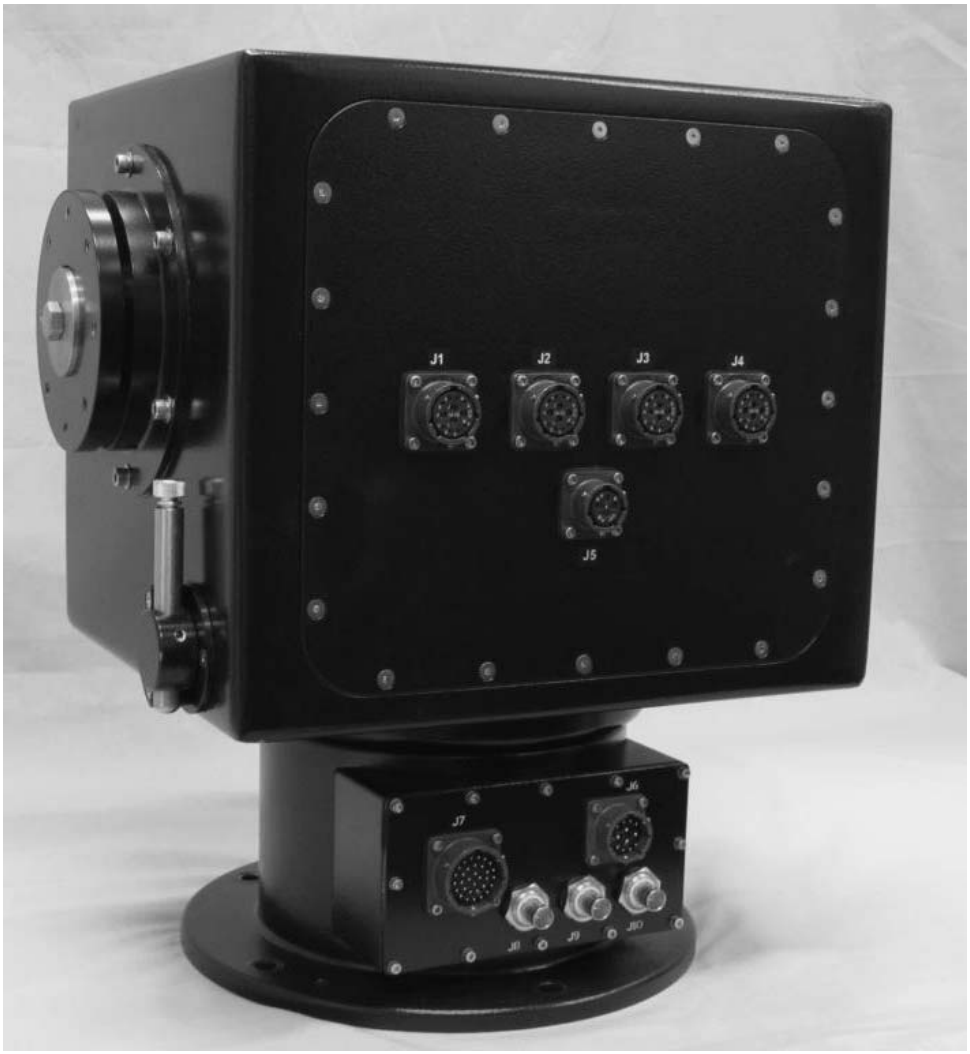
PT150 INTERFACE PROTOCOL



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Revision History

Original Publication Date 10/14/2010:

Revision A: Date 1/28/2011 Corrected minor typos and corrected title page photo

Revision B: Date 4/11/2011 Corrected Command 'X' System Command bits

Revision C: Date 12/16/2011 Corrected Command 'd' Get Link Data Command

Revision D: Date 5/14/2012 Corrected Table 1.2 Header from 0xB6 to 0xBA and added azimuth software stops, acceleration control and digital tachometer

Revision E: Date 8/23/201212 Changed to be identical to the AZ-Stops Interface Protocol Manual Rev D also dated 8/23/12

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1.0 Interface Protocol

1.1 Serial Interface Signal Description

The signal interface to the PT150 will be either an RS-422 or an RS-232 signal interface format. The actual interface format is selected with Setup Switch #8 on the servo board. The default setting is RS-422 corresponding to Setup Switch #8 set to the Off position. 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 J6. The J6 connector is also used as the power input connector. Table 1.1 illustrates the pins used for power and serial messaging. The PT150 serial interface names are based upon the signal relative to the PT150 receivers. The relationship between the J6 input pins and the control source is shown in columns "PT150 Name" and column "Control Name".

Table 1.1: J6 Pins

Pin No	PT150 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 paragraphs 4 and 5. Paragraph 6 has several message examples.

Paragraph 2 will address the 10 Byte message format and paragraph 3 will address 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	ChkSum	Sum (CMD—V7)

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

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1.2 Velocity and Position Formats

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

1.2.1 Velocity Format

The 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	P0	P1	P2	P3	P4	P5	P6	P7
LSD	P8	P9	P10	P11	P12	P13	P14	P15

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.

Table 1.2.1-2 Approximate Velocity Values

Az Velocity	EL Velocity	P0-P3	P4-P7	P8-P11	P12-P15
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
0.002 ˚/s	**0.002 ˚/s**	0 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
0.000 ˚/s	**0.000 ˚/s**	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-0.002 ˚/s	**-0.002 ˚/s**	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1
-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 Position Format

The Position data is calculated by the following formula:

$$\text{Position (deg)} = \frac{360 \text{ deg}}{2^{20}} \times \text{Position (bits)}$$

The position data is resident in three data bytes or digits; and an Upper Significant Digit (USD), a Middle 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 1.2.1-1 Velocity Data Digits

	d7	d6	d5	d4	d3	d2	d1	d0
USD	0	0	0	0	P0	P1	P2	P3
MSD	P4	P5	P6	P7	P8	P9	P10	P11
LSD	P12	P13	P14	P15	P16	P17	P18	P19

The azimuth and elevation positions are shown in Table 1.2.2-2 below. Note that upper 4 bits (d4 - d7) are ignored in the Table 1.2.2-2. They are always set to zero.

Table 1.2.2-2 Position Values

Az Position	EL Position	P0-P3	P4-P7	P8-P11	P12-P15	P16-P19
179.999˚	**179.999˚**	0 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
135.000˚	**135.000˚**	0 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
90.000˚	**90.000˚**	0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
45.000˚	**45.000˚**	0 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
0.00034˚	**0.00034˚**	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 1
0.0000˚	**0.0000˚**	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-0.00034˚	**-0.00034˚**	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
-45.000 ˚	**-45.000˚**	1 1 1 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-90.000˚	**-90.000˚**	1 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-135.000˚	**-135.000˚**	1 0 1 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
-180.000˚	**-180.000˚**	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0

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2.0 Command Message Protocol: 10 Byte

There are only two commands that use the 10 byte protocol. They are the velocity command and the store link command. The velocity command is detailed in paragraph 2.1 and the store link command is detailed in paragraph 2.2

2.1 Velocity Command

The Velocity command is detailed below in Table 2.1.

Table 2.1: 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	AL MSD	0x00 to 0xFF: Least Significant Digit of Elevation Velocity
6	Reserved	0x00
7	Reserved	0x00
8	Check Sum	The LSD of the Sum of Bytes 1 through 7
9	Footer	0x0D

The velocity command is the most common command sent to the PT150. In response to a velocity message, the PT150 responds with a return message which contains the azimuth and elevation position and encoder status. The “Send AZ and EL Value” return message is detailed in paragraph 5.6.

The recommended message rate to the PT150 is 100 messages per second. This leaves enough time to respond with a 13 byte feedback message and is still very responsive to the user commands. There is very little latency between the receipt of a message and the action required by the message.

2.2 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 3.19 discusses the storing and recall of presets. Table 2.2 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 2.2: Ten Byte 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	Speed MSD	MSD of Maximum Preset Speed (0x00 to 0xFF)
8	Speed LSD	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

3.0 Command Message Protocol: 6 Byte

There are several 6 byte messages that may be sent to the PT150 A summary of the messages is presented below in Table 3.1. Detailed descriptions of the commands are presented in the paragraphs listed in the first column of the table

Table 3-1: Six Byte Command Message Summary

Para No	Char CMD	Hex Cmd	Type	Description
3.1.	0	0x30	Get Data	Get azimuth PID values
3.2	1	0x31	Get Data	Get elevation PID values
3.3	2	0x32	PID	Set Azimuth PID Kp
3.4	3	0x33	PID	Set Azimuth PID Ki
3.5	4	0x34	PID	Set Azimuth PID Kd
3.6	5	0x35	PID	Set Azimuth PID Kdelta: azimuth gain after PID
3.7	6	0x36	PID	Set Azimuth PID KiLim: maximum integration value
3.8	7	0x37	Get Data	Get setup data
3.9	9	0x39	Setup	Absolute mode ramp value
3.10	(	0x28	Setup	Set the Azimuth Acceleration Value
3.11	)	0x29	Setup	Set the Elevation Acceleration Value
3.12	<	0x3C	Get Data	Get more PID values
3.13	?	0x3F	Get Data	Get the azimuth and elevation position
3.14	E	0x45	PID	Set Elevation PID Kp
3.15	F	0x46	PID	Set Elevation PID Ki
3.16	G	0x47	PID	Set Elevation PID Kd
3.17	H	0x48	PID	Set Elevation PID Kdelta: elevation gain after PID
3.18	I	0x49	PID	Set Elevation PID KiLim: maximum integration value

Table 3-1: Six Byte Command Message Summary Continued

Para No	Char Cmd	Hex Cmd	Type	Description
3.19	P	0x50	Preset	Preset command
3.20	T	0x54	Setup	Sets the azimuth PAM height
3.21	W	0x57	Setup	Sets the azimuth PAM maximum width
3.22	X	0x58	Setup	System command: zeros azimuth or elevation encoder
3.23	b	0x62	Position	Stay: stay at this position (used when in velocity mode)
3.24	d	0x64	Get Data	Get link memory data
3.25	e	0x65	Position	Go to this azimuth absolute position
3.26	f	0x66	Position	Go to this elevation absolute position
3.27	g	0x67	Get Data	Get PAM values
3.28	l	0x6C	Setup	Set left software limit to this value
3.29	p	0x70	Setup	Set up software limit to this value
3.30	q	0x71	Setup	Set down limit to this value
3.31	r	0x72	Setup	Set right software limit to this value
3.32	t	0x74	Setup	Sets the elevation PAM height
3.33	v	0x76	Setup	Sets the maximum preset speed
3.34	w	0x77	Setup	Sets the maximum elevation PAM width

Each of these commands will be discussed in detail in the following paragraphs.

3.1 Command ‘0’: Get Azimuth PID Values

The Get Azimuth PID Values command is shown in detail in Table 3.1.

Table 3.1: Get Azimuth PID Values Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x30
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the return of a 13 byte message containing the azimuth PID Values K_p, K_i, K_d, K_{Delta}, KLim

3.2 Command ‘1’: Get Elevation PID Values

The Get Elevation PID Values command is shown in detail in Table 3.2.

Table 3.2: Get Elevation PID Values Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x31
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the return of a 13 byte message containing the elevation PID Values K_p, K_i, K_d, K_{Delta}, KLim

3.3 Command '2': Set Azimuth PID K_p

Set the Azimuth PID K_p value. The command is shown in detail in Table 3.3.

Table 3.3: Set Azimuth PID K_p Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x32: When received by the PT150 K_P is converted to floating point
2	K_P MSD	0x00 to 0xFF MSD portion of azimuth proportional PID constant
3	K_P Fract	0x00 to 0xFF Fractional portion of azimuth proportional constant
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.4 Command '3': Set Azimuth PID K_i

Set the Azimuth PID K_i value. The command is shown in detail in Table 3.4

Table 3.4: Set Azimuth PID K_i Value Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x33:When received by the PT150 K_i is converted to floating point
2	K_i MSD	0x00 to 0xFF MSD portion of azimuth integral PID constant
3	K_i Fract	0x00 to 0xFF Fractional portion of azimuth integral constant
4	Variable 3	PID_Status (See Above)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.5 Command '4': Set Azimuth PID K_d

Set the Azimuth PID K_d value. The command is shown in detail in Table 3.5.

Table 3.5: Set Azimuth PID K_d Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x34: When received by the PT150 K_d is converted to floating point
2	K_d MSD	0x00 to 0xFF MSD portion of azimuth derivative PID constant
3	K_d Fract	0x00 to 0xFF Fractional portion of azimuth derivative PID constant
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.6 Command '5': Set Azimuth PID K_{Delta}

Set the Azimuth PID K_{Delta} value. The command is shown in detail in Table 3.6

Table 3.6: Set Azimuth PID K_{Delta} Value Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x35:When received by the PT150 K_{Delta} is converted to floating point
2	K_{Delta} MSD	0x00 to 0xFF MSD portion of azimuth post PID gain
3	K_{Delta} Fract	0x00 to 0xFF Fractional portion of azimuth post PID gain
4	Variable 3	PID_Status (See Above)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.7 Command '6': Set Azimuth PID K_{Lim}

Set the Azimuth PID K_{Lim} value. The command is shown in detail in Table 3.7.

Table 3.7: Set Azimuth PID K_{Lim} Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x36: When received by the PT150 K_{Lim} is converted to an integer
2	K_{Lim} MSD	0x00 to 0xFF MSD of azimuth maximum integral amount
3	K_{Lim} LSD	0x00 to 0xFF LSD of azimuth maximum integral amount
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.8 Command '7': Get Setup Values

The Get Setup Values command is shown in detail in Table 3.8.

Table 3.8: Get Setup Values Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x37
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the return of a 13 byte message containing Read Rate, Absolute Mode Ramp, Loop Time, Up Limit, Down Limit and Absolute Mode Gain

3.9 Command '9': Set Absolute Mode Ramp

Set Absolute Mode Ramp up/down value. The command is shown in detail in Table 3.9.

Table 3.9: Set Absolute Mode Ramp

Byte No	Name	Description
0	Header	0xB6
1	Command	0x39: When received by the PT150 it is converted to an integer
2	MSD	0x00 to 0xFF MSD of absolute mode ramp
3	LSD	0x00 to 0xFF LSD of absolute mode ramp
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.10 Command '(': Set Acceleration

The Set Azimuth Acceleration command is shown in detail in Table 3.10.

Table 3.10: Azimuth Acceleration command .

Byte No	Name	Description
0	Header	0xB6
1	Command	0x28:When received by the PT150 it is converted to an integer
2	MSD	0x00 to 0x10 MSD portion of the azimuth acceleration value
3	LSD	0x64 to 0xFF LSD portion of the azimuth acceleration value
4	0x00	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.11 Command '(': Set Acceleration

The Set Azimuth Acceleration command is shown in detail in Table 3.11.

Table 3.11: Azimuth Acceleration command .

Byte No	Name	Description
0	Header	0xB6
1	Command	0x28:When received by the PT150 it is converted to an integer
2	MSD	0x00 to 0x10 MSD portion of the azimuth acceleration value
3	LSD	0x64 to 0xFF LSD portion of the azimuth acceleration value
4	0x00	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.12 Command '<': Get More PID Values

The Get Additional PID Values command is shown in detail in Table 3.12.

Table 3.12: Get Additional PID Values Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x3C
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the return of a 13 byte message containing the PID Values Azimuth K_{IConst}, Elevation K_{IConst} and PID_Status

3.13 Command '?': Get Azimuth and Elevation Position Data

The Get Azimuth and Elevation Position Data command is shown in detail in Table 3.13.

Table 3.13: Get Azimuth and Elevation Position Data Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x3F
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.14 Command 'E': Set Elevation PID K_p

Set the Elevation PID K_p value. The command is shown in detail in Table 3.14.

Table 3.14: Set Elevation PID K_p Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x45: When received by the PT150 K_P is converted to floating point
2	K_P MSD	0x00 to 0xFF MSD portion of elevation proportional PID constant
3	K_P Fract	0x00 to 0xFF Fractional portion of elevation proportional constant
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.15 Command 'F': Set Elevation PID K_i

Set the Elevation PID K_i value. The command is shown in detail in Table 3.15

Table 3.15: Set Elevation PID K_i Value Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x46: When received by the PT150 K_i is converted to floating point
2	K_i MSD	0x00 to 0xFF MSD portion of elevation integral PID constant
3	K_i Fract	0x00 to 0xFF Fractional portion of elevation integral constant
4	Variable 3	PID_Status (See Above)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.16 Command 'G': Set Elevation PID K_d

Set the Elevation PID K_d value. The command is shown in detail in Table 3.16.

Table 3.16: Set Elevation PID K_d Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x47: When received by the PT150 K_d is converted to floating point
2	K_d MSD	0x00 to 0xFF MSD portion of elevation derivative PID constant
3	K_d Fract	0x00 to 0xFF Fractional portion of elevation derivative PID constant
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.17 Command 'H': Set Elevation PID K_{Delta}

Set the Elevation PID K_{Delta} value. The command is shown in detail in Table 3.17

Table 3.17: Set Elevation PID K_{Delta} Value Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x48:When received by the PT150 K_{Delta} is converted to floating point
2	K_{Delta} MSD	0x00 to 0xFF MSD portion of elevation post PID gain
3	K_{Delta} Fract	0x00 to 0xFF Fractional portion of elevation post PID gain
4	Variable 3	PID_Status (See Above)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.18 Command 'I': Set Elevation PID K_{Lim}

Set the Elevation PID K_{Lim} value. The command is shown in detail in Table 3.18.

Table 3.18: Set Elevation PID K_{Lim} Value Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x49: When received by the PT150 K_{Lim} is converted to an integer
2	K_{Lim} MSD	0x00 to 0xFF MSD of elevation maximum integral amount
3	K_{Lim} LSD	0x00 to 0xFF LSD of elevation maximum integral amount
4	Variable 3	PID_Status (See Below)
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

3.19 Command 'P': 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 PT150 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 detail in Table 3.19-1 and Table 3.19-2 below.

Table 3.19-1: 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

Return: The command results in the "Send AZ and EL Value" reply message

Table 3.19-2: 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

Return: The command results in the "Send AZ and EL Value" reply message

3.20 Command 'T': Set Azimuth PAM Height

Pulse Amplitude Modulation (PAM) is a technique used to enhance slow speed operation. It consists of a series of pulses with the pulse height and pulse width being variable. The Set Azimuth PAM Height command sets the height (voltage) of the pulse. The command is shown in detail in Table 3.20.

Table 3.20: Set Azimuth PAM Height

Byte No	Name	Description
0	Header	0xB6
1	Command	0x54:
2	AzPAMHt	0x00 to 0xFF: Height of the PAM pulse
3	AzPAMHt	0x00 to 0xFF: Same as Byte 2
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.21 Command 'W': Set Azimuth PAM Maximum Width

Pulse Amplitude Modulation (PAM) is a technique used to enhance slow speed operation. It consists of a series of pulses with the pulse height and pulse width being variable. The Set Azimuth PAM Width command sets the width (time) of the pulse. The command is shown in detail in Table 3.21.

Table 3.21: Set Azimuth PAM Width.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x57:
2	AzPAMW	0x00 to 0xFF: Width of the PAM pulse
3	AzPAMW	0x00 to 0xFF: Same as Byte 2
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.22 Command 'X': System Command

The System Command message contains bits which command the PT150 to zero the azimuth encoder, zero the elevation encoder or commands the PT150 to enter the Absolute position mode. The command is shown in detail in Table 3.22.

Table 3.22: System Command

Byte No	Name	Description
0	Header	0xB6
1	Command	0x58:
2	Sys CMD	Bit 6 = 1 Zero Az; bit 5 = 1, zero El; bit 0 = 1 Absolute Mode
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.23 Command 'b': Stay Command

The Stay command instructs the PT150 to enter the absolute position mode and stay at its current location . The command is shown in detail in Table 3.23.

Table 3.23: Stay Command.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x62:
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the "Send AZ and EL Value" reply message

3.24 Command ‘d’: Get Link Data

The Get Link Data Command message requests that the PT150 send the link parameters to the controller. The command is shown in detail in Table 3.24.

Table 3.24: Get Link Data

Byte No	Name	Description
0	Header	0xB6
1	Command	0x64:
2	Variable 1	0x64
3	Variable 2	Link Location
4	Variable 3	Link Offset
5	Footer	0x0D

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

3.25 Command ‘e’: Go to Azimuth Absolute Position

The go to absolute azimuth position message commands the PT150 to go to the azimuth position contained in the message. An ’f’ command must immediately follow the ’e’ command for the action to take place. The command is shown in detail in Table 3.25.

Table 3.25: Go to Azimuth absolute position.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x65:
2	AzUSD	0x00—0xFF: Upper Azimuth position byte
3	AzMSD2	0x00—0xFF: Middle Azimuth position byte
4	AzLSD	0x00—0xFF: Lower Azimuth position byte
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.26 Command ‘f’: Go to Elevation Absolute Position

The go to absolute elevation position message commands the PT150 to go to the elevation position contained in the message. The command is shown in detail in Table 3.26.

Table 3.26: Go to Elevation absolute position.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x66:
2	AzUSD	0x00—0xFF: Upper Azimuth position byte
3	AzMSD2	0x00—0xFF: Middle Azimuth position byte
4	AzLSD	0x00—0xFF: Lower Azimuth position byte
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.27 Command ‘g’: Get PAM Data

The Get PAM Data Command message requests that the PT150 send the PAM parameters to the controller. The command is shown in detail in Table 3.27.

Table 3.27: Get PAM Data

Byte No	Name	Description
0	Header	0xB6
1	Command	0x67:
2	Variable 1	0x00
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the return of a 13 byte message with the Az PAM Height, Az PAM Width, El PAM Height and EL PAM Width

3.28 Command ‘j’: Set Tachometer Gain

Set the Left software limit to command the PT150 to load a new left limit. The command is shown in detail in Table 3.28.

Table 3.28: Set Left Limit.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x6A:
2	Tach Gain	0x01—0x10: Tachometer gain
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

3.29 Command ‘l’: Set left Software Limit

Set the Left software limit to command the PT150 to load a new left limit. The command is shown in detail in Table 3.29.

Table 3.29: Set Left Limit.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x6C:
2	Left SW Limit	0xFF—0x80: Left azimuth software limit
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.30 Command ‘p’: Set Up Software Limit

Set the up software limit to command the PT150 to load a new up limit. The command is shown in detail in Table 3.30.

Table 3.30: Set Up Limit

Byte No	Name	Description
0	Header	0xB6
1	Command	0x70:
2	Up SW Limit	0x00—0x80: Up software elevation limit
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.31 Command ‘q’: Set Down Software Limit

Set the Down software limit to command the PT150 to load a new down limit. The command is shown in detail in Table 3.31.

Table 3.31: Set Down Limit.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x71:
2	Down SW Limit	0xFF—0x80: Down elevation software limit
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.32 Command ‘r’: Set Right Software Limit

Set the right software limit to command the PT150 to load a new right limit. The command is shown in detail in Table 3.32.

Table 3.32: Set Up Limit

Byte No	Name	Description
0	Header	0xB6
1	Command	0x72:
2	Right SW Limit	0x00—0x80: Right software azimuth limit
3	Variable 2	0x00
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.33 Command ‘t’: Set Elevation PAM height

Pulse Amplitude Modulation (PAM) is a technique used to enhance slow speed operation. It consists of a series of pulses with the pulse height and pulse width being variable. The Set Elevation PAM Height command sets the height (voltage) of the pulse. The command is shown in detail in Table 3.33.

Table 3.33 Set Elevation PAM Height.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x74:
2	ELPAMHt	0x00 to 0xFF: Height of the PAM pulse
3	ELPAMHt	0x00 to 0xFF: Same as Byte 2
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.34 Command ‘v’: Set Maximum Preset Speed

Set the Maximum Preset Speed commands the PT150 to load a new Max Preset Speed value The command is shown in detail in Table 3.34.

Table 3.34 Set Maximum Preset Speed

Byte No	Name	Description
0	Header	0xB6
1	Command	0x76:
2	PrstSpdMSD	0x00—0xFF: Max Preset Speed MSD
3	PrstSpdLSD	0x00—0xFF: Max Preset Speed LSD
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

3.35 Command ‘w’: Set Elevation PAM Width

Pulse Amplitude Modulation (PAM) is a technique used to enhance slow speed operation. It consists of a series of pulses with the pulse height and pulse width being variable. The Set Elevation PAM Width command sets the width (time) of the pulse. The command is shown in detail in Table 3.35.

Table 3.35 Set Elevation PAM Width.

Byte No	Name	Description
0	Header	0xB6
1	Command	0x77:
2	ElPAMW	0x00 to 0xFF: Height of the PAM pulse
3	ElPAMW	0x00 to 0xFF: Same as Byte 2
4	Variable 3	0x00
5	Footer	0x0D

Return: The command results in the “Send AZ and EL Value” reply message

4.0 Reply Message Protocol: 10 Byte

There is only a single reply that uses a 10 byte protocol. That is the Send Trace Acknowledgement . This is the response to a Store Link command or a Get Link Data command

4.1 Send Trace Acknowledgement

The Send Trace Acknowledgement Reply is detailed below in Table 4.1.

Table 4.1: Ten Byte Send Trace Acknowledgement Reply 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	MSD of Maximum Preset Speed (0x00 to 0xFF)
8	MaxPrstSpd byte	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

The “Graflex PT Control GUI” makes extensive use of the Send Trace Acknowledgement reply message to load the textboxes in the Link Presets form

5.0 Reply Message Protocol: 13 Byte

There are six messages that use the 13 byte protocol. The six command messages and the six reply messages are listed in Table 5.0. The majority of the command messages result in a reply message providing azimuth and elevation position, velocity and encoder status. The others are specialized responses to a specific command.

Paragraphs 5.1 through 5.6 detail these reply messages.

Table 5.0: Command and Reply Messages

Command Name	Command Paragraph	Reply Name	Reply Paragraph
Get Az PID Values	3.1	Send Az PID Values	5.1
Get EL PID Values	3.2	Send EL PID Values	5.2
Get Setup Values	3.8	Send Setup Values	5.3
Get PID Values 2	3.11	Send PID Values 2	5.4
Get PAM Values	3.27	Send PAM Values	5.5
Get AZ & EL Values	All others	Send Az & EL Values	5.6

Whenever bytes in a message end with an MSD followed by a byte ending with Frac, the message is to reassembled as a floating point number. For example:

Byte 1 AKp_MSD
Byte 2 AKp_Frac

Floating point number is AKp_MSD.AKp_Frac.

Whenever bytes in a message end with byte[1] followed by byte[0], the message is to reassembled as an integer. For example:

Byte 1 AKiLim.byte[1]

Byte 2 AKiLim.byte[0]

Integer AkiLim.word results with AKiLim.byte[1] as the most significant digit and AKiLim.byte[0] being the least significant digit.

5.1 Send Az PID Values

The “Send Az PID Values” message is a reply to the “Get Az PID Values” command described in paragraph 3.1. The details of the message are shown Table 5.1

Table 5.1: Send Az PID Values

Byte No	Name	Description
0	Header	0xA4
1	AKp_MSD	0x00 - 0xFF: Azimuth PID Proportional value MSD
2	AKp_Frac	0x00 - 0xFF: Azimuth PID Proportional value fraction
3	AKi_MSD	0x00 - 0xFF: Azimuth PID Integral value MSD
4	AKi_Frac	0x00 - 0xFF: Azimuth PID Integral fraction
5	AKd_MSD	0x00 - 0xFF: Azimuth PID Derivative value MSD
6	AKd_Frac	0x00 - 0xFF: Azimuth PID Derivative value fraction
7	AKdelta_MSD	0x00 - 0xFF: Azimuth PID Gain value MSD
8	AKdelta_Frac	0x00 - 0xFF: Azimuth PID Gain value fraction
9	AKiLim.byte[1]	0x00 - 0xFF: Azimuth PID Integral Limit value MSD
10	AKiLim.byte[0]	0x00 - 0xFF: Azimuth PID Integral Limit value LSD
11	Footer	0x0D
12	Footer2	0x00

5.2 Send EL PID Values

The “Send EL PID Values” message is a reply to the “Get EL PID Values” command described in paragraph 3.2. The details of the message are shown Table 5.2

Table 5.2: Send EL PID Values

Byte No	Name	Description
0	Header	0xA6
1	EKp_MSD	0x00 - 0xFF: Elevation PID Proportional value MSD
2	EKp_Frac	0x00 - 0xFF: Elevation PID Proportional value fraction
3	EKi_MSD	0x00 - 0xFF: Elevation PID Integral value MSD
4	EKi_Frac	0x00 - 0xFF: Elevation PID Integral fraction
5	EKd_MSD	0x00 - 0xFF: Elevation PID Derivative value MSD
6	EKd_Frac	0x00 - 0xFF: Elevation PID Derivative value fraction
7	EKdelta_MSD	0x00 - 0xFF: Elevation PID Gain value MSD
8	EKdelta_Frac	0x00 - 0xFF: Elevation PID Gain value fraction
9	EKiLim.byte[1]	0x00 - 0xFF: Elevation PID Integral Limit value MSD
10	EKiLim.byte[0]	0x00 - 0xFF: Elevation PID Integral Limit value LSD
11	Footer	0x0D
12	Footer2	0x00

5.3 Send Setup Values

The “Send Setup Values” message is a reply to the “Get Setup Values” command described in paragraph 3.8. The details of the message are shown Table 5.3

Table 5.3: Send Setup Values

Byte No	Name	Description
0	Header	0xA7
1	ReadRate.byte[1]	0x00 - 0xFF: Read Rate value MSD
2	ReadRate.byte[0]	0x00 - 0xFF: Read Rate value LSD
3	AbsRamp.byte[1]	0x00 - 0xFF: Absolute Mode Ramp value MSD
4	AbsRamp.byte[0]	0x00 - 0xFF: Absolute Mode Ramp value LSD
5	LoopTime.byte[1]	0x00 - 0xFF: Time through the Main routine in msec value MSD
6	LoopTime.byte[0]	0x00 - 0xFF: Time through the Main routine in msec value LSD
7	UpLimit	0x00 - 0xFF: Upper software limit (Degrees = UpLimit/360)
8	DownLimit	0x00 - 0xFF: Lower software limit (-Degrees = -DownLimit/360)
9	AbsGain	0x00 - 0xFF: Absolute value error Gain
10	Reserved	0x00
11	Footer	0x0D
12	Footer2	0x00

5.4 Send PID Values 2

The "Send PID Values 2" message is a reply to the "Get PID Values2" command described in paragraph 3.11. This reply contains both azimuth and elevation values. The details of the message are shown Table 5.4

Table 5.4: Send PID Values 2

Byte No	Name	Description
0	Header	0xA5
1	AKconst_MSD	0x00 - 0xFF: Az constant value optionally used in Integral MSD
2	AKconst_Frac	0x00 - 0xFF: Az constant value optionally used in Integral LSD
3	EKconst_MSD	0x00 - 0xFF: EL constant value optionally used in Integral MSD
4	EKconst_Frac	0x00 - 0xFF: EL constant value optionally used in Integral LSD
5	PID_Status	See PID_Status below
6	Reserved	0x00
7	Reserved	0x00
8	Reserved	0x00
9	Reserved	0x00
10	Reserved	0x00
11	Footer	0x0D
12	Footer2	0x00

Name	B7	B6	B5	B4	B3	B2	B1	B0
PID_Status	AzPID	0	AzIcon	AzZero	ElPID	0	ElIcon	ElZero

5.5 Send PAM Values

The "Send PAM Values " message is a reply to the "Get PAM Values" command described in paragraph 3.27. This reply contains both azimuth and elevation values. Pulse Amplitude Modulation (PAM) is a technique used to enhance slow speed operation. It consists of a pulse with the height and a pulse width being variable. Pulse height and width are controllable and the reply of "Send PAM Values" may be used to read the variables currently in the PT 150 memory.

The details of the message are shown Table 5.5.

Table 5.5: Send PAM Values

Byte No	Name	Description
0	Header	0xA2
1	Az_PAM_Ht.byte[1]	0x00 - 0xFF: Height of Azimuth PAM pulse MSD
2	EL_PAM_Ht.byte[1]	0x00 - 0xFF: Height of Elevation PAM pulse MSD
3	Max_Az_PAM_Width	0x00 - 0xFF: Width of Azimuth PAM pulse
4	Max_EL_PAM_Width	0x00 - 0xFF: Width of Elevation PAM pulse
5	Reserved	0x00
6	Reserved	0x00
7	Reserved	0x00
8	Reserved	0x00
9	Reserved	0x00
10	Reserved	0x00
11	Footer	0x0D
12	Footer2	0x00

5.6 Send Az and EL Values

The “Send AZ and EL Values ” message is a reply to all of the messages without a specific message response The details of the message are shown Table 5.6.

Table 5.6: Send Az and EL Values

Byte No	Name	Description							
0	Header	0xAA							
1	AzPosition.byte[2]	0x00 - 0x0F: Upper 4 bits of 20 bit azimuth encoder							
2	AzPosition.byte[1]	0x00 - 0xFF: Middle 8 bits of 20 bit azimuth encoder							
3	AzPosition.byte[0]	0x00 - 0xFF: Lower 8 bits of 20 bit azimuth encoder							
4	Reserved	0x00							
5	Reserved]	0x00							
6	ELPosition.byte[2]	0x00 - 0x0F: Upper 4 bits of 20 bit elevation encoder							
7	ELPosition.byte[1]	0x00 - 0xFF: Middle 8 bits of 20 bit elevation encoder							
8	ELPosition.byte[0]	0x00 - 0xFF: Lower 8 bits of 20 bit elevation encoder							
9	Reserved	0x00							
10	Reserved	0x00							
11	Pan/Tilt_Status	RSwL	Dnlim	ULim	Stow	EOK	DSwL	USwL	LSwL
12	Footer	0x00							

The Pan/Tilt Status byte bits are described below:

1. LSwL = 1: Left Software Limit has been reached
2. USwL = 1: Up Software Limit has been reached
3. DSwL = 1: Down Software Limit has been reached.
4. EOK = 1: Encoders are operational and has been initialized.
5. Stow = 1: The PT150 is in the Stow mode.
6. ULim = 1: Up Electrical limit has been reached.
7. DLim = 1: Down Electrical limit has been reached.
8. RSwL= 1: Right Software Limit has been reached.

6.0 Examples

This section will present three examples of commands to be sent to the PT150. The examples will be based upon the Graflex PT Control GUI.. Table 6.0 lists the three examples to be discussed.

Paragraphs 6.1 through 6.3 show these examples.

Table 6.0: Examples

Paragraph	Example
6.1	Velocity Command: Send a velocity command and examine the reply
6.2	Recall a Preset: Send a recall preset command
6.3	Preset Link: Store a Preset Link and examine its response

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6.1 Velocity Command

A velocity command will be sent to the PT150 and the PT150 will respond with a reply showing the current azimuth and elevation positions.

6.1.1 Velocity command to PT150

The following velocity command will create a slow movement to the right and down. The velocity command is shown in Table 6.1.1

Table 6.1.1: 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 MSD	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

6.1.2 Response to Velocity command

Lets assume that the PT150 is to the right by 22.300 degrees and pointed down by 10.000 degrees. Let us also assume that both the azimuth and elevation encoders are operational and there are no electrical or software limits reached. The response to the velocity command would look as shown below in Table 6.1.2.

Table 6.1.2: Position Response to Velocity Command

Byte No	Name	Description							
0	Header	0xAA							
1	AzPosition.byte[2]	0x00							
2	AzPosition.byte[1]	0xFD							
3	AzPosition.byte[0]	0x39							
4	Reserved	0x00							
5	Reserved]	0x00							
6	ELPosition.byte[2]	0x0F							
7	ELPosition.byte[1]	0x8E							
8	ELPosition.byte[0]	0x39							
9	Reserved	0x00							
10	Reserved]	0x00							
11	Pan/Tilt_Status	1	0	0	0	1	0	0	0
12	Footer	0x00							

6.2 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 6.2 will be sent to the PT150

Table 6.2: 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 PT150 will retrieve the azimuth and elevation positions stored in the preset 12 memory location and will initiate a movement to those positions. The PT150 will return a “Send AZ and EL Value” message. The format of the return message will be the same as described in paragraph 5.6 and discussed in paragraph 6.1.2.

The Recall Preset Command will result in a single “Send AZ and EL Value” message response. To continue to receive position feedback messages, send the “Get Azimuth and Elevation Position Command” as often as you want position feedback data.

6.3 Store a Preset Link

6.3.1 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 6.3.1 below.

Table 6.3.1 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	0x02
7	Speed MSD	0x40
8	Speed LSD	0x00
9	Footer	0x0D

6.3.2 Response to the first store Link Command:

After receiving the Store a Linked Preset Command from paragraph 6.3.1, the PT150 responds with the message in Table 6.3.2

Table 6.3.2 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 thi slinked 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.

6.3.3 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 6.3.3 below.

Table 6.3.3 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

6.3.4 Response to the second store Link Command:

After receiving the Store a Linked Preset Command from paragraph 6.3.3, the PT150 responds with the message in Table 6.3.4

Table 6.3.4 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 thi slinked 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.

6.3.5 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 6.3.5 below.

Table 6.3.5 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

6.3.6 Response to the third and final Store Link Command:

After receiving the Store a Linked Preset Command from paragraph 6.3.5, the PT150 responds with the message in Table 6.3.6

Table 6.3.6 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.