



# STGP3NB60S STGD3NB60S

N-CHANNEL 3A - 600V - TO-220 / DPAK

PowerMESH™ IGBT

| TYPE       | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|------------|------------------|----------------------|----------------|
| STGP3NB60S | 600 V            | < 1.5 V              | 3 A            |
| STGD3NB60S | 600 V            | < 1.5 V              | 3 A            |

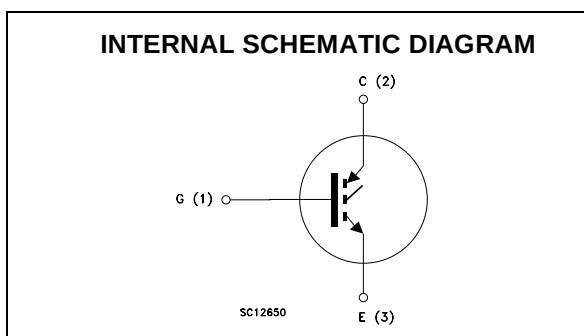
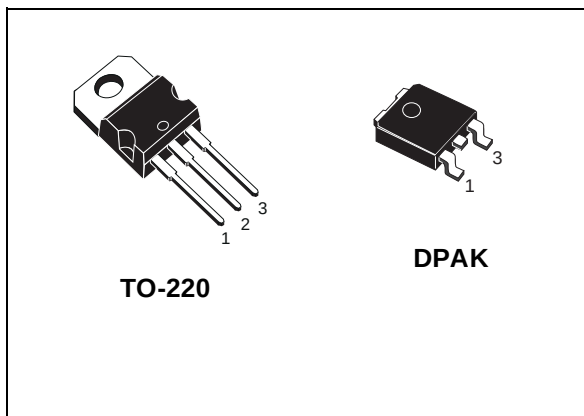
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- VERY LOW ON-VOLTAGE DROP (V<sub>CEsat</sub>)
- OFF LOSSES INCLUDE TAIL CURRENT
- ADD SUFFIX "T4" FOR ORDERING IN TAPE & REEL (SMD VERSION)

## 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 achieve minimum on-voltage drop for low frequency applications (<1kHz).

## APPLICATIONS

- MOTOR CONTROL
- LIGHT DIMMER
- STATIC RELAYS



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                                | Value      |            | Unit |
|---------------------|----------------------------------------------------------|------------|------------|------|
|                     |                                                          | STGP3NB60S | STGD3NB60S |      |
| V <sub>CES</sub>    | Collector-Emitter Voltage (V <sub>GS</sub> = 0)          | 600        |            | V    |
| V <sub>ECR</sub>    | Reverse Battery Protection                               | 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  | 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)                               | 24         |            | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C               | 65         | 45         | 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

**STGP3NB60S - STGD3NB60S****THERMAL DATA**

|           |                                         | TO-220 | DPAK |      |
|-----------|-----------------------------------------|--------|------|------|
| Rthj-case | Thermal Resistance Junction-case Max    | 1.92   | 2.75 | °C/W |
| Rthj-amb  | Thermal Resistance Junction-ambient Max | 62.5   | 100  | °C/W |
| Rthc-h    | Thermal Resistance Case-heatsink Typ    | 0.5    |      | °C/W |

**ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED)****OFF**

| Symbol                | Parameter                                          | Test Conditions                                                                                               | Min. | Typ. | Max.      | Unit     |
|-----------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------|------|-----------|----------|
| V <sub>BR</sub> (CES) | Collectro-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>C</sub> = 25 °C<br>V <sub>CE</sub> = Max Rating, T <sub>C</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> = ±20V, V <sub>CE</sub> = 0                                                                   |      |      | ±100      | nA       |

**ON (1)**

| Symbol                | Parameter                            | Test Conditions                                                                            | Min. | Typ.     | Max. | Unit |
|-----------------------|--------------------------------------|--------------------------------------------------------------------------------------------|------|----------|------|------|
| V <sub>GE</sub> (th)  | Gate Threshold Voltage               | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250µA                                 | 2.5  |          | 5    | V    |
| V <sub>CE</sub> (sat) | Collector-Emitter Saturation Voltage | V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A<br>V <sub>GE</sub> = 15V, I <sub>C</sub> = 1 A |      | 1.2<br>1 | 1.5  | 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>                                     | Input Capacitance                                                 | V <sub>CE</sub> = 25V, f = 1 MHz, V <sub>GE</sub> = 0                      |      | 255              |      | pF             |
| C <sub>oes</sub>                                     | Output Capacitance                                                |                                                                            |      | 30               |      | pF             |
| C <sub>res</sub>                                     | Reverse Transfer Capacitance                                      |                                                                            |      | 5.6              |      | 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,<br>V <sub>GE</sub> = 15V    |      | 18<br>5.4<br>5.5 |      | nC<br>nC<br>nC |
| I <sub>CL</sub>                                      | Latching Current                                                  | V <sub>clamp</sub> = 480 V, T <sub>j</sub> = 150°C<br>R <sub>G</sub> = 1KΩ | 12   |                  |      | A              |

**SWITCHING ON**

| Symbol                                   | Parameter                                         | Test Conditions                                                                                                       | Min. | Typ. | Max. | Unit       |
|------------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|------|------|------------|
| t <sub>d(on)</sub>                       | Turn-on Delay Time                                | V <sub>CC</sub> = 480 V, I <sub>C</sub> = 3 A<br>R <sub>G</sub> = 1KΩ, V <sub>GE</sub> = 15 V                         |      | 170  |      | ns         |
| t <sub>r</sub>                           | Rise Time                                         |                                                                                                                       |      | 540  |      | ns         |
| (di/dt) <sub>on</sub><br>E <sub>on</sub> | Turn-on Current Slope<br>Turn-on Switching Losses | V <sub>CC</sub> = 480 V, I <sub>C</sub> = 3 A, R <sub>G</sub> = 1KΩ<br>V <sub>GE</sub> = 15 V, T <sub>j</sub> = 125°C |      | 300  |      | A/µs<br>µJ |

**ELECTRICAL CHARACTERISTICS (CONTINUED)****SWITCHING OFF**

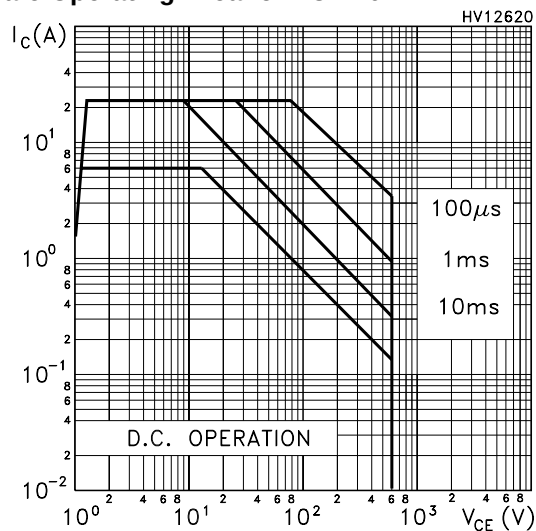
| Symbol         | Parameter               | Test Conditions                                                                                                                       | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $t_c$          | Cross-over Time         | $V_{CC} = 480\text{ V}$ , $I_C = 3\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$                                |      | 1.8  |      | $\mu\text{s}$ |
| $t_r(V_{off})$ | Off Voltage Rise Time   |                                                                                                                                       |      | 1.0  |      | $\mu\text{s}$ |
| $t_d(O_{ff})$  | 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         | $V_{CC} = 480\text{ V}$ , $I_C = 3\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$ ,<br>$T_j = 150^\circ\text{C}$ |      | 2.8  |      | $\mu\text{s}$ |
| $t_r(V_{off})$ | Off Voltage Rise Time   |                                                                                                                                       |      | 1.45 |      | $\mu\text{s}$ |
| $t_d(O_{ff})$  | Delay Time              |                                                                                                                                       |      | 3.6  |      | $\mu\text{s}$ |
| $t_f$          | Fall Time               |                                                                                                                                       |      | 1.2  |      | $\mu\text{s}$ |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                                                                                                       |      | 1.8  |      | mJ            |

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

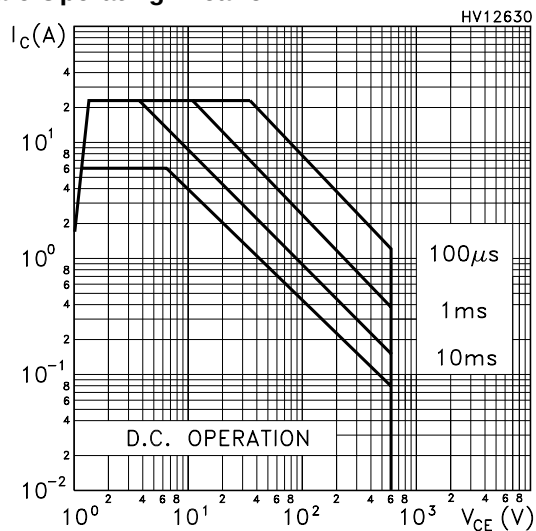
2. Pulse width limited by max. junction temperature.

(\*\*) Losses include Also the Tail (Jedec Standardization)

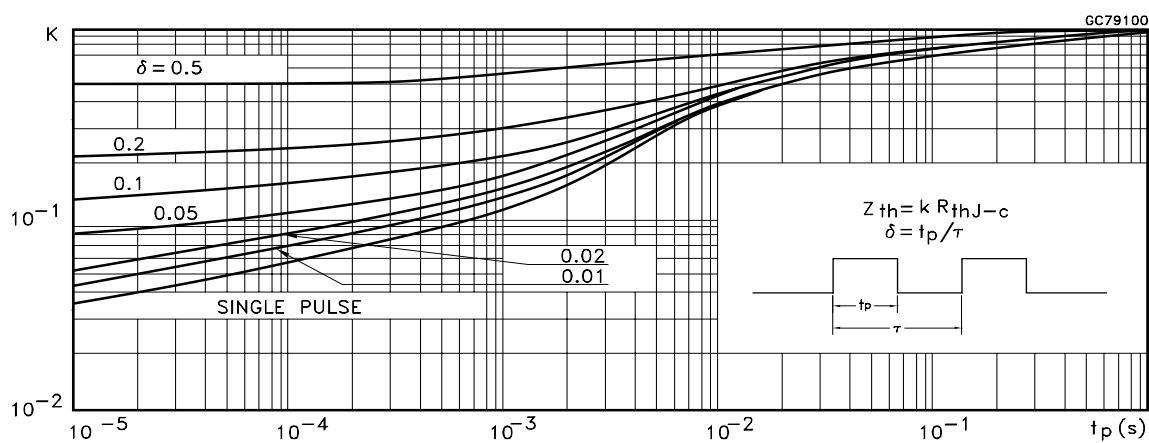
Safe Operating Area for TO-220



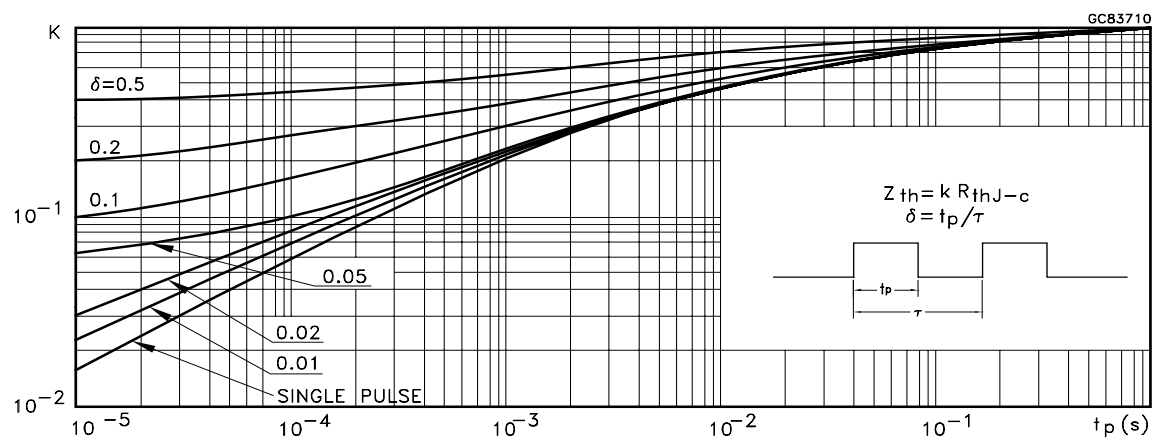
Safe Operating Area for DPAK



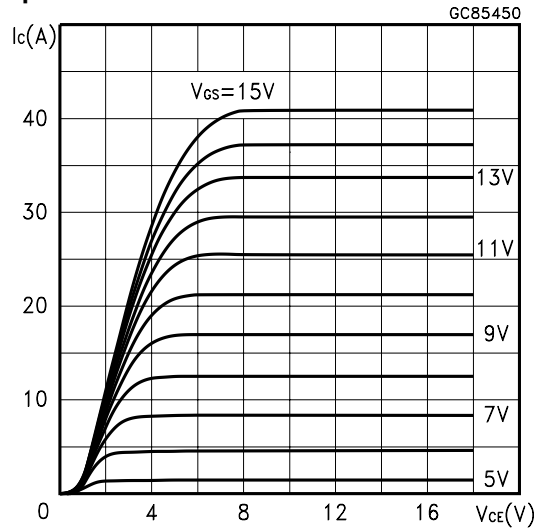
Thermal Impedance for TO-220



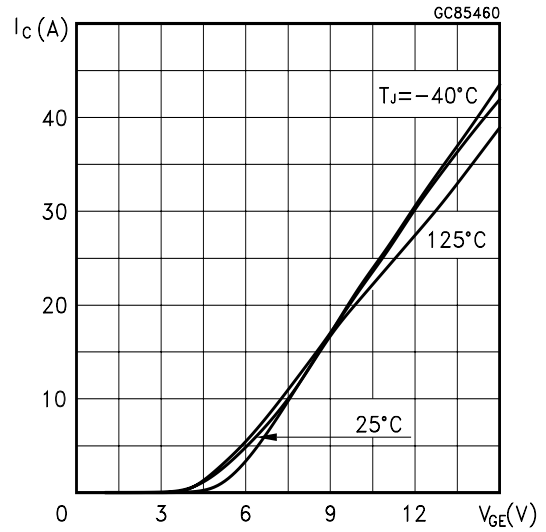
Thermal Impedance for DPAK



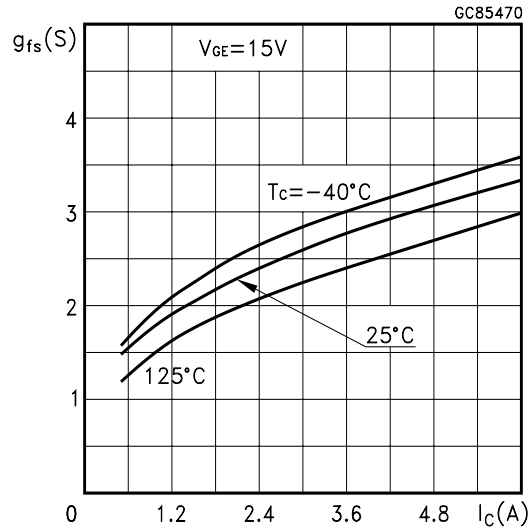
### Output Characteristics



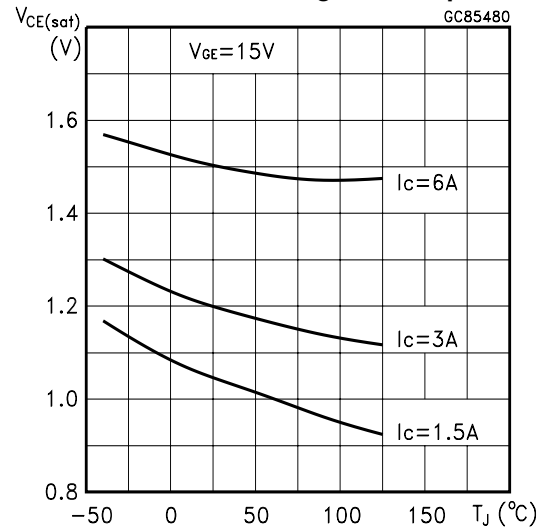
### Transfer Characteristics



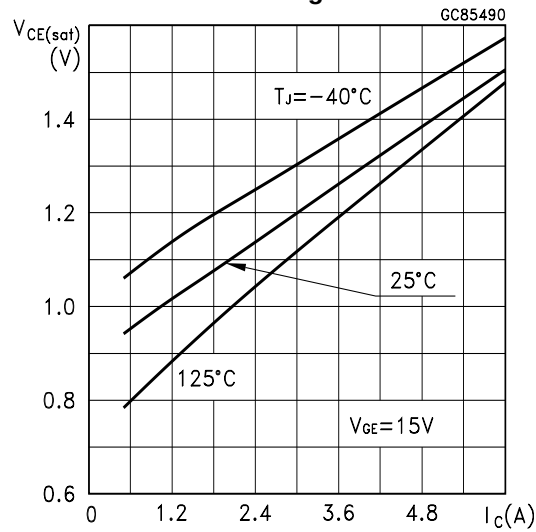
### Transconductance



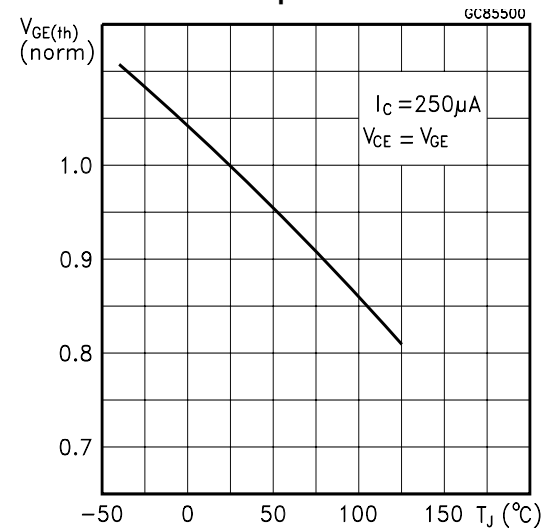
### Collector-Emitter On Voltage vs Temperature



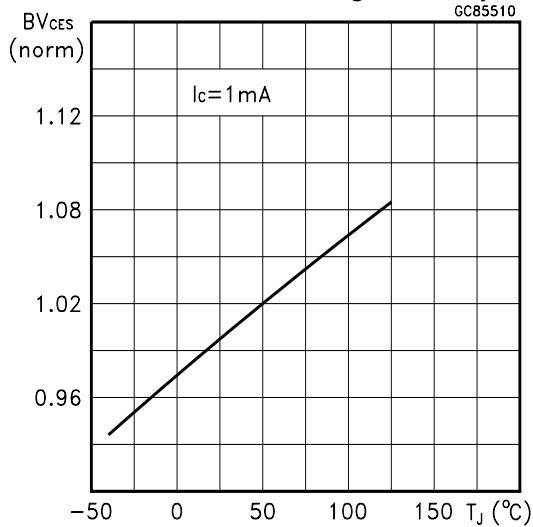
### Collector-Emitter On Voltage vs Collector Current



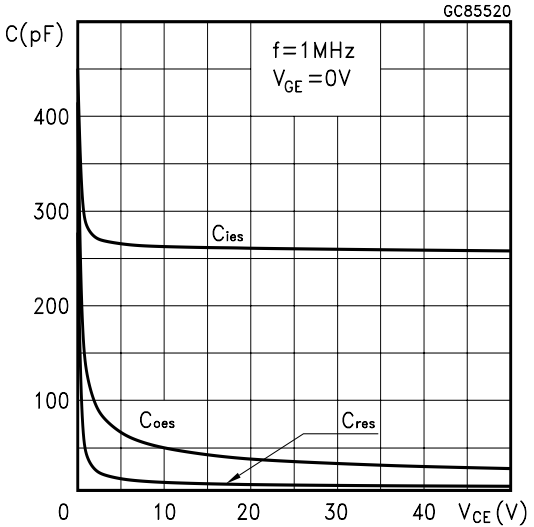
### Gate Threshold vs Temperature



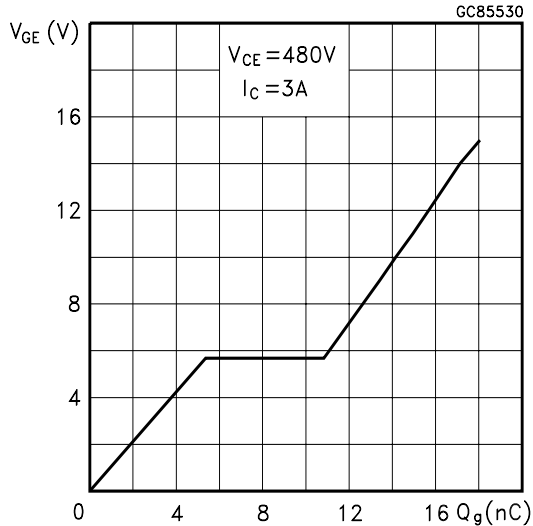
Normalized Breakdown Voltage vs Temperature



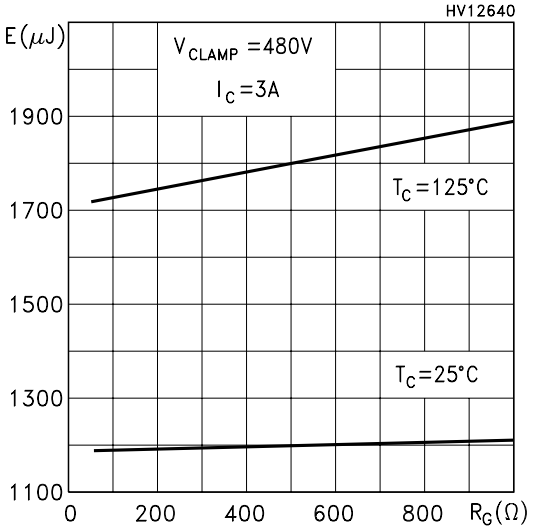
Capacitance Variations



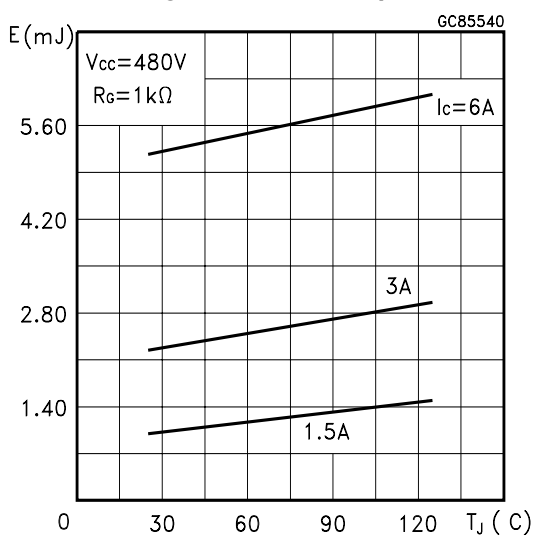
Gate Charge vs Gate-Emitter Voltage



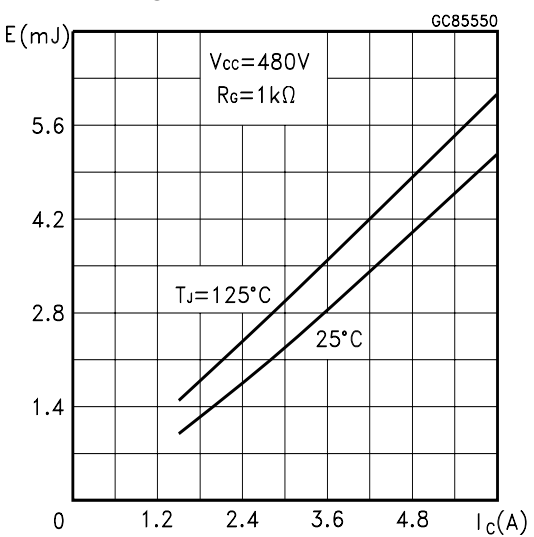
Total Switching Losses vs Gate Resistance



Total Switching Losses vs Temperature



Total Switching Losses vs Collector Current



### Switching Off Safe Operating Area

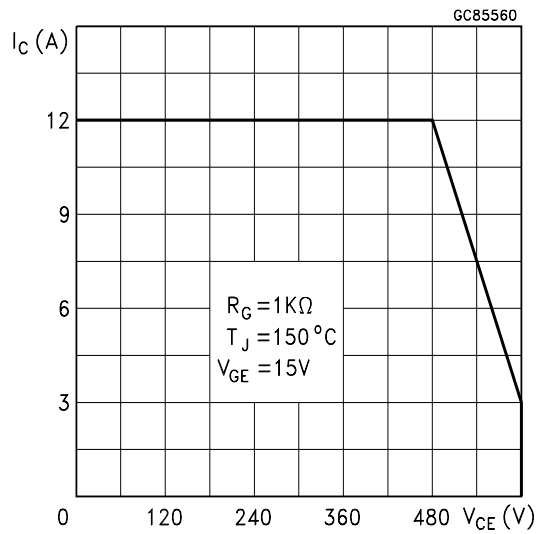


Fig. 1: Gate Charge test Circuit

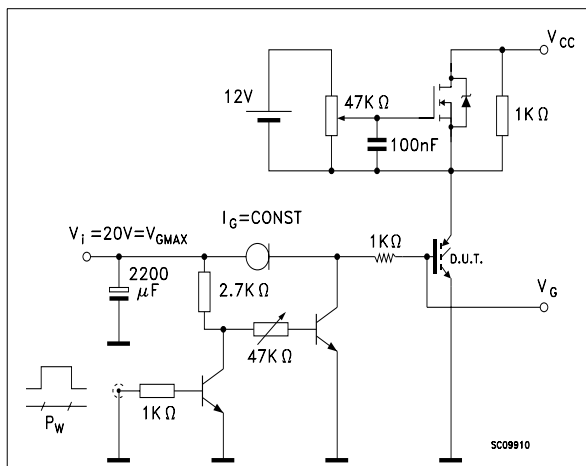
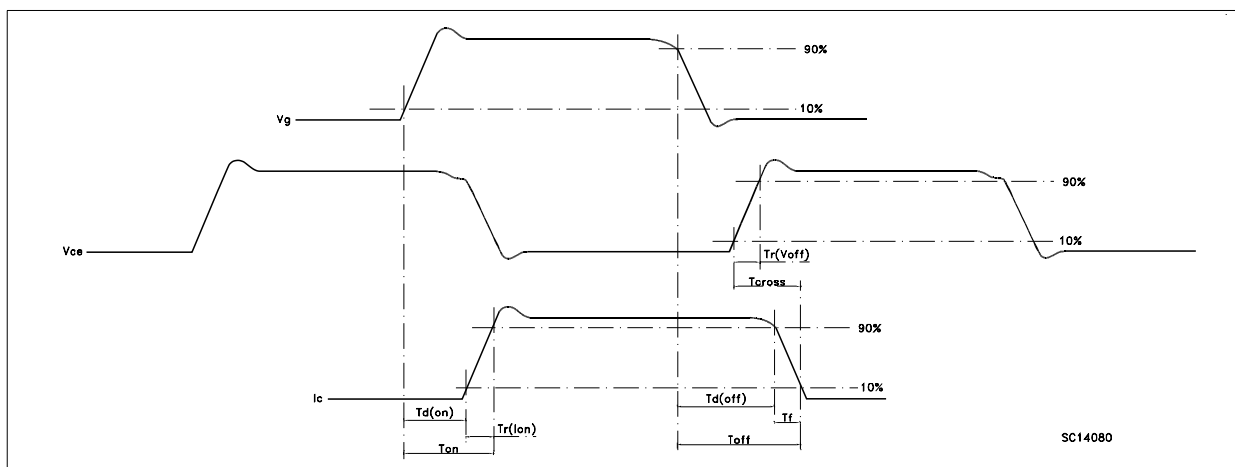
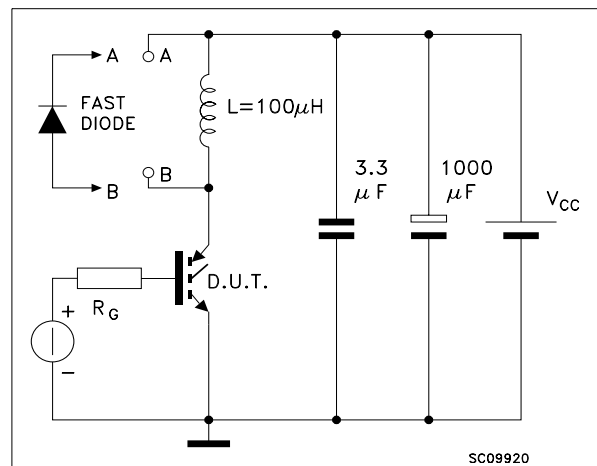
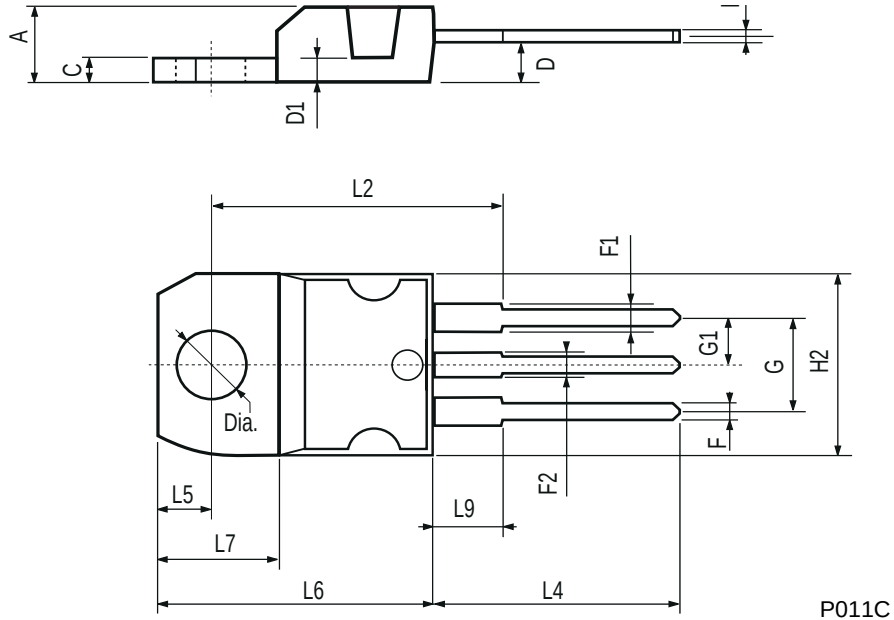


Fig. 2: Test Circuit For Inductive Load Switching



TO-220 MECHANICAL DATA

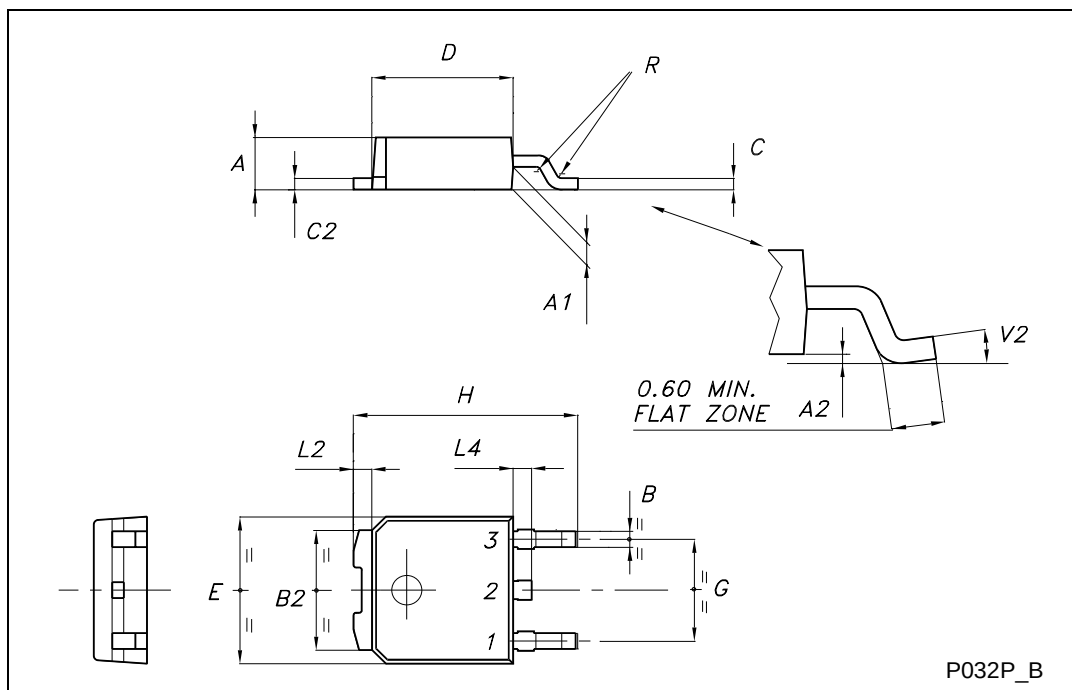
| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 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 |





## TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.20 |      | 2.40  | 0.087 |       | 0.094 |
| A1   | 0.90 |      | 1.10  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.90  | 0.025 |       | 0.035 |
| B2   | 5.20 |      | 5.40  | 0.204 |       | 0.213 |
| C    | 0.45 |      | 0.60  | 0.018 |       | 0.024 |
| C2   | 0.48 |      | 0.60  | 0.019 |       | 0.024 |
| D    | 6.00 |      | 6.20  | 0.236 |       | 0.244 |
| E    | 6.40 |      | 6.60  | 0.252 |       | 0.260 |
| G    | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.10 | 0.368 |       | 0.398 |
| L2   |      | 0.8  |       |       | 0.031 |       |
| L4   | 0.60 |      | 1.00  | 0.024 |       | 0.039 |
| V2   | 0°   |      | 8°    | 0°    |       | 0°    |



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