

60 A, 650 V, very low drop IGBT with soft and fast recovery diode

Datasheet - preliminary data

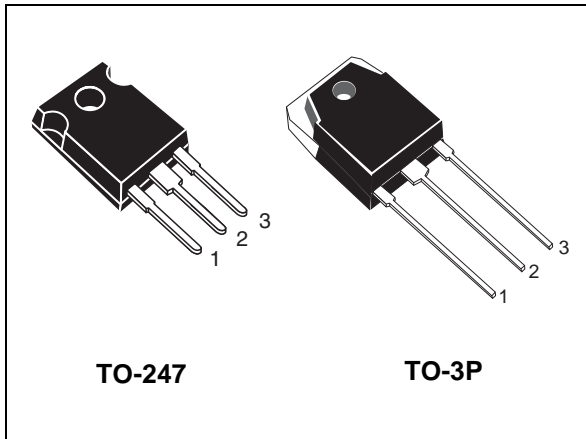
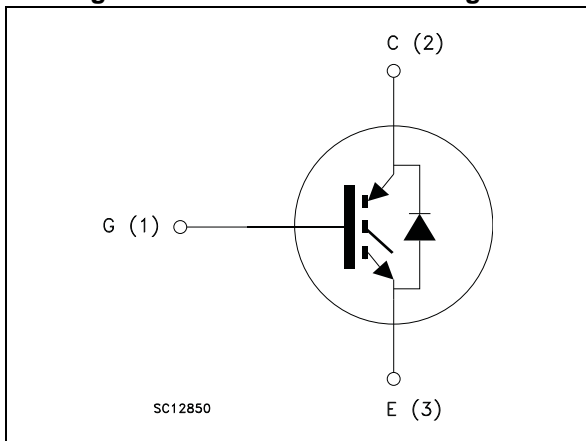


Figure 1. Internal schematic diagram



Features

- Very low on-state voltage drop
- Low switching off
- High current capability
- Very soft Ultrafast recovery antiparallel diode

Applications

- PV inverter
- UPS

Description

The very low drop IGBT is developed using an advanced planar technology, resulting in a device with extremely low on-state voltage and limited turn-off losses. The overall performance of this IGBT makes it ideal for low frequency switches in mixed-frequency topologies for power factors ≤ 1 .

Table 1. Device summary

Order code	Marking	Package	Packaging
STGW50HF65SD	GW50HF65SD	TO-247	Tube
STGWT50HF65SD	GW50HF65SD	TO-3P	Tube

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{CE} = 0$)	650	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
I_F	Diode RMS forward current at $T_C = 25\text{ °C}$	30	A
I_{FSM}	Surge non repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	120	A
T_j	Operating junction temperature	- 55 to 150	$^{\circ}\text{C}$

1. Calculated according to the iterative formula:

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

2. $V_{clamp} = 80\%$ 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
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.44	$^{\circ}\text{C/W}$
$R_{thj-case}$	Thermal resistance junction-case diode	1.25	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^{\circ}\text{C/W}$

2 Electrical characteristics

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

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1 \text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}$		1.15	1.45	V
		$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}, T_J = 125^\circ\text{C}$		1.05		V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250 \mu\text{A}$	3.5		5.7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 650 \text{ V}$			50	μA
		$V_{CE} = 650 \text{ V}, T_J = 125^\circ\text{C}$			500	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} C_{oes} C_{res}	Input capacitance	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$		4300		pF
	Output capacitance		-	400	-	pF
	Reverse transfer capacitance			100		pF
Q_g Q_{ge} Q_{gc}	Total gate charge	$V_{CE} = 480 \text{ V}, I_C = 30 \text{ A}, V_{GE} = 15 \text{ V}$		200		nC
	Gate-emitter charge		-	27	-	nC
	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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	20	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 14)		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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	22	-	ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 125\text{ }^\circ\text{C}$ (see Figure 14)		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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	220	-	ns
t_f	Current fall time	(see Figure 14)		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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	250	-	ns
t_f	Current fall time	$T_J = 125\text{ }^\circ\text{C}$ (see Figure 14)		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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	4.2	-	mJ
E_{ts}	Total switching losses	(see Figure 14)		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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,	-	7.8	-	mJ
E_{ts}	Total switching losses	$T_J = 125\text{ }^\circ\text{C}$ (see Figure 14)		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.

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F = 30\text{ A}$		2.8		V
		$I_F = 30\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$		1.8		V
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 50\text{ V}$,		67		ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$	-	140	-	nC
I_{rrm}	Reverse recovery current	(see Figure 17)		4		A
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 50\text{ V}$,		103		ns
Q_{rr}	Reverse recovery charge	$T_J = 125\text{ }^\circ\text{C}$,	-	390	-	nC
I_{rrm}	Reverse recovery current	$di/dt = 100\text{ A}/\mu\text{s}$		7		A
		(see Figure 17)				

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

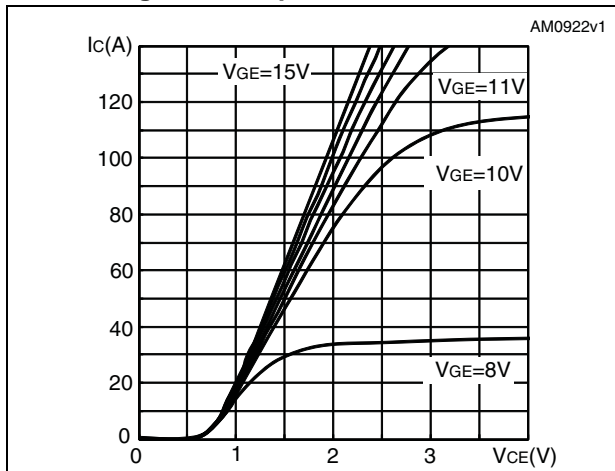


Figure 3. Transfer characteristics

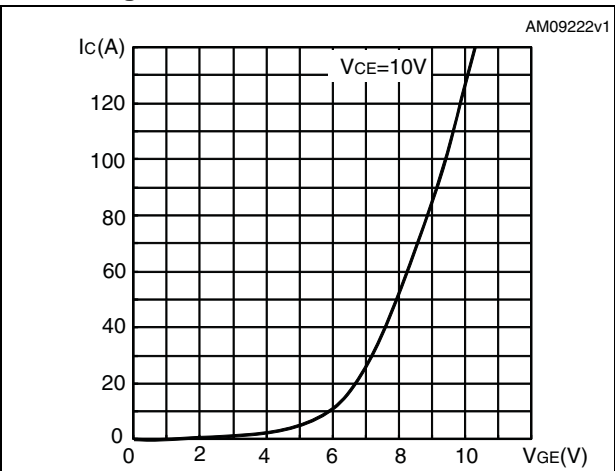


Figure 4. Collector-emitter on voltage vs temperature

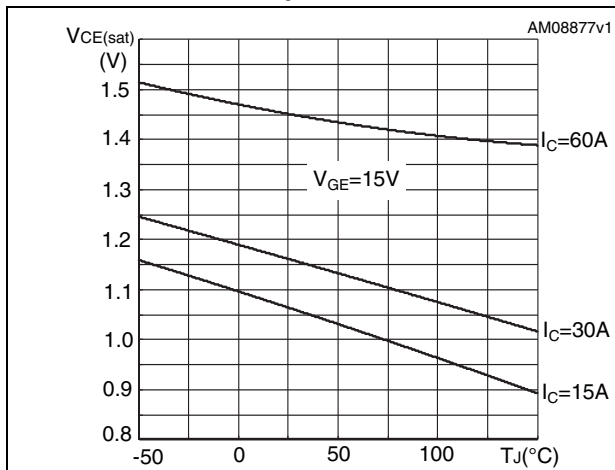


Figure 5. Collector-emitter on voltage vs collector current

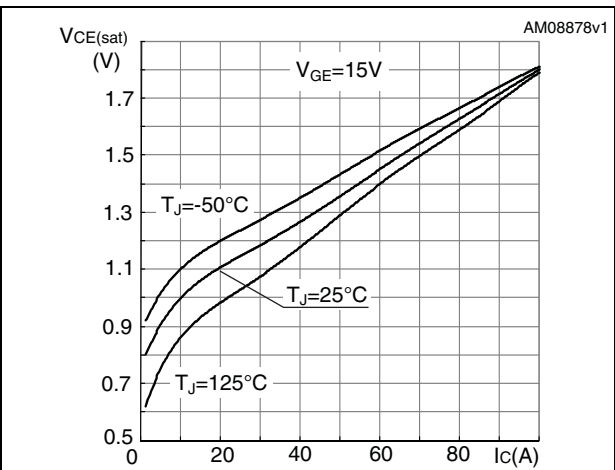


Figure 6. Breakdown voltage vs temperature

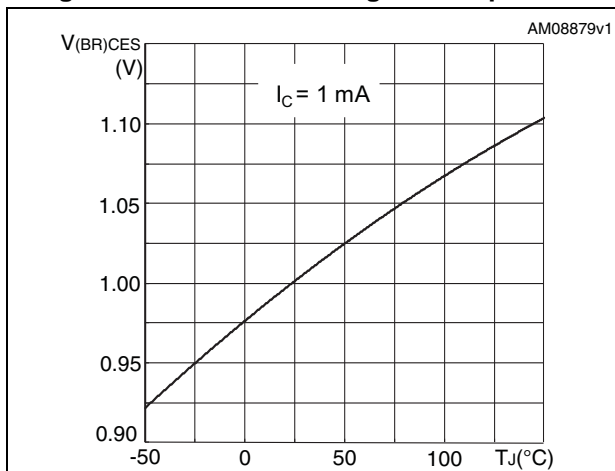


Figure 7. Gate threshold voltage vs temperature

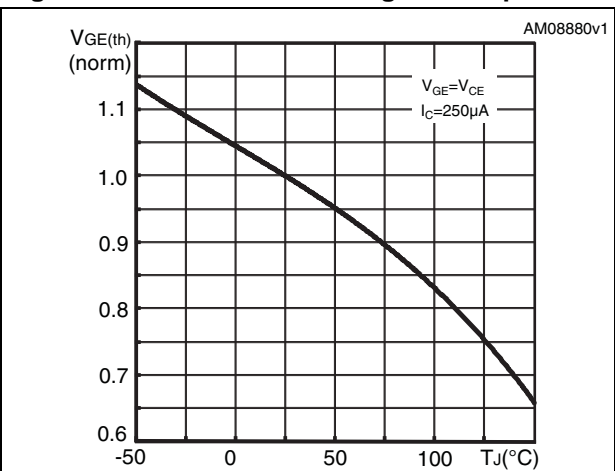


Figure 8. Gate charge vs gate-emitter voltage

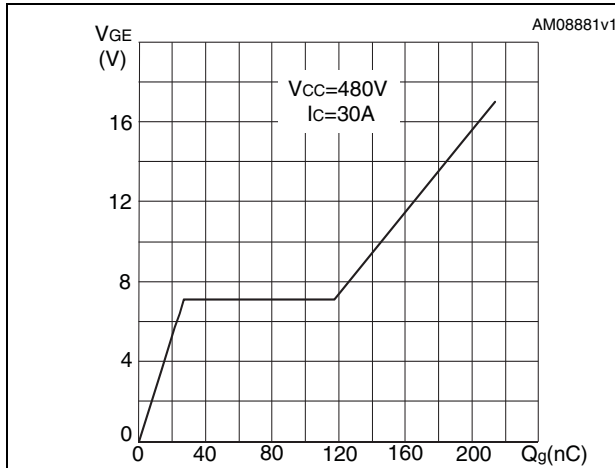


Figure 9. Capacitance variations

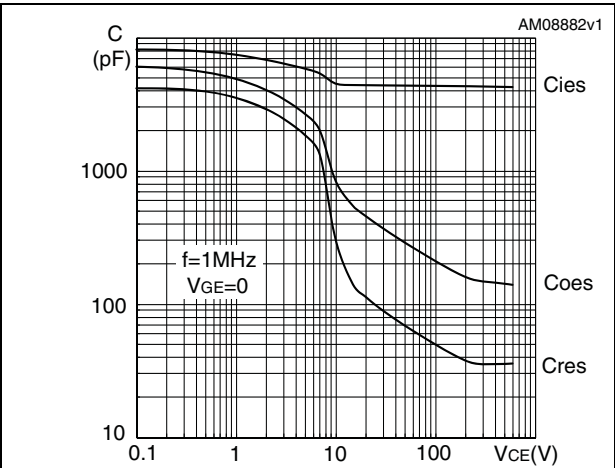


Figure 10. Switching losses vs collector current

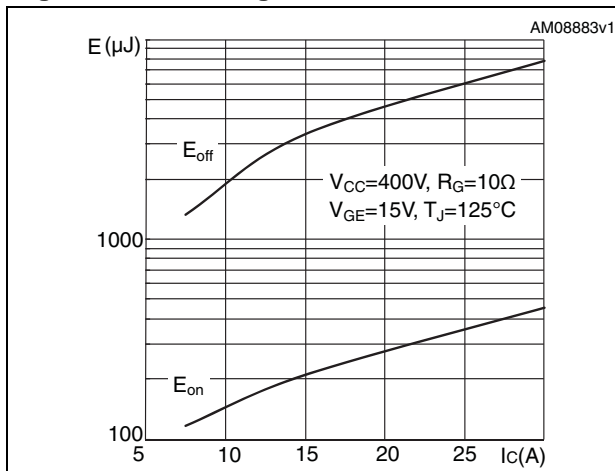


Figure 11. Switching losses vs gate resistance

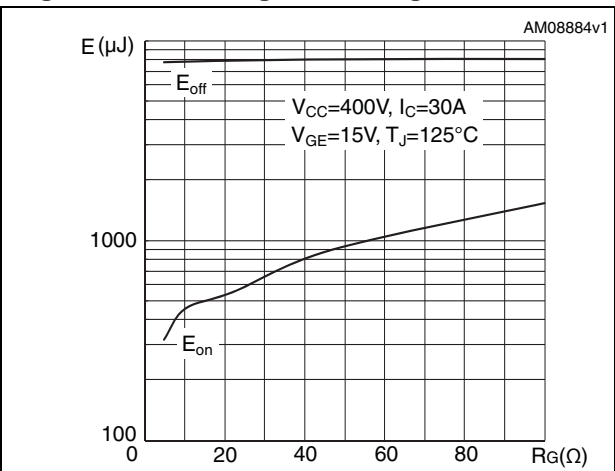


Figure 12. Switching losses vs temperature

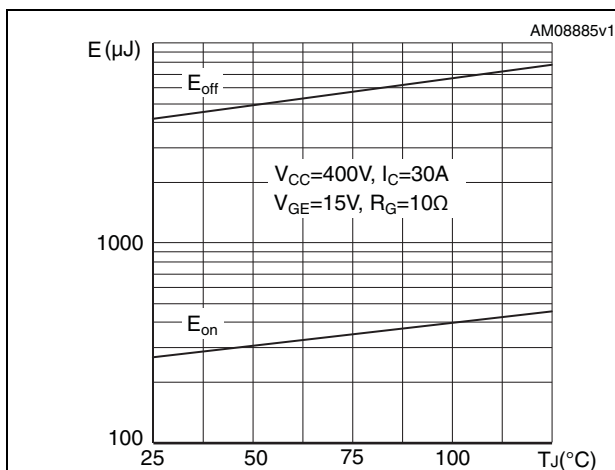
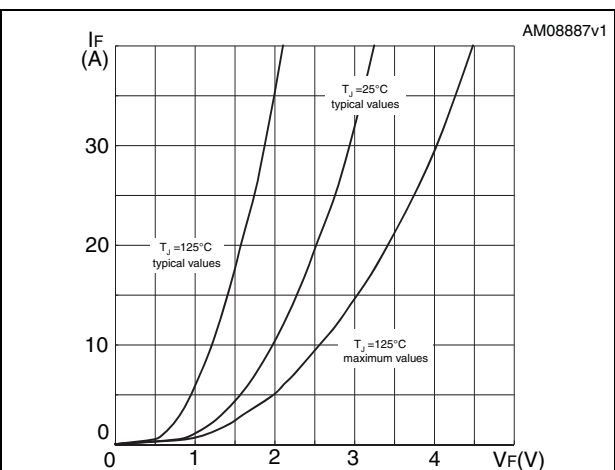


Figure 13. Emitter-collector diode characteristics



3 Test circuits

Figure 14. Test circuit for inductive load switching

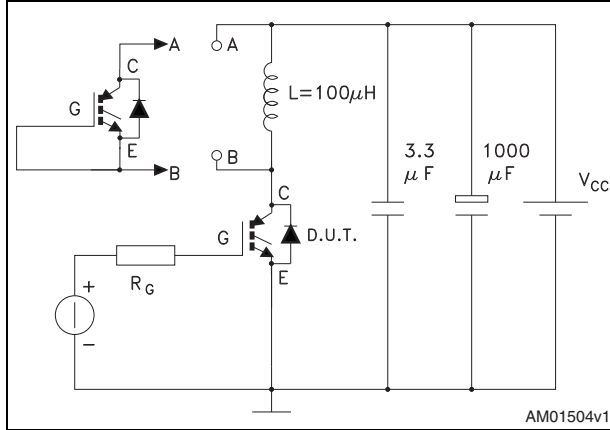


Figure 15. Gate charge test circuit

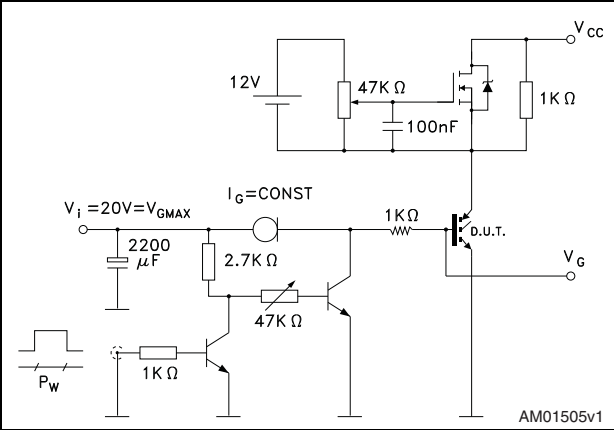


Figure 16. Switching waveform

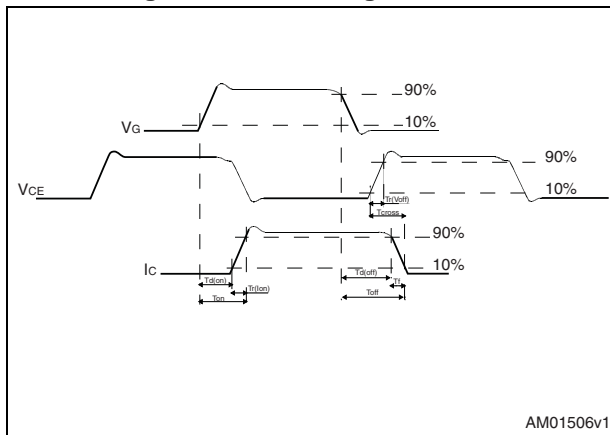
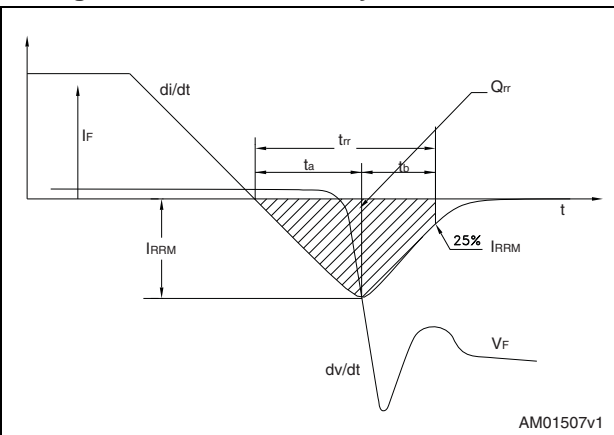


Figure 17. Diode recovery time waveform



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 9. 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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 18. TO-247 drawing

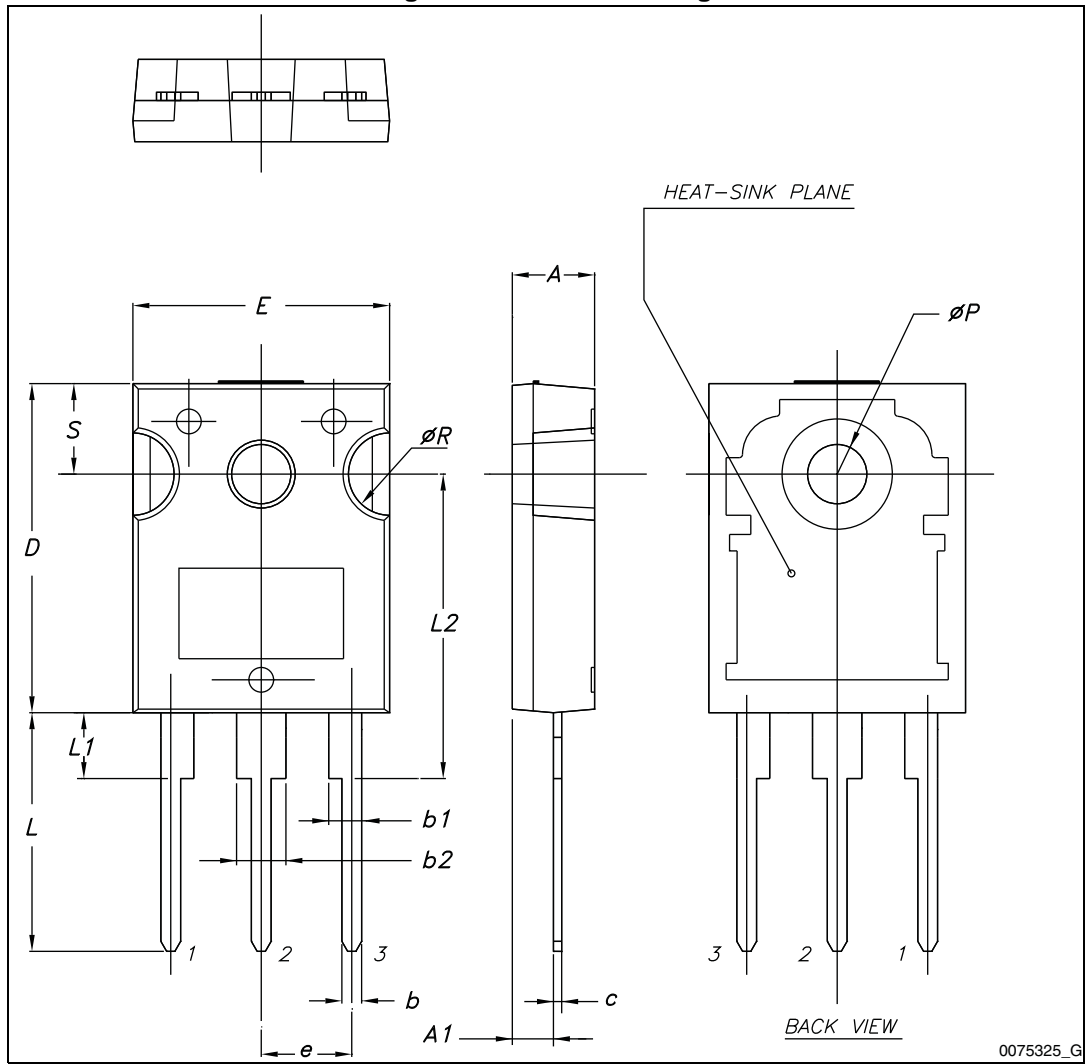
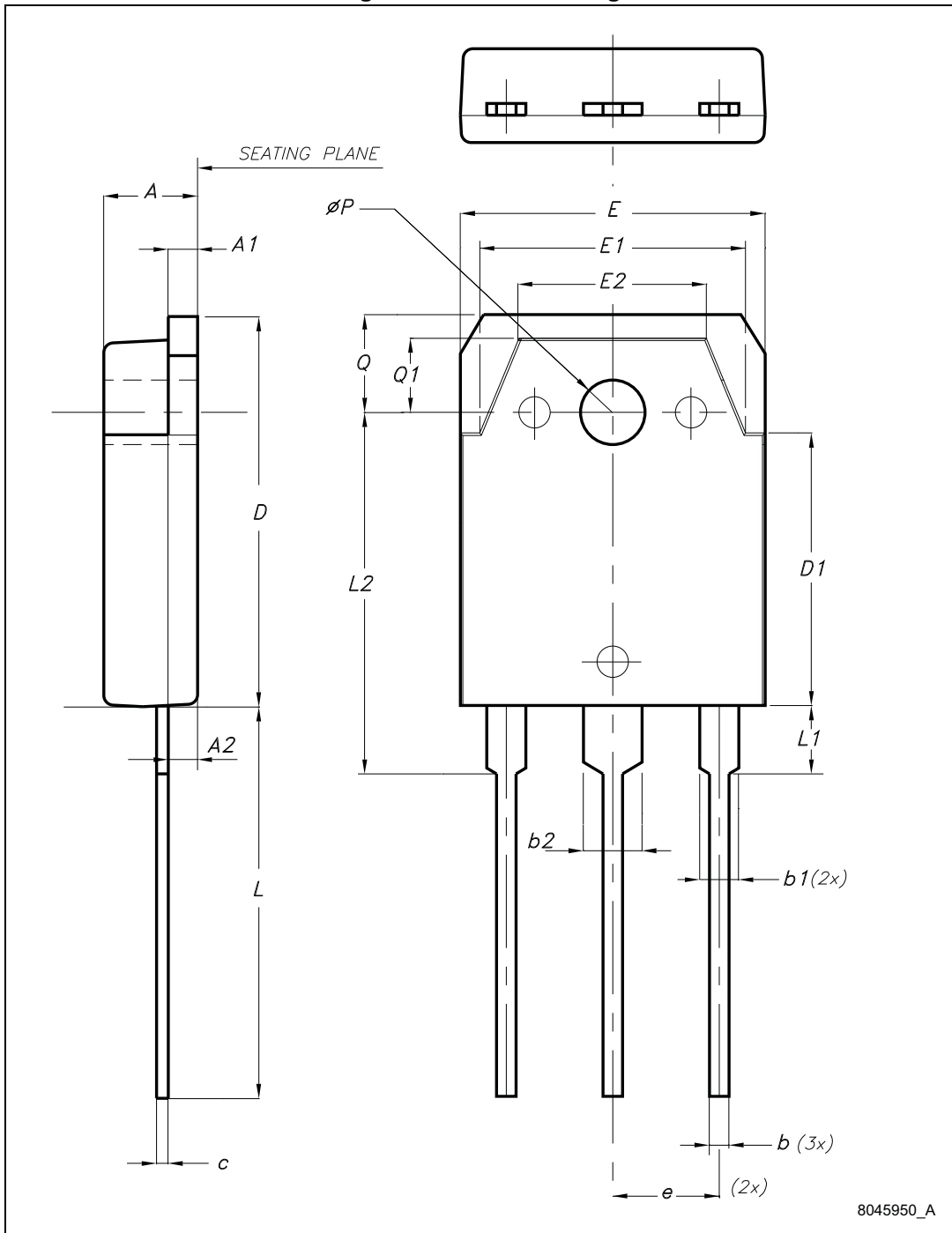


Table 10. TO-3P mechanical data

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 19. TO-3P drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
21-Mar-2013	1	Initial release.

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