



STGB19NC60HD, STGF19NC60HD STGP19NC60HD, STGW19NC60HD

19 A - 600 V - very fast IGBT

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Very soft ultra fast recovery anti-parallel diode

Applications

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

Description

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

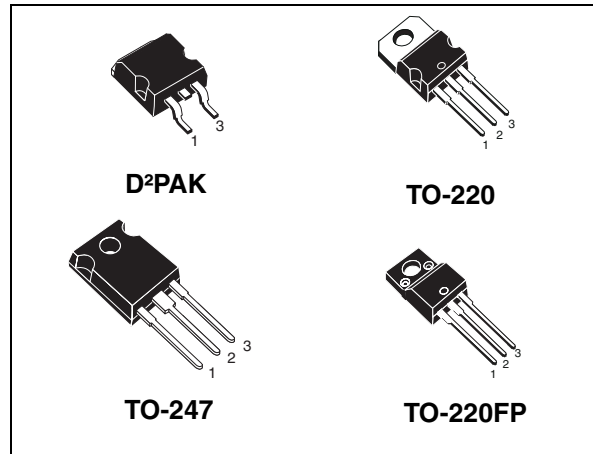


Figure 1. Internal schematic diagram

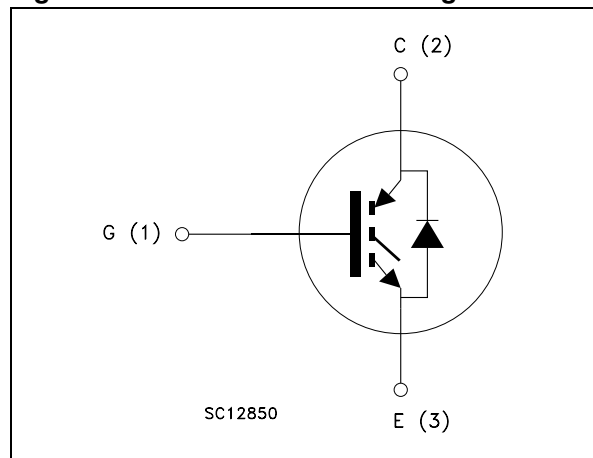


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB19NC60HDT4	GB19NC60HD	D ² PAK	Tape and reel
STGF19NC60HD	GF19NC60HD	TO-220FP	Tube
STGP19NC60HD	GP19NC60HD	TO-220	Tube
STGW19NC60HD	GW19NC60HD	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Test circuits	9
4	Package mechanical data	10
5	Packaging mechanical data	15
6	Revision history	16

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220 D ² PAK	TO-220FP	TO-247	
V _{CES}	Collector-emitter voltage (V _{GE} = 0)	600			V
I _C ⁽¹⁾	Collector current (continuous) at T _C = 25 °C	40	16	42	A
I _C ⁽¹⁾	Collector current (continuous) at T _C = 100 °C	19	10	21	A
I _{CL} ⁽²⁾	Turn-off latching current	40			A
I _{CP} ⁽³⁾	Pulsed collector current	60			A
I _F	Diode RMS forward current at T _C = 25 °C	20			A
I _{FSM}	Surge not repetitive forward current t _p =10 ms sinusoidal	50			A
V _{GE}	Gate-emitter voltage	±20			V
P _{TOT}	Total dissipation at T _C = 25 °C	130	32	140	W
V _{ISO}	Isolation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)	2500			V
T _j	Operating junction temperature	– 55 to 150			°C

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. V_{clamp}=80%V_{CES}, T_J= 150 °C, R_G=1 0 Ω, V_{GE} = 15 V

3. Pulse width limited by maximum permissible junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220 D ² PAK	TO-220FP	TO-247	
R _{thj-case}	Thermal resistance junction-case IGBT	0.95	3.9	0.9	°C/W
	Thermal resistance junction-case diode	3	5.5	3	°C/W
R _{thj-amb}	Thermal resistance junction-ambient	62.5		50	°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	$V_{GE} = 15 \text{ V}, I_C = 12 \text{ A}$ $V_{GE} = 15 \text{ V}, I_C = 12 \text{ A}, T_J = 125^\circ\text{C}$		1.8 1.6	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 ($V_{GE} = 0$)	$V_{CE} = 600 \text{ V}$ $V_{CE} = 600 \text{ V}, T_J = 125^\circ\text{C}$			150 1	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20 \text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15 \text{ V}, I_C = 12 \text{ A}$		5		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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz},$ $V_{GE} = 0$		1180		pF
C_{oes}	Output capacitance			130		pF
C_{res}	Reverse transfer capacitance			36		pF
Q_g	Total gate charge	$V_{CE} = 390 \text{ V}, I_C = 5 \text{ A},$		53		nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15 \text{ V},$		10		nC
Q_{gc}	Gate-collector charge	Figure 20		23		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 21</i>	-	25 7 1600	-	ns ns A/ μ s
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 21</i>	-	24 8 1400	-	ns ns A/ μ s
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 21</i>	-	27 97 73	-	ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 21</i>	-	58 144 128	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} $E_{off}^{(1)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 21</i>	-	85 189 274	-	μ J μ J μ J
E_{on} $E_{off}^{(1)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$, $I_C = 12\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 21</i>	-	187 407 594	-	μ J μ J μ J

1. 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	$I_F = 12\text{ A}$ $I_F = 12\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.6 2.1	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$ <i>Figure 22</i>	-	31 30 2	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 12\text{ A}$, $V_R = 40\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$ <i>Figure 22</i>	-	59 102 4	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

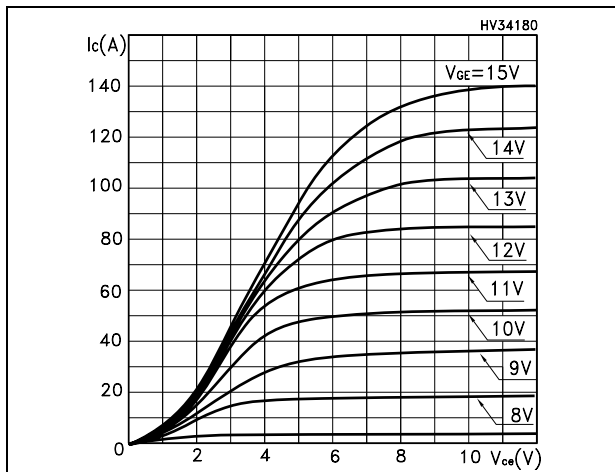


Figure 3. Transfer characteristics

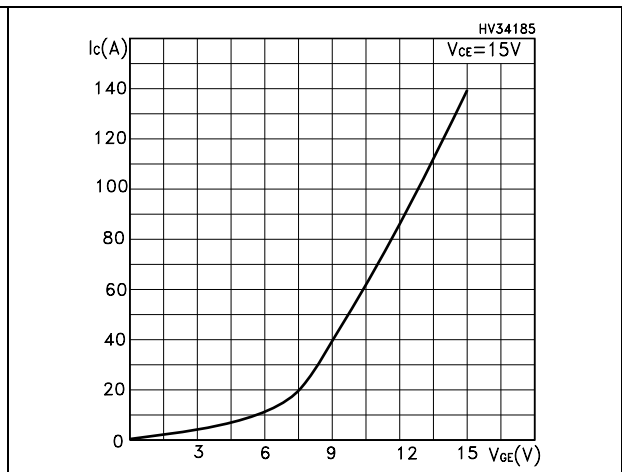


Figure 4. Transconductance

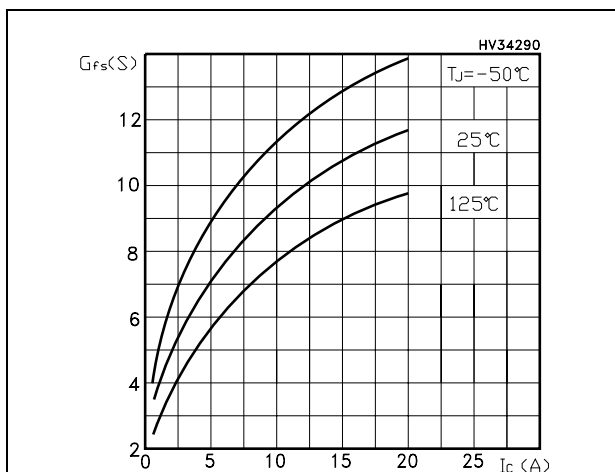


Figure 5. Collector-emitter on voltage vs temperature

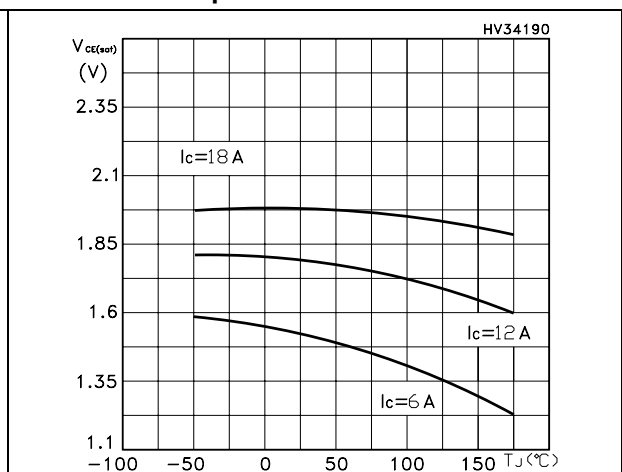


Figure 6. Gate charge vs gate-source voltage

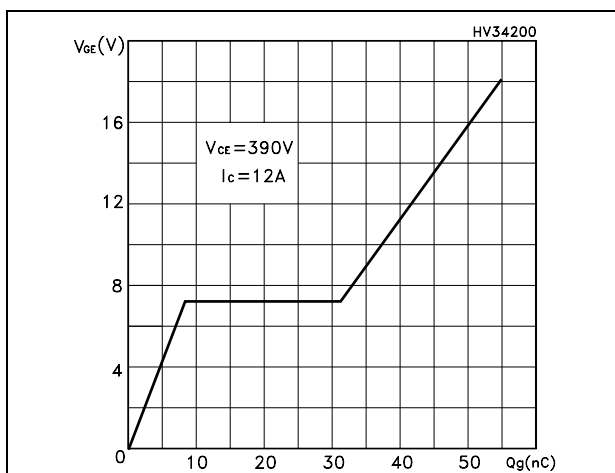


Figure 7. Capacitance variations

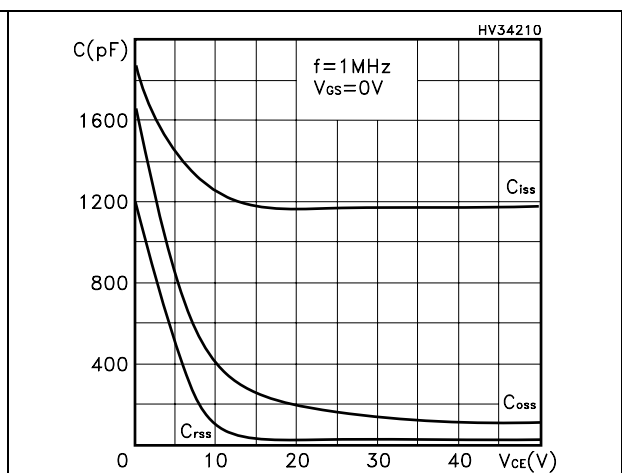


Figure 8. Normalized gate threshold voltage vs temperature

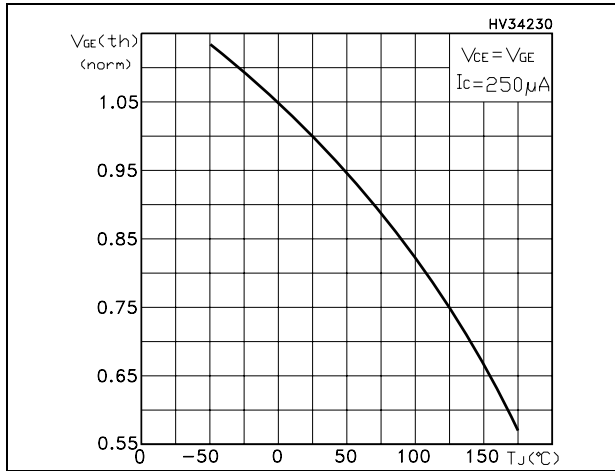


Figure 9. Collector-emitter on voltage vs collector current

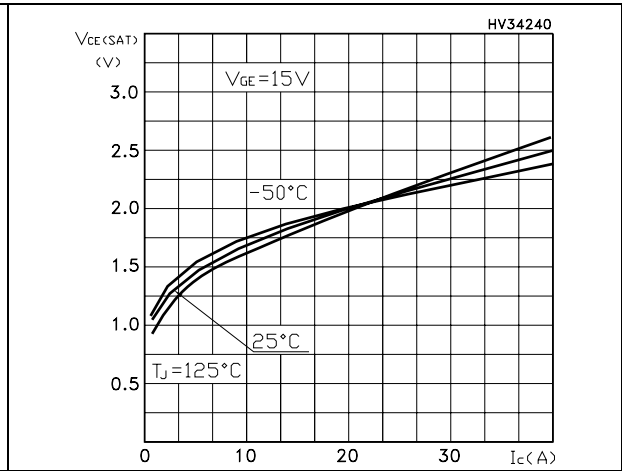


Figure 10. Normalized breakdown voltage vs temperature

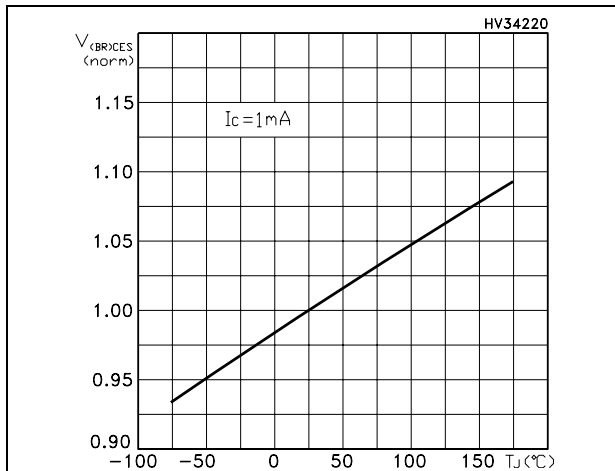


Figure 11. Switching losses vs temperature

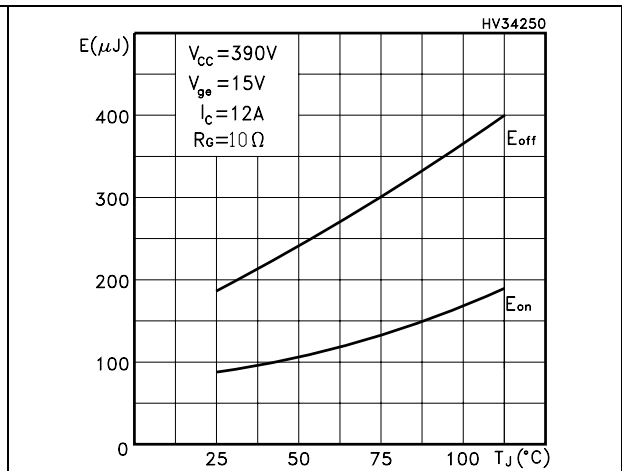


Figure 12. Switching losses vs gate resistance

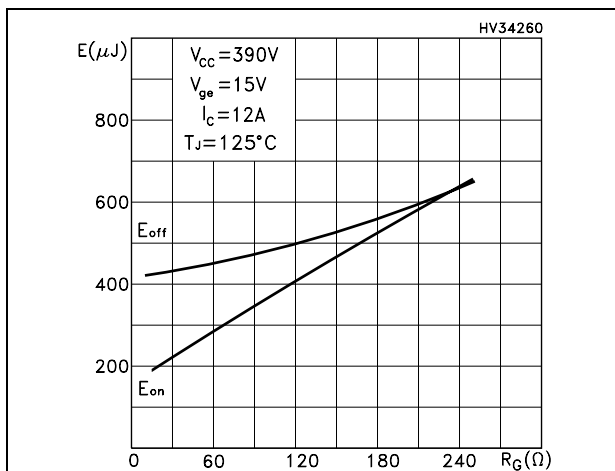


Figure 13. Switching losses vs collector current

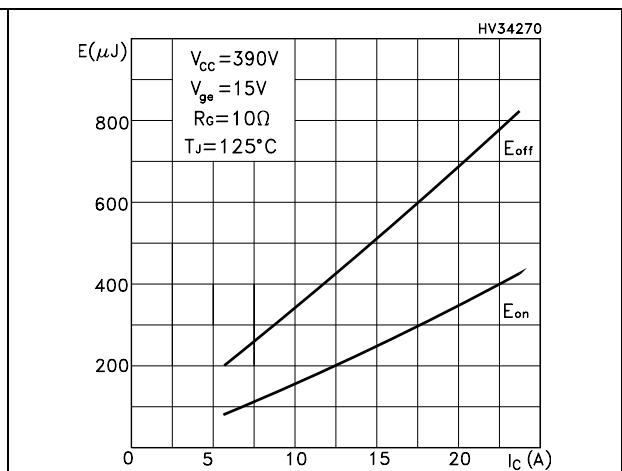


Figure 14. Turn-off SOA

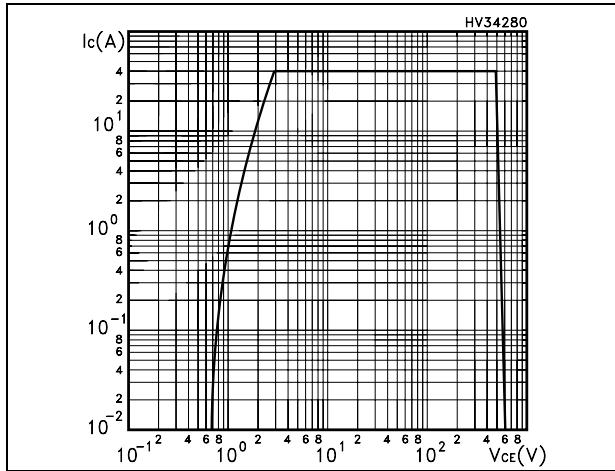


Figure 15. Thermal impedance for TO-247

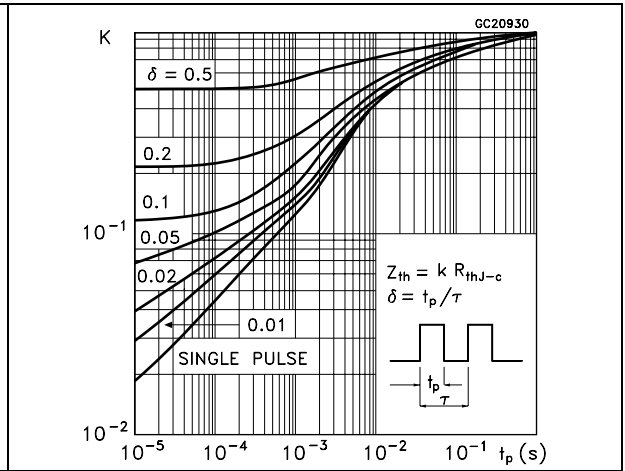


Figure 16. Thermal impedance for TO-220, D²PAK

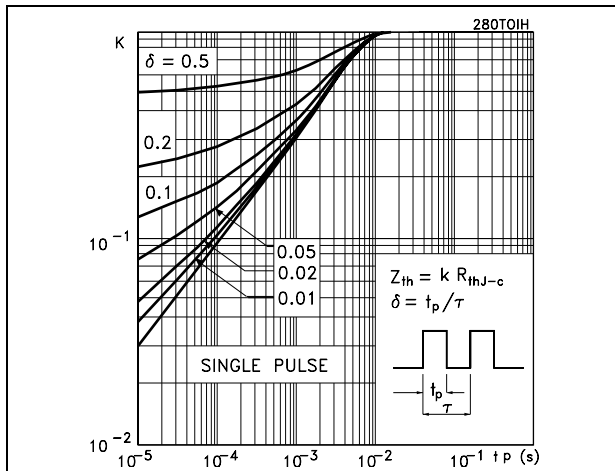


Figure 17. Thermal impedance for TO-220FP

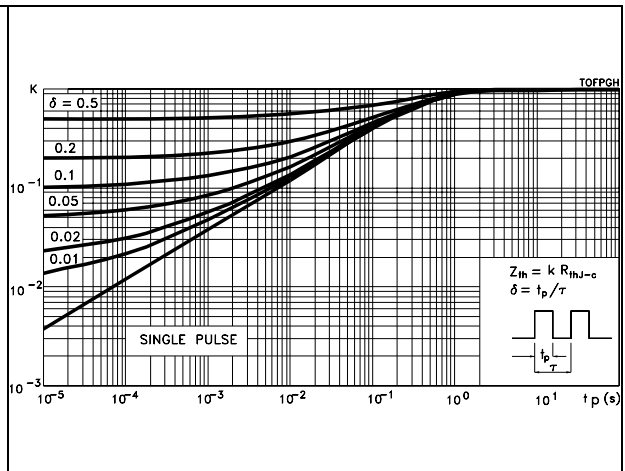
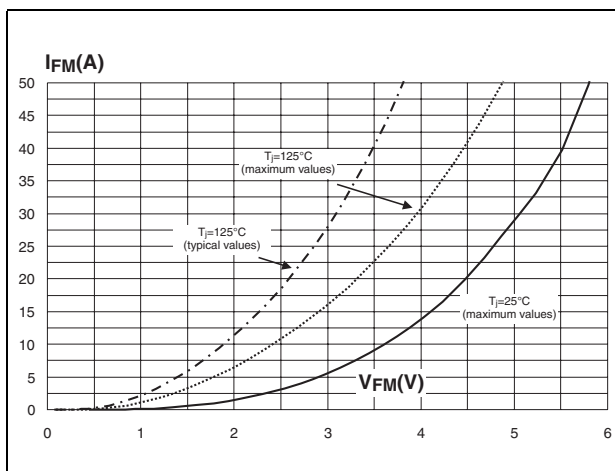


Figure 18. Forward voltage drop versus forward current



3 Test circuits

Figure 19. Test circuit for inductive load switching

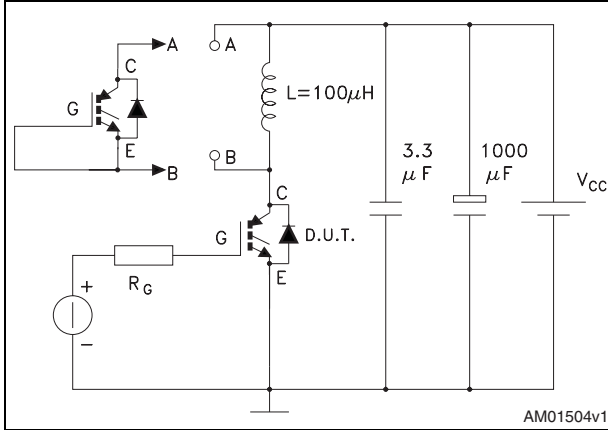


Figure 20. Gate charge test circuit

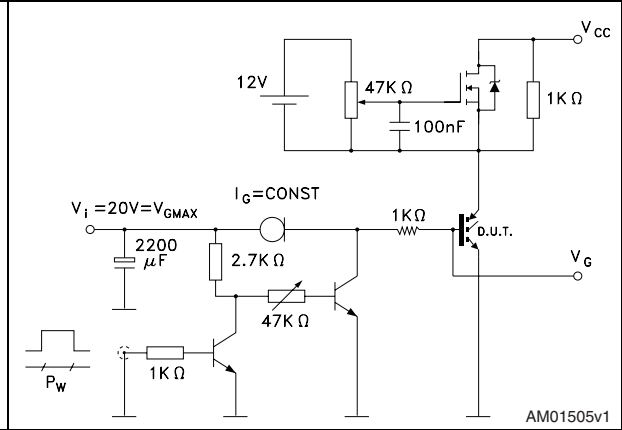


Figure 21. Switching waveform

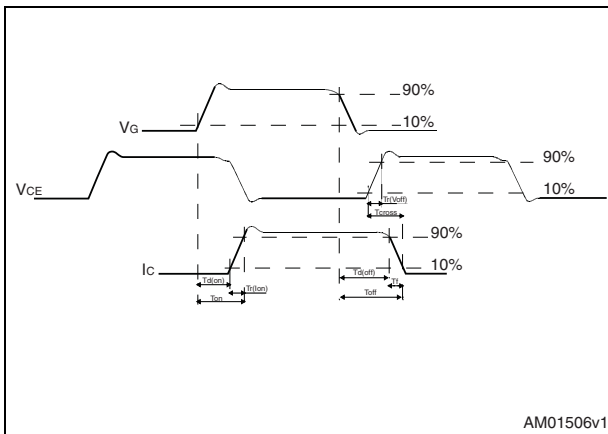
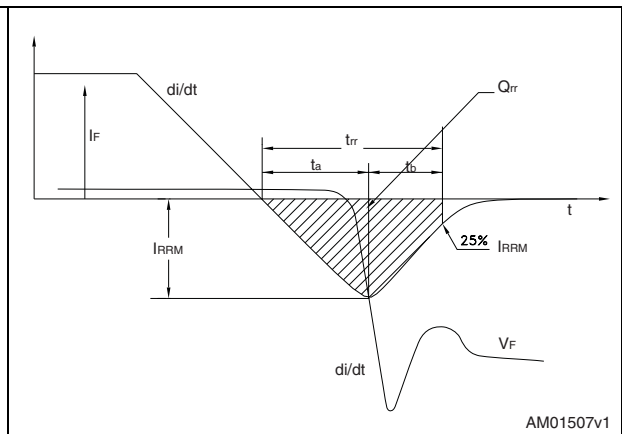


Figure 22. Diode recovery time waveform

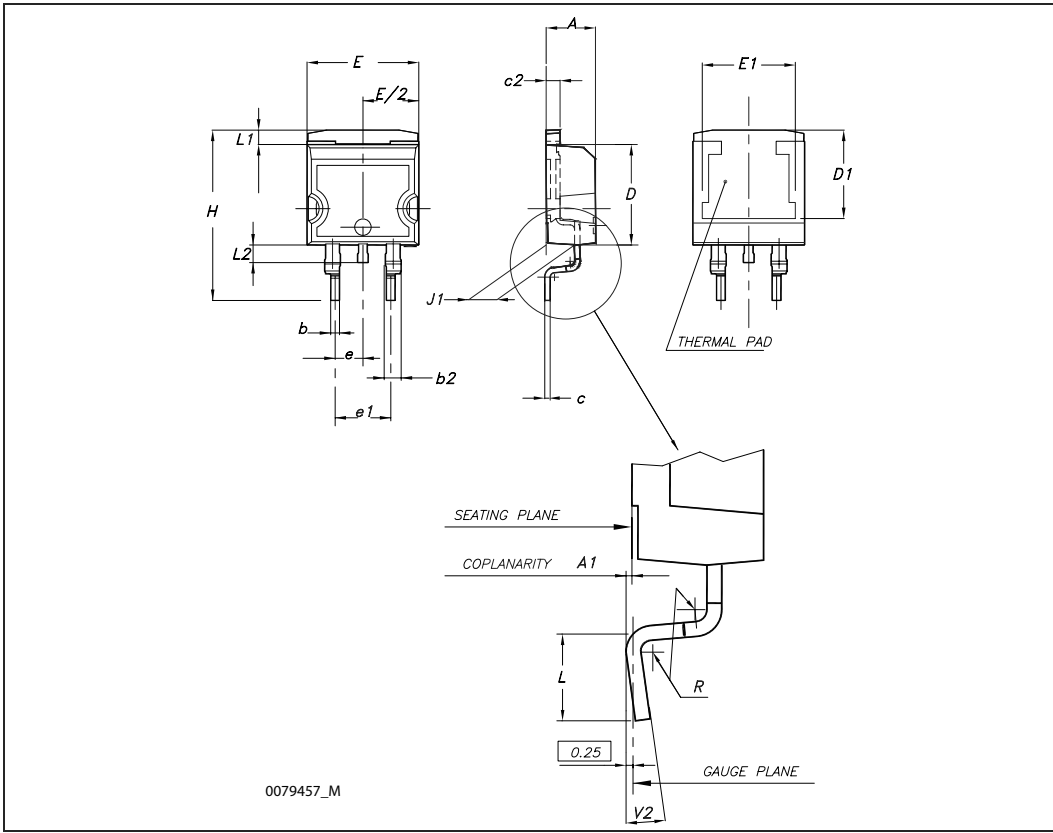


4 Package mechanical data

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.

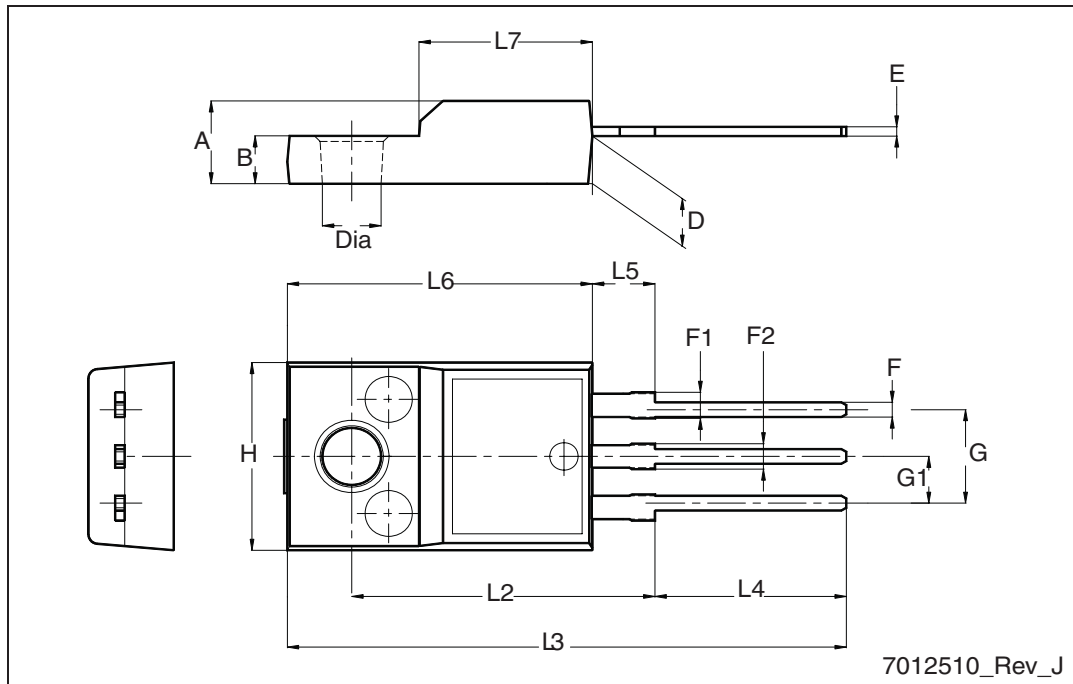
D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



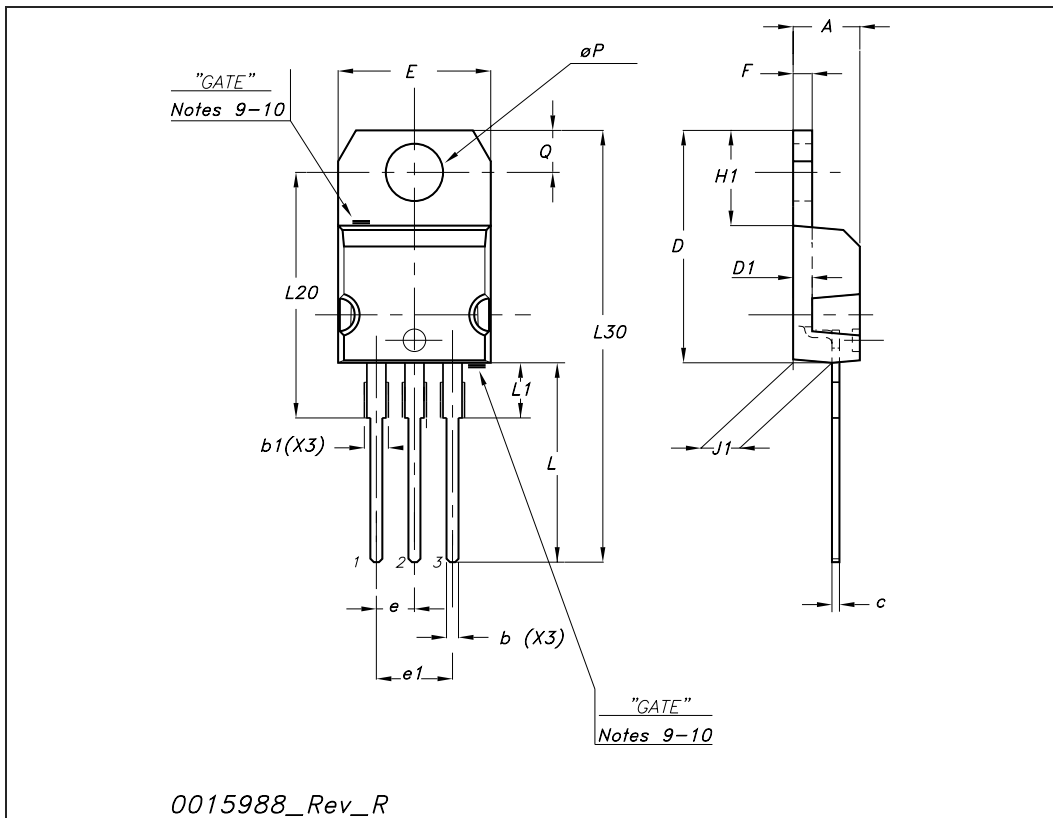
TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



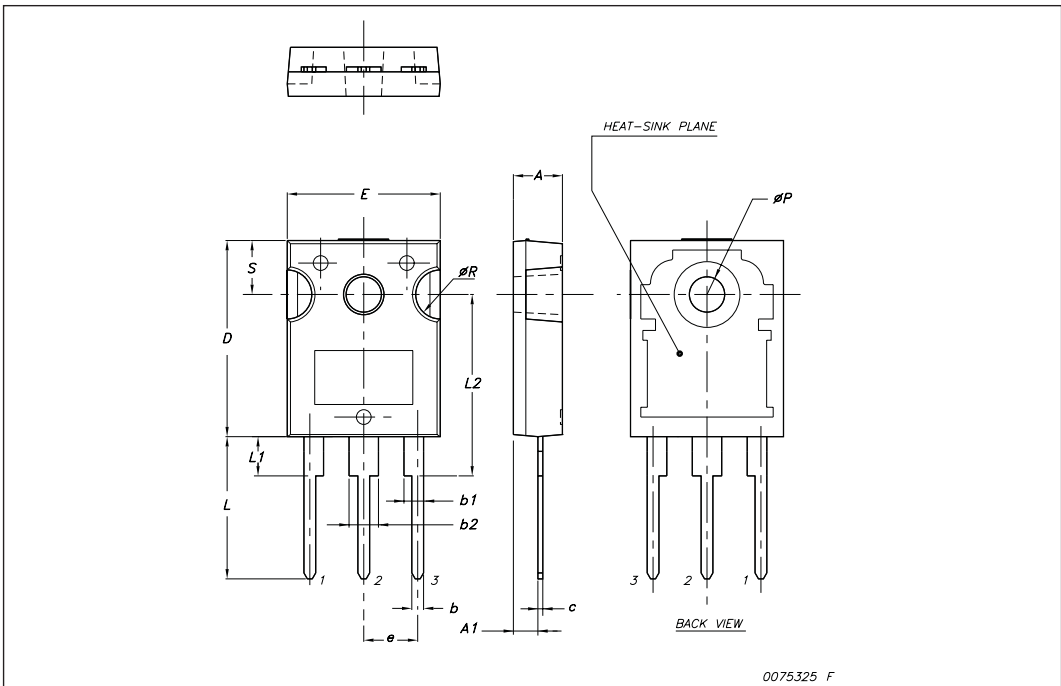
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



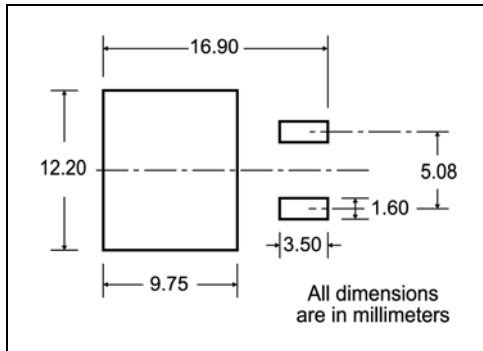
TO-247 mechanical data

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 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

TRL

Bending radius R min.

* on sales type

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
02-Nov-2006	1	Initial release.
05-Jan-2007	2	Complete version
01-Jul-2008	3	Modified: Table 2: Absolute maximum ratings Inserted new packages, mechanical data:TO-220FP, TO-247
13-Oct-2008	4	V _{ISO} inserted in Table 2 for TO-220FP
15-May-2009	5	Updated I _{CP} value
19-May-2009	6	Updated: mechanical data for TO-220FP

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