

20 A - 600 V - short circuit rugged IGBT

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)
- Short circuit withstand time 10 μ s
- IGBT co-packaged with ultra fast free-wheeling diode

Applications

- High frequency inverters
- Motor drivers

Description

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

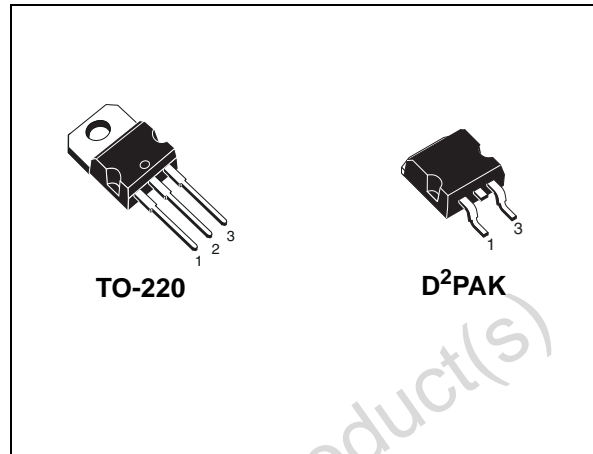


Figure 1. Internal schematic diagram

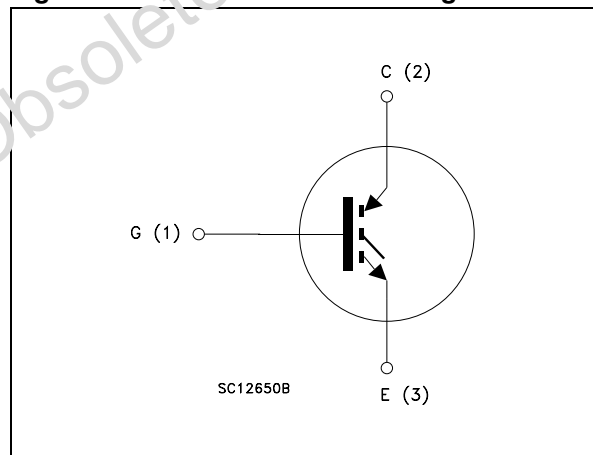


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|---------------|-----------|--------------------|---------------|
| STGB19NC60KT4 | GB19NC60K | D ² PAK | Tape and reel |
| STGP19NC60K | GP19NC60K | TO-220 | Tube |

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Obsolete Product(s) - Obsolete Product(s)



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 $T_C = 25\text{ °C}$ | 35 | A |
| $I_C^{(1)}$ | Collector current (continuous) at $T_C = 100\text{ °C}$ | 20 | A |
| $I_{CL}^{(2)}$ | Turn-off latching current | 75 | A |
| $I_{CP}^{(3)}$ | Pulsed collector current | 75 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 125 | W |
| t_{scw} | Short circuit withstand time, $V_{CE} = 0.5 V_{(BR)CES}$ $T_j = 125\text{ °C}$, $R_G = 10\ \Omega$, $V_{GE} = 12\text{ V}$ | 10 | μs |
| T_j | Operating junction temperature | - 55 to 150 | $^{\circ}\text{C}$ |

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{J(MAX)} - T_C}{R_{thj-c} \times V_{CE(sat)(MAX)} \cdot (T_C, I_C)}$$

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

Table 3. Thermal resistance

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|----------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max. | 0.95 | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max. | 62.5 | $^{\circ}\text{C/W}$ |

2 Electrical characteristics

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

Table 4. Static

| 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 | $V_{GE} = 15\text{ V}, I_C = 12\text{ A}$ | | 2.0 | 2.75 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 12\text{ A}, T_C = 125\text{ °C}$ | | 1.8 | | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = 600\text{ V}$ | | | 150 | μA |
| | | $V_{CE} = 600\text{ V}, T_C = 125\text{ °C}$ | | | 1 | mA |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$ | 4.5 | | 6.5 | V |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{CE} = 15\text{ V}, I_C = 12\text{ A}$ | | 15 | | S |

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

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$ | | 1170 | | pF |
| C_{oes} | Output capacitance | | | 127 | | pF |
| C_{res} | Reverse transfer capacitance | | | 28 | | pF |
| Q_g | Total gate charge | $V_{CE} = 480\text{ V}, I_C = 12\text{ A},$ | | 55 | | nC |
| Q_{ge} | Gate-emitter charge | $V_{GE} = 15\text{ V}$ | | 11 | | nC |
| Q_{gc} | Gate-collector charge | (see Figure 17) | | 26 | | nC |

Table 6. 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 | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16) | | 30 8 1450 | | ns ns A/ μ s |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 16) | | 30 8 1380 | | 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 | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16) | | 35 105 85 | | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 16) | | 65 145 125 | | ns ns ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|---|---|--|-----|-------------------|-----|-------------------------------|
| E_{on} $E_{off}^{(1)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16) | | 165 255 420 | | μ J μ J μ J |
| E_{on} $E_{off}^{(1)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 16) | | 250 445 695 | | μ J μ J μ J |

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

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

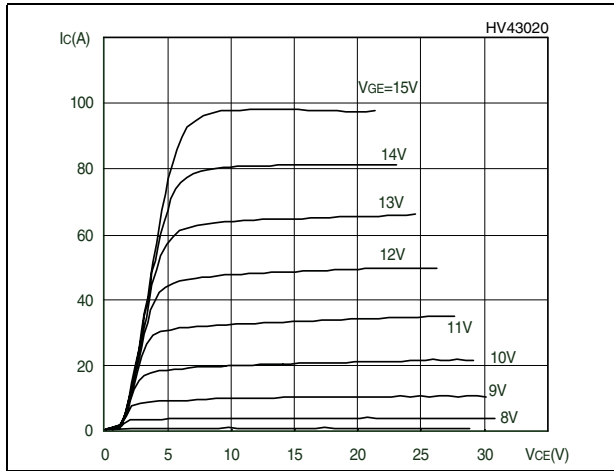


Figure 3. Transfer characteristics

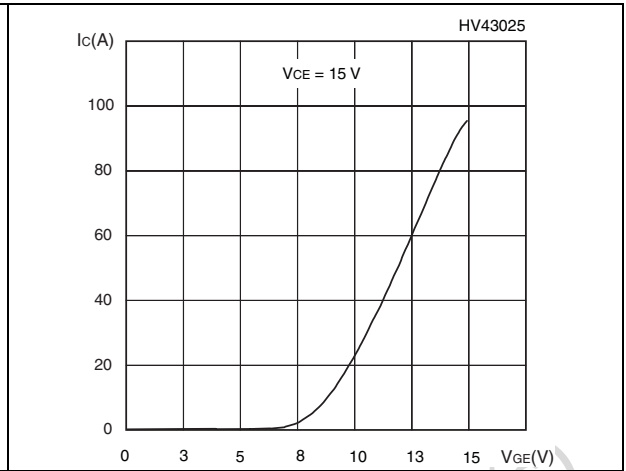


Figure 4. Transconductance

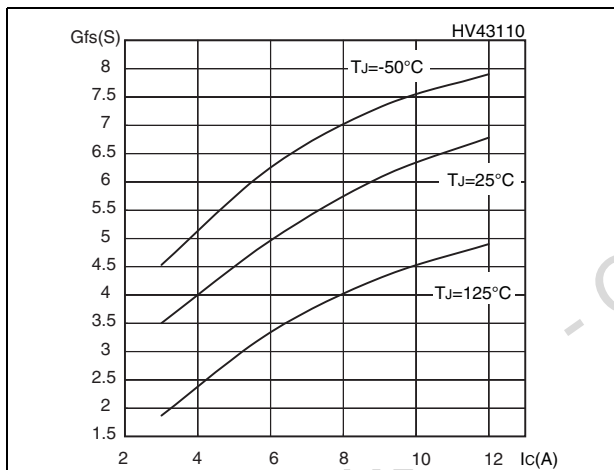


Figure 5. Collector-emitter on voltage vs temperature

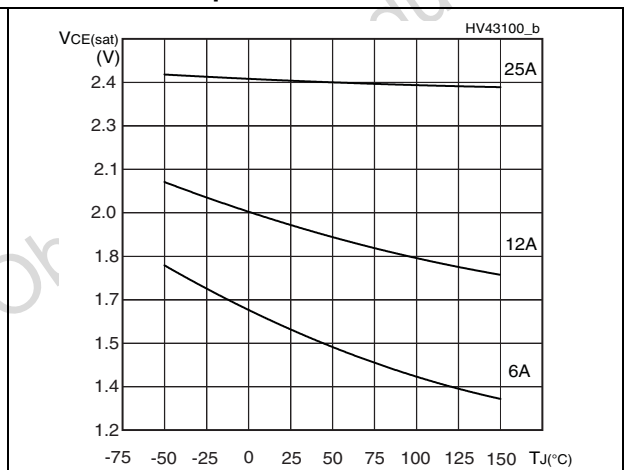


Figure 6. Gate charge vs gate-source voltage Figure 7. Capacitance variations

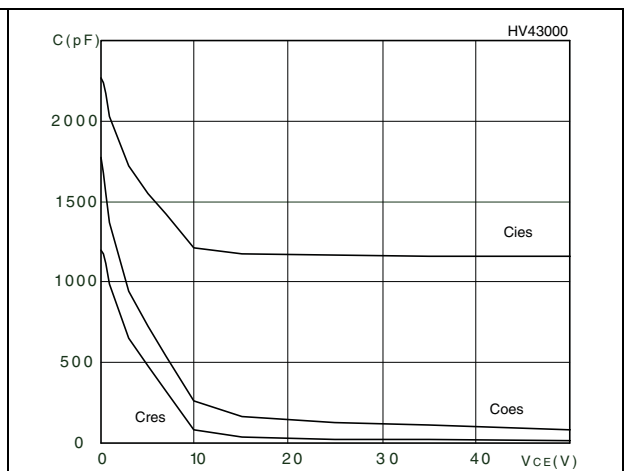
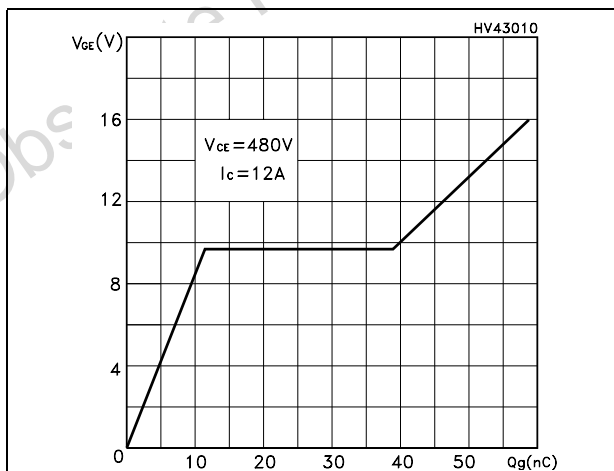


Figure 8. Normalized gate threshold voltage vs temperature

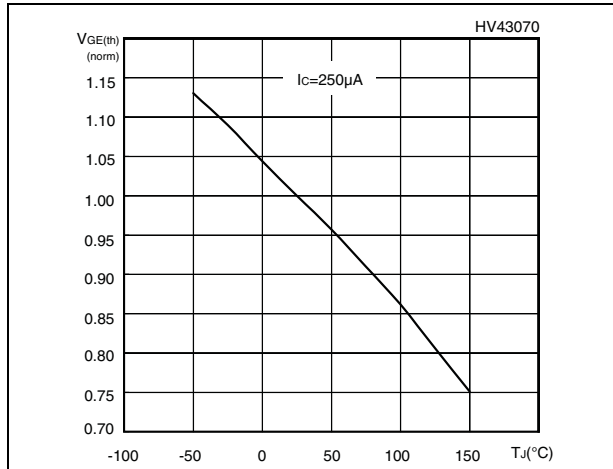


Figure 9. Collector-emitter on voltage vs collector current

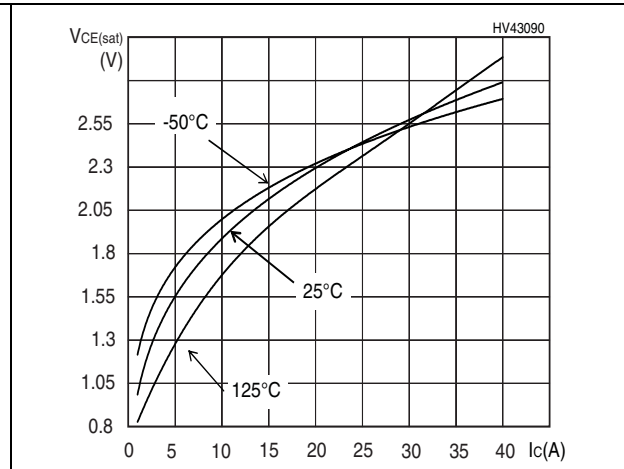


Figure 10. Normalized breakdown voltage vs temperature

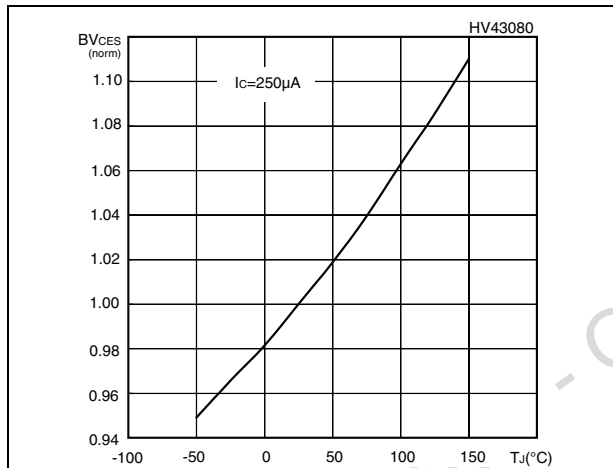


Figure 11. Switching losses vs temperature

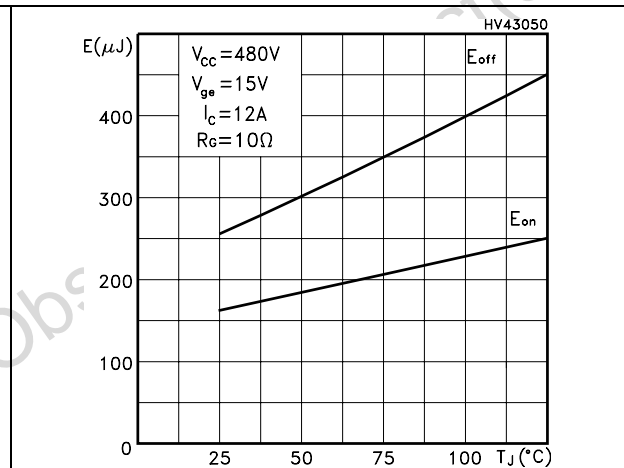


Figure 12. Switching losses vs gate resistance

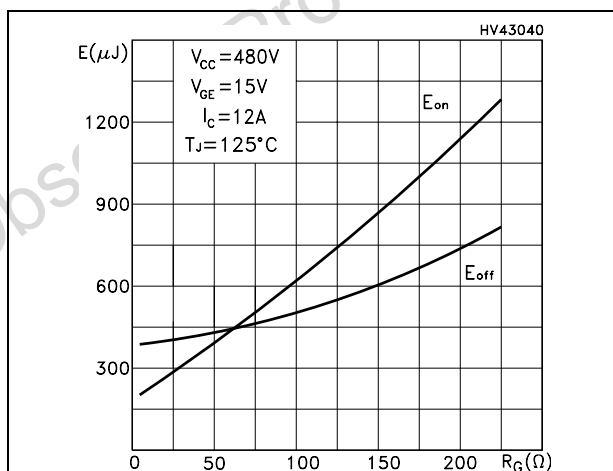


Figure 13. Switching losses vs collector current

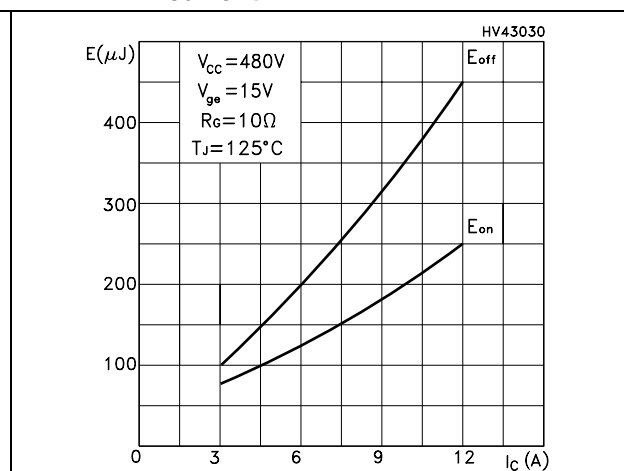


Figure 14. Turn-off SOA

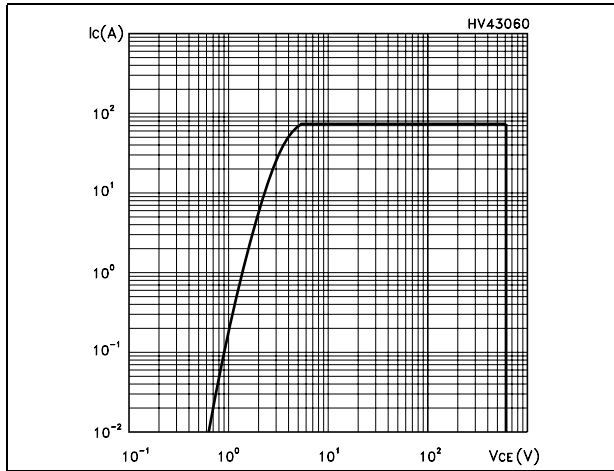
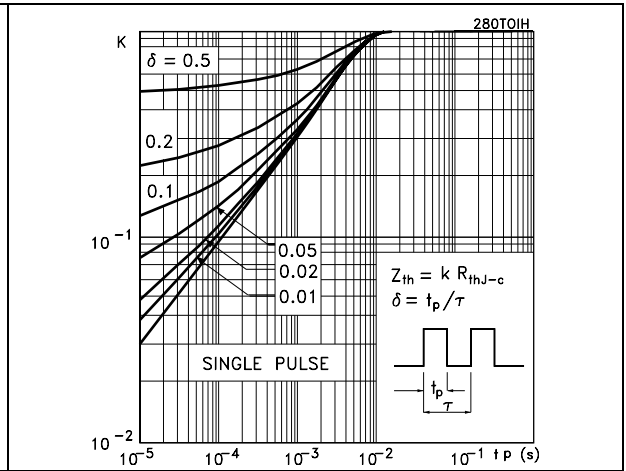


Figure 15. Thermal impedance



Obsolete Product(s) - Obsolete Product(s)

3 Test circuits

Figure 16. Test circuit for inductive load switching

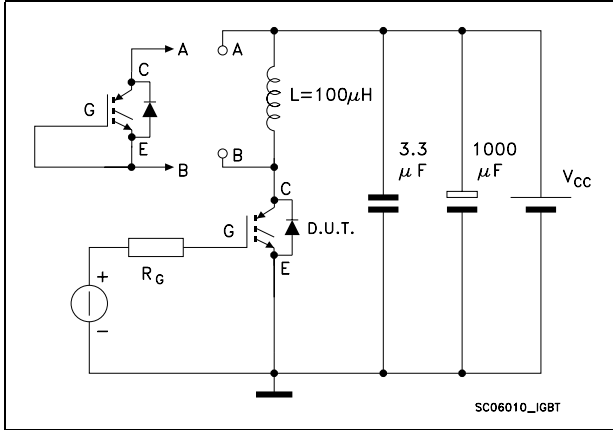


Figure 17. Gate charge test circuit

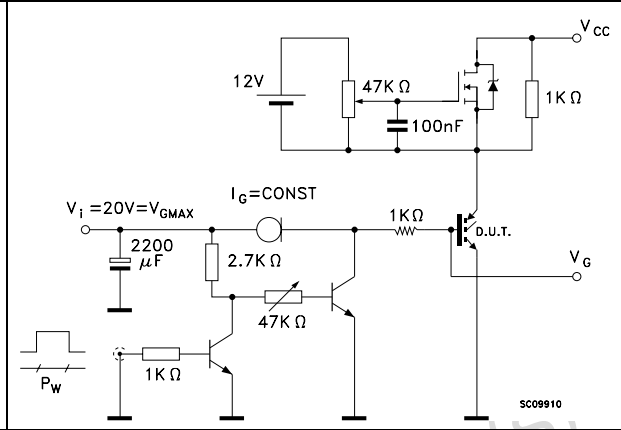
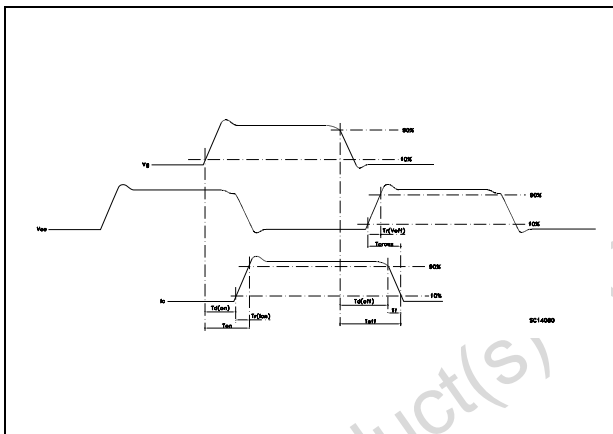


Figure 18. Switching waveforms



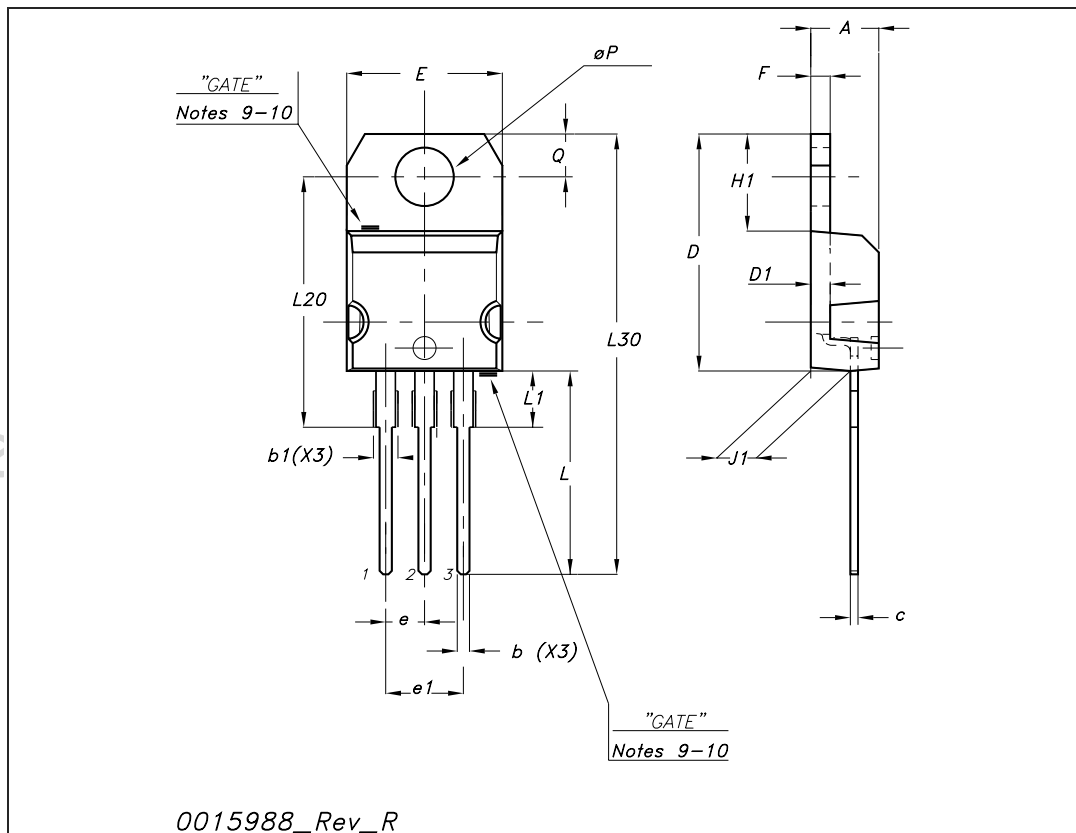
4 Package mechanical data

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

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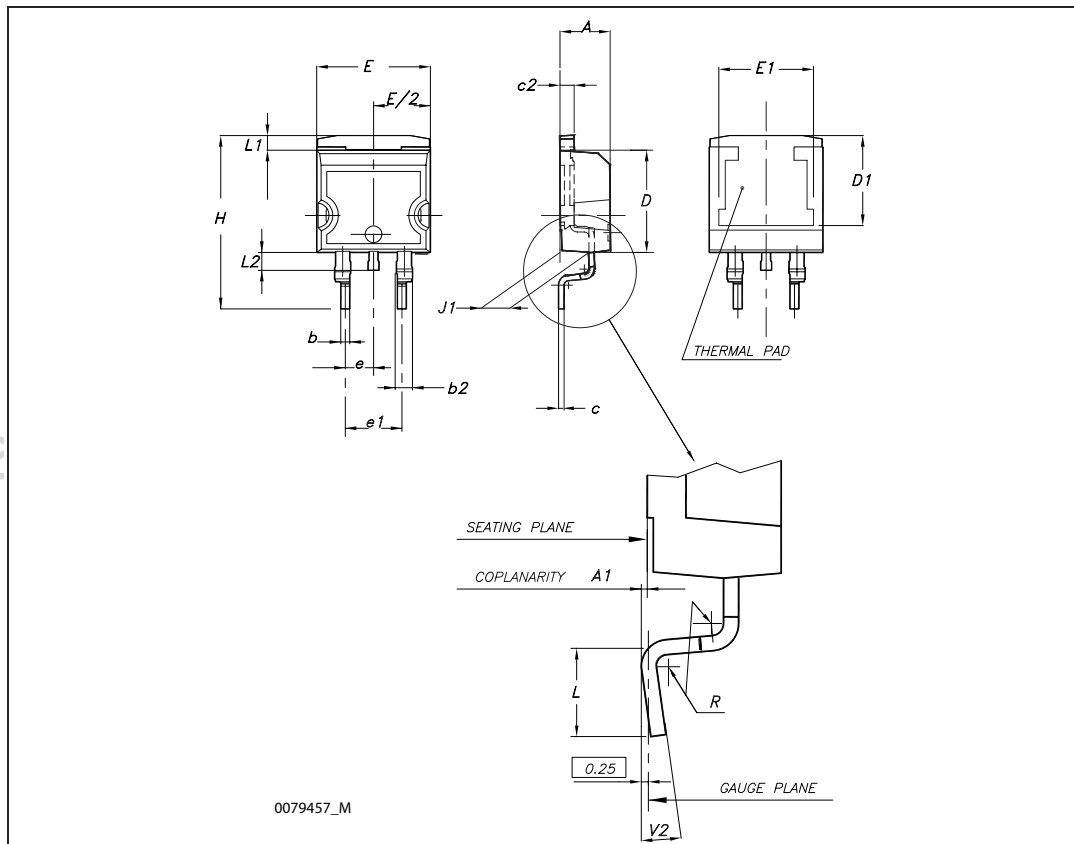
TO-220 mechanical data

| 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 |



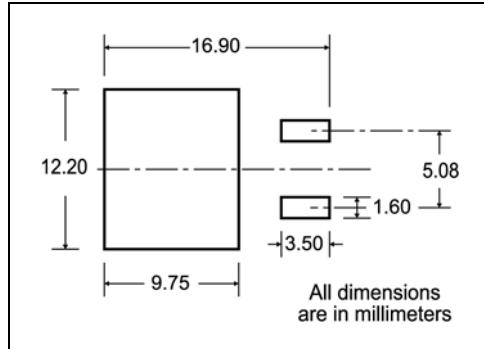
D²PAK (TO-263) mechanical data

| 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 Packing 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 |

* on sales type

6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 14-May-2008 | 1 | Initial release |
| 28-May-2008 | 2 | Inserted new drawing: Figure 15: Thermal impedance |

Obsolete Product(s) - Obsolete Product(s)

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