



STGF19NC60HD

N-channel 600V - 9A - TO-220FP
Very fast PowerMESH™ IGBT

General features

Type	V _{CES}	V _{CE(sat)} (max)@25°C	I _C @100°C
STGF19NC60HD	600V	< 2.5V	9A

- Low on-voltage drop (V_{cesat})
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

Description

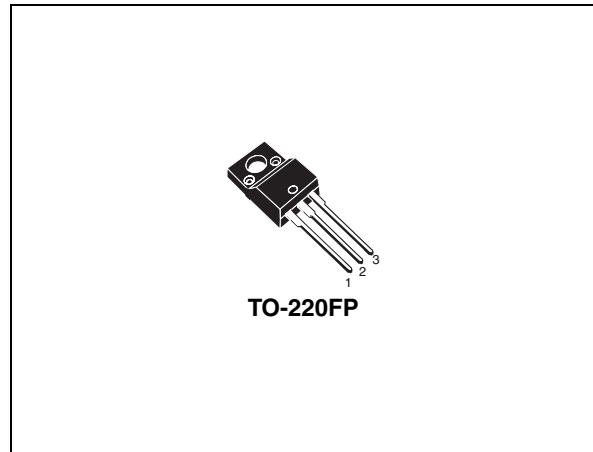
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized for high frequency applications in order to achieve very high switching performances (reduced t_{fall}) maintaining a low voltage drop.

Applications

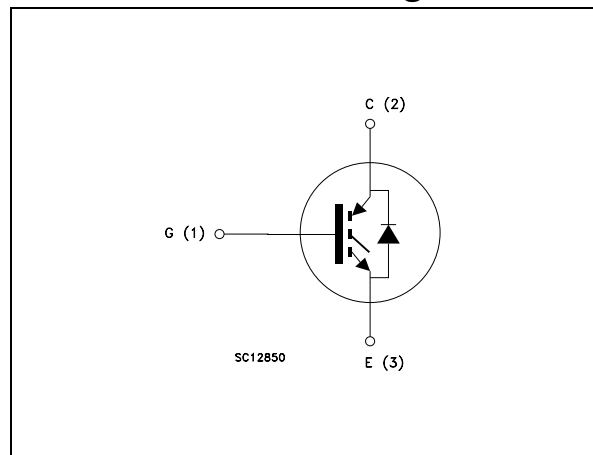
- High frequency motor controls
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

Order codes

Part number	Marking	Package	Packaging
STGF19NC60HD	GF19NC60HD	TO-220FP	Tube



Internal schematic diagram



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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GS} = 0$)	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25^\circ\text{C}$	16	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100^\circ\text{C}$	9	A
$I_{CL}^{(2)}$	Turn-off minimum current	40	A
I_F	Diode RMS forward current at $T_C = 25^\circ\text{C}$	20	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	35	W
T_j	Operating junction temperature	- 55 to 150	$^\circ\text{C}$

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. $V_{clamp}=480\text{V}$, $T_j=150^\circ\text{C}$, $R_G=10\Omega$, $V_{GE}=15\text{V}$

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
Rthj-case	Thermal resistance junction-case max IGBT	3.9	$^\circ\text{C/W}$
	Thermal resistance junction-case max DIODE	5.5	$^\circ\text{C/W}$
Rthj-amb	Thermal resistance junction-ambient max	62.5	$^\circ\text{C/W}$

2 Electrical characteristics

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

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1mA, V_{GE} = 0$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 12A$ $V_{GE} = 15V, I_C = 12A, T_C = 125^{\circ}C$		1.8 1.6	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250 \mu A$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$			150 1	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20V, V_{CE} = 0$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15V, I_C = 12A$		5		S

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25V, f = 1MHz,$ $V_{GE} = 0$		1180		pF
C_{oes}	Output capacitance			130		pF
C_{res}	Reverse transfer capacitance			36		pF
Q_g	Total gate charge	$V_{CE} = 390V, I_C = 5A,$		53		nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15V,$		10		nC
Q_{gc}	Gate-collector charge	Figure 17		23		nC

Table 5. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 12A$		25		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		7		ns
$(di/dt)_{on}$	Turn-on current slope	<i>Figure 18</i>		1600		A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 12A$		24		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		8		ns
$(di/dt)_{on}$	Turn-on current slope	$T_j = 125^\circ C$ <i>Figure 18</i>		1400		A/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 12A$		27		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$		97		ns
t_f	Current fall time	<i>Figure 18</i>		73		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 12A$		58		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$		144		ns
t_f	Current fall time	$T_j = 125^\circ C$ <i>Figure 18</i>		128		ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 12A$		85		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		189		μ J
E_{ts}	Total switching losses	<i>Figure 16</i>		274		μ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 12A$		187		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		407		μ J
E_{ts}	Total switching losses	$T_j = 125^\circ C$ <i>Figure 16</i>		594		μ J

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in *Figure 19* 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 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f	Forward on-voltage	$I_f = 12A$		1.9	2.5	V
		$I_f = 12A, T_j = 125^\circ C$		1.5		V
t_{rr}	Reverse recovery time	$I_f = 12A, V_R = 40V,$		31		ns
Q_{rr}	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100 A/\mu s$		30		nC
I_{rrm}	Reverse recovery current	Figure 19		2		A
t_{rr}	Reverse recovery time	$I_f = 12A, V_R = 40V,$		59		ns
Q_{rr}	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		102		nC
I_{rrm}	Reverse recovery current	Figure 19		4		A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

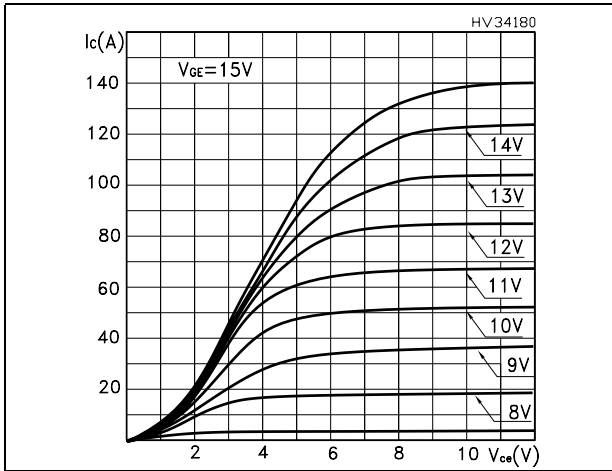


Figure 2. Transfer characteristics

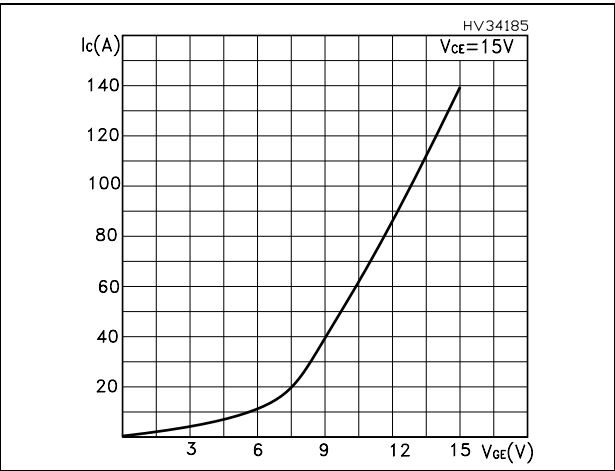


Figure 3. Transconductance

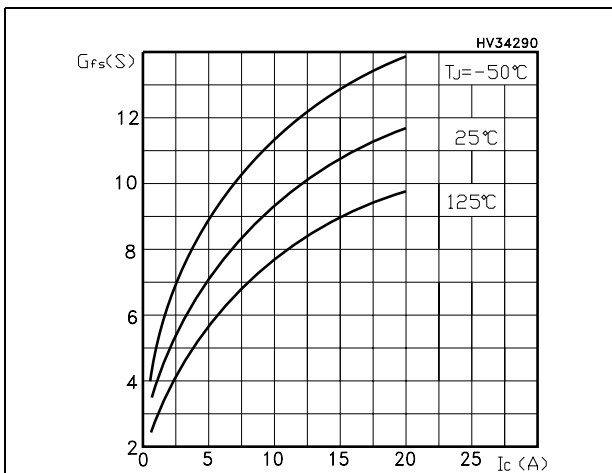


Figure 4. Collector-emitter on voltage vs temperature

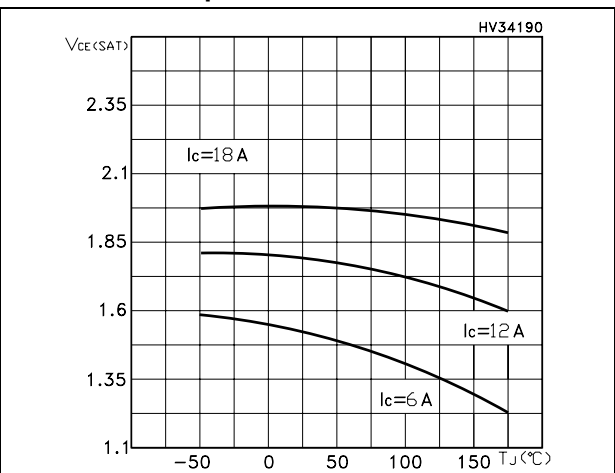


Figure 5. Gate charge vs gate-source voltage

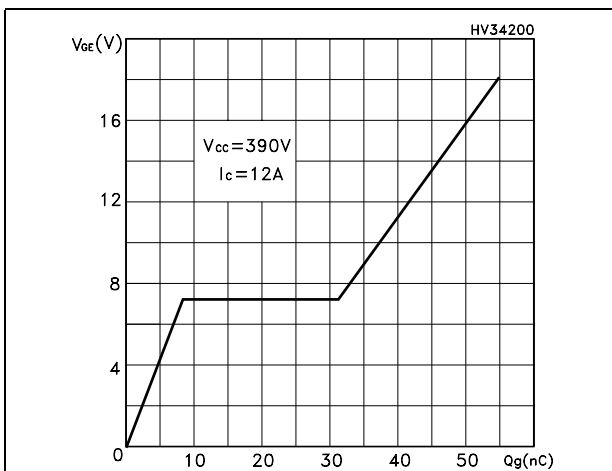


Figure 6. Capacitance variations

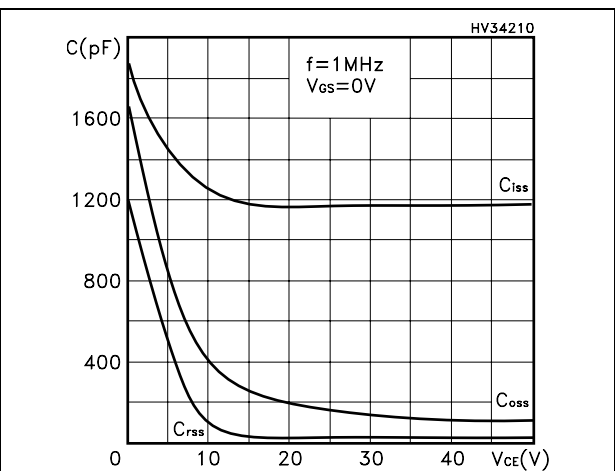


Figure 7. Normalized gate threshold voltage vs temperature

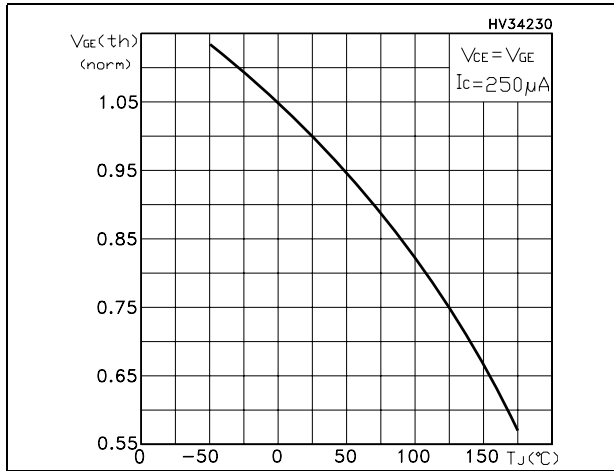


Figure 8. Collector-emitter on voltage vs collector current

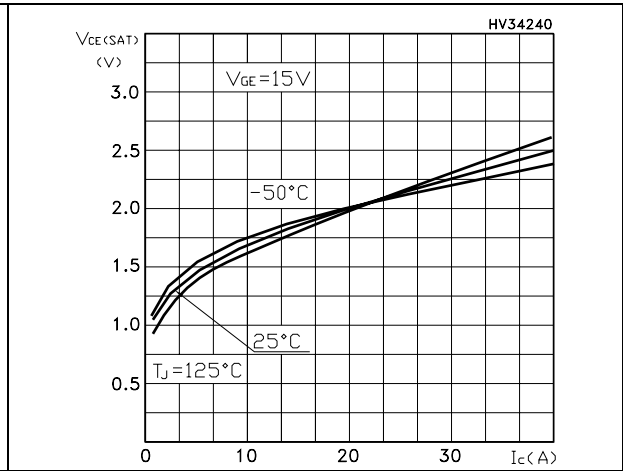


Figure 9. Normalized breakdown voltage vs temperature

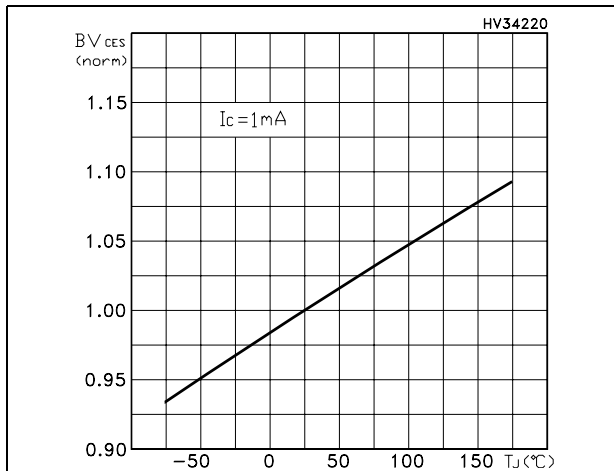


Figure 10. Switching losses vs temperature

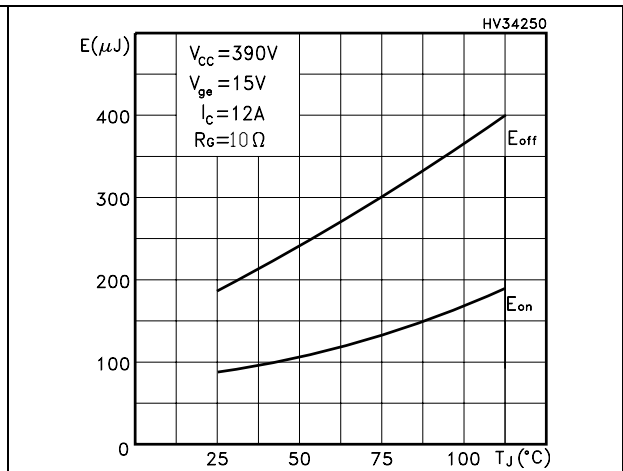


Figure 11. Switching losses vs gate resistance

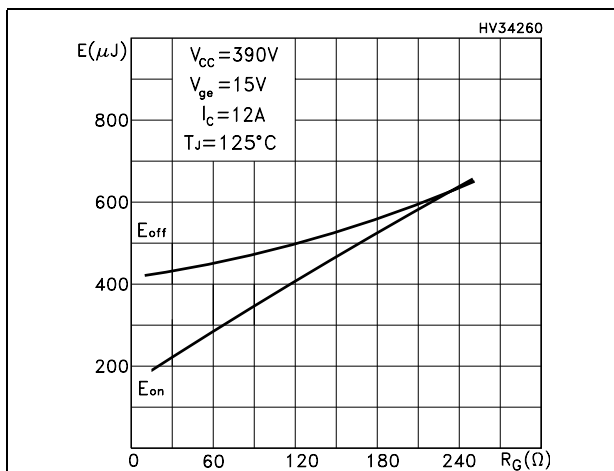


Figure 12. Switching losses vs collector current

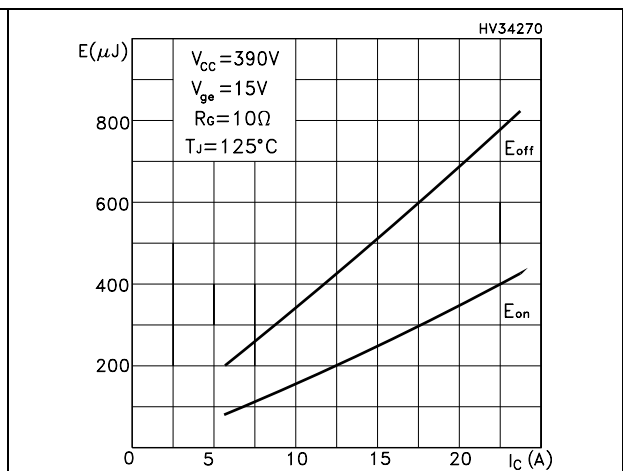


Figure 13. Turn-off SOA

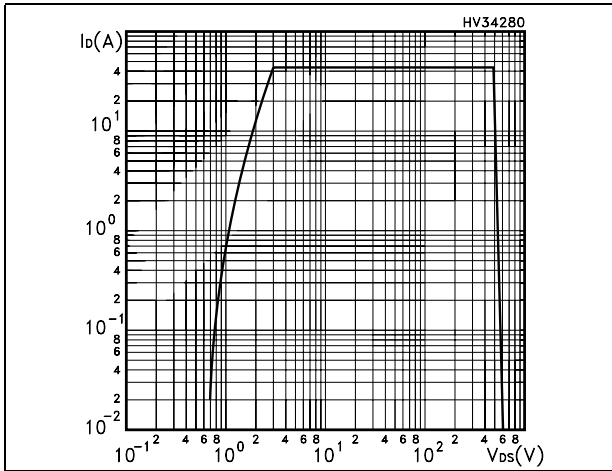


Figure 14. Emitter-collector diode characteristics

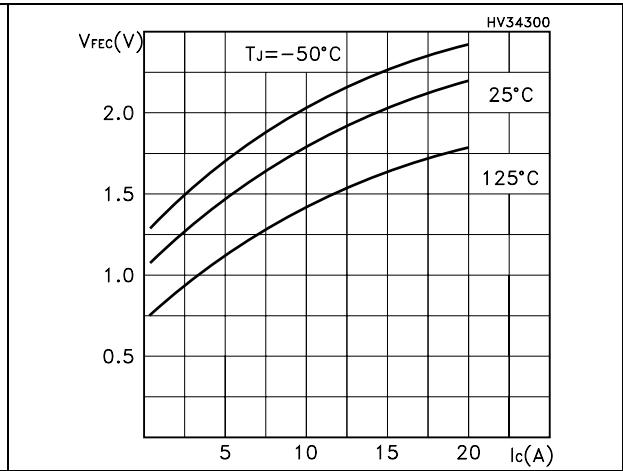
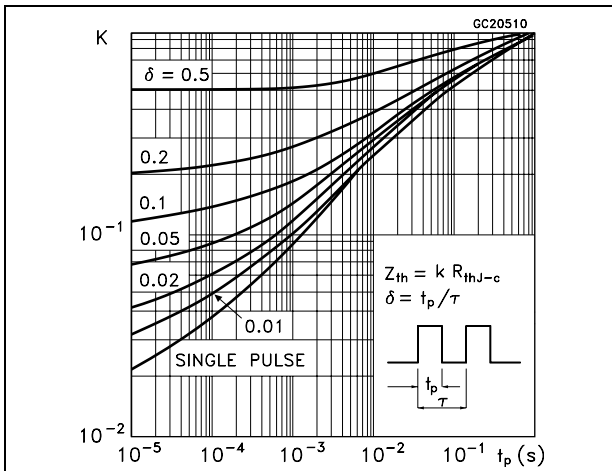


Figure 15. Thermal impedance



3 Test circuit

Figure 16. Test circuit for inductive load switching

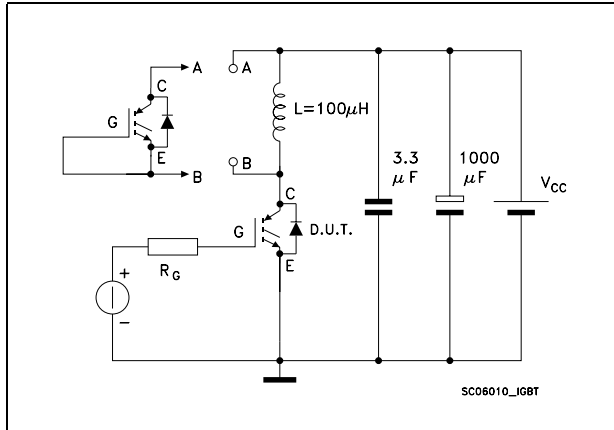


Figure 17. Gate charge test circuit

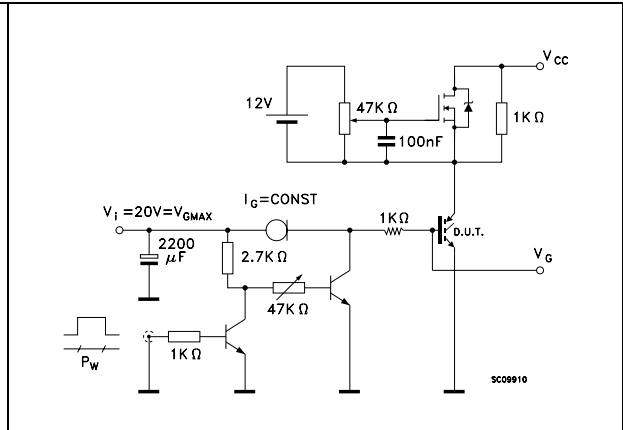


Figure 18. Switching waveform

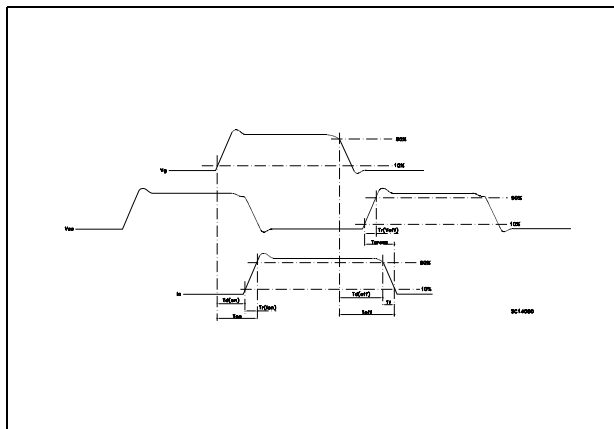
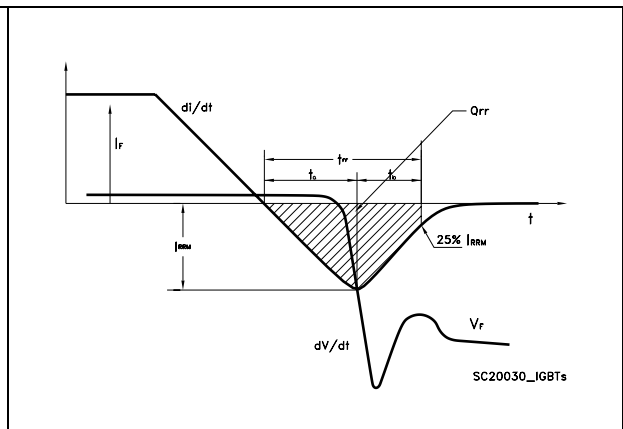


Figure 19. Diode recovery time waveform

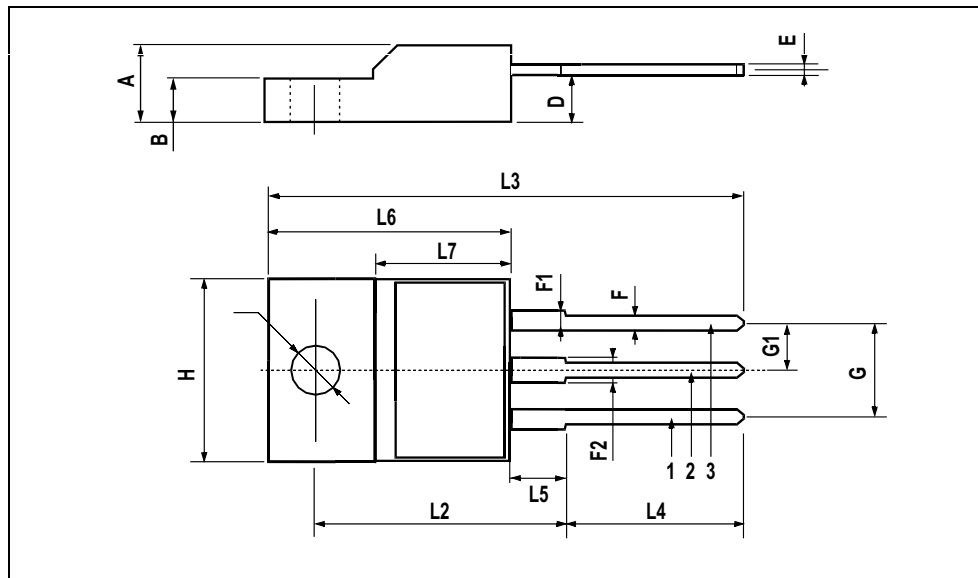


4 Package mechanical data

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-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



5 Revision history

Table 8. Revision history

Date	Revision	Changes
05-Aug-2006	1	Initial release.
27-Sep-2006	2	New value on <i>Absolute maximum ratings</i>
05-Jan-2007	3	Complete version

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