



THE DATASHEET OF STGF19NC60WD





STGF19NC60WD

N-channel 600V - 7A - TO-220
Ultra fast PowerMESH™ IGBT

PRELIMINARY DATA

Features

| Type | V _{CES} | V _{CE(sat)} (max)@25°C | I _C @100°C |
|--------------|------------------|------------------------------------|--------------------------|
| STGF19NC60WD | 600V | < 2.5V | 7A |

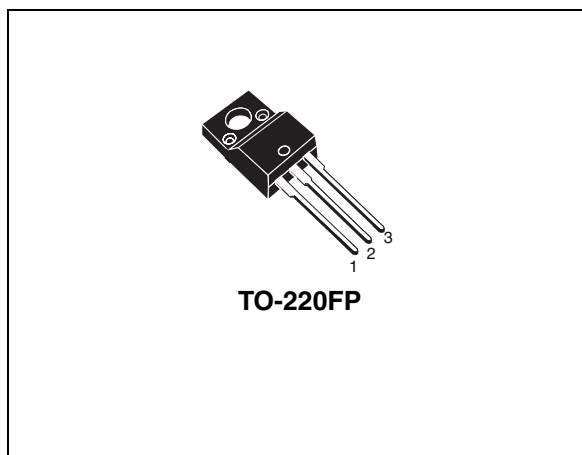
- High frequency operation
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

Description

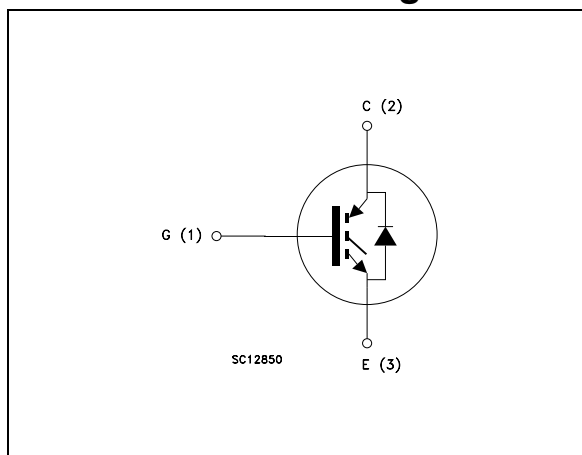
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “W” identifies a family optimized for very high frequency application.

Applications

- High frequency motor controls, inverters, UPS
- HF, SMPS and PFC in both hard switch and resonant topologies



Internal schematic diagram



Order code

| Part number | Marking | Package | Packaging |
|--------------|------------|---------|-----------|
| STGF19NC60WD | GF19NC60WD | TO-220 | Tube |

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1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|------------------|
| V_{CES} | Collector-emitter voltage ($V_{GS} = 0$) | 600 | V |
| $I_C^{(1)}$ | Collector current (continuous) at $T_C = 25^\circ\text{C}$ | 14 | A |
| $I_C^{(1)}$ | Collector current (continuous) at $T_C = 100^\circ\text{C}$ | 7 | A |
| $I_{CL}^{(2)}$ | Collector current (pulsed) | 35 | A |
| I_F | Diode RMS forward current at $T_C = 25^\circ\text{C}$ | 12 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 32 | W |
| T_{stg} | Storage temperature | - 55 to 150 | $^\circ\text{C}$ |
| T_j | Operating junction temperature | | |

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. $V_{clamp}=480\text{V}$, $T_j=150^\circ\text{C}$, $R_G=10\Omega$, $V_{GE}=15\text{V}$

Table 2. Thermal resistance

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 4 | $^\circ\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | $^\circ\text{C/W}$ |

2 Electrical characteristics

($T_{CASE}=25^{\circ}\text{C}$ unless otherwise specified)

Table 3. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|------|-----------|---------------|
| $V_{BR(CES)}$ | Collector-emitter breakdown voltage | $I_C = 1\text{mA}$, $V_{GE} = 0$ | 600 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{V}$, $I_C = 12\text{A}$ | | 2.1 | 2.5 | V |
| | | $V_{GE} = 15\text{V}$, $I_C = 12\text{A}$, $T_C = 125^{\circ}\text{C}$ | | 1.8 | | V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 250\ \mu\text{A}$ | 3.75 | | 5.75 | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = \text{Max rating}$, $T_C = 25^{\circ}\text{C}$ | | | 150 | μA |
| | | $V_{CE} = \text{Max rating}$, $T_C = 125^{\circ}\text{C}$ | | | 1 | mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{V}$, $V_{CE} = 0$ | | | ± 100 | nA |
| g_{fs} | Forward transconductance | $V_{CE} = 15\text{V}$, $I_C = 12\text{A}$ | | 10 | | S |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|------------------------------|---|------|------|------|------|
| C_{ies} C_{oes} C_{res} | Input capacitance | $V_{CE} = 25\text{V}$, $f = 1\text{MHz}$, $V_{GE} = 0$ | | 1180 | | pF |
| | Output capacitance | | | 130 | | pF |
| | Reverse transfer capacitance | | | 26 | | pF |
| Q_g Q_{ge} Q_{gc} | Total gate charge | $V_{CE} = 390\text{V}$, $I_C = 5\text{A}$, | | 53 | | nC |
| | Gate-emitter charge | $V_{GE} = 15\text{V}$, | | 10 | | nC |
| | Gate-collector charge | Figure 16 | | 21 | | nC |

Table 5. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-----------------|------|------------------------|
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ <i>Figure 17</i> | | 25 7 1600 | | ns ns A/ μ s |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>Figure 17</i> | | 25 8 1400 | | ns ns A/ μ s |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ <i>Figure 17</i> | | 22 90 43 | | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>Figure 17</i> | | 47 127 77 | | ns ns ns |

Table 6. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-------------------|------|-------------------------------|
| $E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ <i>Figure 17</i> | | 81 125 206 | | μ J μ J μ J |
| $E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 390V, I_C = 12A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>Figure 17</i> | | 161 255 416 | | μ J μ J μ J |

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in *Figure 15* If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C)
2. Turn-off losses include also the tail of the collector current

Table 7. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|------|------|------|
| V_f | Forward on-voltage | $I_f = 12A$ | | 1.9 | 2.5 | V |
| | | $I_f = 12A, T_j = 125^\circ C$ | | 1.5 | | V |
| t_{rr} | Reverse recovery time | $I_f = 12A, V_R = 50V,$ | | 31 | | ns |
| Q_{rr} | Reverse recovery charge | $T_j = 25^\circ C, di/dt = 100 A/\mu s$ | | 30 | | nC |
| I_{rrm} | Reverse recovery current | Figure 18 | | 2 | | A |
| t_{rr} | Reverse recovery time | $I_f = 12A, V_R = 50V,$ | | 59 | | ns |
| Q_{rr} | Reverse recovery charge | $T_j = 125^\circ C, di/dt = 100A/\mu s$ | | 102 | | nC |
| I_{rrm} | Reverse recovery current | Figure 18 | | 4 | | A |

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

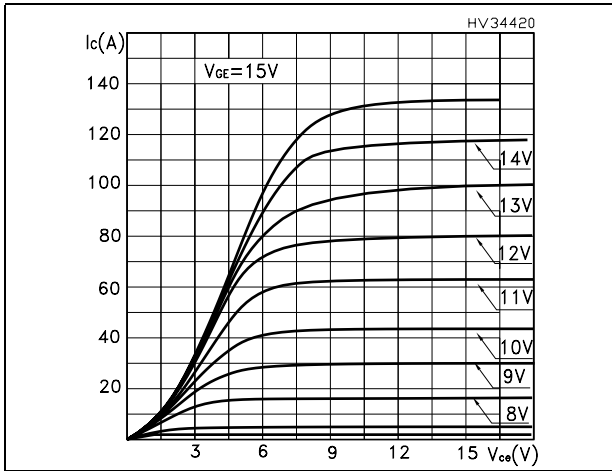


Figure 2. Transfer characteristics

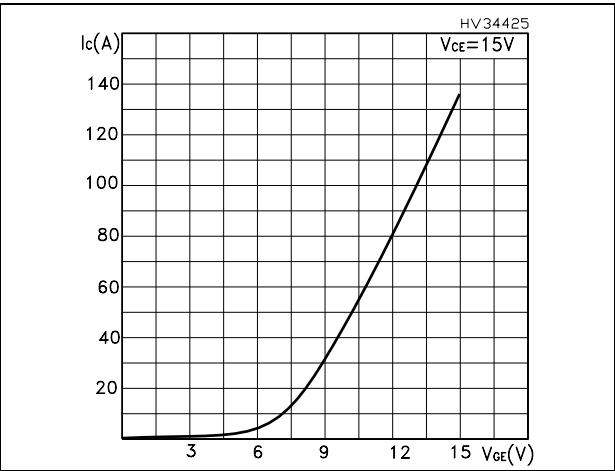


Figure 3. Transconductance

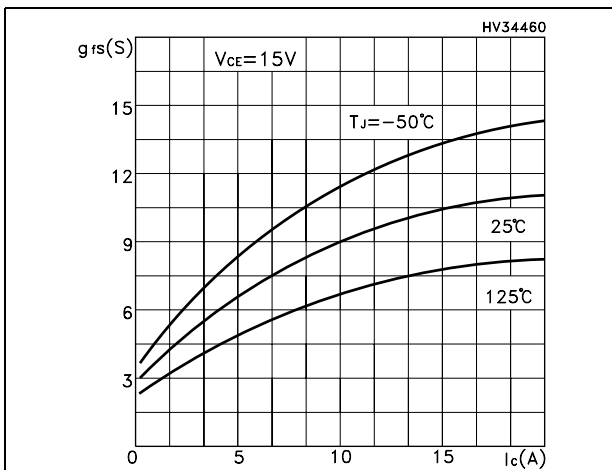


Figure 4. Collector-emitter on voltage vs temperature

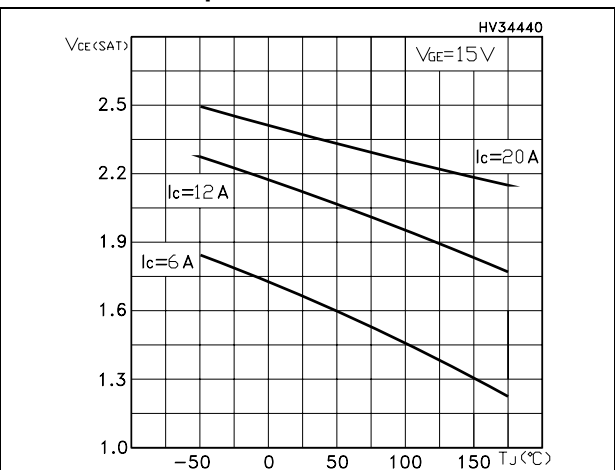


Figure 5. Gate charge vs gate-source voltage

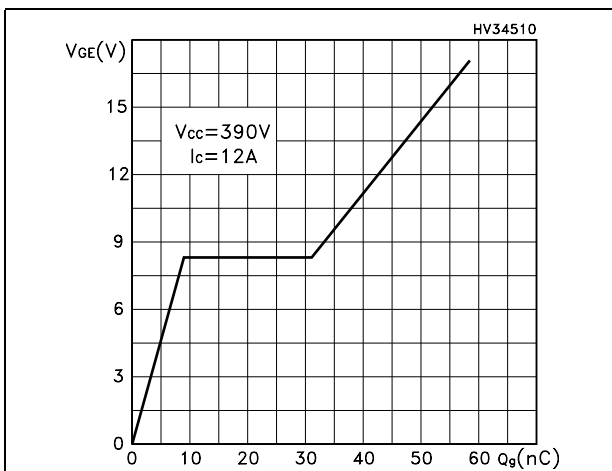


Figure 6. Capacitance variations

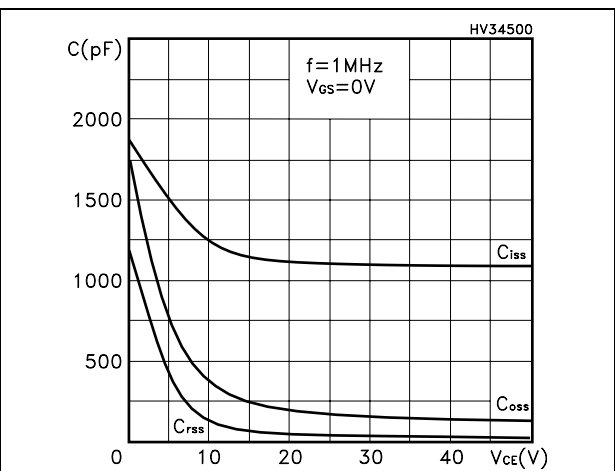


Figure 7. Normalized gate threshold voltage vs temperature

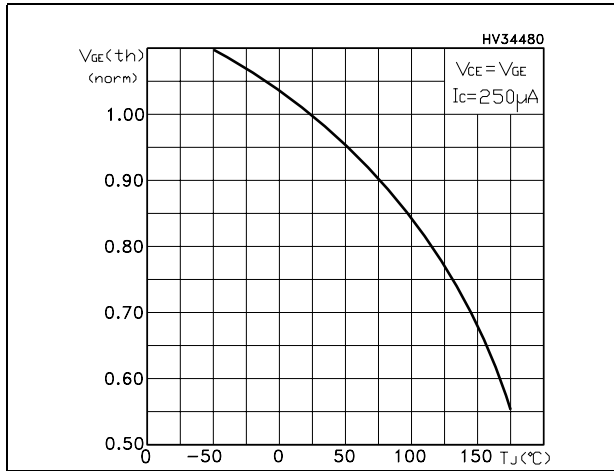


Figure 8. Collector-emitter on voltage vs collector current

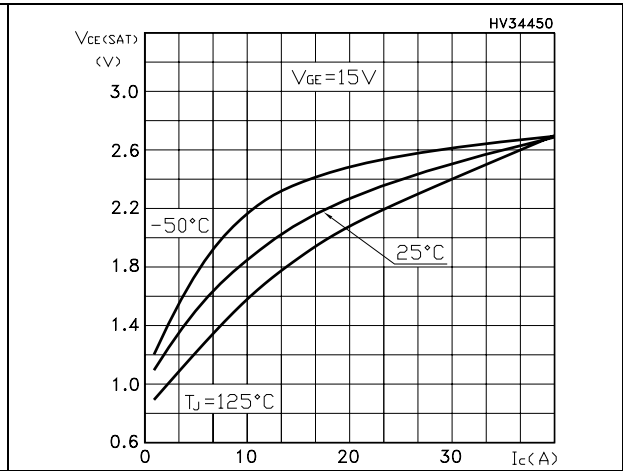


Figure 9. Normalized breakdown voltage vs temperature

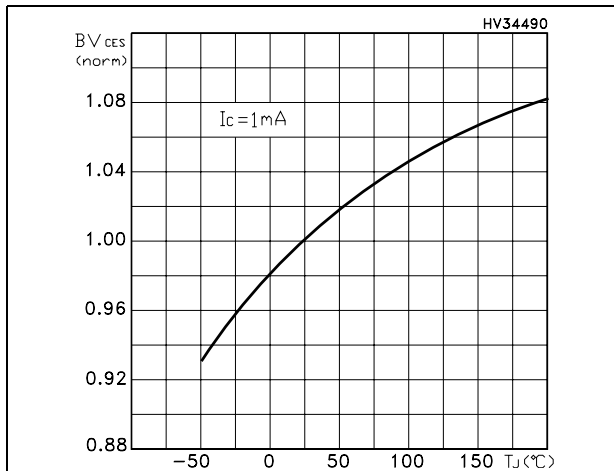


Figure 10. Switching losses vs temperature

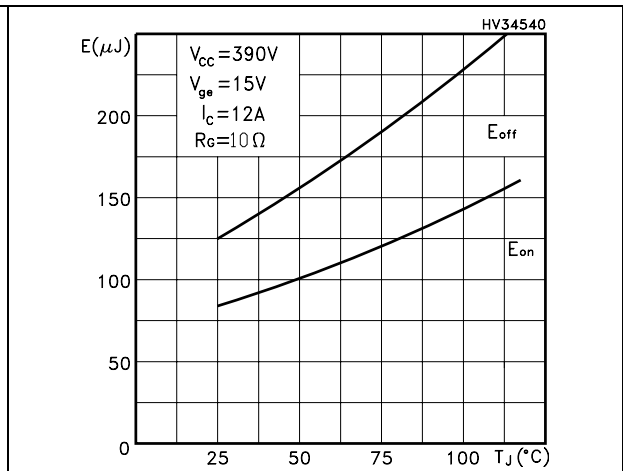


Figure 11. Switching losses vs gate resistance

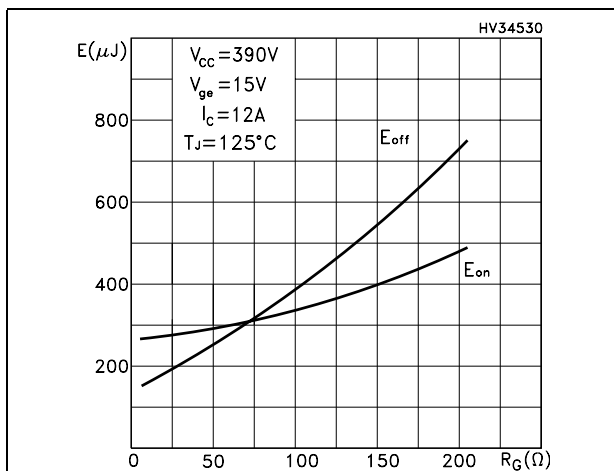


Figure 12. Switching losses vs collector current

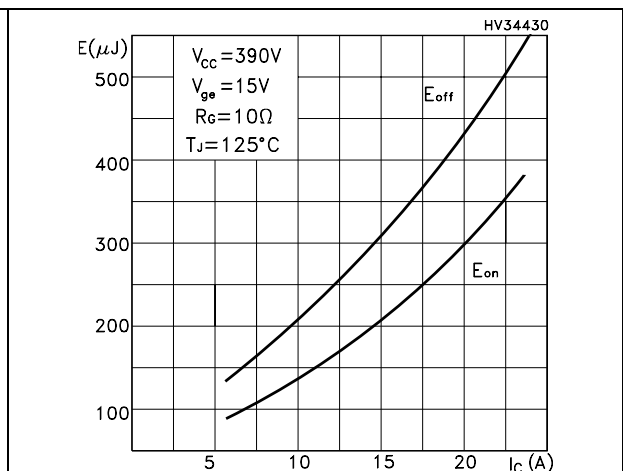


Figure 13. Turn-off SOA

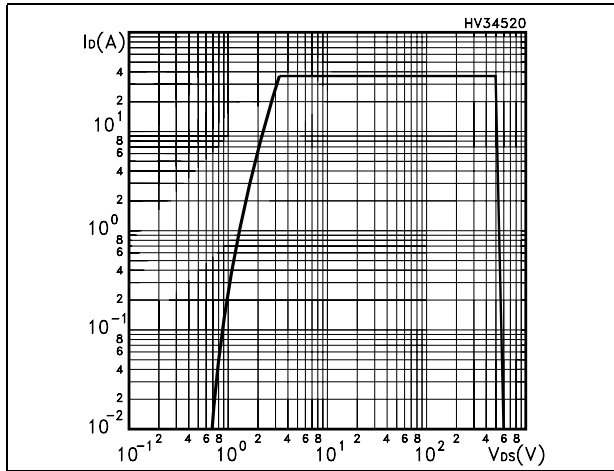
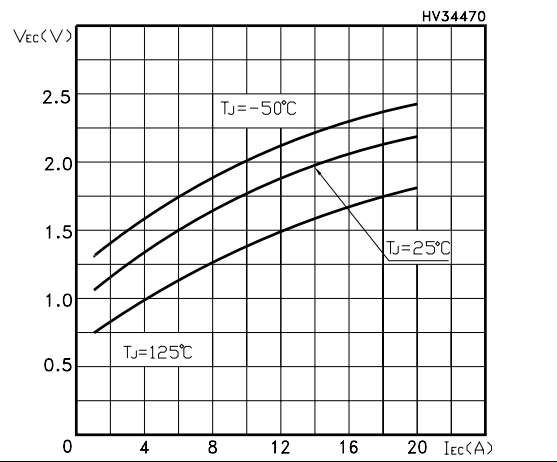


Figure 14. Emitter-collector diode characteristics



3 Test circuit

Figure 15. Test circuit for inductive load switching

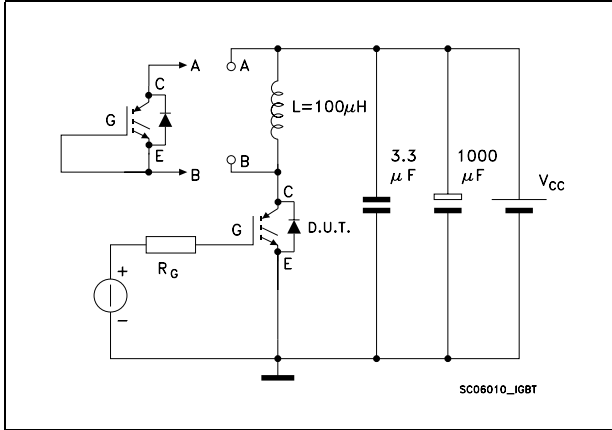


Figure 16. Gate charge test circuit

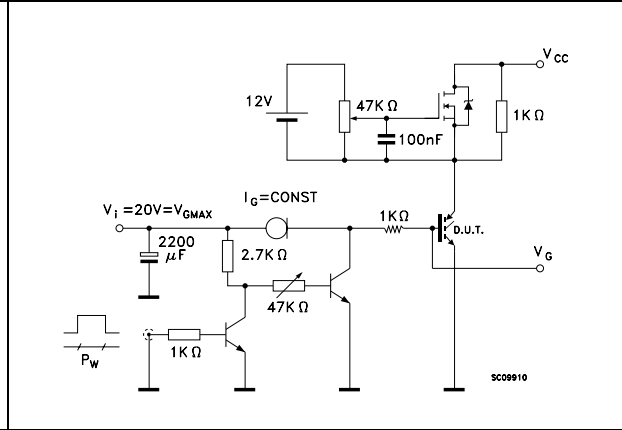


Figure 17. Switching waveform

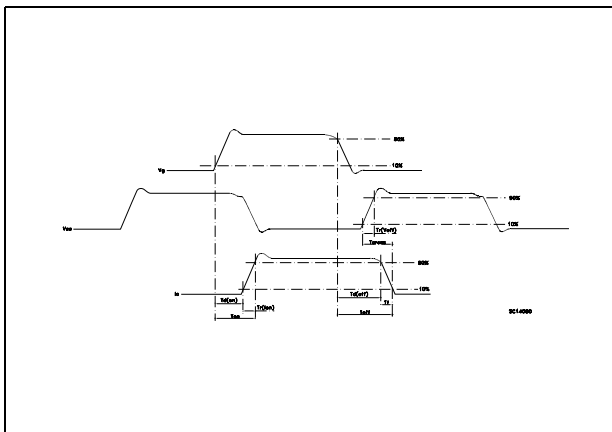
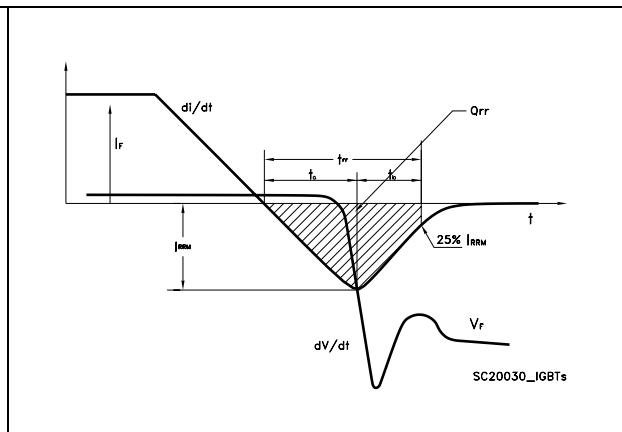


Figure 18. Diode recovery time waveform

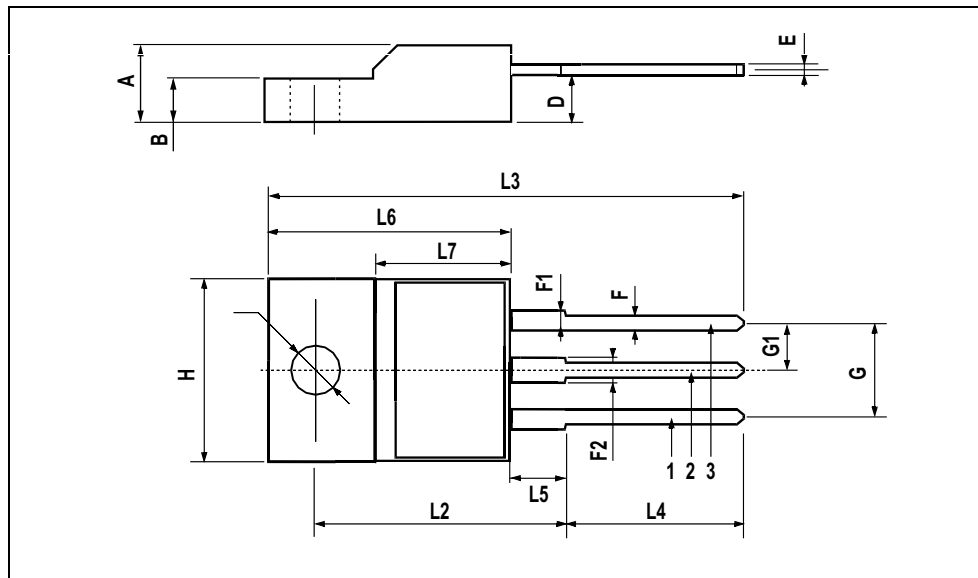


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

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 | | 1.7 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.7 | 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 |



5 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 13-Oct-2006 | 1 | Initial release. |
| 08-May-2007 | 2 | Corrected value on Table 1 , Table 2 |

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