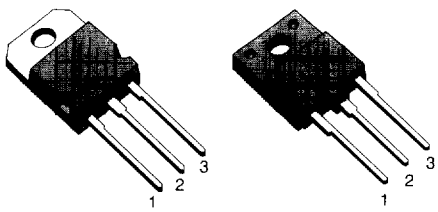
SGS-THOMSON MICROELECTRONICS

# STH60N05
# STH60N05FI

## N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTOR

| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| STH60N05 | 50 V | 0.023 Ω | 60 A |
| STH60N05FI | 50 V | 0.023 Ω | 36 A |

- AVALANCHE RUGGEDNESS TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE FOR STANDARD PACKAGE
- VERY LOW $R_{DS(on)}$
- APPLICATION ORIENTED CHARACTERIZATION
- ISOLATED PACKAGE UL RECOGNIZED, ISOLATION TO 4000V DC

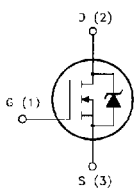



TO-218 ISOWATT218

### 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.)

### INTERNAL SCHEMATIC DIAGRAM




### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | STH60N05 | STH60N05FI | |
| $V_{DS}$ | Drain-source Voltage ($V_{GS}$ = 0) | 50 | | V |
| $V_{DGR}$ | Drain- gate Voltage ($R_{GS}$ = 20 kΩ) | 50 | | V |
| $V_{GS}$ | Gate-source Voltage | ± 20 | | V |
| $I_D$ | Drain Current (continuous) at $T_c$ = 25 °C(#) | 60 | 36 | A |
| $I_D$ | Drain Current (continuous) at $T_c$ = 100 °C | 45 | 22 | A |
| $I_{DM}$(•) | Drain Current (pulsed) | 240 | 240 | A |
| $P_{tot}$ | Total Dissipation at $T_c$ = 25 °C | 180 | 60 | W |
| | Derating Factor | 1.2 | 0.48 | W/°C |
| $T_{stg}$ | Storage Temperature | -65 to 175 | -65 to 150 | °C |
| $T_j$ | Max. Operating Junction Temperature | 175 | 150 | °C |

(•) Pulse width limited by safe operating area
(#) $T_c$ = 50 °C for TO-218

## THERMAL DATA

| | | | TO-218 | ISOWATT218 | |
|---|---|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal Resistance Junction-case | Max | 0.83 | 2.08 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal Resistance Junction-ambient | Max | 30 | | °C/W |
| $R_{thc\text{-}sink}$ | 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, $\delta < 1\%$) | 60 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25$ °C, $I_D = I_{AR}$, $V_{DD} = 25$ V) | 700 | mJ |
| $E_{AR}$ | Repetitive Avalanche Energy (pulse width limited by $T_j$ max. $\delta < 1\%$) | 170 | mJ |
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive ($T_c = 100$ °C, pulse width limited by $T_j$ max, $\delta < 1\%$) | 36 | 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 $V_{GS} = 0$ | 50 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS}$ = Max Rating<br>$V_{DS}$ = Max Rating x 0.8 $T_c = 125$ °C | | | 250<br>1000 | µA<br>µA |
| $I_{GSS}$ | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 20$ 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 | | 4 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10$V $I_D = 30$ A<br>$V_{GS} = 10$V $I_D = 30$ A $T_c = 100$°C | | | 0.023<br>0.046 | 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 | 60 | | | A |

### DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (*) | Forward Transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 30$ A | 16 | | | 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 $V_{GS} = 0$ | | 2500<br>950<br>250 | 3000<br>1200<br>350 | pF<br>pF<br>pF |

## ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on Time | $V_{DD}$ = 40 V $I_D$ = 60 A | | 120 | 160 | ns |
| $t_r$ | Rise Time | $R_G$ = 50 Ω $V_{GS}$ = 10 V (see test circuit, figure 3) | | 320 | 430 | ns |
| $(di/dt)_{on}$ | Turn-on Current Slope | $V_{DD}$ = 40 V $I_D$ = 60 A $R_G$ = 50 Ω $V_{GS}$ = 10 V (see test circuit, figure 5) | | 160 | | A/µs |
| $Q_g$ | Total Gate Charge | $V_{DD}$ = 25 V $I_D$ = 30 A $V_{GS}$ = 10 V | | 65 | 90 | nC |

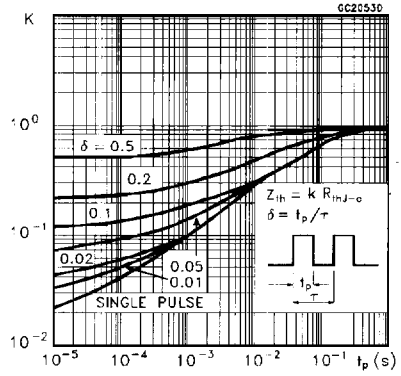
SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD}$ = 40 V $I_D$ = 60 A | | 170 | 230 | ns |
| $t_f$ | Fall Time | $R_G$ = 50 Ω $V_{GS}$ = 10 V | | 170 | 230 | ns |
| $t_c$ | Cross-over Time | (see test circuit, figure 5) | | 340 | 460 | ns |

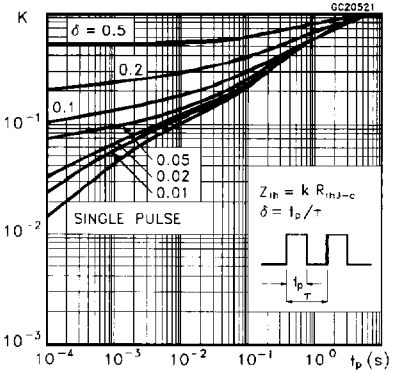
SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain Current | | | | 60 | A |
| $I_{SDM}$(•) | Source-drain Current (pulsed) | | | | 240 | A |
| $V_{SD}$ (*) | Forward On Voltage | $I_{SD}$ = 60 A $V_{GS}$ = 0 | | | 1.7 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$ = 60 A di/dt = 100 A/µs $V_{DD}$ = 25 V $T_j$ = 150 °C | | 120 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | (see test circuit, figure 5) | | 0.25 | | µC |
| $I_{RRM}$ | Reverse Recovery | | | 5 | | A |

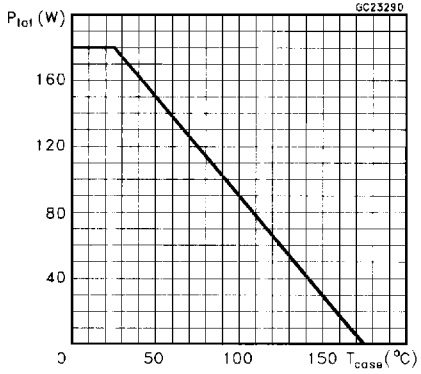
Thermal Impedance For TO-218



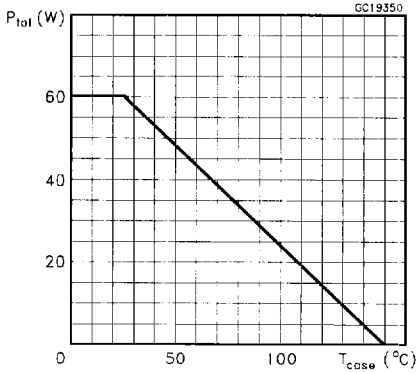

Thermal Impedance For ISOWATT218



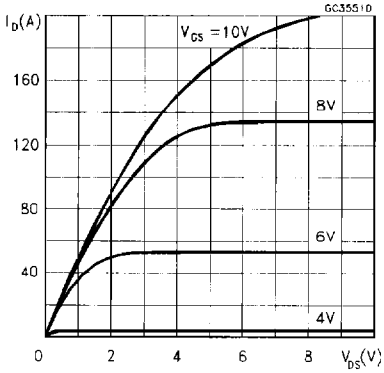

Derating Curve For TO-218



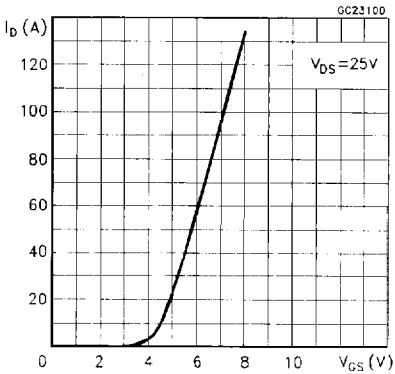

Derating Curve For ISOWATT218



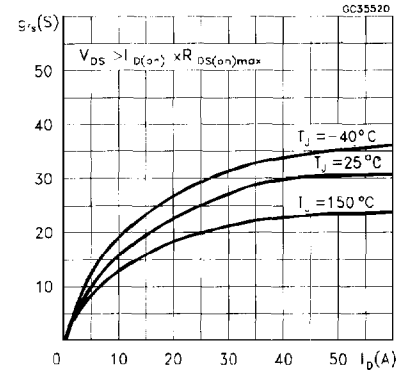

Output Characteristics



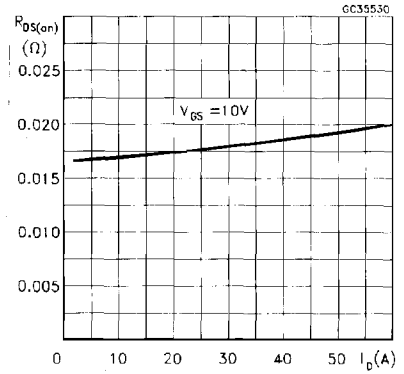

Transfer Characteristics



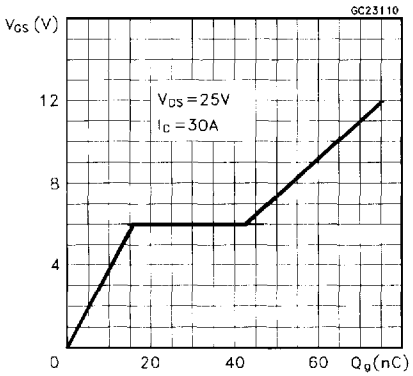
Transconductance



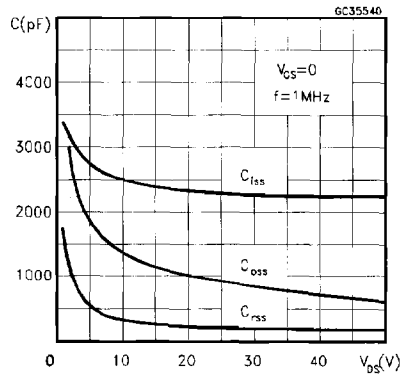

Static Drain-source On Resistance



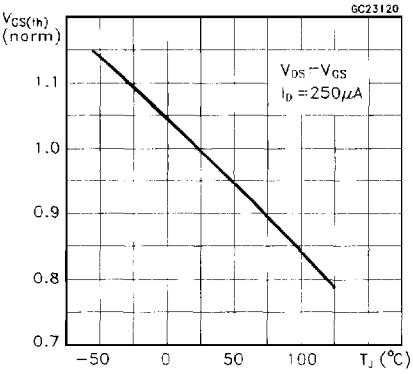

Gate Charge vs Gate-source Voltage



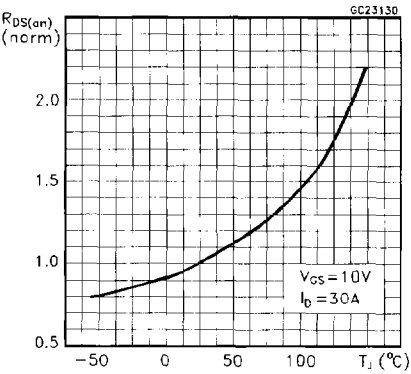

Capacitance Variations




Normalized Gate Threshold Voltage vs Temperature




Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

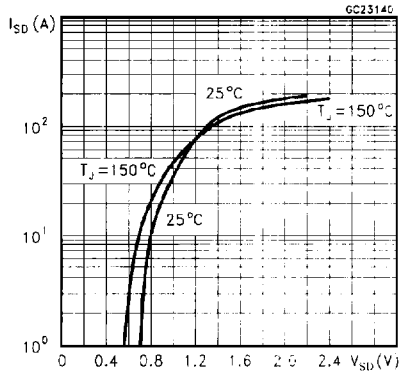



**Fig. 2:** Unclamped Inductive Waveforms

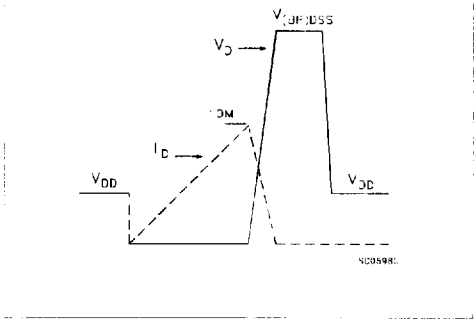



**Fig. 4:** Gate Charge Test Circuit

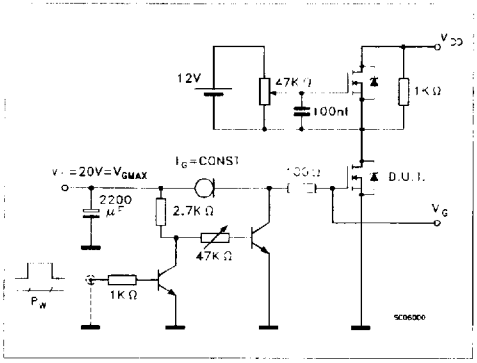



**Fig. 1:** Unclamped Inductive Load Test Circuits

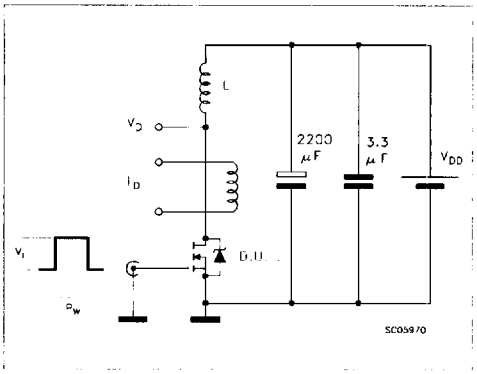



**Fig. 3:** Switching Times Test Circuits For Resistive Load

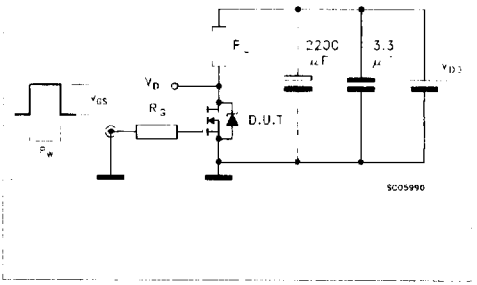



**Fig. 5:** Test Circuit For Inductive Load Switching And Diode Reverse Recovery Time