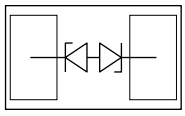
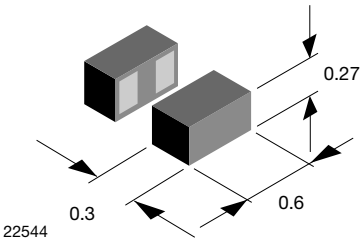
Bidirectional Symmetrical (BiSy) Single Line ESD-Protection Diode in Silicon Package



22543



22544

FEATURES

- Ultra compact CLP0603 package
- Low package height < 0.3 mm
- 1-line ESD-protection
- Working range ± 5.5 V
- Low leakage current < 0.1 µA
- Low load capacitance C_D < 14 pF
- ESD-protection acc. IEC 61000-4-2
  ± 30 kV contact discharge
  ± 30 kV air discharge
- Lead plating: Au (e4)
- Lead material: TiNiAg
- e4 - precious metal (e.g. Ag, Au, NiPd, NiPdAu) (no Sn)
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free

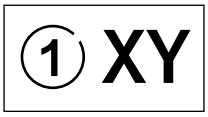
e4

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

MARKING (example only)



22454

1 = Year code
Open circle = Month code and pin 1
XY = Type code

ORDERING INFORMATION			
DEVICE NAME	ORDERING CODE	TAPED UNITS PER REEL (8 mm TAPE ON 7" REEL)	MINIMUM ORDER QUANTITY
VCUT05D1-SD0	VCUT05D1-SD0-G4-08	15 000	15 000

PACKAGE DATA						
DEVICE NAME	PACKAGE NAME	TYPE CODE	WEIGHT	FLAMMABILITY RATING	MOISTURE SENSITIVITY LEVEL	SOLDERING CONDITIONS
VCUT05D1-SD0	CLP0603	5D	0.12 mg	UL 94 V-0	MSL level 1 (according J-STD-020)	260 °C/10 s at terminals Reflow soldering according JEDEC STD-020

ABSOLUTE MAXIMUM RATINGS VCUT05D1-SD0				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	acc. IEC 61000-4-5, 8/20 µs/single shot	I_{PPM}	6	A
Peak pulse power	Pin 1 to pin 2 acc. IEC 61000-4-5; t_p = 8/20 µs; single shot	P_{PP}	78	W
ESD immunity	Contact discharge acc. IEC61000-4-2; 10 pulses	V_{ESD}	± 30	kV
	Air discharge acc. IEC61000-4-2; 10 pulses		± 30	
Operating temperature	Junction temperature	T_J	-55 to +150	°C
Storage temperature		T_{stg}	-55 to +150	°C

For technical questions, contact: ESDprotection@vishay.com

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CUT THE SPIKES WITH VCUT05D1-SD0

The VCUT05D1-SD0 is a Bidirectional and Symmetrical (BiSy) ESD-protection device which clamps positive and negative overvoltage transients to ground. Connected between the signal or data line and the ground the VCUT05D1-SD0 offers a high isolation (low leakage current, low capacitance) within the specified working range. Due to the short leads and small package size of the tiny CLP0603 package the line inductance is very low, so that fast transients like and ESD-strike can be clamped with minimal over- or undershoots.

ELECTRICAL CHARACTERISTICS VCUT05D1-SD0
(T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITIONS/REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand-off voltage	Max. reverse working voltage	V_{RWM}	-	-	5.5	V
Reverse voltage	at I_R = 0.1 µA	V_R	5.5	-	-	V
Reverse current	at V_{RWM} = 5.5 V	I_R	-	-	0.1	µA
Reverse breakdown voltage	at I_R = 1 mA	V_{BR}	6.5	8	9	V
Reverse clamping voltage	at I_{PP} = 1 A	V_C	-	8.8	10	V
	at I_{PP} = I_{PPM} = 6 A	V_C	-	11	13	V
Capacitance	at V_R = 0 V; f = 1 MHz	C_D	-	13	14	pF
	at V_R = 2.5 V; f = 1 MHz	C_D	-	11	-	pF
Clamping voltage	Transmission Line Pulse (TLP); t_p = 100 ns I_{TLP} = 8 A	V_{C-TLP}	-	9.8	-	V
Clamping voltage	Transmission Line Pulse (TLP); t_p = 100 ns I_{TLP} = 16 A	V_{C-TLP}	-	11	-	V
Dynamic resistance	Transmission Line Pulse (TLP); t_p = 100 ns	R_{DYN}	-	0.15	-	Ω

TYPICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

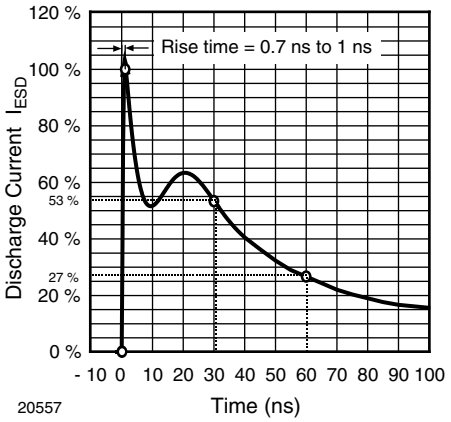

Fig. 1 - ESD Discharge Current Wave Form
acc. IEC 61000-4-2 (330 Ω/150 pF)

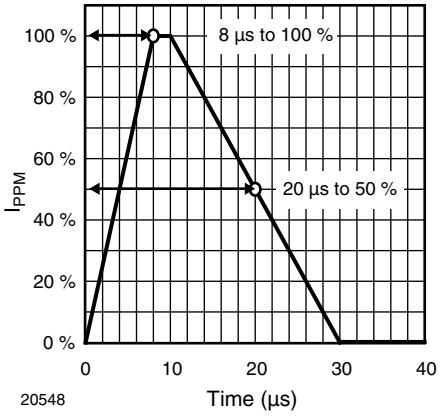

Fig. 2 - 8/20 µs Peak Pulse Current Wave Form
acc. IEC 61000-4-5

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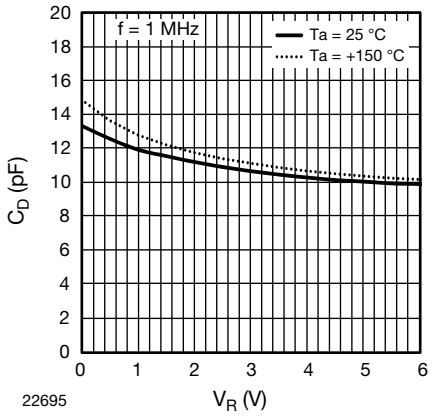

Fig. 3 - Typical Capacitance C_D vs. Reverse Voltage V_R

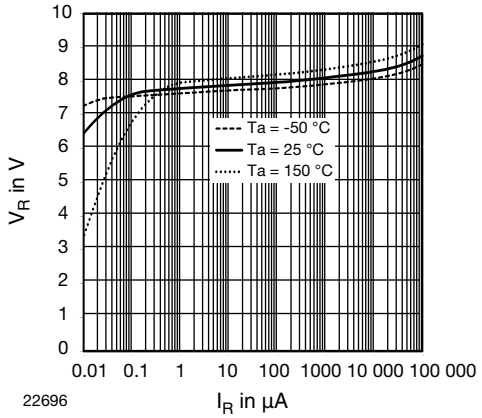

Fig. 4 - Typical Reverse Voltage V_R vs. Reverse Current I_R

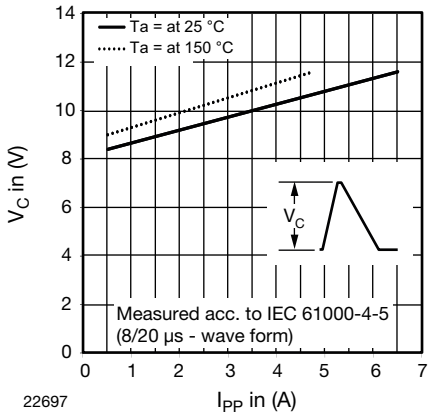

Fig. 5 - Typical Peak Clamping Voltage V_C vs. Peak Pulse Current I_{PP}

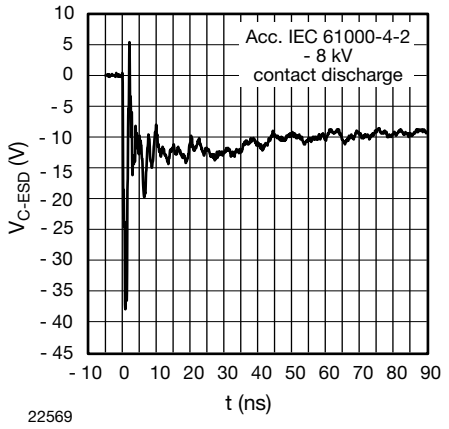

Fig. 6 - Typical Clamping Performance at 8 kV Contact Discharge acc. IEC 61000-4-2

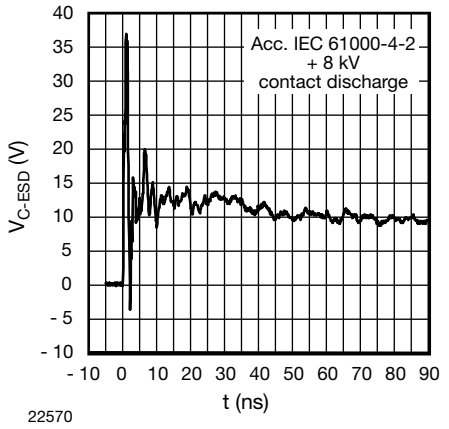

Fig. 7 - Typical Clamping Performance at 8 kV Contact Discharge acc. IEC 61000-4-2

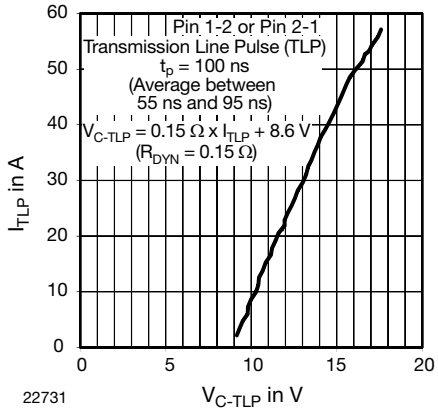

Fig. 8 - Typical Clamping Voltage at 100 ns Transmission Line Pulse (TLP)

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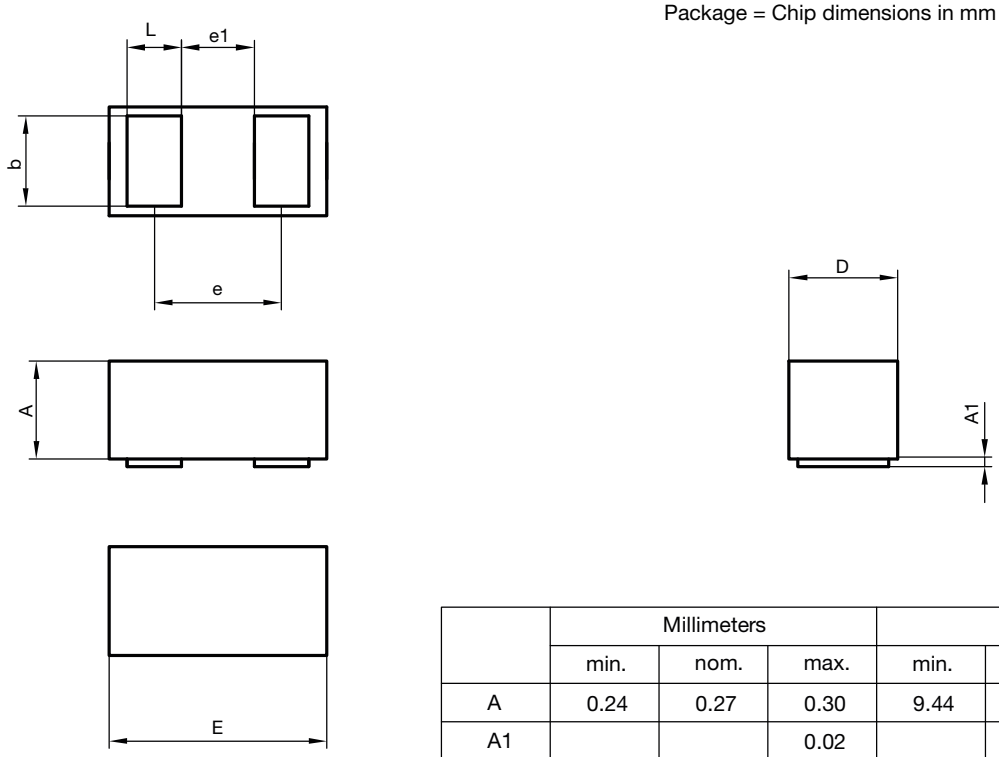
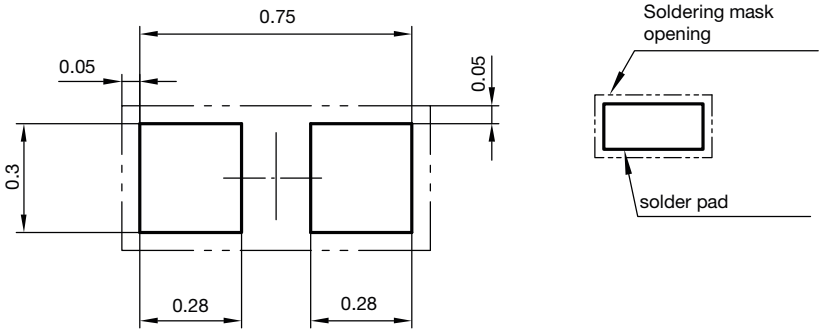
PACKAGE DIMENSIONS in millimeters (mils): **CLP0603-2L**

Package = Chip dimensions in mm



	Millimeters			mils		
	min.	nom.	max.	min.	nom.	max.
A	0.24	0.27	0.30	9.44	10.63	11.81
A1			0.02			0.79
b	0.22	0.25	0.28	8.66	9.84	11.02
D	0.27	0.30	0.33	10.62	11.81	12.99
E	0.57	0.60	0.63	22.44	23.62	24.80
e		0.40			15.75	
e1		0.25			9.84	
L	0.12	0.15	0.18	4.72	5.91	7.09

foot print recommendation:



22606

2 terminal leadless package (CLP0603-2L)
Document no.: S8-V-3906.04-023 (4)
Created - Date: 22. Nov. 2010
Rev.3 - Date: 14. Sept. 2011

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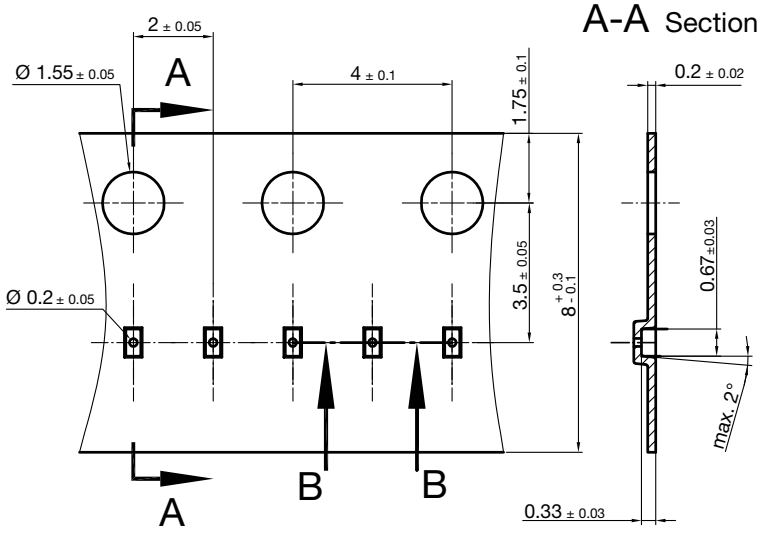
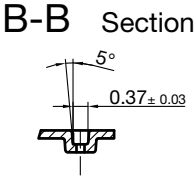
CARRIER TAPE in millimeters: **CLP0603**

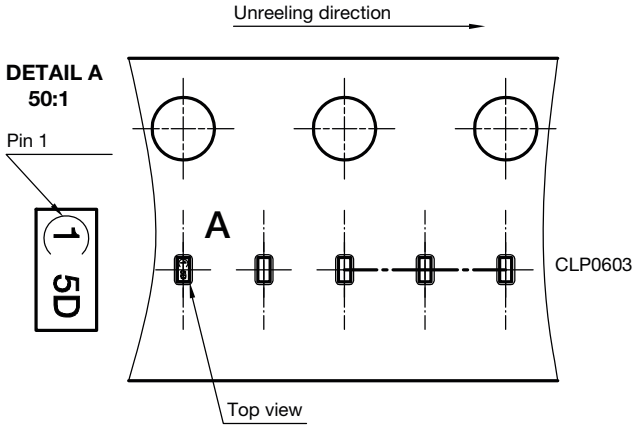




Cummulative tolerances of 10 sprocket holes is +/-0.2mm

22591
Document no. S8-V-3906.04-0025 (4)
Created - Date: 22. Nov. 2010

ORIENTATION IN CARRIER CLP0603



22607

Orientation in Carrier Tape (CLP0603)
S8-V-3906.04-026 (4)
22.10.2010

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APPLICATION NOTE

1. PCB FOOTPRINT DESIGN

Verified by internal tests, Vishay recommends the soldering pad and solder mask opening design as shown in fig. 1. We recommend using a non-solder mask defined (NSMD) design, as shown below. The reason is that with a NSMD design, the size of the actual solder pad is more accurate (tolerances for copper etchings are smaller compared to a solder mask defined process).

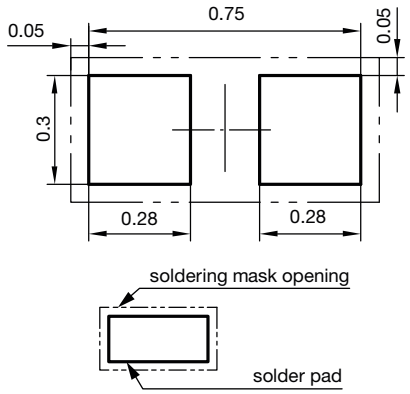

Fig. 1 - Recommended Soldering Pad Design

2. PCB SOLDERING PAD METALLIZATION

There are several common pad metallization/finishes, including OSP (Organic Solderability Protectant), HASL (Hot Air Solder Level), and ENiAu. Because of the CLP0603's extremely small size, Vishay only recommends using the electroless Ni/immersion gold over copper pad plating.

3. SCREEN PRINT PROCESS

The solder paste is applied to the PCB by using a screen print process. The recommended stencil thickness for the CLP0603 package is 80 µm (the absolute maximum is 100 µm). The recommended dimensions for the stencil openings are 12 mil (300 µm) by 8 mil (200 µm) for both pads. The side wall of the stencil openings should be tapered approximately 5 degrees. An electro-polished finish will support a better release of the paste.

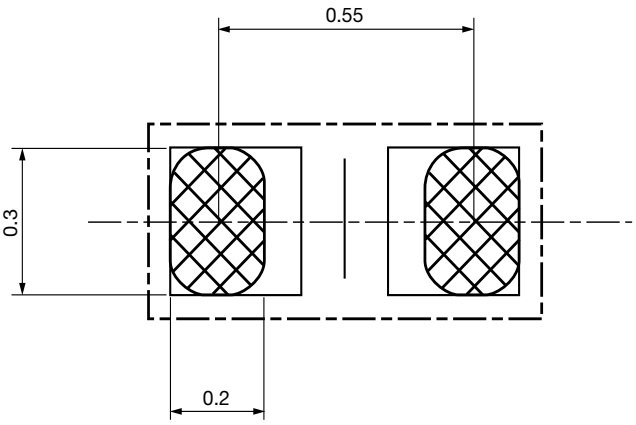

Fig. 2 - Maximum Stencil Openings - for a Stencil Thickness of 80 µm

Note

- A wider stencil opening will result in a better solder paste release from the stencil. So the best quality can be obtained by using the optimum between the stencil quality, thickness, and opening.

If a tilting of the package is observed, the amount of solder paste should be reduced slightly. Please also take into consideration the direct relation between the amount of solder paste and the package shear strength.

4. SOLDER PASTE TYPE

Type 4 solder pastes (or smaller powder sizes) are recommended. In our evaluation we used the Cookson Electronics' Alpha OM-338 CSP (96.5 % Sn/3 % Ag/0.5 % Cu) solder paste.

5. REFLOW SOLDERING PROCESS

A standard surface-mount reflow soldering process can be used (reference: JPC/JEDEC J-STD-020D).

However, for an optimum process, recommendations from the solder paste supplier should be considered. Variations in chemistry and viscosity of the fluxer may require small adjustments to the soldering profile.

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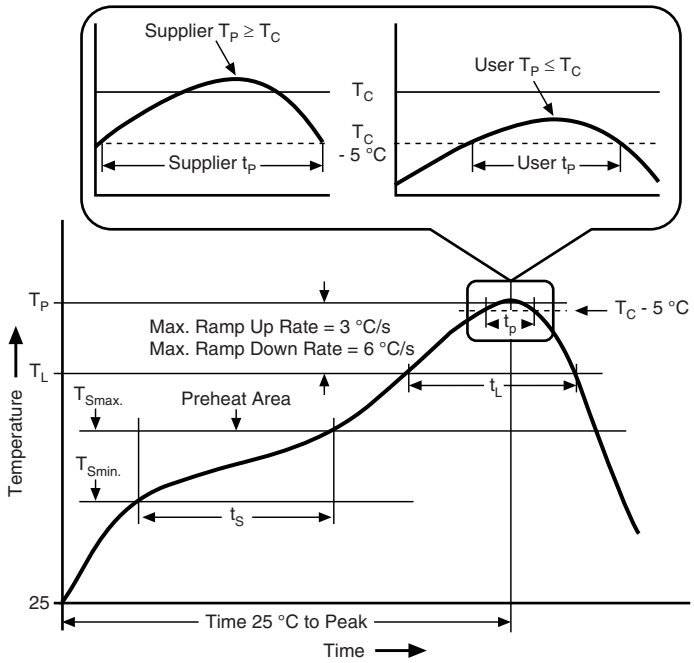

TABLE 1 - CLASSIFICATION REFLOW PROFILES		
PROFILE FEATURE	**SnPb EUTECTIC ASSEMBLY**	**LEAD (Pb)-FREE ASSEMBLY**
PREHEAT AND SOAK		
Temperature min. ($T_{Smin.}$)	100 °C	150 °C
Temperature max. ($T_{Smax.}$)	150 °C	200 °C
Time ($T_{Smin.}$ to $T_{Smax.}$) (t_S)	60 s to 120 s	60 s to 120 s
Average ramp-up rate ($T_{Smax.}$ to T_p)	3 °C/s maximum	
Liquidous temperature (T_L)	183 °C	217 °C
Time to liquidous (t_L)	60 s to 150 s	60 s to 150 s
Peak package temperature (T_p) (1)	See classification temperature in table 3	See classification temperature in table 4
Time (t_p) (2) with 5 °C of the specified classification temperature (T_C)	20 s (2)	30 s (2)
Average ramp-down rate (T_p to $T_{Smax.}$)	6 °C/s maximum	
Time 25 °C to peak temperature	6 min maximum	8 min maximum

Notes

(1) Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and user maximum

(2) Tolerance for time at peak profile temperature (T_p) is defined as a supplier minimum and user maximum

Notes

1. All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow (e.g. live-bug). If parts are reflowed in other than the normal live-bug assembly reflow orientation (i.e. dead-bug). T_p shall be within ± 2 °C of the live-bug T_p and still meet the T_C requirements, otherwise, the profile shall be adjusted to achieve the latter. To accurately measure actual peak package body temperatures refer to JEP140 for the recommended thermocouple use.
2. Reflow profiles in this document are for classification/preconditioning and are not meant to specify board assembly profiles. Actual board assembly profiles should be developed based on specific process needs and board designs and should not exceed the parameters in table 1. For example, if T_C is 260 °C and time t_p is 30 s, this means the following for the supplier and the user:
   - For a supplier: The peak temperature must be at least 260 °C. The time above 255 °C must be at least 30 s.
   - For a user: The peak temperature must not exceed 260 °C. The time above 255 °C must not exceed 30 s.
3. All components in the test load shall meet the classification profile requirements.
4. SMD packages classified to a given moisture sensitivity level by using procedures or criteria defined within any previous version of J-STD-020, JESD22-A112 (rescinded), IPC-SM-786 (rescinded) do not need to be reclassified to the current revision unless a change in classification level or a higher peak classification temperature is desired.

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TABLE 2 - SnPb EUTECTIC PROCESS - CLASSIFICATION TEMPERATURES (T_C)		
PACKAGE THICKNESS	**VOLUME mm³ < 350**	**VOLUME mm³ ≥ 350**
< 2.5 mm	235 °C	220 °C
≥ 2.5 mm	220 °C	220 °C

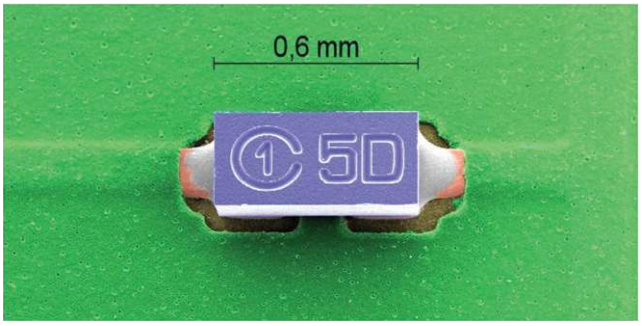
TABLE 3 - LEAD (Pb)-FREE PROCESS - CLASSIFICATION TEMPERATURES (T_C)			
PACKAGE THICKNESS	**VOLUME mm³ < 350**	**VOLUME mm³ 350 to 2000**	**VOLUME mm³ > 2000**
< 1.6 mm	260 °C	260 °C	260 °C
1.6 mm to 2.5 mm	260 °C	250 °C	245 °C
> 2.5 mm	250 °C	245 °C	245 °C

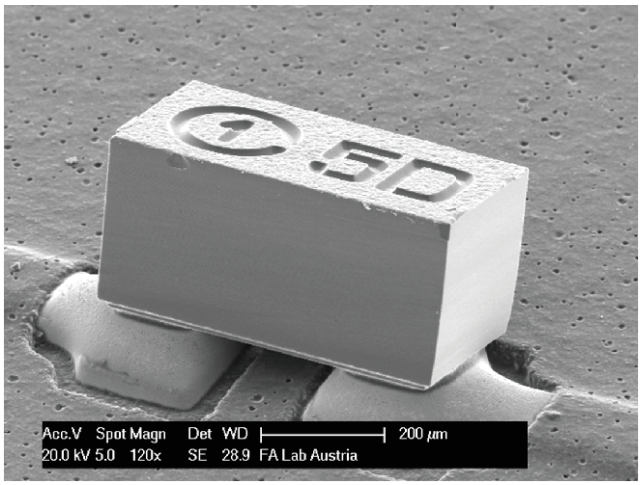
Notes

5. At the direction of the device manufacturer, but not the board assembler/user, the maximum peak package body temperature (T_p) can exceed the values specified in tables 2 and 3. The use of a higher T_p does not change the classification temperature (T_C).
6. Package volume excludes external terminals (e.g., balls, bumps, lands, leads) and/or nonintegral heat sinks.
7. The maximum component temperature reached during reflow depends on package thickness and volume. The use on convection reflow processes reduces the thermal gradients between packages. However thermal gradients due to differences in thermal mass of SMD packages may still exist.
8. Moisture sensitivity levels of components intended for use in a lead (Pb)-free assembly process shall be evaluated using the lead (Pb)-free classification temperatures and profiles defined in table 1 and 3, whether or not lead (Pb)-free.
9. SMD packages classified to a given moisture sensitivity level by using procedures or criteria defined within any previous version of J-STD-020, JESD22-A112 (rescinded), IPC-SM-786 (rescinded) do not need to be reclassified to the current revision unless a change in classification level or a higher peak classification temperature is desired.

6. SOLDERING QUALITY INISPECTION

An X-ray inspection system is required to find defects such as shorts between pads, open contacts, and voids within the solder. In addition, a visual inspection by microscope or camera (of appropriate magnification) can be used to inspect the sides of the solder joints for acceptable shape and molten solder.





7. SHEAR TEST COMPARISON

The data below shows a comparison of shear strength after a reflow soldering process.

	VISHAY	COMPETITOR 1	COMPETITOR 2	COMPETITOR 3
Typical shear strength	500 g	350 g	600 g	440 g

8. REWORK PROCEDURE

For rework, the CLP0603 package must be removed from the PCB if there is any issue with the solder joints. Standard SMT rework systems are recommended for this. Due to the small size of the package, the rework system should be equipped with a proper magnification aid.

9. INTERCHANGEABILITY OF THE CLP WITH A PLASTIC PACKAGE OF THE SAME SIZE

Based on our studies, the CLP is 100 % compatible with plastic packages of the same size.

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