



STGB30NC60W - STGP30NC60W STGW30NC60W

30 A - 600 V - ultra fast IGBT

Features

- High frequency operation
- Lower C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)

Applications

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

Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

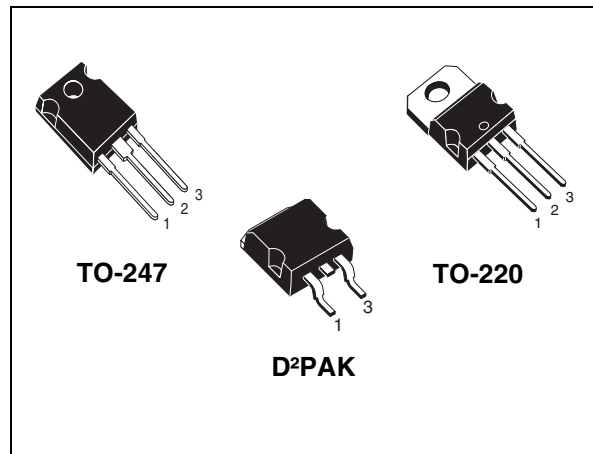


Figure 1. Internal schematic diagram

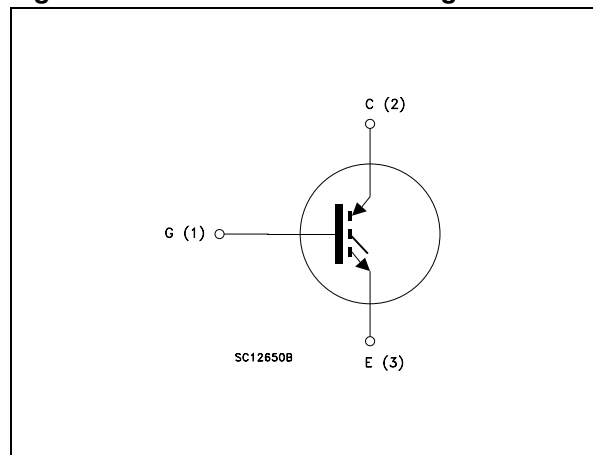


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|---------------|-----------|--------------------|---------------|
| STGB30NC60WT4 | GB30NC60W | D ² PAK | Tape and reel |
| STGP30NC60W | GP30NC60W | TO-220 | Tube |
| STGW30NC60W | GW30NC60W | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|--|-------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$) | 600 | V |
| $I_C^{(1)}$ | Collector current (continuous) at 25 °C | 60 | A |
| $I_C^{(1)}$ | Collector current (continuous) at 100 °C | 30 | A |
| $I_{CL}^{(2)}$ | Turn-off latching current | 150 | A |
| $I_{CP}^{(3)}$ | Pulsed collector current | 150 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| P_{TOT} | Total dissipation at $T_C = 25$ °C | 200 | W |
| T_j | Operating junction temperature | – 55 to 150 | °C |

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. $V_{clamp} = 80\%(V_{CES})$, $T_j = 150$ °C, $R_G = 10$ Ω, $V_{GE} = 15$ V
 3. Pulse width limited by max junction temperature allowed

Table 3. Thermal resistance

| Symbol | Parameter | Value | | Unit |
|----------------|---|--------|------------------------------|------|
| | | TO-247 | TO-220 D ² PAK | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.62 | | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 50 | 62.5 | °C/W |

2 Electrical characteristics

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

Table 4. Static electrical characteristics

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

1. Pulse duration = 300 μs , duty cycle 1.5%

Table 5. Dynamic electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25 \text{ V}, f = 1 \text{ MHz},$ $V_{GE}=0$ | | 2080 | | pF |
| C_{oes} | Output capacitance | | | 175 | | pF |
| C_{res} | Reverse transfer capacitance | | | 52 | | pF |
| Q_g | Total gate charge | $V_{CE} = 390 \text{ V}, I_C = 20 \text{ A},$ $V_{GE} = 15 \text{ V},$ <i>(see Figure 17)</i> | | 102 | | nC |
| Q_{ge} | Gate-emitter charge | | | 17.5 | | nC |
| Q_{gc} | Gate-collector charge | | | 47 | | nC |

Table 6. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$ | | 29.5 | | ns |
| t_r | Current rise time | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 16) | | 12 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1640 | | A/ μ s |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$ | | 29 | | ns |
| t_r | Current rise time | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 16) | | 13.5 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1600 | | A/ μ s |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A},$ | | 19.5 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ (see Figure 18) | | 118 | | ns |
| t_f | Current fall time | | | 27 | | ns |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A},$ | | 46 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 18) | | 151 | | ns |
| t_f | Current fall time | | | 38 | | ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|--|------|------|------|---------|
| E_{on} | Turn-on switching losses | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$ | | 305 | | μ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18) | | 181 | | μ J |
| E_{ts} | Total switching losses | | | 486 | | μ J |
| E_{on} | Turn-on switching losses | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$ | | 455 | | μ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 18) | | 355 | | μ J |
| E_{ts} | Total switching losses | | | 801 | | μ J |

1. Turn-off losses include also the tail of the collector current

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

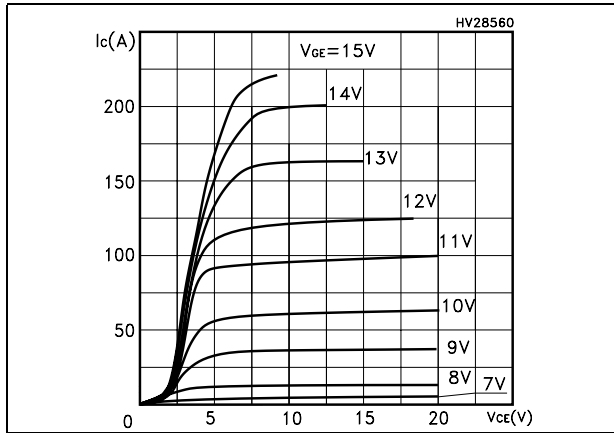


Figure 3. Transfer characteristics

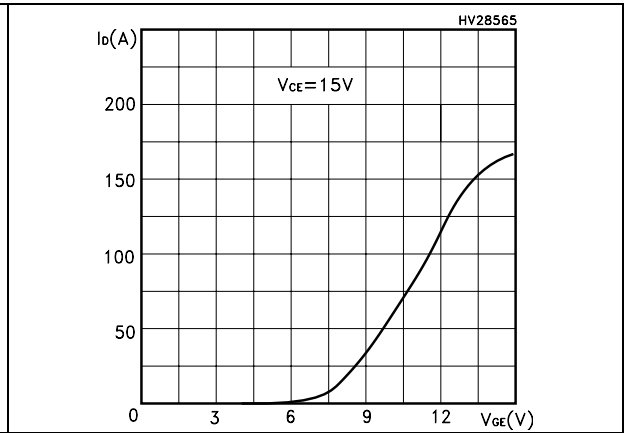


Figure 4. Transconductance

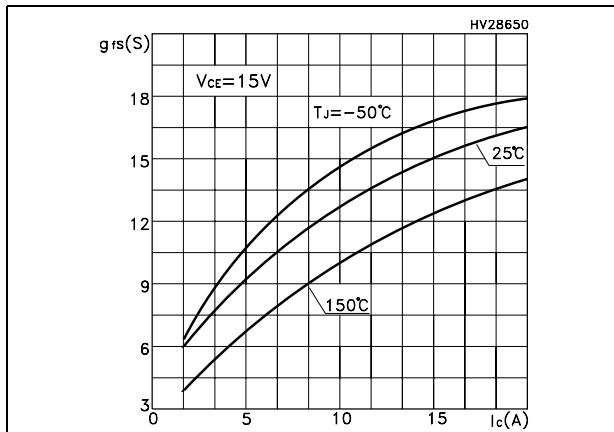


Figure 5. Collector-emitter on voltage vs temperature

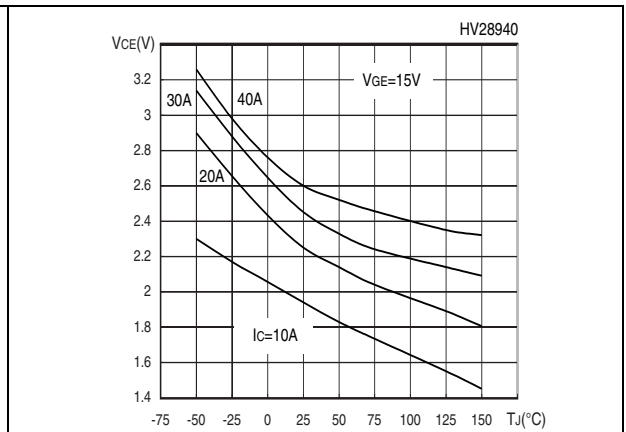


Figure 6. Gate charge vs gate-source voltage

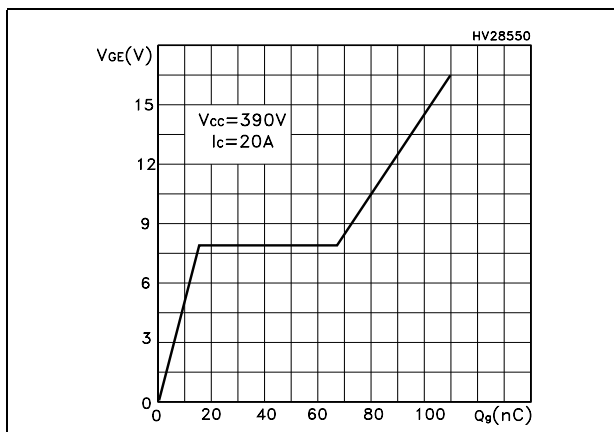


Figure 7. Capacitance variations

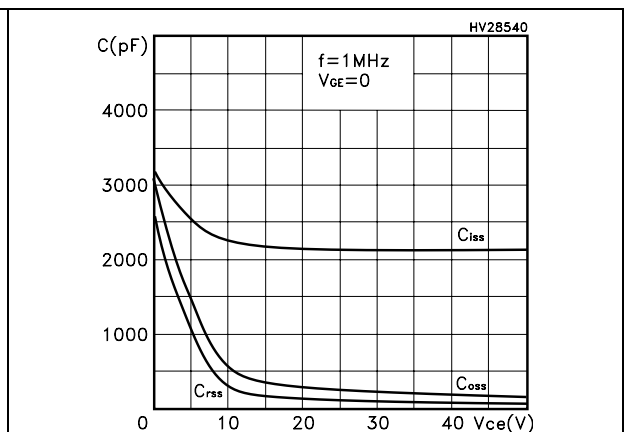


Figure 8. Normalized gate threshold voltage vs temperature

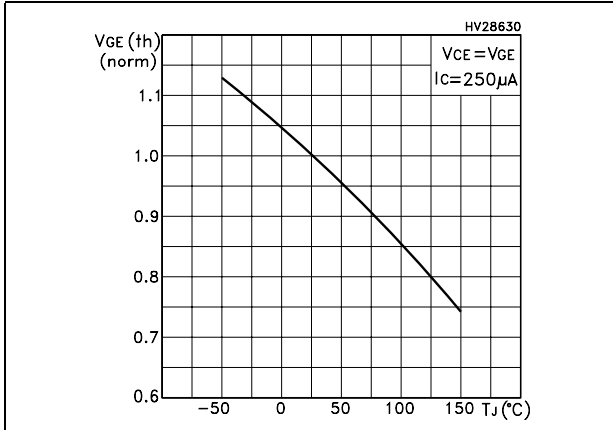


Figure 9. Collector-emitter on voltage vs collector current

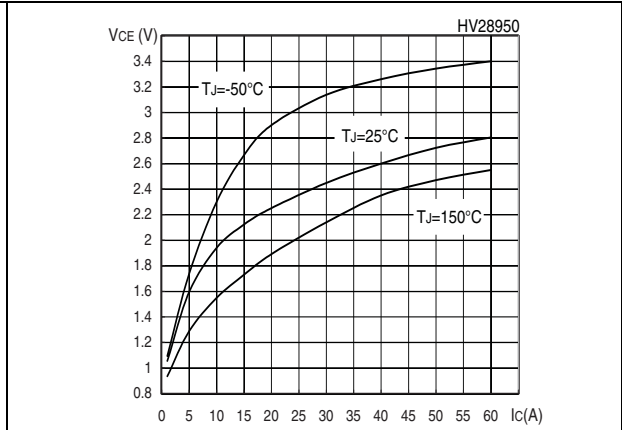


Figure 10. Normalized breakdown voltage vs temperature

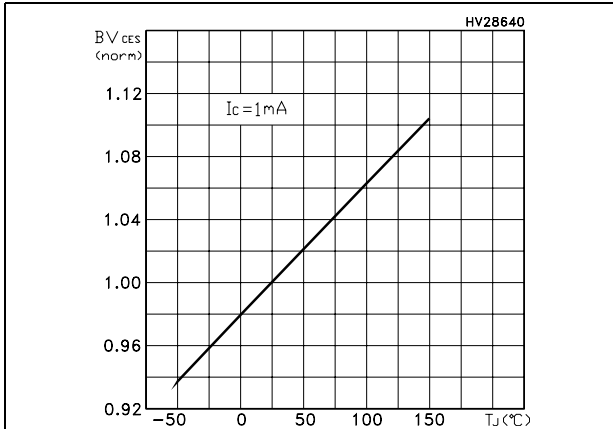


Figure 11. Switching losses vs temperature

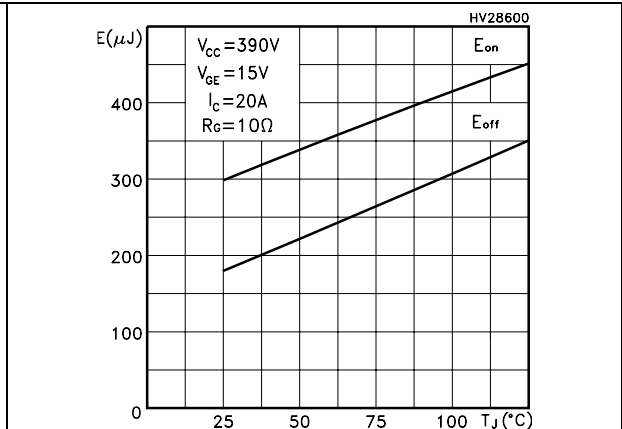


Figure 12. Switching losses vs gate resistance

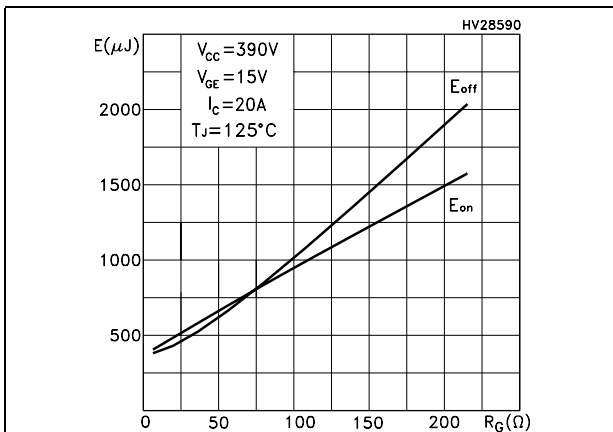


Figure 13. Switching losses vs collector current

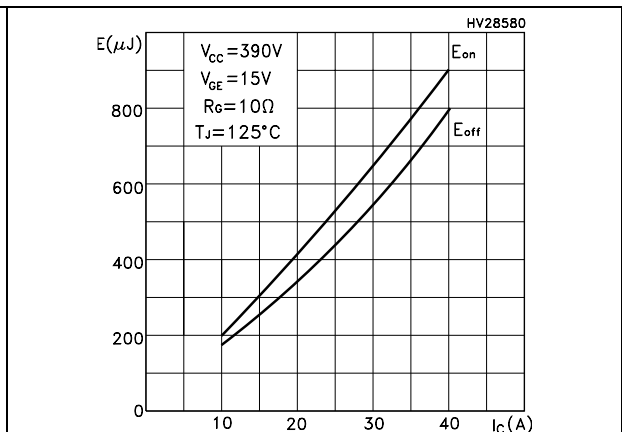


Figure 14. Thermal impedance

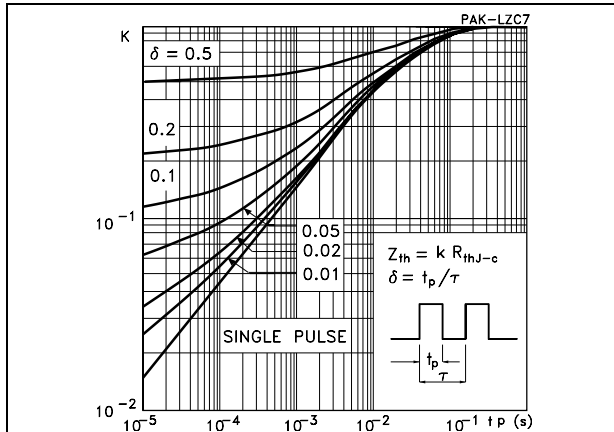
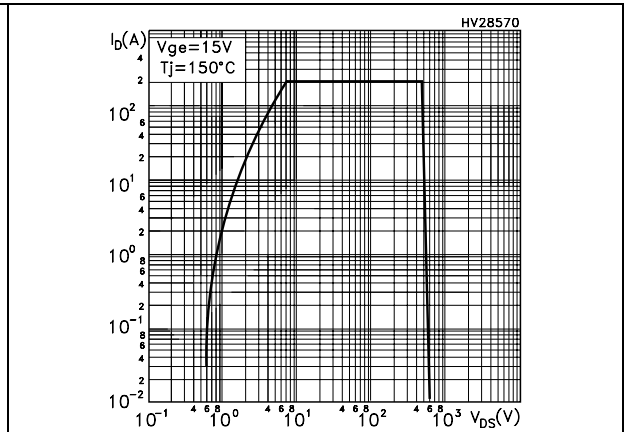


Figure 15. Turn-off SOA



3 Test circuit

Figure 16. Test circuit for inductive load switching

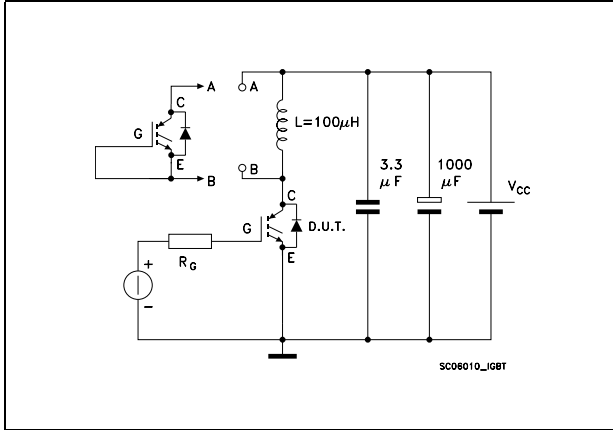


Figure 17. Gate charge test circuit

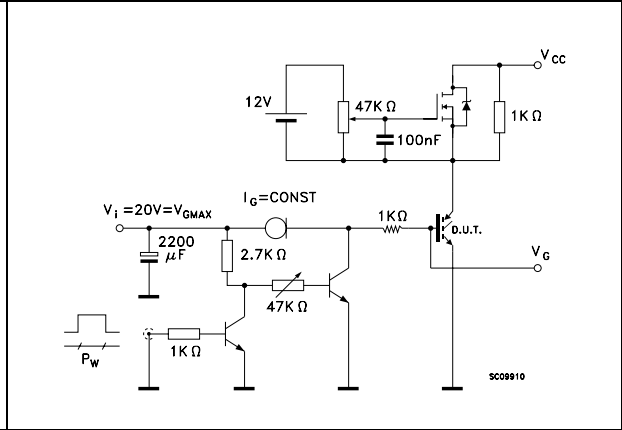
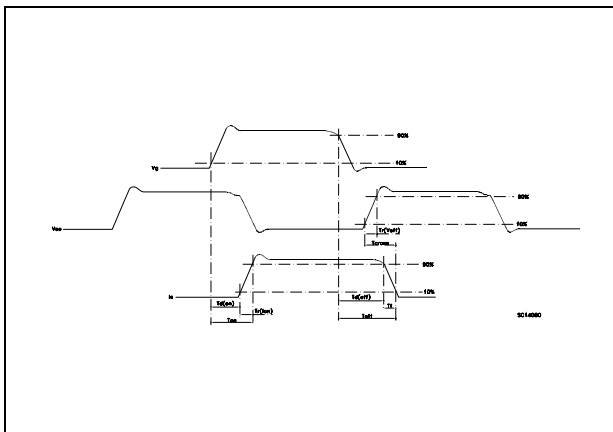


Figure 18. Switching waveform

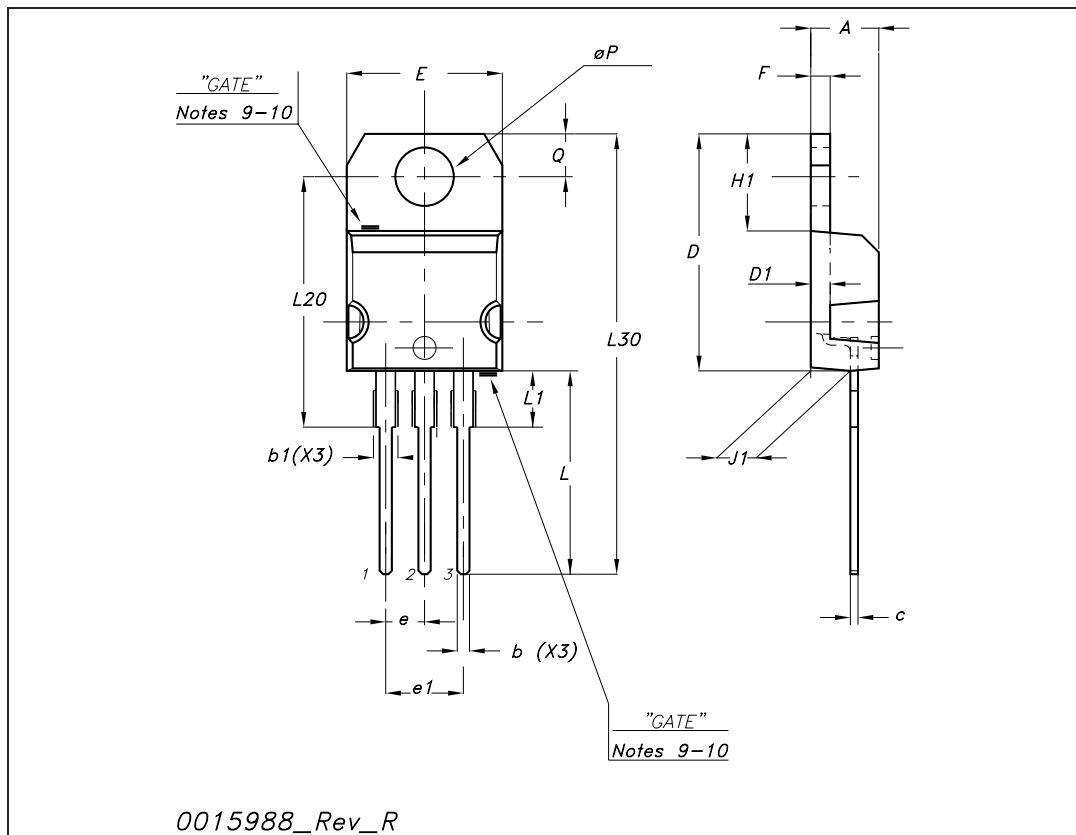


4 Package mechanical data

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

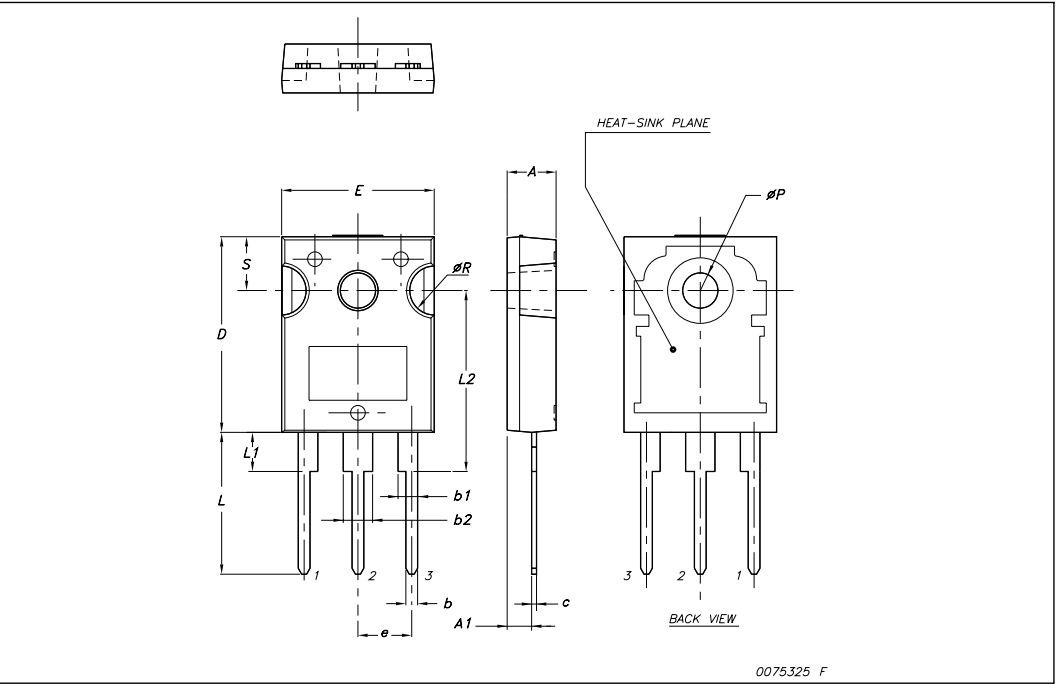
TO-220 mechanical data

| 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 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| 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 | | 0.051 |
| 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 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



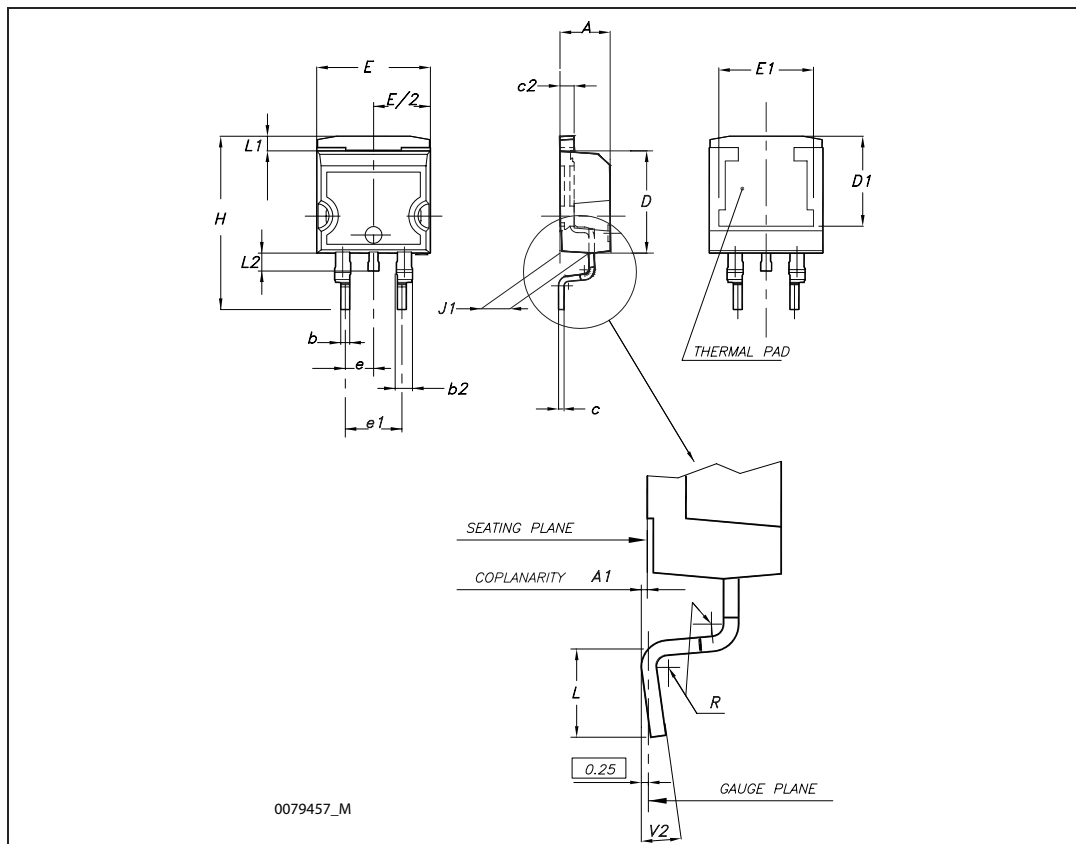
TO-247 Mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| øP | 3.55 | | 3.65 |
| øR | 4.50 | | 5.50 |
| S | | 5.50 | |



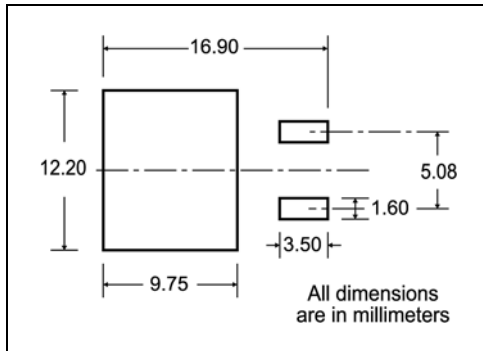
D²PAK (TO-263) mechanical data

| Dim | mm | | | inch | | |
|-----|------|------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.027 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.017 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | | | 0.295 | | |
| E | 10 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.50 | | | 0.334 | | |
| e | | 2.54 | | | 0.1 | |
| e1 | 4.88 | | 5.28 | 0.192 | | 0.208 |
| H | 15 | | 15.85 | 0.590 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.099 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.05 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.051 | | 0.069 |
| R | | 0.4 | | | 0.016 | |
| V2 | 0° | | 8° | 0° | | 8° |



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

Center line of cavity

User Direction of Feed

FEED DIRECTION

TRL

Bending radius R min.

* on sales type

6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 15-Sep-2005 | 1 | Initial release. |
| 04-Jan-2006 | 2 | Inserted TO-220. Complete version |
| 18-Dec-2006 | 3 | The document has been reformatted |
| 15-Feb-2007 | 4 | Mechanical data TO-220 has been updated |
| 26-Mar-2007 | 5 | Typo mistake on page 1 |
| 12-Jul-2007 | 6 | Corrected Figure 11 , Figure 12 , Figure 13 |
| 04-Oct-2007 | 7 | Symbol on Table 4 has been corrected |
| 17-Mar-2008 | 8 | Figure 5 and Figure 9 have been updated Inserted device in D ² PAK |

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