



STGB19NC60H, STGP19NC60H STGW19NC60H

19 A - 600 V - very fast IGBT

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- High frequency operation

Applications

- High frequency motor drives
- 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.

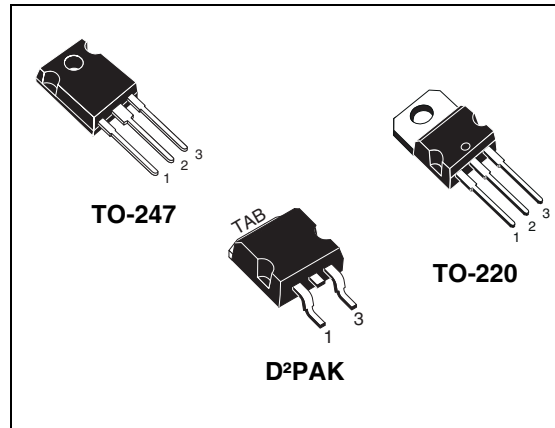


Figure 1. Internal schematic diagram

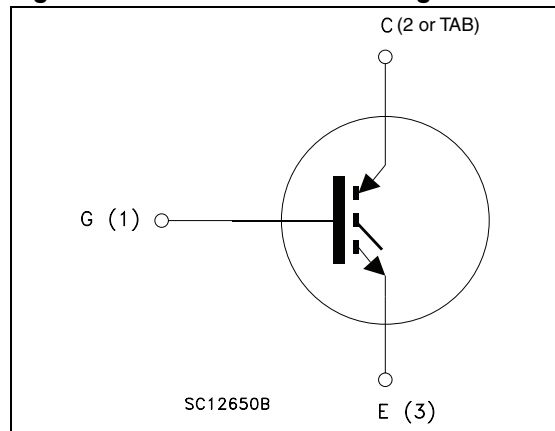


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|---------------|-----------|--------------------|---------------|
| STGB19NC60HT4 | GB19NC60H | D ² PAK | Tape and reel |
| STGP19NC60H | GP19NC60H | TO-220 | Tube |
| STGW19NC60H | GW19NC60H | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|---|-------------|-------------------------------|------|
| | | TO-247 | TO-220, D ² PAK | |
| V _{CES} | Collector-emitter voltage (V _{GE} = 0) | 600 | | V |
| I _C ⁽¹⁾ | Collector current (continuous) at T _C = 25 °C | 42 | 40 | A |
| I _C ⁽¹⁾ | Collector current (continuous) at T _C = 100 °C | 21 | 19 | A |
| I _{CL} ⁽²⁾ | Turn-off latching current | 40 | | A |
| I _{CP} ⁽³⁾ | Pulsed collector current | 60 | | A |
| V _{GE} | Gate-emitter voltage | ±20 | | V |
| P _{TOT} | Total dissipation at T _C = 25 °C | 140 | 130 | W |
| T _j | Operating junction temperature | – 55 to 150 | | °C |

1. Calculated according to the iterative formula:

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

2. V_{clamp}= 80%(V_{CES}), T_j=150 °C, R_G=10 Ω, V_{GE}=15 V
 3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

| Symbol | Parameter | Value | | Unit |
|-----------------------|-------------------------------------|--------|-------------------------------|------|
| | | TO-247 | TO-220, D ² PAK | |
| R _{thj-case} | Thermal resistance junction-case | 0.9 | 0.95 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient | 50 | 62.5 | °C/W |

2 Electrical characteristics

($T_J=25\text{ °C}$ 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 | $V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$, $T_J = 125\text{ °C}$ | | 1.8 1.6 | 2.5 | V V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$ | 3.75 | | 5.75 | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_J = 125\text{ °C}$ | | | 150 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 | $V_{CE} = 15\text{ V}$, $I_C = 12\text{ A}$ | | 5 | | 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 | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$ | | 1180 | | pF |
| C_{oes} | Output capacitance | | - | 130 | - | pF |
| C_{res} | Reverse transfer capacitance | | | | 36 | |
| Q_g | Total gate charge | $V_{CE} = 390\text{ V}$, $I_C = 5\text{ A}$, | | 53 | | nC |
| Q_{ge} | Gate-emitter charge | $V_{GE} = 15\text{ V}$, | | 10 | | nC |
| Q_{gc} | Gate-collector charge | Figure 18 | | 23 | | 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 | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <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 | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 24 8 1400 | - | ns ns A/ μ s |
| $t_{r(Voff)}$ $t_{d(Voff)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i> | - | 27 97 73 | - | ns ns ns |
| $t_{r(Voff)}$ $t_{d(Voff)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 58 144 128 | - | 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 | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i> | - | 85 189 274 | - | μ J μ J μ J |
| E_{on} $E_{off}^{(1)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 187 407 594 | - | 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

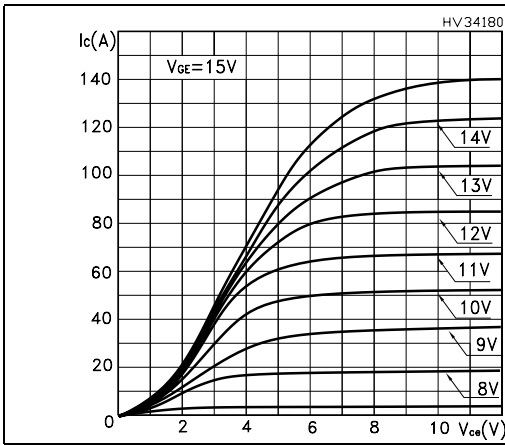


Figure 3. Transfer characteristics

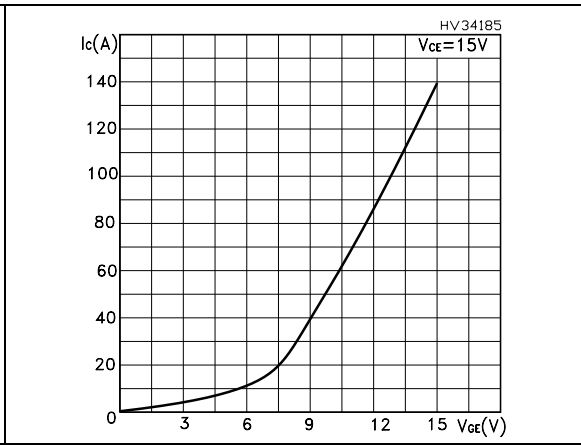


Figure 4. Transconductance

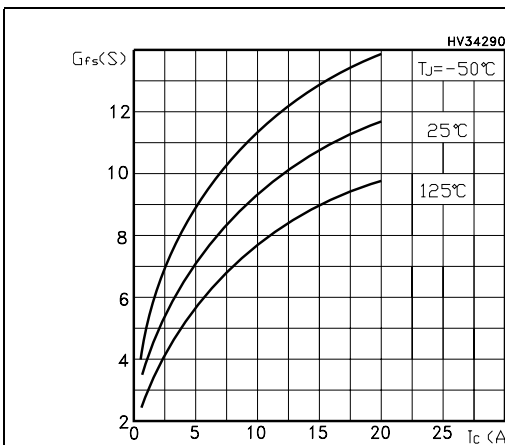


Figure 5. Collector-emitter on voltage vs temperature

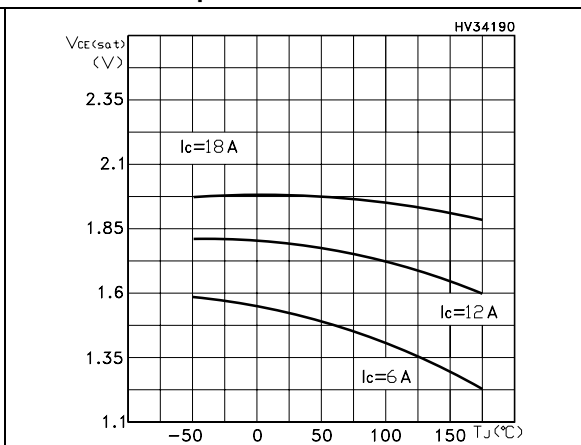


Figure 6. Gate charge vs gate-source voltage Figure 7. Capacitance variations

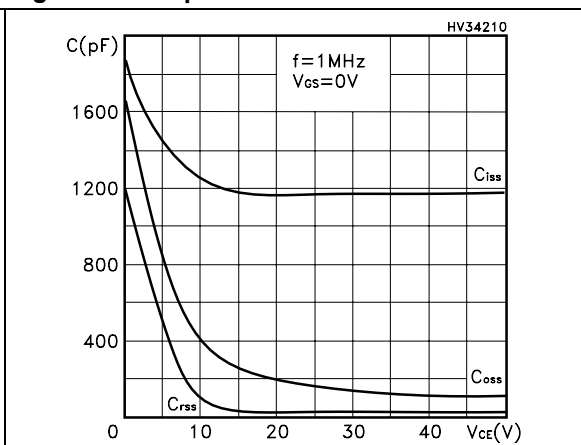
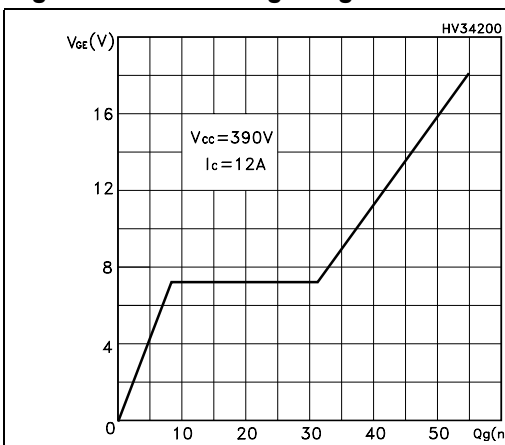


Figure 8. Normalized gate threshold voltage vs temperature

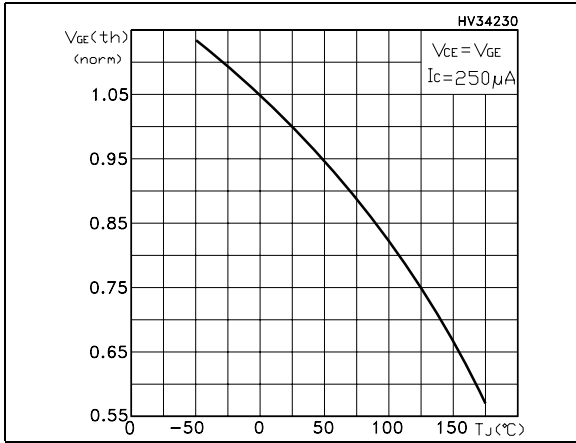


Figure 9. Collector-emitter on voltage vs collector current

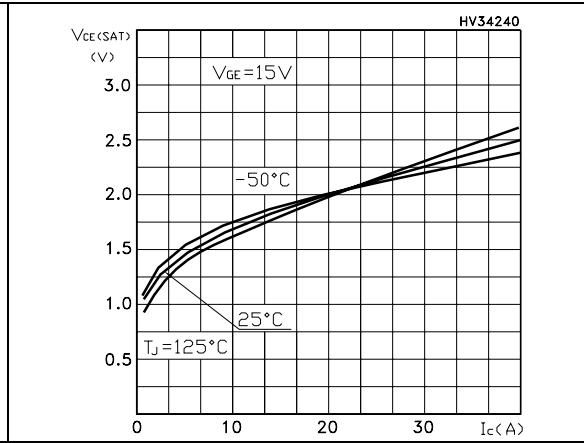


Figure 10. Normalized breakdown voltage vs temperature

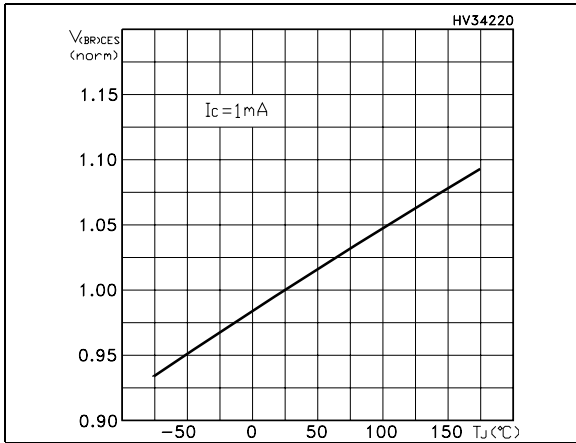


Figure 11. Switching losses vs temperature

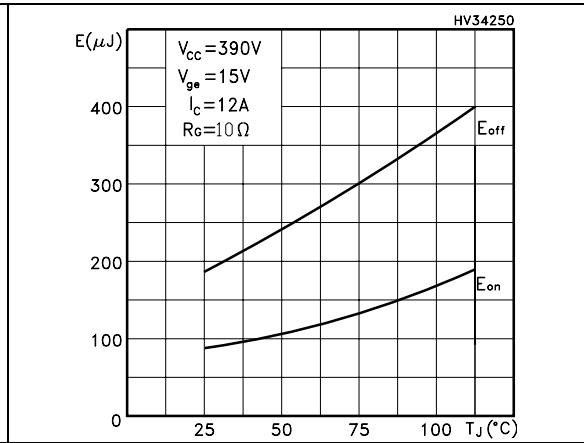


Figure 12. Switching losses vs gate resistance

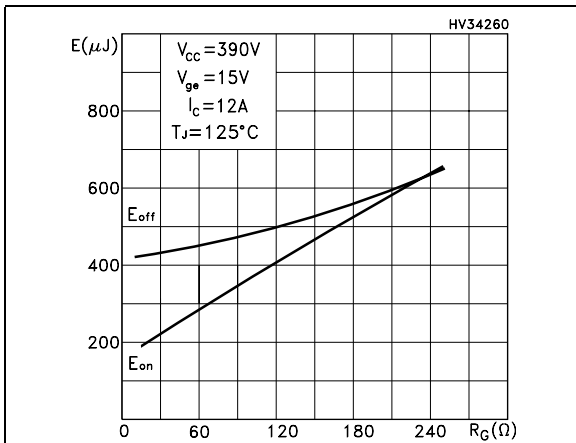


Figure 13. Switching losses vs collector current

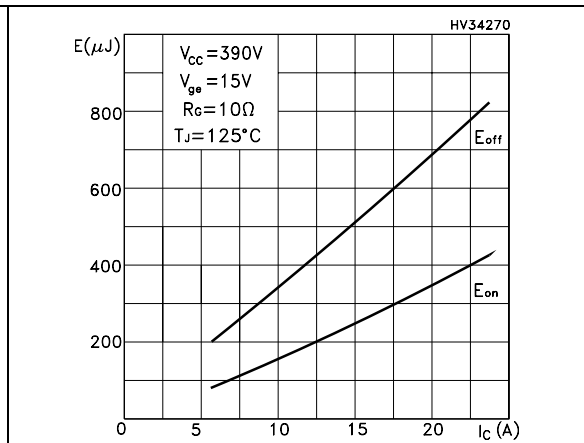


Figure 14. RBSOA

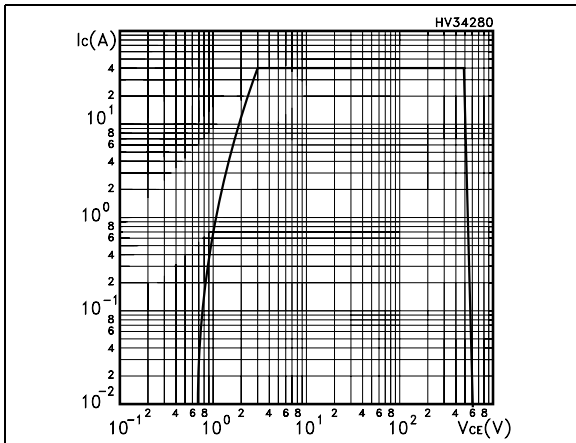


Figure 15. Thermal impedance for TO-220, D²PAK

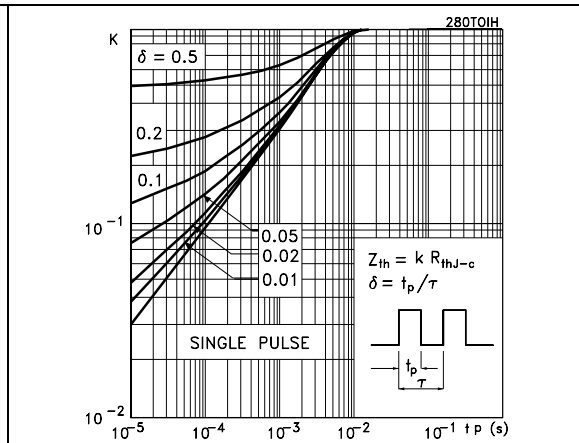
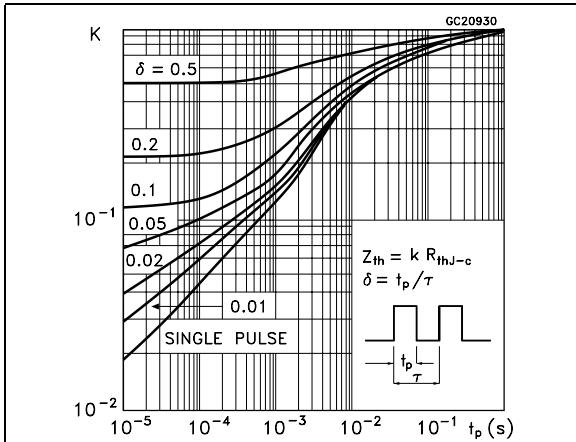


Figure 16. Thermal impedance for TO-247



3 Test circuits

Figure 17. Test circuit for inductive load switching

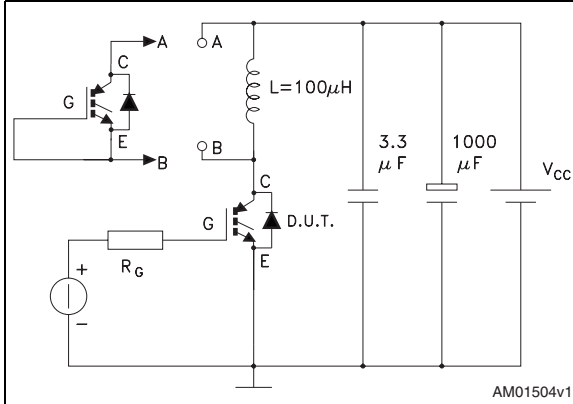


Figure 18. Gate charge test circuit

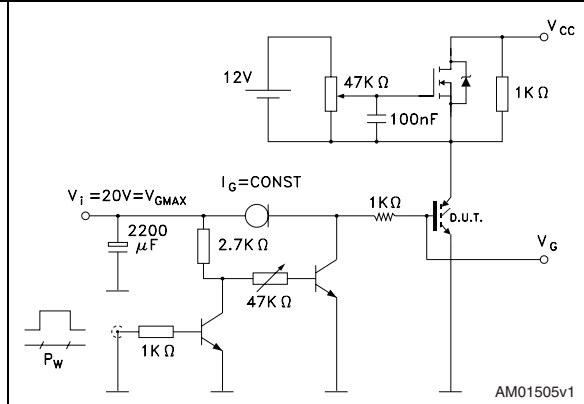
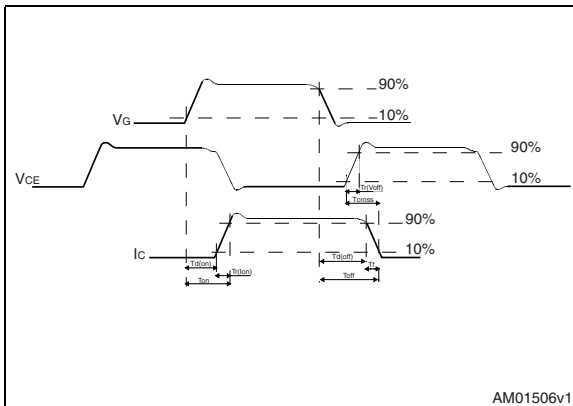


Figure 19. Switching waveform

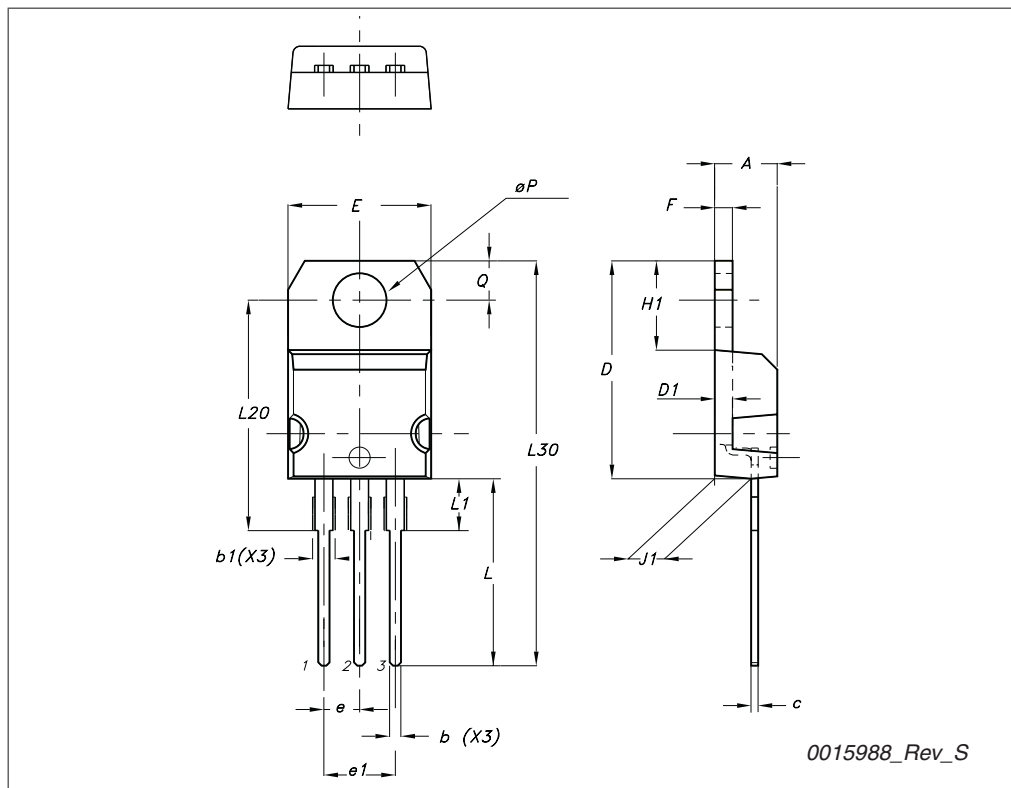


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

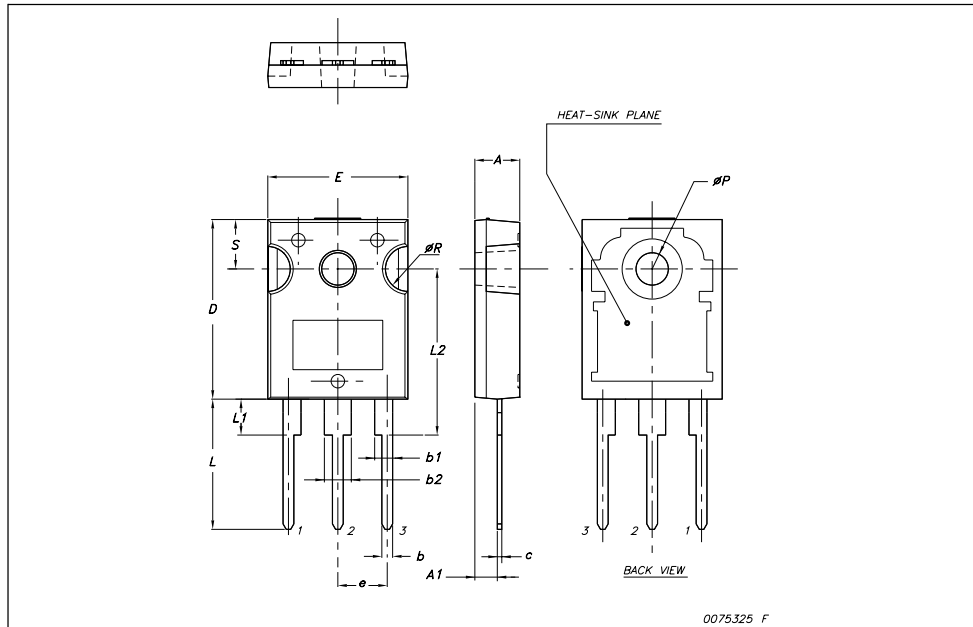
TO-220 type A mechanical data

| Dim | mm | | |
|-----|-------|-------|-------|
| | Min | Typ | Max |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |



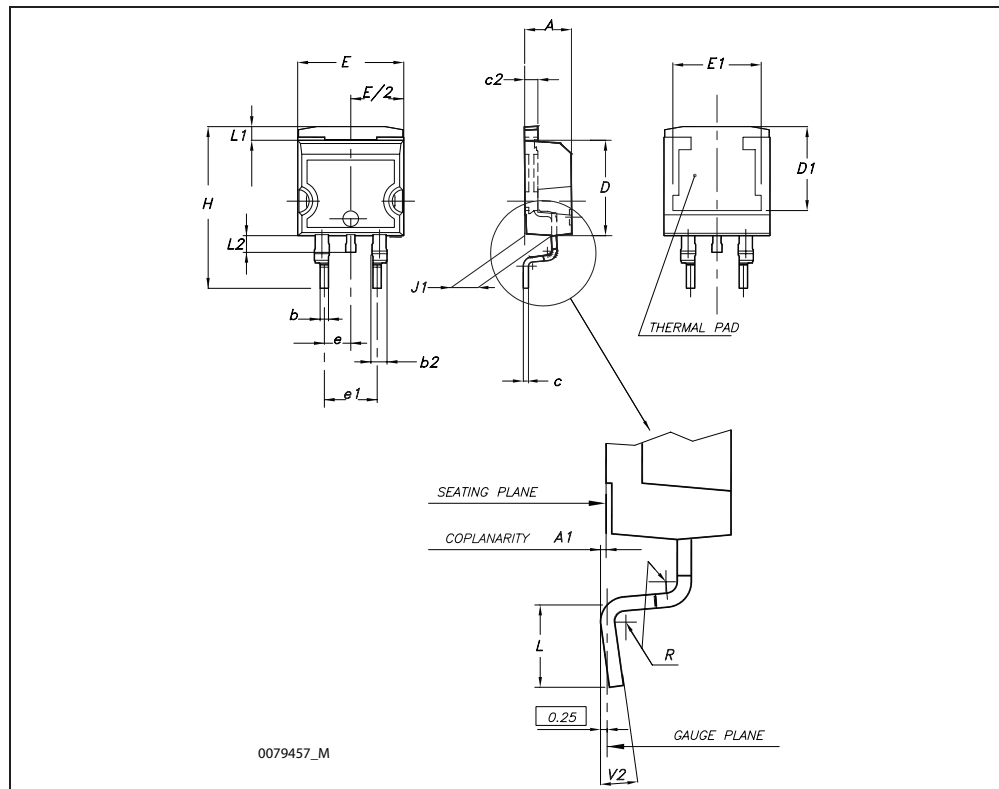
TO-247 Mechanical data

| 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 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 31-Jan-2008 | 1 | Initial release. |
| 28-May-2008 | 2 | Inserted new drawing: Figure 16: Thermal impedance for TO-247 |
| 08-May-2009 | 3 | Updated I_{CP} value |
| 01-Sep-2009 | 4 | Added new package, mechanical data: D ² PAK |

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