



# STGB19NC60W STGP19NC60W, STGW19NC60W

19 A - 600 V - ultra fast IGBT

## Features

- High frequency operation
- Low  $C_{RES} / C_{IES}$  ratio (no cross-conduction susceptibility)

## Applications

- High frequency motor controls, inverters, UPS
- HF, SMPS and PFC in both hard switch and resonant topologies

## Description

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

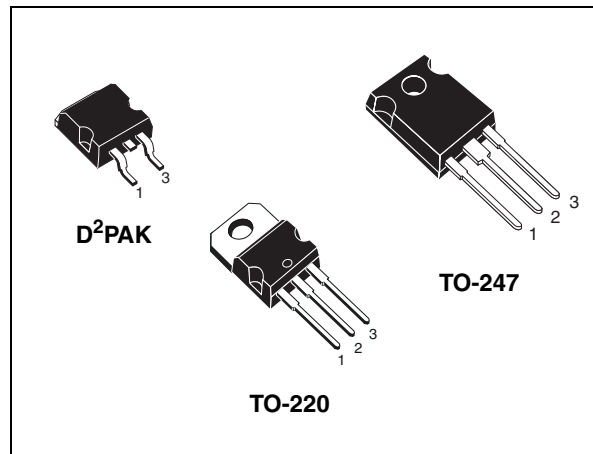


Figure 1. Internal schematic diagram

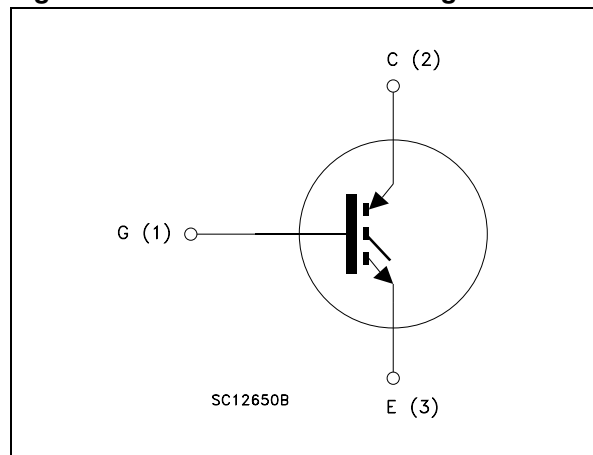


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB19NC60WT4	GB19NC60W	D <sup>2</sup> PAK	Tape and reel
STGP19NC60W	P19NC60W	TO-220	Tube
STGW19NC60W	W19NC60W	TO-247	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK TO-220	TO-247	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0)	600		V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 25°C	40	42	A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	22	23	A
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	30		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	130	140	W
T <sub>j</sub>	Operating junction temperature	-65 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<sub>CLAMP</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 15 V, R<sub>G</sub> = 10 Ω, T<sub>J</sub> = 150 °C

**Table 3. Thermal resistance**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.95	0.9	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	62.5	50	°C/W

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  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	$V_{GE}=15\text{ V}$ , $I_C=12\text{ A}$ $V_{GE}=15\text{ V}$ , $I_C=12\text{ A}$ , $T_C=125^{\circ}\text{C}$		2.1 1.8	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}$ , $I_C=250\text{ }\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE}=0$ )	$V_{CE}=600\text{ V}$ $V_{CE}=600\text{ V}$ , $T_C=125^{\circ}\text{C}$			150 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE}=0$ )	$V_{GE}=\pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE}=15\text{ V}$ , $I_C=12\text{ A}$		10		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE}=25\text{ V}$ , $f=1\text{ MHz}$ , $V_{GE}=0$		1180		pF
$C_{oes}$	Output capacitance			130		pF
$C_{res}$	Reverse transfer capacitance			26		pF
$Q_g$	Total gate charge	$V_{CE}=390\text{ V}$ , $I_C=12\text{ A}$ ,		53		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE}=15\text{ V}$ ,		10		nC
$Q_{gc}$	Gate-collector charge	<a href="#">Figure 16</a>		21		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 17</i>		25		ns
$t_r$	Current rise time			7		ns
$(di/dt)_{on}$	Turn-on current slope			1600		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125^\circ\text{C}$ <i>Figure 17</i>		25		ns
$t_r$	Current rise time			8		ns
$(di/dt)_{on}$	Turn-on current slope			1400		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 17</i>		22		ns
$t_{d(off)}$	Turn-off delay time			90		ns
$t_f$	Current fall time			43		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125^\circ\text{C}$ <i>Figure 17</i>		47		ns
$t_{d(off)}$	Turn-off delay time			127		ns
$t_f$	Current fall time			77		ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 17</i>		81		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses			125		$\mu$ J
$E_{ts}$	Total switching losses			206		$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 12\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125^\circ\text{C}$ <i>Figure 17</i>		161		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses			255		$\mu$ J
$E_{ts}$	Total switching losses			416		$\mu$ J

- $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in *Figure 15*. 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)
- Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

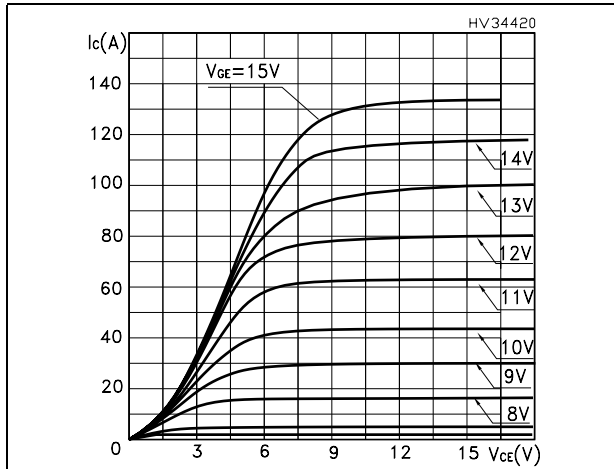


Figure 3. Transfer characteristics

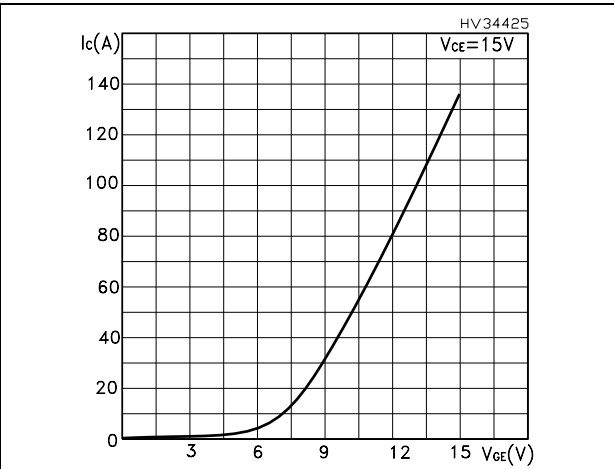


Figure 4. Transconductance

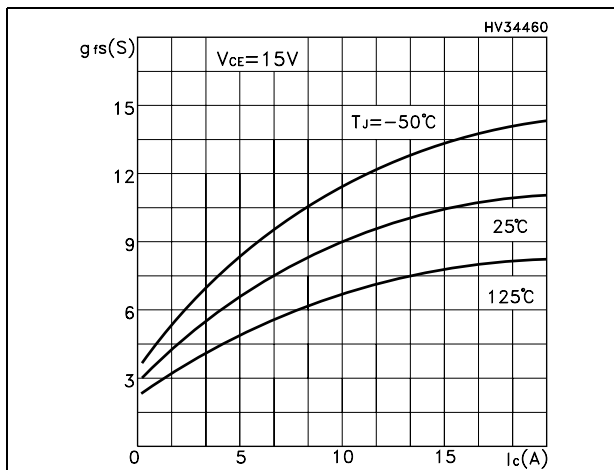


Figure 5. Collector-emitter on voltage vs temperature

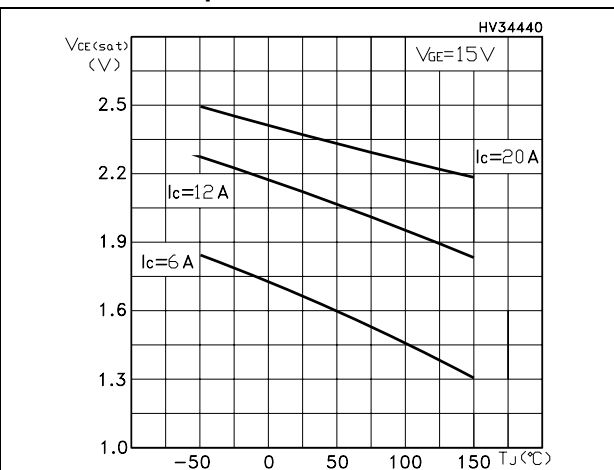


Figure 6. Gate charge vs gate-source voltage

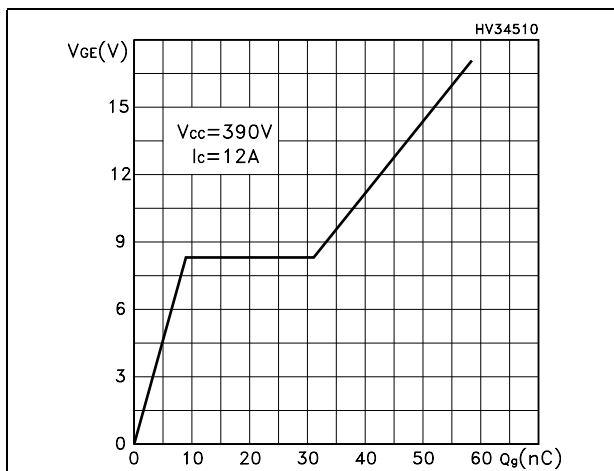


Figure 7. Capacitance variations

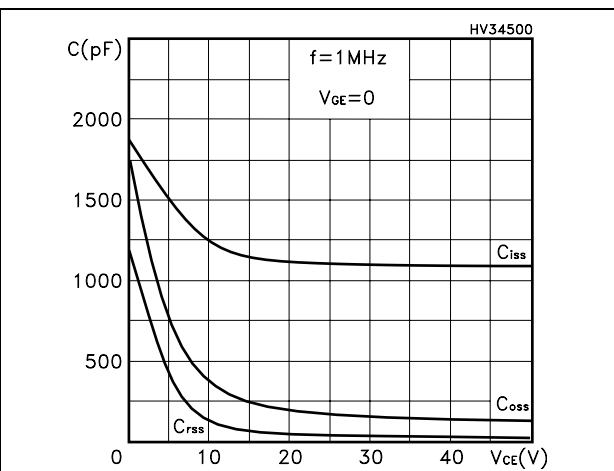


Figure 8. Normalized gate threshold voltage vs temperature

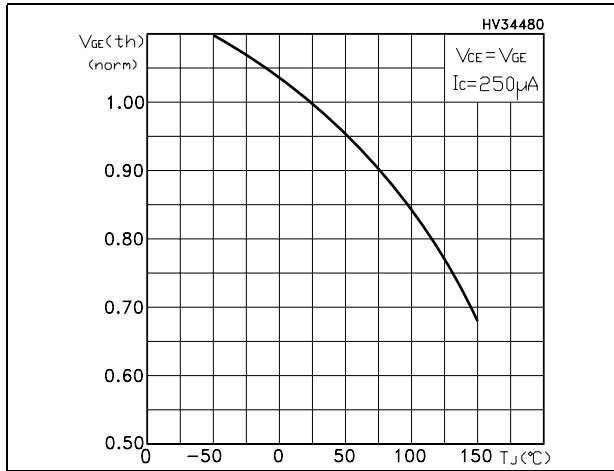


Figure 9. Collector-emitter on voltage vs collector current

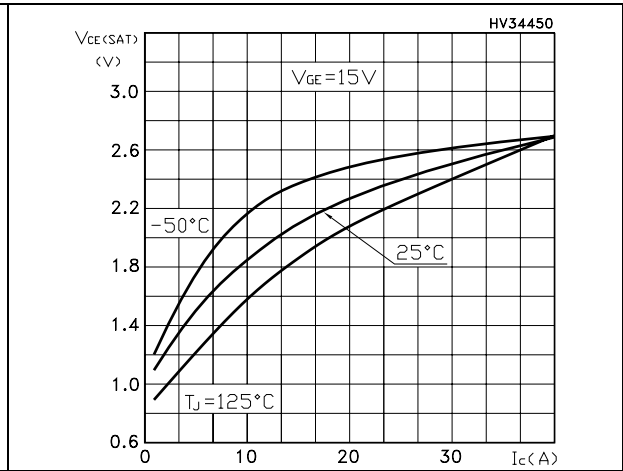


Figure 10. Normalized breakdown voltage vs temperature

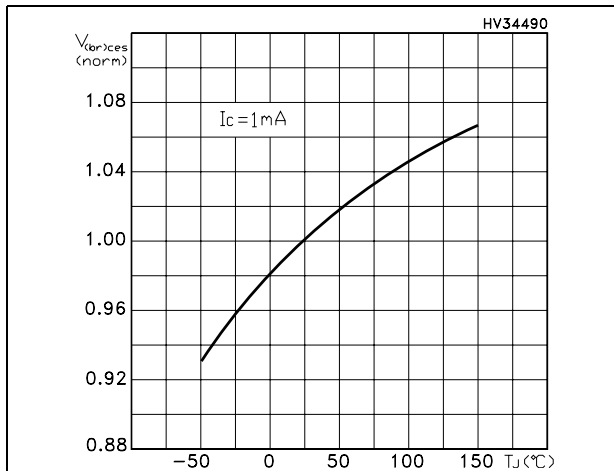


Figure 11. Switching losses vs temperature

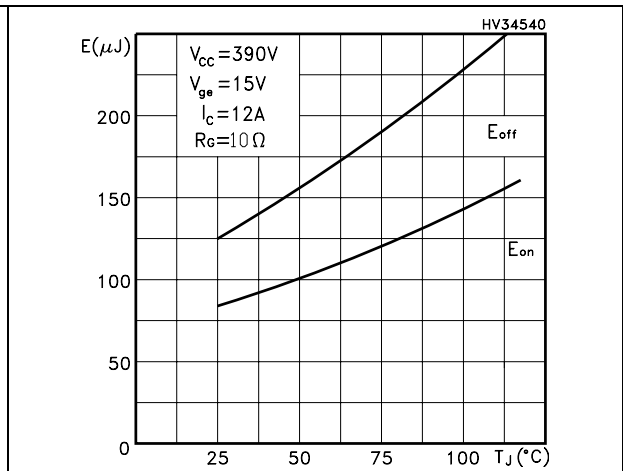


Figure 12. Switching losses vs gate resistance

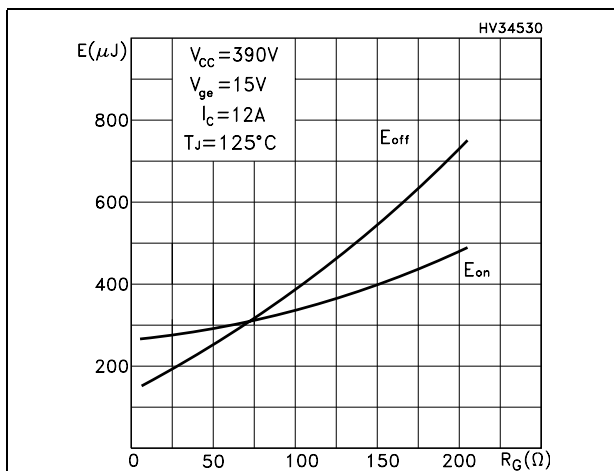


Figure 13. Switching losses vs collector current

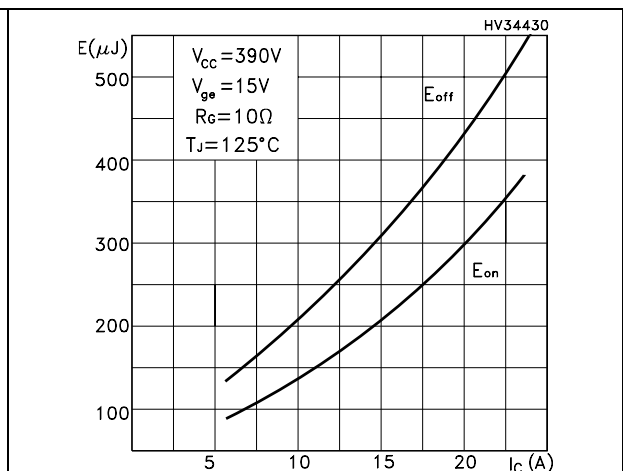
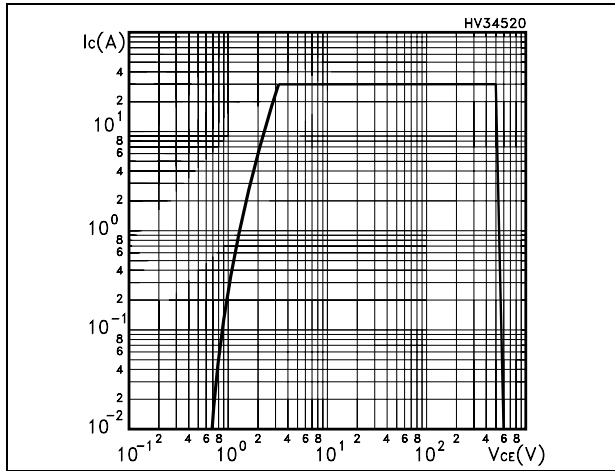


Figure 14. Turn-off SOA





### 3 Test circuit

Figure 15. Test circuit for inductive load switching

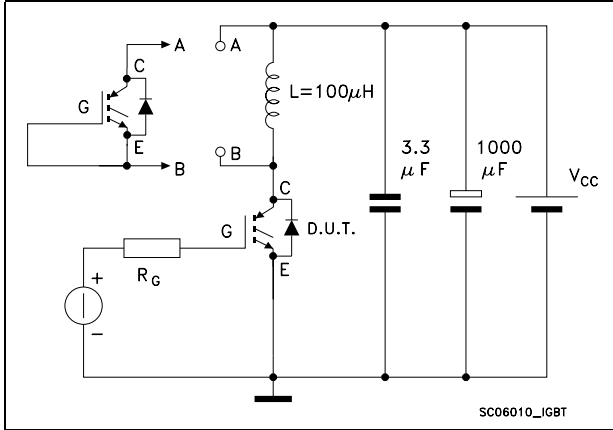


Figure 16. Gate charge test circuit

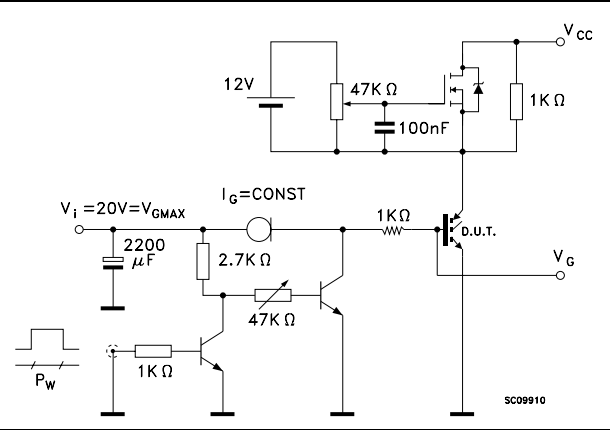
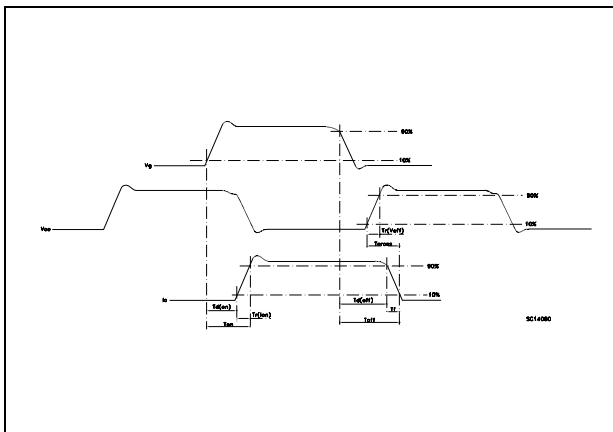


Figure 17. Switching waveform

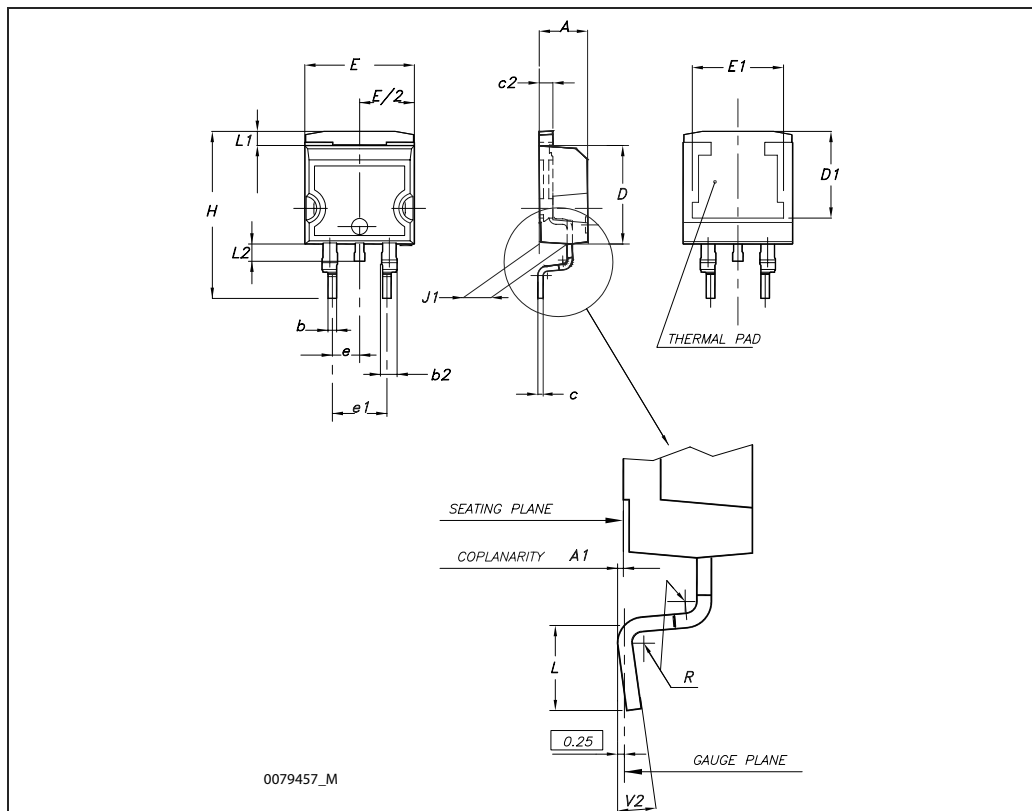


## 4 Package mechanical data

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](http://www.st.com)

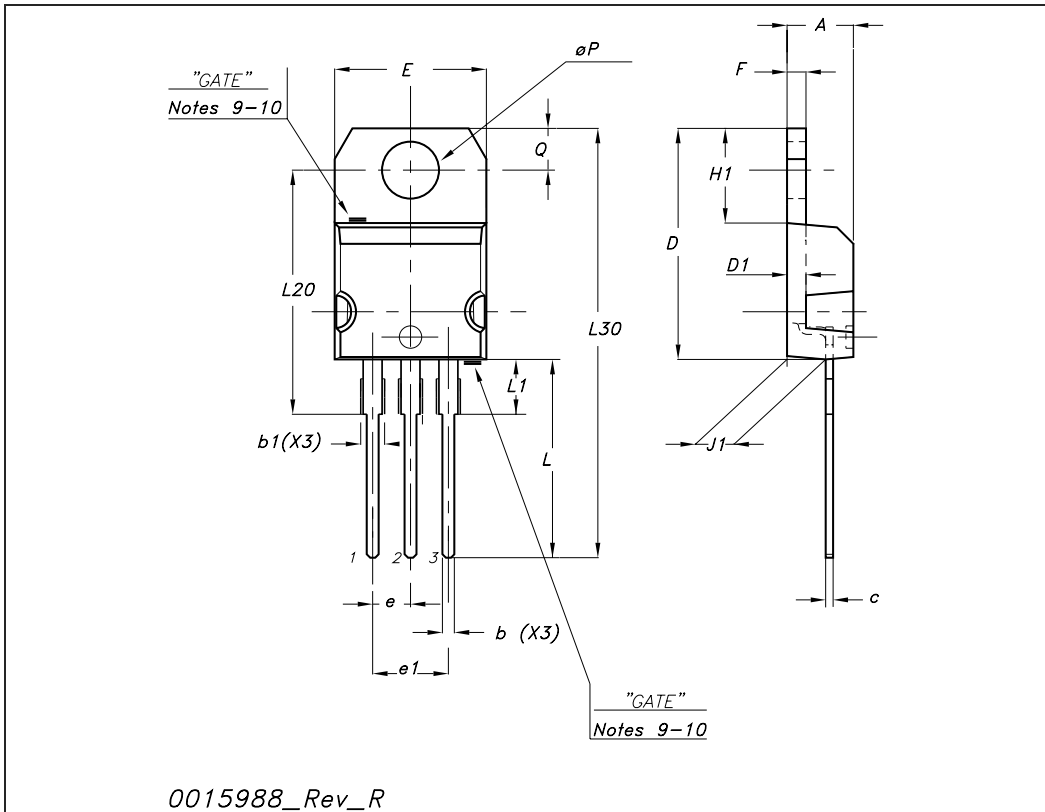
D<sup>2</sup>PAK (TO-263) mechanical data

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°



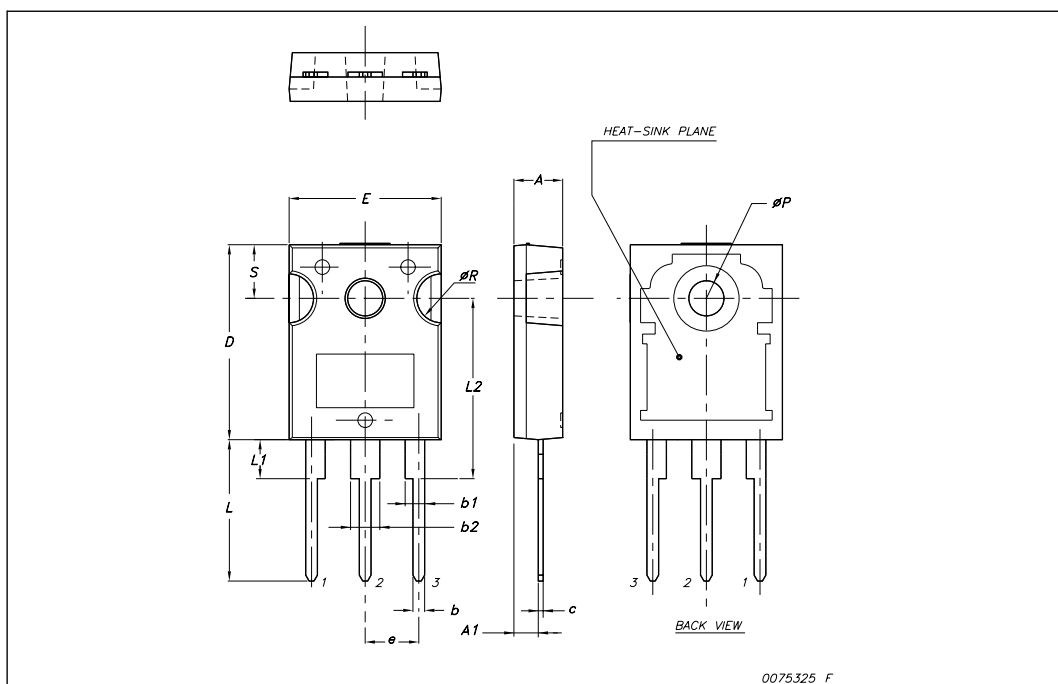
TO-220 mechanical data

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



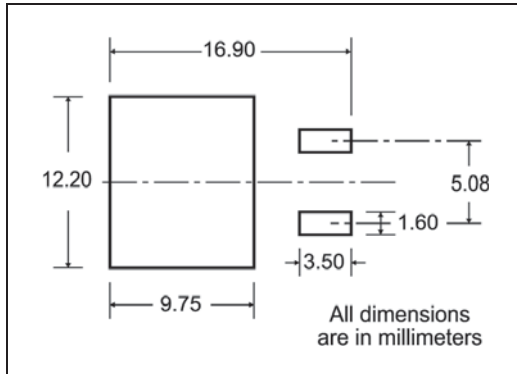
## TO-247 Mechanical data

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

D<sup>2</sup>PAK 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

Feeding radius

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
04-Oct-2006	1	Initial release.
08-May-2007	2	Modified value on <a href="#">Table 2</a>
20-Nov-2008	3	Inserted packages: D <sup>2</sup> PAK and TO-247

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