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STD20NF20 STF20NF20, STP20NF20

N-channel 200 V, 0.10 Ω , 18 A DPAK, TO-220, TO-220FP
low gate charge STripFET™ Power MOSFET

Features

| Type | V _{DSS} | R _{DS(on)} | I _D | P _W |
|-----------|------------------|---------------------|----------------|----------------|
| STD20NF20 | 200 V | < 0.125 Ω | 18 A | 110 W |
| STF20NF20 | 200 V | < 0.125 Ω | 18 A | 30 W |
| STP20NF20 | 200 V | < 0.125 Ω | 18 A | 110 W |

- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

Application

- Switching applications

Description

This Power MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters.

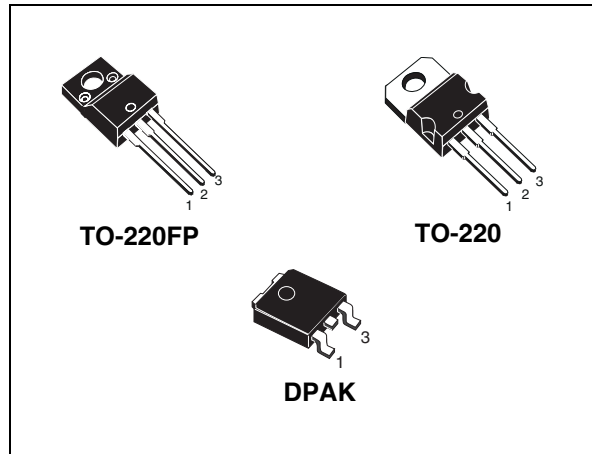


Figure 1. Internal schematic diagram

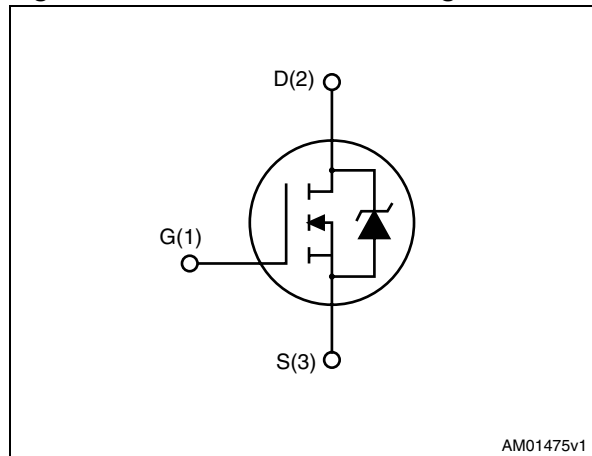


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|----------|---------------|
| STD20NF20 | 20NF20 | DPAK | Tape and reel |
| STF20NF20 | 20NF20 | TO-220FP | Tube |
| STP20NF20 | 20NF20 | TO-220 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|----------------|---|--------------|----------|---------------------|
| | | TO-220, DPAK | TO-220FP | |
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 200 | | V |
| V_{GS} | Gate- source voltage | ± 20 | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 18 | | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 11 | | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 72 | | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 110 | 30 | W |
| | Derating factor | 0.72 | 0.2 | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^\circ\text{C}$) | 2500 | | V |
| T_{stg} | Storage temperature | -55 to 175 | | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | | | |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 18\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | TO-220 | DPAK | TO-220FP | Unit |
|-----------|--|--------|-------------------|----------|---------------------------|
| Rthj-case | Thermal resistance junction-case max | 1.38 | 1.38 | 5 | $^\circ\text{C}/\text{W}$ |
| Rthj-amb | Thermal resistance junction-ambient max | 62.5 | 50 ⁽¹⁾ | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_I | Maximum lead temperature for soldering purpose | | | 300 | $^\circ\text{C}$ |

1. When mounted on 1inch² FR-4, 2 Oz copper board.

Table 4. Avalanche characteristics

| Symbol | Parameter | Max value | Unit |
|----------|--|-----------|------|
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 18 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 110 | mJ |

2 Electrical characteristics

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

Table 5. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1 \text{ mA}, V_{GS} = 0$ | 200 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}\text{C}$ | | | 1 10 | 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 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10 \text{ V}, I_D = 10 \text{ A}$ | | 0.10 | 0.125 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 25 \text{ V}, I_D = 10 \text{ A}$ | - | 13 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25 \text{ V}, f = 1 \text{ MHz},$ $V_{GS} = 0$ | - | 940 197 30 | | pF pF pF |
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on delay time Rise time Turn-off delay time Fall time | $V_{DD} = 100 \text{ V}, I_D = 10 \text{ A},$ $R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ <i>(see Figure 15)</i> | - | 15 30 40 10 | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 160 \text{ V}, I_D = 20 \text{ A},$ $V_{GS} = 10 \text{ V}$ <i>(see Figure 16)</i> | - | 28 5.6 14.5 | 39 | nC nC nC |

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%.

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|---------------------|----------|---------------|
| I_{SD} $I_{SDM}^{(1)}$ | Source-drain current Source-drain current (pulsed) | | - | | 18 72 | A A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 20\text{ A}$, $V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 20\text{ A}$, $di/dt = 100\text{A}/\mu\text{s}$ $V_{DD} = 50\text{ V}$ (see Figure 20) | - | 155 775 10 | | ns nC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 20\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 50\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 20) | - | 183 1061 11.6 | | ns nC 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, DPAK

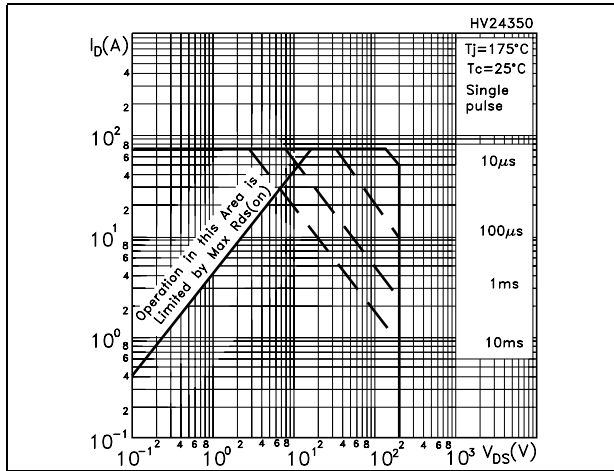


Figure 3. Thermal impedance area for TO-220, DPAK

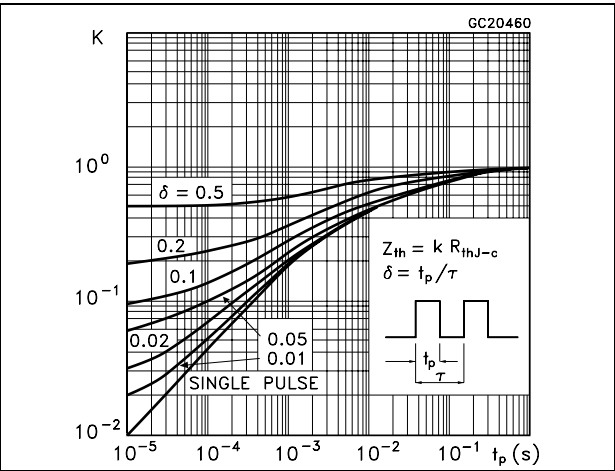


Figure 4. Safe operating area for TO-220FP

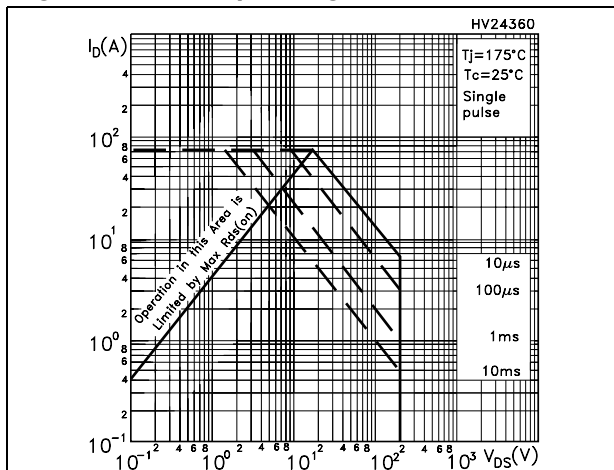


Figure 5. Thermal impedance for TO-220FP

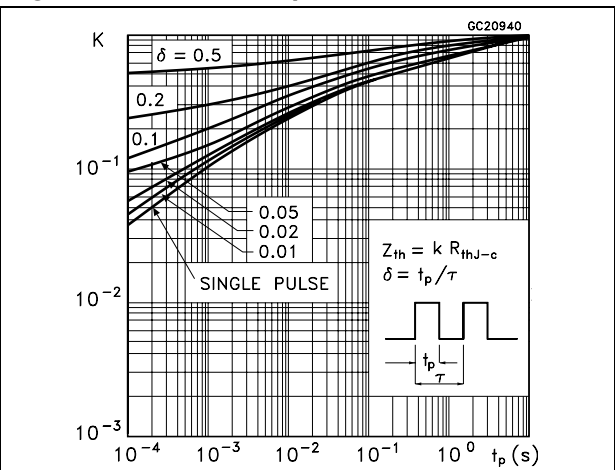


Figure 6. Output characteristics

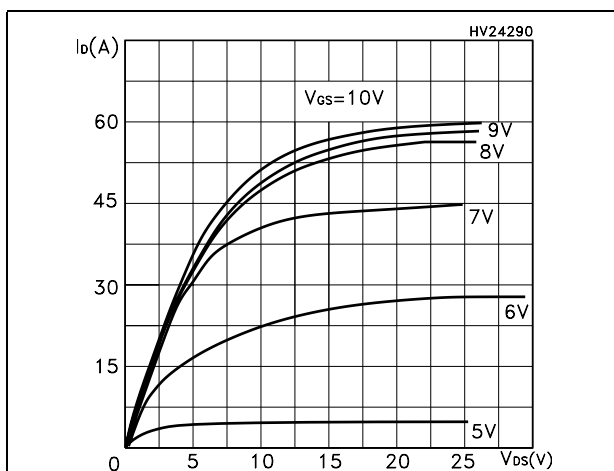


Figure 7. Transfer characteristics

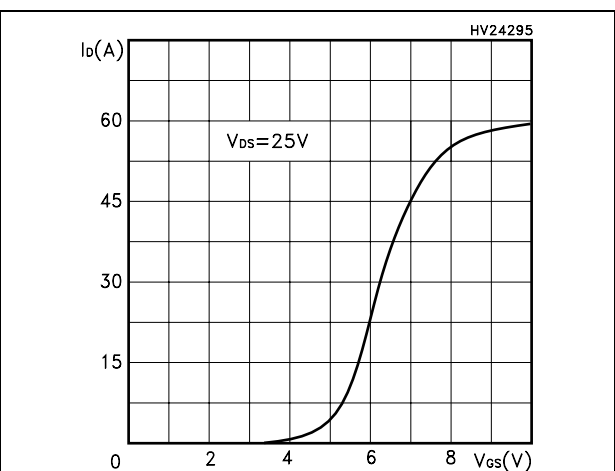


Figure 8. Transconductance

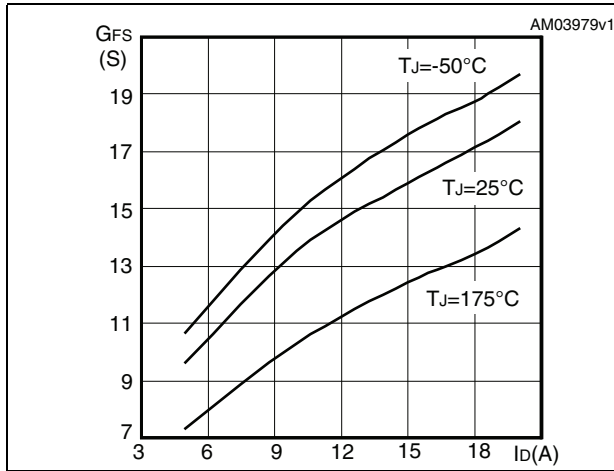


Figure 9. Static drain-source on resistance

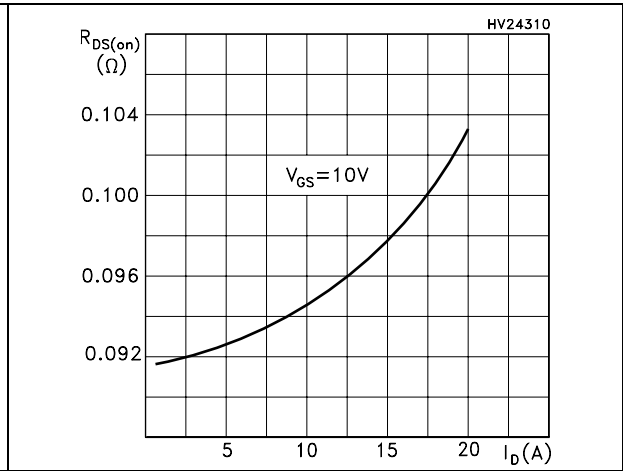


Figure 10. Gate charge vs gate-source voltage

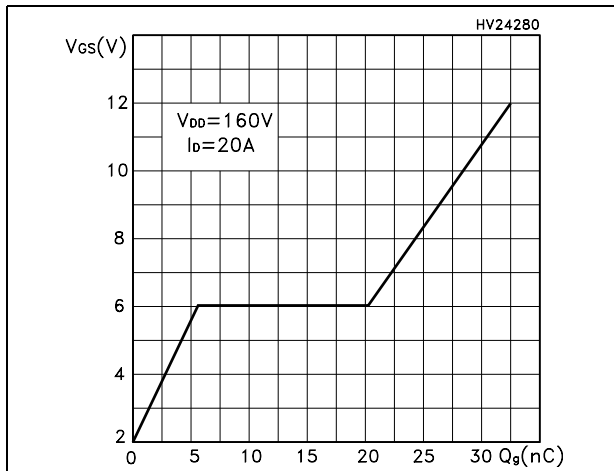


Figure 11. Capacitance variations

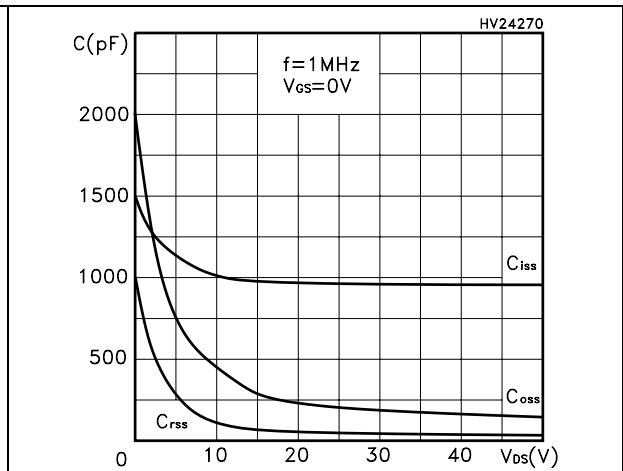


Figure 12. Normalized gate threshold voltage vs temperature

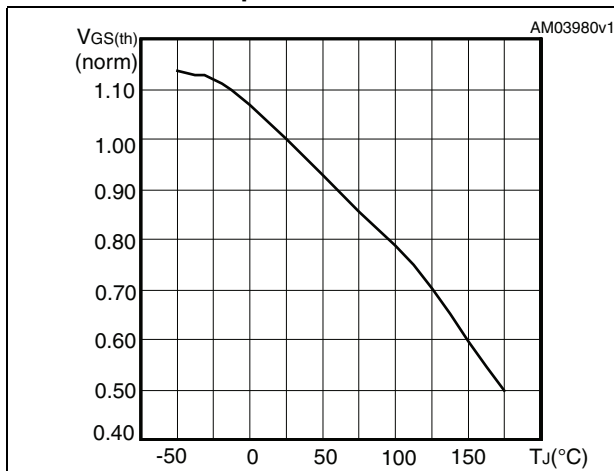


Figure 13. Normalized on resistance vs temperature

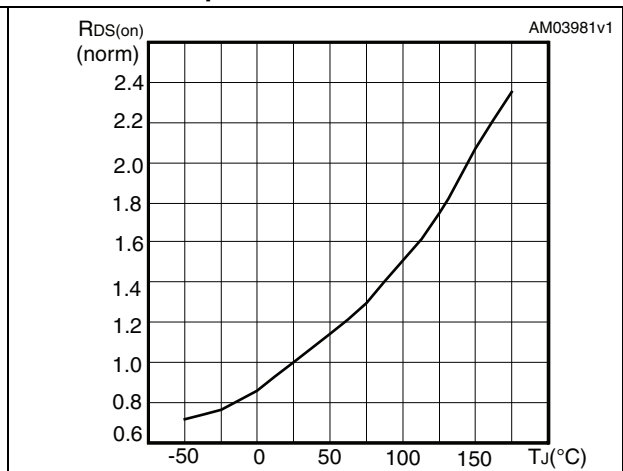
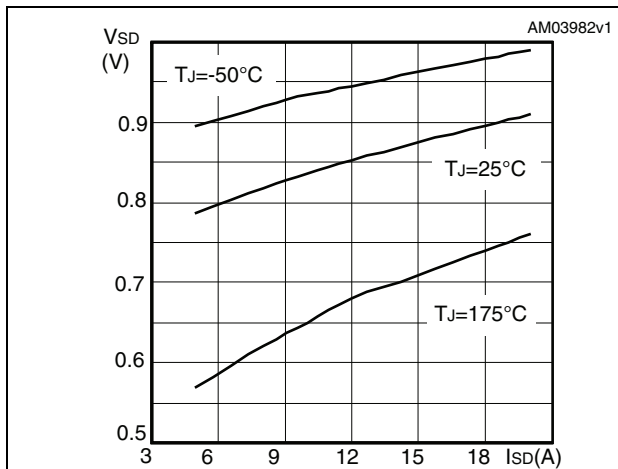


Figure 14. Source-drain diode forward characteristics



3 Test circuits

Figure 15. Switching times test circuit for resistive load

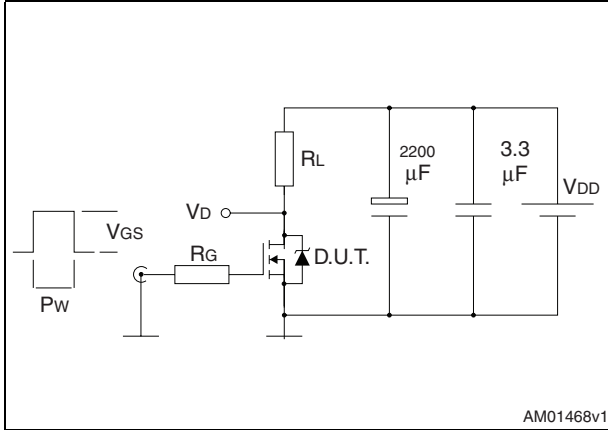


Figure 16. Gate charge test circuit

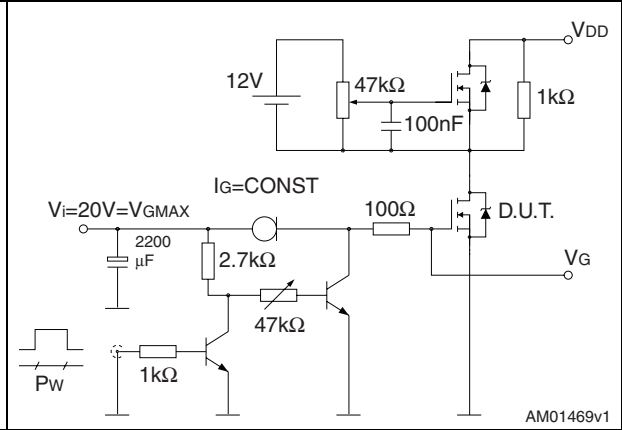


Figure 17. Test circuit for inductive load switching and diode recovery times

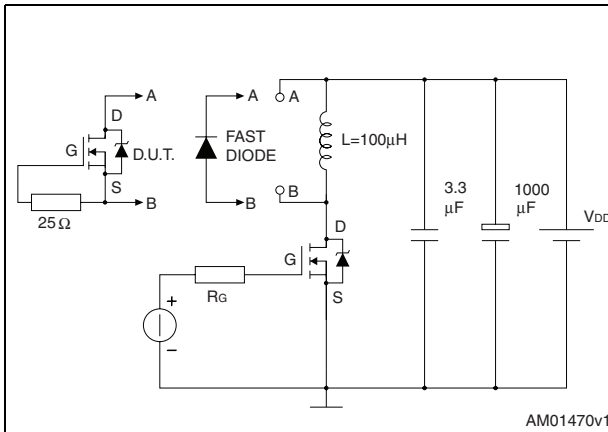


Figure 18. Unclamped inductive load test circuit

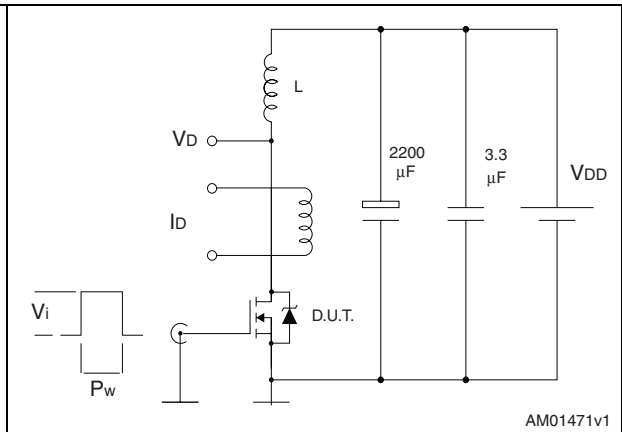


Figure 19. Unclamped inductive waveform

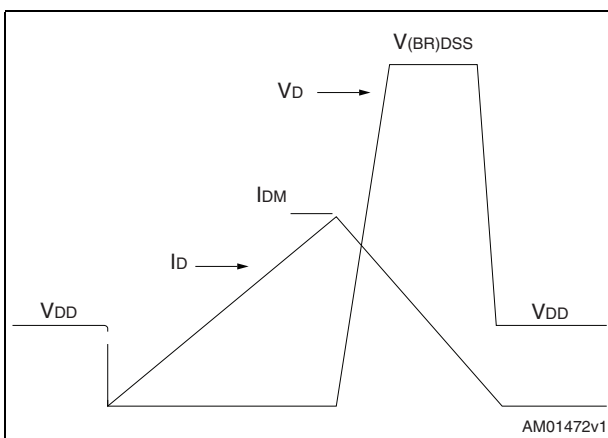
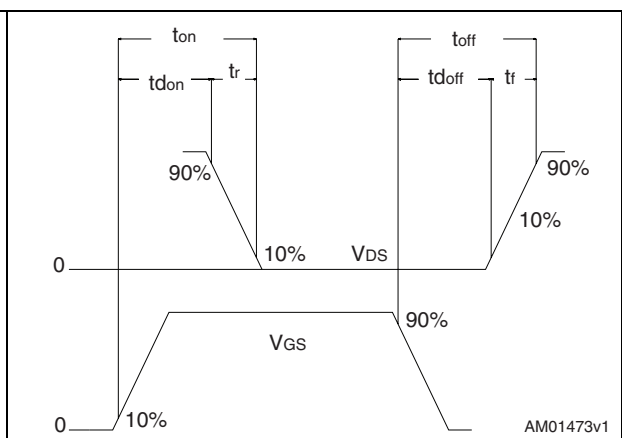


Figure 20. Switching time waveform

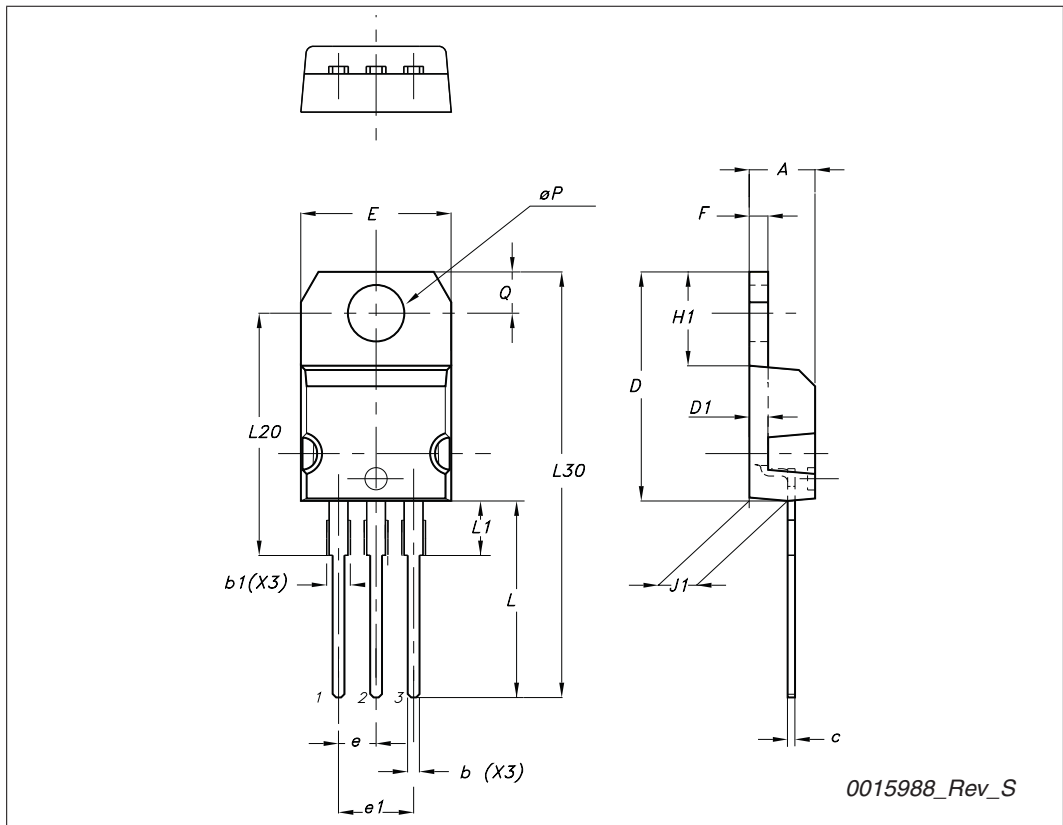


4 Package mechanical data

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.

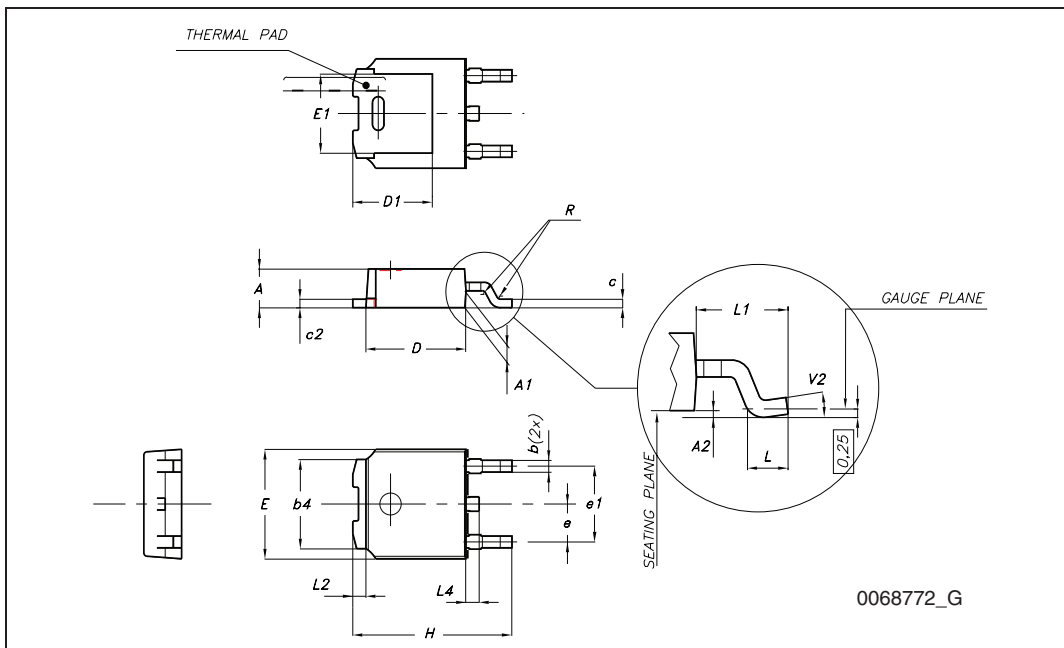
TO-220 type A mechanical data

| 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 |



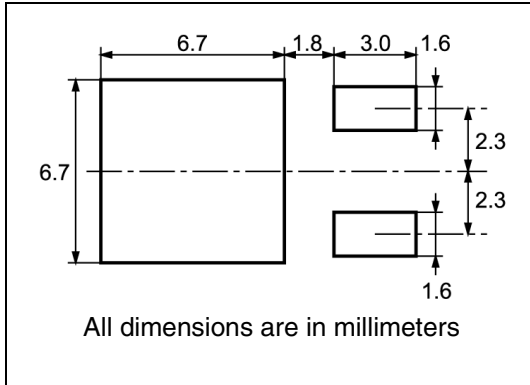
TO-252 (DPAK) mechanical data

| 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° |



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

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

TAPE MECHANICAL DATA

| 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 |

BASE QTY

| |
|------|
| 2500 |
|------|

BULK QTY

| |
|------|
| 2500 |
|------|

TOP COVER TAPE

Center line of cavity

User Direction of Feed

Bending radius R min.

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

TRL

FEED DIRECTION

10 pitches cumulative tolerance on tape +/- 0.2 mm

6 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 25-Jan-2007 | 1 | First release |
| 20-Mar-2007 | 2 | Typo mistake in first page (order codes) |
| 27-Apr-2007 | 3 | Updates on Table 6: Dynamic |
| 10-Dec-2009 | 4 | Modified device summary on first page |

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