

APPENDIX REM – REMOTE CONTROL PROTOCOL

This appendix describes the remote commands available to monitor and control the RC4600 antenna control unit (ACU). It is provided as a supplement to the baseline RC4600 manual. Sections in the baseline manual are 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 units.

Revision History

DATE	MODIFICATION	SW VERSION	INITIALS
27 SEP 2021	Initial Release Version	3.01	RLE
9 NOV 2021	Modified device status to change AGC level	3.06	RLE
6 JUN 2022	Modified device status to change alarm codes to reflect standby state	3.06	RLE
30 NOV 2022	Added platform and horizontal target OID, Off-Axis movement state for bytes 43-45 for device status	3.07	RLE
1 FEB 2024	Added note to flash save command	3.07	RLE

1 INTRODUCTION

The RC4600 Antenna Control Unit (ACU) board set consists of a stackable set of cards allowing for compact and flexible ACU packaging.

PLEASE READ AND UNDERSTAND THE MANUAL. Due to the complexity of the functions performed by the RC4600, time invested in understanding its installation and operation will be well spent.

1.1 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.

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 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.

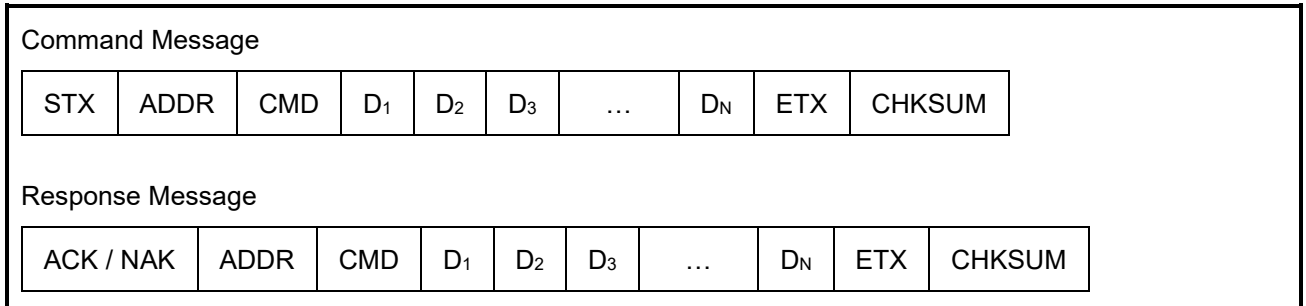


Figure 1 - Message Format

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 default address for the RC4600 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 actually 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 RC4600 antenna controller can be controlled remotely over an Ethernet connection using the User Datagram Protocol (UDP).

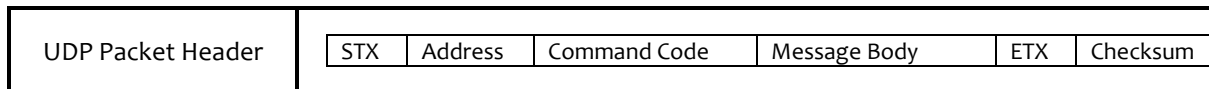
UDP is a simple connectionless protocol where datagrams are sent from a host IP and port to a target IP and port. No acknowledgement, retransmission, or timeout is built in. The SA-Bus protocol used by the RC4600 remote system fills these roles, making UDP the natural choice for monitor and control over an Ethernet connection.

The RC4600 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 RC4600 microprocessor. The RC4600 response is returned to the host in a similar fashion.

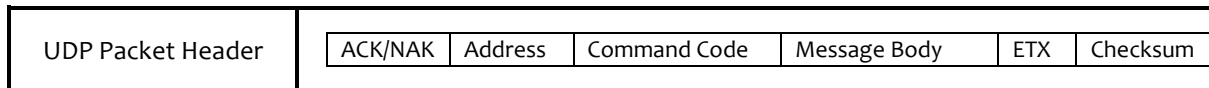
The packet structure of a UDP datagram is beyond the scope of this document. For the following examples, a datagram will consist of a packet header and packet data as illustrated below:



To send a command to the RC4600, 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 RC4600 will be in a similar fashion as shown below:



If no response is received from the RC4600, 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 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 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	2.4.1
31	Device Status	2.4.2
32	Auto Move	2.4.3
33	Azimuth/Elevation/Polarization Jog	2.4.4
34	Polarization	2.4.5
35	Reserved	
36	Miscellaneous	2.4.6
37	Reflect Display	2.4.7
38	Reserved	
39	Write Satellite Data ¹	2.4.8
3A	Read Satellite Data	2.4.9
3B	Write Two-Line Element Data ¹	2.4.10
3C	Read Two-Line Element Data	2.4.11
3D	Write Beacon Data ¹	2.4.12
3E	Read Beacon Data	2.4.13
3F	Read Platform Angles	2.4.14
40	Reserved	
41	Remote Locate	2.4.15
42	Remote Track	2.4.16
43	Write DVB Data ¹	2.4.17
44	Read DVB Data	2.4.18
45	Read Navigation Data	2.4.19
46	Write Navigation Data	2.4.20
47	Azimuth/Elevation/Polarization Jog (with minimal reply)	2.4.21
48	Remote Key Press	2.4.22
49	Write Config Data ¹	2.4.23
4A	Reserved	
4B	Custom Device Status	2.4.24
4C	Reserved	
4D	Write Track Table Data	2.4.25
4E	Read Track Table Data	2.4.26
4F	Write Date/Time	2.4.27
50	Write Location Data	2.4.28
51	Read Location Data	2.4.29
	1 – requires flash save via Write Config Data	

2.4.1 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. 'RC46' = RC4600 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 3-4	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 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 Position	-300.000 to 300.000 degrees
bytes 23-30	Elevation Position	-90.000 to 120.000 degrees
bytes 31-38	Polarization Position	-180.000 to 180.000 degrees

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

byte 39	X-Axis Limits – Binary Data
byte 40	Y-Axis 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 a bit position implies that the antenna is at the limit.

byte 42	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 defines 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 43 X-Axis Movement/Alarm Status – Binary Data
 byte 44 Y-Axis 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
 0001 = Off-Axis Movement, Position Correction
 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 = Sensor Alarm
 1010 = Drift Alarm
 1011 = Follow 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	30 = POL Sensor*
1 = Flash Version Mismatch	31 = POL Follow*
2 = Flash Data Corrupt	32 = POL Drift*
3 = NVRAM Version Mismatch	40 = Limits Inactive
4 = NVRAM Data Corrupt	41 = Drive System Error*
5 = Low Battery	42 = Emergency Stop Active*
6 = Invalid Time/Date	43 = Maintenance Interlock Active
10 = X Sensor*	44 = Movement Interlock Active*
11 = X Follow*	45 = Local Jog Connected
12 = X Drift*	46 = Reserved/Unused
20 = Y Sensor*	47 = Standby Warning*
21 = Y Follow*	
22 = Y Drift*	

* = ACU in Standby

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 = Step-Track Active
- 0010 = Wait Active
- 0011 = Search Active
- 0100 = Reserved/Unused
- 0101 = TLE Track Active
- 0110 = EPT Track Active
- 0111 = Reserved/Unused
- 1001 = ACU Alarm Error
- 1010 = Checksum Error
- 1011 = TLE Data Error
- 1100 = Peak Limit Error

bytes 48-53	Receiver Level	Current Receiver Level
		-140.0 to 100.0
		(+DDD.d decimal dB format)

byte 54 Receiver Source/Lock Status – Binary Data

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

Where ‘L’ is defined as:

- 1 = Receiver Locked
- 0 = Receiver Unlocked

Where ‘CCC’ is defined as:

- 000 = RF
- 001 = Receiver 1 (or external beacon)
- 010 = Receiver 2 (or internal beacon)
- 011 = DVB

Device Status Command (continued)

byte 55 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 56 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 57-61 Reserved

```

byte 62            Current Mode
byte 63            Current State
byte 64            Last Mode
byte 65            Last State

```

See section 2.5.2 for possible mode and state values.

```

byte 66            ETX
byte 67            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 is currently not implemented.

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.

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 '1' = Azim '2' = Elev '3' = Azim & Elev	'4' = Pol '5' = Azim & Pol '6' = Elev & Pol '7' = Azim & Elev & Pol
bytes 6-13	X-Axis (Platform) Azimuth (Horizontal)	-180.000 to 180.000	
bytes 14-21	Y-Axis (Platform) Elevation (Horizontal)	-180.000 to 120.000	
bytes 22-29	Polarization Position	-180.000 to 180.000	
		+DDD.dd (decimal-degrees format) Right-justify and pad with blanks	
byte 27	ETX		
byte 31	Checksum		

The ACK reply to this command will be in the same format as the Device Status Command. 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, ACK will be received, but no movement will occur. 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
Fairing Control	'F'	'D' – Move to Deploy 'S' – Move to Stow 'M' – Move to Maintenance
Feed Slider	'E'	'1' – Feed 1 '2' – Feed 2 'S' – Move to Stow

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' = X-Axis Counter Clockwise 'W' = X-Axis Clockwise 'D' = Y-Axis Counter Clockwise 'U' = Y-Axis Clockwise '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 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 X-Axis/azimuth, Y-Axis/elevation, or polarization drives. The sub-command parameter 'Y' must be 'A', 'E', or 'P' for X-Axis/azimuth, Y-Axis/elevation, or polarization respectively.
'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 respectively. 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. 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 write preset satellite data into the controller memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	39h	Command Code
bytes 3-4	Index	1 to 20 Right justified and padded with blanks
byte 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-20	Longitude	± 180.0 degrees (West longitude negative) Right justified and padded with blanks
bytes 21-22	Inclination	0 to 19 degrees Right justified and padded with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 24	Ephemeris	0 = None, 1 = TLE
byte 25-29	Pol Skew	± 90.0 degrees (CCW negative) Right justified and padded with blanks
byte 30	Polarization	'H' = Horizontal, 'V' = Vertical, 'X' = None
bytes 31-36	COB Latitude	± 90.0 degrees (South latitude negative) Right justified and padded with blanks Set to 0.0 if unknown
bytes 37-42	COB Longitude	± 180.0 degrees (West longitude negative) Right justified and padded with blanks Set to satellite longitude if unknown
byte 43	Scan Type	0 = Normal, 1 = Slow
byte 44	ETX	
byte 45	Checksum	

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

NOTE: Data written with this form 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 2.4.23 of this document for more information.

2.4.9 Read Satellite Data Command

This command reads preset satellite data from the controller memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Ah	Command Code
bytes 3-4	Index	1 to 20 Right justified and padded with blanks
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
bytes 3-4	Index	1 to 20 Right justified and padded with blanks
byte 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-20	Longitude	± 180.0 degrees (West longitude negative) Right justified and padded with blanks
bytes 21-22	Inclination	0 to 19 degrees Right justified and padded with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 25-29	Pol Skew	± 90.0 degrees (CCW negative) Right justified and padded with blanks
byte 30	Polarization	'H' = Horizontal, 'V' = Vertical, 'X' = None
bytes 31-36	COB Latitude	± 90.0 degrees (South latitude negative) Right justified and padded with blanks Set to 0.0 if unknown
bytes 37-42	COB Longitude	± 180.0 degrees (West longitude negative) Right justified and padded with blanks Set to satellite longitude if unknown
byte 43	Scan Type	0 = Normal, 1 = Slow
byte 44	ETX	
byte 45	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 preset satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Bh	Command Code
bytes 3-4	Index	1 to 20 Right justified and padded with blanks
bytes 5-73	TLE Line 1	69 characters (including checksum) of TLE Line1
bytes 74-142	TLE Line 2	69 characters (including checksum) of TLE Line2
byte 143	ETX	
byte 144	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 2.4.23 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 3-4	Index	1 to 20 Right justified and padded with blanks
byte 5	ETX	
byte 6	Checksum	

The ACK Reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	3Ch	Command Code
bytes 3-4	Index	1 to 20 Right justified and padded with blanks
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	

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 preset satellite index.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Dh	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
bytes 5-12	Frequency	dddddd.dd (decimal MHz) Right-justified and padded with blanks
byte 13	Modulation	0 = CW, 1 = BPSK
bytes 14-22	Reserved	Fill with zeros or blanks
byte 23	Polarization	'H' = Horizontal, 'V' = Vertical
byte 24	Locate Flag	0 = Do not use this entry 1 = Use as signpost 2 = Use for confirmation only
byte 25	ETX	
byte 26	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 2.4.23 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.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	3Eh	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
byte 5	ETX	
byte 6	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	3Eh	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
bytes 5-12	Frequency	dddd.d (decimal MHz) Right-justified and padded with blanks
byte 13	Modulation	0 = CW, 1 = BPSK
bytes 14-22	Reserved	Fill with zeros or blanks
byte 23	Polarization	'H' = Horizontal, 'V' = Vertical
byte 24	Locate Flag	0 = Do not use this entry 1 = Use as signpost 2 = Use for confirmation only
byte 25	ETX	
byte 26	Checksum	

2.4.14 Read Count Sensor Command

This command returns the current resolve or encoder value for X-Axis, Y-Axis, 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	X-Axis Position	-180.000 to 180.000
bytes 11-18	Y-Axis Position	-180.000 to 180.000
bytes 19-26	Polarization Position	-180.000 to 180.000
	Platform angles in +DDD.ddd (decimal-degrees format)	
	Right justified and padded with blanks	
	Filled with '*' if sensor error	
byte 27	ETX	
byte 28	Checksum	

2.4.15 Remote Locate Command

This command requests the ACU to perform a LOCATE operation using the data provided.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	41h	Command Code
byte 3	Preset Flat & Preset Index Tens – Binary Data	
	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 5-42
 01 = use preset data stored in the ACU
 10 = use data from the last LOCATE operation

Where 'BB' is the tens digit of a preset index.
 '00' if not specifying a preset satellite.

byte 4	Index Ones	Ones digit of a preset index, '0' if not specifying a preset satellite
byte 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-20	Longitude	±180.0 (West longitude negative) Right justified and padded with blanks
bytes 21-22	Inclination	0 to 19 degrees Right-justified and padded with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 24	Reserved	Fill with zero or blank
bytes 25-29	Pol Skew	±90.0 degrees (CCW negative) Right justified and padded with blanks
byte 30	Polarization	'H' = Horizontal, 'V' = Vertical, 'X' = None This value is ignored if feed type is circular.
bytes 31-36	COB Latitude	±90.0 degrees (South latitude negative) Right justified and padded with blanks
bytes 37-42	COB Longitude	±180.0 degrees (West longitude negative) Right justified and padded with blanks
byte 43	Position Update	'A' = Automatically determine missing navigation data 'U' = Force an update of all navigation data

Remote Locate Command (Continued)

byte 44 Signal Source – Binary Data

```

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 locate sources 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
 0111 = Remote

byte 45 Reserved Fill with zero or blank

byte 46 ETX
 byte 47 Checksum

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

2.4.16 Remote Track Command

This command requests the ACU to perform a TRACK operation using the data provided.

NOTE: 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 Flat & Preset Index Tens – Binary Data	

```

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 5-42
 01 = use preset data stored in the ACU
 10 = use data from the last LOCATE operation

Where 'BB' is the tens digit of a preset index.
 '00' if not specifying a preset satellite.

byte 4	Index Ones	Ones digit of a preset index, '0' if not specifying a preset satellite
byte 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-20	Longitude	±180.0 (West longitude negative) Right justified and padded with blanks
bytes 21-22	Inclination	0 to 19 degrees Right justified and padded with blanks
byte 23	Band	0 = C, 1 = Ku, 2 = L, 3 = X, 4 = Ka, 5 = S
byte 24	Reserved	Fill with zero or blank
bytes 25-29	Pol Skew	±90.0 degrees (CCW negative) Right justified and padded with blanks
byte 30	Reserved	Fill with zero or blank
bytes 31-36	COB Latitude	±90.0 degrees (South latitude negative) Right justified and padded with blanks
bytes 37-42	COB Longitude	±180.0 degrees (West longitude negative) Right justified and padded with blanks
byte 43	Position Update	'A' = Automatically determine missing navigation data 'U' = Force an update of all navigation data

2.4.17 Write DVB Data Command

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

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	43h	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
byte 5	Standard	1= DVB-S1, 2 = DVB-S2
bytes 6-10	Frequency	dddd (MHz) Right-justified and padded with blanks
bytes 11-15	Symbol Rate	dddd (kS/Sec) Right-justified and padded with blanks
byte 16	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to "Auto" for DVB-S2
bytes 17-23	Reserved	Fill with zeros or blanks
byte 25	Locate Flag	0 = Do not use this entry 1 = Use as signpost 2 = Use for confirmation only
byte 26	ETX	
byte 27	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 2.4.23 of this document for more information.

2.4.18 Read DVB Data Command

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

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	44h	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
byte 5	ETX	
byte 6	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	44h	Command Code
bytes 3-4	Index	1 to 20 Right-justified and padded with blanks
byte 5	Standard	1= DVB-S1, 2 = DVB-S2
bytes 6-10	Frequency	dddd (MHz) Right-justified and padded with blanks
bytes 11-15	Symbol Rate	dddd (kS/Sec) Right-justified and padded with blanks
byte 16	FEC	Forward Error Correction 0 = Auto, 1 to 9 = N/N+1 Note: Set to "Auto" for DVB-S2
bytes 17-23	Reserved	Fill with zeros or blanks
byte 25	Locate Flag	0 = Do not use this entry 1 = Use as signpost 2 = Use for confirmation only
byte 26	ETX	
byte 27	Checksum	

2.4.19 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 1 $ 0 X X X

```

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	+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	+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	<pre> ddd.d (decimal degrees format) 0.0 to 359.9 degrees Right-justified and padded with blanks True Heading of mount at azimuth = 0.0 </pre>
byte 35	Magvar Status	<pre> 0x41 = ready (calculated) 0x40 = not ready </pre>
bytes 36-41	Magnetic Variation	<pre> +ddd.d (decimal-degrees format) ±100.0 degrees (West negative) Right-justified and padded with blanks Blank if not available </pre>
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	<pre> +dd.d (decimal-degrees format) ±90.0 degrees (Down negative) Right-justified and padded with blanks Blank if not available </pre>
bytes 48-52	Platform Roll	<pre> +dd.d (decimal-degrees format) ±90.0 degrees (CCW negative) Right-justified and padded with blanks Blank if not available </pre>
byte 53	Reserved	Fill with zero or blank
byte 54	ETX	
byte 55	Checksum	

2.4.20 Write Navigation Data Command

This command can be used to modify the current values of navigation data.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	46h	Command Code
byte 3	Update Latitude/Longitude – Binary Data	
	7 6 5 4	3 2 1 0
	0 1 0 0	\$ 0 0 X X
	Where 'XX' is defined as:	
	00 = Do not change values	
	01 = Get values from sensor	
	10 = Use values from fields below	
bytes 4-12	Latitude	+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	+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
byte 29	Update Heading – Binary Data	
	7 6 5 4	3 2 1 0
	0 1 0 0	\$ 0 0 X X
	Where 'XX' is defined as:	
	00 = Do not change values	
	01 = Get values from sensor	
	10 = Use values from fields below	
bytes 30-34	True Heading	ddd.d (decimal degrees format) 0.0 to 359.9 degrees Right-justified and padded with blanks True Heading of mount at azimuth = 0.0
bytes 35-41	Reserved	Fill with zeros or blanks

Write Navigation Data Command (continued)

byte 42 Update Platform Tilt – Binary Data

```

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

```

Where 'XX' is defined as:

00 = Do not change values

01 = Get values from sensor

10 = Use values from fields below

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	Position Update	'A' = determine missing navigation data when required 'U' = immediately determine missing navigation data (moves antenna if necessary)
byte 54	ETX	
byte 55	Checksum	

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

2.4.21 X-Axis/Y-Axis/Polarization 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' = X-Axis Counter Clockwise 'W' = X-Axis Clockwise 'D' = Y-Axis Counter Clockwise 'U' = Y-Axis Clockwise '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 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' = X-Axis 'E' = Y-Axis '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	

2.4.22 Remote Key Press Command

This command sends a keypad value to the RC4600. The RC4600 will react to the keypad value as if the corresponding key on the RC4600 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.

2.4.23 Write Config Data Command

****** This command should only be sent when the ACU is in an idle state ******

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 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-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.

2.4.24 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 2.5.3 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 2.5.3 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=-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 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.

2.4.25 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 3-4	Index	1 to 20 Right-justified and padded with blanks
bytes 5-6	Table Entry	0 to 47 Right-justified and padded with blanks
bytes 7-14	Azimuth Position	-300.000 to 300.000
bytes 15-22	Elevation Position	-90.000 to 120.000
		+DDD.ddd (decimal-degrees format) Right justified and padded with blanks
byte 23	Update Flag	'Y' = set update flag 'N' = clear update flag
byte 24	ETX	
byte 25	Checksum	

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

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	1 to 20 Right justified and padded with blanks
bytes 5-6	Table Entry	0 to 47 Right justified and padded with blanks
bytes 7-23	'CLEAR'	Clear track table data for this entry Left-justified and padded with blanks
byte 24	ETX	
byte 25	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 3-4	Index	1 to 20 Right justified and padded with blanks
bytes 5-23	'CLEAR ALL'	Clear track table entries Left-justified and padded with blanks
byte 24	ETX	
byte 25	Checksum	

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

2.4.26 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 3-4	Index	1 to 20 Right justified and padded with blanks
bytes 5-6	Table Entry	0 to 47 Right justified and padded with blanks
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	1 to 20 Right justified and padded with blanks
bytes 5-6	Table Entry	0 to 47 Right justified and padded with blanks
bytes 7-11	Sidereal Time	Sidereal time of this entry
bytes 12-19	Azimuth Position	-300.000 to 300.000
bytes 20-27	Elevation Position	-90.000 to 120.000
	When using angular sensors: +ddd.dd (decimal-degrees format) Right justified and padded with blanks	
	When using count sensors: dddddd (unsigned-integer 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	

2.4.27 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.

2.4.28 Write Location Data Command

This command is used to write preset location data into the controller memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	50h	Command Code
bytes 3-4	Index	1 to 10 Right-justified and padded with blanks
bytes 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-23	Latitude	+ddd.dddd (decimal-degrees format) ±90.0 degrees (South latitude negative) Right-justified and padded with blanks
bytes 24-32	Longitude	+ddd.dddd (decimal-degrees format) ±180.0 degrees (West longitude negative) Right-justified and padded with blanks
bytes 33-39	Reserved	Fill with zeros or blanks
byte 40	ETX	
byte 41	Checksum	

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

NOTE: Data written with this form 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 2.4.23 of this document for more information.

2.4.29 Read Location Data Command

This command reads preset location data from the controller memory.

The command has the following format:

byte 0	STX	
byte 1	A	Address
byte 2	51h	Command Code
bytes 3-4	Index	1 to 10 Right-justified and padded with blanks
byte 6	ETX	
byte 7	Checksum	

The ACK reply will be in the following format:

byte 0	ACK	
byte 1	A	Address
byte 2	51h	Command Code
bytes 3-4	Index	1 to 10 Right-justified and padded with blanks
bytes 5-14	Name	10 characters maximum Left-justified and padded with blanks
bytes 15-23	Latitude	+ddd.dddd (decimal-degrees format) ±90.0 degrees (South latitude negative) Right-justified and padded with blanks
bytes 24-32	Longitude	+ddd.dddd (decimal-degrees format) ±180.0 degrees (West longitude negative) Right-justified and padded with blanks
bytes 33-39	Reserved	Fill with zeros or blanks
byte 40	ETX	
byte 41	Checksum	

2.5 Reference Information

2.5.1 ASCII Table

The following table shows the set of ASCII codes available for use by the RC4600 remote protocol.

Table 2.5.1.1 - 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	

2.5.2 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 Table 2.5.2.2. Additional mode-unique states are listed in Table 2.5.2.3 and Table 2.5.2.4. Only values shown should be considered valid.

Table 2.5.2.1 - Operating Modes

Value (hex)	Value (dec)	Mode (byte 60 & 62)
20	32	MANUAL
21	33	MENU
22	34	POSITION
23	35	LOCATION
24	36	HEADING
25	37	LOCATE
26	38	TRACK_ENTRY
27	39	
28	40	TRACK
29	41	
2A	42	SPECIAL_AXIS
2B	43	POWER_UP
2C	44	
2D	45	HEADING_FIX
2E	46	
2F	47	STOW
30	48	DEPLOY
31	49	
32	50	MOVE_TO
33	51	
34	52	
35	53	
36	54	DRIVE_RESET
37	55	
38	56	FLASH_SAVE
39	57	
3A	58	TILT
3B	59	REMOTE_POSITION
3C	60	POSITION_HOLD
3D	61	PEAKUP
3E	62	SHAKE
3F	63	LOCATE_ENTRY
40	64	SERVO_MAINT
41	65	STANDBY
42	66	
43	67	CONFIG
44	68	CONG SUB MODE
45	69	MAINTENANCE
45-56	70-86	MAINT SUB MODES

Table 2.5.2.2 - Common Mode States

Value (hex)	Value (dec)	State (byte 61 & 63)
20	32	INITIALIZING_MODE
21	33	WAITING_FOR_USER_INPUT
22	34	MOVING_TO_DEPLOY
23	35	MOVING_TO_STOW
24	36	
25	37	
26	38	MOVING_OUT_OF_LIMIT
27	39	MOVING_X-Axis
28	40	MOVING_Y-Axis
29	41	MOVING_POLARIZATION
2A	42	MOVING_AZELPL
2B	43	MOVING_SPECIAL_AXIS
2C	44	SEARCHING_FOR_X-Axis_STOW_SWITCH
2D	45	SEARCHING_FOR_POL_STOW_SWITCH
2E	46	ERROR_CANNOT_FIND_X-Axis_STOW_SWITCH
2F	47	ERROR_CANNOT_FIND_POL_STOW_SWITCH
30	48	ERROR_ELEV_NOT_IN_POSITION
31	49	ERROR_SPECIAL_AXIS_NOT_IN_POSITION
32	50	ERROR_NOT_AT_STOW
33	51	ERROR_NOT_AT_DEPLOY
34	52	WAITING_FOR_LATLON
35	53	WAITING_FOR_HEADING
36	54	WAITING_FOR_TILT
37	55	ERROR_NO_LATLON
38	56	ERROR_NO_HEADING
39	57	ERROR_NO_TILT
3A	58	MOVING_TO_DETERMINE_LATLON
3B	59	MOVING_TO_DETERMINE_HEADING
3C	60	MOVING_TO_DETERMINE_TILT
3D	61	MOVING_TO_SYNC_PULSES
3E	62	ERROR_PULSE_SYNC_FAILED
3F	63	

Table 2.5.2.3 - Unique Mode States

Value (hex)	Value (dec)	POWER_UP States	MANUAL States	LOCATE States
40	64	CONFIRM_SAVED_POSITION	JOG_X_CCW	ERROR_NO_LAT_LON
41	65	CONFIRM_TRACK_RESTART	JOG_X_CW	ERROR_NO_HEADING
42	66		JOG_Y_CCW	ERROR_NO_SAT_DATA
43	67		JOG_Y_CW	ERROR_FEED_BAND_MISMATCH
44	68		JOG_POL_CCW	ERROR_AZIM_RANGE
45	69		JOG_POL_CW	ERROR_ELEV_RANGE
46	70		AUTO_MOVE_POL	ERROR_SAT_PRESET_DATA
47	71		IDLE	WAITING_FOR_MODEM
48	72			
49	73			
4A	74			CALCULATING_POINTING
4B	75			CALCULATING_TLE
4C	76			
4D	77			READY_TO_LOCATE
4E	78			LOCATE_COMPLETE
4F	79			LOCATE_FAILED
50	80			
51	81			
52	82			MOVING_TO_INITIAL_SCAN_POSITION
53	83			ERROR_NO_RF_DETECTED
54	84			DETERMINE_NOISE_FLOOR
55	85			MOVING_TO_SCAN_ELEV
56	86			RESCANNING_WITH_WIDER_RANGE
57	87			
58	88			TUNE_DVB
59	89			TUNE_BEACON
5A	90			TUNE_FAILURE
5B	91			ATTEN_BEACON
5C	92			
5D	93			AZIM_SMOOTH_SCAN
5E	94			AZIM_STEP_SCAN
5F	95			
60	96			
61	97			SAMPLE_AGC
62	98			MOVING_TO_LOCK_CENTER
63	99			MOVING_TO_PEAK_SIGNAL
64	100			MOVING_TO_NOMINAL
65	101			NO_PEAK_FOUND
66	102			SPIRAL_SEARCH_BEGIN
67	103			SPIRAL_SEARCH_MOVING_TO_START
68	104			SPIRAL_SEARCH_MOVING_CW
69	105			SPIRAL_SEARCH_MOVING_UP
6A	106			SPIRAL_SEARCH_MOVING_CCW
6B	107			SPIRAL_SEARCH_MOVING_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 2.5.2.4 - Unique Mode States Cont.

Value (hex)	Value (dec)	TRACK_ENTRY States	TRACK States	STOW States
40	64	ERROR_SAT_PRESET_DATA	INIT_PARAMETERS	STOW_COMPLETE
41	65	ERROR_NO_LAT_LON	CONFIRM_EXIT	
42	66	ERROR_NO_HEADING		
43	67			
44	68		TUNE_DVB	
45	69	RETURNING_TO_START	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			
51	81		MEMORY_IDLE	
52	82		MEMORY_REPOSITION	
53	83		MEMORY_UPDATING	
54	84		MEMORY_CHECKING	
55	85		TLE_IDLE	
56	86		TLE_REPOSITION	
57	87			
58	88		EPT PEAKING	
59	89		EPT WAITING FOR SIGNAL TO RETURN	
5A	90		EPT UPDATING	
5B	91		EPT CHECKING	
5C	92		EPT REPOSITION	
5D	93		EPT IDLE	
60	94			
61	95			
62	96		ERROR_PEAK_LIMIT	
63	97		ERROR_ACU_ALARM	
64	98		ERROR_CHECKSUM	
65	99		ERROR_TLE_DATA	
66	100		ERROR_UNDEFINED	

2.5.3 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.

Table 2.5.3.1 - Object IDs

OID	Status Item	Format	Description
x.0.0	CURRENT MODE ITEM	Unsigned	See Section 2.5.2
x.1.0	CURRENT SUBMODE ITEM	Unsigned	See Section 2.5.2
x.2.0	LAST MODE ITEM	Unsigned	See Section 2.5.2
x.3.0	LAST SUBMODE ITEM	Unsigned	See Section 2.5.2
x.5.0	TIMEDATE ITEM	ASCII String	yyyy-mm-ddThh:mm:ss.fffZ
x.6.0	ACTIVE ALARM ITEM	Enumeration	Table 2.5.3.3
x.7.0	LOCATE ACTIVE ITEM	Unsigned	0=Not Done, 1=Done, 2=Good
x.8.0	LOCAL JOG CONNECTED ITEM	Unsigned	0=Not Connected, 1=Connected
x.10.0	POS SAVED ITEM	Unsigned	0 = Not Saved, 1=Saved
x.11.0	POS LOC SOURCE ITEM	Enumeration	Table 2.5.3.4
x.12.0	POS LOC LAT ITEM	Float	+DDD.dddd (degrees)
x.13.0	POS LOC LON ITEM	Float	+DDD.dddd (degrees)
x.14.0	POS LOC ALT ITEM (future)	Unsigned	
x.15.0	POS HDG SOURCE ITEM	Enumeration	Table 2.5.3.4
x.16.0	POS HDG ITEM	Float	DDD.dd (degrees)
x.17.0	POS TILT SOURCE ITEM	Enumeration	Table 2.5.3.4
x.18.0	POS TILT PITCH ITEM	Signed	+DD.d (degrees)
x.19.0	POS TILT ROLL ITEM	Signed	+DD.d (degrees)
x.20.0	SAT SOURCE ITEM	Enumeration	Table 2.5.3.5
x.21.0	SAT INDEX ITEM	Unsigned	1 – 20
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 2.5.3.5
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 2.5.3.5
x.30.0	TROPO MODE ACTIVE ITEM	Unsigned	0=No, 1=Yes
x.31.0	SITE SOURCE ITEM	Enumeration	
x.32.0	SITE INDEX ITEM	Unsigned	0 – 19
x.33.0	SITE NAME ITEM	ASCII String	10 Characters
x.34.0	SITE LAT ITEM	Float	+DDD.dddd (degrees)
x.35.0	SITE LON ITEM	Float	+DDD.dddd (degrees)
x.36.0	SITE ALT ITEM (future)	Unsigned	
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 HORIZ AZ ITEM	Float	+DDD.ddd (degrees)
x.61.0	TARGET HORIZ 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.64.0	TARGET RANGE ITEM	Unsigned	DDDDDD (miles)
x.65.0	TARGET PLAT X ITEM	Float	+DDD.ddd (degrees)
x.66.0	TARGET PLAT Y ITEM	Float	+DDD.ddd (degrees)

Table 2.5.3.2 - Object IDs Cont.

OID	Status Item	Format	Description
x.70.0	AXIS PLATFORM ANGLE ITEM: X	Float	+DDD.ddd (degrees)
x.70.1	AXIS PLATFORM ANGLE ITEM: Y	Float	+DDD.ddd (degrees)
x.70.2	AXIS PLATFORM ANGLE ITEM: PL	Float	+DDD.ddd (degrees)
x.71.0	AXIS HORIZONTAL ANGLE ITEM: AZ	Float	+DDD.ddd (degrees)
x.71.1	AXIS HORIZONTAL ANGLE ITEM: EL	Float	+DDD.ddd (degrees)
x.71.2	AXIS HORIZONTAL ANGLE ITEM: PL	Float	+DDD.ddd (degrees)
x.72.0	AXIS LIMITS ITEM: X	Hexadecimal	Table 2.5.3.8
x.72.1	AXIS LIMITS ITEM: Y	Hexadecimal	Table 2.5.3.8
x.72.2	AXIS LIMITS ITEM: PL	Hexadecimal	Table 2.5.3.8
x.73.0	AXIS ALARMS ITEM: X	Hexadecimal	Table 2.5.3.9
x.73.1	AXIS ALARMS ITEM: Y	Hexadecimal	Table 2.5.3.9
x.73.2	AXIS ALARMS ITEM: PL	Hexadecimal	Table 2.5.3.9
x.74.0	AXIS STATE ITEM: X	Enumeration	Table 2.5.3.6
x.74.1	AXIS STATE ITEM: Y	Enumeration	Table 2.5.3.6
x.74.2	AXIS STATE ITEM: PL	Enumeration	Table 2.5.3.6
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 2.5.3.6
x.91.0	SIGNAL LEVEL ITEM	Signed	-14000 to 10000 (dB*100)
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	Enumeration	Table 2.5.3.7
x.103.0	TRACK ERROR ITEM	Enumeration	Table 2.5.3.7

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

Table 2.5.3.3 - 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	Reserved
8	Reserved
9	Reserved
10	X-Axis Sensor
11	X-Axis Follow
12	X-Axis Drift
15	X-Axis Sync
20	Y-Axis Sensor
21	Y-Axis Follow
22	Y-Axis Drift
25	Y-Axis Sync
30	Polarization Sensor
31	Polarization Follow
32	Polarization Drift
35	Polarization Sync
40	Limits Inactive Warning
41	Drive System Error
42	Emergency Stop Active
43	Maintenance Interlock
44	Movement Interlock
45	Local Jog Connected
46	Summary Limit Warning
47	Standby Warning

Table 2.5.3.4 - 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 2.5.3.5 - Satellite Source, Band, Polarization and Signal Source Enumerated Values

Value (dec)	SAT_SOURCE_ITEM	SAT_BAND_ITEM	SAT_POLARIZATION_ITEM	SITE_SOURCE_ITEM
0	None	C	None	None
1	Manual	Ku	Horizontal	Reserved
2	Preset	L	Vertical	Manual
3	Longitude	X	Right-Hand	Preset
4		Ka	Left-Hand	Remote
5		S	Neutral	

Table 2.5.3.6 - 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	Remote	Alarm
8	Reserved	Off-Target
9	EIRP	
10		

Table 2.5.3.7 - Track Status and Track Error Enumerated Values

Value (dec)	TRACK_STATUS_ITEM	TRACK_ERROR_ITEM
0	Step Track Sub-Mode Active	None
1	Track Wait Sub-Mode Active	ACU Alarm
2	Auto Search Sub-Mode Active	Track Checksum Error
3	Memory Track Sub-Mode Active	Track TLE Data Error
4	NORAD Track Sub-Mode Active	Peak Limit Error
5	EPT Sub-Mode Active	
6	Track Error Sub-Mode Active	

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 2.5.3.8 - 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 2.5.3.9 - AXIS_ALARM_ITEM Mask

Value (hex)	SENSOR	FOLLOW	DRIVFT	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