

Features

- Low on-losses
- Low on-voltage drop ($V_{CE(sat)}$)
- High current capability
- High input impedance (voltage driven)
- Low gate charge
- Ideal for soft switching application

Application

- Induction heating

Description

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

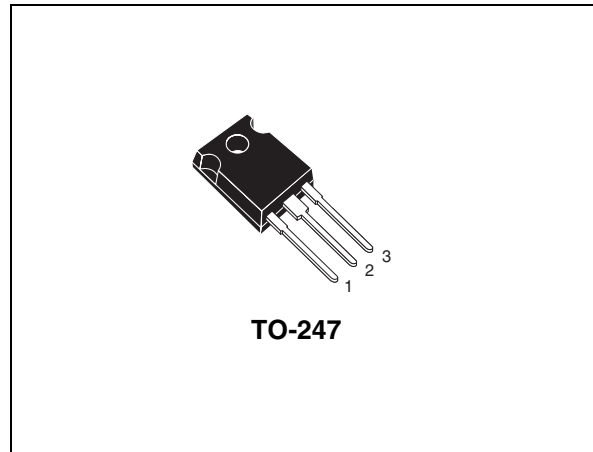


Figure 1. Internal schematic diagram

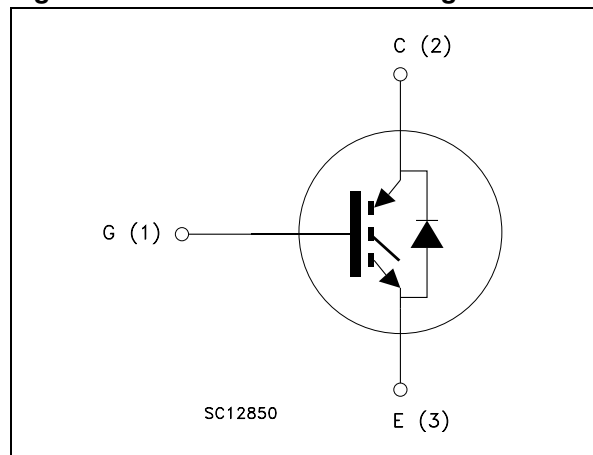


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW35NC120HD	GW35NC120HD	TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	1200	V
$I_C^{(1)}$	Collector current (continuous) at 25 °C	58	A
$I_C^{(1)}$	Collector current (continuous) at 100 °C	34	A
$I_{CL}^{(2)}$	Turn-off latching current	135	A
$I_{CP}^{(3)}$	Pulsed collector current	135	A
V_{GE}	Gate-emitter voltage	±25	V
P_{TOT}	Total dissipation at $T_C = 25$ °C	220	W
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	100	A
T_j	Operating junction temperature	-55 to 150	°C
T_{stg}	Storage temperature		

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. $V_{clamp} = 80\%$ of 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	Min.	Typ.	Max.	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT			0.562	°C/W
	Thermal resistance junction-case diode			1.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient			50	°C/W

2 Electrical characteristics

($T_{CASE}=25^{\circ}C$ unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1 \text{ mA}$	1200			V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 20 \text{ A},$ $V_{GE} = 15 \text{ V}, I_C = 20 \text{ A}, T_C = 125^{\circ}C$		2.2 2.0	2.75	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 leakage current ($V_{GE} = 0$)	$V_{CE} = 1200 \text{ V}$ $V_{CE} = 1200 \text{ V}, T_C = 125^{\circ}C$			500 10	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20 \text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 25 \text{ V}, I_C = 20 \text{ A}$		14		S

1. Pulse duration = 300 μs , duty cycle 1.5%

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$		2510		pF
C_{oes}	Output capacitance			175		pF
C_{res}	Reverse transfer capacitance			30		pF
Q_g	Total gate charge	$V_{CE} = 960 \text{ V},$ $I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$		110	120	nC
Q_{ge}	Gate-emitter charge			16		nC
Q_{gc}	Gate-collector charge			49		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		29		ns
t_r	Current rise time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ <i>(see Figure 17)</i>		11		ns
$(di/dt)_{on}$	Turn-on current slope			1820		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		27		ns
t_r	Current rise time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ <i>(see Figure 17)</i>		14		ns
$(di/dt)_{on}$	Turn-on current slope			1580		A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		90		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ <i>(see Figure 17)</i>		275		ns
t_f	Current fall time			312		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		150		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ <i>(see Figure 17)</i>		336		ns
t_f	Current fall time			592		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		1660		μJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ <i>(see Figure 17)</i>		4438		μJ
E_{ts}	Total switching losses			6098		μJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		3015		μJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ <i>(see Figure 17)</i>		6900		μJ
E_{ts}	Total switching losses			9915		μJ

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F = 20 \text{ A}$ $I_F = 20 \text{ A}, T_C = 125 \text{ }^\circ\text{C}$		1.9 1.7	2.5	V V
t_{rr}	Reverse recovery time	$I_F = 20 \text{ A}, V_R = 27 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ <i>(see Figure 20)</i>		152		ns
Q_{rr}	Reverse recovery charge			722		nC
I_{rrm}	Reverse recovery current			9		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

Figure 3. Transfer characteristics

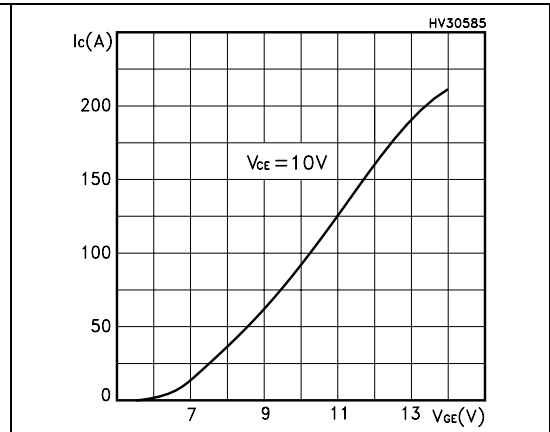
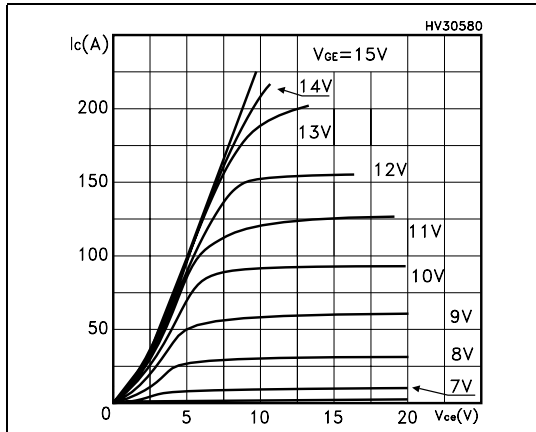


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs. temperature

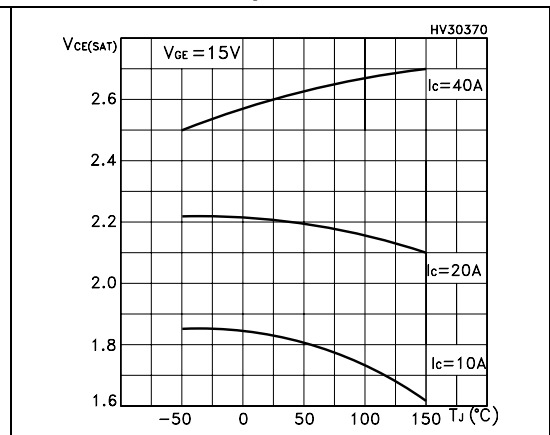
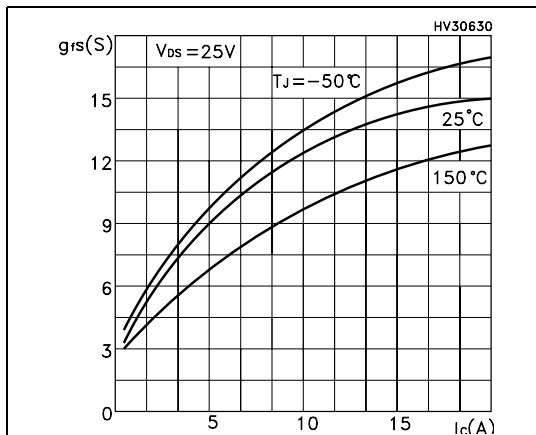


Figure 6. Gate charge vs. gate-source voltage

Figure 7. Capacitance variations

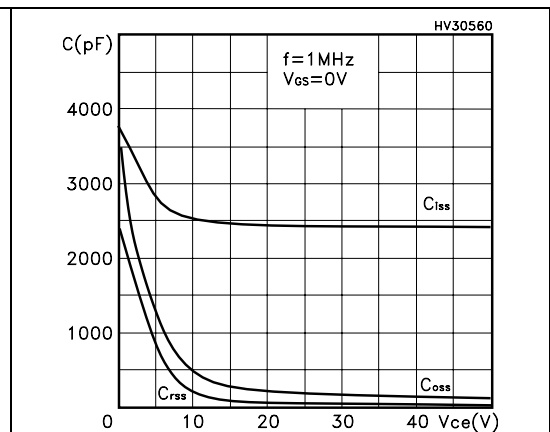
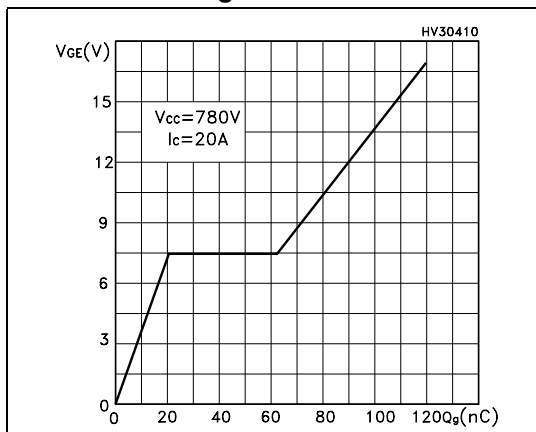


Figure 8. Normalized gate threshold voltage vs. temperature

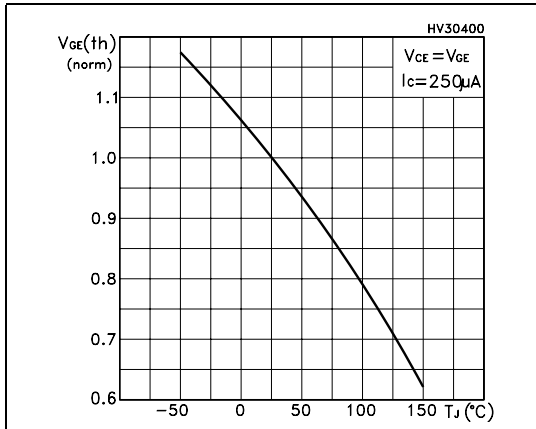


Figure 9. Collector-emitter on voltage vs. collector current

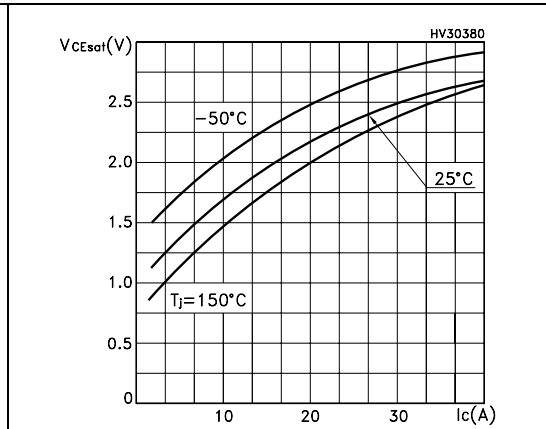


Figure 10. Normalized breakdown voltage vs. temperature

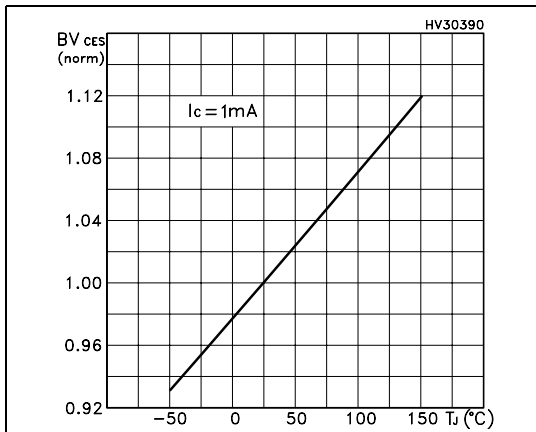


Figure 11. Switching losses vs. temperature

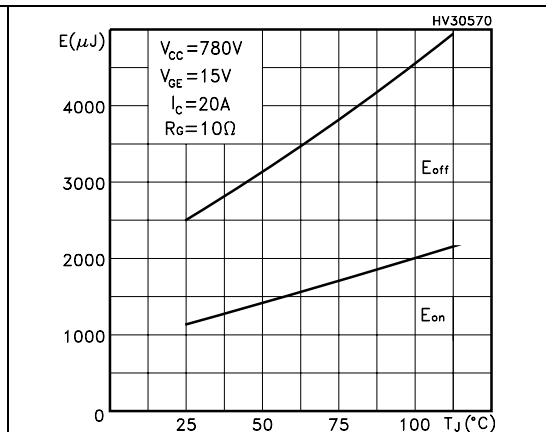


Figure 12. Switching losses vs. gate resistance

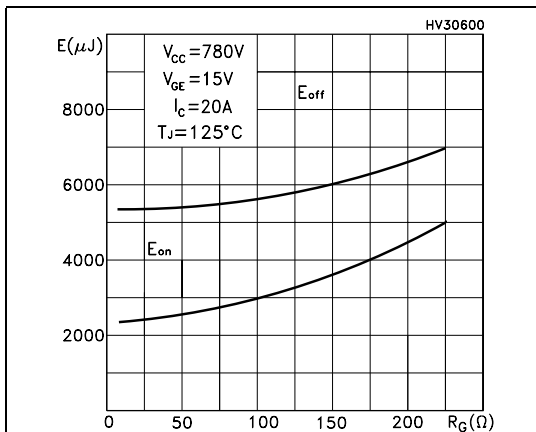


Figure 13. Switching losses vs. collector current

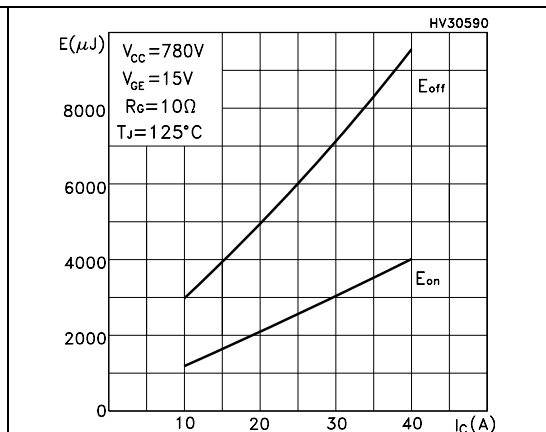


Figure 14. Thermal Impedance

Figure 15. Turn-off SOA

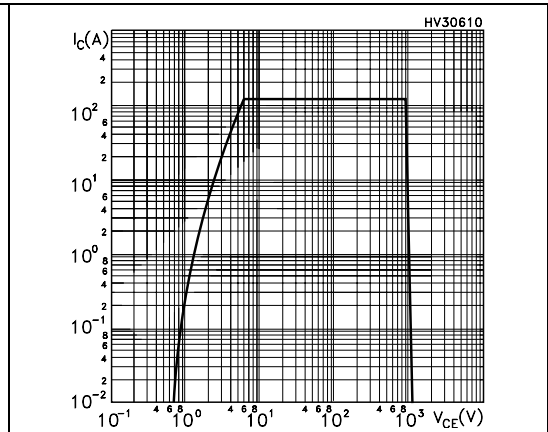
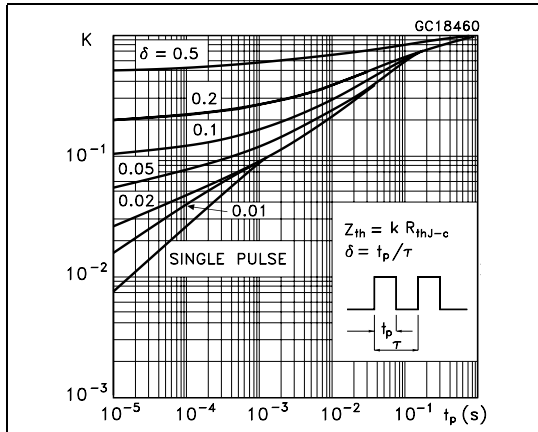
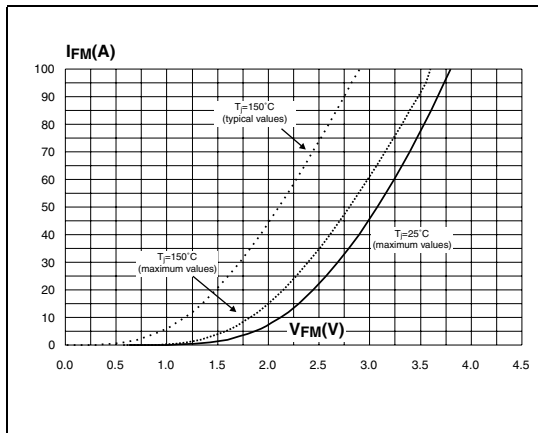


Figure 16. Forward voltage drop vs. forward current



3 Test circuit

Figure 17. Test circuit for inductive load switching

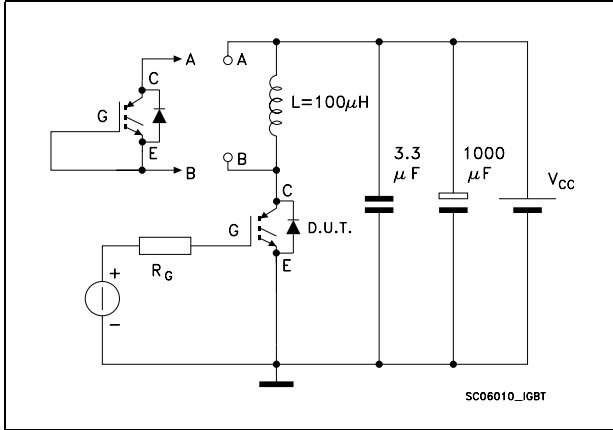


Figure 19. Switching waveform

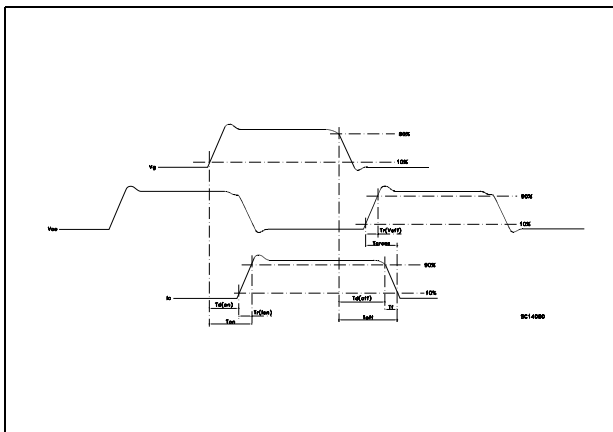


Figure 18. Gate charge test circuit

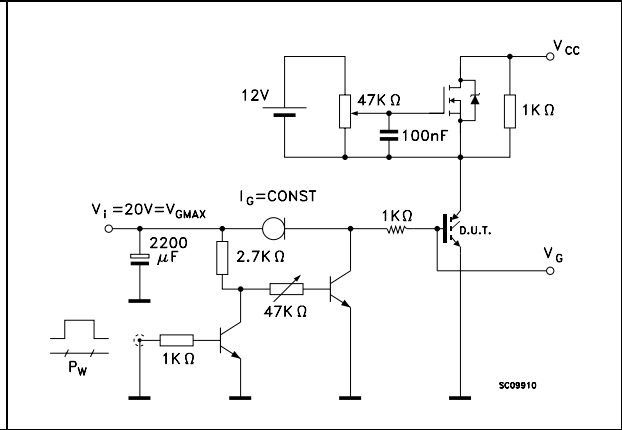
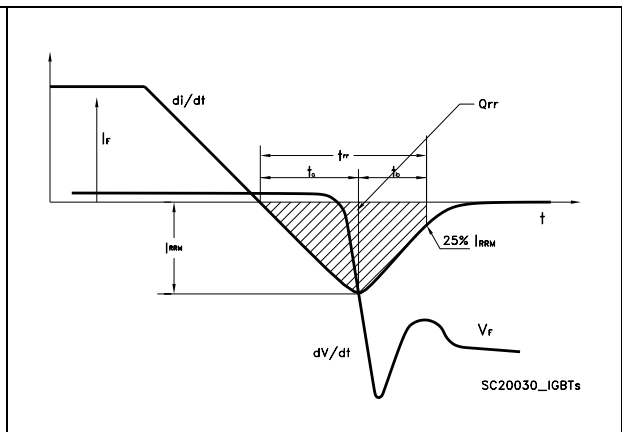


Figure 20. Diode recovery time waveform

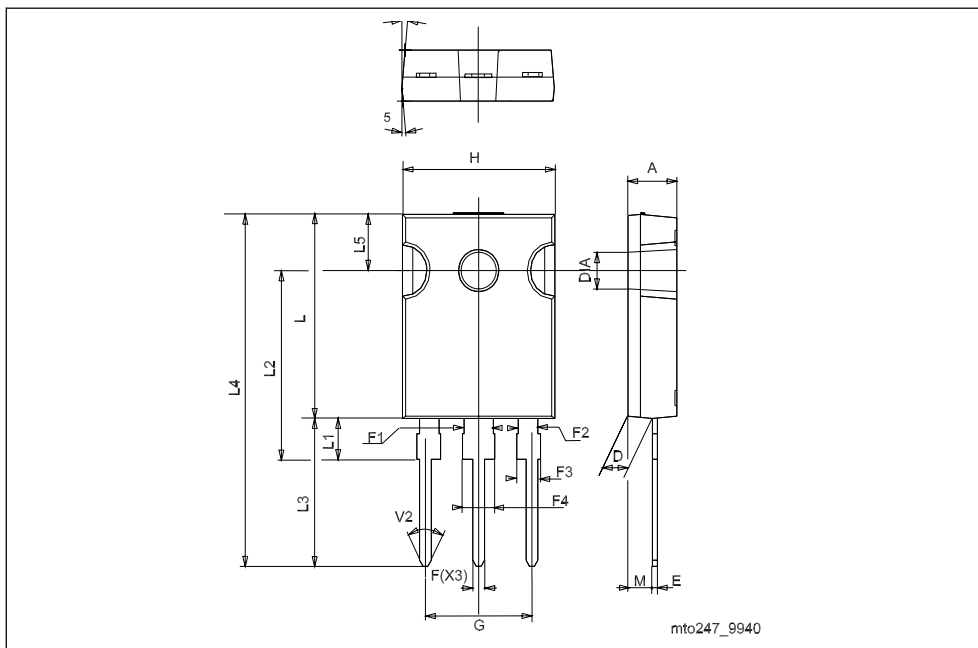


4 Package mechanical data

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.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.90		5.16	0.193		0.203
D	2.35		2.45	0.093		0.096
E	0.6		0.76	0.024		0.030
F	1.2		1.33	0.047		0.052
F1		3			0.118	
F2		2			0.078	
F3	1.9		2.13	0.075		0.084
F4	3.04		3.2	0.120		0.126
G		10.90			0.429	
H	15.77		16.03	0.621		0.631
L	20.83		21.09	0.820		0.830
L1	3.93		4.45	0.155		0.175
L2	18.72		19.18	0.737		0.755
L3	20.04		20.31	0.789		0.800
L4	40.88		41.40	1.609		1.630
L5	6.04		6.30	0.238		0.248
M	2		3		0.078	0.118
V		5°			5°	
V2		60°			60°	
Diam	3.56		3.66	0.140		0.144



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
25-Jan-2008	1	First issue.

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