



## STW220NF75

N-CHANNEL 75V - 0.004  $\Omega$  - 120A TO-247

STripFET™ II POWER MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STW220NF75 | 75V              | <0.0044 $\Omega$    | 120A(**)       |

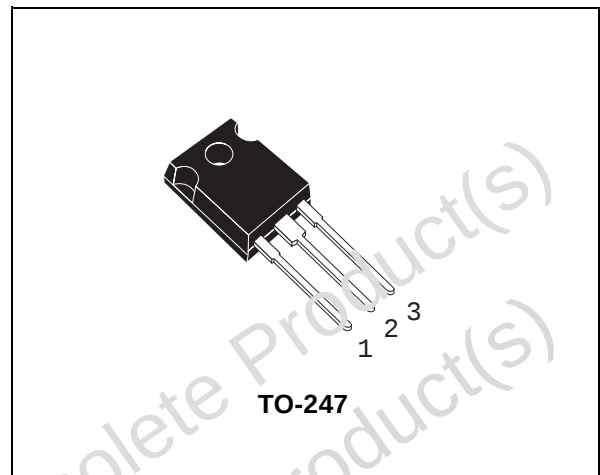
- TYPICAL R<sub>DS(on)</sub> = 0.004 $\Omega$
- STANDARD THRESHOLD DRIVE
- 100% AVALANCHE TESTED

### DESCRIPTION

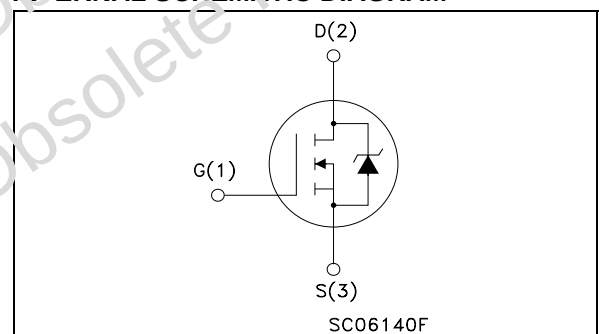
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

### APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- AUTOMOTIVE 42V BATTERY SYSTEM
- OR-ING FUNCTION



### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      | Unit |
|---------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 75         | V    |
| V <sub>DG</sub>     | Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 75         | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | $\pm 20$   | V    |
| I <sub>D</sub> (*)  | Drain Current (continuous) at T <sub>C</sub> = 25°C   | 120        | A    |
| I <sub>D</sub> (**) | Drain Current (continuous) at T <sub>C</sub> = 100°C  | 120        | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 480        | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>C</sub> = 25°C            | 500        | W    |
|                     | Derating Factor                                       | 3.33       | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                     | 10         | V/ns |
| E <sub>AS</sub> (2) | Single Pulse Avalanche Energy                         | 2500       | mJ   |
| T <sub>stg</sub>    | Storage Temperature                                   | -55 to 175 | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                        |            |      |

•) Pulse width limited by safe operating area.

(\*\*) Current Limited by Package

(1) I<sub>SD</sub>  $\leq$  120A, di/dt  $\leq$  100A/ $\mu$ s, V<sub>DD</sub>  $\leq$  V(BR)<sub>DSS</sub>, T<sub>j</sub>  $\leq$  T<sub>JMAX</sub>

(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 60 A, V<sub>DD</sub> = 30V

**STW220NF75****THERMAL DATA**

|                |                                                                                  |     |      |      |
|----------------|----------------------------------------------------------------------------------|-----|------|------|
| Rthj-case      | Thermal Resistance Junction-case                                                 | Max | 0.30 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient                                              | Max | 50   | °C/W |
| T <sub>j</sub> | Maximum Lead Temperature For Soldering Purpose<br>(1.6 mm from case, for 10 sec) | Typ | 300  | °C   |

**ELECTRICAL CHARACTERISTICS** (T<sub>case</sub> = 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                                        | 75   |      |         | 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> = 250 µA | 2    |       | 4      | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 60 A              |      | 0.004 | 0.0044 | Ω    |

**DYNAMIC**

| Symbol              | Parameter                    | Test Conditions                                       | Min. | Typ.  | Max. | Unit |
|---------------------|------------------------------|-------------------------------------------------------|------|-------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> = 25 V I <sub>D</sub> = 60 A          |      | 200   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 12500 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                       |      | 2150  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                       |      | 600   |      | 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                              | $V_{DD} = 38\text{ V}$ $I_D = 60\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 50<br>215        |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD}=38\text{V}$ $I_D=120\text{A}$ $V_{GS}=10\text{V}$                                                              |      | 350<br>60<br>135 | 430  | 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 | $V_{DD} = 38\text{ V}$ $I_D = 60\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 250<br>130 |      | ns<br>ns |

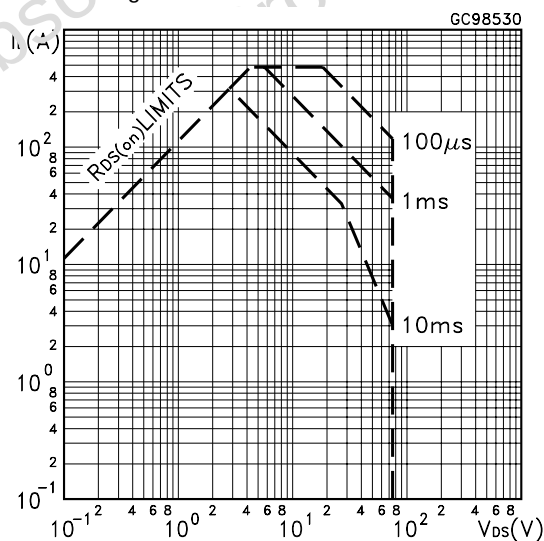
## SOURCE DRAIN DIODE

| Symbol                            | Parameter                                                                    | Test Conditions                                                                                                                                | Min. | Typ.             | Max.       | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------|------------|---------------|
| $I_{SD}$<br>$I_{SDM}(\bullet)$    | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                                                |      |                  | 120<br>480 | A<br>A        |
| $V_{SD}^{(*)}$                    | Forward On Voltage                                                           | $I_{SD} = 120\text{ A}$ $V_{GS} = 0$                                                                                                           |      |                  | 1.5        | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 120\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 32\text{ V}$ $T_J = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 140<br>770<br>11 |            | ns<br>nC<br>A |

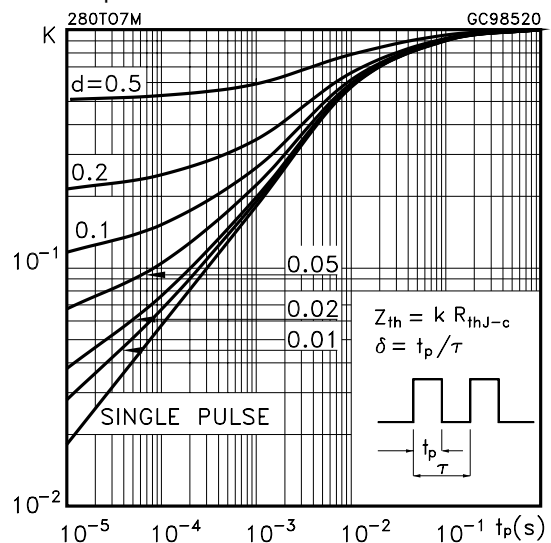
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

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

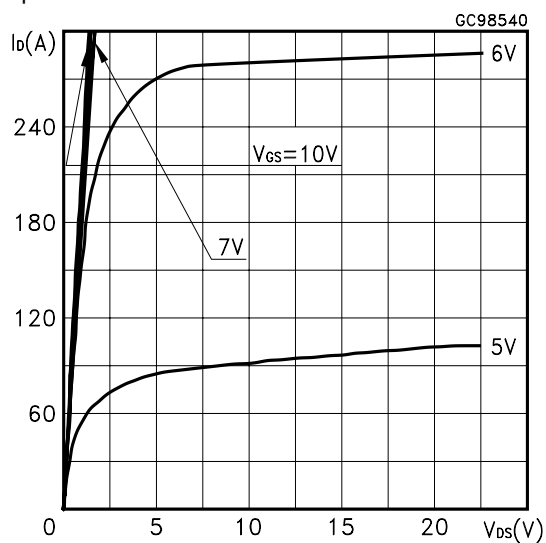
## Safe Operating Area



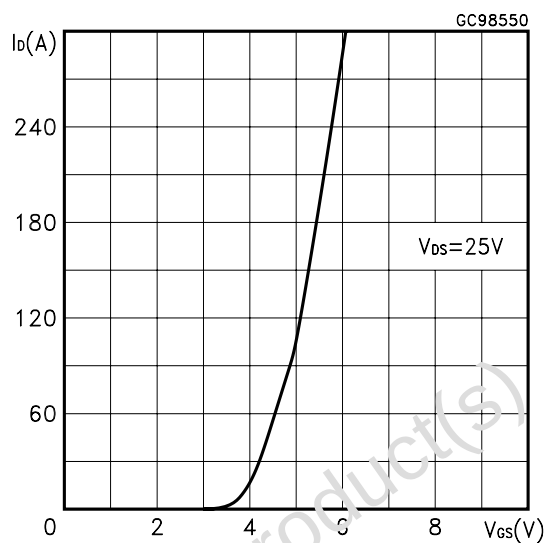
## Thermal Impedance



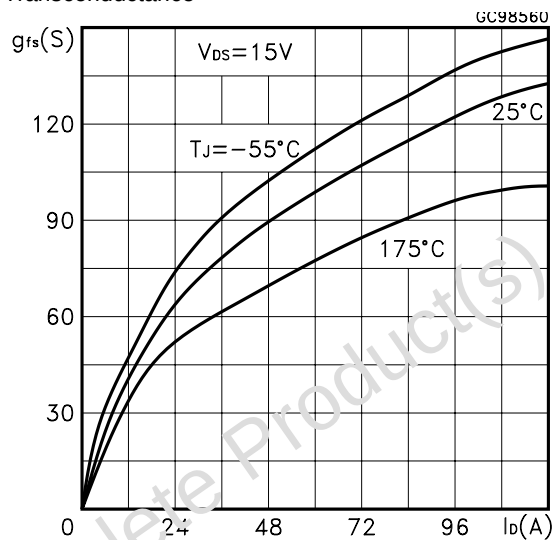
Output Characteristics



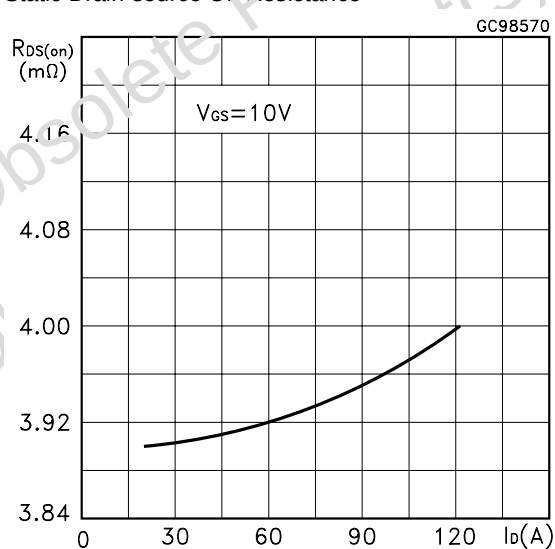
Transfer Characteristics



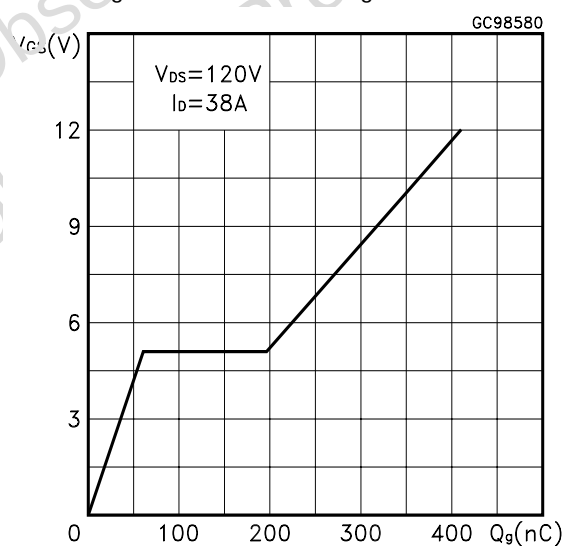
Transconductance



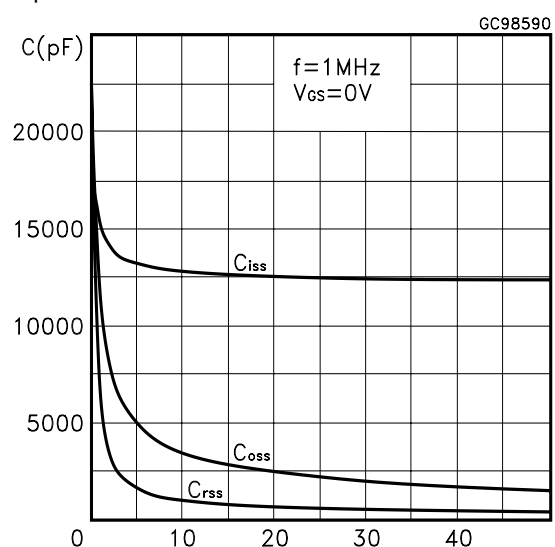
Static Drain-source On Resistance



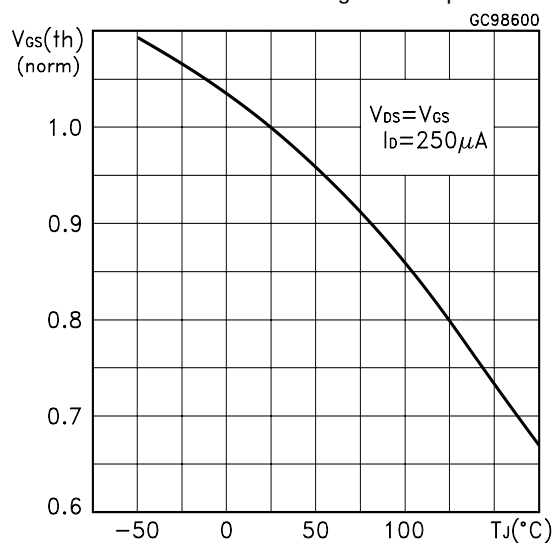
Gate Charge vs Gate-source Voltage



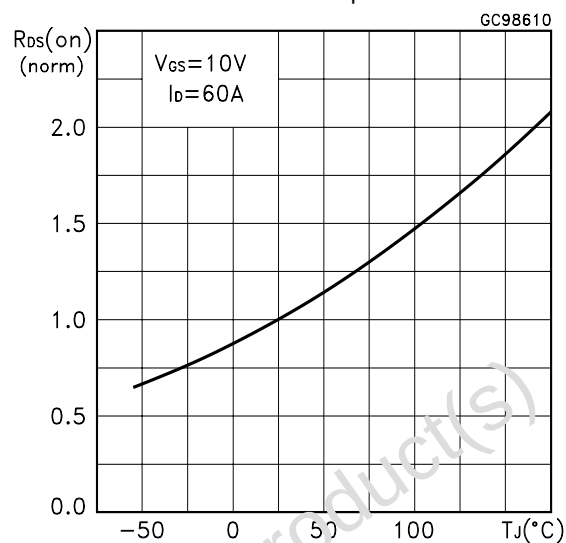
Capacitance Variations



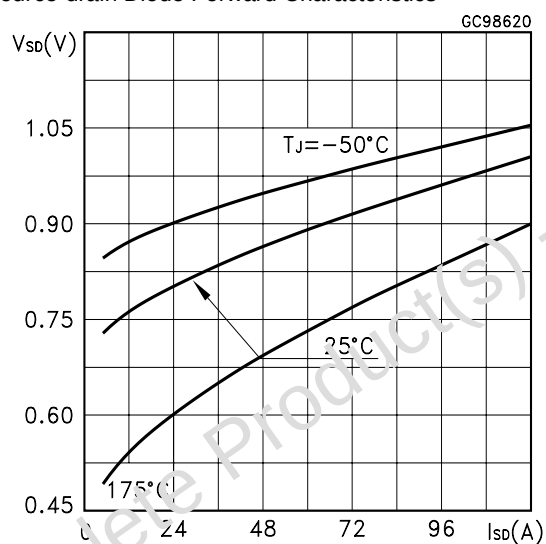
Normalized Gate Threshold Voltage vs Temperature



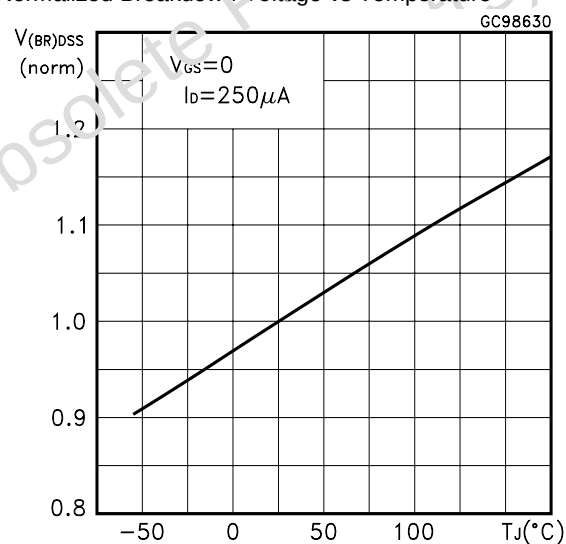
Normalized on Resistance vs Temperature



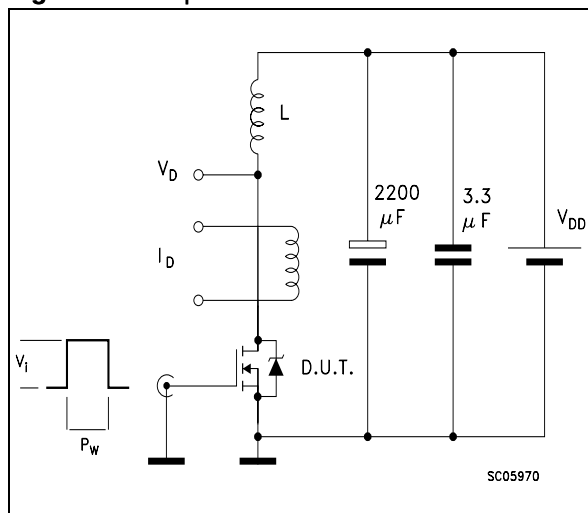
Source-drain Diode Forward Characteristics



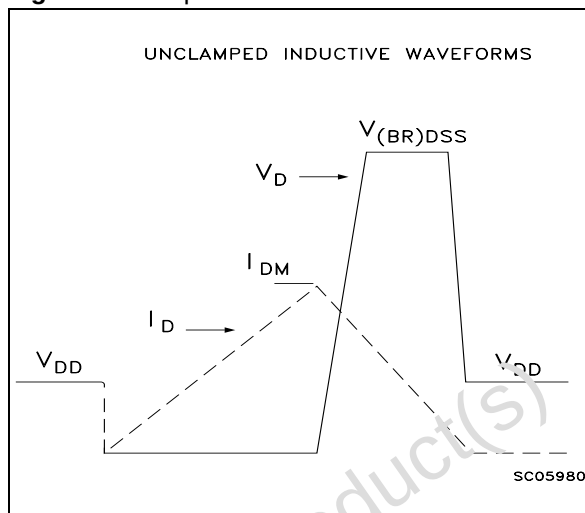
Normalized Breakdown Voltage vs Temperature



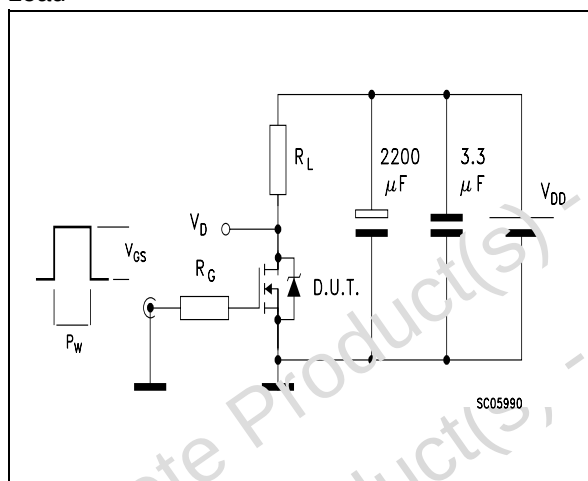
**Fig. 1: Unclamped Inductive Load Test Circuit**



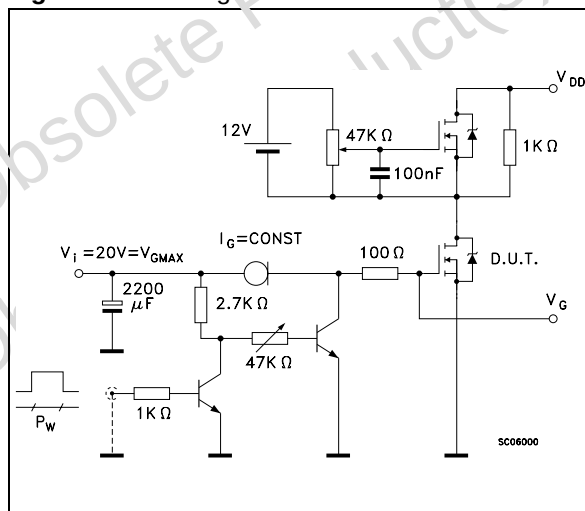
**Fig. 2: Unclamped Inductive Waveform**



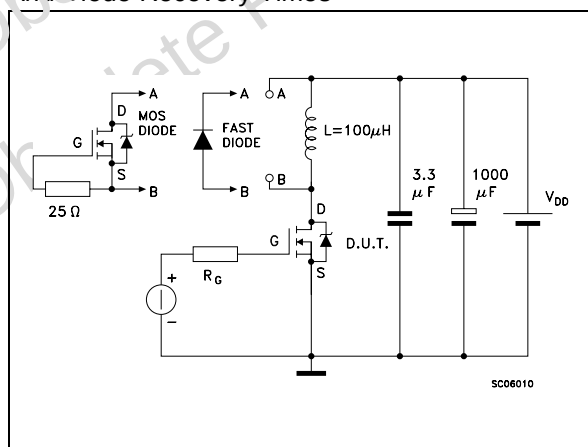
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

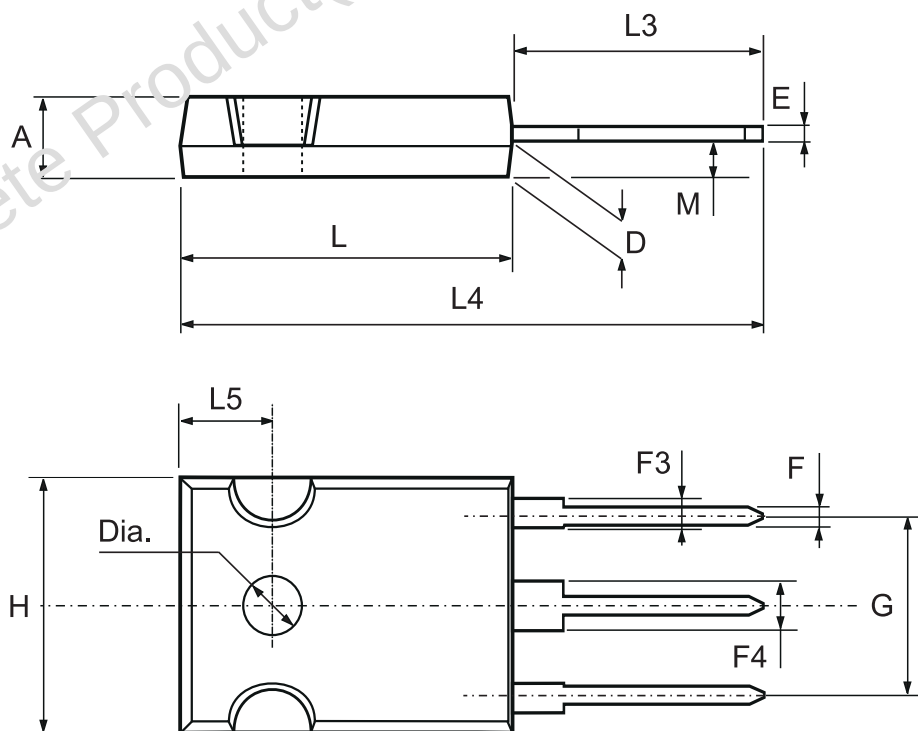


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



## TO-247 MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.7  |      | 5.3  | 0.185 |       | 0.209 |
| D    | 2.2  |      | 2.6  | 0.087 |       | 0.102 |
| E    | 0.4  |      | 0.8  | 0.016 |       | 0.031 |
| F    | 1    |      | 1.4  | 0.039 |       | 0.055 |
| F3   | 2    |      | 2.4  | 0.079 |       | 0.094 |
| F4   | 3    |      | 3.4  | 0.118 |       | 0.134 |
| G    |      | 10.9 |      |       | 0.429 |       |
| H    | 15.3 |      | 15.9 | 0.602 |       | 0.626 |
| L    | 19.7 |      | 20.3 | 0.776 |       | 0.779 |
| L3   | 14.2 |      | 14.8 | 0.559 |       | 0.582 |
| L4   |      | 34.6 |      |       | 1.362 |       |
| L5   |      | 5.5  |      |       | 0.217 |       |
| M    | 2    |      | 3    | 0.079 |       | 0.118 |



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