



## STGW20NB60H

### N-CHANNEL 20A - 600V TO-247 PowerMESH™ IGBT

| TYPE        | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|-------------|------------------|----------------------|----------------|
| STGW20NB60H | 600 V            | < 2.8 V              | 20 A           |

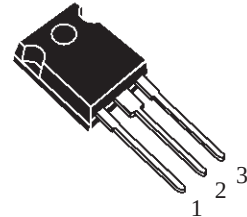
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>CESAT</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT

#### 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).

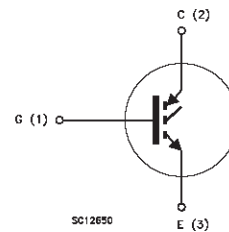
#### APPLICATIONS

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



TO-247

#### 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>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  | 40         | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 100 °C | 20         | A    |
| I <sub>CM</sub> (•) | Collector Current (pulsed)                                | 160        | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C               | 150        | W    |
|                     | Derating Factor                                           | 1.2        | 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 | 0.83 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient | Max | 30   | $^{\circ}C/W$ |
| $R_{thc-h}$    | Thermal Resistance Case-heatsink    | Typ | 0.1  | $^{\circ}C/W$ |

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 | $V_{GE} = 15 V$ $I_C = 20 A$<br>$V_{GE} = 15 V$ $I_C = 20 A$ $T_j = 125^{\circ}C$ |      | 2.3<br>1.9 | 2.8  | V<br>V |

## DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                               | Min.              | Typ.              | Max.              | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------|-------------------|-------------------|-------------------|----------------|
| $g_{fs}$                            | Forward Transconductance                                                | $V_{CE} = 25 V$ $I_C = 20 A$                                  | 7.0               | 10                |                   | S              |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{CE} = 25 V$ $f = 1 \text{ MHz}$ $V_{GE} = 0$              | 1200<br>140<br>28 | 1700<br>200<br>40 | 2200<br>260<br>52 | pF<br>pF<br>pF |
| $Q_G$<br>$Q_{GE}$<br>$Q_{GC}$       | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | $V_{CE} = 480 V$ $I_C = 20 A$ $V_{GE} = 15 V$                 |                   | 110<br>13<br>51   | 145               | nC<br>nC<br>nC |
| $I_{CL}$                            | Latching Current                                                        | $V_{clamp} = 480 V$ $R_G = 10 \Omega$<br>$T_j = 150^{\circ}C$ | 80                |                   |                   | A              |

## SWITCHING ON

| Symbol               | Parameter                | Test Conditions                                                    | Min. | Typ.     | Max. | Unit       |
|----------------------|--------------------------|--------------------------------------------------------------------|------|----------|------|------------|
| $t_{d(on)}$<br>$t_r$ | Delay Time<br>Rise Time  | $V_{CC} = 480 V$ $I_C = 20 A$<br>$V_{GE} = 15 V$ $R_G = 10 \Omega$ |      | 20<br>70 |      | ns<br>ns   |
| $(di/dt)_{on}$       | Turn-on Current Slope    | $V_{CC} = 480 V$ $I_C = 20 A$<br>$R_G = 10 \Omega$ $V_{GE} = 15 V$ |      | 350      |      | A/ $\mu s$ |
| $E_{on}$             | Turn-on Switching Losses | $T_j = 125^{\circ}C$                                               |      | 300      |      | $\mu J$    |

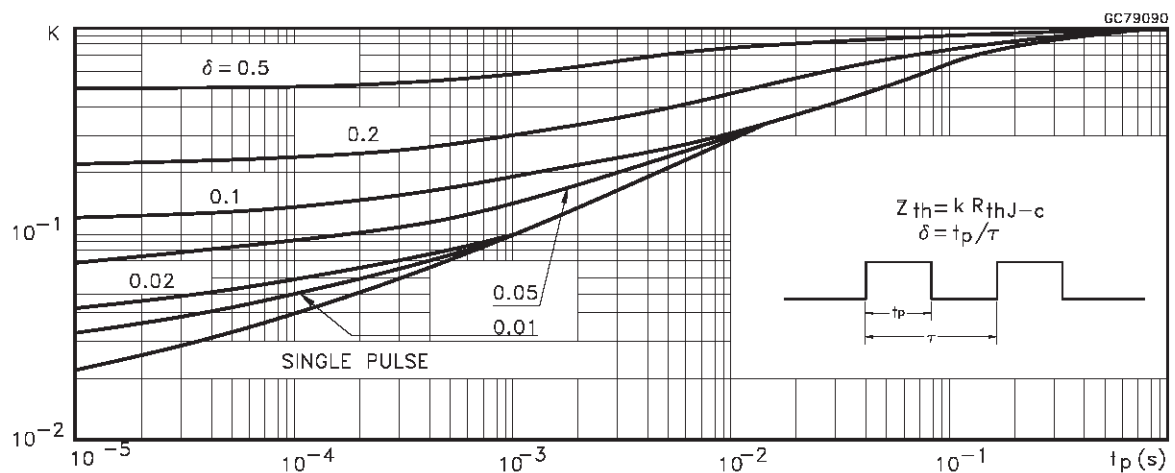
**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING OFF**

| Symbol         | Parameter               | Test Conditions                              | Min. | Typ. | Max. | Unit |
|----------------|-------------------------|----------------------------------------------|------|------|------|------|
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$ $I_C = 20\text{ A}$  |      | 115  |      | ns   |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 10\ \Omega$ $V_{GE} = 15\text{ V}$ |      | 32   |      | ns   |
| $t_d(off)$     | Delay Time              |                                              |      | 170  |      | ns   |
| $t_f$          | Fall Time               |                                              |      | 75   |      | ns   |
| $E_{off(**)}$  | Turn-off Switching Loss |                                              |      | 0.4  |      | mJ   |
| $E_{ts}$       | Total Switching Loss    |                                              |      | 0.65 |      | mJ   |
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$ $I_C = 20\text{ A}$  |      | 190  |      | ns   |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $R_{GE} = 10\ \Omega$ $V_{GE} = 15\text{ V}$ |      | 55   |      | ns   |
| $t_d(off)$     | Delay Time              | $T_j = 125\text{ }^\circ\text{C}$            |      | 210  |      | ns   |
| $t_f$          | Fall Time               |                                              |      | 140  |      | ns   |
| $E_{off(**)}$  | Turn-off Switching Loss |                                              |      | 0.7  |      | mJ   |
| $E_{ts}$       | Total Switching Loss    |                                              |      | 1.0  |      | mJ   |

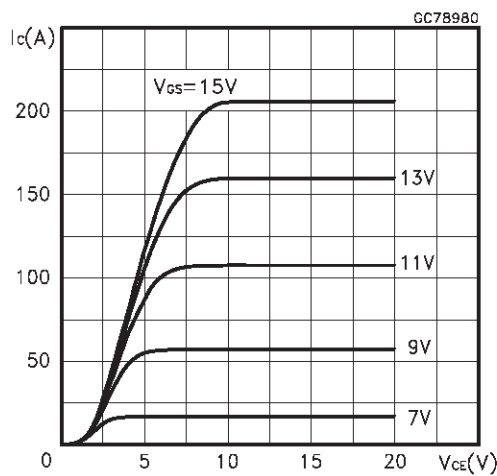
(●) Pulse width limited by max. junction temperature

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

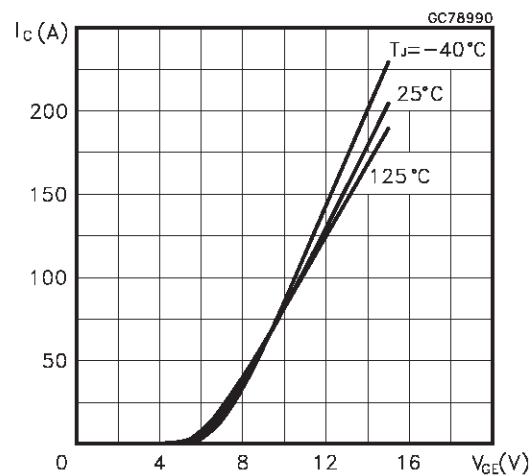
(\*\*) Losses Include Also The Tail (Jedec Standardization)

**Thermal Impedance**

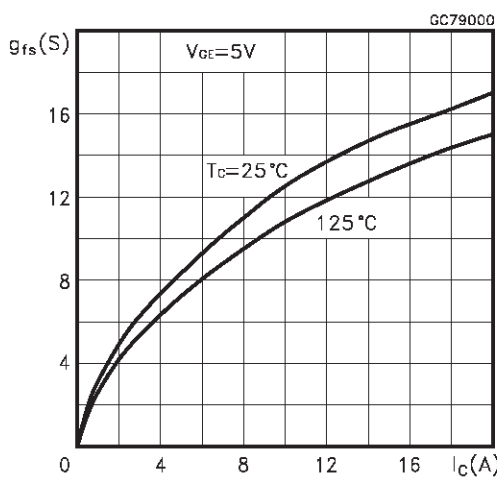
Output Characteristics



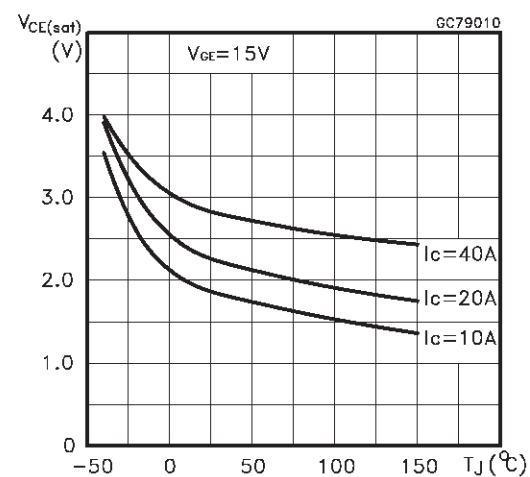
Transfer Characteristics



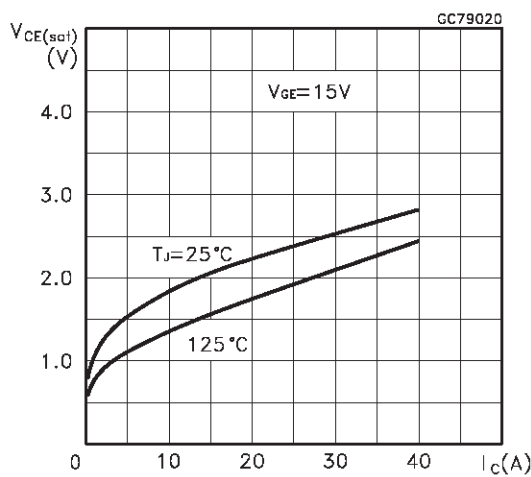
Transconductance



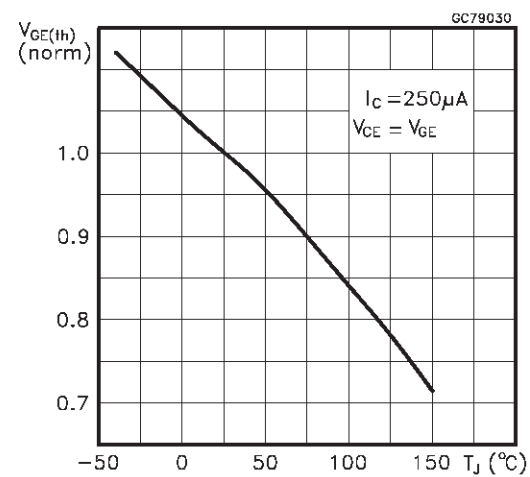
Collector-Emitter On Voltage vs Temperature



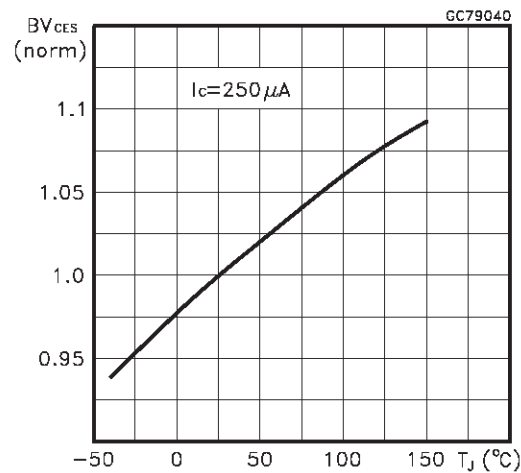
Collector-Emitter On Voltage vs Collector Current



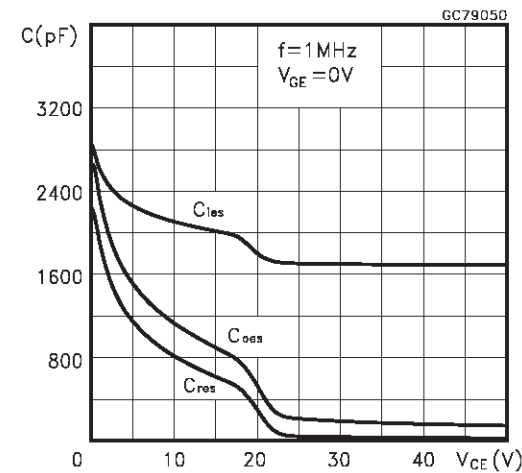
Gate Threshold vs Temperature



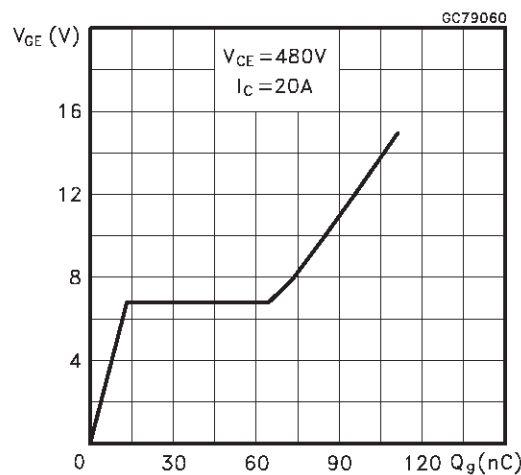
Normalized Breakdown Voltage vs Temperature



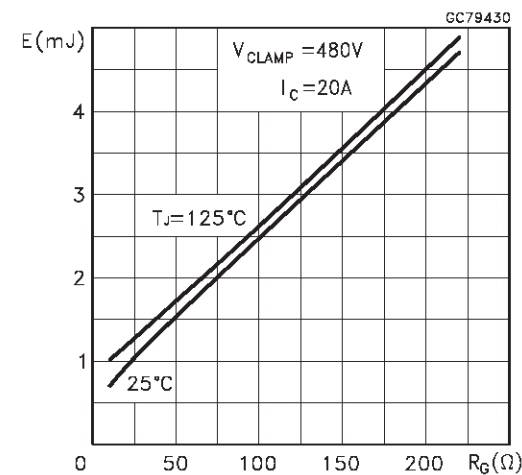
Capacitance Variations



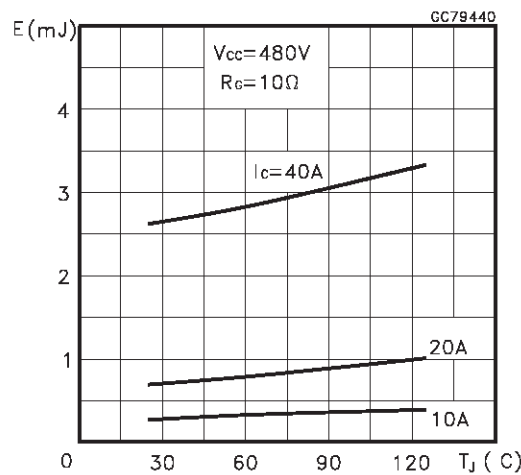
Gate Charge vs Gate-Emitter Voltage



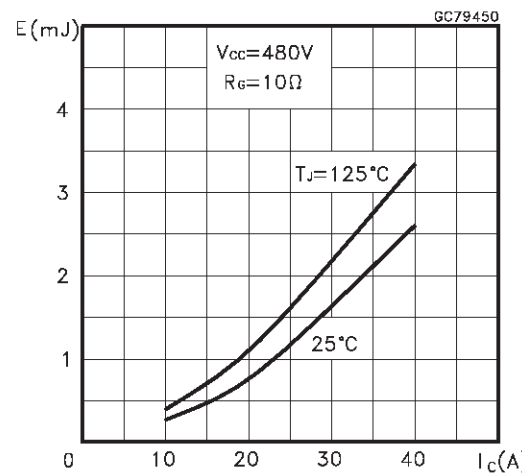
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



Switching Off Safe Operating Area

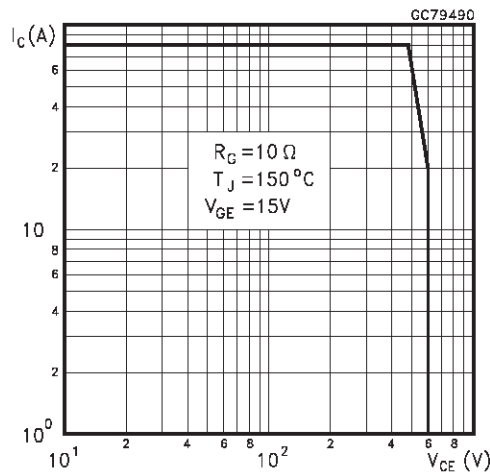


Fig. 1: Gate Charge test Circuit

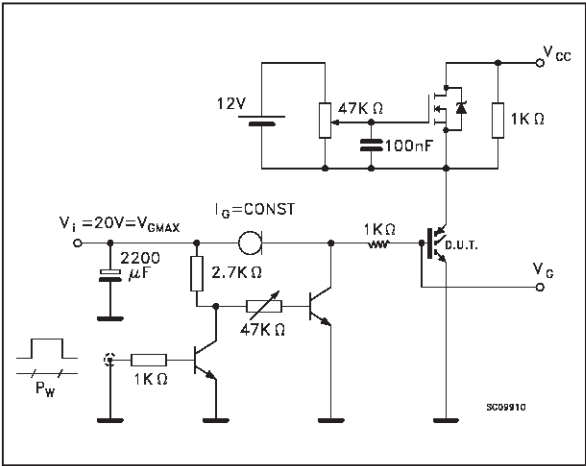


Fig. 2: Test Circuit For Inductive Load Switching

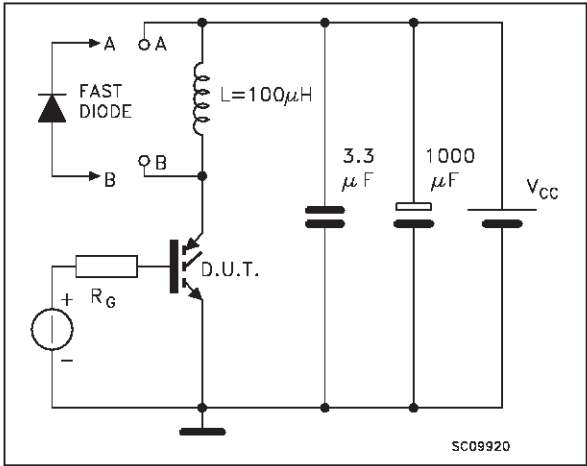
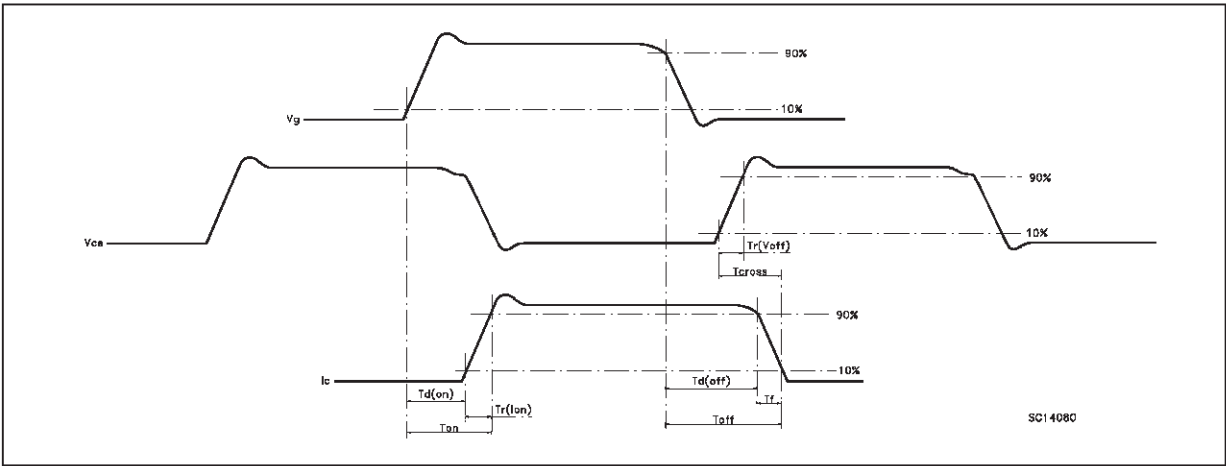
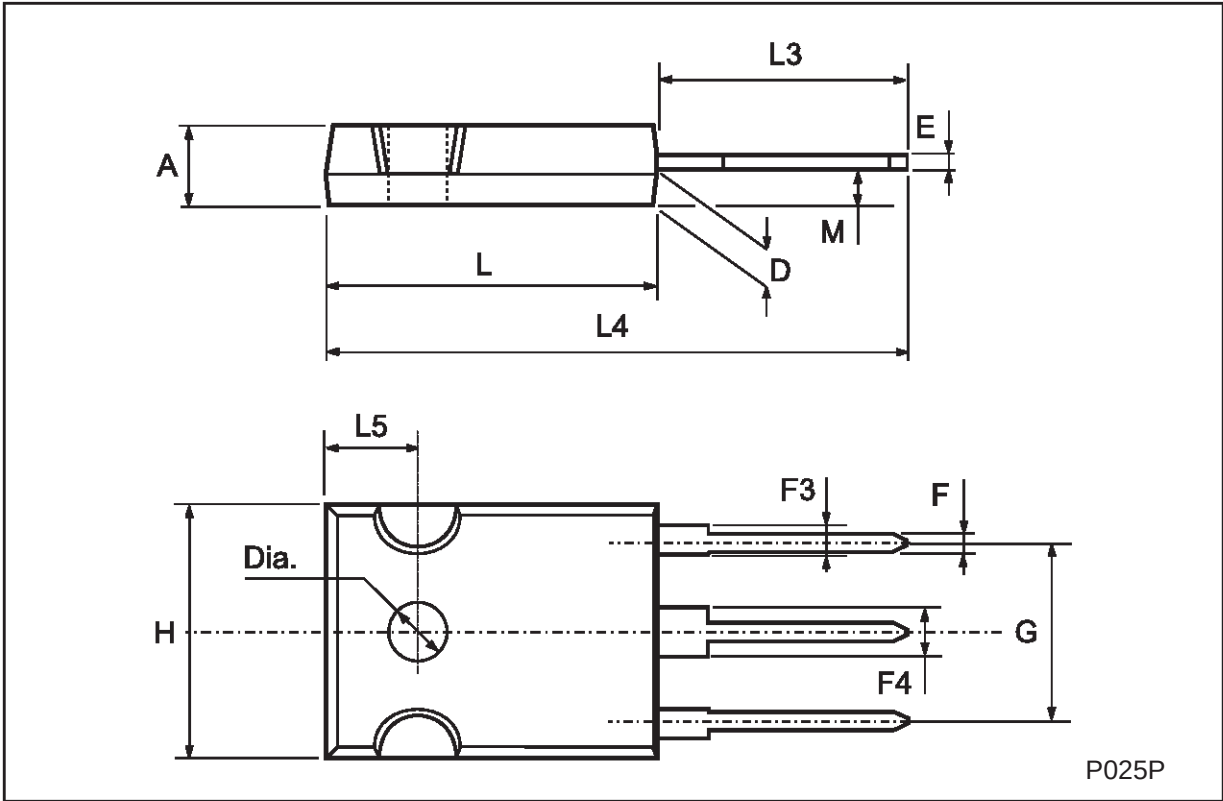


Fig. 3: Switching Waveforms



TO-247 MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.7  |      | 5.3  | 0.185 |       | 0.209 |
| D    | 2.2  |      | 2.6  | 0.087 |       | 0.102 |
| E    | 0.4  |      | 0.8  | 0.016 |       | 0.031 |
| F    | 1    |      | 1.4  | 0.039 |       | 0.055 |
| F3   | 2    |      | 2.4  | 0.079 |       | 0.094 |
| F4   | 3    |      | 3.4  | 0.118 |       | 0.134 |
| G    |      | 10.9 |      |       | 0.429 |       |
| H    | 15.3 |      | 15.9 | 0.602 |       | 0.626 |
| L    | 19.7 |      | 20.3 | 0.776 |       | 0.779 |
| L3   | 14.2 |      | 14.8 | 0.559 |       | 0.582 |
| L4   |      | 34.6 |      |       | 1.362 |       |
| L5   |      | 5.5  |      |       | 0.217 |       |
| M    | 2    |      | 3    | 0.079 |       | 0.118 |



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