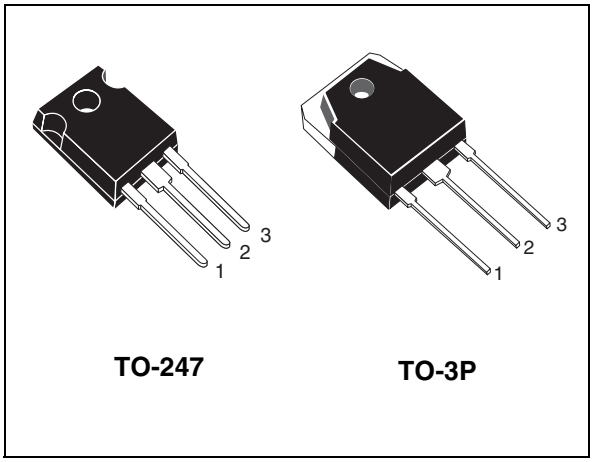
# STGW38IH130D, STGWT38IH130D

## 33 A - 1300 V - very fast IGBT

**Datasheet – production data**

## Features

- Low saturation voltage
- High current capability
- Low switching loss
- Low static and peak forward voltage drop free-wheeling diode




## Applications

- Induction cooking, microwave ovens
- Soft-switching applications

## Description

This device is a very fast IGBT developed using advanced PowerMESH™ technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior. This device is well-suited for resonant or soft-switching applications.

**Figure 1. Internal schematic diagram**

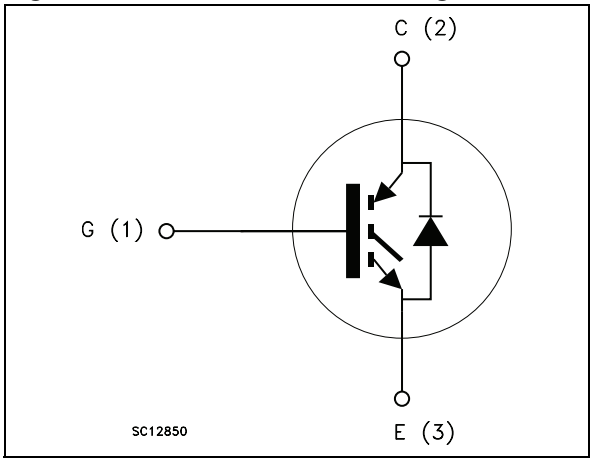



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STGW38IH130D | GW38IH130D | TO-247 long leads | Tube |
| STGWS38IH130D | | TO-247 | |
| STGWT38IH130D | | TO-3P | |

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | TO-3P, TO-247 long leads | TO-247 | |
| $V_{CES}$ | Collector-emitter voltage ($V_{GE}$ = 0) | 1300 | | V |
| $I_C$ (1) | Continuous collector current at $T_C$ = 25 °C | 63 | 55 | A |
| $I_C$ (1) | Continuous collector current at $T_C$ = 100 °C | 33 | 25 | A |
| $I_{CL}$ (2) | Turn-off latching current | 40 | | A |
| $I_{CP}$ (3) | Pulsed collector current | 125 | | A |
| $V_{GE}$ | Gate-emitter voltage | ±25 | | V |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 250 | 180 | 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. $V_{clamp}$ = 960 V, $T_j$ =150 °C, $R_G$=10 Ω, $V_{GE}$=15 V
3. Pulse width limited by maximum permissible junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | TO-3P, TO-247 long leads | TO-247 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case IGBT | 0.5 | 0.7 | °C/W |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case diode | 2 | 2.1 | °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 | 1300 | | | 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 | | 2.1<br>2.0 | 2.8 | 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) | $V_{CE}$ =1300 V<br>$V_{CE}$ =1300 V, $T_J$=125 °C | | | 1<br>10 | mA<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 | | 20 | | S |
| $V_F$ | Diode forward voltage | $I_F$ = 20 A<br>$I_F$ = 20 A, $T_J$ = 125 °C | | <br>1.3 | 1.9<br>1.7 | V<br>V |

1. Pulsed: 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 | - | 2900<br>155<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 | - | 127<br>18<br>50 | - | nC<br>nC<br>nC |

**Table 6. Inductive load switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_r(V_{off})$<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>*(see Figure 16)* | - | 102<br>284<br>180 | - | 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 *(see Figure 16)* | - | 200<br>424<br>316 | - | ns<br>ns<br>ns |

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

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{off}$ (1) | Turn-off switching losses | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>*(see Figure 16)* | - | 3.4 | - | mJ |
| $E_{off}$ (1) | Turn-off switching losses | $V_{CC}$ = 960 V, $I_C$ = 20 A<br>$R_G$= 10 Ω, $V_{GE}$= 15 V,<br>$T_J$= 125 °C *(see Figure 16)* | - | 6.4 | - | mJ |

1. Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

**Figure 2. Output characteristics**

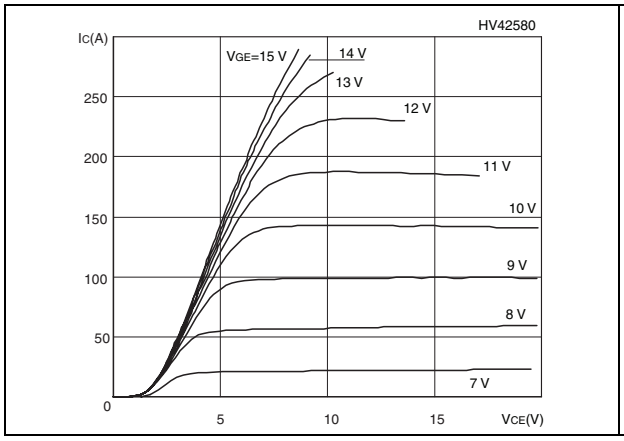



**Figure 3. Transfer characteristics**

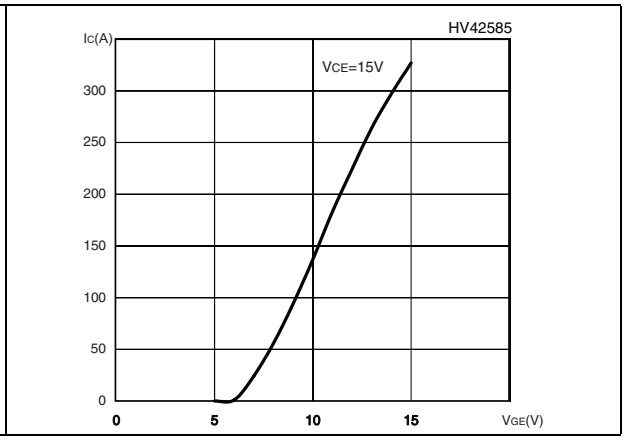



**Figure 4. Transconductance**

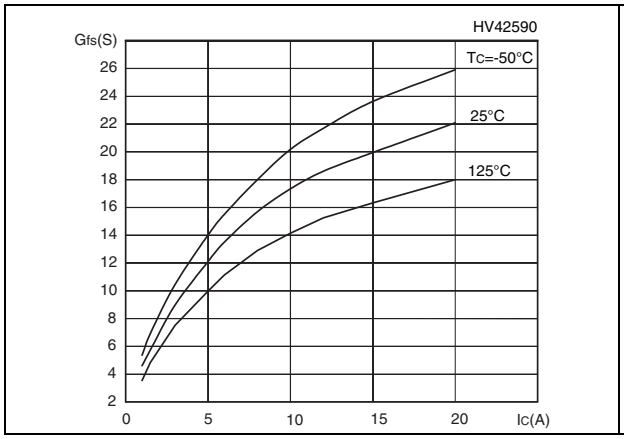



**Figure 5. Collector-emitter on voltage vs. temperature**

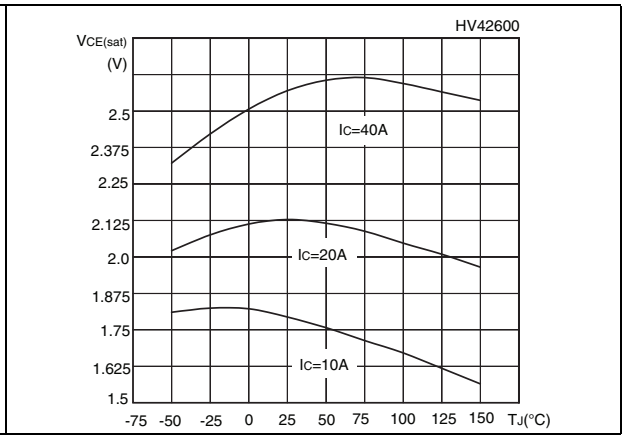



**Figure 6. Normalized breakdown voltage vs. temperature**

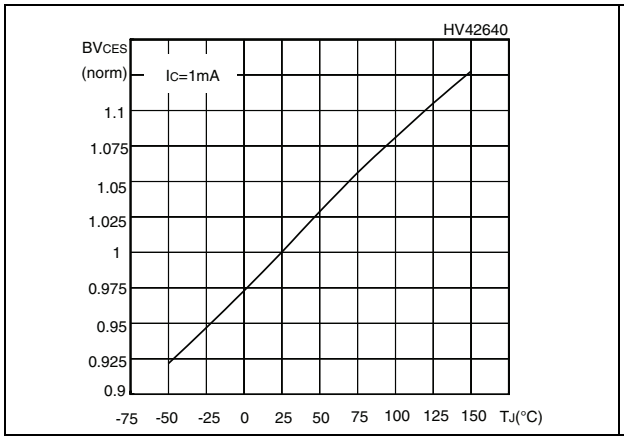



**Figure 7. Gate-charge vs. gate-emitter**

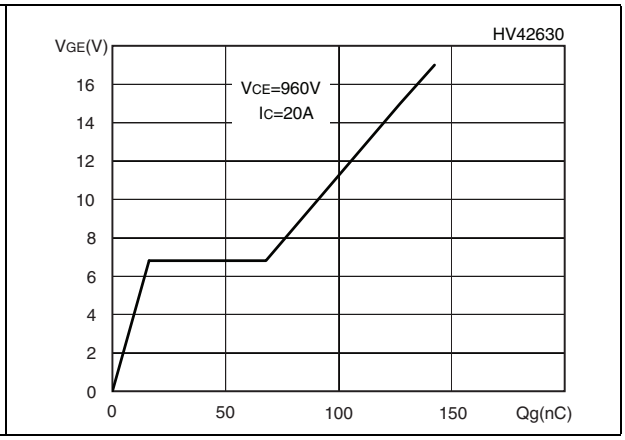


**Figure 8. Normalized gate threshold voltage vs. temperature**

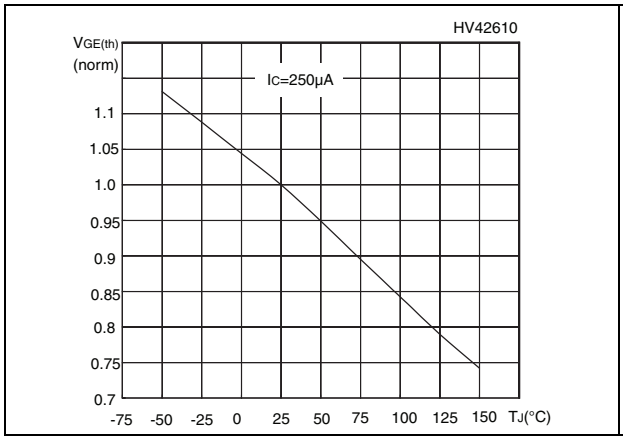



**Figure 9. Collector-emitter on voltage vs. collector current**

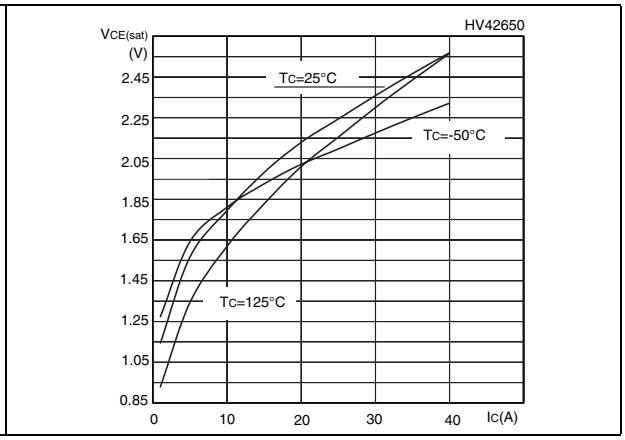



**Figure 10. Switching losses vs. temperature**

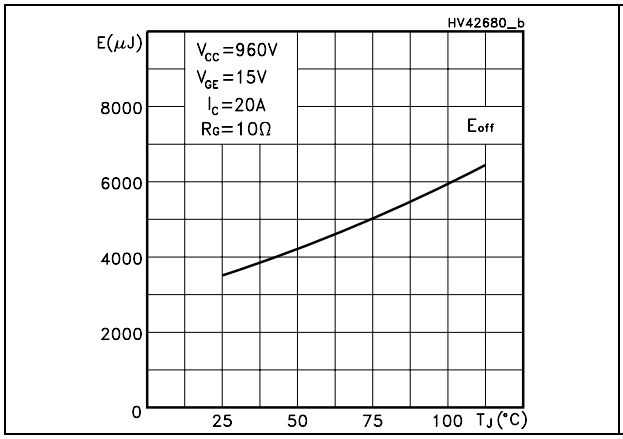



**Figure 11. Switching losses vs. gate resistance**

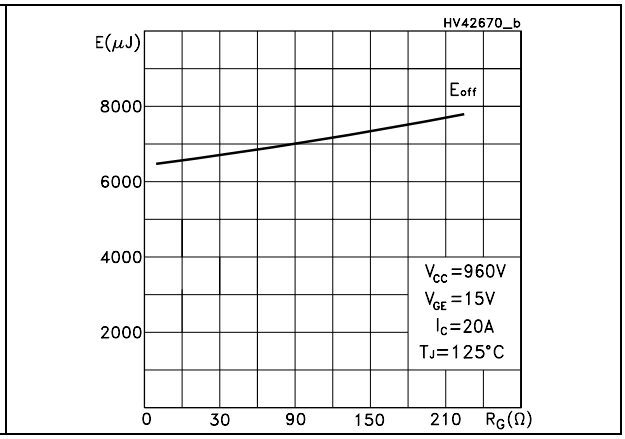



**Figure 12. Switching losses vs. collector current**

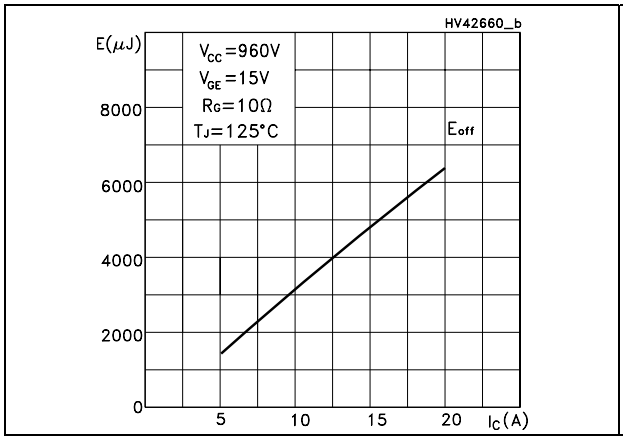



**Figure 13. RBSOA**

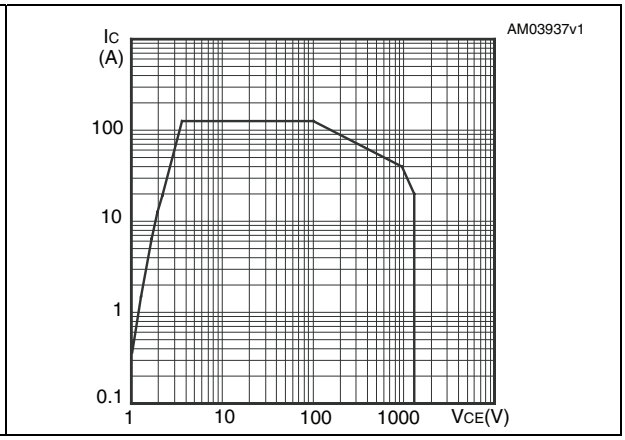


**Figure 14. Emitter-collector diode characteristics**

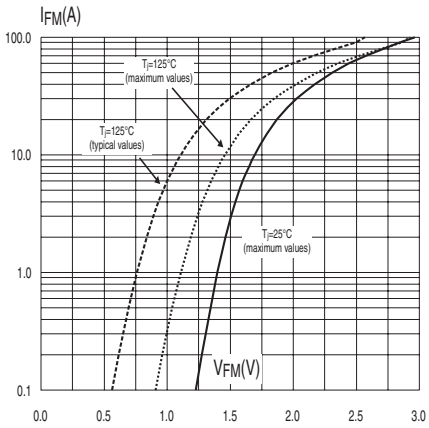
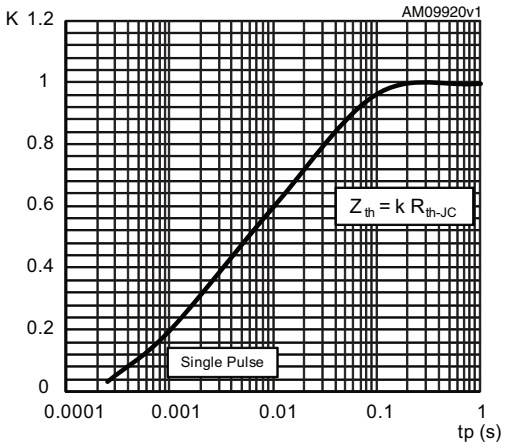



**Figure 15. Thermal impedance**



# 3 Test circuits

**Figure 16. Test circuit for inductive load switching**

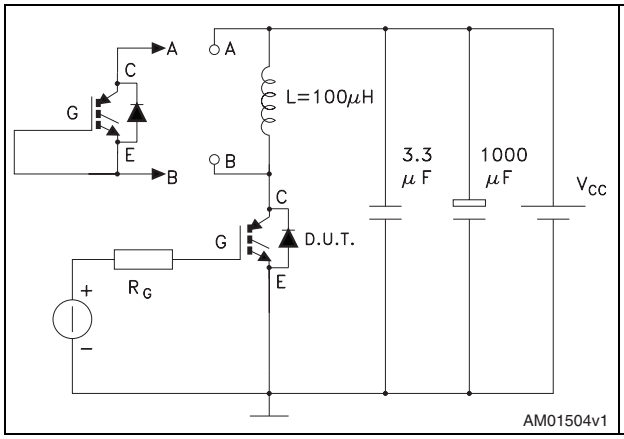



**Figure 17. Gate charge test circuit**

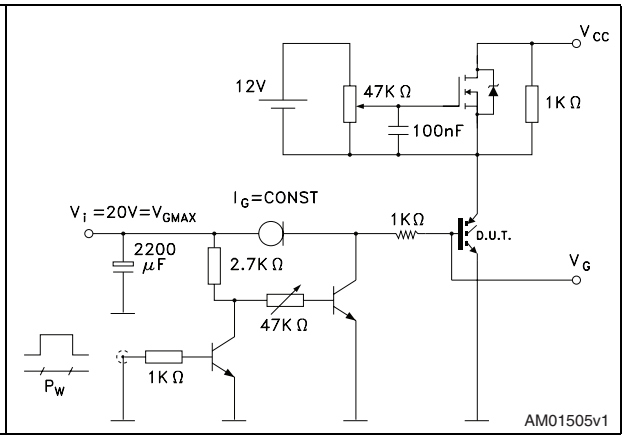
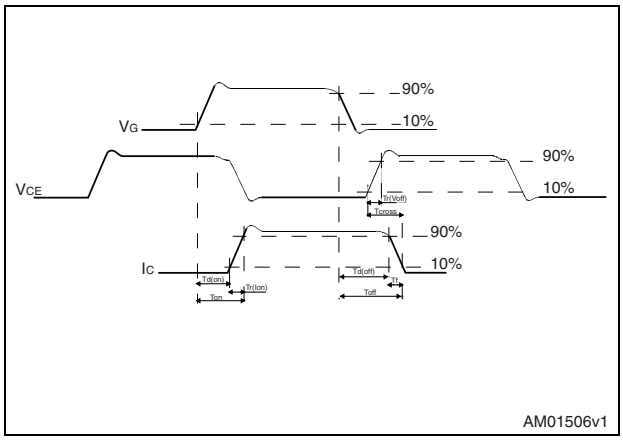



**Figure 18. Switching waveform**



# 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 | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ∅P | 3.55 | | 3.65 |
| ∅R | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

**Figure 19. TO-247 drawing**

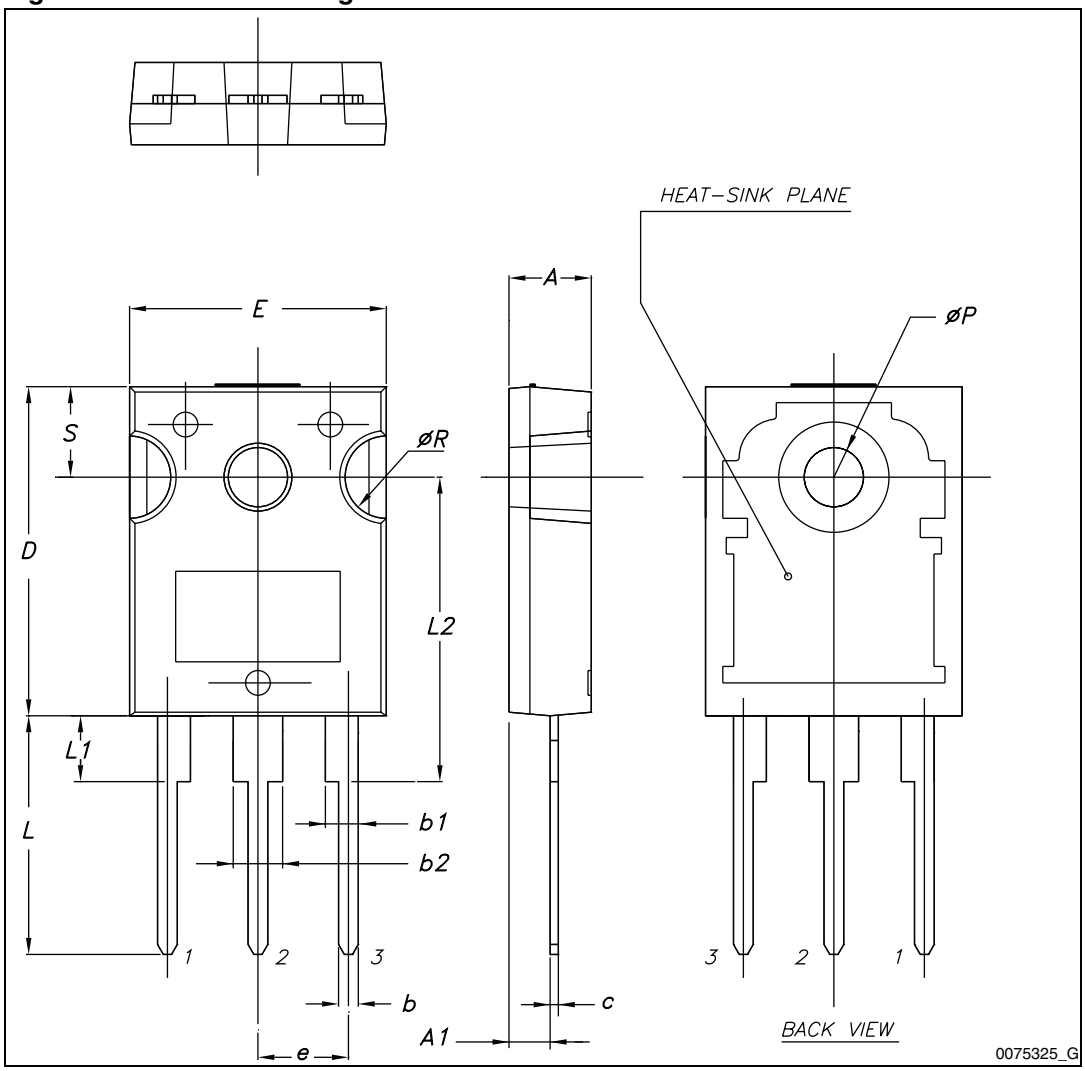


Table 9. TO-247 long leads mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.90 | | 5.15 |
| D | 1.85 | | 2.10 |
| E | 0.55 | | 0.67 |
| F | 1.07 | | 1.32 |
| F1 | 1.90 | | 2.38 |
| F2 | 2.87 | | 3.38 |
| G | | 10.90 BSC | |
| H | 15.77 | | 16.02 |
| L | 20.82 | | 21.07 |
| L1 | 4.16 | | 4.47 |
| L2 | 5.49 | | 5.74 |
| L3 | 20.05 | | 20.30 |
| L4 | 3.68 | | 3.93 |
| L5 | 6.04 | | 6.29 |
| M | 2.27 | | 2.52 |
| V | | 10° | |
| V1 | | 3° | |
| V3 | | 20° | |
| Dia. | 3.55 | | 3.66 |

**Figure 20. TO-247 long leads drawing**

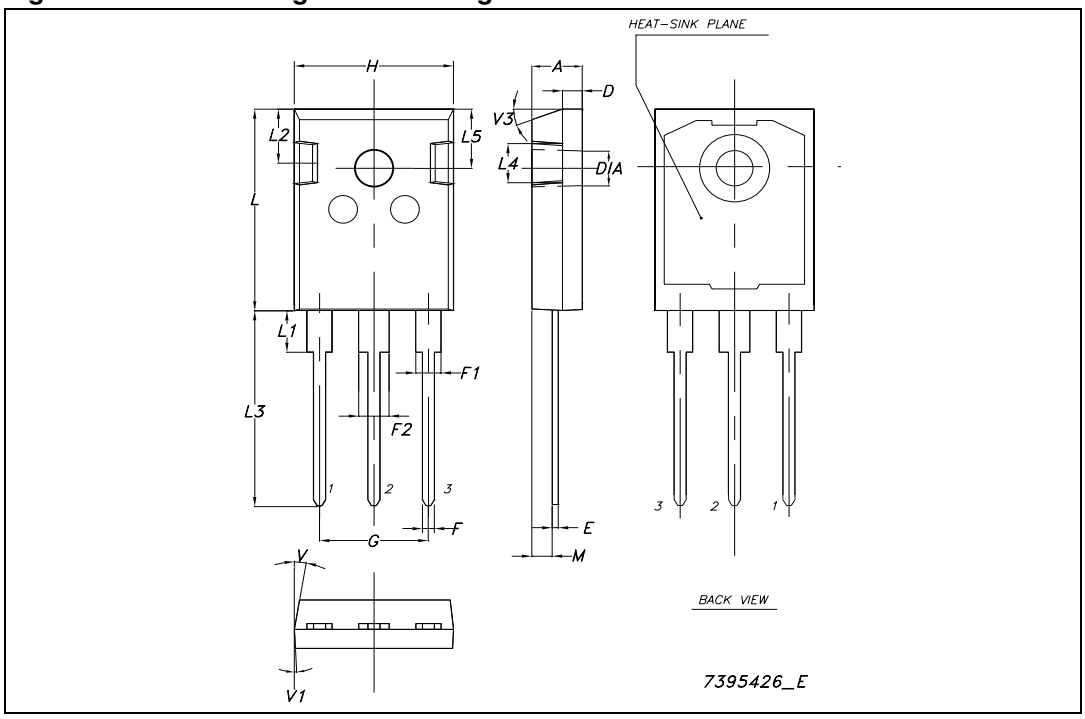
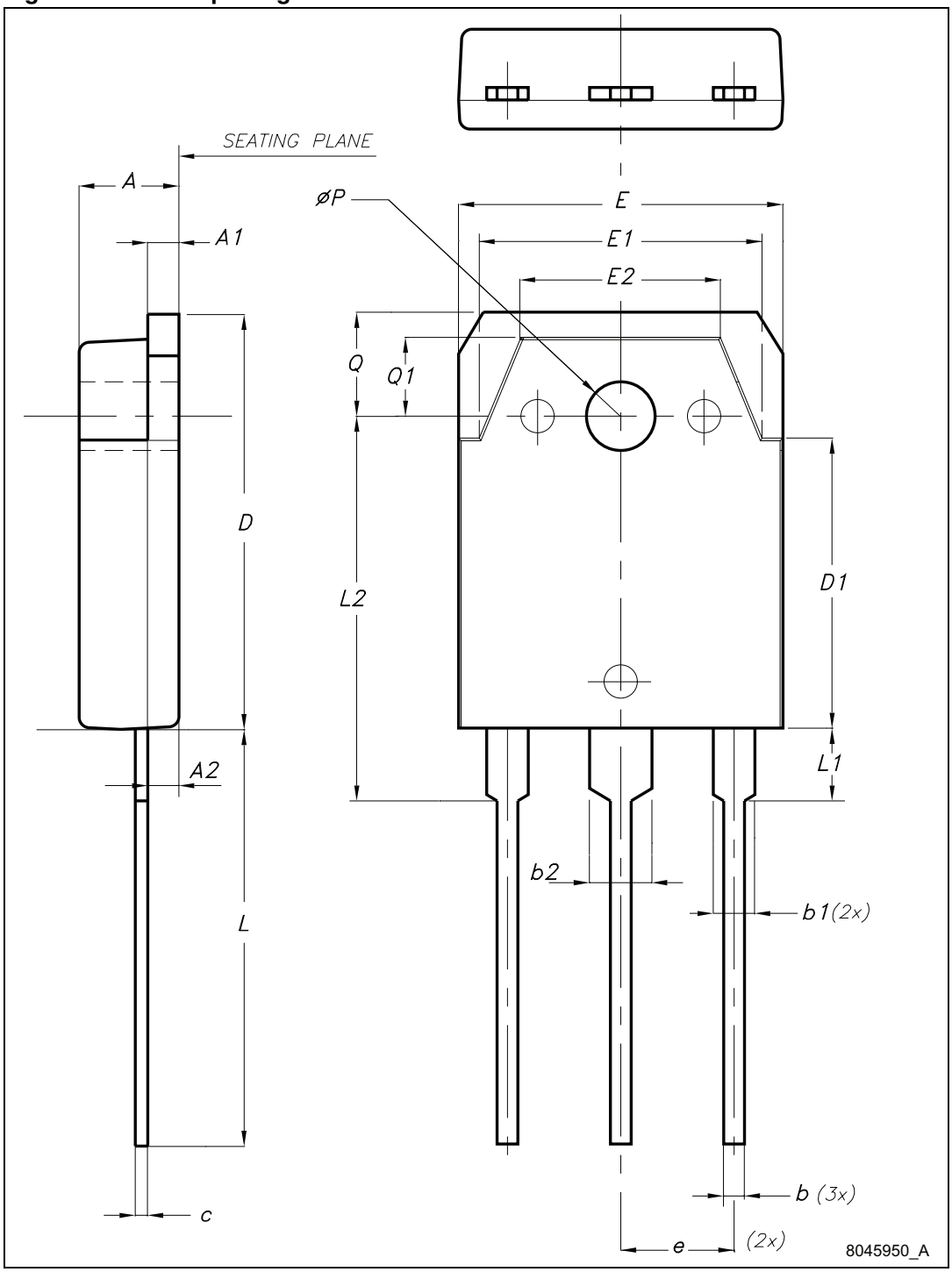


**Table 10. TO-3P mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.60 | | 5 |
| A1 | 1.45 | 1.50 | 1.65 |
| A2 | 1.20 | 1.40 | 1.60 |
| b | 0.80 | 1 | 1.20 |
| b1 | 1.80 | | 2.20 |
| b2 | 2.80 | | 3.20 |
| c | 0.55 | 0.60 | 0.75 |
| D | 19.70 | 19.90 | 20.10 |
| D1 | | 13.90 | |
| E | 15.40 | | 15.80 |
| E1 | | 13.60 | |
| E2 | | 9.60 | |
| e | 5.15 | 5.45 | 5.75 |
| L | 19.50 | 20 | 20.50 |
| L1 | | 3.50 | |
| L2 | 18.20 | 18.40 | 18.60 |
| øP | 3.10 | | 3.30 |
| Q | | 5 | |
| Q1 | | 3.80 | |

**Figure 21. TO-3P package dimensions**



# 5 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 11-May-2009 | 1 | Initial release |
| 16-Jul-2009 | 2 | Document status promoted from preliminary data to datasheet |
| 05-Jul-2011 | 3 | Added: *Figure 15 on page 8* and new package mechanical data *Table 10 on page 14*, *Figure 21 on page 15*. |
| 04-Sep-2012 | 4 | Updated: *Table 1 on page 1*, TO-247 mechanical data *Table 8 on page 10* and *Figure 19 on page 11*. |

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