



# STW6NA80 STH6NA80FI

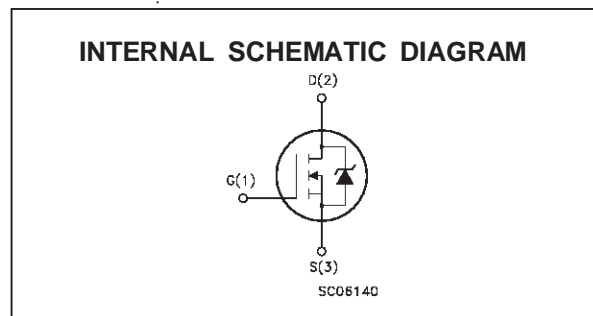
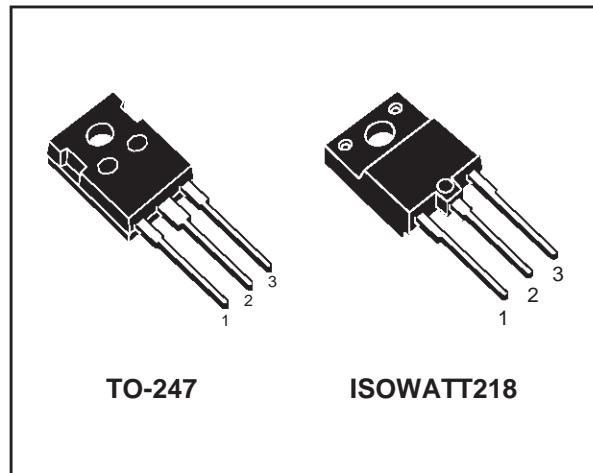
## N - CHANNEL 800V - 1.8Ω - 5.4A - TO-247/ISOWATT218 FAST POWER MOS TRANSISTOR

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STW6NA80   | 800 V            | < 2.2 Ω             | 5.4 A          |
| STH6NA80FI | 800 V            | < 2.2 Ω             | 3.4 A          |

- TYPICAL R<sub>DS(on)</sub> = 1.8 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- VERY HIGH CURRENT CAPABILITY
- APPLICATION ORIENTED CHARACTERIZATION

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- REGULATORS
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter   | Value      |            | Unit |
|---------------------|---|------------|------------|------|
|                     |   | STW6NA80   | STH6NA80FI |      |
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 800        |            | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 800        |            | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | ± 30       |            | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 5.4        | 3.4        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 3.4        | 2.1        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                                | 22         | 22         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 150        | 60         | W    |
|                     | Derating Factor                                       | 1.2        | 0.48       | W/°C |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                     | —          | 4000       | 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

## STW6NA80-STH6NA80FI

### THERMAL DATA

|                       |  | TO-247 | ISOWATT218 |      |      |
|-----------------------|--|--------|------------|------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max    | 0.83       | 2.08 | °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>l</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, δ < 1%)                          | 5.4       | 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)   | 150       | mJ   |
| E <sub>AR</sub> | Repetitive Avalanche Energy (pulse width limited by T <sub>j</sub> max, δ < 1%)  | 5.8       | mJ   |
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (T <sub>c</sub> = 100 °C, pulse width limited by T <sub>j</sub> max, δ < 1%) | 3.4       | A    |

### 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  | 800  |      |          | 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 x 0.8 T <sub>c</sub> = 100 °C |      |      | 25<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  | 2.25 | 3    | 3.75       | V      |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 3 A<br>V <sub>GS</sub> = 10 V I <sub>D</sub> = 3 A T <sub>c</sub> = 100 °C |      | 1.8  | 2.2<br>4.4 | Ω<br>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                            | 5.4  |      |            | 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> = 3 A | 3    | 5.5  |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                               |      | 1250 | 1700 | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 140  | 190  | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 35   | 50   | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

| Symbol         | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit             |
|----------------|-----------------------|---|------|------|------|------------------|
| $t_{d(on)}$    | Turn-on Time          | $V_{DD} = 400\text{ V}$ $I_D = 3\text{ A}$  |      | 40   | 55   | ns               |
| $t_r$          | Rise Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3)  |      | 100  | 135  | ns               |
| $(di/dt)_{on}$ | Turn-on Current Slope | $V_{DD} = 640\text{ V}$ $I_D = 6\text{ A}$<br>$R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 180  |      | A/ $\mu\text{s}$ |
| $Q_g$          | Total Gate Charge     | $V_{DD} = 640\text{ V}$ $I_D = 6\text{ A}$ $V_{GS} = 10\text{ V}$   |      | 55   | 75   | nC               |
| $Q_{gs}$       | Gate-Source Charge    |   |      | 8    |      | nC               |
| $Q_{gd}$       | Gate-Drain Charge     |   |      | 24   |      | nC               |

**SWITCHING OFF**

| Symbol        | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 640\text{ V}$ $I_D = 6\text{ A}$                                |      | 75   | 100  | ns   |
| $t_f$         | Fall Time             | $R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 25   | 35   | ns   |
| $t_c$         | Cross-over Time       |   |      | 110  | 150  | ns   |

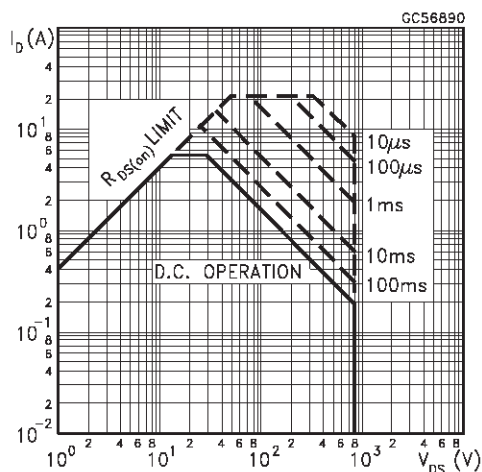
**SOURCE DRAIN DIODE**

| Symbol             | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|---|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |   |      |      | 5.4  | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |   |      |      | 22   | A             |
| $V_{SD}(\ast)$     | Forward On Voltage            | $I_{SD} = 6\text{ A}$ $V_{GS} = 0$  |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 6\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 800  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |   |      | 15.2 |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |   |      | 38   |      | A             |

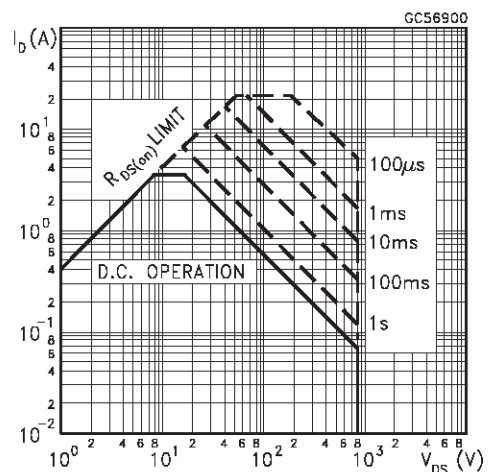
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

(•) Pulse width limited by safe operating area

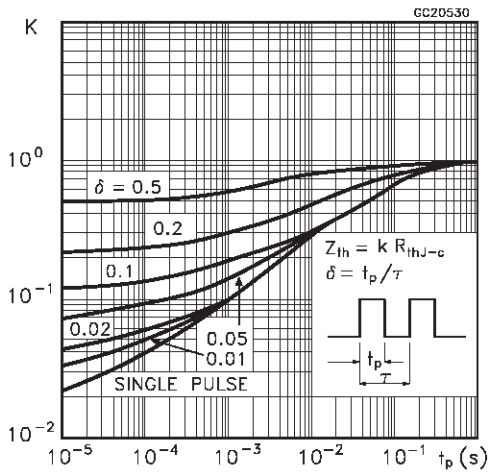
Safe Operating Area for TO-247



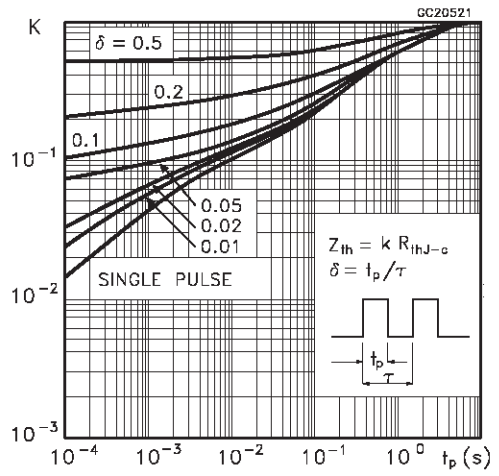
Safe Operating Area for ISOWATT218



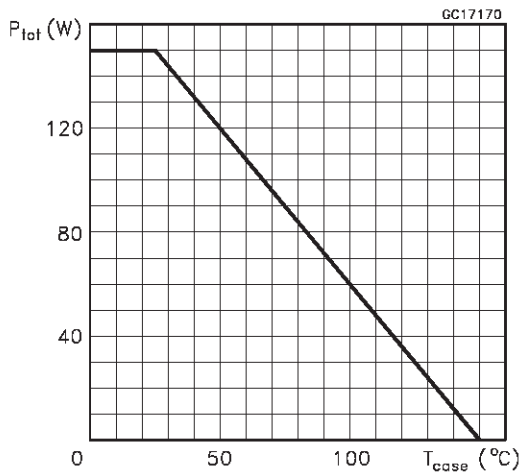
Thermal Impedance for TO-247



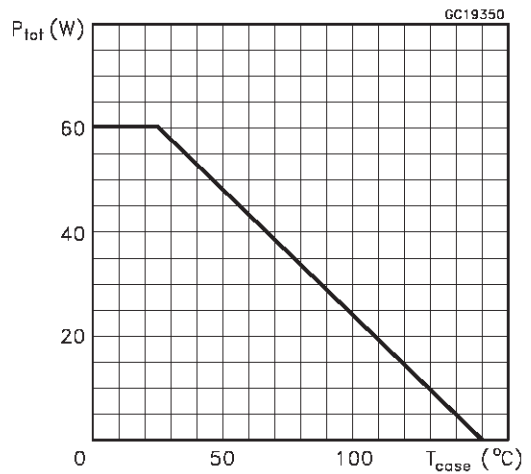
Thermal Impedance for ISOWATT218



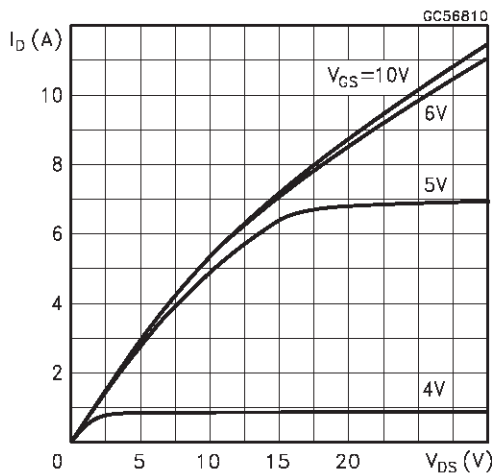
Derating Curve for TO-247



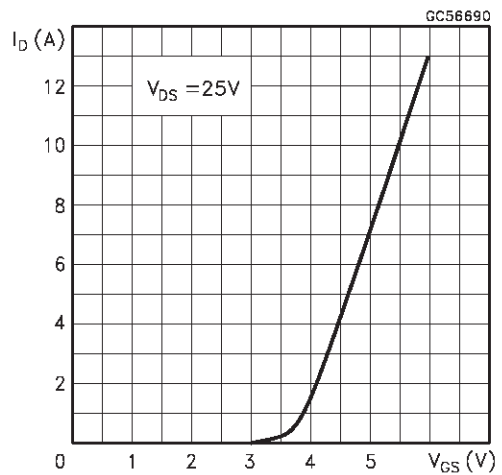
Derating Curve for ISOWATT218



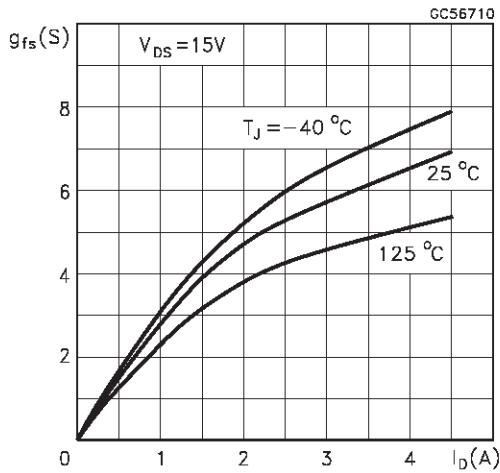
Output Characteristics



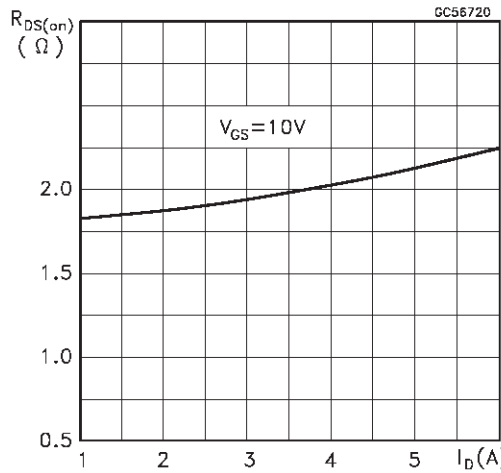
Transfer Characteristics



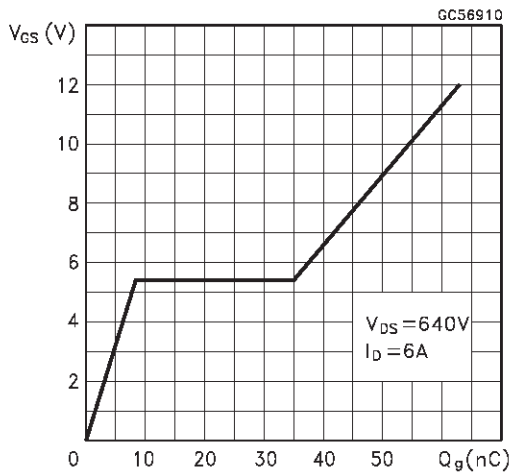
Transconductance



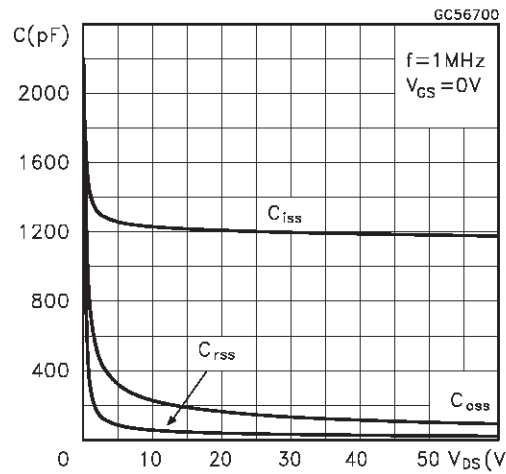
Static Drain-source On Resistance



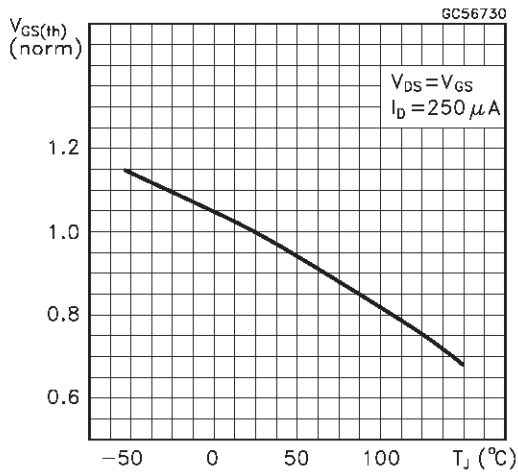
Gate Charge vs Gate-source Voltage



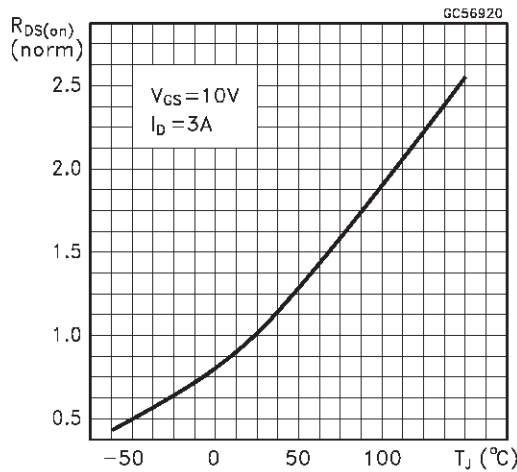
Capacitance Variations



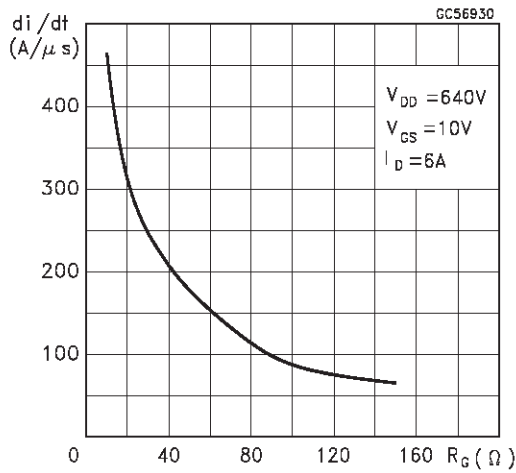
Normalized Gate Threshold Voltage vs Temperature



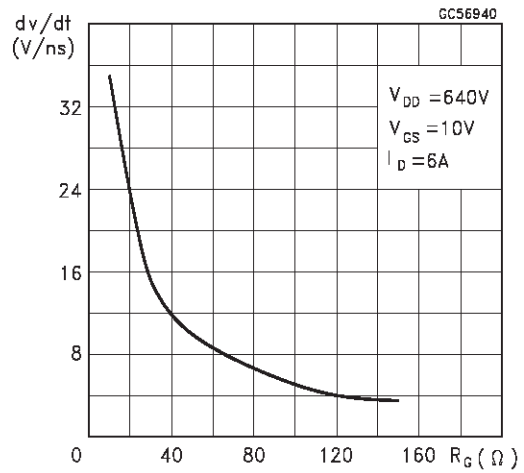
Normalized On Resistance vs Temperature



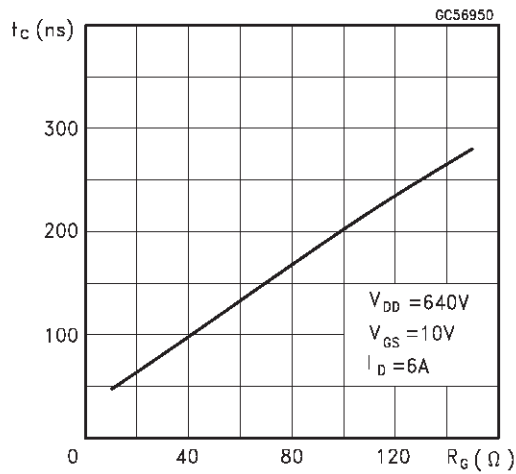
Turn-on Current Slope



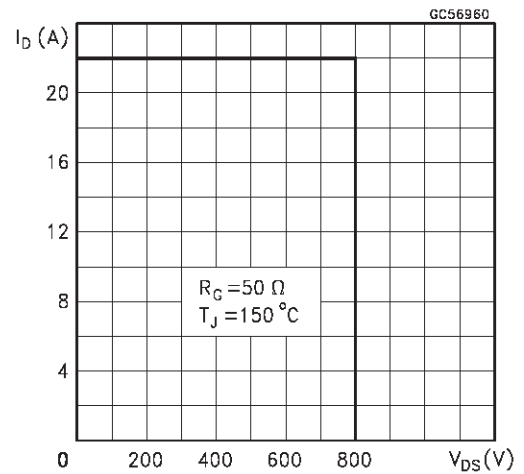
Turn-off Drain-source Voltage Slope



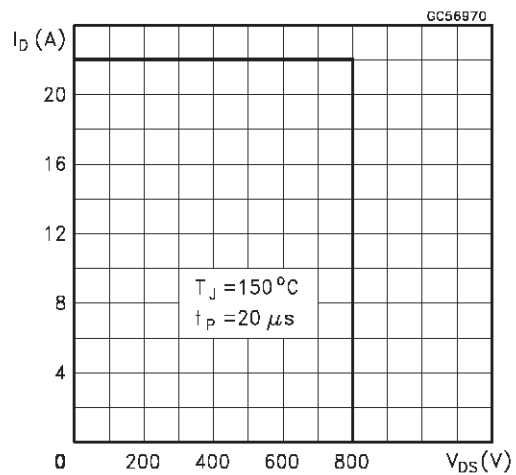
Cross-over Time



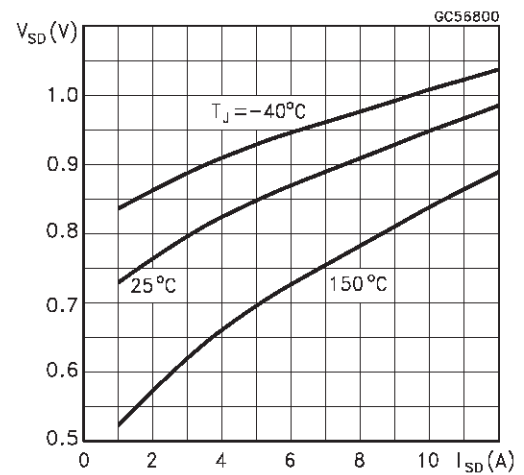
Switching Safe Operating Area



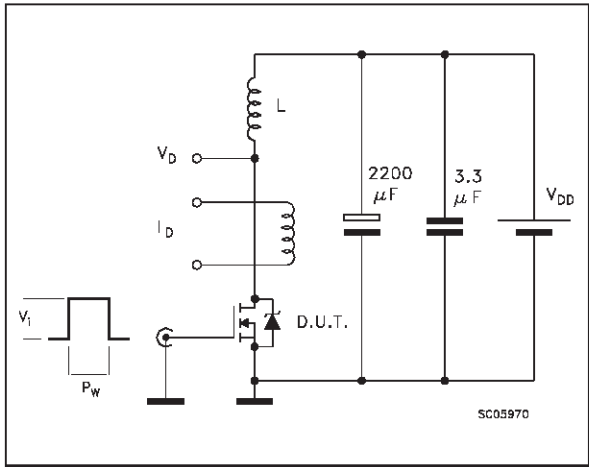
Accidental Overload Area



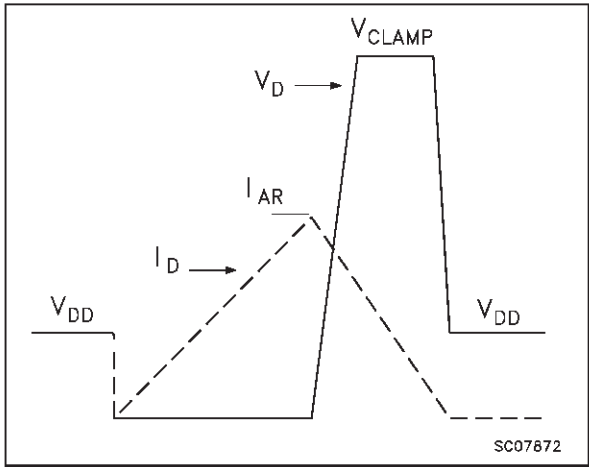
Source-drain Diode Forward Characteristics



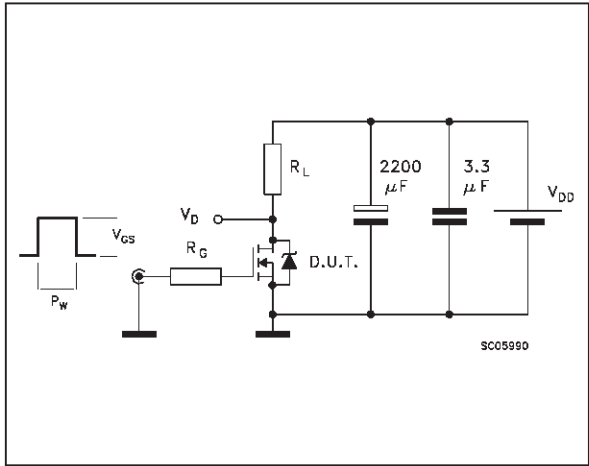
**Fig. 1: Unclamped Inductive Load Test Circuit**



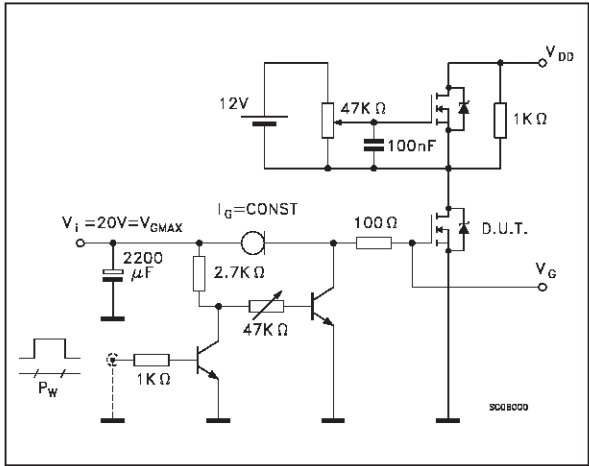
**Fig. 2: Unclamped Inductive Waveform**



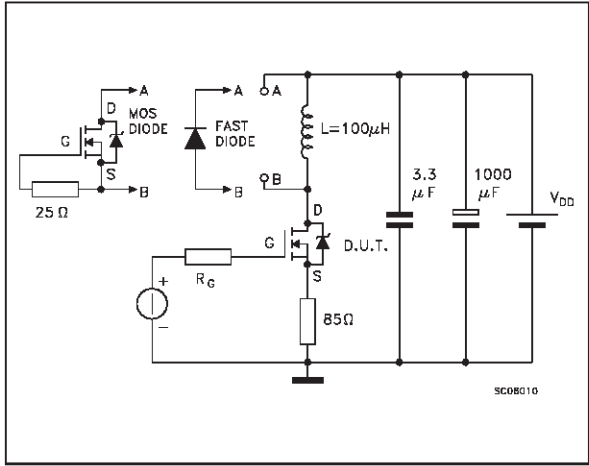
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

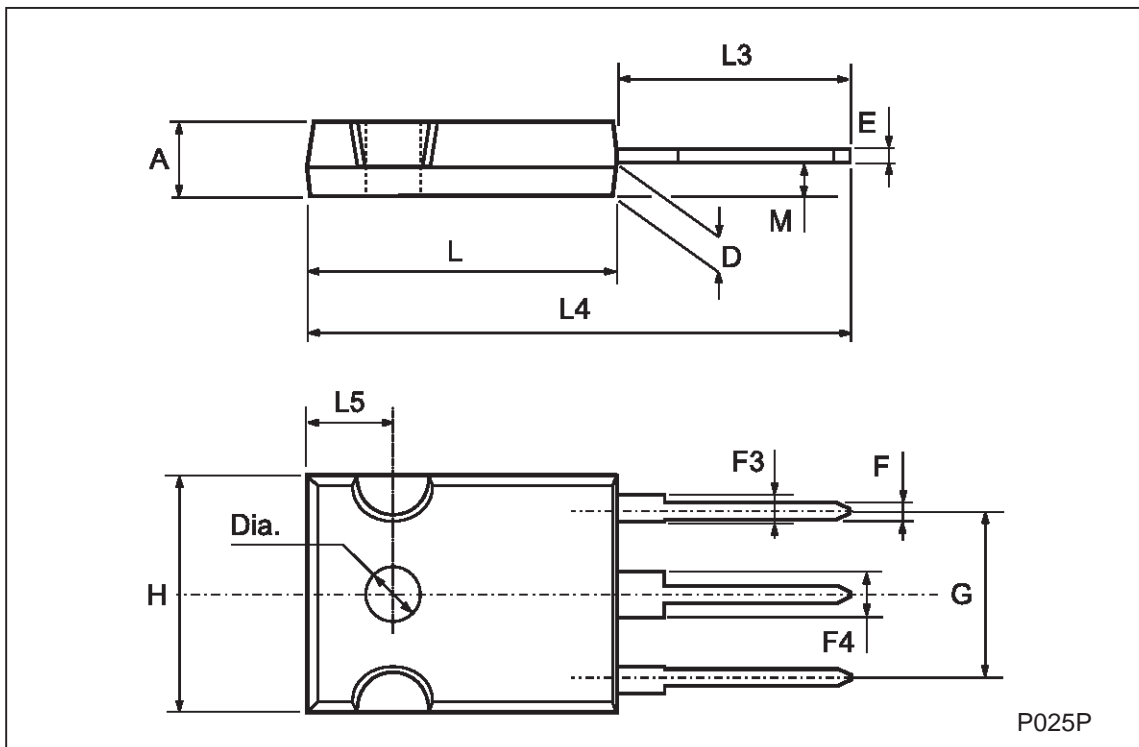


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



TO-247 MECHANICAL DATA

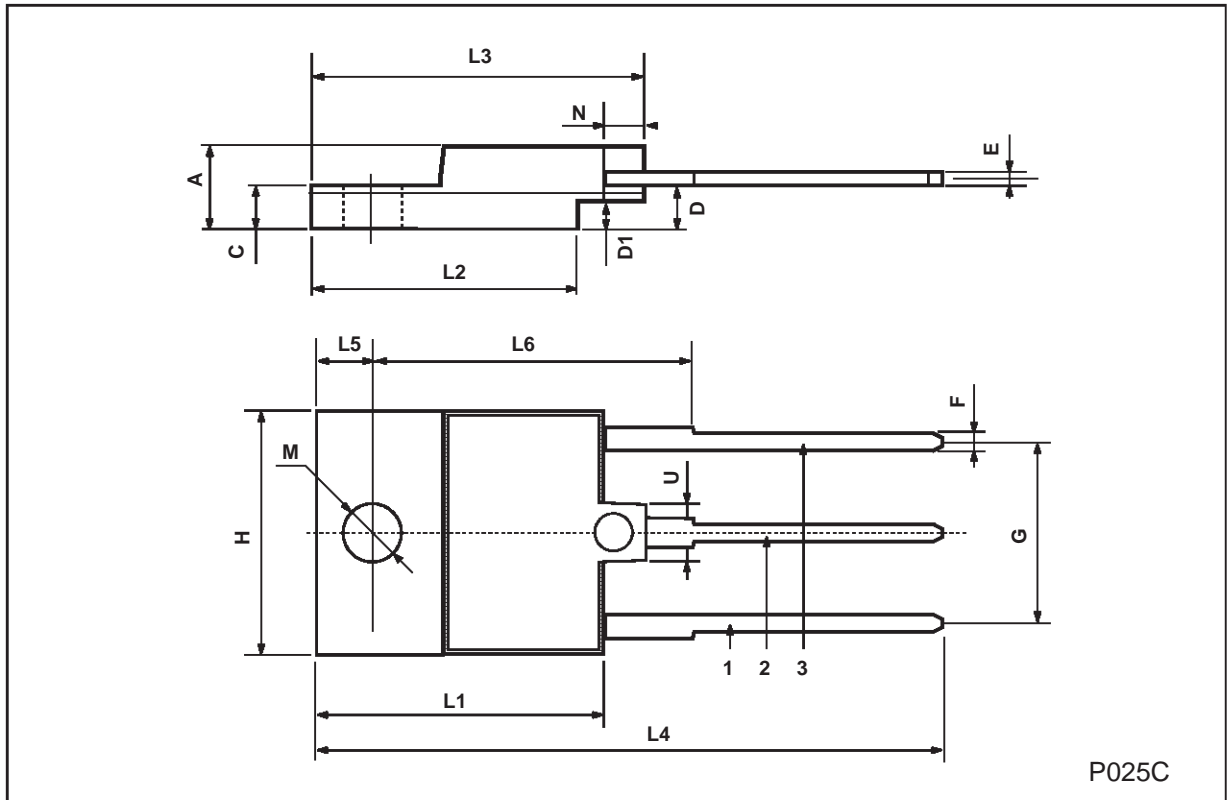
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.7  |      | 5.3  | 0.185 |       | 0.209 |
| D    | 2.2  |      | 2.6  | 0.087 |       | 0.102 |
| E    | 0.4  |      | 0.8  | 0.016 |       | 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 | 0.413 | 0.582 |
| L4   |      | 34.6 |      |       | 1.362 |       |
| L5   |      | 5.5  |      |       | 0.217 |       |
| M    | 2    |      | 3    | 0.079 |       | 0.118 |
| Dia  | 3.55 |      | 3.65 | 0.140 |       | 0.144 |





**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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