



# STGW12NB60HD

## N-CHANNEL 12A - 600V TO-247 PowerMESH™ IGBT

PRELIMINARY DATA

| TYPE         | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|--------------|------------------|----------------------|----------------|
| STGW12NB60HD | 600 V            | < 2.8 V              | 30 A           |

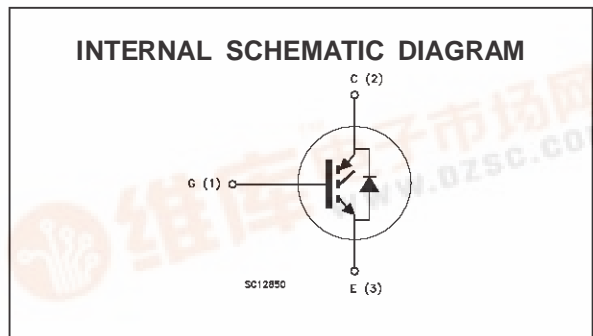
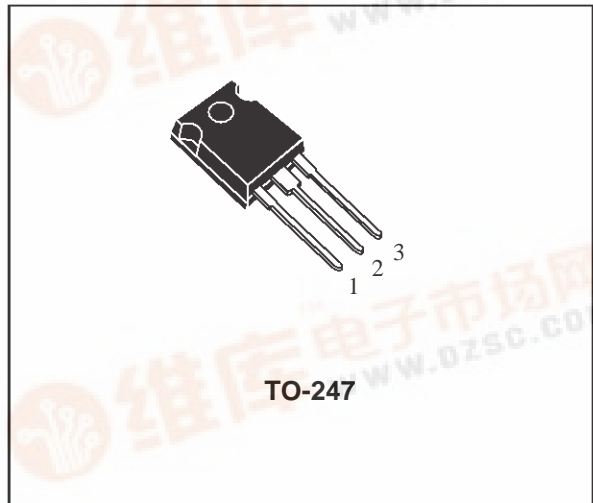
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>CESAT</sub>)
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- VERY HIGH FREQUENCY OPERATION
- OFF LOSSES INCLUDE TAIL CURRENT
- CO-PACKAGED WITH TURBOSWITCH™ ANTIPARALLEL DIODE

### 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
- UPS



### 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  | 24         | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 100 °C | 12         | A    |
| I <sub>CM</sub> (•) | Collector Current (pulsed)                                | 96         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C               | 120        | W    |
|                     | Derating Factor   | 0.96       | 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

## STGW12NB60HD

### THERMAL DATA

|                |                                     |     |      |               |
|----------------|-------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case    | Max | 1.04 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | 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>$V_{CE} = \text{Max Rating}$ $T_j = 125^{\circ}C$ |      |      | 250<br>2000 | $\mu A$<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 | $V_{GE} = 15 V$ $I_C = 12 A$<br>$V_{GE} = 15 V$ $I_C = 12 A$ $T_j = 125^{\circ}C$ |      | 2<br>1.7 | 2.8  | V<br>V |

### DYNAMIC

| Symbol                              | Parameter   | Test Conditions  | Min. | Typ.             | Max. | Unit           |
|-------------------------------------|---|--|------|------------------|------|----------------|
| $g_{fs}$                            | Forward Transconductance  | $V_{CE} = 25 V$ $I_C = 12 A$                               |      | 9.5              |      | S              |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{CE} = 25 V$ $f = 1 MHz$ $V_{GE} = 0$                   |      | 920<br>120<br>27 |      | pF<br>pF<br>pF |
| $Q_G$<br>$Q_{GE}$<br>$Q_{GC}$       | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | $V_{CE} = 480 V$ $I_C = 12 A$ $V_{GE} = 15 V$              |      | 68<br>10<br>30   |      | nC<br>nC<br>nC |
| $I_{CL}$                            | Latching Current  | $V_{clamp} = 480 V$ $R_G = 10 \Omega$ $T_j = 150^{\circ}C$ | 48   |                  |      | A              |

### SWITCHING ON

| Symbol               | Parameter                | Test Conditions  | Min. | Typ.    | Max. | Unit       |
|----------------------|--------------------------|--|------|---------|------|------------|
| $t_{d(on)}$<br>$t_r$ | Delay Time<br>Rise Time  | $V_{CC} = 480 V$ $I_C = 12 A$<br>$V_{GE} = 15 V$ $R_G = 10 \Omega$ |      | 5<br>46 |      | ns<br>ns   |
| $(di/dt)_{on}$       | Turn-on Current Slope    | $V_{CC} = 480 V$ $I_C = 12 A$<br>$R_G = 10 \Omega$ $V_{GE} = 15 V$ |      | 800     |      | A/ $\mu s$ |
| $E_{on(\Delta)}$     | Turn-on Switching Losses | $T_j = 125^{\circ}C$   |      | 290     |      | $\mu J$    |

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING OFF**

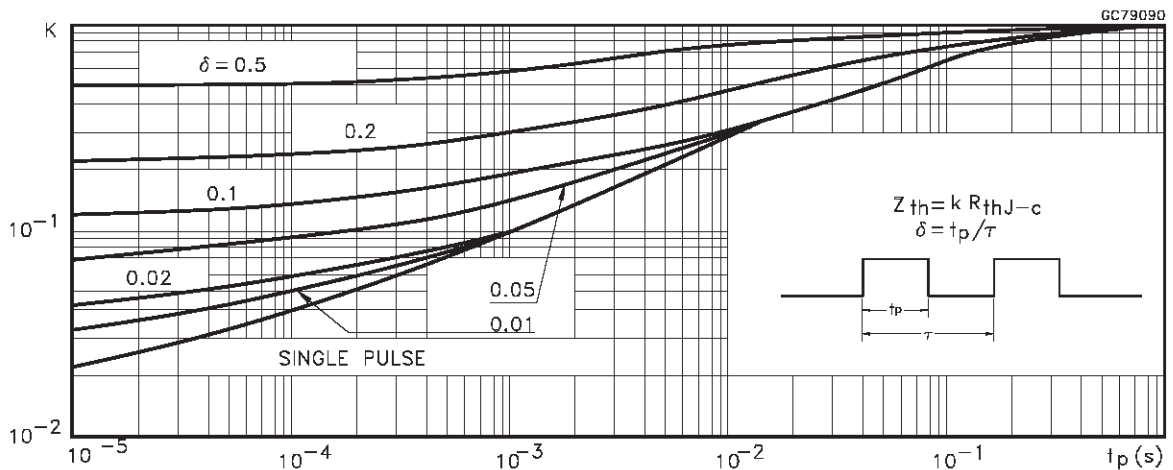
| Symbol          | Parameter               | Test Conditions                   | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------|-----------------------------------|------|------|------|------|
| $t_c$           | Cross-Over Time         | $V_{CC} = 480\text{ V}$           |      | 150  |      | ns   |
| $t_r(V_{off})$  | Off Voltage Rise Time   | $R_{GE} = 10\ \Omega$             |      | 27   |      | ns   |
| $t_{d(off)}$    | Delay Time              | $I_C = 12\text{ A}$               |      | 76   |      | ns   |
| $t_f$           | Fall Time               | $V_{GE} = 15\text{ V}$            |      | 92   |      | ns   |
| $E_{off(**)}$   | Turn-off Switching Loss |                                   |      | 0.21 |      | mJ   |
| $E_{ts(\circ)}$ | Total Switching Loss    |                                   |      | 0.49 |      | mJ   |
| $t_c$           | Cross-Over Time         | $V_{CC} = 480\text{ V}$           |      | 229  |      | ns   |
| $t_r(V_{off})$  | Off Voltage Rise Time   | $R_{GE} = 10\ \Omega$             |      | 76   |      | ns   |
| $t_{d(off)}$    | Delay Time              | $T_j = 125\text{ }^\circ\text{C}$ |      | 95   |      | ns   |
| $t_f$           | Fall Time               | $I_C = 12\text{ A}$               |      | 200  |      | ns   |
| $E_{off(**)}$   | Turn-off Switching Loss | $V_{GE} = 15\text{ V}$            |      | 0.45 |      | mJ   |
| $E_{ts(\circ)}$ | Total Switching Loss    |                                   |      | 0.74 |      | mJ   |

**COLLECTOR-EMITTER DIODE**

| Symbol    | Parameter                | Test Conditions                    | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|------------------------------------|------|------|------|------|
| $I_f$     | Forward Current          |                                    |      |      | 12   | A    |
| $I_{fm}$  | Forward Current pulsed   |                                    |      |      | 96   | A    |
| $V_f$     | Forward On-Voltage       | $I_f = 12\text{ A}$                |      | 1.55 | 2.0  | V    |
|           |                          | $I_r = 12\text{ A}$                |      | 1.3  |      | V    |
|           |                          | $T_j = 125\text{ }^\circ\text{C}$  |      |      |      |      |
| $t_{rr}$  | Reverse Recovery Time    | $I_f = 12\text{ A}$                |      | 100  |      | nS   |
| $Q_{rr}$  | Reverse Recovery Charge  | $V_{clamp} = 200\text{ V}$         |      | 330  |      | nC   |
| $I_{rrm}$ | Reverse Recovery Current | $di/dt = 100\text{ A}/\mu\text{S}$ |      | 6.3  |      | A    |
|           |                          | $T_j = 125\text{ }^\circ\text{C}$  |      |      |      |      |

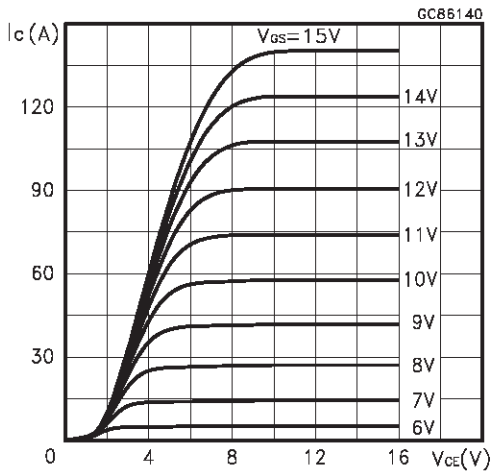
- (\*) Pulse width limited by max. junction temperature
- (\circ) Include recovery losses on the STTA1206 freewheeling diode
- (\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %
- (\*\*) Losses Include Also The Tail (Jedec Standardization)

**Thermal Impedance**

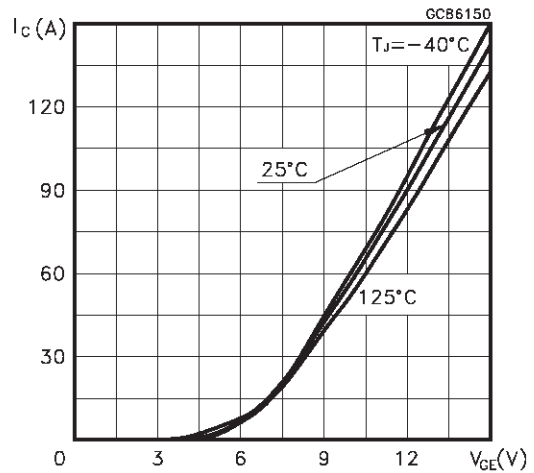


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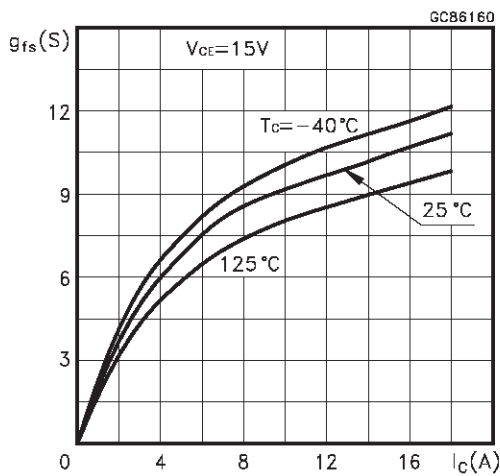
Output Characteristics



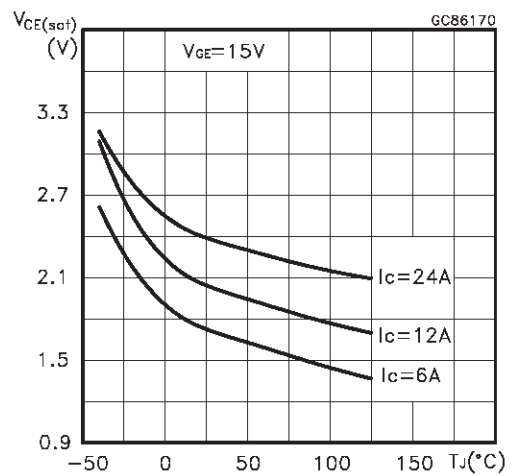
Transfer Characteristics



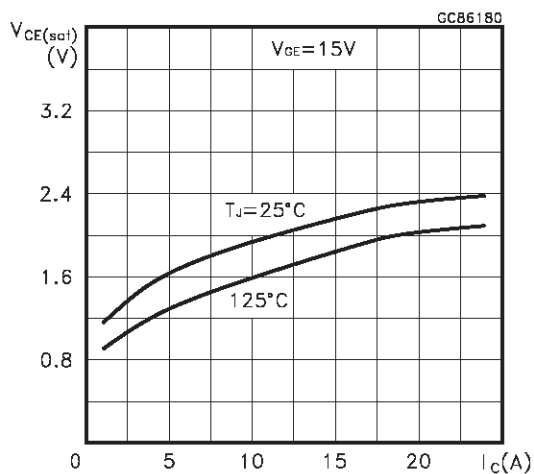
Transconductance



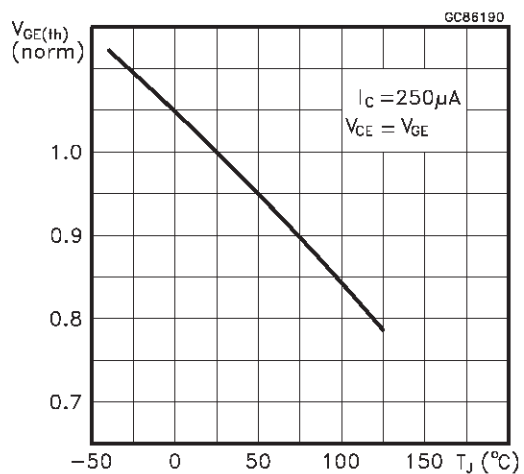
Collector-Emitter On Voltage vs Temperature



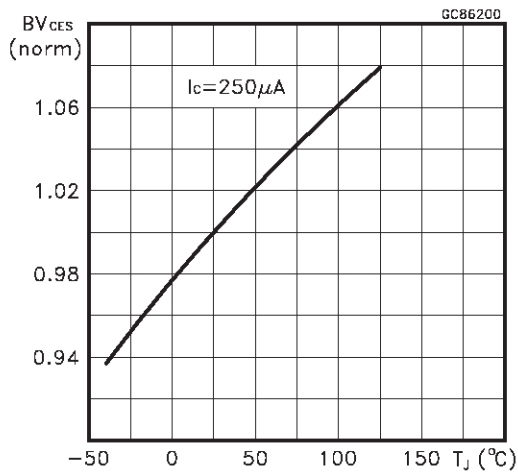
Collector-Emitter On Voltage vs Collector Current



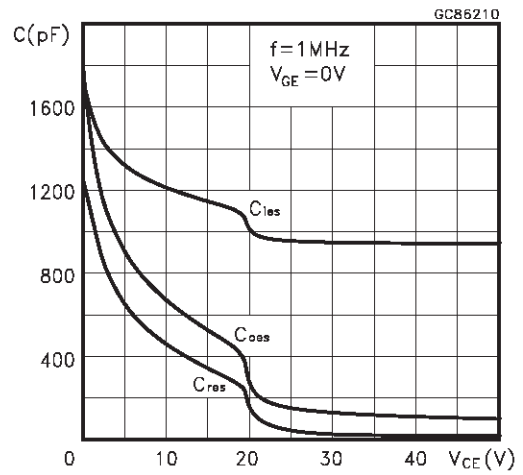
Gate Threshold vs Temperature



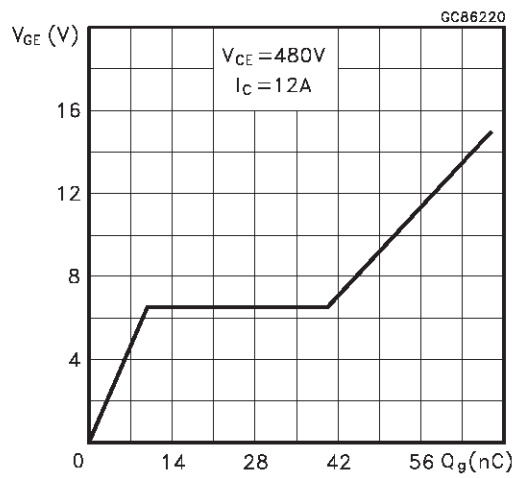
Normalized Breakdown Voltage vs Temperature



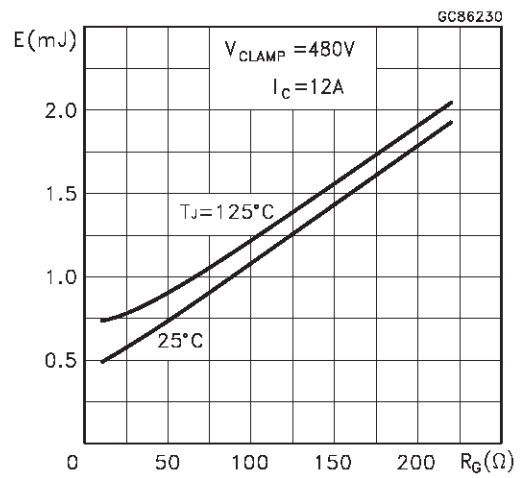
Capacitance Variations



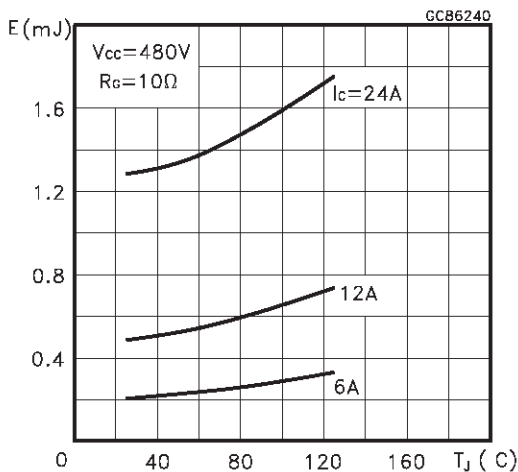
Gate Charge vs Gate-Emitter Voltage



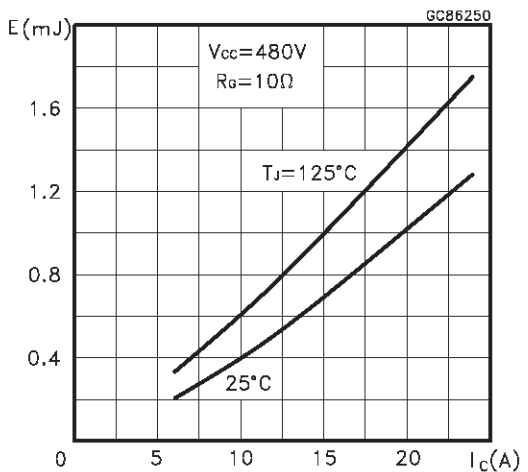
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



# STGW12NB60HD

## Switching Off Safe Operating Area

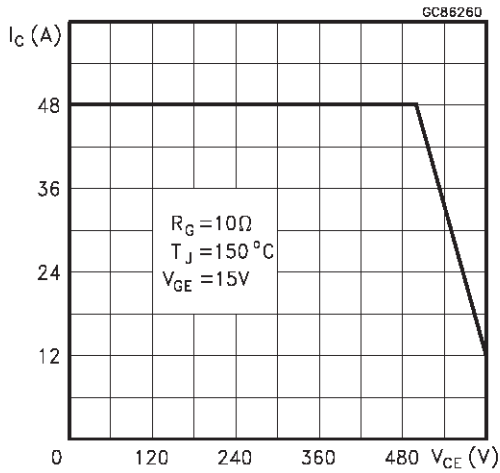


Fig. 1: Gate Charge test Circuit

## Diode Forward Voltage

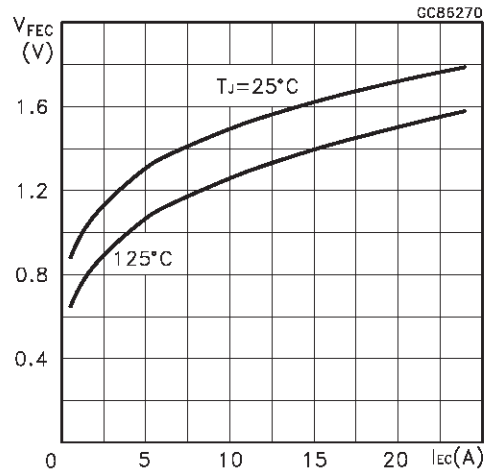


Fig. 2: Test Circuit For Inductive Load Switching

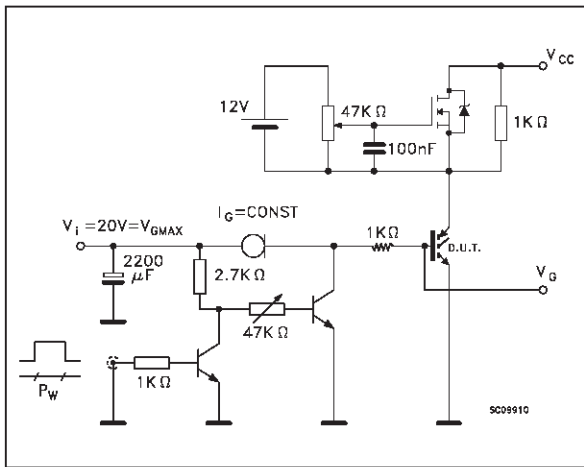
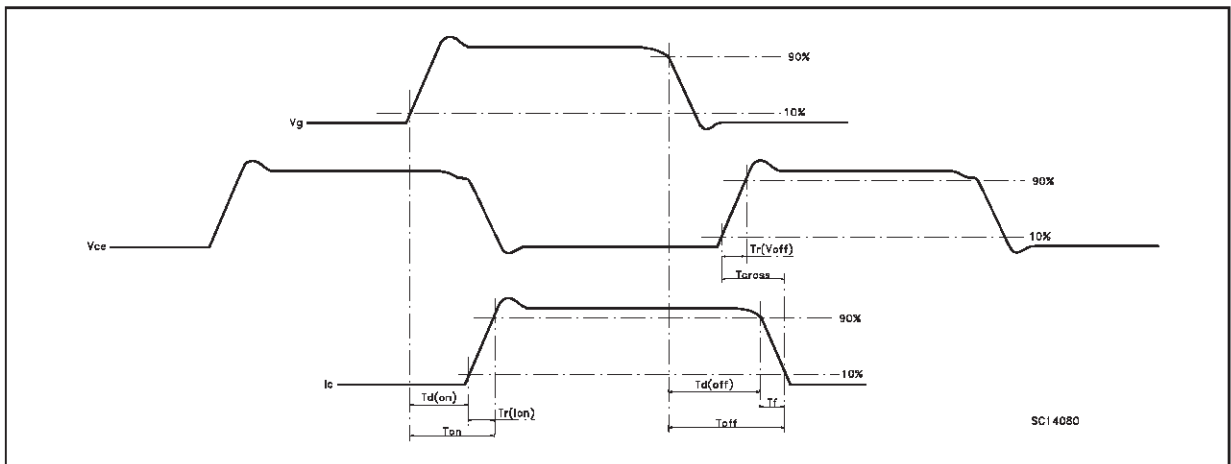
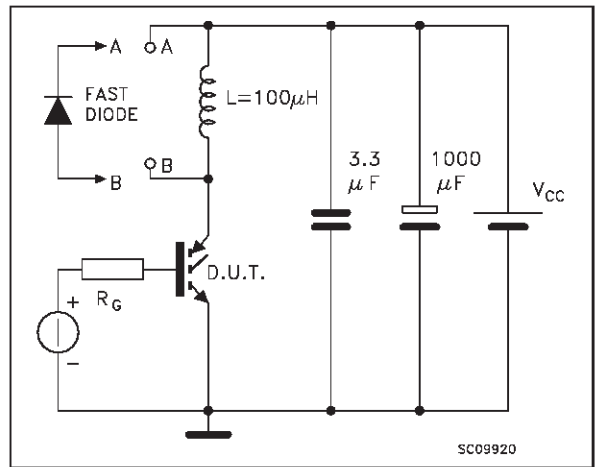
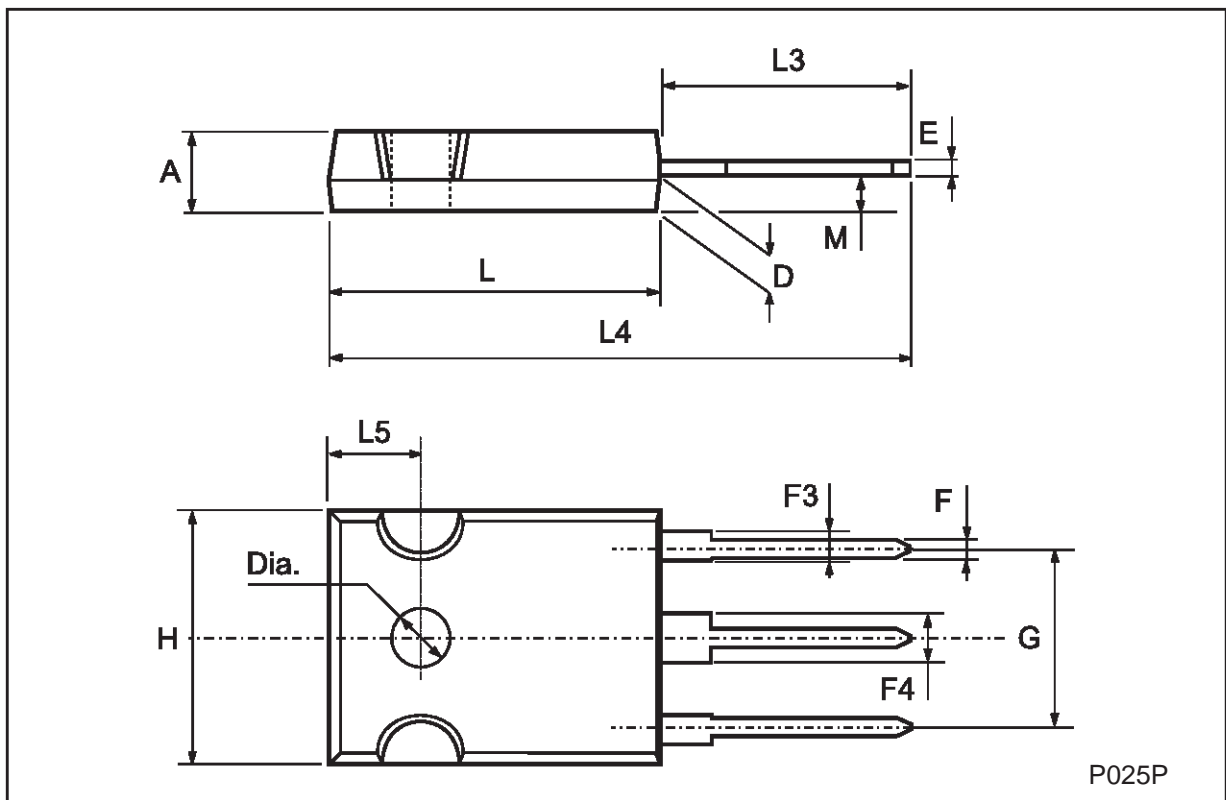


Fig. 3: Switching Waveforms



**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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