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STGW20NC60VD

30 A, 600 V, very fast IGBT

Features

- High current capability
- High frequency operation up to 50 KHz
- Very soft ultra fast recovery antiparallel diode

Description

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

Applications

- High frequency inverters, UPS
- Motor drive
- SMPS and PFC in both hard switch and resonant topologies

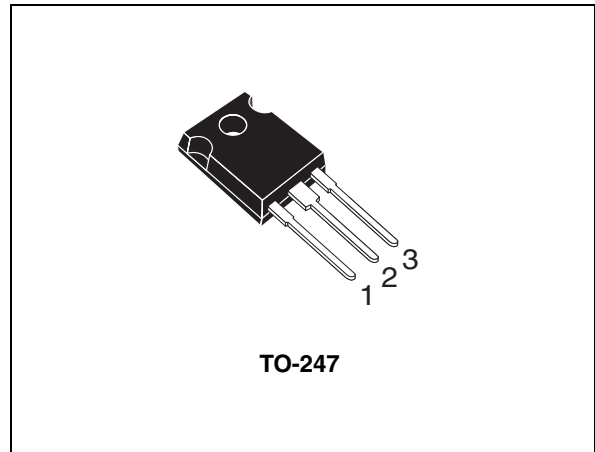


Figure 1. Internal schematic diagram

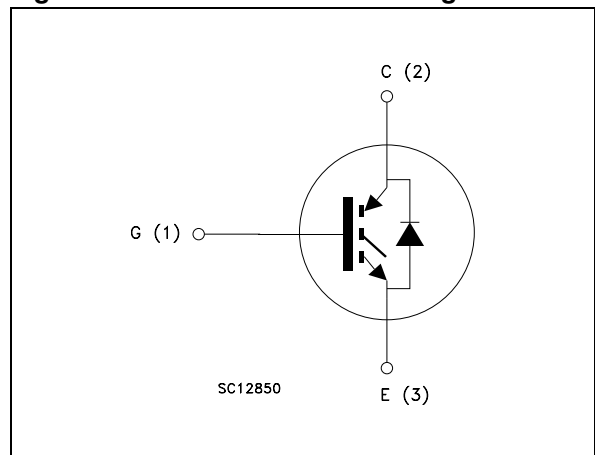


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|--------------|------------|---------|-----------|
| STGW20NC60VD | GW20NC60VD | TO-247 | Tube |

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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 |
| $I_C^{(1)}$ | Continuous collector current at $T_C = 25^\circ\text{C}$ | 60 | A |
| $I_C^{(1)}$ | Continuous collector current at $T_C = 100^\circ\text{C}$ | 30 | A |
| $I_{CP}^{(2)}$ | Pulsed collector current | 150 | A |
| $I_{CL}^{(3)}$ | Turn-off latching current | 100 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| I_F | Diode RMS forward current at $T_C = 25^\circ\text{C}$ | 30 | A |
| I_{FSM} | Surge not repetitive forward current $t_p = 10$ ms sinusoidal | 120 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 200 | W |
| T_j | Operating junction temperature | - 55 to 150 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature | | |

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. Pulse width limited by maximum junction temperature and turn-off within RBSOA.
 3. $V_{clamp} = 80\% V_{CES}$, $T_J = 150^\circ\text{C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\ \text{V}$.

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case IGBT | 0.63 | $^\circ\text{C/W}$ |
| | Thermal resistance junction-case diode | 1.5 | $^\circ\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 50 | $^\circ\text{C/W}$ |

2 Electrical characteristics

($T_j = 25^\circ\text{C}$ 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 | $V_{GE}=15 \text{ V}, I_C=20 \text{ A}$ $V_{GE}=15 \text{ V}, I_C=20 \text{ A}, T_j=125^\circ\text{C}$ | | 1.8 1.7 | 2.5 | 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 ($V_{GE} = 0$) | $V_{CE} = 600 \text{ V}$ $V_{CE}=600 \text{ V}, T_j= 125^\circ\text{C}$ | | | 250 1 | μA mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{V}$ | | | ± 100 | nA |
| g_{fs} | Forward transconductance | $V_{CE} = 15 \text{ V}, I_C= 20 \text{ A}$ | | 15 | | S |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|-----------|------------------------------|---|------|------|-----|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{V}, f = 1 \text{ MHz}, V_{GE}= 0$ | | 2200 | | pF |
| C_{oes} | Output capacitance | | - | 225 | | pF |
| C_{res} | Reverse transfer capacitance | | | 50 | | pF |
| Q_g | Total gate charge | $V_{CE} = 390\text{V}, I_C = 20\text{A},$ $V_{GE} = 15\text{V},$ <i>(see Figure 18)</i> | | 100 | 140 | 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 | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$ (see Figure 17) | - | 31 | - | ns |
| t_r | Current rise time | | | 11 | | ns |
| $(di/dt)_{onf}$ | Turn-on current slope | | | 1600 | | A/ μs |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$, $T_j=125^\circ\text{C}$ (see Figure 17) | - | 31 | - | ns |
| t_r | Current rise time | | | 11.5 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1500 | | A/ μs |
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$ (see Figure 17) | - | 28 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 100 | | ns |
| t_f | Current fall time | | | 75 | | ns |
| $t_{r(Voff)}$ | Off voltage rise time | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$, $T_j=125^\circ\text{C}$ (see Figure 17) | - | 66 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 150 | | ns |
| t_f | Current fall time | | | 130 | | ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|----------------|---------------------------|---|-----|------|-----|---------------|
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$, (see Figure 19) | - | 220 | 300 | μJ |
| E_{off} | Turn-off switching losses | | | 330 | 450 | μJ |
| E_{ts} | Total switching losses | | | 550 | 750 | μJ |
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC}=390\text{ V}$, $I_C=20\text{ A}$, $R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$, $T_j=125^\circ\text{C}$ (see Figure 19) | - | 450 | | μJ |
| E_{off} | Turn-off switching losses | | | 770 | | μJ |
| E_{ts} | Total switching losses | | | 1220 | | μJ |

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in Figure 19. E_{on} include diode recovery energy. If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C).

Table 8. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|-----------|--------------------------|---|-----|------|-----|------|
| V_F | Forward on-voltage | $I_F = 20\text{ A}$ | - | 2 | - | V |
| | | $I_F = 20\text{ A}, T_j = 125^\circ\text{C}$ | - | 1.6 | - | V |
| t_{rr} | Reverse recovery time | $I_F = 20\text{ A}, V_R = 40\text{ V},$ $T_j = 25^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i> | - | 44 | - | ns |
| Q_{rr} | Reverse recovery charge | | | 66 | | nC |
| I_{rrm} | Reverse recovery current | | | 3 | | A |
| t_{rr} | Reverse recovery time | $I_F = 20\text{ A}, V_R = 40\text{ V},$ $T_j = 125^\circ\text{C},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i> | - | 88 | - | ns |
| Q_{rr} | Reverse recovery charge | | | 237 | | nC |
| I_{rrm} | Reverse recovery current | | | 5.4 | | A |

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

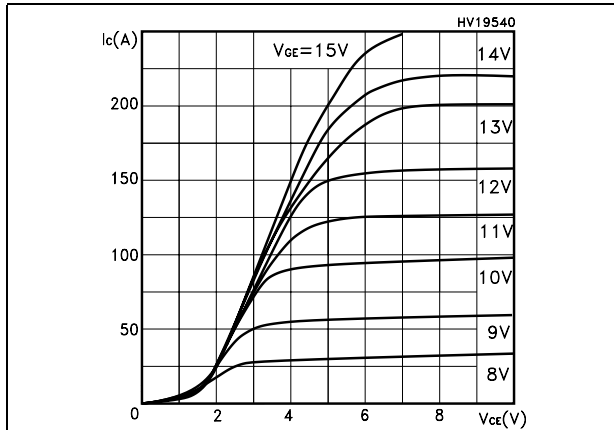


Figure 3. Transfer characteristics

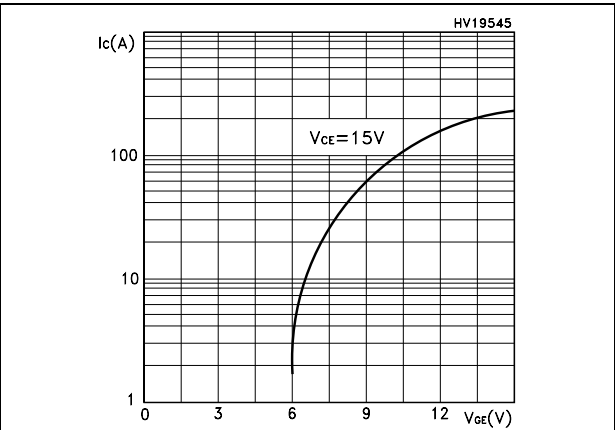


Figure 4. Transconductance

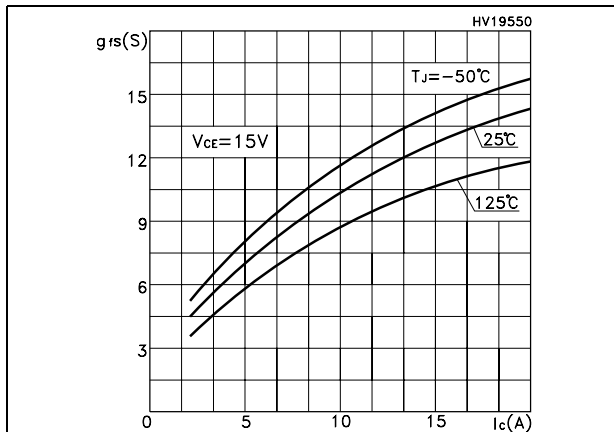


Figure 5. Collector-emitter on voltage vs temperature

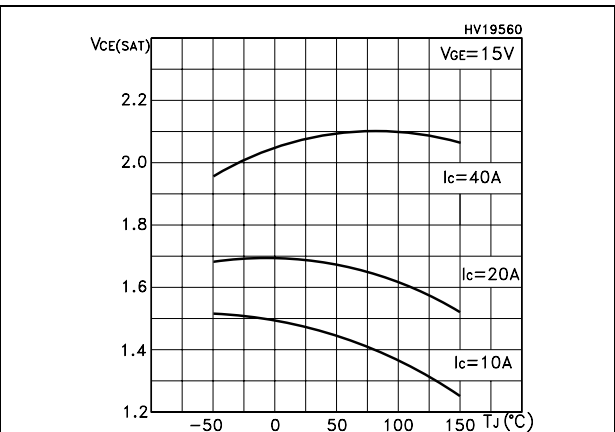


Figure 6. Collector-emitter on voltage vs collector current

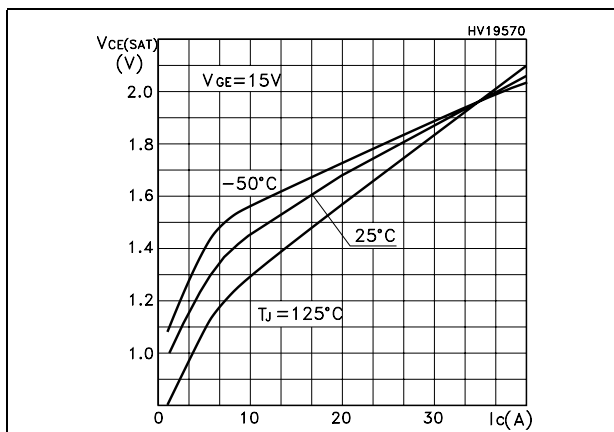


Figure 7. Normalized gate threshold vs temperature

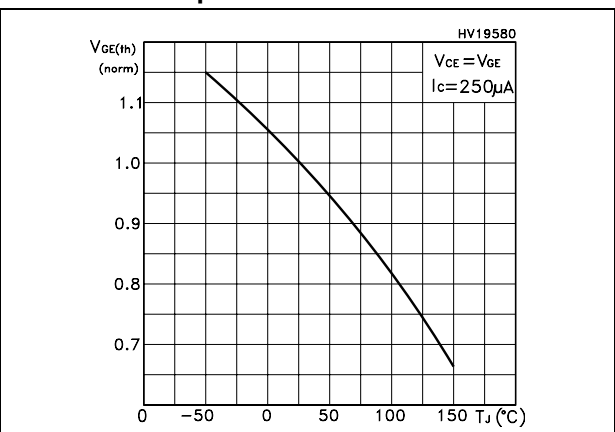


Figure 8. Normalized breakdown voltage vs temperature

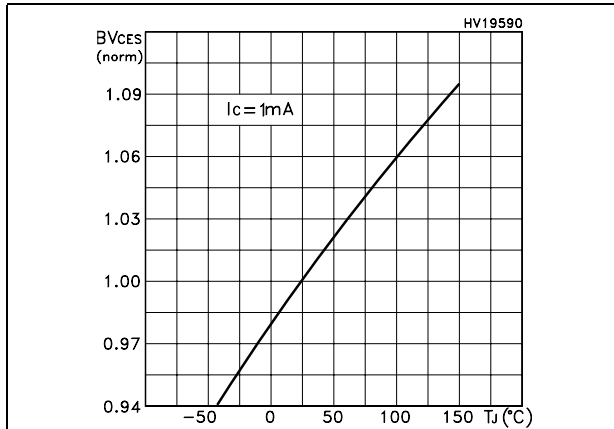


Figure 9. Gate charge vs gate-emitter voltage

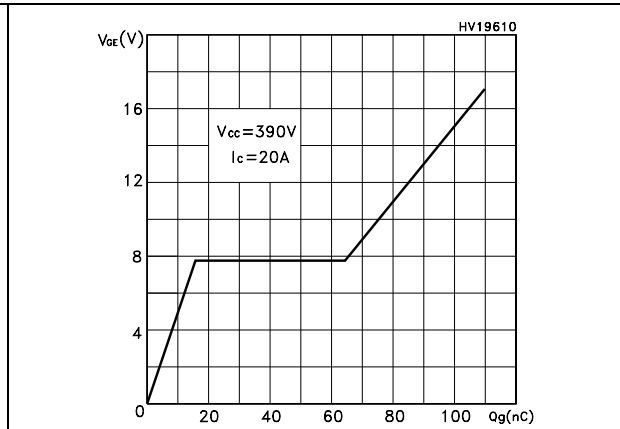


Figure 10. Capacitance variations

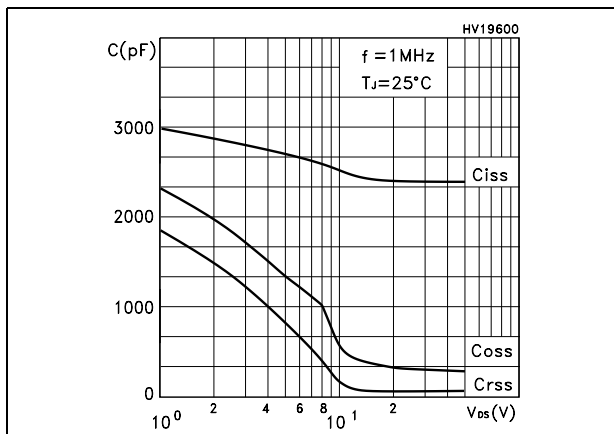


Figure 11. Switching losses vs temperature

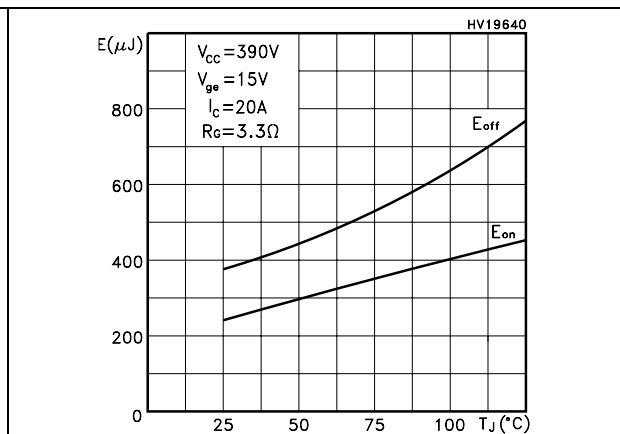


Figure 12. Switching losses vs gate resistance

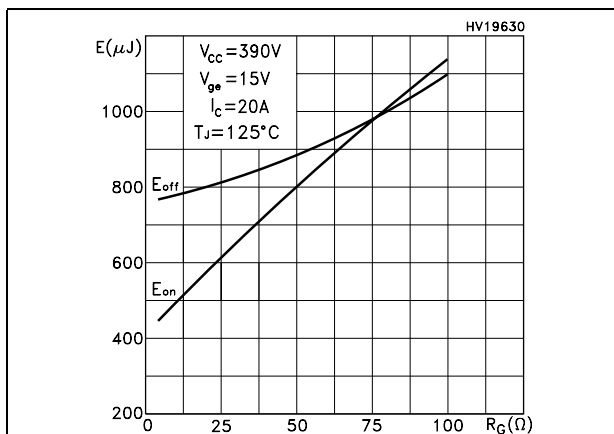


Figure 13. Switching losses vs collector current

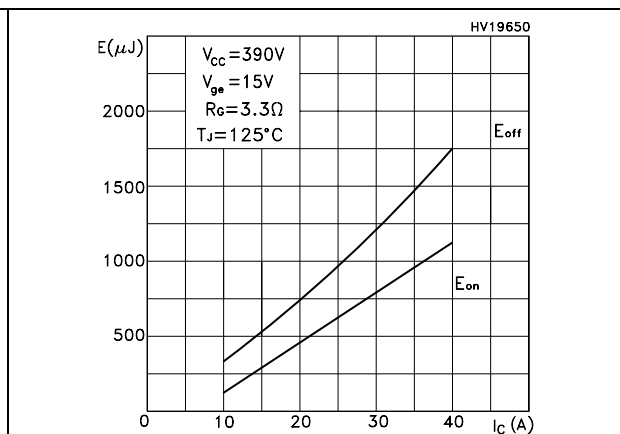


Figure 14. Thermal impedance

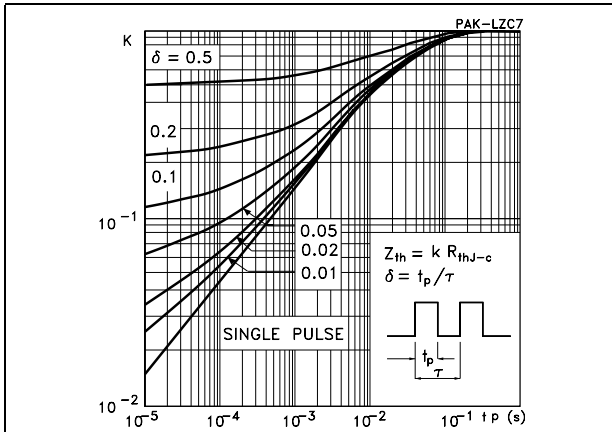


Figure 15. Turn-off SOA

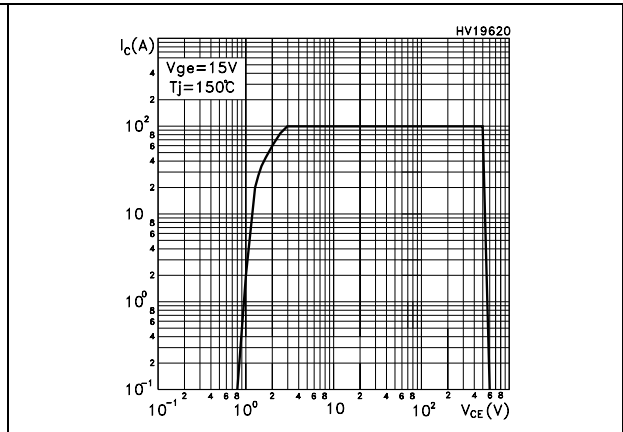
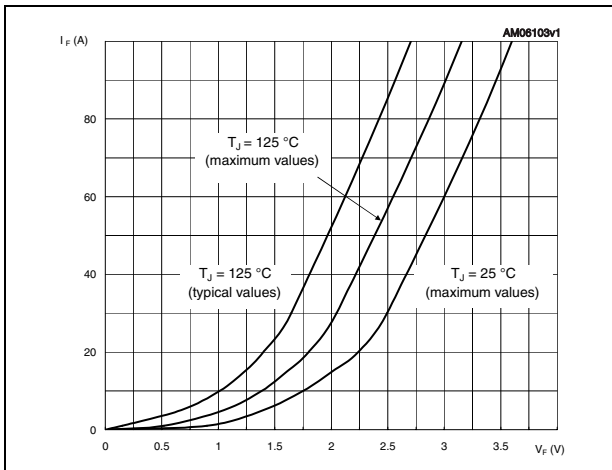


Figure 16. Emitter-collector diode characteristics



3 Test circuits

Figure 17. Test circuit for inductive load switching

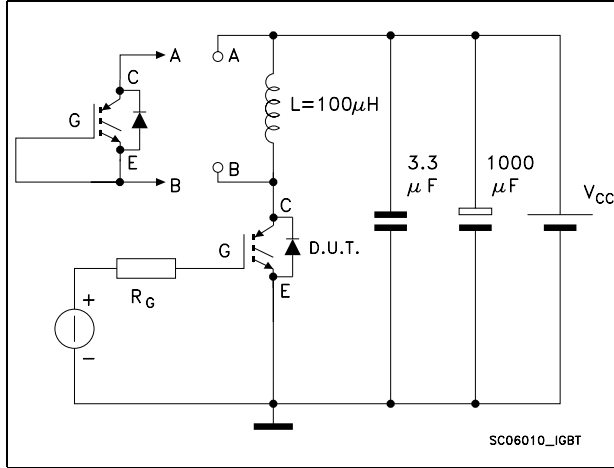


Figure 18. Gate charge test circuit

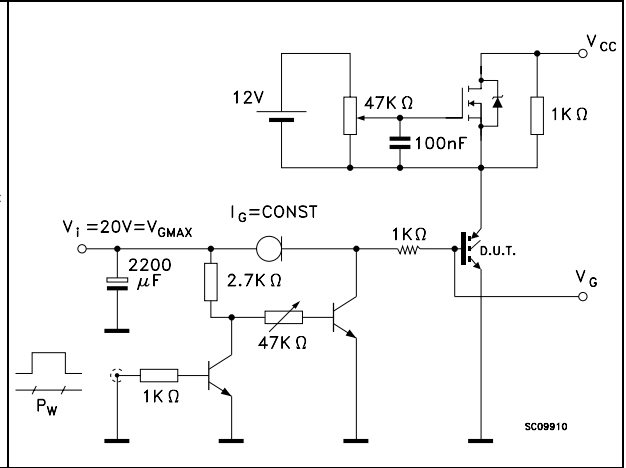


Figure 19. Switching waveforms

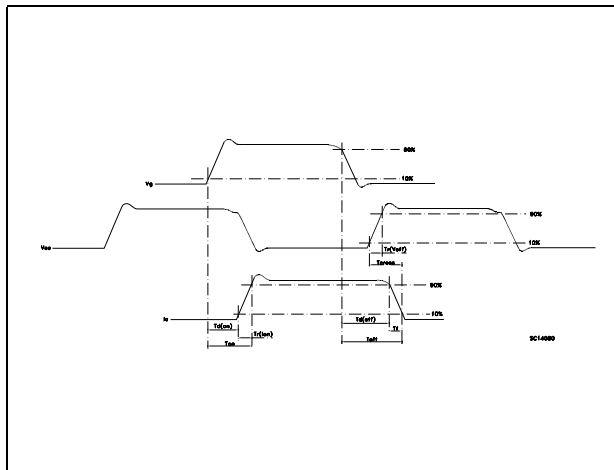
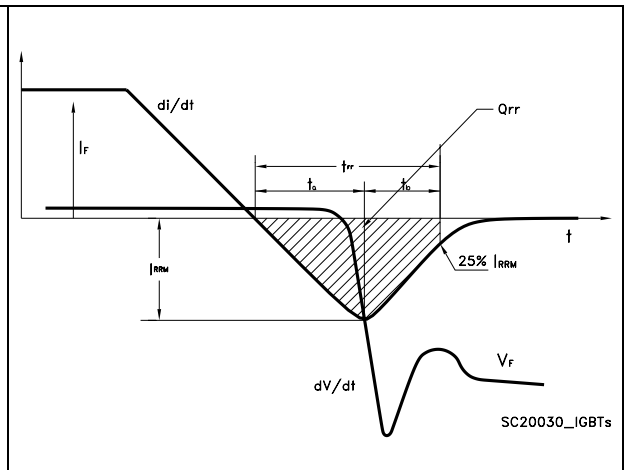


Figure 20. Diode recovery times waveform

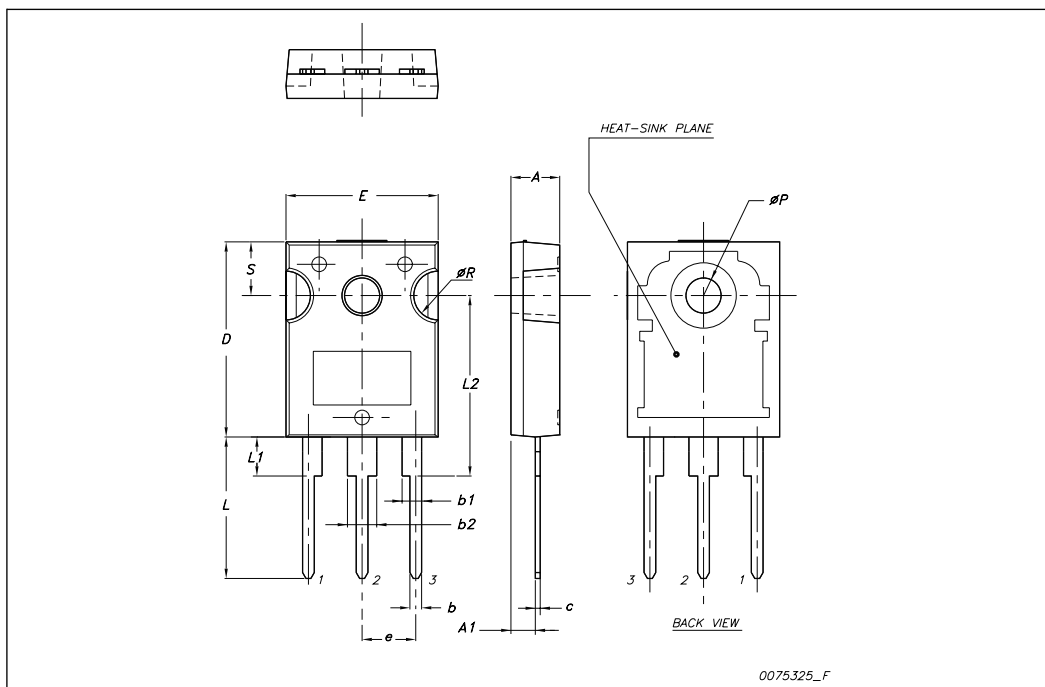


4 Package mechanical data

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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 | |



5 Revision history

Table 9. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 12-Jul-2004 | 4 | Stylesheet updated. Added switching losses maximum values in <i>Table 7: Switching energy (inductive load)</i> . Inserted <i>Figure 20: Diode recovery times waveform</i> . |
| 09-Mar-2010 | 5 | Inserted I_{FSM} parameter on <i>Table 2: Absolute maximum ratings</i> . Updated <i>Figure 16: Emitter-collector diode characteristics</i> and package mechanical data. Minor text changes to improve readability. |

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