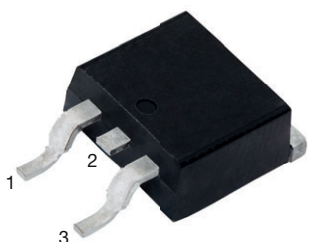
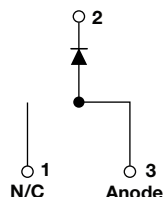


# HEXFRED®, Ultrafast Soft Recovery Diode, 4 A


**D<sup>2</sup>PAK (TO-263AB)**


## FEATURES

- Ultrafast recovery
- Ultrasoft recovery
- Very low  $I_{RRM}$
- Very low  $Q_{rr}$
- Specified at operating temperature
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## BENEFITS

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

## DESCRIPTION

VS-HFA04TB60S is a state of the art ultrafast recovery diode. Employing the latest in epitaxial construction and advanced processing techniques it features a superb combination of characteristics which result in performance which is unsurpassed by any rectifier previously available. With basic ratings of 600 V and 4 A continuous current, the VS-HFA04TB60S is especially well suited for use as the companion diode for IGBTs and MOSFETs. In addition to ultrafast recovery time, the HEXFRED® product line features extremely low values of peak recovery current ( $I_{RRM}$ ) and does not exhibit any tendency to “snap-off” during the  $t_b$  portion of recovery. The HEXFRED features combine to offer designers a rectifier with lower noise and significantly lower switching losses in both the diode and the switching transistor. These HEXFRED advantages can help to significantly reduce snubbing, component count and heatsink sizes. The HEXFRED VS-HFA04TB60S is ideally suited for applications in power supplies and power conversion systems (such as inverters), motor drives, and many other similar applications where high speed, high efficiency is needed.

## PRIMARY CHARACTERISTICS

$I_{F(AV)}$	4 A
$V_R$	600 V
$V_F$ at $I_F$	1.4 V
$t_{rr}$ (typ.)	17 ns
$T_J$ max.	150 °C
Package	D <sup>2</sup> PAK (TO-263AB)
Circuit configuration	Single

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Cathode to anode voltage	$V_R$		600	V
Maximum continuous forward current	$I_F$	$T_C = 100\text{ °C}$	4	A
Single pulse forward current	$I_{FSM}$		25	
Maximum repetitive forward current	$I_{FRM}$		16	
Maximum power dissipation	$P_D$	$T_C = 25\text{ °C}$	25	W
		$T_C = 100\text{ °C}$	10	
Operating junction and storage temperature range	$T_J, T_{Stg}$		-55 to +150	°C

**ELECTRICAL SPECIFICATIONS** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Cathode to anode breakdown voltage	$V_{BR}$	$I_R = 100\ \mu\text{A}$	600	-	-	
Maximum forward voltage	$V_{FM}$	$I_F = 4.0\ \text{A}$	-	1.5	1.8	V
		$I_F = 8.0\ \text{A}$	-	1.8	2.2	
		$I_F = 4.0\ \text{A}, T_J = 125^\circ\text{C}$	-	1.4	1.7	
Maximum reverse leakage current	$I_{RM}$	$V_R = V_R\ \text{rated}$	-	0.17	3.0	$\mu\text{A}$
		$T_J = 125^\circ\text{C}, V_R = 0.8 \times V_R\ \text{rated}$	-	44	300	
Junction capacitance	$C_T$	$V_R = 200\ \text{V}$	-	4.0	8.0	pF
Series inductance	$L_S$	Measured lead to lead 5 mm from package body	-	8.0	-	nH

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Reverse recovery time See fig. 5, 6	$t_{rr}$	$I_F = 1.0\ \text{A}, di_F/dt = 200\ \text{A}/\mu\text{s}, V_R = 30\ \text{V}$	-	17	-	ns
	$t_{rr1}$	$T_J = 25^\circ\text{C}$	-	28	42	
	$t_{rr2}$	$T_J = 125^\circ\text{C}$	-	38	57	
Peak recovery current	$I_{RRM1}$	$T_J = 25^\circ\text{C}$	-	2.9	5.2	A
	$I_{RRM2}$	$T_J = 125^\circ\text{C}$	-	3.7	6.7	
Reverse recovery charge See fig. 7	$Q_{rr1}$	$T_J = 25^\circ\text{C}$	-	40	60	nC
	$Q_{rr2}$	$T_J = 125^\circ\text{C}$	-	70	105	
Peak rate of fall of recovery current during $t_b$ , see fig. 8	$di_{(rec)M}/dt1$	$T_J = 25^\circ\text{C}$	-	280	-	$\text{A}/\mu\text{s}$
	$di_{(rec)M}/dt2$	$T_J = 125^\circ\text{C}$	-	235	-	

**THERMAL - MECHANICAL SPECIFICATIONS**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Lead temperature	$T_{lead}$	0.063" from case (1.6 mm) for 10 s	-	-	300	$^\circ\text{C}$
Thermal resistance, junction-to-case	$R_{thJC}$		-	-	5.0	K/W
Thermal resistance, junction-to-ambient	$R_{thJA}$	Typical socket mount	-	-	80	
Weight			-	2.0	-	g
			-	0.07	-	oz.
Marking device		Case style D <sup>2</sup> PAK (TO-263AB)	HFA04TB60S			

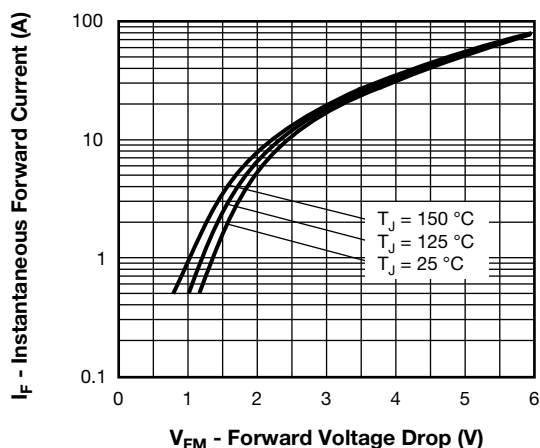


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

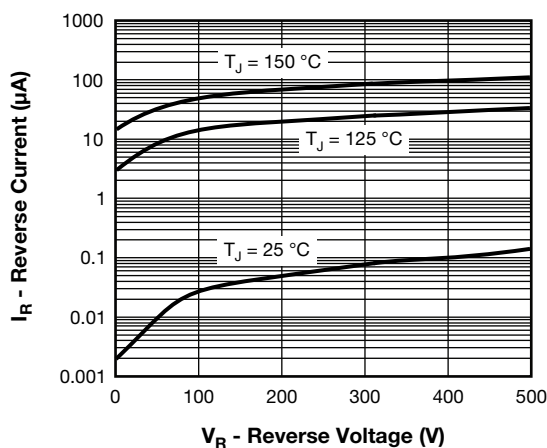


Fig. 2 - Typical Reverse Current vs. Reverse Voltage

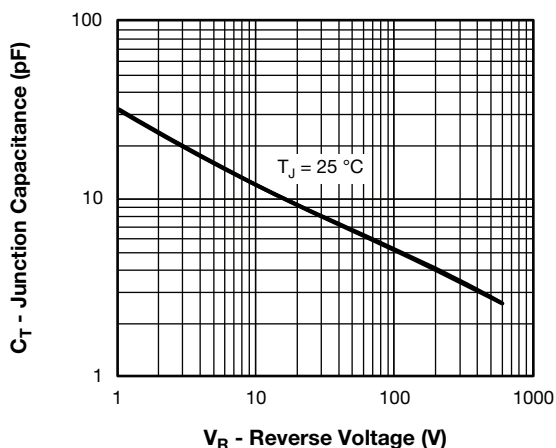
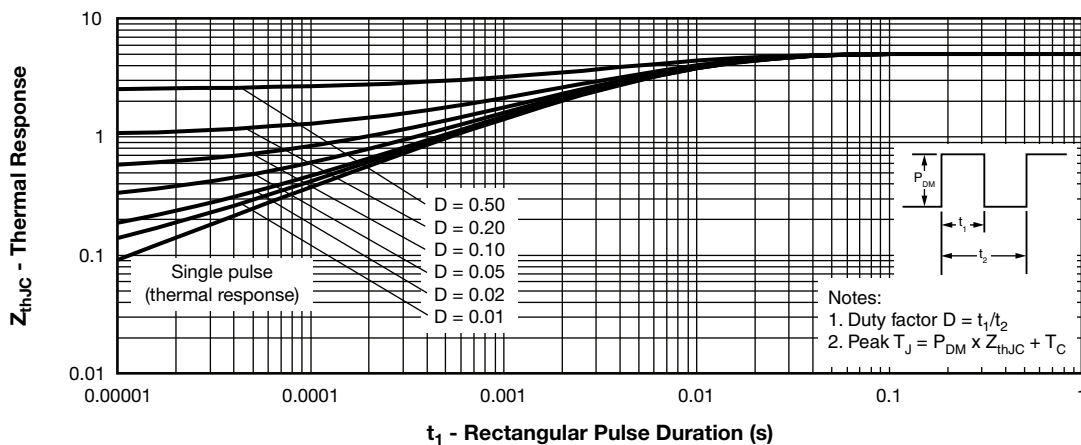
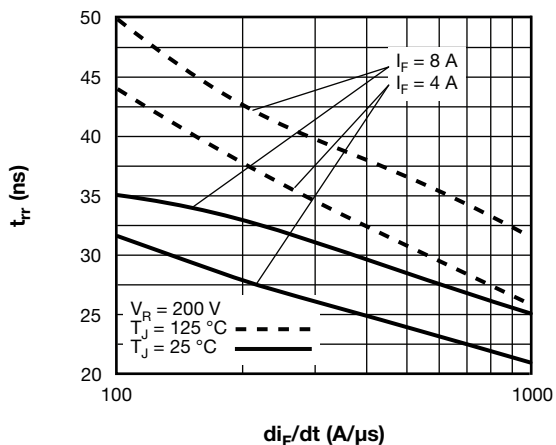
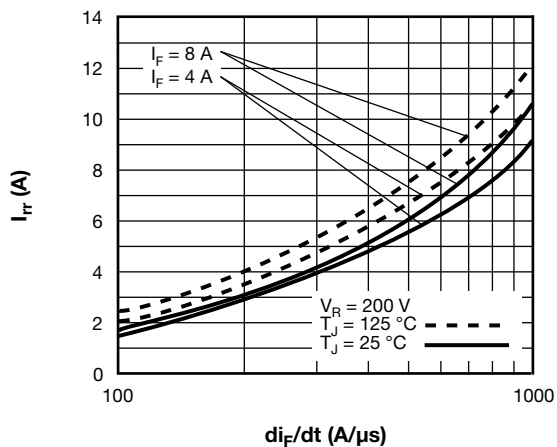


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

Fig. 5 - Typical Reverse Recovery Time vs.  $di_F/dt$ 

Fig. 6 - Typical Recovery Current vs.  $di_F/dt$

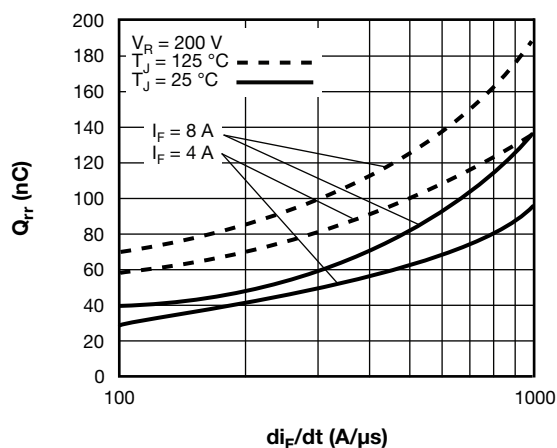
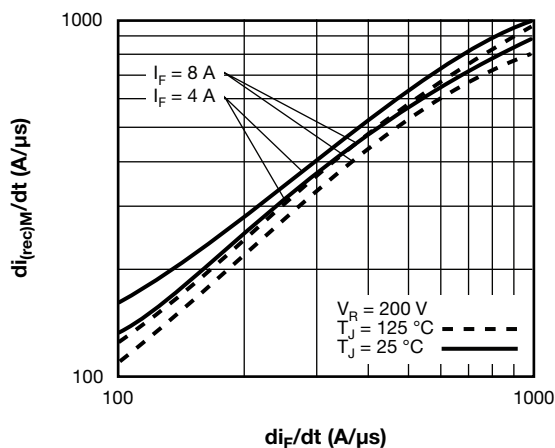
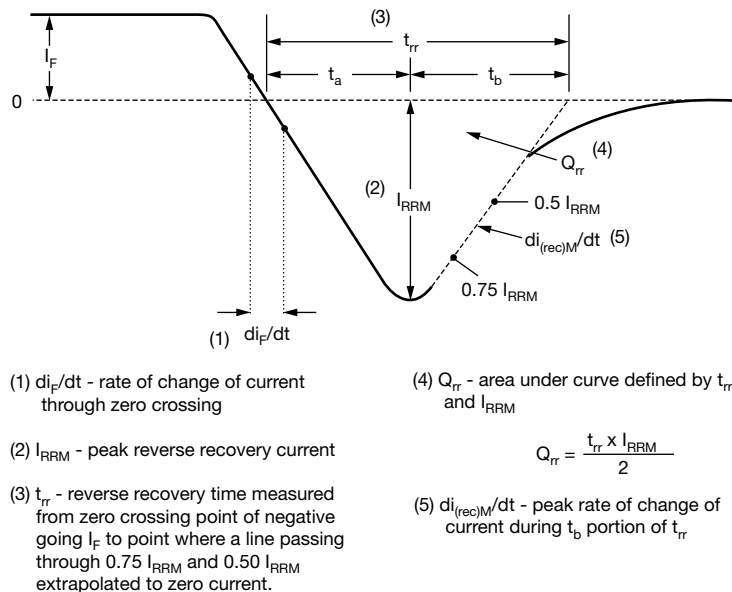

Fig. 7 - Typical Stored Charge vs.  $di_F/dt$ 

Fig. 8 - Typical  $di_{(rec)M}/dt$  vs.  $di_F/dt$ 


Fig. 9 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>HF</b>	<b>A</b>	<b>04</b>	<b>TB</b>	<b>60</b>	<b>S</b>	<b>L</b>	<b>-M3</b>
	1	2	3	4	5	6	7	8	9

- |          |   |  |
|----------|---|--|
| <b>1</b> | - | Vishay Semiconductors product  |
| <b>2</b> | - | HEXFRED® family  |
| <b>3</b> | - | Process designator: A = electron irradiated  |
| <b>4</b> | - | Current rating (04 = 4 A)  |
| <b>5</b> | - | Package outline (TB = TO-220, 2 leads)   |
| <b>6</b> | - | Voltage rating (60 = 600 V)  |
| <b>7</b> | - | S = D <sup>2</sup> PAK (TO-263AB)  |
| <b>8</b> | - | <ul style="list-style-type: none"><li>• None = tube (50 pieces)</li><li>• L = tape and reel (left oriented)</li><li>• R = tape and reel (right oriented)</li></ul> |
| <b>9</b> | - | Environmental digit:<br>-M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free  |

**ORDERING INFORMATION** (Example)

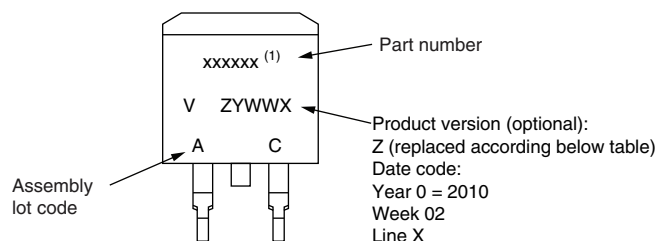
PREFERRED P/N	QUANTITY PER TUBE OR TAPE AND REEL	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-HFA04TB60S-M3	50	1000	Antistatic plastic tube
VS-HFA04TB60SL-M3	800	800	13" diameter reel
VS-HFA04TB60SR-M3	800	800	13" diameter reel

**LINKS TO RELATED DOCUMENTS**

Dimensions	<a href="http://www.vishay.com/doc?96164">www.vishay.com/doc?96164</a>
Part marking information	<a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a>
Packaging information	<a href="http://www.vishay.com/doc?96424">www.vishay.com/doc?96424</a>



## D<sup>2</sup>PAK



Example: This is a xxxxxx <sup>(1)</sup> with  
assembly lot code AC,  
assembled on WW 02, 2010

### Note

(1) If part number contain "H" as last digit, product is AEC-Q101 qualified

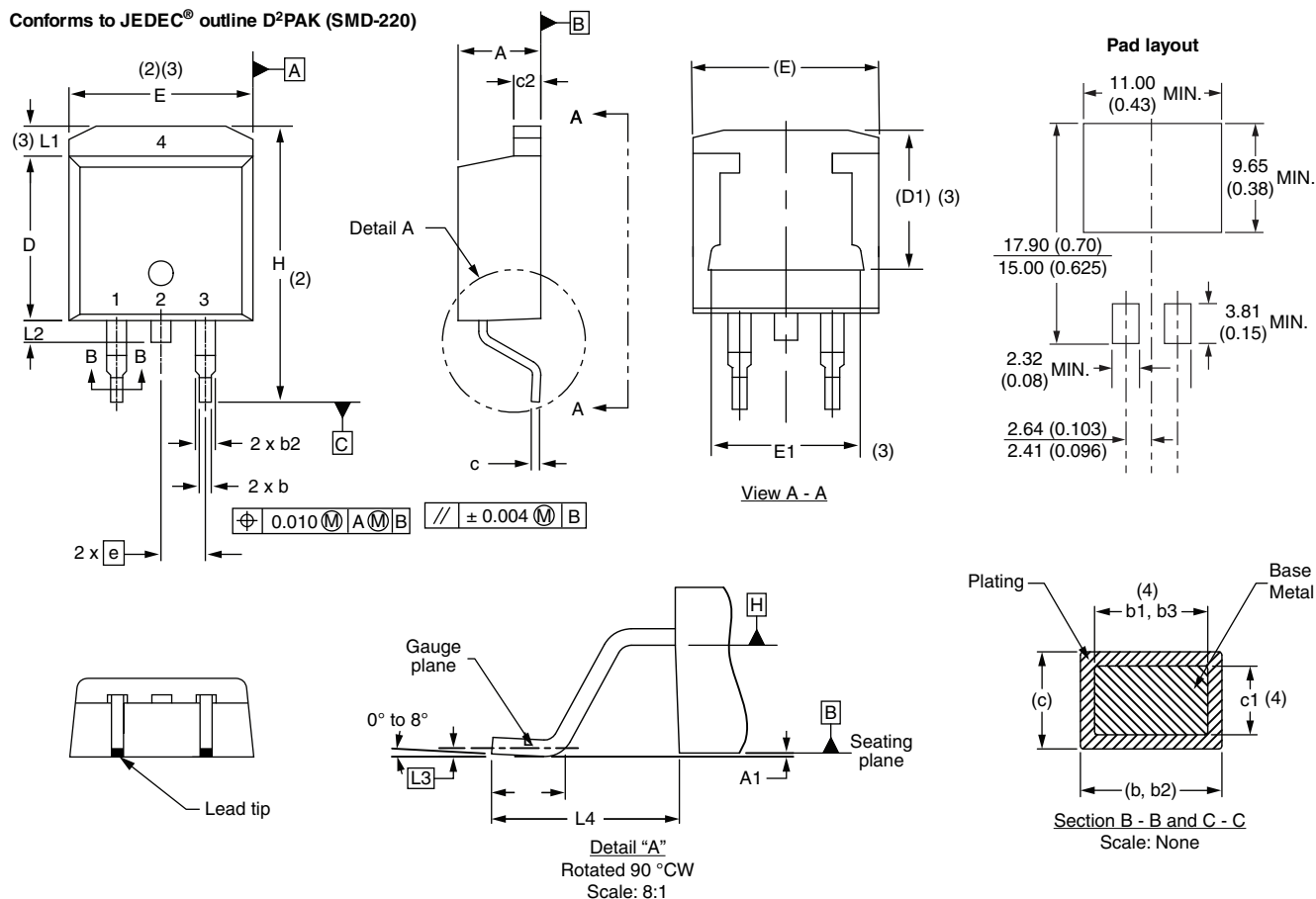
ENVIRONMENTAL NAMING CODE (Z)	PRODUCT DEFINITION
A	Termination lead (Pb)-free
B	Totally lead (Pb)-free
E	RoHS-compliant and termination lead (Pb)-free
F	RoHS-compliant and totally lead (Pb)-free
M	Halogen-free, RoHS-compliant, and termination lead (Pb)-free
N	Halogen-free, RoHS-compliant, and totally lead (Pb)-free
G	Green



### D<sup>2</sup>PAK

#### DIMENSIONS in millimeters and inches

Conforms to JEDEC® outline D<sup>2</sup>PAK (SMD-220)



SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	0.160	0.190	
A1	0.00	0.254	0.000	0.010	
b	0.51	0.99	0.020	0.039	
b1	0.51	0.89	0.020	0.035	4
b2	1.14	1.78	0.045	0.070	
b3	1.14	1.73	0.045	0.068	4
c	0.38	0.74	0.015	0.029	
c1	0.38	0.58	0.015	0.023	4
c2	1.14	1.65	0.045	0.065	
D	8.51	9.65	0.335	0.380	2
D1	6.86	8.00	0.270	0.315	3
E	9.65	10.67	0.380	0.420	2, 3
E1	7.90	8.80	0.311	0.346	3
e	2.54 BSC		0.100 BSC		
H	14.61	15.88	0.575	0.625	
L	1.78	2.79	0.070	0.110	
L1	-	1.65	-	0.066	3
L2	1.27	1.78	0.050	0.070	
L3	0.25 BSC		0.010 BSC		
L4	4.78	5.28	0.188	0.208	

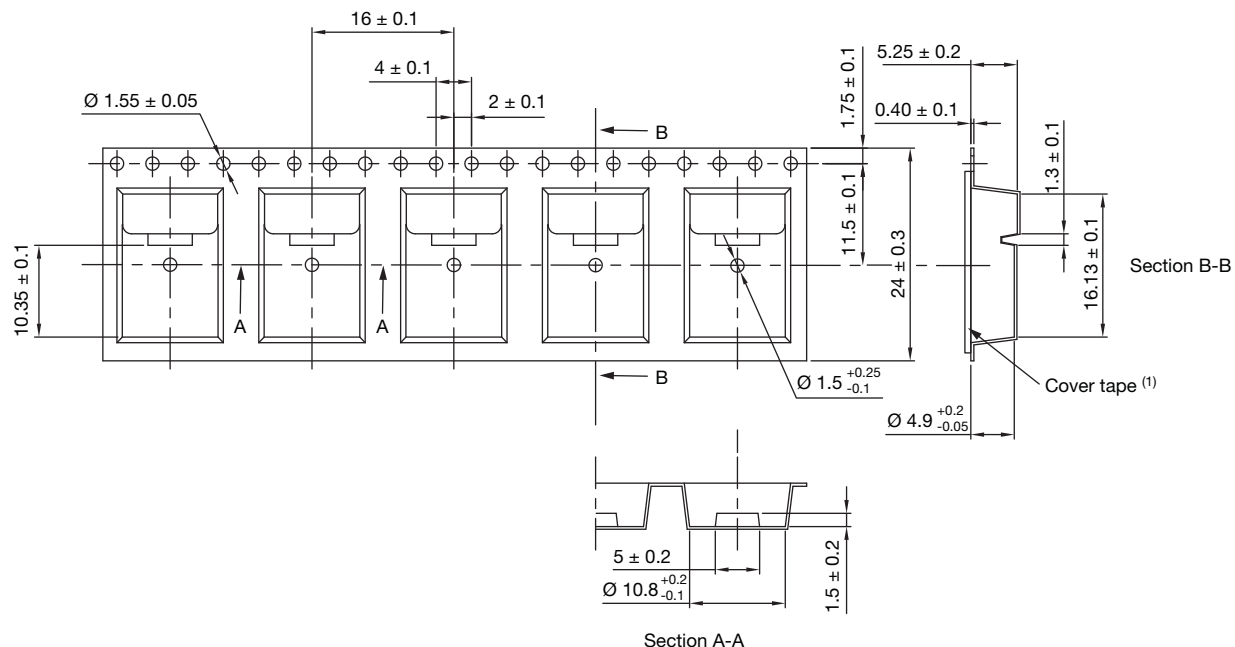
#### Notes

- (1) Dimensioning and tolerancing per ASME Y14.5 M-1994
- (2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Datum A and B to be determined at datum plane H
- (6) Controlling dimension: inches
- (7) Outline conforms to JEDEC® outline TO-263AB



## D<sup>2</sup>PAK (TO-263AB)

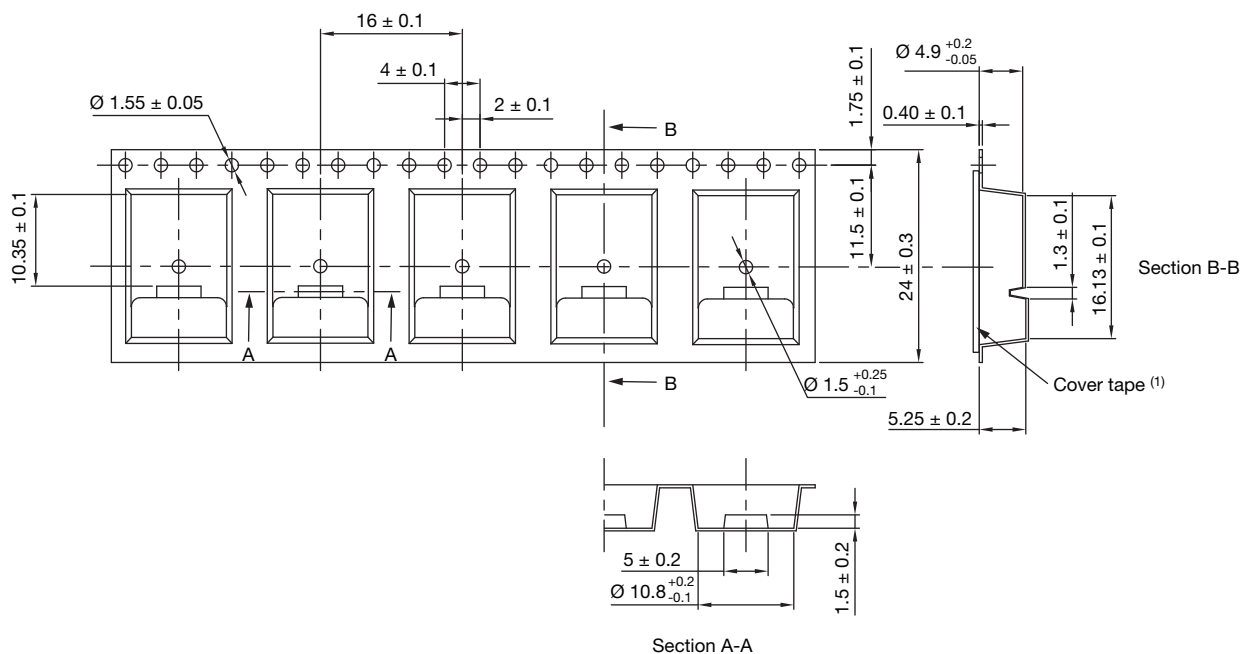
### CARRIER TAPE FOR TAPE AND REEL LEFT in millimeters



#### Note

(1) For dimensions, see next pages

### CARRIER TAPE FOR TAPE AND REEL RIGHT in millimeters



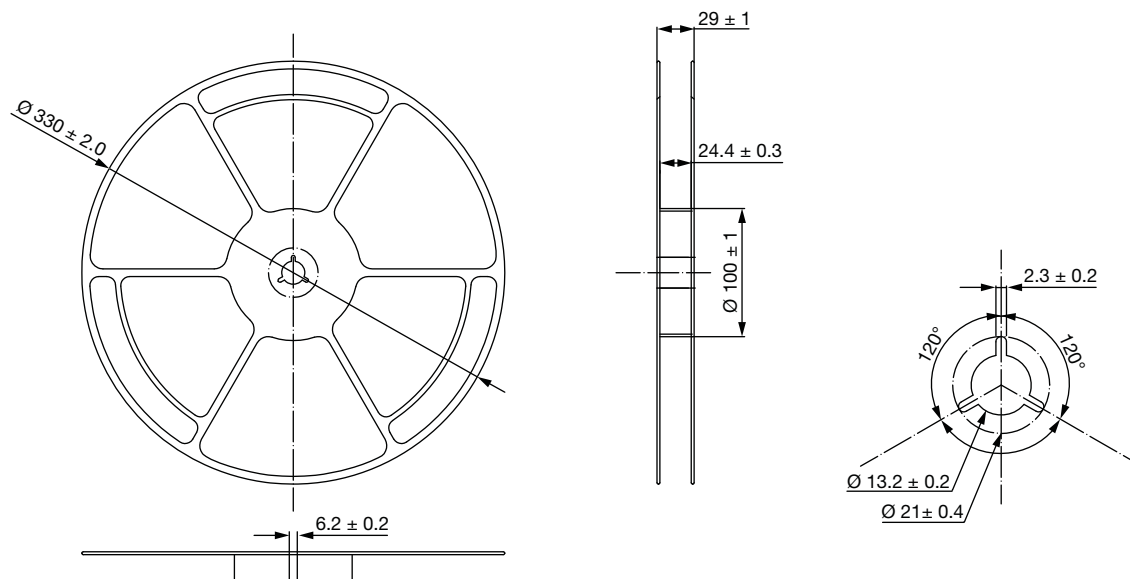
#### Note

(1) For dimensions, see next pages

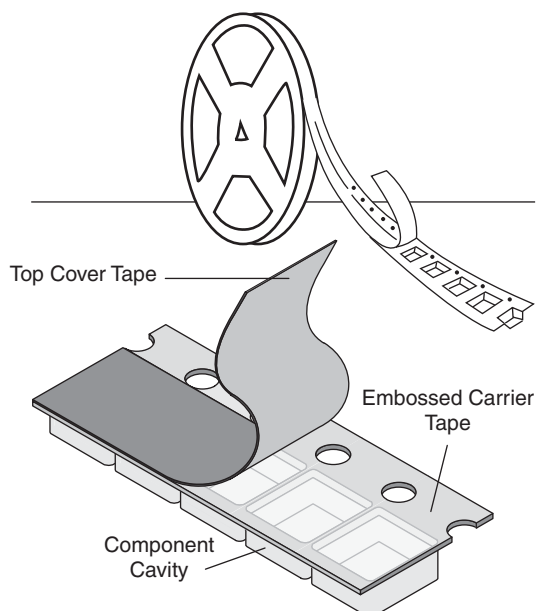




## REEL FOR CARRIER TAPE in millimeters

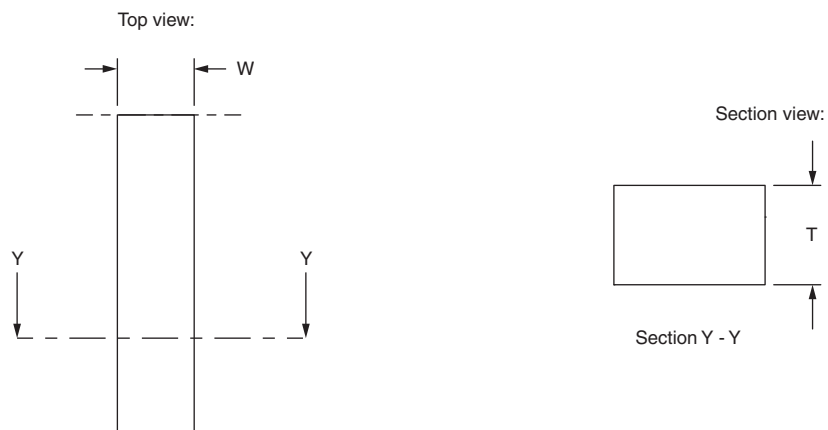


## CARRIER TAPE AND REEL PACKAGING D<sup>2</sup>PAK (TO-263AB)





## COVER TAPE FOR CARRIER TAPE in millimeters



APPLICATION	COVER TAPE WIDTH $W$	COVER TAPE THICKNESS $T$	CARRIER TAPE WIDTH	MATERIAL
D <sup>2</sup> PAK (TO-263AB)	$21.3 \pm 0.1$	$0.060 \pm 0.01$	24	Antistatic/treated/transparent/polyester



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