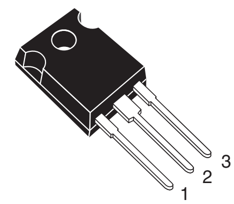
# STGW35NC120HD

## 32 A - 1200 V - very fast IGBT

## 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



TO-247 long leads

## 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**

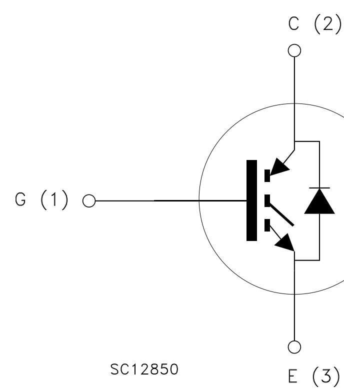



**Table 1. Device summary**

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

# Contents

# 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 °C | 60 | A |
| $I_C$ (1) | Continuous collector current at $T_C$ = 100 °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 °C | 235 | W |
| $I_F$ | Diode RMS forward current at $T_C$ = 25 °C | 30 | A |
| $I_{FSM}$ | Surge non repetitive forward current $t_p$ = 10 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. Vclamp = 80% of $V_{CES}$, $T_j$ =125 °C, $R_G$=10 Ω, $V_{GE}$=15 V
3. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case IGBT | 0.53 | °C/W |
| | Thermal resistance junction-case diode | 1.5 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 50 | °C/W |

# 2 Electrical characteristics

($T_j$ =25 °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 mA | 1200 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$= 15 V, $I_C$= 20 A,<br>$V_{GE}$= 15 V, $I_C$= 20 A, $T_j$ =125 °C | | 2.2<br>2.0 | 2.75 | V<br>V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$= $V_{GE}$, $I_C$= 250µA | 3.75 | | 5.75 | V |
| $I_{CES}$ | Collector cut-off current ($V_{GE}$ = 0) | $V_{CE}$ =1200 V<br>$V_{CE}$ =1200 V, $T_j$ =125 °C | | | 500<br>10 | µA<br>mA |
| $I_{GES}$ | Gate-emitter leakage current ($V_{CE}$ = 0) | $V_{GE}$ =± 20 V | | | ± 100 | nA |
| $g_{fs}$ (1) | Forward transconductance | $V_{CE}$ = 25 V, $I_C$= 20 A | | 14 | | S |

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

**Table 5. Dynamic**

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

**Table 6. 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 | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*Figure 17* | - | 29<br>11<br>1820 | - | ns<br>ns<br>A/µs |
| $t_{d(on)}$<br>$t_r$<br>$(di/dt)_{on}$ | Turn-on delay time<br>Current rise time<br>Turn-on current slope | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_j$ =125 °C *Figure 17* | - | 27<br>14<br>1580 | - | ns<br>ns<br>A/µs |
| $t_r(V_{off})$<br>$t_d(_{off})$<br>$t_f$ | Off voltage rise time<br>Turn-off delay time<br>Current fall time | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*Figure 17* | - | 90<br>275<br>312 | - | 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 | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_j$ =125 °C *Figure 17* | - | 150<br>336<br>592 | - | ns<br>ns<br>ns |

**Table 7. Switching energy (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Eon (1)<br>$E_{off}$ (2)<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching losses<br>Total switching losses | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*Figure 17* | - | 1660<br>4438<br>6098 | - | µJ<br>µJ<br>µJ |
| Eon (1)<br>$E_{off}$ (2)<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching losses<br>Total switching losses | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_j$ =125 °C *Figure 17* | - | 3015<br>6900<br>9915 | - | µJ<br>µJ<br>µJ |

1. Eon 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 | $I_F$ = 20 A<br>$I_F$ = 20 A, $T_C$ = 125 °C | - | 1.9<br>1.7 | 2.5 | V<br>V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{rrm}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_F$ = 20 A, $V_R$ = 27 V,<br>$T_j$ =125 °C, di/dt = 100 A/µs<br>*Figure 20* | - | 152<br>722<br>9 | - | ns<br>nC<br>A |

## 2.1 Electrical characteristics (curves)

**Figure 2. Output characteristics**

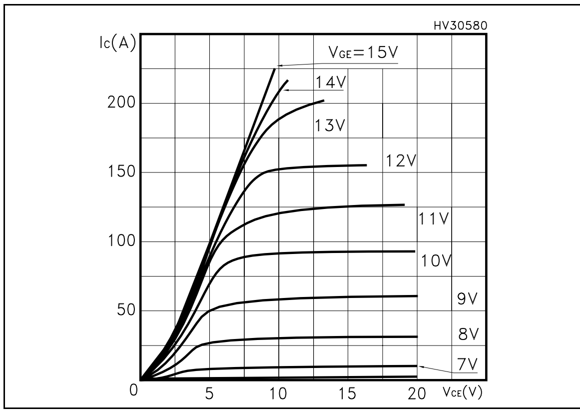



**Figure 3. Transfer characteristics**

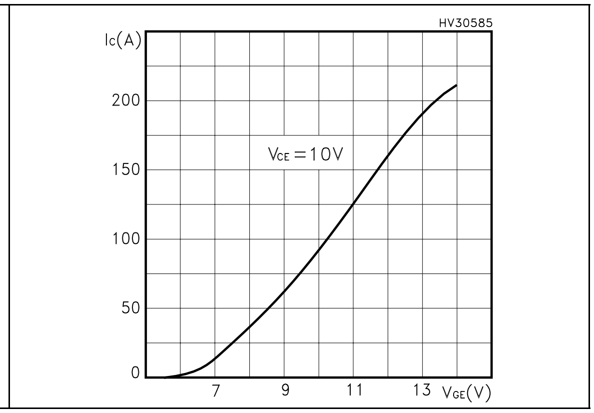



**Figure 4. Transconductance**

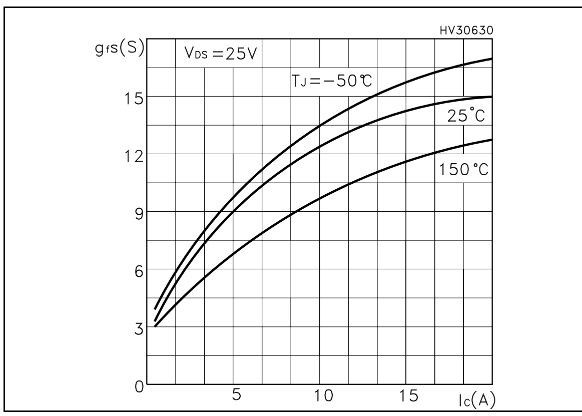



**Figure 5. Collector-emitter on voltage vs. temperature**

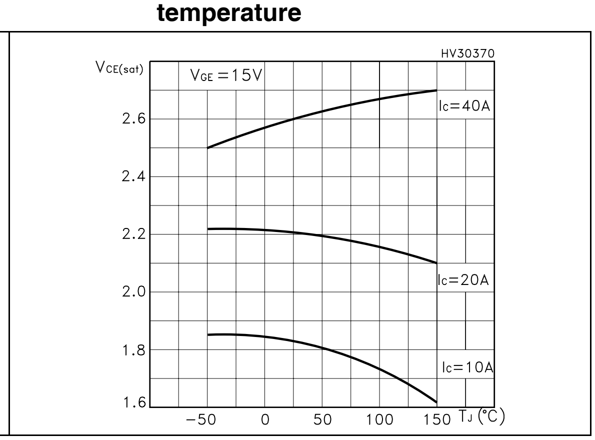



**Figure 6. Gate charge vs. gate-source voltage**

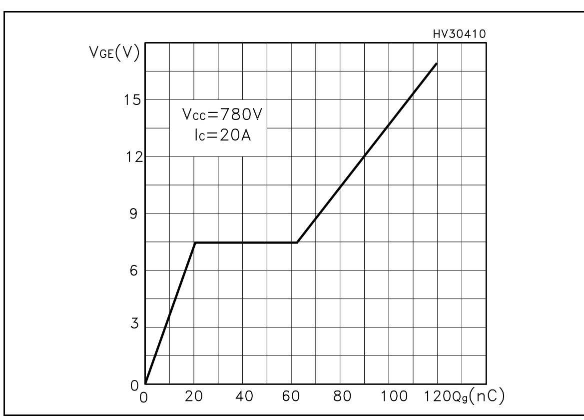



**Figure 7. Capacitance variations**

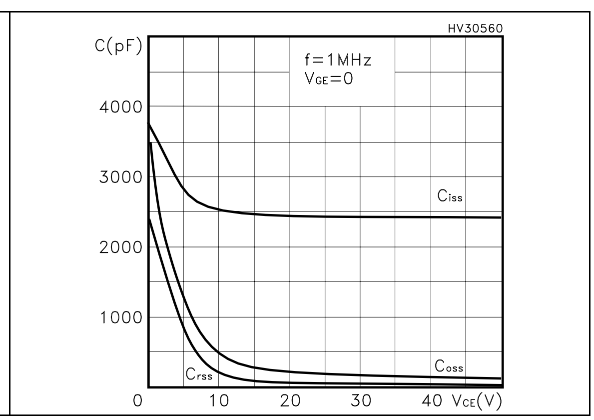


**Figure 8. Normalized gate threshold voltage vs. temperature**

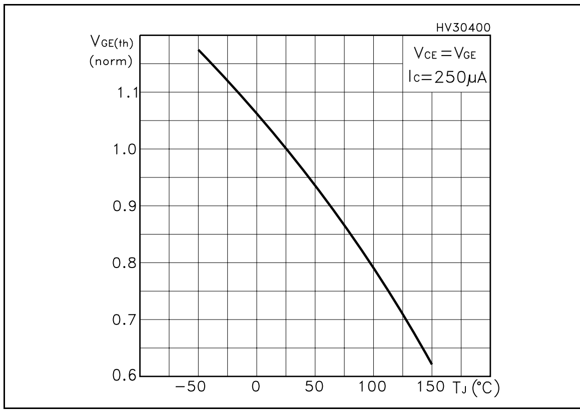



**Figure 9. Collector-emitter on voltage vs. collector current**

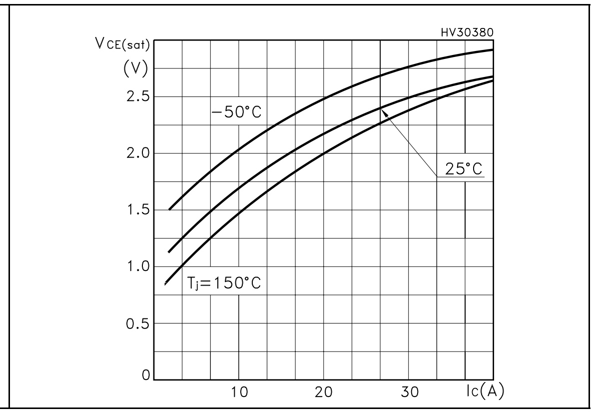



**Figure 10. Normalized breakdown voltage vs. temperature**

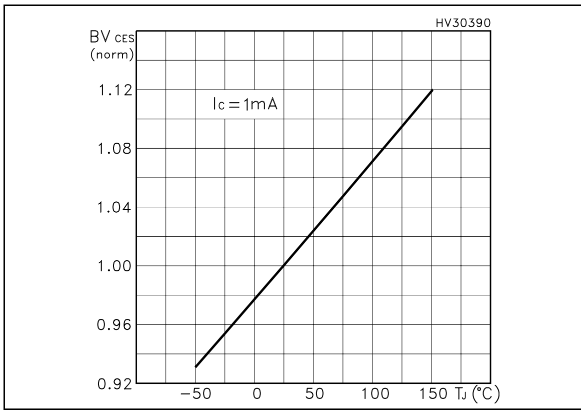



**Figure 11. Switching losses vs. temperature**

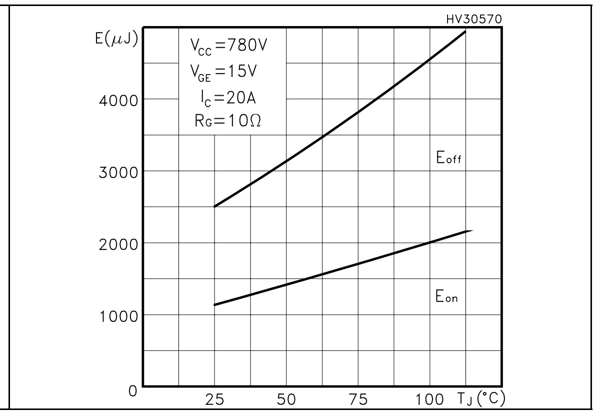



**Figure 12. Switching losses vs. gate resistance**

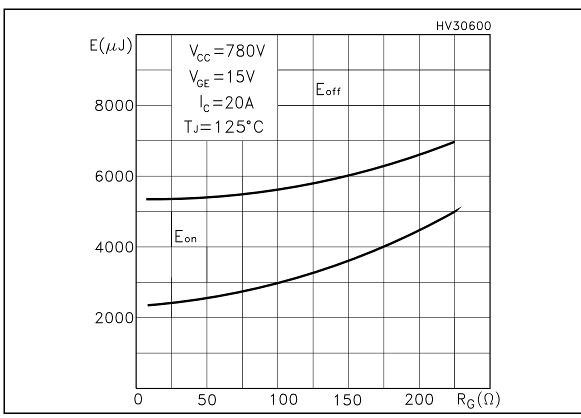



**Figure 13. Switching losses vs. collector current**

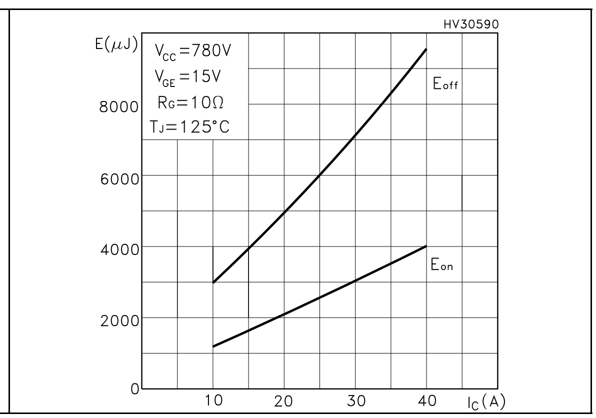


**Figure 14. Thermal Impedance**

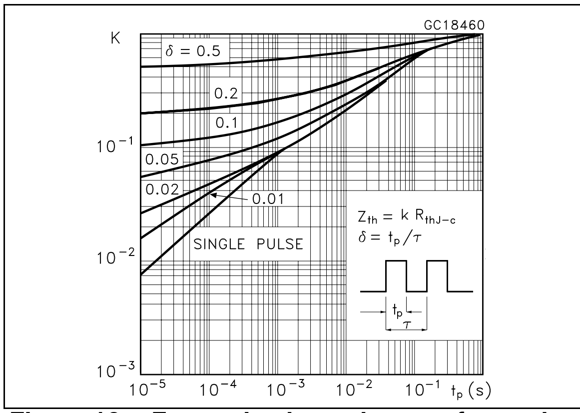



**Figure 15. Reverse biased SOA**

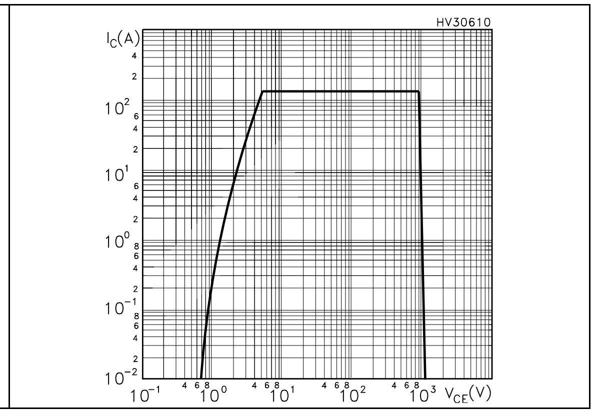
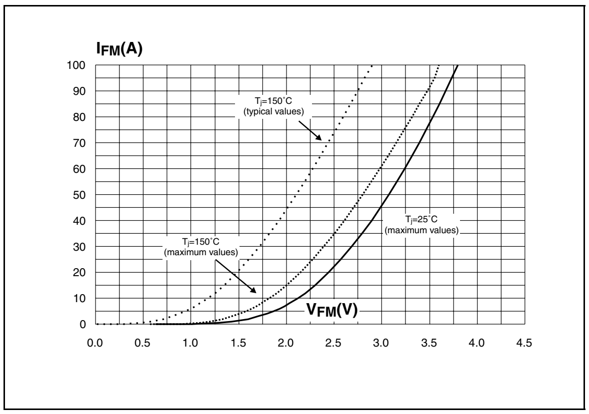



**Figure 16. Forward voltage drop vs. forward current**



# 3 Test circuits

**Figure 17. Test circuit for inductive load switching**

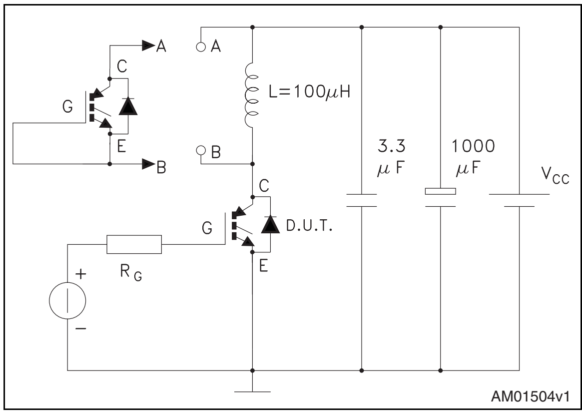



**Figure 18. Gate charge test circuit**

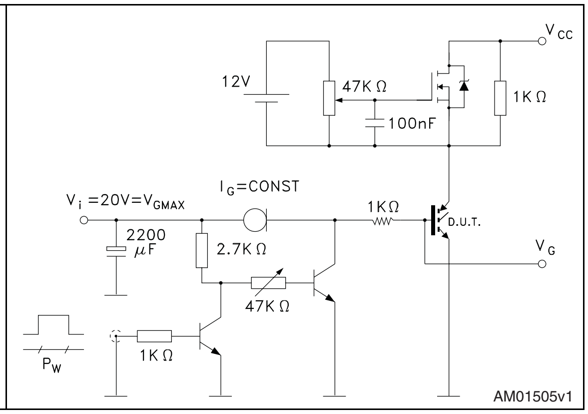



**Figure 19. Switching waveform**

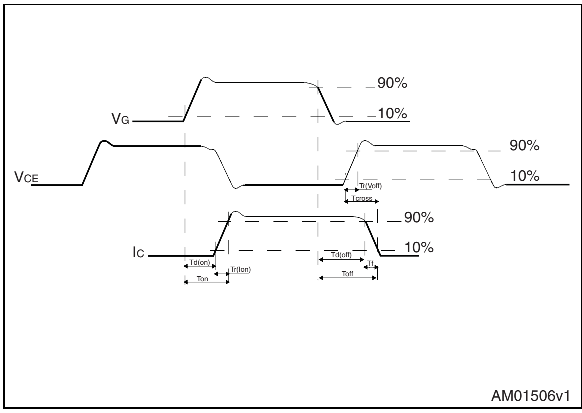
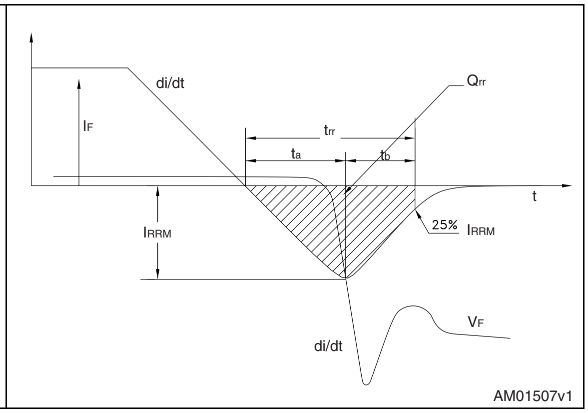



**Figure 20. Diode recovery time waveform**

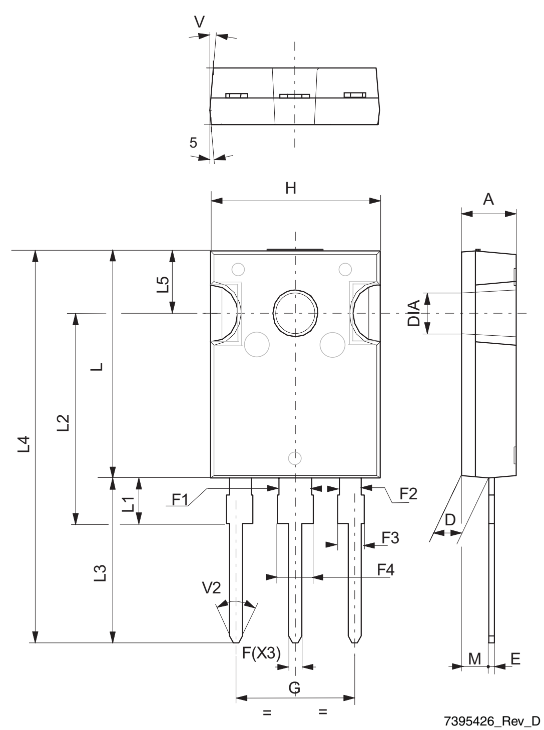


# 4 Package mechanical data

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 | *Section 4: Package mechanical data* has been updated. |