



Low Cost Digital Camera (LCDC) Chipset

PRELIMINARY

DESCRIPTION

STMicroelectronics (ST), Imaging Division (formerly VLSI VISION Ltd.), has utilised its extensive experience in designing imaging sensors for the digital still camera market to develop chipsets for modular systems which will provide the core of a highly cost-competitive new standard in consumer digital stills cameras (DSC).

The Low Cost Digital Camera chipsets from ST, incorporating a CMOS imaging sensor and STV0680A co-processor (formerly DCA1) enable camera manufacturers to offer an end product which is genuinely price competitive with traditional 'point and shoot' film-based cameras.

The chipset provides the basis of an easy-to-use, user friendly camera, which will be equally adaptable for use by children and adults for stills photography or dual-mode use (i.e. Digital stills while untethered, and videoconferencing from the same camera).

Incorporating a wide range of features, the STV0680A chipset offers exceptional performance at a very competitive price point. ST's aim is to enable manufacturers to offer fully functional DSC products to the end consumer for between \$50 and \$100. An evaluation kit (EVK) and reference design manual are available, as well as standard TWAIN and Video for Windows drivers. Alternatively, a software development kit (SDK) allows access to ST colour processing algorithms under licence, to develop OEM software.

The chipset incorporates ST's high performance VV6444/6410 CIF (352 x 288 pixel) or VV6500 VGA (640 x 480 pixel) resolution CMOS sensors. The complete camera will have 20 picture storage capacity for CIF resolution or 80 for QCIF resolution, when using 16MBit memory. When using 64MBit memory, it will have 26 picture storage capacity for VGA resolution or 106 for QVGA resolution. A standby mode which allows full picture retention at extremely low system power consumption gives a battery life of up to several months.

An example upload and colour processing time for a CIF image to the PC is 0.3 seconds when the USB interface is used, and the chipset also offers a high frame rate tethered USB video mode (dependant on PC and USB loading).

The chipset supports a 2x 7-segment display showing number of pictures remaining, a low battery indicator, and operation mode, as well as a buzzer indicating picture taken, camera full, and self-timer countdown.

A CMOS solution gives manufacturers inherent benefits, providing a highly integrated compact solution which has a low system cost, is straightforward to implement, and has low power consumption, giving long battery life.

KEY FEATURES

- CIF (352 x 288) or VGA (640 x 480) resolution sensor
- Using 64MBit memory, 80 picture storage capacity in camera (CIF), 26 (VGA), or 320 (QCIF).
- Using 16MBit memory, 20 picture storage capacity, in camera (CIF), or 80 (QCIF)
- USB/RS232 interface options
- Evaluation kit available
- Low power consumption (typically 75mA) for complete camera and low system cost per pixel
- High speed picture upload with USB
- USB tethered video mode gives a QCIF resolution videoconferencing camera with Vfw support
- 'Continuous' mode for capturing image sequences (while untethered) and downloading to AVI file format
- Memory refresh allows picture retention when camera is in standby mode with very low current consumption
- TWAIN/Video for Windows driver support
- Numeric LCD panel supported
- Colour processing and pixel defect detection/correction software available under license as SDK for development of OEM software. The license to use the colour algorithm (embedded in the PC driver software) is included in the price of the chipset.

PRODUCT FORMATS

Chipsets: For manufacturers wishing to design their own cameras ST offers chipsets combining the colour CMOS sensor with a companion processor.

An evaluation kit, including PC demo software, and a comprehensive reference design manual are available, including schematics and bills of materials.

Modules: For high volume OEM companies, lensed camera modules are available to the basic specification outlined, but geared to the customer's individual requirements, subject to commercial agreement with ST.

SOFTWARE

Driver software is available to support both USB and RS232 interface, included in TWAIN and Video for Windows drivers (Vfw through USB only, WIN98). An AVI creator application allows creation of video files from untethered 'continuous' mode images.

ST colour processing and defect detection/correction software is supplied under licence agreement, as part of a Software Development Kit (SDK). This runs on the host PC under either Windows95™ or Windows98™ .

Table of Contents

1. Introduction	7
1.1 Digital camera chipset	7
1.2 Co-processor choices	7
1.3 Sensor choices	8
1.4 Key system features	8
1.4.1 Image features (STV0680A-002)	8
1.4.2 Image features (STV0680-001)	8
1.4.3 User features on camera	8
1.4.4 User features on PC software	8
1.4.5 Power management features and USB compliance	9
1.4.6 General features	9
2. Detailed features	10
2.1 Sensor type and image formats	10
2.1.1 VV6444	10
2.1.2 VV6410	11
2.1.3 VV6500	11
2.2 User interface	11
2.2.1 Push buttons	11
2.2.2 LED indicator	11
2.2.3 Picture counter using 2 x 7 segment display	11
2.2.4 Piezo buzzer	11
2.3 Battery Level Detect and USB auto-switch	12
2.4 PC interface options and software support	12
2.4.1 USB	12
2.4.2 RS232 (not available on STV0680-001)	12
2.5 Anti-flicker exposure and gain control	12
3. Camera modes of operation	14
3.1 Standby mode (or USB suspend mode)	14
3.1.1 Entering this mode	14
3.1.2 Description	14
3.1.3 Exiting this mode	14
3.2 'Snapshot' mode (in High or Low resolution)	15
3.2.1 Entering this mode	15
3.2.2 Description	15
3.2.3 Exiting this mode	15
3.3 'Continuous Capture' mode (in High or Low resolution)	15
3.3.1 Entering this mode	15
3.3.2 Description	15
3.3.3 Exiting this mode	15
3.4 Self-timer Mode (in High or Low resolution)	15
3.4.1 Entering this mode	15
3.4.2 Description	15
3.4.3 Exiting this mode	15
3.5 'Clear camera'	15
3.5.1 Entering this mode	15
3.5.2 Description	16

3.5.3 Exiting this mode	16
3.6 'Change resolution'	16
3.6.1 Entering this mode	16
3.6.2 Description	16
3.6.3 Exiting this mode	16
3.7 Tethered USB Video mode	16
3.7.1 Entering this mode	16
3.7.2 Description	16
3.7.3 Exiting this mode	16
3.8 Powering the camera off	16
3.8.1 Entering this mode	16
3.8.2 Description	16
3.8.3 Exiting this mode	17
4. STV0680A hardware interfaces	18
4.1 STV0680A pinout	18
4.2 Sensor interface	18
4.3 Memory interface	18
4.3.1 SDRAM Current consumption	18
4.3.2 SDRAM interface timing requirements	18
4.3.3 SDRAM refresh Period	19
4.3.4 SDRAM initialisation Period	20
4.4 USB interface	20
4.5 UART module for RS232 interface	20
4.5.1 RS232 Physical interface	20
4.5.2 UART Module Overview	20
4.6 Power management and battery type	20
4.6.1 Power switching to USB	21
4.6.2 Switched sensor supply	21
4.6.3 Battery type	21
4.7 Quartz Crystal	21
4.8 Numeric LCD interface	21
4.8.1 LCD types	21
4.8.2 LCD interface pinout	21
4.9 Switches and LED's	21
4.9.1 MODE push button and SHUTTER push button: GPIO0 and GPIO1	21
4.9.2 Input to select between 50 and 60Hz flicker frequency: GPIO3	21
4.9.3 LED indicator output: GPIO5	22
4.9.4 Unused pins: GPIO2, 4, 6, 7	22
5. PC software	23
5.1 Driver support available	23
5.2 Demonstration software	23
5.3 OEM software	23
5.4 Software Development Kit (SDK)	23
5.4.1 General	23
5.4.2 API Overview	24
6. Customisation options	25
7. Detailed chipset specifications	26
7.1 Typical camera specifications	26

7.2 STV0680/STV0680A companion processor	26
7.3 VV6444 Sensor	29
7.4 VV6410 and VV6500 sensors	29
7.5 Typical current consumption of complete camera	31
7.5.1 Using VV6444 (sensor operates at @ 5V DC)	32
7.5.2 Using VV6410/6500 (sensor operates at @ 3.3V DC)	33
8. STV0680A Pin descriptions and Package Information	34
8.1 STV0680A Pin Listing	34
8.2 STV0680A pinout diagram	38
8.3 STV0680A Package Dimensions	39
9. Schematics and example parts list for complete camera design	40
9.1 Schematics	40
9.2 Example Parts List	41
10. VV6444 Sensor Pinout and Package Dimensions	44
10.1 VV6444 Pin Listing	45
10.2 VV6444 Pinout Diagram	47
10.3 VV6444 Package Dimensions	48
11. VV6410 Pinout information and package dimensions	50
11.1 VV6410 pinout	50
11.2 VV6410 Pin descriptions	51
11.3 VV6410 package Details (36pin CLCC)	53
12. VV6500 Pinout and pin descriptions (48pin LCC package)	54
12.1 Pinout	54
12.2 VV6500 pin descriptions	55
12.3 VV6500 package Details (48 pin LCC)	57
13. Evaluation kit	58
14. Ordering details	59

Revision notes

The following changes have been included since revision 2.00.

- Removed all schematics and only show example parts list, instead referring to respective reference designs (in Section 9.)
- Documentation now refers to STV0680A which supercedes STV0680 - see Section 1.2 for explanation.
- Clarified which STV0680/680A variants and which PC operating systems offer VfW support and RS232 support, offering VfW support - see Table 3.
- Updated STV0680A pin descriptions (pinout not changed) in Section 8.
- Confirmed user interface functionality in Section 3. and added Table 6 to show modes of operation and button functions.
- Section 3.: Images captured in both 'High' and 'Low' resolution can be stored in camera memory at the same time. Therefore there is no need for images stored in memory to be cleared before changing image resolution.
- Changed IR filter recommendation, see section Section 2.1.1.
- Added approximate shutter speeds, in Table 10.
- Adjusted sensor image array sizes in Section 7. to the correct sizes.
- Updated ordering information in Section 14.
- Updated current consumption information of STV0680, STV0680A, VV6444, and complete camera, see Section 7.2 and Section 7.5.
- Added VfW framerates for STV0680A (Section 2.1).
- New order number STV0680A-002

1. Introduction

1.1 Digital camera chipset

This document describes the features and functionality of a CMOS chipset, comprising an STMicroelectronics (ST) CIF or VGA resolution sensor and an STV0680A companion processor (formerly known as DCA1: Digital Camera ASIC 1), as well as outlining what peripheral components are required/supported in order to complete a camera using the chipset. Such a camera is particularly suited to dual-mode digital stills or toy applications.

In stills mode, the camera stores raw image data in memory. The camera carries out no colour processing, ensuring its simplicity and low cost. Subsequent download of raw data to a PC for processing is done through an RS232 (not STV0680-001) or USB interface, through demo software, a TWAIN driver, or OEM custom application. The license to use the colour algorithm (embedded in the PC driver software) is included in the price of the chipset.

A video option is provided, when tethered through USB, which can allow for Video for Windows applications, and 'video clips' can be recorded while untethered by continuously capturing images while in 'Continuous' mode, then downloaded to the PC for playback, using software to create an AVI file.

Precise design guidelines are available from ST as a reference design (see Section 9.) A PC software development kit (SDK) is available from ST, to interface to the camera and provide the basis for developing a custom software application for stills and/or video, which includes colour processing software.

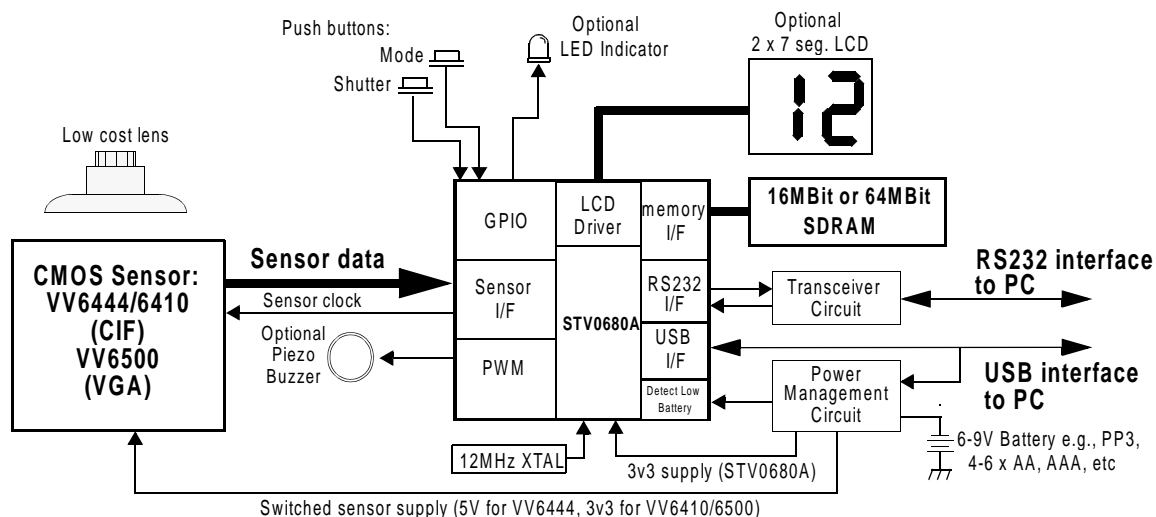


Figure 1 : Typical camera system block diagram

1.2 Co-processor choices

The following co-processor choices are available. The STV0680A supercedes STV0680, and uses different silicon and different firmware compared to STV0680. Functionally it is exactly the same as STV0680 except that it supports a VfW driver. In addition, a new firmware variant means that the STV0680A also supports VV6410 and VV6500 sensors, as well as 64Mbit memory size.

The firmware variant of STV0680 denoted by STV0680-001 does not support RS232 interface.:

Co-processor	Sensors supported	SDRAM supported	USB interface	RS232 interface	Video for Windows support
STV0680-001	VV6444	16Mbit only	Yes	No	No
STV0680A-002	VV6444/6410/6500	16Mbit or 64Mbit	Yes	Yes	Yes

Table 1 : Product choices

1.3 Sensor choices

The following sensors are supported:

Sensor	Resolution	Sensor supply voltage
VV6444	CIF (352 x 288)	5v
VV6410		3.3v
VV6500	VGA (640 x 480)	

Table 2 : Sensor choices with STV0680/STV0680A

1.4 Key system features

The key features of a typical camera based on the STV0680A chipset are as follows:

1.4.1 Image features (STV0680A-002)

- Support for 5V or 3.3V CIF resolution sensor (VV6444 or VV6410) - 352 x 288 pixels
- Support for 3.3V VGA resolution sensor (VV6500) - 640 x 480 pixels
- 80 picture storage capacity possible for CIF, with 64MB memory
- 26 picture storage capacity for VGA, with 64MBit memory
- A greater number of images can be stored when 'Low' resolution mode is enabled (e.g. 80 QCIF images with 16Mbit memory, 106 QVGA images with 64Mbit memory). See Table 4 and Table 5.
- Automatic anti-flicker exposure and gain control

1.4.2 Image features (STV0680-001)

- Supports 5V CIF resolution sensor (VV6444) - 352 x 288 pixels.
- 20 picture storage capacity possible for CIF with 16MB memory.
- 80 picture storage capacity possible for QCIF with 16MB memory.
- Automatic anti-flicker exposure and gain control

1.4.3 User features on camera

- Self-timer mode allows a picture to be captured after several seconds.
- Twin 7 segment LCD panel supported - showing number of pictures left, and modes.
- Picture counter helps the user to know how much memory is left.
- Un-tethered 'Continuous' mode allows capture of image sequences for storage in memory and subsequent download to PC.
- Piezo buzzer indicates a number of useful events to the user, e.g. whether enough light is present for picture capture, etc.
- Indicator LED.

1.4.4 User features on PC software

PC software allows a number of features, including fast download of thumbnail images for picture selection, and automatic detection and correction of sensor defects. Table 3 clarifies the driver compatibility available, including:

- TWAIN driver to suit all TWAIN compatible imaging applications
- Video for Windows driver for tethered video mode (through USB), available at all resolutions, with fastest framerates at QCIF resolution

- AVI video file creation from image sequences captured in 'continuous' mode

Interface type: PC Operating system:	RS232 Win9x, WinNT4, Win2k	USB Win98 and Win2k only
STV680-001	Not available	TWAIN
STV0680A-002	TWAIN	TWAIN, VfW

Table 3 : Driver choices

Custom OEM software can be developed by using the SDK (for SDK availability, contact ST), to upload thumbnails/still images or 'continuous' images, e.g. for AVI file creation.

1.4.5 Power management features and USB compliance

- Picture retention with extremely low power operation, which appears to the user as if the camera is "switched off".
- Auto power-off after 30sec with no user activity
- Operates from 6-9V battery, although system voltage is 5V or 3.3V, dependant on sensor.
- Low battery detection
- Dependant on hardware configuration, switch-over to USB power supply is supported, to allow the device to operate with low batteries or without batteries, when connected to USB.
- Full USB compliance requirements are listed in the USB specification, however, in a camera designed using this chipset, the following must at least be included: (a) an SDRAM with sufficiently low self-refresh current, (b) USB inrush protection circuitry, and (c) (in the case of VV6444 only) a switched 5V sensor supply is used, to maintain sufficient supply voltage to the 5V sensor. See Section 9. for further details.

1.4.6 General features

- High speed picture download over USB
- ST Colour processing algorithms available under license (as part of drivers/SDK)
- USB or RS232 serial interface options, and VfW / TWAIN driver support.
- Customisation of STV0680A is possible to vary the features described in this document, subject to commercial agreement with ST, see Section 6.

2. Detailed features

2.1 Sensor type and image formats

The sensor type is auto-detected by STV0680A, which ensures that the correct sensor timing is enabled, and the correct image resolutions are enabled, as shown in Table 4.

For stills photography, 'High' or 'Low' resolution mode can be selected, to give CIF or QCIF pictures from a CIF sensor, and VGA or QVGA from a VGA sensor (see Table 4 and Section 3.7). Reduced resolution allows for storage of more images. Images captured in both 'High' and 'Low' resolution can be stored in camera memory at the same time. Therefore there is no need for images stored in memory to be cleared before changing image resolution.

Where USB is connected, the host PC software (through a Video for Windows driver) can activate tethered video mode, regardless of the user inputs to the camera buttons. In this case, the image resolution is controlled by the PC driver..

Sensor	Sensor Image Size	Resolution mode	Final Image Size	Max. no. of images stored in 16MBit memory	Max. no. of images stored in 64MBit memory	Approximate VfW framerate (*)
VV6444/6410	CIF 352 x 288	High	CIF 352 x 288	20	80	9 frames/sec
		Low	QCIF 176 x 144 (Subsampled)	80	320 (see notes)	25 frames/sec
VV6500	VGA 640 x 480	High	VGA 640 x 480	(6)	26	2 frames/sec
		Low	QVGA 320 x 240 (Subsampled)	(24)	106	12 frames/sec

Table 4 : Image modes supported (STV0680A-002)

***Notes:**

- VfW framerate is dependant on PC performance and USB bus loading
- Not all image sizes are supported by all STV0680/680A variants - see Table 2 for clarification.
- A CIF camera with STV0680A-002 and 64Mbit SDRAM can store up to 320 images by using QCIF mode. Where >99 images are still available, the LCD display will remain at 99. Where (no. of images available) <99, the LCD display will show the number of images available, as is the case with all other modes.

Sensor	Sensor Image Size	Resolution mode	Final Image Size	Max. no. of images stored in 16MBit memory
VV6444	CIF 352 x 288	High	CIF 352 x 288	20
		Low	QCIF 176 x 144 (Subsampled)	80

Table 5 : Image modes supported (STV0680-001)

2.1.1 VV6444

VV6444 is a CIF resolution, 5V CMOS imaging sensor. A brief specification is shown in Section 7. VV6444 has the same functionality and array size as the un-microlensed VV6404 sensor, but has a microlensed array and different colour characteristics. Although the VV6444 and VV6404 are electrically identical, the STV0680 and STV0680A use the correct

settings for the VV6444 colour set. This means that a VV6404 should not be used with STV0680/680A.

For IR filter design, the best choice filter follows the GS0034 dielectric stack filter specification, which is available from ST. An alternative, although not optimal filter, would be Schott S8612 doped glass, also sold as CM500.

2.1.2 VV6410

VV6410 is a CIF resolution, 3.3V CMOS imaging sensor. A brief specification is shown in Section 7.

A dual design to support VV6444 and VV6410 is not possible, since VV6410 is a 3v3 sensor. A dual footprint for VV6410 and VV6500 is not possible since the package types differ, however, the same support circuit is used. See Section 9.

2.1.3 VV6500

VV6500 is a VGA resolution, 3.3V CMOS imaging sensor. A brief specification is shown in Section 7.

A dual design to support VV6444 and VV6500 is not possible, since VV6500 is a 3v3 sensor. A dual footprint for VV6410 and VV6500 is not possible since the package types differ, however, the same support circuit is used. See Section 9.

2.2 User interface

The user interface supported by STV0680A comprises of user controls, audible signals and visual displays.

! Note

The precise functionality of the **user interface** may vary from that of existing demonstration units. The version shown here is close to the actual functionality available in STV0680A.

2.2.1 Push buttons

The following are typical of the type of functions which are supported by the chipset. These functions are achievable with no more than 2 push buttons.

1. Mode button (Wake-up/Switch between modes): This button allows the user (1.1) to wake the camera up from standby mode when the camera is to be used for taking pictures, or (1.2) to switch between modes of operation shown in Section 3..
2. Shutter button (Shutter/confirm action): This button allows the user to take a picture or confirm an action, as shown in Section 3.

The modes of operation are described in Section 3.

2.2.2 LED indicator

An LED display camera status, i.e. to show that the camera is in 'Snapshot' mode.

2.2.3 Picture counter using 2 x 7 segment display

STV0680A stores a picture counter value, which shows how many images can still be captured. STV0680A supports a 2x7 segment LCD panel. In 'Snapshot' mode and continuous capture mode, this LCD panel displays the number of pictures still available, which is useful to identify when the user is approaching the maximum number of images which can be stored (see Table 4 and Table 5). It is possible to clear the images stored in memory, in order to continue taking pictures, as shown in Table 6. In other modes, this LCD panel shows displays a 2-character code as shown in Table 6, which helps the user to navigate around the modes.

Note: A CIF camera with STV0680A-002 and 64Mbit SDRAM can store up to 320 images by using QCIF mode. Where >99 images are still available, the LCD display will remain at 99. Where (no. of images available) <99, the LCD display will show the number of images available, as is the case with all other modes.

For suitable numeric LCD panel types, see Section 4.8.

2.2.4 Piezo buzzer

An on-chip Pulse Width Modulator (PWM) on STV0680A is used to generate buzzer sounds to signal certain events. The following are typical of the type of events which are indicated by the buzzer, and each has its own distinctive sound:

1. Camera has been 'Woken up' from standby mode (either by the user pressing a button, by re-connecting the power source, or by connecting a USB/RS232 connection).

2. Camera has been 'gone to sleep' i.e. moved into standby mode. Pictures are retained in memory.
3. Picture has been successfully taken after the user presses the capture button.
4. Picture has NOT been taken after the user presses the capture button. This indicates to the user that there is insufficient light, or that the exposure control was not ready due to a rapid change of lighting in the scene.
5. Picture has NOT been taken after the user presses the capture button, due to picture counter having reached the maximum number of images. The user has the chance to zero the counter if desired.
6. End of continuous capture in un-tethered 'Continuous' mode, due to memory full.
7. Self-timer activated and counting down.

2.3 Battery Level Detect and USB auto-switch

An on-chip battery level detector on STV0680A detects when the battery voltage falls below a threshold. This threshold is determined by the designer, dependant on the perception of what remains as 'acceptable' image quality as the battery voltage falls. The chosen threshold level is determined by a resistor value, as shown in Section 9. Where no USB has been detected, the LCD display flashes, which indicates that the battery is low. Where a USB connection has been detected, the camera sources power from USB, if certain additional hardware is fitted.

Note: It may be a requirement of certain USB compliance tests that such additional hardware is included in the camera design, in order to enable the camera to switch to supply from USB and hence report back to the PC while connected to the USB bus without a battery.

2.4 PC interface options and software support

Either USB Interface (full speed 12Mbit/sec max.) or RS232 interface (115.2Kbaud) is supported by the chipset, with driver software available from ST for both. The interface type is auto-detected by the chipset. PC software can be one of the following (exact compatibility is clarified in Table 3):

1. Simple image upload demonstration software supplied by ST, allowing uploading of stills or 'continuous' images. This software should not be supplied as an end-user product.
2. TWAIN driver to suit all TWAIN compatible imaging applications
3. Video for Windows driver for tethered video mode (USB only)
4. Custom end-user software developed by OEM using SDK (for SDK availability, contact ST). The SDK is supplied by ST as a 32-bit DLL format, running on Windows 98, and accessed through a documented software interface. This provides the basis for developing a custom software application for uploading stills and/or video. See Section 5. for further details.

2.4.1 USB

Complete images (displayed as either thumbnails or in full resolution), or the entire SDRAM contents (e.g. for uploading continuously captured image sequences, recorded using 'Continuous Capture' mode) can be downloaded through USB, and USB connection also allows for tethered video mode to be activated by the USB driver.

Thumbnail image download is extremely fast for the entire memory contents in the camera. Once a picture is selected for download, full image download takes approximately 0.15 seconds per image for a CIF image (0.6 seconds for a VGA image), plus post processing time per image.

For USB interface details, see Section 4.4.

Note: Actual USB download and post processing time also depends on PC performance and USB bus loading

2.4.2 RS232 (not available on STV0680-001)

Thumbnails of images, complete stored images, or the entire SDRAM contents can be downloaded through RS232, but tethered video is not supported.

Once a picture is selected for download, full image download takes approximately 10 seconds per image for a CIF image (around 30 seconds for a VGA image), plus post processing time per image (of the order of 1 second approximately).

For RS232 interface details, see Section 4.5.

Note: Actual post processing time after RS232 download also depends on PC performance

2.5 Anti-flicker exposure and gain control

The chipset operates automatic exposure and gain control for either 50Hz or 60Hz mains-driven indoor lighting, using the same 12MHz crystal. This improves picture quality by selecting a set of exposure values which minimise 'flicker' effects. Detection of

the mains frequency is dependant on the status of the GPIO3 pin, which can be achieved by population of a PCB link at a late stage in production, once the country of destination is known, without the need to change the crystal frequency.

The auto exposure and gain algorithm is always enabled during 'Snapshot'/self-timer/continuous mode. When the shutter button is pressed in 'Snapshot' mode, the chipset captures an image if the exposure and gain value has reached a suitable value for the current scene. If the light detected has suddenly changed, the camera may emit an audible tone to indicate that more time is required to reach the correct exposure target. In 'Snapshot' mode the chipset only captures the image data if sufficient light is present in the image. In continuous capture mode, the chipset captures images regardless of whether enough light is present.

Note: Auto-detect of the mains lighting frequency is not currently supported.

3. Camera modes of operation

Mode	If shutter button pressed while in this mode		If mode button pressed while in this mode	If no further action	LCD displays
Standby mode	No function - pictures cannot be taken in standby mode		Wakes up camera into 'Snapshot' mode	Remains in standby mode	(Display is blank)
'Snapshot' mode	Takes one picture, if sufficient light available, then returns to 'Snapshot' mode		Moves to continuous capture mode	Stays in 'Snapshot' mode for 30 seconds then moves to standby mode	Number of pictures still available to take
Continuous capture	Takes a picture every 80mS while button pressed, regardless of light available, then returns to 'Snapshot' mode		Moves to self timer mode	Returns to 'Snapshot' mode after 5 seconds	Number of pictures still available to take
Self timer	Takes one picture after a 10 second count-down, if sufficient light available, then returns to 'Snapshot' mode		Moves to 'Clear camera' mode		"St"
'Clear camera'	(1st press:) Prompts user to clear camera	(2nd press:) Clears all images stored in camera, then returns to 'Snapshot' mode	Moves to 'Change resolution' mode (see note)		"CL"
'Change resolution'	Changes resolution (i.e. Low to High, or High to Low) and returns to 'Snapshot' mode		Returns to 'Snapshot' mode		If currently in Low Resolution: "Hr" If currently in High resolution: "Lr"

Table 6 : Camera modes

Note: In STV0680-001, pressing the Mode button while in 'Clear Camera' mode only moves onto 'Change resolution' mode if the camera has no images stored. This is because in STV0680-001, mixed resolutions (i.e. 'High' and 'Low') cannot be stored at the same time. In STV0680A-002, mixed resolutions can be stored at the same time.

The above modes are interrupted by the detection of a USB or RS232 connection. This is to allow for the possibility that the PC driver takes control of the chipset (e.g. when starting a Vfw application through USB).

3.1 Standby mode (or USB suspend mode)

3.1.1 Entering this mode

The camera enters standby mode automatically after 30 seconds of inactivity if not tethered to USB, or when USB suspend mode is activated by the PC driver.

3.1.2 Description

This allows image data to be stored in memory with extremely low power consumption, which appears to the user as if the camera is switched 'off', since there is no LCD display or LED lit. In VV6444-based designs, STV0680A powers off the sensor completely, in VV6410/6500 based designs, the sensor is placed in suspend mode, and the camera enters a mode where only SDRAM refresh is carried out. The shutter button is inactive in standby mode.

3.1.3 Exiting this mode

Wake-up from standby mode is achieved by any of the following means:

1. Pressing the 'mode' button (only if no USB detected)

2. RS232 receives start bit from host software (only if no USB detected)
3. USB connection detected
4. If in USB suspend mode, USB driver re-starts communications with the camera as per USB specification

3.2 'Snapshot' mode (in High or Low resolution)

3.2.1 Entering this mode

This is the default mode on wake-up when not tethered to the PC, i.e. pressing the Mode button while in standby mode, or powering up the camera. On entering this mode, the current resolution (i.e. 'Hr' or 'Lr') is displayed briefly, and there is a brief pause (approx. 1second) during which pictures cannot be taken. This is to allow the Auto-exposure and Gain control to settle. The LCD then displays the number of pictures still available.

3.2.2 Description

Using the shutter button, 'Snapshot' mode allows single pictures to be grabbed using the capture button. The LCD displays the number of pictures still available. Auto-exposure and gain are continuously enabled. The camera grabs an image when the capture button is pressed, if sufficient light is available, the exposure and gain algorithm is settled, and picture counter has not reached its maximum. Image data is stored in memory and picture counter is decremented.

3.2.3 Exiting this mode

After 30 seconds of non-activity, while not tethered to the PC, the camera goes into Standby mode.

3.3 'Continuous Capture' mode (in High or Low resolution)

3.3.1 Entering this mode

Enabled using the mode button (from 'Snapshot' mode, press once).

3.3.2 Description

The LCD displays "Ct". Auto-exposure and gain are continuously enabled. While the shutter button is pressed, the user can activate continuous capture at approx. 12.5 frames per second, to allow recording of a 'video' sequence, whether or not the camera is tethered to the PC, and regardless of whether enough light is available. The picture counter is decremented once per frame. The continuous image data is stored in memory and can then be downloaded to the PC. Once the memory is full, the user is alerted by an audible tone. It is possible to store a mixture of still images and 'Continuous' images in memory.

3.3.3 Exiting this mode

After 5 seconds of non-activity, or after releasing the shutter button, the camera returns to standby mode.

3.4 Self-timer Mode (in High or Low resolution)

3.4.1 Entering this mode

Enabled using the mode button (from 'Snapshot' mode, press twice).

3.4.2 Description

The LCD displays "St". Auto-exposure and gain are continuously enabled. When the shutter button is pressed, the camera counts down 10 seconds, then grabs an image, if sufficient light available and exposure and gain algorithm settled, and picture counter has not reached its maximum. Image data is stored in memory and picture counter is decremented.

3.4.3 Exiting this mode

After 5 seconds of non-activity, or after the timer has counted down 10 seconds, the camera returns to standby mode.

3.5 'Clear camera'

3.5.1 Entering this mode

Enabled using the mode button (from 'Snapshot' mode, press three times).

3.5.2 Description

The LCD displays "CL". Pressing shutter button twice will clear all the images in the camera.

3.5.3 Exiting this mode

After 5 seconds of non-activity, or after the camera has been cleared, the camera returns to standby mode.

3.6 'Change resolution'

3.6.1 Entering this mode

This is enabled using the mode button (from 'Snapshot' mode, press four times).

Note: In STV0680-001, the images stored in memory must be cleared before this mode can be entered. This is because in STV0680-001, mixed resolutions (i.e. 'High' and 'Low') cannot be stored at the same time.

3.6.2 Description

The LCD displays the target resolution to which the camera can be changed, i.e. if in High resolution "Lr" (Low resolution) is displayed, if in Low resolution, "Hr" (High resolution) is displayed. 'High' resolution stores the full image resolution from the sensor array, while 'Low' subsamples the sensor array, to store 4x the number of images (e.g. 80 in QCIF mode, compared to 20 in CIF mode).

Dependant on the type of sensor used, different resolutions are obtained, see Table 4 or Table 5. By pressing the shutter button, user changes the resolution.

3.6.3 Exiting this mode

After 5 seconds of non-activity, or after the resolution has been changed, the camera returns to standby mode.

3.7 Tethered USB Video mode

3.7.1 Entering this mode

This is activated by the PC Video for Windows driver while the camera is tethered, dependant on whether VFW is supported (see Table 3).

3.7.2 Description

The camera is controlled by the PC driver.

Note: Any images or continuous image sequences contained in the camera are lost when the video for Windows driver starts.

3.7.3 Exiting this mode

This is controlled by the PC drivers.

3.8 Powering the camera off

3.8.1 Entering this mode

This is not truly a mode of operation, but a description of what happens if:

- The battery power and USB connection are removed from the camera
- The battery power is removed, and the PC to which the camera is tethered, is switched off.
- The battery voltage falls extremely low. Ways of avoiding this situation are discussed in the reference design, see Section 9.

Note: normally a camera with USB interface should source power from the USB connection, but this is hardware dependant, see Section 9.

3.8.2 Description

In this situation, all image data is lost.

Note: under certain circumstances, the image data may be maintained if the camera or PC is powered on again after a few

seconds, although this is not guaranteed).

3.8.3 Exiting this mode

When the camera is powered on again, either when the battery is re-fitted, or the USB is re-connected, or the PC is re-started, the camera will power up into standby mode, High resolution, with all images available.

4. STV0680A hardware interfaces

4.1 STV0680A pinout

The STV0680A pinout has been carefully developed to minimise the physical size of the support printed circuit board by facilitating placement of and electrical routing to peripheral support components such as the SDRAM. The complete pinout and listing is shown in Section 8.

4.2 Sensor interface

STV0680A uses a standard ST digital interface from the sensor, and the sensor clock input is provided by an output from STV0680A. Designing a camera using this chipset should design as close as possible to the reference design (Section 9.), in which case the chipset can be regarded as a functional 'black box', and no further details regarding the STV0680A-sensor interface are required.

4.3 Memory interface

STV0680A is designed to interface to an external 16Mbit or 64Mbit SDRAM (see Table 4 and Table 5). The SDRAM device must have a 16 bit wide data bus and operate from a 3.3V supply. Two sizes of SDRAM memory are supported by STV0680A, 16Mbits (1M x 16 bits wide) or 64Mbits (4M x 16 bits wide), the memory size is auto-detected by STV0680A. STV0680A clocks the SDRAM at 6MHz, typically this is well below the figures offered by most manufacturers' devices. Devices which are PC66 and/or PC100 compliant are preferred. For interface wiring, see Section 9.

4.3.1 SDRAM Current consumption

For maximum system battery life while no pictures are being taken, and to assist in meeting requirements for USB compliance, an SDRAM should be chosen with the lowest possible self refresh current specification. For suggested SDRAM part numbers, see Section 9.

4.3.2 SDRAM interface timing requirements

The following timing diagrams should be referred to when selecting SDRAM other than those recommended in Section 9.

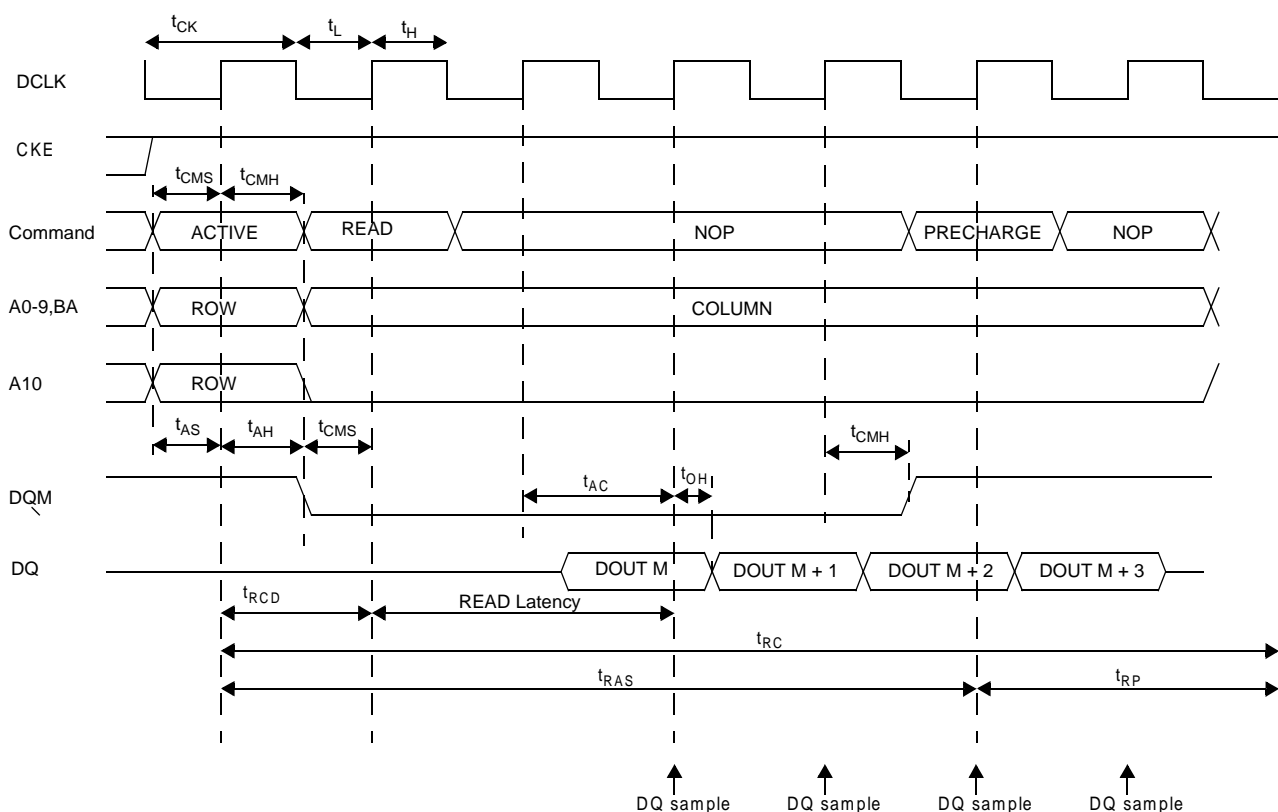


Figure 2 : SDRAM Read Timing (16Mbit device, burst read)

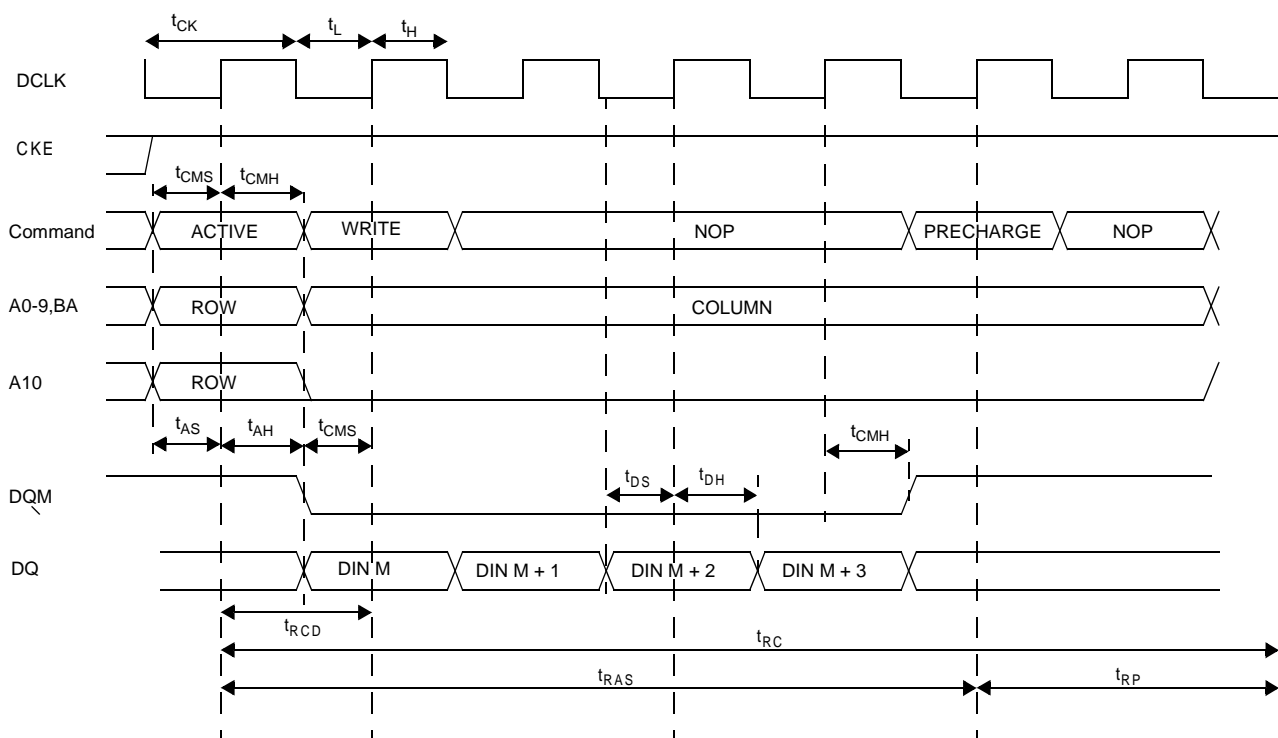


Figure 3 : SDRAM Write Timing (16Mbit device, burst write)

Symbol	Min	Max	Units
t_{CK}	166.45	166.89	ns
t_{CH}	$\frac{1}{2}$		t_{CK}
t_{CL}	$\frac{1}{2}$		t_{CK}
t_{AC}		$\frac{1}{2}$	t_{CK}
t_{OH}	0		ns
t_{CMS}	82.88		ns
t_{CMH}	82.85		ns
t_{AS}	82.88		ns
t_{DS}	81.01		ns
t_{DH}	83.41		ns
t_{RCD}	1		t_{CK}
t_{RAS}	5	5	t_{CK}
t_{RC}	7		t_{CK}
t_{RP}	2		t_{CK}
t_{RCD}	1		t_{CK}
t_{AH}	82.76		ns

Table 7 : Timing parameters for SDRAM read/write

4.3.3 SDRAM refresh Period

The SDRAM refresh period from STV0680A is guaranteed to be no greater than 15.6µS during 'Snapshot'/self-timer/continuous/tethered video modes of operation (i.e. not standby mode). In standby mode, the SDRAM is set to self-refresh, therefore no

refresh from STV0680A takes place.

4.3.4 SDRAM initialisation Period

The SDRAM initialisation period is currently set to 981 μ S in STV0680A.

4.4 USB interface

STV0680A includes a USB Version 1.1 compliant Universal Serial Bus Interface, including a transceiver. This allows direct connection from STV0680A to a USB connector with minimal additional hardware (i.e. a small number of passive discretes) - see Section 9.

The USB interface interfaces the STV0680A to the USB at full speed 12MHz data rate. Some of the features are:

- Compliant with USB protocol revision 1.1.
- USB protocol handling.
- USB device state handling.
- Clock and data recovery from USB.
- Bit stripping and bit stuffing functions.
- CRC5 checking, CRC16 generation and checking.
- Serial to parallel conversion.
- Single bulk end point.

USB drivers are supplied by ST. For USB timing information, please refer to the USB specification V1.1.

4.5 UART module for RS232 interface

The UART module on STV0680A provides a 115200 baud full duplex interface to an external Host.

4.5.1 RS232 Physical interface

STV0680A does not support direct connection to a serial link. Physical line driver circuitry is required, e.g. using a standard RS232 transceiver chip, or by using a small number of low cost discretes (as shown in Section 9.). The schematics shown assume a 3 core cable with a length of no greater than 2m. Unscreened cable can be used, a suitable low cost connector is a 3.5mm audio jack plugs/sockets.

4.5.2 UART Module Overview

Receiving data

The UART module in STV0680A receives serial data through the RXD pin. Data reception is initiated by a 1-to-0 transition on RXD, and the received data is sampled every 8.66 μ S.

If the RXD input is not 0 when the incoming data is first sampled, the UART module goes back to look for another 1-to-0 transition. This is to provide rejection of false start bits. If the start bit proves valid, reception of the rest of the frame will proceed.

Transmitting data

When a transmission is activated by STV0680A, the contents of an internal transmit shift register are shifted onto the TXD pin, every 8.66 μ S.

The UART operates at 12MHz, which is not an integer multiple of 115200, so the actual baud rate is 115232 +/- 0.3%, which is well within the requirements of a typical 16x oversampling UART, which can tolerate a 3.75% error in baud rate.

4.6 Power management and battery type

STV0680A and the SDRAM require a 3.3V supply. Where a VV6410 or VV6500 (3.3v) sensor is used, a single voltage regulator can be used to regulate the supply for all three components from the battery, or the sensor on-board VReg can be used. Where a VV6444 is used, the sensor requires a 5V supply, hence a DC-DC converter is recommended to provide enough voltage when the camera is powered from the USB bus. These are explained more fully in the reference design.

4.6.1 Power switching to USB

Included in the USB compliance requirements, is the ability of the camera to report to the PC when connected to the USB bus, **whether or not** there is a fresh battery in the camera. This means that power sourcing from USB is required, which also saves on battery life while the camera is used in USB tethered video mode. In order to allow switching from battery to USB power, some additional hardware is required (see also Section 9.):

- The USBDETECT input to STV0680A is used to detect that a USB power supply is connected
- If the USB is detected, additional hardware is used to switch off the battery
- An inrush protection circuit can protect the USB bus from current draw in the case of a low battery/battery not fitted. This may be necessary to comply with the USB specification.
- For precise USB compliance requirements, please consult the USB specification version 1.1

4.6.2 Switched sensor supply

Dependant on the hardware implementation, the SENSEPWR output from STV0680A can be used to power off completely the sensor during Standby mode (in the case of VV6444) or put the sensor into Suspend mode (in the case of VV6410/6500). This has a significant improvement on battery life.

4.6.3 Battery type

This is hardware dependant. The schematics referred to in Section 9. assume either three or four 1.5V cells.

4.7 Quartz Crystal

Regardless of the sensor type or anti-flicker requirements, the sensor + STV0680A chipset operates from a single 12MHz fundamental quartz crystal. For specification requirements, see Table 15. STV0680A includes an on-chip low jitter PLL, for PLL characteristics, see Table 14.

4.8 Numeric LCD interface

STV0680A supports a 2-digit LCD panel only, for alpha-numeric display.

4.8.1 LCD types

STV0680A connects to a non multiplexed, direct drive LCD with 2 x 7 segments. Many LCD types are compatible with this interface. The LCD refresh frequency is 34.7Hz.

4.8.2 LCD interface pinout

'0' connects to segment 'a', '1' connects to segment 'b', and so on, where a to g are standard for all 7-segment displays, as well as an LCD common output, giving fifteen signals in total.

4.9 Switches and LED's

The GPIO lines on STV0680A have pre-defined functions as follows, see Section 2.2 for user interface functionality, and Section 9. for precise hardware implementation.

! Note

The precise functionality of early demonstration units may vary from the actual user interface supported by STV0680A.

4.9.1 MODE push button and SHUTTER push button: GPIO0 and GPIO1

Both push button inputs have internal de-bounce circuits, reducing the amount of hardware required externally. It is recommended that labelling is used on the camera casing to help the user understand the functioning of the 2-button interface.

4.9.2 Input to select between 50 and 60Hz flicker frequency: GPIO3

This allows for factory setting of the anti-flicker frequency, dependant on the final country of destination. See also Section 2.5. The polarity of this selection is detailed in the reference design (see Section 9.).

4.9.3 LED indicator output: GPIO5

The LED output has an 8mA current sinking capability.

4.9.4 Unused pins: GPIO2, 4, 6, 7

These should be tied to GND.

5. PC software

5.1 Driver support available

Interface type: PC Operating system:	RS232 Win9x, WinNT4, Win2k	USB Win98 and Win2k only
STV680-001	Not available	TWAIN
STV0680A-002	TWAIN	TWAIN, vfw

Table 8 : Driver choices

5.2 Demonstration software

The following is supplied with evaluation kits/demonstration units (This software is mainly for demonstration purposes and should NOT be supplied as an end-user product.):

1. Simple demonstration software for uploading thumbnails and images.
2. Video demonstration application for STV0680-001 tethered "video" mode through USB (WIN 98 only) (NOT vfw compatible). This is not required for STV0680A, which can be used with standard vfw drivers.
3. AVI creator software for uploading continuous images for creating 'movie' clips.

! Note

With STV0680, a simple **video.exe** application is provided. Whilst not being a vfw application, it gives sufficient framerate to allow for camera test, lens focussing, etc.

5.3 OEM software

OEM's have the following options for productisation of a camera based on the chipset:

1. TWAIN driver for uploading images, this would allow the camera to be bundled with standard TWAIN compatible imaging software.
2. Video for Windows driver for tethered video mode through USB (WIN 98 & WIN2K only). This would allow the camera to be bundled with standard video for windows software.
3. Development of custom end-user software, including the ST colour process, developed under license using the SDK.

5.4 Software Development Kit (SDK)

5.4.1 General

A software development kit is supplied by ST under license agreement, which allows the OEM to develop a custom application which can perform picture download, thumbnail display, and colour processing. This supports Windows95™ (Serial interface only) or Windows98/Win2K™ (Serial or USB), and includes features such as:

- Very fast download (through USB) and colour display of image thumbnails for picture selection
- Download of full image once selected by user software
- Colour processing of full image, using the ST colour process
- Automatic detection and correction of sensor defects

The SDK is supplied by ST as a 32-bit DLL format, running on Windows 98/Win2K™, and accessed through a documented software interface. This provides the basis for developing a custom software application for stills and/or video.

The ST SDK for the chipset comprises the following:

- Interface library containing all Application Programmer's Interface (API) functions. Provided as C library and header files.
- All driver files necessary for chosen communications link (supplied as DLL and SYS files).
- Documentation of all API functions including example code fragments.

All software is built as 32-bit modules for Windows 98/Win2K. The serial communications link is also supported for Windows 95. A development environment of Microsoft Visual C++ v5 or higher is assumed.

5.4.2 API Overview

All OEM application software communicates with the camera by means of the API as illustrated in Figure 4.

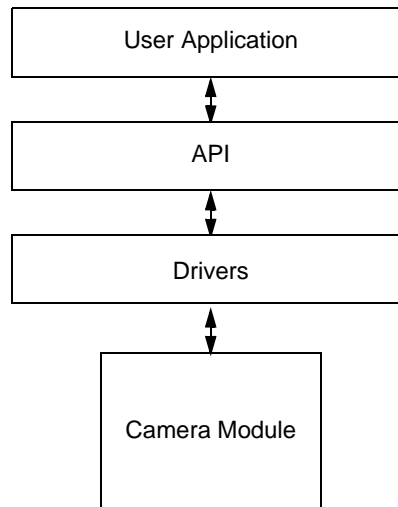


Figure 4 : Software interface

The user application, API and drivers all run on the host PC. The drivers communicate with the camera by the chosen communications link (either serial or USB). The core API functions allow for:

- The camera to be opened and closed as a device under the operating system
- Query of camera information and configuration (e.g., the number of pictures taken, current mode setting)
- Uploading of images and thumbnail images
- Control of camera functions (e.g., taking a picture or resetting the image counter).

Both single-threaded and multi-threaded programming models are supported and the camera may be accessed using either synchronous (i.e., blocking) or asynchronous (i.e., non-blocking or overlapped) communications. Where asynchronous communications are used, the application developer is responsible for coordinating tasks and access to the camera.

6. Customisation options

The feature set of the STV0680A chipset encompasses the vast majority of digital stills and toy camera applications. However, subject to commercial agreement for high volume applications, the configuration of STV0680A could be modified by ST to allow a new chipset to be produced.

Please contact ST for details.

7. Detailed chipset specifications

7.1 Typical camera specifications

The following data assumes that the camera has been built according to reference design shown in Section 9.

Supply Voltage:	6-9V (when powered from battery) or 5V (when powered from USB). (* See Note 1.)
Operating Temperature range	0°C - 40°C
Example lens horizontal FOV	44° (* See note 2)
Max. RS232 cable length supported	2m
CIF output	352 x 288 pixels
QCIF output	176 x 144 pixels
VGA output (using VV6500)	640 x 480 pixels
QVGA output (using VV6500)	320 x 240 pixels
Image upload format	Raw Bayer
PC driver output format	Colour RGB bitmap

Table 9 : Typical camera specifications

Notes:

1. Dual USB or battery power supply is only possible when the required power switching hardware is included, as shown in Section 9.
2. Figures are approximate and depend on actual components sourced.

Sensor	Min	Max
VV6444	8.18µS	39mS
VV6410	8.67µS	44mS
VV6500	7.94µS	66mS

Table 10 : Approximate shutter speeds

7.2 STV0680/STV0680A companion processor

Parameter	Min	Typ	Max	Units
Supply Voltage	3.0	3.3	3.6	V
Current consumption (normal operation)		20	TBD	mA
Standby current consumption (untethered standby mode or PC suspend mode)		0.35	TBD	mA
Operating Temperature range	0		70	°C
Package	100QFP			
Exposure control	1 000 000:1			

Table 11 : STV0680/STV680A Specifications

Description	Range	Unit
Storage Temperature (Approximate)	50 to 150	°C

Table 12 : STV0680/STV0680A Absolute Maximum Ratings

Parameter	Description	Min	Typ	Max	Units	Notes
VDD	Power Supply	3.0	3.3	3.6	V	
V _{ILU}	USB differential pad D+/D- input low			0.8	V	
V _{IHU}	USB differential pad D+/D- input high (driven)	2.0			V	
V _{IHUZ}	USB differential pad D+/D- input high (floating)	2.7		3.6	V	
V _{DI}	USB differential pad D+/D- input sensitivity	0.2			V	1
V _{CM}	USB differential pad D+/D- common mode voltage	0.8		2.5	V	2
V _{OLU}	USB differential pad D+/D- output low voltage	0.0		0.3	V	
V _{OHU}	USB differential pad D+/D- output high voltage	2.8		3.6	V	
V _{OHU}	USB differential pad D+/D- output high voltage	2.8		3.6	V	
V _{CRS}	USB differential pad D+/D- output signal cross over voltage	1.3		2.0	V	
R _{PU}	USB differential pad D+/D- pullup resistor	1.425		1.575	KΩ	
R _{PD}	USB differential pad D+/D- pulldown resistor	14.25		15.75	KΩ	
T _{FR}	Rise Time	4		20	ns	
T _{FF}	Fall Time	4		20	ns	
T _{FRFM}	Differential Rise Time and Fall Time Matching	90		111.11	%	3
Z _{DRV}	Driver Output Resistance	28		44	Ohms	4

Table 13 : STV0680/STV0680A DC CharacteristicsNotes on Table 13:

1. $V_{DI} = |(D+) - (D-)|$
2. V_{CM} includes V_{DI} range.
3. $T_{FRFM} = (T_{FR} / T_{FF})$.
4. Z_{DRV} includes an external resistor of 20 Ohms serial to this transceiver.

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Peak to peak jitters	--	--	170	220	ps	@VCOfreq = 100MHz ~ 200MHz
Duty cycle	--	40	50	60	%	
Operating voltage range	VDD	3	3.3	3.6	V	
Input low voltage	VIL	-		0.8	V	VDD=3.3V
Input high voltage	VIH	0.7VDD		VDD	V	VDD=3.3V
Pull_in Time + Locking Time	Tready	--	--	0.5	ms	

Output Slew Rate [Tsr(Fout)	--	$0.100+0.1082*CL$	--	ns	CL:Output Load(pF)
--------------------	-----------	----	-------------------	----	----	--------------------

Table 14 : STV0680/STV0680A PLL Characteristics

Parameter	Min	Typ	Max	Units
Crystal specification	50/50/10/30 (12mhz Fundamental)			
Crystal frequency		12.000		MHz
Frequency tolerance			50	ppm
Temperature stability			50	ppm
Operating temperature	-10			Deg. C
Load capacitance	30			pF

Table 15 : STV0680/STV0680A Crystal Tolerance

7.3 VV6444 Sensor

Colour Image Format	352 x 288 pixels (CIF)			
Pixel Size	12.0 x 11.0 μ m			
Image array size	4.272mm x 3.212mm			
Array Format	CIF			
Sensor signal / Noise ratio	Approx. 48dB (* See note 1)			
Supply Voltage	5.0V DC +/-5%			
Package type	48LCC			
Operating Temp. range	0°C - 40°C			
Current consumption	Min	Typ	Max	Units
'Snapshot'/self-timer/continuous/tethered video modes of operation		30	TBD	mA
Standby/PC Suspend Mode, sensor powered off (see note 2)		Negligible	TBD	μ A
Standby/PC Suspend Mode, sensor powered on (See note 3)		Approx. 300	TBD	μ A

Table 16 : VV6444 Specifications

* Notes:

1. 48dB refers to VV6404. With the addition of microlenses on VV6444, an increase in sensitivity can be expected.
2. Where the sensor is completely powered off by a FET or switcher (external hardware) during the Standby/PC Suspend Mode.
3. Where the FET/switcher is not implemented, and the sensor is powered throughout Standby/PC Suspend Mode, however the sensor clock is disabled.

Parameter	Min.	Max.	Notes
V _{IL}	-0.5v	0.3 x V _{DD}	Guaranteed input low voltage
V _{IH}	0.7 x V _{DD}	V _{DD} + 0.5v	Guaranteed input high voltage
V _{OL}		0.4V	At max I _{OL} for pad type
V _{OH}	2.4v	V _{DD} - 0.5v	I _{OH} = 100 μ A At max I _{OH} for pad type
T _J Junction Temp	0 deg C	100 deg C	
Internal Pullup resistor	35k Ω	150k Ω	
Internal Pulldown resistor	35k Ω	150k Ω	

Table 17 : VV6444 DC Characteristics

7.4 VV6410 and VV6500 sensors

Colour Image Format	352 x 288 pixels (CIF)
Pixel Size	7.5 x 6.9 μ m

Table 18 : VV6410 Specifications

Image array size	2.67mm x 2.04mm			
Array Format	CIF			
Sensor signal / Noise ratio	Approx. 57dB			
Package type	36LCC			
Supply Voltage	3.3V DC +/-5%			
Operating Temp. range	0°C - 40°C			
Current consumption:	Min	Typ	Max	Units
'Snapshot'/self-timer/continuous/tethered video modes of operation		25	TBD	mA
Standby Mode/PC Suspend Mode, SUSPEND pin asserted (see note 1)		<100	TBD	μA
Standby Mode/PC Suspend Mode, SUSPEND pin <i>not</i> asserted (see note 2)		<300	TBD	μA

Table 18 : VV6410 Specifications

Notes:

1. Assuming appropriate external hardware recommendations are implemented (see Section 9.), the sensor SUSPEND pin is asserted during Standby Mode/PC Suspend Mode. Hence the sensor is placed in Sensor Suspend mode by means of (a) a Serial interface message and (b) the SUSPEND pin being asserted.
2. Where the external hardware does not permit the sensor SUSPEND pin to be asserted during Standby Mode/PC Suspend Mode, the sensor is placed in Sensor Suspend mode by means of a Serial interface message only. This increases current consumption due to a pull-up on the SUSPEND pin.

Colour Image Format	640 x 480 pixels (VGA)			
Pixel Size	7.5 x 7.5μm			
Image array size	4.89mm x 3.66mm			
Array Format	VGA			
Sensor signal / Noise ratio	Approx. 57dB			
Supply Voltage	3.3V DC +/-5%			
Package type	48LCC			
Operating Temp. range	0°C - 40°C			
Current consumption:	Min	Typ	Max	Units
'Snapshot'/self-timer/continuous/tethered video modes of operation		30	TBD	mA
Standby Mode/PC Suspend Mode, SUSPEND pin asserted (see note 1)		<100	TBD	μA
Standby Mode/PC Suspend Mode, SUSPEND pin <i>not</i> asserted (see note 2)		<300	TBD	μA

Table 19 : VV6500 Specifications

Notes:

1. Assuming appropriate external hardware recommendations are implemented (see Section 9.), the sensor SUSPEND pin is

asserted during Standby Mode/PC Suspend Mode. Hence the sensor is placed in Sensor Suspend mode by means of (a) a Serial interface message and (b) the SUSPEND pin being asserted.

- Where the external hardware does not permit the sensor SUSPEND pin to be asserted during Standby Mode/PC Suspend Mode, the sensor is placed in Sensor Suspend mode by means of a Serial interface message only. This increases current consumption due to a pull-up on the SUSPEND pin.

Parameter	Min.	Max.	Notes
V_{IL}	-0.5v	$0.3 \times V_{DD}$	Guaranteed input low voltage
V_{IH}	$0.7 \times V_{DD}$	$V_{DD} + 0.5v$	Guaranteed input high voltage
V_{OL}		0.4V	At max I_{OL} for pad type
V_{OH}	2.4v	$V_{DD} - 0.5v$	$I_{OH} = 100\mu A$ At max I_{OH} for pad type
T_J Junction Temp	0 deg C	100 deg C	
Standard Pullup (SDA, SCL)	35 μA current draw	52 μA current draw	
Standard Pulldown (OEB)	25 μA current draw	42 μA current draw	
Non-standard Pullup (RESETB)	66 μA current draw	250 μA current draw	

Table 20 : VV6410/6500 DC Characteristics

7.5 Typical current consumption of complete camera

The following data assumes that the camera has been built according to reference design referred to in Section 9. Figures are approximate and depend on actual components sourced - see notes.

7.5.1 Using VV6444 (sensor operates at @ 5V DC)

Mode	Typical Current Cons.	Comments
'Snapshot'/Continuous/ Self timer mode (while un-tethered)	80mA	
'Snapshot'/Continuous/ Self timer mode (while tethered to PC)	80mA	Assuming appropriate hardware included, power is sourced from PC while USB connected.
Camera standby mode (when NOT connected to USB)	Approx. 0.4mA + SDRAM self-refresh current (see note 2)	<u>Total current in this mode equals:</u> STV0680/680A Standby current consumption (see note 1) + SDRAM self-refresh current (see note 2) + peripheral circuitry (approx. 50µA, see note 3).
Suspend mode (when connected to USB)	Approx. 0.6mA + SDRAM self-refresh current (see note 2)	<u>Total current in this mode equals:</u> STV0680/680A Standby current consumption (see note 1) + SDRAM self-refresh current (see note 2) + peripheral circuitry (approx. 50µA, see note 3). + 200µA , based on 1.5k pull-up in camera (see Section 9.) and 15k pull-down in PC.

Table 21 : Current consumption, complete STV0680A+VV6444 camera

Notes:

1. See Table 11 on page 26.
2. From limited evaluation, typical self-refresh current figures of certain SDRAM chips are well below manufacturers' maximum specification, e.g. 100-250µA. See Section 9. for recommendations.
3. This is assuming a low quiescent current 3v3 VReg is used, and assuming that the sensor is switched off using external circuitry.

7.5.2 Using VV6410/6500 (sensor operates at @ 3.3V DC)

Mode	Typical	Comments
'Snapshot'/Continuous/ Self timer mode (while un-tethered)	60mA	Assuming appropriate hardware included, power is sourced from PC while USB connected.
'Snapshot'/Continuous/ Self timer mode (while tethered to PC)	60mA	
Standby Mode (when NOT connected to USB): Sensor SUSPEND pin asserted (see note 4)	Approx. 0.5mA + SDRAM self- refresh current (see note 2)	<u>Total current in this mode equals:</u> STV0680A Standby current consumption (see note 1) + SDRAM self-refresh current (see note 2) + peripheral circuitry (approx. 50µA). + Sensor suspend mode current (See note 3)
PC Suspend mode (when connected to USB): Sensor SUSPEND pin asserted (see note 4)	Approx. 0.7mA + SDRAM self- refresh current (see note 2)	<u>Total current in this mode equals:</u> STV0680A Standby current consumption (see note 1) +SDRAM self-refresh current (see note 2) + peripheral circuitry (approx. 50µA). + 200µA , based on 1.5k pull-up in camera (see Section 9.) and 15k pull-down in PC. + Sensor suspend mode current (See note 3)

Table 22 : Current consumption, complete STV0680A+VV6410/6500 camera

Notes:

1. See Table 11 on page page 26. However, STV0680A mean current consumption is to be determined by measurement of sample quantity in due course.
2. From limited evaluation, typical self-refresh current figures of certain SDRAM chips are well below manufacturers' maximum specification, e.g. 100-250µA. See Section 9. for recommendations.
3. Sensor suspend mode current <100µA when SUSPEND pin asserted, see Table 18 and Table 19.
4. If the appropriate hardware to assert the sensor SUSPEND pin is not fitted, an additional current consumption in this mode of up to 200µA can be expected.

8. STV0680A Pin descriptions and Package Information

8.1 STV0680A Pin Listing

Pin no.	Signal	Type	Description	drive
Sensor Interface				
69	SENSPWR	Output, active high	Power-up Sensor	2mA (SL)
68	SENSRST	Output, active low	Reset Sensor	2mA (SL)
60	SCL	Input/Output (OD,T)	Sensor serial interface	4mA (SL)
61	SDA	Input/Output (OD,T)	Sensor serial interface	4mA (SL)
62	SD3	Input (S,T)	Sensor data	
63	SD2	Input (S,T)	Sensor data	
64	SD1	Input (S,T)	Sensor data	
65	SD0	Input (S,T)	Sensor data	
66	QCLK	Input (S,T)	Qualification clock from sensor	
67	SCLKO	Output	Clock output to sensor	4mA
GPIO (see note)				
77	GPIO0 (MODE)	Debounced input	Push button (Wake-up/Mode)	8mA (SL)
76	GPIO1 (SHUTTER)	Debounced input	Push button (Shutter/Confirm)	8mA (SL)
75	GPIO2	IO (OD)	Not used (tie to GND with 0R link)	8mA (SL)
74	GPIO3 (50/60)	Debounced input	Link to select between 50Hz and 60Hz lighting	8mA (SL)
73	GPIO4	IO (OD)	Not used (tie to GND with 0R link)	8mA (SL)
72	GPIO5	Output (OD)	LED indicator	8mA (SL)
71	GPIO6	IO (OD)	Not used (tie to GND with 0R link)	8mA (SL)
70	GPIO7	IO (OD)	Not used (tie to GND with 0R link)	8mA (SL)
USB Interface				
42	USBDETECT	Input (S)	Detect Power source from USB. (For camera with RS232 only, this pin should be tied to GND)	USB specification V1.1 compliant I/O
43	DATA+	Input/Output	USB bus (For camera with RS232 only, this pin should be connected to test points to allow for USB production test (lens focussing))	
44	DATA-	Input/Output	USB bus. (For camera with RS232 only, this pin should be connected to test points to allow for USB production test (lens focussing))	
RS232 Interface				
58	TXD	Output	Serial data transmit (For camera with USB only, this pin should be tied to RXD)	4mA (SL)
59	RXD	Input (S)	Serial data receive (For camera with USB only, this pin should be tied to TXD)	
STV0680A Master Clocks and Reset				
48	XIN	Input	Quartz Crystal IN	
49	XOUT	Output	Quartz Crystal OUT	

Pin no.	Signal	Type	Description	drive
51	RESET	Input (S)	Active (LOW) STV0680A reset	
System Memory (SDRAM) Interface				
20	DQMU	Output	Data input/output mask for dram_DQ[15:8]	2mA (SL)
22	DCLK	Output	Clock: all SDRAM input signals are sampled on the positive edge	4mA
24	CKE	Output	Clock enable: activates (HIGH) and deactivates (LOW) the SDRAM CLK signal	2mA (SL)
28	AD11	Output	SDRAM address A11 for 64M SDRAM or BA for 16M SDRAM	2mA (SL)
31	AD9	Output	SDRAM address A9	2mA (SL)
33	AD8	Output	SDRAM address A8	2mA (SL)
35	AD7	Output	SDRAM address A7	2mA (SL)
37	AD6	Output	SDRAM address A6	2mA (SL)
39	AD5	Output	SDRAM address A5	2mA (SL)
41	AD4	Output	SDRAM address A4	2mA (SL)
40	AD3	Output	SDRAM address A3	2mA (SL)
38	AD2	Output	SDRAM address A2	2mA (SL)
36	AD1	Output	SDRAM address A1	2mA (SL)
34	AD0	Output	SDRAM address A0	2mA (SL)
32	AD10	Output	SDRAM address A10	2mA (SL)
26	AD12	Output	SDRAM address A12, BA0 for 64M SDRAM, unused on 16M	2mA (SL)
30	AD13	Output	SDRAM address A13, BA1 for 64M SDRAM, unused on 16M	2mA (SL)
25	CS	Output, active low	Chip select: enables (registered LOW) and disables (registered HIGH) the SDRAM command decoder.	2mA (SL)
23	RAS	Output, active low	SDRAM row address strobe command	2mA (SL)
21	CAS	Output, active low	SDRAM column address strobe command	2mA (SL)
19	WE	Output, active low	SDRAM write enable command	2mA (SL)
18	DQML	Output	Data input/output mask for dram_DQ[7:0]	2mA (SL)
16	DQ7	Input/Output	SDRAM Data Bus	2mA (SL)
14	DQ6	Input/Output	SDRAM Data Bus	2mA (SL)
12	DQ5	Input/Output	SDRAM Data Bus	2mA (SL)
10	DQ4	Input/Output	SDRAM Data Bus	2mA (SL)
8	DQ3	Input/Output	SDRAM Data Bus	2mA (SL)
6	DQ2	Input/Output	SDRAM Data Bus	2mA (SL)
4	DQ1	Input/Output	SDRAM Data Bus	2mA (SL)
100	DQ0	Input/Output	SDRAM Data Bus	2mA (SL)
2	DQ15	Input/Output	SDRAM Data Bus	2mA (SL)
5	DQ14	Input/Output	SDRAM Data Bus	2mA (SL)
7	DQ13	Input/Output	SDRAM Data Bus	2mA (SL)

Pin no.	Signal	Type	Description	drive
9	DQ12	Input/Output	SDRAM Data Bus	2mA (SL)
11	DQ11	Input/Output	SDRAM Data Bus	2mA (SL)
13	DQ10	Input/Output	SDRAM Data bus	2mA (SL)
15	DQ9	Input/Output	SDRAM Data bus	2mA (SL)
17	DQ8	Input/Output	SDRAM Data bus	2mA (SL)
LCD Interface				
85	LCDCOM	Output	LCD Common	2mA (SL)
93	LCD1_6	Output	LCD digit 1 segment G	2mA (SL)
94	LCD1_5	Output	LCD digit 1 segment F	2mA (SL)
95	LCD1_4	Output	LCD digit 1 segment E	2mA (SL)
96	LCD1_3	Output	LCD digit 1 segment D	2mA (SL)
97	LCD1_2	Output	LCD digit 1 segment C	2mA (SL)
98	LCD1_1	Output	LCD digit 1 segment B	2mA (SL)
99	LCD1_0	Output	LCD digit 1 segment A	2mA (SL)
86	LCD2_6	Output	LCD digit 2 segment G	2mA (SL)
87	LCD2_5	Output	LCD digit 2 segment F	2mA (SL)
88	LCD2_4	Output	LCD digit 2segment E	2mA (SL)
89	LCD2_3	Output	LCD digit 2segment D	2mA (SL)
90	LCD2_2	Output	LCD digit 2segment C	2mA (SL)
91	LCD2_1	Output	LCD digit 2 segment B	2mA (SL)
92	LCD2_0	Output	LCD digit 2 segment A	2mA (SL)
Piezo Interface				
84	PIEZO	Output	Direct connection to piezo buzzer	8mA (SL)
Battery Level Comparator Interface				
80	LO_BAT	Input (A)	Battery level comparator input. The voltage on low_bat is compared to the reference to determine the battery status	
79	LO_BAT_REF	Input (A)	1.22V battery level comparator reference input	
Power and Ground				
1, 27, 50, 56, 78	DVSS[1-5]	Power pin	Digital Ground	
3, 29, 57, 83	DVDD[1-4]	Power pin	Digital Power	
52	PLLGVD	Power pin	PLL Guard Power	
53	PLLGVS	Power pin	PLL Guard Ground	
54	PLLAVD	Power pin	PLL Analog Power	
55	PLLAVS	Power pin	PLL Analog Ground	
Non-user pins				
45	TEST0	Input	Non-user pin - connect to 3V3	
46	TEST1	Input	Non-user pin - connect to 3V3	

Pin no.	Signal	Type	Description	drive
47	TEST2	Input	Non-user pin - connect to 3V3	
81	DACRES	Non-user pin	See example schematic in Section 9.	
82	DACOUT	Non-user pin	See example schematic in Section 9.	

Table 23 : STV0680A Pin listing

Key:

- SL - slew rate limited output
- OD - open drain output
- S - schmitt input
- A - analog input/output
- T - 5V tolerant pad (these pads do not have diode protection)

Where the I/O pad type is not explicitly defined in the above notes, assume CMOS.

Note: GPIO are not 'general purpose', in the sense that their function is predetermined (e.g. GPIO0 = $\overline{\text{MODE}}$, GPIO2 is Unused), dependant on the variant number of STV0680/STV0680A, denoted by the suffix on the part number -00x.

8.2 STV0680A pinout diagram

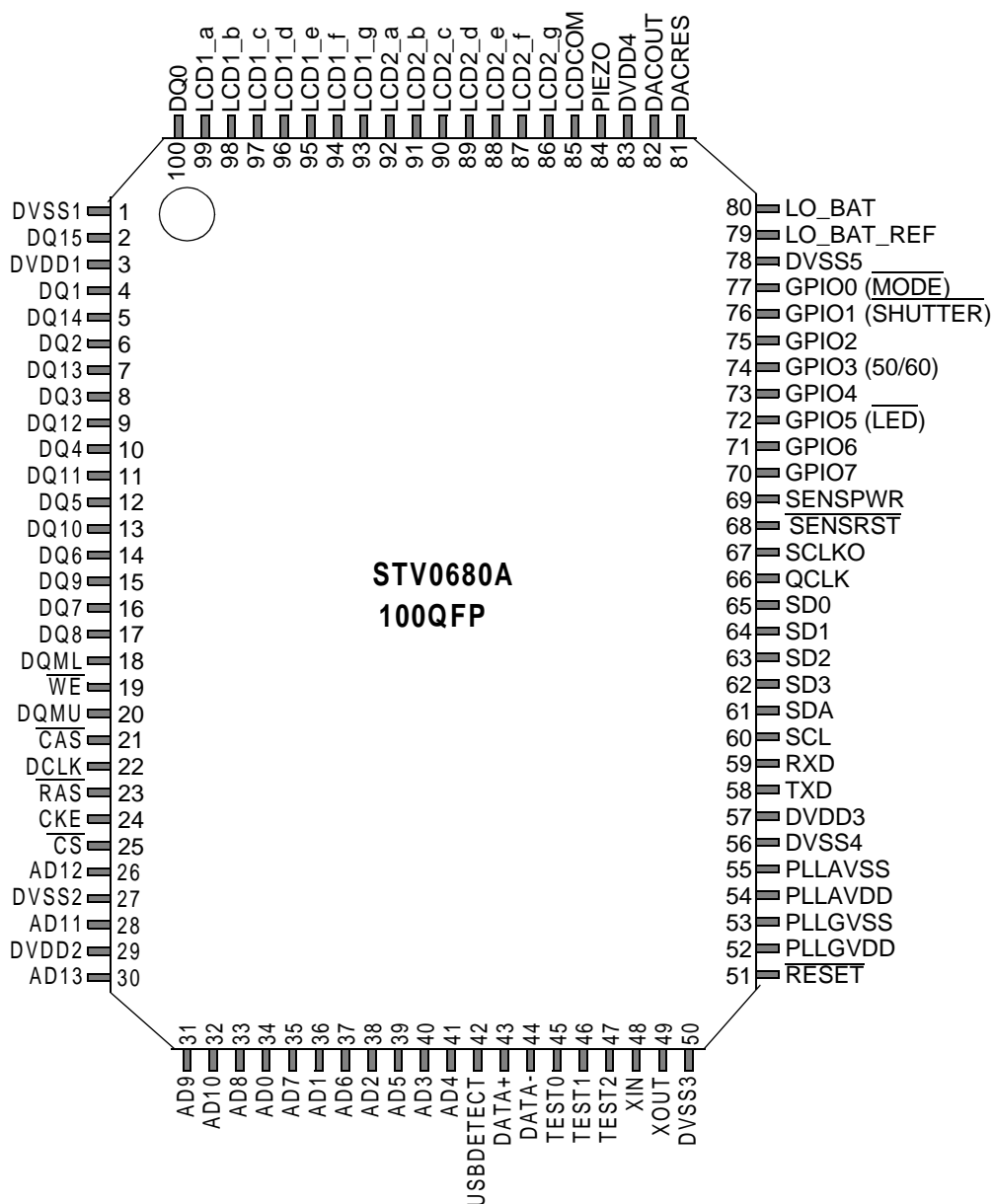


Figure 5 : STV0680A pinout in 100QFP package

8.3 STV0680A Package Dimensions

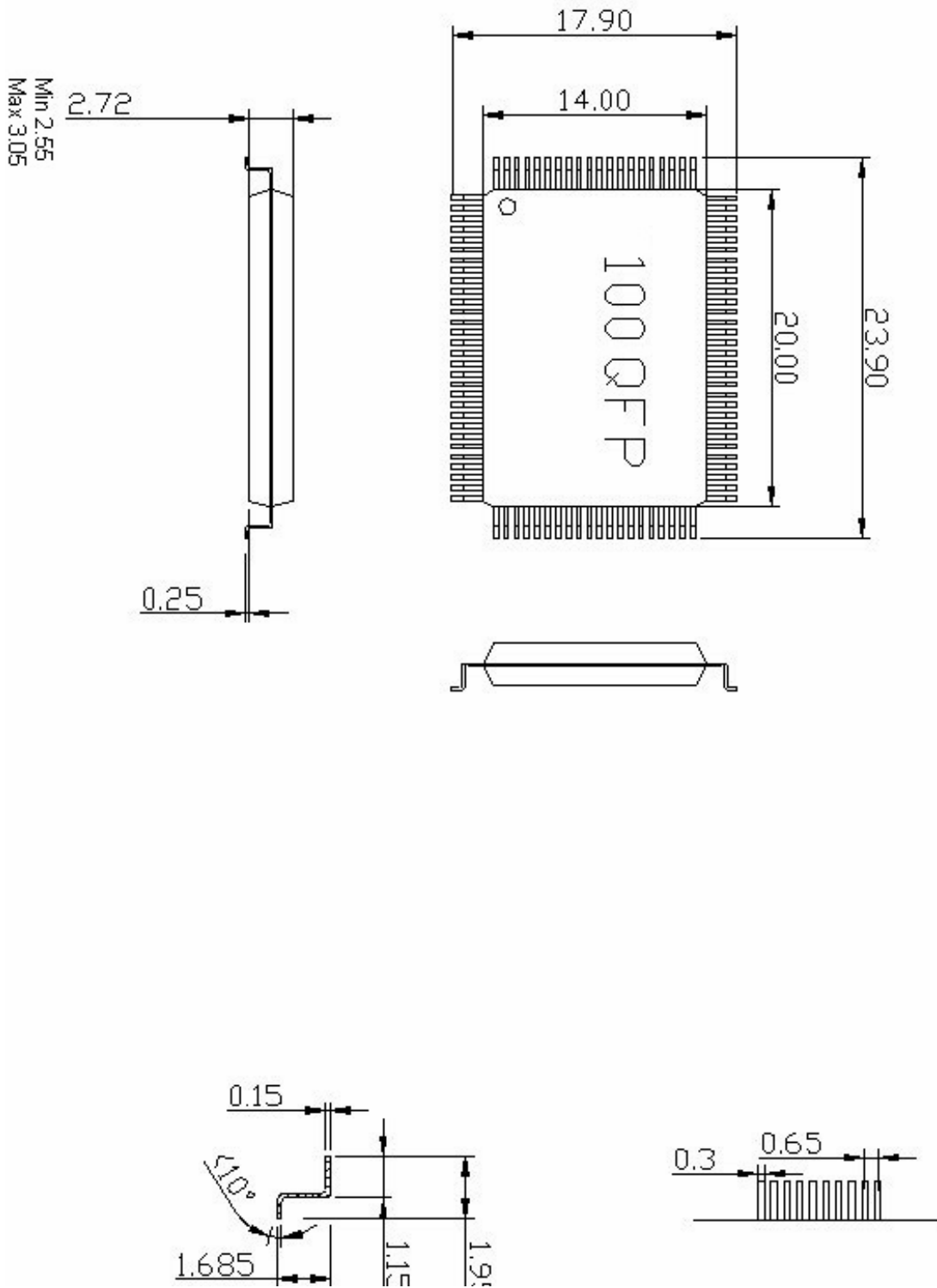


Figure 6 : 100QFP Package dimensions

Note: Pin pitch is 0.65mm

For sensor pinout and package dimensions, see Section 10., Section 11., and Section 12.

9. Schematics and example parts list for complete camera design

9.1 Schematics

Support schematics are shown in the following documents:

- STV0680+VV6444 Reference Design Manual
- STV0680/680A+VV6410/6500 Reference Design Manual

Both are available in the OEM section of the ST Imaging Division web site

- (ST internal access) http://www.edb.st.com/tech_support/home.htm
- (all other access) http://www.vvl.co.uk/tech_support/home.htm

An example parts list is shown in Section 9.2, however the above documents should be referred to for the most up to date information.

9.2 Example Parts List

The following is taken from STV0680A + VV6410/6500 Ref Design Manual Rev 0.1.

Bill of materials for DCA1+VV6410/6500 camera Rev 0.1, 23rd Dec 1999							
6v battery and power supply option 2 (using external 3v3 Vreg) assumed.							
Non-populated options shown with grey background.							
Preliminary							
Page 1							
#	QT	REFDES	DEVICE	PACKAGE	VALUE	COST	NOTES
1	1	B1	BATTERY				Up to 9v with option 2
1	1	B1	BATTERY				Up to 6v with option 1
2	1	C1	CAP	805	10N		
3	2	C3, C4	CAP	805	100N		C3, C4 option 2 only
3	22	C2,C7, C8,C10,C11, C12,C13,C14, C17,C18,C20, C21,C23,C24, C25,C27,C28, C29,C30,C31, C32,C33	CAP	805	100N		
3	1	C37	CAP	805	100N		C37 for option 1 only
4	2	C5,C6	CAP	805	22P		
5	2	C15,C16	CAP	805	1U		
6	2	C19,C26	CAP	805	220P		
7	1	C22	CAP	805	220N		
8	1	C34	ECAP	T/H	10U		
8	2	C35,C36	ECAP	T/H	10U		C35, C36 option 2 only
9	1	D1	1N4001	DO41	1N4001		Gen purpose if 4 x AA or AAA batteries
9	1	D1	Schottky	DO41	Schottky		Only use schottky if 3 x AA or AAA batteries
10	1	D2	DIODE	SOT23	BAS116		Must be low leakage
11	2	D3,D4	DIODE	SOT23	BAS16		Only for RS232
12	3	F1,F2,F3	FERRITE	805			May be required for FCC compliance
13	1	J1	USB_CON	CON_USB_4	P_TYPE_B		Must be Type B for USB compliance
14	1	J2	JACK_SKT	SCJ-0355-	B		Only for RS232
15	1	LCD1	2DIGITLC				
16	1	LED1	LED	2PINTHRU			Could be omitted for reduced current cons.
17	1	Q1	NPN	SOT23	BC848		Q1 only required for option 2
17	2	Q2,Q3	NPN	SOT23	BC848		
18	1	Q4	NPN	SOT23			Only for RS232
19	1	Q5	PNP	SOT23	BCW61		Required for USB inrush protection
20	1	Q6	PNP	SOT23			Only for RS232
20	1	Q10	PNP	SOT23			Only required for option 1
21	1	Q7	SI2301DS	SOT23			Only required for option 2
21	1	Q8	SI2301DS	SOT23			Required for USB inrush protection
21	1	Q9	SI2301DS	SOT23			
22	1	R1	RES	805	220K		
22	1	R4	RES	805	220K		R4 only req'd for RS232 camera with USB test points
23	1	R2	RES	805	6R8		May be required for USB inrush protection (Exact value not verified)
24	2	R9,R13	RES	805	100K		
24	1	R3	RES	805	100K		R3 only required for Option 2.
24	1	R5			100K		R5 only req'd for RS232 camera with USB test points
24	1	R12			100K		R12 required for USB inrush protection
25	3	R10,R14, R16	RES	805	1M		
25	2	R6,R23			1M		Only one of R6/R23 is required
26	1	R7	RES	805	470K		
27	1	R8	RES	805	82K		
28	1	R11	RES	805	430K		Suggested value for 6v battery
28	1	R11	RES	805	510K		Suggested value for 4.5v battery
Total (Page 1)							

Table 24 : STV0680A + VV6410/6500: Parts list (1)

Bill of materials for DCA1+VV6410/6500 camera Rev 0.1, 23rd Dec 1999							
6v battery and power supply option 2 (using external 3v3 Vreg) assumed.							
Non-populated options shown with grey background.							
Preliminary							
Page 2							
#	QT	REFDES	DEVICE	PACKAGE	VALUE	COST	NOTES
29	1	R56	RES	805	OR		Option 1 only
29	1	R15	RES	805	OR		For camera with no RS232
30	1	R17	RES	805	33R		
32	2	R19,R20	RES	805	24R		
33	1	R22	RES	805	120K		
34	9	R24,R26,R27, R37,R38,R42, R43,R44,R51,R52	RES	805	0R		R24 fitting depends on flicker frequency
35	8	R25,R28,R29, R31,R32,R33, R34,R35	RES	805	10K		Fit R51 or R52, not both R25 fitting depends on flicker frequency R31, 32, 33, 34, 35 only for RS232
35	1	R41	RES	805	10K		R41 only required for option 2
36	1	R30	RES	805	2K2		Only for RS232
37	1	R36	RES	805	680R		
38	2	R39,R40	RES	805	4K7		
39	1	R50	RES	805	390R		R50 only required for option 1
41	1	SW1	TOGGLE_S	WI SWITCH			Optional battery off switch when not in use (would lose stored images)
42	2	SW2,SW3	PUSH_SWI	TC FARNELL		58	Push button switches
43	1	T1	PIEZO	FARNELL_9		26	
44	6	TP1,TP2,TP3, TP4,TP5,TP6	TESTPOIN	T TP			Only required for RS232 camera with USB prodn. Test
45	1	U1	3V3REG	SOT89	MC78FC33HT1		Only required for option 2 Could use TO92 instead
46	1	U2	VV6500	48LCC			VGA sensor (different footprint to VV6410) Only require U2 or U6
47	1	U3	STV0680	100QFP			Future replacement STV0680A for Vfw
48	1	U4	GM72V661	64 400MIL_T5OP			SDRAM dual footprint is possible for U4 and U5
49	1	U5	GM72V161	62 400MIL_T5OP			Preferred SDRAM has low self refresh Idd. e.g. (16Mbit) GM72V16162ET75 Hyundai HY57V161610DTC-7 Micron MT48LC1M16A1TG S
50	1	U6	VV6410	36LCC			CIF sensor (different footprint to VV6500) Only require U2 or U6
51	1	U8	VOLTAGE DETECTOR	SOP-23	2.7v threshold		e.g. TELCOM TC54VC2702ECB RICOH Rx5VLxxC SERIES
52	1	X1	XTAL	HC49U	12MHZ		
53	1	Lens					Lens with IR filter
Total (Page 2)							

Table 25 : STV0680A + VV6410/6500: Parts list (2)

! Note

Not all compatible memory chips exhibit a low enough **self-refresh current** to meet the target current for USB suspend mode (see Table 21). Two memory types have been suggested in Table 25, based on *limited* evaluation by ST, however this does not constitute a full characterisation, and no guarantees can be made that the self-refresh current consumption will match the target for USB suspend mode in all cases. Please consult the memory manufacturer for precise information.

10. VV6444 Sensor Pinout and Package Dimensions

VV6444 has the same pinout and electrical characteristics as the previous generation VV6404, but microlenses are added for increased sensitivity, and the colour filters are different.

Although the VV6444 and VV6404 are electrically identical, the STV0680 and STV0680A use the correct settings for the VV6444 colour set. This means that a VV6404 should not be used with STV0680/680A.

10.1 VV6444 Pin Listing

Pin	Name	Type	Description
POWER SUPPLIES			
1	AVCC	PWR	Core analogue power and reference supplies.
48	AGND	GND	Core analogue ground and reference supplies.
43	DVDD	PWR	Core digital power.
44	DVSS/Dsub	GND	Core digital ground.
6	AVDD	PWR	Output stage power.
5	AVSS	GND	Output stage ground.
7	VVDD	PWR	Analogue output buffer power.
9	VVSS	GND	Analogue output buffer ground.
14	ADCVDD	PWR	ADC power.
10	ADCVSS	GND	ADC ground.
19	VDD1	PWR	Digital padding & logic power.
30	VDD2	PWR	Digital padding & logic power.
36	VDD3	PWR	Digital padding & logic power.
20	VSS1	GND	Digital padding & logic ground.
29	VSS2	GND	Digital padding & logic ground.
37	VSS3	GND	Digital padding & logic ground.
ANALOGUE SIGNALS			
45	VBLOOM	OA	Anti-blooming pixel reset voltage
46	VBLTW	OA	Bitline test white level reference
47	VBG	OA	Internally generated bandgap reference voltage 1.22V
2	VCN/ VREF2V5	OA	Common-mode input for OSA and Internally generated 2.5 V reference voltage.
3	VRT	IA	Pixel reset voltage
4	VCDSH	IA	VCDS
11	ADCbot	IA	Bottom voltage reference for ADC
13	ADCtop	IA	Top voltage reference for ADC
13	TopRef	OA	Internally generally top voltage reference for ADC
DIGITAL CONTROL SIGNALS			
12	HOLDPIX	ID↓	Test Pin - do not use
15	SIN	ID↓	Frame timing reset (soft reset).

Pin	Name	Type	Description
16	RESETB	ID↑	System Reset. Active Low.
SERIAL INTERFACE			
42	SCL	ID↑	Serial bus clock (input only).
41	SDA	BI↑	Serial bus data (bidirectional, open drain).
DIGITAL VIDEO INTERFACE			
39 38 35 34	D[3] D[2] D[1] D[0]]	ODT	Tristateable 4-wire output data bus. D[3] is the most significant bit.
33	QCK	ODT	Tristateable data qualification clock.
40	FST	ODT	Not required by STV0680A
17	OEB	ID↓	Digital output (tristate) enable.
SYSTEM CLOCKS			
31	CLKI	ID	Oscillator input.
32	CLKO	OD	Oscillator output.
Do not connect			
18 21-28	DNC		Do not connect

Key			
A	Analogue Input	D	Digital Input
OA	Analogue Output	ID↑	Digital input with internal pull-up
BI	Bidirectional	ID↓	Digital input with internal pull-down
BI↑	Bidirectional with internal pull-up	OD	Digital Output
BI↓	Bidirectional with internal pull-down	ODT	Tristateable Digital Output

10.2 VV6444 Pinout Diagram

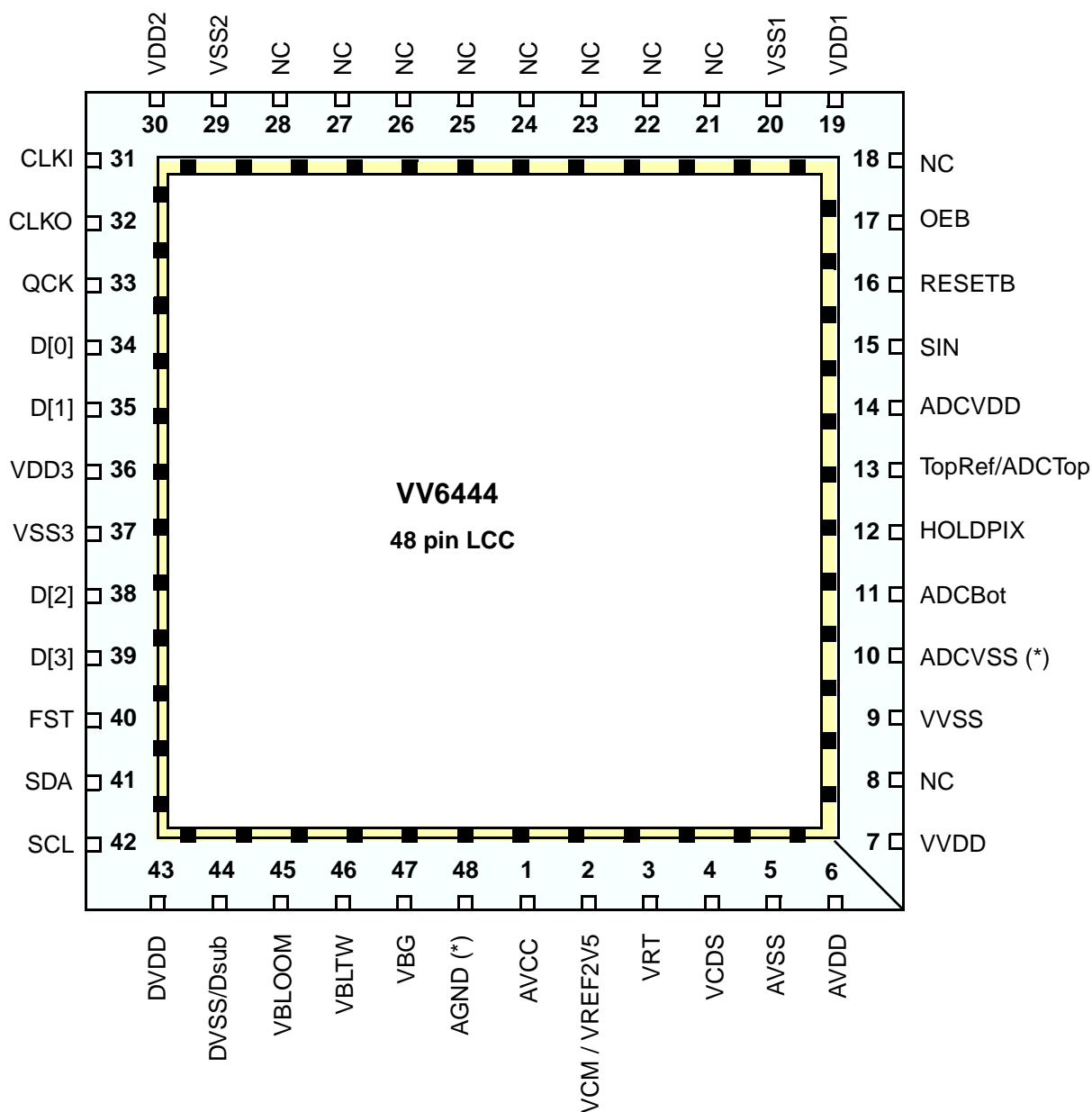


Figure 7 : VV6444 Pinout

Notes:

1. NC - Not connected
2. (*) - Paddle connections

10.3 VV6444 Package Dimensions

Notes.

1. Die is optically centred.
2. Refractive index of glass is ~1.52.
3. Distance to optical surface of Die.
4. Pixel area of sensor.

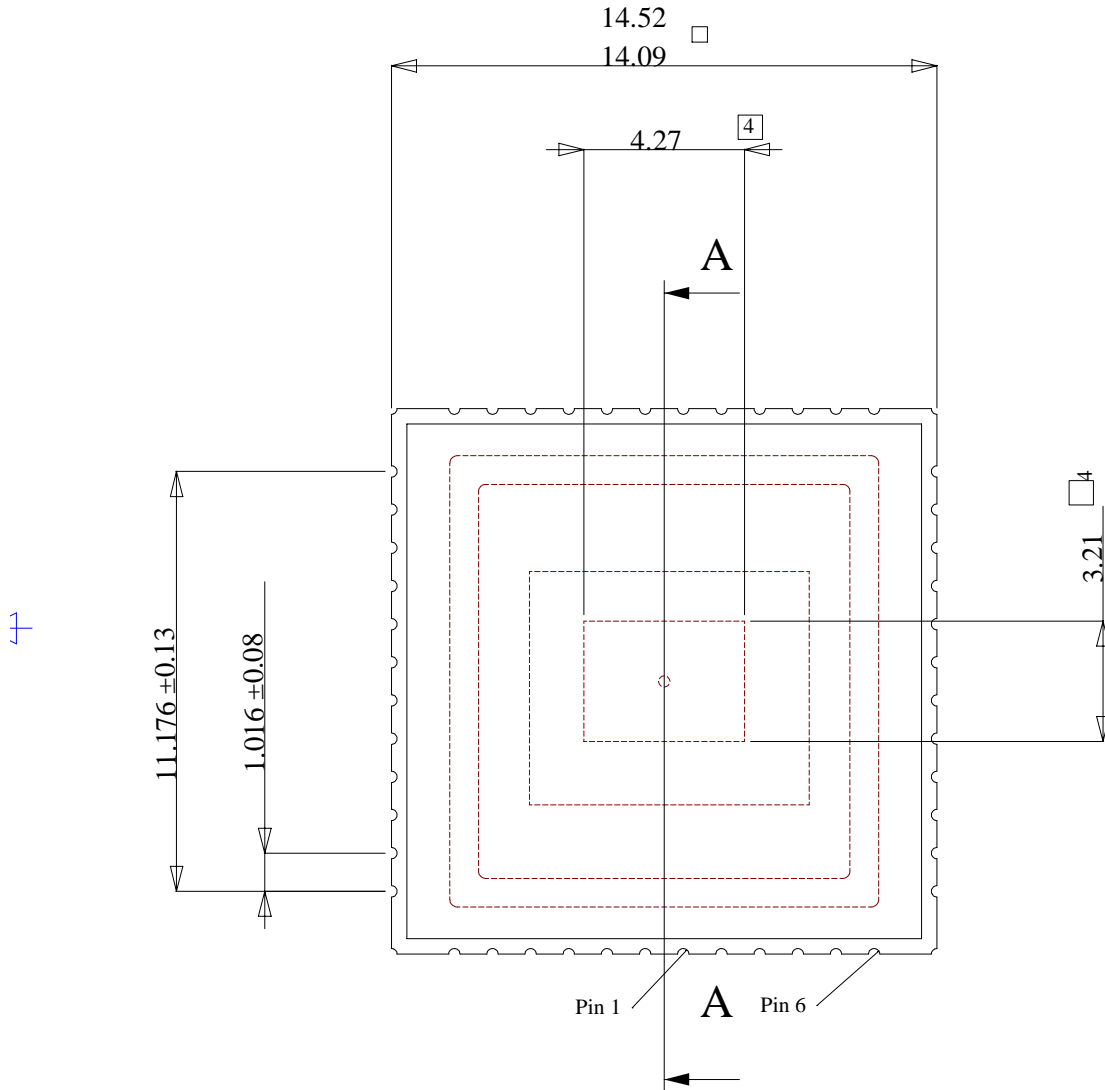


Figure 8 : VV6444 package dimensions in 48LCC (1)

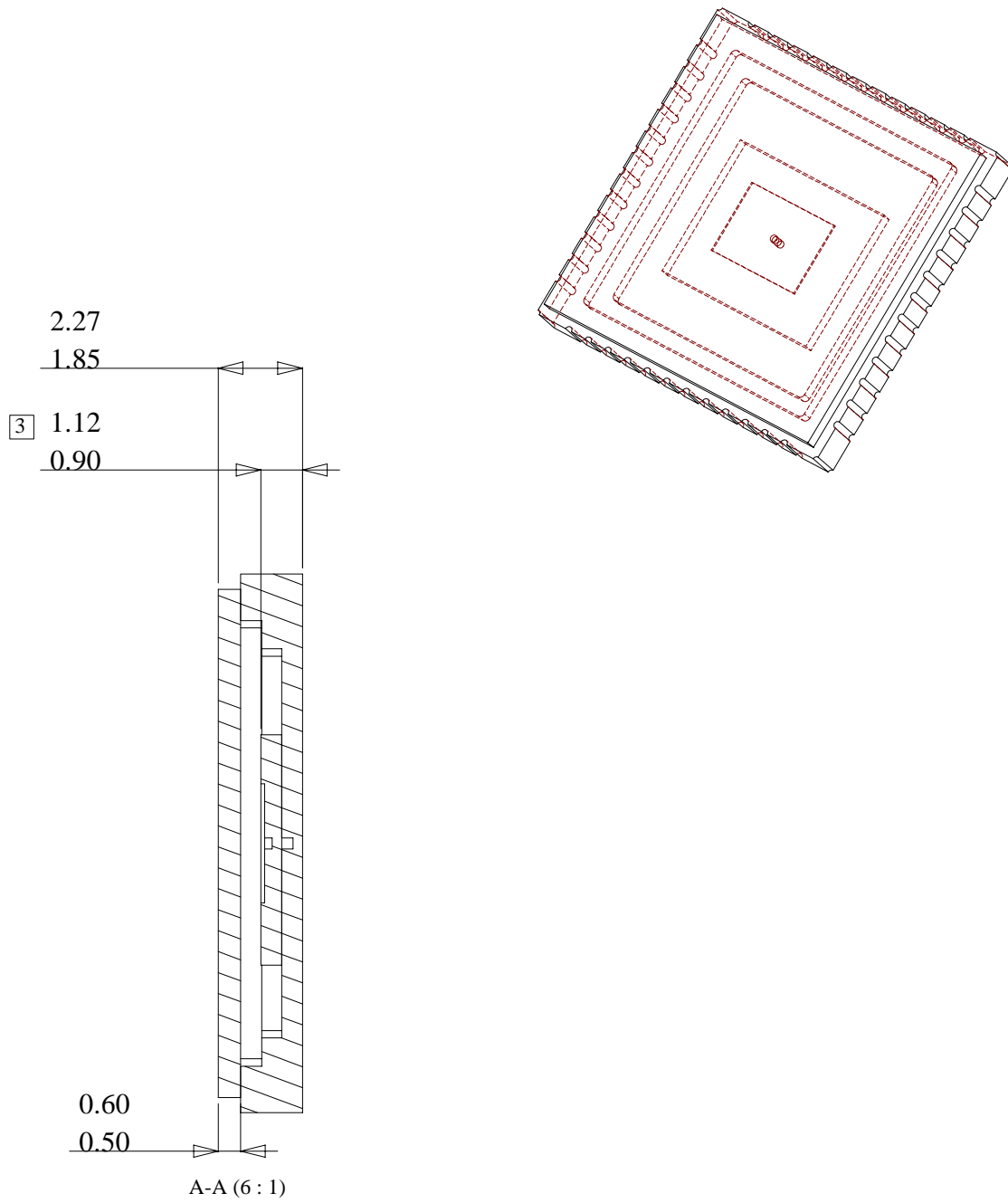


Figure 9 : VV6444 package dimensions in 48LCC (2)

11. VV6410 Pinout information and package dimensions

Note that early VV6410 samples (as can be seen on some STV0680A EVK's) are 48LCC, however the sampling and production package is 36LCC.

11.1 VV6410 pinout

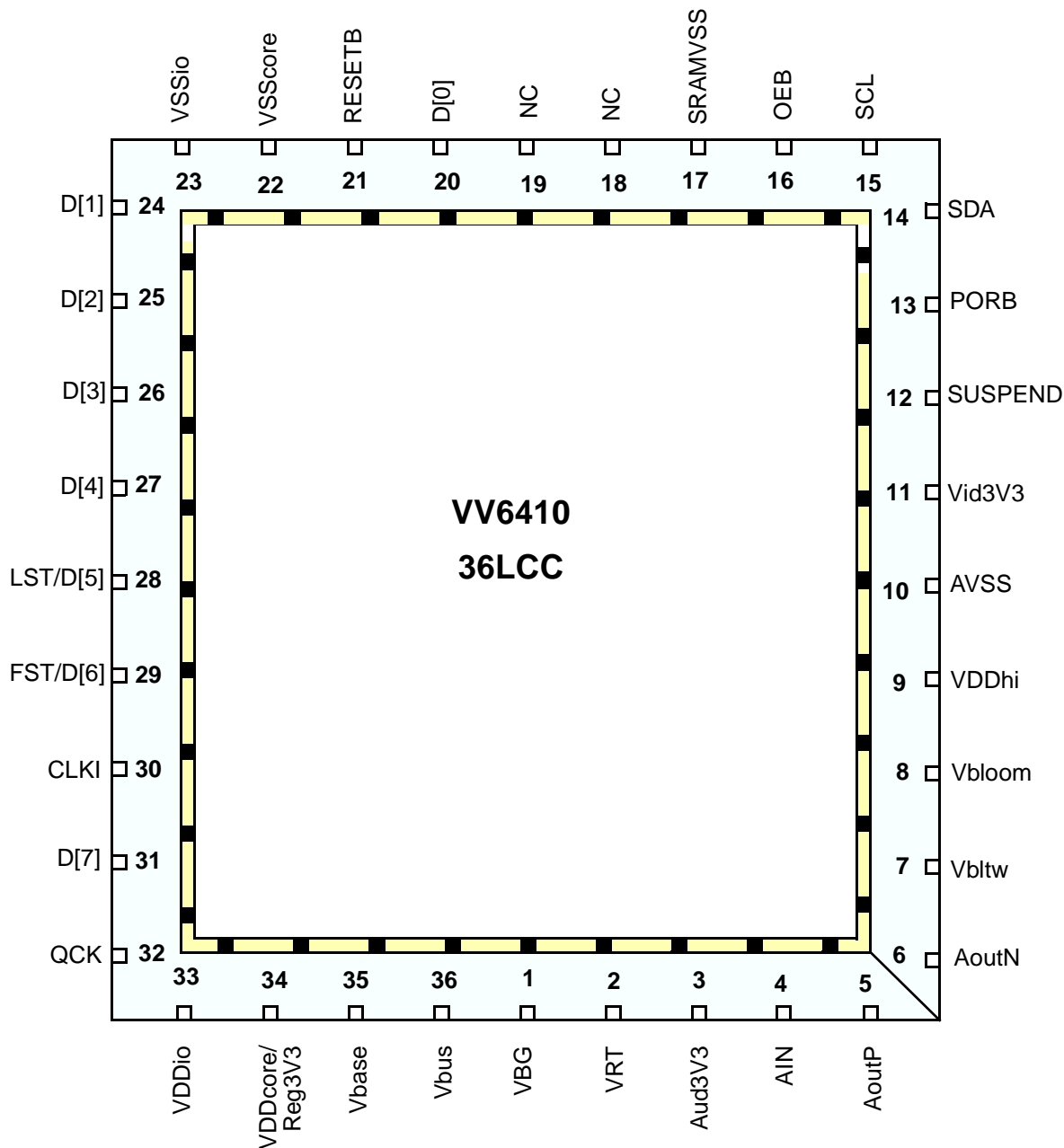


Figure 10 : 36 pin CLCC package pin assignment

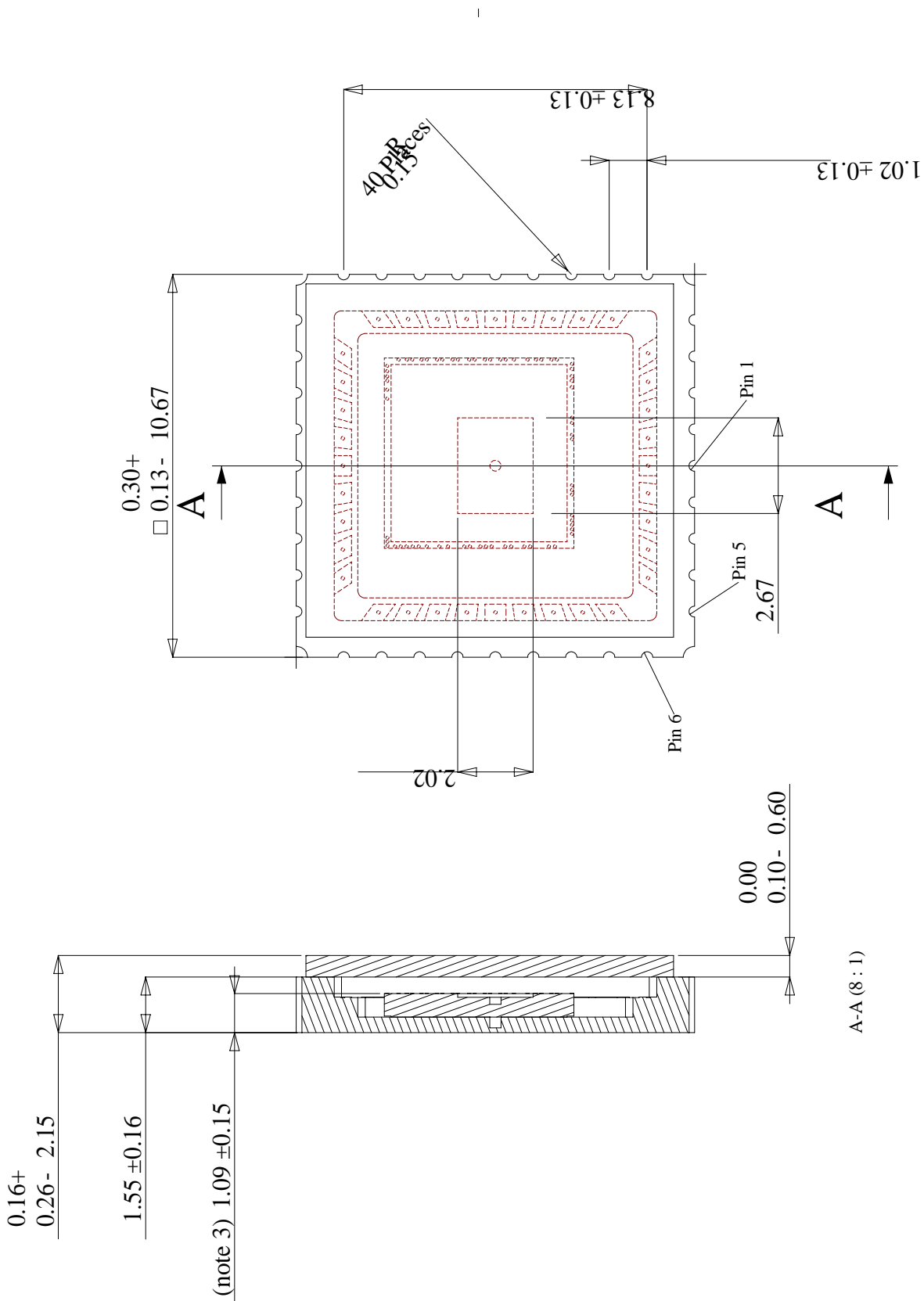
11.2 VV6410 Pin descriptions

Name	Pin Number	Type	Description
POWER SUPPLIES			
AVSS	10	GND	Core analog ground and reference supplies.
SRAMVSS	17	GND	In-column SRAM analog ground.
VDDcore/ Reg3V3	34	PWR	Digital logic power.
VDDio	33	PWR	Digital pad ring power.
VSScore	22	GND	Digital logic ground.
VSSio	23	GND	Digital pad ring ground.
ANALOG SIGNALS			
Vbloom	8	OA	Anti-blooming pixel reset voltage
VBLTW	7	OA	Bitline test white level reference
VBG	1	OA	Internally generated bandgap reference voltage 1.22V
VRT	2	IA	Pixel reset voltage
AIN	4	IA	Analog input to Audio Amplifier
AOutP	5	OA	Analog output of Audio Amplifier (positive)
AOutN	6	OA	Analog output of Audio Amplifier (negative)
VDDHI	9	IA	Incoming power supply 4 -> 6V
VBase	35	OA	Drive for base of external bipolar
Vbus	36	IA	Incoming power supply 3.3 -> 6V
Aud3V3	3	OA	On-chip Audio Amplifier Voltage Regulator Output
Vid3V3	11	OA	On-chip Video Supply Voltage Regulator Output
PORB	13	OD	Power-on Reset (Bar) Output.
DIGITAL VIDEO INTERFACE			
D[4]	27	ODT	Tri-stateable 5-wire output data bus. - D[4] is the most significant bit. - D[4:0] have programmable drive strengths 2, 4 and 6 mA
D[3]	26		
D[2]	25		
D[1]	24		
D[0]	20		
QCK	32	ODT	Tri-stateable data qualification -> clock.
LST/D[5]	28	ODT	Tri-stateable Line start output May be configured as tri-stateable output data bit 5 D[5].
FST/D[6]	29	ODT	Tri-stateable Frame start signal. May be configured as tri-stateable output data bit 6 D[6].

Name	Pin Number	Type	Description
D[7]	31	ODT	Tri-stateable Data wire (ms data bit). May be configured as tri-stateable output data bit 6 D[6].
OEB	16	ID↓	Digital output (tri-state) enable.
DIGITAL CONTROL SIGNALS			
RESETB	21	ID↑	System Reset. Active Low. May be configured as System Sync. Active Low.
SUSPEND	12	ID↑	USB Suspend Mode Control signal. Active High If this feature is not required then the support circuit must pull the pin to ground. The combination of an active high signal and pull up pad was chosen to limit current drawn by the device while in suspend mode.
SERIAL INTERFACE			
SCL	15	BI↑	Serial bus clock (input only).
SDA	14	BI↑	Serial bus data (bidirectional, open drain).
SYSTEM CLOCKS			
CLKI	30	ID↓	Schmitt Buffered Clock input or LVDS positive Clock input
Not connected			
NC	18, 19		Not connected

Key			
A	Analog Input	D	Digital Input
OA	Analog Output	ID↑	Digital input with internal pull-up
BI	Bidirectional	ID↓	Digital input with internal pull-down
BI↑	Bidirectional with internal pull-up	OD	Digital Output
BI↓	Bidirectional with internal pull-down	ODT	Tri-stateable Digital Output

11.3 VV6410 package Details (36pin CLCC)



12. VV6500 Pinout and pin descriptions (48pin LCC package)

12.1 Pinout

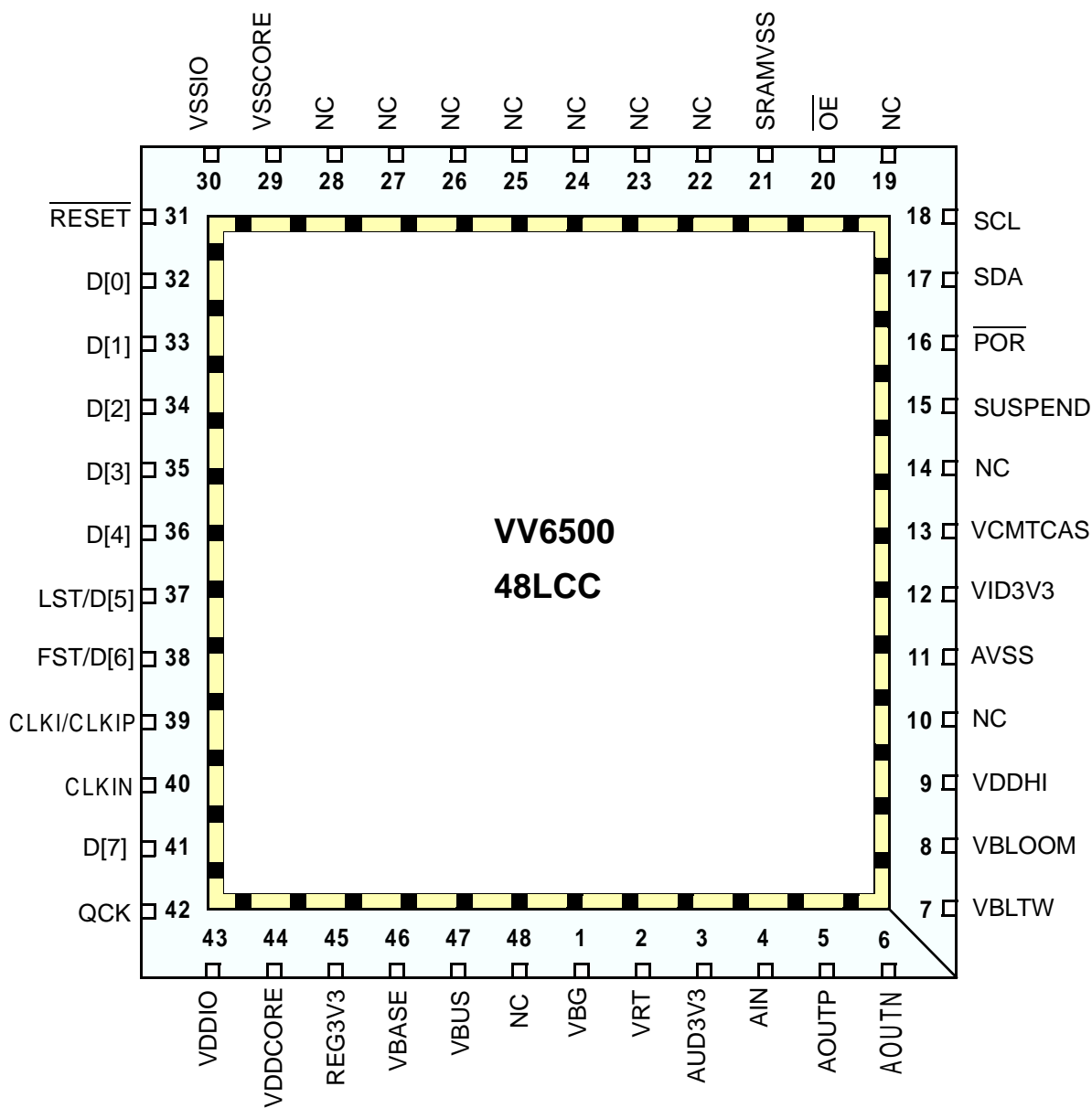


Figure 11 : 48 pin LCC package pin assignment

12.2 VV6500 pin descriptions

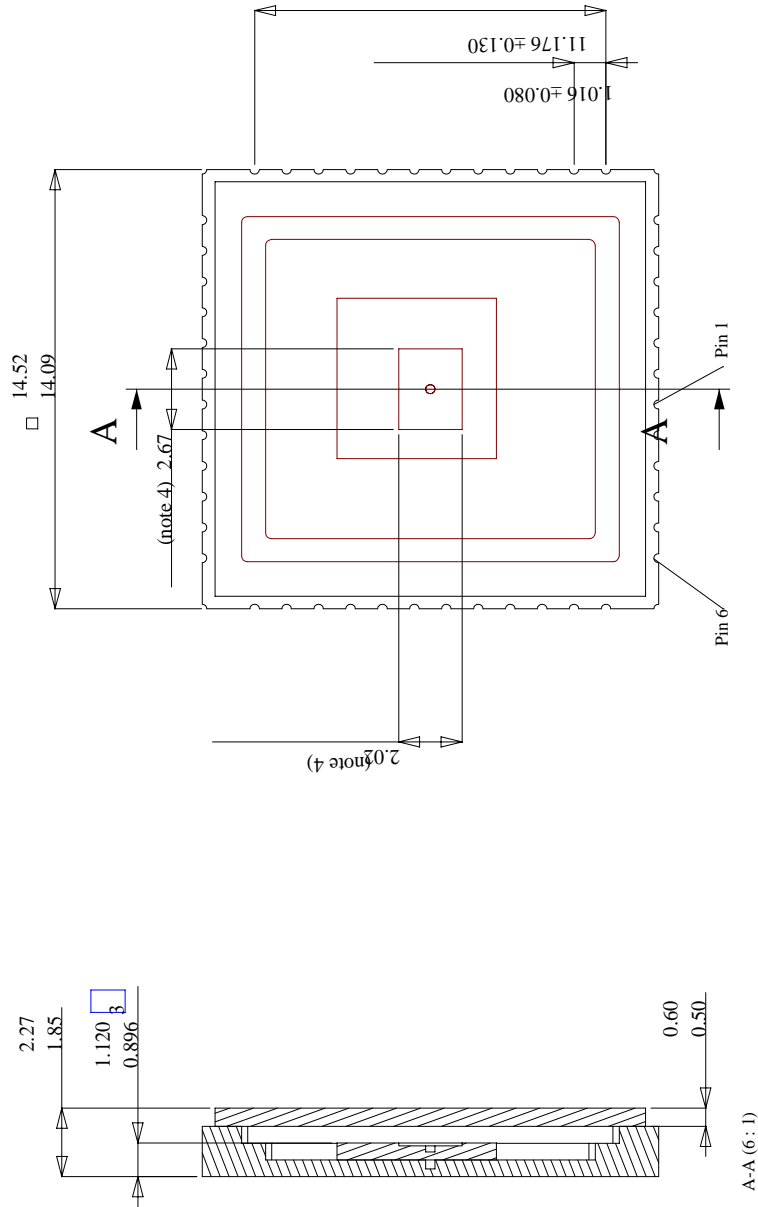
Name	Pin Number	Type	Description
POWER SUPPLIES			
AVSS	11	GND	Core analog ground and reference supplies.
SRAMVSS	21	GND	In-column SRAM analog ground.
VDDcore	44	PWR	Digital logic power.
VDDio	43	PWR	Digital pad ring power.
VSScore	29	GND	Digital logic ground.
VSSio	30	GND	Digital pad ring ground.
SRAMVSS	21	GND	In-column SRAM analogue ground.
ANALOG SIGNALS			
Vbloom	8	OA	Anti-blooming pixel reset voltage
VBLTW	7	OA	Bitline test white level reference
VBG	1	OA	Internally generated bandgap reference voltage 1.22V
VCMTCAS	13	IA	Common-mode input for column pre-amp.
VRT	2	IA	Pixel reset voltage
AIN	4	IA	Analog input to Audio Amplifier
AOutP	5	OA	Analog output of Audio Amplifier (positive)
AOutN	6	OA	Analog output of Audio Amplifier (negative)
VDDHI	9	IA	Incoming power supply 4 -> 6V
VBase	46	OA	Drive for base of external bipolar
Vbus	47	IA	Incoming power supply 3.3 -> 6V
Reg3V3	45	OA	On-chip Voltage Regulator Output
ARef		IA	On-chip Audio Amplifier Reference Input
Aud3V3	3	OA	On-chip Audio Amplifier Voltage Regulator Output
Vid3V3	12	OA	On-chip Video Supply Voltage Regulator Output
PORB	16	OA	Power-on Reset (Bar) Output.
DIGITAL VIDEO INTERFACE			
D[4]	36	ODT	Tri-stateable 5-wire output data bus. - D[4] is the most significant bit. - D[4:0] have programmable drive strengths 2, 4 and 6 mA
D[3]	35		
D[2]	34		
D[1]	33		
D[0]	32		
QCK	42	ODT	Tri-stateable data qualification clock.

Name	Pin Number	Type	Description
CLKIN	40	BI↑	LVDS negative Clock input
LST/D[5]	37	ODT	Tri-stateable Line start output May be configured as tri-stateable output data bit 5 D[5].
FST/D[6]	38	ODT	Tri-stateable Frame start signal. May be configured as tri-stateable output data bit 6 D[6].
D[7]	41	ODT	Tri-stateable Data wire (ms data bit). May be configured as tri-stateable output data bit 6 D[6].
OEB	20	ID↓	Digital output (tri-state) enable.
DIGITAL CONTROL SIGNALS			
RESETB	31	ID↑	System Reset. Active Low. May be configured as System Sync. Active Low.
SUSPEND	31	ID↑	USB Suspend Mode Control signal. Active High If this feature is not required then the support circuit must pull the pin to ground. The combination of an active high signal and pull up pad was chosen to limit current drawn by the device while in suspend mode.
SERIAL INTERFACE			
SCL	18	BI↑	Serial bus clock (input only).
SDA	17	BI↑	Serial bus data (bidirectional, open drain).
SYSTEM CLOCKS			
CLKI/CLKIP	39	ID↓	Schmitt Buffered Clock input or LVDS positive Clock input
Not connected			
NC	10, 14, 19, 22-28, 48		Not connected

Key			
A	Analog Input	D	Digital Input
OA	Analog Output	ID↑	Digital input with internal pull-up
BI	Bidirectional	ID↓	Digital input with internal pull-down
BI↑	Bidirectional with internal pull-up	OD	Digital Output
BI↓	Bidirectional with internal pull-down	ODT	Tri-stateable Digital Output

12.3 VV6500 package Details (48 pin LCC)

- Notes.
 1. Die is optically coated.
 2. Refractive index of glass is 1.5.
 3. Distance to optical surface of Die.
 4. Pixel area of sensor.



13. Evaluation kit

STMicroelectronics recommends using the Evaluation Kit (e.g. **STV-DCA/CIF-E01**) for initial evaluation and design-in. The STV-DCA includes a reference design board (**STV-DCA/CIF-R01**) camera module, containing a STMicroelectronics CMOS sensor + STV0680A chipset, memory, lens, connectors, LCD, battery holder, push buttons/switches, and other componentry as detailed. The push buttons are arranged for ease of operation as a real 'camera'. Optional PCB links enable alternate functionality, and demonstration software is included, as detailed in Section 5. allows for picture download, video, and AVI movie clips

! Note

An **evaluation kit** is not available for STV0680+VV6444. Several small form factor demonstration units (PCB0194) have been built, however, these are not identical to the camera described in this reference design.

14. Ordering details

Description	Part number
STV0680 companion processor (no VfW or RS232 support)	STV0680-001
STV0680A companion processor (including VfW and RS232 support)	STV0680A-002*
VV6444+STV0680/STV680A designs	
LCC packaged CIF Image Sensor (5v)	VV6444C001
STV0680/STV0680A + VV6444 Digital Camera Chipset, Reference Design Manual	Available for download from http://www.vvl.co.uk/tech_support/home.htm
VV6410/6500+STV0680A designs	
36pin CLCC packaged, microlensed CIF ColourMOS sensor	VV6410C036
48pin CLCC packaged, microlensed VGA ColourMOS sensor	VV6500C001
Digital camera Evaluation Kit for STV0680/STV0680A+VV6410	STV-DCA/CIF-E01
Digital camera Evaluation Kit for STV0680/STV0680A+VV6500	STV-DCA/VGA-E01
STV0680/STV0680A + VV6410/6500 Digital Camera Chipset, Reference Design Manual	Available for download from http://www.vvl.co.uk/tech_support/home.htm

Table 26 : **Ordering details**

* Note: The variant number of STV0680A is indicated by the suffix -001, 002, 003, etc. Contact STMicroelectronics for latest information.

Technical support

This document and other related technical support information, such as datasheets, software downloads, etc for STMicroelectronics Imaging Division Products can be found at http://www.vvl.co.uk/tech_support/home.htm

Note: All the above web addresses when accessing from within ST should read www.edb.st.com rather than www.vvl.co.uk

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics

The ST logo is a registered trademark of STMicroelectronics

© 2000 STMicroelectronics - All Rights Reserved



www.vvl.co.uk

www.st.com

asiapacific_sales@vvl.co.uk
central_europe_sales@vvl.co.uk
france_sales@vvl.co.uk
japan_sales@vvl.co.uk
nordic_sales@vvl.co.uk
southern_europe_sales@vvl.co.uk
uk_eire_sales@vvl.co.uk
usa_sales@vvl.co.uk

STMicroelectronics, Imaging Division