

Features

- Low on-losses
- Low on-voltage drop ($V_{CE(sat)}$)
- High current capability
- High input impedance (voltage driven)
- Low gate charge
- Ideal for soft switching application

Application

- Induction heating
- High frequency inverters
- UPS

Description

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

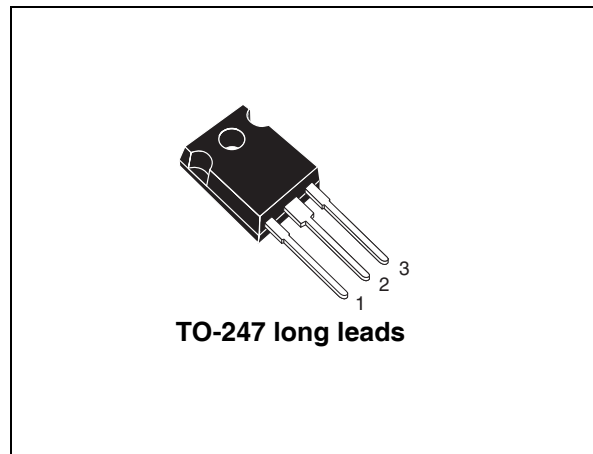


Figure 1. Internal schematic diagram

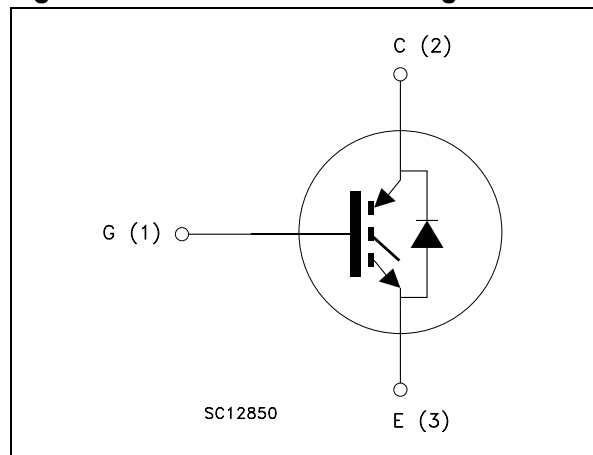


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|---------------|-------------|-------------------|-----------|
| STGW35NC120HD | GW35NC120HD | TO-247 long leads | Tube |

Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|--|------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$) | 1200 | V |
| $I_C^{(1)}$ | Continuous collector current at $T_C = 25\text{ °C}$ | 60 | A |
| $I_C^{(1)}$ | Continuous collector current at $T_C = 100\text{ °C}$ | 32 | A |
| $I_{CL}^{(2)}$ | Turn-off latching current | 135 | A |
| $I_{CP}^{(3)}$ | Pulsed collector current | 135 | A |
| V_{GE} | Gate-emitter voltage | ± 25 | V |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 235 | W |
| I_F | Diode RMS forward current at $T_C = 25\text{ °C}$ | 30 | A |
| I_{FSM} | Surge non repetitive forward current $t_p = 10\text{ ms}$ sinusoidal | 100 | A |
| 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. $V_{clamp} = 80\%$ of V_{CES} , $T_j = 125\text{ °C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$

3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case IGBT | 0.53 | °C/W |
| | Thermal resistance junction-case diode | 1.5 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 50 | °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 ($V_{GE} = 0$) | $I_C = 1\text{ mA}$ | 1200 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_j = 125\text{ °C}$ | | 2.2 2.0 | 2.75 | V 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 cut-off current ($V_{GE} = 0$) | $V_{CE} = 1200\text{ V}$ $V_{CE} = 1200\text{ V}$, $T_j = 125\text{ °C}$ | | | 500 10 | μA mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{CE} = 25\text{ V}$, $I_C = 20\text{ A}$ | | 14 | | S |

1. Pulse duration = 300 μs , duty cycle 1.5%

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$ | - | 2510 | - | pF |
| C_{oes} | Output capacitance | | | 175 | | pF |
| C_{res} | Reverse transfer capacitance | | | 30 | | pF |
| Q_g | Total gate charge | $V_{CE} = 960\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$ | - | 110 | - | nC |
| Q_{ge} | Gate-emitter charge | | | 16 | | nC |
| Q_{gc} | Gate-collector charge | | | 49 | | nC |

Table 6. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-------------------|------|------------------------|
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i> | - | 29 11 1820 | - | ns ns A/ μ s |
| $t_{d(on)}$ t_r $(di/dt)_{on}$ | Turn-on delay time Current rise time Turn-on current slope | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 27 14 1580 | - | ns ns A/ μ s |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i> | - | 90 275 312 | - | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off voltage rise time Turn-off delay time Current fall time | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 150 336 592 | - | ns ns ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|----------------------|------|-------------------------------|
| $E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i> | - | 1660 4438 6098 | - | μ J μ J μ J |
| $E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts} | Turn-on switching losses Turn-off switching losses Total switching losses | $V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i> | - | 3015 6900 9915 | - | μ J μ J μ J |

- E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25 °C and 125 °C)
- Turn-off losses include also the tail of the collector current

Table 8. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|---|------|-----------------|------|---------------|
| V_F | Forward on-voltage | $I_F = 20\text{ A}$ $I_F = 20\text{ A}$, $T_C = 125\text{ }^\circ\text{C}$ | - | 1.9 1.7 | 2.5 | V V |
| t_{rr} Q_{rr} I_{rrm} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_F = 20\text{ A}$, $V_R = 27\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$ <i>Figure 20</i> | - | 152 722 9 | - | ns nC A |

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

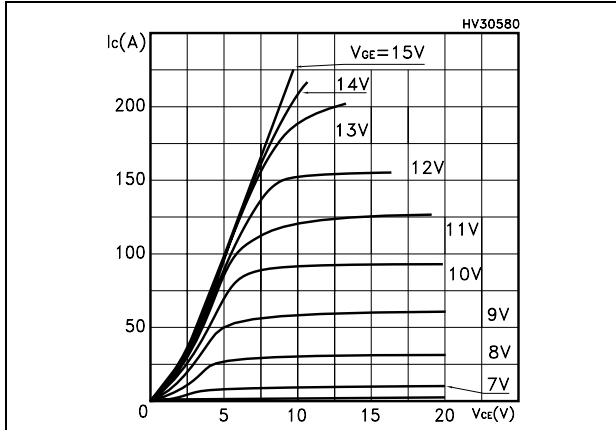


Figure 3. Transfer characteristics

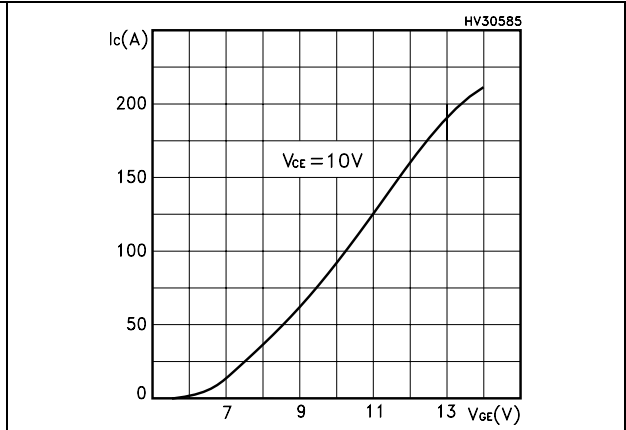


Figure 4. Transconductance

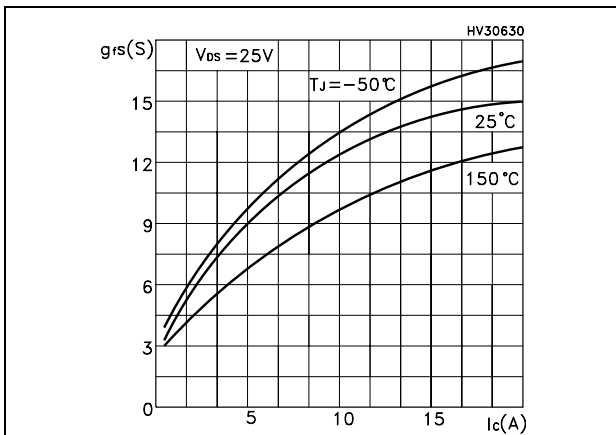


Figure 5. Collector-emitter on voltage vs. temperature

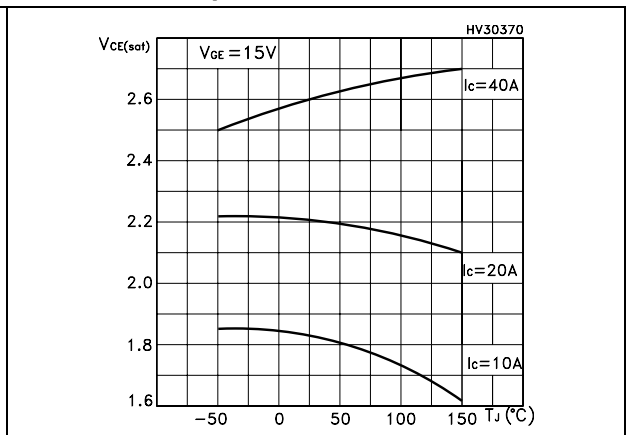


Figure 6. Gate charge vs. gate-source voltage Figure 7. Capacitance variations

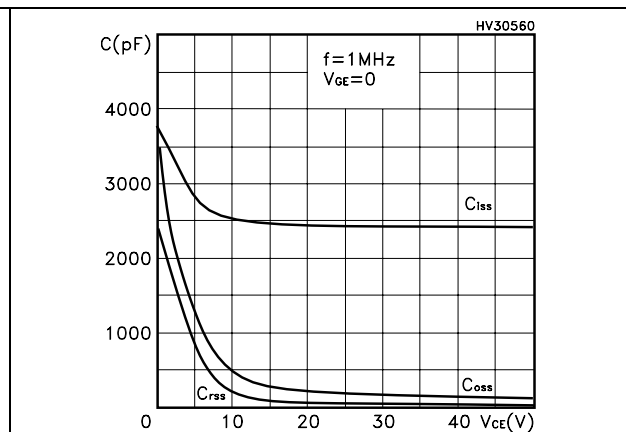
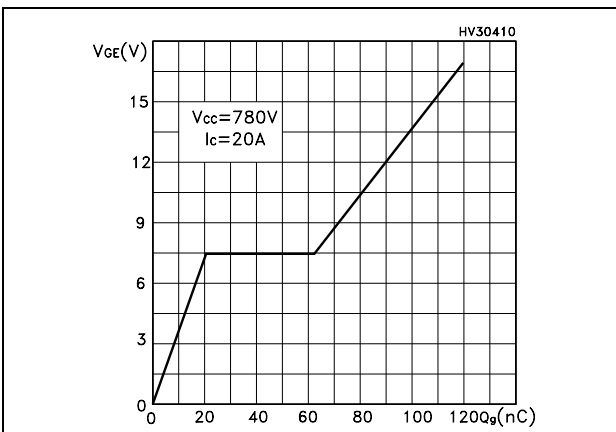


Figure 8. Normalized gate threshold voltage vs. temperature

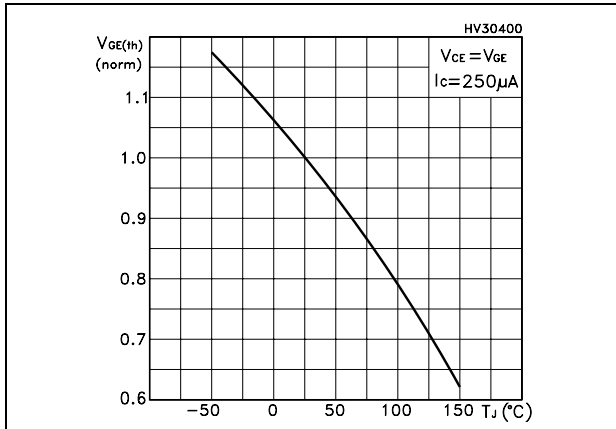


Figure 9. Collector-emitter on voltage vs. collector current

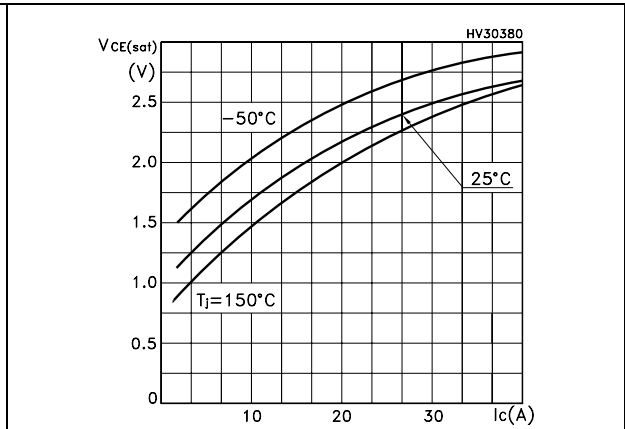


Figure 10. Normalized breakdown voltage vs. temperature

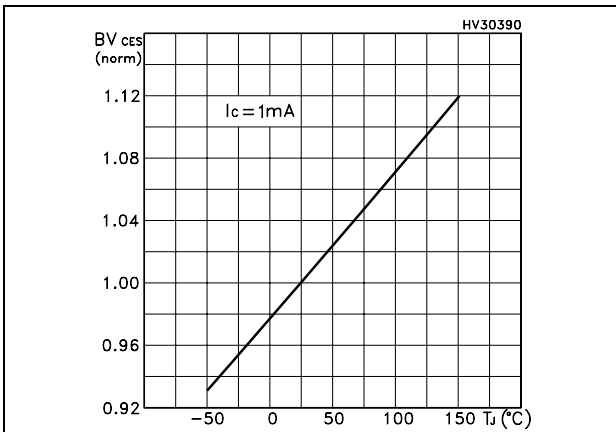


Figure 11. Switching losses vs. temperature

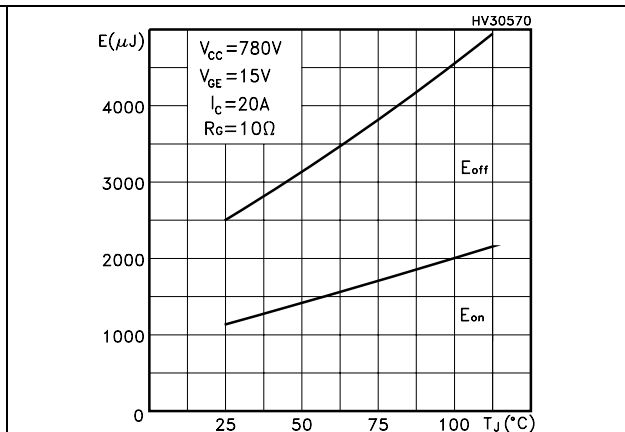


Figure 12. Switching losses vs. gate resistance

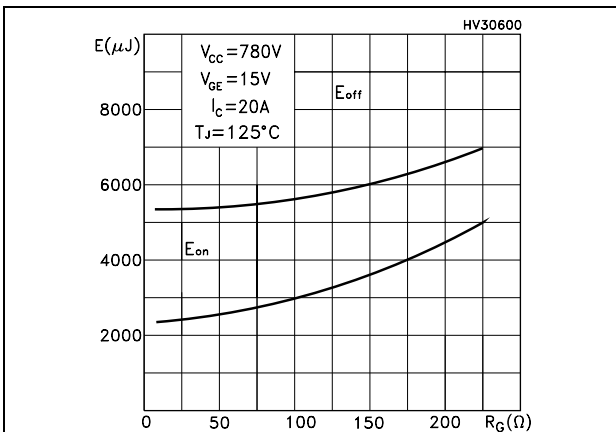


Figure 13. Switching losses vs. collector current

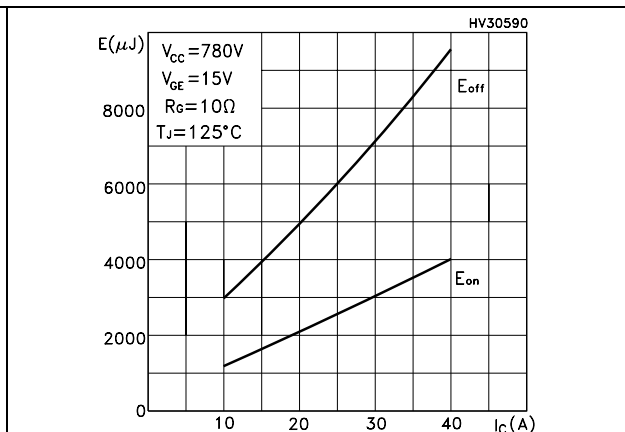


Figure 14. Thermal Impedance

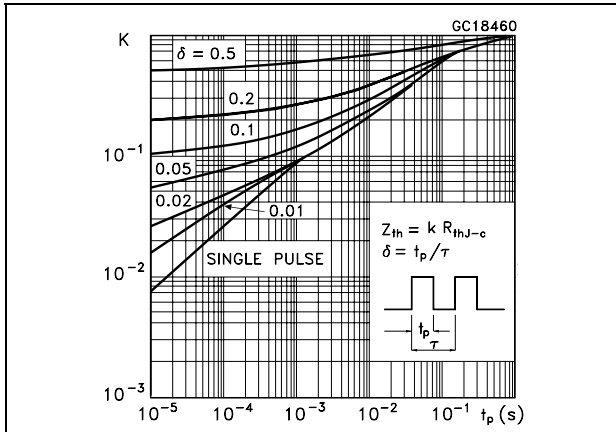


Figure 15. Reverse biased SOA

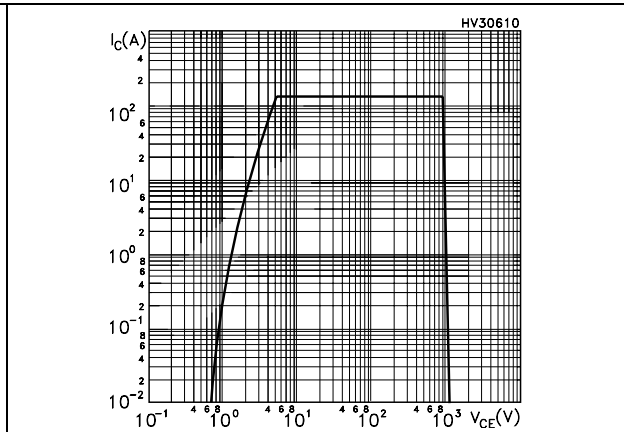
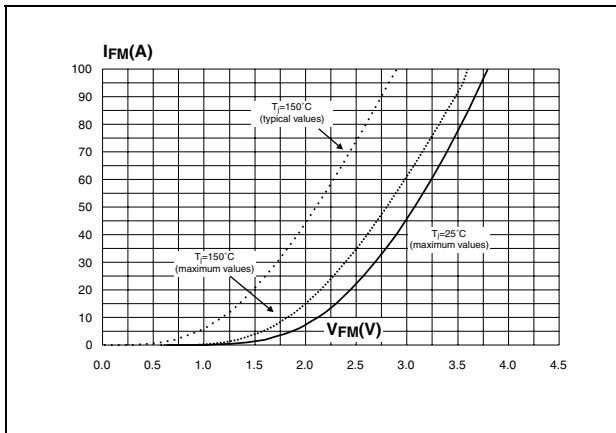


Figure 16. Forward voltage drop vs. forward current



3 Test circuits

Figure 17. Test circuit for inductive load switching

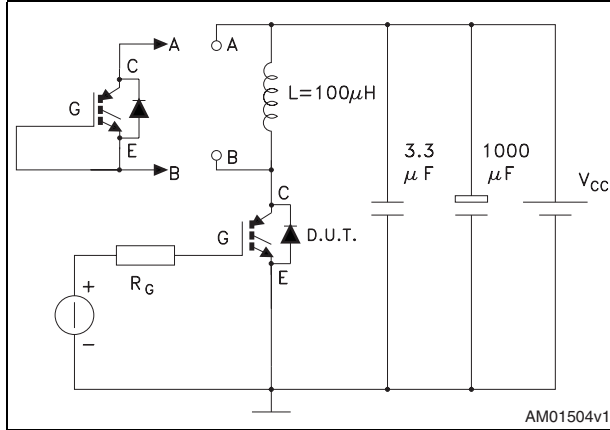


Figure 18. Gate charge test circuit

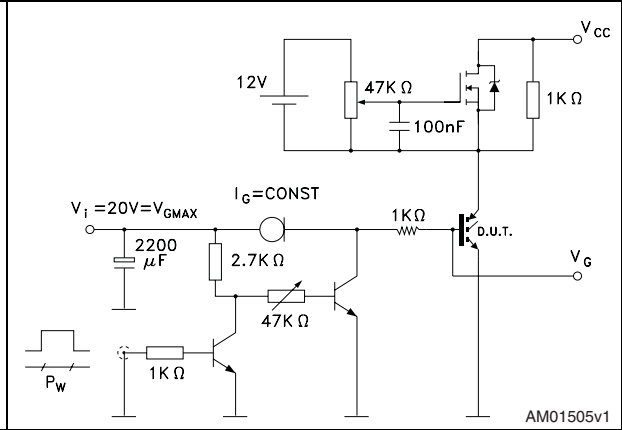


Figure 19. Switching waveform

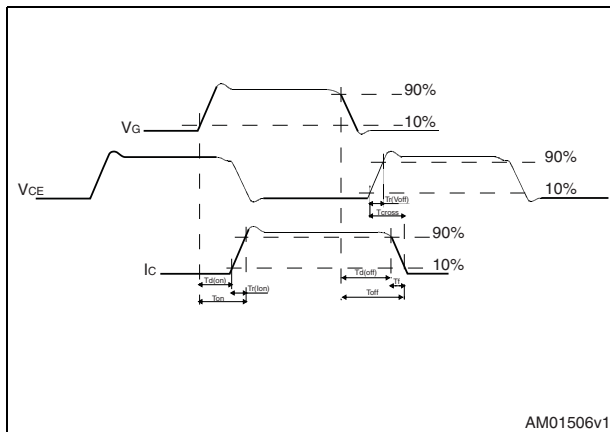
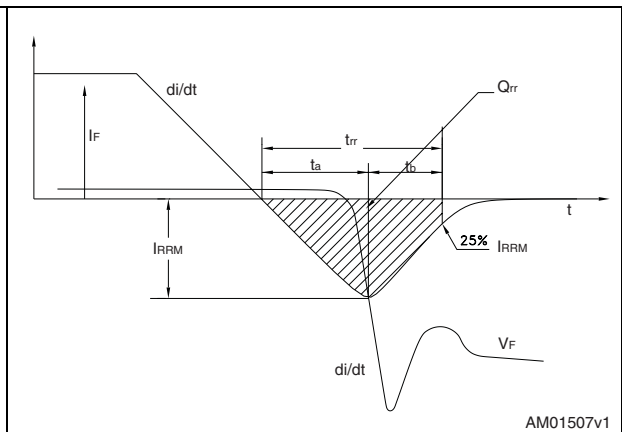


Figure 20. Diode recovery time waveform

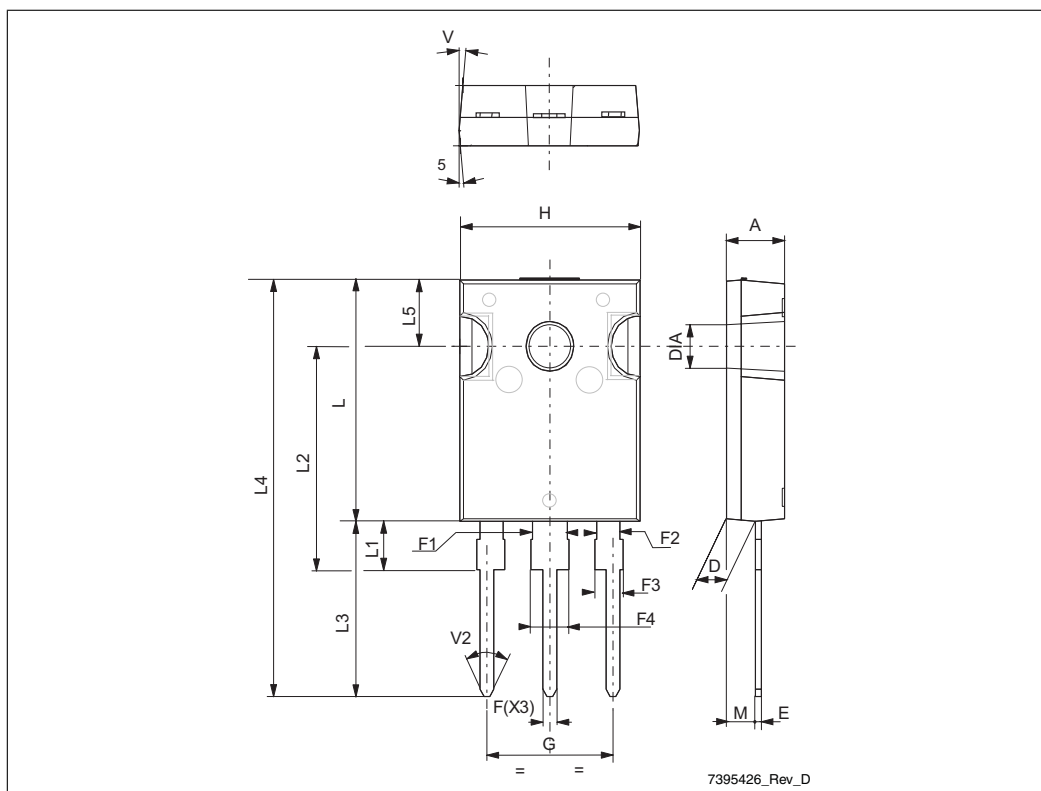


4 Package mechanical data

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.

TO-247 long leads mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.16 |
| D | 2.2 | | 2.6 |
| E | 0.4 | | 0.8 |
| F | 1 | | 1.4 |
| F1 | | 3 | |
| F2 | | 2 | |
| F3 | 1.9 | | 2.4 |
| F4 | 3 | | 3.4 |
| G | | 10.9 | |
| H | 15.45 | | 16.03 |
| L | 19.85 | | 21.09 |
| L1 | 3.7 | | 4.3 |
| L2 | 18.3 | | 19.13 |
| L3 | 14.2 | | 20.3 |
| L4 | 34.05 | | 41.38 |
| L5 | 5.35 | | 6.3 |
| M | 2 | | 3 |
| V | | 5° | |
| V2 | | 60° | |
| DIAM | 3.55 | | 3.65 |



5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 25-Jan-2008 | 1 | First issue. |
| 07-May-2009 | 2 | <i>Section 4: Package mechanical data</i> has been updated. |

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