



## STB60NF06

N-CHANNEL 60V - 0.014Ω - 60A D2PAK

STripFET™ POWER MOSFET

| TYPE      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STB60NF06 | 60V              | < 0.016 Ω           | 60A            |

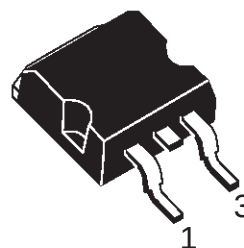
- TYPICAL R<sub>DS(on)</sub> = 0.014Ω
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- APPLICATION ORIENTED CHARACTERIZATION
- ADD SUFFIX "T4" FOR ORDERING IN TAPE & REEL

### 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 for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

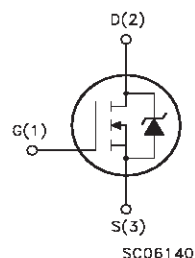
### APPLICATIONS

- HIGH-EFFICIENCY DC-DC CONVERTERS
- UPS AND MOTOR CONTROL
- AUTOMOTIVE



D2PAK

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                            | Value      | Unit |
|---------------------|------------------------------------------------------|------------|------|
| 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 kΩ)         | 60         | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ± 20       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 60         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 42         | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 240        | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 110        | W    |
|                     | Derating Factor                                      | 0.73       | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 4          | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                  | -65 to 175 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  | 175        | °C   |

(●) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 60A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ 24V, T<sub>j</sub> ≤ T<sub>jMAX</sub>

## STB60NF06

### THERMAL DATA

|                |                                                |      |      |
|----------------|------------------------------------------------|------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 1.36 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 62.5 | °C/W |
| T <sub>l</sub> | Maximum Lead Temperature For Soldering Purpose | 300  | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter                                                                                                                  | Max Value | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)                                | 30        | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 30 V) | 360       | mJ   |

### ELECTRICAL CHARACTERISTICS (TCASE = 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                                          | 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> = ± 20V                                                               |      |      | ±100    | nA       |

### ON (1)

| 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> = 250µA | 2    |       | 4     | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30 A               |      | 0.014 | 0.016 | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                       | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|-------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> = 15V, 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 |      | 1810 |      | 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 |
|-------------|--------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 30\text{ V}$ , $I_D = 30\text{ A}$                               |      | 16   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 108  |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 48\text{ V}$ , $I_D = 60\text{ A}$ , $V_{GS} = 10\text{ V}$      |      | 49   | 66   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 18   |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 14   |      | nC   |

## SWITCHING OFF

| Symbol       | Parameter             | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|--------------|-----------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(off)}$ | Turn-off-Delay Time   | $V_{DD} = 30\text{ V}$ , $I_D = 30\text{ A}$                               |      | 43   |      | ns   |
| $t_f$        | Fall Time             | $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 20   |      | ns   |
| $t_{d(off)}$ | Off-voltage Rise Time | $V_{clamp} = 48\text{ V}$ , $I_D = 60\text{ A}$                            |      | 40   |      | ns   |
| $t_f$        | Fall Time             | $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 12   |      | ns   |
| $t_c$        | Cross-over Time       |                                                                            |      | 21   |      | ns   |

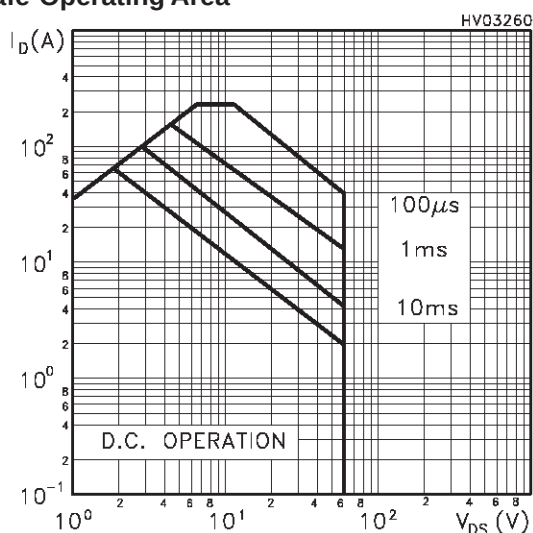
## SOURCE DRAIN DIODE

| Symbol       | Parameter                     | Test Conditions                                             | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------|-------------------------------------------------------------|------|------|------|------|
| $I_{SD}$     | Source-drain Current          |                                                             |      |      | 60   | A    |
| $I_{SDM(1)}$ | Source-drain Current (pulsed) |                                                             |      |      | 240  | A    |
| $V_{SD(2)}$  | Forward On Voltage            | $I_{SD} = 60\text{ A}$ , $V_{GS} = 0$                       |      |      | 1.3  | V    |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 60\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ |      | 73   |      | ns   |
| $Q_{rr}$     | Reverse Recovery Charge       | $V_{DD} = 25\text{ V}$ , $T_J = 150^\circ\text{C}$          |      | 182  |      | nC   |
| $I_{RRM}$    | Reverse Recovery Current      | (see test circuit, Figure 5)                                |      | 5    |      | A    |

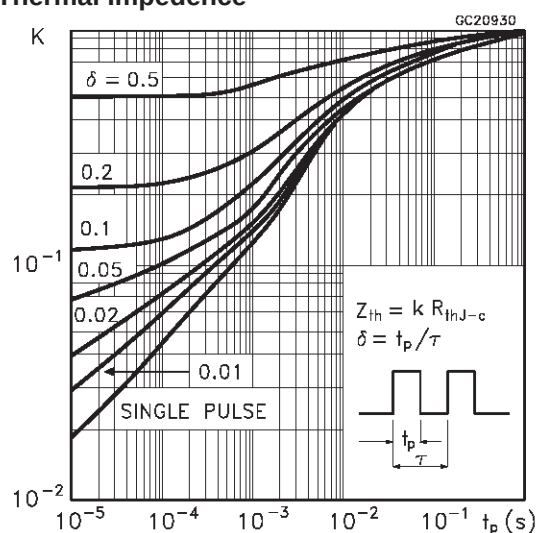
Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

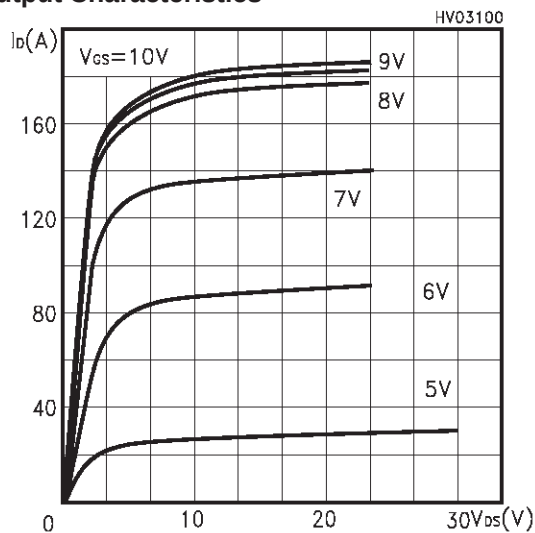
## Safe Operating Area



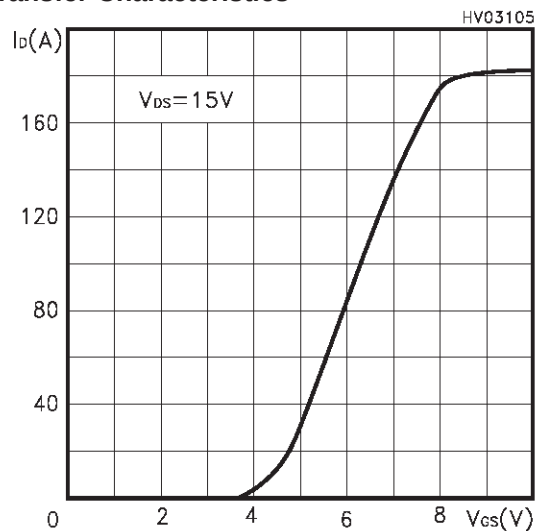
## Thermal Impedance



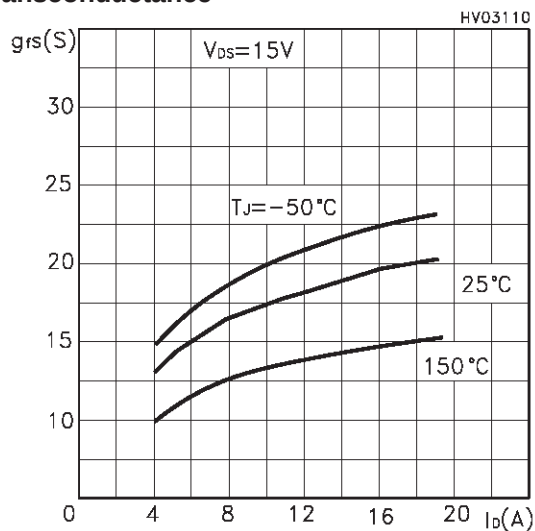
### Output Characteristics



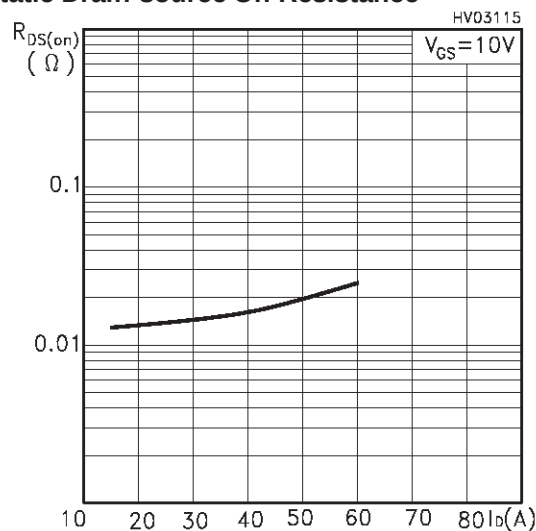
### Transfer Characteristics



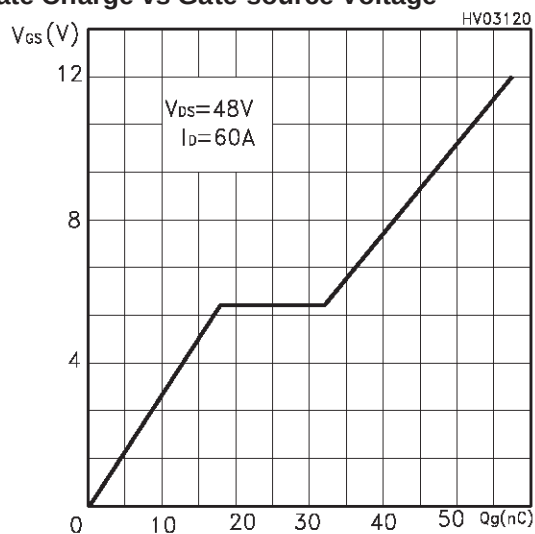
### Transconductance



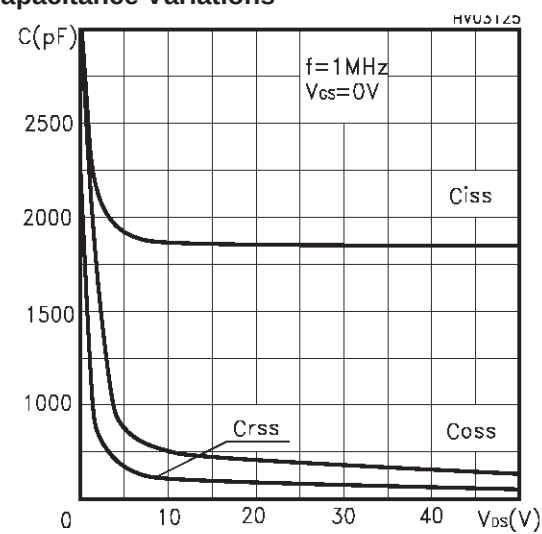
### Static Drain-source On Resistance

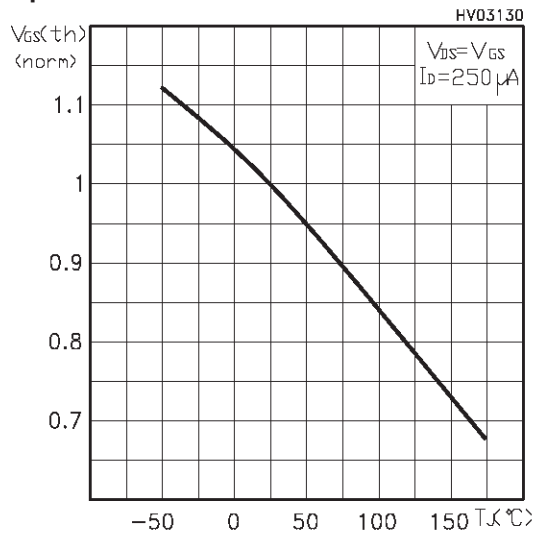
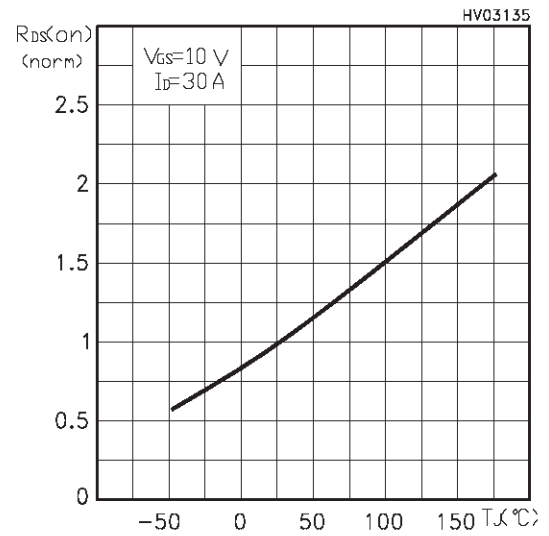
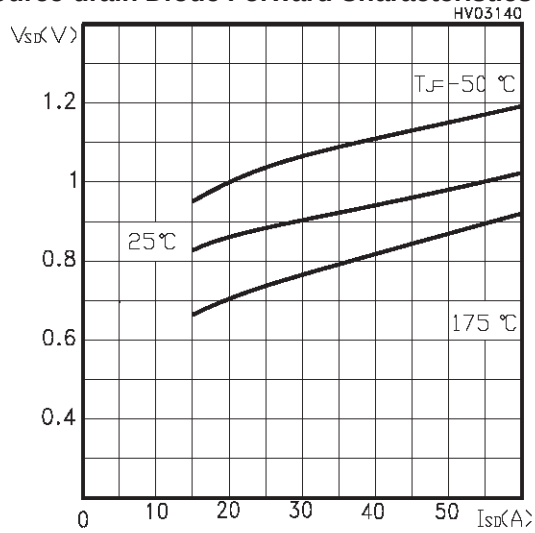


### Gate Charge vs Gate-source Voltage

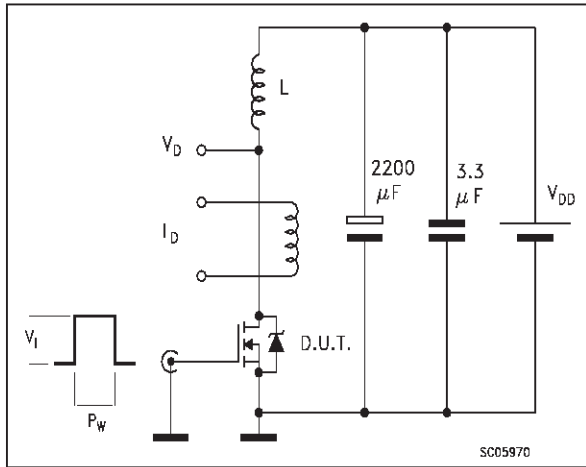


### Capacitance Variations

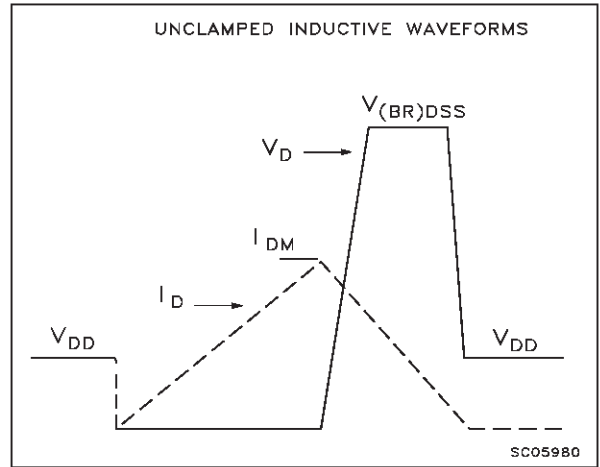


**Normalized Gate Threshold Voltage vs Temperature****Normalized On Resistance vs Temperature****Source-drain Diode Forward Characteristics**

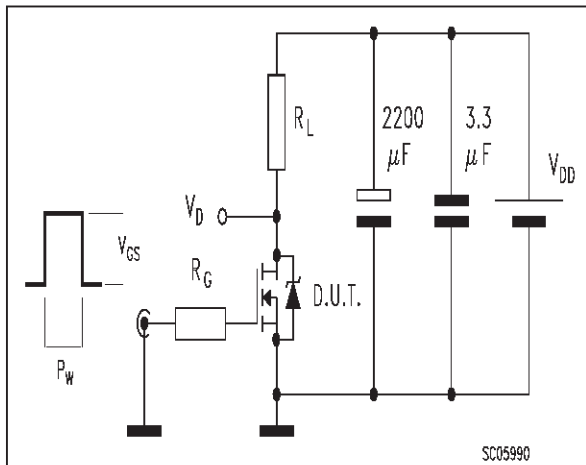
**Fig. 1: Unclamped Inductive Load Test Circuit**



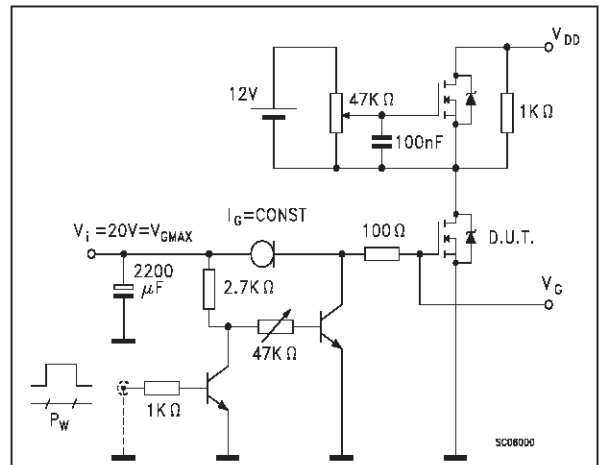
**Fig. 2: Unclamped Inductive Waveform**



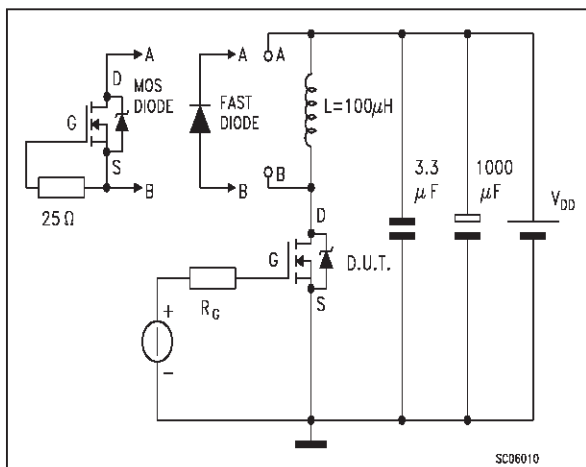
**Fig. 3: Switching Times Test Circuit For Resistive Load**



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

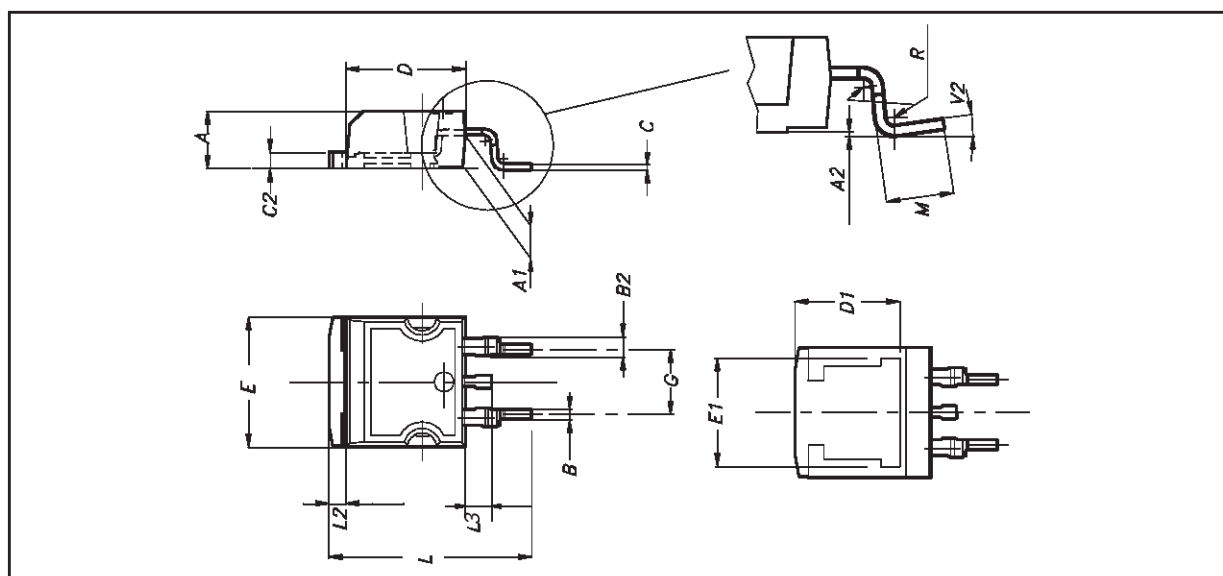


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**

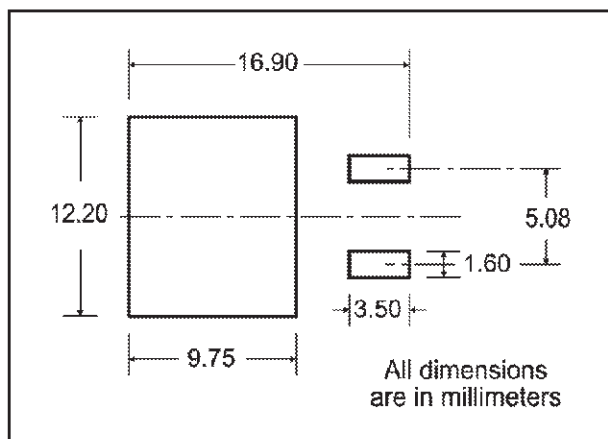


## D<sup>2</sup>PAK MECHANICAL DATA

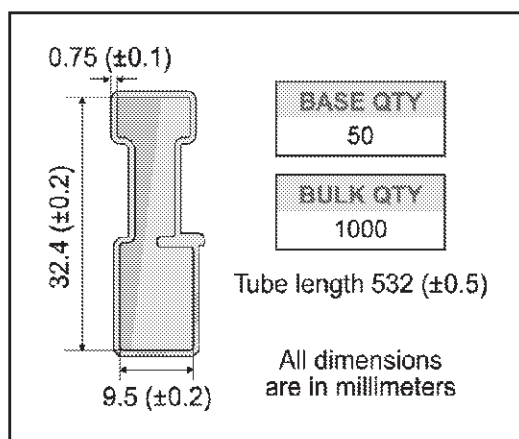
| DIM. | mm.  |     |       | inch  |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6   | 0.173 |       | 0.181 |
| A1   | 2.49 |     | 2.69  | 0.098 |       | 0.106 |
| A2   | 0.03 |     | 0.23  | 0.001 |       | 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°   |     | 8°    |       |       |       |



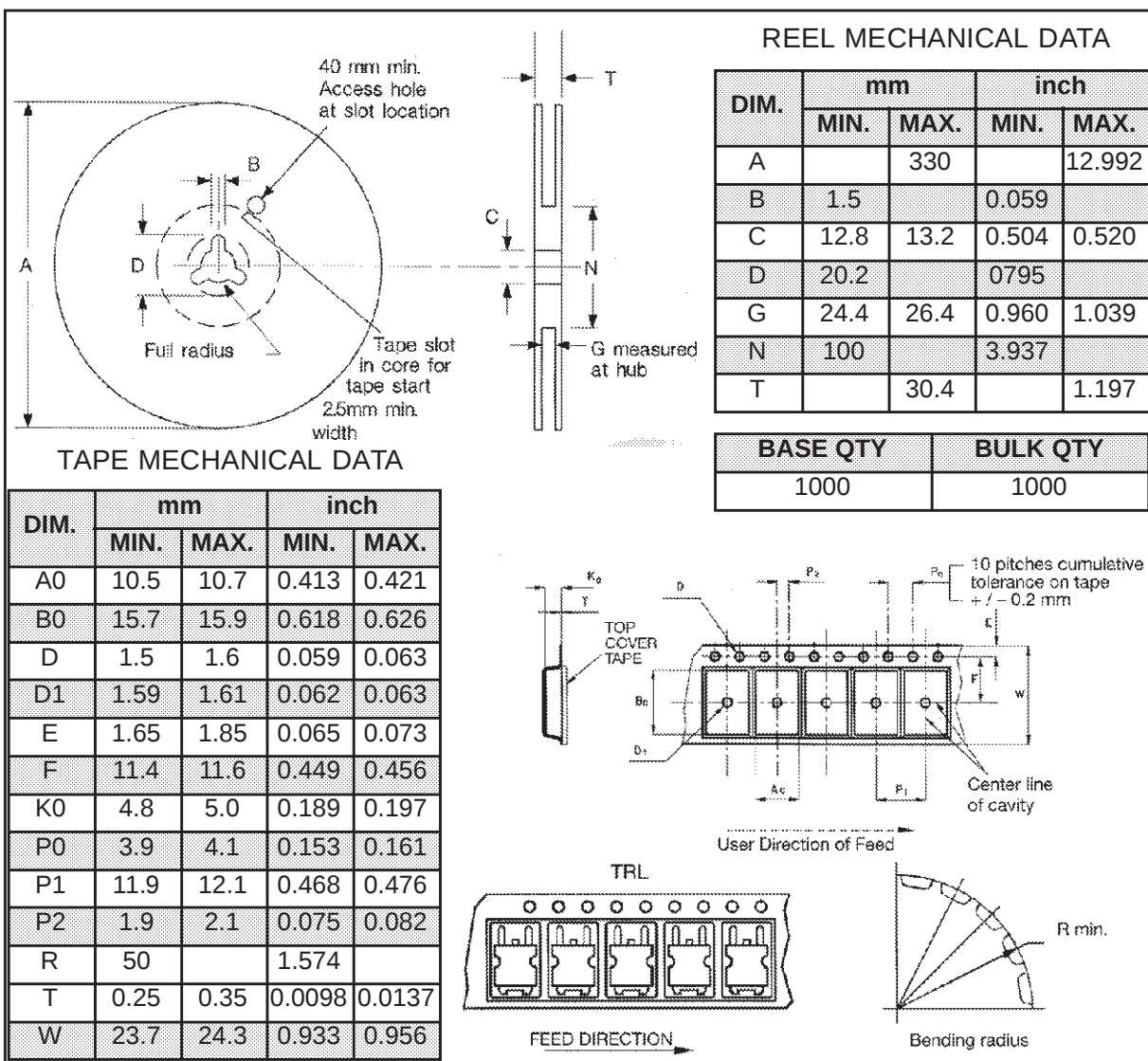
## D<sup>2</sup>PAK FOOTPRINT



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



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



\* on sales type

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