



# STGP20NB60H

## N-CHANNEL 20A - 600V TO-220 PowerMESH™ IGBT

| TYPE        | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|-------------|------------------|----------------------|----------------|
| STGP20NB60H | 600 V            | < 2.8 V              | 20 A           |

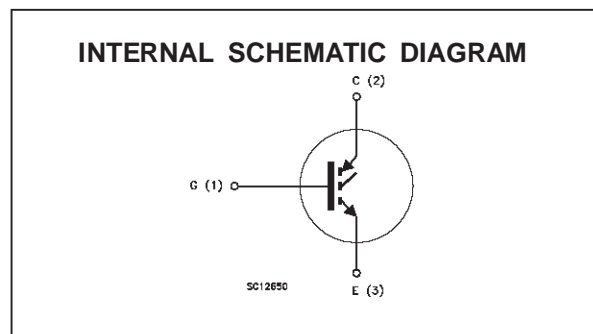
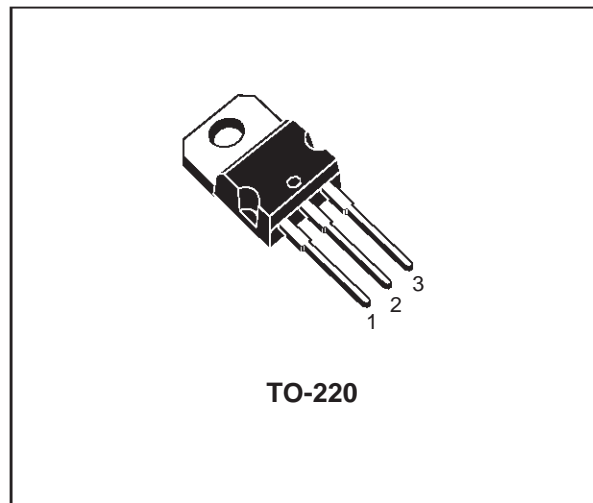
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>CESAT</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT

### 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



### 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               | 125        | W    |
|                     | Derating Factor   | 1.0        | 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

## STGP20NB60H

### THERMAL DATA

|                |                                     |     |      |               |
|----------------|-------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case    | Max | 1.0  | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient | Max | 62.5 | $^{\circ}C/W$ |
| $R_{thc-h}$    | Thermal Resistance Case- heatsink   | Typ | 0.5  | $^{\circ}C/W$ |

### 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 | $V_{GE} = 15 V$ $I_C = 20 A$<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 | $V_{CE} = 25 V$ $f = 1 MHz$ $V_{GE} = 0$                      | 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      |      | $\mu J$    |

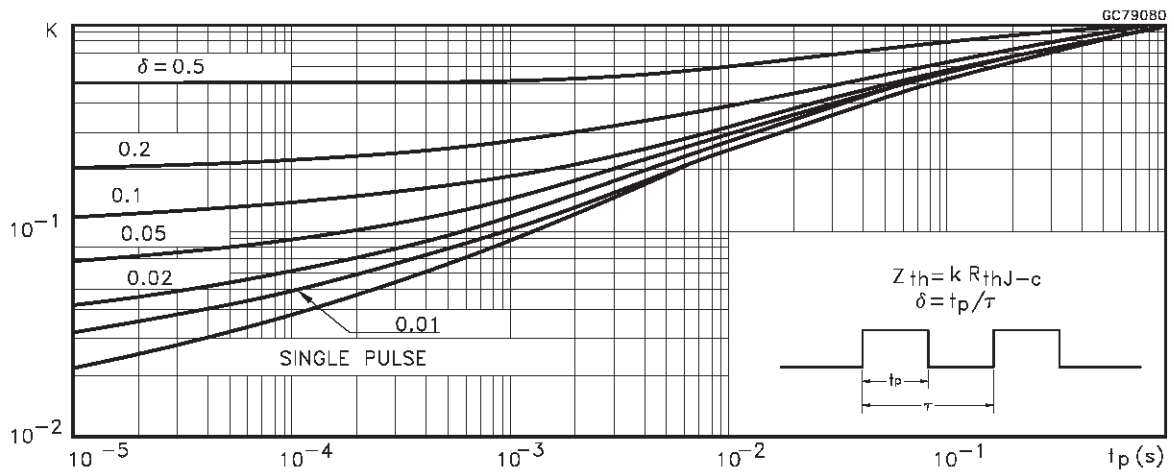
**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING OFF**

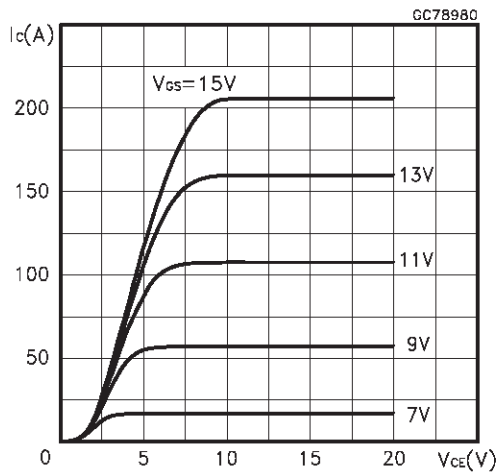
| Symbol         | Parameter               | Test Conditions   | Min. | Typ. | Max. | Unit |
|----------------|-------------------------|---|------|------|------|------|
| $t_c$          | Cross-Over Time         | $V_{CC} = 480\text{ V}$                                     |      | 115  |      | ns   |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $I_C = 20\text{ A}$<br>$R_{GE} = 10\ \Omega$                |      | 32   |      | ns   |
| $t_{d(off)}$   | Delay Time              | $V_{GE} = 15\text{ V}$                                      |      | 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         | $V_{CC} = 480\text{ V}$                                     |      | 190  |      | ns   |
| $t_r(V_{off})$ | Off Voltage Rise Time   | $I_C = 20\text{ A}$<br>$R_{GE} = 10\ \Omega$                |      | 55   |      | ns   |
| $t_{d(off)}$   | Delay Time              | $V_{GE} = 15\text{ V}$<br>$T_j = 125\text{ }^\circ\text{C}$ |      | 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)

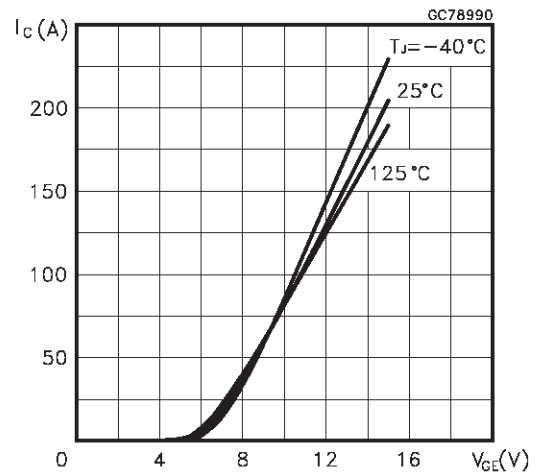
Thermal Impedance



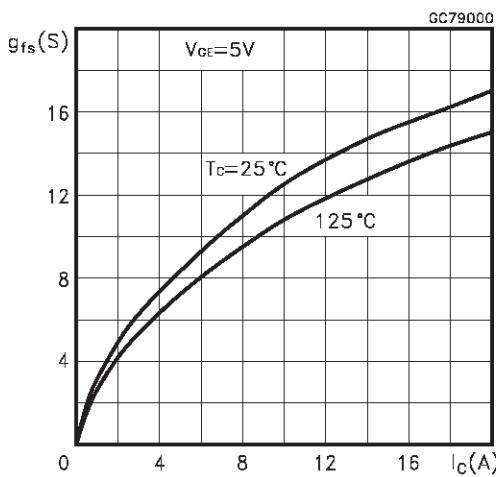
Output Characteristics



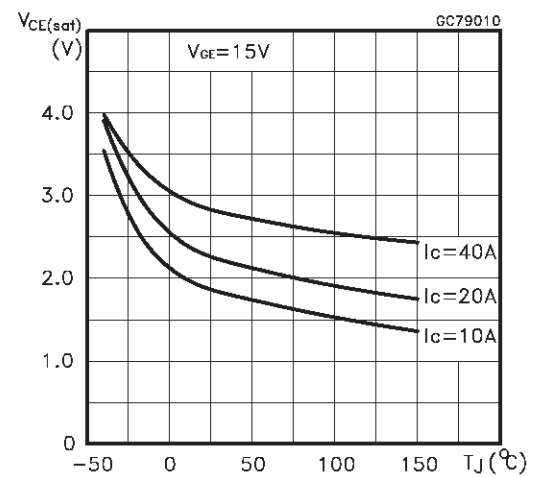
Transfer Characteristics



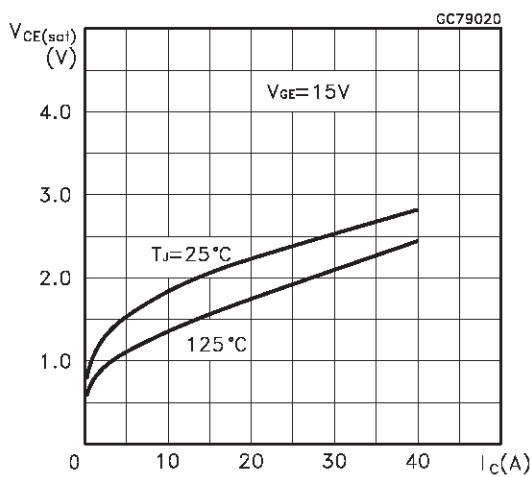
Transconductance



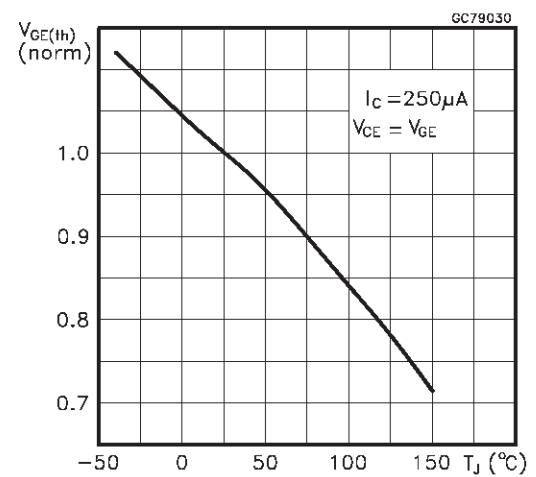
Collector-Emitter On Voltage vs Temperature



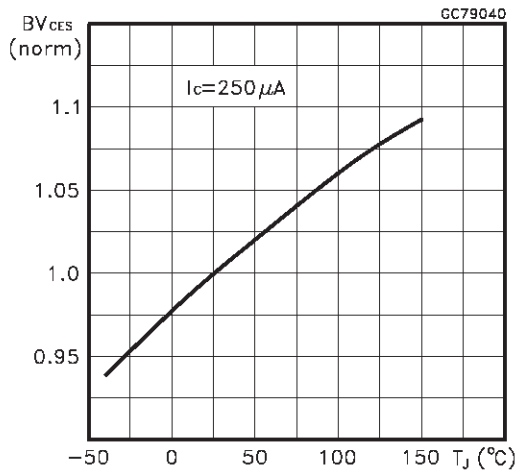
Collector-Emitter On Voltage vs Collector Current



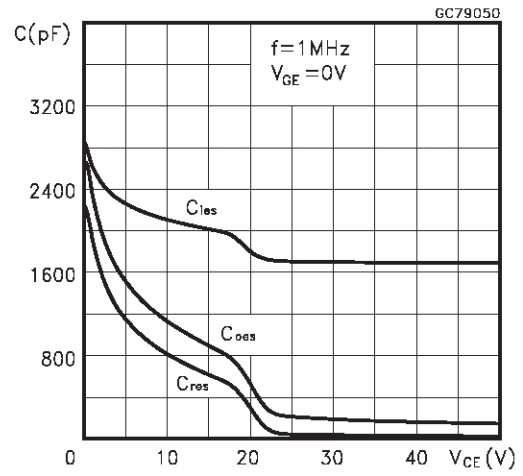
Gate Threshold vs Temperature



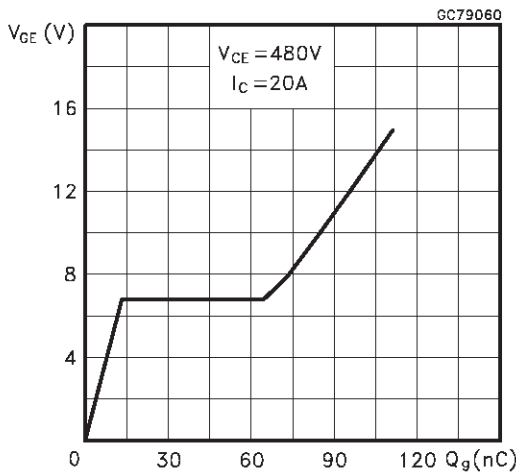
Normalized Breakdown Voltage vs Temperature



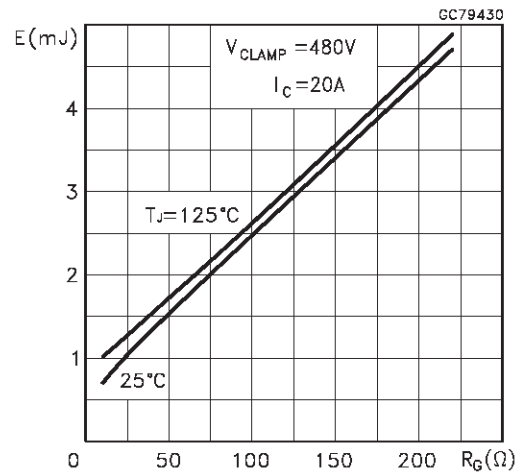
Capacitance Variations



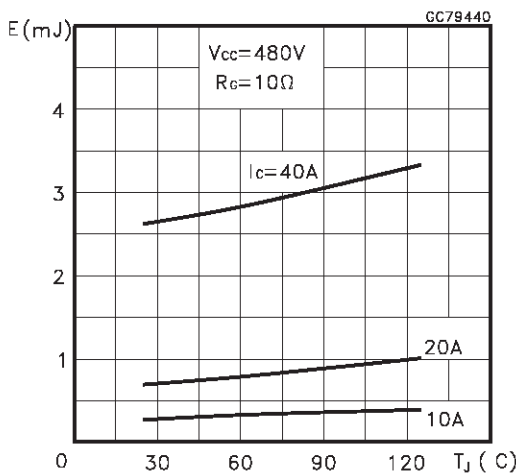
Gate Charge vs Gate-Emitter Voltage



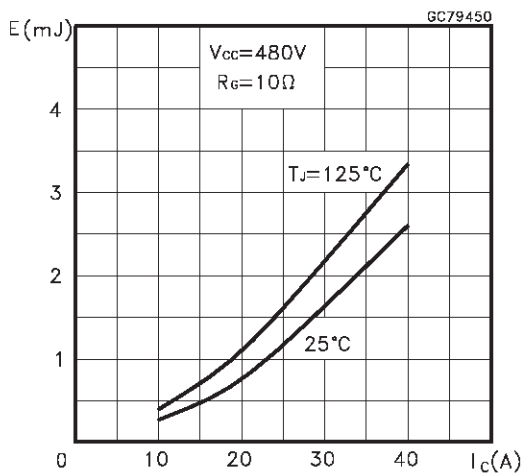
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



Switching Off Safe Operating Area

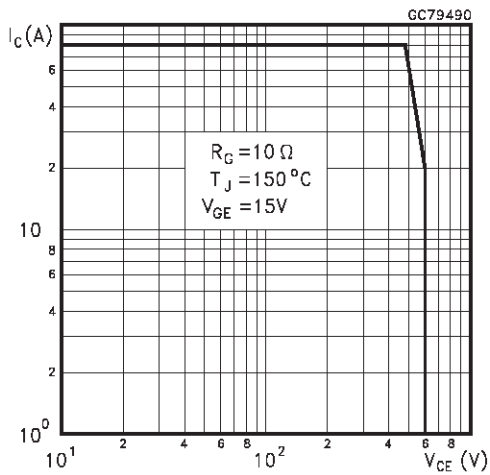


Fig. 1: Gate Charge test Circuit

Fig. 2: Test Circuit For Inductive Load Switching

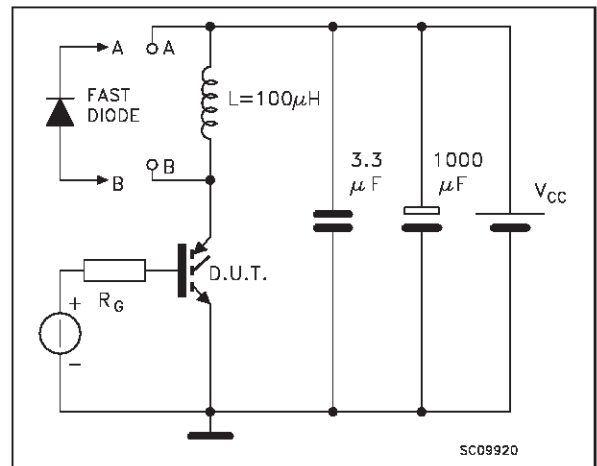
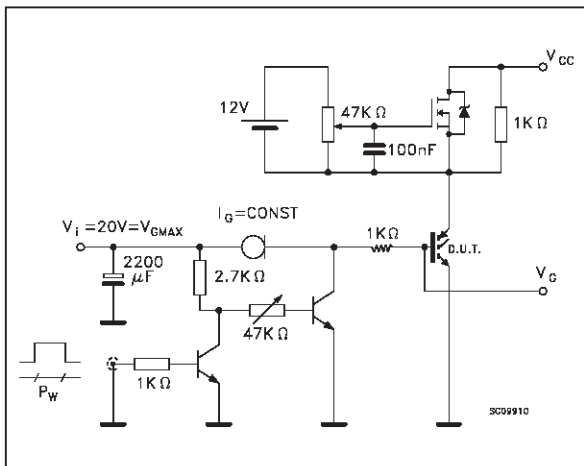
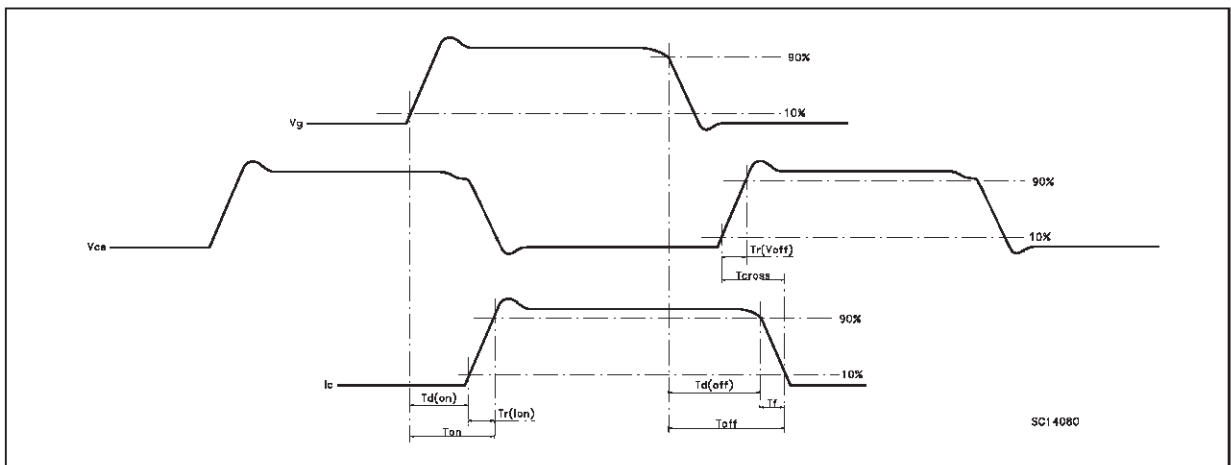
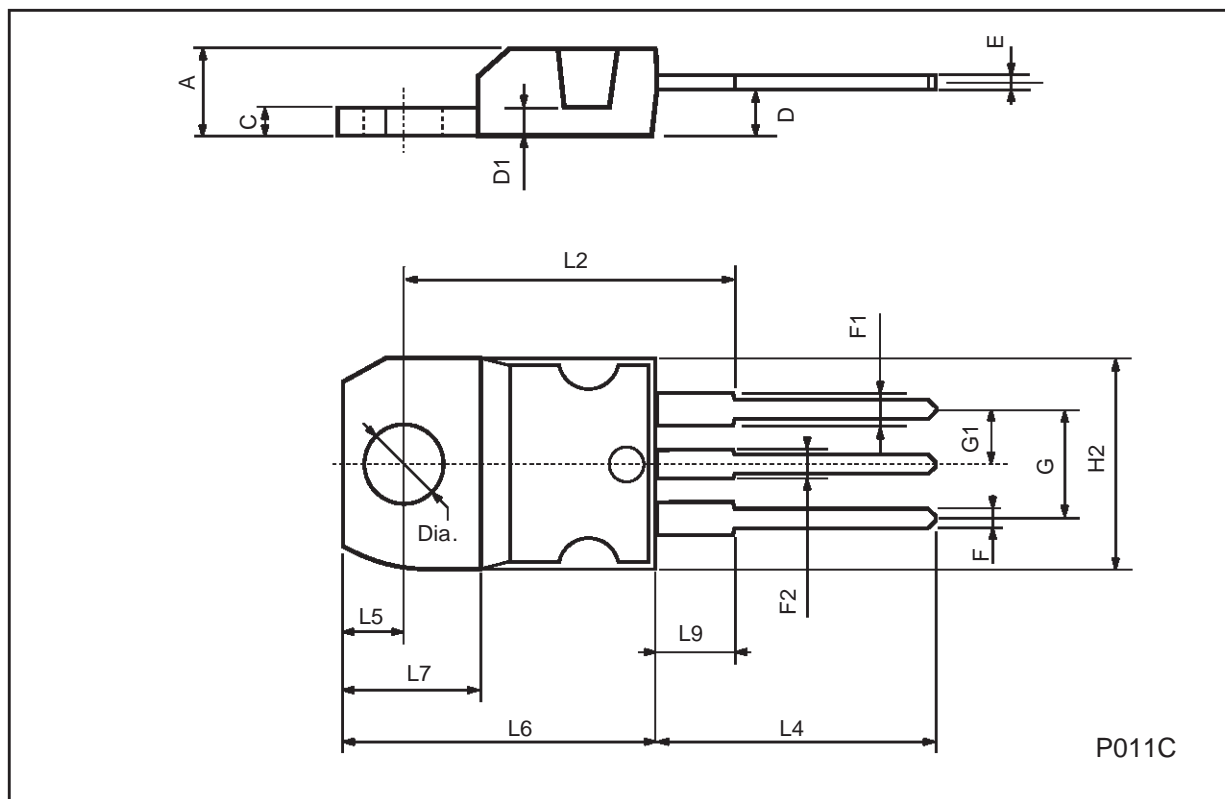


Fig. 3: Switching Waveforms



## TO-220 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 2.72  | 0.094 |       | 0.107 |
| D1   |       | 1.27 |       |       | 0.050 |       |
| E    | 0.49  |      | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |      | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |      | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.4   |      | 2.7   | 0.094 |       | 0.106 |
| H2   | 10.0  |      | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.4 |       |       | 0.645 |       |
| L4   | 13.0  |      | 14.0  | 0.511 |       | 0.551 |
| L5   | 2.65  |      | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |      | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.2   |      | 6.6   | 0.244 |       | 0.260 |
| L9   | 3.5   |      | 3.93  | 0.137 |       | 0.154 |
| DIA. | 3.75  |      | 3.85  | 0.147 |       | 0.151 |



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