## Automotive 600 V, 5 A ultrafast diode



D²PAK            DPAK
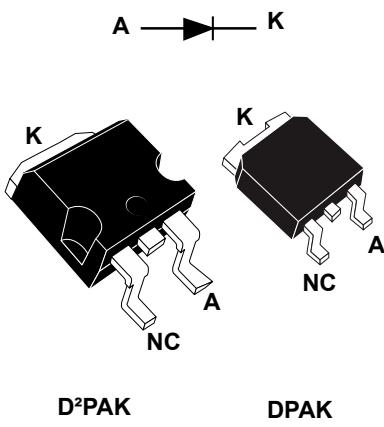
## Features

- AEC-Q101 qualified
- Ultrafast switching
- Low reverse recovery current
- Reduces switching losses
- Low thermal resistance
- ECOPACK compliant

## Applications

- Switching diode
- Free-wheeling diode
- Automotive DC/DC converter

## Description

This 5A, 600 V ultrafast diode is specially suited as a boost diode in continuous mode power factor correction and hard switching conditions.

This STTH5R06-Y is also intended for use as a free wheeling diode in power supplies and other power switching applications.

| Product status links |
|---|
| STTH5R06-Y |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 5 A |
| $V_{RRM}$ | 600 V |
| $T_{j(max.)}$ | 175 °C |
| $V_{F(typ.)}$ | 1.5 V |
| $T_{rr(max.)}$ | 35 ns |

**DS6874 - Rev 2 - March 2019**
For further information contact your local STMicroelectronics sales office.

www.st.com

# 1    Characteristics

**Table 1. Absolute ratings (limiting values, at 25 °C, unless otherwise specified)**

| Symbol | Parameter | | | Value | Unit |
|---|---|---|---|---|---|
| $V_{RRM}$ | Repetitive peak reverse voltage | $T_j$ from -40 °C to 175 °C | | 600 | V |
| $I_{F(RMS)}$ | Forward rms current | $D^2PAK$ | | 25 | A |
| | | DPAK | | 10 | |
| $I_{F(AV)}$ | Average forward current, δ = 0.5, square wave | $D^2PAK$, DPAK | $T_C$ = 145 °C | 5 | A |
| $I_{FSM}$ | Surge non repetitive forward current | $D^2PAK$ | $t_p$ = 10 ms sinusoidal | 70 | A |
| | | DPAK | | 50 | |
| $T_{stg}$ | Storage temperature range | | | -65 to +175 | °C |
| $T_j$ | Operating junction temperature range | | | -40 to +175 | °C |

For more information, please refer to the following application note :

• AN5088 : Rectifiers thermal management, handling and mounting recommendations

**Table 2. Thermal parameters**

| Symbol | Parameter | | Maximum value | Unit |
|---|---|---|---|---|
| $R_{th(j-c)}$ | Junction to case | Per diode | 2.2 | °C/W |

**Table 3. Static electrical characteristics**

| Symbol | Parameter | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $I_R$ [1] | Reverse leakage current | $T_j$ = 25 °C | $V_R = V_{RRM}$ | - | | 30 | µA |
| | | $T_j$ = 125 °C | | - | 30 | 300 | |
| $V_F$ [2] | Forward voltage drop | $T_j$ = 25 °C | $I_F$ = 5 A | - | | 3.20 | V |
| | | $T_j$ = 125 °C | | - | 1.50 | 1.95 | |

1.  Pulse test: $t_p$ = 5 ms, δ < 2%

2.  Pulse test: $t_p$ =380 µs, δ < 2%

To evaluate the conduction losses, use the following equation:

$P = 1.35 \times I_{F(AV)} + 0.12 \times I_{F}^{2}{}_{(RMS)}$

**Table 4.** Dynamic electrical characteristics

| Symbol | Parameter | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $t_{rr}$ | Reverse recovery time | $T_j$ = 25 °C | $I_F$ = 0.5 A, $I_{rr}$ = 0.25 A, $I_R$ = 1 A | - | | 20 | ns |
| | | | $I_F$ = 1 A, $V_R$ = 30 V, $dI_F/dt$ = -50 A/µs | - | | 35 | |
| $I_{RM}$ | Reverse recovery current | $T_j$ = 125 °C | $I_F$ = 5 A, $V_R$ = 400 V, $dI_F/dt$ = -200 A/µs | - | 4.5 | 6 | A |
| $S_{factor}$ | Softness factor | | | - | 0.5 | | - |
| $Q_{rr}$ | Reverse recovery charge | | | - | 110 | | nC |
| $t_{fr}$ | Forward recovery time | $T_j$ = 25 °C | $I_F$ = 5 A, $V_{FR}$ =2.5 V, $dI_F/dt$ = 40 A/µs | | | 220 | ns |
| $V_{FP}$ | Forward recovery voltage | | | | | 4.5 | V |

For more information, please refer to the following application notes related to the power losses:

• AN604: Calculation of conduction losses in a power rectifier
• AN5028: Calculation of turn-off power losses generated by an ultrafast diode

## 1.1　　Characteristics (curves)

**Figure 1. Average forward power dissipation versus average forward current**
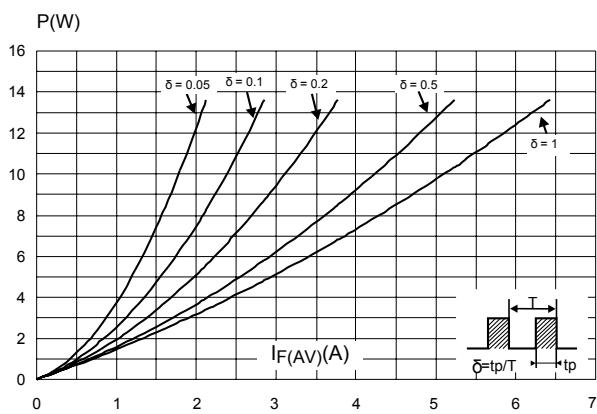


**Figure 2. Forward voltage drop versus forward current**
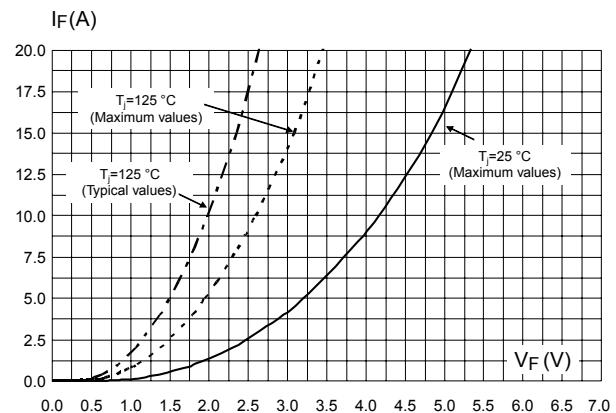


**Figure 3. Relative variation of thermal impedance junction to case versus pulse duration**
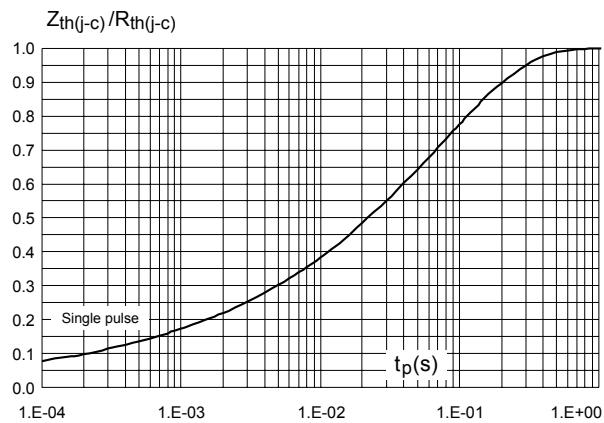


**Figure 4. Peak reverse recovery current versus dI_F/dt (typical values)**
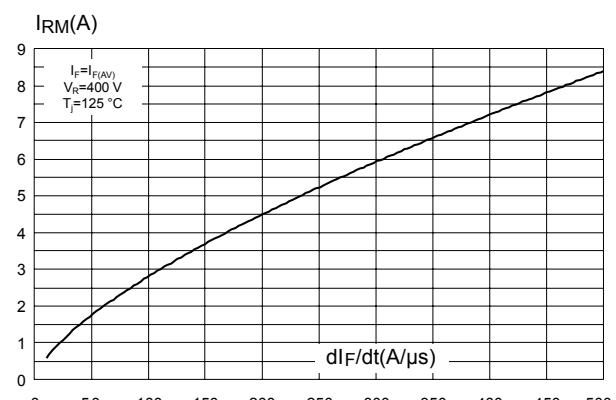
**Figure 5. Reverse recovery time versus dI$_F$/dt (typical values)**

$t_{rr}$(ns)

I$_F$=I$_{F(AV)}$
V$_R$=400 V
T$_j$=125 °C

dI$_F$/dt(A/µs)
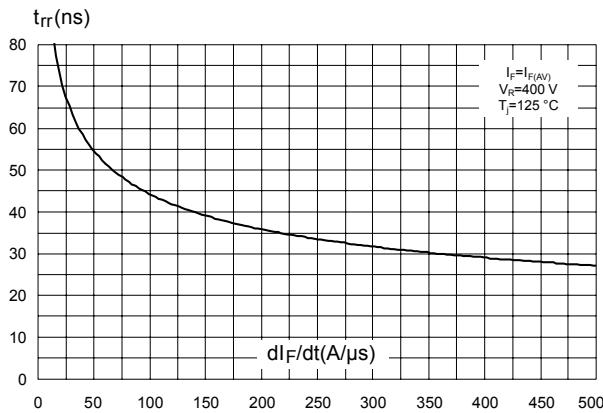
**Figure 6. Reverse recovery charges versus dI$_F$/dt (typical values)**

Q$_{rr}$(nC)

I$_F$=I$_{F(AV)}$
V$_R$=400 V
T$_j$=125 °C

dI$_F$/dt(A/µs)
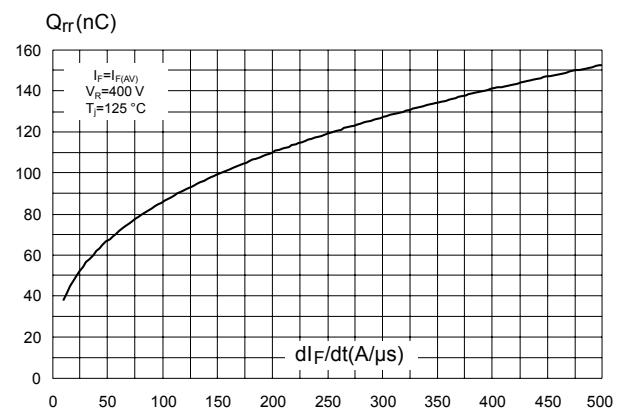
**Figure 7. Softness factor versus dI$_F$/dt (typical values)**

S factor

I$_F$=I$_{F(AV)}$
V$_R$=400 V
T$_j$=125 °C

dI$_F$/dt(A/µs)
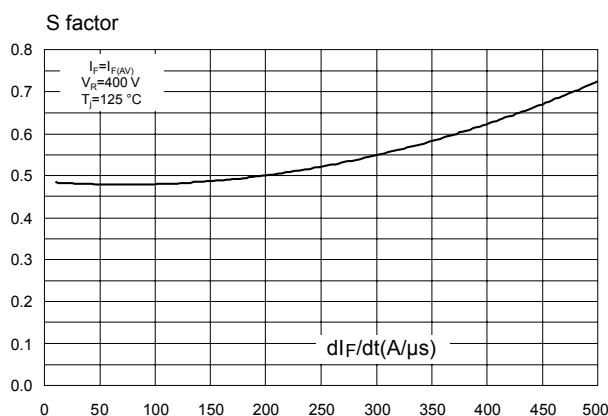
**Figure 8. Relative variations of dynamic parameters versus junction temperature**

I$_F$=I$_{F(AV)}$
V$_R$=400 V
Reference: T$_j$=125 °C

S$_{FACTOR}$

I$_{RM}$

Q$_{RR}$

T$_j$(°C)
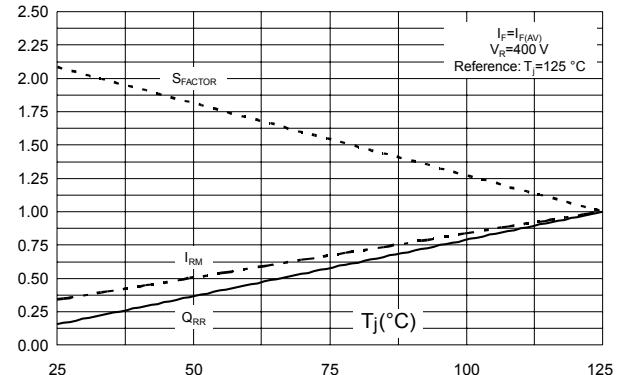
**Figure 9. Transient peak forward voltage versus dI_F/dt (typical values)**
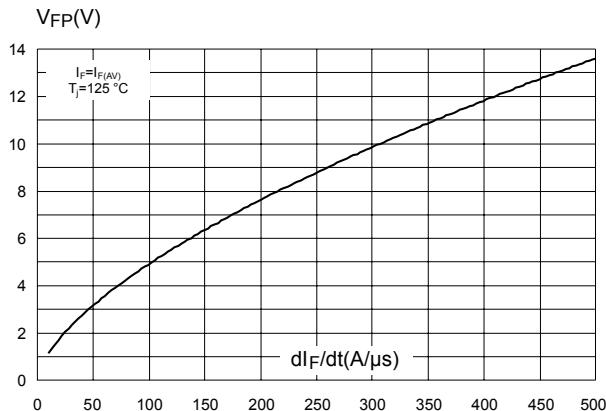


**Figure 10. Forward recovery time versus dI_F/dt (typical values)**
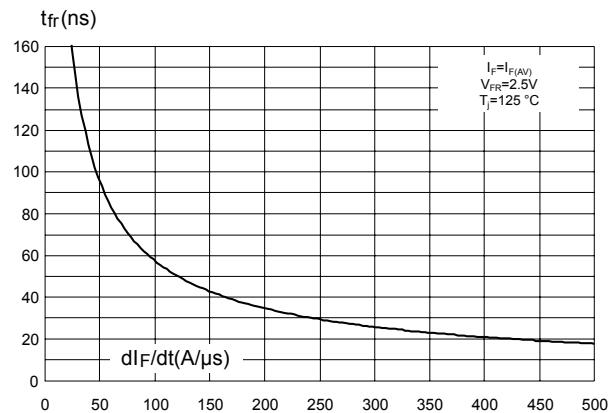


**Figure 11. Junction capacitance versus reverse voltage applied (typical values, per diode)**
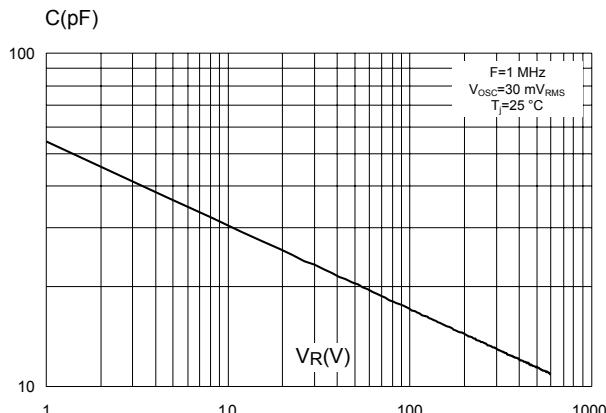


**Figure 12. Thermal resistance junction to ambient versus copper surface under tab (typical values)**
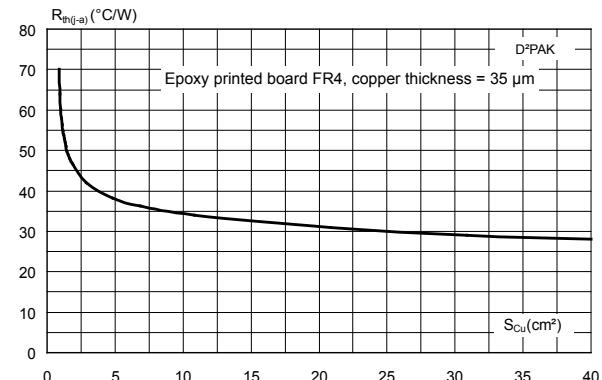


**Figure 13. Thermal resistance junction to ambient versus copper surface under tab (typical values)**
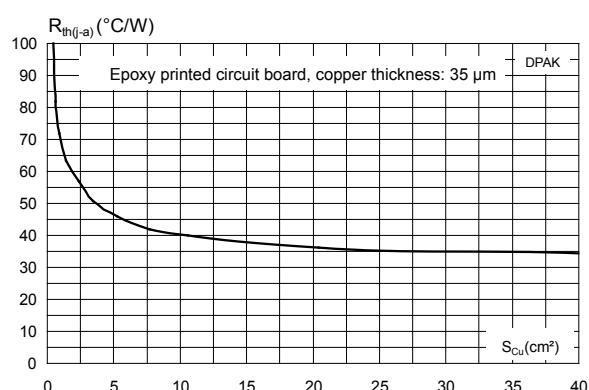
# 2 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

## 2.1 D²PAK package information

- Epoxy meets UL94, V0.
- Cooling method: by conduction (C)

**Figure 14. D²PAK package outline**
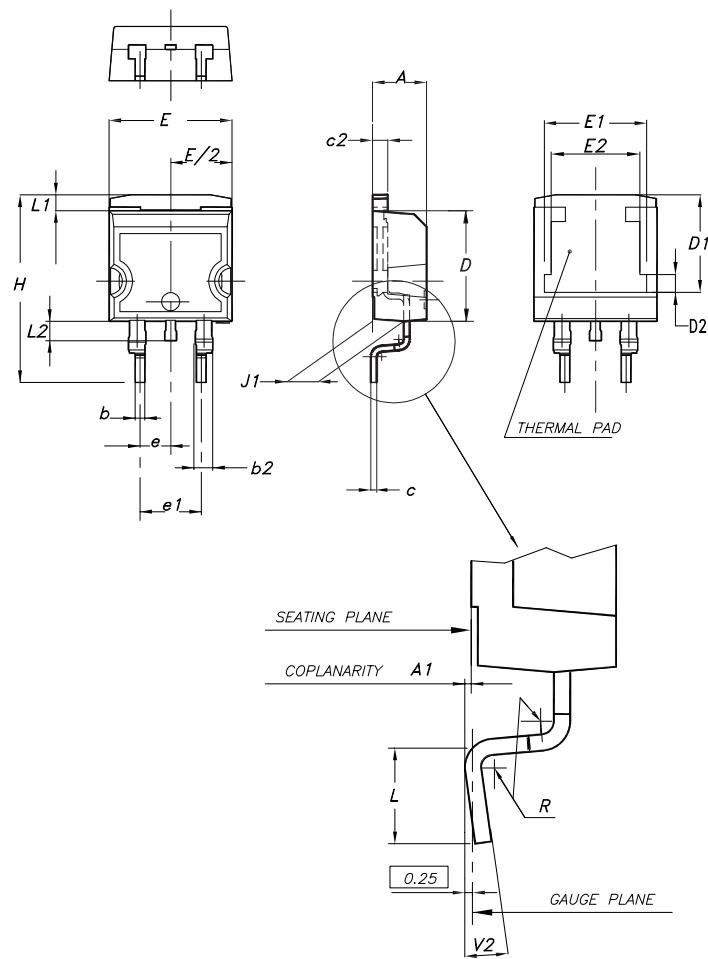


Note: *This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.*

**Table 5. D²PAK package mechanical data**

| Ref. | Dimensions | | | | | |
|------|------------|---|---|---|---|---|
| | Millimeters | | | Inches (for reference only) | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.028 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.018 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | 7.75 | 8.00 | 0.295 | 0.305 | 0.315 |
| D2 | 1.10 | 1.30 | 1.50 | 0.043 | 0.051 | 0.060 |
| E | 10.00 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.30 | 8.50 | 8.70 | 0.335 | 0.343 | 0.346 |
| E2 | 6.85 | 7.05 | 7.25 | 0.266 | 0.278 | 0.282 |
| e | | 2.54 | | | 0.100 | |
| e1 | 4.88 | | 5.28 | 0.190 | | 0.205 |
| H | 15.00 | | 15.85 | 0.591 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.097 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.049 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.050 | | 0.069 |
| R | | 0.40 | | | 0.015 | |
| V2 | 0° | | 8° | 0° | | 8° |

**Figure 15. D²PAK recommended footprint (dimensions are in mm)**
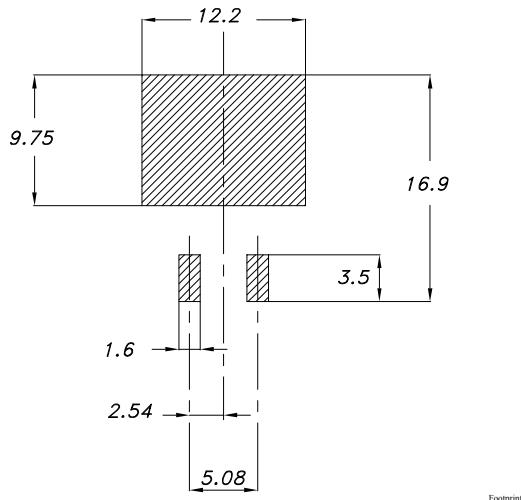
## 2.2 DPAK package information

- Epoxy meets UL94, V0

**Figure 16. DPAK package outline**
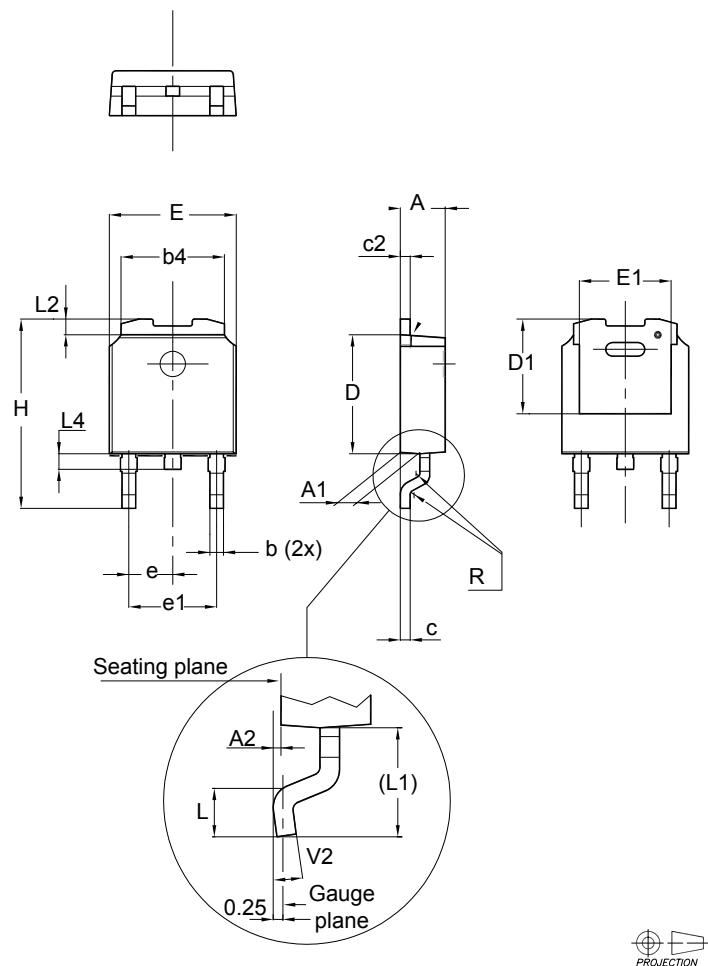
**Table 6. DPAK mechanical data**

| Dim. | Dimensions | | | | | |
|------|-----------|---|---|---|---|---|
| | Millimeters | | | Inches[1] | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 | 0.087 | | 0.094 |
| A1 | 0.90 | | 1.10 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.64 | | 0.90 | 0.025 | | 0.035 |
| b4 | 5.20 | | 5.40 | 0.205 | | 0.213 |
| c | 0.45 | | 0.60 | 0.018 | | 0.024 |
| c2 | 0.48 | | 0.60 | 0.019 | | 0.024 |
| D | 6.00 | | 6.20 | 0.236 | | 0.244 |
| D1 | 4.95 | 5.10 | 5.25 | 0.195 | 0.201 | 0.207 |
| E | 6.40 | | 6.60 | 0.252 | | 0.260 |
| E1 | 4.60 | 4.70 | 4.80 | 0.181 | 0.185 | 0.189 |
| e | 2.159 | 2.286 | 2.413 | 0.085 | 0.090 | 0.095 |
| e1 | 4.445 | 4.572 | 4.699 | 0.175 | 0.180 | 0.185 |
| H | 9.35 | | 10.10 | 0.368 | | 0.398 |
| L | 1.00 | | 1.50 | 0.039 | | 0.059 |
| (L1) | 2.60 | 2.80 | 3.00 | 0.102 | 0.110 | 0.118 |
| L2 | 0.65 | 0.80 | 0.95 | 0.026 | 0.031 | 0.037 |
| L4 | 0.60 | | 1.00 | 0.024 | | 0.039 |
| R | | 0.20 | | | 0.008 | |
| V2 | 0° | | 8° | 0° | | 8° |

1.  Inches dimensions given for reference only

**Figure 17. DPAK recommended footprint (dimensions are in mm)**
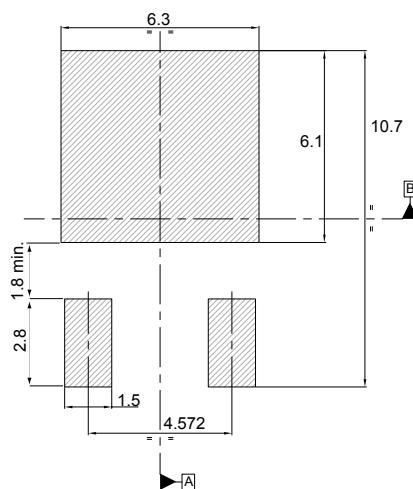


The device must be positioned within ⌖ 0 05 A B

# 3 Ordering information

**Table 7. Order code**

| Order code | Marking | Package | Weight | Base qty. | Delivery mode |
|---|---|---|---|---|---|
| STTH5R06GY-TR | STTH5R06GY | D²PAK | 1.48 g | 1000 | Tape and reel |
| STTH5R06BY-TR | STTH5R06BY | DPAK | 0.35 g | 2500 | Tape and reel |

# Revision history

**Table 8.** Document revision history

| Date | Revision | Changes |
|------|----------|---------|
| 03-Nov-2011 | 1 | First issue. |
| 18-Mar-2019 | 2 | Added Section Applications. Updated Table 7. Order code. |

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