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PELCO "D" PROTOCOL MANUAL

TABLE OF CONTENTS

Document History

1. Initial Release, 7/07/03.
2. Version 2 release, 8/15/03: updated the “Query Response Command Format”, page 10 and the write characters to display footnote on page 12.

LEGAL NOTICES

NOTICE OF DISCLAIMER

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Those receiving this protocol cannot redistribute the protocol without the expressed written consent of Pelco.

QUESTIONS

Questions regarding this protocol, it's implementation, use, and distribution should be addressed to:

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WHAT THIS MANUAL COVERS

This manual describes the minimum requirements for implementing the Pelco "D" protocol. This protocol is used to communicate between a controlling device (e.g. a matrix switching system) and a receiver/driver (e.g. a dome drive).

Not all devices will be able to accommodate all of the features available in this protocol. This protocol is designed to cover the feature sets of a wide variety of equipment.

THE BYTE FORMAT

Transmitters will format a single character and receivers will be able to decipher a single character as: 1 start bit, 8 data bits, 1 stop bit, and no parity.

THE MESSAGE FORMAT

The format for a message is:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync Byte	Address	Command 1	Command 2	Data 1	Data 2	Checksum

Note that values in this document prefixed with "0x" are hexadecimal numbers.

The *synchronization byte* (Sync Byte) is *always* **0xFF**.

The *Address* is the logical address of the receiver/driver device being controlled.

The *Checksum* is calculated by performing the 8 bit (modulo 256) sum of the payload bytes (bytes 2 through 6) in the message.

THE STANDARD COMMAND SET

Command 1 and 2 are represented as follows:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Command 1	Sense	Reserved	Reserved	Auto / Manual Scan	Camera On / Off	Iris Close	Iris Open	Focus Near
Command 2	Focus Far	Zoom Wide	Zoom Tele	Down	Up	Left	Right	***Always 0***

A value of '1' entered in the bit location for the function desired will enable that function. A value of '0' entered in the same bit location will disable or 'stop' the function.

The sense bit (command 1 bit 7) indicates the meaning of bits 4 and 3. If the sense bit is on (value of '1'), and bits 4 and 3 are on, the command will enable auto-scan and turn the camera on. If the sense bit is off (value of '0'), and bits 4 and 3 are on the command will enable manual scan and turn the camera off. Of course, if either bit 4 or bit 3 are off then no action will be taken for those features.

The *reserved bits* (6 and 5) should be set to 0.

Byte 5 contains the pan speed. Pan speed is in the range of '0x00' to '0x3F' (high speed) and '0x40' for "turbo" speed. Turbo speed is the maximum speed the device can obtain and is considered separately because it is not generally a smooth step from high speed to turbo. That is, going from one speed to the next usually looks smooth and will provide for smooth motion with the exception of going into and out of turbo speed. A pan speed value of '0x00' results in very slow motion, not cessation of motion. To stop pan motion both the Left and Right direction bits must be turned off – set to '0' – regardless of the value set in the pan speed byte.

Byte 6 contains the tilt speed. Tilt speed is in the range of '0x00' to '0x3F' (maximum speed). Turbo speed is not allowed for the tilt axis. A tilt speed value of '0x00' results in very slow motion, not cessation of motion. To stop tilt motion both the Down and Up direction bits must be turned off – set to '0' – regardless of the value set in the tilt speed byte.

Byte 7 is the checksum. The checksum is the 8 bit (modulo 256) sum of the payload bytes (bytes 2 through 6) in the message.

EXTENDED COMMANDS

In addition to the "PTZ" commands shown above, there are control commands that allow access to the more advanced features of some equipment. Bytes 3 and 4 can be thought of as the command's opcodes.

Command	Byte 3	Byte 4	Byte 5	Byte 6	Response Type
Set Preset	00	0x03	00	Preset id	General
Clear Preset	00	0x05	00	Preset id	General
Go To Preset	00	0x07	00	Preset id	General
Flip (180° about)	00	0x07	00	0x21	General
Go To Zero Pan	00	0x07	00	0x22	General
Set Auxiliary	00	0x09	00	01 to 08	General
Clear Auxiliary	00	0x0B	00	01 to 08	General
Remote Reset	00	0x0F	00	00	General
Set Zone Start	00	0x11	00	01 to 08	General
Set Zone End	00	0x13	00	01 to 08	General
Write Character to Screen	00	0x15	Column 00 to 0x27	ASCII Value	General
Clear Screen	00	0x17	00	00	General
Alarm Acknowledge	00	0x19	00	01 to 08	General
Zone Scan On	00	0x1B	00	00	General
Zone Scan Off	00	0x1D	00	00	General
Set Pattern Start	00	0x1F	00	Pattern id	General
Set Pattern Stop	00	0x21	00	00	General
Run Pattern	00	0x23	00	Pattern id	General
Set Zoom Speed	00	0x25	00	00 to 03	General
Set Focus Speed	00	0x27	00	00 to 03	General
Reset Camera to defaults	00	0x29	00	00	General
Auto-focus auto/on/off	00	0x2B	00	00-02	General
Auto Iris auto/on/off	00	0x2D	00	00-02	General
AGC auto/on/off	00	0x2F	00	00-02	General
Backlight compensation on/off	00	0x31	00	01-02	General
Auto white balance on/off	00	0x33	00	01-02	General
Enable device phase delay mode	00	0x35	00	00	General
Set shutter speed	00	0x37	Any	Any	General
Adjust line lock phase delay	00-01	0x39	Any	Any	General

Command	Byte 3	Byte 4	Byte 5	Byte 6	Response Type
Adjust white balance (R-B)	00-01	0x3B	Any	Any	General
Adjust white balance (M-G)	00-01	0x3D	Any	Any	General
Adjust gain	00-01	0x3F	Any	Any	General
Adjust auto-iris level	00-01	0x41	Any	Any	General
Adjust auto-iris peak value	00-01	0x43	Any	Any	General
Query[1]	00	0x45	Any	Any	See "Responses" part of this document.

ADVANCED FEATURE SET

Command	Byte 3	Byte 4	Byte 5	Byte 6	Response Type
Reserved Opcode	00	0x47	00	00	Not Applicable
Set Zero Position	00	0x49	00	00	General
Set Pan Position	00	0x4B	Pan position MSB	Pan position LSB	General
Set Tilt Position	00	0x4D	Tilt position MSB	Tilt position LSB	General
Set Zoom Position	00	0x4F	Zoom position MSB	Zoom position LSB	General
Query Pan Position	00	0x51	00	00	Extended (0x59)
Query Tilt Position	00	0x53	00	00	Extended (0x5B)
Query Zoom Position	00	0x55	00	00	Extended (0x5D)
Reserved Opcode	00	0x57	00	00	Not Applicable
Query Pan Response	00	0x59	Pan position MSB	Pan position LSB	Not Applicable
Query Tilt Response	00	0x5B	Tilt position MSB	Tilt position LSB	Not Applicable
Query Zoom Response	00	0x5D	Zoom position MSB	Zoom position LSB	Not Applicable
Set Magnification	00	0x5F	Mag position MSB	Mag position LSB	General
Query Magnification	00	0x61	00	00	Extended (0x63)
Query Magnification Response	00	0x63	Mag position MSB	Mag position LSB	Not Applicable
Reserved Opcode	00	0x65	00	00	Not Applicable

[1] This command can only be used in a point to point application. A device being queried will respond to any address. If more than one device hears this command, multiple devices will transmit at the same time.

Command	Byte 3	Byte 4	Byte 5	Byte 6	Response Type
Reserved Opcode	00	0x67	00	00	Not Applicable
Reserved Opcode	00	0x69	00	00	Not Applicable
Reserved Opcode	00	0x6B	00	00	Not Applicable
Reserved Opcode	00	0x6D	00	00	Not Applicable
Reserved Opcode	00	0x6F	00	00	Not Applicable
Reserved Opcode	00	0x71	00	00	Not Applicable

CREATING LABELS

Many devices have the ability to display labels on the video. Labels that identify the preset or zone being scanned are common. There is a special technique to establish a label that is associated with either a preset or a zone. First, send the label to the receiver/driver using the "Write Character to Screen" command. After the label is on the screen, set the preset or zone. That will establish the label and associate it with the preset. Reference the detailed information in the "Opcode Descriptions" section of this manual.

EXAMPLE MESSAGES

Message to send	Message
Receiver 1, Camera on	0xFF, 0x01, 0x88, 0x00, 0x00, 0x00, 0x89
Receiver 1, Camera off	0xFF, 0x01, 0x08, 0x00, 0x00, 0x00, 0x09
Receiver 2, Pan Left	0xFF, 0x02, 0x00, 0x04, 0x20, 0x00, 0x26
Receiver 2, Stop	0xFF, 0x02, 0x00, 0x00, 0x20, 0x00, 0x22
Receiver 10, Camera on, Focus far, Tilt Down	0xFF, 0x0A, 0x88, 0x90, 0x20, 0x00, 0x42

Note: the checksum calculation for the last message looks like this:

0xFF	1111 1111	Sync byte is ***not used*** for the checksum	
0x0A	0000 1010		
0x88	1000 1000		
Subtotal	1001 0010	0x92	
0x90	1001 0000		
Subtotal	0010 0010	0x22	(modulo 256 allows the high bit to roll off)
0x20	0010 0000		
Subtotal	0100 0010	0x42	
0x00	0000 0000		
	0100 0010	0x42	Final checksum value

RESPONSES

Devices that receive a "D" protocol command will generate a response. The response formats are described below.

The General Response

The General Response has the following format. Note that each block represents 1 byte.

Byte 1	Byte 2	Byte 3	Byte 4
Sync	Address	Alarm Information	Checksum

The alarm information is formatted as follows:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
None	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1

If the bit is on (1) then the alarm is active. If the bit is off (0) then the alarm is inactive.

The checksum is the sum of the ***transmitted command's checksum*** and the alarm information.

The Query (0x45) Response

The response to the Query command is:

Byte 1	Byte 2	Bytes 3 to 17	Byte 18
Sync (1 byte)	Address (1 byte)	Part Number (15 bytes)	Checksum (1 byte)

The address is the address of the device responding to the query. The content of the part number field is dependent on the type and version of the device being programmed, please refer to the table that follows.

The checksum is the 8 bit (modulo 256) sum of the ***transmitted query command's checksum,*** the address of the response, and the 15-byte part number.

Pelco Receiver/Driver	Part number field contents
Spectra	ASCII text string of the program number and version of device, e.g. " PG53-0001-R206 "
Spectra II	ASCII text string of the program number and version of device, e.g. " PG53-0060-S331 "
Spectra III prior to version 1.22	ASCII text string of the program number and version of device, e.g. " PG53-0060-S400 "
Spectra III version 1.22 and later	ASCII text string of the device model number, e.g. " DD53C22-X "
Esprit prior to version 3.10	ASCII text string of the program number and version of device, e.g. " PG53-0097-R306 "
Esprit version 3.10 and later	ASCII text string of the device model number, e.g. " ES31CBW18 "

The Extended Response

The Extended Response has the following format. Note that each block represents 1 byte

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Sync	Address	Future Use	"opcode"	Data1	Data2	Checksum

The address is the address of the device that is responding.

The Future Use byte should always be set to 0.

Opcode, Data1 and Data2 are dependent on the type of response. See the opcode description section of this document for the details of a particular response.

The checksum is the 8 bit (modulo 256) sum of all the bytes excluding the Sync byte.

OPCODE DESCRIPTIONS

Please note that this is not an exhaustive list, the most commonly used commands have been described for clarity of implementation.

Set Preset (0x03)
Clear Preset (0x05)
Go To Preset (0x07)

The parameter in byte 6 of these commands is the ID of the preset to be acted on. Valid preset IDs begin at 1. Most devices support at least 32 presets. Refer to the manual of the device under use for information about what range of presets are valid for that equipment.

Write Character To Screen (0x15)

The parameter in ***byte 5*** of this command indicates the column to write to. This parameter is interpreted as follows:

Columns 0-19 are used to receive ***zone*** labels. [2]

Columns 20-39 are used to receive ***preset*** labels. [3]

Set Pattern Start (0x1F)
Run Pattern (0x23)

The parameter in byte 6 of these commands indicates the pattern to be set/run**.**

Spectra III and ***Spectra III SE*** interpret this byte as follows:

Value	Action
0 or 1	Sets/runs pattern 1
2	Sets/runs pattern 2
3	Sets/runs pattern 3
4	Sets/runs pattern 4

Spectra II and Esprit interpret this byte as follows:

Value	Action
0	Sets/runs the single "long pattern"
1	Sets/runs the first "short pattern"
2	Sets/runs the second "short pattern"

[2] For Spectra III and Spectra III SE *only*, characters written to these positions are not written directly to the screen. Once the *SET_ZONE_START* (opcode 0x11) command is received, the characters are displayed.
[3] For Spectra III and Spectra III SE *only*, characters written to these positions are not written directly to the screen. However, if characters are written to these columns and no *SET_PRESET* (opcode 0x03) command is received within *250 milliseconds of receipt of the last character,* the characters will be displayed on the screen beginning at the first column of the second row of the display.

Reserved Opcode (0x47)

For Pelco internal use only.

Set Zero Position (0x49)

This command is used to set the pan position that the unit uses as a zero reference point for the azimuth on-screen display. The unit's current pan position when this command is received becomes the zero reference point. This command performs the same function as the "Set Azimuth Zero" menu item.

Set Pan Position (0x4B)

This command is used to set the pan position of the device. The position is given in hundredths of a degree and has a range from 0 to 35999 (decimal). Example: the value to use to set the pan position to 45 degrees is 4500. Note that the value used here is always the "absolute" pan position. It **does not** take into account any adjustment to the screen display that may have been made by using the "Set Zero Position", opcode (0x49) command or the "Set Azimuth Zero" menu item.

Set Tilt Position (0x4D)

This command is used to set the tilt position of the device. The position is given in hundredths of a degree and has a range from 0 to 35999 (decimal). Generally these values are interpreted as follows:
Zero degrees indicates that the device is pointed horizontally (at the *horizon*). *Ninety degrees* indicates that the device is pointed straight down.

Examples:

1) the value used to set the tilt position to 45 degrees *below the horizon,* is 4500.

2) the value used to set the tilt position 30 degrees *above the horizon,* is 33000.

Note that different equipment will have different ranges of motion. To determine the abilities of a specific piece of equipment, refer to that device's operation manual.

Set Zoom Position (0x4F)

This command is used to set the zoom position of the device. The position is given as a ratio based on the device's Zoom Limit setting. The position is calculated as follows:

Position = (desired_zoom_position / zoom_limit) * 65535

Where desired_zoom_position and zoom_limit are given in units of magnification.

Example: Given that the zoom limit of the device's camera is X184, calculate the value needed to set the zoom position to X5:

Position = (5 / 184) * 65535 = approximately 1781

Query Pan Position (0x51)

This command is used to query the current pan position of the device. The response to this command uses opcode 0x59. See the description of opcode 0x59 for more information.

Query Tilt Position (0x53)

This command is used to query the current tilt position of the device. The response to this command uses opcode 0x5B. See the description of opcode 0x5B for more information.

Query Zoom Position (0x55)

This command is used to query the current zoom position of the device. The response to this command uses opcode 0x5D. See the description of opcode 0x5D for more information.

Reserved Opcode (0x57)

For Pelco internal use only.

Query Pan Position Response (0x59)

The position is given in hundredths of a degree and has a range from 0 to 35999 (decimal).
Example: a position value of 4500 indicates 45 degrees. Note that the value returned is always the "absolute" pan position. It **does not** take into account any adjustment to the screen display that may have been made by using the "Set Zero Position", opcode (0x49) command or the "Set Azimuth Zero" menu item.

Query Tilt Position Response (0x5B)

The position is given in hundredths of a degree and has a range from 0 to 35999 (decimal). Refer to examples listed in description of the "Set Tilt Position", opcode 0x4D command.

Query Zoom Position Response (0x5D)

The position is given as a ratio based on the device's Zoom Limit setting. This value can be converted into units of magnification by using the following formula:

current_magnification = (position / 65535) * zoom_limit
Where current_zoom_position and zoom_limit are given in units of magnification.

Example: Given that the zoom limit of the device's camera is X184, position value is 1781, calculate the current magnification:

Current magnification = (1781 / 65535) * 184 = approximately X5.

Note: This message is sent in response to the Query Zoom Position (0x55) command.

Set Magnification (0x5F)

This command is used to set the zoom position of the device. The position is given in hundredths of units of magnification. Example: a value of 500 means X5.

Query Magnification (0x61)

This command is used to query the current zoom position of the device. The response to this command uses opcode 0x63. See the description of opcode 0x63 for more information.

Query Magnification Response (0x63)

The value returned is given in hundredths of units of magnification. Example: a value of 500 means X5.

Reserved Opcodes (0x65, 0x67, 0x69, 0x6B, 0x6D, 0x6F, 0x71)

For Pelco internal use only.

Appendix A

Advanced Feature Commands
Equipment Compatibility[4]

	Spectra III, Spectra III SE v1.20 and later	**Esprit ES3xC, ES3xPC v3.05 and later**
Reserved Opcode **(0x47)**	No	No
Set Zero Position **(0x49)**	Yes	Yes
Set Pan Position **(0x4B)**	Yes	Yes
Set Tilt Position **(0x4D)**	Yes	Yes
Set Zoom Position **(0x4F)**	Yes	No
Query Pan Position **(0x51)**	Yes	Yes
Query Tilt Position **(0x53)**	Yes	Yes
Query Zoom Position **(0x55)**	Yes	No
Reserved Opcode **(0x57)**	No	No
Query Pan Response **(0x59)**	Yes	Yes
Query Tilt Response **(0x5B)**	Yes	Yes
Query Zoom Response **(0x5D)**	Yes	No
Set Magnification **(0x5F)**	Yes	Yes
Query Magnification **(0x61)**	Yes	Yes

[4] Pelco products not listed in this table do not implement the 'Advanced Feature' command set and will not be modified to accommodate these features in the future.

Query Magnification Response **(0x63)**	Yes	Yes
Reserved Opcode **(0x65)**	No	No
Reserved Opcode **(0x67)**	No	No
Reserved Opcode **(0x69)**	No	No
Reserved Opcode **(0x6B)**	No	No
Reserved Opcode **(0x6D)**	No	No
Reserved Opcode **(0x6F)**	No	No
Reserved Opcode **(0x71)**	No	No

Appendix B
Details of Document Changes

Revision 2, Version 1:

Page 10, paragraph 1, line 1.

Was:

Devices that receive a “D” protocol command may generate a response.

Is:

Devices that receive a “D” protocol command will generate a response.

Page 10, paragraph 3, line 3.

Was:

The part number is the ASCII text string containing the program number of the device being queried.

Is:

The content of the part number field is dependent on the type and version of the device being programmed, please refer to the table that follows.

Pelco Receiver/Driver	Part number field contents
Spectra	ASCII text string of the program number and version of device, e.g. “ PG53-0001-R206 ”
Spectra II	ASCII text string of the program number and version of device, e.g. “ PG53-0060-S331 ”
Spectra III prior to version 1.22	ASCII text string of the program number and version of device, e.g. “ PG53-0060-S400 ”
Spectra III version 1.22 and later	ASCII text string of the device model number, e.g. “ DD53C22-X ”
Esprit prior to version 3.10	ASCII text string of the program number and version of device, e.g. “ PG53-0097-R306 ”
Esprit version 3.10 and later	ASCII text string of the device model number, e.g. “ ES31CBW18 ”

Page 12, footnote #3.

Was:

However, if characters are written to these columns and no *SET_PRESET* (opcode 0x03) command is received within *250 milliseconds*, the characters will be displayed on the screen beginning at the first column of the second row of the display.

Is:

However, if characters are written to these columns and no *SET_PRESET* (opcode 0x03) command is received *within 250 milliseconds of receipt of the last character,* the characters will be displayed on the screen beginning at the first column of the second row of the display.

Page 15, last paragraph.

Was:

Reserved Opcode (0x65) … Reserved Opcode (0x71)

Is:

Reserved Opcodes (0x65, 0x67, 0x69, 0x6B, 0x6D, 0x6F, 0x71)

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