



STGW45HF60WD

45 A, 600 V ultra fast IGBT

Features

- Improved E_{off} at elevated temperature
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Ultra fast soft recovery antiparallel diode

Applications

- Welding
- High frequency converters
- Power factor correction

Description

The “HF” family is based on a new advanced planar technology concept to yield an IGBT with more stable switching performance (E_{off}) versus temperature, as well as lower conduction losses. The “W” series is a subset of products tailored to high switching frequency operation (over 100 kHz).

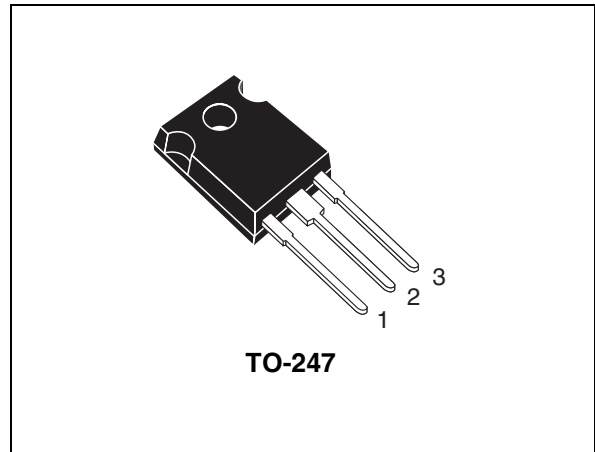


Figure 1. Internal schematic diagram

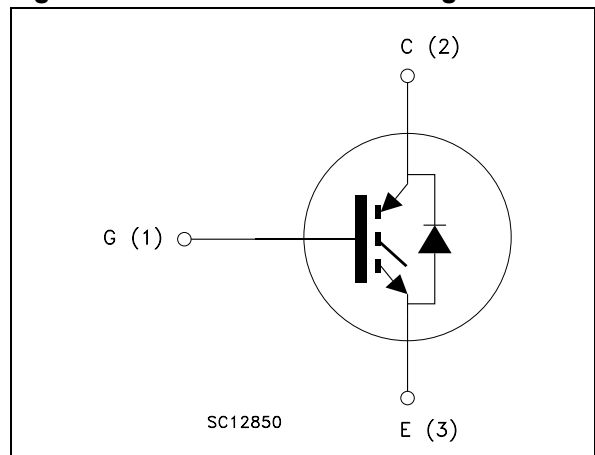


Table 1. Device summary ⁽¹⁾

Order code	Marking	Package	Packaging
STGW45HF60WD	GW45HF60WDA	TO-247	Tube
	GW45HF60WDB		
	GW45HF60WDC		

1. Collector-emitter saturation voltage is classified in group A, B and C, see [Table 5: VCE\(sat\) classification](#). STMicroelectronics reserves the right to ship from any group according to production availability.

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	600	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	70	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	45	A
$I_{CP}^{(2)}$	Pulsed collector current	150	A
$I_{CL}^{(3)}$	Turn-off latching current	80	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 $T_C = 25\text{ °C}$	250	W
T_{stg}	Storage temperature	– 55 to 150	°C
T_j	Operating junction temperature		

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. Pulse width limited by maximum junction temperature and turn-off within RBSOA

3. $V_{CLAMP} = 80\% (V_{CES})$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $T_J = 150\text{ °C}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.5	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
$R_{thj-amb}$	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	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 125\text{ °C}$		1.65	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_J = 125\text{ °C}$			500 5	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA

Table 5. $V_{CE(sat)}$ classification

Symbol	Parameter	Group	Value		Unit
			Min.	Max.	
$V_{CE(sat)}$	Collector-emitter saturation voltage $V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$	A	1.68	1.92	V
		B	1.88	2.17	
		C	2.13	2.50	

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	2900	-	pF
C_{oes}	Output capacitance			260		pF
C_{res}	Reverse transfer capacitance			55		pF
Q_g	Total gate charge	$V_{CE} = 400\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, Figure 17	-	160	-	nC
Q_{ge}	Gate-emitter charge			17		nC
Q_{gc}	Gate-collector charge			65		nC

Table 7. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$		30		ns
t_r	Current rise time	$R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$, (<i>Figure 16</i>)	-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope			2600		A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$		30		ns
t_r	Current rise time	$R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (<i>Figure 16</i>)	-	14	-	ns
$(di/dt)_{on}$	Turn-on current slope			2200		A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$, $R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$	-	30		ns
$t_{d(off)}$	Turn-off delay time			145	-	ns
t_f	Current fall time	(<i>Figure 16</i>)		50		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$, $R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	47		ns
$t_{d(off)}$	Turn-off delay time	(<i>Figure 16</i>)		185	-	ns
t_f	Current fall time			65		ns

Table 8. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$		300		μ J
E_{off}	Turn-off switching losses	$R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$, (<i>Figure 18</i>)	-	330		μ J
E_{ts}	Total switching losses			630		μ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 400\text{ V}$, $I_C = 30\text{ A}$		550		μ J
E_{off}	Turn-off switching losses	$R_G = 6.8\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (<i>Figure 18</i>)	-	550	800	μ J
E_{ts}	Total switching losses			1100		μ J

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in *Figure 18*. If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature ($25\text{ }^\circ\text{C}$ and $125\text{ }^\circ\text{C}$). E_{on} include diode recovery energy.

Table 9. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F = 30\text{ A}$ $I_F = 30\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	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	(<i>see Figure 19</i>)		110	-	nC
I_{rrm}	Reverse recovery current			3		A
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 50\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	140		ns
Q_{rr}	Reverse recovery charge	$T_J = 125\text{ }^\circ\text{C}$, (<i>see Figure 19</i>)		400	-	nC
I_{rrm}	Reverse recovery current			5.5		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

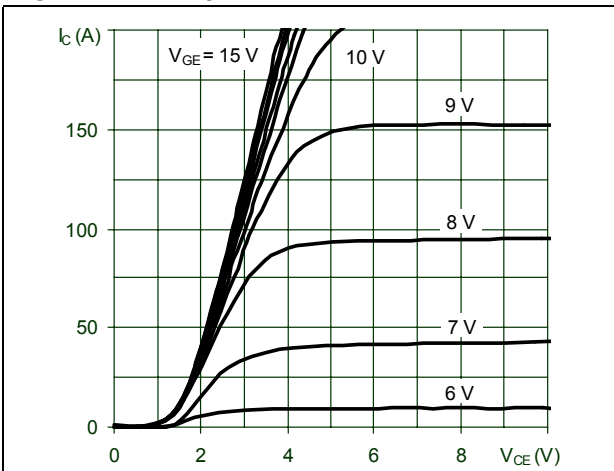


Figure 3. Transfer characteristics

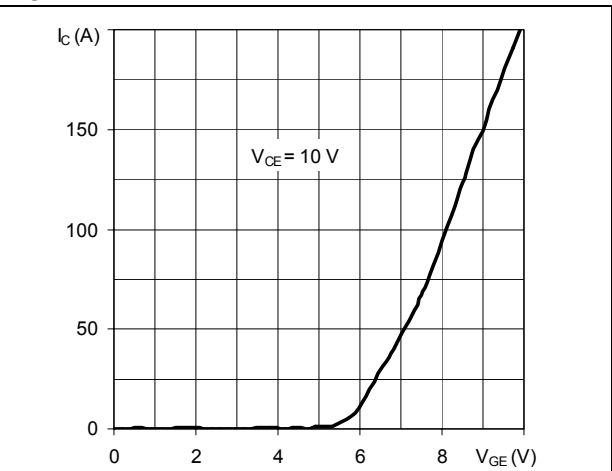


Figure 4. Normalized $V_{CE(sat)}$ vs. I_C

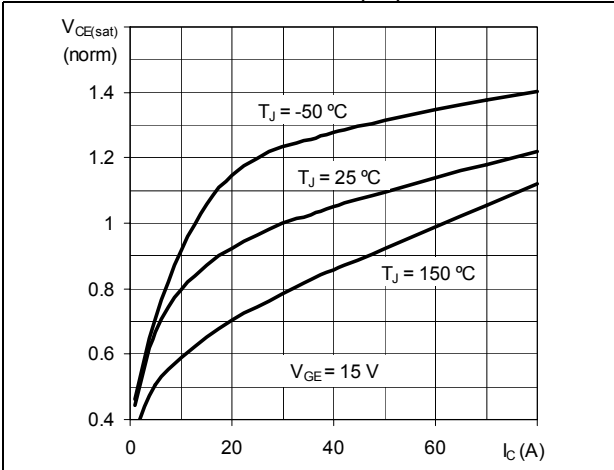


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

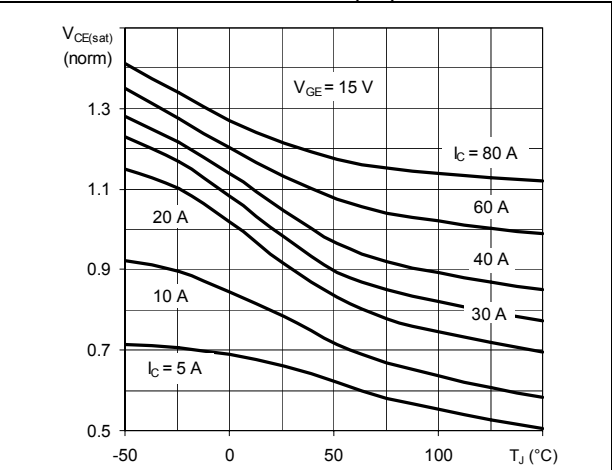


Figure 6. Normalized breakdown voltage vs. temperature

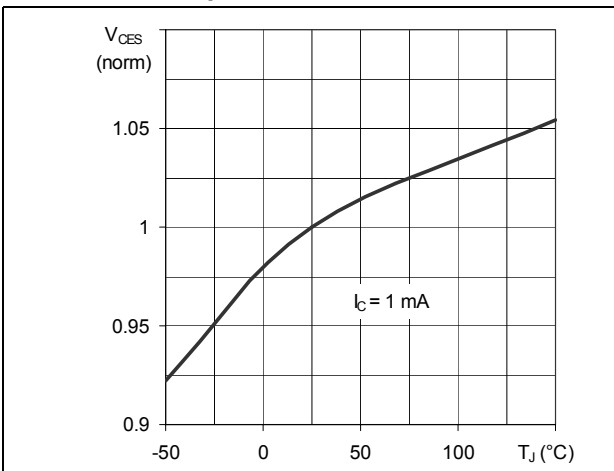


Figure 7. Normalized gate threshold voltage vs. temperature

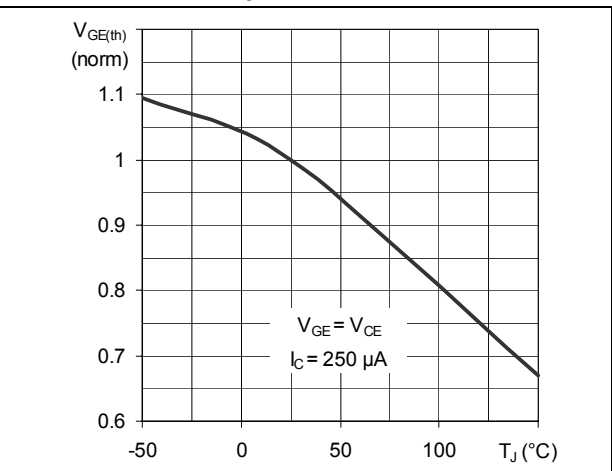


Figure 8. Gate charge vs. gate-emitter voltage

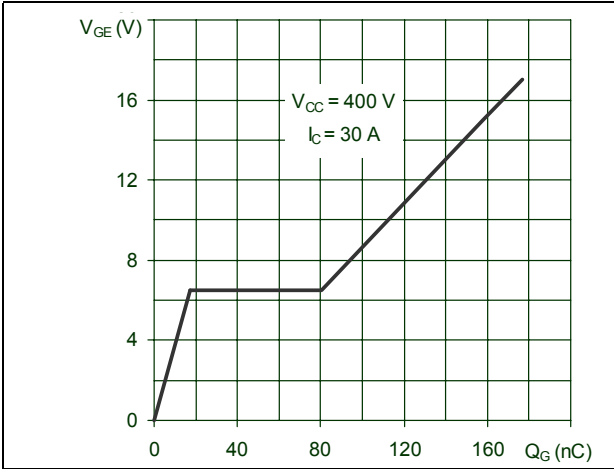


Figure 9. Capacitance variations

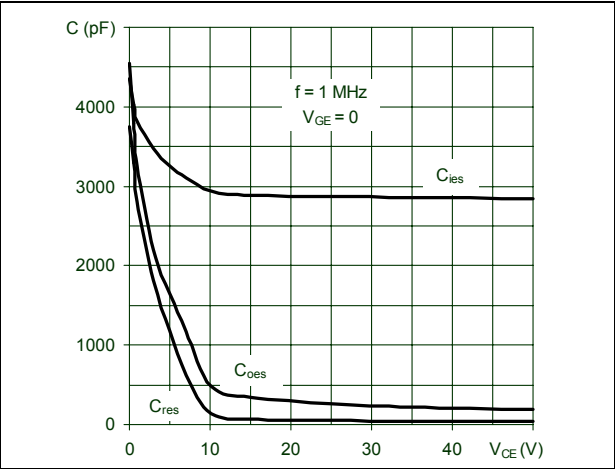


Figure 10. Switching losses vs temperature

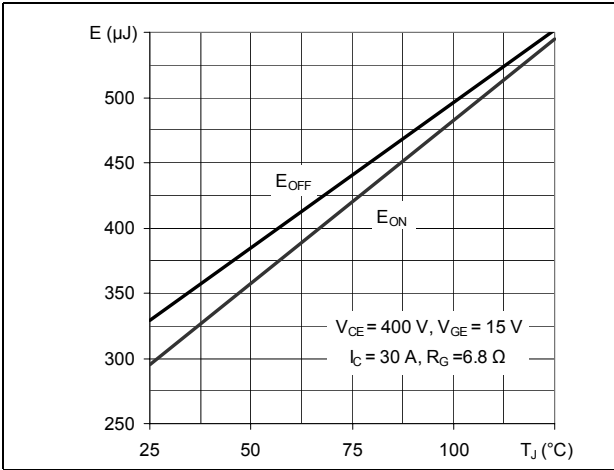


Figure 11. Switching losses vs. gate resistance

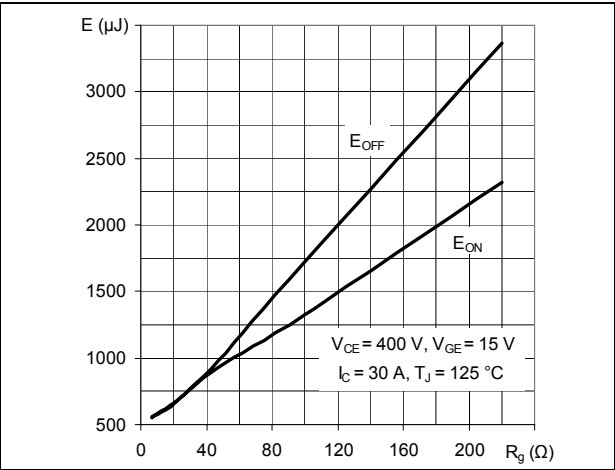


Figure 12. Switching losses vs. collector current

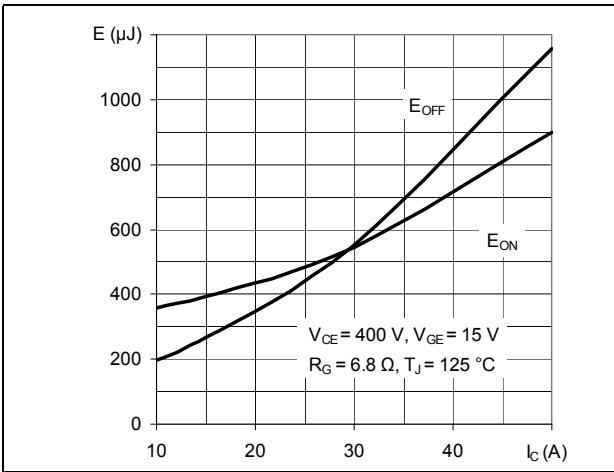


Figure 13. Turn-off SOA

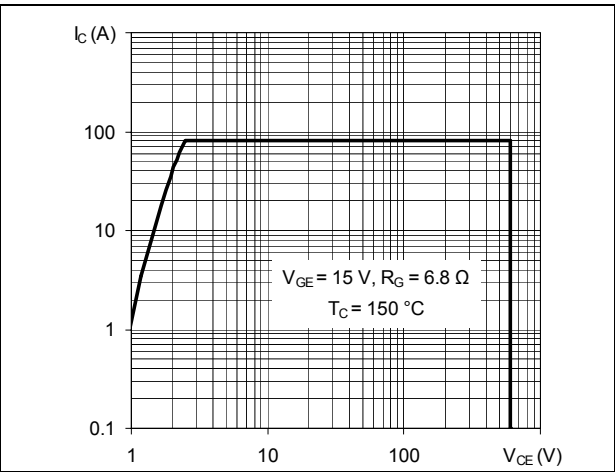


Figure 14. Diode forward on voltage

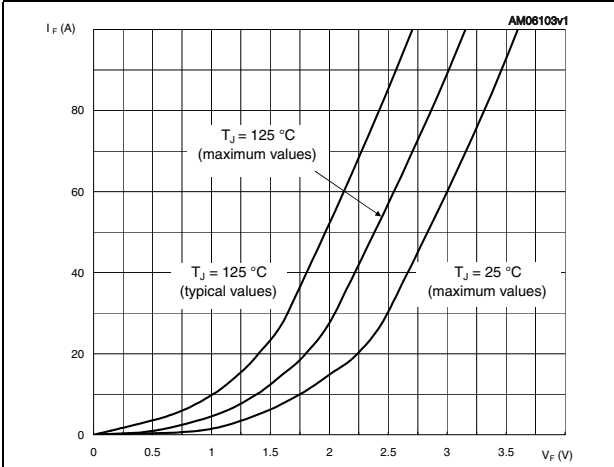
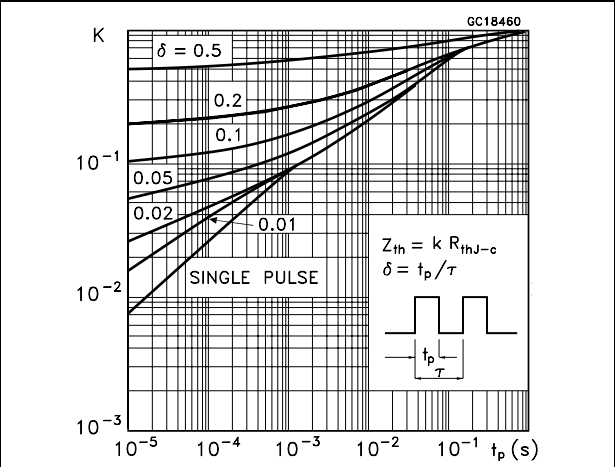


Figure 15. Thermal impedance



3 Test circuits

Figure 16. Test circuit for inductive load switching

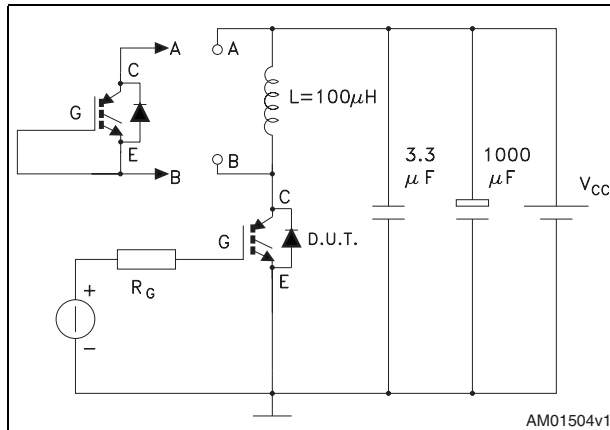


Figure 17. Gate charge test circuit

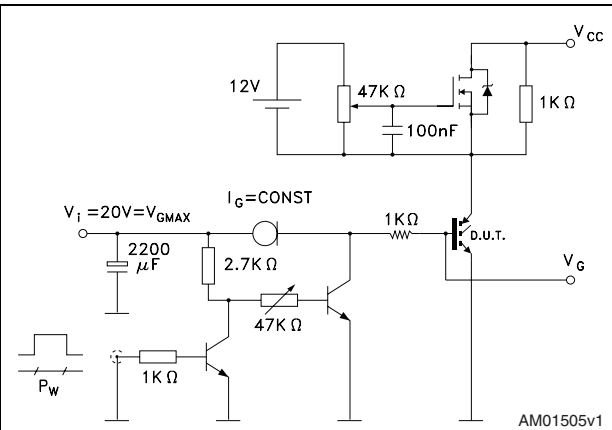


Figure 18. Switching waveform

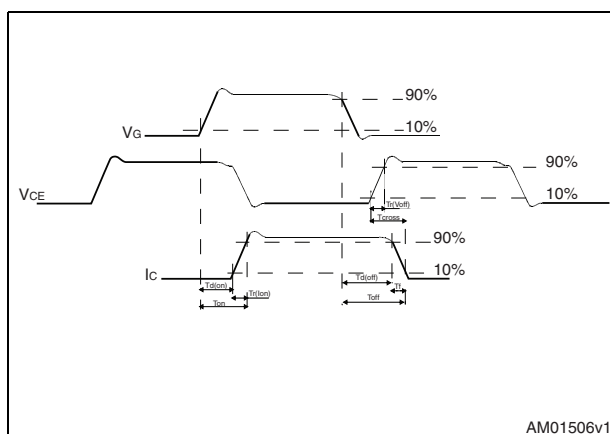
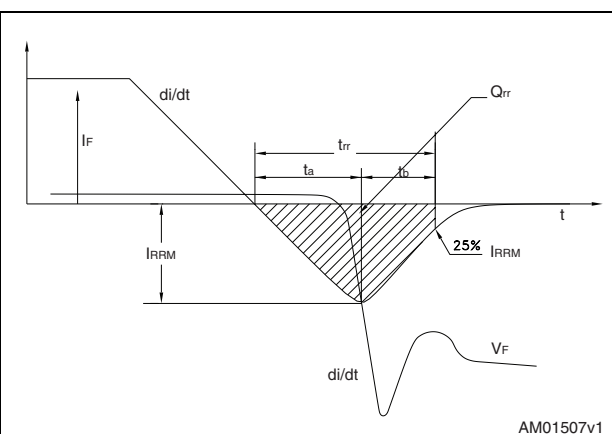


Figure 19. Diode recovery time waveform

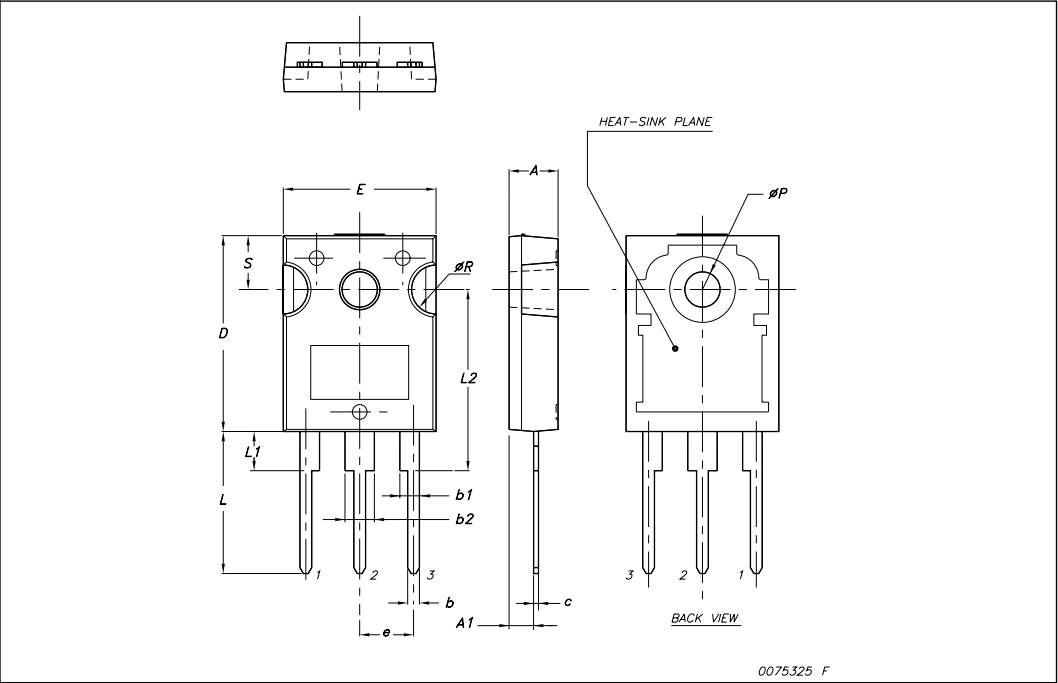


4 Package mechanical data

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.

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	



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
16-Apr-2009	1	Initial release.
04-Aug-2009	2	– Modified I_C value on Test conditions Table 4 – Modified R_G value on Test conditions Table 7 and Table 8
28-Apr-2010	3	– Document status promoted from preliminary data to datasheet – Inserted $V_{CE(sat)}$ grouping A, B and C (see Table 5) – Inserted dynamic parameters on Table 5 , Table 6 and Table 7 – Inserted Section 2.1: Electrical characteristics (curves)

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