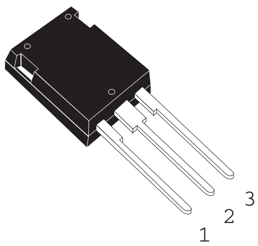
STGY50NC60WD

50 A, 600 V, ultra fast IGBT

Features

- Very high frequency operation
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode



Max247

Applications

- Very high frequency inverters, UPS
- HF, SMPS and PFC in both hard switch and resonant topologies
- Motor drivers
- Welding

Description

This IGBT utilizes the advanced Power MESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

Figure 1. Internal schematic diagram

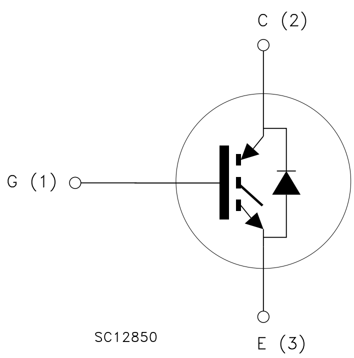


Table 1. Device summary

Order code	Marking	Package	Packaging
STGY50NC60WD	GY50NC60WD	Max247	Tube

Contents

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C (1)	Collector current (continuous) at T_C = 25 °C	110	A
I_C (1)	Collector current (continuous) at T_C = 100 °C	50	A
I_{CL} (2)	Turn-off latching current	180	A
I_{CP} (3)	Pulsed collector current	180	A
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
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at T_C = 25 °C	278	W
T_j	Operating junction temperature	-55 to 150	°C

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. V_{clamp} = 80% of V_{CES}, T_j =150 °C, R_G=10 Ω, V_{GE}=15 V
3. Pulse width limited by max. temperature allowed

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT max.	0.45	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case diode max.	1.5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max.	50	°C/W

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 3. 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 = 40 A V_{GE} = 15 V, I_C = 40 A,T_C=125 °C		2.1 1.9	2.6	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V,T_C= 125 °C			500 5	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15 V, I_C = 40 A		25		S

Table 4. 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		4700 410 90		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 40 A, V_{GE} = 15 V, *Figure 16*		195 32 82		nC nC nC

Table 5. 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} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 17*, *Figure 15*		52 17 2400		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} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 17*, *Figure 15*		50 19 2020		ns ns A/µs
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 17*, *Figure 15*		31 240 35		ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 17*, *Figure 15*		59 280 63		ns ns ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 15*		365 560 925	470 790 1260	µJ µJ µJ
E_{on} (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 15*		635 910 1545		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)
2. Turn-off losses include also the tail of the collector current

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 40 A I_F = 40 A, T_C = 125 °C		3.2 2.2		V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 40 A,V_R = 50 V, di/dt = 100 A/µs *Figure 18*		55 100 3.6		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 40 A,V_R = 50 V, T_C =125 °C, di/dt = 100 A/µs (*Figure 18*)		164 525 6.4		ns nC A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

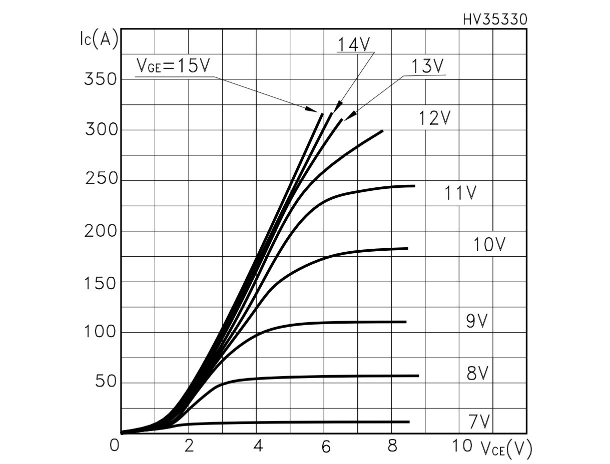


Figure 2. Transfer characteristics

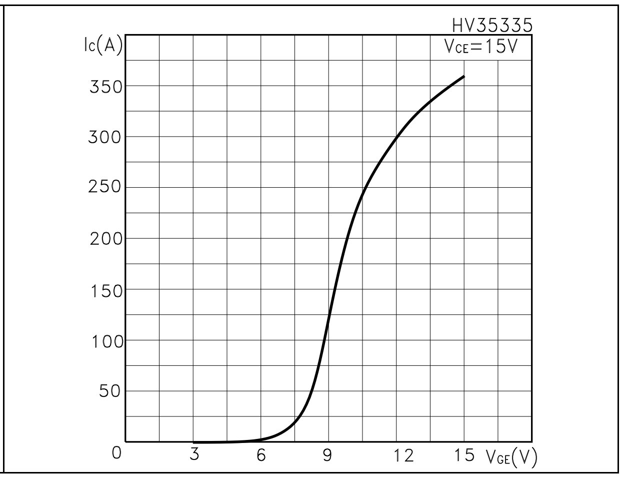


Figure 3. Transconductance

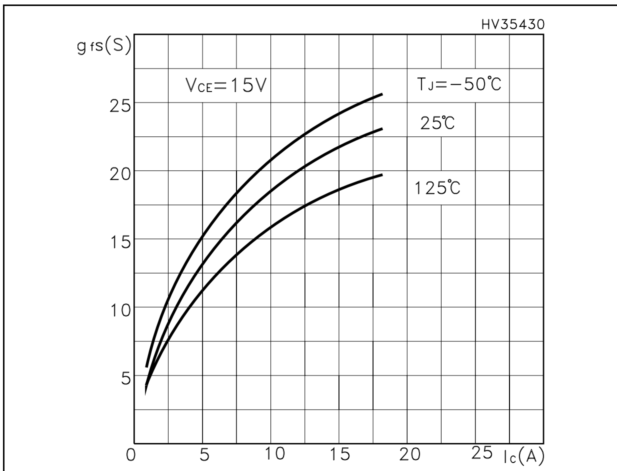


Figure 4. Collector-emitter on voltage vs temperature

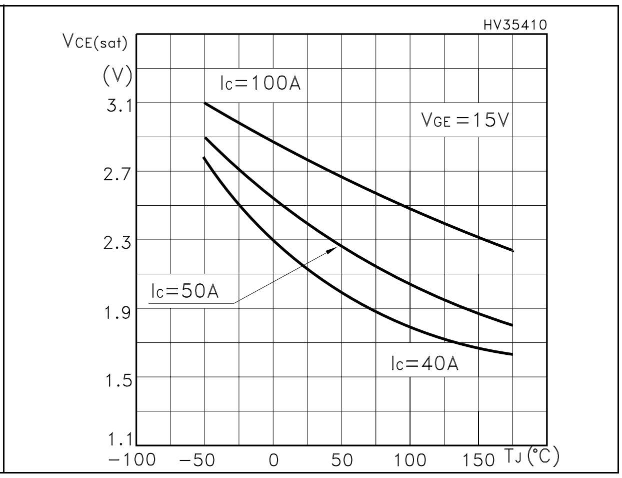


Figure 5. Gate charge vs gate-source voltage

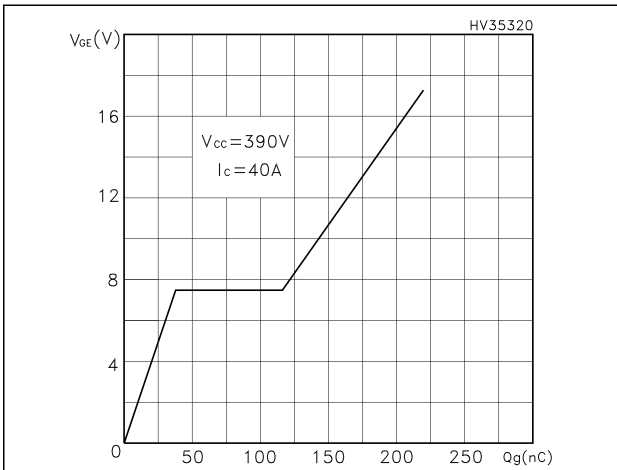


Figure 6. Capacitance variations

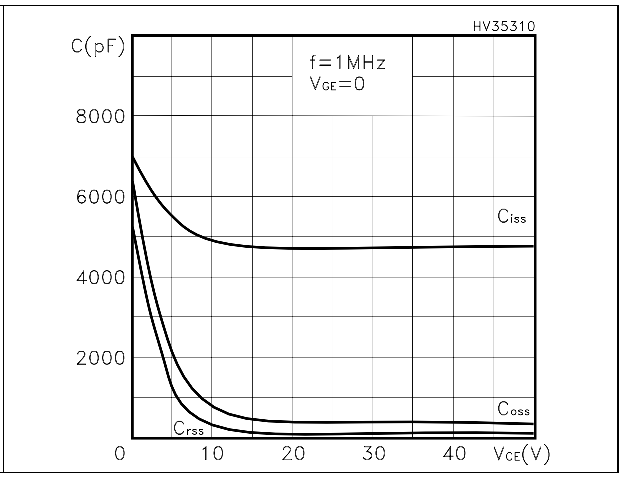


Figure 7. Normalized gate threshold voltage vs temperature

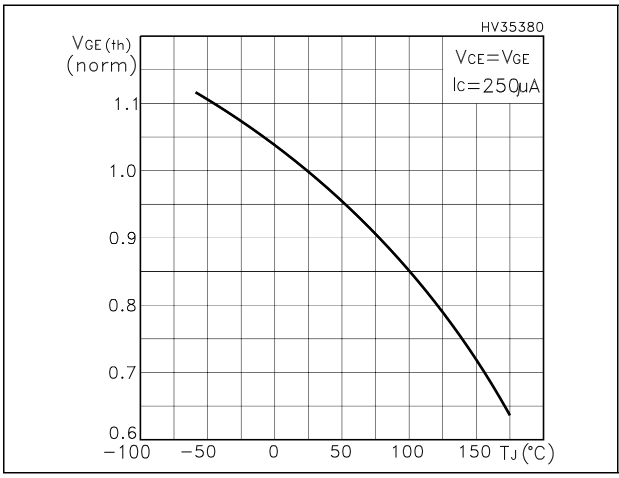


Figure 8. Collector-emitter on voltage vs collector current

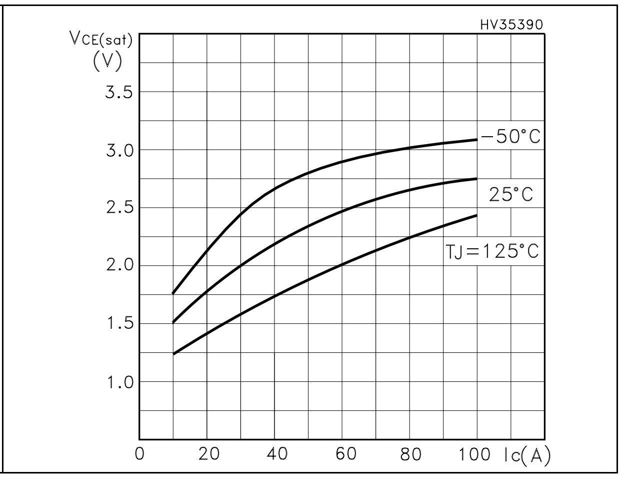


Figure 9. Normalized breakdown voltage vs temperature

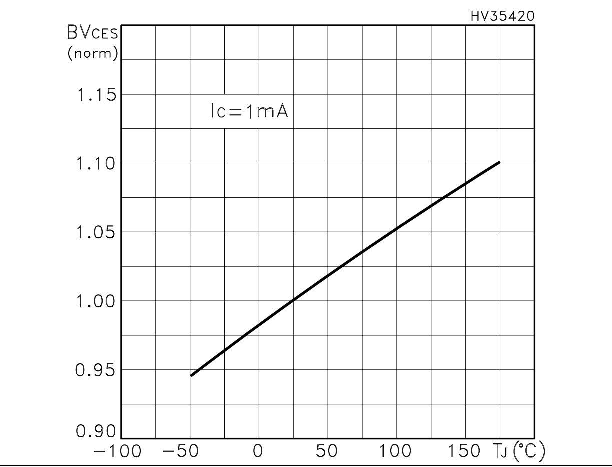


Figure 10. Switching losses vs temperature

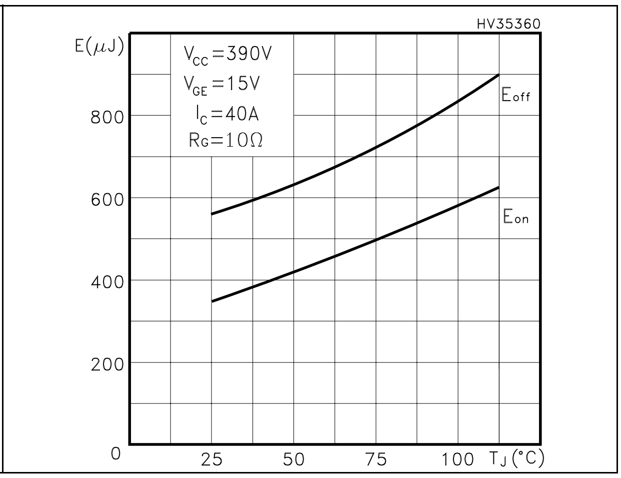


Figure 11. Switching losses vs gate resistance

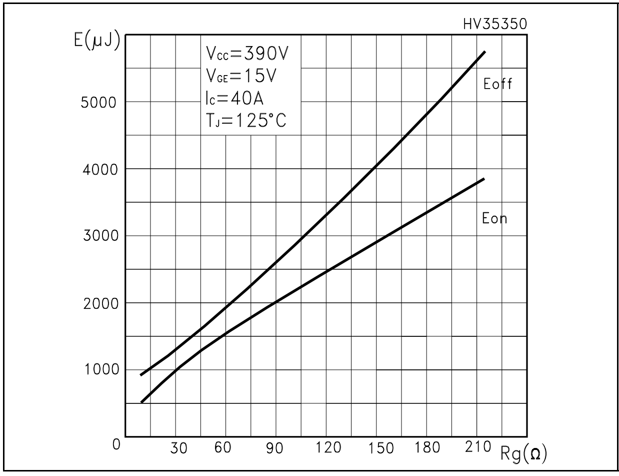


Figure 12. Switching losses vs collector current

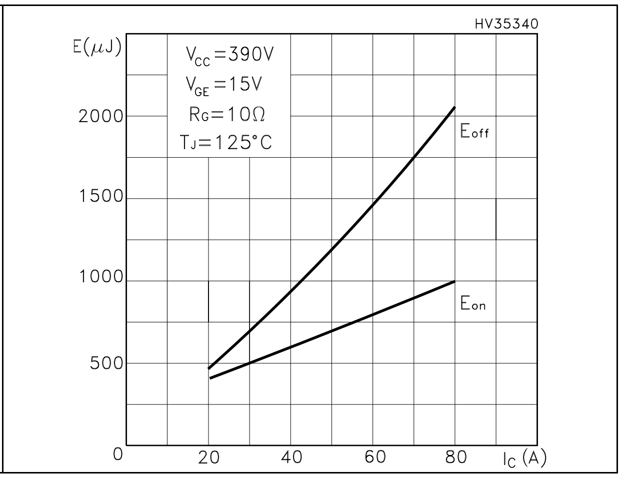


Figure 13. Turn-off SOA

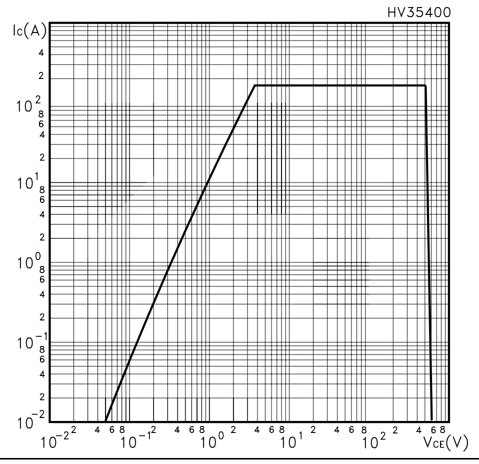
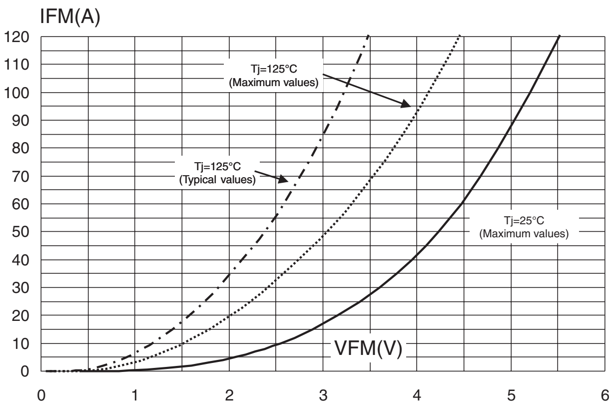


Figure 14. Forward voltage drop vs. forward current



3 Test circuit

Figure 15. Test circuit for inductive load switching

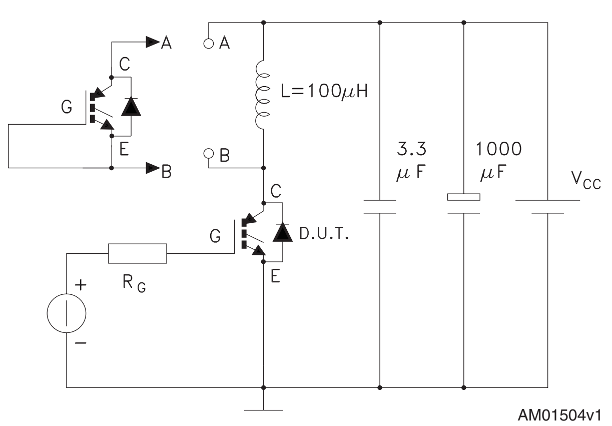


Figure 16. Gate charge test circuit

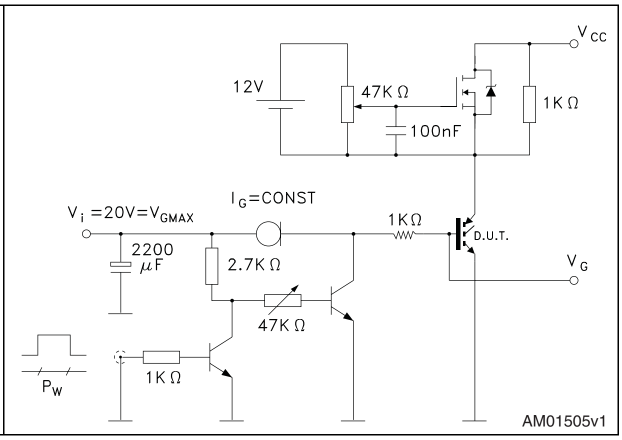


Figure 17. Switching waveform

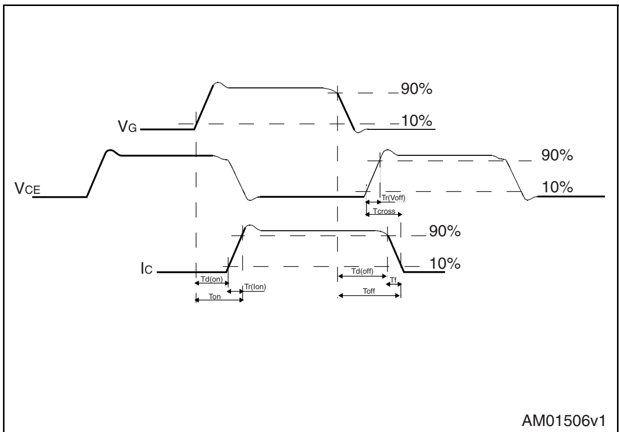
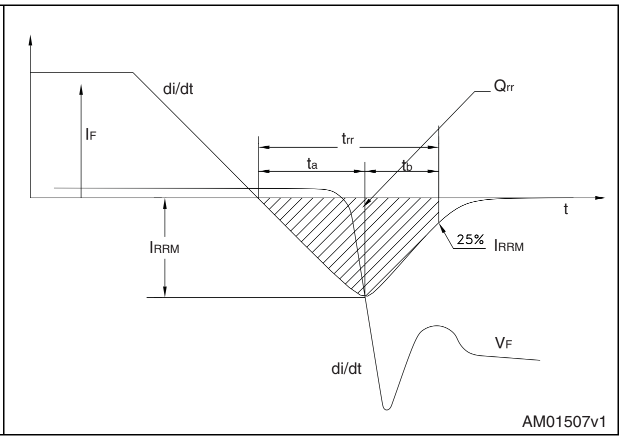


Figure 18. Diode recovery time waveform



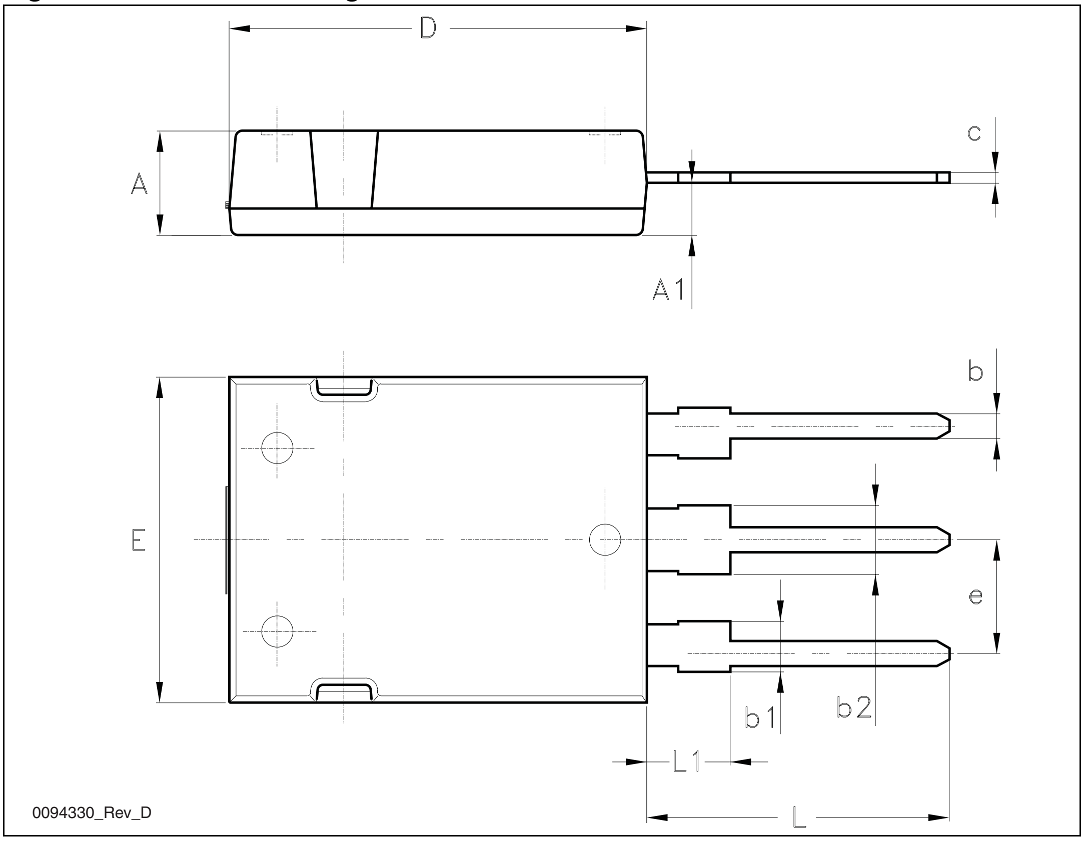
4 Package mechanical data

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 8. Max247 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.70		5.30
A1	2.20		2.60
b	1.00		1.40
b1	2.00		2.40
b2	3.00		3.40
c	0.40		0.80
D	19.70		20.30
e	5.35		5.55
E	15.30		15.90
L	14.20		15.20
L1	3.70		4.30

Figure 19. Max247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
09-Oct-2006	1	Initial release.
07-May-2007	2	Complete version
02-Jul-2007	3	Modified value on *Table 2: Thermal resistance*
04-Nov-2008	4	*Table 8: Max247 mechanical data* and *Figure 19: Max247 drawing* have been updated.
09-Jan-2009	5	*Figure 13: Turn-off SOA* has been updated.