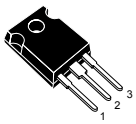
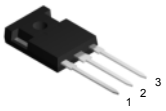
# STGW40H120F2, STGWA40H120F2

Datasheet

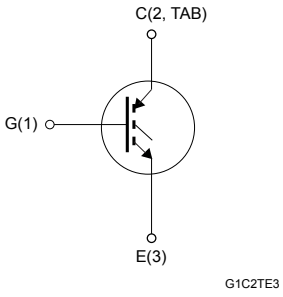
## Trench gate field-stop IGBT, H series 1200 V, 40 A high speed



TO-247



TO-247 long leads




## Features

- Maximum junction temperature: $T_J$ = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 2.1 V (typ.) @ $I_C$ = 40 A
- 5 µs minimum short-circuit withstand time at $T_J$ = 150 °C
- Safe paralleling
- Low thermal resistance

## Applications

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

## Description

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

| Product status links |
|---|
| STGW40H120F2 |
| STGWA40H120F2 |

| Product summary | |
|---|---|
| **Order code** | **STGW40H120F2** |
| **Marking** | G40H120F2 |
| **Package** | TO-247 |
| **Packing** | Tube |
| **Order code** | **STGWA40H120F2** |
| **Marking** | G40H120F2 |
| **Package** | TO-247 long leads |
| **Packing** | Tube |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage ($V_{GE}$ = 0 V) | 1200 | V |
| $I_C$ | Continuous collector current at $T_C$ = 25 °C | 80 | A |
| | Continuous collector current at $T_C$ = 100 °C | 40 | |
| $I_{CP}$ (1) | Pulsed collector current | 160 | A |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 468 | W |
| $T_J$ | Operating junction temperature range | - 55 to 175 | °C |
| $T_{STG}$ | Storage temperature range | - 55 to 150 | °C |

1. *Pulse width limited by maximum junction temperature.*

**Table 2. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance, junction-to-case IGBT | 0.32 | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 50 | °C/W |

# 2 Electrical characteristics

$T_J$ = 25 °C unless otherwise specified.

**Table 3. Static characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE}$ = 0 V, $I_C$ = 2 mA | 1200 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 40 A | | 2.1 | 2.6 | V |
| | | $V_{GE}$ = 15 V, $I_C$ = 40 A, $T_J$ = 125 °C | | 2.4 | | |
| | | $V_{GE}$ = 15 V, $I_C$ = 40 A, $T_J$ = 175 °C | | 2.5 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA | 5 | 6 | 7 | V |
| $I_{CES}$ | Collector cut-off current | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V | | | 25 | µA |
| $I_{GES}$ | Gate-emitter leakage current | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | | ±250 | nA |

**Table 4. Dynamic characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 25 V, f = 1 MHz, $V_{GE}$ = 0 V | - | 3200 | - | pF |
| $C_{oes}$ | Output capacitance | | - | 220 | - | pF |
| $C_{res}$ | Reverse transfer capacitance | | - | 80 | - | pF |
| $Q_g$ | Total gate charge | $V_{CC}$ = 960 V, $I_C$ = 40 A, $V_{GE}$ = 0 to 15 V (see Figure 23) | - | 158 | - | nC |
| $Q_{ge}$ | Gate-emitter charge | | - | 17 | - | nC |
| $Q_{gc}$ | Gate-collector charge | | - | 85 | - | nC |

**Table 5. IGBT switching characteristics (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 600 V, $I_C$ = 40 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V (see Figure 22) | | 18 | - | ns |
| $t_r$ | Current rise time | | | 37 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1755 | - | A/µs |
| $t_{d(off)}$ | Turn-off delay time | | | 152 | - | ns |
| $t_f$ | Current fall time | | | 83 | - | ns |
| $E_{on}$ (1) | Turn-on switching energy | | | 1 | - | mJ |
| $E_{off}$ (2) | Turn-off switching energy | | | 1.32 | - | mJ |
| $E_{ts}$ | Total switching energy | | | 2.32 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE}$ = 600 V, $I_C$ = 40 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, $T_J$ = 175 °C (see Figure 22) | | 36 | - | ns |
| $t_r$ | Current rise time | | | 20 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1580 | - | A/µs |
| $t_{d(off)}$ | Turn-off delay time | | | 161 | - | ns |
| $t_f$ | Current fall time | | | 190 | - | ns |
| $E_{on}$ (1) | Turn-on switching energy | | | 1.81 | - | mJ |
| $E_{off}$ (2) | Turn-off switching energy | | | 2.46 | - | mJ |
| $E_{ts}$ | Total switching energy | | | 4.27 | - | mJ |
| $t_{sc}$ | Short-circuit withstand time | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V, $T_J$ = 150 °C, | 5 | | - | µs |

1. *Including the reverse recovery of the diode. The diode is the same of the co-packed STGW40H120DF2.*
2. *Including the tail of the collector current.*

## 2.1 Electrical characteristics (curves)

**Figure 1. Power dissipation vs. case temperature**

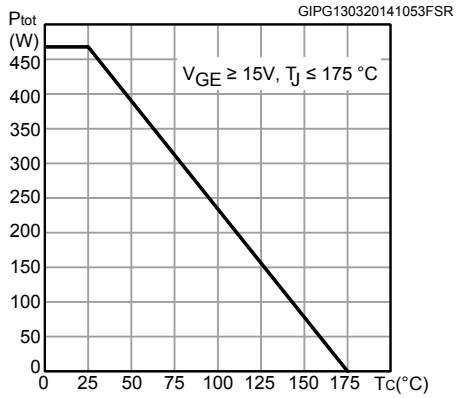



**Figure 2. Collector current vs. case temperature**

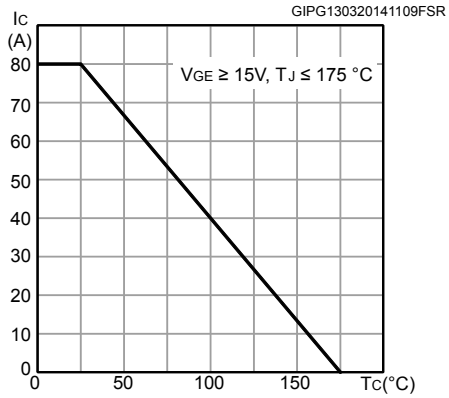



**Figure 3. Output characteristics ($T_J$ = 25 °C)**

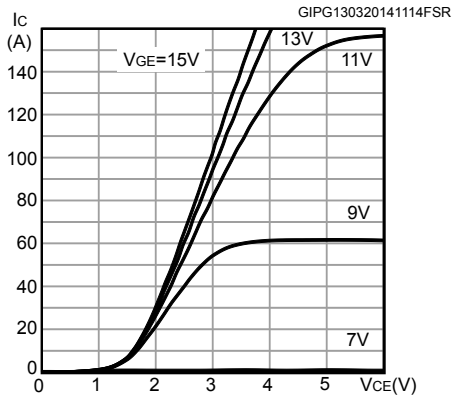



**Figure 4. Output characteristics ($T_J$ = 175 °C)**

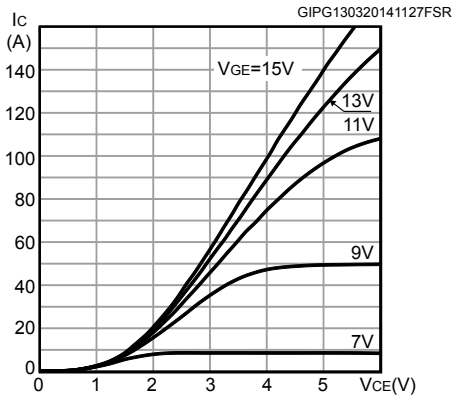



**Figure 5. $V_{CE}$(sat) vs. junction temperature**

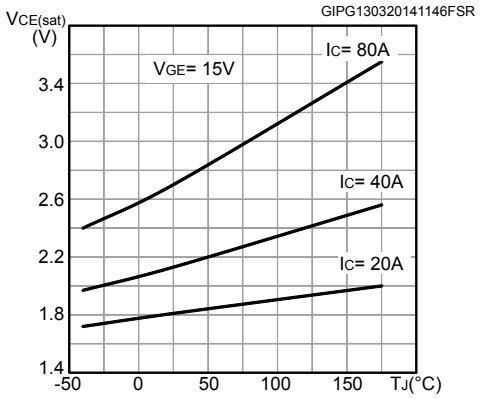



**Figure 6. $V_{CE}$(sat) vs. collector current**

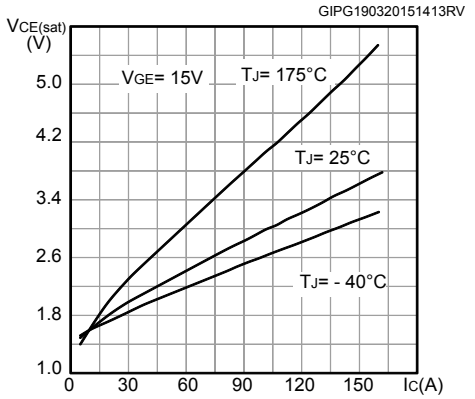


**Figure 7. Collector current vs. switching frequency**

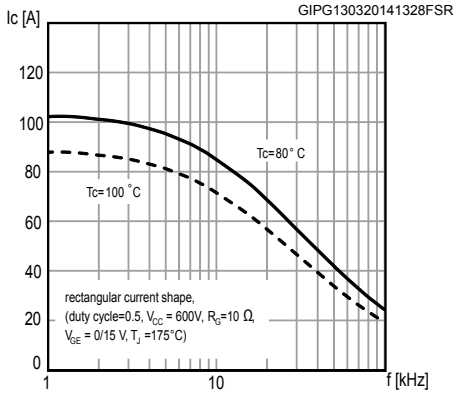



**Figure 8. Forward bias safe operating area**

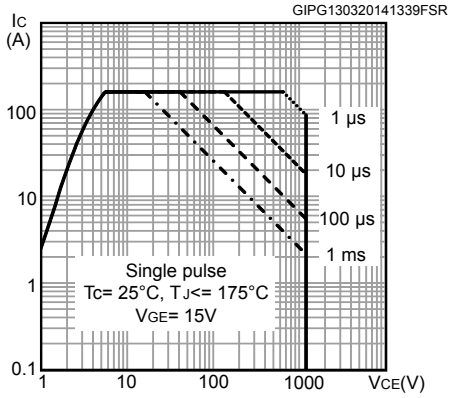



**Figure 9. Transfer characteristics**

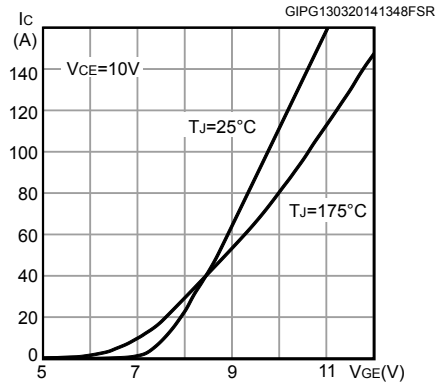



**Figure 10. Normalized $V_{GE(th)}$ vs. junction temperature**

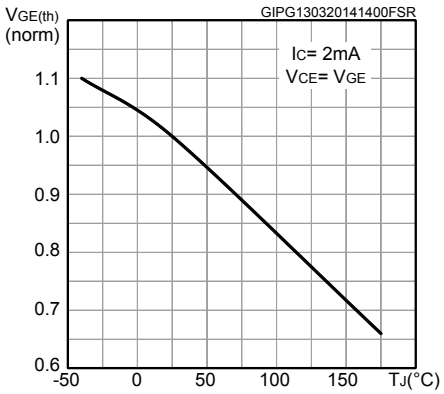



**Figure 11. Normalized $V_{(BR)CES}$ vs. junction temperature**




**Figure 12. Capacitance variations**

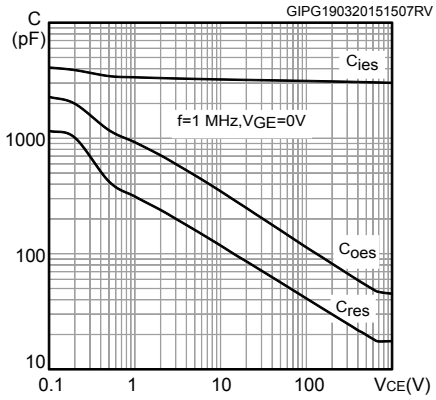


**Figure 13. Gate charge vs. gate-emitter voltage**

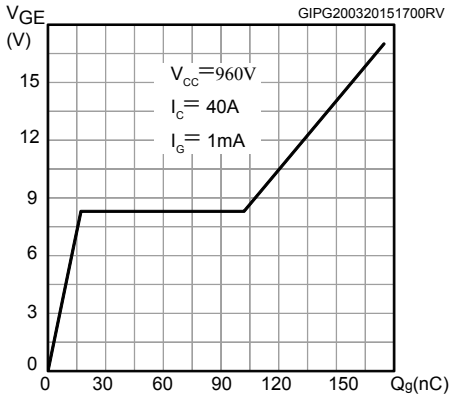



**Figure 14. Switching energy vs. collector current**

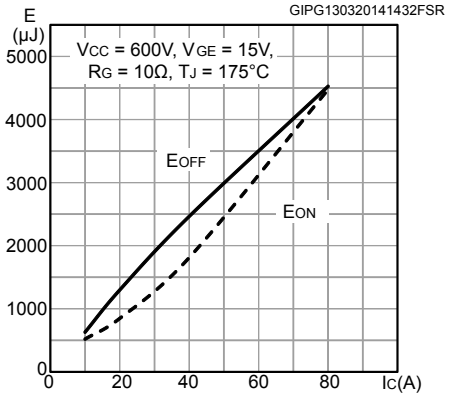



**Figure 15. Switching energy vs. gate resistance**

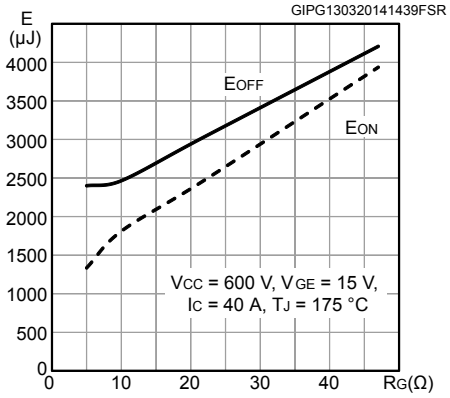



**Figure 16. Switching energy vs. temperature**

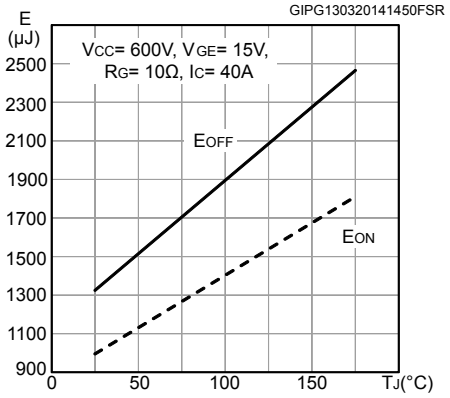



**Figure 17. Switching energy vs. collector emitter voltage**

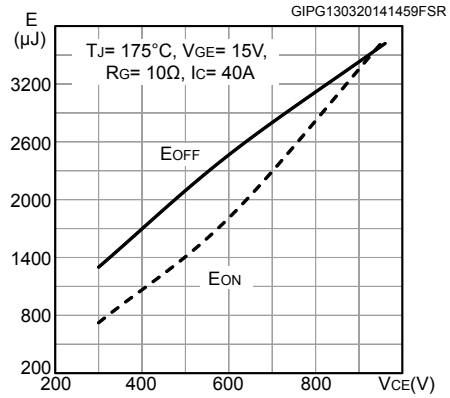



**Figure 18. Switching time vs. collector current**

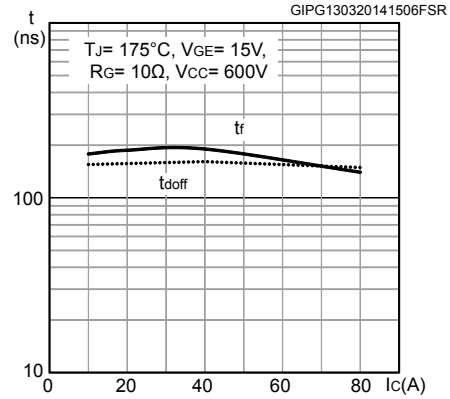


**Figure 19. Switching time vs. gate resistance**

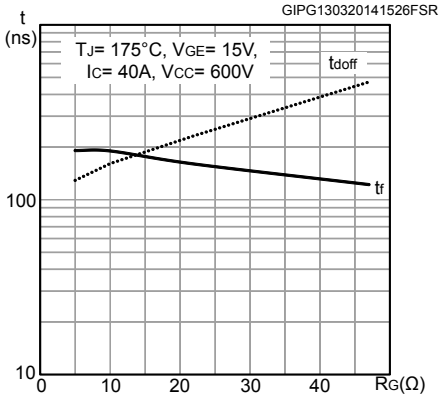



**Figure 20. Short-circuit time and current vs. $V_{GE}$**

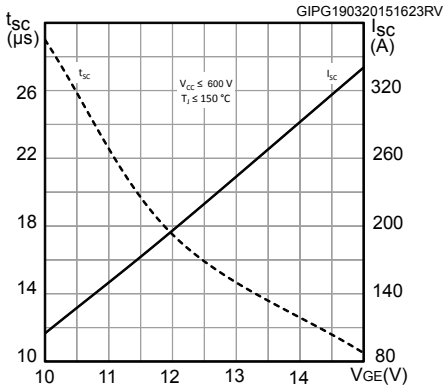
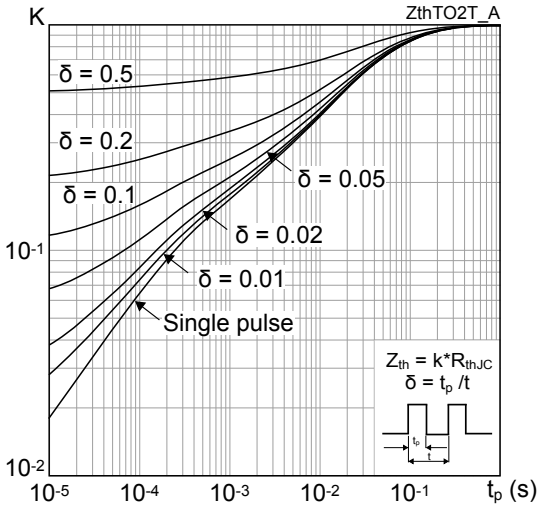



**Figure 21. Thermal impedance**



# 3 Test circuits

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

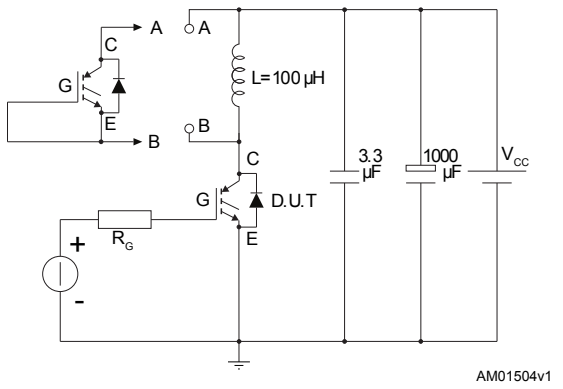



Figure 23. **Gate charge test circuit**

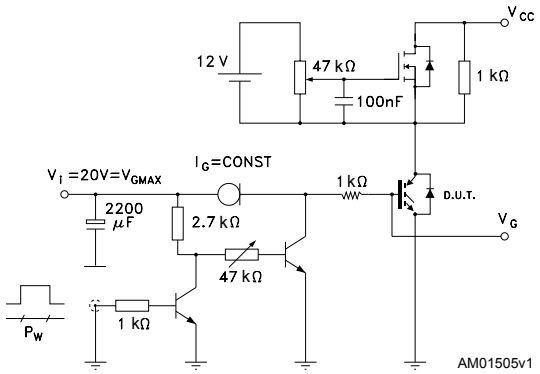
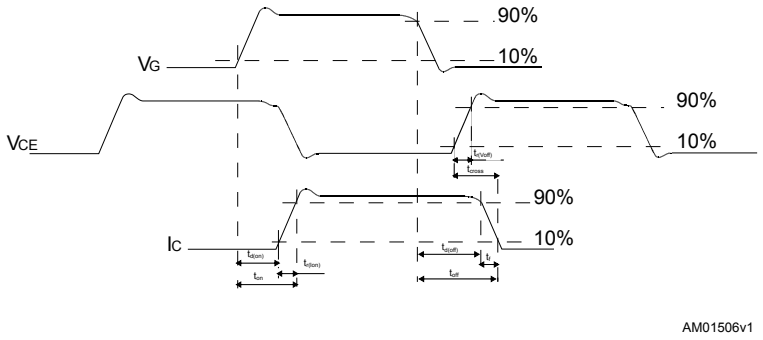



Figure 24. **Switching waveform**

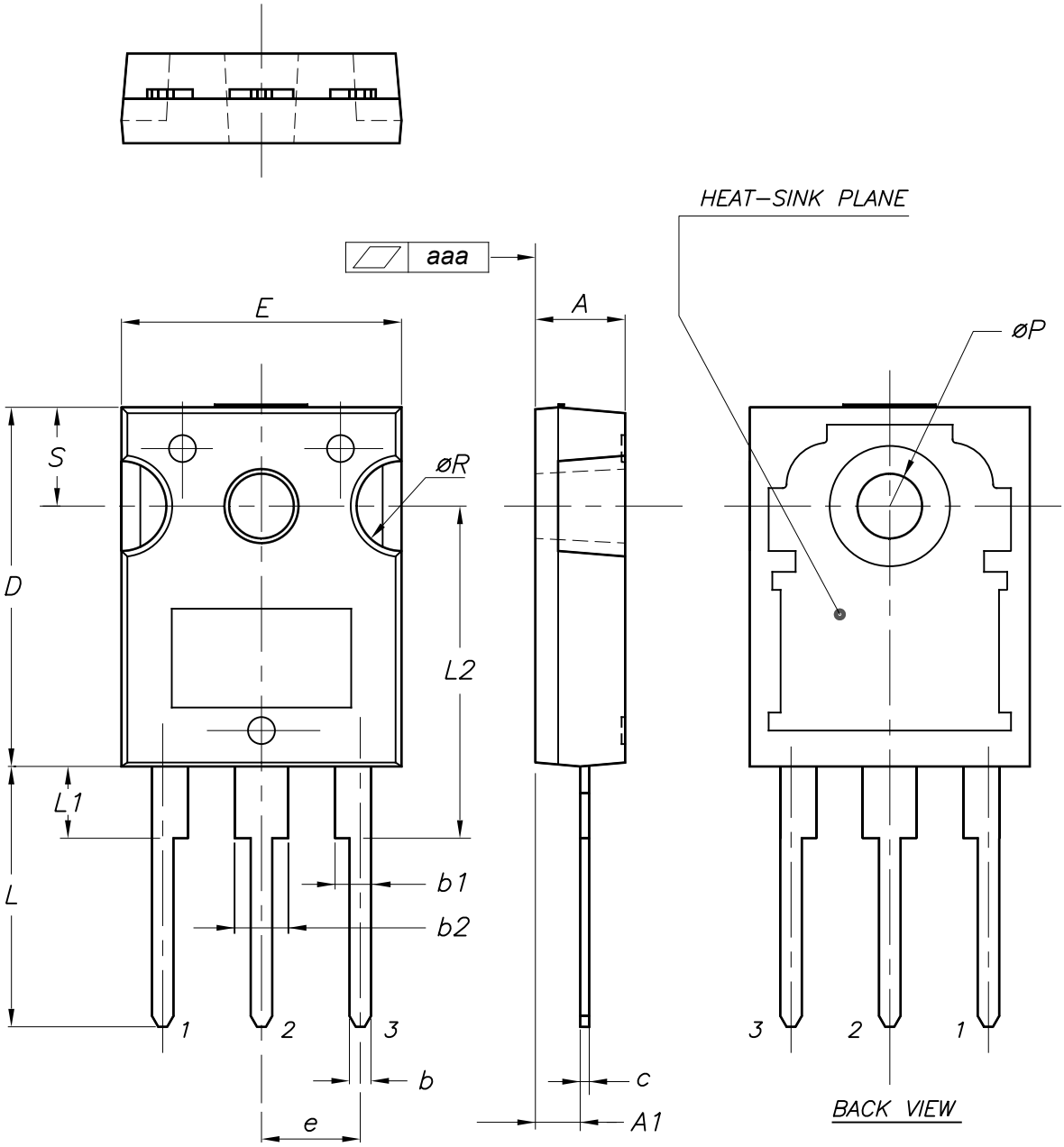


# 4 Package information

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**




0075325_10

Table 6. **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 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |
| aaa | | 0.04 | 0.10 |

## 4.2 TO-247 long leads package information

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

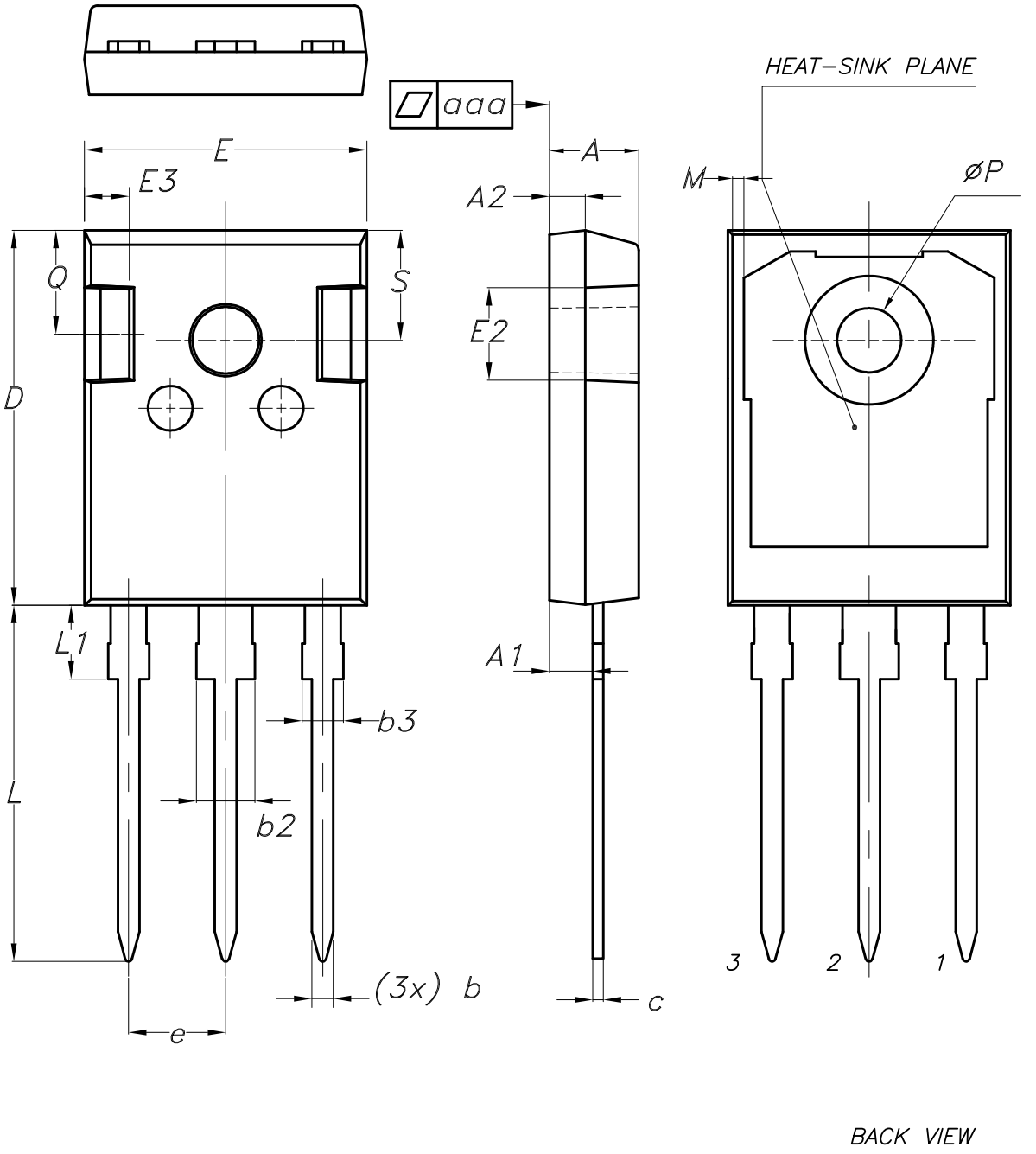


Table 7. **TO-247 long leads package mechanical data**

| 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 |
| M | 0.35 | | 0.95 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 5.60 | | 6.00 |
| S | 6.05 | 6.15 | 6.25 |
| aaa | | 0.04 | 0.10 |

## Revision history

Table 8. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 29-Jan-2014 | 1 | Initial release. |
| 14-Mar-2014 | 2 | Updated *Table 4: Static characteristics* and Table 5: Dynamic characteristics.<br>Added *Section 2.1: Electrical characteristics (curves)*.<br>Updated title in cover page.<br>Minor text changes. |
| 25-Mar-2015 | 3 | Added *4.2: TO-247 long leads, STGWA40H120F2*.<br>Updated *4: Package mechanical data*.<br>Minor text changes. |
| 12-Feb-2025 | 4 | Updated Section 4.1: TO-247 package information, and Section 4.2: TO-247 long leads package information.<br>Minor text changes. |

**IMPORTANT NOTICE – READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2025 STMicroelectronics – All rights reserved