

## 30 A - 600 V - short circuit rugged IGBT

### Features

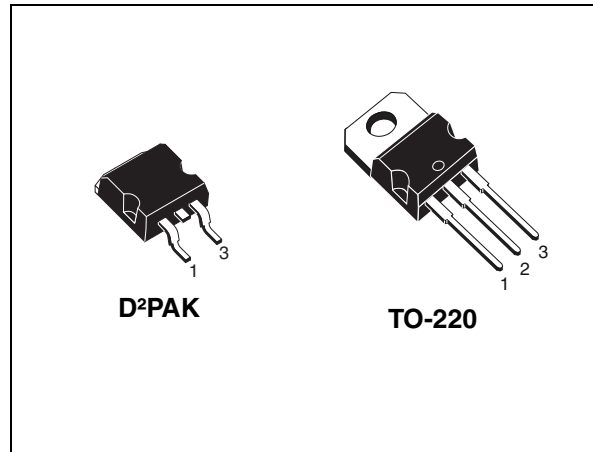
- Low on-voltage drop ( $V_{CE(sat)}$ )
- Low  $C_{res} / C_{ies}$  ratio (no cross conduction susceptibility)
- Short circuit withstand time 10  $\mu$ s

### Applications

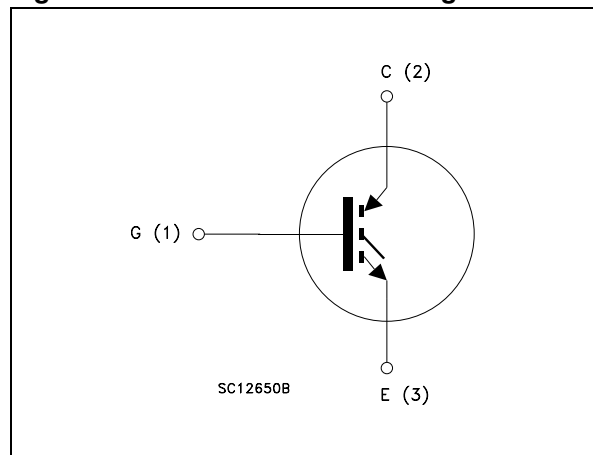
- High frequency inverters
- Motor drivers

### 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
STGB30NC60KT4	GB30NC60K	D <sup>2</sup> PAK	Tape and reel
STGP30NC60K	GP30NC60K	TO-220	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25^\circ\text{C}$	60	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100^\circ\text{C}$	26	A
$I_{CL}^{(2)}$	Turn-off latching current	125	A
$I_{CP}^{(3)}$	Pulsed collector current	125	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	185	W
$t_{scw}$	Short circuit withstand time, $V_{CE} = 0.5V_{(BR)CES}$ $T_j = 125^\circ\text{C}$ , $R_G = 10 \Omega$ , $V_{GE} = 12 \text{ V}$	10	$\mu\text{s}$
$T_j$	Operating junction temperature	- 55 to 150	$^\circ\text{C}$

1. Calculated according to the iterative formula:

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

2.  $V_{clamp} = 80\%(V_{CES})$ ,  $T_j = 150^\circ\text{C}$ ,  $R_G = 10 \Omega$ ,  $V_{GE} = 15 \text{ V}$   
 3. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	0.675	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.5	$^\circ\text{C/W}$

## 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	$V_{GE}=15\text{ V}, I_C=20\text{ A}$		2.1	2.7	V
		$V_{GE}=15\text{ V}, I_C=20\text{ A}, T_C=125^{\circ}\text{C}$		1.9		V
$I_{CES}$	Collector cut-off current ( $V_{GE}=0$ )	$V_{CE}=600\text{ V}$			150	$\mu\text{A}$
		$V_{CE}=600\text{ V}, T_C=125^{\circ}\text{C}$			1	$\text{mA}$
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}, I_C=250\text{ }\mu\text{A}$	4.5		6.5	V
$I_{GES}$	Gate-emitter cut-off current ( $V_{CE}=0$ )	$V_{GE}=\pm 20\text{ V}$			$\pm 100$	$\text{nA}$
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE}=15\text{ V}, I_C=20\text{ A}$		15		S

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE}=25\text{ V}, f=1\text{ MHz}, V_{GE}=0$		2170		$\text{pF}$
$C_{oes}$	Output capacitance			230		$\text{pF}$
$C_{res}$	Reverse transfer capacitance			46		$\text{pF}$
$Q_g$	Total gate charge	$V_{CE}=480\text{ V}, I_C=20\text{ A},$		96		$\text{nC}$
$Q_{ge}$	Gate-emitter charge	$V_{GE}=15\text{ V}$		18		$\text{nC}$
$Q_{gc}$	Gate-collector charge	(see Figure 17)		46		$\text{nC}$

**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	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see Figure 16)		29 12 1520		ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125^\circ\text{C}$ (see Figure 16)		27 14 1360		ns ns A/ $\mu$ s
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see Figure 16)		36 120 85		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_C = 125^\circ\text{C}$ (see Figure 16)		75 160 130		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	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 16)		350 435 785		$\mu$ J $\mu$ J $\mu$ J
$E_{on}$ $E_{off}^{(1)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125^\circ\text{C}$ (see Figure 16)		590 845 1435		$\mu$ J $\mu$ J $\mu$ J

1. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

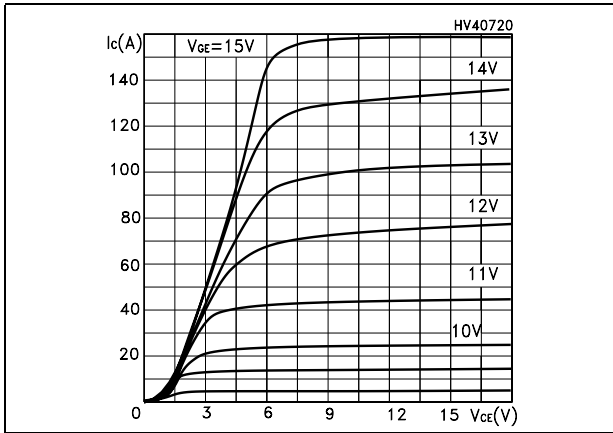


Figure 3. Transfer characteristics

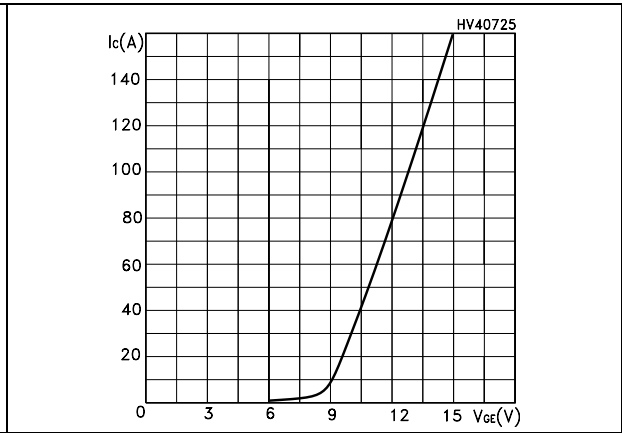


Figure 4. Transconductance

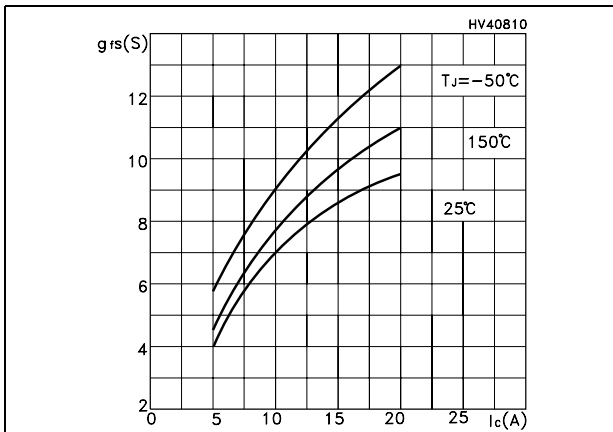


Figure 5. Collector-emitter on voltage vs temperature

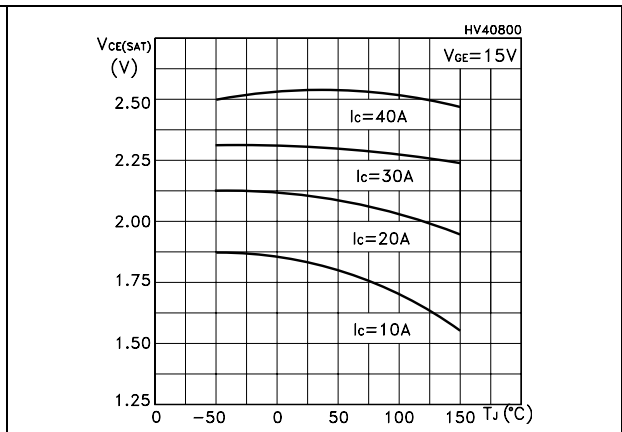


Figure 6. Gate charge vs gate-source voltage

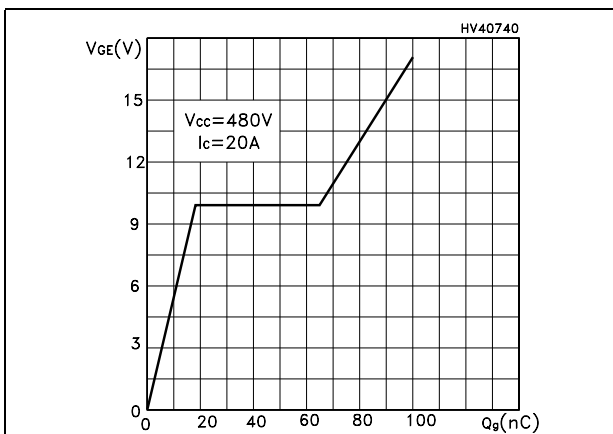


Figure 7. Capacitance variations

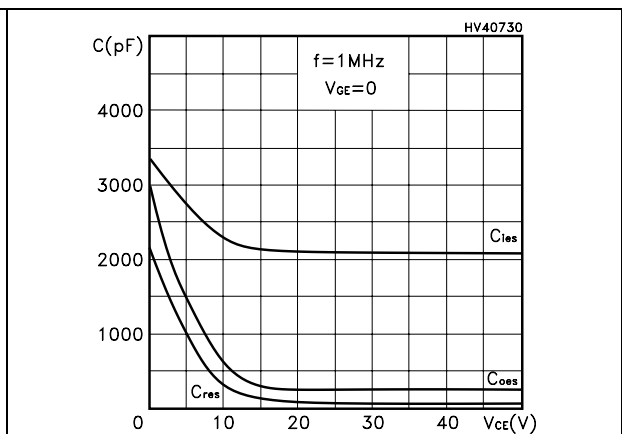


Figure 8. Normalized gate threshold voltage vs temperature

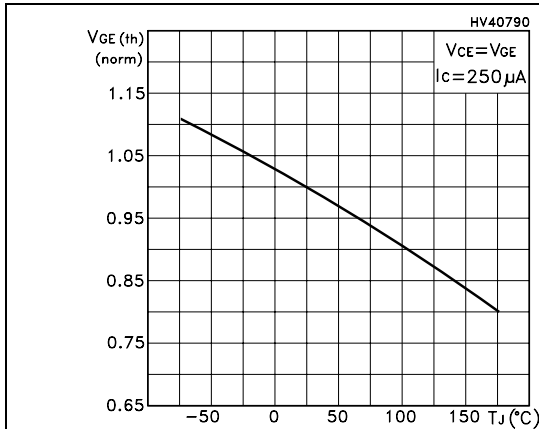


Figure 9. Collector-emitter on voltage vs collector current

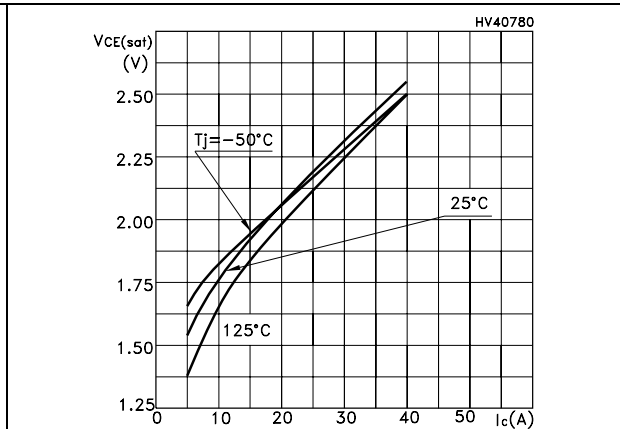


Figure 10. Normalized breakdown voltage vs temperature

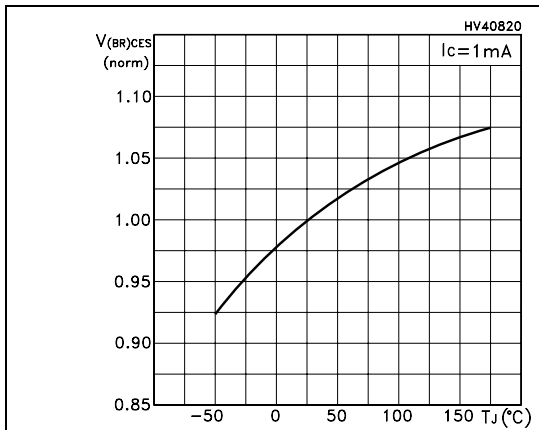


Figure 11. Switching losses vs temperature

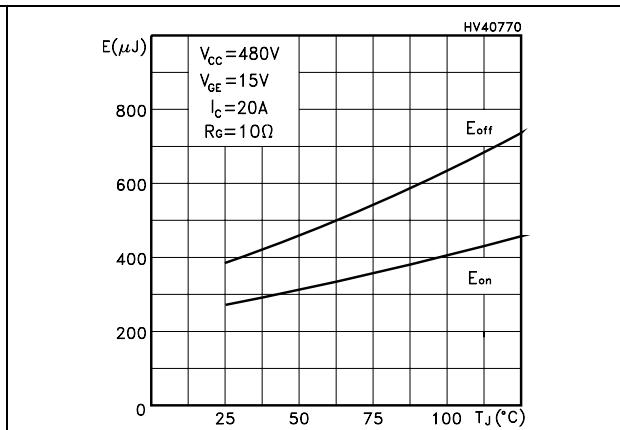


Figure 12. Switching losses vs gate resistance

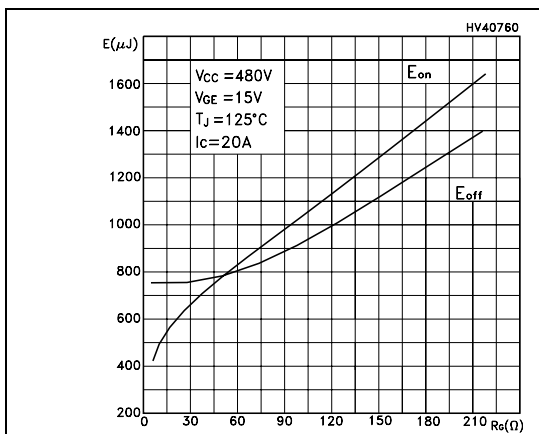


Figure 13. Switching losses vs collector current

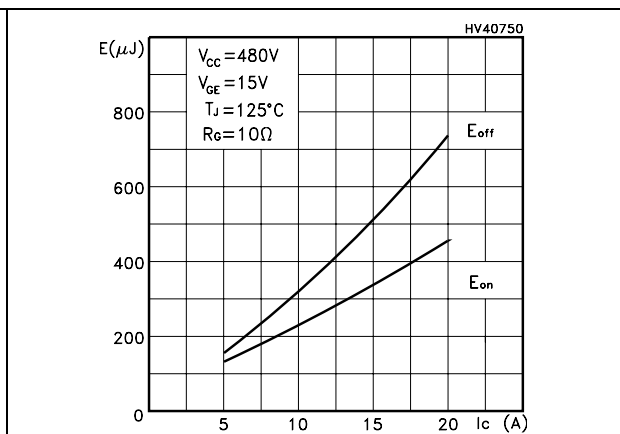


Figure 14. Thermal Impedance

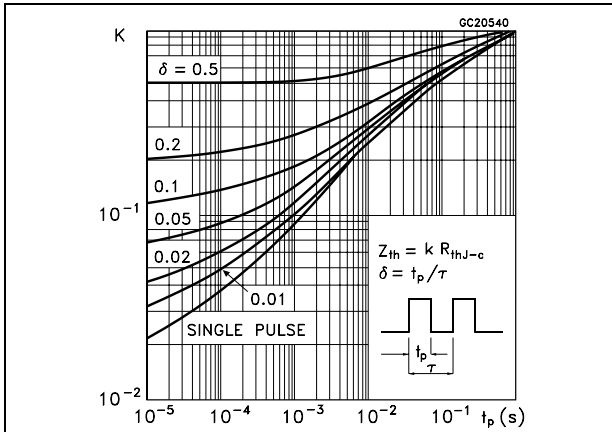
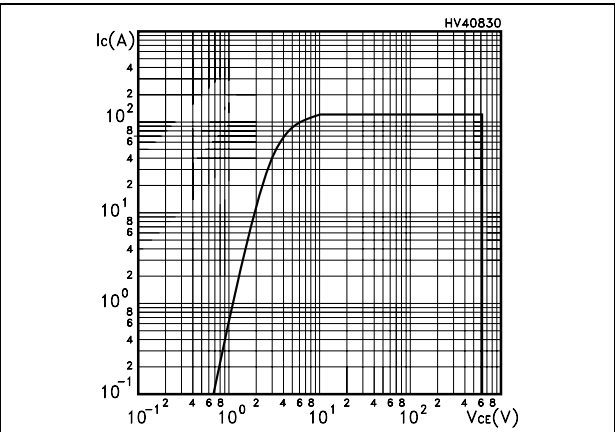


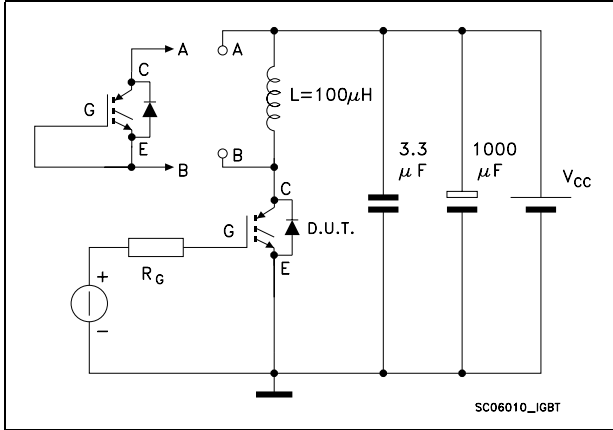
Figure 15. Turn-off SOA



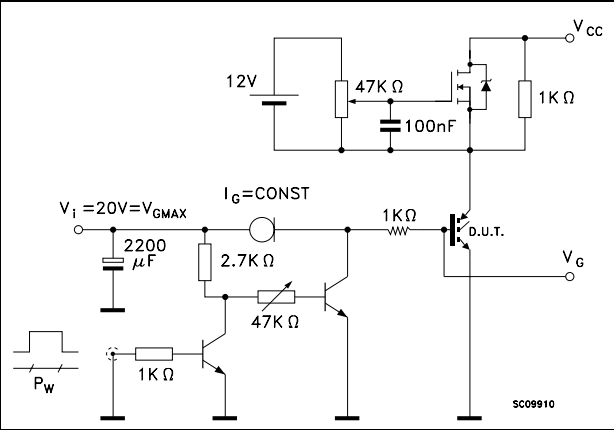


### 3 Test circuit

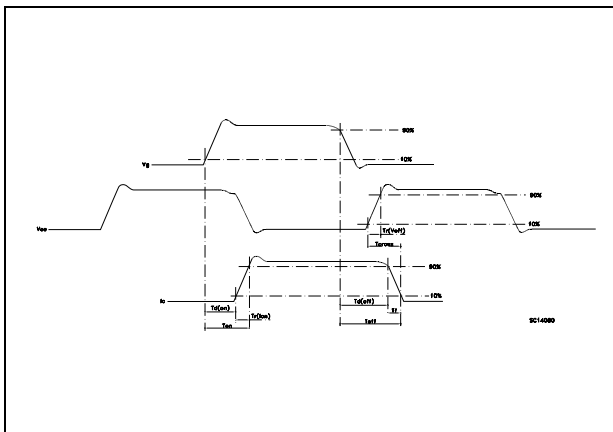
**Figure 16. Test circuit for inductive load switching**



**Figure 17. Gate charge test circuit**



**Figure 18. Switching waveforms**

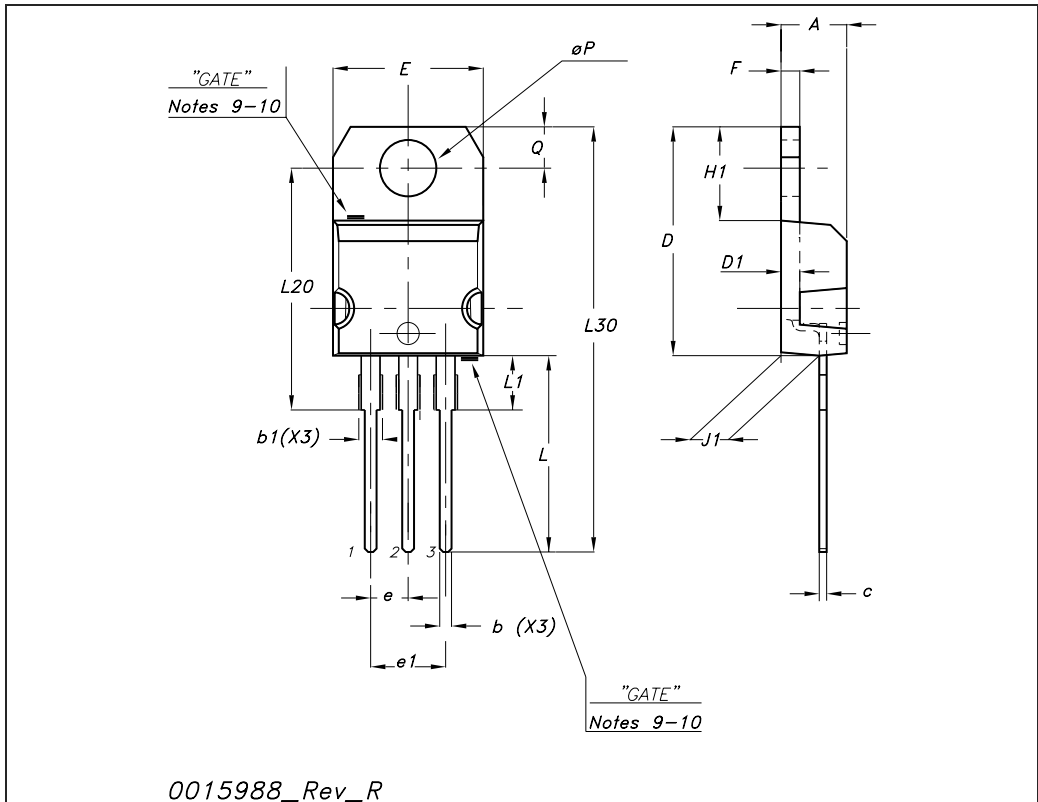


## 4 Package mechanical data

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)

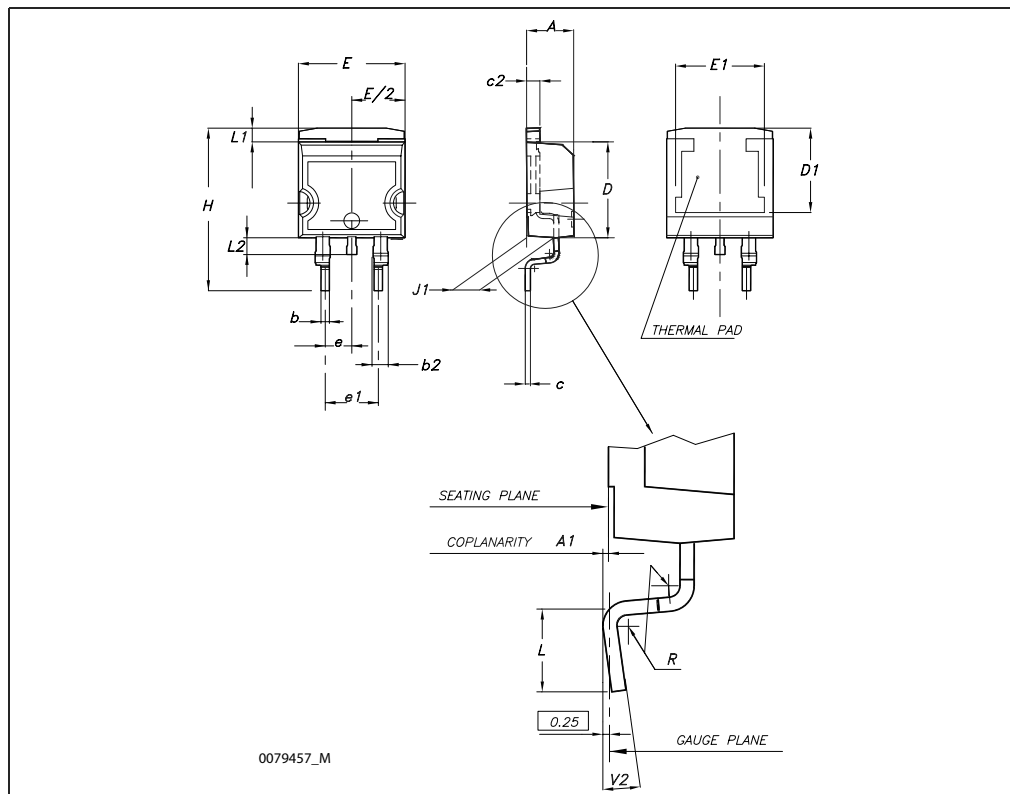
TO-220 mechanical data

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



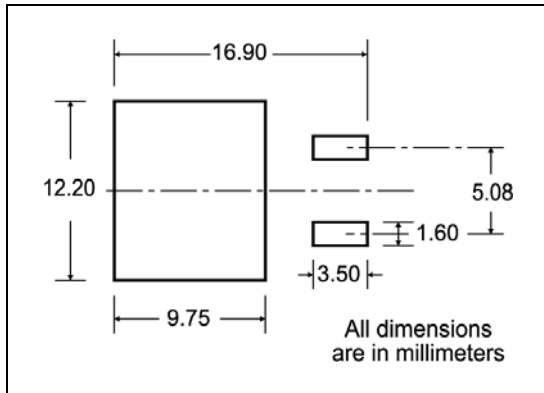
D<sup>2</sup>PAK (TO-263) mechanical data

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°



## 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

User Direction of Feed

FEED DIRECTION

Bending radius

\* on sales type

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
12-Feb-2008	1	Initial release
07-Mar-2008	2	Updated mechanical data for both packages

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