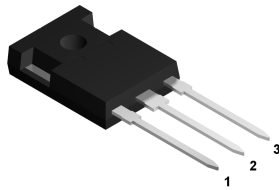
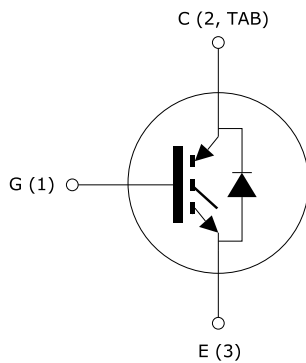


## 40 A, 600 V, fast IGBT with UltraFAST diode



TO-247 long leads



SC12850\_DIODE\_IGBT



### Features

- High current capability
- High frequency operation up to 50 kHz
- Very soft ultra fast recovery antiparallel diode

### Applications

- High frequency inverters, UPS
- Motor drive
- 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

[STGW30NC60VD](#)

#### Product summary

<b>Order code</b>	STGW30NC60VD
<b>Marking</b>	GW30NC60VD
<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	80	A
	Continuous collector current at T <sub>C</sub> = 100 °C	40	
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	100	A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	150	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	30	A
I <sub>FSM</sub>	Surge not repetitive forward current, t <sub>p</sub> = 10 ms sinusoidal	120	A
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	250	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	0.5	°C/W
	Thermal resistance, junction-to-case diode	1.5	°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	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$		1.8	2.5	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$		2.1		
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 100\text{ °C}$		2.9		
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 125\text{ °C}$		1.7		
$V_{GE(th)}$	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	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$			10	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ °C}^{(1)}$			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	$V_{CE} = 15\text{ V}, I_C = 20\text{ A}$		15		S

1. Specified by design, not tested in production.

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	2200		pF
$C_{oes}$	Output capacitance		-	225		
$C_{res}$	Reverse transfer capacitance		-	50		
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}, I_C = 20\text{ A}, V_{GE} = 15\text{ V}$ (see Figure 17. Gate charge test circuit)	-	100	140	nC
$Q_{ge}$	Gate-emitter charge		-	16		
$Q_{gc}$	Gate-collector charge		-	45		

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	31	-	ns
$t_r$	Current rise time	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$	-	11	-	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	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	31	-	ns
$t_r$	Current rise time	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	11.5	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform)	-	1500	-	A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	28	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$	-	100	-	ns
$t_f$	Current fall time	(see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform)	-	75	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	66	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	150	-	ns
$t_f$	Current fall time	(see Figure 16. Test circuit for inductive load switching and Figure 18. Switching waveform)	-	130	-	ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	220	300	$\mu$ J
$E_{off}^{(1)}$	Turn-off switching energy	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$	-	330	450	$\mu$ J
$E_{ts}$	Total switching energy	(see Figure 16. Test circuit for inductive load switching)	-	550	750	$\mu$ J
$E_{on}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$ , $I_C = 20\text{ A}$ ,	-	450		$\mu$ J
$E_{off}^{(1)}$	Turn-off switching energy	$R_G = 3.3\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	770		$\mu$ J
$E_{ts}$	Total switching energy	(see Figure 16. Test circuit for inductive load switching)	-	1220		$\mu$ J

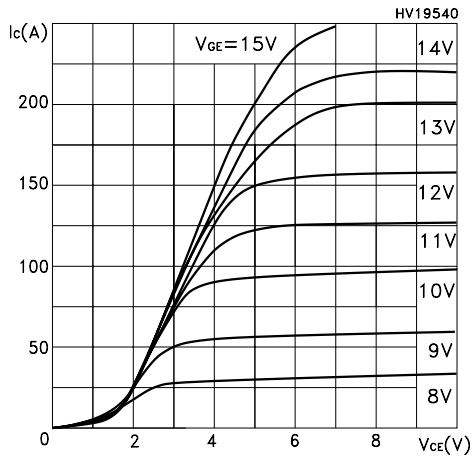
1. Including the tail of the collector current.

**Table 7. Collector-emitter diode**

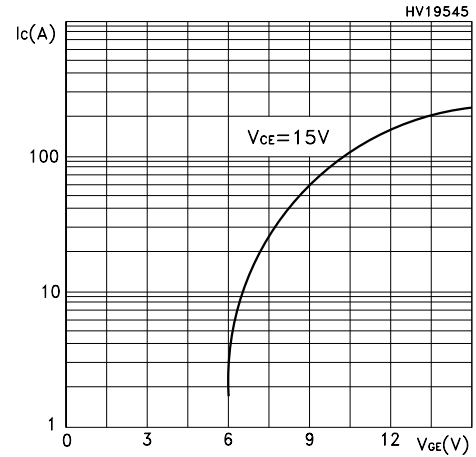
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit		
V <sub>F</sub>	Forward on-voltage	I <sub>F</sub> = 20 A	-	1.8	2.3	V		
		I <sub>F</sub> = 20 A, T <sub>J</sub> = 125 °C	-	1.4		V		
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> = 20 A, V <sub>R</sub> = 40 V, T <sub>J</sub> = 25 °C, di/dt = 100 A/μs (see Figure 19. Diode reverse recovery waveform)	-	44		ns		
Q <sub>rr</sub>	Reverse recovery charge		-	66		nC		
I <sub>rrm</sub>	Reverse recovery current		-	3		A		
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> = 20 A, V <sub>R</sub> = 40 V, T <sub>J</sub> = 125 °C, di/dt = 100 A/μs (see Figure 19. Diode reverse recovery waveform)	-	88		ns		
			Q <sub>rr</sub>	Reverse recovery charge	-	237		nC
			I <sub>rrm</sub>	Reverse recovery current	-	5.4		A

## 2.1 Electrical characteristics (curves)

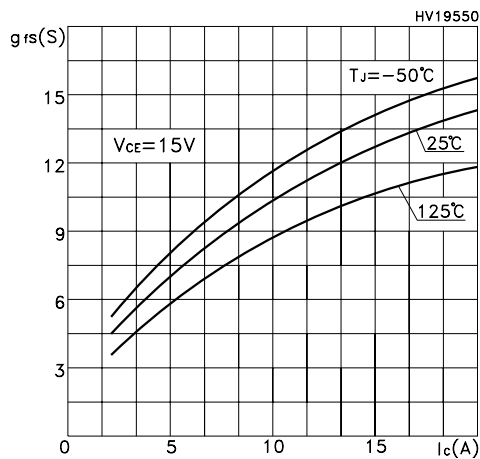
**Figure 1. Output characteristics**



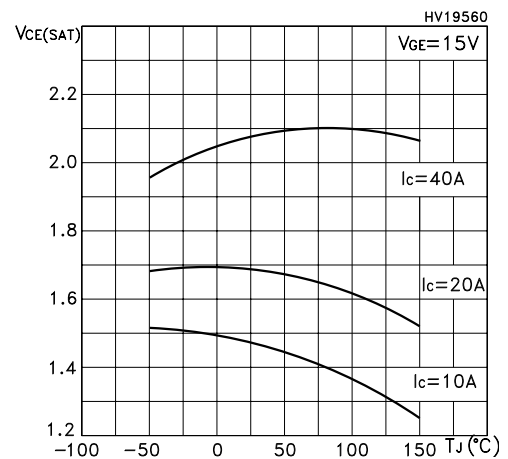
**Figure 2. Transfer characteristics**



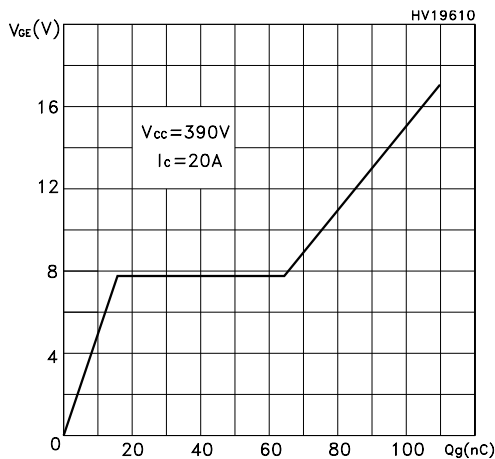
**Figure 3. Transconductance**



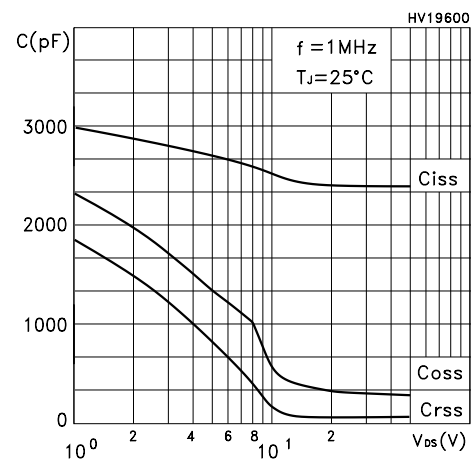
**Figure 4. Collector-emitter on voltage vs temperature**



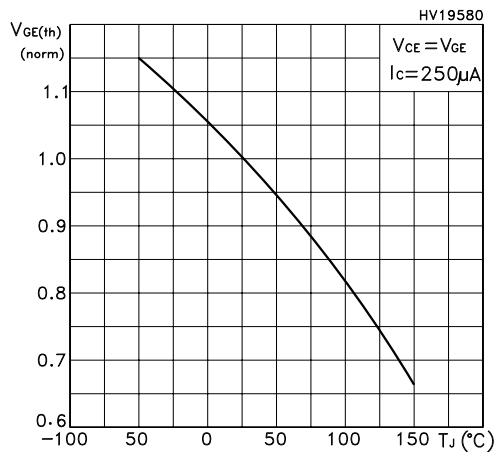
**Figure 5. Gate charge vs gate-source voltage**



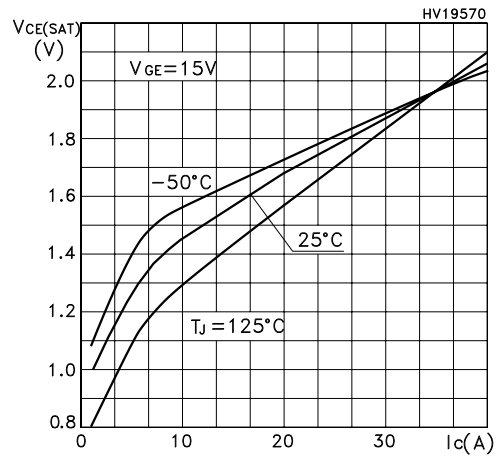
**Figure 6. Capacitance variations**



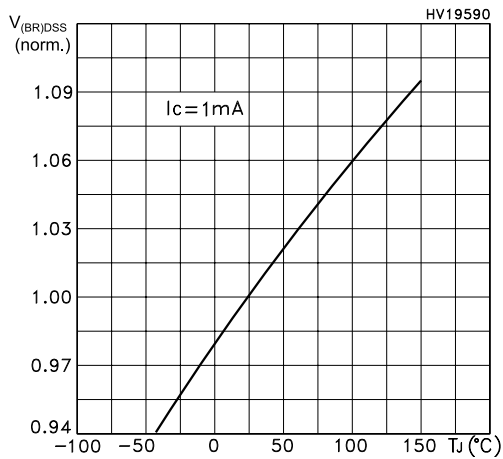
**Figure 7. Normalized gate threshold voltage vs temperature**



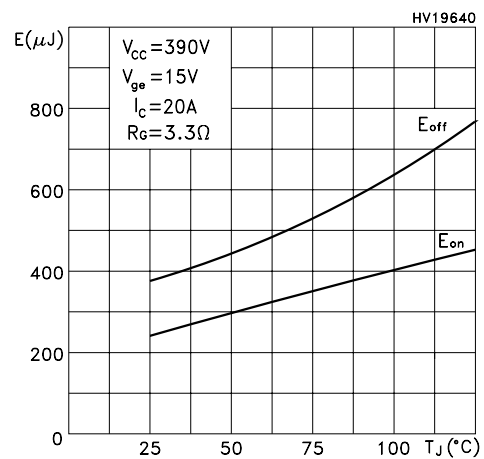
**Figure 8. Collector-emitter on voltage vs collector current**



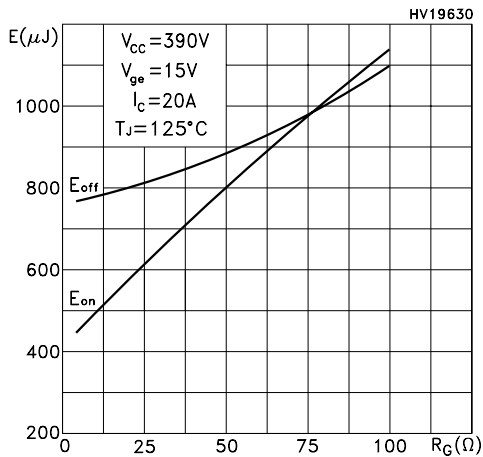
**Figure 9. Normalized breakdown voltage vs temperature**



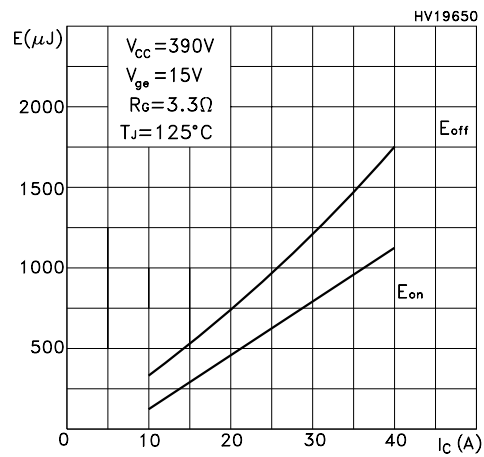
**Figure 10. Switching energy vs temperature**



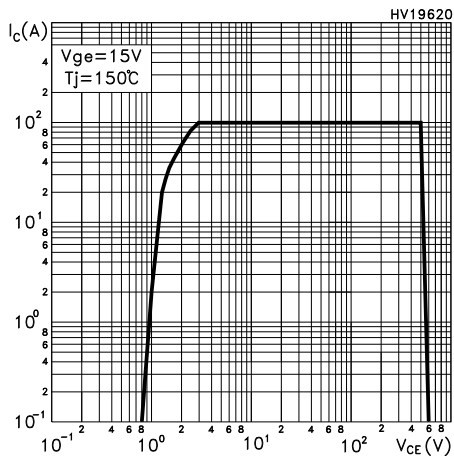
**Figure 11. Switching energy vs gate resistance**



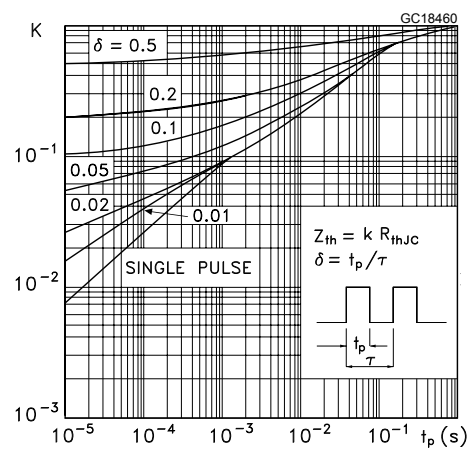
**Figure 12. Switching energy vs collector current**



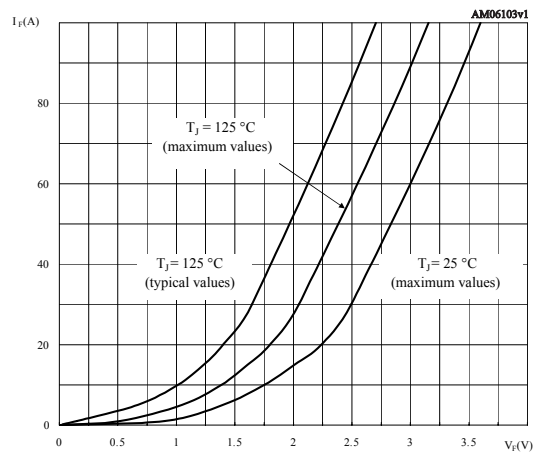
**Figure 13. Turn-off SOA**



**Figure 14. Thermal Impedance**



**Figure 15. Emitter-collector diode characteristics**





### 3 Test circuits

Figure 16. Test circuit for inductive load switching

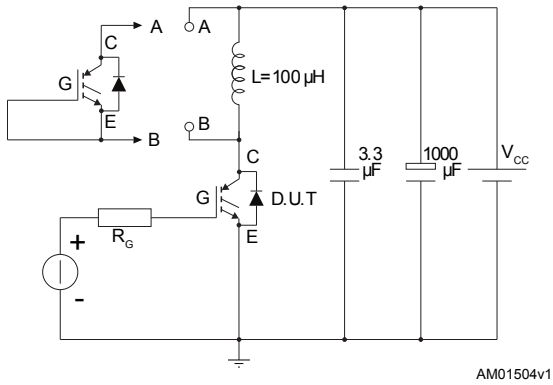


Figure 17. Gate charge test circuit

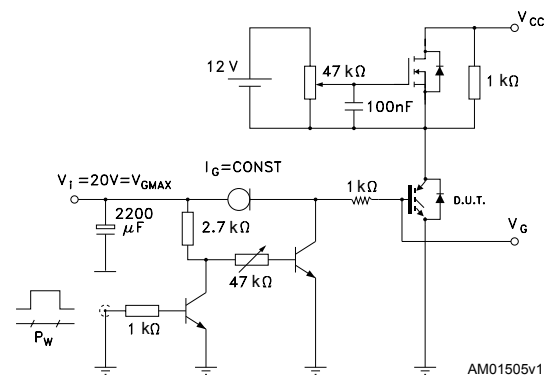


Figure 18. Switching waveform

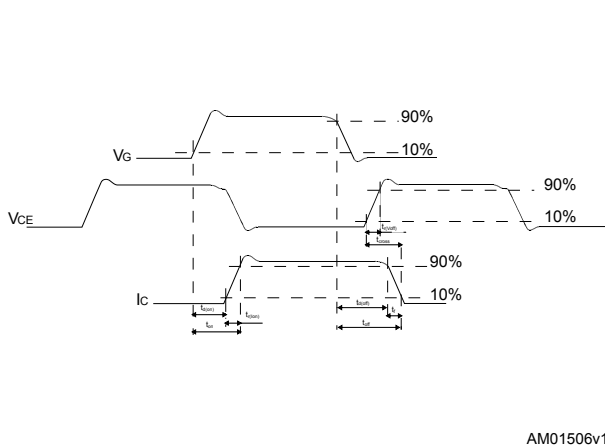
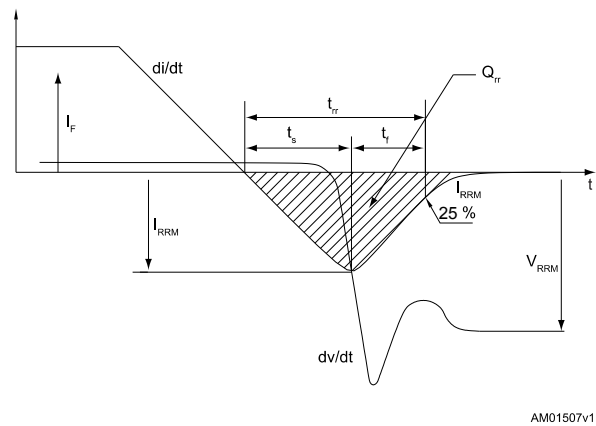


Figure 19. Diode reverse recovery waveform

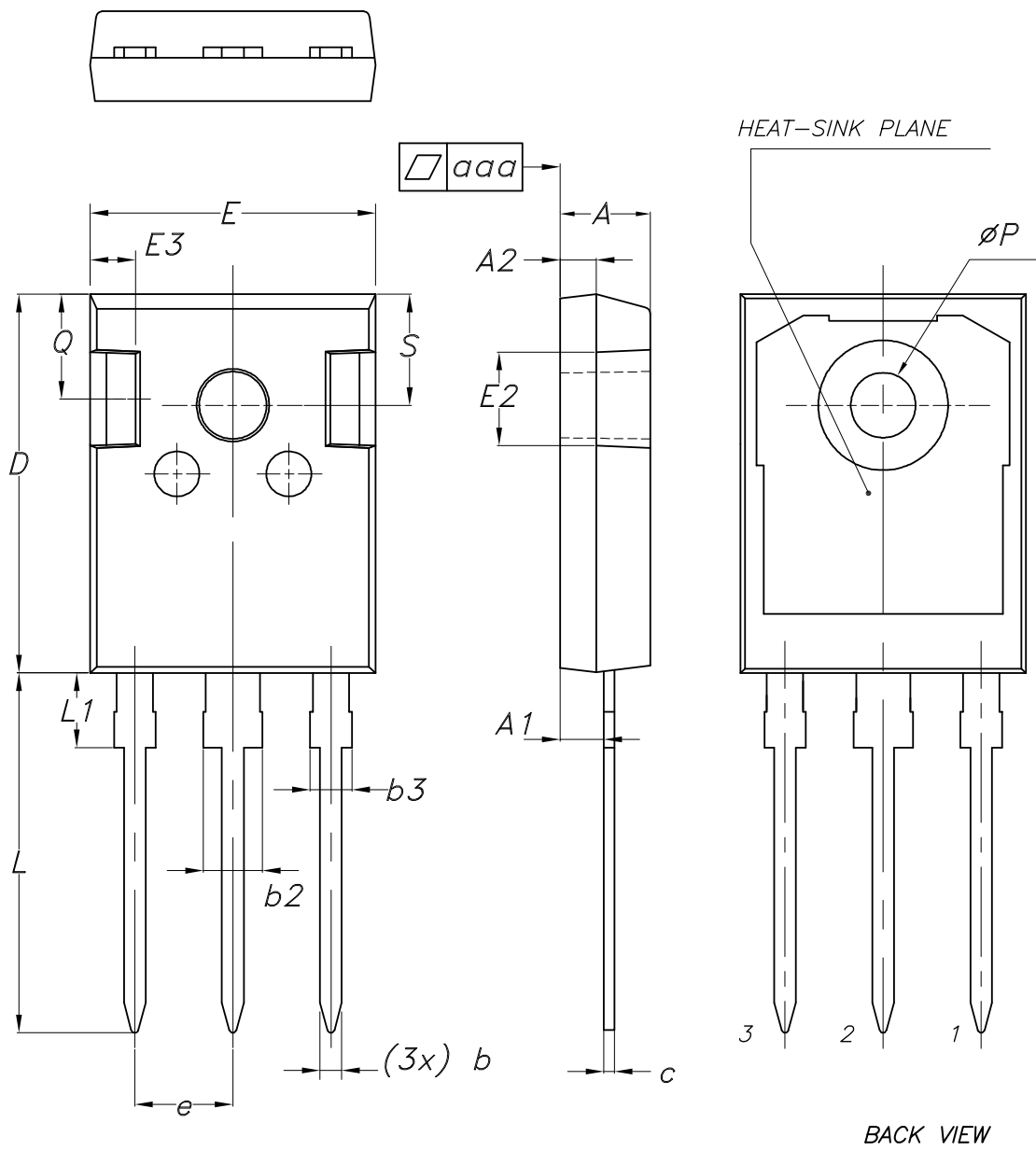


## 4 Package information

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	Version	Changes
12-Feb-2007	1	First release.
19-Feb-2007	2	<i>Figure 6</i> has been updated
12-Mar-2010	3	Inserted IFSM parameter on <i>Table 2: Absolute maximum ratings</i> . Updated <i>Figure 16: Emitter-collector diode characteristics</i> and package mechanical data.
03-Jan-2011	4	Updated <i>Table 4: Static</i> , <i>Table 8: Collector-emitter diode</i> and <i>Figure 14: Thermal impedance</i> .
23-Feb-2011	5	Added $T_L$ row <i>Table 2</i> on page 3.
02-May-2022	6	Updated <a href="#">Section 4.1</a> TO-247 long leads package information. Minor text changes.

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