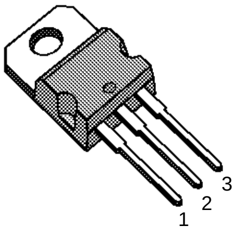
**SGS-THOMSON**
MICROELECTRONICS

# STP3NA60
# STP3NA60FI

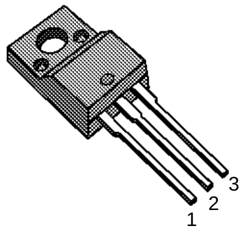
## N - CHANNEL ENHANCEMENT MODE FAST POWER MOS TRANSISTOR

| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| STP3NA60 | 600 V | < 4 Ω | 2.9 A |
| STP3NA60FI | 600 V | < 4 Ω | 2.1 A |

- TYPICAL $R_{DS(on)}$ = 3.3 Ω
- ± 30V GATE TO SOURCE VOLTAGE RATING
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW INTRINSIC CAPACITANCES
- GATE GHARGE MINIMIZED
- REDUCED THRESHOLD VOLTAGE SPREAD



**TO-220**



**ISOWATT220**

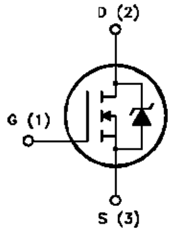
### DESCRIPTION

This series of POWER MOSFETS represents the most advanced high voltage technology. The optimized cell layout coupled with a new proprietary edge termination concur to give the device low $R_{DS(on)}$ and gate charge, unequalled ruggedness and superior switching performance.

### APPLICATIONS

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

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | STP3NA60 | STP3NA60FI | |
| $V_{DS}$ | Drain-source Voltage ($V_{GS}$ = 0) | 600 | | V |
| $V_{DGR}$ | Drain-gate Voltage ($R_{GS}$ = 20 kΩ) | 600 | | V |
| $V_{GS}$ | Gate-source Voltage | ± 30 | | V |
| $I_D$ | Drain Current (continuous) at $T_c$ = 25 °C | 2.9 | 2.1 | A |
| $I_D$ | Drain Current (continuous) at $T_c$ = 100 °C | 1.8 | 1.3 | A |
| $I_{DM}$(•) | Drain Current (pulsed) | 11.6 | 11.6 | A |
| $P_{tot}$ | Total Dissipation at $T_c$ = 25 °C | 80 | 40 | W |
| | Derating Factor | 0.64 | 0.32 | W/°C |
| $V_{ISO}$ | Insulation Withstand Voltage (DC) | — | 2000 | V |
| $T_{stg}$ | Storage Temperature | -65 to 150 | | °C |
| $T_j$ | Max. Operating Junction Temperature | 150 | | °C |

(•) Pulse width limited by safe operating area

## THERMAL DATA

| | | TO-220 | ISOWATT220 | |
|---|---|---|---|---|
| $R_{thj-case}$ | Thermal Resistance Junction-case Max | 1.56 | 3.12 | $^oC/W$ |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient Max | 62.5 | | $^oC/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink Typ | 0.5 | | $^oC/W$ |
| $T_l$ | Maximum Lead Temperature For Soldering Purpose | 300 | | $^oC$ |

## AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max, $\delta < 1\%$) | 2.9 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25\ ^oC$, $I_D = I_{AR}$, $V_{DD} = 50$ V) | 42 | mJ |
| $E_{AR}$ | Repetitive Avalanche Energy (pulse width limited by $T_j$ max, $\delta < 1\%$) | 1.6 | mJ |
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive ($T_c = 100\ ^oC$, pulse width limited by $T_j$ max, $\delta < 1\%$) | 1.8 | A |

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

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D = 250\ \mu A$ $V_{GS} = 0$ | 600 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS}$ = Max Rating<br>$V_{DS}$ = Max Rating x 0.8 $T_c = 125\ ^oC$ | | | 250<br>1000 | µA<br>µA |
| $I_{GSS}$ | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 30$ V | | | ± 100 | nA |

ON (∗)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$ $I_D = 250\ \mu A$ | 2.25 | 3 | 3.75 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10V$ $I_D = 1.5$ A<br>$V_{GS} = 10V$ $I_D = 1.5$ A $T_c = 100^oC$ | | 3.3 | 4<br>8 | Ω<br>Ω |
| $I_{D(on)}$ | On State Drain Current | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10$ V | 2.9 | | | A |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (∗) | Forward Transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 1.5$ A | 1 | 2 | | 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 $V_{GS} = 0$ | | 380<br>57<br>17 | 500<br>75<br>23 | pF<br>pF<br>pF |

## ELECTRICAL CHARACTERISTICS (continued)

### SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on Time<br>Rise Time | $V_{DD}$ = 300 V $I_D$ = 1.5 A<br>$R_G$ = 18 Ω $V_{GS}$ = 10 V<br>(see test circuit, figure 3) | | 14<br>25 | 20<br>35 | ns<br>ns |
| $(di/dt)_{on}$ | Turn-on Current Slope | $V_{DD}$ = 400 V $I_D$ = 3 A<br>$R_G$ = 18 Ω $V_{GS}$ = 10 V<br>(see test circuit, figure 5) | | 300 | | A/µs |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD}$ = 480 V $I_D$ = 3 A $V_{GS}$ = 10 V | | 22<br>6<br>9 | 30 | nC<br>nC<br>nC |

### SWITCHING OFF

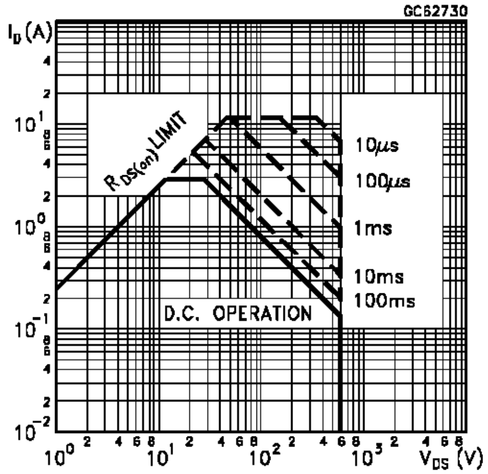
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{r(Voff)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time | $V_{DD}$ = 480 V $I_D$ = 3 A<br>$R_G$ = 18 Ω $V_{GS}$ = 10 V<br>(see test circuit, figure 5) | | 13<br>24<br>12 | 18<br>34<br>17 | ns<br>ns<br>ns |

### SOURCE DRAIN DIODE

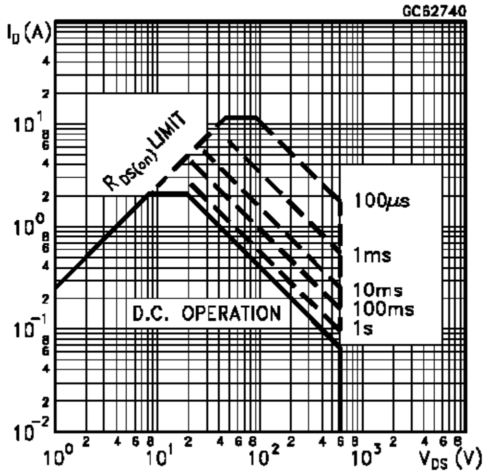
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$(•) | Source-drain Current<br>Source-drain Current (pulsed) | | | | 2.9<br>11.6 | A<br>A |
| $V_{SD}$ (∗) | Forward On Voltage | $I_{SD}$ = 2.9 A $V_{GS}$ = 0 | | | 1.5 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD}$ = 3 A di/dt = 100 A/µs<br>$V_{DD}$ = 100 V $T_j$ = 150 °C<br>(see test circuit, figure 5) | | 460<br>5.6<br>24 | | ns<br>µC<br>A |

(∗) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %
(•) Pulse width limited by safe operating area

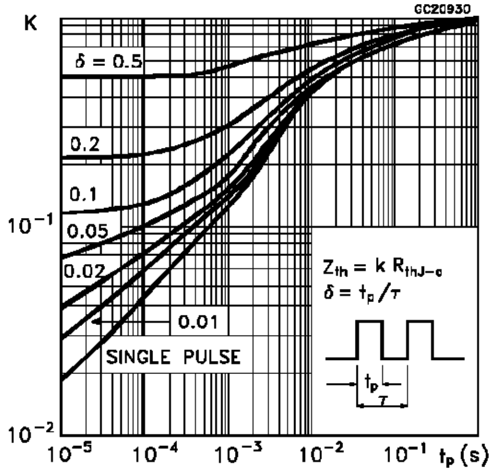
Safe Operating Areas for TO-220



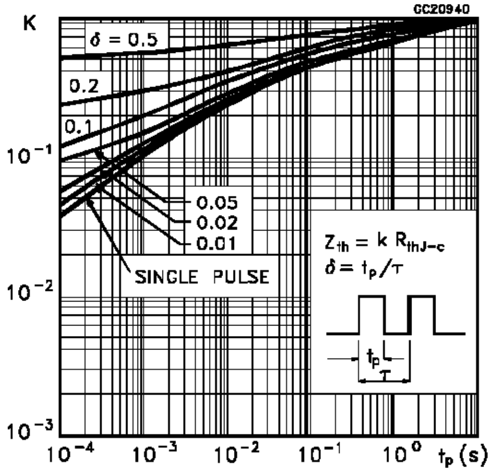
Safe Operating Areas for ISOWATT220



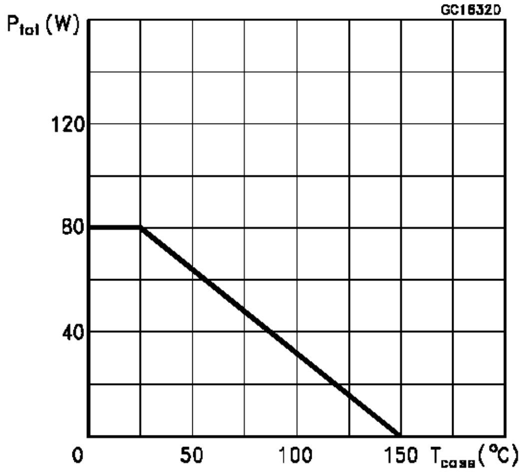
Thermal Impedeance For TO-220



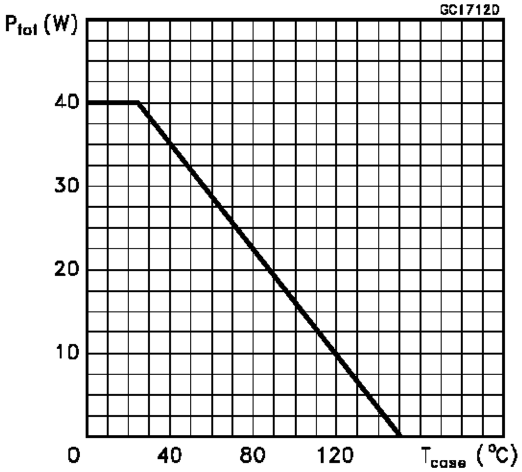
Thermal Impedance For ISOWATT220



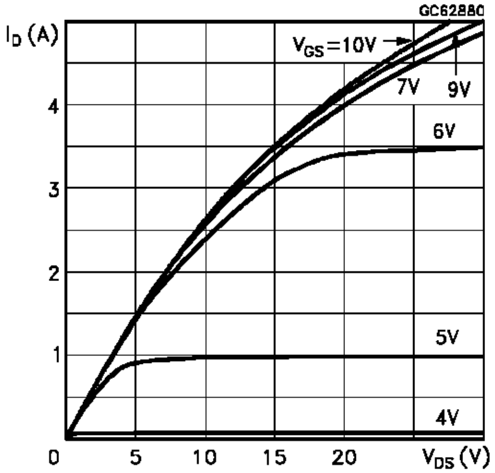
Derating Curve For TO-220



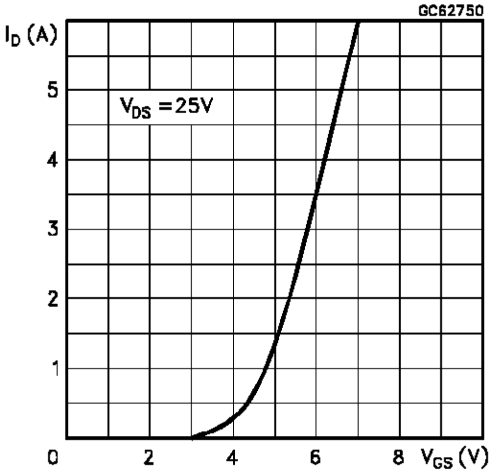
Derating Curve For ISOWATT220



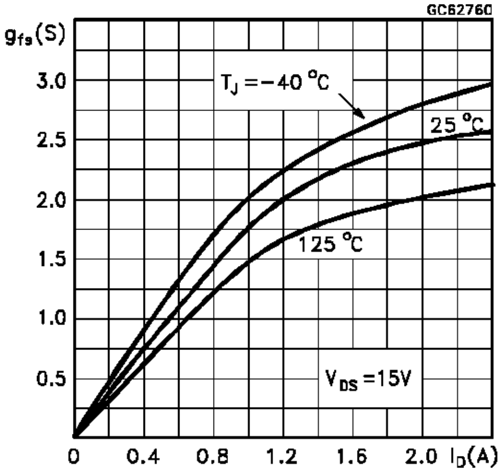
Output Characteristics



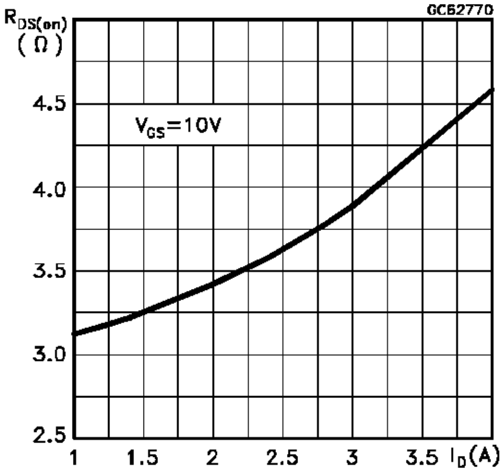
Transfer Characteristics



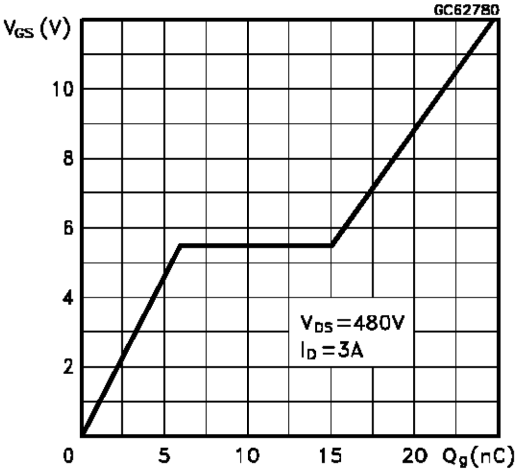
Transconductance



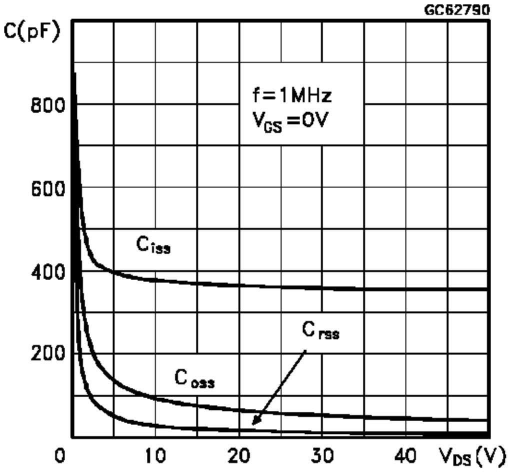
Static Drain-source On Resistance



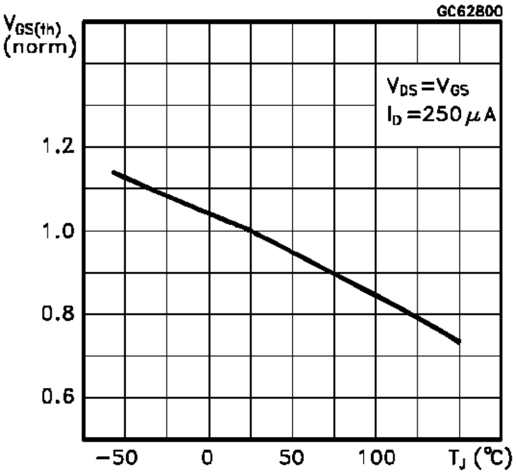
Gate Charge vs Gate-source Voltage



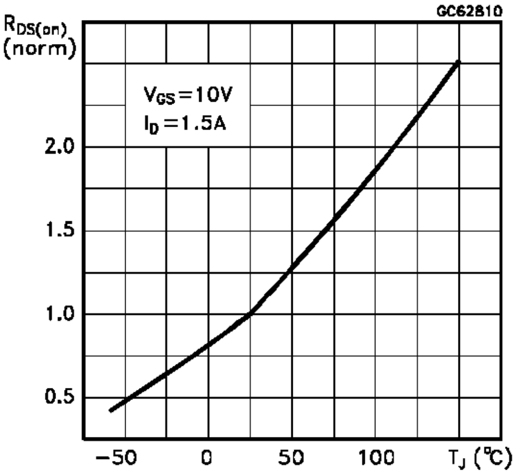
Capacitance Variations



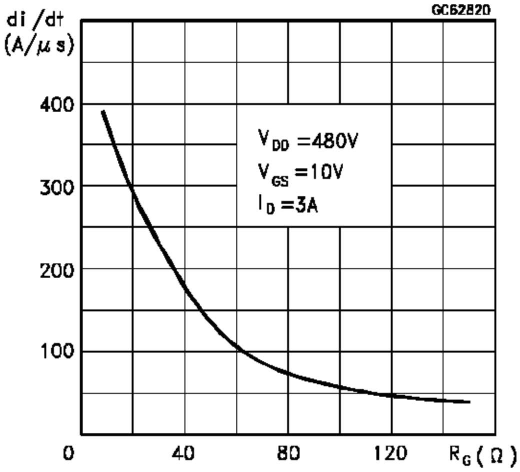
Normalized Gate Threshold Voltage vs Temperature



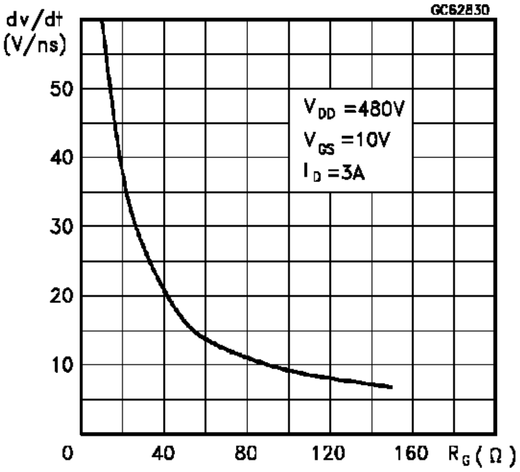
Normalized On Resistance vs Temperature



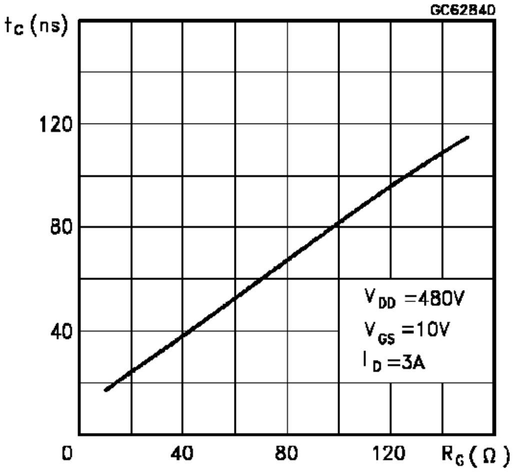
Turn-on Current Slope



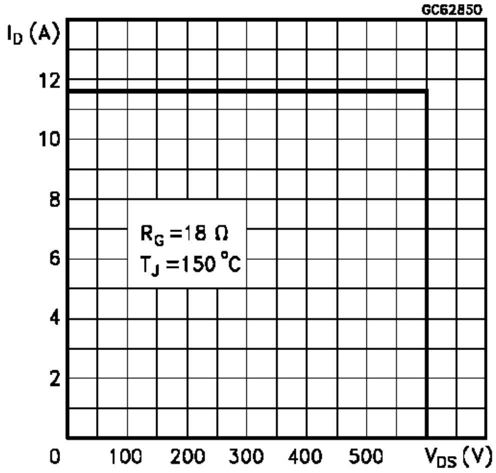
Turn-off Drain-source Voltage Slope



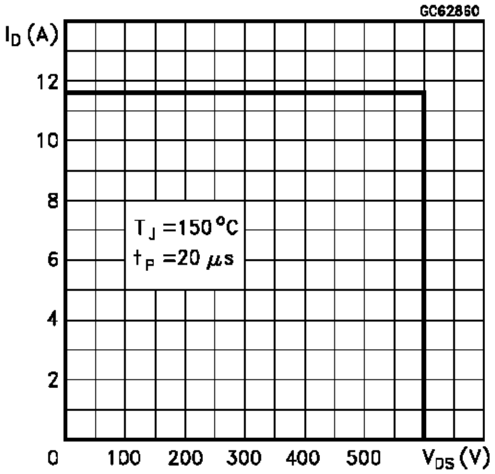
Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

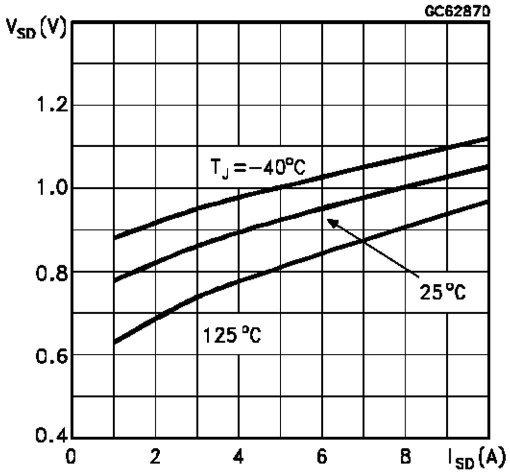


**Fig. 1:** Unclamped Inductive Load Test Circuits

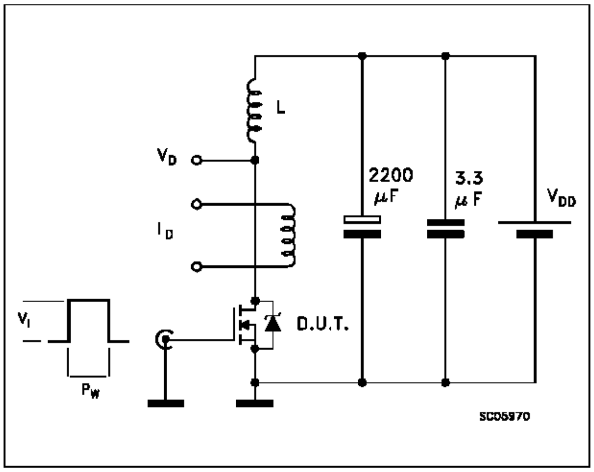


**Fig. 2:** Unclamped Inductive Waveforms

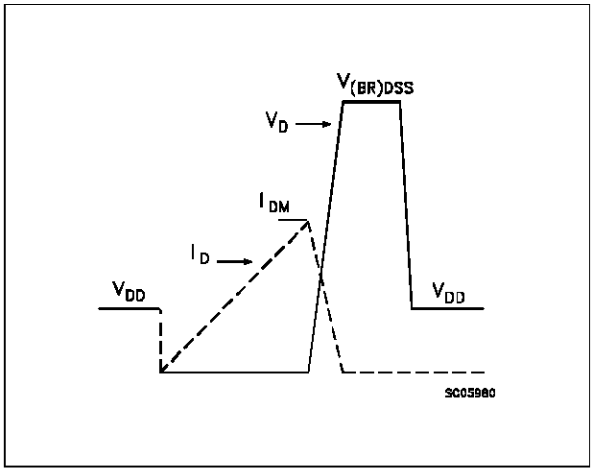


**Fig. 3:** Switching Times Test Circuits For Resistive Load

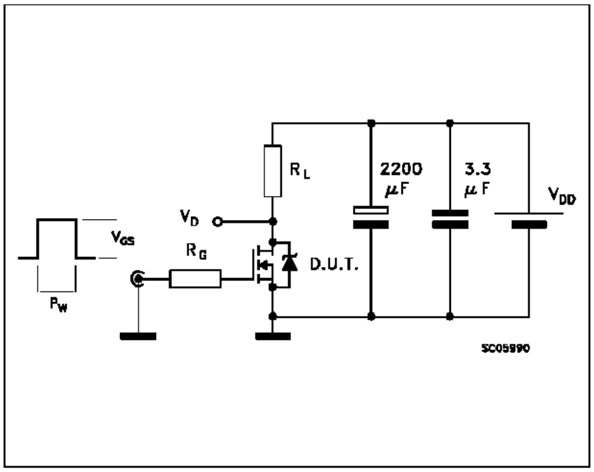


**Fig. 4:** Gate Charge Test Circuit

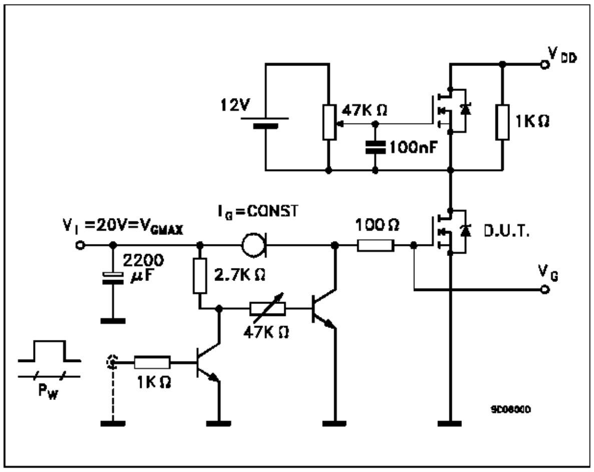
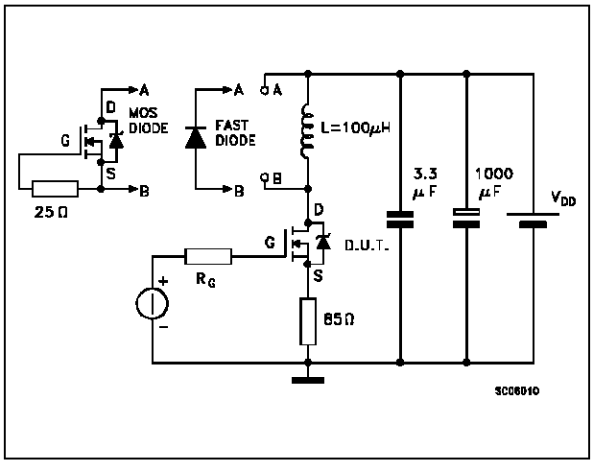
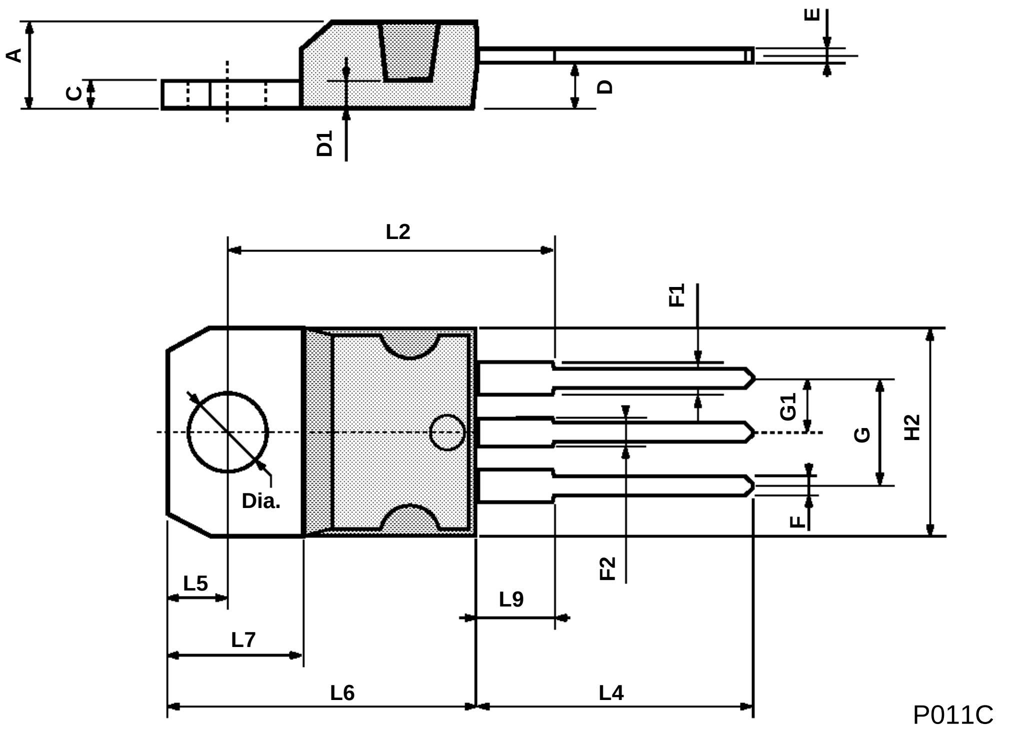


**Fig. 5:** Test Circuit For Inductive Load Switching And Diode Reverse Recovery Time



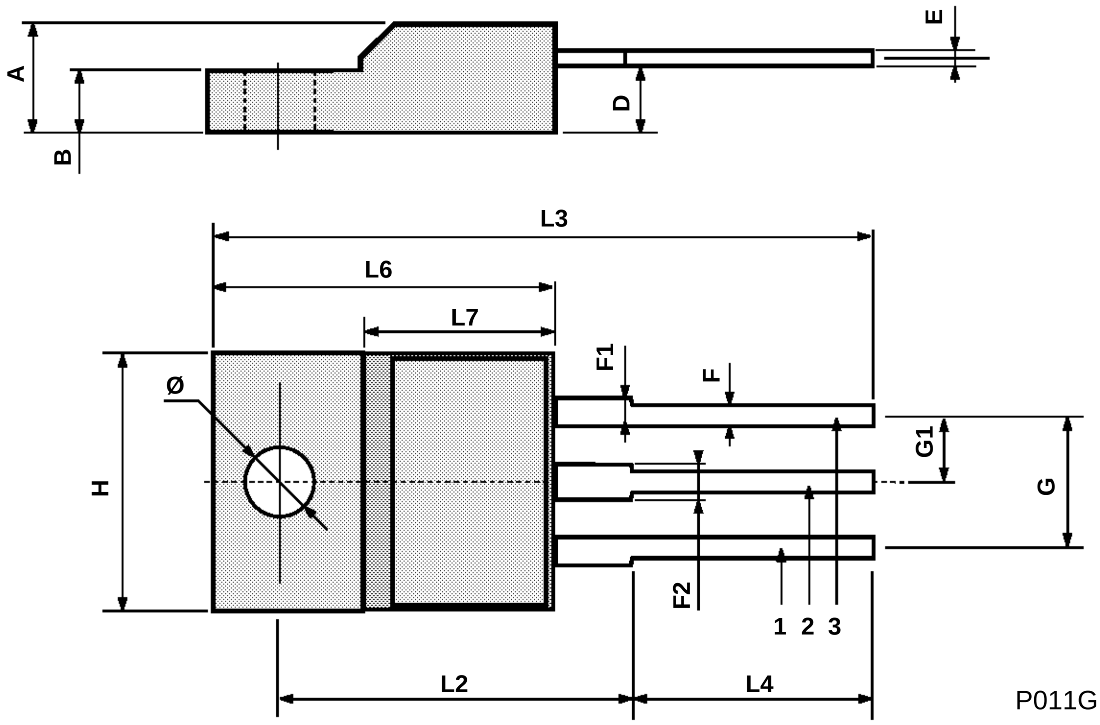
## TO-220 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| C | 1.23 | | 1.32 | 0.048 | | 0.051 |
| D | 2.40 | | 2.72 | 0.094 | | 0.107 |
| D1 | | 1.27 | | | 0.050 | |
| E | 0.49 | | 0.70 | 0.019 | | 0.027 |
| F | 0.61 | | 0.88 | 0.024 | | 0.034 |
| F1 | 1.14 | | 1.70 | 0.044 | | 0.067 |
| F2 | 1.14 | | 1.70 | 0.044 | | 0.067 |
| G | 4.95 | | 5.15 | 0.194 | | 0.203 |
| G1 | 2.4 | | 2.7 | 0.094 | | 0.106 |
| H2 | 10.0 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16.4 | | | 0.645 | |
| L4 | 13.0 | | 14.0 | 0.511 | | 0.551 |
| L5 | 2.65 | | 2.95 | 0.104 | | 0.116 |
| L6 | 15.25 | | 15.75 | 0.600 | | 0.620 |
| L7 | 6.2 | | 6.6 | 0.244 | | 0.260 |
| L9 | 3.5 | | 3.93 | 0.137 | | 0.154 |
| DIA. | 3.75 | | 3.85 | 0.147 | | 0.151 |



# ISOWATT220 MECHANICAL DATA

| DIM. | mm |  |  | inch |  |  |
|---|---|---|---|---|---|---|
|  | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 |  | 4.6 | 0.173 |  | 0.181 |
| B | 2.5 |  | 2.7 | 0.098 |  | 0.106 |
| D | 2.5 |  | 2.75 | 0.098 |  | 0.108 |
| E | 0.4 |  | 0.7 | 0.015 |  | 0.027 |
| F | 0.75 |  | 1 | 0.030 |  | 0.039 |
| F1 | 1.15 |  | 1.7 | 0.045 |  | 0.067 |
| F2 | 1.15 |  | 1.7 | 0.045 |  | 0.067 |
| G | 4.95 |  | 5.2 | 0.195 |  | 0.204 |
| G1 | 2.4 |  | 2.7 | 0.094 |  | 0.106 |
| H | 10 |  | 10.4 | 0.393 |  | 0.409 |
| L2 |  | 16 |  |  | 0.630 |  |
| L3 | 28.6 |  | 30.6 | 1.126 |  | 1.204 |
| L4 | 9.8 |  | 10.6 | 0.385 |  | 0.417 |
| L6 | 15.9 |  | 16.4 | 0.626 |  | 0.645 |
| L7 | 9 |  | 9.3 | 0.354 |  | 0.366 |
| Ø | 3 |  | 3.2 | 0.118 |  | 0.126 |



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