



# STGB20NC60V - STGP20NC60V STGW20NC60V

30 A - 600 V - very fast IGBT

## Features

- High frequency operation up to 50 kHz
- Lower  $C_{RES} / C_{IES}$  ratio (no cross-conduction susceptibility)
- High current capability

## Applications

- High frequency inverters
- UPS, motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies

## Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

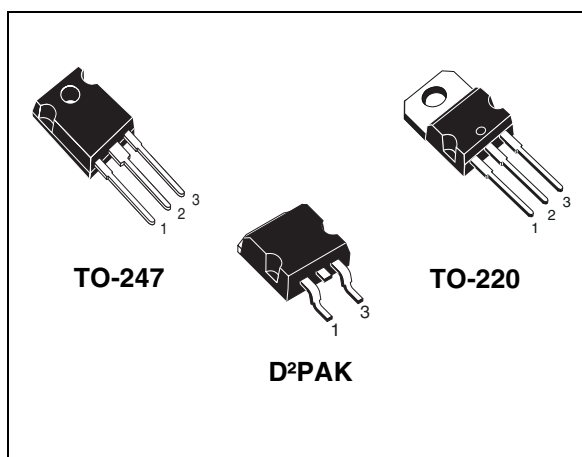


Figure 1. Internal schematic diagram

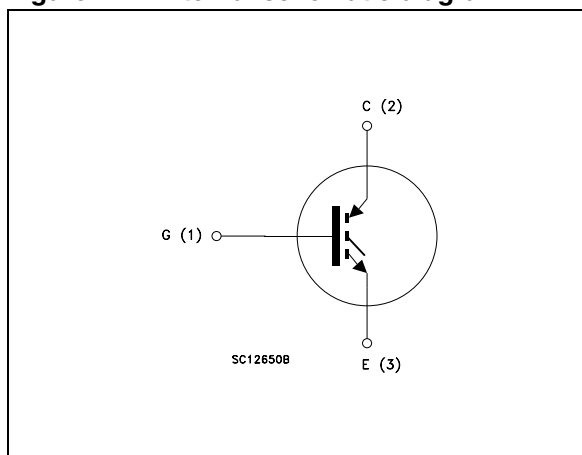


Table 1. Device summary

| Order codes   | Marking   | Package            | Packaging     |
|---------------|-----------|--------------------|---------------|
| STGB20NC60VT4 | GB20NC60V | D <sup>2</sup> PAK | Tape and reel |
| STGP20NC60V   | GP20NC60V | TO-220             | Tube          |
| STGW20NC60V   | GW20NC60V | TO-247             | 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    |
| $I_C^{(1)}$    | Collector current (continuous) at 25 °C    | 60          | A    |
| $I_C^{(1)}$    | Collector current (continuous) at 100 °C   | 30          | A    |
| $I_{CL}^{(2)}$ | Turn-off latching current                  | 100         | A    |
| $I_{CP}^{(3)}$ | Pulsed collector current                   | 100         | A    |
| $V_{GE}$       | Gate-emitter voltage                       | ± 20        | V    |
| $P_{TOT}$      | Total dissipation at $T_C = 25$ °C         | 200         | W    |
| $T_j$          | Operating junction temperature             | - 55 to 150 | °C   |

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2.  $V_{clamp} = 80\%(V_{CES})$ ,  $T_j = 150$  °C,  $R_G = 10$  Ω,  $V_{GE} = 15$  V  
 3. Pulse width limited by max junction temperature allowed

**Table 3. Thermal resistance**

| Symbol         | Parameter                               | Value  |                              | Unit |
|----------------|---|--------|------------------------------|------|
|                |   | TO-247 | TO-220<br>D <sup>2</sup> PAK |      |
| $R_{thj-case}$ | Thermal resistance junction-case max    | 0.62   |                              | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max | 50     | 62.5                         | °C/W |

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  unless otherwise specified)

**Table 4. Static electrical characteristics**

| Symbol         | Parameter  | Test conditions  | Min. | Typ.       | Max.      | Unit                |
|----------------|--|--|------|------------|-----------|---------------------|
| $V_{(BR)CES}$  | Collector-emitter breakdown voltage ( $V_{GE} = 0$ ) | $I_C = 1 \text{ mA}$   | 600  |            |           | V                   |
| $V_{CE(sat)}$  | Collector-emitter saturation voltage                 | $V_{GE}=15 \text{ V}, I_C= 20 \text{ A}$<br>$V_{GE}=15 \text{ V}, I_C= 20 \text{ A}, T_C= 125^{\circ}\text{C}$ |      | 1.8<br>1.7 | 2.5       | V<br>V              |
| $V_{GE(th)}$   | Gate threshold voltage                               | $V_{CE}= V_{GE}, I_C= 250 \mu\text{A}$   | 3.75 |            | 5.75      | V                   |
| $I_{CES}$      | Collector-emitter cut-off current ( $V_{GE} = 0$ )   | $V_{CE} = 600 \text{ V}$<br>$V_{CE} = 600 \text{ V}, T_C=125^{\circ}\text{C}$                                  |      |            | 10<br>1   | $\mu\text{A}$<br>mA |
| $I_{GES}$      | Gate-emitter cut-off current ( $V_{CE} = 0$ )        | $V_{GE} = \pm 20 \text{ V}$  |      |            | $\pm 100$ | nA                  |
| $g_{fs}^{(1)}$ | Forward transconductance                             | $V_{CE} = 15 \text{ V}, I_C= 20 \text{ A}$   |      | 15         |           | S                   |

1. Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic electrical characteristics**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25 \text{ V}, f = 1 \text{ MHz},$<br>$V_{GE}=0$   |      | 2200 |      | pF   |
| $C_{oes}$ | Output capacitance           |   |      | 225  |      | pF   |
| $C_{res}$ | Reverse transfer capacitance |   |      | 50   |      | pF   |
| $Q_g$     | Total gate charge            | $V_{CE} = 390 \text{ V}, I_C = 20 \text{ A},$<br>$V_{GE} = 15 \text{ V},$<br><i>(see Figure 17)</i> |      | 100  |      | nC   |
| $Q_{ge}$  | Gate-emitter charge          |   |      | 16   |      | nC   |
| $Q_{gc}$  | Gate-collector charge        |   |      | 45   |      | nC   |

**Table 6. Switching on/off (inductive load)**

| Symbol         | Parameter             | Test conditions  | Min. | Typ. | Max. | Unit       |
|----------------|-----------------------|--|------|------|------|------------|
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$                           |      | 31   |      | ns         |
| $t_r$          | Current rise time     | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$<br><i>(see Figure 16)</i> |      | 11   |      | ns         |
| $(di/dt)_{on}$ | Turn-on current slope |  |      | 1600 |      | A/ $\mu$ s |
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$                           |      | 31   |      | ns         |
| $t_r$          | Current rise time     | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$                           |      | 11.5 |      | ns         |
| $(di/dt)_{on}$ | Turn-on current slope | $T_C = 125\text{ }^\circ\text{C}$ <i>(see Figure 16)</i>             |      | 1500 |      | A/ $\mu$ s |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A},$                          |      | 28   |      | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V}$                            |      | 100  |      | ns         |
| $t_f$          | Current fall time     | <i>(see Figure 18)</i>   |      | 75   |      | ns         |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 20\text{ A},$                          |      | 66   |      | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$                           |      | 150  |      | ns         |
| $t_f$          | Current fall time     | $T_C = 125\text{ }^\circ\text{C}$ <i>(see Figure 18)</i>             |      | 130  |      | ns         |

**Table 7. Switching energy (inductive load)**

| Symbol          | Parameter                 | Test conditions  | Min. | Typ. | Max. | Unit    |
|-----------------|---------------------------|--|------|------|------|---------|
| $E_{on}$        | Turn-on switching losses  | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$               |      | 220  |      | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$               |      | 330  |      | $\mu$ J |
| $E_{ts}$        | Total switching losses    | <i>(see Figure 18)</i>                                   |      | 550  |      | $\mu$ J |
| $E_{on}$        | Turn-on switching losses  | $V_{CC} = 390\text{ V}, I_C = 20\text{ A}$               |      | 450  |      | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$               |      | 770  |      | $\mu$ J |
| $E_{ts}$        | Total switching losses    | $T_C = 125\text{ }^\circ\text{C}$ <i>(see Figure 18)</i> |      | 1220 |      | $\mu$ J |

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

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

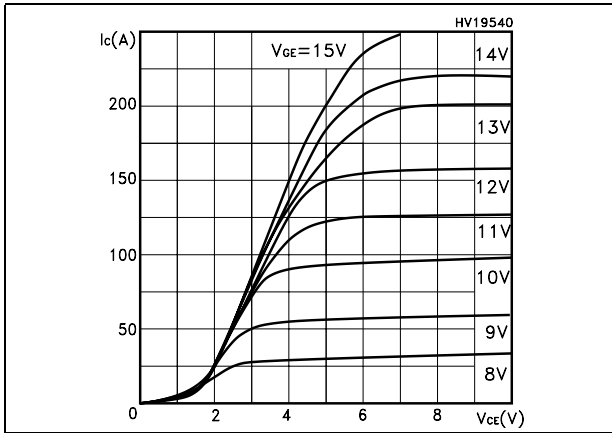


Figure 3. Transfer characteristics

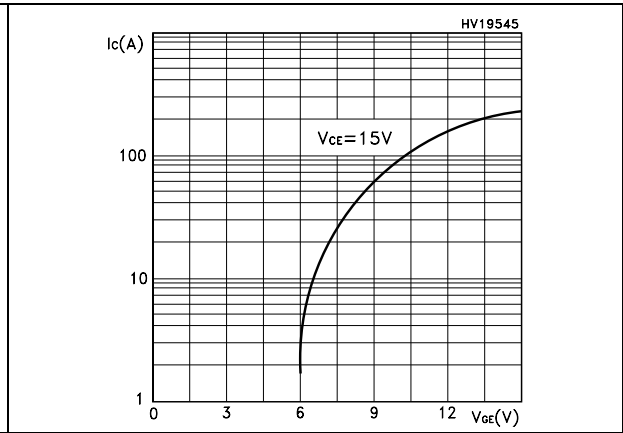


Figure 4. Transconductance

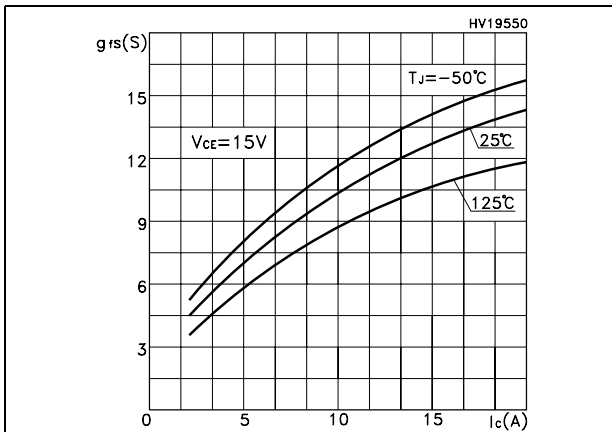


Figure 5. Collector-emitter on voltage vs temperature

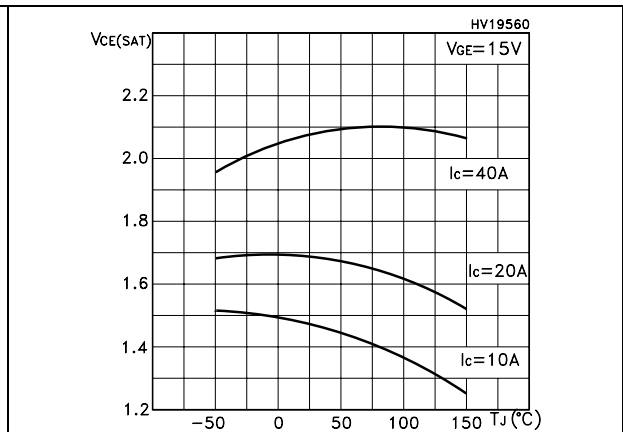


Figure 6. Gate charge vs gate-source voltage

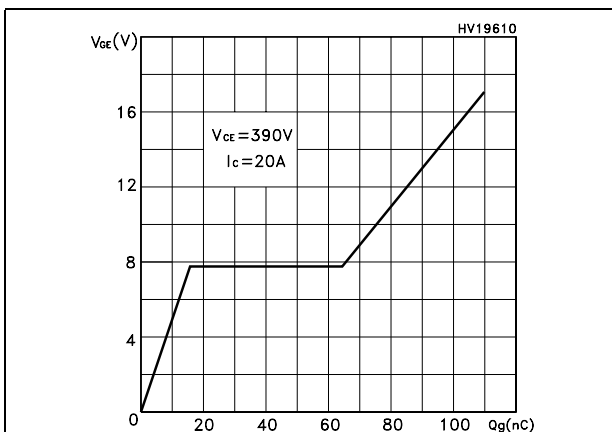


Figure 7. Capacitance variations

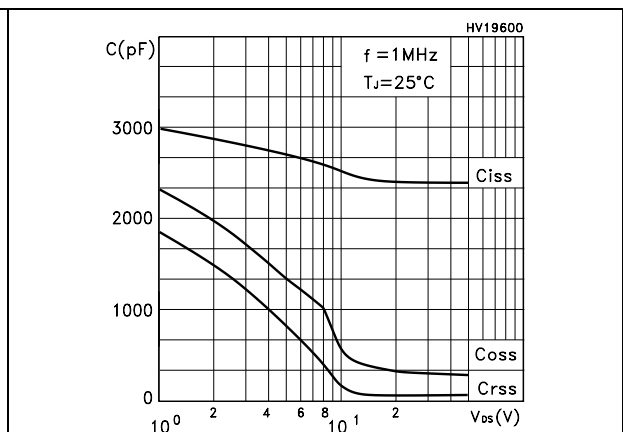


Figure 8. Normalized gate threshold voltage vs temperature

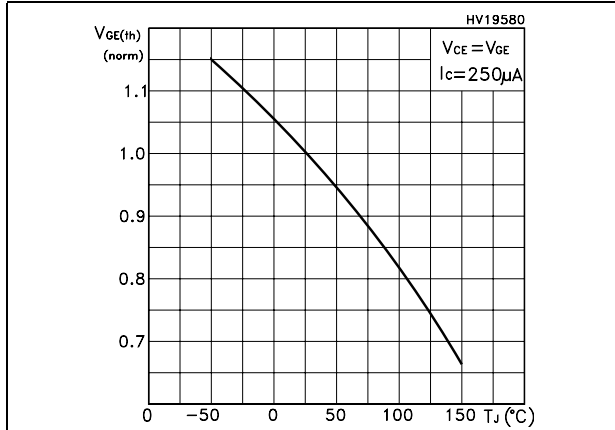


Figure 9. Collector-emitter on voltage vs collector current

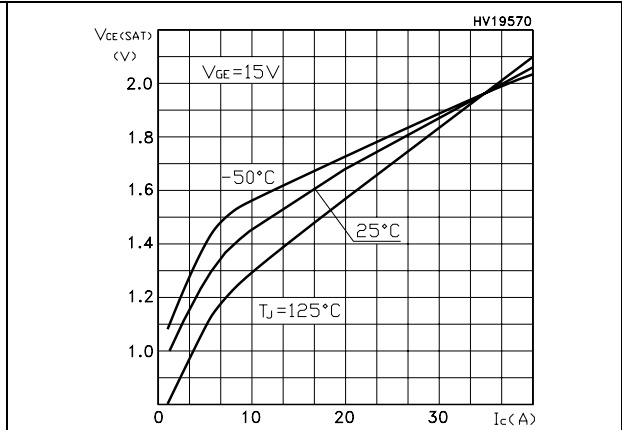


Figure 10. Normalized breakdown voltage vs temperature

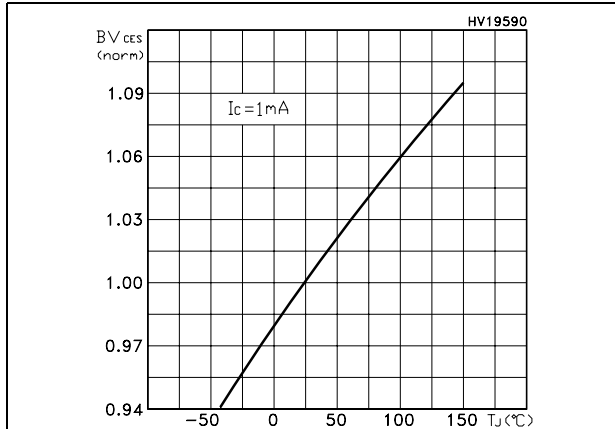


Figure 11. Switching losses vs temperature

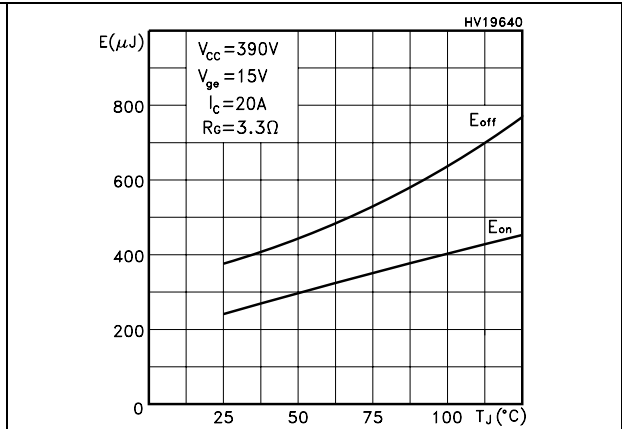


Figure 12. Switching losses vs gate resistance

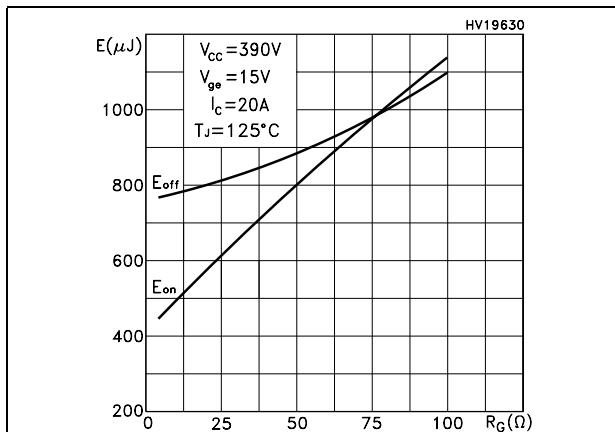


Figure 13. Switching losses vs collector current

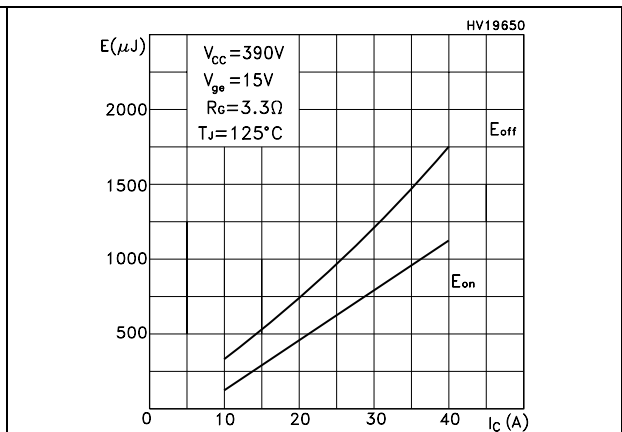


Figure 14. Thermal impedance

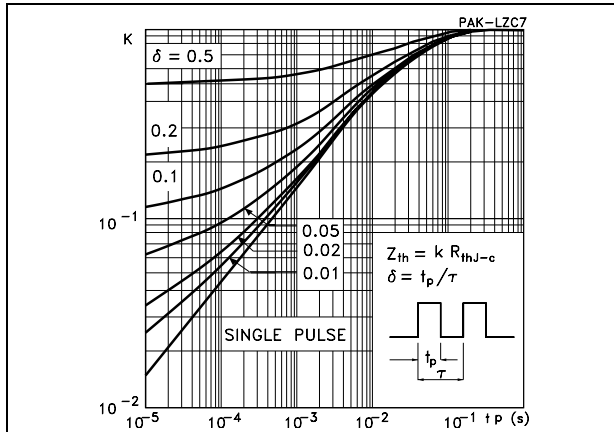
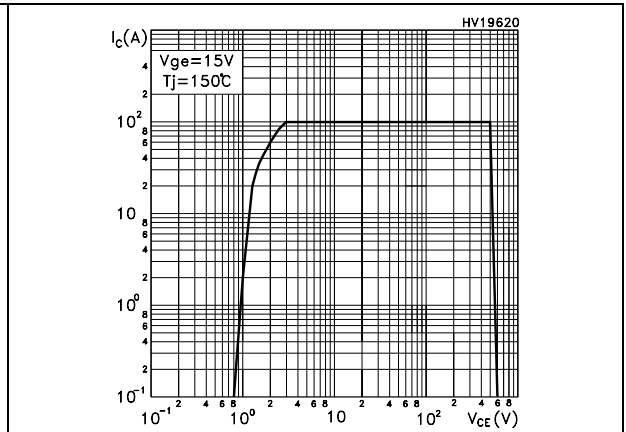


Figure 15. Turn-off SOA





### 3 Test circuit

Figure 16. Test circuit for inductive load switching

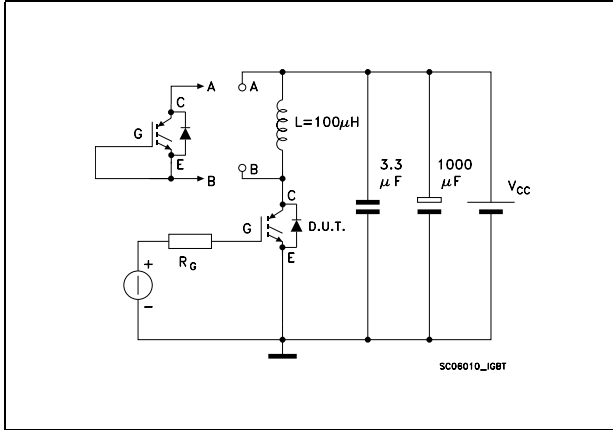


Figure 17. Gate charge test circuit

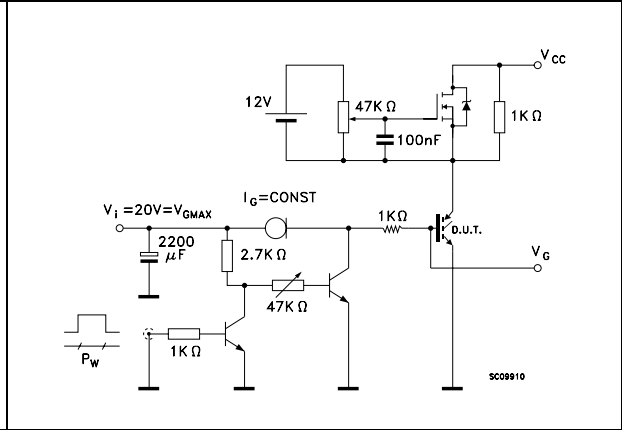
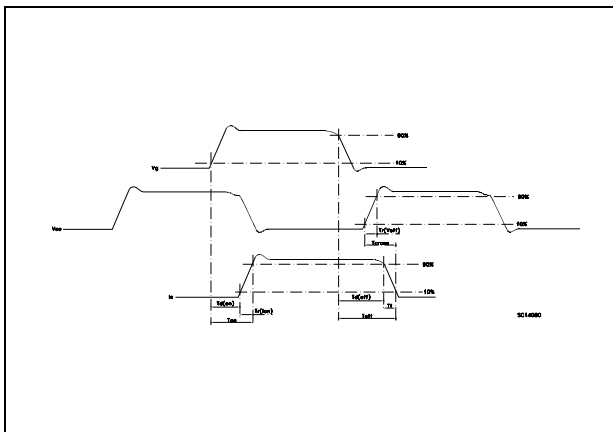


Figure 18. Switching waveform

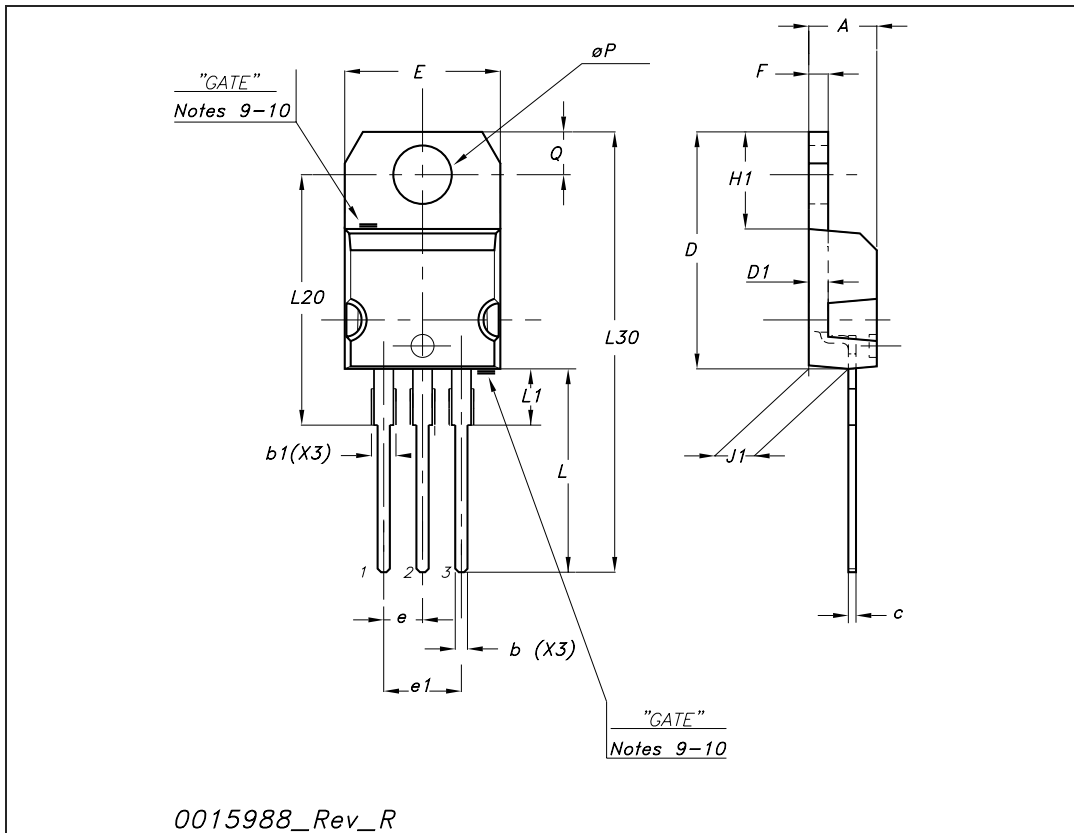


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

TO-220 mechanical data

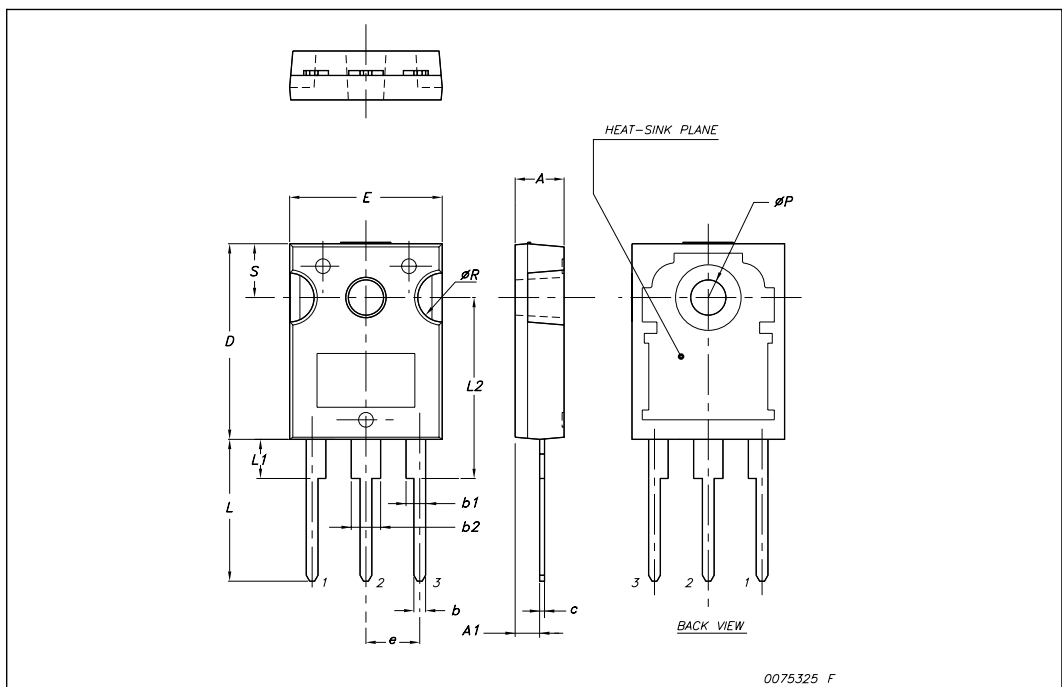
| Dim | mm    |       |       | inch  |       |       |
|-----|-------|-------|-------|-------|-------|-------|
|     | Min   | Typ   | Max   | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b   | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1  | 1.14  |       | 1.70  | 0.044 |       | 0.066 |
| c   | 0.48  |       | 0.70  | 0.019 |       | 0.027 |
| D   | 15.25 |       | 15.75 | 0.6   |       | 0.62  |
| D1  |       | 1.27  |       |       | 0.050 |       |
| E   | 10    |       | 10.40 | 0.393 |       | 0.409 |
| e   | 2.40  |       | 2.70  | 0.094 |       | 0.106 |
| e1  | 4.95  |       | 5.15  | 0.194 |       | 0.202 |
| F   | 1.23  |       | 1.32  | 0.048 |       | 0.051 |
| H1  | 6.20  |       | 6.60  | 0.244 |       | 0.256 |
| J1  | 2.40  |       | 2.72  | 0.094 |       | 0.107 |
| L   | 13    |       | 14    | 0.511 |       | 0.551 |
| L1  | 3.50  |       | 3.93  | 0.137 |       | 0.154 |
| L20 |       | 16.40 |       |       | 0.645 |       |
| L30 |       | 28.90 |       |       | 1.137 |       |
| ∅P  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



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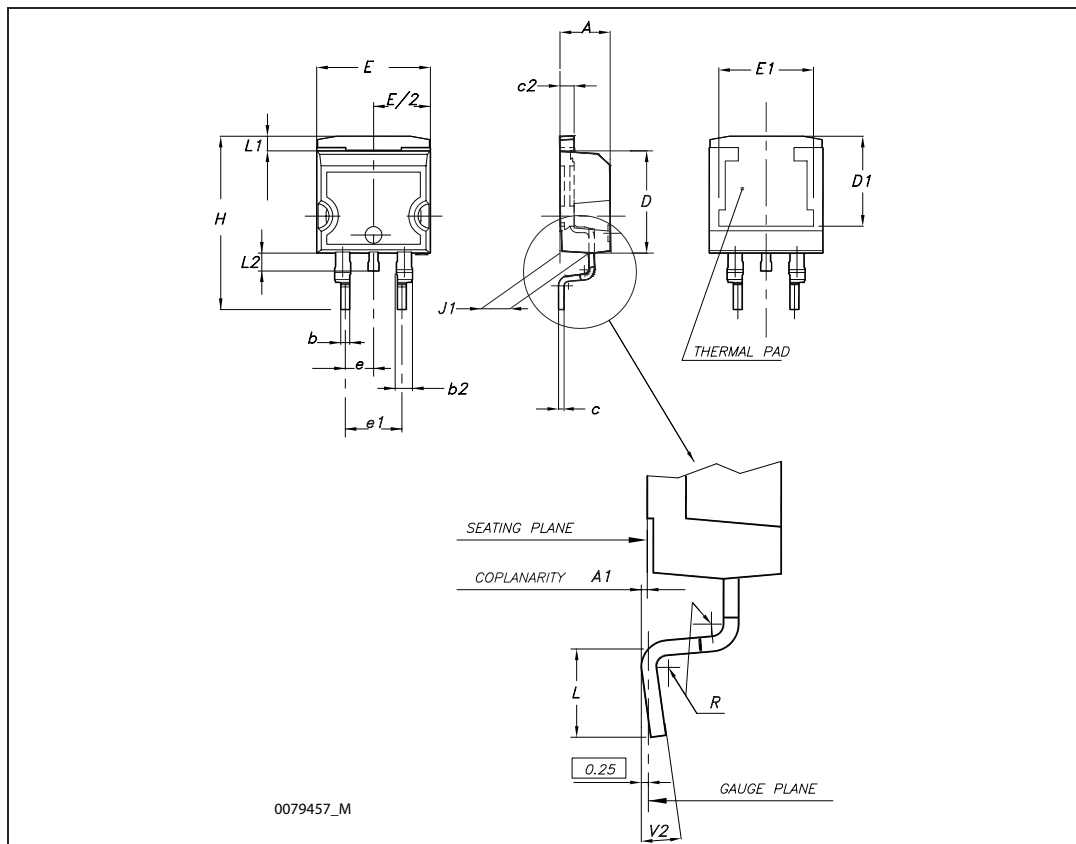
**TO-247 Mechanical data**

| 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    |       | 5.45  |       |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| øP   | 3.55  |       | 3.65  |
| øR   | 4.50  |       | 5.50  |
| S    |       | 5.50  |       |



D<sup>2</sup>PAK (TO-263) mechanical data

| Dim | mm   |      |       | inch  |       |       |
|-----|------|------|-------|-------|-------|-------|
|     | Min  | Typ  | Max   | Min   | Typ   | Max   |
| A   | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| A1  | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| b   | 0.70 |      | 0.93  | 0.027 |       | 0.037 |
| b2  | 1.14 |      | 1.70  | 0.045 |       | 0.067 |
| c   | 0.45 |      | 0.60  | 0.017 |       | 0.024 |
| c2  | 1.23 |      | 1.36  | 0.048 |       | 0.053 |
| D   | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1  | 7.50 |      |       | 0.295 |       |       |
| E   | 10   |      | 10.40 | 0.394 |       | 0.409 |
| E1  | 8.50 |      |       | 0.334 |       |       |
| e   |      | 2.54 |       |       | 0.1   |       |
| e1  | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| H   | 15   |      | 15.85 | 0.590 |       | 0.624 |
| J1  | 2.49 |      | 2.69  | 0.099 |       | 0.106 |
| L   | 2.29 |      | 2.79  | 0.090 |       | 0.110 |
| L1  | 1.27 |      | 1.40  | 0.05  |       | 0.055 |
| L2  | 1.30 |      | 1.75  | 0.051 |       | 0.069 |
| R   |      | 0.4  |       |       | 0.016 |       |
| V2  | 0°   |      | 8°    | 0°    |       | 8°    |



# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT

**TAPE MECHANICAL DATA**

| DIM. | mm   |      | inch   |        |
|------|------|------|--------|--------|
|      | MIN. | MAX. | MIN.   | MAX.   |
| A0   | 10.5 | 10.7 | 0.413  | 0.421  |
| B0   | 15.7 | 15.9 | 0.618  | 0.626  |
| D    | 1.5  | 1.6  | 0.059  | 0.063  |
| D1   | 1.59 | 1.61 | 0.062  | 0.063  |
| E    | 1.65 | 1.85 | 0.065  | 0.073  |
| F    | 11.4 | 11.6 | 0.449  | 0.456  |
| K0   | 4.8  | 5.0  | 0.189  | 0.197  |
| P0   | 3.9  | 4.1  | 0.153  | 0.161  |
| P1   | 11.9 | 12.1 | 0.468  | 0.476  |
| P2   | 1.9  | 2.1  | 0.075  | 0.082  |
| R    | 50   |      | 1.574  |        |
| T    | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W    | 23.7 | 24.3 | 0.933  | 0.956  |

**REEL MECHANICAL DATA**

| DIM. | mm   |      | inch  |        |
|------|------|------|-------|--------|
|      | MIN. | MAX. | MIN.  | MAX.   |
| A    |      | 330  |       | 12.992 |
| B    | 1.5  |      | 0.059 |        |
| C    | 12.8 | 13.2 | 0.504 | 0.520  |
| D    | 20.2 |      | 0.795 |        |
| G    | 24.4 | 26.4 | 0.960 | 1.039  |
| N    | 100  |      | 3.937 |        |
| T    |      | 30.4 |       | 1.197  |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000     | 1000     |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

\* on sales type

## 6 Revision history

**Table 8. Document revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                       |
|-------------|-----------------|--------------------------------------|
| 07-Jun-2004 | 4               | Stylesheet update. No content change |
| 14-May-2008 | 5               | Inserted D <sup>2</sup> PAK          |

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## Стандарт Электрон Связь

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

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