



# STW13NB60 STH13NB60FI

## N - CHANNEL 600V - 0.48Ω - 13A - TO-247/ISOWATT218 PowerMESH™ MOSFET

| TYPE        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STW13NB60   | 600 V            | <0.54 Ω             | 13 A           |
| STH13NB60FI | 600 V            | <0.54 Ω             | 8.6 A          |

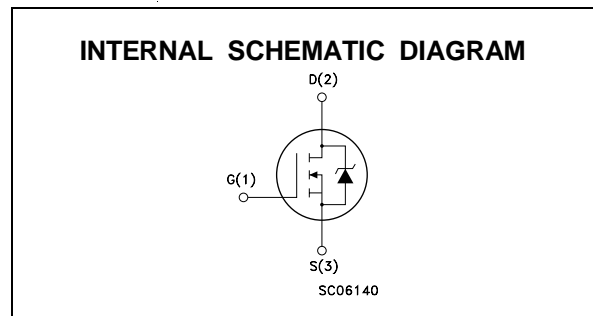
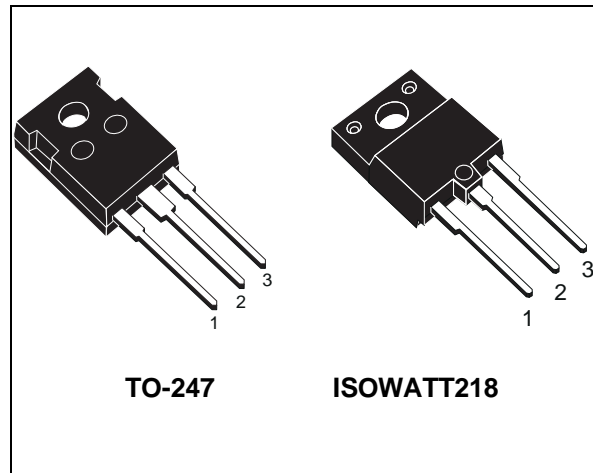
- TYPICAL R<sub>DS(on)</sub> = 0.48 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

### 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 RDS(on) per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

### APPLICATIONS

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



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter   | Value      |             | Unit |
|---------------------|---|------------|-------------|------|
|                     |   | STW13NB60  | STH13NB60FP |      |
| 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  | 13         | 8.6         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 8.2        | 5.4         | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 52         | 52          | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 190        | 80          | W    |
|                     | Derating Factor                                       | 1.52       | 0.64        | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                     | 4          | 4           | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                     | —          | 2000        | 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

(1) I<sub>SD</sub> ≤ 13 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

## STW13NB60 STH13NB60FI

### THERMAL DATA

|                       |  |     | TO-247 | ISOWATT218 |      |
|-----------------------|--|-----|--------|------------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 0.66   | 1.56       | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 30     |            | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink                   | Typ | 0.1    |            | °C/W |
| T <sub>I</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)                                | 13        | 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) | 700       | mJ   |

### 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  | 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 |      |      | 1<br>50 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 30 V   |      |      | ± 100   | nA       |

ON (\*)

| 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                               | 3    | 4    | 5    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V I <sub>D</sub> = 6.5 A  |      | 0.48 | 0.54 | Ω    |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub><br>V <sub>GS</sub> = 10 V | 13   |      |      | A    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--|------|------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> I <sub>D</sub> = 6.5 A | 8    | 12   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                                 |      | 2600 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 325  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 30   |      | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions  | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay Time | $V_{DD} = 300\text{ V}$ $I_D = 2.5\text{ A}$                       |      | 27   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$                         |      | 13   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 480\text{ V}$ $I_D = 13\text{ A}$ $V_{GS} = 10\text{ V}$ |      | 58   | 82   | nC   |
| $Q_{gs}$    | Gate-Source Charge |  |      | 15.5 |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |  |      | 23   |      | nC   |

**SWITCHING OFF**

| Symbol       | Parameter             | Test Conditions                             | Min. | Typ. | Max. | Unit |
|--------------|-----------------------|---|------|------|------|------|
| $t_{r(off)}$ | Off-voltage Rise Time | $V_{DD} = 480\text{ V}$ $I_D = 13\text{ A}$ |      | 15   |      | ns   |
| $t_f$        | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$  |      | 15   |      | ns   |
| $t_c$        | Cross-over Time       |   |      | 25   |      | ns   |

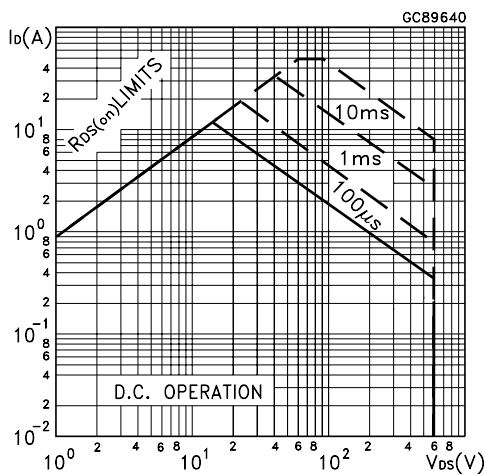
**SOURCE DRAIN DIODE**

| Symbol             | Parameter                     | Test Conditions  | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|--|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |  |      |      | 13   | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |  |      |      | 52   | A             |
| $V_{SD}(\ast)$     | Forward On Voltage            | $I_{SD} = 13\text{ A}$ $V_{GS} = 0$  |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 13\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ |      | 630  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |  |      | 6.8  |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |  |      | 22   |      | A             |

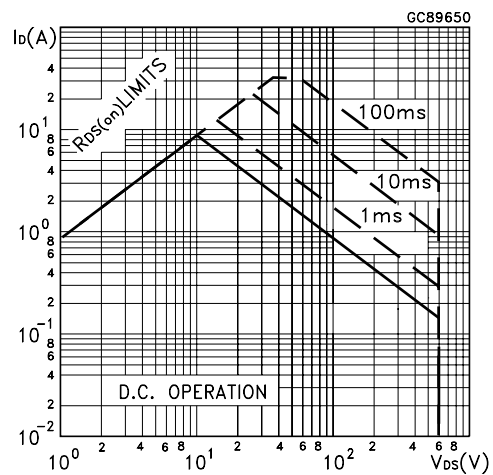
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

(•) Pulse width limited by safe operating area

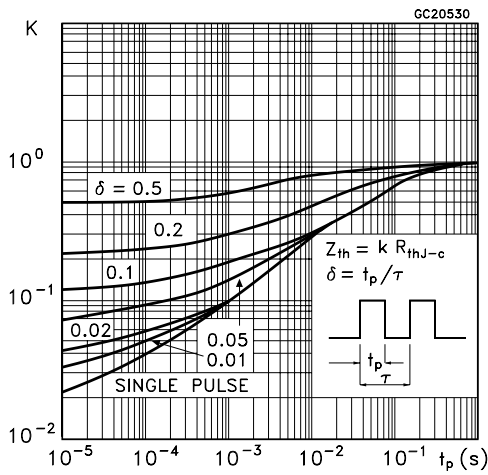
Safe Operating Area for TO-247



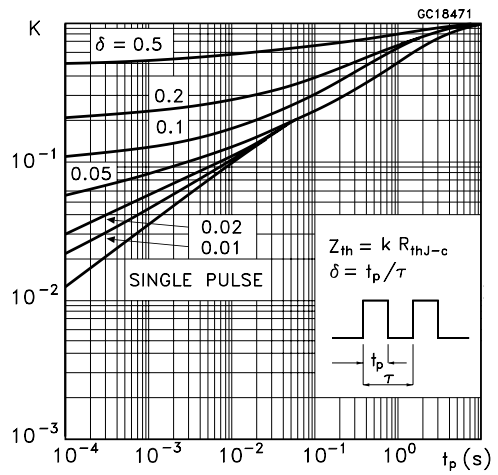
Safe Operating Area for ISOWATT218



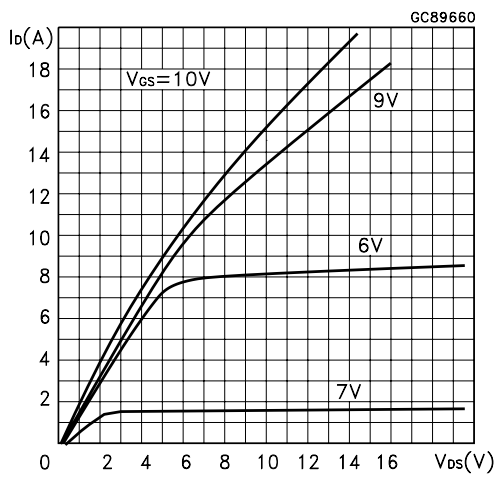
Thermal Impedance for TO-247



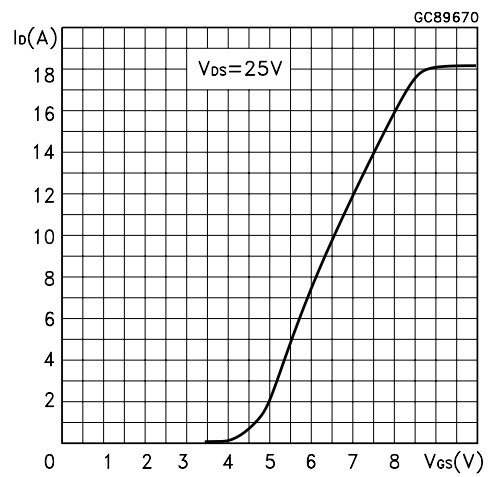
Thermal Impedance for ISOWATT218



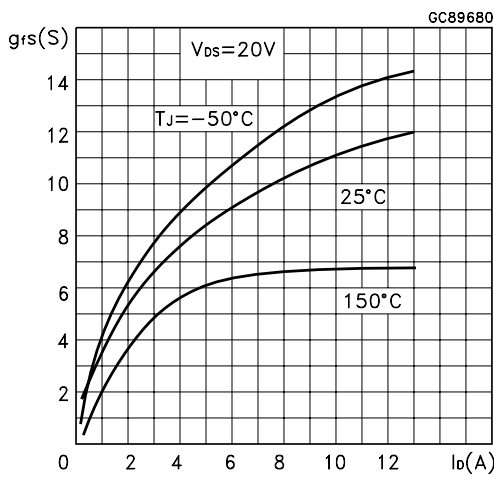
Output Characteristics



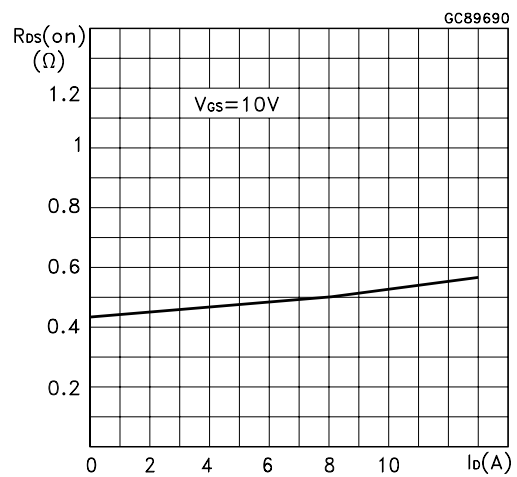
Transfer Characteristics



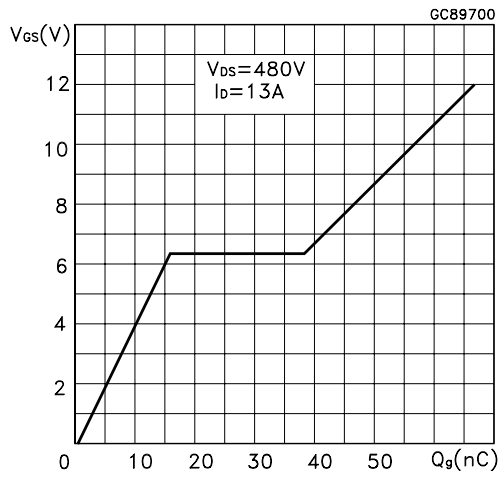
Transconductance



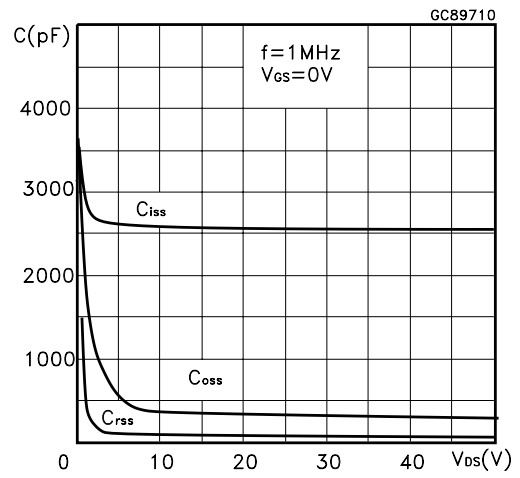
Static Drain-source On Resistance



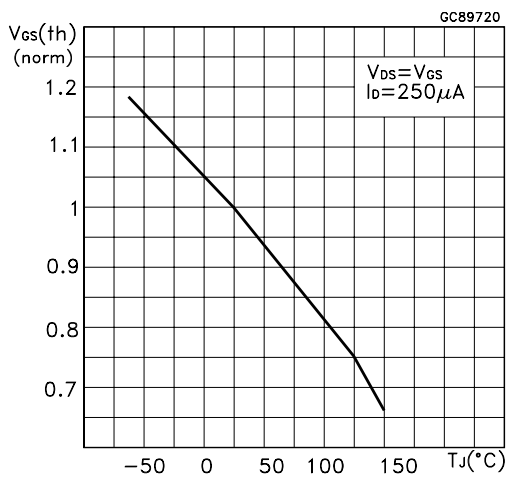
Gate Charge vs Gate-source Voltage



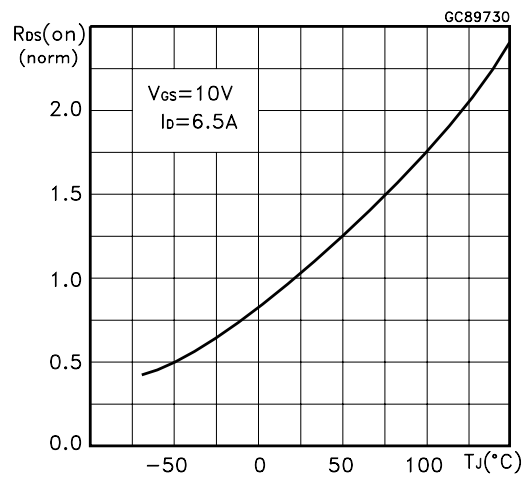
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

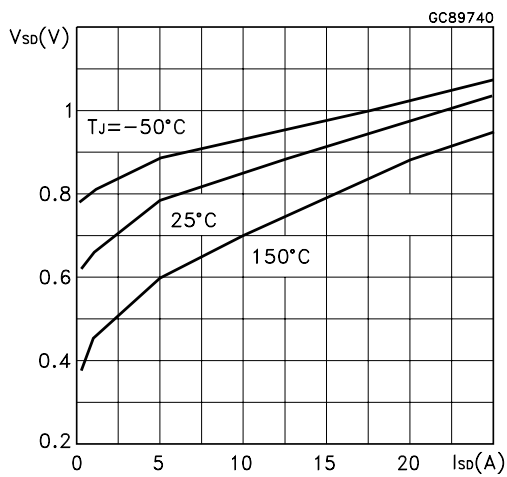


Fig. 1: Unclamped Inductive Load Test Circuit

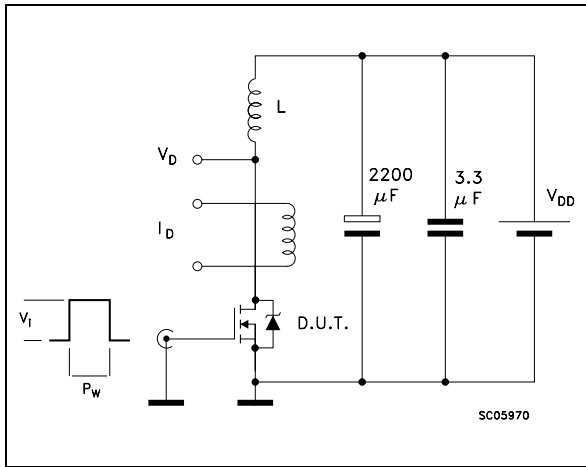


Fig. 2: Unclamped Inductive Waveform

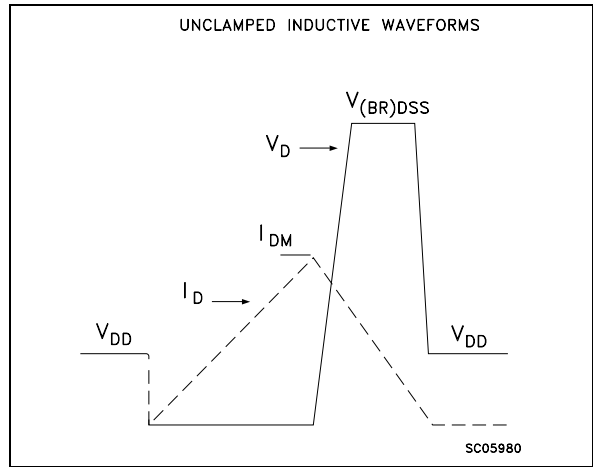


Fig. 3: Switching Times Test Circuits For Resistive Load

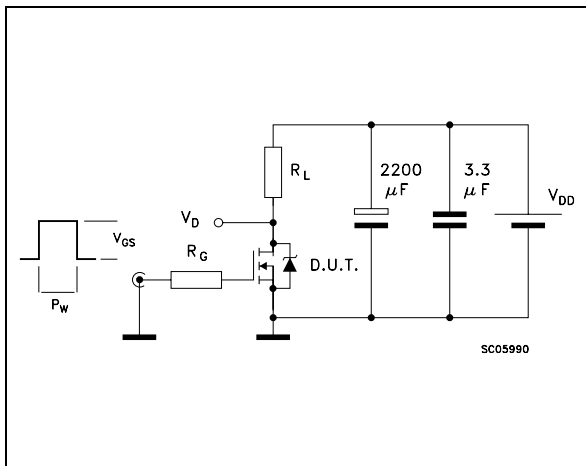


Fig. 4: Gate Charge test Circuit

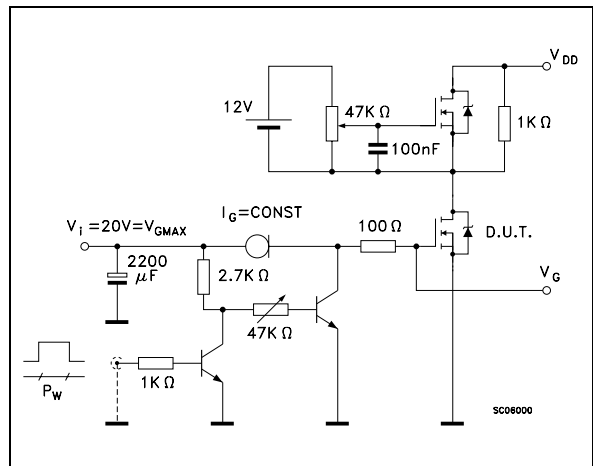
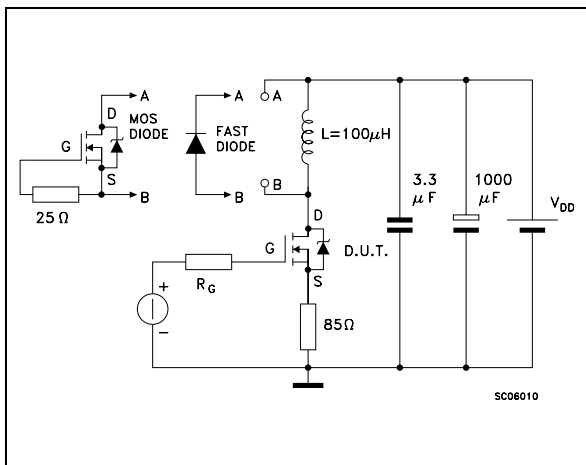
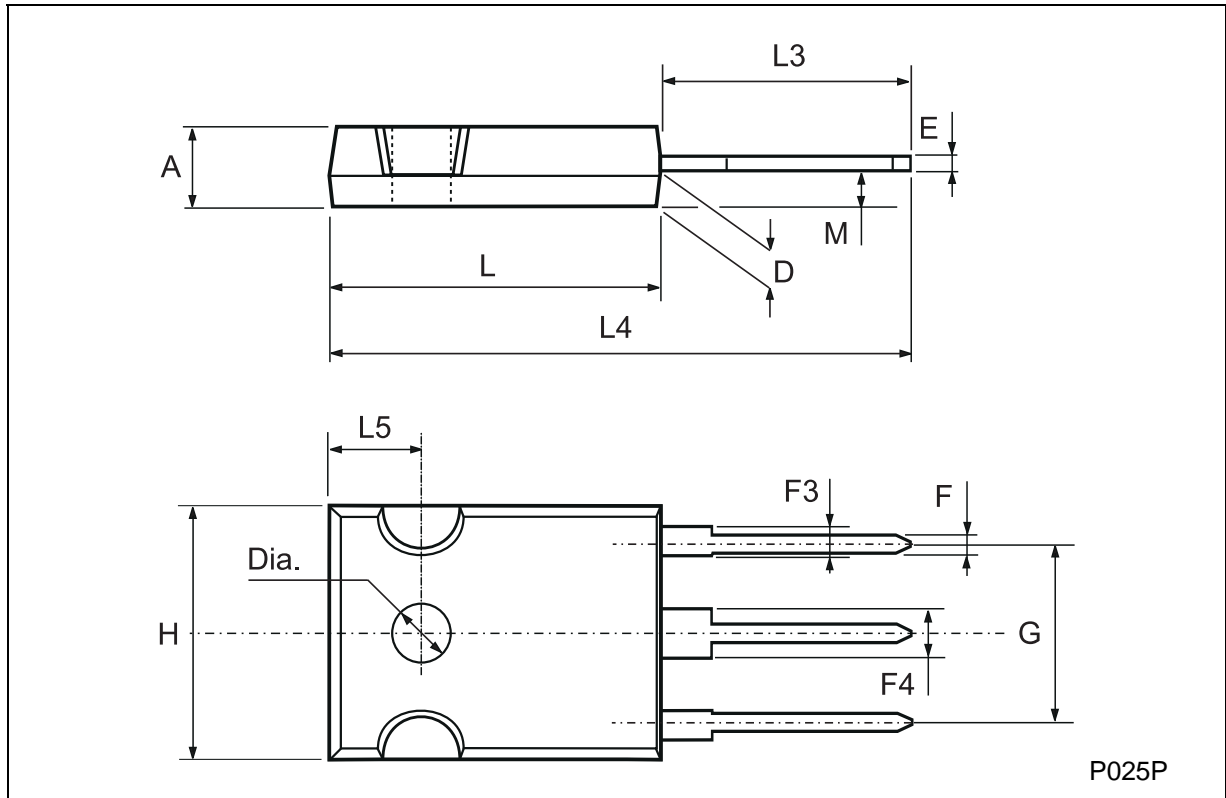


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



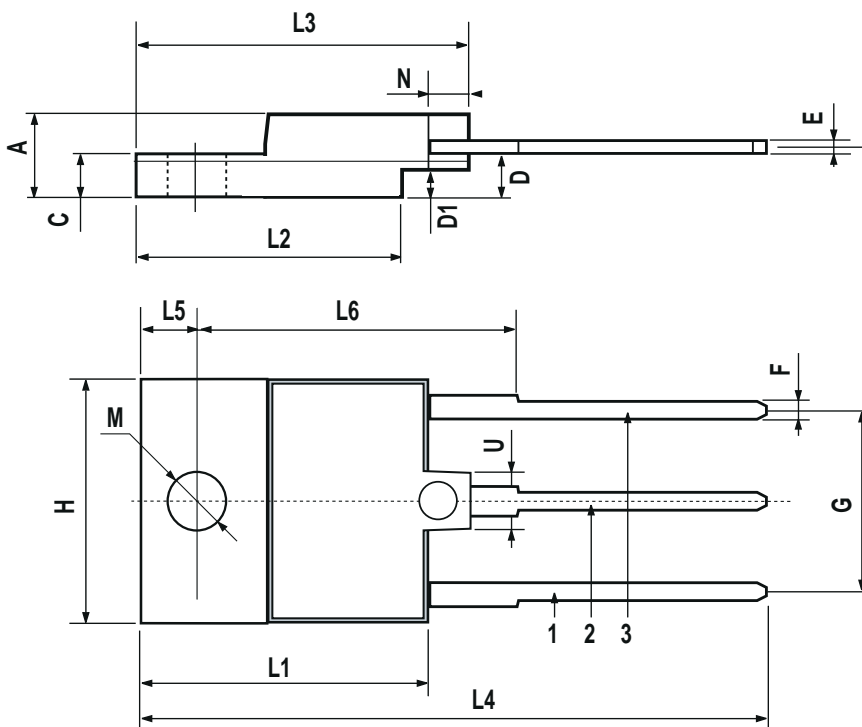
**TO-247 MECHANICAL DATA**

| 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 |



ISOWATT218 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 5.35  |      | 5.65  | 0.210 |       | 0.222 |
| C    | 3.3   |      | 3.8   | 0.130 |       | 0.149 |
| D    | 2.9   |      | 3.1   | 0.114 |       | 0.122 |
| D1   | 1.88  |      | 2.08  | 0.074 |       | 0.081 |
| E    | 0.75  |      | 1     | 0.029 |       | 0.039 |
| F    | 1.05  |      | 1.25  | 0.041 |       | 0.049 |
| G    | 10.8  |      | 11.2  | 0.425 |       | 0.441 |
| H    | 15.8  |      | 16.2  | 0.622 |       | 0.637 |
| L1   | 20.8  |      | 21.2  | 0.818 |       | 0.834 |
| L2   | 19.1  |      | 19.9  | 0.752 |       | 0.783 |
| L3   | 22.8  |      | 23.6  | 0.897 |       | 0.929 |
| L4   | 40.5  |      | 42.5  | 1.594 |       | 1.673 |
| L5   | 4.85  |      | 5.25  | 0.190 |       | 0.206 |
| L6   | 20.25 |      | 20.75 | 0.797 |       | 0.817 |
| M    | 3.5   |      | 3.7   | 0.137 |       | 0.145 |
| N    | 2.1   |      | 2.3   | 0.082 |       | 0.090 |
| U    |       | 4.6  |       |       | 0.181 |       |



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