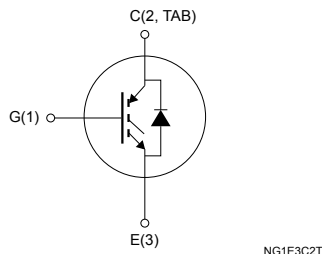
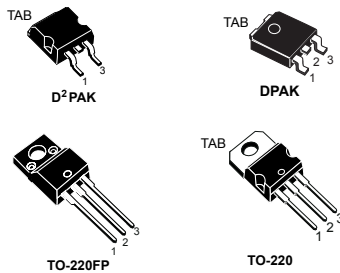


Trench gate field-stop 600 V, 5 A high speed H series IGBT



Features

- High-speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

Applications

- Motor control
- UPS, PFC

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the H series of IGBTs, which represents an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status link

[STGB5H60DF](#)

[STGD5H60DF](#)

[STGF5H60DF](#)

[STGP5H60DF](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | | | Unit |
|--------------------------------|---|----------------------------|------|-------------------|------|
| | | D ² PAK, TO-220 | DPAK | TO-220FP | |
| V _{CES} | Collector-emitter voltage (V _{GE} = 0) | 600 | | | V |
| I _C | Continuous collector current at T _C = 25 °C | 10 | | 10 ⁽¹⁾ | A |
| | Continuous collector current at T _C = 100 °C | 5 | | 5 ⁽¹⁾ | |
| I _{CP} ⁽²⁾ | Pulsed collector current | 20 | | 20 ⁽¹⁾ | A |
| V _{GE} | Gate-emitter voltage | ±20 | | | V |
| I _F | Continuous forward current T _C = 25 °C | 10 | | 10 ⁽¹⁾ | A |
| | Continuous forward current at T _C = 100 °C | 5 | | 5 ⁽¹⁾ | |
| I _{FP} ⁽²⁾ | Pulsed forward current | 20 | | 20 ⁽¹⁾ | A |
| V _{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C) | | | 2500 | V |
| P _{TOT} | Total dissipation at T _C = 25 °C | 88 | 83 | 24 | W |
| T _{STG} | Storage temperature range | -55 to 150 | | | °C |
| T _J | Operating junction temperature range | -55 to 175 | | | |

1. Limited by maximum junction temperature.
2. Pulse width limited by maximum junction temperature.

Table 2. Thermal data

| Symbol | Parameter | Value | | | Unit |
|-------------------|--|----------------------------|------|----------|------|
| | | D ² PAK, TO-220 | DPAK | TO-220FP | |
| R _{thJC} | Thermal resistance junction-case IGBT | 1.7 | 1.8 | 6.2 | °C/W |
| R _{thJC} | Thermal resistance junction-case diode | 4 | 4.5 | 7 | °C/W |
| R _{thJA} | Thermal resistance junction-ambient | 62.5 | 100 | 62.5 | °C/W |

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified.

Table 3. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------|--|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$ | 600 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 5\text{ A}$ | | 1.5 | 1.95 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 5\text{ A}$ $T_J = 125\text{ °C}$ | | 1.6 | | |
| | | $V_{GE} = 15\text{ V}$, $I_C = 5\text{ A}$ $T_J = 175\text{ °C}$ | | 1.7 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$ | 4.8 | 6.2 | 6.9 | V |
| I_{CES} | Collector cut-off current | $V_{CE} = 600\text{ V}$ $V_{GE} = 0\text{ V}$ | | | 25 | μA |
| I_{GES} | Gate-emitter leakage current | $V_{GE} = \pm 20\text{ V}$ $V_{CE} = 0\text{ V}$ | | | ± 250 | nA |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 855 | - | pF |
| C_{oes} | Output capacitance | | | 34 | | |
| C_{res} | Reverse transfer capacitance | | | 19 | | |
| Q_g | Total gate charge | $V_{CC} = 480\text{ V}$, $I_C = 5\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ | - | 43 | - | nC |
| Q_{ge} | Gate-emitter charge | | | 17.5 | | |
| Q_{gc} | Gate-collector charge | | | 6.5 | | |

Table 5. Switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\text{ }\Omega$, $V_{GE} = 15\text{ V}$ | - | 30 | - | ns |
| t_r | Current rise time | | | 10.8 | | |
| $(di/dt)_{on}$ | Turn-on current slope | | | 370 | | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\text{ }\Omega$, $V_{GE} = 15\text{ V}$ $T_J = 175\text{ °C}$ | - | 28 | - | ns |
| t_r | Current rise time | | | 11 | | |
| $(di/dt)_{on}$ | Turn-on current slope | | | 363 | | |

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|------------------------------|--|------|------|------|---------------|
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\ \Omega$, $V_{GE} = 15\text{ V}$ | - | 29 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 140 | | |
| t_f | Current fall time | | | 95 | | |
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\ \Omega$, $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$ | - | 44 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 146 | | |
| t_f | Current fall time | | | 134 | | |
| t_{sc} | Short-circuit withstand time | $V_{CC} \leq 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 47\ \Omega$ | - | 5 | - | μs |

Table 6. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|--|------|-------|------|---------------|
| $E_{on}^{(1)}$ | Turn-on switching energy | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\ \Omega$, $V_{GE} = 15\text{ V}$ | - | 56 | - | μJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | | 78.5 | | |
| E_{ts} | Total switching energy | | | 134.5 | | |
| $E_{on}^{(1)}$ | Turn-on switching energy | $V_{CE} = 400\text{ V}$, $I_C = 5\text{ A}$, $R_G = 47\ \Omega$, $V_{GE} = 15\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$ | - | 87 | - | μJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | | 134 | | |
| E_{ts} | Total switching energy | | | 221 | | |

1. Including the reverse recovery of the diode.
2. Including the tail of the collector current.

Table 7. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|-------|------|------|
| V_F | Forward on-voltage | $I_F = 5\text{ A}$ | - | 2.1 | - | V |
| | | $I_F = 5\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$ | | 1.65 | | |
| t_{rr} | Reverse recovery time | $V_{CC} = 400\text{ V}$; $I_F = 5\text{ A}$; $di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 134.5 | - | ns |
| Q_{rr} | Reverse recovery charge | | | 48 | | nC |
| I_{rrm} | Reverse recovery current | | | 1.38 | | A |
| t_{rr} | Reverse recovery time | $V_{CC} = 400\text{ V}$; $I_F = 5\text{ A}$; $di_F/dt = 100\text{ A}/\mu\text{s}$ $T_J = 175\text{ }^\circ\text{C}$ | - | 157 | - | ns |
| Q_{rr} | Reverse recovery charge | | | 165 | | nC |
| I_{rrm} | Reverse recovery current | | | 2.4 | | A |

2.1 Electrical characteristics curves

Figure 1. Power dissipation vs case temperature for D²PAK and TO-220

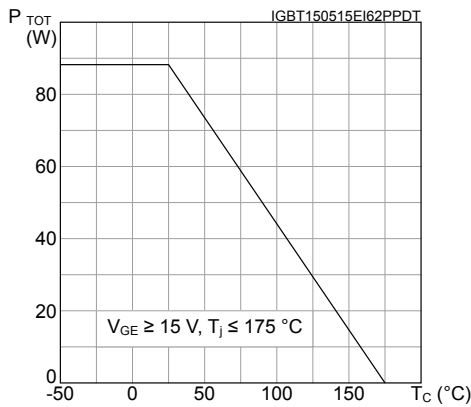


Figure 2. Collector current vs case temperature for D²PAK, DPAK and TO-220

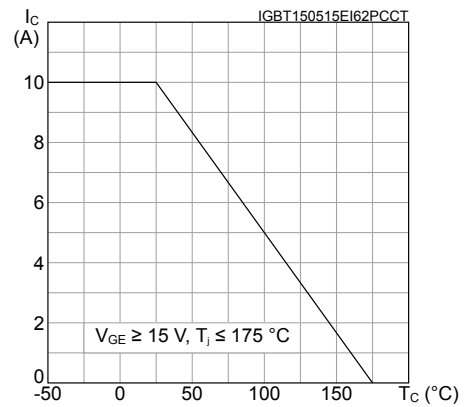


Figure 3. Power dissipation vs case temperature for DPAK

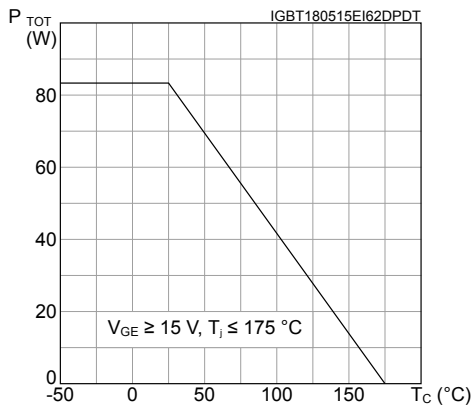


Figure 4. Collector current vs case temperature for DPAK

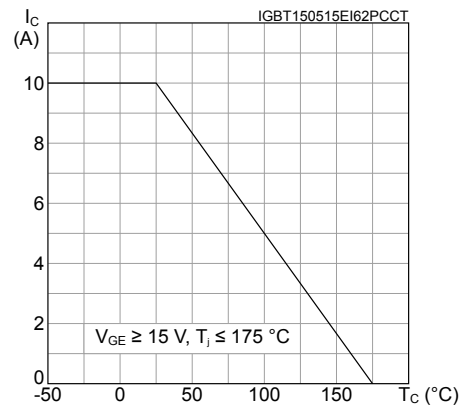


Figure 5. Power dissipation vs case temperature for TO-220FP

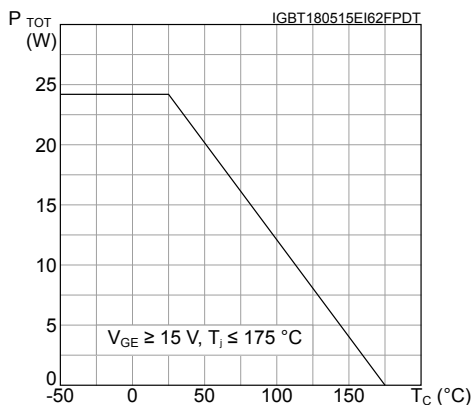


Figure 6. Collector current vs case temperature for TO-220FP

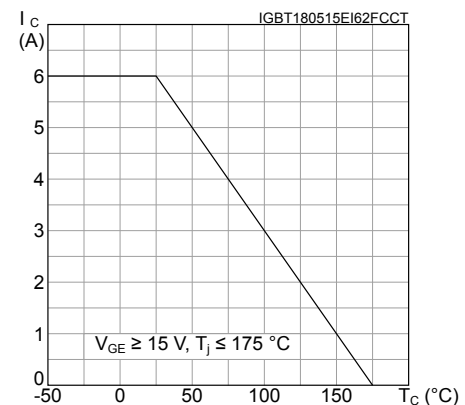


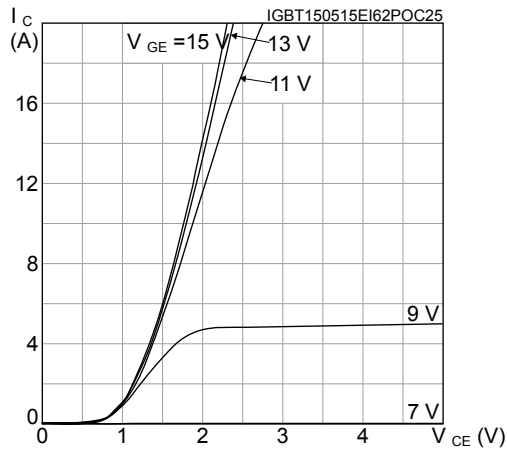
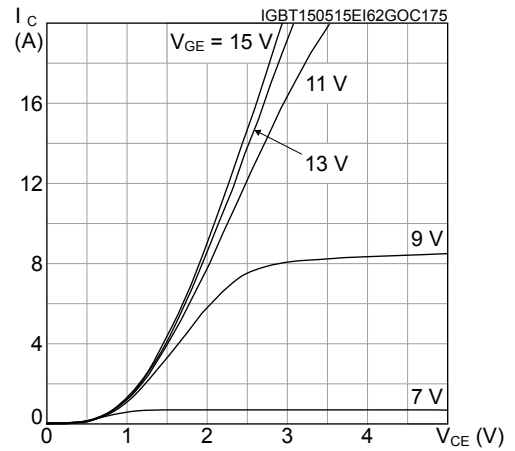
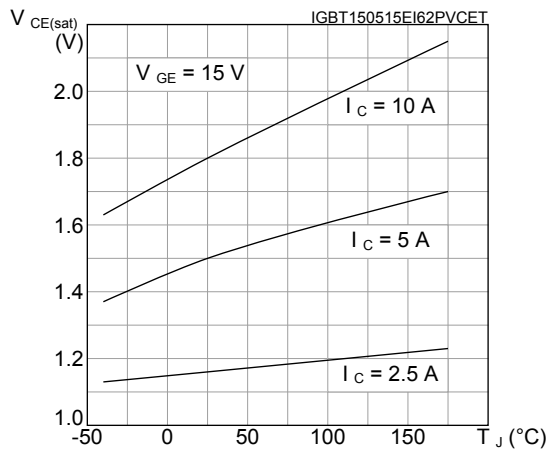
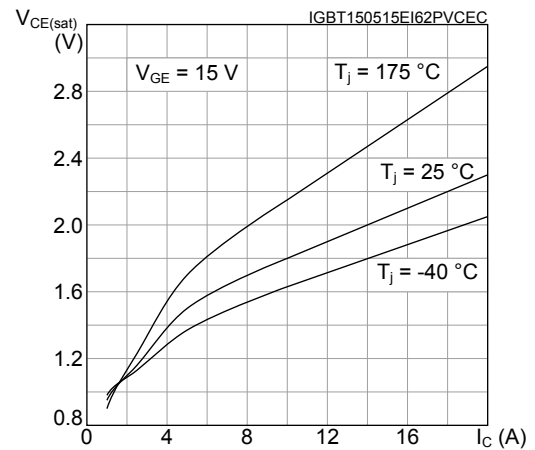
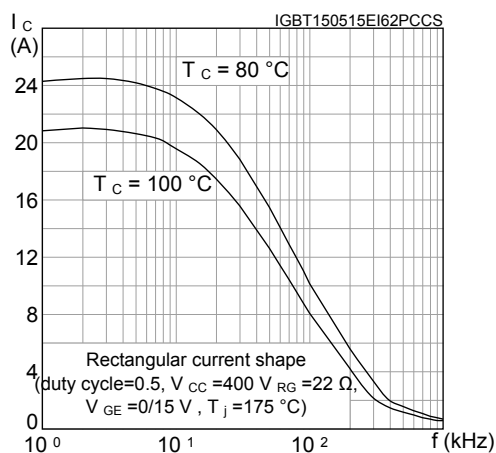
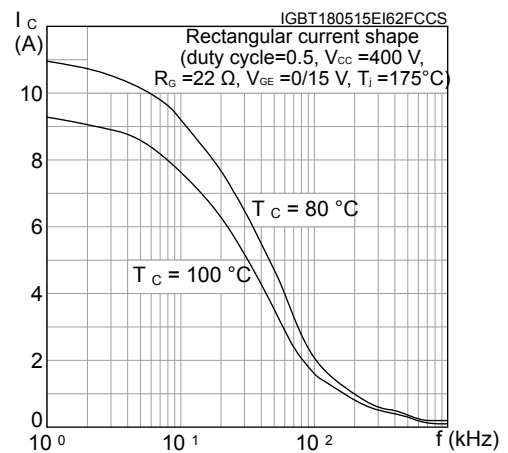
Figure 7. Output characteristics ($T_J = 25^\circ\text{C}$)

Figure 8. Output characteristics ($T_J = 175^\circ\text{C}$)

Figure 9. $V_{CE(sat)}$ vs junction temperature

Figure 10. $V_{CE(sat)}$ vs collector current

Figure 11. Collector current vs switching frequency for D²PAK, DPAK and TO-220

Figure 12. Collector current vs switching frequency for TO-220FP


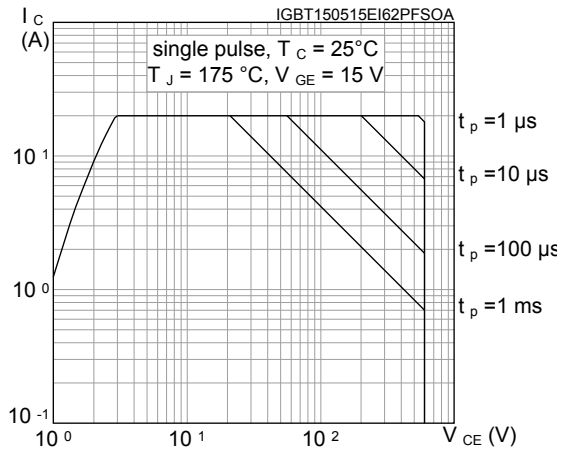
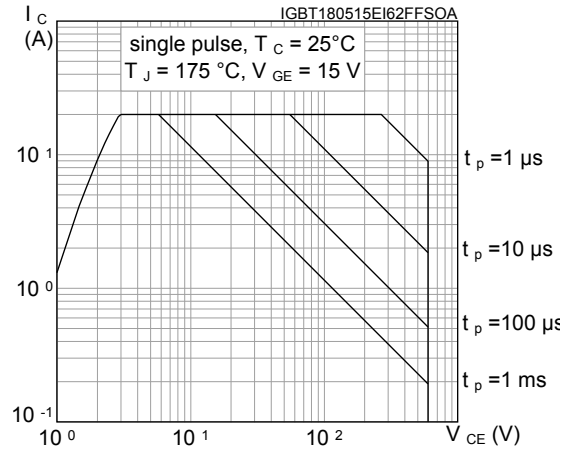
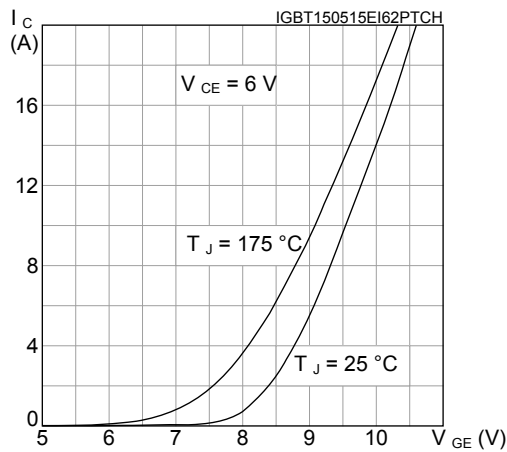
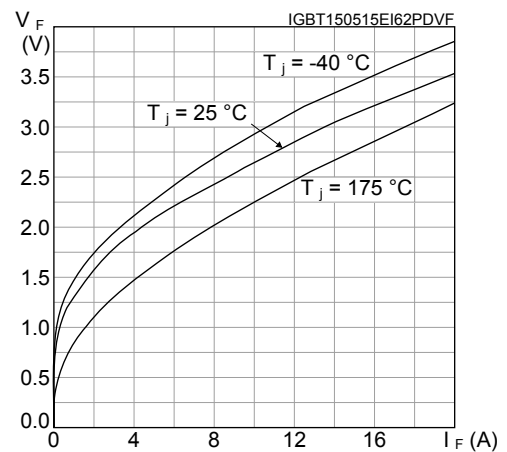
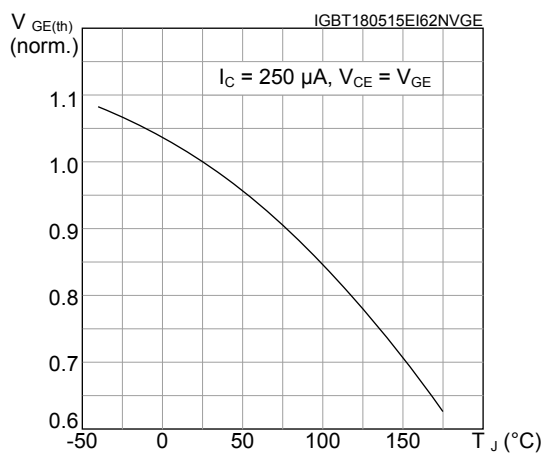
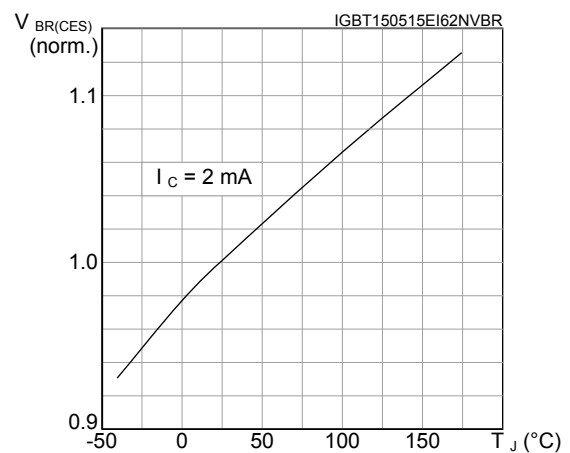
Figure 13. Forward bias safe operating area for D²PAK, DPAK and TO-220

Figure 14. Forward bias safe operating area for TO-220FP

Figure 15. Transfer characteristics

Figure 16. Diode V_F vs forward current

Figure 17. Normalized V_{GE(th)} vs junction temperature

Figure 18. Normalized V_{BR(CES)} vs junction temperature


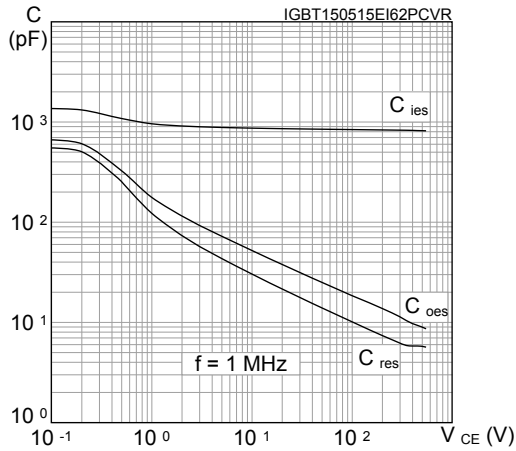
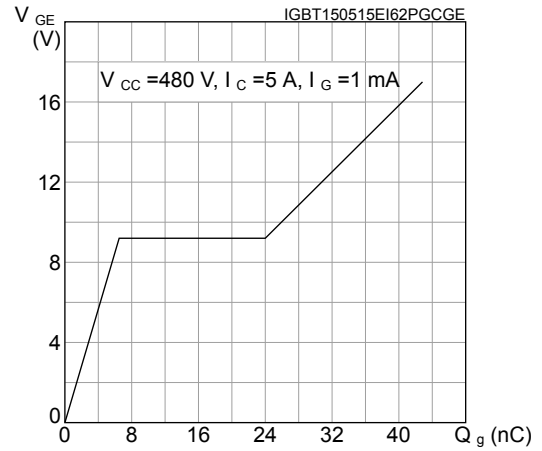
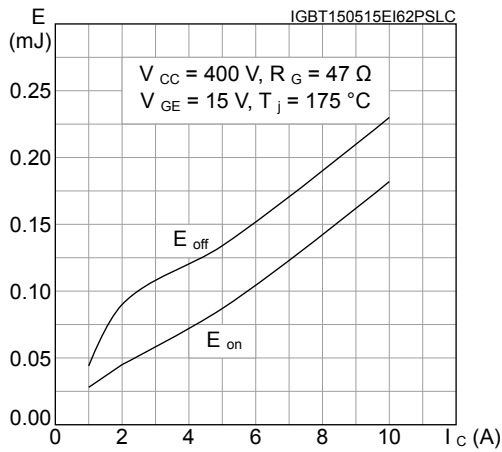
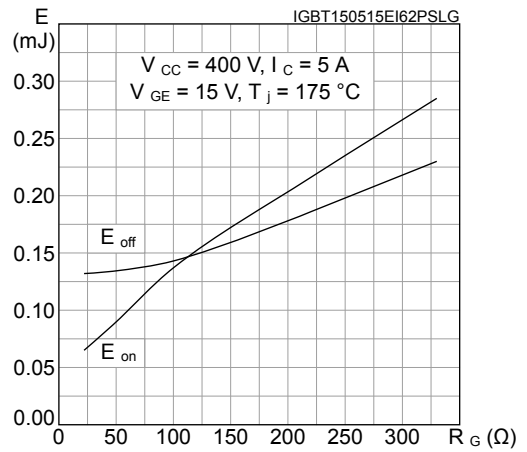
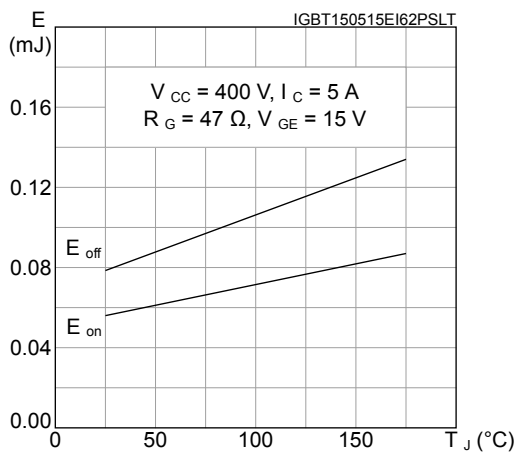
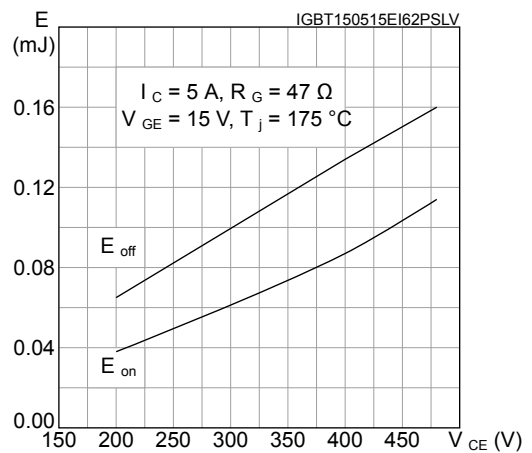
Figure 19. Capacitance variation

Figure 20. Gate charge vs. gate-emitter voltage

Figure 21. Switching energy vs collector current

Figure 22. Switching energy vs gate resistance

Figure 23. Switching energy vs temperature

Figure 24. Switching energy vs collector-emitter voltage


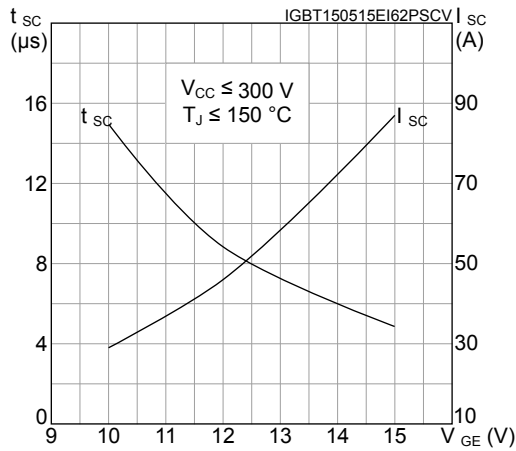
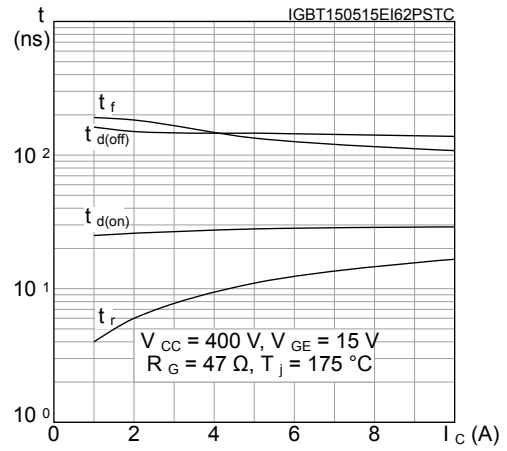
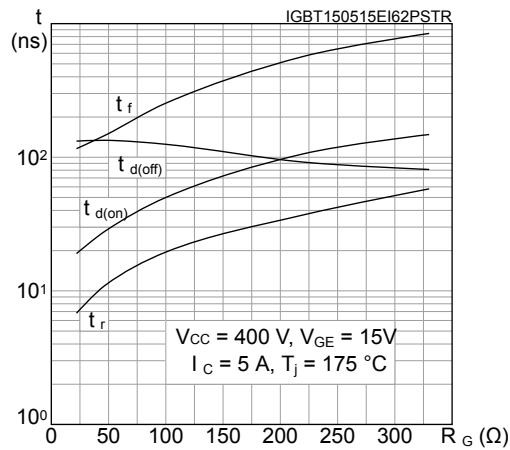
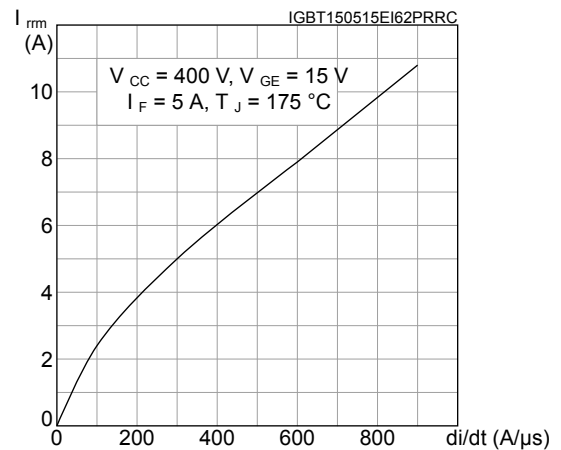
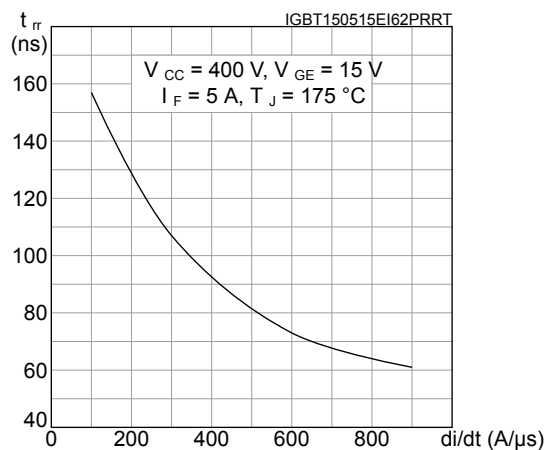
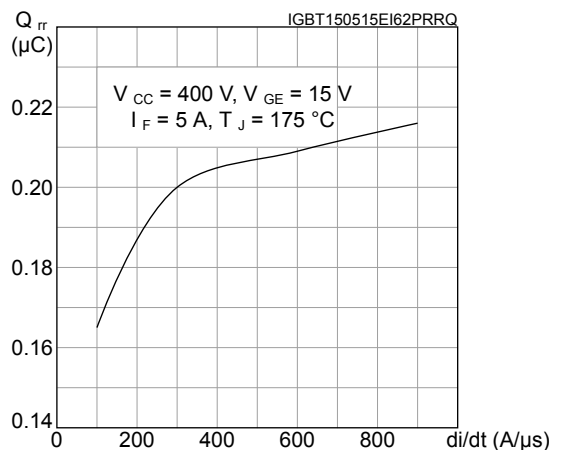
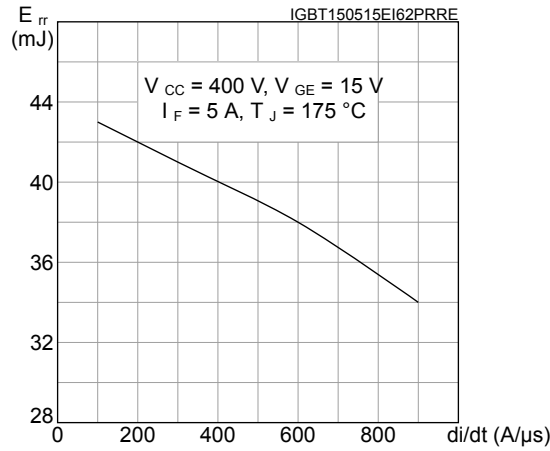
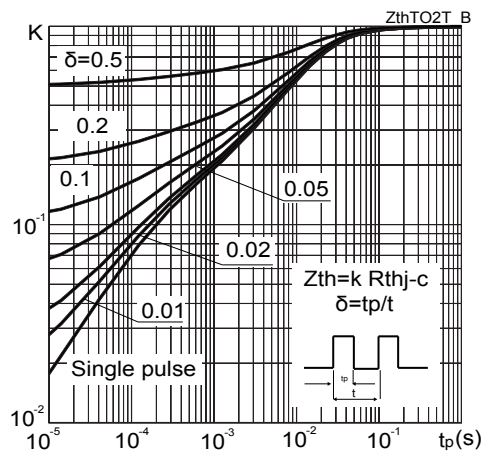
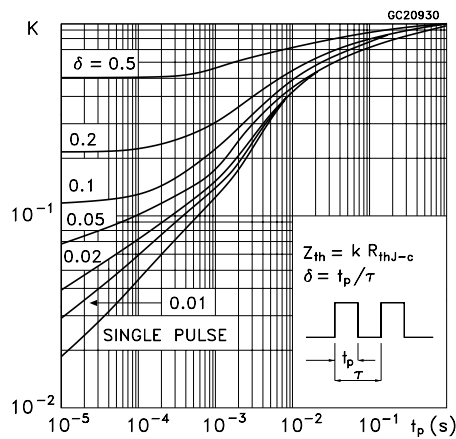
Figure 25. Short circuit time and current vs V_{GE}

Figure 26. Switching times vs collector current

Figure 27. Switching times vs gate resistance

Figure 28. Reverse recovery current vs diode current slope

Figure 29. Reverse recovery time vs diode current slope

Figure 30. Reverse recovery charge vs diode current slope


Figure 31. Reverse recovery energy vs diode current slope

Figure 32. Thermal impedance for D²PAK, DPAK and TO-220 IGBT

Figure 33. Thermal impedance for D²PAK, DPAK and TO-220 diode


3 Test circuits

Figure 34. Test circuit for inductive load switching

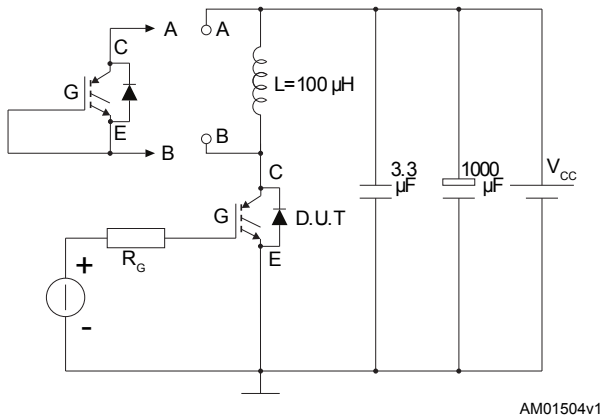


Figure 35. Gate charge test circuit

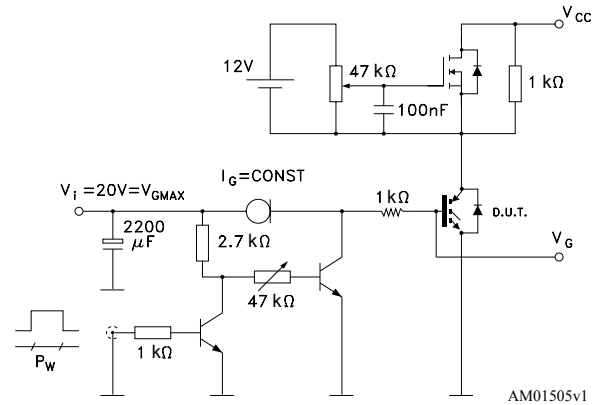


Figure 36. Switching waveform

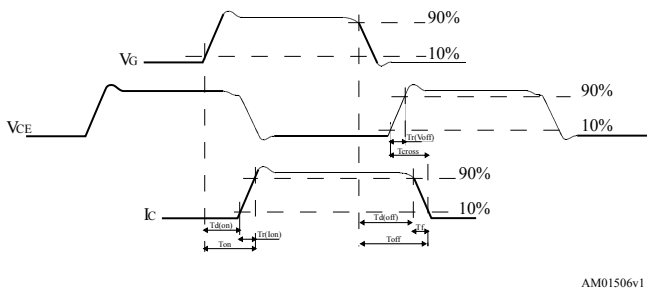
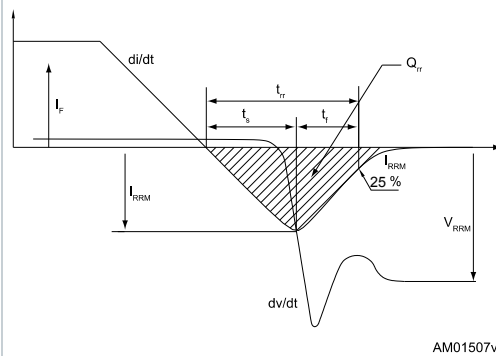


Figure 37. Diode reverse recovery waveform

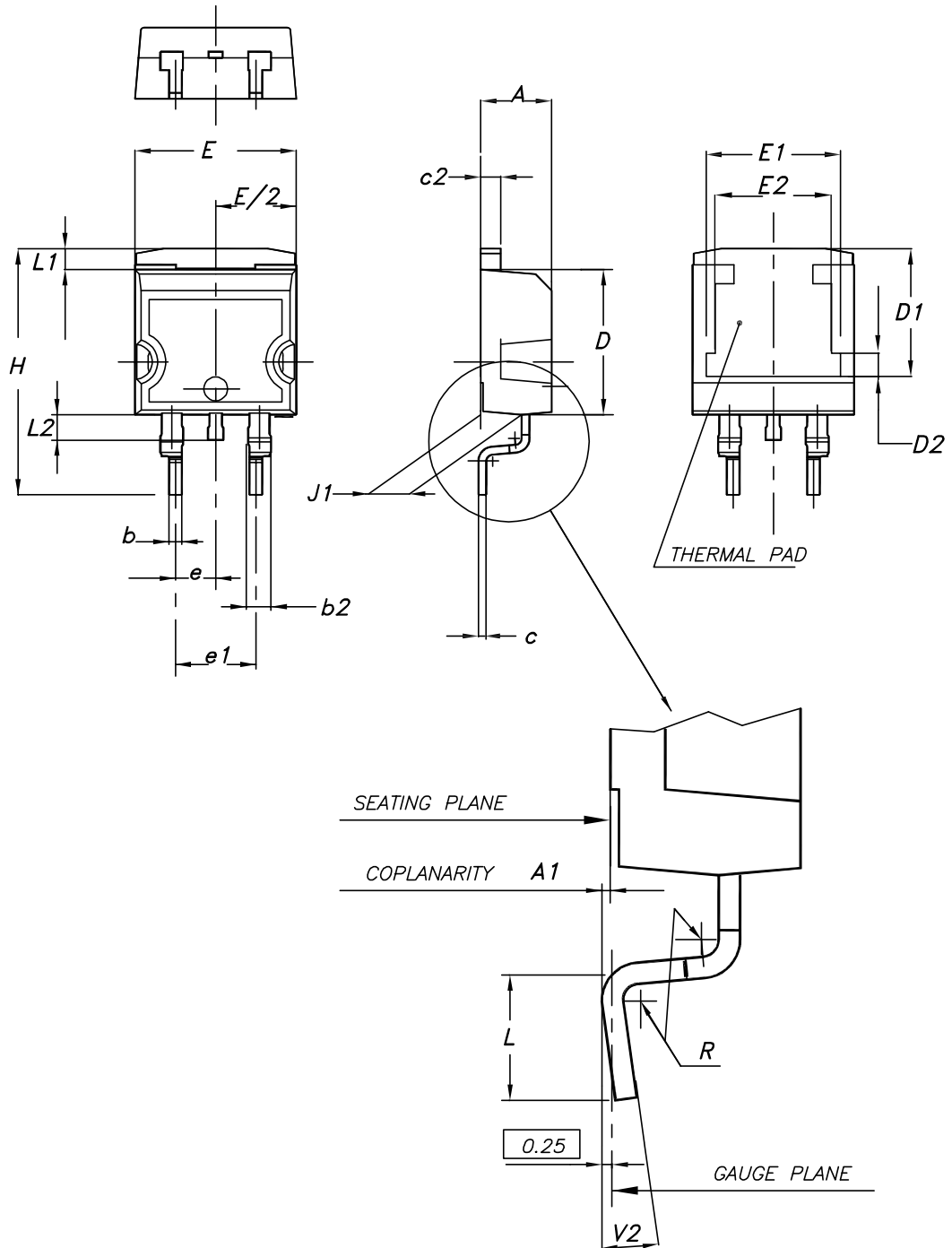


4 Package information

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.

4.1 D²PAK (TO-263) type A package information

Figure 38. D²PAK (TO-263) type A package outline

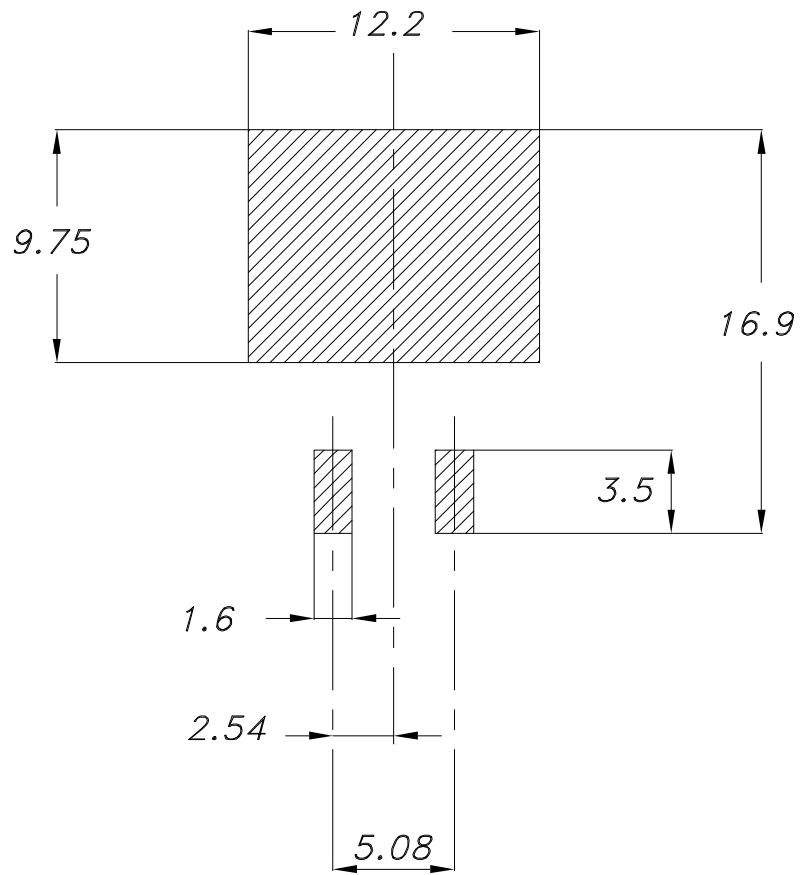


0079457_25

Table 8. D²PAK (TO-263) type A package mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | 7.75 | 8.00 |
| D2 | 1.10 | 1.30 | 1.50 |
| E | 10.00 | | 10.40 |
| E1 | 8.30 | 8.50 | 8.70 |
| E2 | 6.85 | 7.05 | 7.25 |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15.00 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.40 | |
| V2 | 0° | | 8° |

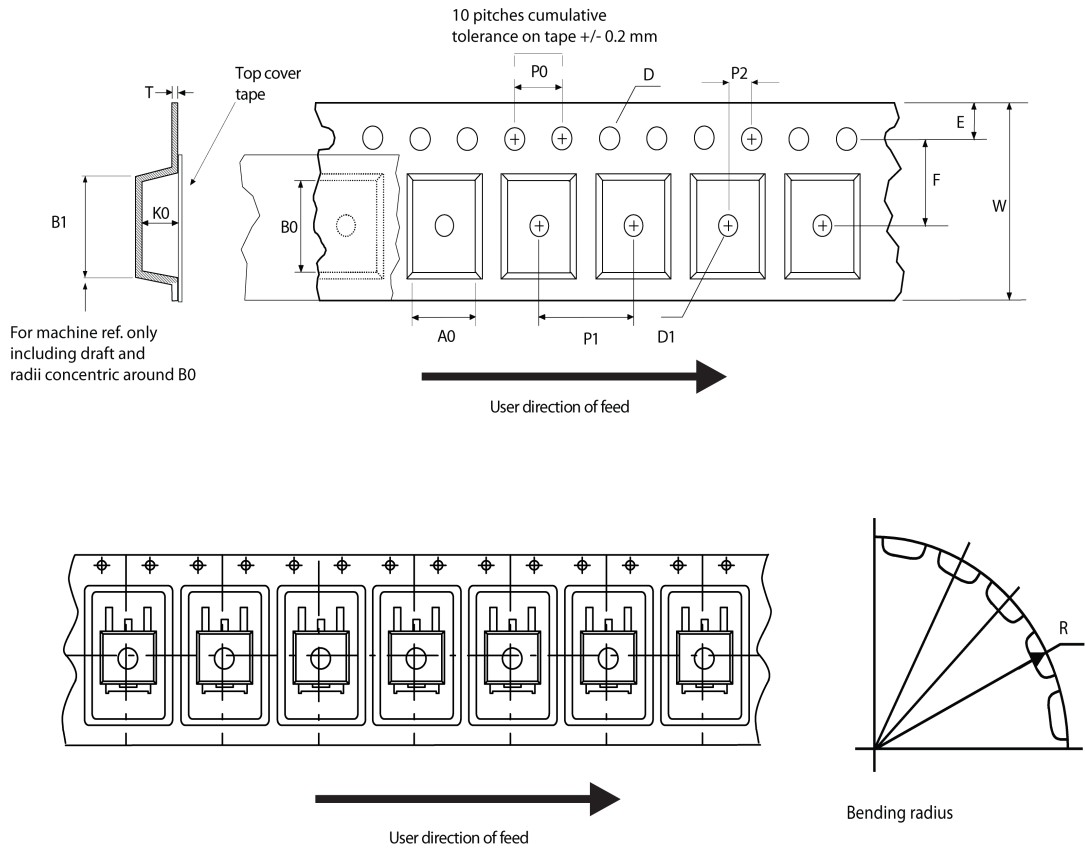
Figure 39. D²PAK (TO-263) recommended footprint (dimensions are in mm)



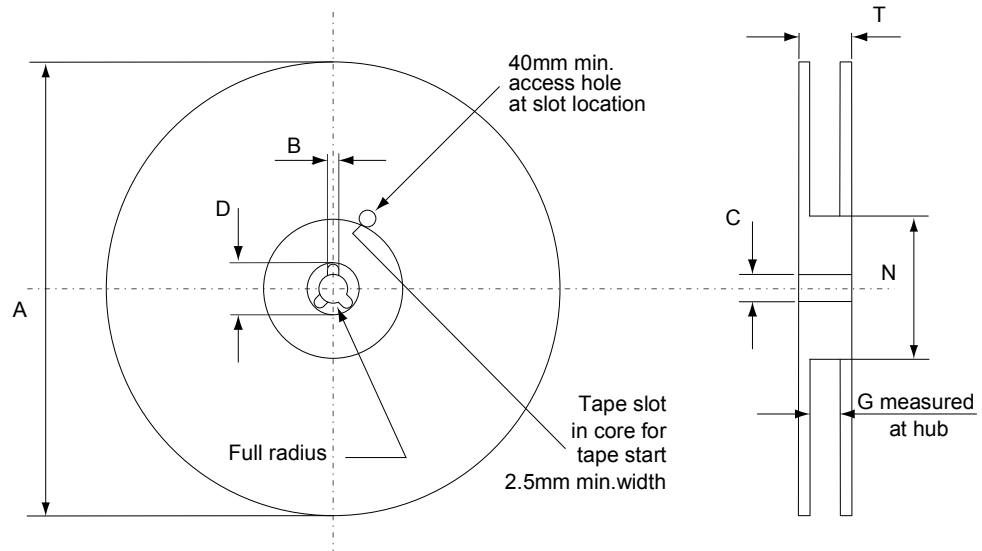
Footprint

4.2 D²PAK packing information

Figure 40. D²PAK tape outline



AM08852v1

Figure 41. D²PAK reel outline


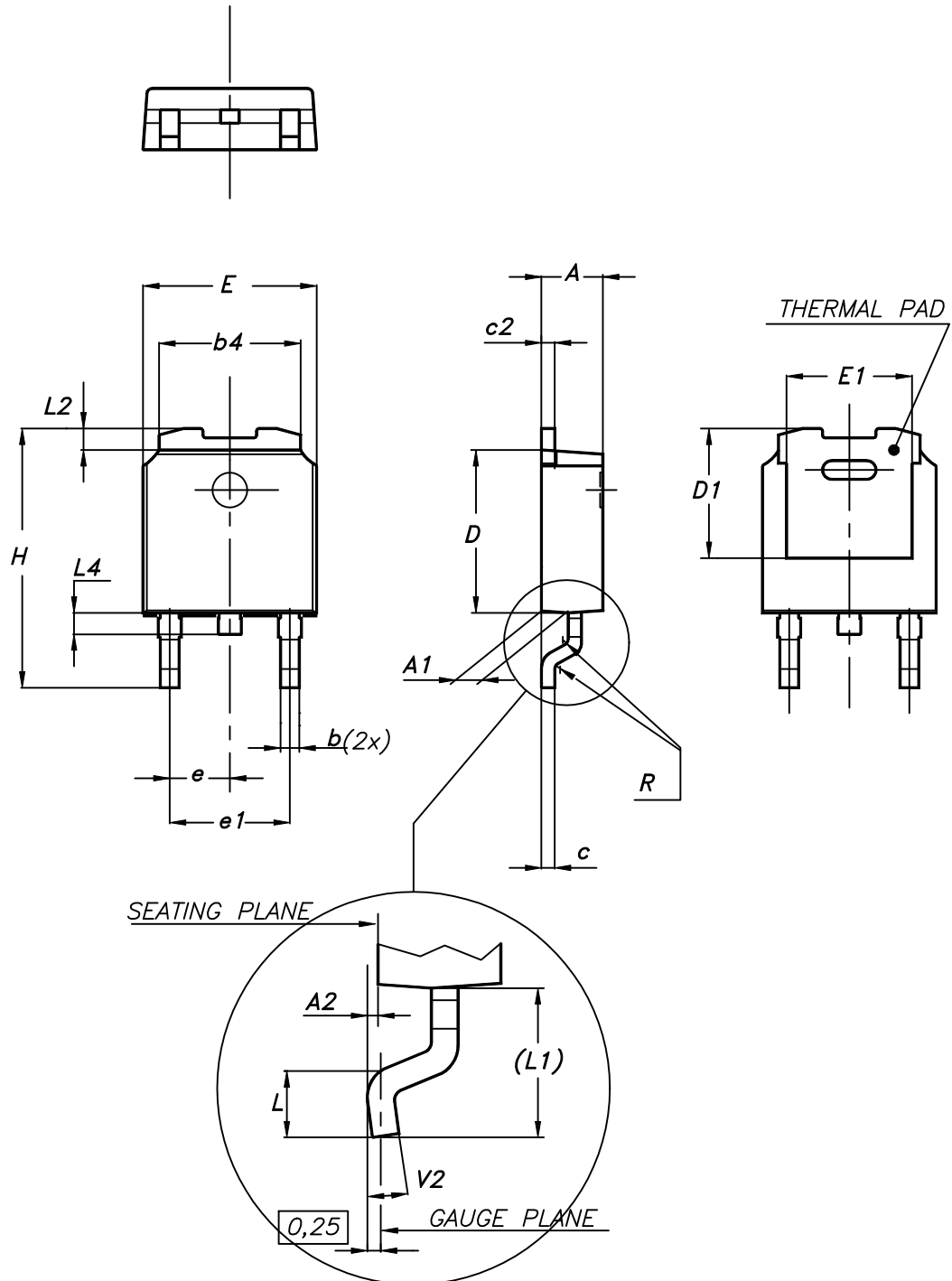
AM06038v1

Table 9. D²PAK tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|---------------|------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 10.5 | 10.7 | A | | 330 |
| B0 | 15.7 | 15.9 | B | 1.5 | |
| D | 1.5 | 1.6 | C | 12.8 | 13.2 |
| D1 | 1.59 | 1.61 | D | 20.2 | |
| E | 1.65 | 1.85 | G | 24.4 | 26.4 |
| F | 11.4 | 11.6 | N | 100 | |
| K0 | 4.8 | 5.0 | T | | 30.4 |
| P0 | 3.9 | 4.1 | | | |
| P1 | 11.9 | 12.1 | Base quantity | | 1000 |
| P2 | 1.9 | 2.1 | Bulk quantity | | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

4.3 DPAK (TO-252) type A2 package information

Figure 42. DPAK (TO-252) type A2 package outline



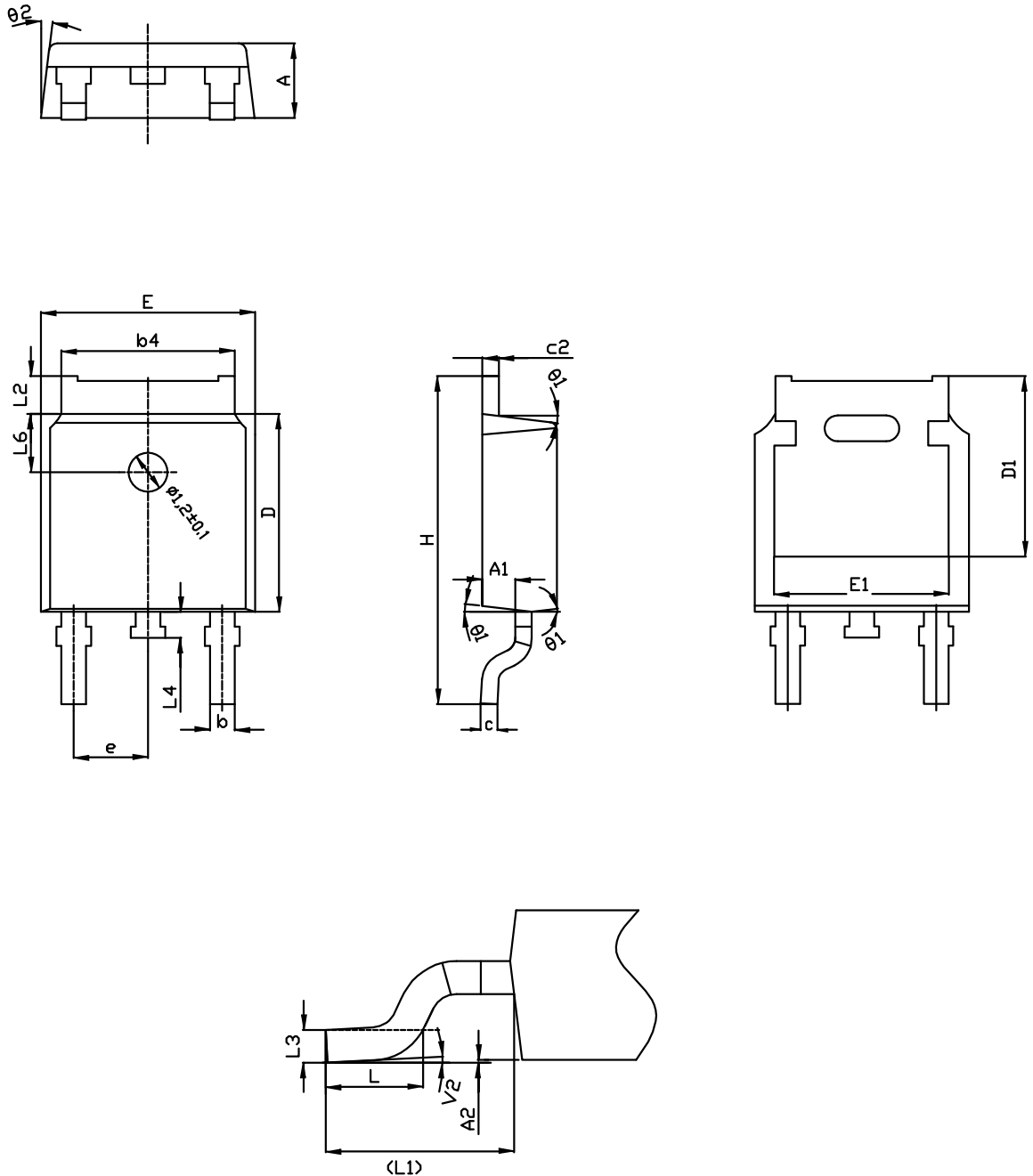
0068772_type-A2_rev25

Table 10. DPAK (TO-252) type A2 mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | 4.95 | 5.10 | 5.25 |
| E | 6.40 | | 6.60 |
| E1 | 5.10 | 5.20 | 5.30 |
| e | 2.159 | 2.286 | 2.413 |
| e1 | 4.445 | 4.572 | 4.699 |
| H | 9.35 | | 10.10 |
| L | 1.00 | | 1.50 |
| L1 | 2.60 | 2.80 | 3.00 |
| L2 | 0.65 | 0.80 | 0.95 |
| L4 | 0.60 | | 1.00 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

4.4 DPAK (TO-252) type C2 package information

Figure 43. DPAK (TO-252) type C2 package outline



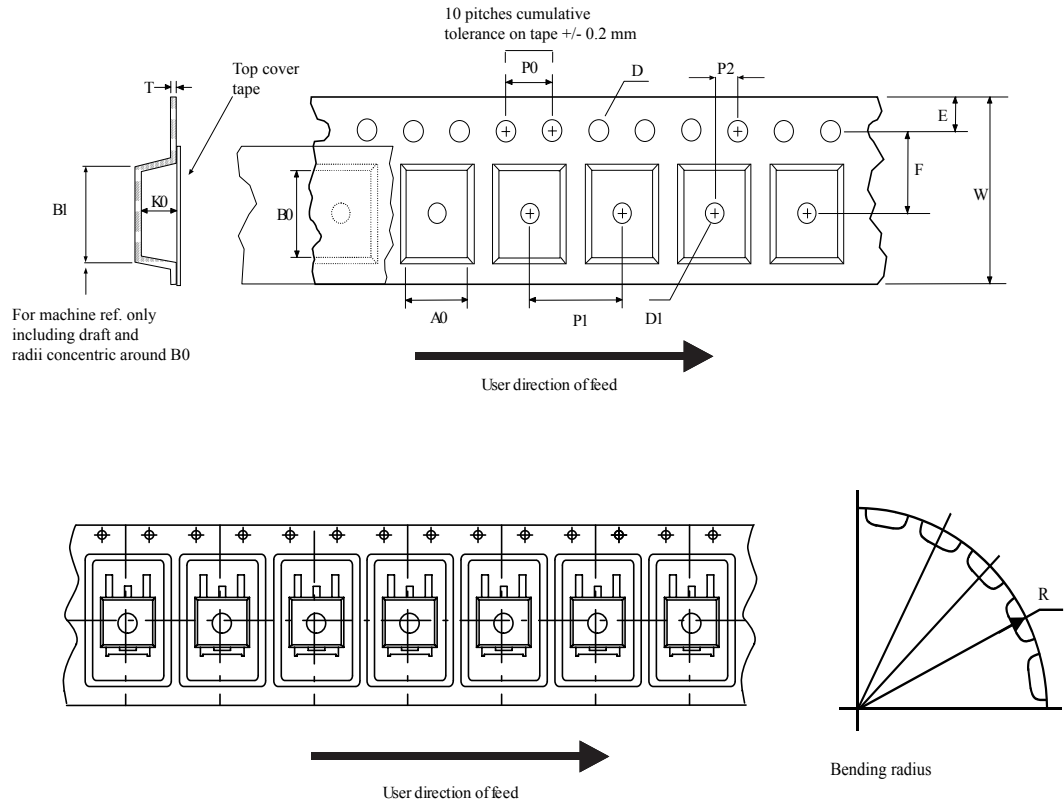
0068772_C2_25

Table 11. DPAK (TO-252) type C2 mechanical data

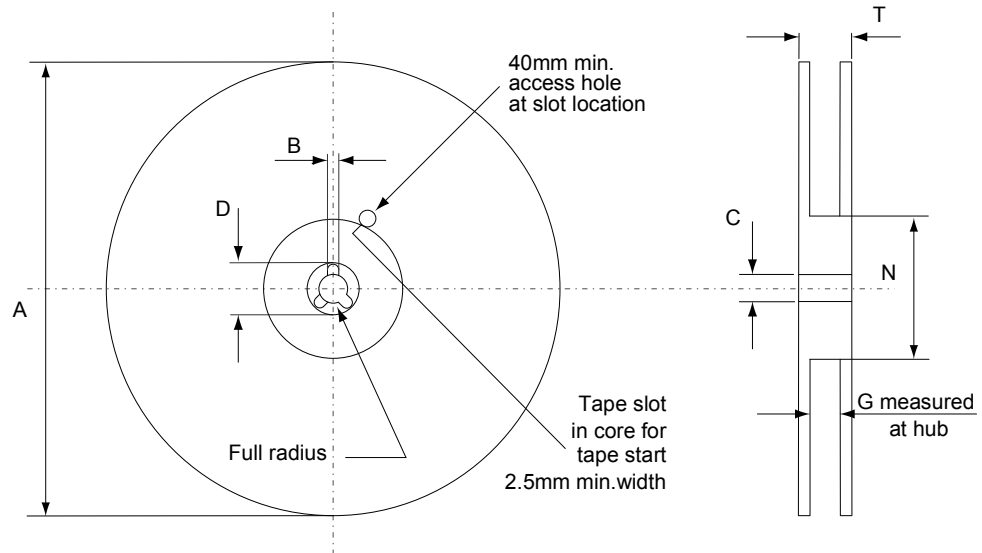
| Dim. | mm | | |
|------|----------|-------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0.90 | 1.01 | 1.10 |
| A2 | 0.00 | | 0.10 |
| b | 0.72 | | 0.85 |
| b4 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | | 0.60 |
| c2 | 0.47 | | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.10 | | 5.60 |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 5.20 | | 5.50 |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.90 | | 1.25 |
| L3 | 0.51 BSC | | |
| L4 | 0.60 | 0.80 | 1.00 |
| L6 | 1.80 BSC | | |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |
| V2 | 0° | | 8° |

4.5 DPAK (TO-252) packing information

Figure 44. DPAK (TO-252) tape outline



AM08852v1

Figure 45. DPAK (TO-252) reel outline


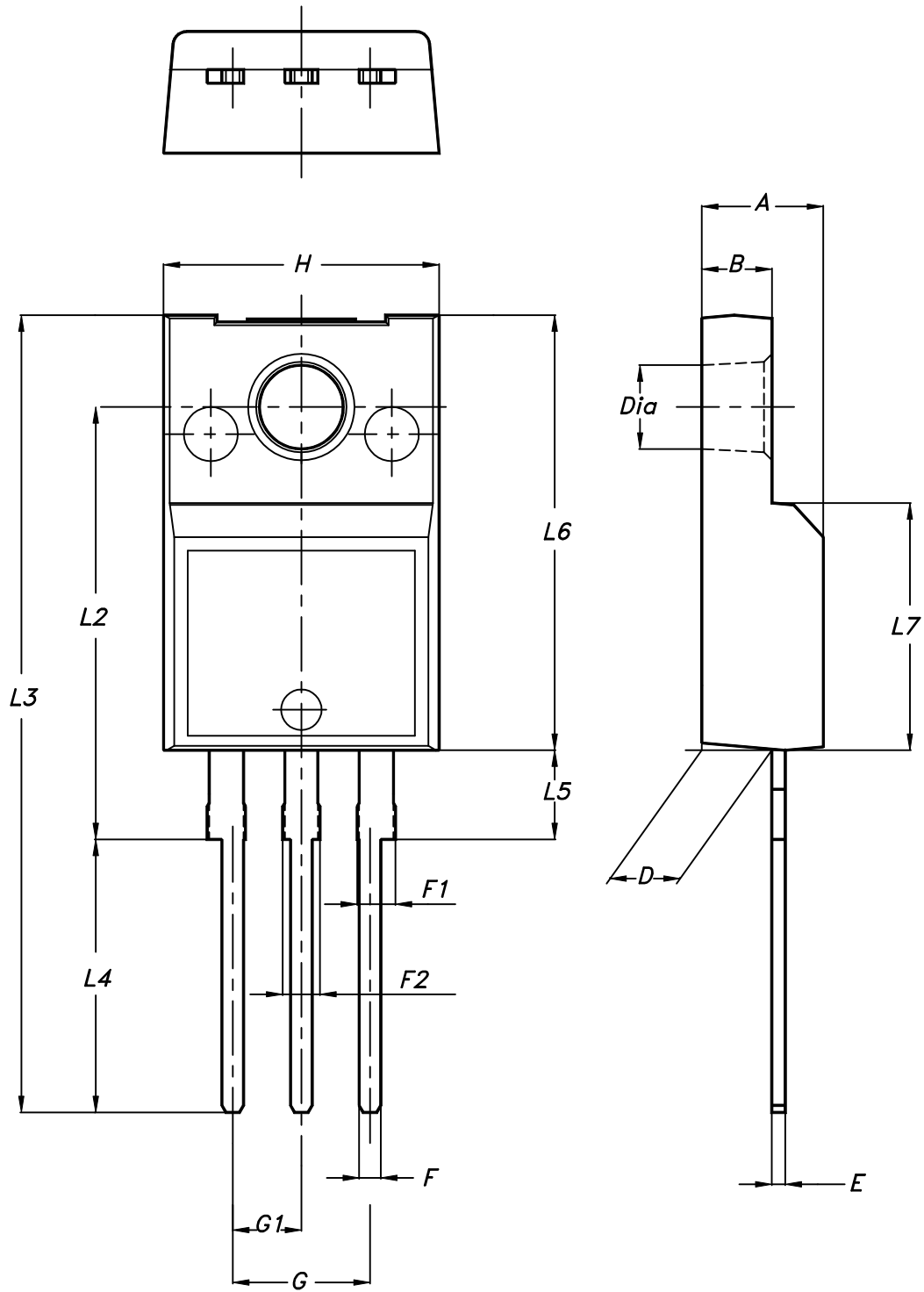
AM06038v1

Table 12. DPAK (TO-252) tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|-----------|------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 6.8 | 7 | A | | 330 |
| B0 | 10.4 | 10.6 | B | 1.5 | |
| B1 | | 12.1 | C | 12.8 | 13.2 |
| D | 1.5 | 1.6 | D | 20.2 | |
| D1 | 1.5 | | G | 16.4 | 18.4 |
| E | 1.65 | 1.85 | N | 50 | |
| F | 7.4 | 7.6 | T | | 22.4 |
| K0 | 2.55 | 2.75 | | | |
| P0 | 3.9 | 4.1 | Base qty. | | 2500 |
| P1 | 7.9 | 8.1 | Bulk qty. | | 2500 |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

4.6 TO-220FP package information

Figure 46. TO-220FP package outline



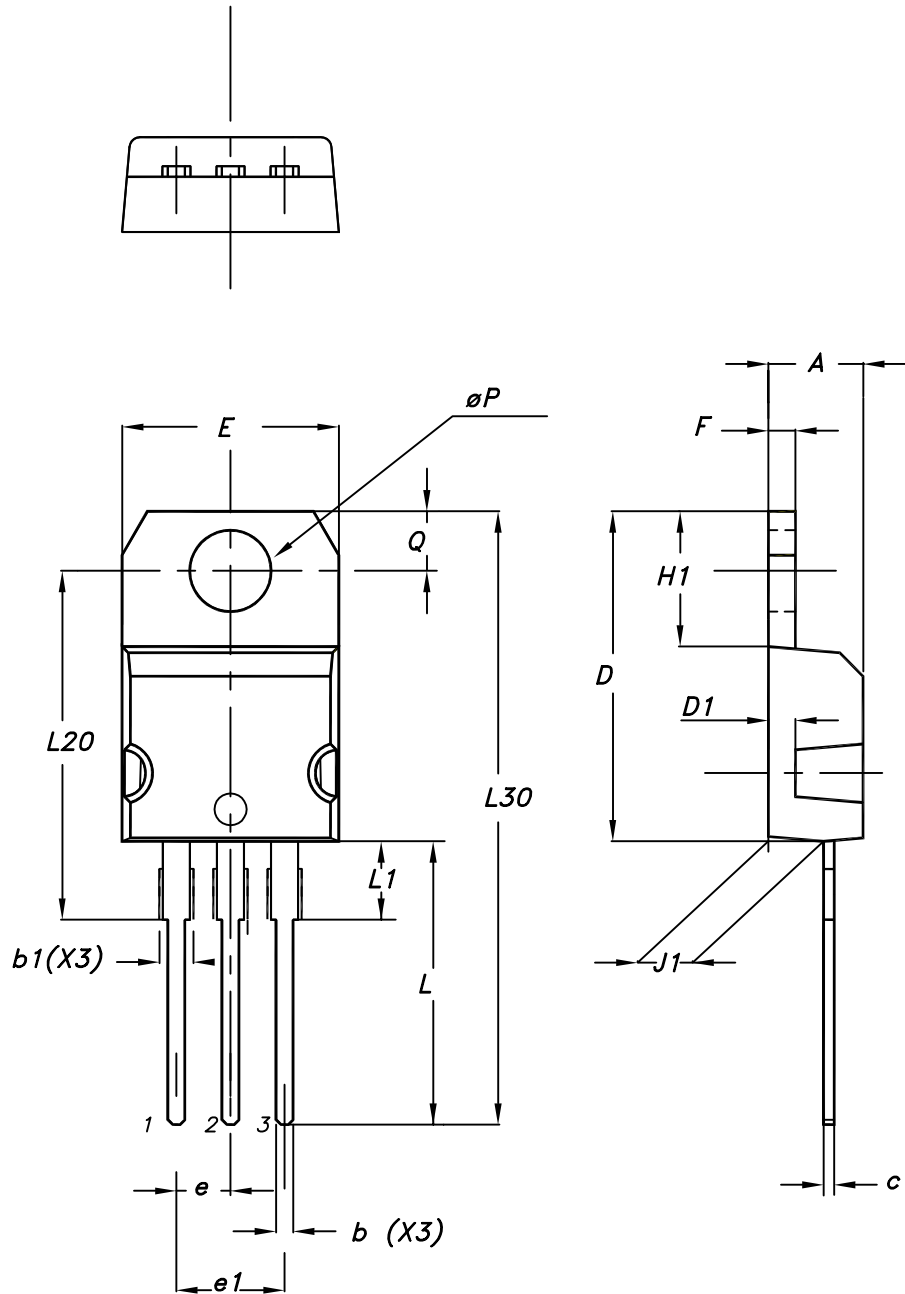
7012510_Rev_12_B

Table 13. TO-220FP package mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 4.4 | | 4.6 |
| B | 2.5 | | 2.7 |
| D | 2.5 | | 2.75 |
| E | 0.45 | | 0.7 |
| F | 0.75 | | 1 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.2 |
| G1 | 2.4 | | 2.7 |
| H | 10 | | 10.4 |
| L2 | | 16 | |
| L3 | 28.6 | | 30.6 |
| L4 | 9.8 | | 10.6 |
| L5 | 2.9 | | 3.6 |
| L6 | 15.9 | | 16.4 |
| L7 | 9 | | 9.3 |
| Dia | 3 | | 3.2 |

4.7 TO-220 type A package information

Figure 47. TO-220 type A package outline



0015988_typeA_Rev_21

Table 14. TO-220 type A package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.55 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10.00 | | 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 | 13.00 | | 14.00 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

5 Ordering information

Table 15. Order codes

| Order code | Marking | Package | Packing |
|------------|----------|--------------------|---------------|
| STGB5H60DF | GB5H60DF | D ² PAK | Tape and reel |
| STGD5H60DF | GD5H60DF | DPAK | |
| STGF5H60DF | GF5H60DF | TO-220FP | Tube |
| STGP5H60DF | GP5H60DF | TO-220 | |

Revision history

Table 16. Document revision history

| Date | Version | Changes |
|-------------|---------|--|
| 28-Nov-2014 | 1 | Initial release. |
| 23-Feb-2015 | 2 | Updated <i>Section 2: Electrical characteristics</i> and <i>Section 4: Package information</i> . Minor text changes. |
| 18-May-2015 | 3 | Text and formatting changes throughout document In <i>Section 1: Electrical ratings</i> : - updated <i>Table 2</i> and <i>Table 3</i> In <i>Section 2: Electrical characteristics</i> : - updated <i>Table 4</i> , <i>Table 5</i> , <i>Table 6</i> , <i>Table 7</i> and <i>Table 8</i> Added <i>Section 2.1: Electrical characteristics (curves)</i> Updated <i>Section 4.2: DPAK package information</i> Document status promoted from "preliminary data" to "production data" |
| 18-Sep-2018 | 4 | Removed maturity status indication from cover page. Updated Section 4 Package information . Minor text changes. |

Contents

| | | |
|------------|--|-----------|
| 1 | Electrical ratings | 2 |
| 2 | Electrical characteristics | 3 |
| 2.1 | Electrical characteristics curves | 5 |
| 3 | Test circuits | 11 |
| 4 | Package information | 12 |
| 4.1 | D ² PAK (TO-263) type A package information | 12 |
| 4.2 | D ² PAK packing information | 15 |
| 4.3 | DPAK (TO-252) type A2 package information | 17 |
| 4.4 | DPAK (TO-252) type C2 package information | 19 |
| 4.5 | DPAK (TO-252) packing information | 21 |
| 4.6 | TO-220FP package information | 23 |
| 4.7 | TO-220 type A package information | 25 |
| 5 | Ordering information | 28 |
| | Revision history | 29 |



IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved