

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	650	V
$I_C$	Continuous collector current at $T_C = 25\text{ }^{\circ}\text{C}$	120	A
$I_C$	Continuous collector current at $T_C = 100\text{ }^{\circ}\text{C}$	60	A
$I_{CP}^{(1)}$	Pulsed collector current	240	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	360	W
$t_{SC}$	Short-circuit withstand time at $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$	6	$\mu\text{s}$
$T_{STG}$	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
$T_J$	Operating junction temperature		

1. 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	0.35	$^{\circ}\text{C/W}$
$R_{thJA}$	Thermal resistance junction-ambient	50	$^{\circ}\text{C/W}$

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$		1.9		V
		$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$ $T_J = 125\text{ }^{\circ}\text{C}$		2.1		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$		6.0		V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 650\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			250	nA

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE}=0$	-	7150	-	pF
$C_{oes}$	Output capacitance			275		pF
$C_{res}$	Reverse transfer capacitance			140		pF
$Q_g$	Total gate charge	$V_{CC} = 400\text{ V}, I_C = 60\text{ A},$ $V_{GE} = 15\text{ V}$		217		nC
$Q_{ge}$	Gate-emitter charge			67		nC
$Q_{gc}$	Gate-collector charge			97		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}^{(1)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	65	-	ns
$t_r^{(1)}$	Current rise time			30		ns
$(di/dt)_{on}^{(1)}$	Turn-on current slope			2000		A/ $\mu$ s
$t_{d(on)}^{(1)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	63	-	ns
$t_r^{(1)}$	Current rise time			33		ns
$(di/dt)_{on}^{(1)}$	Turn-on current slope			1800		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	35	-	ns
$t_{d(off)}$	Turn-off delay time			180		ns
$t_f$	Current fall time			43		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	46	-	ns
$t_{d(off)}$	Turn-off delay time			210		ns
$t_f$	Current fall time			85		ns

1.  $E_{on}$  is the turn-on losses when a SiC diode (STPSC1206D) is used in the test circuit in [Figure 17](#). 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).

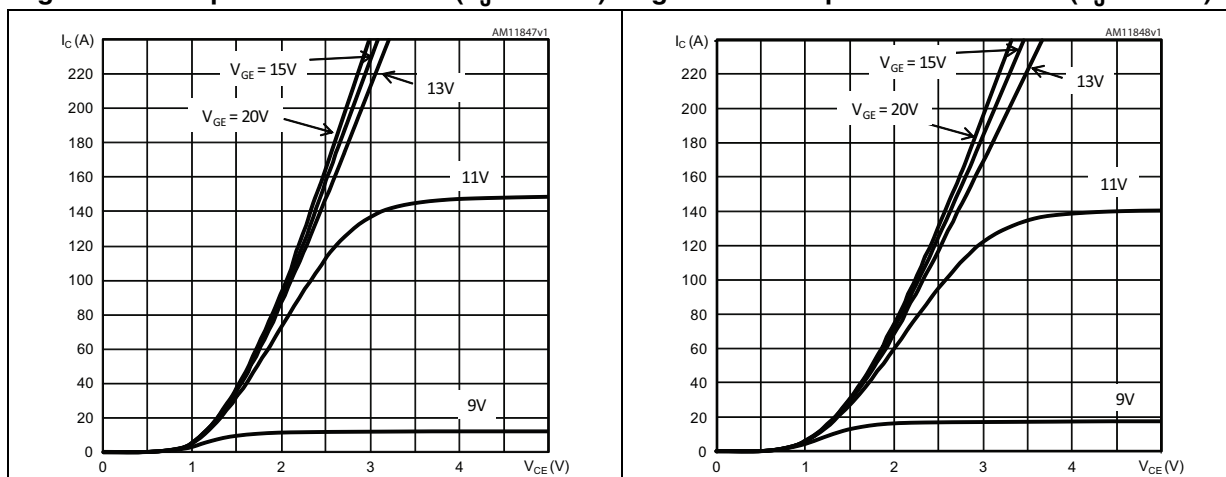
**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	0.75	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			1.05		mJ
$E_{ts}$	Total switching losses			1.80		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 60\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	0.8	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			1.4		mJ
$E_{ts}$	Total switching losses			2.2		mJ

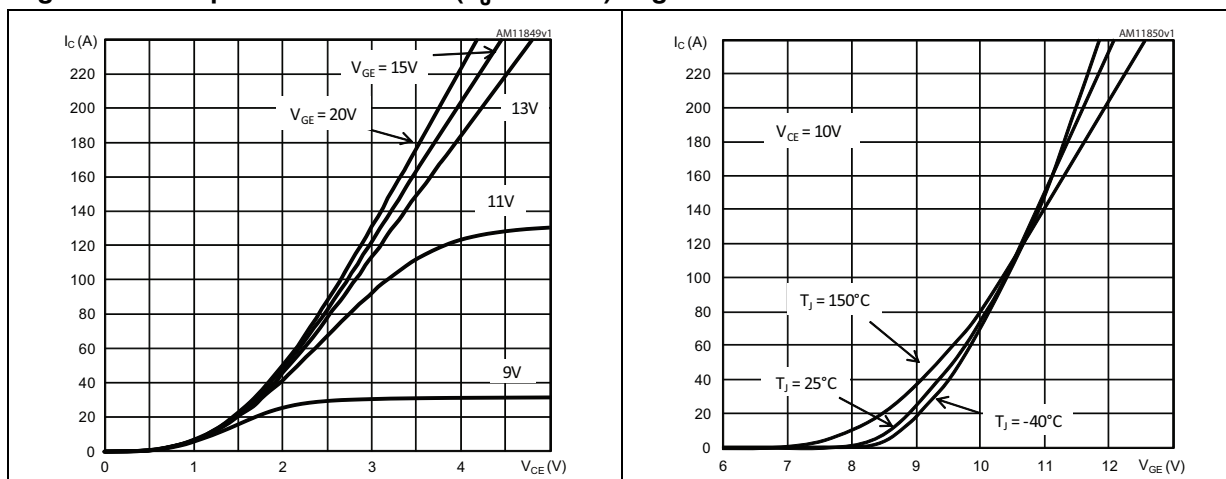
1.  $E_{on}$  is the turn-on losses when a SiC diode (STPSC1206D) is used in the test circuit in [Figure 17](#). If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C).
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

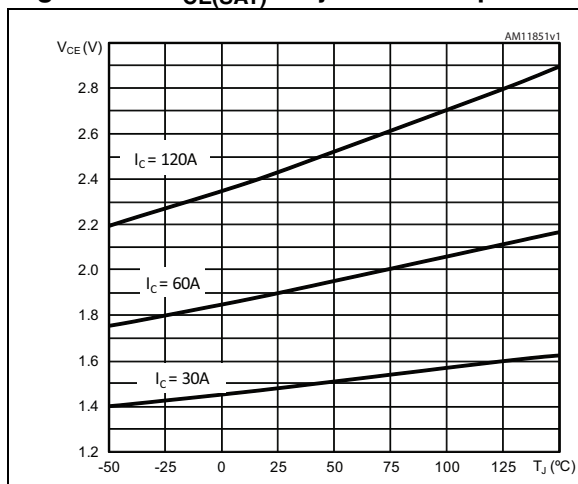
**Figure 2. Output characteristics ( $T_J = -40^\circ\text{C}$ )** **Figure 3. Output characteristics ( $T_J = 25^\circ\text{C}$ )**



**Figure 4. Output characteristics ( $T_J = 150^\circ\text{C}$ )** **Figure 5. Transfer characteristics**



**Figure 6.  $V_{CE(SAT)}$  vs. junction temperature**



**Figure 7.  $V_{CE(SAT)}$  vs. collector current**

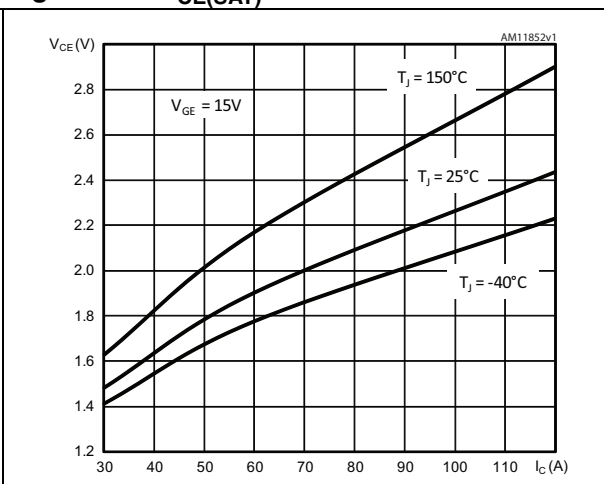


Figure 8. Normalized  $V_{GE(th)}$  vs. junction temperature

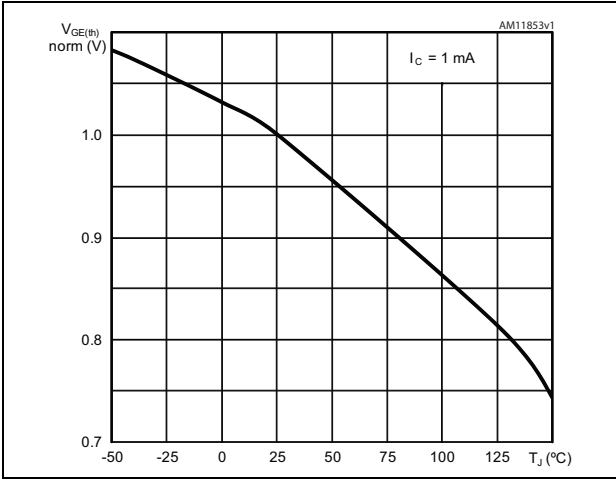


Figure 9. Gate charge vs. gate-emitter voltage

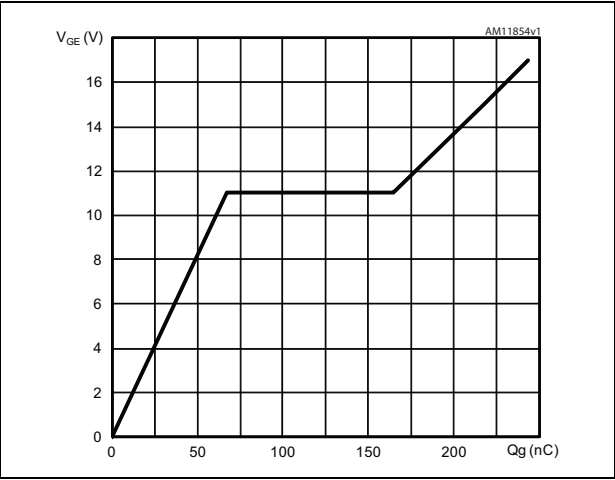


Figure 10. Capacitance variations ( $f = 1\text{ MHz}$ ,  $V_{GE} = 0$ )

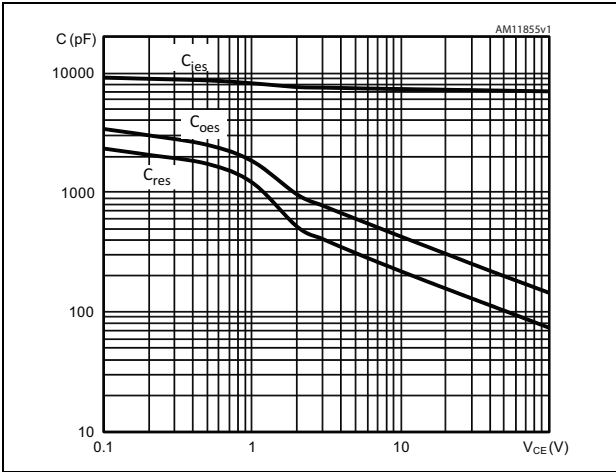


Figure 11. Switching losses vs. collector current

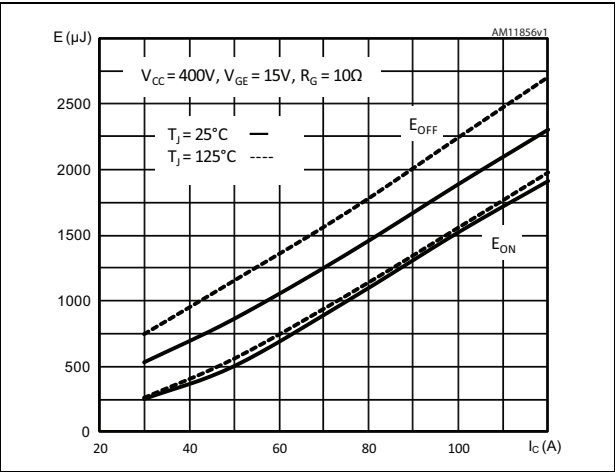


Figure 12. Switching losses vs. gate resistance

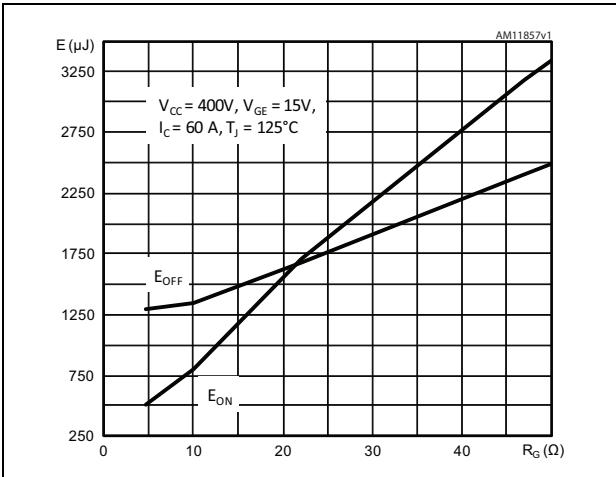


Figure 13. Switching losses vs. temperature

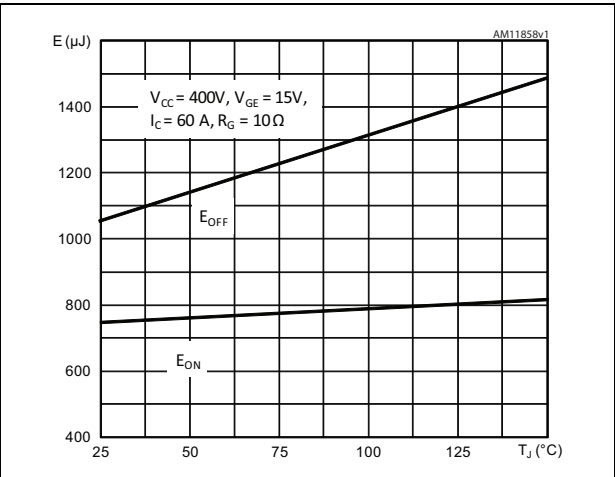


Figure 14. Turn-OFF SOA

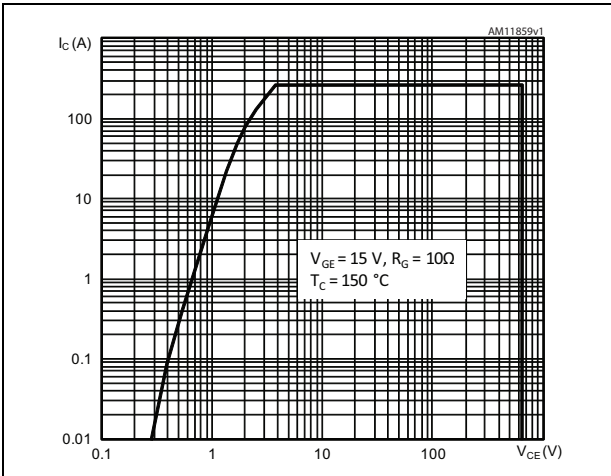


Figure 15. Short circuit time & current vs.  $V_{GE}$

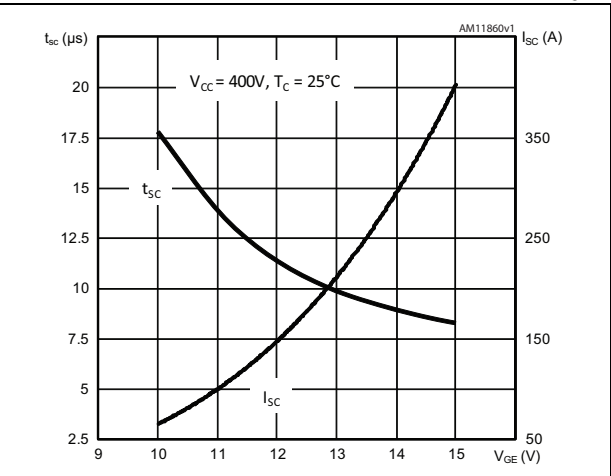
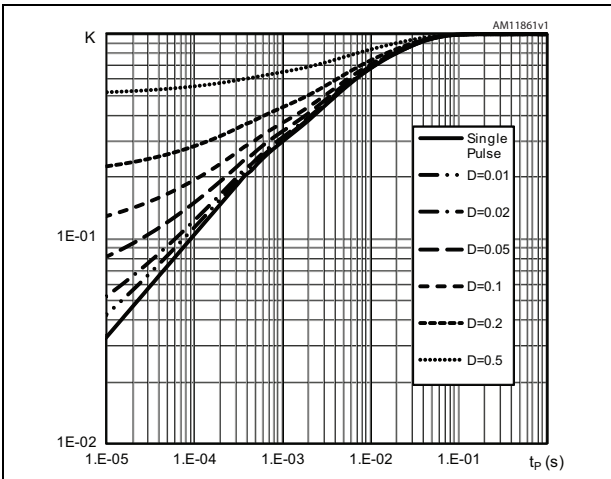


Figure 16. Maximum normalized  $Z_{th}$  junction to case (IGBT)



### 3 Test circuits

Figure 17. Test circuit for inductive load switching

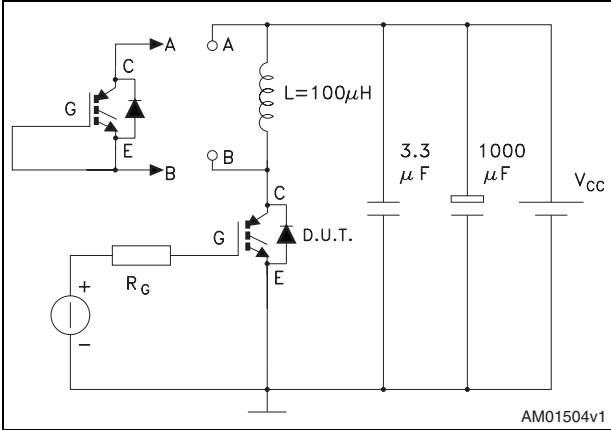


Figure 18. Gate charge test circuit

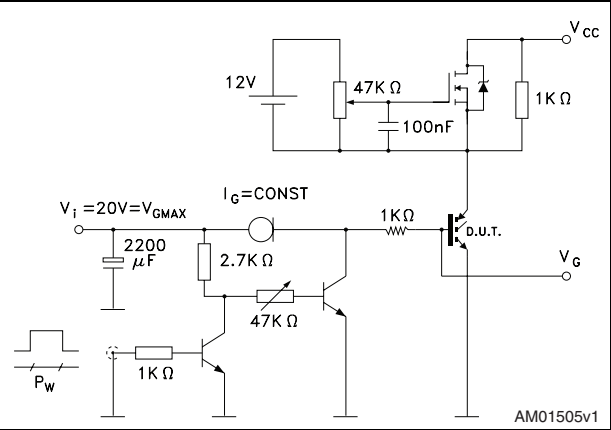
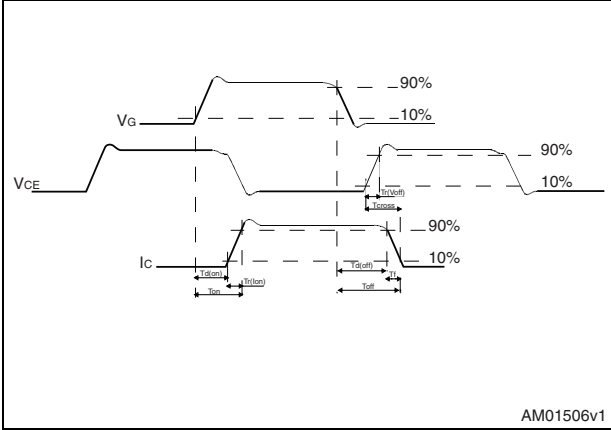


Figure 19. Switching waveform



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> 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 20. TO-247 drawing

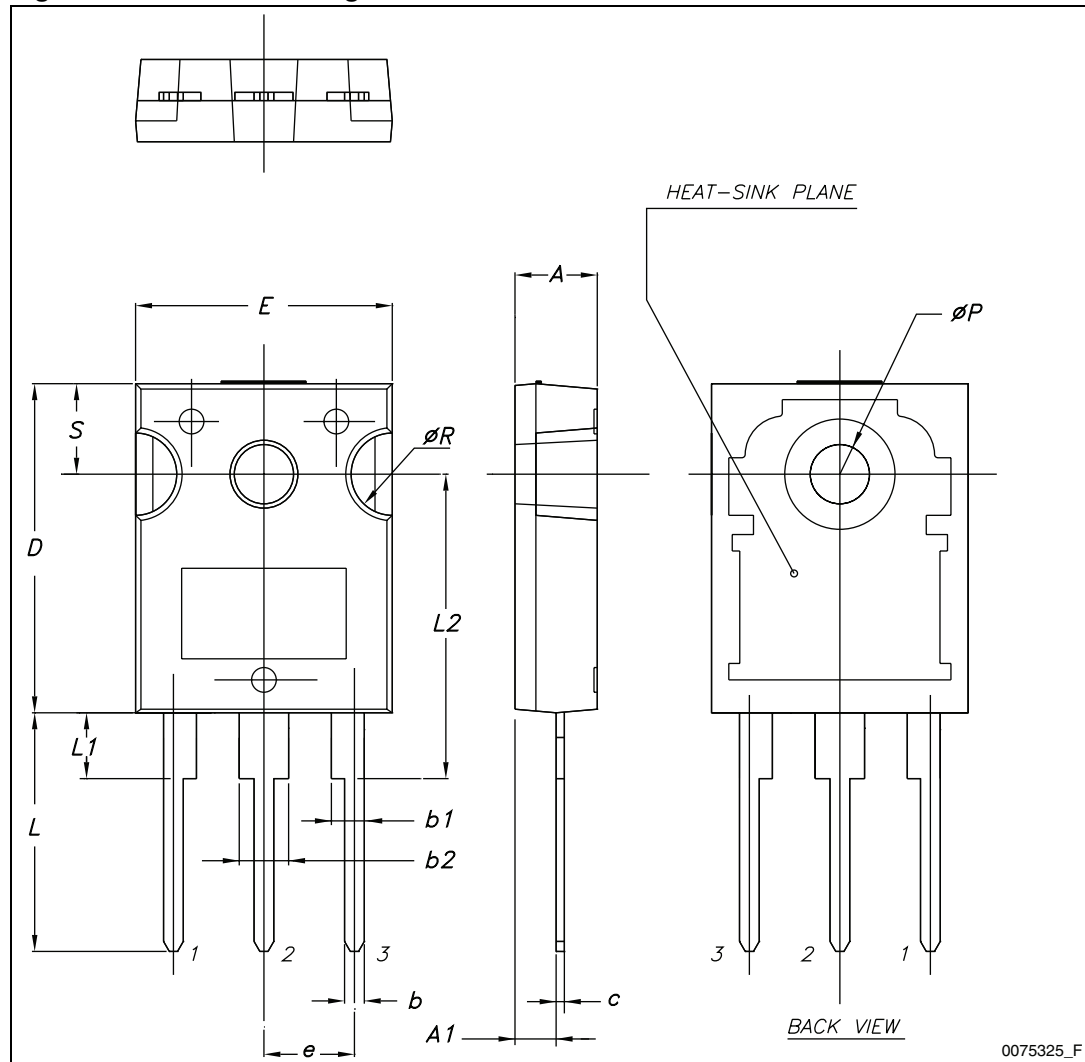
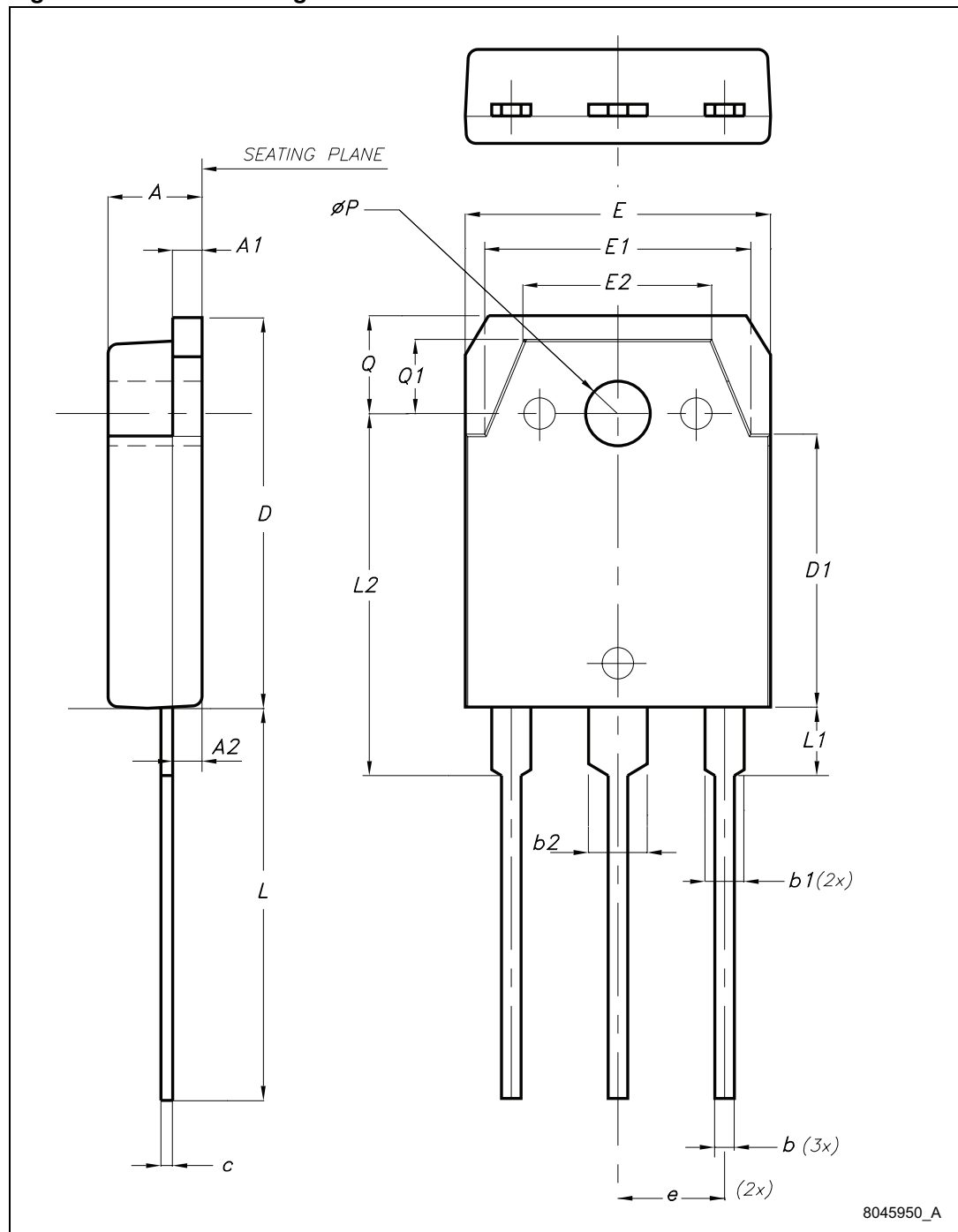


Table 9. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60		5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1	1.20
b1	1.80		2.20
b2	2.80		3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1		13.90	
E	15.40		15.80
E1		13.60	
E2		9.60	
e	5.15	5.45	5.75
L	19.50	20	20.50
L1		3.50	
L2	18.20	18.40	18.60
øP	3.10		3.30
Q		5	
Q1		3.80	

Figure 21. TO-3P drawing



## 5 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
05-Jul-2011	1	Initial release.
12-Jan-2012	2	Document status promoted from preliminary data to datasheet.
10-Feb-2012	3	Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a> .
31-Jul-2012	4	Updated: <a href="#">Figure 8 on page 6</a> .
09-Jan-2013	5	Added: new order code STGWT60H65F, package mechanical data <a href="#">Table 9 on page 11</a> and <a href="#">Figure 21 on page 12</a> .

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