

Viking eUSB
Embedded USB Manual
~
Industrial Products

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Revision History

| Date | Revision | Description |
|------|-----------|---|
| A | 9/12/14 | Initial release VRFDUC3(L)032GYCNxx PN for SM3252 VRFDUC3032GYCNE1 (12/13/2013) Update PN table for new PN's and 16GB (A1, 6/2/2014) Revised Standby Current and Operating Current based on 3.3V NAND devices (A2, 7/8/14) Removed firmware upgrade capability (A3, 8/8/14) Add VRFDUC31024YCG PN (9/12/14). Update PN table description |
| B | 11/4/14 | Add tolerance info to Mechanical Dimensions |
| C | 3/27/15 | Revise PN table to match PSG |
| D | 6/16/15 | Revise PN table 4GB P/N at 5.0V 2-CH: VRFDUC3(L)4096YxHyy 4GB P/N at 3.3V 2-CH: VRFDUC3(L)4096YxH3yy |
| E | 9/1/2015 | Add VRFDUC3(L)2048YxE3yy and VRFDUC3(L)2048YxEyy per PSG update |
| F | 11/9/2015 | update with performance based on IOmeter06 for SMI 3252 controller |
| G | 6/12/16 | Added Part Number VRFDUC3(L)2048YxGyy. Added Note 6 on Figure 3-4 Dimensions (Version 2, standard profile) to show maximum component height on secondary side (Bottom) is 3.7 ± 0.06 mm [0.145 ± 0.003 inches] |
| H | 8/22/16 | specify the SCSI commands supported by the SMI 325/3252 controller. |
| | | |

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Ordering Information: eUSB Family

Viking High Performance USB embedded Drive Ordering Information

| Part Number | Capacity | Device Density | Voltage | # Devices | Channels | LBA |
|----------------------|----------|----------------|---------|-----------|----------|------------|
| VRFDUC3(L)2048YxE3yy | 2GB | 8Gb | 3.3 | 2 | 2 | 3,928,176 |
| VRFDUC3(L)2048YxE3yy | 2GB | 8Gb | 3.3 | 2 | 2 | 3,928,176 |
| VRFDUC3(L)4096YxH3yy | 4GB | 16Gb | 3.3 | 2 | 2 | 7,835,184 |
| VRFDUC3(L)8192YxK3yy | 8GB | 32Gb | 3.3 | 2 | 2 | 15,649,200 |
| VRFDUC3(L)016GYxK3yy | 16GB | 32Gb | 3.3 | 4 | 2 | 31,277,232 |
| VRFDUC3(L)030GYxN3yy | 30GB | 64Gb | 3.3 | 4 | 2 | 62,533,296 |
| | | | | | | |
| VRFDUC3(L)2048YxGyy | 2GB | 8Gb | 5 | 2 | 2 | 3,928,176 |
| VRFDUC3(L)2048YxEyy | 2GB | 8Gb | 5 | 2 | 2 | 3,928,176 |
| VRFDUC3(L)4096YxHyy | 4GB | 16Gb | 5 | 2 | 2 | 7,835,184 |
| VRFDUC3(L)8192YxKyy | 8GB | 32Gb | 5 | 2 | 2 | 15,649,200 |
| VRFDUC3(L)016GYxKyy | 16GB | 32Gb | 5 | 4 | 2 | 31,277,232 |
| VRFDUC3(L)030GYxNyy | 30G | 64Gb | 5 | 4 | 2 | 62,533,296 |

Notes:

1. DUC3xxxx signifies standard profile, DUC3Lxxxx signifies low profile.
2. x = C for Commercial temperature range: 0 to 70°C (32 to 158° F)
or I for Industrial temperature range: -40 to 85°C (-40 to 185° F)
3. Storage capacity listed will vary due to formatting and additional functions,
and therefore is not available for storage.
4. USB's ship formatted from the factory unless otherwise requested.
5. All eUSBs are based on SLC flash unless otherwise requested.
6. All capacities are available in 3.3V versions.
7. yy indicates BOM specific information
8. "L" indicate low profile
9. Maximum of 4KB per page

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1 Introduction

1.1 Product Overview

Viking Technology’s Embedded USB (eUSB) module provides a rugged, reliable and cost effective non-volatile memory, solutions to OEM customers in the Communication, Networking, Embedded and Industrial markets. The eUSB module is a secure pluggable device and a drop-in replacement for Intel® Z-U130 Value Solid State Drive with a USB 2.0 interface, ECC and global wear-leveling. Additional options such as MLC (Multi Level Cell) technology and ESD protection are also available.

Viking’s rugged industrial designed USB’s offer the highest flash storage reliability and performance in harsh environments such as shock, vibration, humidity, altitude, ESD, and extreme temperatures. Viking USB’s meet JEDEC JESD22 standards and pass numerous qualifications including MIL-STDs and NEBS.

Viking can also provide specialized services to OEMs designing customized hardware and systems by offering:

- Locked BOM control with customer product change notification (PCN)
- Pre-installed software, custom software imaging and ID strings
- Custom packaging and labeling
- Comprehensive supply-chain management
- Customer specified testing
- 30k volt ESD protection
- Conformal coating
- Localized Field Application Engineering for complete pre and post sale technical support

1.2 Features

The embedded USB drive delivers the following features:

- USB 2.0 high speed compatible (supports Bulk-Only transport protocol)*
- Up to 35 MB/s Read Speed and 23 MB/s Write Speed (Dual Channel)
- Up to 23 MB/s Read Speed and 12 MB/s Write Speed (Single Channel)
- Host Interface Speed 60MB/s
- Drive Activity indicator signal
- Low power Dissipation- less than 0.45W active; less than 1mW standby

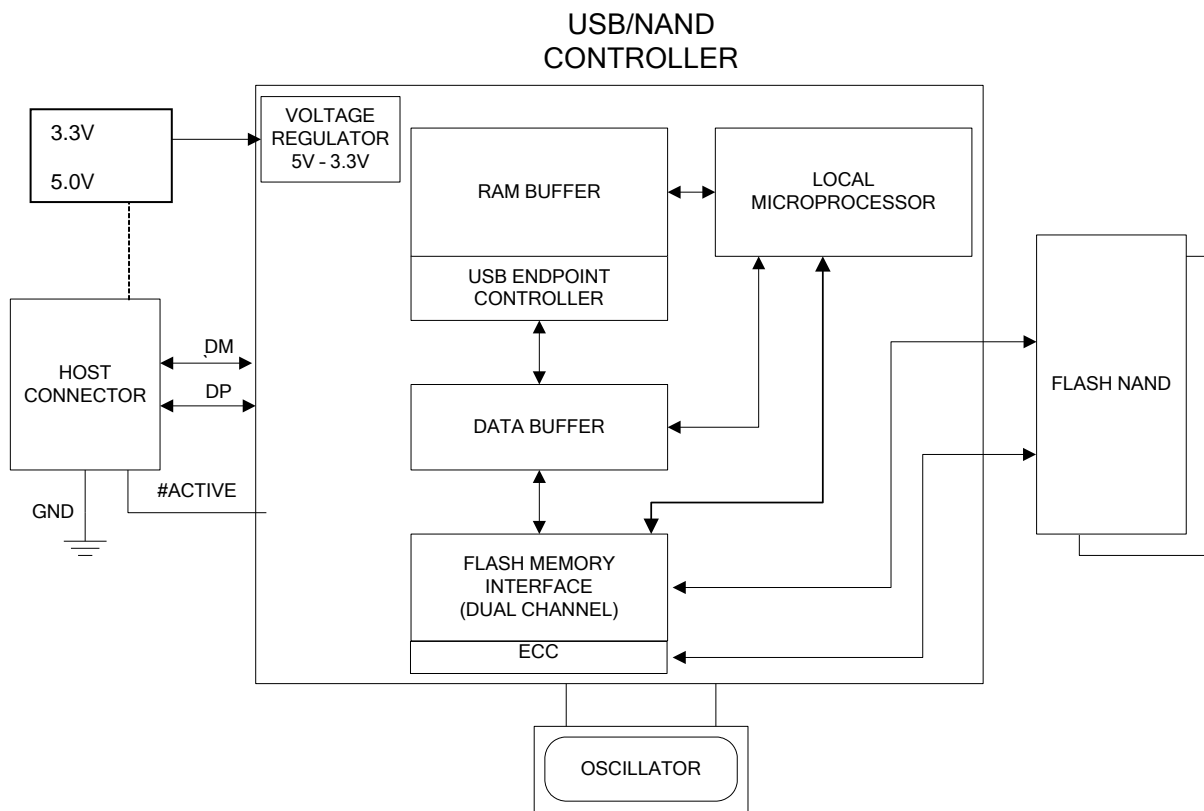
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- Solid state, Non-volatile NAND Memory
- RoHS Compliant
- Static Wear Leveling

* With exception of 3.3V only operation, USB specification is 5V.

1.3 Block Diagram

Figure 1-1: High-Level Block Diagram



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1.4 USB Interface

- The USB interface is compliant with the USB 2.0 specification.
- The USB interface connects the host computer to the embedded USB.
- The USB interface runs at a maximum speed of 2.0 Gbps (gigabits per second). If the host computer is unable to negotiate a speed of 2.0 Gbps, the USB interface automatically renegotiates to lower speeds.

2 Product Specifications

2.1 Performance

The host interface speed is 60MB/s with a read/write bandwidth shown in the following tables.

Table 2-1: Sustained Read and Write Bandwidth¹

| Access Type | MB/s |
|---------------------|------------|
| Read, Dual Channel | Up to 31.2 |
| Write, Dual Channel | Up to 17.4 |

Notes:

1. Based on VRFDUC3L032GYCNE1 MicSLC SM3252 using IOMETER06
2. Based on VRFDUC3L016GYIKK1 TosSLC SM3252 using IOMETER06

Table 2-2: Maximum Sustained Read and Write Bandwidth

| Access Type | MB/s |
|---------------------|--------------|
| Read, Dual Channel | Max up to 35 |
| Write, Dual Channel | Max up to 23 |

2.2 Timing

Table 2-3: Timing Specifications

2.3 Power-up AC timing Requirements

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|-----------------------------------|--------|------|---------|------|------|
| Powerup to Ready (from 2.7V VBUS) | tRESET | 100 | 150 | 250 | ms |

Notes:

1. This power-up timing can be changed to 10ms upon request. The long power-up delay is designed to accommodate slow power-up times of rack systems.

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2.4 Electrical Characteristics

2.4.1 Absolute Maximum Ratings

Table 2-4: Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---------------------|--------|-----------------------|------|
| 5.0 Supply Voltage | VBUS | -0.3 ~ 5.5 | V |
| 3.3 Supply Voltage | VBUS | -0.3 ~ 4.0 | V |
| Input Voltage | VIN | GND - 0.5 ~ VCC + 0.5 | V |
| Storage Temperature | TST | -55 ~ 150 | °C |

Notes:

1. Permanent device damage may occur if 'ABSOLUTE MAXIMUM RATINGS' are exceeded. Functional operation should be restricted to recommended operating condition. Exposure to higher than recommended voltage for extended periods of time could affect device reliability.

2.4.2 DC Operating Conditions and Characteristics

Table 2-5: Voltage and Current Ratings

| Parameter | Symbol | Min. | Typical | Max. | Unit | |
|--|-----------------|------------------|---------|-------------|------------|---------|
| 5.0 Supply voltage ($\pm 5\%$) | VBUS | 4.75 | 5.0 | 5.25 | V | |
| 3.3 Supply voltage ($\pm 5\%$) | VBUS | 3.14 | 3.3 | 3.465 | V | |
| Regulated Output Voltage (internal eUSB voltage) | VDD33O | 2.9 | 3.3 | 3.6 | V | |
| Input high voltage | VIH | 2.0 | - | - | V | |
| Input low voltage | VIL | - | - | 0.8 | V | |
| Output high voltage | VOH | 2.4 | - | - | V | |
| Output low voltage | VOL | - | - | 0.4 | V | |
| Standby Current ² | 1 Flash Device | I _{STB} | - | 16.5 + 6.6 | 23.1 + 33 | μ A |
| | 2 Flash Devices | | - | 16.5 + 13.2 | 23.1 + 66 | μ A |
| | 4 Flash Devices | | - | 16.5 + 19.8 | 23.1 + 132 | μ A |
| Operating Current ² | 1 Flash Device | I _{OP} | - | 132 + 9.9 | 165 + 19.8 | mA |
| | 2 Flash Devices | | - | 132 + 19.8 | 165 + 39.6 | mA |
| | 4 Flash Devices | | - | 132 + 39.6 | 165 + 79.2 | mA |

Notes:

1. Recommended operating conditions (Voltages referenced to GND, TA = 0 to 70C)
2. Based on 3.3V NAND

2.4.3 Power Consumption

All onboard power requirements of the eUSB are derived from the 5V or 3.3V input rail.

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Table 2-6: Power Consumption

| Power | Typical | units |
|-----------|---------|-------|
| Standby | 1 | mW |
| Operating | 450 | mW |

2.4.4 Capacitance

Table 2-7: Bus Line Capacitance

| Parameter | Symbol | Min | Max | Unit |
|----------------------|----------------|-----|-----|------|
| Bus line capacitance | C _L | - | 20 | pF |

2.5 Environmental Conditions

2.5.1 Temperature and Altitude

Table 2-8: Temperature and Altitude Related Specifications

| Conditions | Operating | Shipping | Storage |
|---|---|---|---|
| Commercial Temperature | 0 to 70°C (32 to 158° F) | -40 to 85°C (-40 to 185° F) | -40 to 85°C (-40 to 185° F) |
| Industrial Temperature¹ | -40 to 85°C (-40 to 185° F) | -40 to 85°C (-40 to 185° F) | -40 to 85°C (-40 to 185° F) |
| Humidity (non-condensing) | 5% to 95% | 5% to 95% | 5% to 95% |
| Max Temperature Gradient | 20°C/Hour (36°F/Hour) | n/a | n/a |
| Altitude | -304.8 to 24,384 m (-1,000 to 80,000 ft) | -304.8 to 24,384 m (-1,000 to 80,000 ft) | -304.8 to 24,384 m (-1,000 to 80,000 ft) |
| Storage Time Duration | n/a | n/a | 1 year |

Notes:

1. SLC flash based products are available in the following temperature ranges:
 - a) Commercial temperature range of 0 to 70°C (32 to 158° F)
 - b) Industrial temperature range -40 to 85°C (-40 to 185° F)

2.6 Reliability

Table 2-9: Reliability Specifications

| Parameter | Value |
|--|-----------------|
| Mean Time Between Failures (MTBF) ¹ | 2,500,000 hours |
| Power On/Off Cycles ² | 50,000 cycles |

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| Parameter | Value |
|---------------------------------------|------------------------------------|
| Read Endurance | Unlimited |
| Write or Erase Endurance ³ | (specified by the flash component) |
| Wear-leveling | Global |
| Data retention | >10 years |

Notes:

1. MTBF is calculated based on a Part Stress Analysis. It assumes nominal voltage, with all other parameters within specified range. Telcordia method SR-332 component FIT rate at 55°C.
2. Power On/Off Cycles defined as power being removed from the drive, and then restored. Note that host systems and drive enclosures may remove power from the drive for reasons other than a system shutdown.
3. SLC NAND has a higher endurance than MLC NAND

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3 Mechanical Information

The dimensions of the eUSB (version-1) are based on the following PCB #s: 1208, 1209

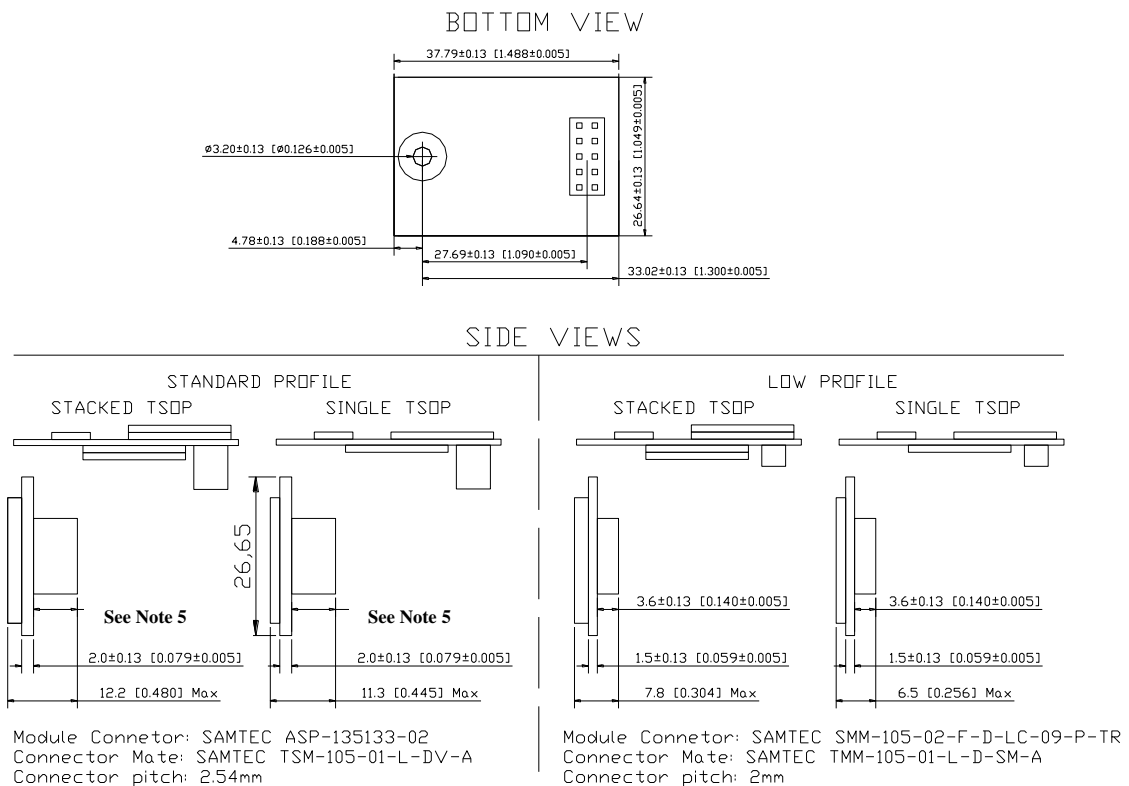
As an example, the 1208 PCB would have a 0001208A marking that is silkscreened at the bottom edge of the PCB near the mounting hole on the same side as the connector (at bottom side of the eUSB) as shown in the following figure.

Figure 3-1: Location of PCB # marking



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Figure 3-2: Dimensions (Version-1)



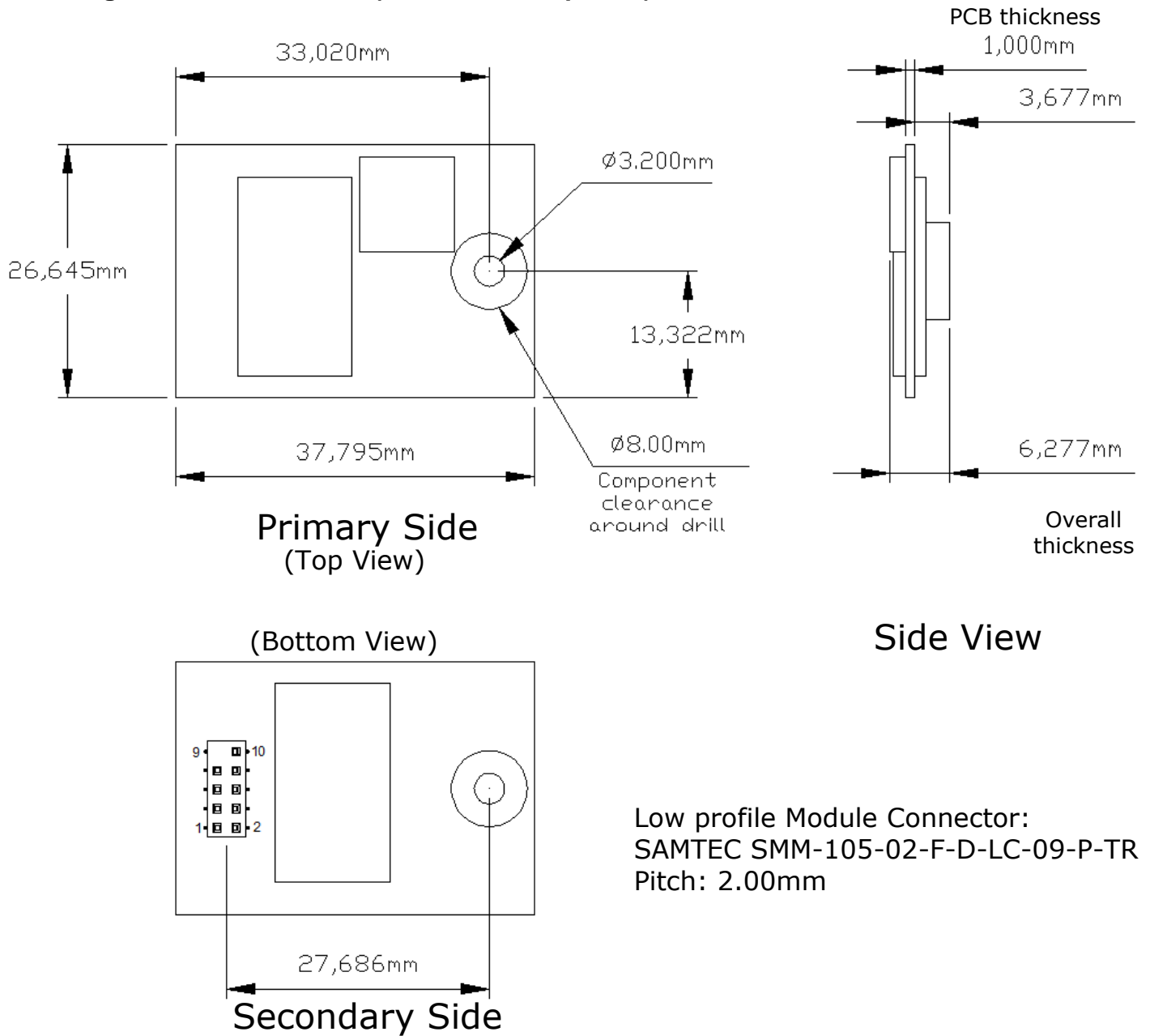
Notes:

1. PCB number is silkscreened on the PCB
2. Dimensions shown in millimeters [inches]
3. Max screw penetration is 5mm at all 4 locations.
4. The module connector height is 7.4 ± 0.13 [0.290± 0.005] plus standoff ~ 0.45mm ± 0.13 when mounted to a PCB.
5. Connector height with standoff is 8.00 ± 0.13 [0.315± 0.005]
6. PCB Tolerance is +/- 0.127mm [0.005 inch], unless otherwise stated

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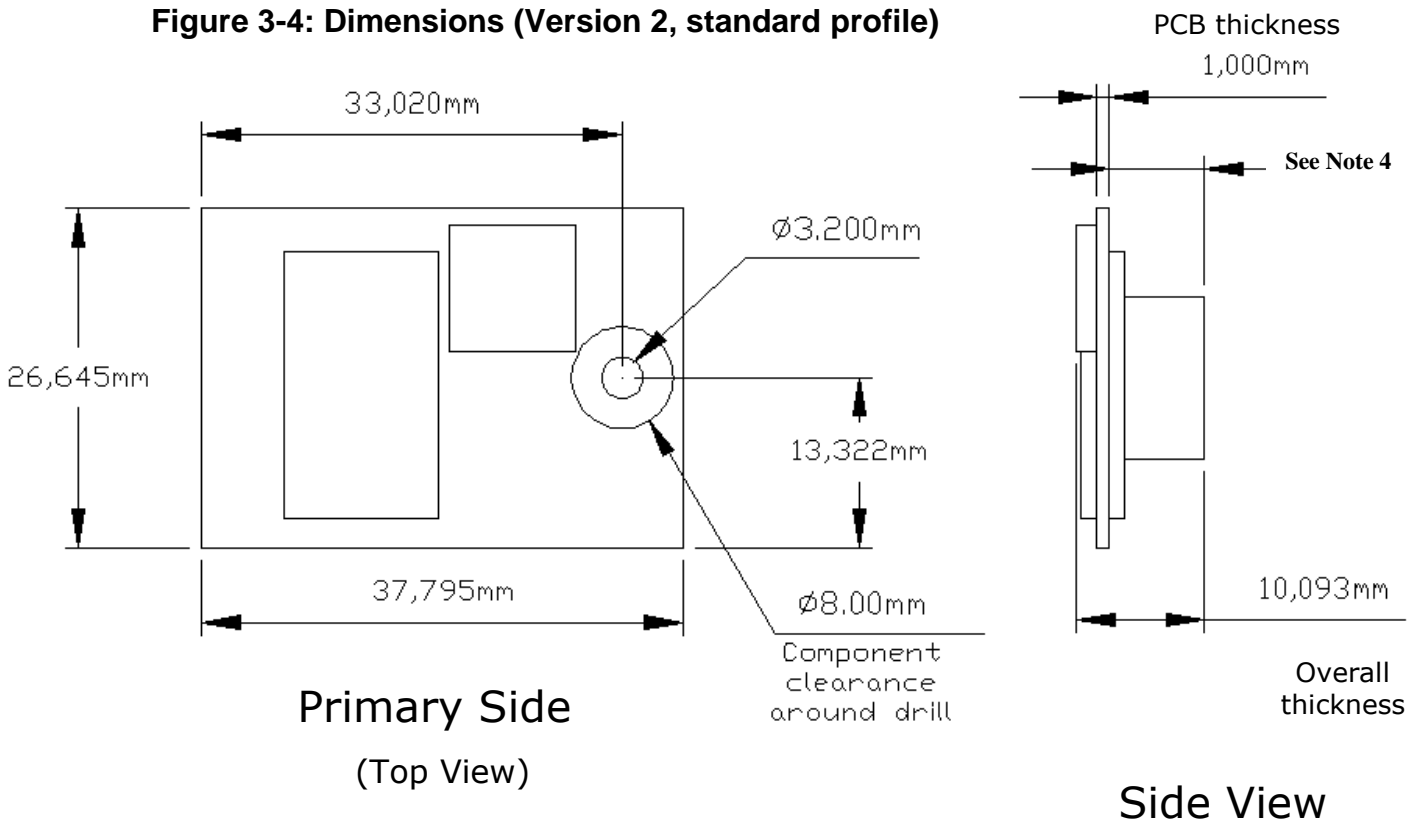
The dimensions of the eUSB (version 2) are based on the following PCB #s: 1448, 1449

Figure 3-3: Dimensions (Version-2, low profile)



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Figure 3-4: Dimensions (Version 2, standard profile)



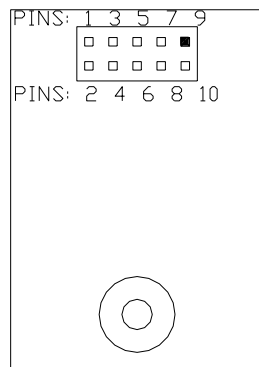
Notes:

1. Standard Profile Module Connector:
SAMTEC SSM-105-L-DV-LC-009-P-TR
Pitch: 2.54mm
2. Dimensions shown in millimeters
3. Max screw penetration is 5mm at all 4 locations.
4. The module connector height is $7.4 \pm 0.13\text{mm}$ [0.290 ± 0.005 inches]
5. PCB Tolerance is $\pm 0.127\text{mm}$ [0.005 inch], unless otherwise stated
6. Maximum component height on secondary side (Bottom) is $3.7 \pm 0.06\text{mm}$ [0.145 ± 0.003 inches]

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4 Pin and Signal Descriptions

Figure 4-1: Connector Pin Assignments



4.1 Signal and Power Description Tables

Table 4-1: eUSB Connector Pin Signal Definitions

| Pin | Signal Name | Type | Description |
|-----|-------------|-------|--|
| 1 | VBUS | Power | 3.3 or 5V power supply |
| 2 | NC | NC | Not connected |
| 3 | DM | I/O | USB 2.0 Data Negative Pin |
| 4 | NC | NC | Not connected |
| 5 | DP | I/O | USB 2.0 Data Positive Pin |
| 6 | NC | NC | Not connected |
| 7 | GND | Power | Ground |
| 8 | NC | NC | Not connected |
| 9 | N/A | Key | Polarization |
| 10 | #Activity | I/O | Status signal that indicates when the drive is busy. This signal may be used to drive a low current LED or other logic on the host to indicate drive status to the user or system. This signal is active low and has a 4mA drive strength. |

Notes:

- * Available custom options: Pin 2 Chassis ground option; Pin 4 Hardware /WP; Pin 6 Hardware /Reset. Custom options available on locked BOMs only.

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5 Command Sets

The tables below summarize the supported SCSI feature set and commands.

Table 5-1: SCSI Feature Set

| SCSI Command | OpCode |
|-----------------------------|--------|
| TEST_UNIT_READY | 0x00 |
| REZERO_UNIT | 0x01 * |
| REQUEST_SENSE | 0x03 |
| FORMAT | 0x04 |
| INQUIRY | 0x12 |
| MODE_SELECT_6 | 0x15 * |
| MODE_SENSE_6 | 0x1A |
| START_STOP_UNIT | 0x1B |
| SEND_DIAGNOSTIC | 0x1D * |
| PREVENT/ALLOW MEDIUM REMOVE | 0x1E + |
| READ_FORMAT_CAPACITIES | 0x23 |
| READ_CAPACITY | 0x25 |
| READ_10 | 0x28 |
| WRITE_10 | 0x2A |
| SEEK | 0x2B * |
| WRITE_AND_VERIFY | 0x2E |
| VERIFY | 0x2F * |
| SYNCHRONIZE_CACHE | 0x35 * |
| READTOC | 0x43 |
| PLAY_AUDIO_10 | 0x45 * |
| MODE_SELECT_10 | 0x55 * |
| MODE_SENSE_10 | 0x5A |
| READ_12 | 0xA8 |
| WRITE_12 | 0xAA |

Notes:

1. SM3252BB/SM325AC SMI Controller
2. Note *: Recognize the command and just response PASS status. No other process.
3. Note +: Recognize the command and just response PASS or Fail status. No other process.
4. Note others : Support command function but not full as described in spec. For example: Command WRITE_AND_VERIFY has write function only.

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Table 5-2: SCSI Error Codes List

| Sense Key | ASC | ASC Q | Description |
|-----------|------|-------|--|
| 0x02 | 0x04 | 0x02 | LOGICAL UNIT NOT READY - INITIALIZATION REQUIRED |
| 0x02 | 0x3A | 0x00 | MEDIUM NOT PRESENT |
| 0x02 | 0x7B | 0x00 | VENDOR SPECIFIC |
| 0x05 | 0x20 | 0x00 | INVALID COMMAND OPERATION CODE |
| 0x05 | 0x21 | 0x00 | LOGICAL BLOCK ADDRESS OUT OF RANGE |
| 0x05 | 0x24 | 0x00 | INVALID FIELD IN CDB |
| 0x06 | 0x28 | 0x00 | NOT READY TO READY CHANGE, MEDIUM MAY HVAE CHANGED |
| 0x07 | 0x27 | 0x00 | WRITE PROTECTED |
| 0x00 | 0x00 | 0x00 | UN C |

6 Certifications and Compliance

Table 6-1: Device Certifications

| Certification/Compliance | Description |
|--------------------------|---|
| RoHS | Viking Technology, Sanmina Corporation ("Viking") shall use commercially reasonable efforts to provide components, parts, materials, products and processes to customers that do not contain: (i) lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) above 0.1% by weight in homogeneous material or (ii) cadmium above 0.01% by weight of homogeneous material, except as provided in any exemption(s) from RoHS requirements (including the most current version of the "Annex" to Directive\ 2002/95/EC of 27 January, 2003), as codified in the specific laws of the EU member countries. Viking strives to obtain appropriate contractual protections from its suppliers in connection with the RoHS Directives. |
| EU WEEE Compliant | The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community directive 2002/96/EC on waste electrical and electronic equipment (WEEE) which, together with the RoHS Directive 2002/95/EC, became European Law in February 2003, setting collection, recycling and recovery targets for all types of electrical goods. |
| Safety | All printed circuit boards (PCBs) have a flammability rating of UL94V-0. |

7 References

- USB Specification, version 2.0

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