# STGFW45HF60W

## 23 A, 600 V Ultrafast IGBT

**Datasheet — preliminary data**

## Features

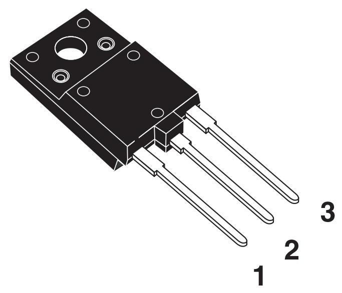
- Improved $E_{off}$ at elevated temperature
- Low $C_{RES}$ / $C_{IES}$ ratio (no cross-conduction susceptibility)

## Applications

- High frequency converters
- Power factor correction

## Description

This Ultrafast IGBT is developed using a new planar technology to yield a device with tighter switching energy variation ($E_{off}$) versus temperature. The suffix "W" denotes a subset of products designed for high switching frequency operation (over 100 kHz).




TO-3PF

**Figure 1. Internal schematic diagram**

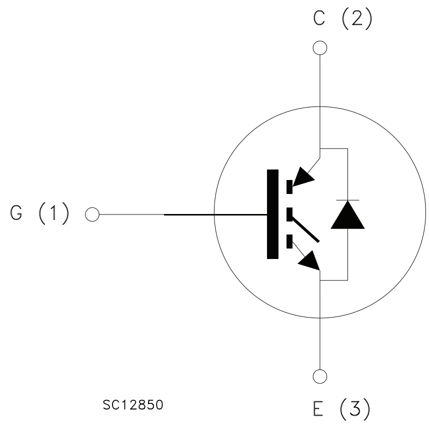



**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STGFW45HF60W | GFW45HF60W | TO-3PF | Tube |



This is preliminary information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage ($V_{GE}$ = 0) | 600 | V |
| $I_C$ | Continuous collector current at $T_C$ = 25 °C | 50 | A |
| $I_C$ | Continuous collector current at $T_C$ = 100 °C | 23 | A |
| $I_{CP}$ (1) | Pulsed collector current | 150 | A |
| $I_{CL}$ (2) | Turn-off latching current | 80 | A |
| $V_{GE}$ | Gate-emitter voltage | ± 20 | V |
| $V_{ISO}$ | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C$ = 25 °C) | 2500 | V |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 128 | W |
| $T_{stg}$ | Storage temperature | – 55 to 150 | °C |
| $T_j$ | Operating junction temperature | | |

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

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj-case}$ | Thermal resistance junction-case IGBT | 0.97 | °C/W |
| $R_{thj-amb}$ | 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 | 600 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$= 30 A<br>$V_{GE}$ = 15V, $I_C$ = 30 A,$T_J$= 125 °C | | 1.9<br>1.65 | 2.5 | V<br>V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA | 3.75 | | 5.75 | V |
| $I_{CES}$ | Collector cut-off current ($V_{GE}$ = 0) | $V_{CE}$ = 600 V<br>$V_{CE}$ = 600 V, $T_J$ = 125 °C | | | 500<br>5 | µA<br>mA |
| $I_{GES}$ | Gate-emitter leakage current ($V_{CE}$ = 0) | $V_{GE}$ = ±20 V | | | ± 100 | nA |

**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,<br>$V_{GE}$ = 0 | - | 2900<br>260<br>55 | - | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{ge}$<br>$Q_{gc}$ | Total gate charge<br>Gate-emitter charge<br>Gate-collector charge | $V_{CE}$ = 400 V, $I_C$ = 30 A,<br>$V_{GE}$ = 15 V,<br>*Figure 16* | - | 160<br>17<br>65 | - | 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 | $V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_G$ = 6.8 Ω, $V_{GE}$ = 15 V,<br>*(Figure 15)* | - | 30<br>12<br>2600 | - | 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 | $V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_G$ = 6.8 Ω, $V_{GE}$ = 15 V,<br>$T_J$ = 125 °C *(Figure 15)* | - | 30<br>14<br>2200 | - | 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 | $V_{CC}$ = 400 V, $I_C$ = 30 A,<br>$R_G$ = 6.8 Ω, $V_{GE}$ = 15 V<br>*(Figure 15)* | - | 30<br>145<br>50 | - | 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 | $V_{CC}$ = 400 V, $I_C$ = 30 A,<br>$R_G$ = 6.8 Ω, $V_{GE}$ =15 V,<br>$T_J$ = 125 °C<br>*(Figure 15)* | - | 47<br>185<br>65 | - | ns<br>ns<br>ns |

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

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{on}$ (1)<br>$E_{off}$<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching losses<br>Total switching losses | $V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_G$ = 6.8 Ω, $V_{GE}$ = 15 V,<br>*(Figure 17)* | - | 200<br>330<br>530 | | µJ<br>µJ<br>µJ |
| $E_{on}$ (1)<br>$E_{off}$<br>$E_{ts}$ | Turn-on switching losses<br>Turn-off switching losses<br>Total switching losses | $V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_G$ = 6.8 Ω, $V_{GE}$ = 15 V,<br>$T_J$ = 125 °C (*Figure 17*) | - | 230<br>550<br>780 | 800 | µJ<br>µJ<br>µJ |

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 16*. If the IGBT is offered in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25 °C and 125 °C). Eon includes diode recovery energy.
If the IGBT is offered in a package without the co-pack diode, a SIC diode is used in the test circuit in *Figure 16*.

## 2.1 Electrical characteristics (curves)

**Figure 2. Output characteristics**

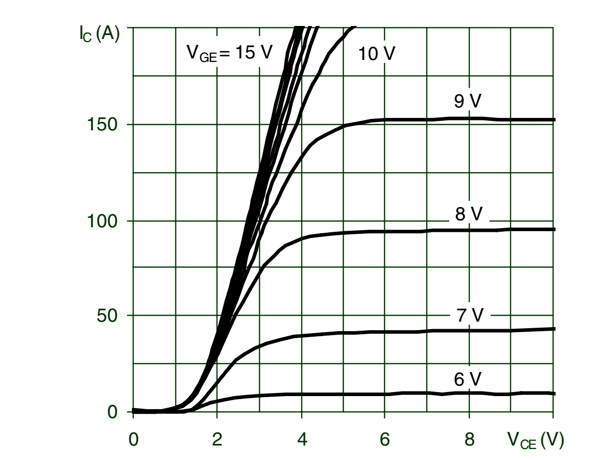



**Figure 3. Transfer characteristics**

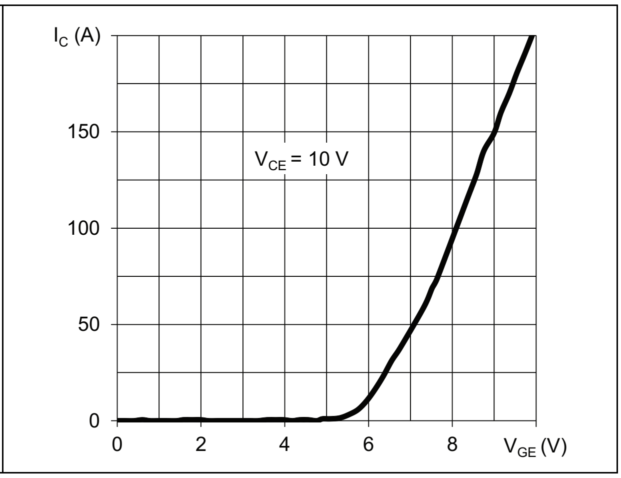



**Figure 4. Normalized $V_{CE(sat)}$ vs. $I_C$**

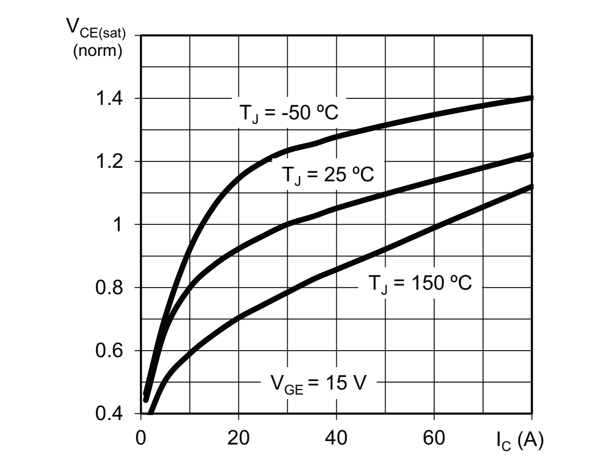



**Figure 5. Normalized $V_{CE(sat)}$ vs. temperature**

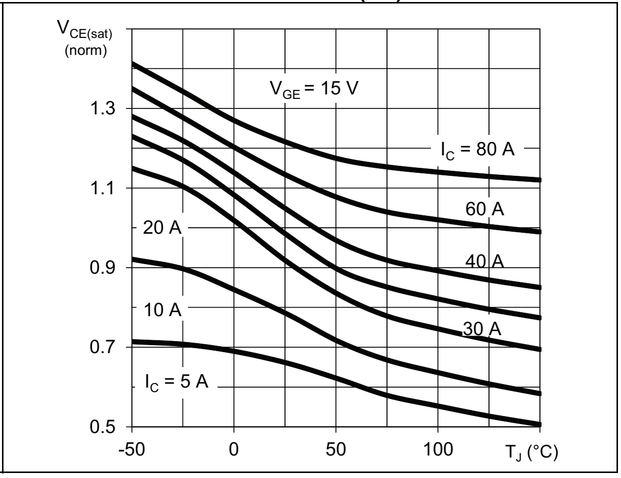



**Figure 6. Normalized breakdown voltage vs. temperature**

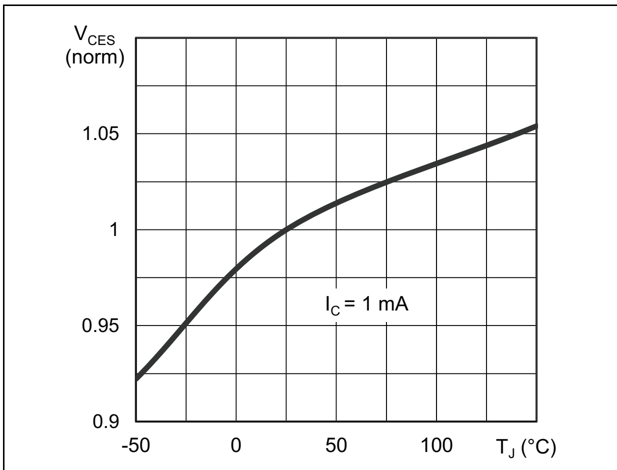



**Figure 7. Normalized gate threshold voltage vs. temperature**

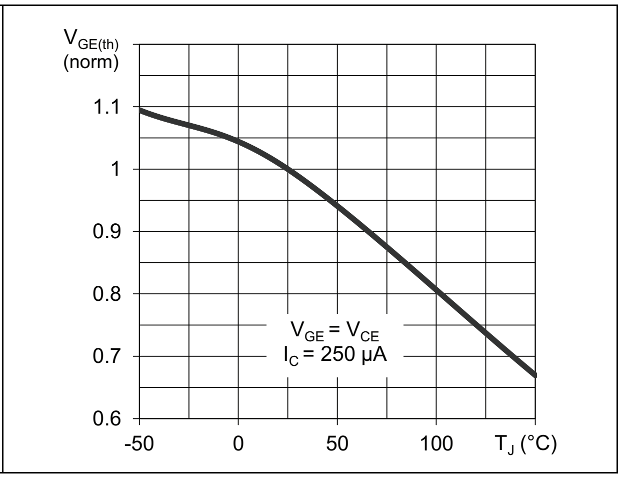


**Figure 8. Gate charge vs. gate-emitter voltage**

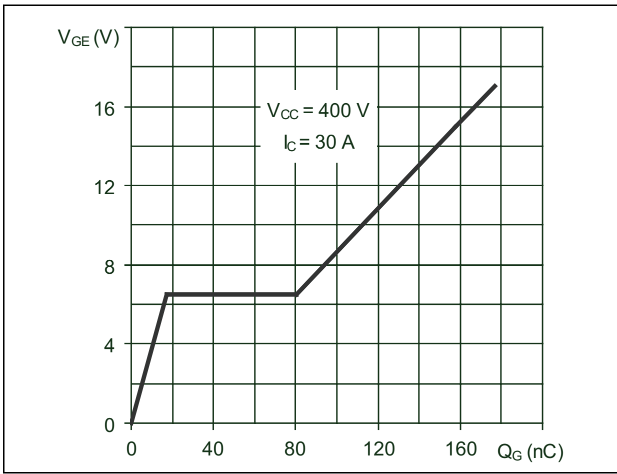



**Figure 9. Capacitance variations**

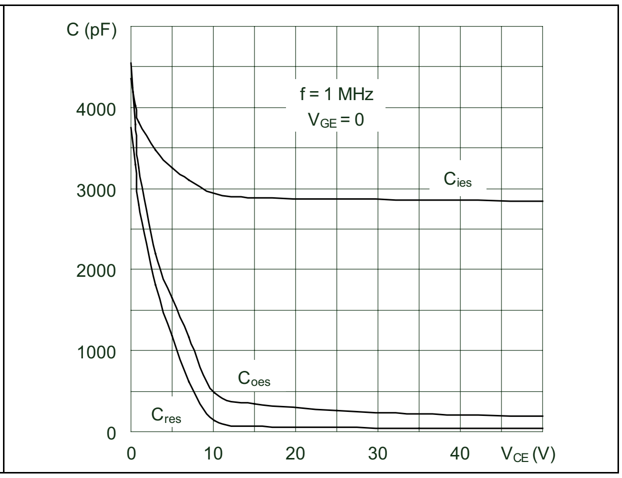



**Figure 10. Switching losses vs temperature**

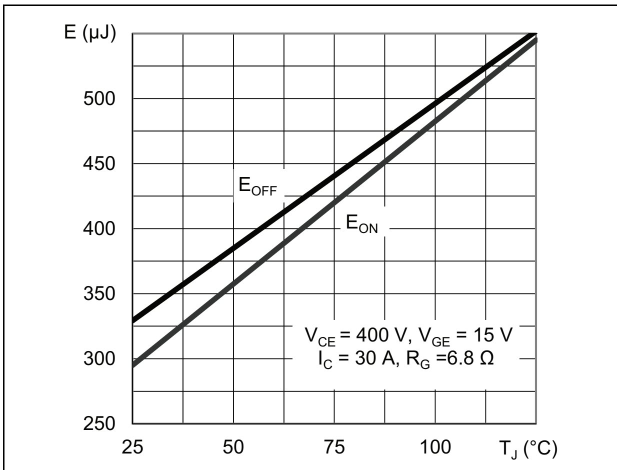



**Figure 11. Switching losses vs. gate resistance**

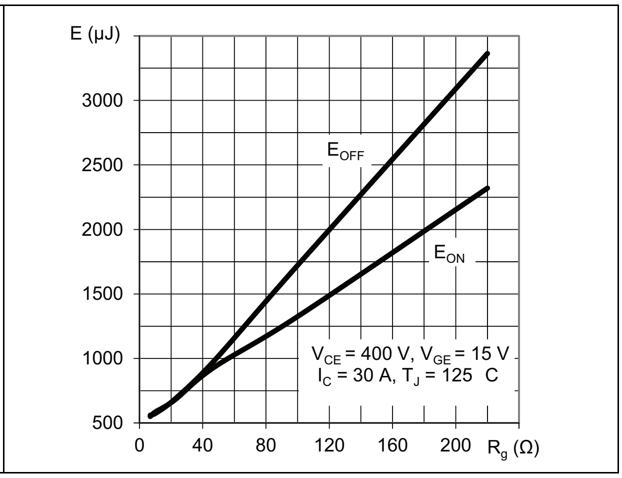



**Figure 12. Switching losses vs. collector current**

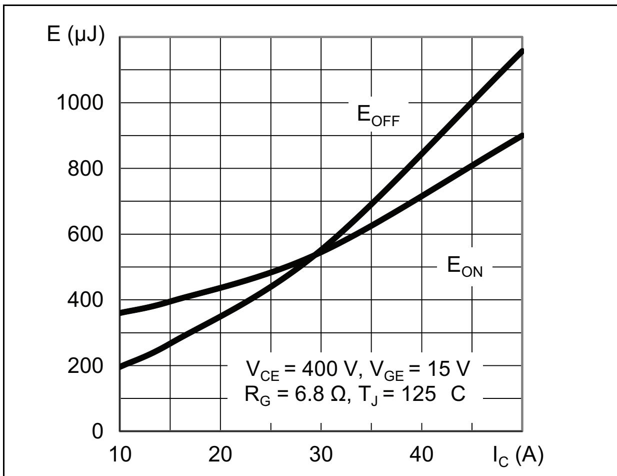



**Figure 13. Turn-off SOA**

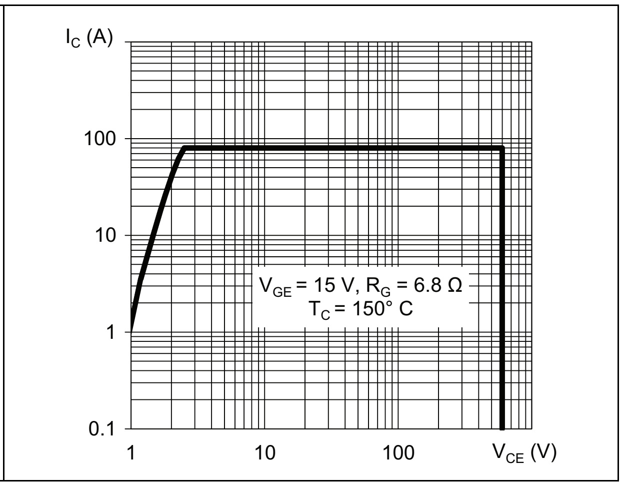
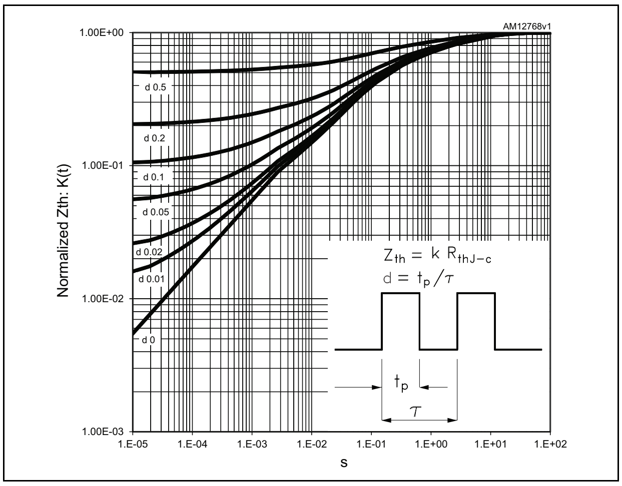


**Figure 14. Thermal impedance**



# 3 Test circuits

**Figure 15. Test circuit for inductive load switching**

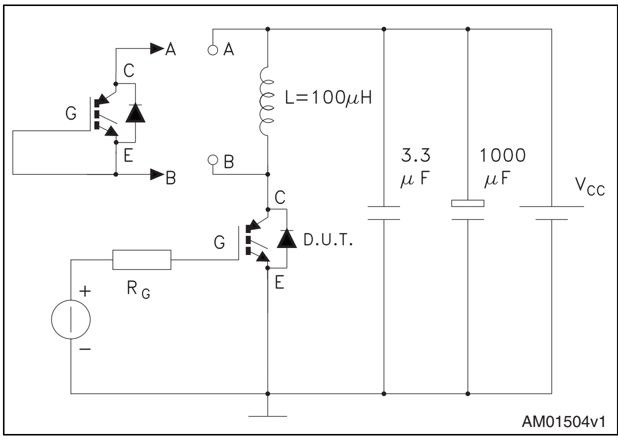



**Figure 16. Gate charge test circuit**

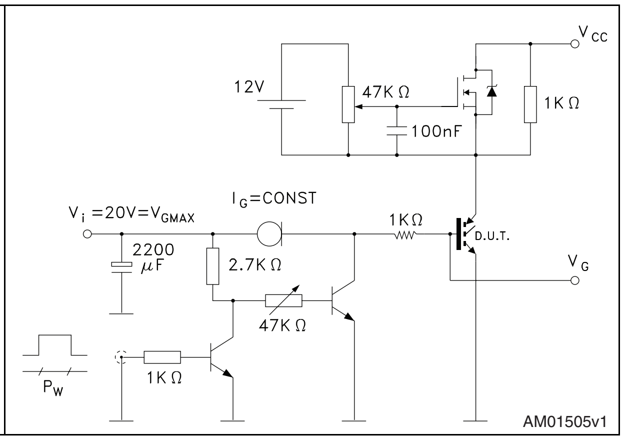
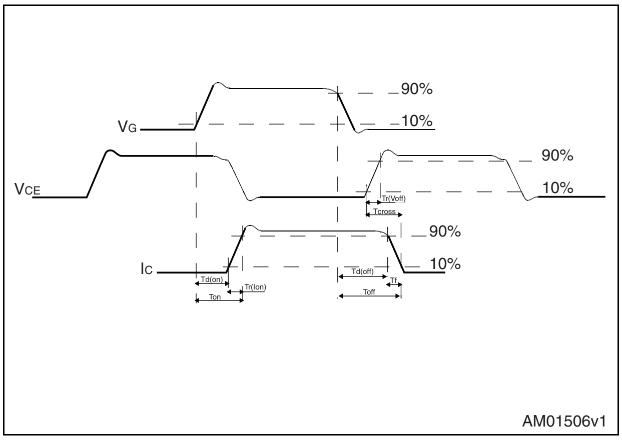



**Figure 17. Switching waveform**



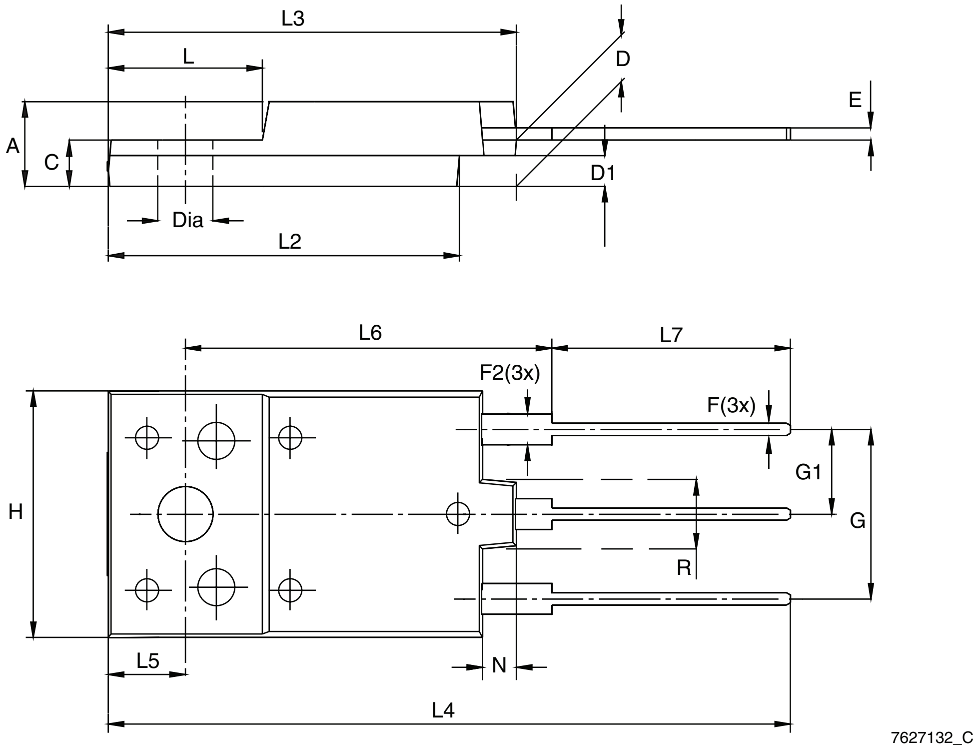
# 4 Package mechanical data

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.

Table 8. TO-3PF mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 5.30 | | 5.70 |
| C | 2.80 | | 3.20 |
| D | 3.10 | | 3.50 |
| D1 | 1.80 | | 2.20 |
| E | 0.80 | | 1.10 |
| F | 0.65 | | 0.95 |
| F2 | 1.80 | | 2.20 |
| G | 10.30 | | 11.50 |
| G1 | | 5.45 | |
| H | 15.30 | | 15.70 |
| L | 9.80 | 10 | 10.20 |
| L2 | 22.80 | | 23.20 |
| L3 | 26.30 | | 26.70 |
| L4 | 43.20 | | 44.40 |
| L5 | 4.30 | | 4.70 |
| L6 | 24.30 | | 24.70 |
| L7 | 14.60 | | 15 |
| N | 1.80 | | 2.20 |
| R | 3.80 | | 4.20 |
| Dia | 3.40 | | 3.80 |

**Figure 18. TO-3PF drawing**



# 5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 24-Jul-2012 | 1 | Initial release. |

**Please Read Carefully:**



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