

# 2 Gb (256 MB) GL-T MIRRORBIT™ Flash

Parallel, 3.0 V

## General description

The S70GL02GT 2-Gb MIRRORBIT™ flash memory device is fabricated on 45-nm MIRRORBIT™ process technology. This device offers a fast page access time of 20 ns with a corresponding random access time of 110 ns. It features a write buffer that allows a maximum of 256 words/512 bytes to be programmed in one operation, resulting in faster effective programming time than standard single byte/word programming algorithms. This makes the device an ideal product for today's embedded applications that require higher density, better performance and lower power consumption.

This document contains information for the S70GL02GT device, which is a dual-die stack of two S29GL01GT dies. For detailed specifications, refer to the discrete die datasheet provided in the below table.

**Table 1**      **Reference documents**

| Document                       | Infineon document number |
|--------------------------------|--------------------------|
| S29GL01GT, S29GL512T datasheet | 002-00247                |

## Features

- CMOS 3.0 V core with versatile I/O
- Two 1024 Mb (S29GL01GT) in a single 64-ball fortified-BGA package (see the [S29GL01GT datasheet](#) for full specifications)
- 45 nm MIRRORBIT™ process technology
- Single supply ( $V_{CC}$ ) for read/program/erase (2.7 V to 3.6 V)
- Versatile I/O feature
  - Wide I/O voltage ( $V_{IO}$ ): 1.65 V to  $V_{CC}$
- ×8 and ×16 data bus
- 16-word/32-byte page read buffer
- 512-byte programming buffer
  - Programming in page multiples, up to a maximum of 512 bytes
- Sector erase
  - Uniform 128-KB sectors
  - S70GL02GT: 2048 sectors
- Suspend and Resume commands for program and erase operations
- Status Register, data polling, and ready/busy pin methods to determine device status
- Advanced sector protection (ASP)
  - Volatile and non-volatile protection methods for each sector
- Separate 1024-byte one time program (OTP) array with two lockable regions
  - Each device supports common flash interface (CFI)
- WP# input
  - Protects the last sector of the device, regardless of sector protection settings

## 2 Gb (256 MB) GL-T MIRRORBIT™ Flash

### Parallel, 3.0 V



#### Performance characteristics

- Temperature range/grade
  - Industrial (–40°C to +85°C)
  - Industrial Plus (–40°C to +105°C)
  - Automotive, AEC-Q100 grade 3 (–40°C to +85°C)
  - Automotive, AEC-Q100 grade 2 (–40°C to +105°C)
- 100,000 program-erase cycles
- 20-year data retention
- Packaging options
  - 64-ball LSH fortified BGA, 13 mm × 11 mm

## Performance characteristics

#### Max read access times (ns)

| Parameter                        | 2 Gb |     |
|----------------------------------|------|-----|
| Random access time ( $t_{ACC}$ ) | 110  | 120 |
| Page access time ( $t_{PACC}$ )  | 20   | 30  |
| CE# access time ( $t_{CE}$ )     | 110  | 120 |
| OE# access time ( $t_{OE}$ )     | 25   | 35  |

#### Typical program and erase rates

| Operation                      | –40°C to +85°C | –40°C to +105°C |
|--------------------------------|----------------|-----------------|
| Buffer programming (512 bytes) | 1.114 MBps     | 1.14 MBps       |
| Sector erase (128 KB)          | 245 KBps       | 245 KBps        |

#### Maximum current consumption

| Operation                   | –40°C to +85°C | –40°C to +105°C |
|-----------------------------|----------------|-----------------|
| Active read at 5 MHz, 30 pF | 60 mA          | 60 mA           |
| Program                     | 100 mA         | 100 mA          |
| Erase                       | 100 mA         | 100 mA          |
| Standby                     | 200 $\mu$ A    | 400 $\mu$ A     |

#### Note

1. Access times are dependent on  $V_{IO}$  operating ranges. See [“Ordering information”](#) on page 20 for further details.

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Block diagram

1 Block diagram

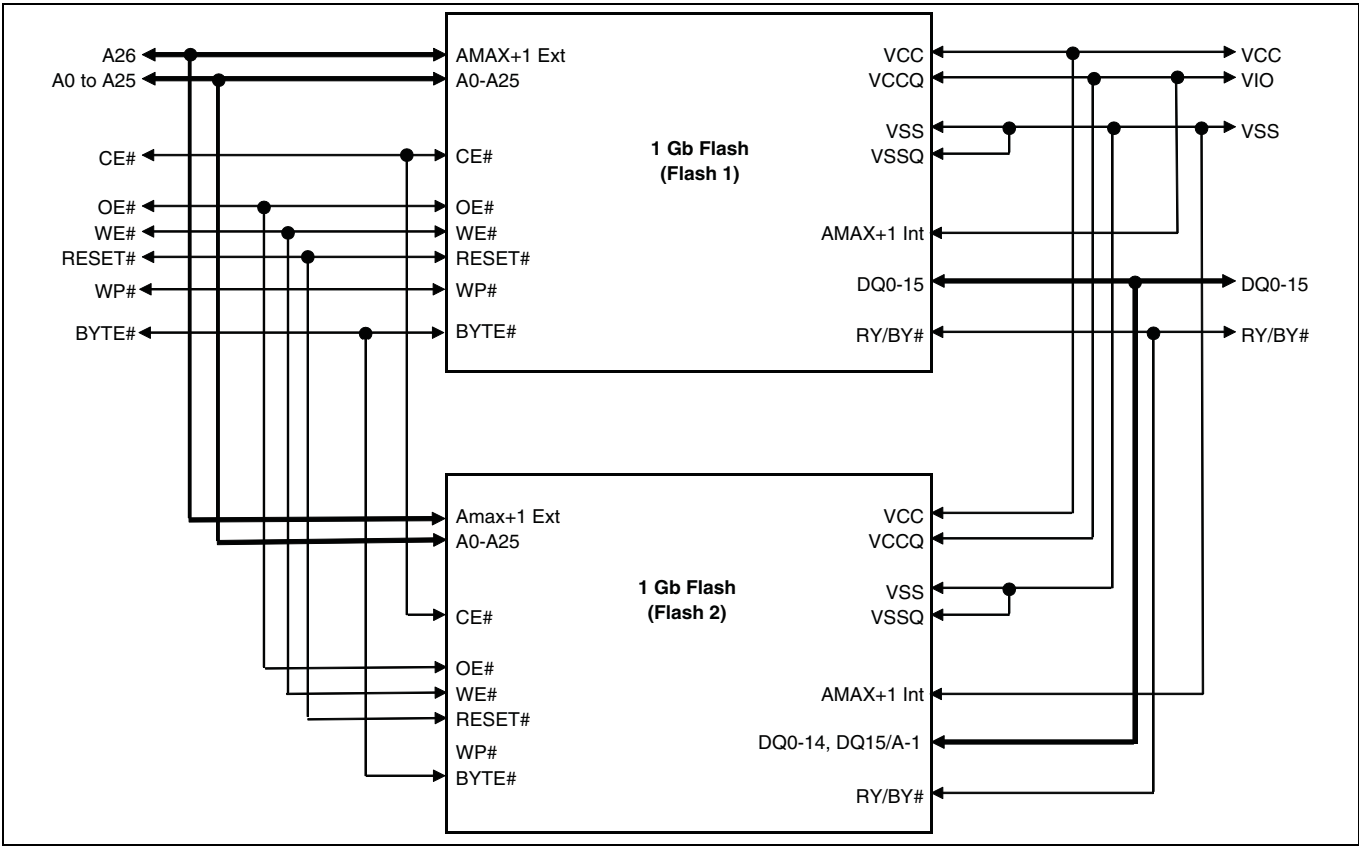
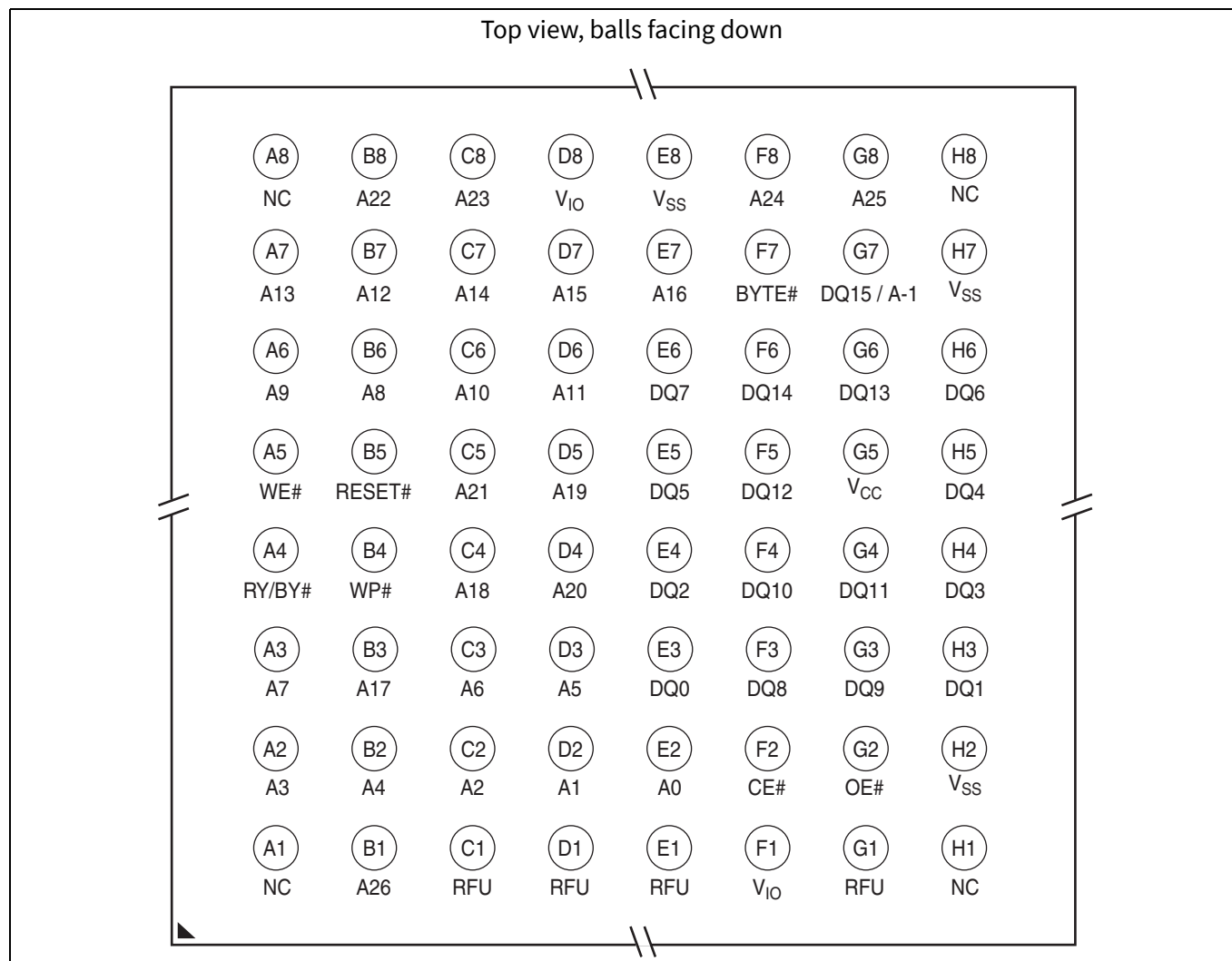


Figure 1 2 x GL01GT (Highest address sector protected) block diagram

Special handling is required for flash memory products in BGA packages.

Flash memory devices in BGA packages may be damaged if exposed to ultrasonic cleaning methods. The package and/or data integrity may be compromised if the package body is exposed to temperatures above 150°C for prolonged periods of time.



**Figure 2**      **64-ball fortified ball grid array**

2. Ball E1, Do Not Use (DNU), a device internal signal is connected to the package connector. The connector may be used by Cypress for test or other purposes and is not intended for connection to any host system signal. Do not use these connections for PCB signal routing channels. Though not recommended, the ball can be connected to  $V_{CC}$  or  $V_{SS}$  through a series resistor.
3. Balls C1, D1, E1, G1: Reserved for Future Use (RFU).
4. Balls A1, A8, H1, H8: No Connect (NC).

### 3 Input/output description and logic symbol

**Table 2** identifies the input and output package connections provided on the device.

**Table 2 Input/output description**

| Symbol   | Type                | Description                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DQ14–DQ0 | I/O                 | Data inputs and outputs.                                                                                                                                                                                                                                                                                                                                                                                                    |
| DQ15/A1  | Input/Output        | DQ15: Data inputs and outputs.<br>A1: LSB address input in byte mode.                                                                                                                                                                                                                                                                                                                                                       |
| CE#      | Input               | Chip Enable. At $V_{IL}$ , selects the device for data transfer with the host memory controller.                                                                                                                                                                                                                                                                                                                            |
| OE#      | Input               | Output Enable. At $V_{IL}$ , causes outputs to be actively driven. At $V_{IH}$ , causes outputs to be high impedance (High-Z).                                                                                                                                                                                                                                                                                              |
| WE#      | Input               | Write Enable. At $V_{IL}$ , indicates data transfer from the host to device. At $V_{IH}$ , indicates data transfer is from the device to host.                                                                                                                                                                                                                                                                              |
| A26–A0   | Input               | Address lines for S29GL02GT.                                                                                                                                                                                                                                                                                                                                                                                                |
| $V_{CC}$ | Supply              | Core power supply.                                                                                                                                                                                                                                                                                                                                                                                                          |
| $V_{IO}$ | Supply              | Versatile I/O power supply.                                                                                                                                                                                                                                                                                                                                                                                                 |
| $V_{SS}$ | Supply              | Power supplies ground.                                                                                                                                                                                                                                                                                                                                                                                                      |
| RY/BY#   | Output — open drain | Ready/Busy. Indicates whether an Embedded Algorithm is in progress or complete. At $V_{IL}$ , the device is actively engaged in an embedded algorithm such as erasing or programming. At High-Z, the device is ready for read or a new command write — requires an external pull-up resistor to detect the High-Z state. Multiple devices may have their RY/BY# outputs tied together to detect when all devices are ready. |
| BYTE#    | Input               | Selects data bus width. At $V_{IL}$ , the device is in byte configuration and data I/O pins DQ7–DQ0 are active and DQ15/A1 becomes the LSB address input. At $V_{IH}$ , the device is in word configuration and data I/O pins DQ15–DQ0 are active.                                                                                                                                                                          |
| RESET#   | Input               | Hardware Reset. At $V_{IL}$ , causes the device to reset control logic to its standby state, ready for reading array data.                                                                                                                                                                                                                                                                                                  |
| WP#      | Input               | Write Protect. At $V_{IL}$ , disables program and erase functions in the highest address 64-kword (128-KB) sector of the device. At $V_{IH}$ , the sector is not protected. WP# has an internal pull-up; When unconnected WP# is at $V_{IH}$ .                                                                                                                                                                              |
| NC       | No Connect          | Not Connected internally. The pin/ball location may be used in the printed circuit board (PCB) as part of a routing channel.                                                                                                                                                                                                                                                                                                |
| DNU      | Reserved            | Do Not Use. Reserved for use by Infineon. The pin/ball is connected internally. The input has an internal pull-down resistance to $V_{SS}$ . The pin/ball can be left open or tied to $V_{SS}$ on the PCB.                                                                                                                                                                                                                  |
| RFU      | No Connect          | Reserved for Future Use. Not currently connected internally but the pin/ball location should be left unconnected and unused by the PCB routing channel for future compatibility. The pin/ball may be used by a signal in the future.                                                                                                                                                                                        |

## 4 Memory map

The S70GL02GT consist of uniform 64 kword (128-KB) sectors organized as shown in [Table 3](#).

**Table 3 S70GL02GT sector and memory address map**

| Uniform sector size | Sector count | Sector range | Address range (16-bit) | Notes                   |
|---------------------|--------------|--------------|------------------------|-------------------------|
| 64 Kword/128 KB     | 2048         | SA00         | 0000000h–000FFFFh      | Sector starting address |
|                     |              | :            | :                      |                         |
|                     |              | SA2047       | 7FF0000H–7FFFFFFFh     | Sector ending address   |

### Note

5. This table has been condensed to show sector-related information for an entire device on a single page. Sectors and their address ranges that are not explicitly listed (such as SA001–SA2046) have sector starting and ending addresses that form the same pattern as all other sectors of that size. For example, all 128 KB sectors have the pattern xxx0000h–xxxFFFFh.

## 5 Autoselect

**Table 4** provides the device identification codes for S70GL02GT. For more information on the autoselect function, refer to the S29GL-S datasheet (Infineon publication number 002-00247).

**Table 4 Autoselect addresses in system**

| Description           | Address      | Read data (word/byte mode)                                                                            |
|-----------------------|--------------|-------------------------------------------------------------------------------------------------------|
| Manufacturer ID       | (Base) + 00h | 0001h                                                                                                 |
| Device ID, Word 1     | (Base) + 01h | 227Eh                                                                                                 |
| Device ID, Word 2     | (Base) + 0Eh | 2248h                                                                                                 |
| Device ID, Word 3     | (Base) + 0Fh | 2201h                                                                                                 |
| Secure Device Verify  | (Base) + 03h | For S70GL02GT highest address sector protect:<br>XX3Fh = Not Factory Locked<br>XXBFh = Factory Locked |
| Sector Protect Verify | (SA) + 02h   | xx01h/01h = Locked, xx00h/00h = Unlocked                                                              |

## 6 Electrical specifications

### 6.1 DC characteristics

**Table 5** DC characteristics (–40°C to +85°C)

| Parameter | Description                                         | Test conditions                                                                                      |               | Min | Typ <sup>[7]</sup> | Max  | Unit |
|-----------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------|-----|--------------------|------|------|
| $I_{LI}$  | Input load current                                  | $V_{IN} = V_{SS}$ to $V_{CC}$ ,<br>$V_{CC} = V_{CC}$ max                                             | All others    | –   | ±0.04              | ±2.0 | μA   |
|           |                                                     |                                                                                                      | WP#,<br>BYTE# | –   | ±1.0               | ±4.0 |      |
| $I_{LO}$  | Output leakage current                              | $V_{OUT} = V_{SS}$ to $V_{CC}$ ,<br>$V_{CC} = V_{CC}$ max                                            | –             | –   | ±0.04              | ±2.0 | μA   |
| $I_{CC4}$ | $V_{CC}$ standby current                            | $CE\#, RESET\#, OE\# = V_{IH}$ ,<br>$V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max | –             | –   | 140                | 200  | μA   |
| $I_{CC5}$ | $V_{CC}$ reset current <sup>[7, 8]</sup>            | $CE\# = V_{IH}$ , $RESET\# = V_{IL}$ ,<br>$V_{CC} = V_{CC}$ max                                      | –             | –   | 20                 | 40   | mA   |
| $I_{CC6}$ | Automatic sleep mode <sup>[9]</sup>                 | $V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max,<br>$t_{ACC} + 30$ ns               | –             | –   | 6                  | 12   | mA   |
|           |                                                     | $V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max,<br>$t_{ASSB}$                      | –             | –   | 200                | 300  | μA   |
| $I_{CC7}$ | $V_{CC}$ current during power-up <sup>[7, 12]</sup> | $RESET\# = V_{IO}$ , $CE\# = V_{IO}$ ,<br>$OE\# = V_{IO}$ , $V_{CC} = V_{CC}$ max,                   | –             | –   | 106                | 160  | mA   |

#### Notes

6.  $I_{CC}$  active while Embedded Algorithm is in progress.
7. Not 100% tested.
8. If an embedded operation is in progress at the start of reset, the current consumption will remain at the embedded operation specification until the embedded operation is stopped by the reset. If no embedded operation is in progress when reset is started, or following the stopping of an embedded operation,  $I_{CC7}$  will be drawn during the remainder of  $t_{RPH}$ . After the end of  $t_{RPH}$  the device will go to standby mode until the next read or write.
9. Automatic sleep mode enables the lower power mode when addresses remain stable for a designated time.
10.  $V_{IO} = 1.65$  V to  $V_{CC}$  or 2.7 V to  $V_{CC}$  depending on the model.
11.  $V_{CC} = 3$  V and  $V_{IO} = 3$  V or 1.8 V. When  $V_{IO}$  is at 1.8 V, I/O pins cannot operate at >1.8 V.
12. During power-up there are spikes of current demand, the system needs to be able to supply this current to insure the part initializes correctly.
13. For all other DC current values, refer to the [S29GL01GT/S29GL512T](#) datasheet.

**Table 6 DC characteristics (–40°C to +105°C)**

| Parameter | Description                                     | Test conditions                                                                                   |               | Min | Typ <sup>[15]</sup> | Max                                  | Unit    |
|-----------|-------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------|-----|---------------------|--------------------------------------|---------|
| $I_{LI}$  | Input load current                              | $V_{IN} = V_{SS}$ to $V_{CC}$ ,<br>$V_{CC} = V_{CC}$ max                                          | All others    | –   | ±0.04               | $\pm 2.0 / \pm 20.0$ <sup>[22]</sup> | $\mu A$ |
|           |                                                 |                                                                                                   | WP#,<br>BYTE# | –   | ±1.0                | $\pm 4.0 / \pm 20.0$ <sup>[22]</sup> |         |
| $I_{LO}$  | Output leakage current                          | $V_{OUT} = V_{SS}$ to $V_{CC}$ ,<br>$V_{CC} = V_{CC}$ max                                         | –             | –   | ±0.04               | ±2.0                                 | $\mu A$ |
| $I_{CC4}$ | VCC standby current                             | CE#, RESET#, OE# = $V_{IH}$ ,<br>$V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max | –             | –   | 140                 | 400                                  | $\mu A$ |
| $I_{CC5}$ | VCC reset current <sup>[15, 16]</sup>           | CE# = $V_{IH}$ , RESET# = $V_{IL}$ ,<br>$V_{CC} = V_{CC}$ max                                     | –             | –   | 20                  | 40                                   | mA      |
| $I_{CC6}$ | Automatic sleep mode <sup>[17]</sup>            | $V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max,<br>$t_{ACC} + 30$ ns            | –             | –   | 6                   | 12                                   | mA      |
|           |                                                 | $V_{IH} = V_{IO}$ , $V_{IL} = V_{SS}$ ,<br>$V_{CC} = V_{CC}$ max,<br>$t_{ASSB}$                   | –             | –   | 200                 | 400                                  | $\mu A$ |
| $I_{CC7}$ | VCC current during power-up <sup>[15, 20]</sup> | RESET# = $V_{IO}$ , CE# = $V_{IO}$ ,<br>OE# = $V_{IO}$ , $V_{CC} = V_{CC}$ max                    | –             | –   | 106                 | 160                                  | mA      |

#### Notes

14.  $I_{CC}$  active while Embedded Algorithm is in progress.
15. Not 100% tested.
16. If an embedded operation is in progress at the start of reset, the current consumption will remain at the embedded operation specification until the embedded operation is stopped by the reset. If no embedded operation is in progress when reset is started, or following the stopping of an embedded operation,  $I_{CC7}$  will be drawn during the remainder of  $t_{RPH}$ . After the end of  $t_{RPH}$  the device will go to standby mode until the next read or write.
17. Automatic sleep mode enables the lower power mode when addresses remain stable for a designated time.
18.  $V_{IO} = 1.65$  V to  $V_{CC}$  or 2.7 V to  $V_{CC}$  depending on the model.
19.  $V_{CC} = 3$  V and  $V_{IO} = 3$  V or 1.8 V. When  $V_{IO}$  is at 1.8 V, I/O pins cannot operate at >1.8 V.
20. During power-up there are spikes of current demand, the system needs to be able to supply this current to ensure that the part initializes correctly.
21. For all other DC current values, refer to the [S29GL01GT/S29GL512T](#) datasheet.
22. For S70GL02GT11FHB02x, S70GL02GT12FHBV1x, and S70GL02GT12FHBV2x devices.

## 6.2 BGA package capacitance

**Table 7 BGA package capacitance**

| Symbol           | Description           | Typ | Max | Unit |
|------------------|-----------------------|-----|-----|------|
| C <sub>IN</sub>  | Input capacitance     | 9   | 11  | pF   |
| C <sub>OUT</sub> | Output capacitance    | 7   | 9   | pF   |
| A26              | Highest order address | 5   | 6   | pF   |
| CE#              | Separated control pin | 4   | 5   | pF   |
| OE#              | Separated control pin | 4   | 5   | pF   |
| WE#              | Separated control pin | 7   | 8   | pF   |
| WP#              | Separated control pin | 5   | 6   | pF   |
| RESET#           | Separated control pin | 39  | 41  | pF   |
| RY/BY#           | Separated control pin | 4   | 5   | pF   |

## 6.3 Thermal resistance

**Table 8 Thermal resistance**

| Parameter | Description                              | Test condition                                                                                                                                     | LSH064 | Unit |
|-----------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|
| Theta JA  | Thermal resistance (Junction to ambient) | Test conditions follow standard test methods and procedures for measuring thermal impedance in accordance with EIA/JESD51. with Still Air (0 m/s). | 29     | °C/W |
| Theta JB  | Thermal resistance (Junction to board)   |                                                                                                                                                    | 11.3   | °C/W |
| Theta JC  | Thermal Resistance (Junction to case)    |                                                                                                                                                    | 8.4    | °C/W |

### Notes

23.Sampled, not 100% tested.

24.Test conditions T<sub>A</sub> = 25°C, f = 1.0 MHz.

## **7 Data integrity**

### **7.1 Erase endurance**

**Table 9 Erase endurance**

| <b>Parameter</b>                                                                  | <b>Minimum</b> | <b>Unit</b> |
|-----------------------------------------------------------------------------------|----------------|-------------|
| Program/erase cycles per main flash array sectors                                 | 100K           | P/E cycle   |
| Program/erase cycles per PPB array or non-volatile register array <sup>[25]</sup> | 100K           | P/E cycle   |

### **7.2 Data retention**

**Table 10 Data retention**

| <b>Parameter</b>    | <b>Test conditions</b>    | <b>Minimum time</b> | <b>Unit</b> |
|---------------------|---------------------------|---------------------|-------------|
| Data retention time | 1K program/erase cycles   | 20                  | Years       |
|                     | 10K program/erase cycles  | 2                   | Years       |
|                     | 100K program/erase cycles | 0.2                 | Years       |

Contact Infineon sales or an FAE representative for additional information regarding data integrity.

#### **Note**

25. Each write command to a non-volatile register causes a P/E cycle on the entire non-volatile register array. OTP bits and registers internally reside in a separate array that is not P/E cycled.

## 8 Device ID and Common Flash Interface (ID-CFI) ASO map

The device ID portion of the ASO (word locations 0h to 0Fh) provides manufacturer ID, device ID, sector protection state, and basic feature set information for the device.

ID-CFI location 02h displays sector protection status for the sector selected by the sector address (SA) used in the ID-CFI enter command. To read the protection status of more than one sector it is necessary to exit the ID ASO and enter the ID ASO using the new SA. The access time to read location 02h is always  $t_{ACC}$  and a read of this location requires CE# to go HIGH before the read and return LOW to initiate the read (asynchronous read access). Page mode read between location 02h and other ID locations is not supported. Page mode read between ID locations other than 02h is supported.

**Table 11 ID (autoselect) address map**

| Description             | Address (×16) | Address (×8) | Read data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|---------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacture ID          | (SA) + 0000h  | (SA) + 0000h | 0001h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Device ID               | (SA) + 0001h  | (SA) + 0002h | 227Eh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Protection verification | (SA) + 0002h  | (SA) + 0004h | Sector protection state (1 = Sector protected, 0 = Sector unprotected).<br>To read a different SA protection state only a new SA needs to be given.                                                                                                                                                                                                                                                                                                                                                                                     |
| Indicator bits          | (SA) + 0003h  | (SA) + 0006h | For S70GL02Gt highest address sector protect:<br>XX3Fh = Not Factory Locked<br>XXBFh = Factory Locked<br>For S70GL02GT lowest address sector protect:<br>XX2Fh = Not Factory Locked<br>XXAFh = Factory Locked<br>DQ15–DQ08 = 1 (Reserved)<br>DQ7 - Factory Locked Secure Silicon Region<br>1 = Locked<br>0 = Not Locked<br>DQ6 - Customer Locked Secure Silicon Region<br>1 = Locked<br>0 = Not Locked<br>DQ5 = 1 (Reserved)<br>DQ4 - WP# Protects<br>0 = lowest address Sector<br>1 = highest address Sector<br>DQ3–DQ0 = 1 (Reserved) |
| RFU                     | (SA) + 0004h  | (SA) + 0008h | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 0005h  | (SA) + 000Ah | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 0006h  | (SA) + 000Ch | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 0007h  | (SA) + 000Eh | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 0008h  | (SA) + 0010h | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 0009h  | (SA) + 0012h | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 000Ah  | (SA) + 0014h | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                         | (SA) + 000Bh  | (SA) + 0016h | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## 2 Gb (256 MB) GL-T MIRRORBIT™ Flash

### Parallel, 3.0 V



Device ID and Common Flash Interface (ID-CFI)  
ASO map

**Table 11** ID (autoselect) address map (Continued)

| Description         | Address (×16) | Address (×8) | Read data                                                                                                                                                                                                                                                                                                                                                        |
|---------------------|---------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lower software bits | (SA) + 000Ch  | (SA) + 0018h | Bit 0 - Status Register support<br>1 = Status Register supported<br>0 = Status Register not supported<br>Bit 1 - DQ polling support<br>1 = DQ bits polling supported<br>0 = DQ bits polling not supported<br>Bit 3–2 - Command Set support<br>11 = Reserved<br>10 = Reserved<br>01 = Reduced Command Set<br>00 = Classic Command set<br>Bits 4–15 - Reserved = 0 |
| Upper software bits | (SA) + 000Dh  | (SA) + 001Ah | Reserved                                                                                                                                                                                                                                                                                                                                                         |
| Device ID           | (SA) + 000Eh  | (SA) + 001Ch | 2248h = 2 Gb                                                                                                                                                                                                                                                                                                                                                     |
| Device ID           | (SA) + 000Fh  | (SA) + 000Eh | 2201h                                                                                                                                                                                                                                                                                                                                                            |

**Table 12 CFI query identification string**

| Word address                                 | Data                    | Description                                                  |
|----------------------------------------------|-------------------------|--------------------------------------------------------------|
| (SA) + 0010h<br>(SA) + 0011h<br>(SA) + 0012h | 0051h<br>0052h<br>0059h | Query unique ASCII string "QRY"                              |
| (SA) + 0013h<br>(SA) + 0014h                 | 0002h<br>0000h          | Primary OEM command set                                      |
| (SA) + 0015h<br>(SA) + 0016h                 | 0040h<br>0000h          | Address for primary extended table                           |
| (SA) + 0017h<br>(SA) + 0018h                 | 0000h<br>0000h          | Alternate OEM command set (00h = none exists)                |
| (SA) + 0019h<br>(SA) + 001Ah                 | 0000h<br>0000h          | Address for alternate OEM extended table (00h = none exists) |

**Table 13 CFI system interface string**

| Word address | Data                          | Description                                                                            |
|--------------|-------------------------------|----------------------------------------------------------------------------------------|
| (SA) + 001Bh | 0027h                         | V <sub>CC</sub> Min (erase/program) (D7–D4: volts, D3–D0: 100 mV)                      |
| (SA) + 001Ch | 0036h                         | V <sub>CC</sub> Max (erase/program) (D7–D4: volts, D3–D0: 100 mV)                      |
| (SA) + 001Dh | 0000h                         | V <sub>PP</sub> Min voltage (00h = No V <sub>PP</sub> pin present)                     |
| (SA) + 001Eh | 0000h                         | V <sub>PP</sub> Max voltage (00h = No V <sub>PP</sub> pin present)                     |
| (SA) + 001Fh | 0008h                         | Typical timeout per single word write 2 <sup>N</sup> μs                                |
| (SA) + 0020h | 0009h                         | Typical timeout for max multi-byte program, 2 <sup>N</sup> μs<br>(00h = Not supported) |
| (SA) + 0021h | 000Ah                         | Typical timeout per individual block erase 2 <sup>N</sup> ms                           |
| (SA) + 0022h | 0015h (2 Gb)                  | Typical timeout for full chip erase 2 <sup>N</sup> ms (00h = Not supported)            |
| (SA) + 0023h | 0002h (85°C)<br>0003h (105°C) | Max timeout for single word write 2 <sup>N</sup> times typical                         |
| (SA) + 0024h | 0001h (85°C)<br>0002h (105°C) | Max timeout for buffer write 2 <sup>N</sup> times typical                              |
| (SA) + 0025h | 0002h                         | Max timeout per individual block erase 2 <sup>N</sup> times typical                    |
| (SA) + 0026h | 0002h                         | Max timeout for full chip erase 2 <sup>N</sup> times typical<br>(00h = Not supported)  |

**Table 14 CFI device geometry definition**

| Word address | Data         | Description                                                                             |
|--------------|--------------|-----------------------------------------------------------------------------------------|
| (SA) + 0027h | 001Ch (2 Gb) | Device size = $2^N$ byte                                                                |
| (SA) + 0028h | 0002h        | Flash device interface description<br>0 = ×8-only, 1 = ×16-only, 2 = ×8/×16 capable     |
| (SA) + 0029h | 0000h        |                                                                                         |
| (SA) + 002Ah | 0009h        | Max. number of byte in multi-byte write = $2^N$<br>(00 = Not supported)                 |
| (SA) + 002Bh | 0000h        |                                                                                         |
| (SA) + 002Ch | 0001h        | Number of erase block regions within device<br>1 = Uniform device, 2 = Boot device      |
| (SA) + 002Dh | 00FFh        | Erase block region 1 information<br>(Refer to JEDEC JESD68-01 or JEP137 specifications) |
| (SA) + 002Eh | 0007h        |                                                                                         |
| (SA) + 002Fh | 0000h        |                                                                                         |
| (SA) + 0030h | 0002h        |                                                                                         |
| (SA) + 0031h | 0000h        | Erase block region 2 information (Refer to CFI publication 100)                         |
| (SA) + 0032h | 0000h        |                                                                                         |
| (SA) + 0033h | 0000h        |                                                                                         |
| (SA) + 0034h | 0000h        |                                                                                         |
| (SA) + 0035h | 0000h        | Erase block region 3 information (Refer to CFI publication 100)                         |
| (SA) + 0036h | 0000h        |                                                                                         |
| (SA) + 0037h | 0000h        |                                                                                         |
| (SA) + 0038h | 0000h        |                                                                                         |
| (SA) + 0039h | 0000h        | Erase block region 4 information (Refer to CFI publication 100)                         |
| (SA) + 003Ah | 0000h        |                                                                                         |
| (SA) + 003Bh | 0000h        |                                                                                         |
| (SA) + 003Ch | 0000h        |                                                                                         |
| (SA) + 003Dh | FFFFh        | Reserved                                                                                |
| (SA) + 003Eh | FFFFh        |                                                                                         |
| (SA) + 003Fh | FFFFh        |                                                                                         |

## 2 Gb (256 MB) GL-T MIRRORBIT™ Flash

Parallel, 3.0 V



Device ID and Common Flash Interface (ID-CFI)

ASO map

**Table 15** CFI primary vendor-specific extended query

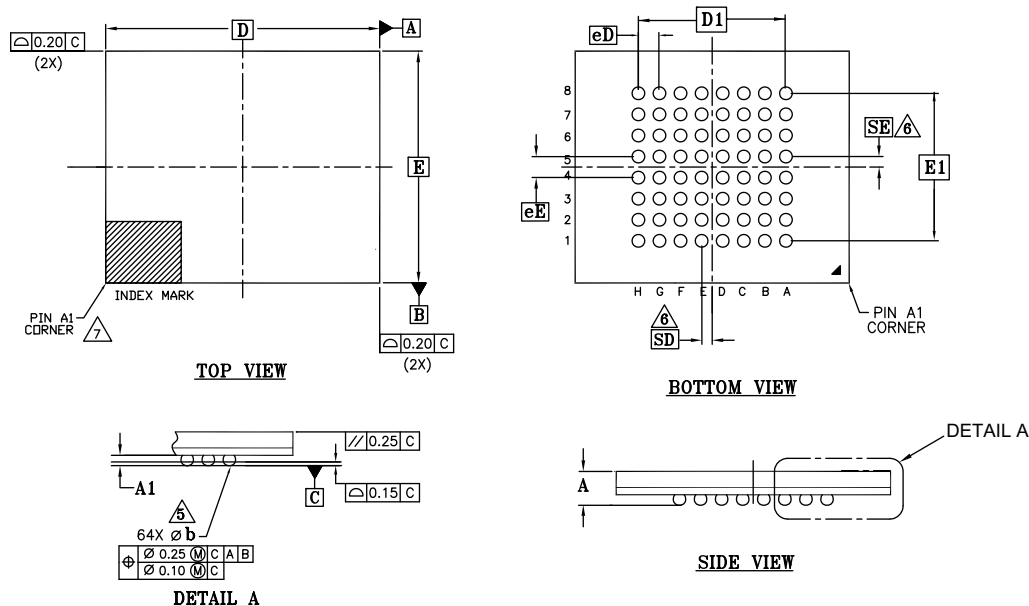
| Word address | Data  | Description                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (SA) + 0040h | 0050h | Query-unique ASCII string "PRI"                                                                                                                                                                                                                                                                                                                                                                                                         |
| (SA) + 0041h | 0052h |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (SA) + 0042h | 0049h |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (SA) + 0043h | 0031h | Major version number, ASCII                                                                                                                                                                                                                                                                                                                                                                                                             |
| (SA) + 0044h | 0035h | Minor version number, ASCII                                                                                                                                                                                                                                                                                                                                                                                                             |
| (SA) + 0045h | 0024h | Address sensitive unlock (Bits 1–0)<br>00b = Required<br>01b = Not required<br>Process technology (Bits 5–2)<br>0000b = 0.23 µm Floating Gate<br>0001b = 0.17 µm Floating Gate<br>0010b = 0.23 µm MIRRORBIT™<br>0011b = 0.13 µm Floating Gate<br>0100b = 0.11 µm MIRRORBIT™<br>0101b = 0.09 µm Floating Gate<br>0110b = 0.09 µm MIRRORBIT™<br>0111b = 0.065 µm MIRRORBIT™<br>1000b = 0.065 µm MIRRORBIT™<br>1001b = 0.045 µm MIRRORBIT™ |
| (SA) + 0046h | 0002h | Erase Suspend<br>0 = Not supported<br>1 = Read only<br>2 = Read and write                                                                                                                                                                                                                                                                                                                                                               |
| (SA) + 0047h | 0001h | Sector protect<br>00 = Not supported<br>X = Number of sectors in smallest group                                                                                                                                                                                                                                                                                                                                                         |
| (SA) + 0048h | 0000h | Temporary sector unprotect<br>00 = Not supported<br>01 = Supported                                                                                                                                                                                                                                                                                                                                                                      |
| (SA) + 0049h | 0008h | Sector protect/unprotect scheme<br>04 = High voltage method<br>05 = Software command locking method<br>08 = Advanced sector protection method                                                                                                                                                                                                                                                                                           |
| (SA) + 004Ah | 0000h | Simultaneous operation<br>00 = Not supported<br>X = Number of banks                                                                                                                                                                                                                                                                                                                                                                     |
| (SA) + 004Bh | 0000h | Burst mode type<br>00 = Not supported<br>01 = Supported                                                                                                                                                                                                                                                                                                                                                                                 |
| (SA) + 004Ch | 0003h | Page mode type<br>00 = Not supported<br>01 = 4 word page<br>02 = 8 word page<br>03 = 16 word page                                                                                                                                                                                                                                                                                                                                       |
| (SA) + 004Dh | 00B5h | ACC (Acceleration) supply minimum<br>00 = Not supported<br>D7–D4: Volt<br>D3–D0: 100 mV                                                                                                                                                                                                                                                                                                                                                 |

**Table 15 CFI primary vendor-specific extended query (Continued)**

| Word address                    | Data        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (SA) + 004Eh                    | 00C5h       | ACC (Acceleration) supply maximum<br>00 = Not supported<br>D7-D4: Volt<br>D3-D0: 100 mV                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (SA) + 004Fh                    | 0005h (Top) | WP# protection<br>00h = Flash device without WP protect (No boot)<br>01h = Eight 8 KB sectors at top and bottom with WP (Dual boot)<br>02h = Bottom boot device with WP protect (Bottom boot)<br>03h = Top boot device with WP protect (Top boot)<br>04h = Uniform, bottom WP protect (Uniform bottom boot)<br>05h = Uniform, top WP protect (Uniform top boot)<br>06h = WP protect for all sectors<br>07h = Uniform, top or bottom WP protect                                                                              |
| (SA) + 0050h                    | 0001h       | Program Suspend<br>00 = Not supported<br>01 = Supported                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (SA) + 0051h                    | 0002h       | Unlock Bypass<br>00 = Not supported<br>01 = Supported                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (SA) + 0052h                    | 0009h       | Secured silicon sector (Customer OTP Area) size $2^N$ (bytes)                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| (SA) + 0053h                    | 008Fh       | Software features<br>bit 0: status register polling (1 = Supported, 0 = Not supported)<br>bit 1: DQ polling (1 = Supported, 0 = Not supported)<br>bit 2: new program suspend/resume commands<br>(1 = Supported, 0 = Not supported)<br>bit 3: word programming (1 = Supported, 0 = Not supported)<br>bit 4: bit-field programming (1 = Supported, 0 = Not supported)<br>bit 5: autodetect programming (1 = Supported, 0 = Not supported)<br>bit 6: RFU<br>bit 7: multiple writes per Line (1 = Supported, 0 = Not supported) |
| (SA) + 0054h                    | 0005h       | Page size = $2^N$ bytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (SA) + 0055h                    | 0006h       | Erase suspend timeout maximum $< 2^N$ ( $\mu$ s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| (SA) + 0056h                    | 0006h       | Program suspend timeout maximum $< 2^N$ ( $\mu$ s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| (SA) + 0057h to<br>(SA) + 0077h | FFFFh       | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (SA) + 0078h                    | 0006h       | Embedded hardware reset timeout maximum $< 2^N$ ( $\mu$ s)<br>Reset with reset pin                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| (SA) + 0079h                    | 0009h       | Non-embedded hardware reset timeout maximum $< 2^N$ ( $\mu$ s)<br>Power-on-reset                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## 9 Physical dimensions

### 9.1 LSH064 — 64-ball fortified ball grid array, 13 x 11 mm



| SYMBOL | DIMENSIONS |      |      |
|--------|------------|------|------|
|        | MIN.       | NOM. | MAX. |
| A      | -          | -    | 1.40 |
| A1     | 0.40       | -    | -    |
| D      | 13.00 BSC  |      |      |
| E      | 11.00 BSC  |      |      |
| D1     | 7.00 BSC   |      |      |
| E1     | 7.00 BSC   |      |      |
| MD     | 8          |      |      |
| ME     | 8          |      |      |
| N      | 64         |      |      |
| Ø b    | 0.50       | 0.60 | 0.70 |
| eD     | 1.00 BSC   |      |      |
| eE     | 1.00 BSC   |      |      |
| SD     | 0.50 BSC   |      |      |
| SE     | 0.50 BSC   |      |      |

#### NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- SOLDER BALL POSITION DESIGNATION PER JEP95, SECTION 3, SPP-020.
- "e" REPRESENTS THE SOLDER BALL GRID PITCH.
- SYMBOL "MD" IS THE BALL MATRIX SIZE IN THE "D" DIRECTION.  
SYMBOL "ME" IS THE BALL MATRIX SIZE IN THE "E" DIRECTION.  
N IS THE NUMBER OF POPULATED SOLDER BALL POSITIONS FOR MATRIX SIZE MD X ME.
- DIMENSION "b" IS MEASURED AT THE MAXIMUM BALL DIAMETER IN A PLANE PARALLEL TO DATUM C.
- "SD" AND "SE" ARE MEASURED WITH RESPECT TO DATUMS A AND B AND DEFINE THE POSITION OF THE CENTER SOLDER BALL IN THE OUTER ROW. WHEN THERE IS AN ODD NUMBER OF SOLDER BALLS IN THE OUTER ROW, "SD" OR "SE" = 0. WHEN THERE IS AN EVEN NUMBER OF SOLDER BALLS IN THE OUTER ROW, "SD" = eD/2 AND "SE" = eE/2.
- A1 CORNER TO BE IDENTIFIED BY CHAMFER, LASER OR INK MARK METALIZED MARK, INDENTATION OR OTHER MEANS.
- "+" INDICATES THE THEORETICAL CENTER OF DEPOPULATED SOLDER BALLS.

002-13243 \*\*

Figure 3 64-ball FBGA (13.0 × 11.0 × 1.4 mm) package outline, 002-13243

## 10 Ordering information

The ordering part number is formed by a valid combination of the following:

| S70GL02GT | 12 | F | H | I | 01 | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------|----|---|---|---|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |    |   |   |   |    | <b>Packing type</b><br>0 = Tray (standard)<br>3 = 13" tape and reel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|           |    |   |   |   |    | <b>Model number (CFI version, VIO, and VCC range)</b><br>CFI Version 1.3<br>03 = VIO = VCC = 2.7 V to 3.6 V, highest address sector protected<br>04 = VIO = VCC = 2.7 V to 3.6 V, lowest address sector protected<br>V3 = VIO = 1.65 V to VCC, VCC = 2.7 V to 3.6 V, highest address sector protected<br>V4 = VIO = 1.65 V to VCC, VCC = 2.7 V to 3.6 V, lowest address sector protected<br><br>CFI Version 1.5<br>01 = VIO = VCC = 2.7 V to 3.6 V, highest address sector protected<br>02 = VIO = VCC = 2.7 V to 3.6 V, lowest address sector protected<br>V1 = VIO = 1.65 V to VCC, VCC = 2.7 V to 3.6 V, highest address sector protected<br>V2 = VIO = 1.65 V to VCC, VCC = 2.7 V to 3.6 V, lowest address sector protected |
|           |    |   |   |   |    | <b>Temperature range / grade</b><br>I = Industrial (−40°C to +85°C)<br>V = Industrial Plus (−40°C to +105°C)<br>A = Automotive, AEC-Q100 grade 3 (−40°C to +85°C)<br>B = Automotive, AEC-Q100 grade 2 (−40°C to +105°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|           |    |   |   |   |    | <b>Package materials set</b><br>A = Standard (Pb)<br>H = Low Halogen, Pb-free                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|           |    |   |   |   |    | <b>Package type</b><br>F = Fortified ball grid array, 1.0 mm pitch package (LSH064), 11 mm x 13 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|           |    |   |   |   |    | <b>Speed option</b><br>11 = 110 ns<br>12 = 120 ns                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|           |    |   |   |   |    | <b>Device number / description</b><br>S70GL02GT<br>3.0 V-only, 2048 Megabit (128M x 16-bit/256M x 8-bit) Page-Mode Flash Memory<br>Manufactured on 45-nm MIRRORBIT™ process technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## 10.1 Recommended combinations

**Table 16** lists various configurations planned to be available in volume. This table will be updated when new combinations are released. Check with your local Infineon sales representative to confirm availability of specific configurations not listed here or to check on newly released combinations.

### 10.1.1 Valid combinations – standard grade

**Table 16 S29GL-T valid combinations**

| Base OPN          | Speed (ns) | Package and temperature       | Model number      | Packing type         | Ordering part number (x = Packing type)                     |
|-------------------|------------|-------------------------------|-------------------|----------------------|-------------------------------------------------------------|
| S70GL02GT         | 110        | FHI, FHV, FAI <sup>[26]</sup> | 01                | 0, 3 <sup>[27]</sup> | S70GL02GT11FHI01x<br>S70GL02GT11FHV01x<br>S70GL02GT11FAI01x |
|                   |            |                               | 02                |                      | S70GL02GT11FHI02x                                           |
|                   |            |                               |                   |                      | S70GL02GT11FAI02x                                           |
|                   |            |                               | 03                |                      | S70GL02GT11FHV02x                                           |
|                   | 04         |                               | S70GL02GT11FAI03x |                      |                                                             |
|                   | 120        |                               | V1                |                      | S70GL02GT11FAI04x                                           |
|                   |            |                               |                   |                      | S70GL02GT12FHIV1x<br>S70GL02GT12FHVV1x                      |
|                   |            |                               |                   |                      | S70GL02GT12FHIV2x                                           |
| S70GL02GT12FHVV2x |            |                               |                   |                      |                                                             |

#### Note

26.BGA package marking omits leading “S70” and packing type designator from ordering part number.

27.Packing type “0” is standard option.

## 10.1.2 Valid combinations – automotive grade / AEC-Q100

**Table 17** lists configurations that are automotive grade/AEC-Q100 qualified and are planned to be available in volume. This table will be updated when new combinations are released. Consult your local sales representative to confirm availability of specific combinations and to check on newly released combinations.

Production part approval process (PPAP) support is only provided for AEC-Q100 grade products.

Products to be used in end-use applications that require ISO/TS-16949 compliance must be AEC-Q100 grade products in combination with PPAP. Non-AEC-Q100 grade products are not manufactured or documented in full compliance with ISO/TS-16949 requirements. AEC-Q100 grade products are also offered without PPAP support for end-use applications that do not require ISO/TS-16949 compliance.

**Table 17 S29GL-T valid combinations**

| Base OPN  | Speed (ns) | Package and temperature  | Model number | Packing type         | Ordering part number (x = Packing type) |
|-----------|------------|--------------------------|--------------|----------------------|-----------------------------------------|
| S70GL02GT | 110        | FHA, FHB <sup>[28]</sup> | 01           | 0, 3 <sup>[29]</sup> | S70GL02GT11FHA01x<br>S70GL02GT11FHB01x  |
|           |            |                          | 02           |                      | S70GL02GT11FHA02x<br>S70GL02GT11FHB02x  |
|           | 120        |                          | V1           |                      | S70GL02GT12FHAV1x<br>S70GL02GT12FHBV1x  |
|           |            |                          | V2           |                      | S70GL02GT12FHAV2x                       |
|           |            |                          |              |                      | S70GL02GT12FHBV2x                       |
|           |            |                          |              |                      |                                         |

### Note

28.BGA package marking omits leading “S70” and packing type designator from ordering part number.

29.Packing type “0” is standard option.

## Revision history

| Document revision | Date       | Description of changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **                | 2016-08-26 | Initial release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| *A                | 2016-10-21 | Updated <b>Electrical specifications</b> :<br>Updated <b>BGA package capacitance</b> :<br>Updated <b>Table 7</b> .<br>Added <b>Thermal resistance</b> .<br>Added <b>Data integrity</b> .<br>Added "Other resources".                                                                                                                                                                                                                                                                                     |
| *B                | 2017-03-16 | Updated <b>Ordering information</b> :<br>Updated <b>Recommended combinations</b> :<br>Updated description.<br>Added 02, V2 model number combinations related information.<br>Added <b>Valid combinations – standard grade</b> .<br>Added <b>Valid combinations – automotive grade / AEC-Q100</b> .<br>Updated to new template.                                                                                                                                                                           |
| *C                | 2017-04-05 | Updated <b>Ordering information</b> :<br>Updated <b>Recommended combinations</b> :<br>Updated <b>Valid combinations – standard grade</b> :<br>Updated <b>Table 16</b> .<br>Updated <b>Valid combinations – automotive grade / AEC-Q100</b> :<br>Updated <b>Table 17</b> .<br>Updated to new template.                                                                                                                                                                                                    |
| *D                | 2017-11-02 | Updated <b>Ordering information</b> :<br>Updated <b>Recommended combinations</b> :<br>Updated <b>Valid combinations – standard grade</b> :<br>Added 03, 04 model number combinations related information.<br>Updated <b>Table 16</b> .                                                                                                                                                                                                                                                                   |
| *E                | 2018-02-13 | Updated <b>Electrical specifications</b> :<br>Updated <b>DC characteristics</b> :<br>Updated <b>Table 6</b> .<br>Updated to new template.                                                                                                                                                                                                                                                                                                                                                                |
| *F                | 2022-08-22 | Updated Document Title to read as "S70GL02T, 2 Gb (256 MB) GL-T MIRRORBIT™ Flash Parallel, 3.0 V".<br>Replaced "MirrorBit® Eclipse" with "MIRRORBIT™" in all instances across the document.<br>Updated <b>General description</b> :<br>Replaced "fast page access time of 25 ns" with "fast page access time of 20 ns".<br>Updated <b>Electrical specifications</b> :<br>Updated <b>Thermal resistance</b> :<br>Updated <b>Table 8</b> .<br>Removed "Other resources".<br>Migrated to Infineon template. |

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