

60 A, 600 V, very low drop IGBT

Features

- Very low on-state voltage drop
- Low switching off
- High current capability

Applications

- PV inverter
- UPS

Description

STGW50HF60S is a very low drop IGBT based on new advanced planar technology, showing extremely low on-state voltage and limited turn-off losses. The overall performance makes this IGBT ideal in low frequency switches of mixed frequency topologies for $PF \leq 1$.

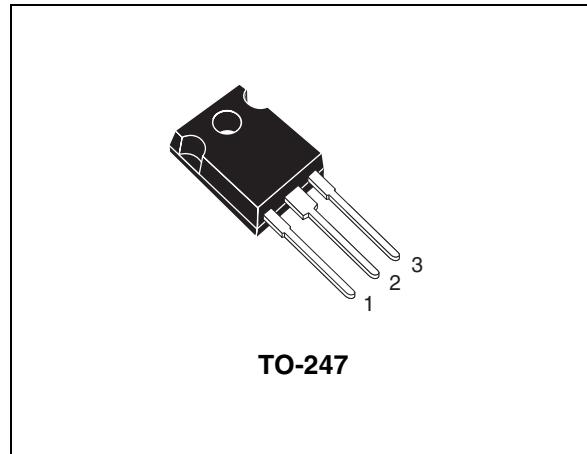


Figure 1. Internal schematic diagram

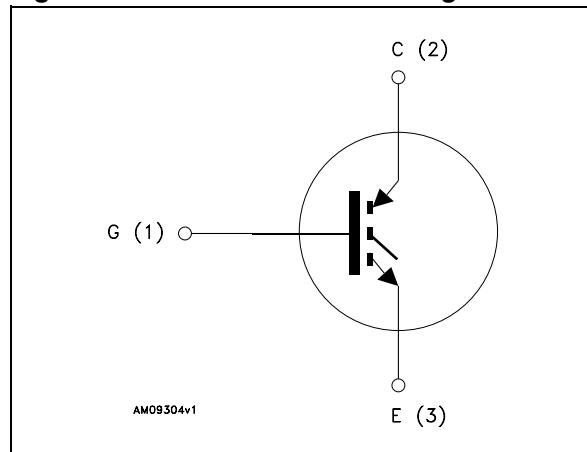


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW50HF60S	GW50HF60S	TO-247	Tube

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	600	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25^\circ C$	110	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100^\circ C$	60	A
$I_{CL}^{(2)}$	Turn-off latching current	60	A
$I_{CP}^{(3)}$	Pulsed collector current	130	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25^\circ C$	284	W
T_j	Operating junction temperature	- 55 to 150	$^\circ C$

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. $V_{clamp} = 80\%$ of V_{CES} , $T_j = 150^\circ C$, $R_G = 10 \Omega$, $V_{GE} = 15 V$
 3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	0.44	$^\circ C/W$
R_{thJA}	Thermal resistance junction-ambient	50	$^\circ C/W$

2 Electrical characteristics

$T_J = 25^\circ\text{C}$ unless otherwise specified.

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{CES}}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1 \text{ mA}$	600			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}$ $V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}, T_J = 125^\circ\text{C}$		1.15 1.05	1.45	V
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250 \mu\text{A}$	3.5		5.7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600 \text{ V}$ $V_{CE} = 600 \text{ V}, T_J = 125^\circ\text{C}$			50 500	μA μA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20 \text{ V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15 \text{ V}, I_C = 30 \text{ A}$		25		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance			4300		pF
C_{oes}	Output capacitance		-	400	-	pF
C_{res}	Reverse transfer capacitance	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$		100		pF
Q_g	Total gate charge			200		nC
Q_{ge}	Gate-emitter charge	$V_{CE} = 480 \text{ V}, I_C = 30 \text{ A}, V_{GE} = 15 \text{ V}$	-	27	-	nC
Q_{gc}	Gate-collector charge			90		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r (di/dt) _{on}	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, (see Figure 14)	-	50 20 1280	-	ns ns A/ μs
$t_{d(on)}$ t_r (di/dt) _{on}	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 14)	-	47 22 1100	-	ns ns A/ μs
$t_r(V_{off})$ $t_d(off)$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, (see Figure 14)	-	370 220 465	-	ns ns ns
$t_r(V_{off})$ $t_d(off)$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 14)	-	700 250 800	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, (see Figure 14)	-	0.25 4.2 4.45	-	mJ mJ mJ
$E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 400 \text{ V}$, $I_C = 30 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 14)	-	0.45 7.8 8.25	-	mJ mJ mJ

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in [Figure 14](#). If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25°C and 125°C).
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

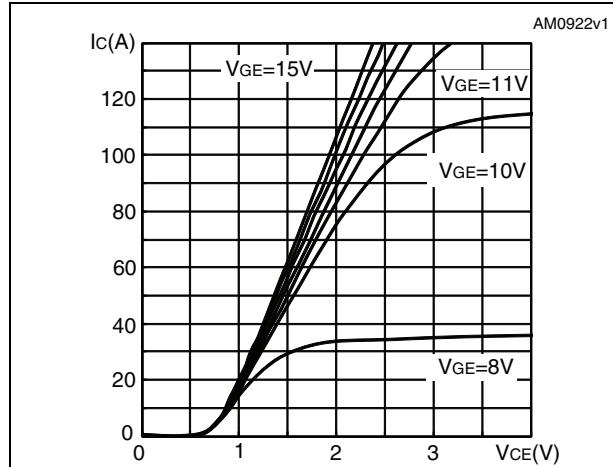


Figure 3. Transfer characteristics

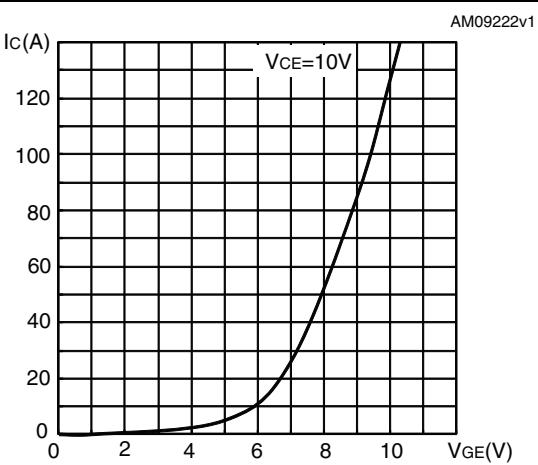


Figure 4. Collector-emitter on voltage vs. temperature

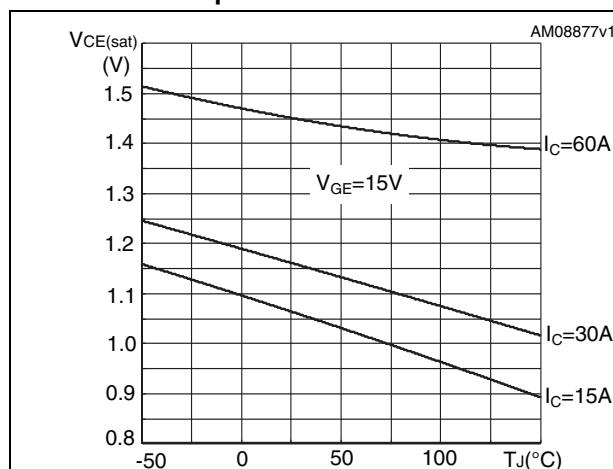


Figure 5. Collector-emitter on voltage vs. collector current

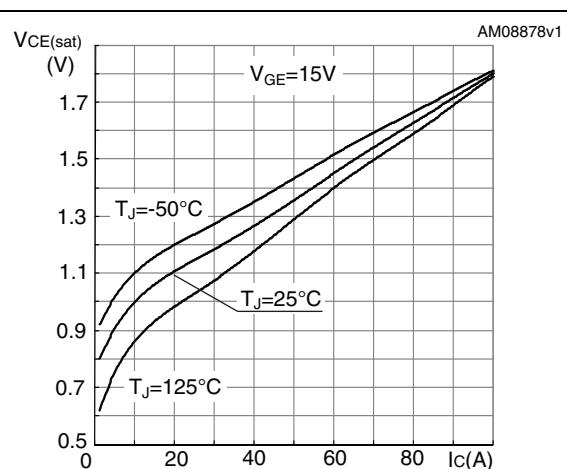


Figure 6. Breakdown voltage vs. temperature

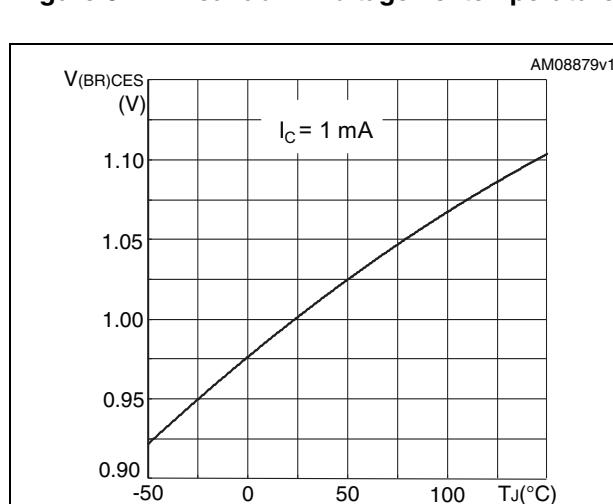


Figure 7. Gate threshold voltage vs. temperature

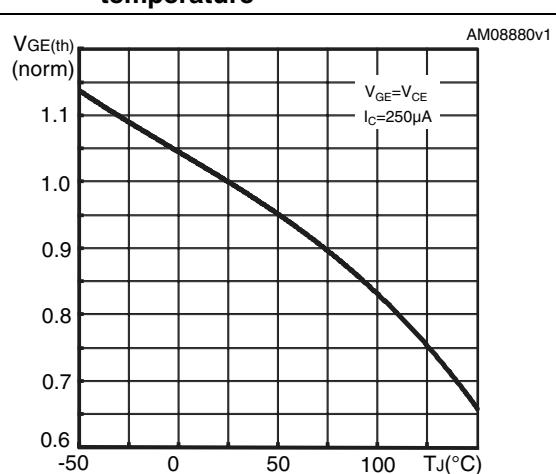


Figure 8. Gate charge vs. gate-emitter voltage

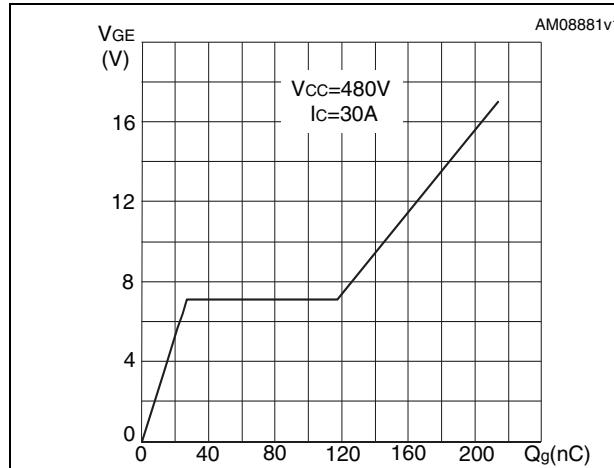


Figure 9. Capacitance variations

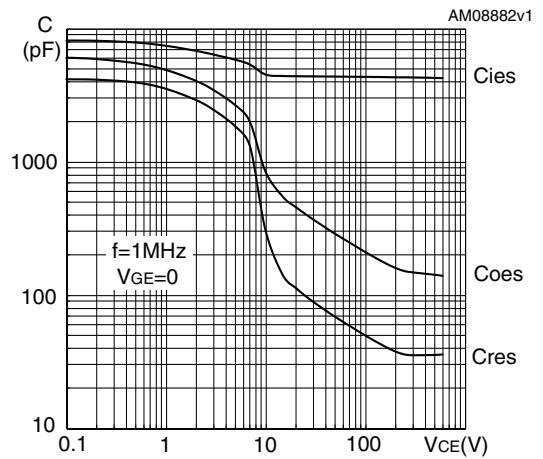


Figure 10. Switching losses vs. collector current

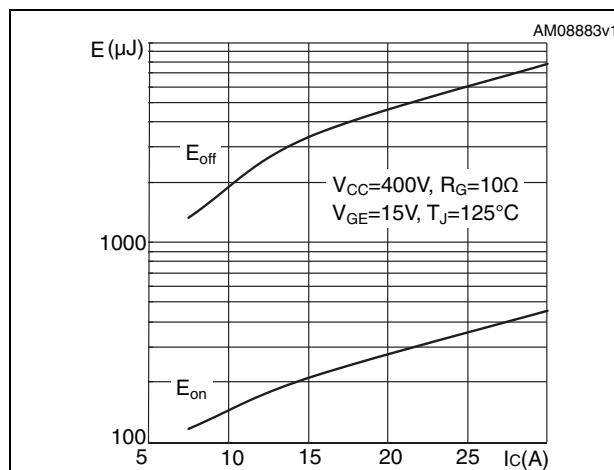


Figure 11. Switching losses vs. gate resistance

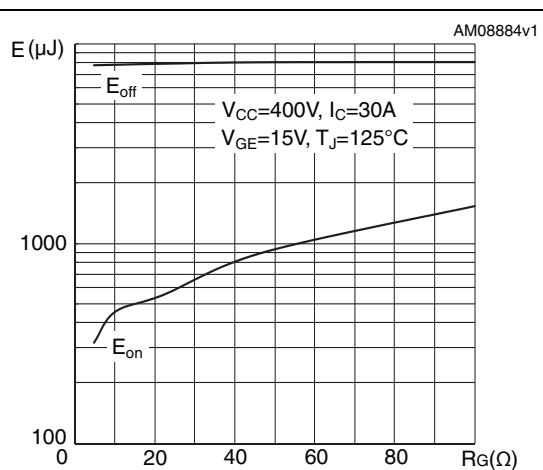


Figure 12. Switching losses vs. temperature

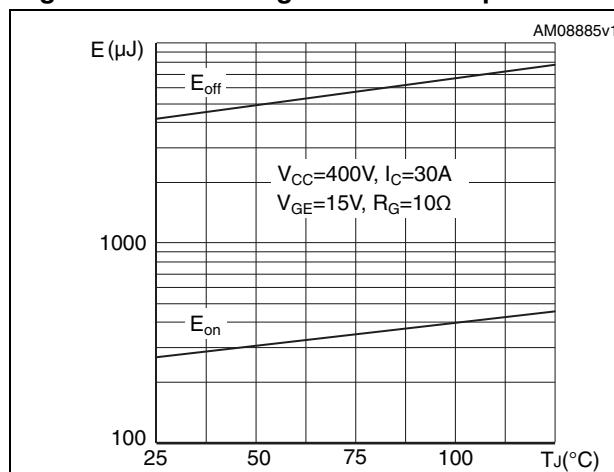
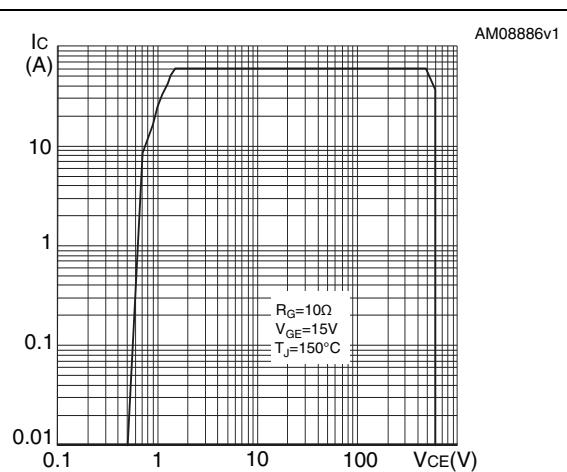


Figure 13. Turn-off SOA



3 Test circuits

Figure 14. Test circuit for inductive load switching

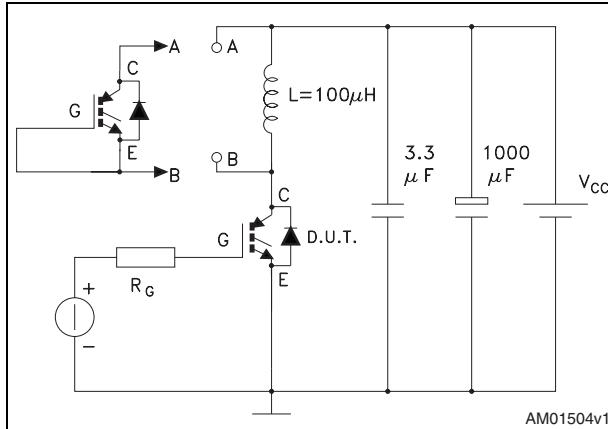


Figure 15. Gate charge test circuit

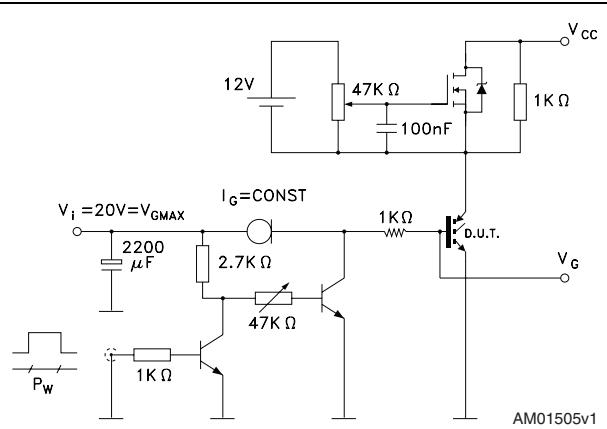
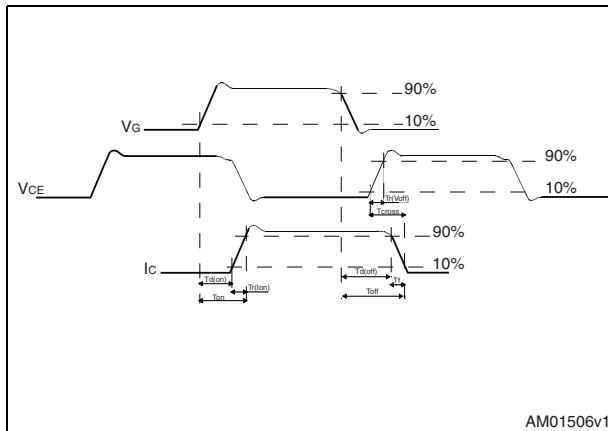


Figure 16. Switching waveform



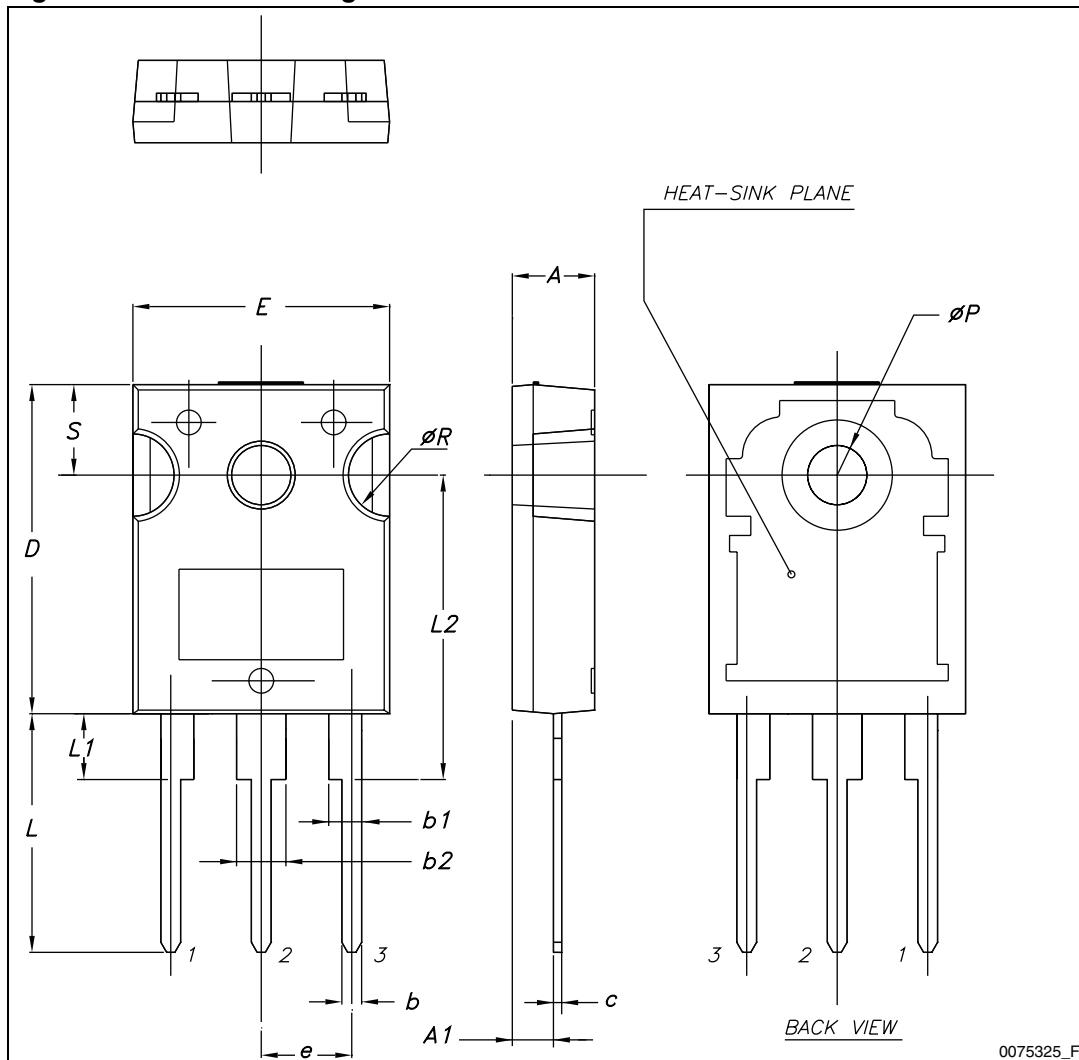
4 Package mechanical data

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. ECOPACK is an ST trademark.

Table 8. 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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S		5.50	

Figure 17. TO-247 drawing



0075325_F

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
18-Jan-2010	1	Initial release.
21-Jan-2011	2	Document status promoted from preliminary data to datasheet.

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