



THE DATASHEET OF STGP10NC60S



Features

- Optimized performance for medium operating frequencies up to 5 kHz in hard switching
- Low on-voltage drop ($V_{CE(sat)}$)

Application

- Motor drive

Description

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

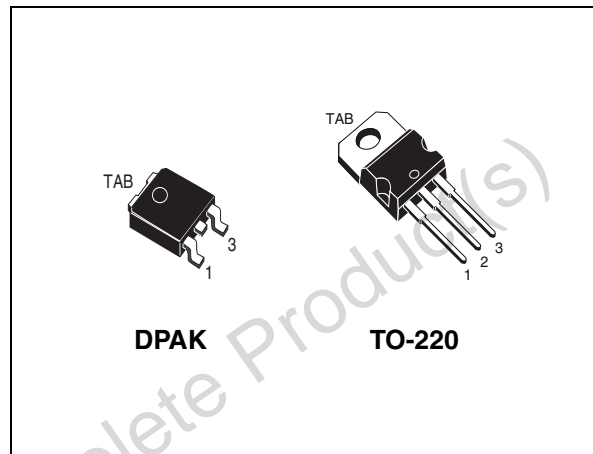


Figure 1. Internal schematic diagram

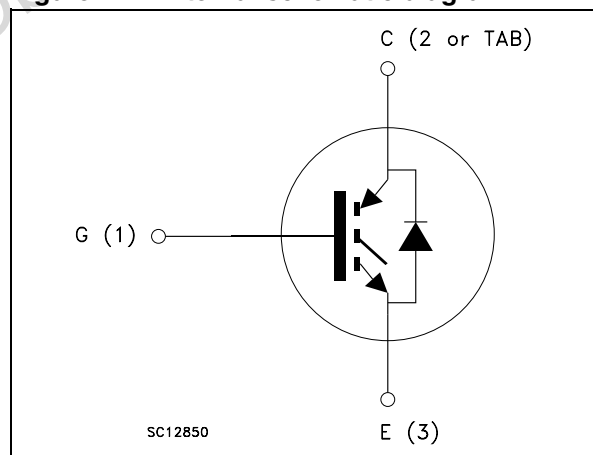


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|---------------|-----------|---------|---------------|
| STGD10NC60ST4 | GD10NC60S | DPAK | Tape and reel |
| STGP10NC60S | GP10NC60S | TO-220 | Tube |

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Obsolete Product(s) - Obsolete Product(s)

1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|--|------------|--------|------|
| | | DPAK | TO-220 | |
| V _{CES} | Collector-emitter voltage (V _{GE} = 0) | 600 | | V |
| I _C ⁽¹⁾ | Continuous collector current at T _C = 25°C | 18 | 21 | A |
| I _C ⁽¹⁾ | Continuous collector current at T _C = 100°C | 10 | 11 | A |
| I _{CL} ⁽²⁾ | Turn-off latching current | 14 | | A |
| I _{CP} ⁽³⁾ | Pulsed collector current | 25 | | A |
| V _{GE} | Gate-emitter voltage | ±20 | | V |
| P _{TOT} | Total dissipation at T _C = 25 °C | 60 | 62.5 | W |
| T _j | Operating junction temperature | -55 to 150 | | °C |

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. V_{clamp} = 80%.(V_{CES}), T_j = 150 °C, R_G = 10 Ω, V_{GE} = 15 V
 3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

| Symbol | Parameter | Value | | Unit |
|-------------------|-------------------------------------|-------|--------|------|
| | | DPAK | TO-220 | |
| R _{thJC} | Thermal resistance junction-case | 2.08 | 2 | °C/W |
| R _{thJA} | Thermal resistance junction-ambient | 100 | 62.5 | °C/W |

2 Electrical characteristics

$T_J = 25\text{ °C}$ 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 | $V_{GE} = 15\text{ V}, I_C = 5\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 5\text{ A}, T_J = 125\text{ °C}$ | | 1.45 1.45 | 1.65 | V V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$ | 3.75 | | 5.75 | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}, T_J = 125\text{ °C}$ | | | 150 1 | μA mA |
| I_{GES} | Gate-emitter leakage ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |
| g_{fs} | Forward transconductance | $V_{CE} = 15\text{ V}, I_C = 5\text{ A}$ | | 3.5 | | S |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--|------|--|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$ | - | 365 | - | pF |
| C_{oes} | Output capacitance | | | 44 | | pF |
| C_{res} | Reverse transfer capacitance | | | 8 | | pF |
| Q_g | Total gate charge | | | $V_{CE} = 480\text{ V}, I_C = 5\text{ A},$ $V_{GE} = 15\text{ V}$ <i>Figure 16</i> | | 18 |
| Q_{ge} | Gate-emitter charge | | - | 8 | - | nC |
| Q_{gc} | Gate-collector charge | | | 3.5 | | nC |

Table 6. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 390\text{ V}, I_C = 5\text{ A}$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ <i>Figure 17</i> | - | 19 | - | ns |
| t_r | Current rise time | | | 4 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1330 | | A/ μs |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 390\text{ V}, I_C = 5\text{ A}$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ $T_J = 125\text{ °C}$ <i>Figure 17</i> | - | 18 | - | ns |
| t_r | Current rise time | | | 4.5 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1000 | | A/ μs |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 5\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ <i>Figure 17</i> | - | 100 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 160 | | ns |
| t_f | Current fall time | | | 205 | | ns |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}, I_C = 5\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ $T_J = 125\text{ °C}$ <i>Figure 17</i> | - | 165 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 250 | | ns |
| t_f | Current fall time | | | 310 | | ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|-----------------|---------------------------|--|-----|------|-----|---------------|
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 480\text{ V}, I_C = 5\text{ A}$ | | 60 | | μJ |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ <i>Figure 15</i> | - | 340 | - | μJ |
| E_{ts} | Total switching losses | | | 400 | | μJ |
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 480\text{ V}, I_C = 5\text{ A}$ | | 90 | | μJ |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_J = 125^\circ\text{C}$ <i>Figure 15</i> | - | 540 | - | μJ |
| E_{ts} | Total switching losses | | | 630 | | μJ |

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in *Figure 15*. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBT's and diode are at the same temperature
2. Turn-off losses included also include also the tail of the collector current

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

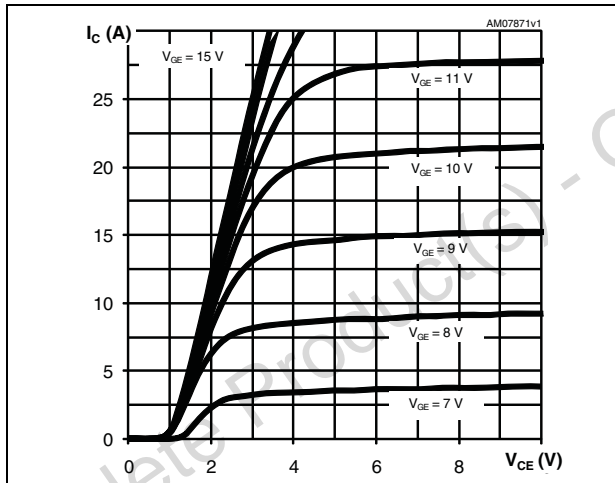


Figure 3. Transfer characteristics

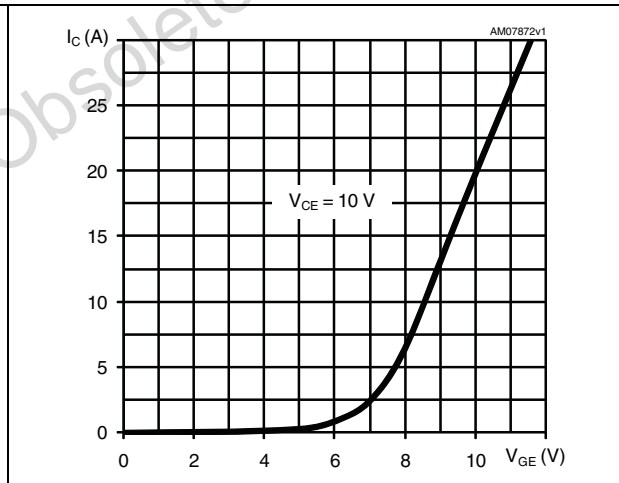


Figure 4. Collector-emitter on voltage vs. collector current

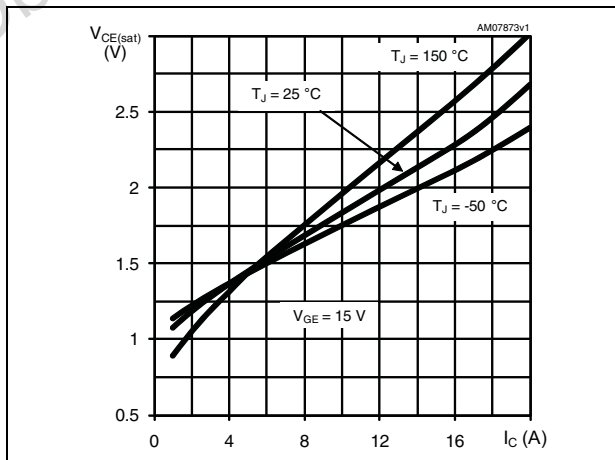


Figure 5. Collector-emitter on voltage vs. temperature

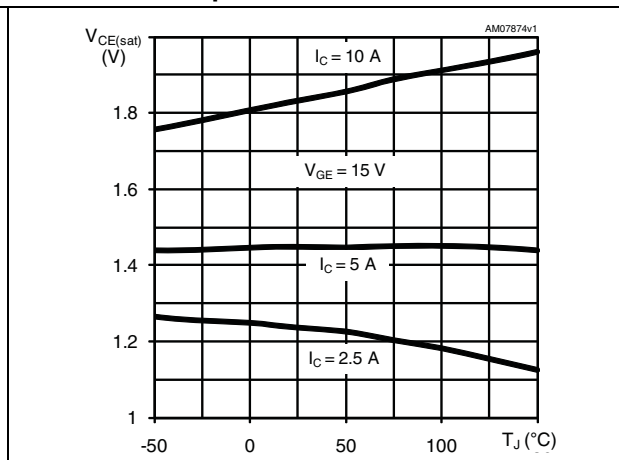


Figure 6. Normalized breakdown voltage vs. temperature

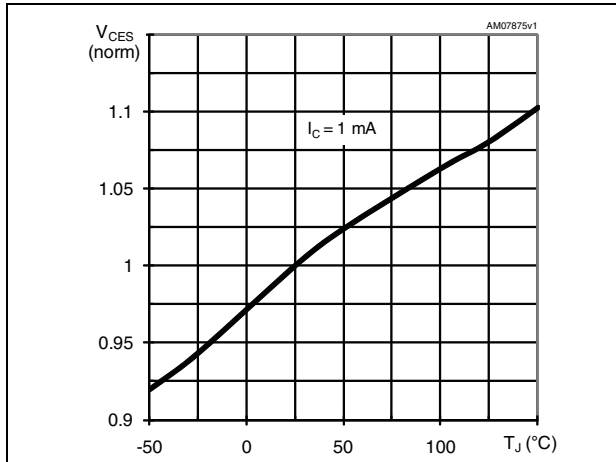


Figure 7. Normalized gate threshold voltage vs. temperature

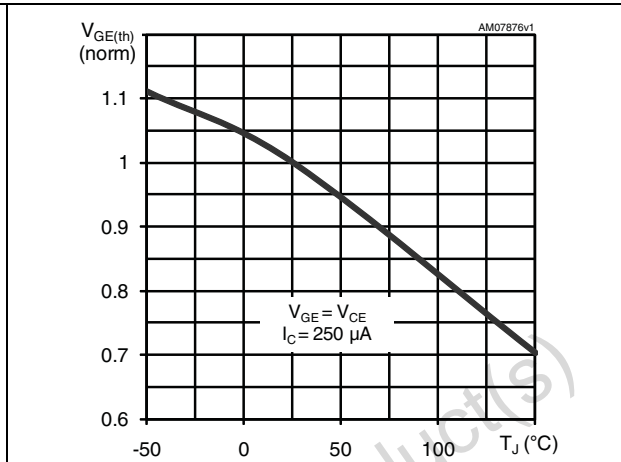


Figure 8. Gate charge vs. gate-emitter voltage

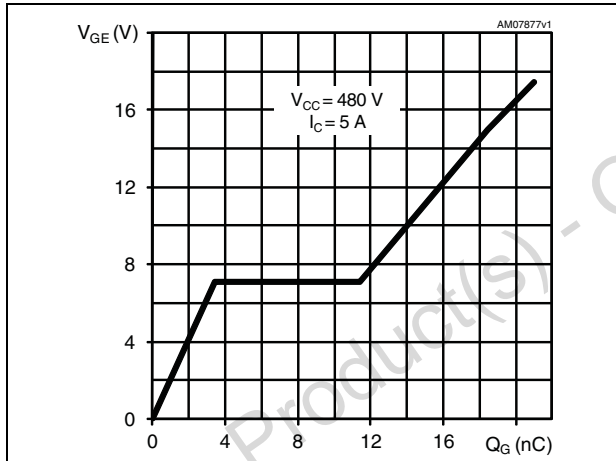


Figure 9. Capacitance variations

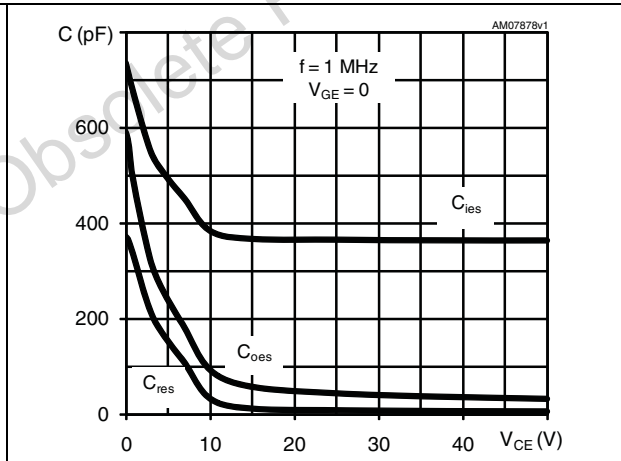


Figure 10. Switching losses vs. temperature

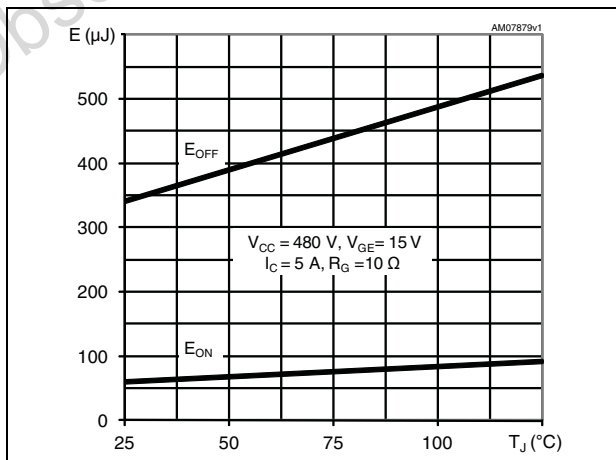


Figure 11. Switching losses vs. gate resistance

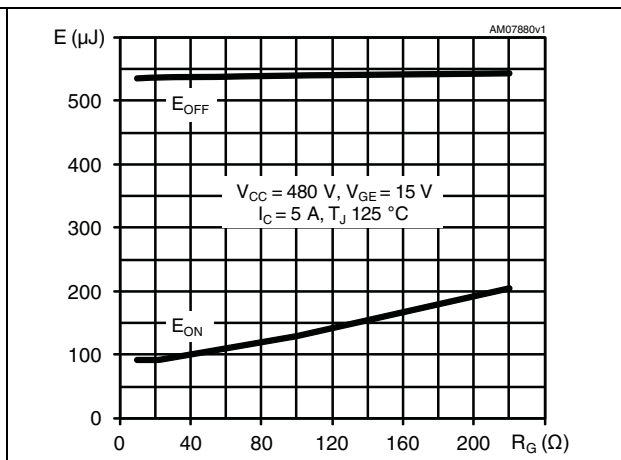


Figure 12. Switching losses vs. collector current

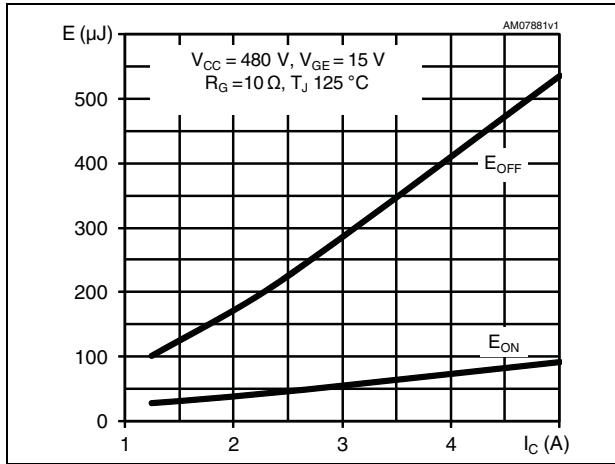


Figure 13. Turn-off SOA

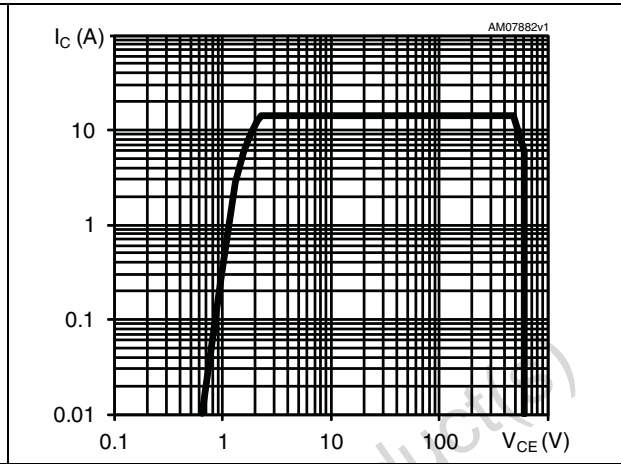
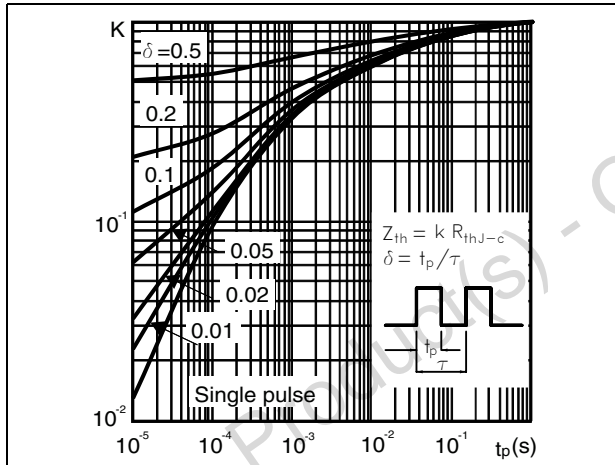


Figure 14. Thermal impedance for DPAK and TO-220



3 Test circuits

Figure 15. Test circuit for inductive load switching

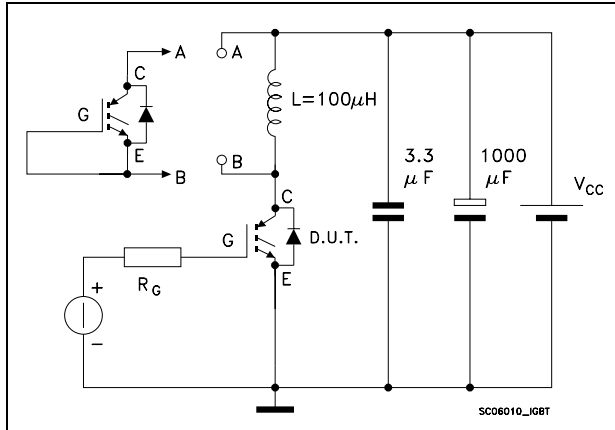


Figure 16. Gate charge test circuit

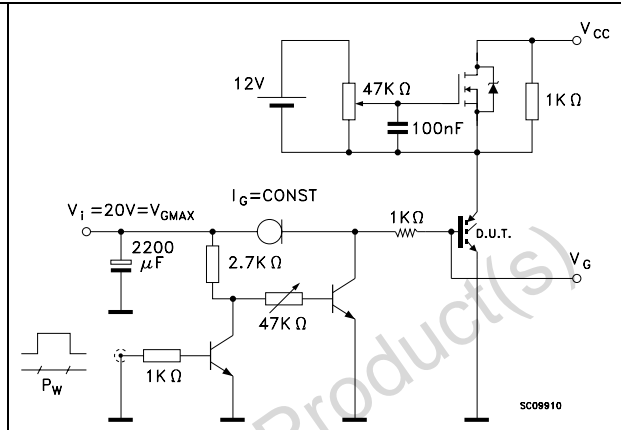
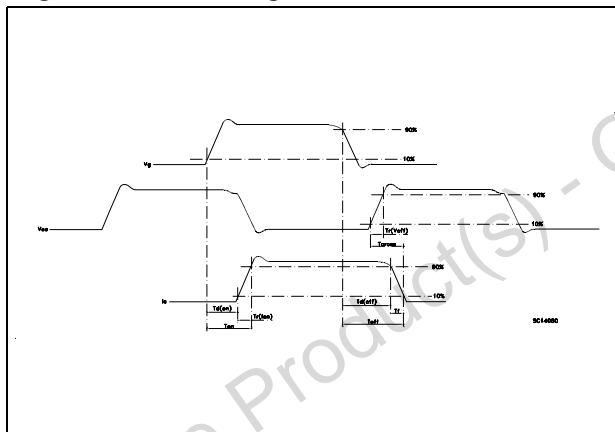


Figure 17. Switching waveforms



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. ECOPACK is an ST trademark.

Obsolete Product(s) - Obsolete Product(s)

Table 8. DPAK (TO-252) mechanical data

| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

Figure 18. DPAK (TO-252) drawing

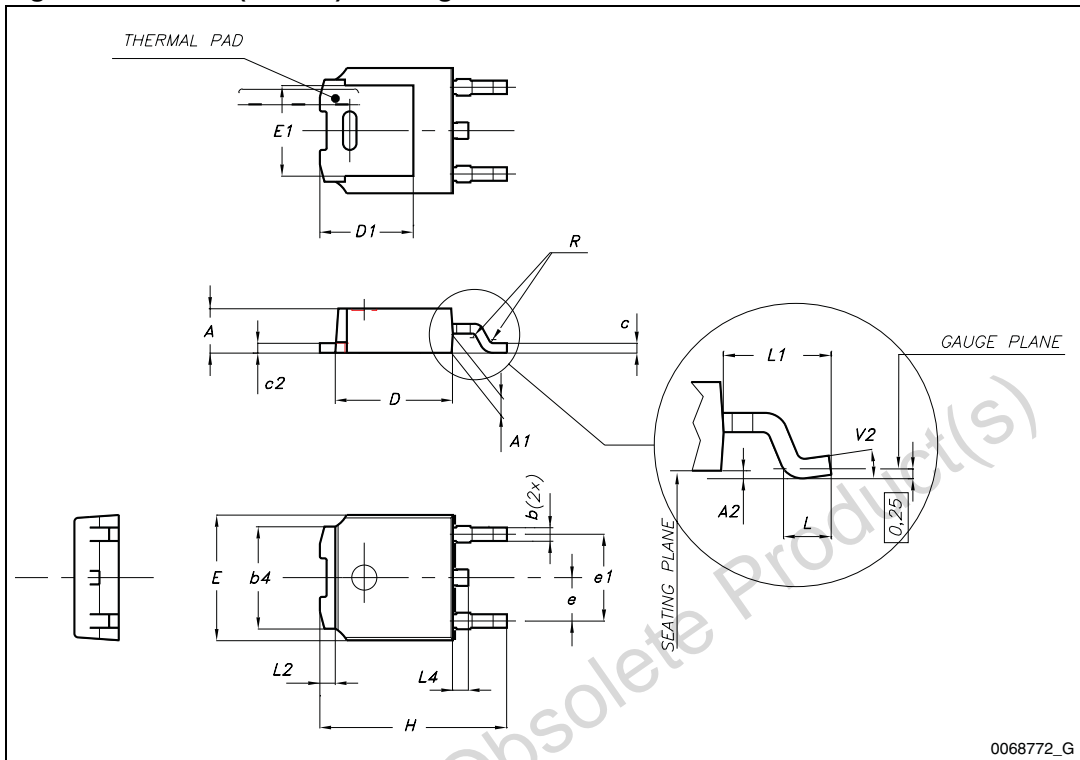
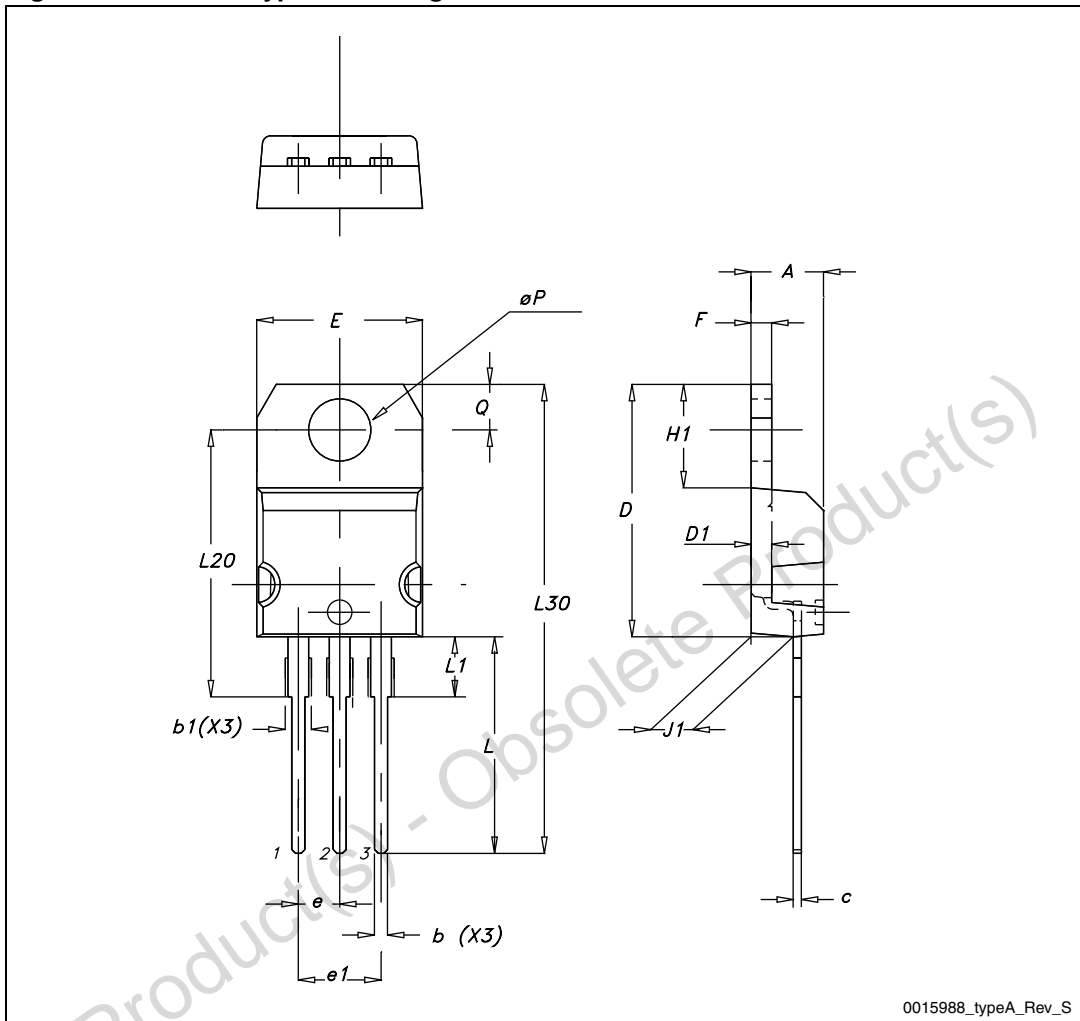


Table 9. TO-220 type A mechanical data

| 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 19. TO-220 type A drawing

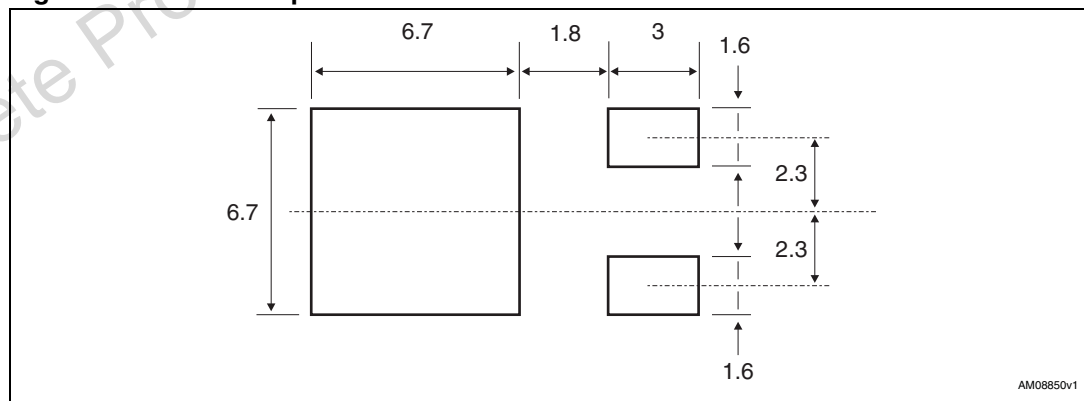


5 Packaging mechanical data

Table 10. DPAK (TO-252) tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|------|-----------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 6.8 | 7 | A | | 330 |
| B0 | 10.4 | 10.6 | B | 1.5 | |
| B1 | | 12.1 | C | 12.8 | 13.2 |
| D | 1.5 | 1.6 | D | 20.2 | |
| D1 | 1.5 | | G | 16.4 | 18.4 |
| E | 1.65 | 1.85 | N | 50 | |
| F | 7.4 | 7.6 | T | | 22.4 |
| K0 | 2.55 | 2.75 | | | |
| P0 | 3.9 | 4.1 | | Base qty. | 2500 |
| P1 | 7.9 | 8.1 | | Bulk qty. | 2500 |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

Figure 20. DPAK footprint^(a)



a. All dimension are in millimeters

Figure 21. Tape for DPAK (TO-252)

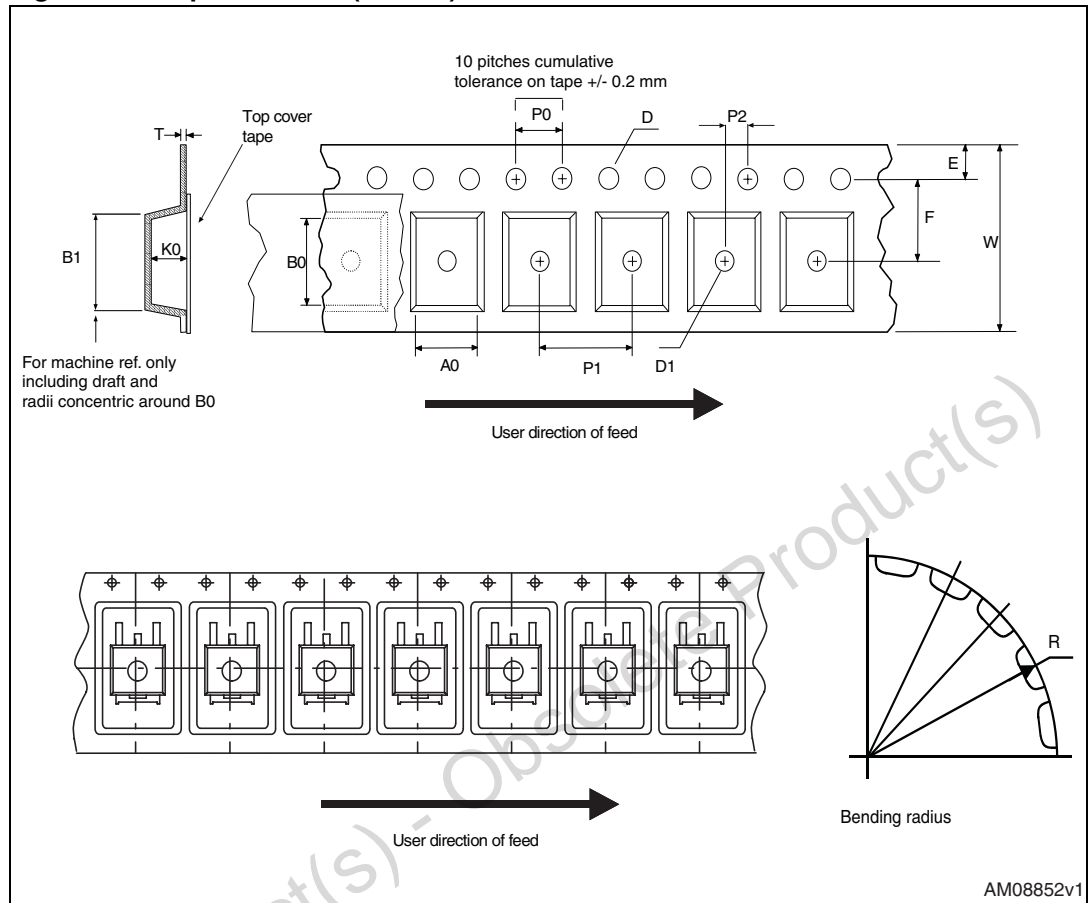
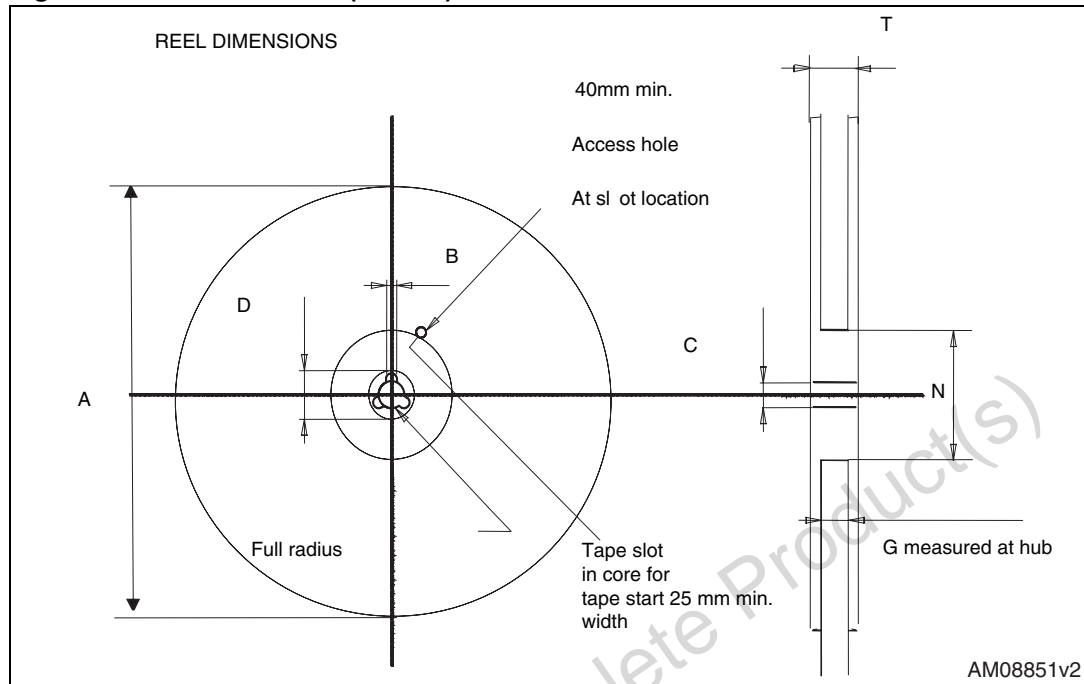


Figure 22. Reel for DPAK (TO-252)



AM08851v2

6 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 06-Jul-2009 | 1 | Initial release |
| 17-Dec-2010 | 2 | Inserted Section 2.1: Electrical characteristics (curves) on page 5 |

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