



# STGP10NB60SFP

N-CHANNEL 10A - 600V - TO-220FP

PowerMesh™ IGBT

| TYPE          | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|---------------|------------------|----------------------|----------------|
| STGP10NB60SFP | 600              | < 1.7 V              | 10 A           |

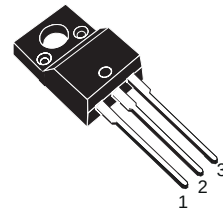
- HIGHT INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT

## 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 "S" identifies a family optimized achieve minimum on-voltage drop for low frequency applications (<1kHz).

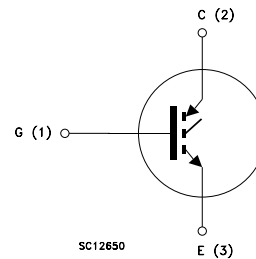
## APPLICATIONS

- LIGHT DIMMER
- STATIC RELAYS
- MOTOR CONTROL



TO-220FP

## 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>    | 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  | 20         | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>C</sub> = 100°C | 10         | A    |
| I <sub>CM</sub> (■) | Collector Current (pulsed)                               | 80         | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C               | 31.5       | W    |
|                     | Derating Factor                                          | 0.21       | 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

## STGP10NB60SFP

### THERMAL DATA

|           |                                         |      |      |
|-----------|-----------------------------------------|------|------|
| Rthj-case | Thermal Resistance Junction-case Max    | 4.7  | °C/W |
| Rthj-amb  | Thermal Resistance Junction-ambient Max | 62.5 | °C/W |
| Rthc-sink | Thermal Resistance Case-sink Typ        | 0.5  | °C/W |

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

OFF

| Symbol        | Parameter                                     | Test Conditions                                                                                         | Min. | Typ. | Max.      | Unit               |
|---------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------|------|------|-----------|--------------------|
| $V_{BR(CES)}$ | Collector-Emitter Break-down Voltage          | $I_C = 250 \mu A$ , $V_{GE} = 0$ ,                                                                      | 600  |      |           | V                  |
| $V_{BR(CES)}$ | Emitter Collector Break-down Voltage          | $I_C = 1 mA$ , $V_{GE} = 0$ ,                                                                           | 20   |      |           | V                  |
| $I_{CES}$     | Collector cut-off Current ( $V_{GE} = 0$ )    | $V_{CE} = \text{Max Rating}$ , $T_J = 25^\circ C$<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 ( $V_{CE} = 0$ ) | $V_{GE} = \pm 20V$ , $V_{CE} = 0$                                                                       |      |      | $\pm 100$ | nA                 |

ON (1)

| Symbol        | Parameter                            | Test Conditions                                                                                                                                                | Min. | Typ.                 | Max. | Unit        |
|---------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|-------------|
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{CE} = V_{GE}$ , $I_C = 250 \mu A$                                                                                                                          | 2.5  |                      | 5    | V           |
| $V_{CE(SAT)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15V$ , $I_C = 5 A$ , $T_J = 25^\circ C$<br>$V_{GE} = 15V$ , $I_C = 10 A$ , $T_J = 25^\circ C$<br>$V_{GE} = 15V$ , $I_C = 10 A$ , $T_J = 125^\circ C$ |      | 1.15<br>1.35<br>1.25 | 1.7  | V<br>V<br>V |

### DYNAMIC

| Symbol    | Parameter                    | Test Conditions                                                | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|----------------------------------------------------------------|------|------|------|------|
| $g_{fs}$  | Forward Transconductance     | $V_{CE} = 25 V$ , $I_C = 10 A$                                 | 5    |      |      | S    |
| $C_{ies}$ | Input Capacitance            | $V_{CE} = 25V$ , $f = 1 MHz$ , $V_{GE} = 0$                    |      | 610  |      | pF   |
| $C_{oes}$ | Output Capacitance           |                                                                |      | 65   |      | pF   |
| $C_{res}$ | Reverse Transfer Capacitance |                                                                |      | 12   |      | pF   |
| $Q_g$     | Gate Charge                  | $V_{CE} = 400V$ , $I_C = 10 A$ ,<br>$V_{GE} = 15V$             |      | 33   |      | nC   |
| $I_{CL}$  | Latching Current             | $V_{clamp} = 480V$ , $R_G = 1k\Omega$ ,<br>$T_J = 125^\circ C$ | 20   |      |      | A    |

### SWITCHING ON

| Symbol         | Parameter                | Test Conditions                                                                                    | Min. | Typ. | Max. | Unit                   |
|----------------|--------------------------|----------------------------------------------------------------------------------------------------|------|------|------|------------------------|
| $t_{d(on)}$    | Turn-on Delay Time       | $V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$<br>$R_G = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$ |      | 0.7  |      | $\mu\text{s}$          |
| $t_r$          | Rise Time                |                                                                                                    |      | 0.46 |      | $\mu\text{s}$          |
| $(di/dt)_{on}$ | Turn-on Current Slope    | $V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$<br>$R_G = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$ |      | 8    |      | $\text{A}/\mu\text{s}$ |
| $E_{on}$       | Turn-on Switching Losses |                                                                                                    |      | 0.6  |      | $\text{mJ}$            |

### SWITCHING OFF

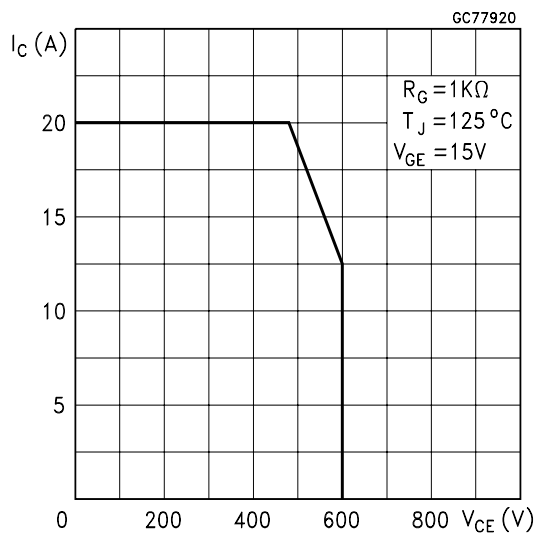
| Symbol           | Parameter               | Test Conditions                                                                                                                                 | Min. | Typ. | Max. | Unit          |
|------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $t_c$            | Cross-over Time         | $V_{clamp} = 480\text{ V}$ , $I_C = 10\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$                                      |      | 2.2  |      | $\mu\text{s}$ |
| $t_r(V_{off})$   | Off Voltage Rise Time   |                                                                                                                                                 |      | 1.2  |      | $\mu\text{s}$ |
| $t_f$            | Fall Time               |                                                                                                                                                 |      | 1.2  |      | $\mu\text{s}$ |
| $E_{off}(^{**})$ | Turn-off Switching Loss |                                                                                                                                                 |      | 5.0  |      | $\text{mJ}$   |
| $t_c$            | Cross-over Time         | $V_{clamp} = 480\text{ V}$ , $I_C = 10\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 15\text{ V}$<br>$T_J = 125\text{ }^\circ\text{C}$ |      | 3.8  |      | $\mu\text{s}$ |
| $t_r(V_{off})$   | Off Voltage Rise Time   |                                                                                                                                                 |      | 1.2  |      | $\mu\text{s}$ |
| $t_f$            | Fall Time               |                                                                                                                                                 |      | 1.9  |      | $\mu\text{s}$ |
| $E_{off}(^{**})$ | Turn-off Switching Loss |                                                                                                                                                 |      | 8.0  |      | $\text{mJ}$   |

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

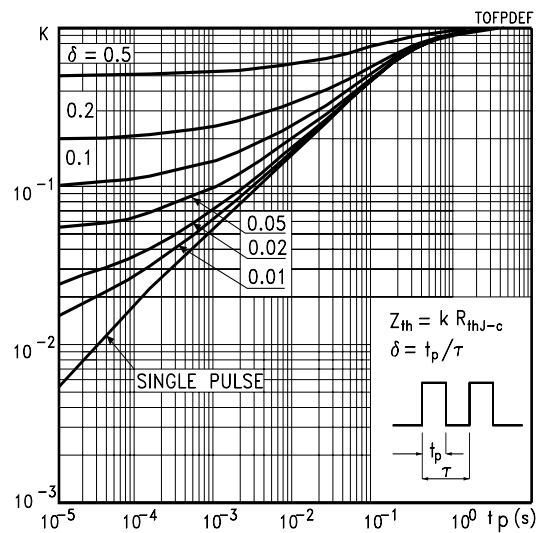
(1) Pulse width limited by max. junction temperature.

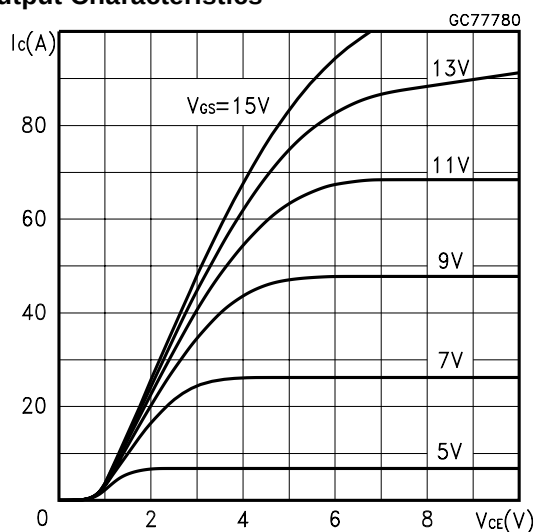
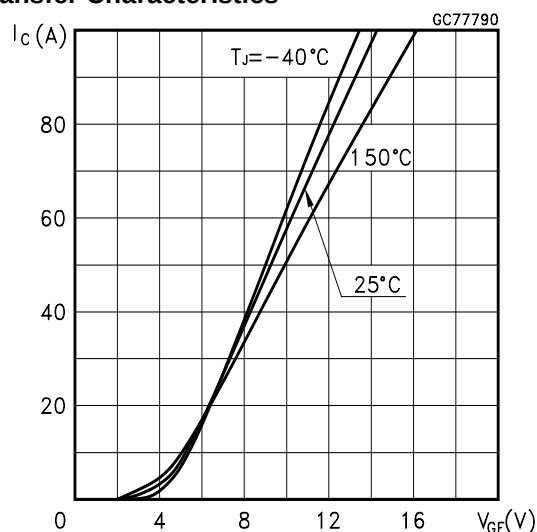
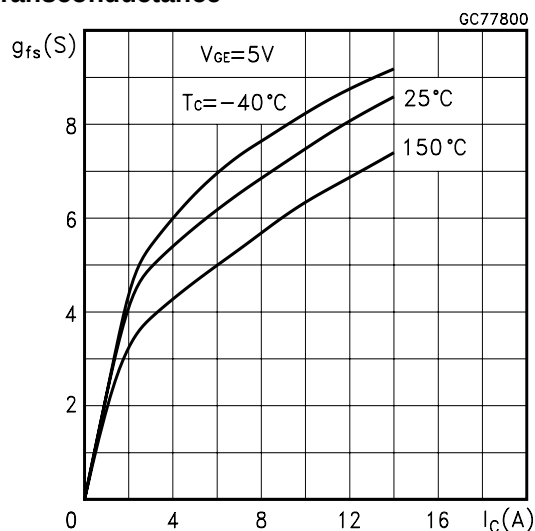
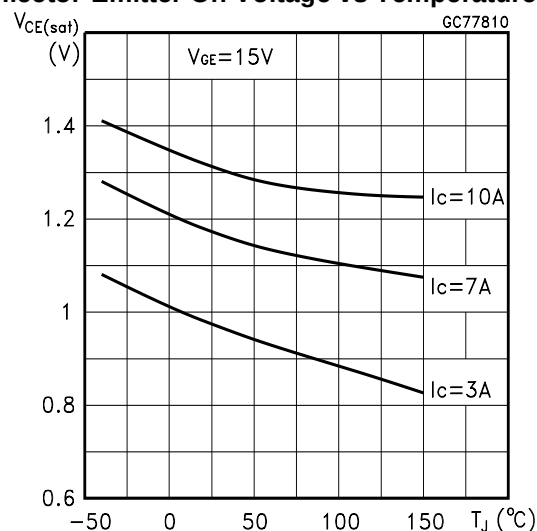
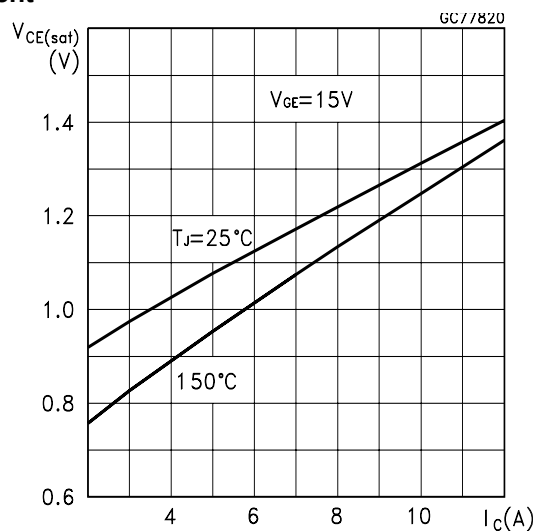
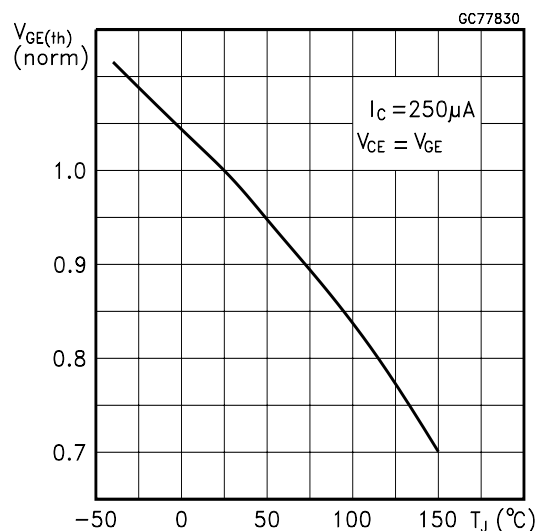
(\*\*) Losses Include Also the Tail

### Switching Off Safe Operating Area

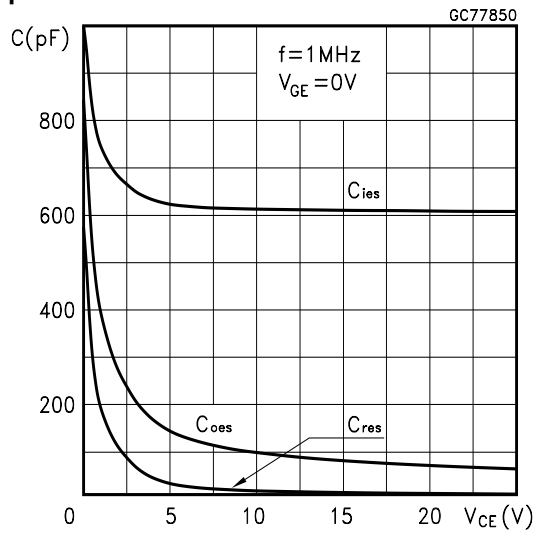


### Thermal Impedance

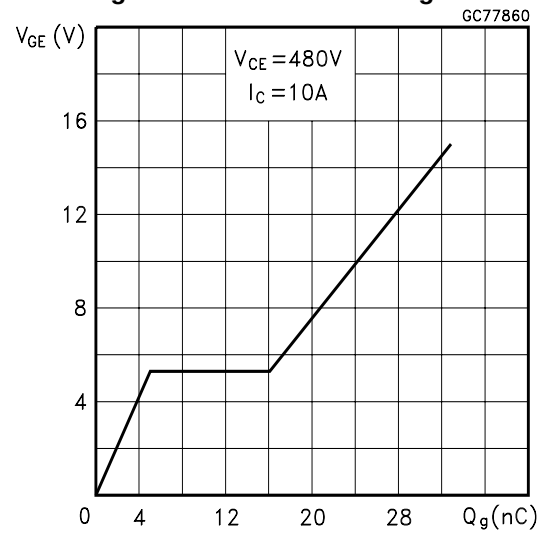


**Output Characteristics**

**Transfer Characteristics**

**Transconductance**

**Collector-Emitter On Voltage vs Temperature**

**Collector-Emitter On Voltage vs Collector Current**

**Gate Threshold Voltage vs Temperature**


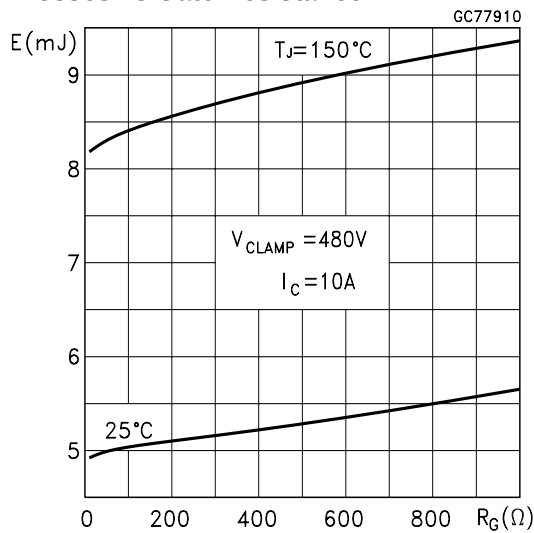
### Capacitance Variations



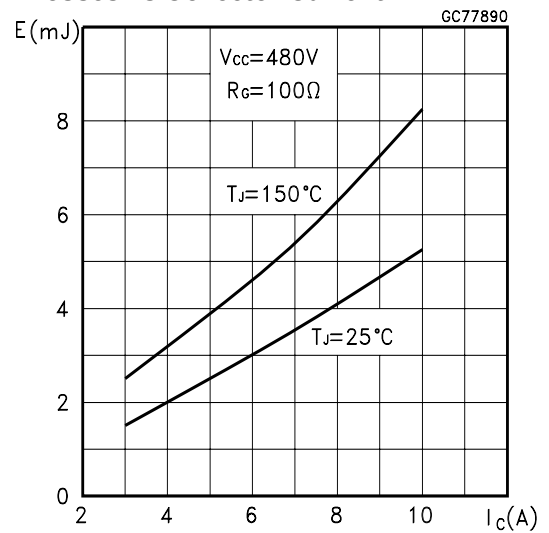
### Gate Charge vs Gate-Emitter Voltage



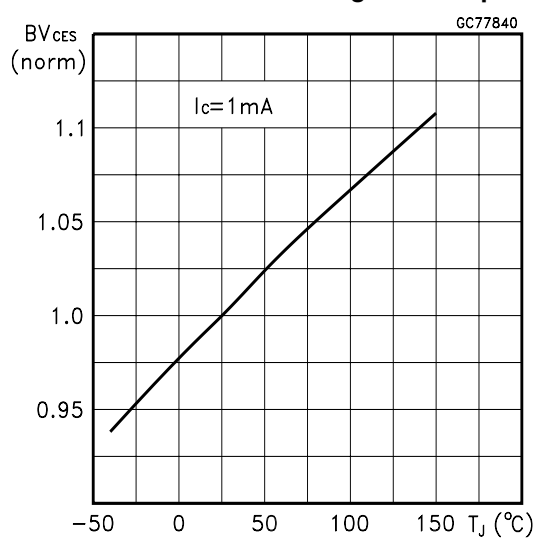
### Off Losses vs Gate Resistance



### Off Losses vs Collector Current



### Normalized Break-down Voltage vs Temp.



### Off Losses vs Temperature

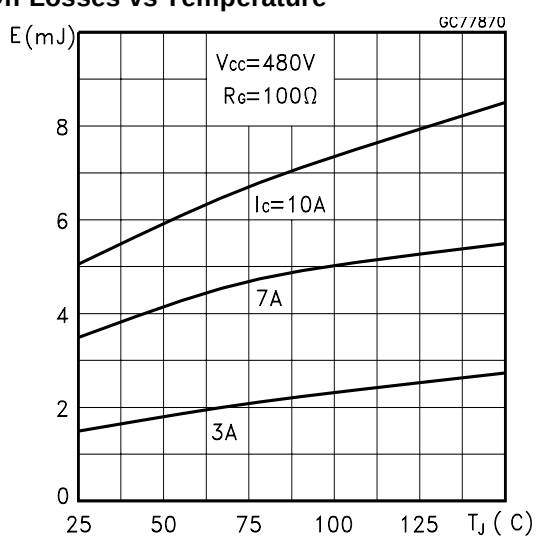


Fig. 1: Gate Charge test Circuit

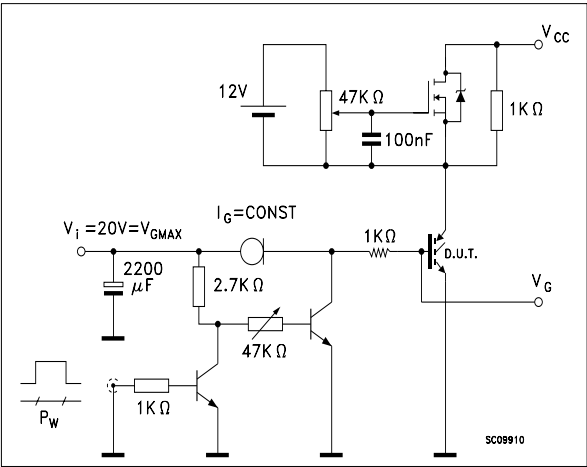
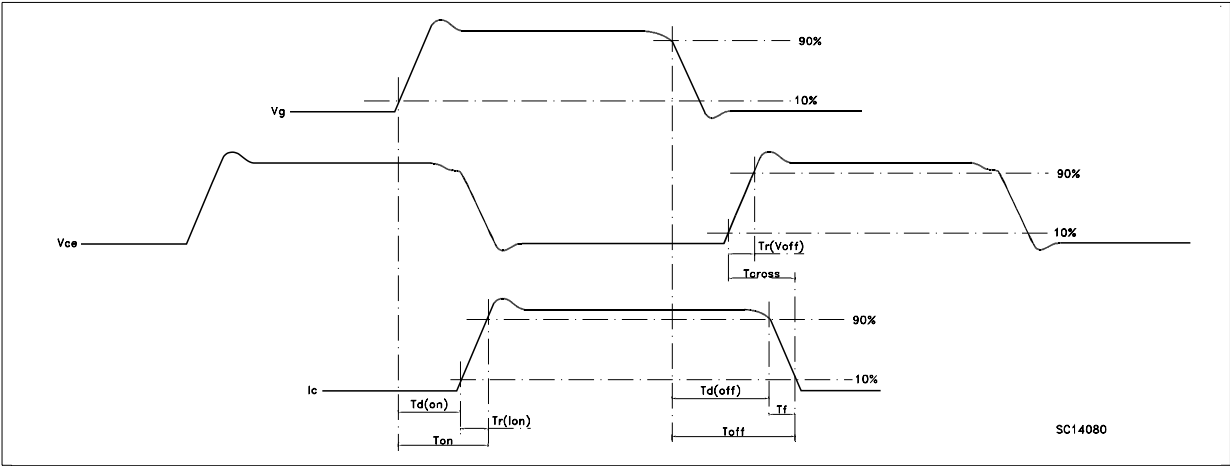
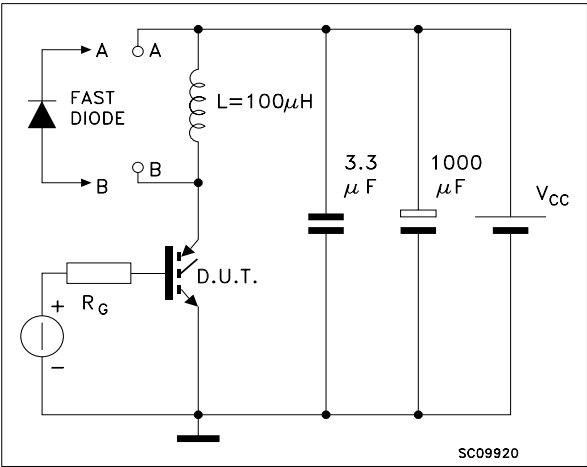
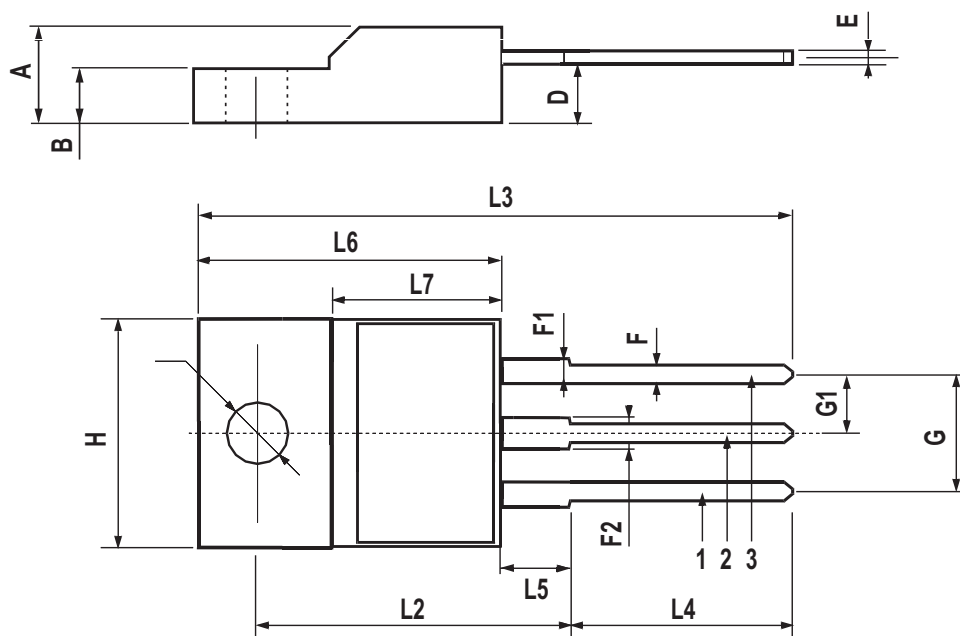


Fig. 2: Test Circuit For Inductive Load Switching



## TO-220FP MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |       |       |
|------|------|-----|------|-------|-------|-------|
|      | MIN. | TYP | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |     | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |     | 2.75 | 0.098 |       | 0.108 |
| E    | 0.45 |     | 0.7  | 0.017 |       | 0.027 |
| F    | 0.75 |     | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |     | 1.5  | 0.045 |       | 0.067 |
| F2   | 1.15 |     | 1.5  | 0.045 |       | 0.067 |
| G    | 4.95 |     | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |     | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |     | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16  |      |       | 0.630 |       |
| L3   | 28.6 |     | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |     | 10.6 | .0385 |       | 0.417 |
| L5   | 2.9  |     | 3.6  | 0.114 |       | 0.141 |
| L6   | 15.9 |     | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |     | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |     | 3.2  | 0.118 |       | 0.126 |



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