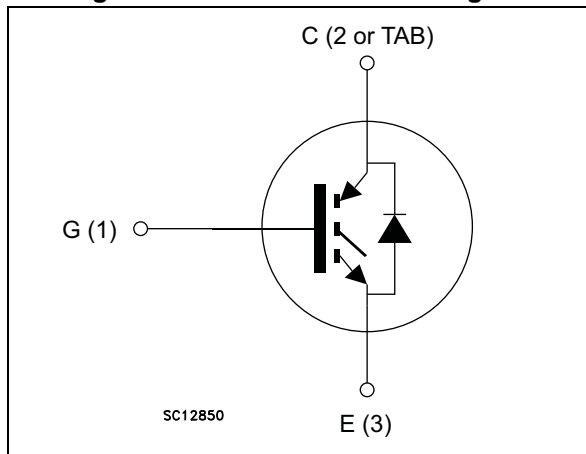


Figure 1. Internal schematic diagram



### Features

- Designed for soft commutation only
- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.8\text{ V (typ.) @ } I_C = 40\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Low  $V_F$  soft recovery co-packaged diode

### Applications

- Induction heating
- Microwave oven
- Resonant converters

### Description

This device is an IGBT developed using an advanced proprietary trench gate field stop structure. The device is part of the V series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, a 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 |
|---------------|-------------|---------|-----------|
| STGW40V60DLF  | GW40V60DLF  | TO-247  | Tube      |
| STGWT40V60DLF | GWT40V60DLF | TO-3P   | 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 $T_C = 25\text{ °C}$  | 80          | A    |
| $I_C$          | Continuous collector current at $T_C = 100\text{ °C}$ | 40          | A    |
| $I_{CP}^{(1)}$ | Pulsed collector current                              | 160         | A    |
| $V_{GE}$       | Gate-emitter voltage                                  | $\pm 20$    | V    |
| $I_F$          | Continuous forward current at $T_C = 25\text{ °C}$    | 80          | A    |
| $I_F$          | Continuous forward current at $T_C = 100\text{ °C}$   | 40          | A    |
| $I_{FP(1)}$    | Pulsed forward current                                | 160         | A    |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ °C}$             | 283         | 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  | 0.53  | °C/W |
| $R_{thJC}$ | Thermal resistance junction-case diode | 1.4   | °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                 | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$                          |      | 1.8  | 2.3  | V             |
|               |  | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$<br>$T_J = 125\text{ °C}$ |      | 2.15 |      |               |
|               |  | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$<br>$T_J = 175\text{ °C}$ |      | 2.35 |      |               |
| $V_F$         | Forward on-voltage                                   | $I_F = 40\text{ A}$  |      | 1.55 | 1.8  | V             |
|               |  | $I_F = 40\text{ A}, T_J = 125\text{ °C}$                           |      | 1.3  |      | V             |
|               |  | $I_F = 40\text{ A}, T_J = 175\text{ °C}$                           |      | 1.25 |      | V             |
| $V_{GE(th)}$  | 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>$V_{GE} = 0$  | -    | 5400 | -    | pF   |
| $C_{oes}$ | Output capacitance           |  | -    | 220  | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |  | -    | 180  | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC} = 480\text{ V}, I_C = 40\text{ A},$<br>$V_{GE} = 15\text{ V}$ (see <a href="#">Figure 27</a> ) | -    | 226  | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |  | -    | 38   | -    | nC   |
| $Q_{gc}$  | Gate-collector charge        |  | -    | 95   | -    | nC   |

Table 6. IGBT switching characteristics (inductive load)

| Symbol          | Parameter                 | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------------|---------------------------|--|------|------|------|---------------|
| $t_{d(off)}$    | Turn-off delay time       | $V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$<br>(see <a href="#">Figure 25</a> )                                     |      | 208  |      | ns            |
| $t_f$           | Current fall time         |  | -    | 20   | -    | ns            |
| $E_{off}^{(1)}$ | Turn-off switching losses |  | -    | 411  | -    | $\mu\text{J}$ |
| $t_{d(off)}$    | Turn-off delay time       | $V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ (see <a href="#">Figure 25</a> ) |      | 220  |      | ns            |
| $t_f$           | Current fall time         |  | -    | 21   | -    | ns            |
| $E_{off}^{(1)}$ | Turn-off switching losses |  | -    | 560  | -    | $\mu\text{J}$ |

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

Table 7. IGBT switching characteristics (capacitive load)

| Symbol          | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------|---------------------------|---|------|------|------|---------------|
| $E_{off}^{(1)}$ | Turn-off switching losses | $V_{CC} = 320\text{ V}$ , $R_G = 10\ \Omega$ ,<br>$I_C = 40\text{ A}$ , $L = 100\ \mu\text{H}$ ,<br>$C_{snub} = 20\text{ nF}$<br>(see <a href="#">Figure 26</a> )                                     | -    | 147  | -    | $\mu\text{J}$ |
|                 |                           | $V_{CC} = 320\text{ V}$ , $R_G = 10\ \Omega$ ,<br>$I_C = 40\text{ A}$ , $L = 100\ \mu\text{H}$ ,<br>$C_{snub} = 20\text{ nF}$ , $T_J = 175\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 26</a> ) | -    | 303  | -    |               |

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

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

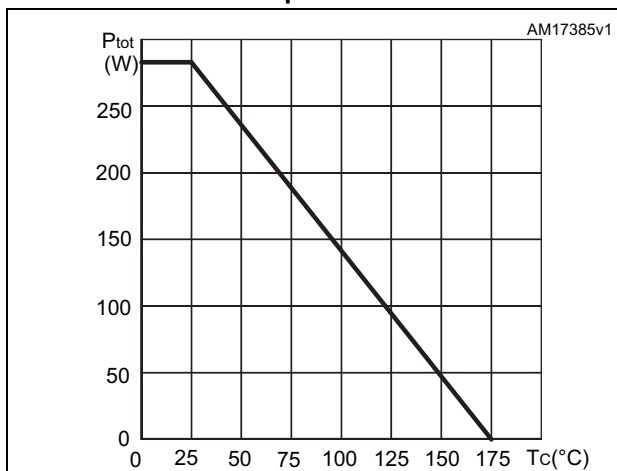


Figure 3. Collector current vs. case temperature

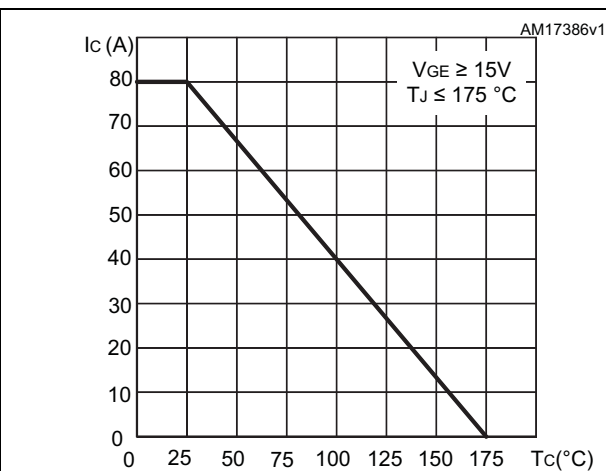


Figure 4. Output characteristics (Tj=25°C)

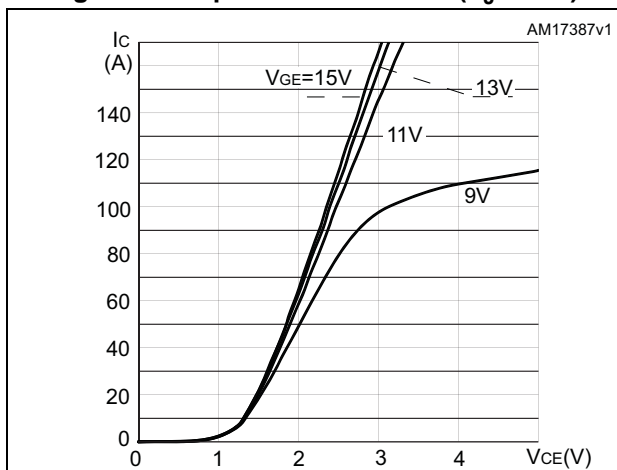


Figure 5. Output characteristics (Tj=175°C)

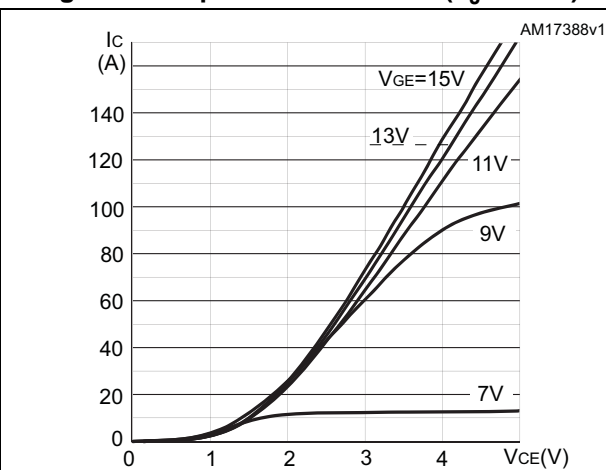


Figure 6. VCE(sat) vs. junction temperature

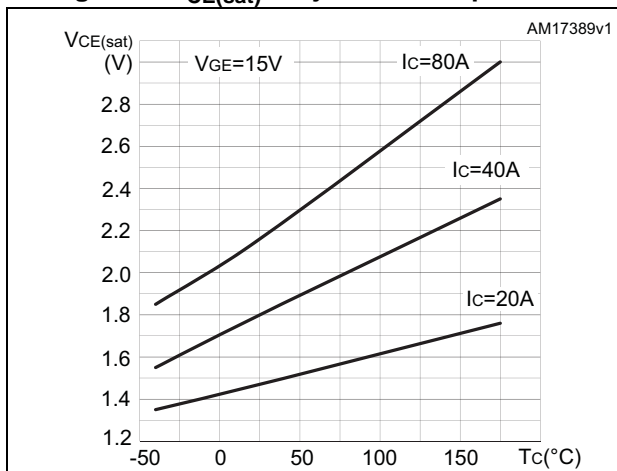


Figure 7. VCE(sat) vs. collector current

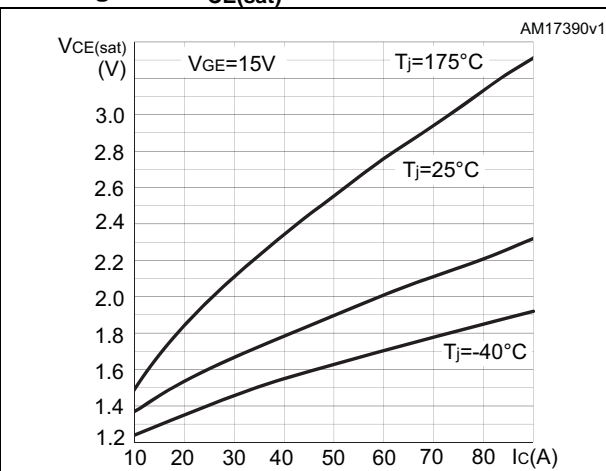


Figure 8. Collector current vs. switching frequency

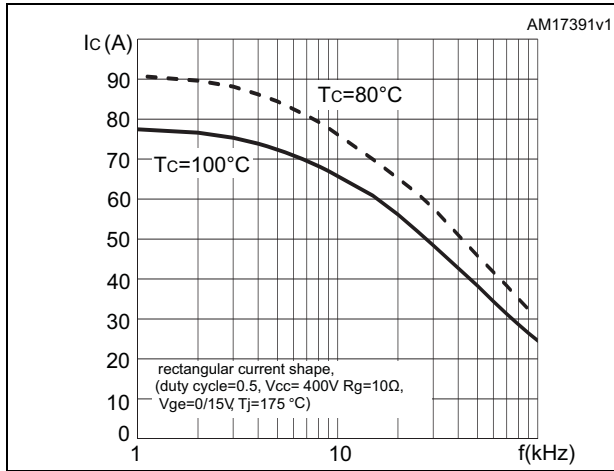


Figure 9. Forward bias safe operating area

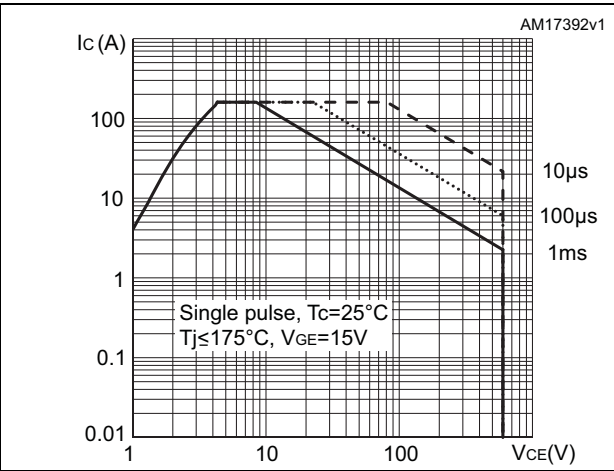


Figure 10. Transfer characteristics

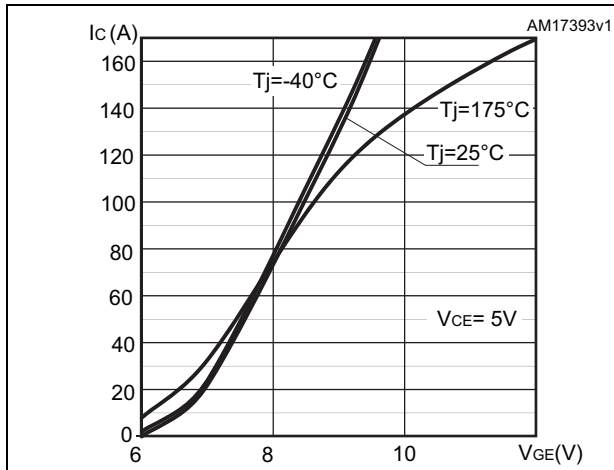


Figure 11. Diode V\_F vs. forward current

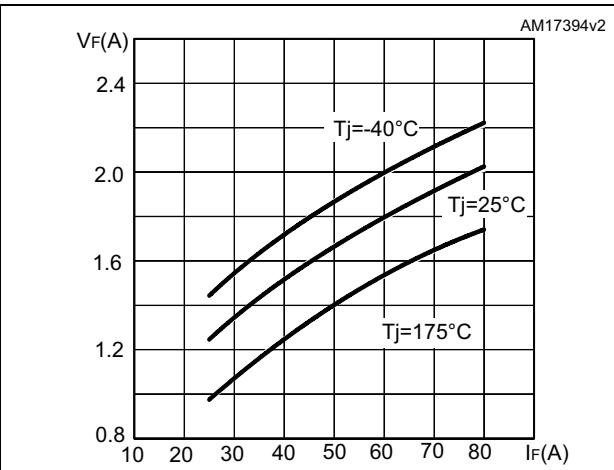


Figure 12. Normalized  $V_{GE(th)}$  vs junction temperature

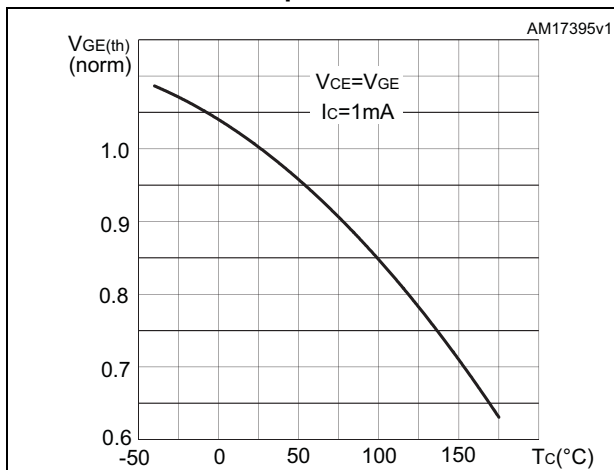


Figure 13. Normalized  $V_{(BR)CES}$  vs. junction temperature

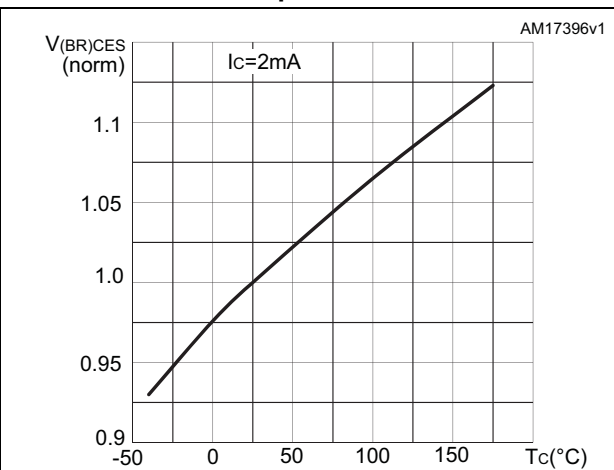


Figure 14. Capacitance variations

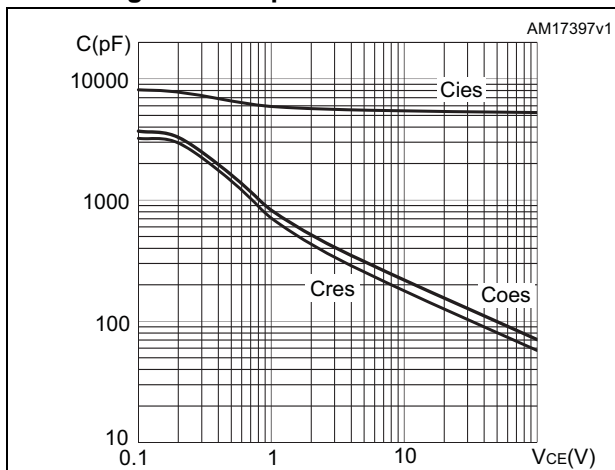


Figure 15. Gate charge vs. gate-emitter voltage

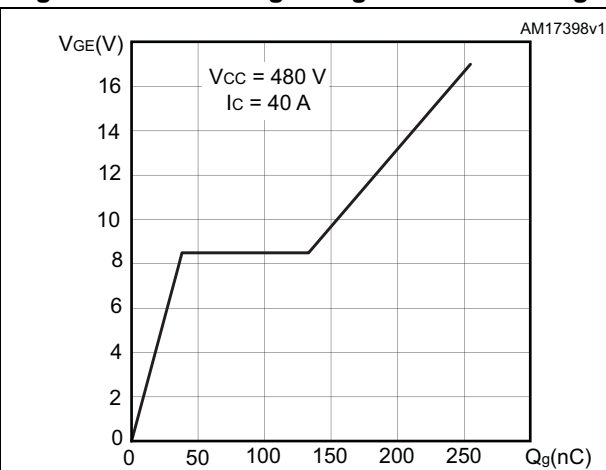


Figure 16. Switching-off losses vs. collector current

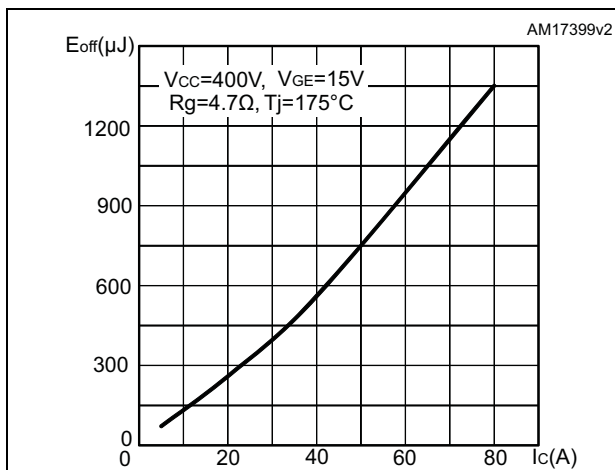


Figure 17. Switching-off losses vs. gate resistance

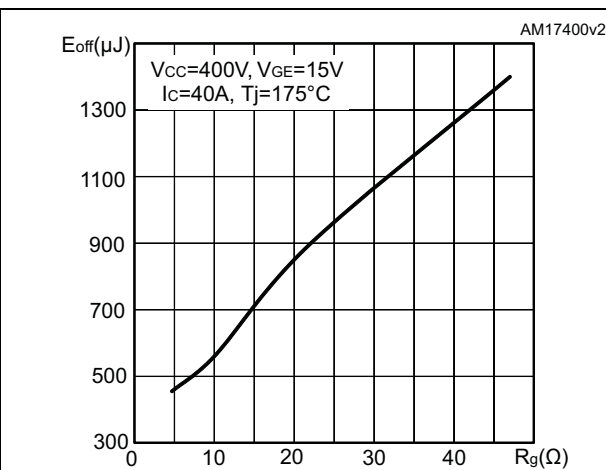


Figure 18. Switching-off losses vs. junction temperature

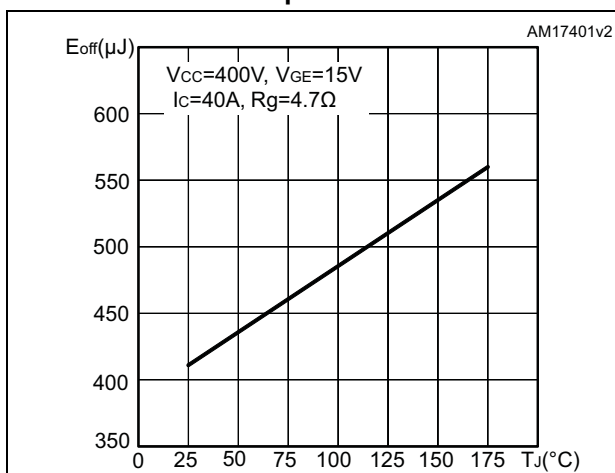


Figure 19. Switching-off losses vs. collector emitter voltage

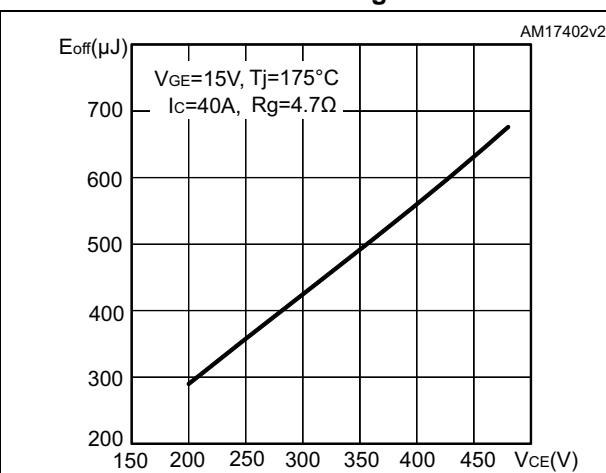




Figure 20. Switching times vs. collector current

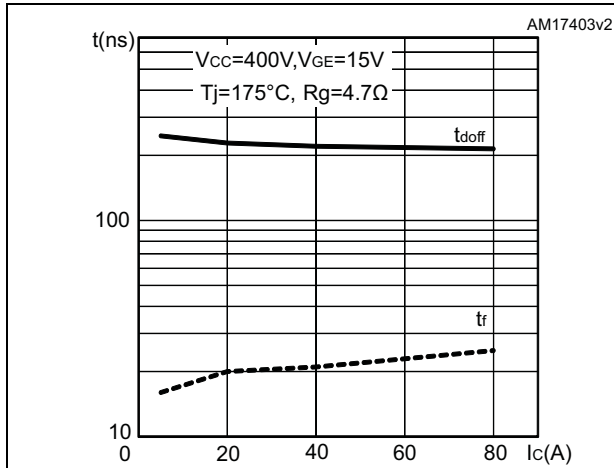


Figure 21. Switching times vs. gate resistance

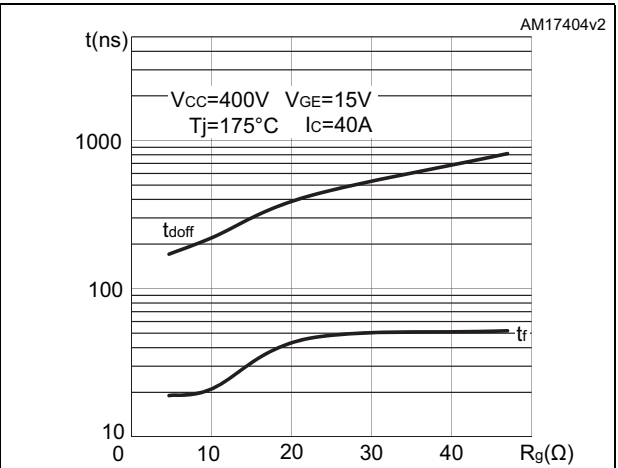


Figure 22. Switching-off losses vs. capacitive load

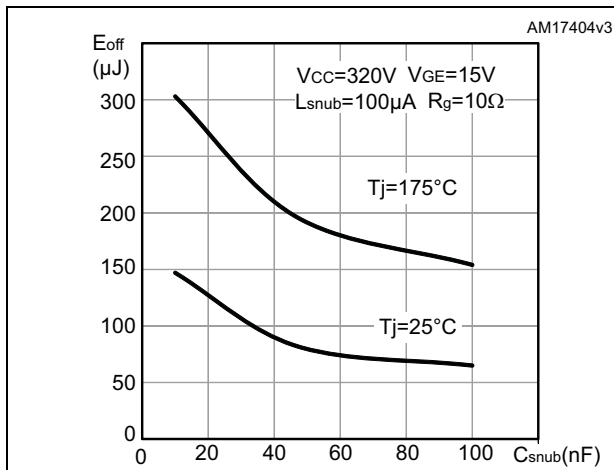


Figure 23. Thermal data for IGBT

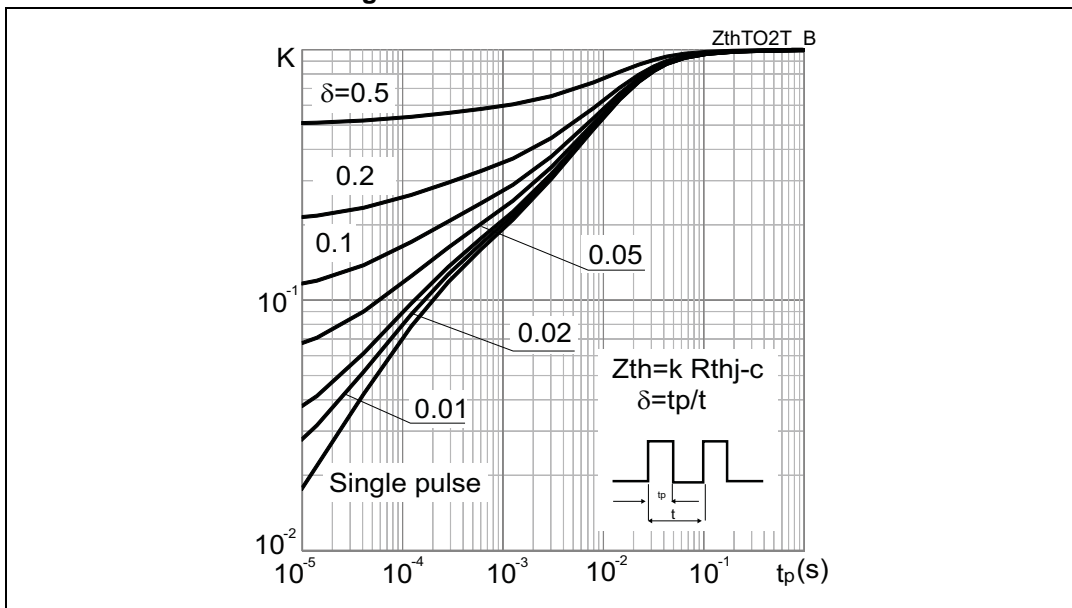
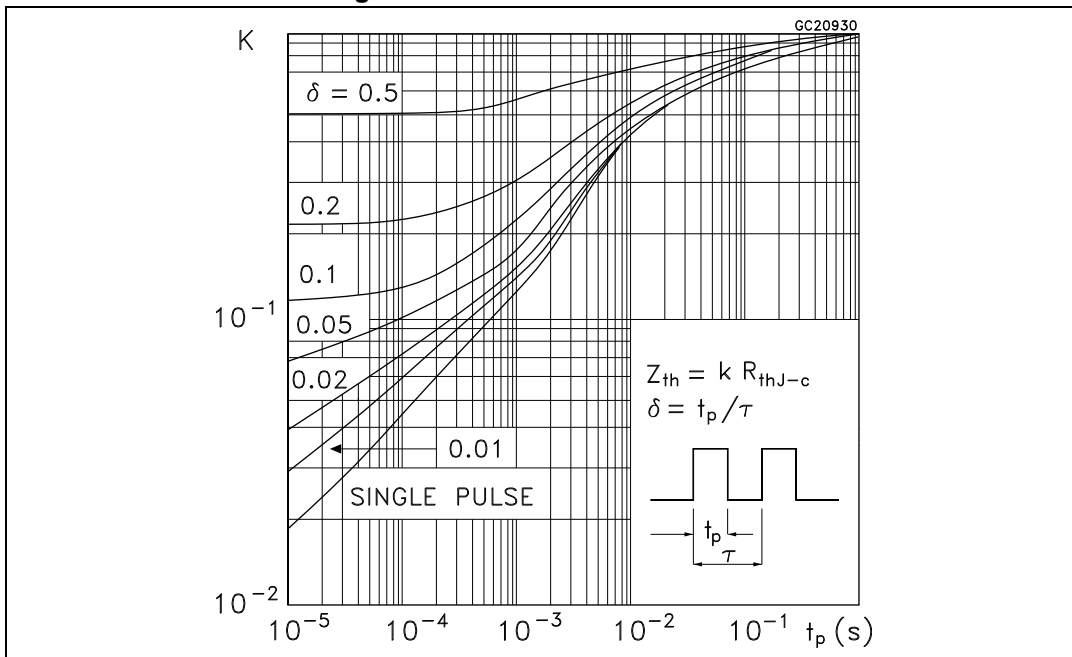


Figure 24. Thermal data for diode



### 3 Test circuits

Figure 25. Test circuit for inductive load switching



Figure 26. Test circuit for capacitive load switching

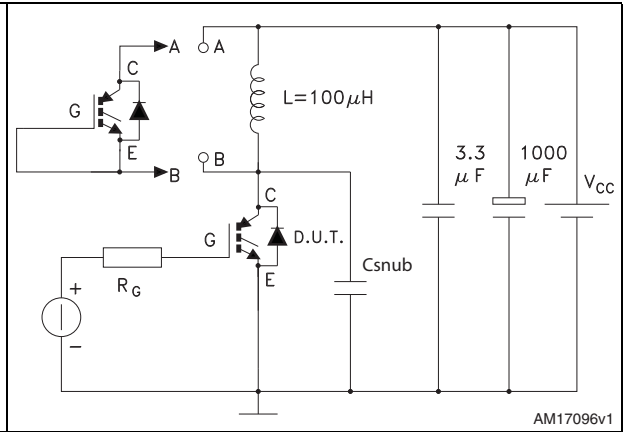


Figure 27. Gate charge test circuit



Figure 28. Switching waveform



Figure 29. Diode recovery time 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](http://www.st.com). ECOPACK is an ST trademark.

**Table 8. 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    | 5.30  | 5.45  | 5.60  |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

Figure 30. TO-247 drawing

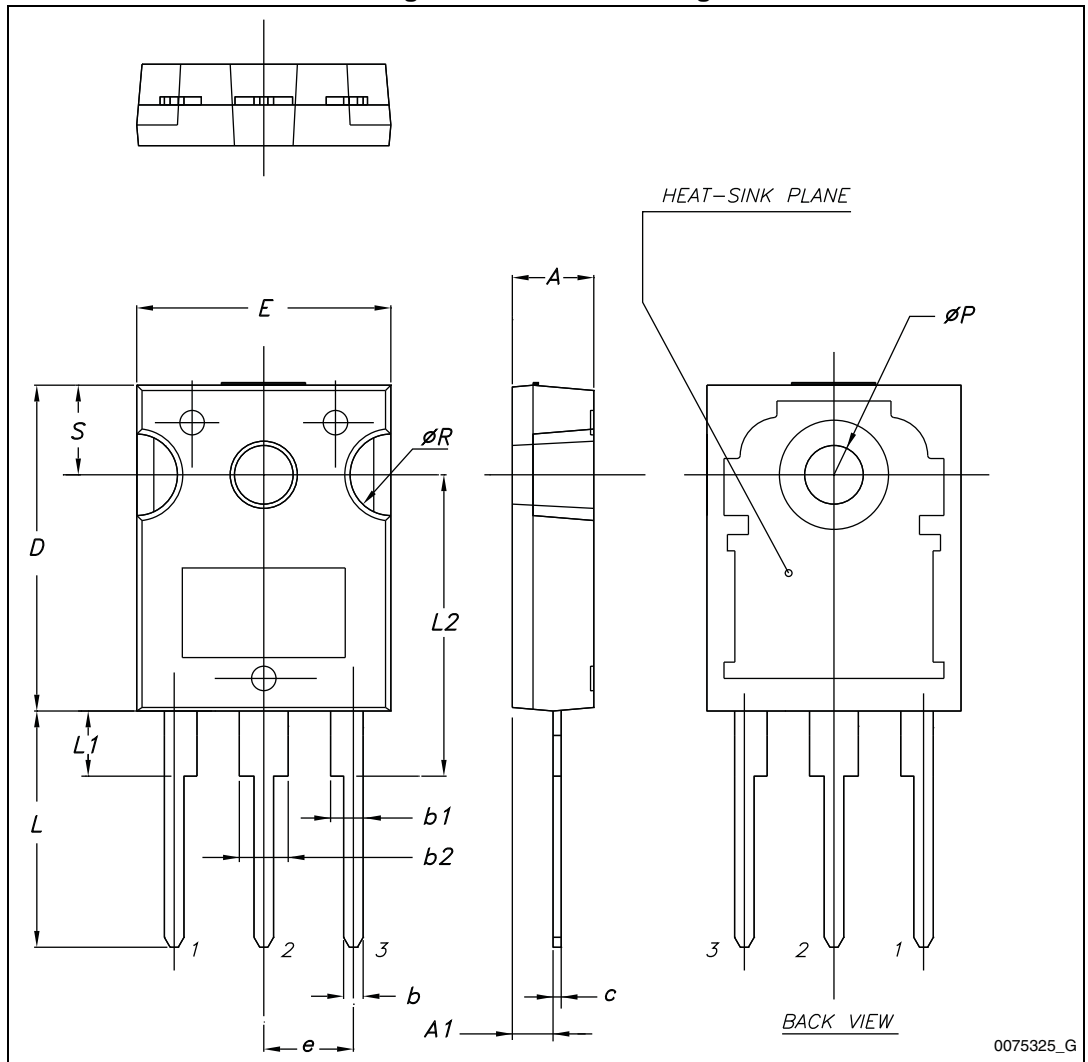
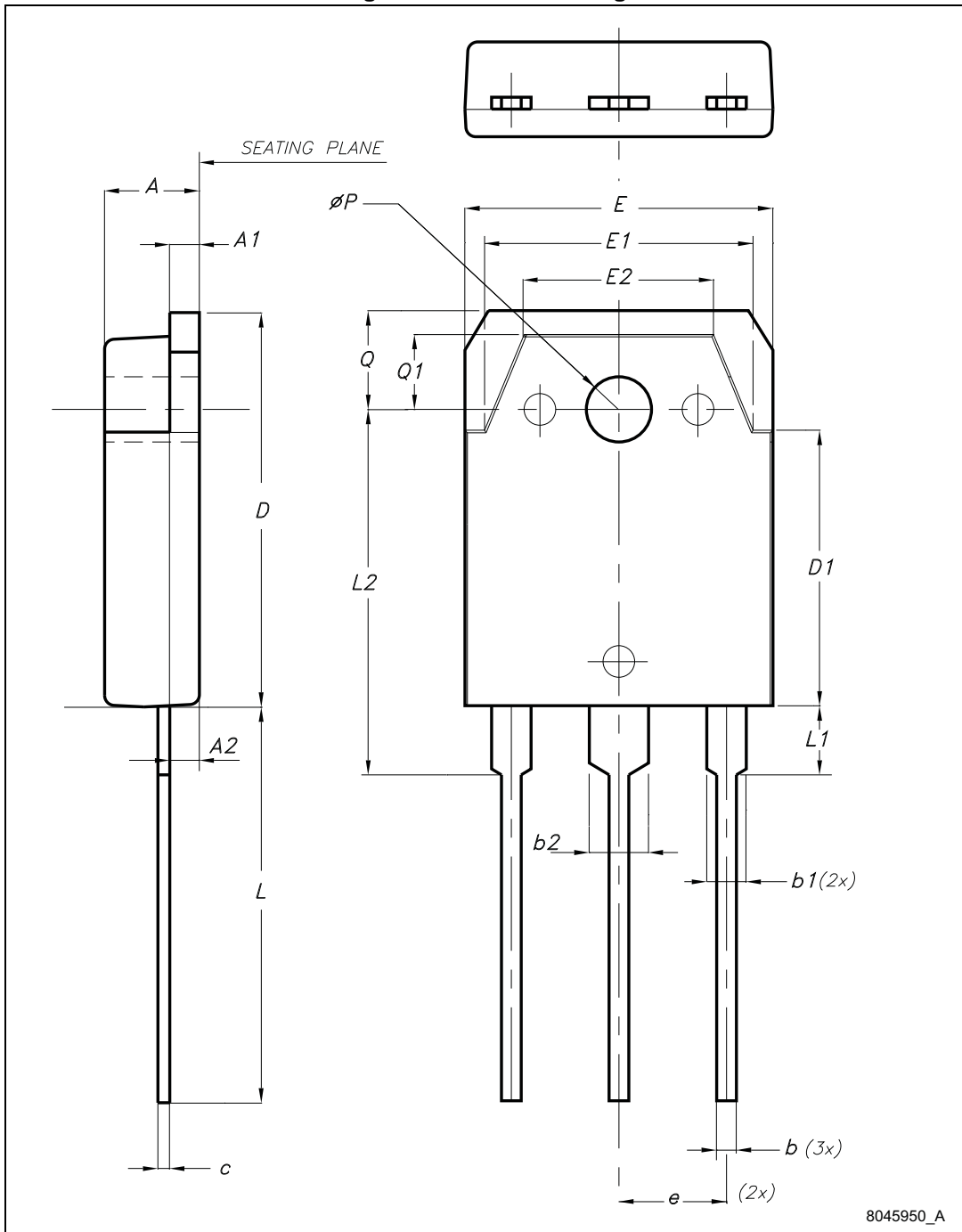


Table 9. TO-3P mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.60  |       | 5     |
| A1   | 1.45  | 1.50  | 1.65  |
| A2   | 1.20  | 1.40  | 1.60  |
| b    | 0.80  | 1     | 1.20  |
| b1   | 1.80  |       | 2.20  |
| b2   | 2.80  |       | 3.20  |
| c    | 0.55  | 0.60  | 0.75  |
| D    | 19.70 | 19.90 | 20.10 |
| D1   |       | 13.90 |       |
| E    | 15.40 |       | 15.80 |
| E1   |       | 13.60 |       |
| E2   |       | 9.60  |       |
| e    | 5.15  | 5.45  | 5.75  |
| L    | 19.50 | 20    | 20.50 |
| L1   |       | 3.50  |       |
| L2   | 18.20 | 18.40 | 18.60 |
| øP   | 3.10  |       | 3.30  |
| Q    |       | 5     |       |
| Q1   |       | 3.80  |       |

Figure 31. TO-3P drawing



8045950\_A

## 5 Revision history

Table 10. Document revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| 07-Feb-2013 | 1        | Initial release.  |
| 17-Jun-2013 | 2        | Document status promoted from preliminary to production data.   |
| 01-Jul-2013 | 3        | Updated <a href="#">Section 2.1: Electrical characteristics (curves)</a> and <a href="#">Section Table 7.: IGBT switching characteristics (capacitive load)</a> |
| 21-Oct-2013 | 4        | Updated title, features and description in cover page.  |



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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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