



# STB60NF06L STP60NF06L STP60NF06LFP

N-CHANNEL 60V - 0.012  $\Omega$  - 60A TO-220/TO-220FP/D<sup>2</sup>PAK  
STripFET™ II POWER MOSFET

| TYPE         | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------------|------------------|---------------------|----------------|
| STB60NF06L   | 60 V             | <0.014 $\Omega$     | 60 A           |
| STP60NF06L   | 60 V             | <0.014 $\Omega$     | 60 A           |
| STP60NF06LFP | 60 V             | <0.014 $\Omega$     | 60 A(*)        |

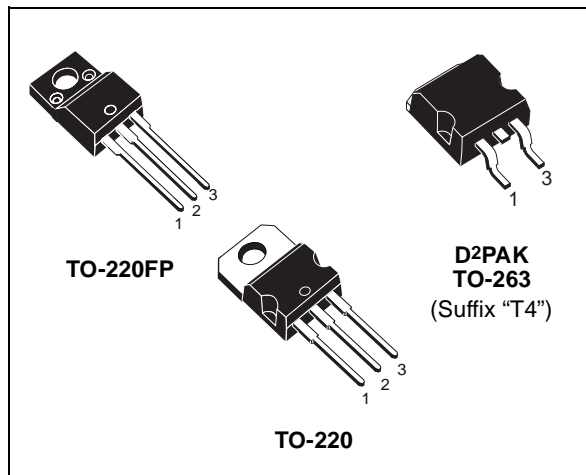
- TYPICAL R<sub>DS(on)</sub> = 0.012 $\Omega$
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- APPLICATION ORIENTED CHARACTERIZATION
- 175 °C OPERATING RANGE
- LOW THRESHOLD DRIVE
- SURFACE-MOUNTING D<sup>2</sup>PAK (TO-263)  
POWER PACKAGE IN TAPE & REEL  
(SUFFIX "T4")

## DESCRIPTION

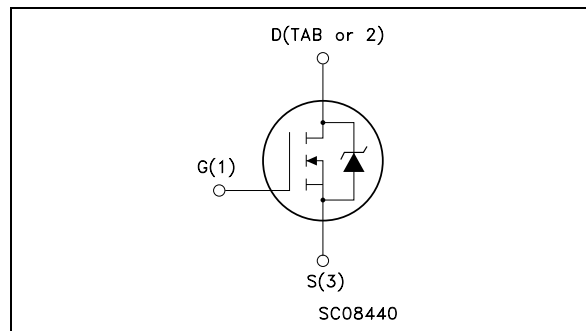
This MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency, high-frequency isolated DC-DC converters for Telecom and Computer applications. It is also intended for any applications with low gate drive requirements.

## APPLICATIONS

- HIGH-EFFICIENCY DC-DC CONVERTERS
- AUTOMOTIVE



## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter   | Value                    |              | Unit |
|---------------------|---|--------------------------|--------------|------|
|                     |   | STB60NF06L<br>STP60NF06L | STP60NF06LFP |      |
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 60                       |              | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 60                       |              | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                  | ± 15                     |              | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C   | 60                       | 60(*)        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C  | 42                       | 42(*)        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                                | 240                      | 240(*)       | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>C</sub> = 25°C            | 110                      | 30           | W    |
|                     | Derating Factor                                       | 0.73                     | 0.2          | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                     | 20                       |              | V/ns |
| E <sub>AS</sub> (2) | Single Pulse Avalanche Energy                         | 320                      |              | mJ   |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                     | -----                    | 2000         | V    |
| T <sub>stg</sub>    | Storage Temperature                                   | -55 to 175               |              | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                        |                          |              |      |

(●) Pulse width limited by safe operating area.

(\*) Refer to SOA for the max allowable current values on FP-type due to R<sub>th</sub> value

(1) I<sub>SD</sub> ≤ 60A, di/dt ≤ 600A/μs, V<sub>DD</sub> ≤ 48V, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

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

**STB60NF06L STP60NF06L/FP****THERMAL DATA**

|                       |  |     | <b>D<sup>2</sup>PAK<br/>TO-220</b> | <b>TO-220FP</b> |      |
|-----------------------|--|-----|------------------------------------|-----------------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 1.36                               | 5.0             | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 62.5                               |                 | °C/W |
| R <sub>thj-pcb</sub>  | Thermal Resistance Junction-pcb(°)             | Max | 35                                 |                 | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose |     | 300                                |                 | °C   |

(°)Only for SMD, When Mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz of Cu.

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

| <b>Symbol</b>        | <b>Parameter</b>                                      | <b>Test Conditions</b>  | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b> |
|----------------------|---|---|-------------|-------------|-------------|-------------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 µA, V <sub>GS</sub> = 0  | 60          |             |             | 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> = ± 15V   |             |             | ±100        | nA          |

**ON (1)**

| <b>Symbol</b>       | <b>Parameter</b>                  | <b>Test Conditions</b>  | <b>Min.</b> | <b>Typ.</b>    | <b>Max.</b>    | <b>Unit</b> |
|---------------------|-----------------------------------|---|-------------|----------------|----------------|-------------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 µA                                   | 1           |                |                | V           |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 5 V I <sub>D</sub> = 30 A<br>V <sub>GS</sub> = 10 V I <sub>D</sub> = 30 A |             | 0.014<br>0.012 | 0.016<br>0.014 | Ω<br>Ω      |

**DYNAMIC**

| <b>Symbol</b>       | <b>Parameter</b>             | <b>Test Conditions</b>                                | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b> |
|---------------------|------------------------------|---|-------------|-------------|-------------|-------------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> = 15 V I <sub>D</sub> = 30 A          |             | 20          |             | S           |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |             | 2000        |             | pF          |
| C <sub>oss</sub>    | Output Capacitance           |   |             | 360         |             | pF          |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |   |             | 125         |             | 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                              | $V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 4.5\text{ V}$<br>(Resistive Load, Figure 3) |      | 35<br>220      |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 48\text{ V}$ $I_D = 60\text{ A}$ $V_{GS} = 4.5\text{ V}$  |      | 35<br>10<br>20 |      | 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 | $V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 4.5\text{ V}$<br>(Resistive Load, Figure 3) |      | 55<br>30 |      | ns<br>ns |

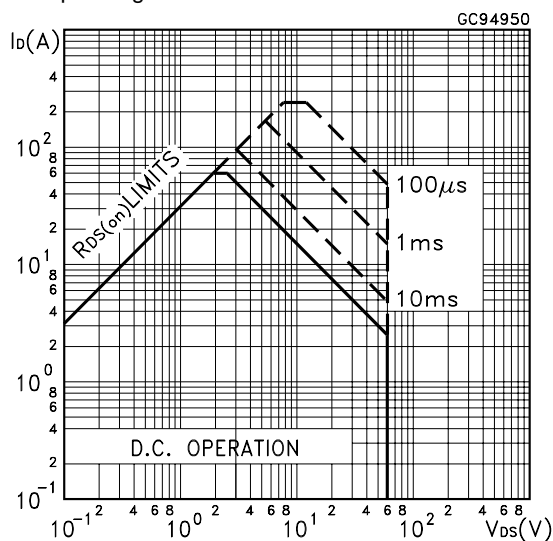
**SOURCE DRAIN DIODE**

| Symbol                            | Parameter  | Test Conditions   | Min. | Typ.              | Max.      | Unit          |
|-----------------------------------|--|---|------|-------------------|-----------|---------------|
| $I_{SD}$<br>$I_{SDM} (\bullet)$   | Source-drain Current<br>Source-drain Current (pulsed)                        |   |      |                   | 60<br>240 | A<br>A        |
| $V_{SD} (*)$                      | Forward On Voltage   | $I_{SD} = 60\text{ A}$ $V_{GS} = 0$   |      |                   | 1.3       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 60\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 30\text{ V}$ $T_J = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 110<br>250<br>4.5 |           | ns<br>nC<br>A |

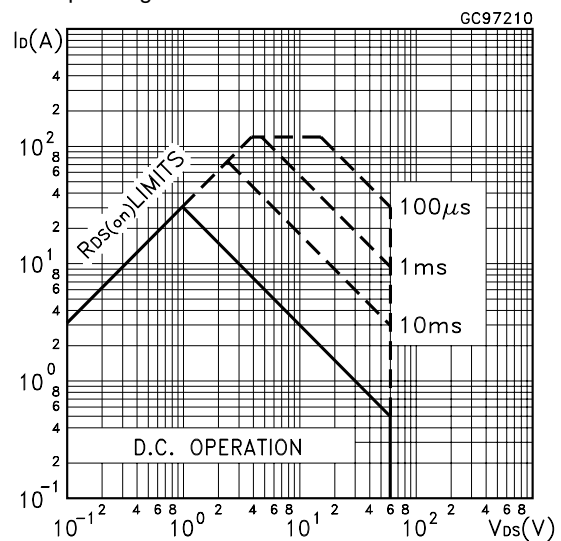
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

(\bullet) Pulse width limited by safe operating area.

Safe Operating Area

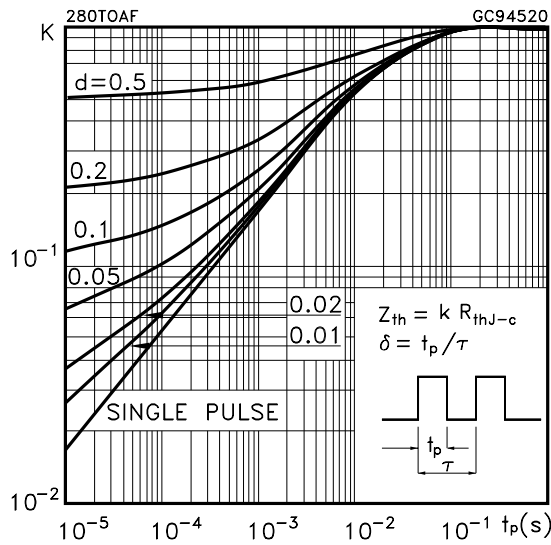


Safe Operating Area for TO-220FP

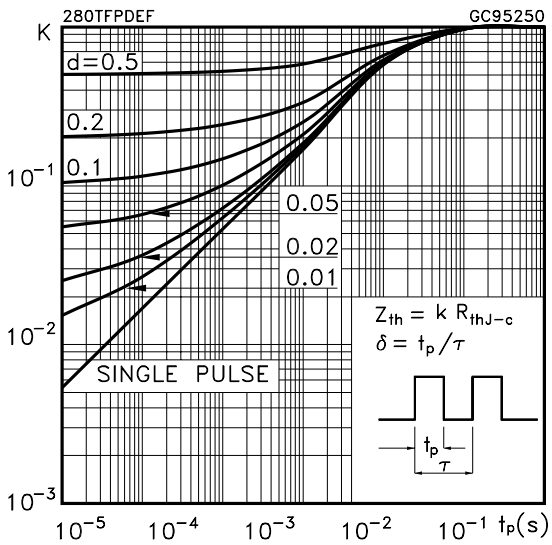


**STB60NF06L STP60NF06L/FP**

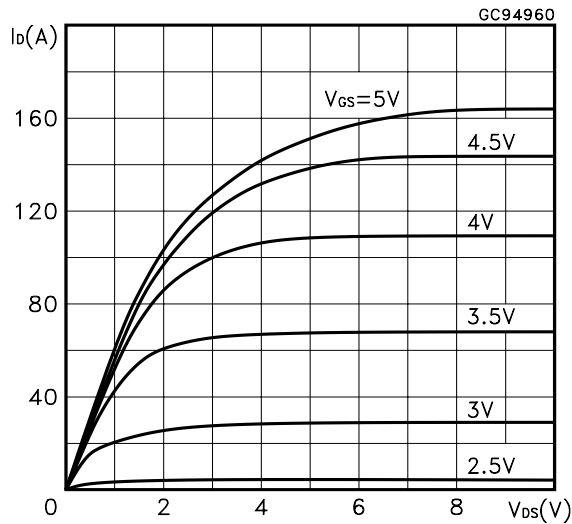
Thermal Impedance



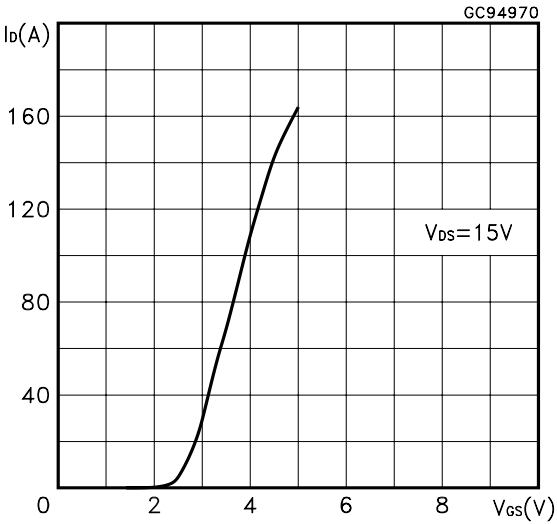
Thermal Impedance for TO-220FP



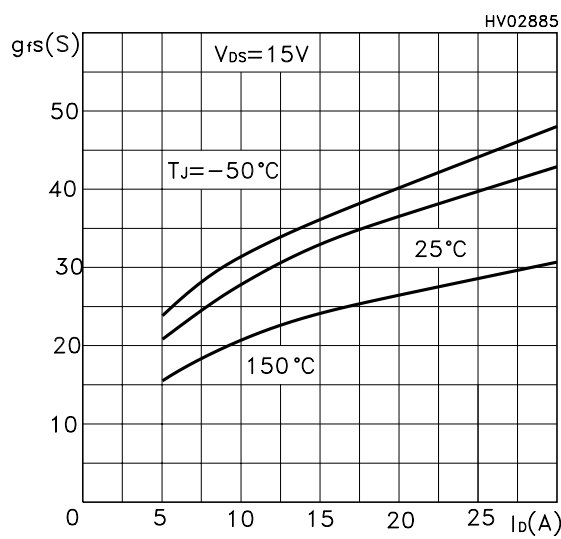
Output Characteristics



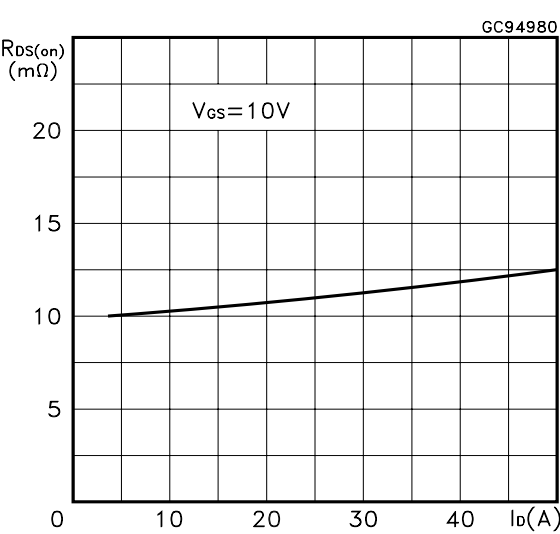
Transfer Characteristics



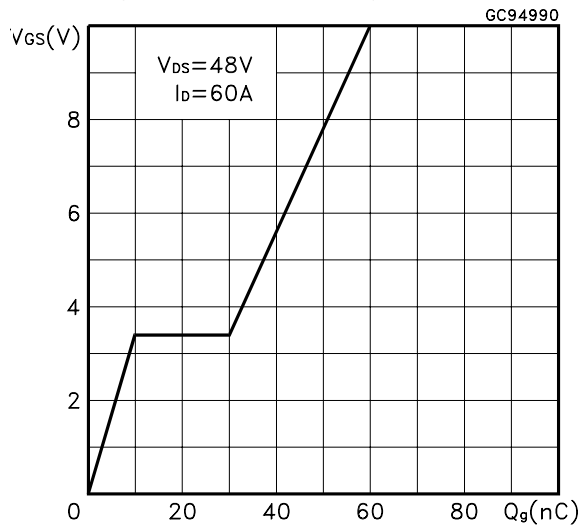
Transconductance



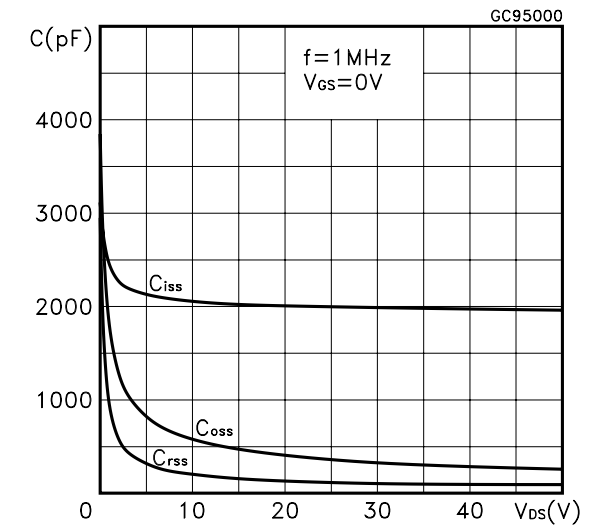
Static Drain-source On Resistance



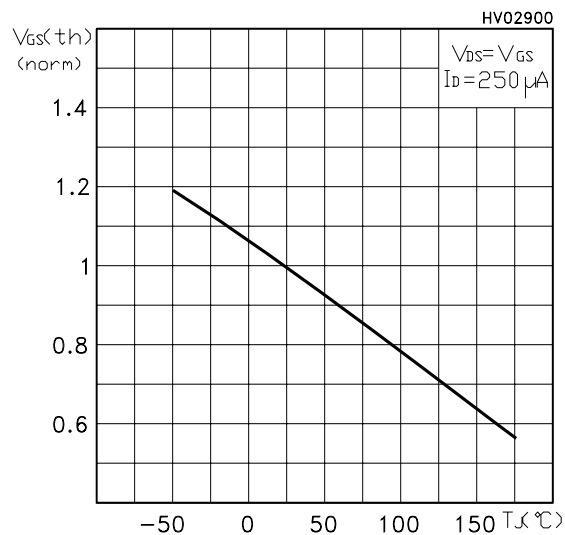
Gate Charge vs Gate-source Voltage



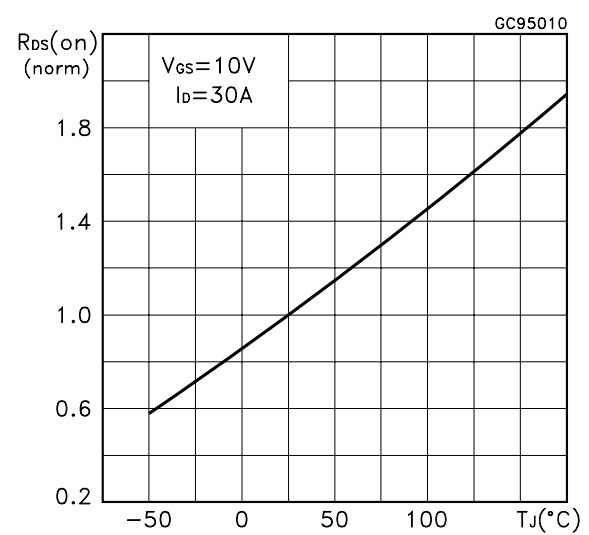
Capacitance Variations



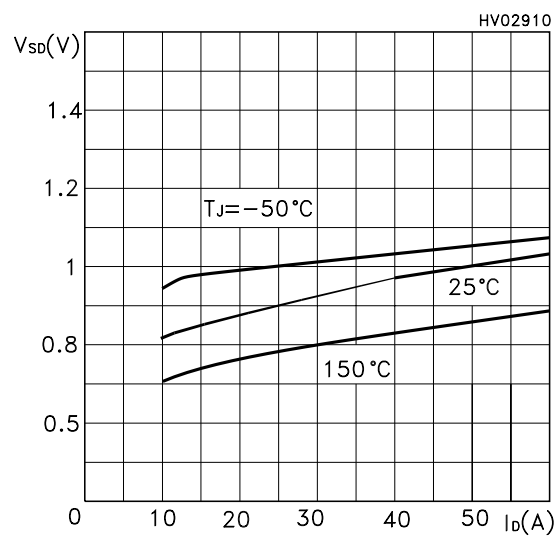
Normalized Gate Threshold Voltage vs Temperature



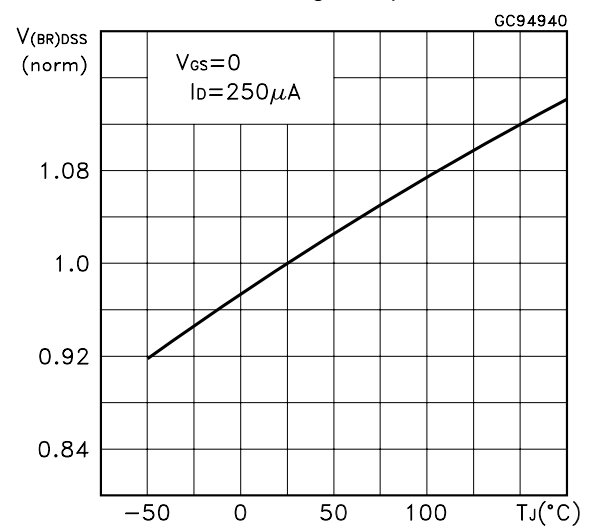
Normalized on Resistance vs Temperature



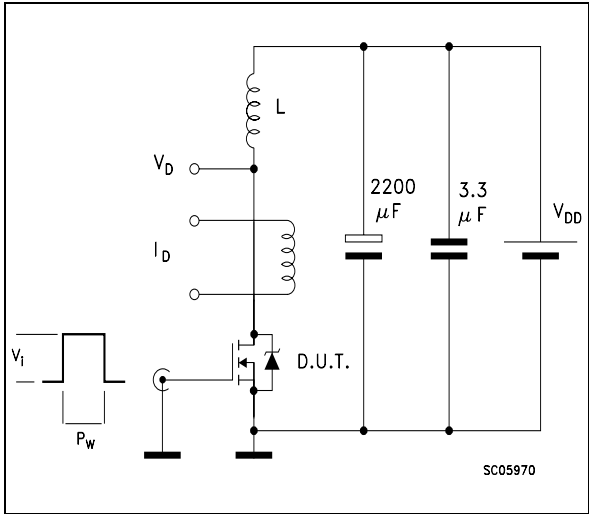
Source-drain Diode Forward Characteristics



Normalized Breakdown Voltage Temperature



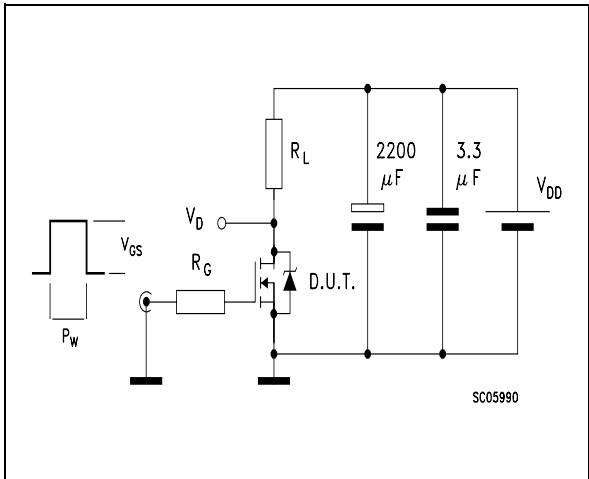
**Fig. 1: Unclamped Inductive Load Test Circuit**



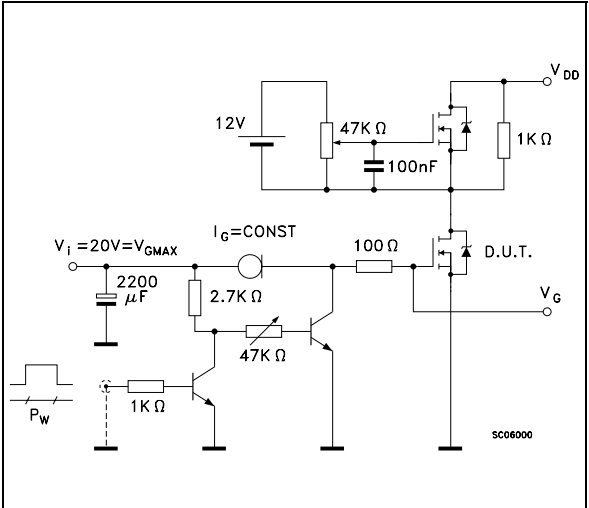
**Fig. 2: Unclamped Inductive Waveform**



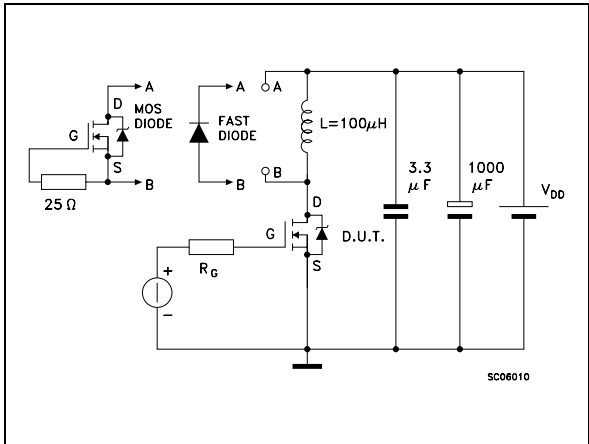
**Fig. 3: Switching Times Test Circuits For Resistive Load**



**Fig. 4: Gate Charge test Circuit**

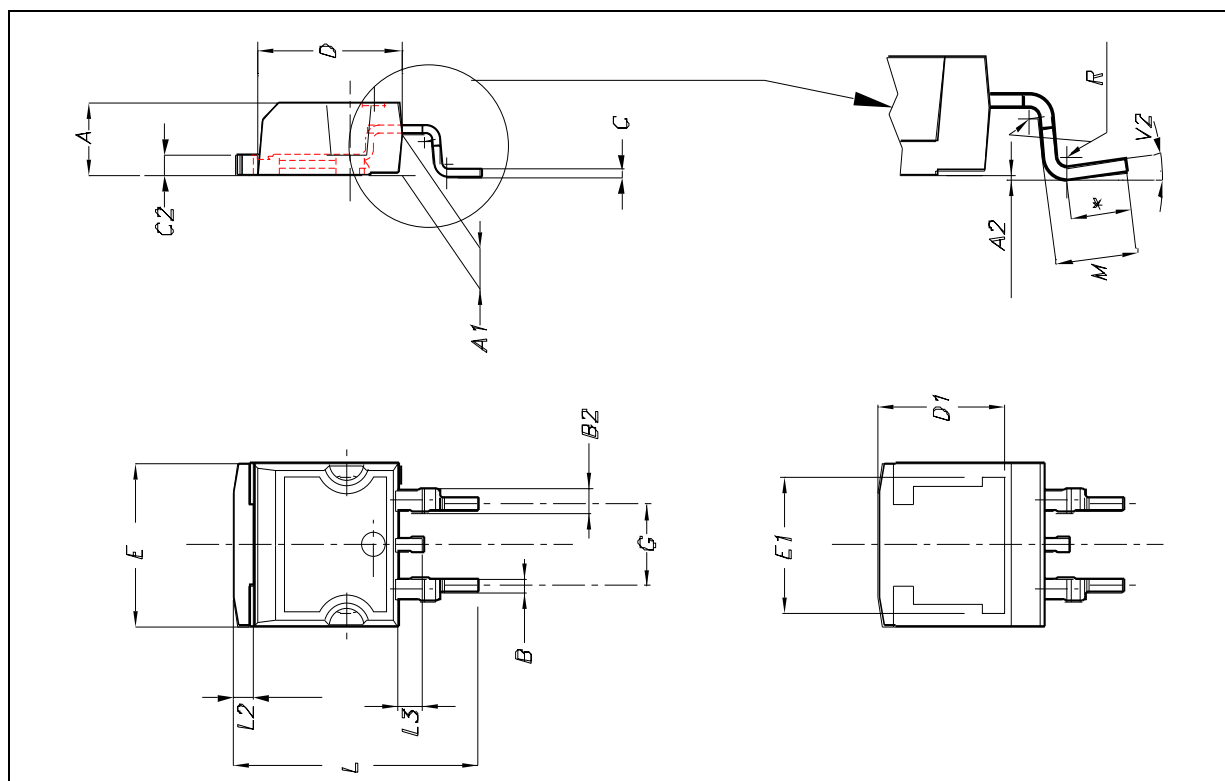


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



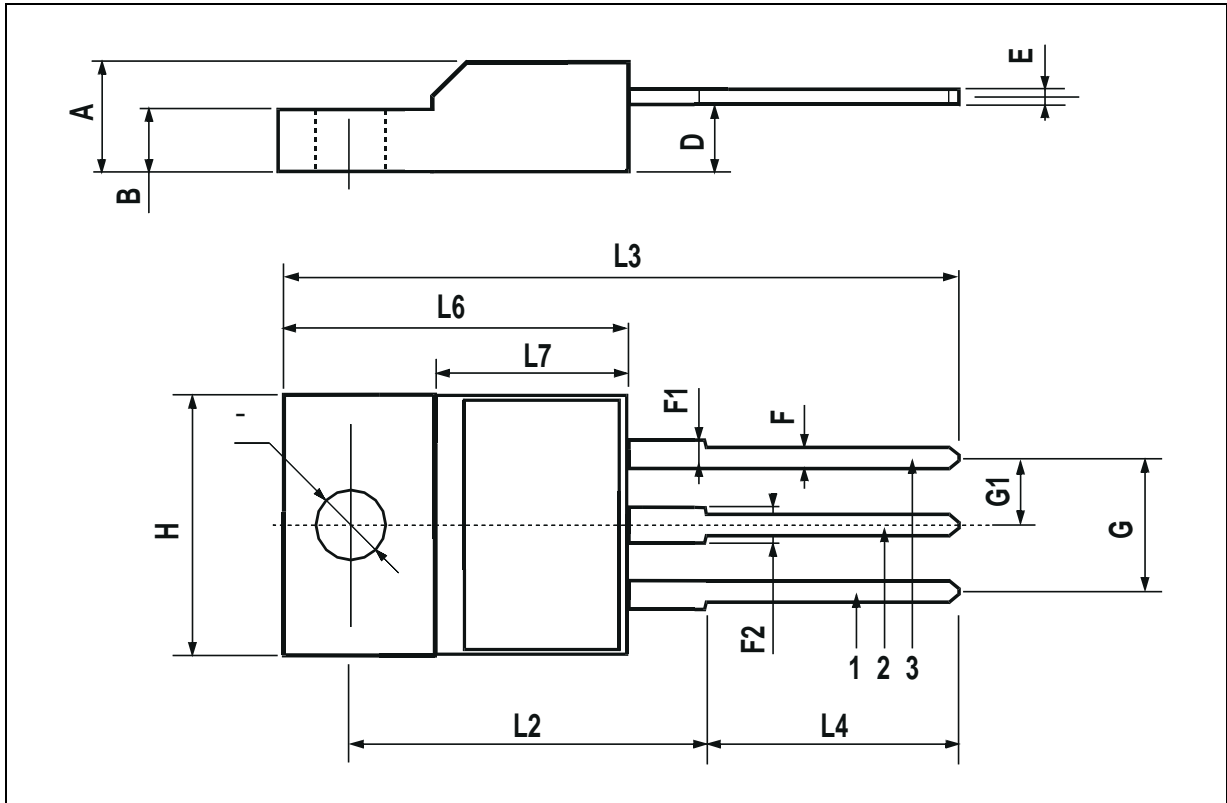
D<sup>2</sup>PAK MECHANICAL DATA

| 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-220FP MECHANICAL DATA

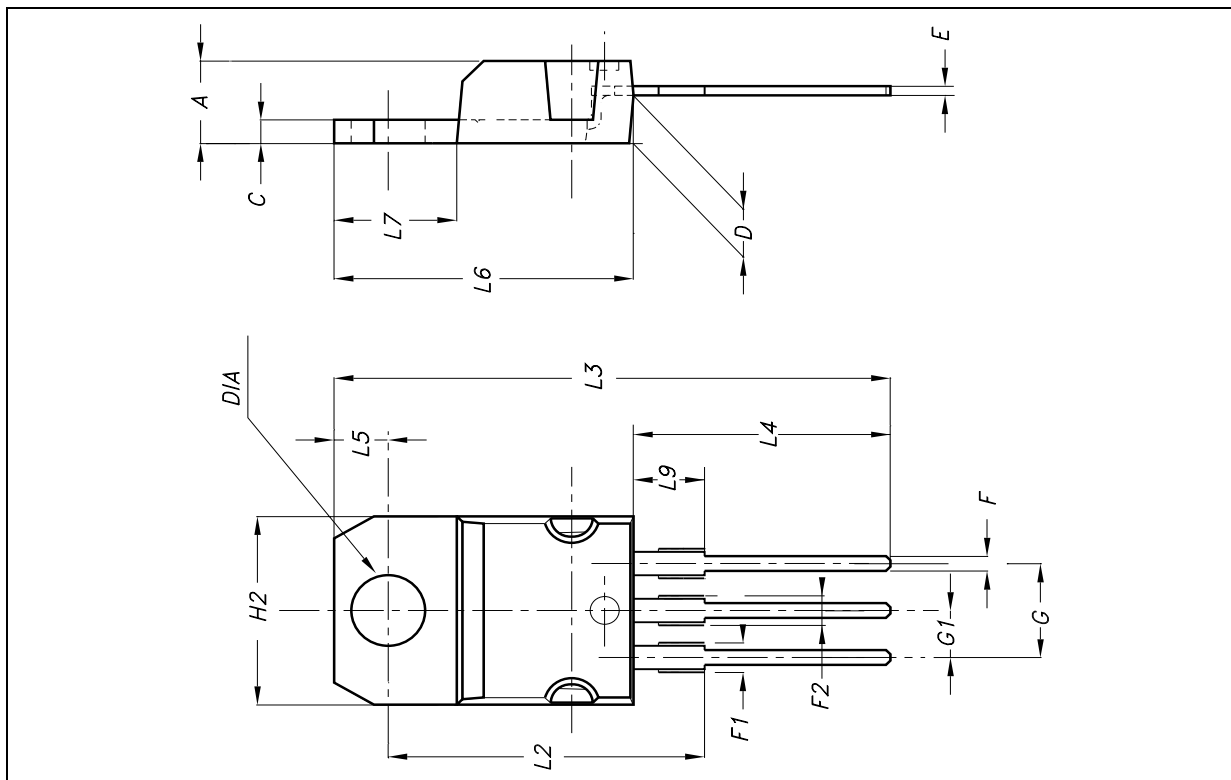
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |      | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |      | 2.75 | 0.098 |       | 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 | 0.385 |       | 0.417 |
| 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 |



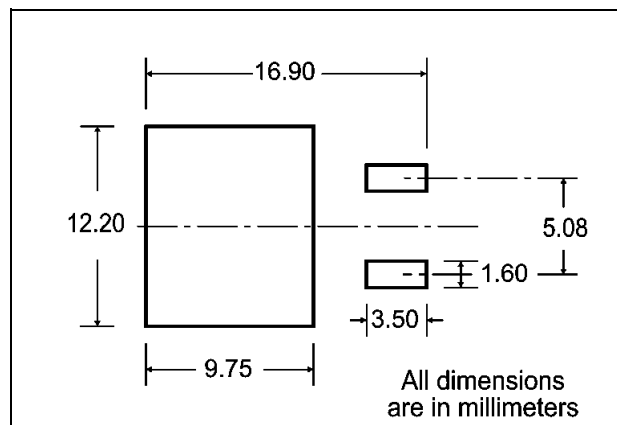


## TO-220 MECHANICAL DATA

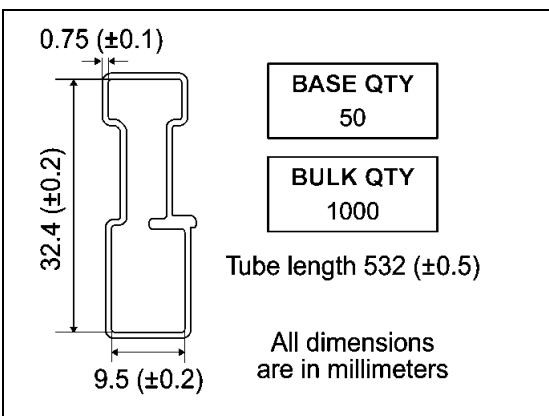
| DIM. | mm.   |       |       | inch. |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX.  | MIN.  | TYP.  | TYP.  |
| A    | 4.4   |       | 4.6   | 0.173 |       | 0.181 |
| C    | 1.23  |       | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |       | 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 |



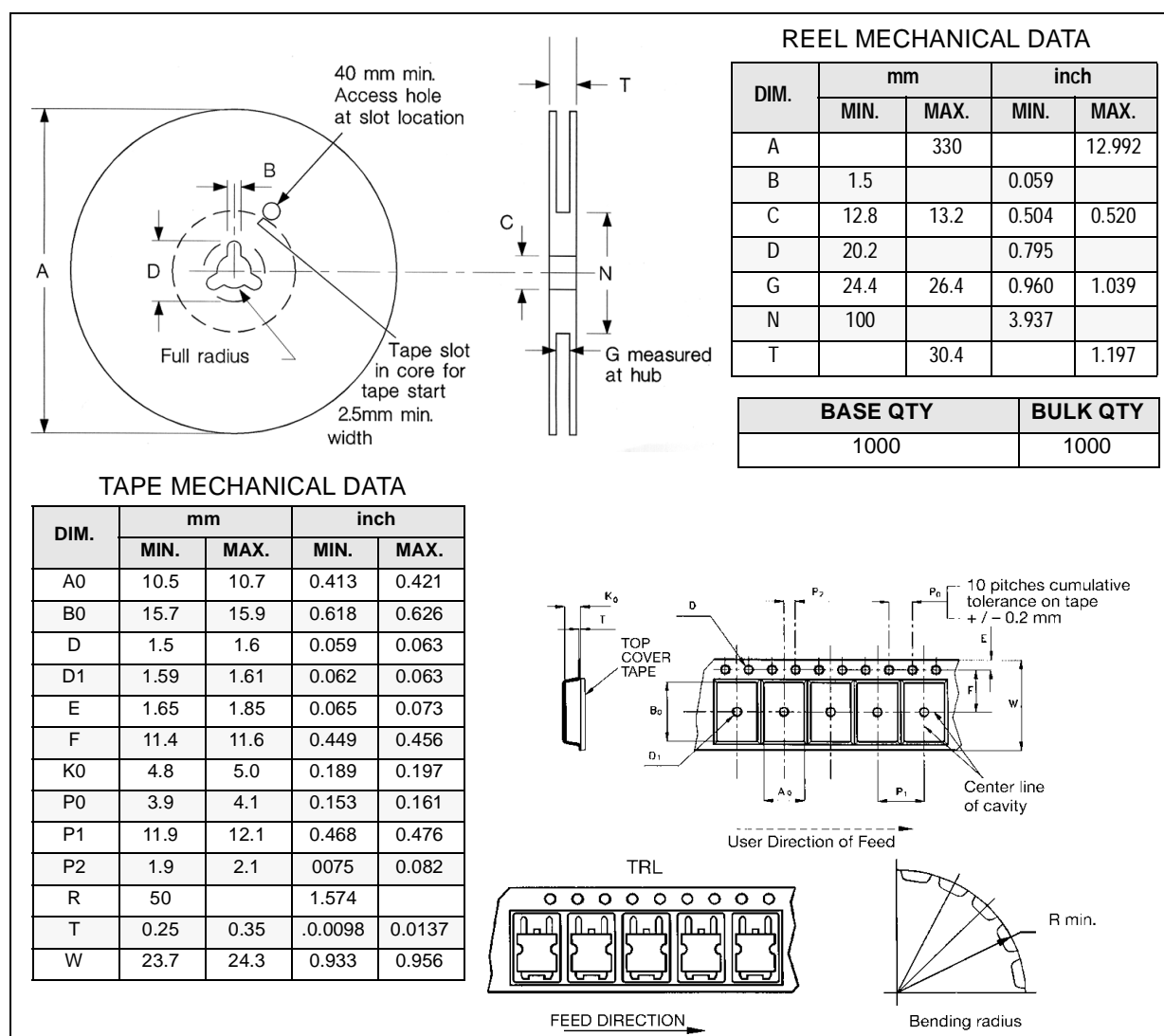
## D2PAK FOOTPRINT



## TUBE SHIPMENT (no suffix)\*



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



\* on sales type

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