TASS Protocol

16 January 2006

Document Notes

Original title was: **"Interface Control Document for Control of Pan/Tilt Mounts, Cameras, and Other Devices"**. The document had a ID of: **"ICD-TASS-001"**. The document that was converted for this note was revision H.

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[1] `$Header: e:/TXB-Tass/RCS/TassDoc.tex,v 1.12 2006-01-16 19:29:17-08 Hamilton Exp Hamilton $`

Note

This document is based on a converted version of the basic TASS Protocol Specification. There have several modifications to the basic document. These are:

1. All instances of their way of representing hexadecimal (AB_H) have been converted into the more conventional "C" language representation (`0xAB`).
2. In many places in the original document, a set of instructions for converting an 8-bit hexadecimal number into ASCII characters is given. Typical original instructions were:

   "Bits 0-3 + `0x30` for 0-9 and + `0x41` for A-F"

   and then have become:

   "Bits 0-3 Atize"

   The actual locations of the bits to be converted varies depending on exactly where it is used. In some places three nibbles have to be converted, in others less.

   This has been changed to the phrase "**Atize**". It isn't a great name, but does save a bunch of paper/typing.
3. An attempt was made to identify all commands and mark THEM IN SMALL CAPS LIKE THIS but they are elusive and all of them might not have been caught. However all that have been caught have been indexed, so at least they may be found again.
4. In several places the original authors used the following abbreviations: (probably several were missed)
   - **CCTV** = Closed-Circuit TeleVision
   - **DCU** = Display Control Unit
   - **DLA** = Desktop/Laptop Annunciator
   - **DSP** = Digital Signal Processor
   - **EIA** = Electronic Industries Association
   - **GFE** = Government Furnished Equipment
   - **LS** = Least Significant
   - **MS** = Most Significant
   - **PTM** = Pan/Tilt Mount
   - **TASS** = Tactical Automated Security System
5. An effort has been made to keep all section numbers the same.

   However the original section numbers are indicated in square brackets ([like this]) at the start of each section.

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[2] `tocdepth = 2`

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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 is where Pelco starts. Everything before this point should be considered "GFE".

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 **PTM** or camera.

The interface protocol defines the process of sending and receiving messages to control functions or features over a data link (Figure 1, page 7). 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 Section 3, page 13 and Section 4, page 23.

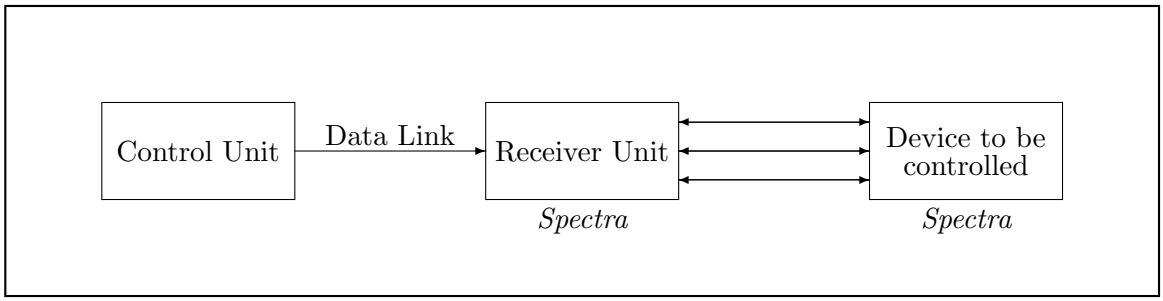

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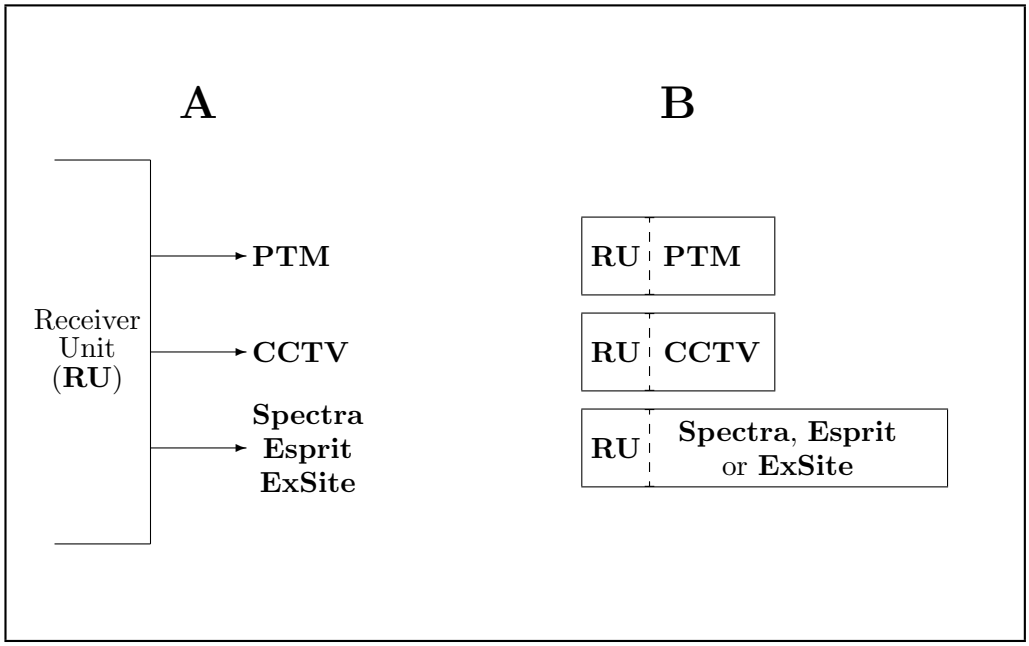
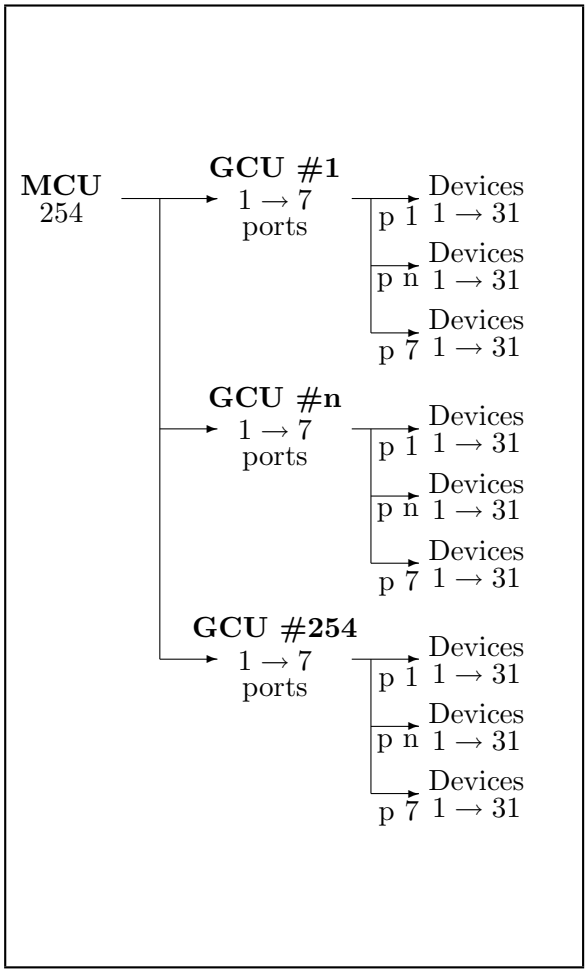
Figure 1. Basic Data Link Block Diagram



$RCSfile: Choice1.inc,v $

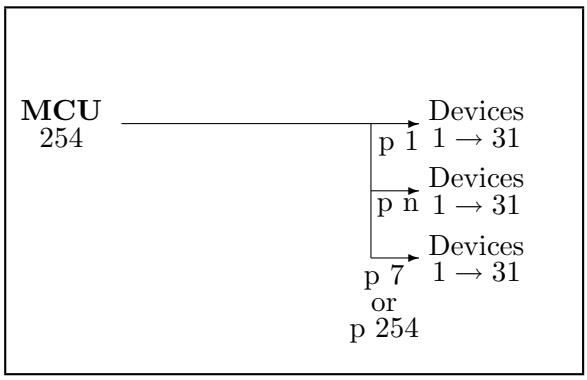
Figure 2. Choices for receiver/device connections

Multiple devices, group control units, and a **single** Master Control Unit (**MCU**) can be connected to the serial data control network defined in this document. Figure 5, page 11 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 (**GCU**). Each Group Control Unit (**GCU**) can have up to seven ports. Up to **254** Group Control Units (**GCU**) can be connected in a cascade manner. One Master Control Unit (**MCU**) is allowed in the system for connecting to Group Control Units (**GCU**) or **directly** to the devices to be controlled.



$RCSfile: Choice2.inc,v $

Figure 3. **MCU** to **GCU** to Devices



$RCSfile: Choice3.inc,v $

Figure 4. **MCU** directly to Devices

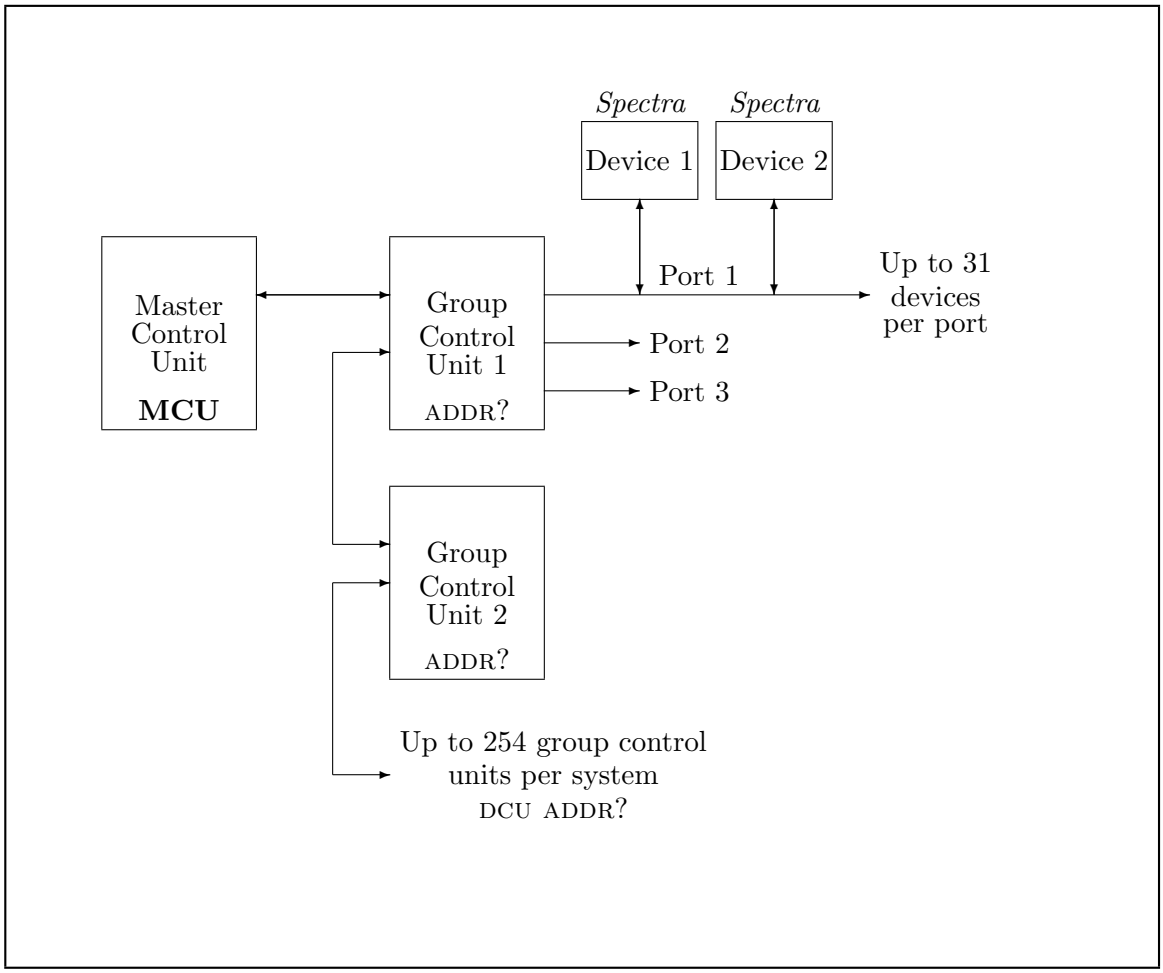


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Figure 5. Block Diagram of Expanded System

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 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, page 13 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 `0xF8` 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 `0xF8` 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 `0xF8` 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. (*Does not apply to Pelco units.*)

Byte	Data	Description
0, (SYNC)	`0xF8`	Autorate character
1, (ADDR)	Address in hex	Message destination address
2, (*)	`*`	Asterisk character (`0x2A`)
3, (DCU ADDR)	Group address	Address of Group Control Unit
4, (SOURCE ADDR)	Address in hex	Message source address
5, (LENGTH)	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.
$6 + length$ (CKSM)	Checksum	`0x80` - `0x8F` NOTE: Checksum + `0x80`

Table 1. Command Message Format

Address	Device
0	reserved
1	Thermal Imager
2	Digital Signal Processor
3	Pan/Tilt Unit *Motion controls,* TYPE 3
4	Compass
5	Visible (CCTV) Camera *Camera controls,* TYPE 5
6	Not yet defined
7	Not yet defined

Table 2. Factory Default Device Addresses

3.3 Command Message Format

3.3.1 <SYNC> (Table 3, page 15): The first byte of a message is always the `0xF8` character. See Table 1, page 14.

Byte #	Description
1	<SYNC> `0xF8` Required first message byte

Table 3. Byte #1 (<SYNC>)

3.3.2 <ADDR> (Table 4, page 15): 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 2, page 14. (See Appendix B.2, page B-3 for an example.)

Byte #	Description
2	<ADDR> 7 6 5 | 4 3 2 1 0 Port # | Address
	Port 3 is for Pan/Tilt functions Port 5 is for Camera functions
	ADDR `0x00` is the wild card ADDR `0x01` → `0x1E` "ordinary" addresses ADDR `0x1F` is the Master Control Unit **MCU**

Table 4. Byte #2, Device address (<ADDR>)

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 **1** to **7**. (See Appendix B.3, page B-4 for more information.)

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 **1** to **31**. (See Appendix B.3, page B-4 for more information.)

3.3.2.3 Address `0x00` is reserved for the "wild card" addressing of any and all devices connected to the data link.

3.3.2.4 Addresses `0x01` to `0x1E` (port number equal to **0** and device addresses from **1** to **30**) are presently undefined.

3.3.2.5 Address `0x1F` is reserved for the **M**aster **C**ontrol **U**nit (**MCU**).

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 <*> (Table 5, page 16): The third byte is an asterisk (*****) (`0x2A`, 42_{10}).

Byte #	Description
3	<*> `0x2A`, 42_{10} TASS Protocol ID

Table 5. Byte #3 (<*>)

3.3.4 <DCU ADDR> (Table 6, page 16): The fourth byte of a message is the **group address** of the specific **DCU** (*keyboard, head end, etc.*) or receiver which connects to the device for which the message is intended. (See Appendix B.2, page B-3 for an example.)

Byte #	Description
4	`0x00` wild card `0x01` → `0xFE` Group address `0xFF` Group address of the Master Conrol Unit

Table 6. Byte #4 Group Address (<DCU ADDR>)

3.3.4.1 The first Group Address is always **1**.

3.3.4.2 There is a limit of **254** groups per system, and group addresses can range from **1** to **254**.

3.3.4.3 Group address `0x00` is reserved for the "wild card" addressing of any and all **DCU**s or other receivers connected to the data link.

3.3.4.4 Group address `0xFF` is reserved for the group address of the Master Control Unit (**MCU**).

3.3.5 <SOURCE ADDRESS> (Table 7, page 17): The fifth byte shall be the **address of the source** of the message. This will allow messages to be sent to other devices. (See Appendix B.2, page B-3 for an example.)

Byte #	Description
5	Same format as Table 4, page 15 or Table 6, page 16

Table 7. Byte # 5, Source Address (<SOURCE ADDRESS>)

3.3.6 <LENGTH> (Table 8, page 17): 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.

Byte #	Description
6	Length, not including header or CKSM

Table 8. Byte #6, Command (<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 nonapplicable 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 (**MCU**).

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 <CKSM> (Table 9, page 18): A checksum will be transmitted with every command message.

Byte #	Description
Last	XOR of data, see Section 3.3.12, page 18

Table 9. Last byte, Command checksum (<CKSM>)

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", `0xF8`, character) and the last byte (checksum), as shown in Table 1, page 14. 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 **1**.

*A typical command is shown in Appendix B.1, page B-1. A set of reset ("*RS*") commands that have their header ID values changing is shown in Appendix B.2, page B-3.*

Byte	1	2	3	4	5	6	7	8
ACK	0xF8	ADDR	*	DCU ADDR	SOURCE ADDR	1	0x06	CKSM
NAK	0xF8	ADDR	*	DCU ADDR	SOURCE ADDR	1	0x15	CKSM

Table 10. ACK and NAK message formats

3.4 Command Message Acknowledgment

3.4.1 Every command will be responded to with a single ACK character (0x06, 6_{10}) or a single NAK character (0x15, 21_{10}) as command data at the transmitted bit rate. ACK/NAK messages have the format shown in Table 1, page 14. *WTF?*

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 retransmitted. 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.

What is a typical time? A maximum time? The older FEDAC equipment took up to 1 second to do its work each time the data passed through them. Satellite links take up to 300 ms, each way.

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 35, page 43 for the communication error message format. *What happens if the error message isn't ACKed orNAKed?*

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. *How long is reasonable? <ACK/NAK Message <Optional time delay> <Response Message>?*

3.5.3 The response format will be the same as the command format in Table 1, page 14.

3.5.4 The device address will be used for the source address (SOURCE ADDR) in the response.

3.5.5 See Section 5, page 38 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 11, page 22.

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. *Pelco equipment can not do this.*

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 `0x23` or 35_{10}, and "n" is the new device ID number in accordance with Section 3.3.2, page 15 above. *Interesting!*

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, page 16 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 25, page 38 for response format
Query Groups	G?	See Table 27, page 39 for response format
Query Devices in a Group	D?	See Table 28, page 40 for response format
Set Group ID	GN	n = new group address See Section 3.3.4, page 16 for format explanation
Set Device	ID	#n n = new device address, see Section 3.3.2, page 15 for format explanation
Request Maximum Data Rate	B?	See Table 26, page 39 for response format
Set Communication Parameters	C	See Table 12, page 24 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 29, page 40 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 21, page 35 for format explanation (n is number of binary bytes)
Extended Message to Device	EM	See Table 22, page 35 for format explanation

Table 11. Control Receiver and General Device Control Commands (TYPE 3)

4 Device-Specific Commands

4.1 Camera and General Lens Control Commands (TYPE 3)

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, `0x1BF`). See Table 14, page 26 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.

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 13, page 25.

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 29, page 40.

Byte	Data	Description
6	0	ASCII 0 = 1200 bits per second
	1	ASCII 1 = 2400 bits per second
	2	ASCII 2 = 4800 bits per second
	3	ASCII 3 = 9600 bits per second
	4	ASCII 4 = 19,200 bits per second
	5	ASCII 5 = 38,400 bits per second
	6	ASCII 6 = 57,600 bits per second
	7	ASCII 7 = 115,200 bits per second
	8...F	Reserved for future data rates
	All other characters	Unused and not reserved
7	7	ASCII 7 = 7 data bits
	8	ASCII 8 = 8 data bits
8	1	ASCII 1 = 1 stop bit
	2	ASCII 2 = 2 stop bits
9	n	n = no parity
	e	e = even parity
	o	o = odd parity
	s	s = space parity

Table 12. Set Communications Parameters Command (TYPE 3)

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 29, page 40 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 29, page 40 for response format
Latch/Status Request	L?	See Table 29, page 40 for response format
Color Balance	L1	Select auto/manual mode
	B1	Increase Blue
	B2	Increase Red
	B0	Increase Stop
Lens Position Request	V?	See Table 30, page 41 for response format
Lens Go-To Command	VZ2Z1Z0F2F1F0	See Table 14, page 26 for format explanation

Table 13. Camera and General Lens Control Commands (TYPE 5)

Byte	Data	Description
6	v	v = Go-to command
7	z2 (MS nibble)	Zoom position, bits 8-11 Atize
8	z1	Bits 4-7 Atize
9	z0 (LS nibble)	Bits 0-3 Atize
10	f2 (MS nibble)	Focus position, bits 8-11 Atize
11	f1	Bits 4-7 Atize
12	f0 (LS nibble)	Bits 0-3 Atize

Table 14. Camera Lens Setting Message (TYPE 5)

This section does not apply to Pelco equipment.

4.2 Thermal Imager-Specific Commands (TYPE 1)

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 16, page 28 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 16, page 28 for the format.

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

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 15, page 27.

Note: Several commands, such as focus in/out/stop, zoom in/out/stop, and power on/off are listed in Section 3.6, page 20 and Section 4.1, page 23 but can be used for thermal imaging devices as well.

Description	Data	Comments
Set Brightness (Level) Value	BV2V1V0	See Table 16, page 28 for format explanation
Set Contrast (Gain) Value	GV2V1V0	See Table 16, page 28 for format explanation
Set Narrow Field-of-View	LN	No response returned
Set Wide Field-of-View	LW	No response returned
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 31, page 41 for response format

Table 15. Imager-Specific Commands *Does not apply to indexitPelco products.*

Byte	Data	Description
6	G or B	g = contrast status, b = brightness status
7	v2 (MS nibble)	Contrast or brightness value, bits 8-11 Atize
8	v1	Bits 4-7 Atize
9	v0 (LS nibble)	Bits 0-3 Atize

Table 16. Imager Contrast and Brightness Message Format *Does not apply to Pelco products.*

4.3 Pan/Tilt Mount Commands (TYPE 3)

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 18, page 32 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 32, page 42.

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). *What is a "time-dependent proportional rate"?*

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 17, page 31.

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 33, page 42 for response format
Latch (Auxiliary Relay) Toggle	L1-L3	Toggles Aux 1, Aux 2, or Aux 3 latches See Table 29, page 40 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 29, page 40 for response format
Go to a Preset or "Home" Position	H0-H9	See Table 33, page 42 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 33, page 42 for response format
Pan/Tilt Position Request	P?	See Table 32, page 42 for response format
Pan/Tilt Go-To Command	PA2A1A0E2E1E0	See Table 18, page 32 for format explanation
Begin Auto-Scan Mode	AS	Auto-scans between positions PA and PB. Use PS or TS to stop.

Table 17. Pan/Tilt Mount Commands (TYPE 3)

Byte	Data	Description
6	P	p = go-to position command
7	a2 (MS nibble)	Azimuth (pan) position, bits 8-11 Atize
8	a1	Bits 4-7 Atize
9	a0 (LS nibble)	Bits 0-3 Atize
10	e2 (MS nibble)	Elevation (tilt) position, bits 8-11 Atize
11	e1	Bits 4-7 Atize
12	e0	Bits 0-3 Atize

Table 18. Pan/Tilt Mount Go To Command Message Format (TYPE 3)

This section does not apply to Pelco equipment.

4.4 Digital Signal Processor Commands (TYPE 2)

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 20, page 34 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 19, page 33.

Description	Data	Comments
Set Compression Level	DCA2A1A0	See Table 20, page 34 for format explanation
Set Quality Factor	DQA2A1A0	See Table 20, page 34 for format explanation
Download	EM	See Table 22, page 35 for format
Grab Image	DG	No response required
Compress Image	DP	Uses the last DC or DQ value
Send Image	DS	See Table 22, page 35 for format
Detect change, Grab & Send	DI	See Table 22, page 35 for format (Uses the last DC or DQ value to compress)
Grab & Send	DH	See Table 22, page 35 for response format (Uses the last DC or DQ value to compress)
Image Recognition	DR	See Table 20, page 34 for response format Note: Same as send format.
DSP Low Power Sleep	LS	No response required.

Table 19. Digital Signal Processor Commands *Does not apply to Pelco products.*

Byte	Data	Description
6	Q	Q = Quality Factor
	C	C = Compression Ratio
	R	R = Image Recognition (template number returned)
7	a2 (MS nibble)	Bits 8-11 Atize
8	a1	Bits 4-7 Atize
9	a0 (LS nibble)	Bits 0-3 Atize

Table 20. Digital Signal Processor Command Format *Does not apply to Pelco products.*

This section does not apply to Pelco equipment.

4.5 Binary Data Message Command Format (TYPE ?)

4.5.1 Table 21, page 35 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 21. Binary Data Message Command Format *Does not apply to Pelco products.*

This section does not apply to Pelco equipment.

4.6 Extended Message Command Format (TYPE ?)

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 22, page 35 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 22. Extended Message Command Format *Does not apply to Pelco products.*

4.7 Joystick Specific Commands (TYPE ?)

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 23, page 36 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, `0x30 - 0x39`)
9	ps0	Pan speed, least significant digit (0-9, `0x30 - 0x39`)
		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, `0x30 - 0x39`)
12	ts0	Tilt speed, least significant digit (0-9, `0x30 - 0x39`)
		NOTE: ts1/ts0 = 00 indicates tilt stop

Table 23. Joystick Control Command Format (TYPE 3)

This section does not apply to Pelco equipment.

4.8 Button/Keypad Specific Commands (TYPE ?)

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 24, page 37 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, Atize)
8	kc0	Key code least significant digit (0..9, Atize)
9	P or R	"P" = press, "R" = release

Table 24. Button/Keypad Control Message Format *Does not apply to Pelco products.*

5 Device-Specific Responses

The following tables document the responses from remote devices.

5.1 Identification Response Message (TYPE ALL)

5.1.1 Table 25, page 38 defines the message returned from a Request ID request.

Byte	Data	Description
6-7	IR	ID Response
8-9	`0x01 - 0x05`	Device type, see Table 2, page 14
10-29	ASCII character string	Device name, padded with `0x20` (space) **if** necessary
30-49	ASCII character string	Serial number of device, padded with `0x20` (space) **if** necessary

Table 25. Device Identification Response Message (TYPE 3)

5.2 Maximum Data Rate Response Message (TYPE ALL)

5.2.1 Table 26, page 39 defines the message returned from a Maximum Data Rate request.

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

Table 26. Data Rate Response Message (TYPE 3)

5.3 Query Groups Response Message (TYPE ALL?)

5.3.1 Table 26, page 39 defines the message returned from a Query Groups request.

Byte	Data	Description
6	G	Group Query Response
7	0x01	Group number for first group
8	0x02 - 0xFF	Group number for second group
...	0x02 - 0xFF	
k	0x02 - 0xFF	Group number for nth group

Table 27. Query Groups Response Message (TYPE 3)

5.4 Query Devices Response message (TYPE ALL?)

5.4.1 Table 28, page 40 defines the message returned from a Query Devices request.

Byte	Data	Description
6	D	Device Query Response
7	0x01 - 0xFF	Group address see Section 3.3.4, page 16 for format explanation
8	0x01 - 0xFF	Device number for first device, see Section 3.3.2, page 15 for format explanation
9	0x01 - 0xFF	Device number for second device ... 0x01 - 0xFF
k	0x01 - 0xFF	Device number for nth device

Table 28. Query Devices Response Message (TYPE 3)

5.5 Camera Status and Latch Response Message (TYPE 5)

5.5.1 Table 29, page 40 defines the message returned from a camera status request.

Byte	Data	Description
6	L	Latch status
7	0x30-0x3F	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	0x30-0x3F	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 29. Camera Status and Latch Response Message (TYPE 3)

5.6 Camera Lens Settings Response Message (TYPE 5)

5.6.1 Table 30, page 41 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 Atize
8	z1	Bits 4-7 Atize
9	z0 (LS nibble)	Bits 0-3 Atize
10	f2 (MS nibble)	Focus position, bits 8-11 Atize
11	f1	Bits 4-7 Atize
12	f0 (LS nibble)	Bits 0-3 Atize

Table 30. Camera Lens Setting Response Message (TYPE 5)

This section does not apply to Pelco equipment.

5.7 Imager Settings Response Message (TYPE 1)

5.7.1 Table 31, page 41 defines the response format to a request for imager status and settings of gain (contrast), brightness (level), and other parameters.

Byte	Data	Description
6	S	S = Status returned
7	g2 (MS nibble)	Contrast value, bits 8-11 Atize
8	g1	Bits 4-7 Atize
9	g0 (LS nibble)	Bits 0-3 Atize
10	b2	Brightness value, bits 8-11 Atize
11	b1	Bits 4-7 Atize
12	b0	Bits 0-3 Atize
13	0x30-0x3F	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

Table 31. Imager Settings Response Message *Does not apply to Pelco products.*

5.8 Pan/Tilt Mount Response Message (TYPE 3)

5.8.1 Table 32, page 42 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 Atize
8	a1	Bits 4-7 Atize
9	a0 (LS nibble)	Bits 0-3 Atize
10	e2 (MS nibble)	Elevation position, bits 8-11 Atize
11	e1	Bits 4-7 Atize
12	e0 (LS nibble)	Bits 0-3 Atize

Table 32. Pan/Tilt Position Response Message (TYPE 3)

5.9 Home Status and Recalibration Message (TYPE 3)

5.9.1 Table 33, page 42 contains the response format for a home status request and a recalibration request.

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

Table 33. Home Status Request Response Message (TYPE 3)

This section does not apply to Pelco equipment.

5.10 Digital Signal Processor Response Message (TYPE 2)

5.10.1 Table 34, page 43 defines the message returned from a digital signal processor status request.

Byte	Data	Description
6	L	L = Latch or other status message
7	0x30-0x3F	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 34. Digital Signal Processor Status Response Message *Does not apply to Pelco products.*

5.11 Communications Error Response Message (TYPE ALL)

5.11.1 Table 35, page 43 defines the message format for a communications error response message.

Byte	Data	Description
6	L	Response to L* messages
7	0x7F	Communications Error

Table 35. Communications Error Response Message (TYPE 3)

APPENDIX A

A All Commands in Alphabetical Order

Cmnd	Table, page	Description
0...F	12, 24	x Bits per Second
A0...AF	17, 31	Set Auto-Move Speed
AS	17, 31	Begin Auto-Scan Mode
AW	11, 22	Request awake status (ping)
B0	13, 25	Increase Stop
B1	13, 25	Increase Blue
B2	13, 25	Increase Red
B?	11, 22	Request Maximum Data Rate
B	16, 28	Brightness Status
BV2V1V0	15, 27	Set Brightness (Level) Value
C	11, 22	Set Communication Parameters
D?	11, 22	Query Devices in a Group
DCA2A1A0	19, 33	Set Compression Level
DG	19, 33	Grab Image
DH	19, 33	Grab & Send
DI	19, 33	Detect Change, Grab & Send
DP	19, 33	Compress Image
DQA2A1A0	19, 33	Set Quality Factor
DR	19, 33	Image Recognition
DS	19, 33	Send Image
E0...EF	17, 31	Set Speed for Tilt Manual Moves (User-defined default rate)
EM	19, 33	Download
EM	11, 22	Extended Message to Device
FF	13, 25	Focus Far
FN	13, 25	Focus Near

Continued on the next page.

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Cmnd	Table, page	Description
FS	13, 25	Focus Stop
G	16, 28	Contrast Status
G?	11, 22	Query Groups
GN	11, 22	Set Group ID
GV2V1V0	15, 27	Set Contrast (Gain) Value
H0...H9	17, 31	Go To a Preset or "Home" Position
H?	17, 31	Preset Position Status Request
HB	15, 27	Set Polarity Black = Hot
HW	15, 27	Set Polarity White = Hot
I?	11, 22	Request ID Information
IA	15, 27	Auto Contrast/Brightness Mode
IC	13, 25	Iris/Aperture Close
ID	11, 22	Set Device
IM	15, 27	Manual Contrast/Brightness Mode
IO	13, 25	Iris/Aperture Open
IS	13, 25	Iris/Aperture Stop
L1	13, 25	Color Balance
L1...L3	17, 31	Latch (Auxiliary Relay) Toggle
L?	13, 25	Latch/Status Request
L?	17, 31	Latch (Auxiliary Relay) Status Request
L1	17, 31	Set Latch 1
L2	17, 31	Set Latch 2
L3	17, 31	Set Latch 3
LA	13, 25	Set Auto Iris Mode
LB	13, 25	Set Manual Iris Mode
LL	13, 25	Toggle Lens Speed Slow/Fast
LM	13, 25	Toggle Auto/Manual Iris

Continued on the next page.

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Cmnd	Table, page	Description
LN	15, 27	Set Narrow Field-of-View
LO	13, 25	Set Lens Speed Slow
LP	11, 22	Toggle Device Power On/Off
LS	19, 33	DSP Low Power Sleep
LT	13, 25	Set Lens Speed Fast
LW	15, 27	Set Wide Field-of-View
P0...P9	17, 31	Store Preset Position
P?	17, 31	Pan/Tilt Position Request
PA	17, 31	Store Auto-Scan Position A
PA2A1A0E2E1E0	17, 31	Pan/Tilt Go-To Command
PB	17, 31	Store Auto-Scan Position B
PF	11, 22	Turn Device Power Off
PL	17, 31	Pan Left
PN	11, 22	Turn Device Power On
PR	17, 31	Pan Right
PS	17, 31	Pan Stop
R0	15, 27	Reticule/Graticule Off
R1...R9	15, 27	Reticule Select 1 - 9
R1	17, 31	Reset (clear) Latch 1
R2	17, 31	Reset (clear) Latch 2
R3	17, 31	Reset (clear) Latch 3
RC	17, 31	Recalibrate
RS	11, 22	Reset Receiver
S0...SF	17, 31	Set Speed for Pan (and Optional Tilt) Manual Moves (User-defined default rate)
S?	15, 27	Request Imager Status
SH	11, 22	Request State of Health
SI	15, 27	Insert Shutter
SR	15, 27	Remove Shutter
TD	17, 31	Tilt Down
TF	11, 22	Disable Test Mode for Device

Continued on the next page.

Continued from the previous page.		
Cmnd	Table, page	Description
TM	11, 22	Enable Test Mode for Device
TS	17, 31	Tilt Stop
TU	17, 31	Tilt Up
v	14, 26	Go-to Command
V?	13, 25	Lens Position Request
vz2z1z0f2f1f0	13, 25	Lens Go-To Command
Xn	11, 22	Binary Message to Device
ZI	13, 25	Zoom In
ZO	13, 25	Zoom Out
ZS	13, 25	Zoom Stop

APPENDIX B

B Typical Commands

These sample commands were collected from various runs of the "ICD Test Tool". The tool does not generate all TASS commands, but it is all that Pelco has that generates TASS Protocol data.

B.1 Sample 1

Configuration is:

1. **Master ID**: 31
2. **Group ID**: 1
3. **Port ID**: 1
4. **Device ID**: 1

Byte	Data	Description
0, (SYNC)	`0xF8`	Autorate character
1, (ADDR)	Address in hex	Message destination address
2, (*)	`*`	Asterisk character (`0x2A`)
3, (DCU ADDR)	Group address	Address of Group Control Unit
4, (SOURCE ADDR)	Address in hex	Message source address
5, (LENGTH)	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.
$6 + length$ (CKSM)	Checksum	`0x80` - `0x8F` NOTE: Checksum + `0x80`

Table B-1. Full Command Message Format (This is the same table as Table 1, page 14.)

F8 21 2A 01 1F 02 52 53 86			
0	0xF8	Section 3.2, page 13 Section 3.3.1, page 15	Autorate character, or "sync"
1	0x21	Section 3.3.2, page 15	Address Bits 0 → 4 = Device Address Bits 5 → 7 = Port Number
2	0x2A	Section 3.3.3, page 16	Asterisk "*"
3	0x01	Section 3.3.4, page 16	Group ID 0x00 = wild card 1 → 254 = Group Address 0xFF = Master Control Unit
4	0x1F	Section 3.3.5, page 17	Source Address Format and range is undocumented
5	0x02	Section 3.3.6, page 17	Length Does not include header or checksum.
6	0x52	Section 3.3.10, page 17	Command First Character "R" In ASCII
7	0x53	Section 3.3.10, page 17	Command Second Character "S" In ASCII
8	0x86	Section 3.3.11, page 18 Section 3.3.12, page 18	Checksum XOR (^) of all lower nibbles of each byte except for byte 0 and 8 (the checksum its self) plus 0x80. 0x2.1 ^ 0x2.A ^ 0x0.1 ^ 0x1.F ^ 0x0.2 ^ 0x5.2 ^ 0x5.3 + 0x80 = 0x86

Table B-2. Typical TASS Command

B.2 Changing Header Fields

Commands with various header fields being changed. All of these are from Appendix D.2, page D-5.

1. The starting configuration is the same as it is on Appendix B.1, page B-1.

   1.1. **Master ID**: 31. Range is 0 → 255.

   1.2. **Group ID**: 1. Range is 0 → 254.

   1.3. **Port ID**: 1. Range is 1 → 7.

   1.4. **Device ID**: 1. Range is 0 → 31.

   Ranges come from this document and from running the "ICD Test Tool" program.

2. Changing IDs, `..` is used for fields that are uninteresting.

	Byte →	1	2	3	4	5	6	7	8	9
Starting reset command	—	f8	21	2a	01	1f	02	52	53	86
	—	..	1-1	..	1	31	..	..	..	..
Change the Master ID to	5	f8	21	2a	01	05	02	52	53	8c
	—	..	..	..	..	5	..	..	..	..
Change the Group ID to	5	f8	21	2a	05	1f	02	52	53	82
	—	..	..	..	5	..	..	..	..	..
Change the Port ID to	5	f8	a1	2a	01	1f	02	52	53	86
	—	..	5-.	..	..	..	..	..	..	..
Change the Device ID to	5	f8	25	2a	01	1f	02	52	53	82
	—	..	.-5	..	..	..	..	..	..	..

Table B-3. Changing Various Fields to "5".

B.2.1 Port/Device IDs

1. Port ID = 0, Device ID = 0: wild card address, Section 3.3.2.3, page 15.
2. Port ID = 0, Device ID = 1 → 30: Unused, Section 3.3.2.4, page 15.
3. Port ID = 0, Device ID = 31: Master Control Unit address, Section 3.3.2.5, page 16.
4. Port ID = 1 → 7, Device ID = 0: DCU (Display Control Unit) use, Section 3.3.2.6, page 16.

B.3 Various Field Formats

B.3.1 Address Byte #1

See also Section 3.3.2.1, page 15 and Section 3.3.2.2, page 15 for more information.

1. Address `0x00` is the wild card address. (Section 3.3.2.3, page 15)
2. Addresses `0x01` to `0x1E` are presently undefined. (Section 3.3.2.4, page 15)
3. Address `0x1F` is reserved for the master control unit. (Section 3.3.2.5, page 16)
4. Addresses with the port number specified and the device bits set to 0 are reserved for a DCU. (Section 3.3.2.6, page 16)

7 6 5	4 3 2 1 0
Port #	Device #

Table B-4. Port # and Device # fields

Address	Device
0	reserved
1	Thermal Imager
2	Digital Signal Processor
3	Pan/Tilt Unit *Motion controls,* TYPE 3
4	Compass
5	Visible (CCTV) Camera *Camera controls,* TYPE 5
6	Not yet defined
7	Not yet defined

Table B-5. Factory Default Device Addresses/Types (This is the same table as Table 2, page 14.)

APPENDIX C

C Menus from the "ICD Test Tool" Test Program

C.1 Initial menu

```
                    ICD Test Tool
================================================
   1) Open port.           2) Close port.
   3) General Commands.    4) Camera Lens Commands.
   5) Imager Commands.     6) Pan/Tilt Commands.
   7) DSP Commands.        8) Joystick/Key Commands.
   9) Get Point Info.     10) Point Device.
  11) Update Parameters. 12) EXIT.
================================================
               Selection [1-12]:
```

C.2 Menu 1, Open port

<none> (<none> indicates that no additional menus appears.)

C.3 Menu 2, Close port

<none>

C.4 Menu 3, General Commands

```
    ICD Test Tool - General Device Commands
================================================
   1) Reset Receiver.     2) Request Awake Status.
   3) Request SOH.        4) Request ID Info.
   5) Query Groups.       6) Query Devices.
   7) Set Group ID.       8) Set Device ID.
   9) Req Data Rate.     10) Set Comm Parameters.
  11) Device Power.      12) Device Test Mode.
  13) Binary Message.    14) Extended Message.
================================================
                Selection [1-14]:

Sub Menu 3-7: Had to kill program and restart testing.
Sub Menu 3-11: Choices
        Turn Device off [0] or on [1]:
Sub Menus 3-12, 3-13 and 3-14: = No action
```

C.5 Menu 4, Camera Lens Commands

```
   ICD Test Tool - Camera Lens Commands
================================================
   1) Focus State.        2) Aperture State.
   3) Zoom State.         4) Iris Mode.
   5) Toggle Iris Mode.   6) Lens Speed.
   7) Toggle Lens Speed.  8) Latch Status Req.
   9) Color Balance.     10) Lens Position Req.
  11) Lens Go To.
================================================
               Selection [1-11]:

Sub Menu 4-1: Choices
Select Focus State:
   1) Focus Stop
   2) Focus Near
   3) Focus Far.
Sub Menus 4-2 --> 4-9: = No action
```

C.6 Menu 5, Imager Commands

```
   ICD Test Tool - Imager Commands
================================================
   1) Set Brightness.     2) Set Contrast.
   3) Set FOV.            4) Set Polarity.
   5) Set ConBri Mode.    6) Set Shutter.
   7) Set Reticule.       8) Request Status.
================================================
               Selection [1-8]:

Sub Menu 5-3: Choices
        Set FOV to wide [0] or narrow [1]:
Sub Menus 5-4 --> 5-7: = No action
```

C.7 Menu 6, Pan/Tilt Commands

```
   ICD Test Tool - Pan/Tilt Mount Commands
================================================
   1) Pan Move.           2) Tilt Move.
   3) Pan Speed.          4) Tilt Speed.
   5) Set Automove.       6) Recalibrate.
   7) Latch Toggle.       8) Set Latch.
   9) Latch Status Req.  10) Goto Preset.
```

```
  11) Store Preset.      12) Get Preset Status.
  13) Get Pan/Tilt Pos.  14) Set Pan/Tilt Pos.
  15) Start Autoscan.
================================================
               Selection [1-15]:

Sub Menu 6-3 Choices:
```

C.8 Menu 7, DSP Commands

```
   ICD Test Tool - DSP Commands
================================================
   1) Set Compression.    2) Set Quality.
   3) Download.           4) Grab Image.
   5) Compress Image.     6) Send Image.
   7) Detect-Grab-Send.   8) Grab and Send.
   9) Image Recognition. 10) DSP Low Power.
================================================
               Selection [1-10]:
```

C.9 Menu 8, Joystick/Key Commands

```
   ICD Test Tool - Joystick/Keypad Commands
================================================
   1) Joystick.           2) Keypad.
================================================
               Selection [1-2]:

Sub Menu 8-1: Choices
        Enter elevation speed [0 - 99]:
        Which elevation? up [0] or down [1]:
        Enter azimuth speed [0 - 99]:
        Which azimuth? left [0] or right [1]:
Sub Menu 8-2: Choices
        Which action? press [0] or release [1]:
        Enter key code [0 - 99]:
```

C.10 Menu 9, Get Point Info

<none>

C.11 Menu 10, Point Device

<none>

C.12 Menu 11, Update Parameters

```
  ICD Test Tool - Change Parameters
================================================
   1) Master ID.          2) Group ID.
   3) Port ID.            4) Device ID.
   5) Baud Rate.          6) Parity.
   7) Data Bits.          8) Stop Bits.
   9) Comm Port          10) Return to main.
================================================
              Selection [1-10]:

Sub Menu 11-1: Choices
        Enter Master ID (%d) [0 - 255]:
Sub Menu 11-2: Choices
        Enter Group ID (%d) [0 - %d]:
Sub Menu 11-3: Choices
        Enter Port ID (%d) [0 - %d]:
Sub Menu 11-4: Choices
        Enter Device ID (%d) [0 - %d]:
Sub Menu 11-5: Choices
   1) 1200.         2) 2400.
   3) 4800.         4) 9600.
   5) 19200.        6) 38400.
   7) 57600.        8) 115200.
   9) Return to main.
Sub Menu 11-6: Choices
   1) No Parity.       2) Even Parity.
   3) Odd Parity.      4) Space Parity.
   5) Return to main.
Sub Menu 11-7: Choices
        Select # of Data Bits (%d) [7 or 8]:
Sub Menu 11-8: Choices
        Select # of Stop Bits (%d) [1 or 2]:
Sub Menu 11-9: Choices
        Select Comm Port # (%d) [1 - 3]:
```

C.13 Menu 12, EXIT

<none>

APPENDIX D

D Typical Commands Generated by the ICD Test Tool

D.1 Capture file Tass1.out

```
$Header: e:/TXB-Tass/RCS/Tass1.out,v 1.2 2005-12-16 11:19:21-08 Hamilton Exp Hamilton $
FTS capture file: E:\Capture\newtest2.cfa (12/15/2005 7:56:53 AM)
Event 1 (12/15/2005 7:34:01.760340 AM) through
Event 1,152 (12/15/2005 7:55:41.497004 AM)

    1: DCE      0.000000    0.000000 f8 21 2a 01 1f 02 52 53 86: 3 1

   10: DCE     29.868193   29.859879 f8 21 2a 01 1f 02 41 57 81: 3 2
   19: DCE     30.880875    1.004420 f8 21 2a 01 1f 02 41 57 81: 3 2
   28: DCE     31.890736    1.001552 f8 21 2a 01 1f 02 41 57 81: 3 2

   37: DCE     44.748011   12.848959 f8 21 2a 01 1f 02 53 48 8c: 3 3
   46: DCE     45.759961    1.003635 f8 21 2a 01 1f 02 53 48 8c: 3 3
   55: DCE     46.769824    1.001553 f8 21 2a 01 1f 02 53 48 8c: 3 3

   64: DCE     54.278682    7.500541 f8 21 2a 01 1f 02 49 3f 81: 3 4
   73: DCE     55.289383    1.002385 f8 21 2a 01 1f 02 49 3f 81: 3 4
   82: DCE     56.304236    1.006543 f8 21 2a 01 1f 02 49 3f 81: 3 4

   91: DCE     63.545107    7.232553 f8 21 2a 01 1f 02 47 3f 8f: 3 5
  100: DCE     64.558927    1.005504 f8 21 2a 01 1f 02 47 3f 8f: 3 5
  109: DCE     65.573677    1.006440 f8 21 2a 01 1f 02 47 3f 8f: 3 5

  118: DCE     72.865513    7.283516 f8 21 2a 01 1f 02 44 3f 8c: 3 6
  127: DCE     73.878179    1.004365 f8 21 2a 01 1f 02 44 3f 8c: 3 6
  136: DCE     74.888255    1.001759 f8 21 2a 01 1f 02 44 3f 8c: 3 6
                                                              : 3 7 reset program
  145: DCE    193.770582  118.874017 f8 21 2a 01 1f 02 23 01 85: 3 8
  154: DCE    194.780763    1.001862 f8 21 2a 01 1f 02 23 01 85: 3 8
  163: DCE    195.790840    1.001761 f8 21 2a 01 1f 02 23 01 85: 3 8

  172: DCE    206.223535   10.424379 f8 21 2a 01 1f 02 42 3f 8a: 3 9
  181: DCE    207.235077    1.003226 f8 21 2a 01 1f 02 42 3f 8a: 3 9
  190: DCE    208.245041    1.001656 f8 21 2a 01 1f 02 42 3f 8a: 3 9

  199: DCE    213.965022    5.711670 f8 21 2a 01 1f 05 43 33 08 01 6e 87: 3 10
  211: DCE    214.979572    1.003116 f8 21 2a 01 1f 05 43 33 08 01 6e 87: 3 10
  223: DCE    215.989537    0.998582 f8 21 2a 01 1f 05 43 33 08 01 6e 87: 3 10

  235: DCE    227.612222   11.611250 f8 21 2a 01 1f 02 50 46 81: 3 11 0

  244: DCE    242.515753   14.895220 f8 21 2a 01 1f 02 50 4e 89: 3 11 1


  253: DCE    325.148181   82.624127 f8 21 2a 01 1f 02 46 53 82: 4 1 1
```

```
262: DCE    326.162730    1.006236 f8 21 2a 01 1f 02 46 53 82: 4 1 1
271: DCE    327.172701    1.001657 f8 21 2a 01 1f 02 46 53 82: 4 1 1

280: DCE    332.241379    5.060363 f8 21 2a 01 1f 02 46 4e 8f: 4 1 2
289: DCE    333.252288    1.002594 f8 21 2a 01 1f 02 46 4e 8f: 4 1 2
298: DCE    334.262255    1.001657 f8 21 2a 01 1f 02 46 4e 8f: 4 1 2

307: DCE    342.780252    8.509680 f8 21 2a 01 1f 02 46 46 87: 4 1 3
316: DCE    343.791675    1.003102 f8 21 2a 01 1f 02 46 46 87: 4 1 3
325: DCE    344.801648    1.001657 f8 21 2a 01 1f 02 46 46 87: 4 1 3

334: DCE    400.216237   55.406266 f8 21 2a 01 1f 02 56 3f 8e: 4 10
343: DCE    401.228286    1.003735 f8 21 2a 01 1f 02 56 3f 8e: 4 10
352: DCE    402.243146    1.006545 f8 21 2a 01 1f 02 56 3f 8e: 4 10

361: DCE    423.105210   20.853748 f8 21 2a 01 1f 02 56 3f 8e: 4 10
370: DCE    424.116768    1.003244 f8 21 2a 01 1f 02 56 3f 8e: 4 10
379: DCE    425.126716    1.001651 f8 21 2a 01 1f 02 56 3f 8e: 4 10

388: DCE    437.198434   12.063408 f8 21 2a 01 1f 07 76 30 30 33 30 30 41 86: 4 11
402: DCE    438.210896    0.998953 f8 21 2a 01 1f 07 76 30 30 33 30 30 41 86: 4 11
416: DCE    439.220871    0.996462 f8 21 2a 01 1f 07 76 30 30 33 30 30 41 86: 4 11


430: DCE    471.626055   32.391673 f8 21 2a 01 1f 04 62 30 30 30 83: 5 1
441: DCE    472.638937    1.002485 f8 21 2a 01 1f 04 62 30 30 30 83: 5 1
452: DCE    473.653723    1.004387 f8 21 2a 01 1f 04 62 30 30 30 83: 5 1

463: DCE    479.268433    5.604242 f8 21 2a 01 1f 04 67 30 30 30 86: 5 2
474: DCE    480.283220    1.004388 f8 21 2a 01 1f 04 67 30 30 30 86: 5 2
485: DCE    481.293266    0.999577 f8 21 2a 01 1f 04 67 30 30 30 86: 5 2

496: DCE    495.706512   14.402853 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0
505: DCE    496.717270    1.002387 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0
514: DCE    497.727242    1.001650 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0

523: DCE    503.451902    5.716344 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1
532: DCE    504.461800    1.001657 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1
541: DCE    505.471667    1.001551 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1

550: DCE    533.416325   27.936267 f8 21 2a 01 1f 02 53 3f 8b: 5 8
559: DCE    534.429945    1.005229 f8 21 2a 01 1f 02 53 3f 8b: 5 8
568: DCE    535.439873    1.001552 f8 21 2a 01 1f 02 53 3f 8b: 5 8


577: DCE    586.214980   50.766791 f8 21 2a 01 1f 02 53 36 82: 6 3 6
586: DCE    587.226801    1.003530 f8 21 2a 01 1f 02 53 36 82: 6 3 6
595: DCE    588.236670    1.001553 f8 21 2a 01 1f 02 53 36 82: 6 3 6

604: DCE    610.618574   22.373594 f8 21 2a 01 1f 02 53 30 84: 6 3 0
613: DCE    611.630208    1.003320 f8 21 2a 01 1f 02 53 30 84: 6 3 0
622: DCE    612.640288    1.001760 f8 21 2a 01 1f 02 53 30 84: 6 3 0
```

```
 631: DCE    624.485613   11.837013 f8 21 2a 01 1f 02 53 46 82: 6 3 15
 640: DCE    625.499438    1.005512 f8 21 2a 01 1f 02 53 46 82: 6 3 15
 649: DCE    626.509300    1.001553 f8 21 2a 01 1f 02 53 46 82: 6 3 15

 658: DCE    642.322651   15.805036 f8 21 2a 01 1f 02 45 30 82: 6 4 0
 667: DCE    643.333338    1.002370 f8 21 2a 01 1f 02 45 30 82: 6 4 0
 676: DCE    644.343317    1.001732 f8 21 2a 01 1f 02 45 30 82: 6 4 0

 685: DCE    650.215751    5.864170 f8 21 2a 01 1f 02 45 37 85: 6 4 7
 694: DCE    651.227910    1.003842 f8 21 2a 01 1f 02 45 37 85: 6 4 7
 703: DCE    652.242757    1.006536 f8 21 2a 01 1f 02 45 37 85: 6 4 7

 712: DCE    659.993483    7.742402 f8 21 2a 01 1f 02 45 46 84: 6 4 15
 721: DCE    661.007325    1.005505 f8 21 2a 01 1f 02 45 46 84: 6 4 15
 730: DCE    662.022188    1.006540 f8 21 2a 01 1f 02 45 46 84: 6 4 15

 739: DCE    675.731257   13.700754 f8 21 2a 01 1f 02 41 30 86: 6 5 0
 748: DCE    676.741334    1.001763 f8 21 2a 01 1f 02 41 30 86: 6 5 0
 757: DCE    677.751299    1.001649 f8 21 2a 01 1f 02 41 30 86: 6 5 0

 766: DCE    685.637130    7.877512 f8 21 2a 01 1f 02 41 38 8e: 6 5 8
 775: DCE    686.650638    1.005269 f8 21 2a 01 1f 02 41 38 8e: 6 5 8
 784: DCE    687.660608    1.001656 f8 21 2a 01 1f 02 41 38 8e: 6 5 8

 793: DCE    694.353641    6.684722 f8 21 2a 01 1f 02 41 46 80: 6 5 15
 802: DCE    695.365176    1.003220 f8 21 2a 01 1f 02 41 46 80: 6 5 15
 811: DCE    696.375044    1.001554 f8 21 2a 01 1f 02 41 46 80: 6 5 15

 820: DCE    738.087213   41.703860 f8 21 2a 01 1f 02 50 3f 88: 6 13
 829: DCE    739.097490    1.001961 f8 21 2a 01 1f 02 50 3f 88: 6 13
 838: DCE    740.107361    1.001547 f8 21 2a 01 1f 02 50 3f 88: 6 13

 847: DCE    758.386157   18.270483 f8 21 2a 01 1f 07 70 30 30 35 30 30 31 86: 6 14
 861: DCE    759.401226    1.001551 f8 21 2a 01 1f 07 70 30 30 35 30 30 31 86: 6 14
 875: DCE    760.411193    0.996456 f8 21 2a 01 1f 07 70 30 30 35 30 30 31 86: 6 14


 889: DCE    886.609880  126.185171 f8 21 2a 01 1f 07 4a 4c 35 30 55 34 30 80: 8 1 1 0 50 0 40
 903: DCE    887.623388    0.999991 f8 21 2a 01 1f 07 4a 4c 35 30 55 34 30 80: 8 1 1 0 50 0 40
 917: DCE    888.633353    0.996455 f8 21 2a 01 1f 07 4a 4c 35 30 55 34 30 80: 8 1 1 0 50 0 40

 931: DCE    936.398385   47.751522 f8 21 2a 01 1f 07 4a 52 36 30 44 37 30 8f: 8 1 1 1 60 1 70
 945: DCE    937.410336    0.998442 f8 21 2a 01 1f 07 4a 52 36 30 44 37 30 8f: 8 1 1 1 60 1 70
 959: DCE    938.420303    0.996455 f8 21 2a 01 1f 07 4a 52 36 30 44 37 30 8f: 8 1 1 1 60 1 70

 973: DCE    981.390359   42.956545 f8 21 2a 01 1f 04 42 32 30 50 81: 8 1 2 20 0
 984: DCE    982.402618    1.001876 f8 21 2a 01 1f 04 42 32 30 50 81: 8 1 2 20 0
 995: DCE    983.412486    0.999516 f8 21 2a 01 1f 04 42 32 30 50 81: 8 1 2 20 0

1006: DCE   1000.244958   16.822080 f8 21 2a 01 1f 04 42 33 30 52 82: 8 1 2 30 1
1017: DCE   1001.256492    1.001137 f8 21 2a 01 1f 04 42 33 30 52 82: 8 1 2 30 1
```

```
 1028: DCE   1002.271320    1.004436 f8 21 2a 01 1f 04 42 33 30 52 82: 8 1 2 30 1

 1039: DCE   1043.147217   40.865484 f8 21 2a 01 1f 04 42 39 39 52 81: 8 1 2 99 1
 1050: DCE   1044.158859    1.001249 f8 21 2a 01 1f 04 42 39 39 52 81: 8 1 2 99 1
 1061: DCE   1045.168720    0.999474 f8 21 2a 01 1f 04 42 39 39 52 81: 8 1 2 99 1


 1072: DCE   1061.627970   16.448851 f8 21 2a 01 1f 02 50 3f 88: 9
 1081: DCE   1062.642617    1.006338 f8 21 2a 01 1f 02 50 3f 88: 9
 1090: DCE   1063.652590    1.001667 f8 21 2a 01 1f 02 50 3f 88: 9


 1099: DCE   1074.262179   10.601274 f8 21 2a 01 1f 02 41 45 83: 10
 1108: DCE   1075.276930    1.006442 f8 21 2a 01 1f 02 41 45 83: 10
 1117: DCE   1076.291897    1.006672 f8 21 2a 01 1f 02 41 45 83: 10


 1126: DCE   1297.705734  221.405520 f8 83 2a 05 14 02 53 48 81: 3 3
 1135: DCE   1298.718270    1.004151 f8 83 2a 05 14 02 53 48 81: 3 3
 1144: DCE   1299.728349    1.001760 f8 83 2a 05 14 02 53 48 81: 3 3

There were a total of    1152 bytes transferred

There were a total of    1152 DCE bytes transferred
The first DCE byte came in at 0.000000 seconds from the start of data collection
The last DCE byte was at 1299.736664 seconds from the start of data collection

There were a total of       0 DTE bytes transferred
The first DTE byte came in at 0.000000 seconds from the start of data collection
The last DTE byte was at 0.000000 seconds from the start of data collection
```

D.2 Capture file `Tass2.out`

```
$Header: e:/TXB-Tass/RCS/Tass2.out,v 1.1 2005-12-16 10:22:16-08 Hamilton Exp Hamilton $
FTS capture file: E:\Capture\newtest2.cfa (12/16/2005 10:16:38 AM)
Event 1 (12/16/2005 9:58:21.867091 AM) through
Event 189 (12/16/2005 10:15:47.957580 AM)

   1: DCE      0.000000    0.000000 f8 21 2a 01 1f 02 52 53 86: 3 1
  10: DCE    106.850852  106.842537 f8 21 2a 01 05 02 52 53 8c: 3 1
  19: DCE    193.725131   86.865969 f8 21 2a 05 1f 02 52 53 82: 3 1
  28: DCE    273.080279   79.346832 f8 a1 2a 01 1f 02 52 53 86: 3 1
  37: DCE    358.862353   85.773759 f8 25 2a 01 1f 02 52 53 82: 3 1
  46: DCE    815.888638  457.017965 f8 21 2a 01 1f 02 52 53 86: 3 1

  55: DCE    965.754592  149.857640 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0
  64: DCE    966.767068    1.004151 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0
  73: DCE    967.782034    1.006650 f8 21 2a 01 1f 02 4c 57 8c: 5 3 0

  82: DCE    977.977582   10.187237 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1
  91: DCE    978.991237    1.005296 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1
 100: DCE    980.001210    1.001655 f8 21 2a 01 1f 02 4c 4e 85: 5 3 1

 109: DCE    992.887702   12.878176 f8 21 2a 01 1f 02 53 3f 8b: 5 8
 118: DCE    993.900281    1.004260 f8 21 2a 01 1f 02 53 3f 8b: 5 8
 127: DCE    994.910245    1.001655 f8 21 2a 01 1f 02 53 3f 8b: 5 8

 136: DCE   1028.205196   33.286625 f8 21 2a 01 1f 02 53 36 82: 6 3 6
 145: DCE   1029.218185    1.004672 f8 21 2a 01 1f 02 53 36 82: 6 3 6
 154: DCE   1030.228052    1.001554 f8 21 2a 01 1f 02 53 36 82: 6 3 6

 163: DCE   1044.060776   13.824408 f8 21 2a 01 1f 02 53 30 84: 6 3 0
 172: DCE   1045.072199    1.003116 f8 21 2a 01 1f 02 53 30 84: 6 3 0
 181: DCE   1046.082172    1.001657 f8 21 2a 01 1f 02 53 30 84: 6 3 0

There were a total of     189 bytes transferred

There were a total of     189 DCE bytes transferred
The first DCE byte came in at 0.000000 seconds from the start of data collection
The last DCE byte was at 1046.090489 seconds from the start of data collection

There were a total of       0 DTE bytes transferred
The first DTE byte came in at 0.000000 seconds from the start of data collection
The last DTE byte was at 0.000000 seconds from the start of data collection
```

APPENDIX E

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