



# STB160N75F3 STP160N75F3 - STW160N75F3

N-channel 75V - 3.5mΩ - 120A - TO-220 - TO-247 - D<sup>2</sup>PAK  
STripFET™ Power MOSFET

## Features

| Type        | V <sub>DSS</sub> | R <sub>DS(on)</sub><br>(max.) | I <sub>D</sub>       |
|-------------|------------------|-------------------------------|----------------------|
| STB160N75F3 | 75V              | 3.7 mΩ                        | 120 A <sup>(1)</sup> |
| STP160N75F3 | 75V              | 4 mΩ                          | 120 A <sup>(1)</sup> |
| STW160N75F3 | 75V              | 4 mΩ                          | 120 A <sup>(1)</sup> |

1. Current limited by package

- Ultra low on-resistance
- 100% Avalanche tested

## Application

- Switching applications

## Description

This N-channel enhancement mode Power MOSFET is the latest refinement of ST's STripFET™ process. The resulting transistor shows extremely high packing density for low on resistance, rugged avalanche characteristics and low gate charge.

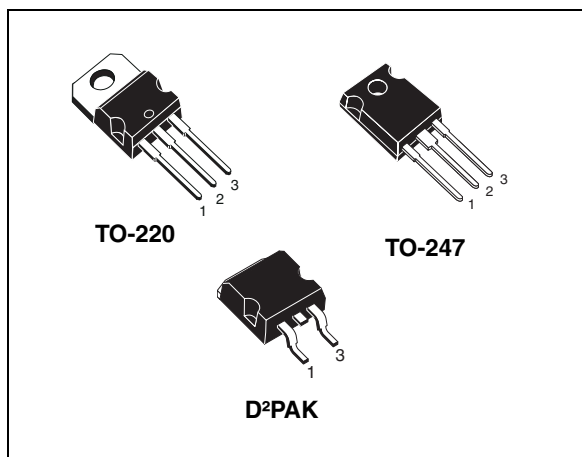


Figure 1. Internal schematic diagram

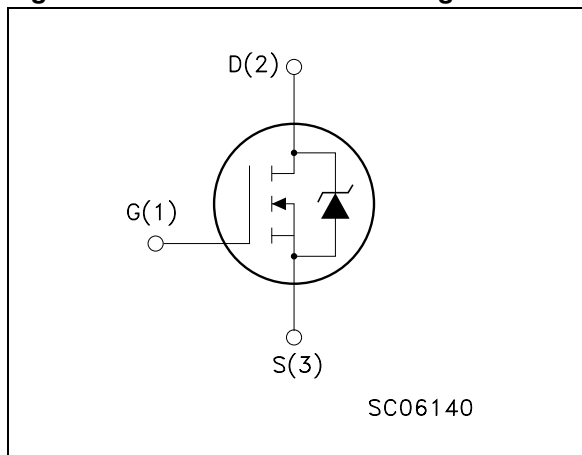


Table 1. Device summary

| Order codes | Marking  | Package            | Packaging   |
|-------------|----------|--------------------|-------------|
| STB160N75F3 | 160N75F3 | D <sup>2</sup> PAK | Tape & reel |
| STP160N75F3 | 160N75F3 | TO-220             | Tube        |
| STW160N75F3 | 160N75F3 | TO-247             | Tube        |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter   | Value      | Unit                |
|--------------------|---|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                   | 75         | V                   |
| $V_{GS}$           | Gate-source voltage                                     | $\pm 20$   | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 120        | A                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 120        | A                   |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                  | 480        | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25^\circ\text{C}$           | 330        | W                   |
|                    | Derating factor   | 2.2        | W/ $^\circ\text{C}$ |
| $dv/dt^{(3)}$      | Peak diode recovery voltage slope                       | 20         | V/ns                |
| $E_{AS}^{(4)}$     | Single pulse avalanche energy                           | 600        | mJ                  |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature   | -55 to 175 | $^\circ\text{C}$    |

1. Current limited by package
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 120\text{A}$ ,  $di/dt \leq 1100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 60\text{V}$ ,  $T_J \leq T_{JMAX}$
4. Starting  $T_J = 25^\circ\text{C}$ ,  $I_D = 60\text{A}$ ,  $V_{DD} = 25\text{V}$

**Table 3. Thermal resistance**

| Symbol              | Parameter                                      | Value  |        |                    | Unit                      |
|---------------------|--|--------|--------|--------------------|---------------------------|
|                     |  | TO-220 | TO-247 | D <sup>2</sup> PAK |                           |
| $R_{thj-case}$      | Thermal resistance junction-case max           | 0.45   |        |                    | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$       | Thermal resistance junction-ambient max        | 62.5   | 50     | --                 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb                | --     | --     | 50                 | $^\circ\text{C}/\text{W}$ |
| $T_l$               | Maximum lead temperature for soldering purpose | 300    |        |                    | $^\circ\text{C}$          |

1. When mounted on 1 inch<sup>2</sup> FR4 2 oz Cu

## 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                   | $I_D = 250\mu A, V_{GS} = 0$  | 75   |            |           | V                      |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating},$<br>$V_{DS} = \text{Max rating}, @ 125^{\circ}C$ |      |            | 10<br>100 | $\mu A$<br>$\mu A$     |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20V$  |      |            | $\pm 200$ | nA                     |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 250\mu A$   | 2    |            | 4         | V                      |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10V, I_D = 60A$   |      | 3.5<br>3.2 | 4<br>3.7  | $m\Omega$<br>$m\Omega$ |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                               | Min | Typ  | Max | Unit |
|-----------|------------------------------|---|-----|------|-----|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$ |     | 6750 |     | pF   |
| $C_{oss}$ | Output capacitance           |   |     | 1080 |     | pF   |
| $C_{rss}$ | Reverse transfer capacitance |   |     | 40   |     | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 37.5V, I_D = 120A$                  |     | 85   |     | nC   |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 10V$                                |     | 27   |     | nC   |
| $Q_{gd}$  | Gate-drain charge            | (see Figure 16)                               |     | 26   |     | nC   |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD}=37.5\text{ V}$ , $I_D=60\text{ A}$ ,<br>$R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ ,<br>(see Figure 18) |      | 22   |      | ns   |
| $t_r$        | Rise time           |   |      | 65   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time |   |      | 100  |      | ns   |
| $t_f$        | Fall time           |   |      | 15   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  |      |      | 120  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  |      |      | 480  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=120\text{ A}$ , $V_{GS}=0$   |      |      | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=120\text{ A}$ , $V_{DD}=20\text{ V}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $T_j=25^\circ\text{C}$<br>(see Figure 17) |      | 70   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 150  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  |      | 4.2  |      | A    |

1. Pulse with limited by safe operating area
2. Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220 / TO-247

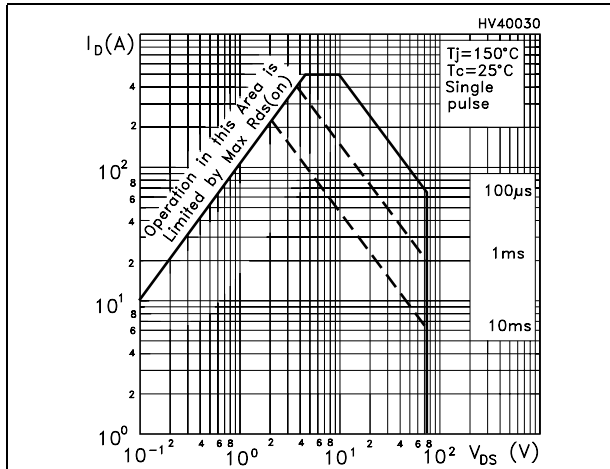


Figure 3. Thermal impedance for TO-220 / TO-247

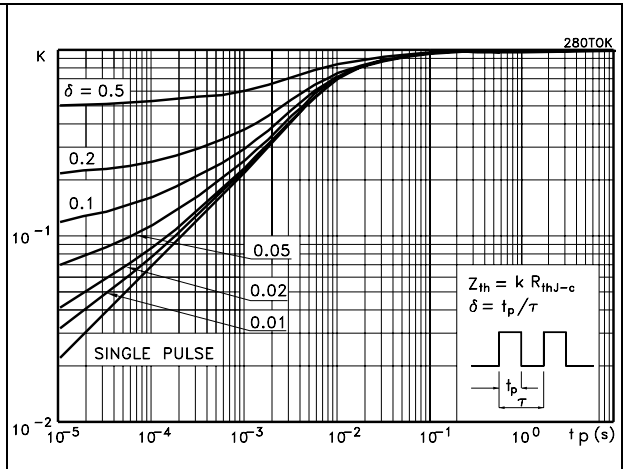


Figure 4. Safe operating area for D<sup>2</sup>PAK

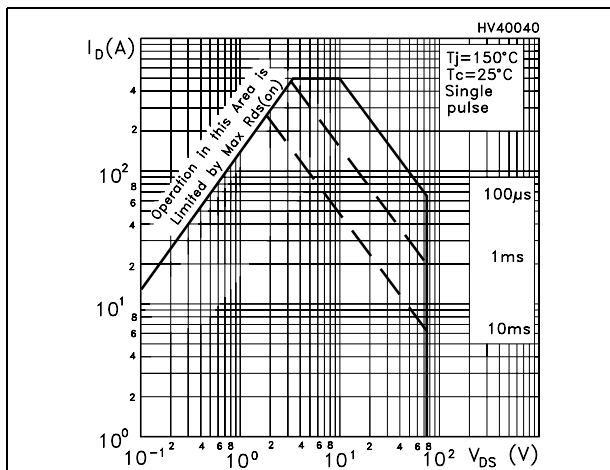


Figure 5. Thermal impedance for D<sup>2</sup>PAK

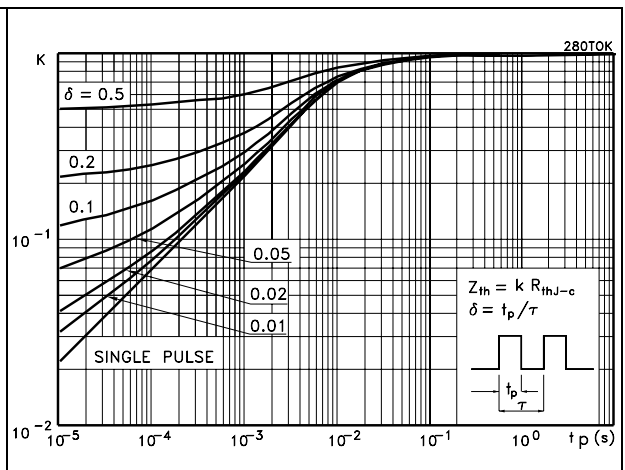


Figure 6. Output characteristics

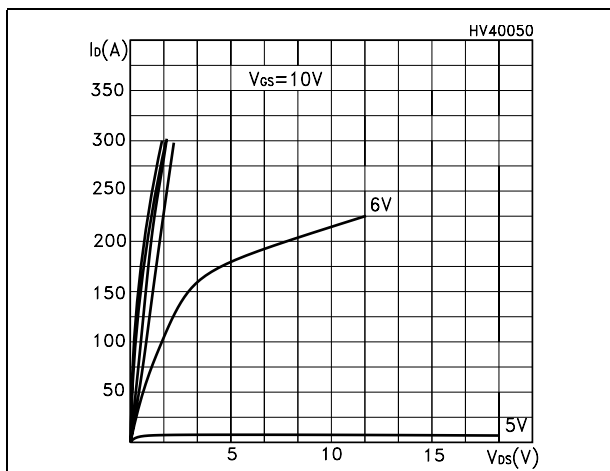


Figure 7. Transfer characteristics

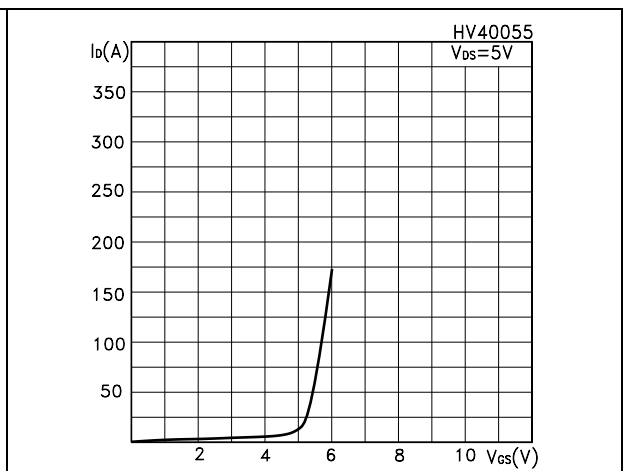


Figure 8. Normalized  $BV_{DSS}$  vs temperature      Figure 9. Static drain-source on resistance

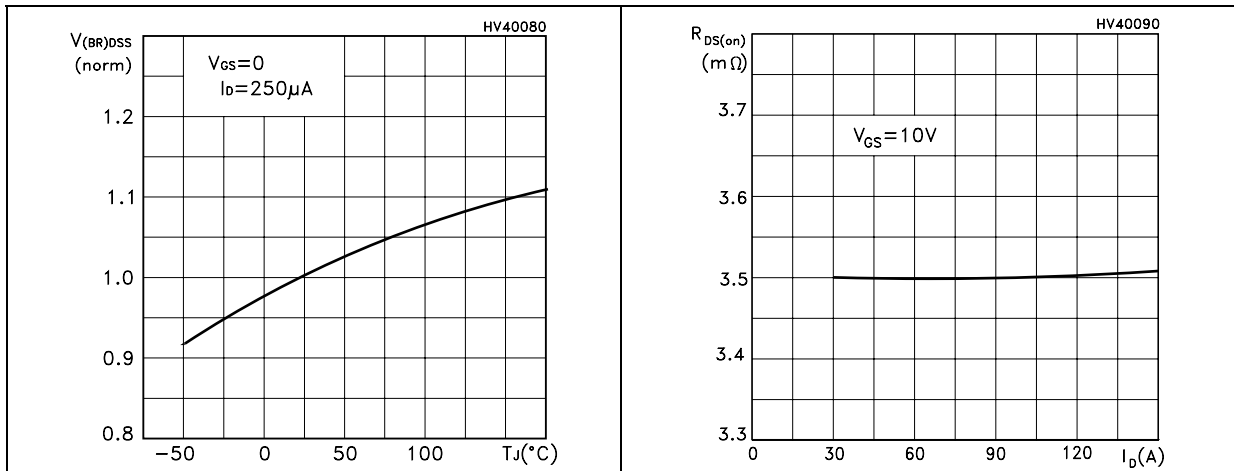


Figure 10. Gate charge vs gate-source voltage      Figure 11. Capacitance variations

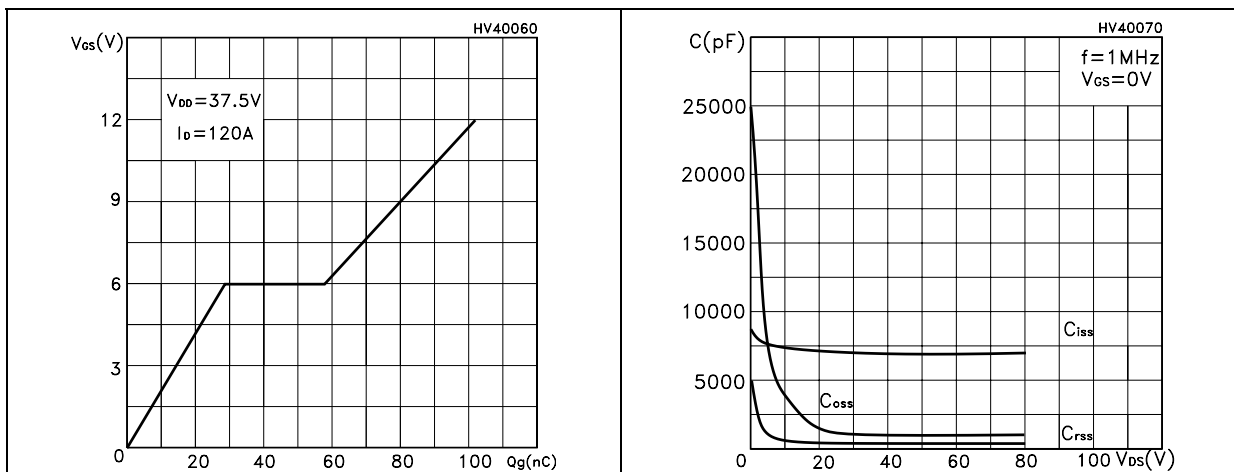


Figure 12. Normalized gate threshold voltage vs temperature      Figure 13. Normalized on resistance vs temperature

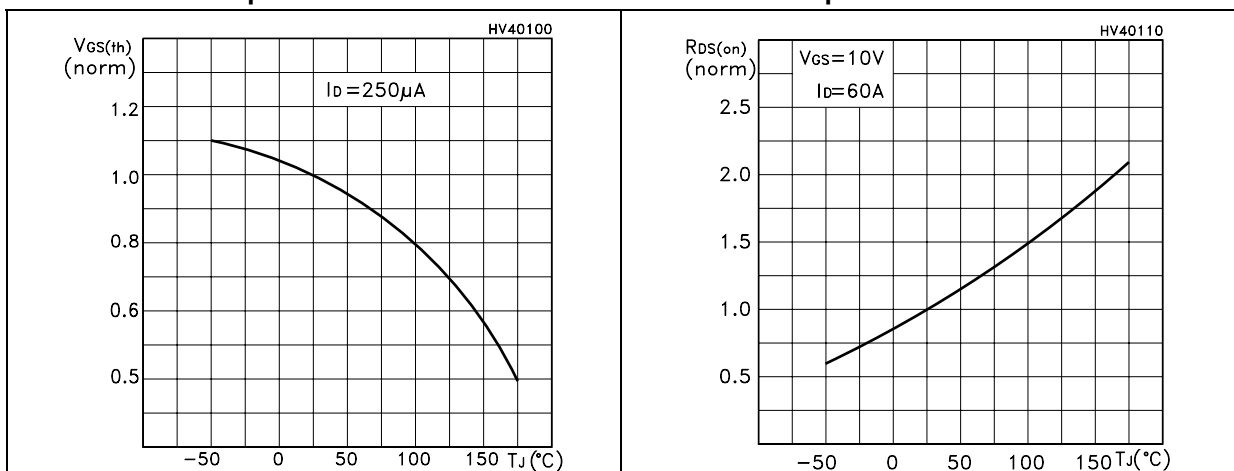
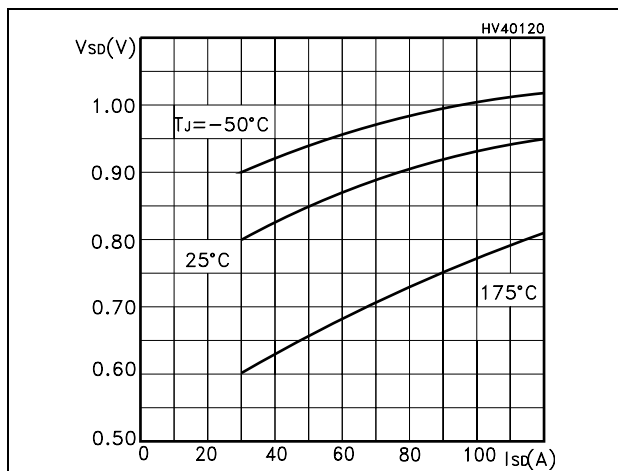


Figure 14. Source-drain diode forward characteristics





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

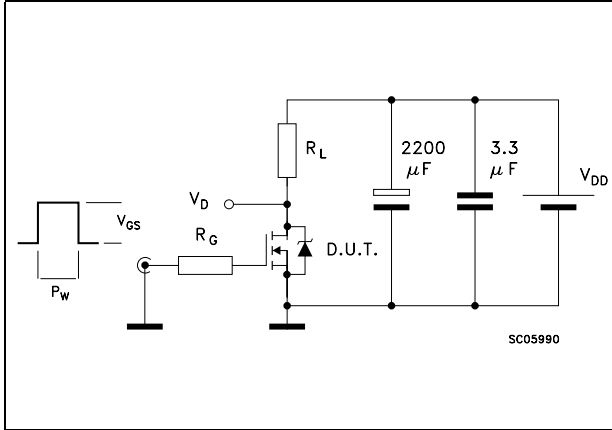


Figure 16. Gate charge test circuit

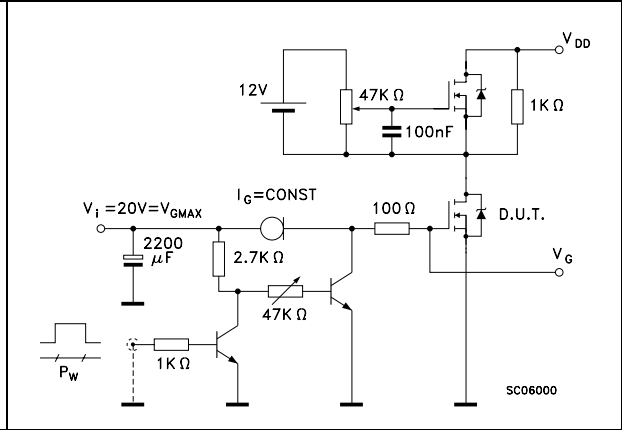


Figure 17. Test circuit for inductive load switching and diode recovery times

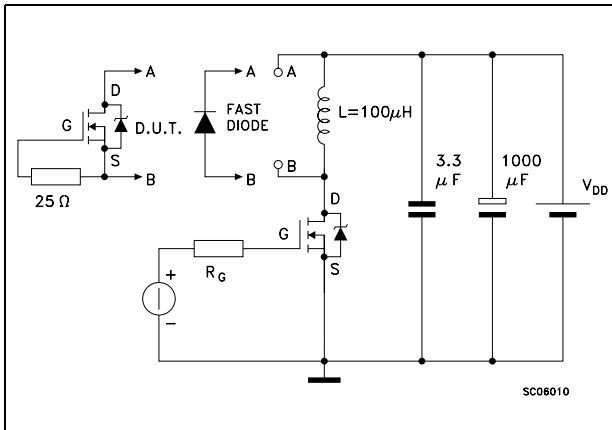


Figure 18. Unclamped inductive load test circuit

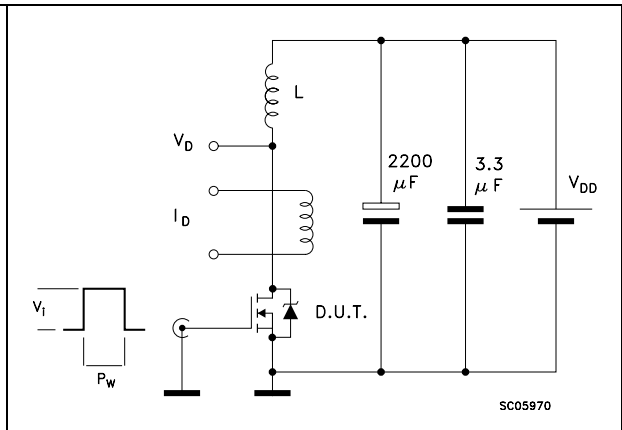


Figure 19. Unclamped inductive waveform

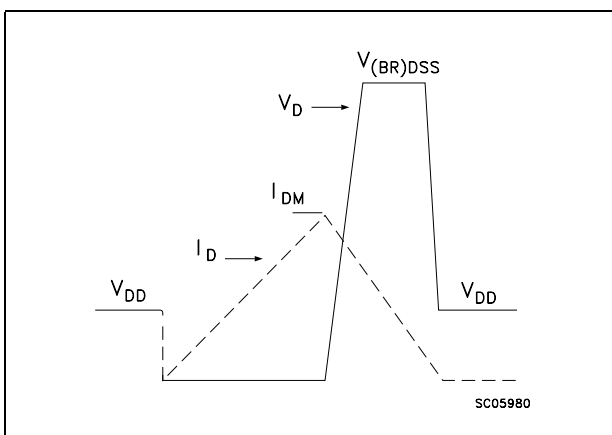
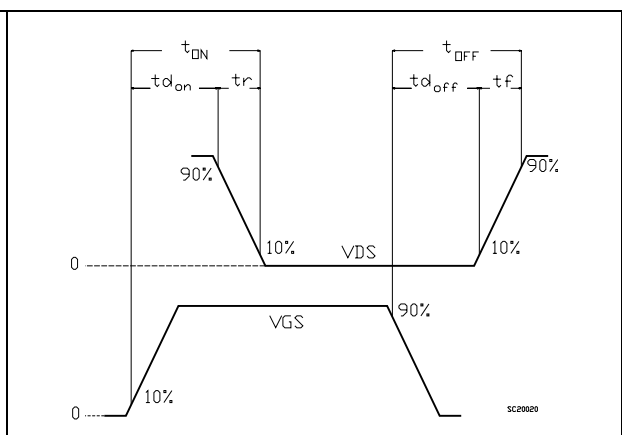


Figure 20. Switching time waveform

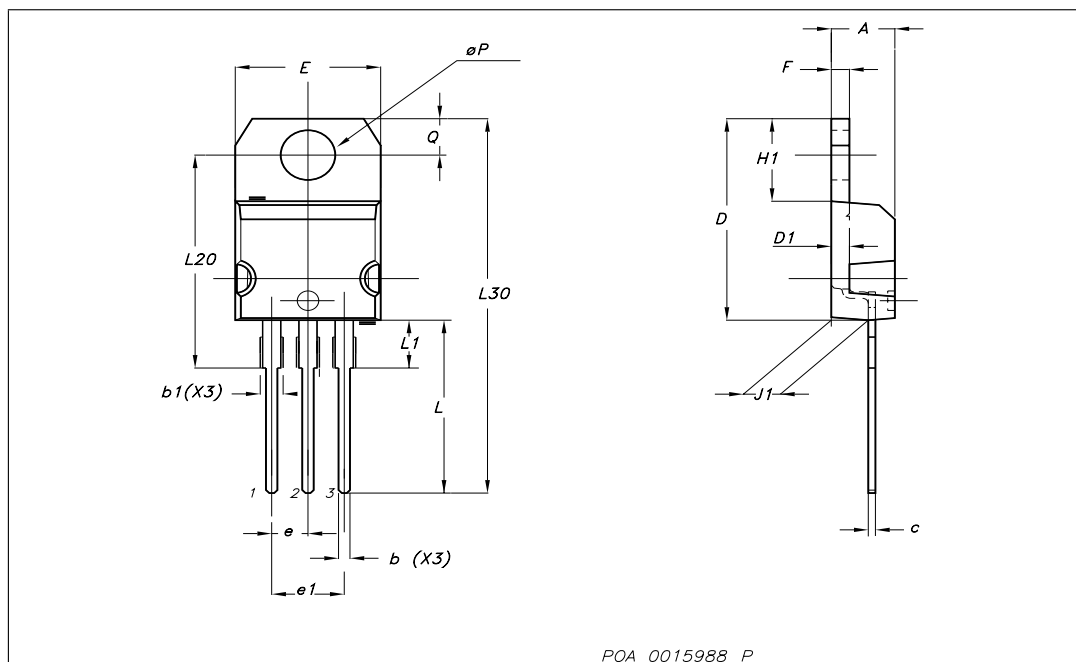


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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](http://www.st.com)

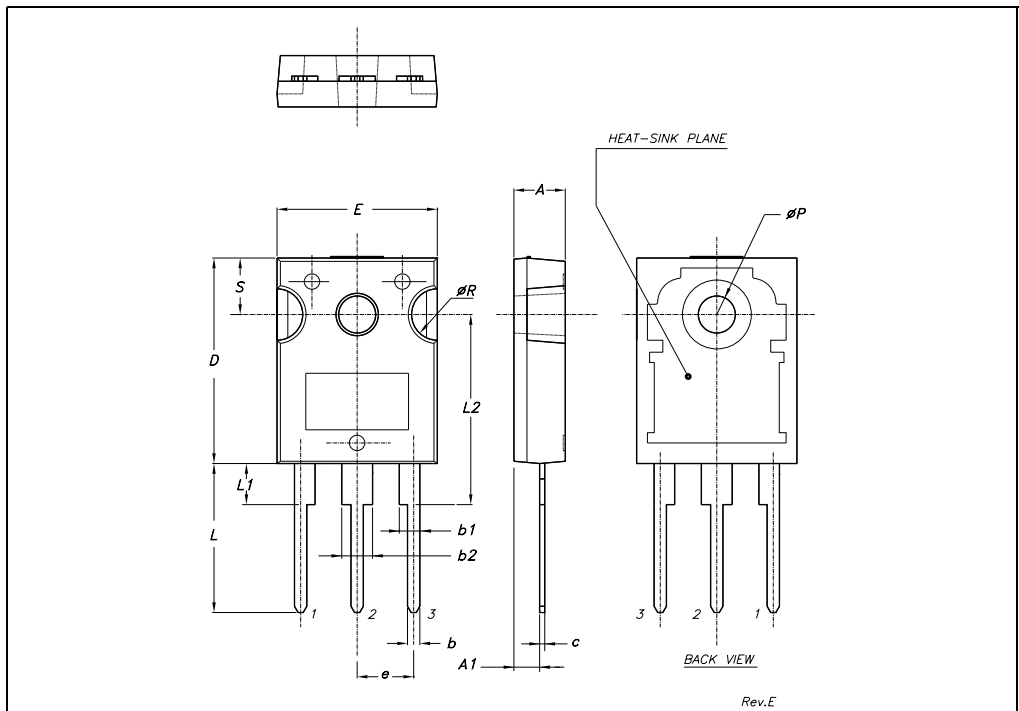
## TO-220 mechanical data

| 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 |       |
| ∅P  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



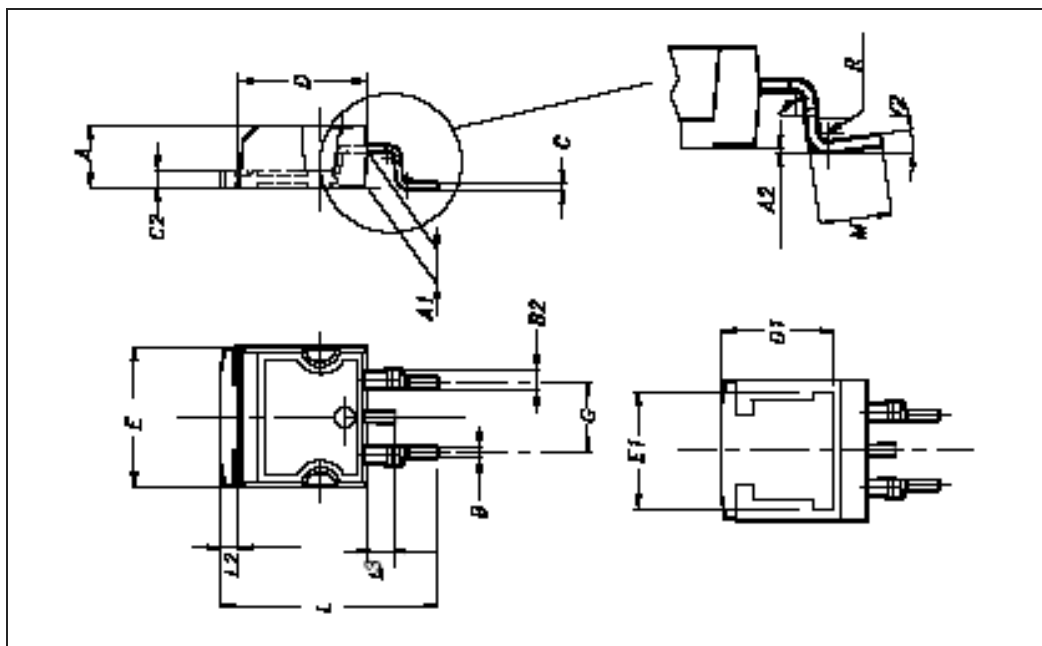
**TO-247 MECHANICAL DATA**

| DIM. | mm.   |       |       | inch  |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.85  |       | 5.15  | 0.19  |       | 0.20  |
| A1   | 2.20  |       | 2.60  | 0.086 |       | 0.102 |
| b    | 1.0   |       | 1.40  | 0.039 |       | 0.055 |
| b1   | 2.0   |       | 2.40  | 0.079 |       | 0.094 |
| b2   | 3.0   |       | 3.40  | 0.118 |       | 0.134 |
| c    | 0.40  |       | 0.80  | 0.015 |       | 0.03  |
| D    | 19.85 |       | 20.15 | 0.781 |       | 0.793 |
| E    | 15.45 |       | 15.75 | 0.608 |       | 0.620 |
| e    |       | 5.45  |       |       | 0.214 |       |
| L    | 14.20 |       | 14.80 | 0.560 |       | 0.582 |
| L1   | 3.70  |       | 4.30  | 0.14  |       | 0.17  |
| L2   |       | 18.50 |       |       | 0.728 |       |
| øP   | 3.55  |       | 3.65  | 0.140 |       | 0.143 |
| øR   | 4.50  |       | 5.50  | 0.177 |       | 0.216 |
| S    |       | 5.50  |       |       | 0.216 |       |



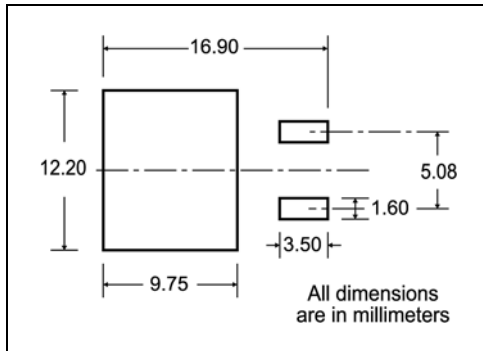
D<sup>2</sup>PAK mechanical data

| 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 |       | 0.409 |
| 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   | 0.50  |       | 0.55  |
| L3  | 1.4  |     | 1.75  | 0.055 |       | 0.68  |
| M   | 2.4  |     | 3.2   | 0.094 |       | 0.126 |
| R   |      | 0.4 |       |       | 0.015 |       |
| V2  | 0°   |     | 4°    |       |       |       |



# 5 Packaging mechanical data

## D<sup>2</sup>PAK 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     |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type

## 6 Revision history

Table 8. Document revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| 07-Feb-2007 | 1        | First release   |
| 02-Oct-2007 | 2        | New section has been added: <a href="#">Electrical characteristics (curves)</a> |

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