



# STB150NF55 STP150NF55 STW150NF55

N-CHANNEL 55V - 0.005  $\Omega$  -120A D<sup>2</sup>PAK/TO-220/TO-247  
STripFET™ II POWER MOSFET

AUTOMOTIVE SPECIFIC

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STB150NF55 | 55 V             | <0.006 $\Omega$     | 120 A(**)      |
| STP150NF55 | 55 V             | <0.006 $\Omega$     | 120 A(**)      |
| STW150NF55 | 55 V             | <0.006 $\Omega$     | 120 A(**)      |

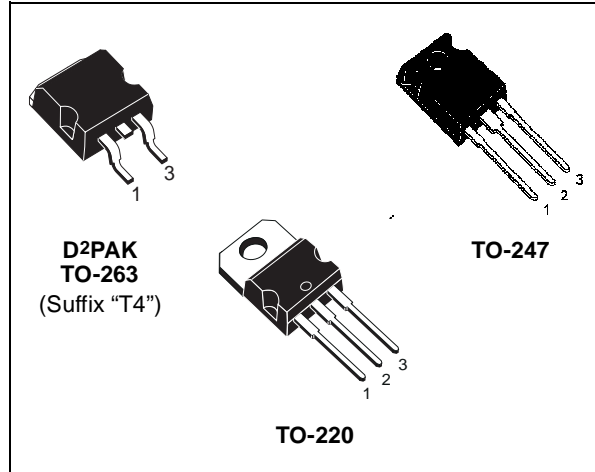
- TYPICAL R<sub>DS(on)</sub> = 0.005  $\Omega$
- SURFACE-MOUNTING D<sup>2</sup>PAK (TO-263) POWER PACKAGE

## DESCRIPTION

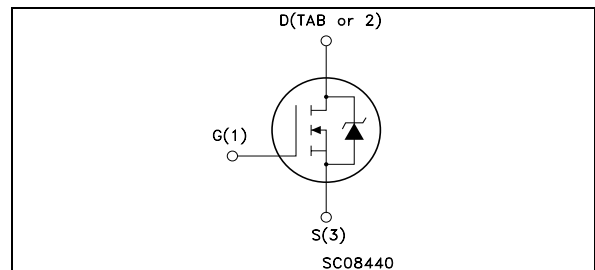
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing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

## APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- DC-DC & DC-AC CONVERTERS
- AUTOMOTIVE



## INTERNAL SCHEMATIC DIAGRAM



## Ordering Information

| SALES TYPE   | MARKING  | PACKAGE            | PACKAGING   |
|--------------|----------|--------------------|-------------|
| STB150NF55T4 | B150NF55 | D <sup>2</sup> PAK | TAPE & REEL |
| STP150NF55   | P150NF55 | TO-220             | TUBE        |
| STW150NF55   | W150NF55 | TO-247             | TUBE        |

## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter   | Value      | Unit |
|---------------------|---|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 55         | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 55         | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                  | $\pm$ 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  | 106        | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 480        | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>C</sub> = 25°C            | 300        | W    |
|                     | Derating Factor                                       | 2.0        | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                     | 8          | V/ns |
| E <sub>AS</sub> (2) | Single Pulse Avalanche Energy                         | 850        | mJ   |
| T <sub>stg</sub>    | Storage Temperature                                   | -55 to 175 | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                        |            |      |

(•) Pulse width limited by safe operating area.  
(\*\*) Current Limited by Package

(1) I<sub>SD</sub>  $\leq$  120A, di/dt  $\leq$  200A/ $\mu$ s, V<sub>DD</sub>  $\leq$  V<sub>(BR)DSS</sub>, T<sub>j</sub>  $\leq$  T<sub>JMAX</sub>  
(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 60 A, V<sub>DD</sub> = 30V

## STB150NF55 STP150NF55 STW150NF55

### THERMAL DATA

|                |  |     |      |      |
|----------------|--|-----|------|------|
| Rthj-case      | Thermal Resistance Junction-case               | Max | 0.5  | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient            | Max | 62.5 | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose | Typ | 300  | °C   |

### ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

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   | 55   |      |         | 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> = ± 20 V  |      |      | ±100    | nA       |

ON (\*)

| Symbol              | Parameter                         | Test Conditions   | Min. | Typ.  | Max.  | Unit |
|---------------------|-----------------------------------|---|------|-------|-------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA | 2    |       | 4     | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 60 A              |      | 0.005 | 0.006 | Ω    |

DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                       | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|---|------|------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> = 15 V I <sub>D</sub> = 60 A          |      | 160  |      | S    |
| C <sub>iSS</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 4400 |      | pF   |
| C <sub>oSS</sub>    | Output Capacitance           |   |      | 1050 |      | pF   |
| C <sub>rSS</sub>    | Reverse Transfer Capacitance |   |      | 350  |      | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

| Symbol                        | Parameter  | Test Conditions  | Min. | Typ.            | Max. | Unit           |
|-------------------------------|--|--|------|-----------------|------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Delay Time<br>Rise Time                              | $V_{DD} = 27.5\text{ V}$ $I_D = 60\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 35<br>180       |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD}=27.5\text{ V}$ $I_D=120\text{A}$ $V_{GS}= 10\text{V}$  |      | 140<br>35<br>70 | 170  | nC<br>nC<br>nC |

**SWITCHING OFF**

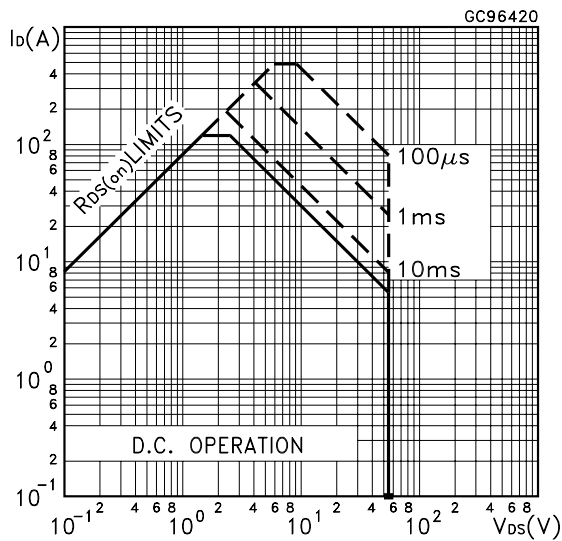
| Symbol                | Parameter                        | Test Conditions  | Min. | Typ.      | Max. | Unit     |
|-----------------------|----------------------------------|--|------|-----------|------|----------|
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall Time | $V_{DD} = 27.5\text{ V}$ $I_D = 60\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 140<br>80 |      | ns<br>ns |

**SOURCE DRAIN DIODE**

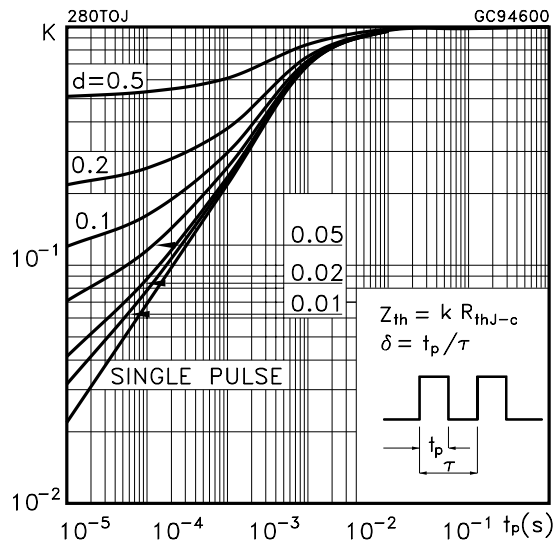
| Symbol                            | Parameter  | Test Conditions   | Min. | Typ.              | Max.       | Unit          |
|-----------------------------------|--|---|------|-------------------|------------|---------------|
| $I_{SD}$<br>$I_{SDM}$ (●)         | Source-drain Current<br>Source-drain Current (pulsed)                        |   |      |                   | 120<br>480 | A<br>A        |
| $V_{SD}$ (*)                      | Forward On Voltage   | $I_{SD} = 120\text{ A}$ $V_{GS} = 0$  |      |                   | 1.5        | 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>$V_{DD} = 25\text{ V}$ $T_j = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 130<br>350<br>7.5 |            | ns<br>nC<br>A |

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
 (●) Pulse width limited by safe operating area.

**Safe Operating Area**

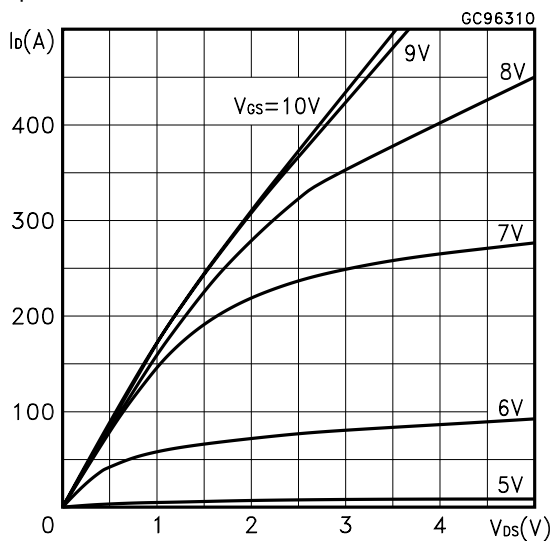


**Thermal Impedance**

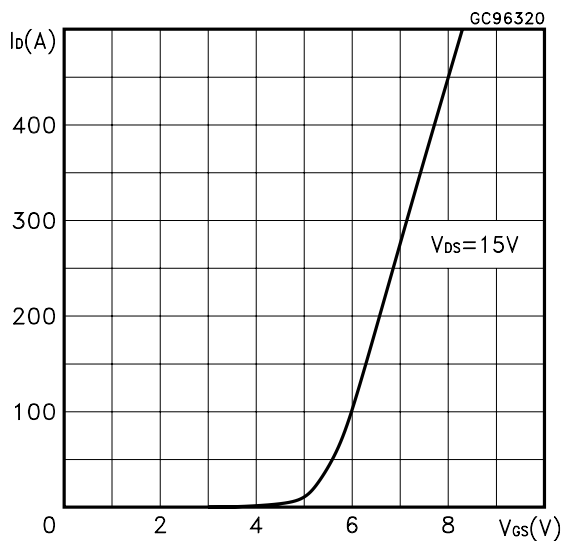


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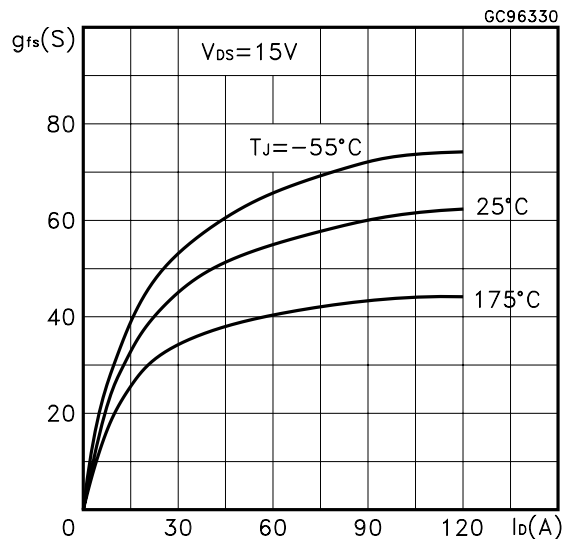
Output Characteristics



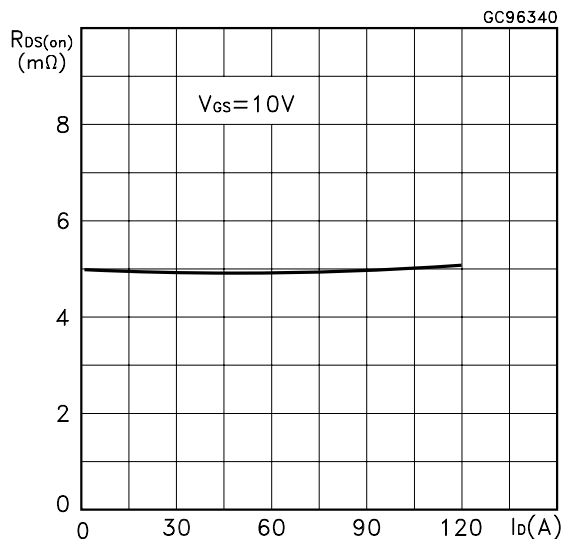
Transfer Characteristics



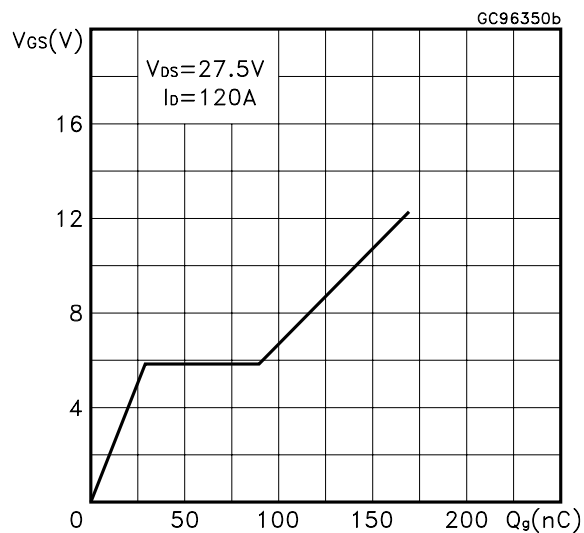
Transconductance



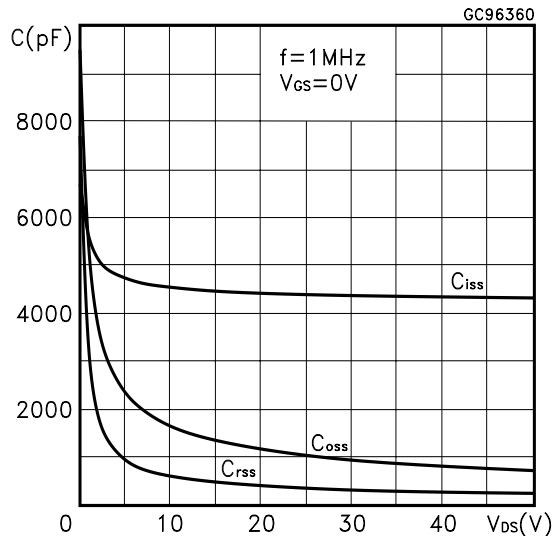
Static Drain-source On Resistance



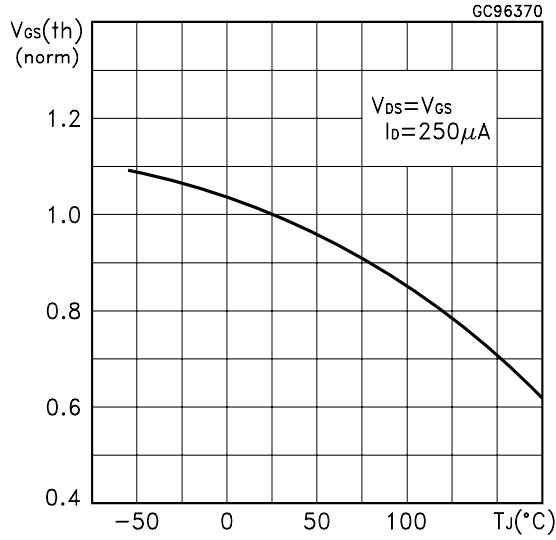
Gate Charge vs Gate-source Voltage



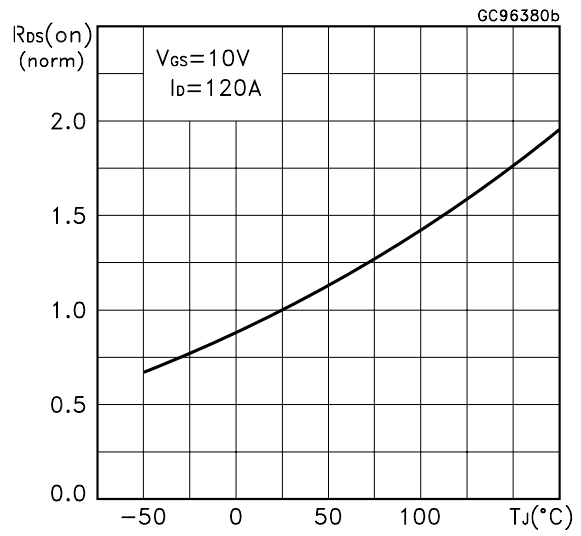
Capacitance Variations



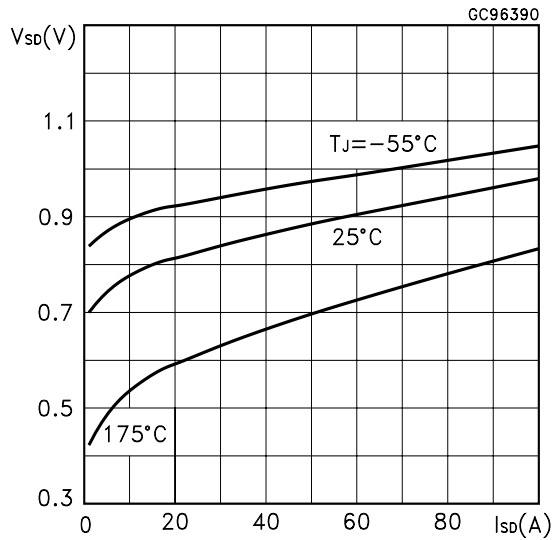
Normalized Gate Threshold Voltage vs Temperature



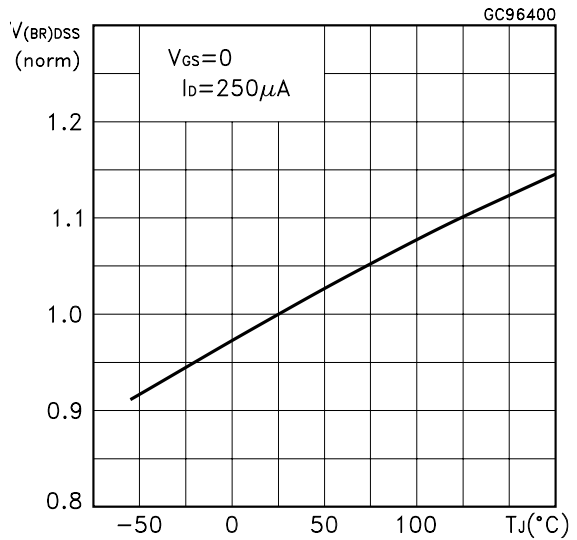
Normalized on Resistance vs Temperature



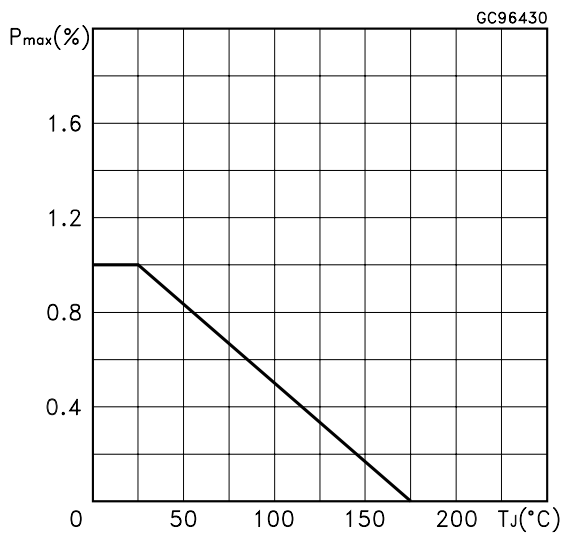
Source-drain Diode Forward Characteristics



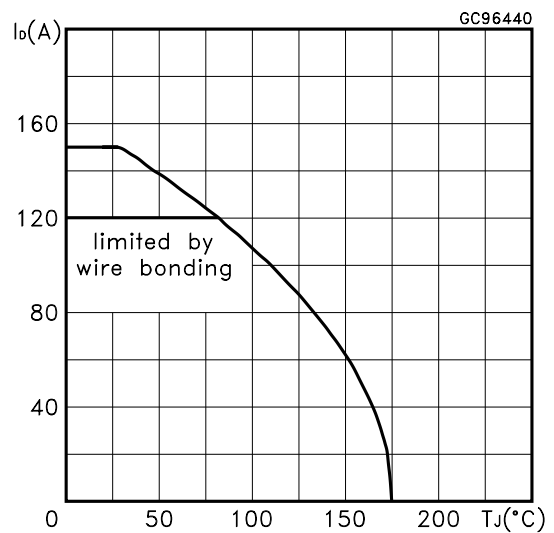
Normalized Breakdown Voltage vs Temperature.



Power Derating vs Tc

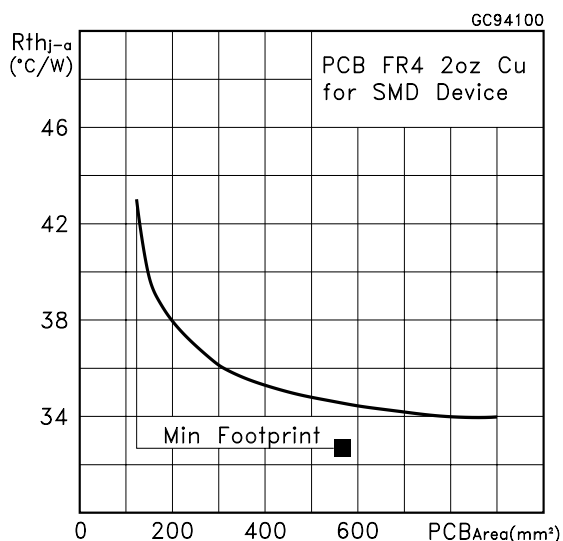


Max Id Current vs Tc.

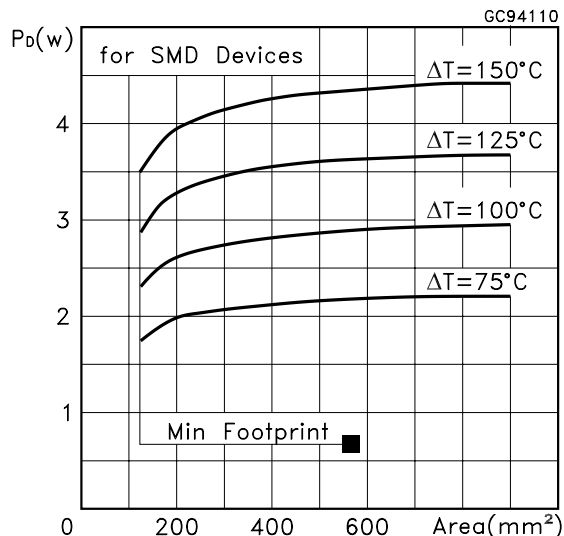


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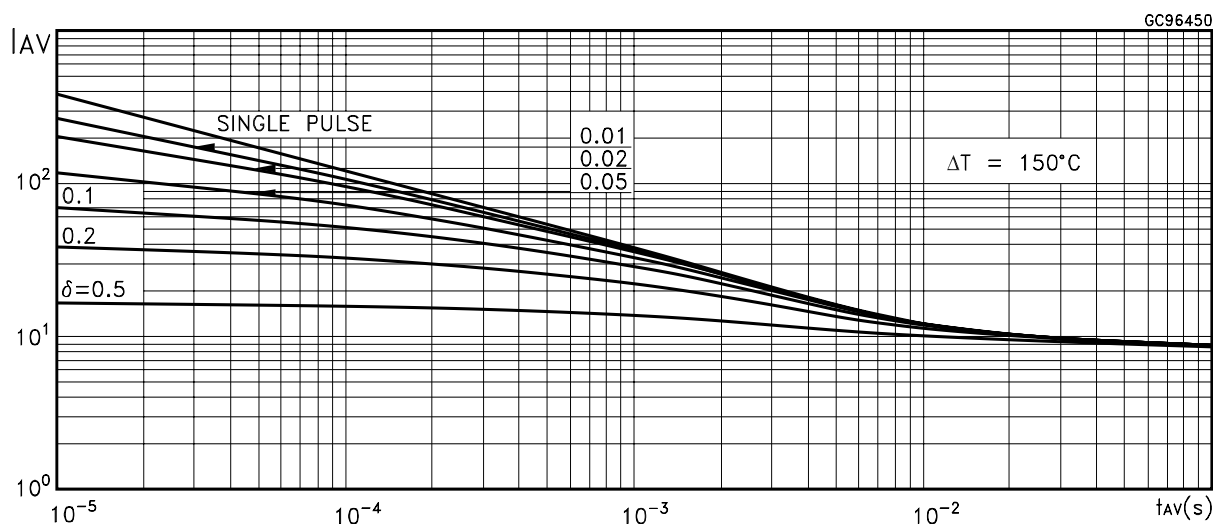
Thermal Resistance Rthj-a vs PCB Copper Area



Max Power Dissipation vs PCB Copper Area



## Allowable Iav 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  $T_{AV}$ .



**SPICE THERMAL MODEL**

| Parameter | Node  | Value  |
|-----------|-------|--------|
| CTHERM1   | 5 - 4 | 0.011  |
| CTHERM2   | 4 - 3 | 0.0012 |
| CTHERM3   | 3 - 2 | 0.05   |
| CTHERM4   | 2 - 1 | 0.1    |
|           |       |        |
| R THERM1  | 5 - 4 | 0.09   |
| R THERM2  | 4 - 3 | 0.02   |
| R THERM3  | 3 - 2 | 0.11   |
| R THERM4  | 2 - 1 | 0.17   |

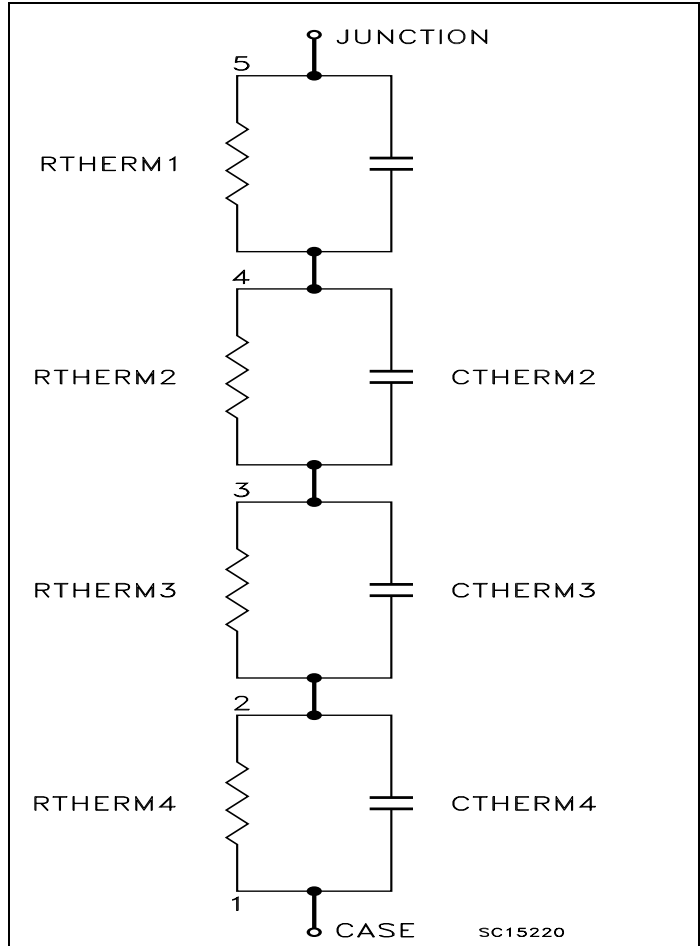


Fig. 1: Unclamped Inductive Load Test Circuit

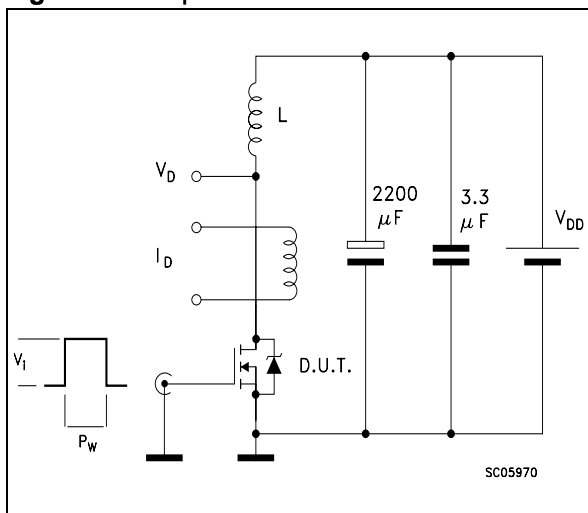


Fig. 2: Unclamped Inductive Waveform

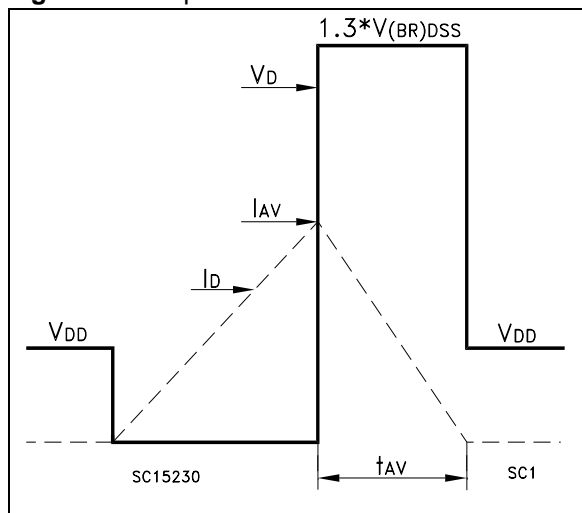


Fig. 3: Switching Times Test Circuits For Resistive Load

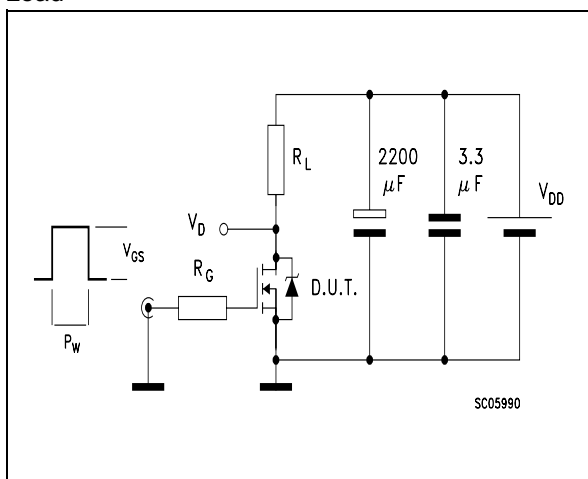


Fig. 3.1: Inductive Load Switching and Diode Recovery Times Waveform

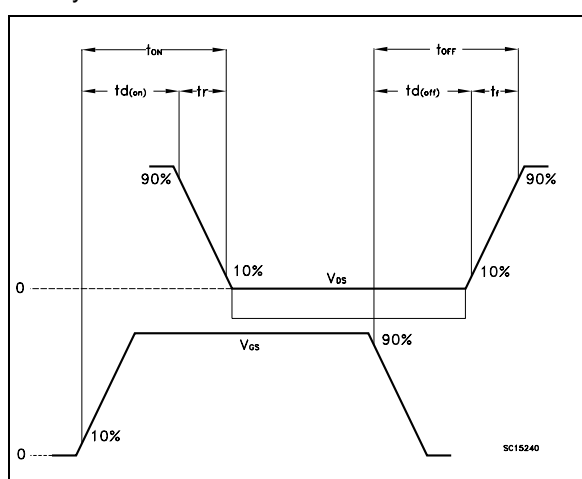


Fig. 4: Gate Charge Test Circuit

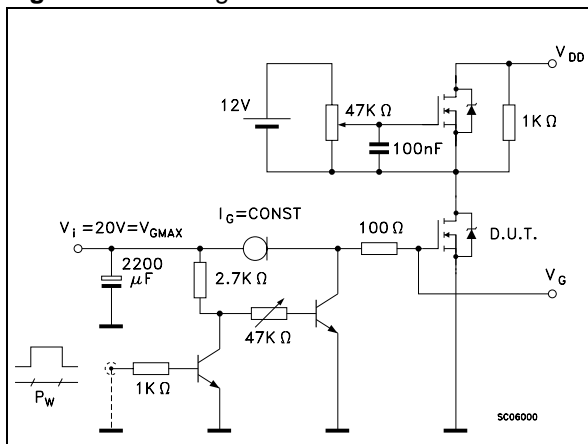


Fig. 4.1: Gate Charge Test Waveform

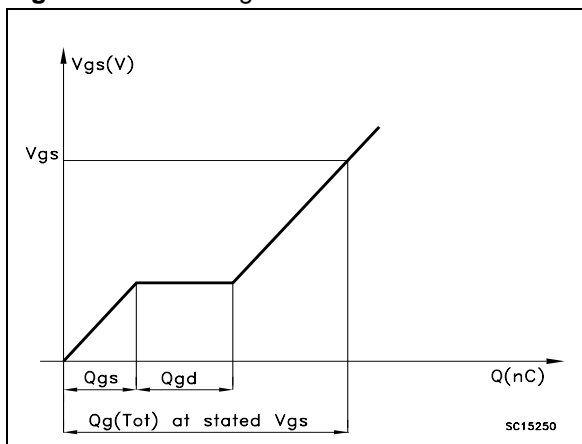


Fig. 5: Unclamped Inductive Load Test Circuit

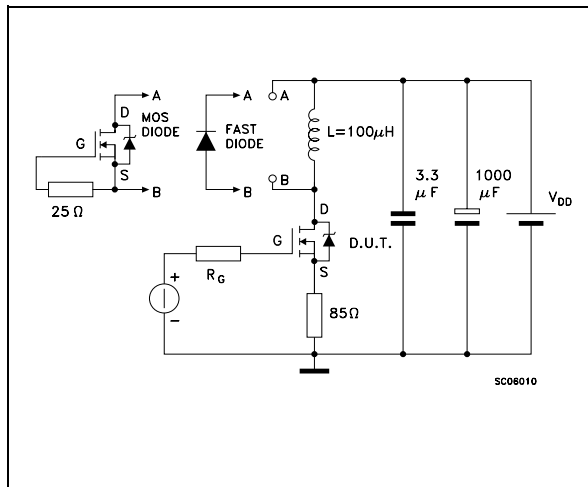
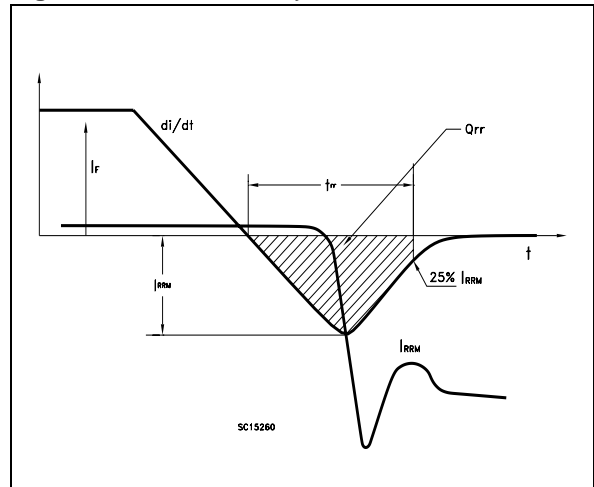
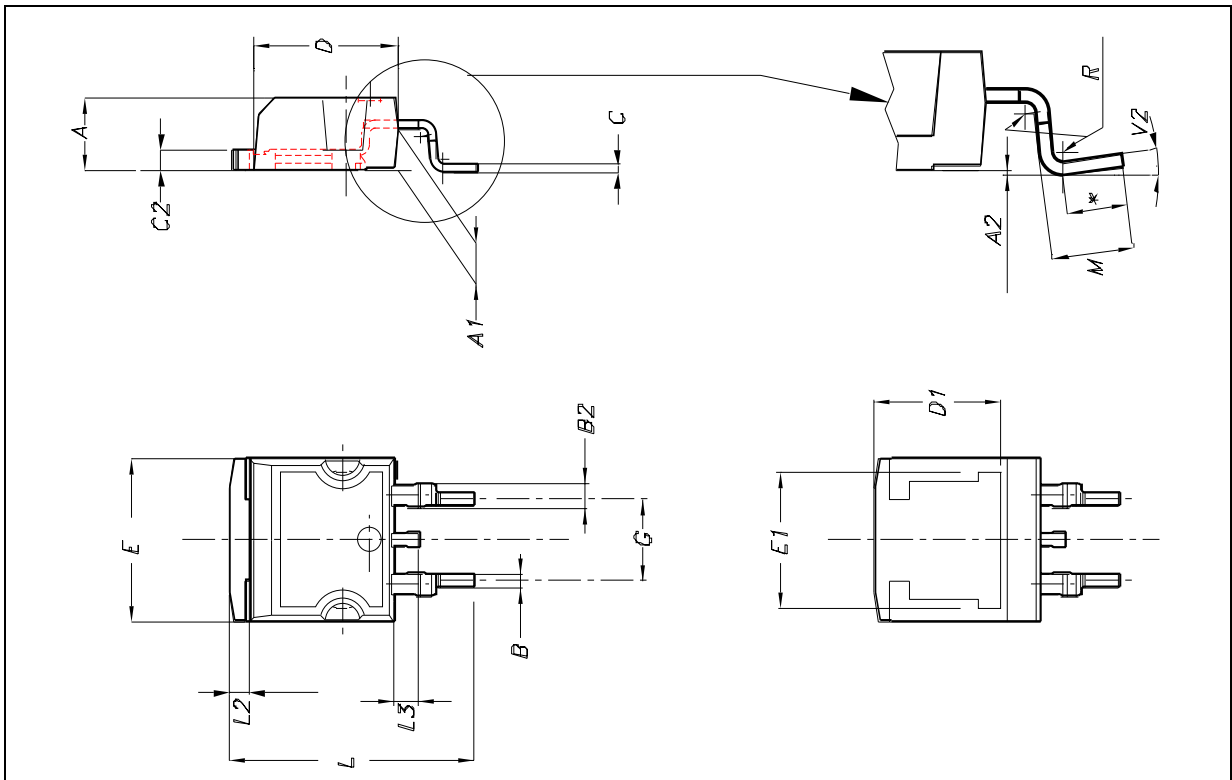


Fig. 5.1: Diode Recovery Times Waveform



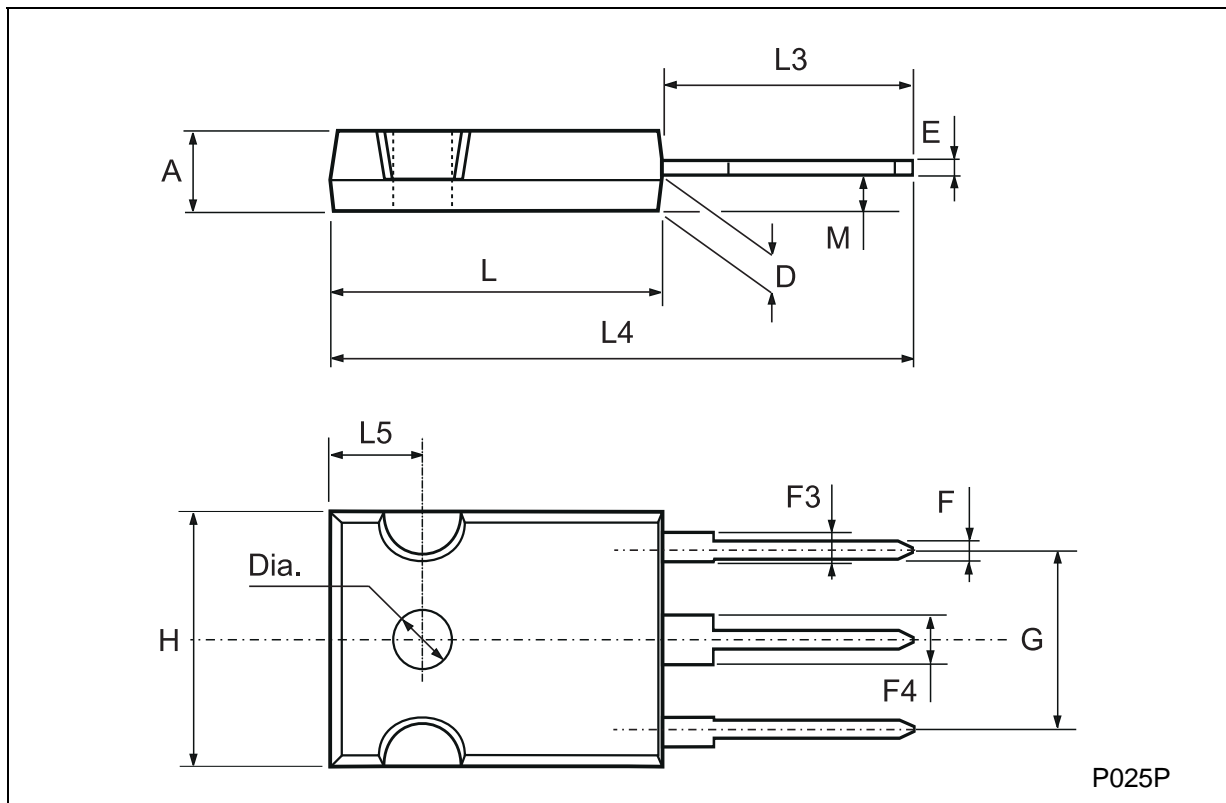
**D<sup>2</sup>PAK MECHANICAL DATA**

| DIM. | mm.  |      |       | inch. |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | TYP.  |
| 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  | 0.028 |       | 0.037 |
| B2   | 1.14 |      | 1.7   | 0.045 |       | 0.067 |
| C    | 0.45 |      | 0.6   | 0.018 |       | 0.024 |
| C2   | 1.21 |      | 1.36  | 0.048 |       | 0.054 |
| D    | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1   |      | 8    |       |       | 0.315 |       |
| E    | 10   |      | 10.4  | 0.394 |       | 0.409 |
| E1   |      | 8.5  |       |       | 0.334 |       |
| G    | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| L    | 15   |      | 15.85 | 0.591 |       | 0.624 |
| L2   | 1.27 |      | 1.4   | 0.050 |       | 0.055 |
| L3   | 1.4  |      | 1.75  | 0.055 |       | 0.069 |
| M    | 2.4  |      | 3.2   | 0.094 |       | 0.126 |
| R    |      | 0.4  |       |       | 0.015 |       |
| V2   | 0°   |      | 8°    | 0°    |       | 8°    |



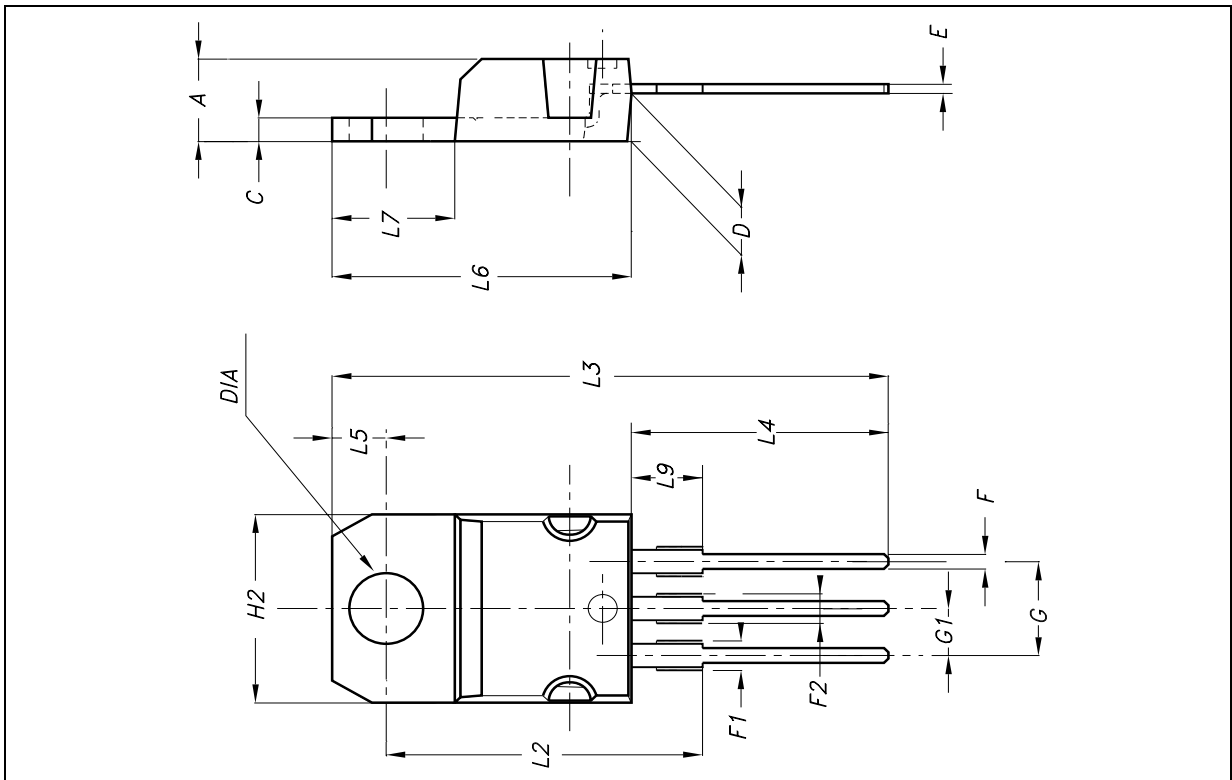
## TO-247 MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.7  |      | 5.3  | 0.185 |       | 0.209 |
| D    | 2.2  |      | 2.6  | 0.087 |       | 0.102 |
| E    | 0.4  |      | 0.8  | 0.016 |       | 0.031 |
| F    | 1    |      | 1.4  | 0.039 |       | 0.055 |
| F3   | 2    |      | 2.4  | 0.079 |       | 0.094 |
| F4   | 3    |      | 3.4  | 0.118 |       | 0.134 |
| G    |      | 10.9 |      |       | 0.429 |       |
| H    | 15.3 |      | 15.9 | 0.602 |       | 0.626 |
| L    | 19.7 |      | 20.3 | 0.776 |       | 0.779 |
| L3   | 14.2 |      | 14.8 | 0.559 |       | 0.582 |
| L4   |      | 34.6 |      |       | 1.362 |       |
| L5   |      | 5.5  |      |       | 0.217 |       |
| M    | 2    |      | 3    | 0.079 |       | 0.118 |

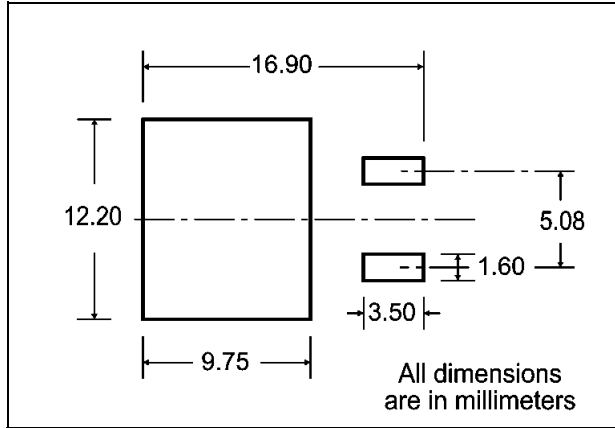


**TO-220 MECHANICAL DATA**

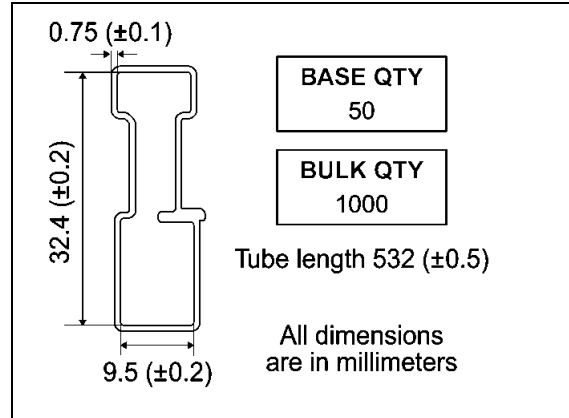
| DIM. | mm.   |       |       | inch. |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX.  | MIN.  | TYP.  | TYP.  |
| A    | 4.4   |       | 4.6   | 0.173 |       | 0.181 |
| C    | 1.23  |       | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |       | 2.72  | 0.094 |       | 0.107 |
| E    | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |       | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |       | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |       | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.40  |       | 2.70  | 0.094 |       | 0.106 |
| H2   | 10    |       | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.40 |       |       | 0.645 |       |
| L3   |       | 28.90 |       |       | 1.137 |       |
| L4   | 13    |       | 14    | 0.511 |       | 0.551 |
| L5   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |       | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.20  |       | 6.60  | 0.244 |       | 0.260 |
| L9   | 3.50  |       | 3.93  | 0.137 |       | 0.154 |
| DIA  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |



**D2PAK FOOTPRINT**



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



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

Diagram showing the tape and reel shipment details. It includes a circular reel view with dimensions A, B, C, D, and a note: "40 mm min. Access hole at slot location". A note also states: "Tape slot in core for tape start 2.5mm min. width". A side view shows dimensions T, C, N, and G (measured at hub).

**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  |

|                 |      |
|-----------------|------|
| <b>BASE QTY</b> | 1000 |
| <b>BULK QTY</b> | 1000 |

**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  |

Diagram showing the tape mechanical data. It includes a side view of the tape with dimensions K0, D, P2, P0, E, F, W, B0, D1, A0, P1, and a note: "10 pitches cumulative tolerance on tape +/- 0.2 mm". A note also states: "Center line of cavity". A top view shows dimensions TRL and FEED DIRECTION. A bending radius diagram shows a note: "Bending radius R min.".

\* on sales type



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