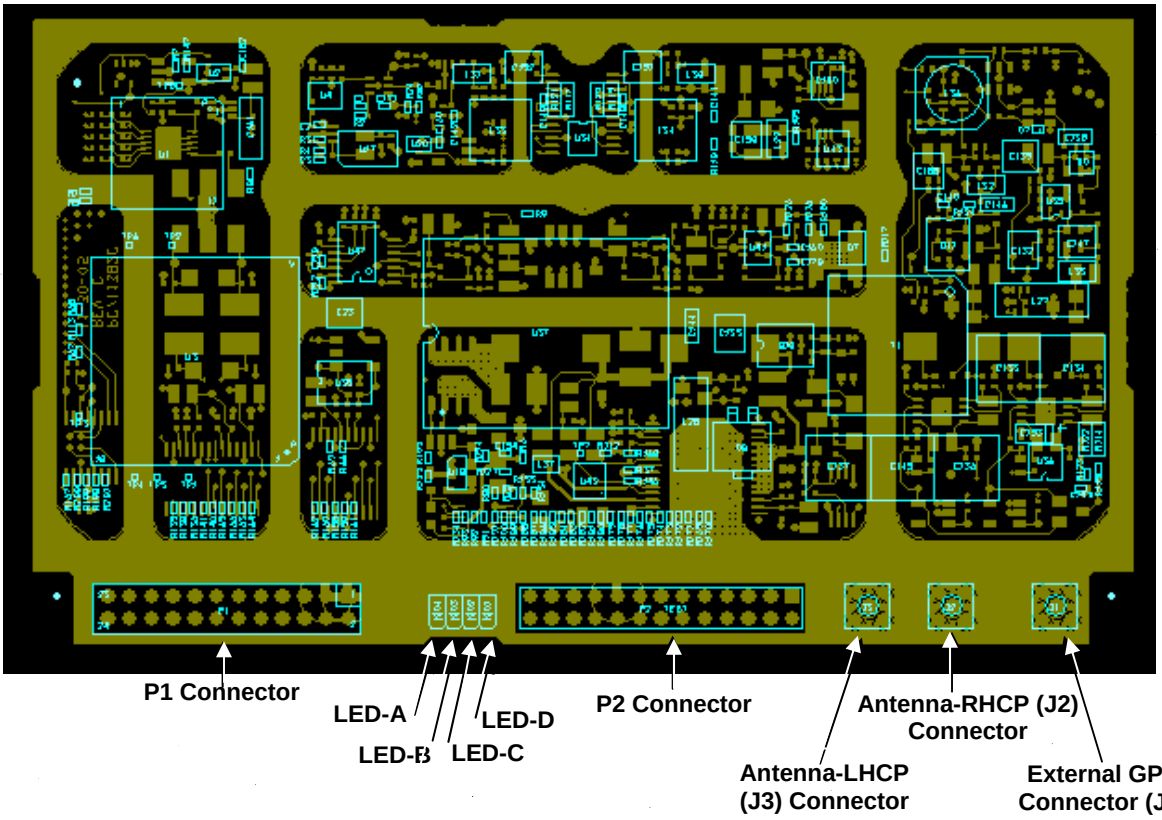
The Control Interface manages the communication between the data source and the transceiver. This interface is also used for loading configuration data and updating the firmware of the module. Power for the MTM-203 Transceiver Module must be provided through this interface.

The antenna interface consists of three coaxial connectors, two of which deliver the received signal from either a left hand (LH) or right hand (RH) circularly polarized (RHCP) antenna to the corresponding low noise amplifier (LNA) circuitry, and the transmit signal from the High Power Amplifier (HPA) to the antenna. Since the module operates only in half-duplex mode, only transmit or receive signal will be present at this interface at any given time. The RF signal from the RHCP antenna is also fed to the on-

board GPS device. The transceiver may be configured to automatically switch from LH to RH (or vice versa) by using the API command to implement worldwide autonomy.

The third coaxial connector is an external GPS input for feeding the RF signal to an external GPS unit.

Figure 3: MTM-203 PC Board showing connectors and LEDs.



3.4. Mounting the Transceiver in a Device

Appendix B provides a mechanical drawing of the MTM-203 module describing mounting holes that should be used to secure the module in a device.

3.5. Connecting to the Transceiver

3.5.1. Control Interface

The Control Interface is implemented in the P1 connector (Molex, Part Number 87831-2420) located on the topside of the MTM-203 module. The following table describes the P1 connector pin-outs and the function of each pin on this connector.

Table 2: P1 Control Interface Pin-outs

Pin-outs	Input/Output (I/O)	Pin Description

CM1

Pin-outs	Input/Output (I/O)	Pin Description
1	N/A	GND
2	Input	VBATT (6.5 – 15 V)
3	N/A	GND
4	Input	VBATT (6.5 – 15 V)
5	Output	LED-C – Flashes during configuration and remains on once the console is configured and ready. D3 LED on the PC board.
6	Output	LED-A – Illuminates while transmitting and illuminates during boot. D1 LED on the PC board.
7	Output	LED-B – Illuminates indicating that the receiver is in lock and High-Level Data Link Control (HDLC) is in-sync when lit. D2 LED on the PC board.
8	Output	AUX_PWR CNTL
9	Input	IGN_SENSE
10	Input	MAIN CNTL (ON/OFF) – Turns module off at .5V. Turns module on at >1.5V. Do not exceed 30V.
11	I/O	User Defined: 0–3 V, 8 mA, max, 3 V logic
12	I/O	User Defined: 0–3 V, 8 mA, max, 3 V logic
13	I/O	User Defined: 0–3 V, 8 mA, max, 3 V logic
14	I/O	User Defined: 0–3 V, 8 mA, max, 3 V logic
15	Input	AUX UART RX IN – Future development
16	Output	AUX UART TX OUT– Future development
17	Input	SER DAT IN – Supports communications using Comtech API commands.
18	Output	SER DAT OUT – Supports communications using Comtech API commands.

CM1

Pin-outs	Input/Output (I/O)	Pin Description
19	Output	3.3 V – Provides debugging. Not recommended for any other use.
20	Output	LED-D – FPGA LED
21	Input	GPS Keep Alive – 1.95-3.6V (40 μA max. at 3.3 V) external power supply to keep the GPS device's real-time clock and backup RAM. Connecting it to the 3.3 V on pin 19 will speed up the fix acquisition of the GPS when using API commands to control power to the internal GPS module. Connect to ground if not used.
22	NC	
23	NC	
24	NCU	

3.5.2. LEDs

Figure 3 illustrates four LEDs: A–D, next to the P1 connector on the top-side of the MTM-203 Transceiver Module. The function of LEDs A-C is also specified in Table 2.

LED-D indicates hardware receive lock from the FPGA. “On” indicates that the FPGA is locked to the received signal. The LED will flicker if the signal is weak and the receiver is reacquiring.

3.5.3. P2 Connector

Figure 3 shows a P2 connector between the LEDs and the antenna interface connectors. The P2 connector was only available during development and is now disabled.

3.5.4. Antenna Interface

The antenna interface on the MTM-203 Transceiver consists of three coaxial connectors: two connectors for an external antenna and a third connector for an external GPS module.

Antenna-LHCP (J3)

Connector J3 feeds the LHCP LNA circuitry when in receive mode and connects to the LHCP HPA circuitry when the transceiver is in transmit mode.

Antenna-RHCP (J2)

Connector J2 feeds the RHCP LNA circuitry in the receive mode and connects to the RHCP HPA circuitry when the transceiver is in transmit mode. The RHCP LNA also feeds the internal GPS module as well as the J1 connector.

CM1

The following table describes the electrical characteristics of the signal in transmit (TX) and receive (RX) directions.

CM1

Table 3: Antenna LHCP and RHCP TX and RX Signal Characteristics

Signal Characteristic	Transmit (TX)	Receive (RX)
Modulation	BPSK DS-SS	BPSK DS-SS
Frequency	1626.5 – 1660.5 MHz	1525 – 1559 MHz – Communication Channel 1575.42 +/- 13 MHz - GPS L1 1227.60 +/- 13 MHz - GPS L2
Level	36.9 dBm Max	-131 dBm

3.5.5. External GPS Connector

The third coaxial connector, J1, feeds the GPS signal to an external GPS module. The signal output from this connector is **only available when the unit is in the receive mode.** The following table describes the electrical characteristics of the signal for this connector.

Table 4: External GPS Rx Signal Characteristics

Signal Characteristics	Receive
Modulation	BPSK DS-SS
Frequency	1525 – 1559 MHz – Communication Channel 1575.42 +/- 13 MHz - GPS L1 1227.60 +/- 13 MHz - GPS L2
Level	-107 dBm

3.6. Booting-up the Transceiver

When applying power to the MTM-203 module, or on system reboot, the transceiver module will go through a standard boot sequence. Boot-up will last a minimum of five seconds, but may take longer depending on the boot time-out setting.

The command to reboot the transceiver module is **`reboot`**. The following table describes the various trace statements that display upon boot up.

Table 5: Boot Trace Description

Line #	Boot Trace Statement	Explanation
1	Default boot	Displays type of boot: default, cold, or warm.
2	CMDC GEN2 Terminal	Displays type of CMDC transceiver
3	Power On Self Test: Passed	Indicates a self test was performed, which includes a test of the FPGA, RX PLL, TX PLL, GPS, Temperature, and Battery. If a Self Test failed, the response would show which systems passed and which systems failed. Example Failed Self Test: > **reboot** Reboot in progress.... Default boot - Watchdog reset CMDC GEN2 Terminal Power On Self Test: 0x20 FPGA: Passed RX PLL: Passed TX PLL: Passed GPS: Passed TEMPERATURE: Passed BATTERY: Failed Code: 0x2 ID ok.
4	ID ok.	Indicates that the transceiver module has been provisioned with a permanent identity. If this line does not state “ID ok,” the transceiver has not been provisioned correctly.
5	> > >	Displays command prompts indicating system is booting up.
6	>api reset	Sets the transceiver to interactive mode with the echo on (display commands). This mode saves a user from typing the entire commands. As the user types in the first few characters of a

CM1

Line #	Boot Trace Statement	Explanation
		command, the transceiver will attempt to interpret the characters and then prompt the user with a known command.
7	> show version?	Indicates that what follows are system software versions.
8	Boot 2.2.E	Indicates version of the boot loader the transceiver is running.
9	Host 3.4.T	Indicates version of the Host application that is running.
10	ALTERA 0.227	Indicates version of the FPGA application that is running.
11	RTOS 2.70	Indicates version of the receiver operating system that is running.
12	>	Displays the command prompt.

3.7. Provisioning

CMDC ships all transceivers fully provisioned. Provisioning establishes the profile of configuration commands inherent to the transceiver as to its operation within the Agent. These configuration settings also adhere to specific requests from the customer as to the behavior of the transceivers interfacing with their software.

CM1

4. Indicators and Diagnostics

4.1. Purpose of this Section

The purpose of this section is to provide basic diagnostics to integrate the MTM-203 into a device. The focus of this section describes how to use the LEDs to interpret transceiver activity and verify system operations.

4.2. Using LEDs

There are three Light Emitting Diodes (LEDs) on the top side of the transceiver between the P1 and P2 connectors (see Figure 3). Each LED represents a transceiver state.

4.2.1. LED A

LED A represents the status of the transmitter. When LED A is on (flickers), the transceiver is transmitting. When LED A is off (not illuminated), the transceiver is not transmitting. Upon each transmission, LED A will turn on for a few milliseconds.

4.2.2. LED B

LED B represents the status of the receiver. When LED B is on solidly (not flickering), the receiver is in-lock. When LED B is on, but the light is flickering, the receiver is out-of-lock. Since the transceiver is half-duplex, upon each transmission, the LED will turn off for a few milliseconds, indicating the receiver is momentarily out-of-lock.

4.2.3. LED C

LED C represents the status of the console or the interface. When LED C is on, the transceiver's interface is available. If LED C is off continuously, the transceiver's interface is unavailable and generally indicates a buffer overflow.

4.2.4. Interpreting LEDs during Boot-Up

If the LEDs are operating in the **`led normal`** state, during boot up, the LEDs will cycle a number of times in what appears to be a random order. Although the process appears random, the LEDs are actually showing the boot up process of the firmware in the transceiver. If none of the LEDs are illuminating at boot up, the LEDs may be in the **`led blackout`** state. If the LEDs are supposed to be in the **`led normal`** state, check the cables you are using, the transceiver is likely not getting adequate power.

4.3. Displaying Receiver Lock Status

The transceiver's interface can be configured to display status of the receiver, (e.g., the receiver is in- or out-of-lock with the satellite). The command **`show receiver status`** queries the receiver one time to determine if it is in-lock or out-of-lock. The transceiver will respond with:

Receiver not in lock	Indicates that receiver does not have a proper link to the satellite.
Receiver in lock	Indicates that receiver has a proper link to the satellite.

Rather than a one-time query, the operator may want to be alerted of changes in real-time. The command **`alert receiver lock`** will instruct the transceiver to display statements each time the receiver changes lock states. The command to stop the transceiver from displaying the status of the receiver is **`ignore receiver lock`**.

If the receiver is not in-lock, the operator should attempt to move the receiver to a better position. The parameter to alert or ignore the receiver status is managed by the Host processor. To make this parameter available after reboot, the client should issue the **`save configuration`** command.

4.4. Measuring Signal to Background Noise

The **`measure cno`** command performs a signal (carrier) to noise ratio (C/No) measurement or measurement of the signal to background noise, using a pilot signal from the satellite. For this measurement to work, the frequency of the pilot for the proper satellite and beam must be set in the transceiver.

4.5. Interpreting Signal to Noise Measurement

The command **`measure cno`** prompts the user for a Repeat Count. The repeat count indicates the number of C/No measurements the user wishes to execute. A repeat count of three or more is recommended. The output of the command will look similar to the following:

```
Measuring C/No at 1556060 kHz, please wait...
Frequency = -1812 Hz
Power = 2.78 dB
C/No = 33.88 dB-Hz
```

The first line of the output shows which C/No frequency the transceiver is using to measure. Three measurements follow: Frequency, Power, and C/No. Frequency should be close to 10,000 Hz (+/- 400 Hz). Carrier power is the second measurement. The third and final measurement is the C/No. A result of greater than 40 dB-Hz indicates the transceiver is performing as expected.

5. Troubleshooting

5.1. Purpose of this Section

The purpose of this section is to provide guidance with troubleshooting problems when integrating the MTM-203 transceiver. The focus of this section is to describe common error messages and how to systematically verify settings to resolve problems.

5.2. Error Messages

The transceiver will display an error message if an incorrect command has been entered. An incorrect command is usually a command in which the syntax was wrong or incomplete. When the transceiver is in API interactive mode and it receives an incomplete command, it responds with the following message:

```
Unrecognized command
```

When the transceiver is in API line mode and it receives an incorrect command, it provides a standard response in two parts. The first part is the text string “Bad Cmd” and the second part is the hex equivalent of the characters of the command that the client attempted to issue.

Example: While in API line mode, the user wants to see a transceiver’s identities. Rather than issuing the show identities command, the user submits the string “show id”. The transceiver responds with the following message:

```
Bad Cmd: "73 68 6F 77 20 69 64"
```

The following table describes common transceiver error messages.

Table 6: Error messages

Error Message	Source of Error
Can't transmit: Receiver not in lock.	The transceiver is out of lock and the transceiver is only permitted to transmit when the receiver is in lock.
SEND FAILED: Bad or missing TO.	The active DSP set does not have a "Default to" or "Default from" set.

5.3. Troubleshooting the MTM-203

To troubleshoot the MTM-203 Transceiver Module, follow the steps below as applicable until the transceiver is corrected or you confirm proper functionality.

1. Verify frequency and receiver lock status.
    a. Open **Hyperterminal**. Click **Start / Programs / Accessories /**

Communications / Hyperterminal.

b. Select **ComPort**.

c. Type **`show receiver status`** and press **Enter**.

d. Verify status for "Receiver in lock".

e. If receiver is not-in-lock, type **`list settings`**.
The following is an example response.

```
> list settings?
1: Tx 1633585/84375/32 I-R, Rx 1532085/84375/32 I-R, 50, To: 1 (BFIELD), From: 3 (TEST-016)
1: Tx 1633585/84375/32 I-R, Rx 1532085/84375/32 I-R, 50, [Active], To: 1 (BFIELD), From: 3 (TEST-016)
2 is available.
>
```

f. Verify the frequency you are using is active.
Note: The last setting displayed in the above example is your active frequency, "Settings Number: 1".

g. If your frequency is not "Active", type **`edit dsp settings`** and press **Enter**.

h. Type **`load dsp settings`** and press **Enter**.

i. Type the Setting Number that corresponds to desired frequency and press **Enter**.

The following is an example response indicating the configuration is loaded.

```
Loaded DSP configuration 1.
```

j. Type **`activate dsp settings`** and press **Enter**.

k. Type **`save configuration`** and press **Enter**.

l. Type **`reboot`** and press **Enter** to reboot the transceiver.

CM1

2. If the frequency setting was correct and/or the receiver showed not-in-lock, follow these steps.

   a. Open **Hyperterminal**. Click **Start / Programs / Accessories / Communications / Hyperterminal**.

   b. Type **`start demod reporting`** and press **Enter**.
   A response displays asking "Interval?" The "Interval" is a parameter that indicates the interval (in seconds) that the demod statistics are displayed.

   c. Type **`5`** to indicate second intervals.

   d. Allow demod reporting to run for about one minute.
   The following is an example demod report set for 5 second intervals.

```
5 sec, Eb/No 7.9 dB Quality 193, Frequency Offset  330
5 sec, Eb/No 7.8 dB Quality 193, Frequency Offset  330
5 sec, Eb/No 8.1 dB Quality 193, Frequency Offset  330
5 sec, Eb/No 7.7 dB Quality 193, Frequency Offset  330
5 sec, Eb/No 8.0 dB Quality 180, Frequency Offset -330
5 sec, Eb/No 7.9 dB Quality 195, Frequency Offset  330
5 sec, Eb/No 0.8 dB Quality  64, Frequency Offset  330
```

   e. Type **`stop demod reporting`** and press **Enter**.

   f. If an E_b/N_0 less than 4.0 is displayed, check the placement of the antenna. Is something obstructing the view of the southern sky? If so, move the obstruction or the antenna.

CM1

3. For confirmation of settings, proceed as follows:

   a. Type **`show dsp settings`** and press **Enter**.
   A list of settings displays. The following is an example display of DSP settings.

```
> show dsp settings?
Config Number: 1
Receive Frequency: 1532085000
Receive Chip Rate: 84375
Receive Spread Ratio: 32
Transmit Frequency: 1633585000
Transmit Chip Rate: 84375
Transmit Spread Ratio: 32
Transmit Acquisition Period: 256
Transmit Acquisition Repeats: 1
Transmit Gain: 100
Transmit Auth: 000000
Default From: TEST-016
Default To: BFIELD
C/N0 Frequency: 1556060000
Active VCTCXO: -990
In-Lock Threshold: 30
Out-Lock Threshold: 20
Retry count 4, interval 20
Repeat count 1, interval 5
Repetitions: 1
Freewheel: 180
Scan Dwell: 4000
Config Flags: 000305
Number: 1, Search Step: 40, Search Dwell: 0
Manual Tuning
Lock to Strongest with Acquisition.
Stored VCTCXO: -442
>
```

   b. Verify settings are correct.

6. Customer Support Contact Information

If you have questions concerning this document, please contact CMDC's Customer Support line at 1-888-428-2101 or send an email to **cservice@comtechmobile.com**.

CM1

7. Warranty

Comtech Mobile Datacom Corporation is obligated, under the provisions of the Warranty for items delivered pursuant to specific contracts, to repair or replace or otherwise provide a remedy for warranted items only if damage or loss results from or is caused by the warranted item. Comtech is not obligated to provide repair, replacement or other remedies in the event that damage or loss is the result of or is caused by actions or events other than the warranted item, to include such causes as (1) misuse or abuse of the item beyond the use contemplated in the Specification; (2) accidental damage. To include aircraft crashes; (3) combat damage; (4) natural disasters, to include flood, earthquake, hurricane, tornado; and (5) fires or explosions not originating on or within the warranted item.

CM1

Appendix A – Specifications

Power Specifications

Power Parameters	Specification	Maximum Current
VBATT input	6.5 – 15 VDC	2.5 Amp Maximum

Environmental / Mechanical Specifications

Environmental / Mechanical Parameters	Specification
Operating Temperature	-40 – 71°C
Storage Temperature	-50 – 85 °C

Input/Output (I/O) Specifications

I/O Parameter	Voltage	Max Current	Signaling	Comment
Serial Tx	0–3 V		3 V logic	
Serial Rx	0–3 V		3 V logic	
Serial ground	0 V			
RF-A (RHCP)	50 ohm load			Max Tx – 4 W Max noise figure – 2.0 dB
RF-B (LHCP)	5 ohm load			Max Tx – 4 W Max noise figure – 2.0 dB
Digital I/O-1	0–3 V	8 mA, max	3 V logic	General purpose I/O
Digital I/O-2	0–3 V	8 mA, max	3 V logic	General purpose I/O
Digital I/O-3	0–3 V	8 mA, max	3 V logic	General purpose I/O
Digital I/O-4	0–3 V	8 mA, max	3 V logic	General purpose I/O
Shutdown	0–5 V		High=shutdown	5 V tolerant input

CM1

I/O Parameter	Voltage	Max Current	Signaling	Comment
Ignition Sense	0-3 V		0 V= ignition on[1]	
LED-A	0-3 V	5 mA, max	3 V = on	LED – "Transmit On" while transmitting. Also lights during boot. D1 LED on the PC Board.
LED-B	0-3 V	5 mA, max	3 V = on	LED – "Receive Lock" Software debounced, receive in lock and HDLC in-sync when lit. D2 LED on the PC Board.
LED-C	0-3 V	5 mA, max	3 V = on	LED – Console status flashes during configuration and then stays on permanently once configured and ready. D3 LED on the PC Board
GPS RF	50 ohm	TBD		External GPS

Satellite Channel Specifications

Channel Parameters	Return Link		Forward Link	Comment
	KHz from Center Frequency	**dB Relative to Carrier**		

[1] This signal is intended to be used with an inverting opto-isolator to monitor a vehicle ignition sense signal.

CM1

Channel Parameters	Return Link		Forward Link	Comment
Transmit phase noise	0.3	-43.0		Based on a 10° peak phase noise value (6.5 degree average)
	1.0	-54.0		
	10.0	-74.0		
	100.0	-94.0		
Transmit out-of band	1525.0 and below	-85		FCC part 25 & ETSI EN301-681 v01.03.02v Specification
Other emissions	FCC Part 15 & 25, ETSI EN301-681 v01.03.02v			FCC & ETSI specification

Regulatory Compliance

The MTM-203 Transceiver Module has been designed to meet the following FCC and ETSI compliance standards:

- FCC Part 15 and 25
- ETSI EN301-681 v01.03.02v Specification
- SAJ1113-13, 1455-4.1, 4.9, 4.10, 4.10.3.1
- MIL-STD 810F – High Temp/Low Temp Operation and Storage, Resonance Survey, Sine-on-Random Vibration, Functional Shock, Crash Hazard Shock, Bench Handling Shock, Humidity, Temperature Shock, Non-Operational Low Pressure, Transit Drop Shock

This device has been tested for compliance and certified under FCC Part 25. Any changes or modifications to the unit not expressly approved by Comtech Mobile Datacom may void the user's authority to operate the equipment.

Antennas: Use only the supplied or an approved replacement antenna. Unauthorized antennas, modification or attachments could cause damage and may violate regulations.

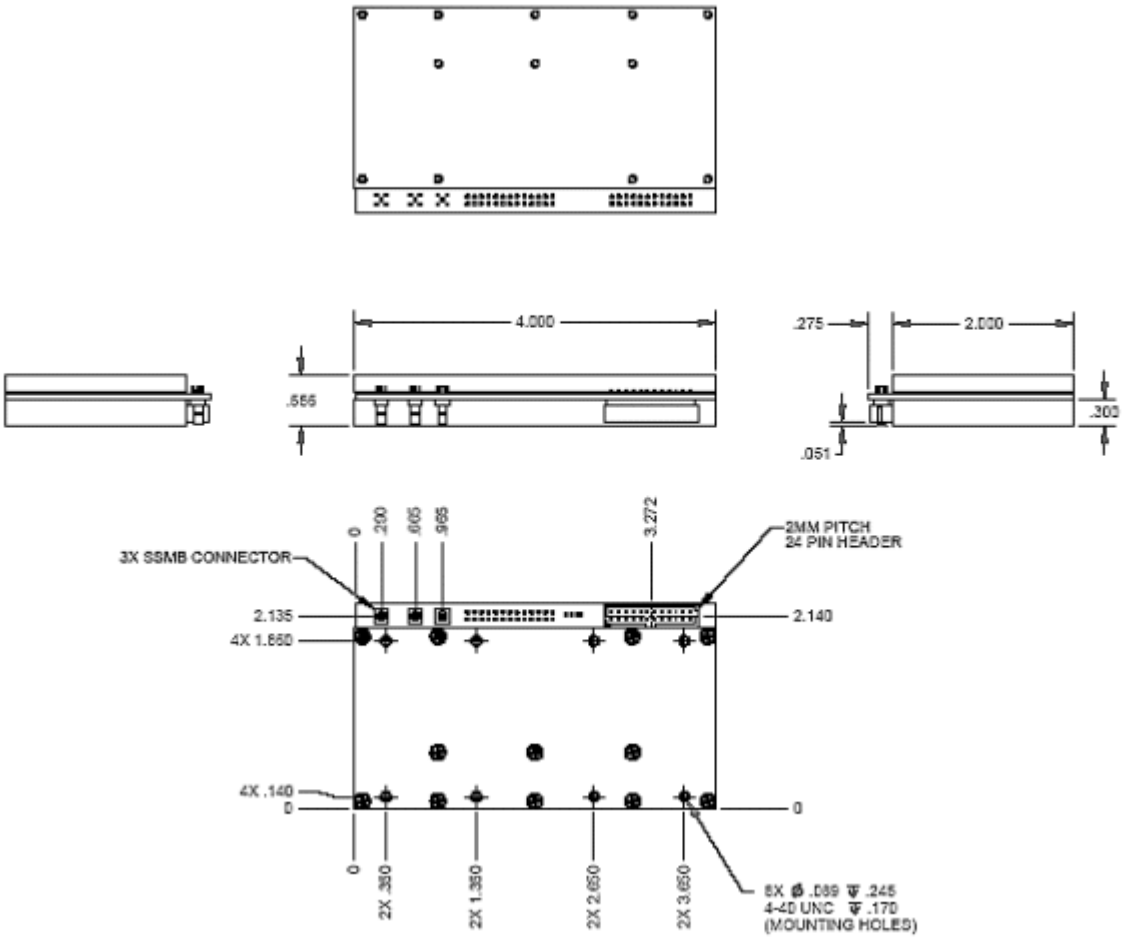
RF Exposure: This unit must be operated with a minimum separation distance of 20 cm from a person's body.

Appendix B – Mechanical Drawings

Physical Description

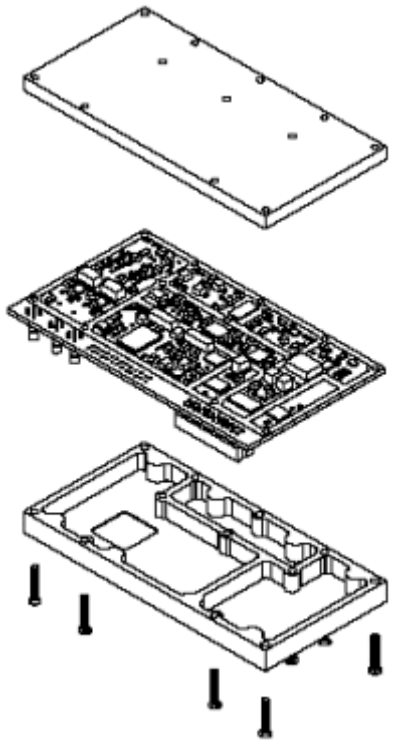
This section provides a physical description of the MTM-203 Transceiver Module. This includes the physical size, location of components, and mounting holes (Figure 4) and a description of the shield housing (Figure 5).

Figure 4: MTM-203 Transceiver, Top Level Mechanical View 1



The MTM-203 Transceiver comes with metal upper and lower shields that have tamper evident seals (see Figure 5). While the shields provide some protection against dust, it is not intended to have direct exposure to the environment. The MTM-203 module should be integrated into housing for a larger system.

Figure 5: MTM-203 Transceiver, Top Level Mechanical View 2



CM1

Glossary

API – Application Programmers Interface

CLI – Command Line Interpreter

CMDC – Comtech Mobile Datacom Corporation

CPU – Central Processing Unit

DDS – Direct Digital Synthesis

FCC – Federal Communications Commission

FPGA – Field Programmable Gate Array

GPS – Global Positioning System

HDLC – High-Level Data Link Control

HPA – High Power Amplifier

IF – Intermediate Frequency

LED – Light Emitting Diode

LH – Left Hand

LHCP – Left-Hand Circularly Polarized

LNA – Low Noise Amplifier

RH – Right Hand

RHCP – Right-Hand Circularly Polarized

RF – Radio Frequency

TCP/IP – Transmission Control Protocol/Internet Protocol

VBAT – Voltage from Battery