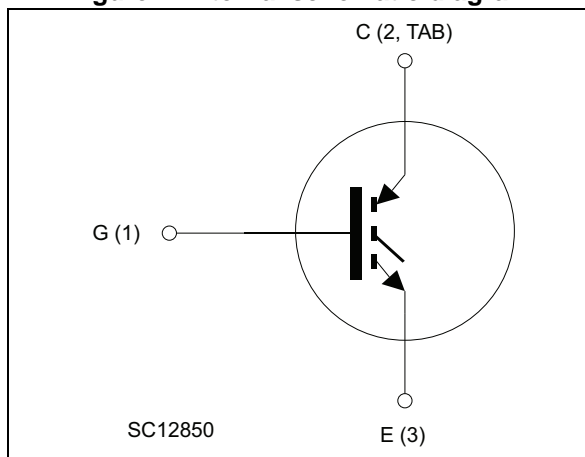


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 2.1\text{ V (typ.) @ } I_C = 40\text{ A}$
- $5\text{ }\mu\text{s}$  minimum short-circuit withstand time at  $T_J = 150\text{ °C}$
- 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 H series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Moreover, 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           | Packaging |
|---------------|-----------|-------------------|-----------|
| STGW40H120F2  | G40H120F2 | TO-247            | Tube      |
| STGWA40H120F2 | G40H120F2 | TO-247 long leads | Tube      |

# Contents

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# 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 $T_C = 25\text{ °C}$  | 80         | A    |
| $I_C$          | Continuous collector current at $T_C = 100\text{ °C}$ | 40         | A    |
| $I_{CP}^{(1)}$ | Pulsed collector current                              | 160        | A    |
| $V_{GE}$       | Gate-emitter voltage                                  | $\pm 20$   | V    |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ °C}$             | 468        | 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    | 0.32  | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50    | °C/W |

## 2 Electrical characteristics

T<sub>J</sub> = 25 °C unless otherwise specified.

**Table 4. Static characteristics**

| Symbol               | Parameter   | Test conditions  | Min. | Typ. | Max. | Unit |
|----------------------|---|--|------|------|------|------|
| V <sub>(BR)CES</sub> | Collector-emitter breakdown voltage (V <sub>GE</sub> = 0) | I <sub>C</sub> = 2 mA  | 1200 |      |      | V    |
| V <sub>CE(sat)</sub> | Collector-emitter saturation voltage                      | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A                            |      | 2.1  | 2.6  | V    |
|                      |   | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A<br>T <sub>J</sub> = 125 °C |      | 2.4  |      |      |
|                      |   | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A<br>T <sub>J</sub> = 175 °C |      | 2.5  |      |      |
| V <sub>GE(th)</sub>  | Gate threshold voltage                                    | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 2 mA                | 5    | 6    | 7    | V    |
| I <sub>CES</sub>     | Collector cut-off current (V <sub>GE</sub> = 0)           | V <sub>CE</sub> = 1200 V   |      |      | 25   | µA   |
| I <sub>GES</sub>     | Gate-emitter leakage current (V <sub>CE</sub> = 0)        | V <sub>GE</sub> = ± 20 V   |      |      | 250  | nA   |

**Table 5. Dynamic characteristics**

| Symbol           | Parameter                    | Test conditions  | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|--|------|------|------|------|
| C <sub>ies</sub> | Input capacitance            | V <sub>CE</sub> = 25 V, f = 1 MHz,<br>V <sub>GE</sub> = 0  | -    | 3200 | -    | pF   |
| C <sub>oes</sub> | Output capacitance           |  | -    | 220  | -    | pF   |
| C <sub>res</sub> | Reverse transfer capacitance |  | -    | 80   | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>CC</sub> = 960 V, I <sub>C</sub> = 40 A,<br>V <sub>GE</sub> = 15 V, see <a href="#">Figure 24</a> | -    | 158  | -    | nC   |
| Q <sub>ge</sub>  | Gate-emitter charge          |  | -    | 17   | -    | nC   |
| Q <sub>gc</sub>  | Gate-collector charge        |  | -    | 85   | -    | nC   |

Table 6. Switching characteristics (inductive load)

| Symbol          | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit             |
|-----------------|------------------------------|---|------|------|------|------------------|
| $t_{d(on)}$     | Turn-on delay time           | $V_{CE} = 600\text{ V}$ , $I_C = 40\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>see <a href="#">Figure 23</a>                                     |      | 18   | -    | ns               |
| $t_r$           | Current rise time            |   |      | 37   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope        |   |      | 1755 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | Turn-off delay time          |   |      | 152  | -    | ns               |
| $t_f$           | Current fall time            |   |      | 83   | -    | ns               |
| $E_{on}^{(1)}$  | Turn-on switching losses     |   |      | 1.0  | -    | mJ               |
| $E_{off}^{(2)}$ | Turn-off switching losses    |   |      | 1.32 | -    | mJ               |
| $E_{ts}$        | Total switching losses       |   |      | 2.32 | -    | mJ               |
| $t_{d(on)}$     | Turn-on delay time           | $V_{CE} = 600\text{ V}$ , $I_C = 40\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 23</a> |      | 36   | -    | ns               |
| $t_r$           | Current rise time            |   |      | 20   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope        |   |      | 1580 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | Turn-off delay time          |   |      | 161  | -    | ns               |
| $t_f$           | Current fall time            |   |      | 190  | -    | ns               |
| $E_{on}^{(1)}$  | Turn-on switching losses     |   |      | 1.81 | -    | mJ               |
| $E_{off}^{(2)}$ | Turn-off switching losses    |   |      | 2.46 | -    | mJ               |
| $E_{ts}$        | Total switching losses       |   |      | 4.27 | -    | mJ               |
| $t_{sc}$        | Short-circuit withstand time | $V_{CE} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ ,<br>$T_J = 150\text{ }^\circ\text{C}$ ,   | 5    |      | -    | $\mu\text{s}$    |

1. Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW40H120DF2
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

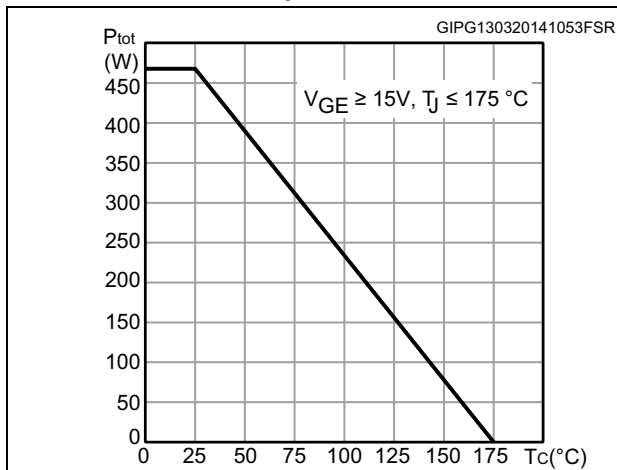


Figure 3. Collector current vs. case temperature

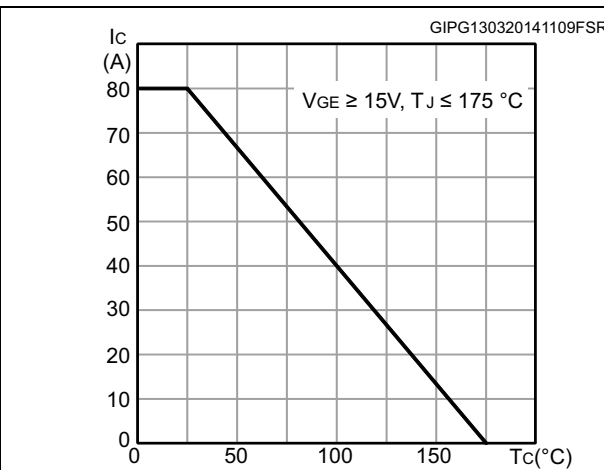


Figure 4. Output characteristics (T<sub>J</sub> = 25°C)

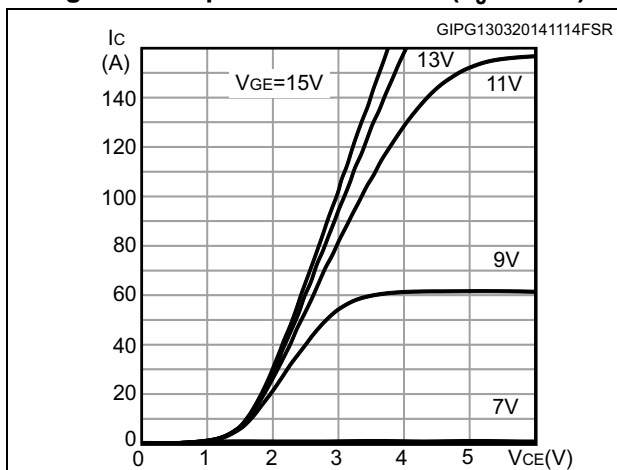


Figure 5. Output characteristics (T<sub>J</sub> = 175°C)

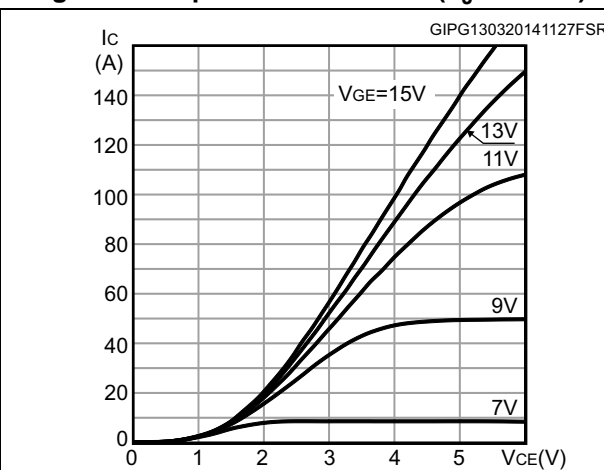


Figure 6. V<sub>CE(sat)</sub> vs. junction temperature

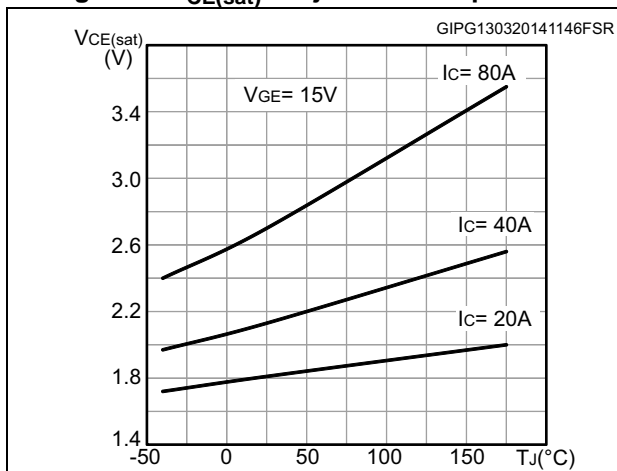


Figure 7. V<sub>CE(sat)</sub> vs. collector current

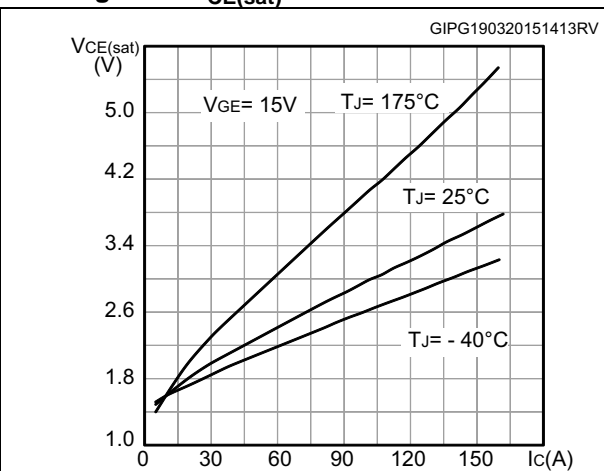


Figure 8. Collector current vs. switching frequency

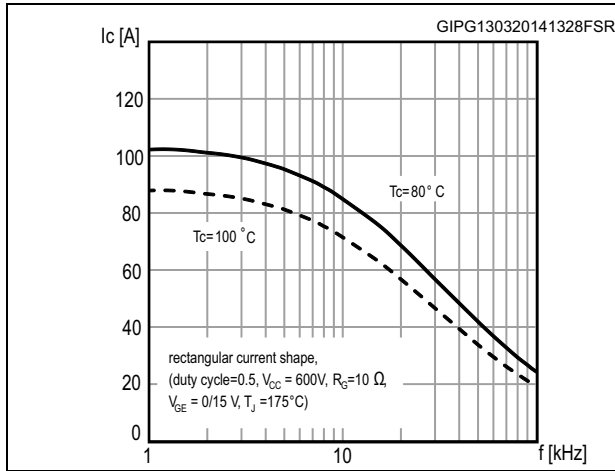


Figure 9. Forward bias safe operating area

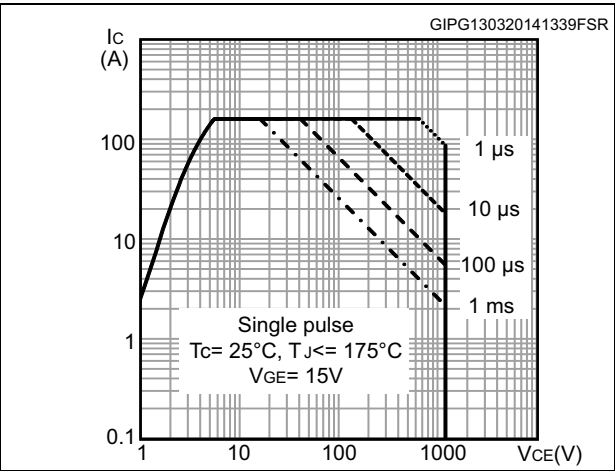


Figure 10. Transfer characteristics

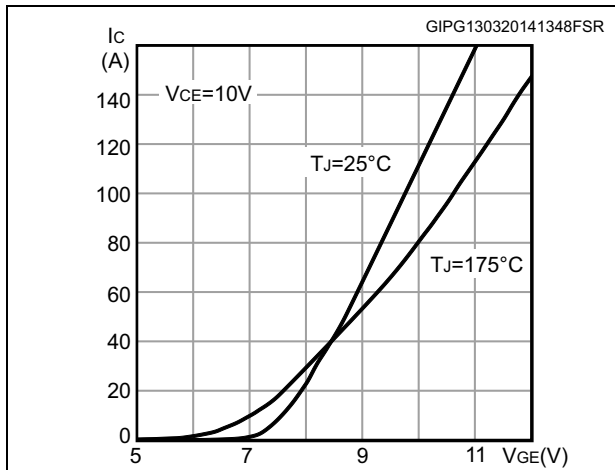


Figure 11. Normalized VGE(th) vs junction temperature

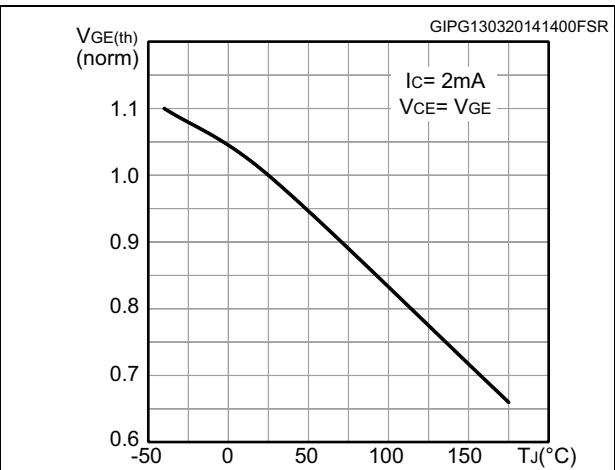


Figure 12. Normalized V(BR)CES vs. junction temperature

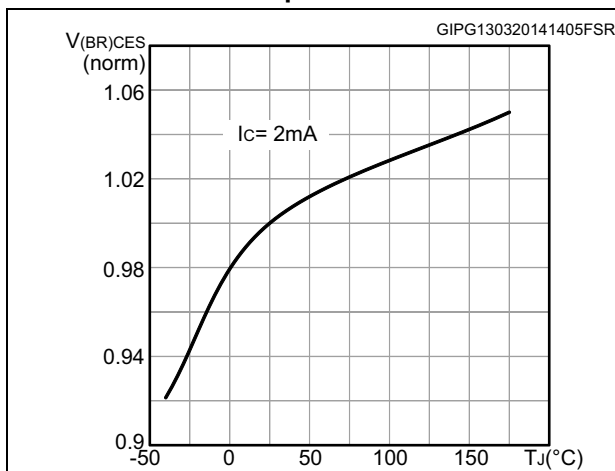


Figure 13. Capacitance variation

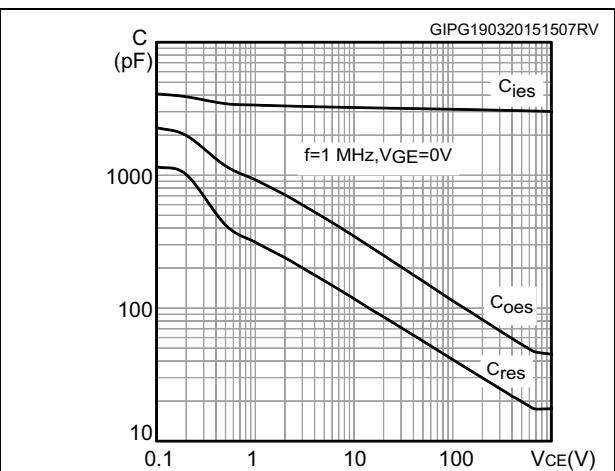


Figure 14. Gate charge vs. gate-emitter voltage

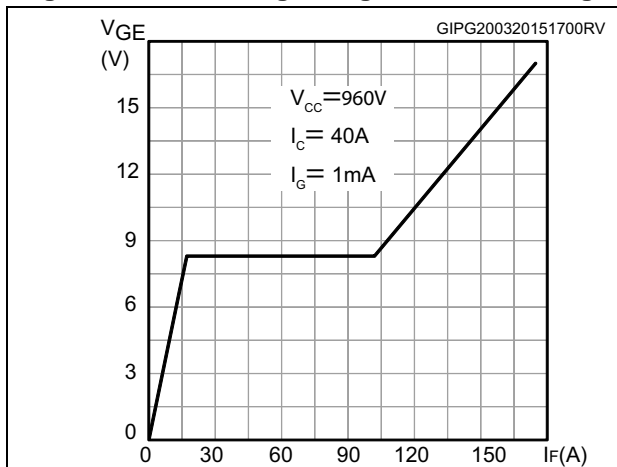


Figure 15. Switching loss vs collector current

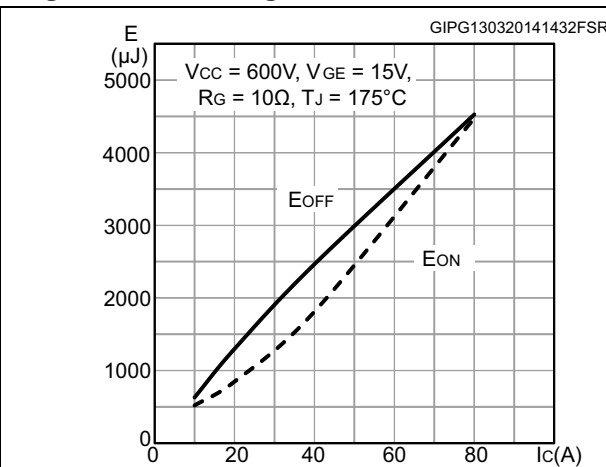


Figure 16. Switching loss vs gate resistance

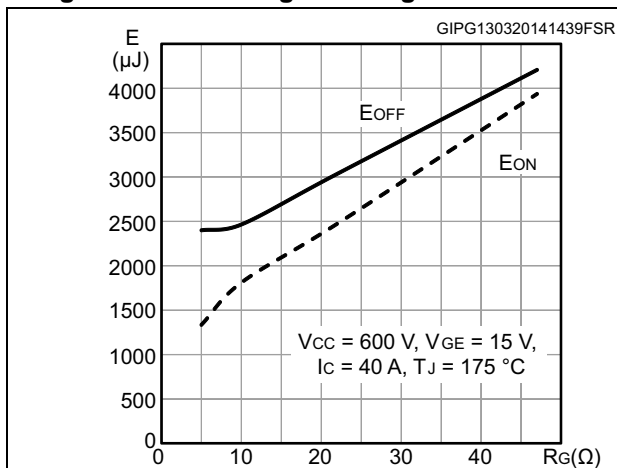


Figure 17. Switching loss vs temperature

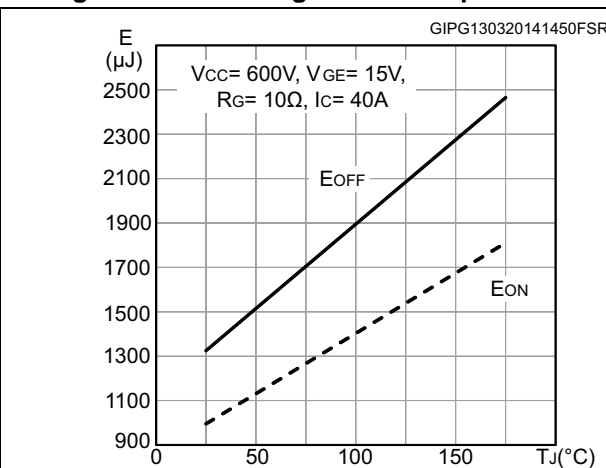


Figure 18. Switching loss vs collector-emitter voltage

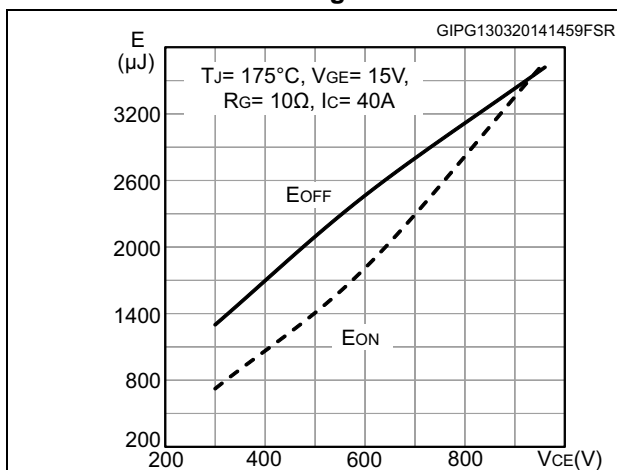


Figure 19. Switching times vs. collector current

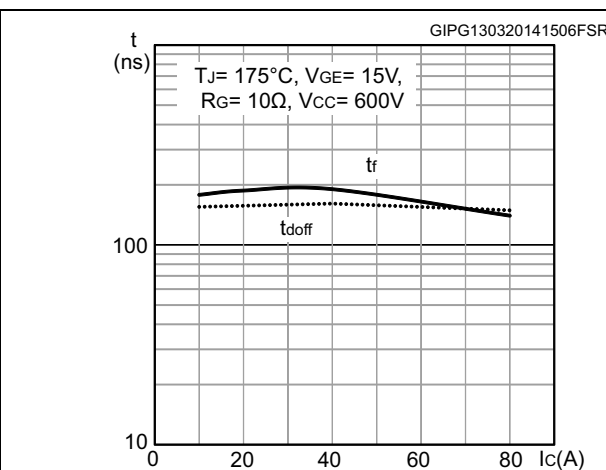




Figure 20. Switching times vs. gate resistance    Figure 21. Short circuit time and current vs.VGE

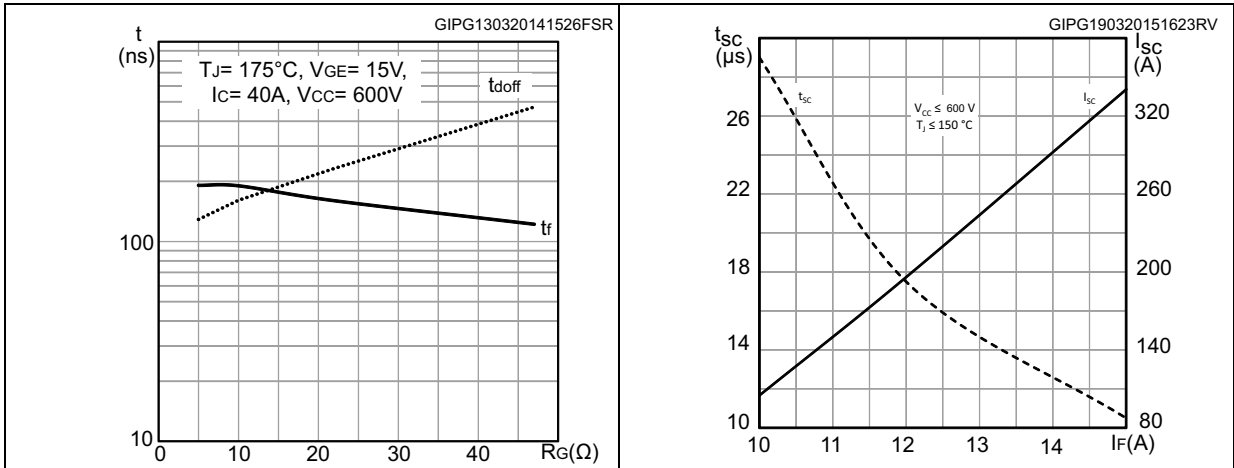
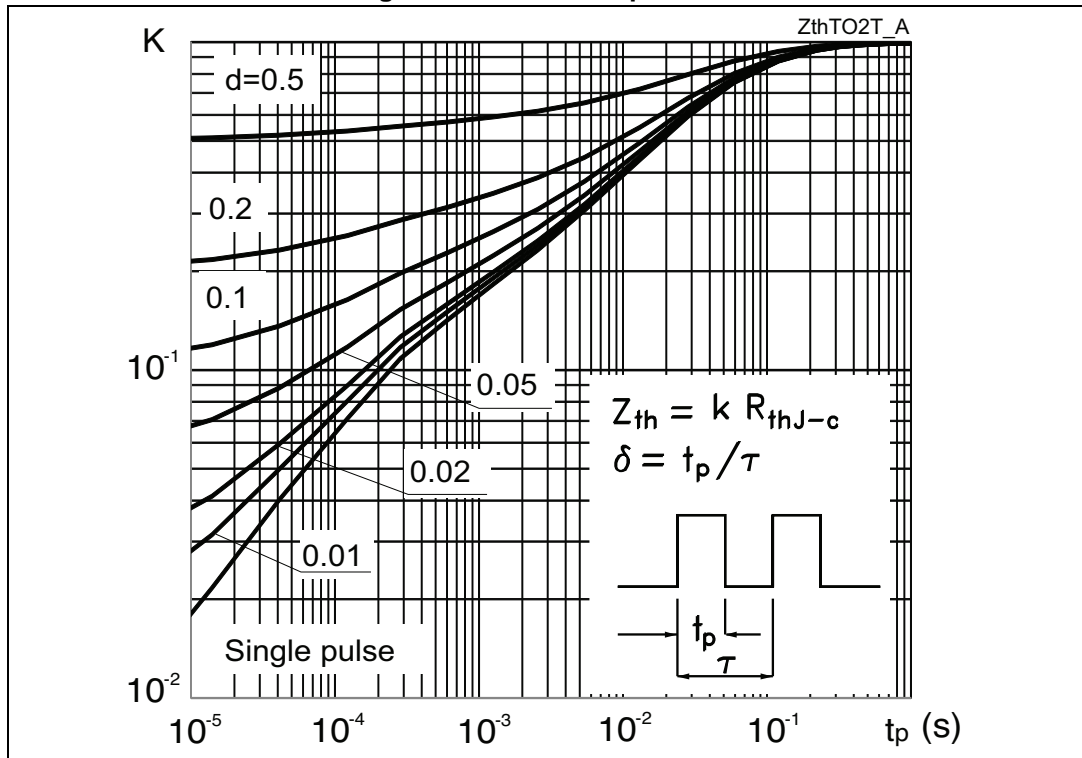


Figure 22. Thermal impedance



### 3 Test circuits

Figure 23. Test circuit for inductive load switching



Figure 24. Gate charge test circuit

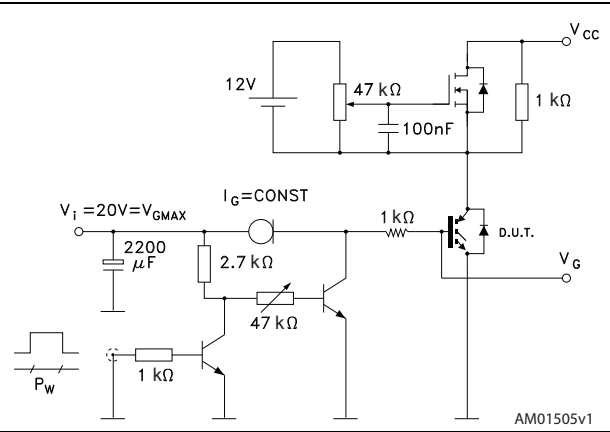


Figure 25. Switching waveform



## 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 TO-247, STGW40H120F2

Figure 26. TO-247 drawing

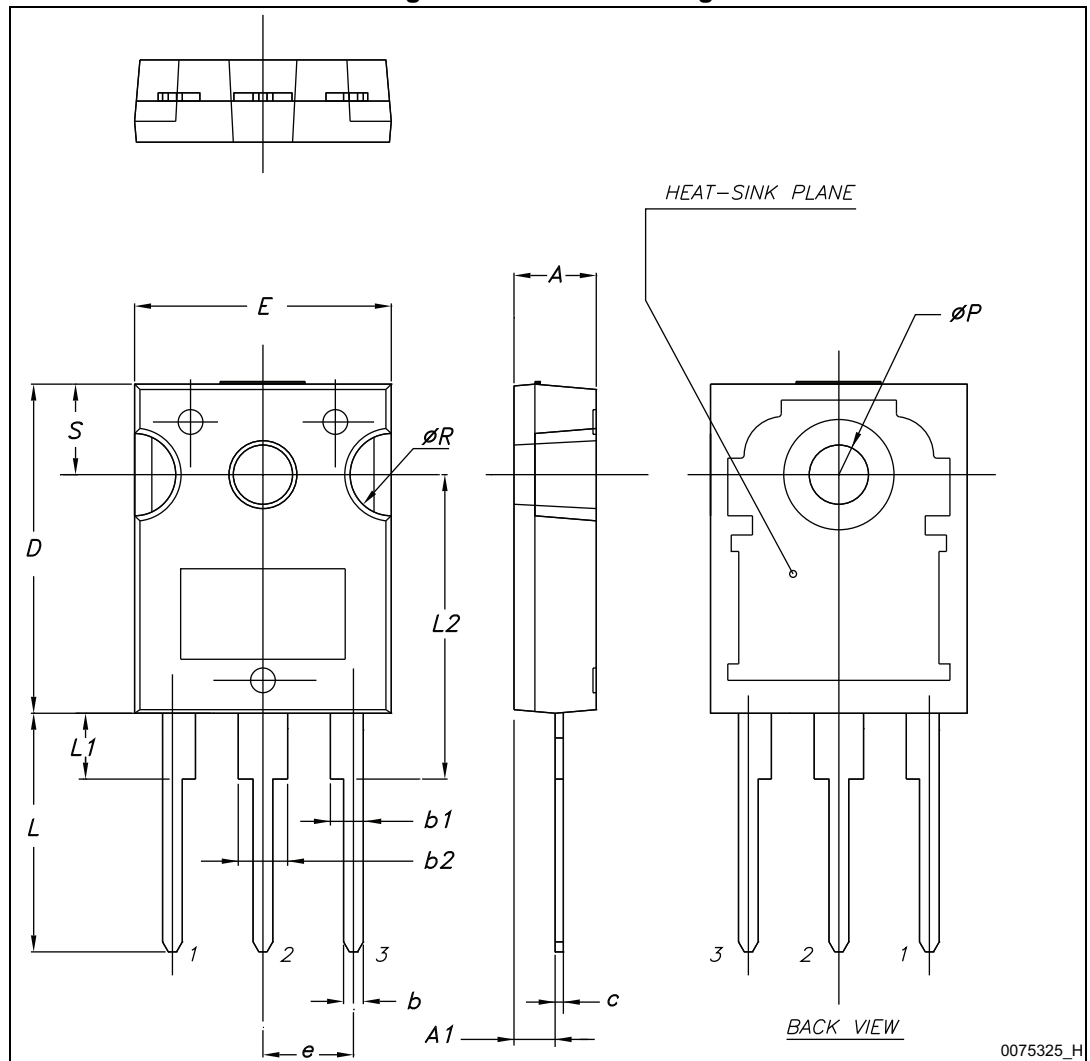


Table 7. TO-247 mechanical data

| 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 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

### 4.2 TO-247 long leads, STGWA40H120F2

Figure 27. TO-247 long leads drawing

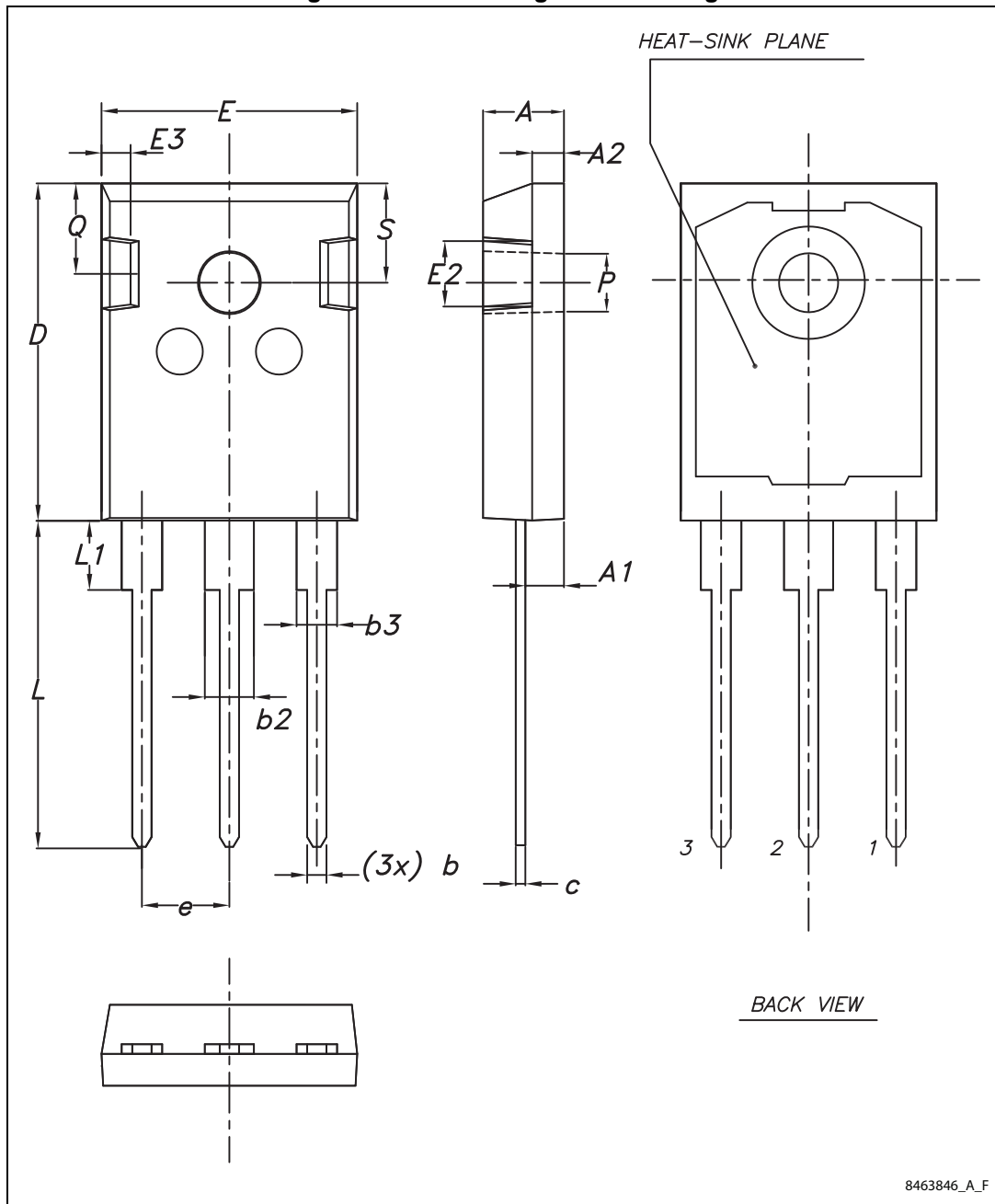


Table 8. TO-247 long leads mechanical data

| 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   |
|-------------|----------|---|
| 29-Jan-2014 | 1        | Initial release.  |
| 14-Mar-2014 | 2        | Updated <a href="#">Table 4: Static characteristics</a> and <a href="#">Table 5: Dynamic characteristics</a> .<br>Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> .<br>Updated title in cover page.<br>Minor text changes. |
| 25-Mar-2015 | 3        | Added <a href="#">4.2: TO-247 long leads, STGWA40H120F2</a><br>Updated <a href="#">4: Package mechanical data</a><br>Minor text changes.  |



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