# STD45P4LLF6AG

## Automotive-grade P-channel -40 V, 12 mΩ typ., -50 A STripFET™ F6 Power MOSFET in a DPAK package

Datasheet - production data

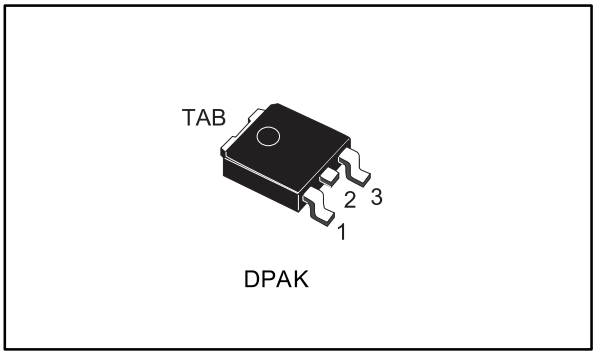
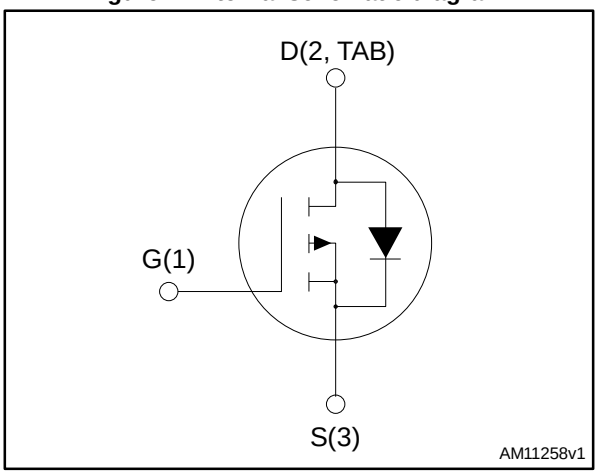



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STD45P4LLF6AG | -40 V | 15 mΩ | -50 A |

- Designed for automotive applications and AEC-Q101 qualified
- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

## Applications

- Switching applications

## Description

This device is a P-channel Power MOSFET developed using the STripFET™ F6 technology, with a new trench gate structure. The resulting Power MOSFET exhibits very low $R_{DS(on)}$ in all packages.

**Table 1: Device summary**

| Order code | Marking | Package | Packing |
|---|---|---|---|
| STD45P4LLF6AG | 45P4LLF6 | DPAK | Tape and reel |



This is information on a product in full production.

# Contents

# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | -40 | V |
| $V_{GS}$ | Gate-source voltage | ±18 V | V |
| $I_D$ | Drain current (continuous) at $T_{case}$ = 25 °C | -50 | A |
| | Drain current (continuous) at $T_{case}$ = 100 °C | -31 | |
| $I_{DM}$(1) | Drain current (pulsed) | -200 | A |
| $P_{TOT}$ | Total dissipation at $T_{case}$ = 25 °C | 58 | W |
| $E_{AS}$(2) | Single pulse avalanche energy | 160 | mJ |
| $T_{stg}$ | Storage temperature | –55 to 150 | °C |
| $T_j$(3) | Operating junction temperature | | |

**Notes:**

(1) Pulse width is limited by safe operating area.

(2) starting $T_j$ = 25 °C, $R_G$ = 47 Ω, $I_{D(min)}$ = -25 A.

(3) HTRB performed at $T_j$ = 175 °C, $V_{DS}$ = 100% $V_{(BR)DSS}$.

**Table 3: Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 2.14 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 50 | |

# 2 Electrical characteristics

($T_{case}$ = 25 °C unless otherwise specified)

**Table 4: Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V, $I_D$ = -250 µA | -40 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = -40 V | | | -1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = -40 V, $T_{case}$ = 125 °C | | | -10 | |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = -18 V | | | -100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = -250 µA | -1 | | -2.5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = -10 V, $I_D$ = -25 A | | 12 | 15 | mΩ |
| | | $V_{GS}$ = -4.5 V, $I_D$ = -25 A | | 17 | 20 | |

**Table 5: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = -25 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 3525 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 345 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 240 | - | |
| $Q_g$ | Total gate charge | $V_{DD}$ = -20 V, $I_D$ = -50 A, $V_{GS}$ = -10 V (see *Figure 14: "Gate charge test circuit"*) | - | 65.5 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 11.5 | - | |
| $Q_{gd}$ | Gate-drain charge | | - | 13 | - | |

**Table 6: Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = -20 V, $I_D$ = -25 A, $R_G$ = 4.7 Ω, $V_{GS}$ = -10 V (see *Figure 13: "Switching times test circuit for resistive load"* ) | - | 12 | - | ns |
| $t_r$ | Rise time | | - | 35.5 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 63.5 | - | |
| $t_f$ | Fall time | | - | 31 | - | |

**Table 7: Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | -50 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | | - | | -200 | A |
| $V_{SD}$(2) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = -50 A | - | | -1.3 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = -50 A, di/dt = -100 A/µs, $V_{DD}$ = -32 V (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*) | - | 27.5 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 24.5 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | -1.8 | | A |

**Notes:**

(1) Pulse width is limited by safe operating area.

(2) Pulse test: pulse duration = 300 µs, duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

**Figure 2: Safe operating area**

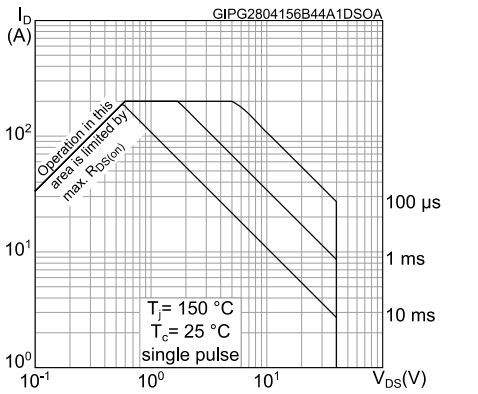



**Figure 3: Thermal impedance**

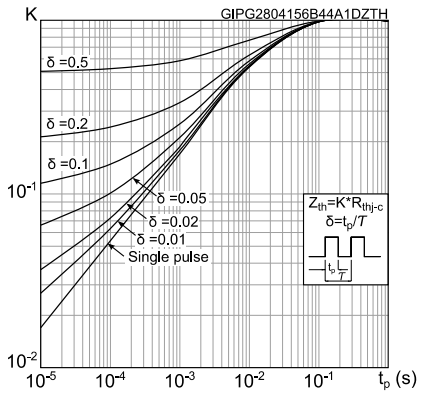



**Figure 4: Output characteristics**

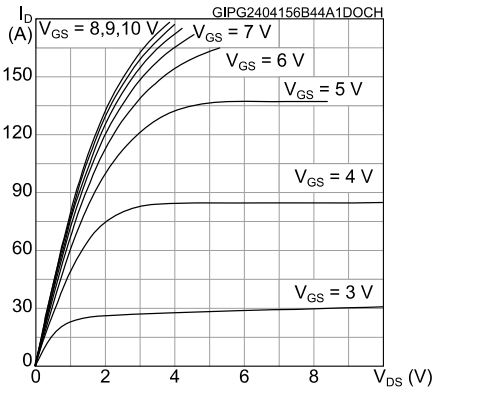



**Figure 5: Transfer characteristics**

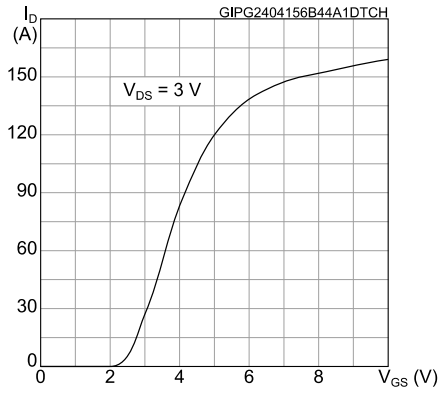



**Figure 6: Gate charge vs gate-source voltage**

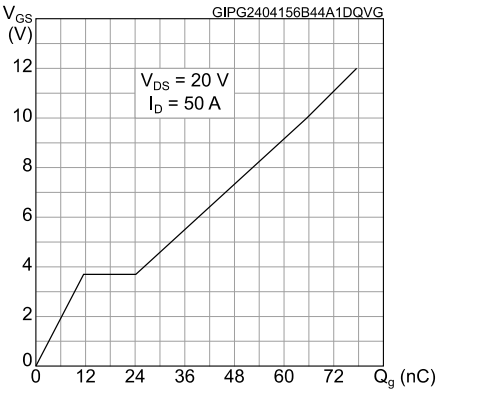



**Figure 7: Static drain-source on-resistance**

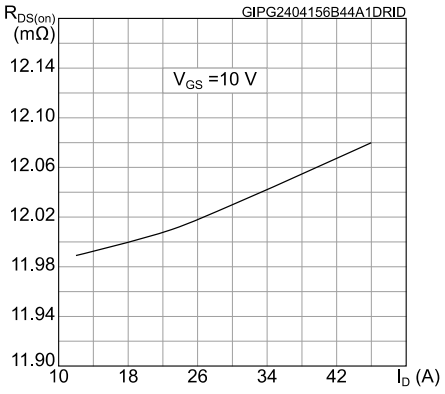


**Figure 8: Capacitance variations**

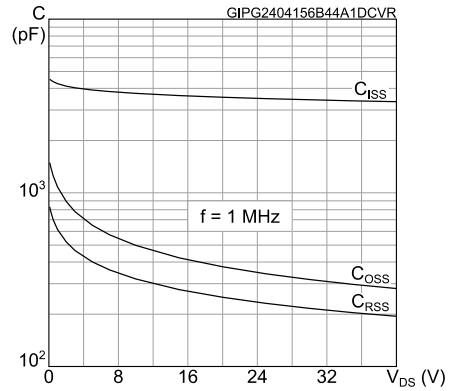



**Figure 9: Normalized gate threshold voltage vs temperature**

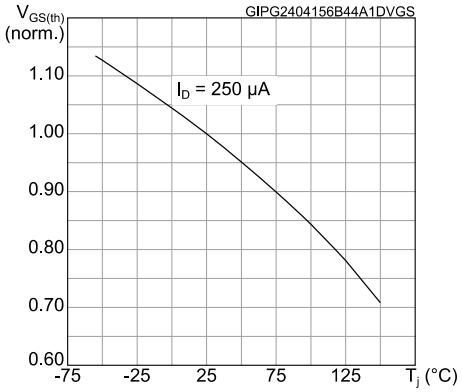



**Figure 10: Normalized on-resistance vs temperature**

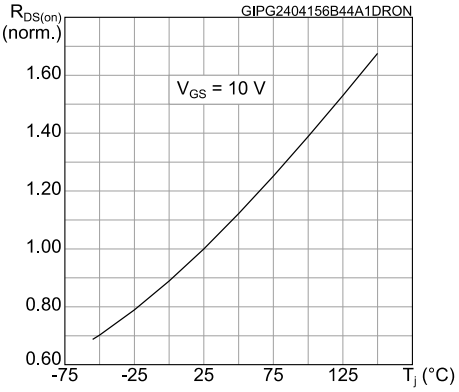



**Figure 11: Normalized V(BR)DSS vs temperature**

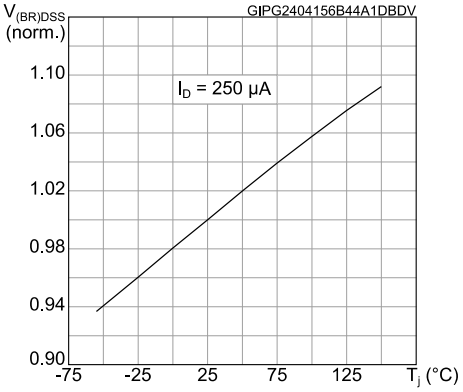
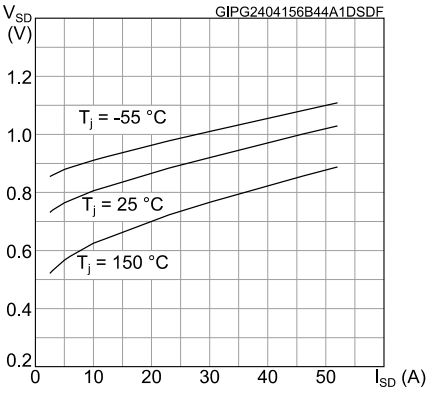



**Figure 12: Source-drain diode forward characteristics**




For the P-channel Power MOSFET, current and voltage polarities are reversed.

# 3 Test circuits

**Figure 13: Switching times test circuit for resistive load**

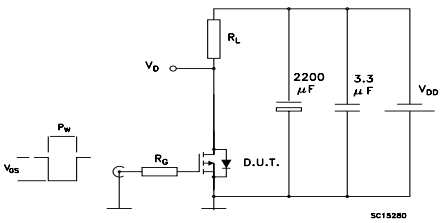



**Figure 14: Gate charge test circuit**

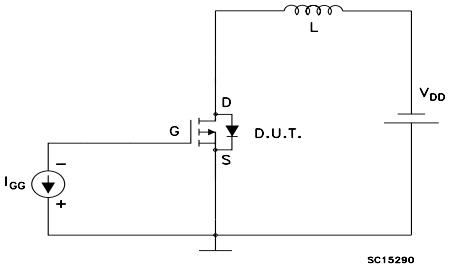
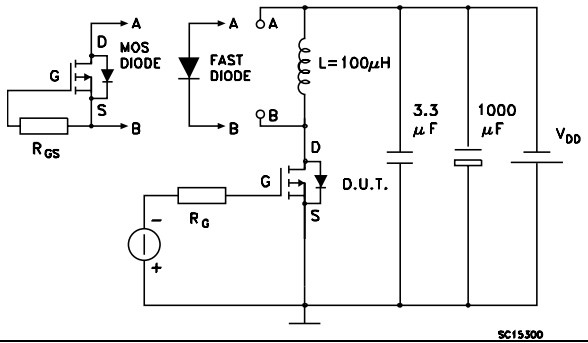



**Figure 15: Test circuit for inductive load switching and diode recovery times**



# 4 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.

## 4.1 DPAK (TO-252) type A2 package information

**Figure 16: DPAK (TO-252) type A2 package outline**

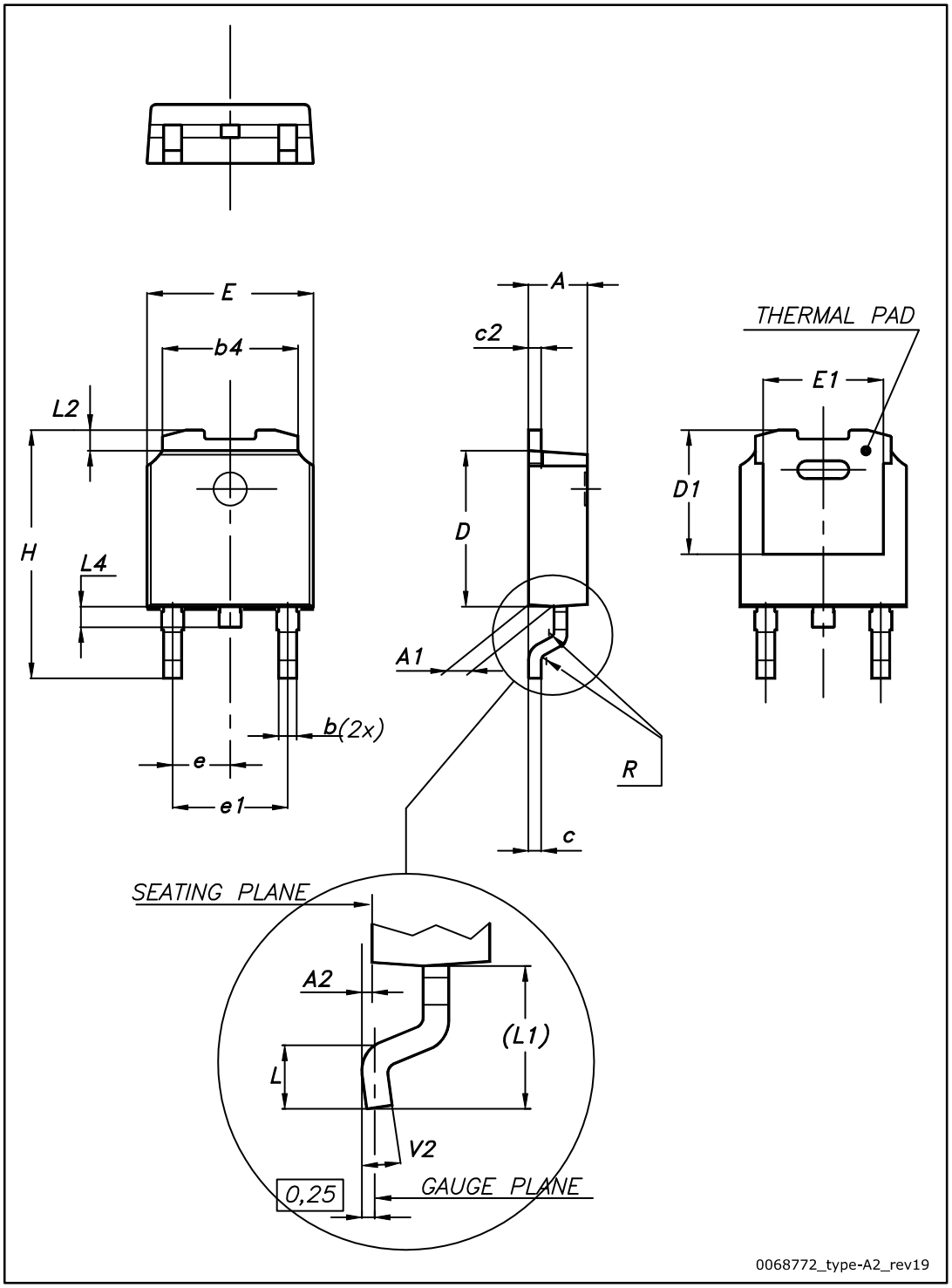
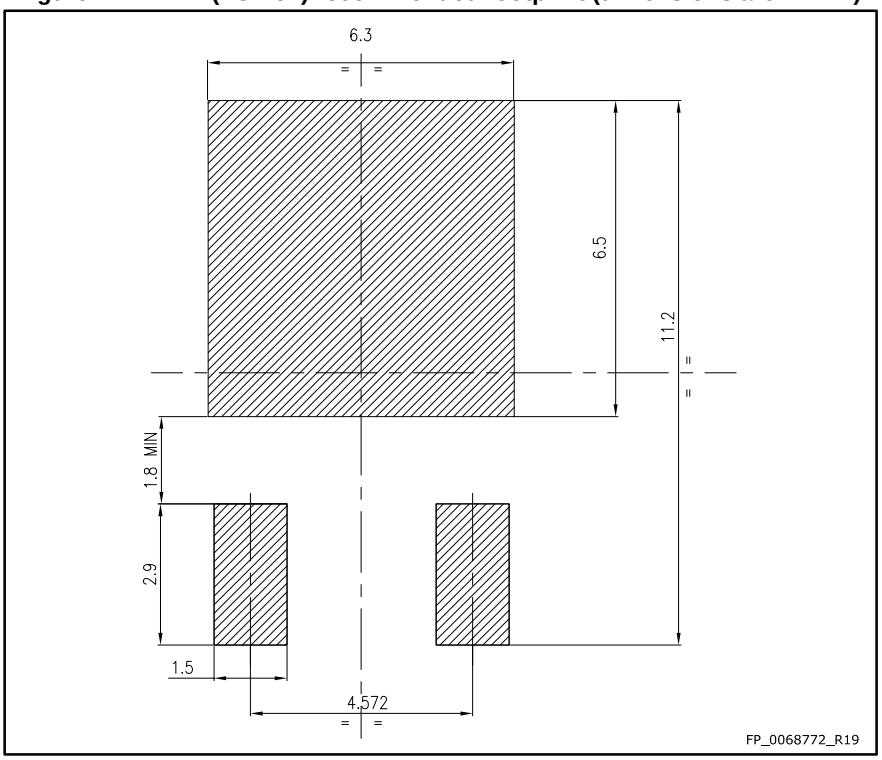


Table 8: DPAK (TO-252) type A2 mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | 4.95 | 5.10 | 5.25 |
| E | 6.40 | | 6.60 |
| E1 | 5.10 | 5.20 | 5.30 |
| e | 2.16 | 2.28 | 2.40 |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| L1 | 2.60 | 2.80 | 3.00 |
| L2 | 0.65 | 0.80 | 0.95 |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

**Figure 17: DPAK (TO-252) recommended footprint (dimensions are in mm)**



## 4.2 DPAK (TO-252) packing information

**Figure 18: DPAK (TO-252) tape outline**

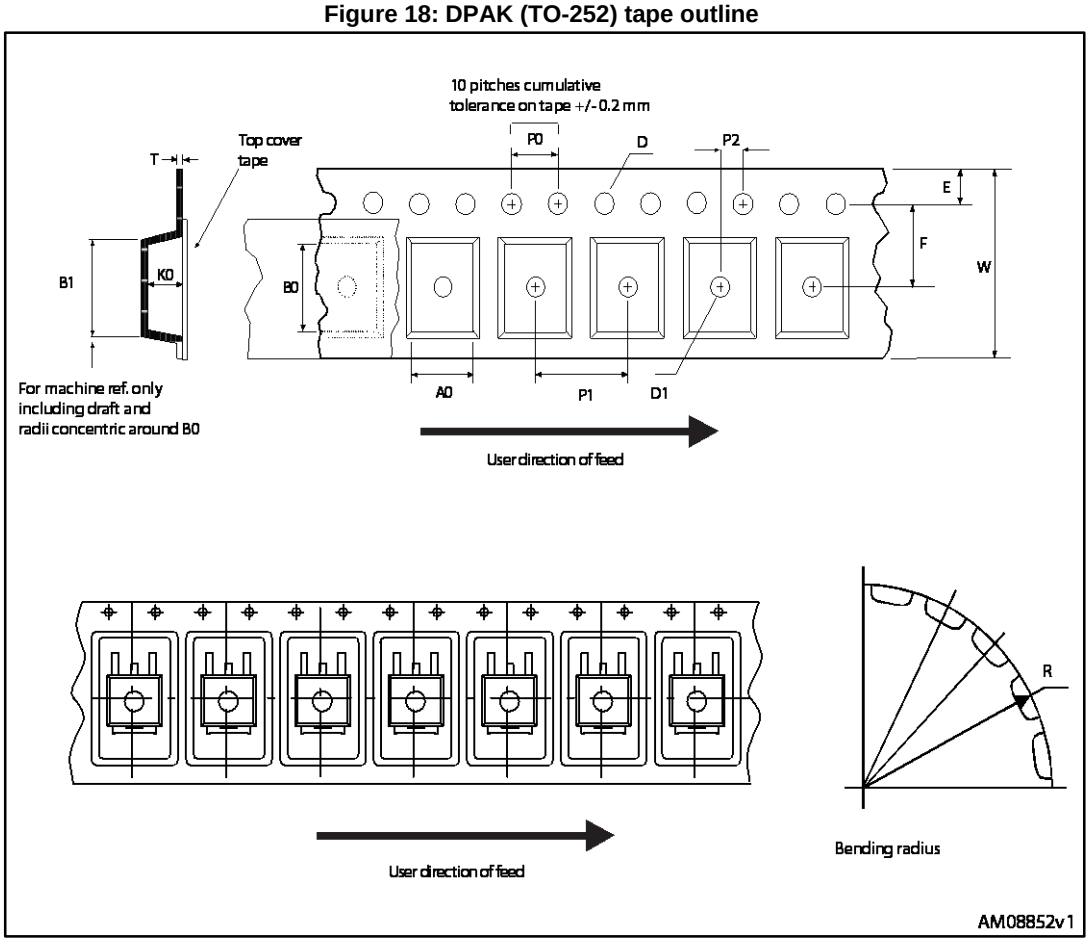


Figure 19: DPAK (TO-252) reel outline

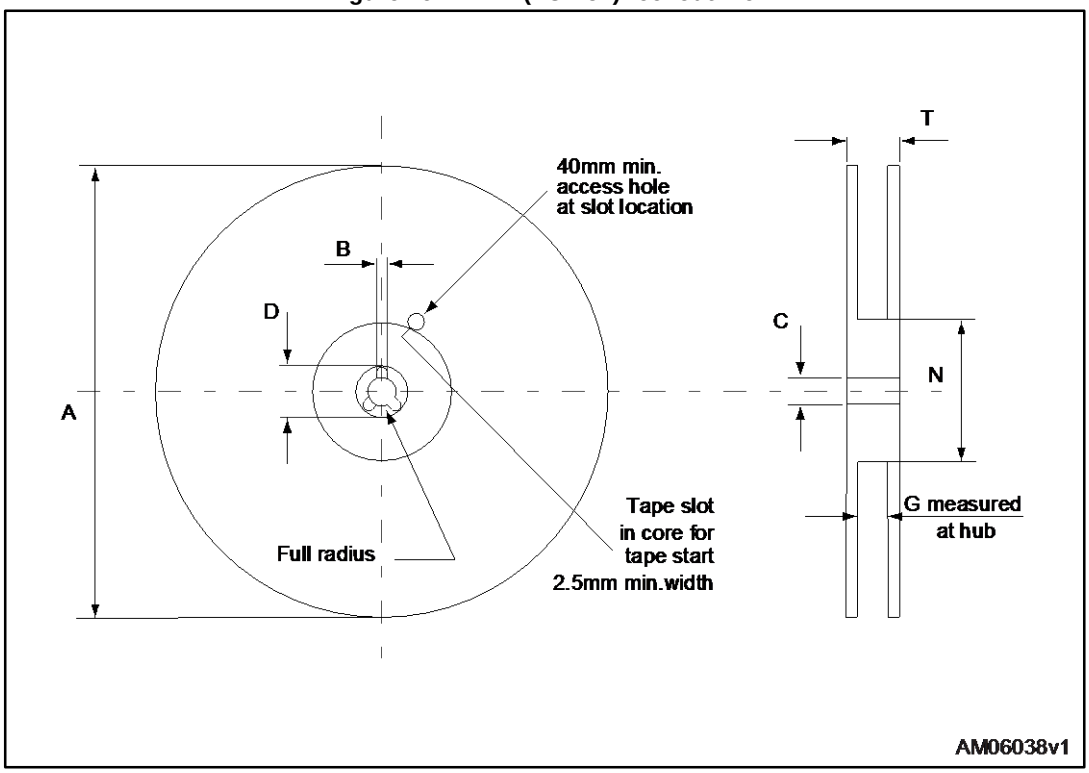



Table 9: DPAK (TO-252) tape and reel mechanical data

| Tape | | | Reel | | |
|---|---|---|---|---|---|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 6.8 | 7 | A | | 330 |
| B0 | 10.4 | 10.6 | B | 1.5 | |
| B1 | | 12.1 | C | 12.8 | 13.2 |
| D | 1.5 | 1.6 | D | 20.2 | |
| D1 | 1.5 | | G | 16.4 | 18.4 |
| E | 1.65 | 1.85 | N | 50 | |
| F | 7.4 | 7.6 | T | | 22.4 |
| K0 | 2.55 | 2.75 | | | |
| P0 | 3.9 | 4.1 | Base qty. | | 2500 |
| P1 | 7.9 | 8.1 | Bulk qty. | | 2500 |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

# 5 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|---|---|---|
| 28-Apr-2015 | 1 | First release. |
| 22-Jul-2015 | 2 | Modified: $V_{GS}$ values in absoute maximum ratings table and static table.<br>Updated: DPAK (TO-252) type A2 package information section updated.<br>Minor text changes. |

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