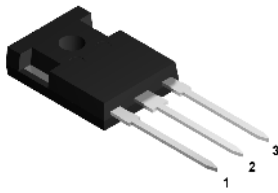
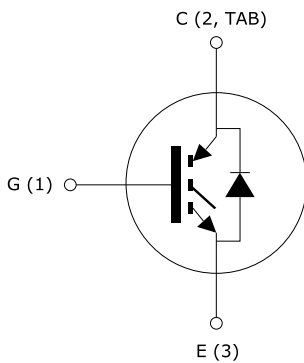


## 31 A, 600 V, fast IGBT with UltraFAST diode



TO-247 long leads



SC12850\_DIODE\_IGBT



### Features

- Low on-voltage drop ( $V_{CE(sat)}$ )
- Very soft UltraFAST recovery anti-parallel diode

### Applications

- High frequency motor drives
- SMPS and PFC in both hard switch and resonant topologies

### Description

This device uses the advanced PowerMESH process resulting in an excellent trade-off between switching performance and low on-state behavior.

#### Product status link

[STGWA19NC60HD](#)

#### Product summary

|                   |                   |
|-------------------|-------------------|
| <b>Order code</b> | STGWA19NC60HD     |
| <b>Marking</b>    | GWA19NC60HD       |
| <b>Package</b>    | TO-247 long leads |
| <b>Packing</b>    | Tube              |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol                         | Parameter   | Value      | Unit |
|--------------------------------|---|------------|------|
| V <sub>CES</sub>               | Collector-emitter voltage (V <sub>GE</sub> = 0 V)                       | 600        | V    |
| I <sub>C</sub> <sup>(1)</sup>  | Continuous collector current at T <sub>C</sub> = 25 °C                  | 52         | A    |
|                                | Continuous collector current at T <sub>C</sub> = 100 °C                 | 31         |      |
| I <sub>CL</sub> <sup>(2)</sup> | Turn-off latching current   | 40         | A    |
| I <sub>CP</sub> <sup>(3)</sup> | Pulsed collector current  | 60         | A    |
| V <sub>GE</sub>                | Gate-emitter voltage  | ±20        | V    |
| I <sub>F</sub>                 | Diode RMS forward current at T <sub>C</sub> = 25 °C                     | 20         | A    |
| I <sub>FSM</sub>               | Surge not repetitive forward current, t <sub>p</sub> = 10 ms sinusoidal | 50         | A    |
| P <sub>TOT</sub>               | Total power dissipation at T <sub>C</sub> = 25 °C                       | 208        | W    |
| T <sub>J</sub>                 | Operating junction temperature range                                    | -55 to 150 | °C   |
| T <sub>STG</sub>               | Storage temperature range   |            | °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<sub>clamp</sub> = 80% V<sub>CES</sub>. T<sub>J</sub> = 150 °C, R<sub>G</sub> = 10 Ω, V<sub>GE</sub> = 15 V.
3. Pulse width limited by maximum junction temperature and turn-off within RBSOA.

**Table 2. Thermal data**

| Symbol            | Parameter                                  | Value | Unit |
|-------------------|--|-------|------|
| R <sub>thJC</sub> | Thermal resistance, junction-to-case IGBT  | 0.6   | °C/W |
|                   | Thermal resistance, junction-to-case diode | 3     | °C/W |
| R <sub>thJA</sub> | Thermal resistance, junction-to-ambient    | 50    | °C/W |

## 2 Electrical characteristics

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

**Table 3. Static**

| Symbol        | Parameter                            | Test conditions   | Min. | Typ. | Max.      | Unit          |
|---------------|--------------------------------------|---|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage  | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$                                | 600  |      |           | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 12\text{ A}$                               |      | 1.8  | 2.5       | V             |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 15\text{ A}$                               |      | 2    |           |               |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 100\text{ °C}$          |      | 2.5  |           |               |
|               |                                      | $V_{GE} = 15\text{ V}, I_C = 12\text{ A}, T_J = 125\text{ °C}$          |      | 1.6  |           |               |
| $V_{GE(th)}$  | Gate threshold voltage               | $V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$                         | 3.75 |      | 5.75      | V             |
| $I_{CES}$     | Collector cut-off current            | $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$                            |      |      | 150       | $\mu\text{A}$ |
|               |                                      | $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ °C}^{(1)}$ |      |      | 1         | mA            |
| $I_{GES}$     | Gate-emitter leakage current         | $V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$                         |      |      | $\pm 100$ | nA            |
| $g_{fs}$      | Forward transconductance             | $V_{CE} = 15\text{ V}, I_C = 12\text{ A}$                               |      | 5    |           | S             |

1. Specified by design, not tested in production.

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$   | -    | 1180 | -    | pF   |
| $C_{oes}$ | Output capacitance           |   | -    | 130  | -    |      |
| $C_{res}$ | Reverse transfer capacitance |   | -    | 36   | -    |      |
| $Q_g$     | Total gate charge            | $V_{CE} = 390\text{ V}, I_C = 12\text{ A}, V_{GE} = 15\text{ V}$<br>(see Figure 17. Gate charge test circuit) | -    | 53   | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |   | -    | 10   | -    |      |
| $Q_{gc}$  | Gate-collector charge        |   | -    | 23   | -    |      |

**Table 5. Switching on/off (inductive load)**

| Symbol         | Parameter             | Test conditions  | Min. | Typ. | Max. | Unit       |
|----------------|-----------------------|--|------|------|------|------------|
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,  | -    | 25   | -    | ns         |
| $t_r$          | Current rise time     | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$  | -    | 7    | -    | ns         |
| $(di/dt)_{on}$ | Turn-on current slope | (see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform) | -    | 1600 | -    | A/ $\mu$ s |
| $t_{d(on)}$    | Turn-on delay time    | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,  | -    | 24   | -    | ns         |
| $t_r$          | Current rise time     | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$              | -    | 8    | -    | ns         |
| $(di/dt)_{on}$ | Turn-on current slope | (see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform) | -    | 1400 | -    | A/ $\mu$ s |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,  | -    | 27   | -    | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$  | -    | 97   | -    | ns         |
| $t_f$          | Current fall time     | (see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform) | -    | 73   | -    | ns         |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,  | -    | 58   | -    | ns         |
| $t_{d(off)}$   | Turn-off delay time   | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$              | -    | 144  | -    | ns         |
| $t_f$          | Current fall time     | (see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform) | -    | 128  | -    | ns         |

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

| Symbol          | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit    |
|-----------------|---------------------------|---|------|------|------|---------|
| $E_{on}$        | Turn-on switching energy  | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,                                 | -    | 85   | -    | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching energy | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$                                     | -    | 189  | -    | $\mu$ J |
| $E_{ts}$        | Total switching energy    | (see Figure 16. Test circuit for inductive load switching)                      | -    | 274  | -    | $\mu$ J |
| $E_{on}$        | Turn-on switching energy  | $V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ ,                                 | -    | 187  | -    | $\mu$ J |
| $E_{off}^{(1)}$ | Turn-off switching energy | $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$ | -    | 407  | -    | $\mu$ J |
| $E_{ts}$        | Total switching energy    | (see Figure 16. Test circuit for inductive load switching)                      | -    | 594  | -    | $\mu$ J |

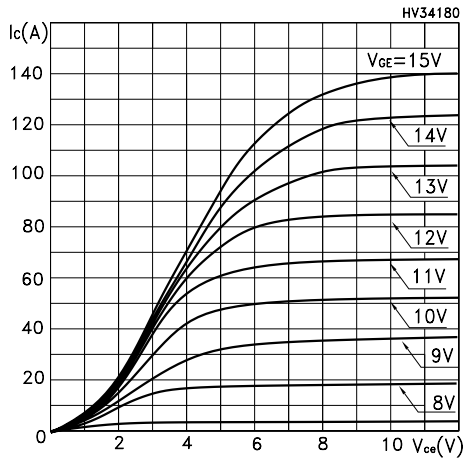
1. Including the tail of the collector current.

**Table 7. Collector-emitter diode**

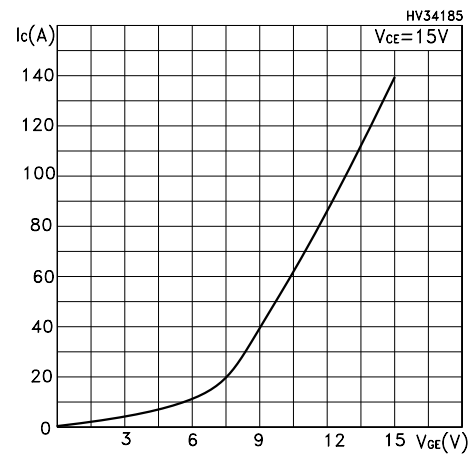
| Symbol    | Parameter                | Test conditions  | Min.      | Typ.                     | Max. | Unit |   |    |
|-----------|--------------------------|--|-----------|--------------------------|------|------|---|----|
| $V_F$     | Forward on-voltage       | $I_F = 12\text{ A}$  | -         | 2.6                      | -    | V    |   |    |
|           |                          | $I_F = 12\text{ A}, T_J = 125\text{ °C}$   | -         | 2.1                      | -    | V    |   |    |
| $t_{rr}$  | Reverse recovery time    | $I_F = 12\text{ A}, V_R = 40\text{ V}, T_J = 25\text{ °C},$<br>$di/dt = 100\text{ A}/\mu\text{s}$ (see <a href="#">Figure 19. Diode reverse recovery waveform</a> )  | -         | 31                       | -    | ns   |   |    |
| $Q_{rr}$  | Reverse recovery charge  |  | -         | 30                       | -    | nC   |   |    |
| $I_{rrm}$ | Reverse recovery current |  | -         | 2                        | -    | A    |   |    |
| $t_{rr}$  | Reverse recovery time    | $I_F = 12\text{ A}, V_R = 40\text{ V}, T_J = 125\text{ °C},$<br>$di/dt = 100\text{ A}/\mu\text{s}$ (see <a href="#">Figure 19. Diode reverse recovery waveform</a> ) | -         | 59                       | -    | ns   |   |    |
|           |                          |  | $Q_{rr}$  | Reverse recovery charge  | -    | 102  | - | nC |
|           |                          |  | $I_{rrm}$ | Reverse recovery current | -    | 4    | - | A  |

## 2.1 Electrical characteristics (curves)

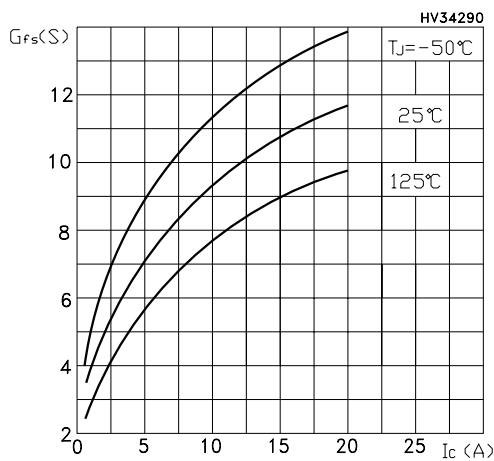
**Figure 1. Output characteristics**



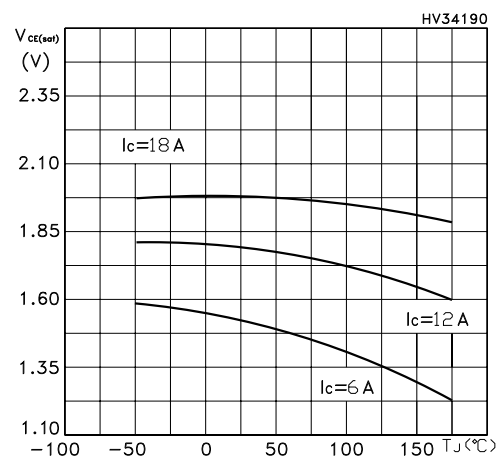
**Figure 2. Transfer characteristics**



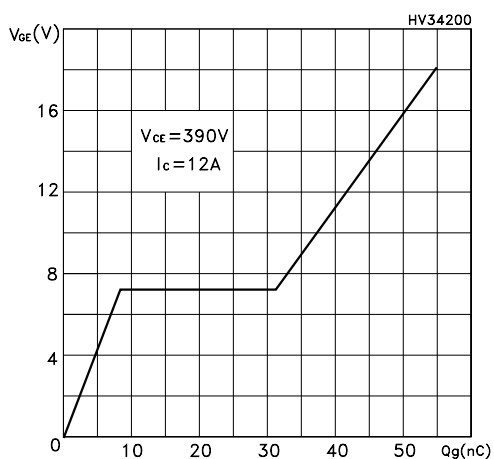
**Figure 3. Transconductance**



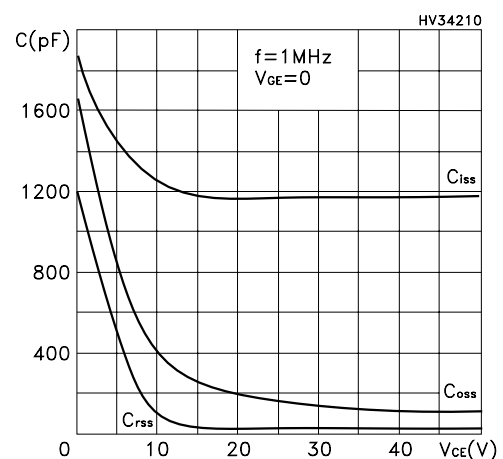
**Figure 4. Collector-emitter on voltage vs temperature**



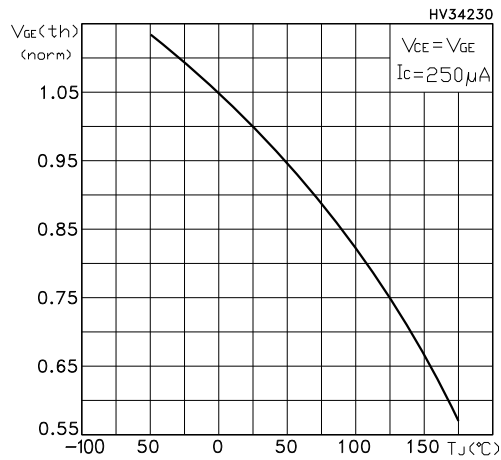
**Figure 5. Gate charge vs gate-source voltage**



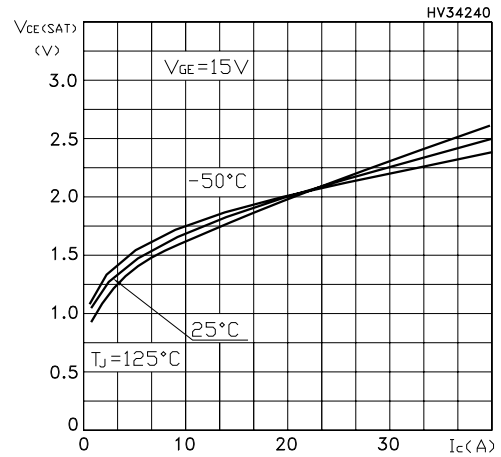
**Figure 6. Capacitance variations**



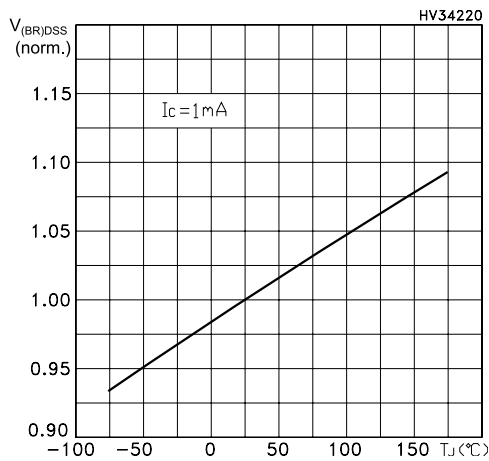
**Figure 7. Normalized gate threshold voltage vs temperature**



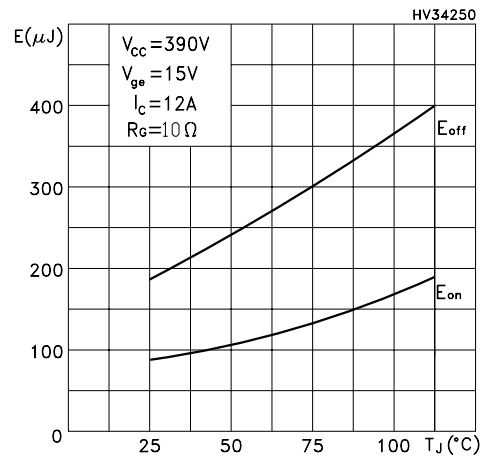
**Figure 8. Collector-emitter on voltage vs collector current**



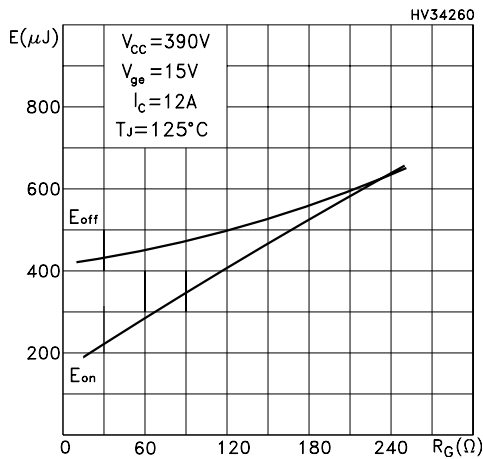
**Figure 9. Normalized breakdown voltage vs temperature**



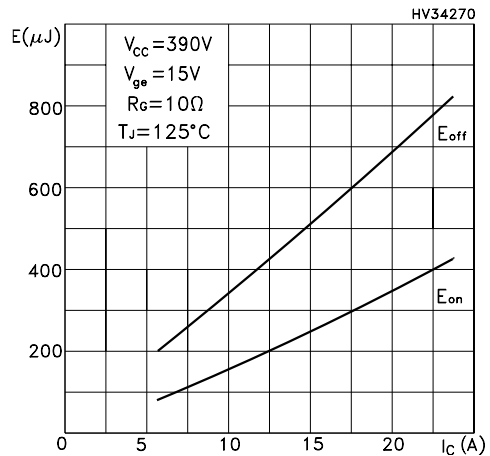
**Figure 10. Switching energy vs temperature**



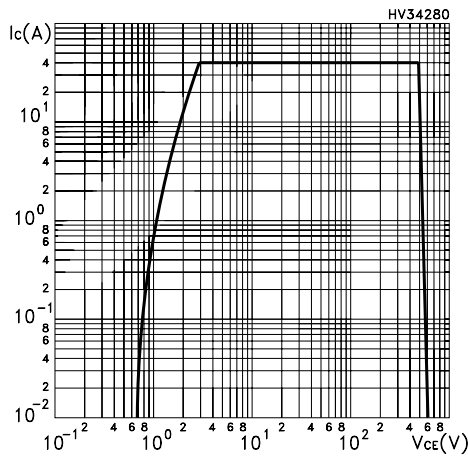
**Figure 11. Switching energy vs gate resistance**



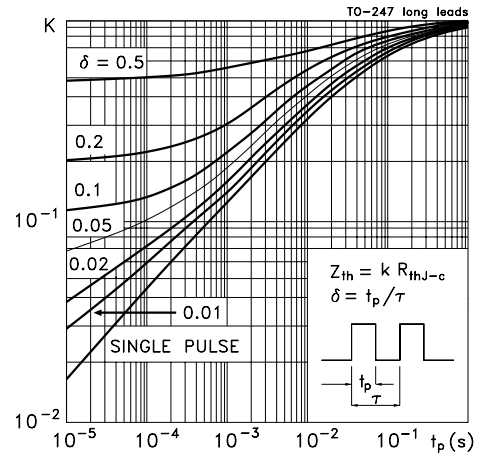
**Figure 12. Switching energy vs collector current**



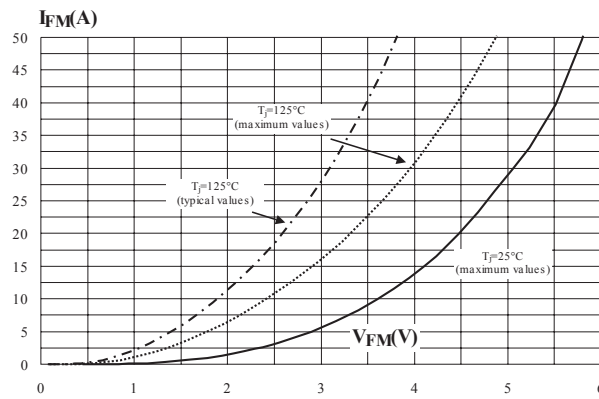
**Figure 13. Turn-off SOA**



**Figure 14. Thermal impedance**



**Figure 15. Forward voltage drop vs. forward current**





### 3 Test circuits

Figure 16. Test circuit for inductive load switching

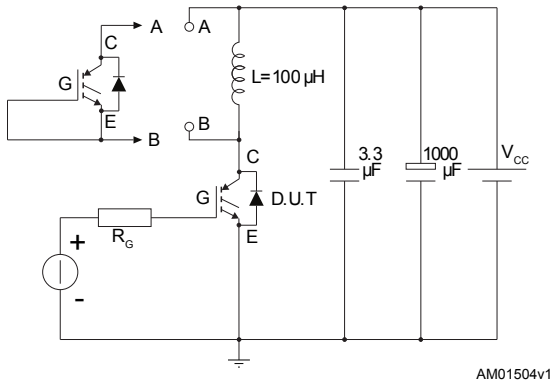


Figure 17. Gate charge test circuit

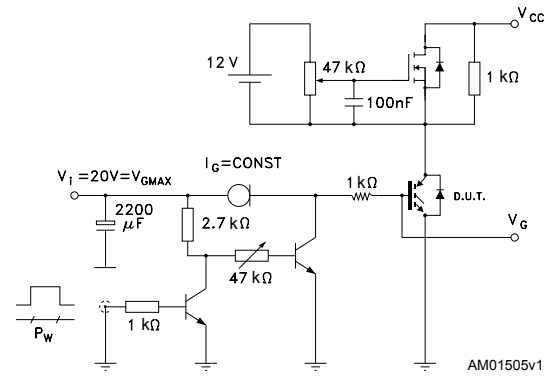


Figure 18. Switching waveform

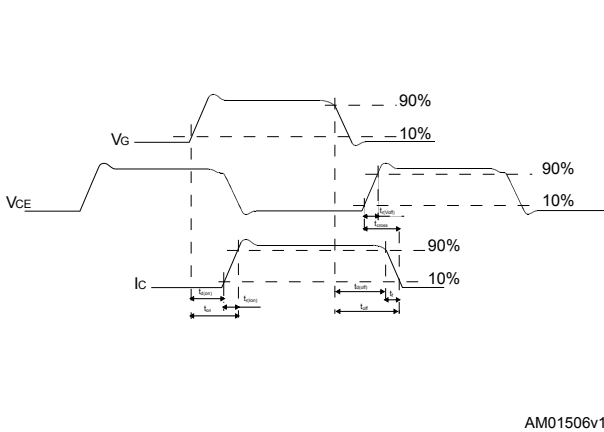
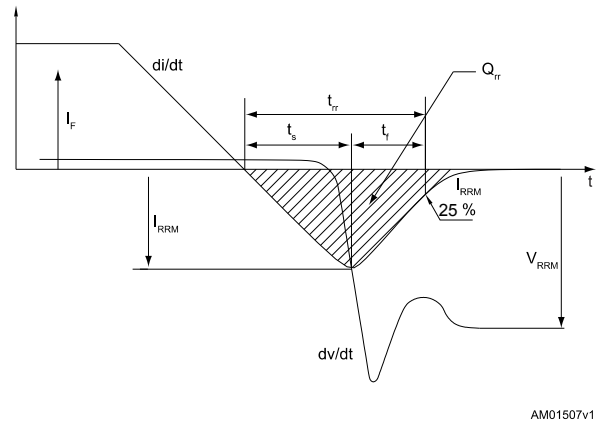


Figure 19. Diode reverse recovery waveform

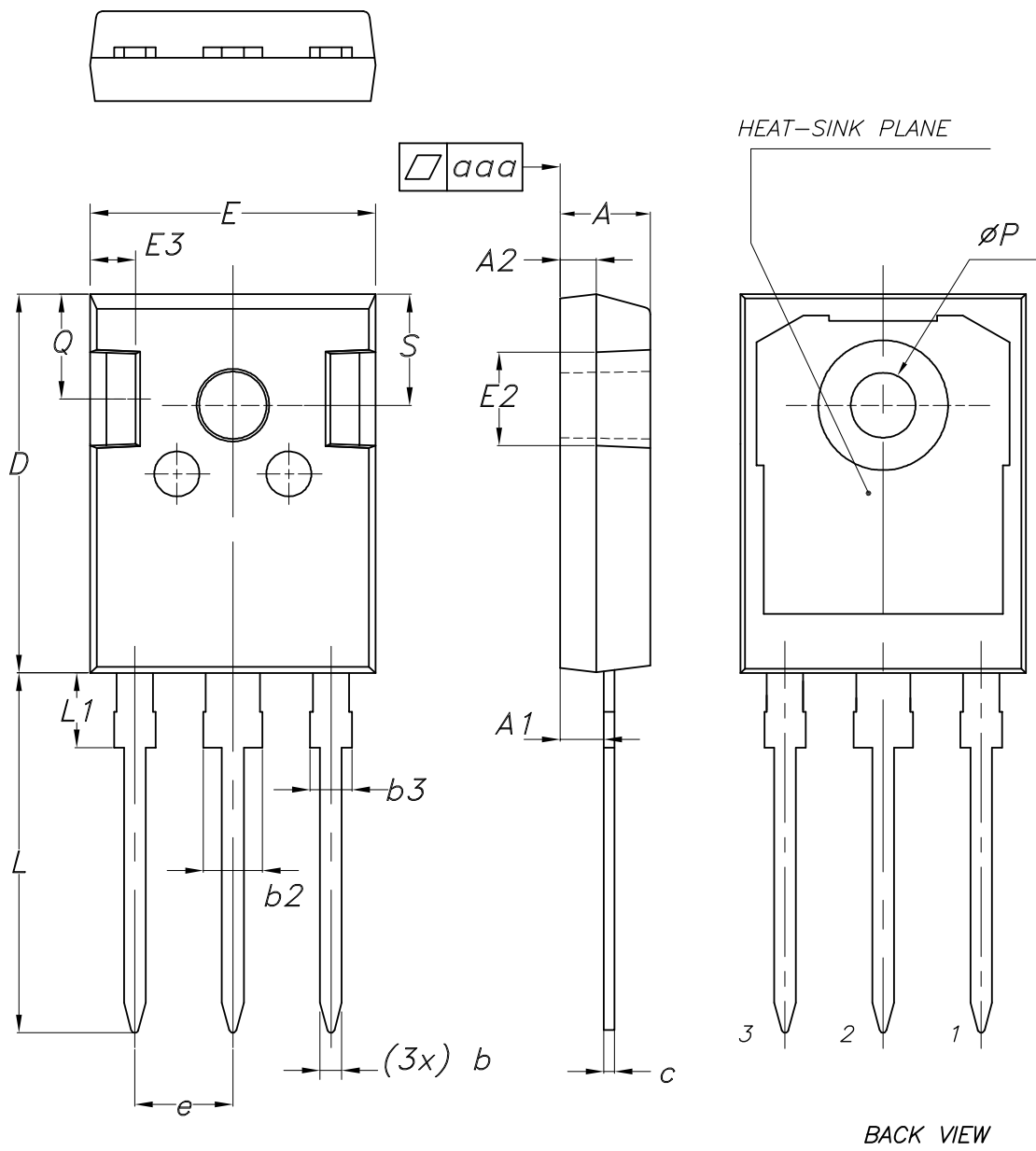


## 4 Package information

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 20. TO-247 long leads package outline



8463846\_3

**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  |
| aaa  |       | 0.04  | 0.10  |

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 14-Sep-2011 | 1        | First release.   |
| 02-May-2022 | 2        | Updated Section 4.1 TO-247 long leads package information<br>Minor text changes. |

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