STGW39NC60V

40 A - 600 V - very fast IGBT

Features

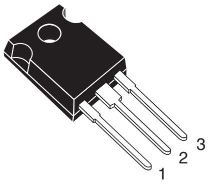
- Low C_{RES} / C_{IES} ratio (no cross conduction susceptibility)

Applications

- High frequency inverters, UPS
- Motor drivers
- Induction heating

Description

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



TO-247

Figure 1. Internal schematic diagram

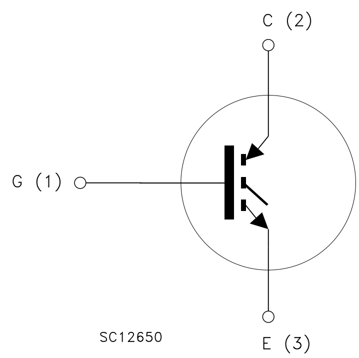


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW39NC60V	GW39NC60V	TO-247	Tube

Contents

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)	Collector current (continuous) at 25 °C	80	A
I_C (1)	Collector current (continuous) at 100 °C	40	A
I_{CL} (2)	Turn-off latching current	220	A
I_{CP} (3)	Pulsed collector current	220	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at T_C = 25 °C	250	W
T_j	Operating junction temperature	– 55 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. Vclamp = 80%(V_{CES}) , Tj = 150 °C, R_G = 10 Ω, V_{GE}= 15 V
3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.5	°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 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} = 15 V, I_C = 30 A,T_C=125 °C		1.8 1.7	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-emitter 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 cut-off current (V_{CE} = 0)	V_{GE} = ± 20 V			±100	nA
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V, I_C= 30 A		20		S

1. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

Table 5. 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 298 59		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 30 A, V_{GE} = 15 V *(see Figure 18)*		126 16 46		nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{onf}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 390 V, I_C = 30 A, R_G=10 Ω, V_{GE} = 15 V *(see Figure 17)*		33 13 2500		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 = 30 A, R_G=10Ω, V_{GE}=15 V T_C=125 °C *(see Figure 17)*		32 14 2280		ns ns A/µs
$t_{r(Voff)}$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 30 A, R_G=10 Ω, V_{GE}=15 V *(see Figure 17)*		33 178 65		ns ns ns
$t_{r(Voff)}$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 30 A, R_G=10 Ω, V_{GE}=15 V T_C=125 °C *(see Figure 17)*		68 238 128		ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
E_{on} E_{off} (1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 19)*		333 537 870		µJ µJ µJ
E_{on} E_{off} (1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, T_C= 125 °C *(see Figure 19)*		618 1125 1743		µJ µJ µJ

1. Turn-off losses include also the tail of the collector current

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

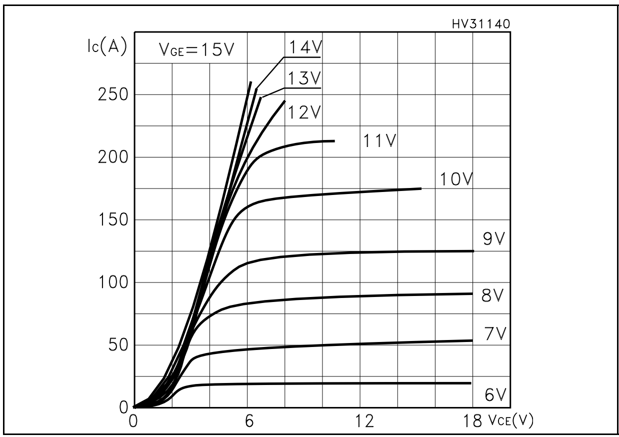


Figure 3. Transfer characteristics

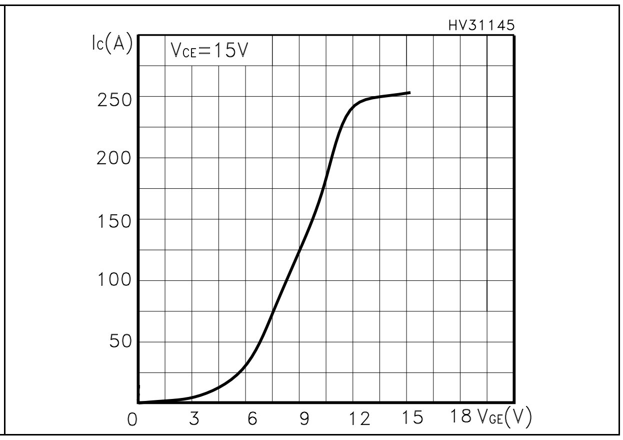


Figure 4. Transconductance

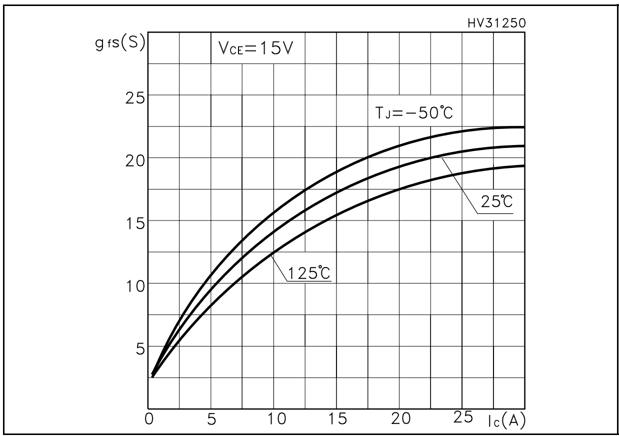


Figure 5. Collector-emitter on voltage vs temperature

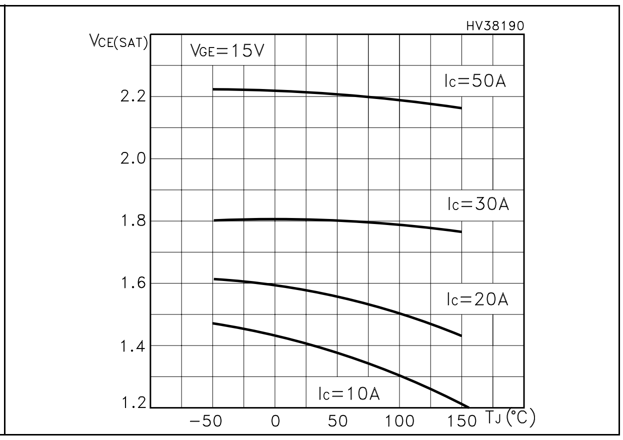


Figure 6. Collector-emitter on voltage vs collector current

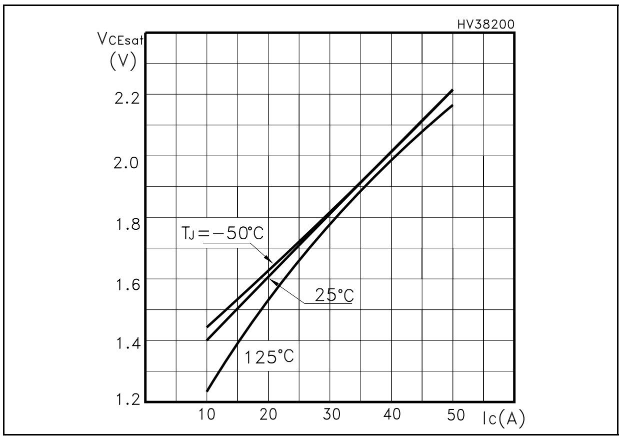


Figure 7. Normalized gate threshold vs temperature

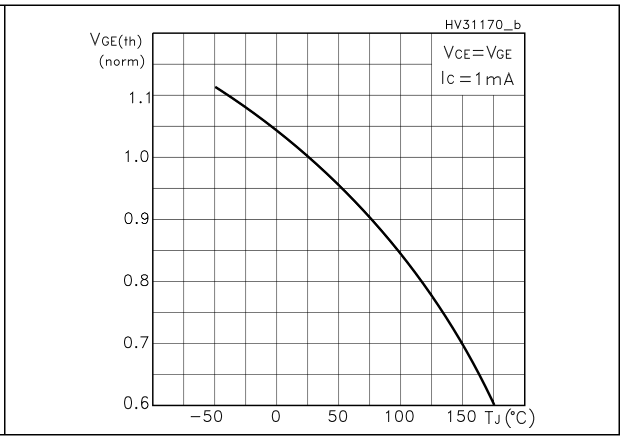


Figure 8. Normalized breakdown voltage vs temperature

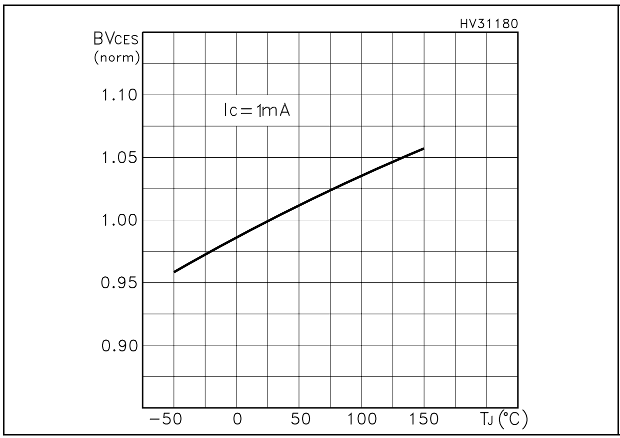


Figure 9. Gate charge vs gate-emitter voltage

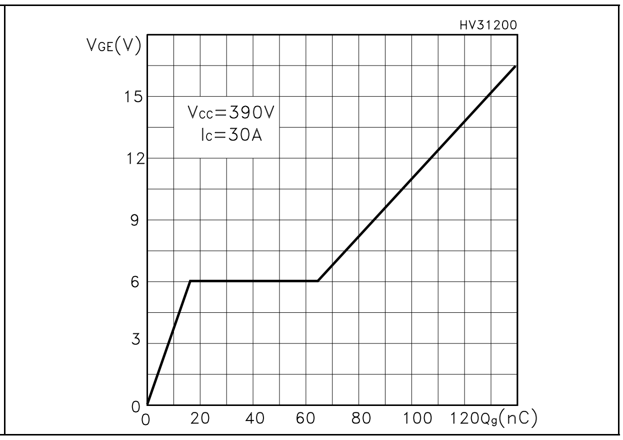


Figure 10. Capacitance variations

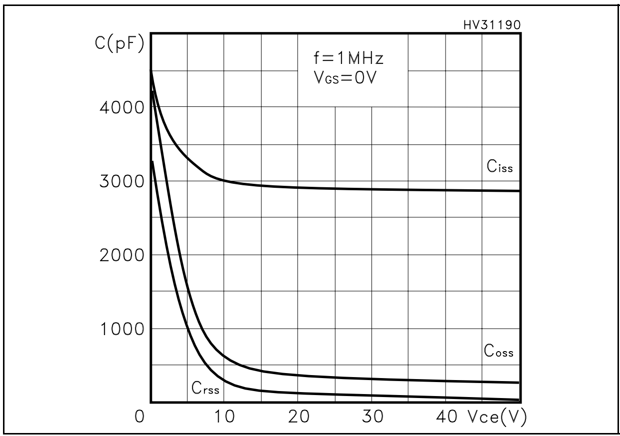


Figure 11. Switching losses vs temperature

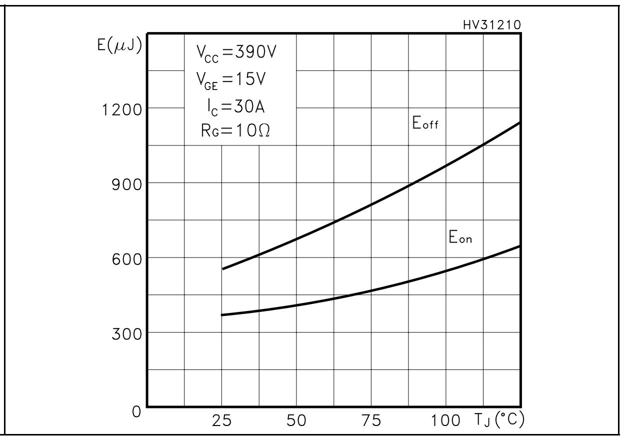


Figure 12. Switching losses vs gate resistance

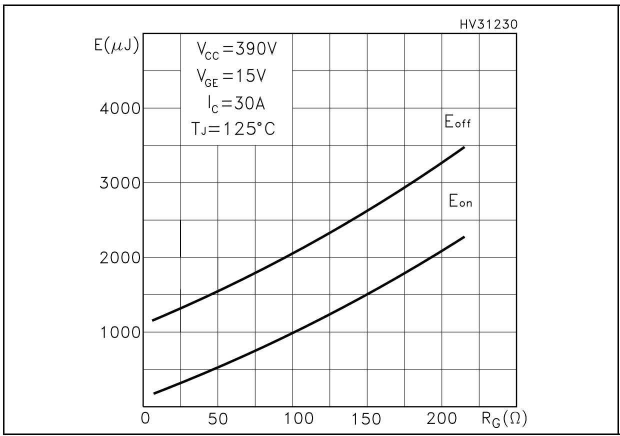


Figure 13. Switching losses vs collector current

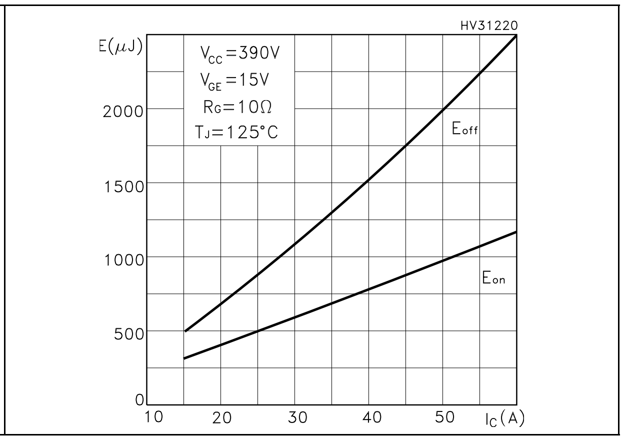


Figure 14. Thermal impedance

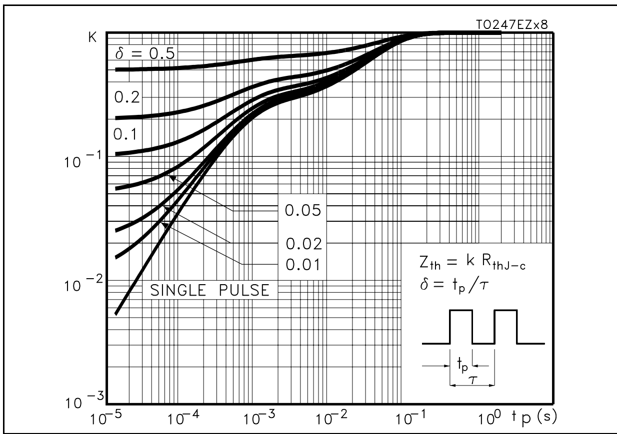


Figure 15. Turn-off SOA

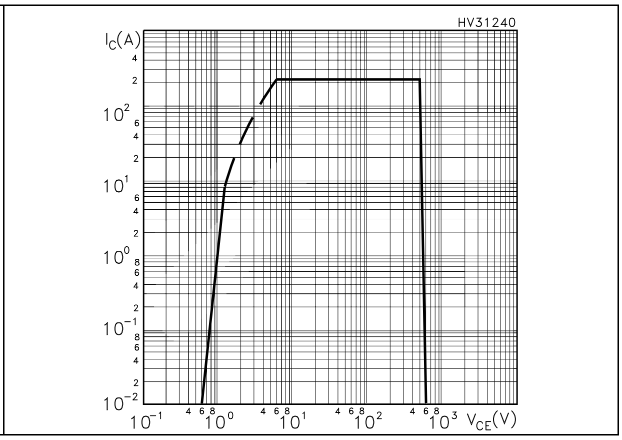
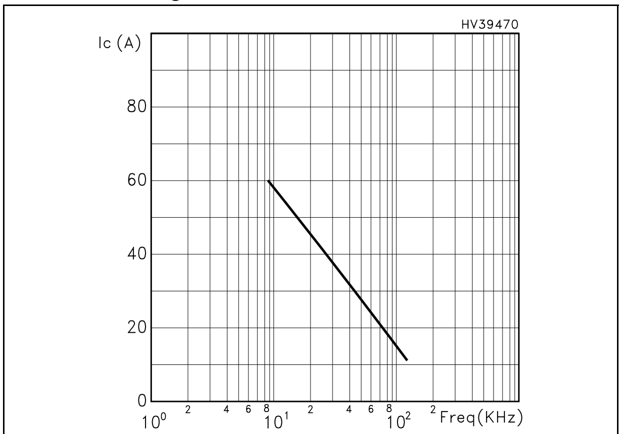


Figure 16. I_C vs. frequency



2.2 Frequency applications

For a fast IGBT suitable for high frequency applications, the typical collector current vs. maximum operating frequency curve is reported. That frequency is defined as follows:

$f_{MAX} = (P_D - P_C) / (E_{ON} + E_{OFF})$

- The maximum power dissipation is limited by maximum junction to case thermal resistance:

Equation 1

$P_D = \Delta T / R_{THJ\text{-}C}$

considering $\Delta T = T_J - T_C$ = 125 °C - 75 °C = 50 °C

- The conduction losses are:

Equation 2

$P_C = I_C * V_{CE(SAT)} * \delta$

with 50% of duty cycle, V_{CESAT} typical value @125 °C.

3 Test circuit

Figure 17. Test circuit for inductive load switching

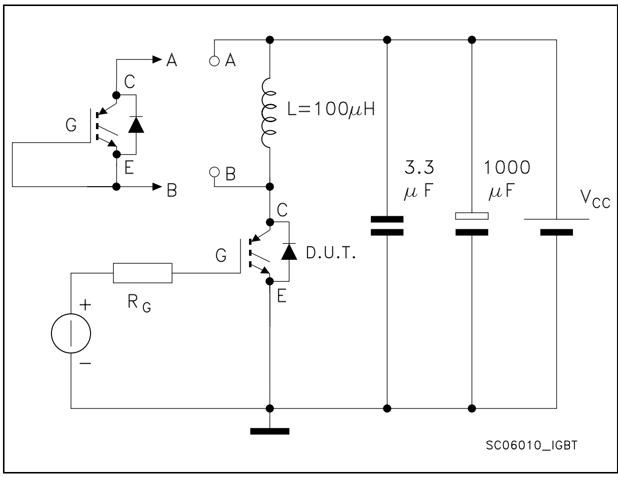


Figure 18. Gate charge test circuit

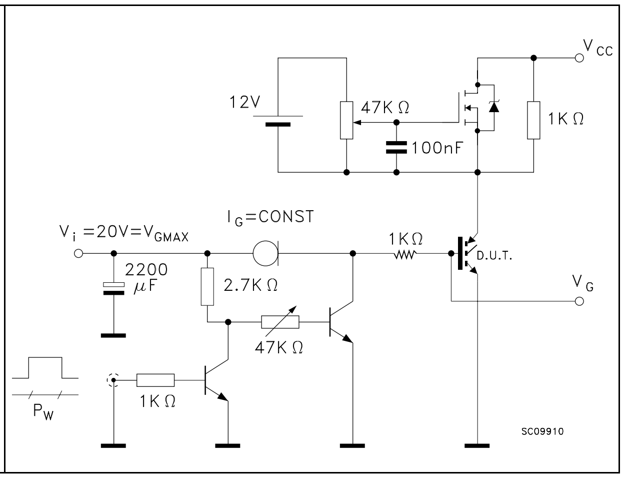
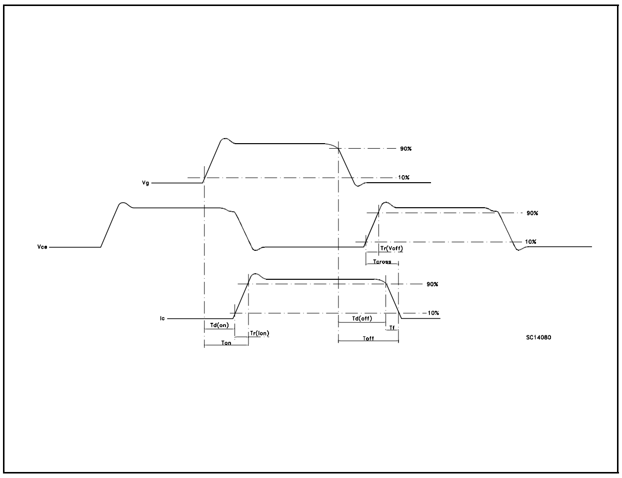


Figure 19. Switching waveforms

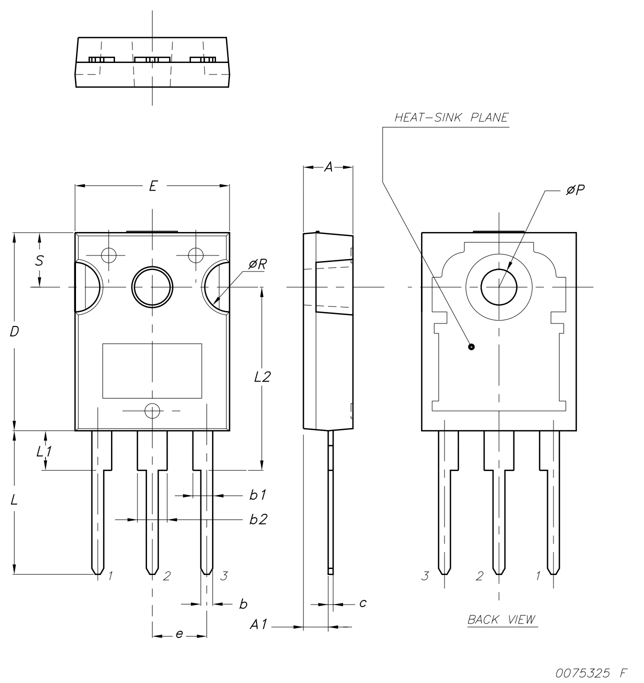


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: *www.st.com*

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 8. Document revision history

Date	Revision	Changes
16-May-2007	1	First release
11-Feb-2008	2	Mechanical data has been updated