Manufacturing Notes for SiTime MEMS-Based Silicon Timing Products

Contents

1 Introduction

These manufacturing notes apply to all SiTime MEMS-based silicon timing products in quad flat no-lead (QFN), SOT23-5, 2.0 x 1.2 mm SMD, WLCSP, ceramic, and stacked-PCB packages. The information in this document is provided to assist customers with manufacturing set-up and use of SiTime products designed into systems.

The materials used in the construction of SiTime products comply with Green standards. They are compliant to current RoHS and REACH SVHC requirements. Material composition reports are available on the SiTime website and can be made available upon request from your sales representative. SiTime products meet all governmental hazardous material regulations. MSDS reports are available upon request for the homogeneous materials used to make SiTime products but are not required for finished SiTime products.

All SiTime products have been qualified to JEDEC JESD47, AEC-Q100, or MIL STD 883 requirements, as applicable to the product and package. Reliability reports are available on the SiTime website or upon request from your sales representative.

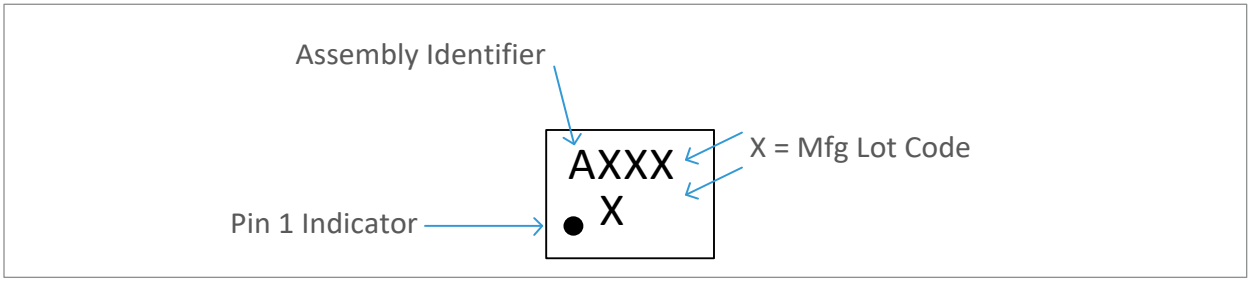
2 Device Packaging

Detailed mechanical dimensions for the various body sizes are provided in the datasheets as package outline drawings.

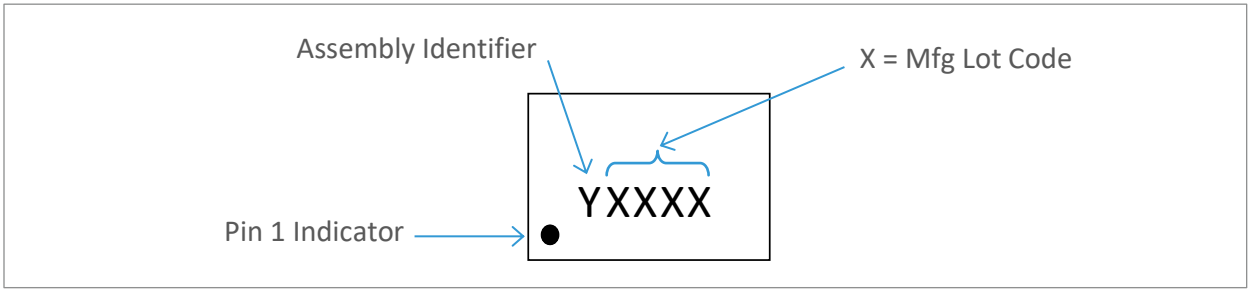
2.1 Package Marking Details – Standard Mark

The standard mark for all SiTime products is shown below. It contains an assembly location code and lot code to allow tracing the manufacturing origin. This marking is used on all samples, low volume and mass production orders. The marking method is laser mark.

2.0 x 1.6 mm package marking diagram



Other packages marking diagram



In the above diagrams, which show the "STANDARD MARK":

"**Y**" denotes assembly identifier:

A or Z as a first letter to indicate Vendor Carsem
B or Y as a first letter to indicate Vendor UTAC
C or X as a first letter to indicate Vendor ASE
E or V as a first letter to indicate Vendor KDS
G or T as a first letter to indicate Vendor HANA

X, Y, Z, V, T character used for marking of Conditional Released parts where full qualification is not completed.

"**XXXX**" denotes four alpha-numeric characters of the manufacturing lot code without any dashes, periods, or symbols.

For QFN 2.0 x 1.2, following are the marking requirements to identify the assembly sites.

- Line 1 : Last 4 digits of Lot code (4 characters max)
- Line 2 : Assembly location (Underline) – depending on assembly location.

- Underline under 2nd digit to indicate Vendor Carsem
- Underline under 3rd digit to indicate Vendor UTAC
- Underline under 4th digit to indicate Vendor HANA

Top Marking Dimensions (otherwise indicated differently)

- All dimensions are in mm
- Font type: LLGOTHIC_ STD or EO135P or EO145
- Tolerance for:
    - Dimensions X, X1, Y and Y1: ±0.25 mm
    - Dimension Y2: ±0.1 mm
    - Char Pitch: ±0.1 mm
    - Char Height/Width: ±0.1 mm
    - Pin 1 Dot Diameter: ±0.1 mm
    - All other tolerances: ±0.20 mm

QFN7050

(as example)

Body size = 7.0 mm x 5.0 mm

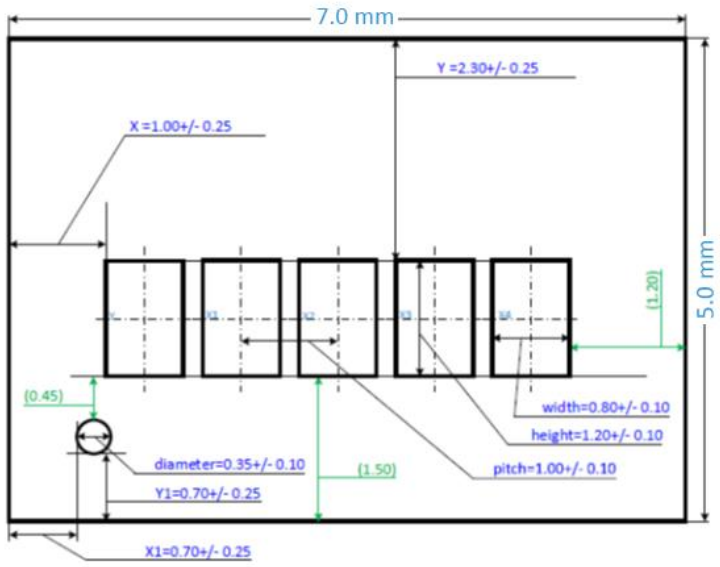


Figure 1: Standard Marking Dimensions – 5.0 x 2.0, 3.2 x 2.5, 5.0 x 3.2, 7.0 x 5.0 mm, and SOT23 Packages

QFN2016

Body size = 2.0 mm x 1.6 mm

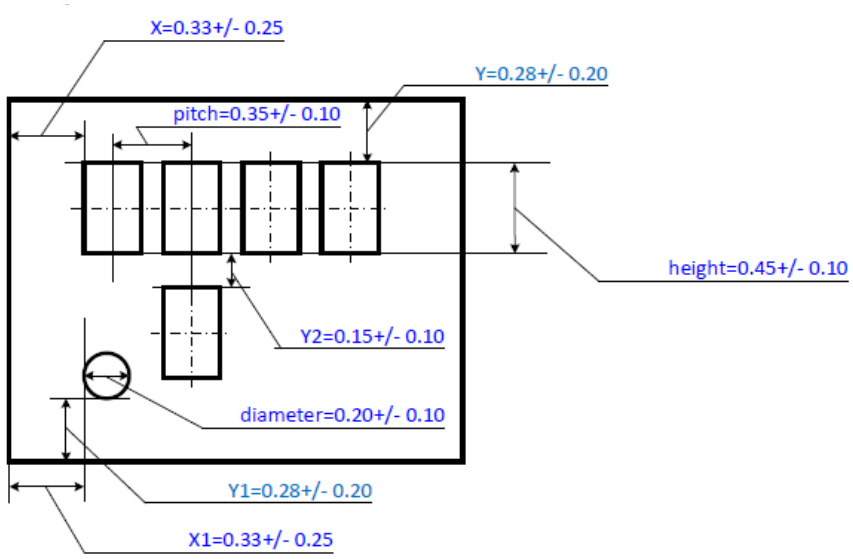


Figure 2: Standard Marking Dimensions for 2.0 x 1.6 mm Package

Table 1: Marking Dimensions for Package Type

Package	X	X1	Y	Y1	Y2	Char Height	Char Width	Char Pitch	Pin 1 Dot diameter
2.5 x 2.0	0.30	0.30	0.85	0.25	N/A	0.45	N/A	0.35	0.25
SOT23	0.55	0.30	0.81	0.25	N/A	0.40	N/A	0.35	0.16
2.7 x 2.4	0.30	0.30	0.85	0.25	N/A	0.45	N/A	0.35	0.25
3.5 x 3.0	0.30	0.30	1.10	0.35	N/A	0.45	N/A	0.45	0.25
3.2 x 2.5	0.30	0.20	1.10	0.35	N/A	0.45	N/A	0.45	0.25
5.0 x 3.2	0.80	0.35	1.80	0.5	N/A	0.90	0.60	0.80	0.25
7.0 x 5.0	1.00	0.70	2.30	0.7	N/A	1.20	0.80	1.00	0.35
2.0 x 1.6	0.33	0.33	0.28	0.28	0.15	0.45	N/A	0.35	0.20

QFN2012

Body size = 2.0 mm x 1.2 mm

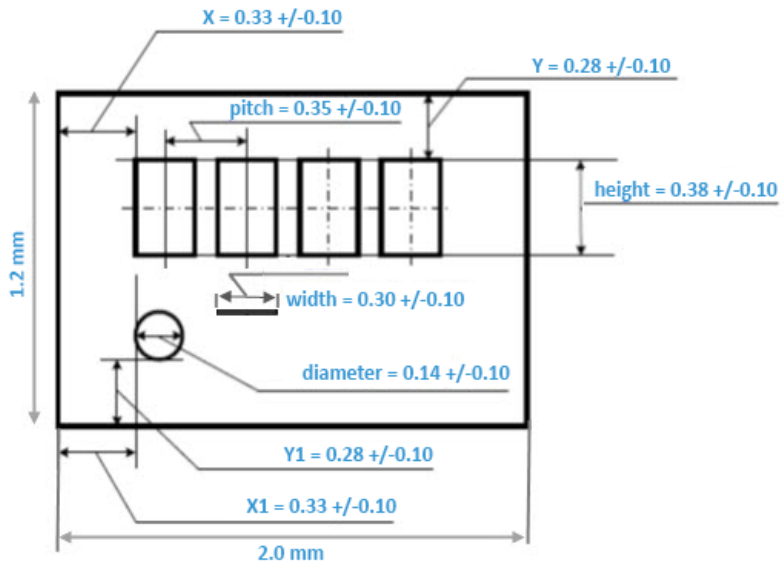
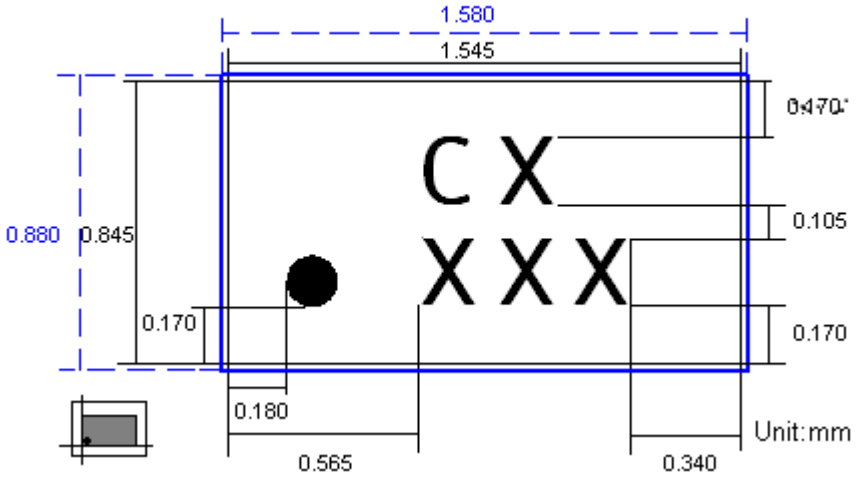


Figure 3: Standard Marking Dimensions for 2.0 mm x 1.2 mm Package

Table 2: Marking Dimensions for SMD Package Type (2.0 mm x 1.2 mm)

Package	Char Height	Underline Width	Char Pitch	Pin 1 Diameter	X	Y	Y1
2.0 x 1.2	0.38	0.3	0.35	0.14	0.33	0.28	0.28



- **Font size tolerance:** (±0.05 mm)
- **Marking shift tolerance:** (±0.15 mm)

Figure 4: Standard Marking Dimensions for WLCSP Package (1.5 mm x 0.8 mm)

Table 3: Marking Dimensions for WLCSP Package (1.5 mm x 0.8 mm)

Item	Description	Position	Font Type	Height	Width	Space	Max Marking Width	Max chars
				↕	↔	↔	←——→	
Pin 1 Dot	Dot	NA	NA	0.15 mm	0.15 mm	NA	NA	NA
Line 1	CX	Left	S_X.FNT	0.20 mm	0.18 mm	0.05 mm	0.41 mm	2
Line 2	XXX	Left	S_X.FNT	0.20 mm	0.18 mm	0.05 mm	0.64 mm	3

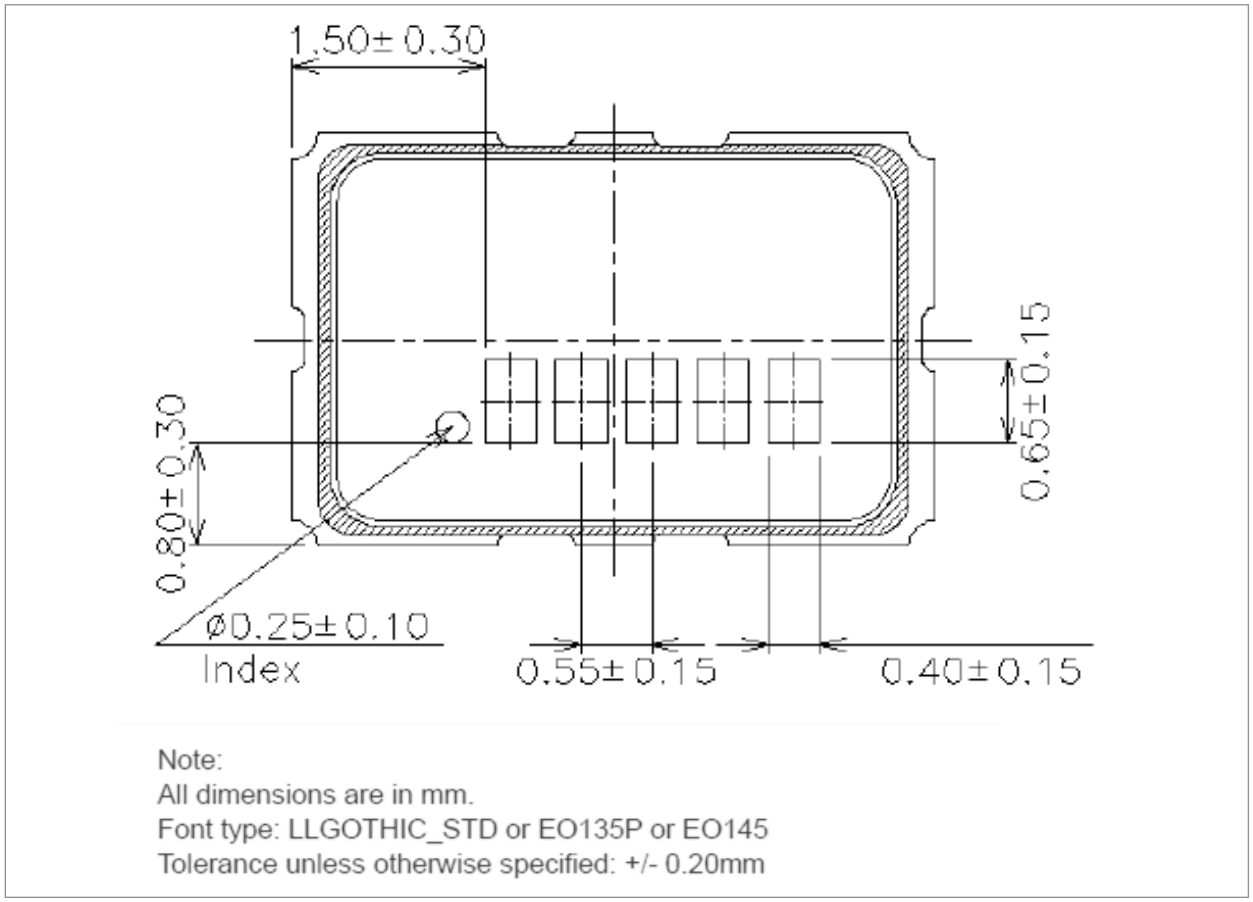


Figure 5: Standard Marking Dimensions for Ceramic Package (5.0 mm x 3.2 mm)

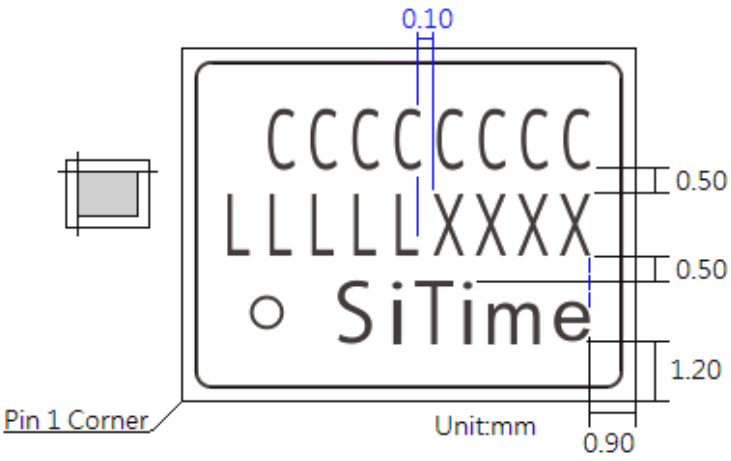


Figure 6: Marking Dimensions for Emerald Package (9.0 mm x 7.0 mm)

Table 4: Marking Dimensions for Emerald Package (9.0 mm x 7.0 mm)

Item	Description	Position	Font Type	Height	Width	Space	Max Width	Max chars
Logo	SiTime	NA	NA	1.20 mm	5.20 mm	NA	NA	NA
Line 1	CCCCCCCC	Right	EO145.FNT	1.20 mm	0.70 mm	0.10 mm	7.10 mm	9
Line 2	LLLLL	Right	EO145.FNT	1.20 mm	0.70 mm	0.10 mm	3.90 mm	5
Line 2	XXXX	Right	EO145.FNT	1.20 mm	0.70 mm	0.10 mm	3.10 mm	4

Where,

Tolerance: Font size: =/- 0.10 mm; Marking Shift: =/- 0.25 mm
Line 1: CCCCCCCC – this is frequency mark request (empty if not required)
Line 2: LLLLL – 5-digit lot code marking
Line 2: XXXX – part serial number from production panel
Line 3: Pin 1 dot and “SiTime” logo

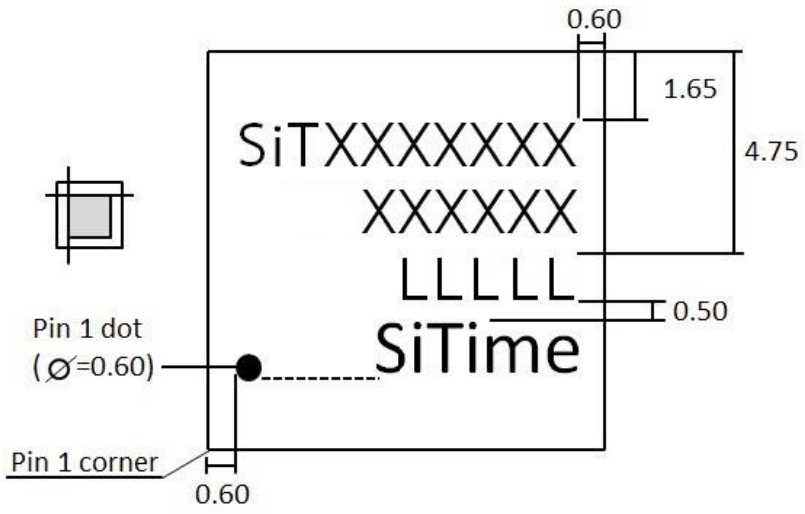


Figure 7: Marking Dimensions for Cascade Package (QFN 9.0 mm x 9.0 mm)

Note: Line 1 and 2 marking will be done post testing and line 3 and logo1 marking will be done during assembly builds.

Table 5: ASSY Marking

Item	Description	Position	Font Type	Height ↕	Width ↔	Space ↔	Max Width ←→	Max chars	Logo Name
Logo1	SiTime	Right	NA	1.05 mm	4.55 mm	NA	NA	NA	SiTime
Item	**Description**	**Position**	**Font Type**	**Height**	**Width**	**Space**	**Max Width**	**Max chars**	**Char Limit**
Line 3	LLLLL	Right	EO145.FNT	1.05 mm	0.60 mm	0.20 mm	3.80 mm	5	A

Table 6: FT Post Marking

Item	Description	Position	Font Type	Height	Width	Space	Max Width	Max chars	Char Limit
Line 1	SiTXXXXXXX	Right	EO145.FNT	1.05 mm	0.60 mm	0.20 mm	3.80 mm	10	A
Line 2	XXXXXXX	Right	EO145.FNT	1.05 mm	0.60 mm	0.20 mm	3.80 mm	6	A

Where,

Tolerance: ±0.20 mm
Line 1: "SiTXXXXXXX", 1st to 10th characters of part number
Line 2: "XXXXXX", 11th to 16th characters of part number, excluding tape and reel suffix
Line 3: "LLLLL", 5 digits lot code marking
Line 4: Pin 1 dot and "SiTime" logo

All dimensions are in mm.

Font type: LLGOTHIC_STD or EO135P or EO145

Font Size Tolerance unless otherwise specified: +/- 0.10mm

Top (1) Marking shift tolerance: (+/- 0.25 mm)

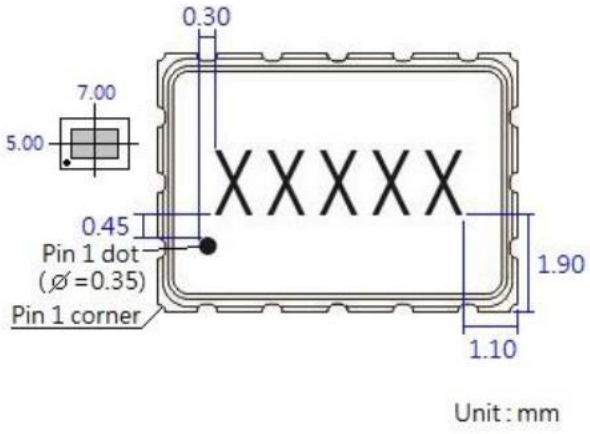


Figure 8: Standard Marking Dimensions for Ceramic Package (7.0 mm x 5.0 mm)

Top(1) Item	Description	Position	Font Type	Height (mm)	Width (mm)	Space (mm)	Max Width (mm)	Max Chars	Chars Limit
				□↕	□ ↔	□↔□	□□□□ ←——→		
Line1	XXXXX	Center	EO145.FNT	1.20	0.80	0.20	4.80	5	B

3 Product Packing

3.1 Tape & Reel

The carrier tape basic dimensions are based on EIA481. The pocket is designed to hold the part for shipping and loading onto SMT manufacturing equipment, while protecting the body and the solder terminals from damaging stresses. The individual pocket design can vary from vendor to vendor, but width and pitch will be consistent.

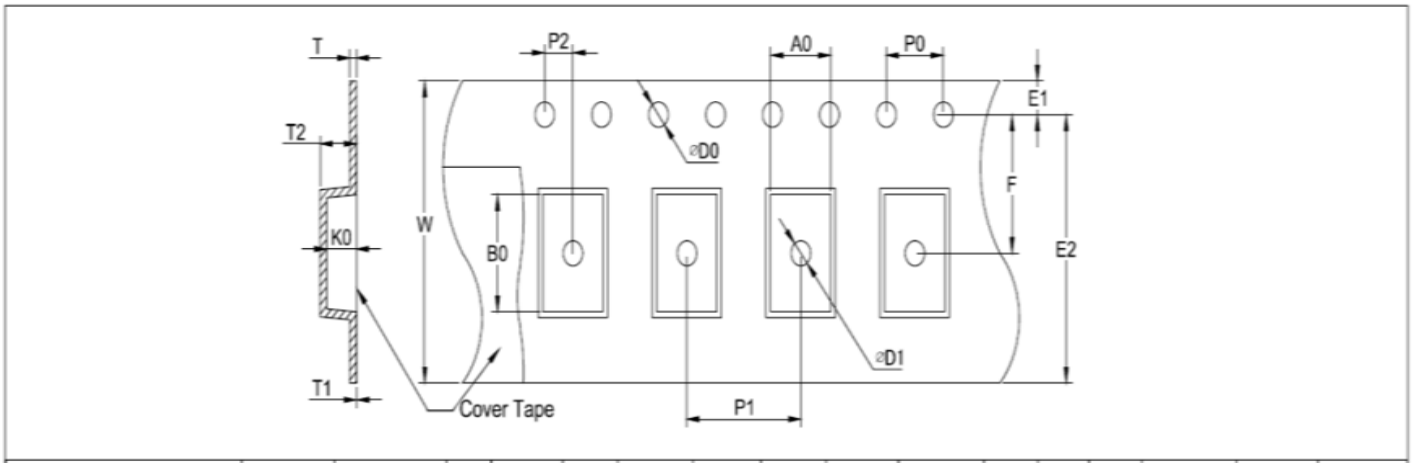
Carrier tape is wound or placed onto a 7” or 13” shipping reel depending on the quantity of parts on the reel and the package body size.

The center hub design is large enough to ensure the radius formed by the carrier tape around it does not put unnecessary stress on the parts.

Prior to shipping, parts are placed into the pockets of the carrier tape. Moisture sensitive parts (MSL level 2a-5a) are baked prior to placement into the pockets of the carrier tape (refer to Sections 4, 6, and 7 for the baking/storage conditions). A cover tape is sealed over the top of the entire length of the carrier tape. The reel is sealed in a protective bag with a dry N2 backfill.

The reel is made with high impact polystyrene and is anti-static material. It is possible that color of the reels may be different in two different shipments depending on drop shipment location. However, the specifications of the reel are identical. The carrier tape is made with polystyrene with carbon impregnation and is static dissipative material. The cover tape is made with polystyrene antistatic material.

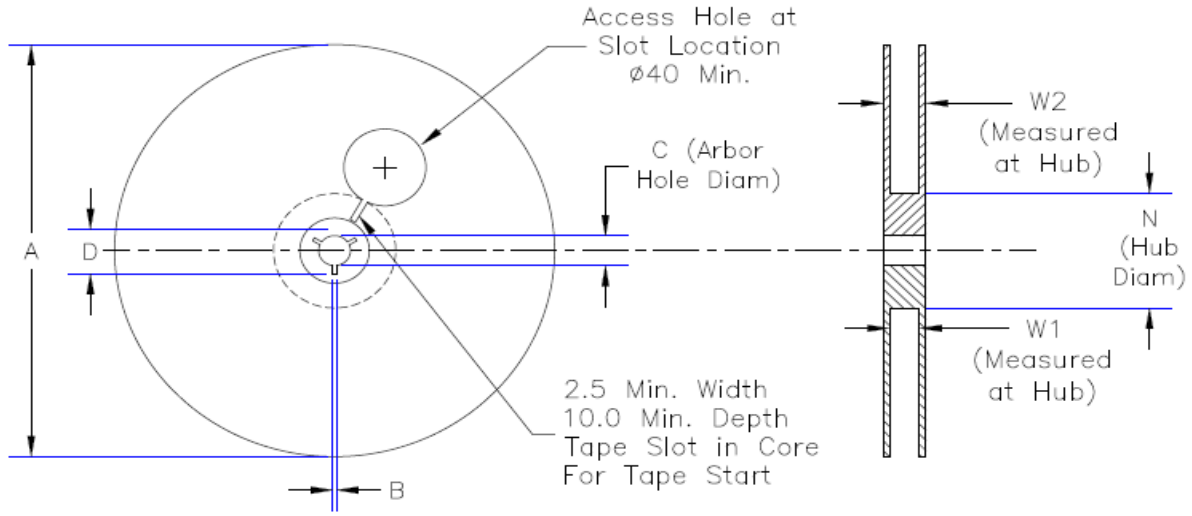
Figure 8 provides relevant dimensions of the carrier tape of Tape & Reel for all packages/PODs in production. Figure 9 provides the dimensions of the reel of the Tape & Reel packing.



Package Outline Drawing	Tape Size	D0	D1 Min	E1	E2 Min	F	PO	P1	P2	T	T1 Max	T2 Max	W Max	A0	B0	K0
POD-001-PQFN-004-X02025	12	1.5 + 0.1/-0.0	1.5	1.75±0.1	10.25	5.5±0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.6	0.1	1.65	12.3	2.3 ± 0.10	2.8 ± 0.10	1.10 ± 0.10
POD-001-PQFN-004-X02025	8	1.55 ± 0.05	1	1.75 ± 0.1	5.85	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.3 ± 0.05	0.1	1.65	8.3	2.25 ± 0.05	2.8 ± 005	1.10 ± 0.10
POD-023-PQFN-004-A2724	12	1.55 ± 0.05	1	1.75 ± 0.1	9.85	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.3 ± 0.05	0.1	1.55	12.3	2.65 ± 0.10	2.95 ± 0.10	1.00 ± 0.10
POD-023-PQFN-004-A2724	8	1.55 ± 0.05	1	1.75 ± 0.1	5.85	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.3 ± 0.05	0.1	1.55	8.3	2.65 ± 0.10	2.95 ± 0.10	1.00 ± 0.10
POD-002-PQFN-004-X03225	12	1.5 +0.1/-0.0	1.5	1.75 ± 0.1	10.25	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.6	0.1	1.65	12	2.9 ± 0.10	3.5 ± 0.10	1.10 ± 0.10
POD-002-PQFN-004-X03225	8	1.5 +0.1/-0.0	1	1.75 ± 0.1	5.95	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.2 ± 0.05	0.1	1.65	8.2	2.7 ± 0.10	3.4 ± 0.10	1.15 ± 0.10
POD-003-PQFN-004-XO5032	12	1.5 +0.1/-0.0	1.5	1.75 ± 0.1	10.25	5.5 ± 0.05	4.0 ± 0.1	8.0 ± 0.1	2.0 ± 0.05	0.6	0.1	1.65	12.3	3.5 ± 0.10	5.3 ± 0.10	1.10 ± 0.10
POD-004-PQFE-004-X07050	16	1.5 +0.1/-0.0	1.5	1.75 ± 0.1	14.25	7.5 ± 0.1	4.0 ± 0.1	80 ± 0.1	2.0 ± 0.1	0.6	0.1	1.8	16.3	5.4 ± 0.10	7.4 ± 0.10	1.3 ± 0.10
POD-009-PQFT-004-803530	12	1.5 +0.1/-0.0	1.5	1.75 ± 0.1	10.25	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.6	0.1	1.65	12.3	3.3 ± 0.10	3.8 ± 0.10	0.65 ± 0.10
POD-026-PQFN-004-X01620	8	1.55 ± 0.05	0.9	1.75 ± 0.1	6.05	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.3 ± 0.05	0.1	1.55	8.3	1.9 ± 0.05	2.3 ± 0.05	1.00 ± 0.10
POD-029-PQFN-004-A02012	8	1.55 ± 0.05	1	1.75 ± 0.1	6.05	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.25 ± 0.05	0.1	1.55	8.3	1.9 ± 0.05	2.3 ± 005	1.00 ± 0.10
POD-032-NCSP-004-C01508	8	1.55 ± 0.05	0.18	1.75 ± 0.1	6.05	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.2 ± 0.02	0.1	1.55	8.3	0.96 ± 0.03	1.66 ± 0.03	0.63 ± 0.03
POD-030-SO23-005-X02829	8	1.55 ± 0.05	1	1.75 ± 0.1	6.05	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.25 ± 0.02	0.1	1.62	8.3	3.23 ± 0.10	3.17 ± 0.10	1.37 ± 0.10
POD-036-CQFN-010-X05032	12	1.5 + 0.1/-0.0	1.5	1.75 ± 0.1	9.85	5.5 ± 0.05	4.0 ± 0.1	8.0 ± 0.1	2.0 ± 0.05	0.3 ± 0.05	0.1	1.65	12.3	3.5 ± 0.10	5.3 ± 0.10	1.10 ± 0.10
POD-038-PQFD-006-C03225	8	1.5 +0.1/-0.0	1	1.75 ± 0.1	5.95	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	0.2 ± 0.05	0.1	1.65	8.2	2.7 ± 0.10	3.4 ± 0.10	1.15 ± 0.10
POD-037-PQFV-006-C07050	16	1.5 + 0.1/-0.0	1.5	1.75 ± 0.1	14.25	7.5 ± 0.1	4.0 ± 0.1	8.0 ± 0.1	2.0 ± 0.1	0.6	0.1	1.8	16.3	5.4 ± 0.10	7.4 ± 0.10	1.3 ± 0.10
POD-086-CQFN-010-X07050	16	1.5 + 0.1/-0.0	1.5	1.75 ± 0.1	14.05	7.5 ± 0.1	4.0 ± 0.1	8.0 ± 0.1	2.0 ± 0.1	0.3	0.1	2.05	16.13	5.32 ± 0.10	7.30 ± 0.10	2.35 ± 0.10
POD-051-PCBA-010-X09070	24	1.5 + 0.1/-0.0	1.5	1.75 ± 0.1	22.3	11.5 ± 0.1	4.0 ± 0.1	120 ± 0.1	2.0 ± 0.1	0.5 ± 0.05	0.1	6.9	24.25	7.35 ± 0.10	9.35 ± 0.10	6.35 ± 0.10
POD-054-PQFN-054-C09090	16	1.55 ± 0.05	1.5	1.75 ± 0.1	13.85	7.5 ± 0.1	4.0 ± 0.1	120 ± 0.1	2.0 ± 0.1	0.3 ± 0.05	0.1	1.65	16.03	9.30 ± 0.10	9.30 ± 0.10	1.10 ± 0.10

Note: All dimensions are in mm

Figure 8: Carrier Tape Dimensions



Tape Size	A Max.	B Min.	C	D Min.	N	W1	W2 Max
8	180	1.5	13.0 +0.6/-0.2	20.2	60+/-0.5	8.4+1.5/-0	14.4
8	330	1.5	13.0 +0.6/-0.2	20.2	100+/-0.5	8.4+1.5/-0	14.4
12	330	1.5	13.0 +0.6/-0.2	20.2	100+/-0.5	12.4+1.5/-0	18.4
12	180	1.5	13.0 +0.6/-0.2	20.2	60+/-0.5	12.4+1.5/-0	18.4
16	330	1.5	13.0 +0.6/-0.2	20.2	100+/-0.5	16.4+1.5/-0	22.4
16	180	1.5	13.0 +0.6/-0.2	20.2	60+/-0.5	16.4+1.5/-0	22.4
24	330	1.5	13.0 +0.6/-0.2	20.2	100+/-0.5	24.4+1.5/-0	30.4

Figure 9: Reel Dimensions

Device orientation in the carrier tape is shown in the diagram below for all QFN, WLCSP, and module (SIP LGA) packages (Figure 10) and SOT23-5 package (Figure 11).

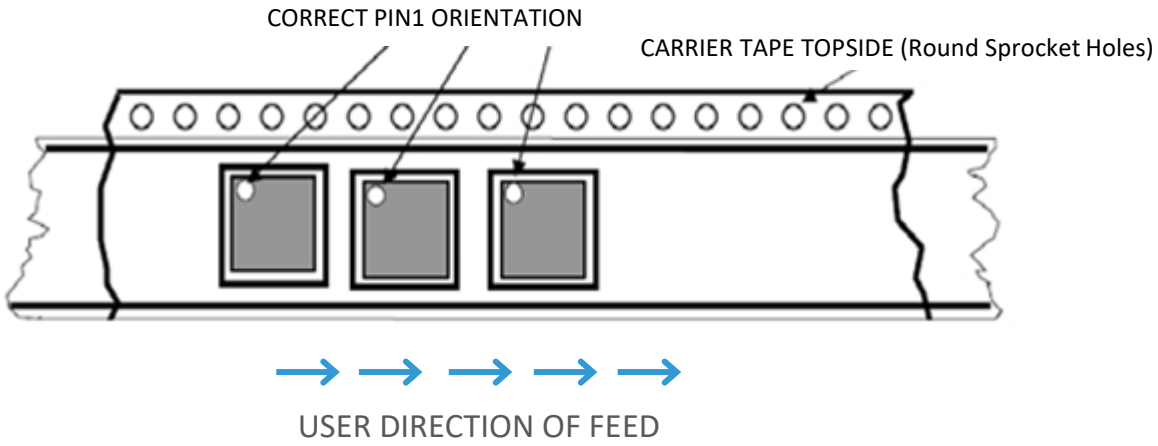


Figure 10: Standard Tape and Reel Pin 1 Orientation (Except for SOT-23)

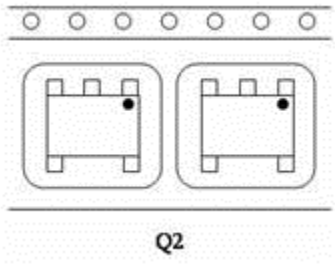


Figure 11: SOT23 Tape and Reel Pin 1 Orientation

Table 7 below provides the ordering details for tape and reel quantity, reel size, and top mark options. The "Suffix" character is the last character in the part number string as shown in the example below. Deviation from this table will be indicated via a custom part number (CS).

SiT8002AI-23-33E-30.00000**Y**

Suffix
Character

Table 7: Marking and Tape & Reel Option Selections with Part Number Coding

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
M	Bulk	All	N/A	Shipped in canister or ESD bag or tube – any qty	2 Lines Frequency Mark
V	16mm Tape & Reel	7.0 x 5.0	13	3000	2 Lines Frequency Mark
	12mm Tape & Reel	5.0 x 3.2	13	3000	
	12mm Tape & Reel	3.2 x 2.5	7	3000	
	12mm Tape & Reel	2.7 x 2.4	7	3000	
	12mm Tape & Reel	2.5 x 2.0	7	3000	
Z	16mm Tape & Reel	7.0 x 5.0	7	1000	2 Lines Frequency Mark
	12mm Tape & Reel	5.0 x 3.2	7	1000	
	12mm Tape & Reel	3.2 x 2.5	7	1000	
	12mm Tape & Reel	2.7 x 2.4	7	1000	
	12mm Tape & Reel	2.5 x 2.0	7	1000	
W	16mm Tape & Reel	7.0 x 5.0	7	250	2 Lines Frequency Mark
	12mm Tape & Reel	5.0 x 3.2	7	250	
	12mm Tape & Reel	3.2 x 2.5	7	250	
	12mm Tape & Reel	2.7 x 2.4	7	250	
	12mm Tape & Reel	2.5 x 2.0	7	250	
H	8mm Tape & Reel	3.2 x 2.5	7	3000	2 Lines Frequency Mark
	8mm Tape & Reel	2.5 x 2.0	7	3000	
	8mm Tape & Reel	SOT23	7	3000	
J	8mm Tape & Reel	3.2 x 2.5	7	1000	2 Lines Frequency Mark
	8mm Tape & Reel	2.5 x 2.0	7	1000	
	8mm Tape & Reel	SOT23	7	1000	
K	8mm Tape & Reel	3.2 x 2.5	7	250	2 Lines Frequency Mark
	8mm Tape & Reel	2.5 x 2.0	7	250	
	8mm Tape & Reel	SOT23	7	250	
T	16mm Tape & Reel	7.0 x 5.0	13	3000	1 Line Standard Mark
	16mm Tape & Reel	9.0 x 9.0	13	3000	
	12mm Tape & Reel	5.0 x 3.2	13	3000	
	12mm Tape & Reel	3.2 x 2.5	7	3000	
	12mm Tape & Reel	2.7 x 2.4	7	3000	
	12mm Tape & Reel	2.5 x 2.0	7	3000	

Table 7: Marking and Tape & Reel Option Selections with Part Number Coding (continued)

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
Y	16mm Tape & Reel	7.0 x 5.0	7	1000	1 Line Standard Mark
	16mm Tape & Reel	9.0 x 9.0	7	1000	
	12mm Tape & Reel	5.0 x 3.2	7	1000	
	12mm Tape & Reel	3.2 x 2.5	7	1000	
	12mm Tape & Reel	2.7 x 2.4	7	1000	
	12mm Tape & Reel	2.5 x 2.0	7	1000	
N	24mm Tape & Reel	9.0 x 7.0	13	500	1 Line Standard Mark
X	24mm Tape & Reel	9.0 x 7.0	13	250	1 Line Standard Mark
	24mm Tape & Reel	9.0 x 7.0	7	250	
	16mm Tape & Reel	7.0 x 5.0	7	250	
	12mm Tape & Reel	9.0 x 9.0	7	250	
	12mm Tape & Reel	5.0 x 3.2	7	250	
	12mm Tape & Reel	3.2 x 2.5	7	250	
	12mm Tape & Reel	2.7 x 2.4	7	250	
	12mm Tape & Reel	2.5 x 2.0	7	250	
D	8mm Tape & Reel	3.2 x 2.5	7	3000	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	3000	
	8mm Tape & Reel	2.0 x 1.6	7	3000	
	8mm Tape & Reel	2.0 x 1.2	7	3000	
	8mm Tape & Reel	SOT23	7	3000	
	8mm Tape & Reel	1.5 x 0.8	7	3000	
C	8mm Tape & Reel	3.2 x 2.5	7	3000	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	3000	
	8mm Tape & Reel	2.0 x 1.6	7	3000	
	8mm Tape & Reel	2.0 x 1.2	7	3000	
	8mm Tape & Reel	SOT23	7	3000	
	8mm Tape & Reel	1.5 x 0.8	7	3000	
	12mm Tape & Reel	5.0 x 3.2	7	3000	
E	8mm Tape & Reel	3.2 x 2.5	7	1000	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	1000	
	8mm Tape & Reel	2.0 x 1.6	7	1000	
	8mm Tape & Reel	2.0 x 1.2	7	1000	
	8mm Tape & Reel	SOT23	7	1000	
	8mm Tape & Reel	1.5 x 0.8	7	1000	

Table 7: Marking and Tape & Reel Option Selections with Part Number Coding (continued)

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
B	8mm Tape & Reel	3.2 x 2.5	7	1000	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	1000	
	8mm Tape & Reel	2.0 x 1.6	7	1000	
	8mm Tape & Reel	2.0 x 1.2	7	1000	
	8mm Tape & Reel	SOT23	7	1000	
	8mm Tape & Reel	1.5 x 0.8	7	1000	
	12mm Tape & Reel	5.0 x 3.2	7	1000	
G	8mm Tape & Reel	3.2 x 2.5	7	250	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	250	
	8mm Tape & Reel	2.0 x 1.6	7	250	
	8mm Tape & Reel	2.0 x 1.2	7	250	
	8mm Tape & Reel	SOT23	7	250	
	8mm Tape & Reel	1.5 x 0.8	7	250	
A	8mm Tape & Reel	3.2 x 2.5	7	250	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	250	
	8mm Tape & Reel	2.0 x 1.6	7	250	
	8mm Tape & Reel	2.0 x 1.2	7	250	
	8mm Tape & Reel	SOT23	7	250	
	8mm Tape & Reel	1.5 x 0.8	7	250	
	12mm Tape & Reel	5.0 x 3.2	7	250	
Q	8mm Tape & Reel	3.2 x 2.5	7	5000	1 Line Standard Mark
	8mm Tape & Reel	2.5 x 2.0	7	5000	
	8mm Tape & Reel	2.0 x 1.6	7	5000	
	8mm Tape & Reel	2.0 x 1.2	7	5000	
	8mm Tape & Reel	SOT23	7	5000	
	8mm Tape & Reel	1.5 x 0.8	7	5000	
S	8mm Tape & Reel	2.0 x 1.2	13	10000	1 Line Standard Mark
	8mm Tape & Reel	SOT23	13	10000	
	8mm Tape & Reel	1.5 x 0.8	13	10000	
F	8mm/12mm Tape & Reel	All	All	Below 250pcs	1 Line Standard Mark
“Blank”	Bulk	All	N/A	Shipped in canister or ESD bag or tube – any qty	1 Line Standard Mark

Tape leader and trailer are per EIA-481 as shown below:

Table 8: Leader and Trailer Lengths

All Reels	Minimum Length
Leader	400 mm
Trailer	160 mm

Peel Strength: The force required to peel off the cover tape from the carrier tape will fall within the range of 0.1 Newton to 1.3 Newton (10 grams to 130 grams) at a peeling speed to 300 mm per minute. This complies with the EIA standard.

4 Storage and Handling

SiTime Emerald and Cascade products are moisture sensitive and need to be handled within proper MSL3 guidelines to avoid damage from moisture absorption and exposure to solder reflow temperatures. Deviation from these guidelines may result in yield and reliability degradation.

Devices are baked and dry-packed before shipment from the SiTime factory. The packing uses a moisture barrier bag (MBB). A humidity indicator card (HIC) and drying desiccant are included inside the MBB. An MSL3 label is attached to caution that the bag contains moisture sensitive devices.

Shelf life of devices in a sealed bag is 12 months at <40°C and <90% room humidity (RH). Upon opening the MBB, the HIC should be checked immediately. Devices require baking before board mounting if the HIC is >10% when read at 23°C ±5°C.

After the MBB is opened, devices should go through reflow for board assembly within 48 hours at factory conditions of <30°C/60% RH or stored at <10% RH. Baking is required before board mounting if the above conditions are not met.

If baking is required, devices should be baked for a minimum of 8 hours at 125°C ±5°C. Retaping and dry packing in a MBB with HIC and drying desiccant may be required if the devices will not be used within 48 hours at factory conditions of <30°C/60% RH or stored at <10% RH conditions.

For other SiTime products which are MSL1 rated, it is recommended that the sealed tape be stored in conditions where the environment does not exceed the following conditions.

→ Temperature: 40°C maximum
→ Relative humidity: 90% maximum
→ No direct exposure to sunlight

5 ESD

SiTime's products are semiconductor based and as such have sensitivity to electro-static discharge (ESD). Care must be taken to ensure careful handling to avoid damaging the components. Refer to JEDEC document JESD625, Requirements for Handling Electrostatic-Discharge-Sensitive Devices. This standard establishes the minimum requirements for ESD control methods, and the materials used to protect electronic devices that are susceptible to damage or degradation from ESD. The passage of a static charge through an electrostatic-discharge-sensitive (ESDS) device can result in catastrophic failure or performance degradation of the part. Device sensitivity to ESD is determined by test methods such as EIA/JESD22-A114/A115/C101.

6 Moisture Sensitivity Level

SiTime Emerald and Cascade products have been qualified to moisture sensitivity level 3 (MSL3). Refer to Section 4 for storage and handling instructions (including rebaking, if required).

Other SiTime products have been qualified to moisture sensitivity level 1 (MSL1) for Pb-Free devices per JEDEC J-STD-020 and are deemed to not be moisture sensitive. This means partially consumed reels may be stored under the conditions outlined in Section 4 indefinitely without re-sealing the protective storage bags in which the reels are shipped. It also means unused reels with a damaged bag seal may be used without baking. Because the parts meet MSL1, the protective storage bags in which the reels are shipped do not require desiccant or HIC cards and are not required to maintain a tight vacuum seal or dry nitrogen purge.

7 PCB Assembly Guidelines

7.1 Solder Reflow Profile

The solder reflow profile shown in Figure 12 is IPC/JEDEC J-STD-020 compliant and applies to all SiTime products and packages. Table 10 provides relevant details of the profile. Refer to Table 9 for the maximum reflow temperature as it is dependent on the package volume and thickness. An optimized reflow profile depends on several factors such as the solder paste, board density, and type of reflow equipment used. Additional reflow information can be obtained from solder paste vendor datasheets. It is recommended that any reflow profile be characterized with a fully populated production PCB and thermocouple placed on or closest to the SiTime component during profile. Thermocouples are generally used to record temperatures across the surface and any sensitive components on the PCB. Ensure that a thermocouple is placed in contact with the top surface of any moisture sensitive component to ensure maximum temperature is not exceeded.

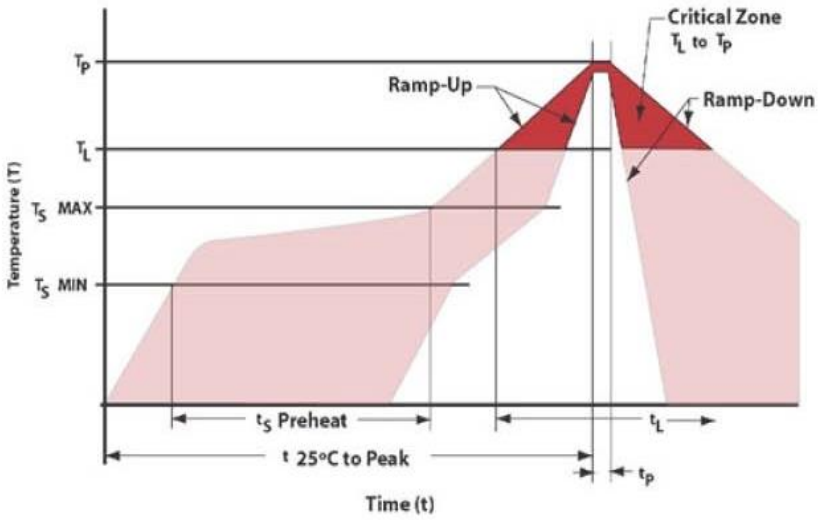


Figure 12: Convection Reflow Soldering Profile, per IPC/JEDEC J-STD-020

Table 9: Lead-Free Process Classification Temperature (Tc)

Package Thickness	Volume, mm^3 < 350	Volume, mm^3 350 - 2000	Volume, mm^3 >2000
<1.6 mm	260°C	260°C	260°C
1.6 to 2.5 mm	260°C	250°C	245°C
>2.5 mm	260°C	245°C	245°C

Table 10: High Temperature Infrared/Convection Reflow Conditions IPC/JEDEC J-STD-020

IPC/JEDEC Standard	IPC/JEDEC J-STD-020
Moisture Sensitivity Level	Level 1
T_S MAX to T_L (Ramp-up Rate)	3°C/second Maximum
Preheat	
Temperature Minimum (T_S MIN)	150°C
Temperature Typical (T_S TYP)	175°C
Temperature Maximum (T_S MAX)	200°C
Time (t_S)	60 - 180 Seconds
Ramp-up Rate (TL to TP)	3°C/second Maximum
Time Maintained Above	
Temperature (T_L) **60 - 150 Seconds**	217°C 260°C Maximum for 10 Seconds
Time (T_L)	60 - 150 Seconds
Peak Temperature (T_P) **60 - 150 Seconds**	260°C Maximum 260°C Maximum for 10 Seconds
Target Peak Temperature (T_P Target)	255°C
Time within 5°C of Actual Peak (t_P)	20 - 40 seconds
Max. Number of Reflow Cycles	3; see Note 2
Ramp-down Rate	6°C/second Maximum
Time 25°C to Peak Temperature (t)	8 minutes Maximum

Note 1: Temperatures shown are applied to body of device.

Note 2: For 9.0 mm x 7.0 mm 10L stacked PCB package Max. Number of Reflow Cycles are 2.

Table 11: Manual Soldering Conditions

Manual Soldering (Iron)	
350°C Maximum for 3 seconds	Caution: Small package body parts heat up very quickly and can be damaged. Proper baking needs to be done prior to manual soldering/desoldering, if not stored as per Section 4, for MSL3 classified products to avoid device damage.

7.2 PCB Cleaning Assembly Notes

Cleaning PCB assemblies after reflow is a common process requirement to remove residual flux and loose solder. No-Clean and water-soluble fluxes are left behind and require removal to meet assembly inspection standards. The package materials of the SiTime products are not susceptible to water or other common solvents (alcohol and acetone) used for assembly cleaning. SiTime recommends not using cleaning and manufacturing equipment (e.g., ultrasonic plastic fusion, plastic saw, plastic test machines, cleaning baths) operating at ultrasonic frequencies. Instead, SiTime recommends that the customer use IPA (Isopropyl Alcohol) baths.

SiTime products, which are in WLCSP package, include a protective, opaque polymer topcoat. If the part will be exposed to intense light, especially in the 1.0-1.2 µm IR spectrum, we recommend a protective "glob-top" epoxy or other cover to keep the light from negatively impacting the frequency stability.

One of the key elements enabling extremely stable MEMS resonators is the SiTime EpiSeal® process which hermetically seals the resonators during wafer processing, eliminating the need for hermetically sealed ceramic packaging. The SiTime EpiSeal resonator is impervious to the highest concentration elements in the atmosphere, nitrogen, and oxygen, and therefore acts as a perfect seal. Previous generations of EpiSeal resonators may have been impacted by large concentrations of small-molecule gas. Newer EpiSeal resonators are impervious to all small-molecule gases. Please contact SiTime for recommended gas-impervious parts for applications where SiTime parts may be exposed to a large concentration of small-molecule gas.

8 Product Packing

8.1 TNR Packing in Inner/Pizza Box

The sealed reel is placed in a static dissipative ESD bag. An ESD label and product label is placed on the ESD bag. One reel/ESD bag is wrapped in anti-static bubble wrap and placed in an inner box/pizza box (Figure 13). Pizza Box packing flow is shown in Figure 14. Desiccants and HICs (humidity indicator cards) are not included for MSL1 products.

Figure 13: ESD Bag Packing in Inner Box

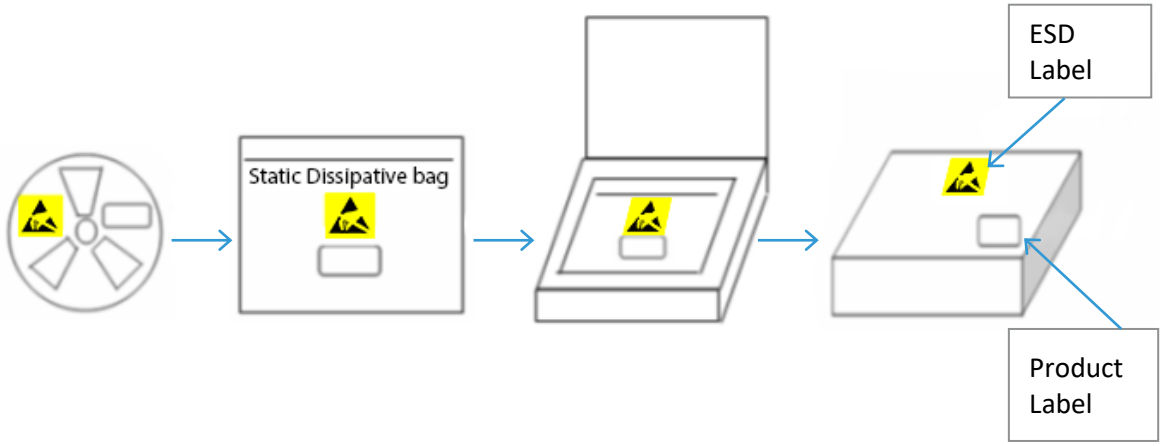


Figure 14: Inner Box/Pizza Box Packing Flow

8.2 Pizza box/Inner box dimensions are provided below

Table 12: Thick Pizza Box Dimension

Reel size	Length (L)	Width (W)	Height (H)
7 inch reel	220 mm	205 mm	50 mm
13 inch reel	370 mm	355 mm	55 mm
			Tolerance 20 mm

Table 13: Thin Pizza Box Dimension

Reel size	Length (L)	Width (W)	Height (H)
7 inch reel	220 mm	205 mm	35 mm
13 inch reel	346 mm	346 mm	35 mm
			Tolerance 5 mm

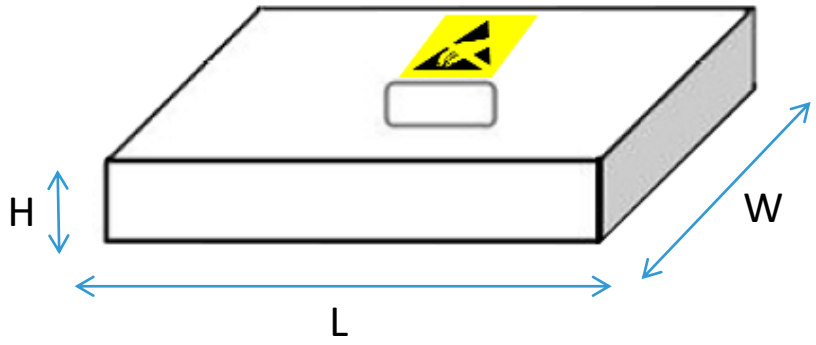


Figure 15: Pizza Box dimensions

8.3 Packing pizza boxes in shipping carton

All pizza boxes will be placed vertically in the shipping carton. Each shipping carton will have the maximum number of pizza boxes which will fit in the carton. Antistatic bubble wrap or popcorn will be used as filler for empty space.

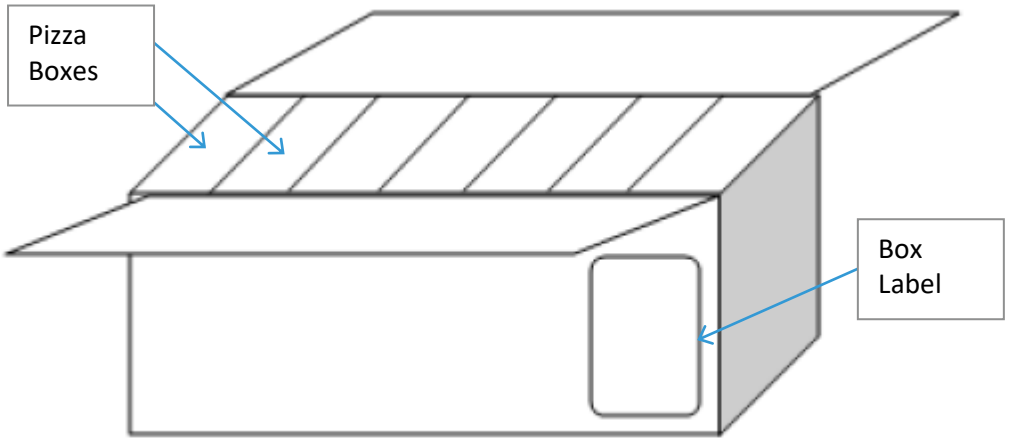


Figure 16: Shipping Carton Packing

9 Package Labeling

9.1 Inner Box/ Pizza Box Labeling

The pizza box or inner box label is shown in Figure 16.

Figure 17: Inner Box/Pizza Box Label

1. **Lot Code:** Five-digit SiTime lot code*
2. **Device:** SiTime marketing part number identified on datasheet
3. **Marketing Part Number:** SiTime marketing part number identified on datasheet
4. **Date Code*:** Product manufacturing date code
5. **Quantity:** Quantity of units in the TNR/box
6. **The following un-barcoded information**

   Company Name: SiTime

   RoHS symbol: **ESD symbol:**

*Note: Up to two lots/date codes can be merged in one TNR

9.2 Outer Box/Carton Labeling

The outer box/carton label is shown in Figure 18.

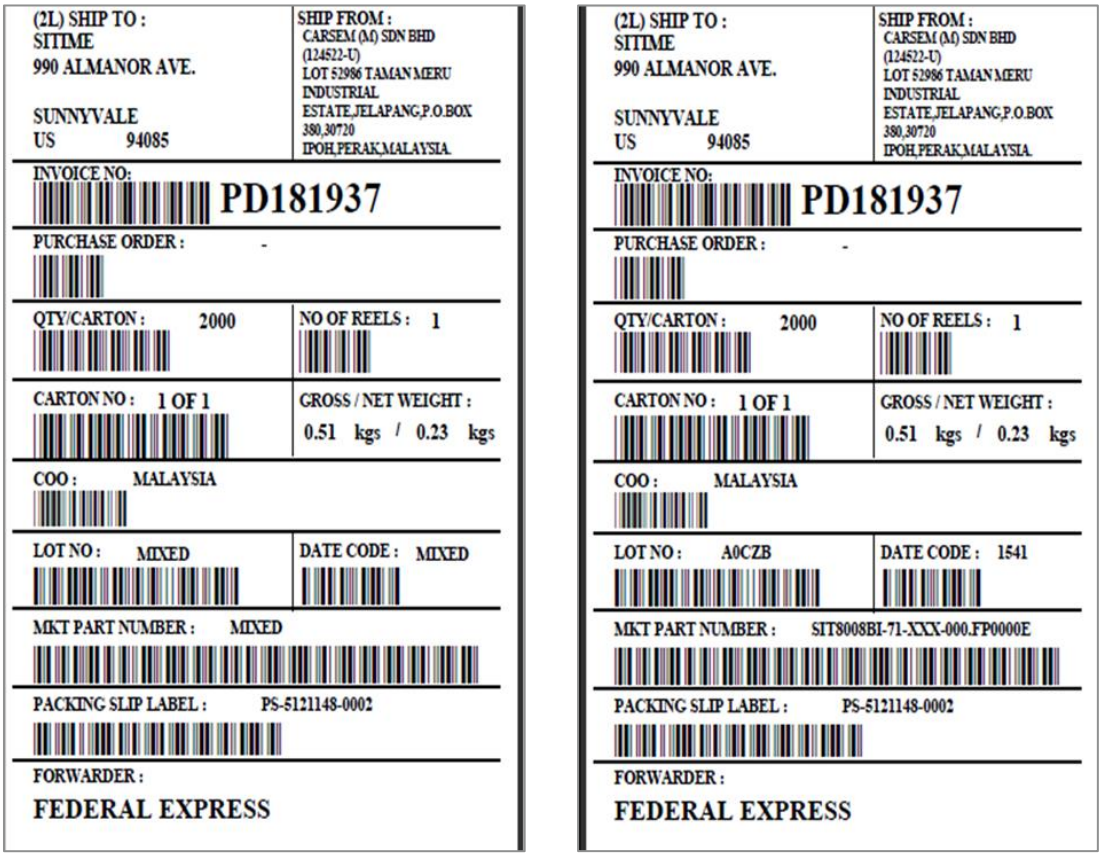


Figure 18: Outer Box/Carton Label

Where,

- Label size will be 4.0” x 6.0”
- Label will contain the following information:
    i. Ship to
    ii. Ship from
    iii. Invoice no – **optional field (vendors internal reference)**
    iv. End customer PO number
    v. Total Box Quantity
    vi. Number of reels
    vii. Number of Carton (s)
    viii. Gross and Net Weight
    ix. Country of Origin (COO)
    x. Lot Number
    xi. Date Code
    xii. Marketing Part Number
    xiii. Packing Slip Label No
    xiv. Forwarder Information

Note: When there is more than one marketing part number or more than one date code or more than one lot code, these fields will be indicated as “MIXED” on the label.

10 Additional Questions?

If you have any questions about the information contained in this manufacturing note or other manufacturing questions, please contact your sales representative.

Table 14: Revision History

Version	Release Date	Change Summary
A23	1-Dec-2020	Reformatted, Table of Contents added, grammatical and other edits for consistency and clarification Figure 8 Tape and Reel Dimension (for POD 36 and POD 38 rows)
A24	23-Jun-2021	Added Note 2 to Max. Number of Reflow Cycles
A25	30-Oct-2021	Update sec 7.2. “SiTime recommends not using cleaning equipment, including baths, operating at ultrasonic frequencies.”
A26	4-Nov-2021	Updated wording in sec 7.2.
A27	9-Dec-2021	Typo correction: “glop-top” to “glob-top”
A28	10-Feb-2022	Packaging Method 8 mm Tape & Reel excluded for 2.7 x 2.4 Package Size
A29	22-Mar-2022	Updated sec 2.1 “Added X, Y, Z, V, T character used for marking of Conditional Released parts where full qualification is not completed.”
A30	24-Jun-2022	Table 7 updated
A31	12-Jul-2022	1) Changes made for POD-038-PQFD-006-C03225 - Tape Size 12 to 8 2) Add in 9.0 x9.0 Carrier tape information for 3000, 1000 & 250 Reel Quantity
A32	6-Oct-2022	Updated section 2 to include QFN 2.0x1.2 Marking
A33	28-Nov-2022	Updated section 2 to include Ceramic Package 7.0x5.0 Marking

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