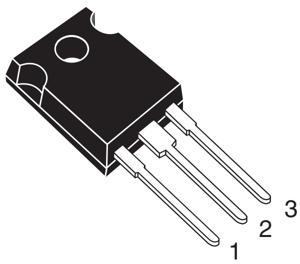
STGW45HF60WD

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



TO-247

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

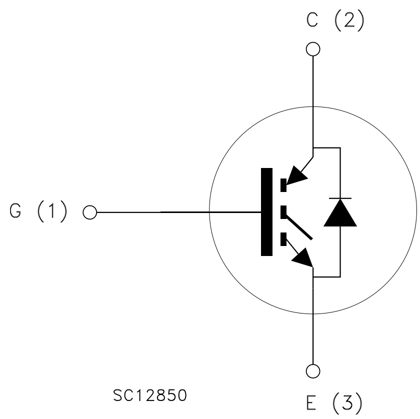


Table 1. Device summary [(1)]

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 °C	70	A
I_C (1)	Continuous collector current at T_C = 100 °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 °C	30	A
I_{FSM}	Surge not repetitive forward current t_p= 10 ms sinusoidal	120	A
P_{TOT}	Total dissipation at T_C = 25 °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 V, R_G = 10 Ω, T_J = 150 °C

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	0.5	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
$R_{thj\text{-}amb}$	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= 30 A V_{GE} = 15V, I_C = 30 A,T_J= 125 °C		 1.65	2.5	V V
$V_{GE(th)}$	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			500 5	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= 30 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	-	2900 260 55	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 400 V, I_C = 30 A, V_{GE} = 15 V, *Figure 17*	-	160 17 65	-	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 = 30 A R_G = 6.8 Ω, V_{GE} = 15 V, *(Figure 16)*	-	30 12 2600	-	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 = 30 A R_G = 6.8 Ω, V_{GE} = 15 V, T_J = 125 °C *(Figure 16)*	-	30 14 2200	-	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 = 30 A, R_G = 6.8 Ω, V_{GE} = 15 V *(Figure 16)*	-	30 145 50	-	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 = 30 A, R_G = 6.8 Ω, V_{GE} =15 V, T_J = 125 °C *(Figure 16)*	-	47 185 65	-	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 = 30 A R_G = 6.8 Ω, V_{GE} = 15 V, *(Figure 18)*	-	300 330 630		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 = 30 A R_G = 6.8 Ω, V_{GE} = 15 V, T_J = 125 °C (*Figure 18*)	-	550 550 1100	800	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 & 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 = 30 A I_F = 30 A, T_J = 125 °C	-	2 1.65	2.5	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 30 A,V_R = 50 V, di/dt = 100 A/µs *(see Figure 19)*	-	55 110 3	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 30 A,V_R = 50 V, di/dt = 100 A/µs T_J =125 °C, *(see Figure 19)*	-	140 400 5.5	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

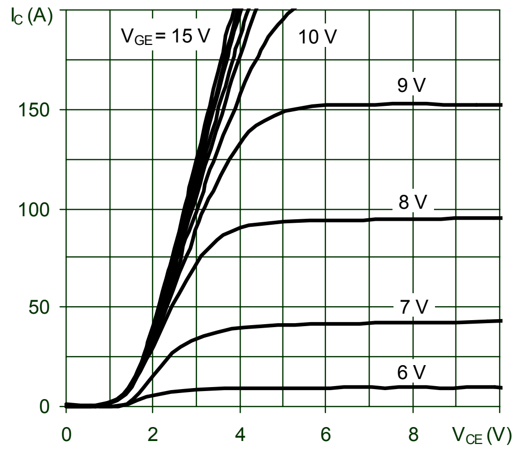


Figure 3. Transfer characteristics

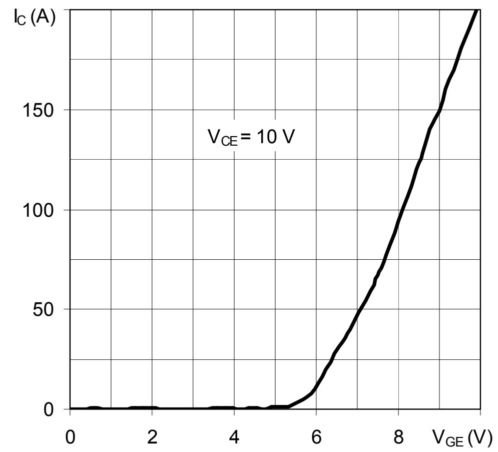


Figure 4. Normalized $V_{CE(sat)}$ vs. I_C

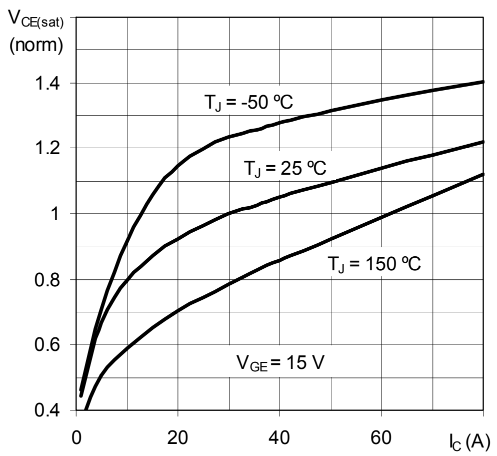


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

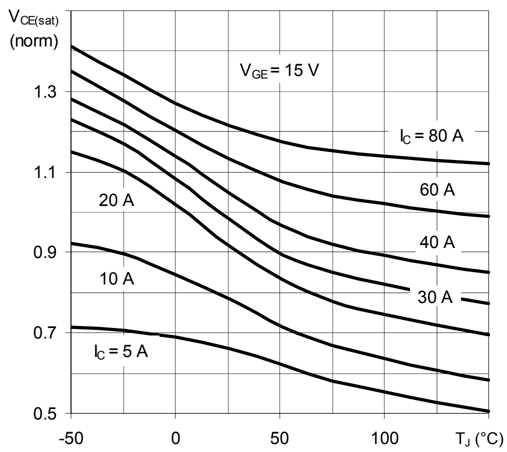


Figure 6. Normalized breakdown voltage vs. temperature

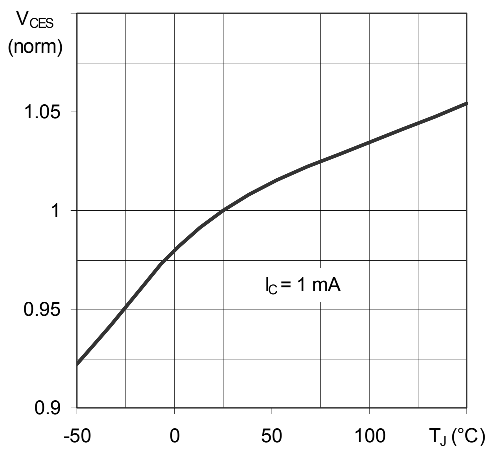


Figure 7. Normalized gate threshold voltage vs. temperature

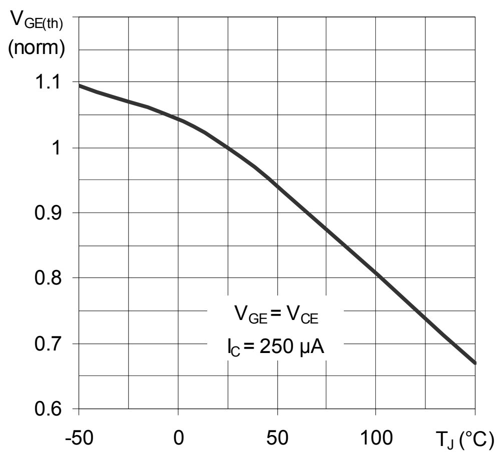


Figure 8. Gate charge vs. gate-emitter voltage

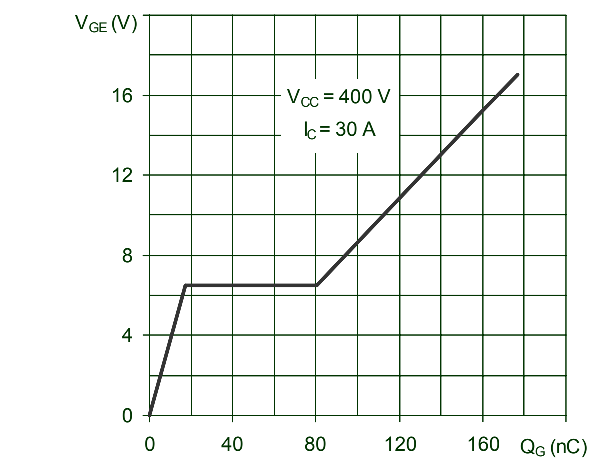


Figure 9. Capacitance variations

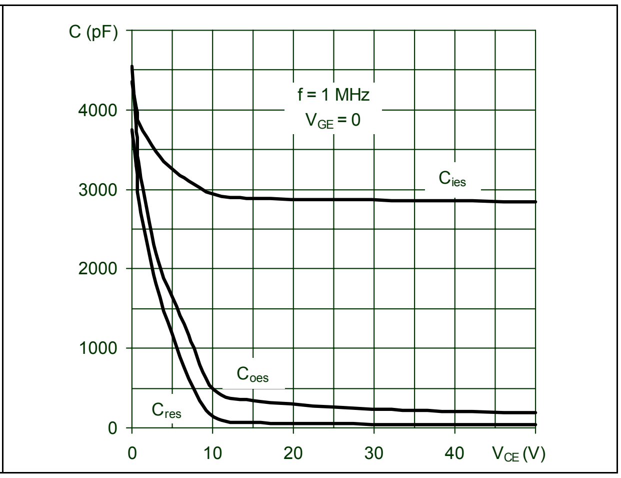


Figure 10. Switching losses vs temperature

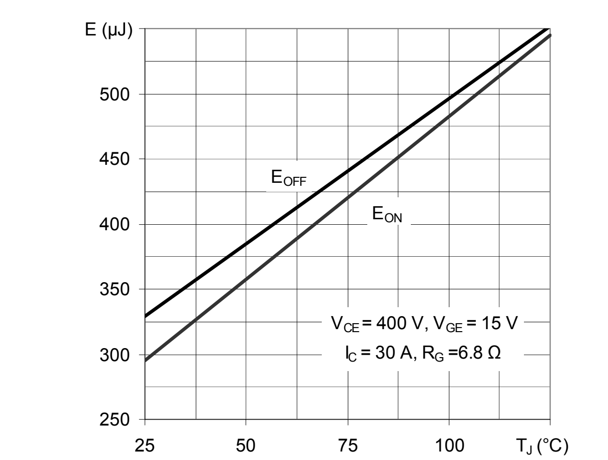


Figure 11. Switching losses vs. gate resistance

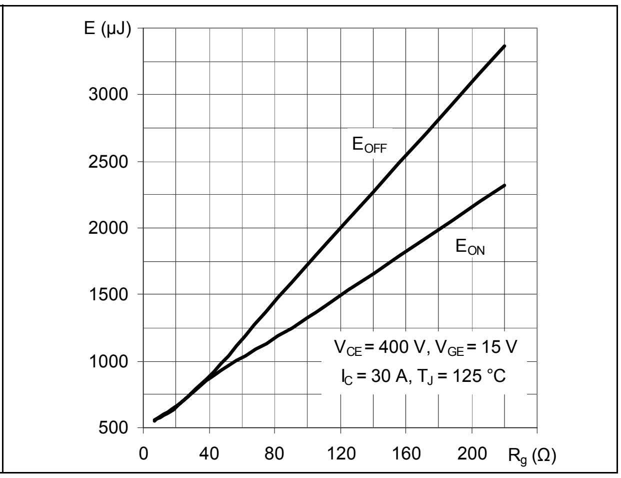


Figure 12. Switching losses vs. collector current

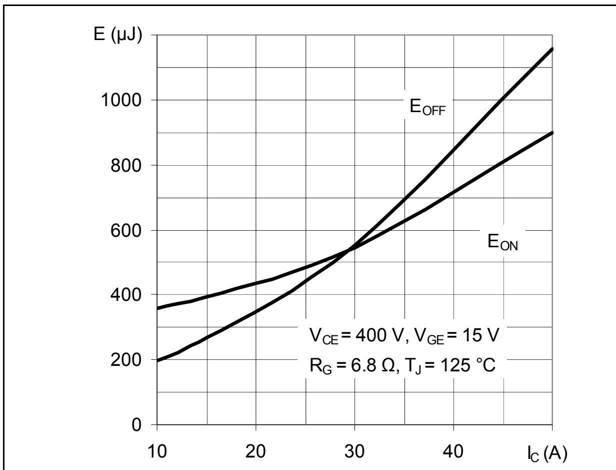


Figure 13. Turn-off SOA

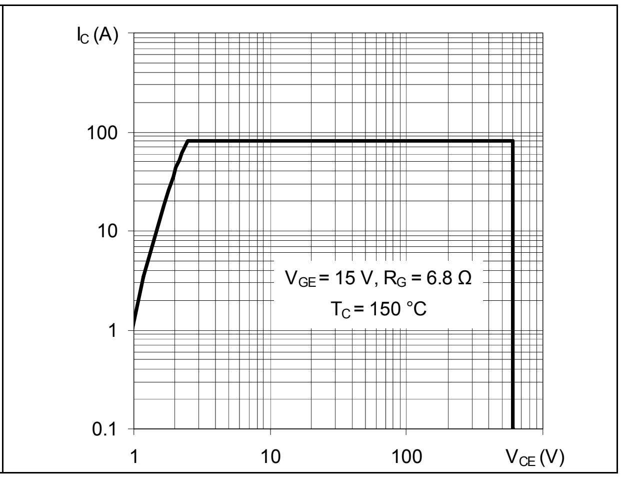


Figure 14. Diode forward on voltage

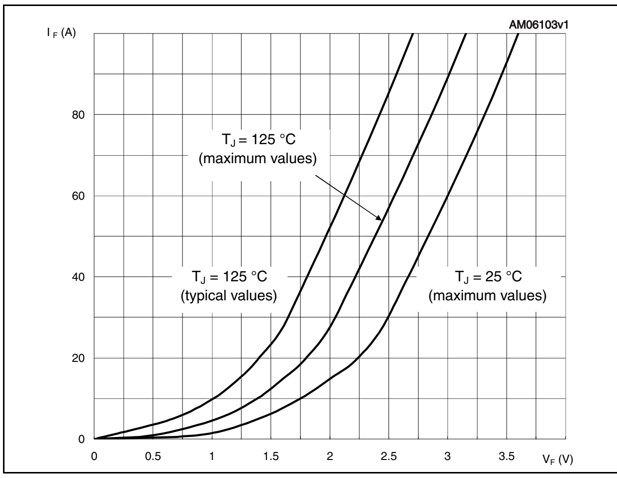
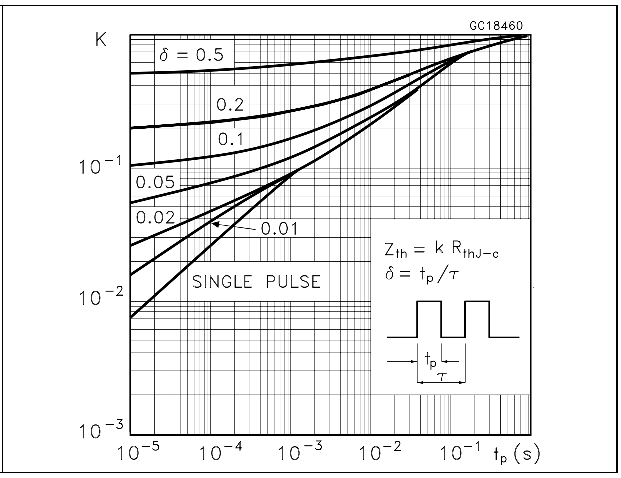


Figure 15. Thermal impedance



3 Test circuits

Figure 16. Test circuit for inductive load switching

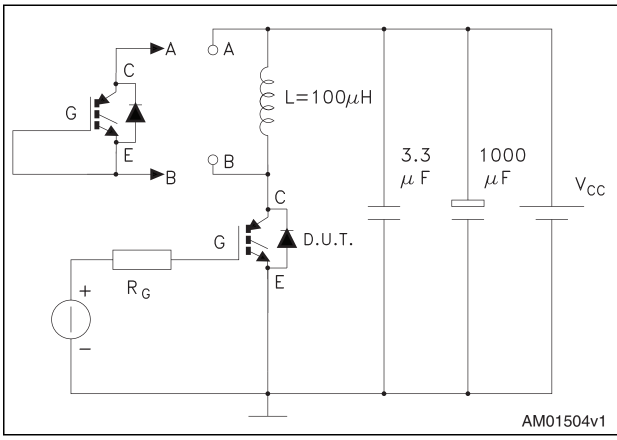


Figure 17. Gate charge test circuit

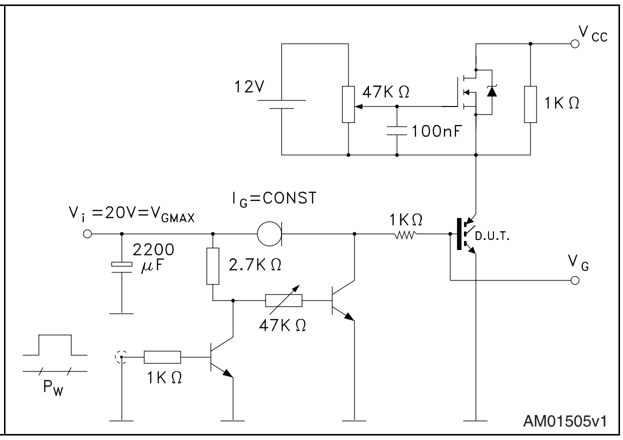


Figure 18. Switching waveform

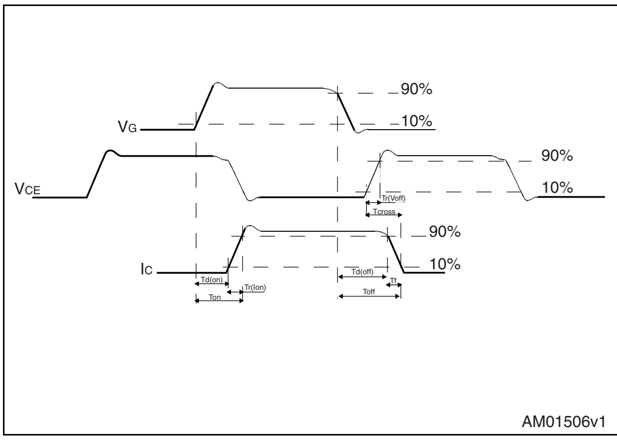
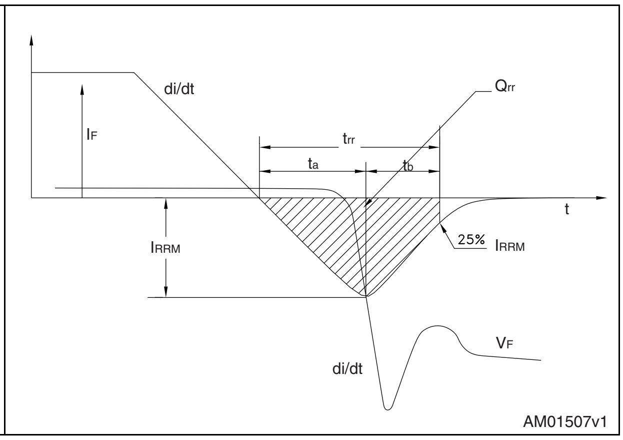


Figure 19. Diode recovery time waveform

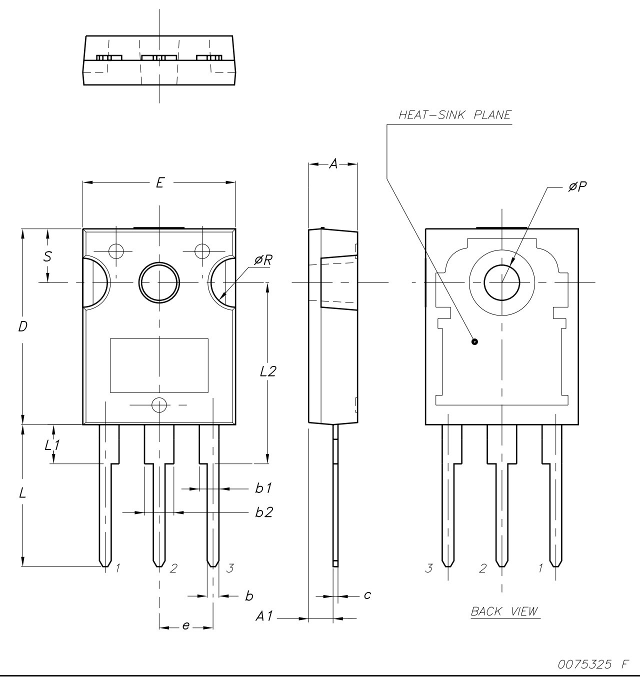


4 Package mechanical data

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
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)*