



STB12NK80Z STP12NK80Z - STW12NK80Z

N-CHANNEL 800V - 0.65Ω - 10.5A - TO220-D²PAK-TO247
Zener-Protected SuperMESH™ MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D	P _w
STB12NK80Z	800 V	<0.75 Ω	10.5 A	190 W
STP12NK80Z	800 V	<0.75 Ω	10.5 A	190 W
STW12NK80Z	800 V	<0.75 Ω	10.5 A	190 W

- EXTREMELY HIGH dv/dt CAPABILITY
- IMPROVED ESD CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEABILITY

Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications.

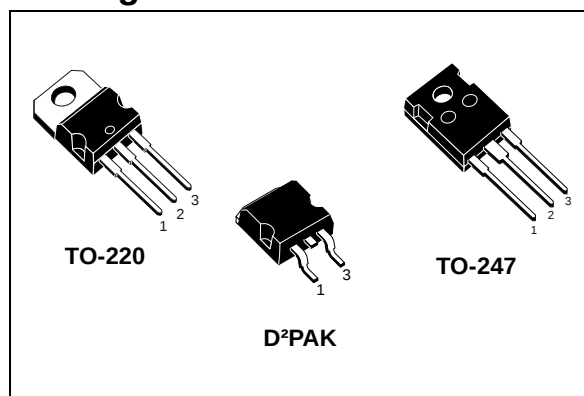
Applications

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES, ADAPTOR AND PFC

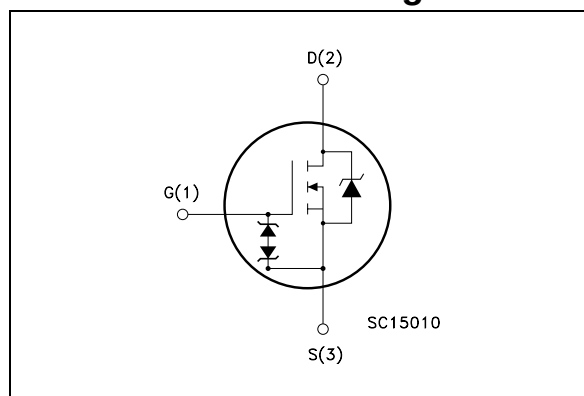
Order codes

Sales Type	Marking	Package	Packaging
STB12NK80ZT4	B12NK80Z	D ² PAK	TAPE & REEL
STP12NK80Z	P12NK80Z	TO-220	TUBE
STW12NK80Z	W12NK80Z	TO-247	TUBE

Package



Internal schematic diagram



1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-Source Voltage ($V_{GS} = 0$)	800	V
V_{DGR}	Drain-gate Voltage ($R_{GS} = 20k\Omega$)	800	V
V_{GS}	Gate-Source Voltage	± 30	V
I_D	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	10.5	A
I_D	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	6.6	A
I_{DM} Note 2	Drain Current (pulsed)	42	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	190	W
	Derating Factor	1.51	W/ $^\circ\text{C}$
$V_{esd}(G-S)$	G-S ESD (HBM $C=100\text{pF}$, $R=1.5k\Omega$)	6000	V
$\frac{dv}{dt}$ Note 1	Peak Diode Recovery voltage slope	4.5	V/ns
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150	$^\circ\text{C}$

Table 2. Thermal data

		TO-220/D ² PAK	TO-247	Unit
$R_{thj-case}$	Thermal Resistance Junction-case Max	0.66		$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal Resistance Junction-amb Max	62.5	50	$^\circ\text{C}/\text{W}$
T_l	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

Table 3. Avalanche characteristics

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, repetitive or Not-Repetitive (pulse width limited by T_j max)	10.5	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j=25^\circ\text{C}$, $I_D=I_{AR}$, $V_{DD}=50\text{V}$)	400	mJ

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-Source Breakdown Voltage	I _D = 1mA, V _{GS} = 0	800			V
I _{DSS}	Zero Gate Voltage Drain Current (V _{GS} = 0)	V _{DS} = Max Rating, V _{DS} = Max Rating, T _c = 125°C			1 50	μA μA
I _{GSS}	Gate Body Leakage Current (V _{DS} = 0)	V _{GS} = ±20V			±10	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 100 μA	3	3.75	4.5	V
R _{DS(on)}	Static Drain-Source On Resistance	V _{GS} = 10 V, I _D = 4.5 A		0.65	0.75	Ω

Table 5. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g _{fs} <i>Note 4</i>	Forward Transconductance	V _{DS} = 15V, I _D = 5.25A		12		S
C _{iss}	Input Capacitance	V _{DS} = 25V, f = 1 MHz, V _{GS} = 0		2620		pF
C _{oss}	Output Capacitance			250		pF
C _{rss}	Reverse Transfer Capacitance			53		pF
C _{oss} eq. <i>Note 5</i>	Equivalent Output Capacitance	V _{GS} = 0, V _{DS} = 0V to 640V		100		pF
Q _g	Total Gate Charge	V _{DD} = 640V, I _D = 10.5 A		87		nC
Q _{gs}	Gate-Source Charge	V _{GS} = 10V		14		nC
Q _{gd}	Gate-Drain Charge	(see Figure 17)		44		nC

Table 6. Switching times

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t _{d(on)} t _r	Turn-on Delay Time Rise Time	V _{DD} = 400 V, I _D = 5.25 A, R _G = 4.7Ω, V _{GS} = 10V (see Figure 18)		30 18		ns ns
t _{d(off)} t _f	Turn-off Delay Time Fall Time	V _{DD} = 400 V, I _D = 5.25A, R _G = 4.7Ω, V _{GS} = 10V (see Figure 18)		70 20		ns ns
t _{r(Voff)} t _f t _c	Off-voltage Rise Time Fall Time Cross-over Time	V _{DD} = 640 V, I _D = 10.5A, R _G = 4.7Ω, V _{GS} = 10V (see Figure 18)		16 15 28		ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				10.5	A
I_{SDM} Note 2	Source-drain Current (pulsed)				42	A
V_{SD} Note 4	Forward on Voltage	$I_{SD}=10.5\text{ A}$, $V_{GS}=0$			1.6	V
t_{rr}	Reverse Recovery Time	$I_{SD}=10.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, $T_j=150^\circ\text{C}$		635		ns
Q_{rr}	Reverse Recovery Charge			5.9		μC
I_{RRM}	Reverse Recovery Current			18.5		A

Table 8. Gate-source zener diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{GSO} Note 6	Gate-Source Breakdown Voltage	$I_{GS}=\pm 1\text{ mA}$ (Open Drain)	30			V

(1) $I_{SD} \leq 10.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

(2) Pulse width limited by safe operating area

(3) Limited only by maximum temperature allowed

(4) Pulsed: pulse duration = 300 μs , duty cycle 1.5%

(5) $C_{OSS\text{ eq}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{OSS} when V_{DS} increases from 0 to 80% V_{DSS}

(6) The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical Characteristics (curves)

Figure 1. Safe Operating Area for TO-220/D²PAK

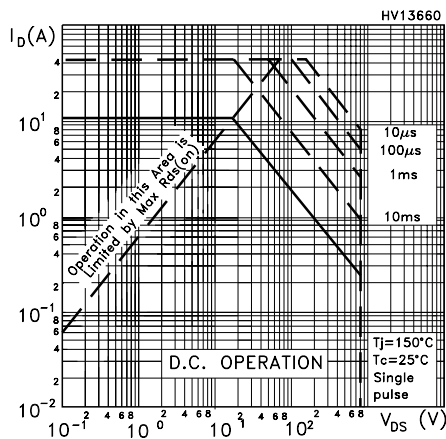


Figure 2. Thermal Impedance for TO-220/D²PAK

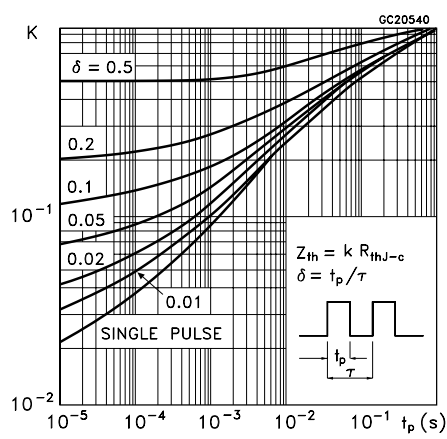


Figure 3. Safe Operating Area for TO-247

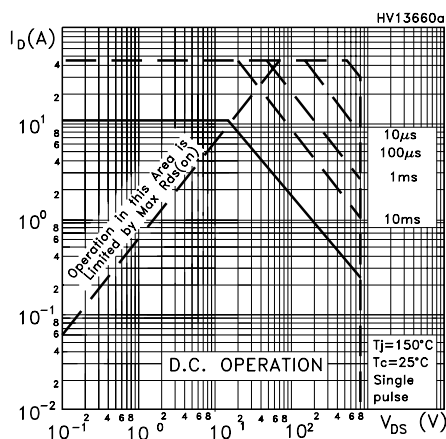


Figure 4. Thermal Impedance for TO-247

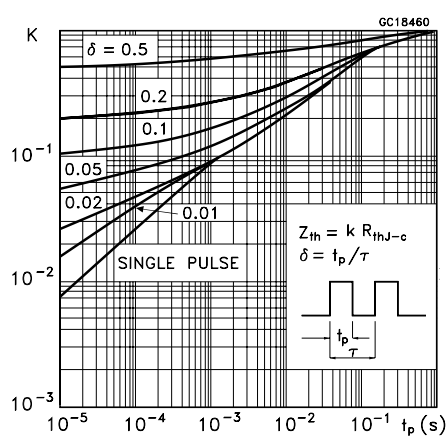


Figure 5. Output Characteristics

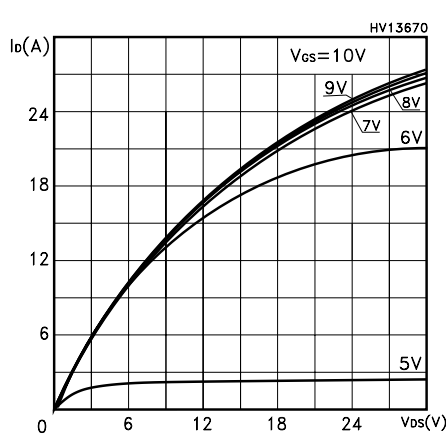


Figure 6. Transfer Characteristics

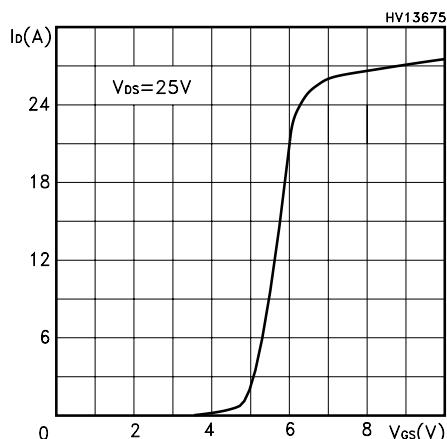


Figure 7. Transconductance

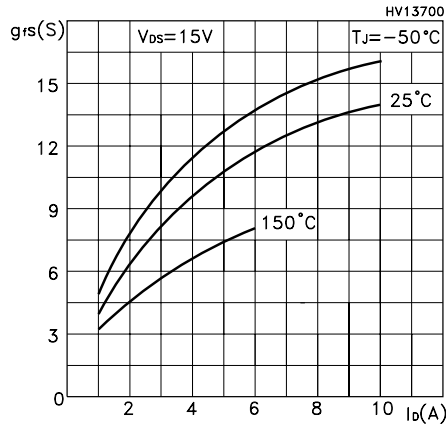


Figure 8. Static Drain-Source on Resistance

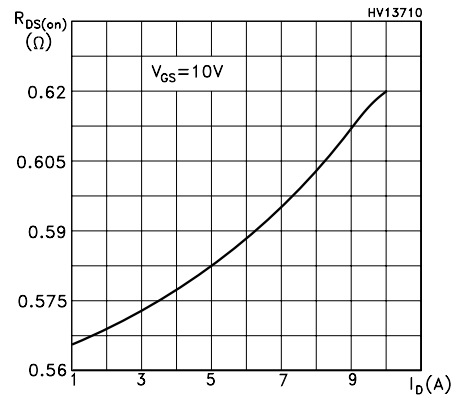


Figure 9. Gate Charge vs Gate -Source Voltage

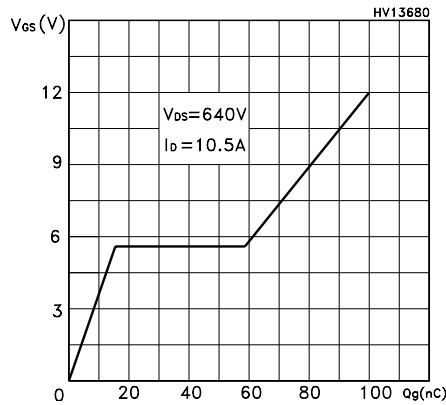


Figure 11. Capacitance Variations

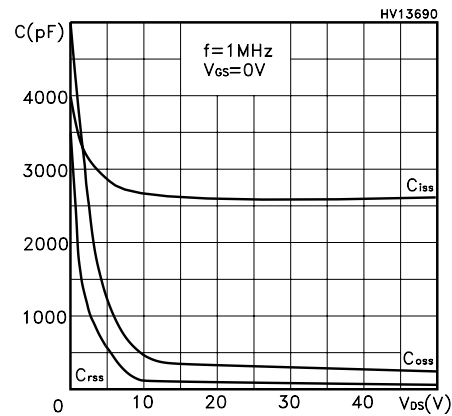


Figure 10. Normalized Gate Threshold Voltage vs Temperature

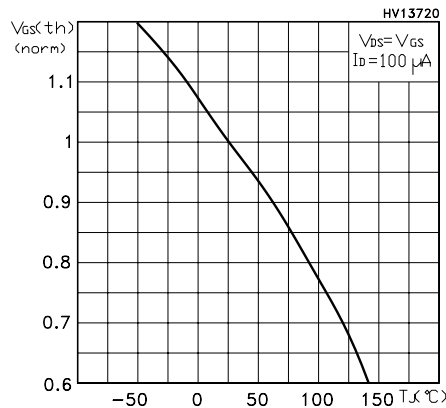


Figure 12. Normalized on Resistance vs Temperature

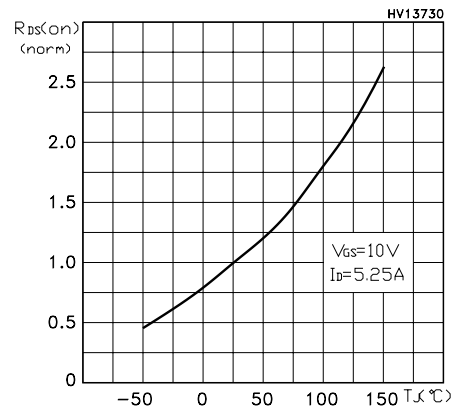


Figure 13. Source-drain Diode Forward Characteristics

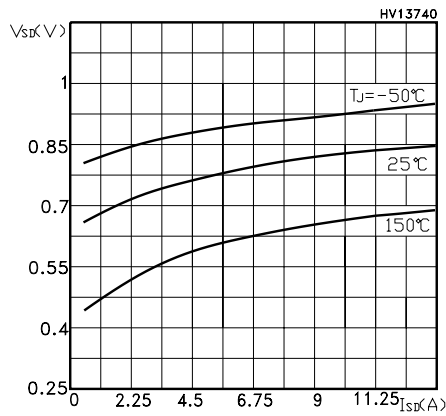


Figure 14. Normalized BVDSS vs Temperature

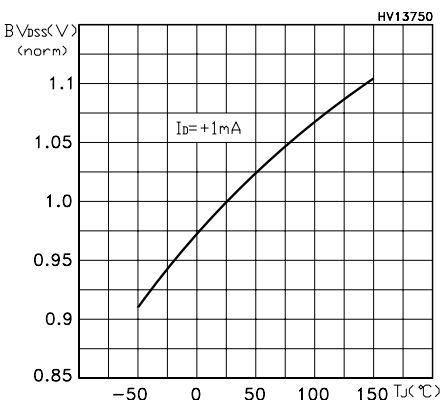
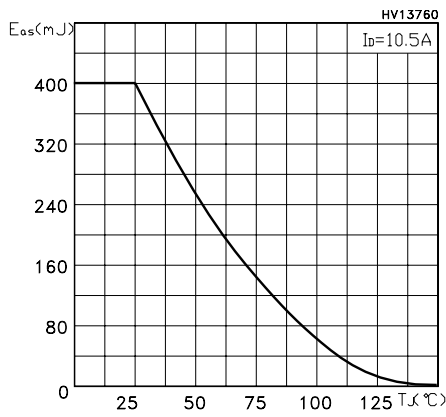


Figure 15. Maximum Avalanche Energy vs Temperature



3 Test circuits

Figure 16. Switching Times Test Circuit For Resistive Load

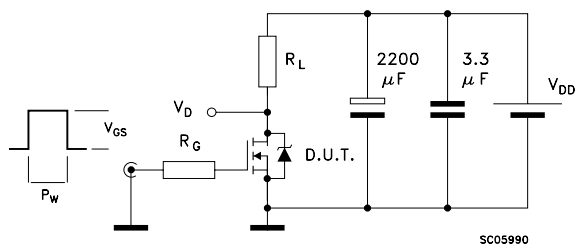


Figure 17. Gate Charge Test Circuit

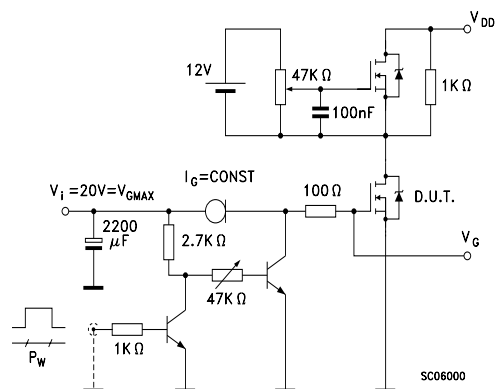


Figure 18. Test Circuit For Inductive Load Switching and Diode Recovery Times

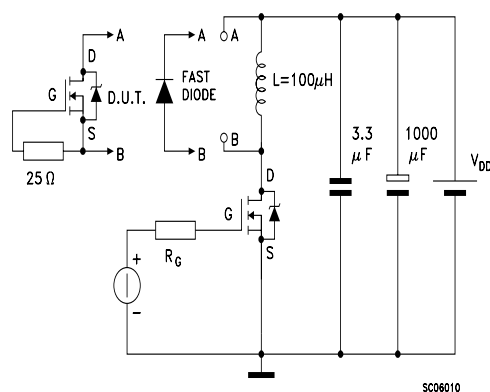


Figure 20. Unclamped Inductive Load Test Circuit

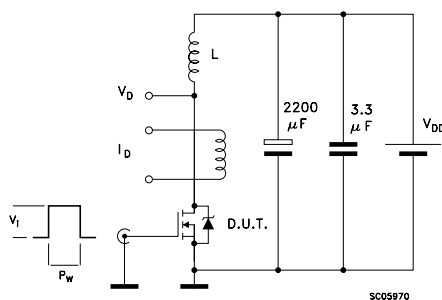
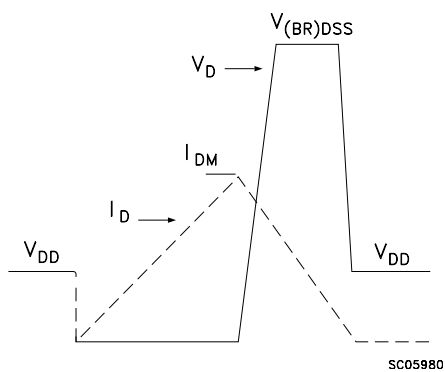


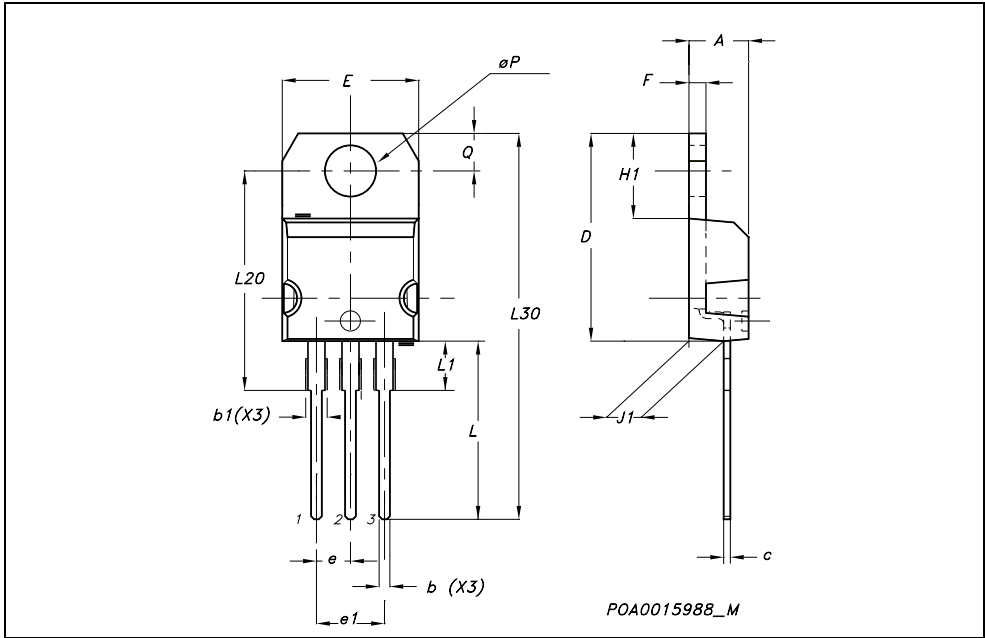
Figure 19. Unclamped Inductive Waveform



4 Package mechanical data

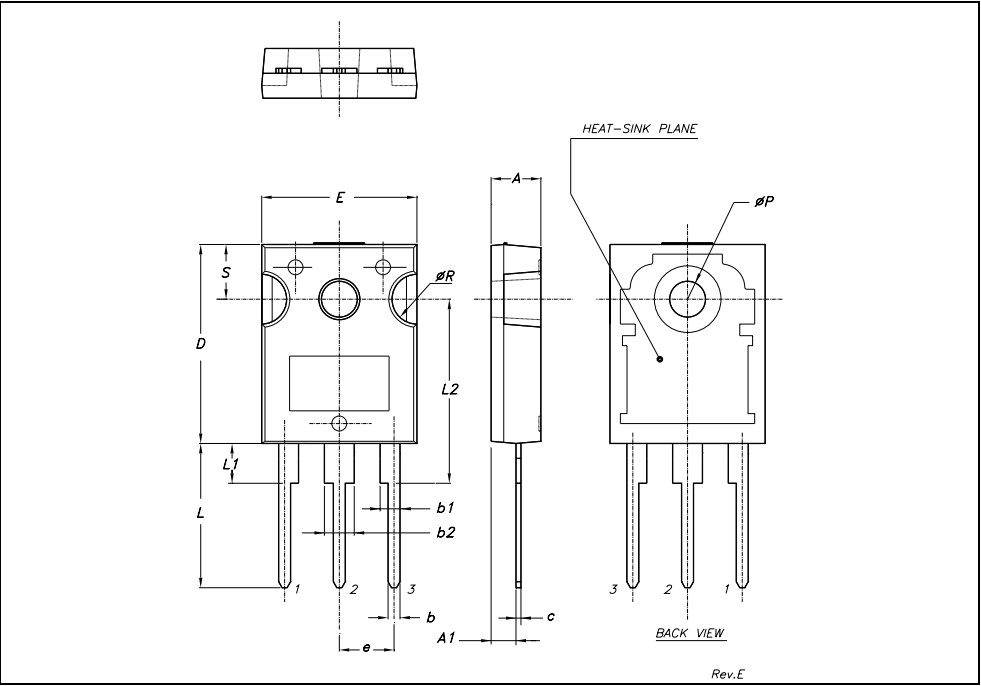
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings 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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



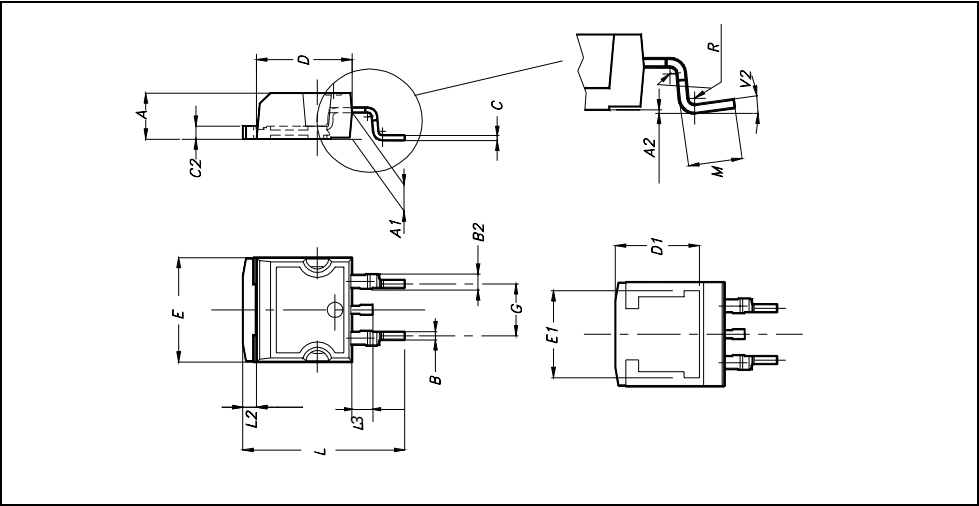
TO-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



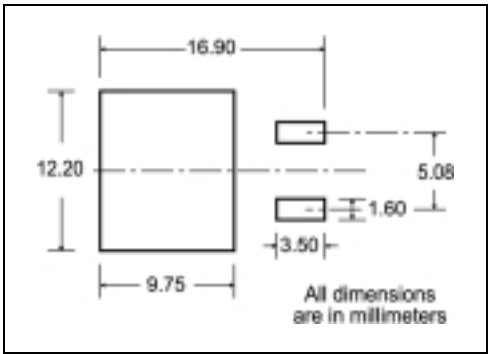
D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			

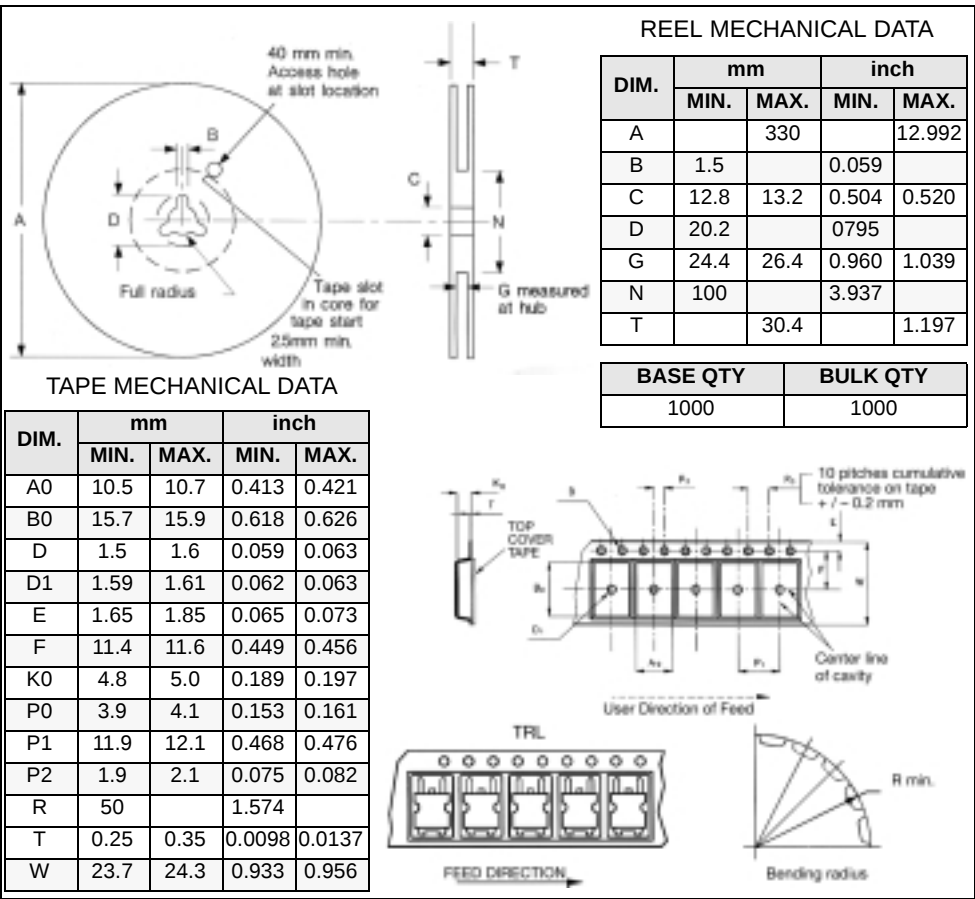


5 Packing mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision History

Date	Revision	Changes
02-Sep-2005	2	Inserted Ecopack indication

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