

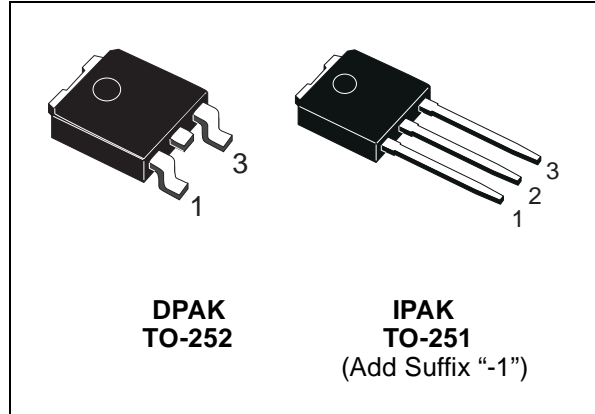


# STD5NM50 STD5NM50-1

## N-CHANNEL 500V - 0.7Ω - 7.5A DPAK/IPAK MDmesh™ Power MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STD5NM50   | 500V             | <0.8Ω               | 7.5 A          |
| STD5NM50-1 | 500V             | <0.8Ω               | 7.5 A          |

- TYPICAL R<sub>DS(on)</sub> = 0.7Ω
- 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



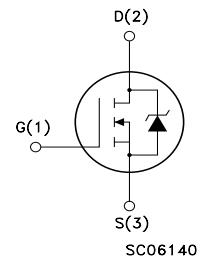
### DESCRIPTION

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

### APPLICATIONS

The MDmesh™ family is very suitable for increasing power density of high voltage converters allowing system miniaturization and higher efficiencies.

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value       | Unit |
|---------------------|--|-------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 500         | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 500         | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ±30         | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 7.5         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 4.7         | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                               | 30          | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 100         | W    |
|                     | Derating Factor                                      | 0.8         | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 15          | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                  | - 55 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  |             |      |

(•)Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 5A, di/dt ≤ 400A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STD5NM50/STD5NM50-1

### THERMAL DATA

|                |  |     |      |      |
|----------------|--|-----|------|------|
| Rthj-case      | Thermal Resistance Junction-case               | Max | 1.25 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient            | Max | 100  | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose |     | 300  | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter  | Max Value | Unit |
|-----------------|--|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)                                | 2.5       | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 300       | mJ   |

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED)

OFF

| Symbol               | Parameter   | Test Conditions   | Min. | Typ. | Max.    | Unit     |
|----------------------|---|---|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0  | 500  |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>10 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ±30V  |      |      | ±100    | nA       |

ON (1)

| Symbol              | Parameter                         | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|--|------|------|------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA | 3    | 4    | 5    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.5A               |      | 0.7  | 0.8  | Ω    |

### DYNAMIC

| Symbol                   | Parameter                     | Test Conditions  | Min. | Typ. | Max. | Unit |
|--------------------------|-------------------------------|--|------|------|------|------|
| g <sub>fs</sub> (1)      | Forward Transconductance      | V <sub>DS</sub> = 25V <sub>x</sub> , I <sub>D</sub> = 2.5A         |      | 3.5  |      | S    |
| C <sub>iss</sub>         | Input Capacitance             | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0              |      | 415  |      | pF   |
| C <sub>oss</sub>         | Output Capacitance            |  |      | 88   |      | pF   |
| C <sub>rss</sub>         | Reverse Transfer Capacitance  |  |      | 12   |      | pF   |
| C <sub>oss eq.</sub> (2) | Equivalent Output Capacitance | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 400V                 |      | 50   |      | pF   |
| R <sub>G</sub>           | Gate Input Resistance         | f=1 MHz Gate DC Bias = 0<br>Test Signal Level = 20mV<br>Open Drain |      | 3    |      | Ω    |

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

2. C<sub>oss eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

**ELECTRICAL CHARACTERISTICS (CONTINUED)**  
SWITCHING ON

| Symbol      | Parameter          | Test Conditions   | Min. | Typ. | Max. | Unit |
|-------------|--------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250V, I_D = 2.5A$                                     |      | 16   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\Omega, V_{GS} = 10V$<br>(see test circuit, Figure 3) |      | 8    |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400V, I_D = 7.5A$                                     |      | 13   |      | nC   |
| $Q_{gs}$    | Gate-Source Charge | $V_{GS} = 10V$  |      | 5    |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |   |      | 6    |      | nC   |

SWITCHING OFF

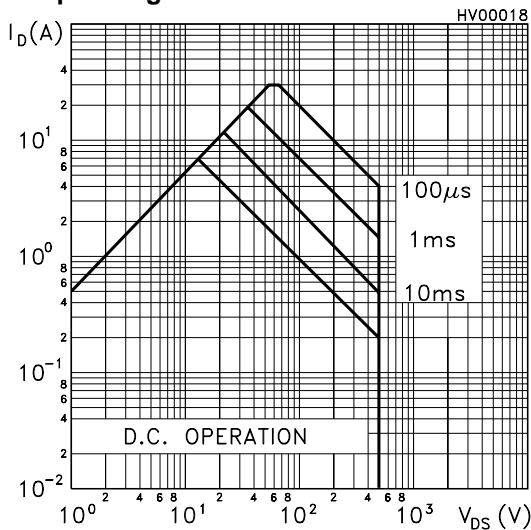
| Symbol        | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(voff)}$ | Off-voltage Rise Time | $V_{DD} = 400V, I_D = 5A,$                                      |      | 14   |      | ns   |
| $t_f$         | Fall Time             | $R_G = 4.7\Omega, V_{GS} = 10V$<br>(see test circuit, Figure 5) |      | 6    |      | ns   |
| $t_c$         | Cross-over Time       |   |      | 13   |      | ns   |

SOURCE DRAIN DIODE

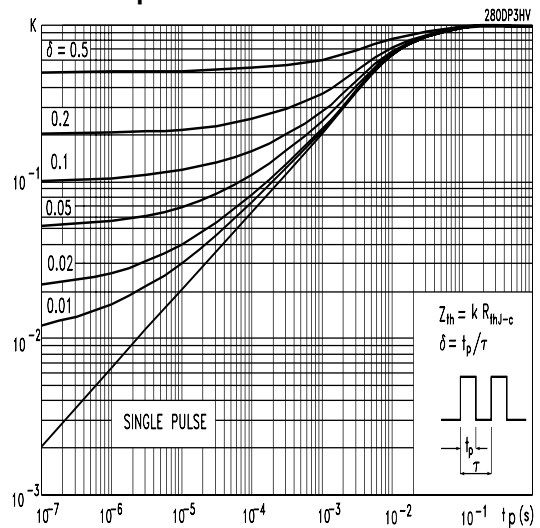
| Symbol        | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit    |
|---------------|-------------------------------|---|------|------|------|---------|
| $I_{SD}$      | Source-drain Current          |   |      |      | 7.5  | A       |
| $I_{SDM} (2)$ | Source-drain Current (pulsed) |   |      |      | 30   | A       |
| $V_{SD} (1)$  | Forward On Voltage            | $I_{SD} = 7.5A, V_{GS} = 0$                                       |      |      | 1.5  | V       |
| $t_{rr}$      | Reverse Recovery Time         | $I_{SD} = 5A, di/dt = 100A/\mu s,$                                |      | 185  |      | ns      |
| $Q_{rr}$      | Reverse Recovery Charge       | $V_{DD} = 100V, T_j = 25^\circ C$<br>(see test circuit, Figure 5) |      | 1.1  |      | $\mu C$ |
| $I_{RRM}$     | Reverse Recovery Current      |   |      | 11.5 |      | A       |
| $t_{rr}$      | Reverse Recovery Time         | $I_{SD} = 5A, di/dt = 100A/\mu s,$                                |      | 270  |      | ns      |
| $Q_{rr}$      | Reverse Recovery Charge       | $V_{DD} = 100V, T_j = 150^\circ C$                                |      | 1.6  |      | $\mu C$ |
| $I_{RRM}$     | Reverse Recovery Current      | (see test circuit, Figure 5)                                      |      | 12   |      | A       |

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

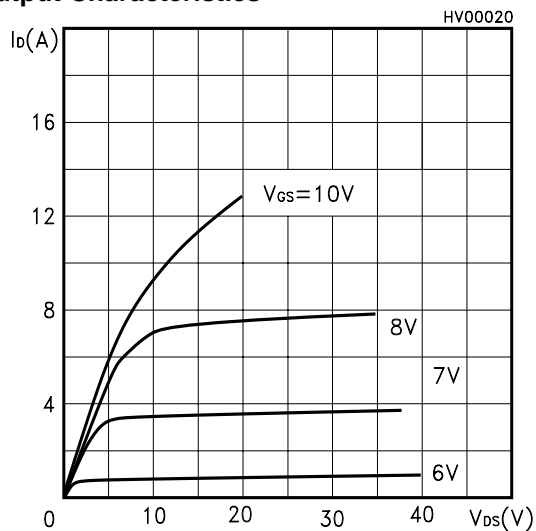
Safe Operating Area



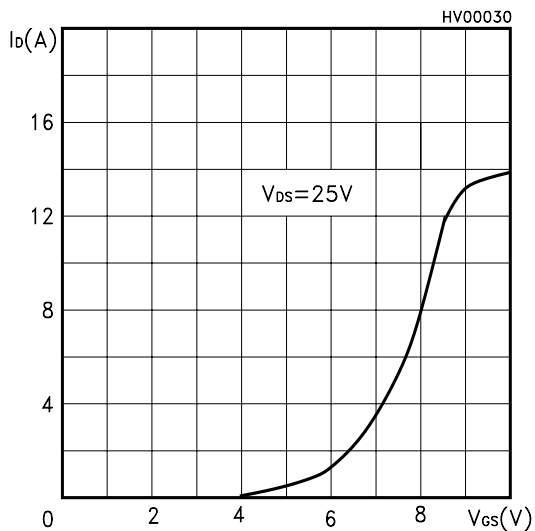
Thermal Impedance



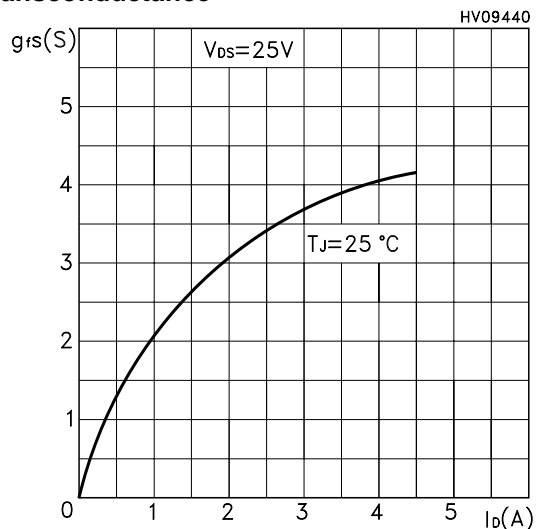
Output Characteristics



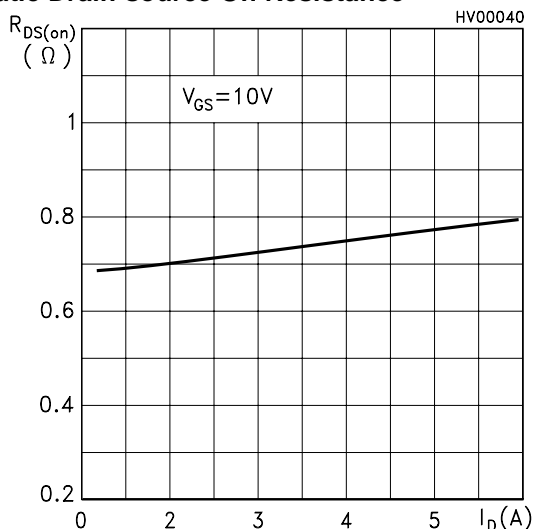
Transfer Characteristics



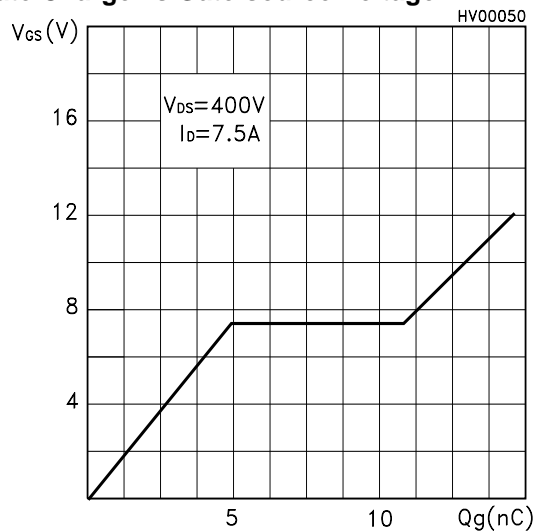
Transconductance



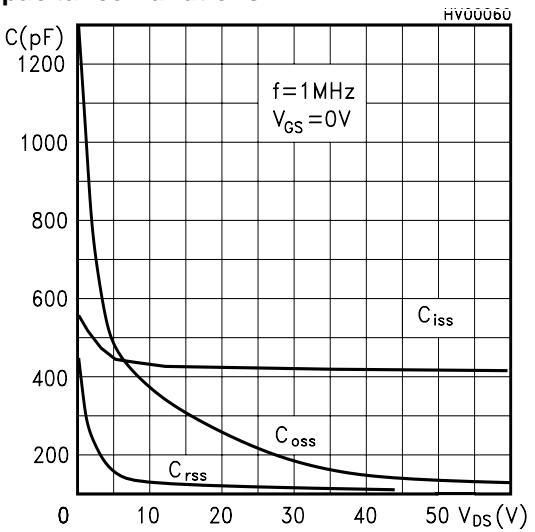
Static Drain-source On Resistance



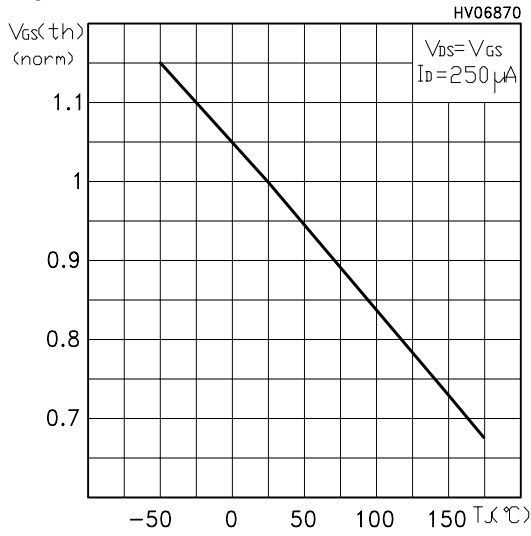
Gate Charge vs Gate-source Voltage



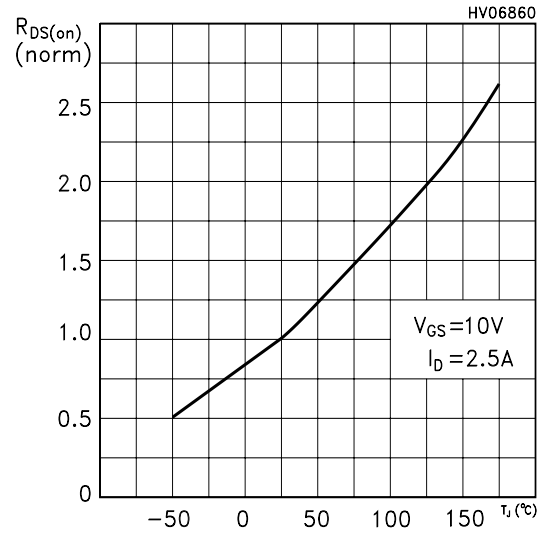
Capacitance Variations



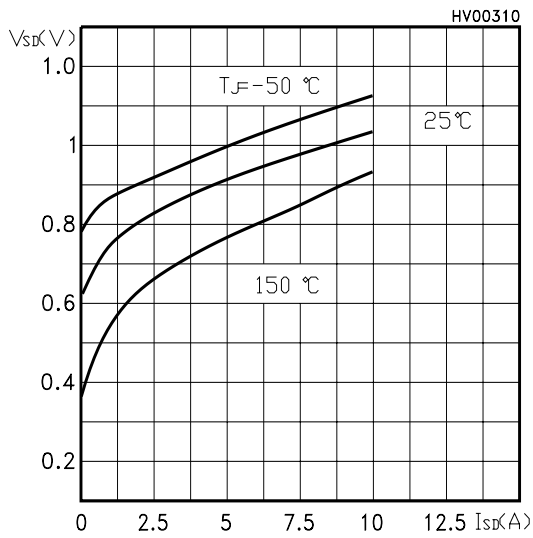
**Normalized Gate Threshold Voltage vs Temperature**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**



**Normalized BV<sub>DSS</sub> vs Temperature**

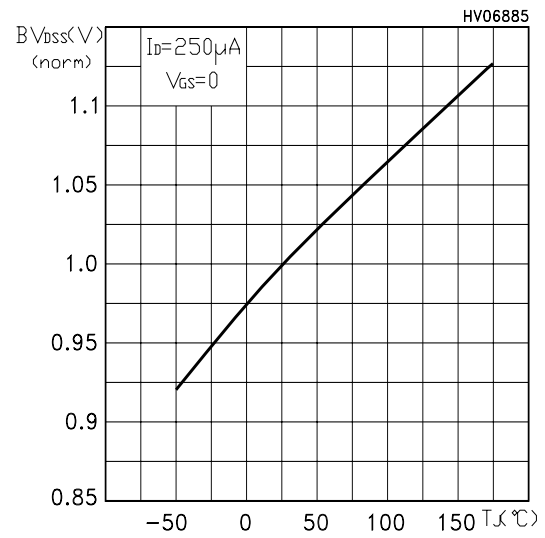


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuit For Resistive Load



Fig. 4: Gate Charge test Circuit

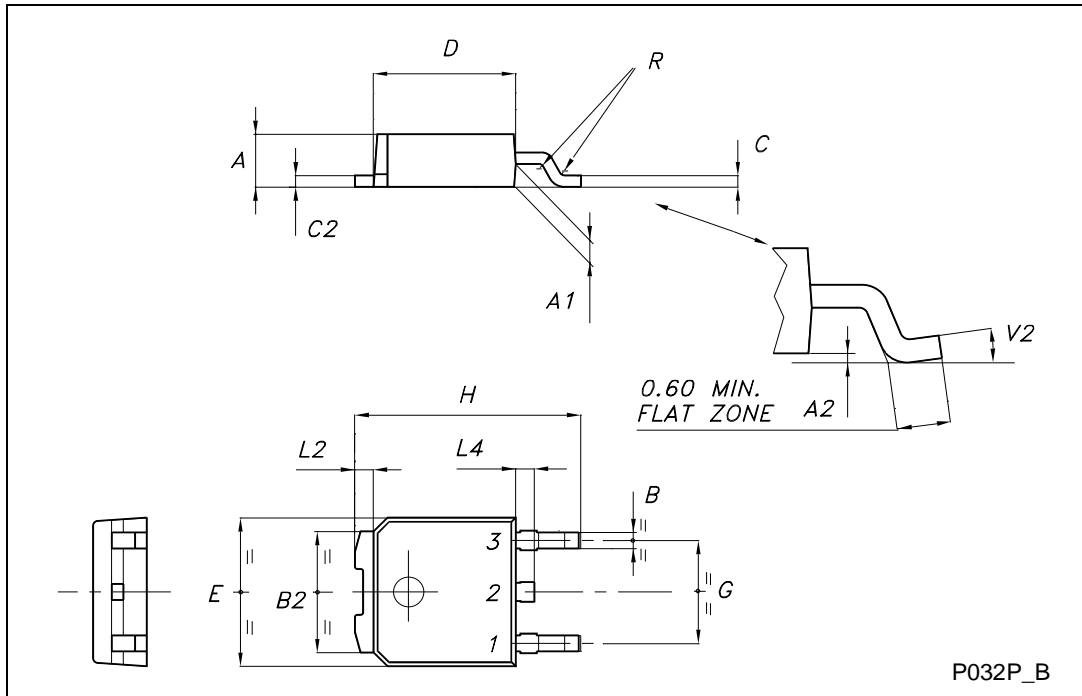


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



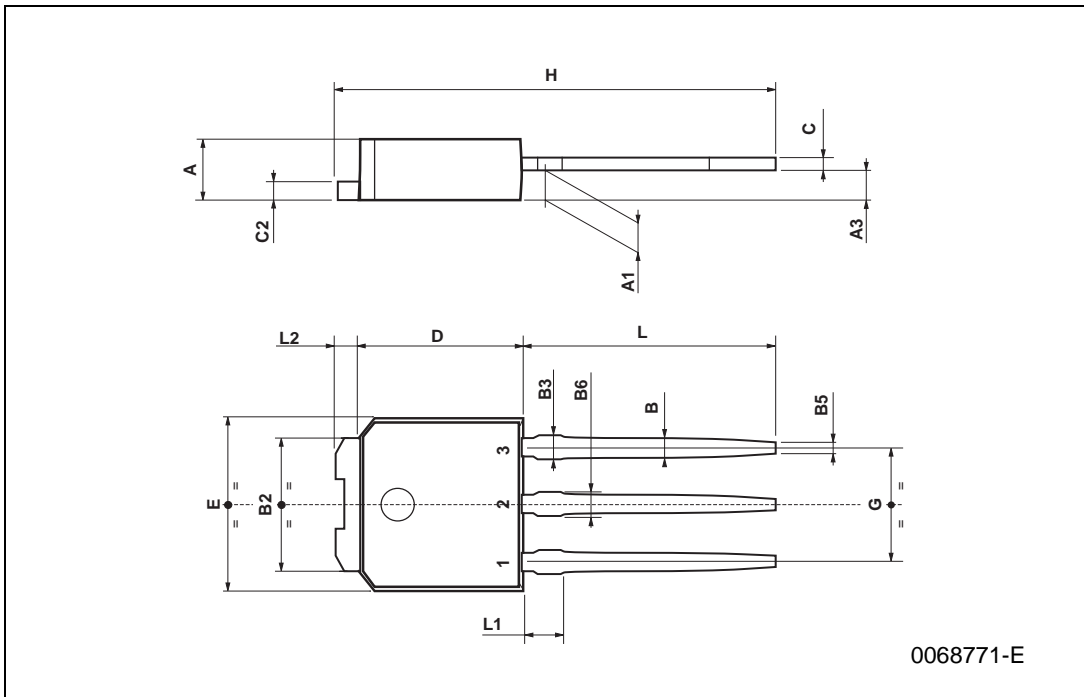
TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.20 |      | 2.40  | 0.087 |       | 0.094 |
| A1   | 0.90 |      | 1.10  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.90  | 0.025 |       | 0.035 |
| B2   | 5.20 |      | 5.40  | 0.204 |       | 0.213 |
| C    | 0.45 |      | 0.60  | 0.018 |       | 0.024 |
| C2   | 0.48 |      | 0.60  | 0.019 |       | 0.024 |
| D    | 6.00 |      | 6.20  | 0.236 |       | 0.244 |
| E    | 6.40 |      | 6.60  | 0.252 |       | 0.260 |
| G    | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.10 | 0.368 |       | 0.398 |
| L2   |      | 0.8  |       |       | 0.031 |       |
| L4   | 0.60 |      | 1.00  | 0.024 |       | 0.039 |
| V2   | 0°   |      | 8°    | 0°    |       | 0°    |



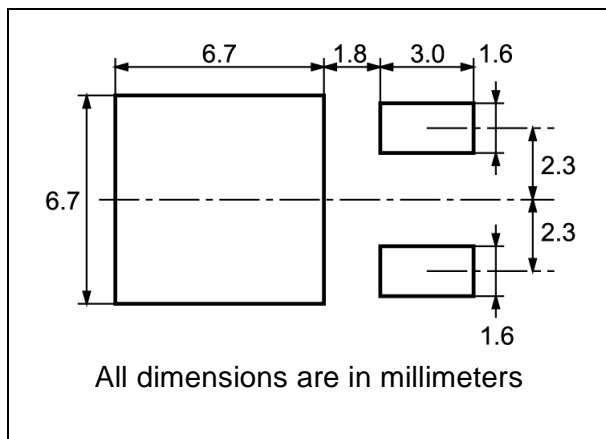
**TO-251 (IPAK) MECHANICAL DATA**

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A3   | 0.7  |      | 1.3  | 0.027 |       | 0.051 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.031 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.85 |       |       | 0.033 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |

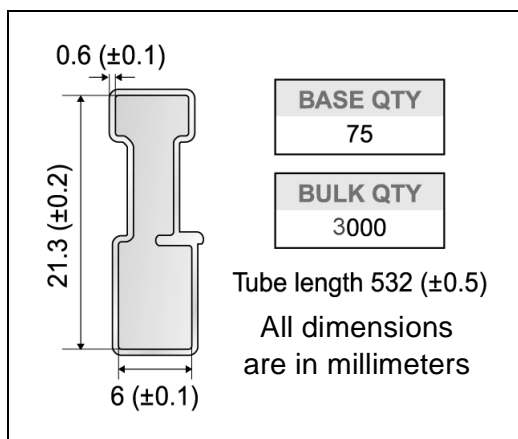




**DPAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

T

N

G measured at hub

**REEL MECHANICAL DATA**

| DIM. | mm   |      | inch  |        |
|------|------|------|-------|--------|
|      | MIN. | MAX. | MIN.  | MAX.   |
| A    |      | 330  |       | 12.992 |
| B    | 1.5  |      | 0.059 |        |
| C    | 12.8 | 13.2 | 0.504 | 0.520  |
| D    | 20.2 |      | 0.795 |        |
| G    | 16.4 | 18.4 | 0.645 | 0.724  |
| N    | 50   |      | 1.968 |        |
| T    |      | 22.4 |       | 0.881  |

|                 |                 |
|-----------------|-----------------|
| <b>BASE QTY</b> | <b>BULK QTY</b> |
| 2500            | 2500            |

**TAPE MECHANICAL DATA**

| DIM. | mm   |      | inch  |       |
|------|------|------|-------|-------|
|      | MIN. | MAX. | MIN.  | MAX.  |
| A0   | 6.8  | 7    | 0.267 | 0.275 |
| B0   | 10.4 | 10.6 | 0.409 | 0.417 |
| B1   |      | 12.1 |       | 0.476 |
| D    | 1.5  | 1.6  | 0.059 | 0.063 |
| D1   | 1.5  |      | 0.059 |       |
| E    | 1.65 | 1.85 | 0.065 | 0.073 |
| F    | 7.4  | 7.6  | 0.291 | 0.299 |
| K0   | 2.55 | 2.75 | 0.100 | 0.108 |
| P0   | 3.9  | 4.1  | 0.153 | 0.161 |
| P1   | 7.9  | 8.1  | 0.311 | 0.319 |
| P2   | 1.9  | 2.1  | 0.075 | 0.082 |
| R    | 40   |      | 1.574 |       |
| W    | 15.7 | 16.3 | 0.618 | 0.641 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

FEED DIRECTION

Bending radius

R min.

For machine ref. only including draft and radii concentric around B0

\* on sales type

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