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# STGB30NC60K STGP30NC60K

30 A - 600 V - short circuit rugged IGBT

## Features

- Low on-voltage drop ( $V_{CE(sat)}$ )
- Low  $C_{res} / C_{ies}$  ratio (no cross conduction susceptibility)
- Short circuit withstand time 10  $\mu$ s

## Applications

- High frequency inverters
- Motor drivers

## Description

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

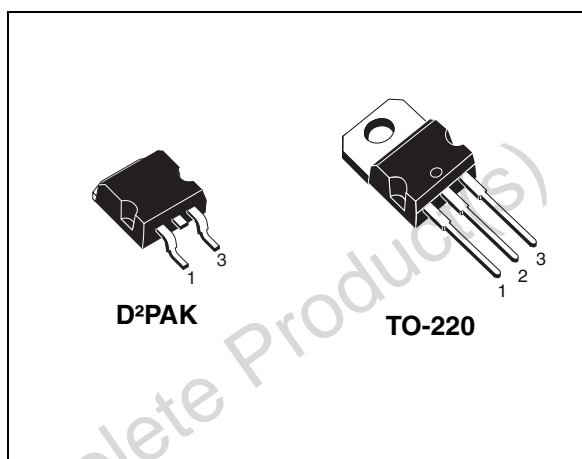


Figure 1. Internal schematic diagram

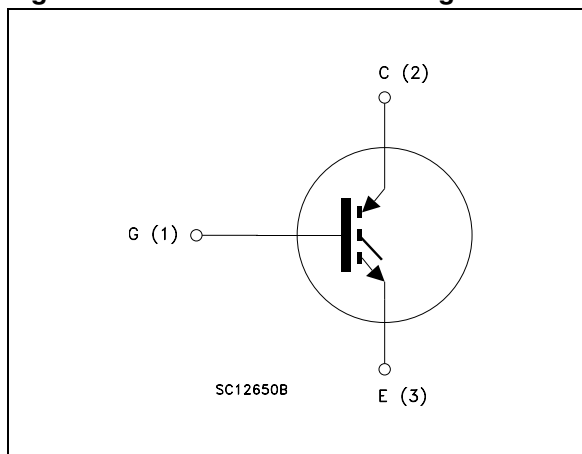


Table 1. Device summary

| Order codes   | Marking   | Package            | Packaging     |
|---------------|-----------|--------------------|---------------|
| STGB30NC60KT4 | GB30NC60K | D <sup>2</sup> PAK | Tape and reel |
| STGP30NC60K   | GP30NC60K | TO-220             | Tube          |

## Contents

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Obsolete Product(s) - Obsolete Product(s)

STGB30NC60K - STGP30NC60K

Electrical ratings

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                         | Parameter  | Value       | Unit |
|--------------------------------|--|-------------|------|
| V <sub>CES</sub>               | Collector-emitter voltage (V <sub>GE</sub> = 0)  | 600         | V    |
| I <sub>C</sub> <sup>(1)</sup>  | Collector current (continuous) at T <sub>C</sub> = 25°C  | 60          | A    |
| I <sub>C</sub> <sup>(1)</sup>  | Collector current (continuous) at T <sub>C</sub> = 100°C   | 26          | A    |
| I <sub>CL</sub> <sup>(2)</sup> | Turn-off latching current  | 125         | A    |
| I <sub>CP</sub> <sup>(3)</sup> | Pulsed collector current   | 125         | A    |
| V <sub>GE</sub>                | Gate-emitter voltage   | ±20         | V    |
| P <sub>TOT</sub>               | Total dissipation at T <sub>C</sub> = 25°C   | 185         | W    |
| t <sub>scw</sub>               | Short circuit withstand time, V <sub>CE</sub> = 0.5V <sub>(BR)CES</sub><br>T <sub>j</sub> = 125°C, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 12 V | 10          | μs   |
| T <sub>j</sub>                 | Operating junction temperature   | - 55 to 150 | °C   |

1. Calculated according to the iterative formula:

$$I_c(T_c) = \frac{T_{J(MAX)} - T_c}{R_{thj-c} \times V_{CE(sat)(MAX)} \cdot (T_c, I_c)}$$

2. V<sub>clamp</sub> = 80% (V<sub>CES</sub>), T<sub>j</sub> = 150°C, R<sub>G</sub> = 10 Ω, V<sub>GE</sub> = 15 V
3. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal resistance**

| Symbol                | Parameter                                | Value | Unit |
|-----------------------|--|-------|------|
| R <sub>thj-case</sub> | Thermal resistance junction-case max.    | 0.675 | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-ambient max. | 62.5  | °C/W |

Electrical characteristics

STGB30NC60K - STGP30NC60K

## 2 Electrical characteristics

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

**Table 4. Static**

| 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>$V_{GE}=15\text{ V}, I_C=20\text{ A}, T_C=125^{\circ}C$ |      | 2.1<br>1.9 | 2.7       | V<br>V              |
| $I_{CES}$      | Collector cut-off current ( $V_{GE}=0$ )           | $V_{CE}=600\text{ V}$<br>$V_{CE}=600\text{ V}, T_C=125^{\circ}C$                                 |      |            | 150<br>1  | $\mu\text{A}$<br>mA |
| $V_{GE(th)}$   | Gate threshold voltage                             | $V_{CE}=V_{GE}, I_C=250\text{ }\mu\text{A}$  | 4.5  |            | 6.5       | V                   |
| $I_{GES}$      | 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. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE}=25\text{ V}, f=1\text{ MHz}, V_{GE}=0$                                |      | 2170 |      | pF   |
| $C_{oes}$ | Output capacitance           |   |      | 230  |      | pF   |
| $C_{res}$ | Reverse transfer capacitance |   |      | 46   |      | pF   |
| $Q_g$     | Total gate charge            | $V_{CE}=480\text{ V}, I_C=20\text{ A}, V_{GE}=15\text{ V}$<br>(see Figure 17) |      | 96   |      | nC   |
| $Q_{ge}$  | Gate-emitter charge          |   |      | 18   |      | nC   |
| $Q_{gc}$  | Gate-collector charge        |   |      | 46   |      | nC   |

**STGB30NC60K - STGP30NC60K**
**Electrical characteristics**
**Table 6. Switching on/off (inductive load)**

| Symbol         | Parameter             | Test conditions                              | Min. | Typ. | Max. | Unit       |
|----------------|-----------------------|--|------|------|------|------------|
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 480\text{ V}, I_C = 20\text{ A}$   |      | 29   |      | ns         |
| $t_r$          | Current rise time     | $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$     |      | 12   |      | ns         |
| $(di/dt)_{on}$ | Turn-on current slope | (see Figure 16)                              |      | 1520 |      | A/ $\mu$ s |
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 480\text{ V}, I_C = 20\text{ A}$   |      | 27   |      | ns         |
| $t_r$          | Current rise time     | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$    |      | 14   |      | ns         |
| $(di/dt)_{on}$ | Turn-on current slope | $T_C = 125^\circ\text{C}$ (see Figure 16)    |      | 1360 |      | A/ $\mu$ s |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 480\text{ V}, I_C = 20\text{ A},$  |      | 36   |      | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$     |      | 120  |      | ns         |
| $t_f$          | Current fall time     | (see Figure 16)                              |      | 85   |      | ns         |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 480\text{ V}, I_C = 20\text{ A},$  |      | 75   |      | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$     |      | 160  |      | ns         |
| $t_f$          | Current fall time     | $T_C = 125^\circ\text{C}$<br>(see Figure 16) |      | 130  |      | ns         |

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

| Symbol          | Parameter                 | Test conditions                              | Min | Typ. | Max | Unit    |
|-----------------|---------------------------|--|-----|------|-----|---------|
| $E_{on}$        | Turn-on switching losses  | $V_{CC} = 480\text{ V}, I_C = 20\text{ A}$   |     | 350  |     | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$    |     | 435  |     | $\mu$ J |
| $E_{ts}$        | Total switching losses    | (see Figure 16)                              |     | 785  |     | $\mu$ J |
| $E_{on}$        | Turn-on switching losses  | $V_{CC} = 480\text{ V}, I_C = 20\text{ A}$   |     | 590  |     | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$    |     | 845  |     | $\mu$ J |
| $E_{ts}$        | Total switching losses    | $T_C = 125^\circ\text{C}$<br>(see Figure 16) |     | 1435 |     | $\mu$ J |

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

Electrical characteristics

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2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

Figure 3. Transfer characteristics

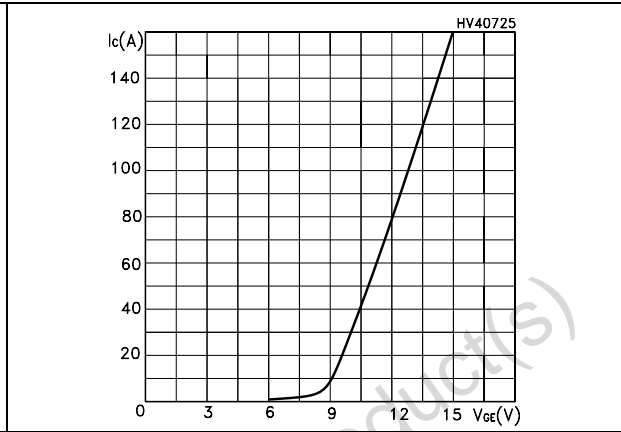
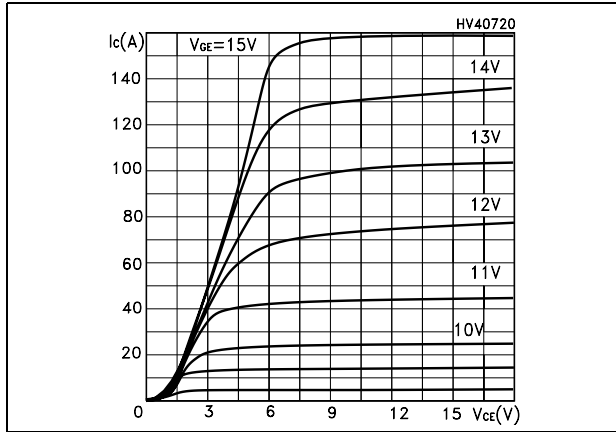


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs temperature

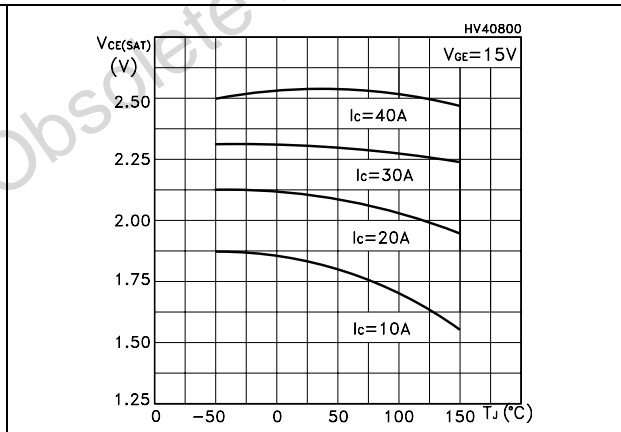
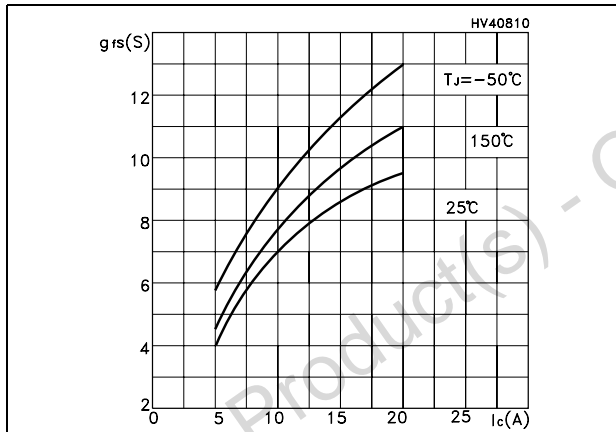
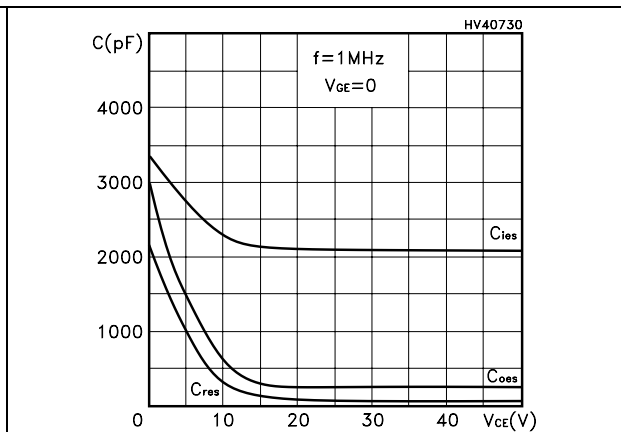
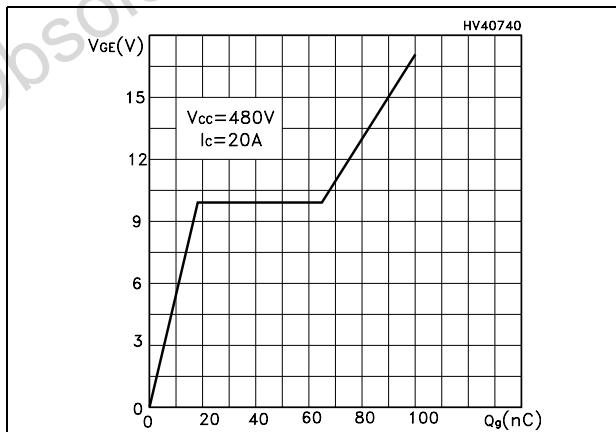


Figure 6. Gate charge vs gate-source voltage

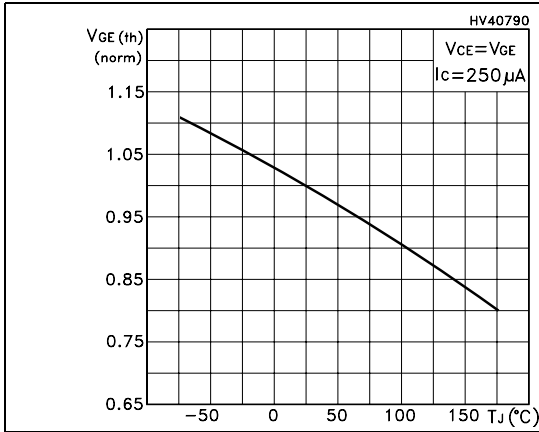
Figure 7. Capacitance variations



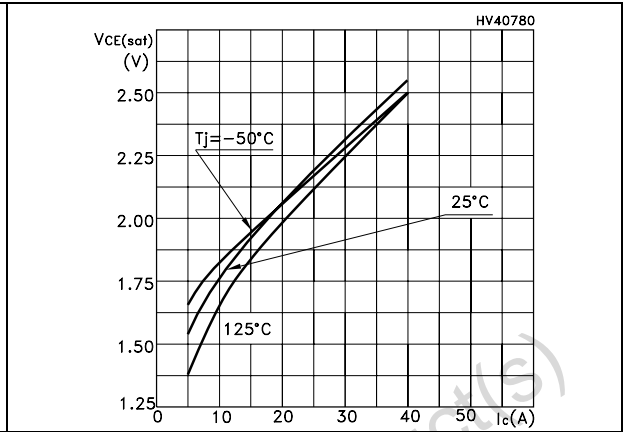
**STGB30NC60K - STGP30NC60K**

**Electrical characteristics**

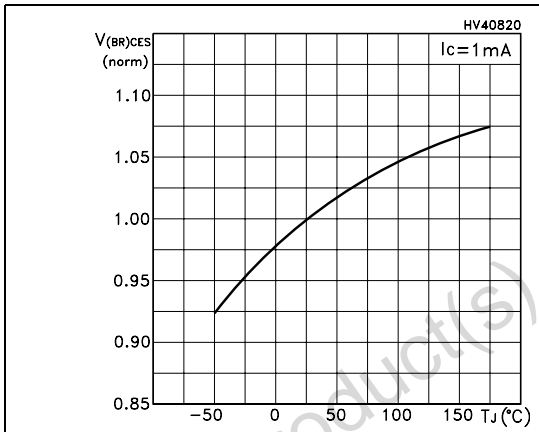
**Figure 8. Normalized gate threshold voltage vs temperature**



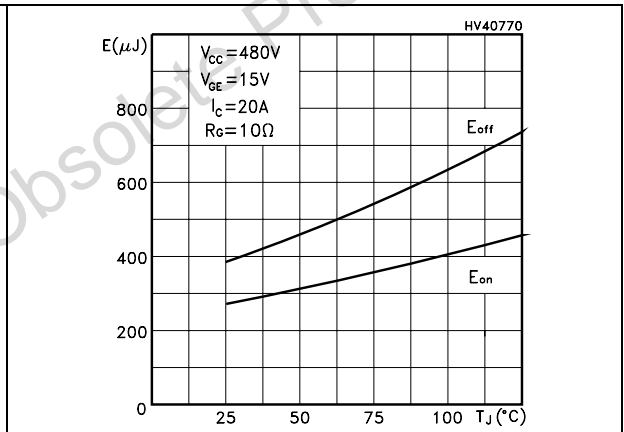
**Figure 9. Collector-emitter on voltage vs collector current**



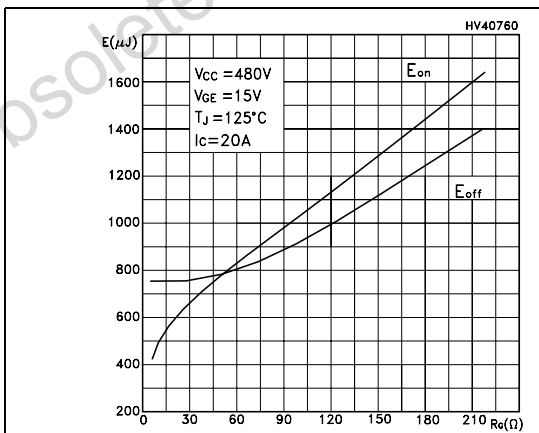
**Figure 10. Normalized breakdown voltage vs temperature**



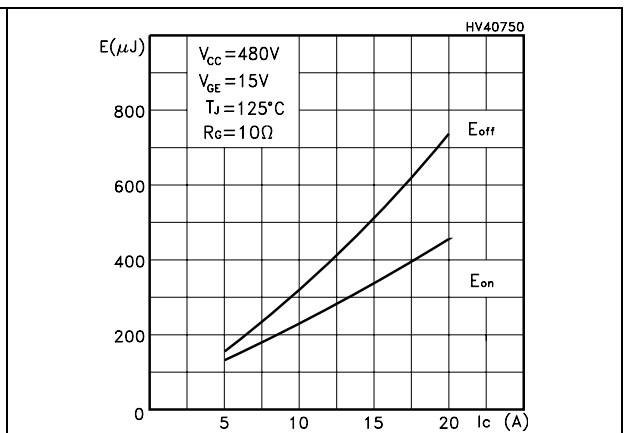
**Figure 11. Switching losses vs temperature**



**Figure 12. Switching losses vs gate resistance**



**Figure 13. Switching losses vs collector current**



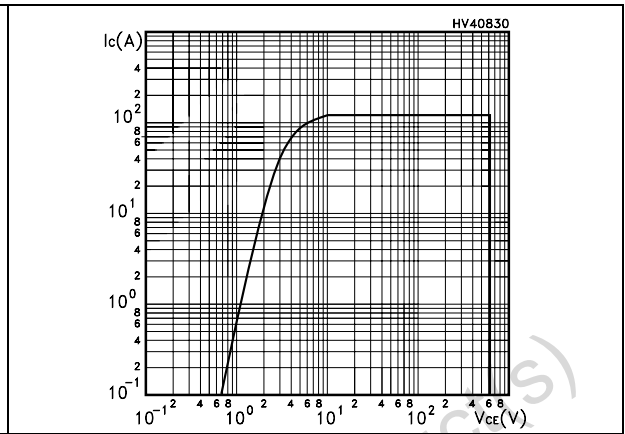
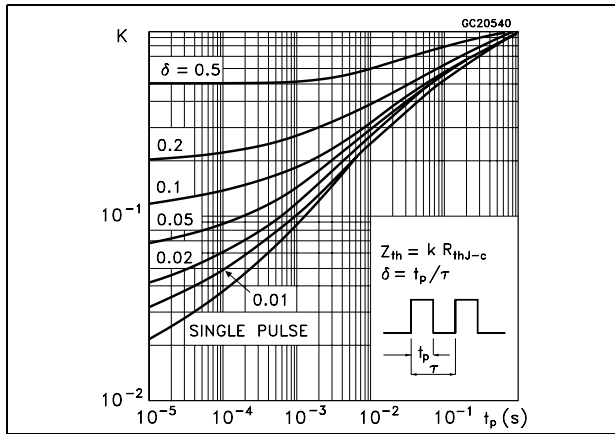


**Electrical characteristics**

**STGB30NC60K - STGP30NC60K**

**Figure 14. Thermal Impedance**

**Figure 15. Turn-off SOA**



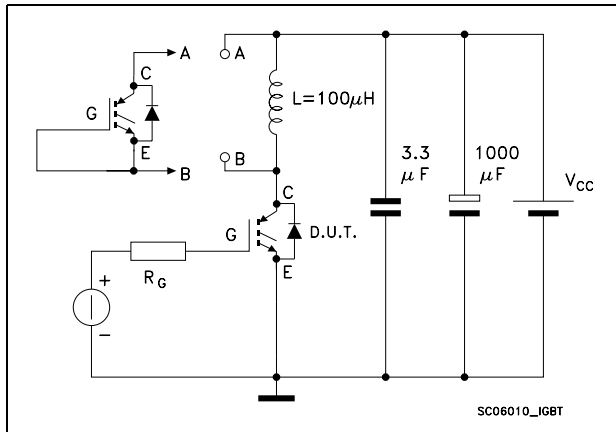
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**STGB30NC60K - STGP30NC60K**

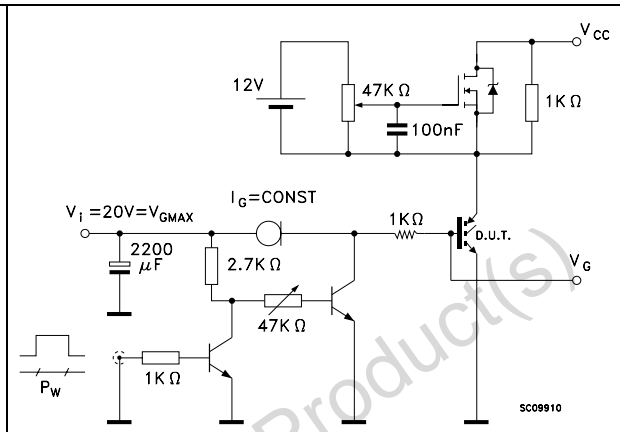
**Test circuit**

**3 Test circuit**

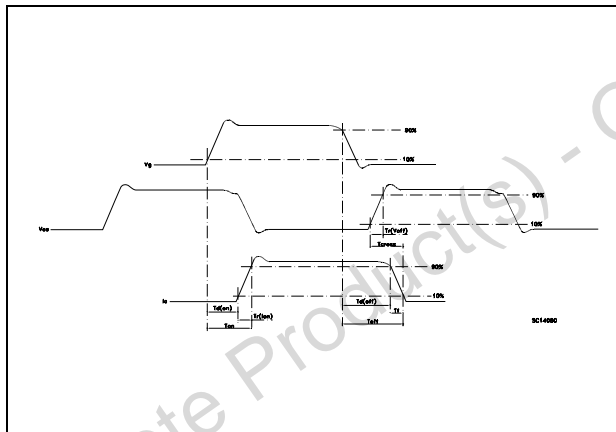
**Figure 16. Test circuit for inductive load switching**



**Figure 17. Gate charge test circuit**



**Figure 18. Switching waveforms**



## 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)

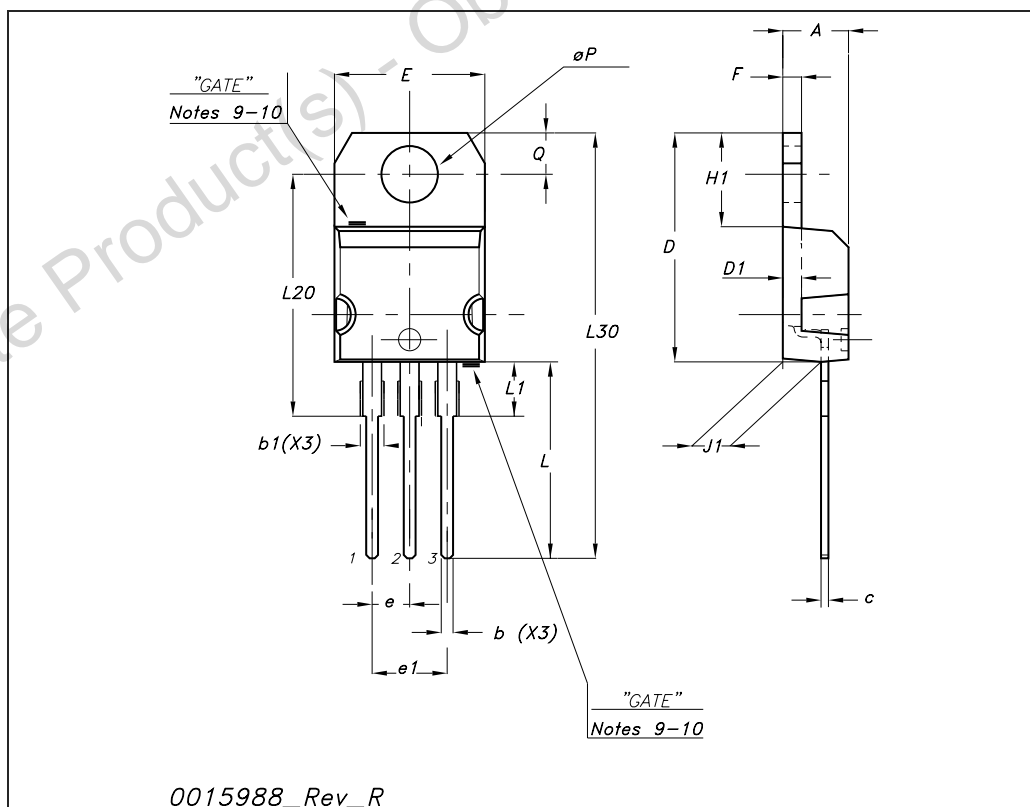
Obsolete Product(s) - Obsolete Product(s)

**STGB30NC60K - STGP30NC60K**

**Package mechanical data**

**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 |

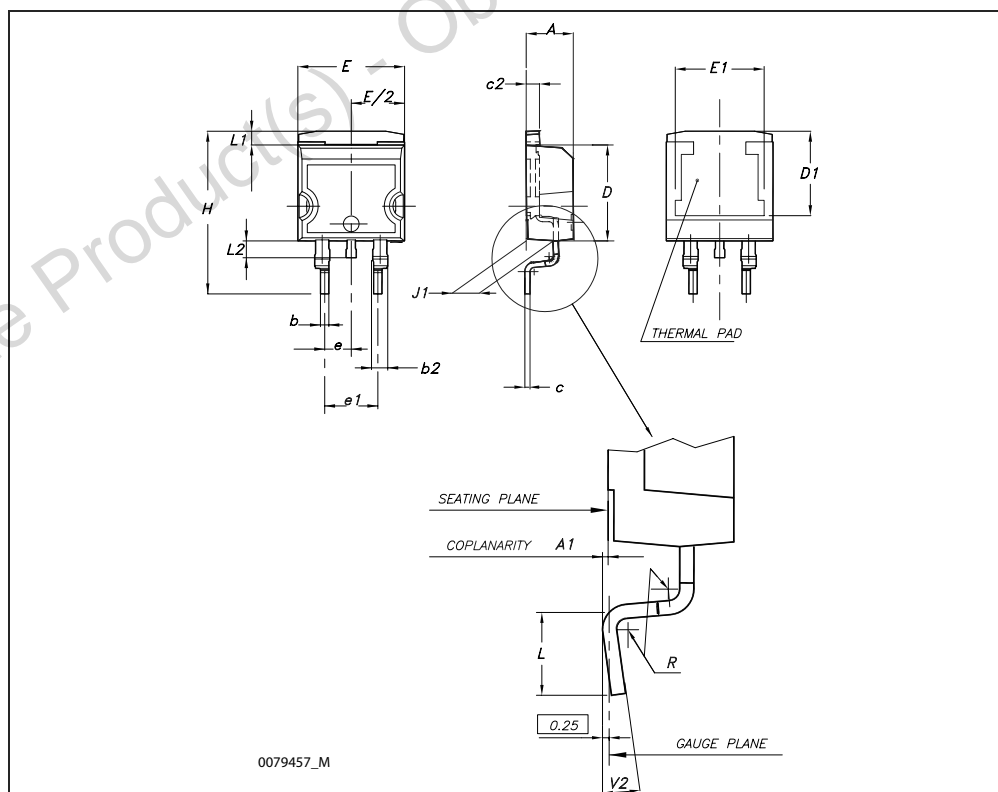


Package mechanical data

STGB30NC60K - STGP30NC60K

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°    |

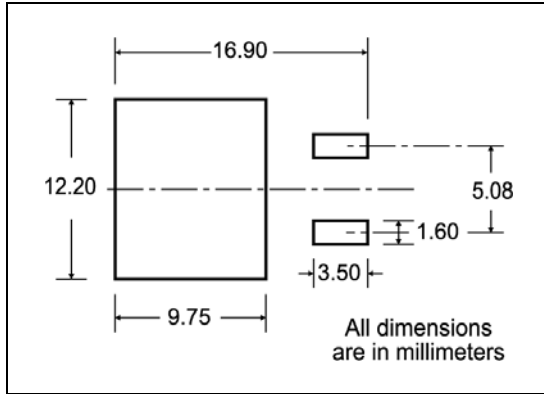


**STGB30NC60K - STGP30NC60K**

**Packaging mechanical data**

**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     |

\* on sales type

## 6 Revision history

Table 8. Document revision history

| Date        | Revision | Changes                                   |
|-------------|----------|---|
| 12-Feb-2008 | 1        | Initial release                           |
| 07-Mar-2008 | 2        | Updated mechanical data for both packages |

Obsolete Product(s) - Obsolete Product(s)

## STGB30NC60K - STGP30NC60K

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