

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.

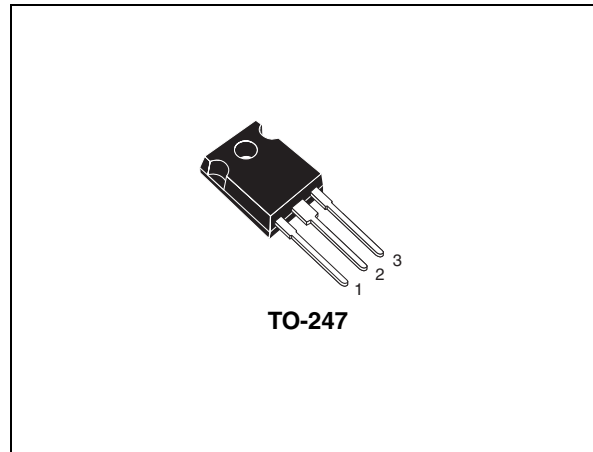


Figure 1. Internal schematic diagram

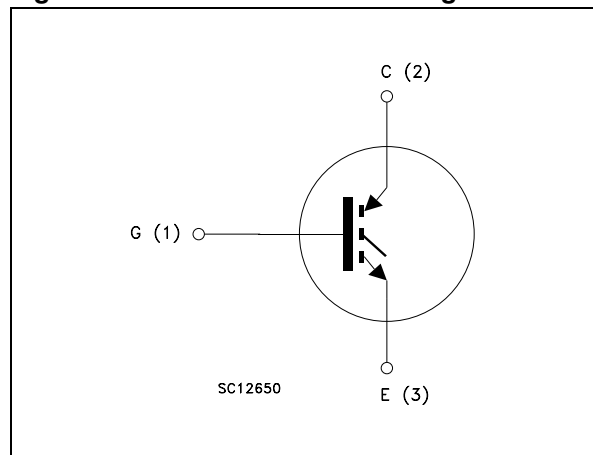


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW39NC60V	GW39NC60V	TO-247	Tube

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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:

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

2. $V_{clamp} = 80\%(V_{CES})$, $T_j = 150$ °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
$R_{thj-case}$	Thermal resistance junction-case max	0.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	°C/W

2 Electrical characteristics

($T_{CASE} = 25\text{ °C}$ 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	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_C = 125\text{ °C}$		1.8 1.7	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-emitter cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}, T_C = 125\text{ °C}$			500 5	μA mA
I_{GES}	Gate-emitter cut-off current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}, I_C = 30\text{ A}$		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}	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$		2900		pF
C_{oes}	Output capacitance			298		pF
C_{res}	Reverse transfer capacitance			59		pF
Q_g	Total gate charge	$V_{CE} = 390\text{ V}, I_C = 30\text{ A},$		126		nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15\text{ V}$		16		nC
Q_{gc}	Gate-collector charge	(see Figure 18)		46		nC

Table 6. Switching on/off (inductive load)

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

Table 7. Switching energy (inductive load)

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

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

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

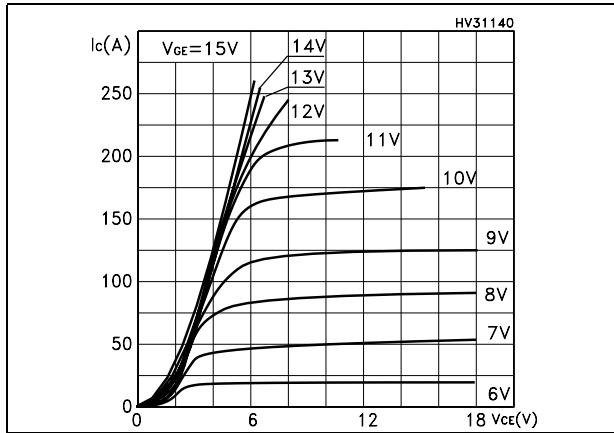


Figure 3. Transfer characteristics

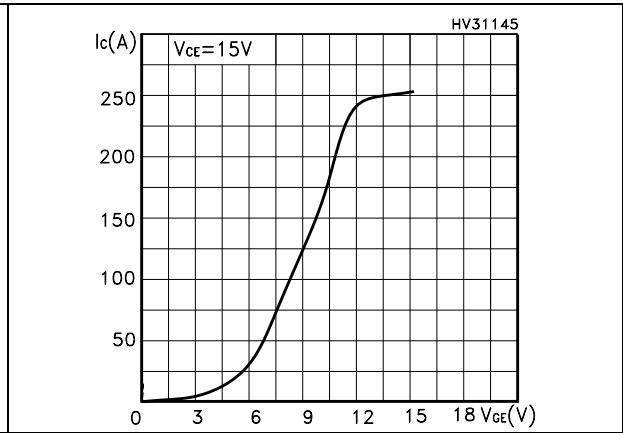


Figure 4. Transconductance

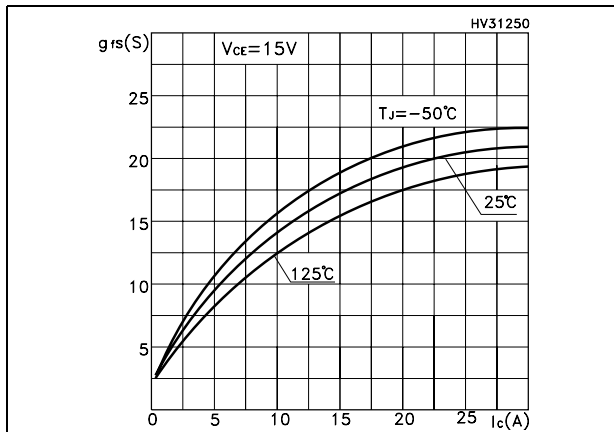


Figure 5. Collector-emitter on voltage vs temperature

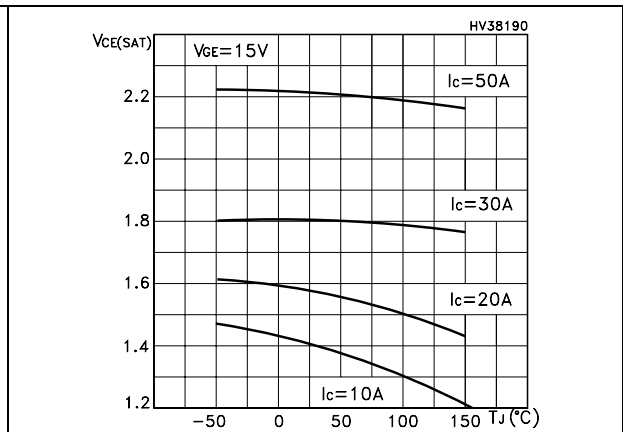


Figure 6. Collector-emitter on voltage vs collector current

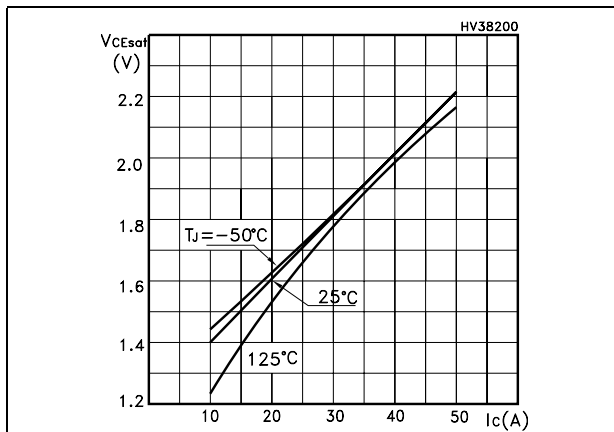


Figure 7. Normalized gate threshold vs temperature

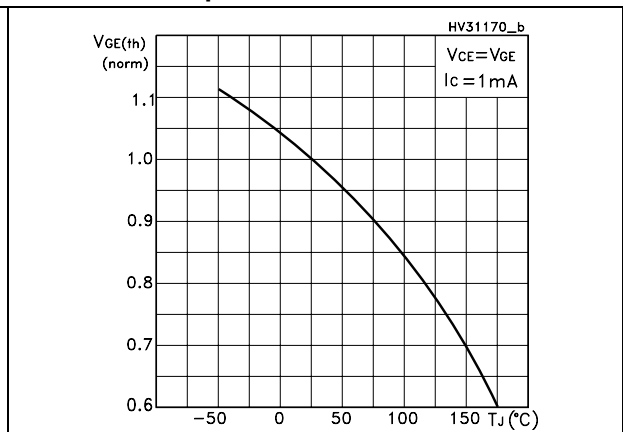


Figure 8. Normalized breakdown voltage vs temperature

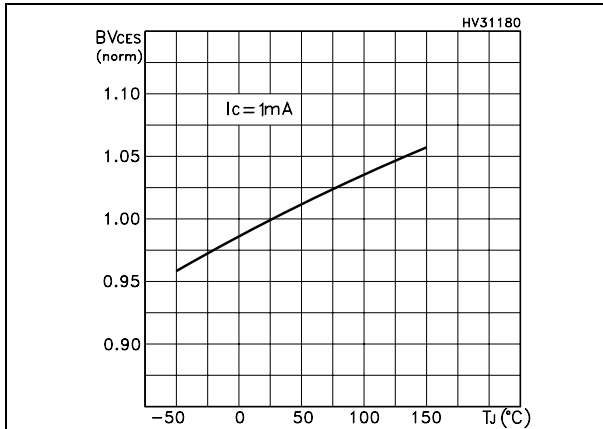


Figure 9. Gate charge vs gate-emitter voltage

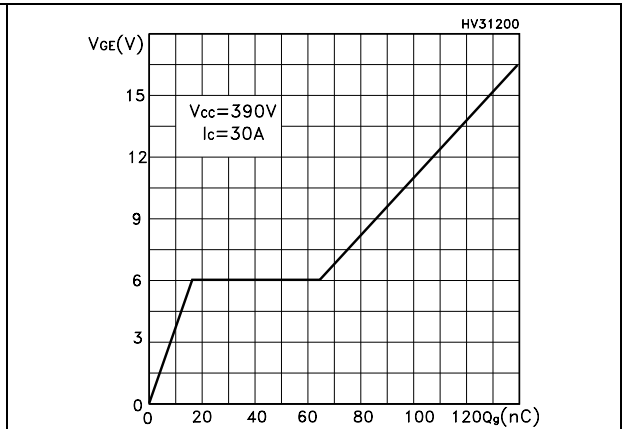


Figure 10. Capacitance variations

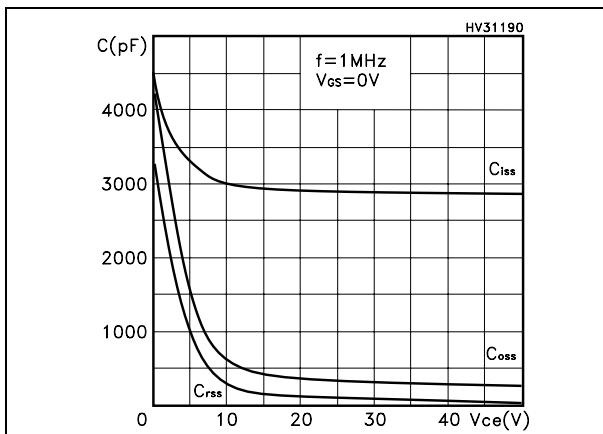


Figure 11. Switching losses vs temperature

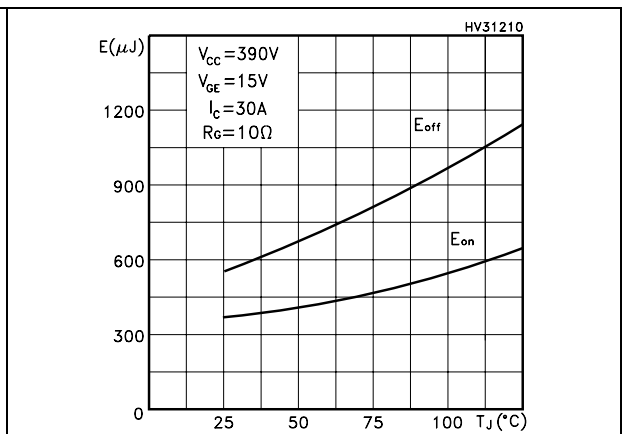


Figure 12. Switching losses vs gate resistance Figure 13. Switching losses vs collector current

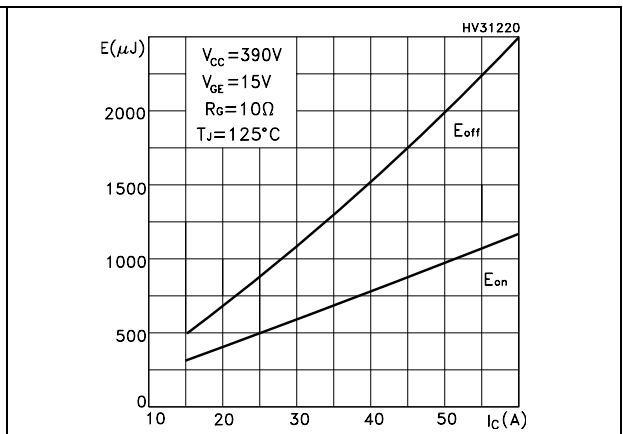
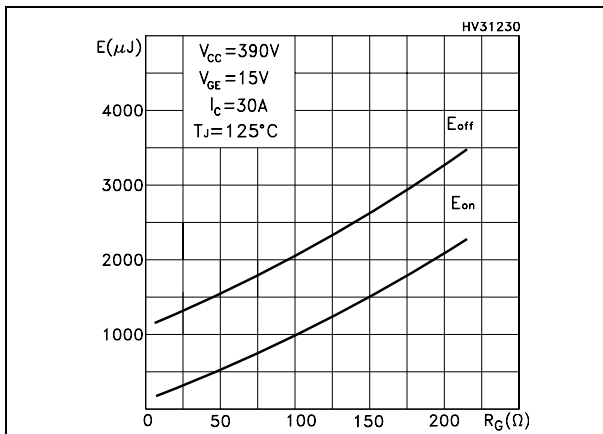


Figure 14. Thermal impedance

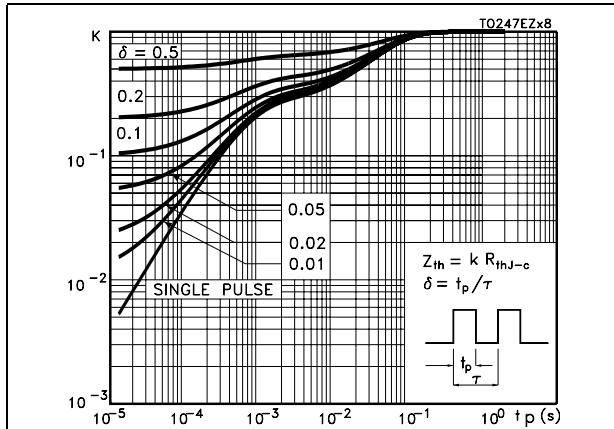


Figure 15. Turn-off SOA

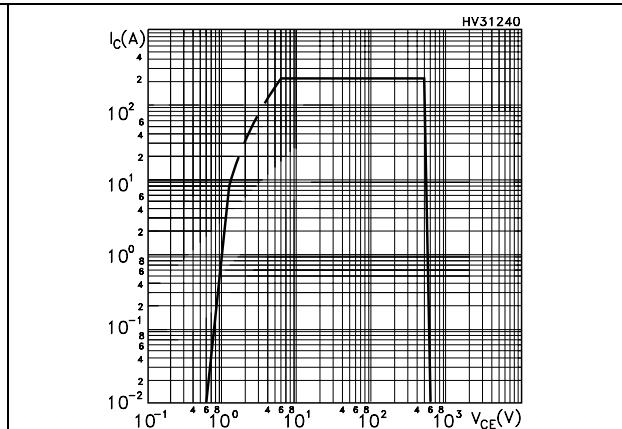
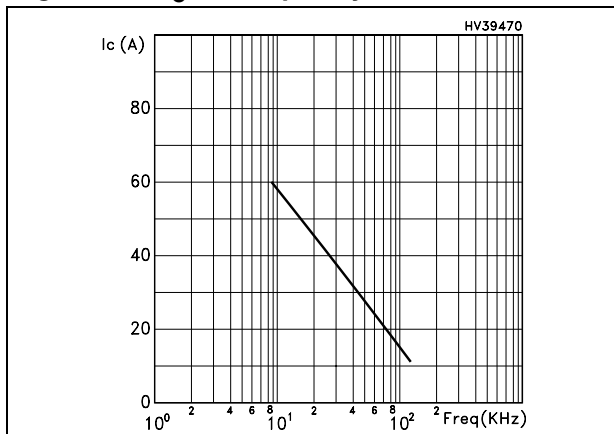


Figure 16. Ic vs. frequency



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

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

considering $\Delta T = T_J - T_C = 125\text{ }^\circ\text{C} - 75\text{ }^\circ\text{C} = 50\text{ }^\circ\text{C}$

- 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

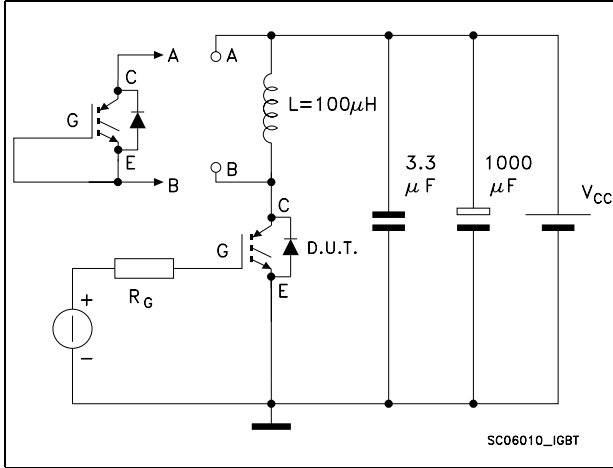


Figure 18. Gate charge test circuit

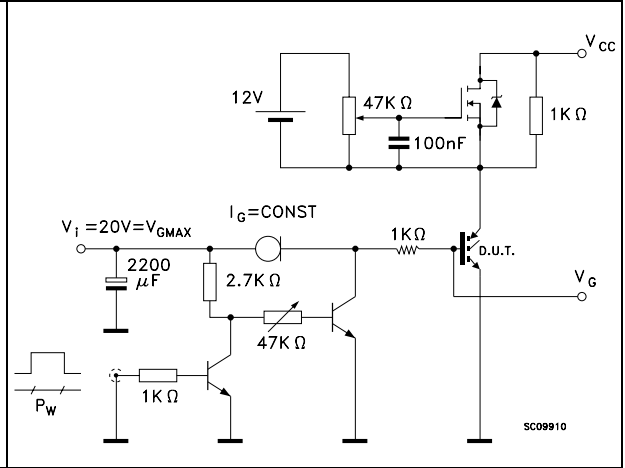
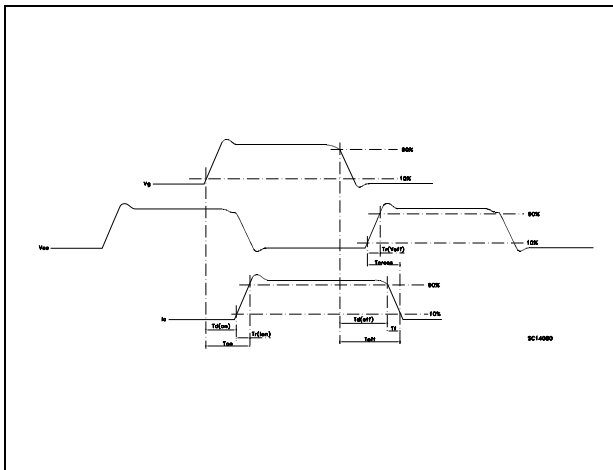


Figure 19. Switching waveforms

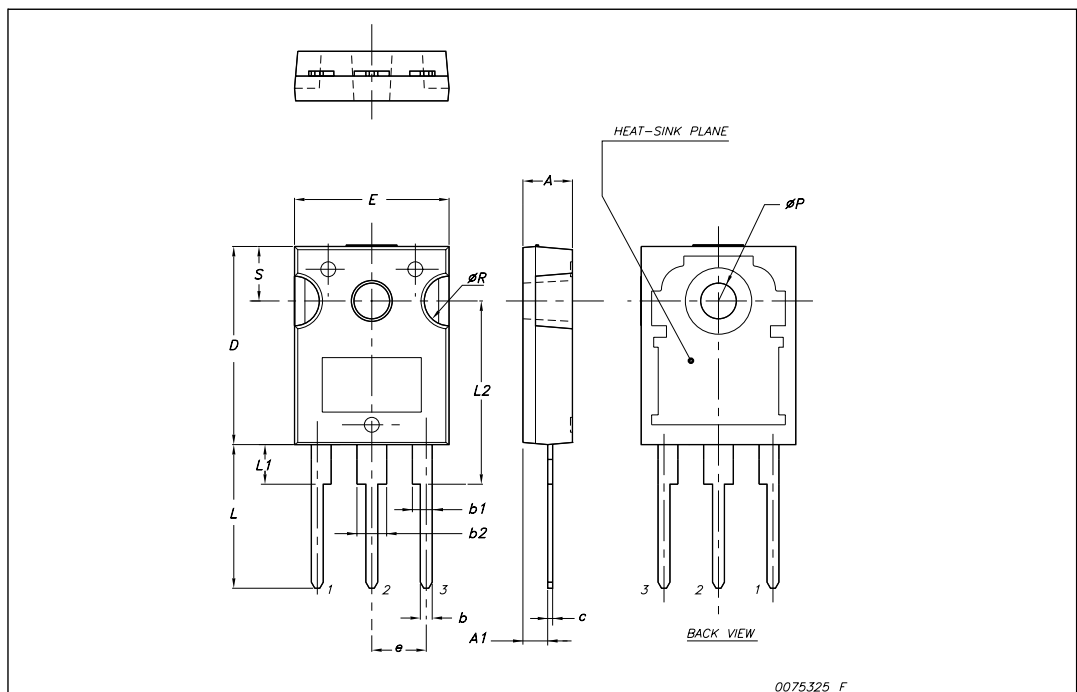


4 Package mechanical data

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

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