



STGW30NC120HD

N-channel 1200V - 30A - TO-247
very fast PowerMESH™ IGBT

Features

| Type | V _{CES} | V _{CE(sat)} @25°C | I _C @100°C |
|---------------|------------------|-------------------------------|--------------------------|
| STGW30NC120HD | 1200V | < 2.75V | 30A |

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

Application

- Induction heating

Description

Using the latest high voltage technology based on its patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, with outstanding performances. The suffix “H” identifies a family optimized for high frequency application in order to achieve very high switching performances (reduced t_{fall}) maintaining a low voltage drop.

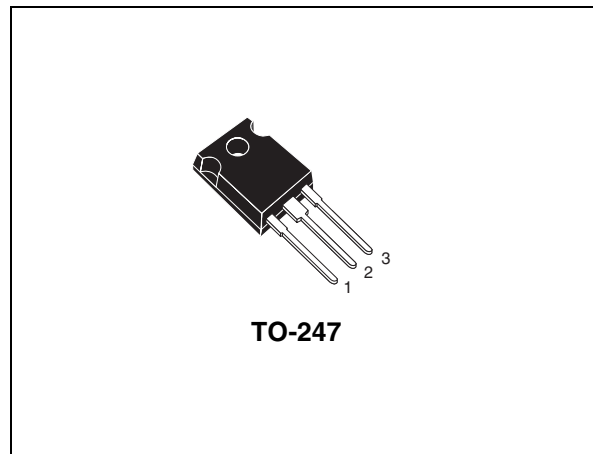


Figure 1. Internal schematic diagram

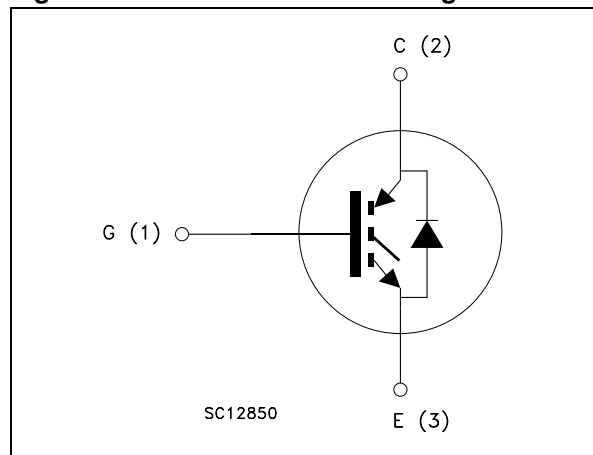


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|---------------|-------------|---------|-----------|
| STGW30NC120HD | GW30NC120HD | TO-247 | Tube |

Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GS} = 0$) | 1200 | V |
| $I_C^{(1)}$ | Collector current (continuous) at 25°C | 60 | A |
| $I_C^{(1)}$ | Collector current (continuous) at 100°C | 30 | A |
| $I_{CL}^{(2)}$ | Collector current (pulsed) | 135 | A |
| V_{GE} | Gate-emitter voltage | ±25 | V |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 220 | W |
| I_f | Diode RMS forward current at $T_C = 25^\circ\text{C}$ | 30 | A |
| T_j | Operating junction temperature | -55 to 150 | °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. $V_{clamp}=80\%$ of BV_{ces} , $T_j=150^\circ\text{C}$, $R_G=10\Omega$, $V_{GE}=15\text{V}$

Table 3. Thermal resistance

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case | 0.57 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient (diode) | 1.6 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient (IGBT) | 30 | °C/W |

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 | $I_C = 1mA, V_{GE} = 0$ | 1200 | | | V |
| $V_{CE(SAT)}$ | Collector-emitter saturation voltage | $V_{GE}= 15V, I_C= 20A, T_j= 25^{\circ}C$ $V_{GE}= 15V, I_C= 20A, T_j=125^{\circ}C$ | | 2.2 2.0 | 2.75 | V V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}= V_{GE}, I_C= 250\mu A$ | 3.75 | | 5.75 | V |
| I_{CES} | Collector-emitter leakage current ($V_{GE} = 0$) | $V_{CE} = \text{Max rating}, T_c=25^{\circ}C$ $V_{CE} = \text{Max rating}, T_c=125^{\circ}C$ | | | 500 10 | μA mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20V, V_{CE} = 0$ | | | ± 100 | nA |
| g_{fs} | Forward transconductance | $V_{CE} = 25V, I_C= 20A$ | | 14 | | S |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25V, f = 1 \text{ MHz}, V_{GE}=0$ | | 2510 | | pF |
| C_{oes} | Output capacitance | | | 175 | | pF |
| C_{res} | Reverse transfer capacitance | | | 30 | | pF |
| Q_g | Total gate charge | $V_{CE} = 960V,$ $I_C= 20A, V_{GE}=15V$ | | 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 |
|----------------|-----------------------|-------------------------------------|------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 960V, I_C = 20A$ | | 29 | | ns |
| t_r | Current rise time | $R_G = 10\Omega, V_{GE} = 15V,$ | | 11 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | $T_j = 25^\circ C$ (see Figure 17) | | 1820 | | A/ μs |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 960V, I_C = 20A$ | | 27 | | ns |
| t_r | Current rise time | $R_G = 10\Omega, V_{GE} = 15V,$ | | 14 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | $T_j = 125^\circ C$ (see Figure 17) | | 1580 | | A/ μs |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 960V, I_C = 20A$ | | 90 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 10\Omega, V_{GE} = 15V,$ | | 275 | | ns |
| t_f | Current fall time | $T_j = 25^\circ C$ (see Figure 17) | | 312 | | ns |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 960V, I_C = 20A$ | | 150 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 10\Omega, V_{GE} = 15V,$ | | 336 | | ns |
| t_f | Current fall time | $T_j = 125^\circ C$ (see Figure 17) | | 592 | | ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|-------------------------------------|------|------|------|---------|
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 960V, I_C = 20A$ | | 1660 | | μJ |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 10\Omega, V_{GE} = 15V,$ | | 4438 | | μJ |
| E_{ts} | Total switching losses | $T_j = 25^\circ C$ (see Figure 17) | | 6098 | | μJ |
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 960V, I_C = 20A$ | | 3015 | | μJ |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 10\Omega, V_{GE} = 15V,$ | | 6900 | | μJ |
| E_{ts} | Total switching losses | $T_j = 125^\circ C$ (see Figure 17) | | 9915 | | μJ |

1. 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)

2. 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 | $I_f = 20A, T_j = 25^\circ C$ $I_f = 20A, T_j = 125^\circ C$ | | 1.9 1.7 | 2.5 | V V |
| t_{rr} | Reverse recovery time | $I_f = 20A, V_R = 27V,$ | | 152 | | ns |
| Q_{rr} | Reverse recovery charge | $T_j = 125^\circ C, di/dt = 100A/\mu s$ | | 722 | | nC |
| I_{rrm} | Reverse recovery current | (see Figure 20) | | 9 | | A |

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

Figure 3. Transfer characteristics

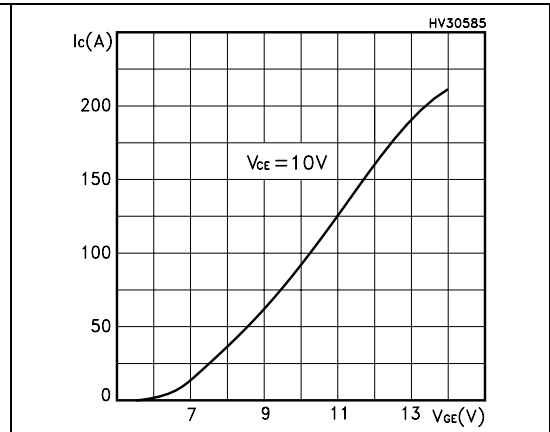
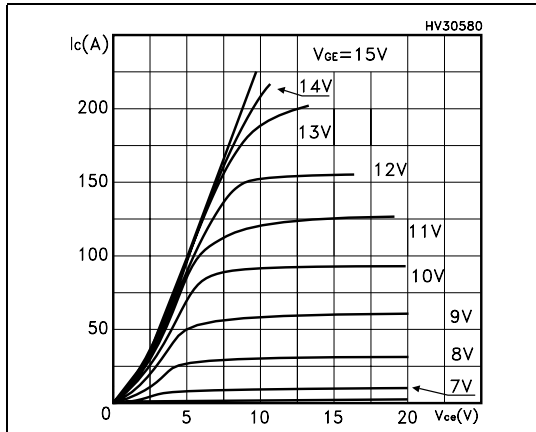


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs. temperature

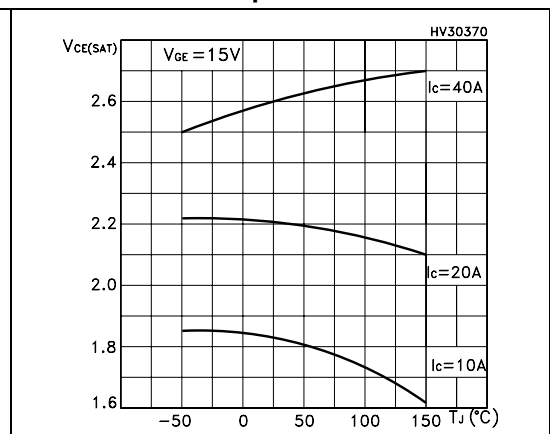
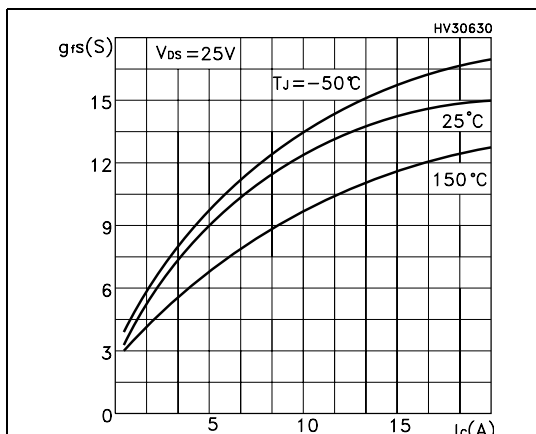


Figure 6. Gate charge vs. gate-source voltage

Figure 7. Capacitance variations

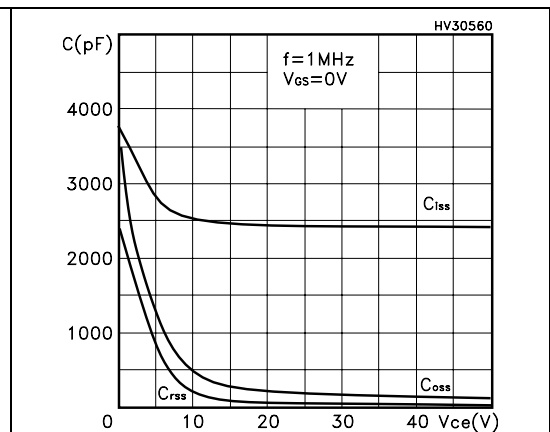
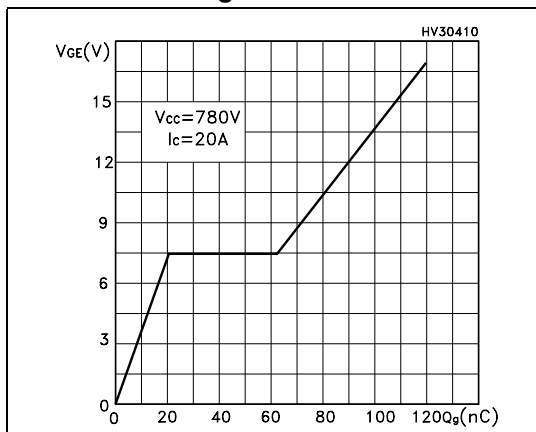


Figure 8. Normalized gate threshold voltage vs. temperature

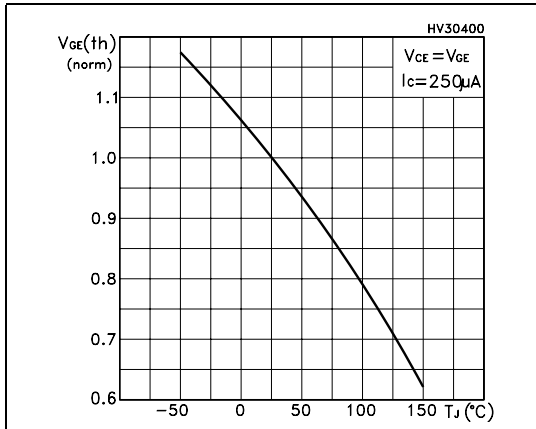


Figure 9. Collector-emitter on voltage vs. collector current

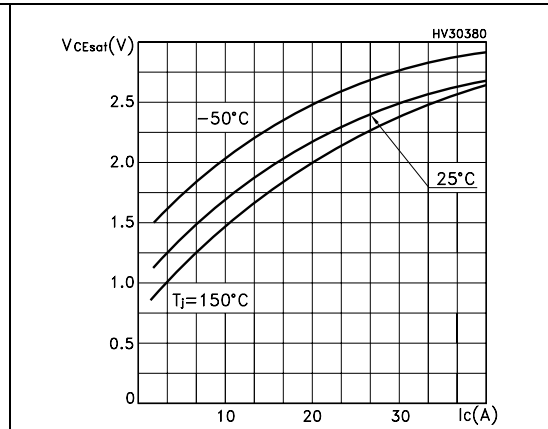


Figure 10. Normalized breakdown voltage vs. temperature

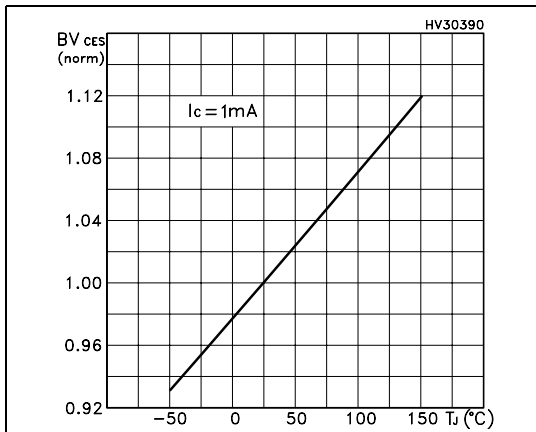


Figure 11. Switching losses vs. temperature

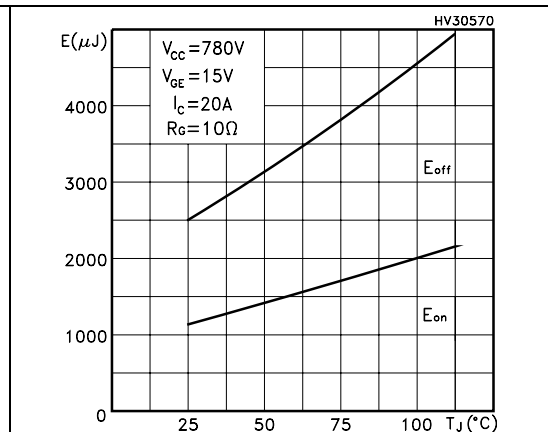


Figure 12. Switching losses vs. gate resistance

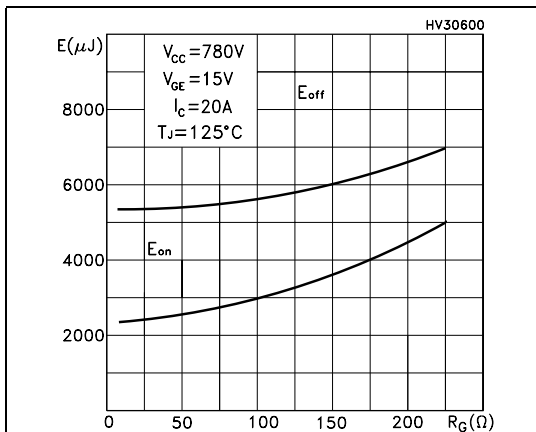


Figure 13. Switching losses vs. collector current

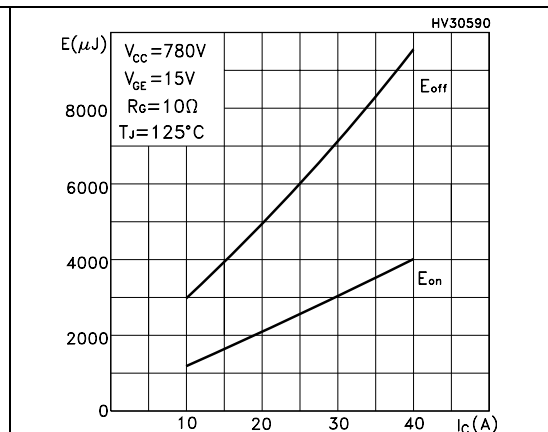


Figure 14. Thermal Impedance

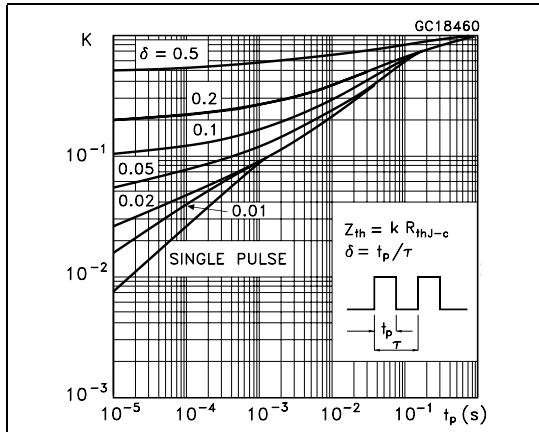


Figure 15. Turn-off SOA

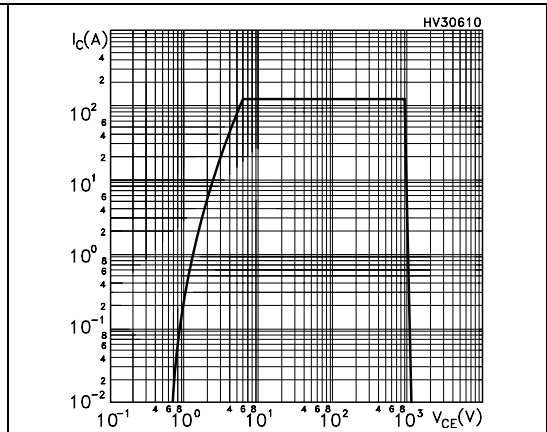
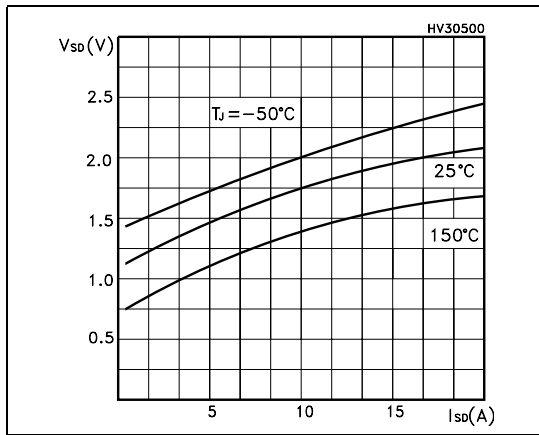


Figure 16. Emitter-collector diode characteristics



3 Test circuit

Figure 17. Test circuit for inductive load switching

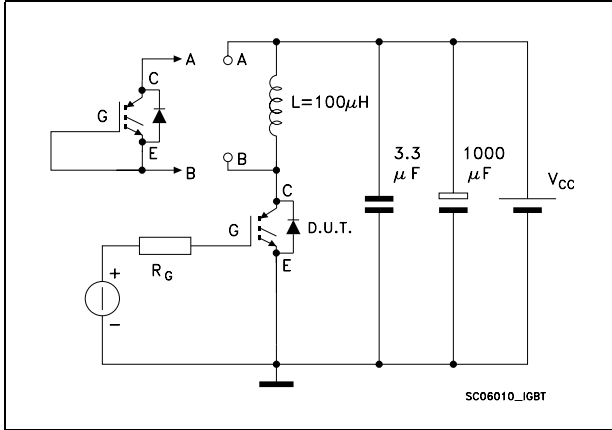


Figure 18. Gate charge test circuit

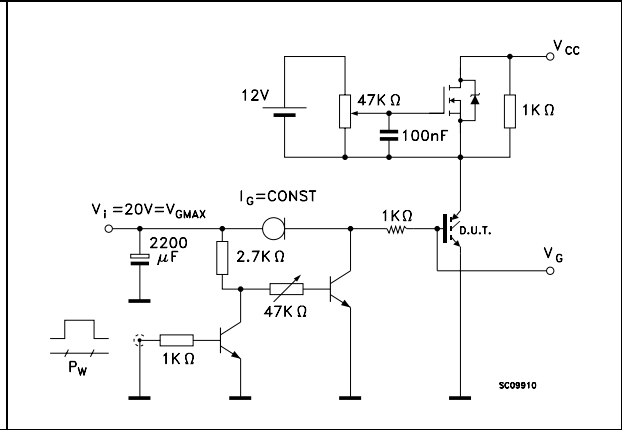


Figure 19. Switching waveform

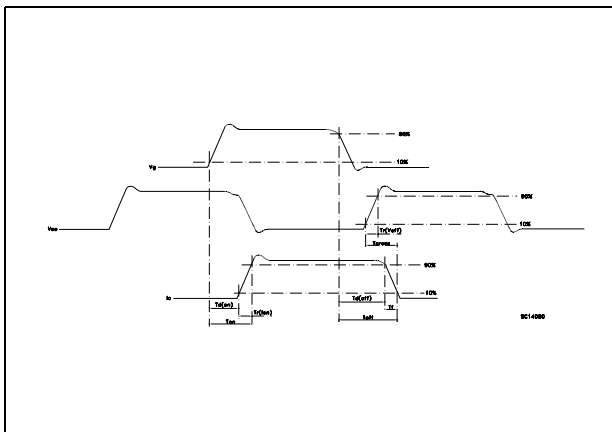
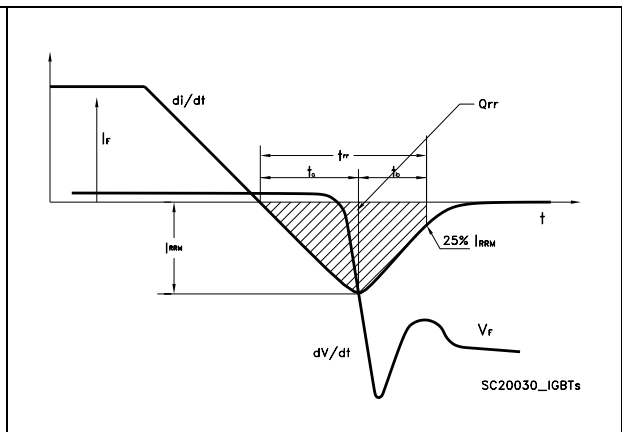


Figure 20. Diode recovery time waveform

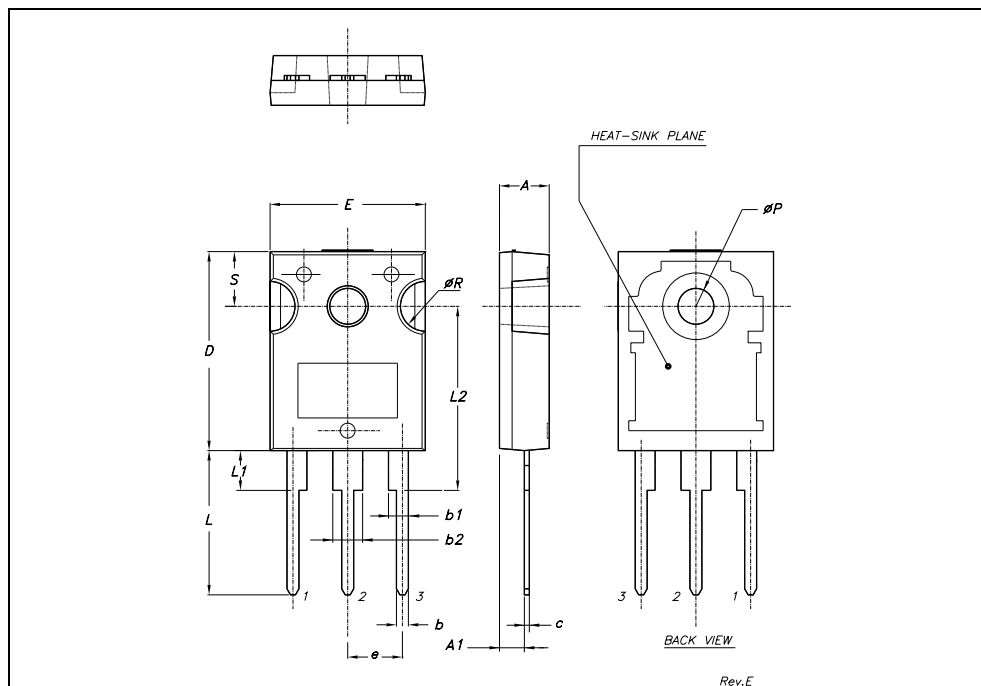


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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

TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |



5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 23-Nov-2005 | 1 | First issue. |
| 17-Mar-2006 | 2 | Complete version |
| 05-May-2006 | 3 | Modified value on Table 2.: Absolute maximum ratings |
| 30-May-2006 | 4 | New values on Table 3: Thermal resistance |
| 23-Jun-2006 | 5 | Modified value on Table 4.: Static |
| 07-Sep-2006 | 6 | Modified T _J temperature range to 150°C in Table 2.: Absolute maximum ratings |
| 14-Nov-2006 | 7 | Modified Figure 5. and Figure 9. |
| 26-Jan-2007 | 8 | Typing error on first page. |
| 04-Oct-2007 | 9 | Modified test conditions in Table 4.: Static |

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