



STD20NF20 STF20NF20 - STP20NF20

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

Features

| Type | V _{DSS} | R _{DS(on)} | I _D | P _W |
|-----------|------------------|---------------------|----------------|----------------|
| STD20NF20 | 200V | <0.125Ω | 18A | 90W |
| STF20NF20 | 200V | <0.125Ω | 18A | 25W |
| STP20NF20 | 200V | <0.125Ω | 18A | 90W |

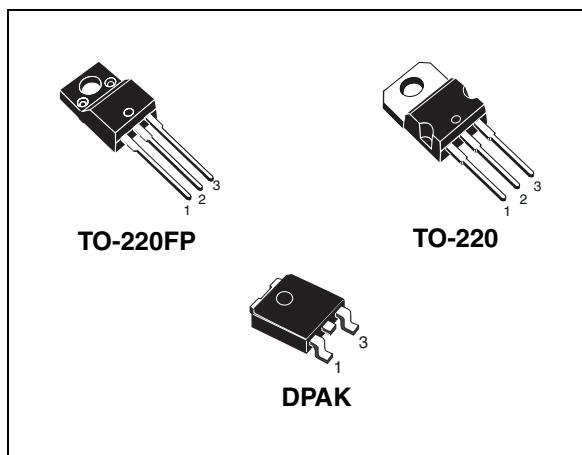
- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

Description

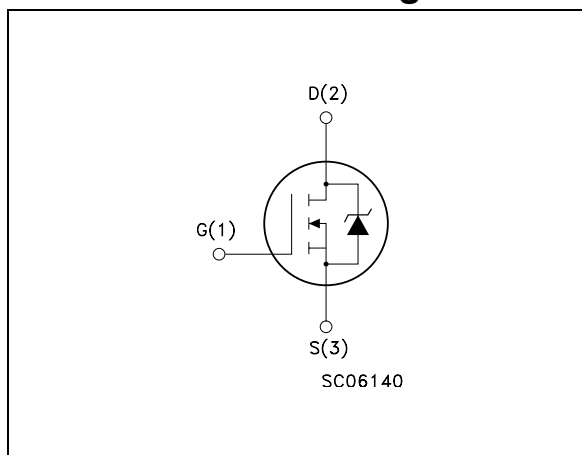
This Power MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters.

Application

- Switching application



Internal schematic diagram



Order codes

| Part number | Marking | Package | Packaging |
|-------------|---------|----------|-------------|
| STD20NF20 | 20NF20 | DPAK | Tape & reel |
| STF20NF20 | 20NF20 | TO-220FP | Tube |
| STP20NF20 | 20NF20 | TO-220 | Tube |

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1 Electrical ratings

Table 1. 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 $T_C = 25^\circ\text{C}$ | 18 | | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 11 | | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 72 | | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 90 | 25 | 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 ($t = 1\text{ s}$; $T_C = 25^\circ\text{C}$) | -- | 2500 | V |
| T_{stg} | Storage temperature | -55 to 150 | | $^\circ\text{C}$ |
| 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 2. Thermal data

| Symbol | Parameter | TO-220 | DPAK | TO-220FP | Unit |
|----------------|--|--------|-------------------|----------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.38 | 1.38 | 5 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | 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 3. 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 $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 110 | mJ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1 \text{ mA}, V_{GS} = 0$ | 200 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$ | | | 1 10 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250 \mu A$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 10 \text{ A}$ | | 0.10 | 0.125 | Ω |

Table 5. 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 | $V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$ | | 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 | $V_{DD} = 100 \text{ V}, I_D = 10 \text{ A},$ $R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ (see Figure 14) | | 15 30 40 10 | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 160V, I_D = 20 \text{ A},$ $V_{GS} = 10V$ (see Figure 15) | | 28 5.6 14.5 | 39 | nC nC nC |

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

Table 6. 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 | $I_{SD} = 20\text{ A}$, $di/dt = 100\text{A}/\mu\text{s}$ $V_{DD} = 50\text{V}$, $T_j = 25^\circ\text{C}$ (see Figure 19) | | 155 775 10 | | ns nC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 20\text{ A}$, $di/dt = 100\text{A}/\mu\text{s}$ $V_{DD} = 50\text{V}$, $T_j = 150^\circ\text{C}$ (see Figure 19) | | 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 1. Safe operating area for TO-220/ DPAK

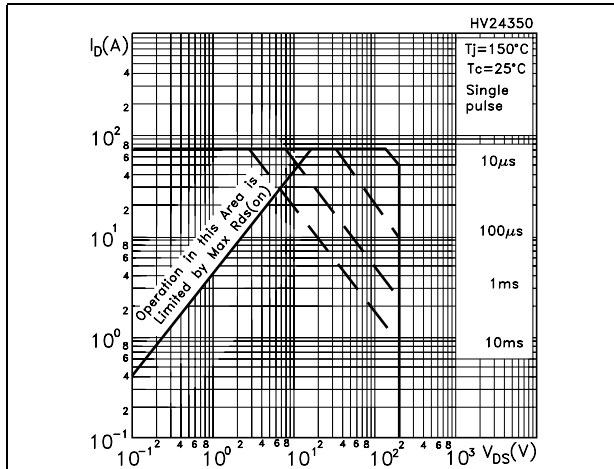


Figure 2. Thermal impedance area for TO-220/ DPAK

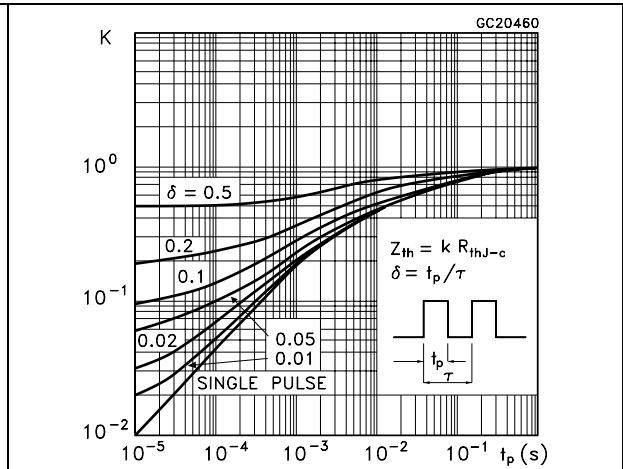


Figure 3. Safe operating area for TO-220FP

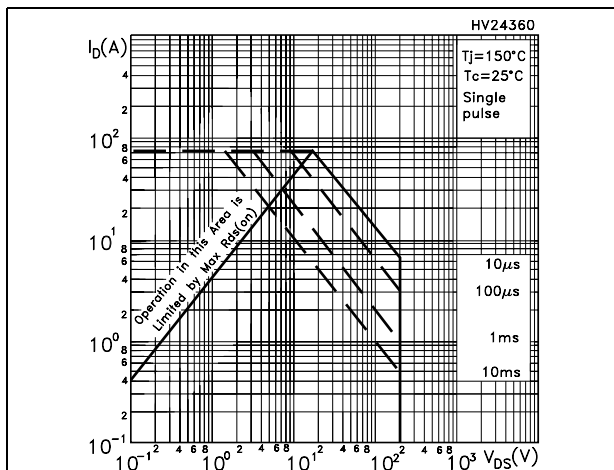


Figure 4. Thermal impedance for TO-220FP

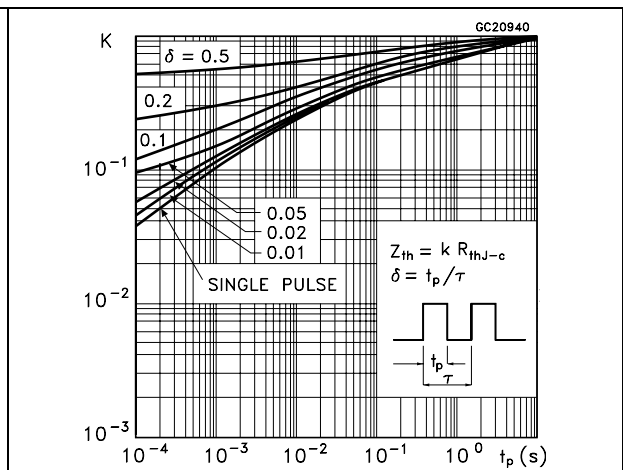


Figure 5. Output characteristics

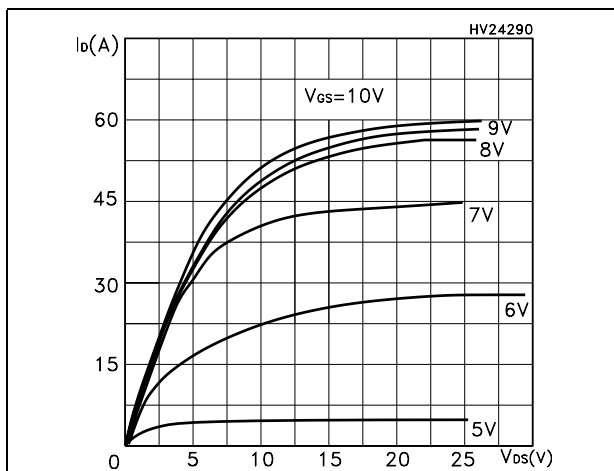


Figure 6. Transfer characteristics

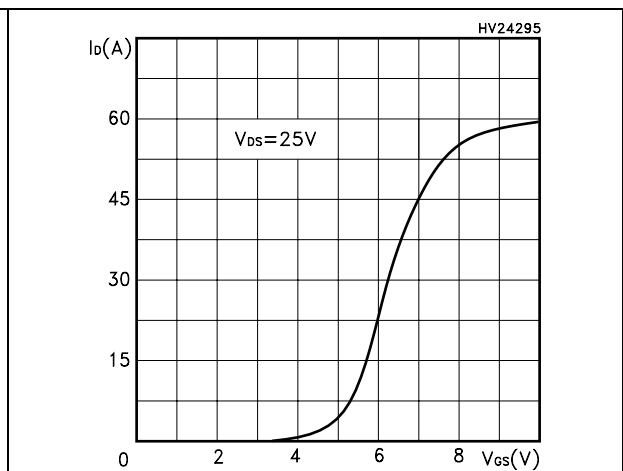


Figure 7. Transconductance

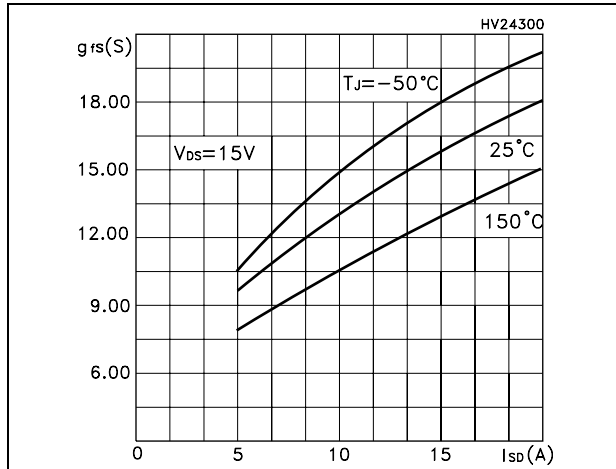


Figure 8. Static drain-source on resistance

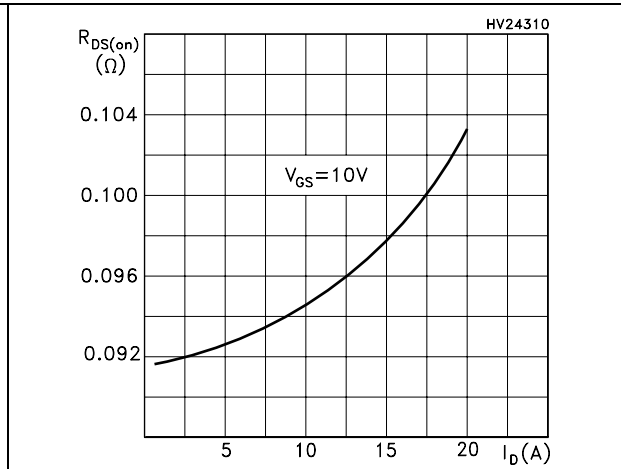


Figure 9. Gate charge vs gate-source voltage Figure 10. Capacitance variations

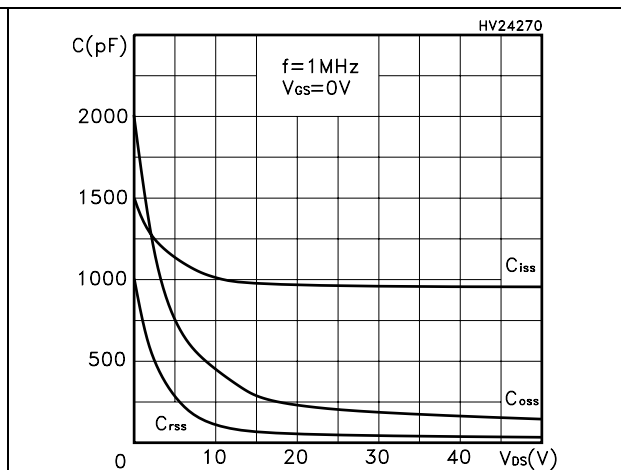
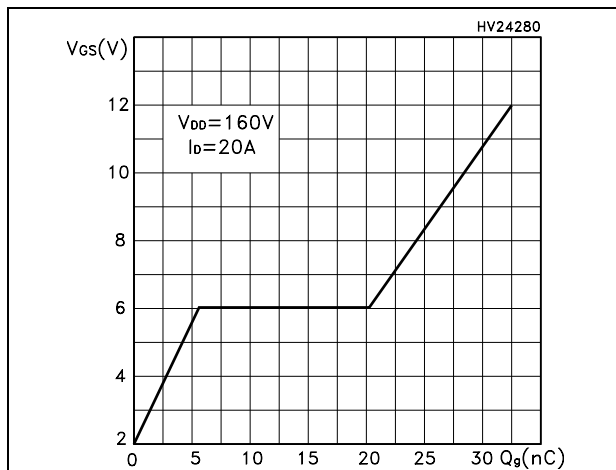


Figure 11. Normalized gate threshold voltage vs temperature

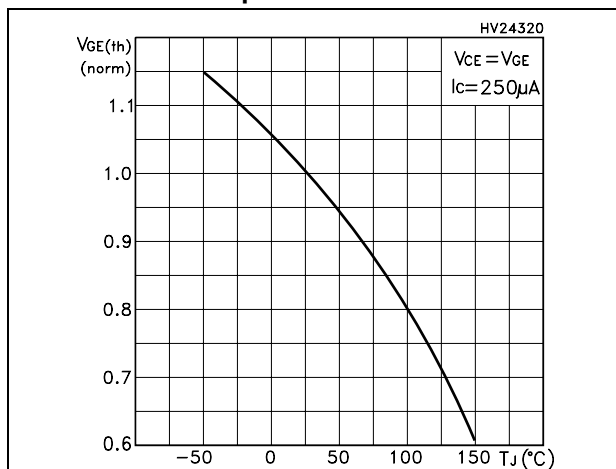


Figure 12. Normalized on resistance vs temperature

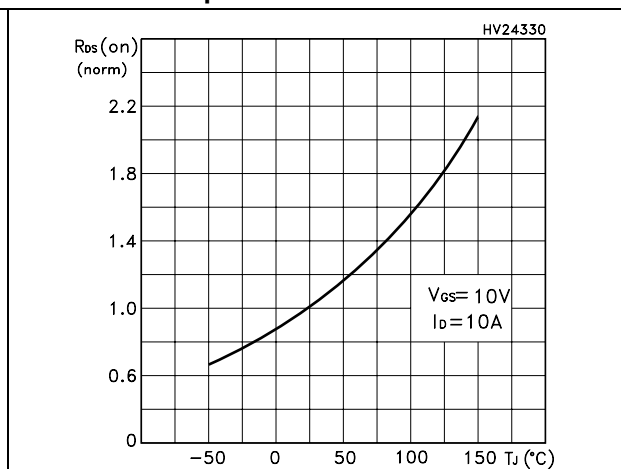
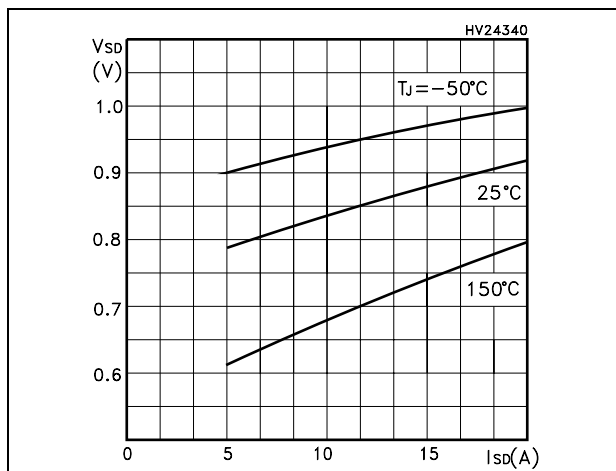


Figure 13. Source-drain diode forward characteristics



3 Test circuit

Figure 14. Switching times test circuit for resistive load



Figure 15. Gate charge test circuit

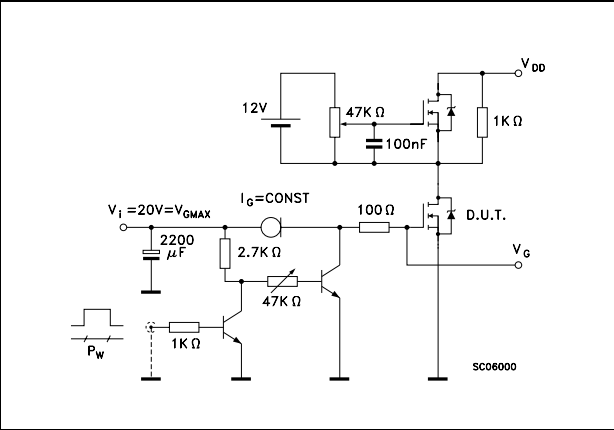


Figure 16. Test circuit for inductive load switching and diode recovery times



Figure 17. Unclamped Inductive load test circuit

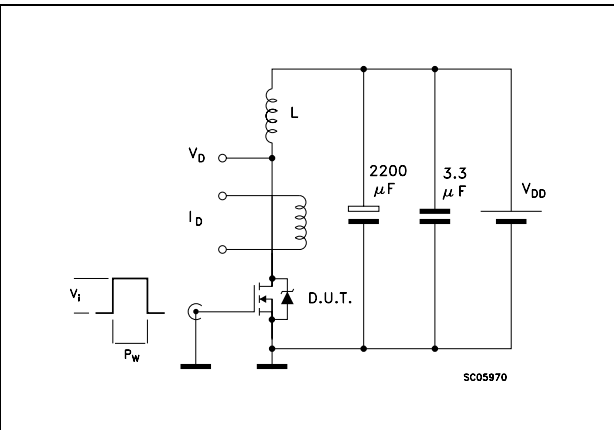
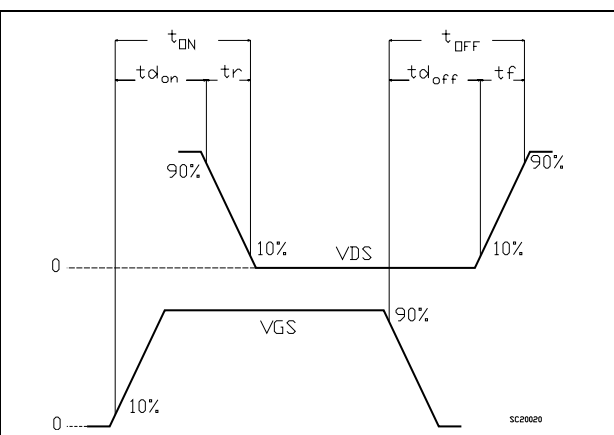


Figure 18. Unclamped inductive waveform



Figure 19. Switching time waveform

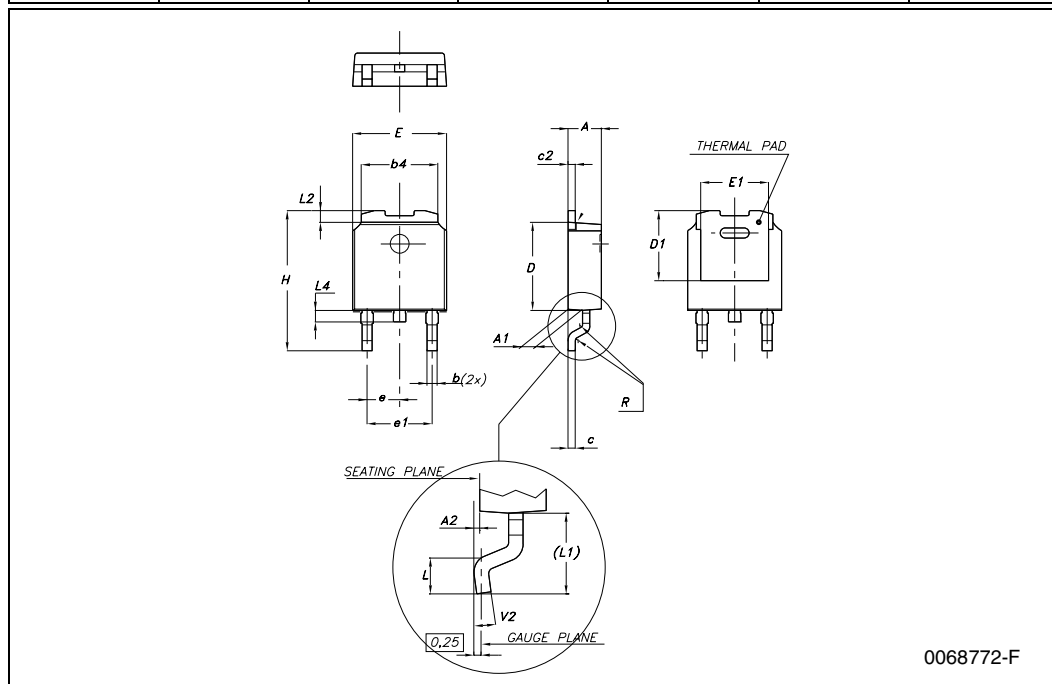


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

DPAK MECHANICAL DATA

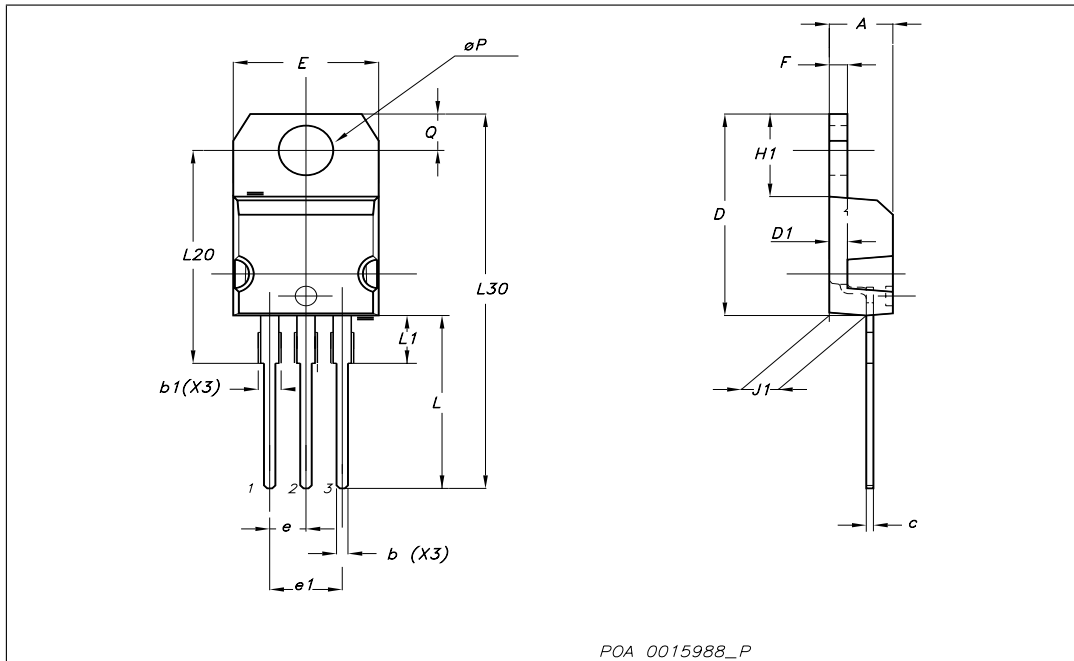
| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.9 | 0.025 | | 0.035 |
| b4 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| D1 | | 5.1 | | | 0.200 | |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| E1 | | 4.7 | | | 0.185 | |
| e | | 2.28 | | | 0.090 | |
| e1 | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 9.35 | | 10.1 | 0.368 | | 0.397 |
| L | 1 | | | 0.039 | | |
| (L1) | | 2.8 | | | 0.110 | |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.6 | | 1 | 0.023 | | 0.039 |
| R | | 0.2 | | | 0.008 | |
| V2 | 0° | | 8° | 0° | | 8° |



0068772-F

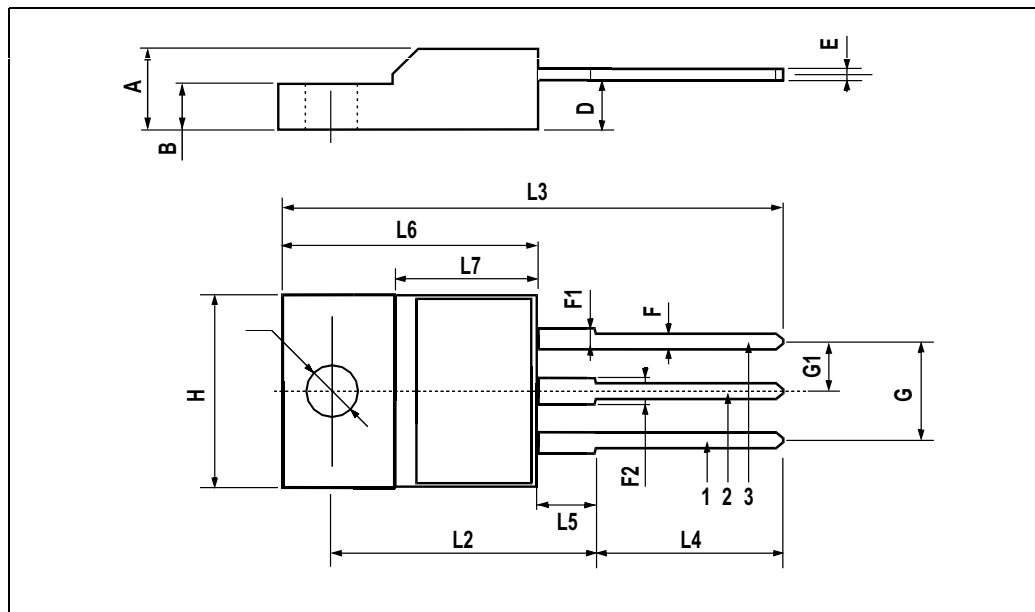
TO-220 mechanical data

| 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 | 0.49 | | 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 | |
| øP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



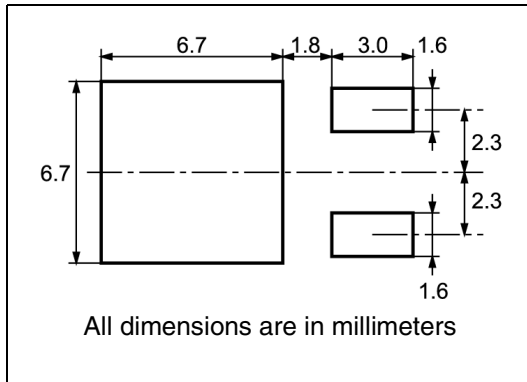
TO-220FP MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 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 | | 0.7 | 0.017 | | 0.027 |
| F | 0.75 | | 1 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.7 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.7 | 0.045 | | 0.067 |
| G | 4.95 | | 5.2 | 0.195 | | 0.204 |
| G1 | 2.4 | | 2.7 | 0.094 | | 0.106 |
| H | 10 | | 10.4 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.8 | | 10.6 | .0385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| L6 | 15.9 | | 16.4 | 0.626 | | 0.645 |
| L7 | 9 | | 9.3 | 0.354 | | 0.366 |
| Ø | 3 | | 3.2 | 0.118 | | 0.126 |



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 |

TOP COVER TAPE

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

6 Revision history

Table 7. Revision history

| Date | Revision | Changes |
|-------------|-----------------|---|
| 25-Jan-2007 | 1 | First release |
| 20-Mar-2007 | 2 | Typo mistake in first page (order codes) |
| 17-Apr-2007 | 3 | Updates on Table 5: Dynamic |

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