



# STGD10NC60H

N-channel 10A - 600V - DPAK  
Very fast PowerMESH™ IGBT

## Features

| Type        | V <sub>CE(S)</sub> | V <sub>CE(sat)</sub><br>(Max)@ 25°C | I <sub>C</sub><br>@100°C |
|-------------|--------------------|-------------------------------------|--------------------------|
| STGD10NC60H | 600V               | < 2.5V                              | 10A                      |

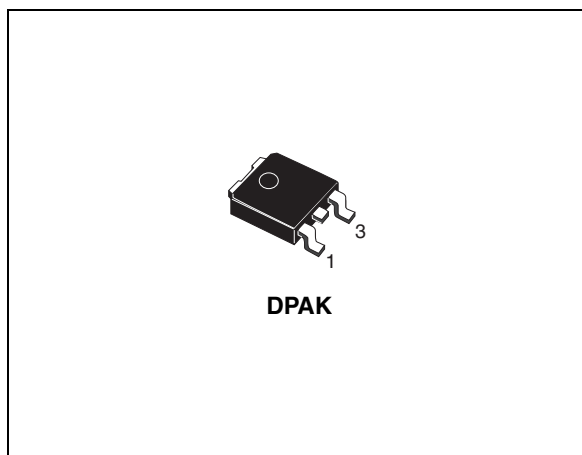
- Low on-voltage drop (V<sub>cesat</sub>)
- Low C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)

## Description

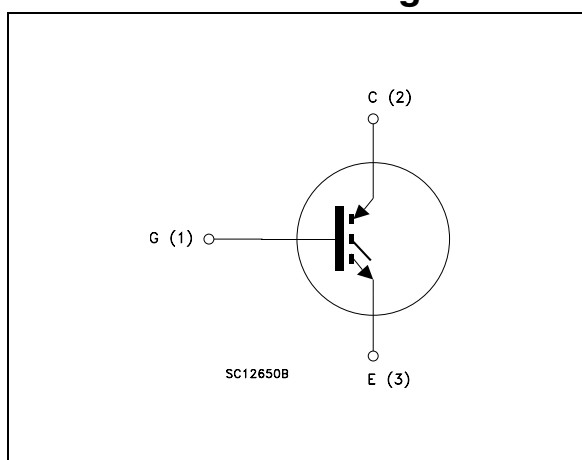
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized for high frequency applications in order to achieve very high switching performances (reduced t<sub>fall</sub>) maintaining a low voltage drop.

## Applications

- High frequency motor controls
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers



## Internal schematic diagram



## Order code

| Part number | Marking   | Package | Packaging   |
|-------------|-----------|---------|-------------|
| STGD10NC60H | GD10NC60H | DPAK    | Tape & reel |

# Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter   | Value       | Unit             |
|----------------|---|-------------|------------------|
| $V_{CES}$      | Collector-emitter voltage ( $V_{GS} = 0$ )                  | 600         | V                |
| $I_C^{(1)}$    | Collector current (continuous) at $T_C = 25^\circ\text{C}$  | 20          | A                |
| $I_C^{(1)}$    | Collector current (continuous) at $T_C = 100^\circ\text{C}$ | 10          | A                |
| $I_{CL}^{(2)}$ | Collector current (pulsed)                                  | 40          | A                |
| $V_{GE}$       | Gate-emitter voltage  | $\pm 20$    | V                |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ\text{C}$               | 60          | W                |
| $T_j$          | Operating junction temperature                              | - 55 to 150 | $^\circ\text{C}$ |

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.  $V_{clamp}=480\text{V}$ ,  $T_j=150^\circ\text{C}$ ,  $R_G=10\Omega$ ,  $V_{GE}=15\text{V}$

**Table 2. Thermal resistance**

| Symbol    | Parameter                               | Value | Unit                      |
|-----------|---|-------|---------------------------|
| Rthj-case | Thermal resistance junction-case max    | 2.08  | $^\circ\text{C}/\text{W}$ |
| Rthj-amb  | Thermal resistance junction-ambient max | 62.5  | $^\circ\text{C}/\text{W}$ |

## 2 Electrical characteristics

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

**Table 3. Static**

| Symbol        | Parameter                                     | Test conditions   | Min. | Typ.       | Max.      | Unit                |
|---------------|---|---|------|------------|-----------|---------------------|
| $V_{BR(CES)}$ | Collector-emitter breakdown voltage           | $I_C = 1\text{mA}, V_{GE} = 0$  | 600  |            |           | V                   |
| $I_{CES}$     | Collector cut-off current ( $V_{GE} = 0$ )    | $V_{CE} = \text{Max rating}, T_C = 25^{\circ}\text{C}$<br>$V_{CE} = \text{Max rating}, T_C = 125^{\circ}\text{C}$ |      |            | 150<br>1  | $\mu\text{A}$<br>mA |
| $I_{GES}$     | Gate-emitter leakage current ( $V_{CE} = 0$ ) | $V_{GE} = \pm 20\text{V}, V_{CE} = 0$   |      |            | $\pm 100$ | nA                  |
| $V_{GE(th)}$  | Gate threshold voltage                        | $V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$   | 3.75 |            | 5.75      | V                   |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage          | $V_{GE} = 15\text{V}, I_C = 5\text{A}$<br>$V_{GE} = 15\text{V}, I_C = 5\text{A}, T_C = 125^{\circ}\text{C}$       |      | 1.9<br>1.7 | 2.5       | V<br>V              |
| $g_{fs}$      | Forward transconductance                      | $V_{CE} = 15\text{V}, I_C = 5\text{A}$  |      | 3.5        |           | S                   |

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25\text{V}, f = 1\text{MHz},$<br>$V_{GE} = 0$ |      | 365  |      | pF   |
| $C_{oes}$ | Output capacitance           |   |      | 43   |      | pF   |
| $C_{res}$ | Reverse transfer capacitance |   |      | 8.3  |      | pF   |
| $Q_g$     | Total gate charge            | $V_{CE} = 390\text{V}, I_C = 5\text{A},$                |      | 19.2 |      | nC   |
| $Q_{ge}$  | Gate-emitter charge          | $V_{GE} = 15\text{V},$                                  |      | 4.5  |      | nC   |
| $Q_{gc}$  | Gate-collector charge        | (see Figure 16)   |      | 7    |      | nC   |

**Table 5. Switching on/off (inductive load)**

| Symbol                                  | Parameter   | Test conditions   | Min. | Typ.              | Max. | Unit                   |
|---|---|---|------|-------------------|------|------------------------|
| $t_{d(on)}$<br>$t_r$<br>$(di/dt)_{on}$  | Turn-on delay time<br>Current rise time<br>Turn-on current slope  | $V_{CC} = 390V, I_C = 5A$<br>$R_G = 10\Omega, V_{GE} = 15V,$<br><i>Figure 15. Figure 17.</i>                            |      | 14.2<br>5<br>1000 |      | ns<br>ns<br>A/ $\mu$ s |
| $t_{d(on)}$<br>$t_r$<br>$(di/dt)_{on}$  | Turn-on delay time<br>Current rise time<br>Turn-on current slope  | $V_{CC} = 390V, I_C = 5A$<br>$R_G = 10\Omega, V_{GE} = 15V,$<br>$T_j = 125^\circ C$<br><i>Figure 15. Figure 17.</i>     |      | 14<br>5<br>920    |      | ns<br>ns<br>A/ $\mu$ s |
| $t_r(V_{off})$<br>$t_{d(off)}$<br>$t_f$ | Off voltage rise time<br>Turn-off delay time<br>Current fall time | $V_{CC} = 390V, I_C = 5A,$<br>$R_{GE} = 10\Omega, V_{GE} = 15V,$<br><i>Figure 15. Figure 17.</i>                        |      | 27<br>72<br>85    |      | ns<br>ns<br>ns         |
| $t_r(V_{off})$<br>$t_{d(off)}$<br>$t_f$ | Off voltage rise time<br>Turn-off delay time<br>Current fall time | $V_{CC} = 390V, I_C = 5A,$<br>$R_{GE} = 10\Omega, V_{GE} = 15V,$<br>$T_j = 125^\circ C$<br><i>Figure 15. Figure 17.</i> |      | 50<br>108<br>139  |      | ns<br>ns<br>ns         |

**Table 6. Switching energy (inductive load)**

| Symbol                                  | Parameter   | Test conditions   | Min. | Typ.                 | Max. | Unit                          |
|---|---|---|------|----------------------|------|-------------------------------|
| $E_{on}$<br>$E_{off}^{(1)}$<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching losses<br>Total switching losses | $V_{CC} = 390V, I_C = 5A$<br>$R_G = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$<br><i>(see Figure 17)</i>       |      | 31.8<br>95<br>126.8  |      | $\mu$ J<br>$\mu$ J<br>$\mu$ J |
| $E_{on}$<br>$E_{off}^{(1)}$<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching Losses<br>Total switching losses | $V_{CC} = 390V, I_C = 5A$<br>$R_G = 10\Omega, V_{GE} = 15V,$<br>$T_j = 125^\circ C$<br><i>(see Figure 17)</i> |      | 61.8<br>173<br>234.8 |      | $\mu$ J<br>$\mu$ J<br>$\mu$ J |

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

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

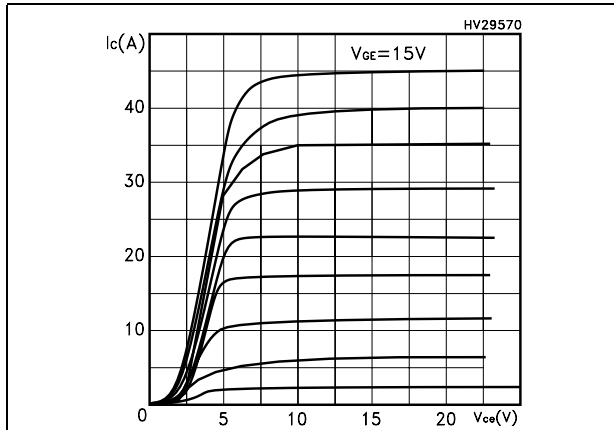


Figure 2. Transfer characteristics

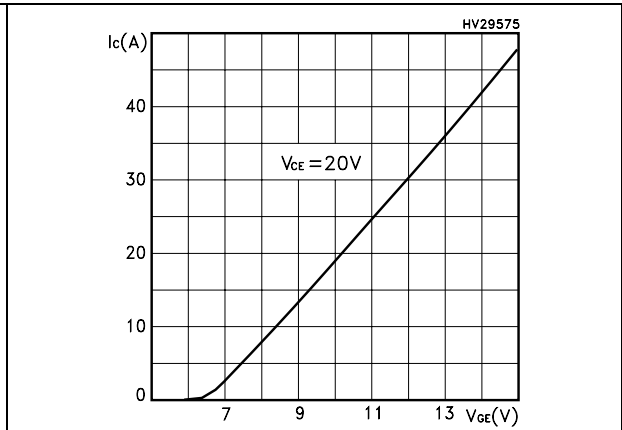


Figure 3. Transconductance

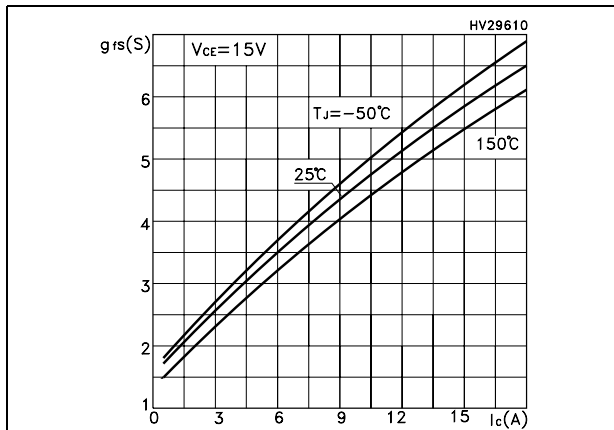


Figure 4. Collector-emitter on voltage vs temperature

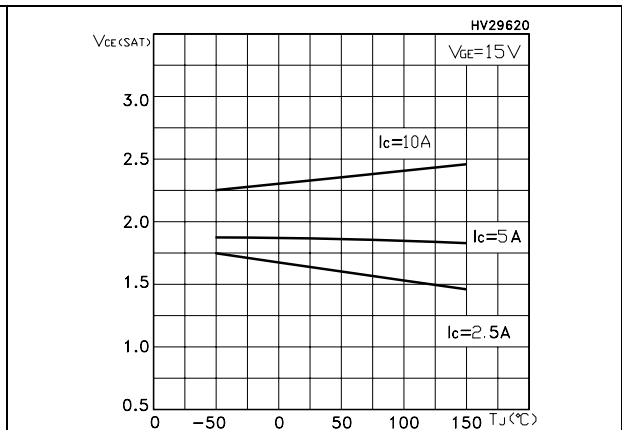


Figure 5. Gate charge vs gate-source voltage

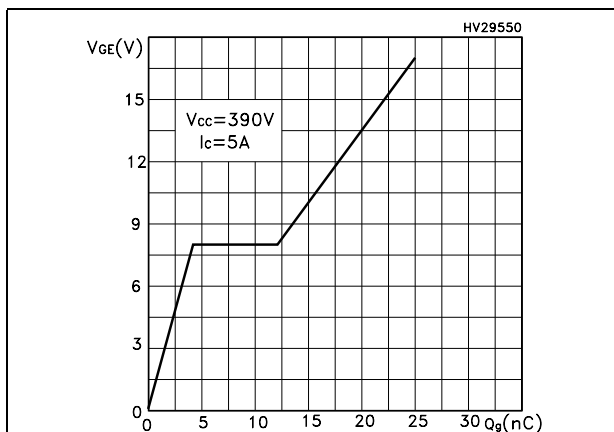


Figure 6. Capacitance variations

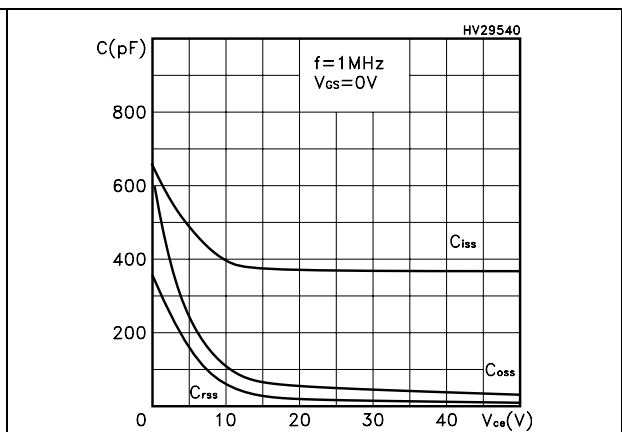


Figure 7. Normalized gate threshold voltage vs temperature

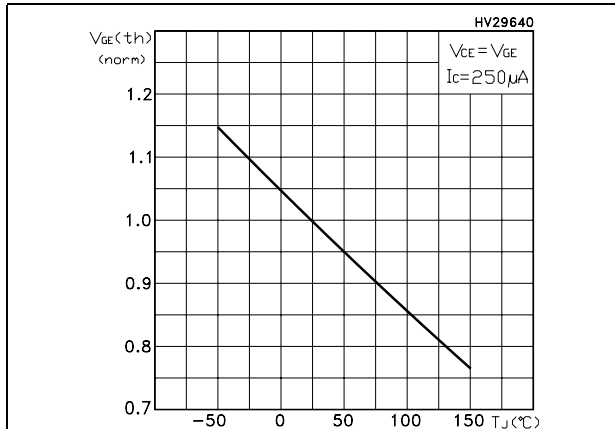


Figure 8. Collector-emitter on voltage vs collector current

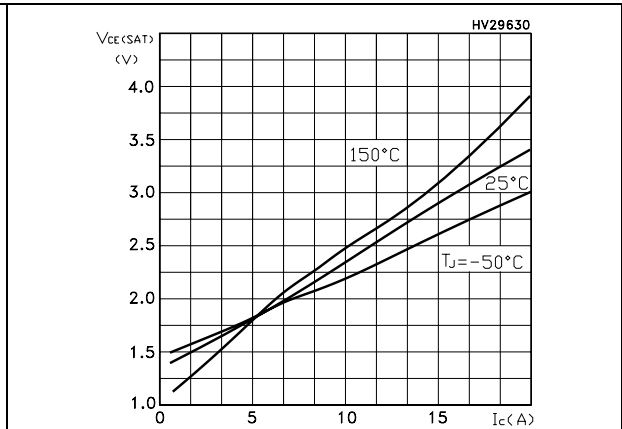


Figure 9. Normalized breakdown voltage vs temperature

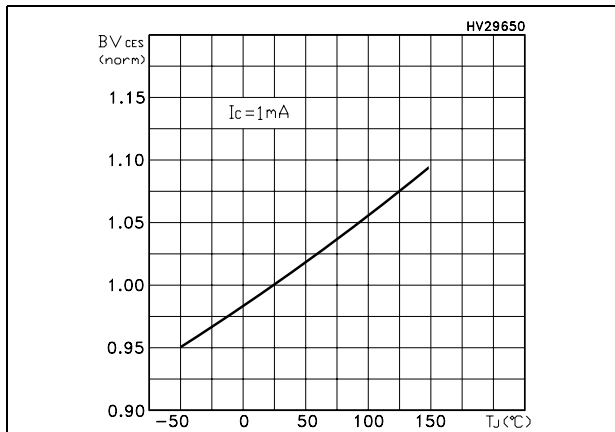


Figure 10. Switching losses vs temperature

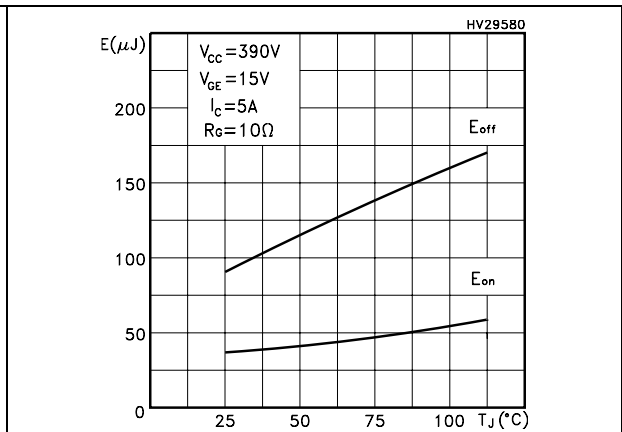


Figure 11. Switching losses vs gate resistance

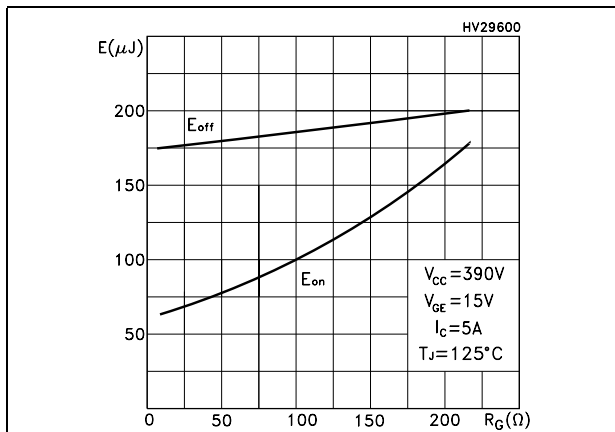


Figure 12. Switching losses vs collector current

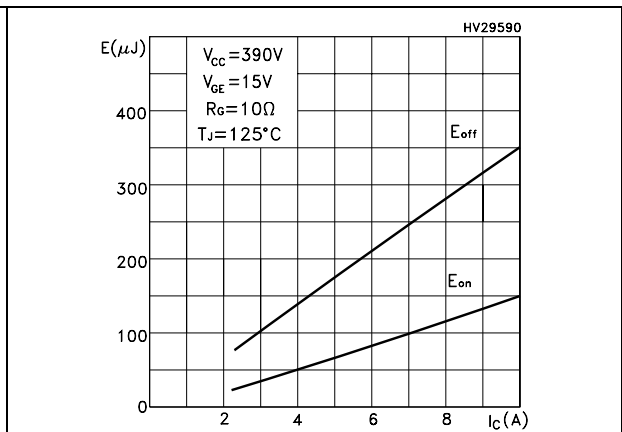


Figure 13. Thermal Impedance

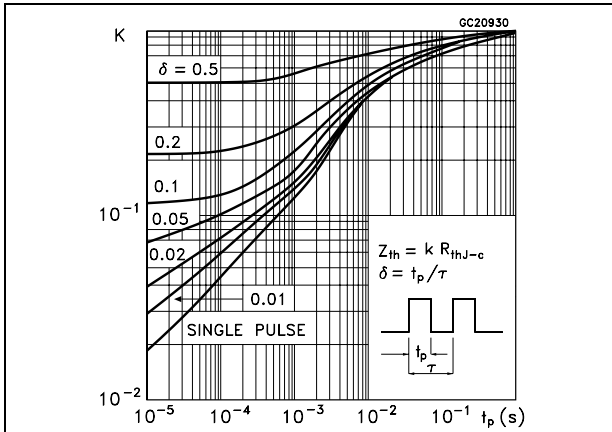
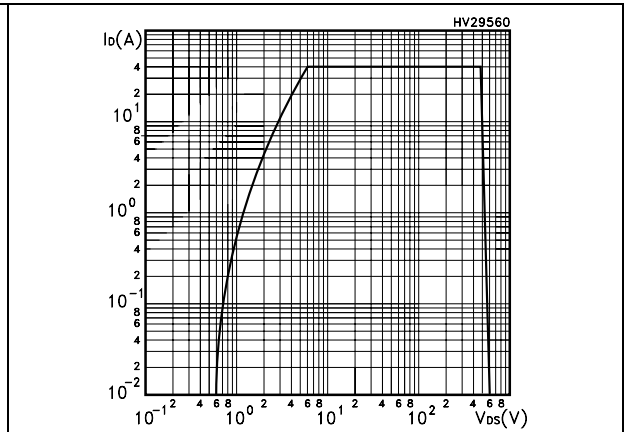


Figure 14. Turn-off SOA





### 3 Test circuits

Figure 15. Test circuit for inductive load switching

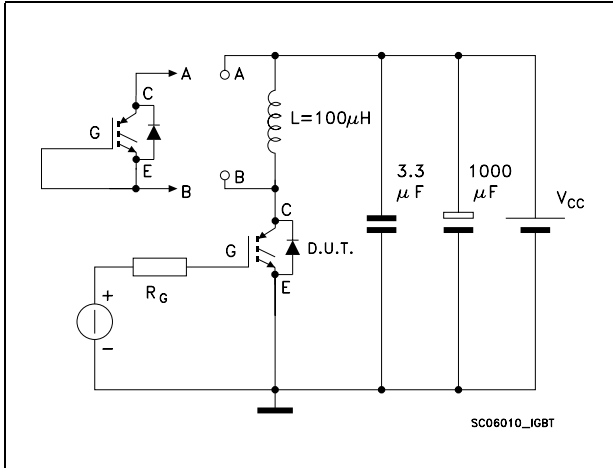


Figure 16. Gate charge test circuit

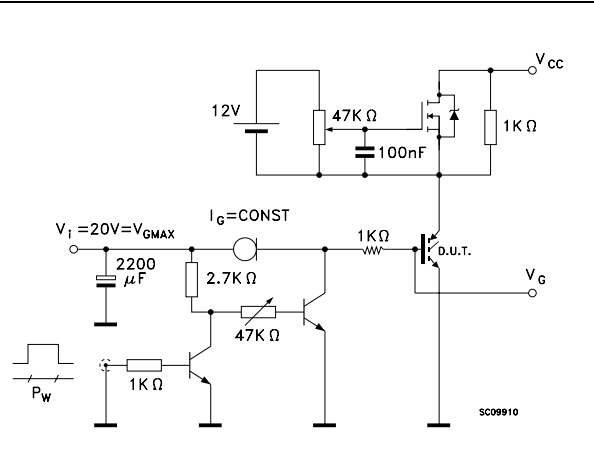
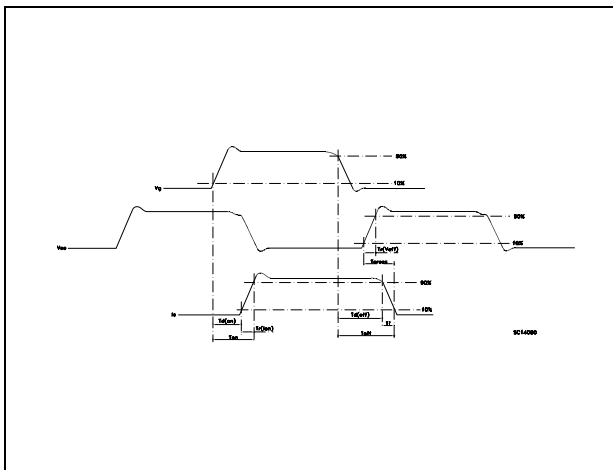


Figure 17. Switching waveform

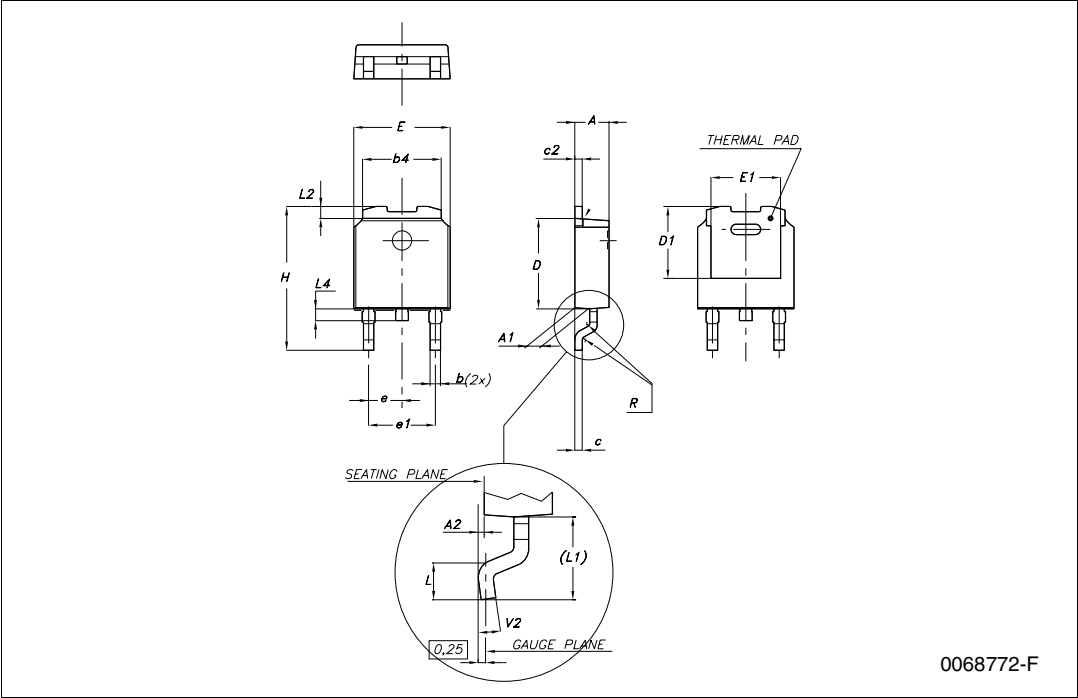


## 4 Package mechanical data

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)

**DPAK MECHANICAL DATA**

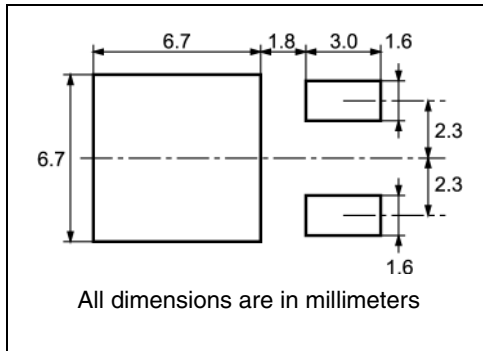
| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| b4   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| D1   |      | 5.1  |      |       | 0.200 |       |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| E1   |      | 4.7  |      |       | 0.185 |       |
| e    |      | 2.28 |      |       | 0.090 |       |
| e1   | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.1 | 0.368 |       | 0.397 |
| L    | 1    |      |      | 0.039 |       |       |
| (L1) |      | 2.8  |      |       | 0.110 |       |
| L2   |      | 0.8  |      |       | 0.031 |       |
| L4   | 0.6  |      | 1    | 0.023 |       | 0.039 |
| R    |      | 0.2  |      |       | 0.008 |       |
| V2   | 0°   |      | 8°   | 0°    |       | 8°    |



0068772-F

# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Tape slot in core for tape start 2.5mm min. width

Full radius

G measured at hub

| 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    | 16.4 | 18.4 | 0.645 | 0.724  |
| N    | 50   |      | 1.968 |        |
| T    |      | 22.4 |       | 0.881  |

| BASE QTY | BULK QTY |
|----------|----------|
| 2500     | 2500     |

| DIM. | mm   |      | inch  |       |
|------|------|------|-------|-------|
|      | MIN. | MAX. | MIN.  | MAX.  |
| A0   | 6.8  | 7    | 0.267 | 0.275 |
| B0   | 10.4 | 10.6 | 0.409 | 0.417 |
| B1   |      | 12.1 |       | 0.476 |
| D    | 1.5  | 1.6  | 0.059 | 0.063 |
| D1   | 1.5  |      | 0.059 |       |
| E    | 1.65 | 1.85 | 0.065 | 0.073 |
| F    | 7.4  | 7.6  | 0.291 | 0.299 |
| K0   | 2.55 | 2.75 | 0.100 | 0.108 |
| P0   | 3.9  | 4.1  | 0.153 | 0.161 |
| P1   | 7.9  | 8.1  | 0.311 | 0.319 |
| P2   | 1.9  | 2.1  | 0.075 | 0.082 |
| R    | 40   |      | 1.574 |       |
| W    | 15.7 | 16.3 | 0.618 | 0.641 |

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

Bending radius R min.

FEED DIRECTION

For machine ref. only including draft and radii concentric around B0

## 6 Revision history

Table 7. Revision history

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 02-Apr-2007 | 1        | Initial release. |

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