

TVS

TVS

## Description

The LCE Series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

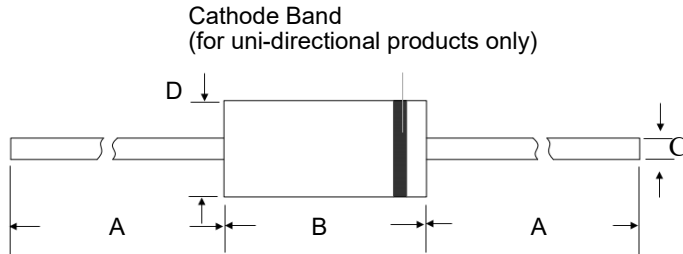
## Applications

- Communication Equipment
- Security & Protection
- Industrial Control Equipment
- Power Supply
- Automotive Electronics
- New Energy
- Lightning Protection

## Features

- 1500 W peak pulse capability at 10/1000  $\mu$ S waveform, repetition rate (duty cycles):0.01%
- Glass passivated chip junction in DO-201 Package
- Fast response time: typically less than 1.0 PS from 0 Volts to BV min
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Low incremental surge resistance
- High temperature to reflow soldering guaranteed: 260 °C/30 sec / 0.375", (9.5 mm) lead length, 5 lbs., (2.3 kg) tension
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Matte tin lead-free plated
- Ideal for data line applications
- Halogen free and RoHS compliant
- Pb-free E3 means 2<sup>nd</sup> level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

## Package Outline Dimensions (DO-201)



DO - 201

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	25.40	-	1.000	-
B	7.20	9.50	0.285	0.375
C	0.96	1.07	0.038	0.042
D	4.80	5.30	0.190	0.210

## Maximum Ratings and Characteristics

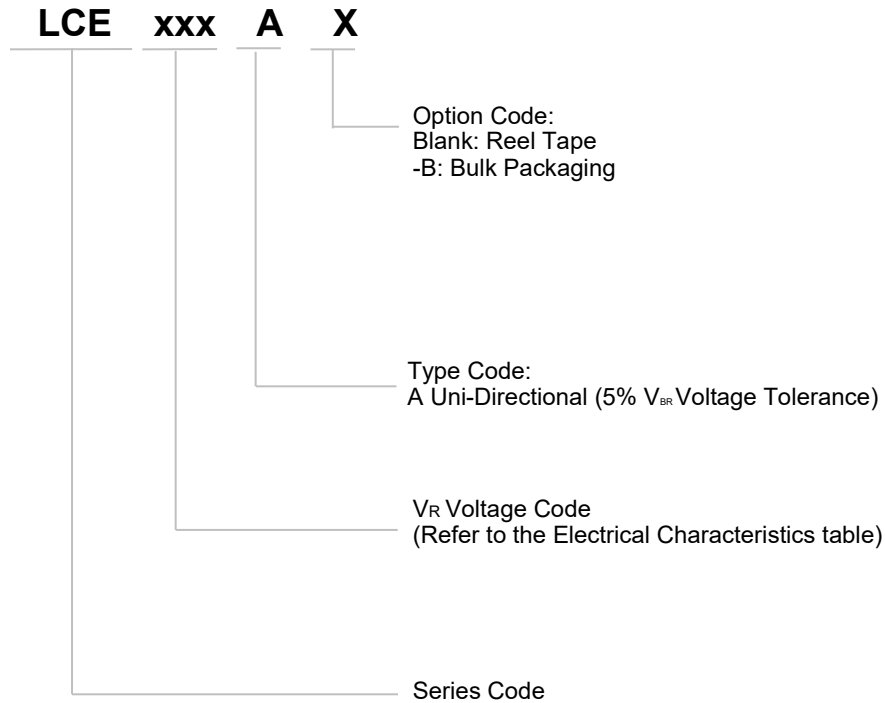
( $T_A = 25\text{ }^\circ\text{C}$  unless otherwise specified.)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation by 10/1000 $\mu\text{S}$ Test Waveform (Fig.1)(Note 1)	$P_{PPM}$	1500	W
Steady State Power Dissipation on Infinite Heat Sink at $T_L=75\text{ }^\circ\text{C}$ (Fig. 5)	$P_D$	6.5	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-65 to 175	$^\circ\text{C}$

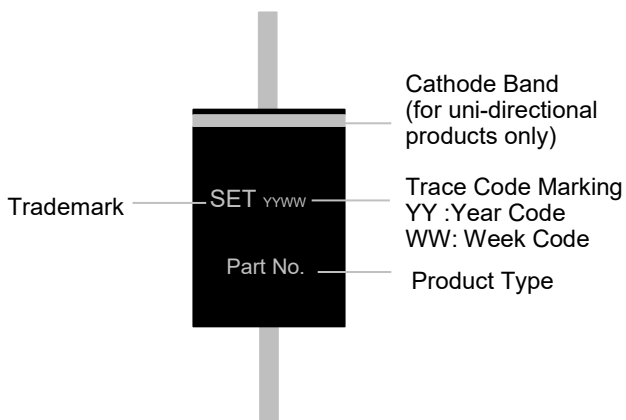
Note

1. Non-repetitive current pulse, per Fig. 3 and derated above  $T_J(\text{initial})=25\text{ }^\circ\text{C}$  per Fig. 2.

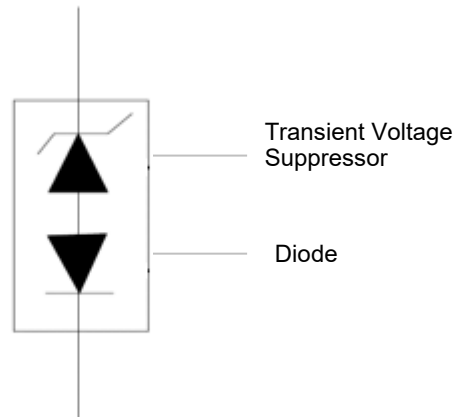
## Part Numbering System



## Marking



## Functional Diagram



## Glossary

Item	Description
$V_C$	<b>Clamping Voltage</b> Voltage across TVS in a region of low differential resistance that serves to limit the voltage across the device terminals.
$V_R$	<b>Reverse Stand-off Voltage</b> Maximum voltage that can be applied to the TVS without operation. NOTE : It is also shown as $V_{WM}$ (maximum working voltage (maximum d.c. voltage)) and known as rated stand-off voltage ( $V_{so}$ ).
$I_R$	<b>Reverse Leakage Current</b> Current measured at $V_R$ .
$V_{BR}$	<b>Breakdown Voltage</b> Voltage across TVS at a specified current $I_T$ in the breakdown region.
$I_{PPM}$	<b>Rated Random Recurring Peak Impulse Current</b> Maximum-rated value of random recurring peak impulse current that may be applied to a device.
$P_{M(AV)}$	<b>Rated Average Power Dissipation</b> Maximum-rated value of power dissipation resulting from all sources, including transients and standby current, averaged over a short period of time.
$P_{PPM}$	<b>Rated Random Recurring Peak Impulse Power Dissipation</b> Maximum-rated value of the product of rated random recurring peak impulse current ( $I_{PPM}$ ) multiplies by specified maximum clamping voltage ( $V_C$ ).
$C_J$	<b>Capacitance</b> Capacitance across the TVS measured at a specified frequency and voltage.
$V_{FS}$	<b>Peak Forward Surge Voltage</b> Peak voltage across an TVS for a specified forward surge current ( $I_{FS}$ ) and time duration. NOTE : Also shown as $V_F$ .
$I_{FS}$	<b>Forward Surge Current</b> Pulsed current through TVS in the forward conducting region. NOTE : Also shown as $I_F$ .
$\alpha_{V(BR)}$	<b>Temperature Coefficient of Breakdown Voltage</b> The change of breakdown voltage divided by the change of temperature.
$I_{PP}$	<b>Peak pulse Current</b> Peak pulse current value applied across the TVS to determine the clamping voltage $V_C$ for a specified wave shape.
$I_T$	<b>Pulsed D.C. Test Current</b> Test current for measurement of the breakdown voltage $V_{BR}$ . This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms. NOTE : Also shown as $I_{BR}$ .

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)

### Electrical Characteristics (T<sub>A</sub>=25 °C unless otherwise noted )Table 1

Part Number	Breakdown Voltage V <sub>BR@I<sub>T</sub></sub>		Test Current I <sub>T</sub>	Reverse Stand-off Voltage V <sub>R</sub>	Max. Reverse Leakage I <sub>R@V<sub>R</sub></sub>	Max. Peak Pulse Current I <sub>PPM</sub>	Max. Clamping Voltage V <sub>C@I<sub>PPM</sub></sub>	Max. Junction Capacitance @0 Volts	Working Inverse Blocking Voltage V <sub>WIB</sub>	Inverse Blocking Leakage Current at I <sub>IB@V<sub>WIB</sub></sub>	Peak Inverse Blocking Voltage V <sub>PIB</sub>
	Min	Max									
Uni	(V)		(mA)	(V)	(μA)	(A)	(V)	(pF)	(V)	(mA)	(V)
LCE6.5A	7.22	7.98	10	6.5	1000	100.0	11.2	100	75	1.0	100
LCE7.0A	7.78	8.60	10	7.0	500	100.0	12.0	100	75	1.0	100
LCE7.5A	8.33	9.21	10	7.5	250	100.0	12.9	100	75	1.0	100
LCE8.0A	8.89	9.83	1	8.0	100	100.0	13.6	100	75	1.0	100
LCE8.5A	9.44	10.40	1	8.5	50	100.0	14.4	100	75	1.0	100
LCE9.0A	10.00	11.10	1	9.0	10	97.0	15.4	100	75	1.0	100
LCE10A	11.10	12.30	1	10.0	5	88.0	17.0	100	75	1.0	100
LCE11A	12.20	13.50	1	11.0	1	82.0	18.2	100	75	1.0	100
LCE12A	13.30	14.70	1	12.0	1	75.0	19.9	100	75	1.0	100
LCE13A	14.40	15.90	1	13.0	1	70.0	21.5	100	75	1.0	100
LCE14A	15.60	17.20	1	14.0	1	65.0	23.2	100	75	1.0	100
LCE15A	16.70	18.50	1	15.0	1	61.0	24.4	100	75	1.0	100
LCE16A	17.80	19.70	1	16.0	1	57.0	26.0	100	75	1.0	100
LCE17A	18.90	20.90	1	17.0	1	54.0	27.6	100	75	1.0	100
LCE18A	20.00	22.10	1	18.0	1	51.0	29.2	100	75	1.0	100
LCE20A	22.20	24.50	1	20.0	1	46.0	32.4	100	75	1.0	100
LCE22A	24.40	26.90	1	22.0	1	42.0	35.5	100	75	1.0	100
LCE24A	26.70	29.50	1	24.0	1	39.0	38.9	100	75	1.0	100
LCE26A	28.90	31.90	1	26.0	1	36.0	42.1	100	75	1.0	100
LCE28A	31.10	34.40	1	28.0	1	33.0	45.5	100	75	1.0	100
LCE30A	33.30	36.80	1	30.0	1	31.0	48.4	100	75	1.0	100
LCE33A	36.70	40.60	1	33.0	1	28.1	53.3	100	75	1.0	100

TVS

TVS

# TVS Diodes

Transient Voltage Suppression Diodes

LCE Series

Part Number	Breakdown Voltage $V_{BR}@I_T$		Test Current $I_T$	Reverse Stand-off Voltage $V_R$	Max. Reverse Leakage $I_R@V_R$	Max. Peak Pulse Current $I_{PPM}$	Max. Clamping Voltage $V_C@I_{PPM}$	Max. Junction Capacitance @0 Volts	Working Inverse Blocking Voltage $V_{WIB}$	Inverse Blocking Leakage Current at $I_B@V_{WIB}$	Peak Inverse Blocking Voltage $V_{PIB}$
	Min	Max									
Uni	(V)		(mA)	(V)	( $\mu$ A)	(A)	(V)	(pF)	(V)	(mA)	(V)
LCE36A	40.00	44.20	1	36.0	1	25.8	58.1	100	75	1.0	100
LCE40A	44.40	49.10	1	40.0	1	23.3	64.5	100	75	1.0	100
LCE43A	47.80	52.80	1	43.0	1	21.6	69.4	100	75	1.0	100
LCE45A	50.00	55.30	1	45.0	1	20.6	72.7	100	75	1.0	100
LCE48A	53.30	58.90	1	48.0	1	19.4	77.4	100	75	1.0	100
LCE51A	56.70	62.70	1	51.0	1	18.2	82.4	100	75	1.0	100
LCE54A	60.00	66.30	1	54.0	1	17.2	87.1	100	100	1.0	125
LCE58A	64.40	71.20	1	58.0	1	16.0	93.6	100	100	1.0	125
LCE60A	66.70	73.70	1	60.0	1	15.5	96.8	100	100	1.0	125
LCE64A	71.10	78.60	1	64.0	1	14.6	103.0	100	100	1.0	125
LCE70A	77.80	86.00	1	70.0	1	13.3	113.0	100	125	1.0	150
LCE75A	83.30	92.10	1	75.0	1	12.4	121.0	100	125	1.0	150
LCE85A	94.40	104.00	1	85.0	1	11.6	129.0	100	125	1.0	150
LCE90A	100.00	111.00	1	90.0	1	10.3	146.0	100	125	1.0	150

Note:

1. For parts without A in the PN, the  $V_{BR}$  tolerance is  $\pm 10\%$  and  $V_C$  is 5% higher than parts with A. The parts without A are currently available, but not recommended for new designs. The parts with A are preferred.

## Performance Curve for Reference ( $T_A=25\text{ }^\circ\text{C}$ unless otherwise noted)

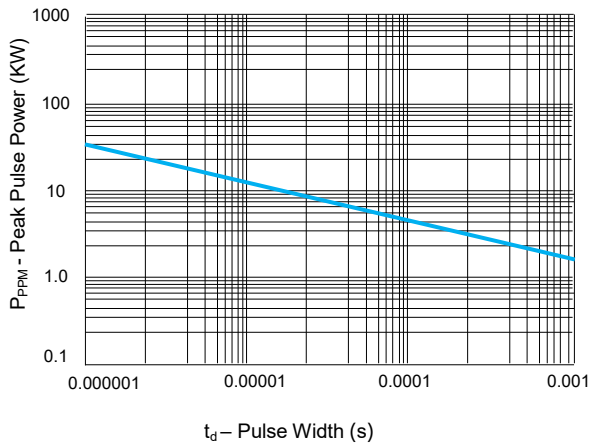


FIGURE 1 Peak Pulse Power Rating Curve

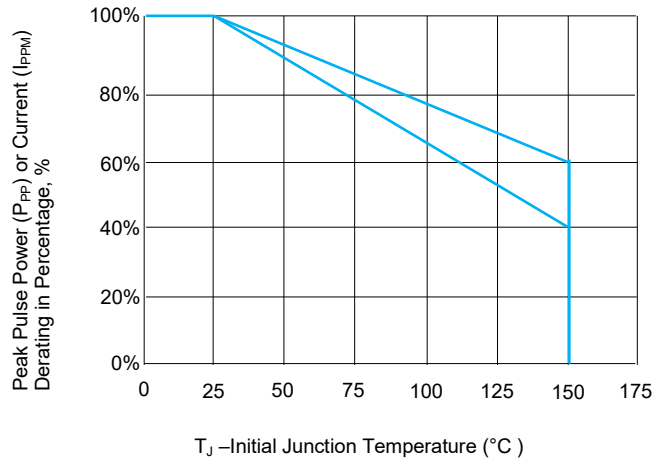


FIGURE 2 Peak Pulse Power Derating Curve

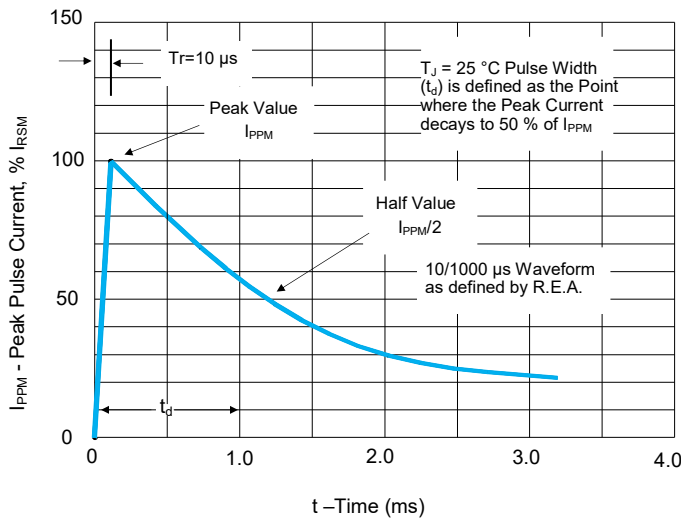
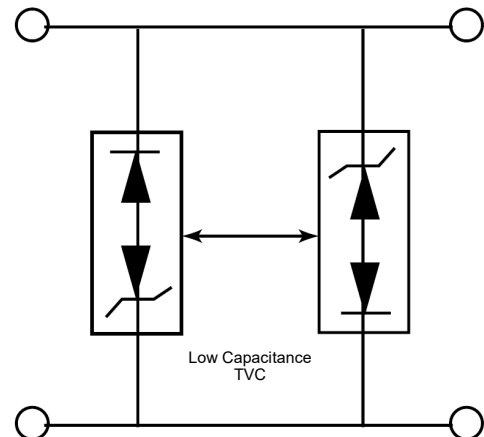


FIGURE 3 Pulse Waveform



**Application Note:** Device must be used with two units in parallel opposite in polarity as shown on circuit for AC signal line protection.

FIGURE 4 AC Line Protection Application

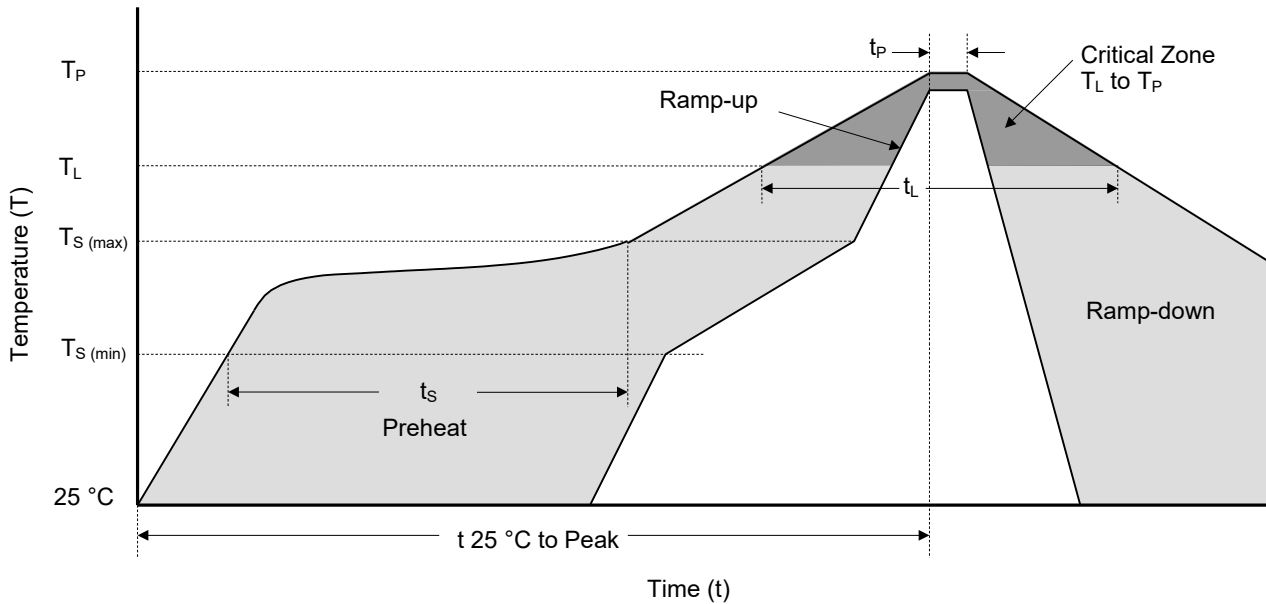
## Environmental Specifications

High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
H3TRB	JESD22-A101
RSH	JESD22-B106

## Physical Specifications

Weight	0.045 oz., 1.2 g
Case	JEDEC DO-201 molded plastic body over passivated junction
Polarity	Color band denotes the cathode except Bipolar.
Terminal	Matte Tin-plated leads, Solderability per JESD22-B102

## Soldering Parameters



Reflowing Condition

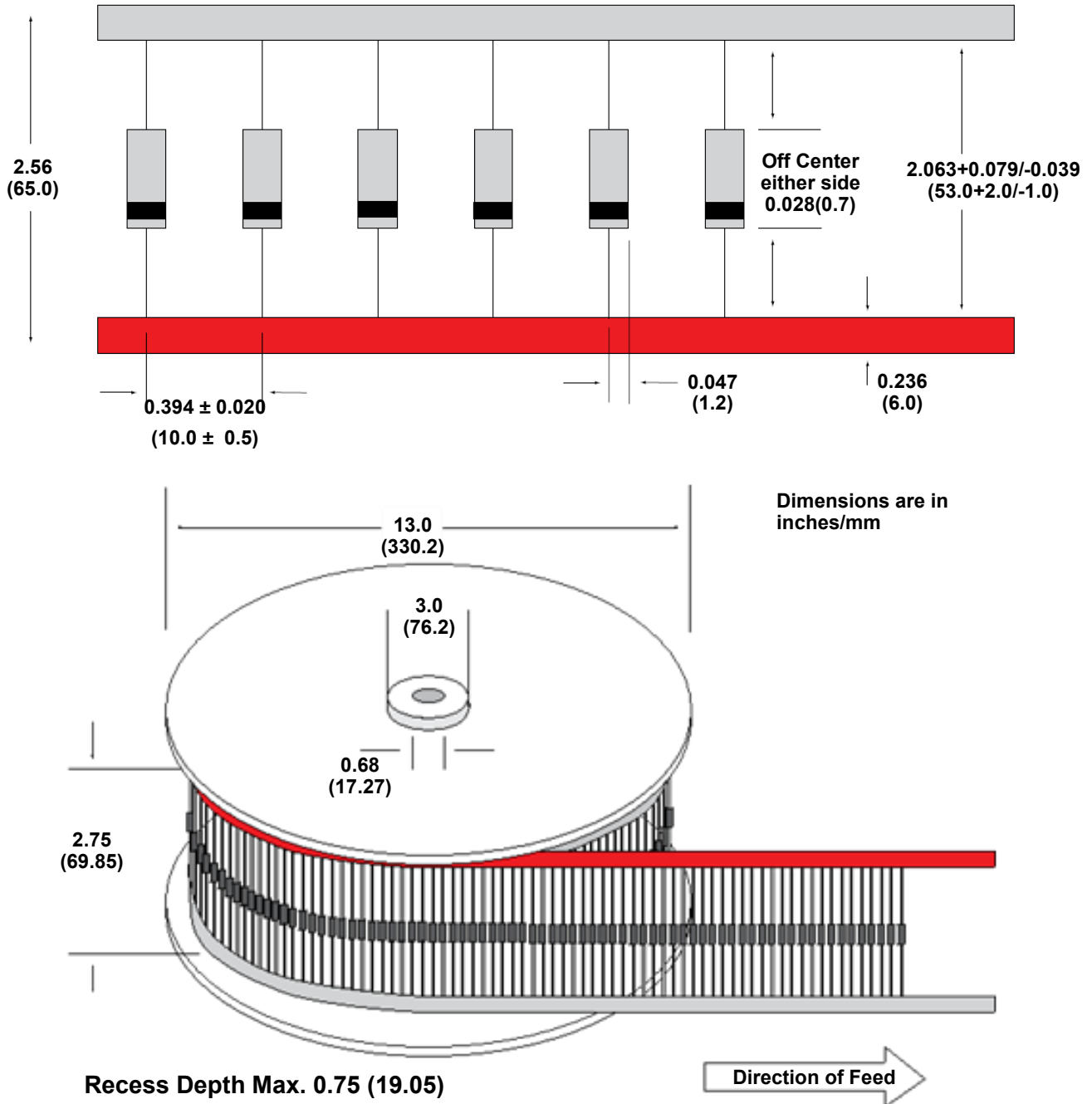
Reflow Soldering Parameters		Lead-Free Assembly
Pre-heat	Temperature Min ( $T_{S (min)}$ )	150 °C
	Temperature Max ( $T_{S (max)}$ )	200 °C
	Time (min to max) ( $t_s$ )	60 ~ 120 Seconds
Average Ramp Up Rate (Liquidus Temp ( $T_L$ ) to Peak)		3 °C / second max.
$T_{S (max)}$ to $T_L$ Ramp-up Rate		3 °C / second max.
Reflow	Temperature ( $T_L$ ) (Liquidus)	217 °C
	Time (min to max) ( $t_L$ )	60 ~ 150 seconds
Peak Temperature ( $T_P$ )		260 <sup>+0/-5</sup> °C
Time of within 5 °C of Actual Peak Temperature ( $t_p$ )		20 ~ 40 seconds
Ramp-down Rate		6 °C / second max.
Time from 25 °C to Peak Temperature		8 Minutes max.
Do Not Exceed		260 °C

## Flow/Wave Soldering (Solder Dipping)

Peak Temperature	265 °C
Dipping Time	10 seconds
Soldering Number	1 time



## Packaging Information



Part Number	Package	QTY's (Reel)	Packaging Option	Packaging Specification
LCExxxXX	DO-201	1200 PCS	Tape & Reel	EIA STD RS-296
LCExxxXX-TB	DO-201	1250 PCS	TB	/
LCExxxXX-B	DO-201	500 PCS	BULK	SETsafe   SETfuse Spec



## ATTENTION

### Usage

- 1.TVS must be operated in the specified ambient temp.
- 2.Do not clean the TVS with strong polar solvent such as ketone, esters, benzene and halogenated hydrocarbon, to avoid damaging the encapsulating layer.
- 3.Please do not apply severe vibration, shock or pressure to TVS, to avoid element cracking.

### Replacement

- 1.If TVS is visually damaged, please replace it.
- 2.TVS is a non-repairable product. For safety sake, please use equivalent TVS for replacement.

### Storage

- 1.Storage Temp. Range: (-55 to 150) °C.
- 2.Do not store the TVS at the high temp., high humidity or corrosive gas environment, to avoid influencing the solder- ability of the lead wires. The product shall be used up within 1 year after receiving the goods.

### Environmental Conditions

- 1.TVS should not be exposed to the open air, nor direct sunshine.
- 2.TVS should avoid rain, water vapor or other condition of high temp. and high humidity.
- 3.TVS should avoid sand dust, salt mist, or other harmful gases.

### Max. Typical Capacitance of TVS

The typical capacitance of TVS is listed in the specifications. Designers may refer to it when designing TVS in High frequency circuit.

### Installation Mechanical Stress

- 1.Do not knock TVS when installing, to avoid mechanical damage.
- 2.Please do not apply severe vibration, shock or pressure to TVS, to avoid surface resin or element cracking.