APPLICATION		REVISIONS			
NEXT ASSY.	USED ON	REV.	DESCRIPTION	DATE	APPROVAL
	TASS	A	Original Edition	95-12-10	
	TASS	B	Add DSP Device	96-1-5	
	TASS	C	Incorporate Cohu Comments	96-1-15	
	TASS	D	Modify Electrical Std. Refs	96-1-23	
	TASS	E	General Restructure	96-3-25	
	TASS	F	Add Message Length, Source	96-5-6	
	TASS	G	Changed tables for group size	98-6-02	
	TASS	H	Added joystick commands, button commands, revised to use standard hexadecimal characters, added size options to the extended message	98-08-31	
	TASS	~~I~~J	Added medium field of view command/data, fixed tables that were missing command character.	03-10-21	

ALL SHEETS ARE AT THE CURRENT REVISION LEVEL

ORIGINAL DATE OF DRAWING 95-12-10

Sandia National Laboratories
-Security Technology Department

DRAFTSMAN	APPROVAL
CHECKED	APPROVAL
APPROVAL	APPROVAL
DESIGN ACTIVITY APPROVAL	
PROCURING ACTIVITY APPROVAL	

Interface Control Document
for Control of
Pan/Tilt Mounts, Cameras and Other Devices

SIZE	ORGN. NO.	DWG. NO.
A	05838	ICD-TASS-001

SCALE: NONE

SHEET 1 OF 27

INTERFACE CONTROL DOCUMENT
FOR CONTROL OF
PAN/TILT MOUNTS, CAMERAS,
AND OTHER DEVICES

Prepared by:
Sandia National Laboratories
Security Technology Department 5838
P. O. Box 5800
Albuquerque, NM 87185-0780

CONTENTS

FIGURES AND TABLES

1.

DESCRIPTION

This document defines an interface protocol and the functions that are available between a control unit and a remote device. The control unit is a device capable of synthesizing a string of ASCII characters, as documented in the protocol, and can be a Display Control Unit (DCU), a Tactical Automated Security System (TASS) Desktop/Laptop Annunciator (DLA), or other device capable of meeting the requirements.

The remote device consists of a receiver circuit or unit and a device to be controlled. The receiver translates the received message string of ASCII characters into the appropriate commands/signals for the device. The device to be controlled can be a pan/tilt mount (PTM), a closed-circuit television (CCTV) camera, a thermal imaging camera, a combination of a PTM and one or more cameras, a digital signal processor (DSP) board, or some auxiliary device located with the PTH or camera.

The interface protocol defines the process of sending and receiving messages to control functions or features over a data link (Figure 1). The data link can be implemented by direct wire connection, RF modem, optical fiber, or virtually any means, providing the link can transmit and receive ASCII characters and supports an EIA-232, EIA-422, or EIA-485 electrical interface at each end of the link.

The data link is the bridge between the control unit and the receiver at the device to be controlled. The command messages and responses that are transmitted between the control unit and the receiver of the device to be controlled are specified in Sections 3 and 4.

Figure 1. Basic Data Link Block Diagram

Multiple devices, group control units, and a single master control unit can be connected to the serial data control network defined in this document. Figure 2 shows a block diagram for the expanded system. In this configuration, up to 31 devices can be connected to a single “port” on a group control unit. Each group control unit can have up to seven ports. Up to 254 group control units can be connected in a cascade manner. One master control unit is allowed in the system for connecting to group control units or directly to the devices to be controlled.

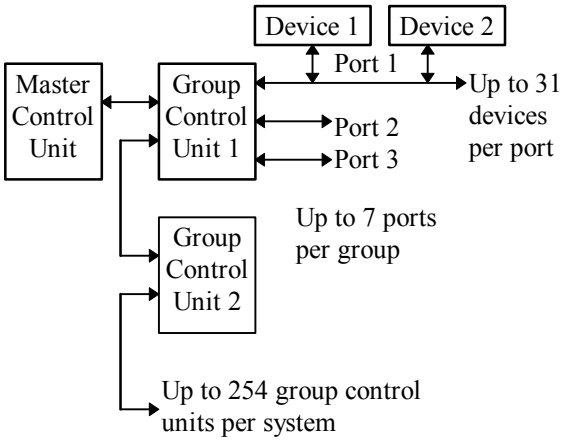

Figure 2. Block Diagram of Expanded System

2. GENERAL FUNCTIONS

The general functions included in the protocol consist of control functions for a pan/tilt mount (PTM), a CCTV camera, a thermal imaging camera, a digital signal processing (DSP) device, or any combination of devices. The protocol includes messages to control three auxiliary devices (relays) and return status to the control unit.

The capability to send and receive large data blocks is also included. Though the format and response for this type of message is usually device specific, a provision is included to have variable-length data block messages. Examples of uses for extended messages include transmission of digitized images and downloading new DSP software to reprogram functionality.

3. PROTOCOL DEFINITION

3.1. Electrical Standards, Signal Formats, and Data Rates

3.1.1. The electrical interface shall be implemented using either Electronic Industries Association (EIA) standard EIA-232, EIA-422, or EIA-485.

3.1.2. The bits per second (bps) rate shall be one or more of the following: 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 bps. It is specified by a single ASCII character, some characters are reserved, others are not used. For some applications, the rate may be different.

3.1.3. Devices are not required to communicate at all data rates but must operate at the default rate and format (start, stop & data bits).

3.1.4. The default data rate shall be 1200 bits per second (bps) with one start bit, eight data bits, one stop bit, and no parity.

3.1.5. The control unit may query the receivers to determine maximum data rate for all devices on the link.

3.1.6. The control unit may send commands to receivers to change data communication parameters to match other devices on the link.

3.1.7. The data rate may be automatically configured with an "autorate" character in the command message. The autorate selection process shall be as outlined in Section 3.2. below.

3.2. Automatic Data Rate Selection

3.2.1. The process for automatically sensing the data rate can be implemented by measuring the width (in time) of the first pulse of the $F8_H$ data byte.

3.2.2. For EIA-232 signals, the first bit (the start bit) is a logic zero or positive voltage.

3.2.3. The $F8_H$ byte is transmitted least significant bit (LSB) first, providing three more logic-zero bits (three positive-voltage bits for EIA-232), for a total of four positive-voltage bits before the signal line goes to a negative voltage to transmit the remaining bits of the $F8_H$ byte.

3.2.4. The bit rate can be calculated from the time duration of this initial pulse.

3.2.5. For EIA-422 or EIA-485, the same procedure will provide the bit rate.

3.2.6. In the event there is insufficient hardware to automatically sense and set the data rate, a process can be used to query each device to determine its maximum data rate, then set the link to operate at a rate compatible with all devices on that link.

3.3. Command Message Format

3.3.1. The first byte of a message is always the F8H character. See Table 2.

3.3.2. The second byte of a message is the address of the specific device for which the message is intended. The factory default device addresses are shown in Table 1.

3.3.2.1. The most significant 3 bits of the address byte are the port number within the receiver unit. There is a limit of 7 ports per receiver, and port numbers can range from one to 7.

3.3.2.2. The least significant 5 bits of the address byte are the address of the particular device within the port. There is a limit of 31 devices per port, and device numbers can range from one to 31.

ADDRESS	DEVICE
0	reserved

1	Thermal Imager
2	Digital Signal Processor
3	Pan/Tilt Unit
4	Compass
5	Visible (CCTV) Camera
6	Not yet defined
7	Not yet defined

Table 1. Factory Default Device Addresses

3.3.2.3. Address 00_H is reserved for the "wild card" addressing of any and all devices connected to the data link.

3.3.2.4. Addresses 01_H to $1E_H$ (port number equal to 0 and device addresses from one to 30) are presently undefined.

3.3.2.5. Address $1F_H$ is reserved for the master control unit.

3.3.2.6. Addresses with the port number specified and the device bits set to 0 are reserved for a DCU or other type of receiver unit that communicates with or controls multiple devices.

3.3.3. The third byte is an asterisk (*) ($2A_H$, 42_{10}).

3.3.4. The fourth byte of a message is the group address of the specific DCU or receiver which connects to the device for which the message is intended.

3.3.4.1. The first group address is always one.

3.3.4.2. There is a limit of 254 groups per system, and group addresses can range from one to 254.

3.3.4.3. Group address 00_H is reserved for the "wild card" addressing of any and all DCUs or other receivers connected to the data link.

3.3.4.4. Group address FF_H is reserved for the group address of the master control unit.

3.3.5. The fifth byte shall be the address of the source of the message. This will allow messages to be sent to other devices.

3.3.6. The sixth byte shall be the length of the command string, in bytes, not including the addressing bytes and checksum byte. This will allow the receiver to accurately check message length.

3.3.7. Devices shall ignore messages not containing their address.

3.3.8. If a message addressed to a device contains an invalid, unrecognized, or non-applicable command, the addressed device shall respond with a NAK to alert the sender that this is an invalid message.

3.3.9. This protocol allows messages to be sent between devices and response messages can be sent to other devices, not just the master control unit.

3.3.10. The command data shall be sent as the ASCII codes for the characters

shown in the tables. Commands consist of 2-byte pairs (2 ASCII characters) and extended messages (greater than 2 bytes).

3.3.11. A checksum will be transmitted with every command message.

3.3.12. The checksum shall be calculated as the EXCLUSIVE-OR of the least significant nibble of all bytes of the command message except for the first byte ("autorate" character) and the last byte (checksum), as shown in Table 2. The least significant nibble of the checksum is all that shall be used. The most significant bit of the checksum byte will be set to one.

BYTE	DATA	DESCRIPTION
0	$F8_H$	Autorate character
1	Address in hex	Message destination address
2	*	Asterisk character ($2A_H$)
3	Group address	Address of group control unit
4	Address in hex	Message source address
5	Length	Length in bytes of command data, does not include bytes 0 through 5 and the checksum byte.
6 to 6 + length-1	Command data	See tables in following sections.
6 + length	Checksum	80_H - $8F_H$ NOTE: Checksum + 80_H

Table 2. Command Message Format

3.4. Command Message Acknowledgment

3.4.1. Every command will be responded to with a single ACK character (06_H, 6_{10}) or a single NAK character (15_H, 21_{10}) as command data at the transmitted bit rate. ACK/NAK messages have the format shown in Table 2.

3.4.2. Each command will be ACKed or NAKed before another command can be sent.

3.4.3. If the calculated checksum is the same as the transmitted checksum, an ACK message is sent back.

3.4.4. If the calculated checksum is not the same as the transmitted checksum, a NAK message is sent back.

3.4.5. If a message is NAKed 3 times, it is discarded.

3.4.6. If no ACK or NAK is received within a "time-out" period, the message is re-transmitted. The message will be transmitted a total of 3 times.

3.4.7. The time-out period shall be short, typically equal to 3 character times plus 5 milliseconds. For a 9600 bps link, this is approximately 8 milliseconds. Special provisions may be made for RF modem links, where the control unit transmitter and the receiver unit transmitter share the same frequency.

3.4.8. If no ACK or NAK is received after the third transmission of a message, the command error message will be sent. See Table 27 for the communication error message format.

3.4.9. Also if no ACK or NAK is received after the third transmission of a message, the data link shall revert to the default data rate and try to reestablish the data link at that speed.

3.5. Response Message Format

3.5.1. If the command requires an extended response, one response will be sent.

3.5.2. If the command requires a response, the response is sent following the ACK. A time delay may be inserted between the ACK and the response message.

3.5.3. The response format will be the same as the command format in Table 2.

3.5.4. The device address will be used for the source address in the response.

3.5.5. See Section 5 for device-specific response messages.

3.6. Control Receiver and General Device Control Commands

3.6.1. The receiver circuit or unit may be integrated into the remote device to be controlled or may be a separate device. It shall respond to receiver commands as defined in Table 3.

3.6.2. The remote device receiver shall execute a reset operation upon receipt of a reset command.

3.6.3. The remote device receivers shall respond to query group message. The group address specified shall be the “wild-card” address. The response message shall consist of all valid group addresses.

3.6.4. All receivers shall respond to a device query. The response message shall consist of the valid device addresses for the receiver.

3.6.5. All devices, if applicable, shall respond to a message requesting an acknowledge. This is also known as an “awake?” query, or "ping".

3.6.6. All devices, if applicable, shall respond to a state-of-health request. The specific response from each remote device may be device dependent.

3.6.7. All devices, if applicable, shall respond to an ID request message. The response message shall identify the unit by transmitting a block of information.

3.6.8. All devices, if applicable, shall respond to a maximum data rate query. The response message shall specify the highest data rate (bits per second) at which the device can communicate.

3.6.9. The control unit shall be able to specify to the devices the data rate, number

of stop bits, number of data bits, and parity at which it will communicate.

3.6.10. The control unit shall be able to turn the device power on and off.

3.6.11. If configured to do so, the remote device receiver shall pass extended messages to the device.

3.6.12. If configured to do so, the remote device receiver shall pass a binary data block to the device.

3.6.13. The control unit shall be able to put remote devices in test mode. This function may be device dependent.

3.7. Changing Device Addresses

3.7.1. The device ID may be programmable over the data link.

3.7.2. A single device can be connected to a control unit and the "#n" message transmitted using wild-card addressing to set the device ID to a new address, where "#" is character 23_H or 35_{10}, and "n" is the new device ID number in accordance with Section 3.3.2. above.

3.7.3. The group ID may be programmable over the data link.

3.7.4. A single group can be connected and the "Gn" message transmitted using wild card addressing to set the group address to a new address, where "n" is the new group address number in accordance with Section 3.3.4. above.

DESCRIPTION	DATA	COMMENTS
Reset Receiver	RS	No response required
Request awake status (ping)	AW	ACK (1-byte) response
Request State of Health	SH	Response is device dependent
Request ID Information	I?	See Table 17 for response format
Query Groups	G?	See Table 19 for response format
Query Devices in a Group	D?	See Table 20 for response format
Set Group ID	Gn	n = new group address See Section 3.3.4. for format explanation
Set Device ID	#n	n = new device address, see Section 3.3.2. for format explanation
Request Maximum Data Rate	B?	See Table 18 for response format
Set Communication Parameters	C	See Table 4 for format explanation
Turn Device Power On	PN	No response required
Turn Device Power Off	PF	No response required
Toggle Device Power On/Off	LP	See Table 21 for response format
Enable Test Mode for Device	TM	Response is device specific
Disable Test Mode for Device	TF	Response is device specific
Binary Message to Device	Xn	See Table 13 for format explanation (n is number of binary bytes)
Extended Message to Device	EM	See Table 14 for format explanation

Table 3. Control Receiver and General Device Control Commands

4. DEVICE-SPECIFIC COMMANDS

4.1. Camera and General Lens Control Commands

4.1.1. The control unit shall be able to command the camera to focus near and far.

4.1.2. The control unit shall be able to open and close the lens iris or aperture.

4.1.3. The control unit shall be able to command the camera to zoom in and out.

4.1.4. The control unit shall be able to command the camera lens to a specific zoom and focus position, with up to 12-bit resolution, each represented by three hexadecimal characters (for example, $1BF_H$). See Table 6 for the position format.

4.1.5. The control unit shall be able to read status from the camera. The status shall consist of zoom and focus information.

4.1.6. The control unit shall be able to allow the camera to be manually focused.

BYTE	DATA	DESCRIPTION
6	C	C = communications parameters command
7~~6~~	0 1 2 3 4 5 6 7 8…F All other characters	ASCII 0 = 1200 bits per second ASCII 1 = 2400 bits per second ASCII 2 = 4800 bits per second ASCII 3 = 9600 bits per second ASCII 4 = 19,200 bits per second ASCII 5 = 38,400 bits per second ASCII 6 = 57,600 bits per second ASCII 7 = 115,200 bits per second Reserved for future data rates Unused and not reserved
8~~7~~	7 8	ASCII 7 = 7 data bits ASCII 8 = 8 data bits
9~~8~~	1 2	ASCII 1 = 1 stop bit ASCII 2 = 2 stop bits
10~~9~~	n e o s	n = no parity e = even parity o = odd parity s = space parity

Table 4. Set Communications Parameters Command

4.1.7. The control unit shall be able to set the camera lens speed.

4.1.8. The control unit shall be able to change the color balance of the image from the camera.

4.1.9. The camera and general lens control commands are shown in Table 5.

Note: Three messages are included in this protocol to "toggle" specific settings. An automatic response is generated by these three messages according to the format in Table 21.

DESCRIPTION	DATA	COMMENTS
Focus Near	FN	Must send FS to stop focusing
Focus Far	FF	Must send FS to stop focusing
Focus Stop	FS	No response required
Iris/Aperture Open	IO	Must send IS to stop opening iris
Iris/Aperture Close	IC	Must send IS to stop closing iris
Iris/Aperture Stop	IS	No response required
Zoom In	ZI	Must send ZS to stop zooming in
Zoom Out	ZO	Must send ZS to stop zooming out
Zoom Stop	ZS	No response required
Set Auto Iris Mode	LA	No response required
Set Manual Iris Mode	LB	No response required
Toggle Auto/Manual Iris	LM	See Table 21 for response format
Set Lens Speed Slow	LO	No response required
Set Lens Speed Fast	LT	No response required
Toggle Lens Speed Slow/Fast	LL	See Table 21 for response format
Latch/Status Request	L?	See Table 21 for response format
Color Balance	L1 B1 B2 B0	Select auto/manual mode Increase Blue Increase Red Increase Stop
Lens Position Request	V?	See Table 22 for response format
Lens Go-To Command	v*z2z1z0f2f1f0*	See Table 6 for format explanation

Table 5. Camera and General Lens Control Commands

BYTE	DATA	DESCRIPTION
6	v	v = go-to command
7	z2 (MS nibble)	Zoom position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
	z1	Bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	z0 (LS nibble)	Bits 0-3 + 30_H for 0-9 and + 41_H for A-F
10	f2 (MS nibble)	Focus position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
11	f1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
12	f0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 6. Camera Lens Setting Message

4.2. Thermal Imager-Specific Commands

4.2.1. The control unit shall enable/disable automatic contrast and brightness (gain and level) control. If disabled, the thermal imager shall be in manual contrast and brightness mode.

4.2.2. The control unit shall be able to set the brightness (level) of the imagery with up to 12-bit resolution, represented by three hexadecimal ASCII characters. See Table 8 for the format.

4.2.3. The control unit shall be able to adjust the contrast (gain) of the imagery with up to 12-bit resolution, represented by three hexadecimal ASCII characters. See Table 8 for the format.

4.2.4. The control unit shall be able to set the field of view ~~to wide or narrow~~as described below.

4.2.5. The control unit shall be able to set the polarity to black or white hot.

4.2.6. The control unit shall be able to change the imager lens focus.

4.2.7. The control unit shall be able to control the imager shutter (if applicable).

4.2.8. The control unit shall be able to turn on/off or change the reticule/graticule overlay on the display (if applicable).

4.2.9. The control unit shall be able to read status from the imager. The status shall consist of contrast, brightness, and other status information.

4.2.10. The imager command format is shown in Table 7.

Note: Several commands, such as focus in/out/stop, zoom in/out/stop, and power on/off are listed in Sections 3.6. and 4.1. but can be used for thermal imaging devices as well.

DESCRIPTION	DATA	COMMENTS
Set Brightness (Level) value	b*v2v1v0*	See Table 8 for format explanation
Set Contrast (Gain) value	g*v2v1v0*	See Table 8 for format explanation
Set Narrow Field-of-View	LN	No response returned
Set Wide Field-of-View	LW	No response returned
Set Medium Field-of-View	LN0 – LN3	Set to one of up to 4four (4) medium fields of view from narrow to wide.
Set Polarity Black = Hot	HB	No response returned
Set Polarity White = Hot	HW	No response returned
Manual Contrast/Brightness Mode	IM	No response returned
Auto Contrast/Brightness Mode	IA	No response returned
Insert Shutter	SI	No response returned
Remove Shutter	SR	No response returned
Reticule/Graticule Off	R0	No response returned
Reticule Select 1-9	R1..R9	No response returned

Request Imager Status	S?	See Table 23 for response format

Table 7. Imager-Specific Commands

BYTE	DATA	DESCRIPTION
6	g or b	g = contrast status, b = brightness status
7	v2 (MS nibble)	Contrast or brightness value, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
8	v1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	v0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 8. Imager Contrast and Brightness Message Format

4.3. Pan/Tilt Mount Commands

4.3.1. The control unit shall specify the pan/tilt mount to program a preset position.

4.3.2. The control unit shall specify the pan/tilt mount to move to a preset position.

4.3.3. The control unit shall request status relating to the preset positions.

4.3.4. The minimum number of preset positions shall be ten.

4.3.5. The control unit shall specify the pan/tilt mount to pan left.

4.3.6. The control unit shall specify the pan/tilt mount to pan right.

4.3.7. The control unit shall specify the pan/tilt mount to stop panning.

4.3.8. The control unit shall specify the pan/tilt mount to move to a specific position, determined by two 12-bit values (azimuth and elevation), each represented by three hexadecimal ASCII characters. See Table 10 for the format.

4.3.9. The position values may not represent the absolute position. The mapping of the 12-bit position values to absolute pan or tilt position angles is device dependent.

4.3.10. The control unit shall request position status from the pan/tilt mount. The position status data shall be formatted as a 12-bit value, represented by three hexadecimal ASCII characters for both azimuth and elevation. The format is shown in Table 24.

4.3.11. The control unit shall specify the pan/tilt mount to tilt down.

4.3.12. The control unit shall specify the pan/tilt mount to tilt up.

4.3.13. The control unit shall specify the pan/tilt mount to stop tilting.

4.3.14. The control unit shall specify the operation of the auxiliary outputs on the pan/tilt mount.

4.3.15. The control unit shall request status of the auxiliary outputs.

4.3.16. The number of auxiliary outputs defined by this standard is three.

4.3.17. The control unit shall specify the pan speed for manual moves. For some applications, this may be combined with the tilt speed command.

4.3.18. The control unit shall specify the tilt speed for manual moves.

4.3.19. The control unit shall specify the speed for auto-moves.

4.3.20. The speed range for manual and automatic moves shall be 0...15, where 0 may be the slowest speed or a time-dependent proportional rate, and 15 is the maximum speed for that type of move (manual or automatic).

4.3.21. The control unit shall command the pan/tilt mount to begin an automatic scanning sequence. The preset positions to be used as the end points of the auto-scan motion are PA and PB.

4.3.22. PA is the left preset and PB is the right preset with reference to the camera's point of view. The auto scan then moves between these left and right positions.

4.3.23. The control unit shall command the pan/tilt mount to recalibrate (RC) or reinitialize (if required). A message shall be returned indicating recalibration is active (HA). A secondary message shall be returned indicating recalibration is complete (HC), or there was a recalibration error (HE).

4.3.24. The pan/tilt command format is shown in Table 9.

DESCRIPTION	**DATA**	**COMMENTS**
Pan Left	PL	At constant speed, must send PS to stop
Pan Right	PR	At constant speed, must send PS to stop
Pan Stop	PS	No response required
Tilt Up	TU	At constant speed, must send TS to stop
Tilt Down	TD	At constant speed, must send TS to stop
Tilt Stop	TS	No response required
Set Speed for Pan (and Optional Tilt) Manual Moves (User-defined default rate)	S0...SF	0 = slow/proportional, F = maximum NOTE: Two-byte message format No response required
Set Speed for Tilt Manual Moves (User-defined default rate)	E0...EF	0 = slow/proportional, F = maximum NOTE: Two-byte message format No response required
Set Auto-Move Speed	A0-AF	0 = slowest, F = maximum
Recalibrate	RC	See Table 25 for response format
Latch (Auxiliary Relay) Toggle	L1-L3	Toggles Aux1, Aux2, or Aux3 latches See Table 21 for response format
Set Latch 1	l1	No response required
Set Latch 2	l2	No response required

Set Latch 3	l3	No response required
Reset (clear) Latch 1	r1	No response required
Reset (clear) Latch 2	r2	No response required
Reset (clear) Latch 3	r3	No response required
Latch (Auxiliary Relay) Status Request	L?	See Table 21 for response format
Go to a Preset or "Home" Position	H0-H9	See Table 25 for response format
Store Preset Position	P0-P9	No response required
Store Auto-Scan Position A	PA	No response required
Store Auto-Scan Position B	PB	No response required
Preset Position Status Request	H?	See Table 25 for response format
Pan/Tilt Position Request	P?	See Table 24 for response format
Pan/Tilt Go-To Command	p*a2a1a0e2e1e0*	See Table 10 for format explanation
Begin Auto-Scan Mode	AS	Auto-scans between positions PA and PB. Use PS or TS to stop.

Table 9. Pan/Tilt Mount Commands

BYTE	DATA	DESCRIPTION
6	p	p = go-to position command
7	a2 (MS nibble)	Azimuth (pan) position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
8	a1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	a0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F
10	e2 (MS nibble)	Elevation (tilt) position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
11	e1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
12	e0	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 10. Pan/Tilt Mount Go To Command Message Format

4.4. Digital Signal Processor Commands

4.4.1. The control unit shall be able to set the compression level and/or quality factor for video compression in the DSP as a 12-bit value represented as three ASCII characters. See Table 12 for the format.

4.4.2. The control unit shall be able to download new information into the DSP. Information could consist of DSP software and/or templates for image recognition or object identification.

4.4.3. The control unit shall be able to command the DSP to grab a video frame.

4.4.4. The control unit shall be able to command the DSP to compress a video frame.

4.4.5. The control unit shall be able to command the DSP to send back a video frame.

4.4.6. The control unit shall be able to command the DSP to grab, compress using the current compression level and send back a video frame.

4.4.7. The control unit shall be able to command the DSP to detect a change in the video scene and then to grab, compress using the current compression level and send back a video frame.

4.4.8. The control unit shall be able to command the DSP to begin an image recognition action.

4.4.9. The control unit shall be able to turn the DSP power on and off.

4.4.10. The control unit shall be able to put the DSP into a low power consumption or sleep state.

4.4.11. The DSP command format is shown in Table 11.

DESCRIPTION	DATA	COMMENTS
Set Compression Level	DC*a2a1a0*	See Table 12 for format explanation
Set Quality Factor	DQ*a2a1a0*	See Table 12 for format explanation
Download	EM	See Table 14 for format
Grab Image	DG	No response required
Compress Image	DP	Uses the last DC or DQ value
Send Image	DS	See Table 14 for format
Detect change, Grab & Send	DI	See Table 14 for format (Uses the last DC or DQ value to compress)
Grab & Send	DH	See Table 14 for response format (Uses the last DC or DQ value to compress)
Image Recognition	DR	See Table 12 for response format Note: Same as send format.
DSP Low Power Sleep	LS	No response required.

Table 11. Digital Signal Processor Commands

BYTE	DATA	DESCRIPTION
6	D	D = DSP command
7~~6~~	Q C R	Q = Quality Factor C = Compression Ratio R = Image Recognition (template number returned)
8~~7~~	a2 (MS nibble)	bits 8-11 + 30_H for 0-9 and + 41_H for A-F
9~~8~~	a1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
10~~9~~	a0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 12. Digital Signal Processor Command Format

4.5. Binary Data Message Command Format

4.5.1. Table 13 defines the message format for a binary data message.

BYTE	DATA	DESCRIPTION
6	X	Binary Data Message Command
7	n (1-255)	Number of binary bytes (255 maximum)
8 to 8+n	Data block	Up to 255 bytes of data

Table 13. Binary Data Message Command Format

4.6.

Extended Message Command Format

4.6.1. An extended data message allows the transmission of large data block of various sizes.

4.6.2. A two-byte command can be included after the 'EM' command. This two-byte command is not defined and can be device specific.

4.6.3. Up to 999 data blocks can be sent, and each data block can be up to 999 bytes.

4.6.4. Table 14 defines the format for a message to send large data blocks.

BYTE	DATA	DESCRIPTION
6-7	EM	Extended Message Command
8-9	xx	2 byte command, device specific
10-12	bbb	Three ASCII characters indicating the number of data blocks (001-999)
13-15	sss	Three ASCII characters indicating the size of each block in bytes (001-999)
16 to 16 + (bbb * sss)	Data blocks	

Table 14. Extended Message Command Format

4.7. Joystick Specific Commands

4.7.1. The control unit shall be able to command the pan/tilt mount to move up, down, left, or right based on the position of a joystick control lever.

4.7.2. The speed control of the movement shall be controllable over a range of 0-99 discrete speeds. The value of zero (0) indicates stop. The value of 99 indicates maximum speed. The maximum speed is not defined and may be device dependent.

4.7.3. Table 15 defines the message format for a joystick control message.

BYTE	DATA	DESCRIPTION
6	J	Joystick Control Command
7	L or R	L = move left, R = move right
8	ps1	Pan speed, most significant digit (0-9, 30_H - 39_H)
9	ps0	Pan speed, least significant digit (0-9, 30_H - 39_H)
		NOTE: ps1/ps0 = 00 indicates pan stop
10	U or D	U = move up, D = move down
11	ts1	Tilt speed, most significant digit (0-9,

		30_H - 39_H)
12	ts0	Tilt speed, least significant digit (0-9, 30_H - 39_H)
		NOTE: ts1/ts0 = 00 indicates tilt stop

Table 15. Joystick Control Command Format

4.8. Button/Keypad Specific Commands

4.8.1. The control unit shall be able to simulate the pressing/releasing of buttons on a keypad unique to the device being controlled.

4.8.2. The button/keypad specific command shall provide 100 unique key codes (0..99) for general purpose keypad input and device control.

4.8.3. The control unit shall be able to indicate press or release of the key.

4.8.4. Table 16 defines the message format for a button or keypad simulation control message.

BYTE	DATA	DESCRIPTION
6	B	Button Command
7	kc1	Key code most significant digit (0..9, 30_H - 39_H)
8	kc0	Key code least significant digit (0..9, 30_H - 39_H)
9	P or R	'P' = press, 'R' = release

Table 16. Button/Keypad Control Message Format

5. DEVICE-SPECIFIC RESPONSES

The following tables document the responses from remote devices.

5.1. Identification Response Message

5.1.1. Table 17 defines the message returned from a Request ID request.

BYTE	DATA	DESCRIPTION
6-7	IR	ID Response
8-9	01_H - 05_H	Device type, see Table 1
10-29	ASCII character string	Device name, padded with 20_H (space) if necessary
30-49	ASCII character	Serial number of device, padded with 20_H

	string	(space) if necessary

Table 17. Device Identification Response Message

5.2. Maximum Data Rate Response Message

5.2.1. Table 18 defines the message returned from a Maximum Data Rate request.

BYTE	DATA	DESCRIPTION
6	B	Communications Status
7	0 1 2 3 4 5 6 7 8 - F All other characters	ASCII 0 = 1200 bits per second ASCII 1 = 2400 bits per second ASCII 2 = 4800 bits per second ASCII 3 = 9600 bits per second ASCII 4 = 19,200 bits per second ASCII 5 = 38,400 bits per second ASCII 6 = 57,600 bits per second ASCII 7 = 115,200 bits per second Reserved for future data rates Unused and not reserved

Table 18. Data Rate Response Message

5.3. Query Groups Response Message

5.3.1. Table 18 defines the message returned from a Query Groups request.

BYTE	DATA	DESCRIPTION
6	G	Group Query Response
7	01_H	Group number for first group
8	02_H - FF_H	Group number for second group
...	02_H - FF_H	
k	02_H - FF_H	Group number for n^{th} group

Table 19. Query Groups Response Message

5.4. Query Devices Response message

5.4.1. Table 20 defines the message returned from a Query Devices request.

BYTE	DATA	DESCRIPTION
6	D	Device Query Response
7	01_H - FF_H	Group address see Section 3.3.4. for format explanation

8	01_H - FF_H	Device number for first device, see Section 3.3.2. for format explanation
9	01_H - FF_H	Device number for second device
...	01_H - FF_H	
k	01_H - FF_H	Device number for n^{th} device

Table 20. Query Devices Response Message

5.5. Camera Status and Latch Response Message

5.5.1. Table 21 defines the message returned from a camera status request.

BYTE	DATA	DESCRIPTION
6	L	Latch status
7	30_H-$3F_H$	LS nibble is 4 bits of status (0 or 1) Bit 0 = Device Power On/Off Bit 1 = Camera/Imager Iris Auto/Manual Bit 2 = Camera Lens Speed Slow/Fast Bit 3 = Auxiliary latch bit
8	A	Auxiliary status
9	30_H-$3F_H$	LS nibble is 4 bits of status (0 or 1) Bit 0 = Auxiliary 1 Bit 1 = Auxiliary 2 Bit 2 = Auxiliary 3 Bit 3 = Auxiliary 4

Table 21. Camera Status and Latch Response Message

5.6. Camera Lens Settings Response Message

5.6.1. Table 22 defines the message returned from a camera lens setting status request.

BYTE	DATA	DESCRIPTION
6	V	V = response
7	z2 (MS nibble)	Zoom position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
8	z1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	z0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F
10	f2 (MS nibble)	Focus position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
11	f1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
12	f0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 22. Camera Lens Setting Response Message

5.7. Imager Settings Response Message

5.7.1. ~~5.7.1.~~ Table 23 defines the response format to a request for imager status and settings of gain (contrast), brightness (level), and other parameters.

5.7.2. All imagers with two or more ~~An imager with two~~ fields of view (FOV) will use the first definition of field 13 (~~bi-FOV imager~~Original) for returning status. In this definition, the upper nibble always has a value of 3 (bits 4 and 5 of the byte set and bits 6 and 7 are cleared). In cases where there are more than two fields of view -- narrow refers to the narrowest FOV- and wide refers to the widest FOV supported.

5.7.3. The second definition (for imagers with multiple fields of view (FOV), e.g., Long range imager) ~~provides imagers with more than 2 FOVs a means~~allows imagers ~~-~~to return their~~a~~ medium FOV field status~~of view value~~. In this definition bit 6 will always be set and bit 0 ~~set to zero~~cleared, and~~. B~~ bits 4 and 5 ~~are then used to~~ provide values in the range of 0 to 3 as their medium ~~middle range of~~ FOVs settings. This provides for a total of 6 fields of view. (Note: Bits 1, 2, and 3 have the same meaning in both cases.)

BYTE	DATA	DESCRIPTION
6	S	S = Status returned
7	g2 (MS nibble)	Contrast value, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
8	g1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	g0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F
10	b2	Brightness value, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
11	b1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
12	b0	bits 0-3 + 30_H for 0-9 and + 41_H for A-F
13 (Original)~~(bi-FOV imager)~~	30_H-$3F_H$	LS nibble is 4 bits of status (0 or 1) Bit 0 = Field of View Wide/Narrow Bit 1 = Polarity White Hot/Black Hot Bit 2 = Automatic Gain/Bright On/Off Bit 3 = Test Mode Inactive/Active
13 (~~Long range imager~~For imagers with up to four (4) medium fields of view.)	40_H-$7E_H$	Bit 0 = 0 Bit 1 = Polarity White Hot/Black Hot Bit 2 = Automatic Gain/Bright On/Off Bit 3 = Test Mode Inactive/Active Bits 4, 5 = Represent the four medium field of view values, 0 – 3 Bit 6 = Always Set..

Table 23. Imager Settings Response Message

5.8. Pan/Tilt Mount Response Message

5.8.1. Table 24 contains the response format for a position status (P?) request.

BYTE	DATA	DESCRIPTION
6	P	P = response to position query
7	a2 (MS nibble)	Azimuth position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
8	a1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
9	a0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F
10	e2 (MS nibble)	Elevation position, bits 8-11 + 30_H for 0-9 and + 41_H for A-F
11	e1	bits 4-7 + 30_H for 0-9 and + 41_H for A-F
12	e0 (LS nibble)	bits 0-3 + 30_H for 0-9 and + 41_H for A-F

Table 24. Pan/Tilt Position Response Message

5.9. Home Status and Recalibration Message

5.9.1. Table 25 contains the response format for a home status request and a recalibration request.

BYTE	DATA	DESCRIPTION
6	H	Home Status
7	0-9 A I E C	ASCII 0-9 = at Home position A = Home active, unit is moving to position I = Not at home or active E = Home error, could not get to home position C = Recalibration complete

Table 25. Home Status Request Response Message

5.10. Digital Signal Processor Response Message

5.10.1. Table 26 defines the message returned from a digital signal processor status request.

BYTE	DATA	DESCRIPTION
6	L	L = Latch or other status message
7	30_H-$3F_H$	Least significant nibble is 4 bits of status Bit 0 = DSP Sleep Mode On/Off Bit 1 = 0 (unused) Bit 2 = 0 (unused) Bit 3 = 0 (unused)

Table 26. Digital Signal Processor Status Response Message

5.11. Communications Error Response Message

5.11.1. Table 27 defines the message format for a communications error response message.

BYTE	DATA	DESCRIPTION
6	L	Response to L* messages
7	$7F_H$	Communications Error

Table 27. Communications Error Response Message