

Eastman Kodak Company

**DC210 Zoom Digital Camera
Host Interface Specification**

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TABLE OF CONTENTS

1. INTRODUCTION.....	4
1.1 Purpose.....	4
1.2 Scope.....	4
1.3 Intended Audience.....	4
2. CAMERA BEHAVIOR IN TERMS OF HOST INTERFACE.....	4
2.1 Camera States.....	4
2.2 Connect State.....	4
2.3 Modes in Connect State.....	5
2.4 Hardware Protocol Information.....	5
2.4.1 Serial	5
2.4.2 IrDA	6
2.5 Command Format.....	6
2.5.1 System Codes.....	6
2.5.2 Host Interface Command.....	7
2.6 Data.....	7
2.7 Communication Flow Control.....	9
2.7.1 Command without Send/Receive Packet (normal case).....	9
2.7.2 Command without Send/Receive Packet (busy case).....	10
2.7.3 Command for Receive Packet (from Camera).....	10
2.7.4 Command for Send Packet (to Camera).....	11
2.7.5 Error Cases	12
2.7.6 Communication Immediately After Powering Up The Camera.....	15
2.7.7 Waking Up Camera from Host (only for serial).....	15
3. DATA FORMATS.....	16
3.1 Camera Status Table.....	16
3.2 Picture Information Table.....	18
3.3 Image Data.....	21
4. FILE ORGANIZATION.....	22
4.1 File Name.....	22
4.1.1 File Name on Card and File Name Number.....	22

4.1.2 Picture Numbers	Internal to the Camera.....	22
4.2 Image Access.....		22
4.2.1 Picture Number Access.....		23
4.2.2 File Name Access.....		23
4.2.3 Image Format.....		23
5. COMMANDS.....		24
5.1 Command Description.....		26
5.1.1 Send Data In Flash Memory (13h, F).....		26
5.1.2 Write Data To Flash Memory (1Dh, F).....		27
5.1.3 Erase Flash Memory (1Eh, F).....		27
5.1.4 Write 256 Byte Data (31h, O/F).....		27
5.1.5 Read 256 Byte Data (32h, O/F).....		28
5.1.6 Set Resolution (36h, O).....		28
5.1.7 Set File Format (37h, O).....		29
5.1.8 Set Baud Rate (41h, O/F, Serial Only).....		29
5.1.9 Send File Names in Album (4Ah, O).....		30
5.1.10 Send Image File on Card (64h, O).....		30
5.1.11 Send Picture Information on Card (65h, O).....		31
5.1.12 Send Thumbnail Image on Card (66h, O).....		31
5.1.13 Set Image Quality (71h, O).....		32
5.1.14 Set Flash Mode (72h, O).....		32
5.1.15 Set Shutter Delay (74h, O).....		33
5.1.16 Set Time (75h, O).....		33
5.1.17 Zoom (78h, O).....		34
5.1.18 Erase Images on Card (7Bh, O).....		34
5.1.19 Take a Picture to Card (7Ch, O).....		35
5.1.20 Check Camera Battery (7Eh, O).....		35
5.1.21 Send Camera Status Table (7Fh, O).....		36
5.1.22 Set Exposure Compensation.....		36
5.1.23 Reset Camera (8Ah, O).....		37
5.1.24 Read Picture Information (91h, O).....		37
5.1.25 Read Summary Information (92h, O).....		38
5.1.26 Read Thumbnail Image (93h, O).....		39
5.1.27 Initialize Memory Card (95h, O).....		40
5.1.28 Open Card (96h, O).....		40
5.1.29 Close Card (97h, O).....		41
5.1.30 Get Card Status (98h, O).....		41
5.1.31 Read Directory Information (99h, O).....		42
5.1.32 Read File (9Ah, O).....		43
5.1.33 Delete File (9Dh, O).....		43
5.1.34 Write Camera ID (9Eh, O).....		44
5.1.35 Enter Adjust Mode (ADh, O).....		44
5.1.36 Completion of Download Mode (AEh, F).....		45

1. INTRODUCTION

This document describes the detailed host interface commands of the DC210 Zoom Digital Camera.

1.1 Purpose

This document specifies the communications interface between the host computer and the DC210 Zoom Digital Camera. This includes all camera commands, data, and control flow between the host and cameras.

1.2 Scope

This document completely specifies the behavior of the product feature set and the concepts. Future changes to the design and/or future additional functionality to these products will be documented in future specifications.

1.3 Intended Audience

This document is intended for any individuals who are involved in the development of software and firmware of the DC210 Zoom Digital Camera product. This document is also intended to assist future software/firmware developers involved in the support of these products.

2. Camera Behavior In Terms Of Host Interface

2.1 Camera States

The camera is always in exactly one of the following states.

- Power Off State
- Capture State
- Review State
- Preferences State
- Connect State

The transition among these states is as follows. Host communication is available only in Connect State, so that is the only state described here.

2.2 Connect State

When the operator turns the mode dial to Connect, the camera goes into this state. In this state, button operation except the mode dial and the power switch are ignored, color LCD is off, Status LCD is off except for the animation below, and the green LED on the back of the camera will indicate when the camera is on and ready. To capture an image, the operator has to use the host software.

The camera activates IrDA and waits for commands to come. If the camera detects active serial cable inserted, the camera deactivate IrDA and starts communicating though serial, and if the camera detects IrDA communication, the camera starts communicating though IrDA and ignore active serial cable insertion. If the camera detects none of them for more than 300 sec, the camera automatically goes into Off State.

Once the mode dial is turned to "Connect", the numeric display on the status LCD will display animation on the status LCD instead of icons. The order of the animation is indicated in the figure below.

When the user moves the mode dial to Review or Preference, the camera leaves Connect State. If the camera is under processing commands when the mode dial is moved, the camera complete the command processing and then moves to Review or Preference State.

When the user wants to change the communication means after communication is once established, the user has to both go to other modes or power-off and go back to connect state.

2.3 Modes in Connect State

The DC210 Zoom Digital Camera has three modes in its Connect State, on-line mode, firmware download mode, adjust mode.

When the mode dial is turned on to Connect, the camera goes automatically to on-line mode. In this mode, the host computer can send on-line commands to control the camera.

Adjust mode is reserved for factory and service use, and is not documented here.

Firmware download mode is for downloading the new firmware into the camera. This mode is available only for serial. Once the camera goes to firmware download mode, the camera will ignore mode dial. Eleven commands are available for this purpose. There are two ways to switch the camera to firmware download mode, a command or manual operation. For how to switch the camera to firmware download mode manually, refer to the user interaction specification[2].

The camera goes to Off State when the user presses the power button (State Transition #2), no communication is detected more than 300 secs (State Transition #8). From Off State, the camera wakes up when the camera detects power button press. It takes about 10 secs maximum for the camera to be command ready. The camera returns BSY system code if camera wakes up but not ready to process commands. By going into Off State, Opened Card status is canceled. Refer to 6.2 for the setting.

Following is the transition diagram of Connect State and its relating states.

NOTE: This chart is Connect State centric and does not fully describe about the relationship among Off State, Review State, and Preference State.

2.4 Hardware Protocol Information

The camera supports two communication protocols, serial and IrDA.

2.4.1 Serial

The DC210 Zoom Digital Camera uses RS-232C as the basis for serial communication with the host. The camera has a stereo 3.5 plug type connector with the pins wired as described in the table below.

Pin	Signal
1	SD
2	RD
3	SG

The DC210 Zoom Digital Camera supports the baud rates of 9600, 19200, 38400, 57600, and 115200 bits per second. The power-up default is 9600 bits per second. All data is transferred in 8 bit, no parity, 1 stop bit format.

Break signal, holding the RD line of serial port high for more than 350 msec, causes the camera to reset the serial port. This should be equivalent to disconnecting and reconnecting cable. The baud rate goes back to 9,600 bps by this signal, but the camera maintains all other settings.

2.4.2 IrDA

The DC210 Zoom Digital Camera supports IrDA ver 1.0, with a maximum communication speed of 115.2 Kbps.

2.5 Command Format

2.5.1 System Codes

System codes are one byte value for hand shaking between the camera and the host. The host should be able to know if the camera correctly receives a command or a packet from these codes. Section 2.7 describes how these codes are used for the camera and the host to communicate and synchronize each other. There are eight system codes as follows.

Code	Description
00h	Command Complete
d1h	Command Received Correctly (ACK)
d2h	Correct Packet
e1h	Command Received Incorrectly (NAK)
e2h	Command Execution Error
e3h	Illegal Packet
e4h	Cancel
f0h	Busy

- **Command Complete (00h)**

The camera sends this code when the camera has completely the command without errors. The host can send the next commands 50 ms after receiving this code. This code is from the camera to the host direction only.

- **Command received correctly (ACK, d1h)**

When the camera sends this code when it receives a correct format of the DC210 Zoom Digital Camera host interface command from the host. This code is from the camera to the host direction only.

- **Correct packet (d2h)**

This code is sent if the checksum of the packet is correct. This code is for both from the camera to the host and from the host to the camera direction.

- **Command received incorrectly (NAK, e1h)**
The camera send this code when it receives a invalid format of the Digital Zoom Camera command from the host. This code is from the camera to the host direction only.
- **Command execution error (e2h)**
The camera sends this code to the host when the camera can not complete the received command. This code is from the camera to the host direction only.
- **Illegal packet (e3h)**
This code is sent if the checksum error is detected on the packet. This code is for both from the camera to the host and from the host to the camera direction.
- **Cancel (e4h)**
This code is to cancel the command execution. This code is from the host to the camera direction only.
- **Busy (f0h)[7]**
This code is for the camera to tell host it is in communication mode but not ready to execute commands yet. This code is from the camera to the host direction only. Also, camera might issue this system code during on-line mode only.

2.5.2 Host Interface Command

Host interface commands consist of 8 bytes of data. The first byte contains a command code (see section 5). The second and sixth byte are always "00", and the last byte is always "1A". The other bytes contain parameter(s) for the commands, or zero.

Offset	Host command
0	Command
1	00
2	Parameter or 00
3	Parameter or 00
4	Parameter or 00
5	Parameter or 00
6	00
7	1A

Some commands are followed by a packet that contains parameter(s) associated with the commands.

2.6 Data

Data (not system codes) are sent as a packet.

Every packet contains a checksum byte at the bottom of each packet. The checksum is calculated by serially XOR-ing together all the data bytes in the packet. When the data ends before the end of a packet, the remainder of the packet may be any value.

In addition, a packet sent from the host (except firmware download mode) contains a packet control byte at the top (the first byte)[7]. Also, a packet sent from the camera to the host contains a packet control byte on top of the packet.

There are several sizes of packet as shown below.

Packets sent from the camera (camera --> host)

- 1,026-byte Image data
- 514- byte Data in the card
- 258-byte Picture information, etc.
- 18-byte Error status (Check condition code), card status, etc.

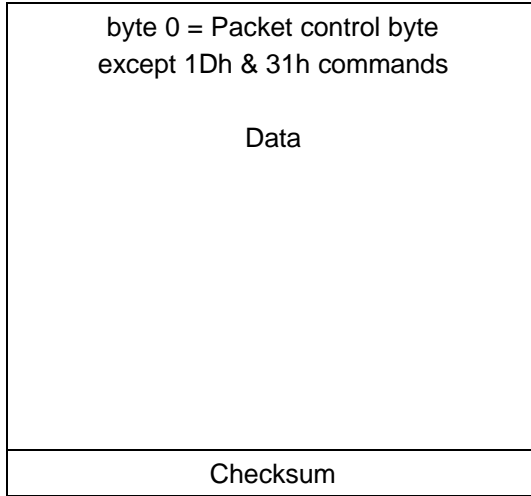
Packets sent from the host (host --> camera)

- 257-byte Data in Firmware Download mode
- 60-byte Command parameters

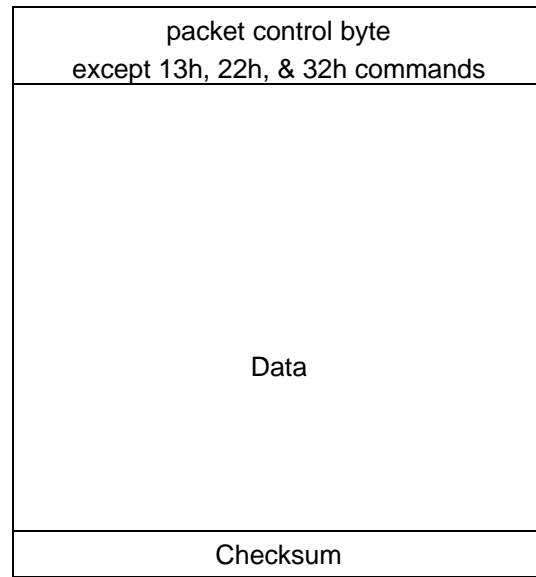
The following table shows required packet size for each on-line command. Commands which are not listed below do not need any packets.

code	Command	Packet size --> camera	Packet size --> host
13	Send data in flash memory	-	257
1D	Write data in flash memory	257	-
22	Send data in EEPROM	-	257
31	Write 256 byte data	257	-
32	Read 256 byte data	-	257
4A	Send file name in album	-	258
64	Send image file in card	-	1,026
65	Send picture information on card	-	258
66	Send thumbnail image on card	-	1,026
66	Send summary information on card	-	258
7F	Send camera status table	-	258
92	Read summary information	60	514
93	Read thumbnail image	60	1026
95	Initialize memory card	60	18
98	Get card status	-	18
99	Read directory information	60	258
9A	Read file	60	514
9A	Delete file	60	
9E	Write camera ID	60	-

Packet from the host to the camera



Packet from the camera to the host



Packet from the host to the camera

Packet control byte	0x00 : Normal packet (followed by next packet)
	0x80 : Final packet
	0xFF : Cancel

Note: If the camera detects 0xFF, the camera does not have to see remaining data of the packet.

Packet from the camera to the host

Packet control byte	0x01 : Normal packet (followed by next packet)
	All other : illegal

2.7 Communication Flow Control

It is always the host which issues commands. The camera responds to the command received from the host with a system code, within 2 secs. If the camera can not reply in normal sequence within 2 secs, it returns the Busy (f0h) system code [7].

The camera discontinues processing commands if it does not receive any response from the host for more than 200 secs

The camera disables its sleep timer during command processing.

2.7.1 Command without Send/Receive Packet (normal case)

2.7.2 Command without Send/Receive Packet (busy case)

2.7.3 Command for Receive Packet (from Camera)

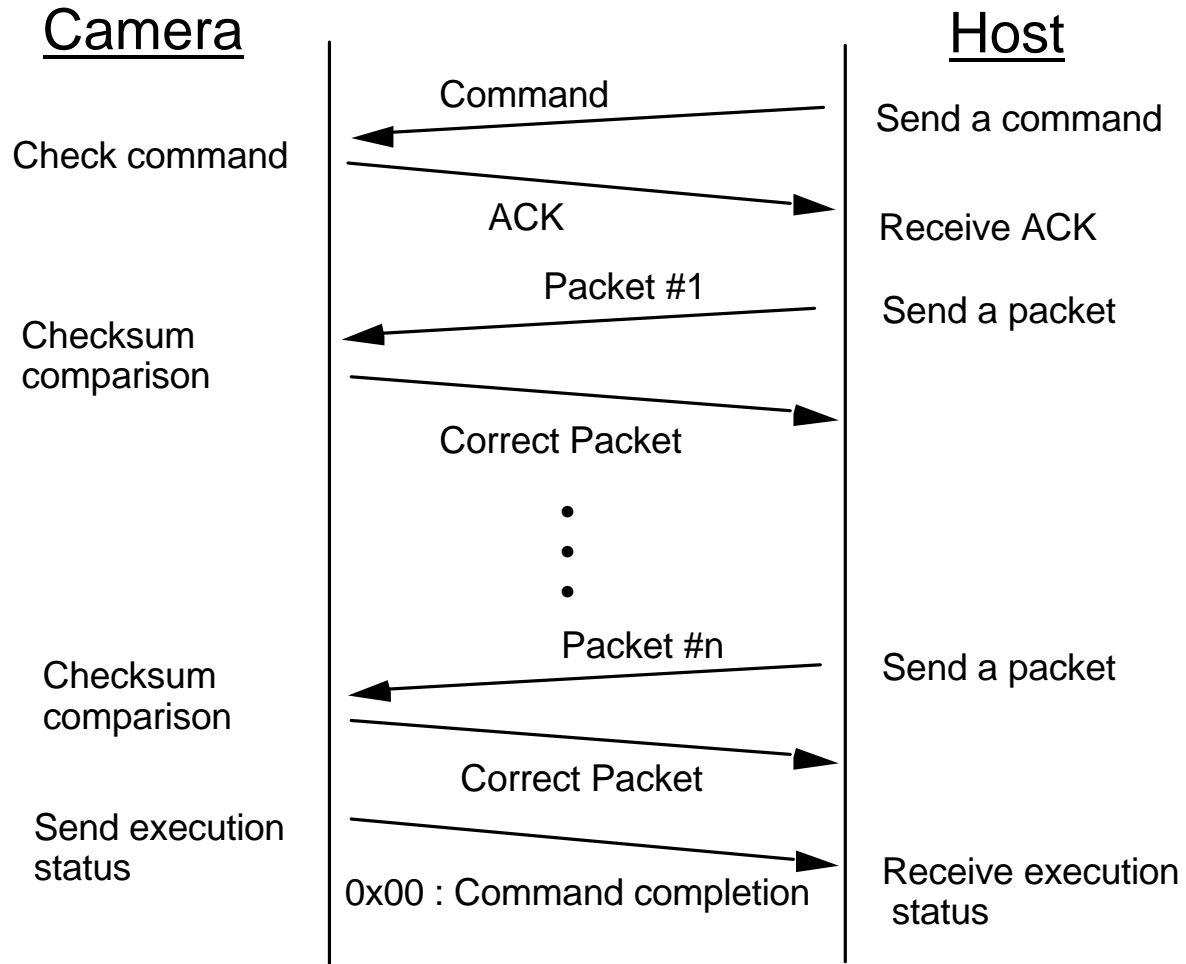
Some commands instruct the camera to send internal data in the camera or on Compact Flash card to the host. Packets will be sent from the camera immediately after the camera recognizes these commands. The host should always know the number of packets to expect from the camera before sending the command. The host always takes the initiative in receiving and sending packets.

2.7.3.1 normal case

2.7.3.2 “busy” case

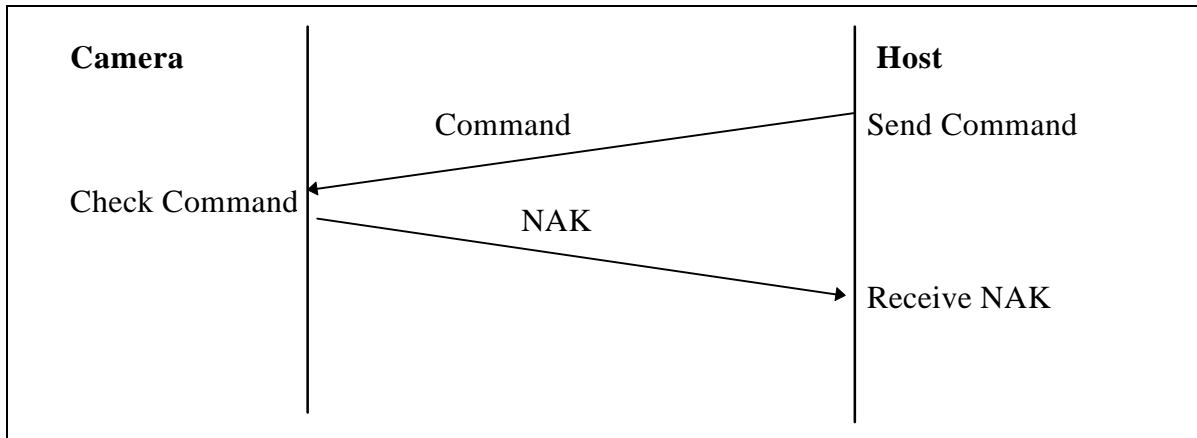
2.7.4 Command for Send Packet (to Camera)

Some commands need to send packets that contain additional parameters for the command or data after sending the command. The camera should always check the top byte of the received packet to know the final packet or cancel is sent. The top byte contains packet control information (see section 2.6).



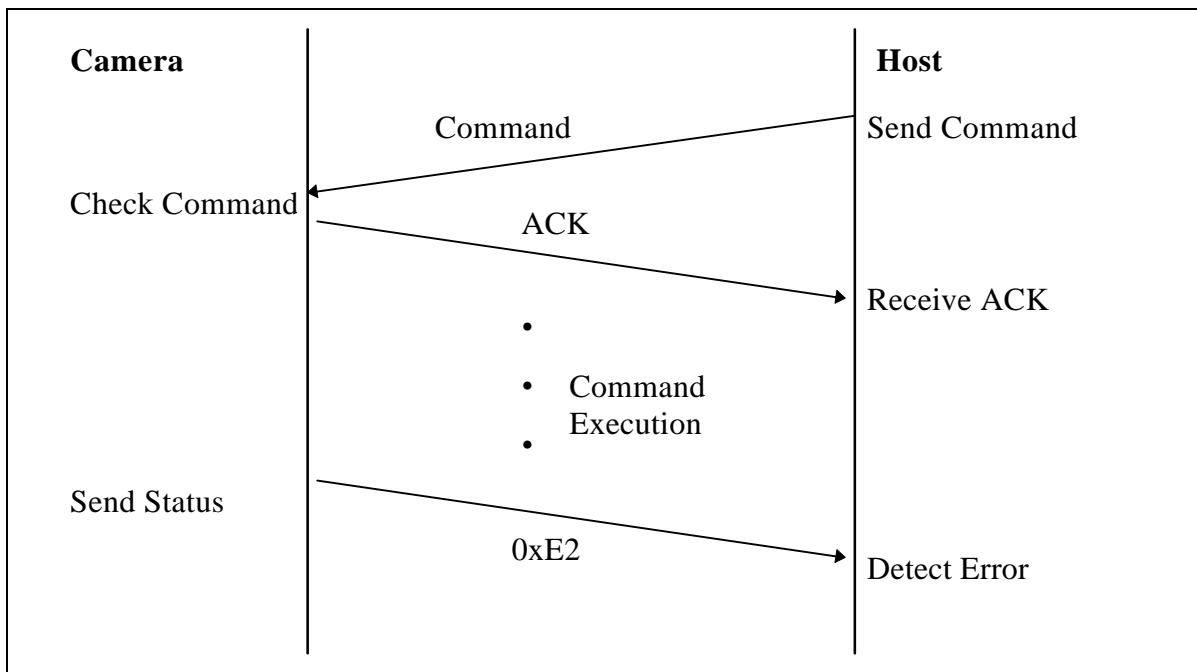
2.7.5 Error Cases

(1) Illegal Command



(2) Command Execution Error

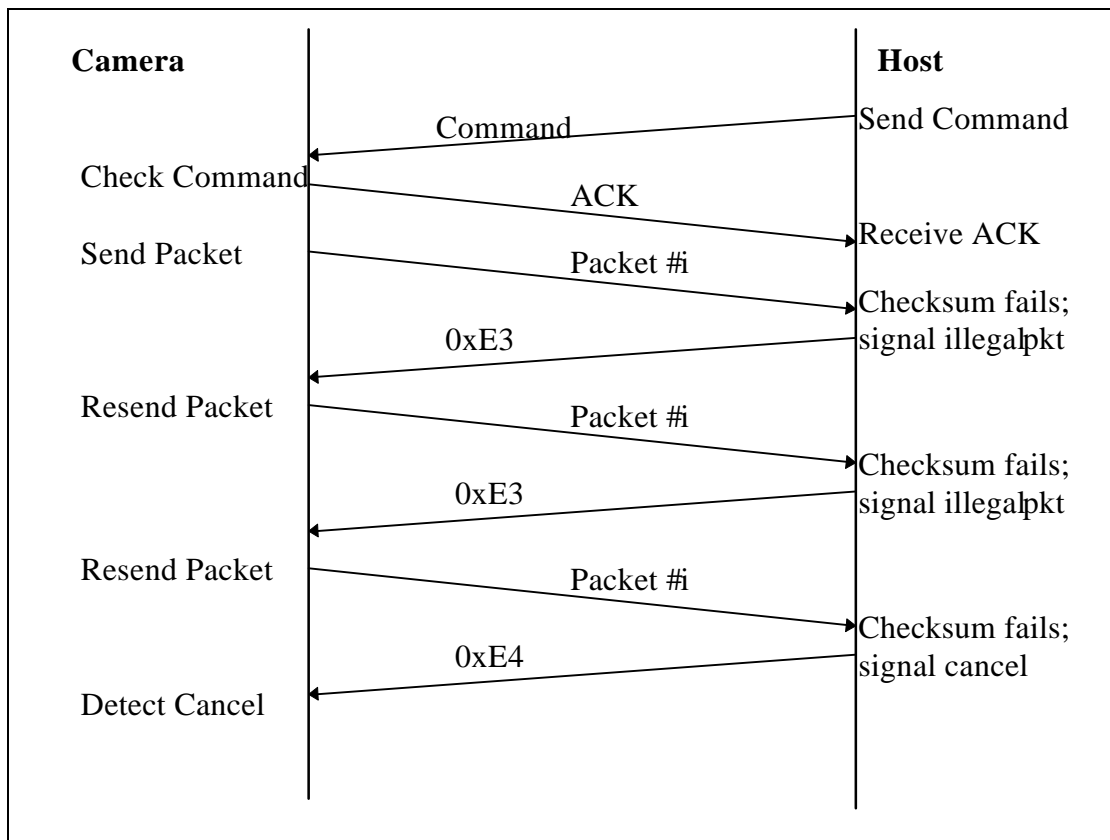
The host can determine what error has occurred when it receives a command error (e2h) from the host. See the possible command error cause at each command description (section 5.1)



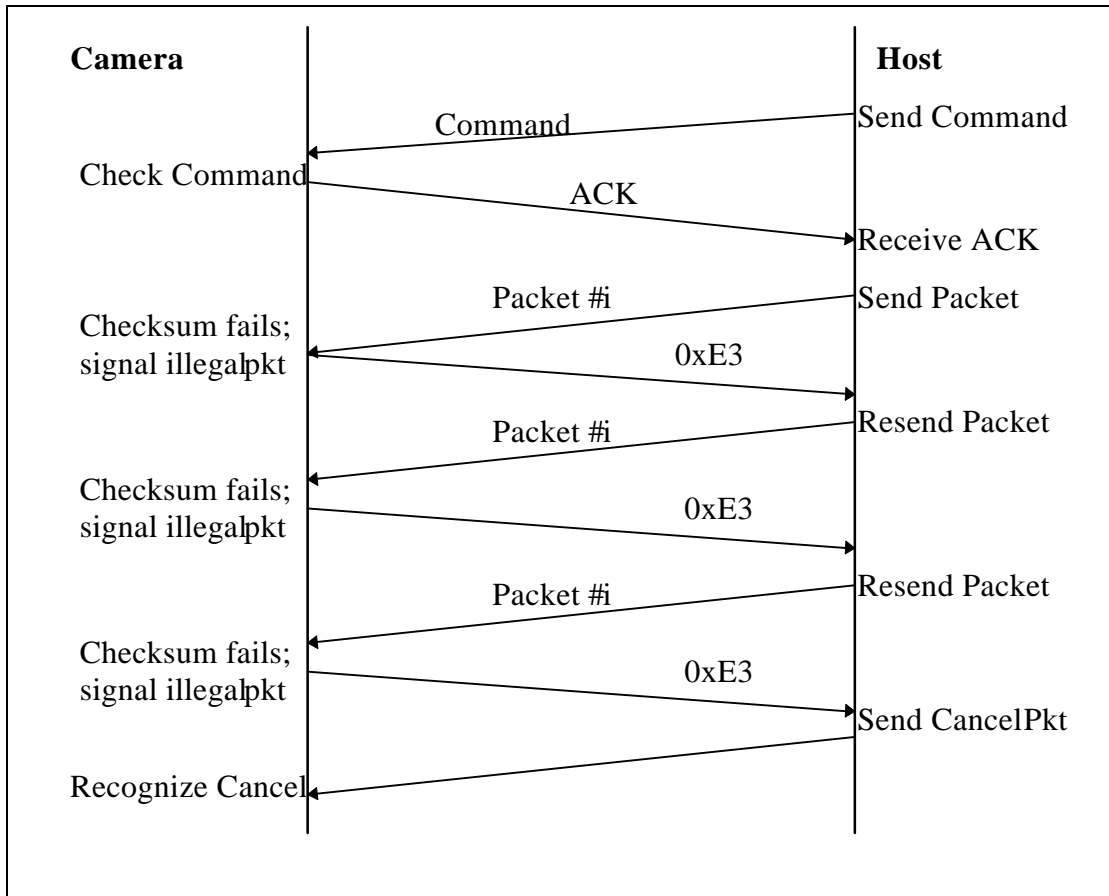
(3) Packet Error

- If the host (or the camera) receives an illegal packet code (e3h) after sending a packet, the host (or the camera) will send the same packet again.
- Only the host can decide to cancel the communication process when a packet communication error is not recovered.
- If the camera receives a cancel code (e4h) or a cancel packet, it responds nothing to the host and will prepare for next command after canceling the current process.

Packets from Camera to Host

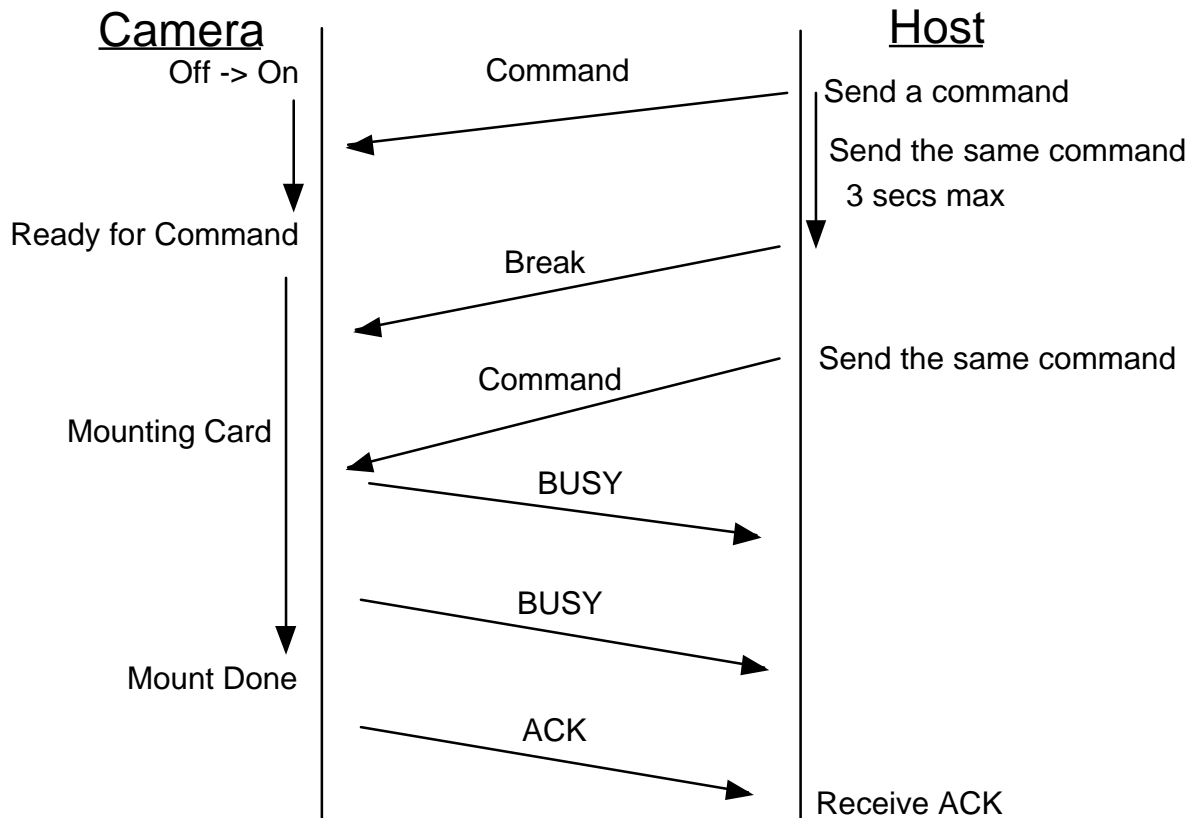


Packets from Host to Camera



2.7.6 Communication Immediately After Powering Up The Camera

Upon power-up, the camera may require about 10 secs (maximum) to be ready. When the camera receives a command before it is ready, it will reply BUSY. If the camera does not respond within 3 secs after the host sends the same command or the camera returns NAK, the host should send break signal to the camera to reset the serial port.



2.7.7 Waking Up Camera from Host (only for serial)

When the camera is in sleep mode (from serial communication only, not from IrDA), the first command from the host wakes up the camera but is then ignored. The host must send the same command again. The same BUSY times apply after a wake-up as if the camera has just been powered on.

3. DATA FORMATS

3.1 Camera Status Table

Notes which apply to certain table entries are denoted by n1, n2, ... and are found immediately following the table.

Byte offset	Description
0	Data Type (01h for camera status table)
1	Camera Type (3 : Reserved, 4 : DC210)
2	Firmware version (Integer part : 0 - 255)
3	Firmware version (Hex interpretation: 00 to ff)
4	ROM Version for SH-DSP (Integer part : 0 - 255)
5	ROM Version for SH-DSP(two decimal places)
6	ROM Version for 8 bit μ (Integer part)
7	ROM Version for 8 bit μ (two decimal places)
8	Battery status (0 : Full, 1 : Low, 2 : Empty)
9	AC adapter flag (0 : No use, 1 : In use)
10-11	Reserved
12	Elapsed time (MSB)
13	Elapsed time
14	Elapsed time
15	Elapsed time (LSB)
16	Zoom position (for DC210), Reserved otherwise (n3)
17	Reserved
18	Flash Status (0: not charged, 1: charged)
19	Compression (0 : No Comp(n1), 1 : Low, 2 : Medium, 3: High)
20	Flash mode (0 : Auto, 1 : Fill, 2 : Off, 3 : Auto Red-eye, 4: Fill Red-eye)
21	Exposure Compensation Value
22	Picture Size (0 : 640x480, 1 : 1152x864)
23	File Type (2 : RAW(n1), 3 : JPEG, 4 : FlashPix)
24	IPChainEnable(n1, 0 : Disable, 1 : Enable)
25	Total Number of Picture Taken (MSB) (n2)
26	Total number of Picture Taken (LSB)
27	Total number of Flash Fired (MSB) (n2)
28	Total number of Flash Fired (LSB)
29	Timer Mode (0 : Off, 1 : On)

30	Memory Card Status (n4)
31	Video Format (0 : NTSC, 1 : PAL)
32	Communication Means (0 : Serial, 1 : IrDA)
33	Camera Modes (2 : Connect)
34-35	Reserved
36	IrDA Baud Rate (MSB)
37	IrDA Baud Rate
38	IrDA Baud Rate
39	IrDA Baud Rate (LSB)
40-55	Reserved
56	# of pictures taken in card (MSB)
57	# of pictures taken in card (LSB)
58-67	Reserved
68	Remaining pictures at Low Comp for card (MSB)
69	Remaining pictures at Low Comp for card (LSB)
70	Remaining pictures at Medium Comp for card (MSB)
71	Remaining pictures at Medium Comp for card (LSB)
72	Remaining pictures at High Comp for card (MSB)
73	Remaining pictures at High Comp for card (LSB)
74-76	Reserved
77-87	Volume ID of the ATA Card (11 characters)
88-89	Reserved
90-121	Camera ID (32 byte ASCII characters) (n5)
122-256	Reserved

n1 Supported only during alpha and beta, not supported from final candidate.

n2 This is the camera life-time statistics.

n3 Zoom position (Byte 16) details:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
16	N/A		Zoom mode		Zoom data			

Zoom mode: 00=Normal 01=Reserved 10=Close up

Zoom data: 0: Approximately 58 mm (35 mm equivalent)

1: Approximately 51 mm (35 mm equivalent)

2: Approximately 41 mm (35 mm equivalent)

3: Approximately 34 mm (35 mm equivalent)

4: Approximately 29 mm (35 mm equivalent)

5: Close-up mode is set

n4	Memory card status (Byte 30)		
Bit 7	1=ATA Card is inserted	0=ATA Card is not inserted	
Bit 6	1=Write protect switch is ON	0=Write protect switch is OFF	
Bit 5	1=Illegal card is inserted	0=Supported card is inserted	
Bit 4	1=Card is not formatted	0=Card is formatted	
Bit 3	1=Card is opened	0=Card is not opened	
Bit 2	Reserved		
Bit 1	Reserved		
Bit 0	Reserved		

Bit 3 (open flag) is set after an "open" command is executed. Bit 3 will be reset if:

- Camera is turned off
- Close command is executed
- Card is ejected

Note that bit 3 is not reset when the camera returns from sleep mode.

- n5 Camera ID (Byte 90-121)
32-byte camera ID is defined in the EEPROM and the ID will be written in the camera status table at camera initialization. This ID is written with "Write Camera ID" command.

3.2 Picture Information Table

Picture information for each image consists of 256 byte data as follows. The host software can know the information of each picture to read this table.

Byte offset	Description
0	Data Type (01h for picture information)
1	Camera Type (3=Reserved; 4=DC210 Zoom)
2	File Type (2=raw CFA(n1, n5), 3=JPEG, 4=FlashPix)
3	Picture Size (0=VGA[640x480]; 1=1152x864)
4	Compression (0=None(n1, n5), 1=Low, 2=Medium, 3=High)
5	IPChainEnable (n1, n5)
6	Picture Number (MSB)
7	Picture Number (LSB)
8	Data Size (MSB) (n2)
9	Data Size
10	Data Size
11	Data Size (LSB)
12	Elapsed Time(MSB) (n3)
13	Elapsed Time
14	Elapsed Time

15	Elapsed Time (LSB)
16	Flash Flag (0=No Flash, 1=Flash)
17	FlashMode (0=Auto, 1=Fill, 2=Off, 3=Auto Red-eye, 4=Fill Red-eye)
18	LV data (n6)
19-20	Reserved
21	Zoom Step
22	Reserved
23	EV Value (n5)
24	AV Value (n5)
25	Reserved
26	Aperture Value (F-Number)
27	Battery Level (0: OK, 1: Weak, 2: Empty)
28	Exposure Time (MSB) (n4)
29	Exposure Time
30	Exposure Time
31	Exposure Time (LSB)
32-43	Image Name (12 characters) "DCPnnnnn.ttt" nnnnn = 5-digit number, ttt = "RAW"(n1), "JPG", or "FPX"
44-45	Reserved
46	Exposure Compensation Value
47	Auto White Balance Mode (0 : Auto)
48	pWbGainR (MSB) (n5)
49	pWbGainR
50	pWbGainR
51	pWbGainR (LSB)
52	pWbGainG (MSB)
53	pWbGainG
54	pWbGainG
55	pWbGainG (LSB)
56	pWbGainB (MSB)
57	pWbGainB
58	pWbGainB
59	pWbGainB (LSB)
60	pWbCalibR (MSB)
61	pWbCalibR
62	pWbCalibR

63	pWbCalibR (LSB)
64	pWbCalibG (MSB)
65	pWbCalibG
66	pWbCalibG
67	pWbCalibG (LSB)
68	pWbCalibB (MSB)
69	pWbCalibB
70	pWbCalibB
71	pWbCalibB (LSB)
73-255	Reserved

n1 “No Compression” mode is for internal use only. In this case, Picture Size = 1, Image Quality = 0, file name extension is “RAW”. These features will be supported during alpha, beta only, not supported from final candidate.

n2 size of picture file.

n3 Elapsed time in 0.5 seconds since 12:00 on 12/31/1996

n4 32 bit value in 10 microsecond increments

n5 Internal use only

n6 LV data (Byte 18)

LV data shows light value measured with CdS. The measured value is shown in 1 byte values from 0x00 to 0x54. Actual LV value is calculated as:

LV value= 6.5 + 0.125 x LVdata where n is content of LV value (0 to 54)

Therefore, the LV data found in table correspond to actual LV values as so:

LV data (hex)	Value (LV)
0x00	6.5
0x01	6.625
...	...
0x53	16.875
0x54	17.0

3.3 Image Data

The DC210 Zoom Camera does not have internal image storage, therefore, all images are stored as DOS files on Compact Flash cards. The image data is stored in either **JPEG** (with header format of EXIF ver 1.1, the sampling rate is 4:1:1), or **FlashPix** format. Each file contains a header, thumbnail image data, and compressed image data. Each image data is stored with unique file name assigned automatically. An image files will be stored under “\DCIMAGES” directory.

Refer to “EXIF File Format 1.1”[3] and “FlashPix File Format 1.0”[4] documents for the details.

(The file format of “No Compression” mode (internal use only) is a special image format which consists of 128 bytes of picture information followed by 1156x434x2 no-compressed raw CFA image. Another special case is IPChainEnable = 0 case, which generates AH2-Interpolated only JPEG file. The extension would be “.JPG”. This feature is during alpha and beta phase only, not supported from final candidate.

4. File Organization

This chapter describes file organization for the internal control and the ATA card and naming rules for the image files. All images on the ATA card are stored as DOS files. The maximum number of image files on ATA card is limited to 999 regardless of memory size of the card.

4.1 File Name

4.1.1 File Name on Card and File Name Number

All the files on Compact Flash card are stored as DOS files with following naming convention.

\DCIMAGES\DCPnnnnn .tth

nnnnn : Serial number that starts with 00001, and is assigned by the camera firmware in a ever-increasing fashion until wraparound occurs.

tth : **JPG** for JPEG, **FPX** for FlashPix

Note that different memory cards can be used with a single camera. For any given memory card, if the serial number for the image just taken is smaller than the biggest number already on the card, the file name will be (the biggest number in the card + 1). In this case, the serial number memorized in the camera is also changed to be (the biggest number in the card + 1).

The maximum file number is 99999. If DCP99999.tth file already exists, the next image file name will be DCP00001.tth (if it does not already exist.) If it already exists and the total image file is less than the maximum, the file name will be the smallest available number.

If an image is erased through the user interface on the camera or through host communication, the file names of other files are not affected.

4.1.2 Picture Numbers Internal to the Camera

The picture number is sequentially assigned to images according to the exposed order in camera. The file system of the camera checks Date/Time of image files to sort them. The oldest image has always the picture number #0. If an image is erased via the camera user interface or host communication, the picture number is reassigned to the images which had bigger number than the erased image automatically in the camera. For example, camera has 4 images.(#0, #1, #2 and #3) If #2 image is erased, the new picture number for the #3 image is assigned as #2, consequently the image numbers will be #0, #1 and #2.

None of this affects the serial number in the filenames at all, i.e., files are not renamed as a result of this internal gap removal.

4.2 Image Access

The host has two ways to access image data on Compact Flash card. One is the sequential picture number access, and the other is file name access via mounter.

4.2.1 Picture Number Access

The host is able to retrieve the file data, thumbnail data, and picture information by specifying the picture number.

4.2.2 File Name Access

The contents of Compact Flash card can be seen as DOS files from the host with camera mounter software. This access is limited to read only. Any moving, copying, renaming, or writing operation is not supported.

To access the file named (on the memory card) `\DCIMAGES\DCP12345.JPG` the path name to be passed through the host command must prepend `\PCCARD` to it, i.e.: `\PCCARD\DCIMAGES\DCP12345.JPG`

4.2.3 Image Format

The camera supports JPEG and FlashPix ver 1.0 [4] file format. Refer to the detailed implementation on [5] and [6].

5. COMMANDS

The following lists the commands that are recognized by three different models of DC cameras. An 'x' mark indicates that the command is supported by that camera. If the camera receives a command that is not supported, the camera will assume an error and will respond a NAK to the host.

If the camera receives a command listed here when the camera is one of the following busy states, the command will be ignored.

- Camera is accessing the ATA card
- Camera is in sleep mode (command itself wakes up the camera but is otherwise ignored)

Commands to the DC210 can be categorized into two modes: On-line mode (O) and Firmware download mode (F). Most commands of each mode cannot be executed in the other mode, however there are exceptions.

Note that the word "send" in this list means send data from the camera to the host.

Code	Description	DC50	DC120	DC210	Mode(*)
13	Send data in flash memory	x	x	x	F
1D	Write data to flash memory	x	x	x	F
1E	Erase flash memory	x	x	x	F
21	Write word data to EEPROM	x	x	x	O/F
22	Send data in EEPROM	x	x	x	O/F
31	Write 256 byte data	x	x	x	O/F
32	Read 256 byte data	x	x	x	O/F
33	Set Date/Time Format		x		O
34	Set Distance Format		x		O
35	Set Default Setting		x		O
36	Set Resolution			x	O
37	Set File Format			x	O
3D	Execute program	x	x		F
41	Set baud rate	x	x	x	O/F
42	Set available Album		x		O
43	Send available Album		x		O
44	Send stored Album		x		O
45	Send number of pictures in Album		x		O
46	Erase Album		x		O
47	Change Album name		x		O
48	Move image to another Album		x		O
49	Set Active Album		x		O
4A	Send file name in Album		x	x	O

51	Send picture in memory	x	x		O
52	Send TIFF/EP information in memory		x		O
54	Send TIFF/EP file in memory		x		O
55	Send picture information in memory	x	x		O
56	Send thumbnail information in memory	x	x		O
61	Send image on card	x	x		O
62	Send attribute data of card				O
63	Write word data to attribute data of card				O
64	Send image file on card		x	x	O
65	Send picture information on card	x	x	x	O
66	Send thumbnail image on card	x	x	x	O
71	Set image quality	x	x	x	O
72	Set flash mode	x	x	x	O
73	Set focus mode	x	x		O
74	Set shutter delay	x	x	x	O
75	Set time	x	x	x	O
76	Card copy	x	x		O
77	Take a picture to flash memory	x	x		O
78	Zoom	x	x	x	O
7A	Erase images in flash memory	x	x		O
7B	Erase images in memory card	x	x	x	O
7C	Take a picture to card	x	x	x	O
7E	Check camera battery	x	x	x	O
7F	Send camera status table	x	x	x	O
80	Set exposure compensation	x	x	x	O
81	Set manual exposure	x	x		O
82	Set sleep time	x	x		O
83	Send camera matrix data	x	x		O
84	Send compression table	x			O
85	Take and send preview image	x			O
86	Request sense	x	x		O/F
87	Store preview image in memory	x			O
88	Store preview image in card	x			O
89	Erase preview image	x			O
8A	Reset	x	x	x	O
8B	Set exposure mode	x	x		O
8C	Execute program	x			O
8D	Switch to ROM mode	x	x	x	O
90	Set program mode	x			O
91	Read Picture Information			x	O
92	Read summary information			x	O

93	Read Thumbnail			x	O
94	Wait				O
95	Initialize memory card	x		x	O
96	Open card	x	x	x	O
97	Close card	x	x	x	O
98	Get card status	x	x	x	O
99	Read directory information	x	x	x	O
9A	Read file	x	x	x	O
9B	Write file information	x			O
9C	Write file	x			O
9D	Delete file	x		x	O
9E	Write camera ID	x	x	x	O
AD	Enter adjust mode	x	x	x	O
AE	Completion of download mode	x	x	x	F

5.1 Command Description

This section describes commands supported by DC210 Zoom Camera only.

'O' and 'F' at each title means on-line and firmware download respectively. An on-line (O) command is used to control the camera remotely. If the camera receives a firmware download specific command in on-line mode, the camera will respond a NAK to the host.

A firmware download (F) command is used to download new camera firmware into the flash memory. If the camera receives an on-line mode specific command in firmware download mode, the camera will respond a NAK to the host.

Firmware download mode is supported only with serial cable connection.

5.1.1 Send Data In Flash Memory (13h, F)

Offset	Host command
0	13
1	00
2	Page address of flash memory (MSB)
3	Page address of flash memory (LSB)
4	00
5	00
6	00
7	1A

This command sends specified page (256 bytes) of the flash memory to the host.

5.1.2 Write Data To Flash Memory (1Dh, F)

Offset	Host command
0	1D
1	00
2	Specified page (MSB)
3	Specified page (LSB)
4	00
5	00
6	00
7	1A

This command writes 256 byte data sent from the host to specified page of the flash memory.

5.1.3 Erase Flash Memory (1Eh, F)

Offset	Host command
0	1E
1	00
2	Data Block
3	00
4	00
5	00
6	00
7	1A

This command erases 256 byte data of specified page in the flash memory.

Data Block

- 0 : All
- 1 : Program
- 2 : Reserved
- 3 : Error
- 4 : Data

5.1.4 Write 256 Byte Data (31h, O/F)

Offset	Host command
0	31
1	00
2	Start address of specified memory (MSB)
3	Start address of specified memory
4	Start address of specified memory
5	Start address of specified memory (LSB)

6	00
7	1A

This command writes 256 byte data sent from the host to specified address of the flash memory.

Start address should be from 0x02000000 to 0x02FFFF00, or from 0x03000000 to 0x03FFFF00.

Note: This command is strictly for firmware debugging. Otherwise, the host program should not use this command.

5.1.5 Read 256 Byte Data (32h, O/F)

Offset	Host command
0	32
1	00
2	Start address of specified memory (MSB)
3	Start address of specified memory
4	Start address of specified memory
5	Start address of specified memory (LSB)
6	00
7	1A

This command writes 256 byte data sent from the host to specified address of the flash memory.

Start address Start address should be from 0x01000000 to 0x013FFF00, from 0x02000000 to 0x02FFFF00, or from 0x03000000 to 0x03FFFF00.

Note: This command is strictly for firmware debugging. Otherwise, the host program should not use this command.

5.1.6 Set Resolution (36h, O)

Offset	Host command
0	36
1	00
2	Resolution (0=640 x 480; 1=1152 x 864)
3	00
4	00
5	00
6	00
7	1A

This command is to change the resolution of image files captured subsequently.

5.1.7 Set File Format (37h, O)

Offset	Host command
0	37
1	00
2	Format (3=JPEG; 4=FlashPix)
3	00
4	00
5	00
6	00
7	1A

This command is to change the file format of image files captured subsequently.

5.1.8 Set Baud Rate (41h, O/F, Serial Only)

Offset	Host command
0	41
1	00
2	96 19 38 57 11 (See below)
3	00 20 40 60 52 (See below)
4	00
5	00
6	00
7	1A

Baud rate definitions

Baud rate	Offset 2	Offset 3
9.6 k	96	00
19.2 k	19	20
38.4 k	38	40
57.6 k	57	60
115.2 k	11	52

This command changes the current baud rate of **serial communication only**. The camera will return NAK when it receives this command during IrDA communication.

The power-up default baud rate of the camera is 9600 bps. When the camera receives the break on/off signal, the baud rate is reset to 9600 bps. The baud rate set by this command will not be affected by moving to sleep mode. If this command is executed correctly, the camera will respond with an ACK.

Note: The camera will not respond with a command completion code for this command. The camera will however return an ACK. The camera requires 100 msec for the new baud rate to take effect after sending an ACK. The host should consider this time before sending next command.

5.1.9 Send File Names in Album (4Ah, O)

Offset	Host command
0	4A
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is to know file names on the card. When this command is received, the camera sends file information for all camera recognizable image files under the \DCIMAGES directory on the memory card as follows (using 257 byte packets):

0-1	Number of entries (n)
2-21	Entry #1
22-41	Entry #2
	•
	• (Entries #3 to n-1)
	•
... - (n*20)+1	Entry #n

Each 20-byte entry is formatted as such (Same information which is sent by Read File Command):

0-11	File name (8.3)
12	File attribute
13-14	Creation time
15-16	Creation date
17-20	File size in bytes

Note: File entries in packed data are ordered by internal picture number. If the memory card is not present, the camera returns a command execution error (e2h).

5.1.10 Send Image File on Card (64h, O)

Offset	Host command
0	64
1	00
2	Picture No.(MSB)
3	Picture No.(LSB)
4	00
5	00
6	00
7	1A

This command sends the whole image file with the specified picture number on Compact Flash card to the host. In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified picture number does not exist on Compact Flash card.

5.1.11 Send Picture Information on Card (65h, O)

Offset	Host command
0	65
1	00
2	Picture No.(MSB)
3	Picture No.(LSB)
4	00
5	00
6	00
7	1A

This command sends the picture information of a specified picture on Compact Flash card to the host. In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified picture number does not exist on Compact Flash card.

5.1.12 Send Thumbnail Image on Card (66h, O)

Offset	Host command
0	66
1	00
2	Picture No.(Upper)
3	Picture No.(LSB)
4	Size (0 : Small, 1 : Full Resolution)
5	00
6	00
7	1A

This command indicates the camera to send a thumbnail image on Compact Flash card to the host.

Picture No. The picture number of image file on Compact Flash card.

Size Size of Thumbnail Image.

0 : 96 x 72 x 4 bit = 3,456 bytes (Bayer Pattern CFA)

1 : 96 x 72 x 3 x 8 bit = 20,736 bytes

Small Thumbnail Image Format (96x72)	$G_{(1,1)} R_{(2,1)} \dots$ $B_{(1,2)} G_{(2,2)} \dots$ $\dots B_{(95,72)} G_{(96,72)}$
--	---

Full Resolution Thumbnail Image Format (96x72x3)	$RGB_{(1,1)} RGB_{(2,1)} \dots$ $RGB_{(1,2)} RGB_{(2,2)} \dots$ $\dots RGB_{(95,72)} RGB_{(96,72)}$
--	---

In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified picture number does not exist on Compact Flash card.

5.1.13 Set Image Quality (71h, O)

Offset	Host command
0	71
1	00
2	Image Quality
3	IPChainEnable
4	00
5	00
6	00
7	1A

This command sets the image quality for pictures captured subsequently.

Image quality 00=No comp (only during alpha and beta phase)

01=Best image

02=Better image

03=Good image

IPChainEnable 00=Enable

01=Disable (only during alpha and beta phase)

If an undefined value is set in the image quality field, the camera will return a command execution error (e2h) to the host.

5.1.14 Set Flash Mode (72h, O)

Offset	Host command
0	72

1	00
2	Flash Mode
3	00
4	00
5	00
6	00
7	1A

This command sets the current flash mode.

Flash Mode 0=Auto flash
 1=Fill
 2=Flash off
 3=Auto Red-eye
 4=Fill Red-eye

If an undefined value is set in the flash mode field, the camera will return a command execution error (e2h) to the host.

5.1.15 Set Shutter Delay (74h, O)

Offset	Host command
0	74
1	00
2	shutter delay
3	00
4	00
5	00
6	00
7	1A

This command sets the shutter delay mode. Shutter Delay value is always 10 secs [2].

Flash Mode 00=Shutter delay is disabled (off)
 01=Shutter delay is enabled (on)

If an undefined value is set in the shutter delay field, the camera will return a command execution error (e2h) to the host.

5.1.16 Set Time (75h, O)

Offset	Host command
0	75
1	00
2	Time data 0 (MSB)
3	Time data 1
4	Time data 2

5	Time data 3 (LSB)
6	00
7	1A

This command sets the time and date to the camera.

Time data (4 bytes value)

Elapsed time in 0.5 seconds since 0:00 on January 1, 1997 0:00.

5.1.17 Zoom (78h, O)

Offset	Host command
0	78
1	00
2	Zoom value (7 steps)
3	00
4	00
5	00
6	00
7	1A

This command sets the zoom position.

Zoom value 0 : Approximately 58 mm (35 mm equivalent)
 1 : Approximately 51 mm (35 mm equivalent)
 2 : Approximately 41 mm (35 mm equivalent)
 3 : Approximately 34 mm (35 mm equivalent)
 4 : Approximately 29 mm (35 mm equivalent, power-up default)
 5 : Close-up Position

If an undefined value is set in the zoom value field, the camera will return a command execution error (e2h) to the host.

5.1.18 Erase Images on Card (7Bh, O)

Offset	Host command
0	7B
1	00
2	Picture No. (MSB)
3	Picture No. (LSB)
4	00
5	00
6	00
7	1A

This command specifies to erase a specified image on Compact Flash card. If the picture No. is 0xFFFF, this command means Erase All Images.

In the following cases, the camera will return a command execution error (e2h).

- Compact Flash card is not inserted in the camera.
- Compact Flash card is protected.
- Specified images does not exist on the card.

5.1.19 Take a Picture to Card (7Ch, O)

Offset	Host command
0	7C
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command specifies to take a picture to save that image on Compact Flash card. In the following cases, the camera will return a command execution error (e2h).

- Compact Flash card is already full.
- Compact Flash card is not inserted in the camera.
- Compact Flash card is protected.

5.1.20 Check Camera Battery (7Eh, O)

Offset	Host command
0	7E
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command checks the battery level of the camera. The result will be written in the camera status table which can then be retrieved.

Note: The battery level in the camera status table is updated in the following other ways:

- The camera is turned on.
- The camera wakes up from the sleep mode.
- Just before a pictured is taken by shutter press.

Note: Executing this command will itself consume some amount of battery power.

5.1.21 Send Camera Status Table (7Fh, O)

Offset	Host command
0	7F
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command sends the current camera status table (see section 3.1) to the host.

5.1.22 Set Exposure Compensation

Offset	Host command
0	80
1	00
2	Exposure compensation value
3	00
4	00
5	00
6	00
7	1A

This command sets an exposure compensation value against the measured EV value electrically. The camera will capture an image with specified compensated electric value. For the DC210 Zoom Camera, the range of EV value is from 5.0 EV to 16 EV(in wide case). Compensation value can be specified within this range. If the measured EV value is 12 EV, the compensation value could be one of the value from 10.0 to 14.0.

Exposure compensation value

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Sign	Value (in 0.5 EV. step)						

Sign 0 : Positive value 1 : Negative value

Value 0 (no compensation) to 4. If the calculated EV value (measured value + compensation value) exceeds the effective EV range, the camera does not assure the image quality.

Examples Sign = 0, value = 0 stands for Auto exposure

 Sign = 0, value = 2 stands for Auto exposure + 1.0 E.V.

 Sign = 1, value = 1 stands for Auto exposure - 0.5 E.V.

If an illegal value is set in the exposure compensation value field, the camera will return a command execution error (e2h) to the host.

5.1.23 Reset Camera (8Ah, O)

Offset	Host command
0	8A
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command resets the camera setting to the system default listed in section 5.2.

5.1.24 Read Picture Information (91h, O)

Offset	Host command
0	91
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is to read picture information of image files on the memory card. This command is followed by a 60-byte packet which contains a file name under the root directory, offset block number from the file header and number of blocks as follows. The camera will send 513-byte packets to the host.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

If "FFFFFFFF" is specified to all bytes in starting block and no. of blocks, the camera should read entire data in the file.

From the host computer viewpoint, the image files will be named as such:

\PCCARD\DCIMAGES\DCPnnnnn.ttt

The content is guaranteed **only for DC210 Readable JPEG/FlashPix** files.
See section 3.2 for the Picture Information Table.

In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified file does not exist on Compact Flash card.
- Specified file is not a DC210 readable JPEG or FlashPix file.

5.1.25 Read Summary Information (92h, O)

Offset	Host command
0	92
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is to read summary information of image files on the memory card. This command is followed by a 60-byte packet which contains a file name under the root directory, offset block number from the file header and number of blocks as follows. The camera will send 513-byte packets to the host.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

If "FFFFFFFF" is specified to all bytes in starting block and no. of blocks, the camera should read entire data in the file.

From the host computer viewpoint, the image files will be named as such:

\PCCARD\DCIMAGES\DCPnnnnn.ttt

This command is guaranteed **only for DC210 Readable FlashPix** files.

Following is the data contents of Summary Information.

0 - 31	Title
32 - 63	Subject
64 - 95	Author
96 - 127	Keywords
128 - 191	Comments
192 - 223	Template
224 - 255	Last Saved By
256 - 287	Revision Number
288 - 295	Create Time (VT_FILETIME)
296 - 328	Name Of Application

329 - 511	Reserved
-----------	----------

In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified file does not exist on Compact Flash card.
- Specified file is not a DC210 readable FlashPix file.

5.1.26 Read Thumbnail Image (93h, O)

Offset	Host command
0	93
1	00
2	00
3	00
4	Size (0 : Small, 1 : Full Resolution)
5	00
6	00
7	1A

This command is to read thumbnail image of image files on the ATA card.

Size Size of Thumbnail Image.
0 : 96 x 72 x 4 bit = 3,456 bytes (Bayer Pattern CFA)
1 : 96 x 72 x 3 x 8 bit = 20,736 bytes

This command is followed by a 60-byte packet which contains a file name under the root directory, offset block number from the file header and number of blocks as follows.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

If "FFFFFFFF" is specified to all bytes in starting block and no. of blocks, the camera should read entire data in the file.

From the host computer viewpoint, the image files will be named as such:

\PCCARD\DCIMAGES\DCPnnnnn. tttt

Small Thumbnail Image Format (96x72)	$G_{(1,1)} R_{(2,1)} \dots$ $B_{(1,2)} G_{(2,2)} \dots$ $\dots B_{(95,72)} G_{(96,72)}$
Full Resolution Thumbnail Image Format (96x72x3)	$RGB_{(1,1)} RGB_{(2,1)} \dots$ $RGB_{(1,2)} RGB_{(2,2)} \dots$ $\dots RGB_{(95,72)} RGB_{(96,72)}$

In the following cases, the camera will return a command execution error (e2h) to the host.

- Compact Flash card is not inserted in the camera.
- Specified file does not exist on Compact Flash card.
- Specified file is not a DC210 readable JPEG/FlashPix file.

5.1.27 Initialize Memory Card (95h, O)

Offset	Host command
0	95
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is to format Compact Flash card. This command is followed by the 60-byte packet of a volume id for the card. The volume id consists of up to 11 characters. If null code is specified for the volume id, the card has no volume id. The host will respond a 17-byte packet that contains number of bytes available for the card if this command is executed correctly.

In the following cases, the camera will return a command execution error (e2h).

- Compact Flash card is not inserted in the camera.
- Card is not a ATA card.
- Compact Flash card is protected.

5.1.28 Open Card (96h, O)

Offset	Host command
0	96
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command allows the camera to receive the following commands.

- Read file
- Read Picture Information
- Read Summary Information

- Read Thumbnail
- Delete File
- Close

Note that "Get card status(98h)" command can be sent to the camera even if the ATA card is not opened. An open command will result in an error if the card has already been opened.

"Open status" is kept even if the opened card is ejected. In this case, if a card is inserted to the camera again, the host should send a close command and then send this command again. If the camera goes to sleep mode, the host should send open command again.

5.1.29 Close Card (97h, O)

Offset	Host command
0	97
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command closes the ATA card logically. Following ATA commands can not be executed when the card is closed.

- Read File
- Read Picture Information
- Read Summary Information
- Read Directory Information
- Read Thumbnail
- Delete File

A close command can be executed even if the card is not opened (nothing will be affected).

5.1.30 Get Card Status (98h, O)

Offset	Host command
0	98
1	00
2	00
3	00
4	00
5	00
6	00

7	1A
---	----

This command gets the following card information. This command can be sent regardless of the card is opened or closed.

- Card status
- Number of bytes available

The camera will send the following data with a 17-byte packet.

Card status (1 byte)
Program status (2 bytes)
of bytes available (4 bytes)

Card status and program status will be read from the camera status table.

5.1.31 Read Directory Information (99h, O)

Offset	Host command
0	99
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is followed by a 60-byte packet that contains directory name with full path name. The camera sends file information for all entries of specified directory on the card as follows (using 257-byte packets):

0-1	No of entries (n)
2-21	Entry #1
22-41	Entry #2
	•
	• (Entries #3 to n-1)
	•
... - (n*20)+1	Entry #n

Each 20-byte entry has the following information.

0-11	File name (8.3)
12	File attribute
13-14	Creation time
15-16	Creation date
17-20	File size in bytes

Note that a command execution error is returned from the camera when this command is sent to the camera if the card is not opened.

5.1.32 Read File (9Ah, O)

Offset	Host command
0	9A
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

Image files on the ATA card can be read with this command. This command is followed by a 60-byte packet that contains a file name under the root directory, offset block number from the file header and number of blocks as follows. The camera will send 513-byte packets for image file to the host.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

If "FFFFFFFF" is specified to all bytes in starting block and no. of blocks, the camera should read entire data in the file.

From the host computer viewpoint, the image files will be named as such:

\PCCARD\DCIMAGES\DCPnnnnnn.ttt

Note that a command execution error (e2h) is returned from the camera when this command is sent to the camera if the card is not opened.

5.1.33 Delete File (9Dh, O)

Offset	Host command
0	9D
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

Image files on the ATA card can be erased with this command. This command is followed by a 60-byte packet that contains a file name under the root directory, offset block number from the file header and number of blocks as follows.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

From the host computer viewpoint, the image files will be named as such:

\PCCARD\DCIMAGES\DCPnnnnn.ttt

Note that a command execution error (e2h) is returned from the camera when this command is sent to the camera if the card is not opened.

5.1.34 Write Camera ID (9Eh, O)

Offset	Host command
0	9E
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command is followed by a 60-byte packet that contains a camera ID. The camera should re-write the camera ID in the EEPROM when a new camera ID is sent from the host.

5.1.35 Enter Adjust Mode (ADh, O)

Offset	Host command
0	AD
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command specifies the camera to enter adjust mode **only from serial communication**. The camera will return NAK when it receives this command during IrDA communication.

5.1.36 Completion of Download Mode (AEh, F)

Offset	Host command
0	AE
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command informs the camera that firmware download is finished. The camera will check whether the firmware is downloaded completely and respond a command completion code (00h) or a command execution error code (e2h) to the host. After this command, the camera powers itself off.

The camera will return NAK when it receives this command during IrDA communication.

5.2 Camera Settings

Camera Setting	System Default	Reset Camera (Connect Mode only)	Power On/Off	Power On/Off	After Exposure
Flash (Auto,Fill,Off)	Auto	<---	<---	Maintained	<---
Flash (Red-eye)	Off	<---	Maintained	<---	<---
Macro (DC210)	Off	<---	<---	Maintained	<---
Zoom (DC210)	Wide	<---	<---	Maintained	<---
Self Timer *	Off	<---	<---	Maintained	Off
Exposure Compensation	0	<---	<---	Maintained	<---
Compression	Low	<---	Maintained	<---	<---
Resolution	High	<---	Maintained	<---	<---
Video Out	NTSC	<---	Maintained	<---	<---
File Format	JPEG	<---	Maintained	<---	<---
Date/time	1/1/1997 0:00	Maintained	<---	<---	<---
QuickView	On	N/A	Maintained	<---	<---
Preview	Off	N/A	Off	N/A	Maintained
Baud Rate	9600	Maintained	9600	Maintained	<---
Serial Connection	Not Selected	Maintained	Not Selected	Maintained	<---

Notes:

System default means factory settings.

<--- indicates that setting returns to system default.

The term "Maintained" means that selected feature of the icon is not changed.

* : Self-timer setting is cleared by moving mode dial