

Features

- High current capability
- High frequency operation up to 50 KHz
- Very soft ultra fast recovery antiparallel diode

Description

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

Applications

- High frequency inverters, UPS
- Motor drive
- SMPS and PFC in both hard switch and resonant topologies

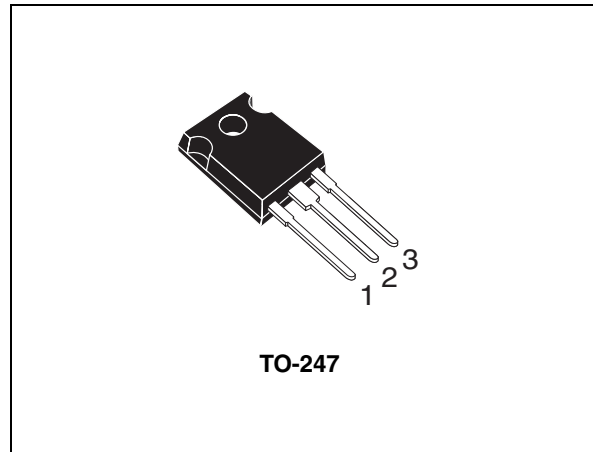


Figure 1. Internal schematic diagram



Table 1. Device summary

Order code	Marking	Package	Packaging
STGW20NC60VD	GW20NC60VD	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
$I_C^{(1)}$	Continuous collector current at $T_C = 25^\circ\text{C}$	60	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100^\circ\text{C}$	30	A
$I_{CP}^{(2)}$	Pulsed collector current	150	A
$I_{CL}^{(3)}$	Turn-off latching current	100	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Diode RMS forward current at $T_C = 25^\circ\text{C}$	30	A
I_{FSM}	Surge not repetitive forward current $t_p = 10$ ms sinusoidal	120	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	200	W
T_j	Operating junction temperature	- 55 to 150	$^\circ\text{C}$
T_{stg}	Storage 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. $V_{clamp} = 80\% V_{CES}$, $T_J = 150^\circ\text{C}$, $R_G = 10 \Omega$, $V_{GE} = 15$ V.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.63	$^\circ\text{C/W}$
	Thermal resistance junction-case diode	1.5	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^\circ\text{C/W}$

2 Electrical characteristics

($T_j = 25^\circ\text{C}$ 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	$V_{GE}=15 \text{ V}, I_C=20 \text{ A}$ $V_{GE}=15 \text{ V}, I_C=20 \text{ A}, T_j=125^\circ\text{C}$		1.8 1.7	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-cut-off current ($V_{GE} = 0$)	$V_{CE} = 600 \text{ V}$ $V_{CE}=600 \text{ V}, T_j= 125^\circ\text{C}$			250 1	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15 \text{ V}, I_C= 20 \text{ A}$		15		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{V}, f = 1 \text{ MHz}, V_{GE}= 0$	-	2200		pF
C_{oes}	Output capacitance			225		pF
C_{res}	Reverse transfer capacitance			50		pF
Q_g	Total gate charge	$V_{CE} = 390\text{V}, I_C = 20\text{A},$ $V_{GE} = 15\text{V},$ <i>(see Figure 18)</i>	-	100	140	nC
Q_{ge}	Gate-emitter charge			16		nC
Q_{gc}	Gate-collector charge			45		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		31		ns
t_r	Current rise time	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$	-	11	-	ns
$(di/dt)_{onf}$	Turn-on current slope	(see Figure 17)		1600		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		31		ns
t_r	Current rise time	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$	-	11.5	-	ns
$(di/dt)_{on}$	Turn-on current slope	$T_j=125^\circ\text{C}$ (see Figure 17)		1500		A/ μs
$t_{r(Voff)}$	Off voltage rise time	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		28		ns
$t_{d(off)}$	Turn-off delay time	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$	-	100	-	ns
t_f	Current fall time	(see Figure 17)		75		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		66		ns
$t_{d(off)}$	Turn-off delay time	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$	-	150	-	ns
t_f	Current fall time	$T_j=125^\circ\text{C}$ (see Figure 17)		130		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		220	300	μJ
E_{off}	Turn-off switching losses	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$,	-	330	450	μJ
E_{ts}	Total switching losses	(see Figure 19)		550	750	μJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC}=390\text{ V}$, $I_C=20\text{ A}$,		450		μJ
E_{off}	Turn-off switching losses	$R_G=3.3\ \Omega$, $V_{GE}=15\text{ V}$,	-	770		μJ
E_{ts}	Total switching losses	$T_j=125^\circ\text{C}$ (see Figure 19)		1220		μJ

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in Figure 19. 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).

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_F	Forward on-voltage	$I_F = 20\text{ A}$ $I_F = 20\text{ A}, T_j = 125^\circ\text{C}$	-	2 1.6	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 20\text{ A}, V_R = 40\text{ V},$ $T_j = 25^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20)	-	44 66 3	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 20\text{ A}, V_R = 40\text{ V},$ $T_j = 125^\circ\text{C},$ $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20)	-	88 237 5.4	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

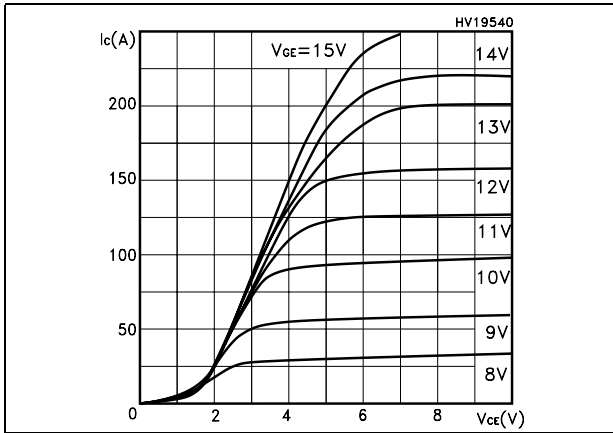


Figure 3. Transfer characteristics

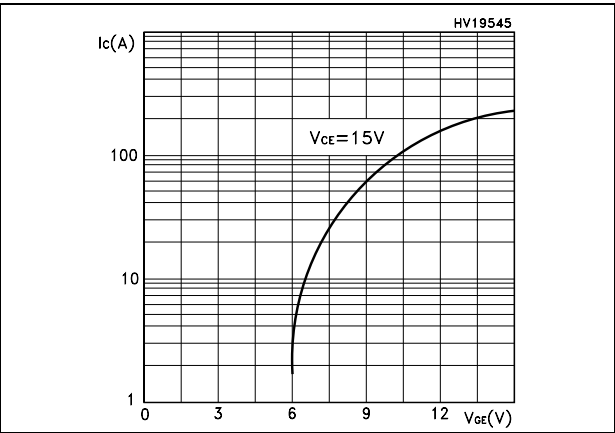


Figure 4. Transconductance

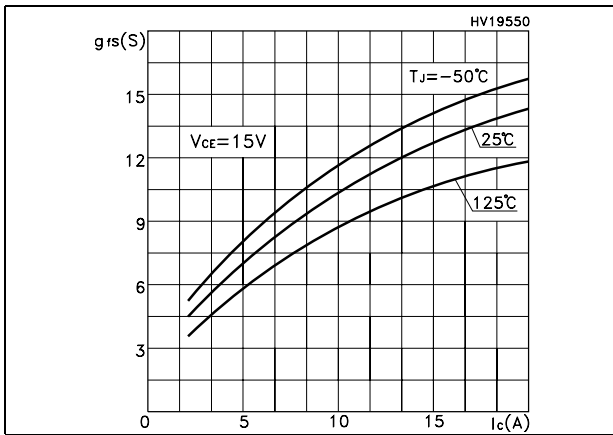


Figure 5. Collector-emitter on voltage vs temperature

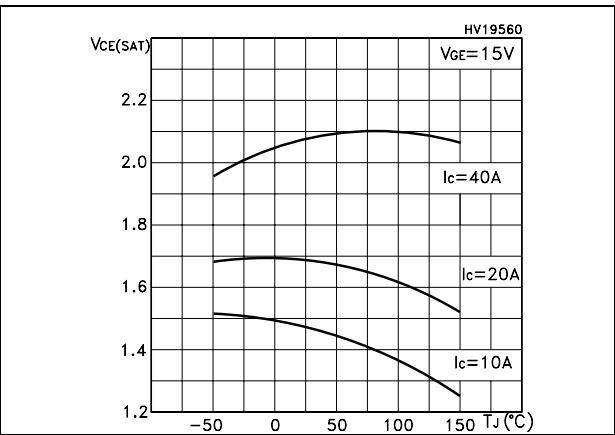


Figure 6. Collector-emitter on voltage vs collector current

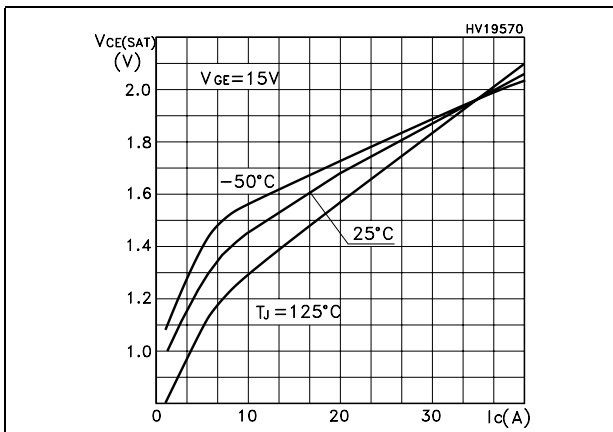


Figure 7. Normalized gate threshold vs temperature

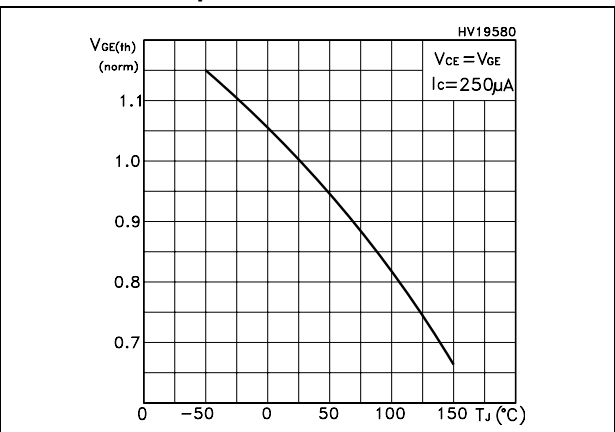


Figure 8. Normalized breakdown voltage vs temperature

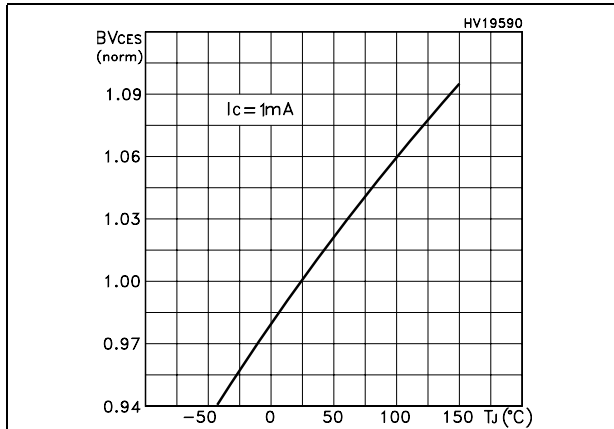


Figure 9. Gate charge vs gate-emitter voltage

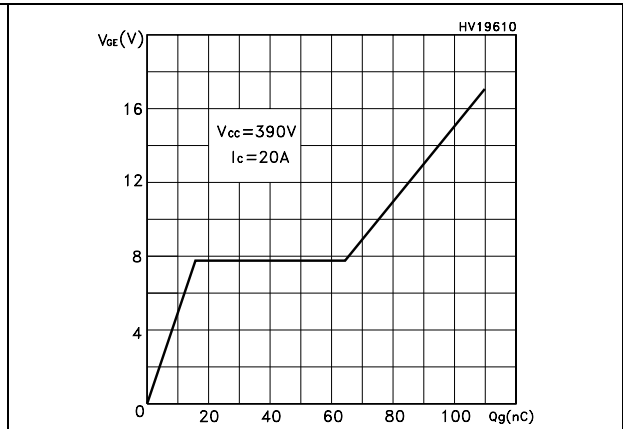


Figure 10. Capacitance variations

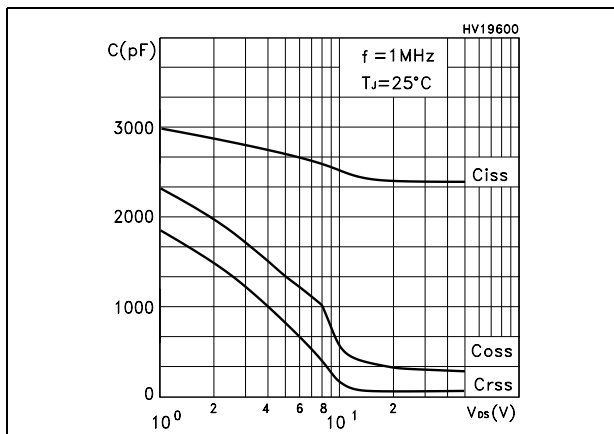


Figure 11. Switching losses vs temperature

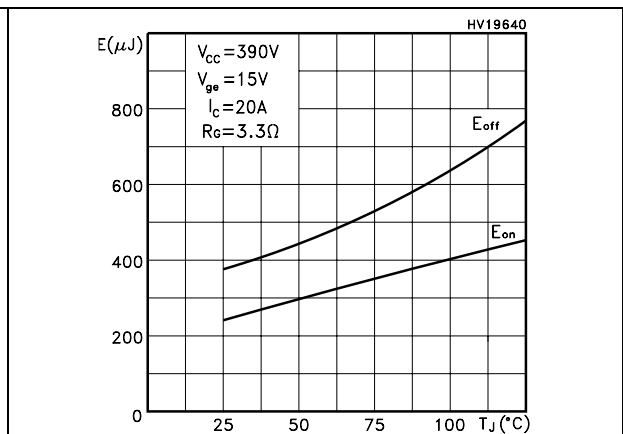


Figure 12. Switching losses vs gate resistance Figure 13. Switching losses vs collector current

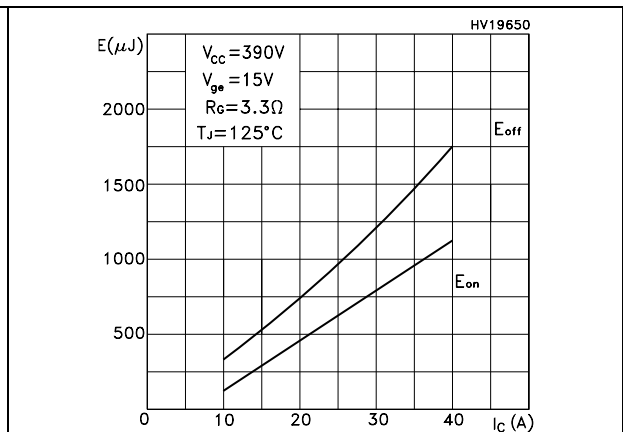
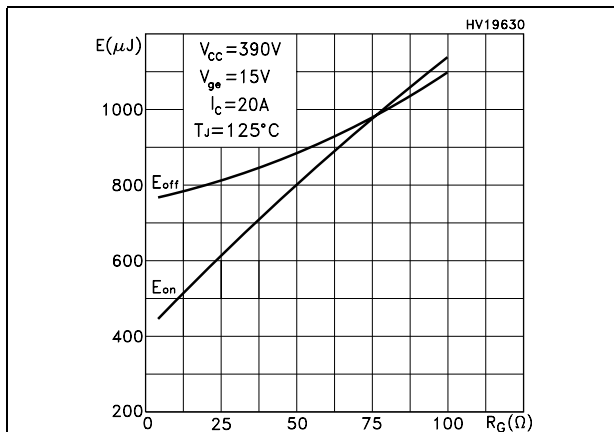


Figure 14. Thermal impedance

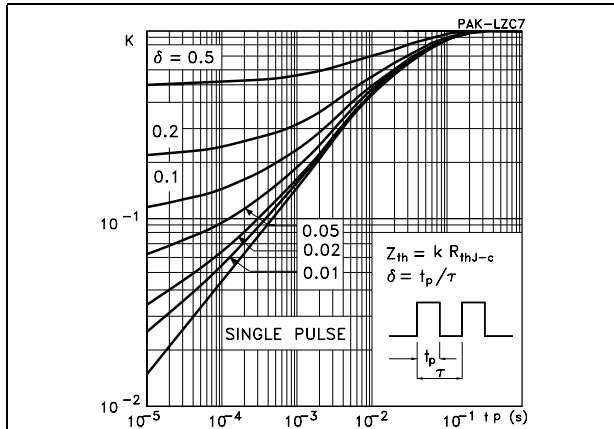


Figure 15. Turn-off SOA

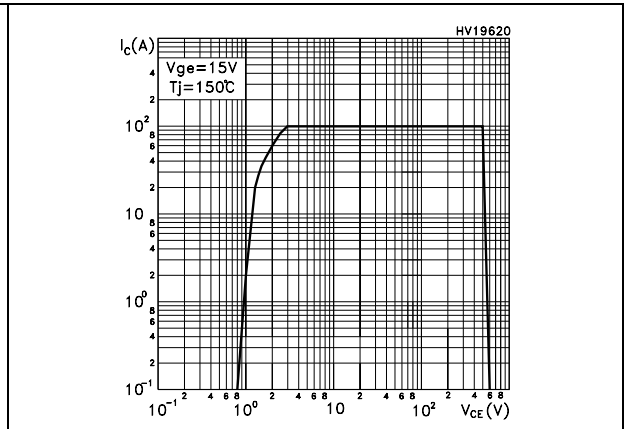
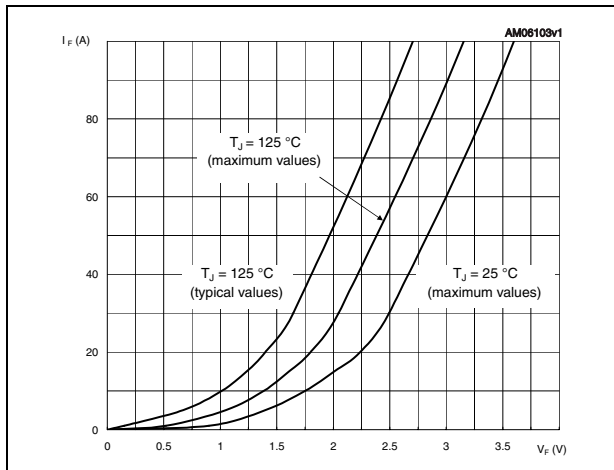


Figure 16. Emitter-collector diode characteristics



3 Test circuits

Figure 17. Test circuit for inductive load switching

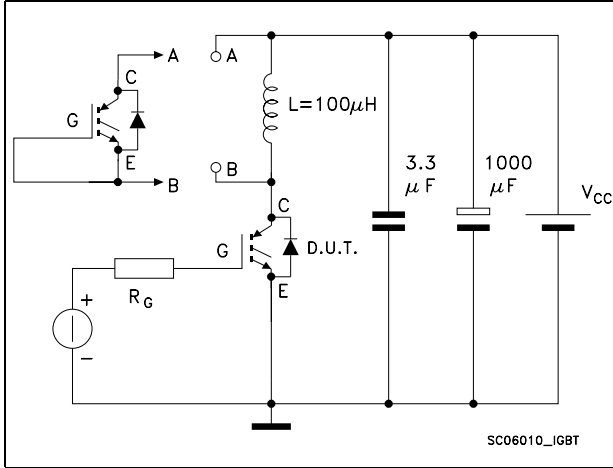


Figure 18. Gate charge test circuit

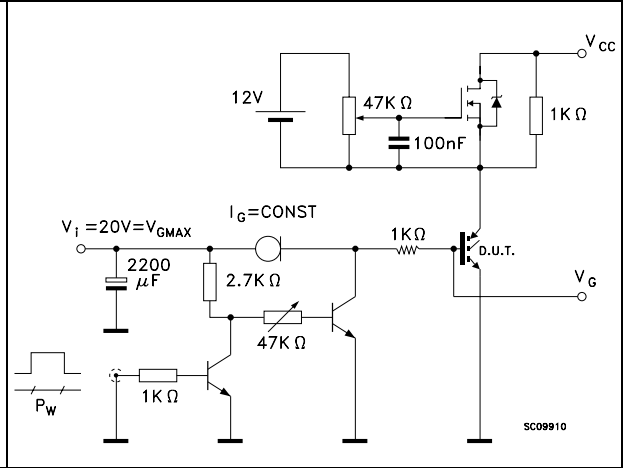


Figure 19. Switching waveforms

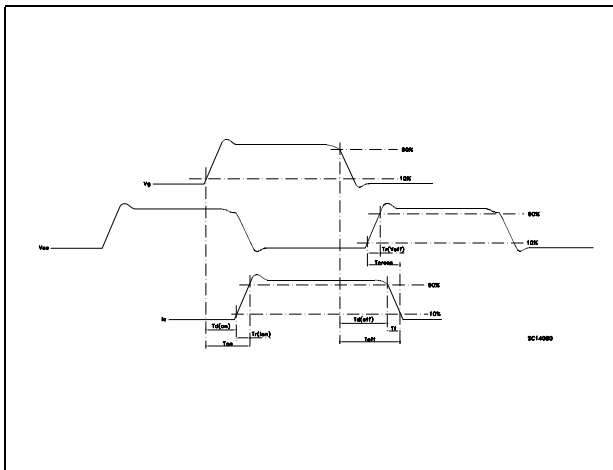
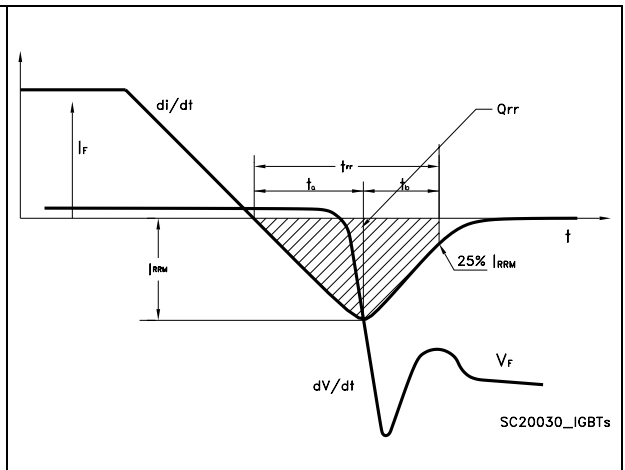


Figure 20. Diode recovery times waveform

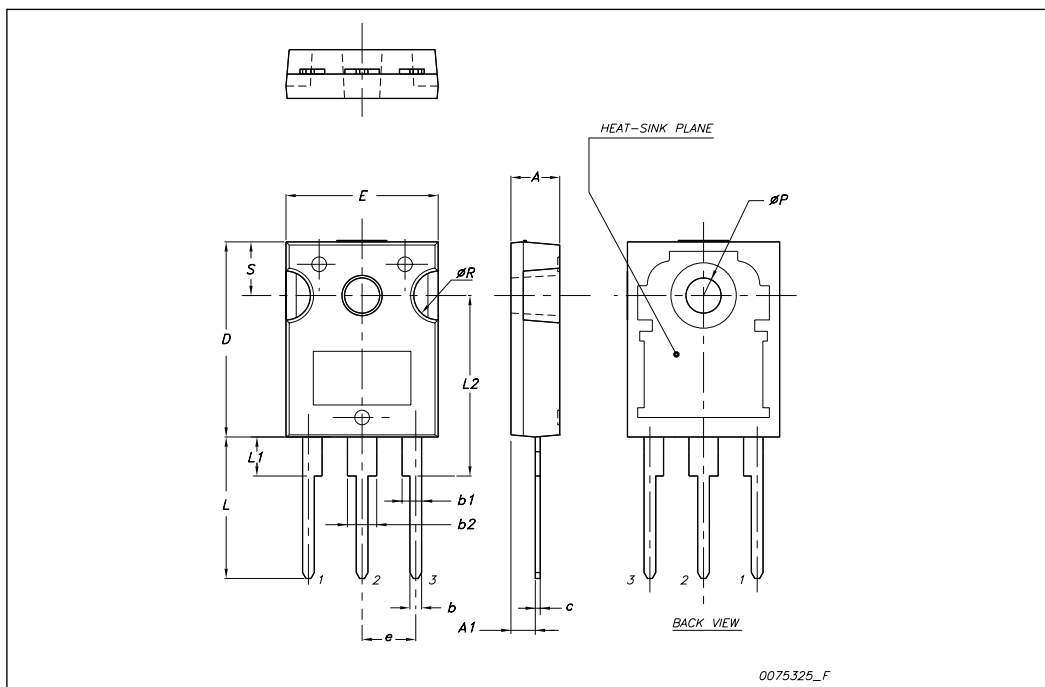


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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 9. Revision history

Date	Revision	Changes
12-Jul-2004	4	Stylesheet updated. Added switching losses maximum values in Table 7: Switching energy (inductive load) . Inserted Figure 20: Diode recovery times waveform .
09-Mar-2010	5	Inserted I_{FSM} parameter on Table 2: Absolute maximum ratings . Updated Figure 16: Emitter-collector diode characteristics and package mechanical data. Minor text changes to improve readability.

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