EXHIBIT VIII

OPERATION AND MAINTENANCE

OF THE

MCC-545*B*

PACKET DATA RADIO

OPERATION AND MAINTENANCE

OF THE

MCC-545B PACKET DATA RADIO

MAN-OM-545B

December 2000

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This page MUST be inserted for any copy of this manual going to the United Kingdom.

WARNING WARNING WARNING

Certain power transistors used in this equipment and their associated heatsink components are manufactured partly or wholly from a beryllium compound. Normally these can be handled without risk of toxicity, but there is a toxic hazard if dust or finely-divided particles of the material are inhaled or enter the body through a cut. Consequently, great care must be taken, and hands must be washed after handling.

Any cuts or abrasions on the hands must be covered by dressings while such components are being handled. If beryllium dust does enter the skin through a cut or abrasion, the affected part must be washed thoroughly and treated by a doctor.

Components containing beryllium may only be machined, cut, abraded, or heated above 400 C under strictly controlled conditions approved by the appropriate Safety Authority.

Disposal of Beryllium

Disposal of faulty components must be carried out according to special arrangements. Should a component containing Beryllium be broken, its parts and particles must be gathered carefully using a moistened tissue (preferably while wearing plastic or rubber gloves), placed in a plastic bag together with any contaminated materials, sealed, labeled, and disposed of in a manner approved of by the Safety Authority.

Beryllium Components in MCC-545B RF Power Components

RF power components in the modules listed below incorporate some Beryllium within the transistor package and must be handled as specified in the above warning notice.

TRANSISTOR CIRCUIT MODULE	MANUFACTURER	REFERENCE
545B 100W Transmitter (54505302-01)	Advanced Semi Corp Motorola	Q1,Q4 Q2

GENERAL WARRANTY

Meteor Communications Corporation (MCC) warrants that its products conform to the published specifications and are free from manufacturing and material defects for one year after shipment. Warranty-covered equipment that fails during the warranty period will be promptly repaired at MCC's facility in Kent, Washington.

International customers shall pay shipping costs to the MCC facility, with Seattle as the point of U.S. entry. MCC shall pay incoming U.S. duty fees. MCC shall pay for shipping costs to return the equipment to the customer, with the customer paying any and all return duty fees.

This warranty is contingent upon proper use of the equipment and does not cover equipment that has been modified in any way without MCC's approval or has been subjected to unusual physical or electrical stress, or on which the original identification marks have been removed or altered.

REVISION PAGE

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I		

TABLE OF CONTENTS

Title **Page**

LIST OF FIGURES

LIST OF TABLES

Introduction

1.0 INTRODUCTION

The MCC-545B PACKET DATA RADIO is part of a Meteor Burst Communications System (MBCS) that allows short and long range communications between any two Stations in the system. The system offers continuous radio signal propagation via ground wave and meteor burst. Ground wave covers short distances, up to 100 km (60 miles). Meteor burst covers longer distances, up to 1,600 km (1,000 miles), reflecting signals off ionized electron trails created by meteors entering the atmosphere at a height of about 100 km (60 miles) above the earth's surface. These trails, called bursts, are random but predictable in number and last from a few milliseconds to several seconds. During this time, information can be exchanged between two Stations. The height of the trails (60 miles) gives the system its 1,000 mile range.

1.1 Presentation

This manual is divided into five major sections:

Section 2. DESCRIPTION
Discusses specifications of each module included in the 545B.

Section 3: INSTALLATION
Presents a brief outline of installation procedures for the 545B. Includes considerations for set-up and cabling, as well as power-up procedures.

Section 4: OPERATION
Outlines operating procedures for hardware and software.

Appendix A contains printouts of 545B commands and command responses.

Appendix B contains for interfacing the Pharos Marine Data Acquisition Unit.

Appendix C contains a list of GPS units supported and instructions for interfacing each unit to the 545B.

Appendix D contains information on configuring the 545B for use in a Flood Warning System.

Appendix E contains information on interfacing to the Campbell Scientific CR10X Data Logger.

Appendix F contains information on the event and I/O programming capability of the 545B.

1.2 Support Documents

Customer Specific System Manual
MCC-520B/MCC-520C Operations Manual

1.3 Conventions

The following conventions are used in this manual:

Any system-dependent options are indicated with an "*".

When presented in the text, user commands and computer printout are boldfaced; e.g., Enter **DELETE.** Command parameters are presented in lower case; e.g., **DEFINE**,id. Optional parameters are enclosed in brackets; e.g., **TIME**{,hh:mm:ss}

Names of terminal keys are capitalized and enclosed in square brackets when mentioned in the text; e.g., Press [ESC].

Names of hardware switches, meters, etc. are capitalized; e.g., PWR ON switch.

NOTE
Used for special emphasis of material

IMPORTANT
Used for added emphasis of material.

CAUTION
Signals the operator to proceed carefully.

WARNING! WARNING! WARNING!
Used in cases where failure to heed the message may result in personal injury or equipment damage.

Description

2.0 DESCRIPTION

2.1 General Description

The MCC-545B Packet Data Radio provides versatile communications from fixed or mobile sites. The 545B can be used for sending and receiving messages, position reporting, data logging, or other specific applications. Designed to operate over a fading groundwave and an intermittent meteor burst communications channel, the unit's low standby-power consumption (<1 watt) makes it ideal for remote locations or mobile operation.

The 545B features rugged construction in a weather-resistant enclosure that measures 10.6 " x 4.0" x 2.42" and weighs less than 3.5 pounds.

A photograph of the 545B is given in Figure 2.1.

The unit operates in a half-duplex mode and contains a solid state Tx/Rx switch that allows a common antenna to be shared for both transmit and receive. It can be operated with a single frequency or on two separate frequencies.

The unit utilizes three phase locked frequency synthesizers to set the Tx and Rx frequencies. The operator can set the frequency to any authorized frequency (10KHz steps) within a 2 MHz band. A factory-trained technician is required to retune the transmitter and synthesizer if operation outside a 2 MHz band is desired. The unit can be factory tuned across the full 37 to 50 MHz band

2.2 Send and Receive Messages

The 545B provides full text message capability. With a portable operating terminal, or a PC running terminal emulation software, you can exchange messages with any other Remote Station in the network.

Messages may be plain text or binary data. They can be routed to single or multiple destinations or, to a Host Computer or Data Center.

2.3 Data Logging

The 545B can be programmed to acquire, store, and transmit data from the various I/O signals noted below. Any analog or digital input can be used to trigger a transmission or to set a discrete output level. Output levels can also be set hi or low via a command received from a distant unit.

I/O CAPABILITY OF MCC 545B

NAME	RANGE	QUANTITY
Analog Inputs	0 to +5V	6
Digital Inputs	Optical isolated	4
Digital Outputs	RS232 (+/- 10V)	2
Digital Outputs	0 to +5V (10 ma)	3
Digital Inputs	0 to + 5V or +/-10V	2
Relay Outputs	Form C 2 amp rating	2

MCC-545B PHOTOGRAPH
FIGURE 2.1

Refer to Appendix E for detailed operation and control of the I/O capability of the MCC 545B.

The MCC can also be connected via an RS 232 port to a variety of Data Loggers such as the Campbell Scientific CR10X or CR23. Data from these loggers can be collected, stored, and transmitted to a distant unit. Refer to Appendix B and E for a description of data logger interface.

2.4 Position Location

The 545B delivers location data from either a built 12 channel GPS (optional) or from an external GPS with NEMA 0183 format, positioning equipment used in mobile units on land, in the air, and at sea. The 545B sends the position location to a Master or Base Station, which forwards the information to a Data Center or Host Computer for processing. This data can be

used in dispatch centers, corporate/district offices, and other monitoring Stations for updating map displays or additional functions. Refer to Appendix B for a description of the GPS commands.

2.5 Maintenance Features

An operator terminal or a remote command from a distant unit can also be used to read and display the 545B's status such as radio propagation channel statistics, battery voltage during transmission (loaded), battery voltage when not transmitting (unloaded), RF forward and reflected power (checks antenna), and receiver noise levels. It can also be used to display and configure the 545B's operating characteristics, as detailed in Chapter 4.

An internal Li ion battery is used to maintain the internal real time clock and battery backed RAM. This battery is capable of operating the clock in a power down state for a period of approximately 6 months. This battery should be removed if the unit is stored without power for extended periods of time.

2.6 Hardware Organization and Layout

The unit contains five printed circuit assemblies:

A 100 watt all solid-state 2 stage power amplifier.

A 2 watt 2 stage preamplifier and power switch.

A BPSK 4 KB/sec transceiver containing a BPSK receiver, vector phase modulator (+13Dbm output) and three frequency synthesizers.

A low-power microprocessor controller used to perform radio control and link and network protocol functions. This assembly also contains a digital signal processor (DSP)and digital to analog converter (DAC)for generating the in-phase (I) and quadrature-phase (Q) base band signals required to generate the BPSK RF signal.

An 8 channel GPS receiver (optional)

The following paragraphs contain a brief description of each of the five main hardware elements in the 545B. Figure 2.2 presents a block diagram for the 545B. Figure 2.3 presents an outline drawing showing mounting holes, connectors, and dimensions.

2.6.1 MCC-545B Transceiver Assembly

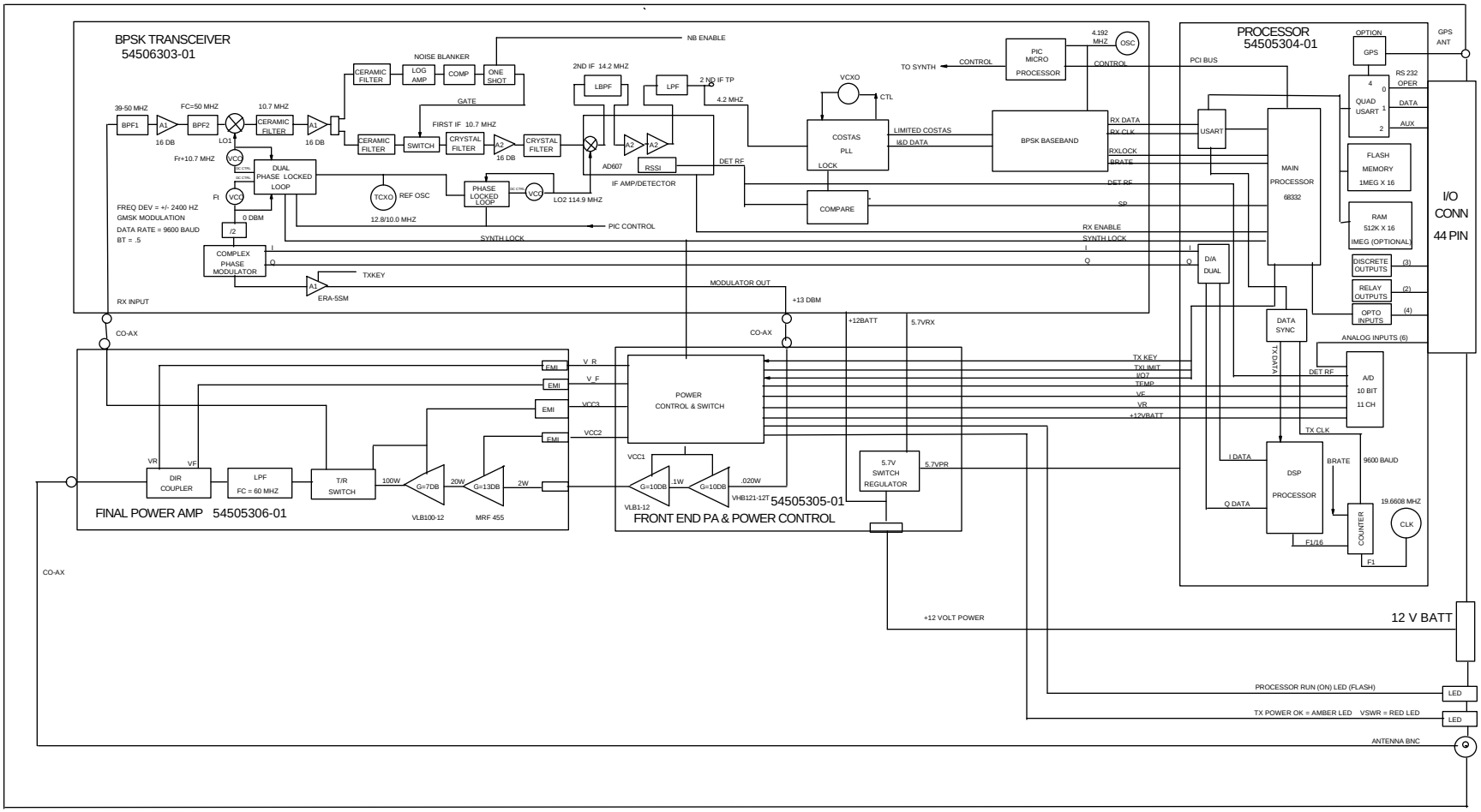
The receiver assembly contains a complete 4K baud Bi Phase Shift Key (BPSK) receiver, a transmit and receive frequency synthesizer module, and a 4K baud BPSK modulator.

BPSK Receiver
- Input band pass filter (37-50 MHz)
- RF amplifier (17 dB)
- Low pass image filter (Fc=50 MHz)
- Mixer
- IF amplifiers and filters (10.7 MHz)
- Noise blanker
- Mixer, 2nd IF filter and amplifier (100 KHz), and RSSI circuit
- Coherent Costas Carrier Tracking Loop
- BPSK bit detector and clock generator

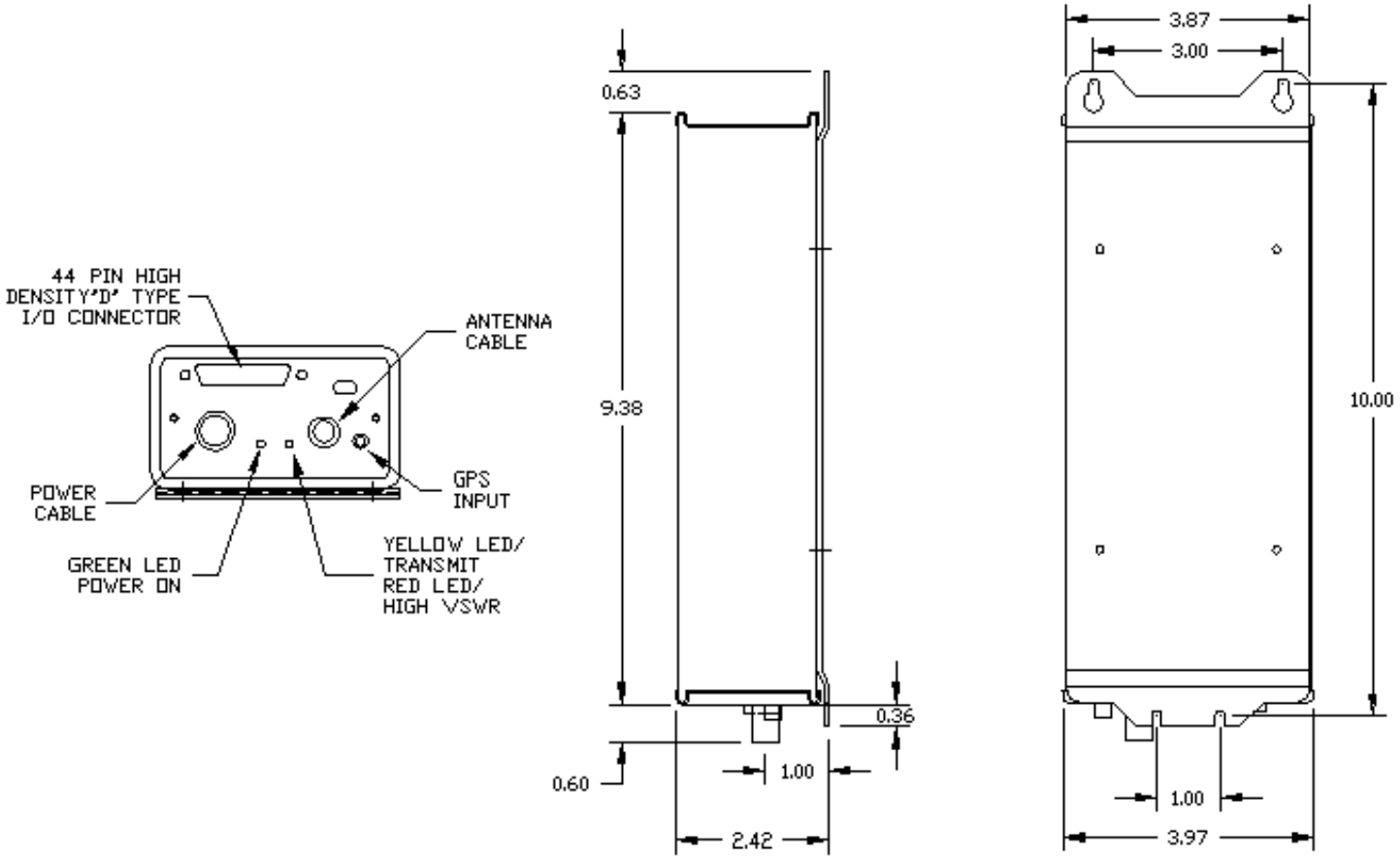
Synthesizer (1st and 2nd local oscillator and transmit oscillator)
- Reference Oscillator (12.8 MHz +/- 2.5 PPM)
- Tx phase lock loop (74-100 MHz output, 20 KHz steps)
- A divide by 2 circuit (37-50 MHz output, 10 KHz steps)
- Rx 1st local oscillator phase lock loop (47.7-60.7 MHz output, 10 KHz steps)
- Rx 2nd local oscillator phase lock loop (10.6 MHz)
- PIC Microcontroller

BPSK Modulator
1. I/Q Vector Phase Modulator (BPSK)
2. Pre amplifier (+13 DBM output)

All components are located on a 8.5”by 3.5” two sided printed circuit board. All components are soldered in (surface mounted). As an option the board can be conformal-coated with an acrylic encapsulate that contains a tropicalizing, anti-fungal agent to increase durability and provide protection against moisture and contamination.



MCC 545B BLOCK DIAGRAM
FIGURE 2.2



MCC 545B OUTLINE DRAWING
FIGURE 2.3

2.6.2 MCC-545B Power Amplifier

The power amplifier assembly contains two printed circuit boards. One board, the 100 watt power amplifier, is mounted inside an aluminum enclosure to provide RF shielding between the low level phase lock loop synthesizers and the high power output. This board contains a T/R switch for half-duplex operation, a harmonic low pass filter, and a dual directional coupler for power level control.

The second board contains two low level amplifiers which amplify the 20 milliwatt input signal from the modulator to a two watt level required by the final power amplifier stage.

All transmitter components are located on a two 4.0" x 3.5'' printed circuit boards. All components are soldered in place. As an option the boards can be conformal-coated with an acrylic encapsulate that contains a tropicalizing, anti-fungal agent to increase durability and provide protection against moisture and contamination.

Both printed circuit boards are mounted to an aluminum heat sink assembly.

2.6.3 MCC-545B Microprocessor

The microprocessor is a Motorola-based, embedded computer housed on a single PCB that contains:

- 512K x 16 of non-volatile flash memory for program storage
- Additional 512K x 16 of non-volatile flash memory for parameter storage
- 1024K x 8 of static RAM for data storage (optionally 2048K x 8)
- External RS-232 I/O ports (3)
- Internal TTL GPS port
- Transmitter communication port
- Receiver communication port
- 10-bit 11 channel A/D converter (6 channels available for external sensors)
- Real-time clock
- Power fail detection circuitry
- Digital Signal Processor with D/A converters
- Optically isolated digital inputs (6)
- Form C Relay Outputs (2) with current rating of 2 amps.

All I/O ports are RS 232 compatible and can be programmed to adapt to various customer protocols. The DATA port contains full flow control hardware lines.

The A/D converter measures TX forward and reverse power, battery voltage, antenna noise voltage, transmitter board temperature, and 6 channels of 0-5V external sensor inputs.

All processor components are located on a 198mm x 95mm (7.8” x 3.75”). All components are soldered in place using the latest in surface mount technologies. As an option the board can be

conformal-coated with an acrylic encapsulate that contains a tropicalizing, anti-fungal agent to increase durability and provide increased protection against moisture and contamination.

Specifications for the unit and the individual circuit boards are given in Tables 2.1 through 2.4.

MCC-545B GENERAL SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Dimensions	10.6"L X 4.0"W X 2.42"H
Weight	2.7 kg (3 lbs.)
Temperature Range	-30° to 60° C (-22° to 140° F)
Power Requirements	Standby: 100 ma (Continuous) Transmit: 25 Amps Nominal (100 msec) 12 VDC Nominal (10-14 VDC)

TABLE 2.1

MCC-545B RECEIVER SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Frequency	37-50 MHz .0005% Synthesized 10KHz steps
Modulation Type Rate Format	 BPSK 4 KBPS NRZ
Noise Figure	< 7 dB minimum
Sensitivity Bit Error Rate < 10^{-3} at 4 kbps	 -120 dBm
IF Bandwidth (3/80 dB)	13/40 KHz typical
RF Bandwidth (3 dB)	13 MHz typical
Signal Acquisition Time	< 5 msec
3rd Order Intercept Point	>- 4 dBm
Image Response Attenuation	> 70 dB minimum
Spurious Response Attenuation	> 70 dB minimum
SP Threshold	Adj. From –115 to –106 dBm Triggered by DET RF and Demodulator Lock
Noise Blanker	> 20 dB Reduction in Impulse Noise
I/O	MCC Standard

TABLE 2.2

MCC-545B TRANSMITTER SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Frequency	36-50 MHz .0005% Synthesized 10KHz steps
RF Power Output	> 100 Watts at 12 VDC Input
Load VSWR	< 2:1 for Rated Power
Harmonic Levels	70 dB below Unmodulated Carrier
Modulation Type Rate Format	 BPSK 4 KBPS NRZ
Spurious	> 70 dB below Unmodulated Carrier
Transmit Modulation Spectrum	10 KHz offset – 40 dB 25 KHz offset – 70 dB
Tx Duty Cycle	16% Max without shutting down 20% shuts down transmitter
T/R Switch	Solid-State Switching Time < 100 micro sec
I/O	MCC Standard
Protection High VSWR	 Withstands Infinite VSWR

TABLE 2.3

MCC-545B MULTIPROCESSOR SPECIFICATIONS

CHARACTERISTIC		SPECIFICATION
Main Processor		Motorola MC68332FC 32-bit Embedded Controller
Memory:	Program Storage	512K x 16 non-volatile Flash memory
	Data Storage	1024K x 8 static RAM (optional 2048K x 8)
	Parameter Storage	512K x 16 non-volatile Flash memory
Switches:	S1	Momentary System Reset
Jumper:	JP2	Modulation Select (In for BPSK) (Out for BPSK)
	JP3	DSP Clock Select (pins 1-2)
	JP4	Mod Filter Select (In for BT=.5) (Out for BT=1.0)
Memory:	Program Storage	

TABLE 2.4

Installation

3.0 INSTALLATION

This section provides general information on site selection and installation of the 545B, as well as 545B power-up procedures.

3.1 Site Selection

One of the most important considerations in the proper operation of the MBCS is the selection of the 545B-operating site. There are a number of factors, which influence selection:

1. External Noise/Interference
2. Horizon angle
3. DC power source
4. Site dimensions
5. Antenna considerations

3.1.1 External Noise/Interference

Noise and signal interference can reduce the performance of the 545B. There are several sources of interference; following are the most common sources:

- Cosmic Noise
- Power Line Noise
- Auto Ignition Noise
- Computer-Generated Interference
- External Signal Interference

Cosmic Noise

Cosmic noise is the limiting noise factor in a meteor burst system, especially in the low frequency band (40-50 MHz). The noise is generated by star systems in the galaxy and is frequency dependent. The noise is approximately 15 dB above thermal at 40 MHz, and 13 dB above thermal at 50 MHz. The noise is also diurnal in nature, being the highest when the antennas are pointed directly at the center of the galaxy and lowest when they are pointed at right angles to it. Daily variations of 3 to 4 dB are to be expected. An optimal meteor burst site is one that is limited only by cosmic noise.

The 545B STAT command is very useful in determining the site antenna noise levels. Since the Receiver has an IF bandwidth of 13 KHz, the STAT reading should read from –120 to –115 dBM if the Receiver to antenna line loss is about 1 to 2 dB (100-200 ft of RG-214). The noise blanker is not effective for cosmic noise, so the noise readings are the same whether the blanker is on or off.

Power Line Noise

One of the main sources of external noise are the high voltage power lines common throughout the country. Noise on these lines is generated by high voltage breakdown occurring on power line hardware such as transformers, insulators, etc. This noise shows up at the Receiver IF test point (using a scope) as a series of spikes that occur every 8 ms (1/60 Hz) or every 10 ms (1/50 Hz). The level of the spikes will be much higher than the normal background noise floor. The number of spikes can vary, depending upon the level of interference, from one or two every 8-10 ms to several dozen every 8-10 ms. The impulse noise blanker can remove a large amount of this noise. However, as the number of spikes increases, the effectiveness of the blanker is reduced. When setting up a site always look at the IF test point with a scope to determine the level of the power line noise interference. It is mandatory that power line noise be avoided. Try to set up Rx antennas well away from power lines and try not to point the antennas directly toward nearby power lines.

NOTE.
Local power companies should maintain power lines to reduce noise. Call your local utility in case of severe noise.

Auto Ignition Noise

Auto ignition noise is generated by any gasoline engine and is a result of the high voltage required to fire the spark plugs in automobiles. A basic characteristic of auto ignition noise is that it is similar to power line noise (i.e., this type of noise generates a DET RF spike visible with an oscilloscope), but it does not have the 8-10 ms period which is associated with power line noise. If the unit is operated on a vehicle, care must be taken to ensure that the vehicle ignition system, any DC motors, and any other source of electrical noise are isolated through shielding, ferrite beads, and-or bypass capacitors.

Computer-Generated Interference

All computers and printers contain high-speed logic circuits which generate spurious signals throughout the 37-50 MHz band. If one of these signals occurs at the receive frequency, interference results when the spurious computer signal is picked up by the receive antenna. To avoid this type of interference keep the antenna away from buildings that contain computers. Separating the antennas from the computers by 100 to 300 feet generally prevents this interference. The noise blanker does not suppress computer-generated interference.

Signal Interference

This type of interference occurs whenever the unit is set up in an area where another transmitter is operating on the desired receiver center frequency. Antenna nulling and spatial separation can be used to reduce this type on interference.

3.1.2 Horizon Angle

The second consideration in site selection is the horizon angle in the direction of the Master Station. To achieve optimum performance at ranges of up to 1600 km (1000 miles), the horizon or look angle must be free from obstructions, buildings, bridges, etc., and must be within 2 or 3 degrees of horizontal. Trees and other shrubbery do not present a problem if they are not within 6.1 m (20 ft) of any element of the antenna. At shorter ranges the horizon angle can be higher.

3.1.3 Power Source

The 545B requires a 12 VDC power source. An automobile battery provides an excellent power source. Care must be taken to ensure that proper wiring is used to support the 545B high in-rush current during transmission. Typical transmit current is 25 to 30 amps for a period of about .10 seconds. A #14 wire (or two #16 wires) should be used for both +12 VDC and ground. Keep the wire length shorter than 10 feet. Remember that this is 20 feet counting the ground return. The 545B contains a 20 amp internal fuse and a special circuit that protects the unit from a power line reversal. The fuse will have to be replaced if the power lines are reversed.

3.1.4 Site Dimensions

In order to obtain the maximum performance from a Meteor Burst Communications System, the Station must be set up on level flat ground. The terrain in front of the antenna must be flat and be free of buildings and other structures for a distance of at least 30 times the height of the antenna. Operation in an area that does not have a ground plane to support ground reflection can reduce meteor performance by a factor of two.

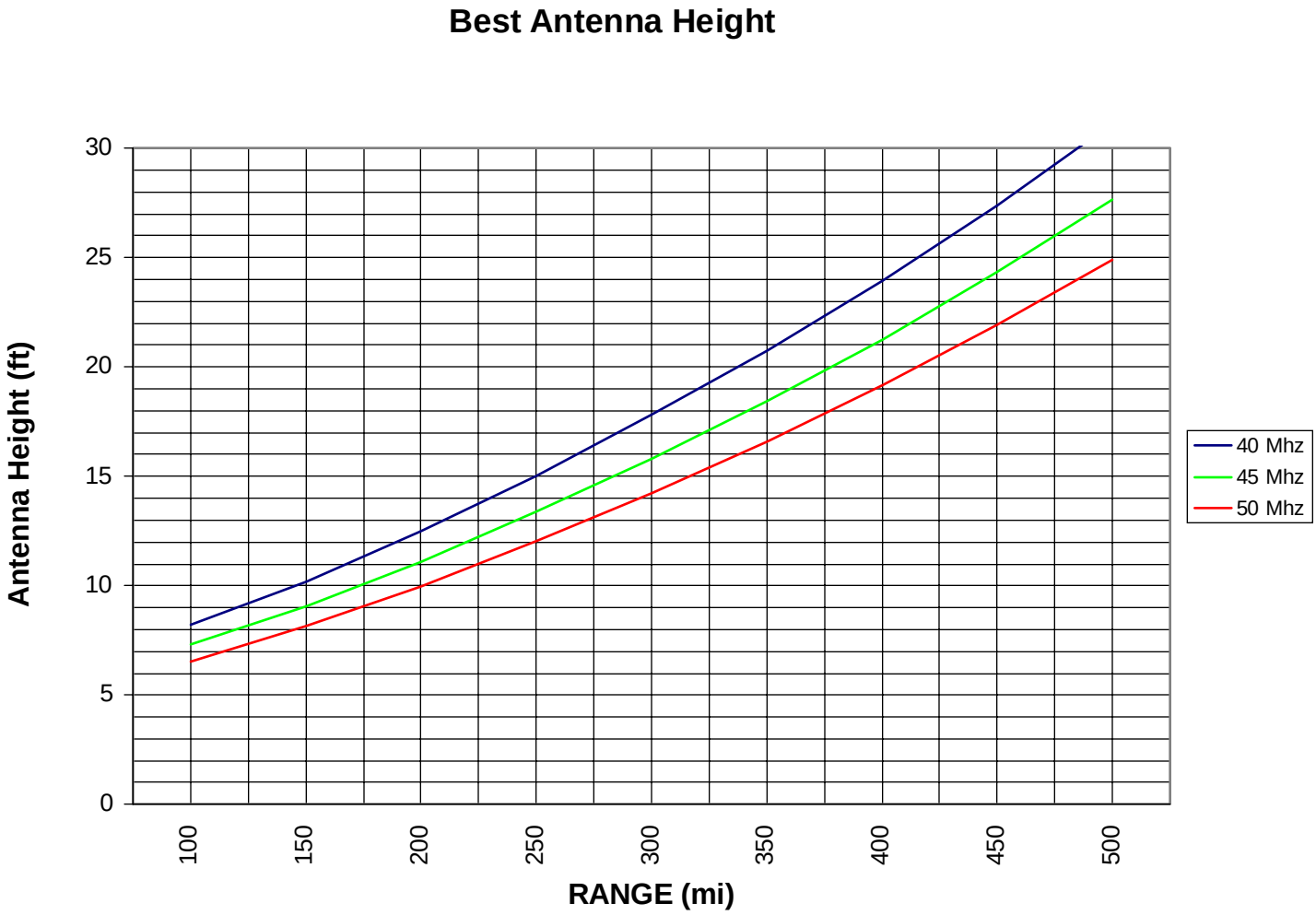
3.1.5 Antenna Considerations

The final consideration in setting up a site is selecting the antenna and co-ax cable. Any antenna that provides a 50 ohm load will work. This impedance must be maintained at both Tx and Rx frequency. In a single frequency system, a very narrow bandwidth antenna can be used. The information bandwidth of the system is less than 15 KHz.

The higher the antenna gain the better the performance. Yagi antennas work better than dipoles (2 to 4 times improvement). Always maintain the same polarization as the Master Station antenna. For example, if you use a whip antenna with the 545B, the Master Station antenna must be vertically polarized.

In a Meteor Burst System, the height of the antenna should be optimized as a function of the distance between the Master Station and the Remote Station. A plot of best antenna height vs. range is given in Figure 3.1-1 below.

In a LOS or ELOS System, the higher the antenna the better. In general every time the height is double the system gain is increased by approximately 6 dB.



REMOTE STATION ANTENNA HEIGHT FOR METEOR BURST
FIGURE 3.1-1

Antenna coax cable length must be kept as short as possible, to minimize line loss. Maintain a line loss between antenna and 545 of less than 1 dB if possible. A table of cable loss (at 50 MHz) for various types of co-ax is given below for reference.

CABLE	Loss/100 feet dB	Diam. Inches	Weight/100 feet lbs.
RG 223, RG 58	3.0	.211	3.4
RG 214, RG 8	1.8	.425	12.6
RG 17	1.2	.870	20.1
LDF4A-50 ½ inch heliax	.48	.500	15.0
LDF5A-50 7/8 inch heliax	.26	.875	33.0

3.2 Equipment Installation

Although the 545B is housed in a metal enclosure, it is not waterproof. If your application requires using the 545B outside of an environmentally controlled shelter or vehicle, you must install the 545B inside a waterproof enclosure. A NEMA enclosure is generally used in outdoor installations. The unit operates over a temperature range of -30°C to +60°C.

3.2.1 Antenna Installation

MCC buys all antennas from an antenna vendor. Each antenna is shipped with a set of assembly instructions. Refer to these instructions for assembly details.

Antenna installation is entirely dependent on site conditions. You should always consult with MCC's engineering department for help in the proper placement of antennas. Remember that antenna placement can make the difference between a system that performs marginally and one that performs well.

3.2.2 Cable Connections

The following is a general description of cable connections for the 545B. The 545B connection data is shown in Table 3.1, along with general connection information.

To ensure proper operation, shielded cable must be used for all connections. All cabling must be grounded at the 545B enclosure. All cables must have adequate strain relief and a weatherproof seal provided at the entry point to the enclosure.

The 545B has one 44 pin I/O connector, that contains three RS232 port wires and one digital/analog data I/O wires. MCC provides a standard cable harness that breaks out the 37 pin connector to three 9 pin RS 232 connectors and one 25 pin I/O connector. A schematic for this connector is given in Figure 3.2 . Table 3.1 describes the pin out of the four I/O connectors.

CONNECTOR	FUNCTION
Power	Input power connector, attaches to battery.
Antenna	BNC antenna connector.
Operator Port	RS-232 port for connection of local operator terminal. D Connector 9S from 14001252 adapter cable.
Data Port	RS-232 port for connection of data logger, GPS or other serial device. D connector 9S from 14001252 adapter cable.
Auxiliary Port	RS-232 port for connection of GPS unit (or other serial device). Also supports MCC test equipment (pins 6, 8, 9). D Connector 9S from 14001252 adapter cable.
I/O Port	Contains analog inputs, digital inputs and outputs, relay outputs, opto coupled inputs, power, ADC reference voltage, and DET RF test point. D connector 25S from 14001252 adapter cable.
GPS Antenna (optional)	SMA connector

ANTENNA		POWER	
Pin	**Signal**	**Pin**	**Signal**
--	BNC Connector	1	+12V
		2	+12V
		3	Ground
		4	Ground

OPERATOR PORT –9S		DATA PORT – 9S		AUX PORT – 9S	
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	CD (tied to pin 4 and 6)	1	Not Used	1	Not Used
2	Tx Data (from 545B)	2	Tx Data (from 545B)	2	Tx Data (from 545B)
3	Rx Data (to 545B)	3	Rx Data (to 545B)	3	Rx Data (to 545B)
4	DTR (tied to pin 1 and 6)	4	DTR (to 545B)	4	Not Used
5	Ground	5	Ground	5	Ground
6	DSR (tied to pin 1 and 4)	6	DSR (from 545B)	6	Ant. Clock (from 545B)
7	RTS (tied to pin 8)	7	RTS (to 545B)	7	Not Used
8	CTS (tied to pin 7)	8	CTS (from 545B)	8	Ant. Dir. (from 545B)
9	Not Used	9	Ring Ind. (from 545B)	9	Ant. Sel. (from 545B)

MCC-545B INTERFACE CONNECTIONS
TABLE 3.1 (1 of 2)

MCC-545B INTERFACE CONNECTIONS

I/O Connector pin	FUNCTION
1	Optocoupled input #1 positive (500 ohm resistor)
2	Optocoupled input #1 return
3	Optocoupled input #2 positive (500 ohm resistor)
4	Optocoupled input #2 return
5	Optocoupled input #3 positive (500 ohm resistor)
6	Optocoupled input #3 return
7	Optocoupled input #4 positive (500 ohm resistor)
8	Optocoupled input #4 return
9	Ground
10	Relay Output #1 Normally Open (2Amp rating)
11	Relay Output #1 Common
12	Relay Output #1 Normally Closed (2Amp rating)
13	Relay Output #2 Normally Open (2Amp rating)
14	Relay Output #2 Common
15	Relay Output #2 Normally Closed (2Amp rating)
16	Ground
17	Analog Input #1 (0 to 5 V)
18	Analog Input #2 (0 to 5 V)
19	Analog Input #3 (0 to 5 V)
20	Analog Input #4 (0 to 5 V)
21	Analog Input #5 (0 to 5 V)
22	Analog Input #6 (0 to 5 V)
23	+5V Reference (10mA for sensor excitation)
24	+12V (0.5A maximum)
25	Detected RF Test Point

MCC-545B INTERFACE CONNECTIONS
TABLE 3.1 (2 of 2)

3.2.2.1 DC Power

Connect +12 to +14VDC to the power plug that mates with the power connector on the 545B front panel. Refer to Table 3.1 for location and proper connections. Use large gauge wire (#16), since the unit can draw up to 30 Amps during transmission. The power connector can only accept #16 wires maximum. Use 2 #16 wires for positive and 2 #16 wires for negative. If runs longer than about 6 feet are necessary, splice a large gauge wire (#10) onto the 2 #16 wires for both positive and negative. The splice should be done within a foot or two of the 545B. (MCC part number 14001261-03 is a 6' power cable with lugs for 3/8" post connection).

The shorter the DC power cable, the more RF power will be available for transmitting since there will be less voltage dropped in the wires.

3.2.2.2 Antenna

Connect the antenna cable to the "BNC" RF connector on the front panel. Use double shielded cable, such as RG-214 for long runs (100 feet). RG-223 can be used for runs less than 20 feet.

3.2.2.3 Ground Wire

Connect a heavy duty ground wire (#12 or larger) between the front panel ground stud and the Station shelter ground.

3.2.2.4 Operator Port

Connect a standard RS-232 cable with a 9-pin male D connector to the OPERATOR port on the front panel. Connect the other end of the cable to the local operator terminal

3.2.2.5 Data Port

Connect a standard RS-232 cable with a 9-pin male D connector to the DATA port on the front panel. Connect the other end of the cable to the data-logging device. Refer to Appendix B for more information on the 545B-to-data logger interface.

3.2.2.6 Auxiliary (AUX) Port

Connect a standard RS-232 cable with a 9-pin male D connector to the AUX port on the front panel. Connect the other end of the cable to the GPS or other position location device. Refer to Appendix C for more information on the 545B-to-GPS interface.

IMPORTANT

The AUX port connector has three extra pins (pins 6, 8, and 9) whose signals do not conform to the RS-232 standard. These are for MCC test purposes and are not used at this time. These pins will NOT interfere with a normal 3-wire RS-232 connector (pins 2, 3, and 5).

3.3 Power-Up Sequence

IMPORTANT

Before you apply power to the 545B, check all connections between the 545B and external equipment (power, antenna, operator terminal, GPS receiver, data logger(s), etc.). Refer to Section 3.2 for complete cabling instructions.

3.3.1 Internal Battery

When the 545B is shipped from the factory, it does NOT have the internal LiIon battery connected to the processor RAM. This battery is used to provide battery back-up of time and date in the event of a power failure. Check to make certain battery is correctly installed.

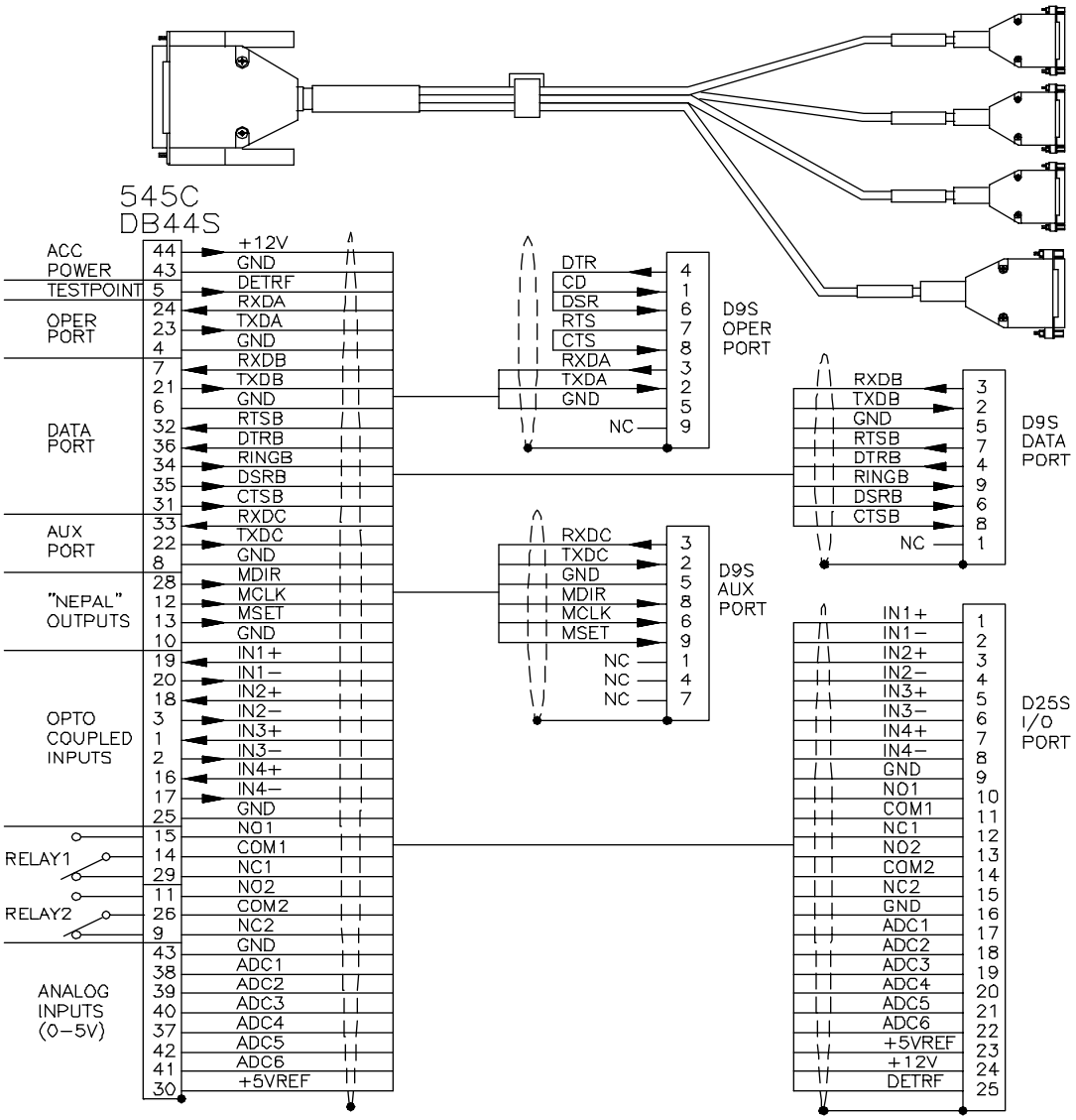
3.3.2 Power On

CAUTION

Disconnect antenna cable until unit ID is set (see paragraph 3.3.3).

To power up the 545B, apply +12VDC to the power connector. When the unit transmits, it will draw up to 25 amps, so make sure that you use a large at least two # 16 gage wires for the power and two for the ground. Limit cable lengths to less than 10 feet. If larger runs are required use larger diameter wires. The voltage drop in the power wires plus the drop in the battery voltage should be less than 2 VDC for proper operation of the unit.

The 545B processor should come start up and print a greeting message on the operator terminal, assuming it was turned on and set to the baud rate that matches the processor on the 545B. The 545B's default baud rate setting is 9600 baud, with no parity, 8-bit data bit, and 1 stop bit. However, the current baud rate is determined by the last configuration settings saved in the 545B's flash memory. If necessary, refer to Chapter 4 for changing the 545B baud rate settings with the SETBAUD and SAVE commands.



MCC 545B INTERFACE CABLE SCHEMATIC
MCC P/N 14001352-01

FIGURE 3.2

3.3.3 Set Unit ID

It is very important that the unit ID be set correctly before operation on an antenna. If the unit transmits with the wrong ID, it may conflict with another unit in the system and result in data or messages being misrouted or lost and network topography and statistics being confused. Use the ID Command to set the unit ID:

ID,nnnn,mmm{,aaaa},INIT

where nnn is the unit ID, mmm is the Master Station assignment and aaaa is the Master connectivity initial setting for Remote operation. Obtain these numbers from your network manager. The 545B will save the ID (and total configuration) and reboot.

3.3.4 Set and Verify Tx/Rx Frequencies

The MCC 545B contains an internal frequency synthesizer that is used to set the Tx frequency and two receiver local oscillator frequencies. The first local oscillator frequency is set to 10.7 MHz above the desired receive frequency. The second local oscillator frequency is set at 10.6 MHz and can not be changed. The unit is programmed by a factory-trained technician to operate on a number of authorized frequency channels. Once programmed , these frequencies can be selected by the operator.

You can set or display the TX and RX frequencies using the following command:

FREQUENCIES, XXXX,YYYY

Where XXXX is the desired transmit frequency and YYYY is the desired receive frequency

Example: FREQUENCIES,4550,4550 for Tx and Rx on 45.50 MHz

You can only select those frequencies programmed into the unit at the factory.

Once the frequencies are selected, you must make sure that the synthesizer is “ON” and locked, by entering the following command:

SYNTHESIZER, ON

The unit will respond with

SYNTHESIZER, ON Locked or Unlocked

If the synthesizer returns an unlocked response, check the frequency command to insure that you have entered the proper frequencies. Note that the unit will not transmit if the synthesizer is not locked.

3.3.5 Perform RF Test

A simple, but very thorough RF test can be accomplished by typing TEST[CR]. TEST forces the processor to key the transmitter and check for the amount of forward and reverse RF power that is transmitted. It also checks the battery voltage under load and the antenna noise voltage.

The following command response results:

Syncs	Xmits	Acks	pwr-fwd	pwr-rev	v-bat	det-RF
XXXX	YYYY	ZZZZ	AAAA	BBBB	CCC	DDD

where:
- XXXX = # Of sync patterns heard from the master
- YYYY = # Of transmissions
- ZZZZ = # Of Acknowledgements from master
- AAAA = Forward power in watts >80
- BBBB = Reflected power in watts <5.0
- CCC = Battery voltage under load (while transmitting) >10.6 volts
- DDD = Received signal strength (usually noise at antenna) in DBM

For full power 545Bs, the forward power should exceed 80 watts. If not, check the battery voltage on the printout. It should be greater than 10.6 VDC. If it is low, check the power source and cables. If the forward power is OK, the reverse RF power should be less than 5 watts. If not, check the antenna and RF cables. Also check the antenna and cables if both the forward and reverse power are low and the battery voltage is okay, since the transmitter is probably shutting down due to an excessive antenna VSWR (>3:1).

This completes the power up of the 545B. If you followed the above check list and everything was satisfactory, the unit should be ready for operation. Refer to Chapter 4 for detailed operating instructions.

Operations

4.0 OPERATIONS

This chapter covers the fundamental operating procedures and is functionally divided into seven sections:

- Getting Started
- Station Operational Parameters
- Sending and Receiving Messages
- Data Logging
- Reporting Position Location
- Master Mode Functions
- Examining Systems Statistics

4.1 Getting Started

4.1.1 Command Entry and Editing

You must enter carriage returns after every command. A list of operator commands follows the operating instructions (Table 4.2).

When a command is accepted, the operator terminal prints the system time. For a description of printouts, see Appendix A.

Before you begin, you should know about the special editing functions that you can use when entering commands:

[DEL] Deletes last character entered.

[CTRL] Prints command line on next line down.

[CTRL]-R Repeats last command line

\X Removes current line from command buffer.

[CR] Terminates line and causes command entered to be executed.
or
[LF]
or
[ENTER]

4.1.2 Unit Name and Station ID

In command descriptions, the parameter "name" is the assigned Station name. The name is the numeric Station ID. For more information on 545B operation as either a Remote or Master, refer to Section 4.2.1. Station IDs, represented by "nnnn", can be assigned as follows:

1 – 245	Master Station
256 – 4095	Remote

Verify the ID is set correctly:

ID

If it is not correct, refer to section 3.3 for procedures to set it.

4.1.3 HELP Command

Information about many 545B commands can be obtained via the HELP command. Typing HELP with no parameters produces a single page display of an alphabetized command list. For selected commands, typing HELP,command yields a summary explanation of how to use the specified command. For example, typing HELP,ASSIGN explains the format to use when you enter the ASSIGN command, along with a brief description of the command's function.

4.1.4 System Time and Date

The system calendar is maintained during power outages. If the date and/or time shown is incorrect, the calendar can be initialized with the following commands:

DATE,mm/dd/yy

TIME,hh:mm{:ss}

The time of day maintained at the 545B is transmitted to all Remote Stations, thus maintaining all units on the same time reference. If the time of day received at a Remote Station is greater than two minutes from the internal Remote clock, the Remote sets its clock to the received time of day.

To properly manage time, each Master and Remote must know how its own time zone relates to UTC and the system time. This relationship is established by relating its time zone to known reference points. UTC is always referenced to GMT; however, system time can be referenced to any desired time zone. The time zone offset in the MCC-520B is defined with the following command:

TIME ZONE,UTC offset,system offset

4.2 Station Operational Parameters

Configure the 545B for operation in your network. Configuration requirements vary from application to application. Refer to your systems manual or consult your systems manager for correct settings.

Use the CONFIG and ASSIGN commands to verify proper configurations. Use the commands described in this section to set the configuration as required.

Finally, enter the SAVE command to write the configuration into the EEPROM for non-volatile storage.

4.2.1 Configuring the 545B

In order for the 545B to operate correctly in your network, it must be properly configured. Configuration parameters include the unit ID, the Master Station assignment, I/O port functions and baud rates, transmit and receive parameters and network parameters. Commands which allow you to display/modify the configuration are marked with an * in the command table. Parameters or operational states set by these commands are retained and determine the way in which the 545B will interact with other equipment at the site and with the communications network.

Most configuration parameters can be viewed with the "config" and the "assign" commands. You should use these commands to verify that the configuration is correct. If it is not correct, use the appropriate command(s) to correct the configuration, then enter the "save" command to write the configuration parameters into the EEPROM.

Saving and Restoring the Configuration - The Theory

In order to understand how the 545B operational configuration is saved and restored, it is necessary to understand a little of the hardware and design philosophy of the 545B.

The 545B is designed to operate unattended in a variety of environments where power may be applied continuously or intermittently. The goal is for the unit to continue to operate without loss of messages, data or configuration even if power is randomly turned on and off. Therefore the software is designed to operate continuously, to save all operational information when power is off and to resume operation from that point when power is restored.

To support this philosophy, the 545B has three types of memory PROM, RAM and EEPROM. Refer to Figure 4.1-1 (MCC-545B Configuration Management Functional Diagram) to see how these memories interact. First, the PROM is non-volatile memory that has been programmed with the 545B's operational software. This software contains the initial value of all operational parameters. The values are referred to as the "factory defaults" because they are present in the

factory when the unit is first manufactured. The ROM can only be changed by replacing the chip with one programmed with the new data.

Second, the RAM contains all dynamic data for the 545B. Any data logger data, positional data, messages, etc. entered into the 545B are stored in RAM. Also, any command parameters - such as configuration changes are stored in RAM. But RAM is volatile. It can only retain information while power is applied. Normally turning off or disconnecting power would cause all RAM information to be lost. In order to prevent this, a small internal NiCad battery is used to maintain power to the RAM when external power is off.

So for normal operation of the 545B, the software operates from the data and parameters in the RAM - even when power has been turned off for several days, then back on. Unfortunately, there are always situations where the RAM data is lost or corrupted. For instance, it the 545B is being stored, the jumper for the NiCad battery should be removed to prevent total discharge of the battery over time. Or the software may fail (crash) and invalidate the RAM data. Or the user may want to clear everything out and start over. Since we do not want these cases to lose our configuration data, we have a third type of memory.

The third type of memory is EEPROM. It is nonvolatile (retains data even when power is removed) and needs special access to program – thus it is not easily corrupted. The 545B can retain a copy of all configuration parameters in EEPROM. But EEPROM is limited to 10,000 write cycles per memory location so the 545B only writes to EEPROM on special commands - "ID" and "SAVE". And then only values that have changed are written. A validation checksum is saved in the 545B to verify its data is correct.

When the 545B ships from the factory it is in a default configuration. The Operator Port (port 0) is set for 9600 baud, 8 data bits, 1 stop bit, no parity, ASCII protocol, no flow control. This provides a known starting point for communicating with the unit with a terminal or computer. From this point, the user can enter the unit ID and other operational parameters and then enter the "Save" command to write them to EEPROM. Note that as soon as parameters are entered they take effect, BUT once the software is rebooted or restart due to a crash or failure of the battery backup RAM, all changes will be lost unless they are saved in EEPROM.

Saving and Restoring Configuration - The Operation

Thus, the sequence is as follows -

1. The software normally executes using data and parameters from RAM. When the unit is turned off or power is disconnected, the RAM information is maintained by battery backup. When main power is restored, the unit continues operation from RAM.

2. If the Reboot command is issued, the white Reset button (S1) is pressed, the internal battery backup is disconnected (by removing jumper JP1 while external power is off), the NiCad battery fails or the software crashes and restarts, the RAM contents is lost. The software detects this and copies the values in EEPROM into RAM when it continues operation.

3. If the contents of the EEPROM is invalid - possibly because of EEPROM failure, software version in PROM is changed or and image has never been written to EEPROM, then the software will revert to the factory settings contained in the PROM.

The user should beware that it is possible to "get in trouble" with this configuration process. For example, assume you accidentally set the protocol for the operator port to MSC. If you do not have the ability to interface using MSC protocol you will immediately lose contact with the 545B. You can no longer issue commands. Power cycling will not help because your change is retained in RAM and lives through power cycling. However, in this case you can recover by removing the lid on the 545B and pressing and releasing the Reset button (S1). The software will reboot and restore the EEPROM settings.

As a variation, assume you want to change the operator port to MSC. You connect in ASCII protocol, command the change to MSC protocol, then switch you PC to also use MSC protocol. Operation resumes and you are happy. But do not forget to do a save - or if the software ever reboots, its back to ASCII. And remember that once you do the save you are committed to MSC protocol. The reset button now reboots to MSC. There is no easy way back to the factory defaults. You will need an MSC capability to command a change back to ASCII.

4.2.2 Selecting 545B Remote/Master Operation

The 545B can operate as either a Remote Station or as a limited Master Station. Use the DEVICE command to select the mode you need.

For normal 545B Remote operation, enter:

DEVICE,REMOTE

For 545B operation as a limited Master Station, enter:

DEVICE,MASTER

NOTE

Additional 545B commands are available when DEVICE,MASTER is selected (No help for this command).

4.2.3 Selecting Network Parameters

MCC recommends using the given default network parameters (values set on power-up or after reset). If you choose to change these parameters, first review the discussion here and in Section 4.8.5 and then use the following command to change the desired settings:

SNP{,pname,value}

where "pname" is the network parameter, and "value" is a limit dependent on "pname". The "pname" parameters are as follows:

TTL – time-to-live in minutes (default 120 minutes); i.e., the time limit for a message to reach its destination before it is deleted from the queue.

The time-to-live parameter input is truncated to a 10-minute boundary for utilization by the 545B (e.g., if you enter 66 or 64, the TTL for the next message starts at 60). A resultant value of 0 (parameter range 0 – 9) means never time out.

TTR – time-to-retransmit in minutes (default 20 minutes); i.e., the message is retransmitted if it has not reached its destinations in this time frame.

NUP – neighbor-up threshold (default 20 acquisitions); the number of times a Station must hear from another Station in one minute before it becomes a neighbor.

NDOWN – neighbor-down threshold in minutes (default 20 minutes); if there is no communication with a neighbor Station within the set time, the route to that neighbor is ignored. Setting NDOWN to 0 keeps a neighbor defined indefinitely.

RDOWN – Remote-down threshold in minutes (default 1,440 minutes); if there is no communication with a Remote Station within set time, the Remote is declared down and is removed from the Remote table. Setting RDOWN to 0 keeps a Remote defined indefinitely. (MASTER OPERATION ONLY)

OTL – outstanding text limit (default 20 texts); the number of messages a Station is allowed to send to another Station without an end-to-end acknowledgment.

CONNP – connectivity message precedence (default 1 precedence); information on changes in the connectivity table is given highest precedence (automatic feature). (MASTER OPERATION ONLY)

ETEAP – end-to-end ACK message precedence (default 0 [zero] precedence); the acknowledgment of a message when it reaches its final destination is given highest precedence.

HTO – history file timeout in minutes (default 10 minutes); maintains information for duplicate filtering.

TEXTL – text size in segments (default 32 segments). (MASTER OPERATION ONLY)

FLOODP – partial "flooding" precedence level (default A precedence). Messages of this precedence level and above are transmitted over all routes of minimum length; messages below this precedence are not sent over all minimum length routes, but

are sent only over the route where the shortest transmit queues exist. (MASTER OPERATION ONLY)

INF – infinity hop quantity (default 8 hops). Defines the width of the network in hops plus one to determine when connectivity to a node is broken. Should be as low as possible to minimize auto-connectivity traffic in the network, but large enough to not erroneously flag nodes as being offline. (MASTER OPERATION ONLY)

RELAY – relay function specification (default ON). Specifies whether the 545B should act like a Remote in terms of relay functionality (i.e., does not share connectivity table with other Masters. (MASTER OPERATION ONLY)

DATAP – priority of data reports initiated at the MCC-545B (default Y precedence). When used in any data collection network, this setting defines the precedence of data reports generated asynchronously by the equipment itself. Typically, it should be lower than operator entered messages and commands.

MBHOP – meteor burst link hop weight (default 1 hop). Defines the number of network hops to associate with a meteor burst Master Station link when determining the minimum path to use in routing a message. Should be high enough to prevent a meteor burst Master Station link to be picked over a line-of-sight Remote to Remote link in a generally line-of-sight network.

4.2.4 Selecting the Burst Monitor

The 545B has a unique meteor burst monitor capability that allows you to monitor the number of characters received, the RF signal level, and other parameters on each reception.

To turn on the burst monitor and record statistics on meteor bursts, type:

MON{,d{,r}}

The two optional parameters are designed to limit the printout. The burst monitor generates two or three lines of printout for every burst. This could conceivably create hundreds of pages of printout a day in a network environment. The first parameter is the duration character count limit. Only meteors lasting long enough to deliver "d" characters will be monitored. The second parameter is the received character count limit; if at least "r" characters are received on the burst, a monitor line will be generated. The default values are 100 for "d" and 1 for "r". For example, to limit the printout, but still get some maintenance benefit from the monitor, enter:

MON,500,100

This limits the printout to meteors that have a duration character count greater than 500, or a received character count greater than 100. You can adjust these parameters as desired.

The command MONOFF turns off the burst monitor.

4.2.5 Controlling the Hourly Statistics Report

By default, an hourly statistics report is generated on the maintenance terminal port on the hour. This report consists of the same statistics reports generated by the BINS, MEM, and STAT commands.

The hourly report can be disabled by entering the command:

HOURLIES,OFF

The hourly report can be re-enabled by entering the command:

HOURLIES,ON

4.2.6 Scheduling 545B Events

The 545B SCHED command allows you to schedule automated command "events". An "event" simply consists giving one or more 545B commands a trigger time. When the 545B's real-time clock reaches the trigger time, the scheduler invokes the command as though you had entered it from the 545B's operator terminal.

Two different types of time trigger options are provided for command scheduling: INTERVAL and TIME. The INTERVAL trigger allows you to schedule a command to be invoked at periodic intervals within a 24-hour time period; the TIME trigger allows you to schedule a command to be invoked only once at a specified point within a 24 hour time period. The command schedule list is restarted each time the real-time clock reaches midnight.

To display current schedule list, enter:

SCHED

To add a new command to the schedule list, enter:

SCHED,type,time{OFFSET,time},command

where: type = INTERVAL or TIME
time = hours:minutes:seconds
OFFSET,hh:mm:ss = time offset from specified timeframe (optional)
command = any 545B command (with parameters)

NOTE

The scheduler ignores certain 545B commands due to their interactive nature. The MESSAGE command is currently the only ignored command

To remove command event(s) from the schedule list:

SCHED,DEL,xxx

where: xxx = ALL (erases entire schedule)
or
= schedule list number (removes single scheduled event from schedule list)

IMPORTANT

The 545B currently supports up to 50 scheduled command events. The schedule list will be erased if the system software re-boots (not to be confused with power failure recovery, which will preserve the schedule list).

You can schedule several command events to trigger at the same time; however, you cannot force one command to execute before or after another. After assigning command events to the schedule, the order of commands displayed in the schedule list is the order in which the events will trigger for any given trigger time (i.e., an event with a low schedule number occurs before an event with a high schedule number).

4.2.7 Setting Timeout Duration

There is one programmable time limit for I/O port input on the 545B. MCC recommends using the given default timeout parameter. If you choose to change the timeout, use the following command. Time limits are set by entering the number of seconds, from 0 to 32767. Enter a 0 to turn off the time limit.

Command	Description
STT,secs	Set Teleprinter Timeout. Time limit for characters at maintenance terminal. Default is 60 seconds (1 minute).

4.2.8 Setting Frequencies

The FREQUENCIES command is used in systems using synthesized frequencies only (see Section 2.7.4). To enable setting frequencies, you must first enter the following command to identify the system as a synthesized frequency system:

SYNTH,ON

You can then display/set the TX and RX frequencies using the following command:

FREQ{UENCIES{,aaaa,bbbb}}

where: aaaa = Tx Frequency (e.g., 4053 for 40.53 MHz)
bbbb = Rx Frequency (e.g., 4153 for 41.53 MHz)

IMPORTANT

Componentry in the MCC-545B limits the usable frequency range to a 2 MHz bandwidth. If frequencies are to be changed outside this bandwidth, hardware modifications must also be made to the MCC-545B.

If the synthesizer is unable to establish phase-lock when the **SYNTH,ON** command is entered, the MCC-545B will respond **UNLOCKED** to the request and turn off the TX key. It will try once a minute thereafter to establish phase-lock. If it fails, the message **Synthesizer unlocked** will be displayed; if it succeeds, the MCC-545B will respond **LOCKED** and turn on the TX key.

4.2.9 Defining Data Relays

Performance at meteor mode Remote units having poor communication paths with a Master Station due to ambient noise conditions, etc., can be enhanced by using an MCC-545B PACKET DATA RADIO located in a quiet location line of sight with the Remote units as a data relay. When used as a data relay, the 545B will concentrate data reports from one or more Remote units and forward them to the Master Station.

When used as a relay, the MCC-545B must be defined as a Master Station and the Remote units to be relayed use the relay as their preferred Master. The relay will receive MCC-550C sensor data GROUP reports (see MCC-550C Operations Manual), repackage them and forward them to the Master Station. A relay unit can handle up to a total of sixteen GROUP reports. These reports can be in any combination; i.e., four groups from each of four Remote units, one group from each of sixteen Remote units or any combination in between. Substitution tables must be established in both the relay unit and also the Master Station to manage the relay function.

When a designated GROUP report is received at the relay, it will substitute its own ID and group number in the report as defined in its substitution table and forward the data to a 520B Master Station using 550C RF format rather than standard 545B message format. When relayed data is received at the 520B, it will reconstruct the original data report based on its own substitution table and route the report as required.

The following command is used to define entries in the substitution table for a relay unit:

SUBST,relay_id,relay_group,remote_id,remote_group

where: relay_id is the relay unit's ID
relay_group is the data group report number at the relay
remote_id is the originating Remote unit's ID
remote_group is the data group report number at the originating Remote unit

4.2.10 Scaling A/D Readings

The 545B appropriately scales readings from its A/D converter for operator use. The readings that require scaling are battery level, detected RF and transmit power. The scaling factors required for these readings depend on the type of hardware configuration in the 545B and are set by operator command using the SCALE command as summarized in Table 4.1.

There are four values that need to be scaled differently depending on the equipment configuration:

- Battery Voltage (STAT/TEST commands)
- Detected RF in dB (MM command, meteor monitor, BINS command)
- Detected RF in microvolts (STAT/TEST commands)
- Transmit power level (STAT/TEST commands)

The required scaling factors are determined by the power supply used in the PACKET DATA RADIO; however, the receiver type (RXTYPE command) is also significant since the 527 and 543 receiver calibration curves which relate detected RF (in dB) to microvolts are nonlinear and significantly different.

To apply the scaling factors, the transmit power A/D reading value must first be squared then then multiply by the factor in the table. For the other values, take the A/D reading directly and multiply by the factor.

MCC-545B SCALING FACTORS

PARAMETER	STANDARD 545B, 12V	EGYPT 543, 36V	NORWAY 545B, 28V
BAT	0.0623	0.05	0.1749
DETRF	0.0188	0.1074	0.0188
TXPWR	0.000353	0.00116	0.000353
RXTYPE	527	543	527

TABLE 4.1

4.3 Sending and Receiving Messages

4.3.1 Entering and Deleting Messages

Entering Messages

There are two ways to enter messages:

1. If you want to send a message to your 545B's default destination (set with the DESTINATION command), enter the MESSAGE command with no parameters by following these steps:

    a. Type MESSAGE. The computer enters the edit mode. If you decide to exit the edit mode before transmitting a message, type [CTRL]A.

    b. Enter a message up to 3,570 characters in length, pressing [CR] at the end of each 80 character line. To correct mistakes made upon entering the message, see Section 4.3.3.

    c. After entering the message, press the [ESC] key. The [ESC] key queues the message for transmission.

The computer prints the following message:

```
hh:mm:ss  Message No:  name:sss, nnnn chars, nnn segments
hh:mm:ss  ROUTING name  :sss  TXT sss/nn  TO: name
```

NOTE

If you want to use source routing, enter 0 for the destination ID. When the Master Station receives your message, it will send the message to the appropriate destination, based on its link table showing which destination(s) are linked with your Station (the source Station where the message was sent from). Refer to the Master Station manual for more information on source routing.

Messages entered in this fashion have a priority of R. If you want to send a message with a higher (or lower) priority to your default destination Station, enter MESSAGE,p where "p" is any letter A (top priority) to Z (lowest priority). If you also want to send the message to another Station, refer to step 2 following.

2. If you want to send a message to another Station in addition to or instead of your default destination, enter the MESSAGE command with priority and destination parameters by following these steps:

    a. Type: MESSAGE,p,dest1,dest2...

where "p" is any letter from A to Z (A is top priority, and Z is the lowest priority).

When you enter the message destinations as command parameters ("dest1", "dest2", etc.), the message is automatically routed to those Stations when you enter the message and press [ESC]. Destination is the Station numerical ID.

.

NOTE

If you also want to send a copy of the message to your default destination, you must enter its Station numerical ID as one of the command parameters ("dest1", "dest2", etc.) as specified above.

b. Enter a message up to 3,570 characters in length, pressing [CR] at the end of each 80 character line. To correct mistakes made upon entering the message, see Section 4.3.3.

c. After entering the message, press the [ESC] key. The [ESC] key queues the message for transmission.

The computer prints the following message:

```
hh:mm:ss  Message No:  name:sss, nnnn chars, nnn segments
hh:mm:ss  ROUTING name  :sss  TXT sss/nn  TO: name
```

Special Features

1. Retransmit a Previously Entered Message.

   You can resend the previous message by simply pressing [ESC] before any other key when the terminal prints ENTER TEXT. The message is sent to any destination(s) you entered when you typed MESSAGE, or to the default destination if you did not enter any destinations.

2. Revise a Previously Entered Message.

   You can add to the previous message or recover an abort by typing a [CTRL]T as the first character after the ENTER TEXT: prompt. The previous message prints, and leaves the cursor at the end of the message. You can now resume editing; press [ESC] to send the message, or [CTRL]D to erase the message.

Deleting Messages

To delete a message once you have placed it on-the-air (maintenance terminal only), type:

DEL MSG,id:sss

where: id - numerical Station ID
sss - message serial number

The maintenance terminal prints the date and time, followed by MESSAGE DELETED. Other commands that you can enter to delete messages are described in Section 4.3.6. See Appendix A for a description of the printouts.

4.3.2 Sending Commands to Remote Stations

Commands may be sent to any Remote Station, in the form of text messages. The commands may be any valid command for that type of Remote, except for message entry. The response text for the command is transmitted back to the 545B in the form of command response packets, and it is displayed on both the console and alternate console ports. The command entry is similar to the MESSAGE command, which is shown in the Section 4.3.1.

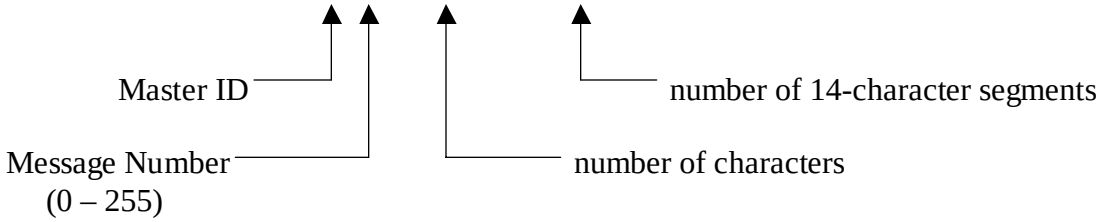
To send a command to a Remote, enter the following:

REMCMD,p,dest1,...destn

where: p - the priority character A to Z
dest1...destn Remote numeric ID

The operator is prompted for the text of the single command to be entered using the message editor. Once the command is entered, press the [ESC] key to send the command. The operator terminal prints:

Hh:mm:ss **Message No:** name:sss, nnnn **chars**, nnn **segments**



The message is enqueued as a type CMD (as displayed by the SMS command). The response is a type MON message.

4.3.3 Editing Messages

There are several keys on the maintenance terminal that provide editing functions while the computer is in the edit mode. If you have left the edit mode by pressing the [ESC] key, you can further edit the message by typing MESSAGE, then [CTRL]T. The contents of the message you have just entered is displayed. You can then edit the message using the following keys:

[DEL]	Deletes the last character entered.
[CTRL]R	Prints the current line of text on the next line down.
[CTRL]I	Performs a fixed tab function.
\	Removes the current line from the edit buffer.
[CR]	Performs a carriage return and line feed.
[LF]	Performs a carriage return and line feed.
[CTRL]X	Removes the current line from the edit buffer and places the cursor at the end of the previous line.
[CTRL]T	Prints the contents of the edit buffer.
[CTRL]D	Erases the entire contents of the edit buffer.
[CTRL]A	Aborts the edit mode and returns to the command mode. A + indicates the command mode.
[ESC]B	Leaves text edit mode and queues message for transmission.

4.3.4 Transmitting Messages

You automatically transmit messages by entering messages with the MESSAGE command. Each message is placed in the transmit queue in order by assigned priority - messages of equal priority are placed in the queue in the order that you enter it. As the originating 545B begins to transmit the message, it prints the following message on the maintenance terminal:

hh:mm:ss Message No: name:sss, nnnn chars, nnn segments
hh:mm:ss ROUTING name :sss TXT sss/nn TO: name

Messages are transmitted in units called packets. Packets can be independently routed to the destination Station. When the next Station receives a message packet, you see an acknowledgement text line formatted as:

mm/dd/yy hh:mm:ss TXTMSG ACK name:sss, xxxx CHARS FROM name

When the message has been delivered to its destination, you will see an end-to-end acknowledgement:

hh:mm:ss END-TO-END ACK OF name:sss FROM name

If the end-to-end ACK is not received within the time-to-live limit, the 545B purges the message from the queue and print the following message:

hh:mm:ss MESSAGE TIME-TO-LIVE EXPIRED, MSG.NO: sss,DESTN: name

You must then reenter the message. If this printout recurs often, you should examine the performance of the equipment. Continued failure to transmit a message indicates that something is wrong with the equipment, or the link (such as too much noise interference).

4.3.5 Receiving Messages

Whenever the header of a new message is received, the message is announced by the following printout:

hh:mm:ss RECEIVING name:sss TXT sss/nn FROM name ROUTED TO: name

The 545B then generates an ACK of the message packet and transmits the ACK back to the neighbor it received the message from:

hh:mm:ss TXTMSG ACK name:sss, nnnn CHARS FROM name

When the destination 545B receives a complete message, it prints the message to the same port at which it was input at the source Station, e.g., it outputs it to the message port if it was input on the message port at the source Station. Messages print in the following format:

hh:mm:ss MSG RECEIVED name:sss, xxxx CHARS
text.....
** end-of-message **

where "name:sss" is the message serial number.

Messages are deleted as they are printed, unless they are also being forwarded to further destinations.

4.3.6 Examining/Revising Message Queues

There are two types of queues for messages:

Queue Name	Description
TXQ (Transmit Queue)	Transmit queue for all transmitting messages. There is a separate transmit queue for each neighbor Station in network. For example, if you enter a message for DEST1, that message is placed in DEST1's transmit queue if DEST1 is a neighbor or in a neighbor Station's transmit queue on the route to DEST1.

RXQ (Receive Queue)	Receive queue for all messages being received. There is a separate receive queue for each neighbor Station in the network. For example, to examine message statistics from NODE5, examine the receive queue from NODE5.

To examine the contents of any of the queues, type:

SHOW TXQ,id or SHOW RXQ,id

For the receive and transmit queues, you must specify the queue by centering either the Station ID or a wild card (-) as a parameter. For example, SHOW TXQ,006 prints statistics for all messages being transmitted to Station 006. See Appendix A for a description of queue printouts.

You can only examine the receive and transmit queues for neighbor Stations in the network.

To delete transmit and receive queues, you must specify the exact queue by entering a Station name:

FLUSH TXQ,id or FLUSH RXQ,id

For each message deleted, the terminal prints:

id:sss unlinked {and deleted}

The "and deleted" text appears only if the message is not present in another queue. When all message have been deleted, the terminal prints:

queue flushed

To delete a specific message, enter:

DEL MSG,id:sss

The terminal prints:

Message deleted

To delete all messages from all queues, enter:

FLUSH MSG

For each message deleted, the terminal prints:

id:sss deleted

Entering the FLUSH MSG command deletes all messages in all queues for every node of the network, including connectivity and end-to-end acknowledgment messages.

4.3.7 Examining Message Status

The software allows the user to examine message status. These commands display data only for your Station. Since the message queues are dynamic, this information constantly changes. After messages have been transmitted to their destinations (i.e., ETEs have been received by the originating Station), the messages are deleted from the queues.

To see message status, enter "show message status":

SMS{,id}

These commands accept wild cards for parameters; i.e, a "*" replaces one character of text, and a "-" replaces any number of characters. Since received messages are deleted after they are completely transferred and printed, the "show message" command does not affect receive queue. See Appendix A for a description of printouts.

4.3.8 Entering Canned Messages

You can put the 545B into canned message mode, and it automatically generates messages for transmission to an assigned neighbor until you terminate the mode. Canned message mode cannot have more than 25 messages in the queue at one time. You can either send a message that you have composed, or you can send a message that is generated from the alphabet.

To enter a canned message generated from the alphabet, enter:

CANMSG,id,msg length{,min. queue depth}

where "id" is your neighbor's Station ID, the message length is from 1 to 3000 characters, and the minimum queue depth is from 1 to 25. The default minimum queue depth is 5. If the number of canned messages in the queue falls below the minimum queue depth, additional canned messages are injected.

To enter a canned message that you compose, enter:

CANMSG,id

where "id" is your neighbor's Station ID. The Station puts you in the edit mode. Compose your message and press [ESC]. The Station routes one canned message, then generates up to 25 messages. After the messages are generated, they are routed in sequence to the destination Station.

Canned messages are ACKed as each message finishes transmitting to the selected neighbor. No ETE is generated.

To terminate the mode, enter:

CANMSG OFF,id

Where "id" is the ID the messages were generating for.

4.3.9 Printing Canned Messages

In the default state, canned messages do not print. To print canned messages as they are received, enter:

CANMSG MODE,PRINT

To turn off the print mode, enter:

CANMSG MODE,NO PRINT

4.4 Data Loggers

The 545B can transmit data that has been collected and stored by a data logger unit. Although each type of data logger operates differently, the 545B allows you to gather data from a supported data logger and deliver it, via a Master Station, to a central Host Computer or Data Center, where it can be placed in a database and/or manipulated for other programs, such as forecasting, modeling, etc.

The 545B interfaces with a number of different data logger units. You can select the data logger you are using by entering the given parameter as part of the ASSIGN command. Refer to Appendix B for specifics on selecting and using each individual type of data logger with the 545B.

MCC is constantly updating its list of data loggers supported by the 545B. Consult the factory for the latest list of supported devices.

4.5 Reporting Position Location

The 545B can transmit position location information supplied by a standard GPS or LORAN unit. This position location can be sent, via the Master Station, to a central Host Computer or Data Center. This data can be used in dispatch centers, corporate district offices, and other monitoring Stations for updating map displays or additional functions.

The 545B interfaces with a number of different GPS or LORAN units and supports various GPS protocols. You can select the GPS unit and protocol you are using by entering the given parameter as part of the ASSIGN and POS commands. Refer to Appendix C for specifics on selecting and using each individual type of GPS unit with the 545B.

MCC is constantly updating its list of GPS units supported by the 545B. Consult the factory for the latest list of supported devices.

4.6 Master Simulator Mode

When in Master Simulator mode, the 545B can generate repeated Master Station probe signals and receive "acquired" signals from answering Remotes. After receiving an acquire, the 545B communicates with the Remote as a Master Station would - the 545B can receive and acknowledge sensor reports and RF performance stats, send and receive messages, and send Remote commands and receive the appropriate command responses.

CAUTION

Unless specifically directed, you should only use Master Simulator mode with the special, low-power 545B configuration. Changes for this low-power configuration include transmitting at 2 watts with the transmit limiter disabled. Consult MCC before operating a full-power 545B in Master Simulator mode.

Master Simulator Set-up

CAUTION

When using the 545B to generate probe signals, make certain you have a suitable antenna connected to the 545B's antenna connector and that the RF link to the Remote unit is balanced.

1. The 545B must be set to Master mode in order to generate probe signals. Set 545B's device type by typing:

   DEVICE,MASTER

2. The 545B's bit rate must match that of the Remote unit you want to generate probes for. The typical MCC Remote unit uses a 4K bit rate. Set transmit/receive bit rate to 4K by typing:

   BRATE,4K

3. The 545B's uses BPSK modulation. You must select this modulation by typing

   MODULATION,BPSK

4. The 545B must transmit in half-duplex mode, due to its built-in T/R switch. Set transmit mode to half-duplex by typing:

   HALFDUPLEX

IMPORTANT

The 545B cannot communicate using full-duplex mode. If you place the 545B in full-duplex mode (in order to simulate a full-duplex Master), the 545B's receiver is disabled by the built-in T/R switch.

The 545B can use two different "roles" when generating probe signals (see also the explanation of the P command following step 6).

If you want to generate repeated probe signals (like a Master Station's "idle" or enquire probe), set 545B role to probe by typing:

ROLE,PROBE

If you only want to produce single pulse probes (for testing an individual Remote's responsiveness), or to probe very slowly, set 545B role to transpond by typing:

ROLE,TRANSPOND

Optionally, you can set the low and high threshold numbers for determination of LOS operation when setting ROLE to TRANSPOND and/or the initial state of the mode (MB or LOS). When operating in the LOS mode, the 545B waits a random number of idle probes between each probe.

6. The 545B's ID must match the assigned Master ID for the Remote unit(s) being probed. Set ID by typing:

   ID,n,INIT

   where "n" is the assigned Master ID of the Remote unit.

IMPORTANT

If you change the 545B's ID, the software reboots after you enter the INIT parameter and press [CR]. The SAVE command is automatically performed, ensuring that your configuration changes are kept in EEPROM (and not lost after power cycling). However, if you do not need to change the 545B's ID (i.e., it was already set to the same ID as the Remote unit's assigned Master), make certain you use the SAVE command before starting to probe or any configuration changes you have made will be lost if the 545B is rebooted.

Now you can generate probes using the 545B.

If you are using the 545B in a pulse probe mode, you need to use the P command to generate probe signals. The P command has the following uses:

P Transmit a single probe.

P,? Display current pulse probe mode settings (whether or not periodic pulses are enabled, and if so, what the period is).

P,x Send a single periodic probe once every "x" seconds (if you set "x" to 60, the 545B generates a single probe once a minute).

P,OFF Turn off periodic pulse mode (you can still enter P to transmit single probes).

4.7 Examining Station Statistics

Statistics on Station operation, meteor bursts, and warnings print hourly at the maintenance terminal (unless HOURLIES has been set to OFF). If you want to see these statistics more frequently, you must request a printout by entering the following commands at the maintenance terminal. Some statistics, such as the receive and transmit statistics, print only on request. See the command table for a more detailed description of these commands. The printouts generated by these commands are explained in Appendix A.

To generate a printout of Station statistics, type:

STAT

The meteor burst statistics and maintenance parameters are automatically posted for transmission from 545B to the Master Station at intervals dictated by using the STAT TIME command. The burst statistic values are accumulated for each period. The RF power, battery, and noise maintenance parameters are among those values read.

To change the time when the 545B's statistics are transmitted to the Master Station, type:

STAT TIME,xx

where "xx" is the time interval (from 1 to 24 hours, starting at midnight) when the statistics are transmitted. For example, if you want the 545B to transmit its statistics every six hours (at 6 a.m., noon, 6 p.m., and midnight), you would enter STAT TIME,6. If you want to transmit statistics only at 6 p.m. in the evening, you would enter

STAT TIME,18.

To display 545B meteor burst statistics, type:

BINS

To examine memory utilization, type:

MEM

To make the 545B send a test transmission, type:

TEST

These are the most common statistics commands. For information on message statistics, see Section 4.3.7. For information on meteor burst statistics, see Section 4.2.3 and Appendix A. For additional commands that are useful for maintenance purposes see the command table list at the end of this chapter.

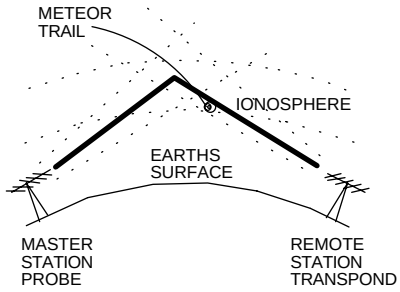
4.8 Configuring an RF Network

Configuring MCC Master Stations and Remotes can be a tedious process. This application note is intended to make the task easier by explaining the process in a layered approach that tends to group features in logical groups rather than taking each parameter individually. The configuration process is accomplished in several steps. It is best to take care of identifying the modem first, then set up the network parameters, then the RF link parameters, then configure all of the I/O ports. The last step is to monitor operation for a time to be sure everything is working. Do not leave a Remote location without the unit working or a repeat trip will in the near future.

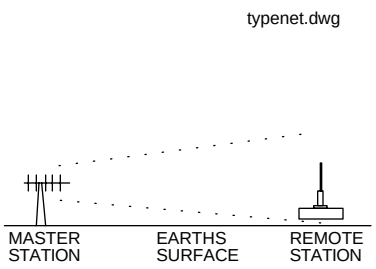
A script file will usually be set up for all the units in a system of a given type. At a minimum, the ID must be different for each unit and sometimes there are other network related parameters that are different for each unit and can not be duplicated in a script file.

4.8.1 Types of Networks

The various types of PACKET DATA RADIOs made by MCC can be configured to operate in a variety of ways to accommodate customer requirements. This discussion attempts to present the RF configuration parameters for the most common types of system configurations. Systems are usually divided into two major categories having to do with the geographic size of the network. Master Stations provide the backbone of a network, and provide all the connectivity management and routing required to route data and message traffic between Remote Stations and user Host systems.



Meteor Burst



Line of Sight

The Meteor Burst (MB) network is used to cover large areas. Each Master Station can cover an area up to 1,200 miles in diameter depending on many physical and data rate requirements. Each Master Station can support up to 3,840 Remote Stations. Typically, this type of system is used for data acquisition where the data acquired by Remote Stations is transmitted to a Master Station at a slow update rate. Typical update rates are usually measured in hours. The RF burst data rate varies from 4,000 to 9,600 bits per second (depending on equipment configuration), and the interval between bursts varies randomly from a few seconds to many minutes. The Master Station is usually a MCC-520B, and the Remotes are a MCC-550B/C Data Acquisition Unit, MCC-545B PACKET DATA RADIO or a combination of both.

A Line of Sight (LOS) network is used in smaller areas or when required data throughput is higher than a Meteor Burst (MB) network can provide. The MCC-545B PACKET DATA RADIO is used for the network Repeater and Base Master Stations. MCC-550B/C Data Acquisition Units or MCC-545B PACKET DATA RADIOs with CR10X Data Loggers are used for data acquisition applications and MCC-545B PACKET DATA RADIOs are used for message and GPS location applications. Each MCC-545B that is set up as a Master Station can operate with up to 80 other Master Stations and up to 256 Remote Stations.

The two types of networks can be combined in a seamless manner to provide both MB and LOS capability when properly designed for optimum performance. Each of these types of networks are discussed in the following sections.

4.8.1.1 Meteor Burst Networks

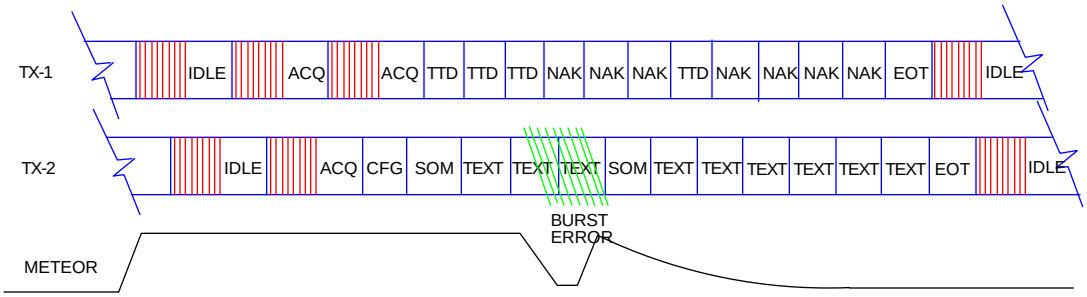
MB networks use the MCC-520B as Master Stations and are used when the Remotes are beyond line-of-sight range from the Masters. If the area to be covered is too large for one Master Station, then multiple Masters can be used. Depending on throughput requirements and whether the Remote Stations need to be able to operate with only one Master or must be able to switch to another Master during maintenance periods, there are several configurations possible. The modes are defined by the "role" of the Master Stations and by whether they are full duplex - dual frequency, or half duplex - single frequency as explained below.

Set up the ID first using the command: **ID,MM,INIT** where **MM** is the Master ID (1-245).

Set up the synthesizer mode: **SYNTH,ON** or **SYNTH,OFF**

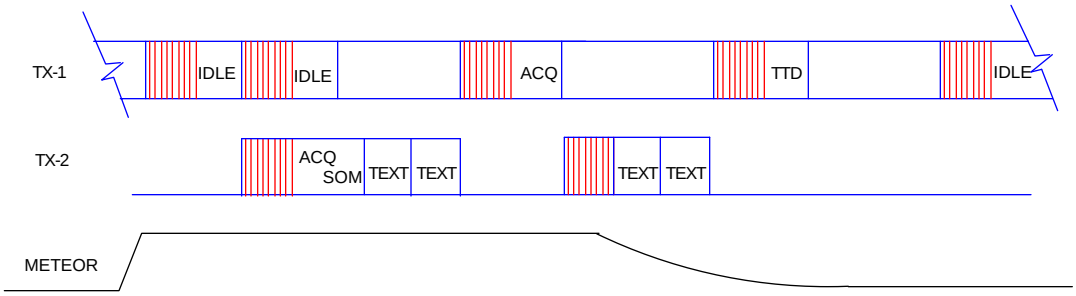
4.8.1.1.1 Full Duplex Network

The Master Station(s) can be set up to communicate between themselves in a full duplex, two frequency mode. This provides a high efficiency data transfer between Masters that is about four times faster than the data rate between Remotes and Masters. Remote Stations always communicate to their Master Station in a half duplex mode.



Full Duplex Masters

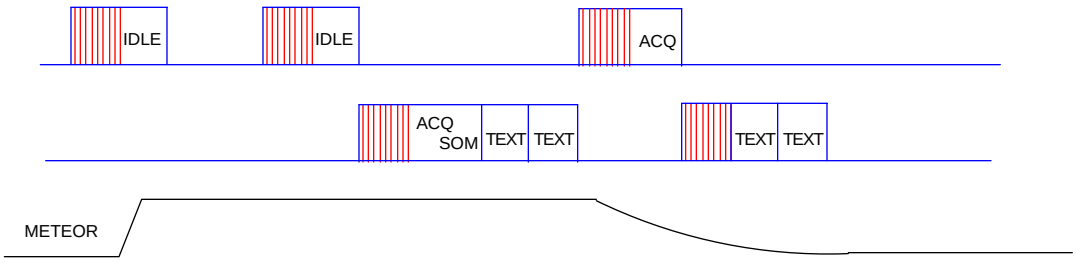
Operating with two frequencies requires the transmit and receive frequencies of the units to be matched to achieve the desired network topology. This situation means that the Tx frequency of one Master must match the Rx frequency of the other Master. Remotes set up to match the frequencies of one Master can not communicate with a Master using the opposite Tx/Rx frequency pair. All Master Stations in this type of network can be set to ROLE,PROBE which means they can continually transmit idle probes and there will be no contention because of the matched frequency pairs. This setup is the best choice for networks having only one or two Master Stations. To select this mode, enter the command: FULL DUPLEX



Full Duplex Master
Half Duplex Remote

4.8.1.1.2 Half Duplex Network

Some situations require a dense connectivity between Masters and Remotes where any Remote can communicate to any Master, and any Master can communicate with any other Master. This topology requires a single Tx and Rx frequency and therefore can not operate in a full duplex mode. The Masters are set up to operate in half duplex and some contention can result between Masters that is solved by one of the following methods. To select this mode, enter the command: HALF DUPLEX, MS where MS is the number of milliseconds between idle probes.



Half Duplex Master
Half Duplex Remote

4.8.1.1.3 Master Probe/Transpond Role

Adjacent half duplex Master Stations will have difficulty establishing an RF link quick enough to make efficient use of meteor trails if they both transmit idle probes continuously. This state occurs because the use of a single frequency causes contention when both transmit at the same time. The Masters must take turns transmitting. One way to do this is to set one Master to a probe role, while the other is set to transpond role. The prober continually transmits the idle probe while the transponder is in a receive-only mode. When the transponder receives the probe from the other Master, it transmits a response and the two Masters exchange data. Note that while this setup allows good performance between Masters, one of them is not transmitting idle probes and cannot initiate communication with a Remote Station.

Example: **ROLE, PROBE** or
ROLE, TRANSPOND

4.8.1.1.4 Master Active/Passive Role

This network operation mode allows full or half duplex communication between two Masters and also allows both Masters to communicate with Remotes. This condition is accomplished by assigning time slots for each of the Masters to transmit idle probes. The Master in the active role transmits idle probes during even minutes. The Master in the passive role transmits idle probes during odd minutes. They effectively swap between the probe and transpond roles each minute.

The Masters can communicate between themselves at any time since they are in complementary roles; they can communicate with their Remotes when it is their time slot to transmit idle probes.

Example:	**ROLE, ACTIVE**	Set to active role. (Master with lowest ID)
	ROLE, PASSIVE, N	Set to passive role and wait **N** minutes for time probe from **ACTIVE** Master before starting to transmit idle probes (Master with highest ID)

4.8.1.2 Line of Sight Networks

An LOS network has all of its member units interconnected with RF links of a short enough range where the meteor burst RF protocols are not necessary. The total width of the network may exceed LOS range but the intermediate hops must be within LOS range. A slow rate idle probe is used to let each Master identify itself and to establish connectivity, but a CSMA protocol is used for link acquisition and communication. A special TDMA mode is used for GPS location reporting. Units are assigned to be either Master Stations or Remotes. The Master Stations provide a network backbone and the Remotes are the units connected to user equipment.

There are two modes of LOS network operation: multi-Master and Base/Repeater. The multi-Master mode allows Master Stations to interconnect automatically and establish a network backbone. The Base/Repeater mode is manually setup for Masters to act as either a Base Station or a Repeater; Bases connect directly to a land line WAN and Repeaters connect via a Base.

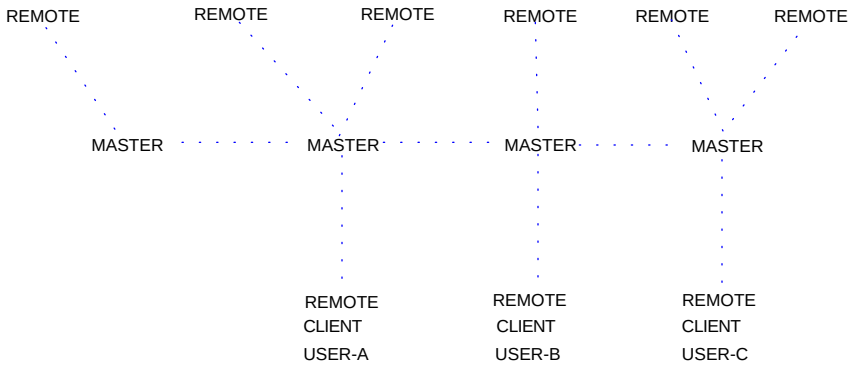
Commands used are:

DEVICE, MASTER	identify unit type
ID, MM, INIT	define the ID (**MM**) of a Master
DEVICE, REMOTE	identify unit type
ID, NNNN, MM, AUTO, INIT	define the ID (**NNNN**) and Master-select mode (**MM,AUTO**) of a Remote
ROLE, LOS	setup the line-of-sight role and CSMA RF protocols.
LOSCHECKIN, P,R	setup the CSMA period (**P**) and retry count (**R**).

4.8.1.2.1 Multi-Master Mode

With the BASE and REPEATER features disabled, a Master will connect to any other Master it can hear well enough to get the required number of idle probe counts per minute. A Master will connect to any Remote that acquires it, letting the Remote choose its best Master. Complete Master-to-Master and Master-to-Remote connectivity tables are automatically exchanged between Masters. Routing from any source unit to any destination unit is accomplished by the Master Stations. Complete networks with no land line connections are supported in this manner.

Connectivity between Masters can be limited to prevent accidental connections that do not work well if so desired. The multi-Master network looks like:



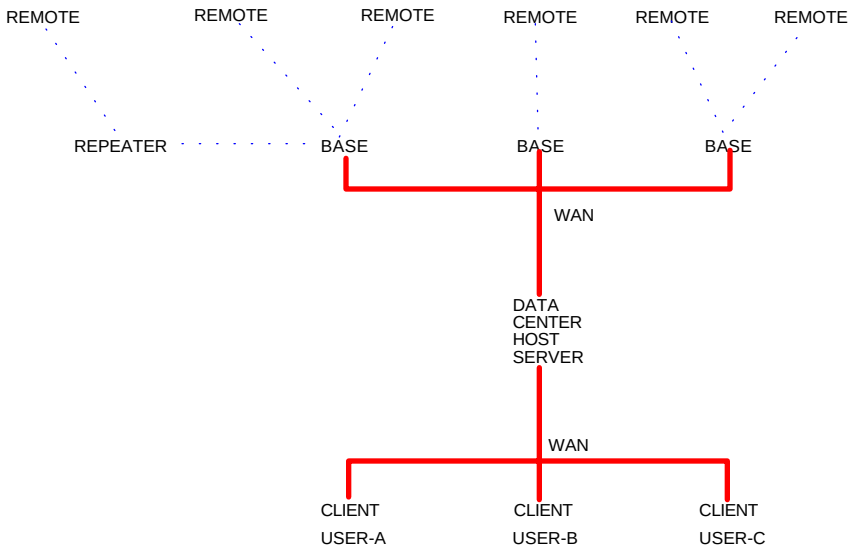
Remotes can be any combination of type with fixed or mobile connectivity. Each message must be routed to a specific destination ID.

Each Master and Remote is configured with the following commands:

BASE, OFF	Disable Base feature
REPEATER, OFF	Disable Repeater feature
CONNECT, N,N,N	Used to limit connectivity to specified Master list (**N,N,N**) or
CONNECT, OFF	Used if manual override of connectivity is not required

4.8.1.2.2 Base/Repeater Mode

The Base/Repeater mode is used when land lines are available to form the backbone of the network using WAN technology. Selected Master Stations are setup to be Base Stations and have direct land line connections into the WAN. Repeaters are then defined, where required, to cover areas where there are no direct land lines and the backbone must be extended to provide RF coverage; multiple Repeaters may be used to establish a WAN connection to a given area. Mobile Remotes, operating with the ID,NNNN,MM,AUTO configuration can then travel anywhere in the backbone of Master Stations and get connected to the WAN. The Base/Repeater network looks like:



All routing from Remote to Repeater to Base is handled by the PACKET DATA RADIO software. Routing between Base Stations is handled by the WAN Data Center computer. Client applications access the central host server databases to access data and send/receive messages, email, etc. Data, position reports and messages are routed to the Host by using DESTINATION, 1 which causes Remotes and Repeaters to route information to the nearest Base for output to the Host. This feature is used in any unit, (Remote, Base or Repeater) that has a BASE command defined. No Master (Base or Repeater) can have an actual ID set to 1 when using this type of network. The following table defines the routing logic used when Destination is set to 1:

Type of unit	Routing Logic used when Destination = 1
Remote	Send to current "Master" which could be another Remote, Repeater or Base
Repeater	Send to Master unit to which it is a Repeater, which could be another Repeater or Base
Base	Print on MNT, DTA and ALT ports for delivery to the Host Computer

In this way, a Remote anywhere in the network can get a message to the Host Computer by assuming it is ID 1. In any network where the units have BASE set to OFF a Master can have its ID set to 1.

In these types of networks, each of the RF sub-networks is independent of the others except through the Host. If a Base looses its Host connection, it is desirable to force the Remotes to select a different Base, if one is available.

This behavior can be controlled using the HOSTMODE command; its options are:

HOSTMODE, OFF	Ignore connection state, continue transmitting.
HOSTMODE, STOP	Stop transmitter if Host connection lost.

HOSTMODE, CONTINUE	Continue transmitting if Host connection lost, but use idle probes to indicate the Host connection is lost so Remotes can pick a different Master who has a host connection.

Commands used are:

DEVICE, MASTER	Identify unit type
ID, MM, INIT	Define the ID (**MM**) of a Master
BASE, L,H	**ALL** units must know low and high ID range for Bases.
REPEATER, B	Any Repeater must know the Base to which it repeats.
CONNECT, N,N,N	Used to limit connectivity to specified Master list (**N,N,N**) or
CONNECT, OFF	Used if manual override of connectivity is not required.
HOSTMODE, AAAA	Define transmit mode when DTA port in MCS protocol mode fails. This can be set to **OFF**, **STOP** or **CONTINUE**.
DESTINATION, 1	Default destination for Remotes set to "special" ID for Host Computer

4.8.2 Remote To Master Assignment

Meteor Burst networks are usually static in nature. There is usually no reason for Remotes to move around although mobile networks are possible. To minimize manual bookkeeping at the Master Stations and to provide reliable efficient routing of messages and remote commands from Masters to Remotes, Remotes are each configured to select their own Master. Remotes can be configured to select their own Master Station in a fixed, preferred or automatic way using the ID command as discussed in the following paragraphs. Usable Remote IDs range from 256 to 4095 and usable Master IDs range from 1 to 245.

4.8.2.1 Fixed Master Selection

Each Remote is told to use a particular Master Station. All other Master Stations are ignored. If a Master Station goes offline, its Remotes are no longer accessible in the network. The ID command defines both the Remote ID and its Master ID. The command used is:

ID,NNNN,MM	where **NNNN** is the Remote ID and **MM** is the Master ID

4.8.2.2 Preferred Master Selection

In networks with more than one Master, it is desirable to let data Remotes send their data to any Master but still allow a single route between Master and Remote for outbound remote commands and text messages. Also, if one Master is offline, it is desirable for the Remote to use another Master to deliver its data through. This mode lets the Remote pick the best Master by counting

idle probes from each one it receives and then selecting the one it hears the most during a specific period of time.

The MCC-545B and the MCC-545 OEM Transceiver both have this capability. The MCC-550B/C DAU does not, but it can operate with up to four Masters at a time. It will transmit data reports and text messages to any Master in its ID list. The MCC-550B/C ID command is entered as shown below:

ID,NNNN,M1,M2,M3,M4

where **NNNN** is the Remote ID and **M1 - M4** are the usable Masters

The MCC-545 OEM Transceiver always operates in this mode. The UR command allows up to four Master Station IDs where the first Master on the list is the preferred Master. Single-segment data reports are sent to any of the defined Masters but text messages, no-text check-ins and longer data reports are sent only to the preferred Master. A fixed 30-minute period is used to count idle probes and select the preferred Master.

The MCC-545 OEM Transceiver ID command is entered as:

UR,NNNN,M1,M2,M3,M4

Where **NNNN** is the Remote ID,
M1 - M4 are the usable Masters with
M1 being the current preferred Master

The MCC-545B is set up using the ID and SNP commands. It will only operate with its preferred Master. Data reports will not be transmitted to other Masters. It will choose its preferred Master at the interval given in the SNP,NDOWN command from among all Masters it receives.

The commands used are:

ID,NNNN,MM, PREF, INIT

where **NNNN** is the Remote ID,
MM is the initial preferred Master ID,
PREF enables the preferred mode of Master selection.

SNP,NUP,N

where **N** is the minimum number of idle probes per minute to qualify as a Master

SNP,NDOWN,D

Where **D** is the period in minutes to count idle probes and choose a preferred Master

4.8.2.3 Automatic Master Selection

The MCC-545B has the ability to automatically select its Master based on an algorithm more suited for LOS mobile networks. When a Remote has no online Master, it monitors all the other units (Masters and Remotes) it can hear for a one minute period. All transmissions made by those units are counted and the average detected RF level for the last two transmissions for each unit is calculated. At the end of the one minute interval the Remote picks the best one from its list to be its Master. The criteria for its choice are:

a) Count must be greater than or equal to SNP,NUP count.
b) Unit must have the highest detected RF level.
c) If several units have the same highest detected RF level, it will choose one with a different ID than the previous Master.
d) For a Remote, only transmissions to a Master will be counted.
e) A Remote will prefer a BASE over a REPEATER and a REPEATER over another Remote.

The Remote chooses the best one, if there is one, clears all the other units out of its temporary counting list and attempts to acquire that unit for the next SNP,NDOWN period. When no successful exchange and acknowledgement have been made for the SNP,NDOWN period, the choice process begins again.

The commands used are:

ID,NNNN,MM, AUTO, INIT

where **NNNN** is the Remote ID,
MM is the current Master,
AUTO is the mode option.

SNP,NUP,N

where **N** is the minimum number of counts per minute to be considered

SNP,NDOWN,D

where **D** is the maximum number of minutes to wait for a good exchange with current Master before declaring it offline and starting to choose a new one.

4.8.3. Destination Considerations

Messages, position reports and data reports can be routed from any origin (Remote or Master) to any other destination unit (Remote or Master). Messages can have multiple destination IDs embedded in the report and position reports can have only a single destination ID embedded; data reports cannot have any destination ID embedded. Moreover, the destination(s) can be entered in the command for messages but position reports and data reports will look at the

default destination assignment for their routing destination(s). This destination is specified using the DESTINATION command:

DESTINATION,OFF	Causes error in text message entry, data reports print locally and are not transmitted.
DESTINATION,0	Specifies source routing (see paragraph 4.8.3.1)
DESTINATION,1	Special Base to Host routing (see paragraph 4.8.3.2)
DESTINATION,D1,D2,D3,D4	Up to 4 destinations can be given

Data reports which use the MCC-550 type of sensor report formats have no bits within the transmitted frame to specify where the report is to be routed or who originated the data. This condition is not an oversight; it is designed that way to be compatible with the older format that is optimized for minimum overhead. If data reports must be forwarded to multiple destinations, they are sent on by the Master using message format; an exception to this rule occurs when the Master is using a substitution table (SUBST command), in which case, the proper ID is substituted according to the table and sent on as though originated at that node.

Position reports sent on to multiple destinations are sent as multiple reports, each containing a single destination ID. Text messages, packet protocol data, remote commands and remote command responses all contain fields for source and destination addresses.

When MCC-550 type sensor frames are received by a Master, the assumption is that the originator is the Remote that transmitted the data frame and that the DESTINATION is 0 (i.e., source routing). Sensor data reports and position reports are transmitted from the originating unit in the shortest possible format with minimum overhead. This approach provides the best throughput in meteor burst networks where the Remote has a MB Master. In LOS networks this criterion is not as critical but all extra bits transmitted contribute to wasting system capacity. In networks where the message or data must be transmitted multiple hops, the longer message format must be used because the relay units are not the originating unit and the origination ID and destination ID must be contained in the message.

4.8.4 Source and Group Routing

Data with no destination and text messages with "0" being the destination can be routed by a Master Station that has a source routing table. This table gives a list of destinations for each data-source Remote. A 520B/C can load this table from its 520B.INI file; whereas, the 545B can only support one table entry that is given in the SOURCE RELAY, ID command. If the Master's ID is in the table for the source of the data report being received, the Master has no table or there is no entry for the source Remote, the Master will print the report on the MNT, DTA, and ALT ports for delivery to the Host Computer. The LINK, DEST, SOURCE, SOURCE, SOURCE, command is used to build the table in the 520B/C Master, for example:

LINK,1000,1200,1201,1202,1203
LINK,1001,1300,1301,1302

Group routing is provided in the 520B/C Master to facilitate the construction of the source routing tables. A list of source IDs can by defined by a group name, then the group name can be used in the LINK command, for example:

GROUP,G1,1200,1201,1203
GROUP,G2,1300,1301,1302
LINK,1000,G1
LINK,1001,G2
LINK,2,G1,G2

The equivalent functionality is provided in a 545B Master using the SOURCE RELAY command, for example:

SOURCE RELAY,2

4.8.5. Network Parameters

Network parameters control how the unit responds in the network. The MCC-550B/C can only be used as a data acquisition Remote. Therefore, their only network related command is to assign the ID code for the Remote and its Master as discussed above in paragraph 4.8.2.1.

The MCC-545B and MCC-520B/C have the following network commands listed below. Each of them are discussed in detail following the list.

SNP,TTL	Message time-to-live
SNP,TTR	Message time-to-retry
SNP,TEXTL	Message packet size
SNP,NUP	Number of receptions for neighbor up
SNP,NDOWN	Number of minutes for neighbor down
SNP,RDOWN	Number of minutes for Remote down
SNP,OTL	Congestion control outstanding text limit
SNP,CONNP	Priority for connectivity messages
SNP,ETEAP	Priority for end-to-end-ack messages
SNP,FLOODP	Priority level to initiate “flood-routing”
SNP,DATAP	Priority for data reports
SNP,HTO	History timeout in minutes for duplicate filtering
SNP,INF	Infinity hop count
SNP,MBHOP	Meteor burst link hop weight
SNP,RELAY	Enable/disable Master’s ability to relay messages for other destinations

SNP,TTL **Message time-to-live**
SNP,TTR **Message time-to-retry**
SNP,TEXTL **Message packet size**

This paragraph explains how message accountability is used to guarantee that text messages get delivered to their proper destinations within an allotted time. Data reports, position reports, and remote commands/responses will not get this guarantee. They get only one chance to get through the network.

Networks can have units go offline for various reasons; local noise can interfere with RF links, congestion can slow throughput to a crawl, RF link bit errors can cause segments of a message to get lost, etc. The more complex a network is, the more chances there are to be problems.

Messages entered at each source unit specify a time-to-live (TTL); this time is the maximum time to attempt to deliver it. If it is not delivered in this time, the operator at the source unit is informed so something can be done about it. The time-to-retry (TTR) is the number of minutes between attempts to deliver the message. Once a message is sent, it goes through the network one hop at a time and can get blocked at some point if the connectivity changes suddenly. The retry attempts are separated to allow network changes to settle out and establish alternate routes. When a message is received by a destination, an end-to-end-acknowledgement (ETE) is sent from the destination back to the source to stop any more retries and let the operator know the message was received.

The maximum message size is determined by the text length (TEXTL) setting. A message packet can consist of up to 3570 characters and is further subdivided into segments. Each message is uniquely identified so it can be tracked through the network and the ETE can be sent for each individual message. The message ID consists of the originator ID (16 bits) and message serial number (8 bits). Serial numbers range from 1 to 255 and are assigned in round-robin order. Each message is then split into 14-byte segments which are in sequence from 0 to 255. The segments allow the message to be transmitted a little at a time over short meteor bursts. The segment sequence numbers are used by the RF link software to identify which ones are acknowledged and to indicate where to resume on each burst.

The first segment (sequence number 0) is the message header and contains all the network overhead (originator ID, message serial number, priority, I/O port entered on, message type, number of destinations, number of segments, time to live, retry count, multi-packet message serial number, packet sequence number, total number of packets and first destination ID code). If the message has only one destination, segment 1 is the start of the actual text. If there are multiple destinations, segment(s) 1, . . . n contain the remaining destination codes, 7 destination codes per segment. The text starts on the next segment after the last destination code.

SNP,NUP **Number of receptions for neighbor-up**
SNP,NDOWN **Number of minutes for Master neighbor down**
SNP,RDOWN **Number of minutes for Remote neighbor down**

Network connectivity tables are automatically created and updated each time a Master detects a new neighbor unit or times out an existing unit. The NUP parameter gives the number of transmissions that must be received in one minute to declare a new neighbor. The NDOWN parameter gives the number of minutes with no receptions to time out a Master neighbor. The

RDOWN parameter gives the number of minutes to time out a Remote neighbor. Setting NDOWN or RDOWN to "0" disables the feature (i.e., never declare neighbors down).

SNP,OTL Congestion control outstanding text limit

The OTL parameter specifies the maximum number of messages that will be transmitted while waiting for ETEs. Limiting messages, as cars are limited to entering the freeway at rush hour, tends to reduce congestion and memory buffer usage in the network and reduce the number of retries that happen as a result. Sending messages one at a time does not take advantage of the overlap caused by the ETE needing to come back through the network and does not take advantage of an occasional large burst that can significantly improve throughput.

SNP,CONNP Priority for connectivity messages
SNP,ETEAP Priority for end-to-end-ack messages
SNP,FLOODP Priority level to initiate "flood-routing"
SNP,DATAP Priority for data reports

The priority of network control messages should be set higher than the data traffic. This setting makes sense if you realize that messages can not get delivered as fast if the network connectivity is incorrect. Certain applications may have reasons for altering these values but any revision to the default priority scheme should be implemented carefully.

SNP,HTO History timeout for duplicate filtering

As each message is received by a unit, the originator ID and message serial number are retained in a history table. The HTO parameter specifies how long to retain each entry. Each received message ID is compared to this table and if the message was previously received and has not timed out, it is considered a duplicate message. The ETE is sent to the originator if it is a text message type but the duplicates are not output to the I/O ports. Duplicates happen due to network connectivity changes and retries.

SNP,INF Infinity hop count

The INF parameter specifies the maximum width of a network in hops + 1. If this parameter is set lower that the actual network width, units will be declared offline when they are not. If the number is set too high, extra connectivity packets are exchanged when a unit goes offline and the system looks for alternate routes.

SNP,MBHOP Meteor burst link hop weight

The MBHOP parameter defines the number of network hops to associate with a meteor burst Master Station link when determining the minimum path to use in routing a message. This parameter should be set high enough to prevent a meteor burst Master Station link to be picked over a line-of-sight Remote to Remote link in a generally line-of-sight network.

SNP,RELAY Enable/disable Master's ability to relay messages for other destinations

The 545B, when configured as a Master Station, will report all its neighbor connectivity to its neighbors with SNP,RELAY set ON. If it is set OFF, it will not report any neighbor connectivity. The OFF setting keeps neighbor units from finding alternate network paths through that node. This option should be left ON unless there is a very good reason to have it OFF for some specific customer requirement.

4.9 Command Reference List

MCC-545B COMMANDS

All implemented 545B commands are listed in Table 4.2 alphabetically for ease of reference. However, many commands are used in conjunction with others. These functional groups are given below. You may also type HELP or HELP,COMMAND to receive an explanation of any listed command. Command responses and unsolicited printouts are shown in Appendix A.

STATION CONFIGURATION COMMANDS

†*ASSIGN
*BRATE
*CHECKIN
†CLOSE PORT
†CONNECT
DATE
*DESTINATION
*DEVICE
*DUTY CYCLE
*FREQUENCIES
†HOST MODE
†*ID
†LOGOFF
†LOGON
*LOS CHECKIN
*MODULATION
†NEW PASSWORD
†OPEN PORT
†PASSWORDMODE
†RCT
†REMOTE TYPE
†RXTYPE
SAVE
†SCALE
†SCHED
SERIAL
*SET BAUD
†*SNP
*SOURCE RELAY
†START
†STOP
†STT
†SUBST
*SYNTH
TIME
†TIME ZONE
*TXLIMIT

STATUS COMMANDS

BINS
CLS
CONFIG
*HOURLIES
MEM
MODE
†MON
†MONOFF
†NETMON
STAT
*STAT TIME
T
TEST

MESSAGE COMMANDS

CANMSG
CANMSG MODE
CANMSG OFF
†COMPRESSION
DEL MSG
DQE RXQ
DQE TXQ
FLUSH MSG
FLUSH RXQ
FLUSH TXQ
*HOLD
MESSAGE
*MSG
*PRINT
REMCMD

POSITION LOCATION COMMANDS

†*POS
†POSRPT
†RED
†RTCM

MODE CONTROL COMMANDS

†CORPAT
*FULL DUPLEX
†*HALF DUPLEX
†*ROLE

MASTER SIMULATOR COMMANDS

*P

MAINTENANCE COMMANDS

BOOT	SHOW TXQ
RESET	SMS
REV	UPDT
SHOW RXQ	

DUAL MASTER STATION COMMANDS

†SWCTL	SWMON

UTILITY COMMANDS

FLASH	HELP

WARNING/WEATHER SYSTEM COMMANDS

†FLOOD TIMEOUT	†SENSOR
†GLOF	†STATION TYPE
†GLOF MONITOR	†WARNING
†HORN	†WARNING TIMEOUT
†PRIORITY	†WEATHER

DATA LOGGER COMMANDS

P77	SDATA
†$PENTM	

CR10X COMMANDS

CR10X	CR10X,ORDER	CR10X,SETPTR
†CR10X,ACQMODE	CR10X,REGISTER	CR10X,SIGNATURE
†CR10X,GROUP	CR10X,RESET	CR10X,STAT
†CR10X,INTERVAL	†CR10X,SCALE	†CR10X,TIME
CR10X,MAXQ	CR10X,SECURITY	CR10X,UPLOAD

MASTER MODE COMMANDS

*BASE	NET STAT	SHOW MAINTENANCE MONITOR
CLEAR MAINTENANCE MONITOR	NET STAT PERIOD	SHOW REMOTES
CONFIGURATION	†POLL	SHOW RXQ
LISTM	PRG	SHOW TXQ
LISTT	REMOTE STAT	SML
MM	*REPEATER	SMS
NET	RX STAT	TYPE

* Parameters/settings specified by these commands are stored in the EEPROM. Changes specified by these commands take effect immediately but are lost when the unit is rebooted unless the SAVE command is issued to write the changes to EEPROM. Changing the unit ID automatically saves the entire configuration.

† Parameters/settings specified by these commands are stored in battery backed-up RAM. Changes specified by these commands take effect immediately but are lost when the unit is rebooted unless the SAVE command is issued to write the changes to BBU RAM; in addition, the BBU jumper must be in place to enable RAM back-up.

If both symbols are present on a command, certain aspects are stored in one way and other aspects are stored in the other. See command table below for clarification.

MCC-545B COMMANDS

COMMAND	DESCRIPTION	PARAMETERS	RANGE
†*ASSIGN {,function,port,protocol {,timeout}} **NOTE** function, port and protocol information for ports 0, 1, 2 are stored in EEPROM; this information for port 3 and all timeout information is stored in BBU RAM.	Control allocation of user interface functions among physical device channels. When no parameters are entered, displays I/O configurations. Port definitions are as follows: Port — Front Panel Connector 0 — OPERATOR PORT 1 — DATA PORT 2 — AUXILIARY PORT 3 — DIAGNOSTICS PORT (Internal) **NOTE** It is possible to "lose control" of the 545B software by assigning control functions to ports with no devices attached or by turning off control functions. For example, if you turn off the Operator Port (**ASSIGN,MNT,OFF**), you will not be able to enter commands or view printouts from the 545B. You must open the 545B and press the Reset button on the microprocessor board to re-enable the Operator Port.	function = user interface function port = physical device channel protocol = link level protocol timeout in seconds	**MNT, POS, MSG, ALT, DTA, C&S,** **0-2, OFF** **APCL5, ASCII, CR10X, DATALITE, ENAV, FWS, GPS, GYRO, IDA, IHS, MSC, PHAROS, PKT, RTCM, TM8T** **0 – 32767**
***BASE**{,nnn,nnn}	Set display range of Master Station IDs reserved for use as Base Stations	nnn = Master Station ID **OFF** = no Bases	**2 – 245**
BINS	Print link distribution statistics		
BOOT	Cold start of Station software. All volatile memory is lost.		

***BRATE**,rate	Set transmit bit rate in kilobits per second. There is a low or high rate setting; effective rate at either setting is based on the componentry installed in the bit clock generator.	rate = **4K/4.8K** or **8K/4K**	
CANMSG,nnnn (,msg length {,min queue depth})	Automatically generate a message of specified length that repeats until turned off with **CANMSG OFF** command. You can compose the message by entering only the destination name (not message length or minimum queue depth). Destination node must be a neighbor node. **CANMSG** cannot contain more than 25 messages in its queue. If the number of canned message in queue falls below minimum queue depth, additional canned messages will be injected.	nnnn = Station ID Master = **1 – 4095** Remote = **256 – 4095** msg length = number of characters in message min queue depth = min. # of canned messages in queue	**1 – 4095** **1 – 3000** **0 – 25**
CANMSG MODE {,mode)	Set reception of canned message to two of the following states: **PRINT** – print all messages **NO PRINT** – does not print messages	mode = **PRINT** **NO PRINT**	
CANMSG OFF,nnnn	Turn canned message mode off	nnnn = Station ID Master = **1 – 245** Remote = **256 - 4095**	**1 – 4095**
***CHECKIN**{,ii}	Select check-in interval in seconds	ii = interval	**1 – 65535**
CLEAR MAINTENANCE MONITOR	Clear monitor Station		

†CLOSE PORT,function {,function,…}	Close specified 545B port from operation. You can enter more than one port name to close, using commas to separate the names on the same line. **CAUTION** The **OPEN/CLOSE PORT** commands directly affect 545B network activity and message flow. Do NOT use these commands unless directed to do so.	function = user interface function	**MNT, POS, MSG, ALT, DTA, C&S**
CLS	Print current values, then clear link statistics (see **STAT**).		
†**COMPRESSION**{,action}	Enable/disable data compression on outbound messages/data reports. Intermediate nodes pass on the information in compressed form. The destination decompresses the information.	action = **ON** – enable **OFF** – disable	
CONFIG	Show current configuration parameters report. **NOTE** Configuration in EEPROM may differ unless the **SAVE** command is used after configuration changes are made.		
CONFIGURATION	List major Master Station configuration settings.		
†CONNECT,{nnn…}	Limits Master-to-Master connectivity for lab and field network configuration	nnn = Master Station **OFF** = no limitation	**1 – 245**
CORPAT	Without parameters, display report of available correlation patterns and indicate usage.		

†**CORPAT,RX**,action {,pppp...}	Define Receiver correlation patterns to recognize. Pattern 1 is the default and is the only pattern recognized if no others specified. Up to 16 pre-defined patterns are recognized.	action = **ON** – define patterns or **OFF** – use only default pattern pppp = pattern number; **ALL** means recognize all patterns	**1 – 8**
†**CORPAT,TX**,pppp {,**ALWAYS**}	Define Transmitter correlation pattern to send. Pattern 1 is the default and is the only pattern recognized if no other specified. Up to 16 pre-defined patterns may be used.	pppp = pattern number **ALWAYS** means use specified pattern instead of received pattern	**1-- 8**
CR10X	Display CR10X configuration parameters		
†**CR10X,ACQMODE**,mode	Set CR10X acquisition mode - Get all reports since last **UPDT**	mode = **ALL** – get all reports since last update **CURRENT** – get only the current data report **LAST**,n – get last "n" data reports	

†**CR10X,GROUP**,source	Specify source of data report group assignment.	source = **545B** – 545B assigns group numbers; CR10X internal group number matches data array **CR10X** – CR10X assigns group numbers; 545B gets group number from first sensor	
†**CR10X,INTERVAL**,n	Acquisition scan interval in seconds. **OFF** disables acq. scan	n = seconds	**0 – 32767**
CR10X,MAXQ,nnn	Set maximum number of reports to queue for each scan of the CR10X	nnn = number of reports	**1 – 200**
CR10X,ORDER,order	Specify order of final storage data (currently only **FIFO** is available).	order = **FIFO** – first in, first out **LIFO** – last in, last out	
CR10X,REGISTER,n{,ddd}	Read/Set internal storage register.	n = register number ddd = value	**1 – 28** Signed floating point number (see CR10X manual)

CR10X,RESET	Reset CR10X internal error counters to zero		
†**CR10X,SCALE**,type	Define sensor scaling type.	type = **545B** – data scaled in integer hexadecimal units **CR10X** – data scaled in Campbell Scientific floating point format	
CR10X,SECURITY,nnnn, nnnn,nnnn	Enter CR10X Internal Security Codes. See CR10X manual. If CR10X program contains security codes, this command (with correct security codes) must precede any other command for CR10X to respond.	nnnn = security code	**0 - 9999**
CR10X,SETPTR,DATE, TIME	Manual set up of last data pointer in the MCC-545B	DATE = mmddyy TIME = hhmm	mm = **1 - 12** dd = **1 - 31** yy = **0 - 99** hh = **0 - 23** mm = **0 - 59**

CR10X,SIGNATURE	Read and Display Current CR10X program signature. The Signature is a checksum of program bytes.	Signature = checksum	**0 - FF** (hex)
CR10X,STAT	Read and display CR10X internal pointers and error statistics.		
†CR10X,TIME,source	Specify source of data report group timestamp.	source = **545B** – 545B assigns timestamp **CR10X** – CR10X assigns timestamp; 545B gets timestamp from second and third sensors	
DATE{,mm/dd/yy}	Set system date. If no parameters are given, show current date. If parameters are given, DOS calendar will also be updated.	mm = month dd = day yy = year	**1 – 12** **1 – 31** **0 – 99**
DEL MSG,nnnn:sss	Delete specified message.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095** sss = message serial #	**1 – 4095** **1 – 255**
***DESTINATION**{,nnnn...}	Set default message/data destination(s). Enter **0** to use source routing at the Master Station. If you turn off the 545B's default destination, no data will be queued, and the message editor will ask you to enter a destination before sending a message. Up to four destinations may be specified.	nnnn = **OFF, 0** or Station ID: Master = **1 – 245** Remote = **256 – 4095**	**0 – 4095**
***DEVICE**{,type}	Select device type mode of operation (i.e., the 545B acts as a Remote or a limited Master Station).	type = **REMOTE** **MASTER**	

DQERXQ,nnnn:sss	Delete specified message from the receive queue	nnnn=Station ID Master = **1 – 245** Remote = **256 – 4095** sss = msg serial number	**1 – 4095** **1 – 245**
DQETXQ,nnnn:sss	Delete specified message from the transmit queue	nnnn=Station ID Master = **1 – 245** Remote = **256 – 4095** sss = msg serial number	**1 – 4095** **1 – 245**
***DUTY CYCLE** {,percent}	Set transmitter duty cycle (default is 10%). Duty cycle increases in increments of 5%.	percent = **1 – 100**	**1 – 100**
FLASH	Initiate flash memory download. You must type a dozen or so "f" characters after entering the command to cause the bootstrap to take control and initiate the download dialog.		
†FLOOD TIMEOUT{,t}	Display/set timeout period in minutes for the time after a flood that the Stations are to report once a minute	t = timeout in minutes	**1 – 1440**
FLUSH MSG	Delete all messages from all queues.		
FLUSH RXQ,nnnn	Delete all elements of specified Station from receive queue.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**
FLUSH TXQ,nnnn	Delete all elements of specified Station from transmit queue.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**

***FREQ{UENCIES}**{,tx,rx}	Set operating frequencies of the MCC-545B/S. Componentry in the MCC-545B/S limits the usable frequency range to a 2 MHz bandwidth. If frequencies are to be changed outside this bandwidth, hardware modifications must also be made. The Frequency Synthesizer must be enabled via the **SYNTH,ON** command for **FREQ{UENCIES}** to have any effect. This command is meaningless on an MCC-545B.	tx = Tx frequency in MHz times 100 rx = Rx frequency in MHz times 100	**4000 – 5000** **4000 – 5000**
***FULL DUPLEX**	Set 545B in full-duplex mode. **IMPORTANT** When set to full-duplex mode, the 545B's receiver is disabled by the built-in Tx/Rx switch.		
†GLOF{,nnnn,nnnn}	Define the IDs for use as GLOF sensor Stations/display total GLOF setup.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095** **OFF** disables GLOF sensor Stations	**1 – 4095**
†GLOF MONITOR,t,action	Setup timeout (in seconds) and action for the GLOF MONITOR Station	t = timeout in seconds action = **ALERT**, **FLOOD**	**10 – 3600**
†*HALF DUPLEX{,n} **NOTE** Duplex state is kept in EEPROM and probe interval is kept in BBU RAM.	Set Master Station to half-duplex mode and specify number of milliseconds between idle probes. If no parameter specified, last setting is used (default = 30).	n = milliseconds between idle probes	**30 – 30,000**

HELP{,command}	Display help information on specified command. If no parameter entered, all commands are sequentially displayed in alphabetical order.	command = valid 545B command	
***HOLD**	Select message hold mode.		
†**HORN**,function{,open, close,on,off,duration}	Defines horn timing setup	function = **TEST, FLOOD, STAGE 2, STAGE3, ALL CLEAR** open = valve opening time close = valve closing time on = on time off = off time duration = overall duration for on/off cycle	All times in seconds **1 – 15** **1 – 15** **1 – 3600** **1 – 3600** **1 - 3600**

†**HOST MODE**{,mode}	Define host mode functionality in composite networks when host link is not available.	**STOP** = stop transmitting if host connection lost **CONTINUE** = keep transmitting if host connection lost, but set bit flagging loss in probe **OFF** = ignore host connection state; keep transmitting and do not set bit flagging loss in probe	
***HOURLIES**{,action}	Turn on/off hourly statistics.	action = **ON** – enable **OFF** – disable	

If device – Remote: Normal operation †***ID**{,nnn,mmm{,mode}{,**INIT**}} **NOTE** Remote and Master IDs are kept in EEPROM and mode is kept in BBU RAM.	Set 545B's assigned Master Station ID to number "nnn". When no parameters are given, current ID is displayed. When system is already initialized, you must enter the **INIT** parameter to change ID. **INIT** gives "OK" to save configuration and reboot unit with new ID. ID changes are automatically saved with the entire configuration in EEPROM. "mode" parameter (if used) specifies initial connectivity with specified Master. **PREF** means Remote considers connectivity established. **AUTO** means no connectivity established. **FIXED** (Default) means connect only with specified Master. **NOTE** If command does not change the ID or Master Station, the **SAVE** and reboot are not performed.	nnn = Remote ID mmm = Master ID mode = **PREF**, **AUTO** or **FIXED**	**256 – 4095** **1 – 245**
†ID,mode	Change " mode" as discussed above without affecting ID; no reboot performed.	mode = **PREF**, **AUTO** or **FIXED**	
If device = Master: ***ID**{,nnn{,**INIT**}}	Set 545B's assigned Master Station ID to number "nnn". When no parameters are given, current ID is displayed. When system is already initialized, you must enter the **INIT** parameter to change ID. **INIT** gives "OK" to save configuration and reboot unit with new ID. ID changes are automatically saved with the entire configuration in EEPROM. **CAUTION** If you enter **INIT**, you will lose all current message information.	nnn = assigned Master ID	**1 – 245**

LISTM{,nnnnn…}	Display Remotes with burst monitor bit set (<u>all</u> Remotes or given IDs up to 12).	nnnnn = Station ID Master = **1 – 245** Remote = **256 - 4095**	**1 – 4095**
LISTT{,nnnnn}	Display Remotes with "Type" flag set (<u>all</u> Remotes or given IDs up to 12)	nnnnn = Station ID Master = **1 – 245** Remote = **256 - 4095**	**1 – 4095**
†LOGOFF	Used to disallow operator commands with automatic 10 minute timeout for LOS role and 60 minute timeout for **TRANSPOND** role. Logs you off, disables ALL following operator commands except **LOGON**, **$PENTM**, or **SDATA**.		
†**LOGON,**password	**LOGON** used to allow operator commands. To log onto a unit, enter the **LOGON** command followed by the current password. This will remain in effect for a timeout period (10 or 60 minutes depending on operating mode), or until you log off. Default = MCC-545B	password = 3-20 character password	**A-Z, 0-9, -**
***LOS CHECKIN**{,ii,rr}	Select check-in interval (in seconds) and retry count for LOS operation.	ii = interval rr = retry	**1 – 65535** **1 – 65535**
MEM	Show usage of dynamic pool memory.		

MESSAGE {,p{,dest1…destn}}	Enter a message with text editor. Message priority and destination are optional parameters. After entering message, press [ESC] to queue for transmission. If you do not enter a destination ID, the 545B automatically sends your message to its default destination (set with the **DESTINATION** command). If you want to use source rounting, enter **0** for the destination.	p = priority dest1. . .destn = destination(s) name = node name nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**A – Z, 0 – 9** **A – Z, 0 – 9** **1 – 4095**
MM	Print current value of RF signal on Receiver		
MODE	Print operating mode information.		
***MODULATION**,degree, encoding	Set the transmit modulation and data encoding. **IMPORTANT** 545B modulation must be the same as other units in the network.	degree = **90** or **30** encoding = **MAN** for Manchester, **DIFF** for differential	
†MON{,d{,r}}	Turn on burst monitor. Only meteors lasting long enough to deliver "d" characters will be monitored. If at least "r" characters were received, a monitor line is generated.	d = duration character count limit r = received character count limit	**0 – 32767** **0 – 32767**
MONITOR{action{,nnn {,nnn,…,nnn}}}	Control monitoring of individual units and print burst statistics. Overrides **MONOFF** command and causes monitor lines to print for each reception from this unit.	action = **ON** – enable **OFF** – disable nnn = units to be monitored **ALL** – default Master = **1 – 245** Remote = **256 - 4095**	**1 - 4095**

†MONOFF	Turn off burst monitor		
***MSG**	Display and delete top operator message in receive queue when message **HOLD** is enabled.		
NET	Display network routing table for all selected neighbors. **NET** – no neighbors **NET1,2** – 1,2, etc. neighbors **NET,all** – all neighbors		
NET STAT	Display network statistics. Statistics accumulate from the beginning of each hour and are cleared at the end of the hour.		
NET STAT PERIOD{,minutes}	Enable display of network statistics and set period between displays (in minutes). Disable display by setting period to zero (0).	Minutes = number of minutes between each display	**0 - 32767**
NEWPASSWORD,old password, new password	Used to change the password. The NEW PASSWORD command is used to change the internal stored password. You must be logged on and know the old password. The password will automatically be saved.	password = 3-20 character password	**A-Z, 0-9, -**
†**OPEN PORT**	Resume activity on specified closed port. You can enter more than one port name to open, using commas to separate the names on the same line. **CAUTION** The **OPEN/CLOSE PORT** commands directly affect 545B network activity and message flow. Do NOT use these commands.	function = user interface function	**MNT, POS, MSG, ALT, DTA, C&S**

***P**{**,?**}{,xxx}{,**OFF**}	Configures 545B for pulse probe mode. If no parameters are entered, transmit single pulse probe. Enter transmit single pulse probe. Enter **P,?** to display current pulse probe mode settings. Enter **P**,xxx to send a single periodic probe once every "xxx" seconds. Enter **P,OFF** to turn off periodic pulse mode (you can still transmit single pulses with **P**).	? = current settings xxx = periodic pulse period (in seconds) OFF = turn off periodic pulse mode	
P77	The **P77** command must be used to place the Julian date into position one, and Hour/Minute into position two. With this setup, the MCC 545B will strip off the first two sensor values and place the date and time derived from these values into the standard MCC 550B report.		
†PASSWORDMODE,action, password	Used to enable/disable use of passwords. Default is disabled. To enable or disable the operation with passwords, enter this command giving the desired action along with the current password for the unit. This will trigger an automatic "save" operation. If set to the ON mode, the state of the unit will be set to "logged-off". All operator and remote commands except scheduled commands, **$PENTM** commands, and **SDATA** commands will respond with "ACCESS DENIED!". You will not be able to turn off the mode without first logging on.	action = **ON** – enable **OFF** – disable password = 3-20 character password	**A-Z, 0-9, -**
$PENTM	Without parameter string, display report of current Entek MDP configuration.		
†**$PENTM, ALERTEVENTS**{,mask}	Set bit mask indicating Entek MDP status bits regarding as alarms. Status bits are checked against this mask on intercepted position reports and an alert message is sent to the local MNT and DTA ports for each match.	mask = hexadecimal bit mask	**0 – FFFF**

†**$PENTM,ALERTMSGS** {,nnn...}	Define canned messages constituting an alert. Any number may be defined (up to 10 per line). Intercepted messages matching one of these numbers cause an alert message to be sent to the local MNT and DTA ports.	nnn = canned message number	**1 – 120**
$PENTM,command string	Send command string to local Entek MDP.	command string = any valid Entek MDP command string	
†**$PENTM**,action	Enable/disable Entek MDP interface. When enabled, allows communication with mobile data processor in vehicle tracking applications and causes received status bits from the MDP to be included with the position data in the Remote's data reports.	action = **ON** – enable **OFF** – disable	
†**POLL**{interval,offset, duration,retry}{,**ALWAYS**}	Define/display polling schedule for Base/Repeater Station. If **ALWAYS** parameter specified, do not timeout on-line units (i.e., ignore retry count in this case).	interval = polling interval in seconds offset = offset from top of minute duration = length of poll retry = retry count for failed polls	**1 – 86400** **1 – 59** **1 – 10** **1 – 99**
***POS**{,interval,format, protocol}	Display/initialize internal 545B timing for reporting GPS position data. Specify update period in seconds, in either binary or text format, using given protocol.	interval = reporting interval in seconds format = display format protocol = GPS unit protocol	**0 – 65535** **BINARY, TEXT** **NMEA, ARNAV, TAIP, TRANSAS**

†**POS,LOCAL**{,interval}	Display/initialize timing for local output of position reports on MNT and DTA ports as well as sending them.	interval = reporting interval in seconds; **OFF** disables local output	**1 – 86400**
†**POSRPT**{,action}	Enable/disable echoing of intercepted position reports to local MNT and DTA ports. Also used to enable/disable duplicate filtering and control format of these reports.	action = **ON** – enable **OFF** – disable **DUPL,ON** – enable duplicate filtering **DUPL,OFF** – disable duplicate filtering **FORMAT,LONG** – output report on two lines **FORMAT,SHORT** – output report on one line	
PRG,nnn	Undefine 545B Station from network.	nnn = Master Station ID	**1 - 245**
***PRINT**	Enable messages to print as they are received.		
†**PRIORITY**,message type,p	Define priority characters for each message type.	message type = **FLOOD, ALERT, ROUTINE** p = priority	**A – Z, 0 – 9**

†RCT{,action}	Display/set remote control terminal functionality. This functionality is applicable to Packet protocol systems only and controls whether the unit ignores intercepted data reports. If enabled, intercepted reports are ignored.	action = **ON** – enable **OFF** – disable	
RED	Without parameters, generates report of current RED setup.		
†RED,ID,nn-nnn	Enables reception of remote emergency indications from an MCC Remote Emergency Device (RED). The entered ID code is used with RED messages generated by the 545B using **RED,TEST** or **RED,TX**.	nn = call sign prefix nnn = call sign suffix	**0 – 99** **0 – 999**
†RED,NUM,n	Set dead-band interval in which repeated RED activations do not generate another alert message.	n = dead-band interval in seconds	**1 – 120**
†RED,OFF	Disable reception of remote emergency indications from an MCC Remote Emergency Device (RED).		
RED,TEST	Simulate a RED test message. Unlike a true RED test button depression, this message is also echoed to the local MNT and DTA ports.		
RED,TX	Simulate a RED alert message. Unlike a true RED alert button depression, this message is also echoed to the local MNT and DTA ports.		
REMCMD ,p,dest1{,…destn}	With the text editor, enter a command to be sent to a Remote. After entering command, press [ESC] to send the command.	p = priority dest1…destn destination(s) name = node name nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**A – Z, 0 – 9** **A – Z, 0 – 9** **1 – 4095**

REMOTE STAT{,nnnnn…}	Display transmit/receive statistics for all Remote Stations or for given IDs (up to 12).	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**
†REMOTE TYPE{,aaaaa}	Display/set communication characteristics of the unit. Determines how certain statistics are reported and how remote commands/messages are framed.	aaaaa = **COMM** **DATA** **PACKET**	
***REPEATER**{,nnn}	Define/display Base Station to which the Repeater site repeats.	nnn = Base Station ID **OFF** clears a previously established definition	**1 – 245**
RESET	Perform hardware reset to clear and reinitialize I/O channels and RF controller. This command retains previous network configurations and message traffic.		
REV	Display part and revision numbers of current Link Controller and Tx/Rx Controller software.		

†*ROLE{,role{,low,high}{,mode}} **NOTE** Role is kept in EEPROM and low, high and mode are kept in BBU RAM.	Define role played in network, either **SILENT** (never transmits), **TRANSPOND** (responds to probes), **PROBE** (actively probes), or **LOS** (line of sight) mode. If role is set to **TRANSPOND**, the low and high parameters can be used to specify the threshold values for automatic meteor burst vs. line of sight modes of operation and the mode parameter can set the starting mode (meteor burst or line of sight). Thresholds are specified in idle probes per minute. To prevent **LOS** operation altogether, set the low threshold to **1000** if the unit's Master is half duplex or **5500** if it is full duplex.	role = **SILENT, LOS, TRANSPOND** or **PROBE** low = threshold for switching from **LOS** to **MB** mode in idle probes per minute high = threshold for switching from **MB** to **LOS** mode in idle probes per minute mode = **MB** or **LOS**	**0 – 32767** **0 – 32767**
†RTCM{,nnn}	Define time latency in seconds between beacon receiver and local time. Without parameter, display report of satellites in view by beacon receiver.	nnn = latency in seconds	**0 – 59**
RX STAT{,**CLEAR**}	Display statistics for the 545B Receiver	**CLEAR** = clear all statistics after display	
SAVE	Save **CONFIG** parameters in EEPROM. Reboot of 545B (or restart due to software failure) returns unit to configuration saved in EEPROM.		

†SCALE{,parameter,value}	Display set A/D scaling factors for the unit. Factors depend on type of receiver and power supply used in the 545B.	parameter = **BAT** – battery voltage **DETRF** – detected RF **TXPWR** – transmit power value = scale factor	
†SCHED{,basis,hh:mm:ss{,**OFFSET**,hh:mm:ss},command string} **IMPORTANT** **SCHED** ignores the **MESSAGE** command. Up to 50 events can be scheduled.	Schedule execution of the specified command string. If timeframe basis = **INTERVAL**, the command string will be executed whenever the specified time interval elapses during the day. If timeframe basis = **TIME**, the command string will be executed at the specified time. The **OFFSET** option allows specification of an offset from the timeframe basis.	basis = **TIME** or **INTERVAL** hh - hours mm - minutes ss - seconds	 **0 – 23** **0 – 59** **0 – 59**
†SCHED,DEL,nn	Delete specified schedule item number. If nn = **ALL**, the entire schedule will be cleared.	nn = schedule item number	**1 – 50**
SDATA,g,c,time stamp, value...	Enter an MCC-550C data report directly from the serial I/O port. Up to 16 values may be entered. Use the **LINK** command to route the data.	g = group number c = sensor count time stamp = mmdddhhmn value = ASCII hex sensor value	**1 – 4** **1 – 16** mm **1 – 12** ddd **1 –365** hh **0 – 23** mn **0 – 59** **0 – FFFF**

†SENSOR{function} {weight}{low,high}}}	Defines the GLOF sensor data limit for fail/dry/wet determination. Gives the "weight" (i.e., how significant) of each case for the flood calculation.	Function: **DRY** **WET** **FLOOD** **FAIL**	LOW **1 - 99** HIGH **1 – 9999** WEIGHT **1 - 99**
SERIAL{,sss}	Set next packet serial number. Parameter "sss" is serial number of last packet transmitted.	sss = message serial number	**1 – 255**
***SET BAUD** {,function,rate,flow}	Adjust baud rate and flow control of specified port. When no parameters are entered, this command displays I/O configurations.	function = user interface function rate = baud rate flow = flow control	**MNT, POS, MSG, ALT, DTA, CANDS,** **110, 150, 300, 600, 1200, 2400, 4800, 9600** **Y** or **N**
SHOW REMOTES	Display ID and assigned 520B of each Remote in system.		
SHOW RXQ,nnnn	Display contents of receive queue for the originating Station.	nnnn = originating Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**
SHOW TXQ,nnnn	Display contents of transmit queue for the destination Station.	nnnn = destination Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**

SML{,nnnn}	Display names and serial numbers of message packets in specified message list. If parameter is not entered, all message packet names and numbers are displayed.	nnnn = destination Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**
SMS{,nnnn}	Display status of message packet in specified message list.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**

†***SNP**{pname,value} **NOTE** Some network parameters are only for use in Master Operation mode (**RDOWN, CONNP, TEXTL, FLOODP, INF, RELAY**). **NOTE** **TTL, TTR, NUP, NDOWN, RDOWN, OTL, HTO, TEXTL, CONNP, ETEAP, FLOODP, RELAY** and **INF** are kept in EEPROM; **DATAP** and **MBHOP** are kept in BBU RAM.	Set network parameters. See range column for values entered for each parameter.	pname – **TTL** time-to-live **TTR** time-to-retransmit **N UP** neighbor up **N DOWN** neighbor down **R DOWN** Remote down **OTL** outstanding text limit **CONNP** connectivity msg. precedence **ETEAP** End-to-End ACK precedence **HTO** history file timeout **TEXTL** text size in segments **FLOODP** partial flooding prec. level **INF** infinity hop quantity **DATAP** priority of data reports created by 545B **MBHOP** meteor burst link hop weight for MS meteor burst links **RELAY** relay function control	**0 – 2550** min. (truncated to 10 min. bndry) default = **120** **0 – 255** min. default = **20** **1 – 255** acq. default = **20** **1 – 255** min. default = **20** **0 – 32767** default = **1440** **1 – 255** default = **20** **0 – 9, A – Z** default = **1** **0 – 9, A – Z** default = **0** **1 – 255** min. default = **120** **5 – 255** default = **32** **A – I** default = **A** **2 = 255** hop default = **8** **A – Z** default = **Y** **1 – 99** default = **1** **ON, OFF**

***SOURCE RELAY**{,nnnn}	Specify source routing table of one entry. The designated Station will receive all information sent without an explicit destination specification. If set to **OFF**, such information is discarded.	nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	
†START	Turn transmitter on.		
STAT	Display RF statistics report.		
***STAT TIME**{,xx}	Set interval (in hours, starting at midnight) when 545B automatically transmits statistics to Master Station.	xx = interval	**1 – 24** hours
†STATION TYPE{,aaaaa}	Display/set special Station functionality. Determines how each Station responds to the messages it receives and limits the type of messages that can be created. Meaningful only in Flood Warning and Maritime Weather Systems.	aaaaa = **OFF** **FLOOD BASE** **FLOOD WARNING** **GLOF SENSOR** **GLOF MONITOR** **GLOF WARNING** **RELAY** **STREAM GAUGE** **SYSTEM MONITOR** **WEATHER**	
†STOP	Turn transmitter off.		
†STT,secs	Set command timeout (in seconds). Default is 15 seconds.	secs = time limit before reset (**0**-off, >**0**-on)	**0 – 32767**

†**SUBST**,rrr,g1,nnn,g2	Substitute Remote unit information in data reports received from a relay unit.	rrr = relay ID g1 = relay grp# nnnn = Remote ID g2 = Remote grp#	**1 – 245** **0 – 15** **256 – 4095** **1 – 4**
†**SUBST,DEL,ALL**	Delete entire substitution table		
†**SUBST,DEL**,rrr,g1	Delete entry in substitution table	rrr = relay ID g1 = relay grp#	**1 – 245** **0 – 15**
†**SWCTL,OFF**	Disables the monitoring and switching function.		
†**SWCTL,ON,**timeout**,**start delay	When the software boots up from a reset state, it will test the two RS-232 ports to determine which one is currently active, assuming the switch may have been manually controlled while it was off. From then on, it monitors the two Masters assuming the primary Master (1) is connected to the DTA port, and the Secondary Master (2) is connected to the ALT port.	timeout = inactivity time in seconds resulting in switchover. start delay = interval in seconds after starting before monitoring Master Stations.	**1 – 32767** **1 - 32767**
SWCTL,SW,n	Switch to designated Master Station switch position.	n = switch position	**1 - 2**
SWMON	Monitors both the RS-232 port and RF link. This **SWMON** command should be placed in the schedule of the 545B at an interval that detects a Master Station failure within the required system design. There are no parameters. A typical example is: **SCHED,I,5:0,SWMON**		
***SYNTH**{,action}	Display/set status of frequency synthesizer. This command is applicable only to the MCC-545B/S.	action = **ON** – enable **OFF**– disable	
T	Show current date/time.		

TEST	Send test transmission and return updated statistics (uses same format as **STAT** command).		
TIME{,hh:mm:ss}	Set system time. If no parameters are specified, show current time. If parameters are given, DOS calendar will also be updated.	hh – hours mm – minutes ss – seconds	**0 – 23** **0 – 59** **0 – 59**
†TIMEZONE{,UTC,sys}	Set local time zone offsets from UTC time (GMT) and system time.	UTC = offset from GMT sys = offset from system time	**-12 – 12** **-12 – 12**
TRACE,action,data stream	Diagnostic command used to enable/disable detailed analysis of the specified data stream.	action = **ON** – enable **OFF** – disable date stream = **RF, GPS, MSC, RTCM**	
***TX LIMIT**{,count}	Set limit on number of transmissions allowed in a 15-minute period (in minutes).	count = # of transmissions period = minute	
TYPE{,action{,nnn{nnn, … ,nnnn}}}	Control auditing of messages entered at specified units and routed through the 545B.	action = **ON** - enable **OFF** - disable nnn = units to be audited. **ALL** – default Master = **1 – 245** Remote = **256 – 4095**	**1 - 4095**

UPDT{,function,parameters}	Send update message to data logger type device.	**NOTX**: Read sensors but do not transmit data read **TX**: Read sensors and transmit data read **TIME:** Set time of 545B in logger **TEST:** Operate a component in test mode: **ALERT** **FLOOD** **HORN** **GATE** **WARNING** **OUT:** Set output register: **BYTE** **BIT,BITNUMBER** **BITS,STARTBIT, ENDBIT** **ARM:** Enable alarm activation **DISARM:** Disable Alarm activation **RESET:** Reset alarm condition **POS:** Schedule position report at same time data report sent	**RM**: Routine message format **RMP**: RMP Message format value appropriate to the register: **0 – 255** **1 – 8** (bit); **0 - 1** **1 – 8** (bits); **0 - 255**

†**WARNING**,{nnnn,nnnn}	Define the IDs for use as the Standard Flood Warning Stations. Without parameters, displays total **WARNING** setup.	**OFF** = disables nnnn = Station ID Master = **1 – 245** Remote = **256 – 4095**	**1 – 4095**
†**WARNING TIMEOUT** {,t}	Define/display timeout period in seconds for a Flood Base Station to determine a communications failure	t = timeout in seconds	**10 – 3600**
†**WEATHER**{,action}	Enable/disable Maritime Weather system functionality. Without parameters, displays total **WEATHER** setup.	action = **ON** – enable **OFF** – disable	
†**WEATHER,REPORT**,t	Defines data reporting interval in minutes for a Maritime Weather Station.	t = report interval in minutes	**0 – 32767**

TABLE 4.2