



STW20NM50FD

N-CHANNEL 500V - 0.22Ω - 20A TO-247 FDmesh™ Power MOSFET (with FAST DIODE)

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|-------------|------------------|---------------------|----------------|
| STW20NM50FD | 500V | <0.25Ω | 20 A |

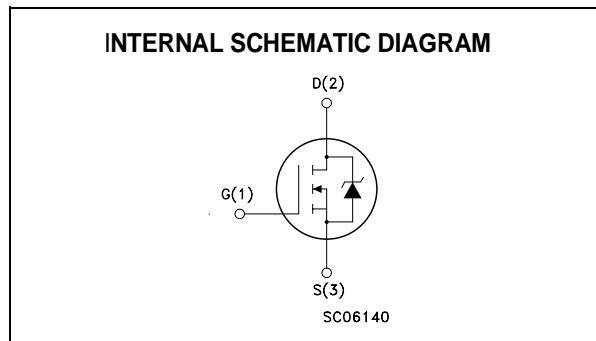
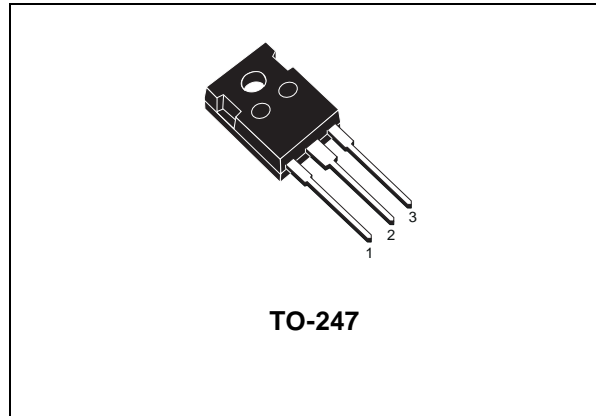
- TYPICAL R_{DS(on)} = 0.22Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS

DESCRIPTION

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

APPLICATIONS

- ZVS PHASE-SHIFT FULL BRIDGE CONVERTERS FOR SMPS AND WELDING EQUIPMENT



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---------------------|--|------------|------|
| 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 | 20 | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 14 | A |
| I _{DM} (●) | Drain Current (pulsed) | 80 | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 214 | W |
| | Derating Factor | 1.42 | W/°C |
| dv/dt(1) | Peak Diode Recovery voltage slope | 20 | V/ns |
| T _{stg} | Storage Temperature | -65 to 150 | °C |
| T _j | Max. Operating Junction Temperature | 150 | °C |

(●)Pulse width limited by safe operating area

(1)I_{SD} ≤ 20A, di/dt ≤ 400A/μs, V_{BD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(*)Limited only by maximum temperature allowed

STW20NM50FD

THERMAL DATA

| | | | | |
|----------------|--|-----|-------|------|
| Rthj-case | Thermal Resistance Junction-case | Max | 0.585 | °C/W |
| Rthj-amb | Thermal Resistance Junction-ambient | Max | 30 | °C/W |
| T _I | 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) | 10 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 35 V) | 700 | mJ |

ELECTRICAL CHARACTERISTICS (TCASE = 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, T _C = 125 °C | | | 1 10 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ±30V | | | ±100 | nA |

ON (1)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|--|------|------|------|------|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250μA | 3 | 4 | 5 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V, I _D = 10A | | 0.22 | 0.25 | Ω |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------------|-------------------------------|---|------|------|------|------|
| g _{fs} (1) | Forward Transconductance | V _{DS} > I _{D(on)} × R _{DS(on)max} , I _D = 10A | | 9 | | S |
| C _{iss} | Input Capacitance | V _{DS} = 25V, f = 1 MHz, V _{GS} = 0 | | 1380 | | pF |
| C _{oss} | Output Capacitance | | | 290 | | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 40 | | pF |
| C _{oss eq.} (2) | Equivalent Output Capacitance | V _{GS} = 0V, V _{DS} = 0V to 400V | | 130 | | pF |
| R _g | Gate Input Resistance | f=1 MHz Gate DC Bias=0 Test Signal Level=20mV Open Drain | | 2.8 | | Ω |

1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %.

2. C_{oss eq.} is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

ELECTRICAL CHARACTERISTICS (CONTINUED)
SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250V, I_D = 10 A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 3) | | 22 | | ns |
| t_r | Rise Time | | | 20 | | ns |
| Q_g | Total Gate Charge | $V_{DD} = 400V, I_D = 20A,$ $V_{GS} = 10V$ | | 38 | 53 | nC |
| Q_{gs} | Gate-Source Charge | | | 18 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 10 | | nC |

SWITCHING OFF

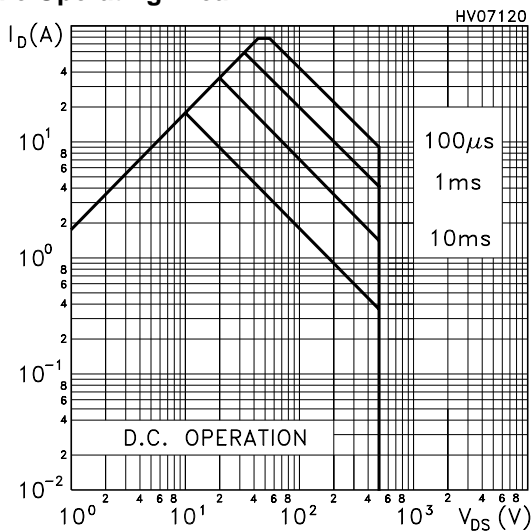
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 400V, I_D = 20 A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 5) | | 6 | | ns |
| t_f | Fall Time | | | 15 | | ns |
| t_c | Cross-over Time | | | 30 | | ns |

SOURCE DRAIN DIODE

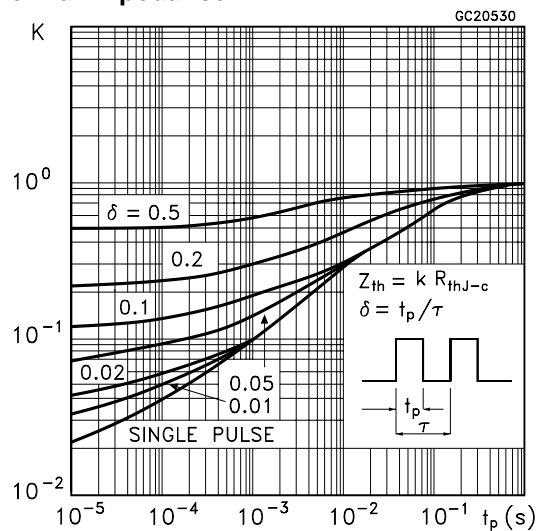
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------|---|------|------|------|---------|
| I_{SD} | Source-drain Current | | | | 20 | A |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) | | | | 80 | A |
| $V_{SD(1)}$ | Forward On Voltage | $I_{SD} = 20 A, V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 20 A, di/dt = 100A/\mu s,$ $V_{DD} = 60V, T_j = 150^\circ C$ (see test circuit, Figure 5) | | 245 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 2 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 16 | | A |

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

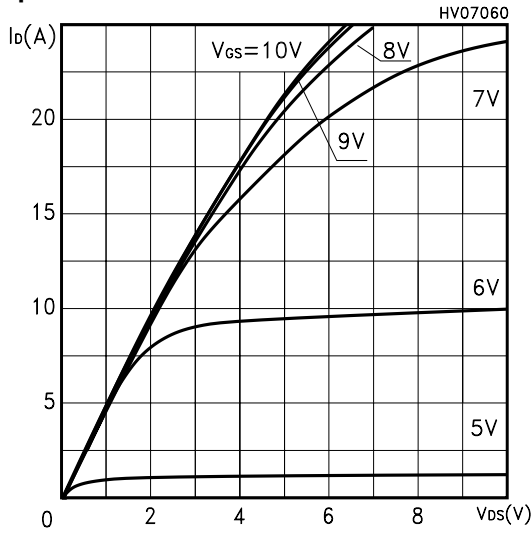
Safe Operating Area



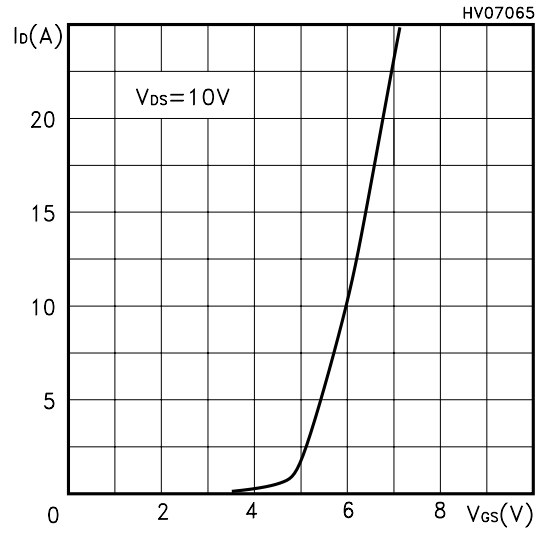
Thermal Impedance



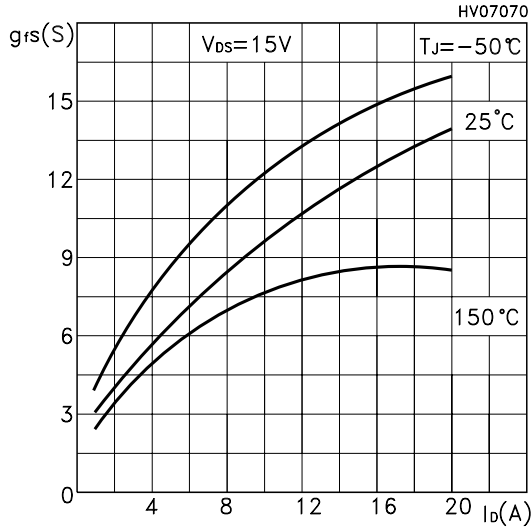
Output Characteristics



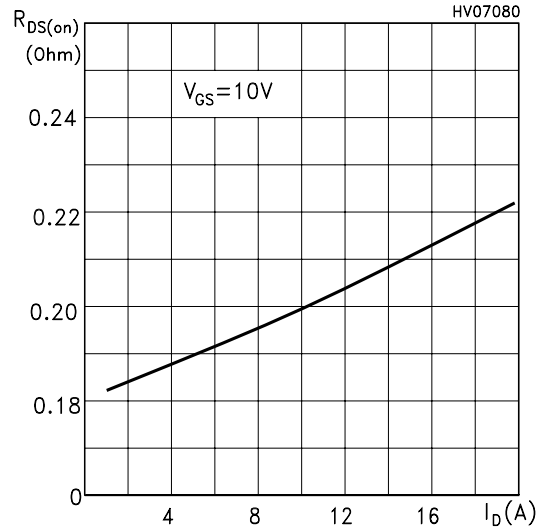
Transfer Characteristics



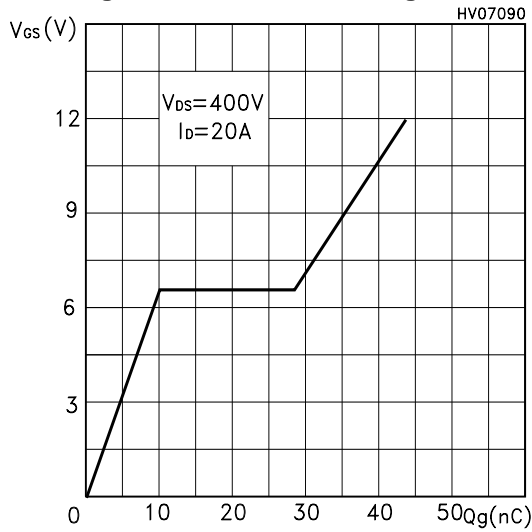
Transconductance



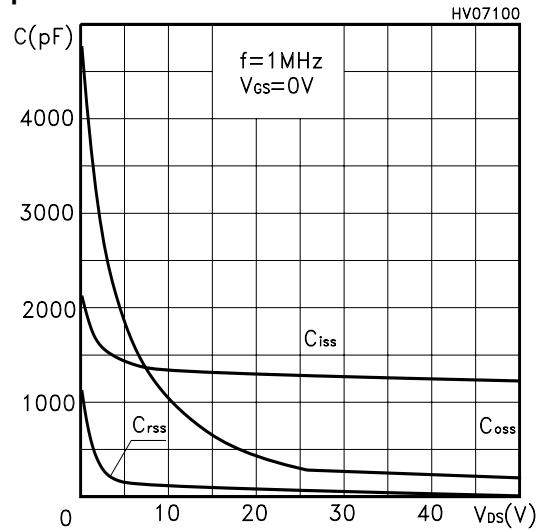
Static Drain-source On Resistance



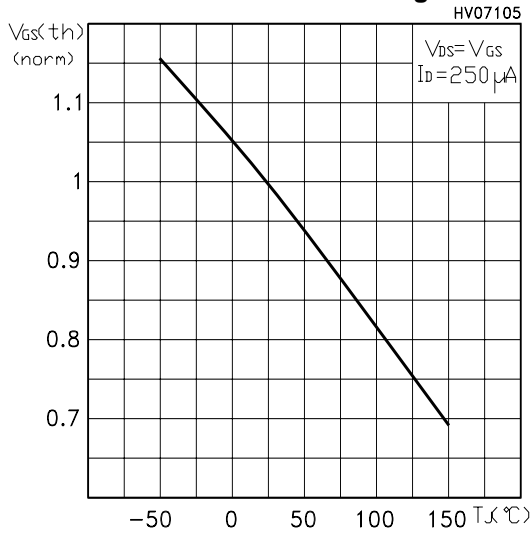
Gate Charge vs Gate-source Voltage



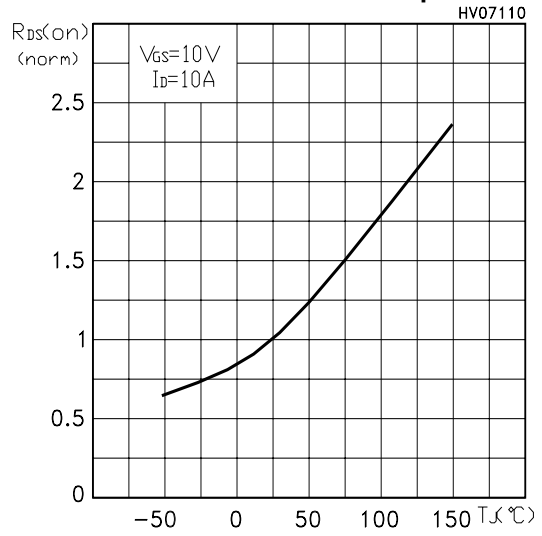
Capacitance Variations



Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

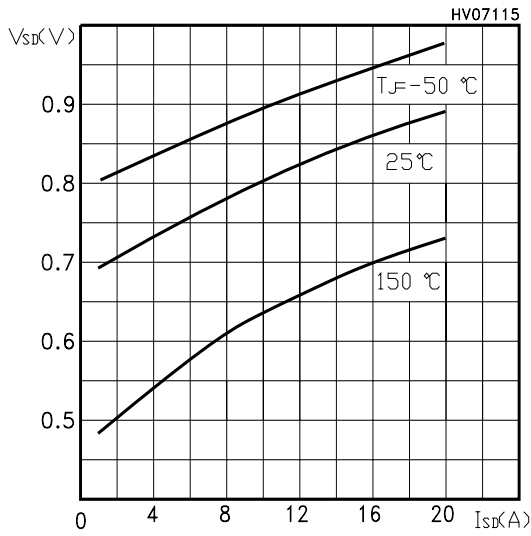


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuits For Resistive Load

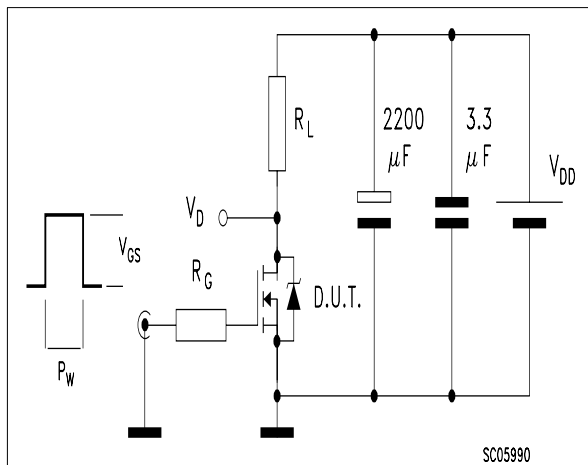


Fig. 4: Gate Charge test Circuit

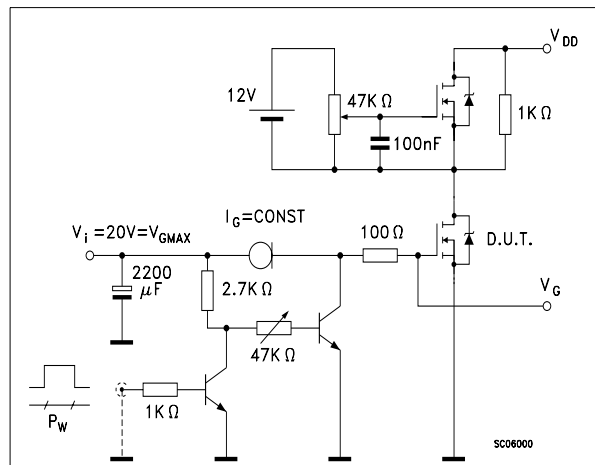
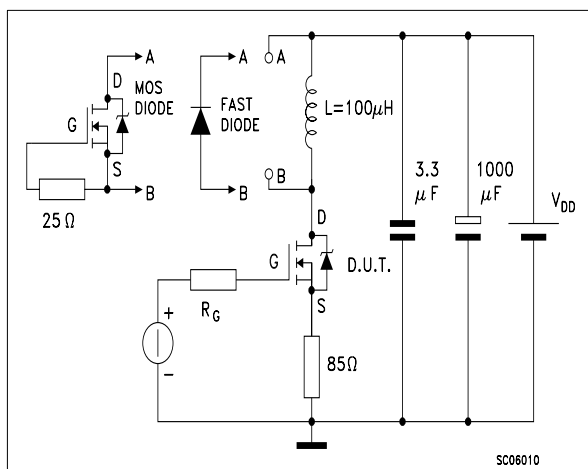
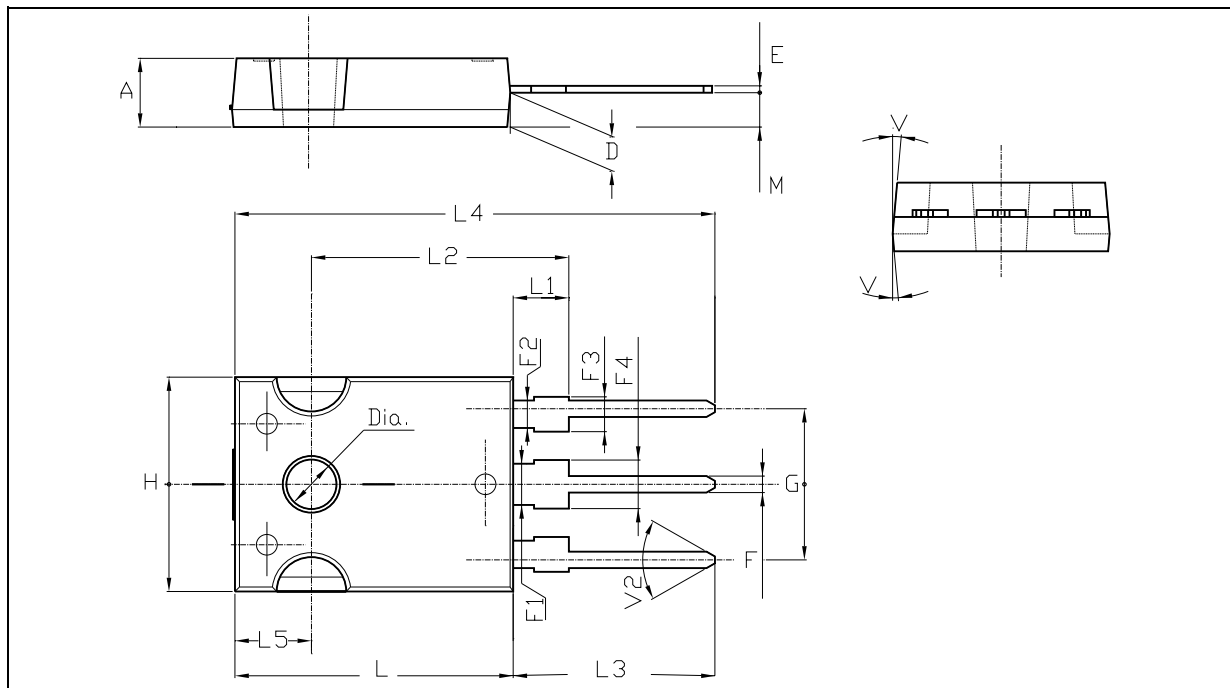


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| D | 2.20 | | 2.60 | 0.08 | | 0.10 |
| E | 0.40 | | 0.80 | 0.015 | | 0.03 |
| F | 1 | | 1.40 | 0.04 | | 0.05 |
| F1 | | 3 | | | 0.11 | |
| F2 | | 2 | | | 0.07 | |
| F3 | 2 | | 2.40 | 0.07 | | 0.09 |
| F4 | 3 | | 3.40 | 0.11 | | 0.13 |
| G | | 10.90 | | | 0.43 | |
| H | 15.45 | | 15.75 | 0.60 | | 0.62 |
| L | 19.85 | | 20.15 | 0.78 | | 0.79 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.72 | |
| L3 | 14.20 | | 14.80 | 0.56 | | 0.58 |
| L4 | | 34.60 | | | 1.36 | |
| L5 | | 5.50 | | | 0.21 | |
| M | 2 | | 3 | 0.07 | | 0.11 |
| V | | 5° | | | 5° | |
| V2 | | 60° | | | 60° | |
| Dia | 3.55 | | 3.65 | 0.14 | | 0.143 |



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