



STP11NC40, STP11NC40FP

N-CHANNEL 400V - 0.44Ω - 9.5A TO-220/TO-220FP

PowerMESH™II Power MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D | P _w |
|-------------|------------------|---------------------|----------------|----------------|
| STP11NC40 | 400 V | < 0.55 Ω | 9.5 A | 120 W |
| STP11NC40FP | 400 V | < 0.55 Ω | 9.5 A(*) | 30 W |

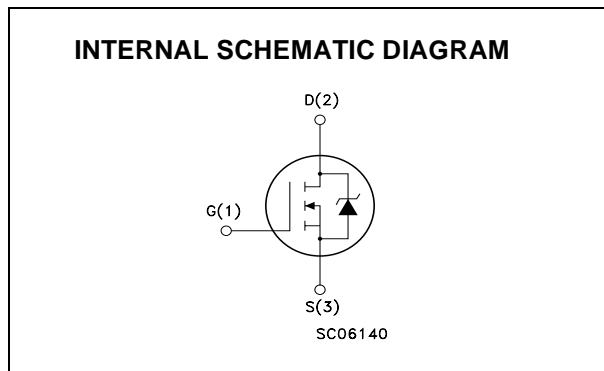
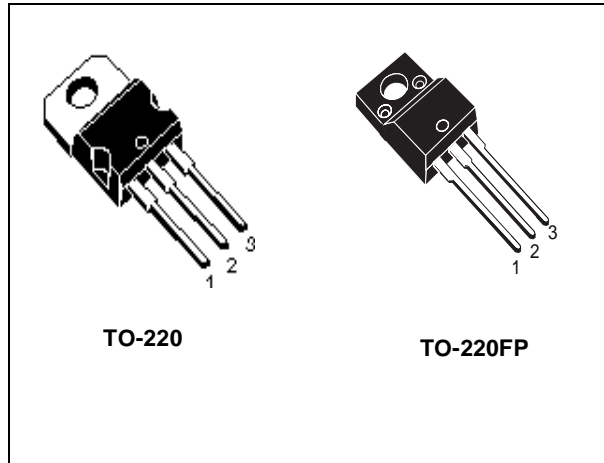
- TYPICAL R_{DS(on)} = 0.44 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

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



ORDERING INFORMATION

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|-------------|-----------|----------|-----------|
| STP11NC40 | P11NC40 | TO-220 | TUBE |
| STP11NC40FP | P11NC40FP | TO-220FP | TUBE |

STP11NC40, STP11NC40FP

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|--|------------|-------------|------|
| | | STP11NC40 | STP11NC40FP | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 400 | | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 kΩ) | 400 | | V |
| V _{GS} | Gate- source Voltage | ± 30 | | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 9.5 | 9.5 (*) | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 6 | 6 (*) | A |
| I _{DM} (•) | Drain Current (pulsed) | 38 | 38 (*) | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 120 | 30 | W |
| | Derating Factor | 0.96 | 0.24 | W/°C |
| dv/dt (1) | Peak Diode Recovery voltage slope | 3.5 | | V/ns |
| V _{ISO} | Insulation Withstand Voltage (DC) | - | 2500 | V |
| T _j | Operating Junction Temperature | -55 to 150 | | °C |
| T _{stg} | Storage Temperature | -55 to 150 | | °C |

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤ 9.5A, di/dt ≤ 100A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(*) Limited only by maximum temperature allowed

THERMAL DATA

| | | TO-220 | TO-220FP | |
|-----------------------|--|--------|----------|------|
| R _{thj-case} | Thermal Resistance Junction-case Max | 1.04 | 4.1 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient Max | 62.5 | | °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) | 9.5 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 300 | mJ |

ELECTRICAL CHARACTERISTICS (TCASE = 25°C UNLESS OTHERWISE SPECIFIED)

ON/OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250 μA, V _{GS} = 0 | 400 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating, T _C = 125 °C | | | 1 50 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ± 30V | | | ±100 | nA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250μA | 2 | 3 | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V, I _D = 5 A | | 0.44 | 0.55 | Ω |

**ELECTRICAL CHARACTERISTICS (TCASE =25°C UNLESS OTHERWISE SPECIFIED)
DYNAMIC**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|------|------------------|------|----------------|
| g_{fs} (1) | Forward Transconductance | $V_{DS} = 15\text{ V}, I_D = 5\text{ A}$ | | 8.6 | | S |
| C_{iss} C_{oss} C_{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ | | 995 172 25 | | pF pF pF |

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|-----------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Rise Time | $V_{DD} = 200\text{ V}, I_D = 5\text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3) | | 15 18 | | ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 320\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}$ | | 32.5 6 15 | 45.5 | nC nC nC |

SWITCHING OFF

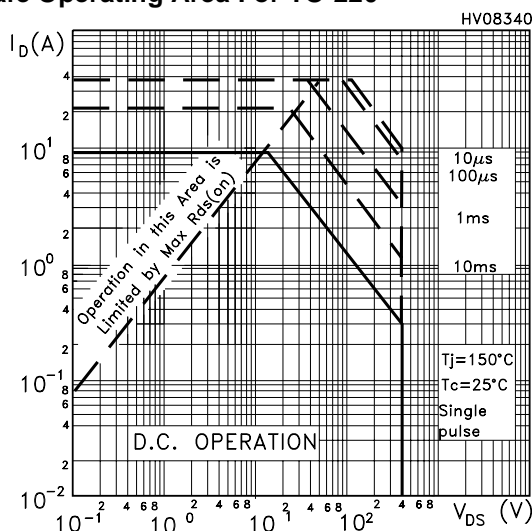
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|---|--|------|-----------------|------|----------------|
| $t_{d(off)}$ t_f | Turn-off Delay Time Fall Time | $V_{DD} = 320\text{ V}, I_D = 5\text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3) | | 43 15 | | ns ns |
| $t_r(V_{off})$ t_f t_c | Off-voltage Rise Time Fall Time Cross-over Time | $V_{DD} = 320\text{ V}, I_D = 10\text{ A},$ $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$ (Inductive Load see, Figure 5) | | 7.5 14 23 | | ns ns ns |

SOURCE DRAIN DIODE

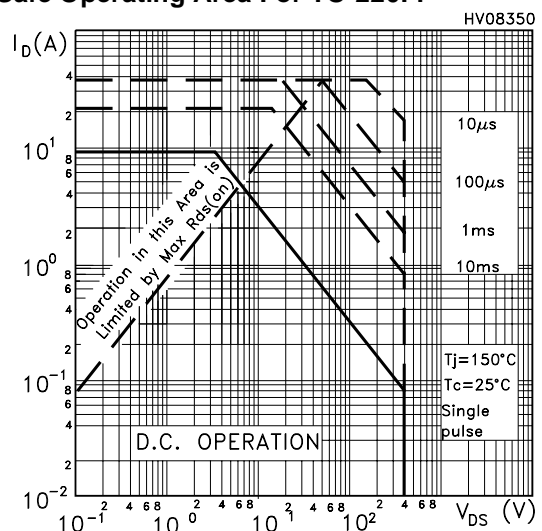
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|---|------|---------------------|-----------|---------------|
| I_{SD} I_{SDM} (2) | Source-drain Current Source-drain Current (pulsed) | | | | 9.5 38 | A A |
| V_{SD} (1) | Forward On Voltage | $I_{SD} = 9.5\text{ A}, V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 9.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}, T_j = 150^\circ\text{C}$ (see test circuit, Figure 5) | | 315 2100 13.6 | | ns nC A |

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

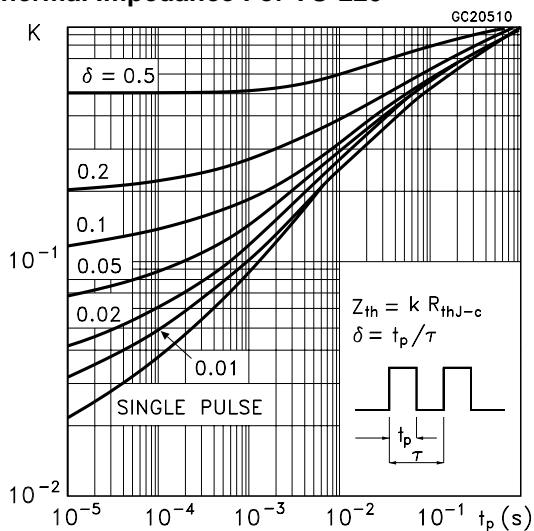
Safe Operating Area For TO-220



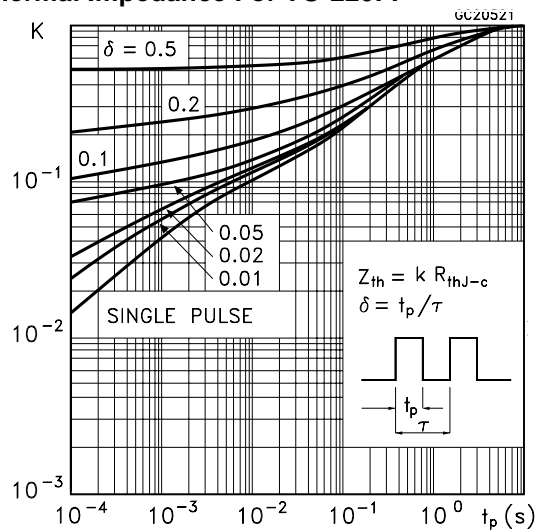
Safe Operating Area For TO-220FP



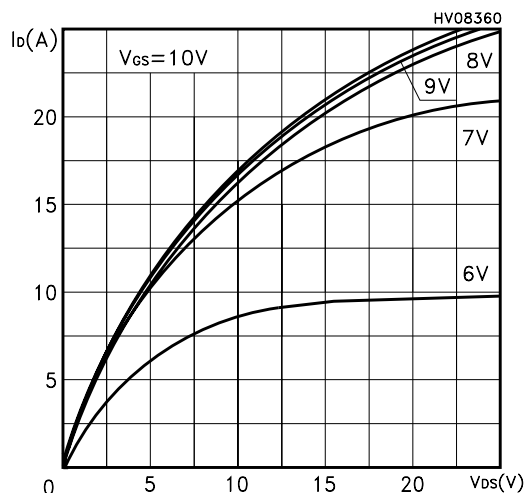
Thermal Impedance For TO-220



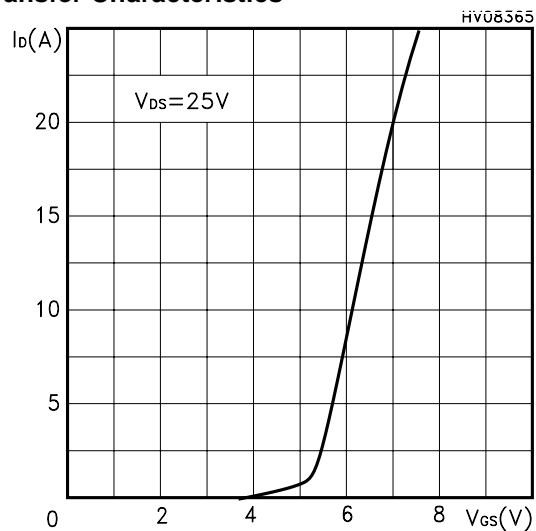
Thermal Impedance For TO-220FP



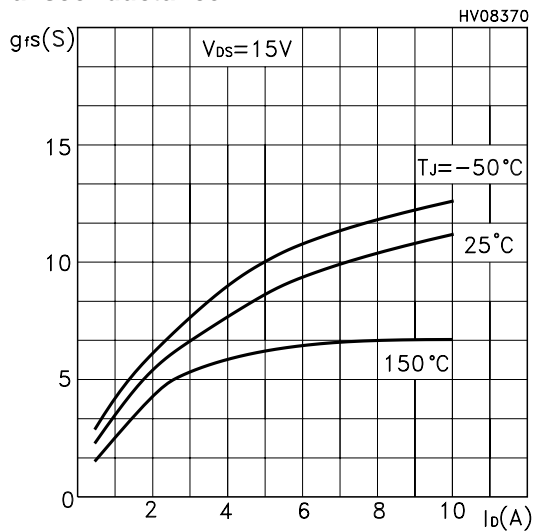
Output Characteristics



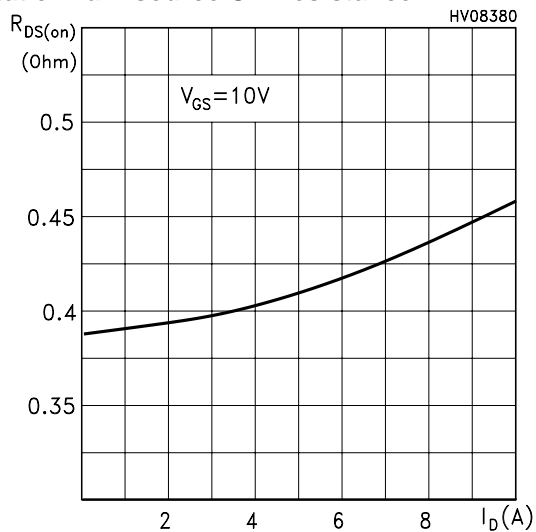
Transfer Characteristics



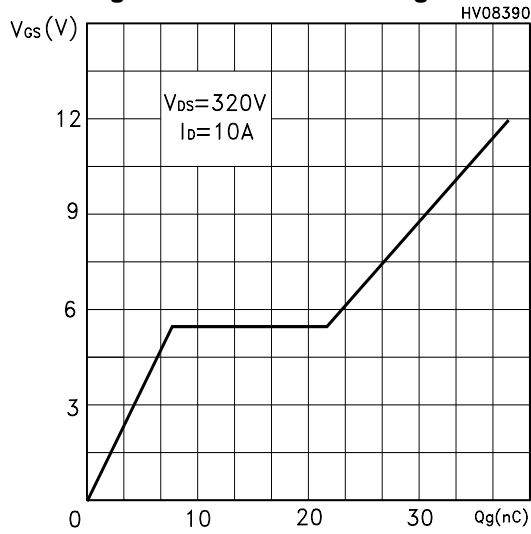
Transconductance



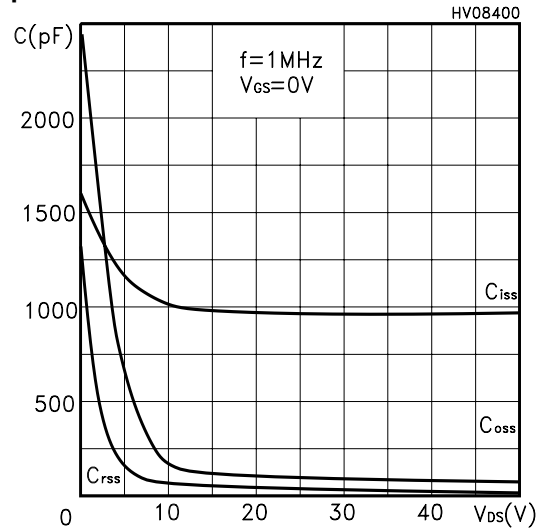
Static Drain-source On Resistance



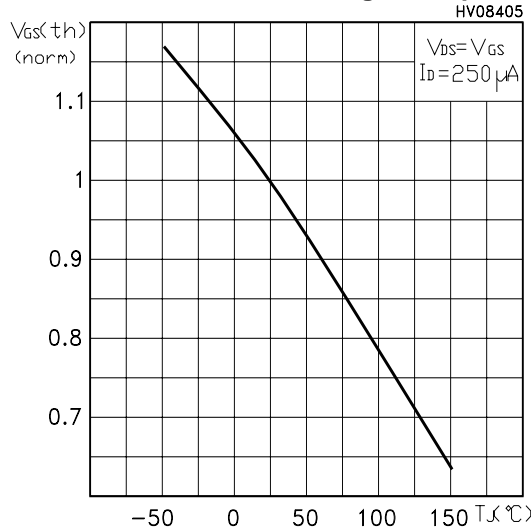
Gate Charge vs Gate-source Voltage



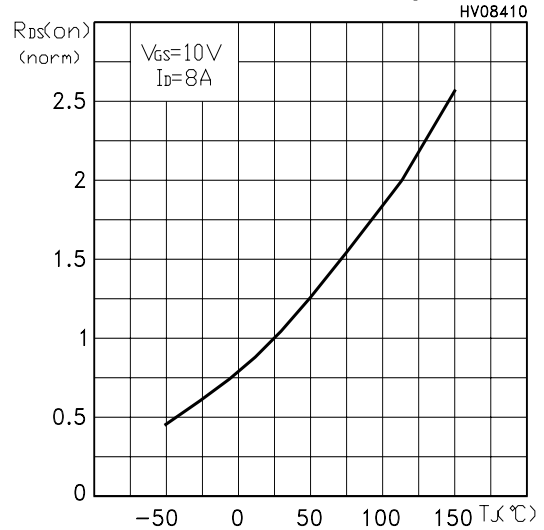
Capacitance Variations



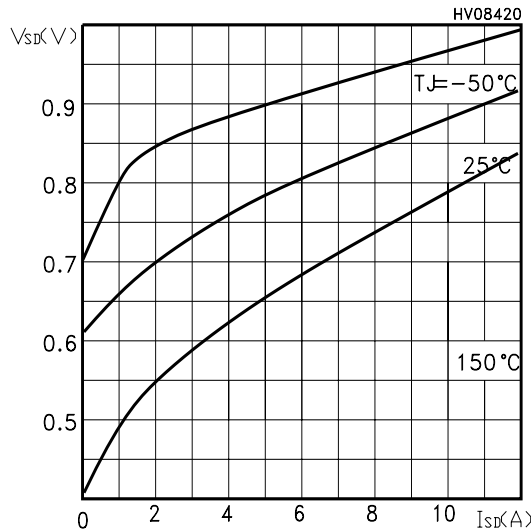
Normalized Gate Threshold Voltage vs Temperature



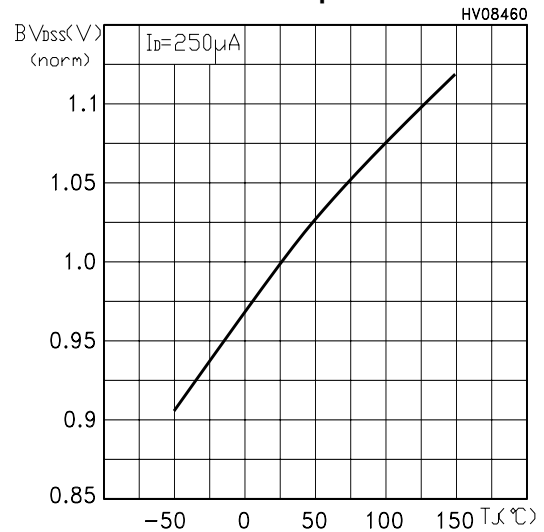
Normalized On Resistance vs Temperature



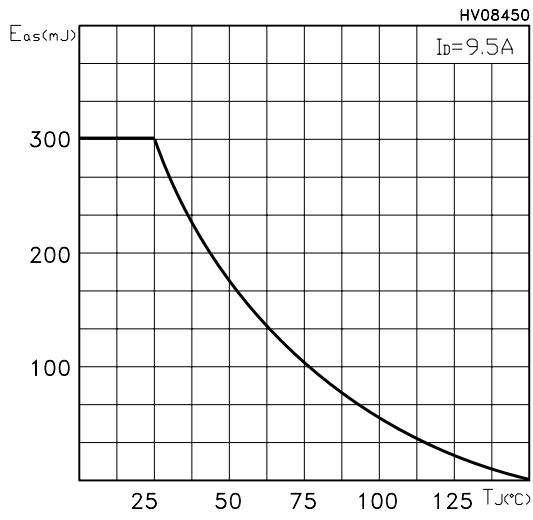
Source-drain Diode Forward Characteristics



Normalized BVDSS vs Temperature



Maximum Avalanche Energy vs Temperature



I_D vs Temperature

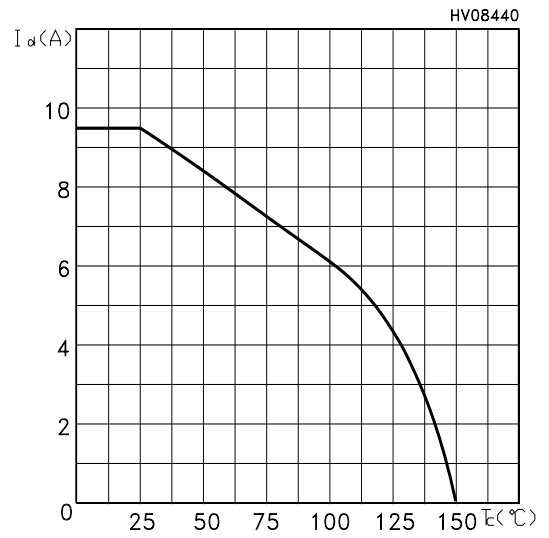


Fig. 1: Unclamped Inductive Load Test Circuit

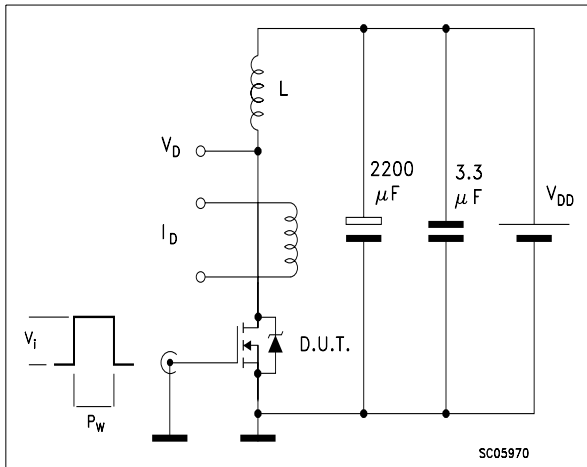


Fig. 2: Unclamped Inductive Waveform

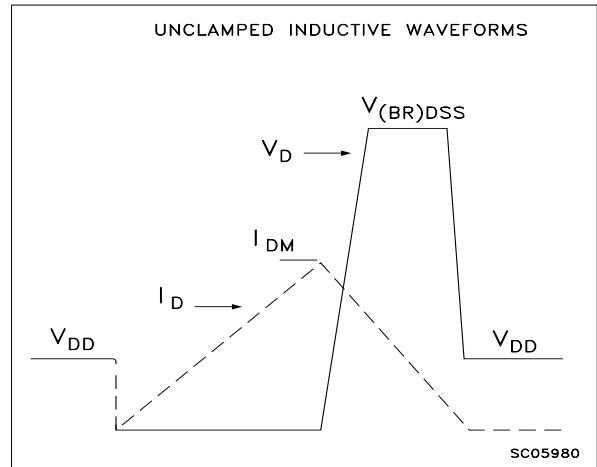


Fig. 3: Switching Times Test Circuit For Resistive Load

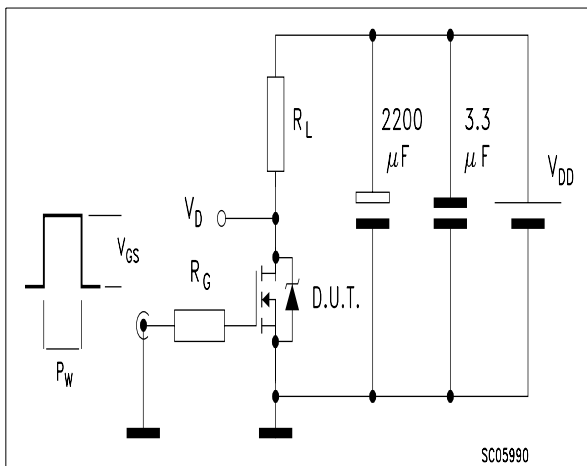


Fig. 4: Gate Charge test Circuit

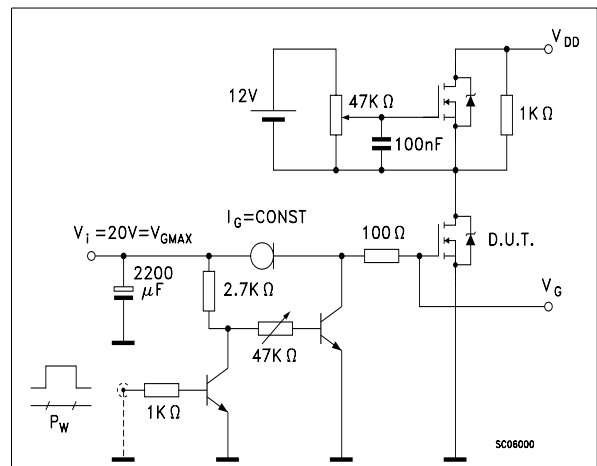


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



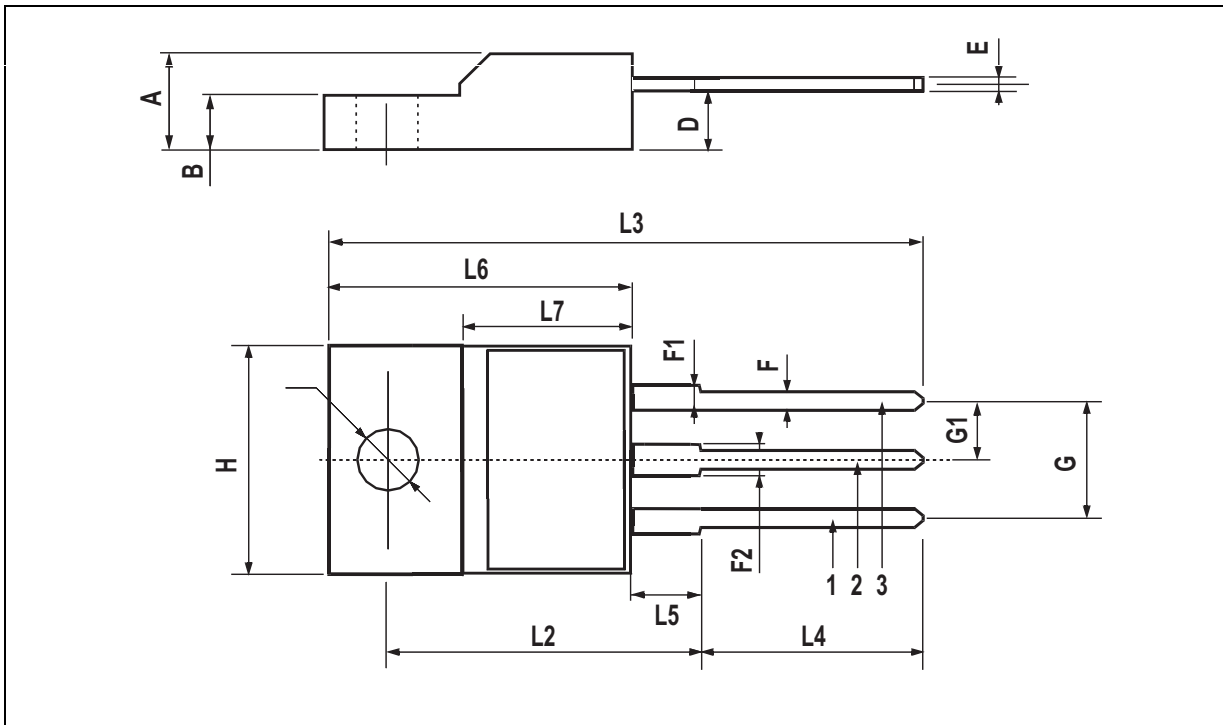
TO-220 MECHANICAL DATA

| 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 |



TO-220FP 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 | 0.45 | | 0.7 | 0.017 | | 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 | .0385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| 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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