APPENDIX REM - REMOTE CONTROL PROTOCOL

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Software Version: 2.10

This appendix describes the remote commands available to monitor and control the RC4600 antenna controller. It is provided as a supplement to the "baseline" RC4600 manual. Sections in the baseline manual will be cited where additional information may be found.

NOTE: RC4600 software is built on a per-mount basis. Some commands may not be available on all devices.

Revision History

03 MAY 2016	Initial document created from RC4000 remote control protocol.	ECG
05 FEB 2018	First document revision and release for RC4600.	RCC
13 MAR 2018	Updated Configuration, Auto Move Command and alarm codes.	RCC
24 MAY 2018	Updated Mode and State tables.	RCC
02 AUG 2018	Updated alarms codes and Custom Status OIDs for v2.10	ECG
20 AUG 2018	Added note for remote keypress.	RLE
21 JAN 2019	Corrected Bytes 43,44,45 of device status, added additional enumerated modes, added OID for AZ/EL/POL locate targets.	RLE
21 MAR 2019	Moved STOW COMPLETE from common modes states to STOW unique states.	RLE
19 APR 2019	Removed Longitude and Band from Write Beacon Data Command, Read Beacon Data Command, Write DVB Data Command, and Read DVB Data Command.	RCC

1.0 THEORY OF OPERATION

Overview

The RC4600 supports a variety of remote monitor and control commands. The controller functions as a slave device within a network. The network is expected to consist of one master and multiple slaves communicating over a single interface (or “bus”). Each slave is internally configured with a unique address.

Message Protocol

Message format and protocol over the bus is a derivative of IBM's binary synchronous communications protocol (BISYNC). The master station sends a command over the bus to all slave devices. The device whose address is specified in the command message carries out the requested commands, and then replies with a response message containing the result. A device does not respond if the command does not contain its address. This prevents bus contention caused by more than one device communicating over the bus at the same time. NOTE: Even if the antenna controller is the only device on the network, it still must be addressed.

Data Format

All data should be in 7-bit ASCII format. The control character subset 00-1F (hex) is reserved for message control. The printable ASCII characters 20-7F (hex) are used for address, command and data characters.

Message Format

Command messages begin with the STX (Start-of-text) byte followed by a remote address, a command byte and multiple data bytes. The ETX (End-of-text) byte is sent following the last data byte, and the message is terminated by a Checksum character. Response messages are identical to command messages in format with the exception of the ACK (Acknowledge) or NAK (Not Acknowledge) byte at the start of the message instead of STX. Figure 1 illustrates the format of the command and response messages. A command or reply message may have a variable length.

Command Message

STX	ADDR	CMD	D_1	D_2	D_3	…	D_N	ETX	CHKSUM

Response Message – Command Acknowledged

ACK	ADDR	CMD	D_1	D_2	D_3	…	D_N	ETX	CHKSUM

Response Message – Command Not Acknowledged (Unable To Execute or Incorrect Command)

NAK	ADDR	CMD	ETX	CHKSUM

Figure 1 – Message Format

Message Delimiters

A command message begins with STX (02 hex). A reply begins with ACK (06 hex) or NAK (15 hex) depending on the result of the command execution. All messages end with the ETX (03 hex), the ASCII End-of-text control character, followed by the Checksum byte.

Address Byte

The device address (ADDR) must be a valid ASCII printable character between 49 (31 hex) and 111 (6F hex); thus, 63 addresses are possible.

Command Byte

The command byte (CMD) immediately follows the device address and specifies one of several possible commands for a particular device.

Checksum Byte

The last character of any message is the Checksum byte (CHK). This character is simply the bit-by-bit exclusive OR of all characters in the message starting with the STX character through the ETX character. This forms a Longitudinal Redundancy parity check over the entire message.

Message Timing

Every message that is received generates a reply. After sending a command, the master should wait for a reply before sending a subsequent command. All replies will be sent within 500 milliseconds.

NOTE: The NAK or ACK reply does not signify that an operation has actually taken place, but only that the message was received and understood. The user should query the controller later to see if the command was actually carried out, or is still in progress.

Command Restrictions

All devices will respond to a command "0" (30 hex) with 6 data bytes of ASCII characters in the following form:

ACK	ADDR	30h	4	K	D_1	.	D_2	D_3	ETX	CHKSUM

where $D_1.D_2D_3$ are ASCII characters representing a software version number (e.g. 1.12).

State Diagram

The state diagram illustrated below presents the implementation of the slave device. Each state that the device can assume is represented by a numbered circle. Transitions between states are represented by an arrow. Each arrow is labeled with the conditions that must be true to move between states.

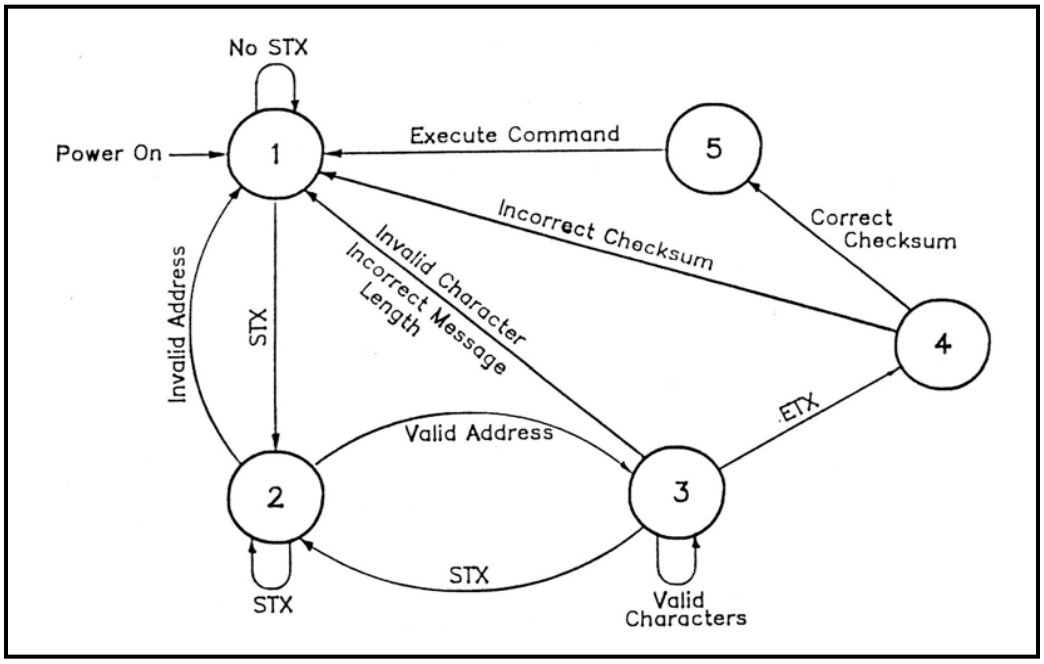

Figure 2 – SA Bus Protocol State Diagram

- State 1 – Idle State
  - The device is ready to receive a new message. A device always powers on in State 1.
  - The device will enter State 2 only if the STX byte is received.
- State 2 – Addressed State
  - The device is waiting to receive the address byte.
  - The device will enter:
    - State 3 if the received address byte is correct.
    - State 1 if the received address byte is not correct.
  - The device will stay in State 2 if the STX byte is received.
- State 3 – Data State
  - The device is engaged in receiving the command data from the master.
  - The device will enter:
    - State 4 if the ETX byte is received signifying the end of data in the message.
    - State 1 if the STX byte, an invalid byte, or the incorrect number of data bytes is received.
- State 4 – Data Error State
  - The device is waiting to receive a Checksum byte.
  - A slave will enter:
    - State 5 if the received byte equals the LRC value computed during message reception.
    - State 1 if the received byte does not equal the LRC value computed.
- State 5 – Command Execute State
  - The device begins execution of the received command.
  - The device begins sending the appropriate response message to the master.
  - The device will enter State 1 only when the entire response has been transmitted.

2.0 CONFIGURATION

Ethernet to Serial

This section describes how the antenna controller can be controlled remotely over an Ethernet connection using the User Datagram Protocol (UDP).

UDP is a simple connectionless protocol where datagrams are sent from a host IP and port to a target IP and port. No acknowledgement, retransmission, or timeout is built in. The SA-Bus protocol used by the ACU remote system fills these roles, making UDP the natural choice for monitor and control over an Ethernet connection.

The ACU maintains an open IP connection for UDP datagrams on the user-defined Applet Port. By default, this port number is 6767. The packet data of an incoming datagram is relayed directly to the ACU's internal serial port. The response is returned to the host in a similar fashion.

The packet structure of a UDP datagram is beyond the scope of this document. For the following examples, a datagram will consist of a packet header and packet data as illustrated below:

UDP Packet Header	UDP Packet Data

To send a command to the ACU, make the packet data equal to the full SA-Bus compliant command including the STX, ETX, and trailing checksum as shown below:

UDP Packet Header	STX	Address	Command Code	Message Body	ETX	Checksum

The reply from the ACU will be in a similar fashion as shown below:

UDP Packet Header	ACK/NAK	Address	Command Code	Message Body	ETX	Checksum

If no response is received from the ACU, the reply datagram will be the ASCII string "TO", indicating a timeout occurred while waiting for a reply:

UDP Packet Header	TO

Research Concepts, Inc. has prepared a demo program written in C#, to assist individuals interested in developing monitor and control software for an antenna controller with the integrated IP option.

3.0 DETAILED OPERATION

3.1 Online/Offline Reply

The software must include the remote control option to process commands. If remote control is not available (or is disabled), and a valid message is received, the offline reply is sent to the host. This reply has the following format:

byte 0	ACK	
byte 1	A	address
byte 2	CC	command code of the received message
byte 3	'F'	ASCII 'F', for offline.
byte 4	ETX	
byte 5	Checksum	

3.2 Command Acknowledged – ACK Reply

In many cases, if a command is received but no response is required, a standard ACK reply is sent to the host. The standard ACK reply has the following format:

byte 0	ACK	
byte 1	A	address
byte 2	CC	command code of the received message
byte 3	ETX	
byte 4	Checksum	

3.3 Unrecognized Commands – NAK Reply

If a valid message is received but the command code is unrecognized or unavailable, or if an error occurred while processing the command data, a NAK reply is sent to the host. Additional failure information may be available for specific commands. The NAK reply has the following format:

byte 0	NAK	
byte 1	A	address
byte 2	CC	command code of the received message
byte 3	ETX	
byte 4	Checksum	

3.4 Command Set

The following table lists the available remote commands. Each command is detailed in the paragraph listed.

Table 1 – Command Set List

CODE (hex)	COMMAND	PARAGRAPH
30	Device Type Command	3.4.1
31	Device Status Command	3.4.2
32	Auto Move Command	3.4.3
33	Azimuth/Elevation/Polarization Jog Command	3.4.4
34	Polarization Command	3.4.5
35	Reserved	
36	Miscellaneous Command	3.4.6
37	Reflect Display Command	3.4.7
38	Reserved	
39	Write Satellite Data Command[1]	3.4.8
3A	Read Satellite Data Command	3.4.9
3B	Write Two-Line Element Data Command[1]	3.4.10
3C	Read Two-Line Element Data Command	3.4.11
3D	Write Beacon Data Command[1]	3.4.12
3E	Read Beacon Data Command	3.4.13
3F	Read Platform Angles Command	3.4.14
40	Reserved	
41	Remote Locate Command	03.4.15
42	Remote Track Command	3.4.16
43	Write DVB Data Command[1]	3.4.173.4.17
44	Read DVB Data Command	3.4.18
45	Read Navigation Data Command	3.4.19
46	Write Navigation Data Command	3.4.20
47	Jog with Minimal Reply Command	3.4.21**Error! Reference source not found.**
48	Remote Key Press Command	3.4.22
49	Write Config Data Command[1]	3.4.233.4.23
4A	Reserved	
4B	Custom Device Status Command[2]	3.4.24
4C	Reserved	
4D	Write Track Table Command[2]	3.4.25
4E	Read Track Table Command[2]	3.4.26
	1 – requires flash save via Write Config Data	
	2 – experimental	

3.4.1 Device Type Command

This command returns the six-byte device type string. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	30h	command code
byte 3	ETX	
byte 4	Checksum	

The reply to this command will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	30h	command code
bytes 3-7	Device Type	The device type identifier. This field will start with “RC46” for RC4600 antenna controllers. Left-justified and padded with blanks.
bytes 8-12	Version	The device version number descriptor. This field will contain the software version in the format “vA.BC”.
byte 13	ETX	
byte 14	Checksum	

3.4.2 Device Status Command

This command returns general device status information. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	31h	command code
byte 3	ETX	
byte 4	Checksum	

The reply will consist of a combination of ASCII and binary data fields. The response will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	31h	command code
bytes 3-4	Satellite Index	The index of the currently selected satellite. This field will contain ‘**’ if nothing is selected. Right-justified and padded with blanks.
bytes 5-14	Satellite Name	The name of the currently selected satellite. Left-justified and padded with blanks.

Device Status Command (continued)

bytes 15-22	Azimuth Horizontal Position	-180.000 to 180.000 degrees
bytes 23-30	Elevation Horizontal Position	-20.000 to 120.000 degrees
bytes 31-38	Polarization Horizontal Position	+/-100.000 degrees

The current angular position
+ddd.ddd (decimal-degrees format)
Right-justified and padded with blanks or '********' if sensor error

byte 39	Azimuth Limits – binary data
byte 40	Elevation Limits – binary data
byte 41	Polarization Limits – binary data

```
7 6 5 4   3 2 1 0
0 1 0 0 $ 0 A B C
```

Where bits 'A', 'B', and 'C' are defined as:

A – Maximum Limit (CW, UP, CW)
B – Minimum Limit (CCW, DOWN, CCW)
C – Stow Limit

A '0' in a bit position implies that the antenna is not at the limit,
a '1' in the bit position implies that the antenna is at the limit.

byte 42 Feed Type/Polarization Code – binary data

```
7 6 5 4   3 2 1 0
0 1 X X $ 0 Y Y Y
```

Where 'XX' is defined as:

00 – Rotating Feed Is Not Present
01 – Single-Port Rotating Feed Is Present
10 – Dual-Port Rotating Feed Is Present

Where 'YYY' is defined as:

000 – No Polarization Code Displayed
001 – 'h' Polarization Code
010 – 'H' Polarization Code
011 – 'v' Polarization Code
100 – 'V' Polarization Code

Device Status Command (continued)

byte 43 Azimuth Movement/Alarm Status – binary data
byte 44 Elevation Movement/Alarm Status – binary data
byte 45 Polarization Movement/Alarm Status – binary data

```
7 6 5 4   3 2 1 0
0 1 0 S $ A A A A
```

Where 'S' is defined as:
0 – Axis Is Configured for Slow Speed Movement
1 – Axis Is Configured for Fast Speed Movement

Where 'AAAA' is defined as:
0000 – No Alarms or Movement
0010 – Negative Jog Movement (CCW, DOWN, CCW)
0011 – Positive Jog Movement (CW, UP, CW)
01xx – Auto Move In-Progress
0110 – Negative Automatic Movement (CCW, DOWN, CCW)
0111 – Positive Automatic Movement (CW, UP, CW)
1xxx – Alarm Active
1000 – Emergency Stop Alarm
1001 – Reserved / Unused
1010 – Drift Alarm
1011 – Follow Error Alarm
1100 – Drive Alarm
1101 – Off-Axis Alarm

Higher value status codes have priority over lower value ones. If as part of an auto move command the antenna is moving clockwise the status will be reported as 'Positive Automatic Movement' rather than 'Auto Move In-Progress'.

byte 46 Alarm Code – binary data

```
7 6 5 4   3 2 1 0
0 1 A A $ A A A A
```

Where 'AAAAAA' specify the alarm code (0-63). Alarm messages flash on the bottom row of the display. NOTE: Some software versions have mount-specific alarm codes.

0 – No Alarm Active
1 – Flash Version Mismatch
2 – Flash Data Corrupt
3 – NVRAM Version Mismatch
4 – NVRAM Data Corrupt
5 – Low Battery
6 – Invalid Time/Date
10 – Azimuth Follow
11 – Azimuth Drift
20 – Elevation Follow
21 – Elevation Drift
30 – Polarization Follow
31 – Polarization Drift
40 – Limits Inactive Warning
41 – Drive System Error
42 – Emergency Stop Active
43 – Maintenance Interlock Active
44 – Movement Interlock Active
45 – Local Jog Connected
46 – Reserved / Unused
47 – Standby Warning

Device Status Command (continued)

byte 47 Track Status – binary data

```
7 6 5 4   3 2 1 0
0 1 0 0 $ S S S S
```

Where ‘SSSS’ is defined as:

0000 – Track Mode Not Active
0001 – Setup Active
0010 – Recall Active
0011 – Step-Track Active
0100 – Wait Active
0101 – Search Active
0110 – Memory-Track Active
0111 – TLE-Track Active
1001 – ACU Alarm Error
1010 – Checksum Error
1011 – TLE Data Error
1100 – Peak Limit Error

bytes 48-51 AGC Level Current AGC channel voltage
0 to 5000
Right-justified and padded with blanks

byte 52 AGC Channel/Lock Status – binary data

```
7 6 5 4   3 2 1 0
0 1 0 L $ 0 C C C
```

Where ‘CCC’ is defined as:

000 – RF
001 – SS1
010 – SS2
011 – DVB
1xx – Reserved

Where ‘L’ is defined as:

1 – Lock Indicated
0 – No Lock Indicated

Device Status Command (continued)

byte 53 HPA Relay/Feed ID Status – binary data

```
7 6 5 4   3 2 1 0
0 1 0 B $ B B A A
```

Where ‘AA’ is defined as:

00 – HPA Relay Disabled by ACU Software
01 – HPA Relay Disabled by External TX Mute
10 – HPA Relay Enabled
11 – Reserved

The bit field ‘BBB’ indicates the current feed id index which will be a value between 0 and 7. The value will be 0 if feed id bits are not supported.

byte 54 Special Axis Limits/Movement Status – binary data

```
7 6 5 4   3 2 1 0
0 1 0 S $ A B C D
```

Where ‘S’ is defined as:

0 – Axis Not Moving
1 – Axis Auto Move Is In-Progress

Where A, B, C, and D indicate the current special axis limit state as:

SPECIAL AXIS	STATE DESCRIPTION	LIMIT CONDITION
Waveguide	Horizontal (Position 1)	B = 1
	Vertical (Position 2)	C = 1
RF Switch	Path 1	A = 0
	Path 2	A = 1
Polarization Mode	Linear Mode	B = 1
	Circular Mode	C = 1

bytes 55-59 Reserved

byte 60 Current Mode
byte 61 Current State
byte 62 Last Mode
byte 63 Last State

ACU mode and mode state indicators, see section 5.3 for possible values.

byte 64 ETX
byte 65 Checksum

3.4.3 Auto Move Command

This command has several forms:

Form 1: This form of the command is not currently implemented.

Form 2: This form of the command causes the controller to position the antenna at the azimuth, elevation, and polarization positions specified. The axis mask field controls which axes will move. If the simultaneous drive option is not enabled, the controller will move elevation, azimuth, then polarization. If the command specifies polarization movement but the Feed Type is set to CIRCULAR, the command will be accepted but no polarization movement will occur.

This command has the following format:

byte 0	STX		
byte 1	A	address	
byte 2	32h	command code	
byte 3	Form Code	'2'	
byte 4	Sensor	'1' = platform angles, '2' = horizontal angles	
byte 5	Axis Mask	'0' – No Axis	'4' – Pol
		'1' – Azim	'5' – Azim & Pol
		'2' – Elev	'6' – Elev & Pol
		'3' – Azim & Elev	'7' – Azim & Elev & Pol
bytes 6-13	Azimuth Position	+/-180.000 degrees	
bytes 14-21	Elevation Position	-20.000 to 120.000 degrees	
bytes 22-29	Polarization Position	+/-100.000 degrees	
		+ddd.ddd (decimal-degrees format) Right-justify and pad with blanks	
byte 30	ETX		
byte 31	Checksum		

The ACK reply to this command will be in the same format as the Device Status Command. The NAK reply will be received if any parameter is invalid.

Auto Move Command (continued)

Form S: This form is only available on mount types where the antenna system is equipped with a special "fourth axis" of motion.

This command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	32h	command code
byte 3	Form Code	'S'
byte 4	Axis Code	
byte 5	Direction Code	

Where special axis and direction codes are defined as follows:

SPECIAL AXIS	AXIS CODE	DIRECTION CODE
Waveguide	'W'	'H' – Horizontal (Position 1) 'V' – Vertical (Position 2)
RF Switch	'R'	'1' – Path 1 '2' – Path 2
Polarization Mode	'P'	'C' – Circular Mode 'L '– Linear Mode

byte 6	ETX	
byte 7	Checksum	

The ACK reply to this command will be in the same format as the Device Status Command. The NAK reply will be received if any parameter is invalid.

3.4.4 Azimuth/Elevation/Polarization Jog Command

This command jogs the antenna in azimuth, elevation, or polarization. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	33h	command code
byte 3	Direction	This field can specify one of the following: 'E' – Azimuth Counter Clockwise 'W' – Azimuth Clockwise 'D' – Elevation Down 'U' – Elevation Up 'O' – Polarization Counter Clockwise 'L' – Polarization Clockwise 'X' – Stop All Movement
byte 4	Speed	Specifies the jog speed, either 'F' (Fast) or 'S' (Slow). This field must contain a valid value even if the direction field specifies 'X' (Stop).
bytes 5-8	Duration	Length to continue the jog milliseconds from '0000' to '9999'. This field must contain a valid value even if the direction field specifies 'X' (Stop). NOTE: The resolution of the timer used to make the move is approximately 10 milliseconds. All durations converted to the closest multiple.
byte 9	ETX	
byte 10	Checksum	

The ACK reply to this command will be in the same format as the Device Status Command. The NAK reply will be received if any parameter is invalid.

NOTE 1: The controller can only support a remote jog about a single axis. For example, if a remote jog is in progress about the azimuth axis and a remote elevation jog command is received, the azimuth jog will terminate regardless of the duration specified for the remote azimuth jog.

NOTE 2: The controller will automatically switch to MANUAL mode to execute this command.

3.4.5 Polarization Command

This command moves the polarization to the specified calculated position. If the Polarization Type is set to DUAL (2 Port Feed) either the 'H' or 'V' argument will result in a move to the single polarization position associated with the satellite. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	34h	command code
byte 3	'X'	This field must specify either 'H', 'V', or 'X' where: H/V – moves the polarization to the horizontal/vertical polarization position associated with the last auto move target satellite X – moves the polarization 90 degrees from the current polarization position
byte 4	ETX	
byte 5	Checksum	

The ACK reply to any form of this command will be in the same format as the Device Status Command. The NAK reply will be received if any parameter is invalid.

NOTE: The controller will automatically switch to MANUAL mode to execute this command.

3.4.6 Miscellaneous Command

This command performs miscellaneous functions. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	36h	command code
byte 3	'X'	sub-command code
byte 4	'Y'	sub-command parameter
byte 5	ETX	
byte 6	Checksum	

The sub-command code 'X' can have the following values:

'X' = 'R'	This sub-command is used to reset the azimuth, elevation, or polarization drives. The sub-command parameter 'Y' must be 'A', 'E', or 'P' (for azimuth, elevation, or polarization respectively).
'X' = 'T'	This sub-command is used to clear tracking errors and restart TRACK mode. The sub-command parameter 'Y' must be 'R'. The reply will be a NAK if TRACK mode is not active. NOTE: If a system error is active (an error message flashing on the bottom row of the display) the error condition must be rectified or the controller will immediately return to the TRACK mode ERROR sub-mode.
'X' = 'S'	This sub-command is used to initiate an automatic antenna STOW command.
'X' = 'D'	This sub-command is used to initiate an automatic antenna DEPLOY command.
'X' = 'P'	This sub-command is used to initiate an automatic antenna PEAKUP command.
'X' = 'L'	This sub-command is used to manually select the band range of a tunable LNB (TLNB). Set parameter 'Y' = '0', '1', '2', or '3' to select mute, low, middle, or high band. NOTE: This sub-command is only available on systems that include TLNB support.
'X' = 'M'	This sub-command is used to turn Standby Mode on or off. 'Y' = 'A' turns Standby Mode on. 'Y' = 'I' turns Standby Mode off.

The ACK reply to this command will be in the same format as the Device Status Command.

3.4.7 Reflect Display Command

This command requests contents of the 4x40 LCD. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	37h	command code
byte 3	ETX	
byte 4	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	37h	command code
bytes 3-42	Row 1	40 characters displayed on row 1 of the LCD
bytes 43-82	Row 2	40 characters displayed on row 2 of the LCD
bytes 83-122	Row 3	40 characters displayed on row 3 of the LCD
bytes 123-162	Row 4	40 characters displayed on row 4 of the LCD
byte 163	Cursor Row	cursor row position (1–4)
bytes 164-165	Cursor Column	cursor column (01–40)
byte 166	Cursor Status	0 = cursor off, blink off 1 = cursor off, blink on 2 = cursor on, blink off 3 = cursor on, blink on
byte 167	ETX	
byte 168	Checksum	

NOTE: The reply to this command is very lengthy and should be limited to a frequency less than 2 Hz.

3.4.8 Write Satellite Data Command

This command writes satellite data into the list of preset satellites. Storage for 20 satellites is available. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	39h	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-14	Sat Name	10 character satellite name
bytes 15-20	Longitude	Nominal satellite longitude -179.9 to 179.9 (West longitude negative) Left-justify and pad with blanks
bytes 21-22	Inclination	Satellite inclination 0 to 19 Left-justify and pad with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 24	Ephemeris	0 = None, 1 = TLE
bytes 25-29	Pol Offset	Polarization Offset -90.0 to 90.0 negative = counterclockwise Left-justify and pad with blanks
byte 30	Default Pol	Default polarization for remote LOCATE command (H = Horizontal, V = Vertical, X = None)
byte 31		ETX
byte 32		Checksum

The reply to this command will be the standard ACK or NAK reply.

NOTE: Data written with this command must be saved to persist between power cycles. The Write Config Data Command should be executed after all changes have been made. Refer to section 3.4.23 of this document for more information.

3.4.9 Read Satellite Data Command

This command reads a stored satellite from the controller memory. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Ah	command code
byte 3-4	Index	Preset satellite table index (01–20)
byte 5		ETX
byte 6		Checksum

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	3Ah	command code
byte 3-4	Index	Preset satellite table index (01–20)
bytes 5-14	Sat Name	10 character satellite name to be associated with index
bytes 15-20	Longitude	Nominal satellite longitude -179.9 to 179.9 (West longitude negative) Left Justify and pad with blanks
bytes 21-22	Inclination	Satellite inclination 0 to 19 Left Justify and pad with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 24	Ephemeris	0 = None, 1 = TLE
bytes 25-29	Pol Offset	Polarization Offset -90.0 to 90.0 negative = counterclockwise Left Justify and pad with blanks
byte 30	Default Pol	Default polarization for remote LOCATE command (H = Horizontal, V = Vertical, X = None)
byte 31	ETX	
byte 32	Checksum	

3.4.10 Write Two-Line Element Data Command

This command writes NORAD Two-Line Element (TLE) ephemeris data into the controller memory. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Bh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-73	TLE Line 1	69 characters (including checksum) of TLE Line 1
bytes 74-142	TLE Line 2	69 characters (including checksum) of TLE Line 2
byte 143	ETX	
byte 144	Checksum	

The reply to this command will be the standard ACK or NAK reply.

Data written with this command must be saved to persist between power cycles. The Write Config Data Command should be executed after all changes have been made. Refer to section 3.4.23 of this document for more information.

3.4.11 Read Two-Line Element Data Command

This command reads a stored set of Two-Line Element (TLE) data. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Ch	command code
bytes 3-4	Index	Preset satellite table index (01–20)
byte 5	ETX	
byte 6	Checksum	

The ACK reply will be in the following format:

byte 0	ACK or NAK	
byte 1	A	address
byte 2	3Ch	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-73	TLE Line 1	69 characters (including checksum) of TLE Line 1
bytes 74-142	TLE Line 2	69 characters (including checksum) of TLE Line 2
byte 143	ETX	
byte 144	Checksum	

3.4.12 Write Beacon Data Command

This command writes beacon tuning data into the controller memory. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Dh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-10	Reserved	Fill with zeros or blanks
byte 11	Polarization	H = horizontal, V = vertical
byte 12	Reserved	Fill with a zero or blank
byte 13	Enable Flag	0 – Do not use this entry 1 – Use as signpost 2 – Use for confirmation only
bytes 14-21	Frequency	Beacon frequency (MHz) in the format (ddddd.dd)
byte 22	Demodulation	0 = CW, 1 = BPSK
bytes 23-31	Reserved	Fill with zeros or blanks
byte 32	ETX	
byte 33	Checksum	

The reply to this command will be the standard ACK or NAK reply.

Data written with this command must be saved to persist between power cycles. The Write Config Data Command should be executed after all changes have been made. Refer to section 3.4.23 of this document for more information.

3.4.13 Read Beacon Data Command

This command reads beacon tuning data from the controller memory. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Eh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
byte 5	ETX	
byte 6	Checksum	

The ACK reply will be in the following format:

byte 0	ACK or NAK	
byte 1	A	address
byte 2	3Eh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-10	Reserved	Filled with zeros or blanks
byte 11	Polarization	H = horizontal, V = vertical
byte 12	Reserved	Filled with a zero or blank
byte 13	Locate Flag	0 – Do not use this entry 1 – Use as signpost 2 – Use for confirmation only
bytes 14-21	Frequency	Beacon frequency (MHz) in the format (ddddd.dd)
byte 22	Demodulation	0 = CW, 1 = BPSK
bytes 23-31	Reserved	Filled with zeros or blanks
byte 32		ETX
byte 33		Checksum

3.4.14 Read Platform Angles Command

This command returns the current platform angles for azimuth, elevation, and polarization. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	3Fh	command code
byte 3	ETX	
byte 4	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	3Fh	command code
bytes 3-10	Azimuth Position	-180.000 to 180.000 degrees
bytes 11-18	Elevation Position	-20.000 to 120.000 degrees
bytes 19-26	Polarization Position	+/-100.000 degrees
	Platform angles in +ddd.ddd (decimal-degrees format) Right-justified and padded with blanks ‘********’ if sensor error	
byte 27	ETX	
byte 28	Checksum	

3.4.15 Remote Locate Command

This command requests a LOCATE operation. The ACU will automatically begin locating the specified satellite using the data provided.

NOTE: The M&C system is required to have confidence that the preset data is programmed correctly. This includes satellite data and associated receiver parameters.

The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	41h	command code
byte 3	Preset Flag & Preset Index Tens	
	7 6 5 4 3 2 1 0 0 1 A A $ 0 0 B B	
		Where 'AA' is defined as: 00 – use data supplied in bytes 5-28 01 – use preset data stored in the ACU 10 – use data from the last LOCATE operation Where 'BB' is the tens digit of preset index, or zero if not specifying a preset satellite.
byte 4	Index Ones	Ones digit of preset index, or zero if not specifying a preset satellite
bytes 5-14	Sat Name	10 character satellite name
bytes 15-20	Longitude	Nominal satellite longitude -179.9 to 179.9 (West longitude negative) Left-justify and pad with blanks
bytes 21-22	Inclination	Satellite inclination 0 to 19 Left-justify and pad with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
bytes 24-28	Pol Offset	Satellite Polarization Offset (relative to equatorial plane) -90.0 to 90.0 (CCW negative) Left-justify and pad with blanks

Remote Locate Command (continued)

byte 29	Polarization	H – Horizontal V – Vertical N – Neutral X – None D – Use default stored in preset list NOTE: This value is ignored if feed type is circular.
byte 30	Position Update	A – Automatically determine missing mount position data U – Force an update of all mount position data
byte 31	Locate Source 7 6 5 4 3 2 1 0 0 1 0 A $ B B B B	Where ‘A’ is defined as: 0 – Use locate source config value 1 – Use source specified by lower nibble Where ‘BBBB’ is defined as: 0000 – None 0001 – Receiver 1 (or external beacon) 0010 – Receiver 2 (or internal beacon) 0101 – RF 0110 – DVB (if available) 0111 – Remote (if available)
bytes 32-34	Reserved	Fill with zeros or blanks
byte 35		ETX
byte 36		Checksum

The reply to this command will be the standard ACK or NAK reply. ACK implies that LOCATE operation will be initiated. Progress of the LOCATE operation may be monitored via the Device Status Command. NAK implies an error in the supplied satellite data.

3.4.16 Remote Track Command

This command requests a TRACK operation. The ACU will automatically begin tracking the specified satellite using the data provided.

NOTE 1: The M&C system is required to have confidence that the preset data is programmed correctly. This includes satellite data and associated receiver parameters.

NOTE 2: It is assumed that the satellite has been positively identified and is currently peaked up in azimuth, elevation, and polarization prior to performing this operation.

The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	42h	command code
byte 3	Preset Flag & Preset Index Tens 7 6 5 4 3 2 1 0 0 1 A A $ 0 0 B B	 Where 'AA' is defined as: 00 – Use data supplied in bytes 5-28 01 – Use preset data stored in the ACU 10 – Use data from the last LOCATE operation Where 'BB' is the tens digit of preset index, or zero if not specifying a preset satellite.
byte 4	Index Ones	Ones digit of preset index, or zero if not specifying a preset satellite
bytes 5-14	Sat Name	10 character satellite name
bytes 15-20	Longitude	Nominal satellite longitude -179.9 to 179.9 (West longitude negative) Left-justify and pad with blanks
bytes 21-22	Inclination	Satellite inclination 0 to 19 Left-justify and pad with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
bytes 24-29	Reserved	Fill with zeros or blanks

Remote Track Command (continued)

byte 30	Position Update	A – Automatically determine missing mount position data U – Force an update of all mount position data
byte 31	Track Source 7 6 5 4 3 2 1 0 0 1 0 A $ B B B B	
		Where 'A' is defined as: 0 – Use locate source config value 1 – Use source specified by lower nibble Where 'BBBB' is defined as: 0001 – Receiver 1 (or external beacon) 0010 – Receiver 2 (or internal beacon) 0101 – RF 0110 – DVB (if available) 0111 – Remote (if available)
byte 32	Track Options	0 – Recall previous track (if available) 1 – Start new track
bytes 33-45	Reserved	Fill with zeros or blanks
byte 46		ETX
byte 47		Checksum

The reply to this command will be the standard ACK or NAK reply. ACK implies that TRACK operation will be initiated. NAK implies an error in the supplied satellite data.

3.4.17 Write DVB Data Command

This command writes DVB tuning data into the controller memory. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	43h	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-10	Reserved	Fill with zeros or blanks
bytes 11-15	Frequency	10700 to 12750 Left-justify and pad with blanks
bytes 16-20	Symbol Rate	1000 to 40000 Left-justify and pad with blanks
byte 21	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to “Auto” for DVB-S2
byte 22	Polarization	H = horizontal, V = vertical
bytes 23-28	Reserved	Fill with zeros or blanks
byte 29	Enable Flag	0 – Do not use this entry 1 – Use as signpost 2 – Use for confirmation only
byte 30	Standard	1= DVB-S1, 2 = DVB-S2
byte 31	Modulation	0 = Auto, 1 = QPSK Note: Set to “Auto” for DVB-S2
byte 32-33	Reserved	Fill with zeros or blanks
byte 34	ETX	
byte 35	Checksum	

The reply to this command will be the standard ACK or NAK reply.

Data written with this command must be saved to persist between power cycles. The Write Config Data Command should be executed after all changes have been made. Refer to section 3.4.23 of this document for more information.

3.4.18 Read DVB Data Command

This command reads DVB tuning data from the controller memory. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	44h	command code
bytes 3-4	Index	Signpost data table index (01–20)
byte 5	ETX	
byte 6	Checksum	

The ACK reply will be in the following format:

byte 0	ACK or NAK	
byte 1	A	address
byte 2	44h	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-10	Reserved	Filled with zeros or blanks
bytes 11-15	Frequency	10700 to 12750 Right-justified and padded with blanks
bytes 16-20	Symbol Rate	1000 to 40000 Right-justified and padded with blanks
byte 21	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to “Auto” for DVB-S2
byte 22	Polarization	H = horizontal, V = vertical
bytes 23-28	Reserved	
byte 29	Enable Flag	0 – Do not use this entry 1 – Use as signpost 2 – Use for confirmation only
byte 30	Standard	1 = DVB-S1, 2 = DVB-S2
byte 31	Modulation	0 = Auto, 1 = QPSK Note: Set to “Auto” for DVB-S2
byte 32-33	Reserved	Filled with zeros or blanks
byte 34	ETX	
byte 35	Checksum	

3.4.19 Read Navigation Data Command

This command uploads the current values of navigation data. The command has the following format:

byte 0	STX

byte 1	A	address
byte 2	45h	command code
byte 3	ETX	
byte 4	Checksum	

The ACK reply will be in the following format:

byte 0	ACK or NAK	
byte 1	A	address
byte 2	45h	command code
byte 3	Latitude/Longitude Source	
	7 6 5 4 3 2 1 0 0 1 0 0 $ 0 X X X	
	where 'XXX' is ...	001 – Lat/Lon data invalid 010 – Lat/Lon read from GPS 011 – User entered location 100 – User selected preset location 101 – Remotely entered lat/lon
bytes 4-8	Latitude	+ddmm (+/- degrees, minutes format) Right-justified and padded with blanks -9000 to +9000 or blanks if not available minus = South, positive (implied) = North 1234 = 12 degrees 34 minutes N -1234 = 12 degrees 34 minutes S
bytes 9-12	Reserved	
bytes 13-18	Longitude	+dddmm (+/- degrees, minutes format) Right-justified and padded with blanks -18000 to +18000 or blanks if not available minus = West, positive (implied) = East 1234 = 12 degrees 34 minutes E -1234 = 12 degrees 34 minutes W
bytes 19-28	Reserved	

Read Navigation Data Command (continued)

byte 29	True Heading Source 7 6 5 4 3 2 1 0 0 1 0 0 $ 0 X X X	
	where 'XXX' is ...	001 – Heading data invalid 010 – Heading read from compass 011 – User entered magnetic heading 100 – User entered true heading 101 – Heading fixed by user 110 – Heading fixed automatically 111 – Remotely entered heading
bytes 30-34	True Heading	ddd.d (decimal degrees format) Right-justified and padded with blanks 0.0 to 359.9 or blanks if not available True Heading of mount at azimuth 0.0
byte 35	Magvar Status	0x41h if magvar ready (calculated) 0x40h if magvar not ready
bytes 36-41	Magnetic Variation	+dd.d (decimal degrees format) Right-justified and padded with blanks -99.9 to 99.9 or blanks if magvar not available (westerly variation negative)
bytes 42-58	Reserved	
byte 59	Platform Tilt Source 7 6 5 4 3 2 1 0 0 1 0 0 $ 0 X X X	
	where 'XXX' is ...	001 – Currently no tilt data 010 – Automatically determined tilt data 011 – User entered tilt data 100 – Remotely entered tilt data
bytes 60-64	Platform Pitch	+dd.d (decimal degrees format) Right-justified and padded with blanks -99.9 to 99.9 or blanks if not available
bytes 65-69	Platform Roll	+dd.d (decimal degrees format) Right-justified and padded with blanks -99.9 to 99.9 or blanks if not available
byte 70	ETX	
byte 71	Checksum	

3.4.20 Write Navigation Data Command

This command writes antenna position data into the ACU. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	46h	command code
bytes 3-7	Latitude	+ddmm (+/- degrees, minutes format) Right-justify and pad with blanks -9000 to 9000 minus = South, positive (implied) = North 1234 = 12 degrees 34 minutes N -1234 = 12 degrees 34 minutes S
bytes 8-13	Longitude	+dddmm (+/- degrees, minutes format) Right-justify and pad with blanks -18000 to 18000 minus = West, positive (implied) = East 1234 = 12 degrees 34 minutes E -1234 = 12 degrees 34 minutes W
bytes 14-18	True Heading	ddd.d (decimal degrees format) Right-justify and pad with blanks 0.0 to 359.9 True Heading of mount at azimuth 0.0 12.3 = 12.3 degrees 179.4 = 179.4 degrees
byte 19	Update Lat/Lon	‘A’ – Do not change lat/lon values ‘U’ – Force update using GPS ‘M’ – Use manual data from fields above
byte 20	Update Heading	‘A’ – Do not change compass value ‘U’ – Force update using compass ‘M’ – Use manual data from fields above
byte 21	Update Options	
	7 6 5 4 3 2 1 0 0 1 0 X $ 0 0 0 0	
	where ‘X’ is ...	0 – Update source flags only 1 – Immediately move antenna to update position data (REMOTE_NAV mode)
bytes 22-26	Reserved	Fill with zeros or blanks

Write Navigation Data Command (continued)

bytes 27-31	Platform Pitch	+dd.d (+/- degrees format) Right-justify and pad with blanks -90.0 to 90.0 12.3 = 12.3 degrees -11.4 = -11.4 degrees
bytes 32-36	Platform Roll	+dd.d (+/- degrees format) Right-justify and pad with blanks -90.0 to 90.0 12.3 = 12.3 degrees -11.4 = -11.4 degrees
bytes 37	Update Tilt	'A' – Do not change pitch/roll values 'U' – Force update of tilt 'M' – Use manual data from fields above
bytes 38-40	Reserved	Fill with zeros or blanks
byte 41	ETX	
byte 42	Checksum	

The reply to this command will be the standard ACK or NAK reply.

3.4.21 Jog with Minimal Reply Command

This command jogs the antenna in azimuth, elevation or polarization. It is functionally the same command as described in section 3.4.4 but with a much shorter reply. Rather than sending the full status reply, only the position (at the time the command is received) of the selected axis is returned.

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	47h	command code
byte 3	Axis	The axis that is being jogged: 'A' – Azimuth 'E' – Elevation 'P' – Polarization
bytes 4-11	Axis Position	The current azimuth, elevation, or polarization angle +ddd.ddd (decimal-degrees format) or '********' if sensor error
byte 12	ETX	
byte 13	Checksum	

3.4.22 Remote Key Press Command

This command sends a keypad value to the controller. The controller will react to the keypad value as if the corresponding key on the controller front panel was pushed. **This is recommended for debugging/development only and should not be part of a full M&C system.** The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	48h	command code
byte 3	Key Code	Key code as defined below

CODE	KEY
30h	0/Speed
31h	1/Pol CCW
32h	2/N/EL UP
33h	3/Pol CW
34h	4/E/AZ CCW
35h	5
36h	6/W/AZ CW
37h	7/H
38h	8/S/EL DN
39h	9/V
3A-3Fh	-- unused –
41h	Stop/decimal pt.
42h	+/-/BKSP
43h	Mode
44h	Scroll Up/Yes
45h	Scroll Dn/No
46h	Enter
47h	Mode Group Change
48h	Null Key

byte 4	ETX
byte 5	Checksum

NOTE: The 47h key code can be used to initiate a mode group change which normally requires the Mode key to be held down for five seconds.

The reply to this command will be the standard ACK or NAK reply.

3.4.23 Write Config Data Command

This command writes CONFIG item values to the controller memory. Data values written by some remote commands are not committed to the flash memory until the save command is sent.

Flash memory has a limited number of write times. Care should be taken to avoid unnecessary calling of this command. For example, if changing a number of preset satellites, don't call Write Config Data until all Write Satellite Data commands have been sent and acknowledged.

The save command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	49h	command code
bytes 3-15	"SAVE"	Left-justify and pad with blanks
byte 16	ETX	
byte 17	Checksum	

The reply to this command will be the standard ACK or NAK reply.

NOTE: The ACU current mode will change to FLASH_SAVE_MODE temporarily while flash data is saved.

3.4.24 Custom Device Status Command

This command requests status information given a variable list of Object IDs. A full list of available OIDs is given in section 5.4 of this document. The command has the following format:

byte 0		STX
byte 1	A	address
byte 2	4Bh	command code
bytes 3-n	Object IDs	A comma-delimited list of up to 16 OIDs. Each code should be in ASCII format with no padding. Example: “2.70.0,2.70.1” requests the azimuth and elevation platform angles.
byte n+1	ETX	
byte n+2	Checksum	

The response to this command will be a comma-delimited list of the requested OIDs and related status values in the same order as they were requested. The return values will be the ASCII representation of character, numeric, or hexadecimal data. The return type is given in section 5.4 of this document.

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	4Bh	command code
bytes 3-n	Object Values	A comma-delimited list of status object values. Each value will be in ASCII format with no padding. No data will be returned if a requested object ID is invalid. Example: “2.70.0=-22.253,2.70.1=47.186” is the reply containing the current azimuth and elevation platform angles.
byte n+1	ETX	
byte n+2	Checksum	

The NAK reply will be received if any parameter is invalid.

NOTE: This functionality is experimental and may change without notice.

3.4.25 Write Track Table Command

This command writes position and update data to a track table entry. The index must be the same as the associated sat preset data index. There are two forms of this command.

Form 1: This command is used to modify track table entries. This command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	4Dh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-6	Table Entry	Zero-based track table entry number (00–47)
bytes 7-14	Azimuth Position	-179.9 to 179.9 +ddd.ddd (decimal-degrees format) Left-justify and pad with blanks
bytes 15-22	Elevation Position	-20.0 to 120.0 +ddd.ddd (decimal-degrees format) Left-justify and pad with blanks
byte 23	Update Flag	'Y' – Set entry update flag 'N' – Clear entry update flag
byte 24	ETX	
byte 25	Checksum	

The reply to this command will be the standard ACK or NAK reply. The associated satellite must be setup as trackable for this command to be successful. The NAK reply will be received if the satellite is not setup as trackable, or if any parameter is invalid.

NOTE: In general, track table data should not be modified. This command is provided only to allow a track table to be restored in the event that the data has been corrupted or lost.

Write Track Table Command (continued)

Form 2: This form is used to clear track table entries. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	4Dh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-6	Table Entry	Zero-based track table entry number (00–47)
bytes 7-15	“CLEAR”	Clear track table data for this entry Left-justify and pad with blanks
	or	
	“CLEAR ALL”	Clear all track table entries Left-justify and pad with blanks
bytes 18-23	Reserved	Fill with zeros or blanks
byte 24	ETX	
byte 25	Checksum	

The reply to this command will be the standard ACK or NAK reply.

3.4.26 Read Track Table Command

This command reads position and update data from a track table entry. The index must be the same as the associated sat preset data index. The command has the following format:

byte 0	STX	
byte 1	A	address
byte 2	4Eh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-6	Table Entry	Zero-based track table entry number (00–47)
byte 7	ETX	
byte 8	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	address
byte 2	4Eh	command code
bytes 3-4	Index	Preset satellite table index (01–20)
bytes 5-6	Table Entry	Track table entry number (00–47)
bytes 7-11	Sidereal Time	Sidereal time of this entry
bytes 12-19	Azimuth Position	-179.9 to 179.9 +ddd.ddd (decimal-degrees format) Right-justified and padded with blanks
bytes 20-27	Elevation Position	-20.0 to 120.0 +ddd.ddd (decimal-degrees format) Right-justified and padded with blanks
byte 28	Update Flag	‘Y’ – Entry update flag is set ‘N’ – Entry update flag is not set
byte 29	Ephemeris Flag	‘0’ – Ephemeris data not used ‘1’ – Ephemeris data used
byte 30	ETX	
byte 31	Checksum	

The associated satellite must be setup as trackable for this command to be successful. The NAK reply will be received if no data exists at the specified entry or if the satellite is not setup as trackable.

4.0 TROUBLESHOOTING

4.1 No Communication Between Antenna Controller And Remote Control Computer

There are numerous situations that could cause no communication:

1) The address set in the ACU is not being used by the remote commands. Check the address in the REMOTE configuration screen and ensure that address is being sent with the commands. Incorrectly addressed commands will be ignored by the ACU.
2) The baud rate set in the ACU is not being used by the remote commands. Check the baud rate in the REMOTE configuration screen and ensure that it is the same as being used by the remote computer. Commands sent at the incorrect baud rate will not be recognized by the ACU.
3) The remote computer or ACU are not both set to RS-232 or RS-422/RS-485. The remote-control system should determine whether it is to work in RS-232, -422 or -485 mode. Check the serial mode in the REMOTE configuration screen. Also check the cabling between the ACU and the remote computer.
4) The remote computer is not actually transmitting through the intended communication port. To check for this possibility, mechanize a “loop back” right at the communication port of the remote computer. The receive mode of the remote-control software should see an exact reflection of the transmitted command.

4.2 Unreliable Communications/ACU Reset

There are some situations that may cause the remote-control communications to be unreliable (such as a garbled status reply) or in the extreme situation to cause the ACU to reset.

1) Allow a previous command to ACK or NAK before sending another command.
2) Don't repeatedly ask for "static" information such as navigation or satellite data.
3) The general recommendation is not to send commands (particularly status requests) at a rate greater than once a second.

5.0 REFERENCE INFORMATION

5.1 MESSAGE DELIMITERS

Here are the delimiters used with SA bus messages, along with their values in hex and decimal.

ASCII Name	Value (hex)	Value (dec)
STX	0x02	2
ETX	0x03	3
ACK	0x06	6
NAK	0x15	21

5.2 ASCII TABLE

As reference, the following table shows the set of ASCII codes available for use by the remote protocol.

HEX	***0_***	***1_***	***2_***	***3_***	***4_***	***5_***	***6_***	***7_***
_0			Blank	0	@	P		p
_1			!	1	A	Q	a	q
_2	STX		"	2	B	R	b	r
_3	ETX		#	3	C	S	c	s
_4			$	4	D	T	d	t
_5		NAK	%	5	E	U	e	u
_6	ACK		&	6	F	V	f	v
_7			'	7	G	W	g	w
_8			(	8	H	X	h	x
_9			)	9	I	Y	i	y
_A			*	:	J	Z	j	Z
_B			+	;	K	[	k	{
_C			,	<	L	\	l	|
_D			-	=	M	]	m	}
_E			.	>	N	^	n	
_F			/	?	O	_	o	

5.3 STATUS REPLY MODE AND STATE VALUES

The following table defines values for bytes 60-63 of the Device Status Poll reply. Possible values are listed for operating modes and mode states which are common to all modes.

Table 5.3.1 – Operating Modes and Common Mode States

Value (hex)	Value (dec)	Mode (byte 60 & 62)	Common Mode States (byte 61 & 63)
20	32	MANUAL	INITIALIZING_MODE
21	33	MENU	WAITING_FOR_USER_INPUT
22	34	POSITION	MOVING_TO_DEPLOY
23	35		MOVING_TO_STOW
24	36		
25	37	LOCATE	
26	38	TRACK_SAT	MOVING_OUT_OF_DOWN
27	39	SETUP	MOVING_AZIMUTH
28	40	TRACK	MOVING_ELEVATION
29	41		MOVING_POLARIZATION
2A	42	SPECIAL_AXIS	MOVING_AZELPL
2B	43	POWER_UP	MOVING_SPECIAL_AXIS
2C	44		SEARCHING_FOR_AZIM_STOW_SWITCH
2D	45	HEADING_FIX	SEARCHING_FOR_POL_STOW_SWITCH
2E	46		ERROR_CANNOT_FIND_AZIM_STOW_SWITCH
2F	47	STOW	ERROR_CANNOT_FIND_POL_STOW_SWITCH
30	48	DEPLOY	ERROR_ELEV_NOT_IN_POSITION
31	49	RECALL	ERROR_SPECIAL_AXIS_NOT_IN_POSITION
32	50	MOVETO	ERROR_ANTENNA_NOT_AT_STOW
33	51		ERROR_ANTENNA_NOT_AT_DEPLOY
34	52		WAITING_FOR_LATLON
35	53		WAITING_FOR_HEADING
36	54	RESET_DRIVE	WAITING_FOR_TILT
37	55	DELETE	ERROR_NO_GPS_INPUT_DETECTED
38	56	FLASH_SAVE	ERROR_NO_HEADING_INPUT_DETECTED
39	57		ERROR_NO_TILT_INPUT_DETECTED
3A	58		MOVING_TO_DETERMINE_LATLON
3B	59	REMOTE_POS	MOVING_TO_DETERMINE_HEADING
3C	60		MOVING_TO_DETERMINE_TILT
3D	61	PEAKUP	MOVING_TO_SYNC_PULSES
3E	62	SHAKE	
3F	63		
40	64	SERVO_MAINT	
41	65	STANDBY	
43	67	CONFIG	
44	68	CONFIG_SUB_MODE	
45	69	MAINTENANCE	
42, 46-56	66, 70-86	Maintenance Sub-Modes	

The following tables define additional values for bytes 61 and 63 of the Device Status Poll reply. Possible values are listed for unique mode states. No unique states exist if the mode is not found in the following table.

Table 5.3.2 – Unique Mode States

Value (hex)	Value (dec)	MANUAL States	LOCATE States	TRACK States
40	64	JOG_AZIM_CCW	ERROR_NO_LATLON	INIT_PARAMETERS
41	65	JOG_AZIM_CW	ERROR_NO_HEADING	CONFIRM_EXIT
42	66	JOG_ELEV_DOWN	ERROR_NO_SAT_DATA	
43	67	JOG_ELEV_UP	ERROR_FEED_BAND_MISMATCH	
44	68	JOG_POL_CCW	ERROR_AZIMUTH_RANGE	TUNE_DVB
45	69	JOG_POL_CW	ERROR_ELEVATION_RANGE	TUNE_BEACON
46	70	AUTO_MOVE_POL	PRESET_DATA_ERROR	TUNE_FAILURE
47	71	IDLE	WAITING_FOR_MODEM	ATTEN_BEACON
48	72			
49	73			STEP_PEAKING
4A	74		CALCULATING_ANGLES	STEP_WAITING_FOR_SIGNAL_TO_RETURN
4B	75		CALCULATING_TLE_ANGLES	STEP_IDLE
4C	76		WAITING_FOR_POL_SELECTION	SEARCH_ACTIVE
4D	77		READY_TO_LOCATE	SEARCH_MOVING_TO_FOUND_PEAK
4E	78		LOCATE_COMPLETE	SEARCH_WAITING_TO_SEARCH_AGAIN
4F	79		LOCATE_FAILED	
50	80			SEARCH_MANUAL_ACTIVE
51	81			MEMORY_IDLE
52	82		MOVING_TO_INITIAL_SCAN_POSITION	MEMORY_REPOSITION
53	83		ERROR_NO_RF_DETECTED	MEMORY_UPDATING
54	84		DETERMING_NOISE_FLOOR	MEMORY_CHECKING
55	85		MOVING_TO_SCAN_ELEVATION	TLE_IDLE
56	86		RESCANNING_WITH_WIDER_RANGE	TLE_REPOSITION
57	87			
58	88		TUNING_DVB	
59	89		TUNING_BEACON	
5A	90		TUNE_FAILURE	
5B	91		ATTENUATING_BEACON	
5C	92			
5D	93		AZIMUTH_SMOOTH_SCAN	
5E	94		AZIMUTH_STEP_SCAN	
5F	95			
60	96			ERROR_PEAK_LIMIT
61	97		SAMPLING_AGC	ERROR_ACU_ALARM
62	98		MOVING_TO_LOCK_CENTER	ERROR_CHECKSUM
63	99		MOVING_TO_PEAK	ERROR_TLE_DATA
64	100		NO_PEAK_MOVING_TO_NOMINAL	ERROR_UNDEFINED
65	101		NO_PEAK_FOUND	
66	102		BEGINNING_SPIRAL_SEARCH	
67	103		SPIRAL_MOVING_TO_START	
68	104		SPIRAL_STEPPING_CW	
69	105		SPIRAL_STEPPING_UP	
6A	106		SPIRAL_STEPPING_CCW	
6B	107		SPIRAL_STEPPING_DOWN	
6C	108			
6D	109			
6E	110			
6F	111			
70	112		MOVING_TO_TARGET_SATELLITE	
71	113		FINAL_POL_MOVE	
72	114			
73	115			
74	116		PERFORMING_PEAKUP	
75	117		PERFORMING_POL_PEAKUP	

Table 5.3.2 – Unique Mode States (continued)

Value (hex)	Value (dec)	POWER_UP States	RECALL States	STOW States
40	64	CONFIRM_TRACK_RESTART	SAT_MEMORY_EMPTY	STOW_COMPLETE
41	65	CONFIRM_SAVED_POSITION		
42	66	ENTER_ANTENNA_POSITION		
43	67			
44	68		MOVING_TO_SAT_POSITION	
45	69			
46	70			
47	71			
48	72			
49	73			

5.4 STATUS OBJECT IDS AND RETURN VALUE TYPES

NOTE: This functionality is experimental and may change at any time without notice.

The following table defines the available status OIDs and their return value types. All values are returned as ASCII characters formatted in the manner described. Supplemental tables follow with individual item detail where indicated.

The leading digit 'x' for each ID identifies the custom status version. Each ACU model may have a different custom status version. It is recommended to determine the version by starting with "1.0.0" and incrementing the first digit until an ACK reply is received.

Table 5.4.1 – Object IDs

OID	Status Item	Format	Description
2.0.0	CURRENT_MODE_ITEM	Unsigned	See Section 5.3
2.1.0	CURRENT_SUBMODE_ITEM	Unsigned	See Section 5.3
2.2.0	LAST_MODE_ITEM	Unsigned	See Section 5.3
2.3.0	LAST_SUBMODE_ITEM	Unsigned	See Section 5.3
2.5.0	TIMEDATE_ITEM (future)	ASCII String	HH:MM:SS (8 Characters)
2.6.0	ACTIVE_ALARM_ITEM	Enumeration	Table 5.4.5
2.8.0	LOCAL_JOG_CONNECTED_ITEM	Unsigned	0=Not Connected, 1=Connected
2.10.0	POS_SAVED_ITEM	Unsigned	0 = Not Saved, 1=Saved
2.11.0	POS_LOC_SOURCE_ITEM	Enumeration	Table 5.4.2
2.12.0	POS_LOC_LAT_ITEM	Signed	+DDMM (degrees/minutes)
2.13.0	POS_LOC_LON_ITEM	Signed	+DDDMM (degrees/minutes)
2.14.0	POS_LOC_ALT_ITEM (future)	Unsigned	AAAA (meters)
2.15.0	POS_HDG_SOURCE_ITEM	Enumeration	Table 5.4.2
2.16.0	POS_HDG_ITEM	Float	DDD.DD (degrees)
2.17.0	POS_TILT_SOURCE_ITEM	Enumeration	Table 5.4.2
2.18.0	POS_TILT_PITCH_ITEM	Signed	+DD.D (degrees)
2.19.0	POS_TILT_ROLL_ITEM	Signed	+DD.D (degrees)
2.21.0	SAT_INDEX_ITEM	Unsigned	0 – 19
2.22.0	SAT_NAME_ITEM	ASCII String	10 Characters
2.23.0	SAT_LON_ITEM	Float	+DDD.D (degrees)
2.24.0	SAT_INCLIN_ITEM	Signed	+DD (degrees)
2.25.0	SAT_BAND_ITEM	Enumeration	Table 5.4.3
2.26.0	SAT_POL_OFFSET_ITEM	Float	+DD.D (degrees)
2.40.0	DVB_FREQ_ITEM	Unsigned	DDDDD (Mhz)
2.41.0	DVB_SYMRATE_ITEM	Unsigned	DDDDD (kS/sec)
2.42.0	DVB_FEC_ITEM	Unsigned	1 – 7, (3=3/4)
2.43.0	DVB_STD_ITEM	Unsigned	1=S1, 2=S2
2.50.0	BCN_FREQ_ITEM	Float	DDDDDD.DD (kHz)
2.51.0	BCN_ATTEN_ITEM	Unsigned	DD (dB)
2.52.0	BCN_DEMOD_ITEM	Unsigned	0=CW, 1=BPSK
2.60.0	Azimuth Locate Target	Float	+DDD.DDD (degrees)
2.61.0	Elevation Locate Target	Float	+DDD.DDD (degrees)
2.62.0	Polarization Horizontal Locate Target	Float	+DDD.DDD (degrees)
2.63.0	Polarization Vertical Locate Target	Float	+DDD.DDD (degrees)
2.70.0	AXIS_PLATFORM_ANGLE_ITEM: AZ	Float	+DDD.DDD (degrees)
2.70.1	AXIS_ PLATFORM_ANGLE_ITEM: EL	Float	+DDD.DDD (degrees)
2.70.2	AXIS_ PLATFORM_ANGLE_ITEM: PL	Float	+DDD.DDD (degrees)
2.71.0	AXIS_HORIZONTAL_ANGLE_ITEM: AZ	Float	+DDD.DDD (degrees)
2.71.1	AXIS_ HORIZONTAL_ANGLE _ITEM: EL	Float	+DDD.DDD (degrees)
2.71.2	AXIS_ HORIZONTAL_ANGLE _ITEM: PL	Float	+DDD.DDD (degrees)
2.72.0	AXIS_LIMITS_ITEM: AZ	Hexadecimal	Table 5.4.6
2.72.1	AXIS_LIMITS_ITEM: EL	Hexadecimal	Table 5.4.6
2.72.2	AXIS_LIMITS_ITEM: PL	Hexadecimal	Table 5.4.6
2.72.0	AXIS_ALARMS_ITEM: AZ	Hexadecimal	Table 5.4.7
2.72.1	AXIS_ALARMS_ITEM: EL	Hexadecimal	Table 5.4.7
2.72.2	AXIS_ALARMS_ITEM: PL	Hexadecimal	Table 5.4.7
2.73.0	AXIS_STATE_ITEM: AZ	Unsigned	Table 5.4.5
2.73.1	AXIS_STATE_ITEM: EL	Unsigned	Table 5.4.5
2.73.2	AXIS_STATE_ITEM: PL	Unsigned	Table 5.4.5

Table 5.4.1 – Object IDs (continued)

OID	Status Item	Format	Description
2.80.0	FEED_INDEX_ITEM	Unsigned	0 – 7
2.81.0	FEED_LNB_INDEX	Unsigned	0 – 2
2.89.0	HPA_ENABLE_ITEM	Unsigned	0=Disabled, 1=Tx Mute, 2=Enabled
2.90.0	SIGNAL_SOURCE_ITEM	Enumeration	Table 5.4.5
2.91.0	SIGNAL_LEVEL_ITEM	Unsigned	0 – 4095
2.92.0	SIGNAL_LOCK_ITEM	Unsigned	0=Off, 1=On, 2=None Defined
2.101.0	TRACK_SIDEREAL_TIME_ITEM	Unsigned	0 -- 84365
2.102.0	TRACK_STATUS_ITEM	Unsigned	Table 5.4.4
2.103.0	TRACK_ERROR_ITEM	Unsigned	Table 5.4.4

The following tables list enumerated values for multiple status items. Only values listed below should be considered valid.

Table 5.4.2 – Location, Heading, and Tilt Source Enumerated Values

Value (dec)	POS_LOC_SOURCE _ITEM	POS_HDG_SOURCE _ITEM	POS_TILT_SOURCE _ITEM
0	None	None	None
1	GPS	Compass	Auto
2	Manual	Manual Magnetic	Manual
3	Preset	Manual True	Remote
4	Reserved	Heading Fixed	
5	Remote	Auto Fixed	
6		Remote	
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			

Table 5.4.3 – Satellite Source, Band, and Polarization Enumerated Values

Value (dec)	SAT_SOURCE _ITEM	SAT_BAND _ITEM	SAT_POLARIZATION _ITEM
0	None	C	None
1	Manual	Ku	Horizontal
2	Preset	L	Vertical
3	Longitude	X	Right-Hand
4		Ka	Left-Hand
5		S	Neutral
6			
7			

Table 5.4.4 – Track Status and Error Enumerated Values

Value (dec)	TRACK_STATUS _ITEM	TRACK_ERROR _ITEM
0	Track Setup Sub-Mode Active	
1	Track Auto Mode Entry	
2	Step Track Sub-Mode Active	
3	Auto Search Sub-Mode Active	
4	Memory Track Sub-Mode Active	
5	Track Error Sub-Mode Active	
6	NORAD Track Sub-Mode Active	
7	Manual Search Sub-Mode Active	
33		Move Jammed Error
34		Move Limit Error
35		Move Drive Error
36		Peak Limit Error
37		Azim Scale Factor Error
38		Track Geo Error
39		Track System Error
40		Track Checksum Error

Table 5.4.5 – Alarm, Signal Source, and Axis State Enumerated Values

Value (dec)	ACTIVE_ALARM _ITEM	SIGNAL_SOURCE _ITEM	AXIS_STATE _ITEM
0	None	None	Idle
1	Flash Version Mismatch	Receiver 1 (External)	Coast
2	Flash Data Corrupted	Receiver 2 (Internal)	Jog Negative
3	NVRAM Version Mismatch	Reserved	Jog Positive
4	NVRAM Data Corrupted	Reserved	Auto Move Config
5	Low Battery	L-Band Power	Auto Move Negative
6	Invalid Time/Date	DVB	Auto Move Positive
10	Azimuth Follow		
11	Azimuth Drift		
20	Elevation Follow		
21	Elevation Drift		
30	Polarization Follow	Remote	Alarm
31	Polarization Drift		
40	Limits Inactive Warning		
41	Drive System Error		
42	Emergency Stop Active		
43	Maintenance Interlock		
44	Movement Interlock		
45	Local Jog Connected		
46	Reserved / Unused		
47	Standby Warning		

The following table lists possible values for the AXIS_LIMITS_ITEM. The hexadecimal value represents a 3-byte bitmask containing limit information. An 'x' indicates a "don't care". Any combination from 000000 to 030303 is possible.

Table 5.4.6 – AXIS_LIMITS_ITEM Mask

Value (hex)	MAX Limit	MIN Limit	STOW Limit
000000	None	None	None
01xxxx	Hard		
02xxxx	Soft		
03xxxx	Both		
xx01xx		Hard	
xx02xx		Soft	
xx03xx		Both	
xxxx01			Hard
xxxx02			Soft
xxxx03			Both

The following table lists possible values for the AXIS_ALARMS_ITEM mask. The hexadecimal value represents a 2-byte bitmask containing axis alarm information. An 'x' indicates a "don't care". Any combination from 0000 to FFFF is possible.

Table 5.4.7 – AXIS_ALARMS_ITEM Mask

Value (hex)	SENSOR	FOLLOW	DRIFT	DRIVE	OFF-AXIS	HALT	MAINT	INTERLOCK
xxx1	Yes							
xxx2		Yes						
xxx4			Yes					
xxx8				Yes				
xx8x					Yes			
x1xx						Yes		
x2xx							Yes	
x4xx								Yes