instrumentation technology systems

TECHNICAL DESCRIPTION

6125DS-DC115PD
Receiver/Driver Unit

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1.0 General

The 6125D-DC115PD Receiver/Driver provides DC drive to the pan-and-tilt motors as well as the camera focus, zoom, and iris. The unit is controlled by a master controller via a serial interface port using the Pelco P or D protocol

Features include:

- Proportional DC pan-and-tilt motor control
- Proportional DC drive for camera focus, and zoom
- Control of visible light or Infrared thermal imaging camera
- Maximum of 20 programmable preset controls
- Four programmable discrete control lines
- Calibrated Azimuth and Elevation
- Serial control port
- Go-To (Set) command function
- Nonvolatile memory.

The unit is designed to operate under the control of a master via the serial control port. The serial port also provides the means to remotely program the receiver driver unit including calibration of the position potentiometers. A "Go-To" function provides the ability of sending Azimuth, Elevation, Focus and Zoom values to the unit, which will position the Pan & Tilt and camera lens accordingly. All program data is stored in nonvolatile memory so that the program characteristics remain if input power is lost to any system element.

The receiver driver unit is housed in an environmentally sealed NEMA enclosure that is 9 inches wide by 6-1/2 inches high by 10-1/2 inches deep. It is powered by a 115 VAC +/- 10%, 50-60 Hz line. (See Figure 1.)

2.0 Characteristics

2.1 Serial Port Control

Serial control is received via an RS-232C/RS-422, asynchronous serial port with a selectable baud rate of 2400, 4800, 9600 and 19200 (See Controls & Connectors section). This port is used to program the following functions:

- Pan-and-tilt presets
- Discrete control.
- Calibration of the Position Potentiometers.

In addition to programming functions, the serial port is used to remotely control the camera and mount including:

- Manual control of mount pan-and-tilt functions
- Manual control of camera focus, zoom and iris functions
- Selection of programmed preset.
- Set pan & tilt and focus/zoom to entered values

The above functions are controlled by ASCII message strings received via the input control port, using the Pelco P and/or the extended Pelco D protocol. The P protocol commands supported are:

Pan, Tilt, Zoom, Focus, Iris, Set Aux 0-3, Clear Aux 0-3, Set zoom speed 0-3 (25% steps), Set Focus Speed 0-3 (25% steps), Set Preset (1-20), Clear Preset, Goto Preset. See Table 7.

The D protocol consists of an extended command set, which is described in Table 8 and 9

2.2 Pan-and-Tilt Motor Control

The receiver driver unit uses DC pan-and-tilt motor control. The polarity of power applied to the motors controls the direction. Proportional control is achieved by controlling the duty cycle.

2.3 Preset Control

There are 20 programmable pan-and-tilt position presets per controller. These presets are programmed and selected via the serial control port by the master. When selected, the camera automatically returns to the preset position. Due to proportional servo control of the pan-and-tilt motors, positioning is very precise and, in most cases, requires no manual compensation.

Note that the sensitivity of the zoom function is not identical on all lenses. In some cases, hunting occurs when the lens is driven to a preset position. In order to adapt the receiver driver to all lenses, four proportional control profiles are provided. The factory set profile works in most cases; however, if there is a problem, another profile may be selected by an internal 8-station DIP switch. Only stations 7 and 8 are used for this function as shown in the table below.

2.3 Preset Control (continued)

Profile	S2-7	S2-8
1. Most sensitive (default)	Off	Off
2.	Off	On
3.	On	Off
4. Least sensitive	On	On

2.4 Discrete Control

There are four discrete contact-closure control outputs. Two are open-drain and two are pull-up to 12 volts. All four are available on the Input/Output connector. Each output may be set or cleared by operator command from the controller via the serial port.

Discrete Bit 1 (open drain) is used to control external power to the IR camera. This output is active (low true) to turn IR power ON.

3.0 Mechanical Configuration

The receiver driver unit is housed in an environmentally sealed NEMA enclosure that is 9 inches wide by 6-1/2 inches high by 10-1/2 inches deep. It is powered by a 115 VAC +/- 10%, 50-60 Hz line. (See Figure 1.)

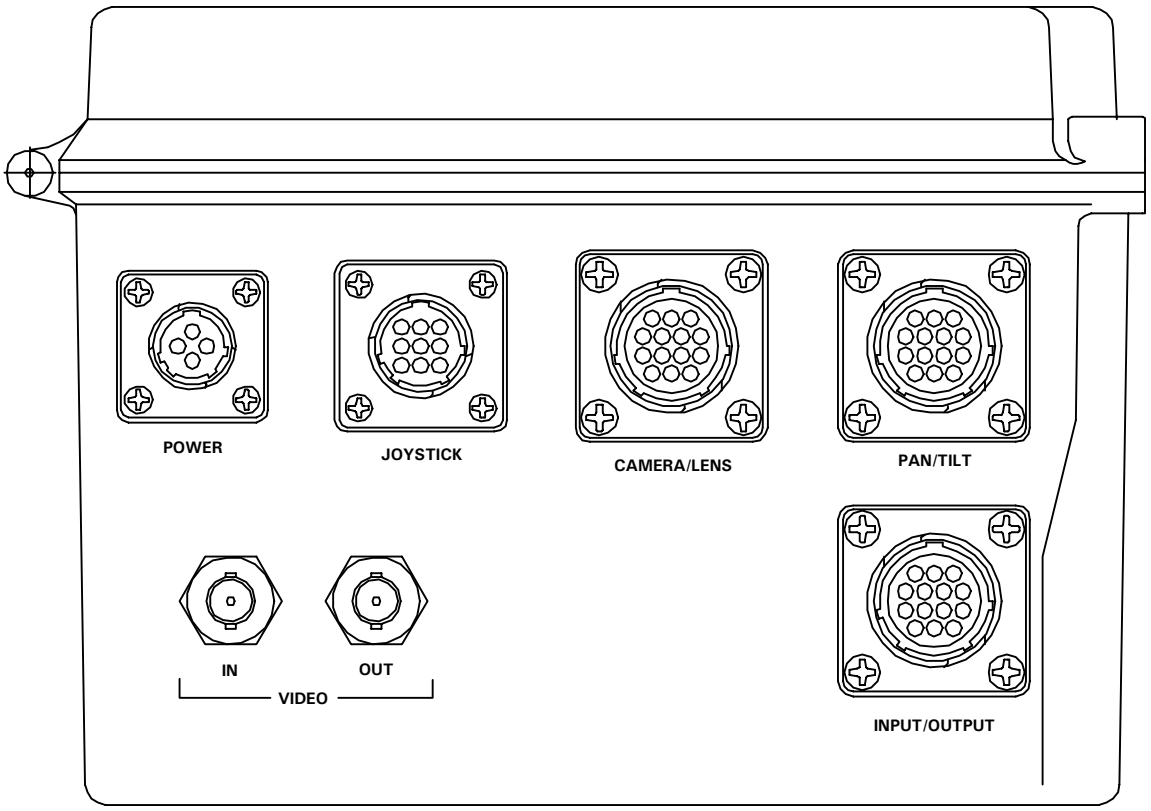

Figure 1
6125DS Receiver/Driver Unit

4.0 Controls and Connectors

<table>
<tr><th>Control/Connector/Indicator</th><th>Description</th></tr>
<tr><td>POWER connector</td><td>4-pin circular connector, Amp series 1 -Receives 115 VAC power input.</td></tr>
<tr><td>JOYSTICK connector</td><td>9-pin circular connector, Amp series 1 - Provides interface to optional, local, joystick controller.</td></tr>
<tr><td>CAMERA/LENS control</td><td>14-pin circular connector, Amp series 1 - Provides control outputs to camera lens. Outputs include one pull-down discrete control line. Note that the same discrete line is also present on the INPUT/OUTPUT connector.</td></tr>
<tr><td>PAN/TILT control</td><td>14-pin circular connector, Amp series 1 - Provides control outputs to pan-and-tilt mount.</td></tr>
<tr><td>INPUT/OUTPUT control</td><td>16-pin circular connector, Amp series 1 - Control performs multiple functions:
Provides bi-directional serial I/O interface to master controller
Uses four discrete control lines, two pull-up and two pull-down.</td></tr>
<tr><td>VIDEO IN/OUT connector</td><td>BNC connectors that provide video pass-through for cable termination.</td></tr>
<tr><td>RS-232/RS-422 Select JP1,jumper plug</td><td>Internal jumper plug that selects control signal protocol. Note: Set JP1 internal jumper plug to connect pins 1-2 for RS-232 and 2-3 for RS-422.</td></tr>
<tr><td>Address switch</td><td>16-position internal rotary switch that provides for unit serial I/O address selection. (Switch is labeled 0 - 15, which translates to 1 - 16. Position 0 is actually position 1.)</td></tr>
<tr><td>Proportional Zoom Control Profile Select switch</td><td>Internal DIP switch selects one of four profiles. See Preset Control above.</td></tr>
<tr><td>Baud Rate Select switch</td><td>Internal DIP switch that selects the master interface baud rate.
<table>
<tr><th>Rate</th><th>S2-1</th><th>S2-2</th></tr>
<tr><td>2400</td><td>ON</td><td>ON</td></tr>
<tr><td>4800</td><td>OFF</td><td>ON</td></tr>
<tr><td>9600</td><td>ON</td><td>OFF</td></tr>
<tr><td>19200</td><td>OFF</td><td>OFF</td></tr>
</table></td></tr>
<tr><td>Camera Select switch</td><td>Internal DIP switch that selects the camera type.
<table>
<tr><th>Camera Type</th><th>S2-3</th></tr>
<tr><td>IR DiOP Field Pro</td><td>ON</td></tr>
<tr><td>Visible light</td><td>OFF</td></tr>
</table></td></tr>
<tr><td>Pan/Tilt Select switch</td><td>Internal DIP switch that selects the Pan/Tilt mount type.
<table>
<tr><th>Pan/Tilt Type</th><th>S2-6</th></tr>
<tr><td>Pelco PT1250DC/PP</td><td>ON</td></tr>
<tr><td>Quickset QPT90</td><td>OFF</td></tr>
</table></td></tr>
</table>

4.0 Controls and Connectors (continued)

Table 1
CONNECTOR TYPES

(All AMP Series 1 type):

Function	Type	Pinout	Wire gauge	P/N - Pin type	Mate - Pin type
Power:	11-4	Std	16-18	206061-2/66103-1	206060-1/66101-3
Joystick:	13-9	Std	20-24	206705-1/66103-3	206708-1/66105-3
Pan/tilt:	17-14	Rev(1)	20-24	206043-1/66105-3	206044-1/66103-3
Camera/lens:	17-14	Rev(1)	20-24	206043-1/66105-3	206044-1/66103-3
Input/output:	17-16	Std	20-24	206036-1/66103-3	206037-1/66105-3

(1) Use keying plug for **Camera/Lens** and **Pan/Tilt** (1 each): 200821-1

Table 2
POWER

Pin	Function	Recommended Wire Gauge
1	AC hot	18 gauge
2	AC neutral	18 gauge
3	Chassis	18 gauge
4	n/u	---

Table 3
JOYSTICK

Pin	Function	Recommended Wire Gauge
1	Pot VREF	24 gauge
2	X axis pot	24 gauge
3	Y axis pot	24 gauge
4	n/u	---
5	Pan/tilt switch	24 gauge
6	Zoom/focus switch	24 gauge
7	GND	24 gauge
8	n/u	---
9	Chassis	Shield with 1-7

4.0 Controls and Connectors (continued)

Table 4
PAN/TILT

Pin	Function	Recommended Wire Gauge
1	Pot VREF	24 gauge
2	Pan pot wiper	24 gauge
3	Tilt pot wiper	24 gauge
4	Pot GND	24 gauge and shield with 11-14
5	n/u	---
6	n/u	---
7	n/u	---
8	n/u	---
9	(key pin)	---
10	Motor ground	Shield with 2-5
11	Tilt up motor	20 gauge twisted with 3
12	Tilt down motor	20 gauge twisted with 2
13	Pan right motor	20 gauge twisted with 6
14	Pan left motor	20 gauge twisted with 5

Recommend Belden 9402 for 1-5 and Belden 9534 for 11-14.

Table 5
CAMERA/LENS

Pin	Function	Recommended Wire Gauge
1	Pot VREF	24 gauge
2	Zoom pot wiper	24 gauge
3	Focus pot wiper	24 gauge
4	Pot GND	24 gauge and shield with 1-4
5	(key pin)	---
6	Camera +12V	20 gauge
7	Lens/camera GND	20 gauge
8	Focus motor	20 gauge
9	TxD (to camera)	24 gauge
10	Zoom motor	20 gauge
11	RxD (from camera)	24 gauge
12	Chassis	20 gauge and shield with 6-14
13	Heater 110VAC hot	20 gauge
14	Heater 110VAC neutral	20 gauge

Recommend Belden 9534 for 1-4 and Belden 9621 for 6-14.

4.0 Controls and Connectors (continued)

Table 6
INPUT/OUTPUT

Pin	Function	Recommended Wire Gauge
1	RS-422 RxD0 from controller	24 gauge
2	RS-422 RxD1 from controller	24 gauge
3	RS-422/RS-232 GND from controller	Shield with 1-2
4	RS-232 RxD from controller	24 gauge if used
5	RS-422 TxD0 to controller	24 gauge
6	RS-422 TxD1 to controller	24 gauge
7	RS-422/RS-232 GND to controller	Shield with 5-6
8	RS-232 TxD to controller	24 gauge
9	(key pin)	---
10	Control +12V	a/r for application
11	Control output 1 (OC)	IR camera power control. (low = ON)
12	Control output 2 (OC)	a/r for application
13	Control output 3 (switched +12)	a/r for application
14	Control output 4 (switched +12)	a/r for application
15	Control GND	a/r for application
16	Chassis	20-24 gauge

Recommend Belden 82841 for 1-3 and 5-7 if RS-422 used.

5.0 Specifications

Item	Description
Pan/tilt motor control	DC, proportional control. Voltage = 115 V; maximum current of each motor = 0.5 A.
Lens control	DC, proportional control to focus and zoom motors and on/off control to iris motor. Voltage = 12 VDC; maximum current to each motor = 300 mA.
Control in	EIA RS-232C and RS-422 asynchronous serial ports, receive only, Baud rate selectable: 2400, 4800,9600,19200.
Command Protocol	Pelco P/D protocol, See Tables 1& 2
Presets	20, Stores pan, tilt, focus, and zoom positions.
Discrete control lines	Four lines, two pull-down and two pull-up (12 V). 1 A maximum
Power	115 VAC +/- 10%, 50-60 Hz 10 W nominal, 30 W average when active, 150 W peak
Enclosure	NEMA box, 9 inches wide by 6-1/2 inches high by 10-1/2 inches deep.
Environmental	Temperature: -10 to 60°C Sealed unit suitable for outside mounting.

6.0 Command Protocol

6.1 P Protocol Description

Table 7
P PROTOCOL COMMAND INPUT BUFFER EQUATES

P-Protocol data format (8 bytes):

0A0h aa qq rr ss tt 0AFh uu

Where: aa = address
qqrr = command
ss = pan data
tt = tilt/aux data
uu = checksum (XOR of first 7 bytes)

Extended function if bit 0 of rr = 1 else motion

Motion commands

```
MPANRF  EQU   02H    ;PAN RIGHT          (rr)
MPANLF  EQU   04H    ;PAN LEFT           (rr)
MTLTUF  EQU   08H    ;TILT UP            (rr)
MTLTDF  EQU   10H    ;TILT DOWN          (rr)
MZOMIF  EQU   20H    ;ZOOM IN            (rr)
MZOMOF  EQU   40H    ;ZOOM OUT           (rr)

MFCSFF  EQU   01H    ;FOCUS FAR (qq)
MFCSNF  EQU   02H    ;FOCUS NEAR         (qq)
MIRSOF  EQU   04H    ;IRIS OPEN          (qq)
MIRSCF  EQU   08H    ;IRIS CLOSE         (qq)
```

Extended function commands

```
MPRSET  EQU   03H    ;PRESET SET 1-20          (data in byte tt)
MPRCLR  EQU   05H    ;PRESET CLEAR 1-20        (data in byte tt)
MPRGO   EQU   07H    ;PRESET GO 1-20           (data in byte tt)
MAUXS   EQU   09H    ;SET AUX 0-3              (data in byte tt)
MAUXC   EQU   0BH    ;CLEAR AUX 0-3            (data in byte tt)
MZSPD   EQU   25H    ;ZOOM SPEED 0-3           (data in byte tt)
MFSPD   EQU   27H    ;FOCUS SPEED 0-3          (data in byte tt)

CMDSTX  EQU   0A0H  ;COMMAND STX               (prefix)
CMDACK  EQU   0A2H  ;COMMAND ACK               (for all validated commands)
CMDNAK  EQU   0AAH  ;COMMAND NAK               (do not use)
CMDETX  EQU   0AFH  ;COMMAND ETX               (suffix)
```

6.2 D Protocol Description

Table 8
COMMAND PROTOCOL (PELCO D)

Description

ITS Model 6125DS-DC115PD command protocol is a modified Pelco D-protocol format. Note that the custom commands and responses shown here follow the Pelco extended command format however occupy currently undefined fields. Pelco has reserved the right to expand their protocol, which could make use of these fields and therefore make this system incompatible with future Pelco command structures.

Command data formats shown are bytes 3-6 of the command message and responses are bytes 3-6 of the Extended response. Bytes 1, 2 & 7 are per the Pelco specifications (See Section 3.0).

Function	**Command**
Pan	Pelco standard format. No response.
Tilt	Pelco standard format. No response.
Zoom	Pelco standard format. No response.
Focus	Pelco standard format. No response.
Set Preset	Pelco standard format. General response.
Go To Preset	Pelco standard format. General response + set motion status flag.
Clear Preset	Pelco standard format. General response.
Cal Pan #1	01H 77H *ab cd*. Response: 01H 77H 00H *qq*.
Cal Pan #2	02H 77H *ab cd*. Response: 02H 77H 00H *qq*.
Cal Tilt #1	03H 77H *ab cd*. Response: 03H 77H 00H *qq*.
Cal Tilt #2	04H 77H *ab cd*. Response: 04H 77H 00H *qq*.
Set Pan	05H 77H *ab cd*. Response 05H 77H 00H *qq* + set motion status flag.
Set Tilt	06H 77H *ab cd*. Response 06H 77H 00H *qq* + set motion status flag.
Set Zoom	07H 77H *ef gh*. Response 07H 77H 00H *qq* + set motion status flag.
Set Focus	08H 77H *ef gh*. Response 08H 77H 00H *qq* + set motion status flag.
Query Pan	09H 77H 00H 00H. Response 09H 77H *ab cd.*
Query Tilt	0AH 77H 00H 00H. Response 0AH 77H *ab cd.*
Query Zoom	0BH 77H 00H 00H. Response 0BH 77H *ef gh.*
Query Focus	0CH 77H 00H 00H. Response 0CH 77H *ef gh.*
Query Motion	0DH 77H 00H 00H. Response 0DH 77H 00H *rr.*
IR Camera OFF	0FH 77H 10H 00H. Response: 0FH 77H 10H 00H.
IR Camera ON	0FH 77H 11H 00H. Response: 0FH 77H 11H *pp*H.
Query IR Com	0FH 77H 17H 00H. Response: 0FH 77H 13H *vv*H

ab cd is a packed BCD angle where *a* is 100's of degrees and *d* is 0.1 degrees (limits *00 00* to *35 99*). Fractional degrees *d* always 0

ef gh is a packed BCD setting where *e* is 1000's and *d* is 1 (limits *00 00* to *10 23*).

qq = 00H if OK, and 01H for format error, 02H for range error (Cal #2 only).

rr=00H if no process active, if mount or lens is moving, per previous command, at the time of the query, the component/s in motion is/are indicated by the value of a corresponding bit with : Bit 0 for Pan, Bit 1 for Tilt, Bit 2 for Zoom, and Bit 3 for Focus

Table 8 Command Protocol (continued)

NOTES:

1. There are no unprompted (asynchronous) responses. All responses are posted immediately after their respective commands.

2. The Pan/Tilt mount's position accuracy is unable to resolve less than 1 degree, so the commands and responses have been truncated to 1 degree. A command of 123.7 degrees will be truncated (not rounded) to 123.0 degrees and the fractional 0.1 degree in the response will always be 0. e.g. A PAN command 0xFF 0x00 0x05 0x77 *0x12 0x37* 0xC5 is the same as 0xFF 0x00 0x05 0x77 *0x12 0x30* 0xBE

Table 9
DiOP Field Pro 5x Thermal Image Camera Commands

Nominal processing time for all < 150ms, except as noted.

Function	**Command**	
AGC Off	22H 77H 00H 00H	
AGC On	22H 77H 00H 01H	
Manual Gain Step Down	22H 77H 01H 00H	
Manual Gain Step Up	22H 77H 01H 01H	
Manual Offset Step Down	22H 77H 02H 00H	
Manual Offset Step Up	22H 77H 02H 01H	
Video Black Hot	22H 77H 03H 00H	
Video White Hot	22H 77H 03H 01H	
FOV Wide	22H 77H 04H 00H	(<3 second process)
FOV Mid	22H 77H 04H 01H	(<3 second process)
FOV Narrow	22H 77H 04H 02H	(<3 second process)
FOV Set	22H 77H 7*n*H *nn*H	where: *nnn*= 64H to 1F4H
Focus Step Infinity	22H 77H 05H *pp*H	where: *pp*=value 0 to FFH x Duration
Focus Step Near	22H 77H 06H *pp*H	where: *pp*=value 0 to FFH x Duration
Focus Step Duration	22H 77H 07H *rr*H	where: *rr*=value 1 to FFH in ms
Auto-Cal Off	22H 77H 08H 00H	
Auto-Cal On	22H 77H 08H 01H	

Table 9, DiOP Field Pro 5x Thermal Image Camera Commands (continued)

Function	Command	
Shutter Off	22H 77H 09H 00H	
Shutter On	22H 77H 09H 01H	
Perform Cal1	22H 77H 0AH 00H	(<3 second process)
Servo Off	22H 77H 0BH 00H	
Servo On	22H 77H 0BH 01H	
Reticle Off	22H 77H 0CH 00H	
Reticle On	22H 77H 0CH 01H	
Auto-Focus	22H 77H 0DH 00H	
Update Flash	22H 77H 0EH 00H	
Verbose Off	22H 77H 0FH 00H	
Manual Gain Set	22H 77H 4*n*H *nn*H	where: *nnn*= 0 to FFFH
Manual Offset Set	22H 77H 5*n*H *nn*H	where: *nnn*= 0 to FFFH
Auto-Cal Interval Set	22H 77H 6*n*H *nn*H	where: *nnn*= 0 to FFFH
Focus for FOV Narrow	22H 77H 8*n*H *nn*H	where: *nnn*= 0 to FFFH
Focus for FOV Mid	22H 77H 9*n*H *nn*H	where: *nnn*= 0 to FFFH
Focus for FOV Wide	22H 77H A*n*H *nn*H	where: *nnn*= 0 to FFFH

7.0 PAN/TILT CALIBRATION PROCEDURE

The 6125DS-115DCPD is designed to operate with 115VDC pan & tilt mounts with position potentiometers, such as the Quickset QPT-90 (model 7-59207-5) or the Pelco PT1250DC/PP. To use either the 'SET', 'Query Pan' or 'Query Tilt' commands it is necessary to calibrate the position pots. DIP switch S3-6 must be set to select attached Pan & Tilt unit. See Paragraph 4.

7.1 Calibration of the Azimuth (Pan) position angle:

1. Point the camera to a calibrated heading
2. Enter the Cal Pan #1 heading for that position (assure you get a valid response)
3. Point the camera to a second calibrated position as far from the first point as possible
4. Enter the Cal Pan #2 heading for that position (assure you get a valid response)

7.2 Calibration of the Elevation (Tilt) position angle:

1. Point the camera to a calibrated heading
2. Enter the Cal Tilt #1 heading for that position (assure you get a valid response)
3. Point the camera to a second calibrated position as far from the first point as possible
4. Enter the Cal Tilt #2 heading for that position (assure you get a valid response)

7.3 Conditions:

The user may combine the Pan and Tilt steps together and calibrate both Pan and Tilt at the same time from any given calibration point if desired (e.g. enter both Cal Pan #1 and Cal Tilt #1 for the same camera heading).

A response byte of "**0**" indicates the entry was accepted without errors.

A response byte of "**1**" indicates that the entered calibration value was not a valid packed BCD value or that the angle was greater than 359.9 (35H 99H).

A response byte of "**2**", which only occurs on command byte #2, indicates that the 6125D has determined that the separation angle between entered values #1 and #2 is out of range for the camera position change (e.g. the difference between entered values #1 and #2 is 90 degrees when the camera has only moved about 5 degrees between calibration points).

Although the calibration values are entered to 0.1 degree, the mechanical characteristics of the Quickset QPT 90 or Pelco PR1250DC/PP mount, limit the position accuracy to 1 degree. The user should use the greatest angle possible between calibration points to get the greatest accuracy. If, for example, the user chooses two points separated by 10 degrees with a position accuracy of 1 degree, the potential error might be 10%; however, if the separation angle were 200 degrees then the potential error would be limited to 0.5%.

7.4 Alternate One Point Calibration Procedure

1. Position the camera to the desired direction.
2. Send the Cal Pan #2 command with the desired angle *(without doing a Cal Pan #1)*.

This process simply realigns the compass rose using the selected angle as an anchor point. It does not change the internal azimuth scale factors. A *full* calibration operation requires doing a Cal Pan #1 before doing a Cal Pan #2. Doing a Cal Pan #2 without a Cal Pan #1 will do the one-point azimuth calibration. Responses are either **0** if ok or **1** if entered angle is invalid (there is no range error in a one-point calibration). A one-point elevation calibration can be done using the same procedure with Cal Tilt #2.