

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

Datasheet - production data

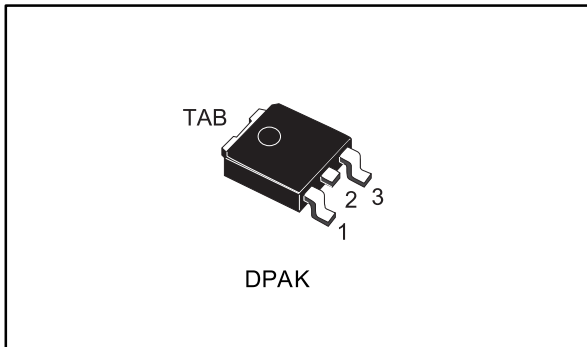
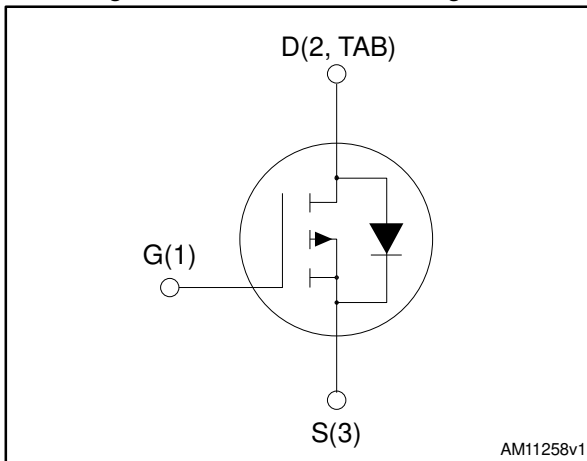


Figure 1: Internal schematic diagram



### Features

| Order code    | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|---------------|-----------------|--------------------------|----------------|
| 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<sub>DS(on)</sub> 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  | $\pm 18$ V | V                |
| $I_D$          | Drain current (continuous) at $T_{case} = 25\text{ }^\circ\text{C}$  | -50        | A                |
|                | Drain current (continuous) at $T_{case} = 100\text{ }^\circ\text{C}$ | -31        |                  |
| $I_{DM}^{(1)}$ | Drain current (pulsed)   | -200       | A                |
| $P_{TOT}$      | Total dissipation at $T_{case} = 25\text{ }^\circ\text{C}$           | 58         | W                |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy  | 160        | mJ               |
| $T_{stg}$      | Storage temperature  | -55 to 150 | $^\circ\text{C}$ |
| $T_j^{(3)}$    | Operating junction temperature                                       |            |                  |

**Notes:**

- (1) Pulse width is limited by safe operating area.  
 (2) starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $R_G = 47\ \Omega$ ,  $I_{D(min)} = -25\text{ A}$ .  
 (3) HTRB performed at  $T_j = 175\text{ }^\circ\text{C}$ ,  $V_{DS} = 100\% V_{(BR)DSS}$ .

**Table 3: Thermal data**

| Symbol         | Parameter                           | Value | Unit               |
|----------------|-------------------------------------|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 2.14  | $^\circ\text{C/W}$ |
| $R_{thj-amb}$  | 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             |
| $I_{\text{DSS}}$            | Zero gate voltage drain current   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = -40\text{ V}$  |      |      | -1   | $\mu\text{A}$ |
|                             |                                   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = -40\text{ V}$ ,<br>$T_{\text{case}} = 125\text{ °C}$ |      |      | -10  |               |
| $I_{\text{GSS}}$            | 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 $\Omega$    |
|                             |                                   | $V_{\text{GS}} = -4.5\text{ V}$ , $I_{\text{D}} = -25\text{ A}$                                      |      | 17   | 20   |               |

**Table 5: Dynamic**

| Symbol           | Parameter                    | Test conditions  | Min. | Typ. | Max. | Unit          |
|------------------|------------------------------|--|------|------|------|---------------|
| $C_{\text{ISS}}$ | Input capacitance            | $V_{\text{DS}} = -25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{\text{GS}} = 0\text{ V}$  | -    | 3525 | -    | $\mu\text{F}$ |
| $C_{\text{OSS}}$ | Output capacitance           |  | -    | 345  | -    |               |
| $C_{\text{RSS}}$ | Reverse transfer capacitance |  | -    | 240  | -    |               |
| $Q_{\text{g}}$   | Total gate charge            | $V_{\text{DD}} = -20\text{ V}$ , $I_{\text{D}} = -50\text{ A}$ ,<br>$V_{\text{GS}} = -10\text{ V}$ (see <a href="#">Figure 14</a> :<br>"Gate charge test circuit") | -    | 65.5 | -    | nC            |
| $Q_{\text{gs}}$  | Gate-source charge           |  | -    | 11.5 | -    |               |
| $Q_{\text{gd}}$  | 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  | $V_{\text{DD}} = -20\text{ V}$ , $I_{\text{D}} = -25\text{ A}$<br>$R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = -10\text{ V}$ (see<br><a href="#">Figure 13</a> : "Switching times test<br>circuit for resistive load") | -    | 12   | -    | ns   |
| $t_{\text{r}}$             | Rise time           |   | -    | 35.5 | -    |      |
| $t_{\text{d}(\text{off})}$ | Turn-off delay time |   | -    | 63.5 | -    |      |
| $t_{\text{f}}$             | Fall time           |   | -    | 31   | -    |      |

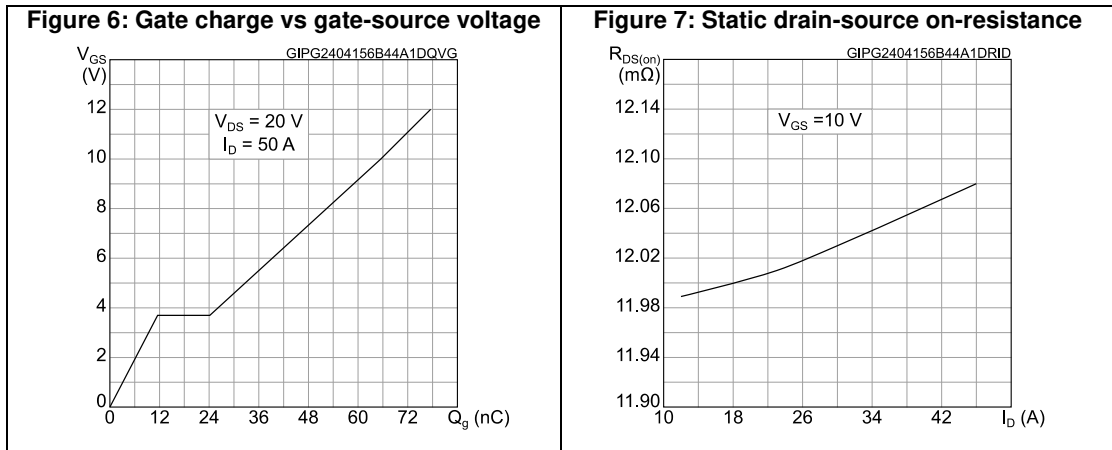
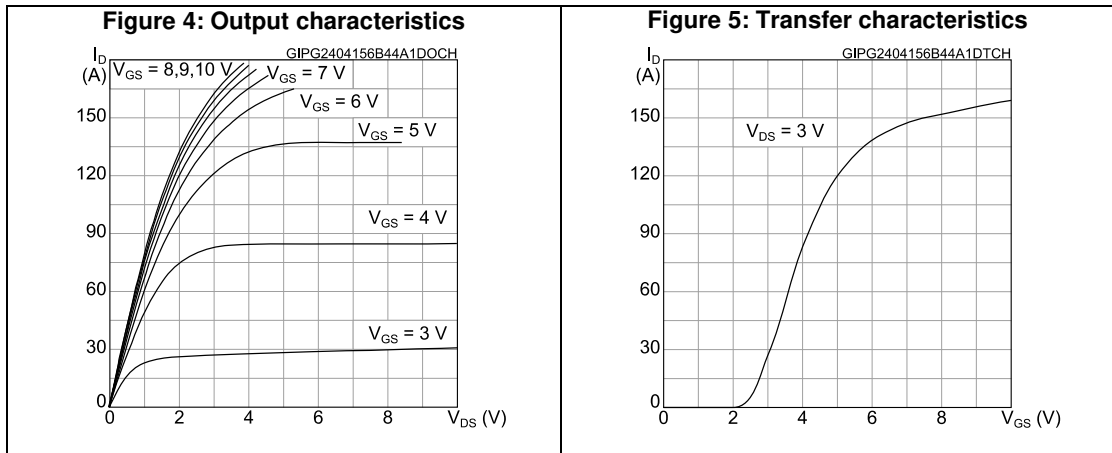
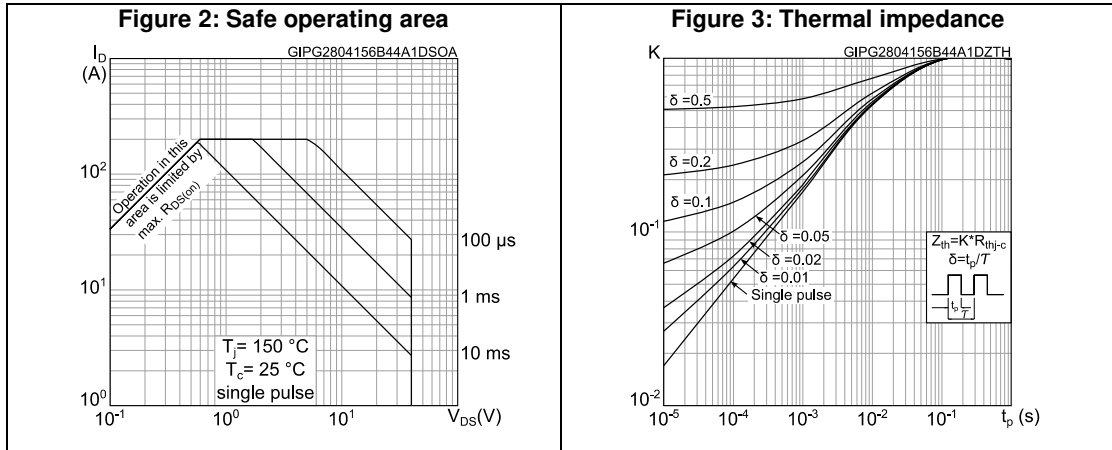
Table 7: Source-drain diode

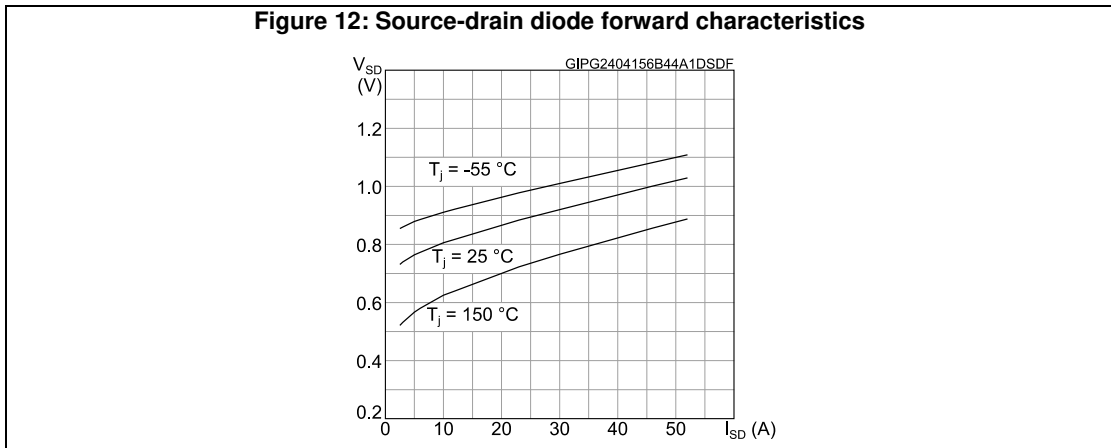
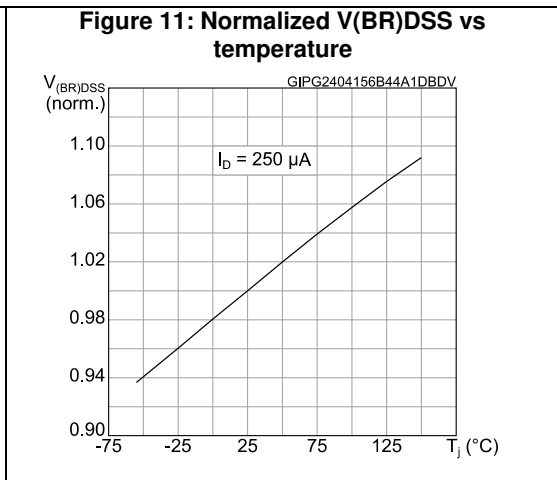
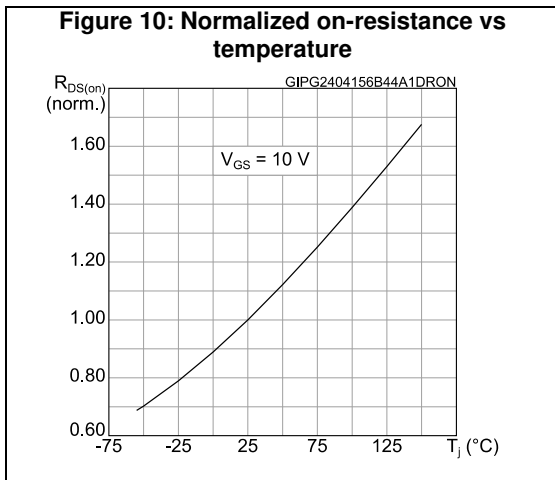
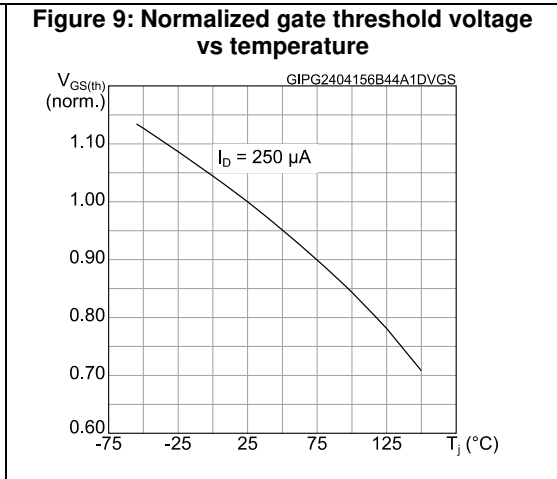
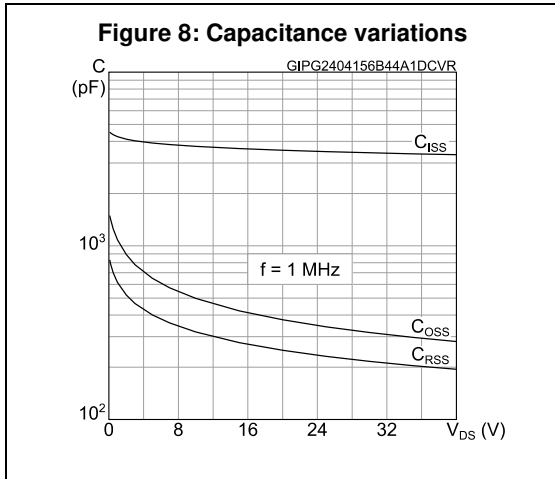
| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| $I_{SD}$        | Source-drain current          |   | -    |      | -50  | A    |
| $I_{SDM}^{(1)}$ | Source-drain 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         | $I_{SD} = -50\text{ A}$ , $di/dt = -100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = -32\text{ V}$ (see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 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  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

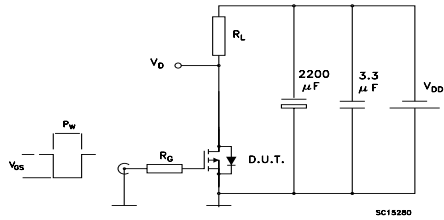




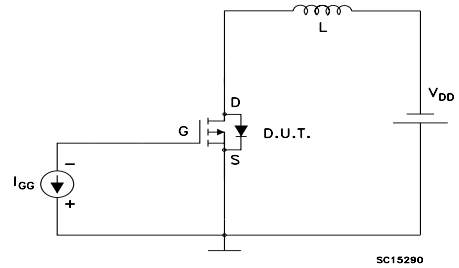
For the P-channel Power MOSFET, current and voltage polarities are reversed.

### 3 Test circuits

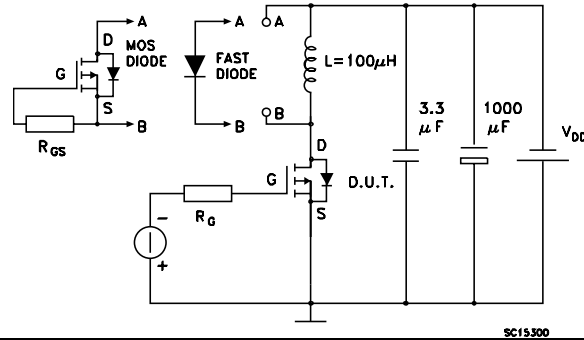
**Figure 13: Switching times test circuit for resistive load**



**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](http://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

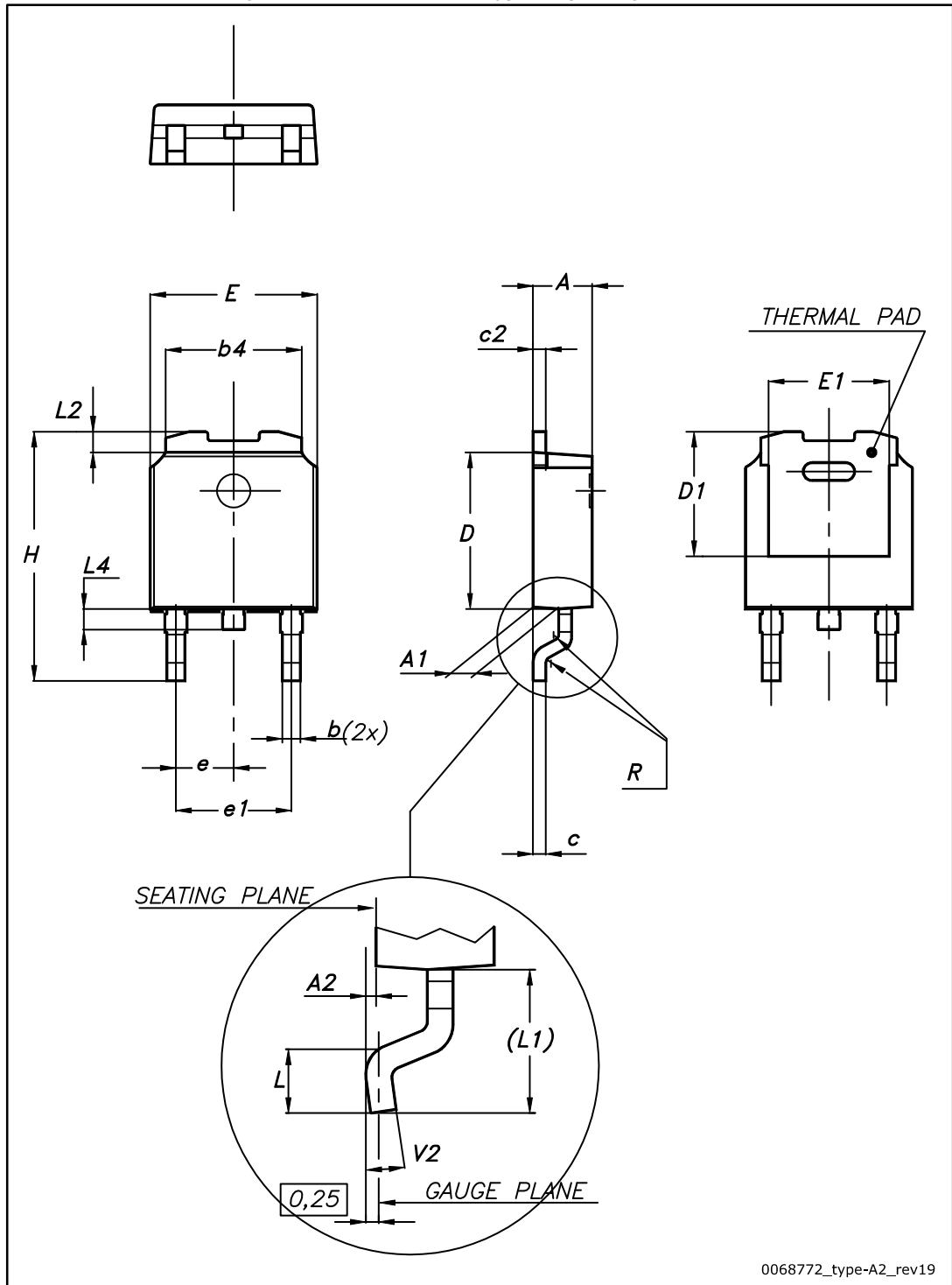
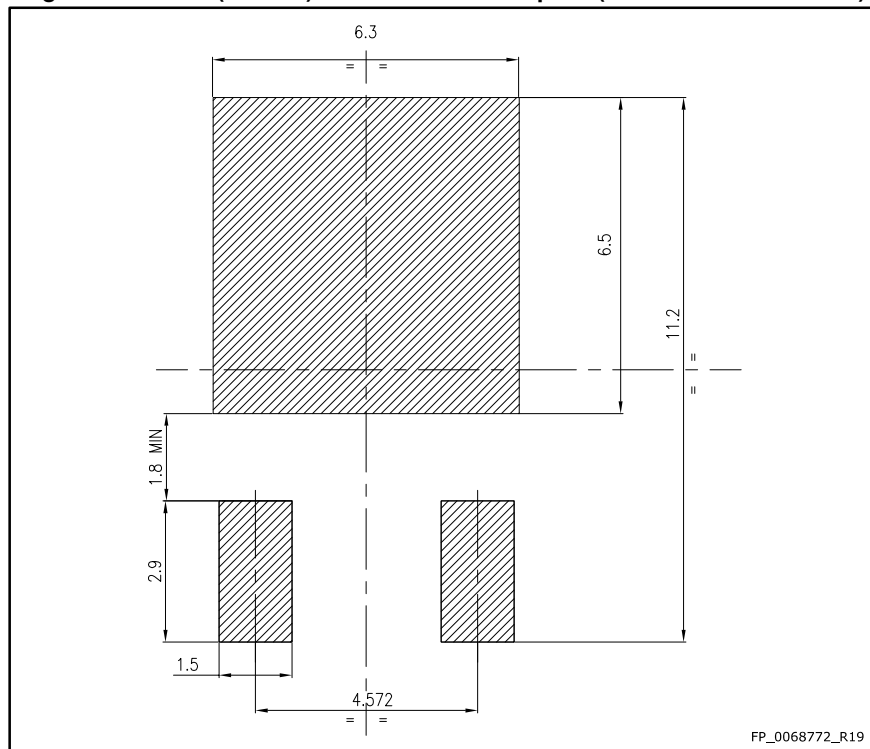


Table 8: DPAK (TO-252) type A2 mechanical data

| 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

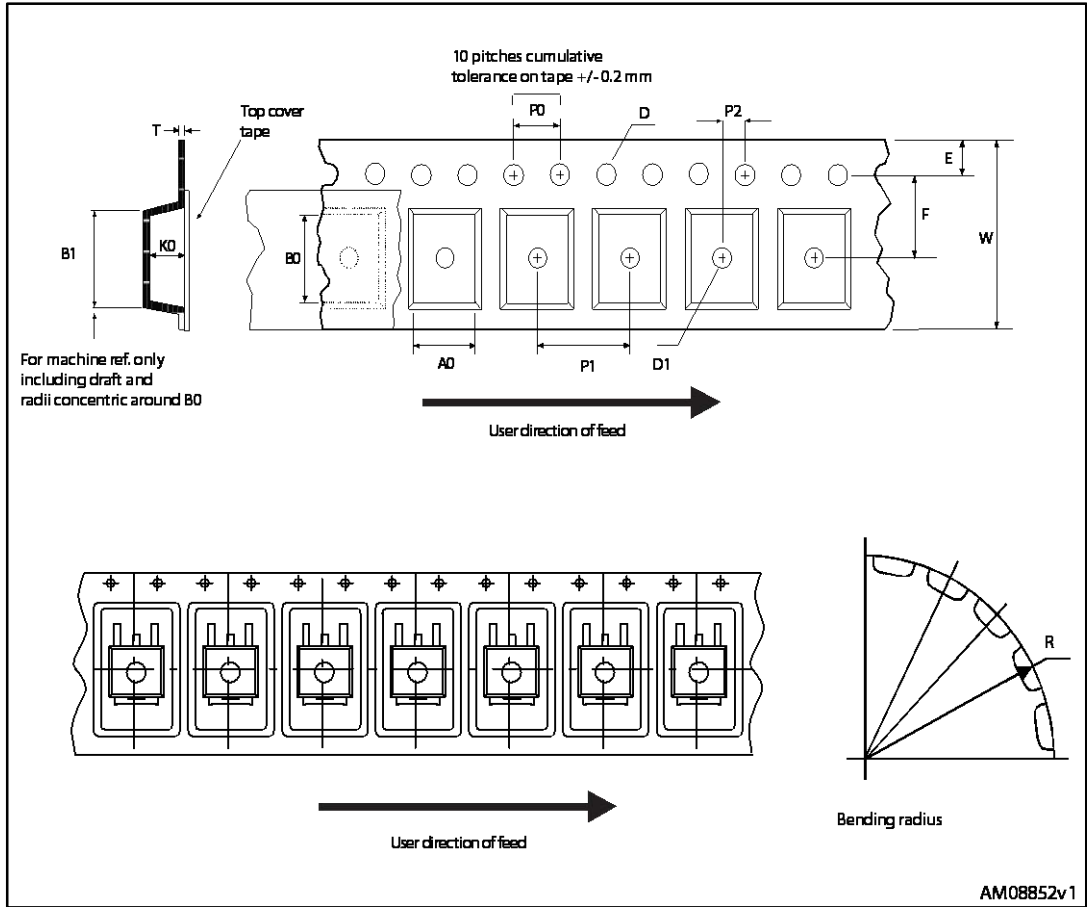


Figure 19: DPAK (TO-252) reel outline

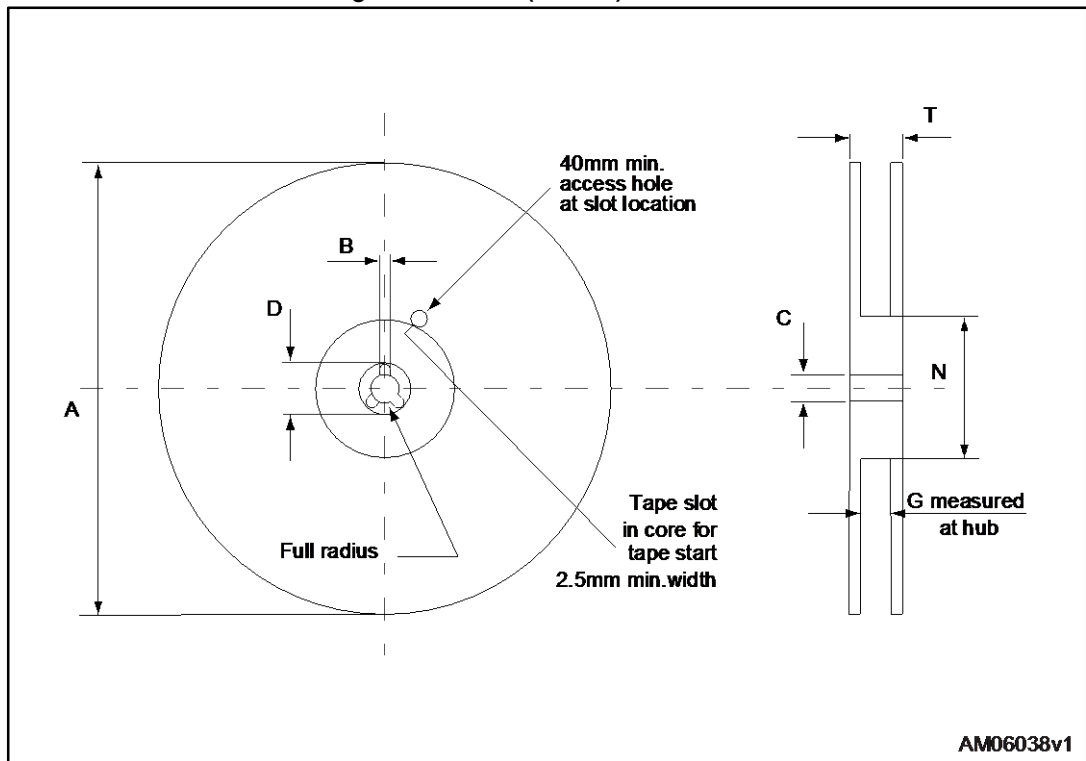


Table 9: DPAK (TO-252) tape and reel mechanical data

| 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.<br>Updated: DPAK (TO-252) type A2 package information section updated.<br>Minor text changes. |

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