

Features

- High speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- 6 μ s short-circuit withstand time
- Lead free package

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- High switching frequency converters

Description

Using advanced proprietary trench gate and field stop structure, this IGBT leads to an optimized compromise between conduction and switching losses maximizing the efficiency for high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and a very tight parameter distribution result in an easier paralleling operation.

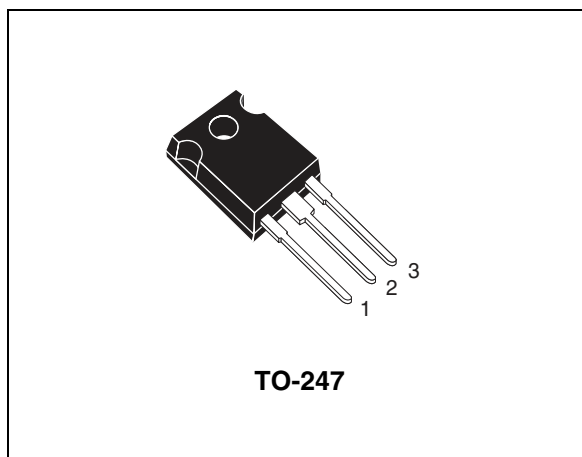


Figure 1. Internal schematic diagram

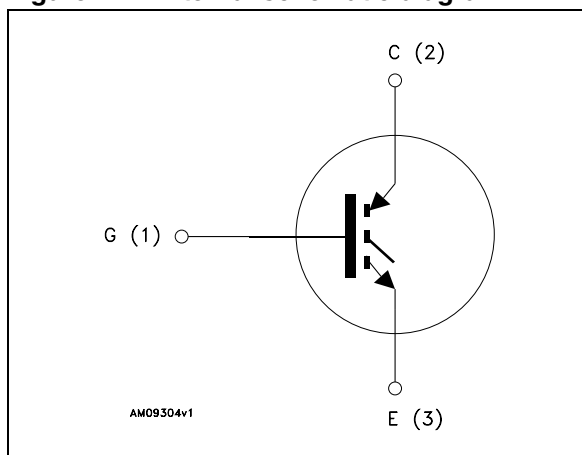


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW60H65F	GW60H65F	TO-247	Tube

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 $T_C = 25\text{ °C}$	120	A
I_C	Continuous collector current at $T_C = 100\text{ °C}$	60	A
$I_{CP}^{(1)}$	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	360	W
t_{SC}	Short-circuit withstand time at $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$	6	μs
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	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance junction-ambient	50	$^{\circ}\text{C}/\text{W}$

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 ($V_{GE} = 0$)	$I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$		1.9		V
		$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$ $T_J = 125\text{ °C}$		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	μA
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/ μs
$t_{d(on)}^{(1)}$	Turn-on delay time	$V_{CE} = 400\text{ V}, I_C = 60\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ °C}$		63		ns
$t_r^{(1)}$	Current rise time		-	33	-	ns
$(di/dt)_{on}^{(1)}$	Turn-on current slope			1800		A/ μs

Table 6. Switching on/off (inductive load)

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

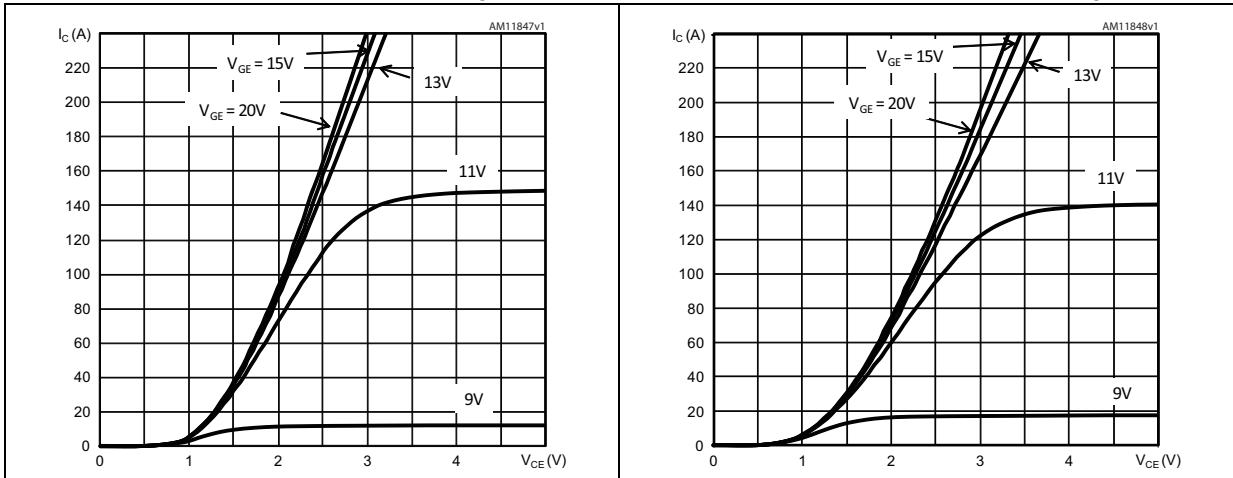


Figure 4. Output characteristics ($T_J = 150\text{ }^\circ\text{C}$) Figure 5. Transfer characteristics

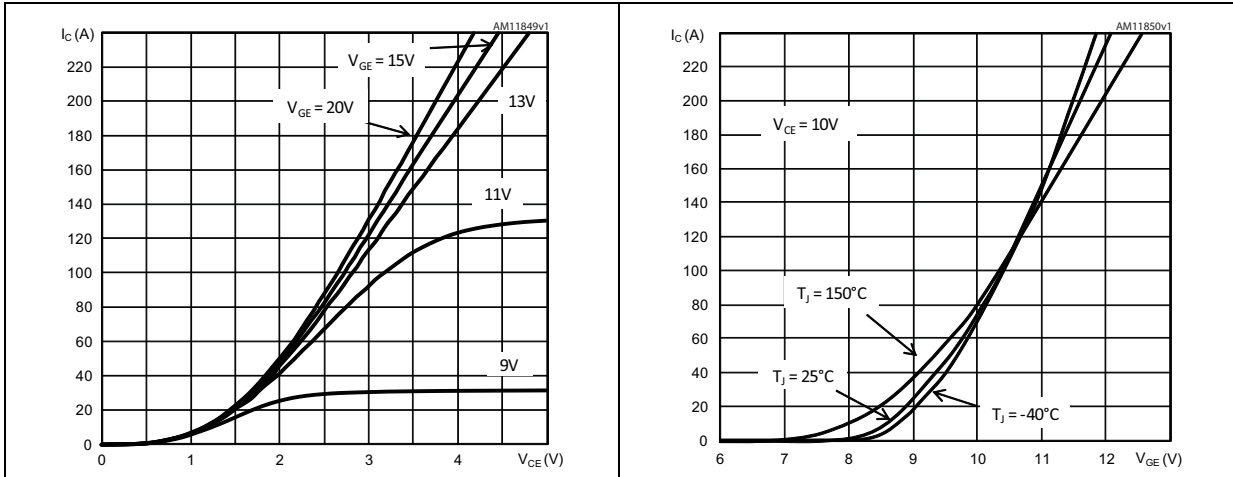


Figure 6. $V_{CE(SAT)}$ vs. junction temperature Figure 7. $V_{CE(SAT)}$ vs. collector current

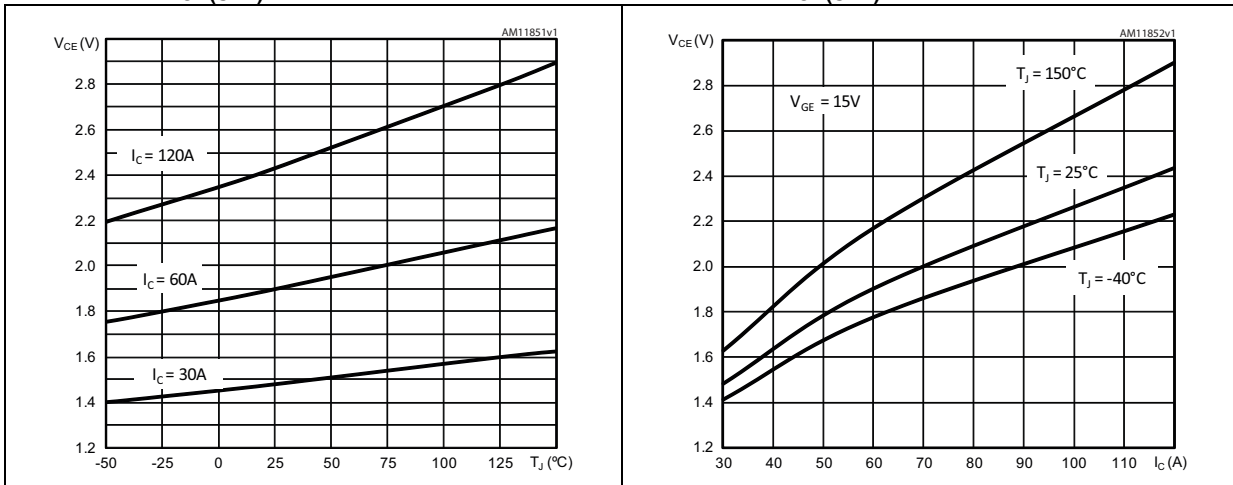


Figure 8. Normalized $V_{GE(th)}$ vs. junction temperature

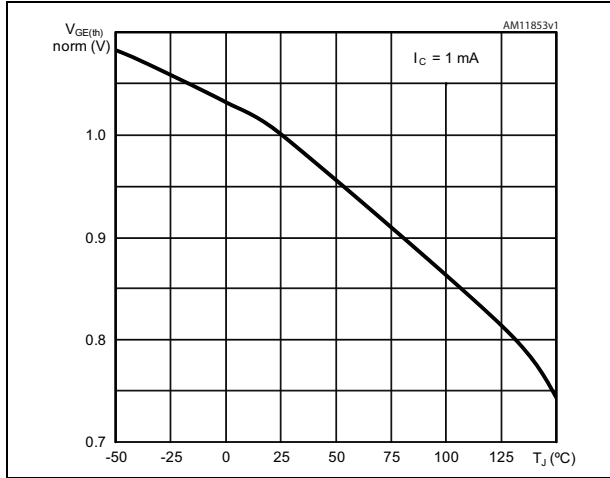


Figure 9. Gate charge vs. gate-emitter voltage

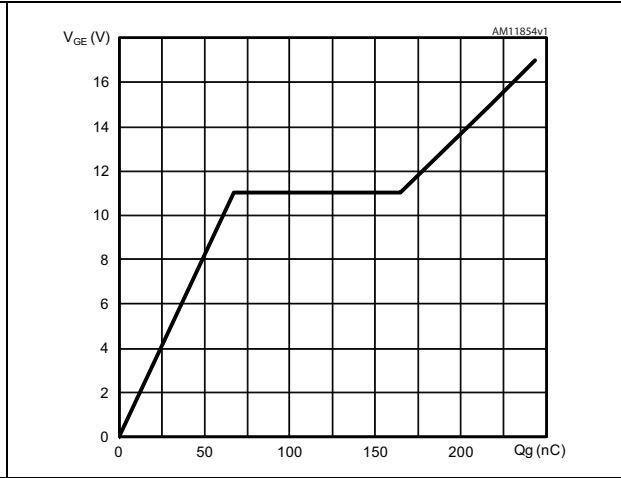


Figure 10. Capacitance variations ($f = 1$ MHz, $V_{GE} = 0$)

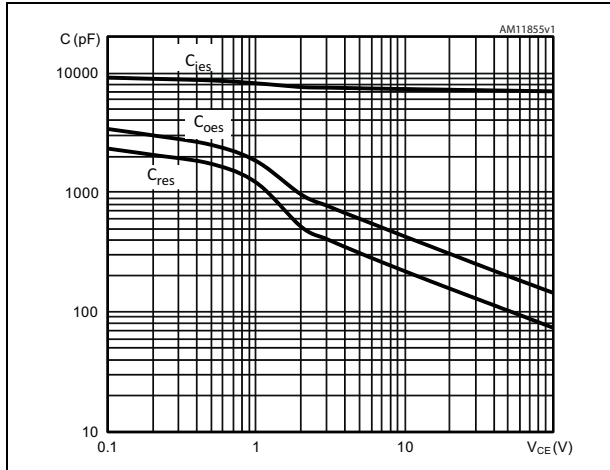


Figure 11. Switching losses vs. collector current

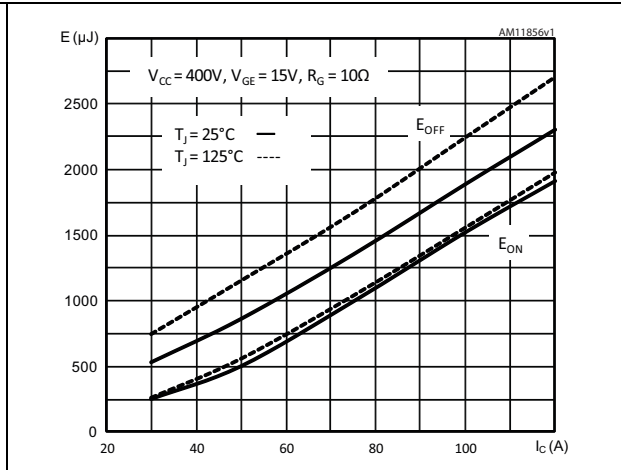


Figure 12. Switching losses vs. gate resistance

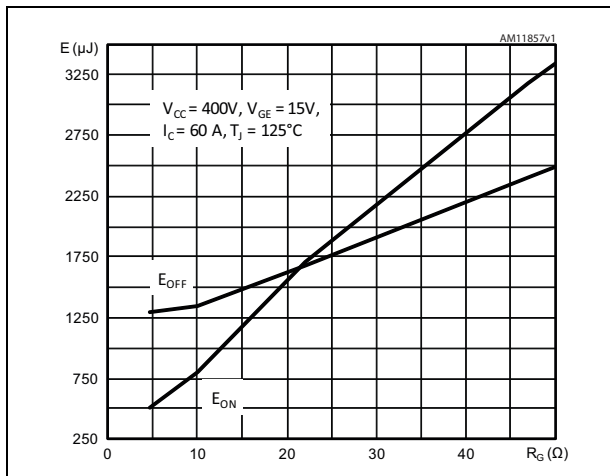


Figure 13. Switching losses vs. temperature

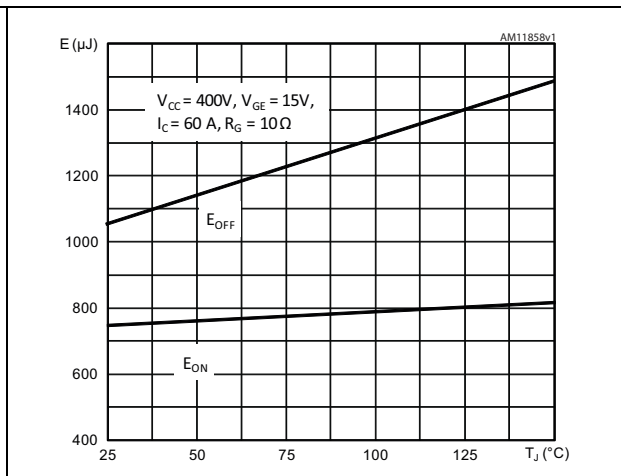


Figure 14. Turn-OFF SOA

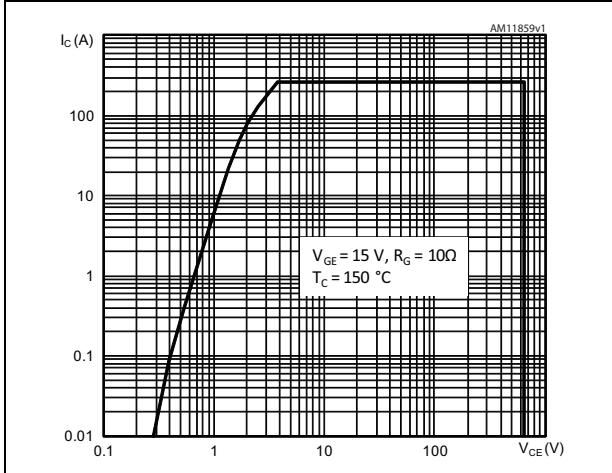


Figure 15. Short circuit time & current vs. V_{GE}

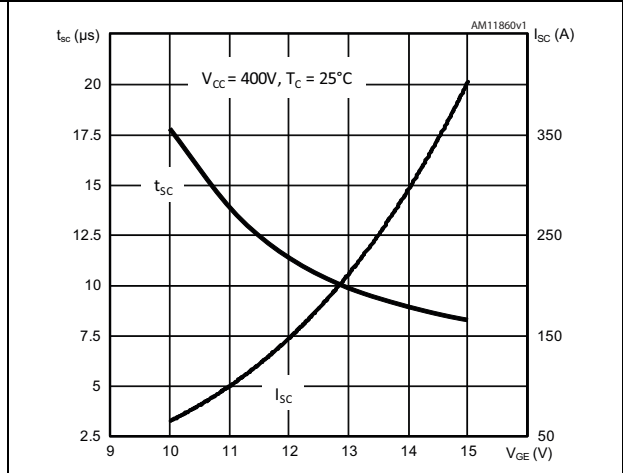
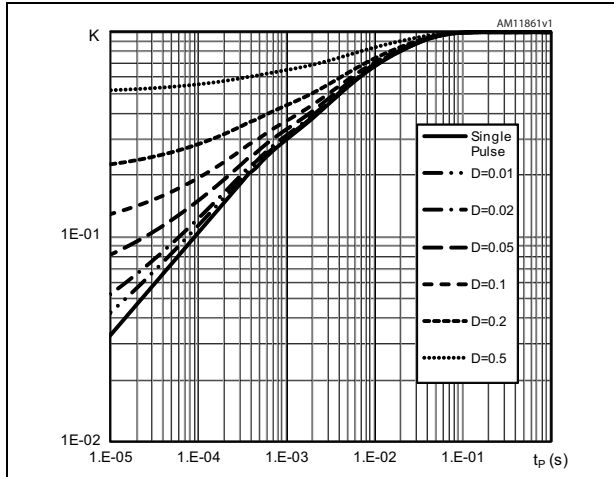


Figure 16. Maximum normalized Z_{th} junction to case (IGBT)



3 Test circuits

Figure 17. Test circuit for inductive load switching

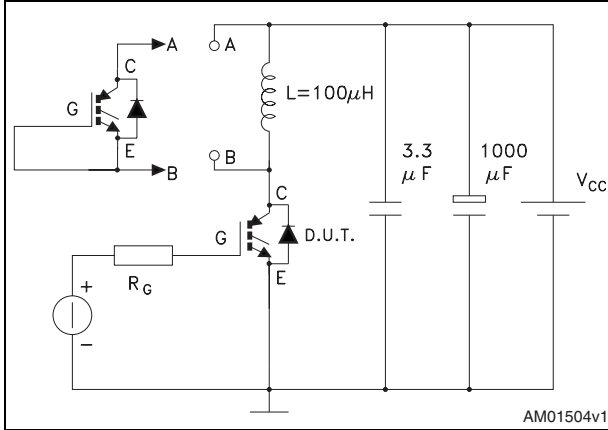


Figure 18. Gate charge test circuit

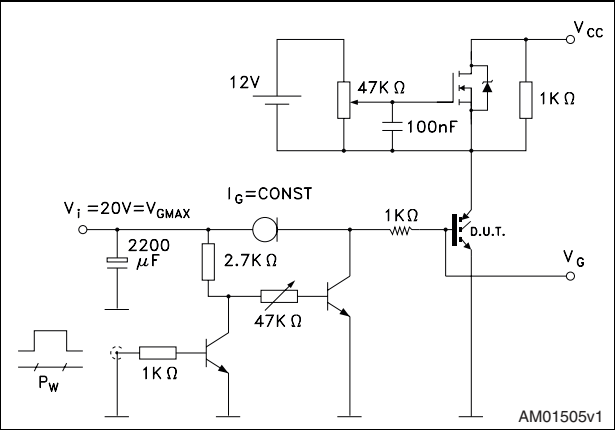
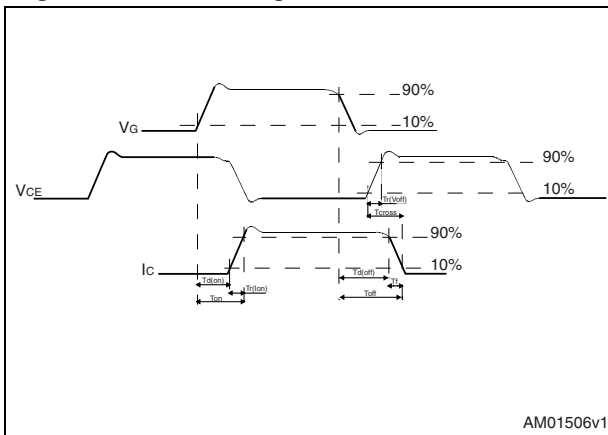


Figure 19. Switching waveform



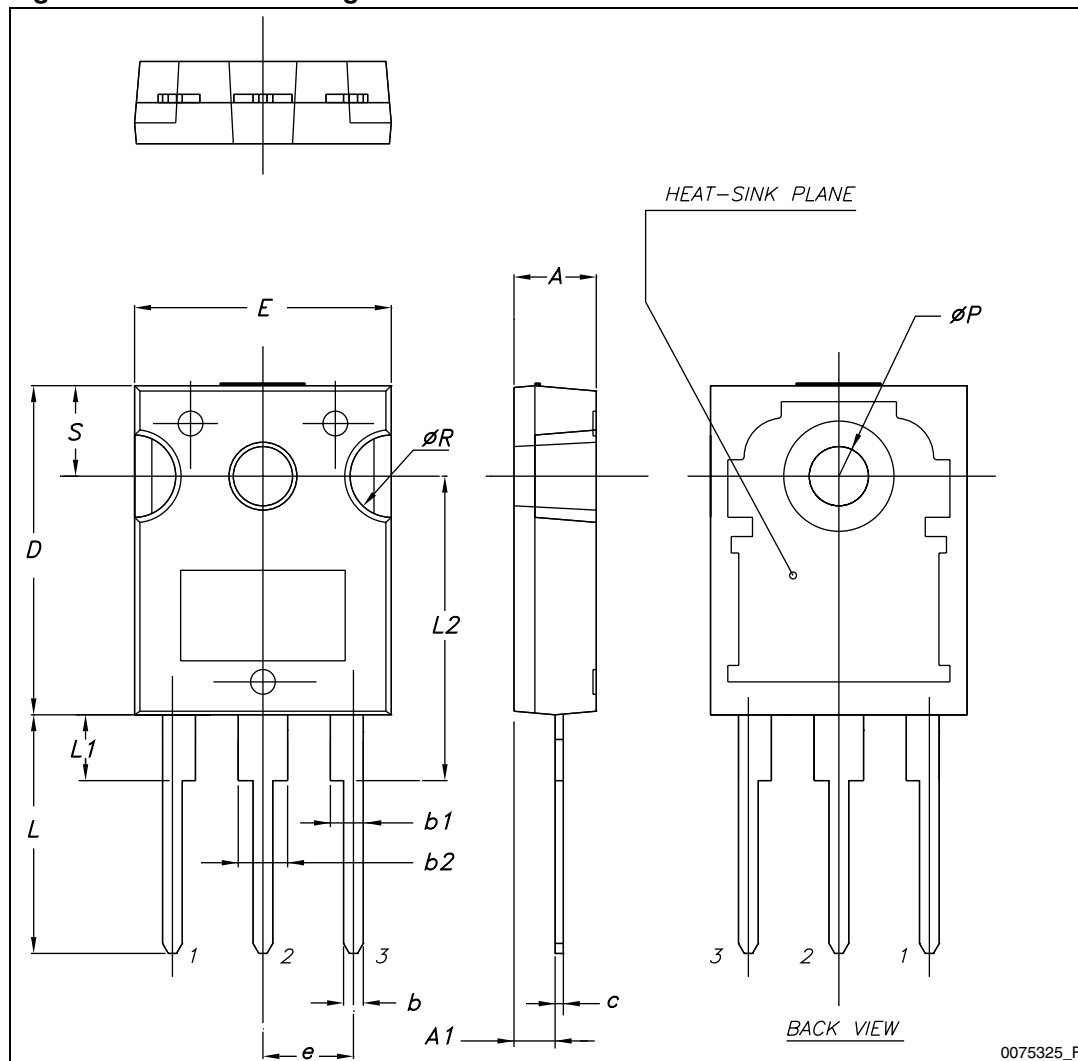
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] 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 20. TO-247 drawing



0075325_F

5 Revision history

Table 9. 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: Section 2.1: Electrical characteristics (curves) .
31-Jul-2012	4	Updated: Figure 8 on page 6 .

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