



STGB19NC60KD STGF19NC60KD - STGP19NC60KD

20 A - 600 V - short circuit rugged IGBT

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)
- Short circuit withstand time 10 μ s
- IGBT co-packaged with ultra fast free-wheeling diode

Applications

- High frequency inverters
- Motor drivers

Description

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

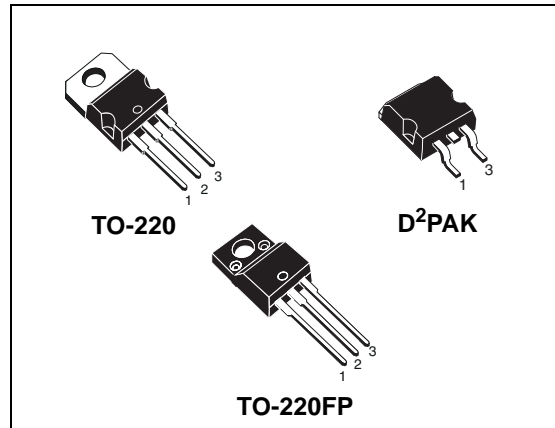


Figure 1. Internal schematic diagram

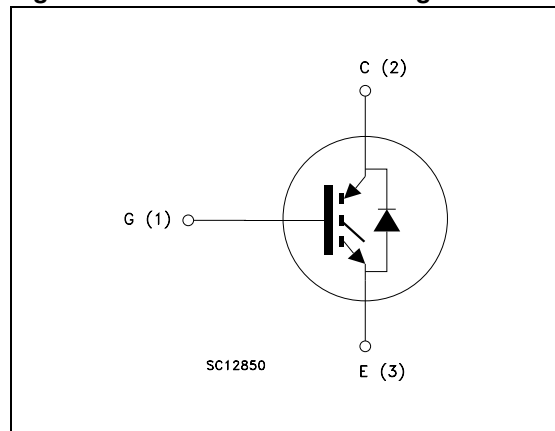


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB19NC60KDT4	GB19NC60KD	D ² PAK	Tape and reel
STGF19NC60KD	GF19NC60KD	TO-220FP	Tube
STGP19NC60KD	GP19NC60KD	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK TO-220	TO-220FP	
V _{CES}	Collector-emitter voltage (V _{GE} = 0)	600		V
I _C ⁽¹⁾	Collector current (continuous) at T _C = 25 °C	35	16	A
I _C ⁽¹⁾	Collector current (continuous) at T _C = 100 °C	20	10	A
I _{CL} ⁽²⁾	Turn-off latching current	75		A
I _{CP} ⁽³⁾	Pulsed collector current	75		A
V _{GE}	Gate-emitter voltage	±20		V
I _F	Diode RMS forward current at T _C = 25 °C	20		A
I _{FSM}	Surge non repetitive forward current t _p = 10 ms sinusoidal	50		A
P _{TOT}	Total dissipation at T _C = 25 °C	125	32	W
t _{scw}	Short circuit withstand time, V _{CE} = 0.5 V _{(BR)CES} T _j = 125 °C, R _G = 10 Ω, V _{GE} = 12 V	10		μs
T _j	Operating junction temperature	- 55 to 150		°C

1. Calculated according to the iterative formula:

$$I_c(T_c) = \frac{T_{J(MAX)} - T_c}{R_{thj-c} \times V_{GE(sat)(MAX)} \cdot (T_c, I_c)}$$

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
		D ² PAK TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case IGBT max.	0.95	3.9	°C/W
	Thermal resistance junction-case diode max.	3	5.6	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max.	62.5		°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	$V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$, $T_C = 125\text{ °C}$		2.0 1.8	2.75	V V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_C = 125\text{ °C}$			150 1	μA mA
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	4.5		6.5	V
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 12\text{ A}$		15		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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$		1170		pF
C_{oes}	Output capacitance			127		pF
C_{res}	Reverse transfer capacitance			28		pF
Q_g	Total gate charge	$V_{CE} = 480\text{ V}$, $I_C = 12\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 19)		55		nC
Q_{ge}	Gate-emitter charge			11		nC
Q_{gc}	Gate-collector charge			26		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$		30		ns
t_r	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)		8		ns
$(di/dt)_{on}$	Turn-on current slope			1450		A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_c = 125\text{ }^\circ\text{C}$ (see Figure 18)		30		ns
t_r	Current rise time			8		ns
$(di/dt)_{on}$	Turn-on current slope			1380		A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$		35		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)		105		ns
t_f	Current fall time			85		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A},$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_c = 125\text{ }^\circ\text{C}$ (see Figure 18)		65		ns
$t_{d(off)}$	Turn-off delay time			145		ns
t_f	Current fall time			125		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
E_{on}	Turn-on switching losses	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$		165		μ J
$E_{off}^{(1)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)		255		μ J
E_{ts}	Total switching losses			420		μ J
E_{on}	Turn-on switching losses	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_c = 125\text{ }^\circ\text{C}$ (see Figure 18)		250		μ J
$E_{off}^{(1)}$	Turn-off switching losses			445		μ J
E_{ts}	Total switching losses			695		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	$I_F = 12\text{ A}$		1.9		V
		$I_F = 12\text{ A}, T_C = 125\text{ °C}$		1.6		V
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}, V_R = 40\text{ V},$		31		ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$		30		nC
I_{rrm}	Reverse recovery current	(see Figure 21)		2		A
t_{rr}	Reverse recovery time	$I_F = 12\text{ A}, V_R = 40\text{ V},$		50		ns
	Reverse recovery charge	$T_C = 125\text{ °C}, di/dt = 100\text{ A}/\mu\text{s}$		70		nC
	Reverse recovery current	(see Figure 21)		4		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

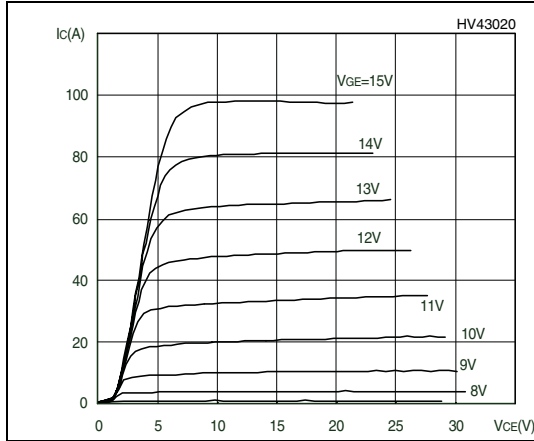


Figure 3. Transfer characteristics

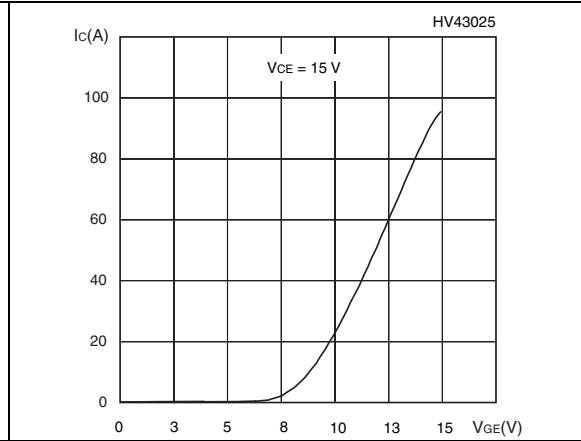


Figure 4. Transconductance

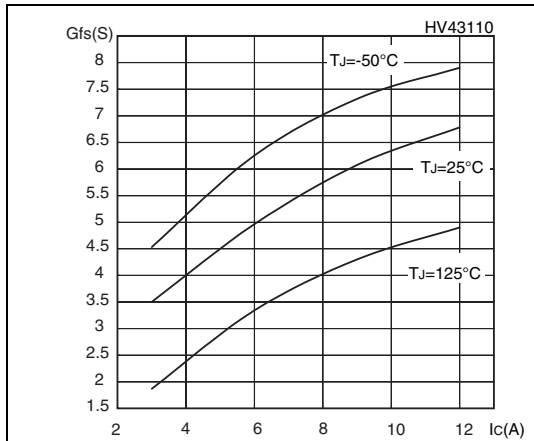


Figure 5. Collector-emitter on voltage vs temperature

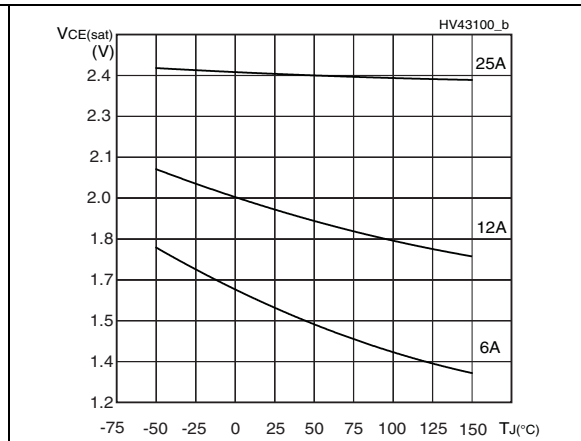


Figure 6. Gate charge vs gate-source voltage

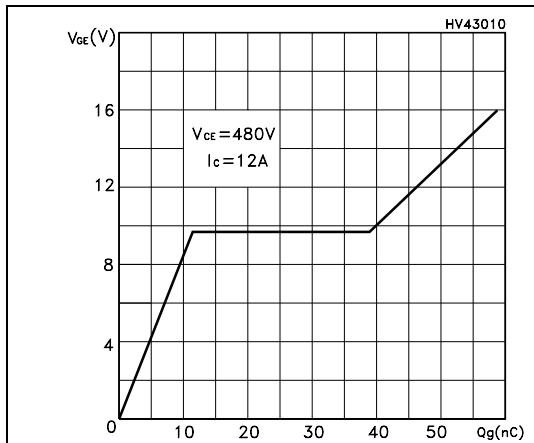


Figure 7. Capacitance variations

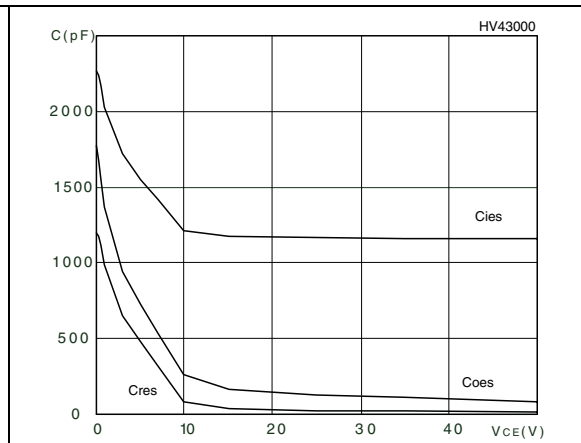


Figure 8. Normalized gate threshold voltage vs temperature

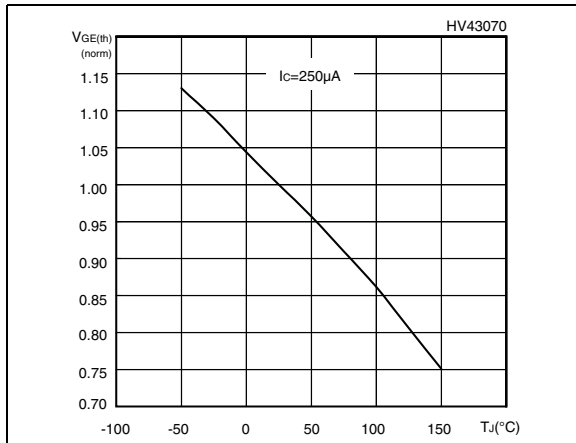


Figure 9. Collector-emitter on voltage vs collector current

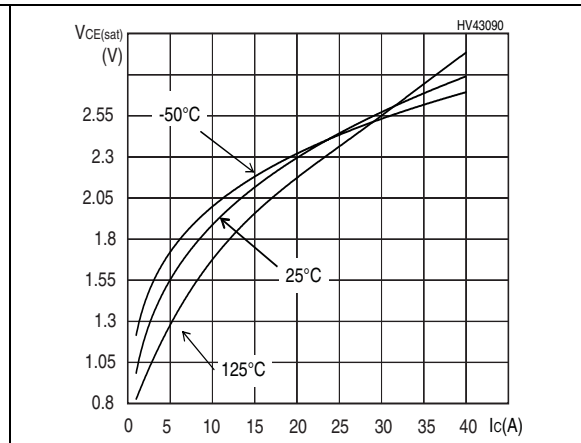


Figure 10. Normalized breakdown voltage vs temperature

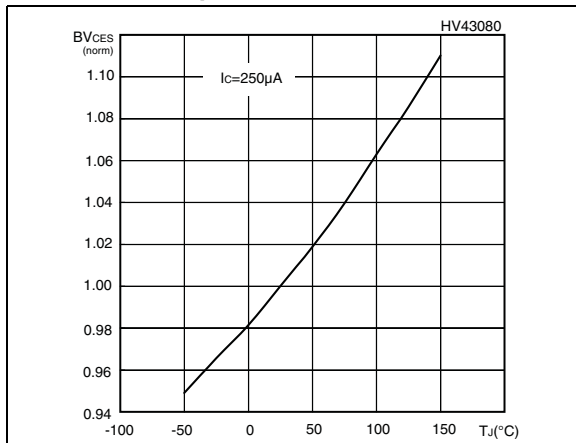


Figure 11. Switching losses vs temperature

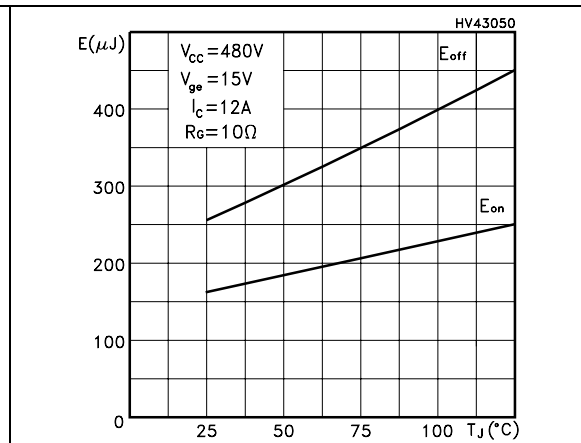


Figure 12. Switching losses vs gate resistance

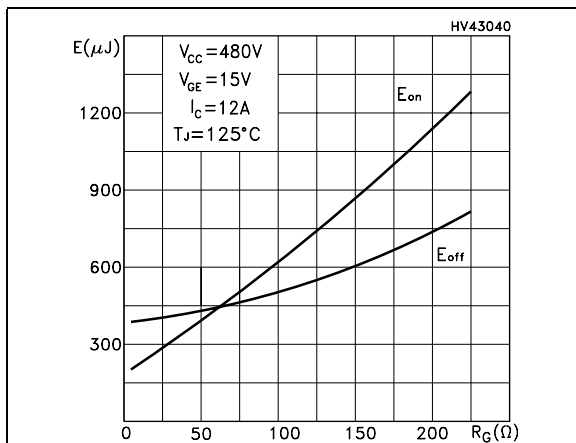


Figure 13. Switching losses vs collector current

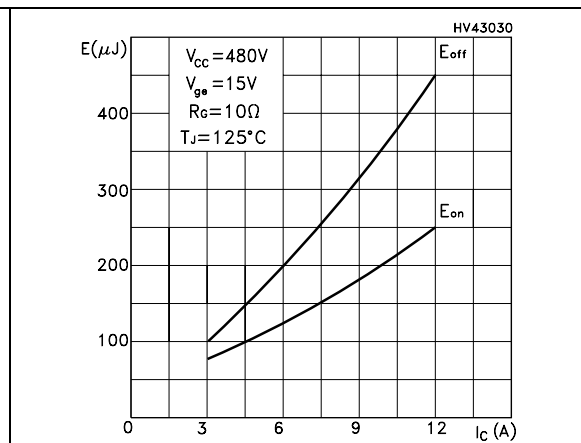


Figure 14. Turn-off SOA

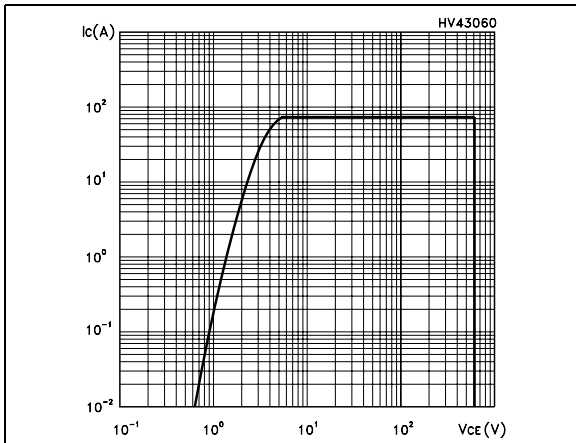


Figure 15. Emitter-collector diode characteristics

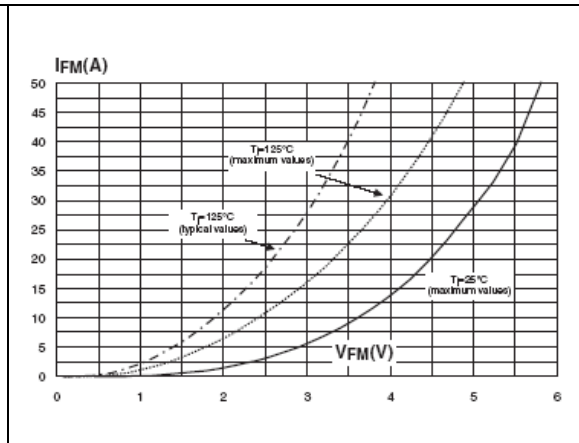


Figure 16. Thermal impedance for TO-220, D²PAK

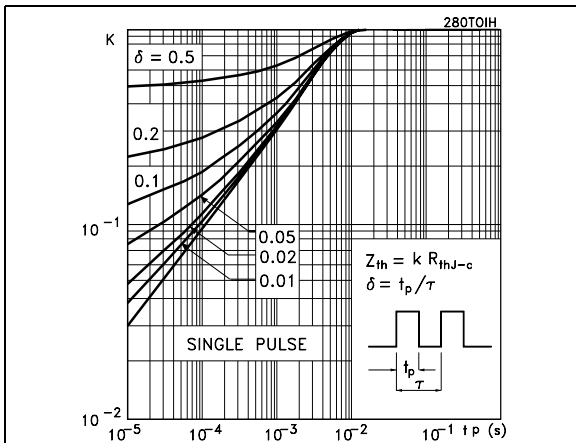
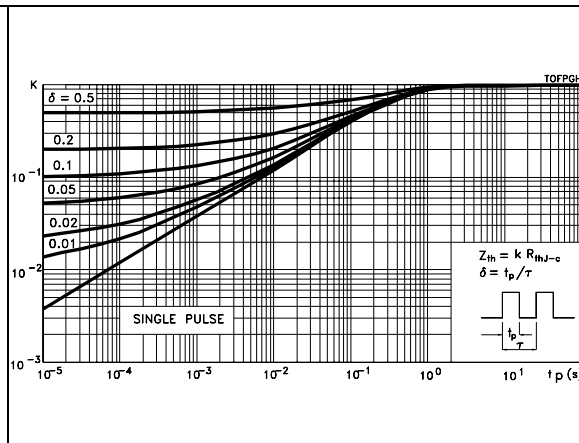


Figure 17. Thermal impedance for TO-220FP



3 Test circuits

Figure 18. Test circuit for inductive load switching

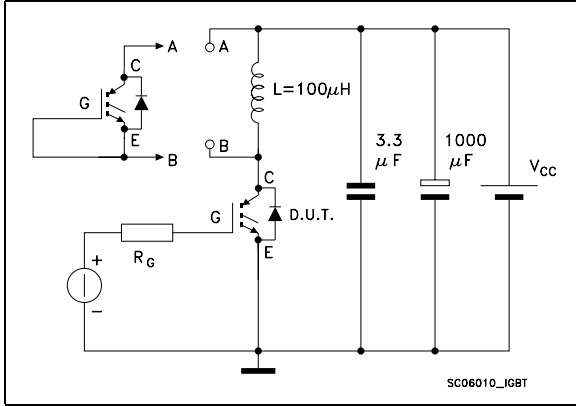


Figure 19. Gate charge test circuit

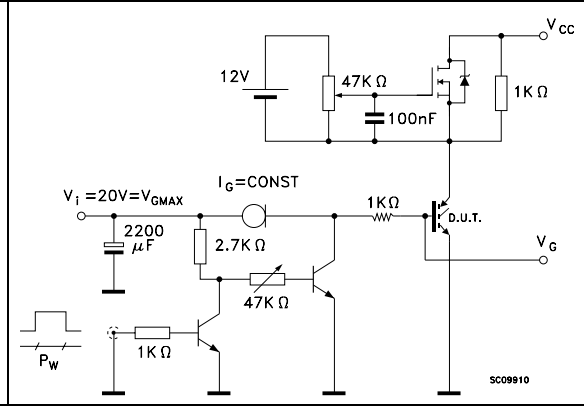


Figure 20. Switching waveforms

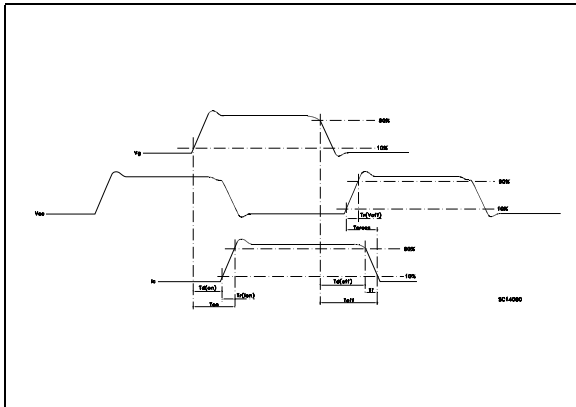
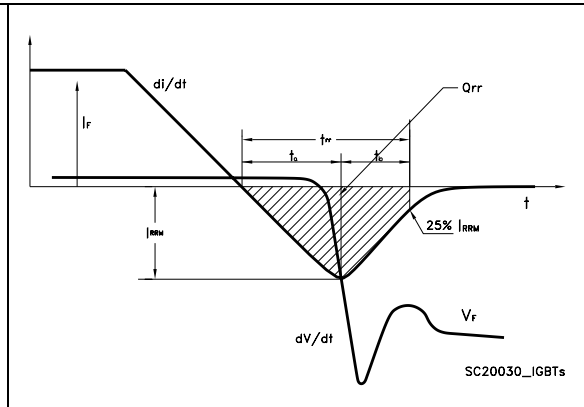


Figure 21. Diode recovery times waveform

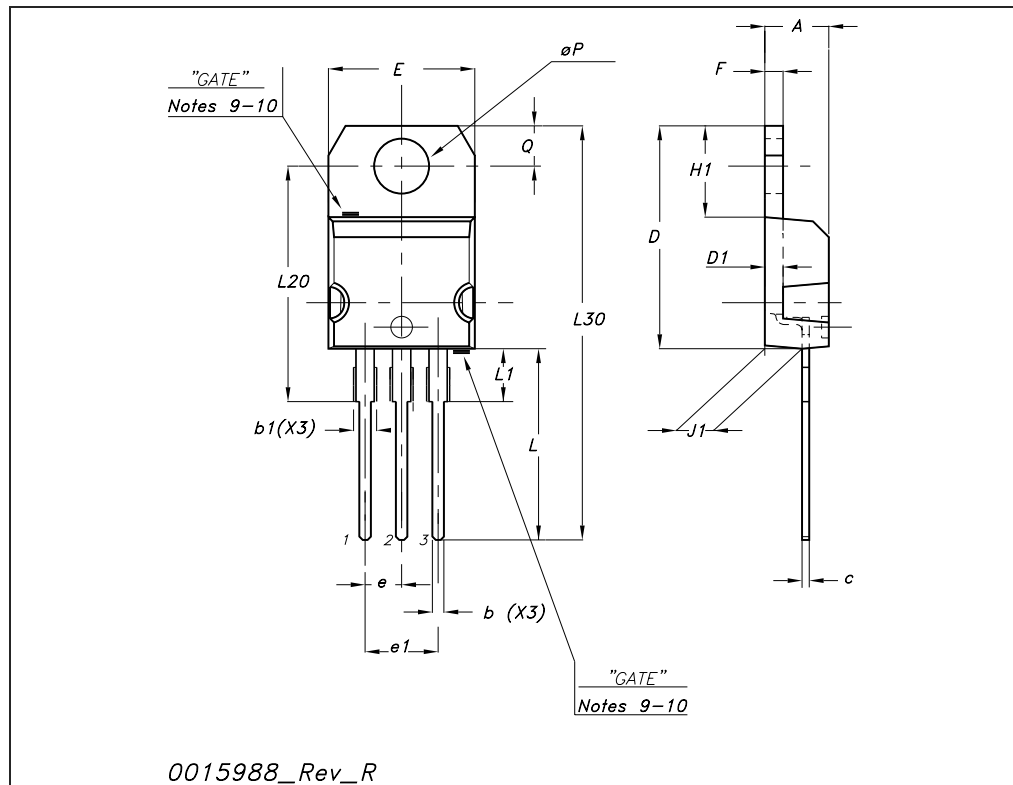


4 Package mechanical data

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

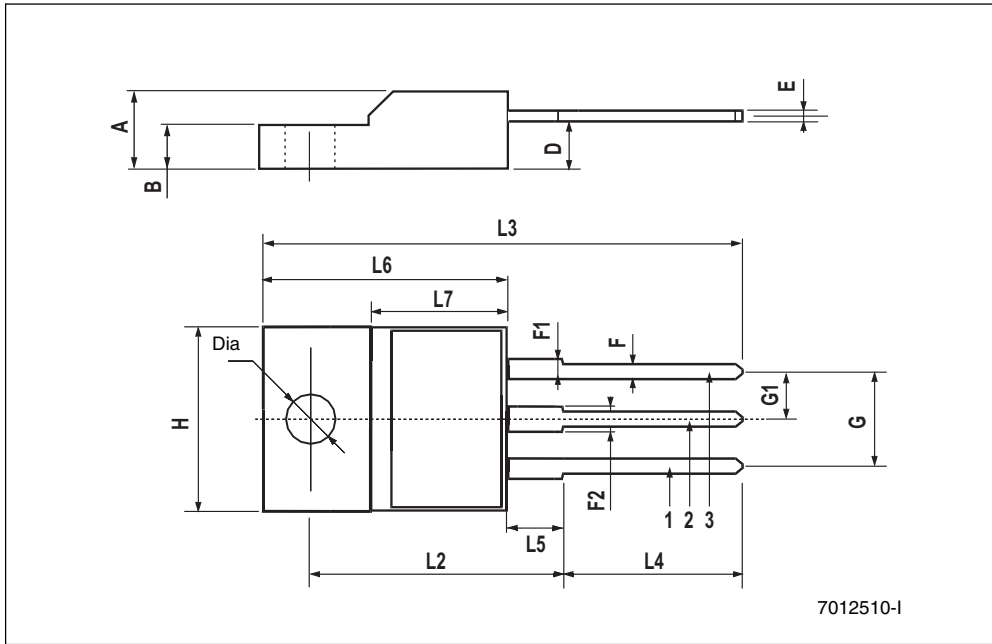
TO-220 mechanical data

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



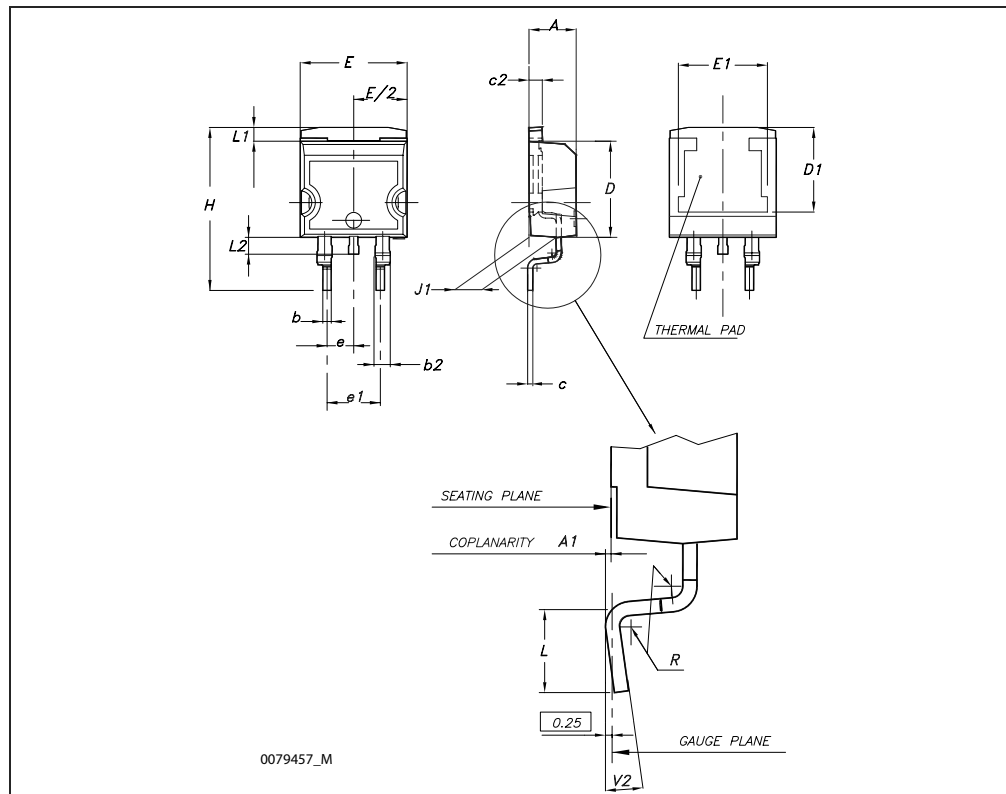
TO-220FP mechanical data

Dim.	mm.			inch		
	Min.	Typ	Max.	Min.	Typ.	Max.
A	4.40		4.60	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		0.70	0.017		0.027
F	0.75		1.00	0.030		0.039
F1	1.15		1.50	0.045		0.067
F2	1.15		1.50	0.045		0.067
G	4.95		5.20	0.195		0.204
G1	2.40		2.70	0.094		0.106
H	10		10.40	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.80		10.60	0.385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.90		16.40	0.626		0.645
L7	9		9.30	0.354		0.366
Dia	3		3.2	0.118		0.126



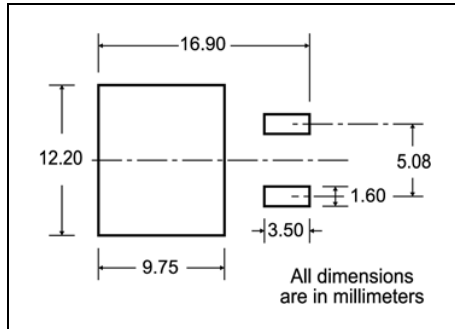
D²PAK (TO-263) mechanical data

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°



5 Packing mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

Full radius

40 mm min. Access hole at slot location

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

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

TOP COVER TAPE

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

* on sales type

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
08-May-2008	1	Initial release
28-May-2008	2	<ul style="list-style-type: none">– Value on Table 3: Thermal resistance has been changed.– Inserted Figure 16: Thermal impedance for TO-220, D²PAK and Figure 17: Thermal impedance for TO-220FP

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