



# STE40NC60

N-CHANNEL 600V - 0.098Ω - 40A ISOTOP

PowerMesh™II MOSFET

| TYPE      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STE40NC60 | 600V             | < 0.13Ω             | 40 A           |

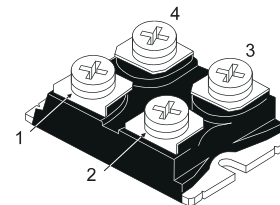
- TYPICAL R<sub>DS(on)</sub> = 0.098 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

## 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.

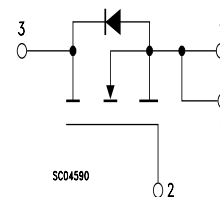
## APPLICATIONS

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



ISOTOP

## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                            | Value      | Unit |
|---------------------|------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 600        | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 600        | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ±30        | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 40         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 23         | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                               | 160        | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 460        | W    |
|                     | Derating Factor                                      | 3.68       | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 3          | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (AC-RMS)                | 2500       | V    |
| 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  
May 2002

(1) I<sub>SD</sub> ≤ 40A, di/dt ≤ 100 A/μs, V<sub>DD</sub> ≤ 24V, T<sub>j</sub> ≤ T<sub>jMAX</sub>

## STE40NC60

### THERMAL DATA

|           |                                                                 |     |       |      |
|-----------|-----------------------------------------------------------------|-----|-------|------|
| Rthj-case | Thermal Resistance Junction-case                                | Max | 0.272 | °C/W |
| Rthc-h    | Thermal Resistance Case-heatsink with Conductive Grease Applied |     | 0.05  | °C/W |

### 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)                                | 40        | 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) | 1150      | 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                                          | 600  |      |           | 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 |      |      | 10<br>100 | 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> = 20A                |      | 0.098 | 0.130 | 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> = 15 A |      | 42   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                    |      | 11.1 |      | nF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                                                          |      | 1190 |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                                                          |      | 100  |      | pF   |

Note: 1. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %.

**ELECTRICAL CHARACTERISTICS (CONTINUED)****SWITCHING ON**

| Symbol      | Parameter          | Test Conditions                                                            | Min. | Typ.  | Max. | Unit |
|-------------|--------------------|----------------------------------------------------------------------------|------|-------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 300\text{ V}$ , $I_D = 20\text{ A}$                              |      | 49    |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 42    |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 480\text{ V}$ , $I_D = 40\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$  |      | 307.5 | 430  | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 48    |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 146.5 |      | nC   |

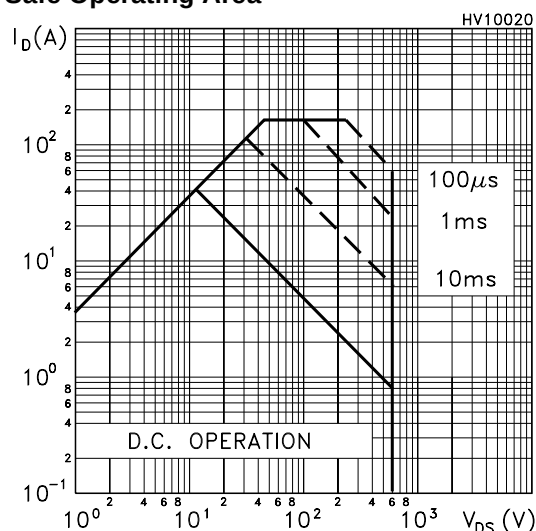
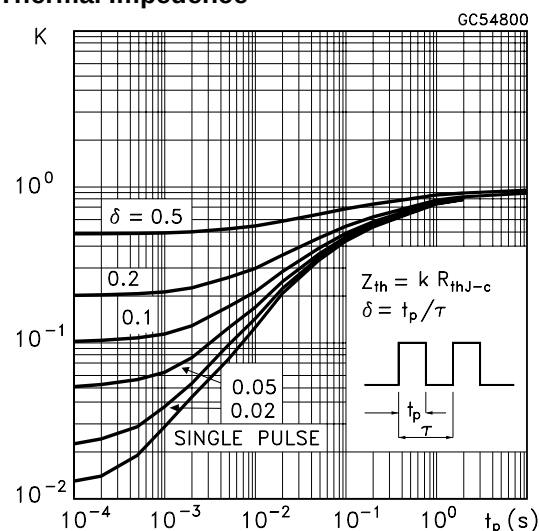
**SWITCHING OFF**

| Symbol        | Parameter             | Test Conditions                                                                               | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|-----------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 480\text{ V}$ , $I_D = 40\text{ A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ |      | 41   |      | ns   |
| $t_f$         | Fall Time             | (see test circuit, Figure 5)                                                                  |      | 26   |      | ns   |
| $t_c$         | Cross-over Time       |                                                                                               |      | 74   |      | ns   |

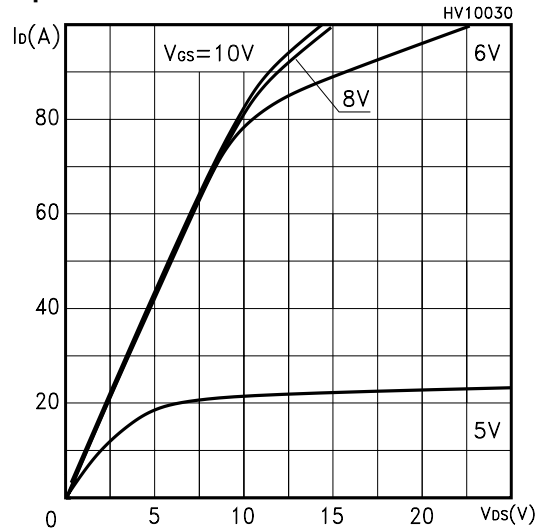
**SOURCE DRAIN DIODE**

| Symbol       | Parameter                     | Test Conditions                                                                                                     | Min. | Typ. | Max. | Unit          |
|--------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$     | Source-drain Current          |                                                                                                                     |      |      | 40   | A             |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) |                                                                                                                     |      |      | 160  | A             |
| $V_{SD(1)}$  | Forward On Voltage            | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0$                                                                               |      |      | 1.6  | V             |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 40\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 40\text{ V}$ , $T_J = 150^\circ\text{C}$ |      | 685  |      | ns            |
| $Q_{rr}$     | Reverse Recovery Charge       | (see test circuit, Figure 5)                                                                                        |      | 15   |      | $\mu\text{C}$ |
| $I_{RRM}$    | Reverse Recovery Current      |                                                                                                                     |      | 44   |      | A             |

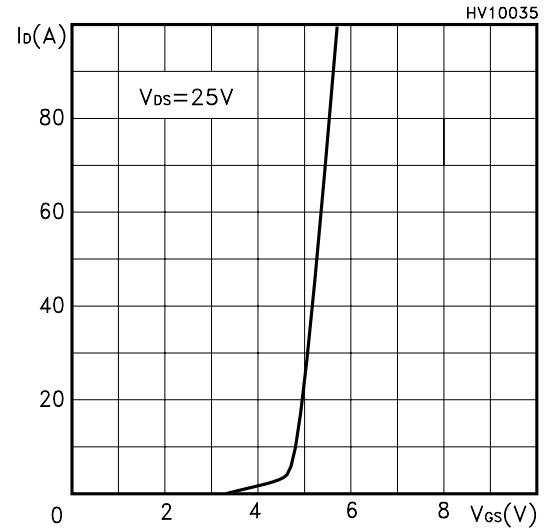
Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

**Safe Operating Area****Thermal Impedence**

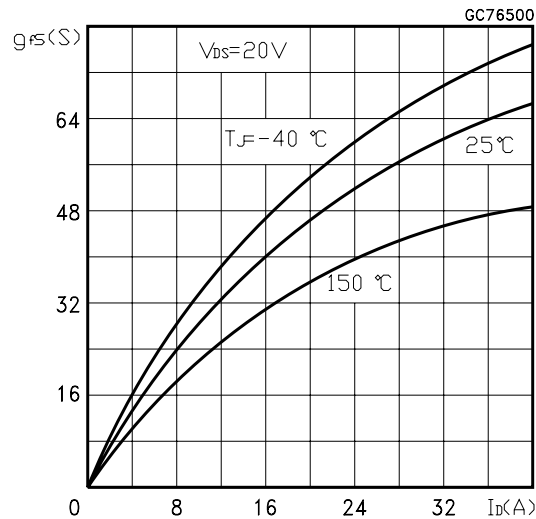
Output Characteristics



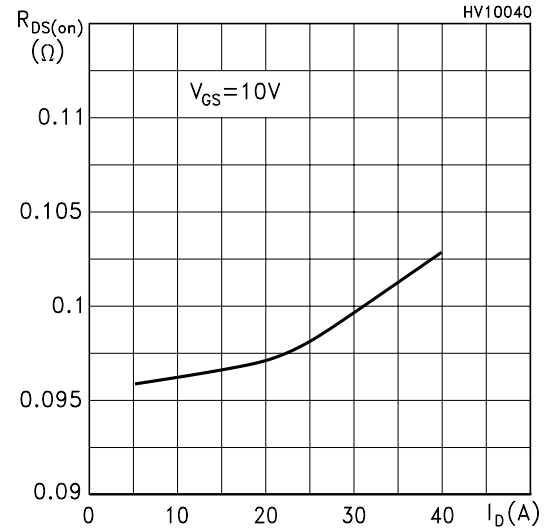
Transfer Characteristics



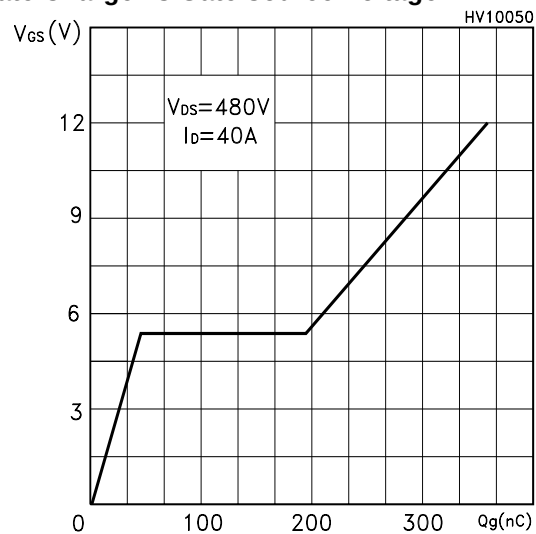
Transconductance



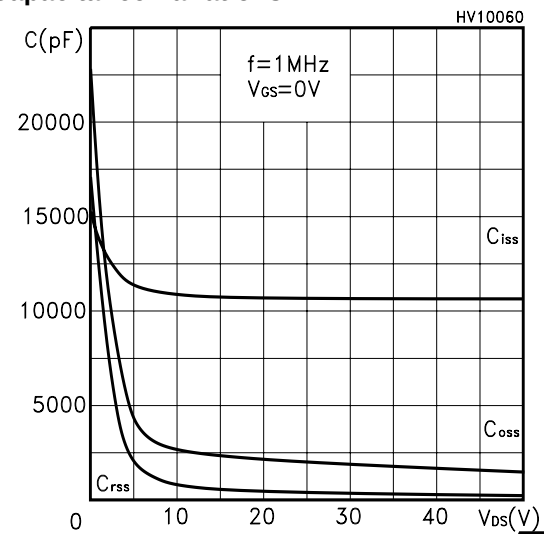
Static Drain-source On Resistance



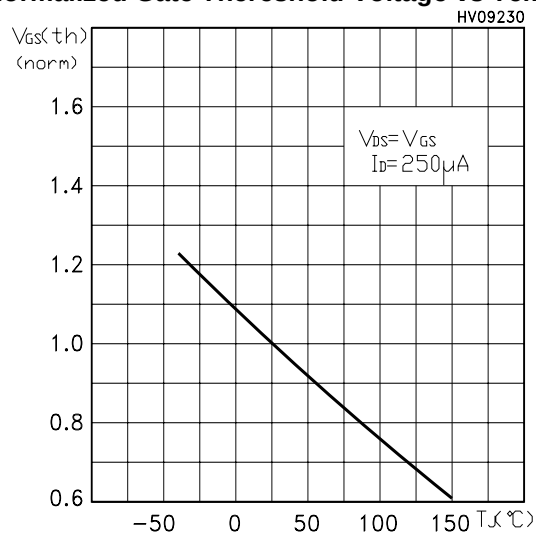
Gate Charge vs Gate-source Voltage



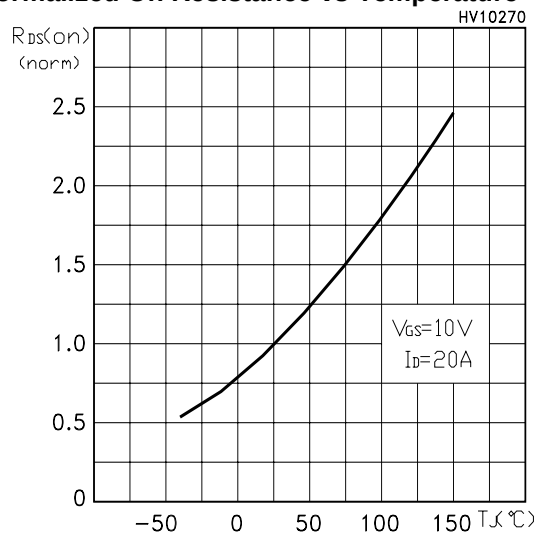
Capacitance Variations



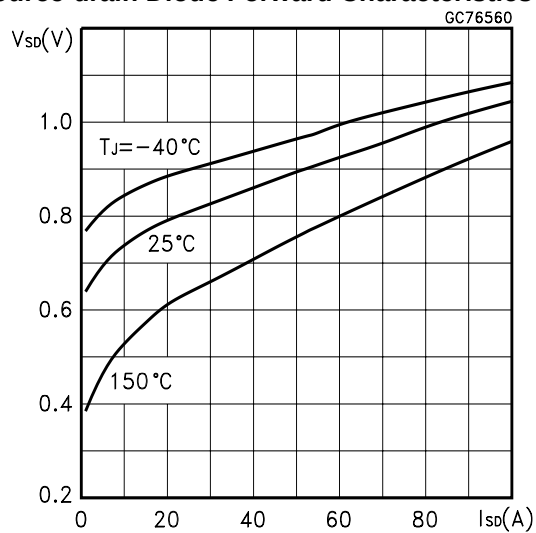
Normalized Gate Threshold Voltage vs Temp.



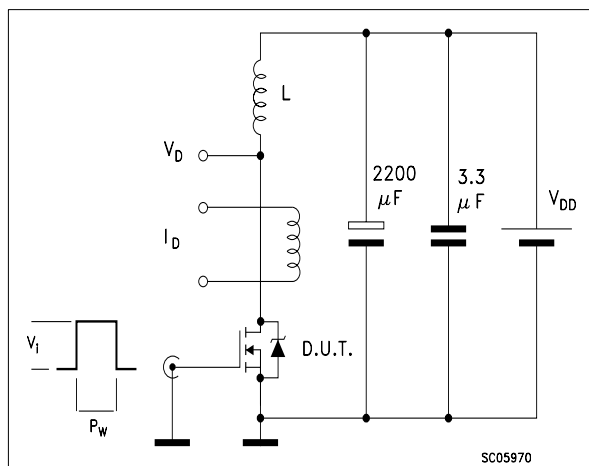
Normalized On Resistance vs Temperature



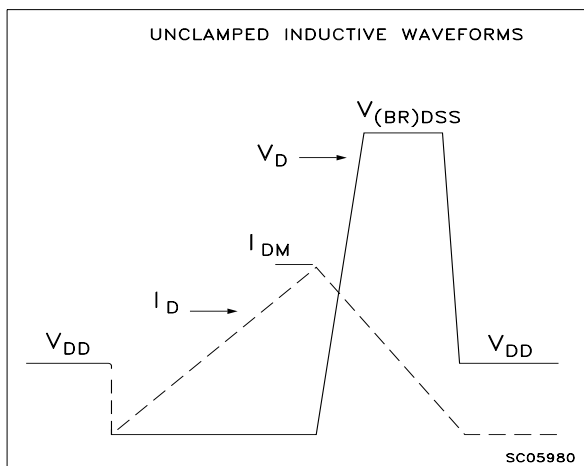
Source-drain Diode Forward Characteristics



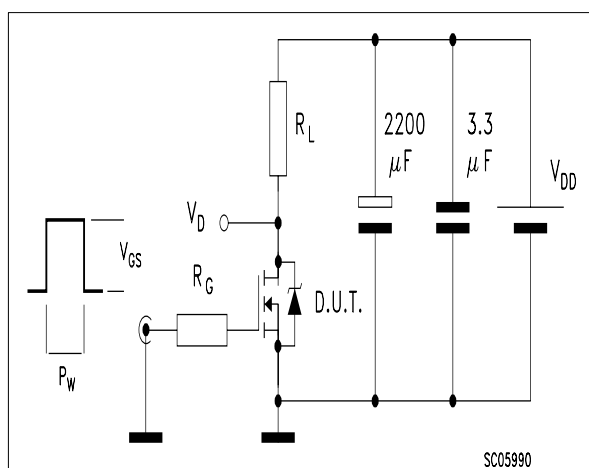
**Fig. 1: Unclamped Inductive Load Test Circuit**



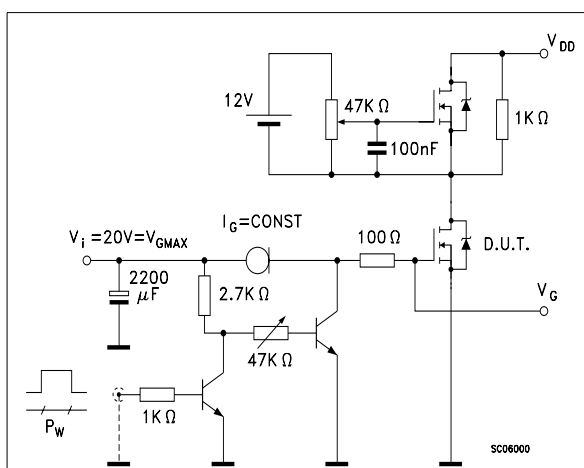
**Fig. 2: Unclamped Inductive Waveform**



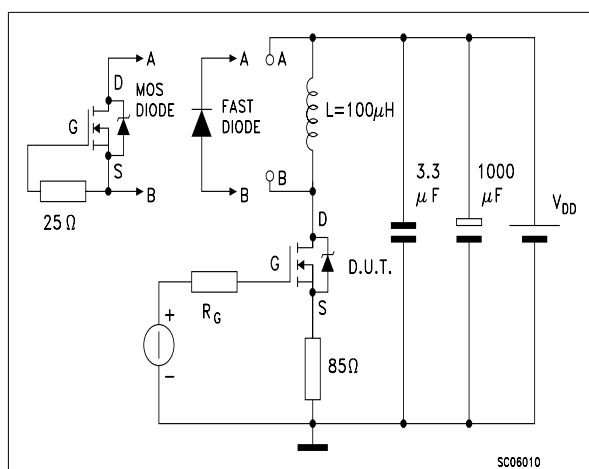
**Fig. 3: Switching Times Test Circuit For Resistive Load**



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

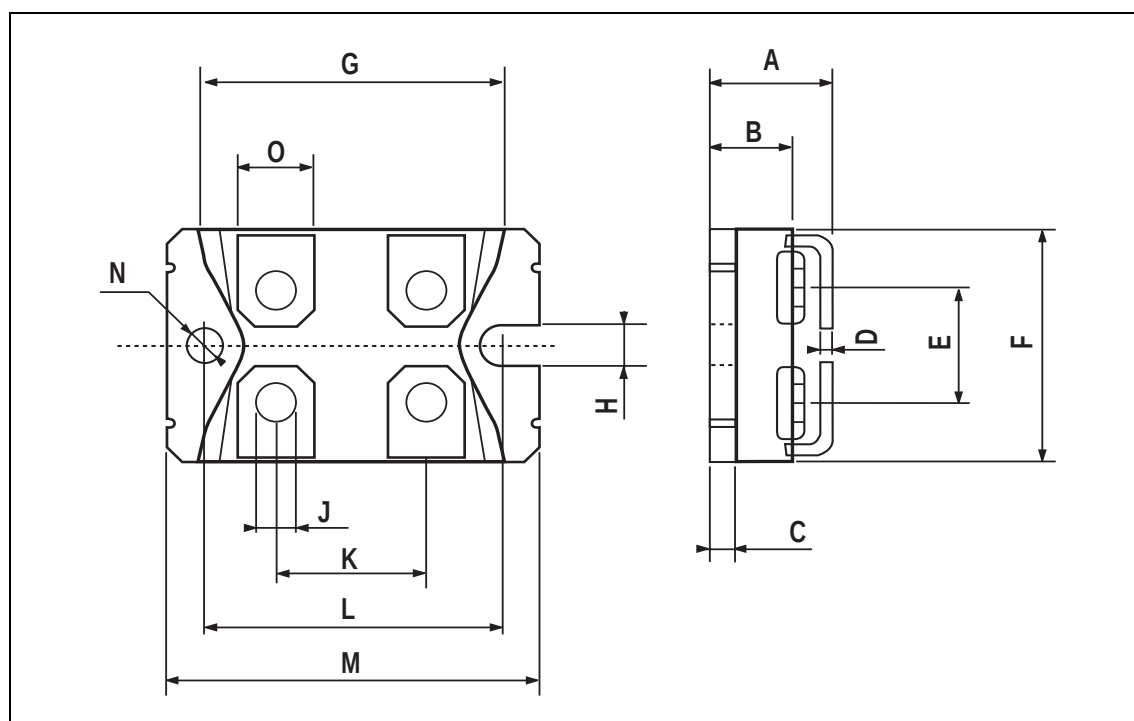


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



## ISOTOP MECHANICAL DATA

| DIM. | mm    |      |      | inch  |      |       |
|------|-------|------|------|-------|------|-------|
|      | MIN.  | TYP. | MAX. | MIN.  | TYP. | MAX.  |
| A    | 11.8  |      | 12.2 | 0.466 |      | 0.480 |
| B    | 8.9   |      | 9.1  | 0.350 |      | 0.358 |
| C    | 1.95  |      | 2.05 | 0.076 |      | 0.080 |
| D    | 0.75  |      | 0.85 | 0.029 |      | 0.033 |
| E    | 12.6  |      | 12.8 | 0.496 |      | 0.503 |
| F    | 25.15 |      | 25.5 | 0.990 |      | 1.003 |
| G    | 31.5  |      | 31.7 | 1.240 |      | 1.248 |
| H    | 4     |      |      | 0.157 |      |       |
| J    | 4.1   |      | 4.3  | 0.161 |      | 0.169 |
| K    | 14.9  |      | 15.1 | 0.586 |      | 0.594 |
| L    | 30.1  |      | 30.3 | 1.185 |      | 1.193 |
| M    | 37.8  |      | 38.2 | 1.488 |      | 1.503 |
| N    | 4     |      |      | 0.157 |      |       |
| O    | 7.8   |      | 8.2  | 0.307 |      | 0.322 |



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