SECRETARIAT: SFF TA TWG

This specification is made available for public review at http://www.snia.org/sff/specifications. Comments may be submitted at http://www.snia.org/feedback. Comments received will be considered for inclusion in future revisions of this specification.

The description of the device in this specification does not assure that the specific component is available from device suppliers. If such a device is supplied, it should comply with this specification to achieve interoperability between suppliers.

**This revision of the specification supersedes and obsoletes all previous versions of this specification.**

**ABSTRACT:** This specification defines the mechanical attributes for a family of form factor devices known as E3 with multiple length and multiple thickness variants that can be used in 2U and 1U rack mounted host systems designed to support this form factor.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers. This specification originates from Enterprise and Datacenter SSD Form Factor Working Group (EDSFF).

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Foreword

The development work on this specification was done by the SNIA SFF TWG, an industry group. Since its formation as the SFF Committee in August 1990, the membership has included a mix of companies which are leaders across the industry.

For those who wish to participate in the activities of the SFF TWG, the signup for membership can be found at http://www.snia.org/sff/join.

Revision History

Rev 1.0 March 3, 2020
- First release

Rev 2.0 November 6, 2020
- Changes to the nomenclature describing the devices
- Increasing the length of a short length device to 112.75mm
- Changed E3.S length tolerance to +/-0.4mm
- Changed E3.L length tolerance to +/-0.4mm
- Changed the device nomenclature of thickness from 2x to 2T
- Changed thickness tolerance of 7.5mm devices to 7.5 +0.2/-0.5mm
- Updated the connector pin 1 location
- Changed Table 6-1 to informative
- Added Note 10 to allow for up to three screws in the riding surfaces
- Added a Section 5.4 for label requirements & added dimensions on label areas
- Added references governing use of Hot Surface Warning Label
- Changes to the LED requirements and location
- Updates to drawings & minor edits to drawing notes
- Made several editorial changes
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1. Scope
This specification defines the mechanical attributes of a family of device form factors that fit in rack mounted host systems designed to support this form factor.

2. References and Conventions

2.1 Industry Documents
The following documents are relevant to this specification:
- ASME Y14.5-2009 Dimensioning and Tolerancing published by ASME
- SFF-TA-1002 Protocol Agnostic Multi-Lane High Speed Connector specification
- SFF-TA-1009 Enterprise and Datacenter SSD Pin and Signal specification
- SFF-TA-1023 Thermal Specification for EDSFF Devices
- UL/IEC/EN 60950-1 Information Technology Equipment – Safety – Part 1: General Requirements
- UL/IEC/EN 62368-1 Audio/Video Information and Communication Technology Equipment

2.2 Sources
The complete list of SFF documents which have been published, are currently being worked on, or that have been expired by the SFF Committee can be found at http://www.snia.org/sff/specifications. Suggestions for improvement of this specification will be welcome, they should be submitted to http://www.snia.org/feedback.

Copies of ASME standards may be obtained from the American Society of Mechanical Engineers (https://www.asme.org).

2.3 Conventions
DEFINITIONS
Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in the definitions or in the text where they first appear.

ORDER OF PRECEDENCE
If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values.

LISTS
Lists sequenced by lowercase or uppercase letters show no ordering relationship between the listed items.

EXAMPLE 1 - The following list shows no relationship between the named items:
- red (i.e., one of the following colors):
  - crimson; or
  - pink;
- blue; or
- green.

Lists sequenced by numbers show an ordering relationship between the listed items.

EXAMPLE 2 - The following list shows an ordered relationship between the named items:
- top;
- middle; and
- bottom.

Lists are associated with an introductory paragraph or phrase, and are numbered relative to that paragraph or phrase (i.e., all lists begin with an a. or 1. entry).
DIMENSIONING CONVENTIONS
The dimensioning conventions are described in ASME-Y14.5, Geometric Dimensioning and Tolerancing. All dimensions are in millimeters, which are the controlling dimensional units (if inches are supplied, they are for guidance only).

NUMBERING CONVENTIONS
The ISO convention of numbering is used (i.e., the thousands and higher multiples are separated by a space and a period is used as the decimal point). This is equivalent to the English/American convention of a comma and a period.

<table>
<thead>
<tr>
<th>American</th>
<th>French</th>
<th>ISO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>0,6</td>
<td>0.6</td>
</tr>
<tr>
<td>1,000</td>
<td>1 000</td>
<td>1 000</td>
</tr>
<tr>
<td>1,323,462.9</td>
<td>1 323 462,9</td>
<td>1 323 462,9</td>
</tr>
</tbody>
</table>
3. Keywords, Acronyms, and Definitions

For the purpose of SFF Specifications, the following definitions apply.

3.1 Keywords

**Mandatory:** Indicates items to be implemented as defined by this specification

**May:** Indicates flexibility of choice with no implied preference

**Optional:** This term describes features which are not required by the SFF Specification. However, if any feature defined by the SFF Specification is implemented, it shall be done in the same way as defined by the Specification. Describing a feature as optional in the text is done to assist the reader. If there is a conflict between text and tables on a feature described as optional, the table shall be accepted as being correct.

**Reserved:** Where this term is used for defining the signal on a connector contact its actual function is set aside for future standardization. It is not available for vendor specific use. Where this term is used for bits, bytes, fields and code values; the bits, bytes, fields and code values are set aside for future standardization. The default value shall be zero. The originator is required to define a reserved field or bit as zero, but the receiver should not check Reserved fields or bits for zero.

**Shall:** Indicates a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to the specification.

**Should:** Indicates flexibility of choice with a strongly preferred alternative. Equivalent to the phrase “it is recommended”.

3.2 Acronyms and Abbreviations

**1C:** Version of SFF-TA-1002 connector that supports an x4 PCIe interface

**1U:** 1 Standard Unit or Rack Unit 44.45 mm (1.75 inches)

**2C:** Version of SFF-TA-1002 connector that supports an x8 PCIe interface

**2T:** Double thick device (16.8mm)

**2U:** 2 Standard Units or Rack Unit 88.90 mm (3.50 inches)

**4C:** Version of SFF-TA-1002 connector that supports an x16 PCIe interface

**NVM:** Acronym for Non-Volatile Memory

**SSD:** Acronym for Solid State Drive

**x4:** 4 lane device interface link width

**x8:** 8 lane device interface link width

**x16:** 16 lane device interface link width

3.3 Definitions

**Host:** Refers to the interface source or master

**Device:** Refers to the interface slave

**Thickness:** Form factor dimension including PCB thickness, z-height of all components plus mechanicals
4. General Description

The application environment for the device form factor is a cabinet or enclosure connecting to one or more devices. The device connects electrically to the system through a card edge connector as defined in SFF-TA-1002. This form factor is intended for use in enclosures that fit within either a 1U or a 2U space (e.g., 1U refers to 1 standard unit of an IT equipment rack and the IT enclosures that fit in this space).

The primary usage of this form factor is for SSDs and/or storage class memory in storage and server systems. Other potential use cases such as accelerators or network interface cards (NICs) are left to the implementer.

The form factor defines a family of devices that vary in length and thickness. Devices may support a variety of interface link widths.

This specification defines the outside dimensions and features of the device enclosure and system interface point. This specification defines the device card edge PCB mating interface with the system but does not define PCB design internal to the device. Internal PCB design is left to the implementer.

Figure 4-1 shows an example of possible 3D views of the device form factors.

Figure 4-1. Example Device 3D Views

The example above includes the following device implementations starting from right to left.

- E3 short single thickness device (E3.S)
- E3 short double thickness device (E3.S 2T)
- E3 long single thickness device (E3.L)
- E3 long double thickness device (E3.L 2T)

Additional variations of the form factor may be defined in future version of this specification.

Connector dimensions and mating interface details are defined in SFF-TA-1002.

Connector signal assignments are defined in SFF-TA-1009.
The form factor is specified including an enclosure, with two (2) mounting holes at the front of the device enclosure and one (1) additional mounting hole on each side of the device enclosure which may be used for latch and/or carrier attachment points. The latch/carrier is beyond the scope of the specification.

Implementations conforming to this form factor may support multiple host connection link widths as defined by SFF-TA-1002. Link widths supported by this form factor include x4 (1C), x8 (2C), x16 (4C), and extended x16 (4C+). The example devices in Figure 4-1 are shown with a x4 (1C) connector. Dashed lines show potential x8 (2C) and x16 (4C) implementations.

The form factor specifies the locations for two (2) LED apertures. Additional LED requirements are defined by the SFF-TA-1009 specification.

This specification defines a series of surfaces that are used for contact or grounding. These surfaces are intentionally called out in the drawings and represent functional surfaces at outer extents of form factor. These surfaces are not necessarily raised and may be co-planer with their surrounding surfaces.
5. Physical Configurations: Device Form Factor

This section specifies the dimensions for the device form factor. The dimensioning convention is per ASME-Y14.5-2009 Dimensioning and Tolerancing. For mating interface details refer to SFF-TA-1002.

This specification allows for device implementations that can vary in length and thickness. Table 5-1 lists the nominal dimensions for four device variations.

<table>
<thead>
<tr>
<th>Device Variation</th>
<th>Height</th>
<th>Length</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>E3.S</td>
<td>76mm</td>
<td>112.75mm</td>
<td>7.5mm</td>
</tr>
<tr>
<td>E3.S 2T</td>
<td>76mm</td>
<td>112.75mm</td>
<td>16.8mm</td>
</tr>
<tr>
<td>E3.L</td>
<td>76mm</td>
<td>142.2mm</td>
<td>7.5mm</td>
</tr>
<tr>
<td>E3.L 2T</td>
<td>76mm</td>
<td>142.2mm</td>
<td>16.8mm</td>
</tr>
</tbody>
</table>

5.1 Datum references

For all the dimensions shown for the different variants of the E3 form factor within this specification, the datums listed in Table 5-2 are defined by this specification or the SFF-TA-1002 specification mating card variants.

<table>
<thead>
<tr>
<th>Datum</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>SFF-TA-1008</td>
</tr>
<tr>
<td>B</td>
<td>SFF-TA-1008</td>
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<td>C</td>
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<td>F</td>
<td>SFF-TA-1002</td>
</tr>
<tr>
<td>G</td>
<td>SFF-TA-1002</td>
</tr>
</tbody>
</table>
5.2 E3 Single Thickness Form Factor Physical Dimensions

This section defines the physical dimensions for the E3 single thickness variations of the E3 form factor. These variations include a short version and a long version. The shape of each form factor is shown for example purposes only.

![Diagram](image)

**Figure 5-1 E3 Front View**

Figure 5-1 defines the center point of the LED apertures. The size and shape of the apertures are left to the device implementer. Additional LED requirements are found in the SFF-TA-1009 specification.

Planes except for keep-out areas (e.g., riding surfaces, screw holes, or labels) may have cutouts for debugging or thermal relief.

![Diagram](image)

**Figure 5-2 Mounting Hole Details**

FASTENER PENETRATION SHALL NOT BE LIMITED BY THREAD COUNT.

DEVICE SHALL ALLOW FOR FASTENER PENETRATION TO THIS DIMENSION.
Figure 5-3 E3.S Top & Side View

NOTES:

1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS FOR A SURFACE APPLY TO A SINGLE POINT MINIMUM. IF A SURFACE IS NOT PARALLEL TO THE DATUM STRUCTURE, THE DIMENSION APPLIES TO THE HIGHEST RAISED LOCATION ON THAT SURFACE.

2. AREA CONDUCTIVE TO GROUND. CONTACT PLANE FOR CARRIER MOUNTING. IF NEEDED, 0.5 DEGREE DRAFT MAXIMUM.

3. MAXIMUM 3 SEPARATE CONCAVE SURFACES Ø.18 MAX ALLOWED IN THESE AREAS

BOTTOM / SIDE A

TOP / SIDE B

28.1.5 MAX BOTH SIDES

3.5 MAX BOTH SIDES

2 MIN BOTH SIDES

112.75 X 4

3.5 MAX BOTH SIDES

2 MIN BOTH SIDES

28.1.5 MAX BOTH SIDES

112.75 X 4

PIN B1

DATUM E

DATUM F

37.890.35 CONTROL DIMENSION FOR XD CARD EDGE

27.740.35 CONTROL DIMENSION FOR XD CARD EDGE

19.685 I

6 PIN I

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Figure 5-4 E3.S Bottom & Side View

NOTES:
1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS FOR A SURFACE APPLY TO A SINGLE POINT MINIMUM. IF A SURFACE IS NOT PARALLEL TO THE DATUM STRUCTURE, THE DIMENSION APPLIES TO THE HIGHEST RAISED LOCATION ON THAT SURFACE.

- DEVICE RIDING SURFACE. IF NECESSARY, 1.5 DEGREE DRAFT MAXIMUM.
- AREA CONDUCTIVE TO GROUND. CONTACT PLANE FOR CARRIER MOUNTING. IF NECESSARY, 0.5 DEGREE DRAFT MAXIMUM.
- MAXIMUM 3 SEPARATE CONCAVE SURFACES Ø 10 MAX ALLOWED IN THESE AREAS
Figure 5-5 E3.L Top & Side View
Figure 5-6 E3.L Side & Bottom View
5.3 E3 Double Thickness Form Factor Physical Dimensions

This section defines the physical dimensions for the E3 2T variations of the E3 form factor. These variations include a short version and a long version. The shape of each form factor is shown for example purposes only.

Planes except for keep-out areas (e.g., riding surfaces, screw holes, or labels) may have cutouts for debugging or thermal relief.

Dimensions not shown are identical to the E3 single thickness variations.

![Diagram of E3 Double Thickness Form Factor](image)

**Figure 5-7 E3 2T Front View**

Figure 5-7 defines the center point of the LED apertures. The size and shape of the apertures are left to the device implementer. Additional LED requirements are found in the SFF-TA-1009 specification.

The example in Figure 5-7 shows a solid body implementation. Implementations may implement finned structures to maximize thermal performance. E3 2T device implementations may be less than 16.8mm thickness as long as they are greater than a single thickness E3 device. Refer to SFF-TA-1023 for thermal requirements and characterizations for device implementations.

Planes except for keep-out areas (e.g., riding surfaces, screw holes, or labels) may have cutouts for debugging or thermal relief.
Figure 5-8 E3.S 2T Top & Side View

NOTES:

1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS FOR A SURFACE APPLY TO A SINGLE POINT MINIMUM. IF A SURFACE IS NOT PARALLEL TO THE DATUM STRUCTURE, THE DIMENSION APPLIES TO THE HIGHEST RAISED LOCATION ON THAT SURFACE.

⚠️ AREA CONDUCTIVE TO GROUND, CONTACT PLANE FOR CARRIER MOUNTING. IF NECESSARY, 0.5 DEGREE DRAFT MAXIMUM.
Figure 5-9 E3.L 2T Side & Bottom View

NOTES:
1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS FOR A SURFACE APPLY TO A SINGLE POINT MINIMUM. IF A SURFACE IS NOT PARALLEL TO THE DATUM STRUCTURE, THE DIMENSION APPLIES TO THE HIGHEST RAISED LOCATION ON THAT SURFACE.

△ AREA CONDUCTIVE TO GROUND, CONTACT PLANE FOR CARRIER MOUNTING. IF NECESSARY, 0.5 DEGREE DRAFT MAXIMUM.
5.4 E3 Labels

The size and position of labels has an impact on the thermal performance of the E3 devices. This section defines the maximum label area allowed and provides guidance on placement to avoid thermal performance degradation.

For single thickness devices, it is recommended to place product specific labels in the area specified on the bottom of the device as illustrated. If the space is insufficient then additional labels may be placed in the same area on the top of the device. Figure 5-10 shows the allowable area for labels on a single thickness device.

Refer to UL/IEC/EN 60950-1 Information Technology Equipment – Safety – Part 1: General Requirements and/or UL/IEC/EN 62368-1 Audio/Video Information and Communication Technology Equipment for requirements governing the use of the Hot Surface Warning Label. If a Hot Surface Warning Label is required, it shall be placed as shown in Figure 5-10.

![Figure 5-10 E3.S Label Area](image)

Labels may be placed on these surfaces. It is recommended labels be placed as illustrated.
Labels may be placed on these surfaces. It is recommended labels be placed as illustrated.

Figure 5-11 E3.L Label Area
For double thick (2T) devices, it is strongly recommended to place product specific labels in the area specified on the bottom of the device. If the device implements fins or other heatsink structure as part of the device case then all labels may be placed on the top of the device. If a device requires a touch temperature warning label, it shall be placed on the top of the drive within the area shown. Figure 5-11 shows the allowable areas for labels on a double thick (2T) device.

**Figure 5-12 E3.S 2T Label Areas**

Labels may be placed on these surfaces. It is recommended labels be placed as illustrated.
Figure 5-13 E3.L 2T Label Areas

Labels may be placed on these surfaces. It is recommended labels be placed as illustrated.
5.5 E3 LEDs

E3 devices shall support two LEDs on the front of the device. The LEDs have the following functions:

**Status LED:** Green or Green/White bi-color

The Status LED indicates the overall status of the device. The green element is mandatory for all device variations and is controlled by the device firmware. The white element is optional and may be implemented by devices that require indication when it is safe to remove the device from the host. If implemented the white element is controlled by the device firmware.

For NVMe SSD devices the white element shall not be implemented.

**Fault LED:** Amber/Blue bi-color

The Fault LED indicates when a device is in a fault condition or when the host needs to identify the device in a chassis. The amber and blue elements are mandatory for all device variations and are controlled by the LED pin on the device connector.

Specific properties for the various LEDs such as wavelength and luminosity are defined in SFF-TA-1009. Definition of the LED control pin is defined in SFF-TA-1009.
6. Informative: E3 Thermal Characteristics

Table 6-1 defines the recommended maximum sustained power allowed by each device variation.

<table>
<thead>
<tr>
<th>Device</th>
<th>E3S</th>
<th>E3L</th>
<th>E3S 2T</th>
<th>E3L 2T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Power</td>
<td>25W</td>
<td>40W</td>
<td>40W</td>
<td>70W</td>
</tr>
</tbody>
</table>

For detailed device thermal requirements refer to SFF-TA-1023 Thermal Specification for EDSFF Devices.
7. Informative: SFF-TA-1002 Edge (Plug) Mechanical Drawings

This section shows the card edge mechanical drawing for convenience only. See SFF-TA-1002 for normative dimensional and performance requirements.

Note: Position A1 on opposite side of card of B1

Figure 7-1. 1C (x4) Mating Card Dimensions

Note: Position A1 on opposite side of card of B1

Figure 7-2. 2C (x8) Mating Card Dimensions
Note: Position A1 on opposite side of card of B1

**Figure 7-3. 4C (x16) Mating Card Dimensions**

Note: Position A1 on opposite side of card of B1

**Figure 7-4. 4C+ (x16) Mating Card Dimensions**