



# STGD7NB60H-1

## N-CHANNEL 7A - 600V IPAK PowerMESH™ IGBT

| TYPE         | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|--------------|------------------|----------------------|----------------|
| STGD7NB60H-1 | 600 V            | < 2.8 V              | 7 A            |

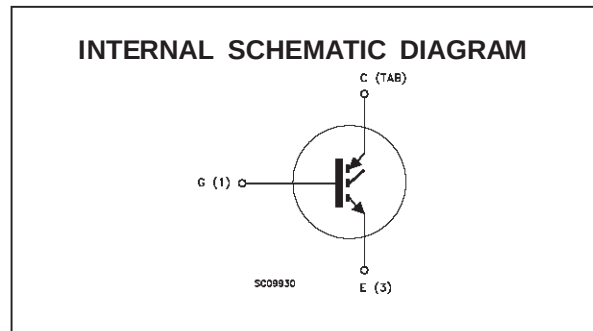
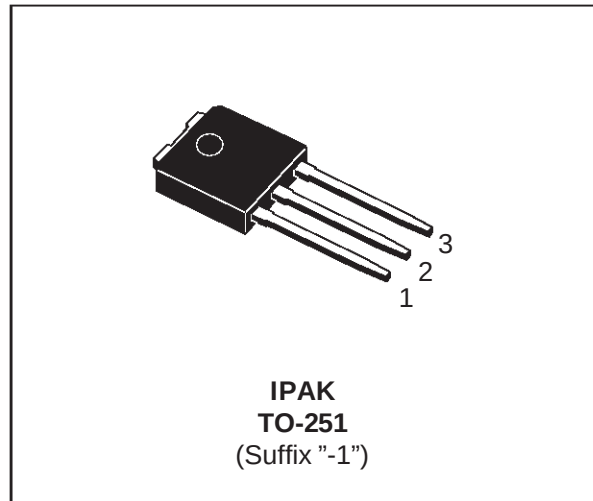
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>cesat</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT
- THROUGH-HOLE IPAK (TO-251) POWER PACKAGE IN TUBE (SUFFIX "-1")

### 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 "H" identifies a family optimized to achieve very low switching times for high frequency applications (<120kHz).

### APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS AND PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                                 | Value      | Unit |
|---------------------|-----------------------------------------------------------|------------|------|
| V <sub>CES</sub>    | Collector-Emitter Voltage (V <sub>GS</sub> = 0)           | 600        | V    |
| V <sub>ECR</sub>    | Emitter-Collector Voltage                                 | 20         | V    |
| V <sub>GE</sub>     | Gate-Emitter Voltage                                      | ± 20       | V    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 25 °C  | 14         | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 100 °C | 7          | A    |
| I <sub>CM</sub> (•) | Collector Current (pulsed)                                | 56         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C               | 55         | W    |
|                     | Derating Factor                                           | 0.44       | 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

## THERMAL DATA

|                |                                     |     |      |               |
|----------------|-------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case    | Max | 2.27 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient | Max | 100  | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink        | Typ | 1.5  | $^{\circ}C/W$ |

ELECTRICAL CHARACTERISTICS ( $T_j = 25^{\circ}C$  unless otherwise specified)

## OFF

| Symbol        | Parameter                                     | Test Conditions                                                                                       | Min. | Typ. | Max.      | Unit               |
|---------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------|------|------|-----------|--------------------|
| $V_{BR(CES)}$ | Collector-Emitter Breakdown Voltage           | $I_C = 250 \mu A$ $V_{GE} = 0$                                                                        | 600  |      |           | V                  |
| $I_{CES}$     | Collector cut-off ( $V_{GE} = 0$ )            | $V_{CE} = \text{Max Rating}$ $T_j = 25^{\circ}C$<br>$V_{CE} = \text{Max Rating}$ $T_j = 125^{\circ}C$ |      |      | 10<br>100 | $\mu A$<br>$\mu A$ |
| $I_{GES}$     | Gate-Emitter Leakage Current ( $V_{CE} = 0$ ) | $V_{GE} = \pm 20 V$ $V_{CE} = 0$                                                                      |      |      | $\pm 100$ | nA                 |

## ON (\*)

| Symbol        | Parameter                            | Test Conditions                                                                 | Min. | Typ.       | Max. | Unit   |
|---------------|--------------------------------------|---------------------------------------------------------------------------------|------|------------|------|--------|
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{CE} = V_{GE}$ $I_C = 250 \mu A$                                             | 3    |            | 5    | V      |
| $V_{CE(SAT)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15 V$ $I_C = 7 A$<br>$V_{GE} = 15 V$ $I_C = 7 A$ $T_j = 125^{\circ}C$ |      | 2.3<br>1.9 | 2.8  | V<br>V |

## DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                               | Min.            | Typ.              | Max.            | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------|-----------------|-------------------|-----------------|----------------|
| $g_{fs}$                            | Forward Transconductance                                                | $V_{CE} = 25 V$ $I_C = 7 A$                                   | 3.5             | 5                 |                 | S              |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{CE} = 25 V$ $f = 1 \text{ MHz}$ $V_{GE} = 0$              | 390<br>45<br>10 | 560<br>68<br>15   | 730<br>90<br>20 | pF<br>pF<br>pF |
| $Q_G$<br>$Q_{GE}$<br>$Q_{GC}$       | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | $V_{CE} = 480 V$ $I_C = 7 A$ $V_{GE} = 15 V$                  |                 | 42<br>7.9<br>17.6 | 55              | nC<br>nC<br>nC |
| $I_{CL}$                            | Latching Current                                                        | $V_{clamp} = 480 V$ $R_G = 10 \Omega$<br>$T_j = 150^{\circ}C$ | 28              |                   |                 | A              |

## SWITCHING ON

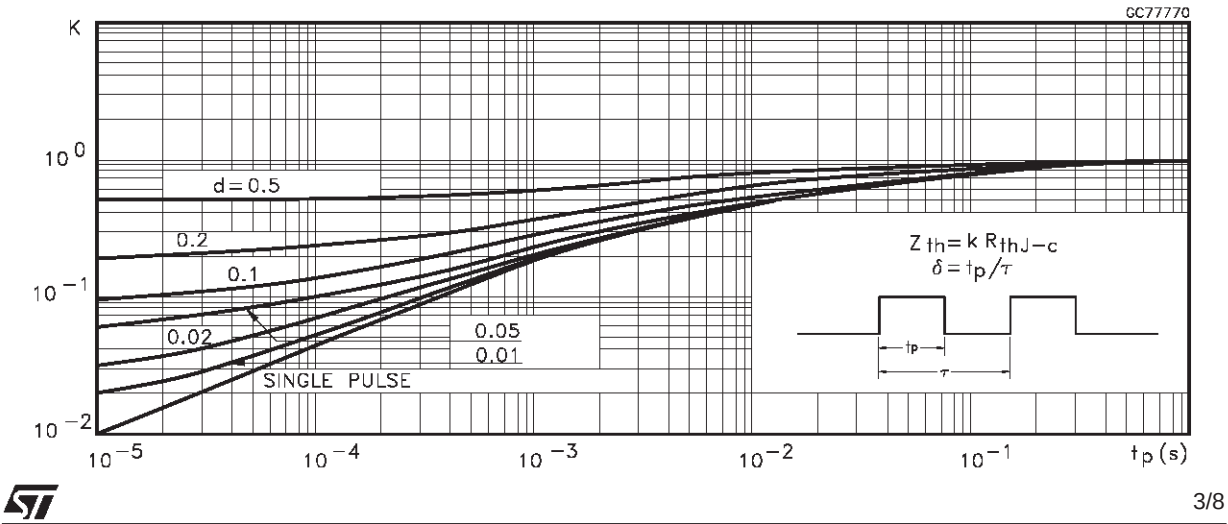
| Symbol               | Parameter                | Test Conditions                                                   | Min. | Typ.     | Max. | Unit       |
|----------------------|--------------------------|-------------------------------------------------------------------|------|----------|------|------------|
| $t_{d(on)}$<br>$t_r$ | Delay Time<br>Rise Time  | $V_{CC} = 480 V$ $I_C = 7 A$<br>$V_{GE} = 15 V$ $R_G = 10 \Omega$ |      | 15<br>48 |      | ns<br>ns   |
| $(di/dt)_{on}$       | Turn-on Current Slope    | $V_{CC} = 480 V$ $I_C = 7 A$<br>$R_G = 10 \Omega$ $V_{GE} = 15 V$ |      | 160      |      | A/ $\mu s$ |
| $E_{on}$             | Turn-on Switching Losses | $T_j = 125^{\circ}C$                                              |      | 70       |      | $\mu J$    |

ELECTRICAL CHARACTERISTICS (continued)  
SWITCHING OFF

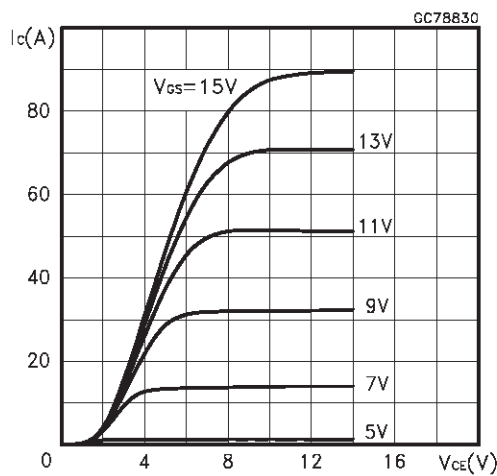
| Symbol         | Parameter               | Test Conditions                                       | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------|-------------------------------------------------------|------|------|------|---------------|
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$<br>$I_C = 7\text{ A}$         |      | 85   |      | ns            |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 10\text{ }\Omega$<br>$V_{GE} = 15\text{ V}$ |      | 20   |      | ns            |
| $t_d(off)$     | Delay Time              |                                                       |      | 75   |      | ns            |
| $t_f$          | Fall Time               |                                                       |      | 70   |      | ns            |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                       |      | 85   |      | $\mu\text{J}$ |
| $E_{ts}$       | Total Switching Loss    |                                                       |      | 130  |      | $\mu\text{J}$ |
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$<br>$I_C = 7\text{ A}$         |      | 150  |      | ns            |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 10\text{ }\Omega$<br>$V_{GE} = 15\text{ V}$ |      | 50   |      | ns            |
| $t_d(off)$     | Delay Time              | $T_j = 125\text{ }^\circ\text{C}$                     |      | 110  |      | ns            |
| $t_f$          | Fall Time               |                                                       |      | 110  |      | ns            |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                       |      | 220  |      | $\mu\text{J}$ |
| $E_{ts}$       | Total Switching Loss    |                                                       |      | 290  |      | $\mu\text{J}$ |

(●) 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)

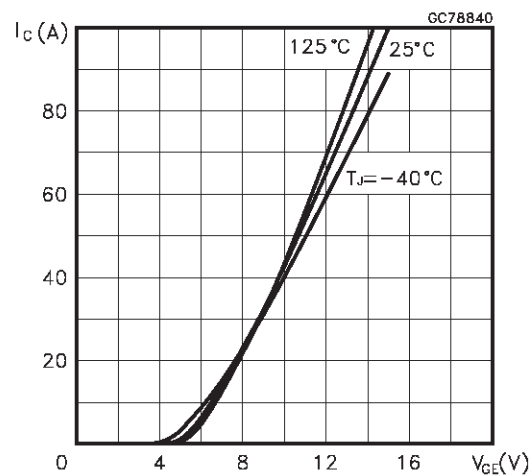
Thermal Impedance



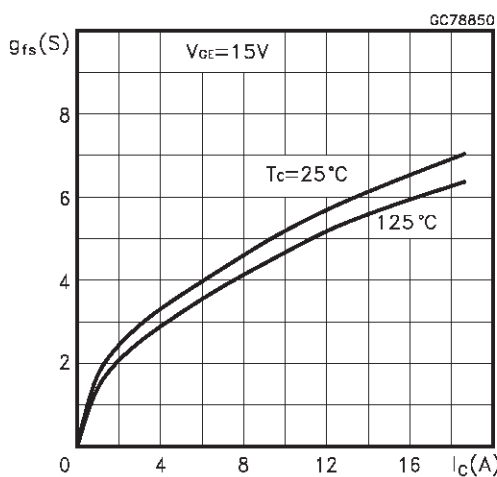
Output Characteristics



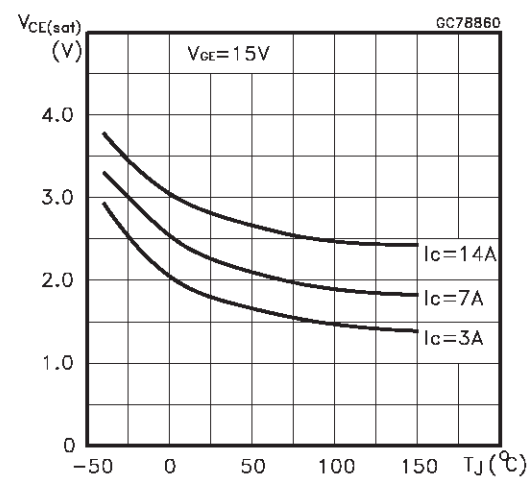
Transfer Characteristics



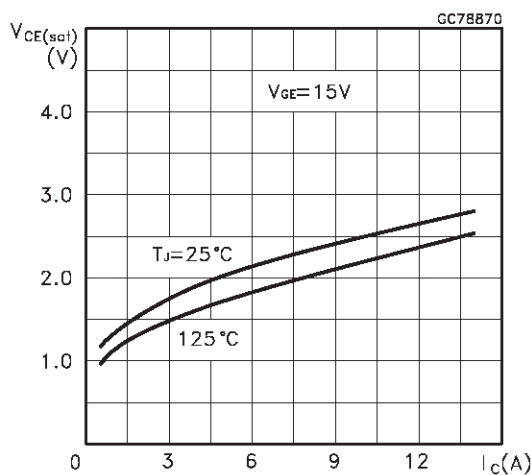
Transconductance



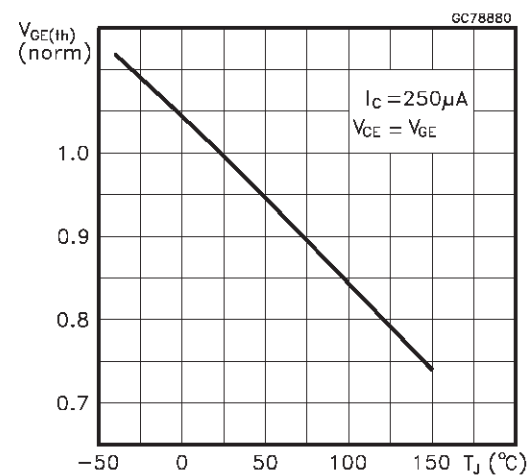
Collector-Emitter On Voltage vs Temperature



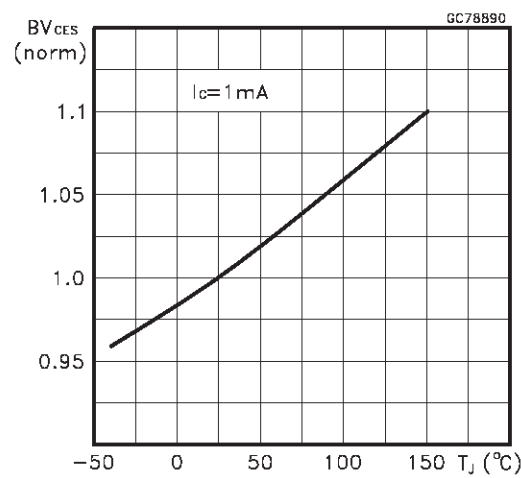
Collector-Emitter On Voltage vs Collector Current



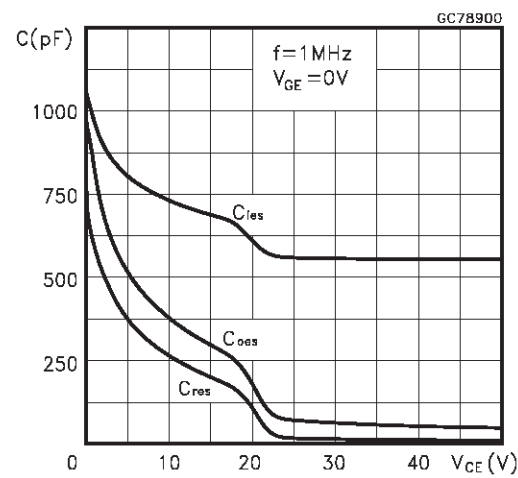
Gate Threshold vs Temperature



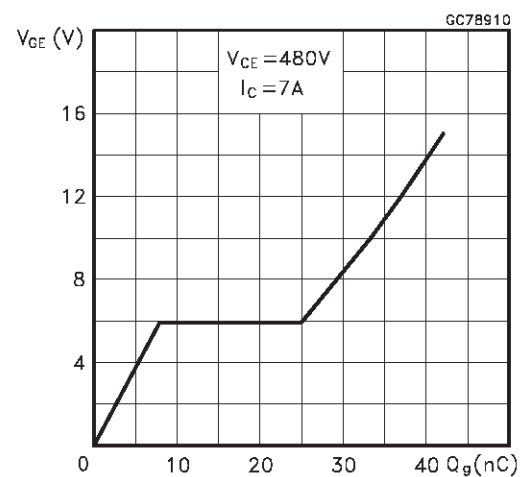
Normalized Breakdown Voltage vs Temperature



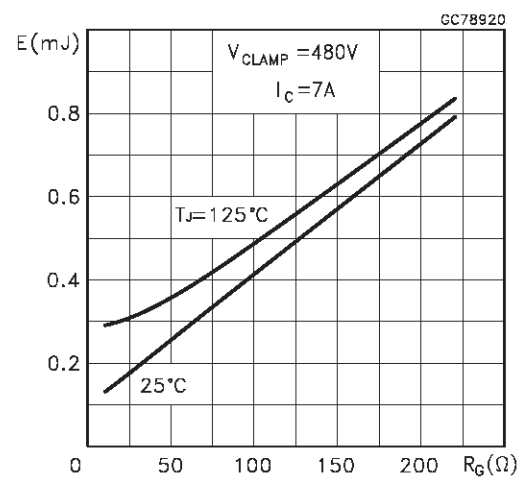
Capacitance Variations



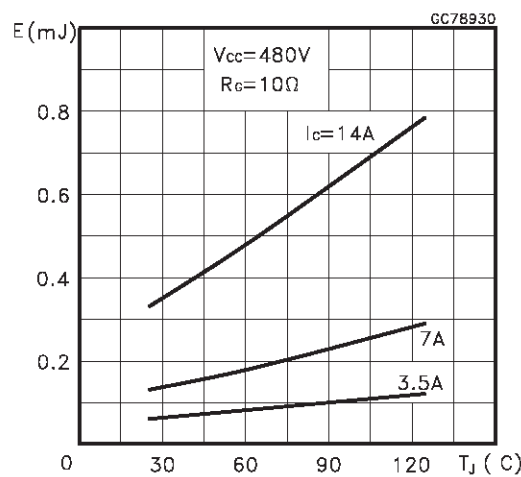
Gate Charge vs Gate-Emitter Voltage



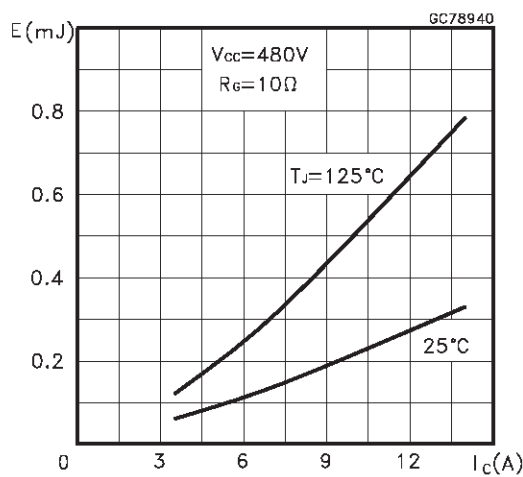
Total Switching Losses vs Gate Resistance

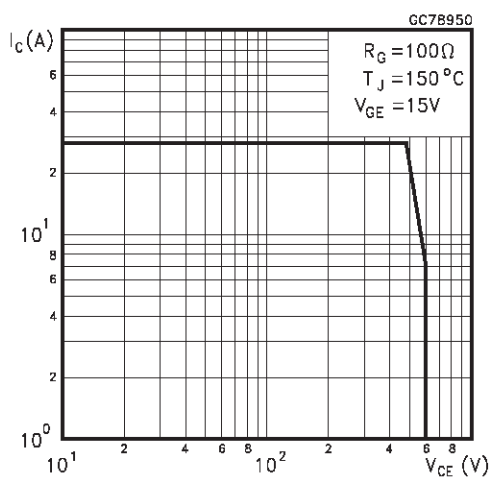


Total Switching Losses vs Temperature

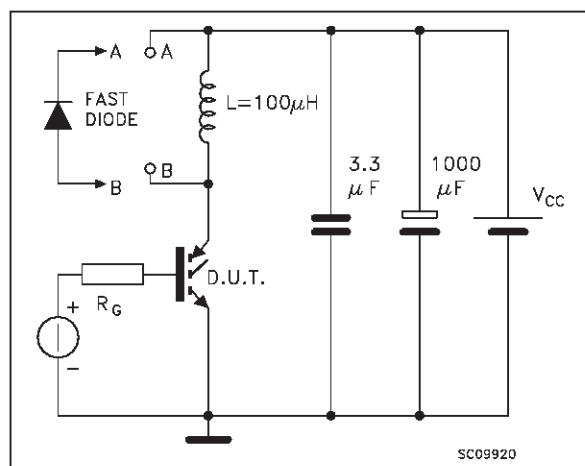
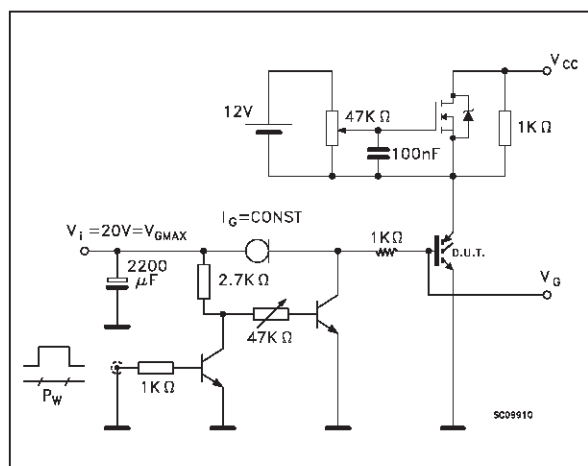
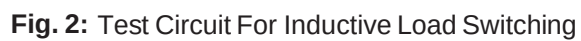


Total Switching Losses vs Collector Current

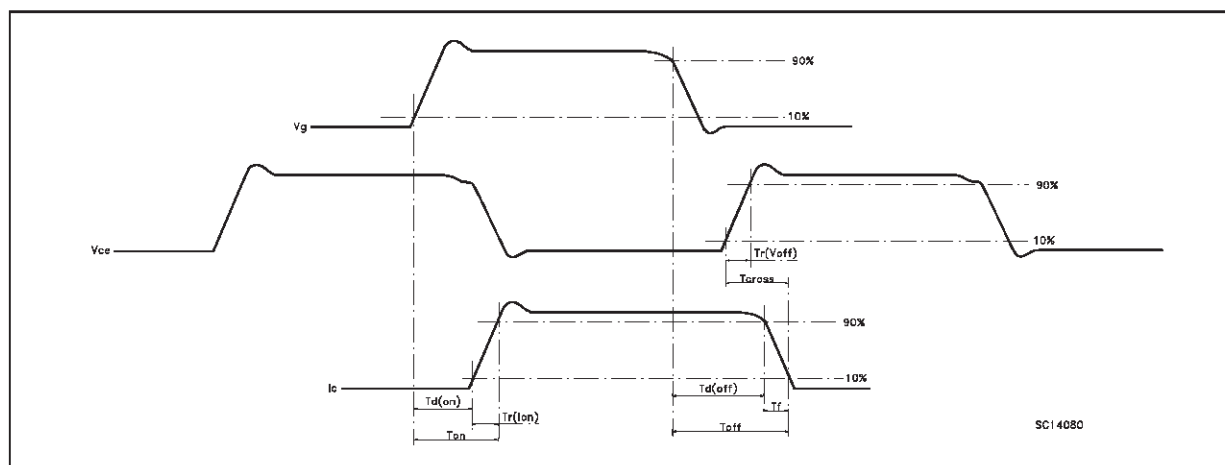




**Fig. 1: Gate Charge test Circuit**

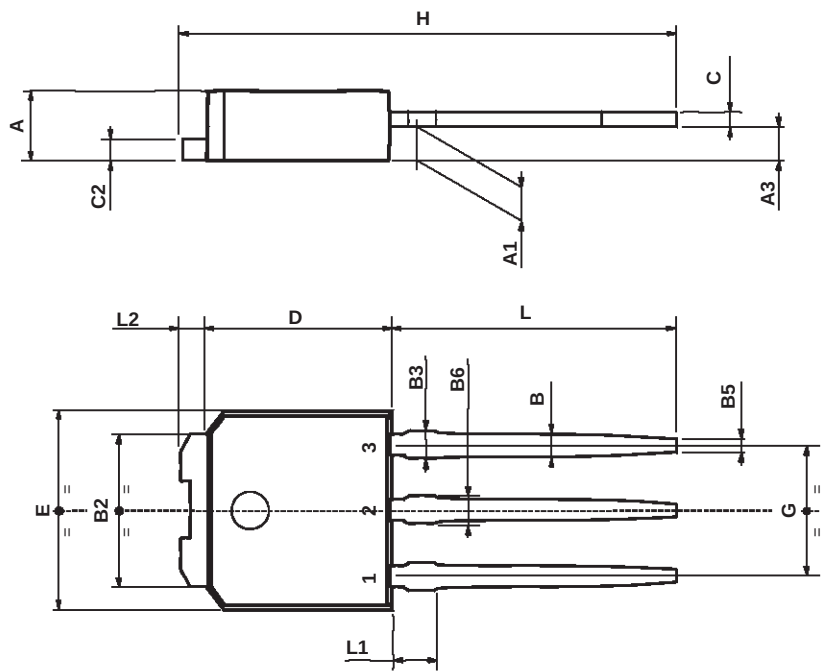


**Fig. 3: Switching Waveforms**



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 |



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