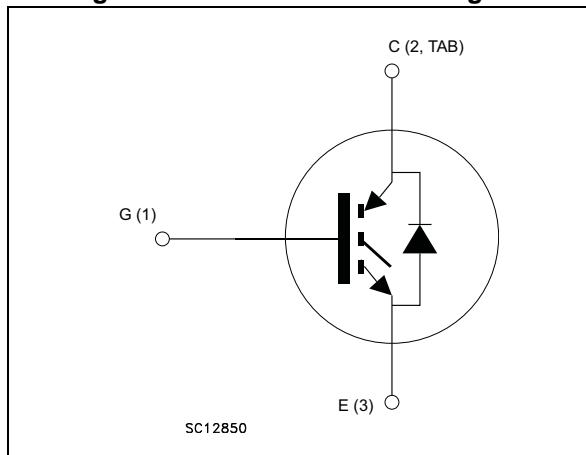


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

### Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very 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 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 codes  | Marking    | Package            | Packaging     |
|--------------|------------|--------------------|---------------|
| STGB30V60DF  | GB30V60DF  | D <sup>2</sup> PAK | Tape and reel |
| STGP30V60DF  | GP30V60DF  | TO-220             | Tube          |
| STGW30V60DF  | GW30V60DF  | TO-247             | Tube          |
| STGWT30V60DF | GWT30V60DF | TO-3P              | Tube          |

# 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                  |
| $V_{GE}$       | Gate-emitter voltage                                  | $\pm 20$    | V                  |
| $I_F$          | 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                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ °C}$             | 258         | W                  |
| $T_{STG}$      | Storage temperature range                             | - 55 to 150 | $^{\circ}\text{C}$ |
| $T_J$          | Operating junction temperature                        | - 55 to 175 | $^{\circ}\text{C}$ |

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  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thJC}$ | Thermal resistance junction-case diode | 2.08  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thJA}$ | Thermal resistance junction-ambient    | 50    | $^{\circ}\text{C}/\text{W}$ |

## 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                 | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$                          |      | 1.85 | 2.3  | V             |
|               |  | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$<br>$T_J = 125\text{ °C}$ |      | 2.15 |      |               |
|               |  | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$<br>$T_J = 175\text{ °C}$ |      | 2.35 |      |               |
| $V_F$         | Forward on-voltage                                   | $I_F = 30\text{ A}$  |      | 2    | 2.6  | V             |
|               |  | $I_F = 30\text{ A}, T_J = 125\text{ °C}$                           |      | 1.7  |      | V             |
|               |  | $I_F = 30\text{ A}, T_J = 175\text{ °C}$                           |      | 1.6  |      | 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>$V_{GE} = 0$  | -    | 3750 | -    | pF   |
| $C_{oes}$ | Output capacitance           |  | -    | 120  | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |  | -    | 77   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC} = 480\text{ V}, I_C = 30\text{ A},$<br>$V_{GE} = 15\text{ V},$ see <a href="#">Figure 29</a> | -    | 163  | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |  | -    | 28   | -    | nC   |
| $Q_{gc}$  | Gate-collector charge        |  | -    | 72   | -    | nC   |

**Table 6. IGBT 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>                                     | -    | 45   | -       | ns         |
| $t_r$           | Current rise time         |   | -    | 16   | -       | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1500 | -       | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 189  | -       | ns         |
| $t_f$           | Current fall time         |   | -    | 19   | -       | ns         |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 383  | -       | $\mu$ J    |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 233  | -       | $\mu$ J    |
| $E_{ts}$        | Total switching losses    | -   | 616  | -    | $\mu$ 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> | -    | 42   | -       | ns         |
| $t_r$           | Current rise time         |   | -    | 17   | -       | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1337 | -       | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 193  | -       | ns         |
| $t_f$           | Current fall time         |   | -    | 32   | -       | ns         |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 794  | -       | $\mu$ J    |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 378  | -       | $\mu$ J    |
| $E_{ts}$        | Total switching losses    | -   | 1172 | -    | $\mu$ J |            |

1. Energy losses include reverse recovery of the diode.
2. 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          |
| $dl_{rr}/dt$ | 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          |
| $dl_{rr}/dt$ | 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 (curves)

Figure 2. Power dissipation vs. case temperature



Figure 3. Collector current vs. case temperature

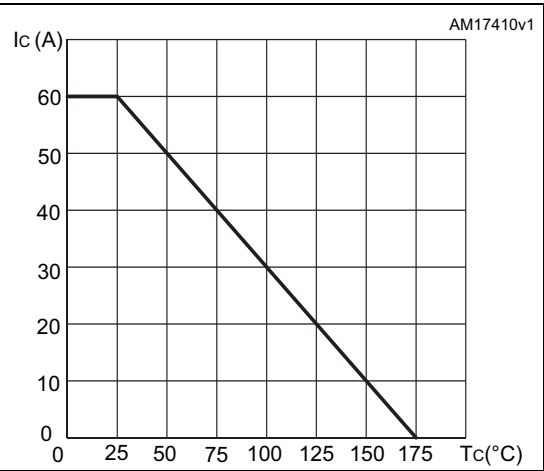


Figure 4. Output characteristics (T<sub>J</sub>=25°C)



Figure 5. Output characteristics (T<sub>J</sub>=175°C)

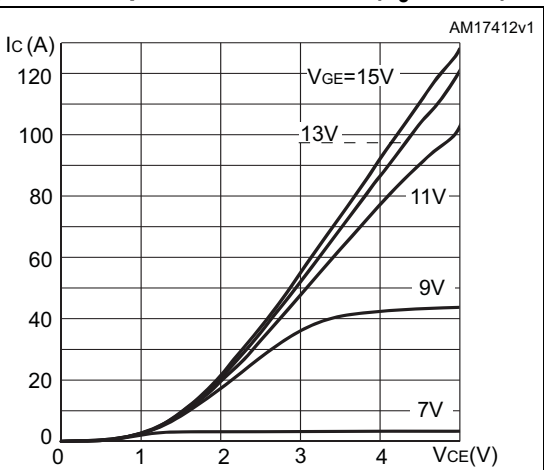


Figure 6. V<sub>CE(sat)</sub> vs. junction temperature

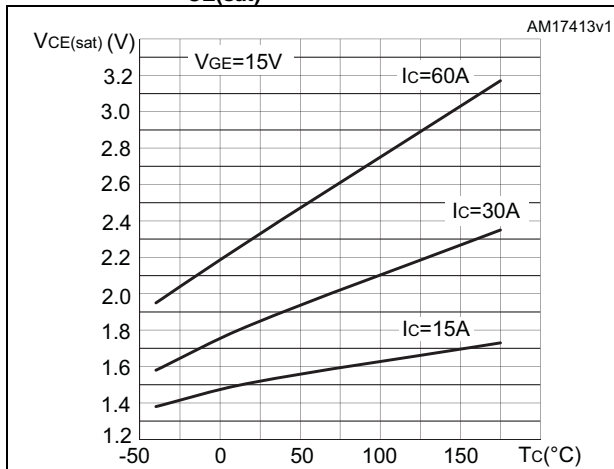


Figure 7. V<sub>CE(sat)</sub> vs. collector current

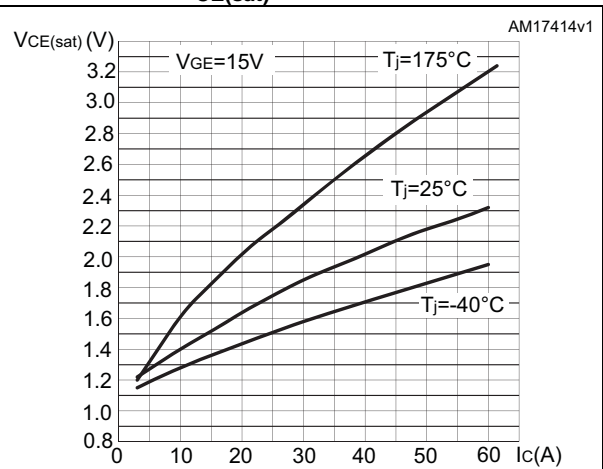


Figure 8. Collector current vs. switching frequency



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

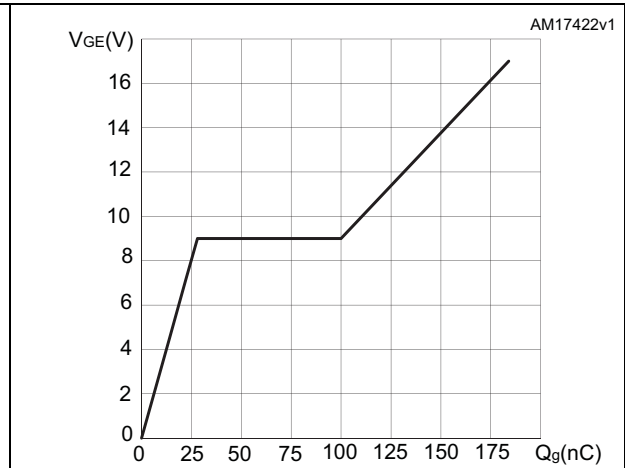


Figure 16. Switching losses vs. collector current



Figure 17. Switching losses vs. gate resistance

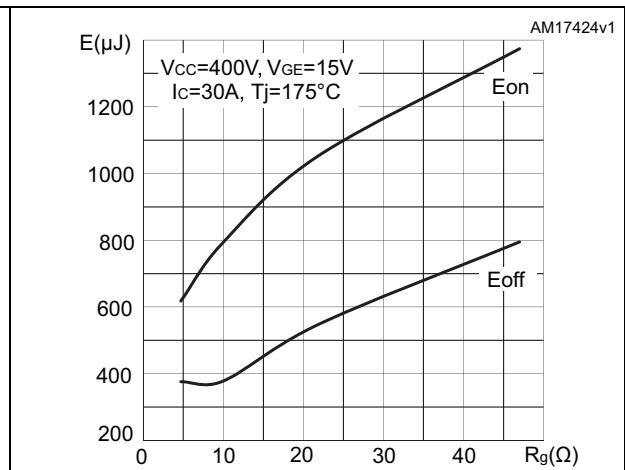


Figure 18. Switching losses vs. junction temperature



Figure 19. Switching losses vs. collector emitter voltage

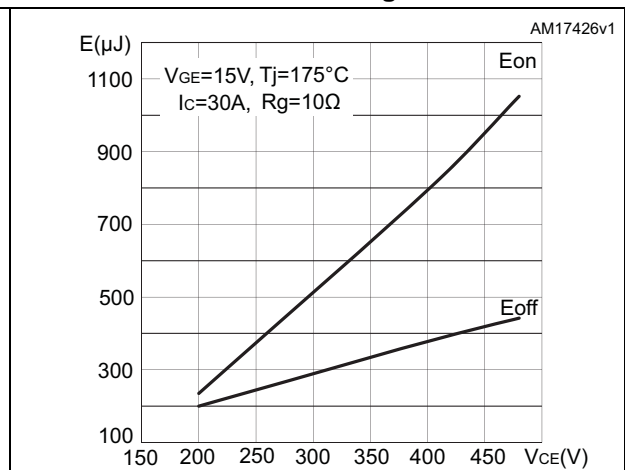


Figure 20. Switching times vs. collector current



Figure 21. Switching times vs. gate resistance

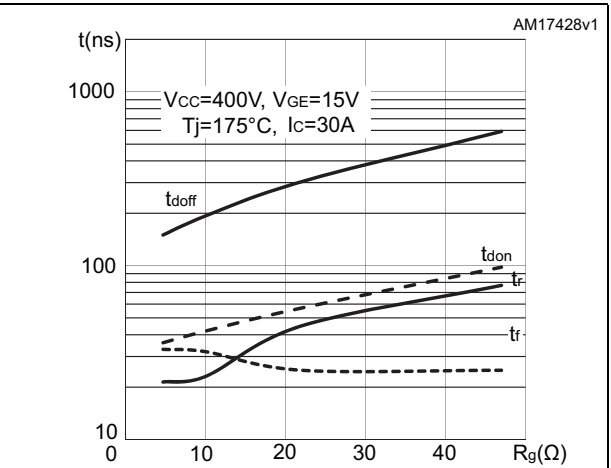


Figure 22. Reverse recovery current vs. diode current slope

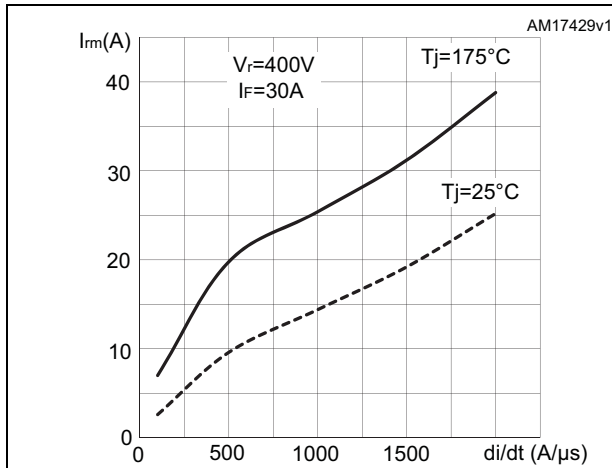


Figure 23. Reverse recovery time vs. diode current slope

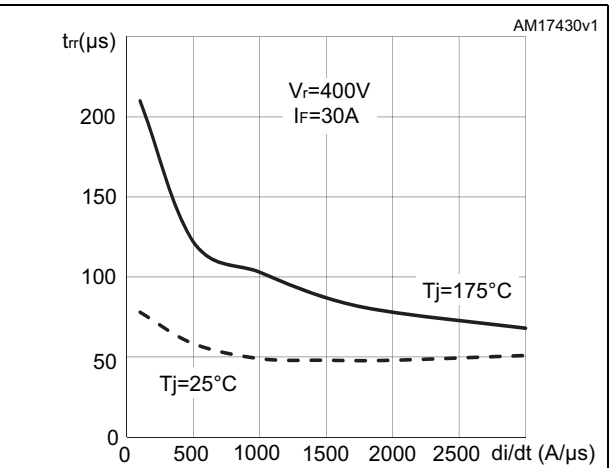


Figure 24. Reverse recovery charge vs. diode current slope

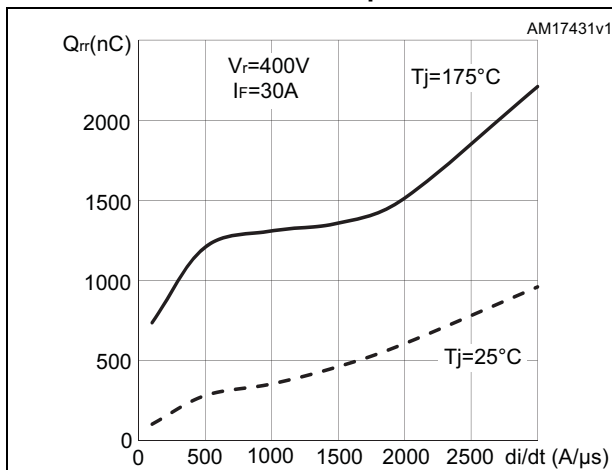


Figure 25. Reverse recovery energy vs. diode current slope

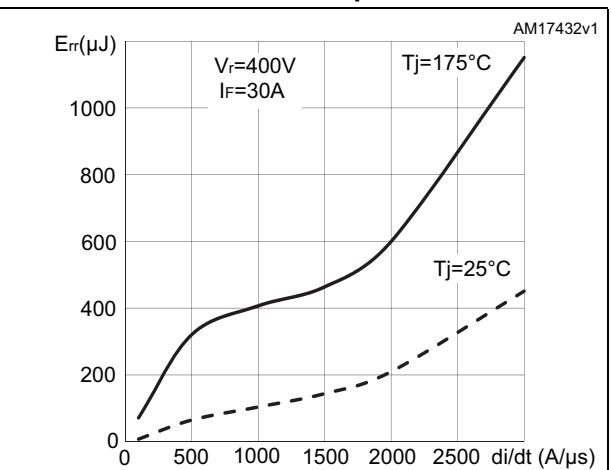




Figure 26. Thermal data for IGBT



Figure 27. Thermal data for diode



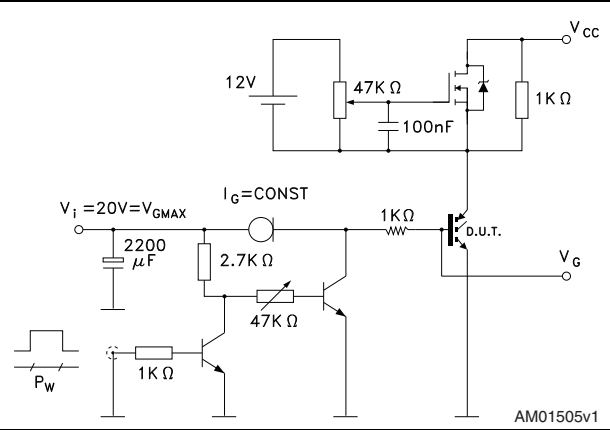
### 3 Test circuits

Figure 28. Test circuit for inductive load switching



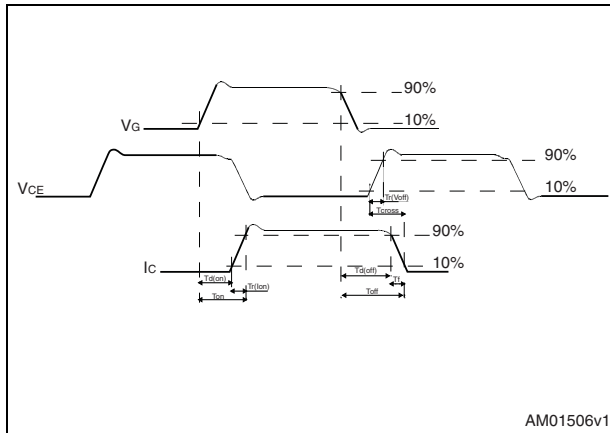
AM01504v1

Figure 29. Gate charge test circuit



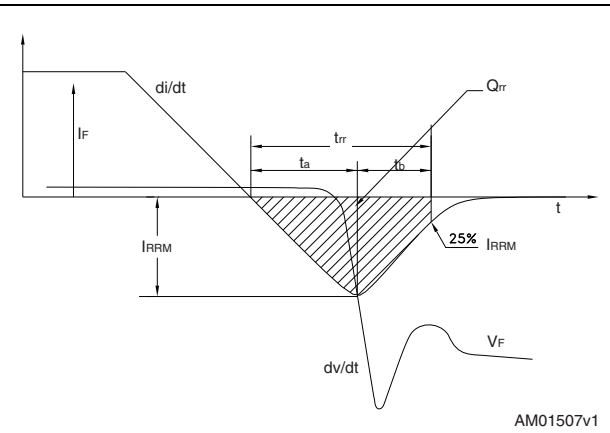
AM01505v1

Figure 30. Switching waveform



AM01506v1

Figure 31. Diode recovery time waveform



AM01507v1

## 4 Package mechanical data

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.

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

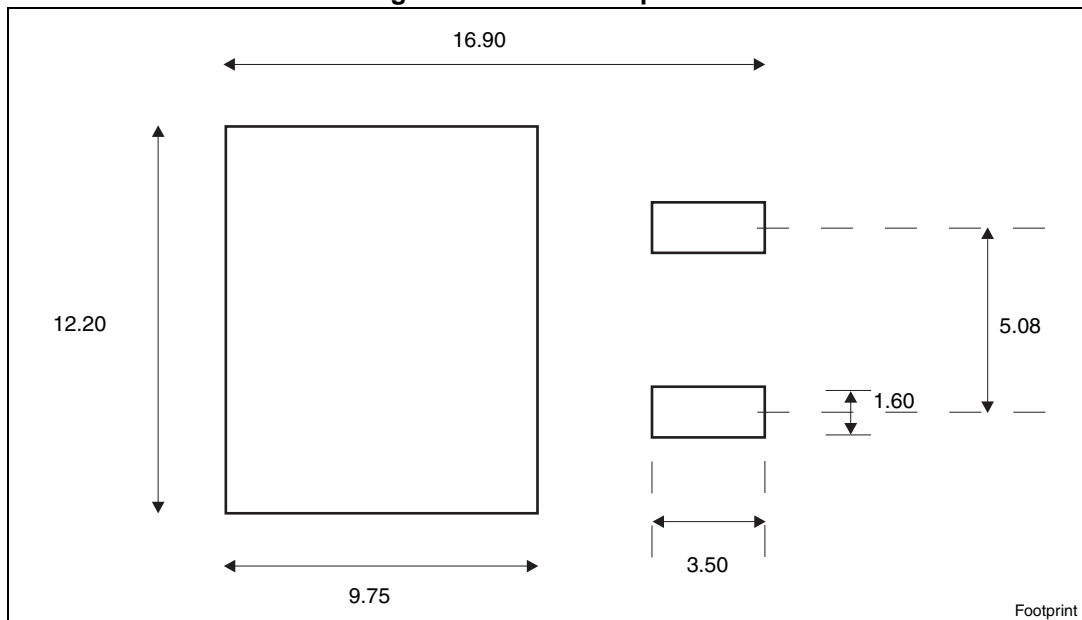
| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| 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 32. D<sup>2</sup>PAK (TO-263) drawing



0079457\_T

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



a. All dimensions are in millimeters

Table 9. TO-220 type A 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  |

Figure 34. TO-220 type A drawing

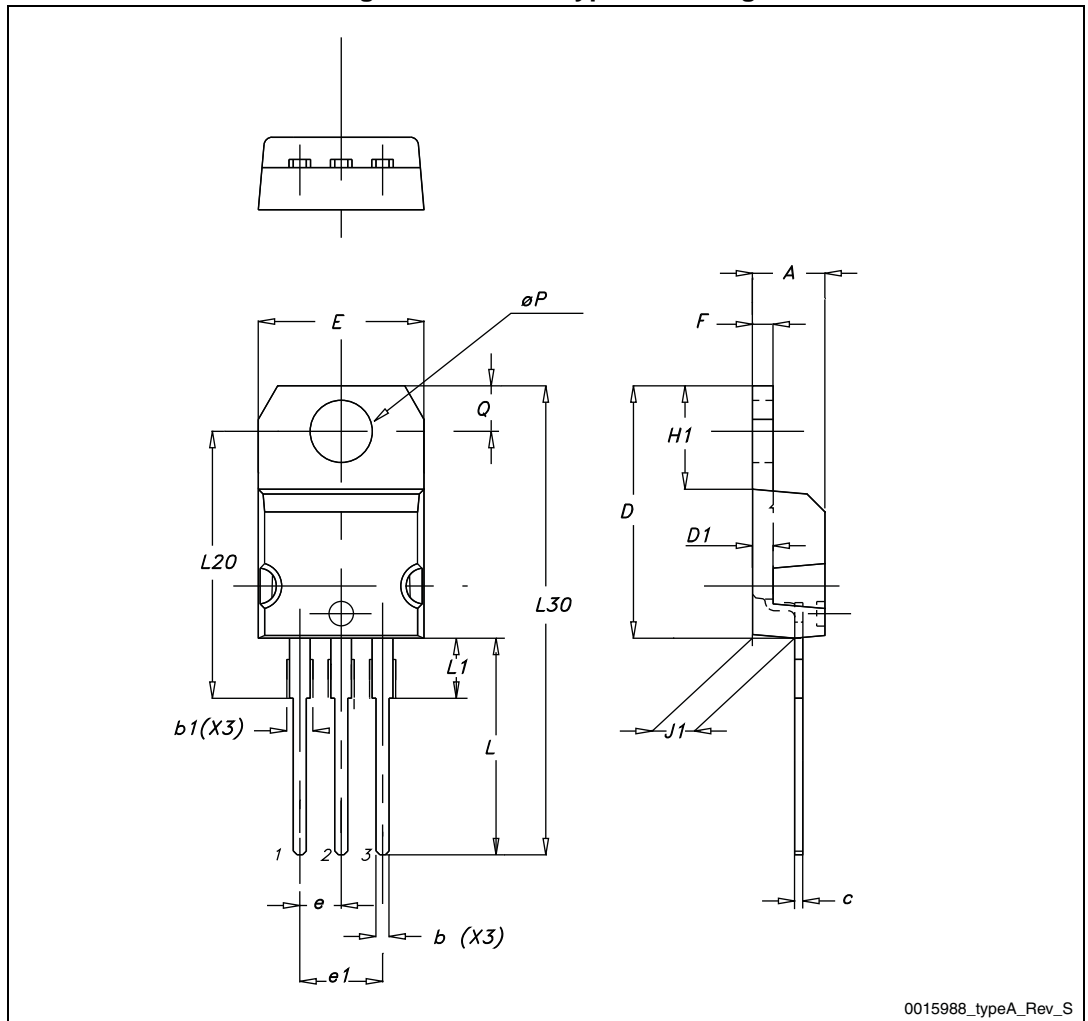


Table 10. TO-247 mechanical data

| 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 35. TO-247 drawing

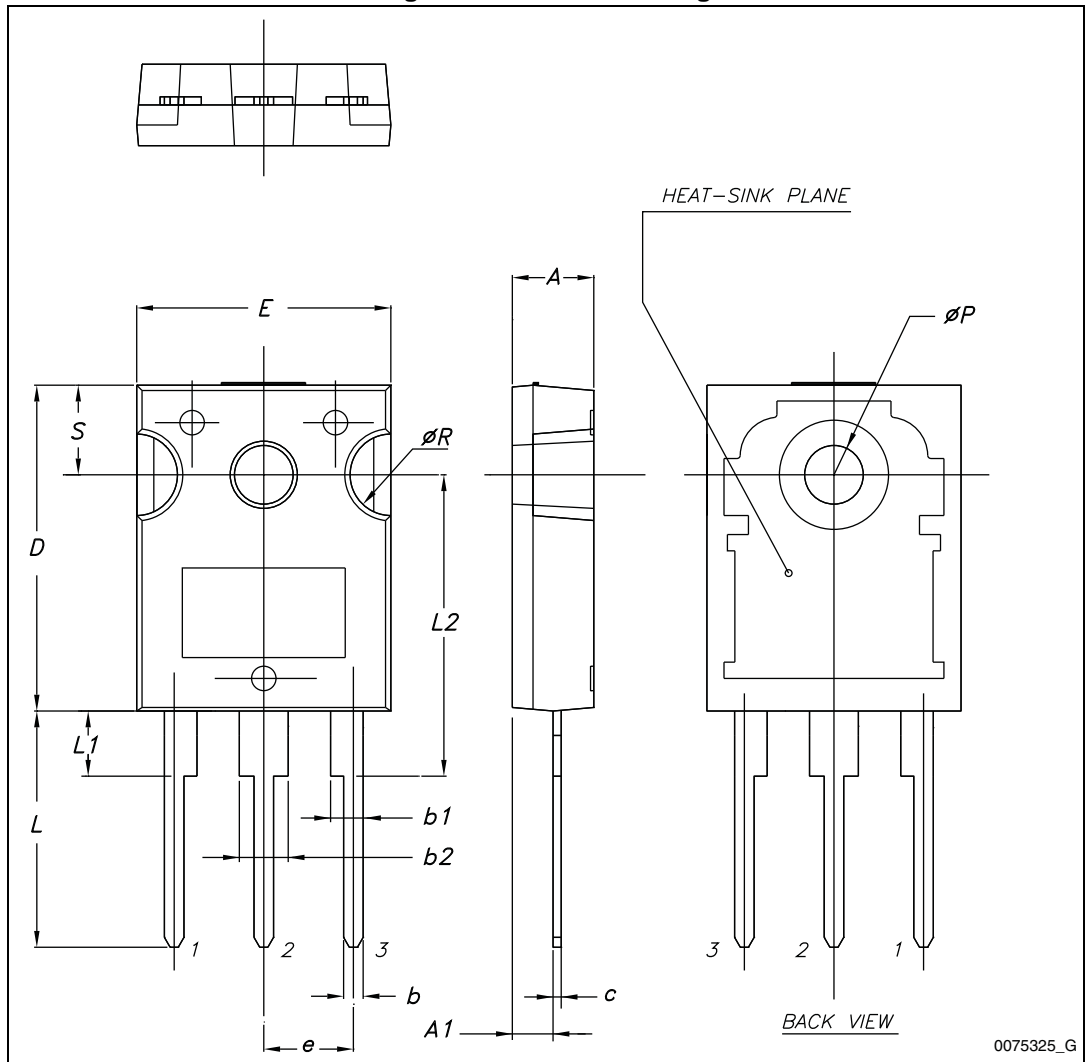




Table 11. TO-3P mechanical data

| 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 36. TO-3P drawing



## 5 Packaging mechanical data

Table 12. 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 |      |          |      |

Figure 37. Tape



Figure 38. Reel



## 6 Revision history

Table 13. Document revision history

| Date        | Revision | Changes  |
|-------------|----------|--|
| 14-Mar-2013 | 1        | Initial release.   |
| 03-May-2013 | 2        | Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a>                                |
| 04-Jun-2013 | 3        | Added minimum and maximum values for $V_{GE(th)}$ in <a href="#">Table 4: Static characteristics</a> . |
| 08-Oct-2013 | 4        | Updated title, features and description in cover page.   |

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## Данный компонент на территории Российской Федерации

### Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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