



STW28NK60Z

N-CHANNEL 600 V - 0.155 Ω - 27A TO-247 Zener-Protected SuperMESH™ MOSFET

Table 1: General Features

| TYPE | V _{DSS} | R _{DS(on)} | I _D | P _W |
|------------|------------------|---------------------|----------------|----------------|
| STW28NK60Z | 600 V | < 0.185 Ω | 27 A | 350 W |

- TYPICAL R_{DS(on)} = 0.155 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATABILITY

DESCRIPTION

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding application. Such series complements ST full range of high vltage MOSFETs including revolutionary MSmesh™ products.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES
- WELDING MACHINES
- LIGHTING

Figure 1: Package

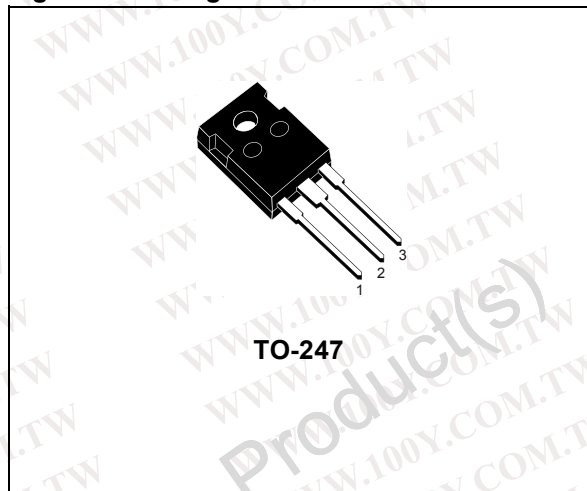


Figure 2: Internal Schematic Diagram

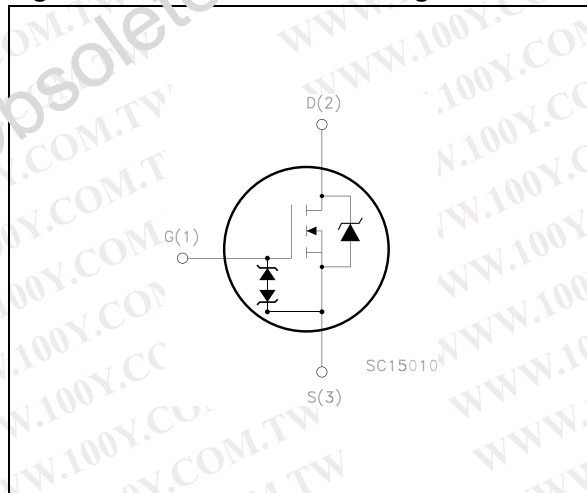


Table 2: Order Codes

| PART NUMBER | MARKING | PACKAGE | PACKAGING |
|-------------|----------|---------|-----------|
| STW28NK60Z | W28NK60Z | TO-247 | TUBE |

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Rev. 1

Table 3: Absolute Maximum ratings

| Symbol | Parameter | Value | Unit |
|------------------------------------|---|------------|------|
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 600 | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 k Ω , | 600 | V |
| V _{GS} | Gate- source Voltage | \leq 30 | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 27 | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 17 | A |
| I _{DM} (*) | Drain Current (pulsed) | 108 | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 350 | W |
| | Derating Factor | 2.77 | W/°C |
| V _{ESD(G-S)} | Gate source ESD (HBM-C = 100pF, R = 1.5 k Ω , | 6000 | V |
| dv/dt (1) | Peak Diode Recovery voltage slope | 4.5 | V/ns |
| T _{stg} T _j | Storage Temperature Operating Junction Temperature | -55 to 150 | °C |

(*) Pulse width limited by safe operating area

(1) I_{SD} \leq 27 A, di/dt \leq 200 A/ μ s, V_{DD} \leq V_{(BR)DSS}, T_J \leq T_{JMAX}

Table 4: Thermal Data

| | | | |
|--|---|-----------|------------|
| R _{thj-case} | Thermal Resistance Junction-case Max | 0.36 | °C/W |
| R _{thj-amb} T _I | Thermal Resistance Junction-ambient Max Maximum Lead Temperature For Soldering Purpose | 50 300 | °C/W °C |

Table 5: Avalanche Characteristics

| Symbol | Parameter | Max Value | Unit |
|-----------------|--|-----------|------|
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max) | 27 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 500 | mJ |

Table 6: Gate-Source Zener Diode

| Symbol | Parameter | Test Condition | Min. | Typ. | Max | Unit |
|-------------------|-------------------------------|---|------|------|-----|------|
| BV _{GSO} | Gate-Source Breakdown Voltage | I _{gs} = \leq 1mA (Open Drain) | 30 | | | A |

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

TABLE 7: ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^{\circ}C$ UNLESS OTHERWISE SPECIFIED)**On /Off**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|-------|----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D = 1 \text{ mA}, V_{GS} = 0$ | 600 | | | S |
| I_{DSS} | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125^{\circ}C$ | | | 1 50 | μA μA |
| I_{GSS} | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 20 \text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 150 \mu A$ | 3 | 3.75 | 4.5 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10 \text{ V}, I_D = 13.5 \text{ A}$ | | 0.155 | 0.185 | Ω |

Table 8: Dynamic

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-----------------------|------|----------------------|
| $g_{fs} (1)$ | Forward Transconductance | $V_{DS} = 15 \text{ V}, I_D = 13.5 \text{ A}$ | | 26 | | S |
| C_{iss} C_{oss} C_{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{DS} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$ | | 6350 615 125 | | pF pF pF |
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on Delay Time Rise Time Turn-off-Delay Time Fall Time | $V_{DD} = 300 \text{ V}, I_D = 14 \text{ A},$ $R_G = 4.7 \Omega (V_{GS} = 10 \text{ V})$ (Resistive Load see Figure 17)) | | 50 45 135 32 | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 480 \text{ V}, I_D = 28 \text{ A},$ $V_{GS} = 10 \text{ V}$ | | 189 34 103 | 264 | nC nC nC |

Table 9: Source Drain Diode

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|--------------------|-----------|--------------------|
| I_{SD} $I_{SDM} (2)$ | Source-drain Current Source-drain Current (pulsed) | | | | 27 108 | A A |
| $V_{SD} (1)$ | Forward On Voltage | $I_{SD} = 27 \text{ A}, V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 28 \text{ A}, di/dt = 100 \text{ A}/\mu s$ $V_{DD} = 35 \text{ V}, T_j = 25^{\circ}C$ (see test circuit Figure 5) | | 820 10 23.5 | | ns μC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 28 \text{ A}, di/dt = 100 \text{ A}/\mu s$ $V_{DD} = 35 \text{ V}, T_j = 150^{\circ}C$ (see test circuit Figure 5) | | 1020 14 27.5 | | ns μC A |

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

(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area

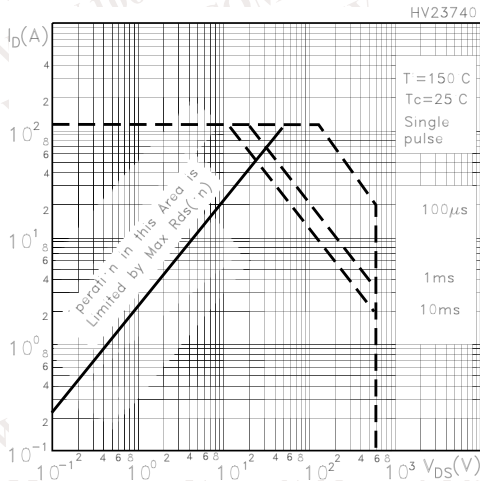


Figure 4: Output Characteristics

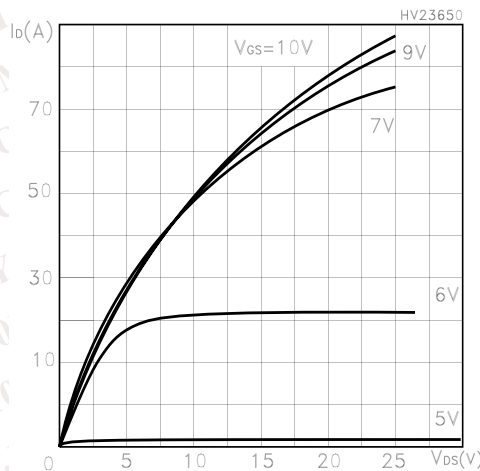


Figure 5: Transconductance

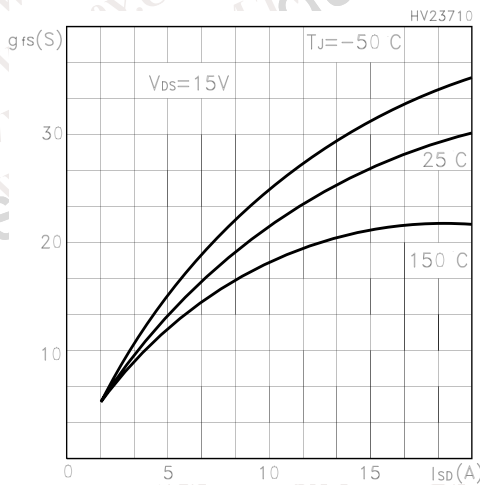


Figure 6: Thermal Impedance

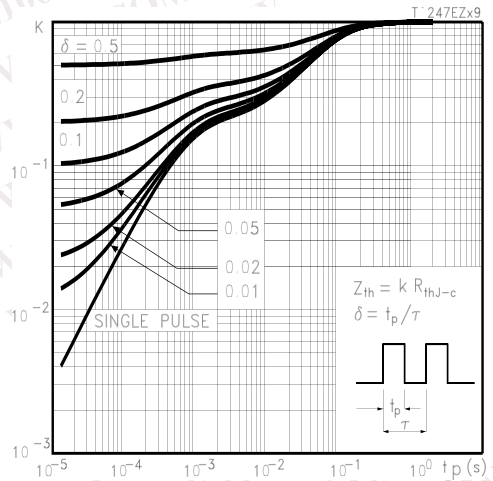


Figure 7: Transfer Characteristics

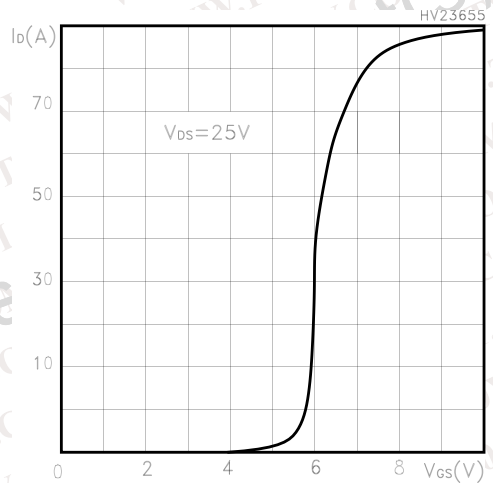


Figure 8: Static Drain-source On Resistance

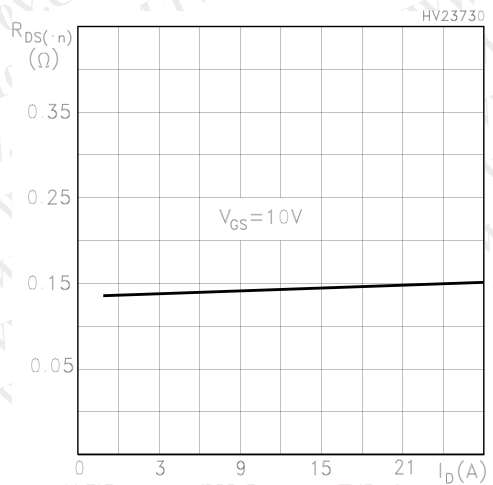


Figure 9: Gate Charge vs Gate-source Voltage

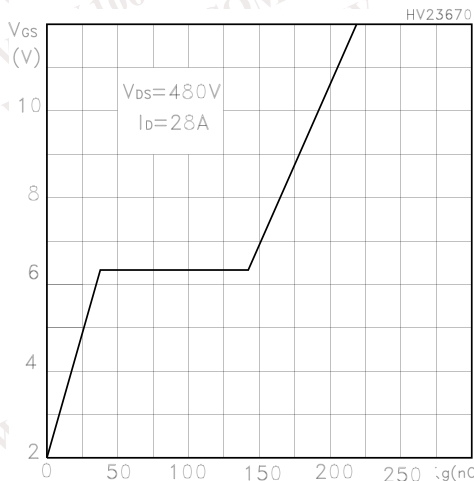


Figure 10: Normalized Gate Threshold Voltage vs Temperature

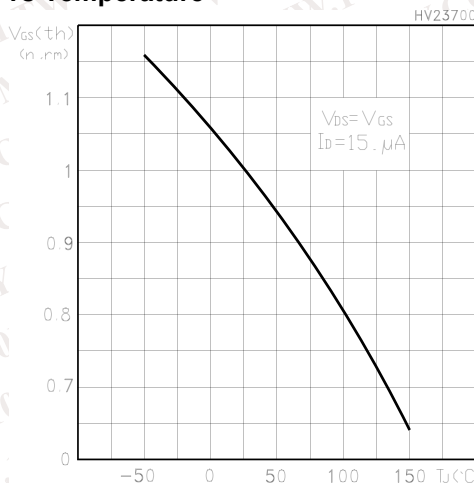


Figure 11: Source-Drain Diode Forward Characteristics

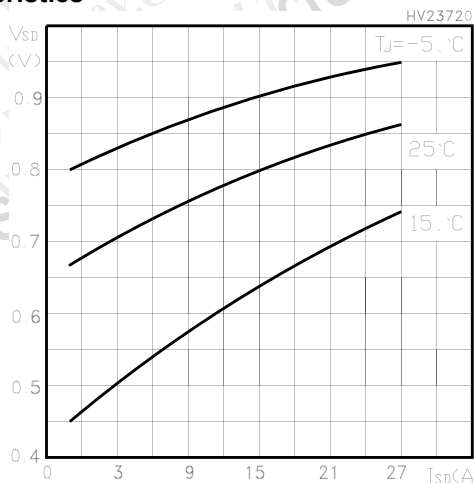


Figure 12: Capacitance Variations

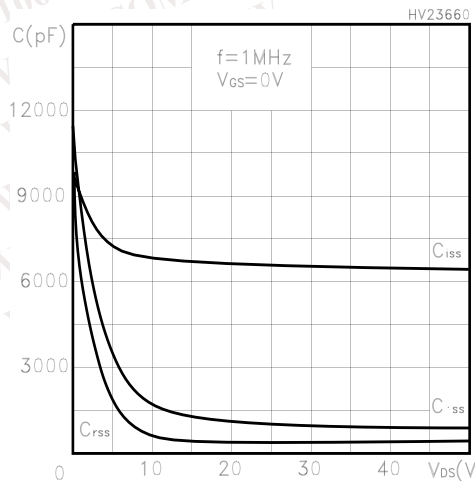


Figure 13: Normalized On Resistance vs Temperature

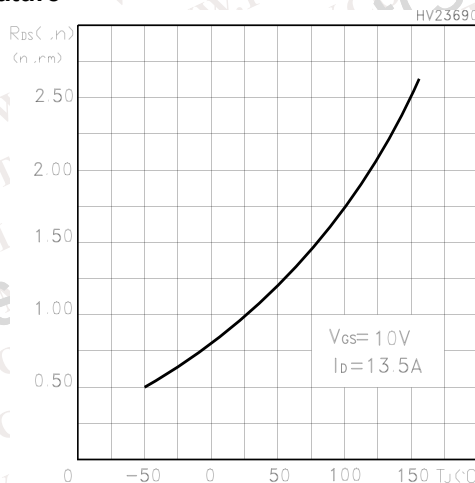


Figure 14: Normalized BV_{DSS} vs Temperature

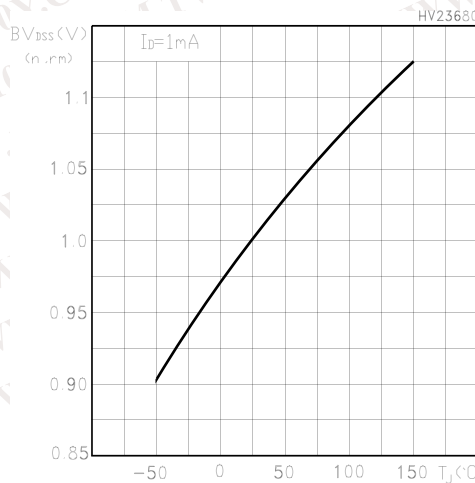
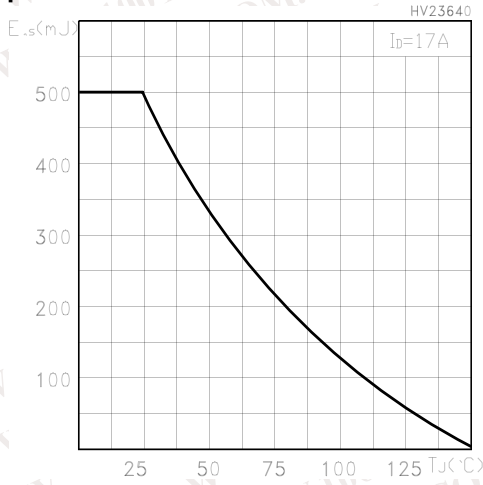


Figure 15: Maximum Avalanche Energy vs Temperature



Obsolete Product(s) - Obsolete Product(s)

Figure 16: Unclamped Inductive Load Test Circuit

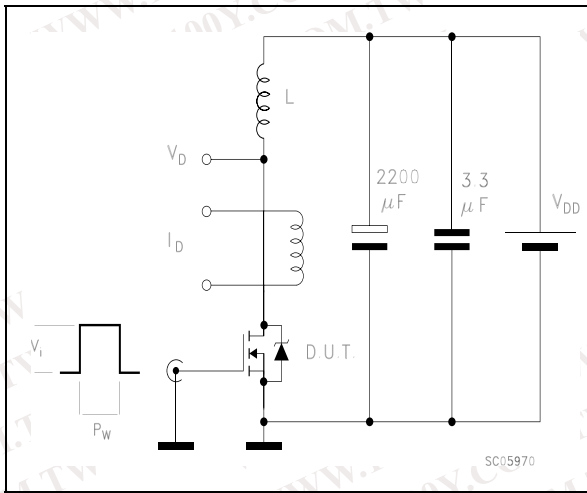


Figure 19: Unclamped Inductive Waferform

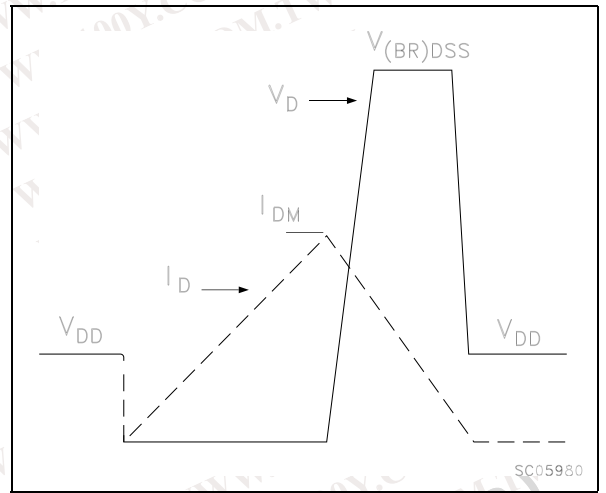


Figure 17: Switching Times Test Circuit For Resistive Load

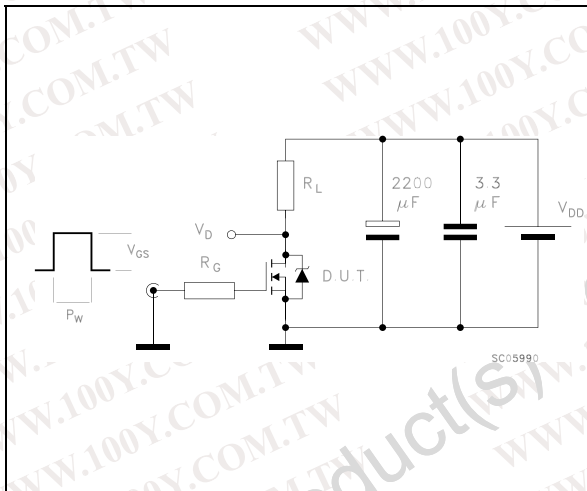


Figure 20: Gate Charge Test Circuit

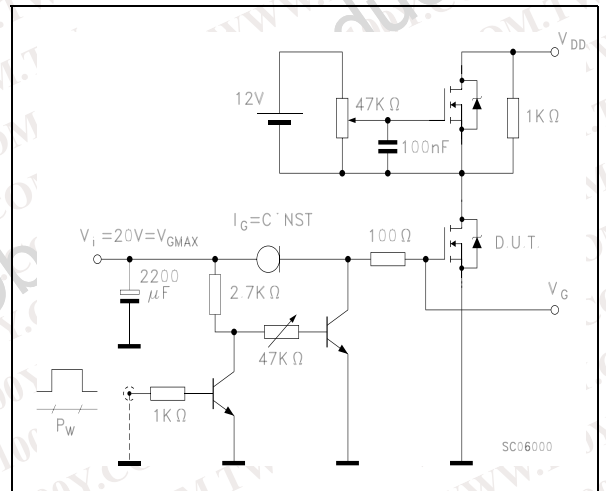
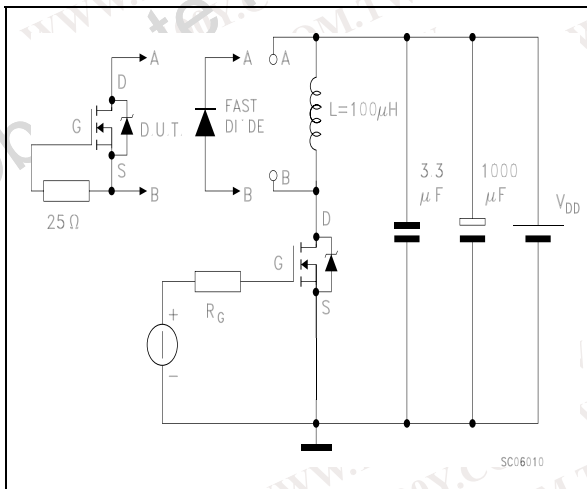


Figure 18: Test Circuit For Inductive Load Switching and Diode Recovery Times



TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |

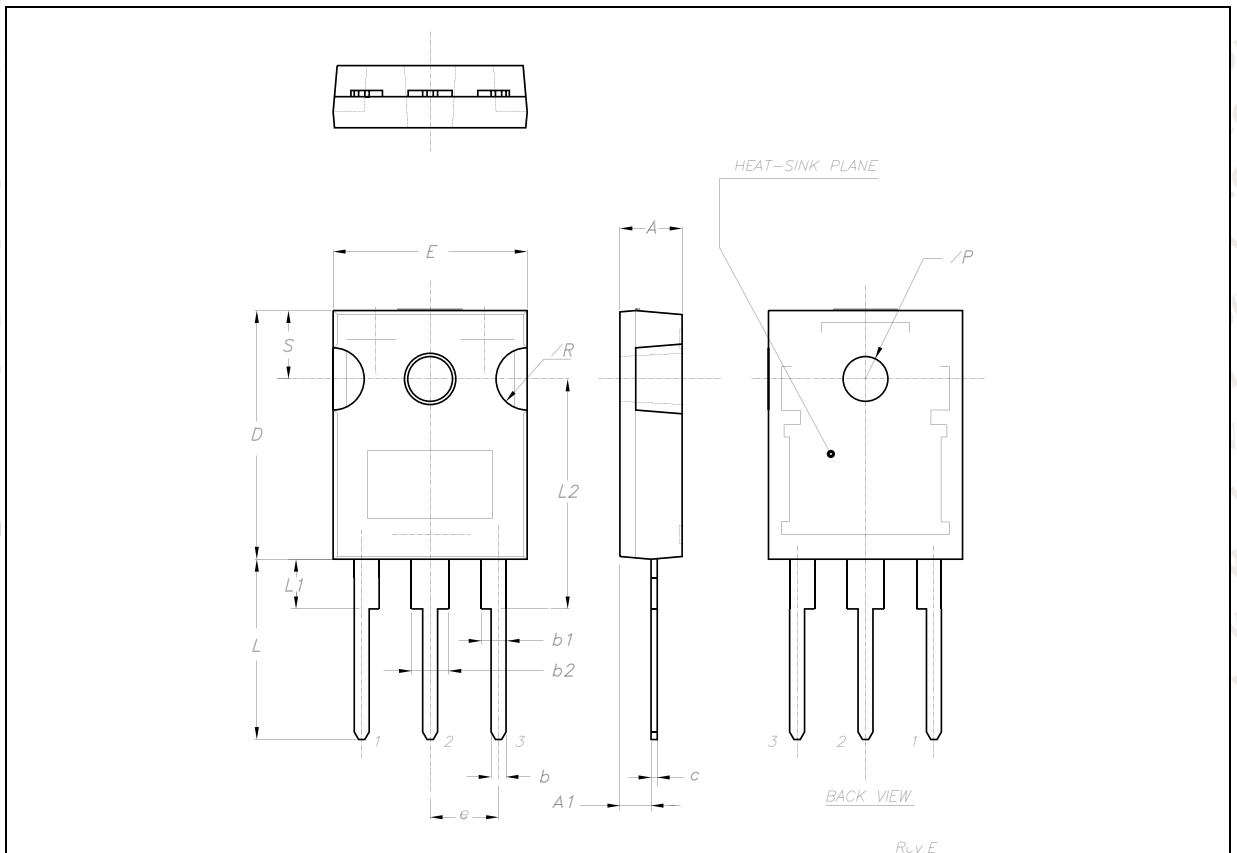


Table 10: Revision History

| Date | Revision | Description of Changes |
|-------------|----------|------------------------|
| 05-Nov-2004 | 1 | First Release. |

Obsolete Product(s) - Obsolete Product(s)

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