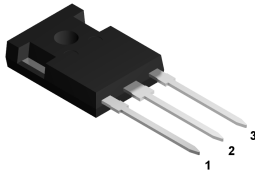
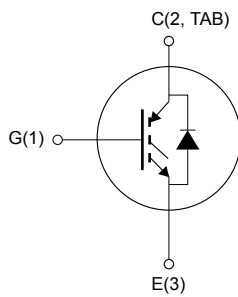


## Trench gate field-stop 650 V, 30 A, soft-switching IH series IGBT in a TO-247 long leads package



TO-247 long leads



NG1E3C2T

### Features

- Designed for soft commutation only
- Maximum junction temperature:  $T_J = 175\text{ °C}$
- $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 30\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low drop voltage freewheeling co-packaged diode
- Positive  $V_{CE(sat)}$  temperature coefficient

### Applications

- Induction heating
- Resonant converters
- Microwave ovens

### Description

The newest IGBT 650 V soft-switching IH series has been developed using an advanced proprietary trench gate field-stop structure, whose performance is optimized both in conduction and switching losses for soft commutation. A freewheeling diode with a low drop forward voltage is included. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching applications.



#### Product status link

[STGWA30IH65DF](#)

#### Product summary

|                   |                   |
|-------------------|-------------------|
| <b>Order code</b> | STGWA30IH65DF     |
| <b>Marking</b>    | G30IH65DF         |
| <b>Package</b>    | TO-247 long leads |
| <b>Packing</b>    | Tube              |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter   | Value       | Unit |
|----------------|---|-------------|------|
| $V_{CES}$      | Collector-emitter voltage ( $V_{GE} = 0$ V)             | 650         | V    |
| $I_C$          | Continuous collector current at $T_C = 25$ °C           | 60          | A    |
|                | Continuous collector current at $T_C = 100$ °C          | 30          |      |
| $I_{CP}^{(1)}$ | Pulsed collector current                                | 90          | A    |
| $V_{GE}$       | Gate-emitter voltage                                    | $\pm 20$    | V    |
|                | Transient gate-emitter voltage ( $t_p \leq 10$ $\mu$ s) | $\pm 30$    | V    |
| $I_F$          | Continuous forward current at $T_C = 25$ °C             | 30          | A    |
|                | Continuous forward current at $T_C = 100$ °C            | 15          |      |
| $I_{FP}^{(1)}$ | Pulsed forward current                                  | 90          |      |
| $P_{TOT}$      | Total power dissipation at $T_C = 25$ °C                | 180         | W    |
| $T_{STG}$      | Storage temperature range                               | - 55 to 150 | °C   |
| $T_J$          | Operating junction temperature range                    | - 55 to 175 |      |

1. Pulse width limited by maximum junction temperature. Defined by design, not subjected to production test.

**Table 2. Thermal data**

| Symbol     | Parameter                              | Value | Unit |
|------------|--|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case IGBT  | 0.83  | °C/W |
|            | Thermal resistance junction-case diode | 2.08  |      |
| $R_{thJA}$ | Thermal resistance junction-ambient    | 50    |      |

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified

**Table 3. Static characteristics**

| Symbol        | Parameter                            | Test conditions  | Min. | Typ. | Max.      | Unit          |
|---------------|--------------------------------------|--|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage  | $V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$            | 650  |      |           | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$                      |      | 1.55 | 2.05      | V             |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 125\text{ °C}$ |      | 1.75 |           |               |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 175\text{ °C}$ |      | 1.80 |           |               |
| $V_F$         | Forward on-voltage                   | $I_F = 15\text{ A}$  |      | 1.65 | 2.35      | V             |
|               |                                      | $I_F = 15\text{ A}, T_J = 125\text{ °C}$                       |      | 1.50 |           |               |
|               |                                      | $I_F = 15\text{ A}, T_J = 175\text{ °C}$                       |      | 1.40 |           |               |
|               |                                      | $I_F = 30\text{ A}$  |      | 2.00 |           |               |
| $V_{GE(th)}$  | Gate threshold voltage               | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$                           | 5    | 6    | 7         | V             |
| $I_{CES}$     | Collector cut-off current            | $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$                   |      |      | 25        | $\mu\text{A}$ |
| $I_{GES}$     | Gate-emitter leakage current         | $V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$                |      |      | $\pm 250$ | nA            |

**Table 4. Dynamic characteristics**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$   | -    | 1490 | -    | pF   |
| $C_{oes}$ | Output capacitance           |   | -    | 82   | -    |      |
| $C_{res}$ | Reverse transfer capacitance |   | -    | 39   | -    |      |
| $Q_g$     | Total gate charge            | $V_{CC} = 520\text{ V}, I_C = 30\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$<br>(see Figure 23. Gate charge test circuit) | -    | 80   | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |   | -    | 11   | -    |      |
| $Q_{gc}$  | Gate-collector charge        |   | -    | 39   | -    |      |

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

| Symbol       | Parameter           | Test conditions  | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}, I_C = 30\text{ A},$<br>$V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega$                      | -    | 200  | -    | ns   |
| $t_f$        | Current fall time   | (see Figure 21. Test circuit for inductive load switching)   | -    | 33   | -    |      |
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}, I_C = 30\text{ A},$<br>$V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega, T_J = 175\text{ °C}$ | -    | 224  | -    | ns   |
| $t_f$        | Current fall time   | (see Figure 21. Test circuit for inductive load switching)   | -    | 88   | -    |      |

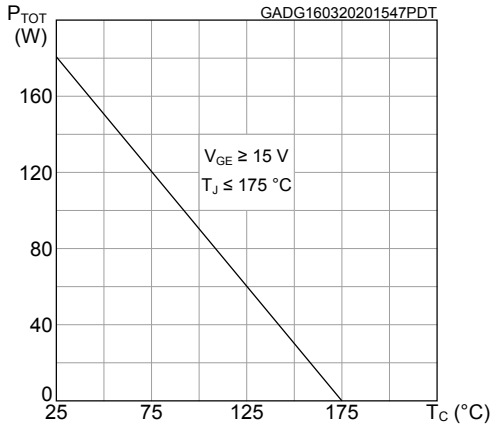
**Table 6. IGBT switching characteristics (capacitive load)**

| Symbol          | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------|---------------------------|---|------|------|------|---------------|
| $E_{off}^{(1)}$ | Turn-off switching energy | $V_{CC} = 320\text{ V}$ , $R_G = 10\ \Omega$ ,<br>$I_C = 30\text{ A}$ , $L = 100\ \mu\text{H}$ ,<br>$C_{snub} = 22\text{ nF}$<br>(see Figure 22. Test circuit for snubbed inductive load switching)                                     | -    | 123  | -    | $\mu\text{J}$ |
|                 |                           | $V_{CC} = 320\text{ V}$ , $R_G = 10\ \Omega$ ,<br>$I_C = 30\text{ A}$ , $L = 100\ \mu\text{H}$ ,<br>$C_{snub} = 22\text{ nF}$ , $T_J = 175\text{ }^\circ\text{C}$<br>(see Figure 22. Test circuit for snubbed inductive load switching) | -    | 298  | -    |               |

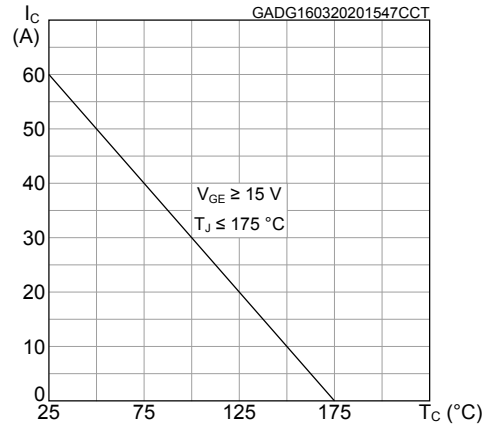
1. Including the tail of the collector current.

## 2.1 Electrical characteristics (curves)

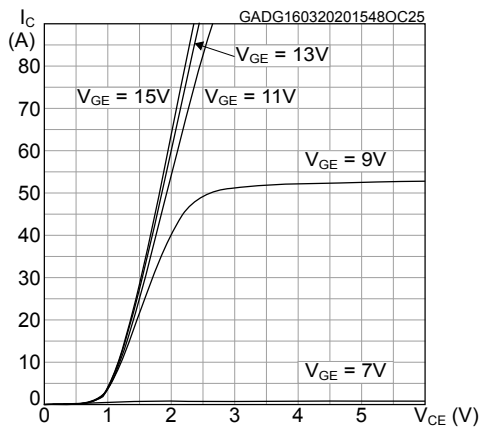
**Figure 1. Power dissipation vs case temperature**



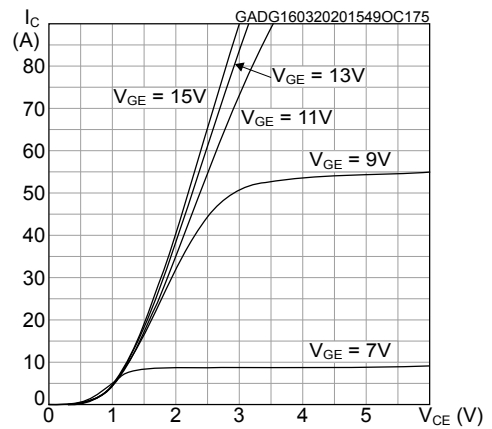
**Figure 2. Collector current vs case temperature**



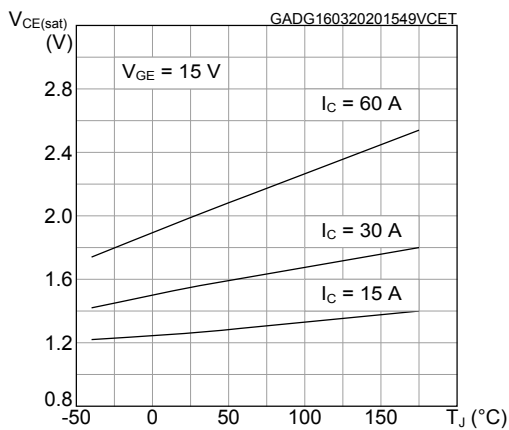
**Figure 3. Output characteristics (T<sub>J</sub> = 25 °C)**



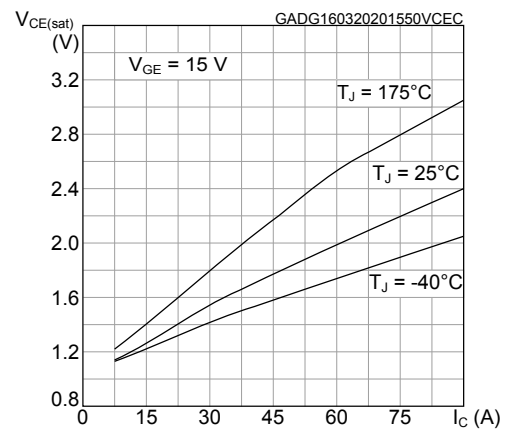
**Figure 4. Output characteristics (T<sub>J</sub> = 175 °C)**



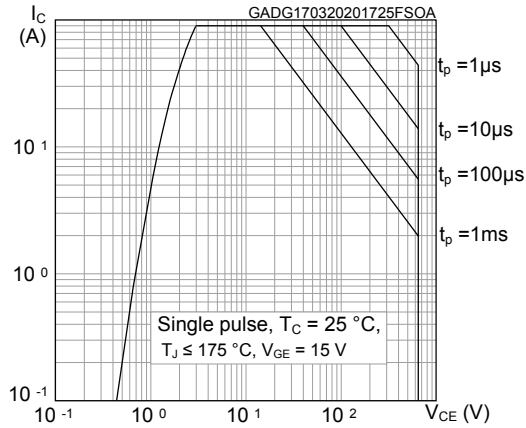
**Figure 5. V<sub>CE(sat)</sub> vs junction temperature**



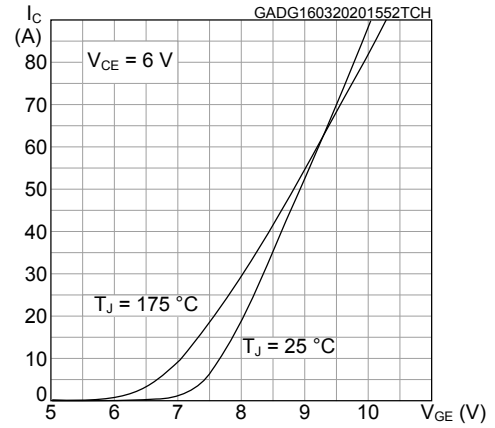
**Figure 6. V<sub>CE(sat)</sub> vs collector current**



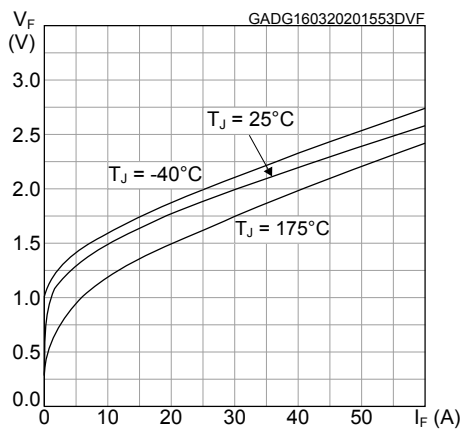
**Figure 7. Forward bias safe operating area**



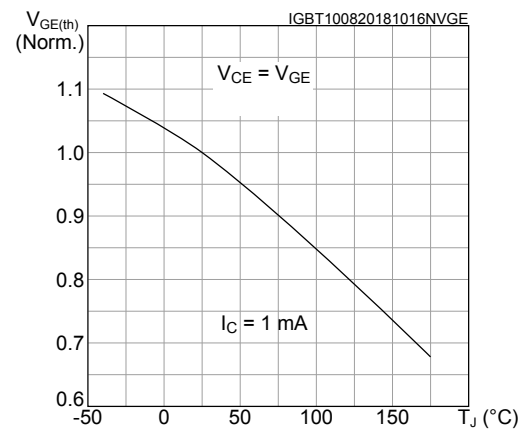
**Figure 8. Transfer characteristics**



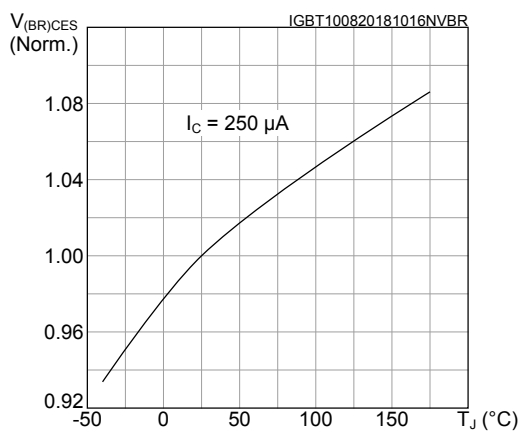
**Figure 9. Diode V\_F vs forward current**



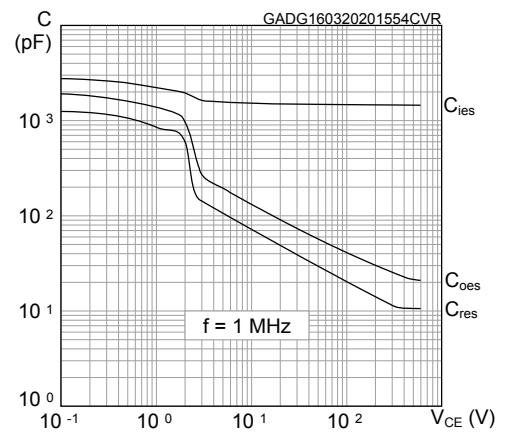
**Figure 10. Normalized V\_GE(th) vs junction temperature**



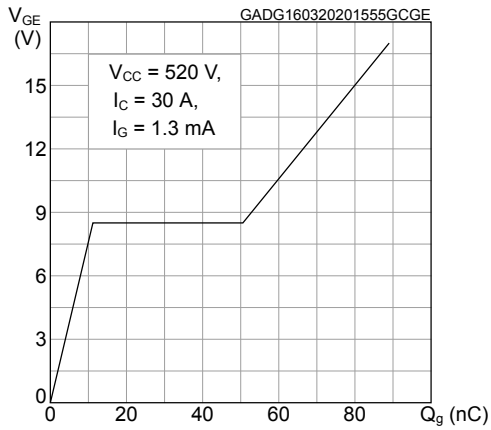
**Figure 11. Normalized V\_(BR)CES vs junction temperature**



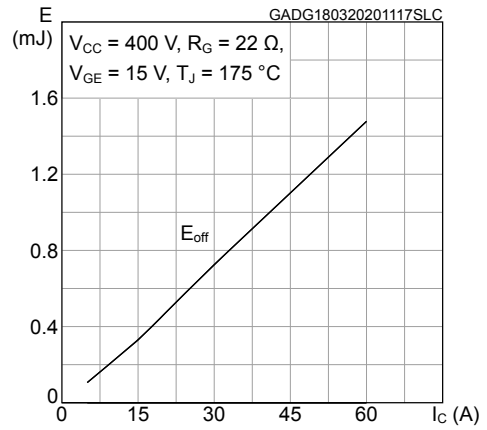
**Figure 12. Capacitance variations**



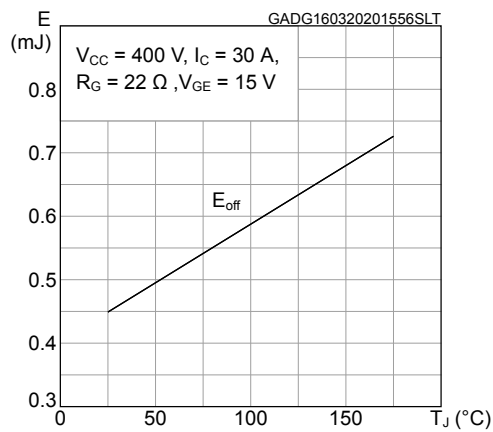
**Figure 13. Gate charge vs gate-emitter voltage**



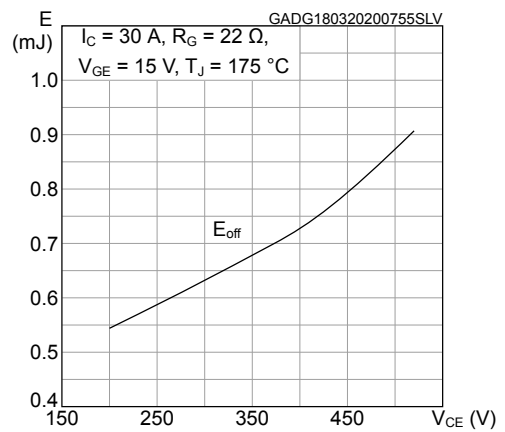
**Figure 14. Switching energy vs collector current**



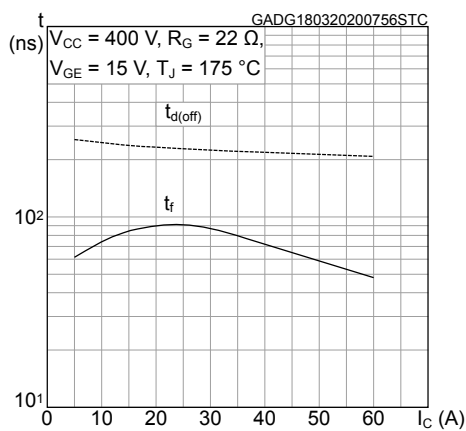
**Figure 15. Switching energy vs temperature**



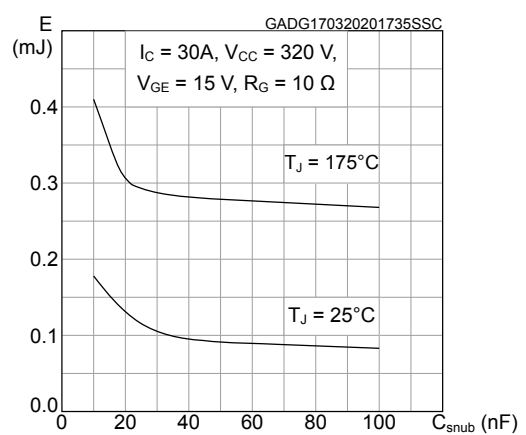
**Figure 16. Switching energy vs collector emitter voltage**



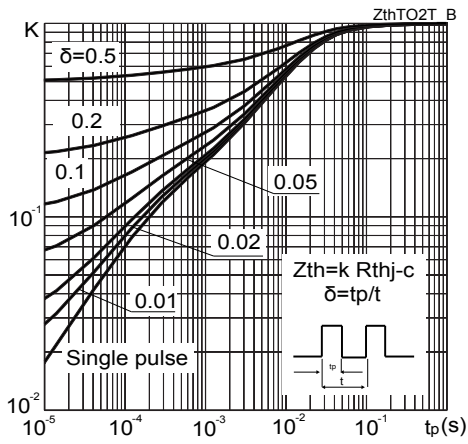
**Figure 17. Switching times vs collector current**



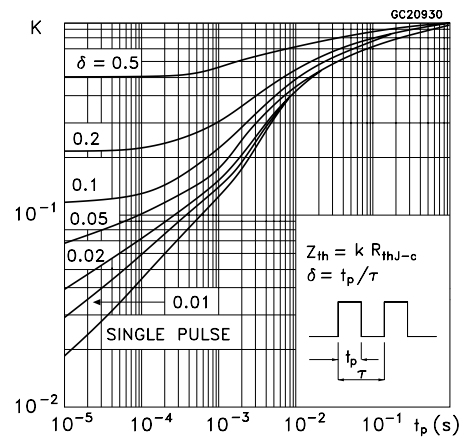
**Figure 18. Switching energy vs snubber capacitance**



**Figure 19. Thermal impedance for IGBT**



**Figure 20. Thermal impedance for diode**





### 3 Test circuits

Figure 21. Test circuit for inductive load switching

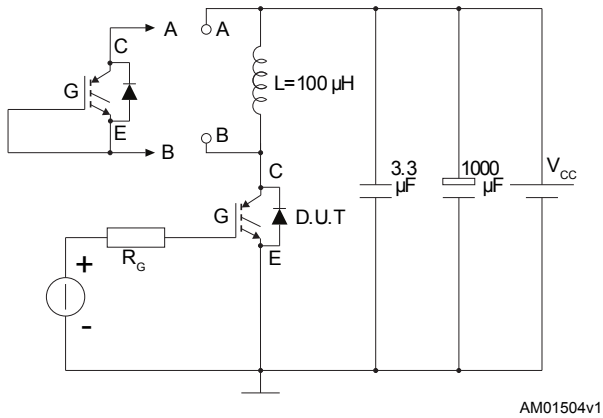


Figure 22. Test circuit for snubbed inductive load switching

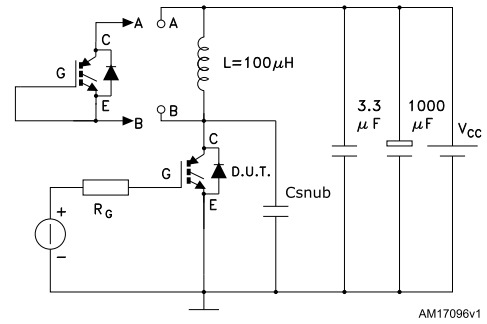


Figure 23. Gate charge test circuit

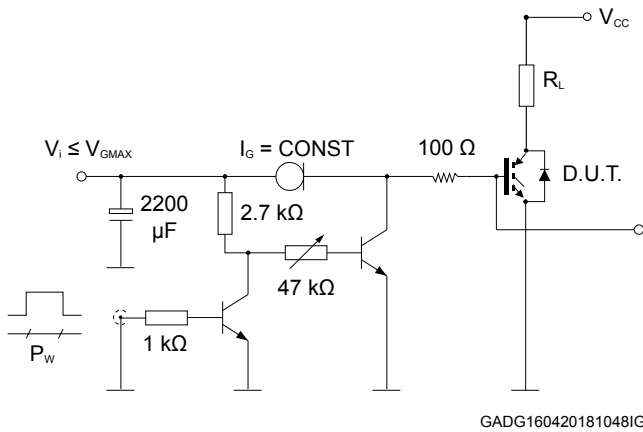
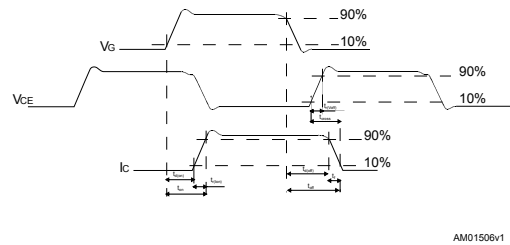


Figure 24. Switching waveform

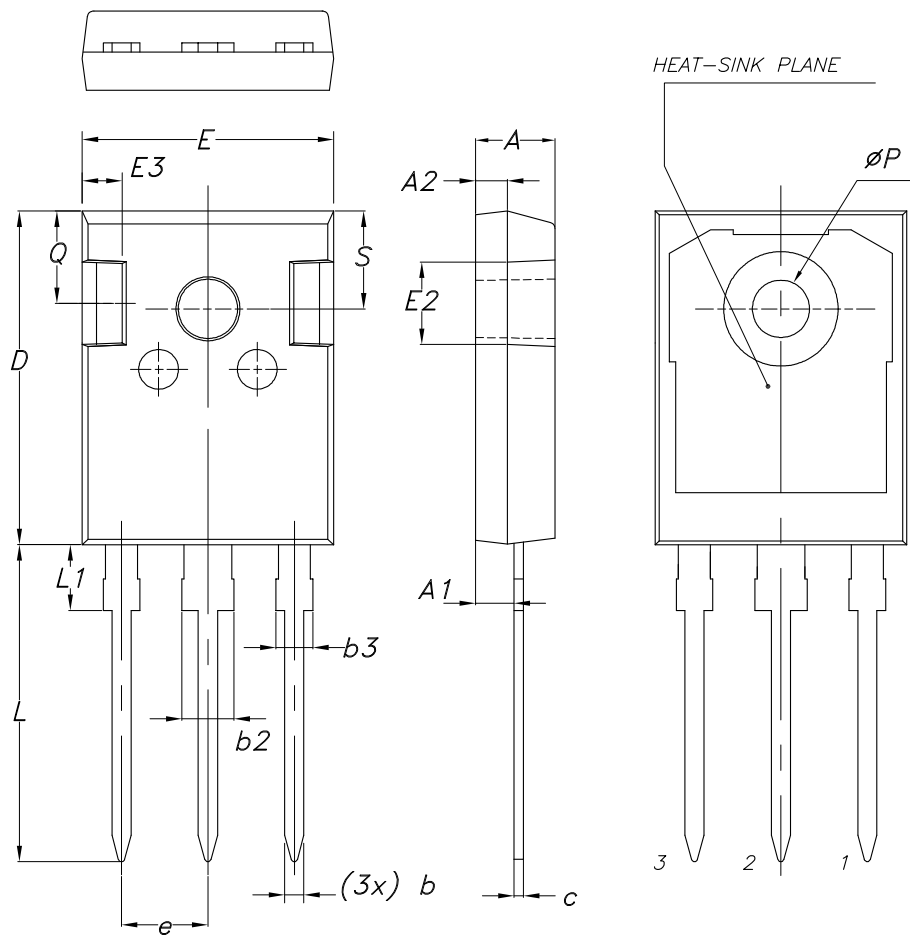


## 4 Package information

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

### 4.1 TO-247 long leads package information

Figure 25. TO-247 long leads package outline



8463846\_2\_F

**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  |
| P    | 3.50  | 3.60  | 3.70  |
| Q    | 5.60  |       | 6.00  |
| S    | 6.05  | 6.15  | 6.25  |

## Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 27-Mar-2020 | 1        | First release. |

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