



STx42N65M5

N-channel 650 V, 0.070 Ω , 33 A MDmesh™ V Power MOSFET
I²PAK, TO-220, TO-220FP, D²PAK, TO-247

Features

| Type | V _{DSS} @ T _{Jmax} | R _{DS(on)} max | I _D |
|------------|---|----------------------------|---------------------|
| STB42N65M5 | 710 V | < 0.079 Ω | 33 A |
| STF42N65M5 | 710 V | < 0.079 Ω | 33 A ⁽¹⁾ |
| STI42N65M5 | 710 V | < 0.079 Ω | 33 A |
| STP42N65M5 | 710 V | < 0.079 Ω | 33 A |
| STW42N65M5 | 710 V | < 0.079 Ω | 33 A |

1. Limited only by maximum temperature allowed

- TO-220 worldwide best R_{DS(on)}
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

Application

- Switching applications

Description

MDmesh V is a revolutionary Power MOSFET technology, which combines an innovative proprietary vertical process with the well known company's PowerMESH™ horizontal layout. The resulting product has an extremely low on-resistance, unmatched among silicon-based Power MOSFETs, making it especially suited for applications which require superior power density and outstanding efficiencies.

Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB42N65M5 | 42N65M5 | D ² PAK | Tape and reel |
| STF42N65M5 | 42N65M5 | TO-220FP | Tube |
| STI42N65M5 | 42N65M5 | I ² PAK | Tube |
| STP42N65M5 | 42N65M5 | TO-220 | Tube |
| STW42N65M5 | 42N65M5 | TO-247 | Tube |

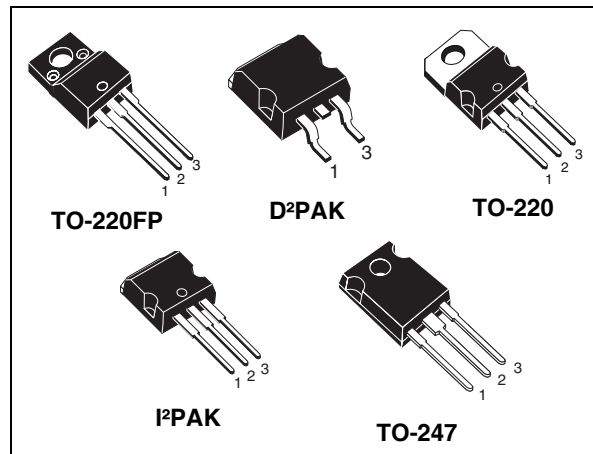
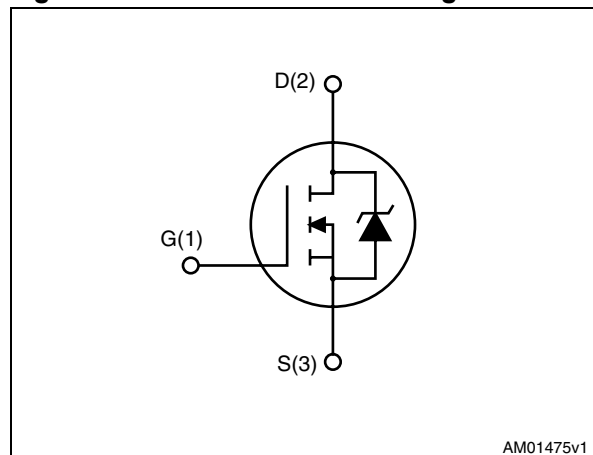


Figure 1. Internal schematic diagram



AM01475v1

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|--|--|---------------------|------|
| | | TO-220, TO-247 D ² PAK, I ² PAK | TO-220FP | |
| V _{GS} | Gate- source voltage | ± 25 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 33 | 33 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 20.8 | 20.8 ⁽¹⁾ | A |
| I _{DM} ⁽²⁾ | Drain current (pulsed) | 132 | 132 ⁽¹⁾ | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 190 | 40 | W |
| I _{AR} | Max current during repetitive or single pulse avalanche (pulse width limited by T _{JMAX}) | 11 | | A |
| E _{AS} | Single pulse avalanche energy (starting T _j = 25°C, I _D = I _{AR} , V _{DD} = 50V) | 950 | | mJ |
| 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) | -- | 2500 | V |
| T _{stg} | Storage temperature | -55 to 150 | | °C |
| T _j | Max. operating junction temperature | 150 | | °C |

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 33 A, di/dt ≤ 400 A/μs, V_{Peak} < V_{(BR)DSS}

Table 3. Thermal data

| Symbol | Parameter | Value | | | | | Unit |
|-----------------------|--|--------------------|--------------------|--------|--------|----------|------|
| | | D ² PAK | I ² PAK | TO-220 | TO-247 | TO-220FP | |
| R _{thj-case} | Thermal resistance junction-case max | 0.66 | | | 3.1 | °C/W | |
| R _{thj-amb} | Thermal resistance junction-ambient max | -- | 62.5 | 50 | 62.5 | °C/W | |
| R _{thj-pcb} | Thermal resistance junction-pcb max | 30 | -- | -- | -- | °C/W | |
| T _l | Maximum lead temperature for soldering purpose | 300 | | | | | °C |

2 Electrical characteristics

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

Table 4. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|-------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 650 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$ | | | 1 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 25\text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 16.5\text{ A}$ | | 0.070 | 0.079 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------|--|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | | 4650 | | pF |
| C_{oss} | Output capacitance | | | 110 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 3.2 | | pF |
| $C_{o(er)}^{(1)}$ | Equivalent output capacitance energy related | $V_{GS} = 0$, $V_{DS} = 0$ to 80% $V_{(BR)DSS}$ | | 100 | | pF |
| $C_{o(tr)}^{(2)}$ | Equivalent output capacitance time related | $V_{GS} = 0$, $V_{DS} = 0$ to 80% $V_{(BR)DSS}$ | | 285 | | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | | 1.1 | | Ω |
| Q_g | Total gate charge | $V_{DD} = 520\text{ V}$, $I_D = 16.5\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 21) | | 100 | | nC |
| Q_{gs} | Gate-source charge | | | 26 | | nC |
| Q_{gd} | Gate-drain charge | | | 38 | | nC |

- $C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}
- $C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|--------------|---------------------|---|------|------|-----|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 20) | | 61 | | ns |
| t_r | Rise time | | | 24 | | ns |
| $t_{d(off)}$ | Turn-off-delay time | | | 65 | | ns |
| t_f | Fall time | | | 13 | | ns |
| | | | | | | |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | | | 33 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 132 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 33\text{ A}$, $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 33\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 25) | | 400 | | ns |
| Q_{rr} | Reverse recovery charge | | | 7 | | μC |
| I_{RRM} | Reverse recovery current | | | 35 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 33\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 25) | | 532 | | ns |
| Q_{rr} | Reverse recovery charge | | | 10 | | μC |
| I_{RRM} | Reverse recovery current | | | 38 | | 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 2. Safe operating area for TO-220, D²PAK, I²PAK

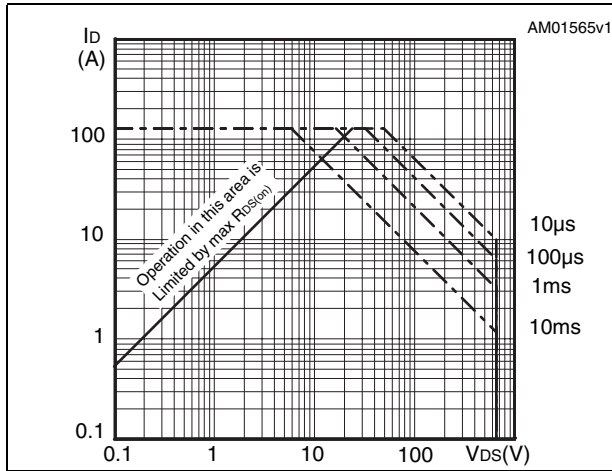


Figure 3. Thermal impedance for TO-220, D²PAK, I²PAK

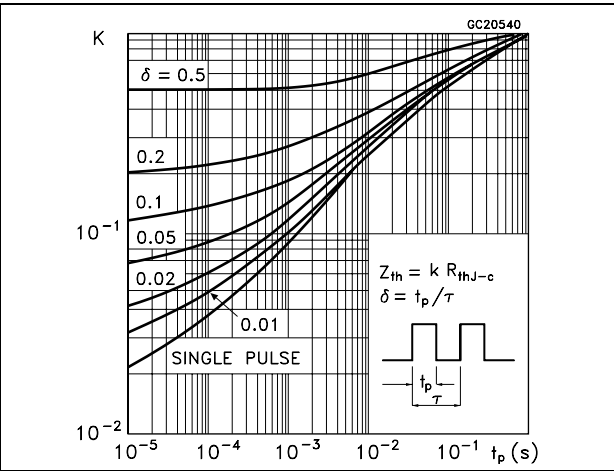


Figure 4. Safe operating area for TO-247

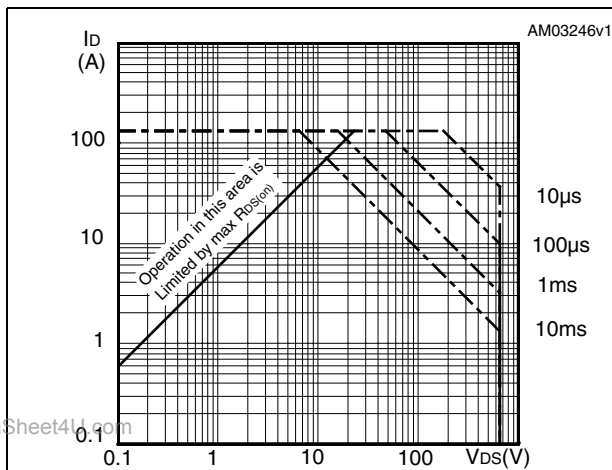


Figure 5. Thermal impedance for TO-247

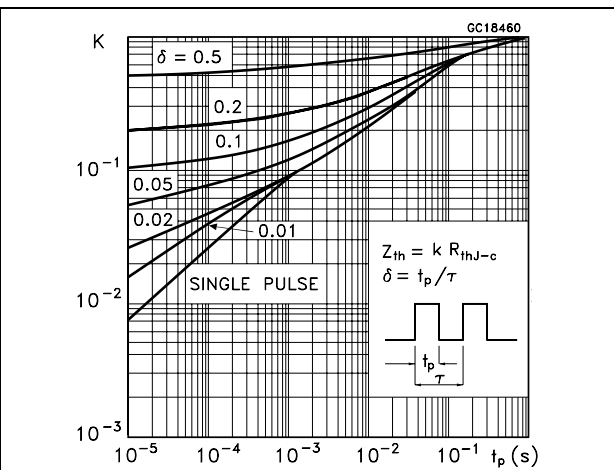


Figure 6. Safe operating area for TO-220FP

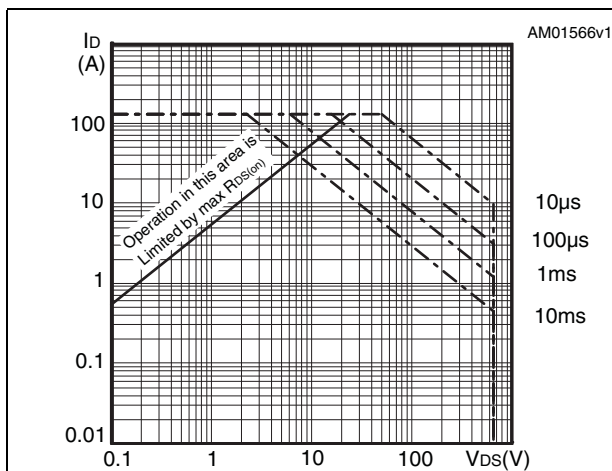


Figure 7. Thermal impedance for TO-220FP

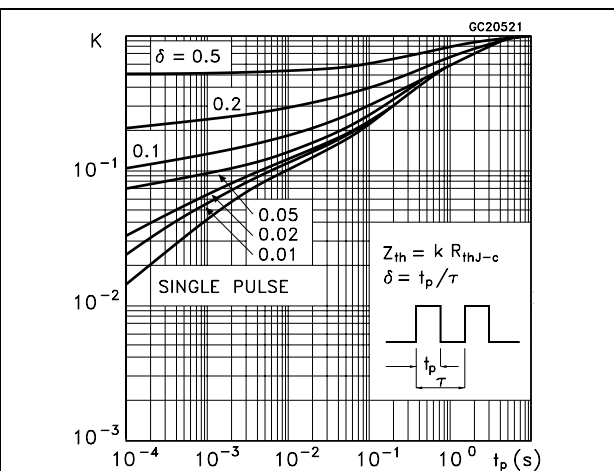


Figure 8. Output characteristics

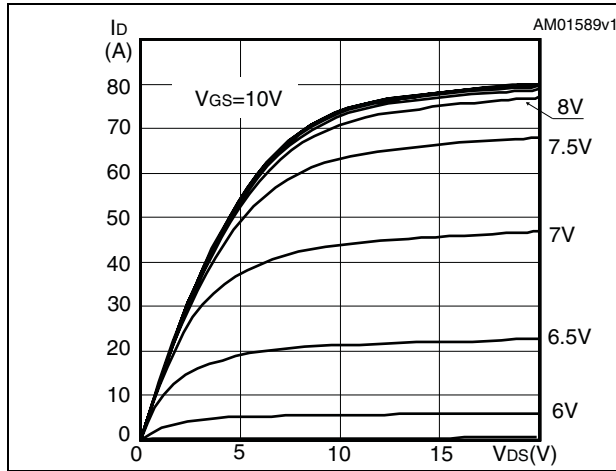


Figure 9. Transfer characteristics

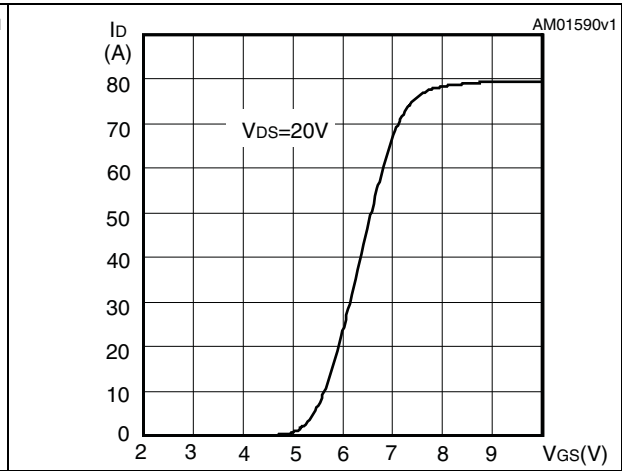


Figure 10. Transconductance

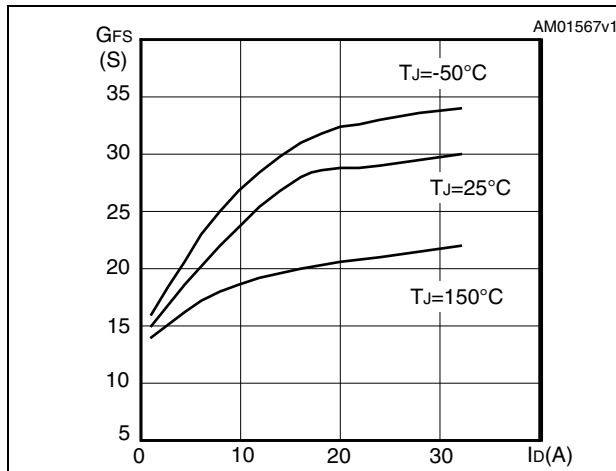


Figure 11. Static drain-source on resistance

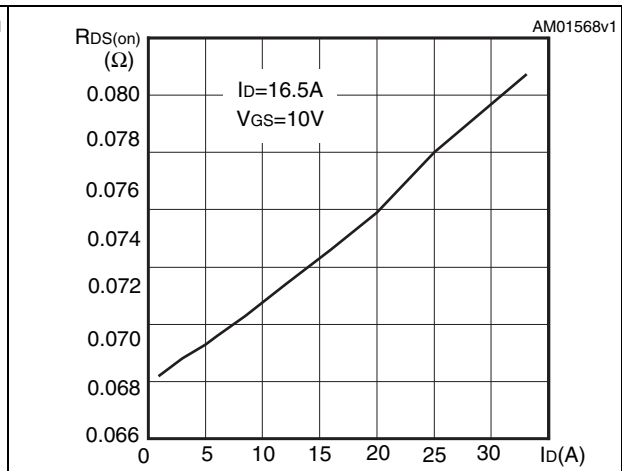


Figure 12. Capacitance variations

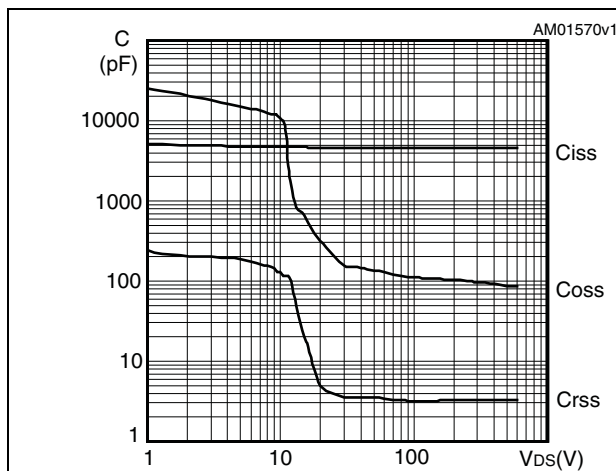
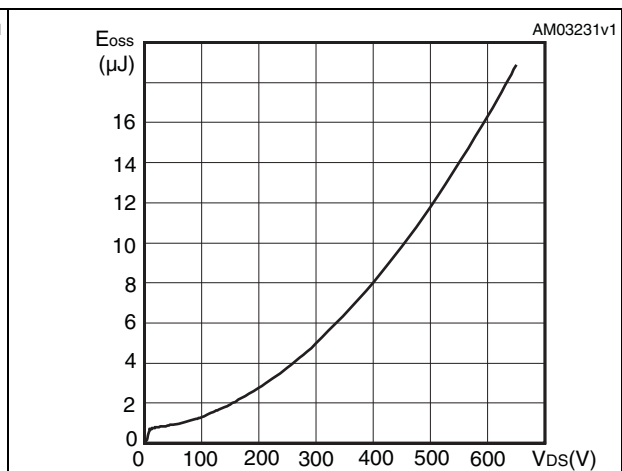


Figure 13. Output capacitance stored energy



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Electrical characteristics

STx42N65M5

Figure 14. Normalized gate threshold voltage vs temperature

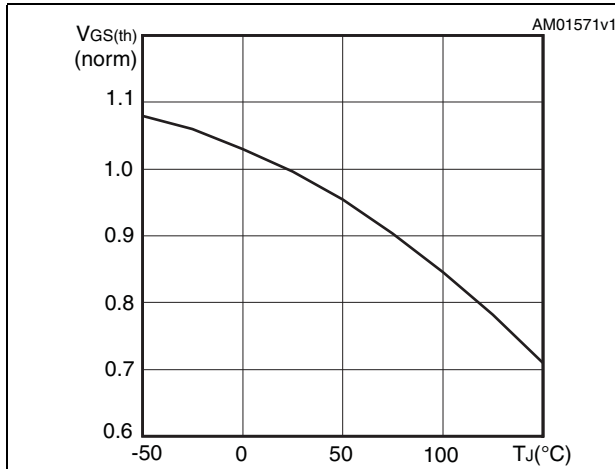


Figure 15. Normalized on resistance vs temperature

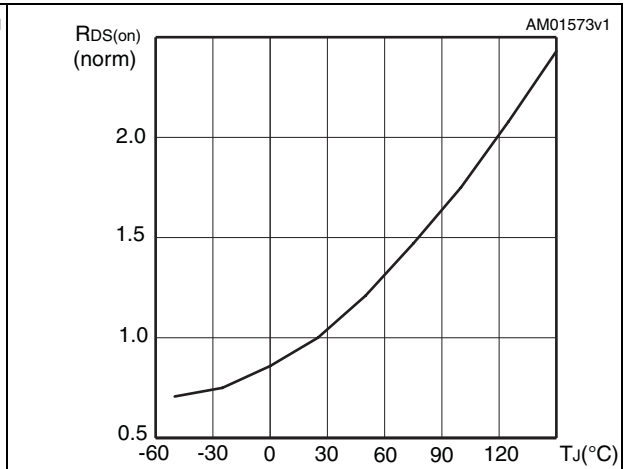


Figure 16. Source-drain diode forward characteristics

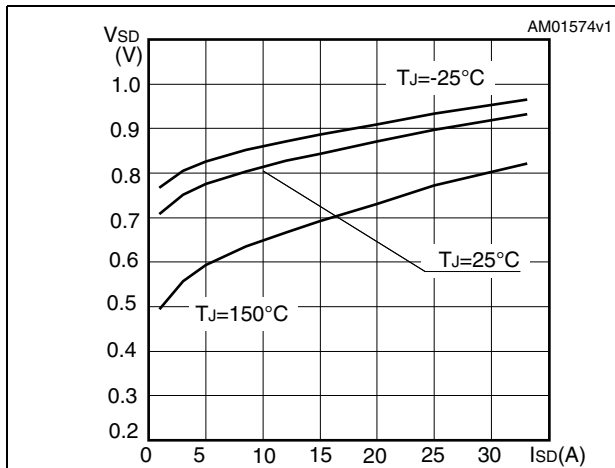


Figure 17. Normalized BV_{DSS} vs temperature

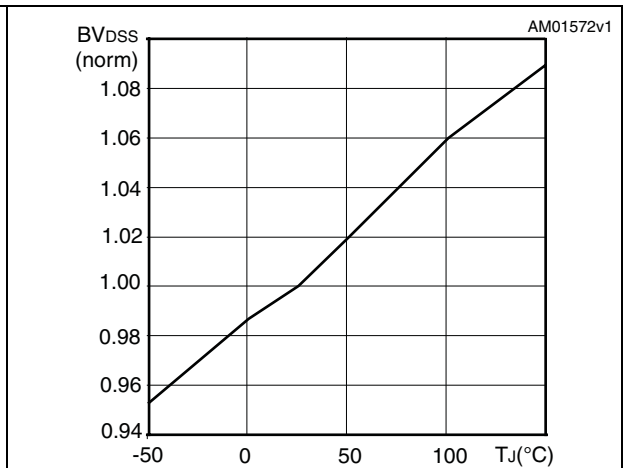


Figure 18. Switching losses vs gate resistance (1)

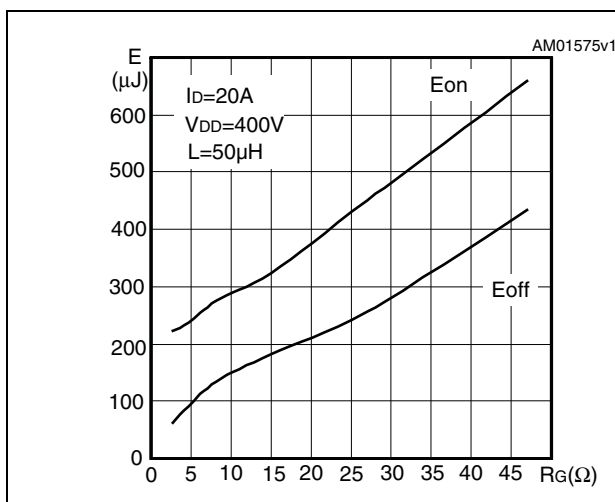
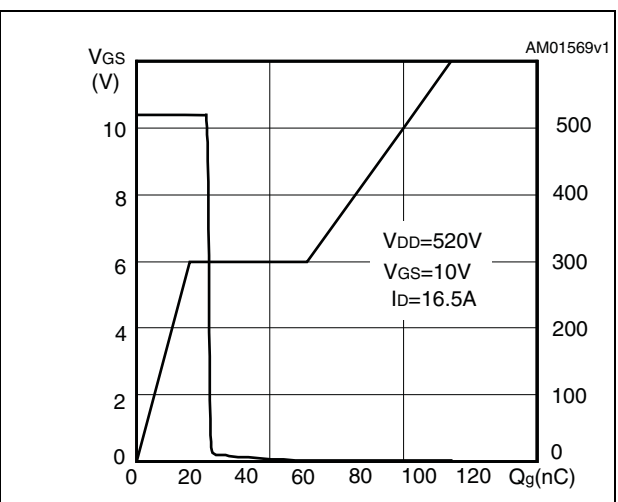


Figure 19. Gate charge vs gate-source voltage

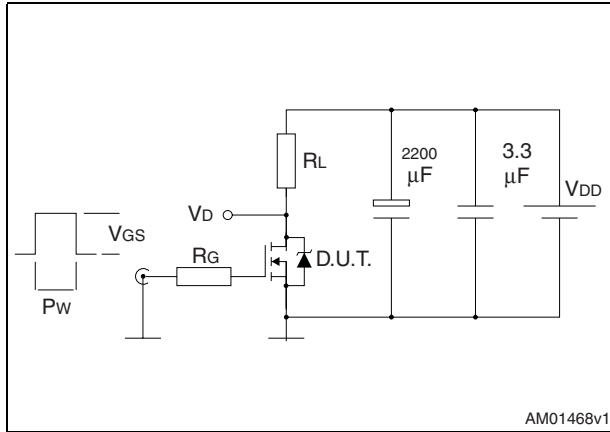


1. Eon including reverse recovery of a SiC diode



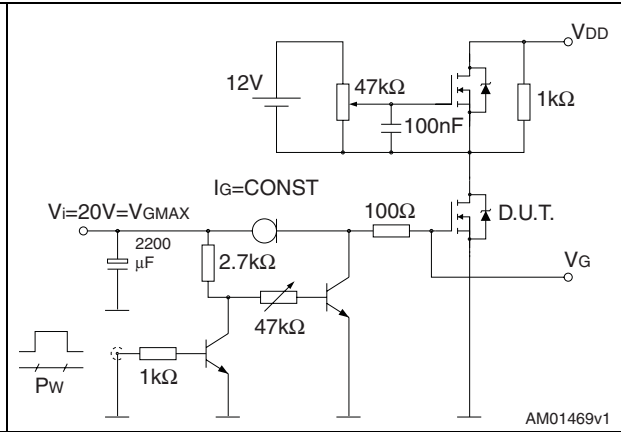
3 Test circuits

Figure 20. Switching times test circuit for resistive load



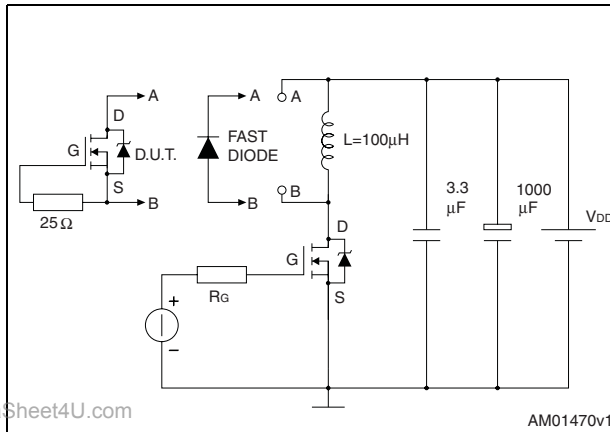
AM01468v1

Figure 21. Gate charge test circuit



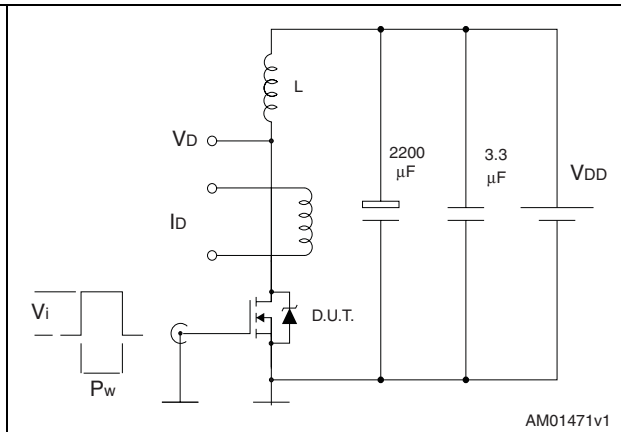
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Figure 22. Test circuit for inductive load switching and diode recovery times



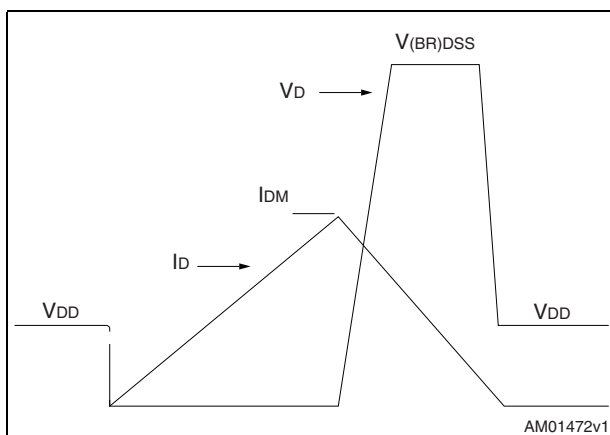
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Figure 23. Unclamped inductive load test circuit



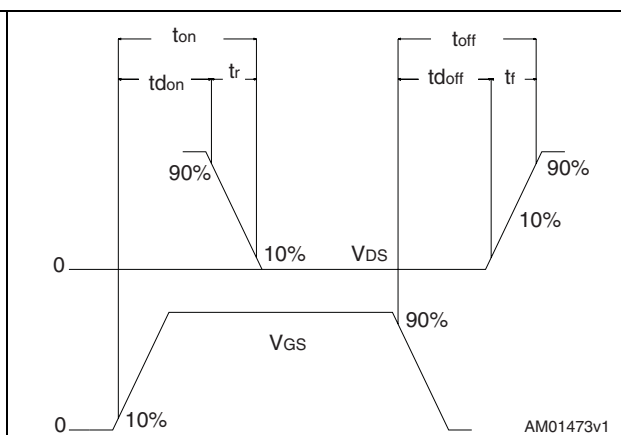
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Figure 24. Unclamped inductive waveform



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Figure 25. Switching time waveform



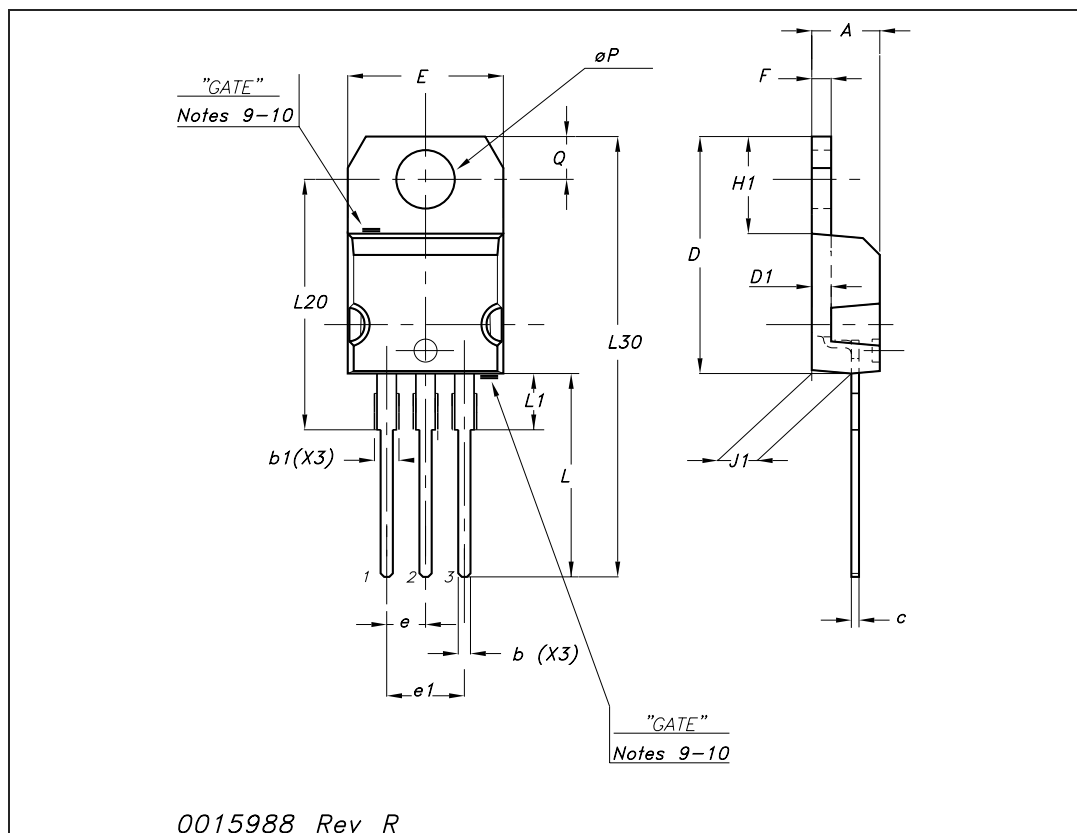
AM01473v1

4 Package mechanical data

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.

TO-220 mechanical data

| Dim | mm | | | inch | | |
|-----|-------|-------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.051 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |

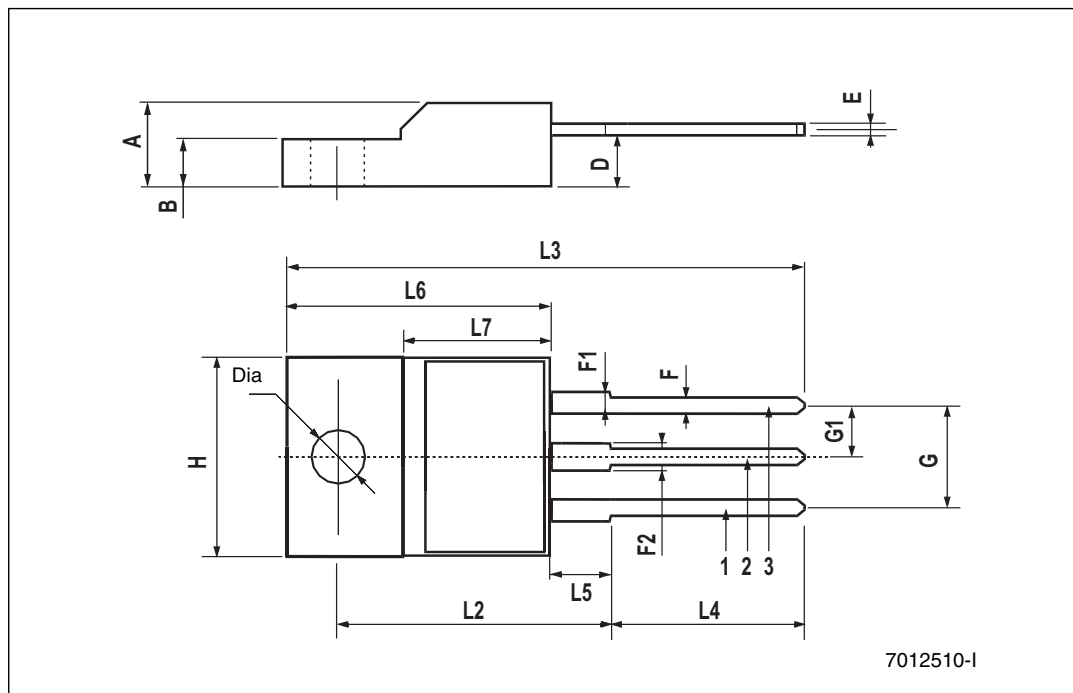


Package mechanical data

STx42N65M5

TO-220FP mechanical data

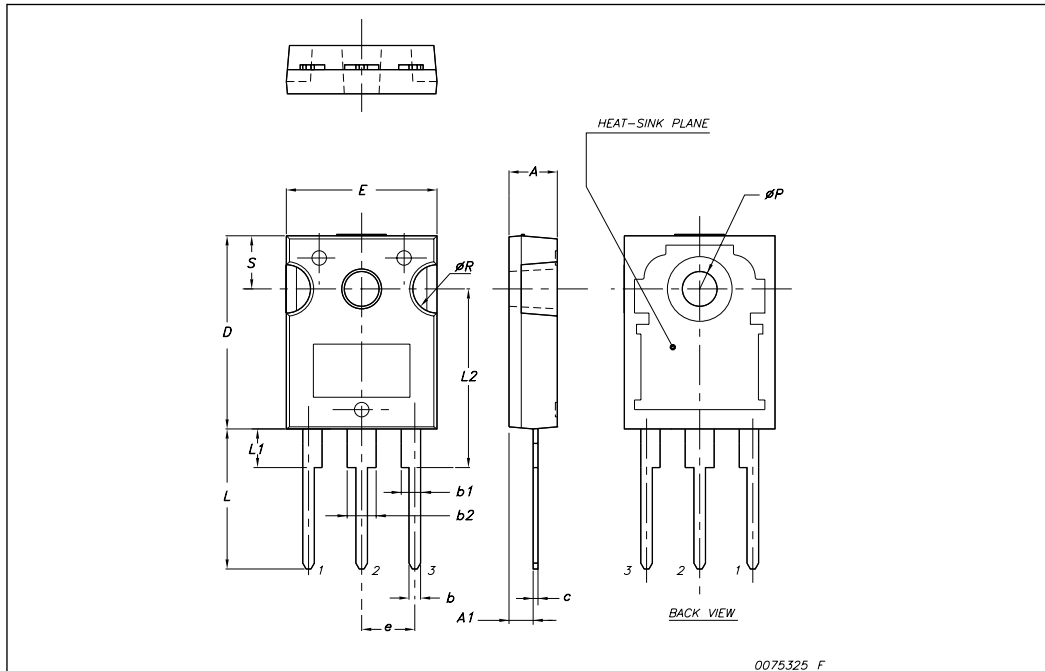
| Dim. | mm. | | | inch | | |
|------|-------|-----|-------|-------|-------|-------|
| | Min. | Typ | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| B | 2.5 | | 2.7 | 0.098 | | 0.106 |
| D | 2.5 | | 2.75 | 0.098 | | 0.108 |
| E | 0.45 | | 0.70 | 0.017 | | 0.027 |
| F | 0.75 | | 1.00 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| G | 4.95 | | 5.20 | 0.195 | | 0.204 |
| G1 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.80 | | 10.60 | 0.385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| L6 | 15.90 | | 16.40 | 0.626 | | 0.645 |
| L7 | 9 | | 9.30 | 0.354 | | 0.366 |
| Dia | 3 | | 3.2 | 0.118 | | 0.126 |



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TO-247 Mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| øP | 3.55 | | 3.65 |
| øR | 4.50 | | 5.50 |
| S | | 5.50 | |

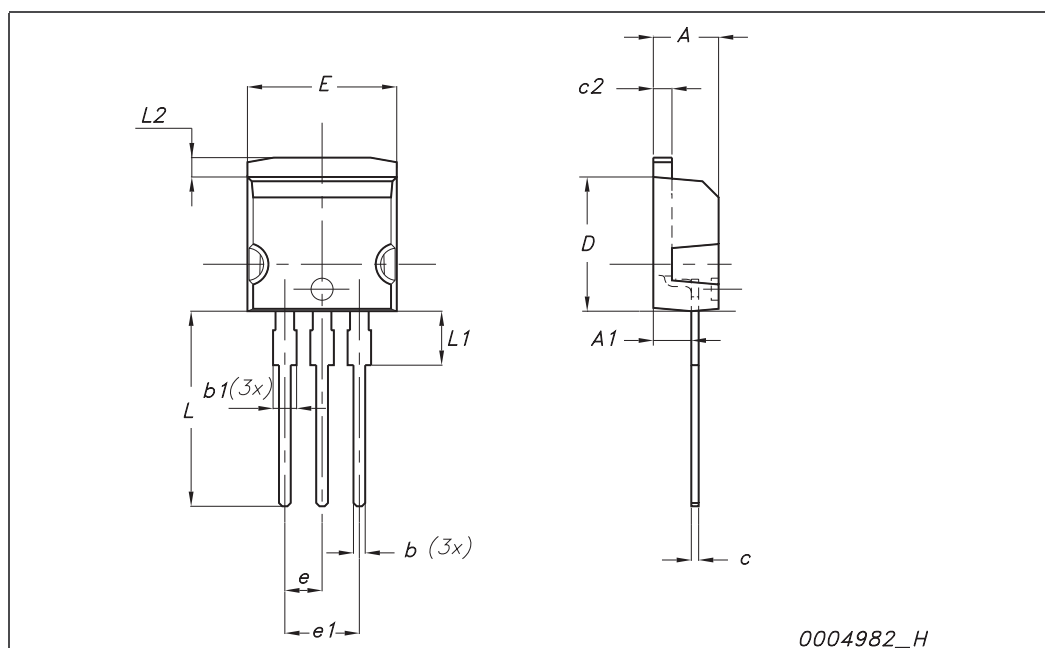


Package mechanical data

STx42N65M5

P²PAK (TO-262) mechanical data

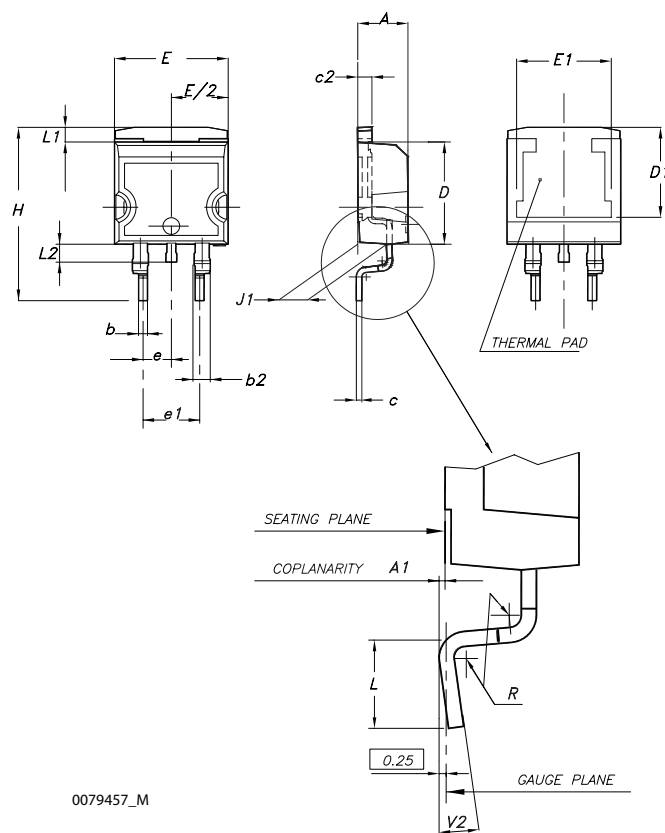
| Dim | mm | | | inch | | |
|-----|------|-----|-------|-------|-----|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 1.23 | | 1.32 | 0.048 | | 0.052 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| E | 10 | | 10.40 | 0.393 | | 0.410 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |



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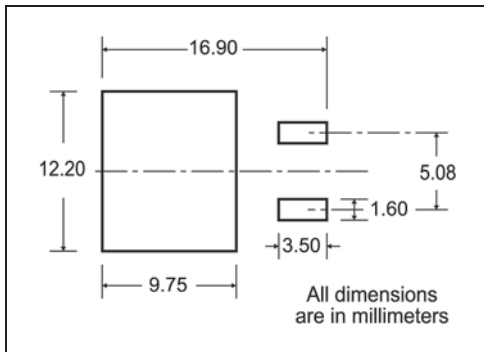
D²PAK (TO-263) mechanical data

| Dim | mm | | | inch | | |
|-----|------|------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.027 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.017 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | | | 0.295 | | |
| E | 10 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.50 | | | 0.334 | | |
| e | | 2.54 | | | 0.1 | |
| e1 | 4.88 | | 5.28 | 0.192 | | 0.208 |
| H | 15 | | 15.85 | 0.590 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.099 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.05 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.051 | | 0.069 |
| R | | 0.4 | | | 0.016 | |
| V2 | 0° | | 8° | 0° | | 8° |



5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000 | 1000 |

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

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6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------|
| 16-Jan-2009 | 1 | First release |

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