

N - CHANNEL ENHANCEMENT MODE FAST POWER MOS TRANSISTOR

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|------------|------------------|---------------------|----------------|
| STP6NA60 | 600 V | < 1.2 Ω | 6.5 A |
| STP6NA60FI | 600 V | < 1.2 Ω | 3.9 A |

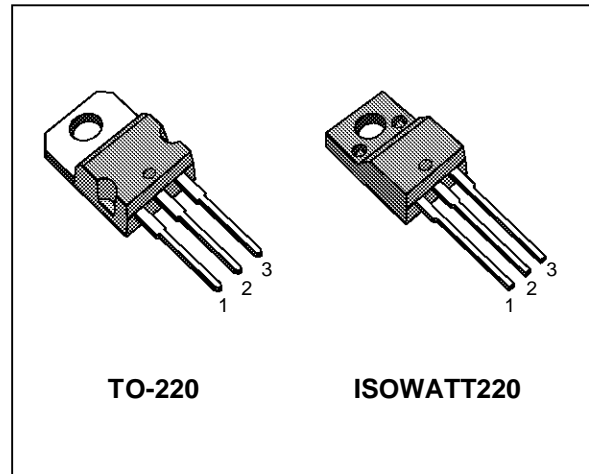
- TYPICAL R_{DS(on)} = 1 Ω
- ± 30V GATE TO SOURCE VOLTAGE RATING
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED
- REDUCED THRESHOLD VOLTAGE SPREAD

DESCRIPTION

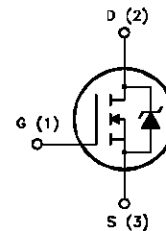
This series of POWER MOSFETS represents the most advanced high voltage technology. The optimized cell layout coupled with a new proprietary edge termination concur to give the device low R_{DS(on)} and gate charge, unequalled ruggedness and superior switching performance.

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 |
|---------------------|---|------------|------------|------|
| | | STP6NA60 | STP6NA60FI | |
| 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 | 6.5 | 3.9 | A |
| I _D | Drain Current (continuous) at T _c = 100 °C | 4.3 | 2.6 | A |
| I _{DM} (•) | Drain Current (pulsed) | 26 | 26 | A |
| P _{tot} | Total Dissipation at T _c = 25 °C | 125 | 45 | W |
| | Derating Factor | 1 | 0.36 | 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 | 2.78 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient | Max | 62.5 | | °C/W |
| R _{thc-sink} | Thermal Resistance Case-sink | Typ | 0.5 | | °C/W |
| T _l | Maximum Lead Temperature For Soldering Purpose | | 300 | | °C |

AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
|-----------------|--|-----------|------|
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max, δ < 1%) | 6.5 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 215 | mJ |
| E _{AR} | Repetitive Avalanche Energy (pulse width limited by T _j max, δ < 1%) | 9.5 | mJ |
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (T _c = 100 °C, pulse width limited by T _j max, δ < 1%) | 4.3 | A |

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|--|------|------|-------------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250 μA V _{GS} = 0 | 600 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating x 0.8 T _c = 125 °C | | | 250 1000 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ± 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 μA | 2.25 | 3 | 3.75 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V I _D = 3 A V _{GS} = 10V I _D = 3 A T _c = 100°C | | 1 | 1.2 2.4 | Ω Ω |
| I _{D(on)} | On State Drain Current | V _{DS} > I _{D(on)} x R _{DS(on)max} V _{GS} = 10 V | 6.5 | | | A |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--|------|------|------|------|
| g _{fs} (*) | Forward Transconductance | V _{DS} > I _{D(on)} x R _{DS(on)max} I _D = 3 A | 3.5 | 5.6 | | S |
| C _{iss} | Input Capacitance | V _{DS} = 25 V f = 1 MHz V _{GS} = 0 | | 1150 | 1550 | pF |
| C _{oss} | Output Capacitance | | | 155 | 210 | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 40 | 55 | pF |

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|---|------|---------------|-----------|----------------|
| $t_{d(on)}$ t_r | Turn-on Time Rise Time | $V_{DD} = 300\text{ V}$ $I_D = 3\text{ A}$ $R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 3) | | 35 90 | 50 125 | ns ns |
| $(di/dt)_{on}$ | Turn-on Current Slope | $V_{DD} = 480\text{ V}$ $I_D = 6\text{ A}$ $R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5) | | 200 | | A/ μ s |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 480\text{ V}$ $I_D = 3\text{ A}$ $V_{GS} = 10\text{ V}$ | | 54 8 23 | 75 | nC nC nC |

SWITCHING OFF

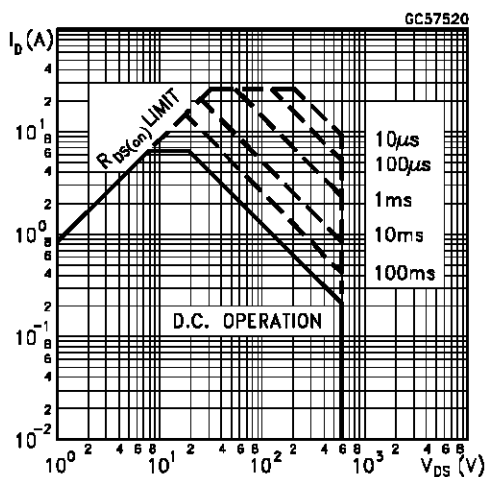
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------------------|---|---|------|-----------------|------------------|----------------|
| $t_{r(Voff)}$ t_f t_c | Off-voltage Rise Time Fall Time Cross-over Time | $V_{DD} = 480\text{ V}$ $I_D = 6\text{ A}$ $R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5) | | 80 20 115 | 110 30 155 | ns ns ns |

SOURCE DRAIN DIODE

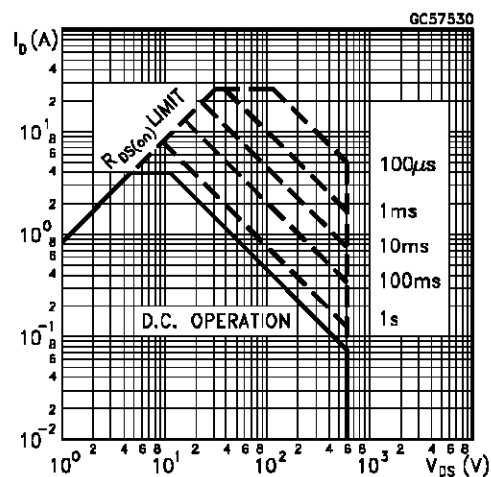
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|---|------|----------------|-----------|--------------------|
| I_{SD} $I_{SDM}(\bullet)$ | Source-drain Current Source-drain Current (pulsed) | | | | 6.5 26 | A A |
| $V_{SD} (*)$ | Forward On Voltage | $I_{SD} = 6.5\text{ A}$ $V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 6\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see test circuit, figure 5) | | 600 9 30 | | ns μ C A |

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

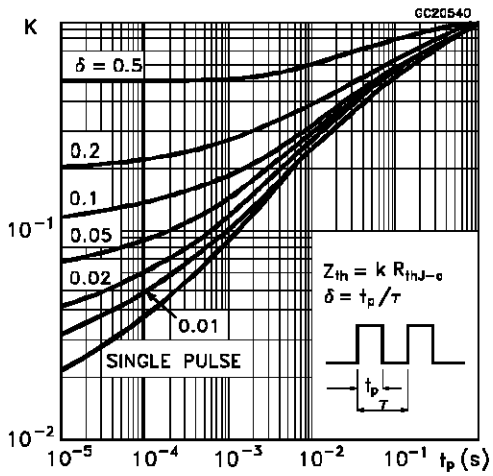
Safe Operating Areas for TO-220



Safe Operating Areas for ISOWATT220



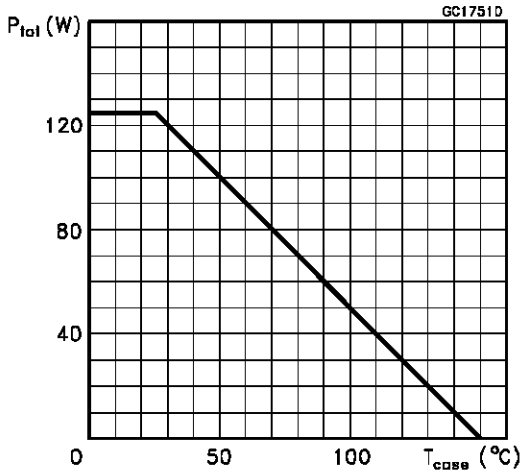
Thermal Impedance For TO-220



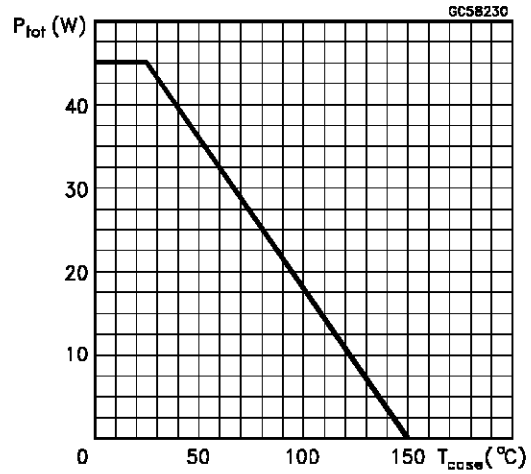
Thermal Impedance For ISOWATT220



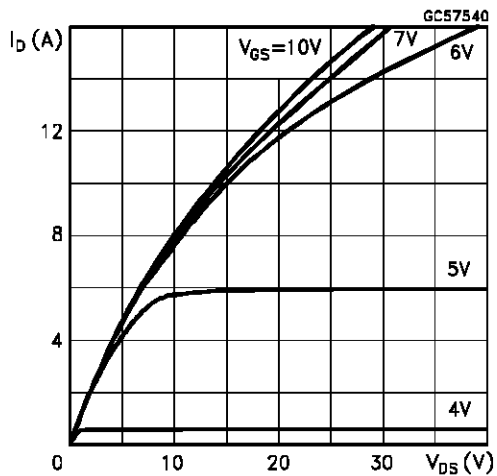
Derating Curve For TO-220



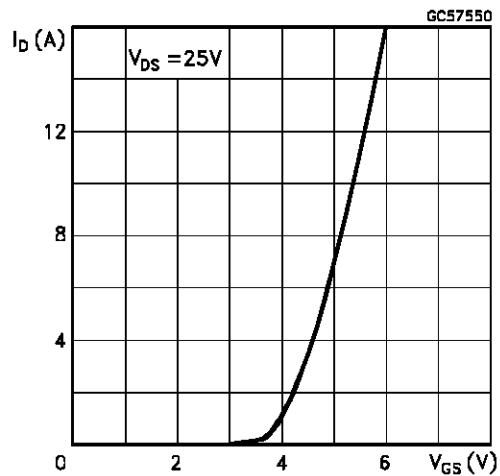
Derating Curve For ISOWATT220



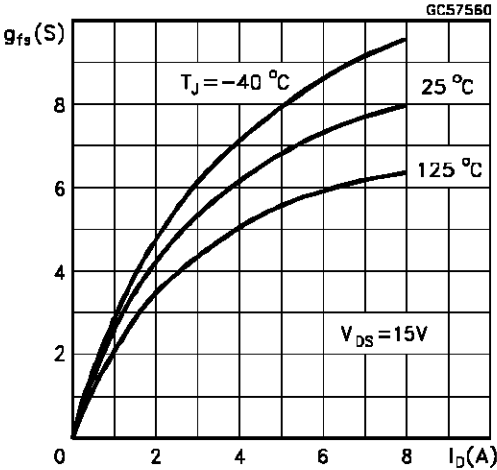
Output Characteristics



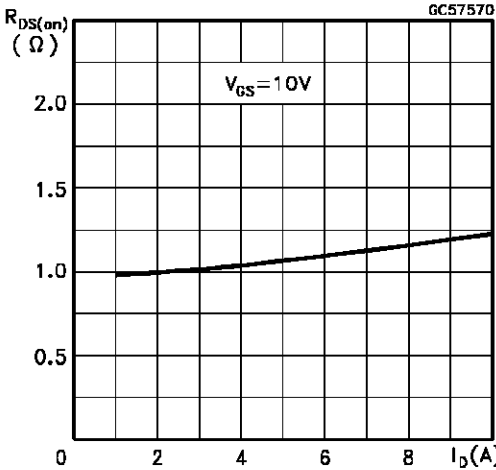
Transfer Characteristics



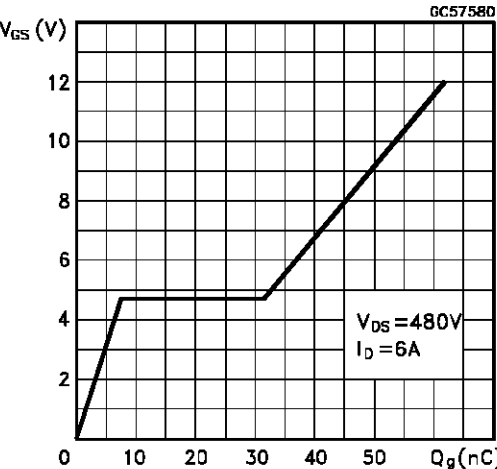
Transconductance



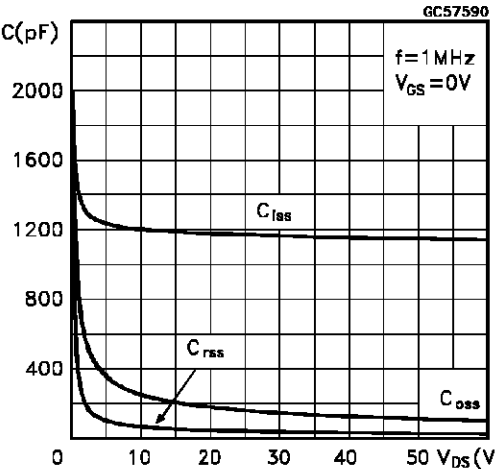
Static Drain-source On Resistance



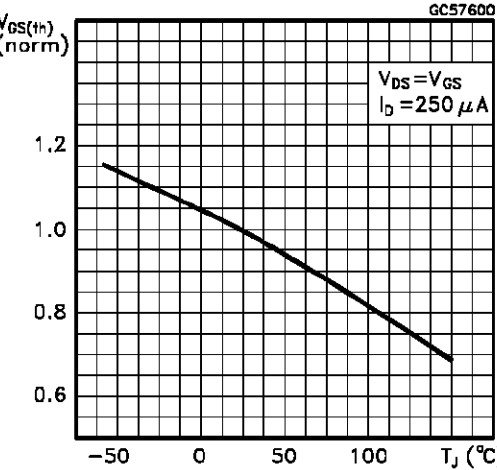
Gate Charge vs Gate-source Voltage



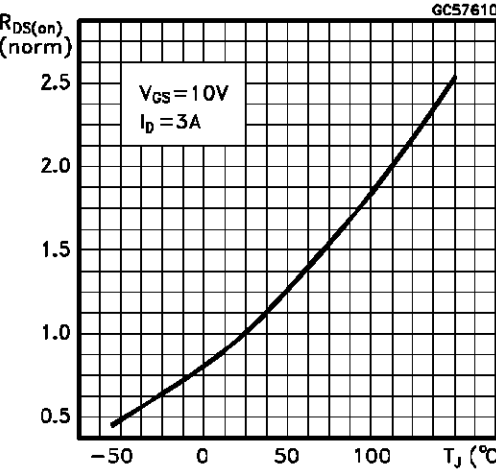
Capacitance Variations



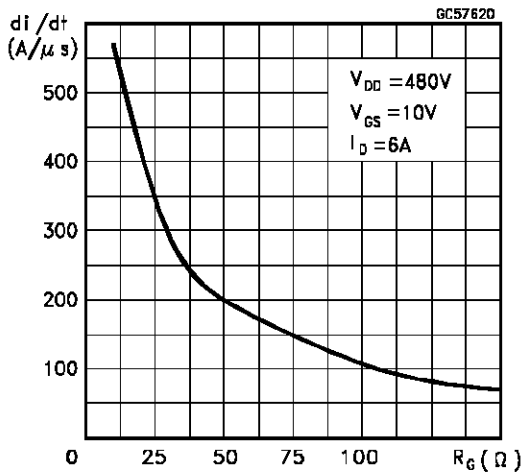
Normalized Gate Threshold Voltage vs Temperature



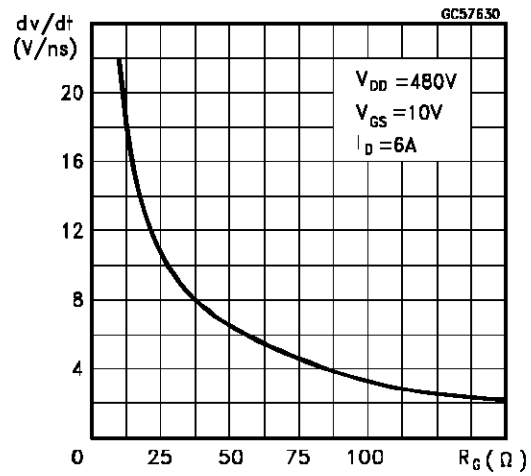
Normalized On Resistance vs Temperature



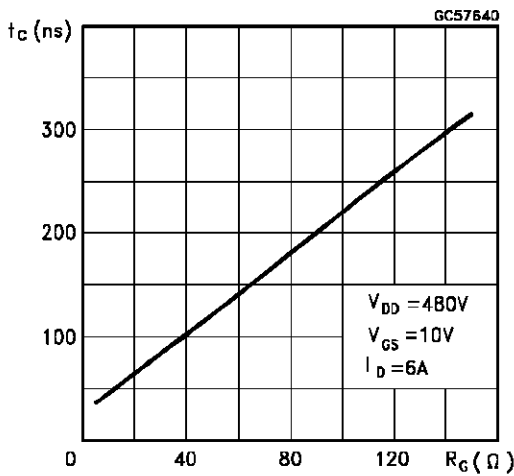
Turn-on Current Slope



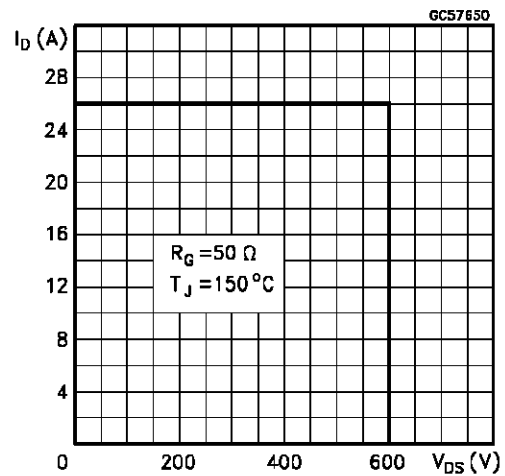
Turn-off Drain-source Voltage Slope



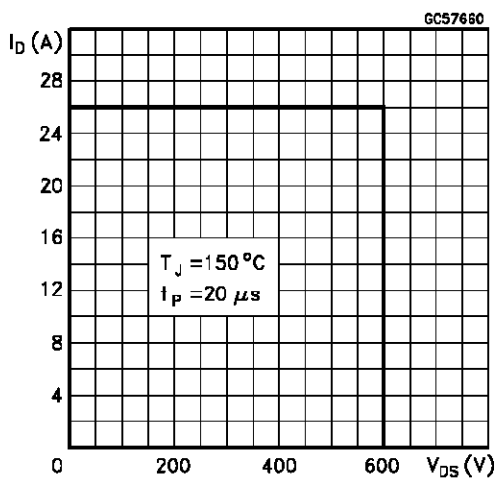
Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

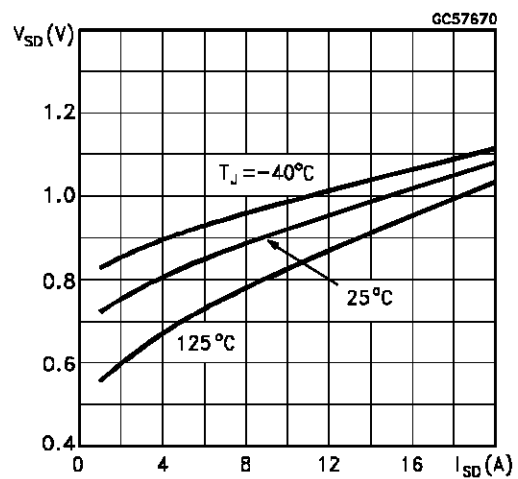


Fig. 1: Unclamped Inductive Load Test Circuits



Fig. 2: Unclamped Inductive Waveforms



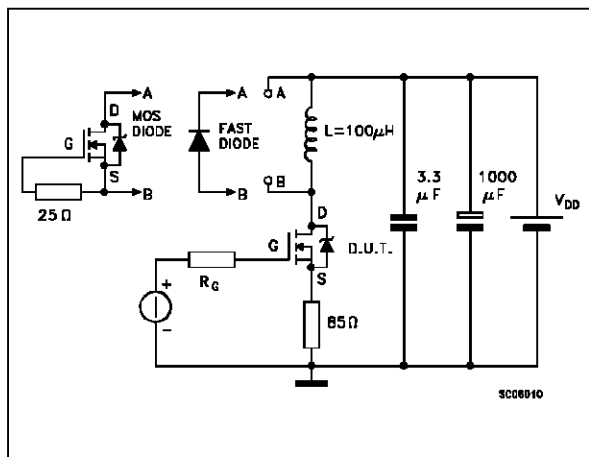
Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge Test Circuit

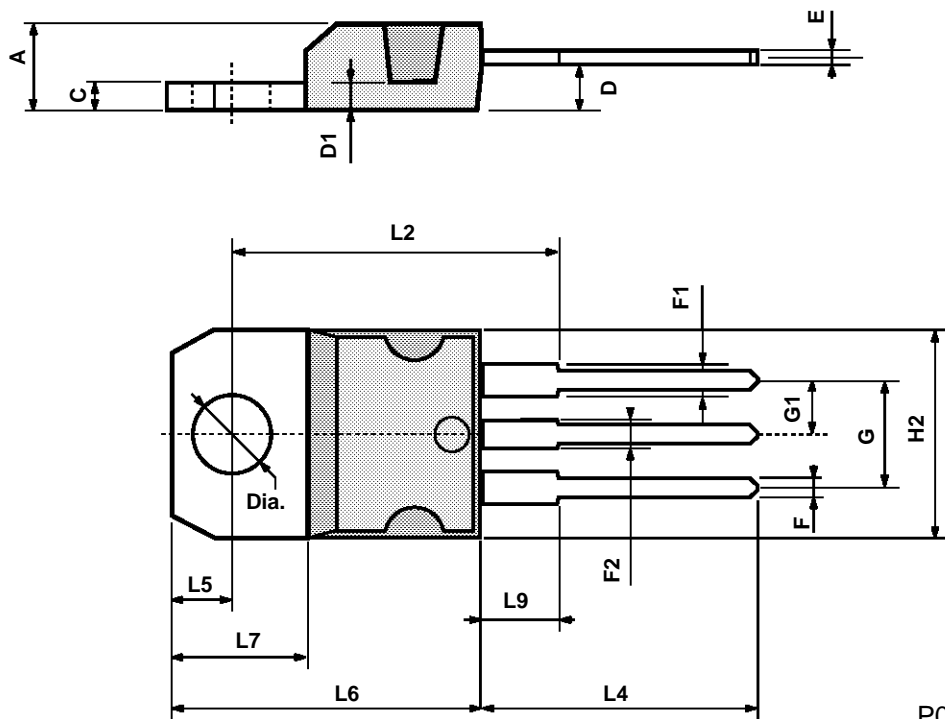


Fig. 5: Test Circuit For Inductive Load Switching And Diode Reverse Recovery Time



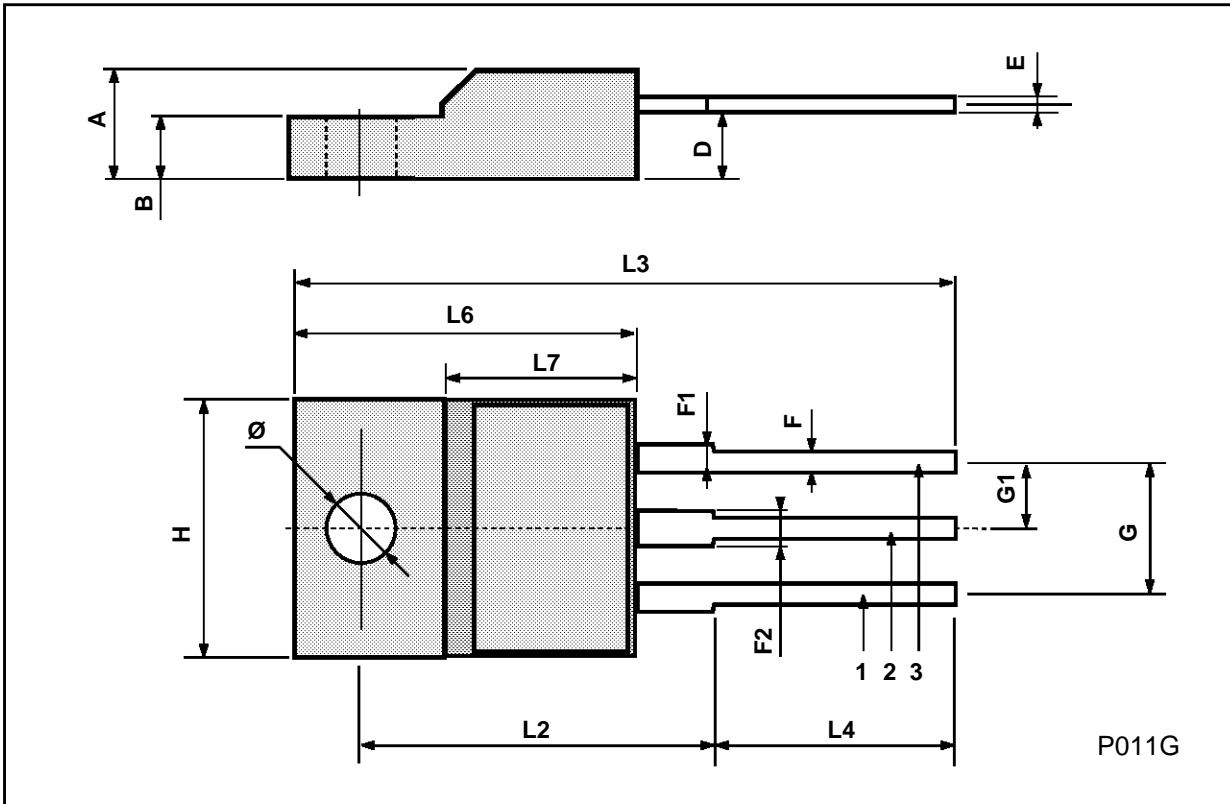
TO-220 MECHANICAL DATA

| 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 |
| ∅ | 3 | | 3.2 | 0.118 | | 0.126 |



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