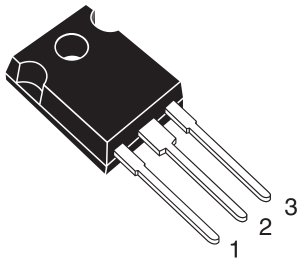
STGW35HF60WD

35 A, 600 V ultra fast IGBT

Features

- Improved E_{off} at elevated temperature
- Minimal tail current
- Low conduction losses
- $V_{CE(sat)}$ classified for easy parallel connection
- Ultra fast soft recovery antiparallel diode



TO-247

Applications

- Welding
- High frequency converters
- Power factor correction

Description

The STGW35HF60WD 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 device is tailored to high switching frequency operation (over 100 kHz).

Figure 1. Internal schematic diagram

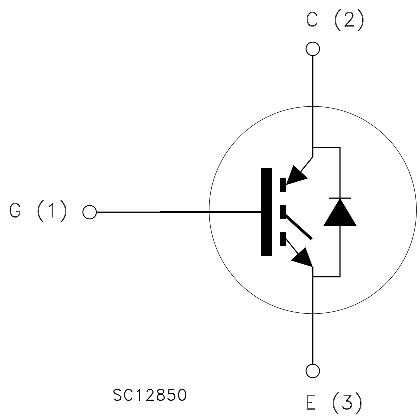


Table 1. Device summary

Order code	Marking(1)	Package	Packaging
STGW35HF60WD	GW35HF60WDA	TO-247	Tube
	GW35HF60WDB		
	GW35HF60WDC		

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 °C	60	A
I_C (1)	Continuous collector current at T_C = 100 °C	35	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 °C	30	A
I_{FSM}	Surge non repetitive forward current t_p= 10 ms sinusoidal	120	A
P_{TOT}	Total dissipation at T_C = 25 °C	200	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 V, R_G = 10 Ω, T_J = 150 °C

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.63	°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 °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 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C= 20 A			2.5	V
		V_{GE} = 15V, I_C = 20 A,T_J= 125 °C		1.65		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, T_J = 125 °C			250 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 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 V, I_C= 20 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} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	2400 235 50	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V, *(see Figure 17)*	-	140 13 52	-	nC nC nC

Table 7. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 16)*	-	30 15 1650	-	ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C *(see Figure 16)*	-	30 15 1600	-	ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} = 15 V *(see Figure 16)*	-	30 175 40	-	ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} =15 V, T_J = 125 °C *(see Figure 16)*	-	50 225 70	-	ns ns ns

Table 8. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}(1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 18)*	-	290 185 475		µJ µJ µJ
E_{on}(1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C *(see Figure 18)*	-	420 350 770	530	µJ µJ µJ

1. Eon is the tun-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-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C). Eon include diode recovery energy.

Table 9. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 20 A I_F = 20 A, T_J = 125 °C	-	1.8 1.4	2.25	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A,V_R = 50 V, di/dt = 100 A/µs *(see Figure 19)*	-	50 90 3	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A,V_R = 50 V, T_J =125 °C, di/dt = 100 A/µs *(see Figure 19)*	-	135 375 5.5	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

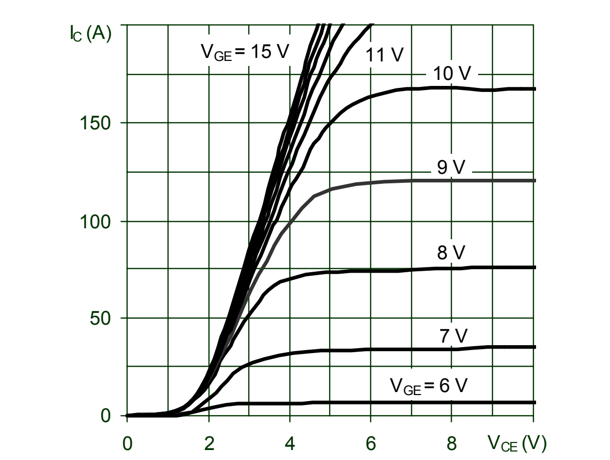


Figure 3. Transfer characteristics

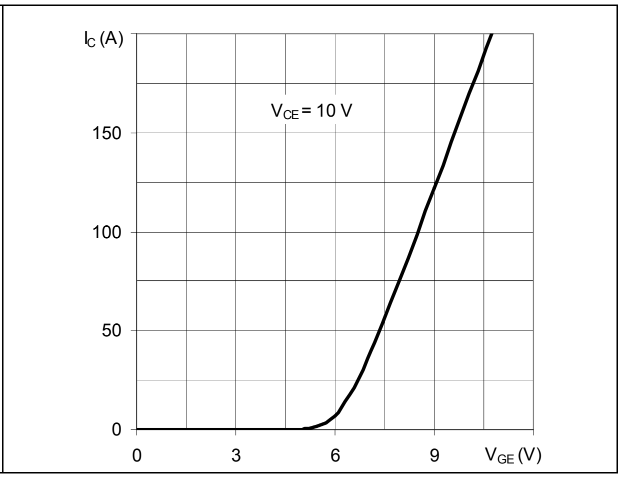


Figure 4. Normalized $V_{CE(sat)}$ vs. I_C

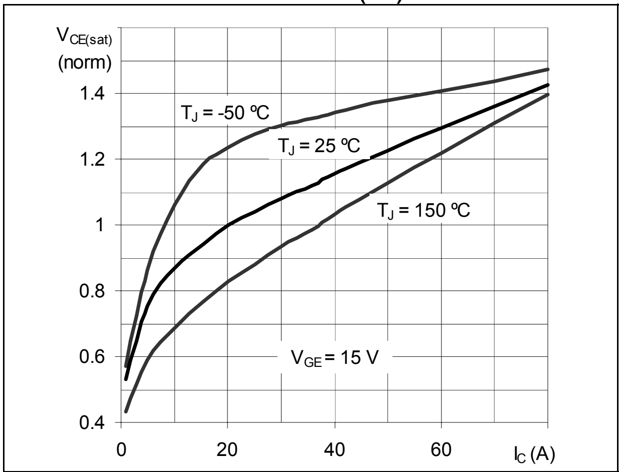


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

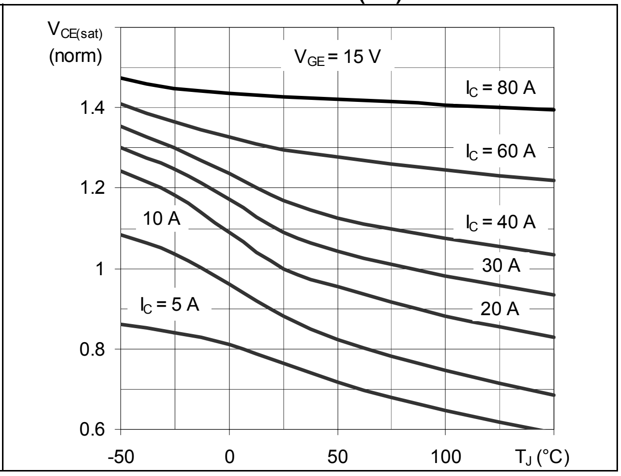


Figure 6. Normalized breakdown voltage vs. temperature

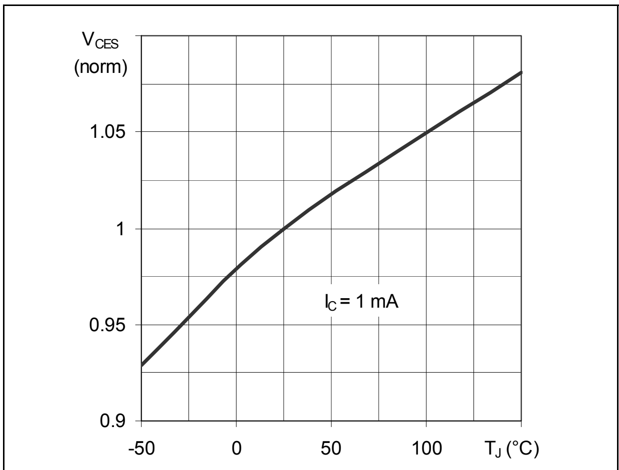


Figure 7. Normalized gate threshold voltage vs. temperature

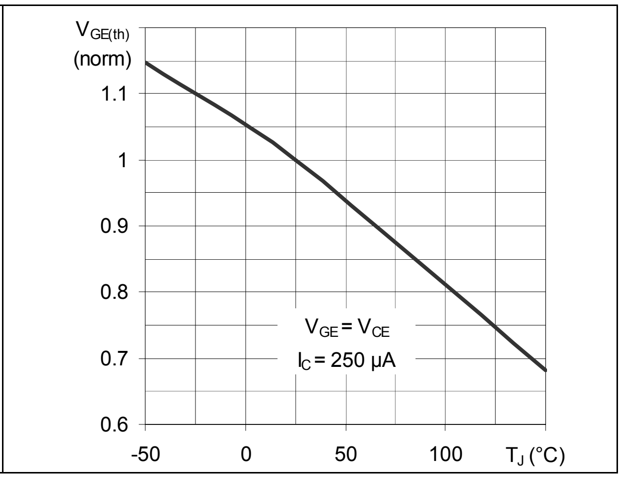


Figure 8. Gate charge vs. gate-emitter voltage

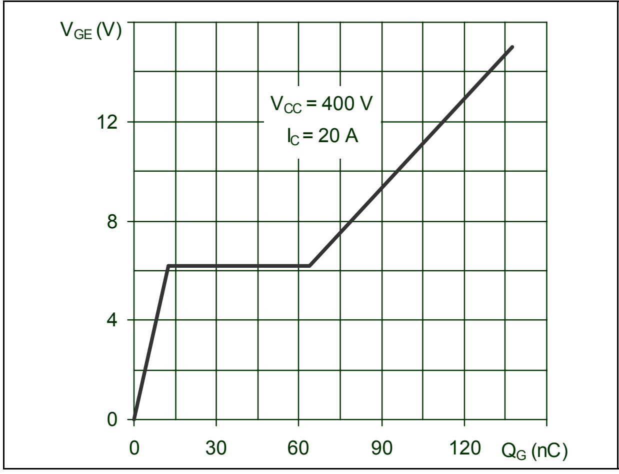


Figure 9. Capacitance variations

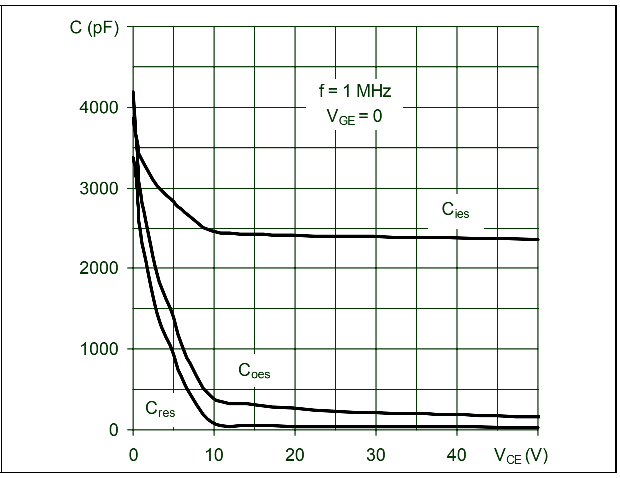


Figure 10. Switching losses vs temperature

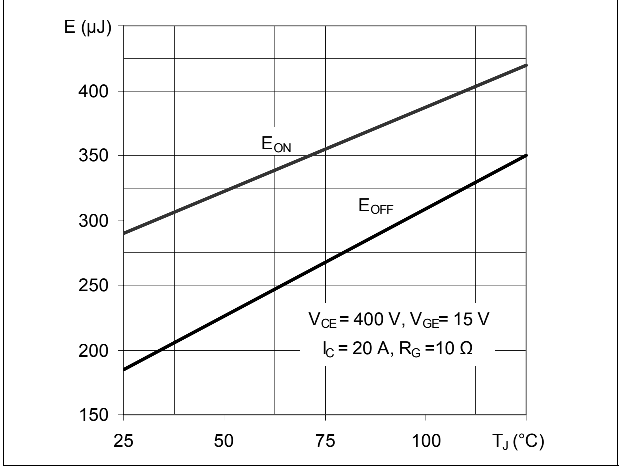


Figure 11. Switching losses vs. gate resistance

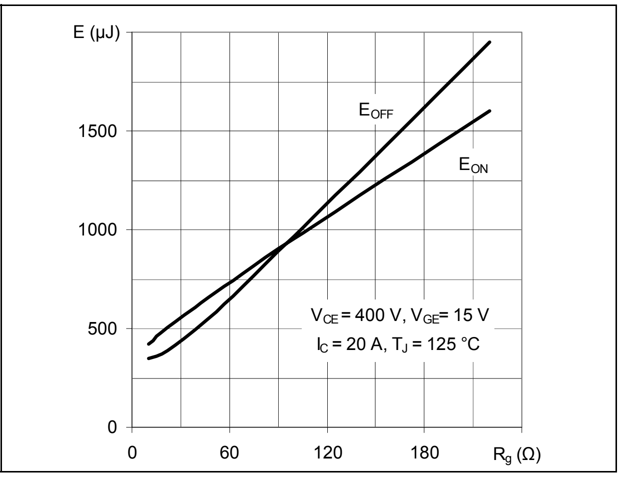


Figure 12. Switching losses vs. collector current

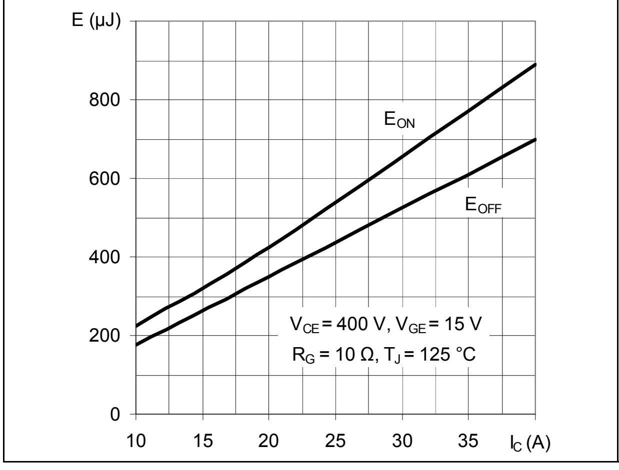


Figure 13. Turn-off SOA

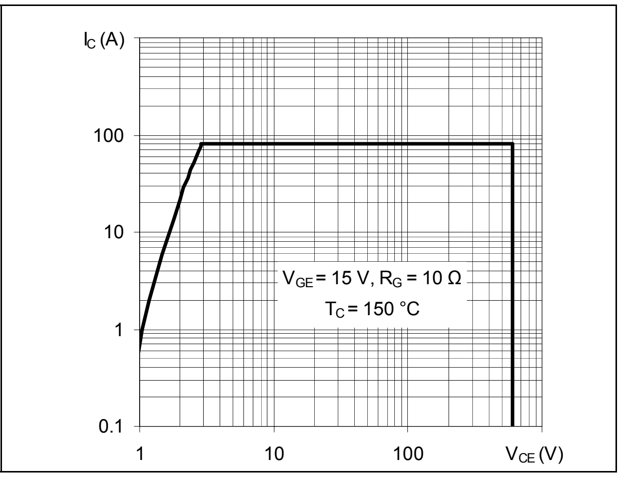


Figure 14. Diode forward on voltage

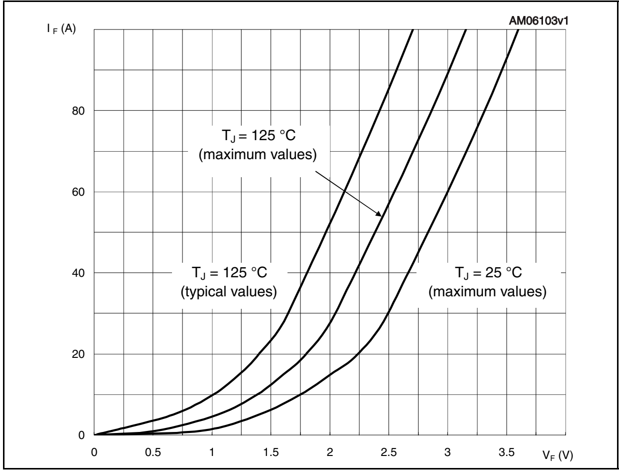
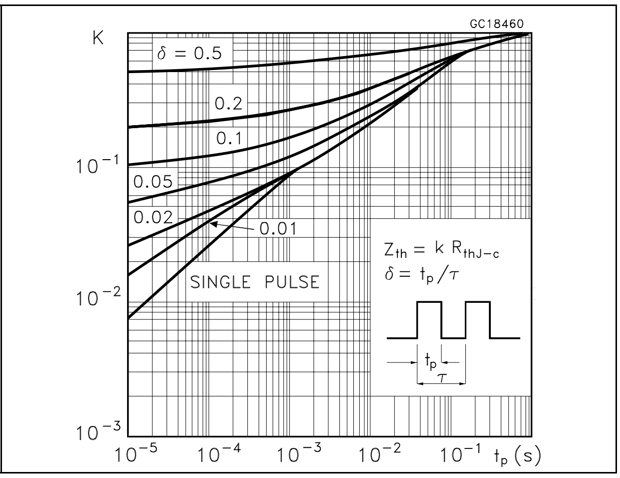


Figure 15. Thermal impedance



3 Test circuits

Figure 16. Test circuit for inductive load switching

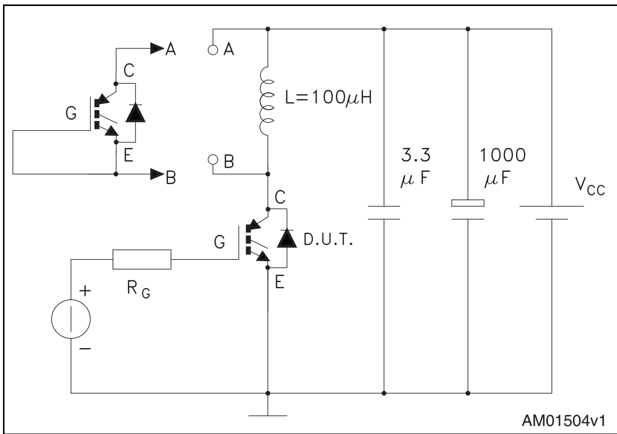


Figure 17. Gate charge test circuit

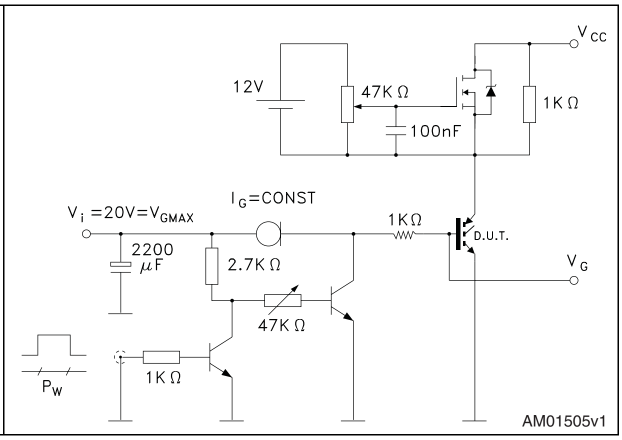


Figure 18. Switching waveform

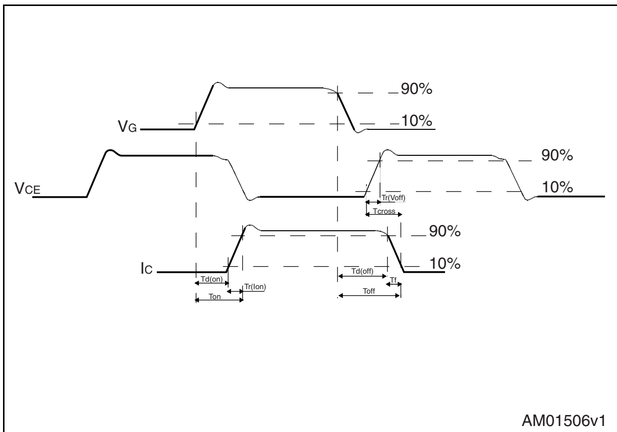
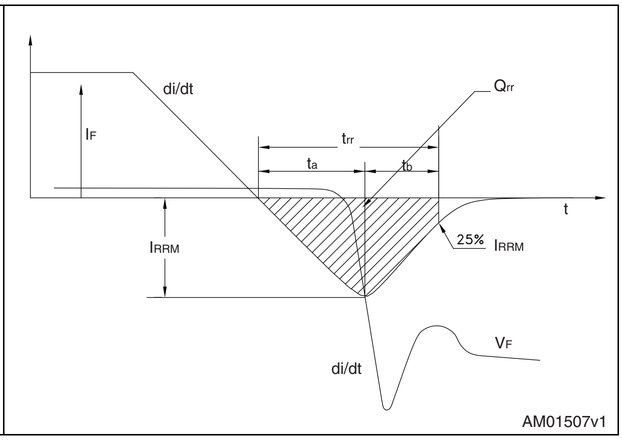


Figure 19. Diode recovery time waveform

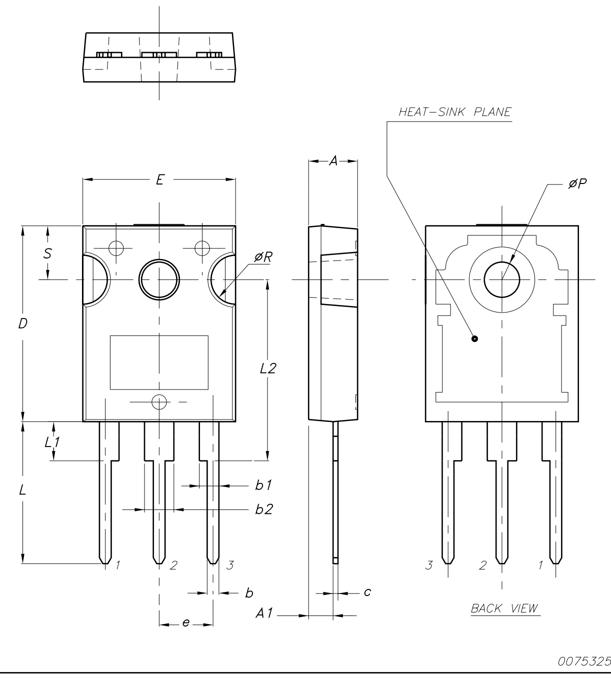


4 Package mechanical data

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
14-Apr-2009	1	Initial release.
03-Aug-2009	2	Inserted dynamic parameters on *Table 6* an *Table 7* Document status promoted from preliminary data to datasheet
02-Sep-2009	3	Minor text changes throughout the document Removed watermark
30-Sep-2009	4	Inserted $V_{CE(sat)}$ grouping A, B and C (see *Table 5: VCE(sat) classification*)
10-May-2010	5	Inserted *Section 2.1: Electrical characteristics (curves)*

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