



Single-chip USB/PS2 optical mouse

Preliminary Data

Features

- Single chip design with minimal support circuitry
- USB and PS2 operation
- Single +5 V supply
- No mechanical moving parts required
- 800 cpi resolution (400 cpi selectable)
- 9600 frames per second
- Tracking at up to 40 ips
- Up to 5 switch inputs and scroll wheel
- Possible customizing for VID, PID and descriptor string with external EEPROM
- Proven, high volume package technology

Description

The VT5363 optical tracking sensor is a complete solid state tracking engine with no moving parts. This single chip optical mouse sensor provides excellent control and precision and works on a wide range of surfaces.

The VT5363 supports 2, 3 or 5 button mouse designs with a mechanical scroll wheel encoder. It contains a dual USB/PS2 interface with automatic interface selection and may be powered directly from the USB or PS2 port. A single 6MHz resonator provides all the clock requirements and a minimum of additional passive components are required.

An external EEPROM may be used to implement customer specific USB configurations (PID, VID and descriptor string).

A specifically designed optical system with integrated light guide and lens is available. This has been optimized for low cost, space saving and ease of mouse manufacture. No kapton tape is required in the assembly process.

Applications

- Optical USB/PS2 mouse for desktop PC, workstation and laptop

Technical specifications

| | |
|-----------------------------------|------------------------------------|
| Resolution | 800 CPI (400 selectable) |
| Pixel size | 30.4 μm |
| Array size | 20*20 pixels |
| Frame rate | 9600 frames/second |
| High Speed Motion Detector | Accurate motion up to 40 ips |
| Clock | 6 MHz resonator |
| Supply voltage | 5 V direct from USB or PS2 port |
| Supply current | 15mA (typ.) (excludes LED) |
| Operating temperature | [0: 60] °C |
| Package type | 7*7mm 32 lead LOQFP ⁽¹⁾ |

1. LOQFP: Low profile Optical Quad Flat Pack

Order codes

| Part Number | Description |
|-------------|------------------------------|
| VT5363V032 | USB/PS2 optical mouse sensor |

Contents

- 1 Introduction 6**
- 2 Design notes 7**
 - 2.1 Pin assignment 7
 - 2.2 Pin description 8
 - 2.3 Reference schematic 9
 - 2.4 Bill of materials - BOM 10
 - 2.5 Switches 10
 - 2.6 Scroll wheel 10
 - 2.7 Driving the navigation LED 11
 - 2.8 LNK_LED output 11
 - 2.9 Optical centre 11
 - 2.10 Sensor orientation on PCB 12
- 3 Configuring the VT5363 13**
 - 3.1 Selecting USB or PS2 operation 13
 - 3.2 Selecting mouse configuration 13
 - 3.3 Changing the CPI 13
 - 3.4 External EEPROM 13
 - 3.5 EEPROM data format 14
 - 3.6 Application support 15
- 4 Optics assembly 16**
 - Mouse assembly guidelines 18
- 5 LED selection 19**
 - 5.1 Overview 19
 - 5.2 Key LED parameters 19
 - 5.3 VCSEL and IR illumination 19
- 6 Electrical characteristics 20**
- 7 Typical performance characteristics 21**

| | | |
|----------|----------------------------------|-----------|
| 8 | Package information | 22 |
| 8.1 | Package mechanical data | 22 |
| 8.2 | LOQFP package guidelines | 23 |
| 9 | Revision history | 24 |

List of tables

| | | |
|----------|----------------------------------------------|----|
| Table 1. | VT5363 pin description | 8 |
| Table 2. | Bill of materials: main components | 10 |
| Table 3. | Configuration selection | 13 |
| Table 4. | Example EEPROM contents. | 14 |
| Table 5. | Key LED parameters | 19 |
| Table 6. | Typical operating conditions | 20 |
| Table 7. | LQFP dimensions (mm) | 23 |
| Table 8. | Document revision history | 24 |

List of figures

| | | |
|------------|-------------------------------------------------------------------|----|
| Figure 1. | VT5363 block diagram | 6 |
| Figure 2. | VT5363 pin assignment | 7 |
| Figure 3. | VT5363 reference schematic | 9 |
| Figure 4. | VT5363 optical centre | 11 |
| Figure 5. | VT5363 orientation | 12 |
| Figure 6. | STV-363-R01 - USB/PS2 mouse reference design board | 15 |
| Figure 7. | Lens and light guide | 16 |
| Figure 8. | 2D assembly drawing of VT5363 (exploded view) | 17 |
| Figure 9. | Typical resolution versus height | 21 |
| Figure 10. | LQFP32 clear resin body 7.0 x 7.0 x 1.40 foot print 1.0 | 22 |

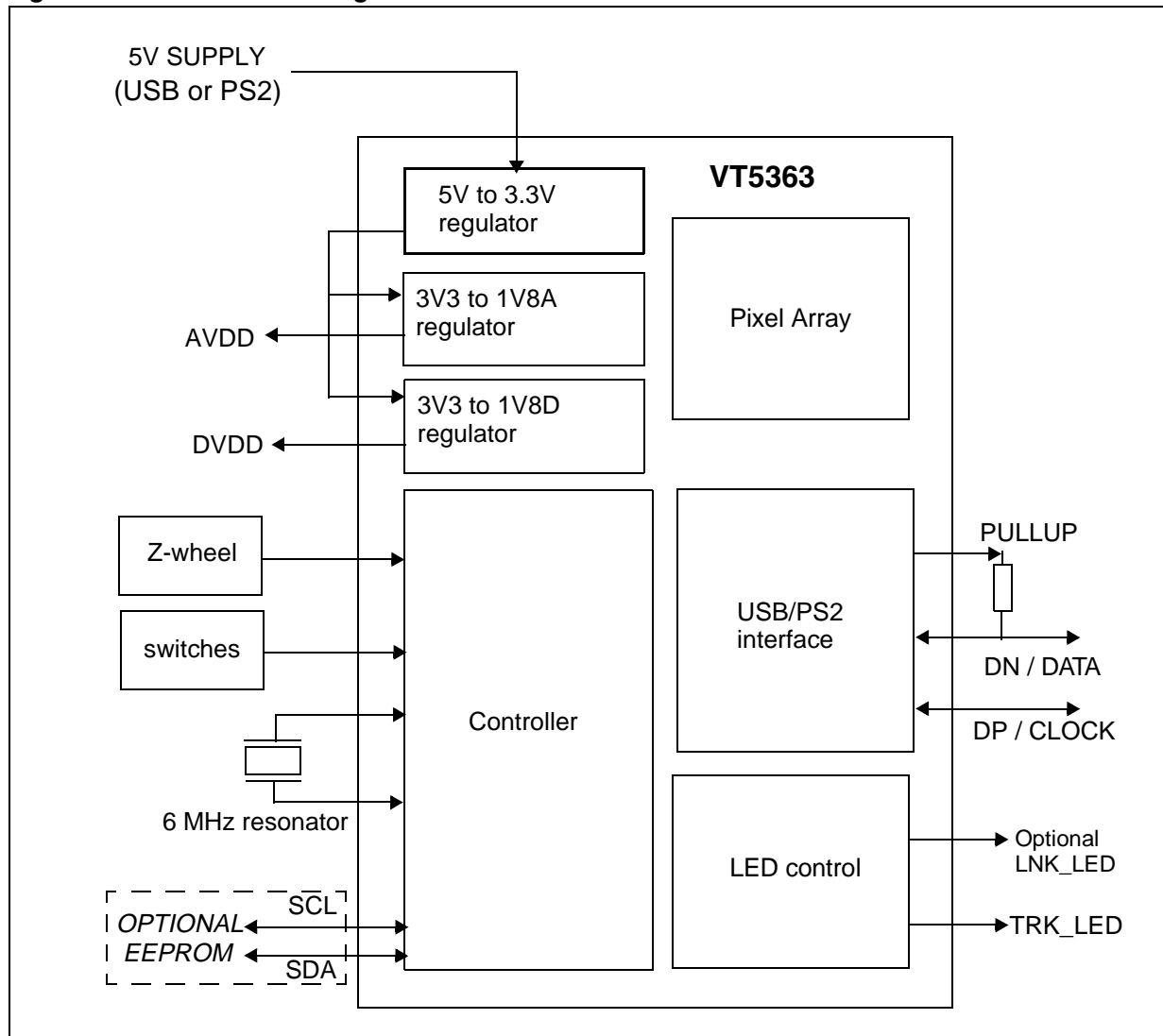
1 Introduction

The VT5363 sensor is a single-chip solid state optical tracking engine with no moving parts. It allows the creation of a high performance, fully featured mouse with the minimum of external components. The device provides excellent navigation control and precision and works on a wide range of surfaces.

VT5363 incorporates features that simplify product design and reduce time to market. By minimising the number of external components, the mouse manufacturer has flexibility for layout and product design.

ST has worked with optical component suppliers to produce a single piece light guide with integrated lens, and recommendations for a compatible LED. Details of the optics and LED are included in this datasheet. The main functional blocks of the VT5363 are shown in [Figure 1](#).

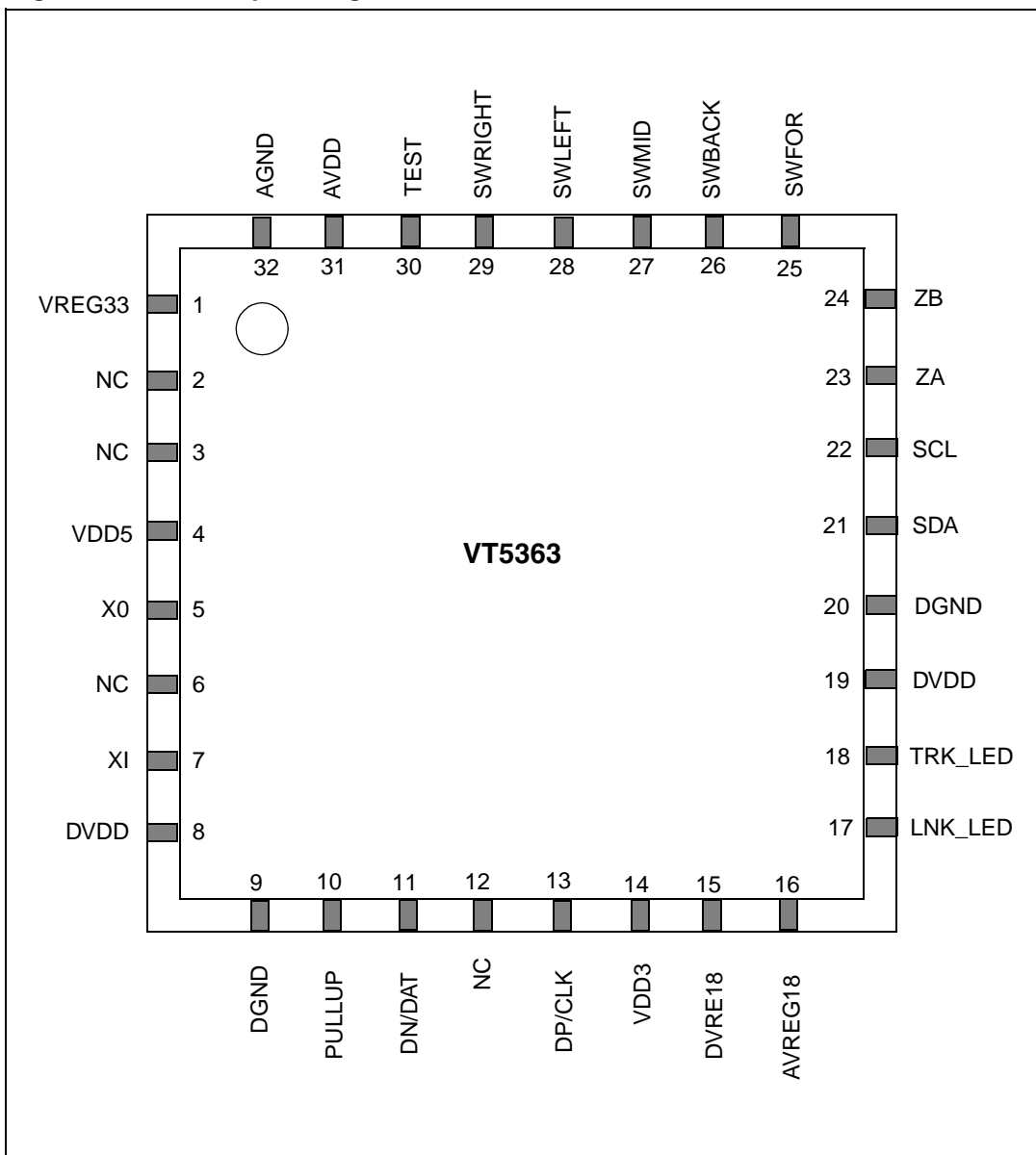
Figure 1. VT5363 block diagram



2 Design notes

2.1 Pin assignment

Figure 2. VT5363 pin assignment



2.2 Pin description

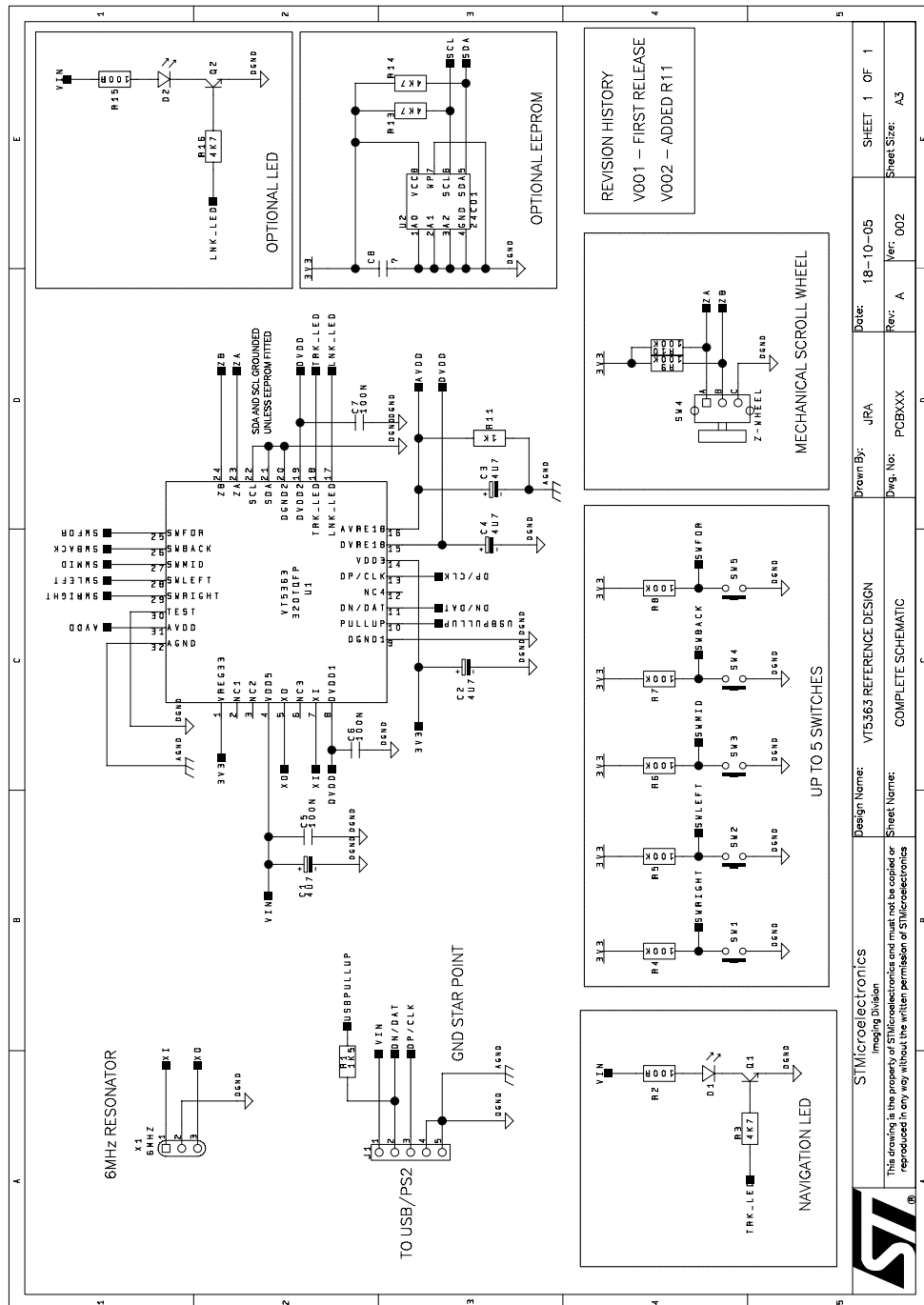
Table 1. VT5363 pin description

| Pin N° | Pin name | Type | Comment |
|--------|----------|------|----------------------------------------------------|
| 1 | VREG33 | PWR | 3.3 V regulator output |
| 4 | VDD5 | PWR | 5V supply - direct from USB or PS2 supply |
| 5 | X0 | OSC | 6MHz resonator |
| 7 | XI | OSC | 6MHz resonator |
| 8 | DVDD | PWR | 1.8V digital supply |
| 9 | DGND | PWR | Digital ground |
| 10 | PULLUP | I/O | connect 1K5 resistor from here to DN/DAT |
| 11 | DN / DAT | I/O | DN in USB mode, DATA in PS2 mode |
| 13 | DP/ CLK | I/O | DP in USB mode, CLOCK in PS2 mode |
| 14 | VDD3 | PWR | 3.3V supply |
| 15 | DVREG18 | PWR | 1.8V digital regulator output - use to drive DVDD |
| 16 | AVREG18 | PWR | 1.8V analogue regulator output - use to drive AVDD |
| 17 | LNK_LED | O | Status LED output |
| 18 | TRK_LED | O | Navigation LED output |
| 19 | DVDD | PWR | 1.8V digital supply |
| 20 | DGND | PWR | Digital ground |
| 21 | SDA | I/O | I2C SDA line |
| 22 | SCL | I/O | I2C SCL line |
| 23 | ZA | I/O | Z-wheel input A |
| 24 | ZB | I/O | Z-wheel input B |
| 25 | SWFOR | I/O | 'Forward' switch input (active low) |
| 26 | SWBACK | I/O | 'Back' switch input (active low) |
| 27 | SWMID | I/O | 'Middle' switch input (active low) |
| 28 | SWLEFT | I/O | 'Left' switch input (active low) |
| 29 | SWRIGHT | I/O | 'Right' switch input (active low) |
| 30 | RESERVED | I | Connect to GROUND |
| 31 | AVDD | PWR | 1.8 V analogue supply |
| 32 | AGND | PWR | Analogue ground |

Note: All other pins are NOT CONNECTED

2.3 Reference schematic

Figure 3. VT5363 reference schematic



STMicroelectronics
Imaging Division
This drawing is the property of STMicroelectronics and must not be copied or reproduced in any way without the written permission of STMicroelectronics

Design Name: VT5363 REFERENCE DESIGN
Sheet Name: COMPLETE SCHEMATIC

Drawn By: JRA
Dwg. No: PCBXXX
Rev: A

Date: 18-10-05
Ver: 002
SHEET 1 OF 1
Sheet Size: A3

2.4 Bill of materials - BOM

Table 2. Bill of materials: main components

| Ref. | Description | Manufacturer | Part number |
|------------------------------------------------|--------------------------------------|----------------------------------------------|-----------------|
| U1 | Optical mouse sensor | STMicroelectronics | VT5363V032 |
| X1 | 6MHz resonator | Murata | CSTLA6M00G55-B0 |
| D1 | Navigation LED | See Chapter 5: LED selection | |
| SW1-4 | Switches | Omron | D2F series |
| SW5 | Mechanical encoder (scroll-wheel) | Alps | EC10E series |
| Q1 | NPN bipolar transistor (to drive D1) | Standard component - many suppliers | |
| C1-C4 | 4u7 tantalum capacitor | Standard component - many suppliers | |
| C5-C7 | 100nF ceramic capacitor | Standard component - many suppliers | |
| R1 | 1k5 resistor | Standard component - many suppliers | |
| R4-R10 | 100k resistors | Standard component - many suppliers | |
| R11 | 1k resistor | Standard component - many suppliers | |
| Only required if EEPROM is fitted | | | |
| U2 | EEPROM | STMicroelectronics | M24C01W |
| R13,R14 | 10k resistors | standard component - many suppliers | |
| Additional items not mounted on the PCB | | | |
| | Optics Assembly | See STV-363-R01 Reference Design Manual | |
| | Aperture Stop | See STV-363-R01 Reference Design Manual | |
| | USB/PS2 cable | Standard component - many suppliers | |

2.5 Switches

The VT5363 supports up to 5 switch inputs. These switches provide the standard mouse functions of LEFT, RIGHT and MIDDLE as well as the advanced functions of BACK and FORWARD. The switch inputs are all active LOW. An external pull-up resistor is required between the switch input and the 3V3 supply.

2.6 Scroll wheel

The VT5363 supports the use of an external mechanical shaft encoder with quadrature outputs to act as a scroll wheel. The EC10E series from Alps are suitable. Pull-up resistors are required between the ZA and ZB outputs of the shaft encoder and the 3V3 supply. Note that the two quadrature outputs ZA and ZB are not interchangeable and must be connected correctly.

2.7 Driving the navigation LED

The VT5363 provides an output (NAV_LED) for driving the LED used to illuminate the mousing surface. This output is active HIGH but cannot be used to drive the navigation LED directly. An external NPN bipolar transistor is recommended as shown in the reference schematic. The maximum current through the LED is controlled by a resistor (R1 on the Reference Schematic).

2.8 LNK_LED output

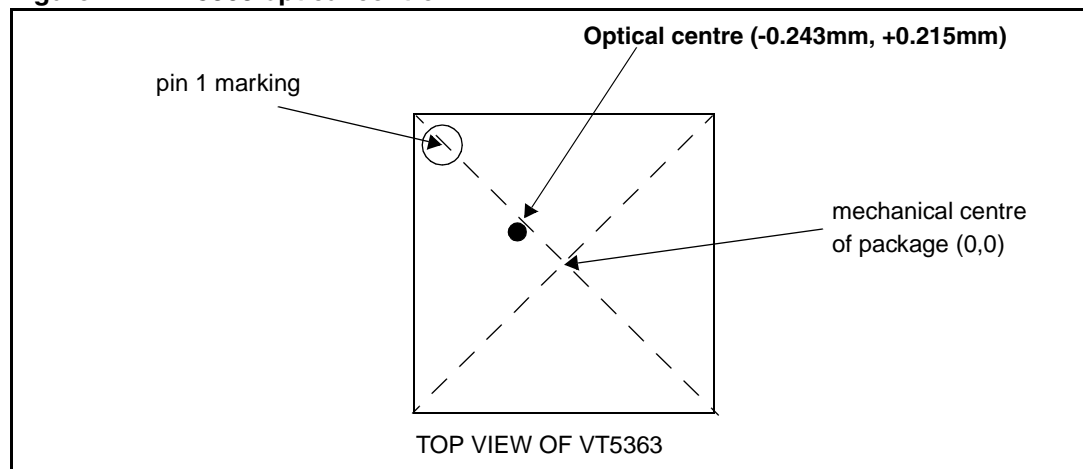
The VT5363 has an output (LNK_LED) which is high whenever the mouse is active (i.e. connected to a PC which is not in a suspend state).

The user does not need to use this output to produce a working mouse but it may be used to drive an additional LED for cosmetic purposes. An external bipolar transistor is required in the same way as the navigation LED.

2.9 Optical centre

The optical centre of the VT5363 is NOT in the centre of the package, it is offset by -0.243mm in the X-axis and 0.215mm in the Y axis with respect to the centre of the package as shown below. The PCB designer must take this into account when laying out the PCB.

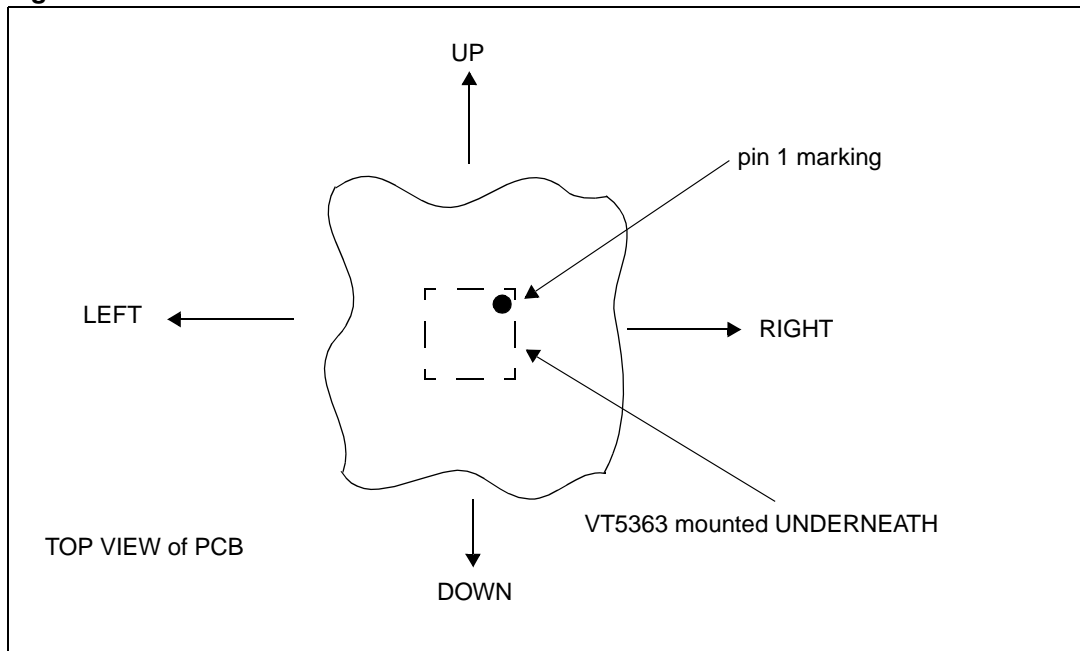
Figure 4. VT5363 optical centre



2.10 Sensor orientation on PCB

The VT5363 must be orientated correctly on the PCB in order to move the cursor in the correct directions when the mouse is moved. This is shown in [Figure 5](#).

Figure 5. VT5363 orientation



3 Configuring the VT5363

3.1 Selecting USB or PS2 operation

The selection of USB or PS2 interface is performed [automatically] by the VT5363 including a USB pull-up resistor connected between Pin No. 10 and the DN/DAT line.

3.2 Selecting mouse configuration

The VT5363 may be configured to be one of three different types of mouse.

- 2 button mouse
- 3 button mouse with scroll wheel
- 5 button mouse with scroll wheel

The configuration is achieved by connecting the unused switch inputs to the LNK_LED output (pin 17). All configurations will report a USB Vendor Identity (VID) of 0x0553 (ST Microelectronics Imaging Division). The three different configurations will result in 3 different USB Product Identities (PIDs) and descriptor strings as described in [Table 3](#).

Table 3. Configuration selection

| Mode | Inputs tied to LNK_LED | VID | PID | USB descriptor string |
|--------------|------------------------|--------|--------|--------------------------------------------|
| 2 button | SWBACK, SWFOR, SWMID | 0x0553 | 0x0A00 | '2 button optical mouse' |
| 3 button + Z | SWBACK, SWFOR | 0x0553 | 0x0A01 | '3 button optical mouse with scroll wheel' |
| 5 button + Z | none | 0x0553 | 0x0A02 | '5 button optical mouse with scroll wheel' |

A user who wishes to use their own PID, VID and descriptor string may use an external serial EEPROM to hold this information.

3.3 Changing the CPI

The default CPI 'Counts Per Inch' of the VT5363 is 800CPI, this can easily be toggled between 800/400CPI by the user, by simply holding down the left and right buttons till LNK_LED goes off. If the PC is shutdown or the mouse unplugged it will return to the default (800 CPI).

3.4 External EEPROM

The VT5363 supports the use of an external 128 byte serial EEPROM for holding customer specific information. EEPROM such as the M24C01W from STMicroelectronics are suitable. The EEPROM must be connected to the SDA and SCL pins of the VT5363. If no EEPROM is used then these lines should be tied to ground. The EEPROM cannot be programmed by the VT5363 itself and must be pre-programmed before being fitted to the final PCB.

3.5 EEPROM data format

A 128 byte serial EEPROM is used to hold USB configuration information. The lower 64 bytes hold USB PID, VID and string information as shown in the table below. The upper bytes may be used to hold special setup information, for example to set the resolution to 400cpi (contact STMicroelectronics for details).

Location 127 in the EEPROM must hold the number 0xAA and is used to detect that an EEPROM has been fitted. If location 127 does not contain 0xAA the EEPROM contents will be ignored.

Table 4. Example EEPROM contents

| EEPROM Location | Contains | Notes |
|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------------|
| 0 | VID (LSB) | Vendor ID (only one VID is stored for all 3 mouse configurations) |
| 1 | VID (MSB) | |
| 2 | PID (LSB) | Product ID for 2 button mouse |
| 3 | PID (MSB) | |
| 4 | PID (LSB) | Product ID for '3 button + Z' mouse |
| 5 | PID (MSB) | |
| 6 | PID (LSB) | Product ID for '5 button + Z' mouse |
| 7 | PID (MSB) | |
| 8 | 0x04 | Language ID Length |
| 9 | 0x03 | Language ID Type |
| 10 | 0x09 | Language ID (2 bytes) |
| 11 | 0x04 | (0x0904 = US English) |
| 12 | 0x0C | String ID Length = (number of characters in string *2) + 2 For the example string 'MOUSE' this is (2*5)+2 = 12 = 0x0C |
| 13 | 0x03 | String ID Type |
| 14 | 0x4D | ASCII code for first character of String (example for 'M') |
| 15 | 0x4F | ASCII code for first character of String (example for 'O') |
| 16 | 0x55 | ASCII code for first character of String (example for 'U') |
| 17 | 0x53 | ASCII code for first character of String (example for 'S') |
| 18 | 0x45 | ASCII code for first character of String (example for 'E') |
| 19 - 62 | 0xFF | Rest of lower half of EEPROM is available for longer strings, up to 50 characters maximum (set unused locations to 0xFF) |
| 64-126 | 0xFF | Leave upper half of EEPROM empty (may be used to hold special setup information - contact STMicroelectronics for details) |
| 127 | 0xAA | Special flag to indicate that EEPROM is present |

3.6 Application support

The user manual for the STV-363-R01 reference design board includes additional information and application support.

Figure 6. STV-363-R01 - USB/PS2 mouse reference design board



4 Optics assembly

The optics assembly is shown in *Figure 7* and *Figure 8*.

Figure 7. Lens and light guide

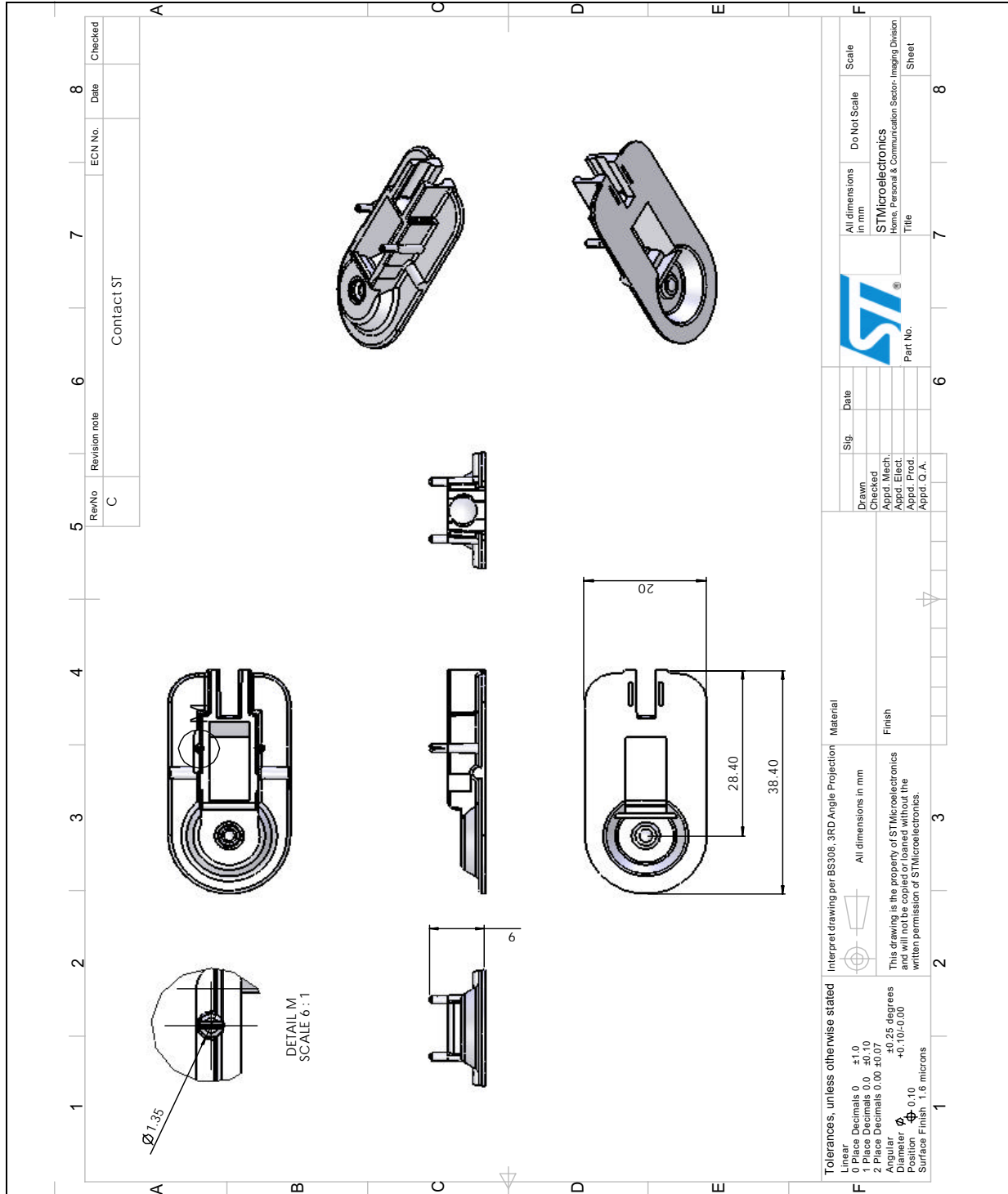
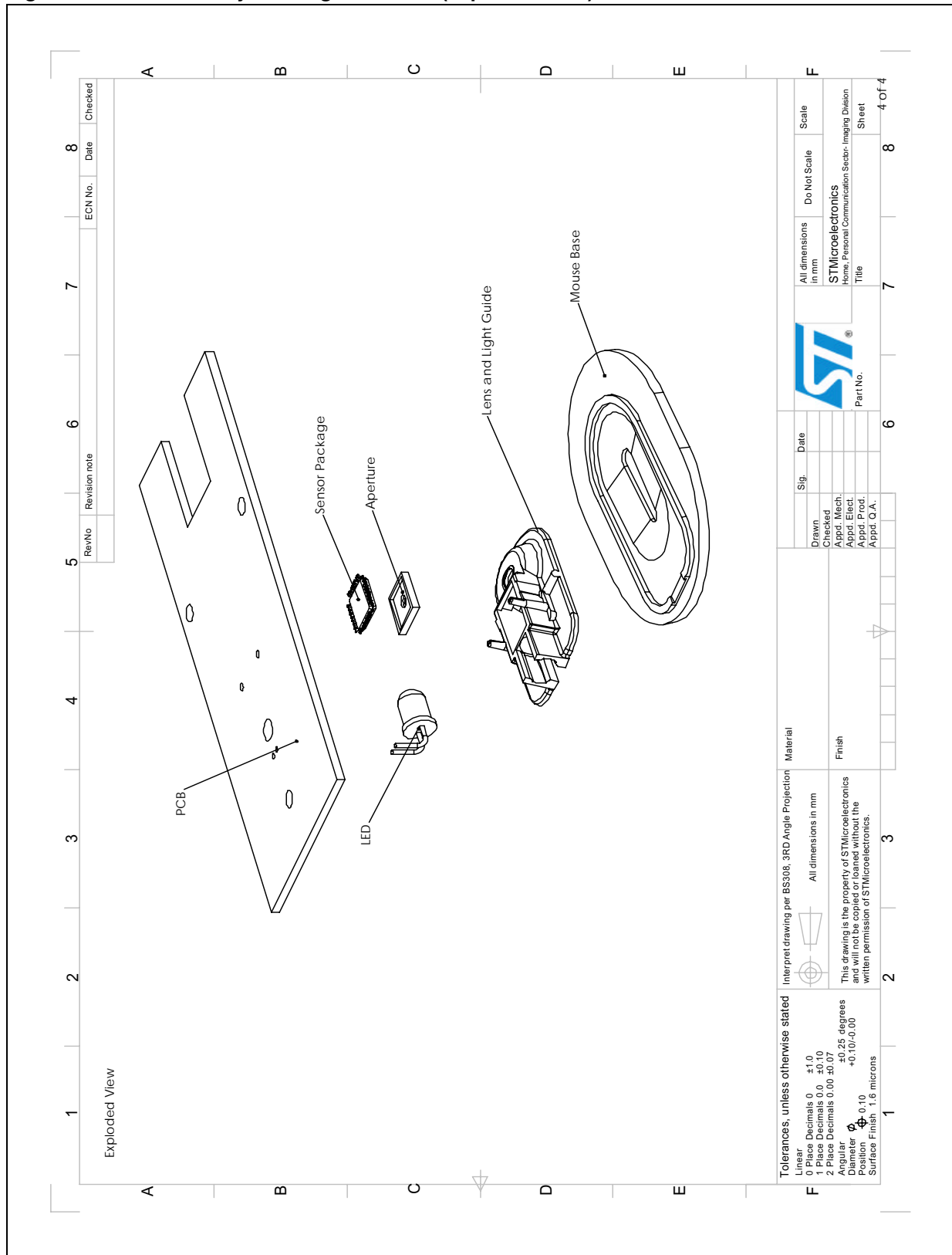


Figure 8. 2D assembly drawing of VT5363 (exploded view)



Mouse assembly guidelines

1. Attach the sensor and all other electrical components onto PCB with the exception of the navigation LED.
2. Form the LED leads and insert the LED into the optical assembly.
3. Fit the optics with aperture to the PCB using the guideposts and feed the navigation LED leads through their openings. Take care to keep contamination off the sensor surface. The aperture should self-align to the VT5363 package.
4. Route the USB/PS2 lead through the base plate then fit the base plate.
5. Solder the navigation LED leads and trim.
6. Add mouse top case and feet.

Note: For more details on the optics (including manufacturers), please refer to the STV-363-R01 user manual.

5 LED selection

5.1 Overview

There are a number of LEDs from a range of suppliers which will work well with the VT5363. It is the responsibility of the customer to ensure that the chosen LED works in their specific implementation. There are various price/performance trade-offs which may be made if the customer chooses to do so.

5.2 Key LED parameters

The VT5363 system requires a bright visible RED LED in a standard 5mm (T1 3/4) package. The ideal viewing angle is 20° and the intensity should be at least 900mcd at a forward current of 20 mA. The key LED parameters are listed in [Table 5](#).

Table 5. Key LED parameters

| Parameter | Recommended Value | Notes |
|----------------------------|-------------------|-----------------------------------------------------|
| Diameter | 5mm | Important for fit with lens |
| Length | 8.6mm | Important for fit with lens |
| Material | AlInGaP | For long-term reliability |
| Luminous Intensity (@20mA) | 900mcd | Minimum value |
| Viewing Angle | 20° | Half intensity |
| Mechanical accuracy | +/- 2° | Accuracy of the die positioning within the LED body |
| Colour | Red | |
| Wavelength | 640nm +/- 50nm | |

5.3 VCSEL and IR illumination

The VT5363 sensor will operate over a wide range of illuminant wavelengths. For devices operating at approx 850 nm (IR LED or VCSEL), the on-die automatic exposure controller (AEC) will compensate for the change in sensitivity compared to 640nm (red LED). Navigation performance may be improved by increasing the illuminated device drive.

6 Electrical characteristics

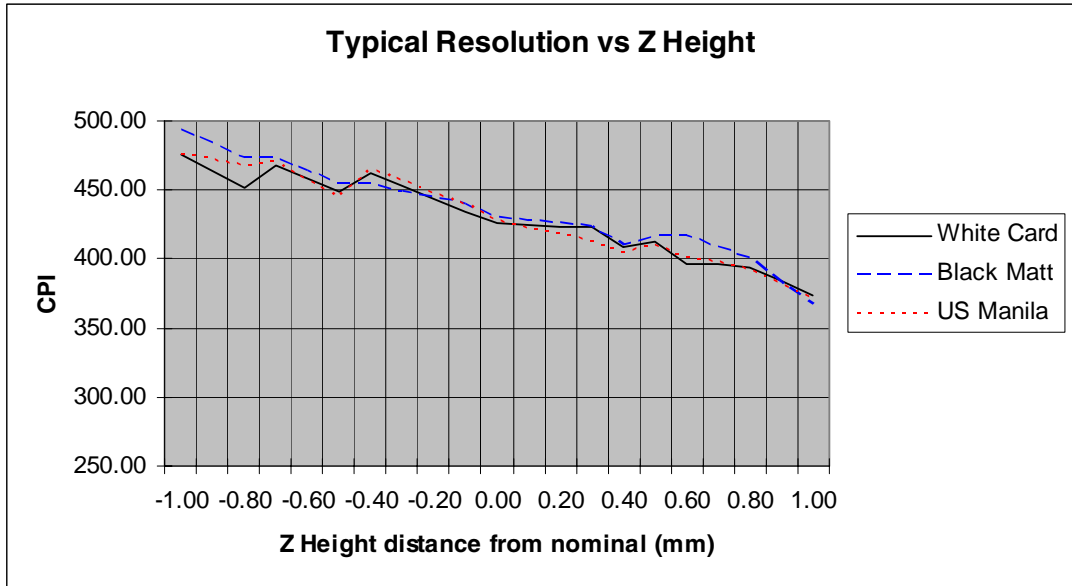
Table 6. Typical operating conditions

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------------|--------------------------|------|------|------|------|
| V _{in} | Supply voltage | 4.1 | 5 | 5.6 | V |
| | Supply current (active) | | 17 | 23.3 | mA |
| | Supply current (suspend) | | 45 | 100 | μA |

7 Typical performance characteristics

Figure 9 shows the typical performance of the VT5363 sensor.

Figure 9. Typical resolution versus height



Note: Z = distance from lens to surface

8 Package information

8.1 Package mechanical data

Figure 10. LQFP32 clear resin body 7.0 x 7.0 x 1.40 foot print 1.0

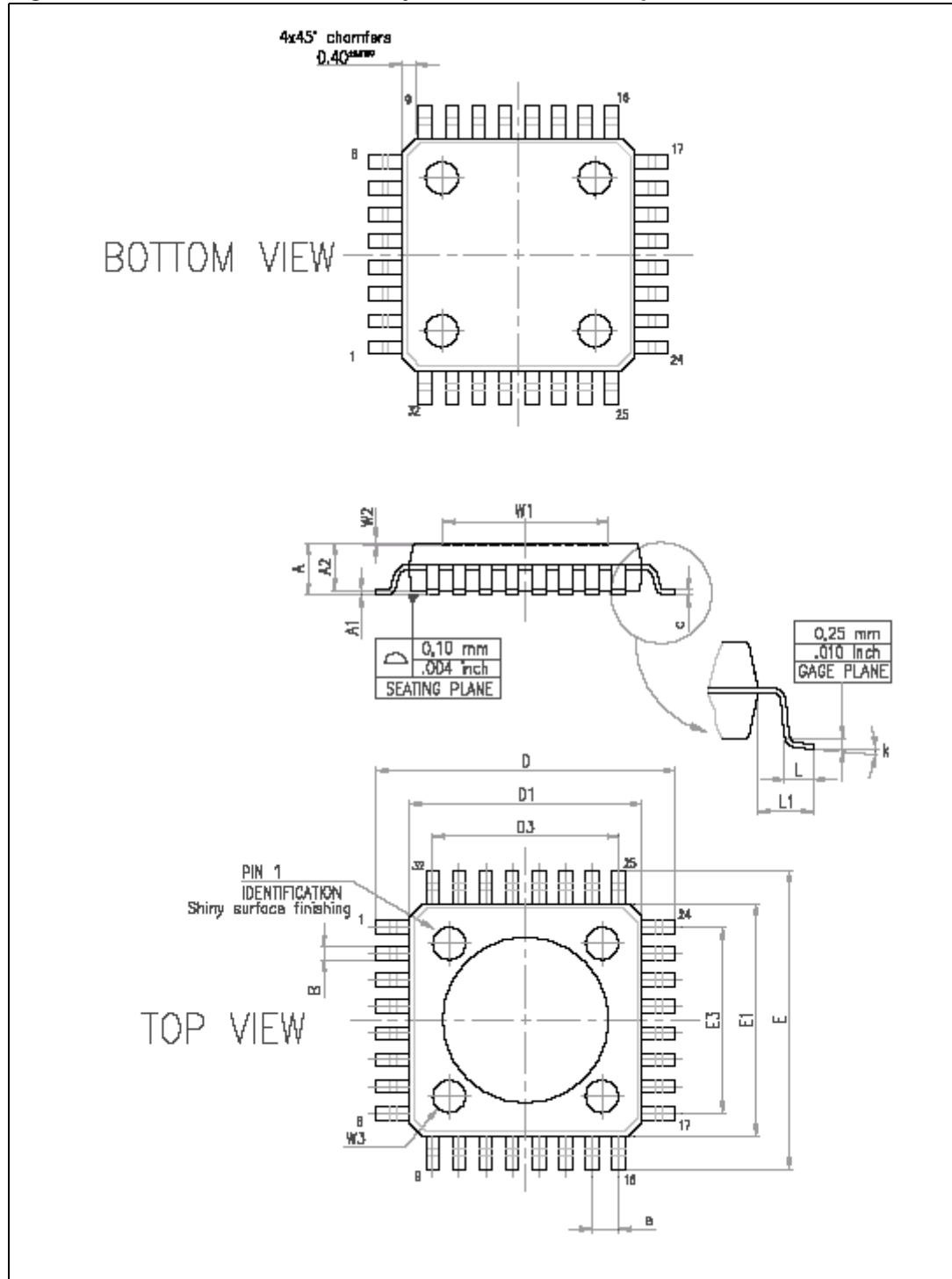


Table 7. LQFP dimensions (mm)

| Reference | Min. (mm) | Typ. (mm) | Max. (mm) |
|-----------|-----------|-----------|-----------|
| A | | | 1.600 |
| A1 | 0.050 | | 0.15 |
| A2 | 1.350 | 1.400 | 1.450 |
| B | 0.300 | 0.370 | 0.450 |
| c | 0.090 | | 0.200 |
| D | | 9.00 | |
| D1 | | 7.000 | |
| D3 | | 5.600 | |
| e | | 0.800 | |
| E | | 9.000 | |
| E1 | | 7.000 | |
| E3 | | 5.600 | |
| L | 0.450 | 0.600 | 0.750 |
| L1 | | 1.000 | |
| k | 0d | 3.5d | 7d |
| W1 | | 5.000 | |
| W2 | | 0.065 | |

- Note:
- 1 Surface finish W1 is 0.07 Ra.
 - 2 Ejectors are on 5.2 mm square for both top and bottom package.
 - 3 On top package, only the identification for pin one is not an engraved ejector.

8.2 LOQFP package guidelines

The IC can be exposed a maximum of 2 times to an IR/Convection reflow solder process having a temperature profile peak of no higher than 240°C.

The package/chip are lead free and is ROHS compliant.

9 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------------------------------------------------|
| 13-Feb-2006 | 1 | Initial release. |
| 18-Apr-2006 | 2 | Updates in the document format. No changes in the content. |

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED REPRESENTATIVE OF ST, ST PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS, WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2006 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

