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STB70N10F4, STD70N10F4 STP70N10F4, STW70N10F4

N-channel 100 V, 0.015 Ω , 60 A, STripFET™ DeepGATE™
Power MOSFET in TO-220, DPAK, TO-247, D²PAK

Features

| Type | V _{DSS} | R _{DS(on)} max | I _D |
|------------|------------------|-------------------------|----------------|
| STB70N10F4 | 100 V | < 0.0195 Ω | 65 A |
| STD70N10F4 | 100 V | < 0.0195 Ω | 60 A |
| STP70N10F4 | 100 V | < 0.0195 Ω | 65 A |
| STW70N10F4 | 100 V | < 0.0195 Ω | 65 A |

- Exceptional dv/dt capability
- Extremely low on-resistance R_{DS(on)}
- 100% avalanche tested

Application

- Switching applications

Description

This STripFET™ DeepGATE™ Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance, with a new gate structure, providing superior switching performance.

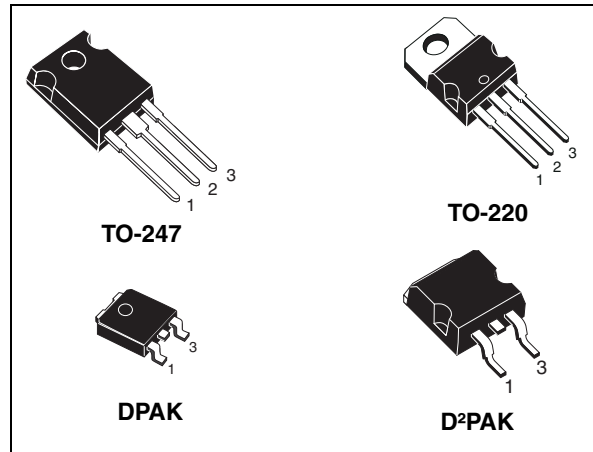


Figure 1. Internal schematic diagram

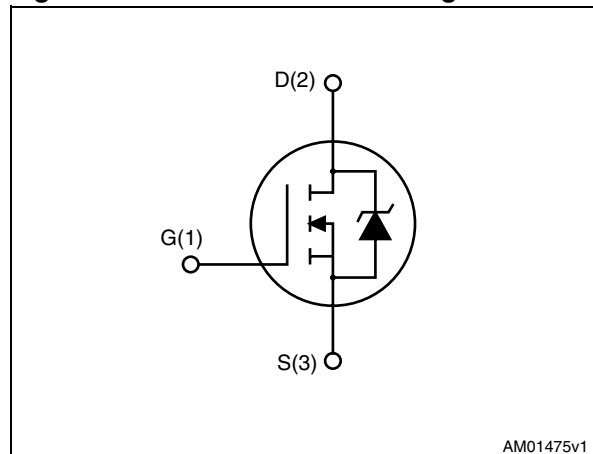


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB70N10F4 | 70N10F4 | D ² PAK | Tape and reel |
| STD70N10F4 | 70N10F4 | DPAK | Tape and reel |
| STP70N10F4 | 70N10F4 | TO-220 | Tube |
| STW70N10F4 | 70N10F4 | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|---|---------------------------------------|------|------|
| | | TO-220, TO-247, D ² PAK | DPAK | |
| V _{DS} | Drain-source voltage (V _{GS} = 0) | 100 | | V |
| V _{GS} | Gate-source voltage | ± 20 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 65 | 60 | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 46 | 43 | A |
| I _{DM} ⁽¹⁾ | Drain current (pulsed) | 260 | 240 | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 150 | 125 | W |
| | Derating factor | 1 | 0.83 | W/°C |
| E _{AS} ⁽²⁾ | Single pulse avalanche energy | 120 | | mJ |
| T _{stg} | Storage temperature | – 55 to 175 | | °C |
| T _j | Max. operating junction temperature | | | |

1. Pulse width limited by safe operating area

2. Starting T_j = 25 °C, I_D = 32.5 A, V_{DD} = 45 V

Table 3. Thermal data

| Symbol | Parameter | Value | | Unit |
|-----------------------|--|---------------------------------------|-------------------|------|
| | | TO-220, TO-247, D ² PAK | DPAK | |
| R _{thj-case} | Thermal resistance junction-case max | 1 | 1.2 | °C/W |
| R _{thj-a} | Thermal resistance junction-ambient max | 62.5 | 50 ⁽¹⁾ | °C/W |
| T _l | Maximum lead temperature for soldering purpose | 300 | | °C |

1. When mounted on FR-4 board of 1 inch², 2 oz Cu

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|-------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage | $I_D = 250\ \mu\text{A}$, $V_{GS} = 0$ | 100 | | | 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 ($V_{DS} = 0$) | $V_{GS} = \pm 20\text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 30\text{ A}$ | | 0.015 | 0.0195 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------|---|------|------|------|------|
| C_{iss} | Input capacitance | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 5800 | | pF |
| C_{oss} | Output capacitance | | | 300 | - | pF |
| C_{rss} | Reverse transfer capacitance | | | 190 | | pF |
| Q_g | Total gate charge | $V_{DD} = 80\text{ V}$, $I_D = 65\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16) | - | 85 | | nC |
| Q_{gs} | Gate-source charge | | | 20 | - | nC |
| Q_{gd} | Gate-drain charge | | | 25 | | nC |

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 50\text{ V}$, $I_D = 30\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15) | - | 30 | | ns |
| t_r | Rise time | | | 20 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | $V_{DD} = 50\text{ V}$, $I_D = 30\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15) | - | 65 | | ns |
| t_f | Fall time | | | 20 | - | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------|--|------|------|-----|------|
| I_{SD} | Source-drain current | | - | | 60 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 240 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 60 \text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 60 \text{ A}$, $V_{DD} = 25 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$, $T_j = 150 \text{ }^\circ\text{C}$ <i>(see Figure 17)</i> | - | 80 | | ns |
| Q_{rr} | Reverse recovery charge | | | 280 | | nC |
| I_{RRM} | Reverse recovery current | | | 6.7 | | 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, TO-247, D²PAK

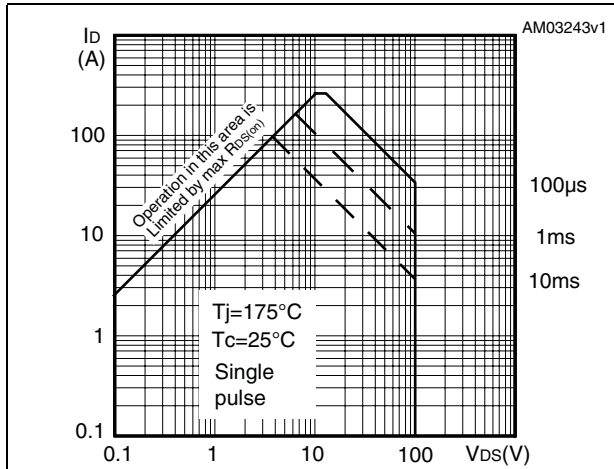


Figure 3. Thermal impedance for TO-220, TO-247, D²PAK

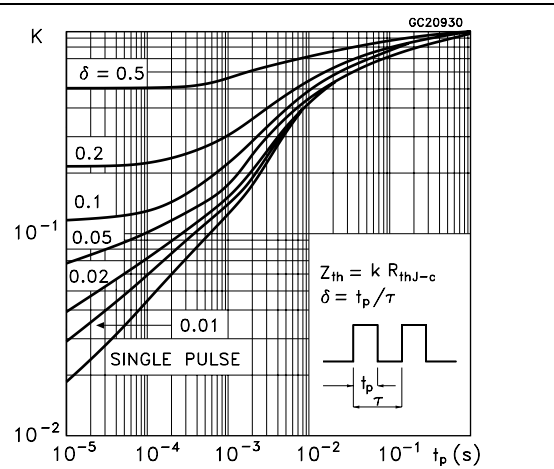


Figure 4. Safe operating area for DPAK

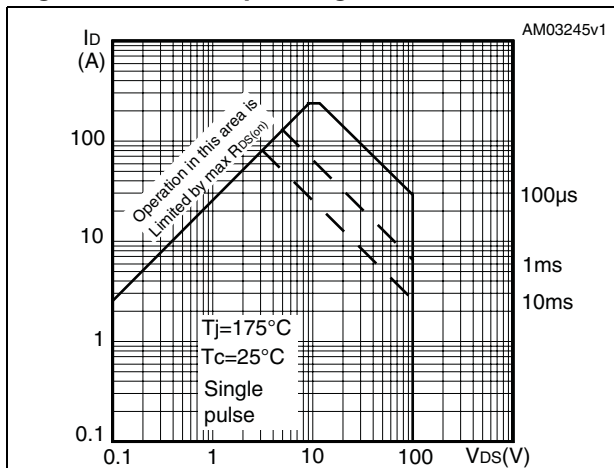


Figure 5. Thermal impedance for DPAK

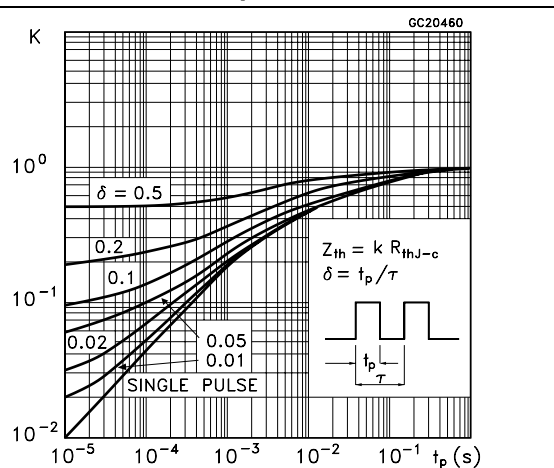


Figure 6. Output characteristics

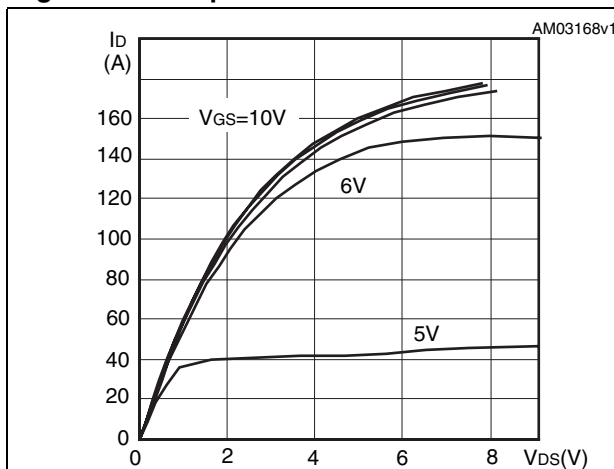


Figure 7. Transfer characteristics

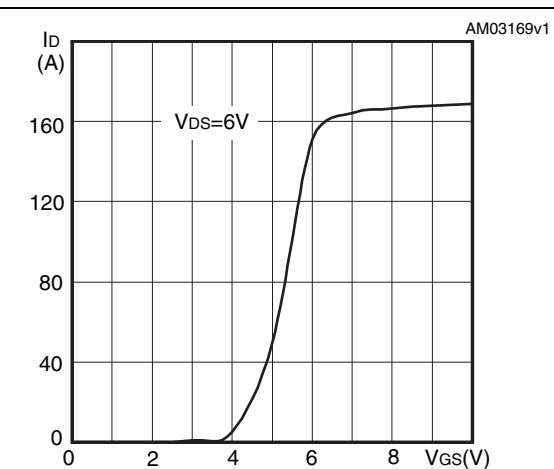


Figure 8. Normalized B_{VDSS} vs temperature

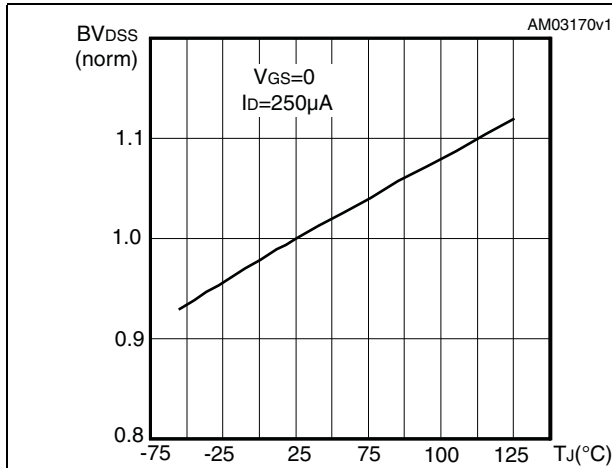


Figure 9. Static drain-source on resistance

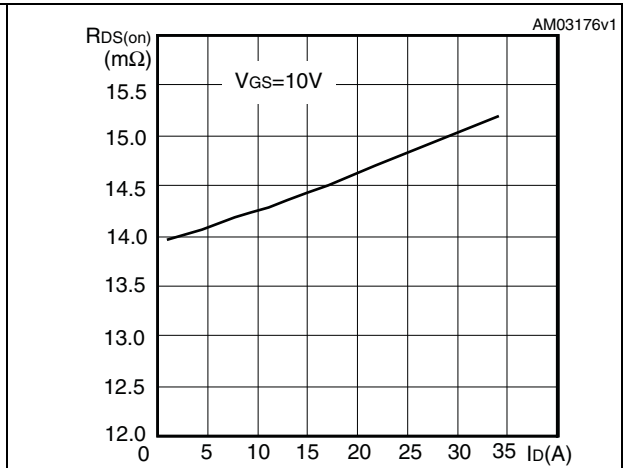


Figure 10. Gate charge vs gate-source voltage

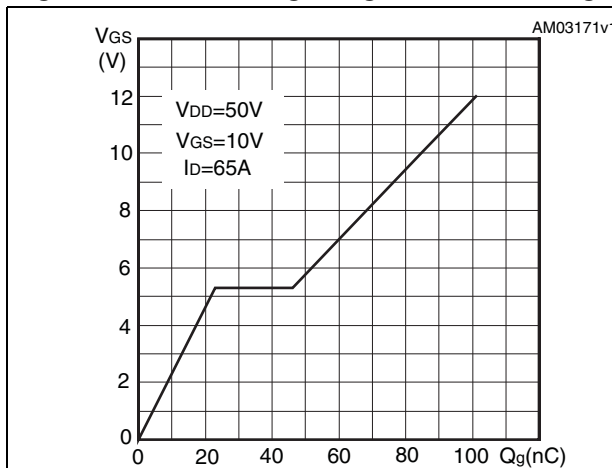


Figure 11. Capacitance variations

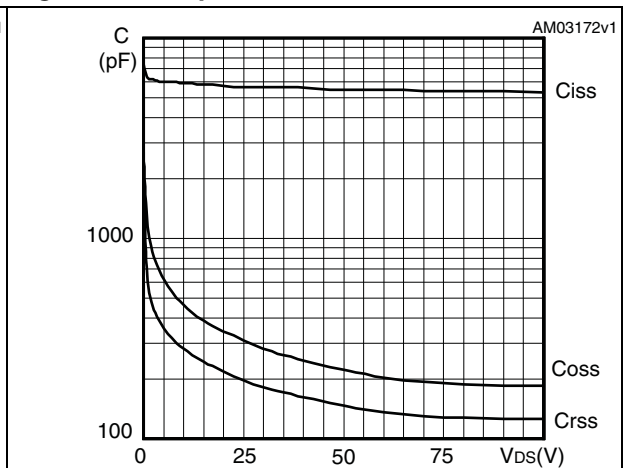


Figure 12. Normalized gate threshold voltage vs temperature

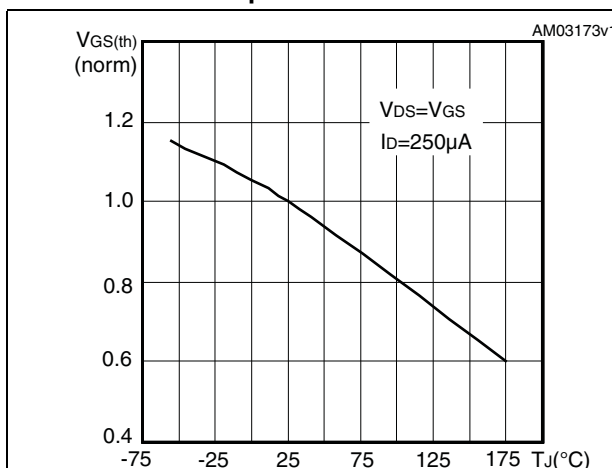


Figure 13. Normalized on resistance vs temperature

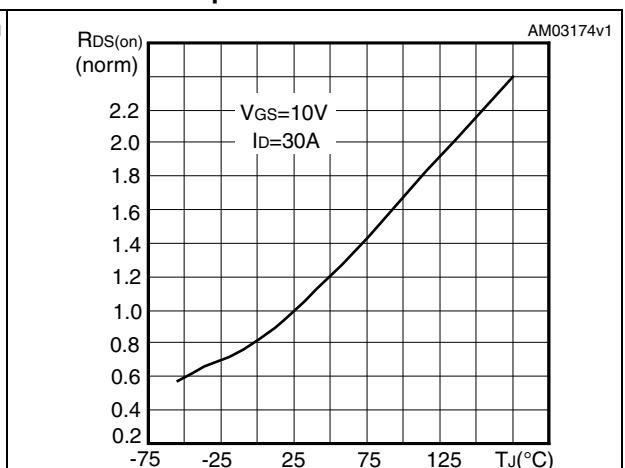
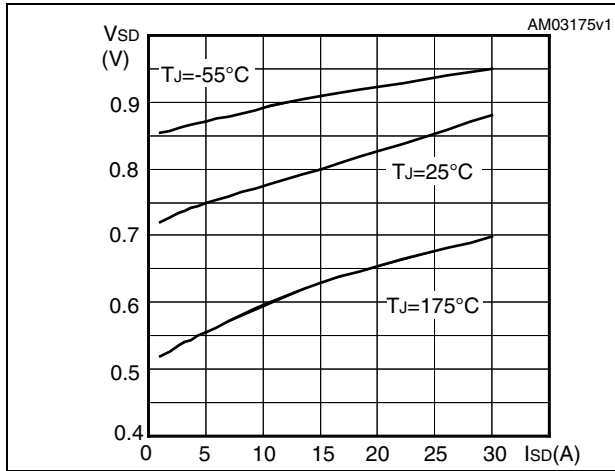


Figure 14. Source-drain diode forward characteristics



3 Test circuits

Figure 15. Switching times test circuit for resistive load

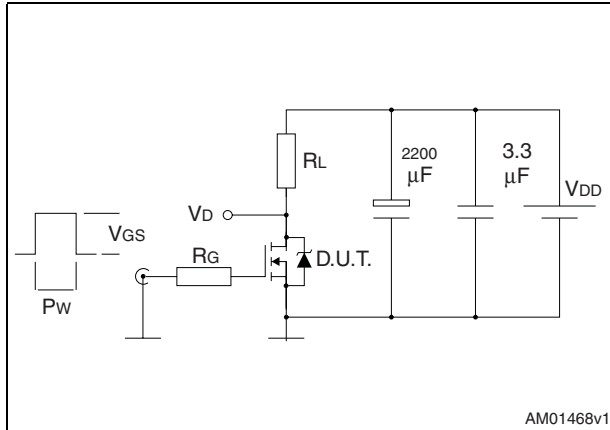


Figure 16. Gate charge test circuit

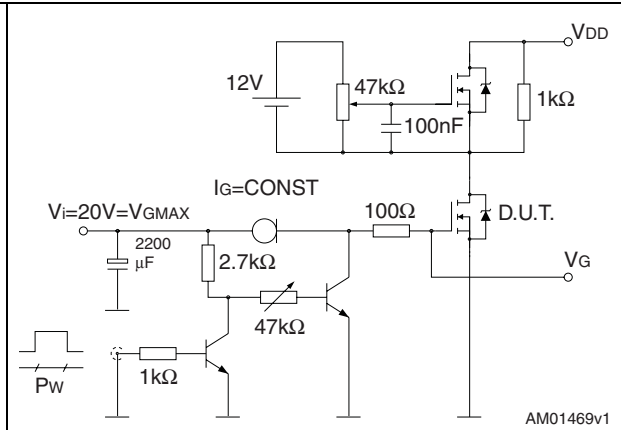


Figure 17. Test circuit for inductive load switching and diode recovery times

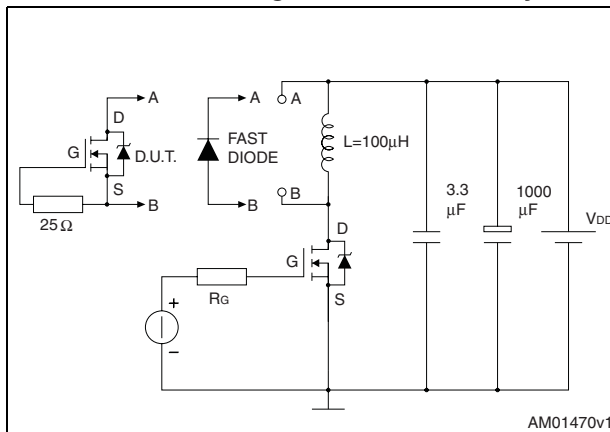


Figure 18. Unclamped inductive load test circuit

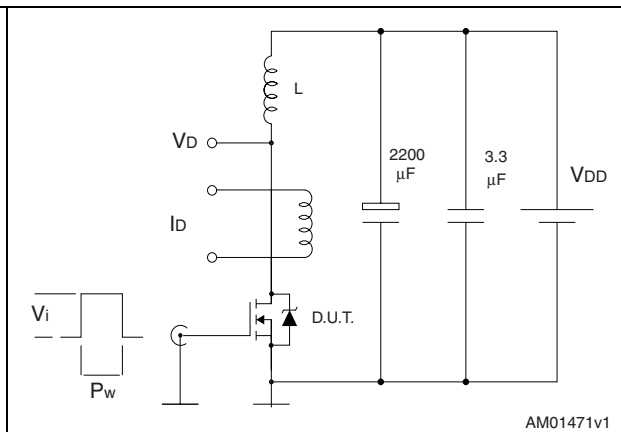


Figure 19. Unclamped inductive waveform

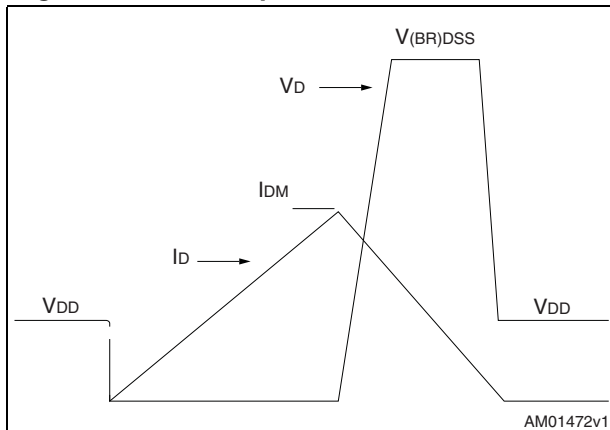
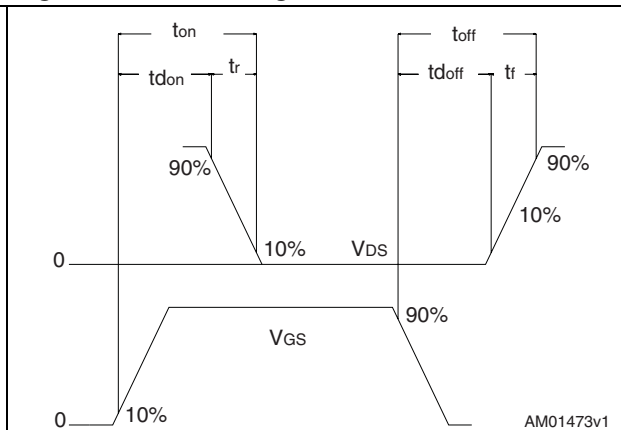


Figure 20. Switching time waveform

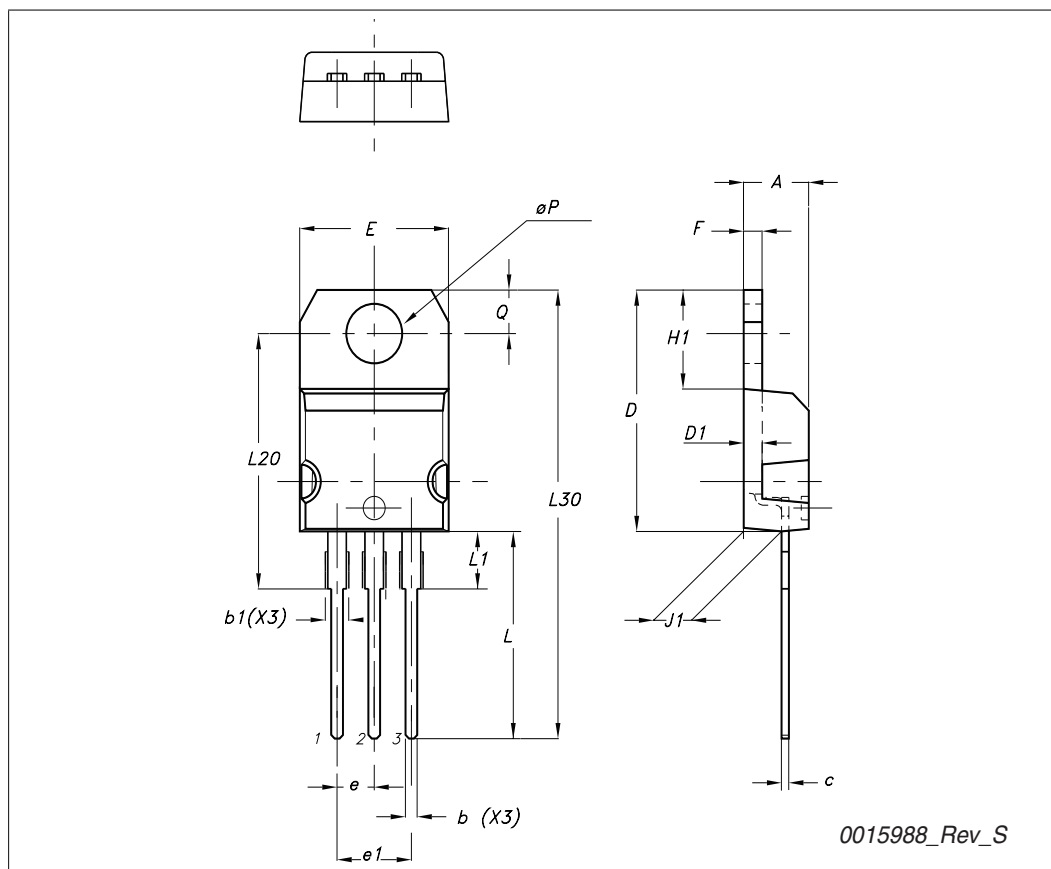


4 Package mechanical data

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.

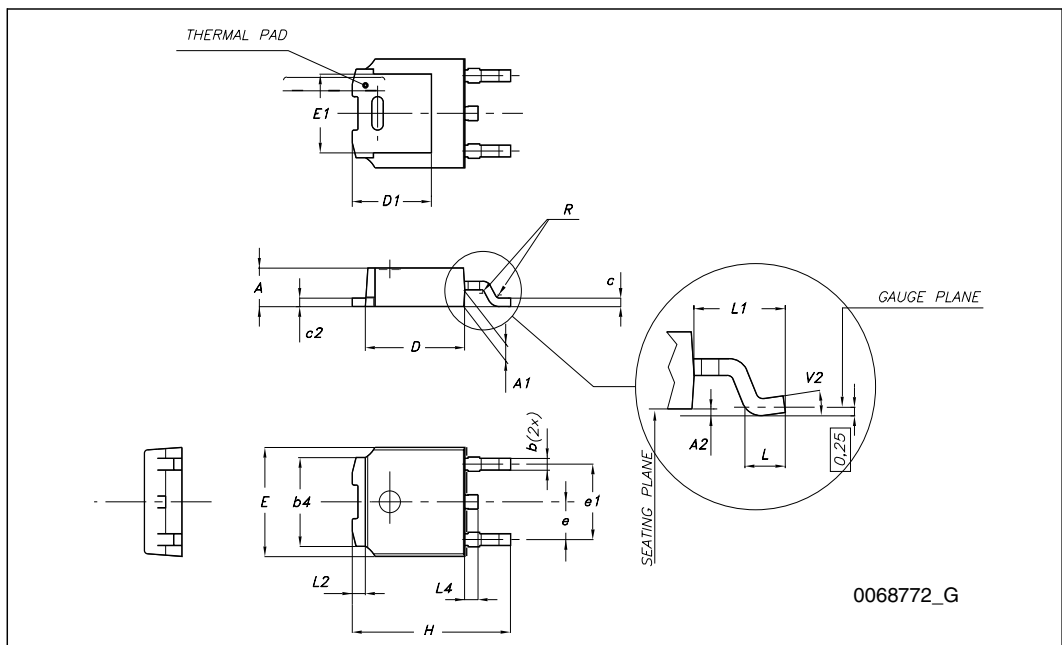
TO-220 type A mechanical data

| 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 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |



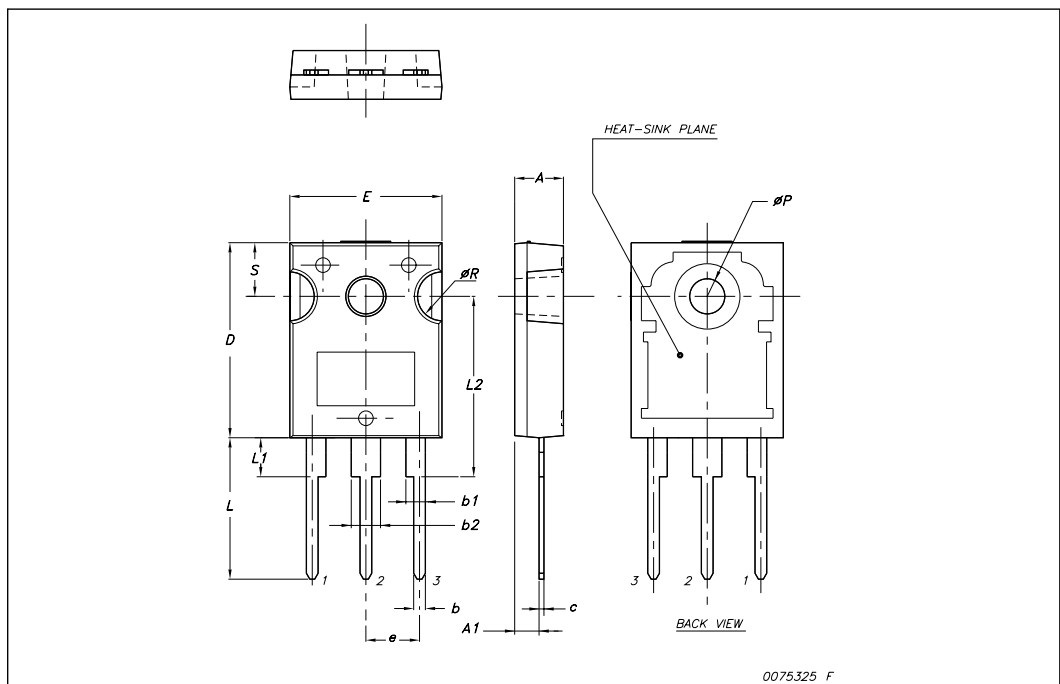
TO-252 (DPAK) mechanical data

| 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 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |



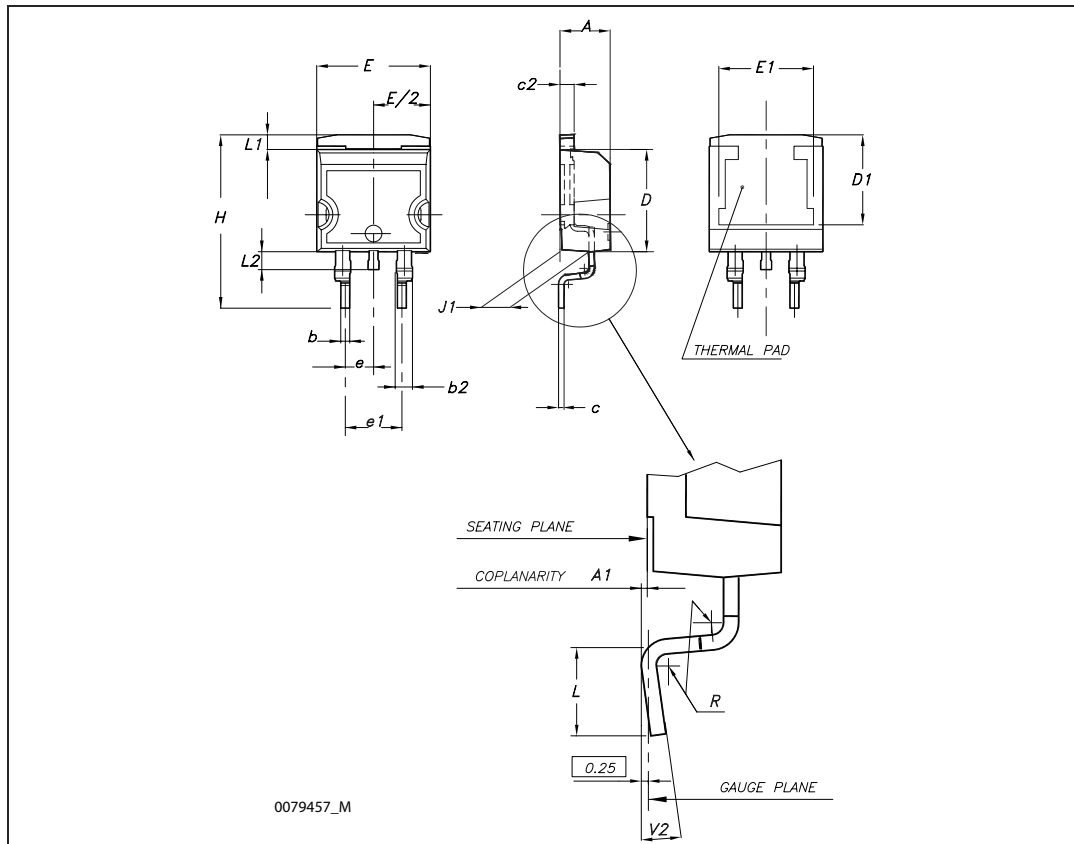
TO-247 Mechanical data

| 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 | |
| $\varnothing P$ | 3.55 | | 3.65 |
| $\varnothing R$ | 4.50 | | 5.50 |
| S | | 5.50 | |



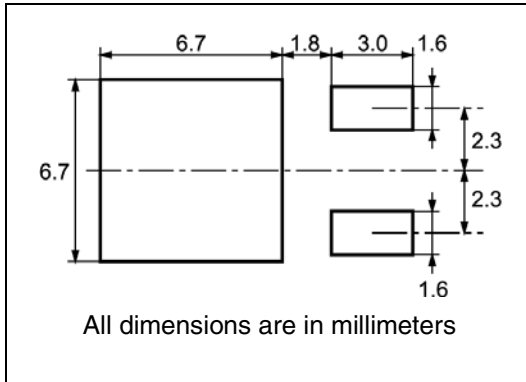
D²PAK (TO-263) mechanical data

| 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

DPAK 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

G measured at hub

| 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 | 16.4 | 18.4 | 0.645 | 0.724 |
| N | 50 | | 1.968 | |
| T | | 22.4 | | 0.881 |

| BASE QTY | BULK QTY |
|----------|----------|
| 2500 | 2500 |

| DIM. | mm | | inch | |
|------|------|------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 6.8 | 7 | 0.267 | 0.275 |
| B0 | 10.4 | 10.6 | 0.409 | 0.417 |
| B1 | | 12.1 | | 0.476 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.5 | | 0.059 | |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 7.4 | 7.6 | 0.291 | 0.299 |
| K0 | 2.55 | 2.75 | 0.100 | 0.108 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 7.9 | 8.1 | 0.311 | 0.319 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 40 | | 1.574 | |
| W | 15.7 | 16.3 | 0.618 | 0.641 |

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

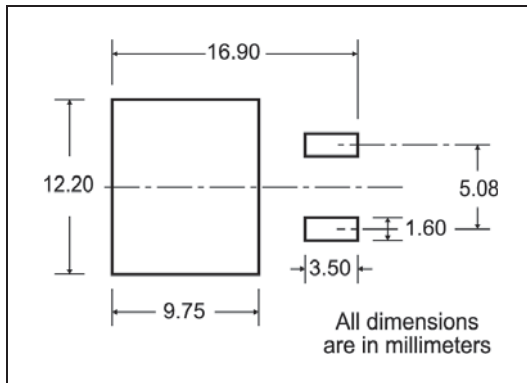
Bending radius R min.

FEED DIRECTION

TRL

For machine ref. only including draft and radii concentric around B0

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

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 |

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 |

6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 12-Nov-2008 | 1 | First release |
| 14-Jan-2009 | 2 | Added new package, mechanical data DPAK |
| 09-Oct-2009 | 3 | Added new package, mechanical data D ² PAK |

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