

N - CHANNEL ENHANCEMENT MODE FAST POWER MOS TRANSISTOR

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|-------------|------------------|---------------------|----------------|
| STH15NA50 | 500 V | < 0.4 Ω | 14.6 A |
| STH15NA50FI | 500 V | < 0.4 Ω | 9.3 A |
| STW15NA50 | 500 V | < 0.4 Ω | 14.6 A |

- TYPICAL R_{DS(on)} = 0.33 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.

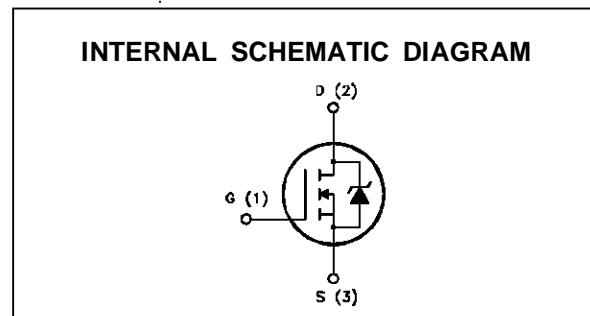
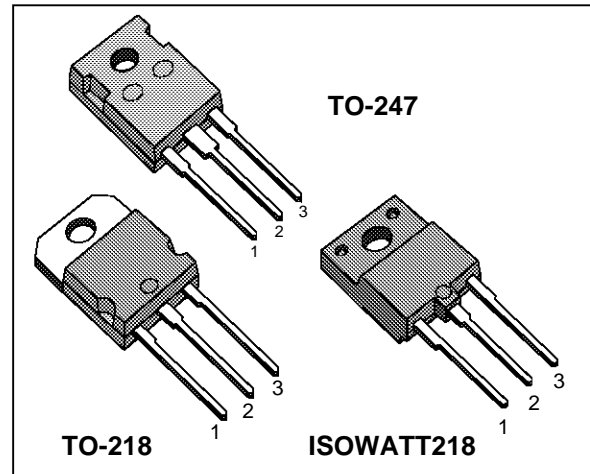
APPLICATIONS

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

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|---|---------------|-------------|------|
| | | STH/STW15NA50 | STH15NA50FI | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 500 | | V |
| V _{DGR} | Drain- gate Voltage (R _{GS} = 20 kΩ) | 500 | | V |
| V _{GS} | Gate-source Voltage | ± 30 | | V |
| I _D | Drain Current (continuous) at T _c = 25 °C | 14.6 | 9.3 | A |
| I _D | Drain Current (continuous) at T _c = 100 °C | 9.2 | 5.5 | A |
| I _{DM} (•) | Drain Current (pulsed) | 58.4 | 58.4 | A |
| P _{tot} | Total Dissipation at T _c = 25 °C | 190 | 80 | W |
| | Derating Factor | 1.52 | 0.64 | W/°C |
| V _{ISO} | Insulation Withstand Voltage (DC) | — | 4000 | V |
| T _{stg} | Storage Temperature | -65 to 150 | | °C |
| T _j | Max. Operating Junction Temperature | 150 | | °C |

(•) Pulse width limited by safe operating area



STH15NA50/FI - STW15NA50

THERMAL DATA

| | | | TO-218/TO-247 | ISOWATT218 | |
|-----------------------|--|-----|---------------|------------|------|
| R _{thj-case} | Thermal Resistance Junction-case | Max | 0.66 | 1.56 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient | Max | 30 | | °C/W |
| R _{thc-sink} | Thermal Resistance Case-sink | Typ | 0.1 | | °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%) | 14.6 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 850 | mJ |
| E _{AR} | Repetitive Avalanche Energy (pulse width limited by T _j max, δ < 1%) | 30 | mJ |
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (T _c = 100 °C, pulse width limited by T _j max, δ < 1%) | 9.2 | 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 | 500 | | | 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 = 7.5 A V _{GS} = 10V I _D = 7.5 A T _c = 100°C | | 0.33 | 0.4 0.8 | Ω Ω |
| I _{D(on)} | On State Drain Current | V _{DS} > I _{D(on)} x R _{DS(on)max} V _{GS} = 10 V | 14.6 | | | 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 = 7.5 A | 9 | 13 | | S |
| C _{iss} | Input Capacitance | V _{DS} = 25 V f = 1 MHz V _{GS} = 0 | | 2500 | 3250 | pF |
| C _{oss} | Output Capacitance | | | 345 | 450 | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 105 | 140 | pF |

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|-----------------|----------|----------------|
| $t_{d(on)}$ t_r | Turn-on Time Rise Time | $V_{DD} = 225\text{ V}$ $I_D = 7.5\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 3) | | 24 37 | 34 50 | ns ns |
| $(di/dt)_{on}$ | Turn-on Current Slope | $V_{DD} = 400\text{ V}$ $I_D = 15\text{ A}$ $R_G = 47\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5) | | 225 | | A/ μ s |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 400\text{ V}$ $I_D = 15\text{ A}$ $V_{GS} = 10\text{ V}$ | | 110 15 55 | 140 | nC nC nC |

SWITCHING OFF

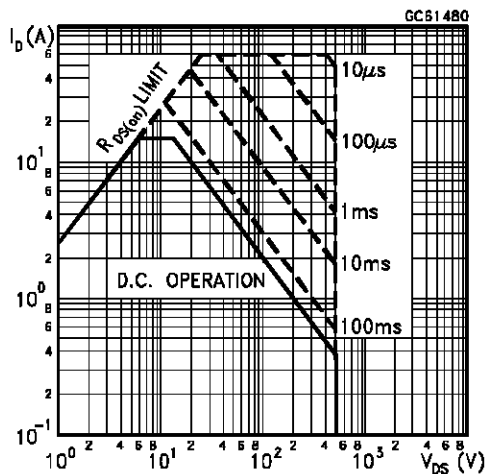
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------------------|---|---|------|----------------|----------------|----------------|
| $t_{r(Voff)}$ t_f t_c | Off-voltage Rise Time Fall Time Cross-over Time | $V_{DD} = 400\text{ V}$ $I_D = 15\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5) | | 25 17 45 | 35 24 60 | ns ns ns |

SOURCE DRAIN DIODE

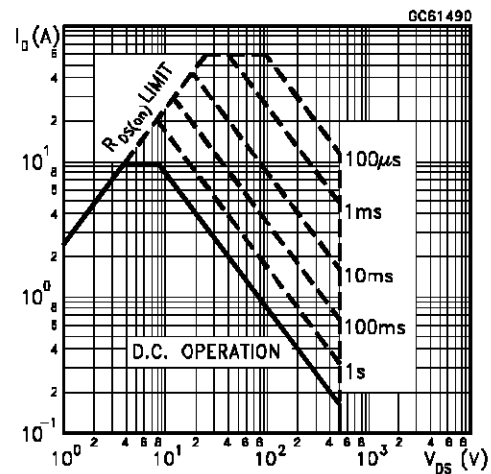
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|-------------------|--------------|--------------------|
| I_{SD} $I_{SDM}(\bullet)$ | Source-drain Current Source-drain Current (pulsed) | | | | 14.6 58.4 | A A |
| $V_{SD} (*)$ | Forward On Voltage | $I_{SD} = 15\text{ A}$ $V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 15\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see test circuit, figure 5) | | 640 12.8 40 | | 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-218 and TO-247

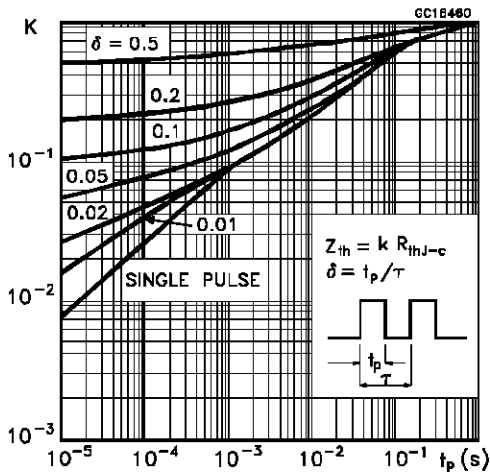


Safe Operating Areas For ISOWATT218

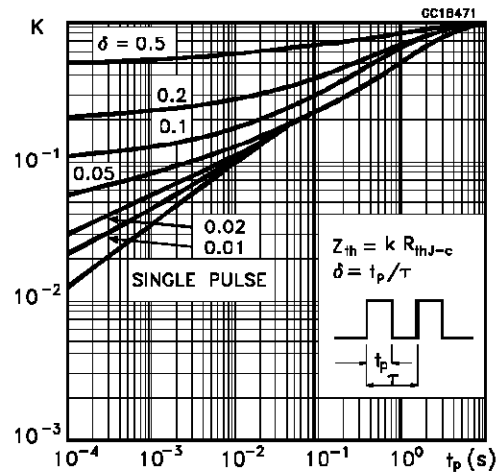


STH15NA50/FI - STW15NA50

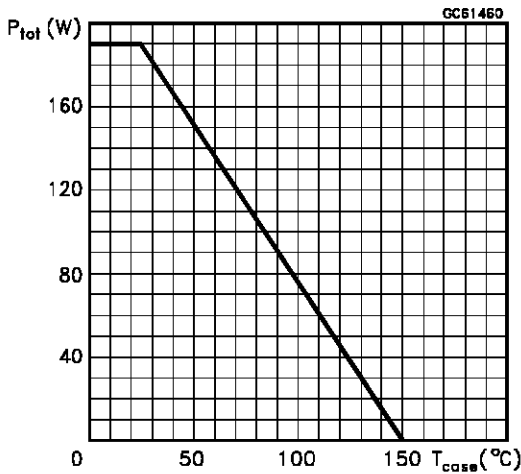
Thermal Impedance For TO-218 and TO-247



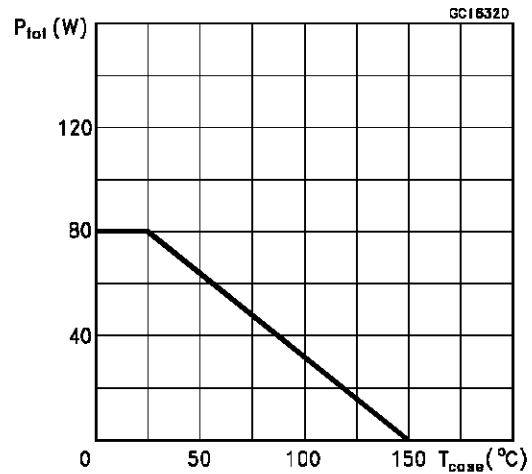
Thermal Impedance For ISOWATT218



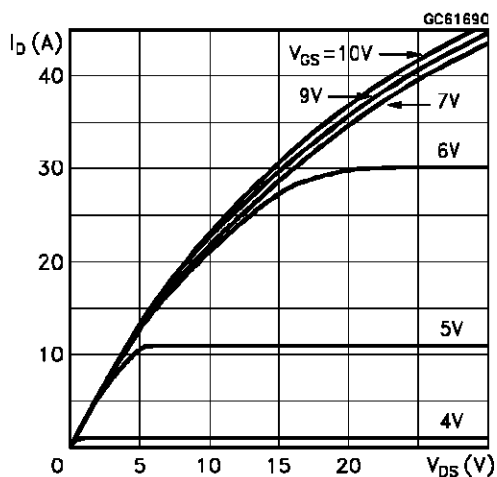
Derating Curve For TO-218 and TO-247



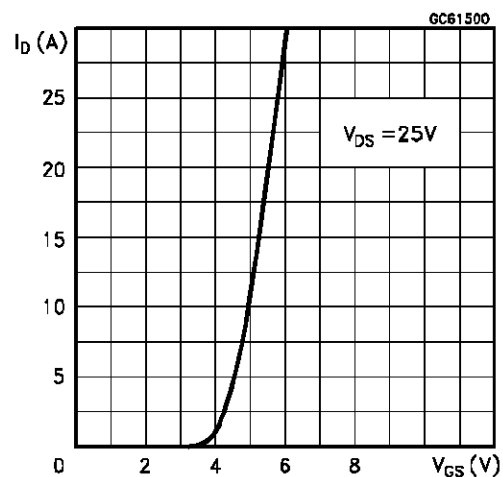
Derating Curve For ISOWATT218



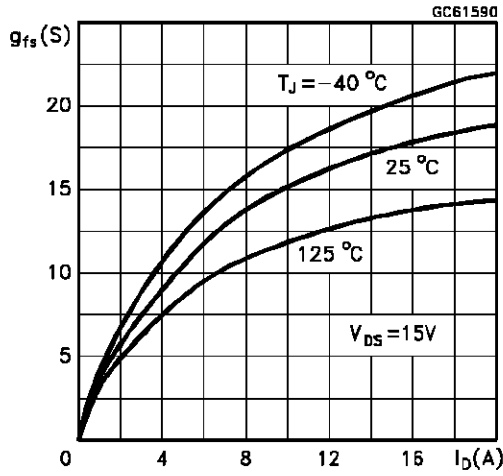
Output Characteristics



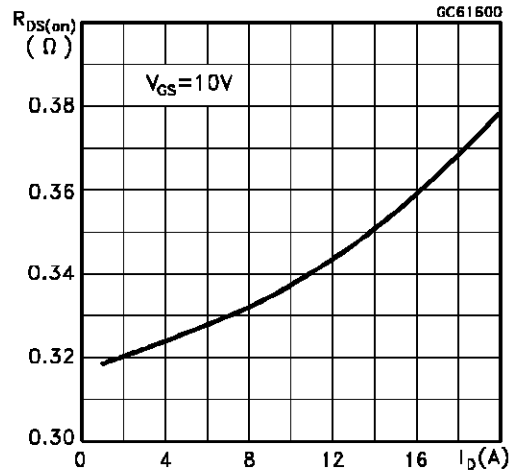
Transfer Characteristics



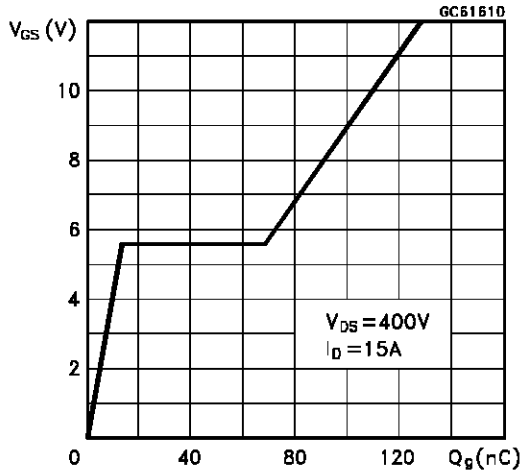
Transconductance



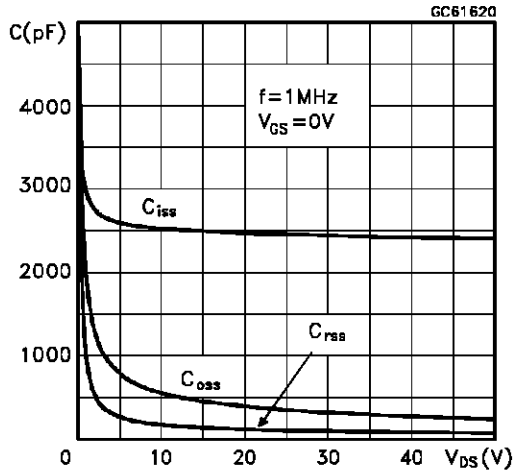
Static Drain-source On Resistance



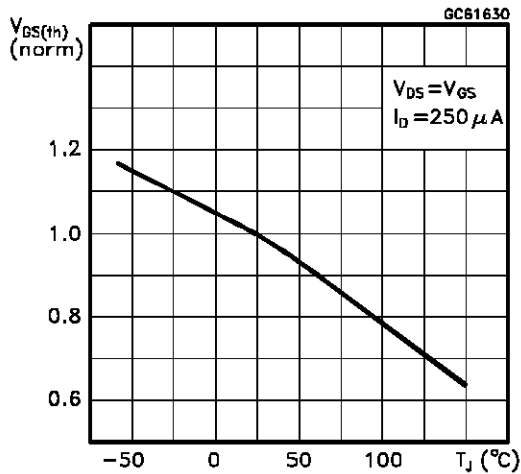
Gate Charge vs Gate-source Voltage



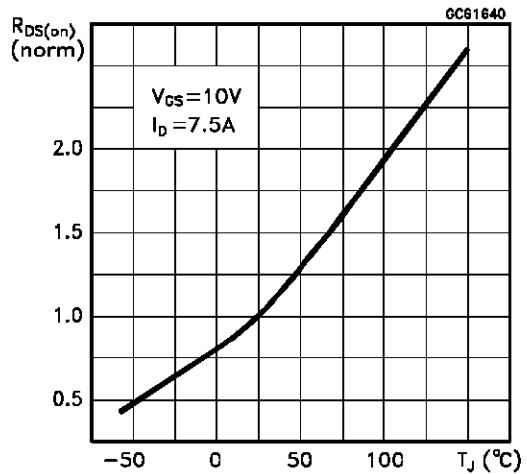
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature

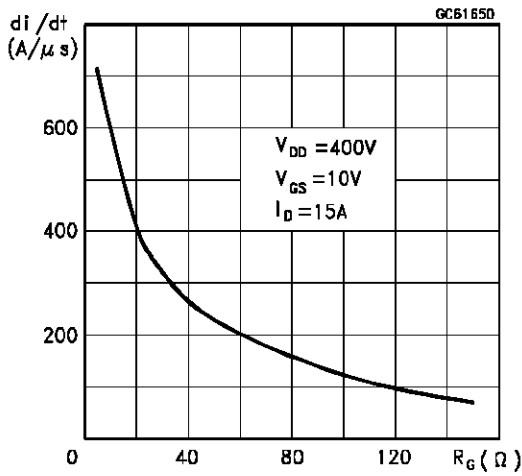


Normalized On Resistance vs Temperature

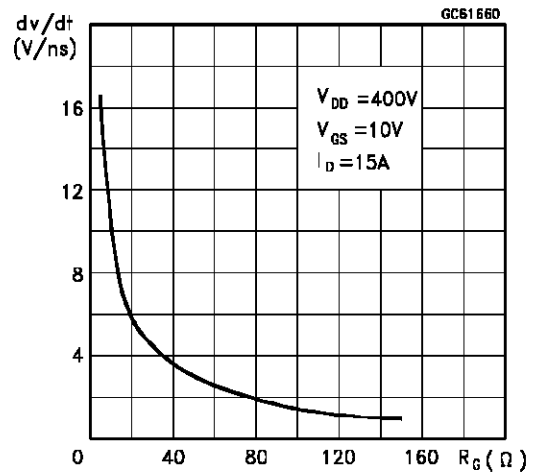


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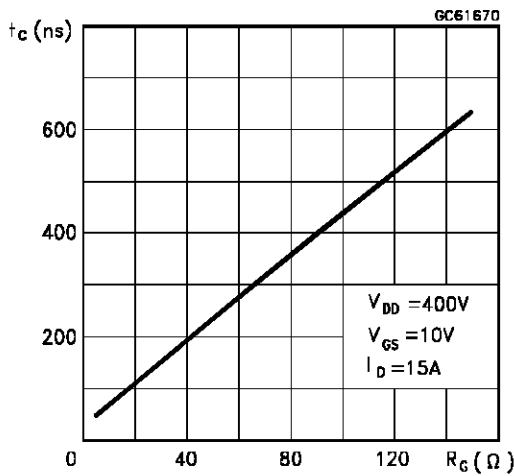
Turn-on Current Slope



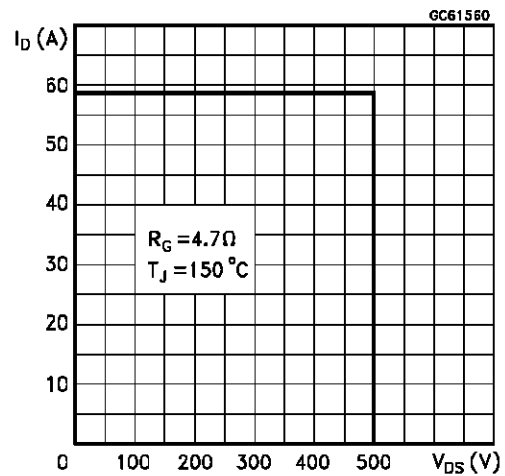
Turn-off Drain-source Voltage Slope



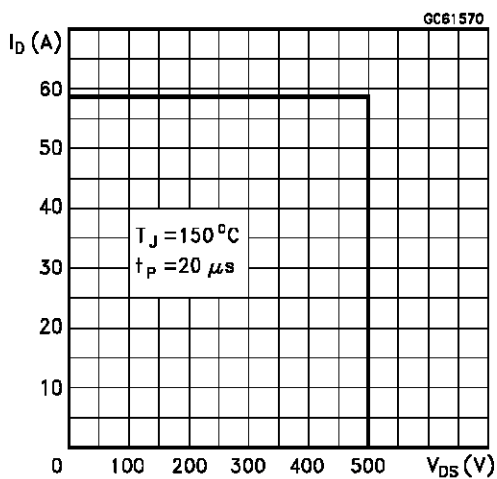
Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

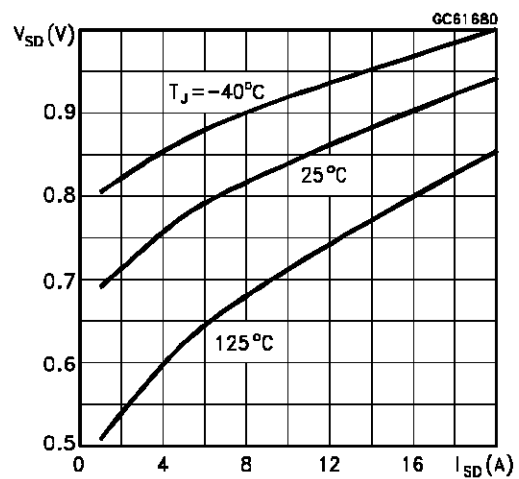


Fig. 1: Unclamped Inductive Load Test Circuits

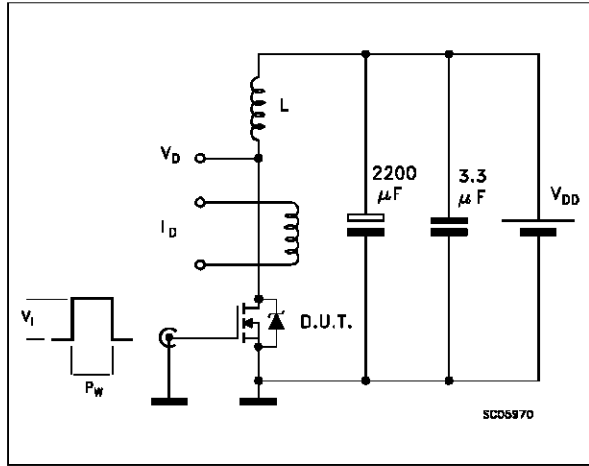


Fig. 2: Unclamped Inductive Waveforms

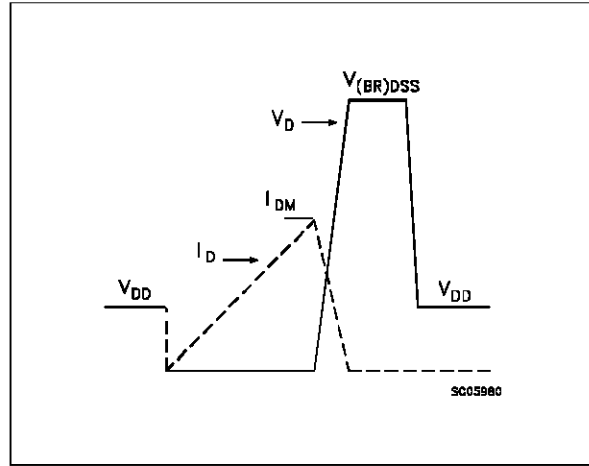


Fig. 3: Switching Times Test Circuits For Resistive Load

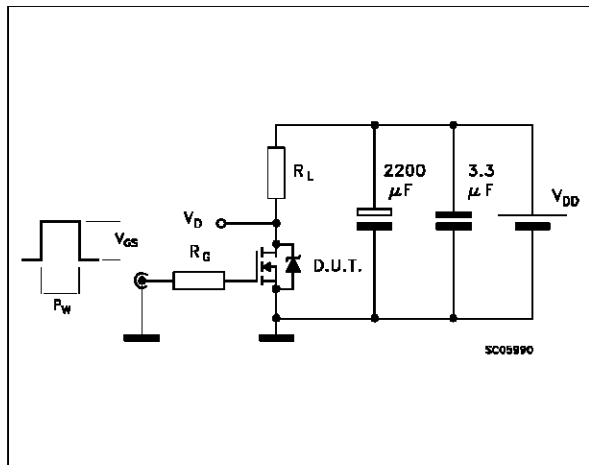


Fig. 4: Gate Charge Test Circuit

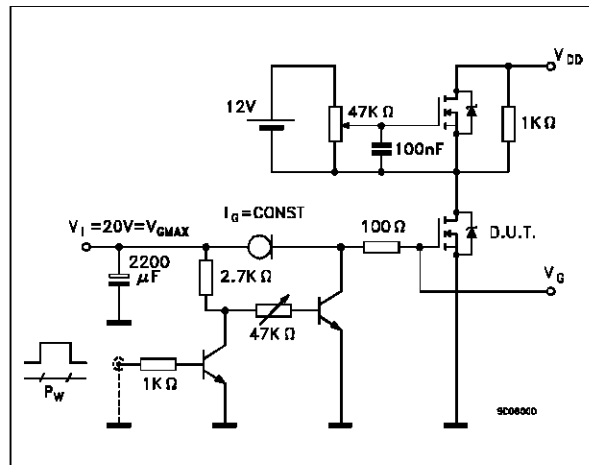
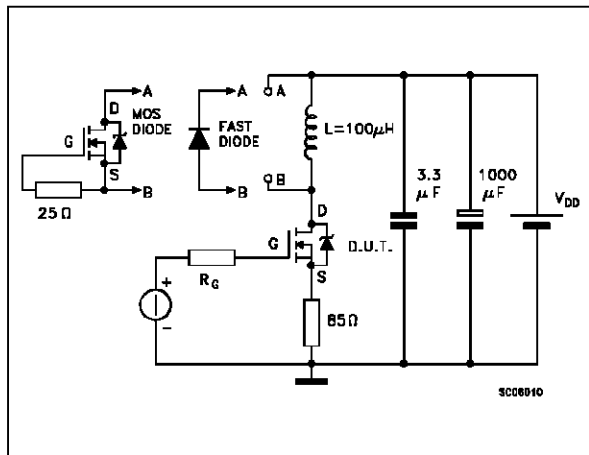
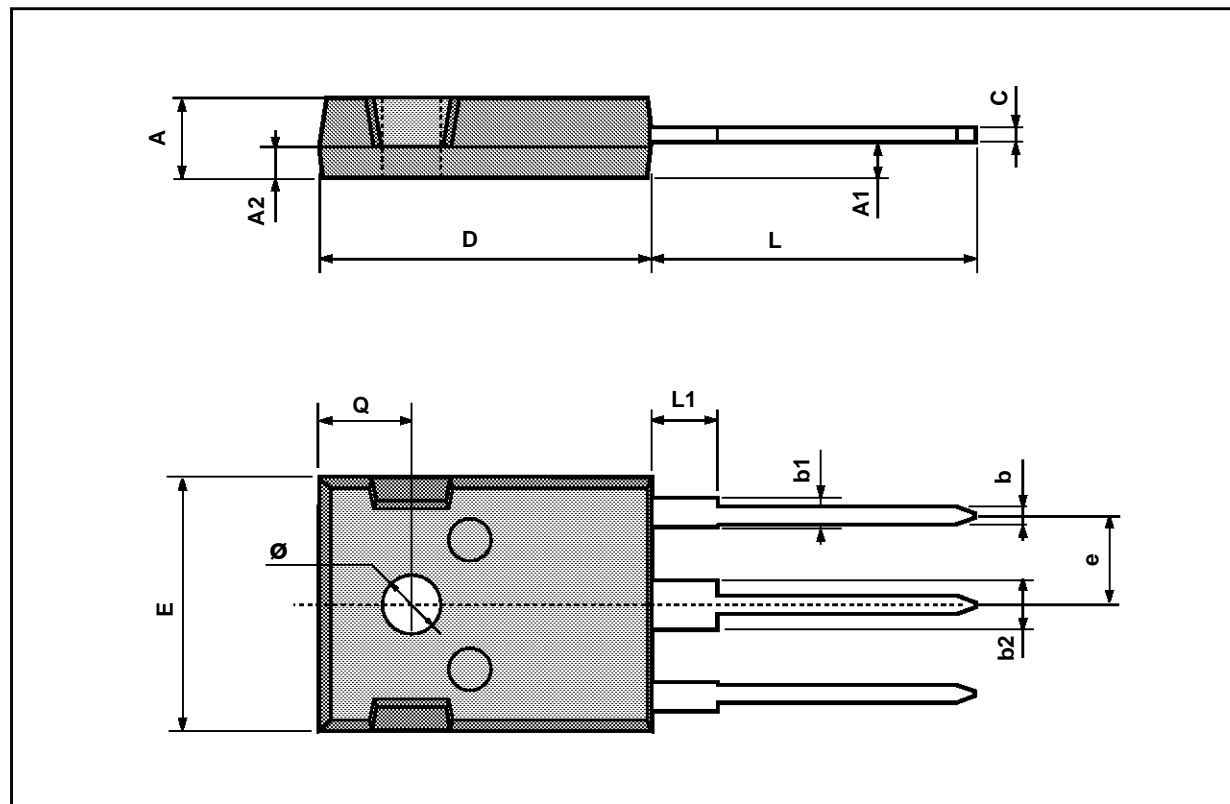


Fig. 5: Test Circuit For Inductive Load Switching And Diode Reverse Recovery Time



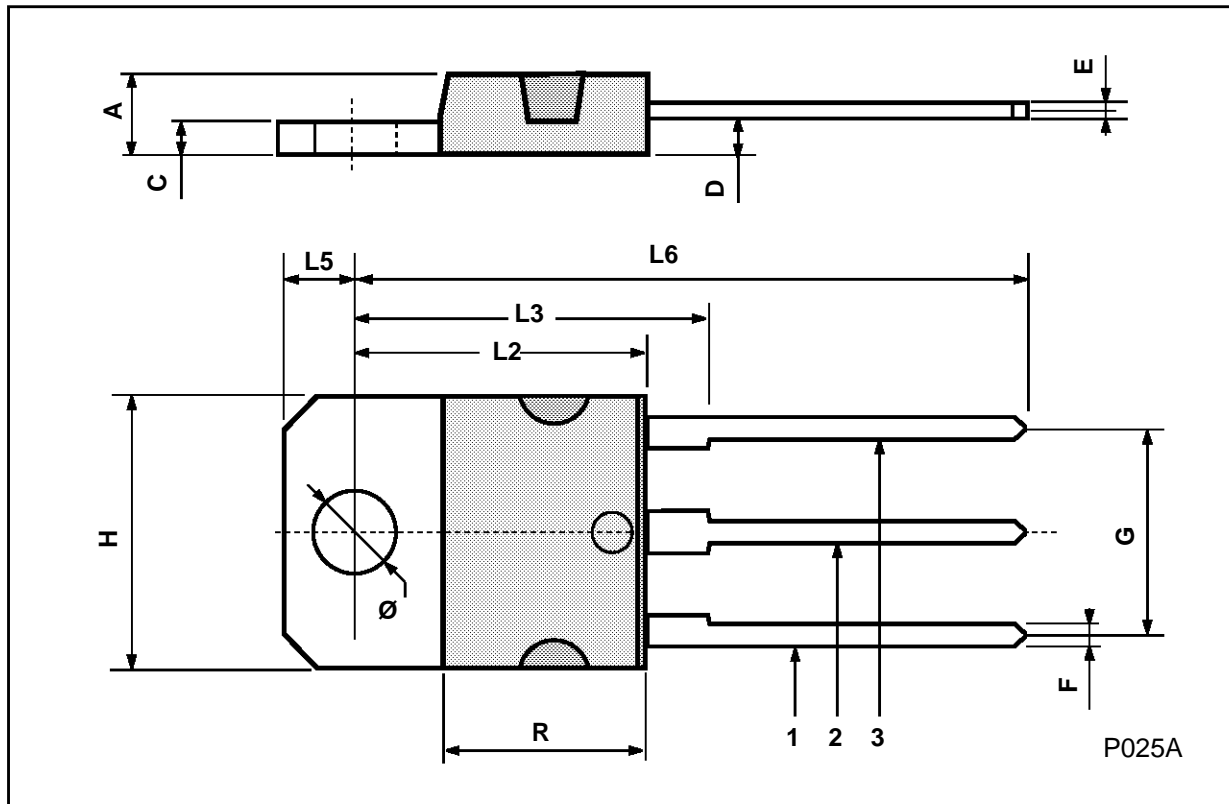
TO-247 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|-------|------|-------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.7 | | 5.3 | 0.185 | | 0.208 |
| A1 | | | 2.87 | | | 0.113 |
| A2 | 1.5 | | 2.5 | 0.059 | | 0.098 |
| b | 1 | | 1.4 | 0.039 | | 0.055 |
| b1 | | | 2.25 | | | 0.088 |
| b2 | 3.05 | | 3.43 | 0.120 | | 0.135 |
| C | 0.4 | | 0.8 | 0.015 | | 0.031 |
| D | 20.4 | | 21.18 | 0.803 | | 0.833 |
| e | 5.43 | | 5.47 | 0.213 | | 0.215 |
| E | 15.3 | | 15.95 | 0.602 | | 0.628 |
| L | 15.57 | | | 0.613 | | |
| L1 | 3.7 | | 4.3 | 0.145 | | 0.169 |
| Q | 5.3 | | 5.84 | 0.208 | | 0.230 |
| ØP | 3.5 | | 3.71 | 0.137 | | 0.146 |



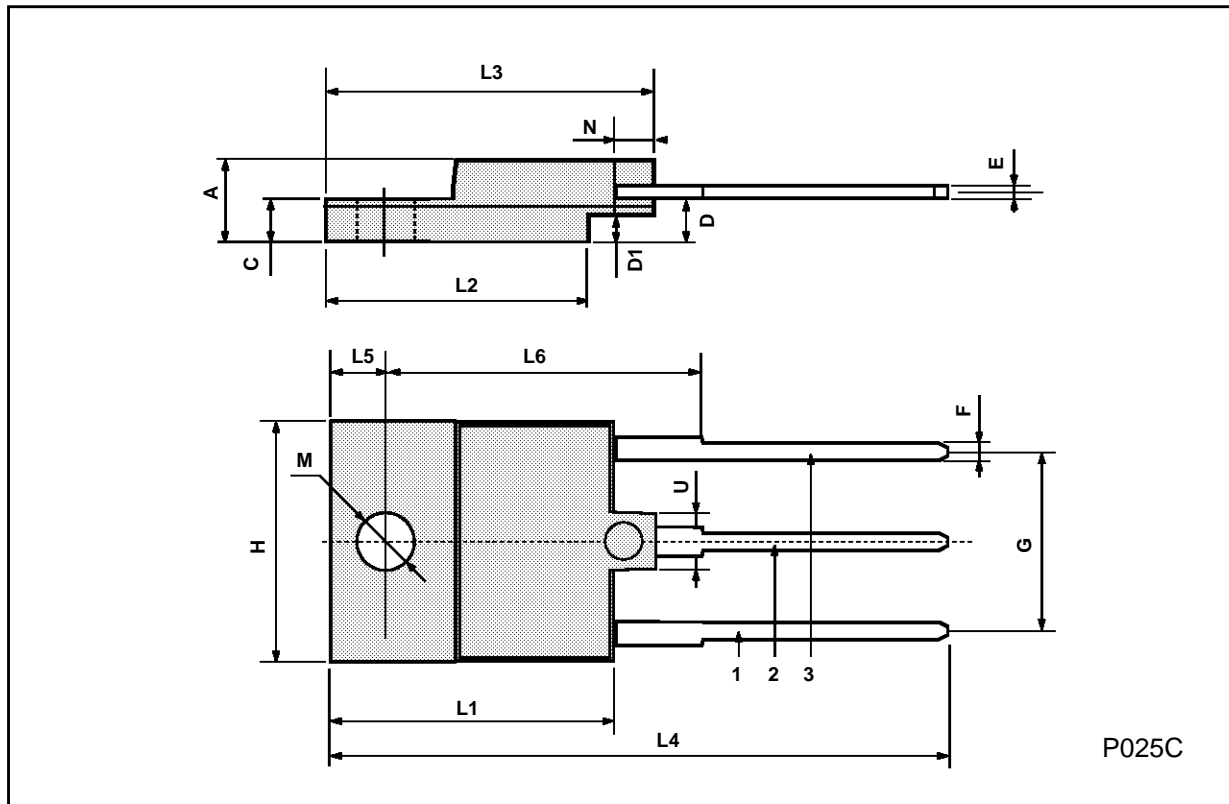
TO-218 (SOT-93) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.7 | | 4.9 | 0.185 | | 0.193 |
| C | 1.17 | | 1.37 | 0.046 | | 0.054 |
| D | | 2.5 | | | 0.098 | |
| E | 0.5 | | 0.78 | 0.019 | | 0.030 |
| F | 1.1 | | 1.3 | 0.043 | | 0.051 |
| G | 10.8 | | 11.1 | 0.425 | | 0.437 |
| H | 14.7 | | 15.2 | 0.578 | | 0.598 |
| L2 | - | | 16.2 | - | | 0.637 |
| L3 | | 18 | | | 0.708 | |
| L5 | 3.95 | | 4.15 | 0.155 | | 0.163 |
| L6 | | 31 | | | 1.220 | |
| R | - | | 12.2 | - | | 0.480 |
| Ø | 4 | | 4.1 | 0.157 | | 0.161 |



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 | 0.45 | | 1 | 0.017 | | 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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