"D" PROTOCOL TRANSCEIVER SPECIFICATION

Change History

Rev	Date	Change Reason
A	*5/16/03*	Revision is the initial release
B	*6/4/03*	Corrected example checksum calculation on page 8 and added valid address range explanation on page 4.

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LEGAL NOTICES

NOTICE OF DISCLAIMER

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QUESTIONS

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WHAT THIS MANUAL COVERS

This manual describes the minimum requirements for designing a Pelco "D" protocol compliant receiver or transmitter that establishes a serial communication link between a controlling device (e.g. a matrix switching system) and a receiver (e.g. a dome drive).

THE PHYSICAL LAYER

Receivers and transmitters will adhere to the EIA RS422 and EIA RS485 electrical specifications.

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 communications rate for both receivers and transmitters is 2400 baud with a percentage error of +/- 0.16.

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, which has a valid range of 0 to 254 decimal (0 to 0xFE).

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

The sense bit (command 1 bit 7) indicates the meaning of bits 4 and 3. If the sense bit is on, and bits 4 and 3 are on, the command will enable auto-scan and turn the camera on. If the sense bit is off 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 0x00 (stop) 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.

Byte 6 contains the tilt speed. Tilt speed is in the range 0x00 (stop) to 0x3F (maximum speed). Turbo speed is not allowed for the tilt axis.

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. Byte 4 can be thought of as the command's opcode.

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
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.

[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	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)
Download	00	0x57	00	00	General
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
Activate Echo Mode	00	0x65	00	00	General
Set Remote Baud Rate	00	0x67	00	00 to 05.	General
Start Download	00	0x69	00	00	General
Query Device Type	00	0x6B	00	00	Extended (0x6D)
Query Device Type Response	00	0x6D	Software Type	Hardware Type	Not Applicable
Query Diagnostic Info	00	0x6F	00	00	Extended (0x71)
Query Diagnostic Info Response	00	0x71	Device Dependent	Device Dependent	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.

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, Left 1/2 speed	0xFF, 0x02, 0x00, 0x04, 0x20, 0x00, 0x26
Receiver 2, Stop	0xFF, 0x02, 0x00, 0x00, 0x00, 0x00, 0x02
Receiver 10, Camera on, Focus far, Down, half speed	0xFF, 0x0A, 0x88, 0x90, 0x20, 0x00, 0x42

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

```
0x0A      00001010
0x88      10001000
Subtotal  10010010  0x92
0x90      10010000
Subtotal  00100010  0x22 (modulo 256 allows the high bit to roll off)
0x20      00100000
Subtotal  01000010  0x42
0x00      00000000
          01000010  0x42 Final checksum value
```

RESPONSES

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

The General Response

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

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:

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

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.

The Extended Response

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

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 start at 1. Most devices support at least 32 presets. See the documentation for the equipment that you are working with for information about what presets are valid for that equipment.

Write Char. To Screen (0x15)

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

Columns 0-19 are used to receive zone labels. Characters written to these positions are not written directly to the screen.

Columns 20-39 are used to receive preset labels. Characters written to these positions are USUALLY not written directly to the screen. However if characters are written to these columns and no EC_SET_PRESET 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. The purpose of this functionality is to display translator board sign on messages.

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

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

Reserved Opcode (0x47)

For 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 of 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 (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 of from 0 to 35999 (decimal). Example: the value to use to set the tilt position to 45 degrees is 4500. Spectra interprets theses values as follows: Zero degrees is when the camera is pointed horizontally. Ninety degrees is when the camera is pointed straight down.

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 dome'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 dome is X184, calculate the value to 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.

Prepare For Download (0x57)

Puts the device into a state where it is prepared to receive a firmware update.

Query Pan Position Response (0x59)

The position is given in hundredths of a degree and has a range of from 0 to 35999 (decimal). Example: a position value of 4500 means 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 (0x49)" command or the "Set Azimuth Zero" menu item.

Note: This message is sent in response to the Query Pan Position (0x51) command.

Query Tilt Position Response (0x5B)

The position is given in hundredths of a degree and has a range of from 0 to 35999 (decimal). Example: a position value of 4500 means 45 degrees. The orientation Spectra uses is illustrated by the following: zero degrees is returned when the camera is pointed horizontally. Ninety degrees is returned when the camera is pointed straight down.

Note: This message is sent in response to the Query Tilt Position (0x53) command.

Query Zoom Position Response (0x5D)

The position is given as a ratio based on the dome'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 dome 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.

Note: This message is sent in response to the Query Magnification (0x61) command.

Activate Echo Mode (0x65)

Puts the unit into a mode in which characters that are received by the unit are immediately retransmitted. The unit comes out of this mode when of following happens: more than 100 milliseconds pass without receipt of a character or more than 180 characters have been received.

Currently only the Spectra III BIOS supports this command.

THIS COMMAND IS INTENDED FOR INTERNAL USE BY PELCO. ITS FUNCTIONALITY MAY CHANGE IN THE FUTURE WITHOUT NOTICE.

Set Remote Baud Rate (0x67)

Sets the unit's baud rate. Valid values for this command are:

Value	Baud
0	2400
1	4800
2	9600
3	19200
4	38400
5	115200

Note that the unit sends its response to this command before changing its baud. The baud automatically returns to 2400 after 100 milliseconds of no activity.

Currently only the Spectra III BIOS supports this command.

THIS COMMAND IS INTENDED FOR INTERNAL USE BY PELCO. ITS FUNCTIONALITY MAY CHANGE IN THE FUTURE WITHOUT NOTICE.

Start Download (0x69)

Puts the unit into a state where it looks for download commands (instead of "D" protocol commands).

THIS COMMAND IS INTENDED FOR INTERNAL USE BY PELCO. ITS FUNCTIONALITY MAY CHANGE IN THE FUTURE WITHOUT NOTICE.

Query Device Type (0x6B)

This command is used to query the device for information about the hardware platform the device is running on and the type of software that is running on the platform. The response to this command uses opcode 0x6D. See the description of opcode 0x6D for more information.

Query Device Type Response (0x6D)

The value returned "byte 5" is the hardware type. Valid values are:

17 (hex) – MMC2107 processor.

The value returned in "byte 6" is the software type. Valid values are:

01 – Spectra III Application
02 – Spectra III BIOS

Note: This message is sent in response to the Query Device Type (0x6B) command.

Query Diagnostic Info (0x6F)

This command is used to query the device for diagnostic information . The response to this command uses opcode 0x71. See the description of opcode 0x71 for more information.

THIS COMMAND IS INTENDED FOR INTERNAL USE BY PELCO. ITS FUNCTIONALITY MAY CHANGE IN THE FUTURE WITHOUT NOTICE.

Query Diagnostic Info Response (0x71)

This message is sent in response to the Query Diagnostic Info command (0x6F). The contents of the message may vary based on the type of device that is being queried. For Spectra III the contents of the message are defined as follows:

byte 5 of the message is 0.

Bit 0 of byte 6 is the pan sensor indicator. If the bit is on then the unit is oriented such that the pan sensor is being detected.

Bit 1 of byte 6 is the tilt sensor indicator. If the bit is on then the unit is oriented such that the tilt sensor is being detected.

Note: This message is sent in response to the Query Diagnostic Info (0x6F) command.

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