



# STW10NC60 STH10NC60FI

N-CHANNEL 600V - 0.6Ω - 10A - TO-247/ISOWATT218

PowerMesh™ II MOSFET

| TYPE        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STW10NC60   | 600 V            | < 0.75 Ω            | 10 A           |
| STH10NC60FI | 600 V            | < 0.75 Ω            | 10 A (*)       |

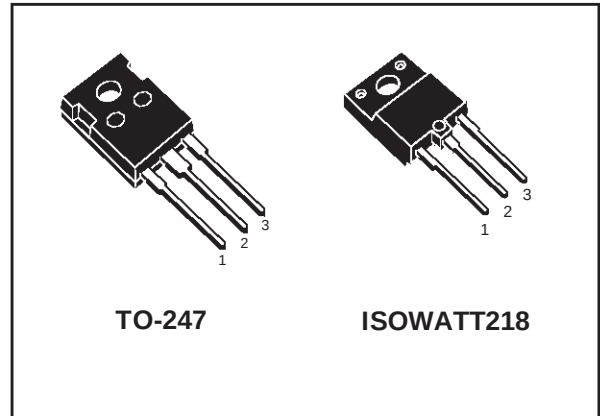
- TYPICAL R<sub>DS(on)</sub> = 0.6 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

## 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

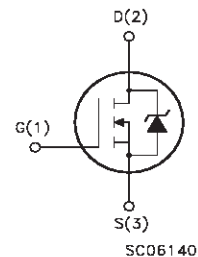
- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVER



TO-247

ISOWATT218

## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                            | Value       |             | Unit |
|---------------------|------------------------------------------------------|-------------|-------------|------|
|                     |                                                      | STW10NC60   | STH10NC60FI |      |
| 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  | 10          | 10 (*)      | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 6.3         | 6.3 (*)     | A    |
| I <sub>DM</sub> (1) | Drain Current (pulsed)                               | 40          | 40 (*)      | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 160         | 60          | W    |
|                     | Derating Factor                                      | 1.28        | 0.48        | W/°C |
| dv/dt               | Peak Diode Recovery voltage slope                    | 3.5         |             | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                    | -           | 2500        | V    |
| T <sub>stg</sub>    | Storage Temperature                                  | - 55 to 150 |             | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  |             |             |      |

(\*) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 10A, di/dt ≤ 100A/μs, V<sub>DD</sub> ≤ V(BR)DSS, T<sub>j</sub> ≤ T<sub>JMAX</sub>

(\*) Limited only by Maximum Temperature Allowed

## THERMAL DATA

|                |                                                | TO-247 | ISOWATT218 |      |
|----------------|------------------------------------------------|--------|------------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 0.78   | 2.08       | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 30     |            | °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)                                | 10        | 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) | 820       | 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> = ±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> = 4.5 A              |      | 0.6  | 0.75 | Ω    |

## DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                       | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|-------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 4.5A         |      | 9    |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 1420 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                       |      | 205  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                       |      | 35   |      | pF   |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

## SWITCHING ON

| Symbol      | Parameter          | Test Conditions                                                 | Min. | Typ. | Max. | Unit |
|-------------|--------------------|-----------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 300V, I_D = 4.5 A$<br>$R_G = 4.7\Omega, V_{GS} = 10V$ |      | 20   |      | ns   |
| $t_r$       | Rise Time          | (see test circuit, Figure 3)                                    |      | 16   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 480V, I_D = 9.0 A,$<br>$V_{GS} = 10V$                 |      | 55   | 77   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                 |      | 4.5  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                 |      | 31   |      | nC   |

## SWITCHING OFF

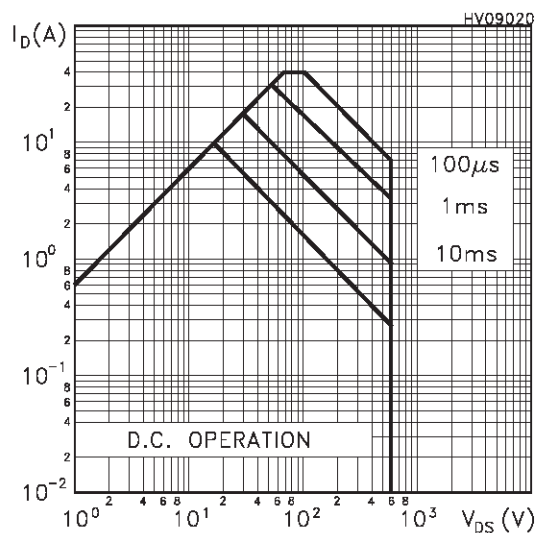
| Symbol        | Parameter             | Test Conditions                                                   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|-------------------------------------------------------------------|------|------|------|------|
| $t_{d(off)}$  | Turn-off Delay Time   | $V_{DD} = 300 V, I_D = 4.5 A$<br>$R_G = 4.7\Omega, V_{GS} = 10 V$ |      | 64   |      | ns   |
| $t_f$         | Fall Time             | (Resistive Load see, Figure 3)                                    |      | 32   |      | ns   |
| $t_{r(voff)}$ | Off-voltage Rise Time | $V_{DD} = 480V, I_D = 9.0 A,$<br>$R_G = 4.7\Omega, V_{GS} = 10V$  |      | 19   |      | ns   |
| $t_f$         | Fall Time             | (Inductive Load see, Figure 5)                                    |      | 13   |      | ns   |
| $t_c$         | Cross-over Time       |                                                                   |      | 32   |      | ns   |

## SOURCE DRAIN DIODE

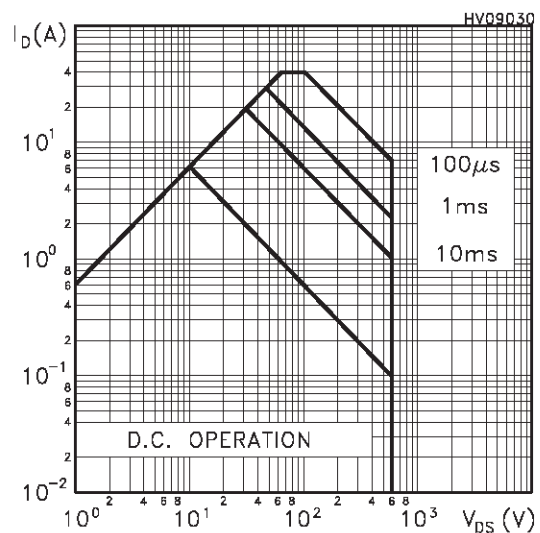
| Symbol       | Parameter                     | Test Conditions                                                           | Min. | Typ. | Max. | Unit    |
|--------------|-------------------------------|---------------------------------------------------------------------------|------|------|------|---------|
| $I_{SD}$     | Source-drain Current          |                                                                           |      |      | 10   | A       |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) |                                                                           |      |      | 40   | A       |
| $V_{SD(1)}$  | Forward On Voltage            | $I_{SD} = 9 A, V_{GS} = 0$                                                |      |      | 1.6  | V       |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 9 A, di/dt = 100A/\mu s,$<br>$V_{DD} = 100V, T_J = 150^\circ C$ |      | 600  |      | ns      |
| $Q_{rr}$     | Reverse Recovery Charge       | (see test circuit, Figure 5)                                              |      | 4.7  |      | $\mu C$ |
| $I_{RRM}$    | Reverse Recovery Current      |                                                                           |      | 15.5 |      | A       |

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

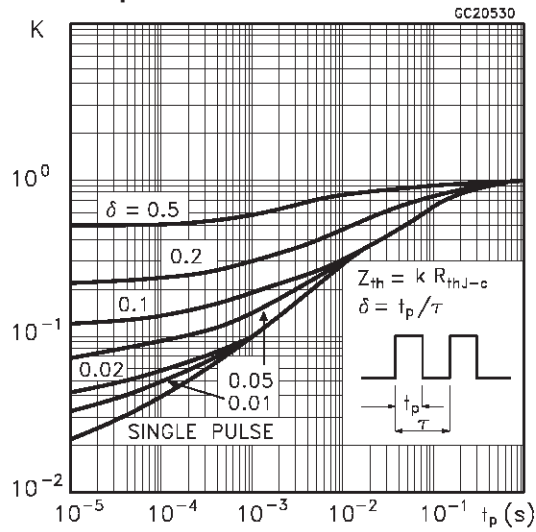
## Safe Operating Area for TO-247



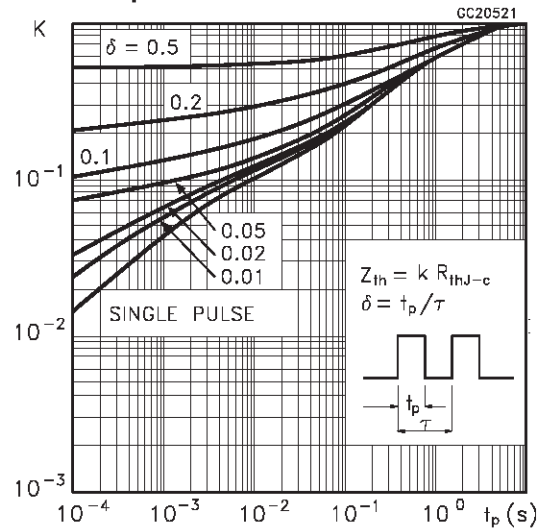
## Safe Operating Area for ISOWATT218



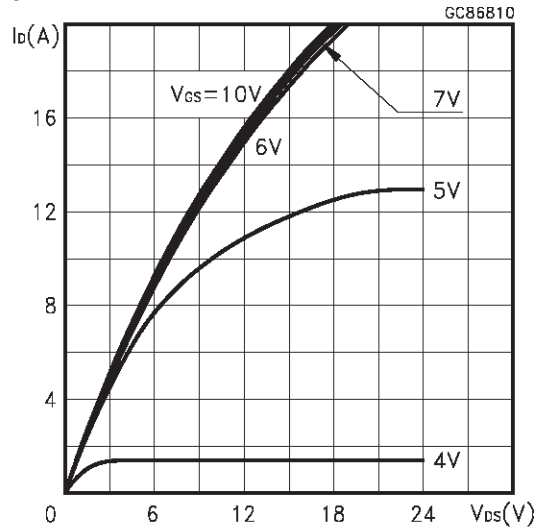
Thermal Impedance for TO-247



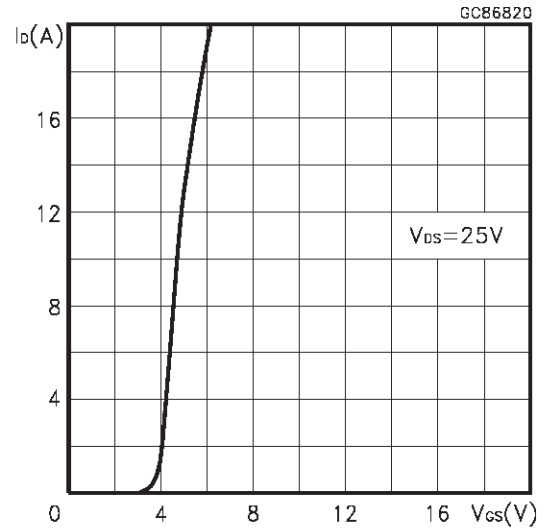
Thermal Impedance for ISOWATT218



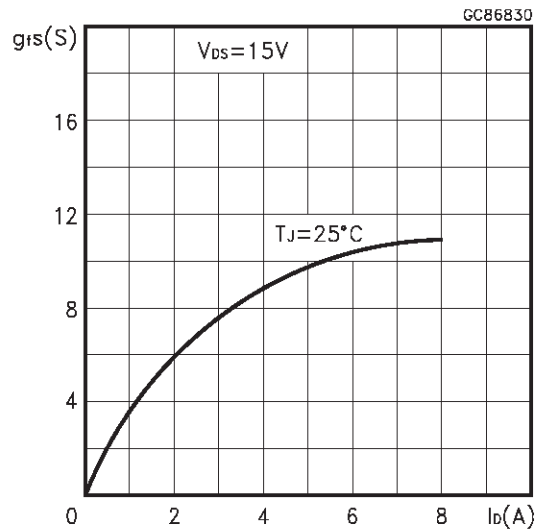
Output Characteristics



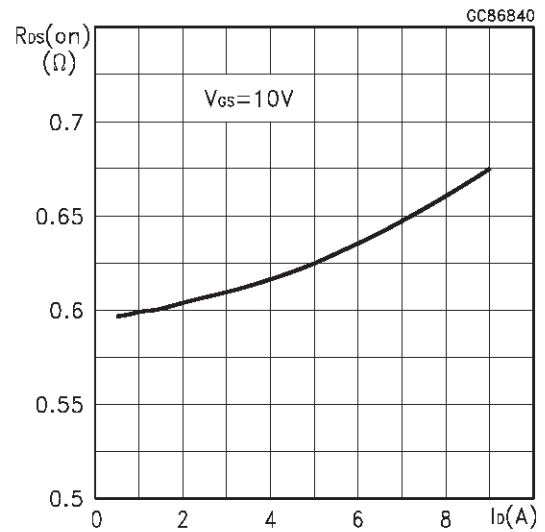
Transfer Characteristics



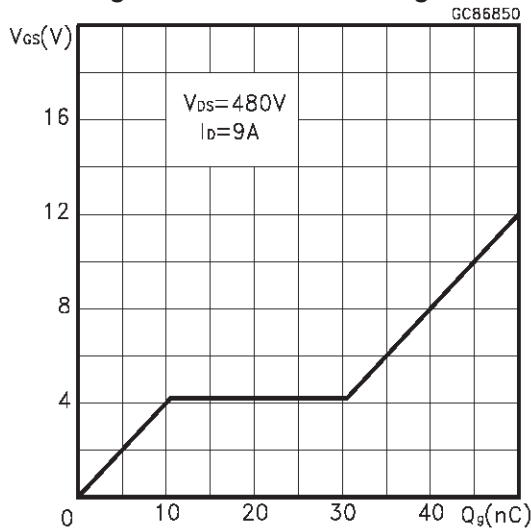
Transconductance



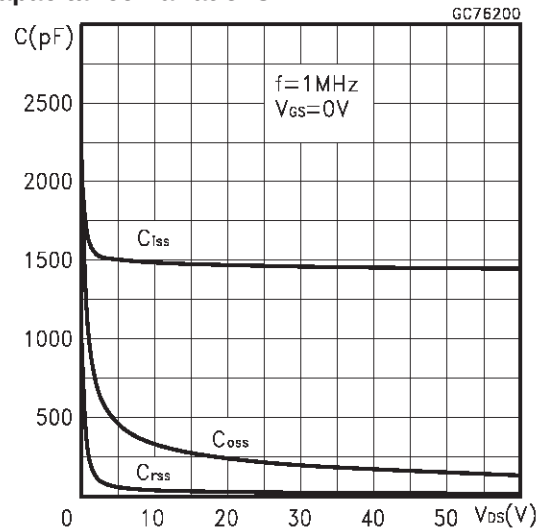
Static Drain-source On Resistance



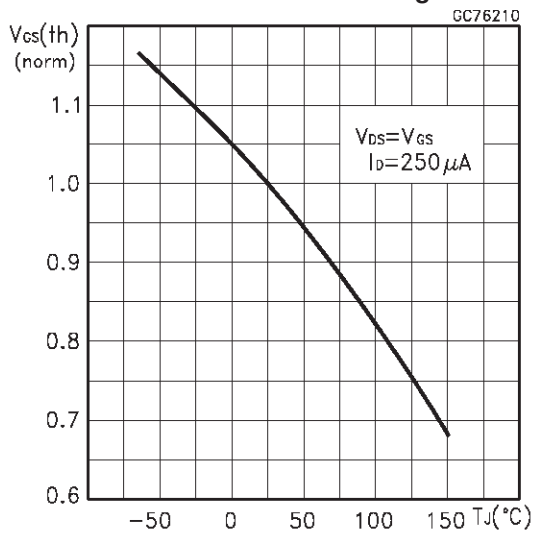
Gate Charge vs Gate-source Voltage



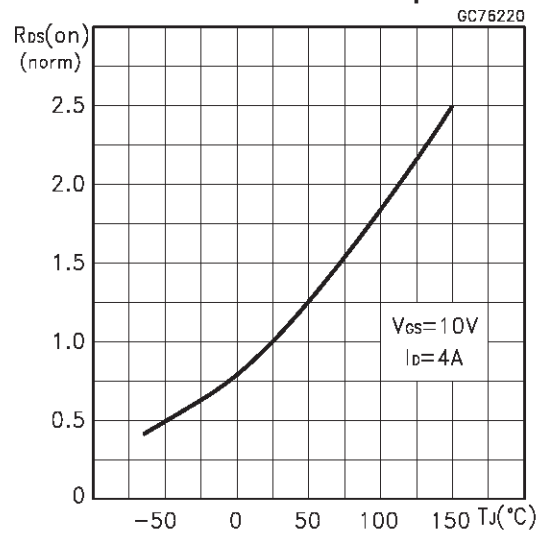
Capacitance Variations



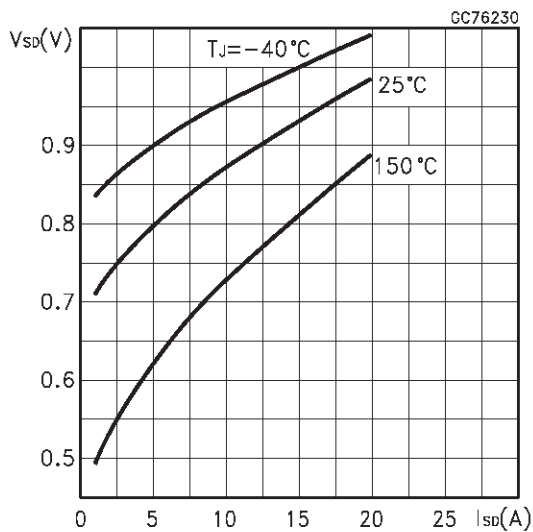
Normalized Gate Threshold Voltage vs Temp.



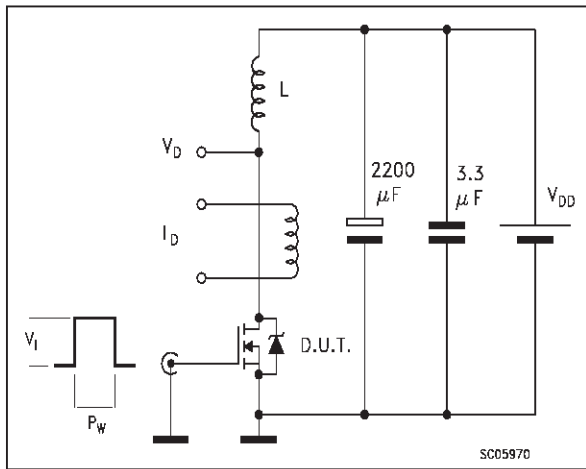
Normalized On Resistance vs Temperature



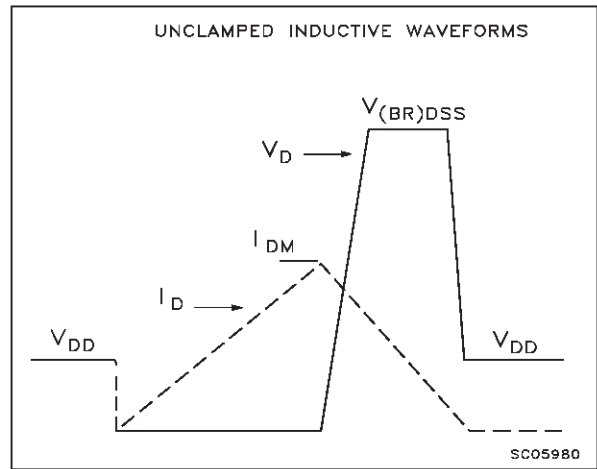
Source-drain Diode Forward Characteristics



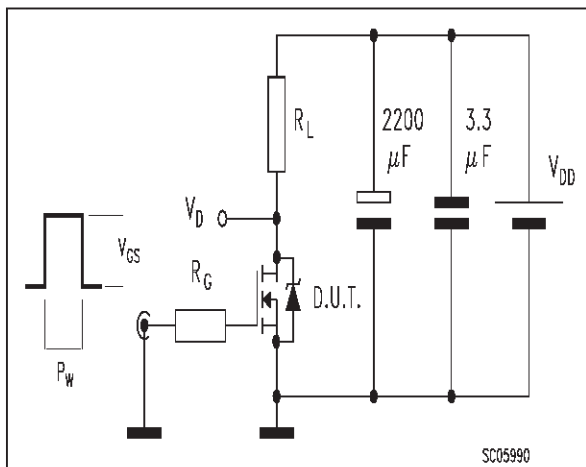
**Fig. 1: Unclamped Inductive Load Test Circuit**



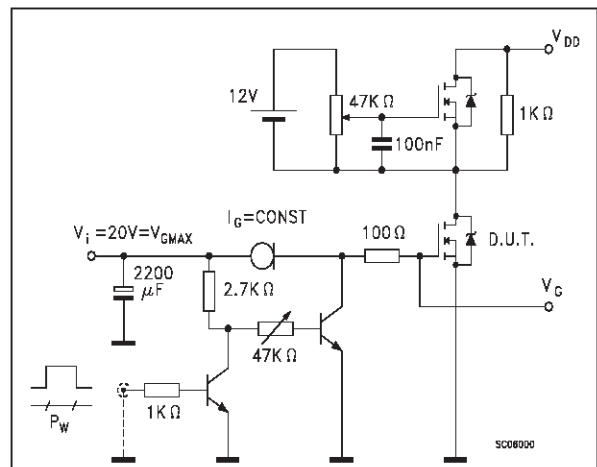
**Fig. 2: Unclamped Inductive Waveform**



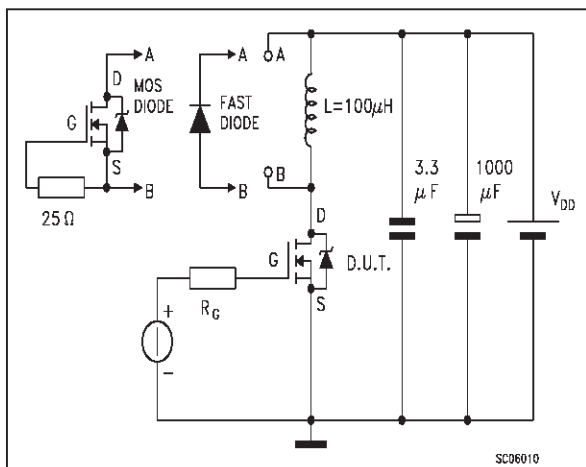
**Fig. 3: Switching Times Test Circuit For Resistive Load**



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

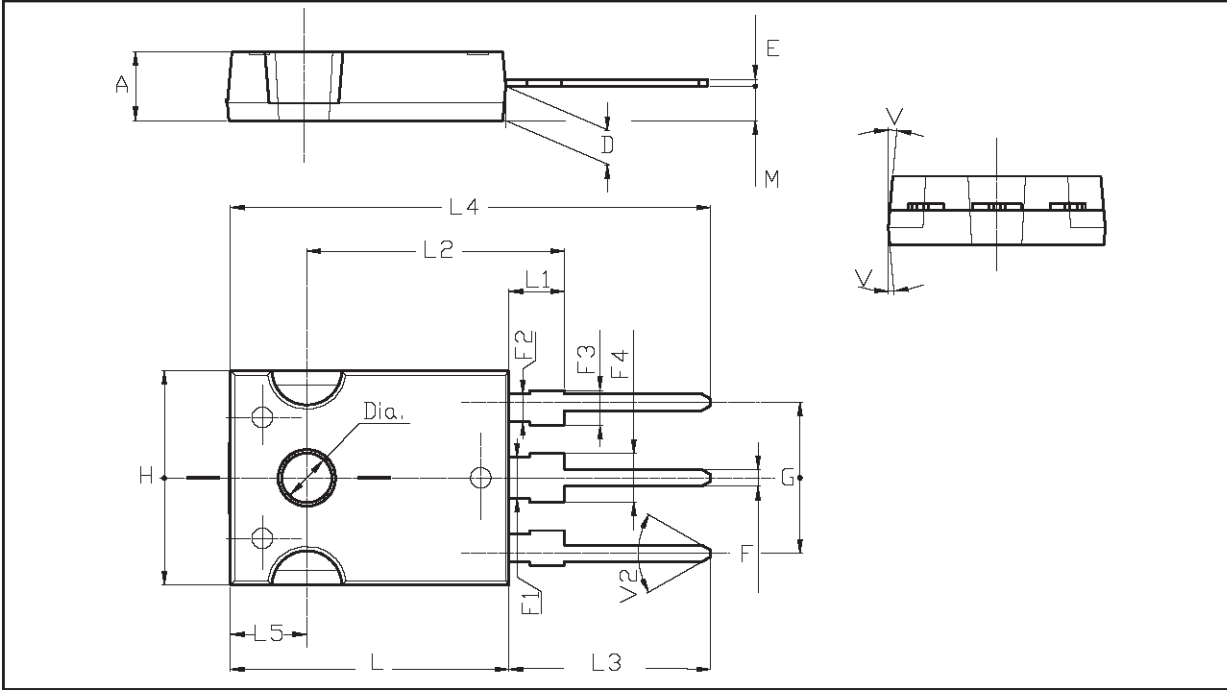


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



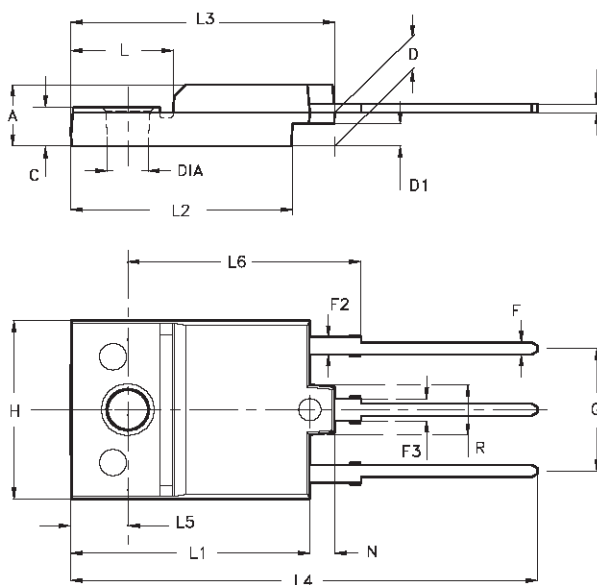
TO-247 MECHANICAL DATA

| DIM. | mm.   |       |       | inch  |      |       |
|------|-------|-------|-------|-------|------|-------|
|      | MIN.  | TYP   | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.85  |       | 5.15  | 0.19  |      | 0.20  |
| D    | 2.20  |       | 2.60  | 0.08  |      | 0.10  |
| E    | 0.40  |       | 0.80  | 0.015 |      | 0.03  |
| F    | 1     |       | 1.40  | 0.04  |      | 0.05  |
| F1   |       | 3     |       |       | 0.11 |       |
| F2   |       | 2     |       |       | 0.07 |       |
| F3   | 2     |       | 2.40  | 0.07  |      | 0.09  |
| F4   | 3     |       | 3.40  | 0.11  |      | 0.13  |
| G    |       | 10.90 |       |       | 0.43 |       |
| H    | 15.45 |       | 15.75 | 0.60  |      | 0.62  |
| L    | 19.85 |       | 20.15 | 0.78  |      | 0.79  |
| L1   | 3.70  |       | 4.30  | 0.14  |      | 0.17  |
| L2   |       | 18.50 |       |       | 0.72 |       |
| L3   | 14.20 |       | 14.80 | 0.56  |      | 0.58  |
| L4   |       | 34.60 |       |       | 1.36 |       |
| L5   |       | 5.50  |       |       | 0.21 |       |
| M    | 2     |       | 3     | 0.07  |      | 0.11  |
| V    |       | 5°    |       |       | 5°   |       |
| V2   |       | 60°   |       |       | 60°  |       |
| Dia  | 3.55  |       | 3.65  | 0.14  |      | 0.143 |



## ISOWATT218 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 5.35  |      | 5.65  | 0.211 |       | 0.222 |
| C    | 3.30  |      | 3.80  | 0.130 |       | 0.150 |
| D    | 2.90  |      | 3.10  | 0.114 |       | 0.122 |
| D1   | 1.88  |      | 2.08  | 0.074 |       | 0.082 |
| E    | 0.75  |      | 0.95  | 0.030 |       | 0.037 |
| F    | 1.05  |      | 1.25  | 0.041 |       | 0.049 |
| F2   | 1.50  |      | 1.70  | 0.059 |       | 0.067 |
| F3   | 1.90  |      | 2.10  | 0.075 |       | 0.083 |
| G    | 10.80 |      | 11.20 | 0.425 |       | 0.441 |
| H    | 15.80 |      | 16.20 | 0.622 |       | 0.638 |
| L    |       | 9    |       |       | 0.354 |       |
| L1   | 20.80 |      | 21.20 | 0.819 |       | 0.835 |
| L2   | 19.10 |      | 19.90 | 0.752 |       | 0.783 |
| L3   | 22.80 |      | 23.60 | 0.898 |       | 0.929 |
| L4   | 40.50 |      | 42.50 | 1.594 |       | 1.673 |
| L5   | 4.85  |      | 5.25  | 0.191 |       | 0.207 |
| L6   | 20.25 |      | 20.75 | 0.797 |       | 0.817 |
| N    | 2.1   |      | 2.3   | 0.083 |       | 0.091 |
| R    |       | 4.6  |       |       | 0.181 |       |
| DIA  | 3.5   |      | 3.7   | 0.138 |       | 0.146 |



- Weight : 4.9 g (typ.)
- Maximum Torque (applied to mounting flange) Recommended: 0.8 Nm; Maximum: 1 Nm
- The side of the dissipator must be flat within 80 µm

P025C/A



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specification mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a trademark of STMicroelectronics

© 2001 STMicroelectronics – Printed in Italy – All Rights Reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia - Malta - Morocco -  
Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>