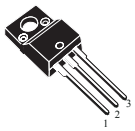
# STB8N65M5, STD8N65M5, STF8N65M5

Datasheet

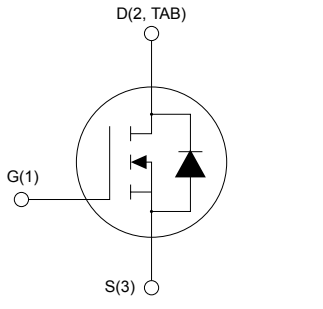
## N-channel 650 V, 560 mΩ typ., 7 A MDmesh M5 Power MOSFETs in a D²PAK, DPAK and TO-220FP packages


D²PAK


DPAK




TO-220FP




STPOWER

## Features

| Order codes | $V_{DS}$ @ $T_J$ max. | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STB8N65M5 | 710 V | 600 mΩ | 7 A | 70 W |
| STD8N65M5 | | | | 70 W |
| STF8N65M5 | | | | 25 W |

- 100% avalanche tested
- Excellent switching performance
- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

| Product status links |
|---|
| STB8N65M5 |
| STD8N65M5 |
| STF8N65M5 |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | D²PAK | DPAK | TO-220FP | |
| $V_{GS}$ | Gate-source voltage | ±25 | | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 7 | | 7(1) | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 4.4 | | 4.4(1) | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 28 | | 28(1) | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 70 | | 25 | W |
| dv/dt (3) | Peak diode recovery voltage slope | 15 | | | V/ns |
| $V_{ISO}$ | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C$ = 25 °C) | | | 2.5 | kV |
| $T_j$ | Operating junction temperature range | -55 to 150 | | | °C |
| $T_{stg}$ | Storage temperature range | | | | |

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *$I_{SD}$ ≤ 7 A, di/dt ≤ 400 A/µs; $V_{DS}$ (peak) < $V_{(BR)DSS}$, $V_{DD}$ = 400 V.*

**Table 2. Thermal data**

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | D²PAK | DPAK | TO-220FP | |
| $R_{thJC}$ | Thermal resistance, junction-to-case | 1.79 | | 5 | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 30(1) | 50(1) | 62.5 | °C/W |

1. *When mounted on a standard 1 inch² area of FR-4 PCB with 2-oz copper.*

**Table 3. Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_J$ max.) | 2 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 120 | mJ |

# 2 Electrical characteristics

$T_C$ = 25 °C unless otherwise specified.

**Table 4. On/off states**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D$ = 1 mA, $V_{GS}$ = 0 V | 650 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 650 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 650 V, $T_C$ = 125 °C(1) | | | 100 | µA |
| $I_{GSS}$ | Gate body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±25 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 3.5 A | | 560 | 600 | mΩ |

1. *Specified by design, not tested in production.*

**Table 5. Dynamic**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 100 V, f = 1 MHz, $V_{GS}$ = 0 V | | 690 | | pF |
| $C_{oss}$ | Output capacitance | | | 18 | | |
| $C_{rss}$ | Reverse transfer capacitance | | | 2 | | |
| $C_{o(tr)}$ (1) | Equivalent output capacitance time related | $V_{DS}$ = 0 to 520 V, $V_{GS}$ = 0 V | | 17 | | pF |
| $C_{o(er)}$ (2) | Equivalent output capacitance energy related | | | 52 | | pF |
| $R_g$ | Gate input resistance | f = 1 MHz open drain | 2(3) | 5 | 8(3) | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 520 V, $I_D$ = 3.5 A, $V_{GS}$ = 0 to 10 V (see Figure 18. Test circuit for gate charge behavior) | | 15 | | nC |
| $Q_{gs}$ | Gate-source charge | | | 3.6 | | |
| $Q_{gd}$ | Gate-drain charge | | | 6 | | |

1. *$C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as Coss while $V_{DS}$ is rising from 0 V to the stated value.*
2. *$C_{o(er)}$ is an equivalent capacitance that provides the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 V to the stated value.*
3. *Specified by design, not tested in production.*

**Table 6. Switching times**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(off)}$ | Turn-off delay time | $V_{DD}$ = 400 V, $I_D$ = 4 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see Figure 19. Test circuit for inductive load switching and diode recovery times and Figure 22. Switching time waveform) | - | 50 | - | ns |
| $t_{r(v)}$ | Voltage rise time | | - | 14 | - | |
| $t_{c(off)}$ | Crossing time off | | - | 20 | - | |
| $t_{f(i)}$ | Current fall time | | - | 11 | - | |

**Table 7. Source-drain diode**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 7 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 28 | |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 7 A, $V_{GS}$ = 0 V | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 7 A, di/dt = 100 A/µs | - | 200 | | ns |
| $Q_{rr}$ | Reverse recovery charge | $V_{DD}$ = 100 V (see Figure 19. Test circuit for inductive load switching and diode recovery times) | - | 1.6 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 16 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 7 A, di/dt = 100 A/µs | - | 263 | | ns |
| $Q_{rr}$ | Reverse recovery charge | $V_{DD}$ = 100 V, $T_J$ = 150 °C (see Figure 19. Test circuit for inductive load switching and diode recovery times) | - | 1.9 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 15 | | A |

1. *Pulse width limited by safe operating area.*
2. *Pulsed: pulse duration = 300 µs, duty cycle 1.5%.*

## 2.1 Electrical characteristics (curves)

**Figure 1. Safe operating area for D²PAK**

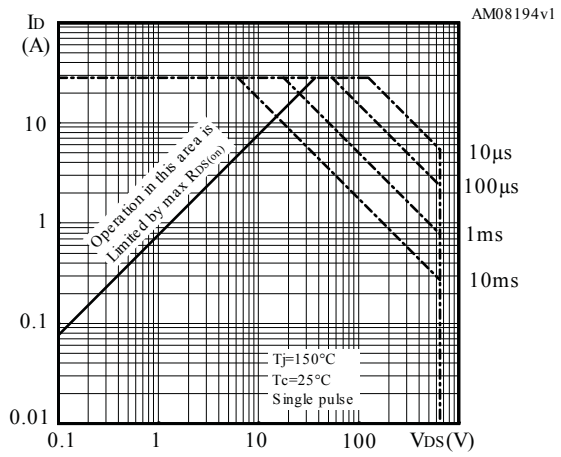



**Figure 2. Thermal impedance for D²PAK**

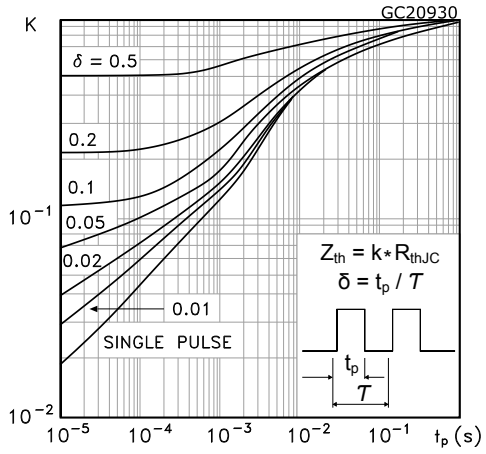



**Figure 3. Safe operating area for DPAK**

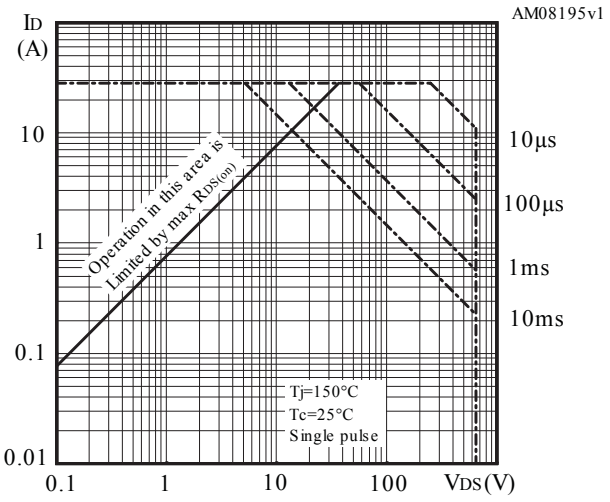



**Figure 4. Thermal impedance for DPAK**

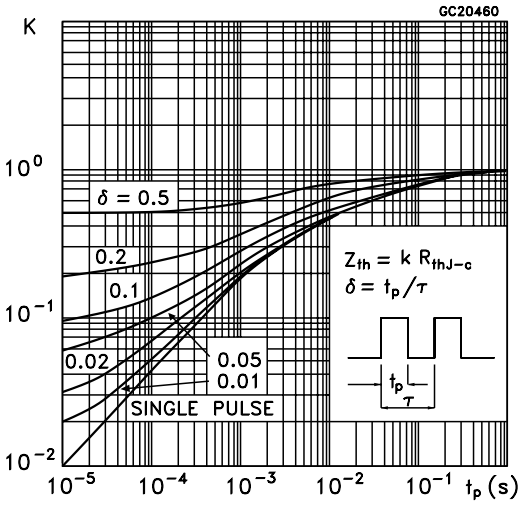



**Figure 5. Safe operating area for TO-220FP**

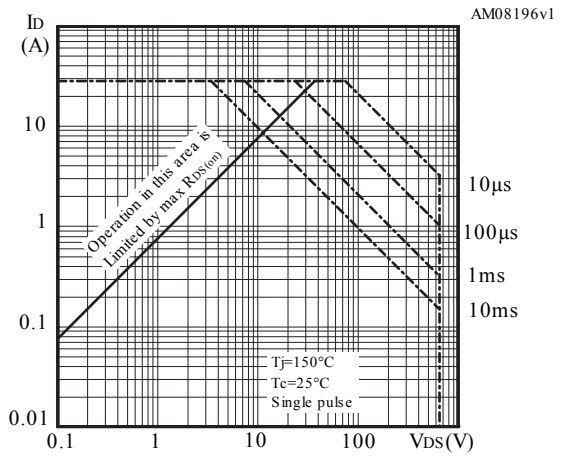



**Figure 6. Thermal impedance for TO-220FP**

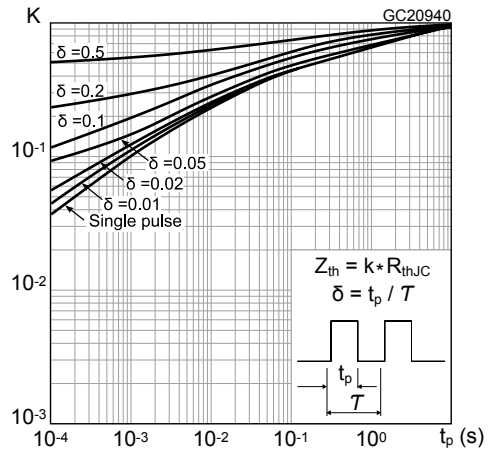


**Figure 7. Output characteristics**

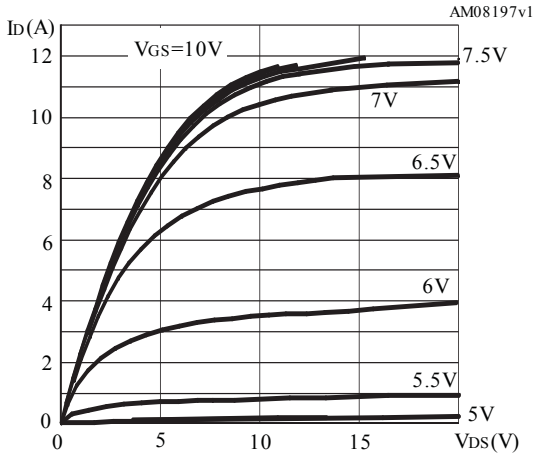



**Figure 8. Transfer characteristics**

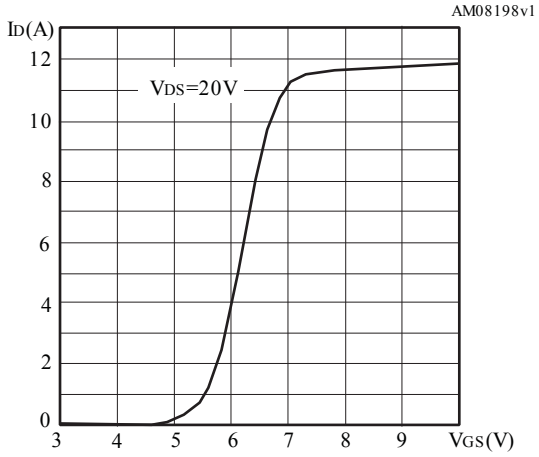



**Figure 9. Gate charge vs gate-source voltage**

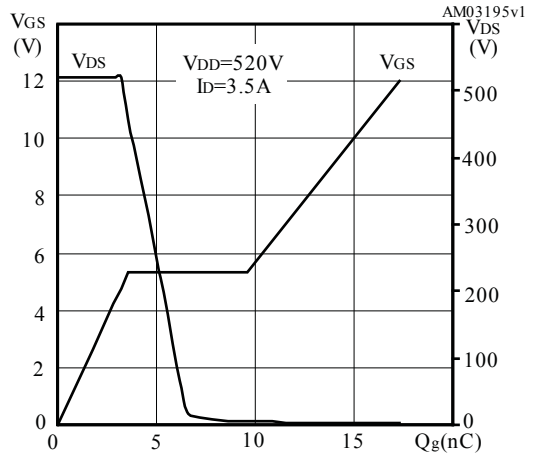



**Figure 10. Static drain-source on-resistance**

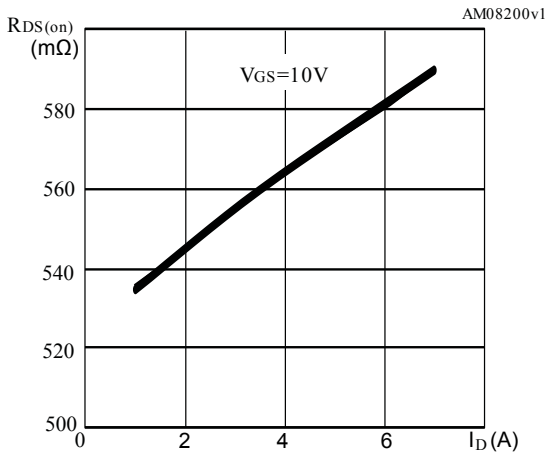



**Figure 11. Capacitance variations**

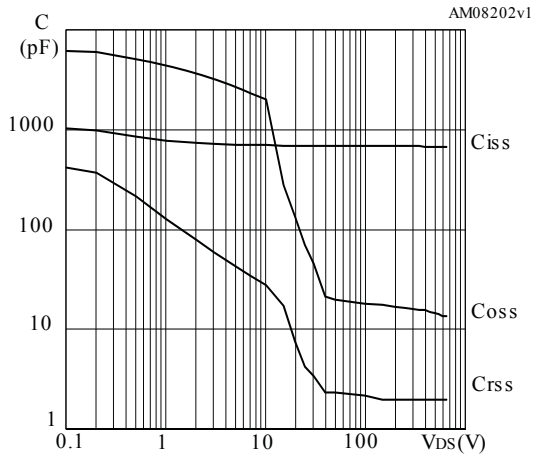



**Figure 12. Output capacitance stored energy**

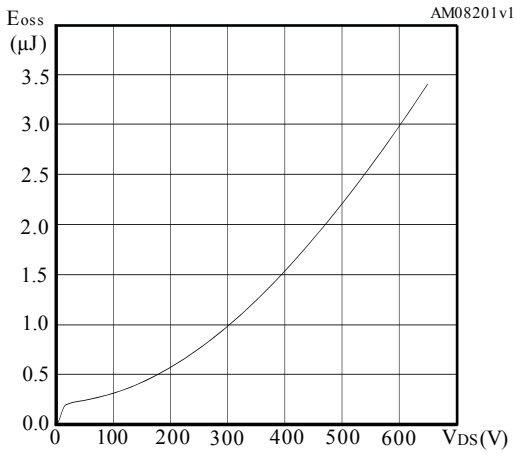


**Figure 13. Normalized gate threshold voltage vs temperature**

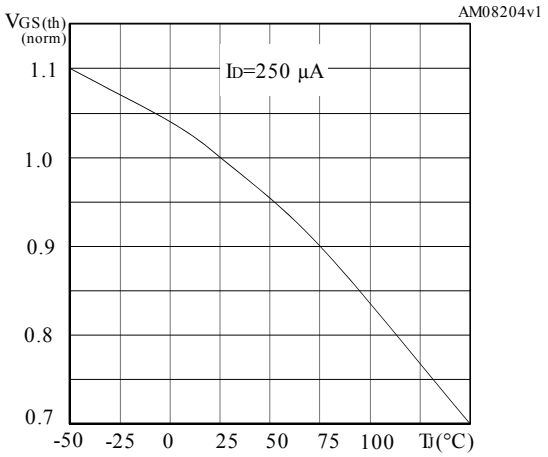



**Figure 14. Normalized on-resistance vs temperature**

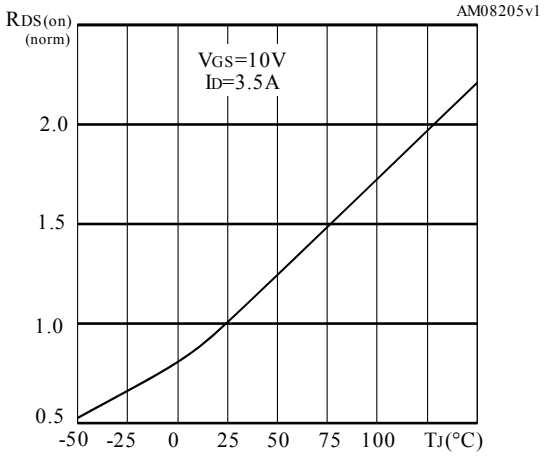



**Figure 15. Switching energy vs gate resistance**

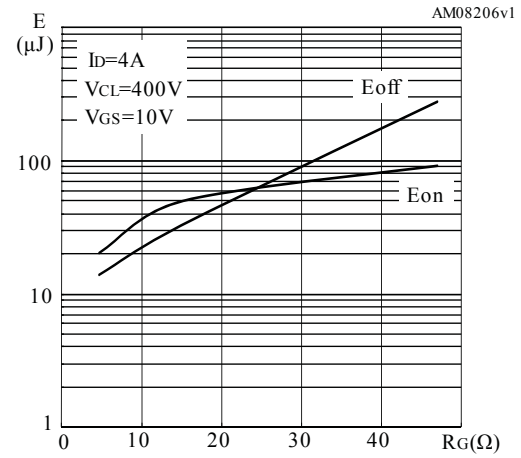
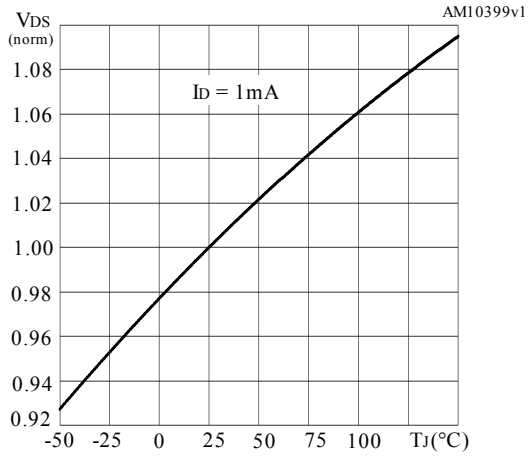



**Figure 16. Normalized $V_{(BR)DSS}$ vs temperature**




*Note: $E_{on}$ including reverse recovery of a SiC diode.*

# 3 Test circuits

**Figure 17. Test circuit for resistive load switching times**

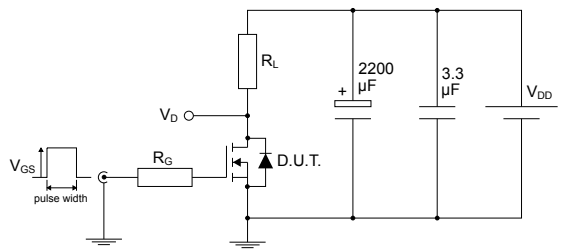



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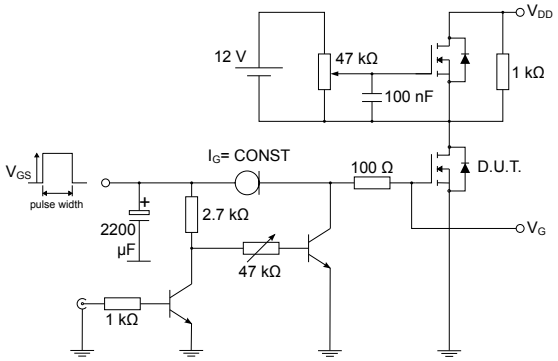
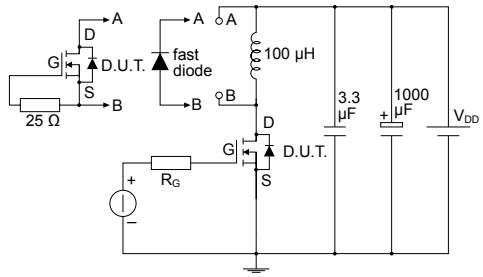
**Figure 18. Test circuit for gate charge behavior**



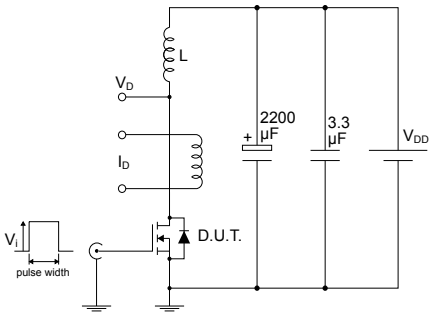

AM01469v1

**Figure 19. Test circuit for inductive load switching and diode recovery times**



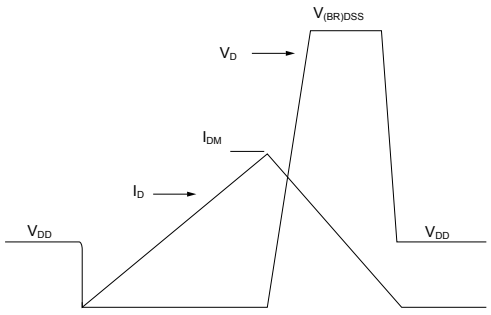

AM01470v1

**Figure 20. Unclamped inductive load test circuit**



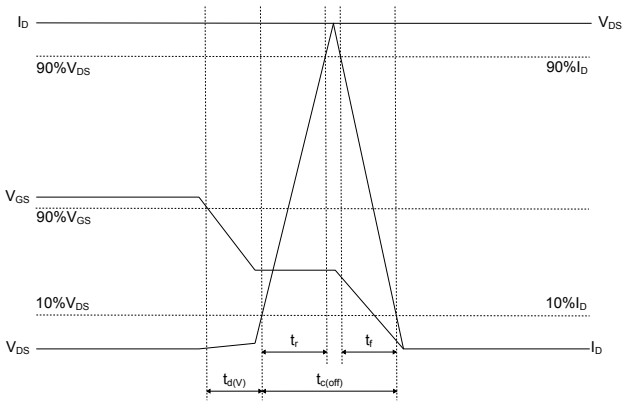

AM01471v1

**Figure 21. Unclamped inductive waveform**




AM01472v1

**Figure 22. Switching time waveform**




AM05540v2

# 4 Package information

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 D²PAK (TO-263) type A package information

Figure 23. **D²PAK (TO-263) type A package outline**

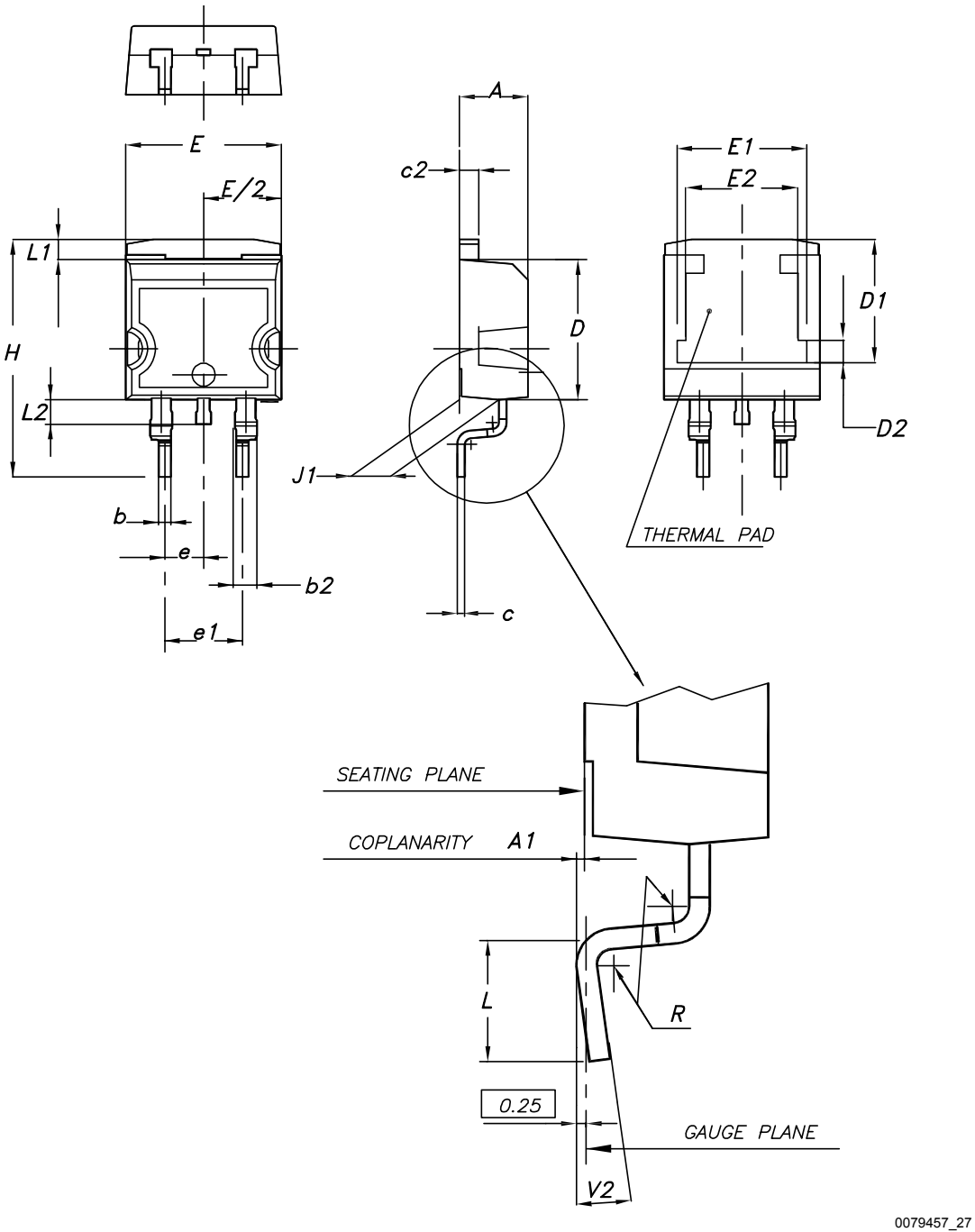
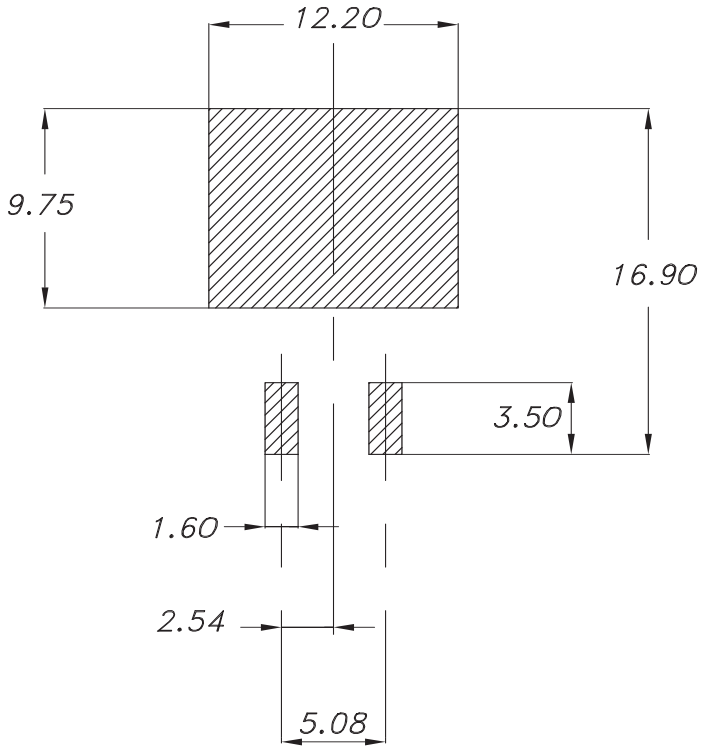


Table 8. D²PAK (TO-263) type A package mechanical data

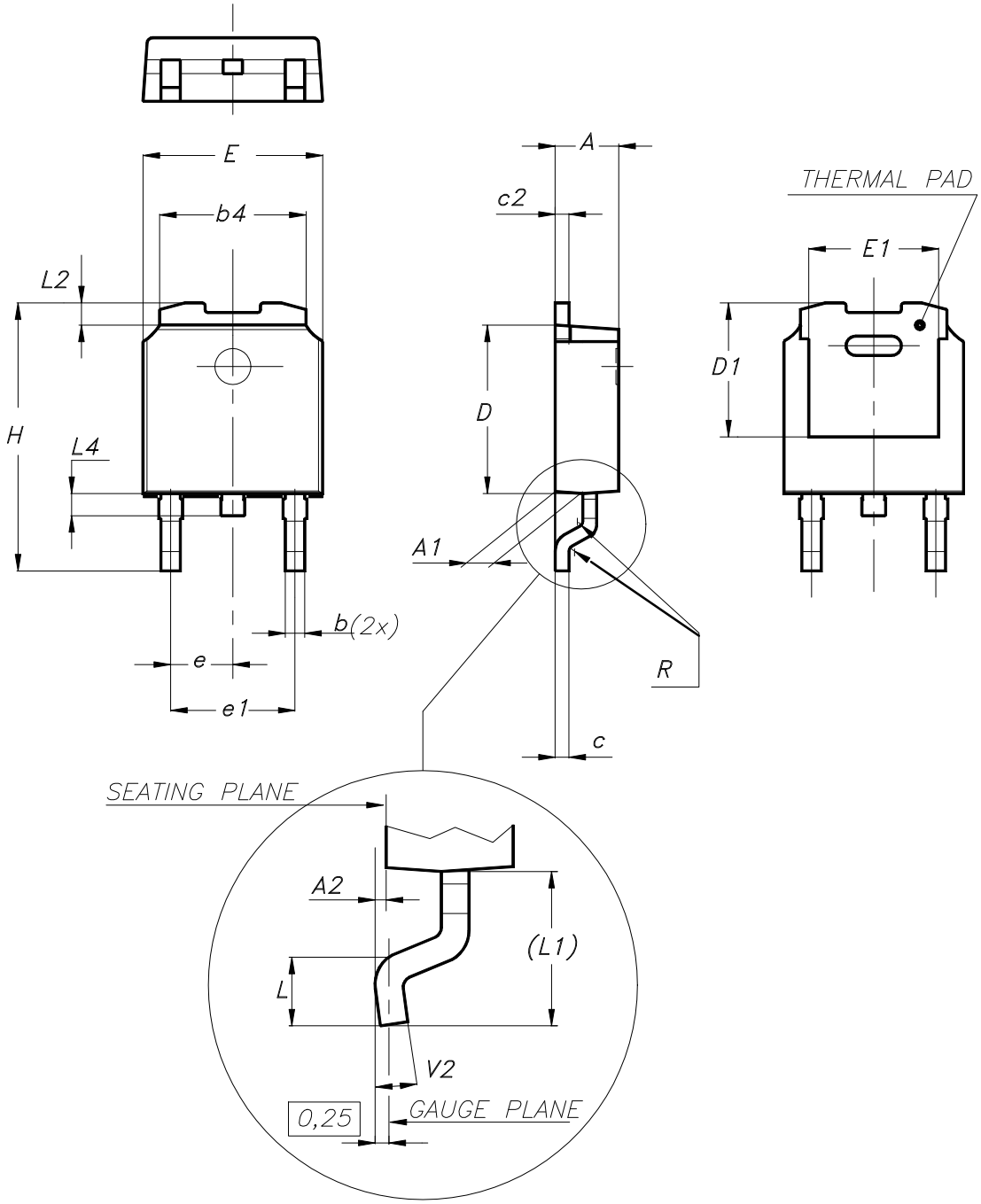
| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | 7.75 | 8.00 |
| D2 | 1.10 | 1.30 | 1.50 |
| E | 10.00 | | 10.40 |
| E1 | 8.30 | 8.50 | 8.70 |
| E2 | 6.85 | 7.05 | 7.25 |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15.00 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.40 | |
| V2 | 0° | | 8° |

Figure 24. D²PAK (TO-263) recommended footprint (dimensions are in mm)



## 4.2 DPAK (TO-252) type A package information

Figure 25. **DPAK (TO-252) type A package outline**




0068772_A_36

Table 9. **DPAK (TO-252) type A 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 | 4.60 | 4.70 | 4.80 |
| e | 2.159 | 2.286 | 2.413 |
| e1 | 4.445 | 4.572 | 4.699 |
| 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° |

## 4.3 DPAK (TO-252) type C package information

Figure 26. **DPAK (TO-252) type C package outline**

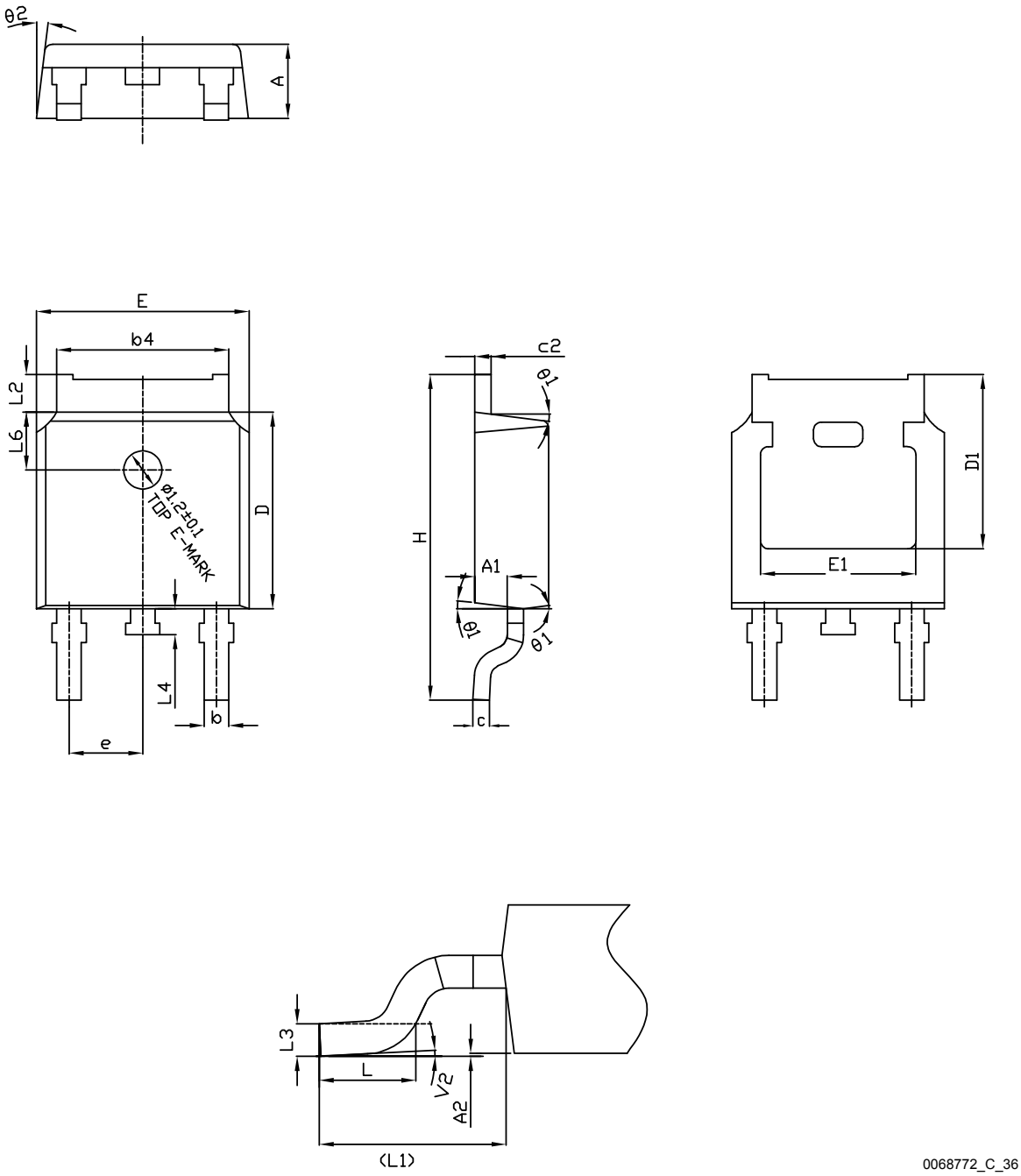


Table 10. **DPAK (TO-252) type C mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0.90 | 1.01 | 1.10 |
| A2 | 0.00 | | 0.10 |
| b | 0.72 | | 0.85 |
| b4 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | | 0.60 |
| c2 | 0.47 | | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.15 | 5.40 | 5.65 |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 4.70 | 4.85 | 5.00 |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | | 2.90 REF | |
| L2 | 0.90 | | 1.25 |
| L3 | | 0.51 BSC | |
| L4 | 0.60 | 0.80 | 1.00 |
| L6 | | 1.80 BSC | |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |
| V2 | 0° | | 8° |

## 4.4 DPAK (TO-252) type E package information

Figure 27. **DPAK (TO-252) type E package outline**

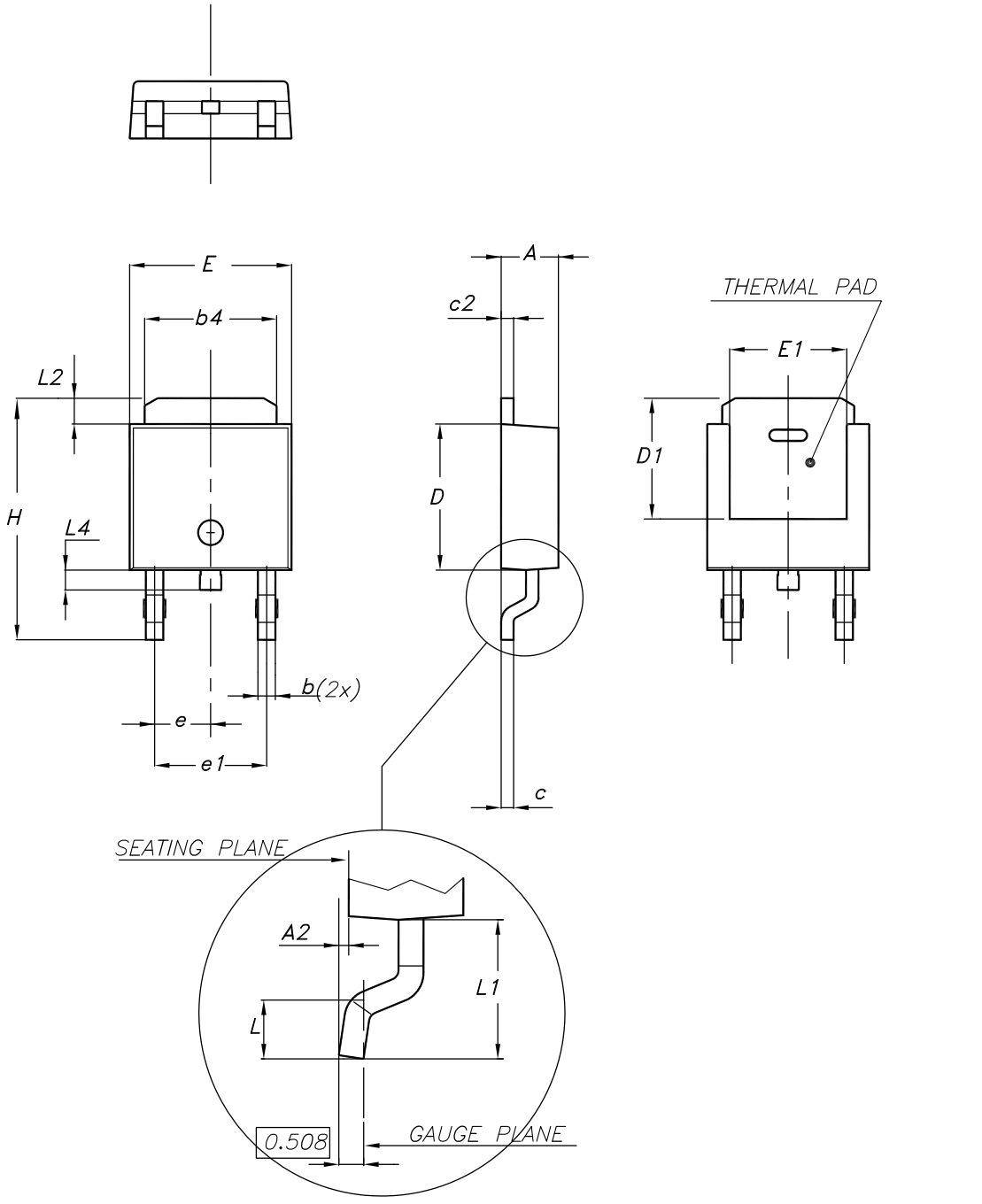
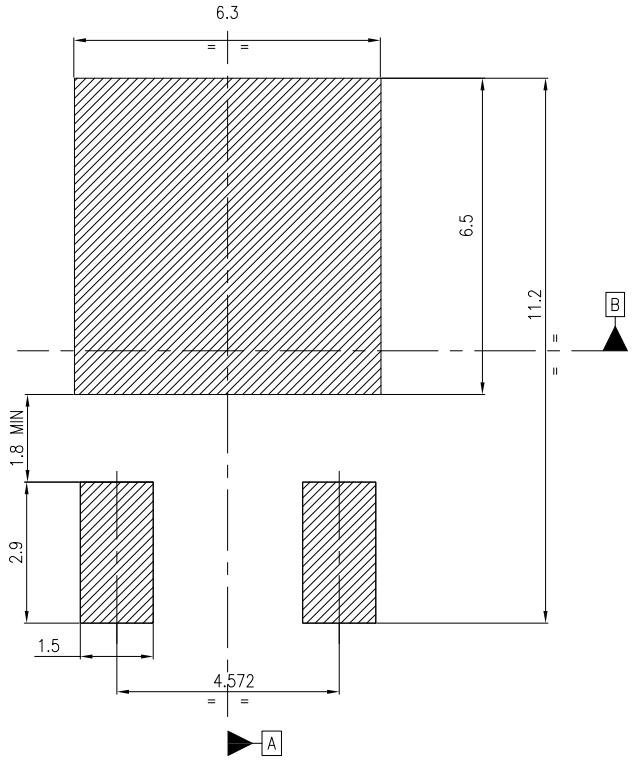


Table 11. **DPAK (TO-252) type E mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 2.18 | | 2.39 |
| A2 | | | 0.13 |
| b | 0.65 | | 0.884 |
| b4 | 4.95 | | 5.46 |
| c | 0.46 | | 0.61 |
| c2 | 0.46 | | 0.60 |
| D | 5.97 | | 6.22 |
| D1 | 5.21 | | |
| E | 6.35 | | 6.73 |
| E1 | 4.32 | | |
| e | | 2.286 | |
| e1 | | 4.572 | |
| H | 9.94 | | 10.34 |
| L | 1.50 | | 1.78 |
| L1 | | 2.74 | |
| L2 | 0.89 | | 1.27 |
| L4 | | | 1.02 |

Figure 28. **DPAK (TO-252) recommended footprint (dimensions are in mm)**




Notes:

1) This footprint is able to ensure insulation up to 630 Vrms (according to CEI IEC 664−1)

2) The device must be positioned within ⌖ 0.05 A B

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## 4.5 TO-220FP type B package information

Figure 29. **TO-220FP type B package outline**

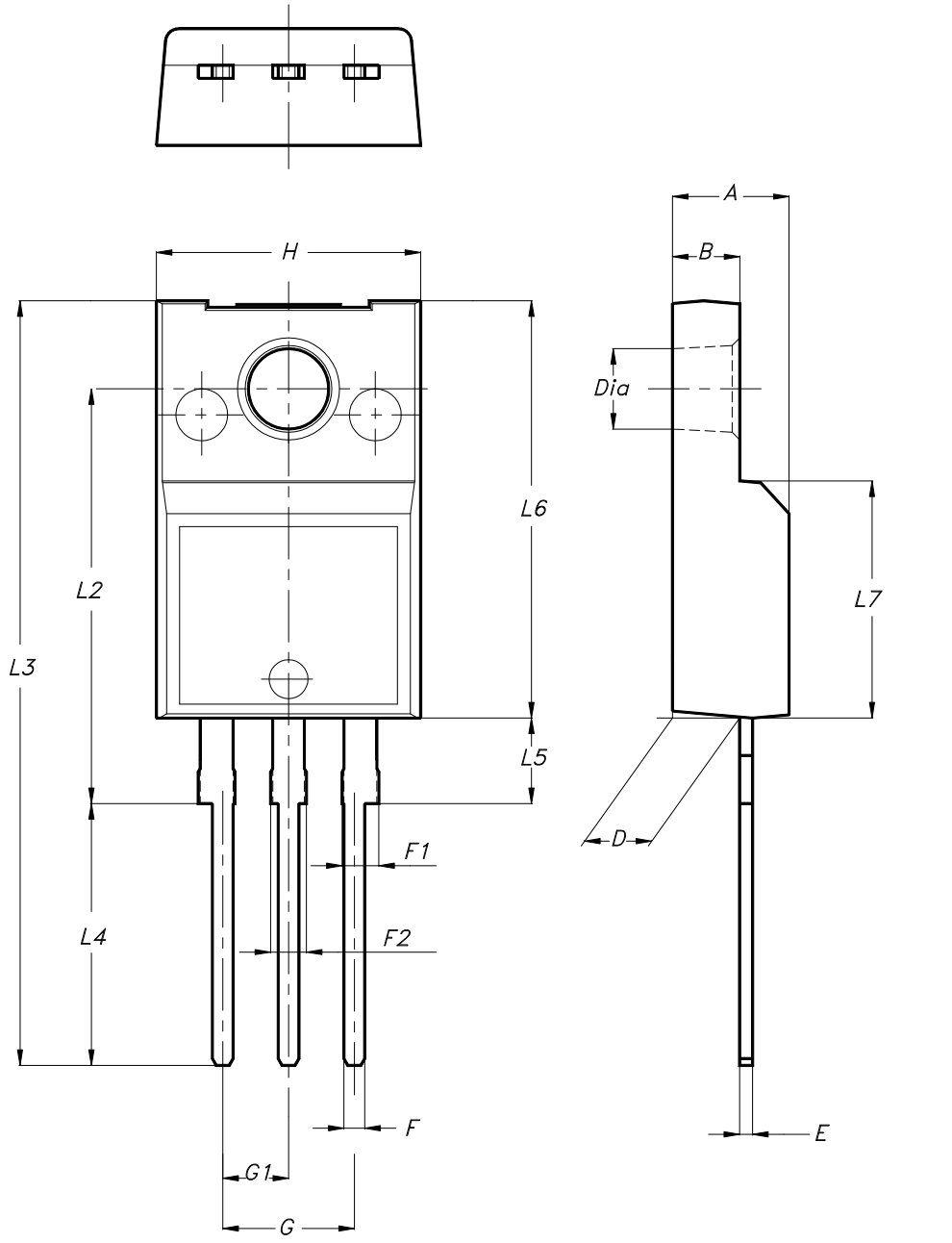
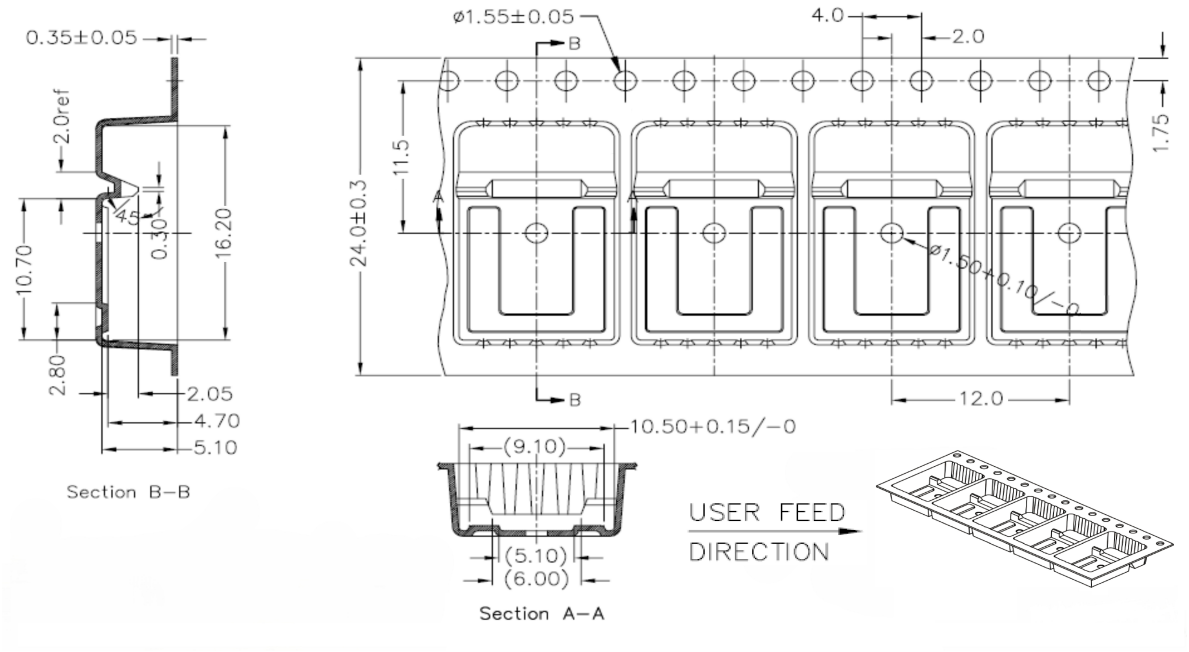


Table 12. **TO-220FP type B package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| E | 0.45 | | 0.70 |
| F | 0.75 | | 1.00 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.20 |
| G1 | 2.40 | | 2.70 |
| H | 10.00 | | 10.40 |
| L2 | | 16.00 | |
| L3 | 28.60 | | 30.60 |
| L4 | 9.80 | | 10.60 |
| L5 | 2.90 | | 3.60 |
| L6 | 15.90 | | 16.40 |
| L7 | 9.00 | | 9.30 |
| Dia | 3.00 | | 3.20 |

## 4.6 D²PAK packing information

Figure 30. **D²PAK tape drawing (dimensions are in mm)**

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## 4.7 DPAK packing information

Figure 31. **DPAK tape outline**

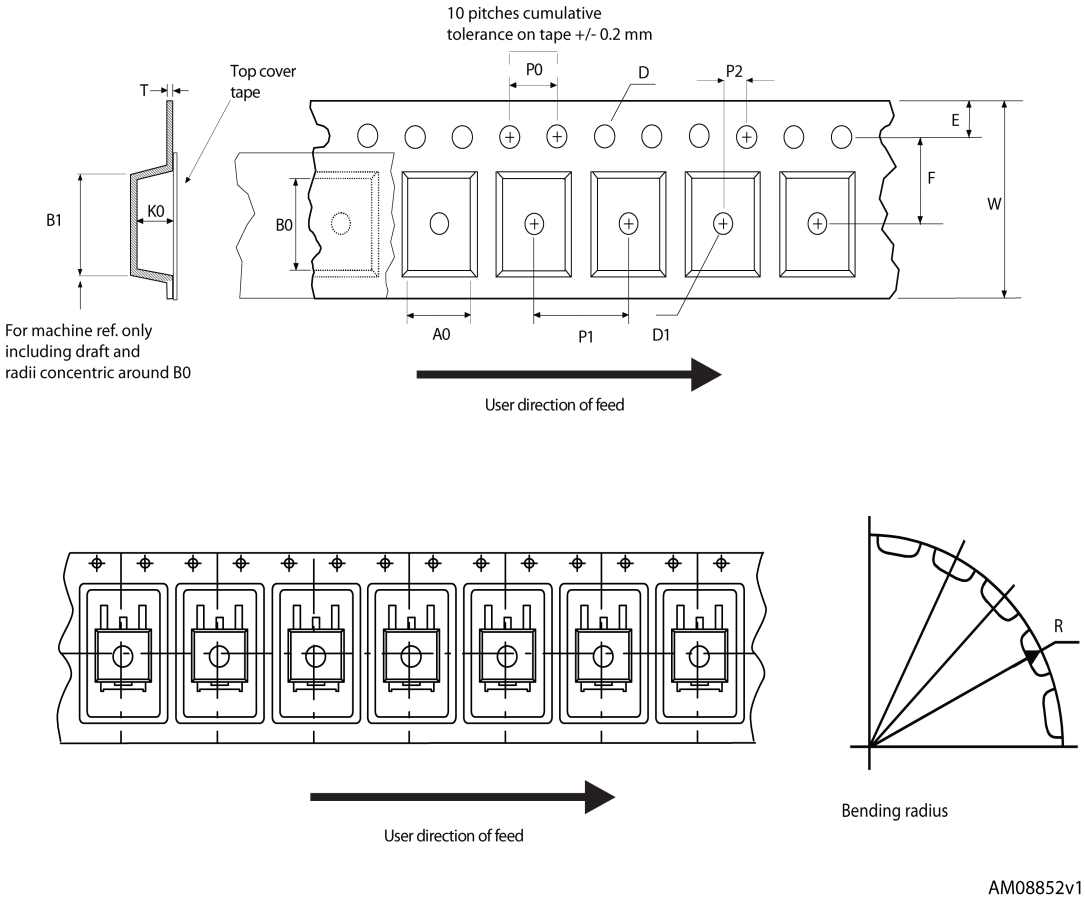

Figure 32. **DPAK reel outline**

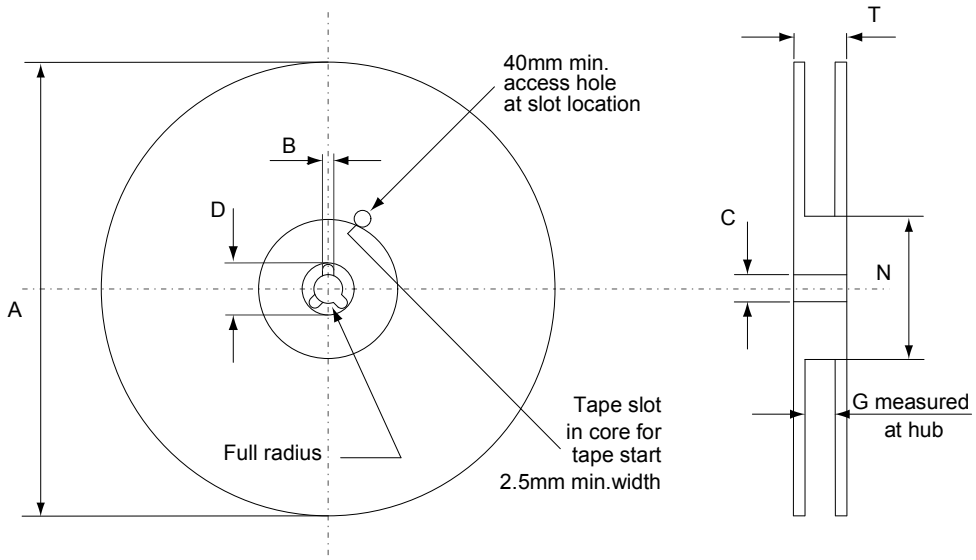


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Table 13. **DPAK tape and reel mechanical data**

| 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 Ordering information

Table 14. **Order codes**

| Order codes | Marking | Package | Packing |
|---|---|---|---|
| STB8N65M5 | 8N65M5 | D²PAK | Tape and reel |
| STD8N65M5 | | DPAK | Tape and reel |
| STF8N65M5 | | TO-220FP | Tube |

## Revision history

Table 15. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 23-Oct-2009 | 1 | First release. |
| 14-Oct-2010 | 2 | Document status promoted from preliminary data to datasheet. |
| 05-Jul-2011 | 3 | *Table 7: Source drain diode* has been updated. |
| 04-Oct-2012 | 4 | – Updated: *Figure 1, 10, 14* and *17*.<br>– Updated: *note1* and *3* below *the Table 2*<br>– Updated the entire *Section 4: Package mechanical data.*<br>– Updated title and description on the cover page. |
| 29-Oct-2012 | 5 | – Updated $R_g$ values in *Table 5*. |
| 03-Mar-2022 | 6 | The part numbers STI8N65M5, STP8N65M5, STU8N65M5 have been moved to a separate datasheet and the document has been updated accordingly.<br>Modified $R_g$ value in *Table 5. Dynamic*.<br>Updated *Section 4 Package information*.<br>Minor text changes. |
| 21-Aug-2025 | 7 | Updated Section 4: Package information.<br>Minor text changes. |

# Contents