

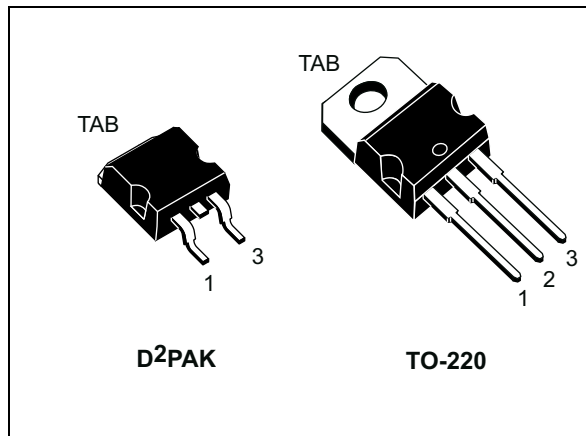
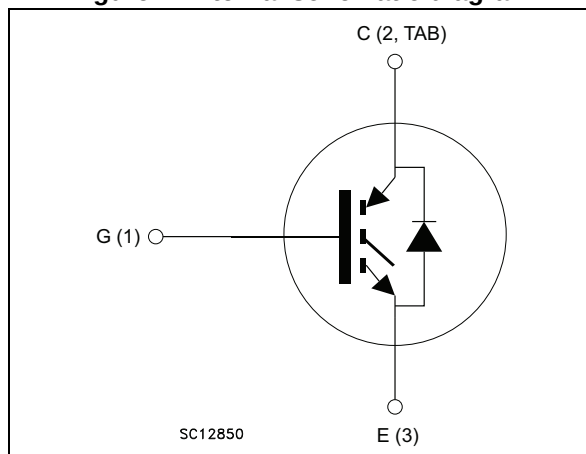


Figure 1. Internal schematic diagram



## Features

- Maximum junction temperature:  $T_J = 175\text{ }^{\circ}\text{C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

## Applications

- Photovoltaic inverters
- High frequency converters

## Description

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

Table 1. Device summary

| Order code   | Marking    | Package | Packaging     |
|--------------|------------|---------|---------------|
| STGB30H60DFB | GB30H60DFB | D2PAK   | Tape and reel |
| STGP30H60DFB | GP30H60DFB | TO-220  | Tube          |

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                             | Value       | Unit |
|----------------|-------------------------------------------------------|-------------|------|
| $V_{CES}$      | Collector-emitter voltage ( $V_{GE} = 0$ )            | 600         | V    |
| $I_C$          | Continuous collector current at $T_C = 25\text{ °C}$  | 60          | A    |
| $I_C$          | Continuous collector current at $T_C = 100\text{ °C}$ | 30          | A    |
| $I_{CP}^{(1)}$ | Pulsed collector current                              | 120         | A    |
| $I_F$          | Continuous forward current at $T_C = 25\text{ °C}$    | 60          | A    |
| $I_F$          | Continuous forward current at $T_C = 100\text{ °C}$   | 30          | A    |
| $I_{FP}^{(1)}$ | Pulsed forward current                                | 120         | A    |
| $V_{GE}$       | Gate-emitter voltage                                  | $\pm 20$    | V    |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ °C}$             | 260         | W    |
| $T_{STG}$      | Storage temperature range                             | - 55 to 150 | °C   |
| $T_J$          | Operating junction temperature                        | - 55 to 175 | °C   |

1. Pulse width limited by maximum junction temperature.

**Table 3. Thermal data**

| Symbol     | Parameter                              | Value | Unit |
|------------|----------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case IGBT  | 0.58  | °C/W |
| $R_{thJC}$ | Thermal resistance junction-case diode | 2.08  | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient    | 50    | °C/W |

## 2 Electrical characteristics

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

**Table 4. Static characteristics**

| Symbol        | Parameter                                            | Test conditions                                                       | Min. | Typ. | Max. | Unit          |
|---------------|------------------------------------------------------|-----------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage ( $V_{GE} = 0$ ) | $I_C = 2\text{ mA}$                                                   | 600  |      |      | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage                 | $V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$                          |      | 1.55 | 2    | V             |
|               |                                                      | $V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$<br>$T_J = 125\text{ °C}$ |      | 1.65 |      |               |
|               |                                                      | $V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$<br>$T_J = 175\text{ °C}$ |      | 1.75 |      |               |
| $V_F$         | Forward on-voltage                                   | $I_F = 30\text{ A}$                                                   |      | 2    | 2.6  | V             |
|               |                                                      | $I_F = 30\text{ A}$ ; $T_J = 125\text{ °C}$                           |      | 1.7  |      |               |
|               |                                                      | $I_F = 30\text{ A}$ ; $T_J = 175\text{ °C}$                           |      | 1.6  |      |               |
| $V_{GE(th)}$  | Gate threshold voltage                               | $V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$                               | 5    | 6    | 7    | V             |
| $I_{CES}$     | Collector cut-off current ( $V_{GE} = 0$ )           | $V_{CE} = 600\text{ V}$                                               |      |      | 25   | $\mu\text{A}$ |
| $I_{GES}$     | Gate-emitter leakage current ( $V_{CE} = 0$ )        | $V_{GE} = \pm 20\text{ V}$                                            |      |      | 250  | nA            |

**Table 5. Dynamic characteristics**

| Symbol    | Parameter                    | Test conditions                                                                                           | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|-----------------------------------------------------------------------------------------------------------|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GE} = 0$                                             | -    | 3659 | -    | pF   |
| $C_{oes}$ | Output capacitance           |                                                                                                           | -    | 101  | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |                                                                                                           | -    | 76   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC} = 520\text{ V}$ , $I_C = 30\text{ A}$ ,<br>$V_{GE} = 15\text{ V}$ , see <a href="#">Figure 29</a> | -    | 149  | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |                                                                                                           | -    | 25   | -    | nC   |
| $Q_{gc}$  | Gate-collector charge        |                                                                                                           | -    | 62   | -    | nC   |

Table 6. Switching characteristics (inductive load)

| Symbol          | Parameter                 | Test conditions                                                                                                                                                       | Min. | Typ. | Max. | Unit       |
|-----------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------------|
| $t_{d(on)}$     | Turn-on delay time        | $V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>see <a href="#">Figure 28</a>                                     | -    | 37   | -    | ns         |
| $t_r$           | Current rise time         |                                                                                                                                                                       | -    | 14.6 | -    | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |                                                                                                                                                                       | -    | 1643 | -    | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |                                                                                                                                                                       |      | 146  | -    | ns         |
| $t_f$           | Current fall time         |                                                                                                                                                                       | -    | 23   | -    | ns         |
| $E_{on}$        | Turn-on switching losses  |                                                                                                                                                                       | -    | 383  | -    | $\mu$ J    |
| $E_{off}^{(1)}$ | Turn-off switching losses |                                                                                                                                                                       | -    | 293  | -    | $\mu$ J    |
| $E_{ts}$        | Total switching losses    |                                                                                                                                                                       | -    | 676  | -    | $\mu$ J    |
| $t_{d(on)}$     | Turn-on delay time        | $V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 28</a> | -    | 35   | -    | ns         |
| $t_r$           | Current rise time         |                                                                                                                                                                       | -    | 16.1 | -    | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |                                                                                                                                                                       | -    | 1496 | -    | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |                                                                                                                                                                       | -    | 158  | -    | ns         |
| $t_f$           | Current fall time         |                                                                                                                                                                       | -    | 65   | -    | ns         |
| $E_{on}$        | Turn-on switching losses  |                                                                                                                                                                       | -    | 794  | -    | $\mu$ J    |
| $E_{off}^{(1)}$ | Turn-off switching losses |                                                                                                                                                                       | -    | 572  | -    | $\mu$ J    |
| $E_{ts}$        | Total switching losses    |                                                                                                                                                                       | -    | 1366 | -    | $\mu$ J    |

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

Table 7. Diode switching characteristics (inductive load)

| Symbol       | Parameter                                                  | Test conditions                                                                                                                                                                           | Min. | Typ. | Max. | Unit       |
|--------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------------|
| $t_{rr}$     | Reverse recovery time                                      | $I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ ,<br>$di/dt = 1000\text{ A}/\mu\text{s}$ ,<br>$V_{GE} = 15\text{ V}$ ,<br>(see <a href="#">Figure 28</a> )                                     | -    | 53   | -    | ns         |
| $Q_{rr}$     | Reverse recovery charge                                    |                                                                                                                                                                                           | -    | 384  | -    | nC         |
| $I_{rrm}$    | Reverse recovery current                                   |                                                                                                                                                                                           | -    | 14.5 | -    | A          |
| $di_{rr}/dt$ | Peak rate of fall of reverse recovery current during $t_b$ |                                                                                                                                                                                           | -    | 788  | -    | A/ $\mu$ s |
| $E_{rr}$     | Reverse recovery energy                                    |                                                                                                                                                                                           | -    | 104  | -    | $\mu$ J    |
| $t_{rr}$     | Reverse recovery time                                      | $I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ ,<br>$di/dt = 1000\text{ A}/\mu\text{s}$ ,<br>$V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ , (see <a href="#">Figure 28</a> ) | -    | 104  | -    | ns         |
| $Q_{rr}$     | Reverse recovery charge                                    |                                                                                                                                                                                           | -    | 1352 | -    | nC         |
| $I_{rrm}$    | Reverse recovery current                                   |                                                                                                                                                                                           | -    | 26   | -    | A          |
| $di_{rr}/dt$ | Peak rate of fall of reverse recovery current during $t_b$ |                                                                                                                                                                                           | -    | 310  | -    | A/ $\mu$ s |
| $E_{rr}$     | Reverse recovery energy                                    |                                                                                                                                                                                           | -    | 407  | -    | $\mu$ J    |

# 2.1 Electrical characteristics (curve)

Figure 2. Power dissipation vs. case temperature

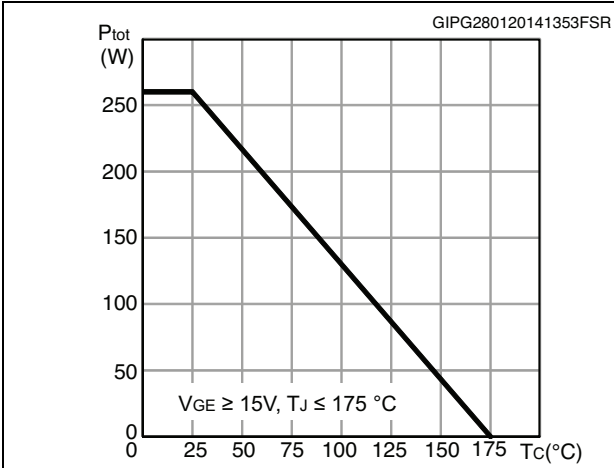


Figure 3. Collector current vs. case temperature

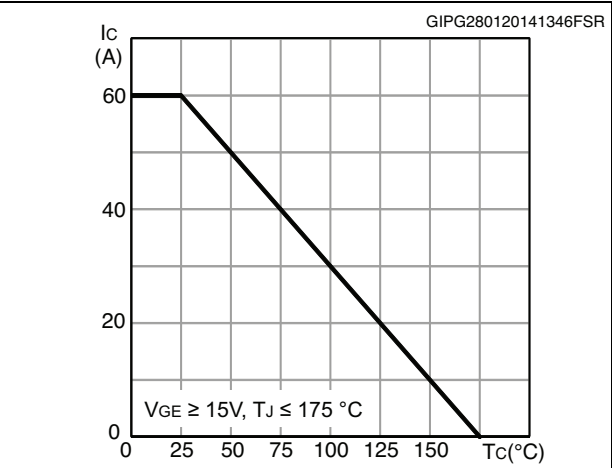


Figure 4. Output characteristics ( $T_J = 25^\circ\text{C}$ )

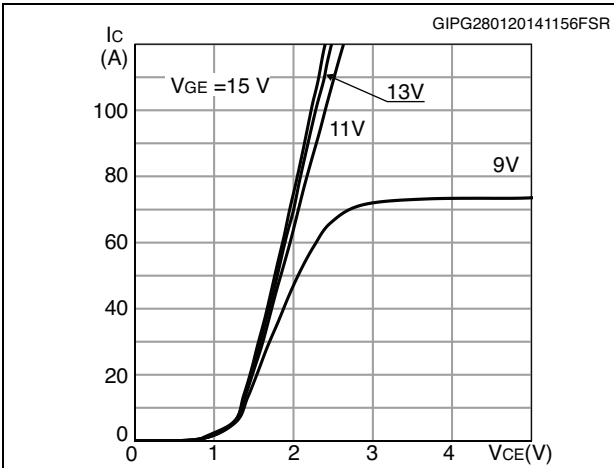


Figure 5. Output characteristics ( $T_J = 175^\circ\text{C}$ )

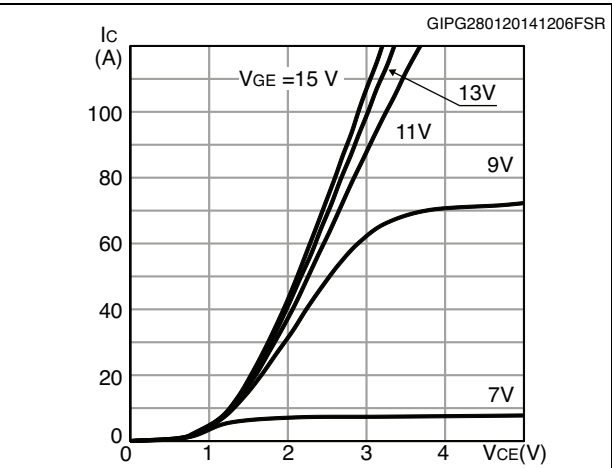


Figure 6.  $V_{CE(sat)}$  vs. junction temperature

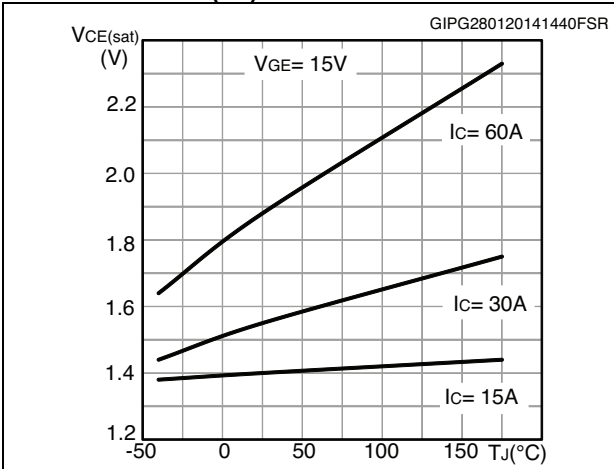


Figure 7.  $V_{CE(sat)}$  vs. collector current

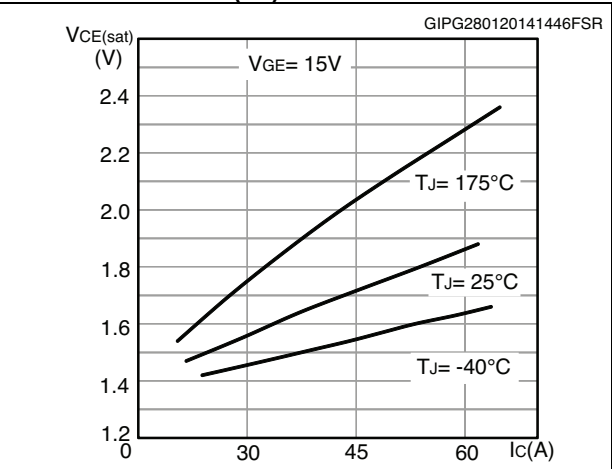


Figure 8. Collector current vs. switching frequency

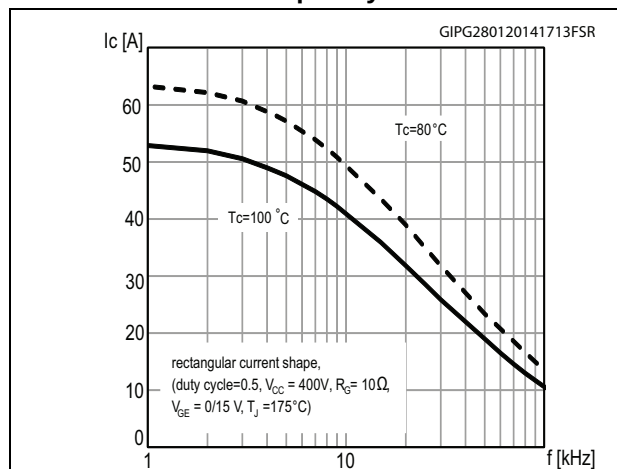


Figure 9. Forward bias safe operating area

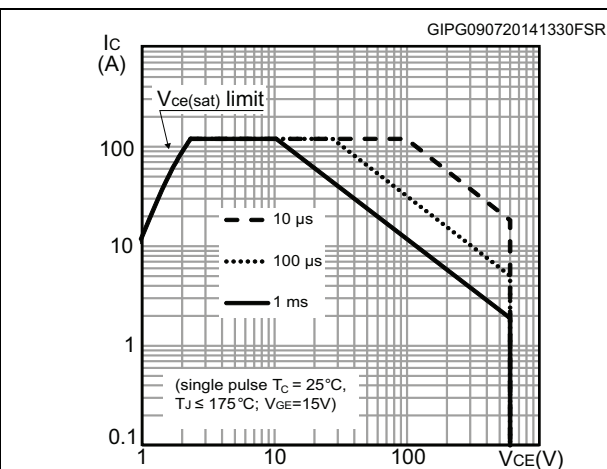


Figure 10. Transfer characteristics

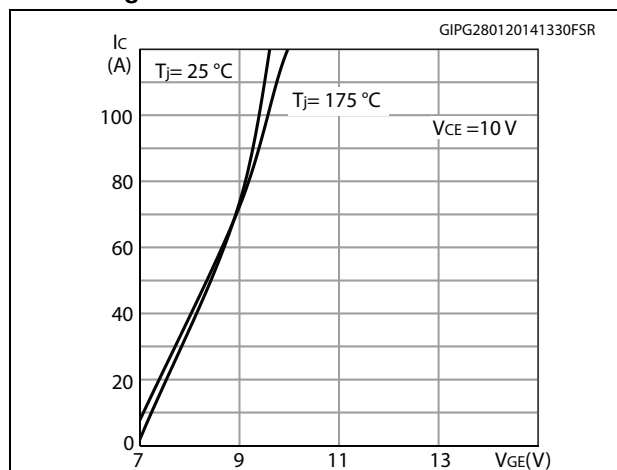


Figure 11. Diode VF vs. forward current

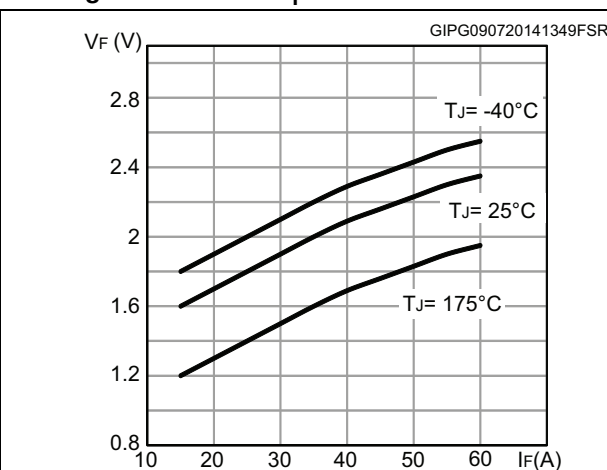


Figure 12. Normalized VGE(th) vs junction temperature

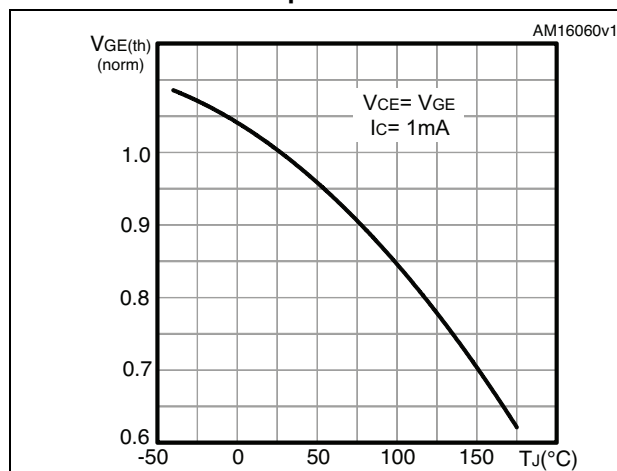


Figure 13. Normalized V(BR)CES vs. junction temperature

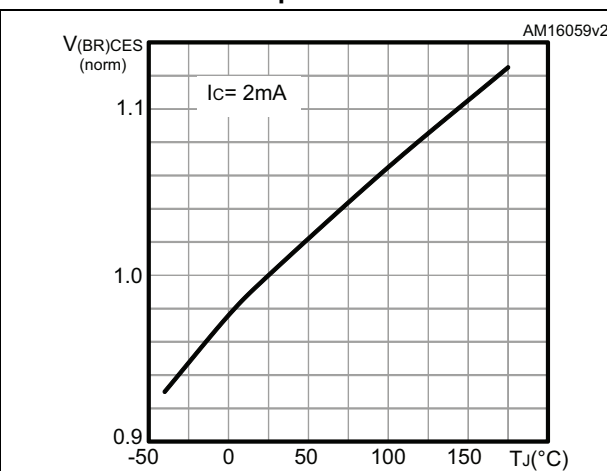


Figure 14. Capacitance variation

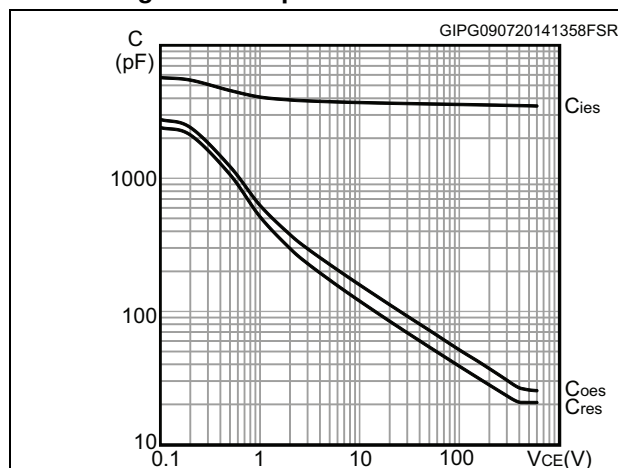


Figure 15. Gate charge vs. gate-emitter voltage

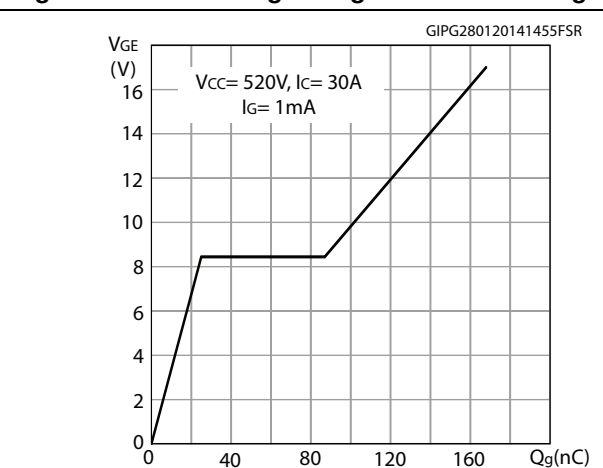


Figure 16. Switching loss vs collector current

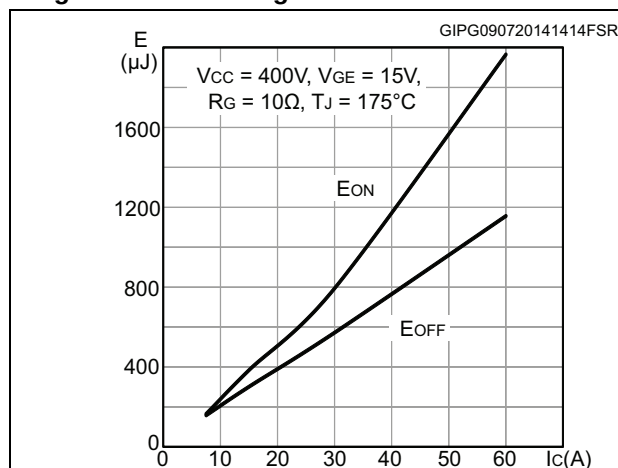


Figure 17. Switching loss vs gate resistance

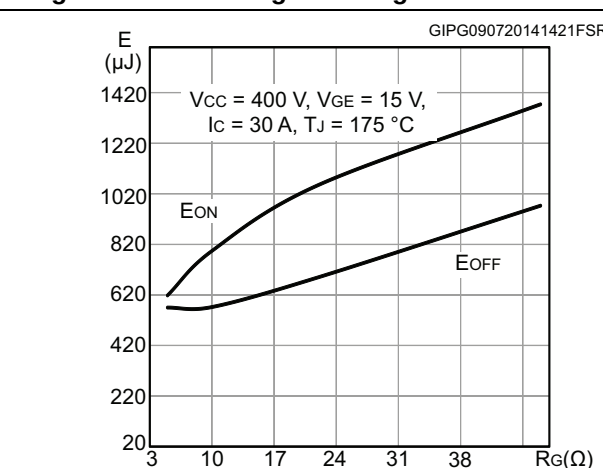


Figure 18. Switching loss vs temperature

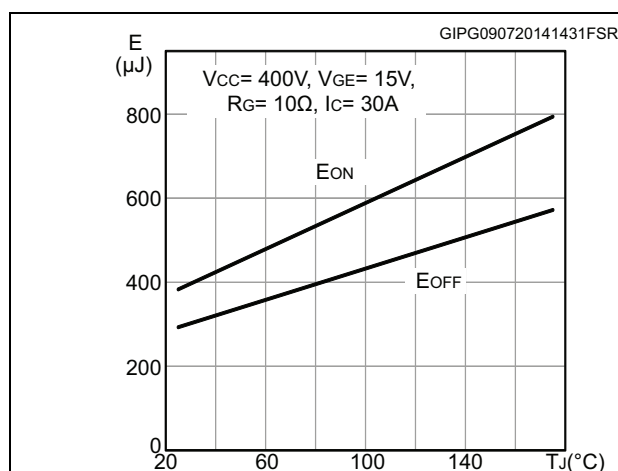


Figure 19. Switching loss vs collector-emitter voltage

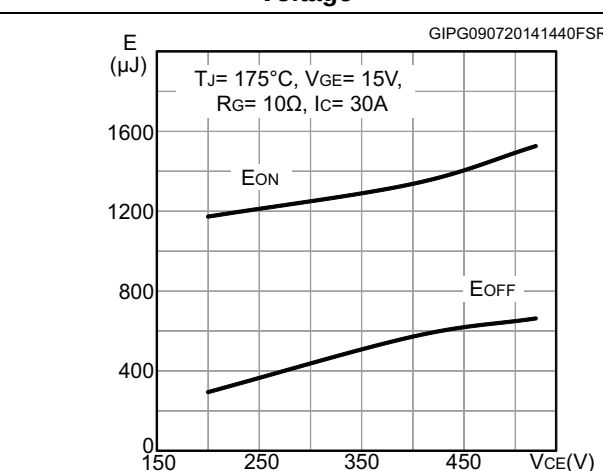




Figure 20. Switching times vs. collector current

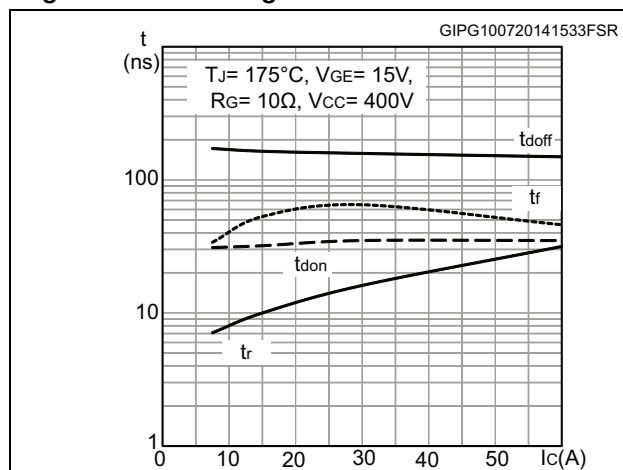


Figure 21. Switching times vs. gate resistance

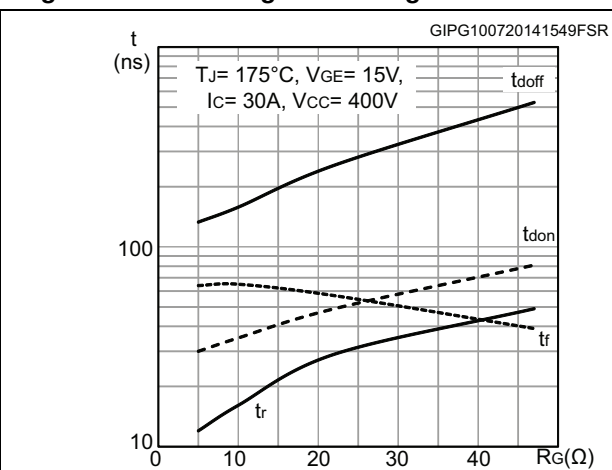


Figure 22. Reverse recovery current vs. diode current slope

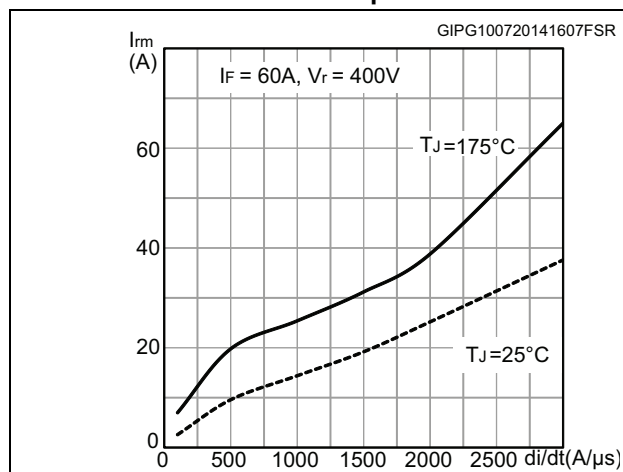


Figure 23. Reverse recovery time vs. diode current slope

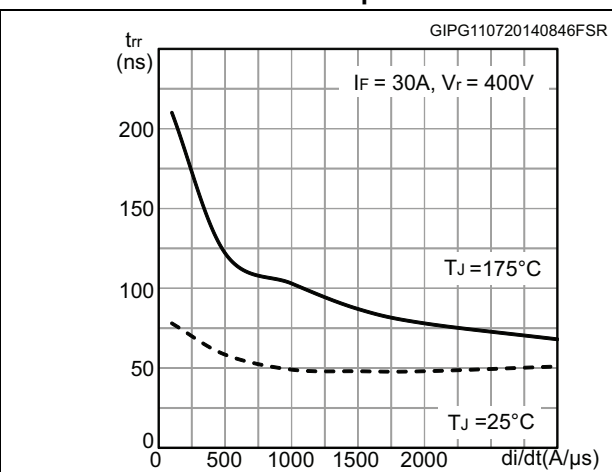


Figure 24. Reverse recovery charge vs. diode current slope

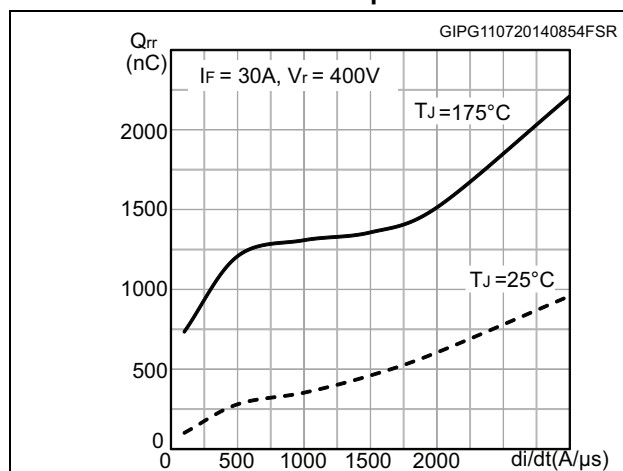


Figure 25. Reverse recovery energy vs. diode current slope

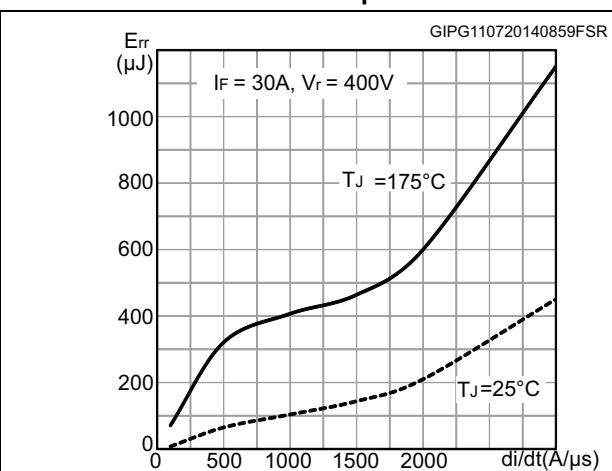


Figure 26. Thermal impedance for IGBT

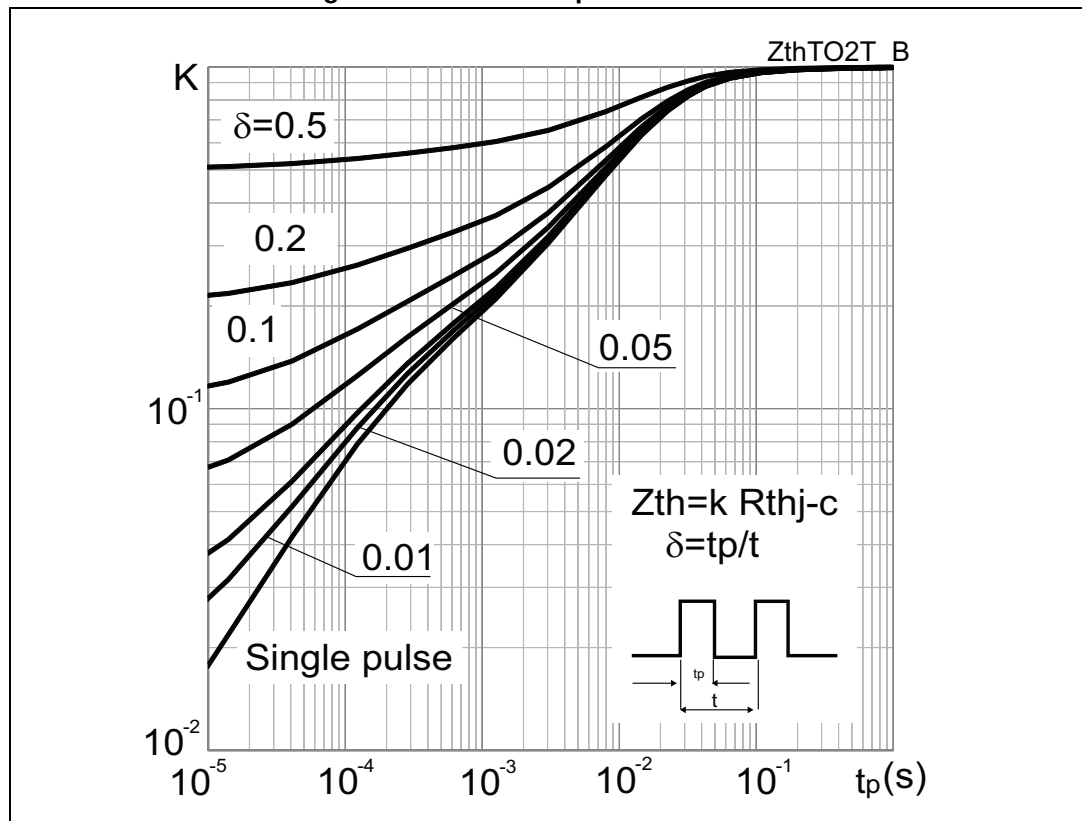
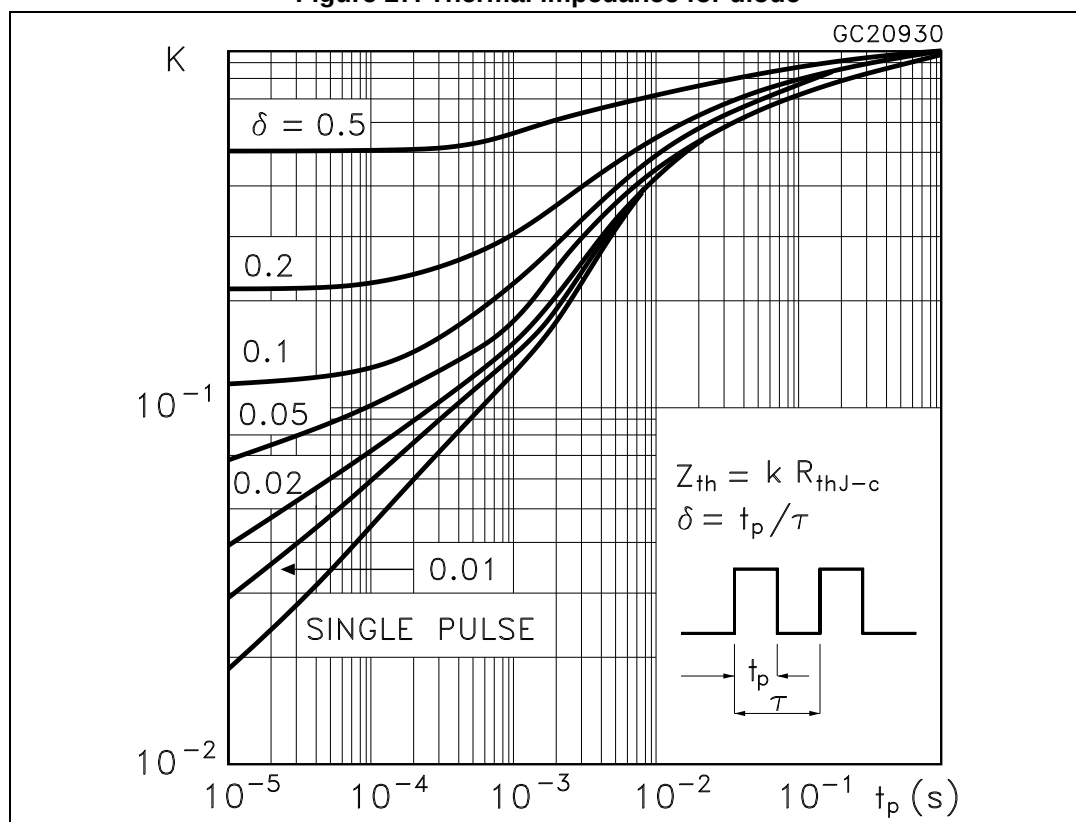


Figure 27. Thermal impedance for diode



### 3 Test circuits

Figure 28. Test circuit for inductive load switching

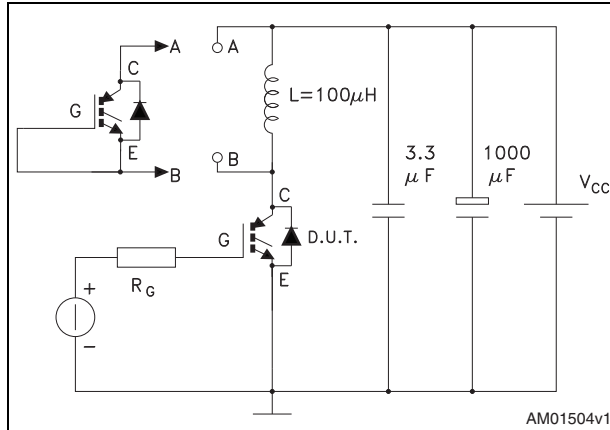


Figure 29. Gate charge test

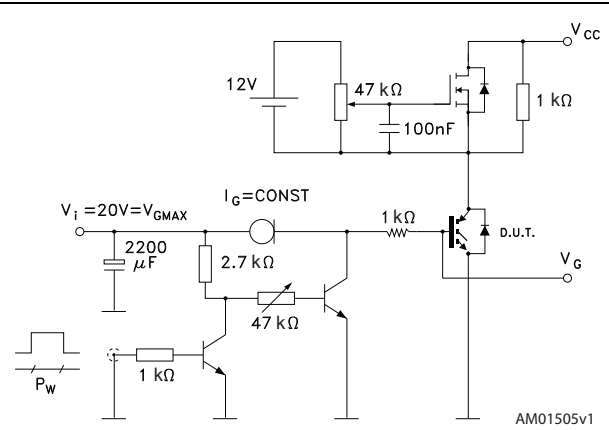


Figure 30. Switching waveform

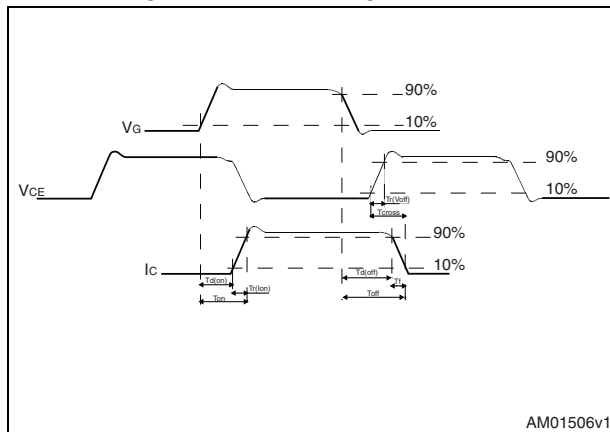
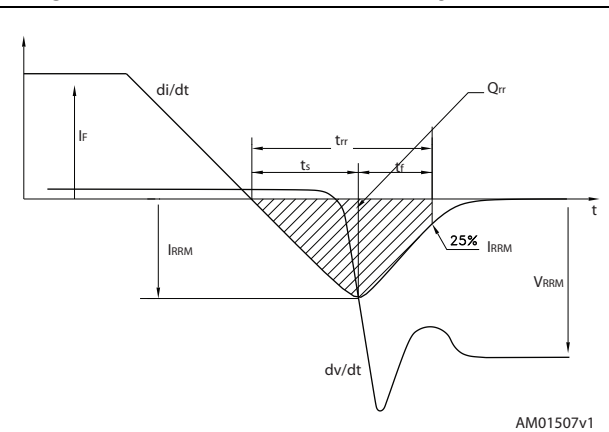


Figure 31. Diode reverse recovery waveform



## 4 Package information

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

### 4.1 D<sup>2</sup>PAK package information

Figure 32. D<sup>2</sup>PAK (TO-263) type A package outline

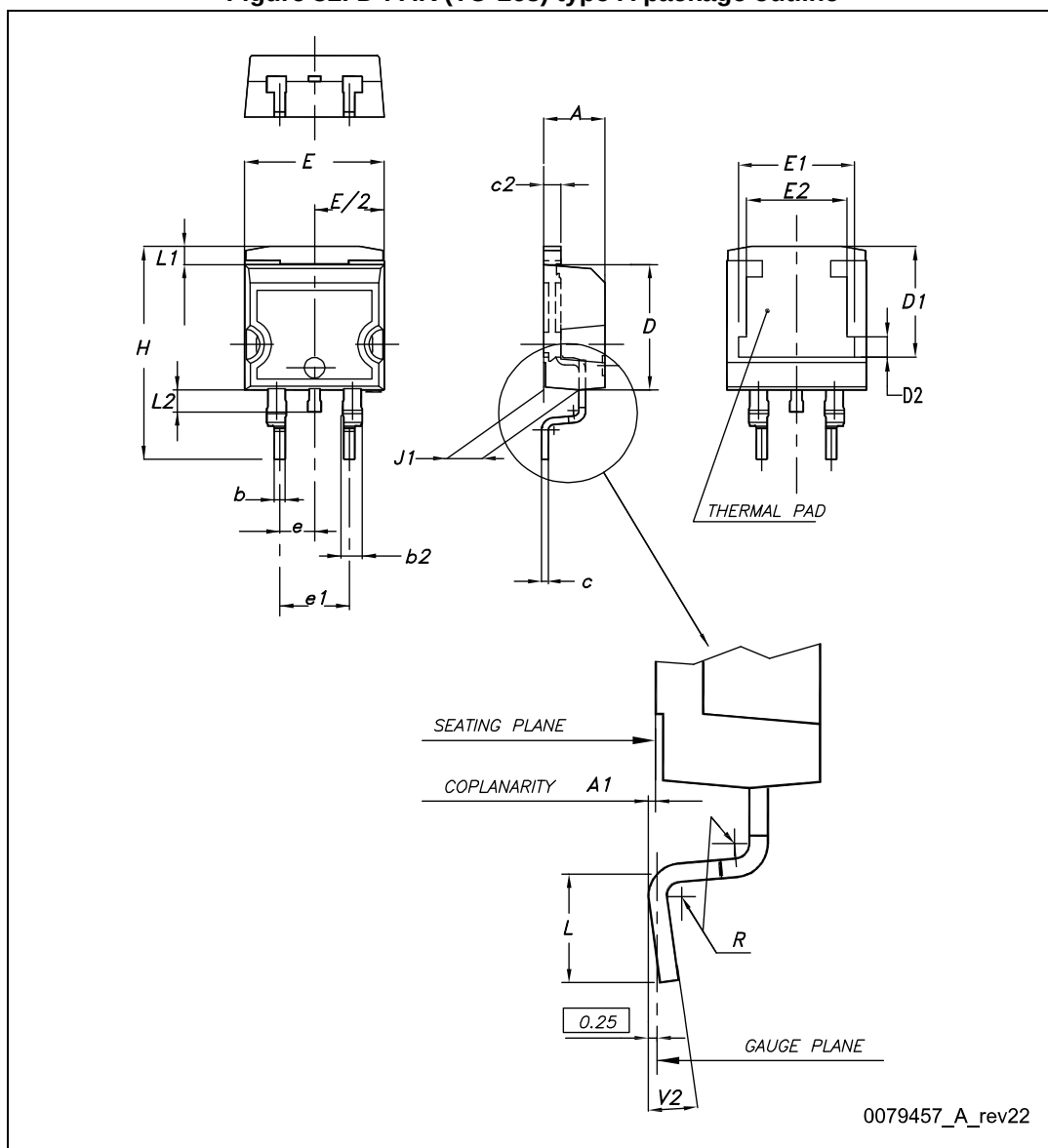
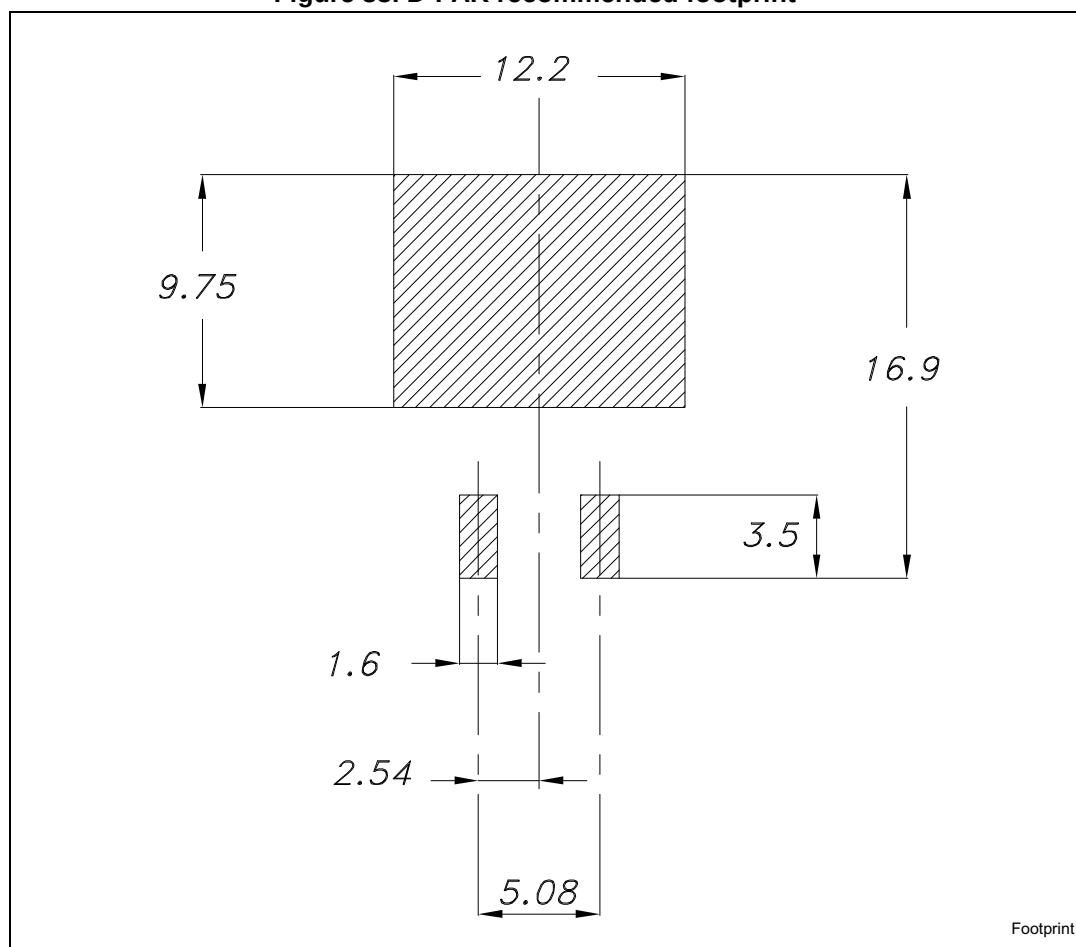


Table 8. D<sup>2</sup>PAK (TO-263) type A mechanical data

| 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   |      | 10.40 |
| E1   | 8.50 | 8.70 | 8.90  |
| E2   | 6.85 | 7.05 | 7.25  |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

Figure 33. D<sup>2</sup>PAK recommended footprint<sup>(a)</sup>

a. All dimension are in millimeters

## 4.2 TO-220 package information

Figure 34. TO-220 type A package outline

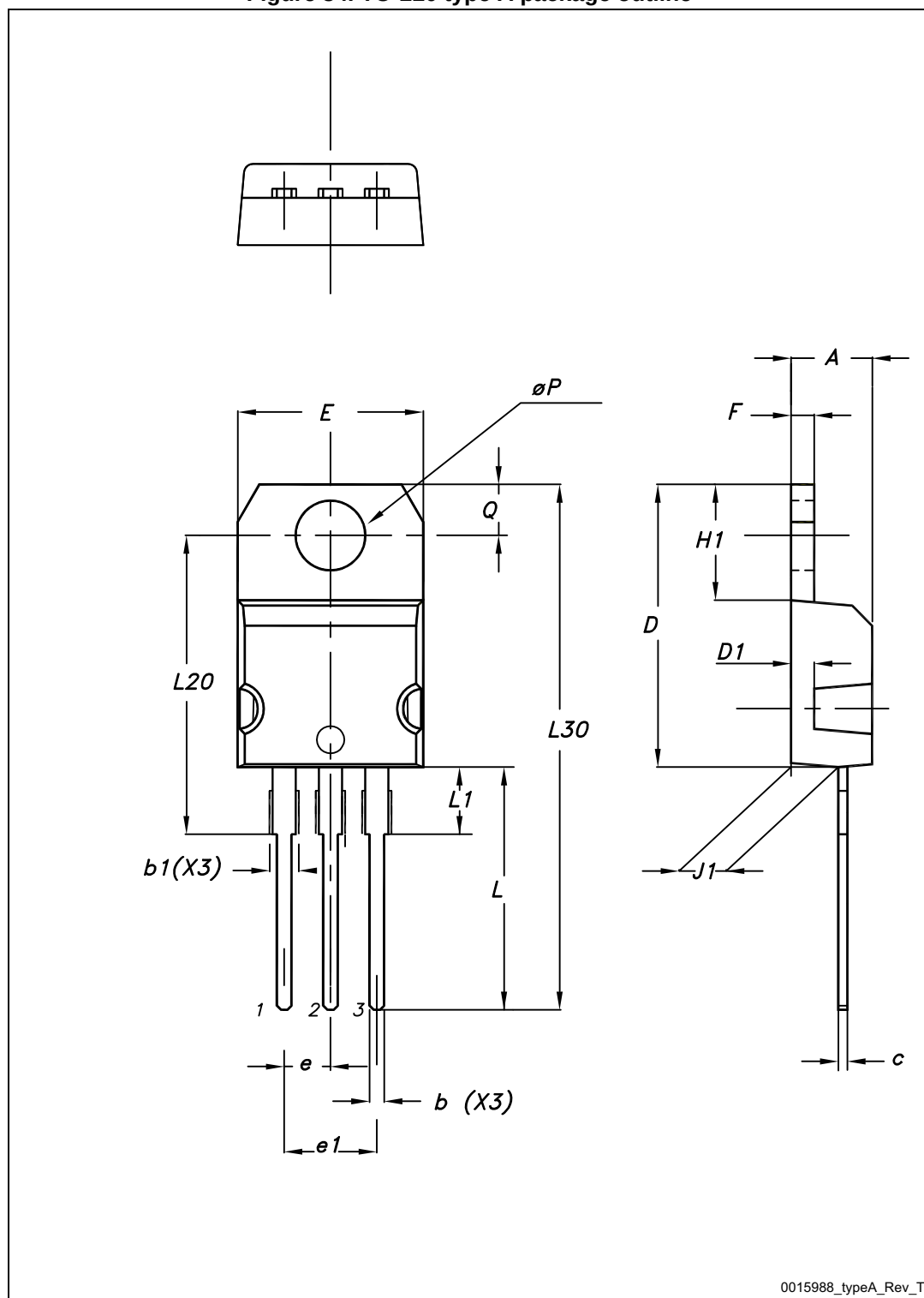




Table 9. TO-220 type A package mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| 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 |       |
| øP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

5 Packing information

Figure 35. Tape

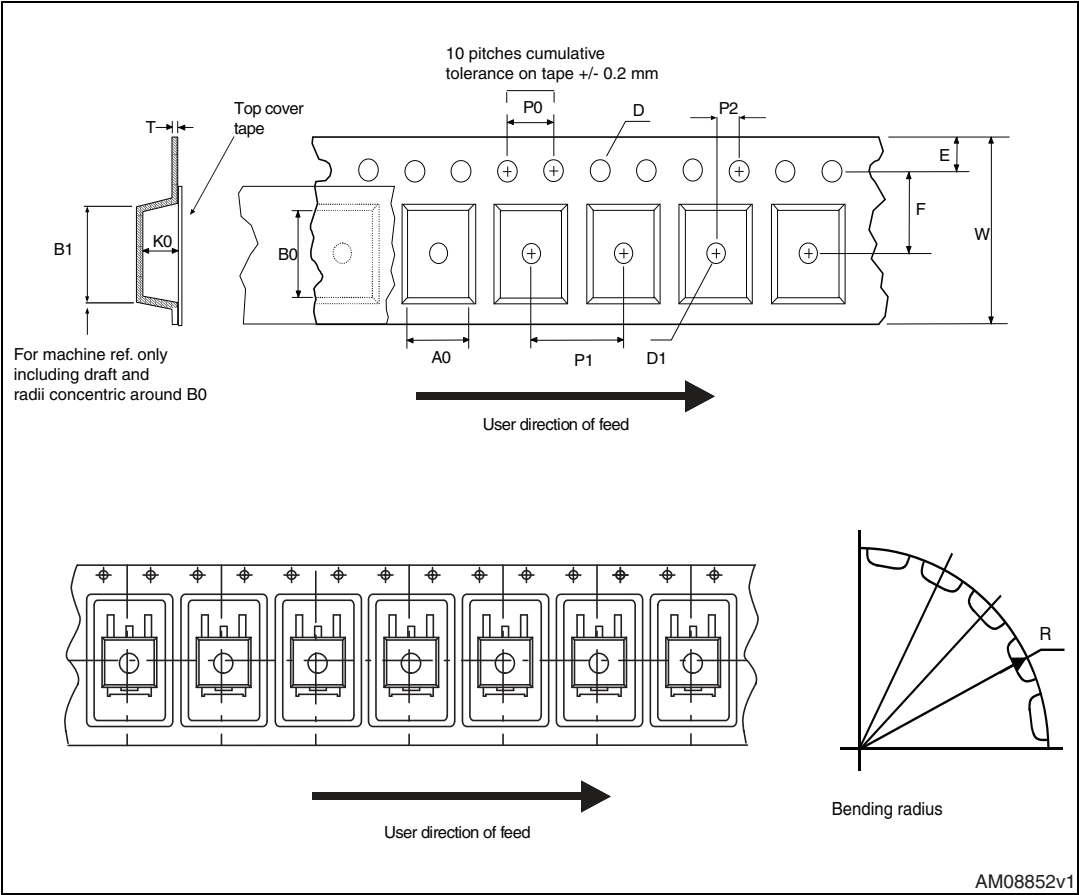
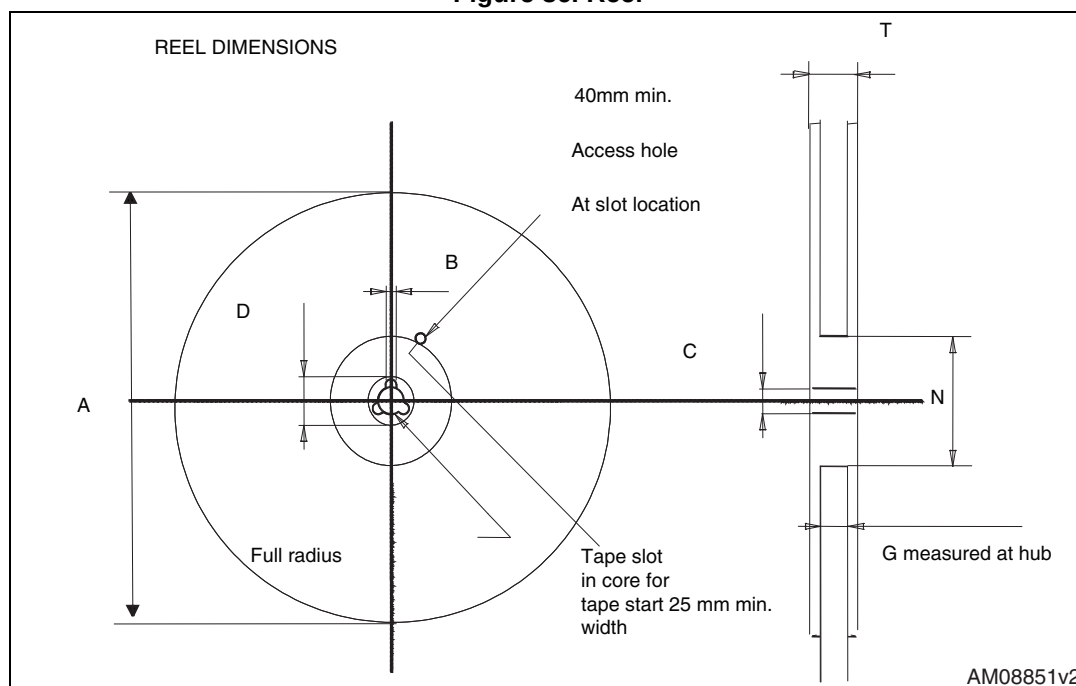


Figure 36. Reel

Table 10. D<sup>2</sup>PAK (TO-263) 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 qty |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk qty |      | 1000 |
| R    | 50   |      |          |      |      |
| T    | 0.25 | 0.35 |          |      |      |
| W    | 23.7 | 24.3 |          |      |      |

## 6 Revision history

**Table 11. Document revision history**

| Date        | Revision | Changes                                                                                  |
|-------------|----------|------------------------------------------------------------------------------------------|
| 07-Aug-2014 | 1        | Initial release.                                                                         |
| 28-Oct-2015 | 2        | Updated <a href="#">Figure 23</a> and <a href="#">Section 5</a> .<br>Minor text changes. |

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