



# STGD3NB60SD

## N-CHANNEL 3A - 600V DPAK Power MESH™ IGBT

PRELIMINARY DATA

| TYPE        | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|-------------|------------------|----------------------|----------------|
| STGD3NB60SD | 600 V            | < 1.5 V              | 3 A            |

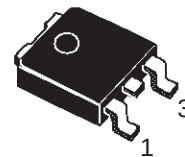
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- VERY LOW ON-VOLTAGE DROP (V<sub>cesat</sub>)
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- INTEGRATED FREEWHEELING DIODE
- SURFACE-MOUNTING DPAK (TO-252)  
POWER PACKAGE IN TAPE & REEL (SUFFIX "T4")

### DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "S" identifies a family optimized to achieve minimum on-voltage drop for low frequency applications (<1kHz).

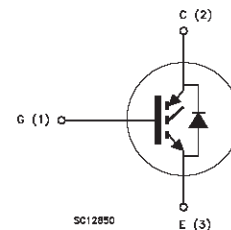
### APPLICATIONS

- GAS DISCHARGE LAMP
- STATIC RELAYS
- MOTOR CONTROL



**DPAK  
TO-252**  
(Suffix "T4")

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                                 | Value      | Unit |
|---------------------|-----------------------------------------------------------|------------|------|
| V <sub>CES</sub>    | Collector-Emitter Voltage (V <sub>GS</sub> = 0)           | 600        | V    |
| V <sub>GE</sub>     | Gate-Emitter Voltage                                      | ± 20       | V    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 25 °C  | 6          | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 100 °C | 3          | A    |
| I <sub>CM</sub> (•) | Collector Current (pulsed)                                | 25         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C               | 40         | W    |
|                     | Derating Factor                                           | 0.32       | W/°C |
| T <sub>stg</sub>    | Storage Temperature                                       | -65 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                       | 150        | °C   |

(•) Pulse width limited by safe operating area

## STGD3NB60SD

### THERMAL DATA

|                       |                                     |     |       |      |
|-----------------------|-------------------------------------|-----|-------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case    | Max | 3.125 | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient | Max | 100   | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink        | Typ | 1.5   | °C/W |

### ELECTRICAL CHARACTERISTICS (T<sub>j</sub> = 25 °C unless otherwise specified)

#### OFF

| Symbol               | Parameter                                          | Test Conditions                                                                                             | Min. | Typ. | Max.      | Unit     |
|----------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|-----------|----------|
| V <sub>BR(CES)</sub> | Collector-Emitter Breakdown Voltage                | I <sub>C</sub> = 250 µA V <sub>GE</sub> = 0                                                                 | 600  |      |           | V        |
| I <sub>CES</sub>     | Collector cut-off (V <sub>GE</sub> = 0)            | V <sub>CE</sub> = Max Rating T <sub>j</sub> = 25 °C<br>V <sub>CE</sub> = Max Rating T <sub>j</sub> = 125 °C |      |      | 10<br>100 | µA<br>µA |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current (V <sub>CE</sub> = 0) | V <sub>GE</sub> = ± 20 V V <sub>CE</sub> = 0                                                                |      |      | ± 100     | nA       |

#### ON (\*)

| Symbol               | Parameter                            | Test Conditions                                                                            | Min. | Typ.     | Max. | Unit   |
|----------------------|--------------------------------------|--------------------------------------------------------------------------------------------|------|----------|------|--------|
| V <sub>GE(th)</sub>  | Gate Threshold Voltage               | V <sub>CE</sub> = V <sub>GE</sub> I <sub>C</sub> = 250 µA                                  | 2.5  |          | 5    | V      |
| V <sub>CE(SAT)</sub> | Collector-Emitter Saturation Voltage | V <sub>GE</sub> = 15 V I <sub>C</sub> = 3 A<br>V <sub>GE</sub> = 15 V I <sub>C</sub> = 1 A |      | 1.2<br>1 | 1.5  | V<br>V |

### DYNAMIC

| Symbol                                                   | Parameter                                                               | Test Conditions                                                            | Min. | Typ.             | Max. | Unit           |
|----------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------|------|------------------|------|----------------|
| g <sub>fs</sub>                                          | Forward Transconductance                                                | V <sub>CE</sub> = 25 V I <sub>C</sub> = 3 A                                | 1.7  | 2.5              |      | S              |
| C <sub>ies</sub><br>C <sub>oes</sub><br>C <sub>res</sub> | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | V <sub>CE</sub> = 25 V f = 1 MHz V <sub>GE</sub> = 0                       |      | 255<br>30<br>5.6 |      | pF<br>pF<br>pF |
| Q <sub>G</sub><br>Q <sub>GE</sub><br>Q <sub>GC</sub>     | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | V <sub>CE</sub> = 480 V I <sub>C</sub> = 3 A V <sub>GE</sub> = 15 V        |      | 18<br>5.4<br>5.5 |      | nC<br>nC<br>nC |
| I <sub>CL</sub>                                          | Latching Current                                                        | V <sub>clamp</sub> = 480 V R <sub>G</sub> = 1kΩ<br>T <sub>j</sub> = 150 °C | 12   |                  |      | A              |

### SWITCHING ON

| Symbol                               | Parameter                | Test Conditions                                                                             | Min. | Typ.       | Max. | Unit     |
|--------------------------------------|--------------------------|---------------------------------------------------------------------------------------------|------|------------|------|----------|
| t <sub>d(on)</sub><br>t <sub>r</sub> | Delay Time<br>Rise Time  | V <sub>CC</sub> = 480 V I <sub>C</sub> = 3 A<br>V <sub>GE</sub> = 15 V R <sub>G</sub> = 1kΩ |      | 170<br>540 |      | ns<br>ns |
| (di/dt) <sub>on</sub>                | Turn-on Current Slope    | V <sub>CC</sub> = 480 V I <sub>C</sub> = 3 A<br>R <sub>G</sub> = 1kΩ V <sub>GE</sub> = 15 V |      | 50         |      | A/µs     |
| E <sub>on</sub>                      | Turn-on Switching Losses | T <sub>j</sub> = 125 °C                                                                     |      | 1100       |      | µJ       |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING OFF**

| Symbol         | Parameter               | Test Conditions                                    | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------|----------------------------------------------------|------|------|------|---------------|
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$ $I_C = 3\text{ A}$         |      | 1.8  |      | $\mu\text{S}$ |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 1\text{ k}\Omega$ $V_{GE} = 15\text{ V}$ |      | 1.0  |      | $\mu\text{S}$ |
| $t_{d(off)}$   | Delay Time              |                                                    |      | 3.4  |      | $\mu\text{S}$ |
| $t_f$          | Fall Time               |                                                    |      | 0.72 |      | $\mu\text{S}$ |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                    |      | 1.15 |      | mJ            |
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$ $I_C = 3\text{ A}$         |      | 2.8  |      | $\mu\text{S}$ |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 10\ \Omega$ $V_{GE} = 15\text{ V}$       |      | 1.45 |      | $\mu\text{S}$ |
| $t_{d(off)}$   | Delay Time              | $T_j = 125\text{ }^\circ\text{C}$                  |      | 3.6  |      | $\mu\text{S}$ |
| $t_f$          | Fall Time               |                                                    |      | 1.2  |      | $\mu\text{S}$ |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                    |      | 1.8  |      | mJ            |

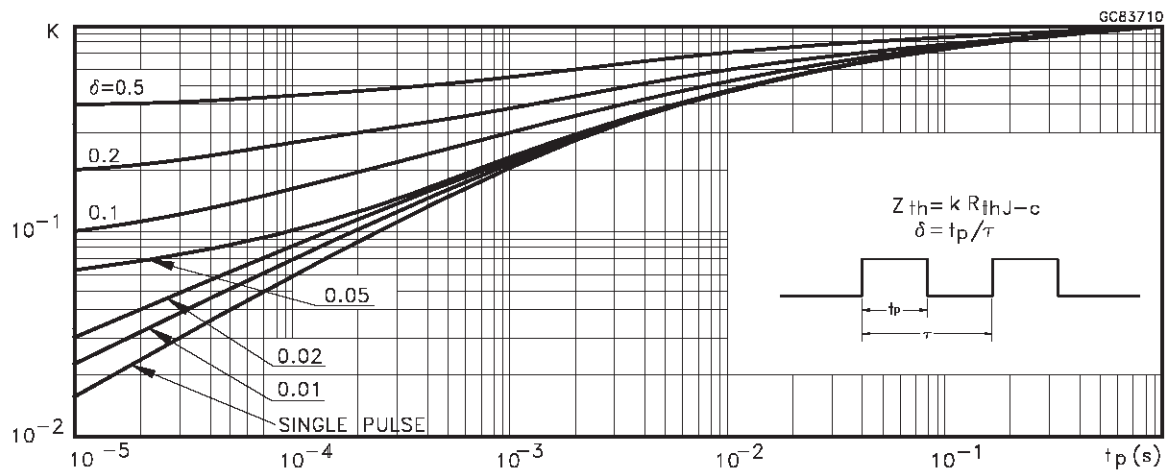
**COLLECTOR-EMITTER DIODE**

| Symbol    | Parameter                | Test Conditions                                                      | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|----------------------------------------------------------------------|------|------|------|------|
| $I_f$     | Forward Current          |                                                                      |      |      | 3    | A    |
| $I_{fm}$  | Forward Current pulsed   |                                                                      |      |      | 25   | A    |
| $V_f$     | Forward On-Voltage       | $I_f = 3\text{ A}$                                                   |      | 1.55 | 1.9  | V    |
|           |                          | $I_f = 1\text{ A}$                                                   |      | 1.15 |      | V    |
| $t_{rr}$  | Reverse Recovery Time    | $I_f = 3\text{ A}$ $V_R = 200\text{ V}$                              |      | 1390 |      | ns   |
| $Q_{rr}$  | Reverse Recovery Charge  | $di/dt = 100\text{ A}/\mu\text{S}$ $T_j = 125\text{ }^\circ\text{C}$ |      | 6000 |      | nC   |
| $I_{rrm}$ | Reverse Recovery Current |                                                                      |      | 8.75 |      | A    |

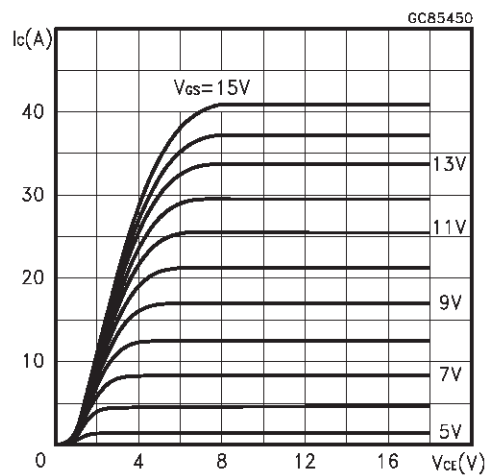
(●) Pulse width limited by max. junction temperature

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

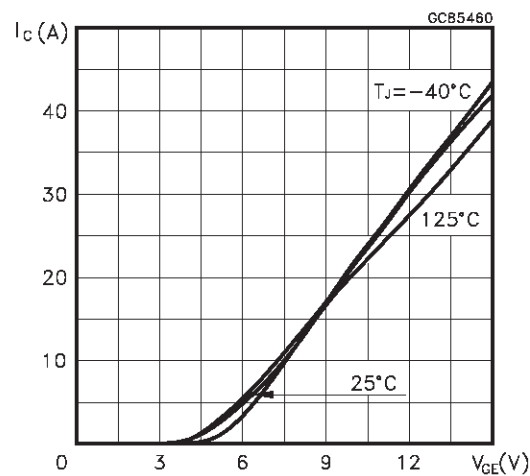
(\*\*) Losses Include Also The Tail (Jedec Standardization)

**Thermal Impedance**

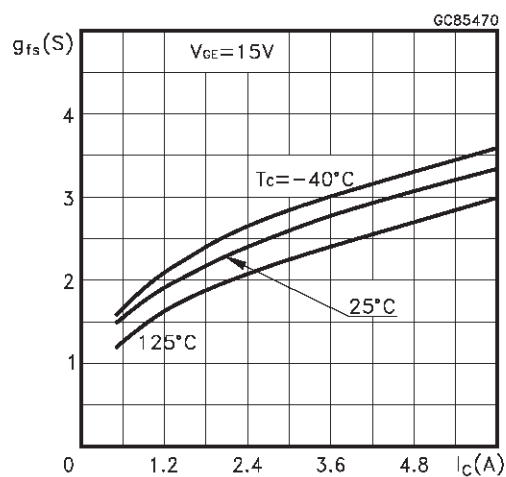
Output Characteristics



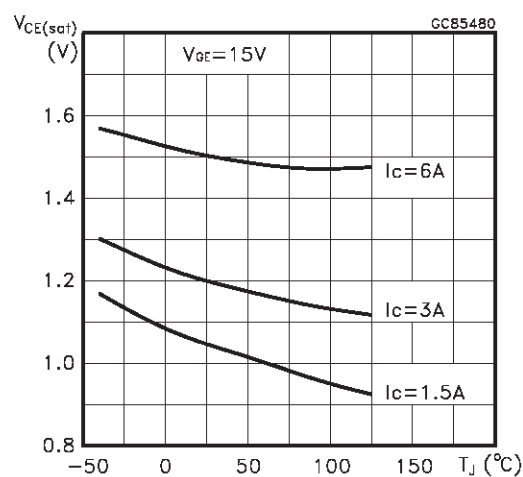
Transfer Characteristics



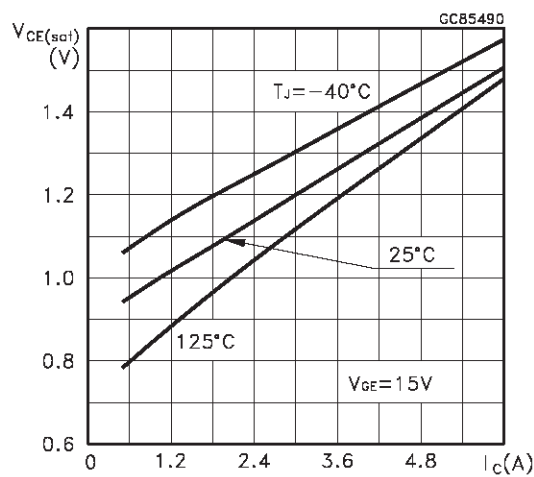
Transconductance



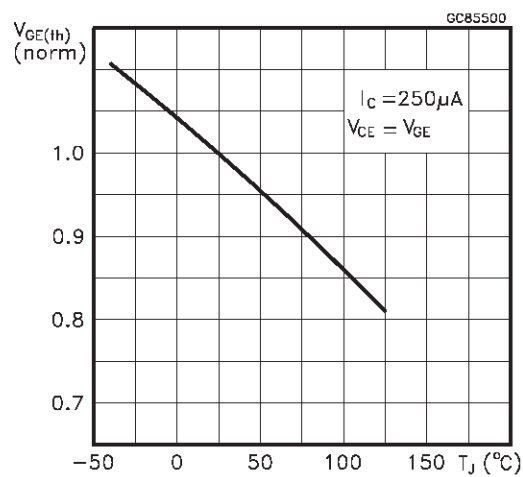
Collector-Emitter On Voltage vs Temperature



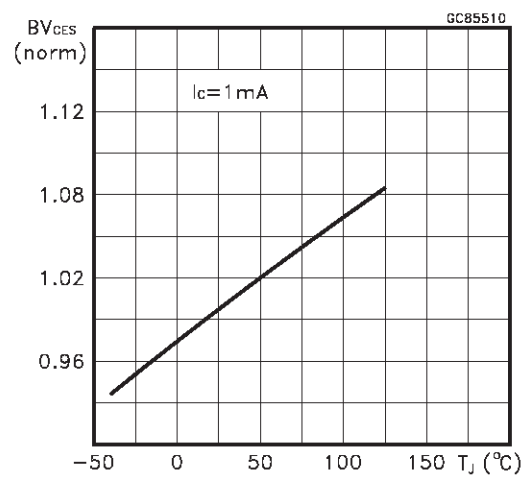
Collector-Emitter On Voltage vs Collector Current



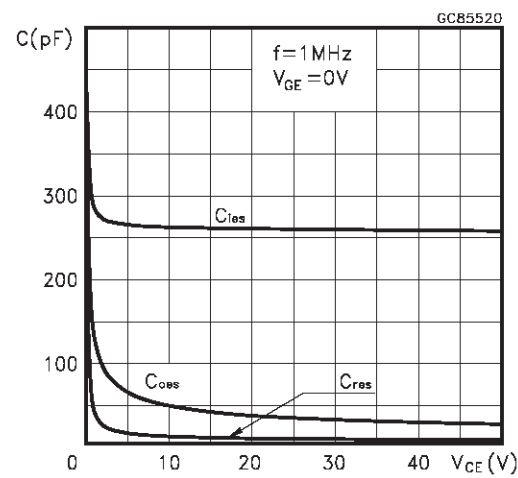
Gate Threshold vs Temperature



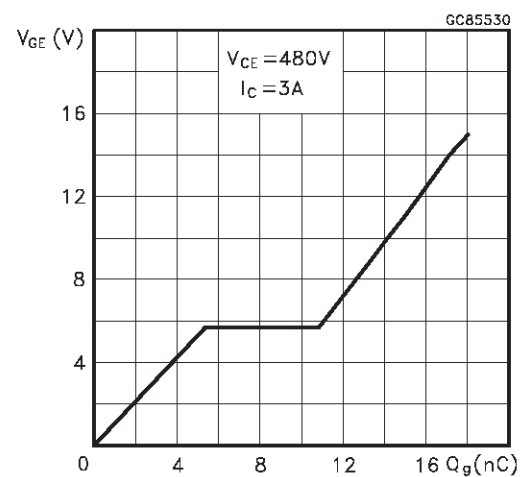
Normalized Breakdown Voltage vs Temperature



Capacitance Variations

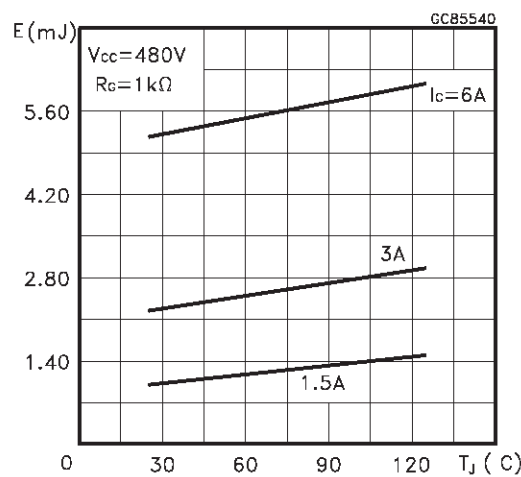


Gate Charge vs Gate-Emitter Voltage

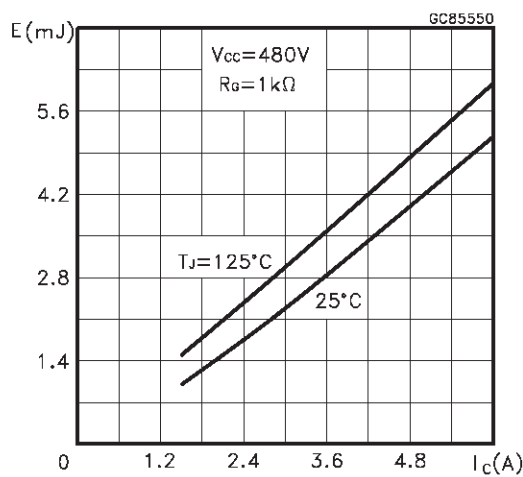


Total Switching Losses vs Gate Resistance

Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



Switching Off Safe Operatin Area

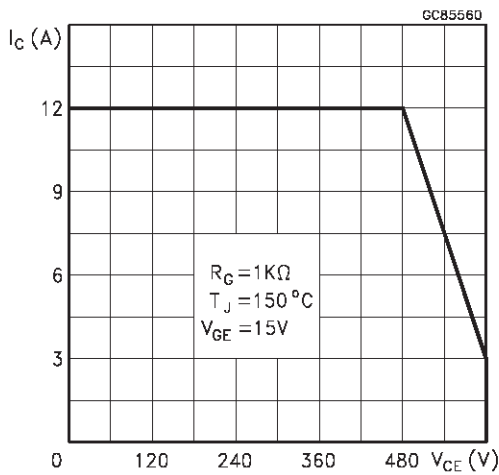


Fig. 1: Gate Charge test Circuit

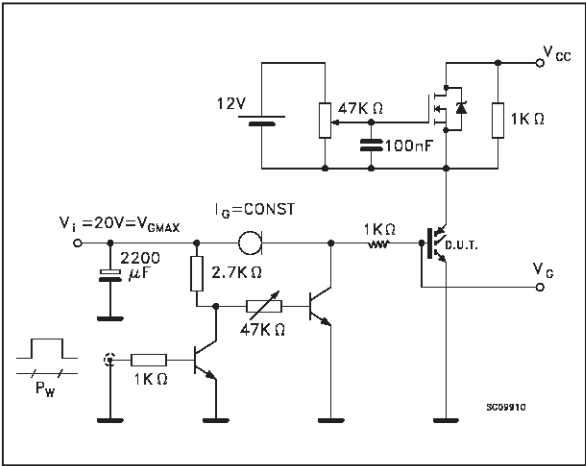
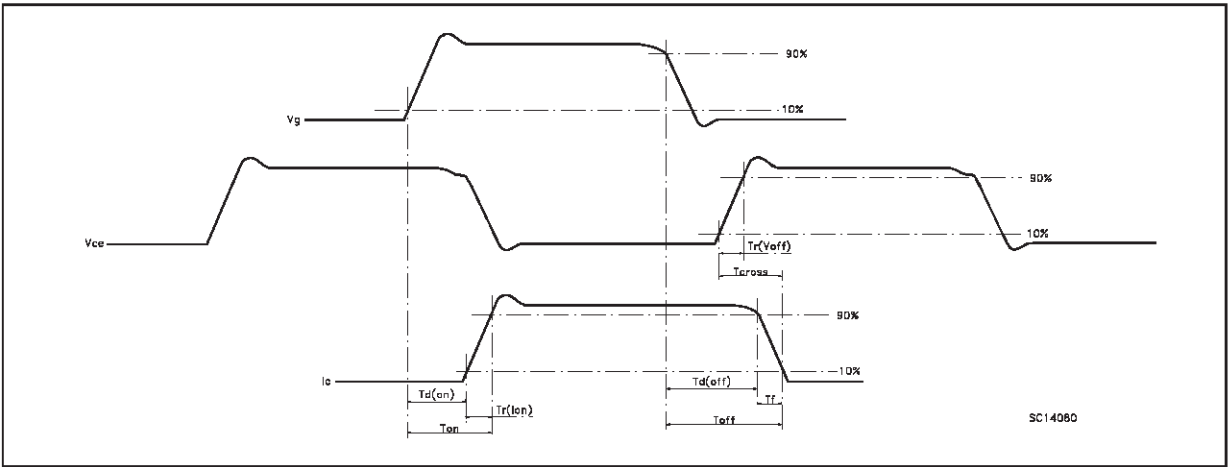


Fig. 3: Switching Waveforms



Diode Forward Voltage

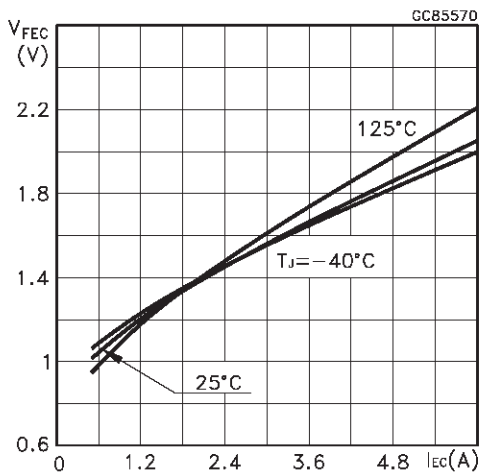
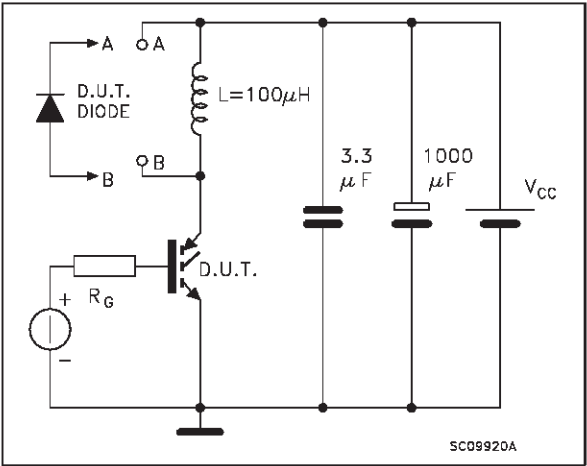
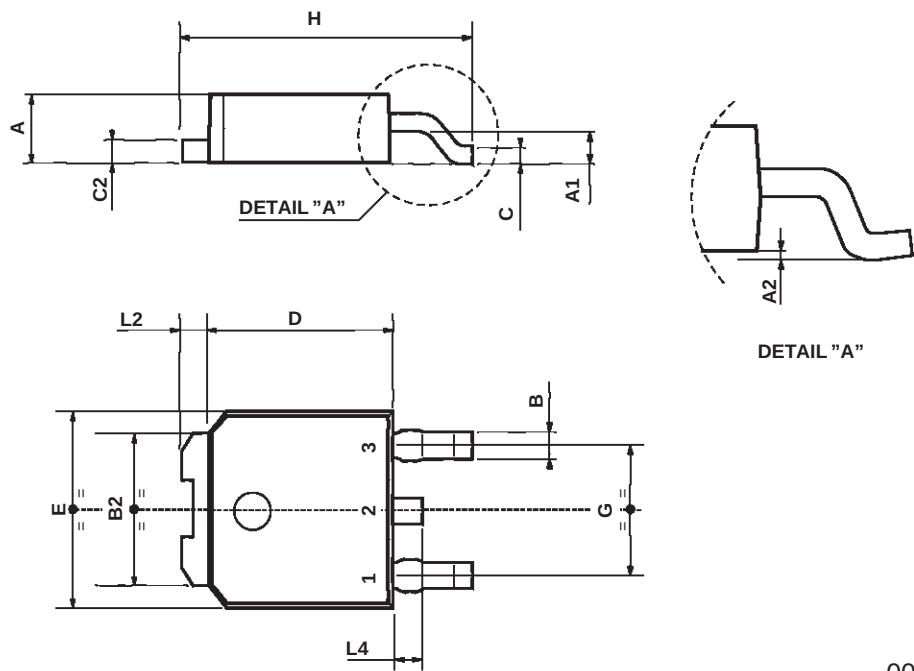


Fig. 2: Test Circuit For Inductive Load Switching



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 |



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