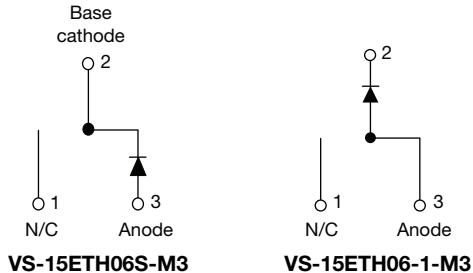
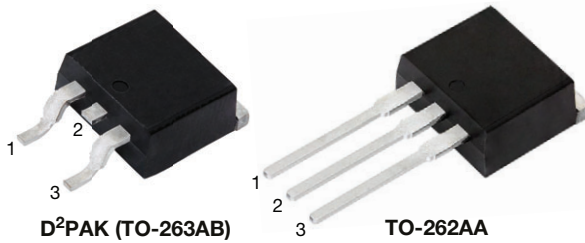


Hyperfast Rectifier, 15 A FRED Pt[®]



FEATURES

- Hyperfast recovery time
- Low forward voltage drop
- Low leakage current
- 175 °C operating junction temperature
- Single die center tap module
- 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



RoHS
COMPLIANT
HALOGEN
FREE

DESCRIPTION / APPLICATIONS

State of the art hyperfast recovery rectifiers designed with optimized performance of forward voltage drop, hyperfast recovery time, and soft recovery.

The planar structure and the platinum doped life time control guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in PFC boost stage in the AC/DC section of SMPS, inverters or as freewheeling diodes.

The extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

| PRIMARY CHARACTERISTICS | |
|-------------------------|---|
| $I_{F(AV)}$ | 15 A |
| V_R | 600 V |
| V_F at I_F | 1.3 V |
| t_{rr} (typ.) | 22 ns |
| T_J max. | 175 °C |
| Package | D ² PAK (TO-263AB), TO-262AA |
| Circuit configuration | Single |

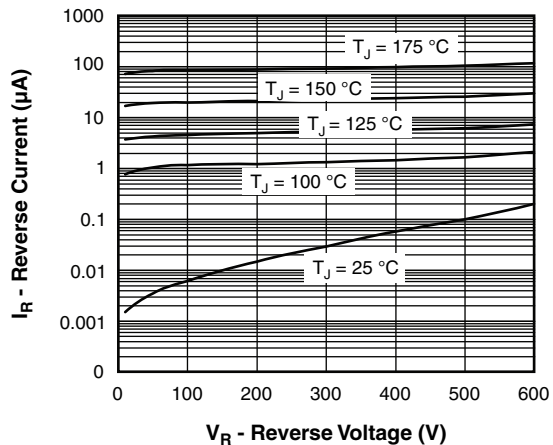
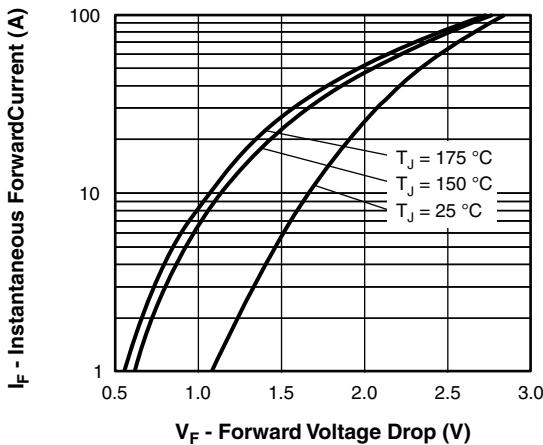
| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|----------------|-----------------|-------------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
| Peak repetitive reverse voltage | V_{RRM} | | 600 | V |
| Average rectified forward current | $I_{F(AV)}$ | $T_C = 140$ °C | 15 | A |
| Non-repetitive peak surge current | I_{FSM} | $T_J = 25$ °C | 120 | |
| Peak repetitive forward current | I_{FM} | | 30 | |
| Operating junction and storage temperatures | T_J, T_{Stg} | | -65 to +175 | °C |

| ELECTRICAL SPECIFICATIONS ($T_J = 25$ °C unless otherwise specified) | | | | | | |
|---|---------------|--|------|------|------|---------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Breakdown voltage, blocking voltage | V_{BR}, V_R | $I_R = 100$ μ A | 600 | - | - | V |
| | | | | | | |
| Forward voltage | V_F | $I_F = 15$ A | - | 1.8 | 2.2 | V |
| | | $I_F = 15$ A, $T_J = 150$ °C | - | 1.3 | 1.6 | |
| Reverse leakage current | I_R | $V_R = V_R$ rated | - | 0.2 | 50 | μ A |
| | | $T_J = 150$ °C, $V_R = V_R$ rated | - | 30 | 500 | |
| Junction capacitance | C_T | $V_R = 600$ V | - | 20 | - | pF |
| Series inductance | L_S | Measured lead to lead 5 mm from package body | - | 8.0 | - | nH |



| DYNAMIC RECOVERY CHARACTERISTICS (T _C = 25 °C unless otherwise specified) | | | | | | |
|--|------------------|---|------|------|------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time | t _{rr} | I _F = 1 A, dI _F /dt = 100 A/μs, V _R = 30 V | - | 22 | 30 | ns |
| | | I _F = 15 A, dI _F /dt = 100 A/μs, V _R = 30 V | - | 28 | 35 | |
| | | T _J = 25 °C | - | 29 | - | |
| | | T _J = 125 °C | - | 75 | - | |
| Peak recovery current | I _{RRM} | T _J = 25 °C | - | 3.5 | - | A |
| | | T _J = 125 °C | - | 7 | - | |
| Reverse recovery charge | Q _{rr} | T _J = 25 °C | - | 57 | - | μC |
| | | T _J = 125 °C | - | 300 | - | |
| Reverse recovery time | t _{rr} | I _F = 15 A dI _F /dt = 800 A/μs V _R = 390 V | - | 51 | - | ns |
| Peak recovery current | I _{RRM} | | - | 20 | - | A |
| Reverse recovery charge | Q _{rr} | | - | 580 | - | nC |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|-----------------------------------|---|--------------|------|------------|------------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Maximum junction and storage temperature range | T _J , T _{Stg} | | -65 | - | 175 | °C |
| Thermal resistance, junction to case per leg | R _{thJC} | | - | 1.0 | 1.3 | °C/W |
| Thermal resistance, junction to ambient per leg | R _{thJA} | Typical socket mount | - | - | 70 | |
| Thermal resistance, case to heatsink | R _{thCS} | Mounting surface, flat, smooth, and greased | - | 0.5 | - | |
| Weight | | | - | 2.0 | - | g |
| | | | - | 0.07 | - | oz. |
| Mounting torque | | | 6.0 (5.0) | - | 12 (10) | kgf · cm (lbf · in) |
| Marking device | | Case style D ² PAK (TO-263AB) | 15ETH06S | | | |
| | | Case style TO-262AA | 15ETH06-1 | | | |



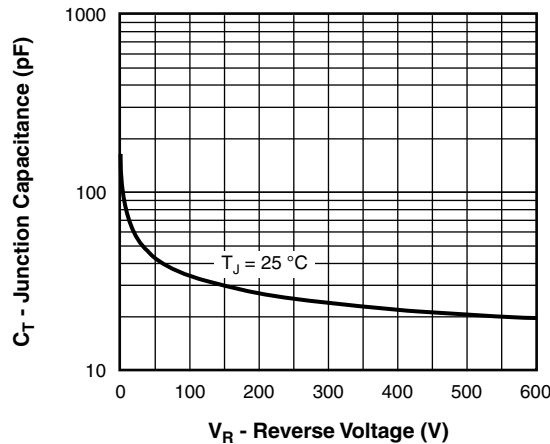


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

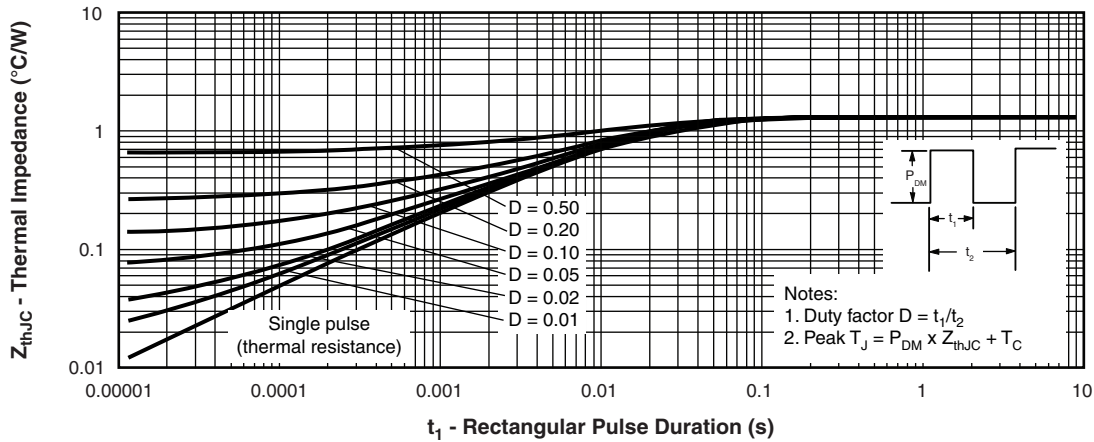


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

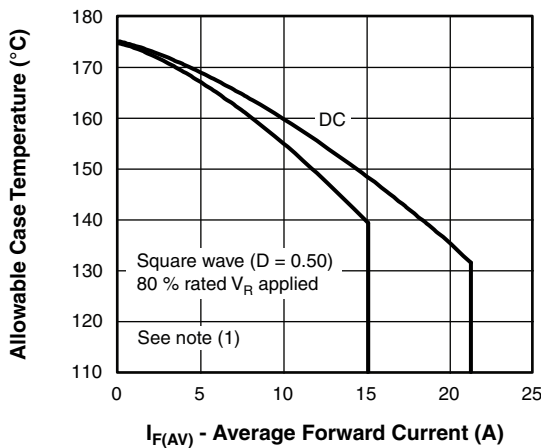


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

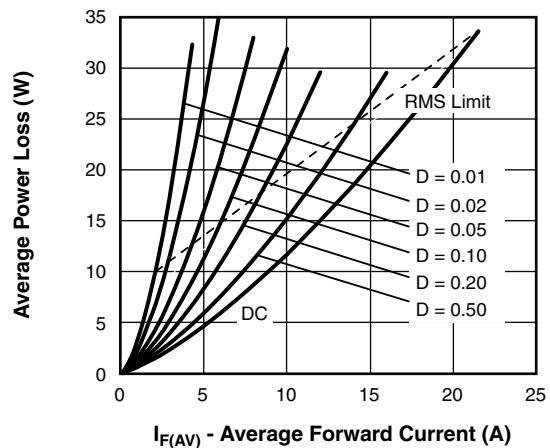


Fig. 6 - Forward Power Loss Characteristics

Note

- (1) Formula used: $T_C = T_J - (P_d + P_{d_{REV}}) \times R_{thJC}$;
 P_d = forward power loss = $I_{F(AV)} \times V_{FM}$ at $(I_{F(AV)}/D)$ (see fig. 6);
 $P_{d_{REV}}$ = inverse power loss = $V_{R1} \times I_R (1 - D)$; I_R at V_{R1} = rated V_R

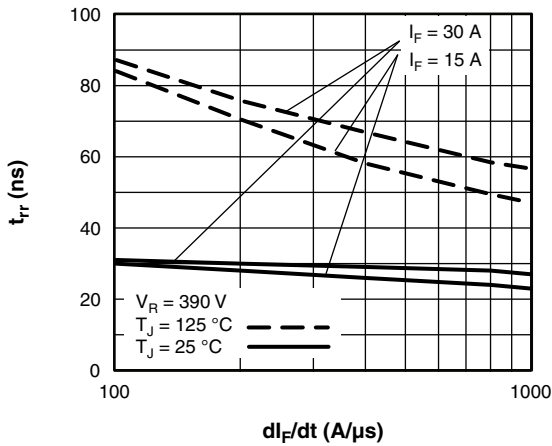


Fig. 7 - Typical Reverse Recovery vs. di_F/dt

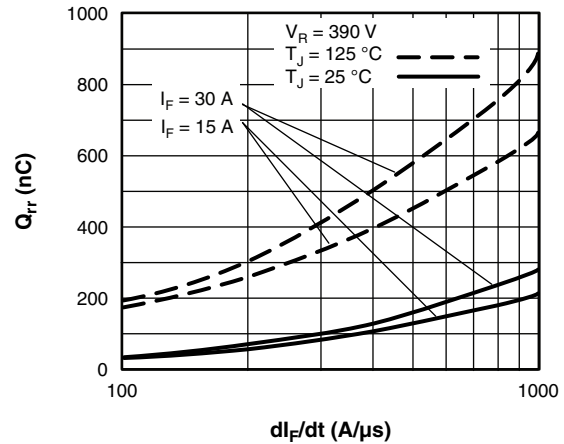
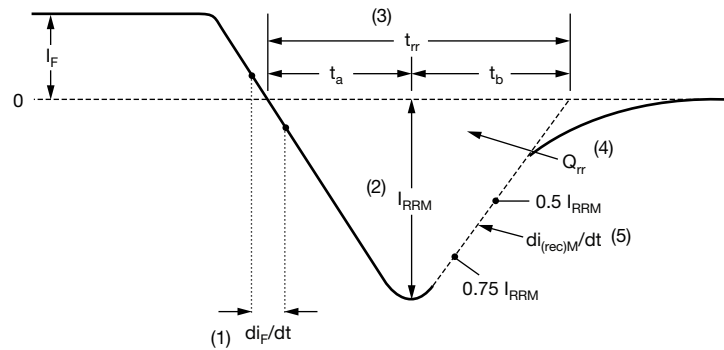


Fig. 8 - Typical Stored Charge vs. di_F/dt

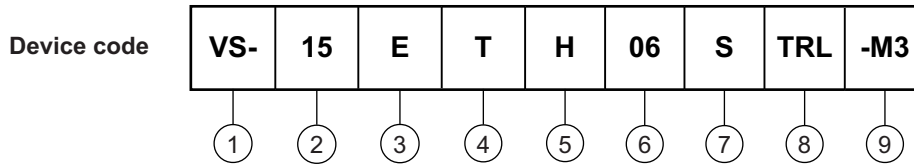


- (1) di_F/dt - rate of change of current through zero crossing
 - (2) I_{RRM} - peak reverse recovery current
 - (3) t_{rr} - reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through $0.75 I_{RRM}$ and $0.50 I_{RRM}$ extrapolated to zero current.
 - (4) Q_{rr} - area under curve defined by t_{rr} and I_{RRM}
- $$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$
- (5) $di_{(rec)M}/dt$ - peak rate of change of current during t_b portion of t_{rr}

Fig. 9 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (15 A)
- 3** - E = single diode
- 4** - T = TO-220, D²PAK
- 5** - H = hyperfast rectifier
- 6** - Voltage rating (06 = 600 V)
- 7** -
 - S = D²PAK
 - -1 = TO-262
- 8** -
 - None = tube (50 pieces)
 - TRL = tape and reel (left oriented, for D²PAK package)
 - TRR = tape and reel (right oriented, for D²PAK package)
- 9** - Environmental digit:
 - M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

| ORDERING INFORMATION (Example) | | | |
|--------------------------------|-------------------|------------------------|------------------------------------|
| PREFERRED P/N | QUANTITY PER REEL | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION |
| VS-15ETH06S-M3 | 50 | 1000 | Antistatic plastic tubes |
| VS-15ETH06TRRS-M3 | 800 | 800 | 13" diameter plastic tape and reel |
| VS-15ETH06STRL-M3 | 800 | 800 | 13" diameter plastic tape and reel |
| VS-15ETH06-1-M3 | 50 | 1000 | Antistatic plastic tubes |

| LINKS TO RELATED DOCUMENTS | | |
|----------------------------|-------------------------------|--|
| Dimensions | D ² PAK (TO-263AB) | www.vishay.com/doc?96164 |
| | TO-262 | www.vishay.com/doc?96165 |
| Part marking information | D ² PAK (TO-263AB) | www.vishay.com/doc?95444 |
| | TO-262 | www.vishay.com/doc?95443 |
| Packaging information | | www.vishay.com/doc?96424 |

TO-262



Example: This is a xxxxxx-1 ⁽¹⁾ with assembly lot code AC, assembled on WW 19, 2001 in the assembly line "X"

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 |



D²PAK



Example: This is a xxxxxx ⁽¹⁾ 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 |

D²PAK

DIMENSIONS in millimeters and inches

Conforms to JEDEC® outline D²PAK (SMD-220)



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

TO-262AA

DIMENSIONS in millimeters and inches

Modified JEDEC® outline TO-262



| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|-------|-----------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | 0.160 | 0.190 | |
| A1 | 2.03 | 3.02 | 0.080 | 0.119 | |
| 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 | | |
| L | 13.46 | 14.10 | 0.530 | 0.555 | |
| L1 | - | 1.65 | - | 0.065 | 3 |
| L2 | 3.56 | 3.71 | 0.140 | 0.146 | |

Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-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) Controlling dimension: inches
- (6) Outline conform to JEDEC® TO-262 except A1 (max.), b (min., max.), b1 (min.), b2 (max.), c (min.), c1(min.), c2 (max.), D (min.), E (max.), L1 (max.), L2 (min., max.)



D²PAK (TO-263AB)

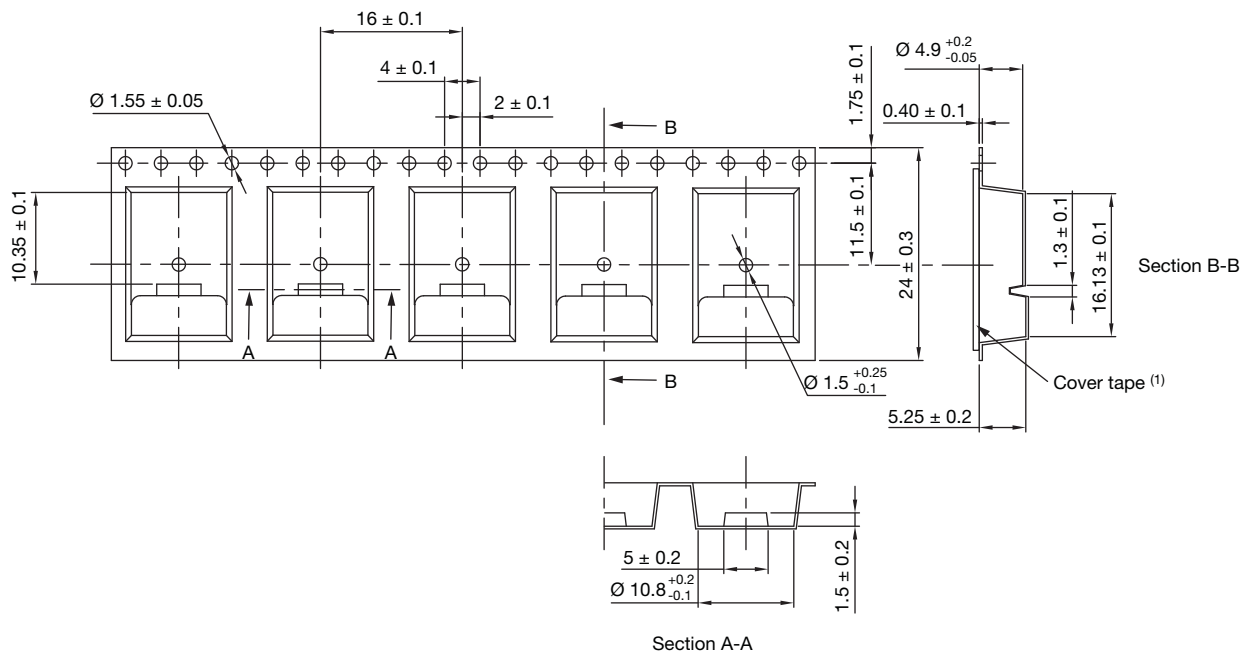
CARRIER TAPE FOR TAPE AND REEL LEFT in millimeters



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

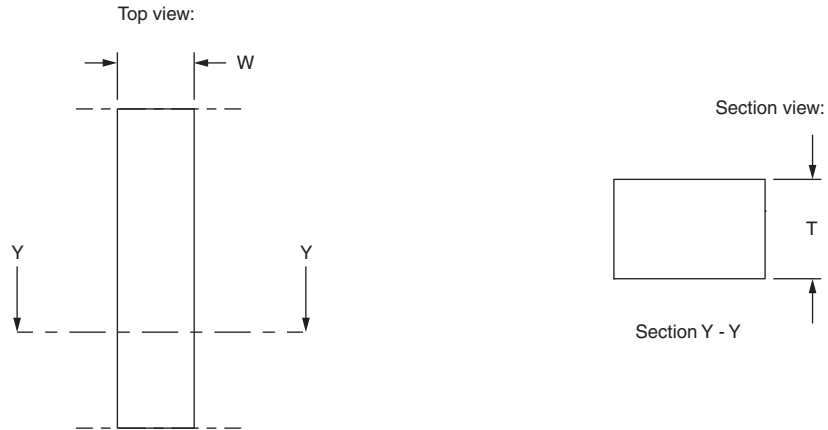


CARRIER TAPE AND REEL PACKAGING D²PAK (TO-263AB)





COVER TAPE FOR CARRIER TAPE in millimeters



| APPLICATION | COVER TAPE WIDTH W | COVER TAPE THICKNESS T | CARRIER TAPE WIDTH | MATERIAL |
|----------------------------------|-----------------------|---------------------------|--------------------|--|
| D ² PAK (TO-263AB) | 21.3 ± 0.1 | 0.060 ± 0.01 | 24 | Antistatic/treated/transparent/polyester |



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