



STV0680B+ VV6410/6411/6500

DUAL-MODE DIGITAL CAMERA CHIPSET

DESCRIPTION

STMicroelectronics Imaging Division has enhanced the feature set of the STV0680B low cost dual-mode camera chipset to allow a new line of low cost cameras or toy products to be brought to the market.

STANDARD FEATURES

ST have maintained the standard features already available in the successful STV0680B-001 chipset, including:

- STV0680B-003 fully backward compatible with STV0680B-001
- Support for VV6410/6411 (CIF) and VV6500 (VGA) CMOS imaging sensors.
- Support for SDRAM sizes 16MBit (up to 20 CIF images) or 64Mbit (up to 80 CIF or 26 VGA images).
- Low resolution “economy” mode allows for more images to be stored.
- High frame rate web cam (tethered video) over USB.
- Automatic anti-flicker exposure control.
- Image up load over RS232 or USB.
- Driver support for Win98/Win2k/WinME and MacOS 8.6/9.0/9.1.
- Continuous capture while untethered (except when Flashgun enabled) and downloading to AVI file format
- Power-saving “stand-by” mode which maintains memory contents, as well as generally low power consumption.
- Simple user interface including 2 buttons, status LCD display, and buzzer.
- Evaluation Kit (EVK) available.
- Software Development Kit (SDK) allows OEM PC Software applications to be written.

NEW FEATURES AVAILABLE IN STV0680B-003

- Audio record/playback and “Delete Last” function
- Custom sounds playback (e.g. “Talking” or “Musical” camera)
- Flashgun support
- Quick Power Down (by holding Mode Button).

Audio Record And Playback

The enhanced features included in STV0680B-003 allow audio memos to be recorded, stored in SDRAM, and uploaded to the PC over USB or RS232, to be played back using an OEM software application developed using the SDK

With the addition of playback hardware, recorded audio sounds can also be played back on the camera, and it is possible to download a set of custom sounds from the PC to allow (e.g.) shutter “Click-Whirr”, or for a “Talking Camera”. This has limitless possibilities for OEM language customising or licensing.

Flashgun Support and “Delete Last” Function

STV0680B-003 includes flashgun support for an OEM flashgun module. An additional user interface function is available in STV0680B-003 which allows the user to delete the last image, continuous clip or audio memo which was captured or recorded.

Evaluation Kit and Reference Design

Evaluation kits are available for both standard features and enhanced STV0680B-003 features. Precise design guidelines are available from ST as a separate STV0680B Reference design manual (see [Chapter 12](#)).

Note: Simultaneous audio record and continuous video capture is not possible.

Table of contents

| | | |
|------------------|---|-----------|
| Chapter 1 | Introduction | 6 |
| 1.1 | Digital camera chipset | 6 |
| 1.2 | Co-processor choices | 7 |
| 1.3 | Sensor choices | 7 |
| 1.4 | Key system features | 7 |
| Chapter 2 | Detailed features | 10 |
| 2.1 | Sensor type and image formats | 10 |
| 2.2 | User interface | 11 |
| 2.3 | Battery level detect and USB auto-switch | 13 |
| 2.4 | Audio record and playback | 13 |
| 2.5 | PC interface options and software support | 14 |
| 2.6 | Anti-flicker exposure and gain control | 15 |
| Chapter 3 | Camera modes of operation | 16 |
| 3.1 | Modes available (STV0680B-001) | 16 |
| 3.2 | Modes available (STV0680B-003) | 17 |
| 3.3 | Description of modes | 17 |
| Chapter 4 | STV0680B hardware interfaces | 20 |
| 4.1 | STV0680B pinout | 20 |
| 4.2 | Sensor interface | 20 |
| 4.3 | Memory interface | 20 |
| 4.4 | USB interface | 22 |
| 4.5 | UART module for RS232 interface | 23 |
| 4.6 | Power management and battery type | 23 |
| 4.7 | Quartz crystal | 24 |
| 4.8 | Numeric LCD interface | 24 |
| 4.9 | Switches and LED's | 24 |
| 4.10 | Flashgun hardware interface (STV0680B-003 only) | 25 |
| 4.11 | IR filter | 25 |
| Chapter 5 | Software support | 26 |

| | | |
|-------------------|--|-----------|
| 5.1 | General features | 26 |
| 5.2 | Software installation | 26 |
| Chapter 6 | Detailed chipset specifications | 28 |
| 6.1 | Typical camera specifications | 28 |
| 6.2 | STV0680B companion processor | 29 |
| 6.3 | VV6444 sensor | 30 |
| 6.4 | VV6410/6411 and VV6500 sensors | 32 |
| 6.5 | Typical current consumption of complete camera | 33 |
| Chapter 7 | STV0680 Camera System Defect Specification | 35 |
| 7.1 | General | 35 |
| 7.2 | Defect specification | 35 |
| 7.3 | Definition of the "Camera System" | 35 |
| 7.4 | Definition of the "Test Conditions" | 37 |
| 7.5 | Definition of a "Major Visible Defect" | 37 |
| 7.6 | Definition of the "Final Colour Image" | 39 |
| 7.7 | Definition of a "Minor Visible Defect" | 39 |
| Chapter 8 | STV0680B pinout information and package dimensions | 40 |
| 8.1 | STV0680B pinout | 40 |
| 8.2 | STV0680B pin description | 46 |
| 8.3 | STV0680B package dimensions | 47 |
| Chapter 9 | VV6410/6411 pinout information and package dimensions | 48 |
| 9.1 | VV6410/6411 pinout | 48 |
| 9.2 | VV6410/6411 pin description | 49 |
| 9.3 | VV6410/6411 package dimensions | 51 |
| Chapter 10 | VV6500 pinout information and package dimensions | 53 |
| 10.1 | VV6500 pinout | 53 |
| 10.2 | VV6500 pin description | 54 |
| 10.3 | VV6500 package dimensions | 56 |
| Chapter 11 | Schematics and example parts list | 58 |
| 11.1 | Schematics | 58 |

| | | |
|-------------------|---|-----------|
| 11.2 | Example parts list | 58 |
| Chapter 12 | Evaluation Kit and Reference design manual | 61 |
| 12.1 | Ordering details | 61 |
| 12.2 | Technical support | 62 |

Revision update

Main changes applied since last release, version 3.3:

- Updated camera defect specification

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 STV0680B companion processor (DCA1), 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 or Macintosh for processing is done through an RS232 or USB interface, through demo software, a TWAIN driver, or OEM custom application. The license to use the colour algorithm (embedded in the PC or Mac 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.

Using STV0680B-003, the firmware also includes the capability to trigger a flashgun module through a two wire interface (enable input and trigger output), and the capability to record audio sounds into the SDRAM, for subsequent upload to the PC, or to replay audio sounds which have either been recorded on the camera or downloaded from the PC (stored on the PC as WAV files).

Precise design guidelines are available from ST as a reference design (see [Section 4](#)). A software development kit (SDK) for PC 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 as object code.

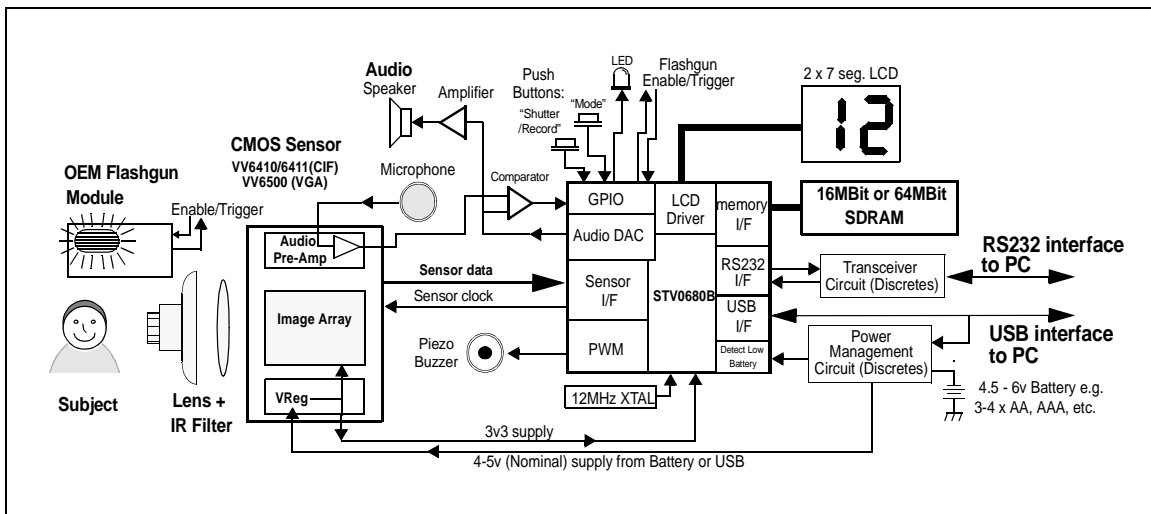


Figure 1 : Typical camera system block diagram

1.2 Co-processor choices

Two revisions of the STV0680B are produced by ST. Although there are certain functional differences between these revisions, both have an identical pinouts and STV0680B-003 retains all the functionality of STV0680B-001, hence is backwards compatible.

| Order number | STV0680B-001 | STV680B-003 |
|---------------------------|----------------------------|--------------------------------------|
| Silicon revision | STV0680B | STV0680B |
| Firmware revision | v1.00 | v3.00 |
| Sensor supported | VV6444 VV6410 VV6500 | VV6444 VV6410 VV6411 VV6500 |
| SDRAM supported | 16Mbit or 64Mbit | 16Mbit or 64Mbit |
| USB | Yes | Yes |
| RS232 | Yes | Yes |
| Video for Windows support | Yes | Yes |
| Flash-gun support | No | Yes |
| Audio record + playback | No | Yes |
| Custom sounds | No | Yes |

Table 1 : Differences between STV0680B-001 and STV0680B-003

1.3 Sensor choices

The following sensors are supported:

| Sensor | Resolution | Sensor supply voltage |
|-------------|-----------------|-----------------------|
| VV6444 | CIF (352 x 288) | 5v |
| VV6410/6411 | | 3.3v |
| VV6500 | VGA (640 x 480) | |

Table 2 : Sensor choices with STV0680B

1.4 Key system features

The key features of a typical camera based on the STV0680B chipset are as follows:

1.4.1 Image features (STV0680B-001)

- Support for 5V or 3.3V CIF resolution sensor (VV6444 or VV6410/6411) - 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, 107 QVGA images with 64Mbit memory). See [Table 3](#).
- Automatic anti-flicker exposure and gain control

1.4.2 Image features (STV0680B-003)

- All image features for STV0680B-001 are supported.
- Support for flashgun.

1.4.3 User features on camera (STV0680B-001)

- 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.
- "Clear all" function clears camera.
- "Low Resolution" mode increases number of images which can be captured by reducing image resolution.

1.4.4 User features on camera (STV0680B-003)

- All user features of STV0680B-001 are supported.
- Audio Record function (if audio record hardware detected) allows sounds to be recorded.
- Audio Playback function (if audio playback hardware fitted) allows sounds which have been recorded to be played back.
- "Delete last" function allows user to delete audio memos, pictures or continuous clips, deletion must be carried out "most reset first".
- Camera can be configured by the user to play custom sounds at certain functions, using a PC application.
- "Go to sleep" function, whereby the camera can be put into standby mode while untethered.

1.4.5 User features on PC software (STV0680B-001)

PC software allows a number of features, including fast download of thumbnail images for picture selection, and automatic detection and correction of sensor defects. The driver compatibility includes:

- TWAIN driver to suit all TWAIN compatible imaging applications
- Video for Windows PC 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
- Quicktime Video driver and Adobe Photoshop stills plug-in for Mac

Custom OEM PC 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.

1.4.6 User features on PC software (STV0680B-003)

All PC software written for a STV0680B-001 camera will function with a STV0680B-003 camera which is only used to take still images/video.

The SDK (version 2.90 or later) allows for:

- the OEM to write a custom application for uploading sound memos, based on the example LCDC demo software.
- the OEM to write a custom application for downloading custom sounds to the camera, based on the example CustomSound software.

1.4.7 Power management features and USB compliance

- Retention of pictures, recorded sounds, and downloaded custom sounds 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 4.5-6V 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 4](#) for further details.

1.4.8 General features

- High speed picture/sounds upload to PC/Mac over USB
- ST Colour processing algorithms included under license (as part of drivers/SDK)
- USB or RS232 serial interface options, and VfW / TWAIN driver support.

2 Detailed features

2.1 Sensor type and image formats

The sensor type is auto-detected by STV0680B, which ensures that the correct sensor timing is enabled, and the correct image resolutions are enabled, as shown in [Table 3](#).

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 3](#)). 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.

Note: *When tethered VfW video (PC) or Quicktime driver (Mac) is activated, all images or recorded sounds or video clips will be deleted from the camera SDRAM. A software solution is available ("Camera control", as part of the SDK for PC, and "Plug'n Save" for Mac) which can monitor whether a camera is connected and will warn the user if activating the VfW driver will cause SDRAM contents to be deleted.*

| Sensor | Sensor Image Size | Resolution mode | Final Image Size | Max. no. of images stored in 16MBit memory (Note 2) | Max. no. of images stored in 64MBit memory (Note 2) | Approximate VfW framerate (Note 1) |
|-------------|-------------------|-----------------|-----------------------------|---|---|--|
| VV6444 | CIF 352 x 288 | High | CIF 352 x 288 | 20 | 80 | 15 frames/sec. |
| | | Low | QCIF 176 x 144 (Subsampled) | 80 | 322 (see Note 3) | 25 frames/sec. |
| VV6410/6411 | CIF 352 x 288 | High | CIF 352 x 288 | 20 | 80 | 15 frames/sec. |
| | | Low | QCIF 176 x 144 (Subsampled) | 80 | 322 (see Note 3) | 22.5 frames/sec. |
| VV6500 | VGA 640 x 480 | High | VGA 640 x 480 | (6) | 26 | 2 frames/sec. |
| | | Low | QVGA 320 x 240 (Subsampled) | (26) | 107 (see Note 3) | 12 frames/sec. |

Table 3 : Image modes supported (STV0680B-001)

Note: 1 *VfW framerate is dependent on PC performance and USB bus loading*

2 *On a camera using STV0680B-003, the number of images which can be stored is reduced if Audio sounds have been recorded on the camera or if custom sounds have been downloaded from the PC to the camera. The reduction of capacity depends on the length of audio clip, but a rough guide is that if 1 CIF image uses the same amount of SDRAM as 10sec of audio, and one VGA image uses the same amount of SDRAM as 30 sec. of audio.*

3 A CIF camera with STV0680B-001 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.

2.1.1 VV6444

VV6444 is a CIF resolution, 5V CMOS imaging sensor and has been superseded by VV6410/6411.

2.1.2 VV6410

VV6410 is a CIF resolution, 3.3V CMOS imaging sensor. A brief specification is shown in [Chapter 6](#).

A dual design to support VV6444 and VV6410/6411 is not possible, since VV6410/6411 is a 3v3 sensor. A single footprint for VV6410/6411 and VV6500 is not possible since the package types differ, however, the same support circuit is used.

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.

2.1.3 VV6411

VV6411 is a CIF resolution, 3.3V CMOS imaging sensor. A brief specification is shown in [Chapter 6](#).

The functionality, pixel size, resolution and support circuit are identical to VV6410, however, the colour filter material is slightly different, and the package type and pinout may differ to VV6410. Contact ST for further details.

A single footprint to support VV6411 and VV6500 is not possible because of the package difference. A single footprint to support VV6410 and VV6411 may be possible, dependant on the final package for VV6411.

2.1.4 VV6500

VV6500 is a VGA resolution, 3.3V CMOS imaging sensor. A brief specification is shown in [Chapter 6](#)

A dual design to support VV6444 and VV6500 is not possible, since VV6500 is a 3v3 sensor. A single footprint for VV6410/6411 and VV6500 is not possible since the package types differ, however, the same support circuit is used. See [Chapter 6](#).

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.

2.1.5 SDRAM

This is covered in more details in [Chapter 4](#).

2.2 User interface

The user interface supported by STV0680B comprises of user controls, buzzer sounds or customised audio sounds and visual displays.

2.2.1 Push buttons

The following are the 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 [Chapter 3](#).
- 2 Shutter button (Shutter/confirm action): This button allows the user to take a picture or confirm an action, as shown in [Chapter 3](#)

The modes of operation are described in [Chapter 3](#).

It may also be desirable to include an on-off slider switch. This has advantages and disadvantages, and its exact function is discussed further in the reference design available from ST.

Where a flashgun module is included in the camera, it will be necessary to include a flash on/flash off push button or slider switch, dependant on the exact flashgun module design. possible implementations are discussed in a separate application note AN1312 regarding flashgun implementation, available from ST.

2.2.2 LED indicator

An LED display camera status, i.e. to show that the camera is not in Standby/PC suspend mode.

2.2.3 Picture counter using 2 x 7 segment display

STV0680B stores a picture counter value, which shows how many images can still be captured. STV0680B 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 3](#)). It is possible to clear the images stored in memory, in order to continue taking pictures. In other modes, this LCD panel shows displays a 2-character code, which helps the user to navigate around the modes.

Note: A CIF camera with STV0680B 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 STV0680B 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.

2.2.5 Custom sounds

A camera which includes STV0680B-003 and Audio playback hardware can have a set of custom sounds downloaded from a PC application. A different sound can be associated with each of the following functions:

| | |
|---|------------------------|
| Power On | Sound delete |
| Power Off | Continuous clip delete |
| Good picture | Clear memory |
| Bad picture (Normally due to insufficient light) | Confirm action |
| Memory full | Low power |
| Self timer #1 | Flashgun ON |
| Self timer #2 | Flashgun OFF |
| Low resolution | Flashgun Trigger |
| High resolution | Frequency 50kHz |
| Picture delete | Frequency 60kHz |

Table 4 : List of custom sound functions

Note: 1 Where a given function has a sound associated with it stored in SDRAM, the piezo buzzer does not give any beeps for that function. Not all functions need to have custom sounds associated with them, this is the choice of the user or OEM.

2 A demonstration PC application "CustomSounds" is available from ST, however this is not intended for end-users. Source code is available which allows the EOM to build their own PC application using the SDK.

2.3 Battery level detect and USB auto-switch

An on-chip battery level detector on STV0680B 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 [Chapter 6](#) 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 Audio record and playback

2.4.1 Record

A camera which includes STV0680B-003 and a microphone, comparator and other periphery (also utilizing the sensor pre-amplifier) can be used to record sounds which are stored in the same way as images. STV0680B-003 will auto-detect the presence of Audio record hardware and include

audio record and “delete last” functions into the user interface. The audio sample rate is 11.025kHz, and the signal is digitised using a successive approximation A-D converter with 8 bits resolution. The SDRAM stores 1 second of Audio recording per 11k Bytes of memory.

2.4.2 Playback

A camera which includes STV0680B-003 and an amplifier, speaker/headphone socket, and other periphery, can be used to playback sounds which were either recorded on the camera or downloaded from the PC.

The quality of Audio playback is largely dependant on the type of speaker used, and on the correct mounting of the speaker in the camera plastics.

2.5 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:

- 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.

2.5.1 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

2.5.2 RS232

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

2.6 Anti-flicker exposure and gain control

2.6.1 General

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.

The exposure control algorithm in STV0680B chooses exposure values which minimise "flicker" effects from occurring under fluorescent lighting. STV0680B can only prevent flicker in lighting powered by 50Hz or 60Hz electricity supply, but automatic detection of the flicker frequency is not possible. Hence choosing the correct anti-flicker setting is important, in order to prevent dark stripes from appearing across the image, and this selection must be done in hardware.

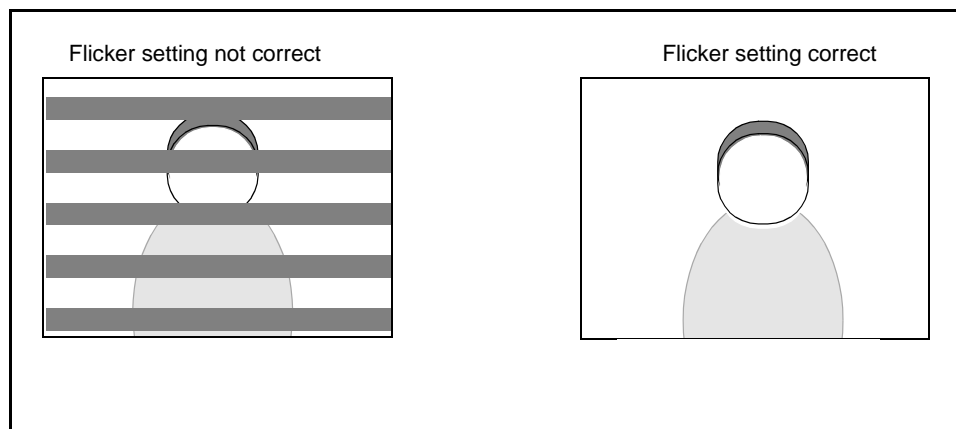


Figure 2 : Illustration of flicker problem

2.6.2 Flashgun exposure

Where STV0680B-003 and a flashgun module are included in the camera, and the flashgun enable signal is HIGH, the exposure mode will operate in a different manner. The CMOS sensor progressive scan readout requires that the sensor is set to maximum exposure so that all lines are being exposed at a certain point in time.

The "window" within which the flashgun needs to fire in order to correctly expose all sensor lines is of the order of a few 100µsec (contact ST for more precise details), therefore the flashgun module design should have reached maximum light output within this period after the falling edge of the flash trigger output from STV0680B-003.

Possible flashgun implementations, regarding hardware interface, charge sensing, and flash energy required are discussed in a separate application note AN1312 regarding flashgun implementation, available from ST.

3 Camera modes of operation

This section refers to the two switches as discussed in section [Section 2.2.1](#)

- “Mode”: connects GPIO0 pin of STV0680B to GND when pressed
- “Shutter”: connects GPIO1 pin of STV0680B to GND when pressed

Pressing the mode switch repeatedly cycles through a series of modes as displayed on the LCD. When a given mode is displayed it may be selected by pressing the shutter button. If an option is not selected within 5 seconds the display will revert to showing the number of available pictures.

3.1 Modes available (STV0680B-001)

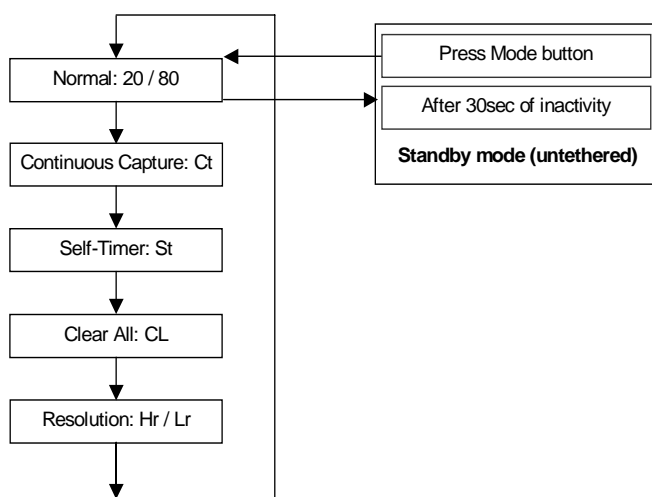


Figure 3 : STV0680B-001modes (CIF camera with 16Mbit SDRAM assumed)

Note that the number of images displayed depends on the sensor and SDRAM type - see [Table 3](#).

3.2 Modes available (STV0680B-003)

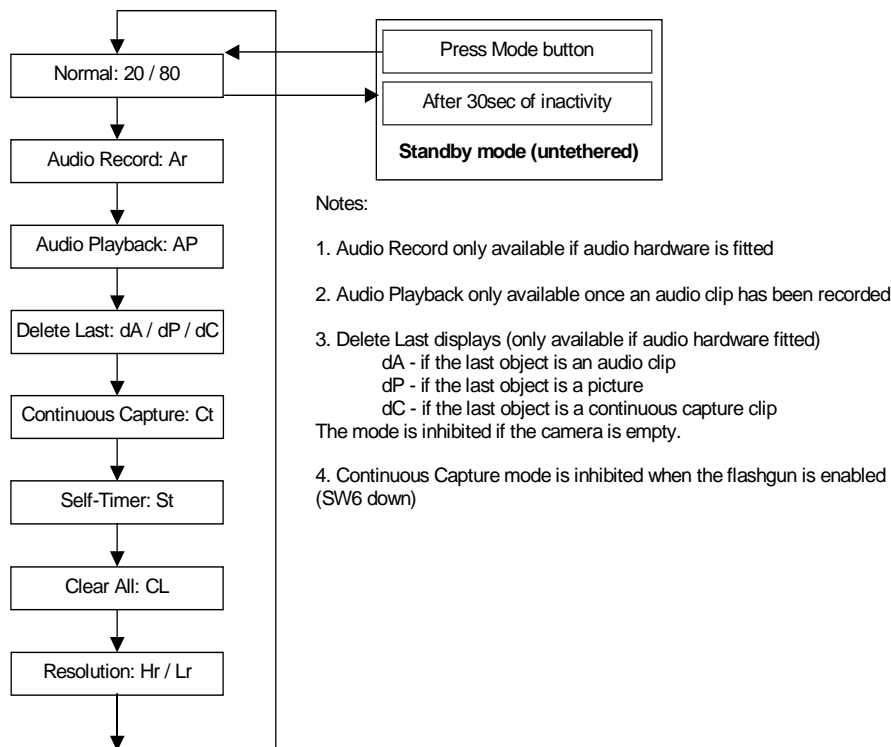


Figure 4 : STV0680B-003modes (CIF camera with 16Mbit SDRAM assumed)

3.3 Description of modes

Note that certain modes are only available using STV0680B-003, and with appropriate hardware fitted on the camera.

3.3.1 Standby mode (untethered) and Wake-up

On power-up, or wake-up from untethered standby mode, (i.e. by pressing the Mode button), the camera will beep twice. The LCD will briefly indicate the camera resolution either 'Hr.' for high resolution (80 CIF or 26 VGA images - using 64Mbit memory) or 'Lr' for low resolution (322 QCIF or 107 VGA images - using 64Mbit memory) and then display the number of pictures which may be taken. Please note that in Low Resolution Mode, although there can be up to 322 images available, the LCD counter will only go up to 99, it will continue reporting 99 until there are less than 99 images left.

The camera will go back to standby mode either after 30 seconds of inactivity, LED1 will turn off and the LCD will go blank. This can also be done (STV0680B-003 only) by pressing the mode switch for more than 2 seconds.

3.3.2 Normal mode

Pressing the shutter button will take a picture. The camera will beep. A high pitched beep indicates that the picture was taken successfully and the counter will decrement (if there are less than 99 images left to take). A low beep indicates insufficient light to take a picture. A series of beeps indicates that the camera is full.

Stored pictures may be uploaded to a PC at any time, whether or not the camera is full. Plugging the USB connector into the camera will cause it to reset and issue a double beep but all stored pictures will remain. When the USB connector is unplugged the camera will go to sleep. When connected to the PC the camera may still be used in the normal way.

Note: With the flashgun enabled (STV0680B-003 only) the camera will always take a picture, whether or not there is sufficient light.

3.3.3 Audio record - Ar

This mode is available on STV0680B-003 only, with audio record hardware fitted.

Pressing the shutter button within 5 seconds will cause the camera to start recording for as long as the shutter button is pressed down. If the shutter button is not pressed within 5 seconds the camera will revert to normal picture taking mode. Whilst recording, the LCD display flashes 'Ar'. If the recording stops because the memory is full, the 'memory full' audio tone is sounded and the display will stop flashing and display '00'. The audio data is digitised and stored in SDRAM.

3.3.4 Audio Playback - AP

This mode is available on STV0680B-003 only, with audio playback hardware fitted.

Pressing the shutter button within 5 seconds will cause the camera to play back the most recent audio recording. If the shutter button is not pressed within 5 seconds the camera will revert to normal picture taking mode. Whilst playing, the LCD display flashes 'AP'.

Once in Audio Playback mode, repeated presses of the shutter button will step the camera through each of the audio recordings in the camera (most recent first). Keeping the shutter button pressed down will also cycle through the audio recordings. Pressing the mode button during playback will stop the audio clip.

Note: Minimum audio recording length is set to 0.5 seconds.

3.3.5 Delete last object - dA/dP/dC

This mode is available on STV0680B-003 only, with audio record hardware fitted.

If the last object captured was an audio recording 'dA' (delete audio) will be displayed, if the last object was an image, then 'dP' (delete picture) will be displayed, or, if the last object was part of a continuous capture sequence, then 'dC' (delete continuous) will be displayed. If the camera is empty, the mode will be suppressed. The mode works in the same way as 'CL' (Clear All), i.e. once the mode is selected, pressing the shutter button once will cause the camera to beep and 'dA', 'dP' or 'dC' to start flashing. Pressing the shutter button again within 5 seconds will delete the last audio clip, picture or continuous capture sequence.

3.3.6 Continuous mode - Ct

Pressing the shutter button within 5 seconds will cause the camera to start taking pictures for as long as the shutter button is pressed down (and the camera is not full). If the shutter button is not pressed within 5 seconds the camera will revert to normal picture taking mode.

Note: 1 During continuous mode the camera will allow pictures to be taken regardless of the available light, which could result in insufficient exposure.

2 In continuous mode, only every alternate field is grabbed hence capture rate is halved. E.g. 12.5fps CIF and 7.5fps VGA

3 On STV0680B-003, Continuous Mode is suppressed when the FlashGun enable signal (GPIO2) is high.

3.3.7 Self timer - St

Pressing the shutter button will now start a 10-second self-timer. The camera will issue a short beep every second and then a longer beep. A further beep will then indicate that the picture has been taken (high beep - picture successful, low beep - insufficient light, picture not taken). The self-timer mode can not be selected when the camera is full. The self-timer countdown cannot be stopped once it has started.

3.3.8 Clearing the camera memory - CL

Pressing the shutter button once will cause the camera to beep and the 'CL' to start flashing. Pressing the shutter button again within 5 seconds will clear all the images/audio clips in the camera and reset the counter.

3.3.9 Changing picture resolution - Hr/Lr

The resolution option is displayed, either Hr. to change to high-resolution mode (if currently in low-resolution mode) or Lr to change to low-resolution (if currently in high-resolution mode). Press the shutter button within 5 seconds of selecting the resolution option, the camera will beep and the display will reset indicating the number of pictures available in the new mode. The picture resolution can be changed at any time, i.e. the camera can store both high and low resolution images.

4 STV0680B hardware interfaces

4.1 STV0680B pinout

The STV0680B 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 [Chapter 6](#)

4.2 Sensor interface

STV0680B uses a standard ST digital interface from the sensor, and the sensor clock input is provided by an output from STV0680B. Designing a camera using this chipset should design as close as possible to the reference design ([Chapter 6](#)), in which case the chipset can be regarded as a functional 'black box', and no further details regarding the STV0680B-sensor interface are required.

4.3 Memory interface

STV0680B is designed to interface to an external 16Mbit or 64Mbit SDRAM (see [Table 3](#)). 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 STV0680B, 16Mbits (1M x 16 bits wide) or 64Mbits (4M x 16 bits wide), the memory size is auto-detected by STV0680B. STV0680B 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 [Chapter 6](#)

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 [Chapter 6](#)

In addition, the USB suspend mode current specification requires that the camera will consume no greater than 300 μ A when un-tethered. Meeting this specification, which is included in the requirements for USB compliance, assumes an SDRAM with up to approximately 250 μ A self-refresh current, based on a current consumption of approximately 50 μ A for STV0680B+support circuit.

4.3.2 SDRAM interface timing requirements

The following timing diagrams should be referred to when selecting SDRAM other than those recommended in [Chapter 6](#)

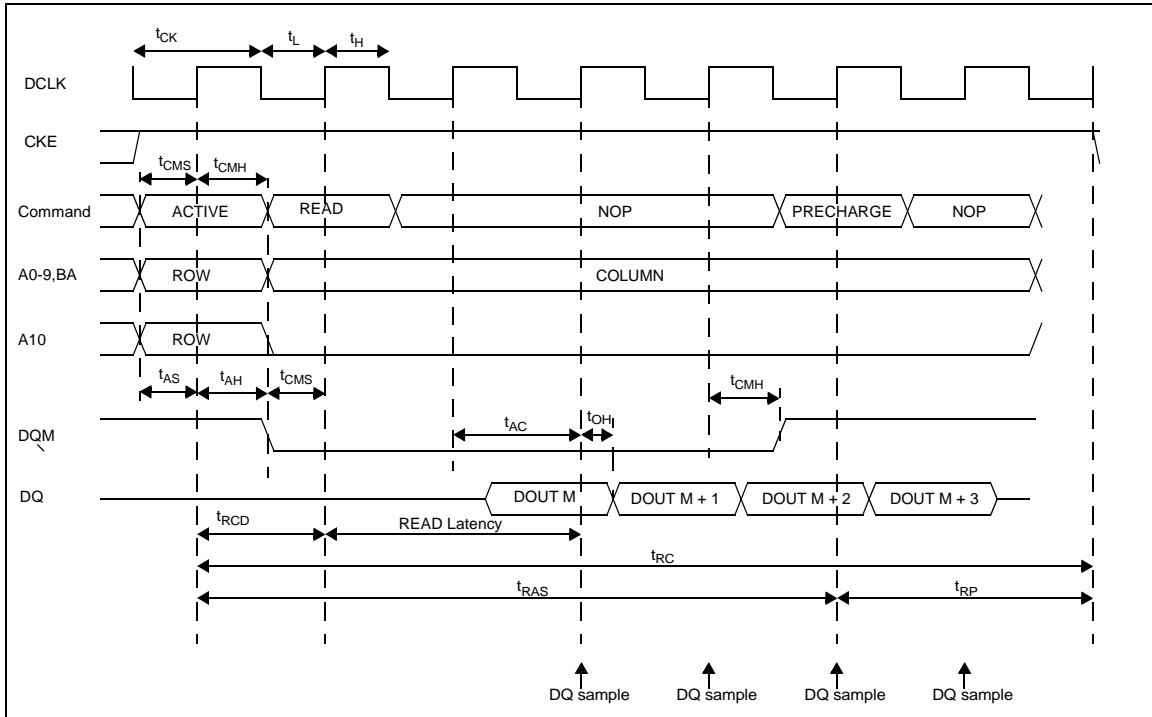


Figure 5 : SDRAM read timing (16Mbit device, burst read)

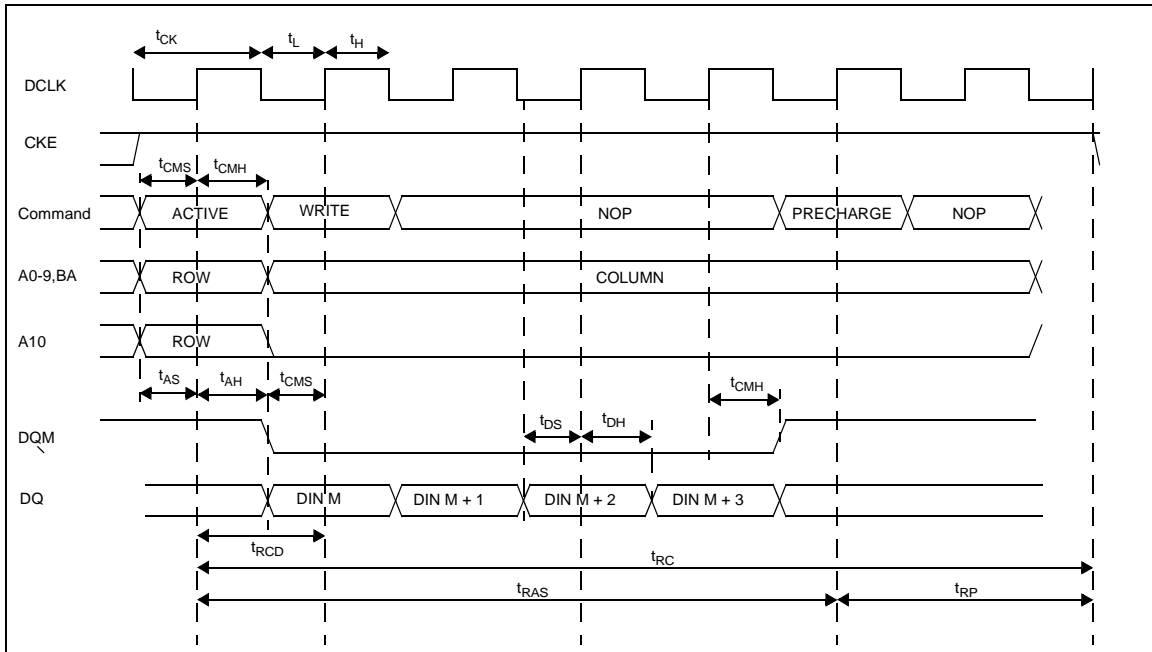


Figure 6 : SDRAM write timing (16Mbit device, burst write)

| Symbol | Min. | Max | Units |
|------------------|--------|--------|-----------------|
| t _{CK} | 166.45 | 166.89 | ns |
| t _{CH} | ½ | | t _{CK} |
| t _{CL} | ½ | | t _{CK} |
| t _{AC} | | ½ | t _{CK} |
| t _{OH} | 0 | | ns |
| t _{CMS} | 82.88 | | ns |
| t _{CMH} | 82.85 | | ns |
| t _{AS} | 82.88 | | ns |

| Symbol | Min. | Max | Units |
|------------------|-------|-----|-----------------|
| 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 5 : Timing parameters for SDRAM read/write

4.3.3 SDRAM refresh period

The SDRAM refresh period from STV0680B 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 STV0680B takes place.

4.3.4 SDRAM initialisation period

The SDRAM initialisation period is currently set to 981µs in STV0680B.

4.4 USB interface

STV0680B includes a USB Version 1.1 compliant Universal Serial Bus Interface, including a transceiver. This allows direct connection from STV0680B to a USB connector with minimal additional hardware (i.e. a small number of passive discretes) - see [Chapter 6](#)

The USB interface interfaces the STV0680B 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 STV0680B provides a 115200 baud full duplex interface to an external Host.

4.5.1 RS232 physical interface

STV0680B 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 [Chapter 6](#)). 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 STV0680B 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 STV0680B, 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

STV0680B and the SDRAM require a 3.3V supply. Where a VV6410/6411 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 [Chapter 6](#)):

- The USBDETECT input to STV0680B 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 SENSPWR output from STV0680B 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 VV6410/6411/6500). This has a significant improvement on battery life.

4.6.3 Battery type

This is hardware dependant. The schematics referred to in [Chapter 6](#) assume either three or four 1.5V cells.

4.7 Quartz crystal

Regardless of the sensor type or anti-flicker requirements, the sensor + STV0680B chipset operates from a single 12MHz fundamental quartz crystal. For specification requirements, see [Table 13](#). STV0680B includes an on-chip low jitter PLL, for PLL characteristics, see [Table 12](#).

4.8 Numeric LCD interface

STV0680B supports a 2-digit LCD panel only, for alpha-numeric display.

4.8.1 LCD types

STV0680B 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

The convention for segment numbering is as follows: '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 STV0680B have pre-defined functions as follows, see [Section 2.2](#) for user interface functionality, and [Chapter 6](#) for precise hardware implementation

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 2.6](#). The polarity of this selection is detailed in the reference design (see [Chapter 6](#)).

4.9.3 LED indicator output: GPIO5

The LED output has an 8mA current sinking capability.

4.9.4 Other pins: GPIO2, 4, 6, 7

With STV0680B-001, these pins are un-used and should be tied to GND.

With STV0680B-003, these pins are used, as detailed in [Table 6](#).

| GPIO | 2 | 4 | 6 | 7 |
|----------------|-----|-----|-----|-----|
| Audio Record | No | Yes | No | No |
| Audio Playback | No | No | Yes | No |
| Flashgun | Yes | No | No | Yes |

Table 6 : Other GPIO usage with STV0680-003

Their specific functions are detailed in the reference design and in the following documents available from ST:

- Audio: Application note AN1310
- Flashgun: Application note AN1312

4.9.5 Audio record hardware interface (STV0680B-003 only)

The firmware implements a successive approximation A/D conversion by outputting successive analogue levels through the DAC output, which are compared with the actual signal level (output from the sensor microphone preamplifier), and the resultant high or low signal from the comparator is read at GPIO4. The sampling frequency is 11kHz, and the successive approximation is done at 8 bits resolution per sample. It is not possible to speed up the sampling frequency due to the limitation of STV0680B firmware speed.

An actual hardware implementation is given in the audio application note AN1310.

4.9.6 Audio playback hardware interface (STV0680B-003 only)

The firmware outputs the desired signal level through the DAC output, which is amplified to the speaker or headphone socket. GPIO6 is used to switch off the amplifier during periods of audio recording, to prevent the successive approximation waveform from being heard during periods of recording, and to reduce the power consumption and unwanted crackle through the speaker.

An actual hardware implementation is given in the audio application note AN1310.

4.10 Flashgun hardware interface (STV0680B-003 only)

STV0680B-003 will revert to flashgun exposure when it detects GPIO2 is high. Ideally the hardware should combine the two factors of (a) user intention (e.g. user switches on flashgun) and (b) charge sensing (i.e. flash is charged up and ready to fire).

These two factors (a) and (b) are independent, since there may be a delay of several seconds between switching on the flashgun charger, and the flashgun being able to fire. To revert to flashgun exposure before the flashgun is completely charged up would cause very bad pictures to be taken in low light conditions because there is no "low light" threshold when flashgun exposure is enabled, since the camera expects a flash to fire. A suggested flashgun hardware interface is given in the flashgun application note AN1312.

When flashgun exposure is enabled and the shutter button is pressed, a picture will be taken and the flash trigger pin GPIO7 will be pulsed low at the correct point in time so that all lines of the CMOS imager are exposed.

4.11 IR filter

An Infra-Red Blocking Filter is required to achieve correct colour response. The exact specification for the IR filter characteristics are given in the reference design manual.

5 Software support

5.1 General features

The chipset is a dual-mode camera, i.e. stills and video, and is supported by a range of demonstration software, standard drivers, and software development options.

Driver software is available to support both USB and RS232 interface including standard TWAIN and video for Windows drivers (VfW through USB only) for Win98/Win2k/WinME. Quicktime drivers and a Photoshop stills plug in for MacOS 8.6/9.0/9.1 are also supported.

Example software applications (PC only) are provided to create .AVI video files from untethered continuous capture of images (AVICreator), to upload still images and recorded sounds (LCDCdemo) and to download .WAV files from the PC to the camera (CustomSound). In each case, PC source code is provided to assist in OEM software development using the SDK.

ST colour processing and defect detection/correction software runs on the host and is supplied under licence agreement, as part of all host software/drivers/SDK.

5.1.1 *Still image upload*

This is available through demonstration software, OEM custom software, or using standard TWAIN applications. Features include:

- Fast upload through USB, or upload through RS232.
- Colour display of image thumbnails for picture selection.
- Download of full image once selected by user software.
- Automatic detection and correction of sensor defects
- Colour processing of full image, using the ST colour process

The above features also apply to “AVI Creator” or any OEM custom software for AVI video creation from pictures taken while un-tethered, since this is essentially a “stills” function.

5.1.2 *Streaming video (only while tethered to USB)*

This is available through demonstration software, or using standard VfW applications. Features include:

- Streaming video through standard VfW driver
- Automatic detection and correction of sensor defects
- Colour processing of full image, using the ST colour process

5.2 Software installation

The following software support is only available to OEMs. Access to the latest installation files is possible through a password-protected web page, contact ST for details. The install file gives the option to install:

- Drivers (always check web site for latest driver version).
- EVK software, i.e. LCDCdemo.exe and AVICreator.exe, G2Video.exe, and CTItest2.exe
- SDK installation: source code for sample applications, and documentation

5.2.1 Driver support available

| | | |
|-----------------------------|--|---|
| Interface type: | RS232 | USB |
| PC Operating system: | Win9x, WinNT4, Win2k, Windows Millennium | Win98 and Win2k only, Windows millenium |
| Mac OS | N/A | 8.6, 9.0, 9.1 |
| STV0680B-001 | TWAIN | TWAIN, VfW |
| STV0680B-003 | | |

Table 7 : Driver choices

5.2.2 EVK software

Note: The following is also supplied with evaluation kits/demonstration units, but all the following software is only for demonstration purposes and should NOT be supplied as an end-user product. However, application-level source code (i.e. not driver/colour processing source) for LCDCdemo.exe, AVI creator, and CTItest.exe is available as part of the SDK, which allows similar applications to be built by the software developer:

- 1 Simple demonstration software **LCDCdemo.exe** for uploading thumbnails and images.
- 2 **AVIcreator.exe** software for uploading continuous images for creating 'movie' clips.
- 3 **G2Video.exe** is a VfW application which shows streaming video while tethered to USB and allows creation of AVI video clips.
- 4 **CTItest.exe** is only for debugging purposes, for software developers using the SDK

5.2.3 Software Development Kit (SDK) and source code

A software development kit allows the OEM to develop a custom application which calls the same range of drivers as listed in [Section 5.2.1](#), hence allowing the OEM application to perform picture download, thumbnail display, and colour processing using the ST colour process. Inclusion of source code for the applications listed in [Section 5.2.2](#) allows the software developer to use these as the basis for their own application.

The SDK is supplied by ST as a 32-bit DLL format, running on Windows 98/Win2K™, and accessed through a documented software interface. Development requires Microsoft Visual Studio Ver. 6 or later. This provides the basis for developing a custom software application for stills.

Note: Source code for PC Drivers, Defect Correction, and Colour Processing algorithms are not available.

6 Detailed chipset specifications

6.1 Typical camera specifications

The following data assumes that the camera has been built according to reference design shown in [Chapter 6](#)

| | |
|--|---|
| Supply Voltage | 4.1-6V (when powered from battery or USB) |
| Operating Temperature range | 0°C - 40°C |
| 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 |
| SDRAM storage and image upload format | Raw Bayer |
| PC driver output format | Colour RGB bitmap |

Table 8 : Typical camera specifications

Note: 1 Dual USB or battery power supply is only possible when the required power switching hardware is included, as shown in [Chapter 6](#)

2 Figures are approximate and depend on actual components sources.

| Sensor | Min. | Max |
|---------------|-------------|------------|
| VV6444 | 8.18µS | 39mS |
| VV6410/6411 | 8.67µS | 44mS |
| VV6500 | 7.94µS | 66mS |

Table 9 : Approximate shutter speeds

6.2 STV0680B companion processor

| Parameter | Min. | Typ. | Max. | Units |
|--|---------------|------|------|-------|
| Supply voltage | 3.0 | 3.3 | 3.6 | V |
| Current consumption (normal operation) | | 20 | - | mA |
| Stand-by current consumption (untethered standby or tethered PC suspend mode) | - | - | 5 | μA |
| Operating temperature range | 0 | - | 70 | °C |
| Package | 100QFP | | | |
| Exposure control | 1 000 000 : 1 | | | |
| Storage Temperature (Approximate) | 50 to 150 | | | °C |

Table 10 : STV0680B specifications

| 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 _{CRS} | USB differential pad D+/D- output signal cross over voltage | 1.3 | | 2.0 | V | |
| R _{PU} | USB differential pad D+/D- pull up resistor | 1.425 | | 1.575 | kΩ | |
| R _{PD} | USB differential pad D+/D- pull-down 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 11 : STV0680B USB specifications

Note: 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 | Conditions | Symbol | Min. | Typ | Max | Unit |
|-----------------------------|----------------------------|-----------|--------|-----------------|-----|------|
| Peak to peak jitters | @VCOfreq = 100MHz ~ 200MHz | -- | -- | 170 | 220 | ps |
| Duty cycle | | -- | 40 | 50 | 60 | % |
| Operating voltage range | | VDD | 3 | 3.3 | 3.6 | V |
| Input low voltage | VDD=3.3V | VIL | - | | 0.8 | V |
| Input high voltage | VDD=3.3V | VIH | 0.7VDD | | VDD | V |
| pull in Time + Locking Time | | Ready | -- | -- | 0.5 | ms |
| Output Slew Rate | CL: Output Load (pF) | Tsr(Fout) | -- | 0.100+0.1082*CL | -- | ns |

Table 12 : STV0680B PLL characteristics

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

Table 13 : STV0680B crystal tolerance

6.3 VV6444 sensor

This has been superseded by VV6410/6411

| | |
|-----------------------------|--|
| Colour Image Format | 352 x 288 pixels (CIF) |
| Pixel Size | 12.0 x 11.0µm |
| 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% |

Table 14 : VV6444 specifications

Note: 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 switch (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.

| | | | | |
|--|-------------|-------------|------------|--------------|
| 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 | | mA |
| Stand-by/PC Suspend Mode, sensor powered off (see Note 2) | | Negligible | | μA |
| Stand-by/PC Suspend Mode, sensor powered on (See Note 3) | | Approx. 300 | | μA |

Table 14 : VV6444 specifications

Note: 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 switch (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.

6.4 VV6410/6411 and VV6500 sensors

| | | | | |
|--|-----------------------------|------------|-------------|--------------|
| Colour Image Format | 352 x 288 pixels (CIF) | | | |
| Pixel Size | 7.5 x 6.9µm | | | |
| Image array size | 2.67mm x 2.04mm | | | |
| Array Format | CIF | | | |
| Sensor signal / Noise ratio | Approx. 57dB | | | |
| Package type | 36LCC (VV6410) TBD (VV6411) | | | |
| 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 | 40 | mA |
| Stand-by Mode/PC Suspend Mode | | <70 | 100 | µA |

Table 15 : VV6410/6411 specifications

| | | | | |
|---|------------------------|------------|------------|--------------|
| 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 | 50 | mA |
| Standby Mode/PC Suspend Mode, SUSPEND pin asserted (see Note 1) | | <100 | 150 | µA |
| Standby Mode/PC Suspend Mode, SUSPEND pin <i>not</i> asserted (see Note 2) | | <200 | 200 | µA |

Table 16 : VV6500 specifications

Note: 1 Assuming appropriate external hardware recommendations are implemented (see [Chapter 6](#)), 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. This only applies to VV6500.

6.5 Typical current consumption of complete camera

The following data assumes that the camera has been built according to reference design referred to in [Chapter 6](#) Figures are approximate and depend on actual components sources - see notes.

6.5.1 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 stand-by mode (when NOT connected to USB) | Approx. 220µA + SDRAM self-refresh current (see Note 2) | Total current in this mode equals: 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. 80µA + SDRAM self-refresh current (see Note 2) | Total current in this mode equals: 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 4) and 15k pull-down in PC. |

Table 17 : Current consumption, complete STV0680B+VV6444 camera

Note: 1 See [Table 10](#) in [Section 6.2](#)

- 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 4](#) 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.

6.5.2 Using VV6410/6411/6500 (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 | |
| While playing back audio sounds through speaker | 90mA | Assuming 8Ω speaker as explained in application note AN1310 |
| Standby Mode (when NOT connected to USB): Sensor SUSPEND pin asserted (see Note 4) | Approx. 220μA + SDRAM self-refresh current (see Note 2) + sensor suspend mode current (see Note 3) | Total current in this mode equals: STV0680B 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. 50μA + SDRAM self-refresh current (see Note 2) + sensor suspend mode current (see Note 3) | Total current in this mode equals: STV0680B 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 Chapter 6) and 15k pull-down in PC. + Sensor suspend mode current (See Note 3) |
| Standby Mode (when NOT connected to USB): sensor powered off using FET (see Note 5) | Approx. 220μA + SDRAM self-refresh current (see Note 2) | Total current in this mode equals: STV0680B Standby current consumption (see Note 1) + SDRAM self-refresh current (see Note 2) + peripheral circuitry (approx. 50μA). |
| PC Suspend mode (when connected to USB): sensor powered off using FET (see Note 5) | Approx. 100μA + SDRAM self-refresh current (see Note 2) | Total current in this mode equals: STV0680B Standby current consumption (see Note 1) +SDRAM self-refresh current (see Note 2) + peripheral circuitry (approx. 50μA). |

Table 18 : Current consumption, complete STV0680B+VV6410/6411/6500 camera

Note: 1 See [Table 10](#) in [Section 6.2](#).

- 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 4](#) for recommendations.
- 3 Sensor suspend mode current <100μA (needs SUSPEND pin asserted with VV6500), see [Table 15](#) and [Table 16](#).
- 4 If the appropriate hardware to assert the sensor SUSPEND pin is not fitted, an additional current consumption in Standby/PC Suspend mode of Approx. 50μA can be expected with VV6500.
- 5 Option included in reference design to save current consumption, which can increase battery life and increase chances of meeting USB suspend mode compliance requirements.

7 STV0680 Camera System Defect Specification

Note: The information in this chapter is subject to change without notice. Contact ST for precise details and information on correct driver versions.

7.1 General

ST CMOS Sensors can contain defects as part of their standard sales specification. The sensor defect specification, if required, can be found in the appropriate sensor datasheet, however this specification is not the same as the camera system defect specification.

When an ST CMOS Sensor is used in a STV0680B camera system, a defect correction algorithm in the camera system will correct the sensor defects so that in the vast majority of cases the user should not see defects in the final colour image generated by the PC/Mac driver. This chapter clarifies the defect specification for the overall camera system.

7.2 Defect specification

When using the specified Camera System, under the specified Test Conditions:

- 1 No Major Visible defects are allowed in the Final Colour Image from a CIF camera (VV6410/6411/6444) or VGA Camera (using VV6500 shipped by ST until end of Q1 2001), except under certain limitations given in [Section 7.2.1](#) and [Section 7.3.7](#).
- 2 No Major Visible defects are allowed in the "Inner area" (within the central 242 x 322 pixels) of the Final Colour Image from a VGA camera (VV6500 shipped by ST after start of Q2 2001), except under certain limitations given in [Section 7.2.1](#) and [Section 7.3.7](#).
- 3 Some Minor Visible defects are allowed in the "Outer area" (outside the central 242 x 322 pixels) of the Final Colour Image from a VGA camera (VV6500 shipped by ST after start of Q2 2001), but no Major Visible Defects are allowed in the "Outer area", except under certain limitations given in [Section 7.2.1](#) and [Section 7.3.7](#).

7.2.1 Appearance of defects under other conditions

During normal camera use (e.g. lensed camera used in a "real situation"), it is possible that defects may be visible under certain conditions:

- At the sharp edge of certain light/dark transitions

7.3 Definition of the "Camera System"

All of the following conditions must be met for the defect specification to be applicable to the "Camera System".

Note that the EVK units STV-DCA/CIF-E01 or -E04 and STV-VGA/VGA-E01 or -E04 both conform to these conditions, hence have the same defect specification as detailed in [Section 7.2](#).

7.3.1 CMOS Imaging Sensor

The defect specification applies to the Camera System if any of the following sensors are used.

- VV6444-C001
- VV6410-C036
- VV6411-C036

- VV6500-C001

7.3.2 Companion ASIC

The defect specification applies to the Camera System, if any of the following companion ASICs are used, subject to the firmware notes shown in [Section 7.3.3](#):

- STV0680
- STV0680A
- STV0680B

7.3.3 Companion ASIC Firmware:

Only standard firmware sold by ST is covered by this defect specification. Any OEM modification of companion ASIC firmware through the STV0680 FDK means that this defect spec does not apply. Devices containing standard firmware are sold under the following order codes:

- STV0680-001
- STV0680A-002
- STV0680B-001
- STV0680B-003

7.3.4 Camera Hardware

Camera built according to the ST Imaging Division Reference Design, including any of the options shown.

7.3.5 Host Interface

USB or RS232 interfaces can be used.

7.3.6 Host Operating System

- PC running Windows 98, Windows 2k, Windows ME, or Mac running Mac OS 8.6 or above.
- PC Drivers with VV6444/6410 and VV6500 until end Q1 2001: Version 1.00 or above.
- PC Drivers with all sensors, including VV6500 shipped after start of Q2 2001: Version 1.14 or above.

7.3.7 PC Software:

- Standard TWAIN Interface (PC) or Photoshop compatible plug-in (Mac)
- LCDCdemo.exe (see note 1), AVICreator.exe, or other OEM application generated through SDK (see note 1).
- Any VfW Application (see note 2) on PC or Quicktime application on Mac.

Notes on non-default software settings:

- Note: 1 With the "Greyscale" checkbox enabled in LCDCdemo.exe, uploading a full resolution image by double clicking on the image thumbnail will produce a raw "Bayer" image which can include defects. The "Greyscale" facility is intended for OEM debug purposes only, and cannot be regarded as a "final colour image".*
- 2 When running any VfW application, the Source->Advanced->Anti-Speckle function can be used to enable/disable defect correction and select the correct method of defect correction in the final colour image. Hence it is possible to see defects when the "Anti Speckle" checkbox is cleared, or when the anti-speckle filter does not match the sensor type.*

- Sensors VV6410/6411/6444 and VV6500 shipped before end Q1 2001 require Anti-speckle 1
- Sensors VV6500 shipped after start Q2 2001 require Anti-speckle 2

7.4 Definition of the "Test Conditions"

7.4.1 Optics

- No Lens or IR filter
- No dirt on sensor glass

7.4.2 Illumination and uniformity of scene

No lens should be used. The intensity of required illumination and the uniformity of the scene can be defined thus. A defect-free image should give a luminosity histogramme (8 bits resolution) with the following statistics:

- 1 Mean: (45% of full scale) < Mean < (65% of full scale). Ideal luminosity (mid grey) = 50-60% of full scale.
- 2 Standard Deviation: Standard Deviation < 10.

7.5 Definition of a "Major Visible Defect"

Anything which is visible with the naked eye under the conditions described, is worthy of further investigation. For example:

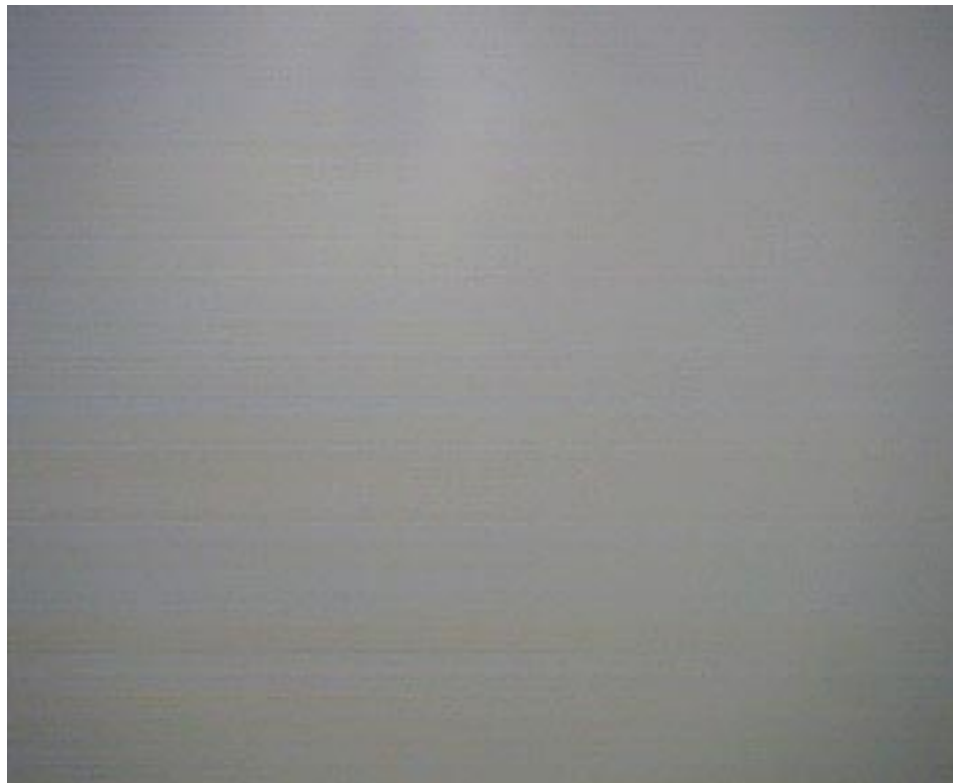


Figure 7 : No "Visible" defects

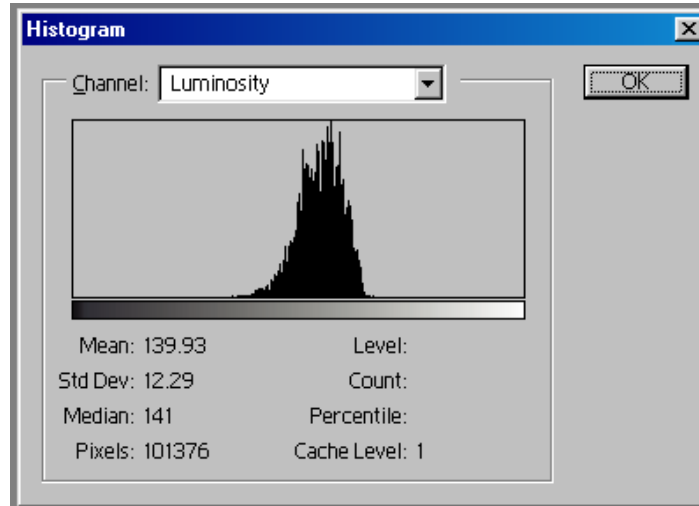


Figure 8 : Histogram of No "Visible" defects; Mean = 139; Minimum = 90

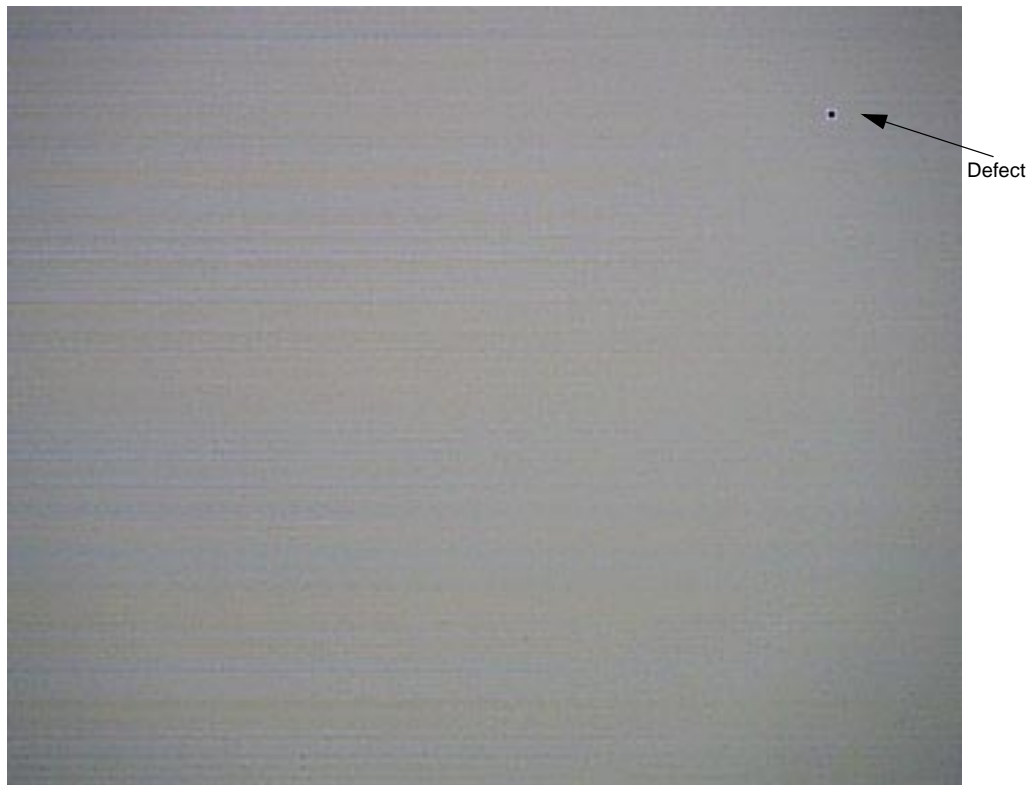


Figure 9 : "Visible" defect

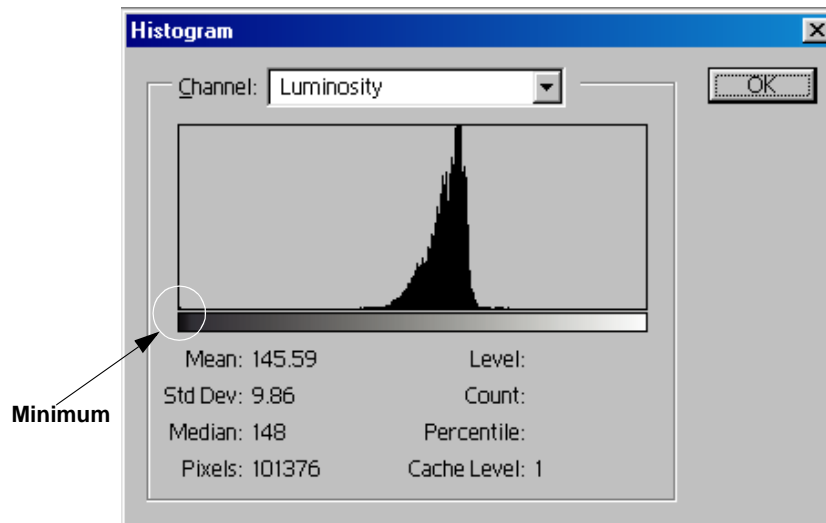


Figure 10 : Histogram of image with "Visible" defect; Mean = 145; Minimum = 0

7.6 Definition of the "Final Colour Image"

This means the Bitmap (.bmp) image displayed by the PC software as described in [Section 7.3.7](#).

7.7 Definition of a "Minor Visible Defect"

Please refer to sensor datasheet.

8 STV0680B pinout information and package dimensions

8.1 STV0680B pinout

| 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 notes) | | | | |
| 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 (FL-EN) | IO (OD) | Flash enable input (Note 3) | 8mA (SL) |
| 74 | GPIO3 (50/60) | Debounced input | Link to select between 50Hz and 60Hz lighting | 8mA (SL) |
| 73 | GPIO4 (AUD-COMP) | IO (OD) | Audio comparator input (Note 3) | 8mA (SL) |
| 72 | GPIO5 | Output (OD) | LED indicator | 8mA (SL) |
| 71 | GPIO6 (AMP-EN) | IO (OD) | Audio Amp enable (Note 3) | 8mA (SL) |
| 70 | GPIO7 (FL-TRIG) | IO (OD) | Flash trigger (Active Low) (Note 3) | 8mA (SL) |

Table 19 : STV0680B Pin listing

| Pin no. | Signal | Type | Description | Drive |
|---|-----------|--------------|---|--|
| USB Interface | | | | |
| 42 | USBDETECT | Input (S) | Detect Power source from USB. (For camera with RS232 only, this pin should be tied to GND) | USB specific ation V1.1 compliance 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) | |
| STV0680B Master Clocks and Reset | | | | |
| 48 | XIN | Input | Quartz Crystal IN | |
| 49 | XOUT | Output | Quartz Crystal OUT | |
| 51 | RESET | Input (S) | Active (LOW) STV0680B 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) |

Table 19 : STV0680B Pin listing

| Pin no. | Signal | Type | Description | Drive |
|---------|--------|--------------------|---|----------|
| 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) |

Table 19 : STV0680B Pin listing

| Pin no. | Signal | Type | Description | Drive |
|----------------------|--------|--------------|-----------------------|----------|
| 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) |
| 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 2 segment E | 2mA (SL) |
| 89 | LCD2_3 | Output | LCD digit 2 segment D | 2mA (SL) |

Table 19 : STV0680B Pin listing

| Pin no. | Signal | Type | Description | Drive |
|---|------------|-----------|---|----------|
| 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 rowboat 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 Analogue Power | |
| 55 | PLLAVS | Power pin | PLL Analogue Ground | |
| Non-user pins | | | | |
| 45 | TEST0 | Input | Non-user pin - connect to 3V3 | |
| 46 | TEST1 | Input | Non-user pin - connect to 3V3 | |
| 47 | TEST2 | Input | Non-user pin - connect to 3V3 | |
| Audio DAC | | | | |
| 81 | DACRES | I(A) | DAC bias amplifier reference input. See Note 2 . | |
| 82 | DACOUT | O (A) | 8-bit DAC current source output. See Note 2 . | 0-10mA |

Table 19 : STV0680B Pin listing

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

Note: 1 GPIO are not 'general purpose', in the sense that their function is predetermined (e.g. GPIO0 = MODE, GPIO2 is Unused), dependant on the STV0680B firmware.

2 Audio implementation is shown in an Applications Note available from ST.

3 Only with STV0680B-003. With STV0680B-001, tie low.

4 GPIO2, 4, 6, 7 MUST be tied low with STV0680B-003 where no Audio/Flashgun functionality is required.

8.2 STV0680B pin description

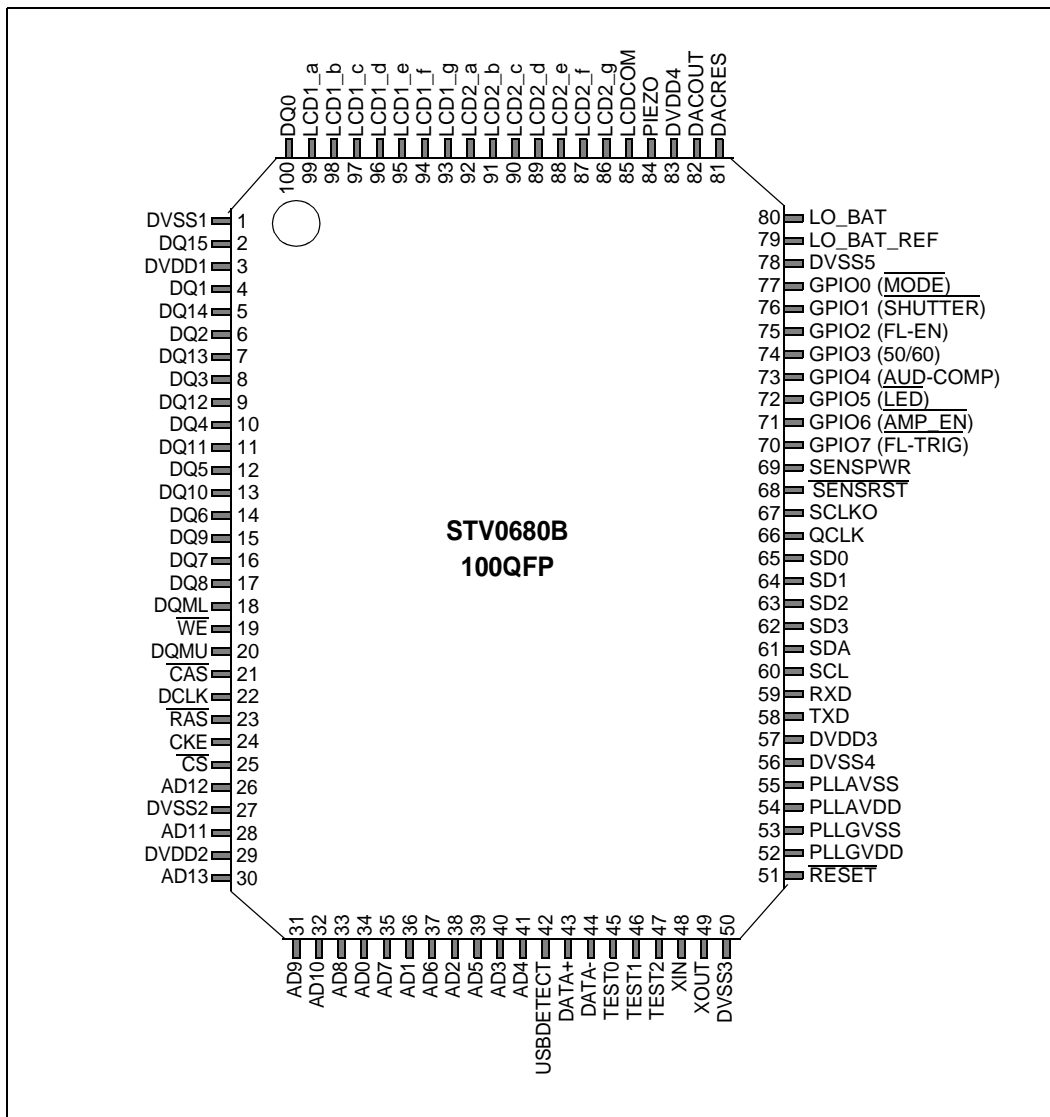
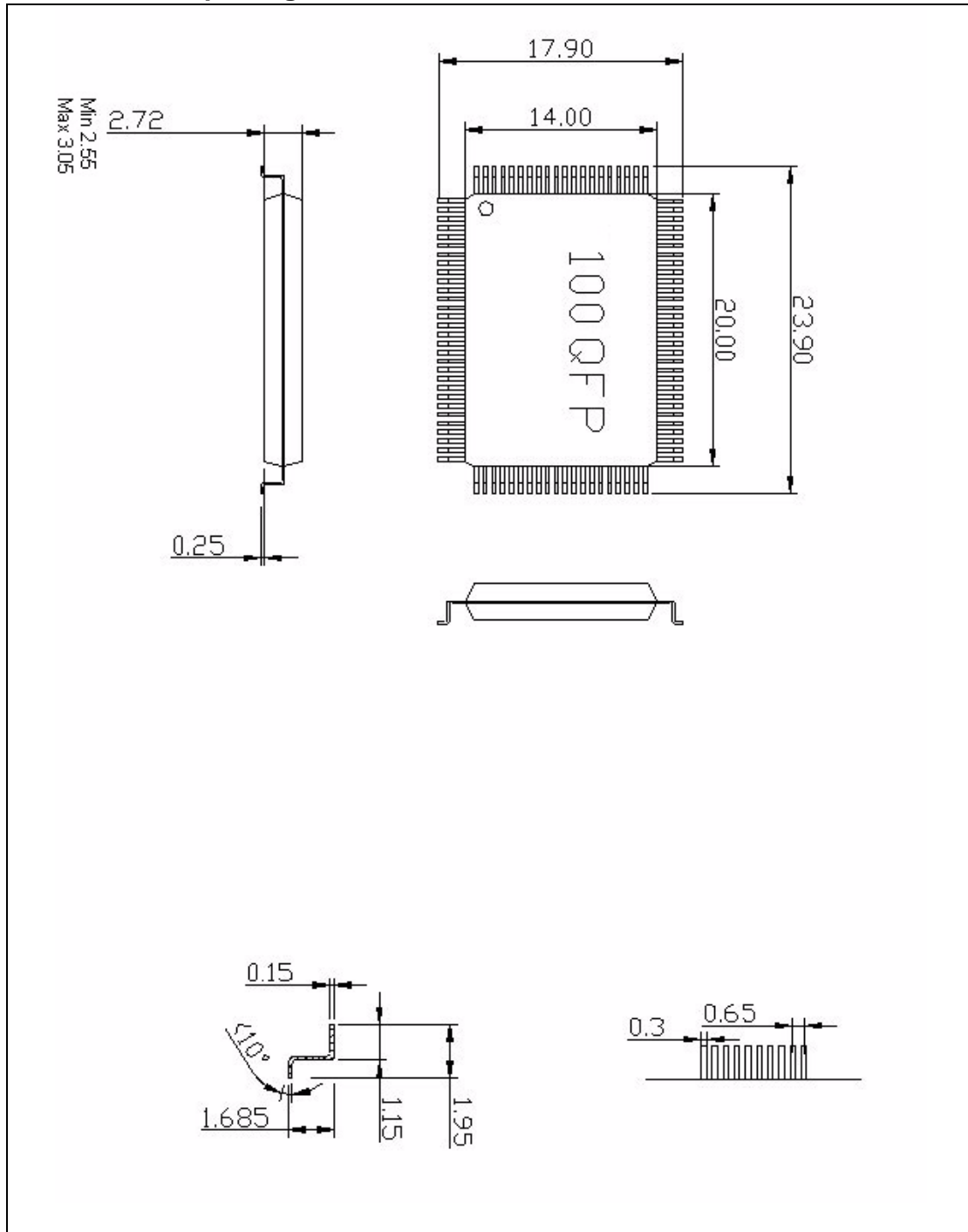


Figure 11 : STV0680B pinout in 100QFP package

8.3 STV0680B package dimensions



Note: Pin pitch is 0.65mm

9 VV6410/6411 pinout information and package dimensions

9.1 VV6410/6411 pinout

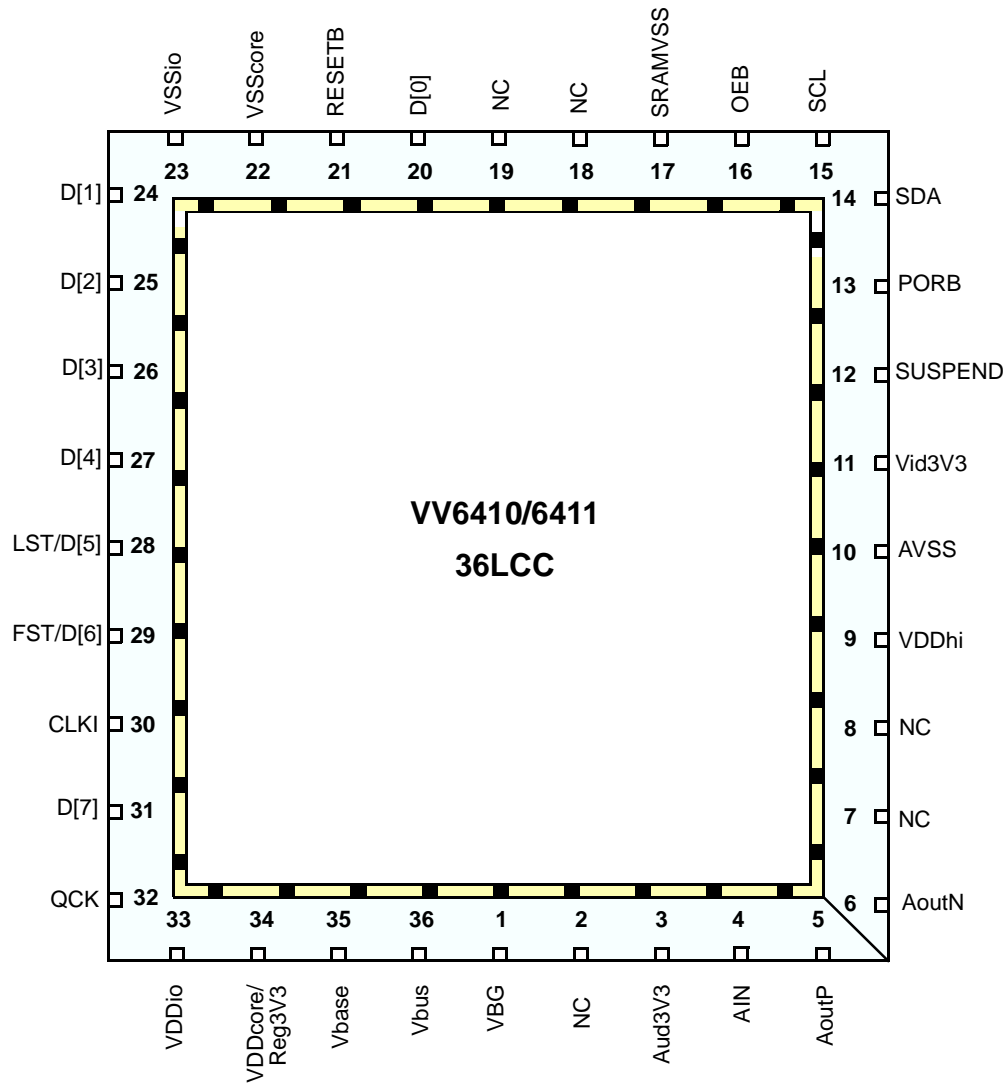


Figure 12 : 36 pin LCC package pin assignment

9.2 VV6410/6411 pin description

| Name | Pin Number | Type | Description |
|--------------------------------|------------|------|--|
| Power supplies | | | |
| AVSS | 10 | GND | Core analogue ground and reference supplies. |
| SRAMVSS | 17 | GND | In-column SRAM analogue 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. |
| Analogue signals | | | |
| VBG | 1 | OA | Internally generated bandgap reference voltage 1.22V |
| AIN | 4 | IA | Analogue input to Audio Amplifier |
| AOutP | 5 | OA | Analogue output of Audio Amplifier (positive) |
| AOutN | 6 | OA | Analogue 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]. |
| 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. |

Table 20 : VV6410 pin description

| Name | Pin Number | Type | Description |
|--------------------------------|-----------------|------|---|
| 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 | 2, 7, 8, 18, 19 | | Not connected |

Table 20 : VV6410 pin description

| 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 | Tri-stateable Digital Output |

Note: 1 Early VV6410/6411 pre-production samples were 48LCC, however the sampling and production package is 36LCC.

9.3 VV6410/6411 package dimensions

(36pin LCC).

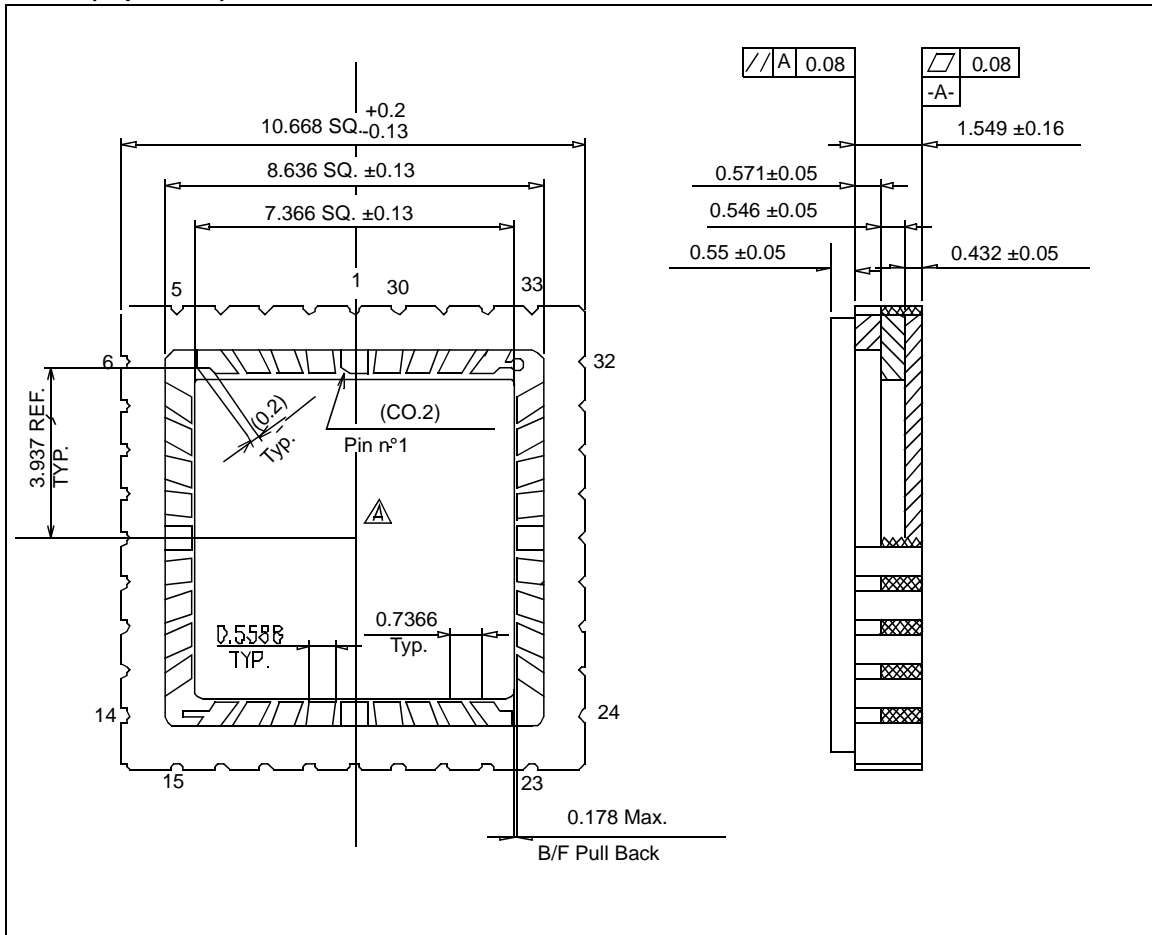


Figure 13 : VV6410/6411 36LCC Package Detail

Note: 1 Die is optically centred

2 Refractive Index of Glass is approx. 1.52

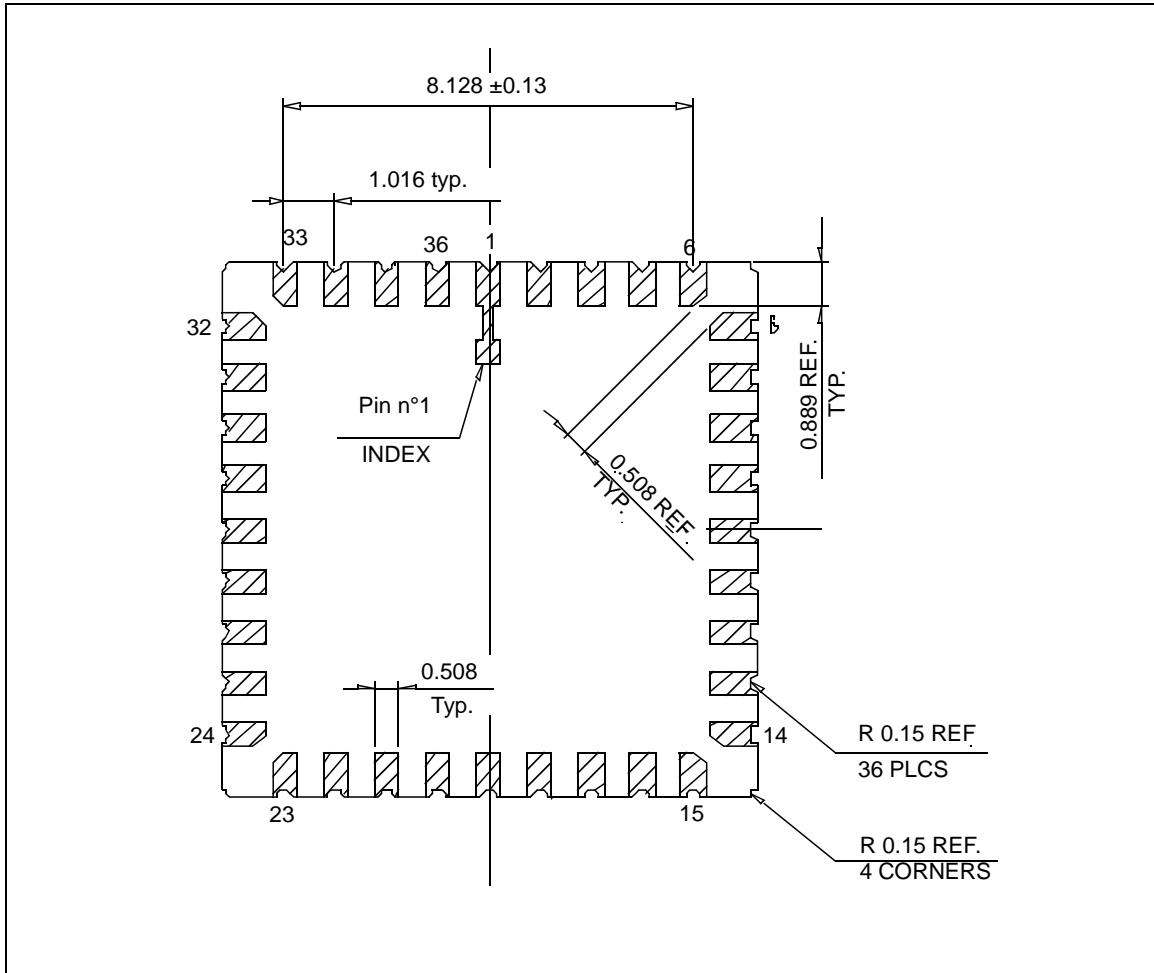


Figure 14 : VV6410/6411 36LCC Package Detail

Note: 1 Die is optically centred

2 Refractive Index of Glass is approx. 1.52

10 VV6500 pinout information and package dimensions

10.1 VV6500 pinout

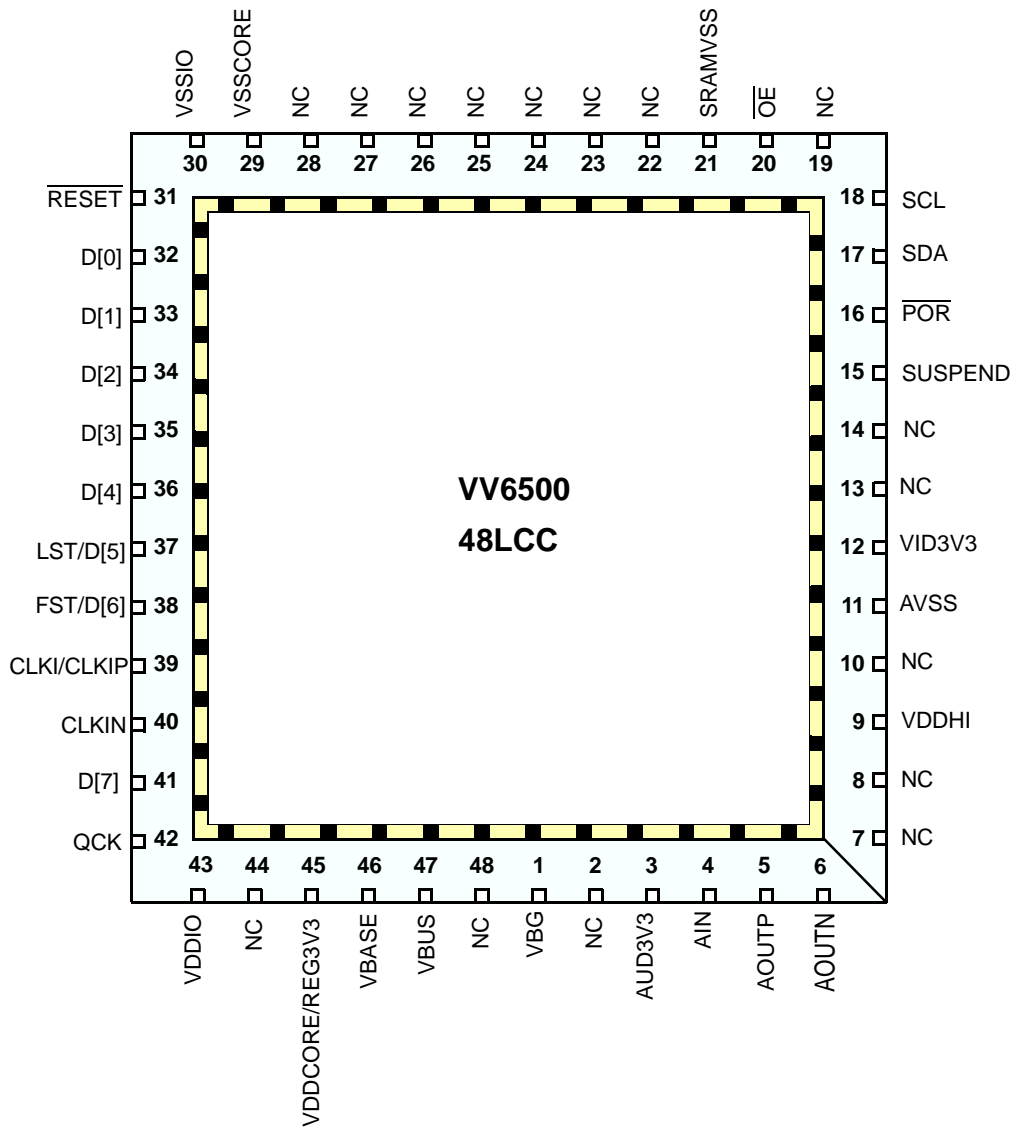


Figure 15 : 48 pin LCC package pin assignment

10.2 VV6500 pin description

| Name | Pin Number | Type | Description |
|-------------------------|------------|------|--|
| Power supplies | | | |
| AVSS | 11 | GND | Core analogue ground and reference supplies. |
| SRAMVSS | 21 | GND | In-column SRAM analogue ground. |
| 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. |
| Analogue signals | | | |
| VBG | 1 | OA | Internally generated bandgap reference voltage 1.22V |
| AIN | 4 | IA | Analogue input to Audio Amplifier |
| AOutP | 5 | OA | Analogue output of Audio Amplifier (positive) |
| AOutN | 6 | OA | Analogue 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 |
| VDDCORE/ 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. |

Table 21 : VV6500 pin description

| Name | Pin Number | Type | Description |
|--------------------------------|---|------|---|
| 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. |
| 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 | 2, 7, 8, 10,13, 14, 19, 22-28, 48 | | Not connected |

Table 21 : VV6500 pin description

| 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 | Tri-stateable Digital Output |

10.3 VV6500 package dimensions

(48 pin LCC)

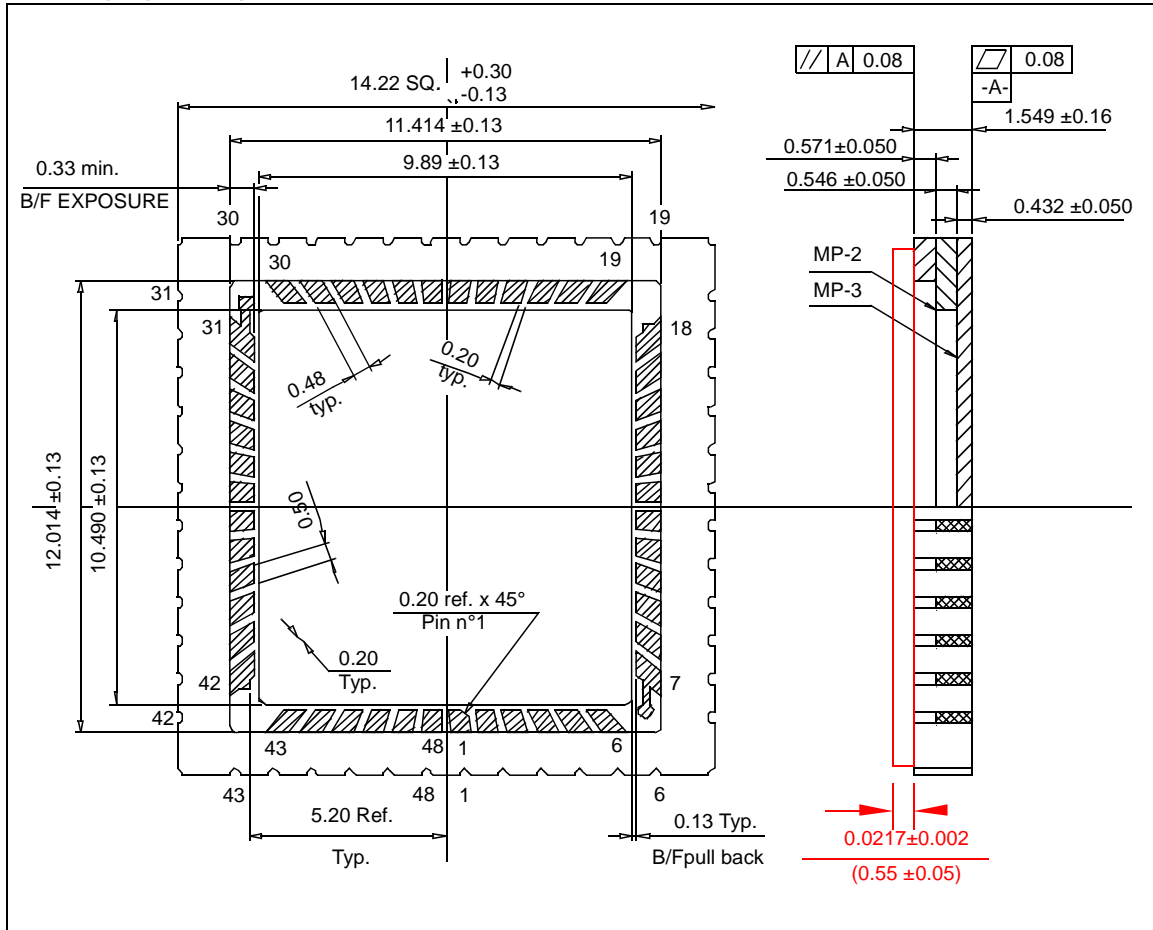


Figure 16 : VV6500 Package details

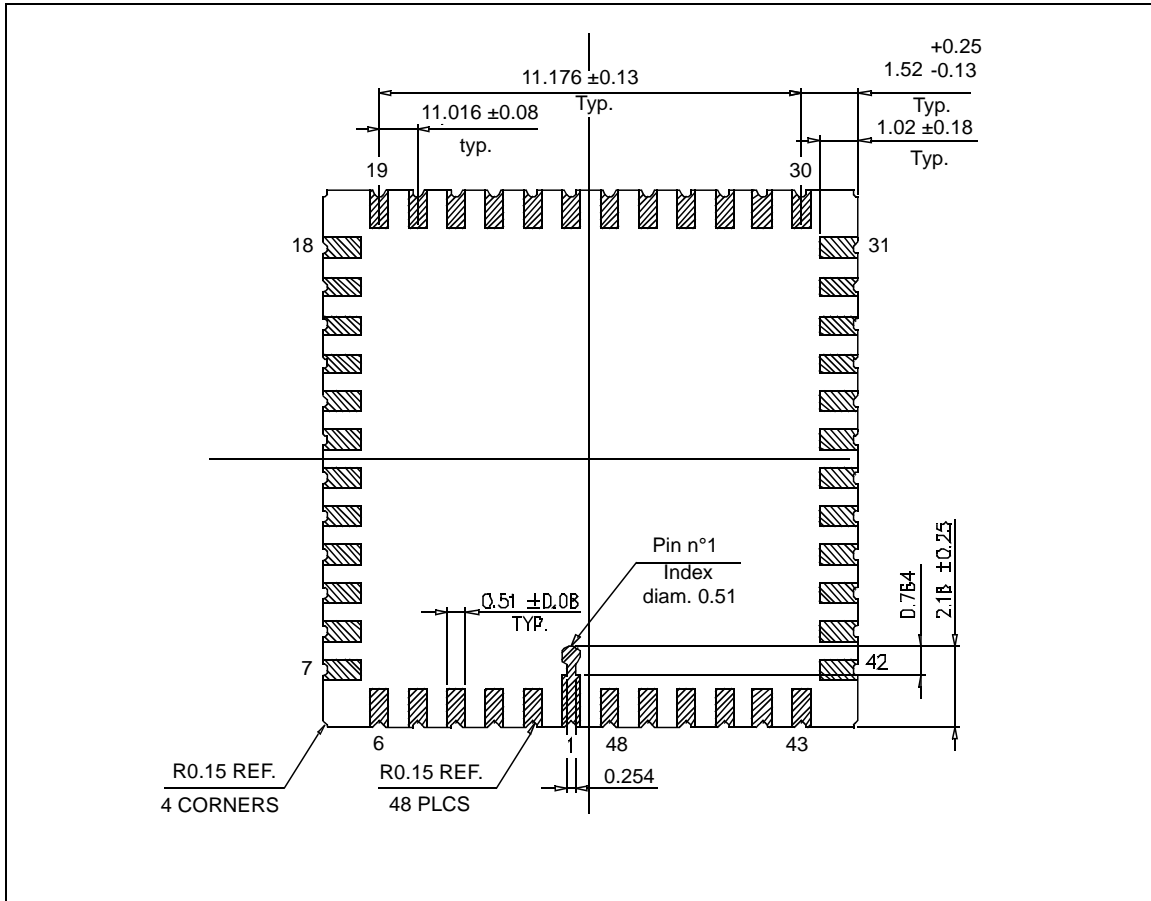


Figure 17 : VV6500 Package details

Note: 1 Die is optically centred

2 Refractive Index of Glass is approx. 1.52

11 Schematics and example parts list

11.1 Schematics

Support schematics are shown in the following documents:

- STV0680+VV6444 Reference Design Manual
- STV0680B+VV6410/6411/6500 Reference Design Manual

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

<http://www.st.com> (click on “Imaging Products”)

An example parts list is shown in [Section 11.2](#), however the above documents should be referred to for the most up-to-date information.

11.2 Example parts list

The following is taken from STV0680B + VV6410/6411/6500 Ref Design Manual Rev 2.2. Audio and Flashgun hardware are not included.

Assuming VV6410/6411 camera with power supply “option1”, 16MBit SDRAM and 6V battery, with USB and RS232, non-populated options are shown with a grey background.

| # | Qty | Refdes | Device | Package | Value | Notes |
|----|-----|---|----------|-----------|----------|--|
| 1 | 1 | B1 | Battery | | | Up to 6V, or up to 9V with different schematic |
| 2 | 1 | C23 | CAP | 805 | 100N | |
| 3 | 20 | C2,C7, C8, C10, C11, C12, c13, C14, C17, C18, C24, C25, C27, C28, C29, C30, C31, C32, C33, C37 | CAP | 805 | 100N | |
| 4 | 2 | C40, C41 | CAP | 805 | 100N | C40-41: option 2 only |
| 5 | 2 | C5, C6 | CAP | 805 | 22P | |
| 6 | 2 | C15, C16 | CAP | 805 | 1U | |
| 7 | 2 | C19, C26 | CAP | 805 | 220P | |
| 8 | 1 | C22 | CAP | 805 | 220N | |
| 9 | 2 | C34, C35 | ECAP | T/H | 10U | |
| 10 | 1 | C38 | ECAP | T/H | 10U | C38: option 2 only |
| 11 | 1 | D1 | 1N4001 | D041 | 1N4001 | Gen. purpose if 4 x A4 or AA batteries |
| 12 | 1 | D1 | Schottky | D041 | Schottky | Only use Schottky if 3 x AA or AAA batteries |
| 13 | 1 | D2 | Diode | SOT23 | BAS116 | Must be low leakage |
| 14 | 2 | D3,D4 | Diode | SOT23 | BAS16 | Only for RS232 |
| 15 | 3 | F1, F2, F3 | Ferrite | 805 | | May be required for FCC compliance |
| 16 | 1 | J1 | USB_CON | CON-USB-4 | P_TYPE_B | See notes. Consult USB spec for USB compliance |

Table 22 : STV0680B + VV6410/6411/6500 - Parts list

| # | Qty | Refdes | Device | Package | Value | Notes |
|----|-----|------------------------------|----------|-----------|-------|---|
| 17 | 1 | J2 | JACK_SKT | SCJ-0355- | B | Only for RS232 |
| 18 | 1 | LCD1 | 2DIGITLC | | | |
| 19 | 1 | LED1 | LED | 2PINTHRU | | Could be omitted for reduced current cons. |
| 20 | 1 | Q1 | NPN | SOT23 | BC848 | |
| 21 | 2 | Q2, Q3 | NPN | SOT23 | BC848 | |
| 22 | 1 | Q4 | NPN | SOT23 | | |
| 23 | 1 | Q5 | PNP | SOT23 | BCW61 | For USB inrush protection |
| 24 | 1 | Q6 | PNP | SOT23 | | Only for RS232 |
| 25 | 1 | Q8 | SI2301DS | SOT23 | | For USB inrush protection |
| 26 | 1 | Q9 | SI2301DS | SOT23 | | |
| 27 | 1 | Q10 | SI2301DS | SOT23 | | |
| 28 | 1 | Q12 | SI2301DS | SOT23 | | Only for option 2. Switches sensor off in standby mode |
| 29 | 1 | R1 | RES | 805 | 220K | |
| 30 | 1 | R72 | RES | 805 | 220K | R72 only req'd for RS232 camera with USB test points |
| 27 | 1 | R2 | RES | 805 | 1R2 | R2 for USB inrush protection |
| 28 | 2 | R9, R55 | RES | 805 | 100K | |
| 29 | 1 | R54 | RES | 805 | 100K | R54: option 1 only |
| 30 | 1 | R59 | RES | 805 | 100K | R59 only re'q'd for RS232 camera with USB test points |
| 31 | 1 | R12 | RES | 805 | 100K | R12 for USB inrush protection |
| 32 | 5 | r10, R13, R14, R16, R23 | RES | 805 | 1M | |
| 33 | 1 | R71 | RES | 805 | 1M | Only for RS232 camera <i>without</i> USB for production test |
| 34 | 1 | R7 | RES | 805 | 470K | |
| 35 | 1 | R8 | RES | 805 | 82K | |
| 36 | 1 | R11 | RES | 805 | 330K | Suggested value for 6V battery |
| 36 | 1 | R11 | RES | 805 | 510K | Suggested value for 4.5V battery |
| 36 | 1 | R11 | RES | 805 | | Suggested value for 9V battery (different schematic) |
| 36 | 1 | R66 | RES | 805 | 0R | |
| 37 | 1 | R6 | RES | 805 | 0R | Only fit if no USB inrush protection required |
| 38 | 3 | R37, R61, R66 | RES | 805 | 0R | R37, R61, R66: option 2 only |
| 39 | 1 | R65 | RES | 805 | 0R | Only for camera with no RS232 |
| 40 | 4 | R43, R44, R62, R63 | RES | 805 | 0R | R43, R44: option 1 only R62, R63: option 1 only |
| 41 | 1 | R17 | RES | 805 | 33R | |
| 42 | 2 | R19, R20 | RES | 805 | 24R | |
| 43 | 1 | R22 | RES | 805 | 120K | |
| 44 | 5 | R24, R67, R68, R69, R70 | RES | 805 | 0R | R24: only fit for 60Hz flicker select |
| 45 | 6 | R25, R31, R32, R33, R34, R35 | RES | 805 | 10K | R25: R24: only fit for 50Hz flicker select R31-R35: only for RS232 |
| 46 | 2 | R28, R29 | RES | 805 | 330K | |
| 47 | 1 | R41 | RES | 805 | 10K | |
| 48 | 1 | R30 | RES | 805 | 2K2 | |

Table 22 : STV0680B + VV6410/6411/6500 - Parts list

| # | Qty | Refdes | Device | Package | Value | Notes |
|-------|-----|------------------------------|---------------------|--------------|--------------|---|
| 49 | 1 | R21 | RES | 805 | 1K5 | |
| 50 | 1 | R64 | RES | 805 | 1K5 | Only for RS232 camera <i>without</i> USB for production test |
| 51 | 1 | R36 | RES | 805 | 680R | Value depends on LED1 type |
| 52 | 2 | R39, R40 | RES | 805 | 4K7 | |
| 53 | 1 | R50 | RES | 805 | 390R | |
| 54 | 1 | SW1 | TOGGLE_S | SWITCH | | Optional battery off switch when not in use (would lose store images) |
| 55 | 2 | SW2, SW3 | PUSH_SWI | TC FARNEL | 58 | Push button switches |
| 56 | 1 | SW4 | TOGGLE_S | SWITCH | | Only required for user selection of flicker frequency (see alternate schematic and explanatory notes) |
| 57 | 1 | T1 | PIEZO | FARNELL_9 | 26 | |
| 58 | 6 | TP1, TP2, TP3, TP4, TP5, TP6 | TESTPOINT | TP | | Only required for RS232 camera with USB production Test (lens focusing) |
| 59 | 1 | U2 | VV6500 | 48LCC | | VGA sensor (different footprint to VV6410) |
| 60 | 1 | U3 | STV0680B | 100QFP | | Only require U2 or U6 STV0680 or STV0680A also suitable |
| 61 | 1 | U4 | GM72V661 | 64 400MIL_OP | | SDRAM dual footprint is possible for U4 and U5 |
| 62 | 1 | U5 | GM72V161 | 62 400MIL_OP | | Preferred SDRAM has low self refresh Idd. e.g. (16Mbit) LG semicon: GM72V16162ET75 Hyundai: HY57V161610DTC-7 Micron: MT48LC1M16A1TG S Samsung: KM416S11200T-G10 |
| 63 | 1 | U6 | VV6410 | 36LCC | | CIF sensor (different footprint to VV6500) only require U2 or U6 |
| 64 | 1 | U8 | Power-on-reset chip | SOT23 | 2.7-2.93V | U8 only for option 2 e.g. MAXIM MAX809SEURT (2v93 threshold) TELCOM TCM809SENB (2v93 threshold) DALLAS DS1233 (SOT223) |
| 65 | 1 | U10 | 5VREG | SOT89-5 | XC62HR500 2 | U10 only required for 9V battery |
| 66 | 1 | U11 | 3V3REG | SOT89 | MC78FC33H T1 | U11 only for option2 |
| 67 | 1 | X1 | XTAL | HC49U | 12MHz | |
| 68 | 1 | Lens | | | | Lens with IR filter |
| Total | 131 | | | | | |

Table 22 : STV0680B + VV6410/6411/6500 - Parts list

Note: Not all compatible memory chips exhibit a low enough **self-refresh current** to meet the target current for USB suspend mode (see [Table 17](#)). Two memory types have been suggested in [Table 18](#), 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

12 Evaluation Kit and Reference design manual

STMicroelectronics recommends using the Evaluation Kit for initial evaluation and design-in.

Both evaluation kits (**STV-DCA/CIF-E04** and **STV-DCA/VGA-E04**) now include audio record and playback circuitry as well as flashgun interface circuitry and a flashgun hotshoe connector (to allow the OEM to use a standard camera flashgun), allowing the new features as well as the existing features to be demonstrated.

Also included are a STV0680B + CMOS sensor chipset, memory, lens, connectors, LCD, battery holder, push buttons/switches, and other components as detailed. Optional PCB links enable alternate functionality, and demonstration software is included, allowing for tethered video, upload to the PC of pictures, sounds, and AVI movie clips, and download to the camera of custom sounds.

A reference design manual is available, giving the camera designer everything required to design a complete camera with standard features. It includes schematics, explanatory notes, parts list and layout advice. Audio and flashgun hardware are the subject of separate applications notes, contact ST for details.

12.1 Ordering details

| Description | Part number |
|--|-----------------|
| 36pin LCC, CIF CMOS sensor | VV6410C036 |
| | VV6411C036 |
| 48pin LCC, VGA CMOS sensor | VV6500C001 |
| Standard features | |
| STV0680B companion processor | STV0680B-001 |
| Evaluation Kit for STV0680B+VV6410 | STV-DCA/CIF-E01 |
| Evaluation Kit for STV0680B+VV6500 | STV-DCA/VGA-E01 |
| “Standard” + “New” features: Including Audio, Custom sounds, and Flashgun | |
| STV0680B companion processor | STV0680B-003 |
| Evaluation Kit for STV0680B+VV6410 | STV-DCA/CIF-E04 |
| Evaluation Kit for STV0680B+VV6500 | STV-DCA/VGA-E04 |

Table 23 : Ordering details for the STV0680B + VV6410/6411/6500

12.2 Technical support

Technical support information, such as datasheets, software downloads, etc, for products of the STMicroelectronics Imaging Division can be found at <http://www.vvl.co.uk/> or www.st.com (click on Imaging products)

General sales/technical enquiries can be directed to regional email contacts:
asiapacific.imaging@st.com

centraleurope.imaging@st.com

france.imaging@st.com

japan.imaging@st.com

nordic.imaging@st.com

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