

APPENDIX REM – REMOTE CONTROL PROTOCOL

This appendix describes the remote commands available to monitor and control the RC4500/4800 antenna control unit (ACU). It is provided as a supplement to the baseline RC4500/4800 manual. Sections in the baseline manual are cited where additional information may be found.

NOTE: RC4500/4800 software is built on a per-antenna basis. Some commands may not be available on all units.

Revision History

DATE	MODIFICATION	SW VERSION	INITIALS
	Initial Version	3.00	RLE

1 INTRODUCTION

PLEASE READ AND UNDERSTAND THE MANUAL. Due to the complexity of the functions performed by the ACU, time invested in understanding its installation and operation will be well spent.

1.1 Overview

The RC4500/4800 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.

1.2 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.

1.2.1 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.

1.2.2 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 except for 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.

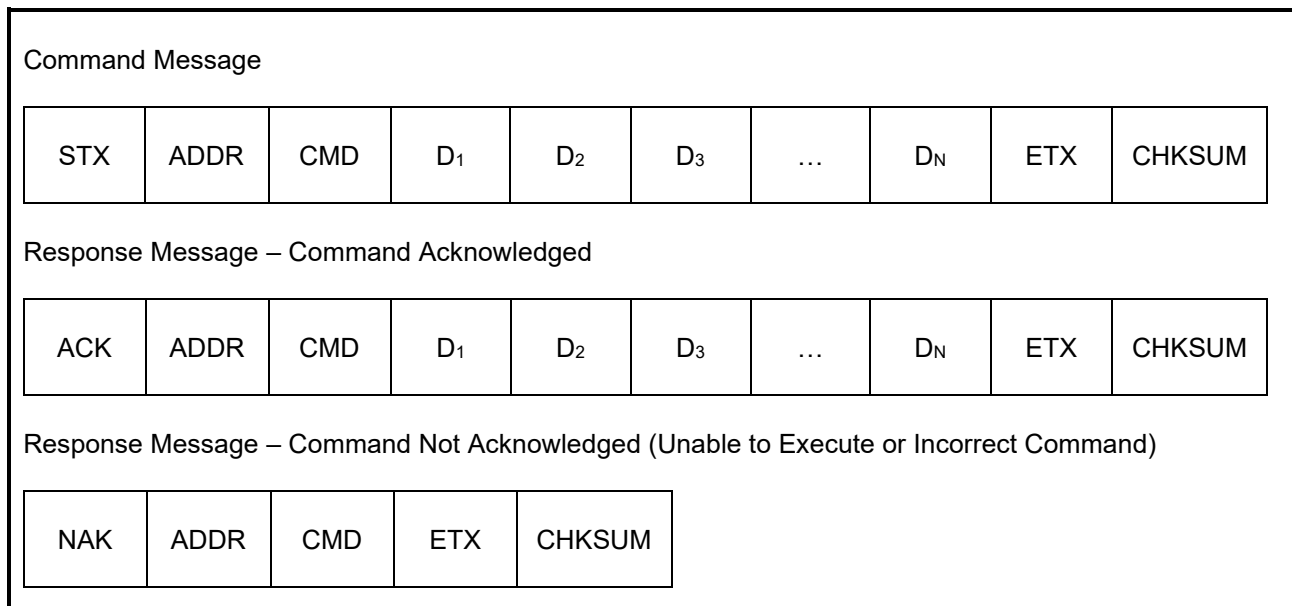


Figure 1 - Message Format

1.2.3 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.

1.2.4 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. The address for the ACU is 50 (32 hex).

1.2.5 Command Byte

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

1.2.6 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.

1.2.7 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 taken place, but only that the message was received and understood. The user should query the controller later to see if the command is still in progress.

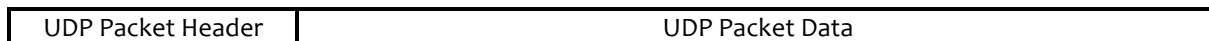
1.3 UDP Encapsulation

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

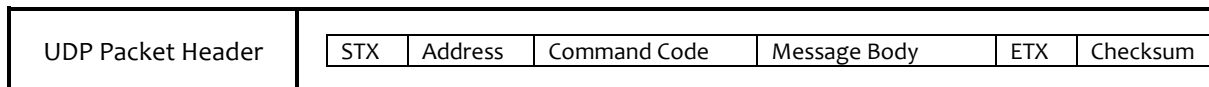
UDP is a simple connectionless protocol where datagrams are sent from a host IP and port to a target IP and port. No acknowledgement, retransmission, or timeout is built in. The SA-Bus protocol used by the ACU remote system fills these roles, making UDP the natural choice for monitor and control over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

The ACU maintains an open IP connection for UDP datagrams on the port defined in the ACU configuration portion of the IP interface. By default, this port number is 6767. The packet data of an incoming datagram is relayed directly to the ACU microprocessor. The ACU response is returned to the host in a similar fashion.

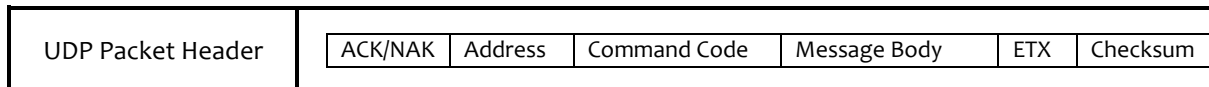
The packet structure of a UDP datagram is beyond the scope of this document. For the following examples, a datagram will consist of a packet header and packet data as illustrated below:



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:



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



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:



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.

2 DETAILED OPERATION

2.1 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
byte 3	'F'	ASCII 'F' for offline
byte 4	ETX	
byte 5	Checksum	

2.2 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
byte 3	ETX	
byte 4	Checksum	

2.3 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. The NAK reply has the following format:

byte 0	NAK	
byte 1	A	Address
byte 2	CC	Command code
byte 3	Error	'1' – Command not implemented '2' – Command length incorrect '3' – Local jog connected '4' – Illegal parameter
byte 4	ETX	
byte 5	Checksum	

2.4 Command Set

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

CODE (hex)	COMMAND	PARAGRAPH
30	Device Type Command	2.4.1
31	Device Status Command	2.4.2
32	Auto Move Command	2.4.3
33	Azimuth/Elevation/Polarization Jog Command	2.4.4
34	Polarization Command	2.4.5
35	Reserved	
36	Miscellaneous Command	2.4.6
37	Reflect Display Command	2.4.7
38	Reserved	
39	Write Satellite Data Command ¹	2.4.8
3A	Read Satellite Data Command	2.4.9
3B	Write Two-Line Element Data Command ¹	2.4.10
3C	Read Two-Line Element Data Command	2.4.11
3D	Write Beacon Data Command ¹	2.4.12
3E	Read Beacon Data Command	2.4.13
3F	Reserved	
40	Reserved	
41	Reserved	
42	Reserved	
43	Write DVB Data Command ¹	2.4.14
44	Read DVB Data Command	2.4.15
45	Read Navigation Data Command	2.4.16
46	Reserved	
47	AZ/EL/POL Jog Command (with minimal reply)	2.4.17
48	Remote Key Press Command	2.4.18
49	Write Config Data Command	2.4.19
4A	Reserved	
4B	Custom Device Status Command ²	2.4.20
4C	Reserved	
4D	Write Track Table Command	2.4.21
4E	Read Track Table Command	2.4.22
4F	Write Date/Time Command	2.4.23
	1 – requires flash save via Write Config Data	
	2 – experimental	

2.4.1 Device Type Command

This command returns device type and software version.

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 'RC45'=RC4500, 'RC48'=RC4800 Left justified and padded with blanks
bytes 8-16	Version	The device version number descriptor The software version in the format: "vA.BB.CCC" Left justified and padded with blanks
byte 17	ETX	
byte 18	Checksum	

2.4.2 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 3-5	Satellite Index	The Index of the currently selected satellite This field will contain '****' if no satellite is selected Right justified and padded with blanks
bytes 6-15	Satellite Name	The name of the currently selected satellite Left justified and padded with blanks

Device Status Command (continued)

bytes 16-23	Azimuth Position	0.000 to 360.000 degrees
bytes 24-31	Elevation Position	-20.00 to +120.00 degrees
bytes 32-39	Polarization Position	±100.00

The current angular position
+DDD.ddd (decimal-degrees format)
Filled with '*' if the sensor value is invalid
Right justified and padded with blanks

byte 40	Azimuth Limits – Binary Data
byte 41	Elevation Limits – Binary Data
byte 42	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 a bit position implies that the antenna is at the limit

byte 43	Feed Type/Polarization Code – Binary Data
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7	6	5	4	3	2	1	0	
0	1	X	X	\$	0	Y	Y	Y

Where 'XX' is defined as:

00 = Circular Polarization
01 = Single-Port Linear Polarization
10 = Two-Port Linear Polarization

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 44 Azimuth Movement/Alarm Status – Binary Data
 byte 45 Elevation Movement/Alarm Status – Binary Data
 byte 46 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
 1001 = Sensor Alarm
 1010 = Runaway Alarm (4500) / Drift Alarm (4800)
 1011 = Jammed Alarm (4500)/ Follow Alarm (4800)
 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 47 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	22 = Elevation Runaway/Drift
1 = Flash Version Mismatch	30 = Polarization Sensor
2 = Flash Data Corrupt	31 = Polarization Jammed/Follow
3 = NVRAM Version Mismatch	32 = Polarization Runaway/Drift
4 = NVRAM Data Corrupt	40 = Limits Inactive Warning
5 = Low Battery	41 = Drive System Error
6 = Invalid Time/Date	42 = Emergency Stop Active
10 = Azimuth Sensor	43 = Maintenance Interlock Active
11 = Azimuth Jammed/Follow	44 = Movement Interlock Active
12 = Azimuth Runaway/Drift	45 = Local Jog Connected
20 = Elevation Sensor	46 = Summary Limit Warning
21 = Elevation Jammed/Follow	47 = Standby Warning

Device Status Command (continued)

byte 48 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 = EPT-Track Active
- 0111 = TLE-Track Active
- 1001 = ACU Alarm Error
- 1010 = Checksum Error
- 1011 = TLE Data Error
- 1100 = Peak Limit Error

bytes 49-52 Receiver Level Current receiver level displayed in dB
 -DD.d to DD.d
 Right justified and padded with blanks

byte 53 Receiver Source/Lock Status – Binary Data

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

Where ‘L’ is defined as:

- 1 = Receiver Locked
- 0 = Receiver Unlocked

Where ‘CCCC’ 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)

Device Status Command (continued)

byte 54 HPA Relay/Feed ID Status – Binary Data

```

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

```

The bit field 'AAA' 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.

Where 'BB' is defined as:

```

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

```

byte 55 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 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) Vertical (Position 2)	B = 1 C = 1
RF Switch	Path 1 Path 2	A = 0 A = 1
Polarization Mode	Linear Mode Circular Mode	B = 1 C = 1

bytes 56-60 Reserved

```

byte 61            Current Mode
byte 62            Current State
byte 63            Last Mode
byte 64            Last State

```

See section 2.5.3 for possible mode and state values

```

byte 65            ETX
byte 66            Checksum

```

2.4.3 Auto Move Command

This command causes the controller to automatically position the antenna in azimuth, elevation, and polarization. This command has several forms.

Form 1: This form of the command automates the controller RECALL mode. The satellite requested must have previously been saved via the STORE operation. The controller will move the antenna to the azimuth, elevation, and polarization positions associated with the satellite. If the command specifies polarization movement but the Feed Type is set to CIRCULAR, no polarization movement will occur.

A list of satellite indexes can be accessed using the Read Satellite data command in section 2.4.9

This command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	32h	Command code
byte 3	Form Code	'1'
bytes 4-6	Index	The index of the satellite to RECALL Right-justified and padded with blanks
byte 7	Polarization	'H' = horizontal, 'V' = vertical Use 'H' for circular or 2 port feed
bytes 8-13	Reserved	Fill with zeros or blanks
byte 14	ETX	
byte 15	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 no valid data was found with the given parameters.

Form 2: With this form of the command, the controller will 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, 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	'A' = angular sensor	
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	0.000 to 359.999	
bytes 14-21	Elevation Position	-20.000 to 120.000	
bytes 22-29	Polarization Position	±100.00	
		+DDD.ddd (decimal-degrees format)	
		Right justified and padded 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 L: With this form of the command, the controller will calculate and move the antenna to the azimuth, elevation, and polarization positions associated with the given satellite longitude. The polarization used will be the horizontal position. If the Feed Type is set to CIRCULAR, 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	'L'
bytes 4-9	Longitude	Nominal satellite longitude -179.9 to 180.0 (West longitude negative) Left justified and padded with blanks
bytes 10-13	Reserved	Fill with zeros or blanks
byte 14	ETX	
byte 15	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. If the command generates polarization movement but the feed type is set to CIRCULAR, ACK will be received, but no movement will occur. The NAK reply will be received if any parameter is invalid.

2.4.4 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 Counterclockwise 'W' = Azimuth Clockwise 'D' = Elevation Down 'U' = Elevation Up 'O' = Polarization Counterclockwise '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 are 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.

2.4.5 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.

2.4.6 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' = 'P'	This sub-command is used to initiate an automatic antenna PEAKUP command.
'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. Only available on the 4800.

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.

2.4.7 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 position (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.

2.4.8 Write Satellite Data Command

This command is used to manage stored satellites. There are two forms of this command.

Form 1: This form is used to add a stored satellite to an empty index in memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	39h	Command Code
bytes 3-5	Index	Stored satellite index
bytes 6-15	Satellite Name	10 characters maximum Left justified and padded with blanks
bytes 16-21	Satellite Longitude	-179.9 to 180.0 (West longitude negative) Left justified and padded with blanks
bytes 22-23	Satellite Inclination	0 to 19 degrees Left justified and padded with blanks
byte 24	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 25-30	Reserved	Fill with zeros or blanks
byte 31	Track Mode	'0' – No Tracking '1' – EPT/Step '2' – Step/EPT '3' – Step/TLE '4' – TLE Only
byte 32	Signal Source	'0' – None '1' – External receiver '2' – Internal beacon tracking receiver '5' – L-Band power detector '6' – DVB (if available) '7' – Remote (if available)
bytes 33-40	Azimuth Position	0.000 to 359.999
bytes 41-48	Elevation Position	-20.000 to 120.000
bytes 49-56	H Pol Position	±100.000
bytes 57-64	V Pol Position	±100.000
		+DDD.ddd (decimal-degrees format) Right justified and padded with blanks
bytes 65-72	Reserved	Fill with zeros or blanks
byte 73	ETX	
byte 74	Checksum	

The reply to this command will be the standard ACK or NAK reply. The given index must be empty for this command to be successful. The NAK reply will be received if data already exists for the given index or if any parameter is invalid.

NOTE: Data written with this form must be saved using the Write Config Data Command after changes have been made. Refer to section 2.4.19 of this document for more information.

Write Satellite Data Command (continued)

Form 2: This form is used to delete stored satellites from memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	39h	Command Code
bytes 3-5	Index	Stored satellite index
bytes 6-15	'DELETE'	Cleared stored satellite data for this index Left justified and padded with blanks
	or	
	'DELETE ALL'	Clear all stored satellite data
bytes 16-18	Reserved	Fill with zeros or blanks
byte 19	ETX	
byte 20	Checksum	

The reply to this command will be the standard ACK or NAK reply. The NAK reply will be received if any parameter is invalid.

NOTE: This command also clears any associated tracking or receiver data.

2.4.9 Read Satellite Data Command

This command reads stored satellite from the controller memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Ah	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	ETX	
byte 7	Checksum	

The ACK Reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	3Ah	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-15	Satellite Name	10-character satellite name Left justified and padded with blanks
bytes 16-21	Satellite Longitude	-179.9 to 180.0 (West longitude negative) Left justified and padded with blanks
bytes 22-23	Satellite Inclination	0 to 19 degrees Left justified and padded with blanks
byte 24	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 25-30	Reserved	Filled with zeros or blanks
byte 31	Track Mode	'0' – No Tracking '1' – EPT/Step '2' – Step/EPT '3' – Step/TLE '4' – TLE Only
byte 32	Signal Source	'0' – None '1' – External receiver '2' – Internal beacon tracking receiver '5' – L-Band power detector '6' – DVB (if available) '7' – Remote (if available)
bytes 33-40	Azimuth Position	0.000 to 359.999
bytes 41-48	Elevation Position	-20.000 to 120.000
bytes 49-56	H Pol Position	±100.000
bytes 57-64	V Pol Position	±100.000
		+DDD.ddd (decimal-degrees format) Right justified and padded with blanks
bytes 65-72	Reserved	Filled with zeros or blanks
byte 72	ETX	
byte 73	Checksum	

2.4.10 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 stored satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Bh	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-74	TLE Line 1	69 characters (including checksum) of TLE Line1
bytes 75-143	TLE Line 2	69 characters (including checksum) of TLE Line2
byte 144	ETX	
byte 145	Checksum	

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

NOTE: Data written with this form must be saved using the Write Config Data Command after changes have been made. Refer to section 2.4.19 of this document for more information.

2.4.11 Read Two-Line Element Data Command

This command reads a set of Two-Line Element (TLE) data from the controller memory. The index must be the same as the associated preset satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Ch	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	ETX	
byte 7	Checksum	

The ACK Reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	3Ch	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-74	TLE Line 1	69 characters (including checksum) of TLE Line 1
bytes 75-143	TLE Line 2	69 characters (including checksum) of TLE Line 2
byte 144	ETX	
byte 145	Checksum	

The associated stored satellite must be setup for tracking for this command to be successful. The NAK reply will be received if no stored satellite exists at the specified index or if the stored satellite is not setup for tracking.

2.4.12 Write Beacon Data Command

This command writes beacon tuning data into the controller memory. The index must be the same as the associated stored satellite index. For circular or 2-port feeds, always use the horizontal parameters and fill the vertical parameters with zeros.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Dh	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-13	H-Frequency	Horizontal beacon frequency DDDDD.dd (decimal MHz) Right justified and padded with blanks
byte 14	H-Modulation	Horizontal beacon modulation 0 = CW, 1 = BPSK
bytes 15-22	V-Frequency	Vertical beacon frequency DDDDD.dd (decimal MHz) Right justified and padded with blanks
byte 23	V-Modulation	Vertical beacon modulation 0 = CW, 1 = BPSK
byte 24	ETX	
byte 25	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 2.4.19 of this document for more information.

2.4.13 Read Beacon Data Command

This command reads beacon tuning data from the controller memory. The index must be the same as the associated preset satellite index. For circular and 2-port feeds, only the horizontal parameters will be used.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Eh	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	ETX	
byte 7	Checksum	

The ACK reply will be in the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Dh	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-13	H-Frequency	Horizontal beacon frequency DDDDD.dd (decimal MHz) Right justified and padded with blanks
byte 14	H-Modulation	Horizontal beacon modulation 0 = CW, 1 = BPSK
bytes 15-22	V-Frequency	Vertical beacon frequency DDDDD.dd (decimal MHz) Right justified and padded with blanks
byte 23	V-Modulation	Vertical beacon modulation 0 = CW, 1 = BPSK
byte 24	ETX	
byte 25	Checksum	

2.4.14 Write DVB Data Command

This command writes DVB tuning data into the controller memory. The index must be the same as the associated stored satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	43h	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	Standard	1= DVB-S1, 2 = DVB-S2
bytes 7-11	Frequency	DDDDD (MHz) Right justified and padded with blanks
bytes 12-16	Symbol Rate	DDDDD (kS/Sec) Right justified and padded with blanks
byte 17	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to "Auto" for DVB-S2
bytes 18-26	Reserved	Fill with zeros or blanks
byte 27	ETX	
byte 28	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 2.4.19 of this document for more information.

2.4.15 Read DVB Data Command

This command reads DVB tuning data from the controller memory. The index must be the same as the associated stored satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	44h	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	ETX	
byte 7	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	44h	Command Code
bytes 3-5	Index	The stored satellite index
byte 6	Standard	1= DVB-S1, 2 = DVB-S2
bytes 7-11	Frequency	DDDDD (MHz) Right justified and padded with blanks
bytes 12-16	Symbol Rate	DDDDD (kS/Sec) Right justified and padded with blanks
byte 17	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to "Auto" for DVB-S2
bytes 18-26	Reserved	Fill with zeros or blanks
byte 27	ETX	
byte 28	Checksum	

2.4.16 Read Navigation Data Command

This command returns 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	
byte 1	A	Address
byte 2	45h	Command Code

byte 3	Latitude/Longitude Source – Binary Data
--------	---

```

7 6 5 4   3 2 1 0
0 1 0 F $ 0 X X X

```

Where 'F' is defined as:

0 = Lat/Lon formatted as degrees-minute
 1 = Lat/Lon formatted as decimal-degrees

Where 'XXX' is defined as:

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 4-12	Latitude	+dddmm (degrees-minute format) or +DDD.dddd (decimal-degrees format) ±90.0 degrees (South latitude negative) Right justified and padded with blanks Blank if not available
bytes 13-21	Longitude	+dddmm (degrees-minute format) or +DDD.dddd (decimal-degrees format) ±180.0 degrees (West longitude negative) Right justified and padded with blanks Blank if not available
bytes 22-28	Reserved	Fill with zeros or blanks

Read Navigation Data Command (continued)

byte 29	True Heading Source – Binary Data	
		<pre> 7 6 5 4 3 2 1 0 0 1 0 0 \$ 0 X X X </pre>
		Where 'XXX' is defined as:
		<pre> 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 </pre>
bytes 30-34	True Heading	DDD.d (decimal degrees format) 0.0 to 359.9 degrees Right justified and padded with blanks
byte 35	Magvar Status	0x41 = ready (calculated) 0x40 = not ready
bytes 36-41	Magnetic Variation	+DDD.d (decimal-degrees format) ±100.0 degrees (West negative) Right justified and padded with blanks Blank if not available
byte 42	Platform Tilt Source – Binary Data	
		<pre> 7 6 5 4 3 2 1 0 0 1 0 0 \$ 0 X X X </pre>
		Where 'XXX' is defined as:
		<pre> 001 = Currently no tilt data 010 = Automatically determined tilt data 011 = User entered manual tilt data 100 = Remotely entered tilt data </pre>
bytes 43-47	Platform Pitch	+DD.d (decimal-degrees format) ±90.0 degrees (Down negative) Right justified and padded with blanks Blank if not available
bytes 48-52	Platform Roll	+DD.d (decimal-degrees format) ±90.0 degrees (CCW negative) Right justified and padded with blanks Blank if not available
byte 53	Reserved	Fill with zero or blank
byte 54	ETX	
byte 55	Checksum	

2.4.17 AZ/EL/POL Jog Command (with minimal reply)

This command jogs the antenna in azimuth, elevation, or polarization. It is functionally the same as the command described in section 2.4.4 but with a much shorter reply.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	47h	Command Code
byte 3	Direction	This field can specify one of the following: 'E' = Azimuth Counterclockwise 'W' = Azimuth Clockwise 'D' = Elevation Down 'U' = Elevation Up 'O' = Polarization Counterclockwise '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 are converted to the closest multiple.
byte 9	ETX	
byte 10	Checksum	

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	+DDD.ddd (decimal-degrees format) This field will contain '*****' if sensor error. Right justified and padded with blanks.
byte 12	ETX	
byte 13	Checksum	

2.4.18 Remote Key Press Command

This command sends a keypad value to the ACU. The ACU will react to the keypad value as if the corresponding key on the ACU front panel was pushed.

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/PoI CCW
		32h	2/N/EL Up
		33h	3/PoI CW
		34h	4/E/AZ CCW
		35h	5
		36h	6/W/AZ CW
		37h	7/H
		38h	8/S/EL Down
		39h	9/V
		3A-3Fh	– unused –
		41h	Stop/Decimal Point
		42h	±/BKSP
		43h	Mode
		44h	Scroll Up/Yes
		45h	Scroll Down/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.

2.4.19 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 several stored satellites, do not 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 justified and padded 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.

2.4.20 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 2.5.4 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' request the current azimuth and elevation 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 2.5.4 of this document.

byte 0	ACK	
byte 1	A	Address
byte 2	4Bh	Command Code
bytes 3-n	Object IDs	A comma-delimited list of up to 16 OIDs. Each value will be in ASCII format with no padding. No data will be returned if a request OID is invalid. Example: '2.70.0=187.783,2.70.1=41.076' is the reply containing the current azimuth angle (187.783) and elevation angle (41.076).
byte n+1	ETX	
byte n+2	Checksum	

The NAK reply will be received if any OID is invalid or if too many OIDs are requested.

NOTE: The first digit in the OID represents the OID tree version. In the examples above, the version is 2. A discovery process can be performed to determine the version by requesting a single OID... 1.0.0, 2.0.0, 3.0.0, and so on...until an ACK is received.

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

2.4.21 Write Track Table Command

This command is used to manage track table data for a given stored satellite. There are three forms of this command.

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

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 3-5	Index	The stored satellite index
bytes 6-4	Table Entry	00 to 47
bytes 8-15	Azimuth Position	0.000 to 360.000
bytes 16-23	Elevation Position	-20.000 to 120.000
	+DDD.ddd (decimal-degrees format)	
	Right justified and padded with blanks	
byte 24	Update Flag	Y' = set update flag 'N' = clear update flag
byte 25	ETX	
byte 26	Checksum	

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

The reply to this command will be the standard ACK or NAK reply. The associated stored satellite must be setup as trackable for this command to be successful. The NAK reply will be received if no stored satellite exists at the specified index, if the stored satellite is not setup as trackable, or if any parameter is invalid.

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 3-5	Index	The stored satellite index
bytes 6-7	Table Entry	00 to 47
bytes 8-20	'CLEAR'	Clear track table data for this entry Left-justified and padded with blanks
byte 21	ETX	
byte 22	Checksum	

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

Form 3: This form is used to clear all track table entries.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	4Dh	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-20	'CLEAR ALL'	Clear track table entries Left-justified and padded with blanks
byte 21	ETX	
byte 22	Checksum	

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

2.4.22 Read Track Table Command

This command reads track table data from a given stored satellite.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	4Eh	Command Code
bytes 3-5	Index	The stored satellite index
bytes 6-7	Table Entry	00 to 47
byte 8	ETX	
byte 9	Checksum	

The ACK reply will be in the following format:

byte 0	ACK		
byte 1	A	Address	
byte 2	4Eh	Command Code	
bytes 3-5	Index	The stored satellite index	
bytes 6-7	Table Entry	00 to 47	
bytes 8-12	Sidereal Time	Sidereal time of this entry	
bytes 13-18	Azimuth Position	0.000 to 360.000	0 to 65535 counts
bytes 19-24	Elevation Position	-20.000 to 120.000	0 to 65535 counts
	+DDD.ddd (decimal-degrees format) Right justified and padded with blanks or '*****' if data is invalid		
byte 25	Update Flag	'Y' = entry update flag is set 'N' = entry update flag is not set	
byte 26	Ephemeris Flag	'0' = ephemeris data not used '1' = ephemeris data used	
bytes 27-30	Reserved	Filled with zeros or blanks	
byte 31	ETX		
byte 32	Checksum		

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

2.4.23 Write Date/Time Command

This command sets the date and time of the internal real-time clock.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	4Fh	Command Code
byte 3	'W'	
bytes 4-13	Date	Date formatted as: 'YYYY-MM-DD'
byte 14	'T'	
bytes 15-26	Time	Time formatted as: 'HH:MM:SS.sss'
byte 27	'Z'	
byte 28	ETX	
byte 29	Checksum	

The reply to this command will be the standard ACK if the date/time is accepted and applied. The NAK reply will be received if any parameter is invalid.

2.5 Reference Information

2.5.1 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

2.5.2 ASCII Table

The following table shows the set of ASCII codes available for use by the ACU remote protocol.

Table 2.5.2.1 - ASCII Conversion Table

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	

2.5.3 Device Status Reply Mode and State Values

The following tables list the possible values for ACU modes and states returned by the Device Status reply. All modes can enter the states listed in **Error! Reference source not found.**. Additional mode-unique states are listed in **Error! Reference source not found.** and **Error! Reference source not found.**. Only values shown should be considered valid.

Table 2.5.3.1 - Operating Modes

Value (hex)	Value (dec)	Mode (byte 60 & 62)
20	32	MANUAL
21	33	MENU
22	34	
23	35	
24	36	
25	37	
26	38	
27	39	SETUP
28	40	TRACK
29	41	
2A	42	SPECIAL_AXIS
2B	43	POWER_UP
2C	44	
2D	45	
2E	46	
2F	47	
30	48	
31	49	RECALL
32	50	MOVETO
33	51	
34	52	
35	53	
36	54	
37	55	DELETE
38	56	FLASH SAVE
39	57	
3A	58	
3B	59	
3C	60	
3D	61	
3E	62	SHAKE
3F	63	

Table 2.5.3.2 - Common Mode States

Value (hex)	Value (dec)	State (byte 61 & 63)
20	32	INITIALIZING_MODE
21	33	WAITING_FOR_USER_INPUT
22	34	
23	35	
24	36	
25	37	
26	38	MOVING_OUT_OF_LIMIT
27	39	MOVING_AZIMUTH
28	40	MOVING_ELEVATION
29	41	MOVING_POLARIZATION
2A	42	MOVING_AZELPL
2B	43	MOVING_SPECIAL_AXIS
2C	44	
2D	45	
2E	46	
2F	47	
30	48	ERROR_ELEV_NOT_IN_POSITION
31	49	ERROR_SPECIAL_AXIS_NOT_IN_POSITION
32	50	
33	51	
34	52	
35	53	
36	54	
37	55	
38	56	
39	57	
3A	58	
3B	59	
3C	60	
3D	61	
3E	62	
3F	63	

Table 2.5.3.3 - Unique Mode States

Value (hex)	Value (dec)	POWER_UP States	MANUAL States	SETUP States
40	64	CONFIRM_SAVED_POSITION	JOG_AZIM_CCW	SAT_MEMORY_FULL
41	65	CONFIRM_TRACK_RESTART	JOG_AZIM_CW	TRACK_MEMORY_FULL
42	66	ENTER_ANTENNA_POSITION	JOG_ELEV_DOWN	
43	67		JOG_ELEV_UP	
44	68		JOG_POL_CCW	
45	69		JOG_POL_CW	
46	70		AUTO_MOVE_POL	
47	71		IDLE	
48	72			SAVING_DATA
49	73			MOVING_TO_POL_SELECTED

Table 2.5.3.4 - Unique Mode States Cont.

Value (hex)	Value (dec)	RECALL States	TRACK States	
40	64	SAT_MEMORY_EMPTY	INIT_PARAMETERS	
41	65		CONFIRM_EXIT	
42	66			
43	67			
44	68	MOVING_TO_SAT_POSITION	TUNE_DVB	
45	69		TUNE_BEACON	
46	70		TUNE_FAILURE	
47	71		ATTEN_BEACON	
48	72			
49	73		STEP_PEAKING	
4A	74		STEP_WAITING_FOR_SIGNAL	
4B	75		STEP_IDLE	
4C	76		SEARCH_ACTIVE	
4D	77		SEARCH_MOVING_TO_PEAK	
4E	78		SEARCH_WAITING_TO_SEARCH_AGAIN	
4F	79			
50	80		SEARCH_MANUAL_ACTIVE	
51	81		EPT_IDLE/MEMORY_IDLE	
52	82		EPT_REPOSITION/MEMORY_REPOSITION	
53	83		EPT_UPDATE/MEMORY_UPDATING	
54	84		EPT_CHECKING/MEMORY_CHECKING	
55	85		TLE_IDLE	
56	86		TLE_REPOSITION	
57	87			
58	88			
59	89			
5A	90			
5B	91			
5C	92			
5D	93			
5E	94			
5F	95			
60	96		ERROR_PEAK_LIMIT	
61	97		ERROR_ACU_ALARM	
62	98		ERROR_CHECKSUM	
63	99		ERROR_TLE_DATA	
64	100		ERROR_UNDEFINED	

2.5.4 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.

Table 2.5.4.1 - Object IDs

OID	Status Item	Format	Description
x.0.0	CURRENT_MODE_ITEM	Unsigned	See Section 2.5.3
x.1.0	CURRENT_SUBMODE_ITEM	Unsigned	See Section 2.5.3
x.2.0	LAST_MODE_ITEM	Unsigned	See Section 2.5.3
x.3.0	LAST_SUBMODE_ITEM	Unsigned	See Section 2.5.3
x.5.0	TIMEDATE_ITEM	ASCII String	yyyy-mm-ddThh:mm:ss.fffZ
x.6.0	ACTIVE_ALARM_ITEM	Enumeration	Table 2.5.4.2
x.8.0	LOCAL_JOG_CONNECTED_ITEM	Unsigned	0=Not Connected, 1=Connected
x.12.0	POS_LOC_LAT_ITEM	Signed	+DDMM (degrees/minutes)
		Float	+DDD.DDDD (degrees)
x.13.0	POS_LOC_LON_ITEM	Signed	+DDMM (degrees/minutes)
		Float	+DDD.DDDD (degrees)
x.14.0	POS_LOC_ALT_ITEM (future)	Unsigned	
x.20.0	SAT_SOURCE_ITEM	Enumeration	Table 2.5.4.4
x.21.0	SAT_INDEX_ITEM	Unsigned	1 – 100 ????
x.22.0	SAT_NAME_ITEM	ASCII String	10 Characters
x.23.0	SAT_LON_ITEM	Float	+DDD.D (degrees)
x.24.0	SAT_INCLIN_ITEM	Signed	+DD (degrees)
x.25.0	SAT_BAND_ITEM	Enumeration	Table 2.5.4.4
x.26.0	SAT_POL_SKEW_ITEM	Float	+DD.D (degrees)
x.27.0	SAT_EPHEM_ITEM	Unsigned	0=None, 1=TLE
x.28.0	SAT_POLARIZATION_ITEM	Enumeration	Table 2.5.4.4
x.40.0	DVB_FREQ_ITEM	Unsigned	DDDDD (Mhz)
x.41.0	DVB_SYMRATE_ITEM	Unsigned	DDDDD (kS/sec)
x.42.0	DVB_FEC_ITEM	Unsigned	1 – 7, (3=3/4)
x.43.0	DVB_STD_ITEM	Unsigned	1=S1, 2=S2
x.50.0	BCN_FREQ_ITEM	Float	DDDDDD.dd (kHz)
x.51.0	BCN_ATTEN_ITEM	Unsigned	DD (dB)
x.52.0	BCN_DEMOD_ITEM	Unsigned	0=CW, 1=BPSK
x.60.0	TARGET_AZ_ITEM	Float	+DDD.ddd(degrees) ????
x.61.0	TARGET_EL_ITEM	Float	+DDD.ddd (degrees) ????
x.62.0	TARGET_PL_H_ITEM	Float	+DDD.ddd (degrees) ????
x.63.0	TARGET_PL_V_ITEM	Float	+DDD.ddd (degrees) ????
x.70.0	AXIS_ANGLE_ITEM: AZ	Float	+DDD.ddd (degrees)
x.70.1	AXIS_ANGLE_ITEM: EL	Float	+DDD.ddd (degrees)
x.70.2	AXIS_ANGLE_ITEM: PL	Float	+DDD.ddd (degrees)
x.72.0	AXIS_LIMITS_ITEM: AZ	Hexadecimal	Table 2.5.4.7
x.72.1	AXIS_LIMITS_ITEM: EL	Hexadecimal	Table 2.5.4.7
x.72.2	AXIS_LIMITS_ITEM: PL	Hexadecimal	Table 2.5.4.7
x.73.0	AXIS_ALARMS_ITEM: AZ	Hexadecimal	Table 2.5.4.8
x.73.1	AXIS_ALARMS_ITEM: EL	Hexadecimal	Table 2.5.4.8
x.73.2	AXIS_ALARMS_ITEM: PL	Hexadecimal	Table 2.5.4.8
x.74.0	AXIS_STATE_ITEM: AZ	Unsigned	Table 2.5.4.5
x.74.1	AXIS_STATE_ITEM: EL	Unsigned	Table 2.5.4.5
x.74.2	AXIS_STATE_ITEM: PL	Unsigned	Table 2.5.4.5
x.80.0	FEED_INDEX_ITEM	Unsigned	0 – 7
x.81.0	FEED_LNB_INDEX	Unsigned	0 – 2
x.89.0	HPA_ENABLE_ITEM	Unsigned	0=Disabled, 1=Tx Mute, 2=Enabled
x.90.0	SIGNAL_SOURCE_ITEM	Enumeration	Table 2.5.4.5
x.91.0	SIGNAL_LEVEL_ITEM	Signed	????
x.92.0	SIGNAL_LOCK_ITEM	Unsigned	0=Off, 1=On, 2=None Defined
x.101.0	TRACK_SIDEREAL_TIME_ITEM	Unsigned	0 – 84365
x.102.0	TRACK_STATUS_ITEM	Unsigned	Table 2.5.4.6
x.103.0	TRACK_ERROR_ITEM	Unsigned	Table 2.5.4.6

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

Table 2.5.4.2 - System Alarm Enumerated Values

Value (dec)	ACTIVE_ALARM_ITEM
0	None
1	Flash Version Mismatch
2	Flash Data Corrupted
3	NVRAM Version Mismatch
4	NVRAM Data Corrupted
5	Low Battery
6	Invalid Time/Date
7	Azimuth Jammed
8	Azimuth Runaway
9	Elevation Jammed
10	Elevation Runaway
11	Polarization Jammed
12	Polarization Runaway
13	Limits Inactive Warning
14	Drive System Error
15	Emergency Stop Active
16	Maintenance Interlock
17	Movement Interlock
18	Local Jog Connected
19	Summary Limit Warning
20	Azimuth Sensor
21	Elevation Sensor
22	Polarization Sensor

Table 2.5.4.3 - 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	

Table 2.5.4.4 - Satellite Source, Band, Polarization and Signal Source 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

Table 2.5.4.5 - Signal Source and Axis State Enumerated Values

Value (dec)	SIGNAL_SOURCE_ITEM	AXIS_STATE_ITEM
0	None	Idle
1	External	Coast
2	Internal	Jog Negative
3	Reserved	Jog Positive
4	Reserved	Auto Move Config
5	L-Band Power	Auto Move Negative
6	DVB	Auto Move Positive
7		
8		
9		
10		
11	Remote	Alarm

Table 2.5.4.6 - Track Status and Track 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	EPT/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

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 FFFFFFFF is possible.

Table 2.5.4.7 - 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 2.5.4.8 - AXIS_ALARM_ITEM Mask

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

3 TROUBLESHOOTING

3.1 No Communication Between ACU And Remote-Control Computer

- 1) The address set in the ACU is not being used by the remote commands. Verify remote commands coming from the PC are targeting address 50.
- 2) The port that is being used by the remote PC to communicate with the ACU is not correct. Verify the communications port settings on both the configuration page of the ACU and the remote PC.
- 3) The remote PC is setup in such a manner that it can't access the IP address of the ACU. Verify IP setting on the remote PC.

3.2 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) Do not repeatedly ask for "static" command such as navigation or satellite data.
- 3) The general recommendation is not to send commands (particularly status request) at a rate greater than once a second