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STGW50HF60S

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 $PF \leq 1$.

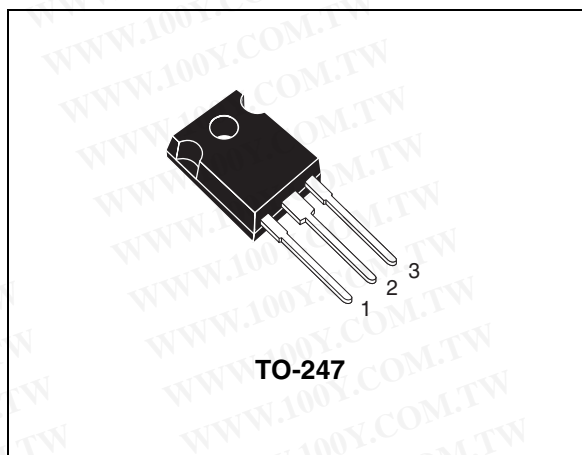


Figure 1. Internal schematic diagram

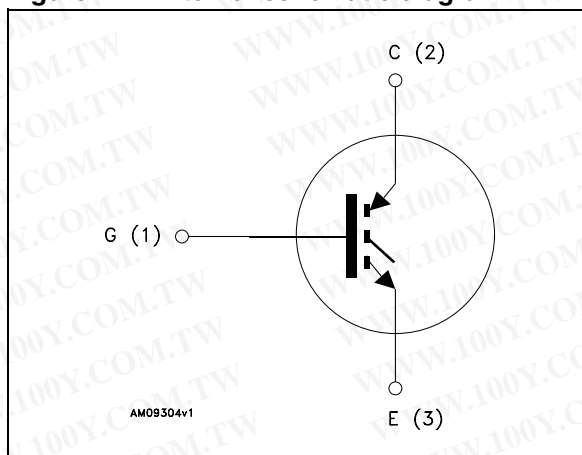


Table 1. Device summary

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 $T_C = 25\text{ °C}$	110	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	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 $T_C = 25\text{ °C}$	284	W
T_j	Operating junction temperature	- 55 to 150	$^{\circ}\text{C}$

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(\max)} - T_C}{R_{thj-c} \times V_{CE(\text{sat})}(\max)(T_{j(\max)}, I_C(T_C))}$$

2. $V_{\text{clamp}} = 80\%$ of V_{CES} , $T_j = 150\text{ °C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$

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	$^{\circ}\text{C/W}$
R_{thJA}	Thermal resistance junction-ambient	50	$^{\circ}\text{C/W}$

2 Electrical characteristics

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

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 125\text{ °C}$		1.15 1.05	1.45	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.5		5.7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_J = 125\text{ °C}$			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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	400	-	pF
C_{res}	Reverse transfer capacitance			100		pF
Q_g	Total gate charge	$V_{CE} = 480\text{ V}$,		200		nC
Q_{ge}	Gate-emitter charge	$I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$	-	27	-	nC
Q_{gc}	Gate-collector charge			90		nC

Table 6. Switching on/off (inductive load)

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

Table 7. Switching energy (inductive load)

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

- 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).
- Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

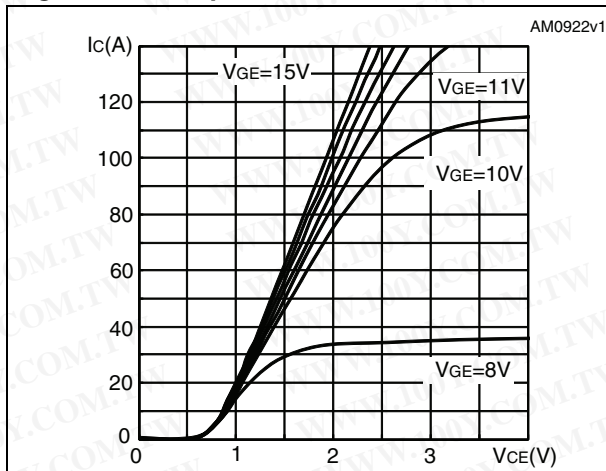


Figure 3. Transfer characteristics

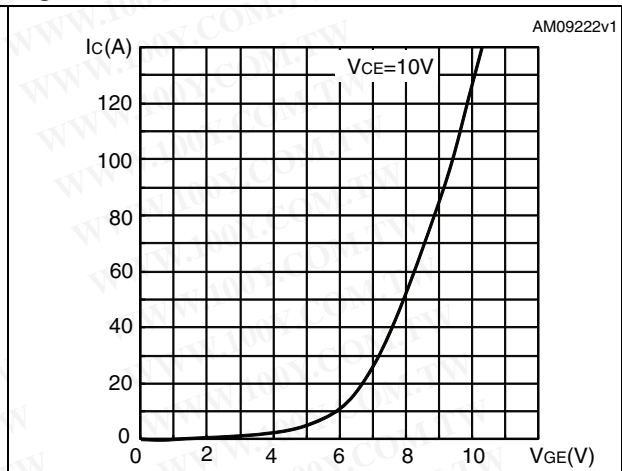


Figure 4. Collector-emitter on voltage vs. temperature

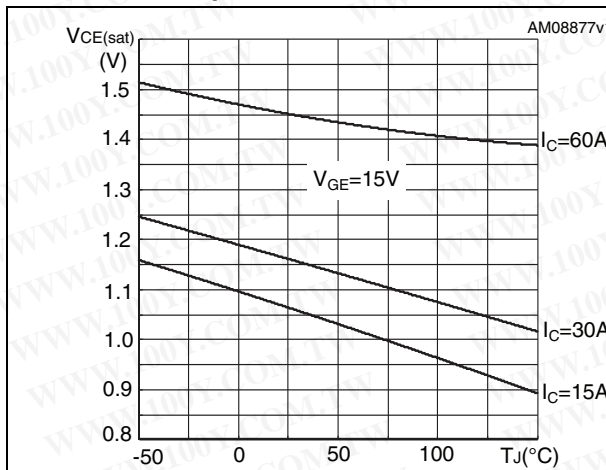


Figure 5. Collector-emitter on voltage vs. collector current

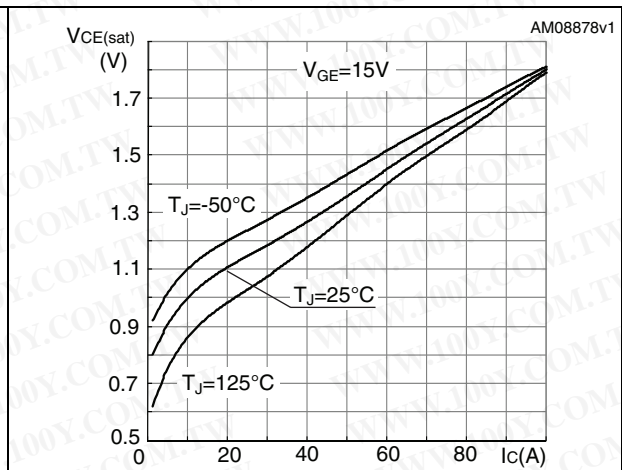


Figure 6. Breakdown voltage vs. temperature

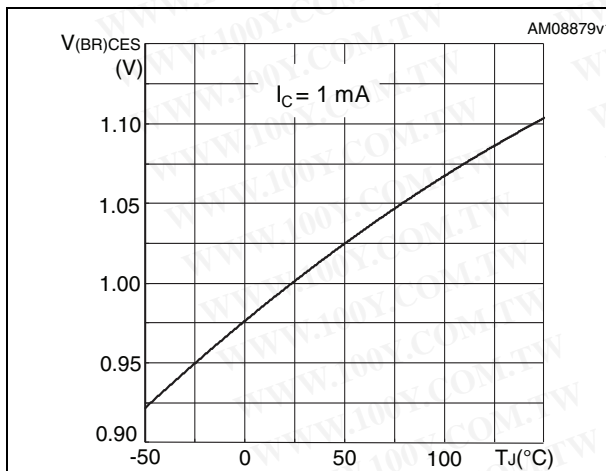


Figure 7. Gate threshold voltage vs. temperature

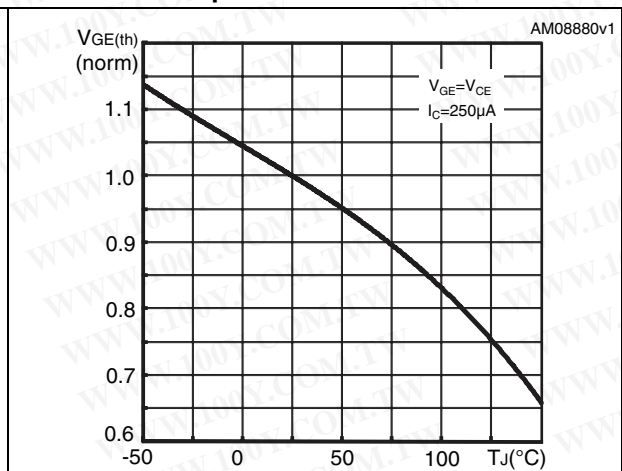


Figure 8. Gate charge vs. gate-emitter voltage

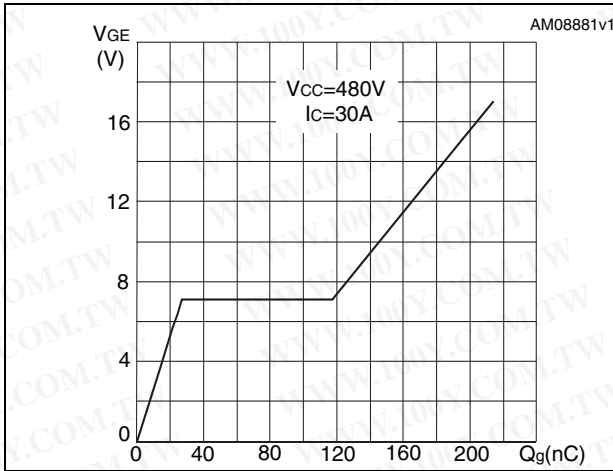


Figure 9. Capacitance variations

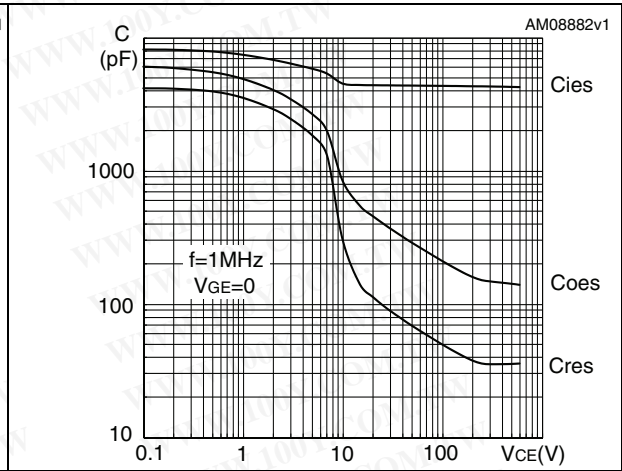


Figure 10. Switching losses vs. collector current

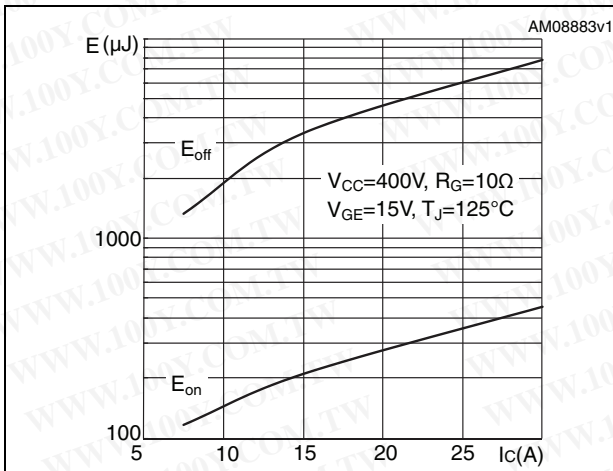


Figure 11. Switching losses vs. gate resistance

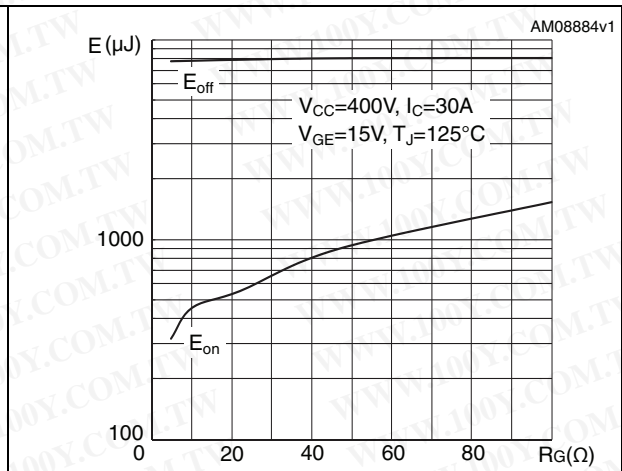


Figure 12. Switching losses vs. temperature

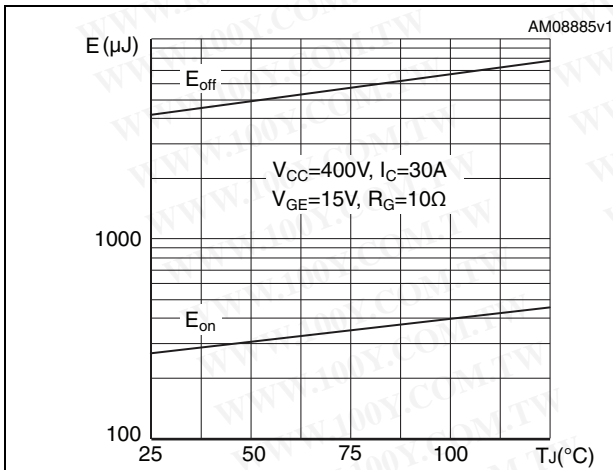
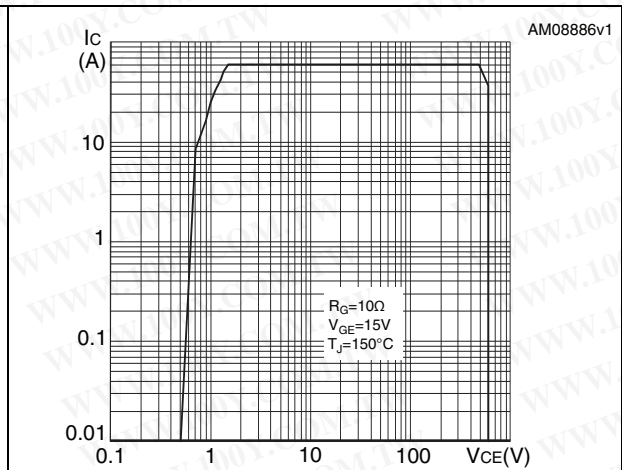


Figure 13. Turn-off SOA



3 Test circuits

Figure 14. Test circuit for inductive load switching

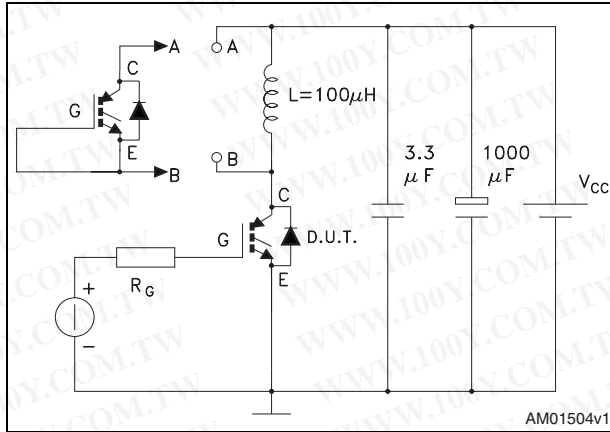


Figure 15. Gate charge test circuit

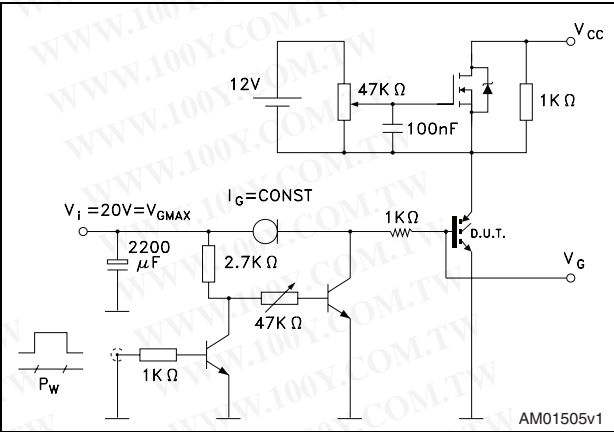
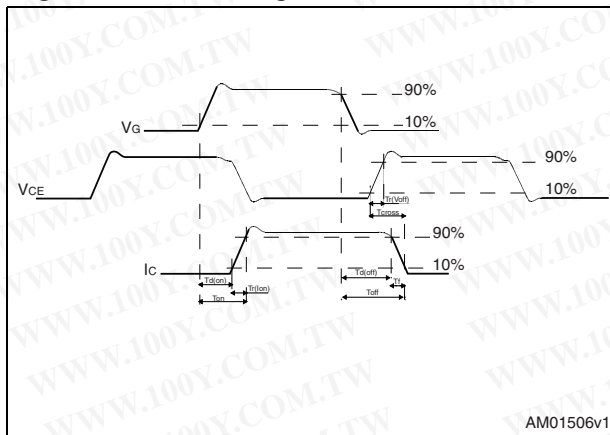


Figure 16. Switching waveform



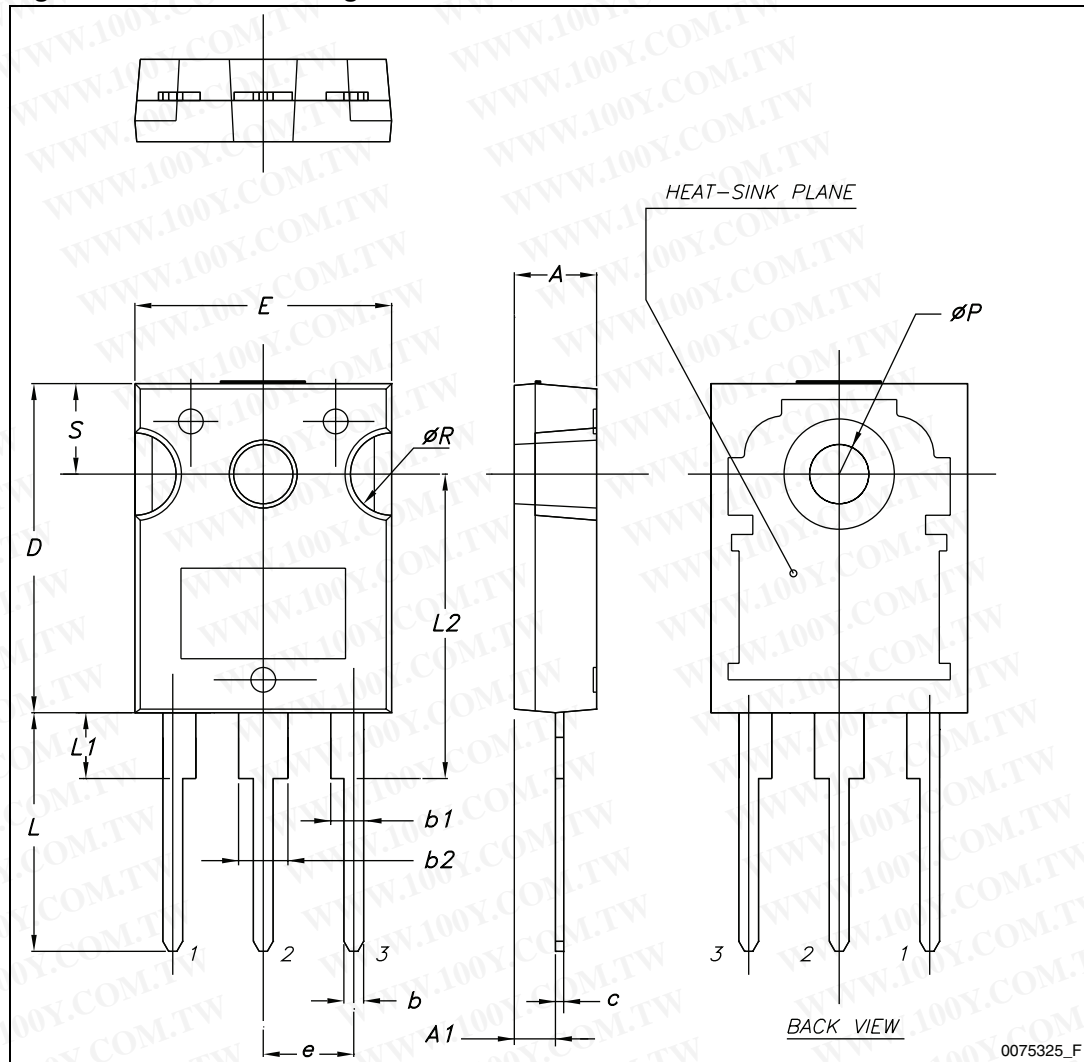
4 Package mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S		5.50	

Figure 17. TO-247 drawing



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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