



THE DATASHEET OF STP40N65M2



N-channel 650 V, 0.087 Ω typ., 32 A MDmesh™ M2 Power MOSFET in I²PAK and TO-220 packages

Datasheet - production data

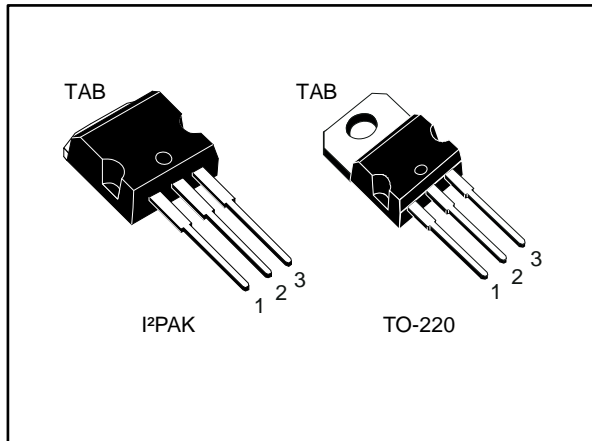


Figure 1: Internal schematic diagram

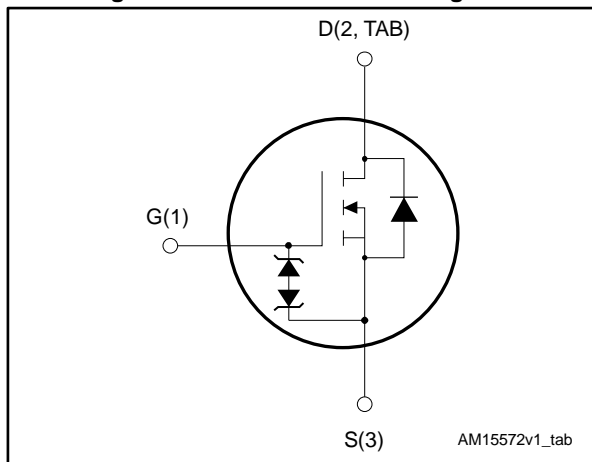


Table 1: Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|--------------------|-----------|
| STI40N65M2 | 40N65M2 | I ² PAK | Tube |
| STP40N65M2 | | TO-220 | |

Features

| Order code | V _{DS} | R _{DS(on)} max. | I _D |
|------------|-----------------|--------------------------|----------------|
| STI40N65M2 | 650 V | 0.099 Ω | 32 A |
| STP40N65M2 | | | |

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high efficiency converters.

Contents

| | | |
|----------|--|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| | 2.2 Electrical characteristics (curves)..... | 6 |
| 3 | Test circuits | 8 |
| 4 | Package information | 9 |
| | 4.1 I ² PAK package information | 9 |
| | 4.2 TO-220 type A package information..... | 11 |
| 5 | Revision history | 13 |

1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 32 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 20 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 128 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 250 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| T_{stg} | Storage temperature | - 55 to 150 | °C |
| T_j | Max. operating junction temperature | 150 | |

Notes:

⁽¹⁾ Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 32\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$

⁽³⁾ $V_{DS} \leq 520\text{ V}$

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.5 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.50 | °C/W |

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax}) | 3 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 820 | mJ |

2 Electrical characteristics

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

Table 5: On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|--|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$ | 650 | | | V |
| I_{DSS} | Zero gate voltage Drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 16\text{ A}$ | | 0.087 | 0.099 | Ω |

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 2355 | - | pF |
| C_{oss} | Output capacitance | | - | 102 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 2.7 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ V to } 520\text{ V}$, $V_{GS} = 0\text{ V}$ | - | 380 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$, open drain | - | 4.5 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 520\text{ V}$, $I_D = 32\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Gate charge test circuit") | - | 56.5 | - | nC |
| Q_{gs} | Gate-source charge | | - | 8 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 24 | - | nC |

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 325\text{ V}$, $I_D = 16\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform") | - | 15 | - | ns |
| t_r | Rise time | | - | 10 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 96.5 | - | ns |
| t_f | Fall time | | - | 12 | - | ns |

Table 8: Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 32 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 128 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 32\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 32\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16 : " <i>Test circuit for inductive load switching and diode recovery times</i> ") | - | 468 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 8.7 | | μC |
| I_{RRM} | Reverse recovery current | | - | 37.5 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 32\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16 : " <i>Test circuit for inductive load switching and diode recovery times</i> ") | - | 610 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 11.7 | | μC |
| I_{RRM} | Reverse recovery current | | - | 39 | | A |

Notes:

⁽¹⁾ Pulse width is limited by safe operating area

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

2.2 Electrical characteristics (curves)

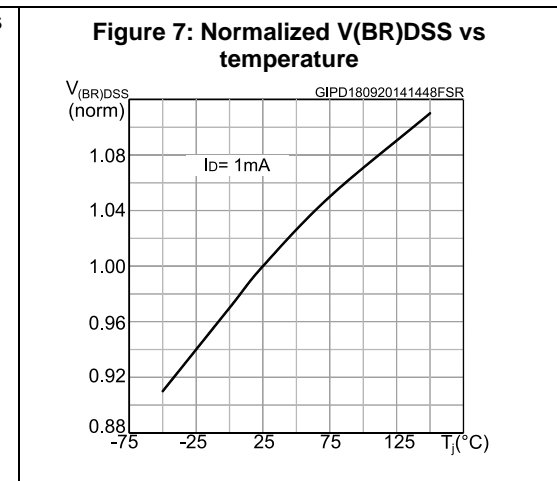
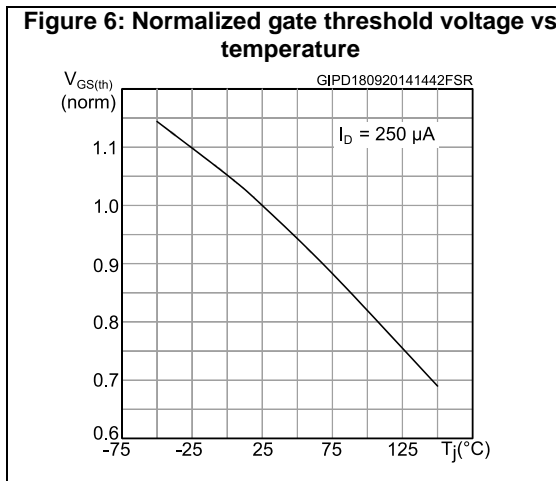
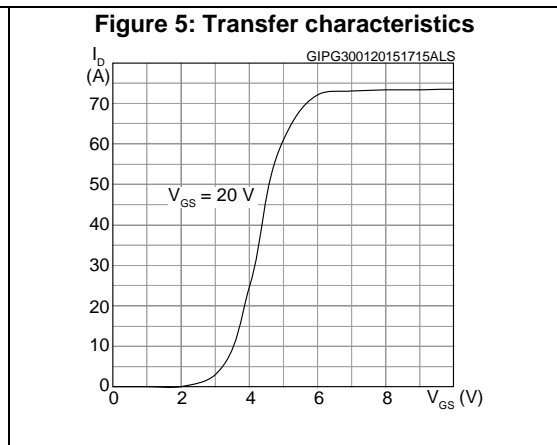
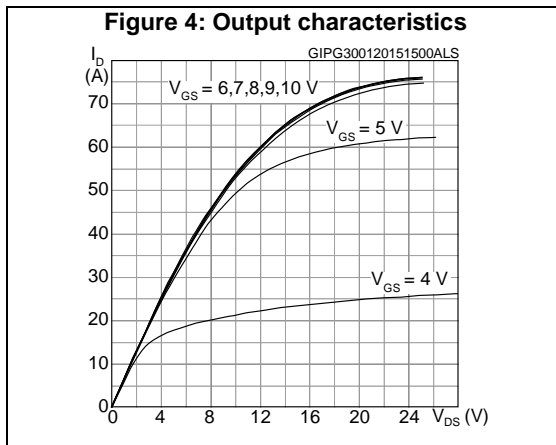
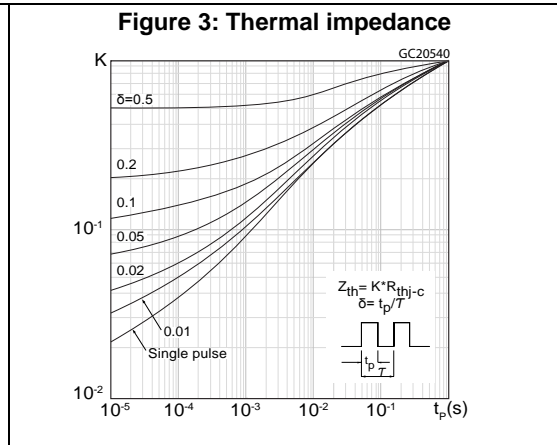
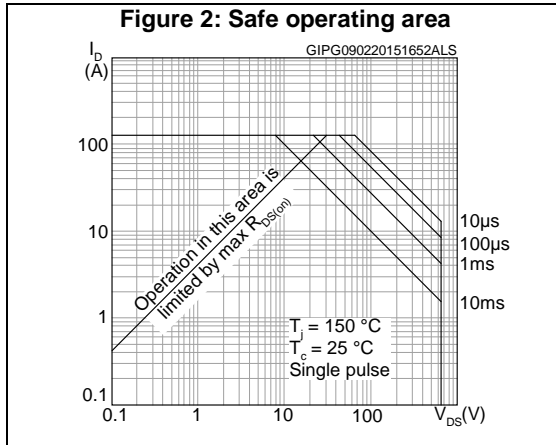


Figure 8: Static drain-source on-resistance

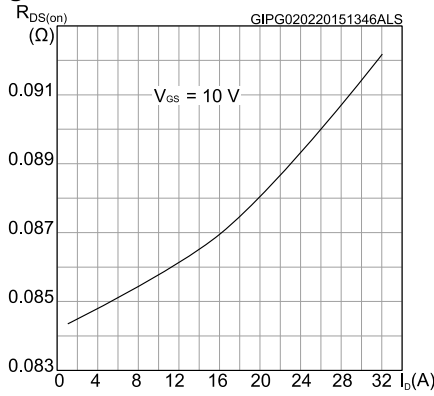


Figure 9: Normalized on-resistance vs. temperature

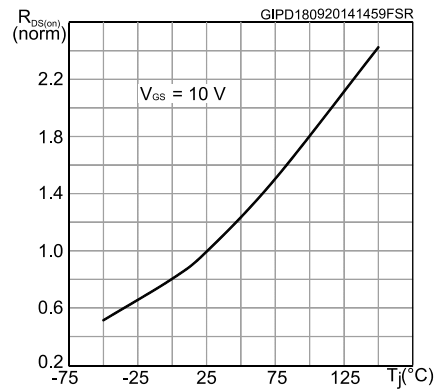


Figure 10: Gate charge vs. gate-source voltage

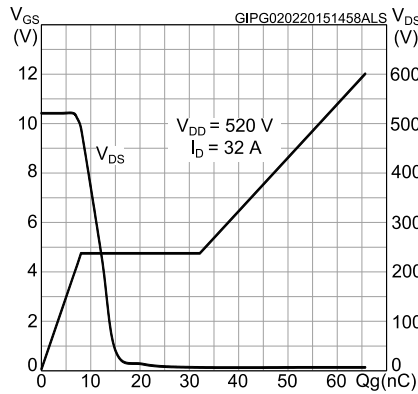


Figure 11: Capacitance variations

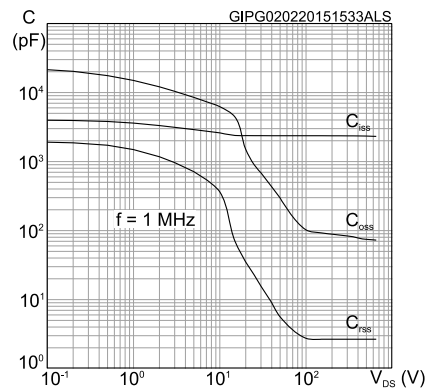


Figure 12: Output capacitance stored energy

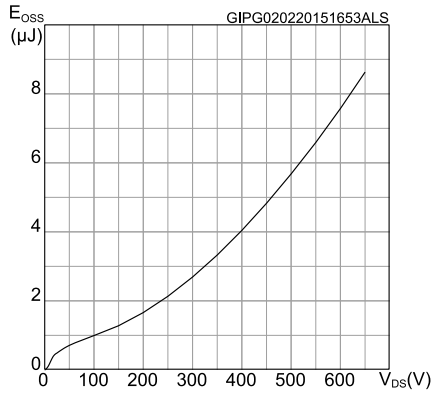
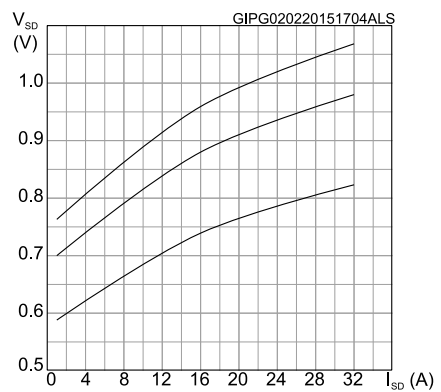
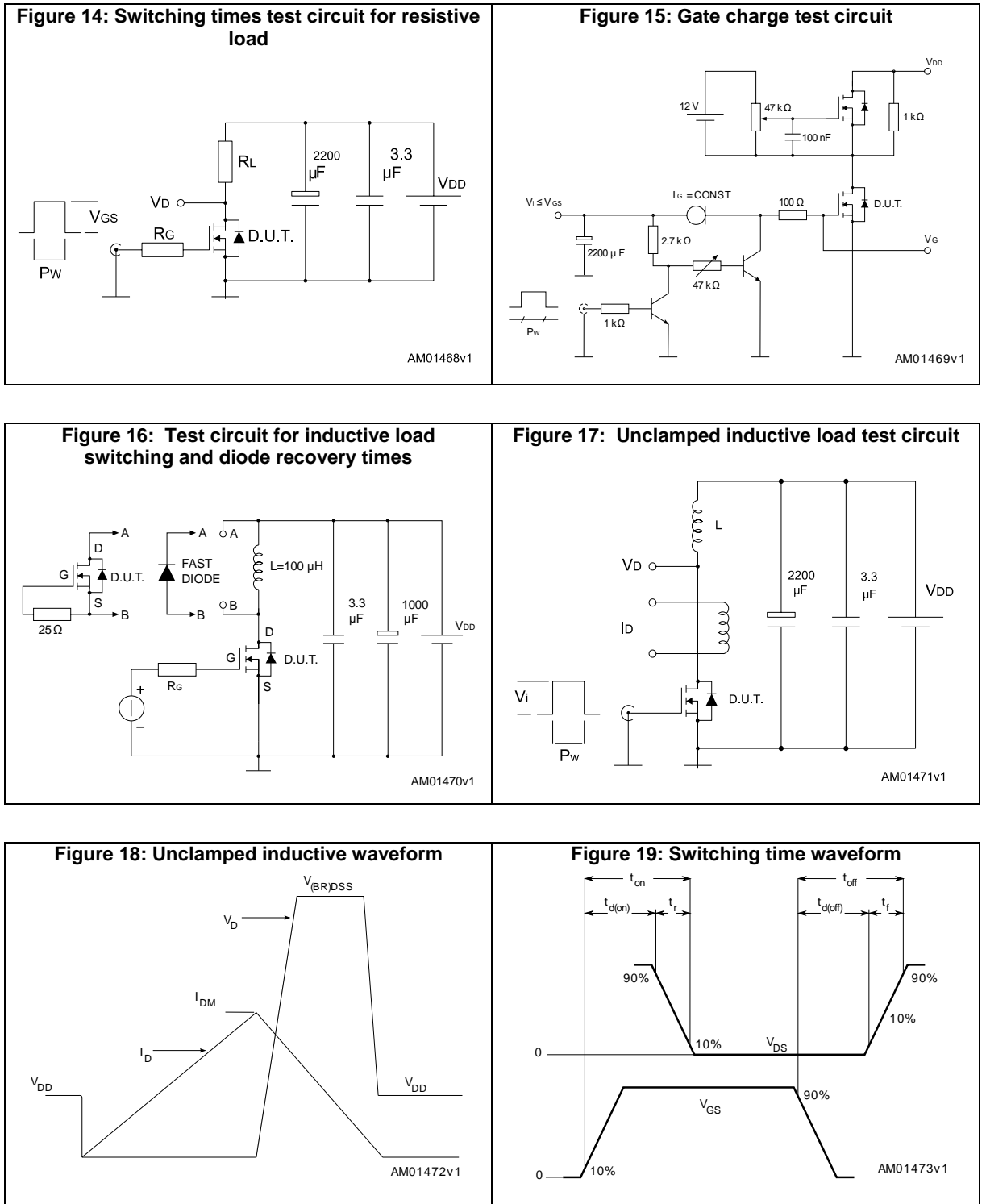


Figure 13: Source-drain diode forward characteristics



3 Test circuits



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 I²PAK package information

Figure 20: I²PAK package outline

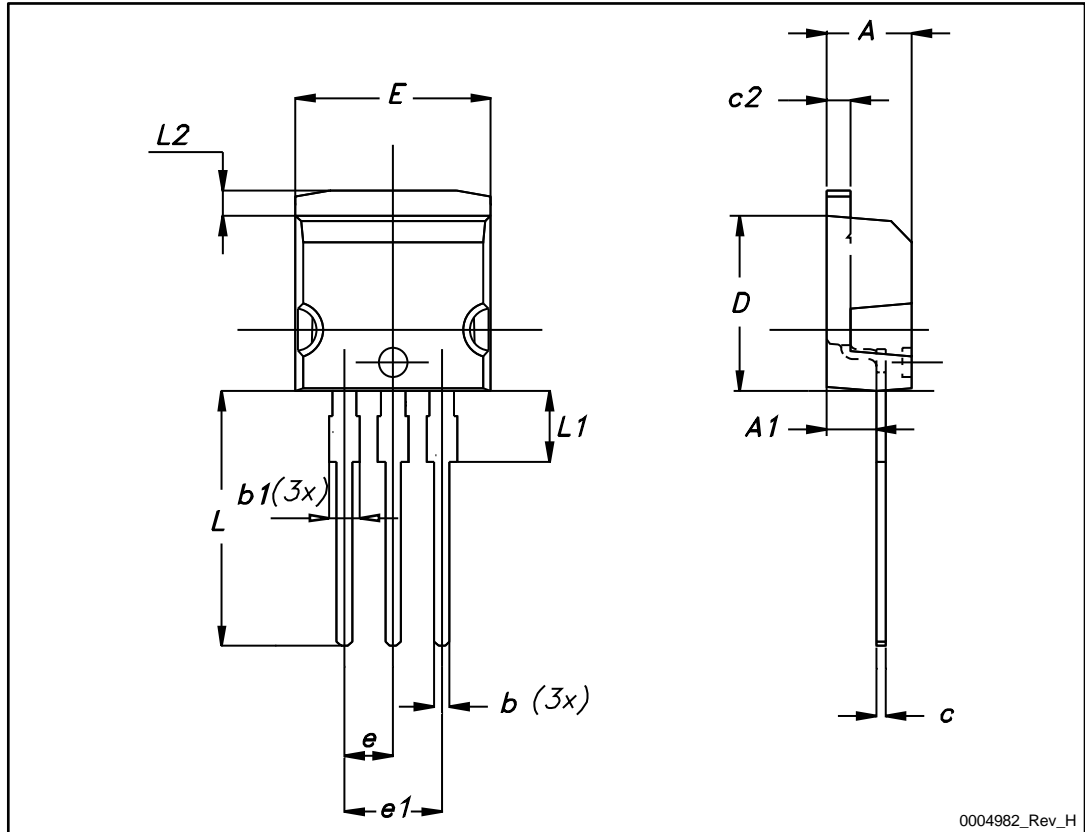


Table 9: I²PAK mechanical data

| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | – | 4.60 |
| A1 | 2.40 | – | 2.72 |
| b | 0.61 | – | 0.88 |
| b1 | 1.14 | – | 1.70 |
| c | 0.49 | – | 0.70 |
| c2 | 1.23 | – | 1.32 |
| D | 8.95 | – | 9.35 |
| e | 2.40 | – | 2.70 |
| e1 | 4.95 | – | 5.15 |
| E | 10 | – | 10.40 |
| L | 13 | – | 14 |
| L1 | 3.50 | – | 3.93 |
| L2 | 1.27 | – | 1.40 |

Table 10: TO-220 type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

5 Revision history

Table 11: Document revision history

| Date | Revision | Changes |
|-------------|----------|----------------|
| 09-Feb-2014 | 1 | First release. |

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