



STGB10NC60HD STGP10NC60HD

N-channel 600V - 10A - TO-220 - D²PAK
Very fast PowerMESH™ IGBT

General features

| Type | V _{CE(S)} | V _{CE(sat)} (Max)@ 25°C | I _C @100°C |
|--------------|--------------------|-------------------------------------|--------------------------|
| STGB10NC60HD | 600V | < 2.5V | 10A |
| STGP10NC60HD | 600V | < 2.5V | 10A |

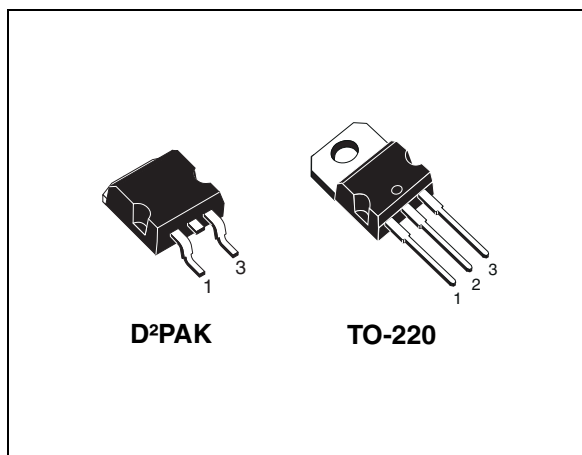
- Low on-voltage drop (V_{cesat})
- Low C_{RES} / C_{I(ES)} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

Description

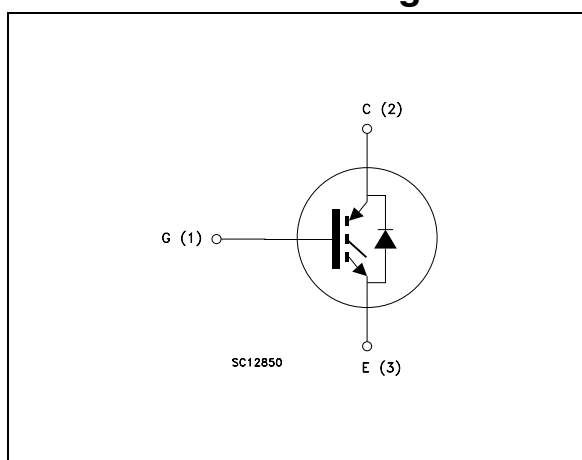
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “H” identifies a family optimized for high frequency applications in order to achieve very high switching performances (reduced t_{fall}) maintaining a low voltage drop.

Applications

- High frequency motor controls
- Sm_ps and p_fc in both hard switch and resonant topologies
- Motor drivers



Internal schematic diagram



Order codes

| Part Number | Marking | Package | Packaging |
|--------------|------------|--------------------|-------------|
| STGB10NC60HD | GB10NC60HD | D ² PAK | Tape & reel |
| STGP10NC60HD | GP10NC60HD | TO-220 | Tube |

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 $T_C = 25^\circ\text{C}$ | 20 | A |
| $I_C^{(1)}$ | Collector current (continuous) at $T_C = 100^\circ\text{C}$ | 10 | A |
| $I_{CL}^{(2)}$ | Collector current (pulsed) | 40 | A |
| I_F | Diode RMS forward current at $T_C = 25^\circ\text{C}$ | 10 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 60 | 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 | 2.08 | $^\circ\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | $^\circ\text{C/W}$ |

2 Electrical characteristics

($T_{CASE}=25^{\circ}C$ 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 | $V_{GE} = 15\text{V}, I_C = 5\text{A}$ $V_{GE} = 15\text{V}, I_C = 5\text{A}, T_C = 125^{\circ}C$ | | 1.9 1.7 | 2.5 | V 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 ($V_{GE} = 0$) | $V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$ | | | 150 1 | μA 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 | $V_{CE} = 15\text{V}, I_C = 5\text{A}$ | | 3.5 | | S |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{V}, f = 1\text{MHz},$ $V_{GE} = 0$ | | 365 | | pF |
| C_{oes} | Output capacitance | | | 43 | | pF |
| C_{res} | Reverse transfer capacitance | | | 8.3 | | pF |
| Q_g | Total gate charge | $V_{CE} = 390\text{V}, I_C = 5\text{A},$ | | 19.2 | | nC |
| Q_{ge} | Gate-emitter charge | $V_{GE} = 15\text{V},$ | | 4.5 | | nC |
| Q_{gc} | Gate-collector charge | (see Figure 17) | | 7 | | 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 | $V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$ <i>(see Figure 16)</i> | | 14.2 5 1000 | | ns ns A/ μs |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i> | | 14 5 920 | | ns ns A/ μs |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390V, I_C = 5A,$ $R_{GE} = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$ <i>(see Figure 16)</i> | | 27 72 85 | | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390V, I_C = 5A,$ $R_{GE} = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i> | | 50 108 139 | | 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 | $V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 25^\circ C$ <i>(see Figure 16)</i> | | 31.8 95 126.8 | | μJ μJ μJ |
| $E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i> | | 61.8 173 234.8 | | μJ μJ μJ |

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. 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 | $I_f = 2.5A$ $I_f = 2.5A, T_j = 125^\circ C$ | | 1.75 | 2.1 | V |
| | | | | 1.3 | | V |
| t_{rr} | Reverse recovery time | $I_f = 5A, V_R = 40V,$ $T_j = 25^\circ C, di/dt = 100 A/\mu s$ <i>(see Figure 19)</i> | | 21.5 | | ns |
| Q_{rr} | Reverse recovery charge | | | 14.2 | | nC |
| I_{rrm} | Reverse recovery current | | | 1.32 | | A |
| t_{rr} | Reverse recovery time | $I_f = 5A, V_R = 40V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$ <i>(see Figure 19)</i> | | 33 | | ns |
| Q_{rr} | Reverse recovery charge | | | 30.5 | | nC |
| I_{rrm} | Reverse recovery current | | | 1.85 | | A |

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

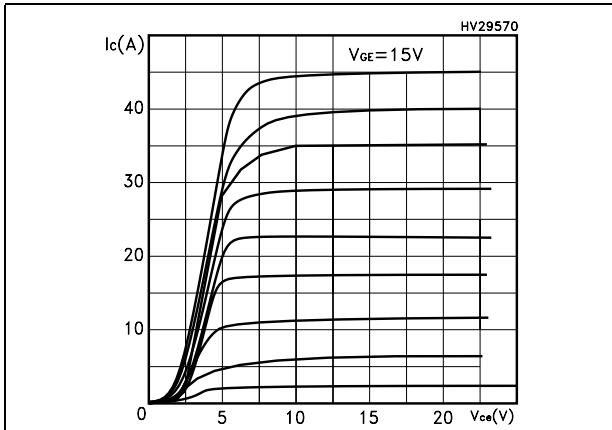


Figure 2. Transfer characteristics

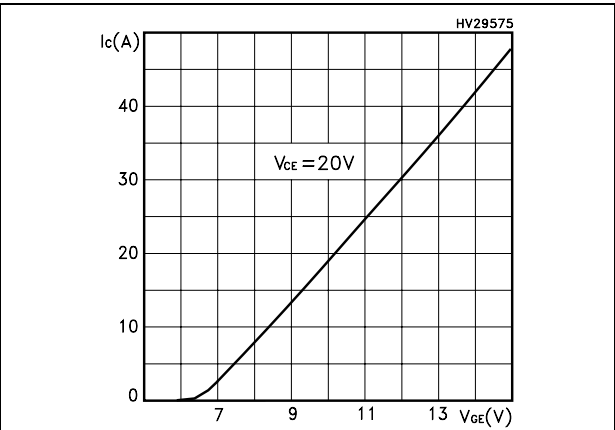


Figure 3. Transconductance

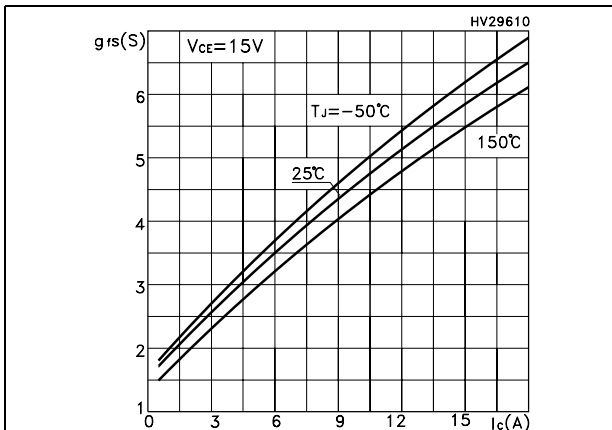


Figure 4. Collector-emitter on voltage vs temperature

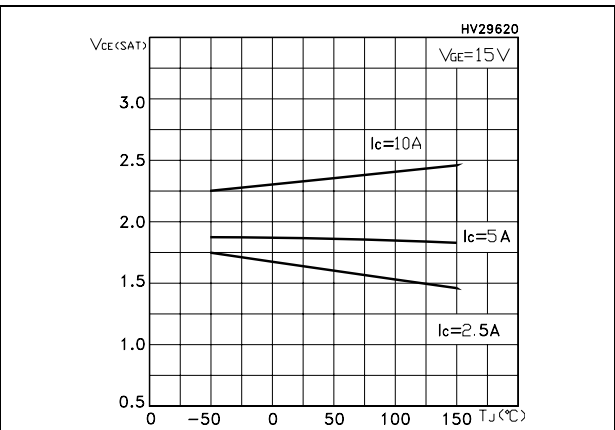


Figure 5. Gate charge vs gate-source voltage

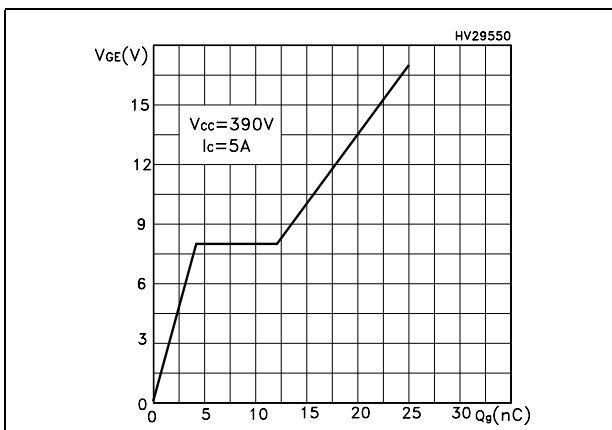


Figure 6. Capacitance variations

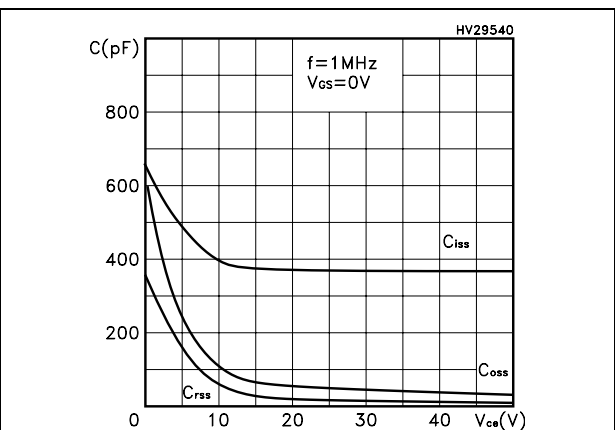


Figure 7. Normalized gate threshold voltage vs temperature

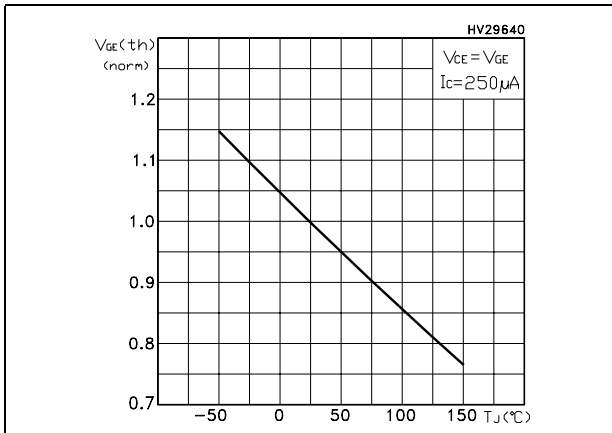


Figure 8. Collector-emitter on voltage vs collector current

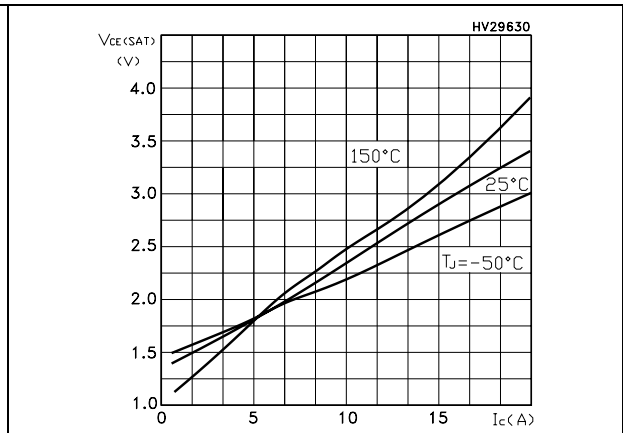


Figure 9. Normalized breakdown voltage vs temperature

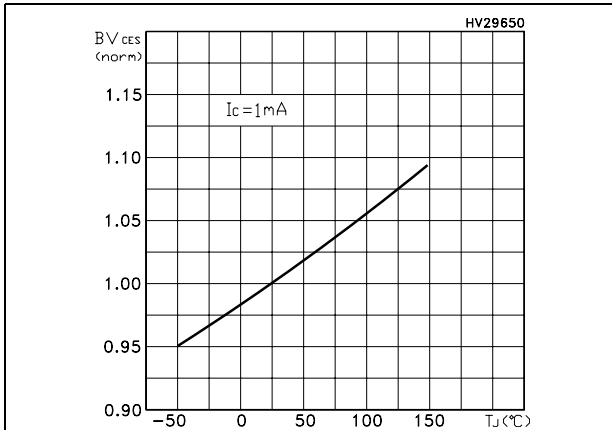


Figure 10. Switching losses vs temperature

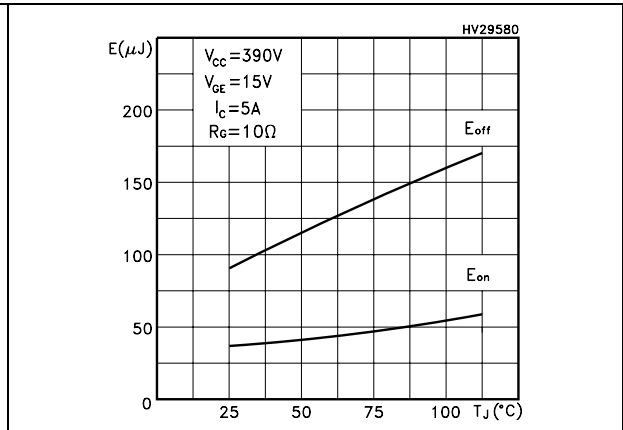


Figure 11. Switching losses vs gate resistance

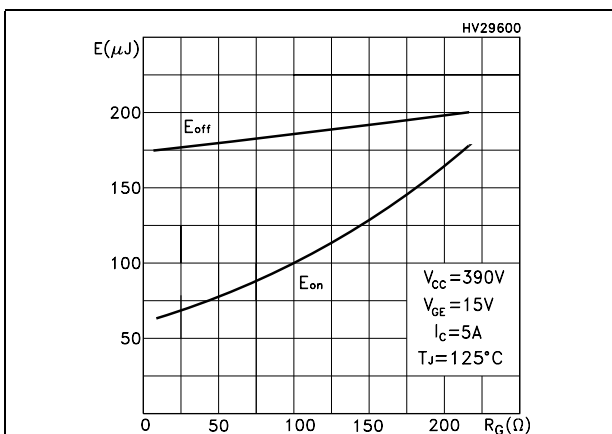


Figure 12. Switching losses vs collector current

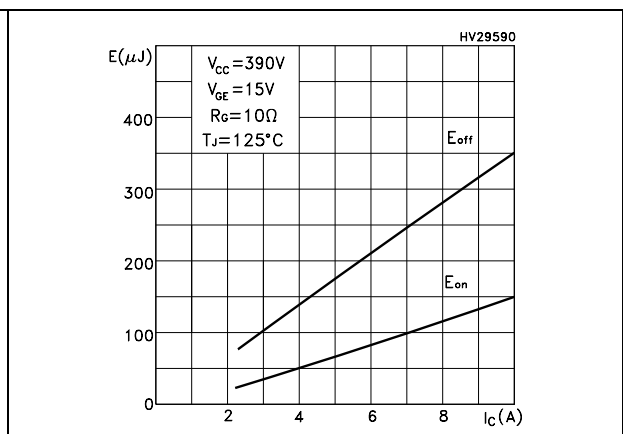


Figure 13. Thermal Impedance

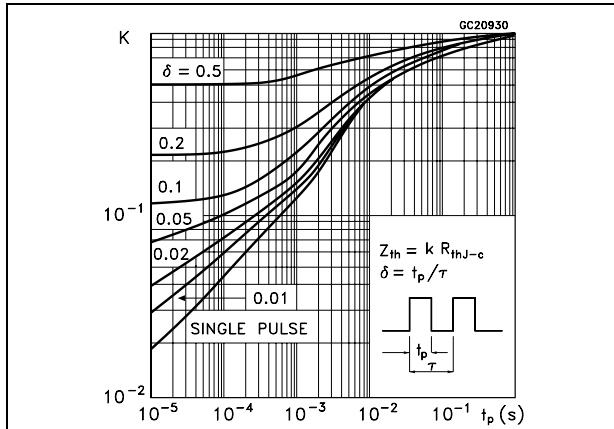


Figure 14. Turn-off SOA

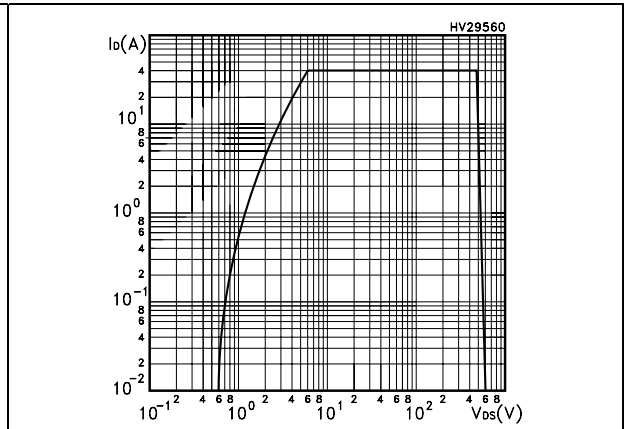
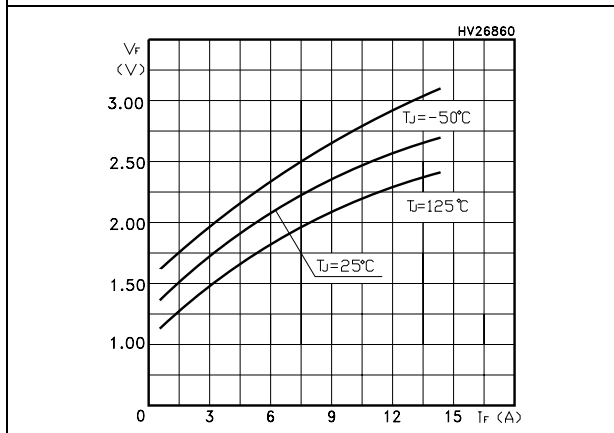


Figure 15. Emitter-collector diode characteristics



3 Test circuit

Figure 16. Test circuit for inductive load switching

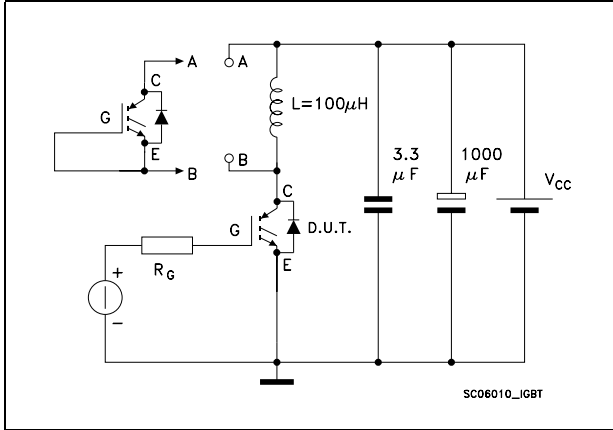


Figure 17. Gate charge test circuit

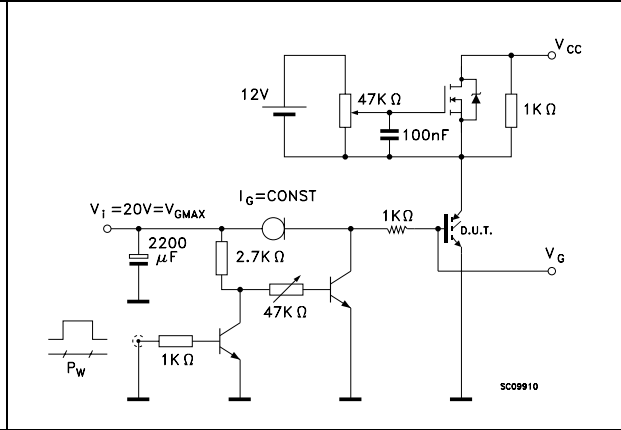


Figure 18. Switching waveform

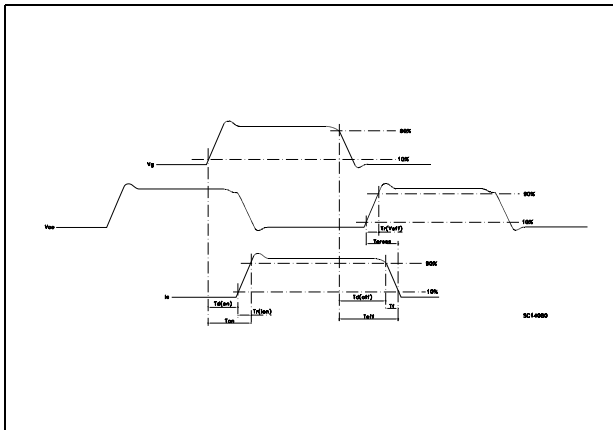
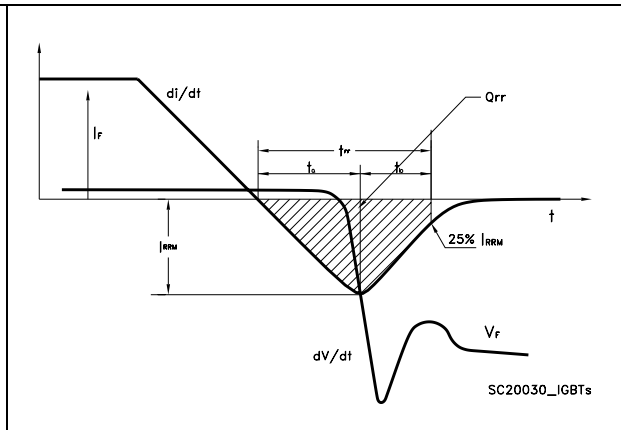


Figure 19. Diode recovery time waveform



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

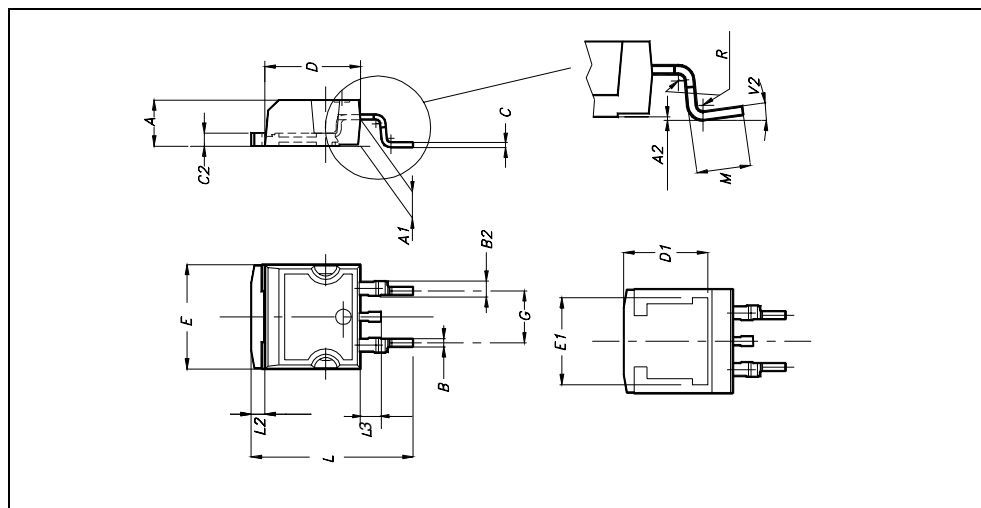
TO-220 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.15 | | 1.70 | 0.045 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.60 | | 0.620 |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.052 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| øP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



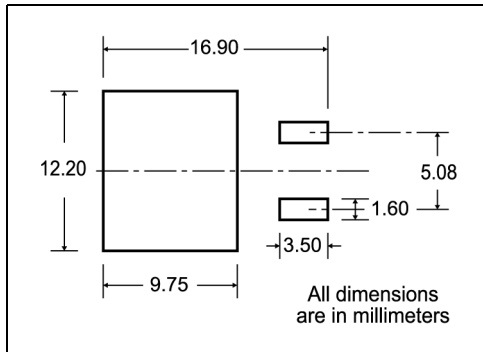
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.393 | | |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.590 | | 0.625 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.068 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 4° | | | |



5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000 | 1000 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

* on sales type

6 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|-----------------|-----------------------------------|
| 30-Jan-2006 | 1 | Initial release. |
| 06-Nov-2006 | 2 | Complete version |
| 08-Feb-2007 | 3 | The document has been reformatted |

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