

Features

- Low C_{RES} / C_{IES} ratio (no cross conduction susceptibility)
- IGBT co-packaged with ultra fast free-wheeling diode
- High frequency operation

Applications

- High frequency inverters, UPS
- Motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies
- Welding
- Induction heating

Description

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

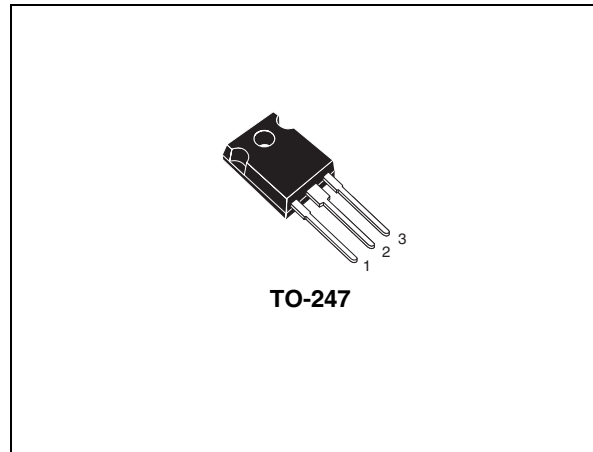


Figure 1. Internal schematic diagram

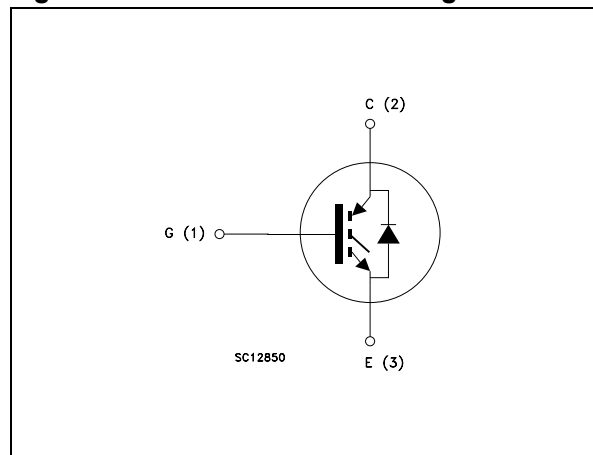


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW40NC60WD	GW40NC60WD	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	70	A
$I_C^{(1)}$	Collector current (continuous) at 100 °C	40	A
$I_{CL}^{(2)}$	Turn-off latching current	230	A
$I_{CP}^{(3)}$	Pulsed collector current	230	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	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. $V_{clamp} = 80\%(V_{CES})$, $T_j = 150$ °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 (IGBT)	0.5	°C/W
$R_{thj-case}$	Thermal resistance junction-case max (diode)	1.5	°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	$V_{GE}= 15\text{ V}$, $I_C= 30\text{ A}$ $V_{GE}= 15\text{ V}$, $I_C= 30\text{ A}$, $T_C=125\text{ °C}$		2.1 1.9	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}= V_{GE}$, $I_C= 250\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector-emitter cut-off current ($V_{GE} = 0$)	$V_{GE} = 600\text{ V}$ $V_{GE} = 600\text{ V}$, $T_C=125\text{ °C}$			500 5	μA mA
I_{GES}	Gate-emitter cut-off current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C= 30\text{ A}$		20		S

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	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		33		ns
t_r	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V}$		12		ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)		2600		A/ μ s
$t_{d(on)}$	Turn-on delay timeE	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		32		ns
t_r	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$		14		ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)		2300		A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A},$		26		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V}$		168		ns
t_f	Current fall time	(see Figure 17)		36		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A},$		54		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		213		ns
t_f	Current fall time			67		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		302		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V}$		349		μ J
E_{ts}	Total switching losses	(see Figure 17)		651		μ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		553		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$		750		μ J
E_{ts}	Total switching losses	(see Figure 17)		1303		μ J

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2 E_{on} include diode recovery energy. If the IGBT is offered in a package with a co-pak diode, the co-pak 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 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_F	Forward on-voltage	$I_F = 30\text{ A}$ $I_F = 30\text{ A}, T_C = 125\text{ °C}$		2.4		V
				1.8		V
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}, V_R = 50\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i>		45		ns
Q_{rr}	Reverse recovery charge			56		nC
I_{rrm}	Reverse recovery current			2.55		A
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}, V_R = 50\text{ V},$ $T_C = 125\text{ °C},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i>		100		ns
Q_{rr}	Reverse recovery charge			290		nC
I_{rrm}	Reverse recovery current			5.8		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

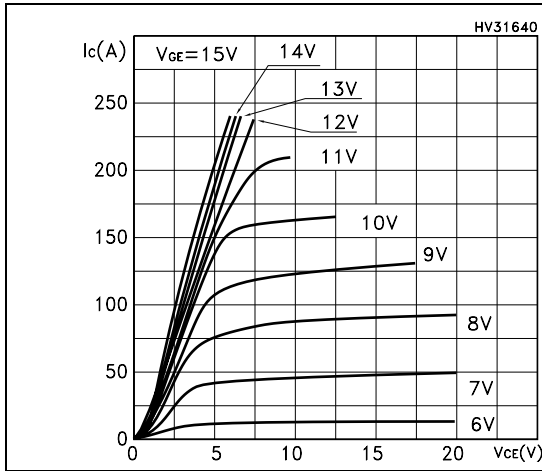


Figure 3. Transfer characteristics

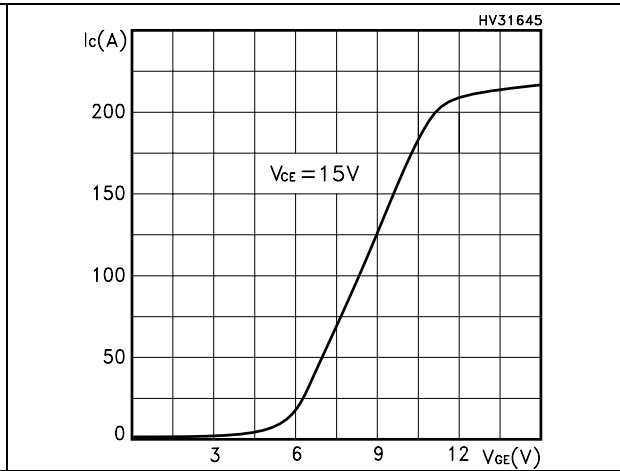


Figure 4. Transconductance

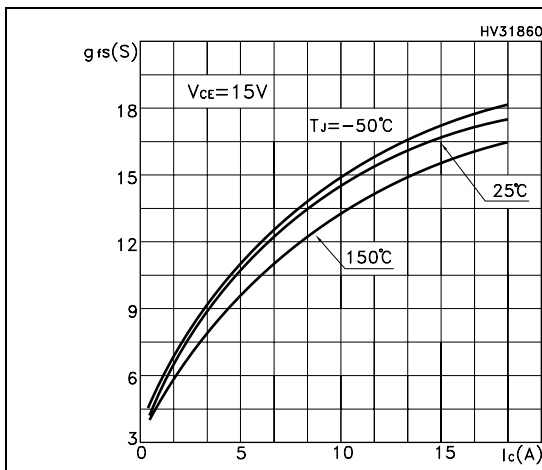


Figure 5. Collector-emitter on voltage vs temperature

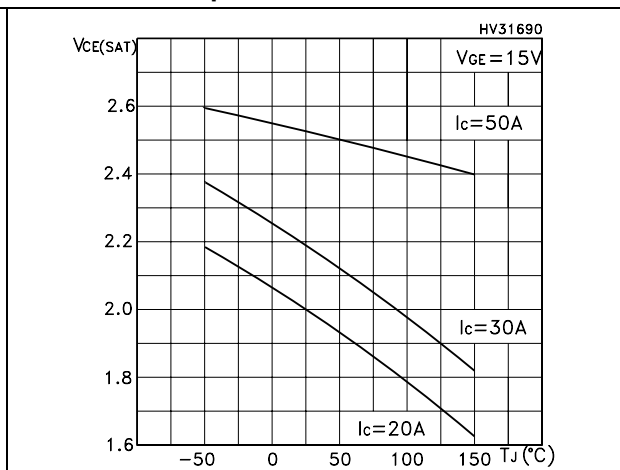


Figure 6. Collector-emitter on voltage vs collector current

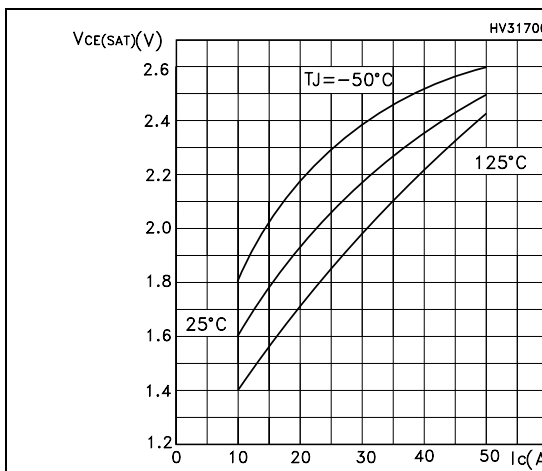


Figure 7. Normalized gate threshold vs temperature

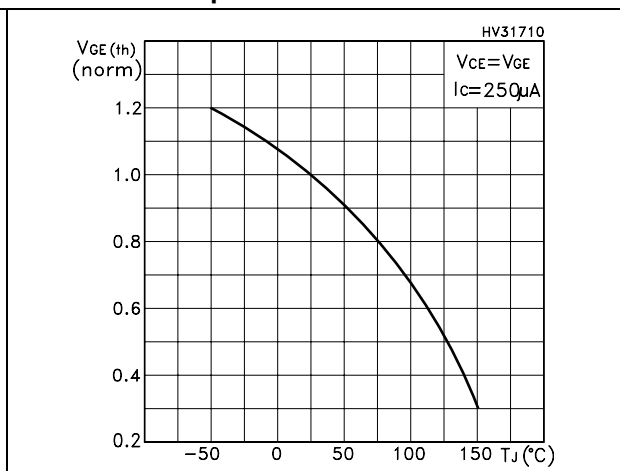


Figure 8. Normalized breakdown voltage vs temperature

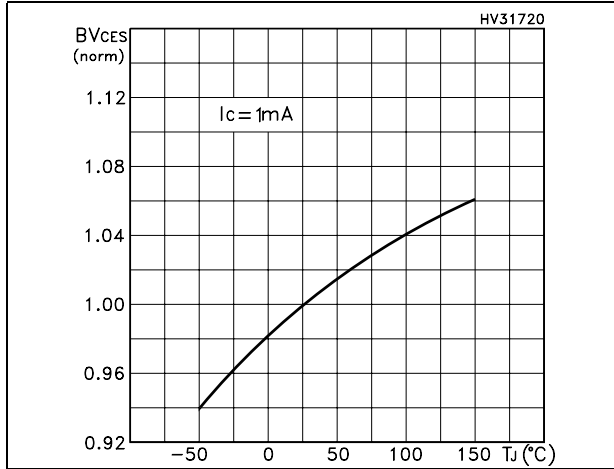


Figure 9. Gate charge vs gate-emitter voltage

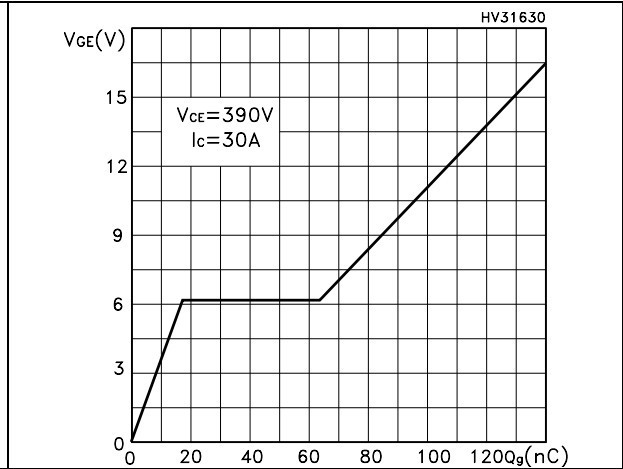


Figure 10. Capacitance variations

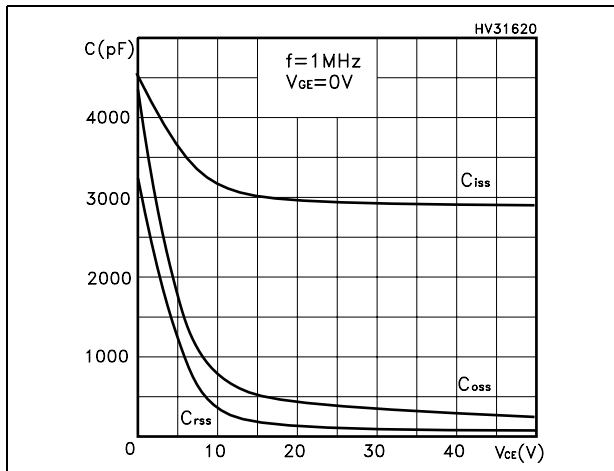


Figure 11. Switching losses vs temperature

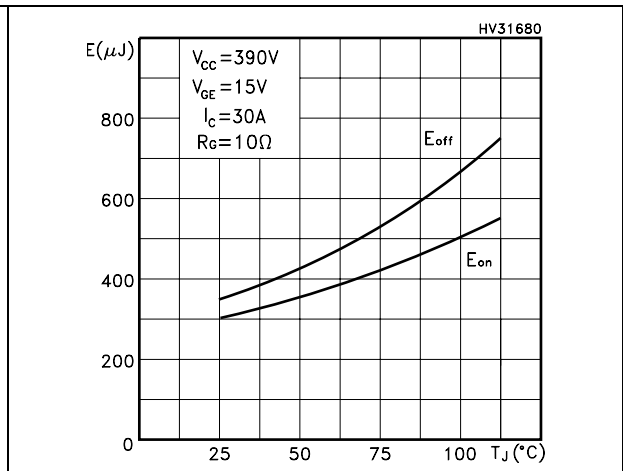


Figure 12. Switching losses vs gate resistance

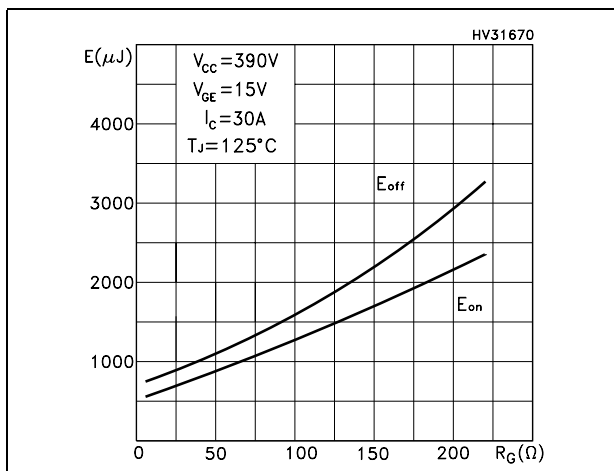


Figure 13. Switching losses vs collector current

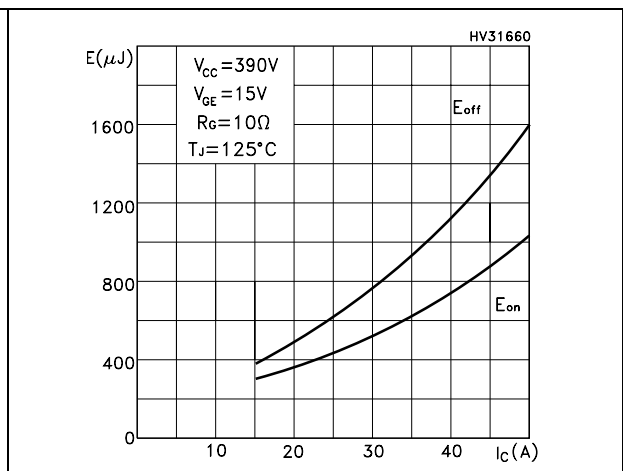


Figure 14. Thermal impedance

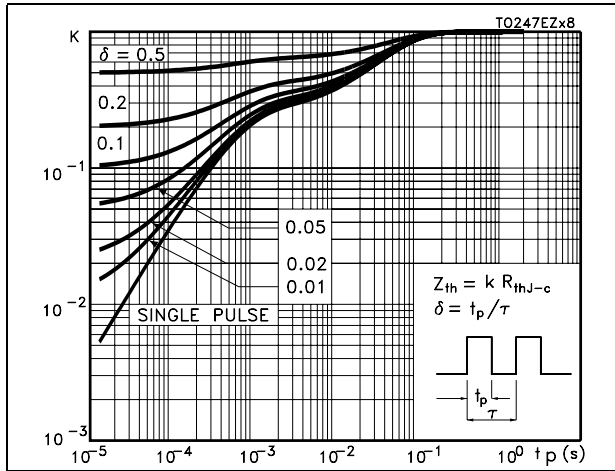


Figure 15. Turn-off SOA

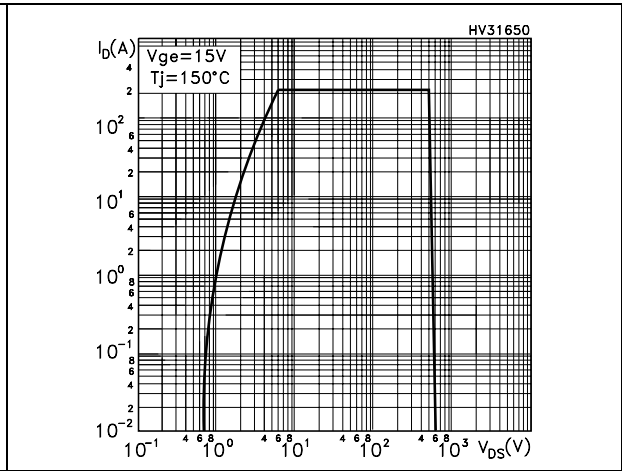
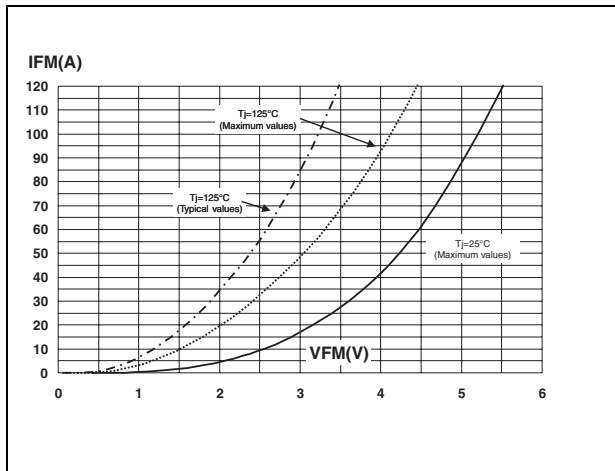


Figure 16. Emitter-collector diode characteristics



3 Test circuit

Figure 17. Test circuit for inductive load switching

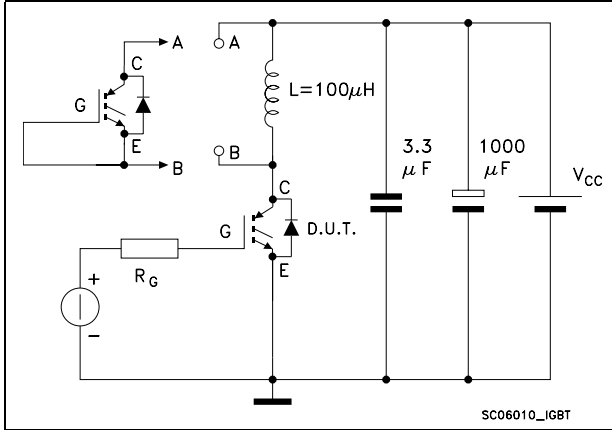


Figure 18. Gate charge test circuit

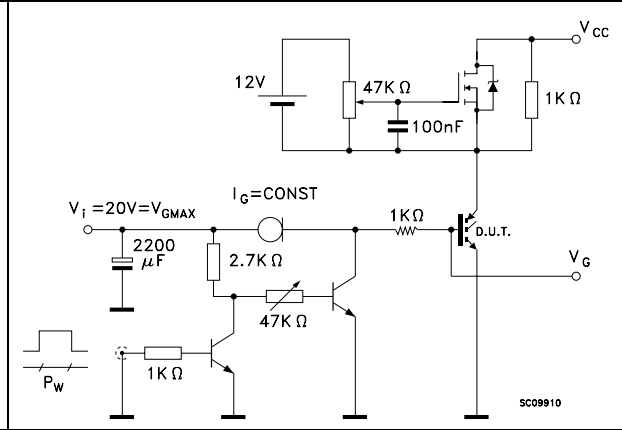


Figure 19. Switching waveforms

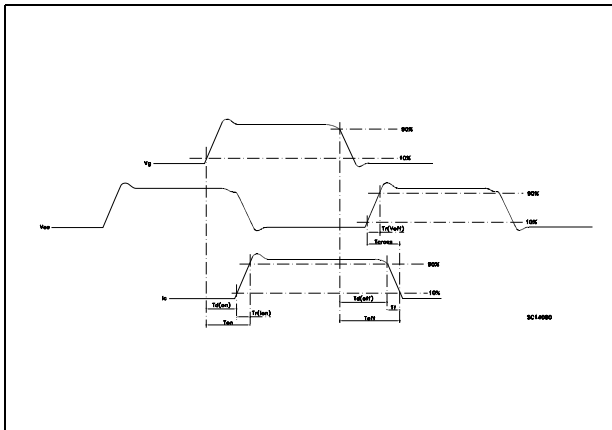
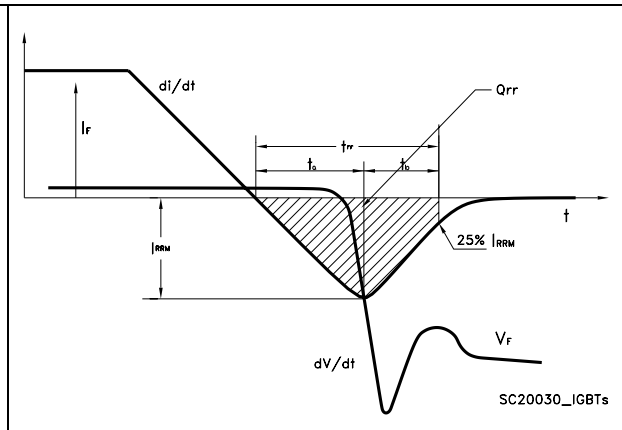


Figure 20. Diode recovery times waveform

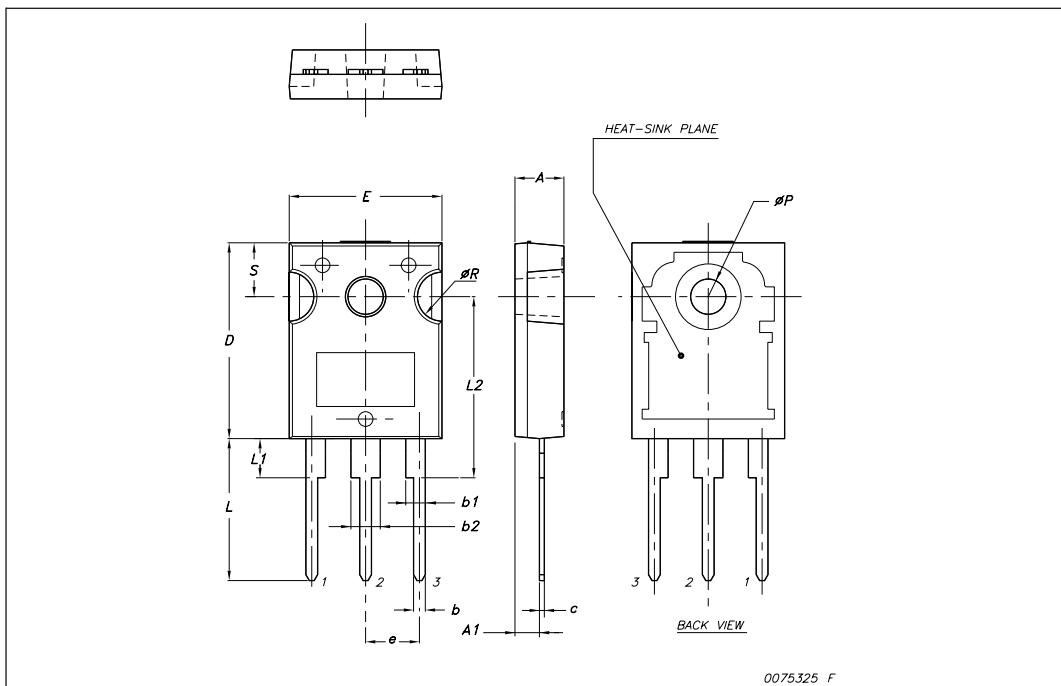


4 Package mechanical data

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 9. Document revision history

Date	Revision	Changes
8-Jun-2006	1	First release
08-Nov-2006	2	Modified <i>Dynamic</i>
01-Feb-2008	3	Updated <i>Table 7</i>
09-Jul-2008	4	Added new feature

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