23IR User Manual

Release:

1. Aug 28, 2008 – official released

General Description

The 23IR module is a highly integrated serial camera board that can be attached to a wireless or PDA host performing as a video camera or a JPEG compressed still camera. It provides a serial interface (RS-232) and JPEG compression engine to act as a low cost and low powered camera module for high resolution serial bus security system or PDA accessory applications.
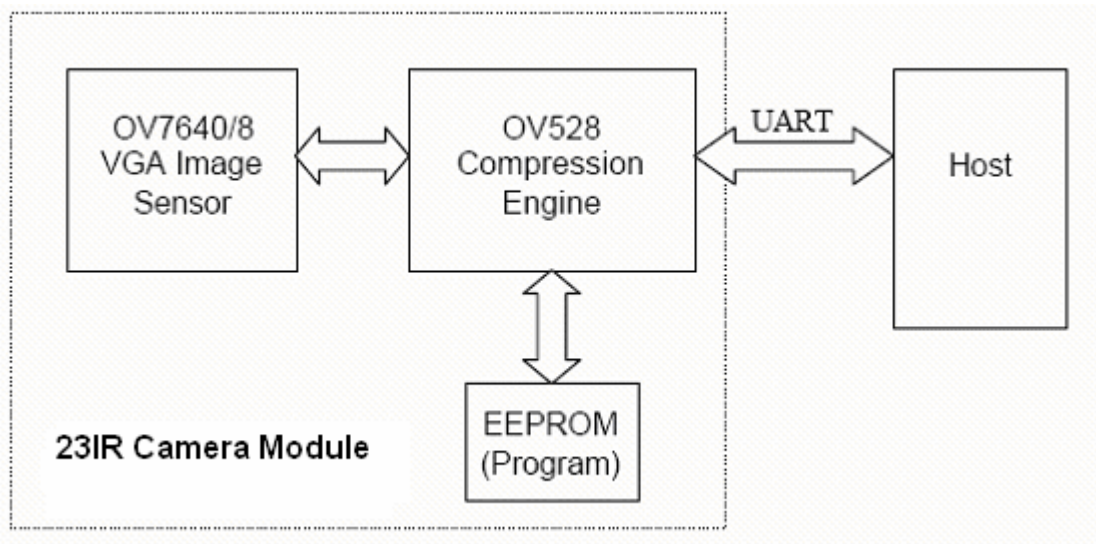

Figure 1 – System Block Diagram

Features

- Small in size, low cost and low powered (3.3V) camera module for high resolution serial bus security system or PDA accessory applications.
- On-board EEPROM provides a command based interface to external host via RS-232.
- UART: 115.2Kbps for transferring JPEG still pictures or 160x128 preview @8bpp with 0.75fps.
- On board OmniVision OV7640/8 VGA color sensor.
- Built-in JPEG CODEC for different resolutions.
- Built-in down sampling, clamping and windowing circuits for VGA, QVGA, 160x120 or 80x60 image resolutions.
- Built-in color conversion circuits for 2-bit gray, 4-bir gray, 8-bit gray, 8-bit RGB, 12-bit RGB, 16-bit RGB or standard JPEG preview images.
- No external DRAM required.

System Configuration

1. Camera Sensor

   The 23IR module uses OmniVision OV7640/8 VGA color digital CameraChips with an 8-bit YCbCr interface.

2. OV528 Serial Bridge

   The OV528 Serial Bridge is a JPEG CODEC embedded controller chip that can compress and

transfer image data from CameraChips to external device. The OV528 takes 8-bit YCbCr 422 progressive video data from an OV7640/8 CameraChip. The camera interface synchronizes with input video data and performs down-sampling, clamping and windowing functions with desired resolution, as well as color conversion that is requested by the user through serial bus host commands.

The JPEG CODEC can achieve higher compression ratio and better image quality for various image resolutions.

3. Program EEPROM

A serial type program memory is built-in for 23IR to provide a set of user-friendly command interfacing to external host.
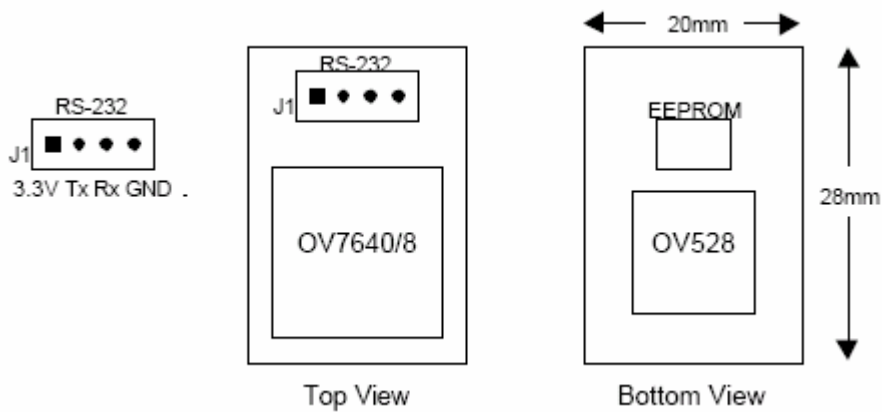
Board Layout

Figure 2 – 23IR board layout and serial interface pin

Serial Interface

1. Single Byte Timing Diagram

A single byte RS-232 transmission consists of the start bit, 8-bit contents and the stop bit. A start bit is always 0, while a stop bit is always 1. LSB is sent out first and is right after the start bit.
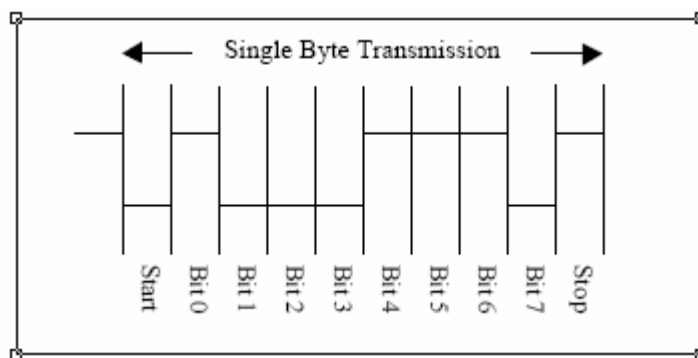

Figure 3 – RS-232 single byte timing diagram

2. Command Timing Diagram

A single command consists of 6 continuous single byte RS-232 transmissions. The following is an example of SYNC (AA0D00000000h) command.
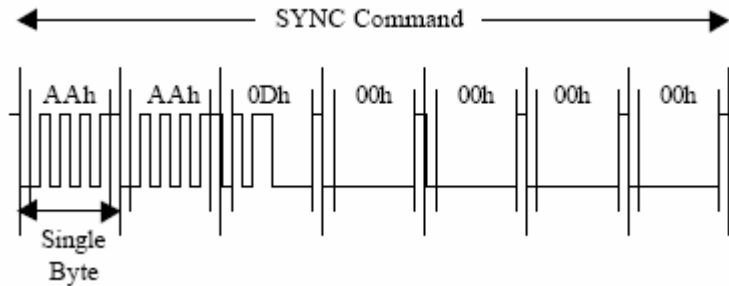

Figure 4 – RS-232 SYNC command timing diagram

Command Set

The 23IR module supports total 12 commands for interfacing to host as following:

Command	ID Number	Parameter 1	Parameter 2	Parameter 3	Parameter 4
Initialise	AA01h	00h	Color Type	Preview Resolution	JPEG Resolution
Get Picture	AA04h	Picture Type	00h	00h	00h
Snapshot	AA05h	Snapshot Type	Skip Frame Low Byte	Skip Frame High Byte	00h
Set Packet Size	AA06h	08h	Packet Size Low Byte	Packet Size High Byte	00h
Set Baud rate	AA07h	1st Divider	2nd Divider	00h	00h
Reset	AA08h	Reset Type	00h	00h	xxh*
Power Off	AA09h	00h	00h	00h	00h
Data	AA0Ah	Data Type	Length Byte 0	Length Byte 1	Length Byte 2
SYNC	AA0Dh	00h	00h	00h	00h
ACK	AA0Eh	Command ID	ACK counter	00h/Packat ID Byte 0	00h/Packet ID Byte 1
NAK	AA0Fh	00h	NAK counter	Error Number	00h
Light Frequency	AA13h	Frequency Type	00h	00h	00h

* If the parameter is 0xFF, it is a special Reset command. The 23IR module will reset immediately.

1. Initialise (AA01h)

The host issues this command to configure the preview image size and color type. After receiving

this command, the module will send out an ACK command to the host if the configuration success. Otherwise, an NACK command will be sent out.

1.1 Color Type

23IR can support 7 different color types as follow:

2-bit Gray Scale	01h
4-bit Gray Scale	02h
8-bit Gray Scale	03h
8-bit Color	04h
12-bit Color	05h
16-bit Color	06h
JPEG	07h

1.2 Preview Resolution

80x60	01h
160x120	03h
320x240	05h
640x480	07h
128x128	09h
128x96	0bh

1.3 JPEG Resolution

Since the Embedded JPEG Code can support only multiple of 16, the JPEG preview mode can support following image sizes. It is different from normal preview mode.

80x60	01h
160x120	03h
320x240	05h
640x480	07h
128x128	09h
128x96	0bh

2. Get Picture (AA04h)

The host gets a picture from 23IR by sending this command.

2.1 Picture Type

Snapshot Picture	01h

Preview Picture	02h
JPEG Preview Picture	03h

3. Snapshot (AA05h)

23IR keeps a single frame of JPEG still picture data in the buffer after receiving this command.

3.1 Snapshot Type

Compressed Picture	00h
Uncompressed Picture	01h

3.2 Skip Frame Counter

The number of dropped frames can be defined before compression occurs. "0" keeps the current frame, "1" captures the next frame, and so forth.

4. Set Packet Size (AA06h)

The host issues this command to change the size of data packet which is used to transmit image data from the 23IR to the host. This command should be issued before sending Snapshot command or Get Picture command to 23IR. It is noted that the size of the last packet varies for different image.

4.1 Packet Size

The default size is 64 bytes and the maximum size is 512 bytes.

ID (2 bytes)	Data Size (2 bytes)	Image Data (Packet Size – 6 bytes)	Verify Code (2 bytes)

ID   ->   Packet ID, starts from zero for an image

Data Size   ->   Size of image data in the packet

Verify Code ->   Simple error detection code, equals to the accumulated number of byte

                    sent out from 23IR to host via RS-232

5. Set Baud Rate (AA07h)

Set the 23IR baud rate by issuing this command. As the default baud rate is 14400bps, host should make connection with 23IR at this baud rate each time power on.

5.1 Baud rate Divider

Baud rate = 14.7456MHz / 2 x (2nd Divider + 1) / 2 x (1st Divider + 1)

Baud rate	1st Divider	2nd Divider	Baud rate	1st Divider	2nd Divider
7200 bps	Ffh	01h	28800 bps	3fh	01h
9600 bps	Bfh	01h	38400 bps	2fh	01h

| 14400 bps | 7fh | 01h | 57600 bps | 1fh | 01h |
| 19200 bps | 5fh | 01h | 115200 bps | 0fh | 01h |

6. Reset (AA08h)

The host reset 23IR by issuing this command.

6.1 Reset Type

00h	Resets the whole system. 23IR will reboot and reset all registers and state machines
01h	Resets state machines only

7. Power Off (AA09h)

23IR will go into sleep mode after receiving this command. SYNC command (AA0Dh) must be sent to wake up 23IR for certain period until receiving ACK command from 23IR.

8. Data (AA0Ah)

23IR issues this command for telling the host the type and the size of the image data which is ready for transmitting out to the host.

8.1 Data Type

Snapshot Picture	01h
Preview Picture	02h
JPEG Preview Picture	05h

8.2 Length

These three bytes represent the length of data of the Snapshot Picture, Preview Picture or JPEG Preview Picture.

9. SYNC (AA0Dh)

Either the host or the 23IR can issue this command to make connection. An ACK command must be sent out after receiving this command.

10. ACK (AA0Eh)

This command indicates the success of last operation. After receiving any valid command, ACK command must be sent out except when getting preview data. The host can issue this command to request image data packet with desired packet ID after receiving Data command from 23IR. The host should send this command with packet ID F0F0h after receiving a packet to end the packet transfer. Note that the field "command ID" should be 00h when request image data packet.

10.1 Command ID

The command with that ID is acknowledged by this command.

10.2 ACK Counter

No use.

10.3 Packet ID

For acknowledging Data command, these two bytes represent the requested packet ID. While for acknowledging other commands, these two bytes are set to 00h.

11. NAK (AA0Fh)

This command indicates corrupted transmission or unsupported features.

11.1 NAK Counter

No use.

11.2 Error Number

Picture Type Error	01h	Parameter Error	0bh
Picture Up Scale	02h	Send Register Timeout	0ch
Picture Scale Error	03h	Command ID Error	0dh
Unexpected Reply	04h	Picture Not Ready	0fh
Send Picture Timeout	05h	Transfer Packet Number Error	10h
Unexpected Command	06h	Set Transfer Packet Size Wrong	11h
SRAM JPEG Type Error	07h	Command Header Error	F0h
SRAM JPEG Size Error	08h	Command Length Error	F1h
Picture Format Error	09h	Send Picture Error	F5h
Picture Size Error	0ah	Send Command Error	Ffh

12. Light Frequency (AA13h)

The host issues this command to change the light frequency of 23IR camera.

12.1 Light Frequency Type

50 Hz	00h
60 Hz	01h

Command Protocol

1   SYNC Command
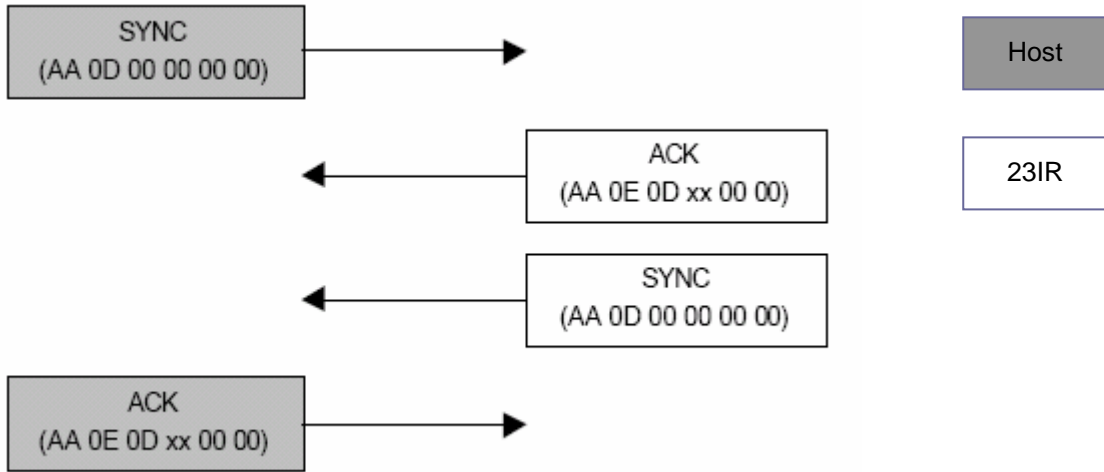
2   Make Connection with 23IR

Send the SYNC command (at 14400bps) until receiving ACK command from 23IR (usually an ACK command is receive after sending 25 times of SYNC command). This must be done after power up.
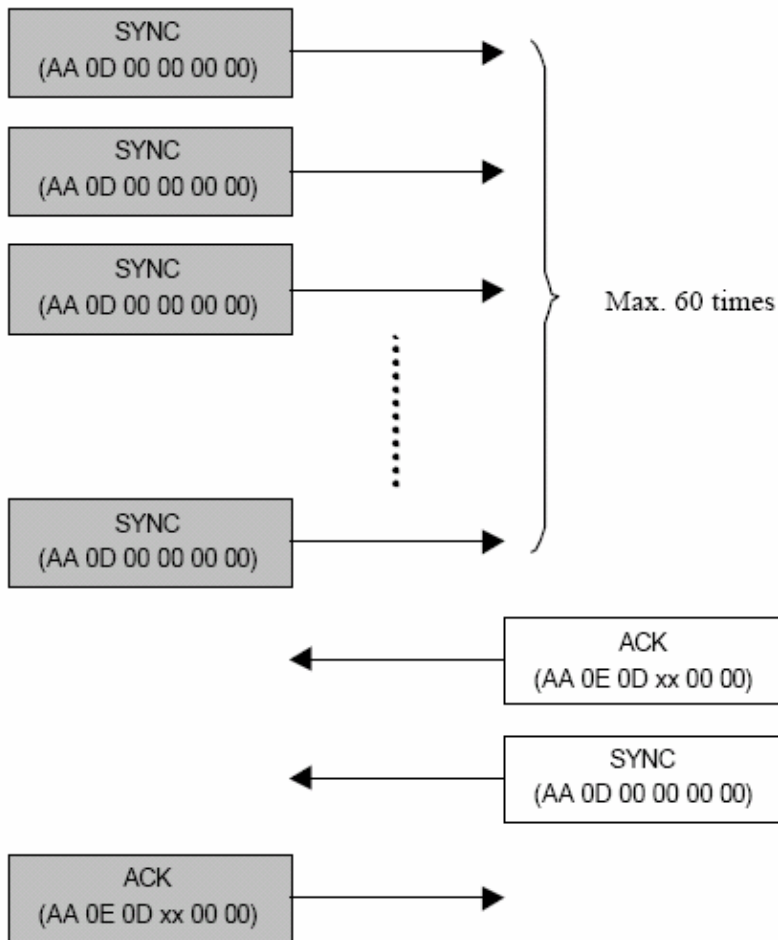
3   Initial, Get Picture, Snapshot, Set Packet Size, Set Baudrate, Reset and Power Off Command

```
┌─────────────────────────┐
│          SYNC           │
│  Get Picture Snapshot   │
│     Set Packet Size     │──────────────────────►
│     Set Baud Rate       │
│         Reset           │
│        Power Off        │
└─────────────────────────┘

                    ◄──────────────┌──────────────────────┐
                                   │        ACK           │
                                   └──────────────────────┘
```
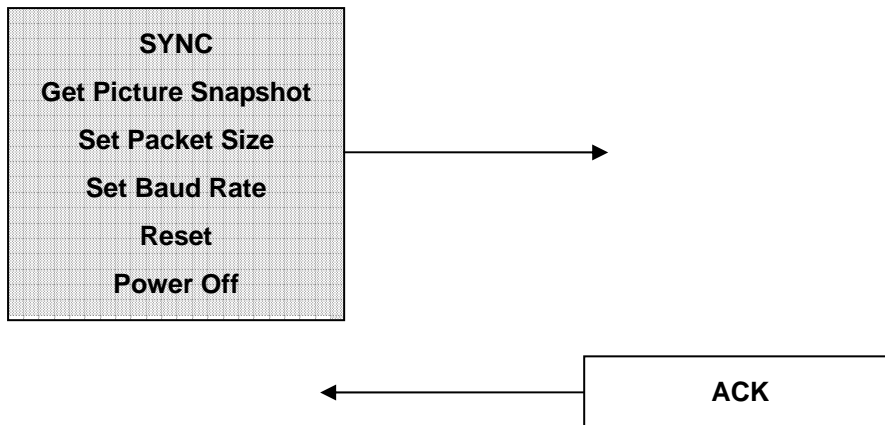
4   Getting a Snapshot JPEG Picture for RS232

   Make sure connection is made before the following communication.

4.1. JPEG Snapshot Picture (e.g. 640x480 VGA format

Note: xx,yy: Don't care

~~zz: Image size return by 23IR
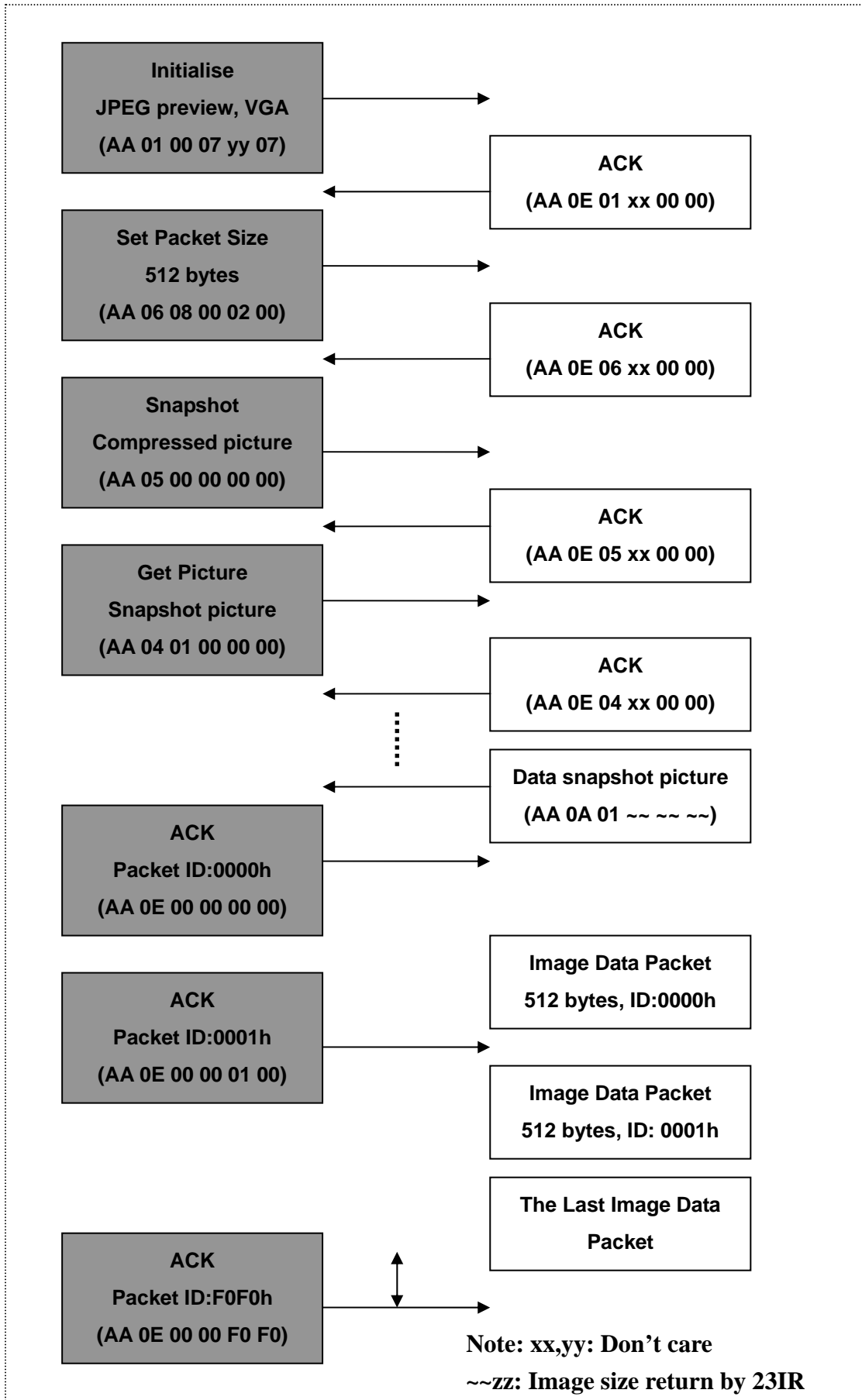
4.2 Snapshot Picture (uncompressed snapshot picture)


```
┌────────────────────┐
│      Initial        │──────────────►
│   preview, VGA      │
│ (AA 01 00 06 07 zz) │            ┌────────────────────┐
└────────────────────┘◄───────────│        ACK          │
                                   │ (AA 0E 01 xx 00 00) │
┌────────────────────┐            └────────────────────┘
│     Snapshot        │──────────────►
│ uncompressed picture│
│ (AA 05 01 00 00 00) │            ┌────────────────────┐
└────────────────────┘◄───────────│        ACK          │
                                   │ (AA 0E 05 xx 00 00) │
┌────────────────────┐            └────────────────────┘
│    Get Picture      │──────────────►
│  snapshot picture   │
│ (AA 04 01 00 00 00) │            ┌────────────────────┐
└────────────────────┘◄───────────│        ACK          │
                                   │ (AA 0E 04 xx 00 00) │
                                   └────────────────────┘

                                   ┌────────────────────┐
                       ◄───────────│        Data         │
                                   │  snapshot picture   │
                                   │ (AA 0A 01 ~~ ~~ ~~) │
                                   └────────────────────┘

                                   ┌────────────────────┐
                       ◄───────────│     Image Data      │
┌────────────────────┐            │    whole picture    │
│        ACK          │──────────►└────────────────────┘
│ (AA 0E 0A xx 00 00) │            Note:
└────────────────────┘            xx, zz : Don't care
```
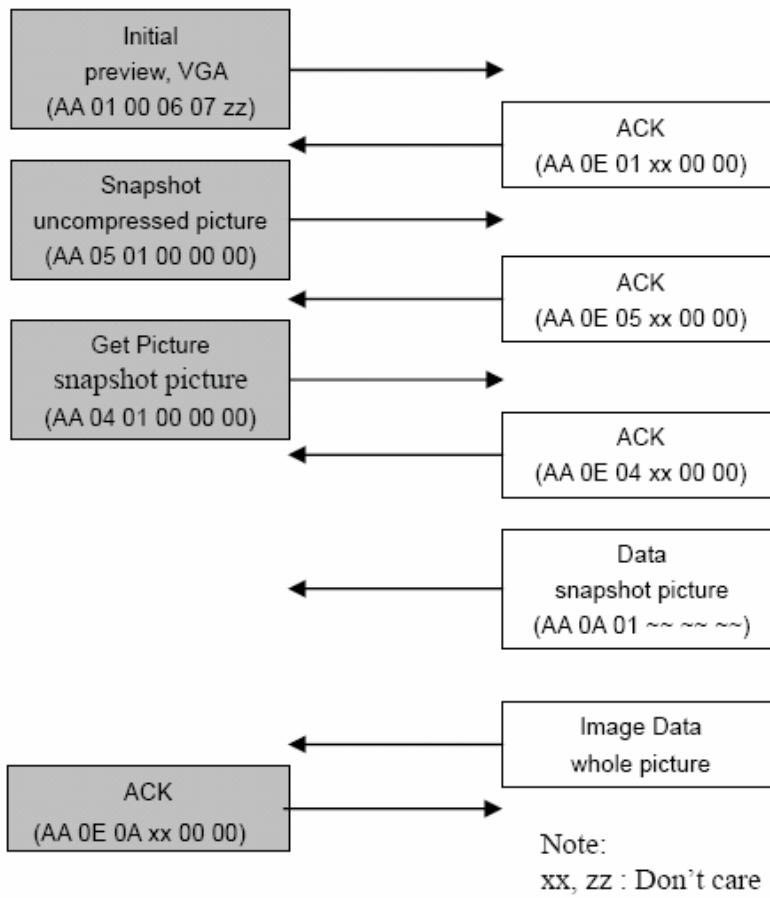
5   Getting JPEG preview pictures (video) for RS232

Make sure connection is made before the following communication.

5.1 JPEG Preview Pictures

Note:

xx, yy: Don't care

~~: Image size return by 23IR
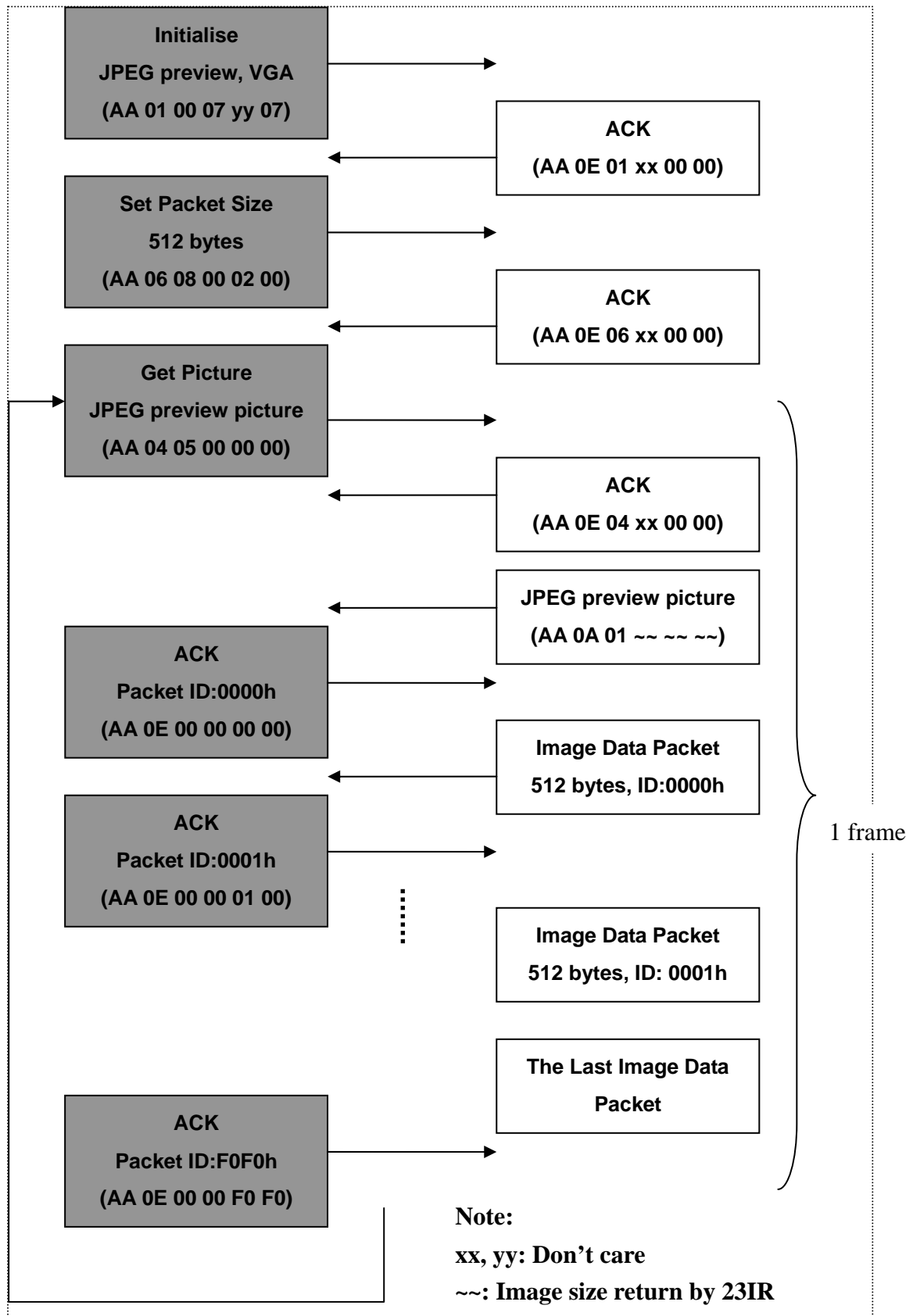
5.2 Preview Picture (Uncompressed Preview Picture)

```
┌──────────────────┐
│     Initial       │
│  preview, VGA     │─────────────────────►
│ (AA 01 00 06 07 zz)│
└──────────────────┘              ┌──────────────────┐
                           ◄──────│      ACK          │
                                  │ (AA 0E 01 xx 00 00)│
┌──────────────────┐              └──────────────────┘
│   Get Picture     │
│  preview picture  │─────────────────────►           ┐
│ (AA 04 02 00 00 00)│                                 │
└──────────────────┘              ┌──────────────────┐ │
                           ◄──────│      ACK          │ │
                                  │ (AA 0E 04 xx 00 00)│ │
                                  └──────────────────┘ │
                                  ┌──────────────────┐ │
                           ◄──────│      Data         │ ├ 1 frame
                                  │  preview picture  │ │
                                  │ (AA 0A 02 ~~ ~~ ~~)│ │
                                  └──────────────────┘ │
                                  ┌──────────────────┐ │
                           ◄──────│   Image Data      │ │
┌──────────────────┐              │  whole picture    │ ┘
│      ACK          │─────────────└──────────────────┘
│ (AA 0E 0A xx 00 00)│            Note:
└──────────────────┘             xx, zz: Don't care
```