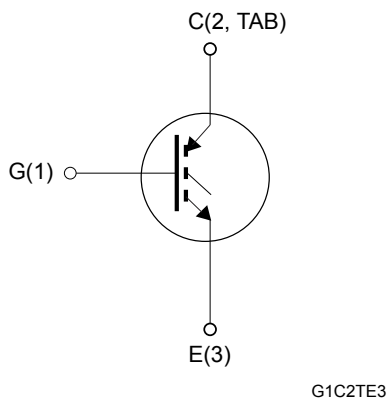
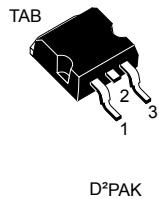


Trench gate field-stop IGBT, HB series 650 V, 40 A high speed



Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage: $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 40\text{ A}$
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance

Applications

- Photovoltaic inverters
- High frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status link

[STGB40H65FB](#)

Product summary

| | |
|-------------------|--------------------|
| Order code | STGB40H65FB |
| Marking | GB40H65FB |
| Package | D ² PAK |
| Packing | Tape and reel |

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|------------------------------------------------|-------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$ V) | 650 | V |
| I_C | Continuous collector current at $T_C = 25$ °C | 80 | A |
| | Continuous collector current at $T_C = 100$ °C | 40 | |
| $I_{CP}^{(1)}$ | Pulsed collector current | 160 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| P_{TOT} | Total power dissipation at $T_C = 25$ °C | 283 | W |
| T_{STG} | Storage temperature range | - 55 to 150 | °C |
| T_J | Operating junction temperature range | - 55 to 175 | |

1. Pulse width limited by maximum junction temperature.

Table 2. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|-------------------------------------|-------|------|
| R_{thJC} | Thermal resistance junction-case | 0.53 | °C/W |
| R_{thJA} | Thermal resistance junction-ambient | 62.5 | |

2 Electrical characteristics

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

Table 3. Static characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------|----------------------------------------------------------------------|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$ | 650 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$ | | 1.6 | 2 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 125\text{ °C}$ | | 1.7 | | |
| | | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 175\text{ °C}$ | | 1.8 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$ | 5 | 6 | 7 | V |
| I_{CES} | Collector cut-off current | $V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$ | | | 25 | μA |
| I_{GES} | Gate-emitter leakage current | $V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$ | | | ± 250 | nA |

Table 4. Dynamic characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 5412 | - | pF |
| C_{oes} | Output capacitance | | - | 198 | - | |
| C_{res} | Reverse transfer capacitance | | - | 107 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 22. Gate charge test circuit) | - | 210 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 39 | - | |
| Q_{gc} | Gate-collector charge | | - | 82 | - | |

Table 5. Switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\ \Omega$ (see Figure 21. Test circuit for inductive load switching) | - | 40 | - | ns |
| t_r | Current rise time | | - | 13 | - | |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 2413 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | | - | 142 | - | ns |
| t_f | Current fall time | | - | 27 | - | |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 498 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 363 | - | |
| E_{ts} | Total switching energy | | - | 861 | - | |
| $t_{d(on)}$ | Turn-on delay time | | $V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 21. Test circuit for inductive load switching) | - | 38 | - |
| t_r | Current rise time | - | | 14 | - | |
| $(di/dt)_{on}$ | Turn-on current slope | - | | 2186 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | - | | 141 | - | ns |
| t_f | Current fall time | - | | 61 | - | |
| $E_{on}^{(1)}$ | Turn-on switching energy | - | | 1417 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | - | | 764 | - | |
| E_{ts} | Total switching energy | - | | 2181 | - | |

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

2.1 Electrical characteristics (curves)

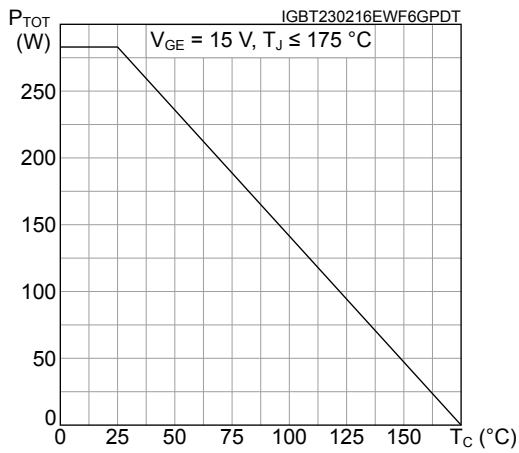
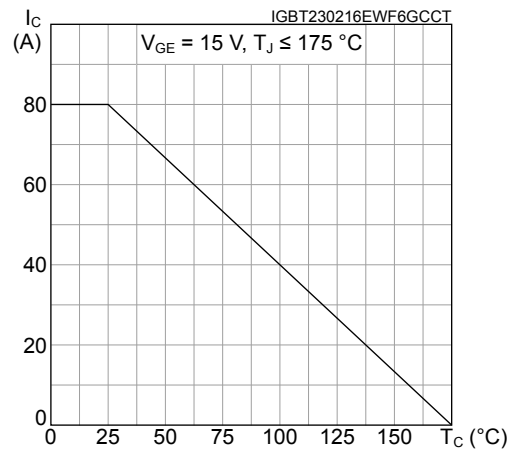
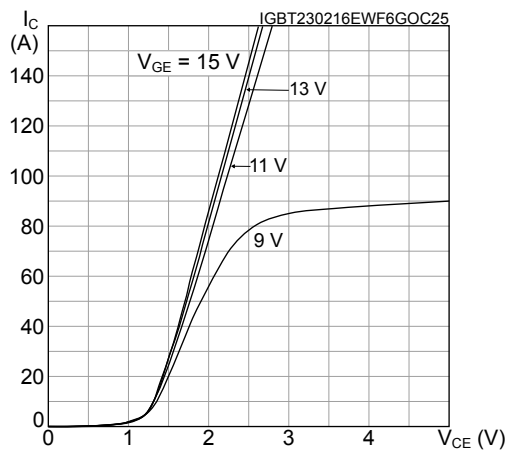
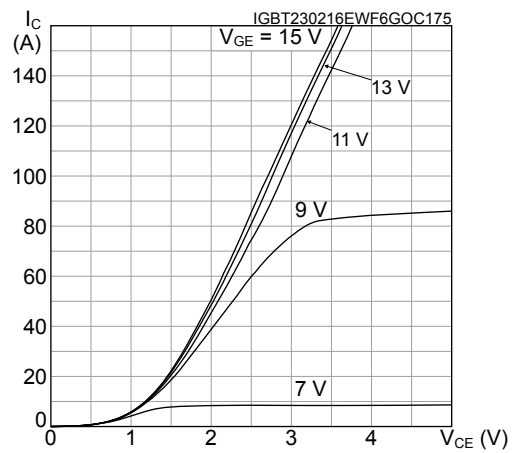
Figure 1. Power dissipation vs. case temperature

Figure 2. Collector current vs. case temperature

Figure 3. Output characteristics ($T_J = 25\text{ }^\circ\text{C}$)

Figure 4. Output characteristics ($T_J = 175\text{ }^\circ\text{C}$)


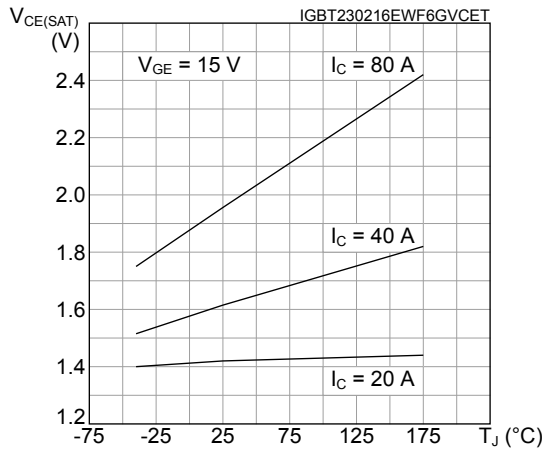
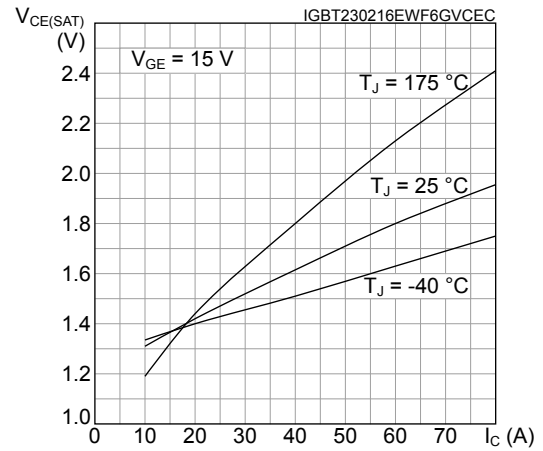
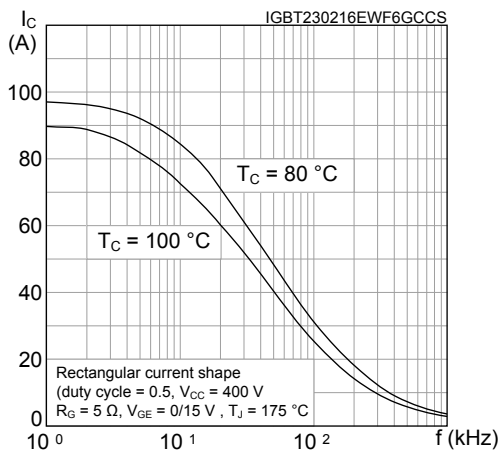
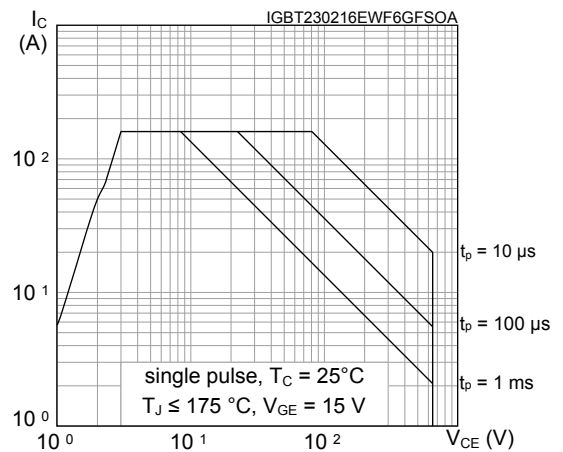
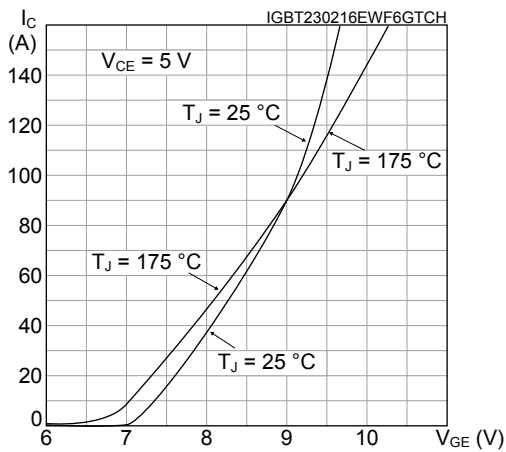
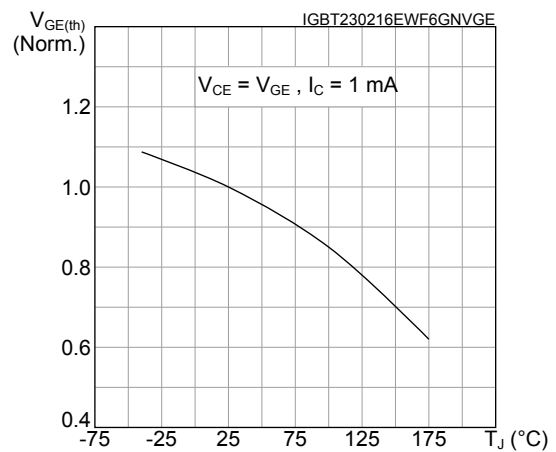
Figure 5. $V_{CE(sat)}$ vs. junction temperature

Figure 6. $V_{CE(sat)}$ vs. collector current

Figure 7. Collector current vs. switching frequency

Figure 8. Forward bias safe operating area

Figure 9. Transfer characteristics

Figure 10. Normalized $V_{GE(th)}$ vs. junction temperature


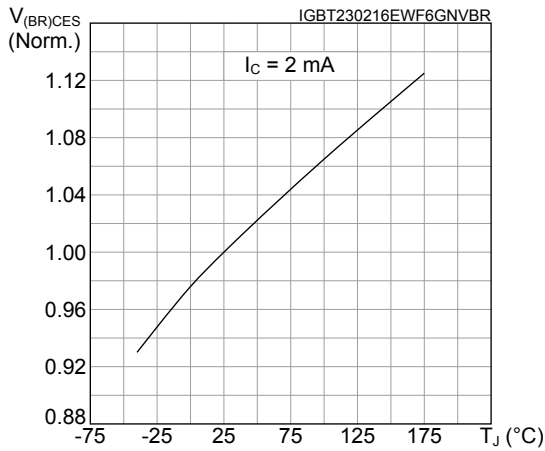
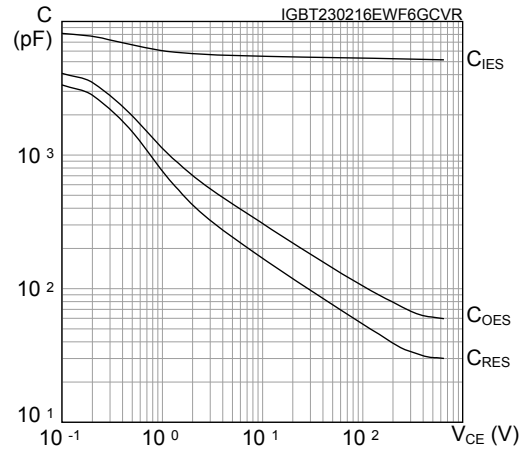
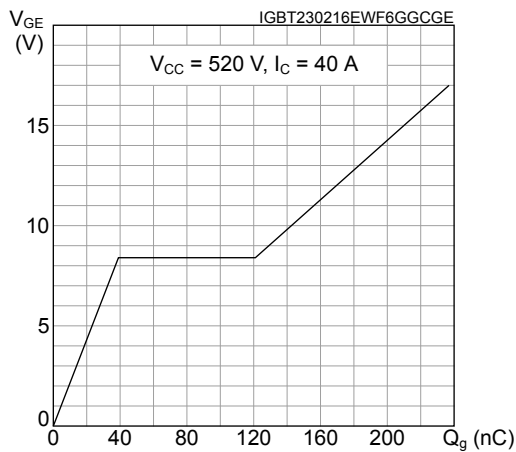
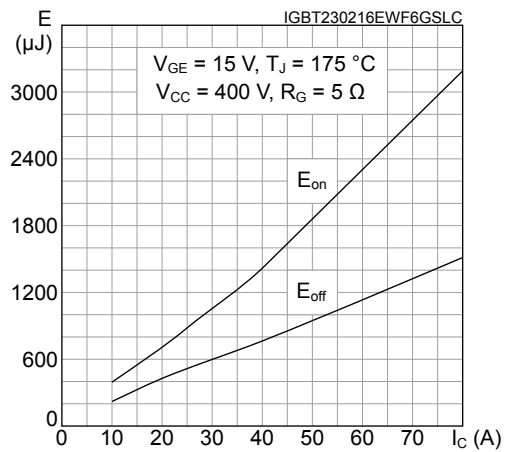
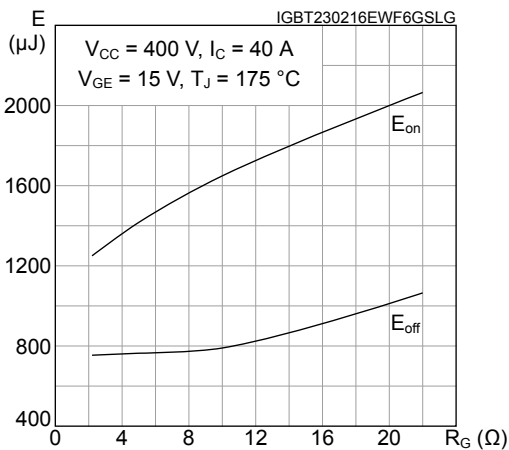
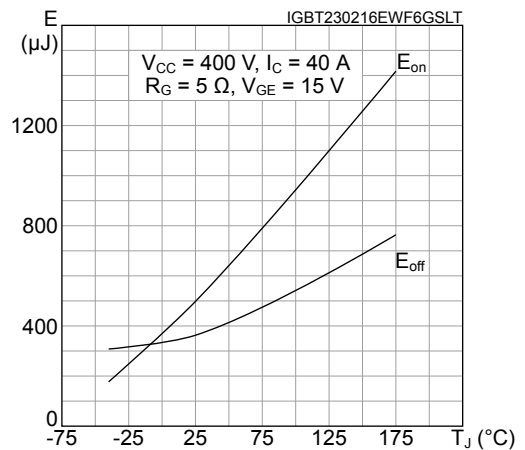
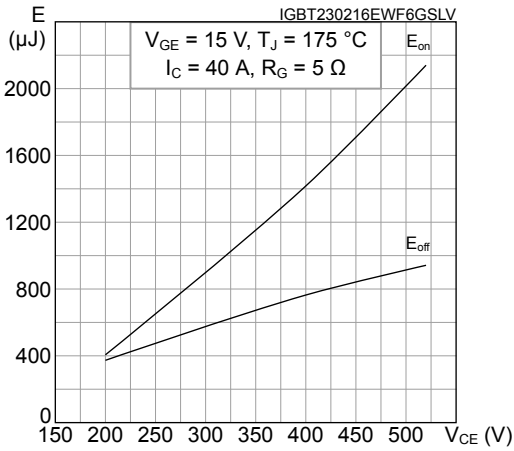
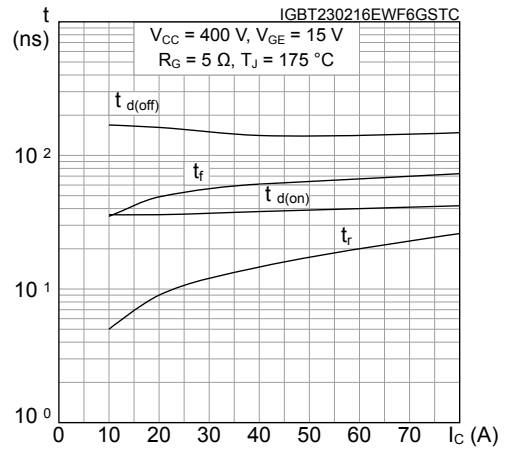
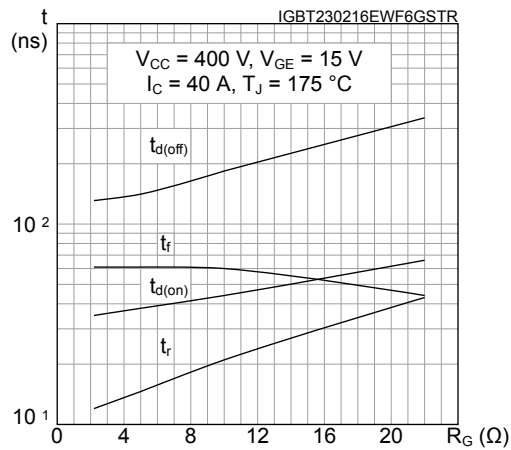
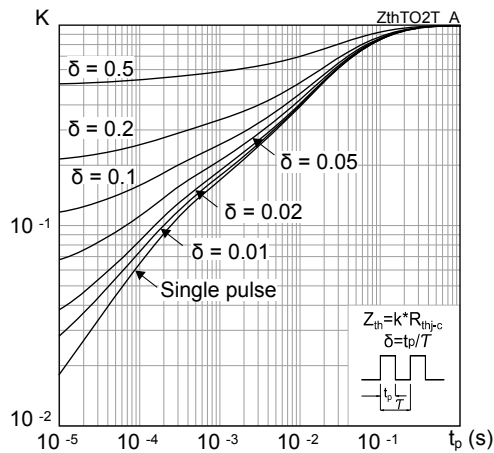
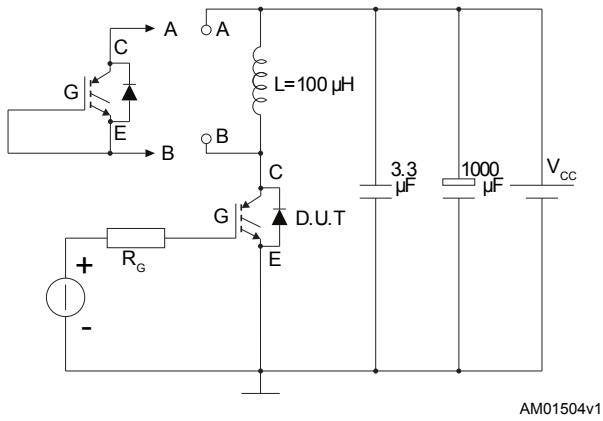
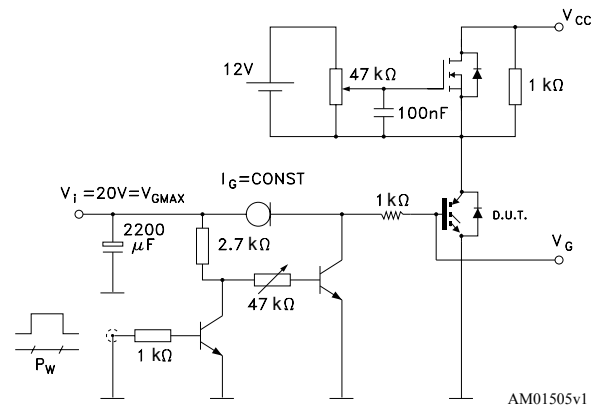
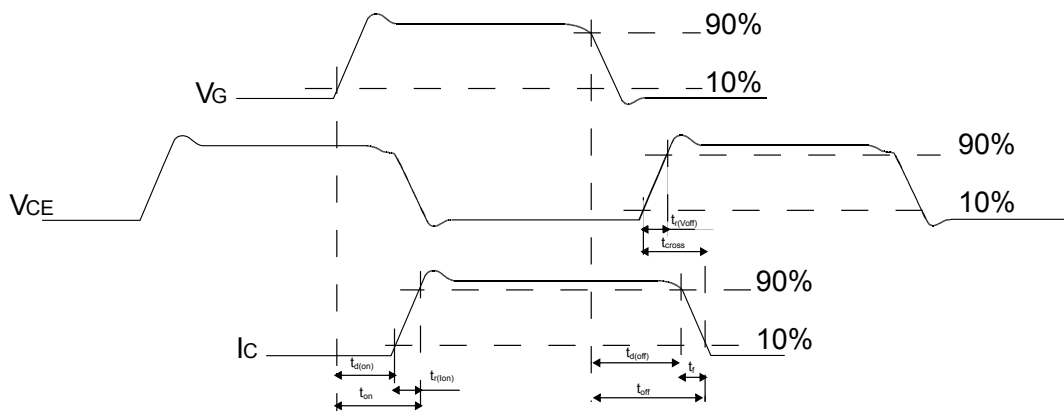
Figure 11. Normalized $V_{(BR)CES}$ vs. junction temperature

Figure 12. Capacitance variations

Figure 13. Gate charge vs. gate-emitter voltage

Figure 14. Switching energy vs. collector current

Figure 15. Switching energy vs. gate resistance

Figure 16. Switching energy vs. temperature


Figure 17. Switching energy vs. collector emitter voltage

Figure 18. Switching times vs. collector current

Figure 19. Switching times vs. gate resistance

Figure 20. Thermal impedance


3 Test circuits

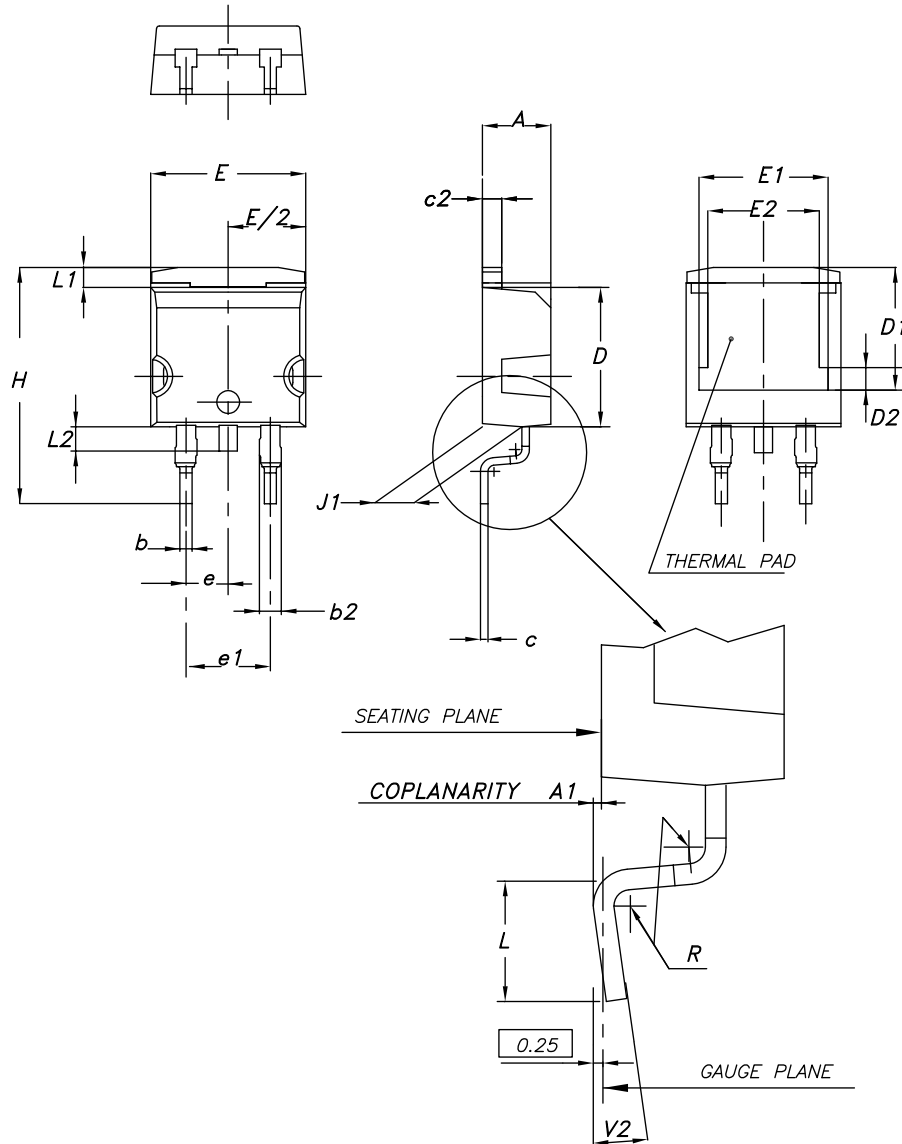
Figure 21. Test circuit for inductive load switching

Figure 22. Gate charge test circuit

Figure 23. Switching 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 A2 package information

Figure 24. D²PAK (TO-263) type A2 package outline

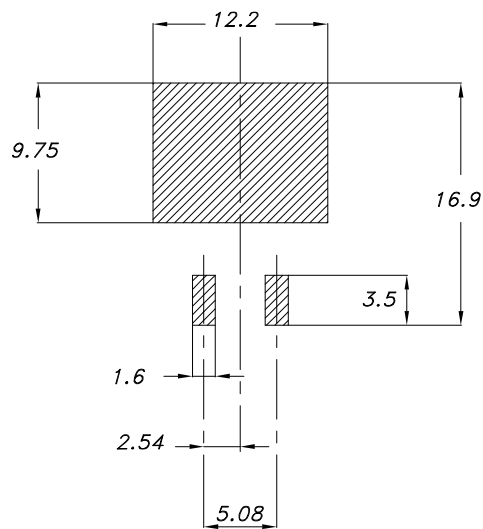


0079457_A2_25

Table 6. D²PAK (TO-263) type A2 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 | 8.70 | 8.90 | 9.10 |
| E2 | 7.30 | 7.50 | 7.70 |
| 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° |

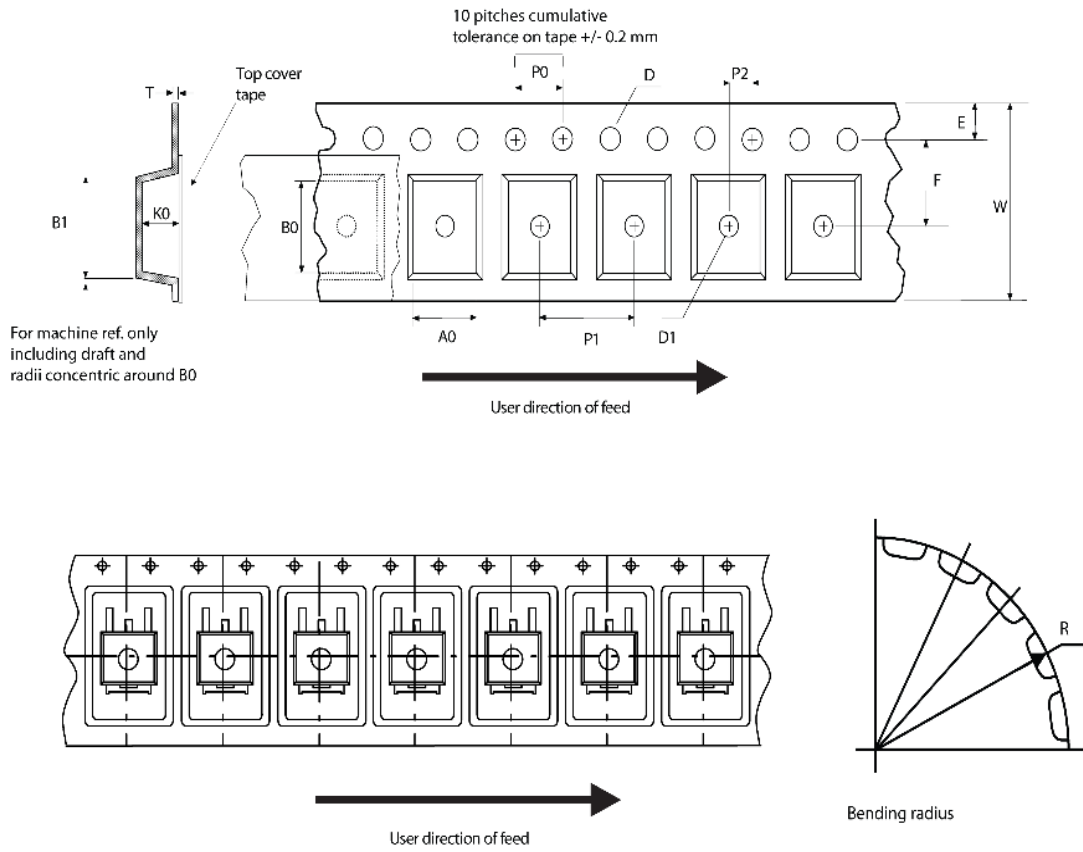
Figure 25. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint

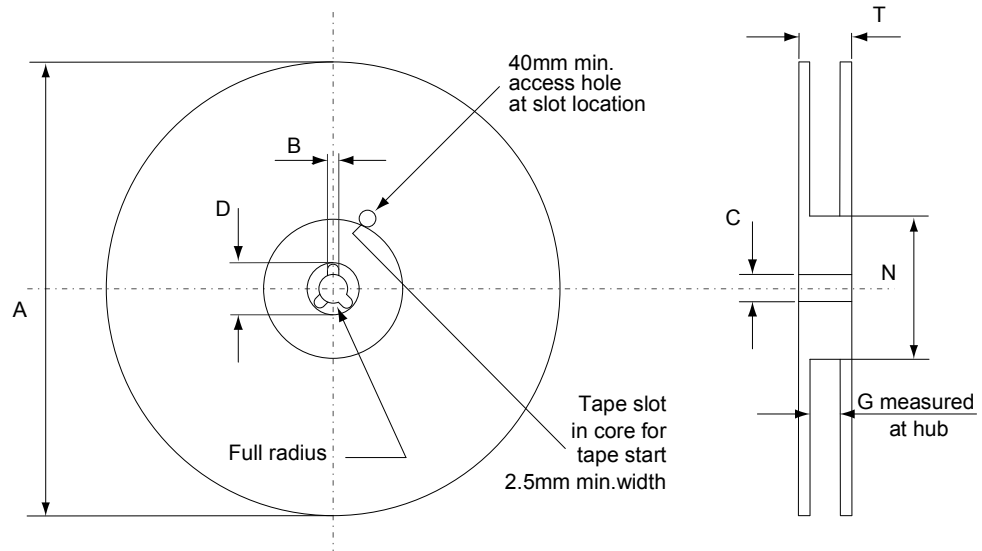
4.2 D²PAK packing information

Figure 26. D²PAK tape outline



AM08852v1

Figure 27. D²PAK reel outline



AM06038v1

Table 7. 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 | Base quantity | | | | |
| P1 | 11.9 | 12.1 | | | | 1000 | |
| P2 | 1.9 | 2.1 | | | | Bulk quantity | |
| R | 50 | | | | | 1000 | |
| T | 0.25 | 0.35 | | | | | |
| W | 23.7 | 24.3 | | | | | |

Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------------------------------------------------------------------------------------|
| 27-Jun-2016 | 1 | Initial release. |
| 13-Feb-2019 | 2 | Updated Section 4.1 D²PAK (TO-263) type A2 package information . |

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