



# STP200NF04 STB200NF04 - STB200NF04-1

N-CHANNEL 40V - 120 A - 3.3 mΩ TO-220/D<sup>2</sup>PAK/I<sup>2</sup>PAK  
STripFET™II MOSFET

Table 1: General Features

| Type         | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> | P <sub>w</sub> |
|--------------|------------------|---------------------|----------------|----------------|
| STB200NF04   | 40 V             | < 0.0037 Ω          | 120 A          | 310 W          |
| STB200NF04-1 | 40 V             | < 0.0037 Ω          | 120 A          | 310 W          |
| STP200NF04   | 40 V             | < 0.0037 Ω          | 120 A          | 310 W          |

- STANDARD THRESHOLD DRIVE
- 100% AVALANCHE TESTED

### DESCRIPTION

This MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

### APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- AUTOMOTIVE

Figure 1: Package

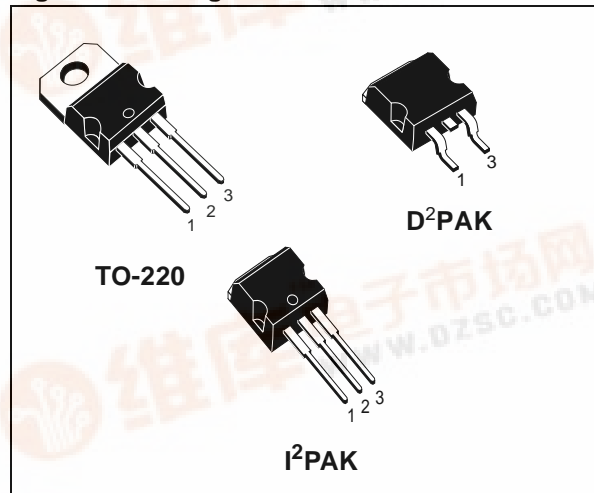


Figure 2: Internal Schematic Diagram

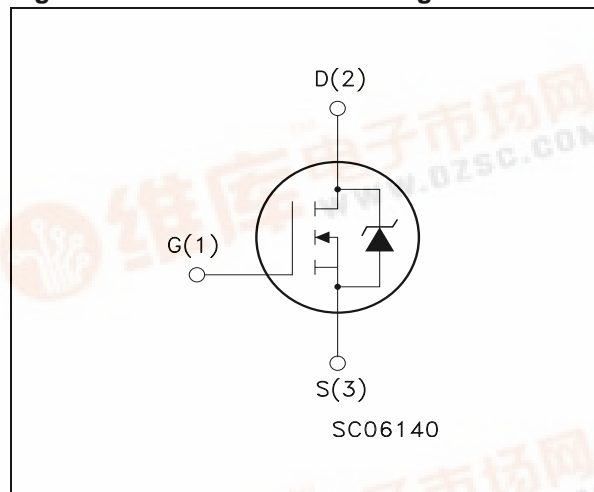


Table 2: Order Codes

| SALES TYPE   | MARKING  | PACKAGE            | PACKAGING   |
|--------------|----------|--------------------|-------------|
| STB200NF04T4 | B200NF04 | D <sup>2</sup> PAK | TAPE & REEL |
| STB200NF04-1 | B200NF04 | I <sup>2</sup> PAK | TUBE        |
| STP200NF04   | P200NF04 | TO-220             | TUBE        |

## STP200NF04 - STB200NF04 - STB200NF04-1

**Table 3: Absolute Maximum ratings**

| Symbol                             | Parameter   | Value      | Unit |
|------------------------------------|---|------------|------|
| V <sub>DS</sub>                    | Drain-source Voltage (V <sub>GS</sub> = 0)            | 40         | V    |
| V <sub>DGR</sub>                   | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)          | 40         | V    |
| V <sub>GS</sub>                    | Gate- source Voltage                                  | ± 20       | V    |
| I <sub>D</sub> (#)                 | Drain Current (continuous) at T <sub>C</sub> = 25°C   | 120        | A    |
| I <sub>D</sub> (#)                 | Drain Current (continuous) at T <sub>C</sub> = 100°C  | 120        | A    |
| I <sub>DM</sub> (•)                | Drain Current (pulsed)                                | 480        | A    |
| P <sub>TOT</sub>                   | Total Dissipation at T <sub>C</sub> = 25°C            | 310        | W    |
|                                    | Derating Factor                                       | 2.07       | W/°C |
| dv/dt (1)                          | Peak Diode Recovery voltage slope                     | 1.5        | V/ns |
| E <sub>AS</sub> (2)                | Single Pulse Avalanche Energy                         | 1.3        | J    |
| T <sub>j</sub><br>T <sub>stg</sub> | Operating Junction Temperature<br>Storage Temperature | -55 to 175 | °C   |

(•) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 120A, di/dt ≤ 500A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

(2) Starting T<sub>j</sub> = 25°C, I<sub>d</sub> = 60A, V<sub>DD</sub> = 30 V

(#) Current Limited by Package

**Table 4: Thermal Data**

|                       |  | TO-220 / I <sup>2</sup> PAK / D <sup>2</sup> PAK |      |
|-----------------------|--|--|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case Max               | 0.48   | °C/W |
| R <sub>thj-pcb</sub>  | Thermal Resistance Junction-pcb Max                | (see Figure 17)                                  | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient (Free air) Max | 62.5   | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose     | 300  | °C   |

## ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25°C UNLESS OTHERWISE SPECIFIED)

**Table 5: On/Off**

| Symbol               | Parameter   | Test Conditions   | Min. | Typ. | Max.    | Unit     |
|----------------------|---|---|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0  | 40   |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>10 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 20V   |      |      | ±100    | nA       |
| V <sub>GS(th)</sub>  | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                            | 2    |      | 4       | V        |
| R <sub>DS(on)</sub>  | Static Drain-source On Resistance                     | V <sub>GS</sub> = 10V, I <sub>D</sub> = 90 A  |      | 3.3  | 3.7     | mΩ       |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**Table 6: Dynamic**

| Symbol                              | Parameter   | Test Conditions                                      | Min. | Typ.                | Max. | Unit           |
|-------------------------------------|---|--|------|---------------------|------|----------------|
| $g_{fs}$ (1)                        | Forward Transconductance  | $V_{DS} = 15\text{ V}, I_D = 90\text{ A}$            |      | 150                 |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ |      | 5100<br>1600<br>600 |      | pF<br>pF<br>pF |

**Table 7: Switching On/Off**

| Symbol  | Parameter   | Test Conditions   | Min. | Typ.                    | Max. | Unit                 |
|---|---|---|------|-------------------------|------|----------------------|
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on Delay Time<br>Rise Time<br>Turn-off Delay Time<br>Fall Time | $V_{DD} = 20\text{ V}, I_D = 90\text{ A}$<br>$R_G = 4.7\Omega, V_{GS} = 10\text{ V}$<br>(see Figure 20) |      | 30<br>320<br>140<br>120 |      | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge        | $V_{DD} = 20\text{ V}, I_D = 120\text{ A},$<br>$V_{GS} = 10\text{ V}$<br>(see Figure 23)                |      | 170<br>30<br>62         | 210  | nC<br>nC<br>nC       |

**Table 8: Source Drain Diode**

| Symbol                            | Parameter  | Test Conditions   | Min. | Typ.             | Max.       | Unit          |
|-----------------------------------|--|---|------|------------------|------------|---------------|
| $I_{SD}$<br>$I_{SDM}$ (2)         | Source-drain Current<br>Source-drain Current (pulsed)                        |   |      |                  | 120<br>480 | A<br>A        |
| $V_{SD}$ (1)                      | Forward On Voltage   | $I_{SD} = 120\text{ A}, V_{GS} = 0$   |      |                  | 1.3        | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 120\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 30\text{ V}, T_j = 150^\circ\text{C}$<br>(see Figure 21) |      | 85<br>190<br>4.5 |            | ns<br>nC<br>A |

(1) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area

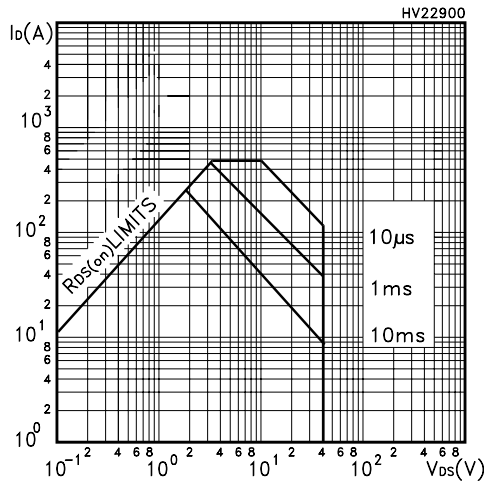


Figure 4: Output Characteristics

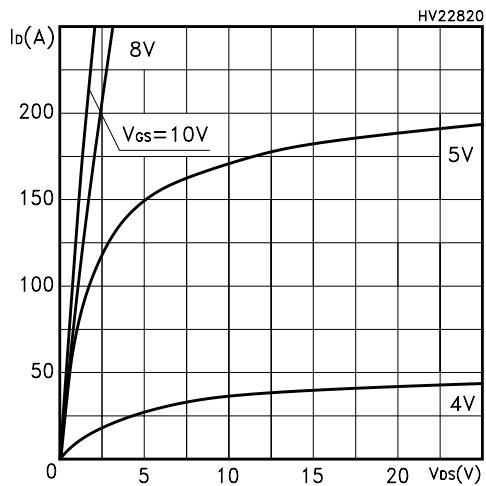


Figure 5: Transconductance

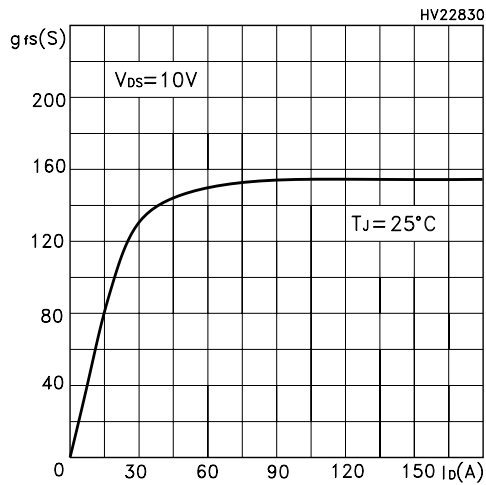


Figure 6: Thermal Impedance

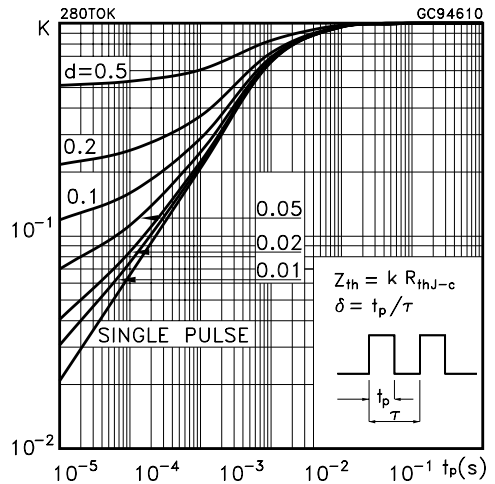


Figure 7: Transfer Characteristics

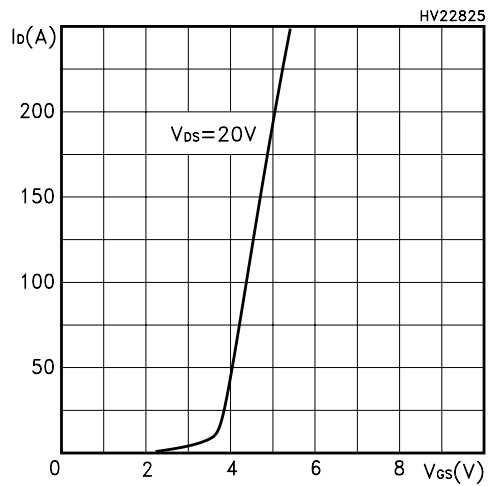


Figure 8: Static Drain-source On Resistance

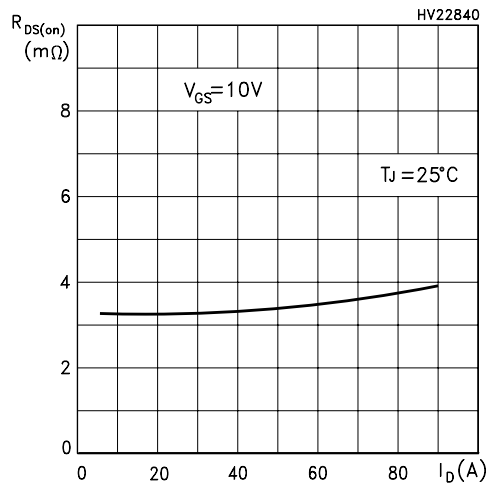


Figure 9: Gate Charge vs Gate-source Voltage

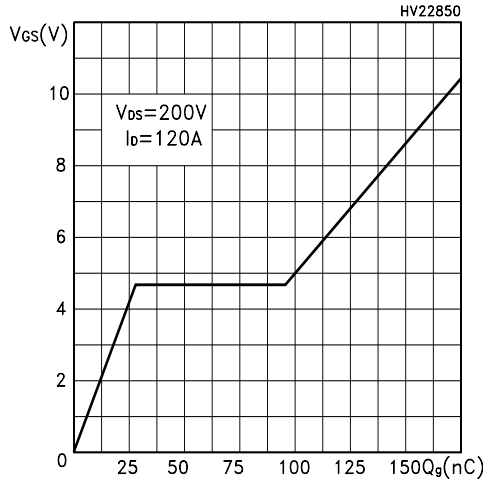


Figure 10: Normalized Gate Threshold Voltage vs Temperature

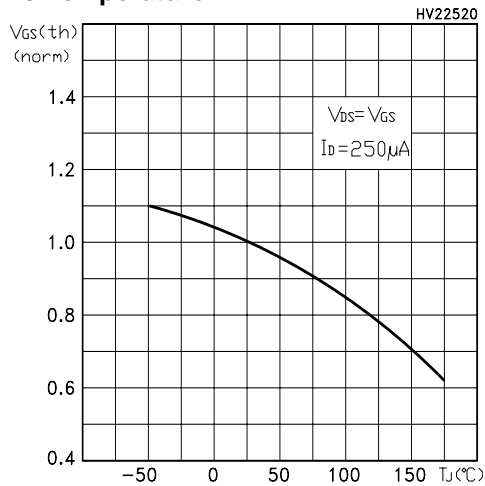


Figure 11: Dource-Drain Diode Forward Characteristics

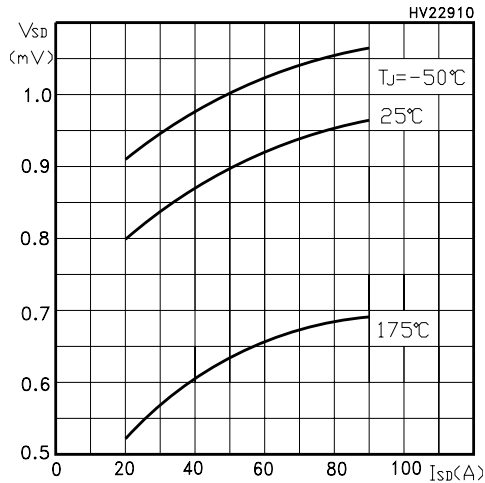


Figure 12: Capacitance Variations

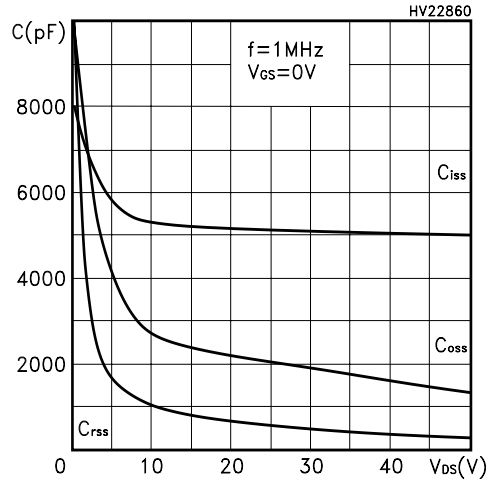


Figure 13: Normalized On Resistance vs Temperature

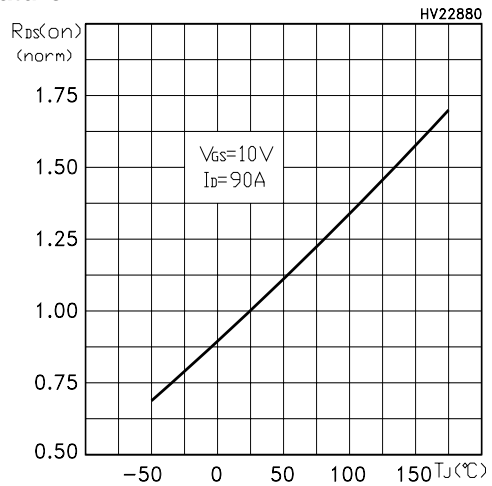
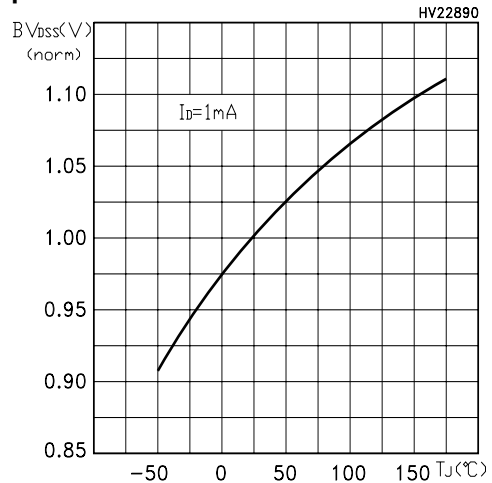
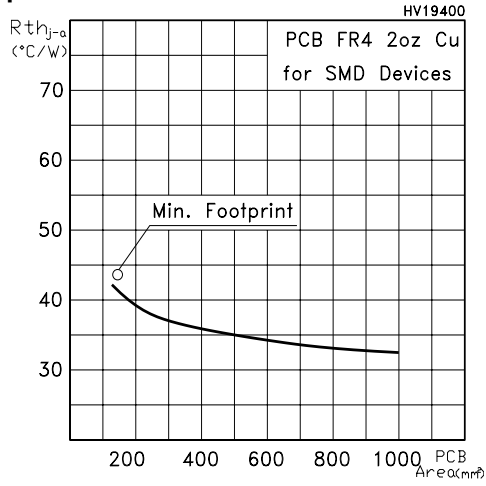


Figure 14: Normalized Breakdown Voltage vs Temperature



**STP200NF04 - STB200NF04 - STB200NF04-1**

**Figure 15: Thermal Resistance Rthj-a vs PCB Copper Area**



**Figure 16: Max Power Dissipation vs PCB Copper Area**

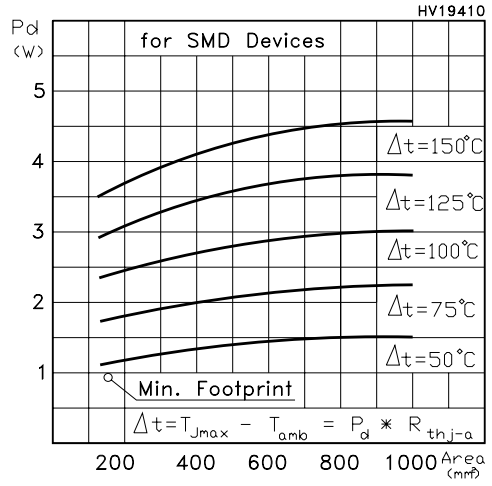
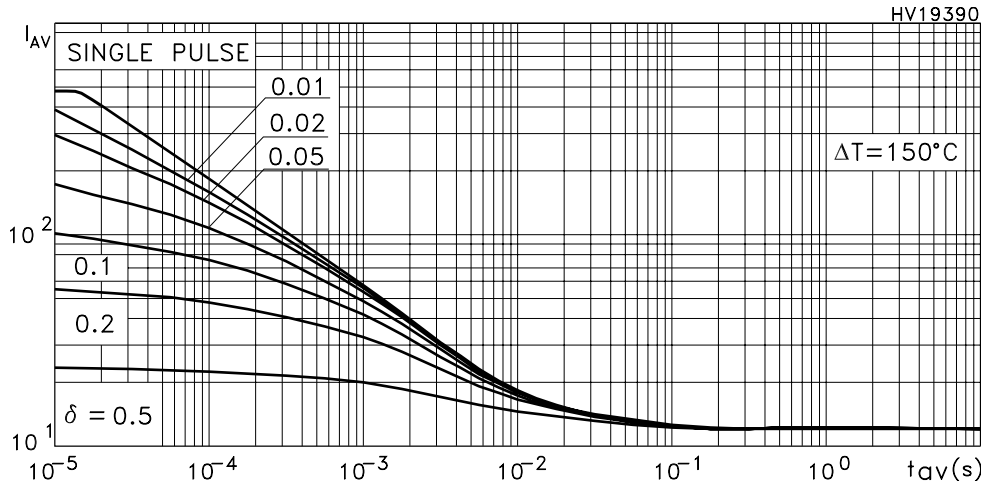


Figure 17: Allowable  $I_{AV}$  vs. Time in Avalanche



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

$I_{AV}$  is the Allowable Current in Avalanche

$P_{D(AVE)}$  is the Average Power Dissipation in Avalanche (Single Pulse)

$t_{AV}$  is the Time in Avalanche

To derate above 25 °C, at fixed  $I_{AV}$ , the following equation must be applied:

$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:

$Z_{th} = K * R_{th}$  is the value coming from Normalized Thermal Response at fixed pulse width equal to  $T_{AV}$ .





Figure 19: Unclamped Inductive Load Test Circuit

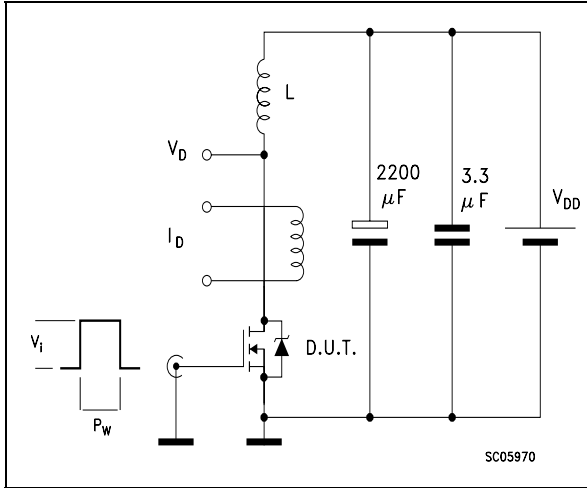


Figure 20: Switching Times Test Circuit For Resistive Load

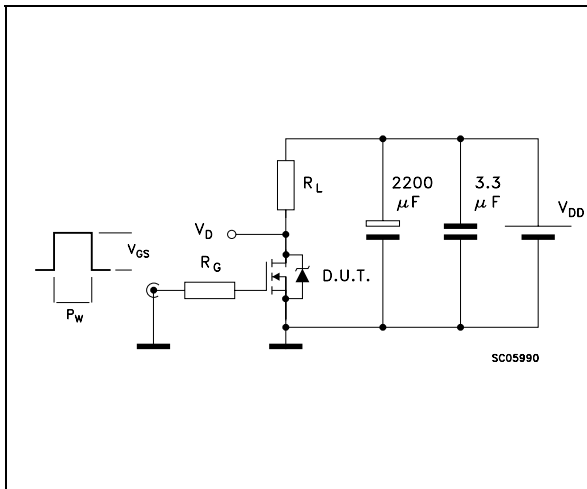


Figure 21: Test Circuit For Inductive Load Switching and Diode Recovery Times

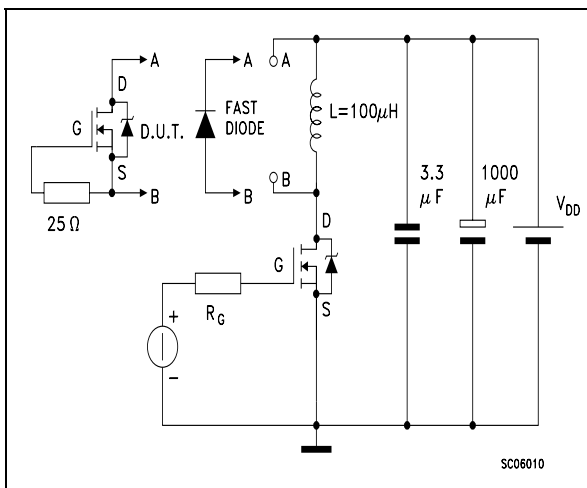


Figure 22: Unclamped Inductive Wafeform

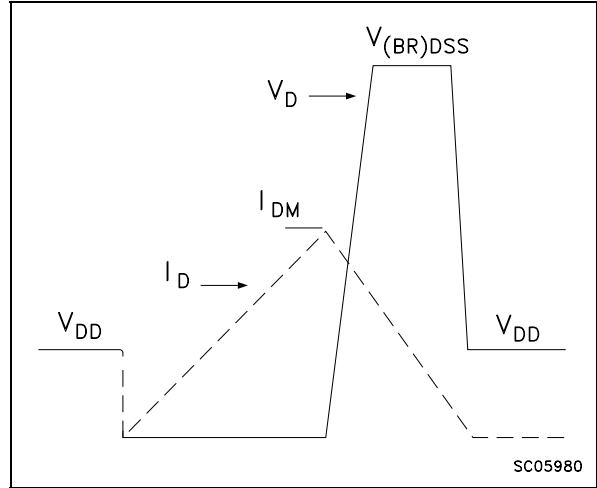
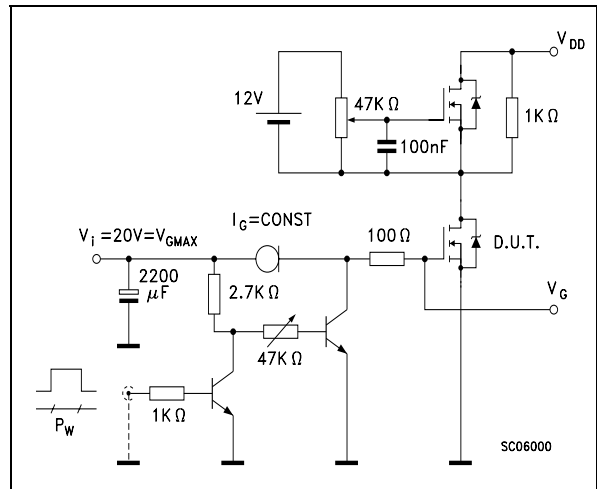


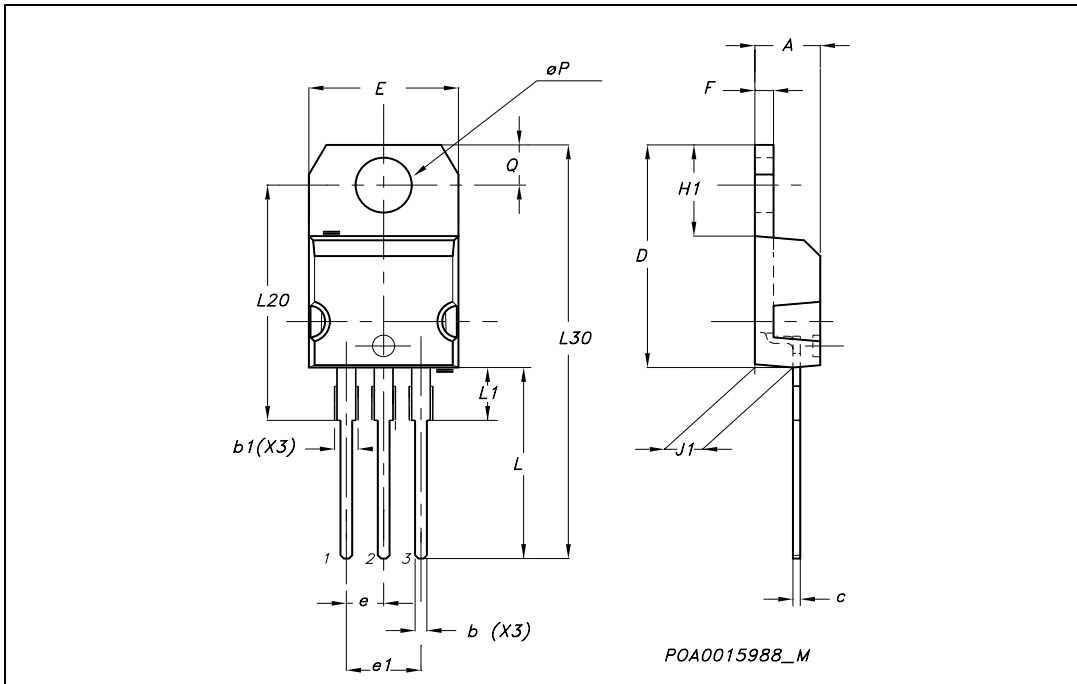
Figure 23: Gate Charge Test Circuit



**STP200NF04 - STB200NF04 - STB200NF04-1**

**TO-220 MECHANICAL DATA**

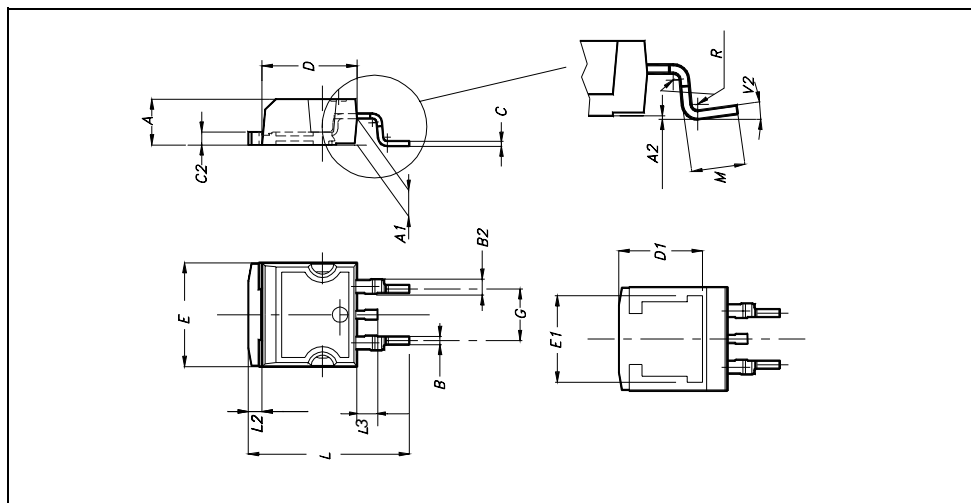
| DIM. | mm.   |       |       | inch  |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP   | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b    | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1   | 1.15  |       | 1.70  | 0.045 |       | 0.066 |
| c    | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| D    | 15.25 |       | 15.75 | 0.60  |       | 0.620 |
| 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 |       | 0.052 |
| 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 |



STP200NF04 - STB200NF04 - STB200NF04-1

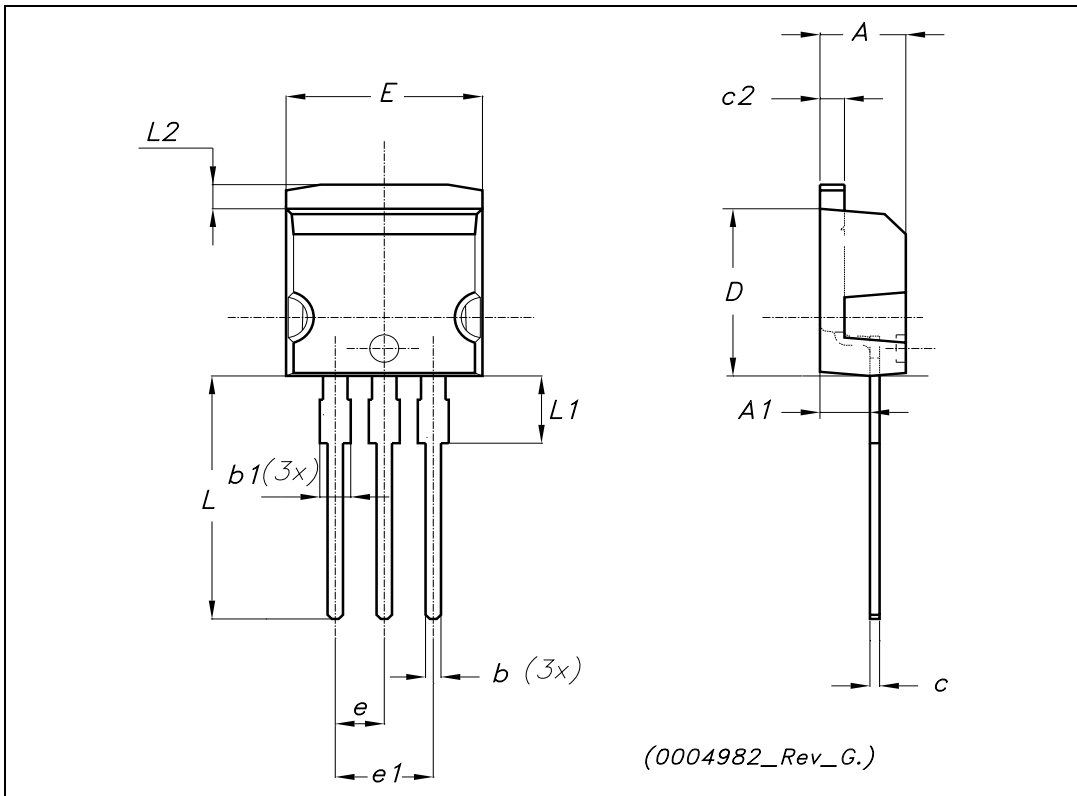
D<sup>2</sup>PAK MECHANICAL DATA

| DIM. | mm.  |     |       | inch  |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6   | 0.173 |       | 0.181 |
| A1   | 2.49 |     | 2.69  | 0.098 |       | 0.106 |
| A2   | 0.03 |     | 0.23  | 0.001 |       | 0.009 |
| B    | 0.7  |     | 0.93  | 0.027 |       | 0.036 |
| B2   | 1.14 |     | 1.7   | 0.044 |       | 0.067 |
| C    | 0.45 |     | 0.6   | 0.017 |       | 0.023 |
| C2   | 1.23 |     | 1.36  | 0.048 |       | 0.053 |
| D    | 8.95 |     | 9.35  | 0.352 |       | 0.368 |
| D1   |      | 8   |       |       | 0.315 |       |
| E    | 10   |     | 10.4  | 0.393 |       |       |
| E1   |      | 8.5 |       |       | 0.334 |       |
| G    | 4.88 |     | 5.28  | 0.192 |       | 0.208 |
| L    | 15   |     | 15.85 | 0.590 |       | 0.625 |
| L2   | 1.27 |     | 1.4   | 0.050 |       | 0.055 |
| L3   | 1.4  |     | 1.75  | 0.055 |       | 0.068 |
| M    | 2.4  |     | 3.2   | 0.094 |       | 0.126 |
| R    |      | 0.4 |       |       | 0.015 |       |
| V2   | 0°   |     | 4°    |       |       |       |

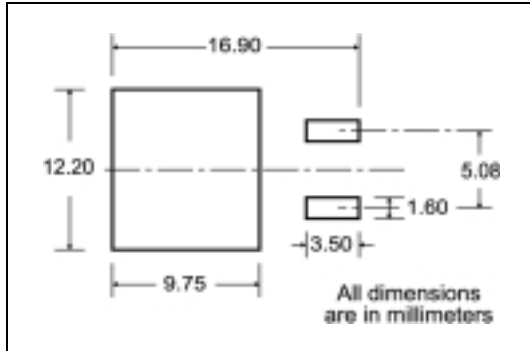


**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

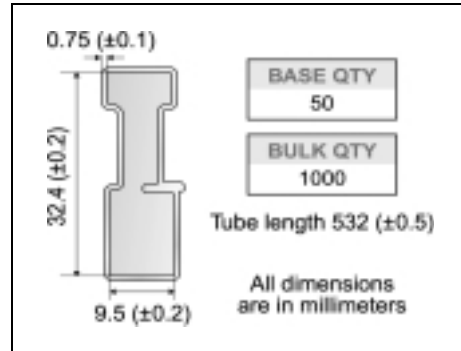
| DIM. | mm.  |      |       | inch  |      |       |
|------|------|------|-------|-------|------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.40 |      | 4.60  | 0.173 |      | 0.181 |
| A1   | 2.40 |      | 2.72  | 0.094 |      | 0.107 |
| b    | 0.61 |      | 0.88  | 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 |



**D<sup>2</sup>PAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

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

**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     |

10 pitches cumulative tolerance on tape +/- 0.2 mm

TOP COVER TAPE

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type

## STP200NF04 - STB200NF04 - STB200NF04-1

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**Table 10: Revision History**

| Date        | Revision | Description of Changes            |
|-------------|----------|-----------------------------------|
| 28-Sep-2004 | 2        | New Stylesheet. No Content Change |
| 11-Oct-2004 | 3        | Final datasheet                   |

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