

## Automotive-grade P-channel -80 V, 18.5 mΩ typ., -40 A STripFET™ F6 Power MOSFET in a DPAK package

Datasheet - production data

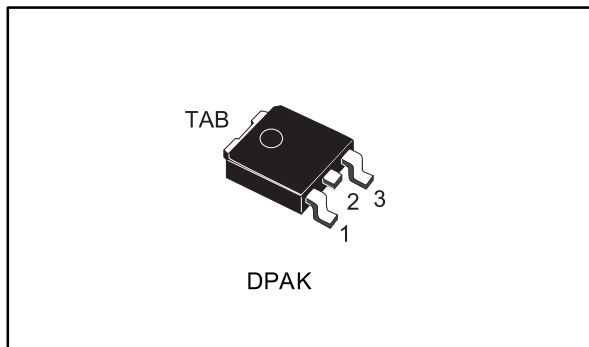
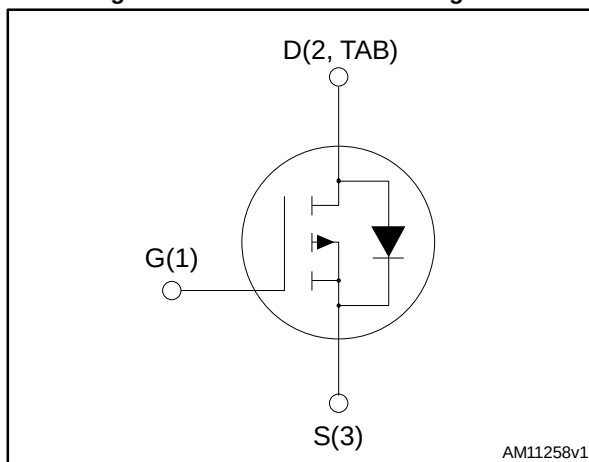


Figure 1: Internal schematic diagram



### Features

| Order code  | V <sub>DSS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|-------------|------------------|--------------------------|----------------|
| STD40P8F6AG | -80 V            | 28 mΩ                    | -40 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       |
|-------------|---------|---------|---------------|
| STD40P8F6AG | 40P8F6  | DPAK    | Tape and reel |

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## Contents

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol         | Parameter                                                                                                                     | Value      | Unit               |
|----------------|-------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|
| $V_{DS}$       | Drain-source voltage                                                                                                          | -80        | V                  |
| $V_{GS}$       | Gate-source voltage                                                                                                           | $\pm 20$   | V                  |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$                                                              | -40        | A                  |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$                                                             | -28        | A                  |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                                                                        | -160       | A                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$                                                                       | 100        | W                  |
| $E_{AS}$       | Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$ , $I_D = -40\text{ A}$ , $V_{DD} = -60\text{ V}$ ) | 240        | mJ                 |
| $T_{stg}$      | Storage temperature range                                                                                                     | -55 to 175 | $^{\circ}\text{C}$ |
| $T_J$          | Junction temperature range                                                                                                    |            |                    |

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

Table 3: Thermal data

| Symbol         | Parameter                                          | Value | Unit                 |
|----------------|----------------------------------------------------|-------|----------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max               | 1.5   | $^{\circ}\text{C/W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max <sup>(1)</sup> | 50    | $^{\circ}\text{C/W}$ |

**Notes:**

<sup>(1)</sup>When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

## 2 Electrical characteristics

(T<sub>C</sub> = 25 °C unless otherwise specified)

Table 4: Static

| Symbol               | Parameter                         | Test conditions                                                                        | Min. | Typ. | Max. | Unit |
|----------------------|-----------------------------------|----------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage    | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -1 mA                                          | -80  |      |      | V    |
| I <sub>DSS</sub>     | Zero gate voltage Drain current   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -60 V                                         |      |      | -1   | μA   |
|                      |                                   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -60 V, T <sub>C</sub> = 125 °C <sup>(1)</sup> |      |      | -10  | μA   |
| I <sub>GSS</sub>     | Gate-body leakage current         | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V                                         |      |      | ±100 | nA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA                           | -2   |      | -4   | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -20 A                                        |      | 18.5 | 28   | mΩ   |

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

Table 5: Dynamic

| Symbol           | Parameter                    | Test conditions                                                                                                                       | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| C <sub>iss</sub> | Input capacitance            | V <sub>DS</sub> = -25 V, f = 1 MHz, V <sub>GS</sub> = 0 V                                                                             | -    | 4112 | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                                                                                       | -    | 366  | -    | pF   |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                                                                                       | -    | 188  | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = -40 V, I <sub>D</sub> = -40 A, V <sub>GS</sub> = -10 V (see <a href="#">Figure 14: "Gate charge test circuit"</a> ) | -    | 73   | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           |                                                                                                                                       | -    | 17.1 | -    | nC   |
| Q <sub>gd</sub>  | Gate-drain charge            |                                                                                                                                       | -    | 18   | -    | nC   |

Table 6: Switching times

| Symbol       | Parameter           | Test conditions                                                                                                                                                                          | Min. | Typ. | Max. | Unit |
|--------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = -40\text{ V}$ , $I_D = -20\text{ A}$ , $R_G = 4.7\ \Omega$ ,<br>$V_{GS} = -10\text{ V}$ (see <a href="#">Figure 13</a> :<br>"Switching times test circuit for resistive load") | -    | 17.5 | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                                                                          | -    | 28.5 | -    | ns   |
| $t_{d(off)}$ | Turn-off-delay time |                                                                                                                                                                                          | -    | 68.5 | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                                                                          | -    | 34.5 | -    | ns   |

Table 7: Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                    | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                    | -    |      | -40  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                    | -    |      | -160 | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = -40\text{ A}$                                                                                                                                                    | -    |      | -1.2 | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = -40\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = -64\text{ V}$ , (see <a href="#">Figure 15</a> : "Test circuit for inductive load switching and diode recovery times") | -    | 35   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                    | -    | 44   |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                    | -    | -2.5 |      | A    |

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

<sup>(2)</sup>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.

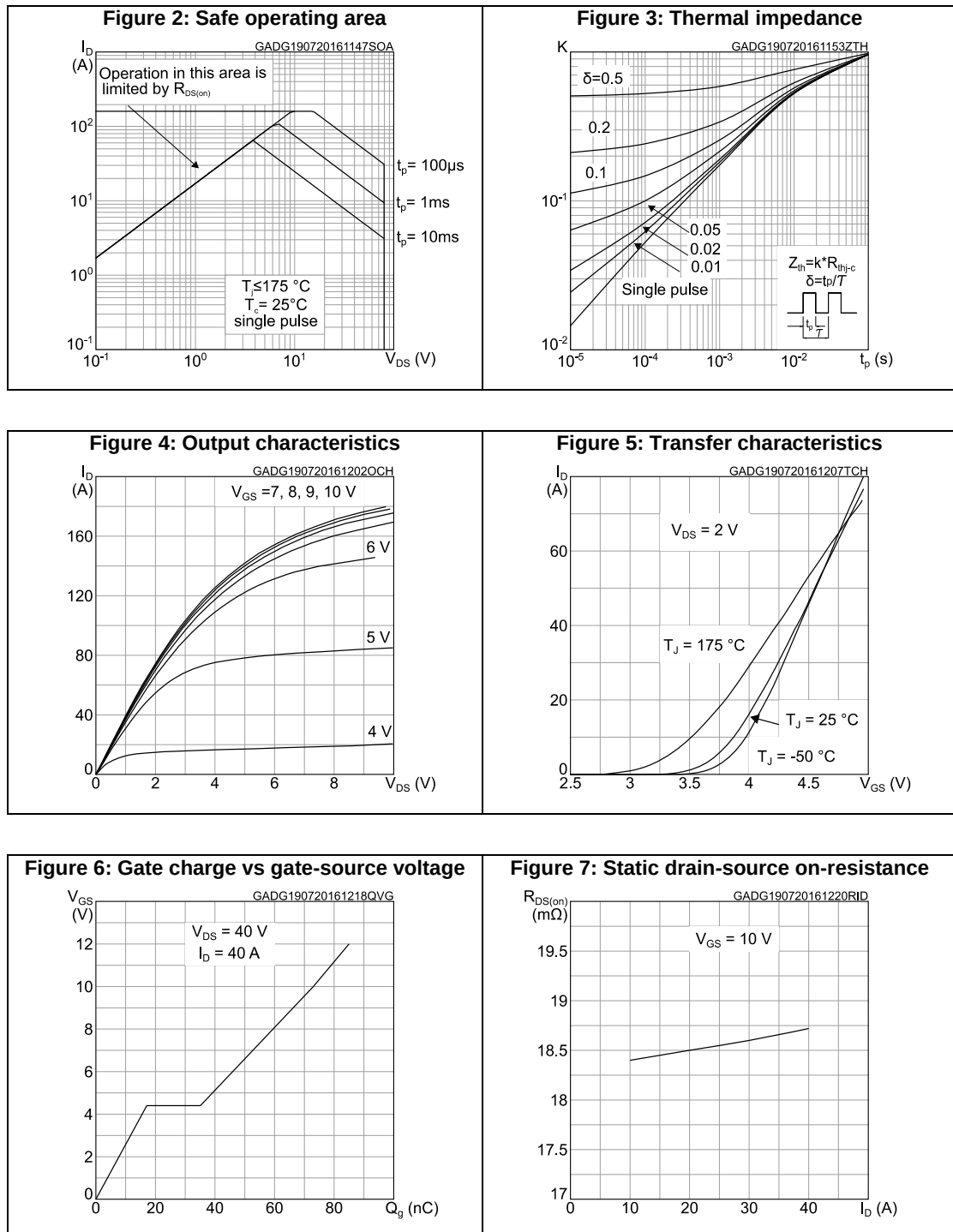


Figure 8: Capacitance variations

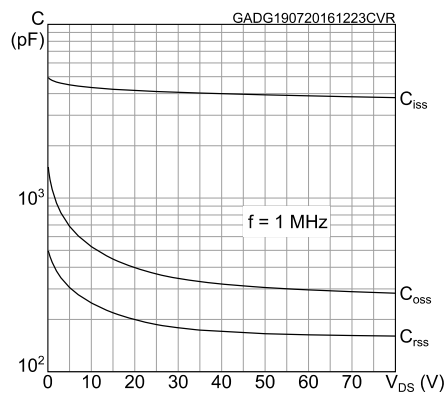
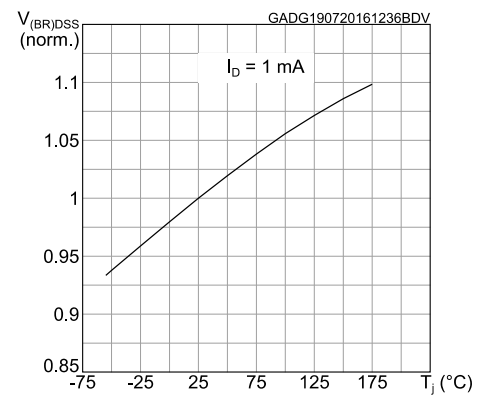
Figure 9: Normalized  $V_{(BR)DSS}$  vs temperature

Figure 10: Normalized gate threshold voltage vs temperature

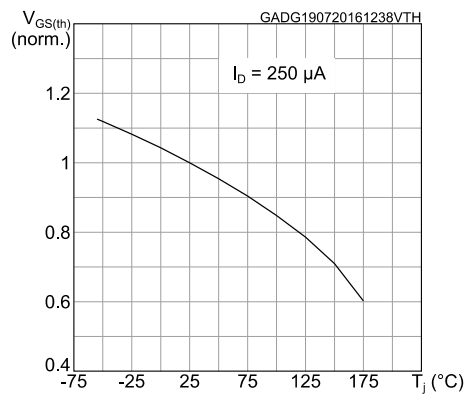


Figure 11: Normalized on-resistance vs temperature

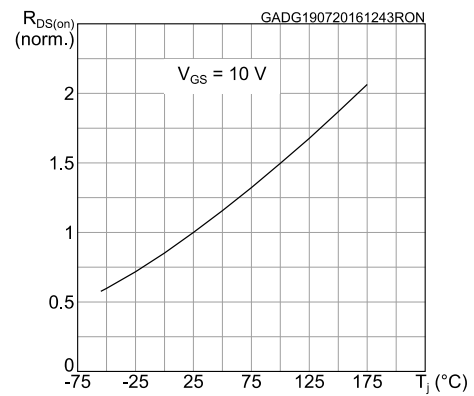
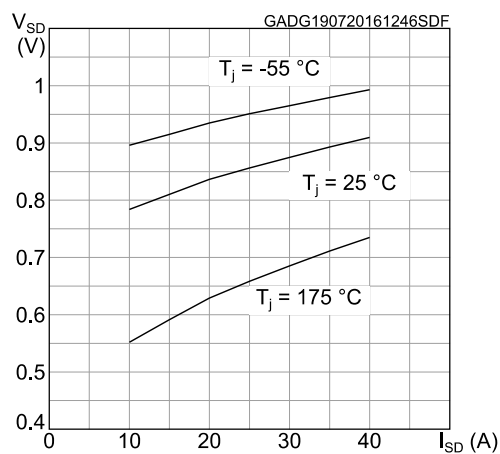


Figure 12: Source-drain diode forward characteristics



### 3 Test circuits

Figure 13: Switching times test circuit for resistive load

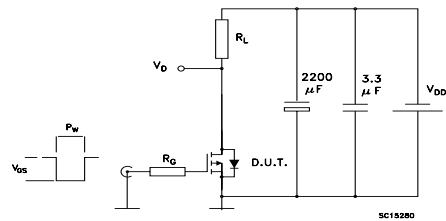


Figure 14: Gate charge test circuit

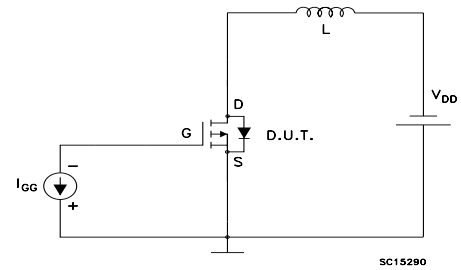
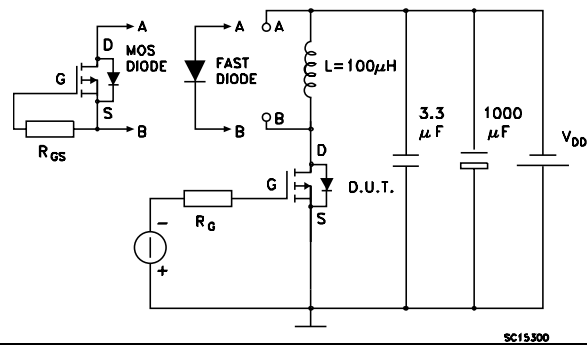


Figure 15: Test circuit for inductive load switching and diode recovery times





## 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 type A2 package information

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

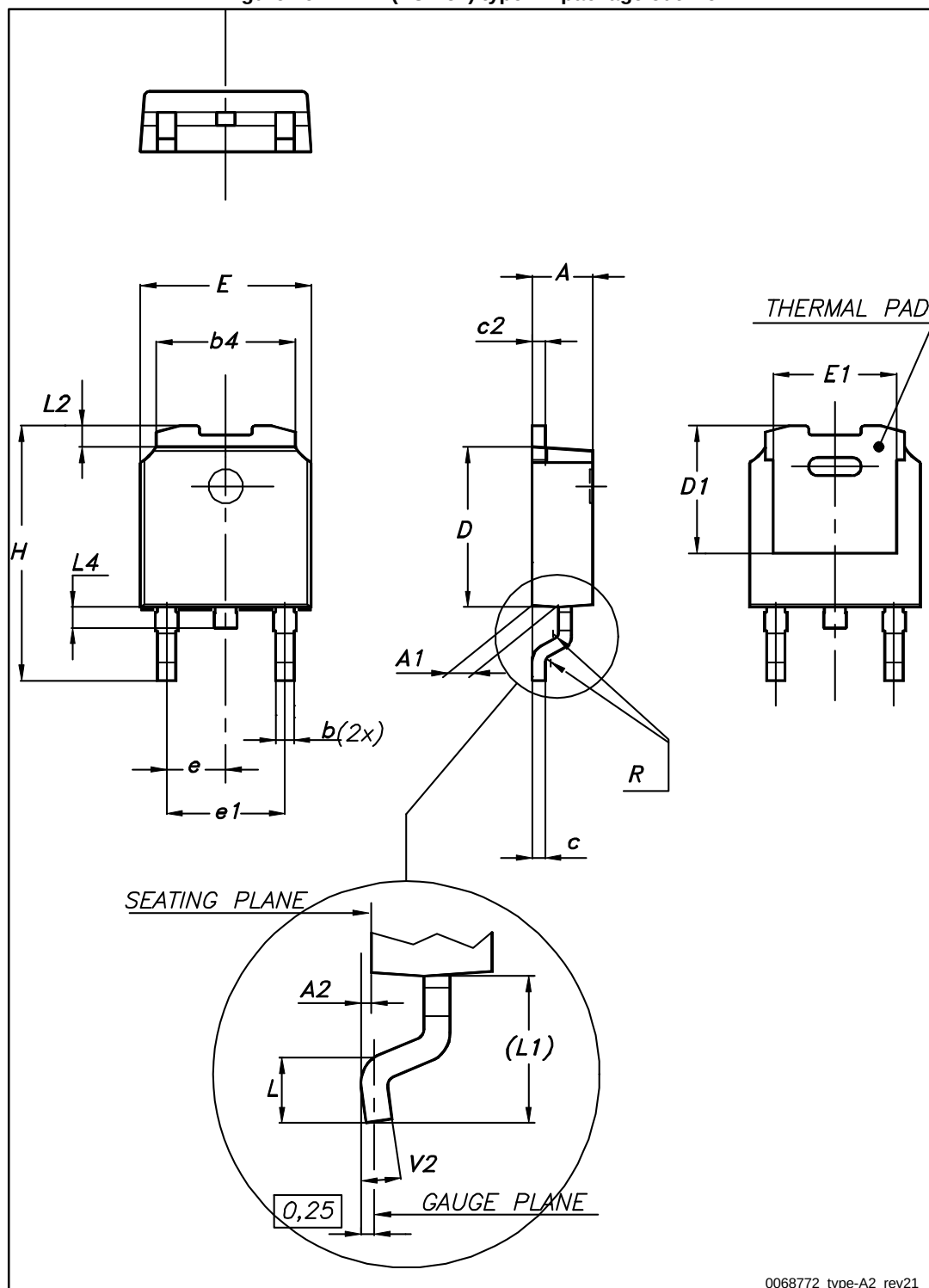
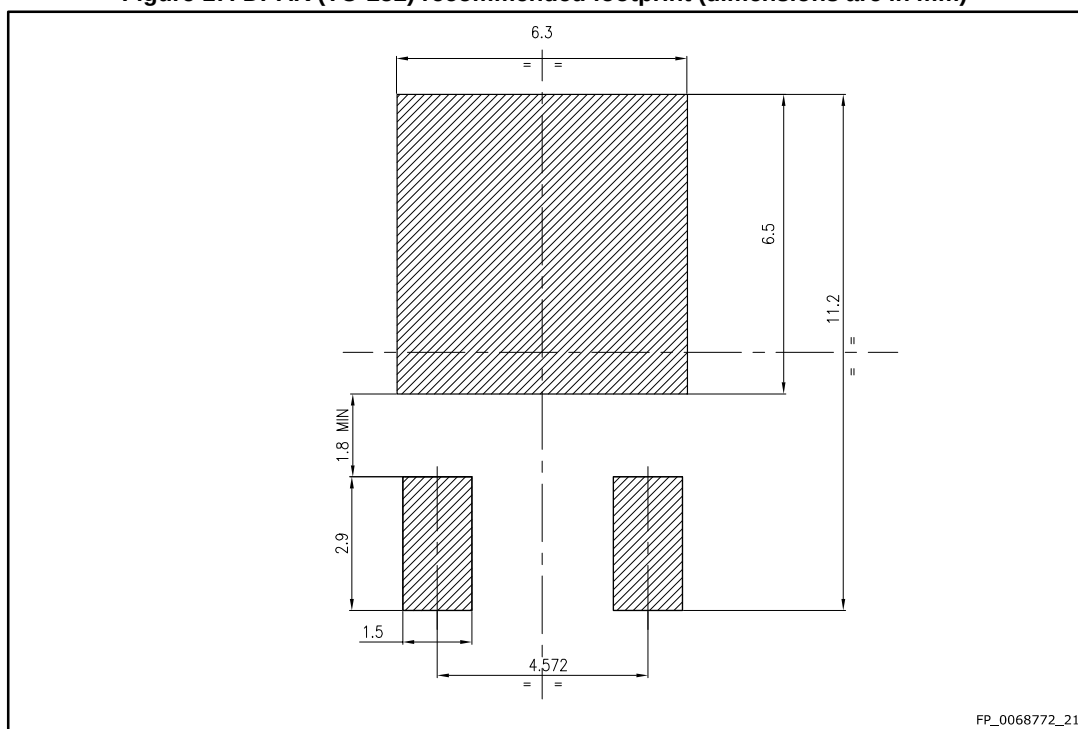


Table 8: DPAK (TO-252) type A2 mechanical data

| 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 packing information

Figure 18: DPAK (TO-252) tape outline

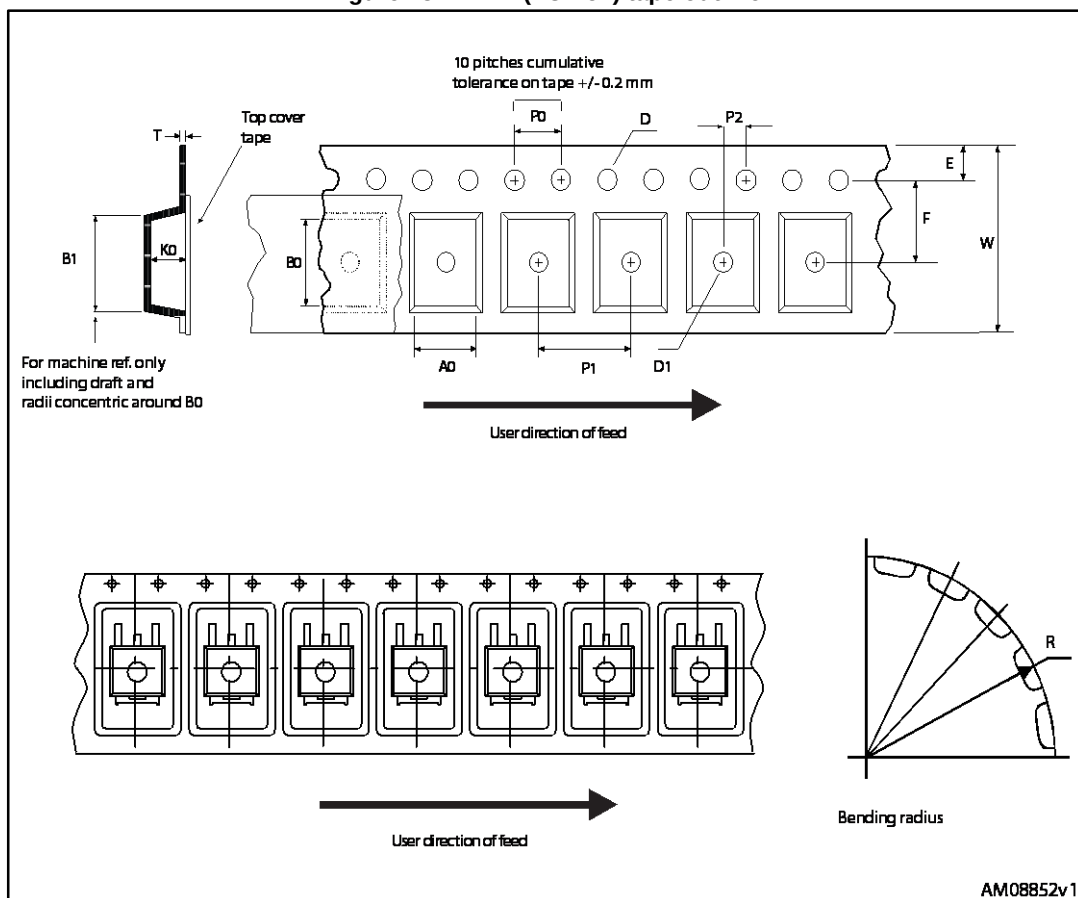


Figure 19: DPAK (TO-252) reel outline

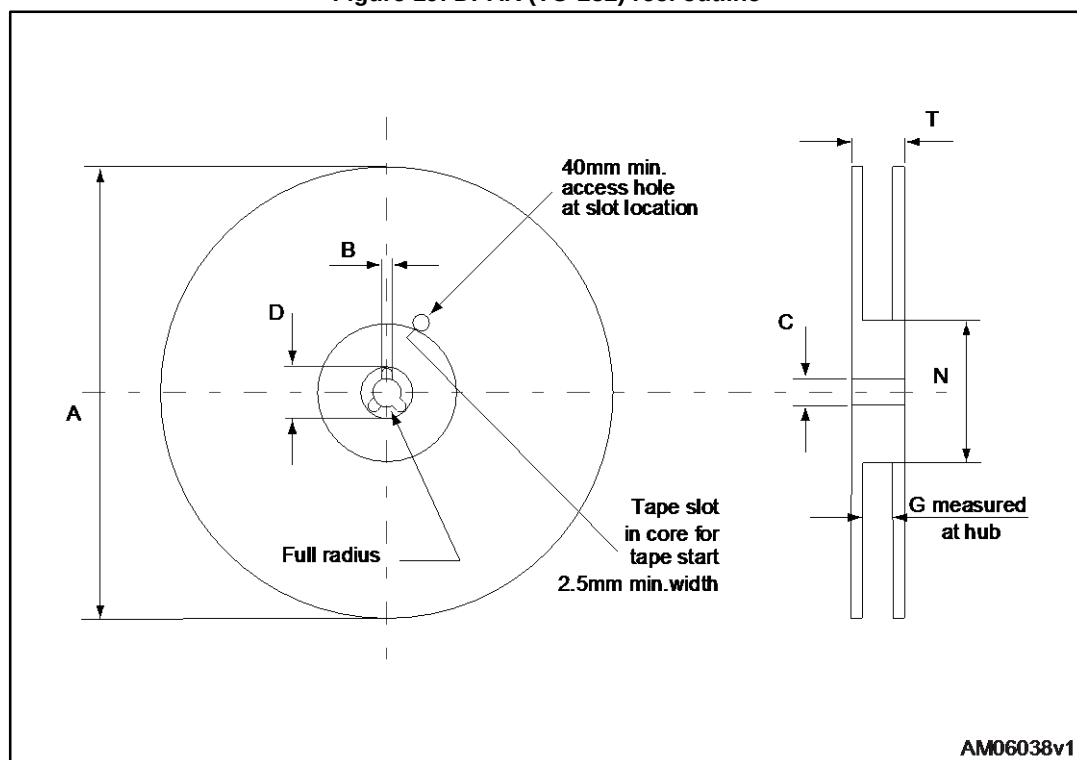


Table 9: DPAK (TO-252) tape and reel mechanical data

| 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        |
|-------------|----------|----------------|
| 19-Jul-2016 | 1        | First release. |

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