# STGW50HF60S

## 60 A, 600 V, very low drop IGBT

## Features

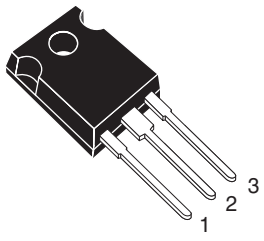
- Very low on-state voltage drop
- Low switching off
- High current capability

## Applications

- PV inverter
- UPS

## Description

STGW50HF60S is a very low drop IGBT based on new advanced planar technology, showing extremely low on-state voltage and limited turn-off losses. The overall performance makes this IGBT ideal in low frequency switches of mixed frequency topologies for PF ≤ 1.




**TO-247**

**Figure 1. Internal schematic diagram**

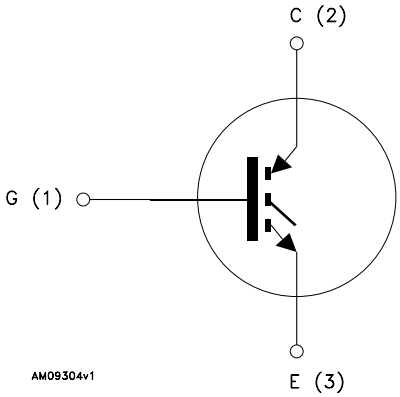



**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STGW50HF60S | GW50HF60S | TO-247 | Tube |

# 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 °C | 110 | A |
| $I_C$ (1) | Continuous collector current at $T_C$ = 100 °C | 60 | A |
| $I_{CL}$ (2) | Turn-off latching current | 60 | A |
| $I_{CP}$ (3) | Pulsed collector current | 130 | A |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 284 | W |
| $T_j$ | 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 $V_{CES}$, $T_j$ =150 °C, $R_G$=10 Ω, $V_{GE}$=15 V
3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance junction-case | 0.44 | °C/W |
| $R_{thJA}$ | 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>$V_{GE}$= 15 V, $I_C$= 30 A, $T_J$ =125 °C | | 1.15<br>1.05 | 1.45 | V<br>V |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$= $V_{GE}$, $I_C$= 250 µA | 3.5 | | 5.7 | V |
| $I_{CES}$ | Collector cut-off current ($V_{GE}$ = 0) | $V_{CE}$ =600 V<br>$V_{CE}$ =600 V, $T_J$=125 °C | | | 50<br>500 | µA<br>µA |
| $I_{GES}$ | Gate-emitter leakage current ($V_{CE}$ = 0) | $V_{GE}$ =± 20 V | | | ± 100 | nA |
| $g_{fs}$ | Forward transconductance | $V_{CE}$ = 15 V, $I_C$= 30 A | | 25 | | S |

**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 | - | 4300<br>400<br>100 | - | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{ge}$<br>$Q_{gc}$ | Total gate charge<br>Gate-emitter charge<br>Gate-collector charge | $V_{CE}$ = 480 V, $I_C$= 30 A,$V_{GE}$=15 V | - | 200<br>27<br>90 | - | 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>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*(see Figure 14)* | - | 50<br>20<br>1280 | - | 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>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_J$ = 125 °C *(see Figure 14)* | - | 47<br>22<br>1100 | - | 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>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*(see Figure 14)* | - | 370<br>220<br>465 | - | 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>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_J$ = 125 °C *(see Figure 14)* | - | 700<br>250<br>800 | - | 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 | $V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*(see Figure 14)* | - | 0.25<br>4.2<br>4.45 | - | mJ<br>mJ<br>mJ |
| Eon (1)<br>$E_{off}$ (2)<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>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_J$ = 125 °C *(see Figure 14)* | - | 0.45<br>7.8<br>8.25 | - | mJ<br>mJ<br>mJ |

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 14*. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C).
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

**Figure 2. Output characteristics**

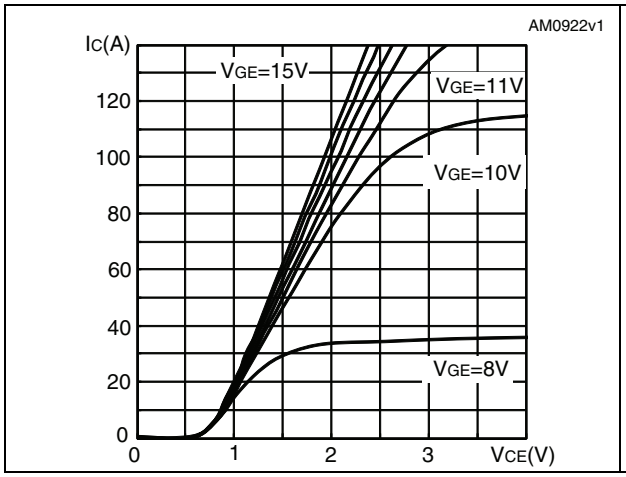



**Figure 3. Transfer characteristics**

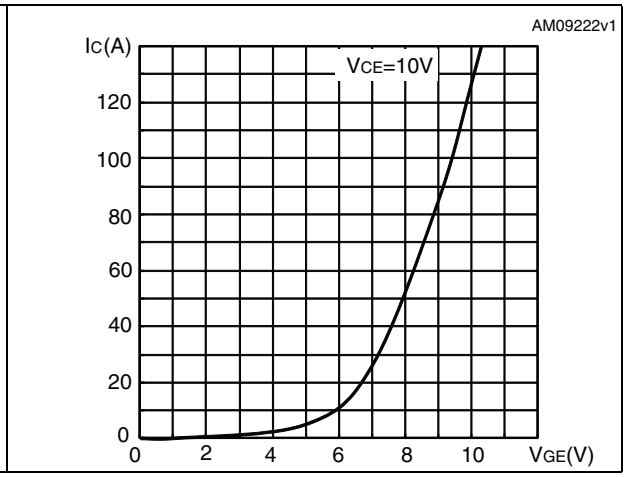



**Figure 4. Collector-emitter on voltage vs. temperature**

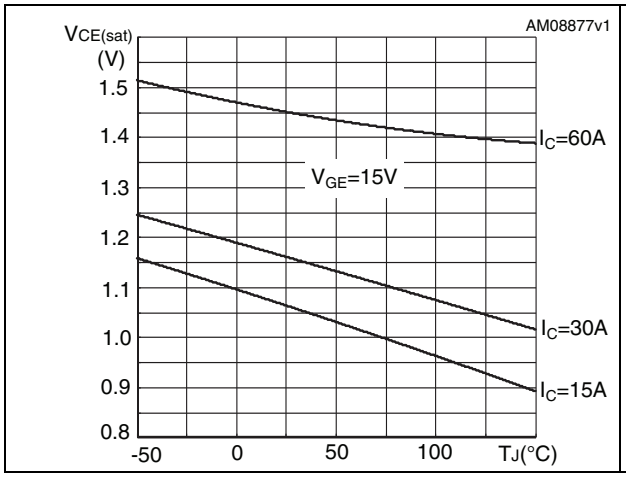



**Figure 5. Collector-emitter on voltage vs. collector current**

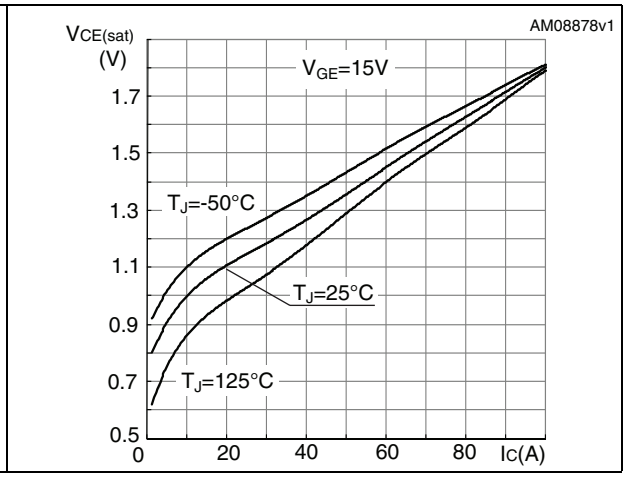



**Figure 6. Breakdown voltage vs. temperature**

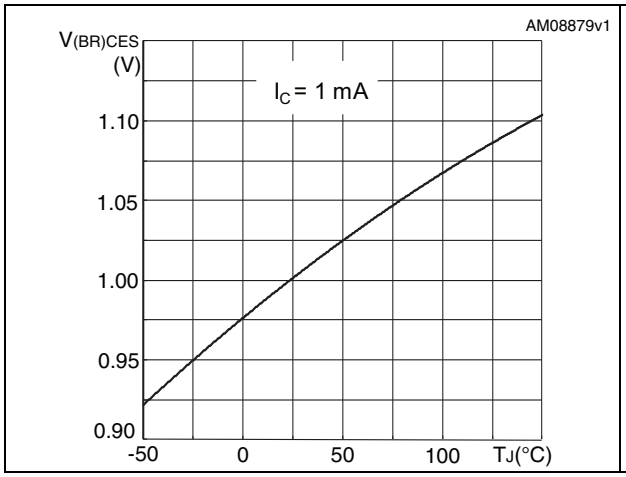



**Figure 7. Gate threshold voltage vs. temperature**

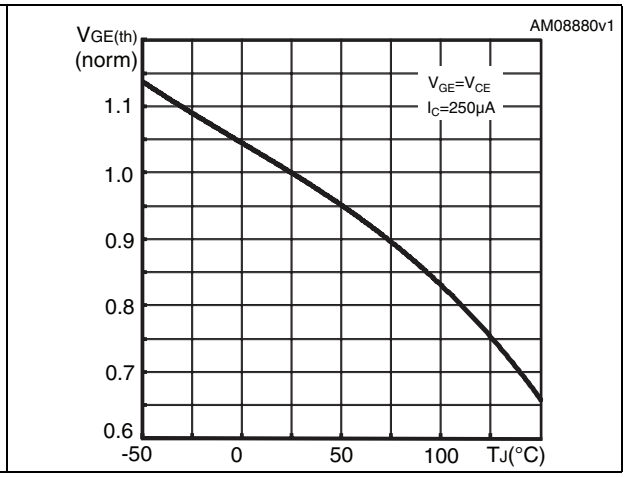


**Figure 8. Gate charge vs. gate-emitter voltage**

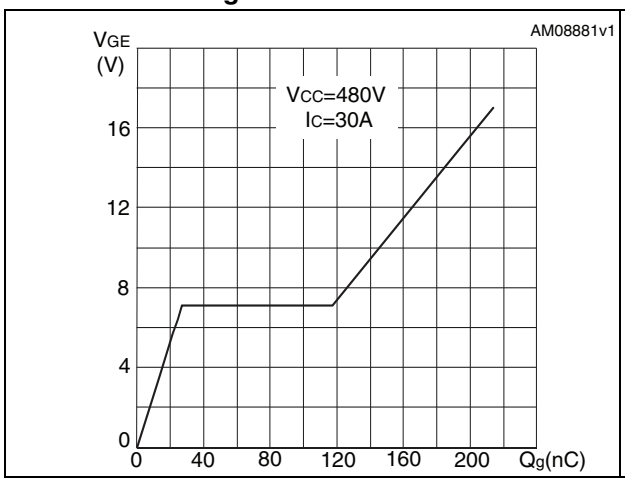



**Figure 9. Capacitance variations**

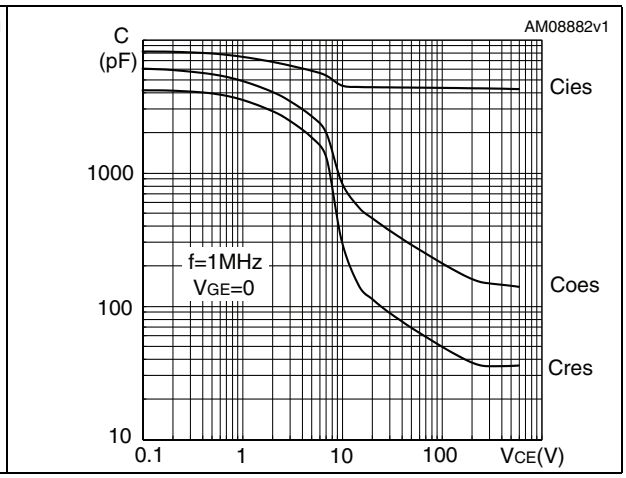



**Figure 10. Switching losses vs. collector current**

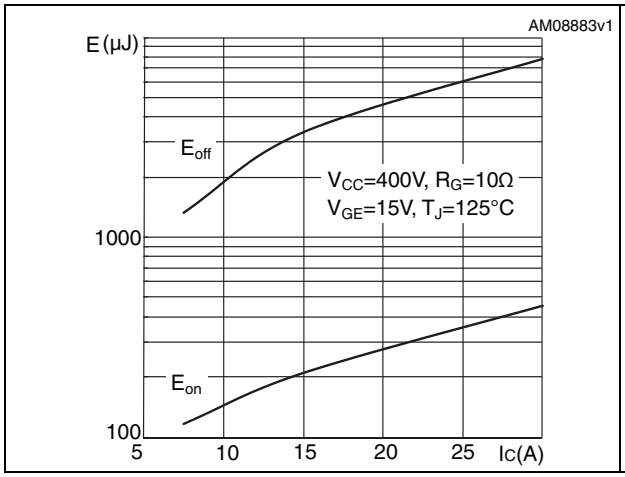



**Figure 11. Switching losses vs. gate resistance**

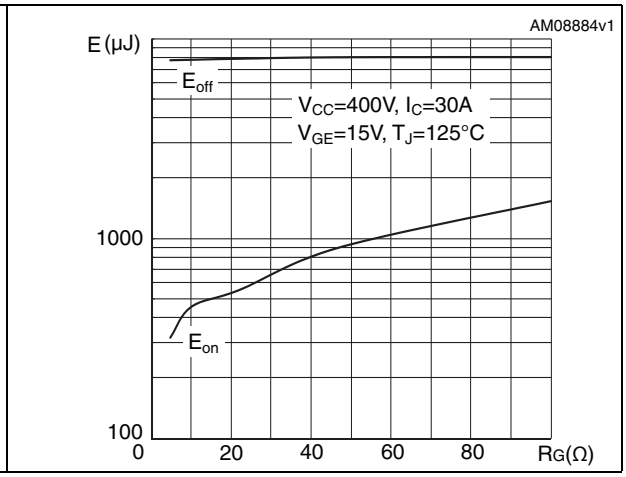



**Figure 12. Switching losses vs. temperature**

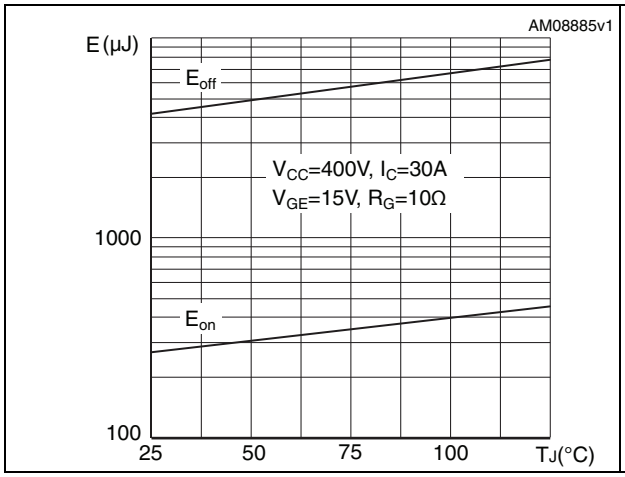
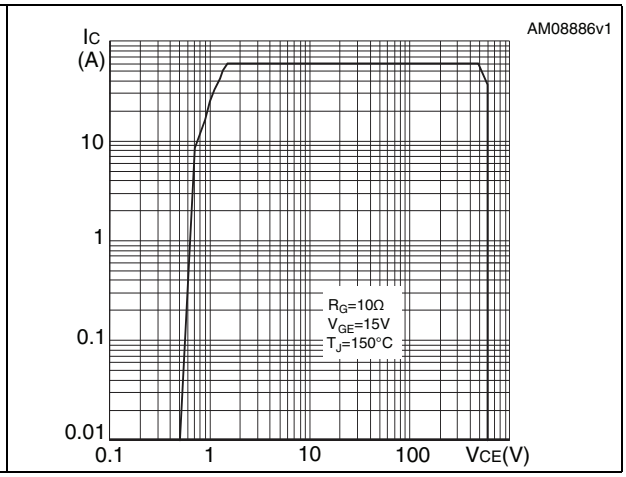



**Figure 13. Turn-off SOA**



# 3 Test circuits

**Figure 14. Test circuit for inductive load switching**

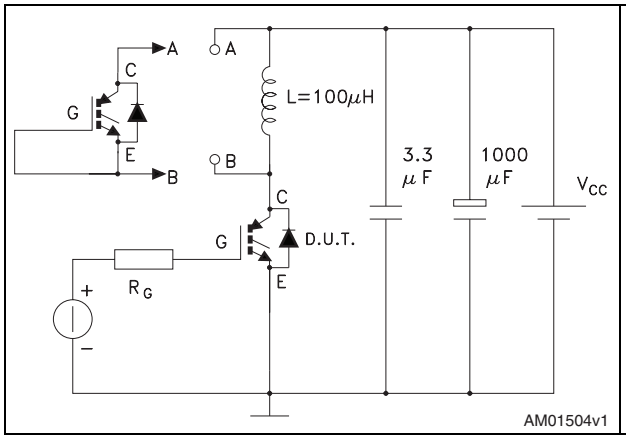



**Figure 15. Gate charge test circuit**

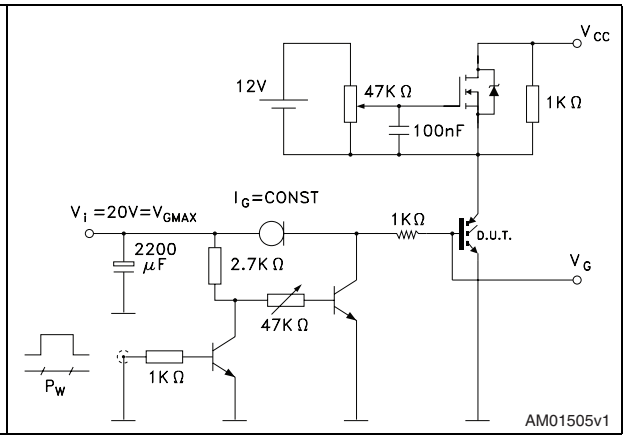
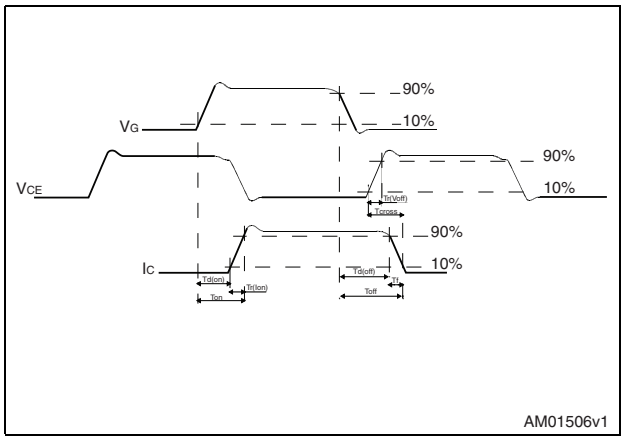



**Figure 16. Switching waveform**



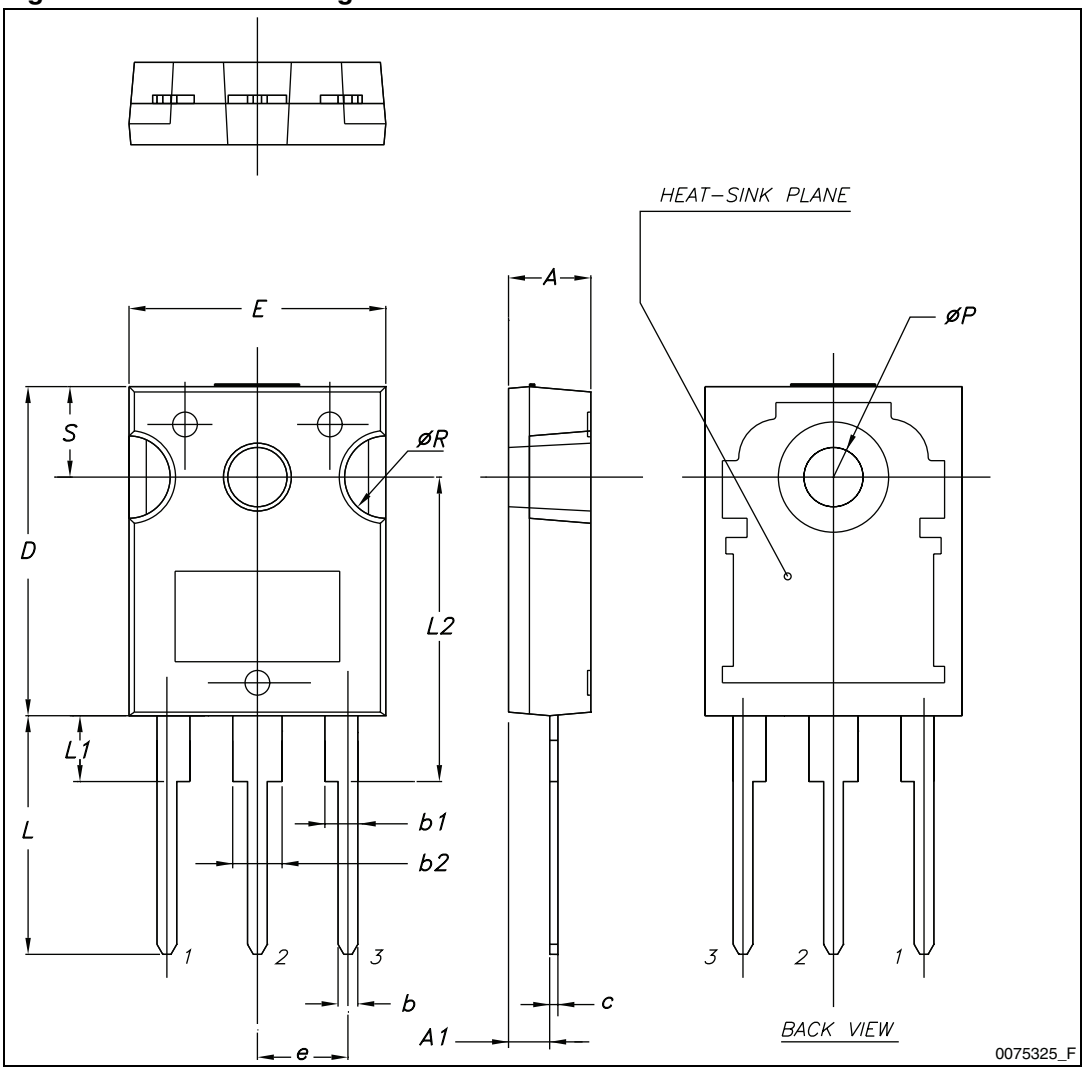
# 4 Package mechanical data

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-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 | |
| ∅P | 3.55 | | 3.65 |
| ∅R | 4.50 | | 5.50 |
| S | | 5.50 | |

**Figure 17. TO-247 drawing**



# 5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 18-Jan-2010 | 1 | Initial release. |
| 21-Jan-2011 | 2 | Document status promoted from preliminary data to datasheet. |

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