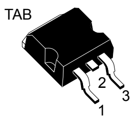
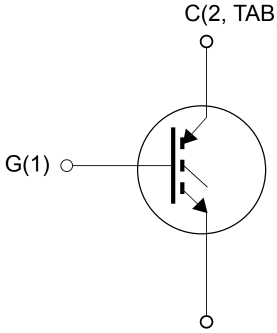
# STGB50H65FB2

Datasheet

## Trench gate field-stop, 650 V, 50 A, high-speed HB2 series IGBT in a D²PAK package




D²PAK




G1C2TE3

| Product status link |
| --- |
| STGB50H65FB2 |

| Product summary | |
| --- | --- |
| **Order code** | STGB50H65FB2 |
| **Marking** | G50H65FB2 |
| **Package** | D²PAK |
| **Packing** | Tape and reel |

## Features

- Maximum junction temperature: $T_J$ = 175 °C
- Low $V_{CE(sat)}$ = 1.55 V(typ.) @ $I_C$ = 50 A
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

## Applications

- Welding
- Power factor correction
- UPS
- Solar inverters
- Chargers

## Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performance of the HB2 series is optimized in terms of conduction, thanks to a better $V_{CE(sat)}$ behavior at low current values, as well as in terms of reduced switching energy. The result is a product specifically designed to maximize efficiency for a wide range of fast applications.

# 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 | 86 | A |
| | Continuous collector current at $T_C$ = 100 °C | 53 | |
| $I_{CP}$ (1)(2) | Pulsed collector current | 150 | |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| | Transient gate-emitter voltage ($t_p \leq 10$ μs) | ±30 | |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 272 | W |
| $T_{stg}$ | Storage temperature range | -55 to 150 | °C |
| $T_J$ | Operating junction temperature range | -55 to 175 | |

1. *Defined by design, not subject to production test.*
2. *Pulse width is limited by maximum junction temperature.*

Table 2. **Thermal data**

| Symbol | Parameter | Value | Unit |
| --- | --- | --- | --- |
| $R_{thJC}$ | Thermal resistance junction-case | 0.55 | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50 | |

# 2 Electrical characteristics

$T_C$ = 25 °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 V, $I_C$ = 1 mA | 650 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 50 A | | 1.55 | 2 | V |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A, $T_J$ = 125 °C | | 1.8 | | |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A, $T_J$ = 175 °C | | 1.9 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA | 5 | 6 | 7 | V |
| $I_{CES}$ | Collector cut-off current | $V_{GE}$ = 0 V, $V_{CE}$ = 650 V | | | 25 | µA |
| $I_{GES}$ | Gate-emitter leakage current | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | | ±250 | nA |

**Table 4. Dynamic characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 25 V, f = 1 MHz, $V_{GE}$ = 0 V | - | 2928 | - | pF |
| $C_{oes}$ | Output capacitance | | - | 162 | - | |
| $C_{res}$ | Reverse transfer capacitance | | - | 78 | - | |
| $Q_g$ | Total gate charge | $V_{CC}$ = 520 V, $I_C$ = 50 A, $V_{GE}$ = 0 to 15 V (see Figure 22. Gate charge test circuit) | - | 151 | - | nC |
| $Q_{ge}$ | Gate-emitter charge | | - | 30 | - | |
| $Q_{gc}$ | Gate-collector charge | | - | 63 | - | |

**Table 5. Switching characteristics (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V, $R_G$ = 4.7 Ω (see Figure 21. Test circuit for inductive load switching) | - | 28 | - | ns |
| $t_r$ | Current rise time | | - | 20 | - | ns |
| $E_{on}$ (1) | Turn-on switching energy | | - | 910 | - | µJ |
| $t_{d(off)}$ | Turn-off delay time | | - | 115 | - | ns |
| $t_f$ | Current fall time | | - | 40 | - | ns |
| $E_{off}$ (2) | Turn-off switching energy | | - | 580 | - | µJ |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V, $R_G$ = 4.7 Ω, $T_J$ = 175 °C (see Figure 21. Test circuit for inductive load switching) | - | 24 | - | ns |
| $t_r$ | Current rise time | | - | 17 | - | ns |
| $E_{on}$ (1) | Turn-on switching energy | | - | 1800 | - | µJ |
| $t_{d(off)}$ | Turn-off delay time | | - | 135 | - | ns |
| $t_f$ | Current fall time | | - | 90 | - | ns |

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{off}$ [(2)] | Turn-off switching energy | $V_{CC}$ = 400 V, $I_C$ = 50 A,<br>$V_{GE}$ = 15 V, $R_G$ = 4.7 Ω, $T_J$ = 175 °C<br>(see Figure 21. Test circuit for inductive load switching) | - | 1090 | - | µJ |

1. *Including the reverse recovery of the external diode. The diode is the same of the co-packed STGWA50H65DFB2.*
2. *Including the tail of the collector current.*

## 2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

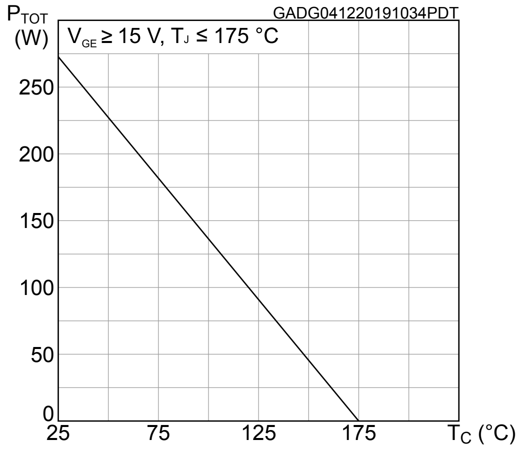



Figure 2. Collector current vs case temperature

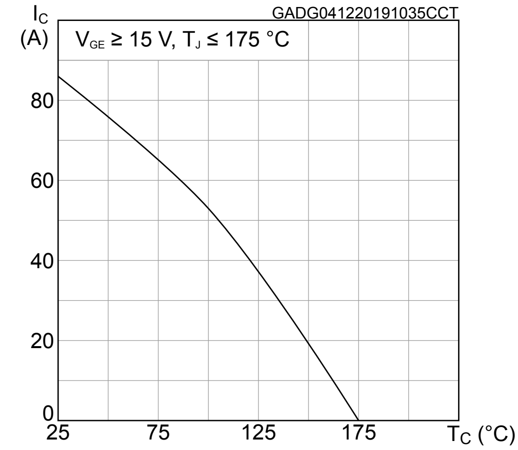



Figure 3. Output characteristics ($T_J$ = 25 °C)

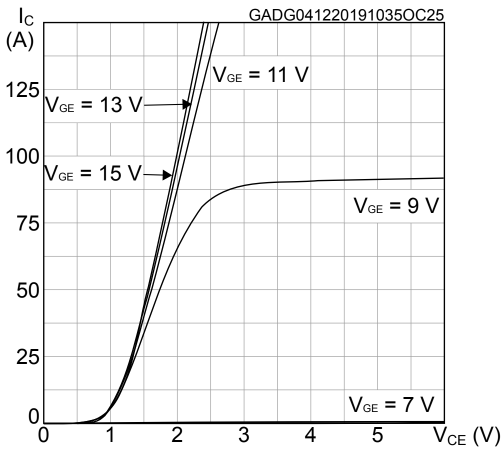



Figure 4. Output characteristics ($T_J$ = 175 °C)

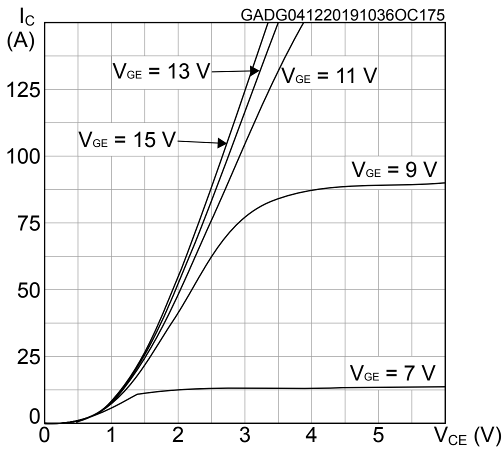



Figure 5. $V_{CE(sat)}$ vs junction temperature

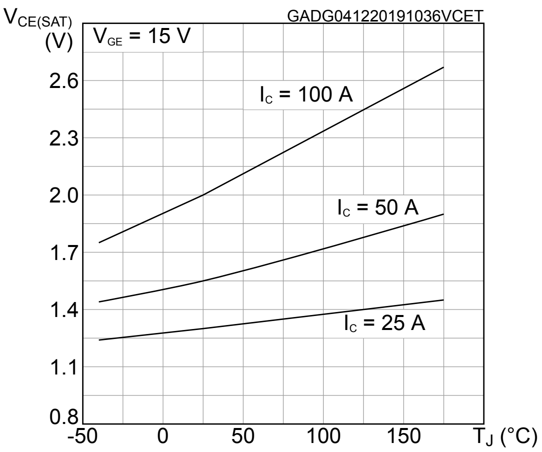



Figure 6. $V_{CE(sat)}$ vs collector current

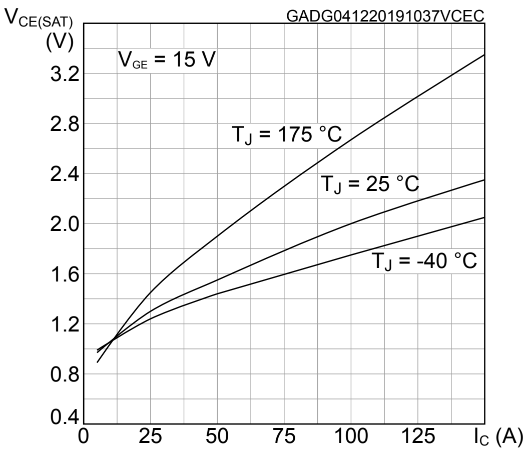


**Figure 7. Collector current vs switching frequency**

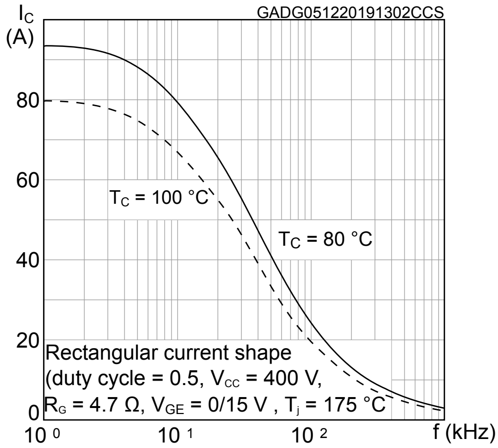



**Figure 8. Forward bias safe operating area**

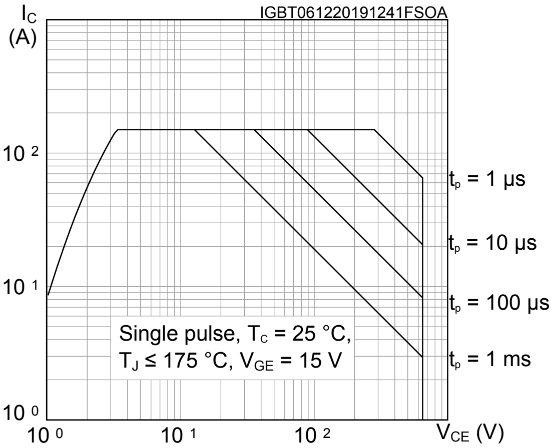



**Figure 9. Transfer characteristics**

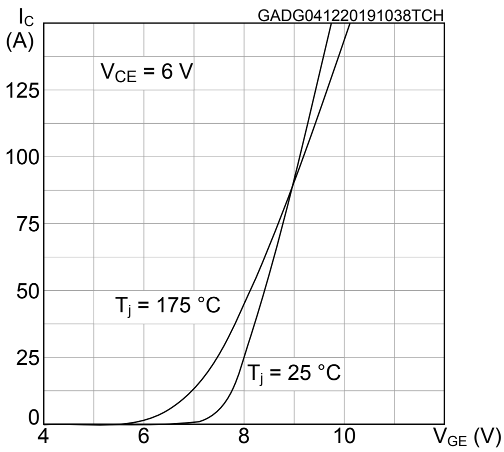



**Figure 10. Normalized $V_{GE(th)}$ vs junction temperature**

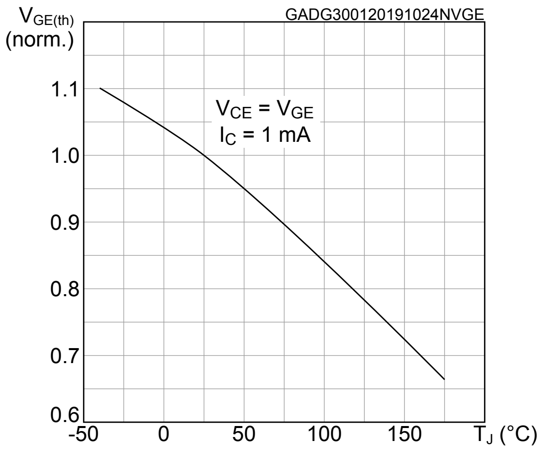



**Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature**

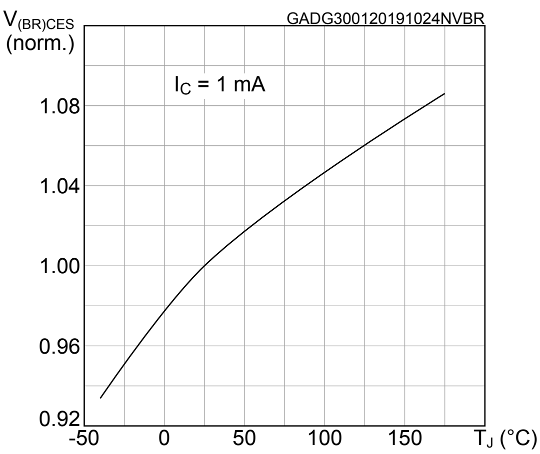



**Figure 12. Capacitance variations**

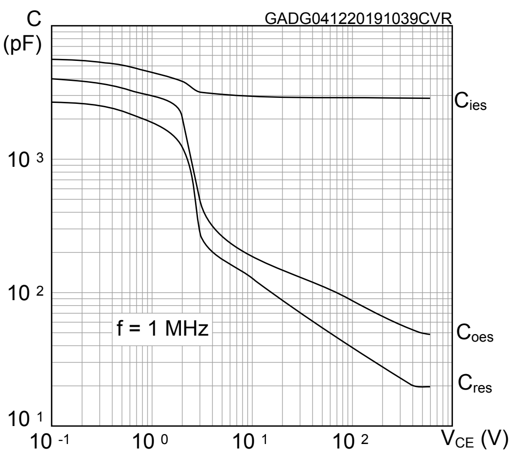


**Figure 13.** Gate charge vs gate-emitter voltage

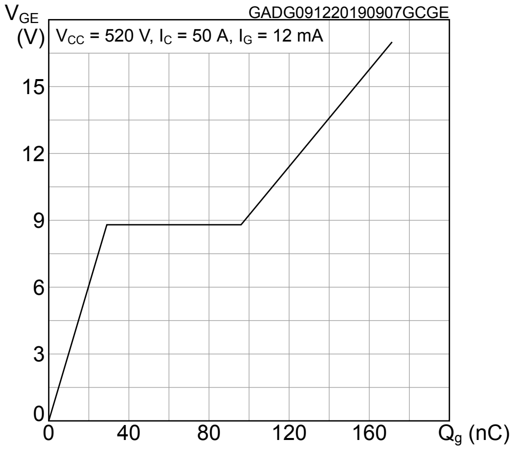



**Figure 14.** Switching energy vs collector current

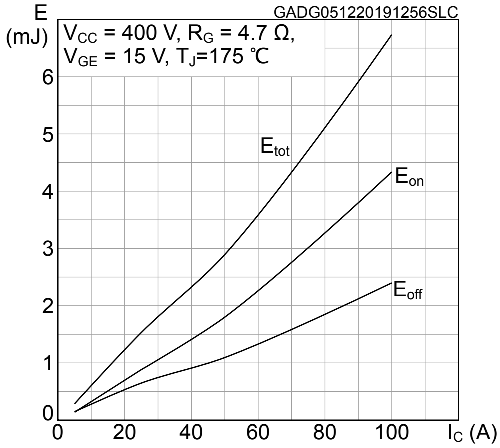



**Figure 15.** Switching energy vs temperature

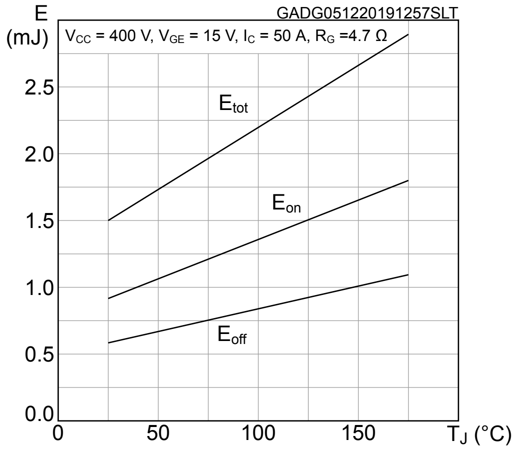



**Figure 16.** Switching energy vs collector emitter voltage

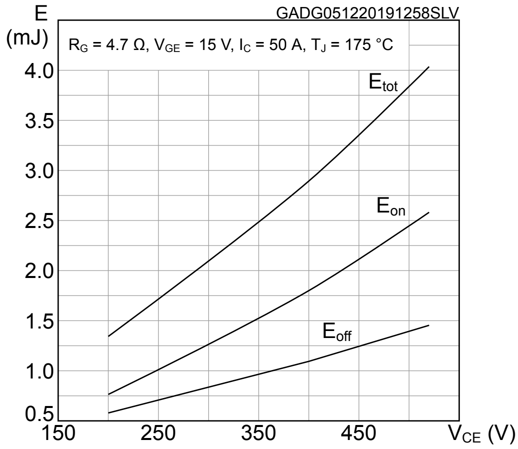



**Figure 17.** Switching energy vs gate resistance

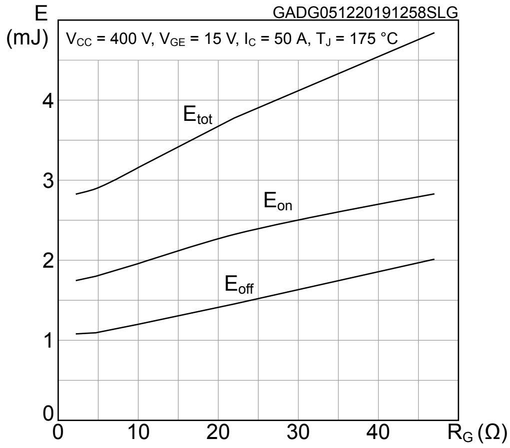
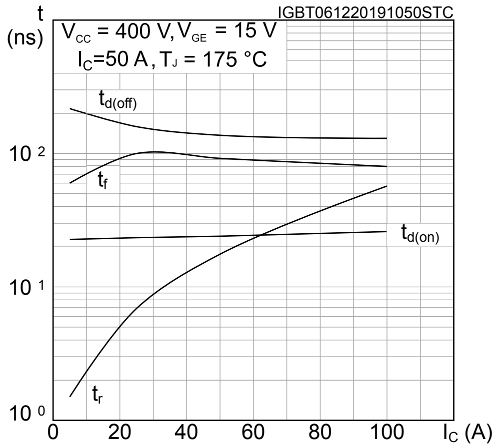



**Figure 18.** Switching times vs collector current



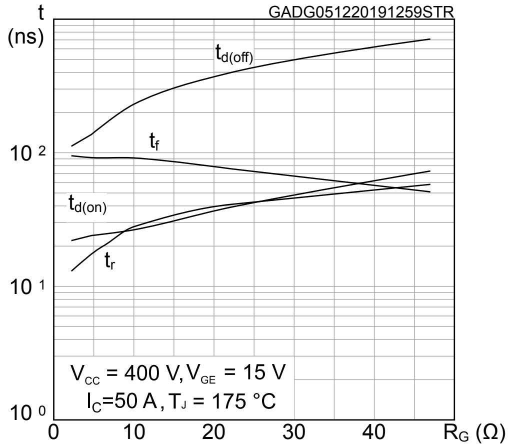



**Figure 19.** Switching times vs gate resistance

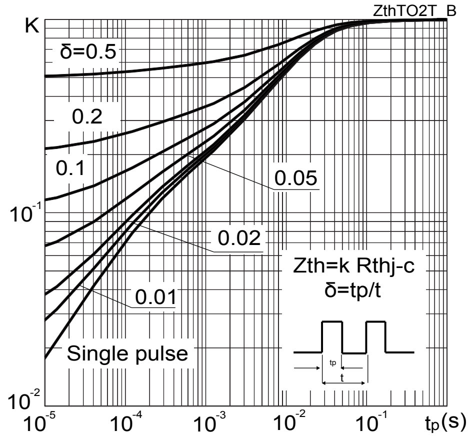



**Figure 20.** Thermal impedance

# 3 Test circuits

**Figure 21.** Test circuit for inductive load switching

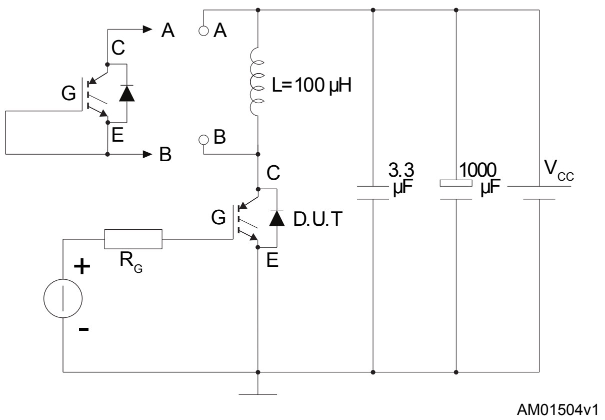



**Figure 22.** Gate charge test circuit

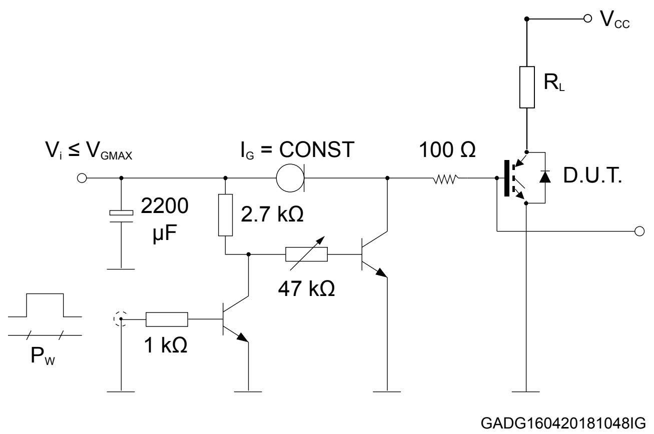
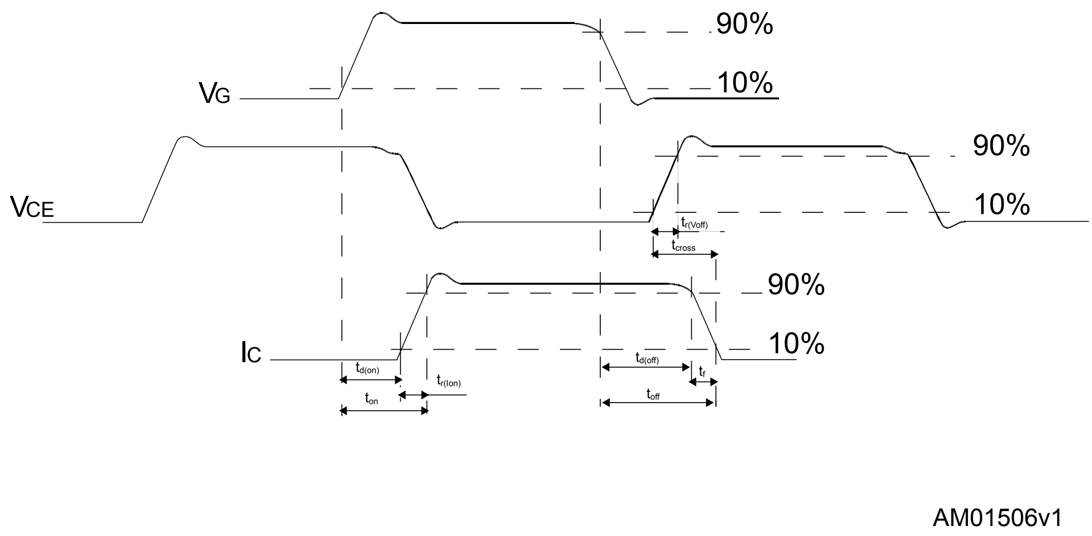



**Figure 23.** Switching waveform

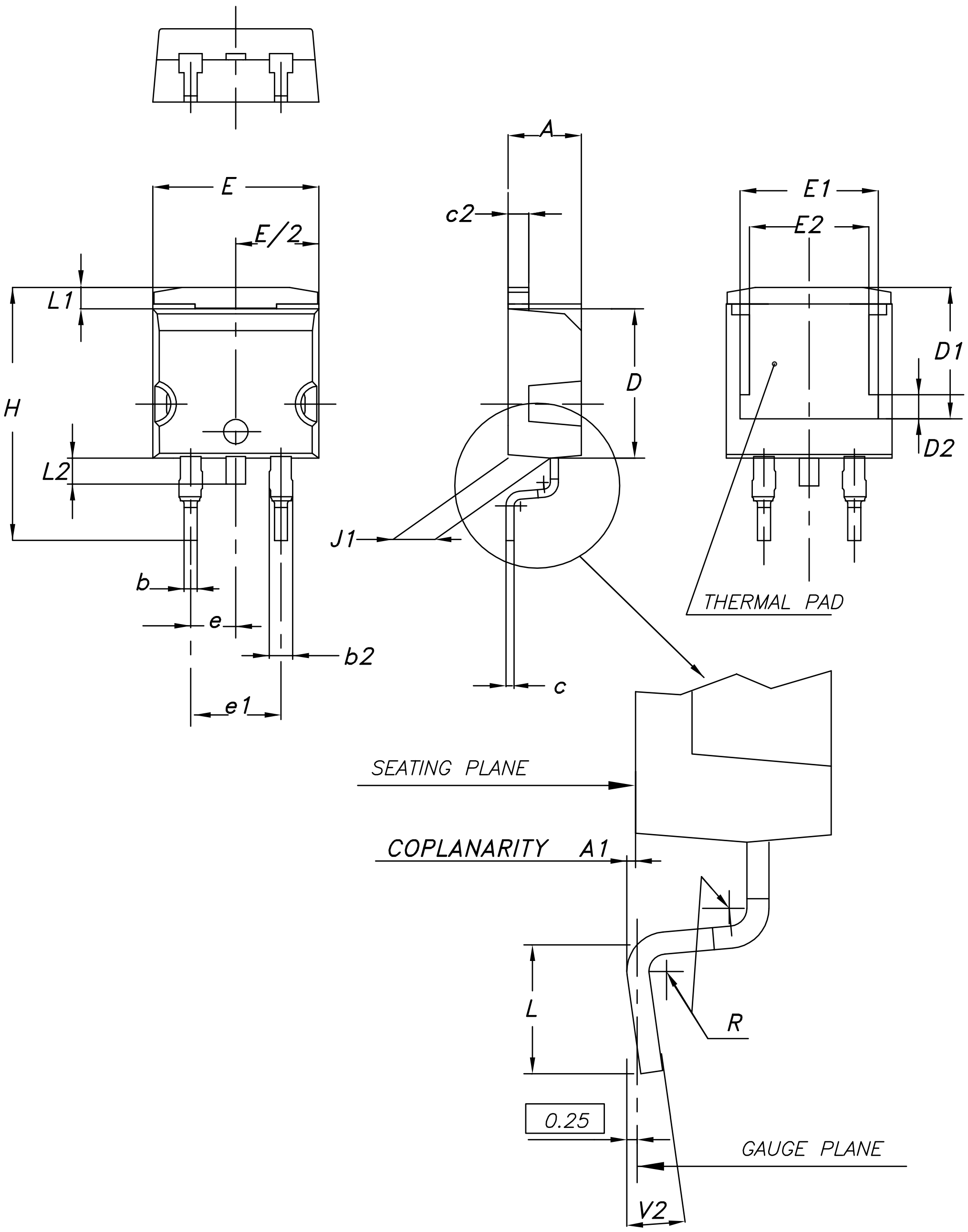


# 4 Package information

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

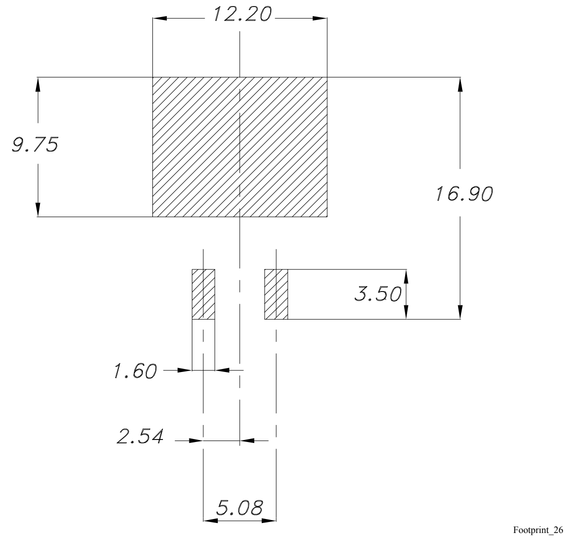



0079457_A2_26

**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)



## 4.2 D²PAK packing information

Figure 26. D²PAK tape outline

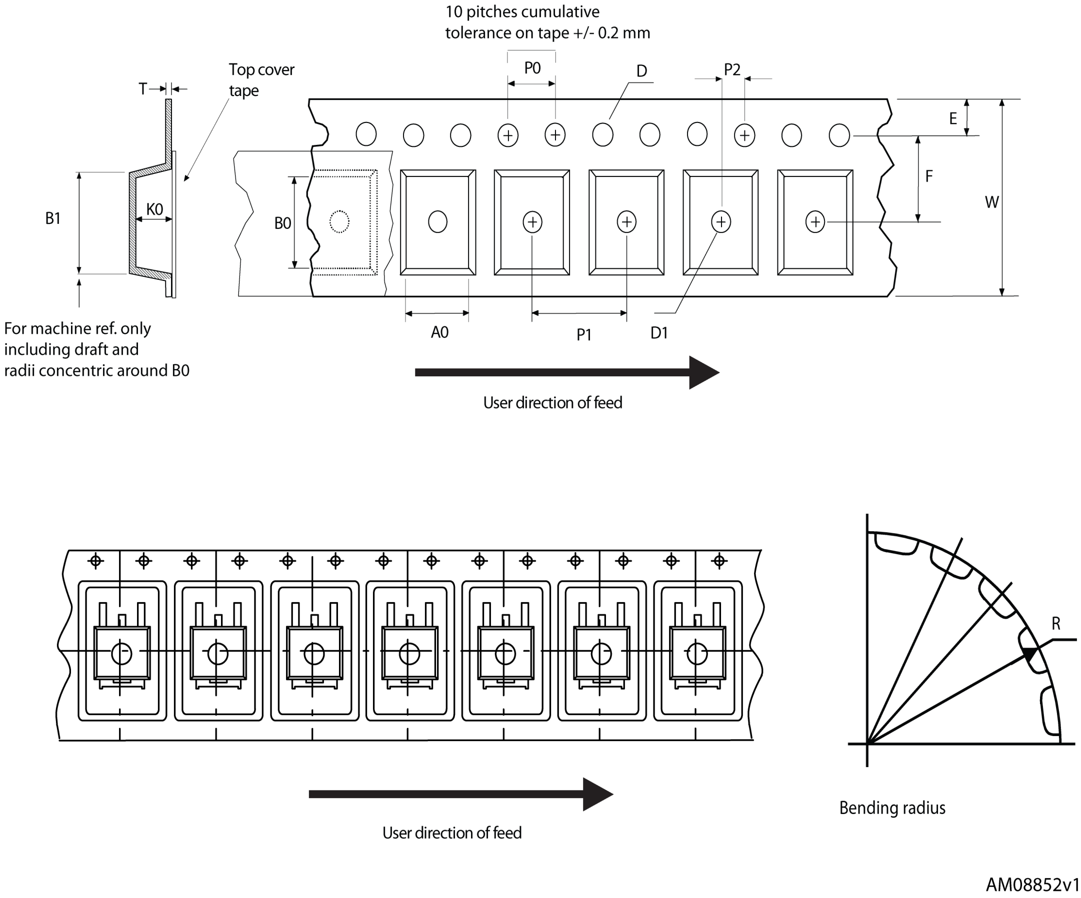


**Figure 27.** D²PAK reel outline

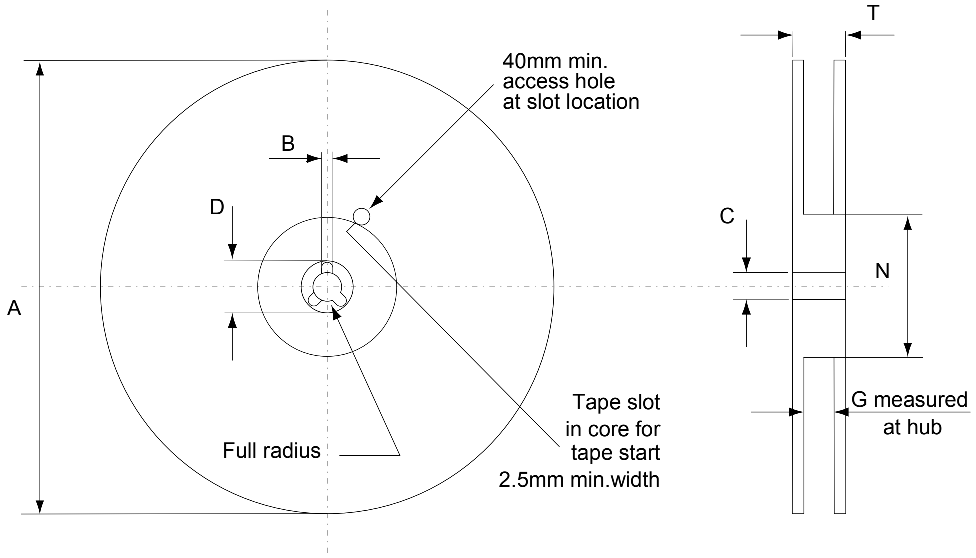



**Table 7.** D²PAK tape and reel mechanical data

| 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 | | | |
| 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 | | | |

## Revision history

**Table 8. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 16-Jan-2020 | 1 | First release. |
| 21-May-2020 | 2 | Updated Section 4 Package information. |

## Contents