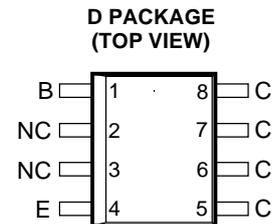


# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

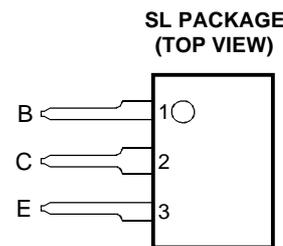
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- **Designed Specifically for High Frequency Electronic Ballasts**
- **Integrated Fast  $t_{rr}$  Anti-parallel Diode, Enhancing Reliability**
- **Diode  $t_{rr}$  Typically 500 ns**
- **New Ultra Low-Height SOIC Power Package**
- **Tightly Controlled Transistor Storage Times**
- **Voltage Matched Integrated Transistor and Diode**
- **Characteristics Optimised for Cool Running**
- **Diode-Transistor Charge Coupling Minimised to Enhance Frequency Stability**
- **Custom Switching Selections Available**
- **Surface Mount and Through-Hole Options**

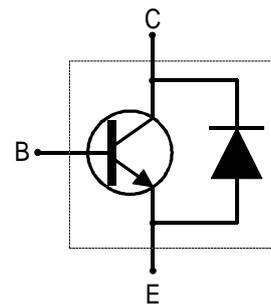


NC - No internal connection



PACKAGE	PART # SUFFIX
Small-outline	D
Small-outline taped and reeled	DR
Single-in-line	SL

device symbol



## description

The new BULDxx range of transistors have been designed specifically for use in High Frequency Electronic Ballasts (HFEB's). This range of switching transistors has tightly controlled storage times and an integrated fast  $t_{rr}$  anti-parallel diode. The revolutionary design ensures that the diode has both fast forward and reverse recovery times, achieving the same performance as a discrete anti-parallel diode plus transistor.

The integrated diode has minimal charge coupling with the transistor, increasing frequency stability, especially in lower power circuits where the circulating currents are low. By design, this new device offers a voltage matched integrated transistor and anti-parallel diode.

This device is available in the now well established 8 pin low height surface mount D package, and the TO-220 pin compatible SL package. Use of the SL package allows for a 40% height saving, making it ideal for compact ballast applications.

## absolute maximum ratings at 25°C ambient temperature (unless otherwise noted)

RATING	SYMBOL	VALUE	UNIT
Collector-emitter voltage ( $V_{BE} = 0$ )	$V_{CES}$	600	V
Collector-base voltage ( $I_E = 0$ )	$V_{CBO}$	600	V
Collector-emitter voltage ( $I_B = 0$ )	$V_{CEO}$	400	V
Emitter-base voltage	$V_{EBO}$	9	V

## PRODUCT INFORMATION

Information is current as of publication date. Products conform to specifications in accordance with the terms of Power Innovations standard warranty. Production processing does not necessarily include testing of all parameters.



# BULD25D, BULD25DR, BULD25SL

## NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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### absolute maximum ratings at 25°C ambient temperature (unless otherwise noted) (continued)

RATING		SYMBOL	VALUE	UNIT
Continuous collector current (see Note 1)		$I_C$	2	A
Peak collector current (see Note 2)		$I_{CM}$	4	A
Continuous base current (see Note 1)		$I_B$	1.5	A
Peak base current (see Note 2)		$I_{BM}$	2.5	A
Continuous device dissipation at (or below) 25°C ambient temperature	BULD25D BULD25SL	$P_{tot}$	see Figure 10 see Figure 11	W
Maximum average continuous diode forward current at (or below) 25°C ambient temperature		$I_{E(av)}$	0.5	A
Operating junction temperature range		$T_j$	-65 to +150	°C
Storage temperature range		$T_{stg}$	-65 to +150	°C

- NOTES: 1. This value applies for  $t_p = 1$  s.  
2. This value applies for  $t_p = 10$  ms, duty cycle  $\leq 2\%$ .

### electrical characteristics at 25°C ambient temperature

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{CEO(sus)}$ Collector-emitter sustaining voltage	$I_C = 0.1$ A		400			V
$I_{CES}$ Collector-emitter cut-off current	$V_{CE} = 600$ V	$V_{BE} = 0$			10	$\mu$ A
$I_{EBO}$ Emitter cut-off current	$V_{EB} = 9$ V	$I_C = 0$			1	mA
$V_{BE(sat)}$ Base-emitter saturation voltage	$I_B = 0.1$ A	$I_C = 0.5$ A (see Notes 3 and 4)		0.9	1.1	V
$V_{CE(sat)}$ Collector-emitter saturation voltage	$I_B = 0.1$ A $I_B = 0.2$ A	$I_C = 0.5$ A $I_C = 1$ A (see Notes 3 and 4)		0.3 0.6	0.5 1	V
$h_{FE}$ Forward current transfer ratio	$V_{CE} = 10$ V $V_{CE} = 1.5$ V $V_{CE} = 5$ V	$I_C = 0.01$ A $I_C = 0.5$ A $I_C = 1$ A (see Notes 3 and 4)	10 10 10	18 15 15	20 20	
$V_{EC}$ Anti-parallel diode forward voltage	$I_E = 1$ A	(see Notes 3 and 4)		1.5	1.7	V

- NOTES: 3. These parameters must be measured using pulse techniques,  $t_p = 300$   $\mu$ s, duty cycle  $\leq 2\%$ .  
4. These parameters must be measured using voltage-sensing contacts, separate from the current carrying contacts, and located within 1 mm from the device body for the D package and 3.2 mm from the device body for the SL package.

### thermal characteristics

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JA}$ Junction to free air thermal resistance	D package SL Package			165 115	°C/W

### switching characteristics at 25°C ambient temperature

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{rr}$ Anti-parallel diode reverse recovery time	Measured by holding transistor in an off condition, $V_{EB} = -3$ V (see Note 5)			0.5	1	$\mu$ s
$t_s$ Storage time	(see Note 5)		2	3.5	5	$\mu$ s
$t_f$ Fall time	(see Note 5)			0.25	0.35	$\mu$ s

NOTE 5: Refer to Figures 12, 13 and 14 for Functional Test Circuit and Switching Waveforms.

## PRODUCT INFORMATION

TYPICAL CHARACTERISTICS

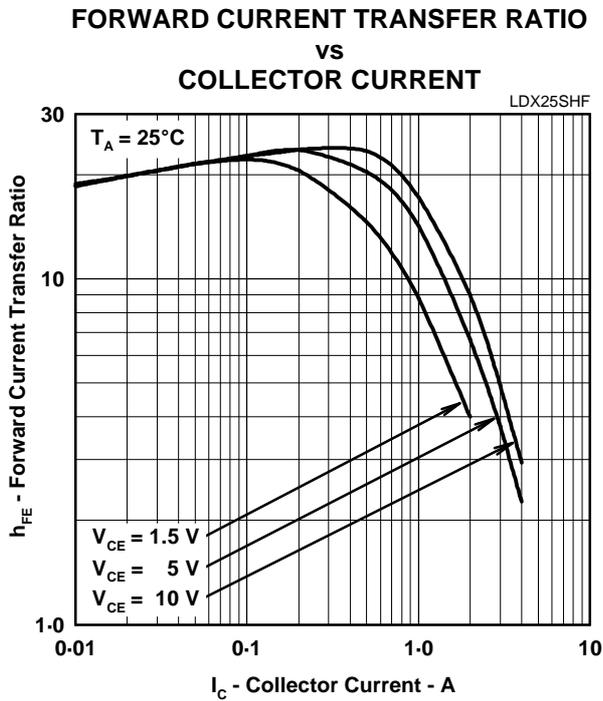


Figure 1.

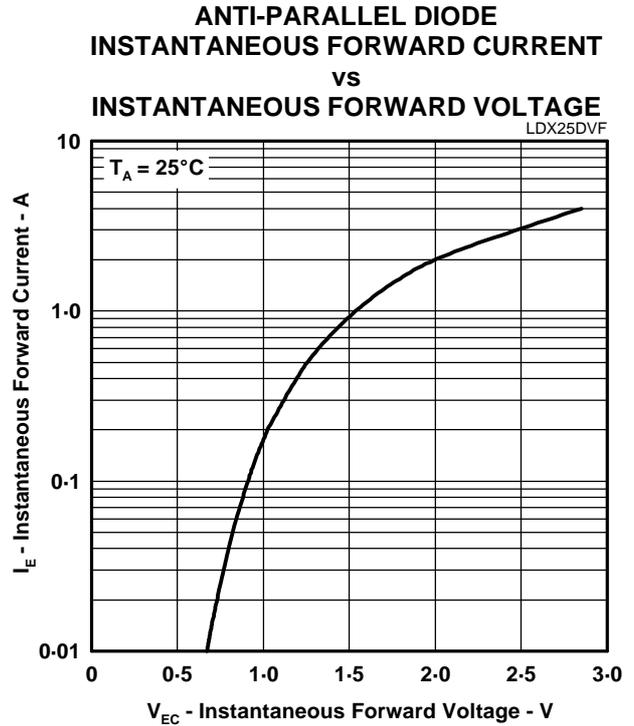


Figure 2.

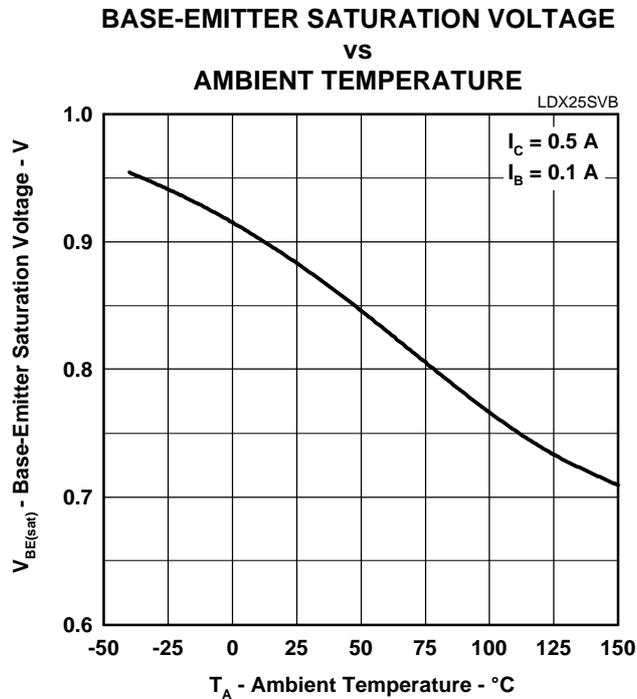
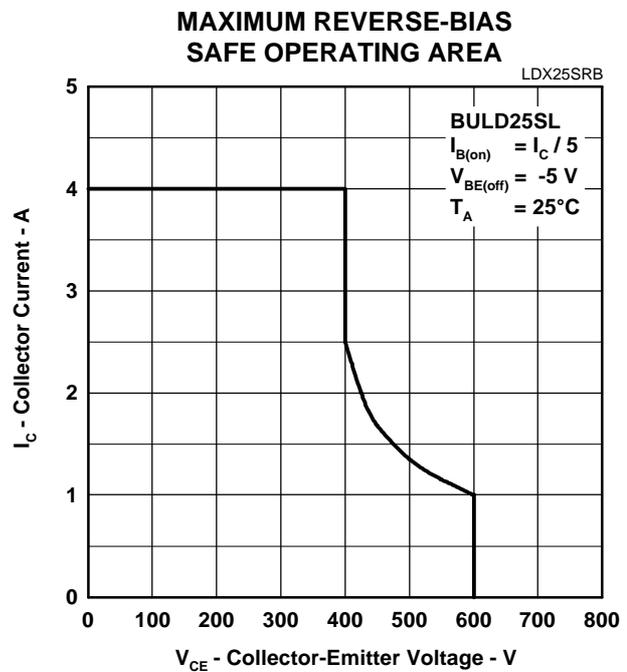
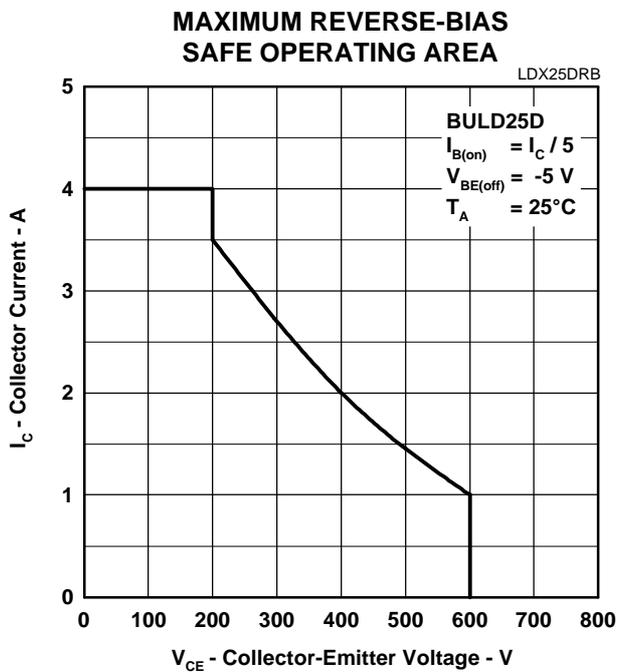
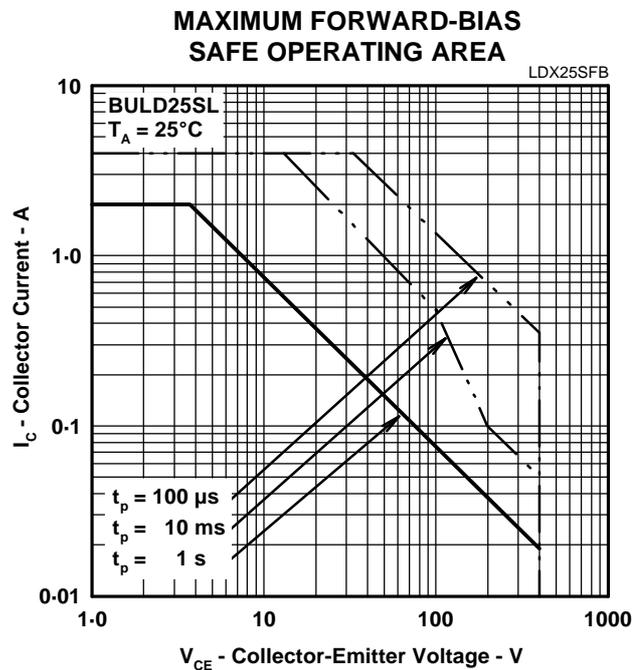
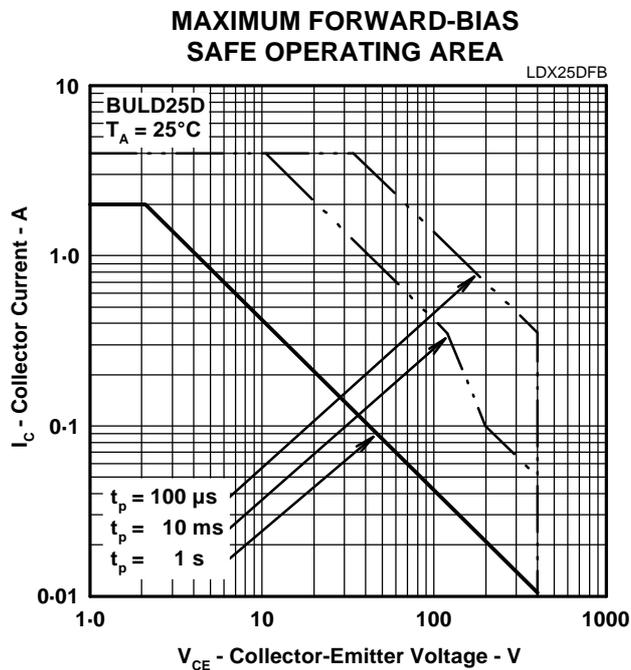


Figure 3.

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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## MAXIMUM SAFE OPERATING REGIONS



THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO AMBIENT  
VS  
POWER PULSE DURATION

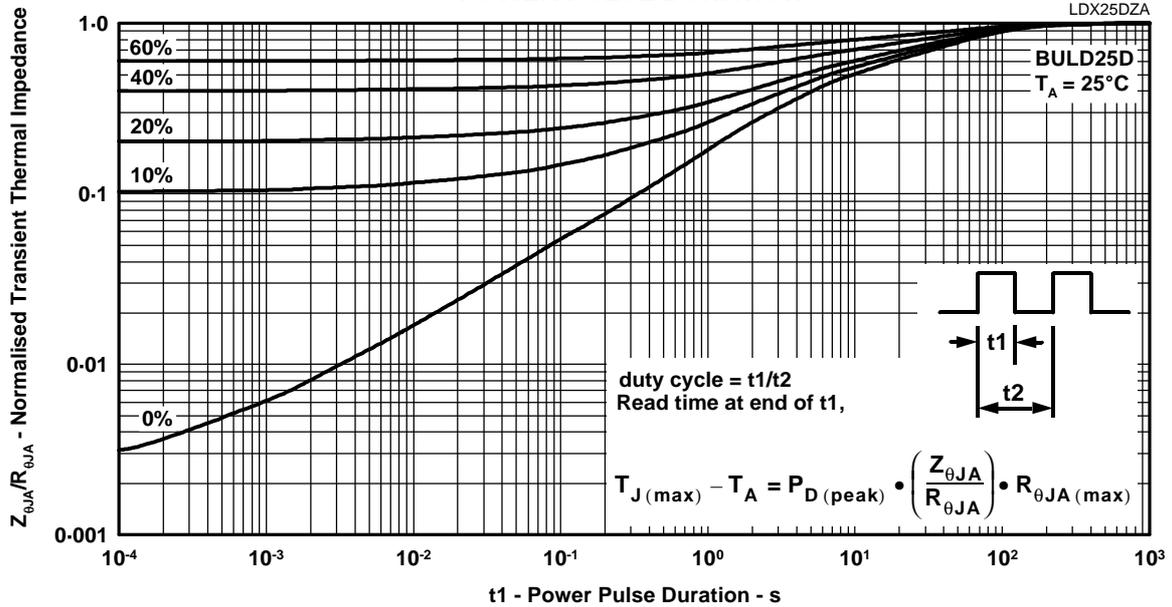


Figure 8.

THERMAL RESPONSE JUNCTION TO AMBIENT  
VS  
POWER PULSE DURATION

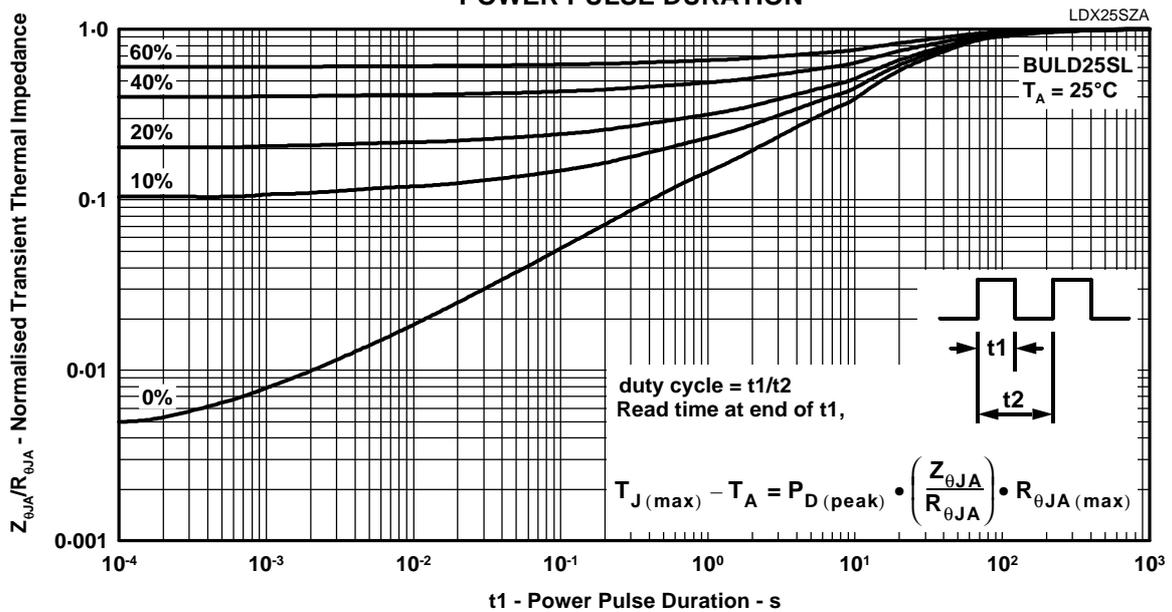


Figure 9.

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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## THERMAL INFORMATION

### MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT VS POWER PULSE DURATION

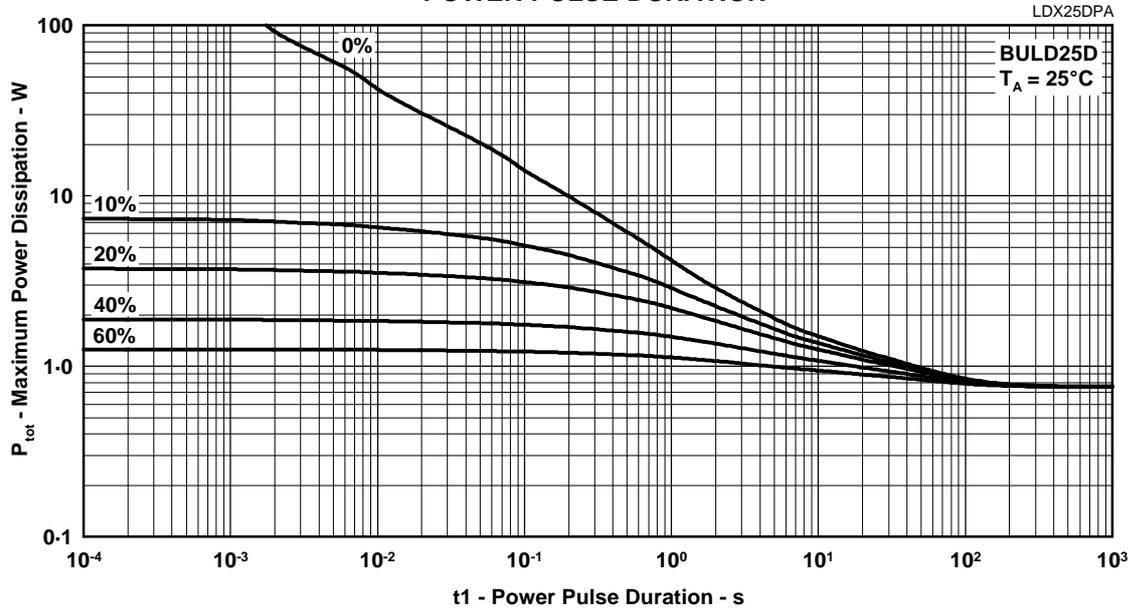


Figure 10.

### MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT VS POWER PULSE DURATION

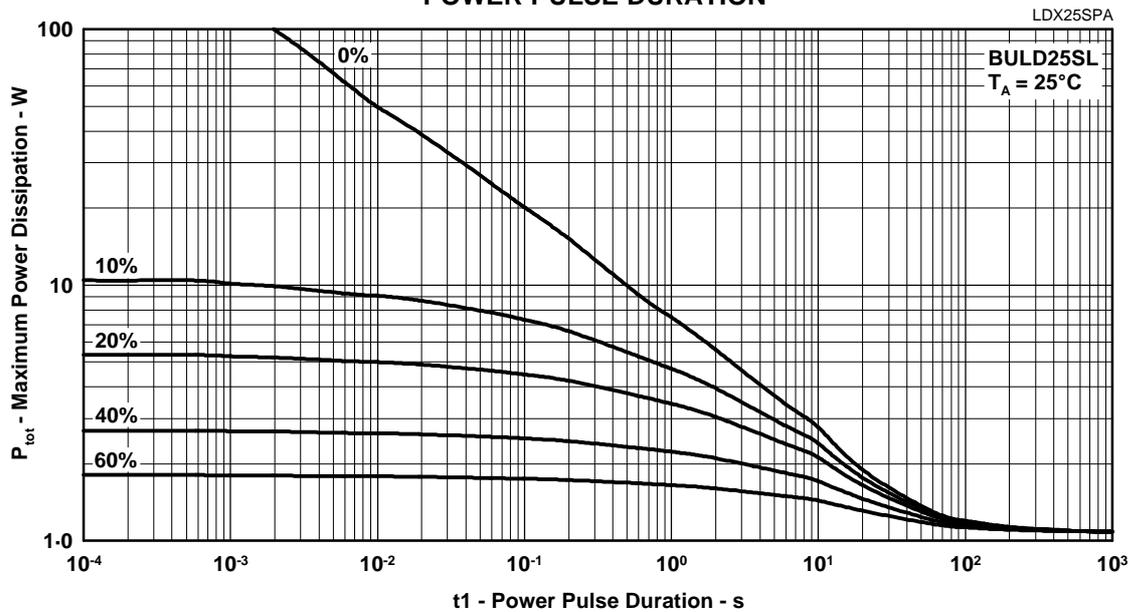


Figure 11.

## PRODUCT INFORMATION

FUNCTIONAL TEST CIRCUIT

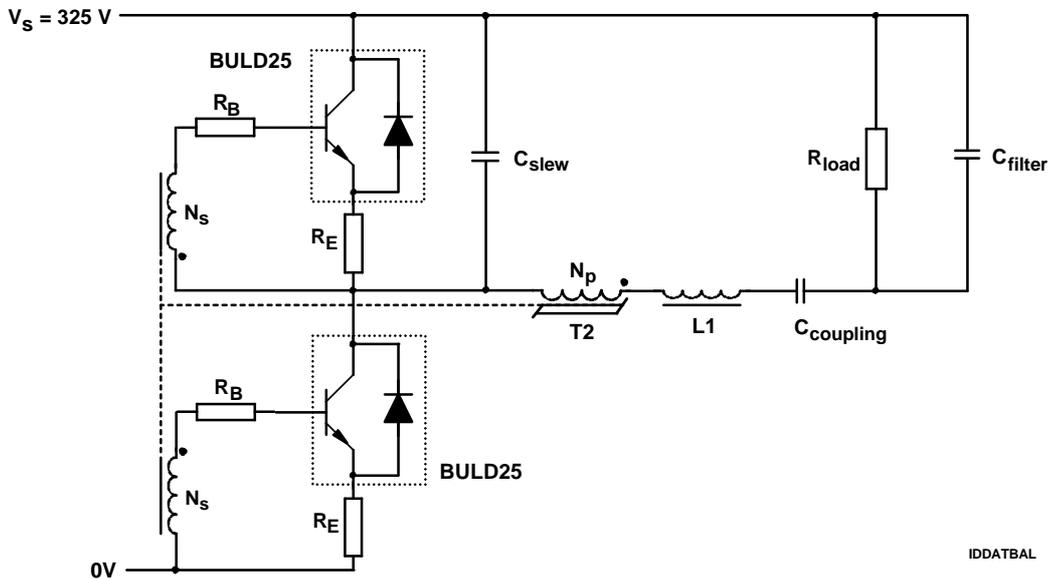


Figure 12.

COMPONENT VALUES USED IN FUNCTIONAL TEST CIRCUIT	
$R_B$	22 $\Omega$
$R_E$	1.8 $\Omega$
$R_{load}$	470 $\Omega$
$C_{coupling}$	47 nF
$C_{slew}$	1.5 nF
$C_{filter}$	3.2 nF
L1	2.5 mH
T2 $N_p : N_s$	5 : 3

Figure 13.

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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## FUNCTIONAL TEST SWITCHING WAVEFORMS

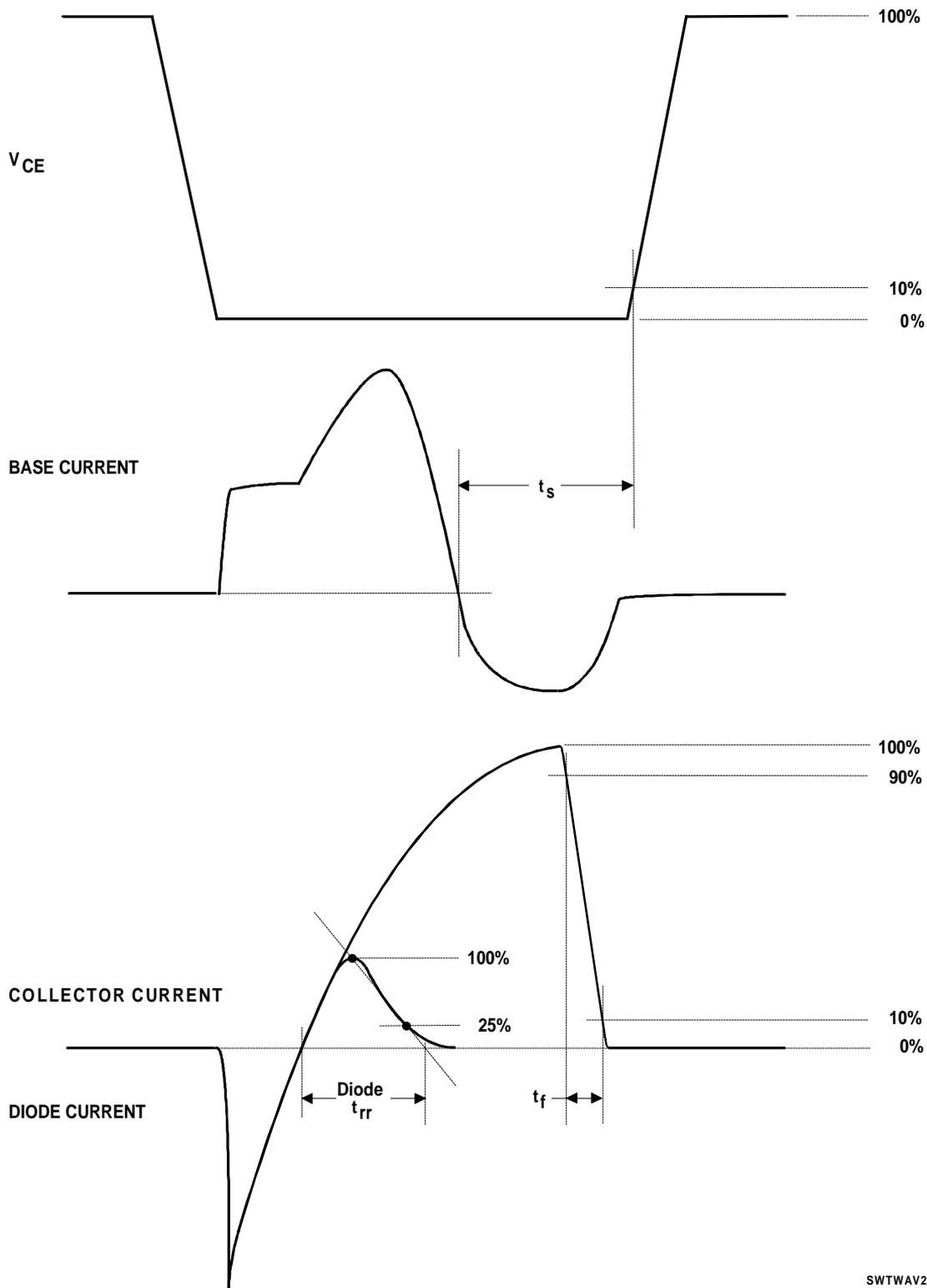


Figure 14. Switching Waveforms of device in Functional Test Circuit

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

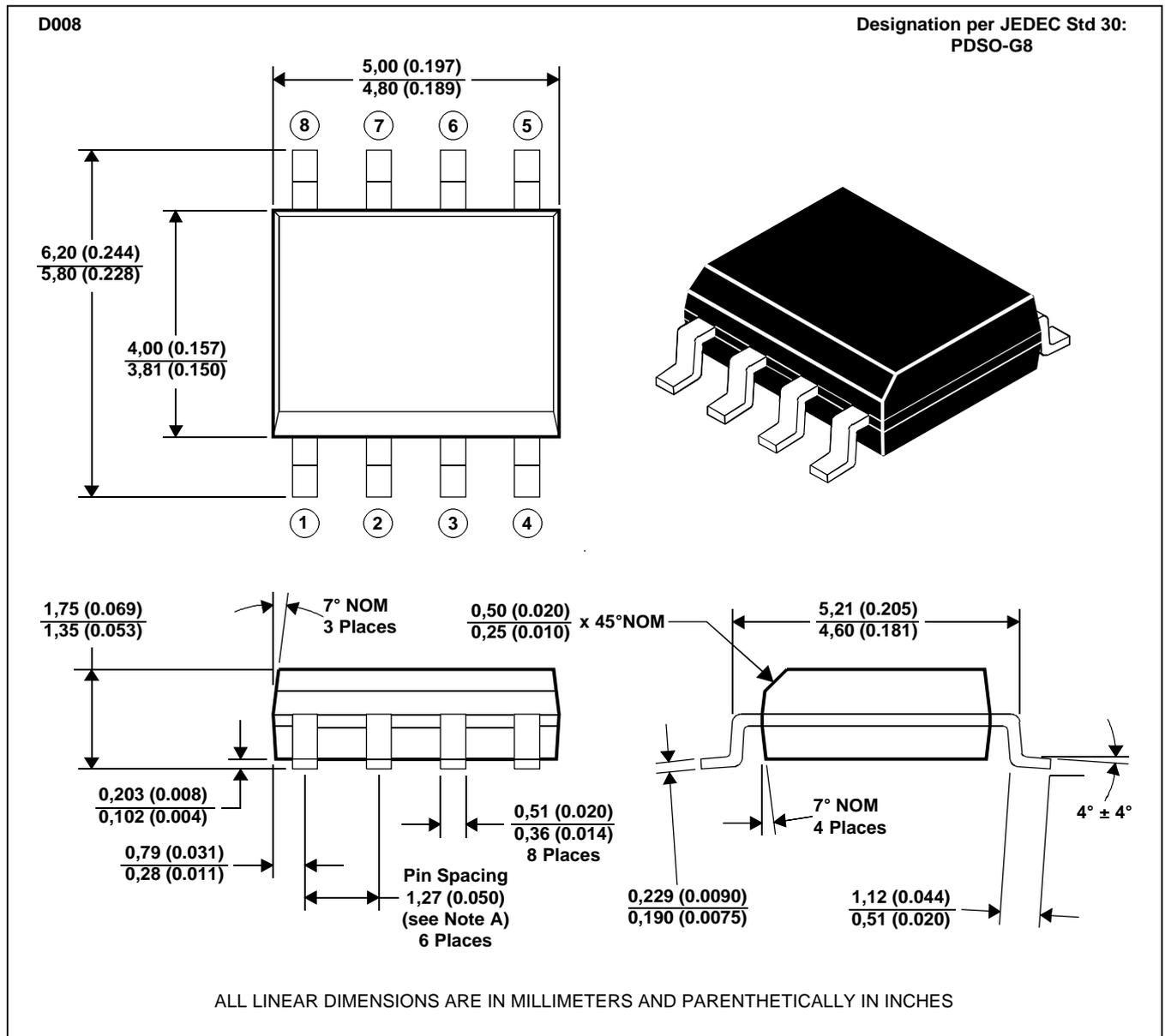
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## MECHANICAL DATA

### D008

#### plastic small-outline package

This small-outline package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



- NOTES: A. Leads are within 0,25 (0.010) radius of true position at maximum material condition.  
B. Body dimensions do not include mold flash or protrusion.  
C. Mold flash or protrusion shall not exceed 0,15 (0.006).  
D. Lead tips to be planar within ±0,051 (0.002).

MDXXAA

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

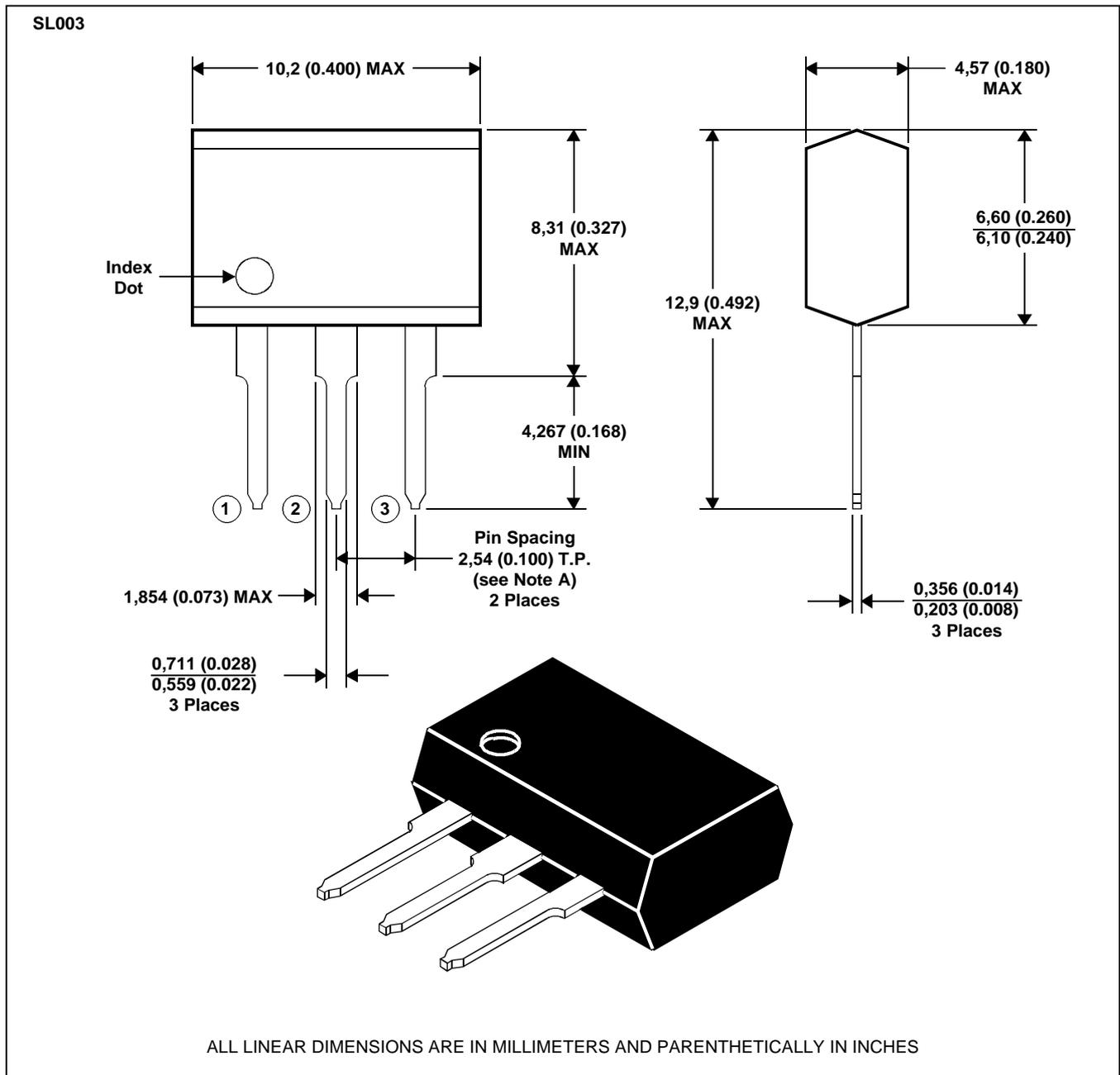
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## MECHANICAL DATA

### SL003

#### 3-pin plastic single-in-line package

This single-in-line package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



NOTES: A. Each pin centerline is located within 0,25 (0.010) of its true longitudinal position.  
B. Body molding flash of up to 0,15 (0.006) may occur in the package lead plane.

MDXXAD

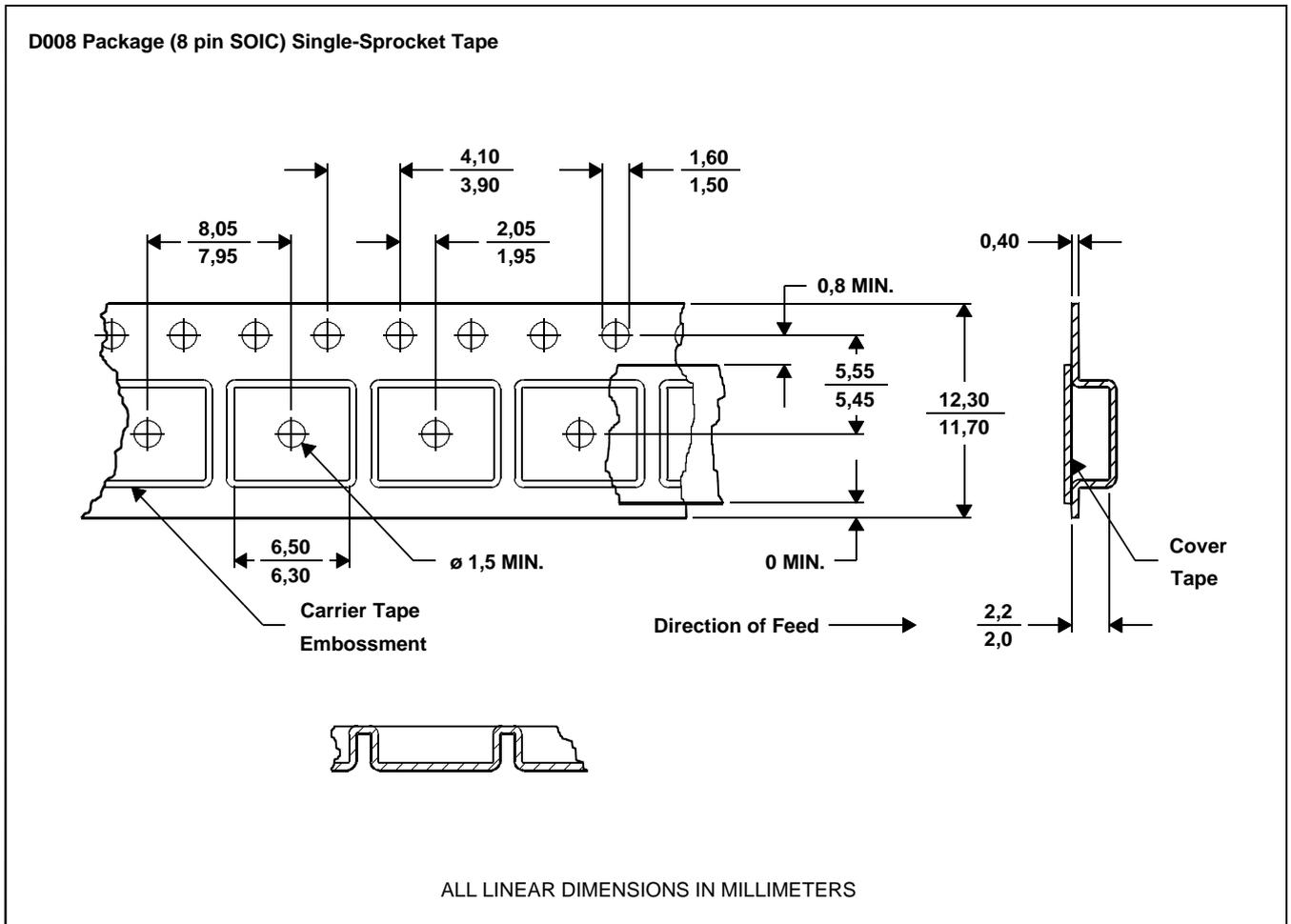
## PRODUCT INFORMATION

# BULD25D, BULD25DR, BULD25SL NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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## MECHANICAL DATA

### D008 tape dimensions



NOTES: A. Taped devices are supplied on a reel of the following dimensions:-

MDXXAT

Reel diameter:	330 +0,0/-4,0 mm
Reel hub diameter:	100 ±2,0 mm
Reel axial hole:	13,0 ±0,2 mm

B. 2500 devices are on a reel.

# **BULD25D, BULD25DR, BULD25SL**

## **NPN SILICON TRANSISTOR WITH INTEGRATED DIODE**

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