



# STD3NC50 STD3NC50-1

N-CHANNEL 500V - 2.2Ω - 3.2A DPAK / IPAK  
PowerMesh™II MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STD3NC50   | 500 V            | < 2.7Ω              | 3.2 A          |
| STD3NC50-1 | 500 V            | < 2.7Ω              | 3.2 A          |

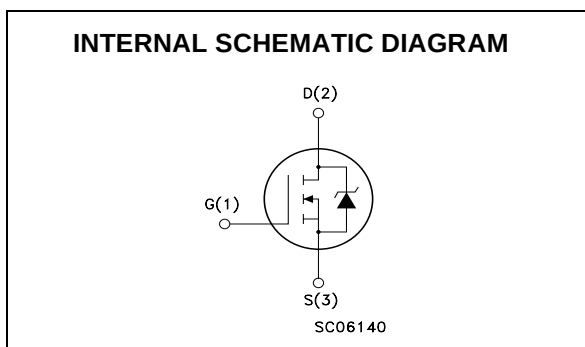
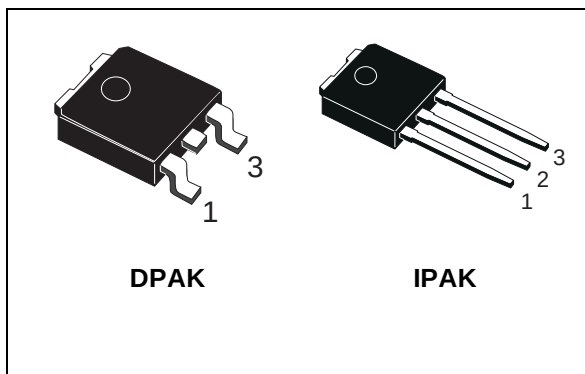
- TYPICAL R<sub>DS(on)</sub> = 2.2Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

## DESCRIPTION

The PowerMESH™II is the evolution of the first generation of MESH OVERLAY™. The layout refinements introduced greatly improve the Ron\*area figure of merit while keeping the device at the leading edge for what concerns switching speed, gate charge and ruggedness.

## APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVERS



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                            | Value      | Unit |
|---------------------|------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 500        | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 500        | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ±30        | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 3.2        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 2          | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                               | 12.8       | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 60         | W    |
|                     | Derating Factor                                      | 0.48       | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                    | 3.5        | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                  | -65 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  | 150        | °C   |

(•)Pulse width limited by safe operating area

(1)I<sub>SD</sub> ≤ 3.2A, di/dt ≤ 100A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STD3NC50 / STD3NC50-1

### THERMAL DATA

|                |                                                |     |      |
|----------------|------------------------------------------------|-----|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 2   | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 100 | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose | 275 | °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)                                | 3.2       | 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> = 50 V) | 210       | 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                                          | 500  |      |         | 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>50 | µA<br>µA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ±30V                                                                |      |      | ±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    | 3    | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 1.5 A              |      | 2.2  | 2.7  | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                                                           | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|-------------------------------------------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)</sub> max,<br>I <sub>D</sub> = 1.5 A |      | 2.7  |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                     |      | 315  |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                                                           |      | 52   |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                                                           |      | 7.7  |      | pF   |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

### SWITCHING ON

| Symbol      | Parameter          | Test Conditions                                                                                       | Min. | Typ. | Max. | Unit |
|-------------|--------------------|-------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250V$ , $I_D = 1.5 A$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10V$<br>(see test circuit, Figure 3) |      | 10   |      | ns   |
| $t_r$       | Rise Time          |                                                                                                       |      | 13   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400V$ , $I_D = 3.5 A$ ,<br>$V_{GS} = 10V$                                                   |      | 12.5 | 17   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                                                       |      | 2.7  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                                                       |      | 6.1  |      | nC   |

### SWITCHING OFF

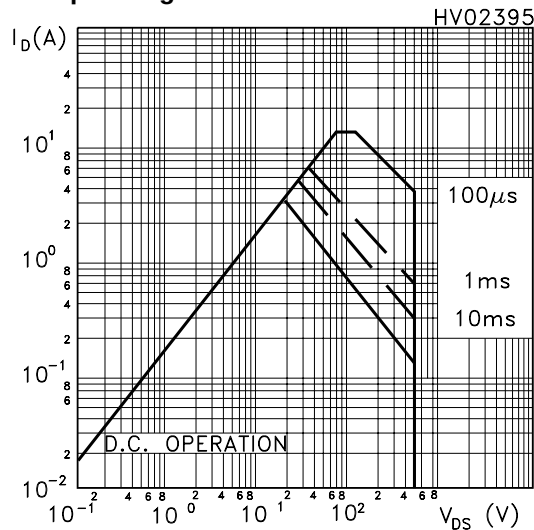
| Symbol        | Parameter             | Test Conditions                                                                                         | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 400V$ , $I_D = 3.5 A$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 10V$<br>(see test circuit, Figure 5) |      | 15   |      | ns   |
| $t_f$         | Fall Time             |                                                                                                         |      | 13   |      | ns   |
| $t_c$         | Cross-over Time       |                                                                                                         |      | 20   |      | ns   |

### SOURCE DRAIN DIODE

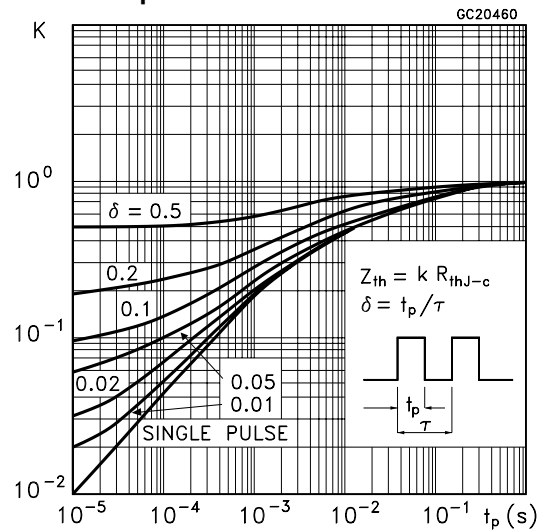
| Symbol        | Parameter                     | Test Conditions                                                                                                    | Min. | Typ. | Max. | Unit    |
|---------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------|------|------|------|---------|
| $I_{SD}$      | Source-drain Current          |                                                                                                                    |      |      | 3.2  | A       |
| $I_{SDM} (2)$ | Source-drain Current (pulsed) |                                                                                                                    |      |      | 12.8 | A       |
| $V_{SD} (1)$  | Forward On Voltage            | $I_{SD} = 3.5 A$ , $V_{GS} = 0$                                                                                    |      |      | 1.6  | V       |
| $t_{rr}$      | Reverse Recovery Time         | $I_{SD} = 3.5 A$ , $di/dt = 100A/\mu s$ ,<br>$V_{DD} = 100V$ , $T_j = 150^\circ C$<br>(see test circuit, Figure 5) |      | 400  |      | ns      |
| $Q_{rr}$      | Reverse Recovery Charge       |                                                                                                                    |      | 1.64 |      | $\mu C$ |
| $I_{RRM}$     | Reverse Recovery Current      |                                                                                                                    |      | 8.2  |      | A       |

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

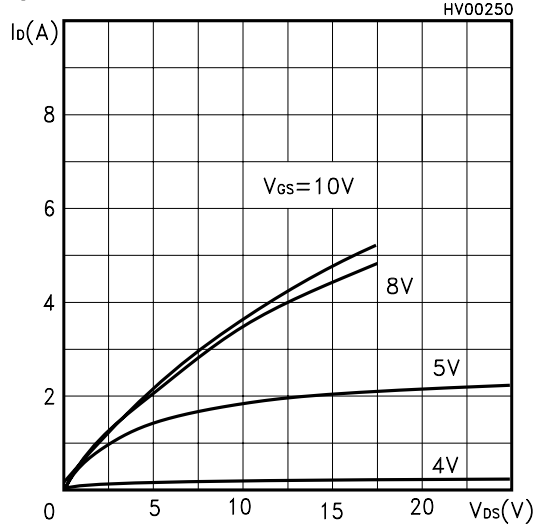
### Safe Operating Area



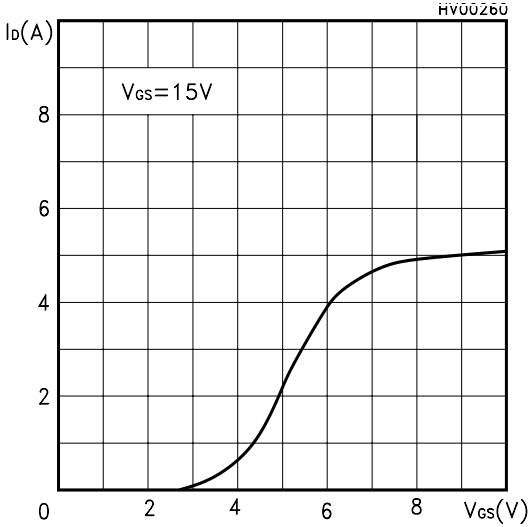
### Thermal Impedance



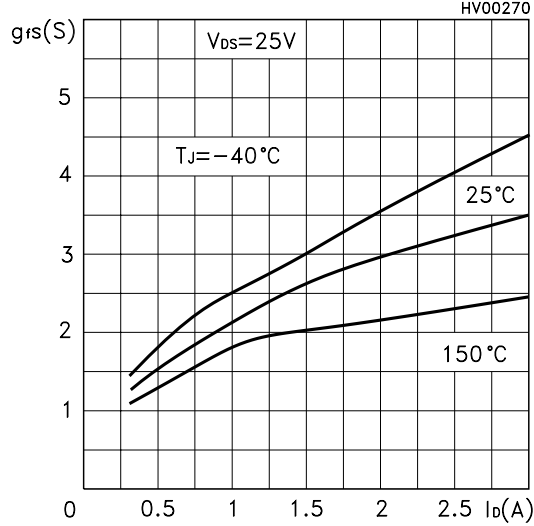
Output Characteristics



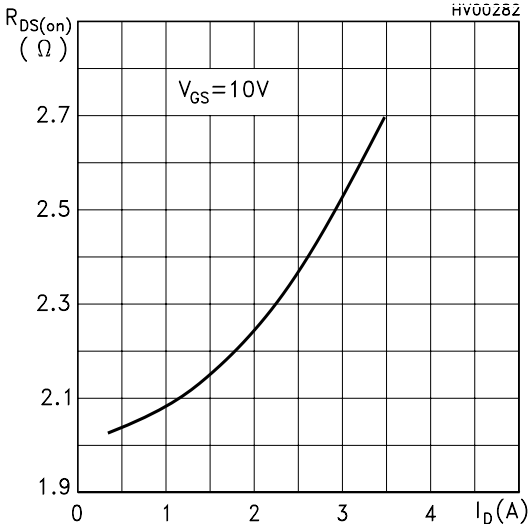
Transfer Characteristics



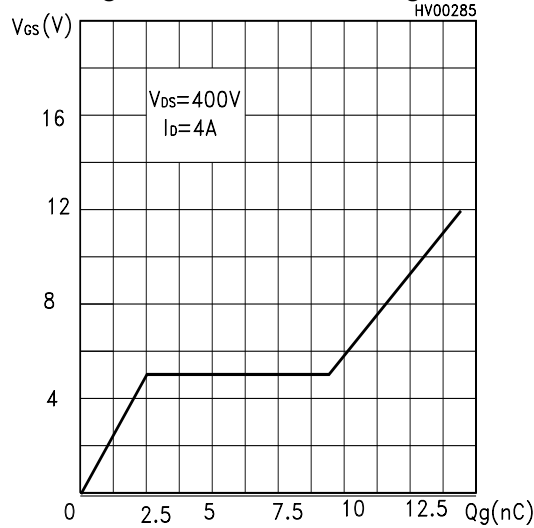
Tranconductance



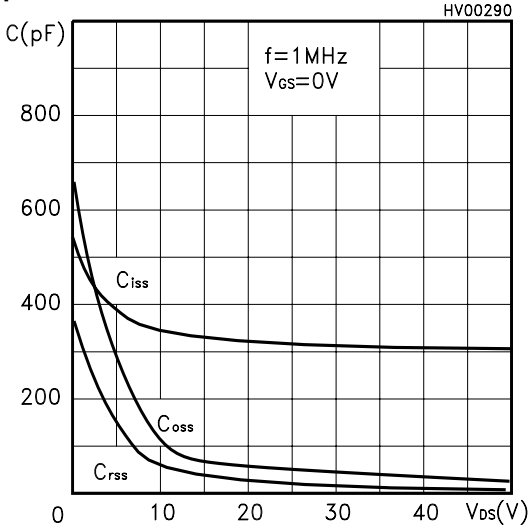
Static Drain-Source On Resistance



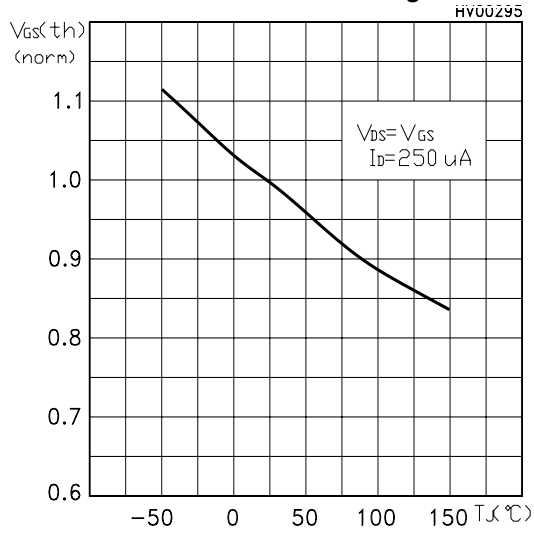
Gate Charge vs Gate-source Voltage



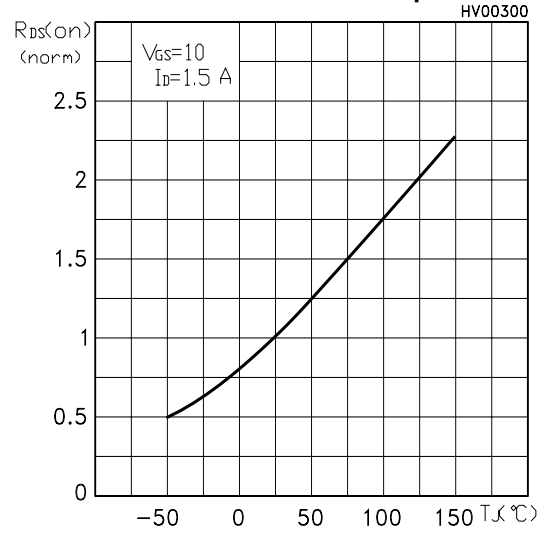
Capacitance Variations



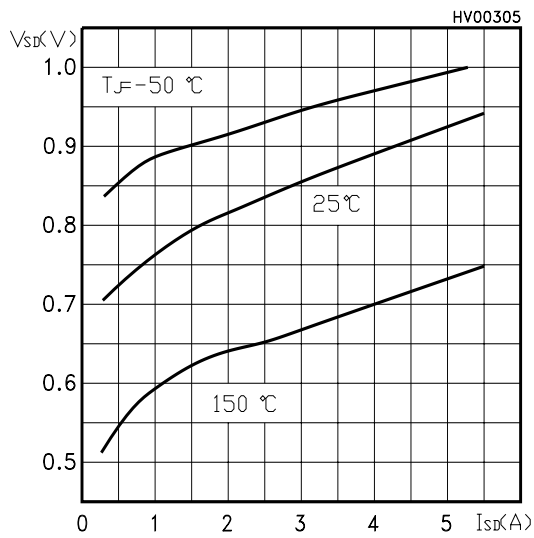
Normalized Gate Threshold Voltage vs Temp.



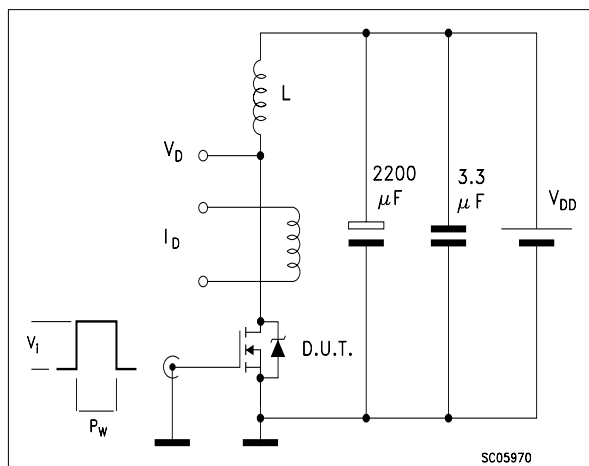
Normalized On Resistance vs Temperature



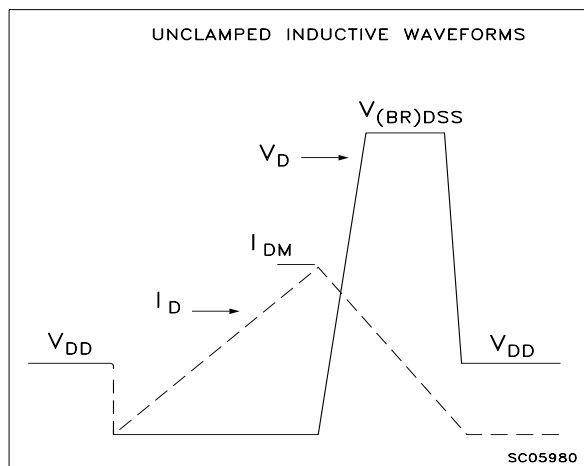
Source-drain Diode Forward Characteristics



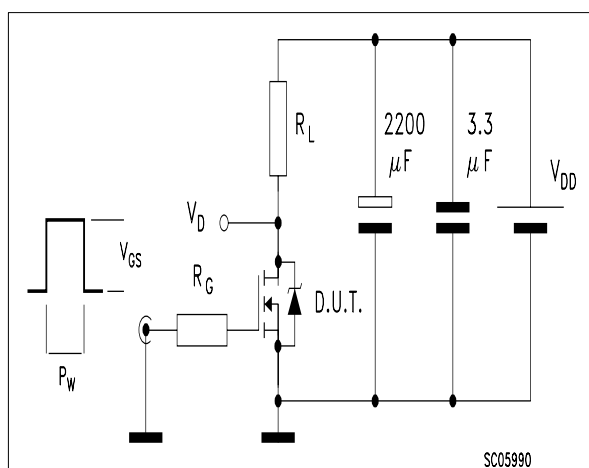
**Fig. 1: Unclamped Inductive Load Test Circuit**



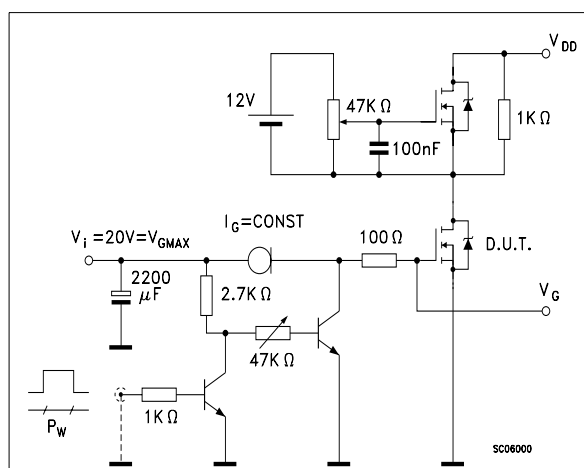
**Fig. 2: Unclamped Inductive Waveform**



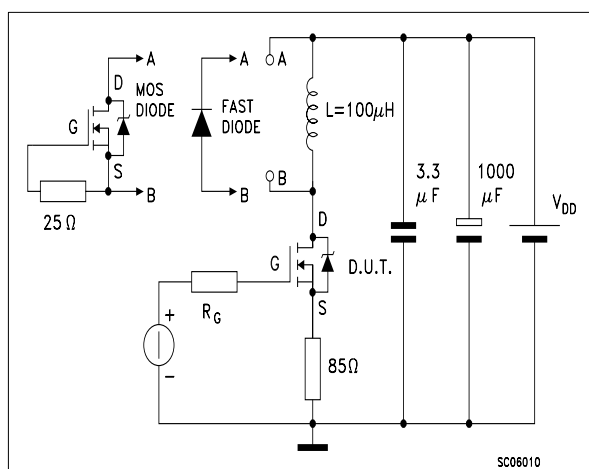
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

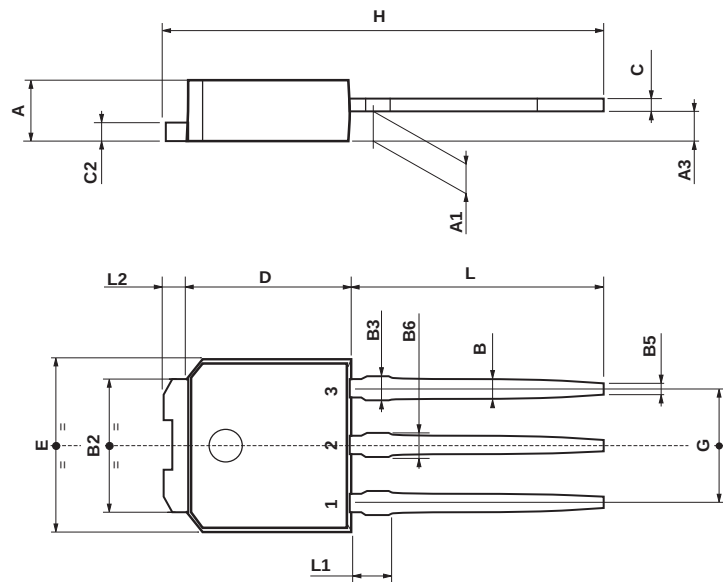


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



TO-251 (IPAK) MECHANICAL DATA

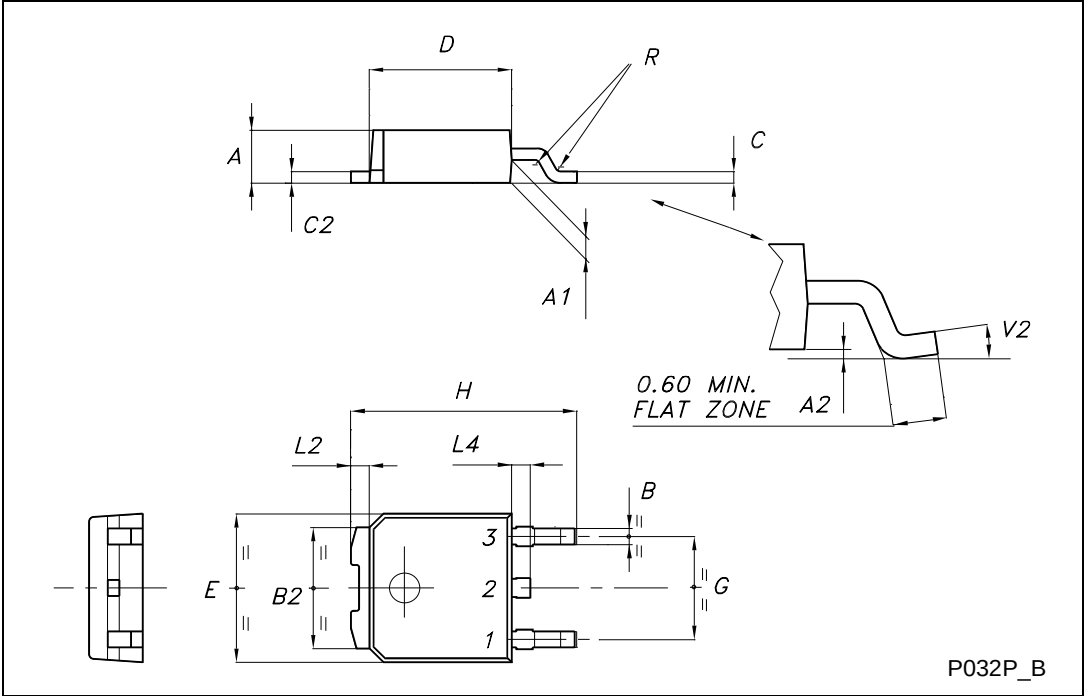
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A3   | 0.7  |      | 1.3  | 0.027 |       | 0.051 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.031 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.85 |       |       | 0.033 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |



0068771-E

TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.20 |      | 2.40  | 0.087 |       | 0.094 |
| A1   | 0.90 |      | 1.10  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.90  | 0.025 |       | 0.035 |
| B2   | 5.20 |      | 5.40  | 0.204 |       | 0.213 |
| C    | 0.45 |      | 0.60  | 0.018 |       | 0.024 |
| C2   | 0.48 |      | 0.60  | 0.019 |       | 0.024 |
| D    | 6.00 |      | 6.20  | 0.236 |       | 0.244 |
| E    | 6.40 |      | 6.60  | 0.252 |       | 0.260 |
| G    | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.10 | 0.368 |       | 0.398 |
| L2   |      | 0.8  |       |       | 0.031 |       |
| L4   | 0.60 |      | 1.00  | 0.024 |       | 0.039 |
| V2   | 0°   |      | 8°    | 0°    |       | 0°    |





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