

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

Datasheet - production data

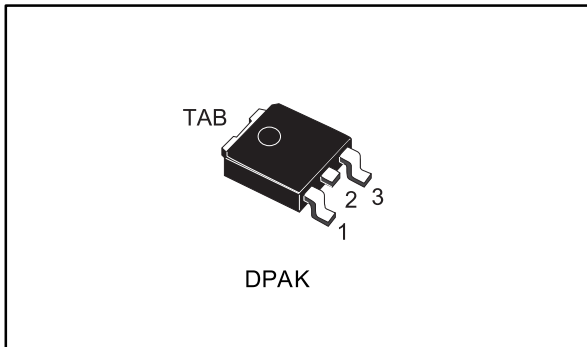
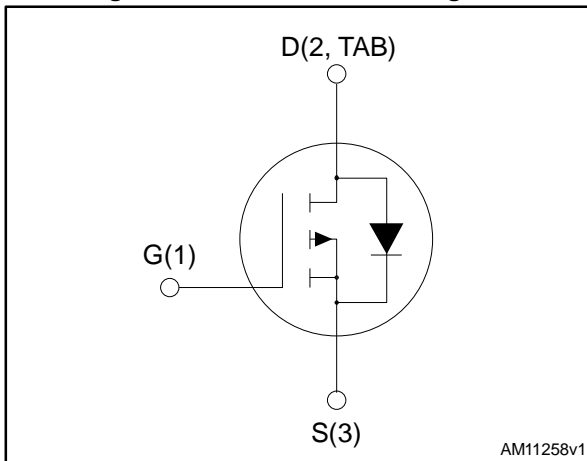


Figure 1: Internal schematic diagram



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 |

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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 |
|----------------|-------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case | 2.14 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 50 | |

2 Electrical characteristics

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

Table 4: Static

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

Table 5: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|--|------|------|------|---------------|
| C_{ISS} | Input capacitance | $V_{\text{DS}} = -25\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$ | - | 3525 | - | μF |
| C_{OSS} | Output capacitance | | - | 345 | - | |
| C_{RSS} | Reverse transfer capacitance | | - | 240 | - | |
| Q_{g} | Total gate charge | $V_{\text{DD}} = -20\text{ V}$, $I_{\text{D}} = -50\text{ A}$, $V_{\text{GS}} = -10\text{ V}$ (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 |
|----------------------------|---------------------|--|------|------|------|------|
| $t_{\text{d}(\text{on})}$ | Turn-on delay time | $V_{\text{DD}} = -20\text{ V}$, $I_{\text{D}} = -25\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = -10\text{ V}$ (see Figure 13 : "Switching times test circuit for resistive load") | - | 12 | - | ns |
| t_{r} | Rise time | | - | 35.5 | - | |
| $t_{\text{d}(\text{off})}$ | Turn-off delay time | | - | 63.5 | - | |
| t_{f} | Fall time | | - | 31 | - | |

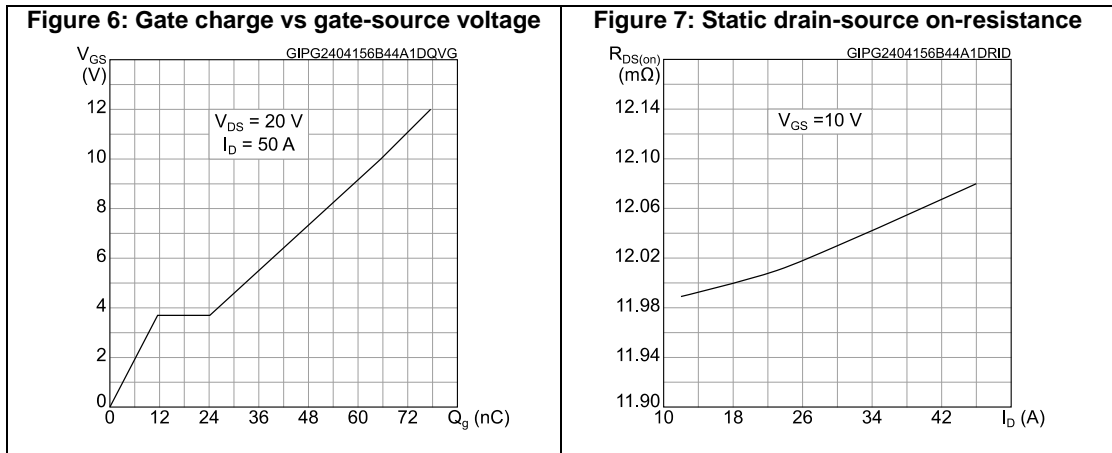
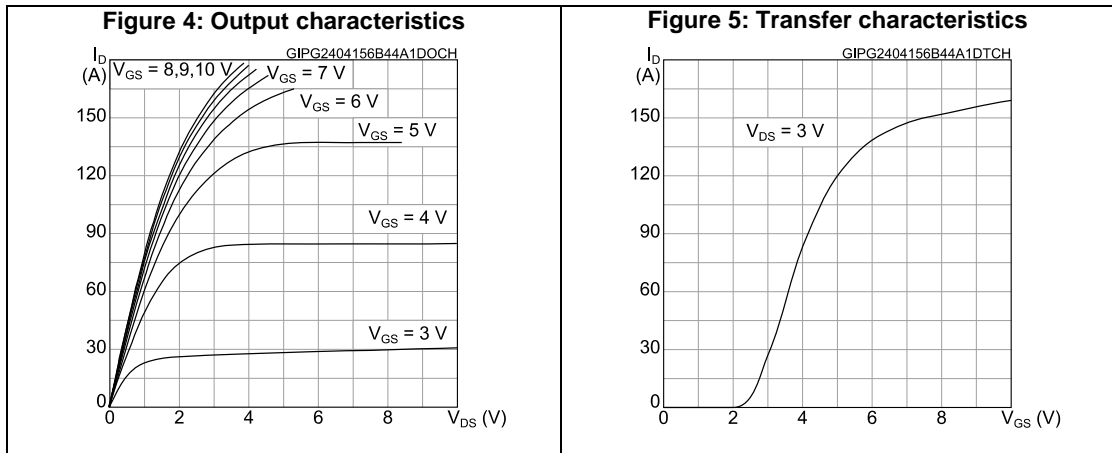
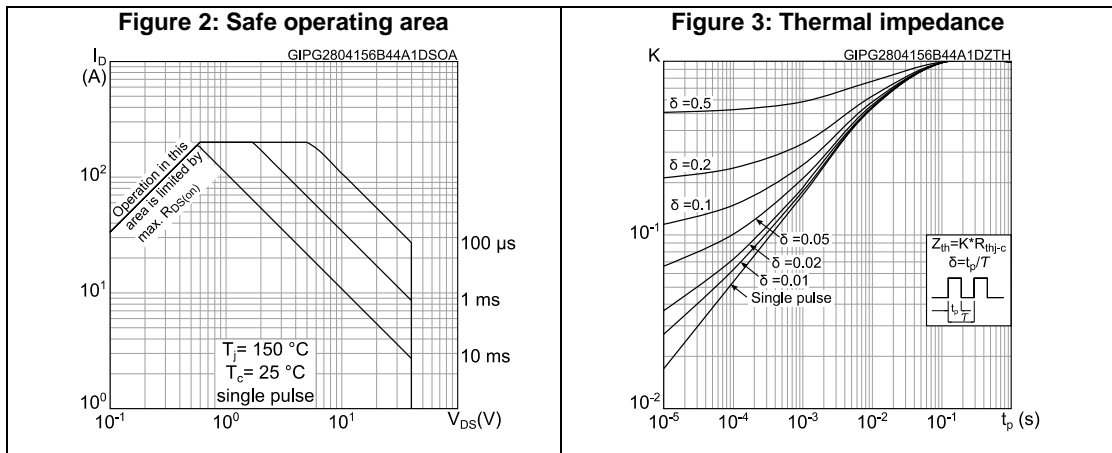
Table 7: Source-drain diode

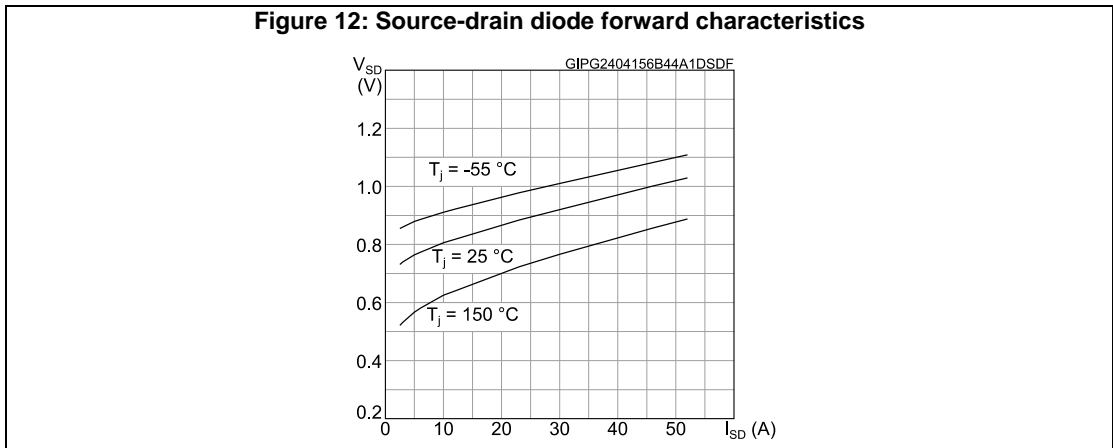
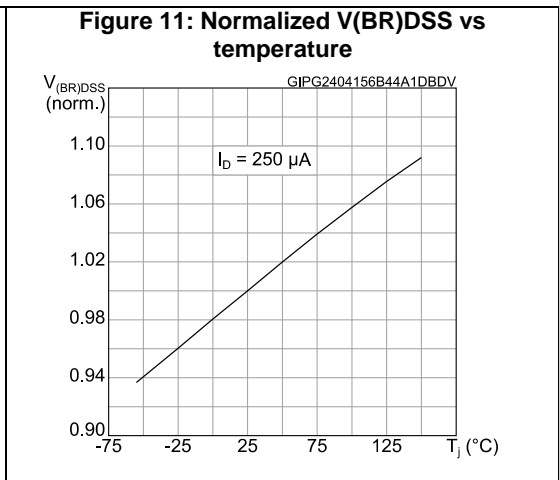
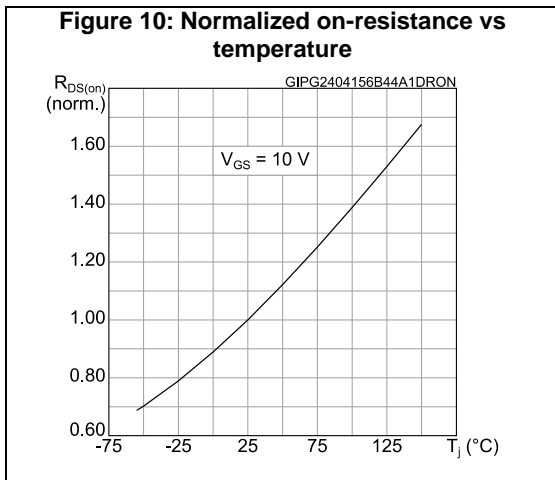
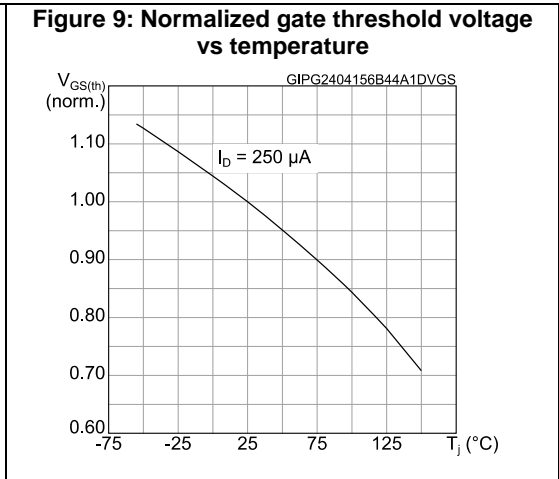
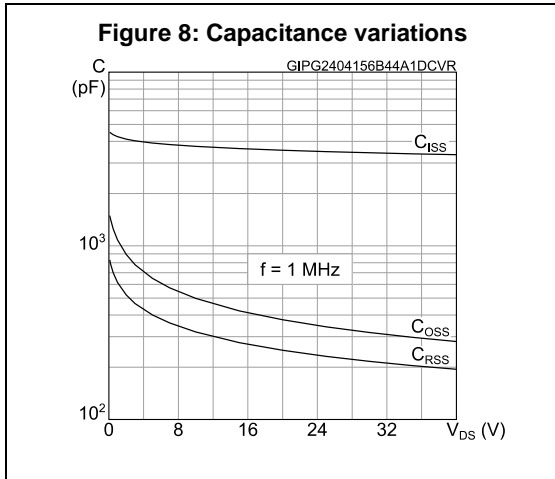
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| I_{SD} | Source-drain current | | - | | -50 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | -200 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = -50\text{ A}$ | - | | -1.3 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = -50\text{ A}$, $di/dt = -100\text{ A}/\mu\text{s}$, $V_{DD} = -32\text{ V}$ (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)





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

3 Test circuits

Figure 13: Switching times test circuit for resistive load

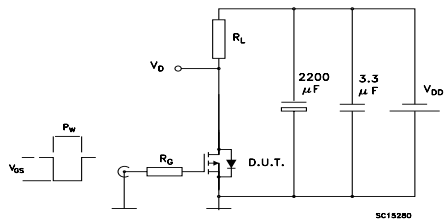


Figure 14: Gate charge test circuit

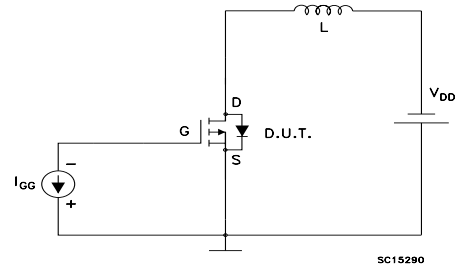
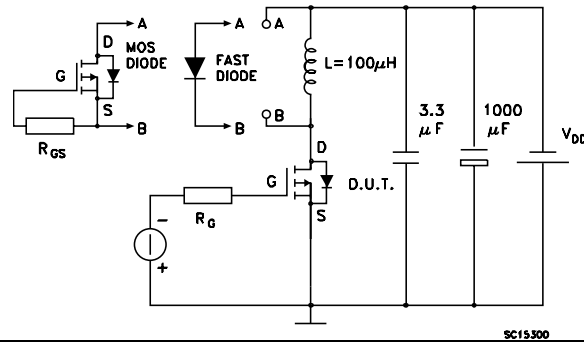


Figure 15: Test circuit for inductive load switching and diode recovery times



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

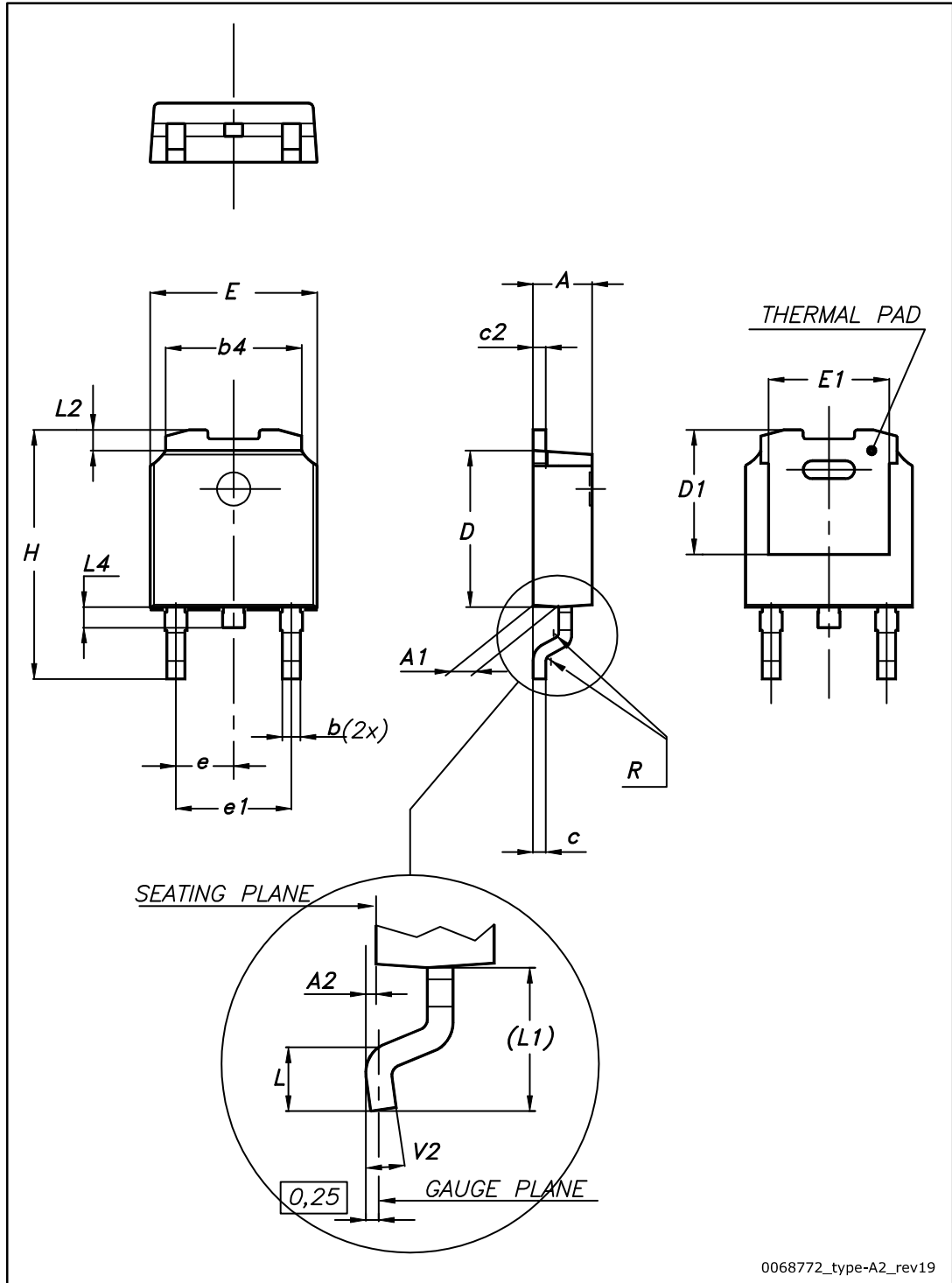
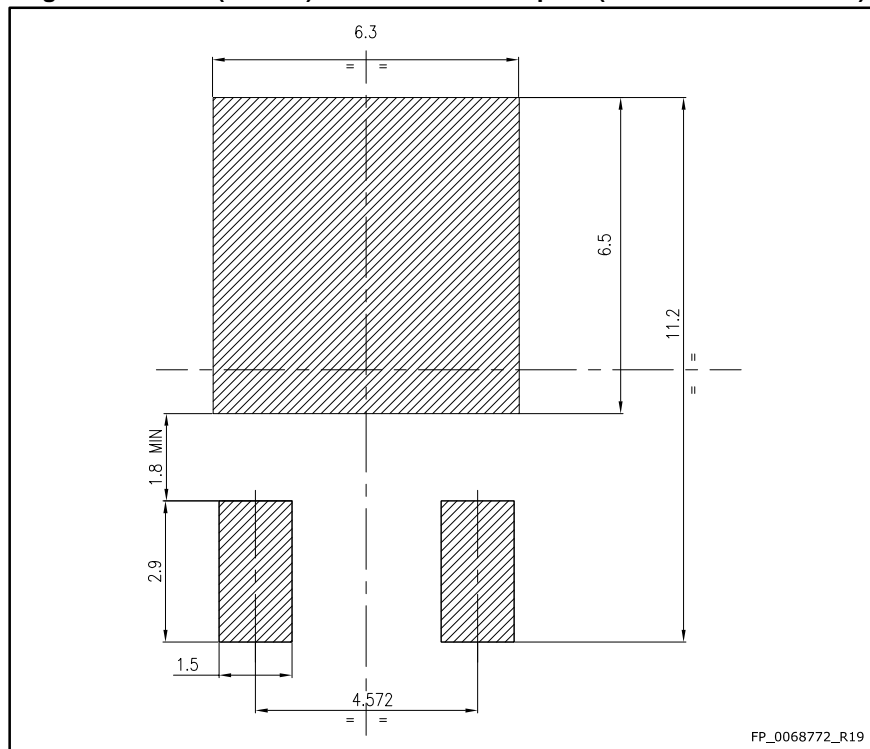


Table 8: DPAK (TO-252) type A2 mechanical data

| 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

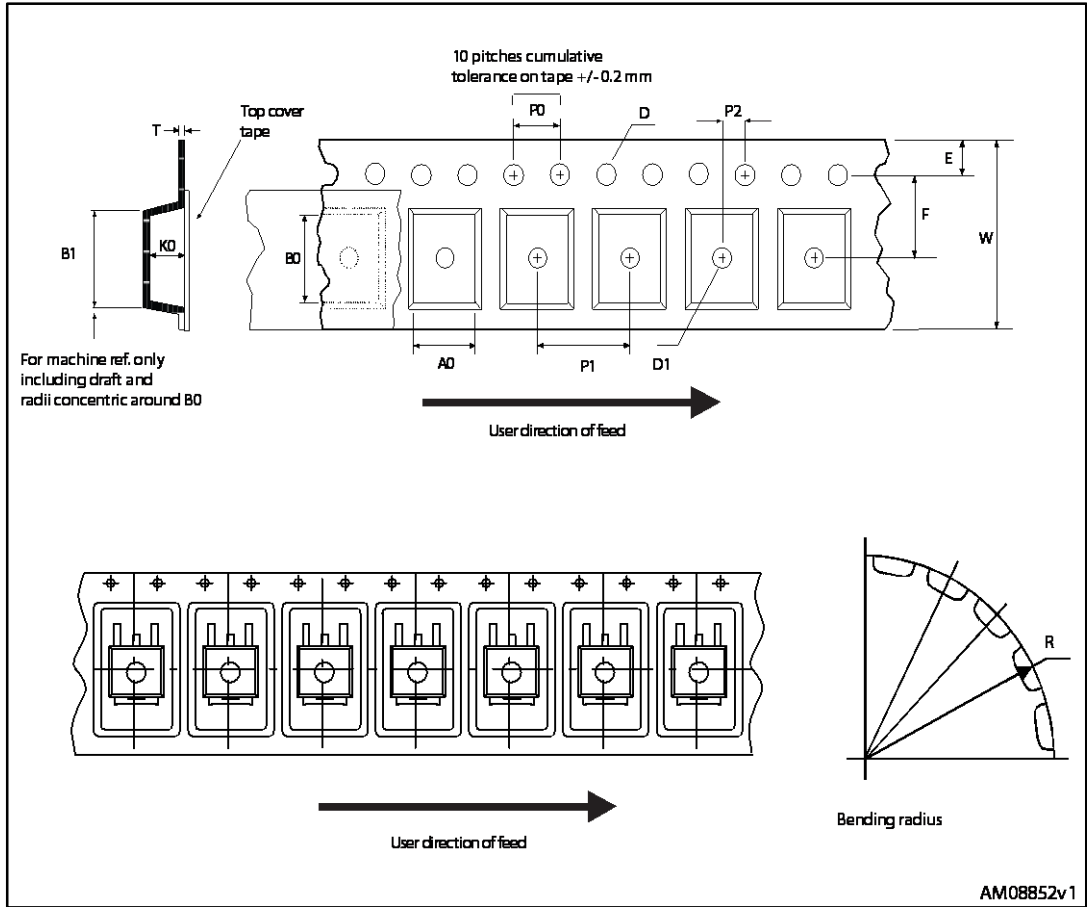


Figure 19: DPAK (TO-252) reel outline

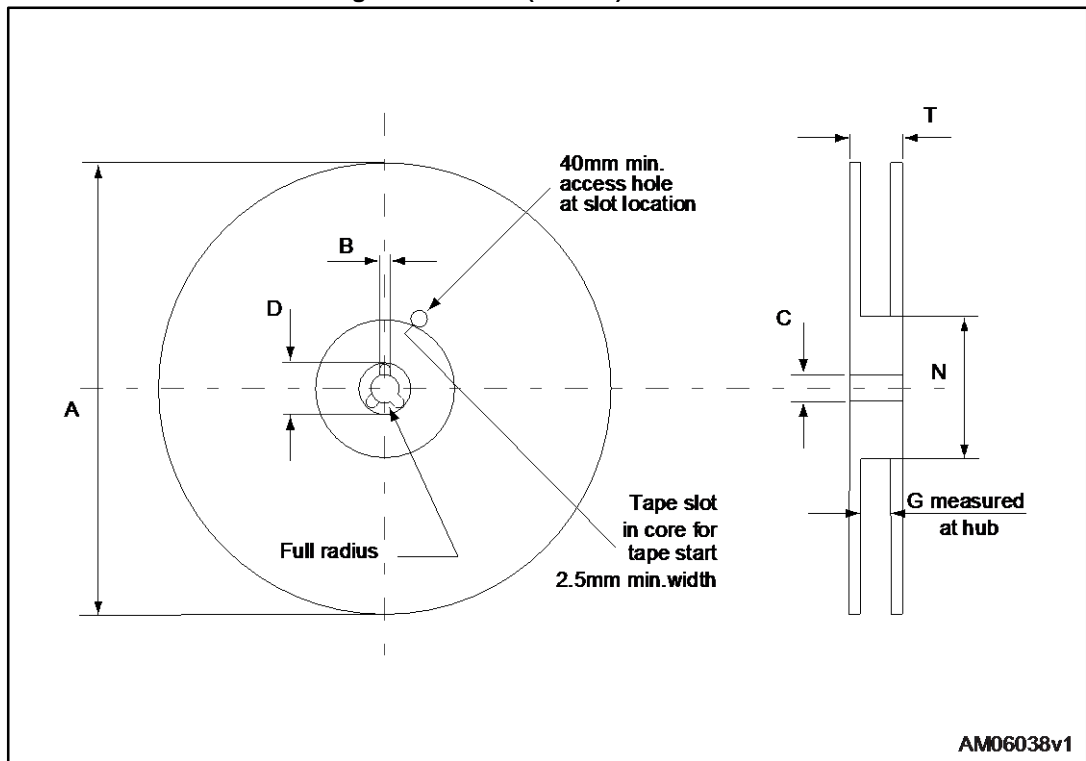


Table 9: DPAK (TO-252) tape and reel mechanical data

| 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 absolute maximum ratings table and static table. Updated: DPAK (TO-252) type A2 package information section updated. Minor text changes. |

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