

### Features

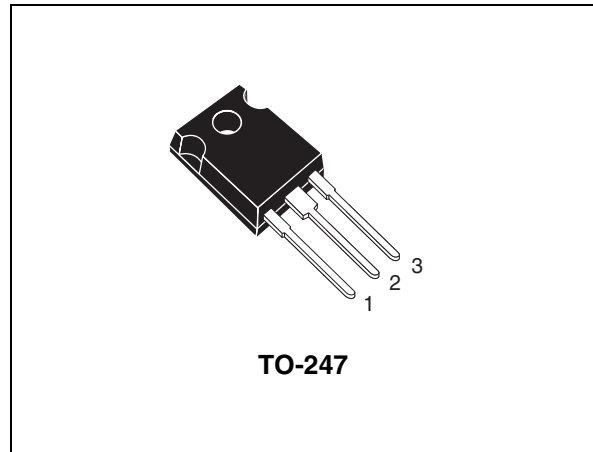
- Very low on-state voltage drop
- Low switching off
- High current capability

### Applications

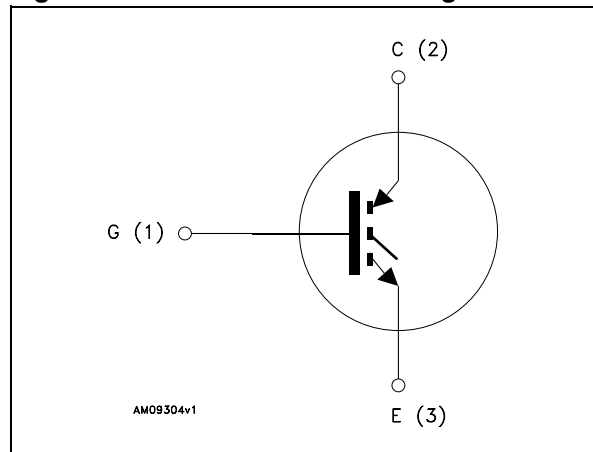
- PV inverter
- UPS

### 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 <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0)	600	V
I <sub>C</sub> <sup>(1)</sup>	Continuous collector current at T <sub>C</sub> = 25 °C	110	A
I <sub>C</sub> <sup>(1)</sup>	Continuous collector current at T <sub>C</sub> = 100 °C	60	A
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	60	A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	130	A
V <sub>GE</sub>	Gate-emitter voltage	±20	V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	284	W
T <sub>j</sub>	Operating junction temperature	- 55 to 150	°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% of 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 3. Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thJC</sub>	Thermal resistance junction-case	0.44	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient	50	°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	$\mu\text{A}$ $\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	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	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$	-	4300	-	pF
$C_{oes}$	Output capacitance			400		pF
$C_{res}$	Reverse transfer capacitance			100		pF
$Q_g$	Total gate charge	$V_{CE} = 480\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$	-	200	-	nC
$Q_{ge}$	Gate-emitter charge			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 <a href="#">Figure 14</a> )	-	20	-	ns
$(di/dt)_{on}$	Turn-on current slope			1280		A/ $\mu$ 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 <a href="#">Figure 14</a> )	-	22	-	ns
$(di/dt)_{on}$	Turn-on current slope			1100		A/ $\mu$ 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 <a href="#">Figure 14</a> )	-	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 <a href="#">Figure 14</a> )	-	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 <a href="#">Figure 14</a> )	-	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 <a href="#">Figure 14</a> )	-	7.8	-	mJ
$E_{ts}$	Total switching losses			8.25		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

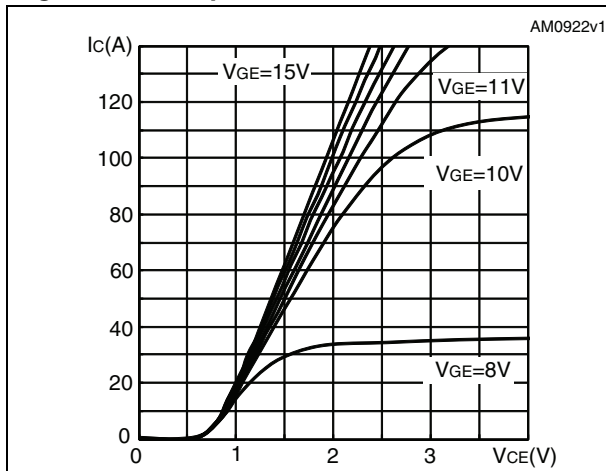


Figure 3. Transfer characteristics

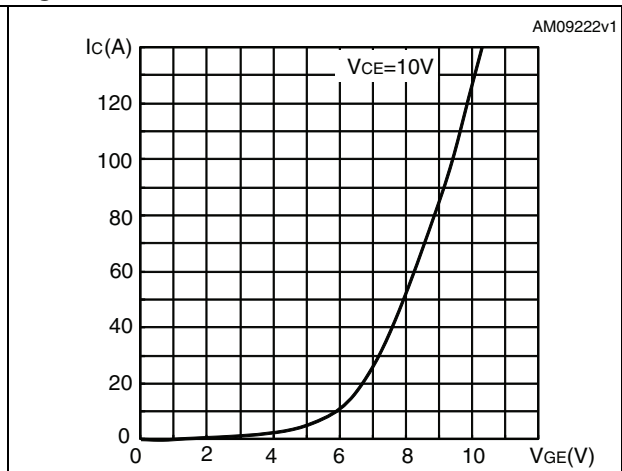


Figure 4. Collector-emitter on voltage vs. temperature

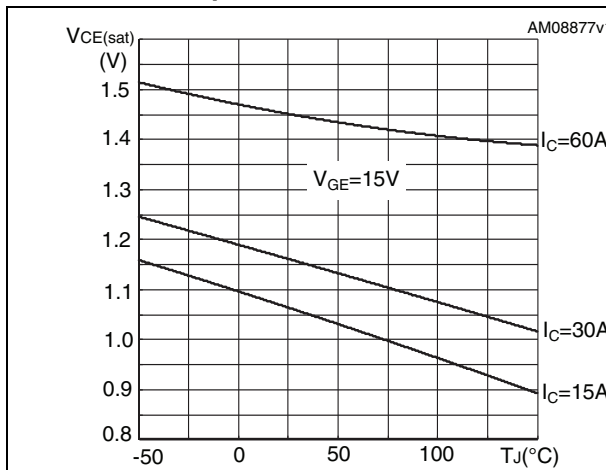


Figure 5. Collector-emitter on voltage vs. collector current

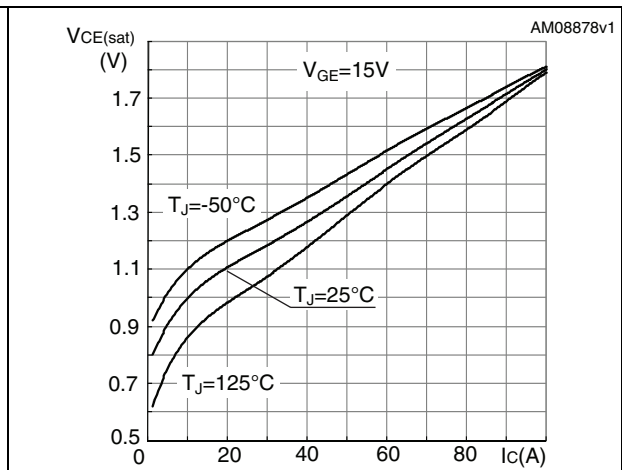


Figure 6. Breakdown voltage vs. temperature

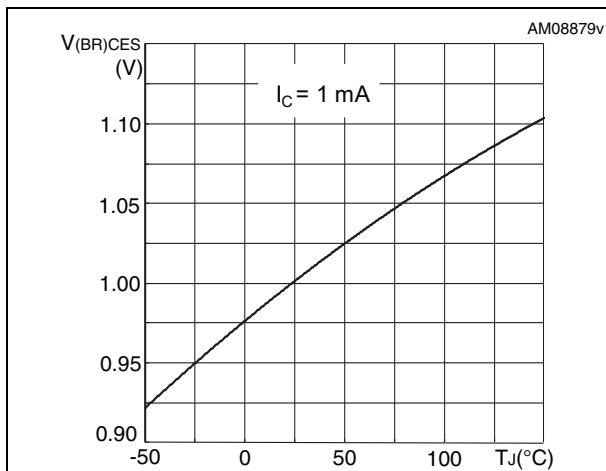


Figure 7. Gate threshold voltage vs. temperature

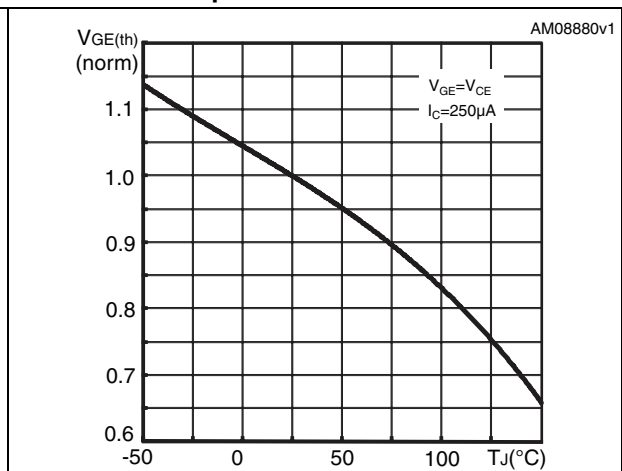


Figure 8. Gate charge vs. gate-emitter voltage

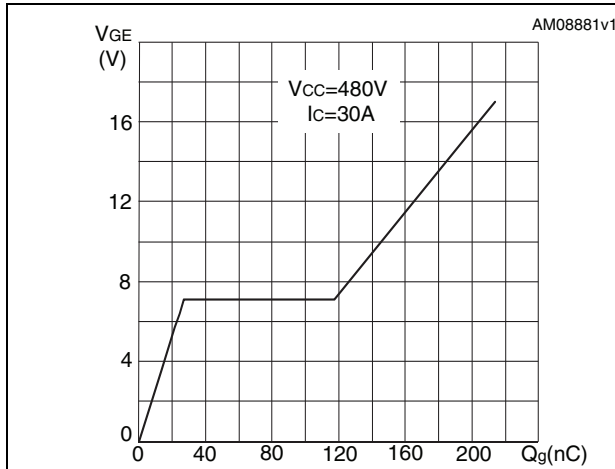


Figure 9. Capacitance variations

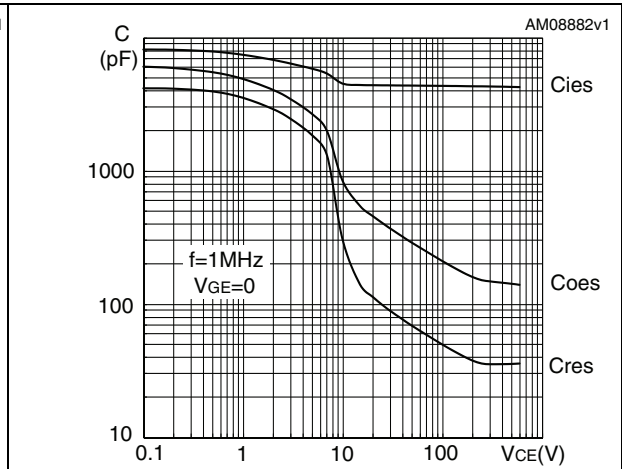


Figure 10. Switching losses vs. collector current

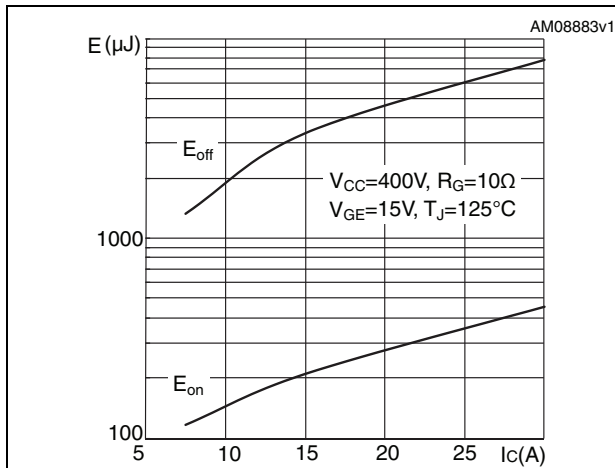


Figure 11. Switching losses vs. gate resistance

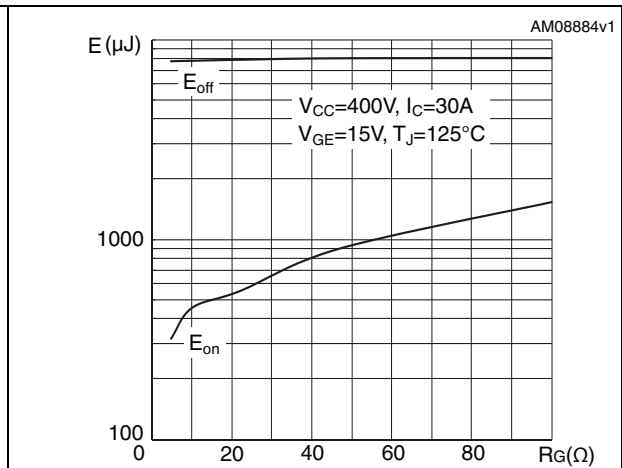


Figure 12. Switching losses vs. temperature

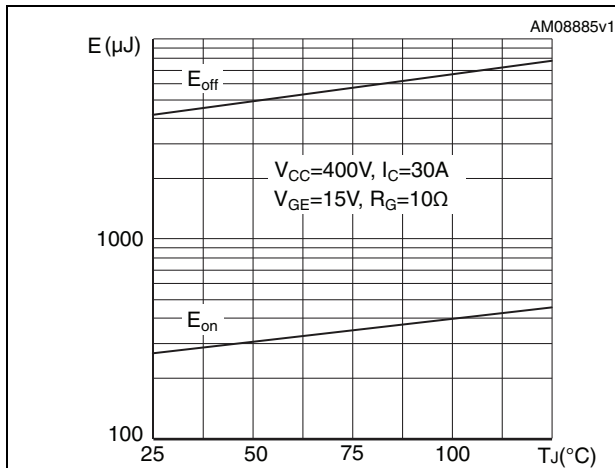
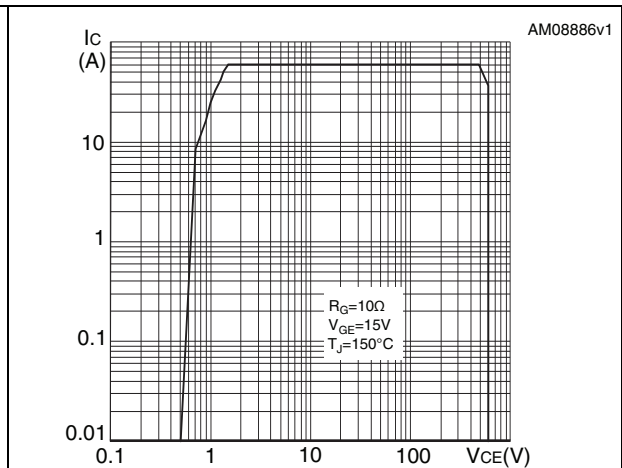
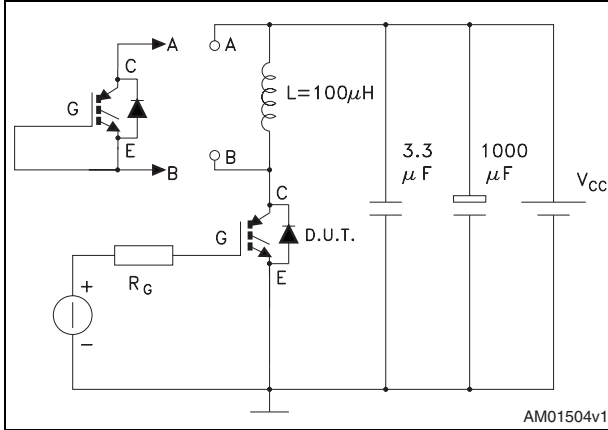


Figure 13. Turn-off SOA

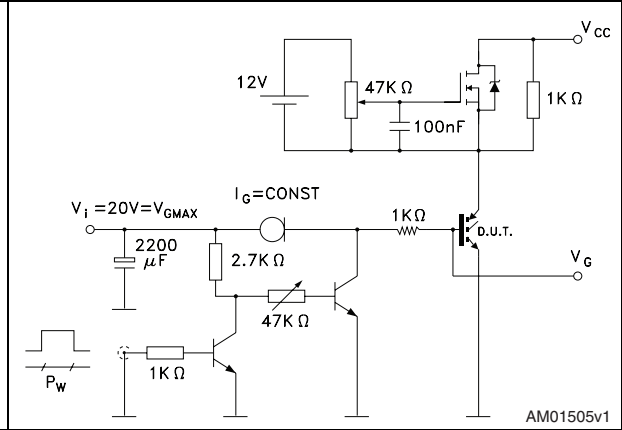


### 3 Test circuits

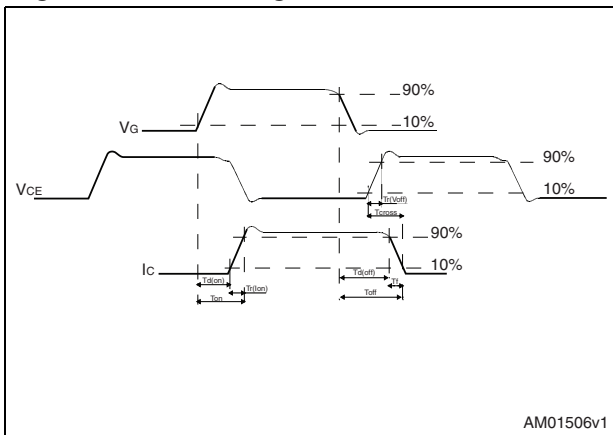
**Figure 14. Test circuit for inductive load switching**



**Figure 15. Gate charge test circuit**



**Figure 16. Switching waveform**



## 4 Package mechanical data

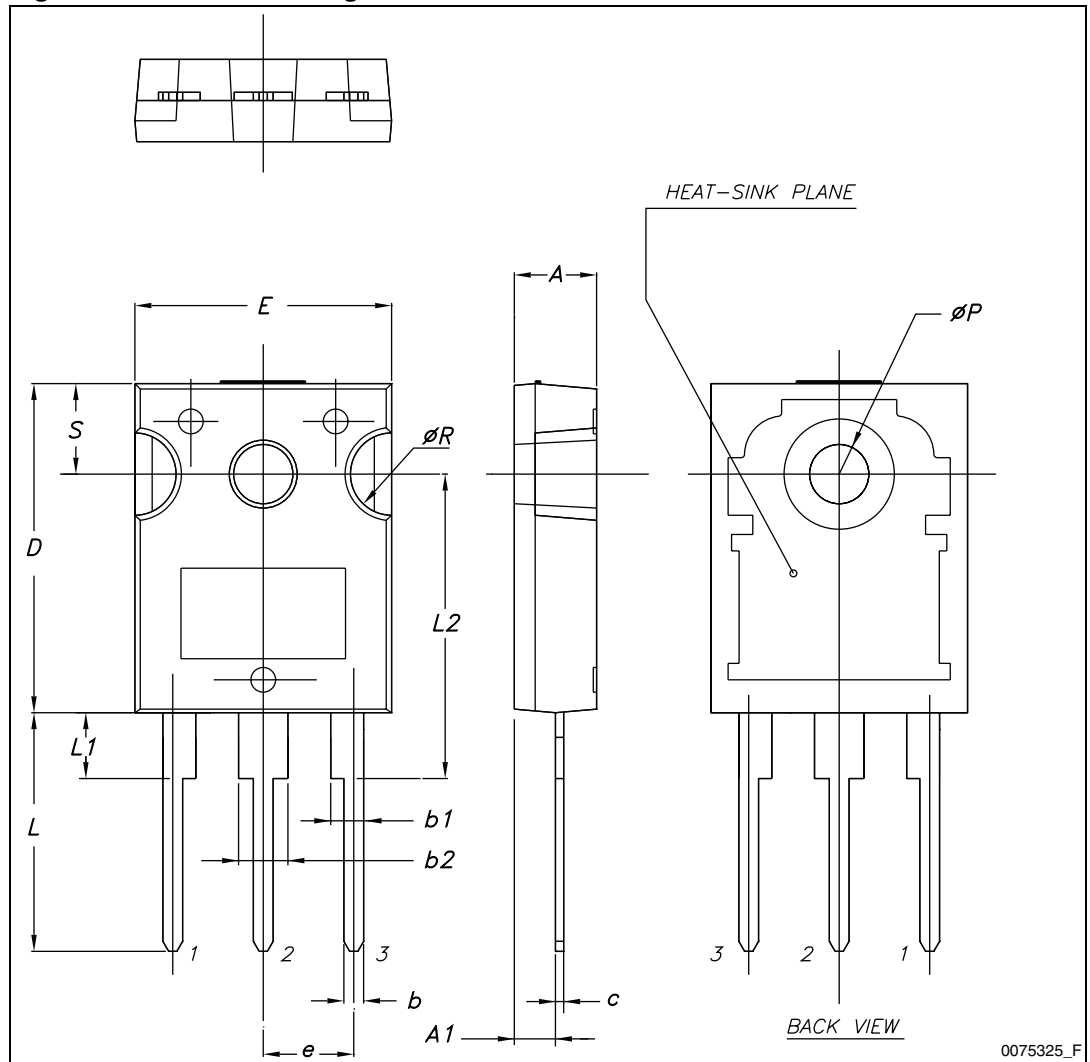
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**Table 8. TO-247 mechanical data**

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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