



# STE38NB50F

## N - CHANNEL 500V - 0.11 $\Omega$ - 38A - ISOTOP PowerMESH™ MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STE38NB50F | 500 V            | < 0.14 $\Omega$     | 38 A           |

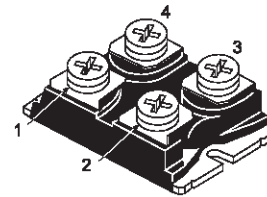
- TYPICAL R<sub>DS(on)</sub> = 0.11  $\Omega$
- EXTREMELY HIGH dv/dt CAPABILITY
- $\pm 30$ V GATE TO SOURCE VOLTAGE RATING
- 100% AVALANCHE TESTED
- LOW INTRINSIC CAPACITANCE
- GATE CHARGE MINIMIZED
- REDUCED VOLTAGE SPREAD

### DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

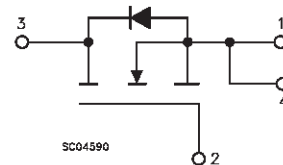
### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLY (SMPS)
- DC-AC CONVERTER FOR WELDING EQUIPMENT AND UNINTERRUPTABLE POWER SUPPLY AND MOTOR DRIVE



ISOTOP

### INTERNAL SCHEMATIC DIAGRAM



### 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 k $\Omega$ ) | 500        | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                    | $\pm 30$   | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C   | 38         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C  | 24         | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                 | 152        | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C            | 400        | W    |
|                     | Derating Factor                                        | 3.2        | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                      | 4.5        | 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>  $\leq$  38 A, di/dt  $\leq$  200 A/ $\mu$ s, V<sub>DD</sub>  $\leq$  V<sub>(BR)DSS</sub>, T<sub>j</sub>  $\leq$  T<sub>JMAX</sub>

## STE38NB50F

### THERMAL DATA

|                |                                                |     |      |               |
|----------------|------------------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case               | Max | 0.31 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient            | Max | 30   | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink                   | Typ | 0.1  | $^{\circ}C/W$ |
| $T_I$          | Maximum Lead Temperature For Soldering Purpose |     | 300  | $^{\circ}C$   |

### AVALANCHE CHARACTERISTICS

| Symbol   | Parameter                                                                                        | Max Value | Unit |
|----------|--------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)               | 38        | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}C$ , $I_D = I_{AR}$ , $V_{DD} = 50 V$ ) | 1200      | mJ   |

### ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}C$ unless otherwise specified)

#### OFF

| Symbol        | Parameter                                        | Test Conditions                                                                   | Min. | Typ. | Max.      | Unit               |
|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage                   | $I_D = 250 \mu A$ $V_{GS} = 0$                                                    | 500  |      |           | V                  |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$<br>$V_{DS} = \text{Max Rating}$ $T_c = 125^{\circ}C$ |      |      | 10<br>100 | $\mu A$<br>$\mu A$ |
| $I_{GSS}$     | Gate-body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30 V$                                                               |      |      | $\pm 100$ | nA                 |

#### ON (\*)

| Symbol       | Parameter                         | Test Conditions                                              | Min. | Typ. | Max. | Unit     |
|--------------|-----------------------------------|--------------------------------------------------------------|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}$ $I_D = 250 \mu A$                          | 3    | 4    | 5    | V        |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10 V$ $I_D = 19 A$                                 |      | 0.11 | 0.14 | $\Omega$ |
| $I_{D(on)}$  | On State Drain Current            | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10 V$ | 38   |      |      | A        |

### DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                        | Min. | Typ.              | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------|------|-------------------|------|----------------|
| $g_{fs} (*)$                        | Forward Transconductance                                                | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 19 A$ |      | 27                |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25 V$ $f = 1 MHz$ $V_{GS} = 0$               |      | 5900<br>880<br>80 |      | pF<br>pF<br>pF |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|-------------|--------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time       | $V_{DD} = 250\text{ V}$ $I_D = 19\text{ A}$                                |      | 45   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 35   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400\text{ V}$ $I_D = 38\text{ A}$ $V_{GS} = 10\text{ V}$         |      | 140  | 196  | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 38   |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 61   |      | nC   |

**SWITCHING OFF**

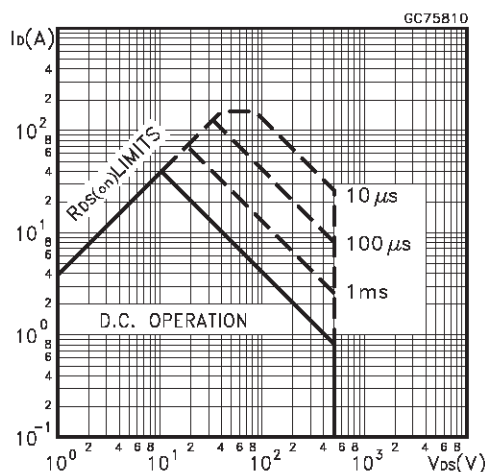
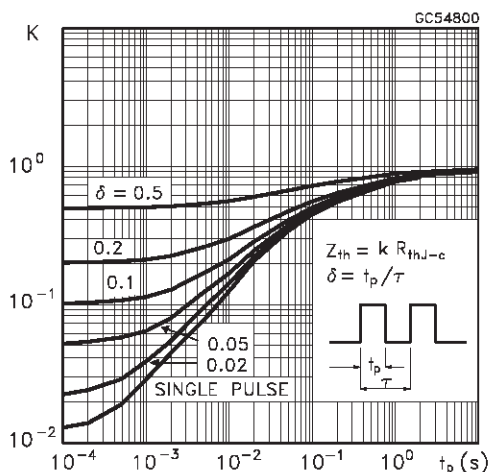
| Symbol         | Parameter             | Test Conditions                             | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|---------------------------------------------|------|------|------|------|
| $t_r(V_{off})$ | Off-voltage Rise Time | $V_{DD} = 400\text{ V}$ $I_D = 38\text{ A}$ |      | 28   |      | ns   |
| $t_f$          | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$  |      | 30   |      | ns   |
| $t_c$          | Cross-over Time       | (see test circuit, figure 5)                |      | 60   |      | ns   |

**SOURCE DRAIN DIODE**

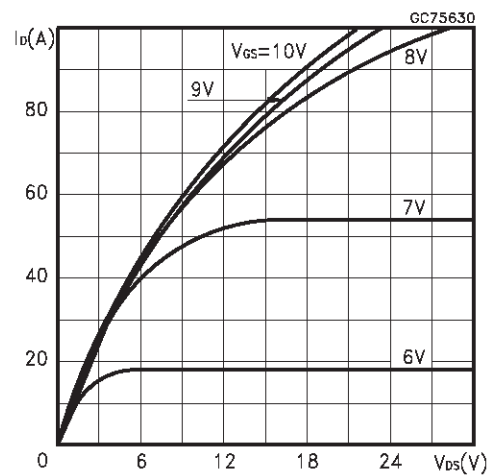
| Symbol             | Parameter                     | Test Conditions                                                                                                                                | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |                                                                                                                                                |      |      | 38   | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |                                                                                                                                                |      |      | 152  | A             |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 38\text{ A}$ $V_{GS} = 0$                                                                                                            |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 38\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150^\circ\text{C}$<br>(see test circuit, figure 5) |      | 715  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |                                                                                                                                                |      | 11.8 |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |                                                                                                                                                |      | 33   |      | A             |

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

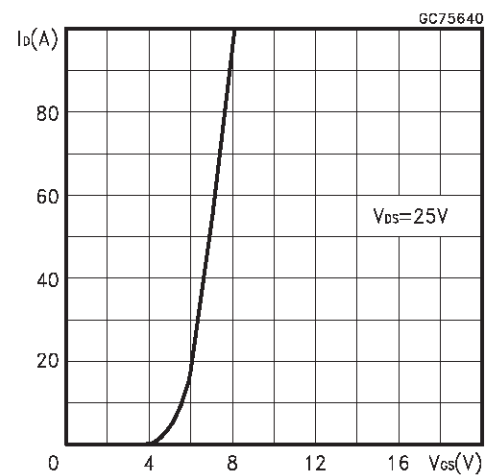
(\bullet) Pulse width limited by safe operating area

**Safe Operating Area****Thermal Impedance**

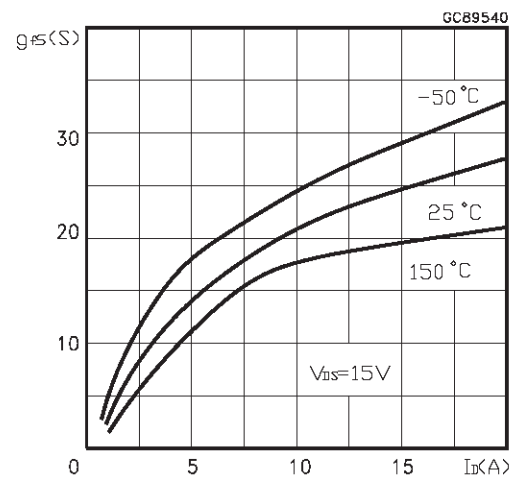
Output Characteristics



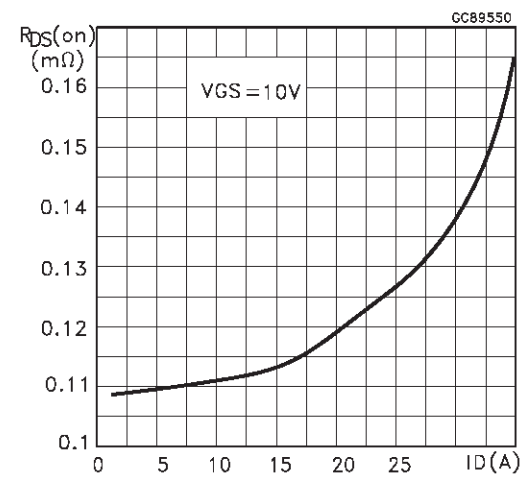
Transfer Characteristics



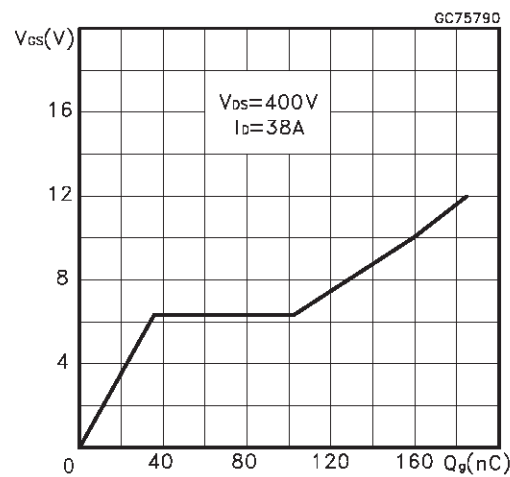
Transconductance



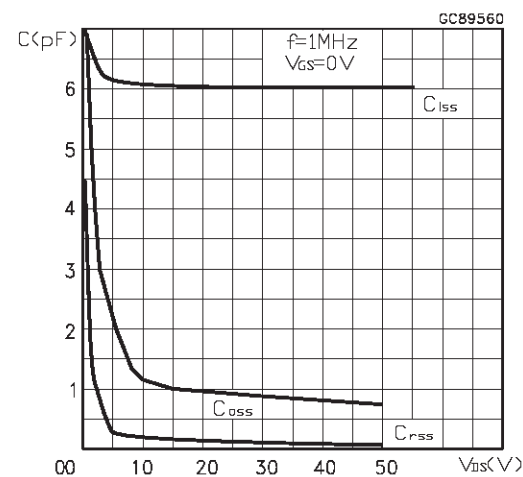
Static Drain-source On Resistance



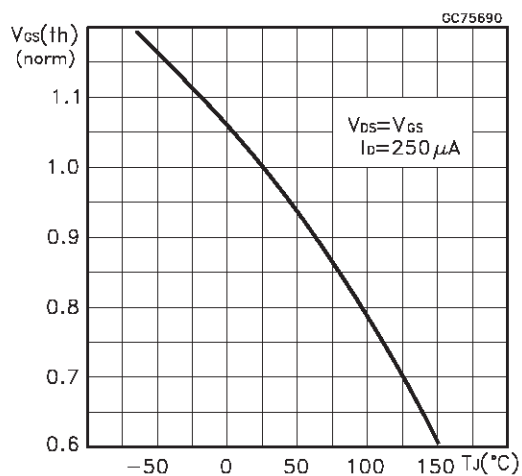
Gate Charge vs Gate-source Voltage



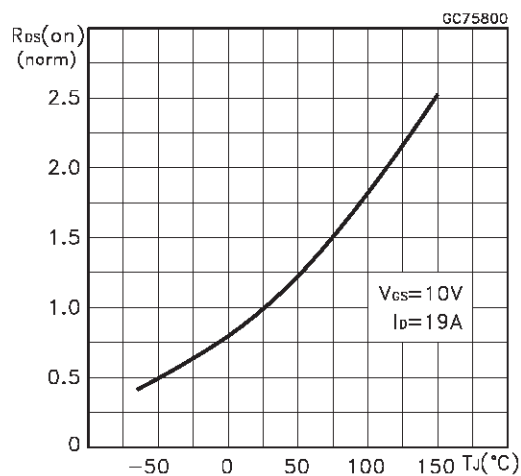
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

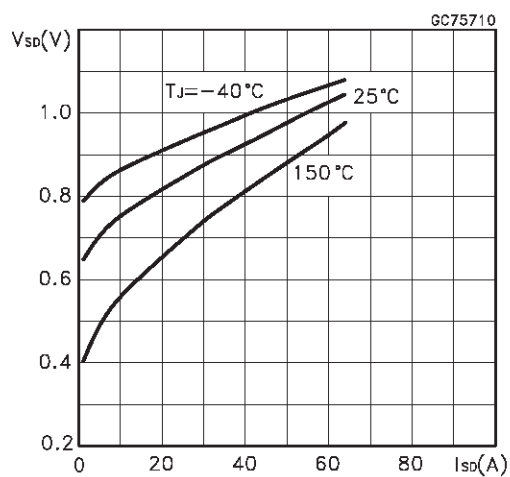


Fig. 1: Unclamped Inductive Load Test Circuit

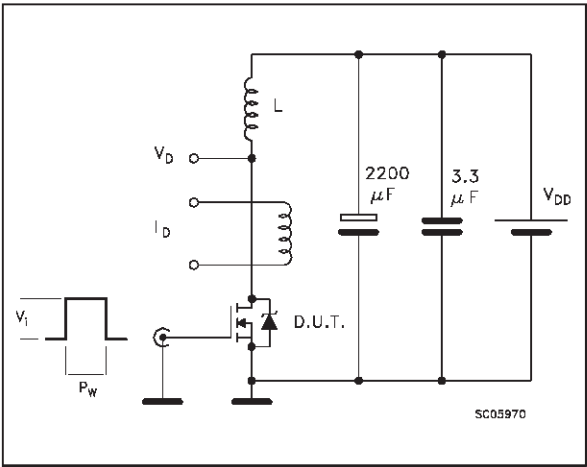


Fig. 2: Unclamped Inductive Waveform

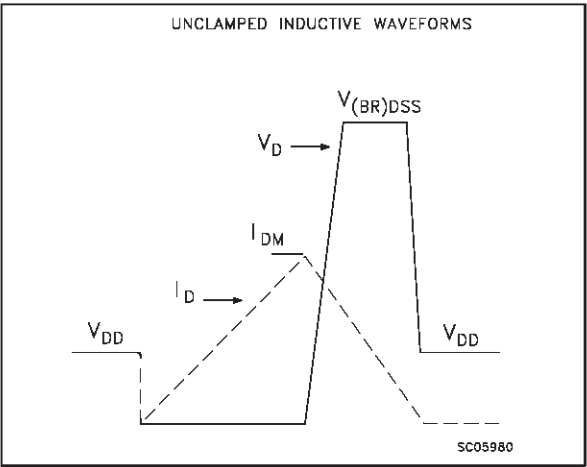


Fig. 3: Switching Times Test Circuits For Resistive Load

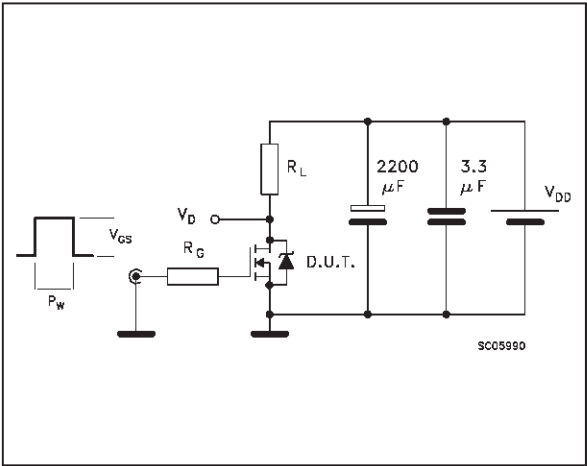


Fig. 4: Gate Charge test Circuit

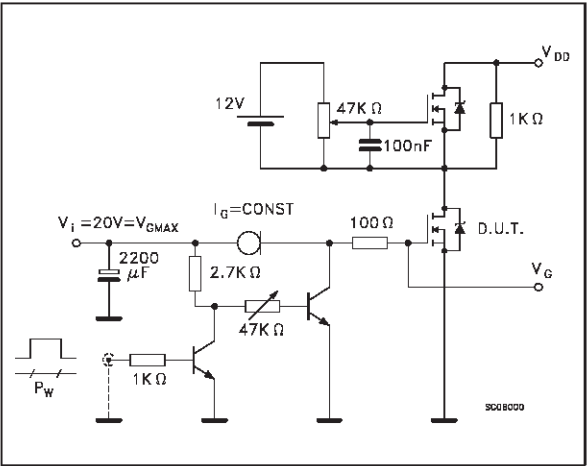
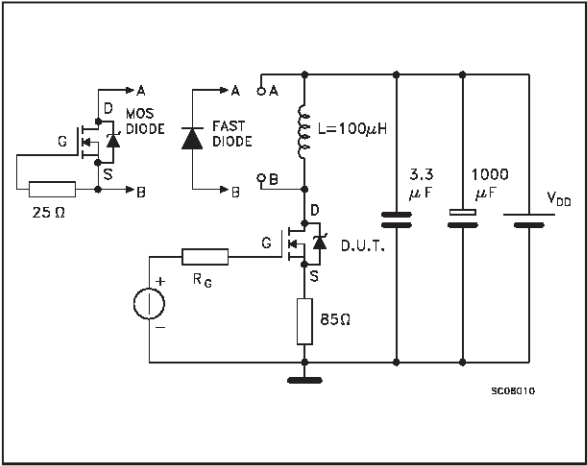
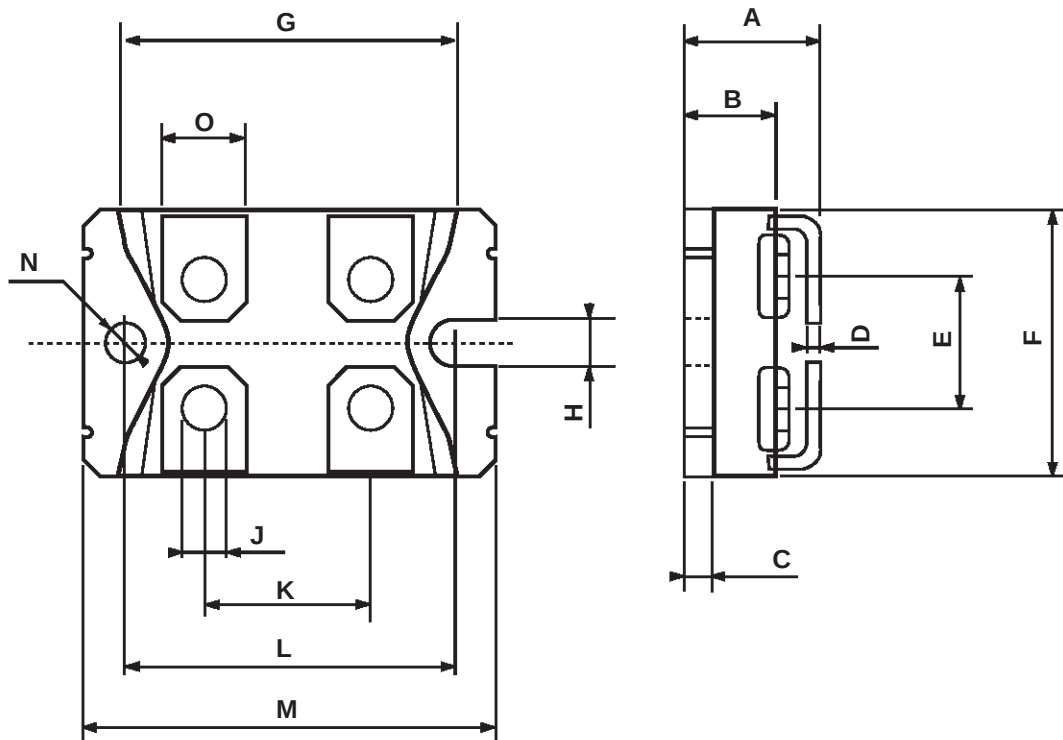


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



## 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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