

Manufacturing Notes for SiTime MEMS-Based Silicon Timing Products

1 Introduction

These manufacturing notes apply to all of SiTime's MEMS-based Silicon Timing products in Quad, Flat No-Lead (QFN) package, SOT23-5 package, 2.0 x 1.2mm SMD, WLCSP and Ceramic package. The information provided in this document is meant to assist customers with manufacturing set-up and use of SiTime products designed into systems.

The materials used in the construction of SiTime's products comply with Green standards. They are compliant to current RoHS and REACH SVHC requirements. Material composition reports are available on 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's 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 SiTime web site or upon request from your sales representative.

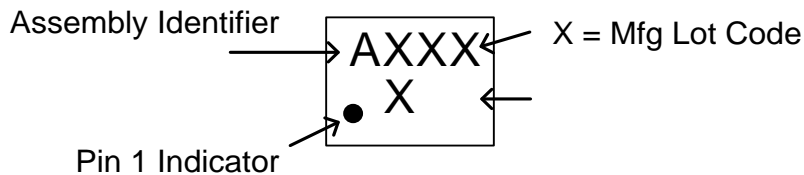
2 Device Packaging

Detailed mechanical dimensions for the various body sizes are provided in the data sheets as Package Outline Drawings.

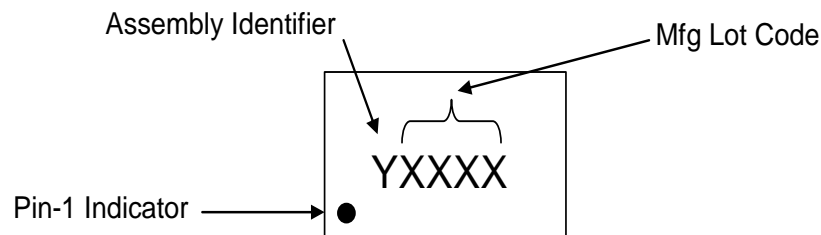
2.1 Package Marking Details - Standard Mark

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.

2.0x1.6 package marking diagram:



Other packages marking diagram:



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

"Y" denotes assembly identifier:

- A as a first letter to indicate Vendor A (Carsem)
- B as a first letter to indicate Vendor B (UTAC)
- C as a first letter to indicate Vendor C (ASE)
- E as a first letter to indicate Vendor E (KDS)

"XXXX" denotes 4 alpha-numeric characters of the manufacturing lot code without any dashes, periods, or symbols.

Top Marking Dimensions (otherwise indicated differently)

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

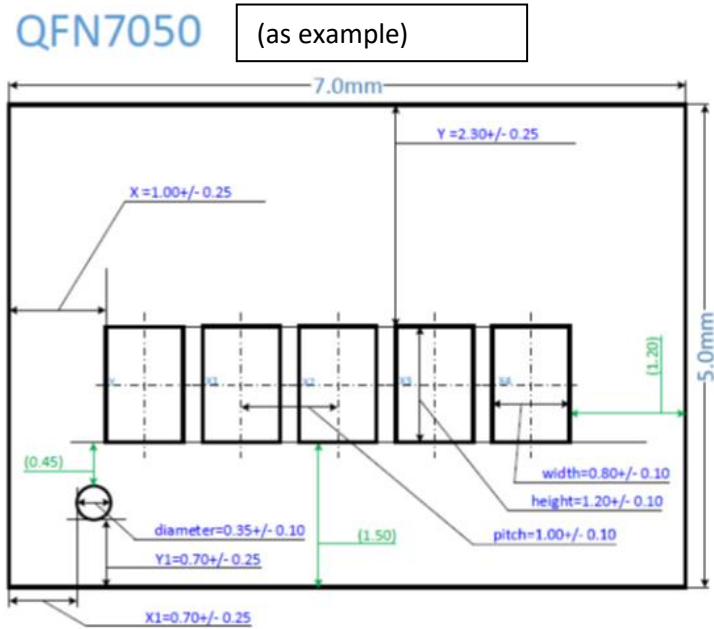


Figure 1. Standard Marking Dimensions- 5x2.0, 3.2x2.5, 5.0x3.2, 7.0x5.0mm, and SOT23 Packages

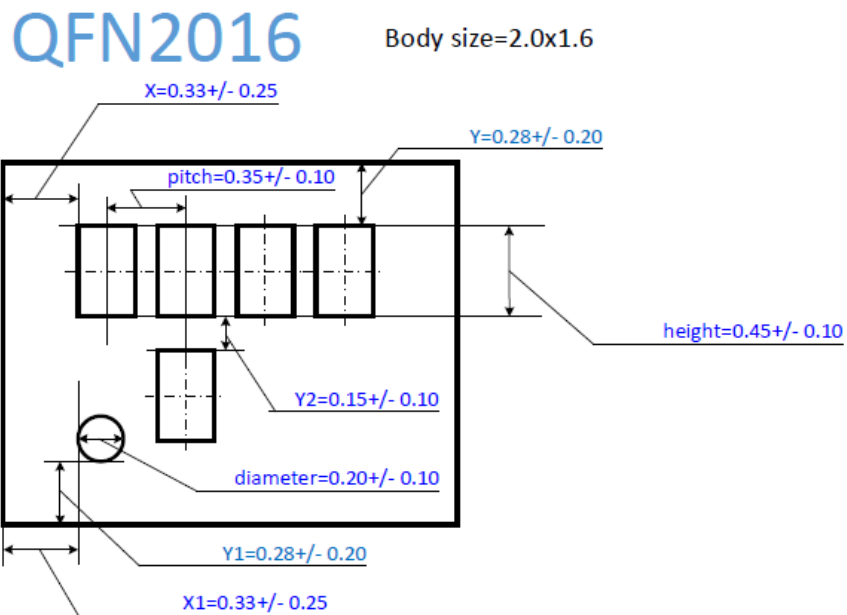


Figure 2. Standard Marking Dimensions for 2.0x1.6mm Package

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 - CARSEM

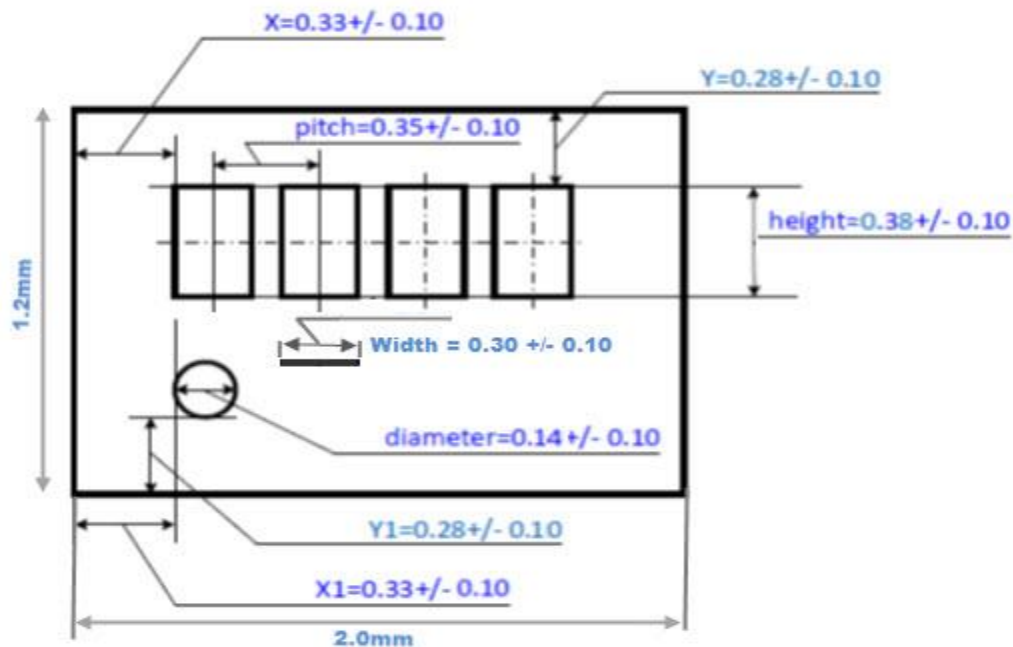
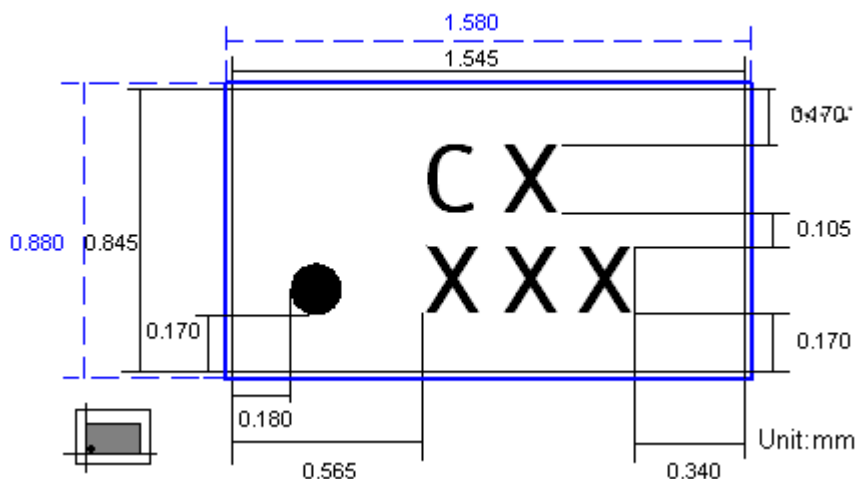


Figure 3. Standard Marking Dimensions for 2.0x1.2mm Package

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

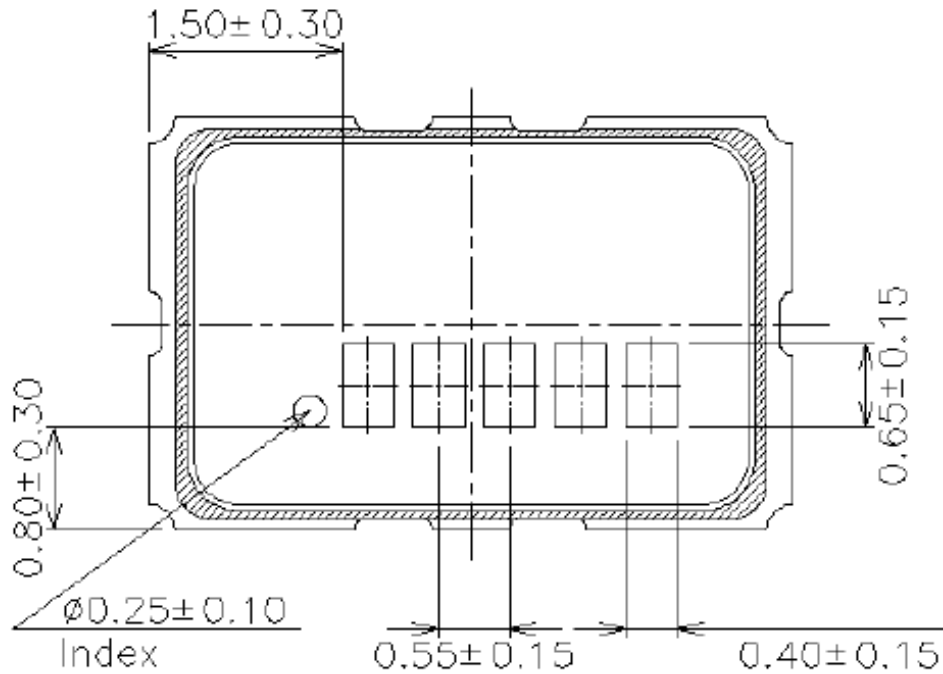


- ▶ Font size tolerance: (+/- 0.05mm)
- ▶ Marking shift tolerance: (+/- 0.15mm)

Figure 4. Standard Marking Dimensions for WLCSP Package (1.5mm x 0.8mm)
Table 3. Marking Dimensions for WLCSP Package (1.5mm x 0.8mm)

	Description	Position	Font Type	Height	Width	Space	Max Marking Width	Max chars
				X ↓	X ↔	X ↔ X	X X X X X ←-----→	
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

5.0 x 3.2 mm ceramic package marking diagram:



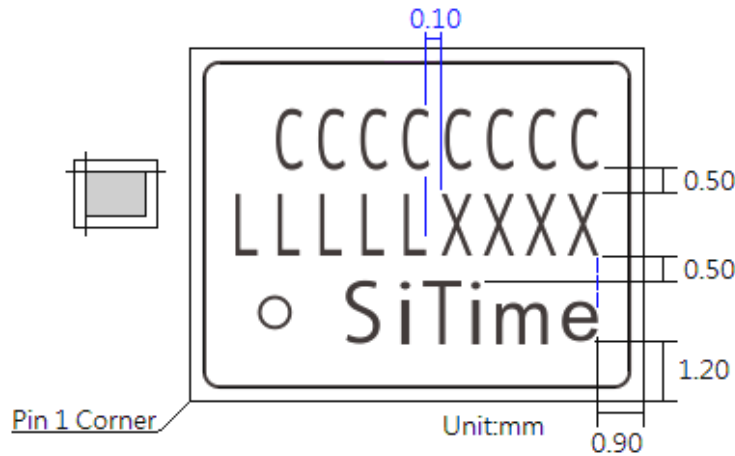
Note:

All dimensions are in mm.

Font type: LLGOTHIC_STD or EO135P or EO145

Tolerance unless otherwise specified: ± 0.20 mm

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



	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 3	XXXX	Right	EO145.FNT	1.20 mm	0.70 mm	0.10 mm	3.10 mm	4

Where,

Tolerance: Font size: $\pm 0.10\text{mm}$; Marking Shift: $\pm 0.25\text{ mm}$

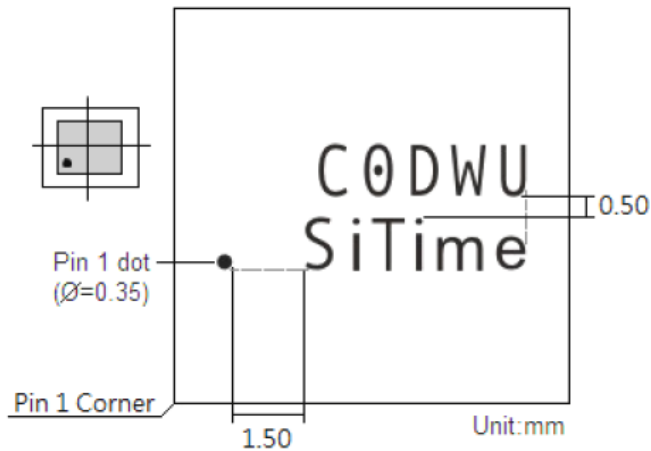
Line 1: CCCCCCCC – this is frequency mark request (empty if not required)

Line 2: LLLLLL – 5-digit lot code marking

Line 2: XXXX – part serial number from production panel

Line 3: Pin 1 dot and “SiTime” logo

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



	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	C0DWU	Left	EO145.FNT	1.20 mm	0.80 mm	0.20 mm	4.80 mm	5

Where,

Tolerance: Font size: ± 0.10 mm; Marking Shift: ± 0.25 mm

Line 1: LLLLL – 5-digit lot code marking

Line 2: Pin 1 dot and “SiTime” logo

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

3 Product Packing

3.1 Tape & Reel

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.

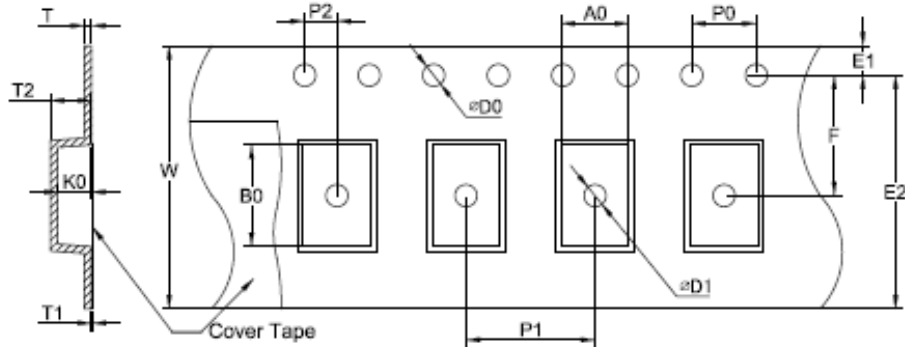
Carrier tape is wound or placed onto a 7” or 13” shipping reel depending on the quantity of parts on the reel and the package body size

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	P0	P1	P2	T	T1 Max.	T2 Max.	W Max.	A0	B0	K0
POD-001-PQFN-004-XD2025	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-XD2025	8	1.55 ±0.05	1.0	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 ±0.05	1.10 ±0.10
POD-023-PQFN-004-A2724	12	1.55 ±0.05	1.0	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	1.0	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-XD3225	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	2.8 ±0.10	3.5 ±0.10	1.10 ±0.10
POD-002-PQFN-004-XD3225	8	1.5 +0.1/-0.0	1.0	1.75 ±0.1	5.95	3.5 ±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-XD5032	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-XD7050	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-009-PQFT-004-B03530	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-XD1620	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-AQ2012	8	1.55 ±0.05	1.0	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 ±0.05	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-SQ23-005-XD2829	8	1.55 ±0.05	1.0	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-XD5032	12	1.55 ±0.05	1.0	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	1.55	12.3	2.65 ±0.10	2.95 ±0.10	1.00 ±0.10
POD-038-PQFD-006-C03225	12	1.55 ±0.05	1.0	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-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-051-PCBA-010-XD9070	24	1.5 +0.1/-0.0	1.5	1.75 ±0.1	22.3	11.5 ±0.1	4.0 ±0.1	12.0 ±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	12.0 ±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

	SPEC	REVERSION	CONTENT	Date
	TNR-1	003	Tape And Reel Dimension	2020/07/29

Note: All dimensions are in mm

Figure 8. Carrier Tape Dimensions

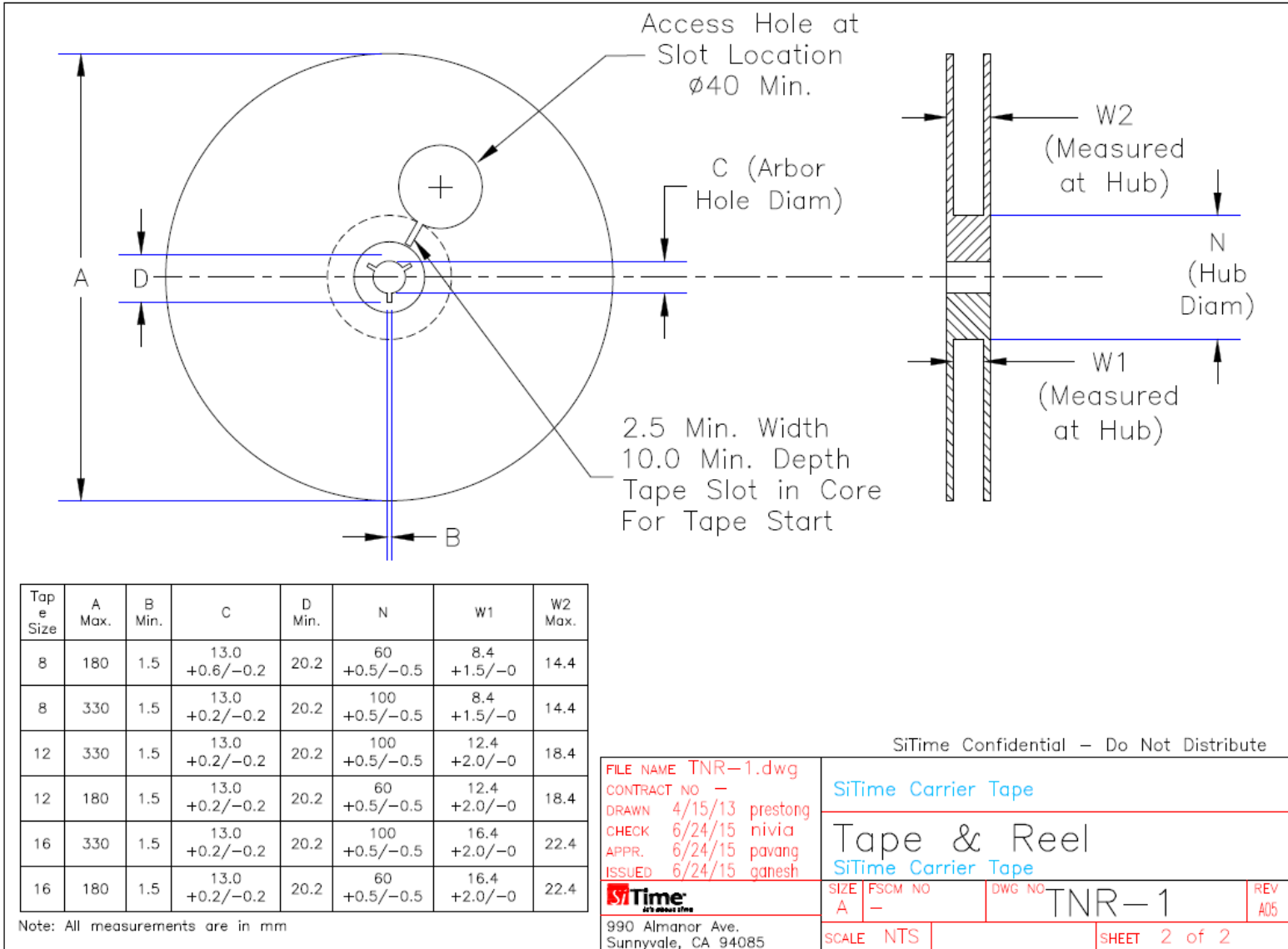


Figure 9. Reel Dimensions

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).

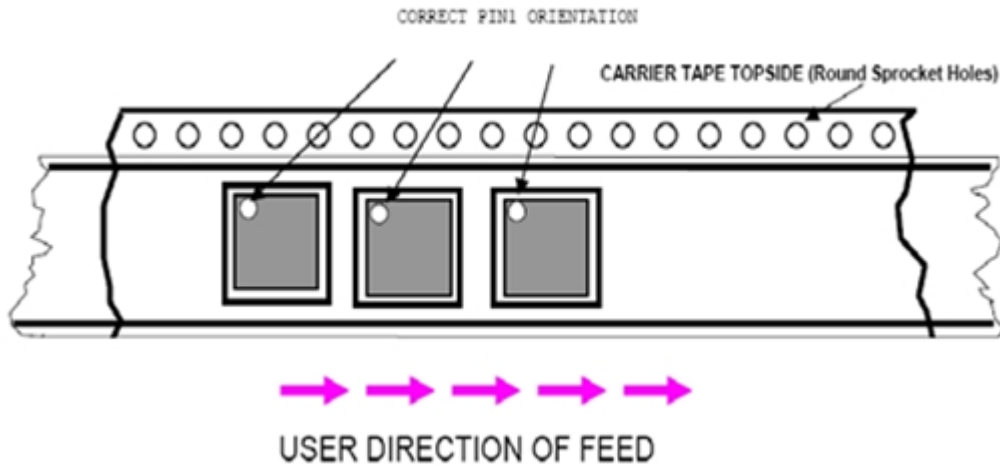


Figure 10. Standard Tape and Reel Pin 1 orientation (all except for SOT-23)

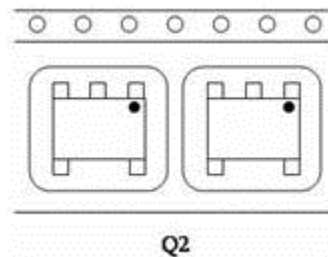


Figure 11. SOT23 Tape and Reel Pin 1 orientation

Table 4 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-30.00000Y

↑
Suffix
Character

Table 4. 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	2.7 x 2.4	7	3000	
	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	2.7 x 2.4	7	1000	
	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	2.7 x 2.4	7	250	
	8mm Tape & Reel	2.5 x 2.0	7	250	
	8mm Tape & Reel	SOT23	7	250	

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
T	16mm Tape & Reel	7.0 x 5.0	13	3000	1 Line Standard 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	
Y	16mm Tape & Reel	7.0 x 5.0	7	1000	1 Line Standard 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	
X	16mm Tape & Reel	7.0 x 5.0	7	250	1 Line Standard 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	
D	8mm Tape & Reel	3.2 x 2.5	7	3000	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	3000	
	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	

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
C	8mm Tape & Reel	3.2 x 2.5	7	3000	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	3000	
	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	
E	8mm Tape & Reel	3.2 x 2.5	7	1000	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	1000	
	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	
B	8mm Tape & Reel	3.2 x 2.5	7	1000	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	1000	
	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	
G	8mm Tape & Reel	3.2 x 2.5	7	250	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	250	
	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	

Suffix	Packaging Method	Package Size (mm)	Reel Size (inches)	Qty per Reel	Top Mark
A	8mm Tape & Reel	3.2 x 2.5	7	250	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	250	
	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	
Q	8mm Tape & Reel	3.2 x 2.5	7	5000	1 Line Standard Mark
	8mm Tape & Reel	2.7 x 2.4	7	5000	
	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 5. 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's Emerald and Cascade products are moisture sensitive and need to be handled within proper MSL 3 guidelines to avoid damage from moisture absorption and exposure to solder reflow temperatures. This could result in yield and reliability degradation.

Devices are baked and dry-packed before shipment from SiTime's factory. The packing uses a Moisture Barrier Bag (MBB). A Humidity Indicator Card (HIC) and drying desiccant are included inside the MBB. An MSL 3 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 of 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 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 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 MBB with HIC and drying desiccant may be required if the devices are not going to be used within 48 hours at factory conditions of <30°C/60% RH or stored at <10% RH conditions.

For rest of the SiTime products which are MSL1, it is recommended that the sealed tape be stored in conditions where the environment does not exceed:

- 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. Care must be taken to ensure careful handling to avoid damaging the components. Reference to JEDEC document JESD625, Requirements for Handling Electrostatic-Discharge-Sensitive Devices. This standard establishes the minimum requirements for Electrostatic Discharge (ESD) control methods and materials used to protect electronic devices that are

susceptible to damage or degradation from electrostatic discharge (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. Refer to Section 4 for storage and handling instructions (including rebaking, if required).

The rest of the SiTime's products have been qualified to Moisture Sensitivity Level 1 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 conditions given in Section 4 indefinitely without re-sealing the protective storage bags in which the reels are shipped in. It also means unused reels with a damaged bag seal may be used without baking. Because the parts meet moisture sensitivity level 1, 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/packages; Table-7 provides relevant details of the profile. Refer to Table-6 for the maximum reflow temperature as it is package volume/thickness dependent. 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 data sheets. 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.

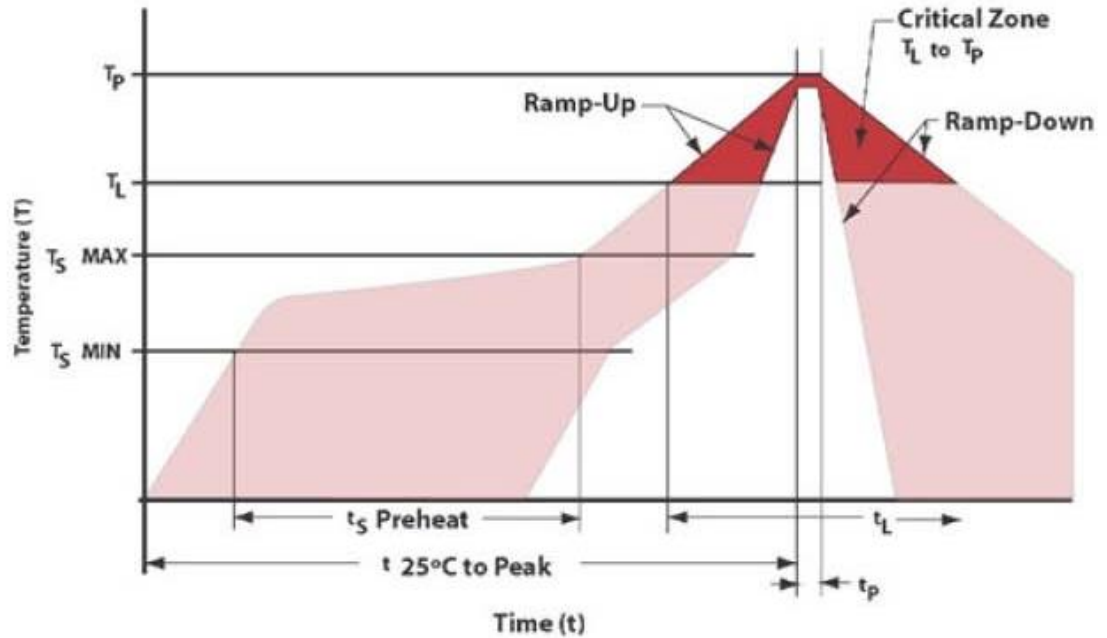


Figure 12. Convection Reflow Soldering Profile, per IPC/JEDEC J-STD-020

Table 6. Lead-Free Process Classification temperature (T_c)

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 - 2.5 mm	260 °C	250 °C	245 °C
>2.5 mm	260 °C	245 °C	245 °C

Table 7. High Temperature Infrared/Convection Reflow Conditions IPC/JEDEC J-STD-020

IPC/JEDEC Standard	IPC/JEDEC J-STD-020
Moisture Sensitivity Level	Level 1
TS MAX to TL (Ramp-up Rate)	3°C/second Maximum
Preheat	
- Temperature Minimum (TS MIN)	150°C
- Temperature Typical (TS TYP)	175°C
- Temperature Maximum (TS MAX)	200°C
- Time (tS)	60 - 180 Seconds
Ramp-up Rate (TL to TP)	3°C/second Maximum
Time Maintained Above:	
- Temperature (TL)	217°C
60 - 150 Seconds	260°C Maximum for 10 Seconds
- Time (TL)	60 - 150 Seconds
Peak Temperature (TP)	260°C Maximum
60 - 150 Seconds	260°C Maximum for 10 Seconds
Target Peak Temperature (TP Target)	255°C
Time within 5°C of actual peak (tP)	20 - 40 seconds
Max. Number of Reflow Cycles	3
Ramp-down Rate	6°C/second Maximum
Time 25°C to Peak Temperature (t)	8 minutes Maximum

Note: Temperatures shown are applied to body of device.

Table 8. 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 Sec 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 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 top-coat. If the part will see intense light, especially in the 1.0-1.2 μm IR spectrum, we recommend a protective “glop-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 SiTime’s EpiSeal™ process which hermetically seals the resonators during wafer processing, eliminating any need for hermetically sealed ceramic packaging. SiTime’s 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 in case you are planning to use a SiTime device in large concentrations of small-molecule gas, so that we can recommend an appropriate, immune part.

8 Additional Questions?

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

SiTime Corporation
5451 Patrick Henry
Drive, Santa Clara, CA
95054 USA
Phone: 4088-328-4400
<http://www.sitime.com>

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