



Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- 6 μ s short-circuit withstand time
- Ultrafast soft recovery antiparallel diode
- 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.

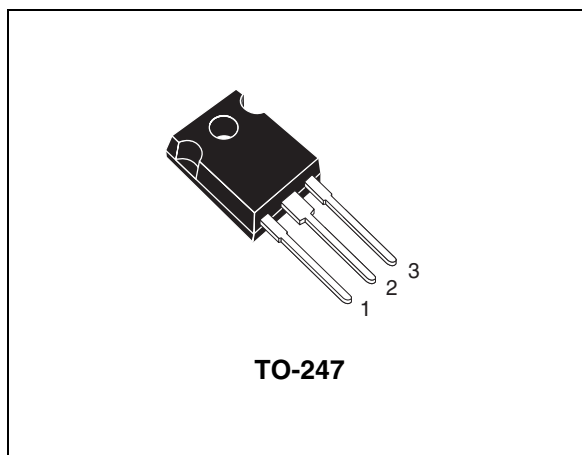


Figure 1. Internal schematic diagram

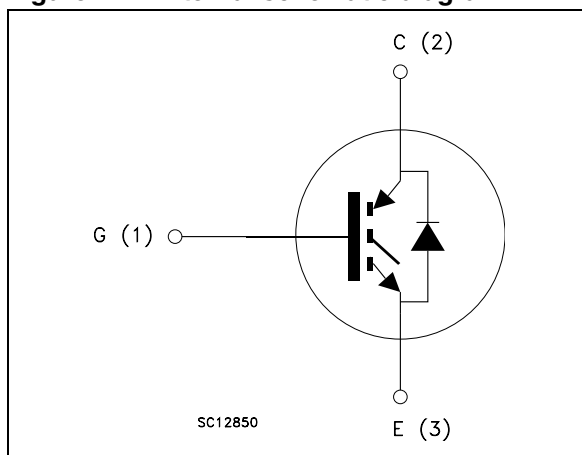


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW50H60DF	GW50H60DF	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	Continuous collector current at $T_C = 25\text{ °C}$	100	A
I_C	Continuous collector current at $T_C = 100\text{ °C}$	50	A
$I_{CP}^{(1)}$	Pulsed collector current	200	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Diode RMS forward current at $T_C = 25\text{ °C}$	30	A
I_{FSM}	Surge not repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	120	A
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 IGBT	0.35	$^{\circ}\text{C/W}$
R_{thJC}	Thermal resistance junction-case diode	1.5	$^{\circ}\text{C/W}$
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 ($V_{GE} = 0$)	$I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$		1.8		V
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $T_J = 125\text{ }^{\circ}\text{C}$		2.0		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$		6.0		V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$			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	$V_{CC} = 400\text{ V}, I_C = 50\text{ A},$ $V_{GE} = 15\text{ V}$	-	217	-	nC
Q_{ge}	Gate-emitter charge		-	61	-	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	$V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}$	-	62	-	ns
t_r	Current rise time			28		ns
$(di/dt)_{on}$	Turn-on current slope			1800		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ }^{\circ}\text{C}$	-	62	-	ns
t_r	Current rise time			29		ns
$(di/dt)_{on}$	Turn-on current slope			1680		A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}$	-	34	-	ns
$t_{d(off)}$	Turn-off delay time			178		ns
t_f	Current fall time			40		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}, I_C = 50\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V}$ $T_J = 125\text{ }^{\circ}\text{C}$	-	45	-	ns
$t_{d(off)}$	Turn-off delay time			205		ns
t_f	Current fall time			80		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$, $I_C = 50\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$	-	0.89	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			0.86		mJ
E_{ts}	Total switching losses			1.75		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$, $I_C = 50\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$	-	1.24	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses			1.15		mJ
E_{ts}	Total switching losses			2.39		mJ

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in [Figure 20](#). 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.

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F = 30\text{ A}$ $I_F = 30\text{ A}$, $T_J = 125\text{ °C}$	-	2 1.65	2.5	V V
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 50\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	55	-	ns
Q_{rr}	Reverse recovery charge			110		nC
I_{rrm}	Reverse recovery current			3		A
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 50\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 125\text{ °C}$	-	140	-	ns
Q_{rr}	Reverse recovery charge			400		nC
I_{rrm}	Reverse recovery current			5.5		A

2.1 Electrical characteristics (curves)

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

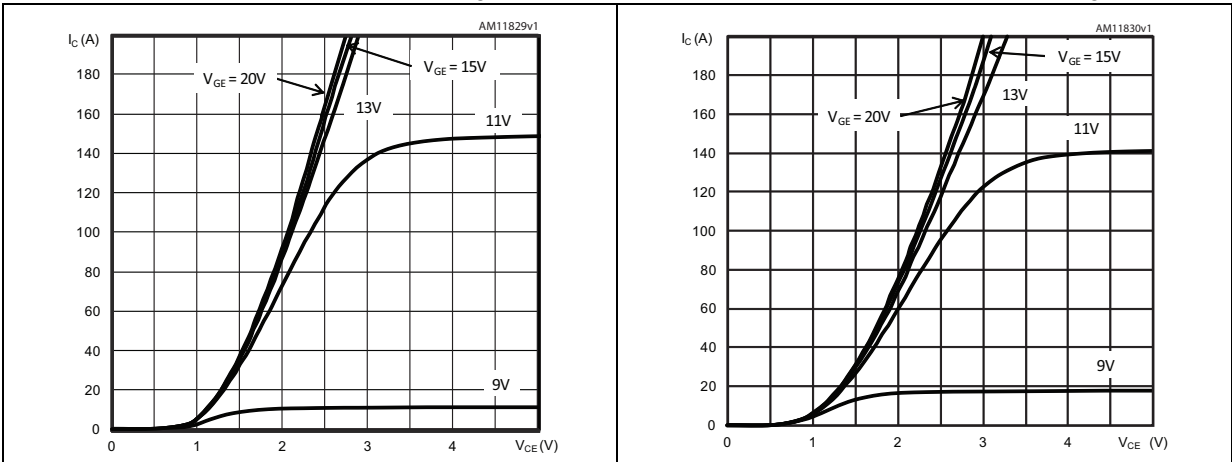


Figure 4. Output characteristics ($T_J = 150\text{ }^{\circ}\text{C}$) **Figure 5. Transfer characteristics**

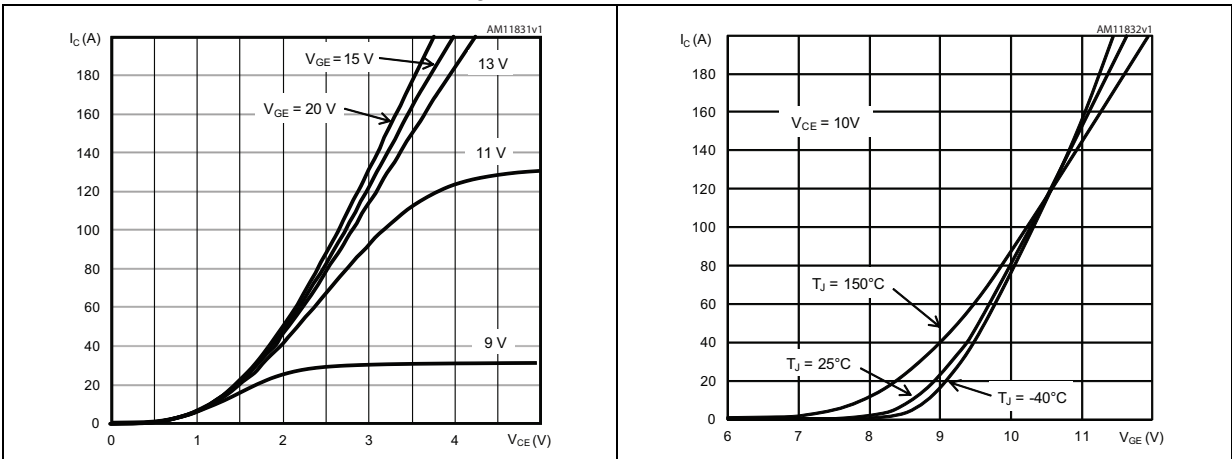


Figure 6. $V_{CE(SAT)}$ vs. junction temperature **Figure 7. $V_{CE(SAT)}$ vs. collector current**

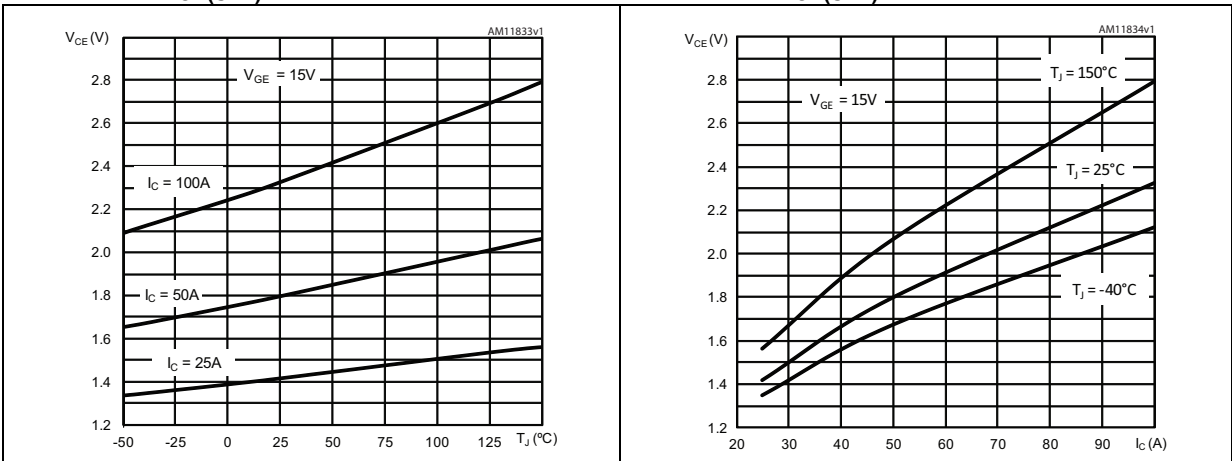


Figure 8. Normalized $V_{GE(th)}$ vs. junction temperature

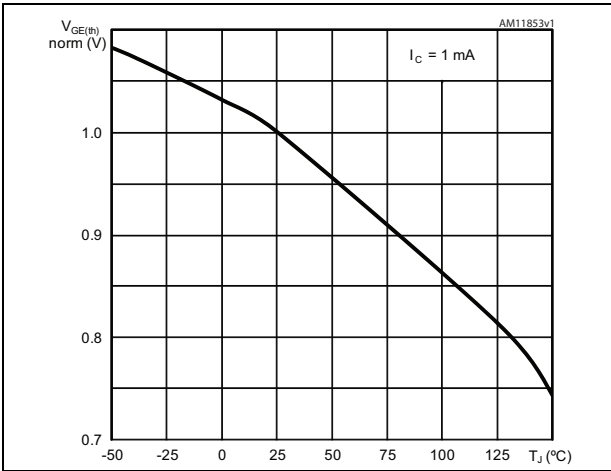


Figure 9. Gate charge vs. gate-emitter voltage

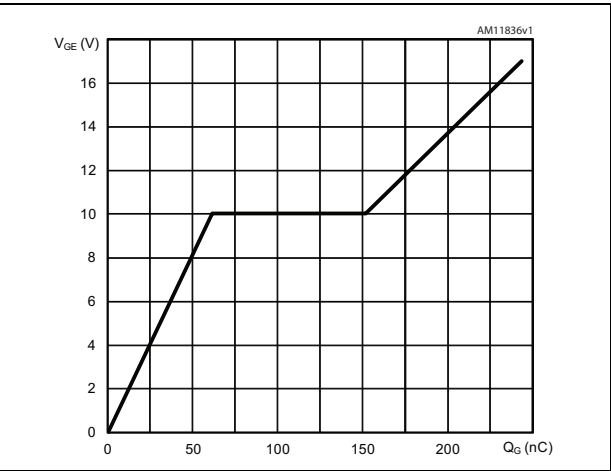


Figure 10. Capacitance variations ($f = 1$ MHz, $V_{GE} = 0$)

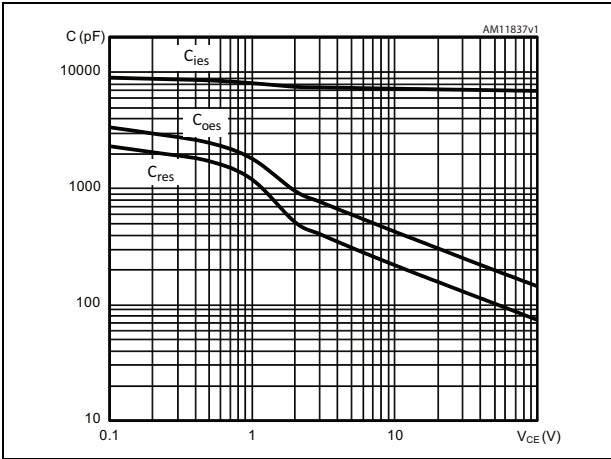


Figure 11. Switching losses vs. collector current

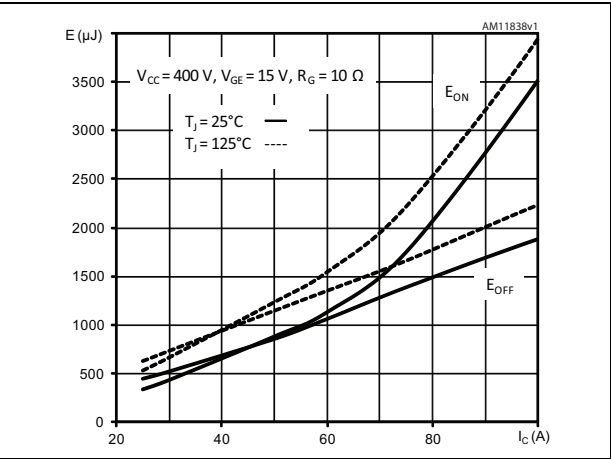


Figure 12. Switching losses vs. gate resistance

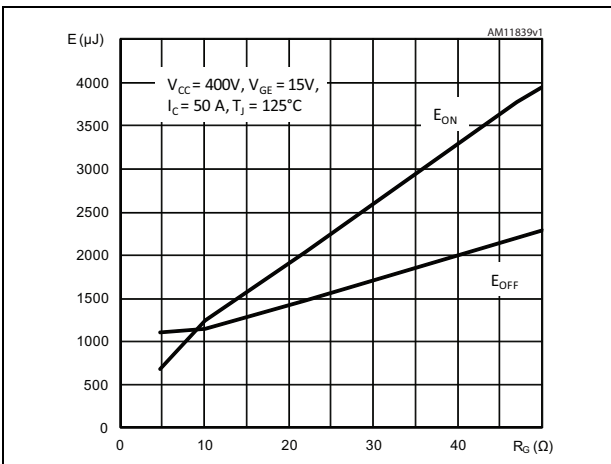


Figure 13. Switching losses vs. temperature

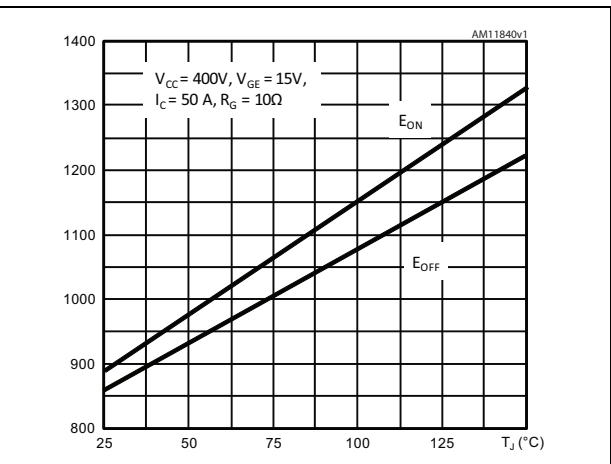


Figure 14. Turn-OFF SOA

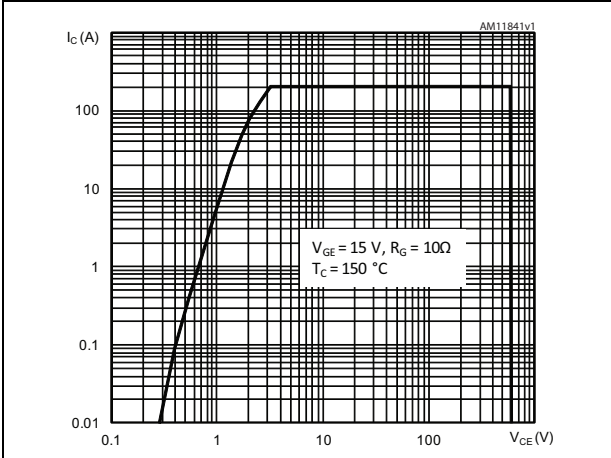


Figure 15. Short circuit time & current vs. V_GE

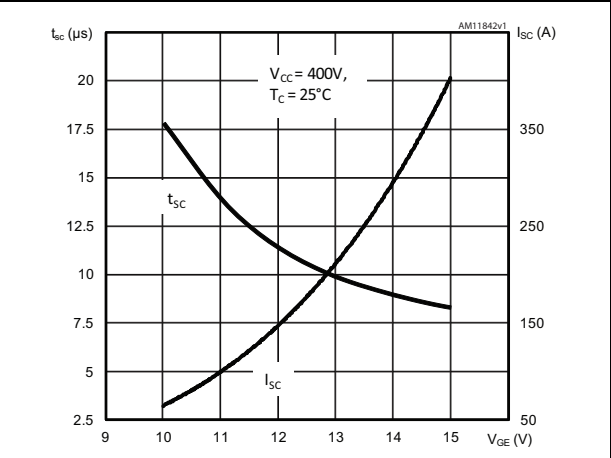


Figure 16. Diode forward current vs. forward voltage

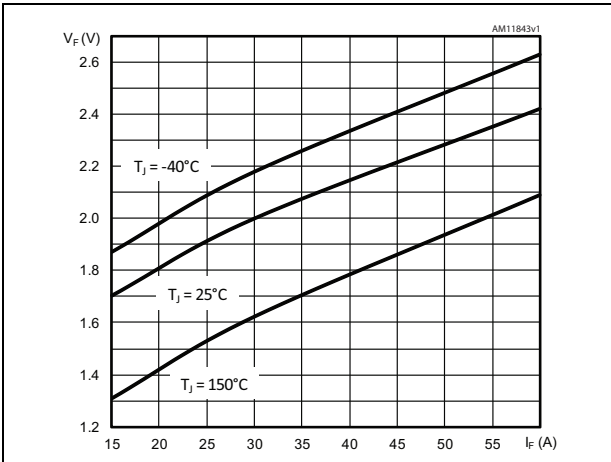


Figure 17. Diode forward current vs. junction temperature

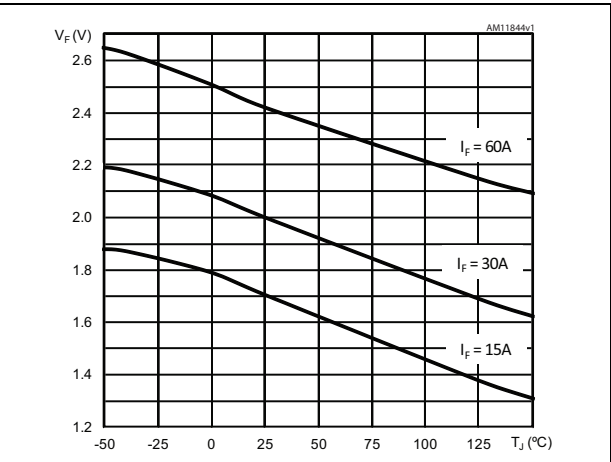


Figure 18. Maximum normalized Z_th junction to case (IGBT)

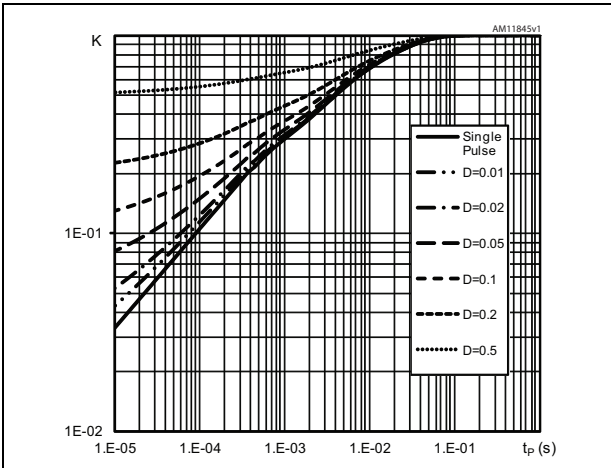
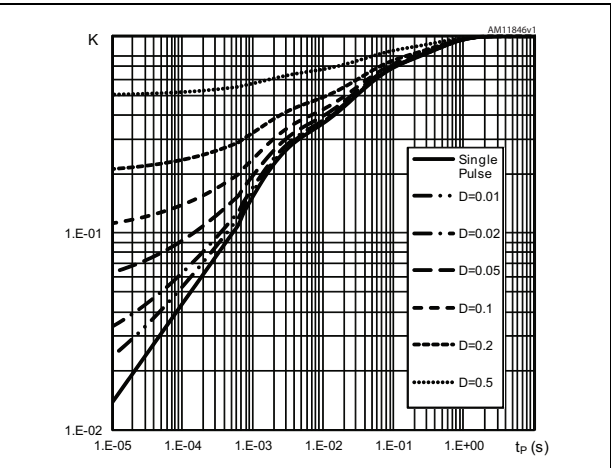


Figure 19. Maximum normalized Z_th junction to case (Diode)



3 Test circuits

Figure 20. Test circuit for inductive load switching

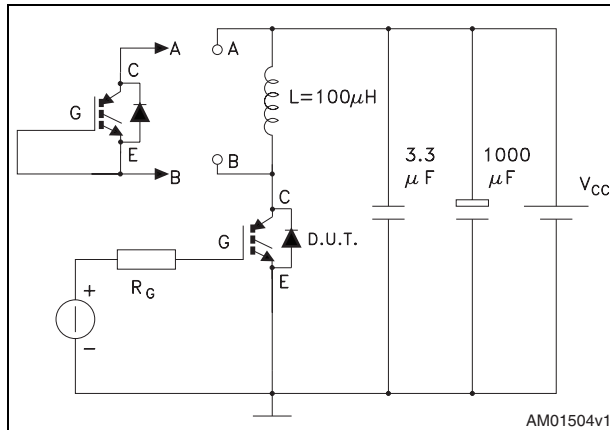


Figure 21. Gate charge test circuit

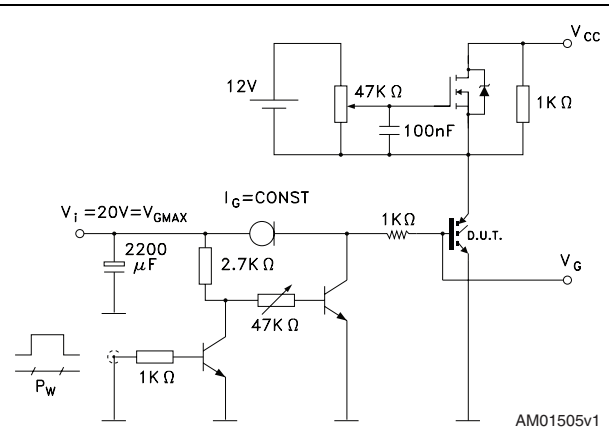


Figure 22. Switching waveform

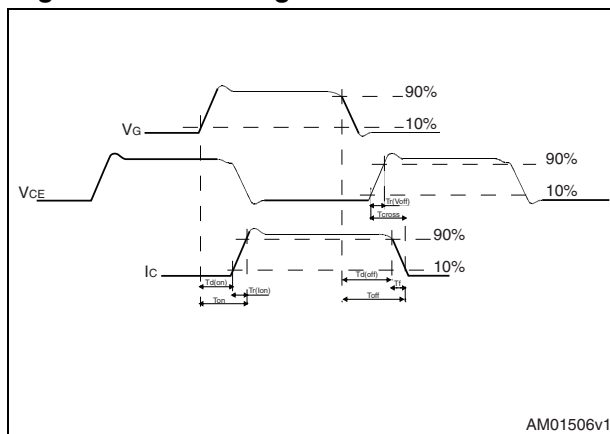
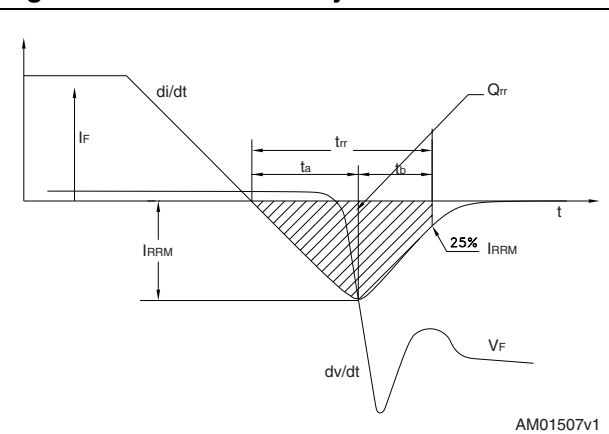


Figure 23. Diode recovery time waveform



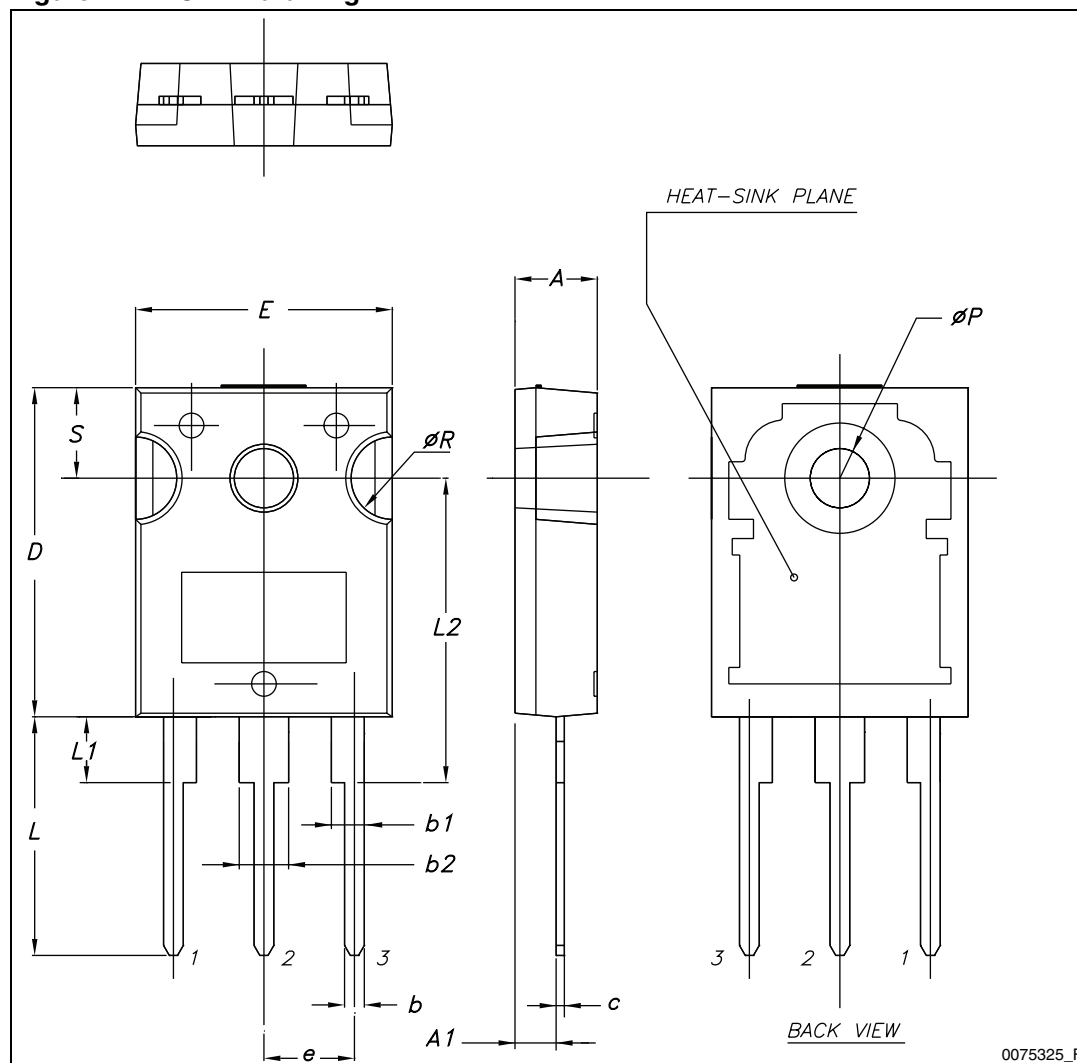
4 Package mechanical data

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		5.45	
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 24. TO-247 drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
28-Apr-2011	1	Initial release.
26-Jul-2011	2	Added: t_{SC} and T_{STG} Table 2 on page 2 . Updated: Table 4 , Table 5 , Table 6 on page 3 and Table 7 on page 4 .
12-Jan-2012	3	Document status promoted from preliminary data to datasheet.
10-Feb-2012	4	Added: Section 2.1: Electrical characteristics (curves) .
26-Jul-2012	5	Modified: Figure 8 on page 6 .

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