PT75 Interface Protocol Manual

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Always on Target

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1.0 Interface Protocol

1.1 Serial Interface Signal Description

The signal interface to the PT75 may be either an RS-422 or an RS-232 signal interface format. The actual interface format is selected with Setup Switch #1 on the servo board. The default setting is RS-232 corresponding to Setup Switch #1 set to the On position. The protocol should be set to PT75/PT150 as described in the PT75 Positioner Operators Manual". The serial interface details are as follows:

- Baud Rate: 38400
- Bits: 8
- Start bit:1
- Parity: None
- Stop bit: 1
- Handshake: None

The serial interface connector is P1. The P1 connector is also used as the power input connector. Table 1.1 illustrates the pins used for power and serial messaging. The PT75 serial interface names are based upon the signal relative to the PT75 receivers. The relationship between the P1 input pins and the control source is shown in columns "PT75 Name" and column "Controller Name".

Table 1.1: P1 Pins

Pin No	PT75 Name	Controller Name
A	TX+	RCV+
B	TX-	RCV-
C	GND	GND
D	RCV+	TX+
E	RCV-	TX-
J	+24 VDC	+24VDC
K	+24 VDC	+24VDC
L	GND	GND
M	GND	GND

There are two command message formats. The 6 byte message format is shown in Table 1.3 and the 10 Byte message format is shown in Table 1.2. There are also two reply formats. The reply formats will be addressed in paragraph 3. Paragraph 4 has several message examples.

Paragraph 2.0 will address the 10 Byte message format and the 6 Byte message format.

Table 1.2: Ten Byte Command Message

No	Byte	Description
0	Header	0xBA
1	CMD	Message Dependent
2	V1	Variable 1
3	V2	Variable 2
4	V3	Variable 3
5	V4	Variable 4
6	V5	Variable 5
7	V6	Variable 6
8	V7	Variable 7
9	Footer	0x00

Table 1.3: Six Byte Command Message

No	Byte	Description
0	Header	0xB6
1	CMD	Message Dependent
2	V1	Variable 1
3	V2	Variable 2
4	V3	Variable 3
5	Footer	0x0D

1.2 Velocity and Position Formats

The Velocity and Position formats are described in the following paragraphs.

1.2.1 Velocity Format

The pan and tilt velocity data is calculated by the following formula:

$$\text{Velocity (deg/s)} = \frac{60 \text{ deg/s}}{2^{15}} \times \text{Velocity (bits)}$$

The velocity data is resident in two data bytes or digits; and a Most Significant Digit (MSD) and a Least Significant Digit (LSD). The Table 1.2.1-1 below illustrates the bit relationship within each digit. Where d7 is the Most Significant Bit.

Table 1.2.1-1 Velocity Data Digits

	d7	**d6**	**d5**	**d4**	**d3**	**d2**	**d1**	**d0**
MSD	P15	P14	P13	P12	P11	P10	P9	P8
LSD	P7	P6	P5	P4	P3	P2	P1	P0

The azimuth and elevation velocities are shown in Table 1.2.1-2 below. Note that 0.00 deg/sec has a value of 0x8000. Values less than 0x8000 are velocities up or right, while velocities greater than 0x8000 are down or to the left. All values shown below are approximate values and do not represent actual velocities

Table 1.2.1-2 Approximate Velocity Values

Az Velocity	**EL Velocity**	**P15-P12**	**P11-P8**	**P7-P4**	**P3-P0**
60 ˚/s	**60 ˚/s**	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
45 ˚/s	**45 ˚/s**	0 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0
30 ˚/s	**30 ˚/s**	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0
15 ˚/s	**15 ˚/s**	0 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0
0.000 ˚/s	**0.000 ˚/s**	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-15˚/s	**-15˚/s**	1 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0
-30 ˚/s	**-30 ˚/s**	1 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-45 ˚/s	**-45 ˚/s**	1 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0
-60 ˚/s	**-60 ˚/s**	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1

1.2.2 Azimuth Position Format

The Azimuth position data is calculated by the following formula:

$$\text{Pan Position (deg)} = \frac{360 \text{ deg}}{65536} \times \text{Position (bits)}$$

The position data is resident in two data bytes or digits; a Most Significant Digit (MSD) and a Least Significant Digit (LSD). The Table 1.2.2-1 below illustrates the bit relationship within each digit. Where d7 is the Most Significant Bit.

Table 1.2.2-1 Position Data Digits

	d7	**d6**	**d5**	**d4**	**d3**	**d2**	**d1**	**d0**
MSD	P15	P14	P13	P12	P11	P10	P9	P8
LSD	P7	P6	P5	P4	P3	P2	P1	P0

The azimuth position has 16 bits of resolution with the least significant bit being 0.0055 degrees. If an angular position is +10 degrees, the position feedback would have a decimal value of 1820 and a hexadecimal value of 0x071C. If an angular position is –30 degrees, the position data feedback would have a decimal count of 60075 or a hexadecimal value of 0xEAAB.

The azimuth positions are shown in Table 1.2.2-2 below.

Table 1.2.2-2 Azimuth Position Values

Az Position	**P15-P12**	**P11-P8**	**P7-P4**	**P3-P0**
179.995˚	0 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
135.00˚	0 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0
90.00˚	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0
45.00˚	0 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0
0.0055˚	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1
0.00˚	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-0.0055˚	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
-45.00 ˚	1 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0
-90.00˚	1 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-135.00˚	1 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0
-179.995˚	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1

1.2.3 Elevation Position Format

The elevation position data is calculated by the following formula:

$$\text{Tilt Position (deg)} = \frac{360 \text{ deg}}{65536} \times \text{Position (bits)}$$

The position data is resident in two data bytes or digits; a Most Significant Digit (MSD) and a Least Significant Digit (LSD). The Table 1.2.3-1 below illustrates the bit relationship within each digit. Where d7 is the Most Significant Bit.

Table 1.2.3-1 Position Data Digits

	d7	d6	d5	d4	d3	d2	d1	d0
MSD	P15	P14	P13	P12	P11	P10	P9	P8
LSD	P7	P6	P5	P4	P3	P2	P1	P0

The elevation position has 16 bits of resolution with the least significant bit being 0.0055 degrees. If an angular position is +10 degrees, the position feedback would have a decimal value of 1820 and a hexadecimal value of 0x071C. If an angular position is –60 degrees, the position data feedback would have a decimal count of 54613 or a hexadecimal value of 0xD555.

The elevation positions are shown in Table 1.2.3-2 below.

Table 1.2.3-2 Elevation Position Values

EL Position	P15-P12	P11-P8	P7-P4	P3-P0
90.00˚	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0
60.00˚	0 1 0 0	1 0 1 0	1 0 1 0	1 0 1 1
45.00˚	0 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0
30.00˚	0 0 0 1	0 1 0 1	0 1 0 1	0 1 0 1
0.0055˚	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1
0.00˚	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-0.0055˚	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
-30.00 ˚	1 1 1 0	0 1 0 1	0 1 0 1	0 1 1 1
-45.00 ˚	1 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0
-60.00˚	1 1 0 1	0 1 0 1	0 1 0 1	0 1 0 1
-90.00˚	1 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0

2.0 Command Message Protocols: 10 Byte and 6 Byte

There are six commands that use the 10 byte protocol listed in Table 2.0.1 below and 10 commands that use the 6 Byte protocol listed in Table 2.0.

Table 2.0.1 Ten Byte Commands

Para No	Hex Cmd	Type	Description
2.1	0x05	Set Data	Set Azimuth Setup Values
2.2	0x06	Set Data	Set Elevation Setup Values
2.3	0x07	Set Data	Set Azimuth & Elevation software Limits
2.4	0x4D	Set Data	Store a Trace Memory
2.5	0x56	Command	Azimuth & Elevation Velocity input
2.6	0x68	Command	Go To Azimuth & Elevation Absolute Position

Table 2.0.2 Six Byte Commands

Para No	Hex Cmd	Type	Description
2.7	0x13	Get Data	Get Azimuth or Elevation Setup Values
2.8	0x3F	Get Data	Get Azimuth and Elevation Position Data
2.9	0x50	Command	Preset Command
2.10	0x58	Command	System Command (Zero AZ or EL, Set Absolute mode)
2.11	0x64	Get Data	Get a Trace Memory Data Set
2.12	0x65	Command	Goto an Azimuth Absolute Position
2.13	0x66	Command	Goto an Elevation Absolute Position
2.14	0x6A	Set Data	Set Maximum Preset Speed
2.15	0x69	Set Data	Set Maximum Pan Preset Speed
2.16	0x76	Set Data	Set Maximum Tilt Preset Speed

2.1 Azimuth Setup Command

The Azimuth Setup Command is detailed below in Table 2.1

Table 2.1: Ten Byte Azimuth Setup Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x05
2	MaxPanPrstError	0x00 to 0x32: Maximum Allowable Preset Error (default = 1)
3	PanPrstRamp	0x32to 0xFA: Pan Preset Ramp (default = 100)
4	PanPrstGain	0x00 to 0xFF: Pan Preset Gain (default = 100)
5	MinPanPrstSpd	0x00 to 0xFA: Minimum Pan Preset Speed (default = 128)
6	Pan_PAM_Height	0x01 to 0x80: Pan PAM Height (default = 100)
7	Pan_PAM_Width	0x01 to 0x80: Pan PAM Width (default = 20)
8	CheckSum	Sum of byte 1 through byte 7
9	Footer	0x0D

The Azimuth Setup Command allows the control source to control the selection of preset parameters which may vary according to the end user application. The MaxPanPrstError sets how any count error is allowed when going to a preset or absolute position. Zero is an allowable value but may cause a slight “hunting” around the targeted position. The PanPrstRamp controls the initial slope of the preset move. The PanPrstGain is simply a gain applied to the calculated preset speed. The MinPanPrstSpd is the minimum speed used during a preset move.

Azimuth Setup Command also provides an adjustment of the Pulse Amplitude Modulation (PAM) pulse height and maximum pulse width. The PAM is used to allow pan motion

The CheckSum is the Least significant digit of the sum of bytes 1 through 7.

2.2 Elevation Setup Command

The Elevation Setup Command is detailed below in Table 2.2

Table 2.2: Ten Byte Elevation Setup Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x06
2	MaxTiltPrstError	0x00 to 0x32: Maximum Allowable Preset Error (default = 1)
3	TiltPrstRamp	0x32to 0xFA: Tilt Preset Ramp (default = 200)
4	TiltPrstGain	0x00 to 0xFF: Tilt Preset Gain (default = 125)
5	MinTiltPrstSpd	0x00 to 0xFA: Minimum Tilt Preset Speed (default = 128)
6	Tilt_PAM_Height	0x01 to 0x80: Tilt PAM Height (default = 100)
7	Tilt_PAM_Width	0x01 to 0x80: Tilt PAM Width (default = 20)
8	CheckSum	Sum of byte 1 through byte 7
9	Footer	0x0D

The Elevation Setup Command allows the control source to control the selection of preset parameters which may vary according tom the end user application. The MaxTiltPrstError sets how any count error is allowed when going to a preset or absolute position. Zero is an allowable value but may cause a slight “hunting” around the targeted position. The TiltPrstRamp controls the initial slope of the preset move. The TiltPrstGain is simply a gain applied to the calculated preset speed. The MinTiltPrstSpd is the minimum speed used during a preset move.

The Elevation Setup Command also provides an adjustment of the Pulse Amplitude Modulation (PAM) pulse height and maximum pulse width. The PAM is used to allow tilt motion

2.3 Azimuth and Elevation Software Limits Command

The Azimuth and Elevation Software Limits Command is detailed below in Table 2.3.

Table 2.3: Ten Byte Azimuth and Elevation Software Limits Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x07
2	UpSWLimit	0x01 to 0x7F: Software Up Limit
3	DownSWLimit	0xFF to 0x80: Software Down Limit
4	RightSWLimit	0x01 to 0x80: Software Right Limit
5	LeftSWLimit	0x81to 0xFF: Software Left Limit
6	Reserved	0x00
7	Reserved	0x00
8	CheckSum	Sum of byte 1 through byte 7
9	Footer	0x0D

The PT75 has electrical limits as well as software limits. To adjust the elevation electrical limits, see PT75 Operators Manual. The software limits are adjusted by entering a positive number between 0 and 180 for the Up and Right software limits and a negative number between –180 and 0 for Down and Left software limits. It is recommended that the elevation software limits be set such they are engaged before the elevation electrical limits.

2.4 Store Link Command

The link mode is simply a mode that links several preset positions together. This allows the user to setup a scanning strategy that visits several previously defined preset positions. To accomplish this, preset position must first be stored in memory. Paragraph 2.9 discusses the storing and recall of presets. Table 2.4 shows the Store Link command.

To store a recallable link, each of the individual presets to be visited needs to be stored via an individual Store Link command and in the order they are to be recalled. For example, if we wanted to have a 4 preset link and store them at link location 16, we would do the following:

A) Determine the Link number (LinkLoc): 16
B) Begin with the first of the 4 presets (Offset): 1
C) Determine the number of presets (Number): 4
D) Determine which preset we want to store at this initial location (Preset): 1
E) Determine the dwell time we spend at the first linked preset (Dwell): 2 Sec
F) Determine the speed desired to get to the first linked position (Speed): 0x8000
G) Send the Store Link command
H) Increment Offset by 1 and perform D through H until the Offset is greater than 4.

Table 2.4: Ten Byte Store Link Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x4D
2	LinkLoc	Initial Memory Location (1 through 16)
3	Offset	Rank order of the preset number to be stored (1 to Number)
4	Number	Number of presets in link (1 to 16)
5	Preset	Preset Number to be stored (1 to 256)
6	Dwell	The amount of time at each preset (1 to 255 Sec)
7	SpeedMSD	MSD of Maximum Preset Speed (0x00 to 0xFF)
8	SpeedLSD	LSD of Maximum Preset Speed (0x00 to 0xFF)
9	Footer	0x0D

Return: The 10 byte Send Trace Acknowledge reply is returned with the LinkLoc, Offset, Number, Preset, Dwell and Max Preset Speed

2.5 Velocity Command

The Velocity command is detailed below in Table 2.5.

Table 2.5: Ten Byte Velocity Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x56
2	AZ MSD	0x00 to 0xFF: Most Significant Digit of Azimuth Velocity
3	AZ LSD	0x00 to 0xFF: Least Significant Digit of Azimuth Velocity
4	EL MSD	0x00 to 0xFF: Most Significant Digit of Elevation Velocity
5	EL MSD	0x00 to 0xFF: Least Significant Digit of Elevation Velocity
6	Reserved	0x00
7	Reserved	0x00
8	Reserved	0x00
9	Footer	0x0D

The velocity command is the most common command sent to the PT75.

In response to a Goto Azimuth and Elevation Position message, the PT75 responds with a return message which contains the azimuth and elevation position. The “Return Azimuth and Elevation Values” return message is detailed in paragraph 3.1 or will respond with continuous position feedback when the Continuous Feedback bit is set in the system command see “**Command ‘X’: System Command”**

2.6 Go To Azimuth and Elevation Position

The Go To Azimuth and Elevation Position is detailed below in Table 2.6.

Table 2.6: Ten Byte Go To Azimuth and Elevation Command Message

Byte	**Name**	Description
0	Header	0xBA
1	CMD	0x68
2	AZ USD	0x00
3	AZ MSD	0x00 to 0x1F: Most Significant Digit of Azimuth Position
4	AZ LSD	0x00 to 0xFF: Least Significant Digit of Azimuth Position
5	EL USD	0x00
6	EL MSD	0x00 to 0x3E: Most Significant Digit of Elevation Position
7	EL LSD	0x00 to 0xFF: Least Significant Digit of Elevation Position
8	Reserved	0x00
9	Footer	0x0D

The Goto Azimuth and Elevation Position command provides a single message to drive the pan & tilt head to a user defined position. This message can be used to command the pan & tilt head to a series of user defined positions at user defined pan and tilt speeds.

In response to a Goto Azimuth and Elevation Position message, the PT75 responds with a return message which contains the azimuth and elevation position. The “Return Azimuth and Elevation Values” return message is detailed in paragraph 3.2 or will respond with continuous position feedback when the Continuous Feedback bit is set in the system command see “**Command ‘X’: System Command”**

2.7 Get Setup Data Command

The Get Setup Data is detailed below in Table 2.7.

Table 2.7: Six Byte Get Setup Data Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x13
2	RtnDataCmd	0x00 to 0x03
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

If RtnDataCmd = 0x00, then return Azimuth and Elevation position data. If RtnDataCmd = 0x01, then return Azimuth Setup Data. If RtnDataCmd = 0x02, then return Elevation Setup Data If RtnDataCmd = 0x03, then return Version data.

2.8 Get Position Data Command

The Get Position Data is detailed below in Table 2.8.

Table 2.8: Six Byte Get Position Data Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x3F: Command returns the Azimuth & Elevation Position Data
2	Reserved	0x00
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

2.9 Preset Command

The Preset Command makes use of several bits in Preset CMD to further define the command. The preset command is used to evoke either a Preset Store or Recall command or a Link Initialization command. The MSB of the Preset CMD defines whether the command is a preset or a link initialization command. Bit 5 (Recall) is set when a preset is to be recalled or a link initialization routine is to begin. Bit 4 (Store) commands the PT75 to store a preset. There may be as many as 256 preset locations addressed and up to 16 Link locations available. The preset location is defined in the Preset No. byte.

The commands are shown in Table 2.9-1 and Table 2.9-2 below.

Table 2.9-1: Preset Command:Preset Mode

Byte No	Name	Description
0	Header	0xB6
1	Command	0x50:
2	Preset CMD	0x20 to a Recall preset or 0x10 to store preset
3	Preset No.	0x00 to 0xFF: Preset number
4	Variable 3	0x00
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

Table 2.9-2: Preset Command: Initialize Trace

Byte No	Name	Description
0	Header	0xB6
1	Command	0x50:
2	Preset CMD	0xA0: Initialize a link routine
3	Link No.	0x00 to 0xFF: Link number
4	Variable 3	0x00
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

2.10 System Command

The System Command is detailed below in Table 2.10.

Table 2.10. System Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x58
2	SysCmd	b7 = 1 Absolute Mode;
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

Byte 2: The SysCmd byte has allows the Azimuth and/or Elevation encoders to be zeroed.

- b7: Absolute Mode: is not used

Command returns the Azimuth & Elevation Position Data

2.11 Get a Trace Memory Set Command

The Get a Trace Memory Set is detailed below in Table 2.11.

Table 2.11: Six Byte Get a Trace Memory Set

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x64:
2	Reserved	0x64
3	Reserved	0x00 to 0x0F: Link Location
4	Reserved	0x00 to 0x0F: Link Offset
5	Footer	0x0D

Command returns Trace Acknowledgment Command

2.12 Go to Azimuth Position Command

Table 2.12: Go to Azimuth Position Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x65
2	AzUSD	0x00
3	AzMSD	0x00 to 0xFF: MSD of Absolute Azimuth Position
4	AzLSD	0x00 to 0xFF: LSD of Absolute Azimuth Position
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

2.13 Go to Elevation Position Command

Table 2.13: Go to Azimuth Position Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x66
2	ELUSD	0x00
3	ELMSD	0x00 to 0xFF: MSD of Absolute Elevation Position
4	ELLSD	0x00 to 0xFF: LSD of Absolute Elevation Position
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

2.14 Set Maximum Preset Speed Command

Table 2.14: Set Maximum Preset Speed Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x76
2	PrstSpd	0x00 to 0x7F
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

2.15 Set Maximum Pan Preset Speed Command

Table 2.15: Set Maximum Pan Preset Speed Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x6A
2	PanPrstSpd	0x00 to 0x7F
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

2.16 Set Maximum Tilt Preset Speed Command

Table 2.16: Set Maximum Tilt Preset Speed Command Message

Byte	**Name**	Description
0	Header	0xB6
1	CMD	0x69
2	TiltPrstSpd	0x00 to 0x7F
3	Reserved	0x00
4	Reserved	0x00
5	Footer	0x0D

Command returns the Azimuth & Elevation Position Data

3.0 Reply Messages

There is one reply that uses a 10 byte protocol -the Send Trace Acknowledgement. This is the response to a Store Link command or a Get Link Data command. The other replies are 14 byte messages.

3.1 Send Trace Acknowledgement

The Send Trace Acknowledgement Reply is detailed below and is the response to a Store Link command or a Get Link Data command

Table 3.1: Send Trace Acknowledgement Message

Byte No	**Name**	Description
0	Header	0xA3
1	Action	0x4D
2	Link Loc	0x00 to 0x0F: Repeat of Link Loc sent
3	Offset	0x00 to 0x0F: Repeat of Offset sent
4	Number	0x00 to 0x0F: Repeat of the number of presets sent
5	Preset Pos	0x00 to 0xFF: Repeat of Preset number sent
6	Dwell Time	0x00 to 0xFF: Repeat of Dwell Time sent
7	MaxPrstSpd byte 1	MSD of Maximum Preset Speed (0x00 to 0xFF)
8	MaxPrstSpd byte 0	LSD of Maximum Preset Speed (0x00 to 0xFF)
9	Footer	0x0D

The Send Trace Acknowledgement reply is used to verify the receipt of the proper data for loading and operating the Link commands. The message format is virtually identical to the Store Link Command received

3.2 Return AZ and EL Values

The “Return AZ and EL Values ” message is a reply to all of the messages without a specific message response .

Table 3.2: Return AZ and EL Values Message

Byte No	Name	Description							
0	Header	0xAA							
1	ID	0x00							
2	AZPosition.byte[1]	0x00 - 0x1F: Upper 5 bits of Azimuth Position							
3	AZPosition.byte[0]	0x00 - 0xFF: Lower 8 bits of Azimuth Position							
4	AZVelocity.byte[1]	0x00 - 0xFF: Upper 8 bits of Azimuth Velocity							
5	AZVelocity.byte[0]	0x00 - 0xFF: Lower 8 bits of Azimuth Velocity							
6	Reserved	0x00							
7	ELPosition.byte[1]	0x00 - 0x1F: Upper 5 bits of Elevation Position							
8	ELPosition.byte[0]	0x00 - 0xFF: Lower 8 bits of Elevation Position							
9	ELVelocity.byte[1]	0x00 - 0xFF: Upper 8 bits of Elevation Velocity							
10	ELVelocity.byte[0]	0x00 - 0xFF: Lower 8 bits of Elevation Velocity							
11	Limit_Status	Rt	Lt	Up	Dn	SRt	SLt	SUp	SDn
12	Reserved	0x00							
13	Footer	0x00							

Limit_Status:

- Rt, Lt, Up and Dn are the Right, Left, Up and Down electrical limit switch indications.
- SRt, SLt, SUp and SDn are the Right, Left, Up and Down software limit indications.
- A “1” indicates a limit has been reached.

3.3 Return Azimuth Setup Data

The “Return Azimuth Setup Data” message is a reply to the commands requiring a return of the Azimuth setup values

Table 3.3: Return Azimuth Setup Data Message

Byte No	Name	Description
0	Header	0xAE
1	ID	0x1A
2	MaxPanPrstError	0x00 - 0x32: Maximum Allowable Azimuth Preset Error
3	PanPrstRamp	0x01 - 0xFA: Azimuth Preset Ramp Adjustment
4	PanPrstGain	0x01 - 0xFA: Azimuth Preset Velocity Gain
5	MinPanPrstSpd	0x01 - 0xFA: Minimum Allowable Azimuth Preset Velocity
6	RightSWLimit	0 to 180 Degrees to Set the Right Software Limit
7	LeftSWLimit	0 to -180 Degrees to Set the Left Software Limit
8	PAM_Height_Pan	0x01 - 0xFA: Sets the Height of the PAM Pulse
9	PAM_Width_Pan	0x01 - 0xFA: Sets the Maximum Width of the PAM Pulse
10	Reserved	0x00
11	Reserved	0x00
12	Reserved	0x00
13	Footer	0x0D

Software Limits: Are shown in degrees

3.4 Return Elevation Setup Data

The “Return Elevation Setup Data” message is a reply to the commands requiring a return of the Elevation setup values

Table 3.4: Return Elevation Setup Data Message

Byte No	Name	Description
0	Header	0xAE
1	ID	0x1E
2	MaxTiltPrstError	0x00 - 0x32: Maximum Allowable Elevation Preset Error
3	TiltPrstRamp	0x01 - 0xFA: Elevation Preset Ramp Adjustment
4	TiltPrstGain	0x01 - 0xFA: Elevation Preset Velocity Gain
5	MinTiltPrstSpd	0x01 - 0xFA: Minimum Allowable Elevation Preset Velocity
6	UpSWLimit	0 to 180 Degrees to Set the Up Software Limit
7	DownSWLimit	0 to -180 Degrees to Set the Down Software Limit
8	PAM_Height_Tilt	0x01 - 0xFA: Sets the Height of the PAM Pulse
9	PAM_Width_Tilt	0x01 - 0xFA: Sets the Maximum Width of the PAM Pulse
10	Reserved	0x00
11	Reserved	0x00
12	Reserved	0x00
13	Footer	0x0D

Software Limits: Are shown in degrees

3.5 Return Version

The "Return Version" message returns the Pan & Tilt Type and version number of the firmware. Table 3.5 shows the return for the PT75 firmware version v1.75.50. This is with 16 bit Avago encoders.

Table 3.5 Return Version Message

Byte No	Name	Description
0	Header	0xAE
1	ID	0x10
2	Reserved	' '
3	Reserved	'7'
4	Reserved	'5'
5	Reserved	' '
6	Reserved	'1'
7	Reserved	'.'
8	Reserved	'7'
9	Reserved	'5'
10	Reserved	'.'
11	Reserved	'5'
12	Reserved	'0'
13	Footer	0x0D

4.0 Examples

This section will present three examples of commands to be sent to the PT75. The examples will be based upon the Graflex PT Control GUI. Table 4.0 lists the three examples to be discussed.

Paragraphs 4.1 through 4.3 explain these examples.

Table 4.0: List of Examples

Paragraph	Example
4.1	Velocity Command: Send a velocity command and examine the reply
4.2	Recall a Preset: Send a recall preset command
4.3	Preset Link: Store a Preset Link and examine its response

4.1 Velocity Command

A velocity command will be sent to the PT75 and the PT75 will respond with a reply showing the current azimuth and elevation positions.

4.1.1 Velocity command to PT75

The following velocity command will create a slow movement to the right and down. The velocity command is shown in Table 4.1.1

Table 4.1.1: Velocity Command

Byte No	Name	Value	Description
0	Header	0xBA	Constant for 10 byte header
1	CMD	0x56	Constant for Velocity command
2	AZ MSD	0x7F	An AZ velocity of 0x7FF0 represents a small right velocity
3	AZ LSD	0xF0	
4	EL MSD	0x80	An EL velocity of 0x8010 represents a small down velocity
5	EL LSD	0x10	
6	Reserved	0x00	
7	Reserved	0x00	
8	Check Sum	0xD4	(The LSD of the Sum of Bytes 1 through 7)
9	Footer	0x0D	Constant for 10 byte footer

Zero azimuth velocity is equal to 0x8000. So, the azimuth velocity of 0x7FF0 represents a small velocity to the right. An equally small velocity increment to the left would have been 0x8010.

Similarly, zero elevation velocity is equal to 0x8000. So, the elevation velocity of 0x8010 represents a small velocity down. An equally small velocity increment to the up side would have been 0x7FF0.

The Check Sum = 0x56 + 0x7F + 0xF0 + 0x00 + 0x10 + 0x00 + 0x00 = 0xD4

4.1.2 Response to Velocity command

Lets assume that the PT75 is to the right by 45 degrees and pointed down by 20.000 degrees. Let us also assume there are no electrical or software limits reached. The response to the velocity command would look as shown below in Table 4.1.2.

Table 4.1.2: Position Response to Velocity Command

Byte No	**Name**	**Description**							
0	Header	0xAA							
1	AZPosition.byte[2]	0x00							
2	AZPosition.byte[1]	0x40							
3	AZPosition.byte[0]	0x00							
4	ELPosition.byte[2]	0x00							
5	ELPosition.byte[1	0x3A							
6	ELPosition.byte[0]	0xC3							
7	Limit_Status	0	0	0	0	0	0	0	0
8	CheckSum	0x3D							
9	Footer	0x0D							

4.2 Recall a Preset

Let us assume we have a preset stored in preset location 12 and we want to recall the preset. The recall preset 12 command shown in Table 4.2 will be sent to the PT75

Table 4.2: Recall Preset Number 12 Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x50:
2	Preset CMD	0x20
3	Preset No	0x0C
4	Variable 3	0x00
5	Footer	0x0D

Upon receipt of the recall command the PT75 will retrieve the azimuth and elevation positions stored in the preset 12 memory location and will initiate a movement to those positions. The PT75 will return a “Return AZ and EL Value” message.

4.3 Store a Link

4.3.1 Store the first location:

In order to store a link preset sequence, the command must be sent repeatedly. The command must be sent for each of the presets that need to be stored. For example, if we want to create a linked preset group of presets 2, 4 and 8 and store them in Link Location 7, we would do the following.

A) Determine the link storage location (LinkLoc): 7

B) Begin with the first of the 3 presets (Offset): 1. The Offset is the order of the current preset. In this case it would be 1 corresponding to the first preset to be stored

C) Determine the total number of presets (Number): 3

D) Determine which preset we want to store at this initial location (Preset): 2

E) Determine the dwell time we spend at the first linked preset (Dwell): Assume a relatively short dwell time of 2 Sec. The dwell time begins when the preset reaches its azimuth and elevation position.

F) Determine the speed desired to get to the first of the linked preset positions (Speed): Assume a medium speed of 0x4000.

G) Send the Store Link command shown Table 4.3.1 below.

Table 4.3.1 Store the first of the three linked presets

Byte No	**Name**	**Description**
0	Header	0xBA
1	CMD	0x4D
2	LinkLoc	0x07
3	Offset	0x01
4	Number	0x03
5	Preset	0x02
6	Dwell (in Sec)	0x02
7	Speed MSD	0x40
8	Speed LSD	0x00
9	Footer	0x0D

4.3.2 Response to the first store Link Command:

After receiving the Store a Linked Preset Command from paragraph 4.3.1, the PT75 responds with the message in Table 4.3.2

Table 4.3.2 Store a linked preset response to 1st command

Byte	**Name**	Description
0	Header	0xA3: Header
1	Action	0x4D: Same header as the command
2	LinkLoc	0x07: Location where the link will be stored
3	Offset	**0x01: This is the 1st preset in the sequence**
4	Number	0x03: There are to be 3 presets in this linked group
5	Preset Pos	**0x02: This is Preset Number 2**
6	Dwell Time	**0x02: The Dwell Time is 2 seconds**
7	MaxPrstSpd byte	**0x40: MSD of Preset Speed**
8	MaxPrstSpd byte	**0x00: LSD of Preset Speed**
9	Footer	0x0D

The values shown in bold are unique to this first message. These values will change with each succeeding response.

4.3.3 Store the second location:

In order to store a link preset sequence, the command must be sent repeatedly. This is the second message:

A) Determine the link storage location (LinkLoc): 7
B) Begin with the second of the 3 presets (Offset): 2. The Offset is the order of the current preset. In this case it would be 1 corresponding to the first preset to be stored
C) Determine the total number of presets (Number): 3
D) Determine which preset we want to store at this initial location (Preset): 4
E) Determine the dwell time we spend at the first linked preset (Dwell): Assume a shorter dwell time of 1 Sec.
F) Determine the speed desired to get to the first of the linked preset positions (Speed): Assume a slower speed of 0x2000.
G) Send the Store Link command shown Table 4.3.3 below.

Table 4.3.3 Store the second of the linked pre-

Byte No	**Name**	Description
0	Header	0xBA
1	CMD	0x4D
2	LinkLoc	0x07
3	Offset	0x02
4	Number	0x03
5	Preset	0x04
6	Dwell	0x01
7	Speed MSD	0x20
8	Speed LSD	0x00
9	Footer	0x0D

4.3.4 Response to the second store Link Command:

After receiving the Store a Linked Preset Command from paragraph 4.3.3, the PT75 responds with the message in Table 4.3.4

Table 4.3.4 Store a linked preset response to 2nd command

Byte	**Name**	Description
0	Header	0xA3: Header
1	Action	0x4D: Same header as the command
2	LinkLoc	0x07: Location where the link will be stored
3	Offset	**0x02: This is the 2nd preset in the sequence**
4	Number	0x03: There are to be 3 presets in this linked group
5	Preset Pos	**0x04: This is Preset Number 4**
6	Dwell Time	**0x01: The Dwell Time is 1 second**
7	MaxPrstSpd byte	**0x20: MSD of Preset Speed**
8	MaxPrstSpd byte	**0x00: LSD of Preset Speed**
9	Footer	0x0D

The values shown in bold are unique to this second message. These values will change with each succeeding response.

4.3.5 Store the third location:

In order to store a link preset sequence, the command must be sent repeatedly. This is the third message:

A) Determine the link storage location (LinkLoc): 7
B) Begin with the third of the 3 presets (Offset): 3. The Offset is the order of the current preset. In this case it would be 1 corresponding to the first preset to be stored
C) Determine the total number of presets (Number): 3
D) Determine which preset we want to store at this initial location (Preset): 8
E) Determine the dwell time we spend at the first linked preset (Dwell): Assume a long dwell time of 5 Sec.
F) Determine the speed desired to get to the first of the linked preset positions (Speed): Assume a higher speed of 0x7000.
G) Send the Store Link command shown Table 4.3.5 below.

Table 4.3.5 Store the third of the linked presets

Byte No	**Name**	Description
0	Header	0xBA
1	CMD	0x4D
2	LinkLoc	0x07
3	Offset	0x03
4	Number	0x03
5	Preset	0x08
6	Dwell	0x05
7	Speed MSD	0x70
8	Speed LSD	0x00
9	Footer	0x0D

4.3.6 Response to the third and final Store Link Command:

After receiving the Store a Linked Preset Command from paragraph 4.3.5, the PT75 responds with the message in Table 4.3.6

Table 4.3.6 Store a linked preset response to 2nd command

Byte	**Name**	Description
0	Header	0xA3: Header
1	Action	0x4D: Same header as the command
2	LinkLoc	0x07: Location where the link will be stored
3	Offset	**0x03: This is the 3rd preset in the sequence**
4	Number	0x03: There are to be 3 presets in thi slinked group
5	Preset Pos	**0x08: This is Preset Number 8**
6	Dwell Time	**0x05: The Dwell Time is 5 second**
7	MaxPrstSpd byte	**0x70: MSD of Preset Speed**
8	MaxPrstSpd byte	**0x00: LSD of Preset Speed**
9	Footer	0x0D

The values shown in bold are unique to this third message. These values will change with each succeeding response.

5.0 PT75 Basic Specifications

Characteristics:

Dimensions	9.5”(w) x 8.8” (d) x 10.1” (h)
Weight	28 Pounds
Base Dimension	6.5” Square
Construction	Aluminum and Stainless Steel
Tilt Limits	Adjustable over 200 degree range
Drive Motor	DC Brush

Electrical:

Travel	
Pan	Continuous
Tilt	+100 to –100 adjustable limits
Feedback	16 Bit On-Axis Absolute Encoder
Max Speed	
Pan	60 Degrees/sec
Tilt	60 Degrees/sec
Resolution	0.0055 Degrees
Repeatability	0.02 Degrees
Accuracy	0.05 Degrees
Voltage	+18 VDC to +36 VDC
Power	
w/o Heater	25W nominal, 175 Watts Max
w/Heater	75W nominal, 225Watts Max

Communications:

Interface Connector:	PT02-14-12P
Serial Interface (Rs-232 or RS-422)	5 @ 2 Amp slip rings
Power	4 @ 5 Amp slip rings
Sensor Pass Through Connector	PT02-18-32P
Pass Through rings	32 @ 2 Amp slip rings
Video	2 BNC/ Coax slip rings
Control	GUI supplied

Options:

Finish	Multiple colors and finishes
Payload Mount	Side or Over the Top
Heaters	Heaters & Thermostat
Shock Mount	Contact Factory

Environmental:

Operating Temperature	0 to 70 degrees C (w/o heater)
Ingress Protection	IP66
Shock	Mil 810E: Proc 516.4

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