



# STD16NF06L

## N-CHANNEL 60V - 0.060 Ω - 24A DPAK/IPAK STripFET™ II POWER MOSFET

**Table 1: General Features**

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STD16NF06L | 60 V             | < 0.070 Ω           | 24 A           |

- TYPICAL R<sub>DS(on)</sub> = 0.060 Ω
- LOGIC LEVEL DEVICE
- THROUGH-HOLE IPAK (TO-251) POWER PACKAGE IN TUBE (SUFFIX "-1")
- SURFACE-MOUNTING DPAK (TO-252) POWER PACKAGE IN TAPE & REEL (SUFFIX "T4")

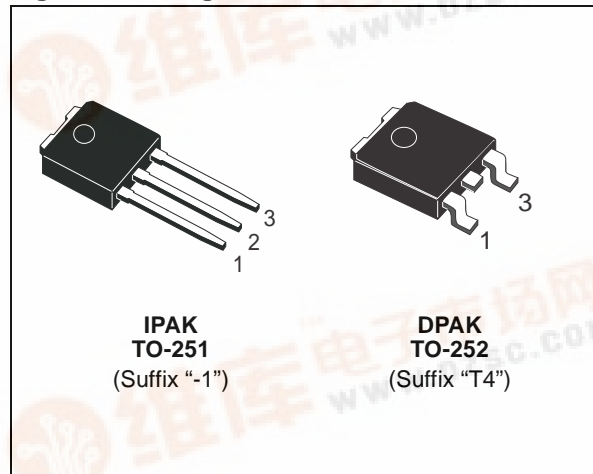
### DESCRIPTION

This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility

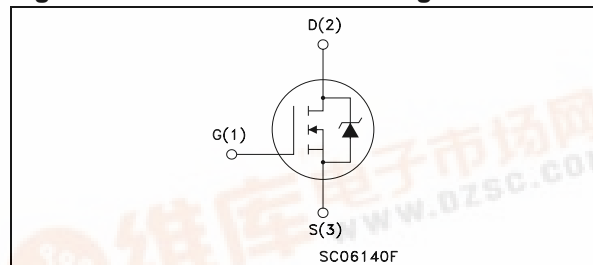
### APPLICATIONS

- SWITCHING APPLICATIONS

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 2: Order Codes**

| SALES TYPE   | MARKING  | PACKAGE | PACKAGING   |
|--------------|----------|---------|-------------|
| STD16NF06LT4 | D16NF06L | TO-252  | TAPE & REEL |
| STD16NF06L-1 | D16NF06L | TO-251  | TUBE        |

**Table 3: ABSOLUTE MAXIMUM RATINGS**

| Symbol              | Parameter  | Value      | Unit |
|---------------------|--|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 60         | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 60         | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ± 18       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 24         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 17         | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 96         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 40         | W    |
|                     | Derating Factor                                      | 0.27       | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 11.5       | V/ns |
| E <sub>AS</sub> (2) | Single Pulse Avalanche Energy                        | 200        | mJ   |
| T <sub>stg</sub>    | Storage Temperature                                  | -55 to 175 | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                       |            |      |

(●) Pulse width limited by safe operating area.

(1) I<sub>SD</sub> ≤ 16A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 20A, V<sub>DD</sub> = 48V



## STD16NF06L

**Table 4: THERMAL DATA**

|                |  |     |      |      |
|----------------|--|-----|------|------|
| Rthj-case      | Thermal Resistance Junction-case   | Max | 3.75 | °C/W |
| Rthj-pcb       | (*)Thermal Resistance Junction-PCB   | Max | 62   | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose<br>(1.6 mm from case, for 10 sec) |     | 275  | °C   |

(\*) When Mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz of Cu

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

**Table 5: 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  | 60   |      |         | 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> = ± 18V   |      |      | ±100    | nA       |

**Table 6: ON <sup>(5)</sup>**

| 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> = 250 μA                                 | 1    |                |                | V      |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 8 A<br>V <sub>GS</sub> = 5 V I <sub>D</sub> = 8 A |      | 0.060<br>0.070 | 0.070<br>0.085 | Ω<br>Ω |

**Table 7: DYNAMIC**

| Symbol              | Parameter                    | Test Conditions                                     | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|---|------|------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> = 15 V I <sub>D</sub> = 12 A        |      | 12   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V f = 1 MHz V <sub>GS</sub> = 0 |      | 370  |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |   |      | 69   |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |   |      | 30   |      | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)

**Table 8: SWITCHING ON**

| Symbol                        | Parameter  | Test Conditions   | Min. | Typ.              | Max. | Unit           |
|-------------------------------|--|---|------|-------------------|------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Delay Time<br>Rise Time                              | $V_{DD} = 30\text{ V}$ $I_D = 8\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$<br>(Resistive Load, Figure 17) |      | 12<br>30          |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 30\text{ V}$ $I_D = 16\text{ A}$ $V_{GS} = 5\text{ V}$  |      | 7.5<br>2.5<br>4.2 |      | nC<br>nC<br>nC |

**Table 9: SWITCHING OFF**

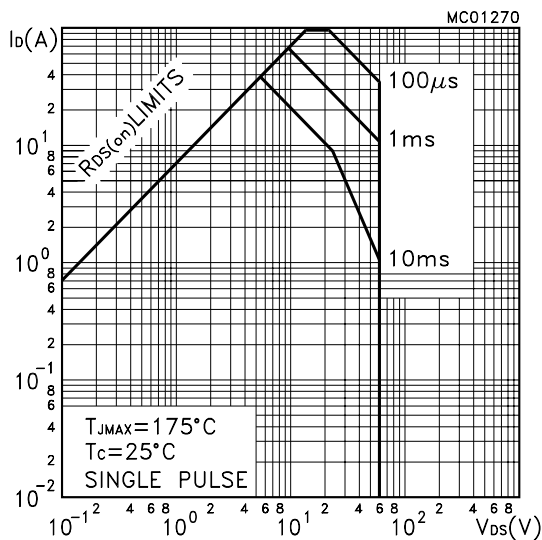
| Symbol                | Parameter                        | Test Conditions   | Min. | Typ.    | Max. | Unit     |
|-----------------------|----------------------------------|---|------|---------|------|----------|
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall Time | $V_{DD} = 30\text{ V}$ $I_D = 8\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$<br>(Resistive Load, Figure 17) |      | 20<br>6 |      | ns<br>ns |

**Table 10: SOURCE DRAIN DIODE**

| Symbol                            | Parameter  | Test Conditions  | Min. | Typ.            | Max.     | Unit                     |
|-----------------------------------|--|--|------|-----------------|----------|--------------------------|
| $I_{SD}$<br>$I_{SDM} (*)$         | Source-drain Current<br>Source-drain Current (pulsed)                        |  |      |                 | 16<br>64 | A<br>A                   |
| $V_{SD} (*)$                      | Forward On Voltage   | $I_{SD} = 64\text{ A}$ $V_{GS} = 0$  |      |                 | 1.5      | V                        |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 16\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 25\text{ V}$ $T_j = 150^\circ\text{C}$<br>(see test circuit, Figure 19) |      | 53<br>85<br>3.2 |          | ns<br>$\mu\text{C}$<br>A |

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

**Figure 3: Safe Operating Area**



**Figure 4: Thermal Impedance**

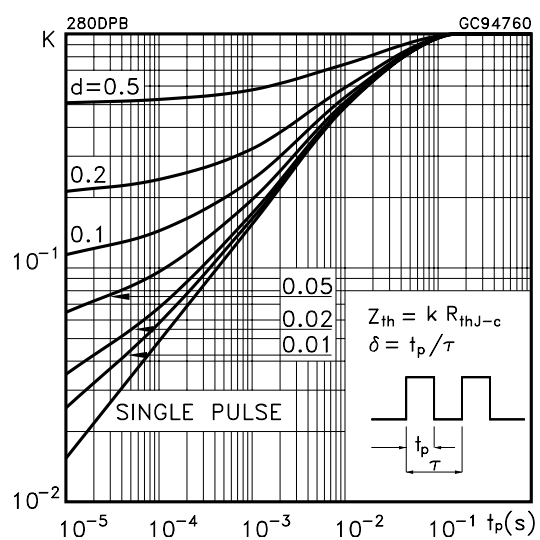


Figure 5: Output Characteristics

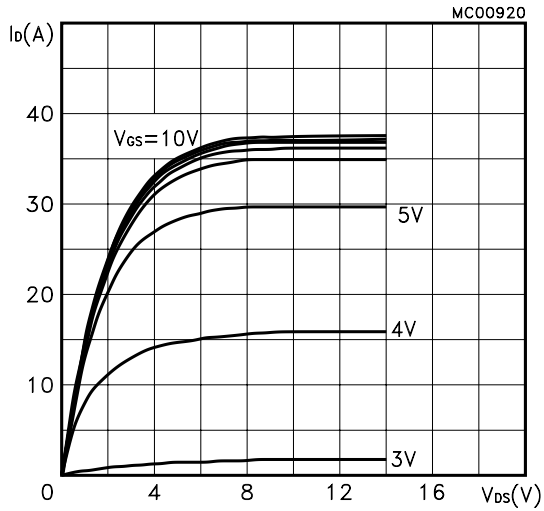


Figure 6: Transfer Characteristics

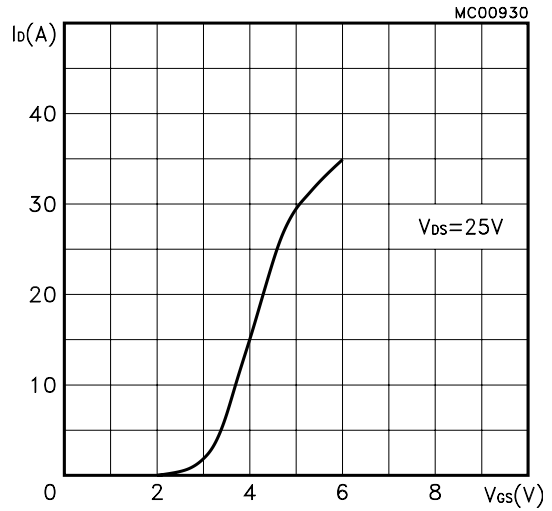


Figure 7: Transconductance

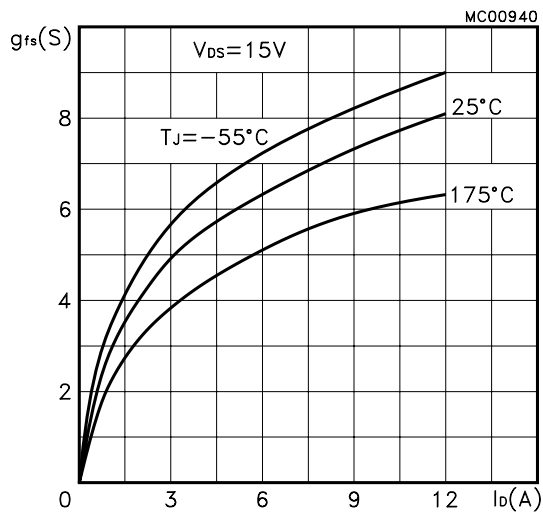


Figure 8: Static Drain-source On Resistance

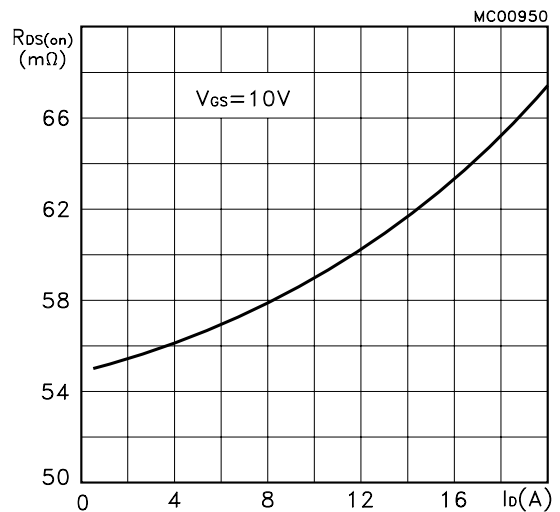


Figure 9: Gate Charge vs Gate-source Voltage

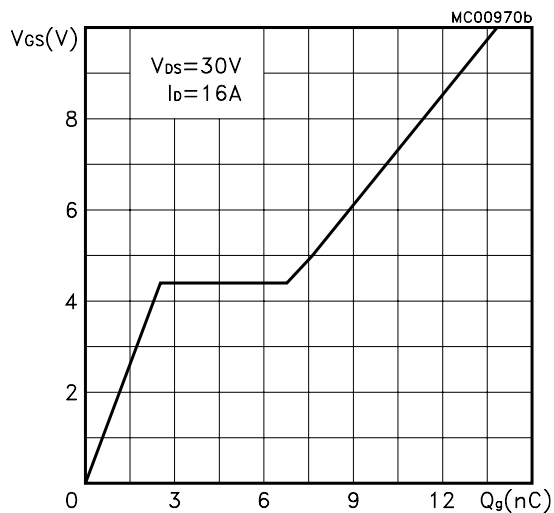


Figure 10: Capacitance Variations

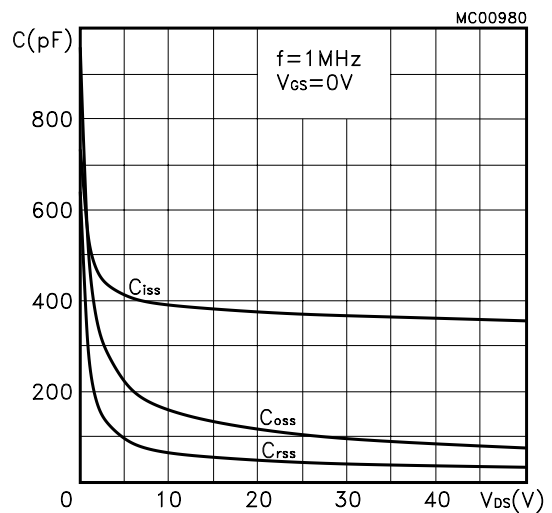


Figure 11: Normalized Gate Threshold Voltage vs Temperature

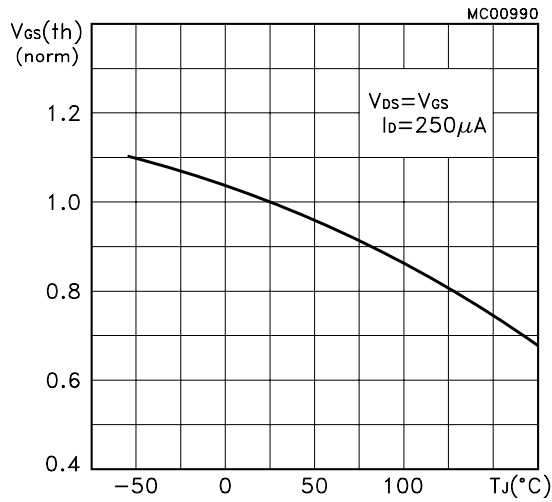


Figure 12: Normalized on Resistance vs Temperature

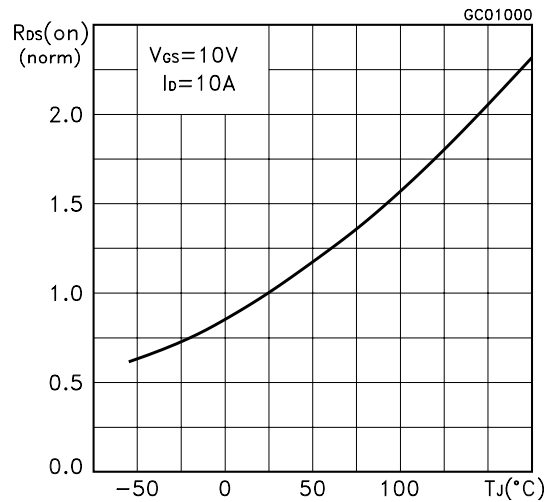


Figure 13: Source-drain Diode Forward Characteristics

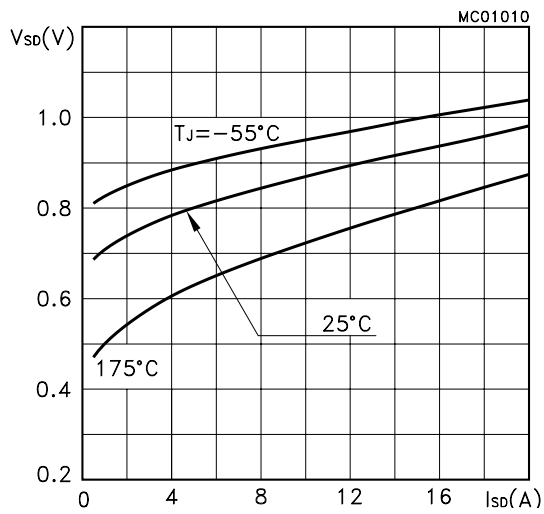
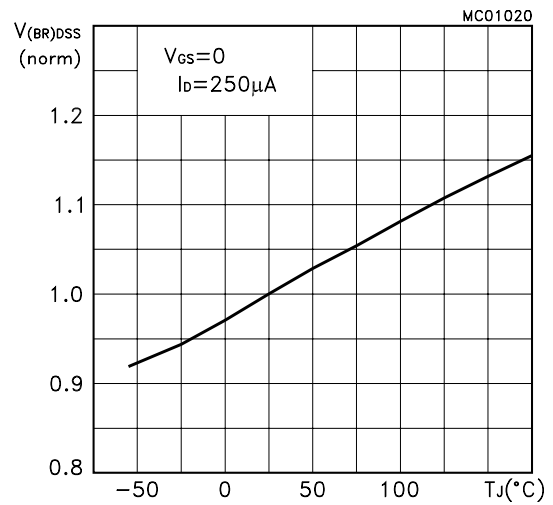
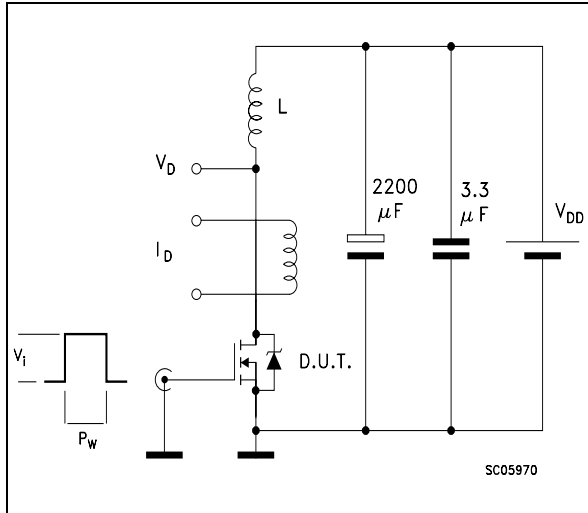


Figure 14: Normalized Breakdown Voltage vs Temperature.

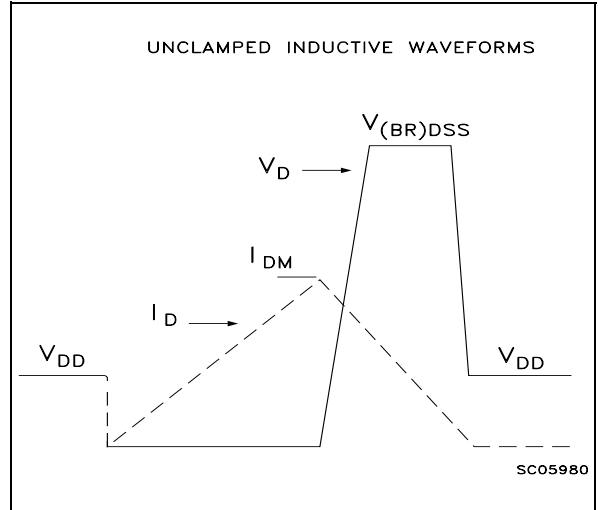


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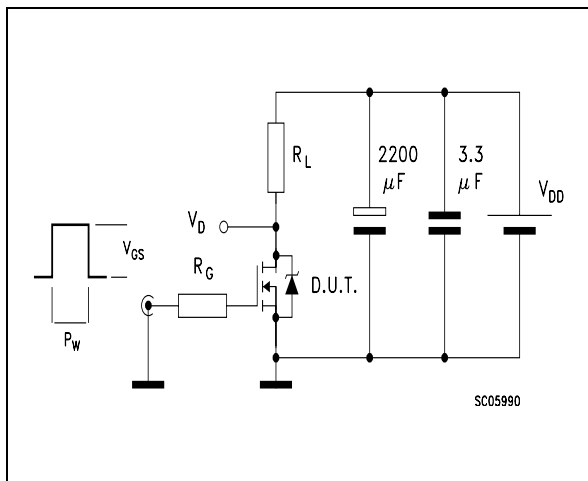
**Figure 15: Unclamped Inductive Load Test Circuit**



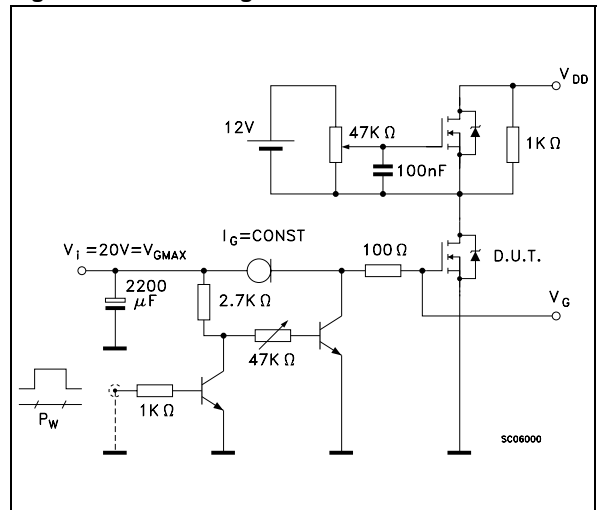
**Figure 16: Unclamped Inductive Waveform**



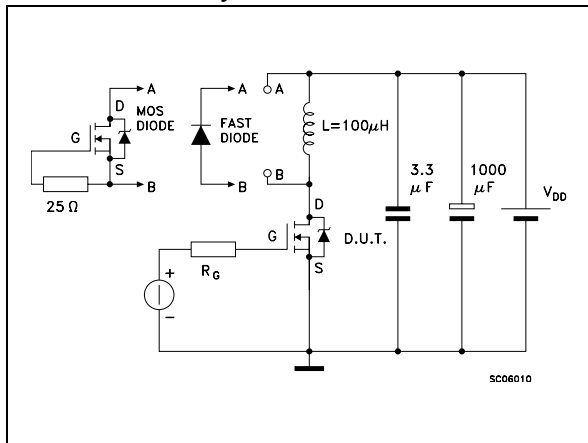
**Figure 17: Switching Times Test Circuits For Resistive Load**



**Figure 18: Gate Charge test Circuit**

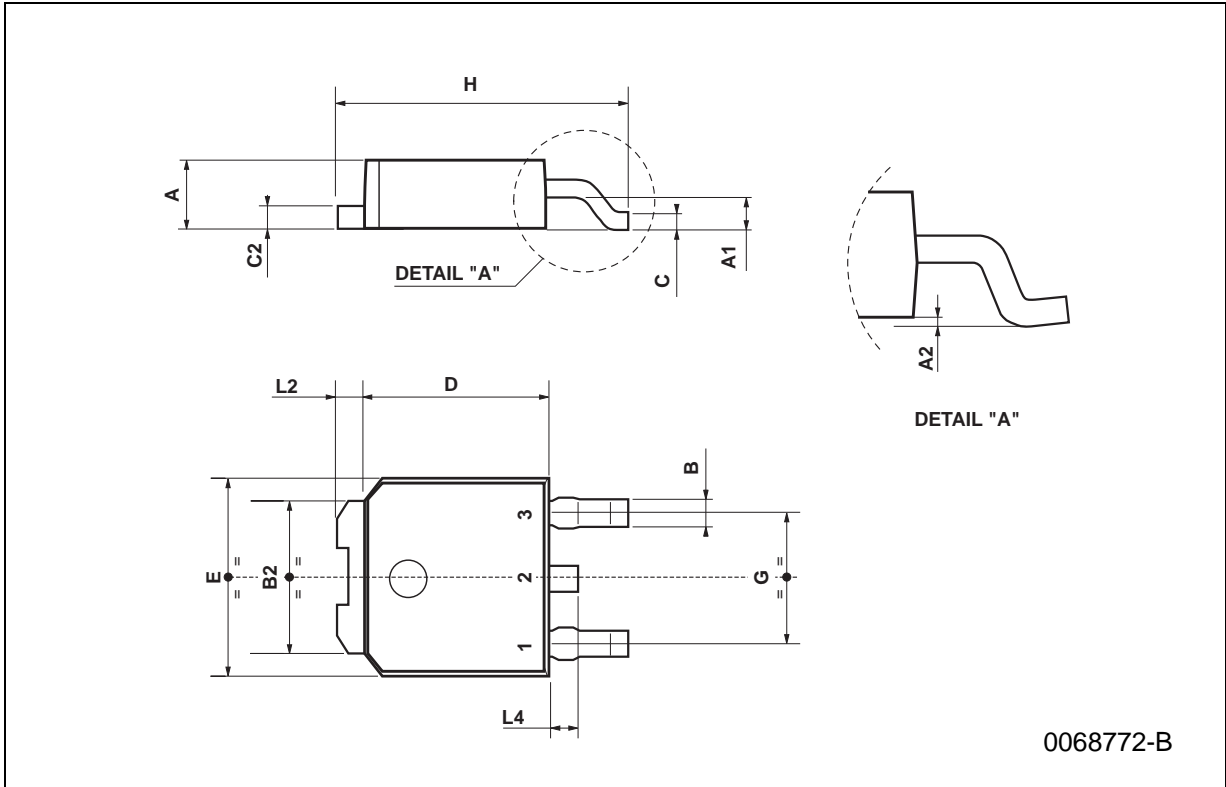


**Figure 19: Test Circuit For Inductive Load Switching And Diode Recovery Times**



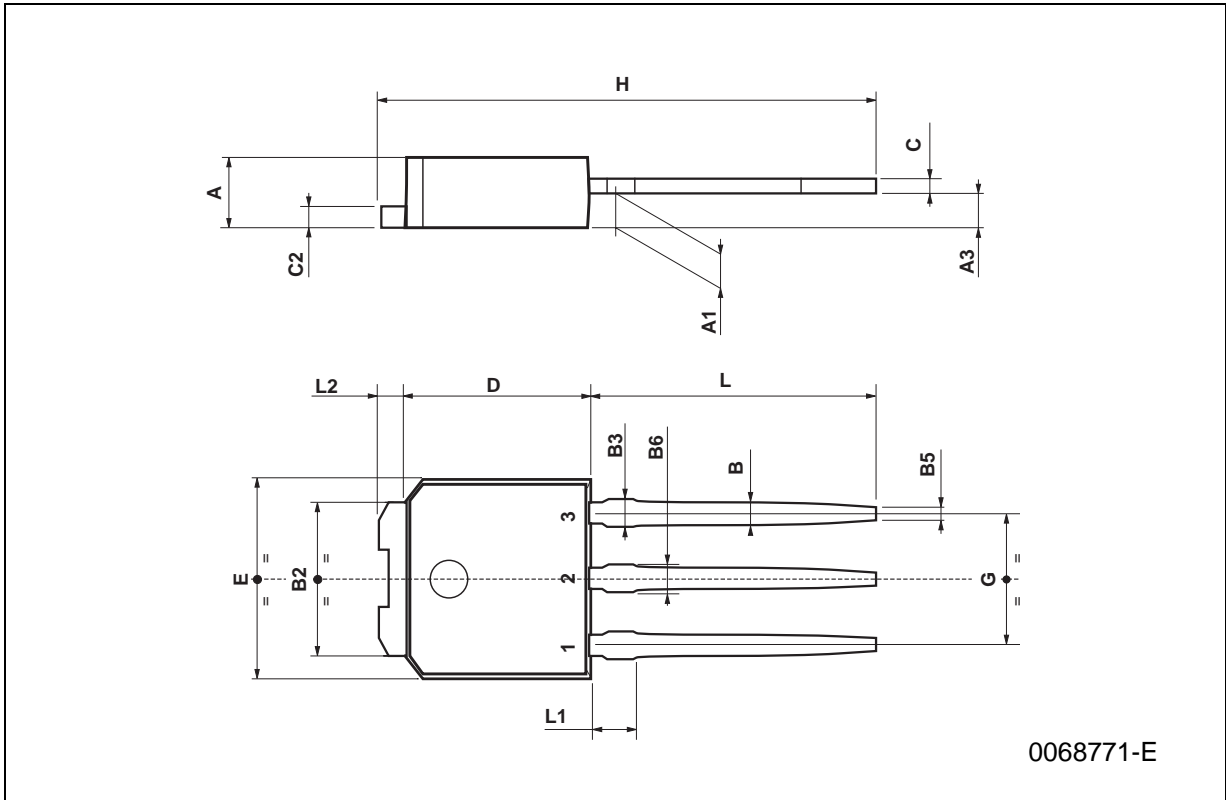
**TO-252 (DPAK) MECHANICAL DATA**

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| 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    | 9.35 |      | 10.1 | 0.368 |       | 0.397 |
| L2   |      | 0.8  |      |       | 0.031 |       |
| L4   | 0.6  |      | 1    | 0.023 |       | 0.039 |



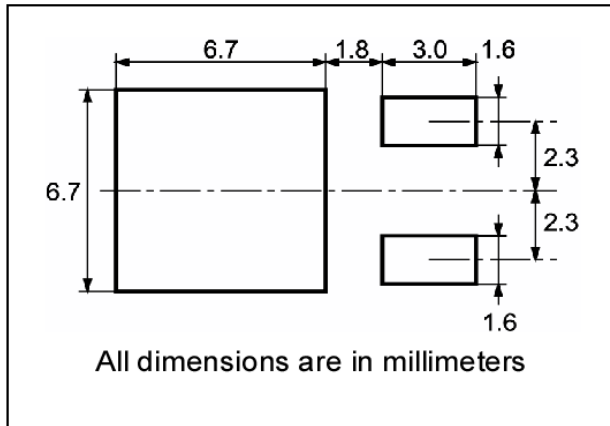
**TO-251 (IPAK) MECHANICAL DATA**

| 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 |

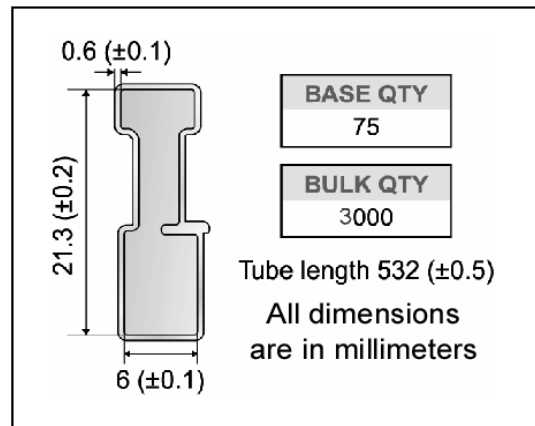




**DPAK FOOTPRINT**



**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  |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000     | 1000     |

**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

TRL

FEED DIRECTION

Bending radius

R min.

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

\*on sales type

## STD16NF06L

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**Table 11:Revision History**

| Date       | Revision | Description of Changes |
|------------|----------|------------------------|
| March 2005 | 3.0      | ADDED PACKAGE TO-251   |

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