EKJ R&D Digital Camera Development

DC240 Digital Camera
Host Interface Specification for Developer

Revision Number 1. 02
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Revision History

Rev. #	Date	Name	Summary
1.00	3/5/99	H.Yamagata	Modified from the internal spec for DC240.
1.01	3/25/99	H.Yamagata	Delete the words to restrict information on the head page and the header of each page.
1.02	3/26/1999	H.Yamagata	Modified response data format for "Initialize memory card" command.(5.1.36)

1. INTRODUCTION

DC240 is a 3x zoom TTL AF digital camera with 1.3M pixel CCD. This document describes the detailed host interface commands of the DC240 digital cameras. This document reflects the design required to meet the functionality requirements as specified in the Engineering Requirement Specification[1] and the User Interaction Specification[2]. This document addresses the software and firmware design of the DC240 digital camera Host I/F.

1.1 Purpose

This document specifies the communications interface between the host computer and DC240 digital camera. This includes all camera commands, data, and control flow between the host and the camera.

1.2 Scope

This document completely specifies the behavior of the product feature sets and the concepts. Future changes to the design and/or additional functionality to this product 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 DC240 product. This document is also intended to assist future software/firmware developers involved in the support of this product.

2. Camera Behavior In Terms Of Host Interface

2.1 Camera State

The camera is always in one of the following modes.
- Off State
- Capture State
- Review State
- Camera Settings State
- Connect State
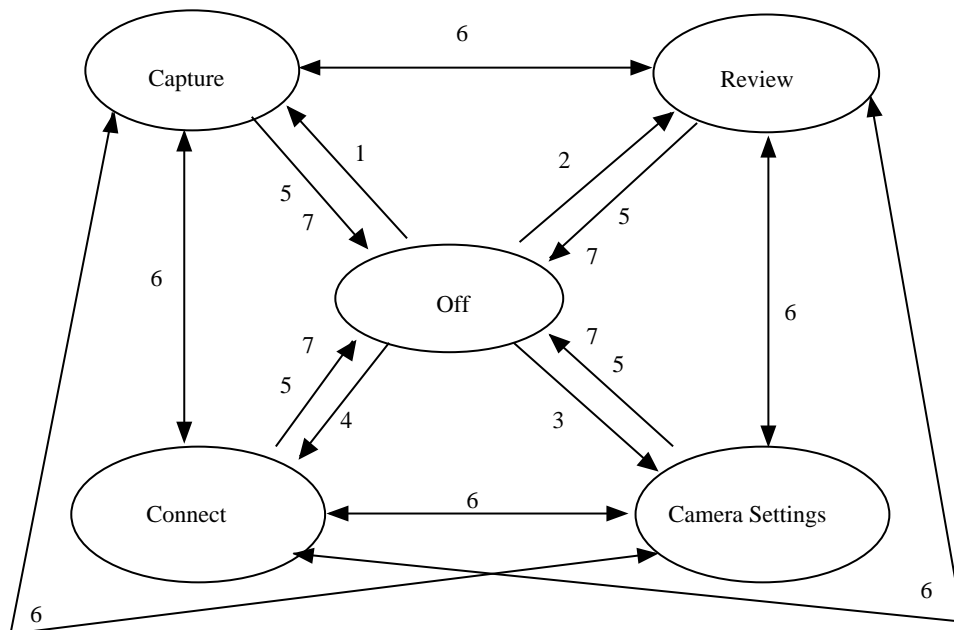
The transition among these modes is as follows. Host communication is available only in Connect State.

       1 : Power on by button and Capture
       2 : Power on by button and Review
       3 : Power on by button and Connect
       4 : Power on by button and Camera Settings
       5 : Power off by button
       6 : Mode dial change
       7 : Time out (8 min for Normal, 4 min for Power Save, 1 hrs for AC)

NOTE : See UI spec[1] for the time out for other modes than connect

2.2 Connect State

When the user 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 the animation below. To capture an image, the user has to use the host software. Lens cover is closed, and is opened only when the camera receives a command to capture form Host.

If the camera detects active serial cable inserted, the camera starts communicating though serial, and if the camera detects USB cable insertion, the camera starts communicating though USB. Once the camera establishes either serial of USB, the other I/F cable insertion will be ignored. If the camera detects none of them for more than 8 minutes for Normal, 4 minutes for Power Save, and 1 hours in case of AC adapter power supply, the camera automatically goes into Off State.

Once the mode dial is turned to "Connect", the numeric display on the status LCD will display an animation on the status LCD instead of icons. The order of the animation is indicated in the figure below. When communication is lost, the animation stops.
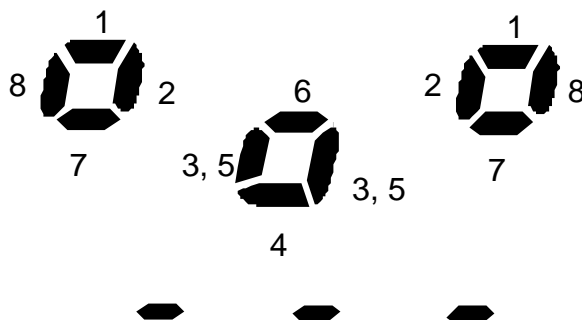
If there is no card in the camera, Status LCD will display "---" as shown below.

When the user moves the mode dial to other modes, the camera leaves Connect State. If the camera is under processing commands when the mode dial is moved, the camera completes the command processing and then moves to other modes.

When the user wants to change the communication means after communication is once established, the user has to either 1) go to other modes and come back connect, 2) disconnect a cable and reconnect, or 3) power off -> on the camera.

2.3 Modes in Connect State

DC240 camera has three internal modes in its Connect Mode, 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 and maintenance internal data in 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 Mode when the user presses the power button (State Transition #5), or no communication gets time out (State Transition #7). From Off State, the camera wakes up when the camera detects power button press. It takes about 10 seconds 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.
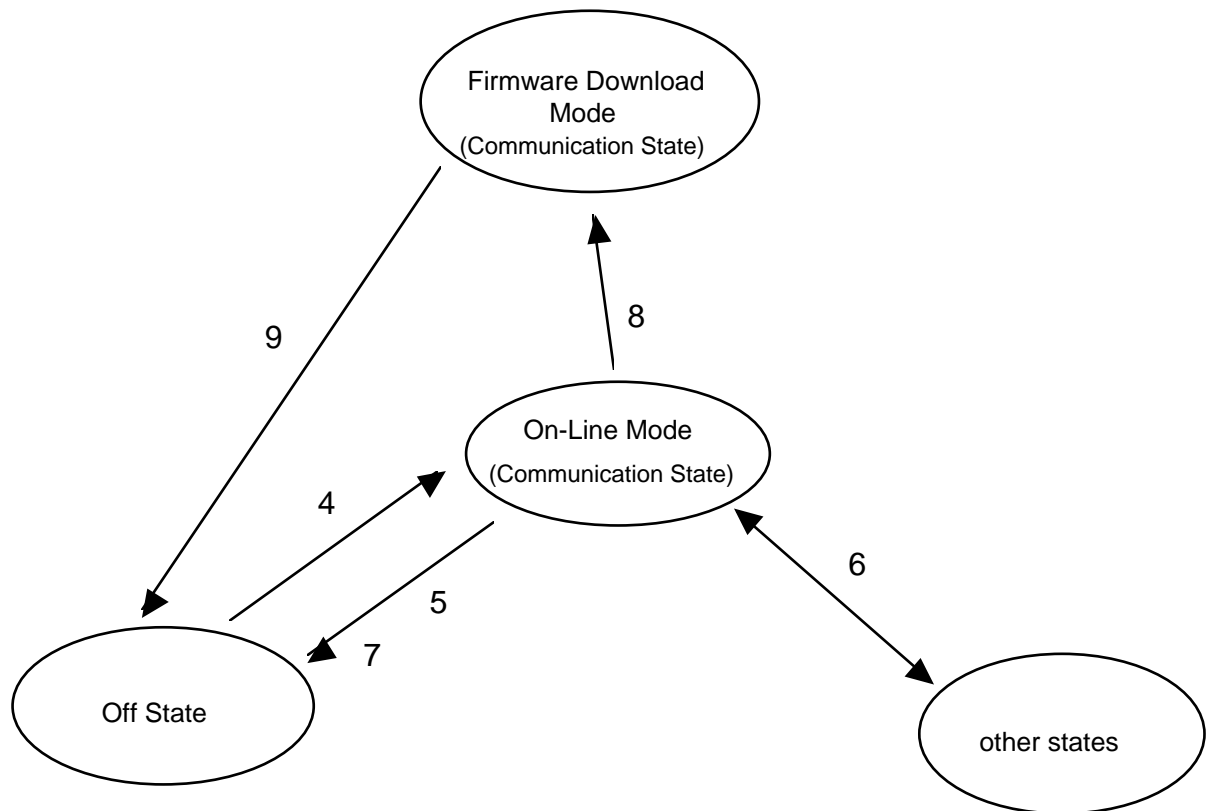
4 : Power on by button and Communication
5 : Power off by button
6 : Mode dial change
7 : Time out (8 min for Normal, 4 min for Power Save, 10 hrs for AC)
8 : ROM mode command (serial only)
9 : ROM mode completed (serial only)

NOTE : This chart is Connect State centric and does not fully describe about the relationship among all states.

2.4 Hardware

The camera supports two communication protocols, serial and USB.

2.4.1 Serial

DC240 uses RS-232C as the basis for serial communication with the host.

DC240 cameras support the baud rate 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.

The PC has to hold DTR signal to high for at least 470 msecs before starting any communication.

Break signal, holding the RxD line of serial port low for more than 200 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 and HPBS (see 2.6 Data and Set Host Packet Buffer Size (2Ah) command), but the camera maintains all other settings.

2.4.2 USB

DC240 camera uses USB lines as other communication means. Since Image Device Class of USB is not fully defined yet and is premature to be implemented onto a camera, DC240 uses basically the same protocol as serial is using.

Following is the list of DC240 specific data/string for USB.

            idVendor   0x040A
            idProduct   0x0120
            iManufacturer   "Eastman Kodak Company"
            iProduct   "KODAK DC240 Zoom Digital Camera"

iSerialNumber is not used in this camera.

2.5 Command Format

2.5.1 System Code

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 Communication Flow Control 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 Completed
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 receive correctly (ACK, d1h)

    When the camera sends this code when it receives a correct format of DC240 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 DC240 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 in below condition. This code is for both from the camera to the host and from the host to the camera direction.
  ・The checksum error is detected on the packet.
  ・The head of data packet is not the value specified as control byte.

- 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 Interface Command

Host interface commands consist of 8 byte data. The first byte contains a command code. 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)

- 11266 bytes   Image data on card
- 258 bytes   Picture information, etc.
- 18 bytes   Error status, card status, etc.

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

- 257 bytes   Data in Firmware Download mode
- 60 bytes   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
75	Set time	60	
7F	Send camera status table	-	258
8E	Execute diagnostic	--	18
91	Read picture information	60	258
93	Read thumbnail image	60	HPBS (*1)
95	Initialize memory card	60	18
98	Get card status	-	18
99	Read directory information	60	258
9A	Read file	60	HPBS (*1)

9C	Write file	60/HPBS (*1)	-
9D	Delete file	60	-
9E	Write camera ID	60	-

*1 : Set HPBS (Host Packet Buffer Size) with Set Host Packet Buffer Size Command (2Ah). The power-on default is 514, and the maximum size available is 32770. This is applicable to both serial and USB.

Packet from the host to the camera   Packet from the camera to the host

byte 0 = Packet control byte except 1Dh & 31h commands
Data
Checksum

packet control byte except 13h, 22h, & 32h commands
Data
Checksum
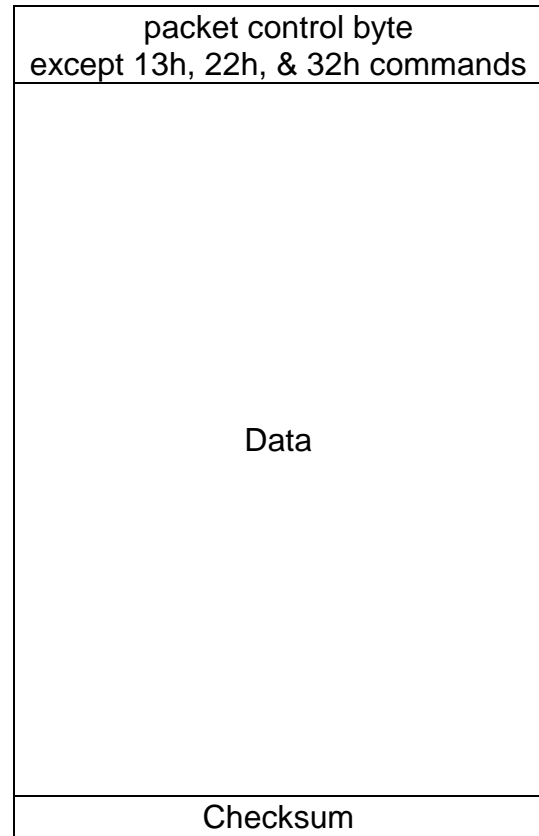
Packet from the host to the camera
    Packet control byte   0x00 : Normal packet (followed by next packet)
                                 0x80 : Final packet
                                 0xFF : Cancel

        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 host against the received command with system code within 2 secs. If the camera can not reply in normal sequence within 2 secs, it returns Busy (f0h) system code[7].

The camera does not discontinue communication in the middle of processing commands unless the camera does not receive any expected respond from the host more than 200 secs.

2.7.1 Command without Send/Receive Packet (normal case)
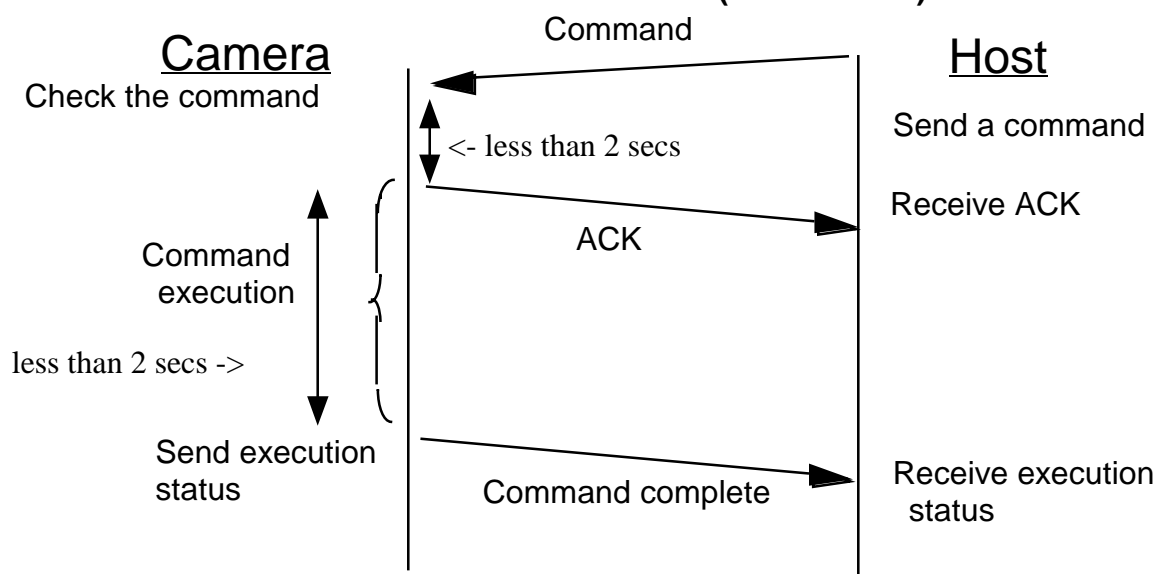
2.7.2 Command without Send/Receive Packet (busy case)
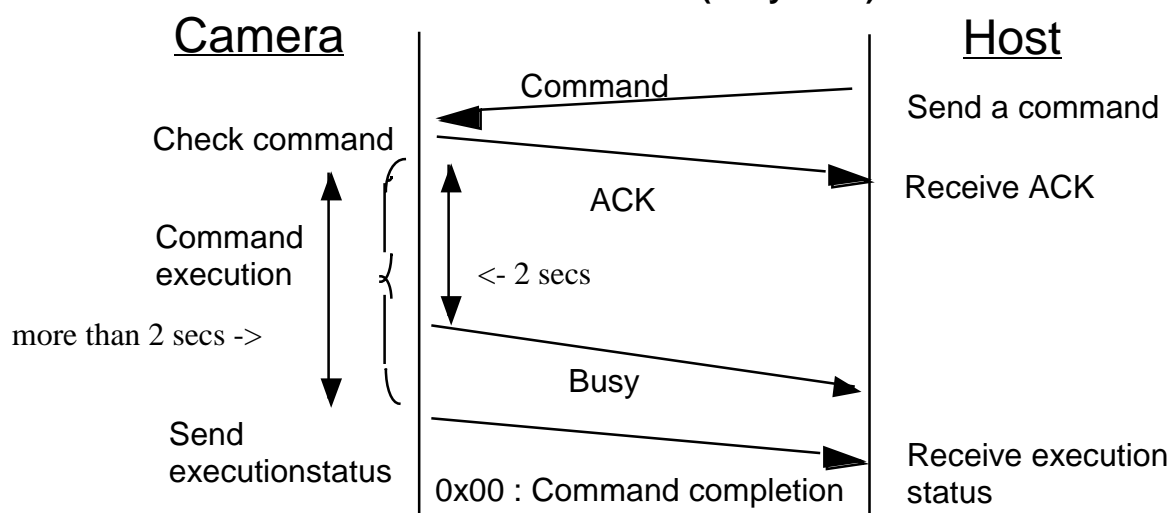
2.7.3 Command for Receive Packet (from Camera)

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 after the camera recognized these commands. The camera will send a packet after it recognized the sent command immediately. The host should always know the number of packets from the camera before sending the command. The host always takes the initiative in receiving and sending packets.

2.7.3.1 normal case

Camera		Host
	Command	Send a command
Check command		
	ACK	Receive ACK
	Packet #1	
Send a packet		Checksum comparison
	<- less than 200 secs	
	Correct Packet	
Send a packet	• • • Packet #n	Checksum comparison
	Correct Packet	
Send execution status	0x00 : Command completion	Receive execution status

2.7.3.2 "busy" case

Camera   Host

                    Command   Send a command

Check command

                    ACK   Receive ACK
                    Packet #1

Send a packet   Checksum comparison

                    Correct Packet

more than 2 secs ->

                    Busy
                      •
Send a packet   •
                      •   Packet #n

                                                 Checksum comparison

                    Correct Packet

Send execution
status
                    0x00 : Command completion   Receive execution
                                                   status

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).

Camera   Host

Command   Send a command

Check command

ACK   Receive ACK

Packet #1   Send a packet

Checksum
comparison

Correct Packet

•
•
•

Packet #n   Send a packet

Checksum
comparison

Correct Packet

Send execution
status

0x00 : Command completion   Receive execution
                                                  status
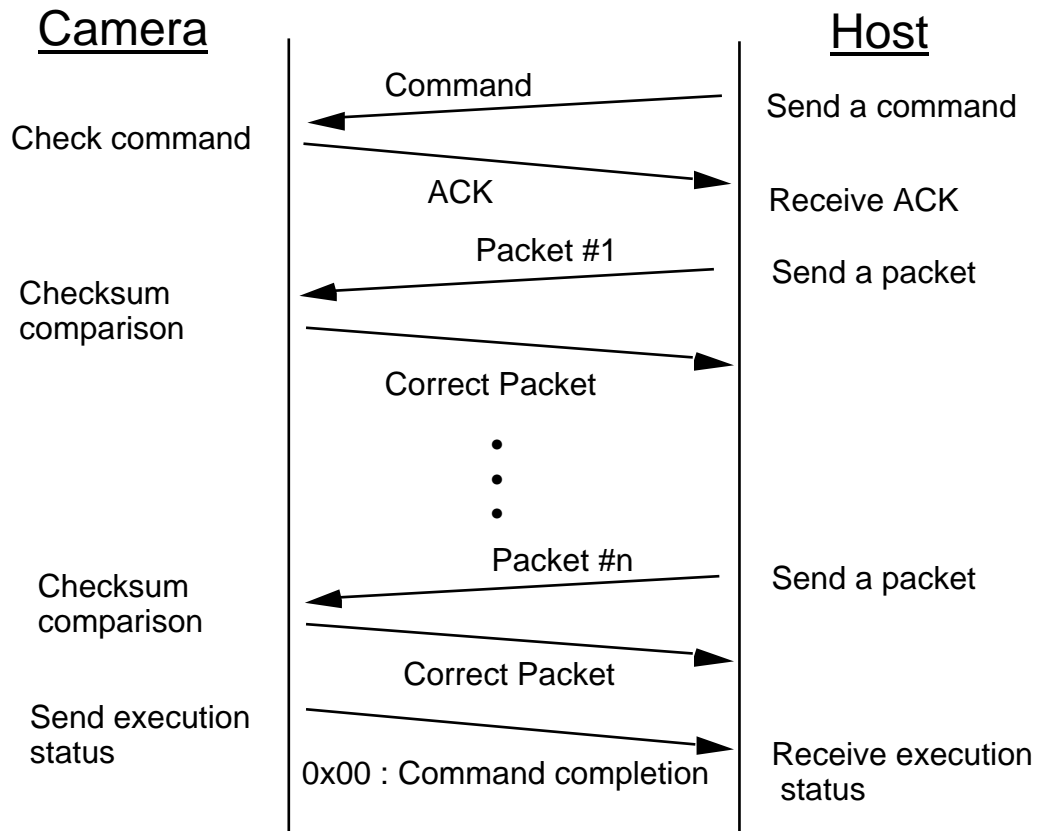
2.7.5 Error Cases

(1) Illegal Command
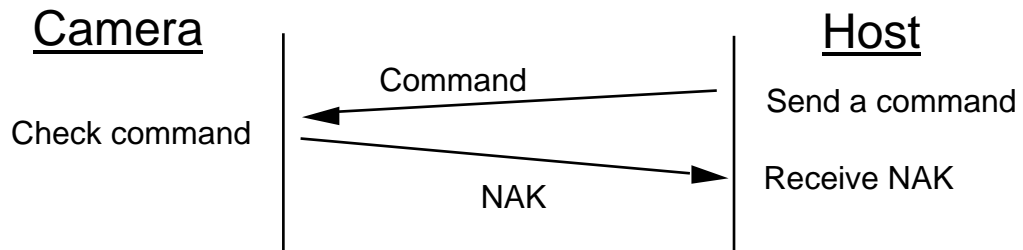
(2) Command Execution Error

The host can know what error is occurred when it receives a command error (e2h) from the host. See the possible command error cause at each command description (5.1).
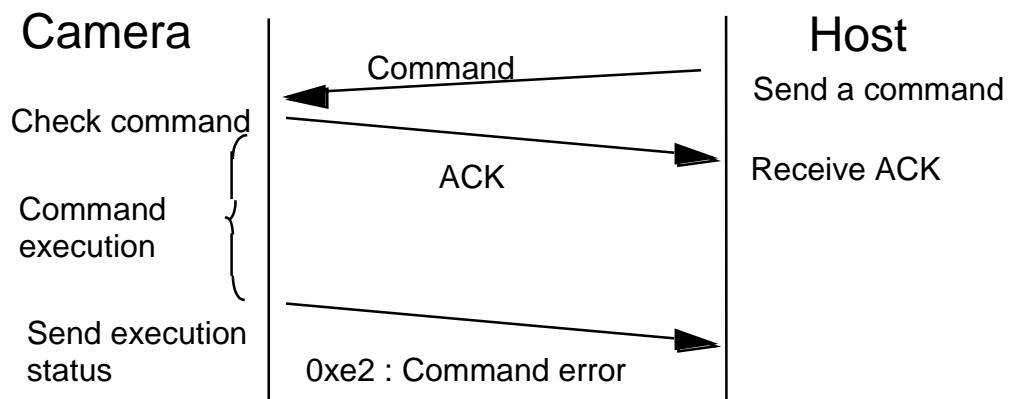
(3) **Packet Error**

- 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.

Host --> Camera

Camera --> Host

Camera   # Host

Command
→ Send a command

Check command

ACK
→ Receive ACK

Packet #i
Send a packet

Checksum
comparison

Illegal packet

Packet #i
Send a packet

Checksum
comparison

Illegal packet

Packet #i
Send a packet

Checksum
comparison

Illegal packet

Recongnize
cancel
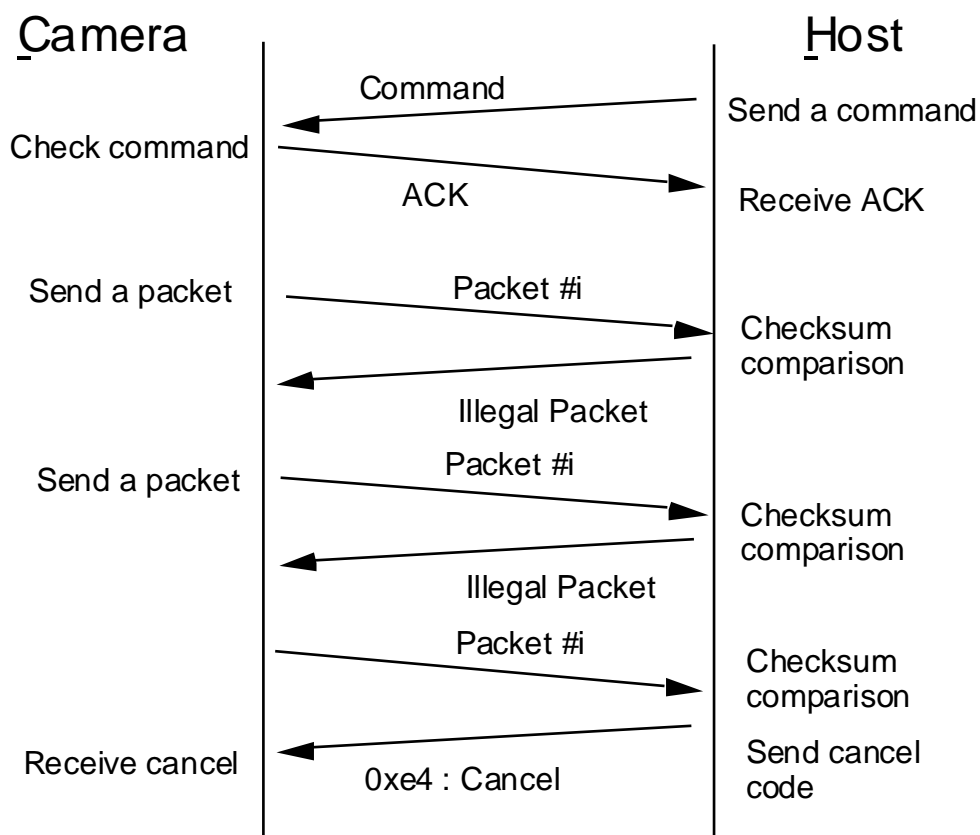
Send cancel
packet
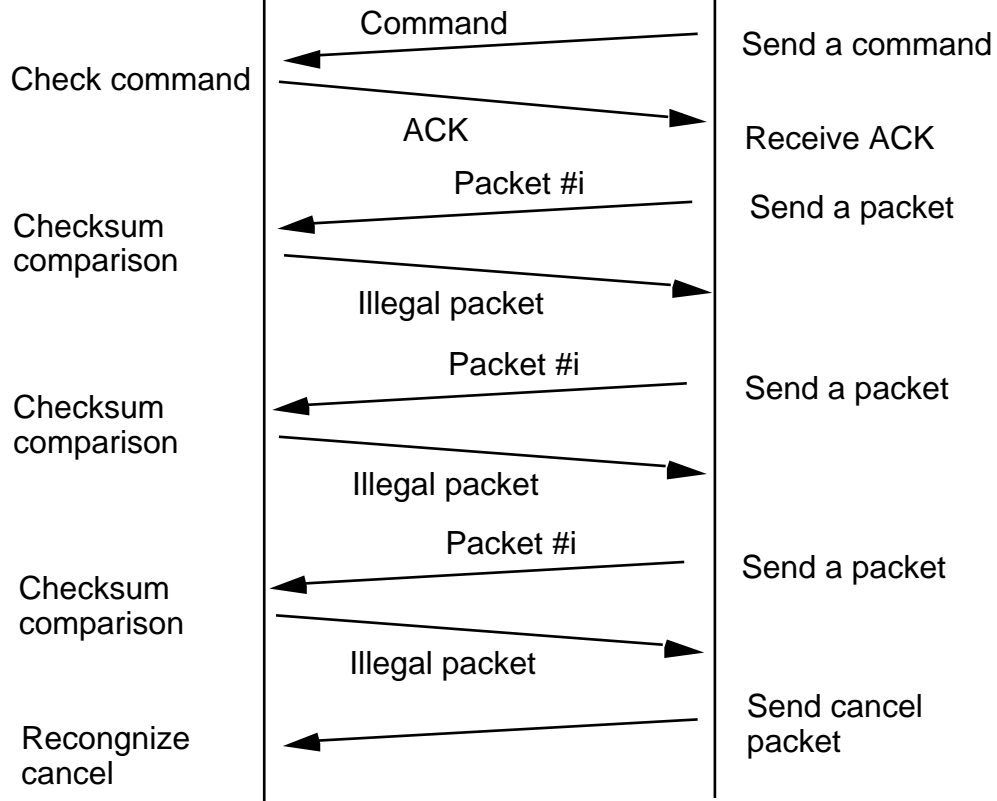
2.7.6 Communication Immediately After Power Up The Camera

When the camera receives the command immediately after the power-up, the camera may require about 10 secs maximum to be ready, and it will reply BSY if the camera is not ready to process commands. If the camera does not respond more than 2 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.

Camera Off -> On / Host

Camera		Host
	← Command	Send a command
		Send the same command 3 secs max
Ready for Command		
	← Break	
Mounting Card	← Command	Send the same command
	BUSY →	
	BUSY →	
Mount Done		
	ACK →	Receive ACK
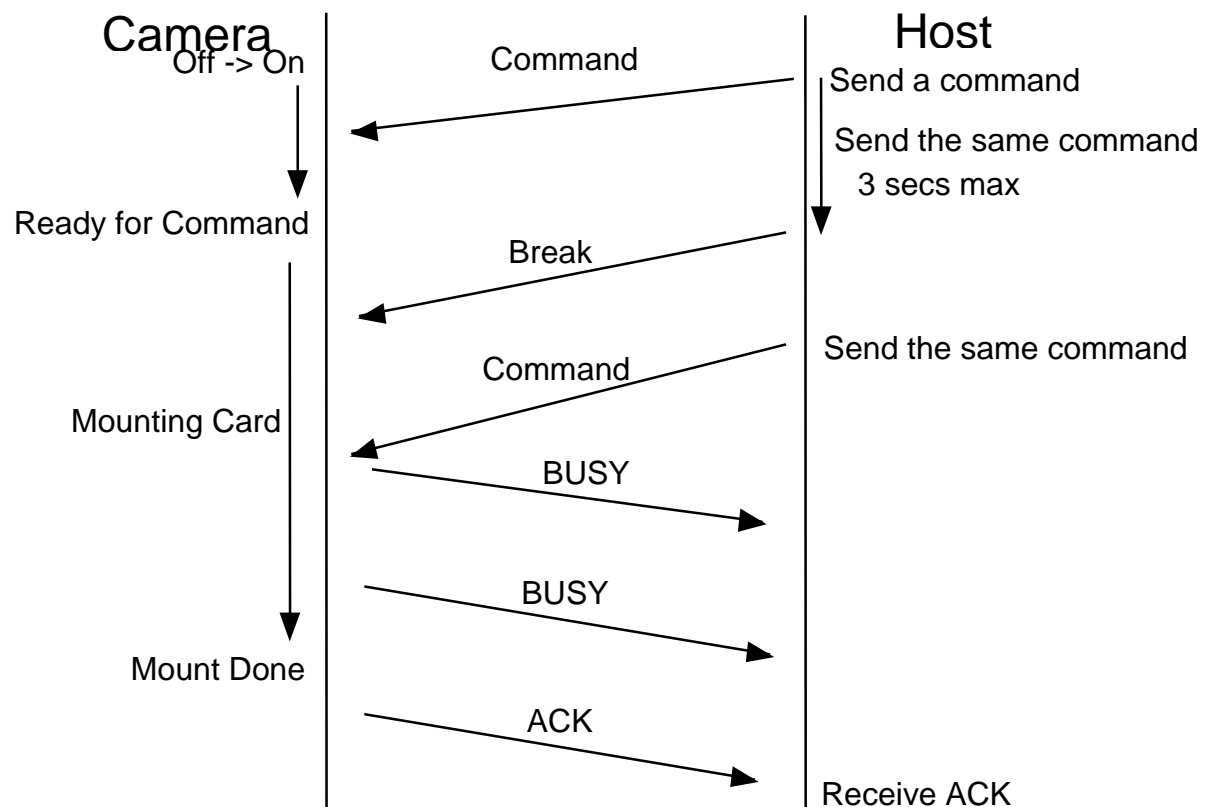
3. DATA FORMAT

3.1 Camera Status Table

Byte offset	Description
0	Data Type (01h for camera status table)
1	Camera Type (5 : DC240)
2	Firmware version (Integer part : 0 - 255)
3	Firmware version (Hex interpretation: 00 to ff)
4	ROM Version for 32-bit µ (Integer part : 0 - 255)
5	ROM Version for 32-bit µ (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 : OK, 1 : Weak, 2 : Empty)
9	AC adapter flag (0 : Not Used, 1 : In Use)
10	Strobe Status (0 : Not Charged, 1 : Charged)
11	Memory Card Status (*1)
12	Video Format (0 : NTSC, 1 : PAL)
13	Reserved
14	# of Picture Taken in Card (MSB)
15	# of Picture Taken in Card (LSB)
16 ● ● 26	Volume ID of CF Card (11 characters)
27	Reserved
28 ● ● 59	Camera ID (32-byte ASCII) (*2)
60	Remaining Pictures at Low Quality (MSB)
61	Remaining Pictures at Low Quality (LSB)
62	Remaining Pictures at Medium Quality (MSB)
63	Remaining Pictures at Medium Quality (LSB)
64	Remaining Pictures at High Quality (MSB)
65	Remaining Pictures at High Quality (LSB)
66	Total Number of Picture Taken (MSB) (*3)

67	Total number of Picture Taken (LSB)
68	Total number of Strobe Fired (MSB)
69	Total number of Strobe Fired (LSB)
70	Reserved
71	Beep (0 : Off, 1 : Limited, 2 : On)
72	Reserved
●	
●	
77	
78	File Type (3 : EXIF)
79	Picture Size (0 : 640x480, 1 : 1280x960)
80	Image Quality (1 : High, 2 : Medium 3: Low)
81	IP Chain Disable (0 : Enabled)
82	Image Incomplete Flag (0 : complete)
83	Timer Mode (0 ; Off, 1 : On)
84	Reserved
●	
●	
87	
88	Year (MSB)
89	Year (LSB)
90	Month
91	Day
92	Hour
93	Minute
94	Second
95	TenM Second (unit in 10 msecs)
96	Reserved
97	Strobe Mode (0 : Auto, 1 : Fill, 2 : Off, 3 : Auto Red-eye)
98	Exposure Compensation (MSB) (x100, -200 to 200)
99	Exposure Compensation (LSB)
100	AE Mode (0 : Auto, 1 : Center Weight)
101	Focus Mode (0 : Auto, 2: Close-up, 3: Infinity)
102	AF Mode (2 : Spot)
103	AWB Mode (0 : Auto, 1 : Fluorescent, 2 : Tungsten, 3 : Daylight/Strobe)
104	Zoom Magnification (MSB) (100 – 600)
105	Zoom Magnification

106	Zoom Magnification
107	Zoom Magnification (LSB) (more than 300 in case of digital zoom)
108	Reserved
109	Reserved
110	Reserved
111	Reserved
112	Reserved
113	Reserved
114	Reserved
115	Reserved
116	Reserved
117	Reserved
118	Reserved
119	Reserved
120	Reserved
121	Reserved
122	Reserved
123	Reserved
124	Reserved
125	Reserved
126	Reserved
127	Reserved
128	Reserved
129	Exposure Mode (*7)
130	Reserved
131	Sharpness Control (-1(soft), 0(normal), 1(sharp))
132	Exposure Time (MSB) (in 10 µ sec unit)
133	Exposure Time
134	Exposure Time
135	Exposure Time (LSB)
136	F Value (MSB) (f x 100; 280 – 2300)
137	F Value (LSB)
138	Image Effect (*5)
139	Date & Time Stamp (*8)

140 ● ● 151	Border File Name (8.3 chars) (*6) xxxxxxxx.BDR This field is invalid if bit 3 of Image Effect is not set
152	Exposure Lock (0 : Off 1 : On)
153 ● ● 255	Reserved

*1 : Memory card status (Byte 11)

Bit 7　1 : Compact Flash Card is inserted
　　　　0 : Compact Flash Card is not inserted
Bit 6　Reserved
Bit 5　Reserved
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 when an open command is executed. In the following cases, bit 3 will be reset.

- 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.

*2 : Camera ID (Byte 28-59)

32-byte camera ID is defined in the Flash memory and the ID will be written in the camera status table at the camera initialization. This ID can be written with "Write Camera ID" command. Camera has a default strings "DC240 DIZITAL ZOOM CAMERA".

*3 : Total number of picture taken (Byte 66-69)

This is the camera life-time statistics.

* 5 : Image Effect (Byte 138)

The on (1) or off(0) of each bit represents each effect respectively

0 = disable image effect,

bit0 = Gray scale,

bit1 = Sepia,

bit2 = Document,

bit3 = Border composition

* 6 : Border File Name (Byte 144-155)

The file name in this field is currently selected file name. This will be a null string if no file is selected.

* 7 : Exposure Mode (Byte 131)

Upper 4bits(bit7-4)
    0:Auto (TTL-On)
Lower 4bits(bit3-0)
    0:Normal

*8 : The display format is described below.

0x0	Off		
0x1	YYYY MM DD	0x4	YYYY MM DD hh:mm
0x2	DD MM YYYY	0x5	DD MM YYYY hh:mm
0x3	MM DD YYYY	0x6	MM DD YYYY hh:mm

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 (5 : DC240)
2	File Type (3 : EXIF)
3	Picture Size (0 : 640x480, 1 : 1280x960)
4	Image Quality (1 : High, 2 : Medium 3: Low)
5	IP Chain Disable (0 : Enabled)
6	Image Incomplete Flag (0 : complete)
7	Timer Mode (0 ; Off, 1 : On)
8 ● ● 11	Reserved
12	Year (MSB)
13	Year (LSB)
14	Month
15	Day
16	Hour
17	Minute
18	Second
19	TenM Second (unit in 10 msecs)
20	Strobe Flag (0 : Not Fired, 1 : Fired)
21	Strobe Mode (0 : Auto, 1 : Fill, 2 : Off, 3 : Red-eye)
22	Exposure Compensation (MSB) (x100, -200 to +350(*6))
23	Exposure Compensation (LSB)
24	AE Mode (0 : Auto, 1 : Center Weight)
25	Focus Mode(0 : Auto, 2: Close-up, 3: Infinity)
26	AF Mode (2 : Spot)
27	AWB Mode (0 : Auto, 1 : Fluorescent, 2 : Tungsten, 3 : Daylight/Strobe)
28	Zoom Magnification (MSB) (100 – 600)
29	Zoom Magnification
30	Zoom Magnification

31	Zoom Magnification (LSB) (more than 300 in case of digital zoom)
32	Reserved
33	Reserved
34	Reserved
35	Reserved
36	Reserved
37	Reserved
38	Reserved
39	Reserved
40	Reserved
41	Reserved
42	Reserved
43	Reserved
44	EV(MSB) (EV x 1000, 5000 – 17000)
45	EV
46	EV
47	EV (LSB)
48	Reserved
49	Reserved
50	Reserved
51	Reserved
52	Battery Level (0 : OK, 1 : Weak , 2 : Empty)
53	Exposure Mode (See Camera Status Table)
54	Reserved
55	Sharpness Control (-1(soft), 0(normal), 1(Sharp))
56	Exposure Time (MSB) (in 10 μ sec unit)
57	Exposure Time
58	Exposure Time
59	Exposure Time (LSB)
60	F Value (MSB) (f x 100; 280 – 2300)
61	F Value (LSB)
62	Image Effect (*4)
63	Date & Time Stamp (*5)

64 ● ● 75	Boader File Name (8.3 chars) xxxxxxxx.JPG This field is invalid if bit 3 of Image Effect is not set
76	Exposure Lock (0 : Off 1 : On)
77 ● 91	Reserved
92	Thumbnail Data Size (MSB)
93	Thumbnail Data Size
94	Thumbnail Data Size
95	Thumbnail Data Size (LSB)
96	Thumbnail Height (MSB)
97	Thumbnail Height (LSB)
98	Thumbnail Width (MSB)
99	Thumbnail Width (LSB)
100	Protect Status (0 : not protected, 1 : read only)
101 102 103	Reserved
104	File Size (MSB)
	File Size
	File Size
107	File Size (LSB)
108 ● ● 255	Reserved

*4 : The on (1) or off(0) of each bit represents each effect respectively

      0 = disable image effect

      bit0 = Gray scale

      bit1 = Sepia

      bit2 = Document

      bit3 = Border composition

*5 : The display format is described below.

    0x0   Off

0x1	YYYY MM DD	0x4	YYYY MM DD hh:mm
0x2	DD MM YYYY	0x5	DD MM YYYY hh:mm
0x3	MM DD YYYY	0x6	MM DD YYYY hh:mm

*6 : If Effects is Document, then Exposure Compensation value is add the
     base value to 1.5 EV.

4. File Organization

This chapter describes file organization for the internal control and the Compact Flash card and naming rules for the image files. All images on the Compact Flash card are stored as DOS files. The camera does not handle long file name and VFAT defined for Windows 95/98.

4.1 Image Data

DC240 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 EXIF 2.1. Each file contains a header, thumbnail image data and full size compressed image data. Each image data is stored with unique file name assigned automatically. An image files will be stored under "\DCIM\xxxDC240" directory, where the xxx is a three-digit value starting from 100. The number "xxx" will be a smallest three-digit decimal among the all directories starting with "xxx" naming on the "\DCIM" directory on the card.

Refer to JEIDA-49-1998 Digital Still Camera Image File Format Standard (Exchangeable image file format for Digital Still Camera: EXIF) Version 2.1 [3] document for the detail. Also, JEIDA-49-2-1998 DCF (Design rule for Camera File system) Version1.0 [6] should be referred to.

4.2 File Name

4.2.1 Directory Name on Card

All image files are stored in a DOS directory with following naming convention.

> \DCIM\xxxDC240\
>> xxx :   Directory name number that starts with 100

The xxx is an image directory number, starting from 100.

If there is no image directory on card, the camera generates

\DCIM\100DC240\

If there are multiple Kodak camera directories on card, the camera stores new images under the directory with the highest number. For example, if there are

> \DCIM\100 DC240\
> \DCIM\103 DC240\
> \DCIM\124 DC240\

directories on the card, the camera stores new images under the 124 directory.

If the directory with the highest number is not a Kodak camera directory, then the camera finds the highest numbered Kodak camera directory and stores any new images there. For example, if there are

\DCIM\100DC240\
\DCIM\103CANON\
\DCIM\124RICOH\

directories on the card, then the camera will store new images in

\DCIM\100DC240\

Similarly, if there are

\DCIM\100DC240\
\DCIM\103CANON\
\DCIM\124DC280\

directories on the card and the camera is a Kodak DC240, then the camera will also store new images in

\DCIM\100DC240\

If the memory card contains an image number of 9999 and cannot find a higher-numbered directory for the next capture, then the camera will prevent any further capture of images and display an appropriate warning message. One scenario that will cause the warning message is after creating file \DCIM\999DC240\DCP_9999.JPG. In this rare situation, it is expected that the user will delete the 999 directory and/or other image files and directories before re-inserting the card.

Similarly, if a non-Kodak camera directory 999 exists, then the warning message will be displayed after image file \DCIM\998DC240/DCP_9999.JPG is created.

4.2.2 Image File Name

All image files are stored with the following naming convention.

> DCP_nnnn.ttt
>> nnnn : image number with range 0001-9999
>> ttt : JPG for compressed files

The image number starts at 0001 and increases by 1 for each picture taken, and is stored into the camera EEPROM (The folder number is not stored in the EEPROM). Thus, the maximum number of images per native directory is 9999. Onto the Compact Flash card, for example, the camera's first images would be stored as follows:

> \DCIM\100DC240\DCP_0001.JPG
>
> \DCIM\100DC240\DCP_0002.JPG
>
> \DCIM\100DC240\DCP_0003.JPG
>
> etc.

Upon power-up or when a new Compact Flash card is inserted (mounted), the image number for the next captured image will be determined based on the contents of the new card and the image number value within the EEPROM.

For example, if the new card contains the following files and directories:

> \DCIM\100DC240\DCP_0001.JPG
>
> \DCIM\104DC240\DCP_0015.JPG
>
> \DCIM\107DC240\DCP_0009.JPG
>
> \DCIM\124CANON\
>
> \DCIM\129JAPAN\

and the EEPROM value for the last image number is 0009, then the next image file would be

> \DCIM\107DC240\DCP_0010.JPG.

However, for the exact same card structure and an EEPROM value of 0025, then the next image file would be \DCIM\107DCmmm\DCP_0026.JPG, and the EEPROM would be updated to show 0026 as the last image captured. The reason to adopt this image numbering behavior is to avoid duplicate file names and inconvenience when copying images from the camera to the PC.

The only exception to the above case is if the "capture to album" feature is enabled. In that case, the camera firmware will determine the current album directory and store new images there.

In the wraparound case where the camera creates image number 9999, the next image will be stored in a new directory and the EEPROM will be updated accordingly. For example on the card with images such as

> \DCIM\101DC240\DCP_9998.JPG
>
> \DCIM\101DC240\DCP_9999.JPG

the next image would be

      \DCIM\102DC240\DCP_0001.JPG.

In the case where the current native directory is not the highest numbered directory on the card, the camera will increment the current number until a free directory number is found. For example, on the card with images such as

      \DCIM\100DC240\DCP_0001.JPG

      \DCIM\107DC240\DCP_0009.JPG

      …

      \DCIM\107DC240\DCP_9999.JPG   - Last picture taken

      \DCIM\108JAPAN\   - Next 2 directory numbers are used

      \DCIM\109RICOH\

      \DCIM\124CANON\   - Non-native directory

      \DCIM\129NAGAN\   - Highest directory number is album

the new directory will have number 110 and the next image would be stored as

      \DCIM\110DC240\DCP_0001.JPG

When an image is erased through the user interface on the camera or through the host PC interface, the file names of the remaining files are not affected.

4.2.3 Border File Name on Card

Borders as implemented in the DC240 camera may be supported in other future Kodak cameras. Borders are stored as DOS files with following naming convention.

xxxxxxxx .BDR

xxxxxxxx : 8-character filename, only legal DOS characters.

Border files are to be located in the \SYSTEM\BDR4X3\ directory on the Compact Flash card. Border files located in other directories will be ignored.

4.3 File Access

The host has a way to access image data as well as border file on Compact Flash card.

4.3.1 File Name Access

The contents of Compact Flash card is visible as DOS files from the host though commands. The access is limited to read and delete for all files, and writing for border files only. Any moving, copying, renaming, or writing operation except border files is not supported.

For an image file, the path name to be passed through the host command should have "\PCCARD" string on top of the actual full path from the card's root as listed below.

\PCCARD\DCIM\xxxDC240\Image File Name

In other word, on the card an image file exists as.

\DCIM\xxxDC240\Image File Name

For a border file, the path name to be passed through the host command should have "\PCCARD" string on top of the actual full path from the card's root as listed below.

\PCCARD\SYSTEM\BDR4X3\Border File Name

In other word, on the card a border file exists as.

\SYSTEM\BDR4X3\ Border File Name

4.4 File Format

4.4.1 Image File Format

The camera supports EXIF ver 2.1 file format. Refer to the detailed implementation on [3].

4.4.2 Border File Format

To utilize border feature of DC240 camera, the border file has to follow the special format defined in "Border File for M3 Zoom version 0.2"[6] documentation.

Basically, it is JFIF, with JPG extension under \BORDER directory on card. App1 contains thumbnail in JPEG compressed YCC 4:2:2 160x120 format, app2 contains screennail in JPEG compressed RGB 1:1:1 104x240 format, and app3 contains the border image in JPEG compressed YCC 4:1:1 640x480 format.

5. COMMANDS

The following is a list of the commands that are recognized by three different models of DC cameras. 'x' mark indicates that the command is supported by each camera. If the camera receives a command that is not supported, the camera will handle this as an error and respond with an NAK to the host. If the camera receives a command listed here when the camera is one of the following state (camera is busy) , the command will be ignored.

- Camera is accessing the Compact Flash card
- Camera is in sleep mode

These commands can be categorized into two modes, on-line mode and firmware download mode. Most commands of each mode can not be executed in other mode, however some commands can. Note that the word "send" in this list means send data from the camera to the host.

In the Mode column below, 'O' means on-line command and 'F' means firmware download command.

* : Mode only applies to DC240 cameras.

Code	Description	DC120	DC200 DC210	DC240	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
2A	Set Host Packet Buffer Size			x	O
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	x	O
37	Set File Format		x	x	O
38	Set AWB			x	O
39	Set Exposure Lock			x	O
3B	Set Sharpness Control			x	O
3C	Set Date/Time Stamp			x	O
3D	Execute program	x			F
3E	Set Effect			x	O
3F	Set Border File			x	O
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
4B	Send last reviewed image name			x	O
4C	Send last taken image name			x	O
51	Send picture in memory	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			O
56	Send thumbnail information in memory	x			O
61	Send image on card	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		O
66	Send thumbnail image on card	x	x		O
71	Set image quality	x	x	x	O
72	Set strobe 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			O
77	Take a picture to flash memory	x			O
78	Set Zoom	x	x	x	O
79	Set AE			x	O
7A	Erase images in flash memory	x			O
7B	Erase images in memory card	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			O
82	Set sleep time	x			O
83	Send camera matrix data	x			O
84	Send compression table				O
85	Take and send preview image				O
86	Request sense	x			O/F
87	Store preview image in memory				O
88	Store preview image in card				O
89	Erase preview image				O
8A	Reset Camera	x	x	x	O
8B	Set Exposure Mode	x			O
8C	Execute Program				O
8E	Execute Diagnostic			x	O
8D	Switch to ROM mode	x	x	x	O
90	Set program mode				O
91	Read picture information		x	x	O
92	Read summary information		x		O
93	Read Thumbnail		x	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				O
9C	Write file			x (*1)	O
9D	Delete file		x	x	O
9E	Write camera ID	x	x	x	O
9F	Set Protect			x	O
AE	Completion of download mode	x	x	x	F

*1 : This command is intended to be used only for Border file download.

5.1 Command Description

This section describes commands supported by DC240 cameras only. 'O' and 'F' at each title means on-line and firmware download respectively.

On-line 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.

Firmware download command is used to download the camera firmware into the flash memory. If the camera receives a on-line mode specific command in firmware download mode, the camera will respond a NAK to the host. **Firmware download mode is supported only though serial.**

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 Word Data to EEPROM (21h, O/F)

Offset	Host command
0	21
1	00
2	Address of EEPROM (MSB)
3	Address of EEPROM (LSB)
4	Word data (MSB)
5	Word data (LSB)
6	00
7	1A

This command writes a word data to specified address of EEPROM in the camera.

Address of EEPROM   The address of EEPROM to be stored.

Word data   16 bit data to store to EEPROM.

If the "End address" equals or less than the "Start address" will cause a command execution error code (e2h).

Note: This command should be used for firmware debugging and downloading. Otherwise, the host program should not use this command.

5.1.5 Send Data in EEPROM (22h, O/F)

Offset	Host command
0	22
1	00
2	Start address of EEPROM (MSB)
3	Start address of EEPROM (LSB)
4	End address of EEPROM (MSB)
5	End address of EEPROM (LSB)
6	00
7	1A

This command sends specified data area in EEPROM to the host. The camera will send data with 257-byte packet(s) to the host.

Start address of EEPROM   The start address of data area to be sent.

End address of EEPROM   The end address of data area to be sent.

If the "End address" less than the "Start address" will cause a command execution error code (e2h).

Note: **This command should be used for firmware debugging *and downloading*. Otherwise, the host program should not use this command.**

5.1.6 Set Host Packet Buffer Size (2Ah, O)

Offset	Host command
0	2A
1	00
2	HPBS (host packet buffer size, MSB)
3	HPBS (LSB)
4	00
5	00
6	00
7	1A

This command is to change the host packet buffer size only for .

Read Thumbnail Image (93h)

Read File (9Ah)

Write File (9Ch)

Commands in both Serial and USB communication. The power-on default value is the minimum (514 byte). The HPBS value is maintained until the camera turned off.

HPBS   value between 0x202 (512+2) and 0x8002(32768 +2) in Hex

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

5.1.7 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   Start address should be set the area below.

	Address Cache Area	Cache through Area
SH Internal ROM/RAM	0x00000000 to 0x01FFFF00	0x00000000 to 0x01FFFF00
Flash Memory (**Supported Read Only**)	0x02000000 to 0x020FFF00	0x22000000 to 0x220FFF00
JPEG	0x04000000 to 0x04001F00	0x24000000 to 0x24001F00
USB	0x04002000 to 0x04002F00	0x24002000 to 0x24002F00
ASIC	0x04003000 to 0x04003F00	0x24003000 to 0x24003F00
DRAM	0x06000000 to 0x063FFF00	0x26000000 to 0x263FFF00
CF	0x08000000 to 0x09FFFF00	0x28000000 to 0x29FFFF00
Exception Vector	0x10000000 to 0x10000300	N/A
Internal XROM	0x10000400 to 0x10007700	N/A
Internal XRAM	0x1000E000 to 0x1000FF00	N/A
Internal YROM	0x10010000 to 0x10017700	N/A
Internal YRAM	0x1001E000 to 0x1001FF00	N/A
Associative Purge	0x40000000 to 0x47FFFF00	N/A
Address Array R/W	0x60000000 to 0x7FFFFF00	N/A
Data Array R/W	0xC0000000 to 0xC0000F00	N/A
Peripheral Module Area	0xFFFFFC00 to 0xFFFFFF00	N/A

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

5.1.8 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　　　See 5.1.7 Write 256 bytes Data Command

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

5.1.9 Set Resolution (36h, O)

Offset	Host command
0	36
1	00
2	Resolution
3	00
4	00
5	00
6	00
7	1A

This command is to change the resolution of image file.

Resolution　　　　　0 : 640 x 480
　　　　　　　　　　　1 : 1280 x 960

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

5.1.10 Set File Format (37h, O)

Offset	Host command
0	37
1	00
2	Format
3	00
4	00
5	00
6	00
7	1A

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

Format

3 : EXIF

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

5.1.11 Set AWB (38h, O)

Offset	Host command
0	38
1	00
2	AWB Mode
3	00
4	00
5	00
6	00
7	1A

This command is to change the AWB.

AWB Mode   0 : Auto
1 : Fluorescent
2 : Tungsten
3 : Daylight/Strobe

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

5.1.12 Set Exposure Lock (39h, O)

Offset	Host command
0	39
1	00
2	Exposure Lock
3	00
4	00
5	00
6	00
7	1A

This command is to change Exposure Lock feature.

Exposure Lock   0 : Off
                         1 : On

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

5.1.13 Set Sharpness Control (3Bh, O)

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

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

Sharpness   *-1(Soft), 0 (normal), 1(Sharp)*

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

5.1.14 Set Date/Time Stamp (3Ch, O)

Offset	Host command
0	3C
1	00
2	Date/Time Stamp
3	00
4	00
5	00
6	00
7	1A

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

Date/Time Stamp

    0x0   Off

    0x1   YYYY MM DD   0x4   YYYY MM DD hh:mm

    0x2   DD MM YYYY   0x5   DD MM YYYY hh:mm

    0x3   MM DD YYYY   0x6   MM DD YYYY hh:mm

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

5.1.15 Set Effect (3Eh, O)

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

This command is to change the effect mode of the camera.

Effect   *0 : All off*
                 1 : Gray scale
                 2 : Sepia
                 4 : Document
                 8 : Border composition

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

If Border composition bit is set and Border file name is not set by "Set Border File" command, then Camera will take a picture without Border data.

5.1.16 Set Border File (3Fh, O)

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

This command is to specify the border file to be used when Effect is set to Border Composition. This command is followed by a 60-byte packet described below that contains a file name, start block and number of block to write.

- *File name (up to 48 characters)*

NOTE: Do not input long file/directory name. The camera does not guarantee the result of the file operation.
- *Reserved (4 bytes)*
- *Reserved (4 bytes)*

<table>
<tr><td>

File name (48 characters)

</td></tr>
<tr><td>*Reserved (4 bytes)*</td></tr>
<tr><td>*Reserved (4 bytes)*</td></tr>
</table>
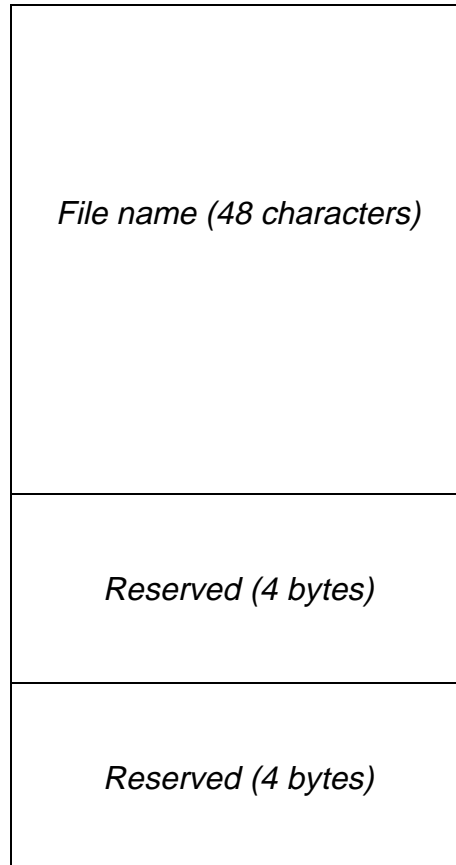
The border file has the following file name from host computer viewpoint.

　　　　\PCCARD\SYSTEM\BDR4X3\ Border file name　　　　border file in the card

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, or if the specified file does not exist on the card.

If CF is removed, then NULL data is padded.

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

Offset	Host command
0	41
1	00
2	See below
3	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 USB communication. The power-up default baud rate of the camera is 9,600 bps. When the camera receives the break on/off signal, the baud rate is changed to 9,600 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 a command completion code for this command like other commands will. The camera will return an ACK for this command. The camera requires 100 msec for serial to changes the baud rate after sending an ACK. The host should consider this time before sending next command.

5.1.18 Send Last Reviewed Image Name (4Bh, O)

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

The camera will send file information in 258-byte packet form of the full path image name on CF card which displayed on the Color LCD or Video in Review Mode. The file name will be in DOS file system full path format starting with \PCCARD\DCIM\. If camera have not been to review mode and CF is removed, then the camera will be return execution error (e2h).

Note that a command execution error (e2h) will be returned from the camera when this command is sent to the camera if there is no card.

5.1.19 Send Last Taken Image Name (4Ch, O)

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

The camera will send file information in 258-byte packet form of the full path image name on CF card which taken last. The file name will be in DOS file system full path format starting with \PCCARD\DCIM\. If the camera isn't still taken a picture, then the camera will be return execution error (e2h).

Note that a command execution error (e2h) will be returned from the camera when this command is sent to the camera if there is no card.

5.1.20   Set Image Quality (71h, O)

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

This command sets the current image quality for pictures.

Image quality   01 : High
                    02 : Medium
                    03 : Low
IPChainDisable
                    00 : Enable

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

5.1.21 Set Strobe Mode (72h, O)

Offset	Host command
0	72
1	00
2	Strobe Mode
3	00
4	00
5	00
6	00
7	1A

This command sets the current strobe mode.

Strobe Mode   00 : Auto
01 : Fill
02 : Off
03 : Auto Red-eye

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

5.1.22 Set Focus Mode (73h, O)

Offset	Host command	
0	73	
1	00	
2	Focus Mode (bit 7-4)	AF Mode (bit 3-0)
3	00	
4	00	
5	00	
6	00	
7	1A	

This command sets the current focus mode.

Focus Mode   0 : Auto
2 : Close-up
3 : Infinity (Landscape)

AF Mode
2 : Spot

"AF Mode" field is valid only when "Focus Mode" is either "Auto."

If an illegal value is set in the focus mode / AF mode field, the camera will return a command execution error (e2h) to the host.

5.1.23 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 is always 10 secs[2].

If the timer is set, this feature will be canceled in the following cases.

  (1) After a picture is taken.

  (2) The mode is changed via the mode dial.

Shutter Delay 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.

5.1.24 Set Time (75h, O)

Offset	Host command
0	75
1	00
2	00
3	00
4	00
5	00
6	00
7	1A

This command sets the time and date to the camera.

This command is followed by a 60-byte packet that contains date and time data which corresponds to Picture Information format.

0	Year (MSB)
1	Year (LSB)
2	Month (1 byte)
3	Day (1 byte)
4	Hour (1 byte)
5	Minute (1 byte)
6	Second (1 bytes)
7	TenM Second (unit of 10 msecs)

If the data contains unsupported or invalid data except from 1999/1/31 12:00 to 2025/12/31 23:59, the camera will return a command execution error (e2h) to the host.

5.1.25 Set Zoom (78h, O)

Offset	Host command
0	78
1	00
2	Zoom Magnification (MSB)
3	Zoom Magnification
4	Zoom Magnification
5	Zoom Magnification (LSB)
6	00
7	1A

This command specifies to set the zoom position in corresponding format of Picture Information.

Zoom Magnification   100 - 600

Note : 100-300 is optical zoom range. Mechanically available zoom step is 100, 130, 170, 200, 230, 270. 300. Within this range, any intermediate value would be round up/down to the closer step. For example, 114 -> 100, 115 -> 130, 149->130, 150 -> 170.

Note : 301-600 is digital zoom range. Available zoom step is 10.

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

5.1.26 Set AE (79h, O)

Offset	Host command
0	79
1	00
2	AE Mode
3	00
4	00
5	00
6	00
7	1A

This command specifies the AE mode.

AE Mode   0 : Auto
          1 : Center Weighted

The camera will return a command execution error (e2h) if AE Mode field has invalid data.

5.1.27 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.

5.1.28 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. The host program should read the written value from the camera status.

Note: The battery level in the camera status table is updated in the following cases except this command.

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

If the camera is in Communication State, the battery level is updated only this command. Note that this command execution will consume a lot of battery power.

5.1.29 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.

5.1.30 Set Exposure Compensation (80h, O)

Offset	Host command
0	80
1	00
2	Exposure compensation (MSB)
3	Exposure compensation (LSB)
4	00
5	00
6	00
7	1A

This command sets an exposure compensation value against the measured EV value electrically in corresponding format of Picture Information. The camera will capture an image with specified compensate electric value. For DC240 camera, the range of EV value is from 5.0 EV to 16 EV. Compensation value can be specified within this range. If the measured EV value is 12 EV, the compensation value could be one of the values from 10.0 to 14.0.

> *Exposure compensation value   -200 to +200 (signed short format)*

Examples   0x0000 (decimal 0) stands for Auto exposure
             0x0100 (decimal +100) stands for Auto exposure + 1.0 E.V.
             0xff6a (decimal -150) stands for Auto exposure - 1.5 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.

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5.1.31 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 reset the camera setting to the system default listed on 6.2.

5.1.32 Switch to ROM Mode (8Dh, O)

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

This command switches from on-line mode to ROM mode **only from serial communication** with the current baud rate setting to download the camera firmware. The following figure shows the initial command sequence to download the firmware. The camera will return NAK when it receives this command during USB communication.

1. The host sends this command to the camera.
2. The camera enters ROM mode when it receives this command.
3. The camera responds the command completion code when switching is over.
4. The host sends a password "PgDxWmLcNrKq" to the camera.
5. The camera sends a password "qKsMaOiVyCjP" to the host.
6. The host should change the baud rate 9,600 bps. At this time, the host does not have to send any baud rate change command to the camera.
7. The camera requires at least 100 msec to initialize the serial port. The host should wait for more than 100 msec.
8. Then the host can send any ROM commands, including baud rate command to the camera.

9. When the firmware download is finished, the control will switch to RAM mode automatically. At this time, old firmware is working in the camera. To run the new firmware, the user should power off/on the camera.

Camera   Host

Command   → Send a command

Check command

ACK   → Receive ACK

Switch to ROM mode

Send execution status   Command execution

     Send password

Send inversed password

     Receive echo

ACK   Set 9,600 baud

Initialize the serial port (at least 5 msec is required)   Wait for more than 5 msec.

Send ROM commands to download firmware

•
•
•
•
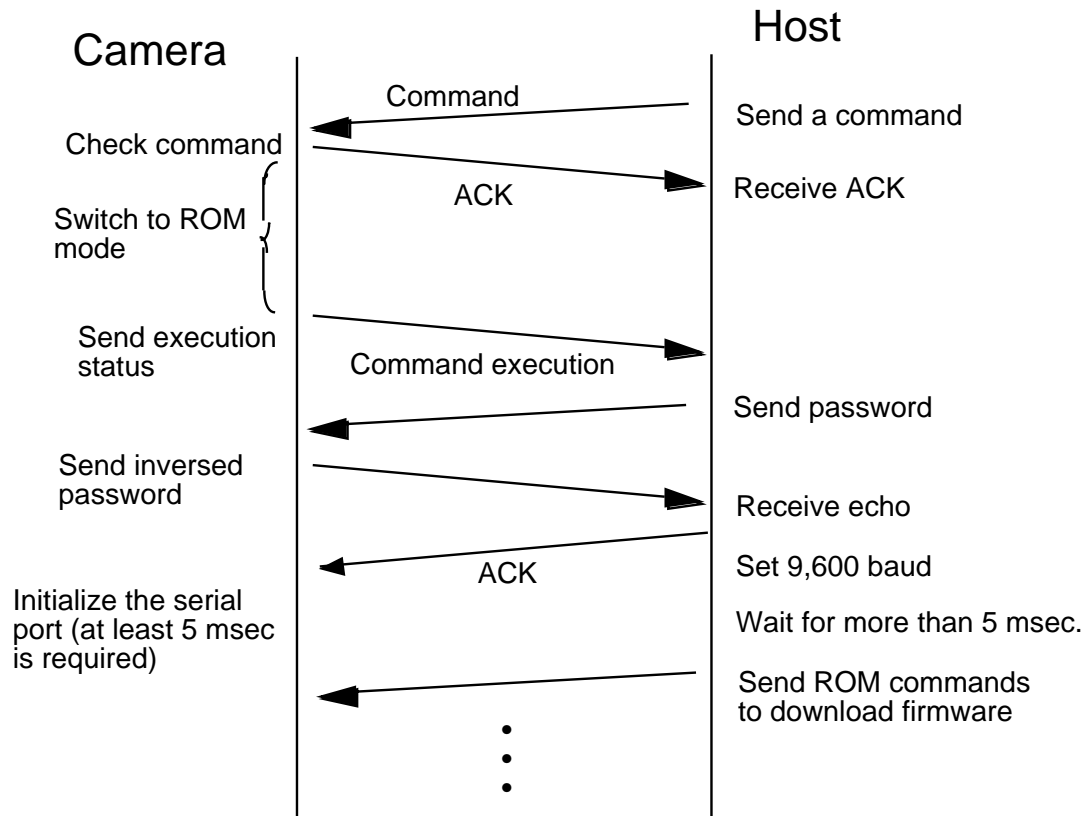
Note that power supply is cut or the serial cable is plugged off during firmware downloading, d1 error is displayed even the camera is turned on. To recover this status, the same step should be done as above.

When the camera is switched to ROM mode by manual operation, the firmware download procedure differs to the procedures described above.

1. Set the baud rate 9,600 bps.
2. Set the camera to ROM mode with manual operation.
3. The host sends the password to the camera.
4. The camera responds the same password to the host.
5. The host sends firmware packets to the camera.
6. When the firmware downloading is finished, the camera is still ROM mode. To run the new firmware, the user should power off/on the camera.

5.1.33 Execute Diagnostic (8Eh, O)

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

This command executes diagnostic functions according to the arguments, and return the execution status and/or diagnostic data.

The camera will send data within a 18-byte packet.

Note : The diagnostic functions and its behavior will be documented in a different specification.

Following is the list of diagnostic test defined as of this version of document. ('x' means Don't Care)

Switch Monitor (Arg#1 = 1, Arg#2 = x)

On receiving the command, the camera will copy the 32-bit current button scan information onto the top four bytes of the data part of the 18-byte packet and send it back to the host.

＜ 18bytes packet ＞

Switch Information (MSB)   (4bytes)
Switch Information
Switch Information
Switch Information (LSB)
  Not Used

＜ Struct of Switch information data＞

Bit	Type of Switch
0	Strobe
01	Macro Mode
02	Self Timer Mode
03	Up
04	Down
05	Right
06	Left
07	S1
08	Menu
09	Mode Dial (Capture)
10	Mode Dial (Review)
11	Mode Dial (Connect)
12	Mode Dial (Setting)
13	Do It
14	Zoom (Tele)
15	Zoom (Wide)
16-26	Reserved
27	AC Cable (0x1 : Inserted 0x0 : Removed)
28	Serial / USB Cable (0x1 : Inserted 0x0 : Removed)
29	Video Cable (0x1 : Inserted 0x0 : Removed)
30	Compact Flash State Cable

	(0x1 : Inserted 0x0 : Removed)
31	Power

Motor Test (Arg#1 = 2, Arg#2 = x)

On receiving this command, the camera will check the motors of lens unit using the home position sensor, and return one-byte bit map to notify if there is a NG motor among them.

＜ 18byte packet ＞

Result   (1 byte)
Not used (17 bytes)

＜ Struct of Result Data＞

Bit	Type of Motor
0	Zoom motor (0: Normal 1: Abnormal)
1	Focus motor (0: Normal 1: Abnormal)
2-7	Reserved

<u>CdS Sensor Test (Arg#1 = 3, Arg#2 = x)</u>

On receiving this command, the camera will measure the exposure using the CdS sensor, and return the only raw data. Users can get calibrated data to use Send Data in EEPROM Command (22h).

$<$ 18byte packet $>$

Cds measured time (MSB) (4Byte)
Cds measured time
Cds measured time
Cds measured time (LSB)
Not used (14 bytes)

(unit : 2μ sec)

If an illegal combination of values are set in the argument field, the camera will return a command execution error (e2h) to the host.

5.1.34 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 summary information of image files on the Compact Flash. 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 258-byte packets for image file and program script file to the host.

- File name (Up to 48 characters)
- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)
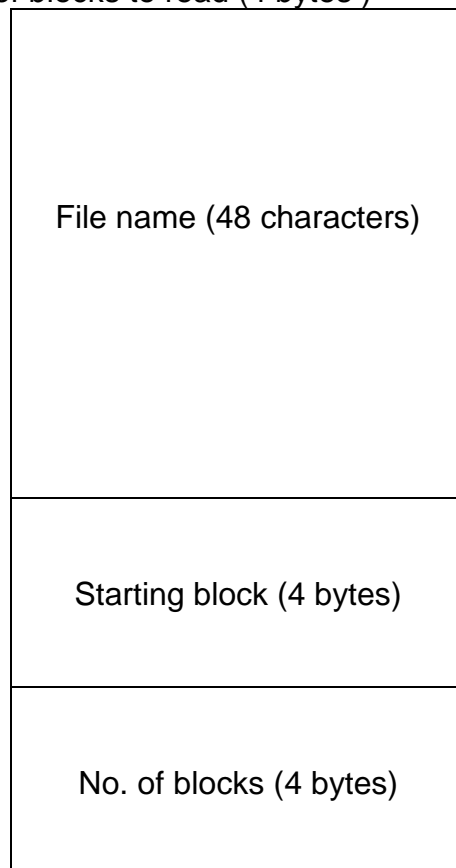
File name (48 characters)
Starting block (4 bytes)
No. of blocks (4 bytes)

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

The image file will have the following file names from host computer viewpoint.

    \PCCARD\DCIM\xxxDC240\file name   Image file on the card

The content is guaranteed **only for DC240 Readable** files.

    See 3.2 for Picture Information Table.

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

  • Specified file does not exist on Compact Flash card.
  • The card is not opened yet.
  • Specified file is not a DC240 readable file.

5.1.35 Read Thumbnail Image (93h, O)

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

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

Note : **To use Format = 0 or 1, the image file should be DC200/210 camera generated. Check the Camera Type field of Picture Information.**

Note : To use Format = 2, the image file should be DC240 camera generated. Check the Camera Type field of Picture Information.

Format   Format 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
                2 : JPEG compressed variable size.

Note : In case of JPEG compressed, the data is in EXIF format without any app field.

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)

File name (48 characters)

Starting block (4 bytes)

No. of blocks (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.

The image file will have the following file names from host computer viewpoint.

\PCCARD\DCIM\xxxDC240\file name   Image file on the card

The camera will send HPBS-byte packets (see Set Host Packet Buffer Size (2Ah) command description)for image file to the host.

$G_{(1,1)}R_{(2,1)}$.....
$B_{(1,2)}G_{(2,2)}$.....
•
•
•
                                                        ....$B_{(95,72)}G_{(96,72)}$

Thumbnail Image Format (Format = 0)

$RGB_{(1,1)}RGB_{(2,1)}$.....
$RGB_{(1,2)}RGB_{(2,2)}$.....
•
•
•
                                                        ....$RGB_{(95,72)}RGB_{(96,72)}$

Thumbnail Image Format (Format = 1, 96 x 72)

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

- Compact Flash card is not opened.
- Specified file does not exist on Compact Flash card.
- Specified file is not a DC240 readable file.

5.1.36 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 which includes 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 camera will respond with a 18-byte packet which contains number of bytes available for the card if this command is executed correctly.

```
# of bytes available
    (4 bytes)
```

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 compact flash card

5.1.37 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.

- Set Border File (3Fh)
- Read Picture Information (91h)
- Read Thumbnail Image (93h)

- Read File (9Ah)
- Write File (9Ch)
- Read Directory Information (99h)
- Set Protect(9Fh)
- Delete File (9Dh)

Note that "Get card status(98h)" command can be sent to the camera even if the Compact Flash card is not opened. An open command will be 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.

5.1.38 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 Compact Flash card logically. Following Compact Flash commands can not be executed when the card is closed.

- Read Picture Information (91h)
- Read Thumbnail Image (93h)
- Read File (9Ah)
- Write File (9Ch)
- Read Directory Information (99h)
- Set Protect(9Fh)
- Delete File (9Dh)

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

5.1.39 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 within a 18-byte packet.

Card status (1 byte)
Reserved (2 bytes)
# of bytes available (4 bytes)

Card status will be read from the camera status table.

5.1.40 Read Directory Information (99h, O)

Offset	Host command
0	99
1	00
2	Entry Only
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. Wild card is available for this full path name.

File name (48 characters)
Starting block (4 bytes)
No. of blocks (4 bytes)
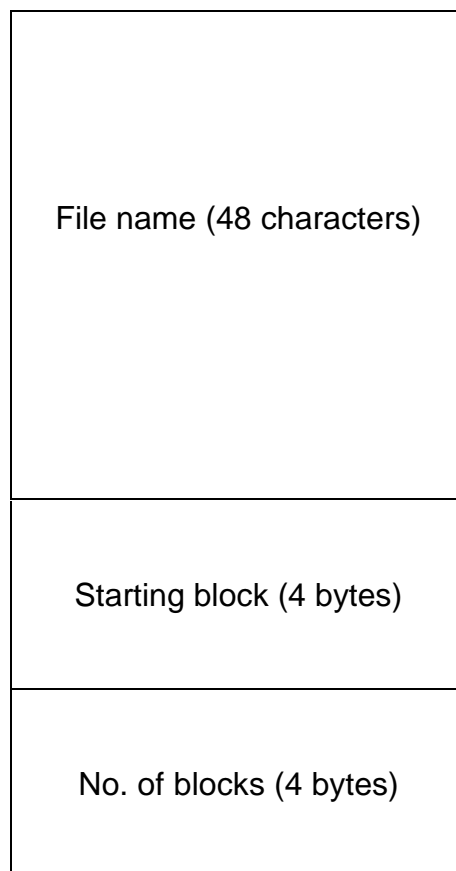
The camera will send file information in 258-byte packet form for all entries of specified directory of the Compact Flash card in order of entry chain as follows.

Note : If Entry Only field is set to 1, the camera returns No. of Entries only, meaning the first two byte data is valid and the camera returns only one packet.

```
  0 ┌─────────────────────────────┐
    │      No of entries (n)      │
    │        (2 bytes)            │
  2 ├─────────────────────────────┤
    │                             │
    │                             │
    │     Entry #1 (20 bytes)     │
    │                             │
    │                             │
 22 ├─────────────────────────────┤
    │                             │
    │                             │
    │     Entry #2 (20 bytes)     │
    │                             │
    │                             │
 42 ├─────────────────────────────┤
    │                             │
    │              •              │
    │              •              │
    │              •              │
    │              •              │
    │                             │
    ├─────────────────────────────┤
    │                             │
    │                             │
    │     Entry #n (20 bytes)     │
    │                             │
    │                             │
    └─────────────────────────────┘
```
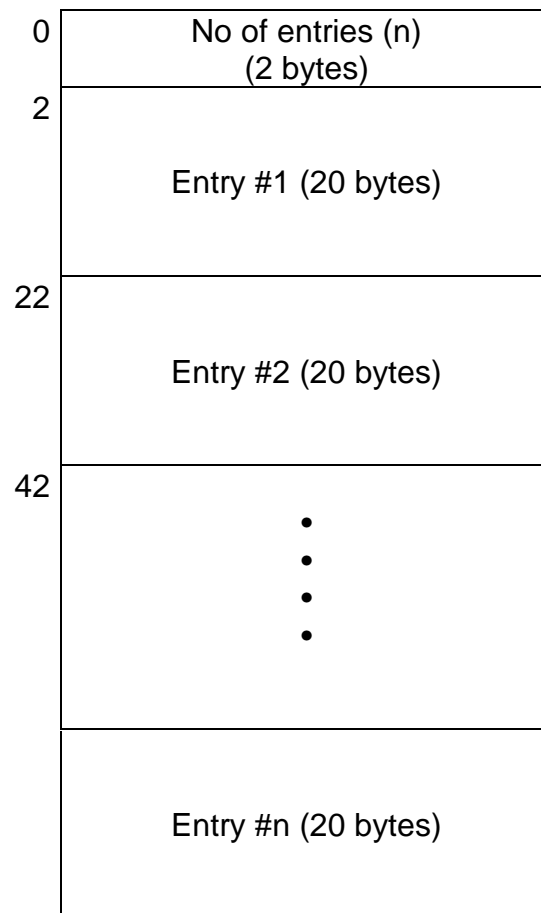
Each entry has the following information.

```
  0 ┌─────────────────────────────┐
    │                             │
    │          File name          │
    │ (8 characters for file name │
    │             and             │
    │ 3 characters for file type) │
    │                             │
 11 ├─────────────────────────────┤
    │    File attribute (1 byte)  │
 12 ├─────────────────────────────┤
    │        Creation time        │
    │         (2 bytes)           │
 14 ├─────────────────────────────┤
    │        Creation date        │
    │         (2 bytes)           │
 16 ├─────────────────────────────┤
    │       File size in byte     │
    │         (4 bytes)           │
 19 └─────────────────────────────┘
```
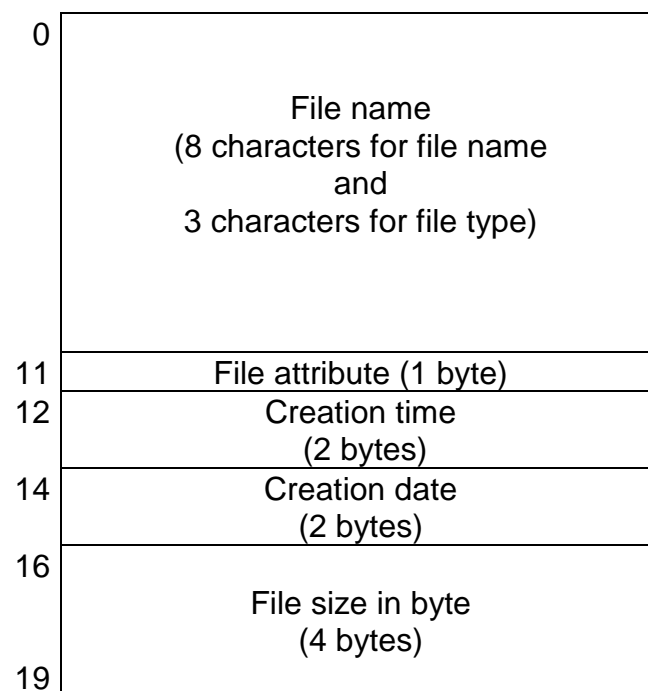
Note that a command execution error is returned from the camera when this command is sent to the camera if the card is not opened.

5.1.41 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 Compact Flash 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 HPBS-byte packets (see Set Host Packet Buffer Size (2Ah) command description)for image file to the host. If host stops receiving read file data, System Cancel code(0xe4) specified in 2.5.1 need to be send.

- File name (Up to 48 characters)

NOTE: Do not input long file/directory name. The camera does not guarantee the result of the file operation.

- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)

```
┌─────────────────────────────┐
│                             │
│                             │
│                             │
│                             │
│                             │
│     File name (48 characters) │
│                             │
│                             │
│                             │
│                             │
│                             │
├─────────────────────────────┤
│                             │
│                             │
│     Starting block (4 bytes) │
│                             │
│                             │
├─────────────────────────────┤
│                             │
│                             │
│     No. of blocks (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.

The file will have the following file names from host computer viewpoint.

> \PCCARD\DCIM\xxxDC240\file name   Image file in the card

> \PCCARD\SYSTEM\BDR4X3\ or
> \SYSTEM\BDR3X2\ file name   Border file in the card

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, or the camera can not find the specified file on the card.

5.1.42 Write File (9Ch, O)

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

This command is intended **only to write border files**. This command is followed by a 60-byte packet described blow that contains a file name, start block and number of block to write, then HPBS-byte packet (See Set Host Packet Buffer Size (2Ah) command description) of the data will follow. If the folder in the File name doesn't exist, then Camera creates the new folder and create the new file. If host stops sending write file data, Cancel byte (0xff) specified in 2.6 need to be set to Packet control byte.

- *File name (up to 48 characters)*

NOTE: Do not input long file/directory name. The camera does not guarantee the result of the file operation.
- *Reserved (should be zero, 4bytes)*
- *Size of the file to be written (4 bytes)*

File name (48 characters)
Reserved (4 bytes)
No. of blocks (4 bytes)
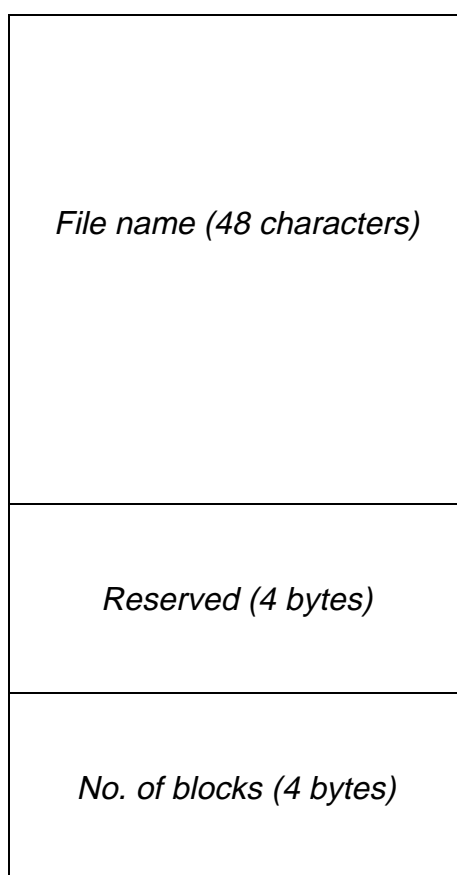
The border file has the following file name from host computer viewpoint.

\PCCARD\SYSTEM\BDR4X3\ file name   border file in the card

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.

5.1.43 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 Compact Flash 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)

NOTE: Do not input long file/directory name. The camera does not guarantee the result of the file operation. And do not use some wild card string ('?','*').

- Offset block number (4 bytes)
- Number of blocks to read (4 bytes)
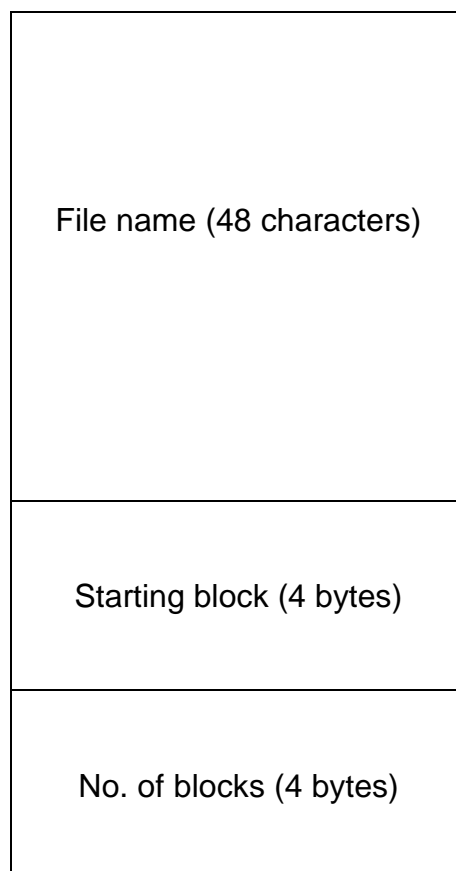
File name (48 characters)
Starting block (4 bytes)
No. of blocks (4 bytes)

The file will have the following file names from host computer viewpoint.

> \PCCARD\DCIM\xxxDC240\file name   image file in the card
> \PCCARD\SYSTEM\BDR4X3\ file name   border file in the card

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, or the camera can not find the specified file on card.

5.1.44 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.

5.1.45 Set Protect (9Fh, O)

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

The read only attribute of image files on the Compact Flash card can be set with this command.

> Protect Status   0 : not protected
>   1 : read only

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)

NOTE: Do not input long file/directory name. The camera does not guarantee the result of the file operation.
- Offset block number (4 bytes)

- Number of blocks to read (4 bytes)

File name (48 characters)
Starting block (4 bytes)
No. of blocks (4 bytes)

The file will have the following file names from host computer viewpoint.

\PCCARD\DCIM\xxxDC240\file name   image file in the card

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, or the camera can not find the specified file on card.

5.1.46 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 power itself off**.

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

- 1 -

APPENDIX 1

1. REFERENCES

[1] : "DC240 Engineering Requirements Specification", Version 1.00

[2] : "DC240 User Interaction Specification" Version 1.02

[3] : JEIDA-49-1998 Digital Still Camera Image File Format Standard (Exchangeable image file format for Digital Still Camera : EXIF) Version 2.1

[4] : JEIDA—49-2-1998 DCF(Design rule for Camera File system) Version1.0

[5] : "EKJ Proposal for Digital Camera File Organization (Version 0.7)"

2. Camera Settings[2]

Camera Setting	Factory Default	Power Off/On	Change mode	After exposure	Wake from Sleep
Hardware Controls					
Zoom	Wide angle	<-----	<-----	Maintained	Maintained
Digital Zoom	Off	<-----	<-----	Maintained	Maintained
Flash	Auto*	<-----* **	Maintained	Maintained	Maintained
Infinity	Off	<-----	Maintained	Maintained	Maintained
Close-Up	Off	<-----	Maintained	Maintained	Maintained
Self Timer	Off	<-----	<-----	<-----	<-----
Capture mode					
Preview	Off	<-----	Maintained	Maintained	Maintained
Exposure Compensation	0.0	<-----**	Maintained	Maintained	Maintained
Quality	Best	Maintained	Maintained	Maintained	Maintained
Resolution	High	Maintained	Maintained	Maintained	Maintained
QuickView	On	Maintained	Maintained	Maintained	Maintained
Date/Time stamp	Off	Maintained	Maintained	Maintained	Maintained
White Balance	Auto	Maintained**	Maintained	Maintained	Maintained
AE Mode	Multi pattern	Maintained	Maintained	Maintained	Maintained
Exposure lock mode	Off	<-----	Maintained	Maintained	Maintained
Borders	Off	Off**	Maintained	Maintained	Maintained
Effects	Off	Off**	Maintained	Maintained	Maintained

* The redeye state is saved at power off. If the flash was set to Auto, Fill, or Off at power off, the flash is set to Auto at power on. If the flash was set to Redeye at power off, the flash is set to Redeye at power on.

** depends on Power off default setting (section 7.5)

Camera Setting	Factory Default	Power Off/On	Change mode	After exposure	Wake from Sleep
Review mode					
Picture Information	Off	<-----	<-----	N/A	Maintained
Magnify mode	Off	<-----	<-----	N/A	Maintained
Protect mode	Off	<-----	<-----	N/A	Maintained
Delete mode	Off	<-----	<-----	N/A	Maintained
Print order	Off	<-----	<-----	N/A	Maintained
Slide show	Off	<-----	<-----	N/A	N/A
Camera Setting mode					
Beep	On (shutter release/warning only)	Maintained	Maintained	Maintained	Maintained
Video Out	NTSC	Maintained	Maintained	Maintained	Maintained
Power save mode	Off	Maintained	Maintained	Maintained	Maintained
Date/Time	1999/1/31; 12:00	Maintained	Maintained	Maintained	Maintained
Language	English	Maintained	Maintained	Maintained	Maintained
About…	Off	<-----	<-----	<-----	<-----
Format memory card	Off	<-----	<-----	N/A	<-----

Note the system default means factory settings. The term "Maintained" means that selected feature of the icon is not changed.