18. General Command Protocol

A command is issued by the host PC and a response is returned by the STV0680 module. The STV0680 does not generate unsolicited messages.

Within a single command exchange, data is either sent or received. Where large amounts of data (e.g. more than a few tens of bytes) are to be uploaded from the STV0680 a different data read method is used (implemented as a bulk data transfer for USB)

To support a common user API, the same command data structure is used for both USB and RS-232 implementations. The structure comprises the following data:

Command ID (byte)

Parameter 1 (byte)

Parameter 2 (byte)

Data Size

Data Buffer

The Command ID is a unique byte identifying the command. The most significant bit is used to indicate whether data is to be sent or received by the host PC. If the MSB is zero, then the command is assumed to be sending data (from host to STV0680), if the MSB is one, then the command is assumed to be receiving data. For commands which do not send or receive data, the Data Size must be set to zero and the MSB of the Command ID also set to zero.

Parameter bytes 1 and 2 are always present in a command exchange. If they are not used they should be set to zero. For some commands they may be treated as a single 16-bit word.

The Data Size gives the number of bytes of data which are to be sent or received (over and above the two parameter bytes). This value is fixed for each defined command and may be zero. Data is transferred by a user supplied buffer. Note that the Data Size specifies the maximum number of bytes to be transferred, a command which receives data may receive less than this number (this will be indicated by the transport layer) although this will often indicate an error condition at the higher level (it is not an error in the transport layer).

Commands have varying levels of permission. A command will only be executed if it has the required permission. The camera has four operating modes, four exposure modes and two communication modes. To have the required permission a command must be allowed in the current operating mode AND the current exposure mode AND the current communications mode.

If a command is rejected by the STV0680 (e.g. unknown Command ID or illegal parameter) an error is returned by the transport layer and any data in the Data Buffer should be treated as invalid. A successful return of the command with data does not necessarily mean the command executed successfully - it is the responsibility of the caller to check the returned data (e.g. for the expected number of bytes, range of returned data, etc.).

19. Command Summary

19.1 Command Codes

The following table lists all STV0680 commands by ID. They are described in more detail in the following sections.

Command Code	ID	Tx Rx	Data Len	Bulk Data	Param 1	Param 2
CMDID_CLEAR_COMMS_ERROR	0x00	-	0	-	0	0
CMDID_WRITE_CTRLREG	0x01	Tx	1-16	-	0-255	0-3
CMDID_WRITE_SDRAM	0x02	Tx	1-16	-	0-1	0
CMDID_UPLOAD_SDRAM	0x03	Tx	8	Yes	0	0
CMDID_CANCEL_TRANSACTION	0x04	-	0	-	0	0
CMDID_GRAB_IMAGE	0x05	Tx	0	-	0-255	0-255
CMDID_SET_IMAGE_INDEX	0x06	-	0	-	0-15	0-255
CMDID_SET_CAMERA_MODE	0x07	Tx	8	-	0-255	0
CMDID_TEST_CONTROL	0x08	Tx	0-8	-	1-4	0-255
CMDID_START_VIDEO	0x09	-	-	Yes	0-3	0
CMDID_STOP_VIDEO	0x0A	-	0	-	0	0
CMDID_ERASE_FLASH	0x0B	-	0	-	0-31	0
CMDID_PROGRAM_FLASH	0x0C	Tx	1-16	-	64-127	0-255
CMDID_SET_AEC_MODE	0x0D	Tx	0	-	0-3	0
CMDID_SET_CLKDIV	0x0E	Tx	0	-	0-15	0
CMDID_SET_EXPOSURE	0x0F	Tx	2	-	0-255	0-255
CMDID_SET_GAIN	0x10	Tx	0	-	0-255	0
CMDID_SET_GAIN_AND_EXP	0x11	Tx	4	-	0-255	0
CMDID_GET_LAST_ERROR	0x80	Rx	2	-	0	0
CMDID_READ_CTRLREG	0x81	Rx	1-16	-	0-255	0-3
CMDID_READ_SDRAM	0x82	Rx	1-16	-	0-1	0
CMDID_UPLOAD_IMAGE	0x83	Rx	16	Yes	0-15	0-255
CMDID_UPLOAD_THUMBNAIL	0x84	Rx	16	Yes	0-15	0-255
CMDID_GET_CAMERA_INFO	0x85	Rx	16	-	0	0
CMDID_GET_IMAGE_INFO	0x86	Rx	16	-	0	0
CMDID_GET_CAMERA_MODE	0x87	Rx	8	-	0	0
CMDID_PING	0x88	Rx	2	-	0-255	0-255
CMDID_GRAB_UPLOAD	0x89	Rx	8	Yes	0-255	0-255
CMDID_GET_COLDATA_SIZE	0x8A	Rx	2	-	0	0

Table 2 : STV0680 Commands and Responses

Command Summary

Command Code	ID	Tx Rx	Data Len	Bulk Data	Param 1	Param 2
CMDID_GET_COLDATA	0x8B	Rx	0-255	-	0	0
CMDID_GET_BUTTON_INFO	0x8C	Rx	1	-	0	0
CMDID_GET_USER_IO	0x8D	Rx	8	-	0	0
CMDID_READ_FLASH	0x8E	Rx	1-16	-	64-127	0-255
CMDID_GET_IMAGE_HEADER	0x8F	Rx	16	-	0-15	0-255
CMDID_GET_TABLE_ENTRY	0x90	Rx	16	-	0-15	0-255
CMDID_GET_ENTRY_POINTS	0x91	Rx	16	-	0	0

Table 2 : STV0680 Commands and Responses

NOTE:

1. 16-bit and 32-bit data words are sent and received with the most significant byte first.

2. Tx means data sent from PC to camera, Rx means data received from camera.

19.2 Command Permissions

This table summarises whether or not a command will be accepted according to the state of the camera. For example, many commands are not accepted during the camera startup sequence. If a command is not permitted, the camera will return a negative acknowledgement.

Command	Idle	Busy	Video	Start Up	Auto Exposure	Manual Exposure	Fixed Gain	Limite d Gain	USB	Serial
GET LAST ERROR	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
WRITE CTRLREG	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
WRITE SDRAM	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
UPLOAD SDRAM	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
CANCEL TRANSAC-TION	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES
GRAB IMAGE	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
SET IMAGE INDEX	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
SET CAMERA MODE	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
TEST CONTROL	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
START VIDEO	YES	NO	NO	NO	YES	YES	YES	YES	YES	NO

Table 3 : STV0680 Command Permissions

Command Summary

Command	Idle	Busy	Video	Start Up	Auto Exposure	Manual Exposure	Fixed Gain	Limite d Gain	USB	Serial
STOP VIDEO	NO	NO	YES	NO	YES	YES	YES	YES	YES	NO
ERASE FLASH	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
PROGRAM FLASH	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
SET AEC MODE	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES
SET CLK DIV	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
SET EXPOSURE	YES	YES	YES	NO	NO	YES	NO	NO	YES	YES
SET GAIN	YES	YES	YES	NO	NO	YES	YES	NO	YES	YES
SET GAIN AND EXPOSURE	YES	YES	YES	NO	NO	YES	NO	NO	YES	YES
GET LAST ERROR	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
READ CTRLREG	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
READ SDRAM	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
UPLOAD IMAGE	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
UPLOAD THUMBNAIL	YES	NO	NO	NO	YES	YES	YES	YES	NO	YES
GET CAMERA INFO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
GET IMAGE INFO	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
GET CAMERA MODE	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
PING	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
GRAB UPLOAD	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
GET COLDATA SIZE	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
GET COLDATA	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
GET BUTTON INFO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 3 : STV0680 Command Permissions

Command Summary

Command	Idle	Busy	Video	Start Up	Auto Exposure	Manual Exposure	Fixed Gain	Limite d Gain	USB	Serial
GET USER INFO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
READ FLASH	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
UPLOAD IMAGE HEADER	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
GET TABLE ENTRY	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES
GET ENTRY POINTS	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES

Table 3 : STV0680 Command Permissions

20. Camera Information and Utility Commands

20.1 Get Last Error

Used to return the last error code stored by the STV0680 firmware.

Command	ID	CMDID_GET_LAST_ERROR
	Direction	Receive
	Param 1	Not used (set to 0x00)
	Param 2	Not used (set to 0x00)
	Data Size	2
Data	Byte 0	Error code (zero is OK condition)
	Byte 1	Additional error data (depends on error)

Note: unlike other commands, this command does not modify the camera's internal error code.

The following error codes are defined

Code	Additional Data	Description
CAMERR_OK (0)	Command ID or operation code	The last command or operation completed successfully. The additional data will be sent to the Command ID of the last command packet received or the last operation completed.
CAMERR_BUSY (1)	Command ID or operation code	The camera is busy with another command or operation which can not be interrupted by the current request. The additional data is sent to the ID of the command or operation already in progress.
CAMERR_TIMEOUT (2)	Command ID or operation code	The command or operation failed because camera is busy with another command or operation which can not be interrupted by the current request. The additional data is sent to the ID of the command or operation already in progress.
CAMERR_V2W_ERROR (3)	None	A read/write error to the sensor over the V2W interface failed.
CAMERR_COMMS_ERROR (4)	None	A basic comms error has occurred. This will require a call to the clear comms error command (as opposed to a higher level comms error - such as a bad parameter in a packet - which leave the comms OK).
CAMERR_BAD_EXPOSURE (5)	g_Ap	An image was not grabbed because the AEC could not obtain a suitable exposure (one within the min/max range defined by the virtual registers). This error will not occur if the AEC is over-ridden. The additional error data is set to the average pixel value of the image.

CAMERR_BAD_INDEX (6)	None	The requested image index was out of range for the current camera mode. Note that the legal range is zero to *ImagesMax*.
CAMERR_CAMERA_FULL (7)	None	An image was not grabbed because the current image index is already at max images.
CAMERR_BAD_COMMAND (8)	Command ID	The last command packet received contained an unrecognised Command ID. Additional error data is sent to the ID.
CAMERR_BAD_PARAM (9)	Command ID	The command packet contained a bad parameter (Param1, Param2, DataLen) for the given Command ID. This is the general parameter check performed on all command packets received.
CAMERR_BAD_DATALEN (10)	Command ID	Some commands perform additional checking on their parameters. This error code is set if, for a particular command and parameters, the incorrect amount of data is provided or requested.
CAMERR_TASK_FAILED (11)	Command ID	A background task failed
CAMERR_FLASH_PROGRAM _FAILED (12)	Command ID	Bytes written to flash (code) memory could not be verified
CAMERR_BAD_ADDRESS (13)	Command ID	An illegal address was specified
CAMERR_BAD_PAGE (14)	Command ID	An illegal page number for flash memory was specified
CAMMERR_EXISTING_IMAGE _SMALLER (15)	Command ID	The format of the image being grabbed is too large to be stored in the selected image index
CAMMERR_COMMAND_NOT _ALLOWED (16)	Command ID	This command is not allowed in the current operating mode/aec mode/comms mode.
CAMERR_NO_SENSOR_DETECTED (17)	Command ID	No sensor detected
CAMERR_COLOUR_MATRIX _UNAVAILABLE (18)	Command ID	Colour Matrix not available

20.2 Ping Camera

Used to check camera comms and establish that an STV0680 unit is in fact connected.

Command	ID	CMDID_PING
	Direction	Receive
	Param 1	Any value
	Param 2	Any value
	Data Size	2
Data	Bytes 0-1	Echo of Param 1, 2 value as sent from host.

Camera Information and Utility Commands

20.3 Get Camera Info

This command returns static information about the camera (i.e. configuration information which can not be changed by the user).

Command	ID	CMDID_GET_CAMERA_INFO
	Direction	Receive
	Param 1	Not used (set to 0x00)
	Param 2	Not used (set to 0x00)
	Data Size	16
Data	Bytes 0-1	Firmware revision (major rev / minor rev)
	Bytes 2-3	ASIC revision (major rev / minor rev)
	Bytes 4-5	Sensor ID (MSB / LSB)
	Byte 6	Hardware config
		- bit 0: Comms link, 0=USB, 1=serial
		- bit 1: Flicker freq, 0=50Hz, 1=60Hz
		- bit 2: Mem size, 0=64Mbit, 1=16Mbit
		- bit 3: Thumbnails, 0=N/A, 1=supported
		- bit 4: Video, 0=N/A, 1=supported
		- bit 5: Startup Complete, 0=no, 1=yes
		- bit 6: Monochrome (0=colour, 1=mono)
		- bit 7: Mem fitted (0=no fit, 1=fitted)
	Byte 7	Capabilities (bit set TRUE if supported)
		- bit 0: CIF
		- bit 1: VGA
		- bit 2: QCIF
		- bit 3: QVGA
		- bits 7-4 reserved (set to zero)
	Byte 8-9	Vendor ID (default Vision ID 0x0553)
	Byte 10-11	Product ID (default STV0680 0x0202)
	Byte 12-15	Reserved (set to zero)

20.4 Get Camera Mode

Returns information on the camera's current user mode. At this stage of development, this is solely the image resolution.

Command	ID	CMDID_GET_CAMERA_MODE
	Direction	Receive
	Param 1	Not used (set to zero)
	Param 2	Not used (set to zero)

	Data Size	8
Data	Byte 0	Image format code: - 0x00 CIF - 0x01 VGA - 0x02 QCIF - 0x03 QVGA
	Bytes 1-7	Reserved (set to zero)

20.5 Get Image Info

Returns information on the camera's current image format.

Command	ID	CMDID_GET_IMAGE_INFO
	Direction	Receive
	Param 1	Not used (set to 0x00)
	Param 2	Not used (set to 0x00)
	Data Size	16
Data	Bytes 0-1	Current image index
	Bytes 2-3	Max images
	Bytes 4-5	Image width (in pixels)
	Bytes 6-7	Image height (in pixels)
	Bytes 8-11	Image size (in bytes)
	Bytes 12	Thumbnail width (in pixels)
	Bytes 13	Thumbnail height (in pixels)
	Bytes 14-15	Thumbnail size (in bytes)

To obtain information on a specific image use CMDID_GET_IMAGE_HEADER (with mixed image formats, images may have been captured in a format other than the current one).

20.6 Get Colour Data Size

Returns the size (in bytes) of the colour data block (matrix, tilts, etc.) stored on the camera. If the returned size is zero, the host PC must supply suitable defaults (e.g. based on sensor type). Note, returned data is in proprietary format and should be treated as a byte buffer of given size.

Command	ID	CMDID_GET_COLDATA_SIZE
	Direction	Receive
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	2
Data	Byte 0	Size of data block in bytes (0-64)
	Byte 1	Reserved (set to zero)

Camera Information and Utility Commands

20.7 Get Colour Data

Returns the colour data block (matrix, tilts, etc.) stored on the camera. Note, returned data is in proprietary format and should be treated as a byte buffer of given size. Remember serial can only return up to 16 bytes at a time.

Command	ID	CMDID_GET_COLDATA
	Direction	Receive
	Param 1	Offset into data (current size -1)
	Param 2	Reserved (set to zero)
	Data Size	Num bytes
Data		Colour data

20.8 Get Button Info

Returns status info on the camera's user buttons (and possibly in the future other user input)

Command	ID	CMDID_GET_BUTTON_INFO
	Direction	Receive
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	1
Data	Byte 0	Button press mask bit 0: set if button A is depressed bit 1: set if button B is depressed bit 2: set if button C is depressed bit 3: set if button D is depressed bits 7:4 reserved (set to zero)

20.9 Get User Info

Returns general info about camera state from a user interface point of view (including button presses).

Command	ID	CMDID_GET_USER_INFO
	Direction	Receive
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	8
Data	Byte 0	Button press mask
	Byte 1	Camera user mode
	Bytes 2-3	Current Image Index
	Bytes 4-5	Max Images
	Byte 6	Current Image Format
	Byte 7	Reserved (set 0)

Camera user mode is reported as follows:-

1 = START MODE, 2 = VIDEO_MODE, 4 = BUSY_MODE, 8 = IDLE_MODE

NOTE: If the camera is in START_MODE zero will be reported for the current image index and max images.

20.10 Clear Comms Error

This command attempts to clear any communications errors. It will terminate any bulk transfer in progress. On an RS-232 transport layer, it will act as a comms reset (any data being transmitted from the camera is aborted, both RX and TX buffers on the camera are cleared and reset - the host ones must be cleared by the CPI/CTI functions which issue this command).

Command	ID	CMDID_CLEAR_COMMS_ERROR
	Direction	Send (no data)
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	0
Data	N/A	N/A

This is a high priority command. Any low priority command or operation currently in progress will be terminated.

20.11 Cancel Transaction

This command will terminate any command and bulk transfer in progress. This is a high priority command. Any low priority command or operation currently in progress will be terminated.

Command	ID	CMDID_CANCEL_TRANSACTION
	Direction	Send (no data)
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	0
Data	N/A	N/A

NOTE: This will return the camera to IDLE_MODE. If received during VIDEO_MODE the camera will behave as if a STOP_VIDEO command had been received during VIDEO_MODE.

21. Image Grab, Upload and Index Commands

All images are referenced by an *image index*. This is a number between 0 and the maximum number of images. The maximum number of images (*images max*) depends both on the camera's current image format (e.g., CIF, QCIF) and the number and format of images which have already been taken. *Images max* is recalculated each time the image format is changed, when the camera is cleared, when the image index is changed and when the camera mode is changed (e.g., between video and stills mode). The current value of *Images max* is obtained by using the CMDID_GET_USER_IO or CMDID_GET_IMAGE_INFO commands.

21.1 Grab Image

Causes the camera to grab an image. Note that this command only initiates the grab, it is executed as an internal task which continues to run after the completion of this command. To obtain the status of the grab task (ie, whether still busy and the completion status) use CMDID_GET_LAST_ERROR. Note also that if the grab fails due to bad lighting conditions (too bright or too dark) the original image is still lost.

Command	ID	CMDID_GRAB_IMAGE
	Direction	Send
	Param 1	7:4 Flags 3:0 Image Index MS nibble
	Param 2	7:0 Image Index LS byte
	Data Size	0

The flags are defined as follows

Param1 bit-4	Update Image Index	Update image index within camera. Ignored if bit 7 not set.
Param1 bit-5	Grab to Last Location	If set the image will be acquired to the last legal location in memory. Any image index supplied will be ignored.
Param1 bit-6	Suppress Beep	If this bit is set, any grab related beeps are suppressed for the grab.
Param1 bit-7	Use camera index	If this bit is set, the image index specified in the rest of the parameter data is ignored and the image is grabbed at the location given by the camera's internal image index counter (as also shown on the LCD display). If the maximum number of images has already been taken, the grab will fail.

Legal flag combinations are summarized below.

Bit 7	Bit 6	Bit 5	Bit 4	Description
1	X	0	X	**Grab to current location**. The image is grabbed to the current location. If the camera is already full the command will fail. Parameter 2 and the lower nibble of Parameter 1 are ignored. If bit-4 is set and the grab is successful, the camera's image index and hence the LCD display is updated (the image index is incremented, the LCD display indicating the number of images left is decremented). The beep indicating success or failure of the grab may be inhibited by setting bit-6.

0	X	0	0	**Grab to specified index**. The image is grabbed to the index specified by Parameter 2 and the lower nibble of Parameter 1. The image index must be in the range 0 ... *ImagesMax*-1. If the specified location already contains an image with a format smaller than the current camera format the command will fail. The camera's image index (and hence the LCD display) is left unchanged after this operation. The beep indicating success or failure of the grab may be inhibited by setting bit-6.
0	X	1	0	**Grab to last location**. The image is grabbed to the last legal location in memory. The camera's image index (and hence the LCD display) is left unchanged after this operation. The beep indicating success or failure of the grab may be inhibited by setting bit-6. This option is intended for use by the host driver and colourisation software when performing calibration operations. Bit-7 will override bit-5 if set.

21.2 Grab and Upload Image

Causes the camera to grab and upload an image as an atomic operation. The command returns image data size as its response and the actual image data is returned on the bulk channel. In all other ways the command is the same as CMDID_GRAB_IMAGE. .

Command	ID	CMDID_GRAB_UPLOAD
	Direction	Receive
	Param 1	7:4 Flags (as for CMDID_GRAB_IMAGE 3:0 Image Index 11:8
	Param 2	7:0 Image Index 7:0
	Data Size	8
Data	Bytes 0-3	Image data size in bytes.
	Bytes 4-5	Image width in pixels.
	Bytes 6-7	Image height in pixels.

21.3 Set Image Index

Sets the camera's internal image index (and LCD display) to the specified image index. Note that STV0680 display counts down from the maximum number of images so that setting the image index to zero results in a display of *MaxImages*.

Command	ID	CMDID_SET_IMAGE_INDEX
	Direction	Send (no data)
	Param 1	7:4 Reserved (set to zero) 3:0 Image Index MS nibble
	Param 2	7:0 Image Index LS byte
	Data Size	0
Data	N/A	N/A

The normal usage of this function is to clear the camera images by setting the image index to zero. **All images with index above the new value are lost** and their corresponding *ImageValid* flag will be reset (*ImageValid* := FALSE).

Image Grab, Upload and Index Commands

The image index can only be set to values lower than its current value, that is, it can only be "rewound" towards zero. Higher image indices will be rejected.

This command will not interrupt any other command or operation already in progress.

To read the camera index use the CMDID_GET_IMAGE_INFO or CMDID_GET_USER_IO commands.

21.4 Get Image Header

Uploads the image header for the specified image.

Command	ID	CMDID_GET_IMAGE_HEADER
	Direction	Receive
	Param 1	7:4 (reserved, set to zero) 3:0 Image Index 11:8
	Param 2	7:0 Image Index 7:0
	Data Size	16
Data	Bytes 0-3	Image data size in bytes. Byte 0 is MSB
	Bytes 4-5	Image width in pixels. Byte 4 is MSB
	Bytes 6-7	Image height in pixels. Byte 6 is MSB
	Bytes 8-9	Sensor FINE exposure
	Bytes 10-11	Sensor COARSE exposure
	Byte 12	Sensor GAIN
	Byte 13	Sensor CLKDIV
	Byte 14	Average pixel value (g_Ap)
	Byte 15	Image flags

Note that the image data size is the number of bytes which will be uploaded on the bulk channel in response to the command CMDID_UPLOAD_IMAGE. For some image formats, this may be greater than the product of width and height. This occurs when the image size is not divisible by 8. Note also that the image width and height may not always be exact CIF/QCIF/VGA sizes, etc., since all of the sensor pixel data is transmitted including border pixels. Host software must apply the appropriate size corrections along with the colourisation of the raw pixel data.

The image flags are defined as follows:

Bit 0	Image Invalid	This is set to 1 (TRUE) when the image data is invalid. It is reset to zero (FALSE) if the data is valid. The bit is set under the following condition: (i) the camera is first turned on and no pictures have been taken (ii) the image index has been rewound past the image's location (iii) the image format has been changed
Bit 1	Reserved	Do not use
Bit 2	Continuous Capture	This bit is set for any images which were grabbed as part of a continuous capture sequence.
Bit 3	Reserved	Do not use
Bit 4	Cts Capture Start	This bit is set for the first image in a continuous capture sequence to allow adjacent sequences to be distinguished.
Bit 7-5	Reserved	Do not use

21.5 Upload Image

Uploads an image from the camera. After a successful response to the command packet, image data is transmitted on the bulk channel.

Command	ID	CMDID_UPLOAD_IMAGE
	Direction	Receive
	Param 1	7:4 (reserved, set to zero) 3:0 Image Index 11:8
	Param 2	7:0 Image Index 7:0
	Data Size	16
Data	Bytes 0-15	Image header

The image header is defined in the CMDID_GET_IMAGE_HEADER section. Note that the image data size is set to the number of bytes which are to be uploaded on the bulk channel. For some image formats, this may be greater than the product of width and height. This occurs when the image size is not divisible by 8.

21.6 Upload Thumbnail

This command is for serial communications only (USB uploads a complete image to the host and subsamples it there). The command elicits a response that gives the size of the thumbnail. The thumbnail data is then sent as “bulk” data over the serial link. The command will fail (negative acknowledgement) if called when the camera is configured for USB. , the command packet response is generated but no bulk data is transmitted.

Command	ID	CMDID_UPLOAD_THUMBNAIL
	Direction	Receive
	Param 1	7:4 (reserved, set to zero) 3:0 Image Index 11:8
	Param 2	7:0 Image Index 7:0
	Data Size	16
Data	Bytes 0-15	Image header

The image header is defined in the CMDID_GET_IMAGE_HEADER section. Note that within the header, image data size is set to the number of bytes which are to be uploaded on the bulk channel (ie, the size of the thumbnail data) which may be greater than the product of width and height. This occurs when the thumbnail size is not divisible by 8. The image width and height are set to the thumbnail size.

21.7 Get Table Entry

Returns internal storage details for the selected image.

Command	ID	CMDID_GET_TABLE_ENTRY
	Direction	Receive
	Param 1	7:4 0, Reserved 0:3 Image Index 11:8
	Param 2	Image Index 7:0
	Data Size	16

Image Grab, Upload and Index Commands

Data	Bytes 0-3	Image start address within SDRAM
	Bytes 4-7	Image length
	Bytes 8-9	Image width
	Bytes 10-11	Image height
	Byte 12	Image flags
	Bytes 13-15	0 Reserved

This command is intended for use with serial communications where image uploads are done by a series of block uploads.

21.8 Upload SDRAM

This command initiates a bulk transfer over the USB. It is also defined for the RS-232 transport layer but its usage is slightly different (see the RS-232 documentation).

Command	ID	CMDID_UPLOAD_SDRAM
	Direction	Send
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	8
Data	Bytes 0-3	Start address. Byte 0 is MSB
	Bytes 4-7	Number of bytes. Byte 4 is MSB

Note that the command data size is 8. The number of data bytes to be transferred over the bulk pipe is given in the command data (bytes 4-7). Bulk data is returned over the bulk data pipe (on USB).

22. Camera Configuration Commands

22.1 Set Camera Mode

Sets the camera's current user mode.

Command	ID	CMDID_SET_CAMERA_MODE
	Direction	Receive
	Param 1	Data mask (see below)
	Param 2	Not used (set to 0x00)
	Data Size	8
Data	Byte 0	Image format code: - 0x00 CIF - 0x01 VGA - 0x02 QCIF - 0x03 QVGA
	Bytes 1-7	Reserved (set to zero)

The data mask (Param 1) defines which data bytes are to be used. Set bit 0 of Param 1 to use data byte 0 and so on (all 8 data bytes must be supplied even if they are not used). Thus to change the image format, set Param 1 to 0x01 and supply the desired format code in data bytes 0. If Param 1 is zero, this command will have no effect.

22.2 Start Video

This command puts the camera into video mode. Any existing tasks (including those initiated by user buttons) will be terminated. The camera will remain in video mode until the CMDID_STOP_VIDEO or CMDID_CANCEL_TRANSACTION commands are issued.

Command	ID	CMDID_START_VIDEO
	Direction	Send (no data)
	Param 1	Image format: 0x00 CIF 0x01 VGA 0x02 QCIF 0x03 QVGA
	Param 2	Reserved (set to zero)
	Data Size	0
Data	N/A	N/A

Notes:

- If an unsupported image format is requested, the command will fail.
- Camera capabilities can be obtained using the CMDID_GET_CAMERA_INFO command.
- The camera must be connect over a USB link.
- All user buttons are disabled when in video mode.
- The camera will appear to be continually in a video task to other commands.

Camera Configuration Commands

22.3 Stop Video

This command terminates the video mode and returns the camera to normal operation.

Command	ID	CMDID_STOP_VIDEO
	Direction	Send (no data)
	Param 1	Reserved (set to zero)
	Param 2	Reserved (set to zero)
	Data Size	0
Data	N/A	N/A

Notes:

- The command has no effect and is ignored if the camera is not in video mode.

- If this command fails for some other reason (ascertained by GET_LAST_ERROR) the camera may no longer be in VIDEO_MODE causing further STOP_VIDEO commands to be rejected.

23. RS-232 Implementation of Command Protocol

As far as possible, implementation of the command protocol is mapped directly to the RS-232 transport layer.

A command is sent (from PC to camera) as a sequence of bytes comprising a command header and, optionally, data. This is illustrated below.

STX	CMD	LEN	P1	P2	DCS	CCS	ETX	D1	D2	. . .	Dn

where

STX	The standard ASCII character (0x02)
CMD	The command ID
LEN	The number of command data bytes to be sent or received. Note, that when the command receives data, this field is non-zero but the sent message has no additional data.
P1, P2	The command parameter bytes (set to zero if not used)
DCS	Data checksum. This is module 256 sum of the data (D1 - Dn). If no data is sent with the command, DCS=0.
CCS	Command checksum. This is module 256 sum of the command header excluding CCS (CMD, LEN, P1, P2,DCS, ETX)
ETX	The standard ASCII character (0x03)
D1 - Dn	The command data bytes sent. These are not present for commands which receive data (ie, bit-7 of Cmd ID set) and the message becomes a fixed format of 8 bytes. In this case LEN gives the amount of data which is expected to be returned to the PC in response to the command.

A Command message will always generate a response message from the STV0680 module. Where the command does not expect to receive data, this message simply serves as an acknowledgement and the message contains no additional data. The format is the same the sent message apart from the absence of the two parameter bytes. This is illustrated below.

STX	CMD	LEN	DCS	CCS	ETX	D1	D2	. . .	Dn

If no data is returned (ie, camera to PC) the message is 6 bytes long and both LEN and DCS will be set to zero.

When a command is failed or ignored by the camera (ie, USB command status = FALSE) the Command ID in the response message is set to 0xFF (CMDID_COMMAND_FAIL) so that the serial CTI layer can report the CTISTATUS_COMMAND_FAILED error code in an identical manner to the USB driver. Such a response message has LEN=0, regardless of the original command.

Note: because of the limited serial receive buffer on the camera (24 bytes), no command message should be more than 24 bytes long including the command header (ie, max 16 bytes of data) and no other messages should be sent until a response from the camera has been obtained (a good response guarantees that the camera's receive buff is empty).

Bulk data is sent as raw unformatted binary data in response to the certain commands. The bulk data is sent immediately following the command's response message, the number of bulk bytes to be sent is encoded in the response message.

RS-232 Implementation of Command Protocol