# STGW15H120F2, STGWA15H120F2

## Trench gate field-stop IGBT, H series 1200 V, 15 A high speed

**Datasheet - production data**

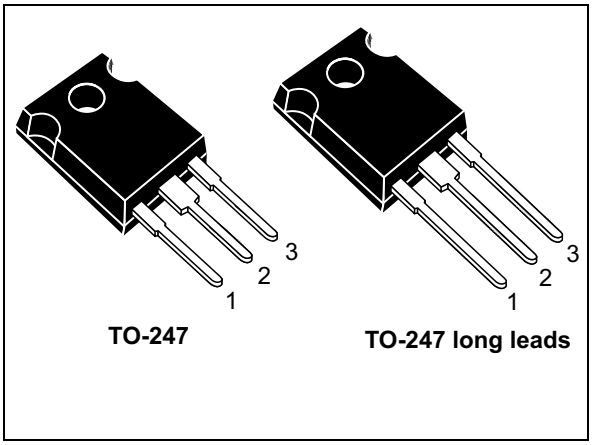
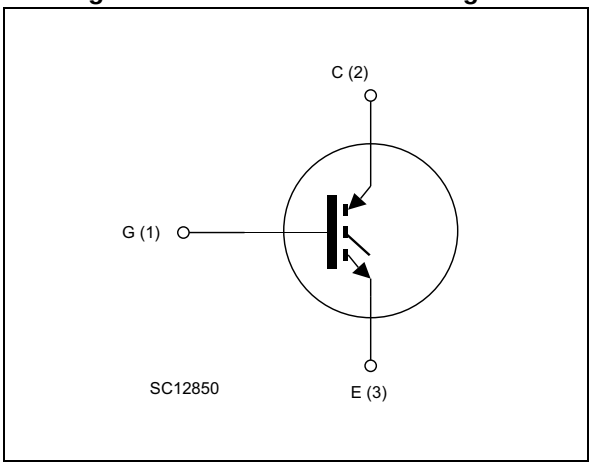



**Figure 1. Internal schematic diagram**




## Features

- Maximum junction temperature: $T_J$ = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 2.1 V (typ.) @ $I_C$ = 15 A
- 5 µs minimum short-circuit withstand time at $T_J$=150 °C
- Safe paralleling
- Low thermal resistance

## Applications

- Uninterruptible power supply
- Welding machines
- Photovoltaic inverters
- Power factor correction
- High frequency converters

## Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the improved H series of IGBTs, which represent an optimum compromise between conduction and switching loss to maximize the efficiency of high frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

**Table 1. Device summary**

| Order code | Marking | Package | Packing |
|---|---|---|---|
| STGW15H120F2 | G15H120F2 | TO-247 | Tube |
| STGWA15H120F2 | G15H120F2 | 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 |
| $I_C$ | Continuous collector current at $T_C$ = 25 °C | 30 | A |
| $I_C$ | Continuous collector current at $T_C$ = 100 °C | 15 | A |
| $I_{CP}$(1) | Pulsed collector current | 60 | A |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 259 | W |
| $T_{STG}$ | Storage temperature range | -55 to 150 | °C |
| $T_J$ | Operating junction temperature | -55 to 175 | °C |

1. Pulse width limited by maximum junction temperature.

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance junction-case | 0.58 | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50 | °C/W |

# 2 Electrical characteristics

$T_J$ = 25 °C unless otherwise specified.

**Table 4. Static characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage ($V_{GE}$ = 0) | $I_C$ = 2 mA | 1200 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 15 A | | 2.1 | 2.6 | V |
| | | $V_{GE}$ = 15 V, $I_C$ = 15 A $T_J$ = 125 °C | | 2.4 | | |
| | | $V_{GE}$ = 15 V, $I_C$ = 15 A $T_J$ = 175 °C | | 2.5 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 500 µA | 5 | 6 | 7 | V |
| $I_{CES}$ | Collector cut-off current ($V_{GE}$ = 0) | $V_{CE}$ = 1200 V | | | 25 | µA |
| $I_{GES}$ | Gate-emitter leakage current ($V_{CE}$ = 0) | $V_{GE}$ = ± 20 V | | | ± 250 | nA |

**Table 5. Dynamic characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 25 V, f = 1 MHz, $V_{GE}$ = 0 | - | 1300 | - | pF |
| $C_{oes}$ | Output capacitance | | - | 105 | - | pF |
| $C_{res}$ | Reverse transfer capacitance | | - | 32 | - | pF |
| $Q_g$ | Total gate charge | $V_{CC}$ = 960 V, $I_C$ = 15 A, $V_{GE}$ = 15 V, see *Figure 23* | - | 67 | - | nC |
| $Q_{ge}$ | Gate-emitter charge | | - | 8 | - | nC |
| $Q_{gc}$ | Gate-collector charge | | - | 38 | - | nC |

**Table 6. Switching characteristics (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 600 V, $I_C$ = 15 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, see *Figure 22* | - | 23 | - | ns |
| $t_r$ | Current rise time | | - | 7.4 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 1621 | - | A/µs |
| $t_{d(off)}$ | Turn-off delay time | | | 111 | - | ns |
| $t_f$ | Current fall time | | - | 111 | - | ns |
| $E_{on}$(1) | Turn-on switching loss | | - | 0.38 | - | mJ |
| $E_{off}$(2) | Turn-off switching loss | | - | 0.37 | - | mJ |
| $E_{ts}$ | Total switching loss | | - | 0.75 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 600 V, $I_C$ = 15 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, $T_J$ = 175 °C, see *Figure 22* | - | 23.5 | - | ns |
| $t_r$ | Current rise time | | - | 8 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 1525 | - | A/µs |
| $t_{d(off)}$ | Turn-off delay time | | - | 118 | - | ns |
| $t_f$ | Current fall time | | - | 253 | - | ns |
| $E_{on}$(1) | Turn-on switching loss | | - | 0.65 | - | mJ |
| $E_{off}$(2) | Turn-off switching loss | | - | 0.93 | - | mJ |
| $E_{ts}$ | Total switching loss | | - | 1.58 | - | mJ |
| $t_{sc}$ | Short-circuit withstand time | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V, $T_J$ = 150 °C, | 5 | | - | µs |

1. Energy loss include reverse recovery of the external diode. The diode is the same of the co-packed STGW15H120DF2
2. Turn-off loss include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

**Figure 2. Power dissipation vs. case temperature**

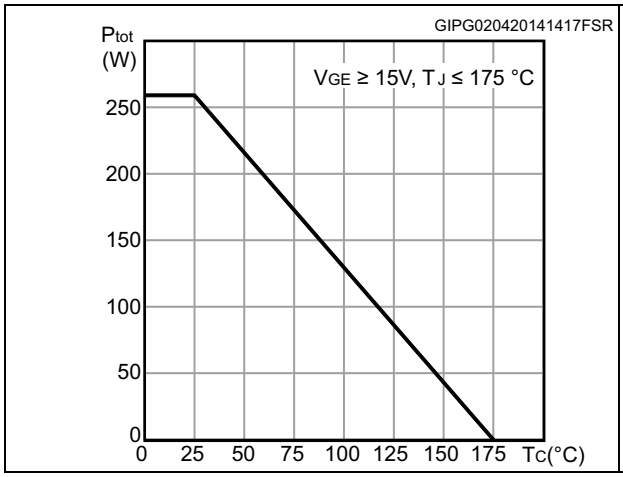



**Figure 3. Collector current vs. case temperature**

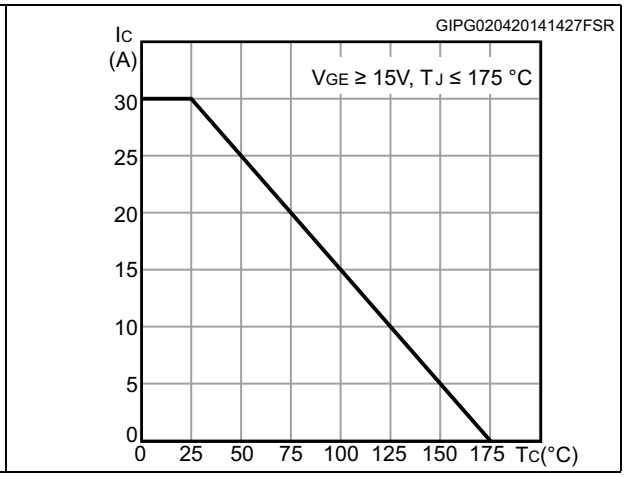



**Figure 4. Output characteristics ($T_J$ = 25°C)**

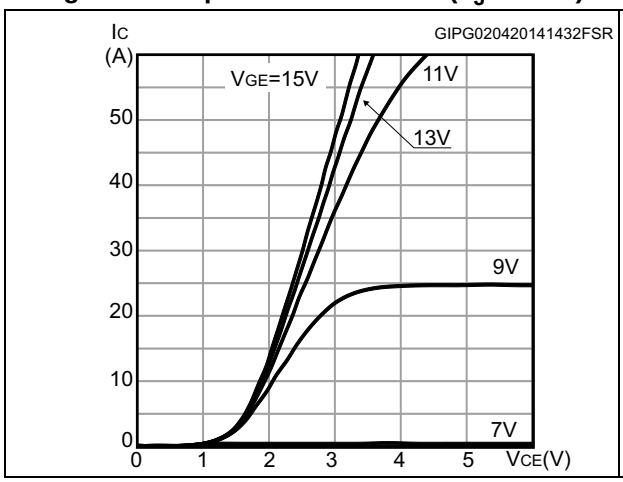



**Figure 5. Output characteristics ($T_J$ = 175°C)**

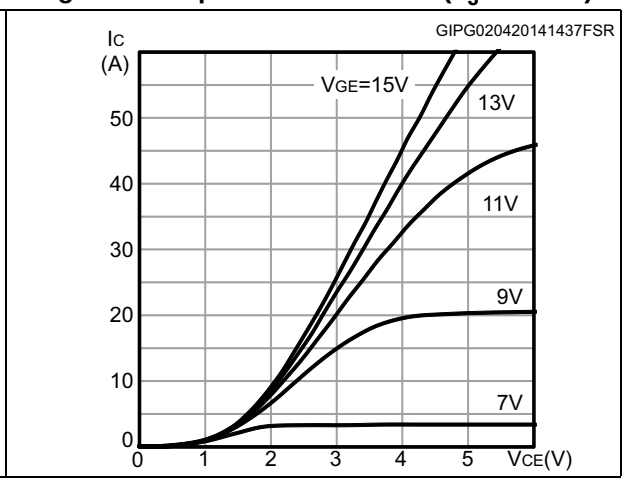



**Figure 6. $V_{CE(sat)}$ vs. junction temperature**

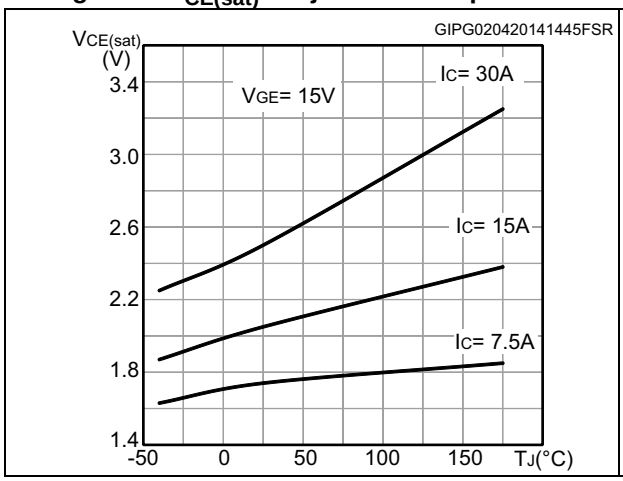



**Figure 7. $V_{CE(sat)}$ vs. collector current**

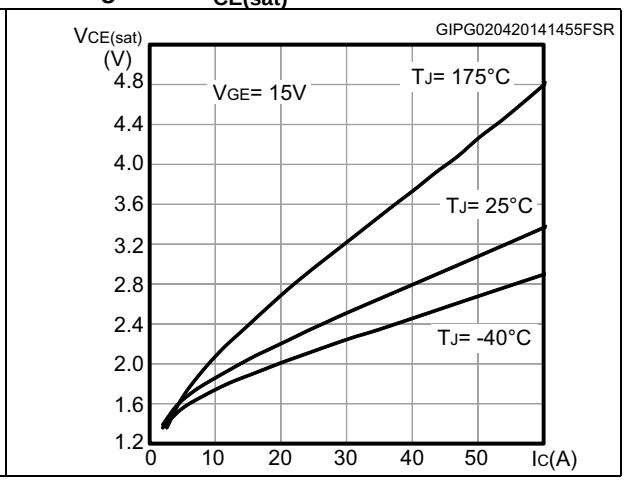


**Figure 8. Collector current vs. switching frequency**

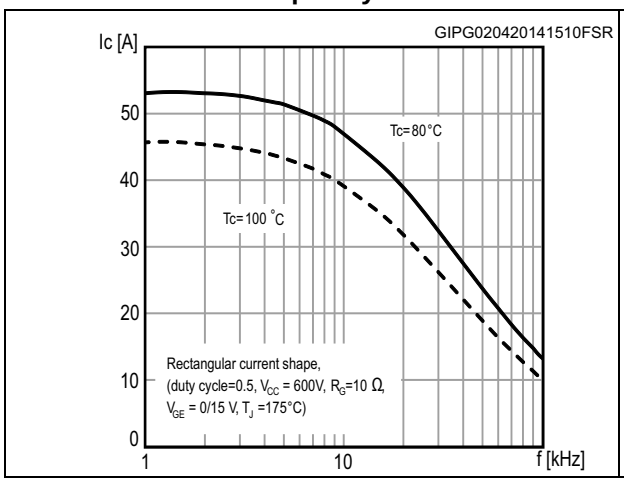



**Figure 9. Forward bias safe operating area**

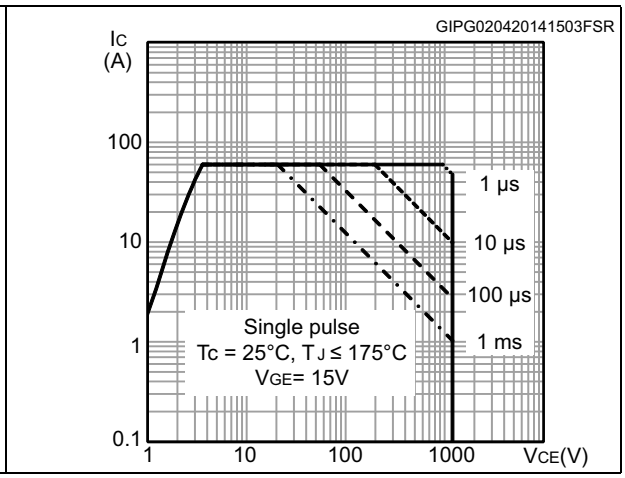



**Figure 10. Transfer characteristics**

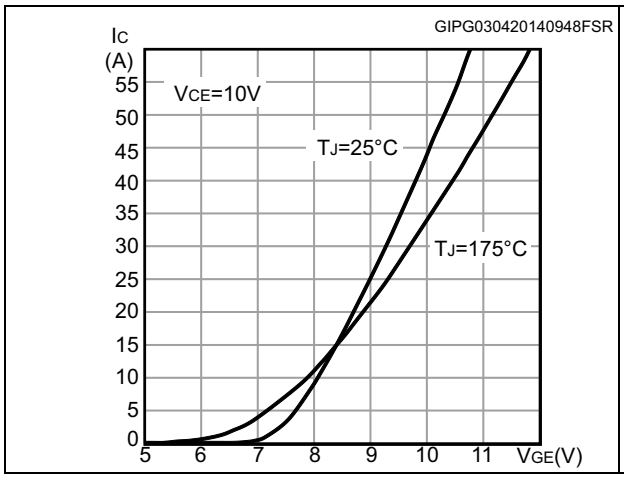



**Figure 11. Normalized $V_{GE(th)}$ vs junction temperature**

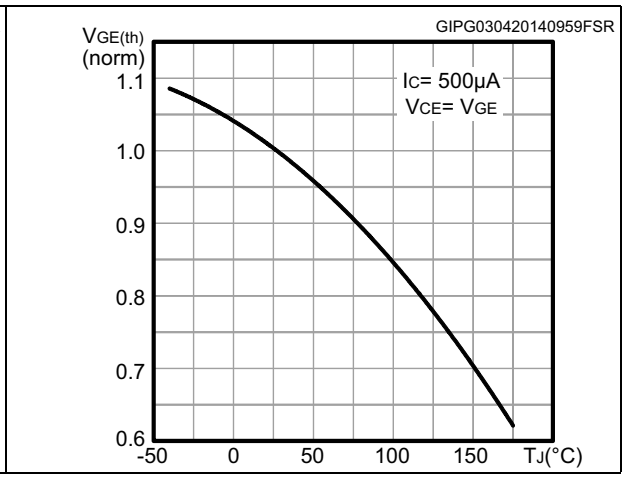



**Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature**

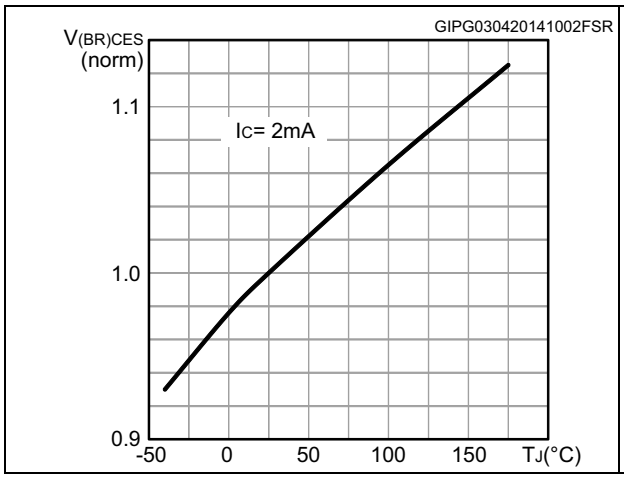



**Figure 13. Capacitance variation**

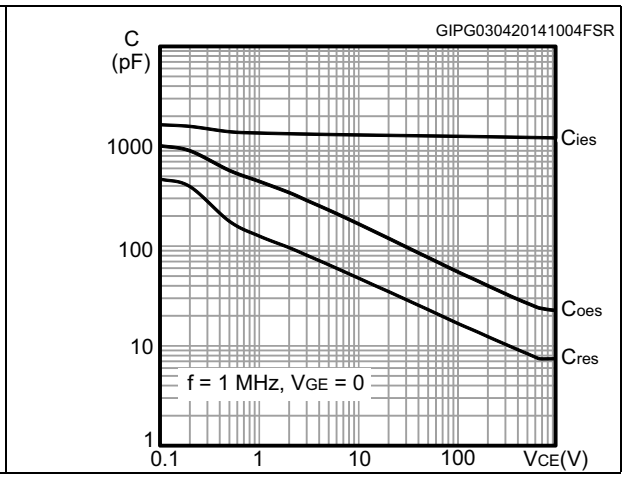


**Figure 14. Gate charge vs. gate-emitter voltage**

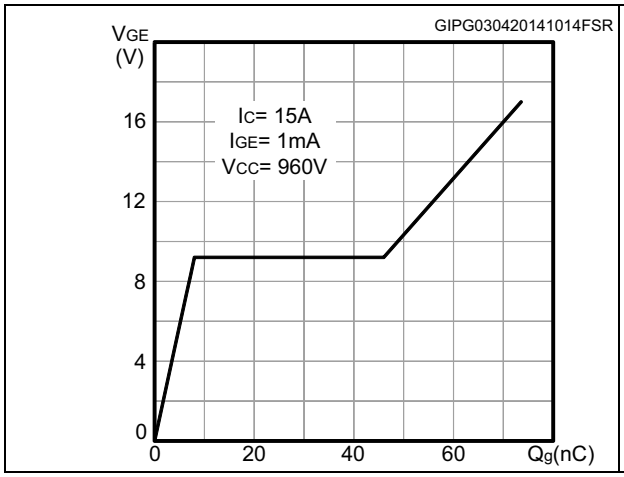



**Figure 15. Switching loss vs collector current**

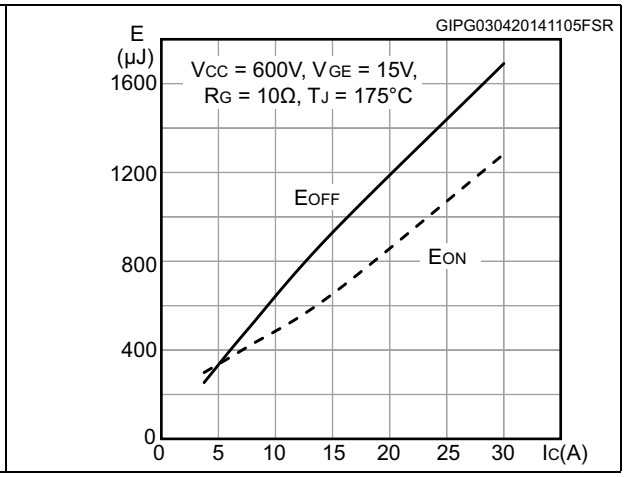



**Figure 16. Switching loss vs gate resistance**

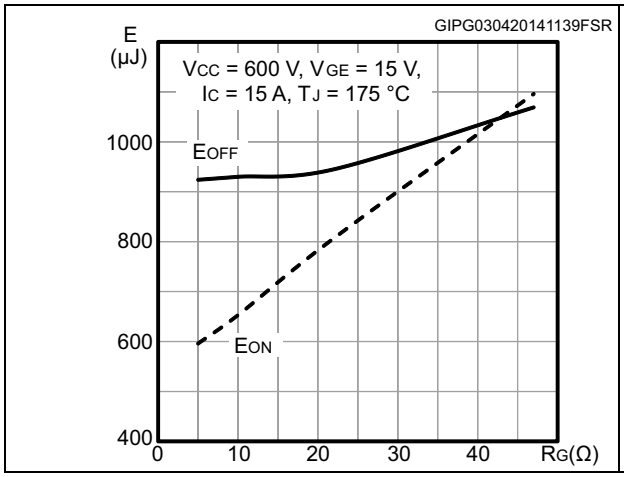



**Figure 17. Switching loss vs temperature**

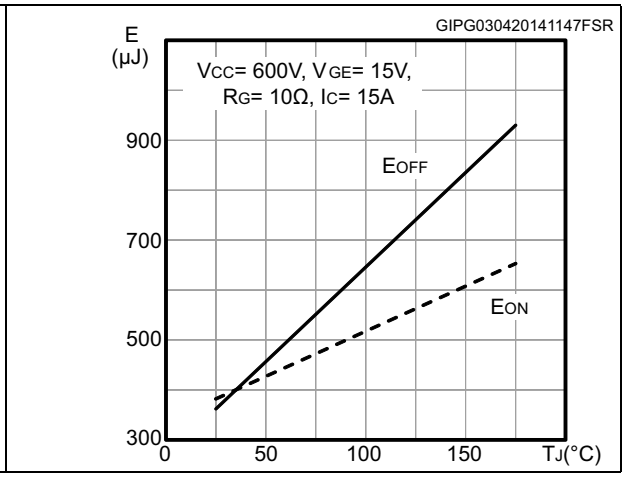



**Figure 18. Switching loss vs collector-emitter voltage**

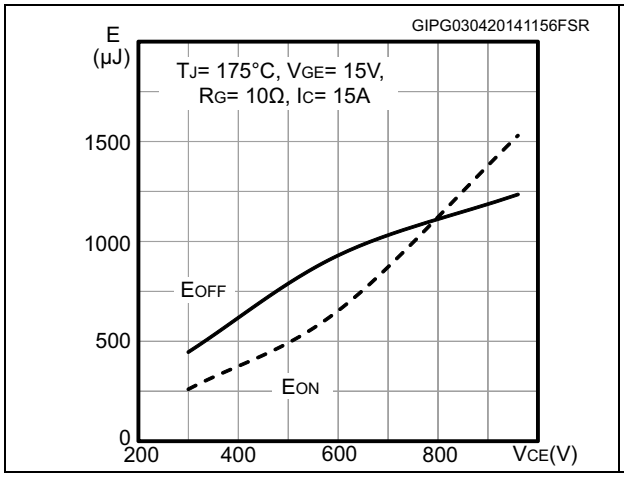



**Figure 19. Switching times vs. gate resistance**

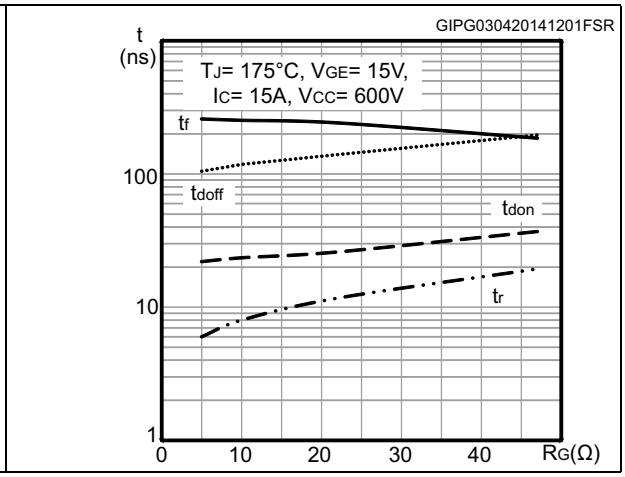


**Figure 20. Switching times vs. collector current**

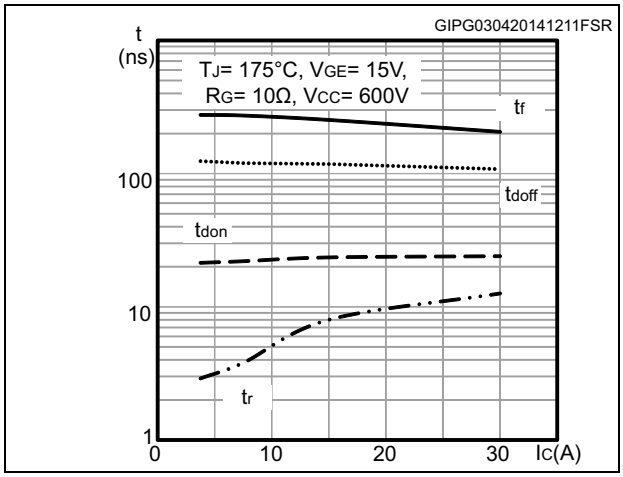
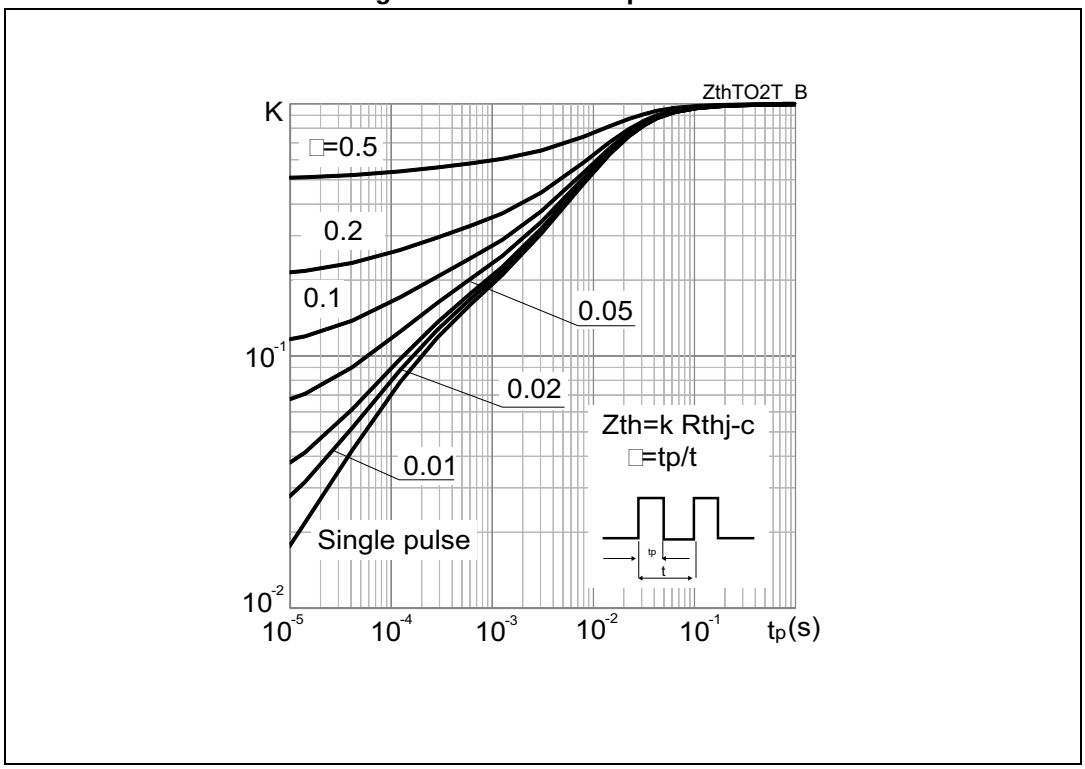


**Figure 21. Thermal impedance**



# 3 Test circuits

**Figure 22. Test circuit for inductive load switching**

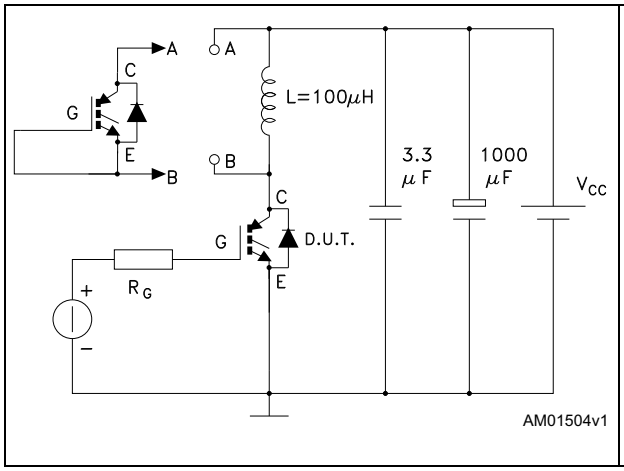



**Figure 23. Gate charge test circuit**

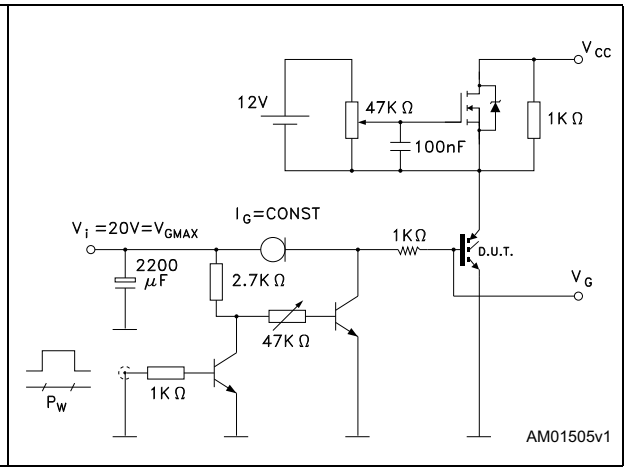
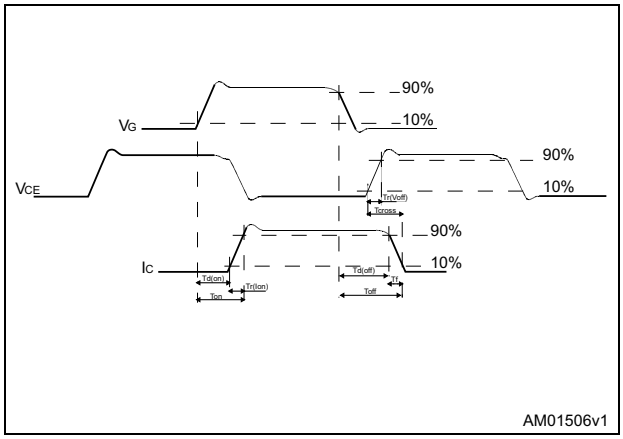



**Figure 24. Switching waveform**



# 4 Package information

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.

## 4.1 TO-247 package information

**Figure 25. TO-247 package outline**

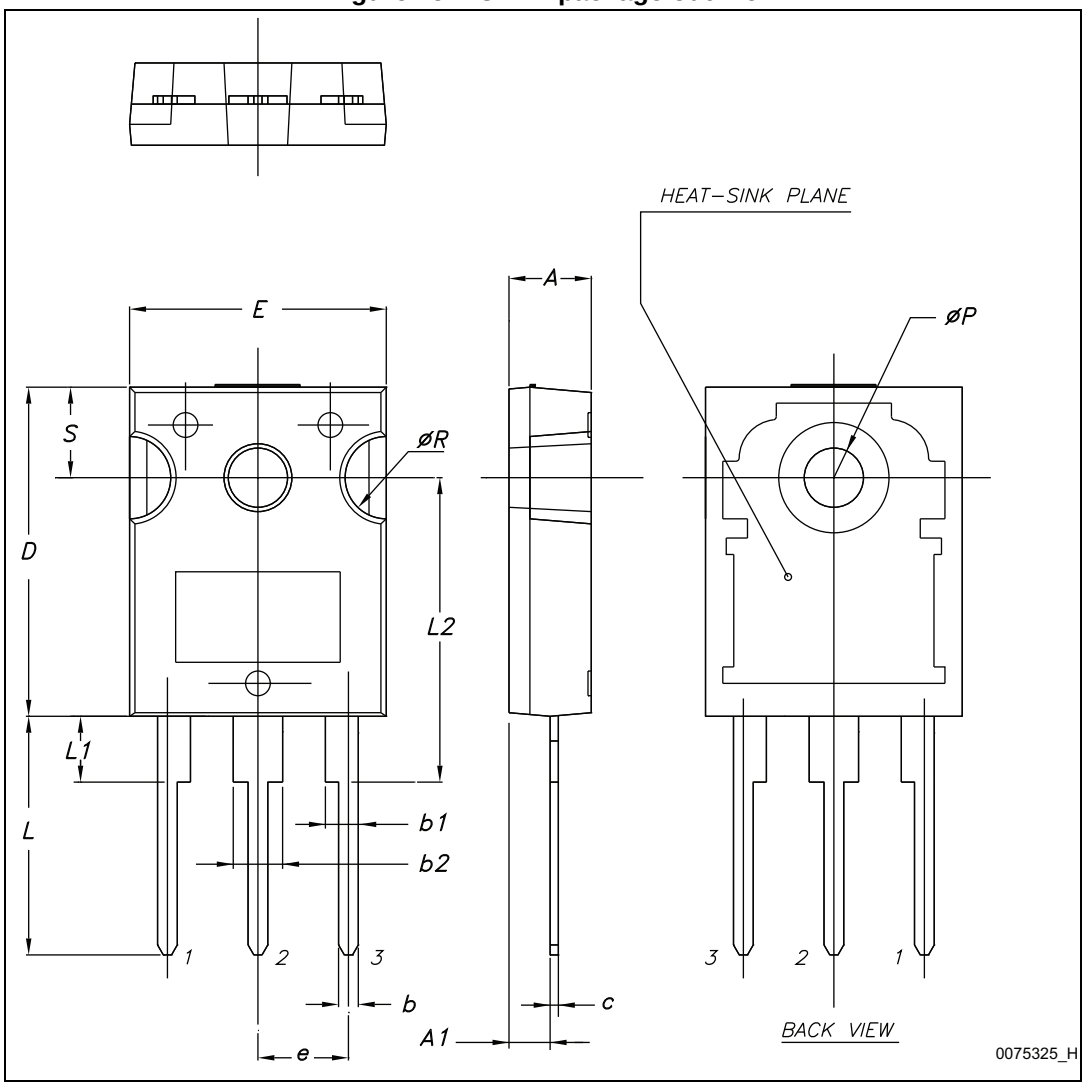


**Table 7. TO-247 package mechanical data**

| 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 |

## 4.2 TO-247 long leads package information

**Figure 26. TO-247 long leads package outline**

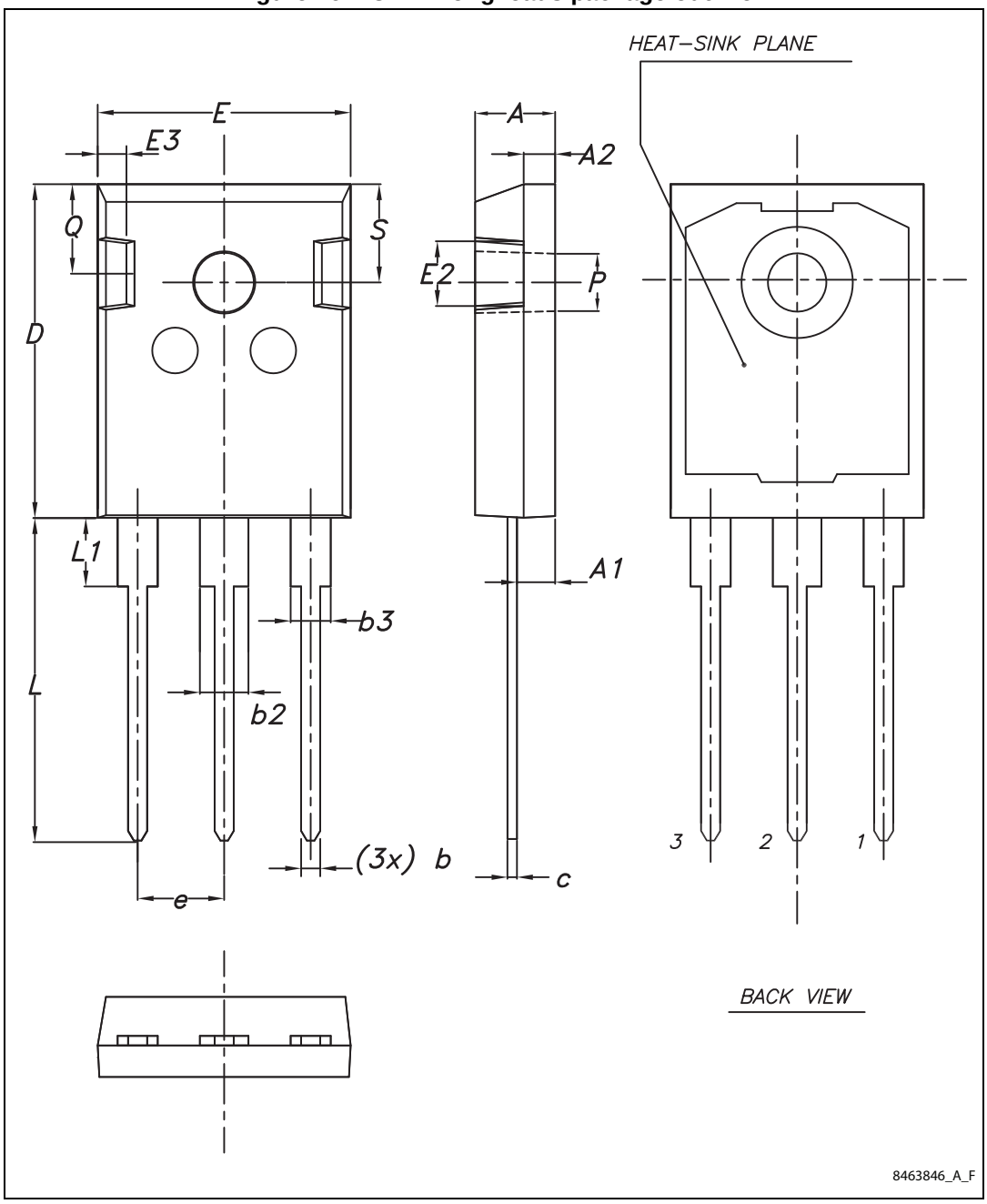


Table 8. TO-247 long leads package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.90 | 5.00 | 5.10 |
| A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.16 | | 1.26 |
| b2 | | | 3.25 |
| b3 | | | 2.25 |
| c | 0.59 | | 0.66 |
| D | 20.90 | 21.00 | 21.10 |
| E | 15.70 | 15.80 | 15.90 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 5.34 | 5.44 | 5.54 |
| L | 19.80 | 19.92 | 20.10 |
| L1 | | | 4.30 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 5.60 | | 6.00 |
| S | 6.05 | 6.15 | 6.25 |

# 5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 03-Mar-2014 | 1 | Initial release. |
| 08-Apr-2014 | 2 | Document status promoted from preliminary to production data.<br>Added *Section 2.1: Electrical characteristics (curves)*.<br>Minor text changes. |
| 28-Jan-2015 | 3 | updated *4.1: TO-247 package information* and *4.2: TO-247 long leads package information*<br>Minor text changes |
| 04-Mar-2015 | 4 | Updated *Figure 4.: Output characteristics ($T_J$ = 25°C)*<br>Minor text changes. |
| 01-Apr-2015 | 5 | Removed figure of Diode reverse recovery waveform<br>Minor text changes. |

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