



# STB12NK80Z STP12NK80Z - STW12NK80Z

N-CHANNEL 800V - 0.65Ω - 10.5A - TO220-D<sup>2</sup>PAK-TO247  
Zener-Protected SuperMESH™ MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
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.

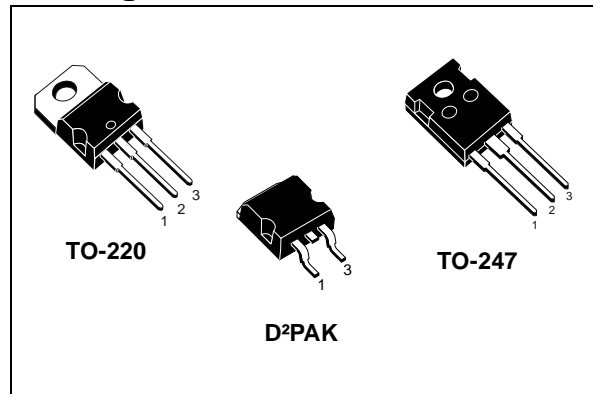
## Applications

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

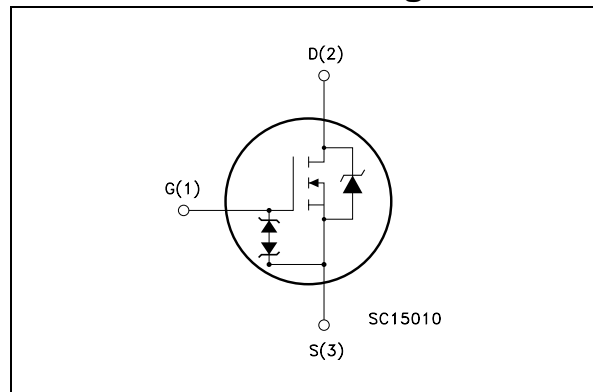
## Order codes

Sales Type	Marking	Package	Packaging
STB12NK80ZT4	B12NK80Z	D <sup>2</sup> 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	$\pm 30$	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
$I_{DM}$ <i>Note 2</i>	Drain Current (pulsed)	42	A
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	190	W
	Derating Factor	1.51	W/ $^\circ\text{C}$
Vesd(G-S)	G-S ESD (HBM C=100pF, R=1.5k $\Omega$ )	6000	V
$\frac{dv}{dt}$ <i>Note 1</i>	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 <sup>2</sup> PAK	TO-247	Unit
Rthj-case	Thermal Resistance Junction-case Max	0.66		$^\circ\text{C}/\text{W}$
Rthj-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

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

**Table 4. On/off states**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	800			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating},$ $V_{DS} = \text{Max Rating}, T_c = 125\text{ °C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate Body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 100\ \mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10\ \text{V}, I_D = 4.5\ \text{A}$		0.65	0.75	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ <i>Note 4</i>	Forward Transconductance	$V_{DS} = 15\text{ V}, I_D = 5.25\text{ A}$		12		S
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, f = 1\ \text{MHz}, V_{GS} = 0$		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	$V_{GS} = 0, V_{DS} = 0\text{ V to } 640\text{ V}$		100		pF
$Q_g$	Total Gate Charge	$V_{DD} = 640\text{ V}, I_D = 10.5\ \text{A}$		87		nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 10\text{ V}$		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	$V_{DD} = 400\ \text{V}, I_D = 5.25\ \text{A},$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (see Figure 18)		30 18		ns ns
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 400\ \text{V}, I_D = 5.25\ \text{A},$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (see Figure 18)		70 20		ns ns
$t_{r(Voff)}$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 640\ \text{V}, I_D = 10.5\ \text{A},$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (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
$I_{SDM}$ <i>Note 2</i>	Source-drain Current (pulsed)				42	A
$V_{SD}$ <i>Note 4</i>	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		$\mu\text{C}$
$I_{RRM}$	Reverse Recovery Current			18.5		A

**Table 8. Gate-source zener diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}$ <i>Note 6</i>	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 $\mu\text{s}$ , 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/D<sup>2</sup>PAK

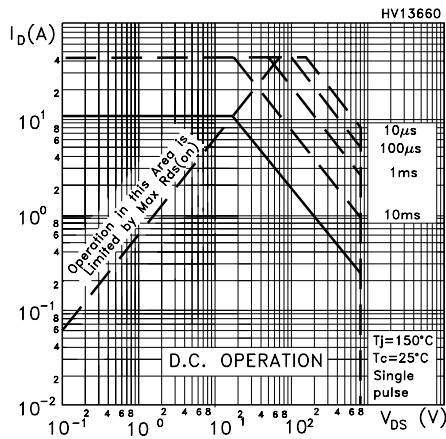


Figure 2. Thermal Impedance for TO-220/D<sup>2</sup>PAK

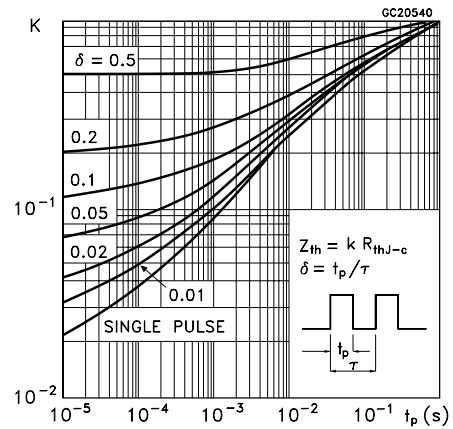


Figure 3. Safe Operating Area for TO-247

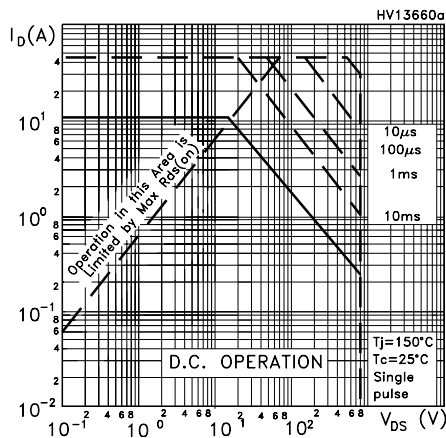


Figure 4. Thermal Impedance for TO-247

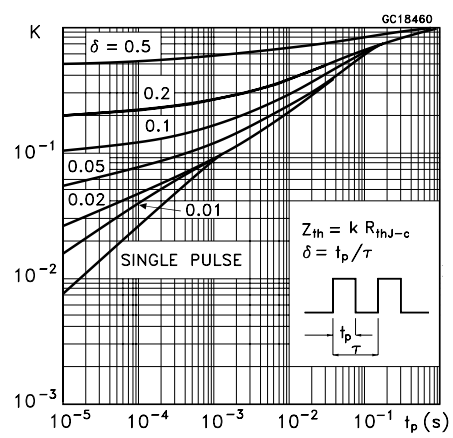


Figure 5. Output Characteristics

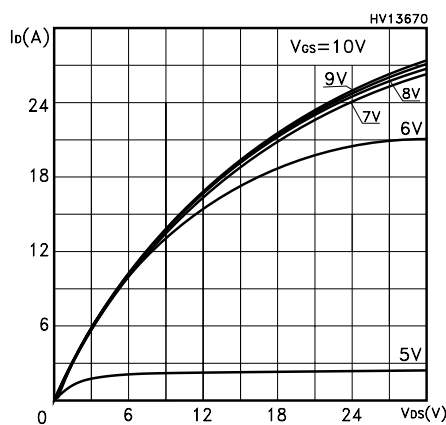


Figure 6. Transfer Characteristics

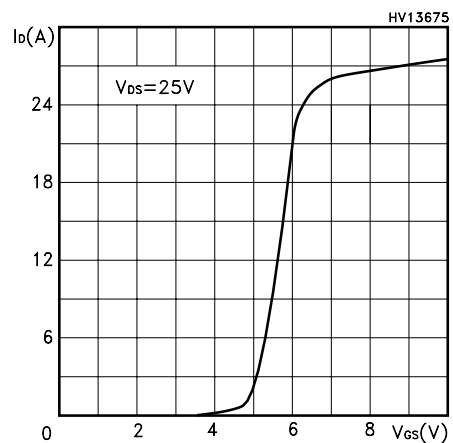


Figure 7. Transconductance

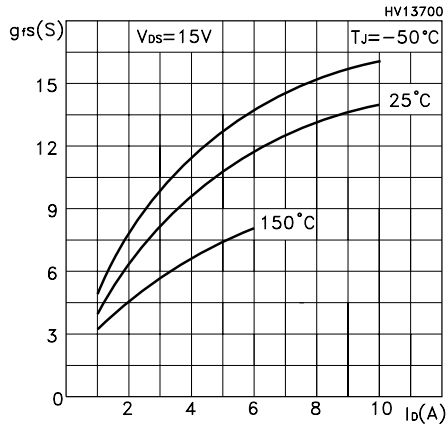


Figure 8. Static Drain-Source on Resistance

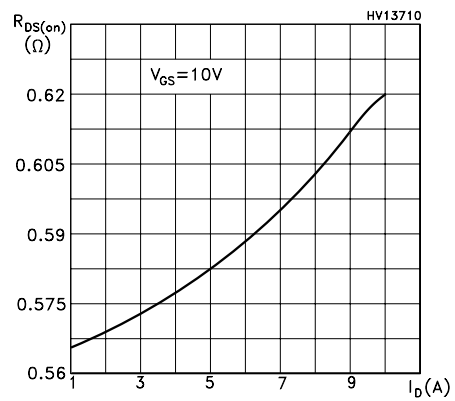


Figure 9. Gate Charge vs Gate -Source Voltage

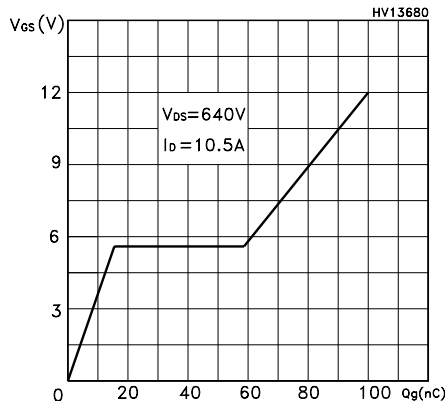


Figure 11. Capacitance Variations

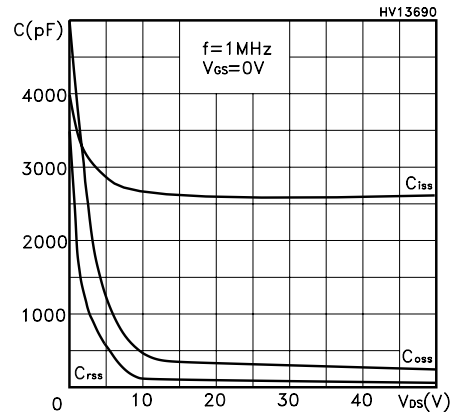


Figure 10. Normalized Gate Threshold Voltage vs Temperature

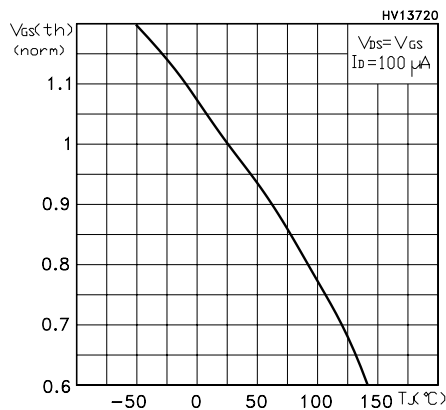


Figure 12. Normalized on Resistance vs Temperature

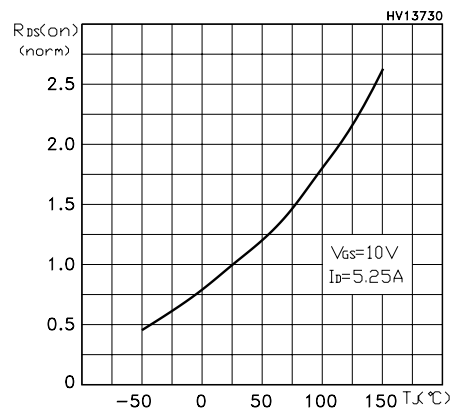


Figure 13. Source-drain Diode Forward Characteristics

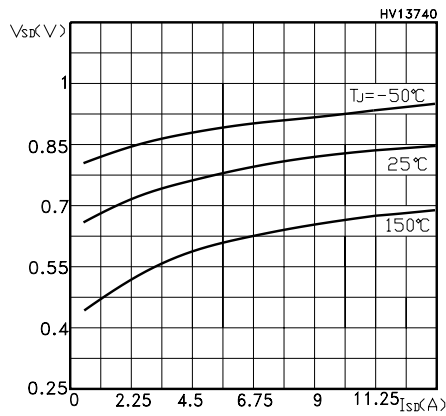


Figure 14. Normalized BVDSS vs Temperature

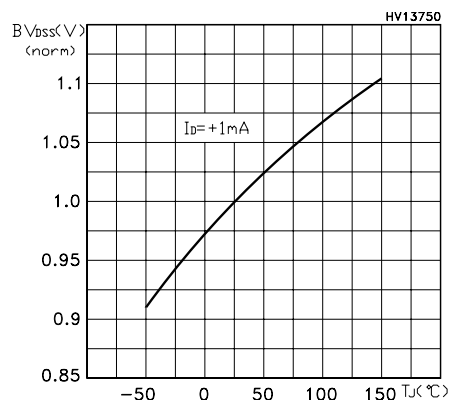
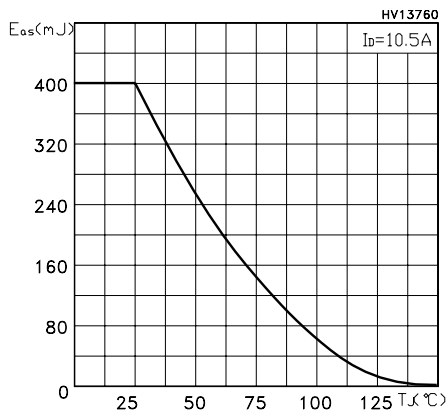


Figure 15. Maximum Avalanche Energy vs Temperature



### 3 Test circuits

Figure 16. Switching Times Test Circuit For Resistive Load

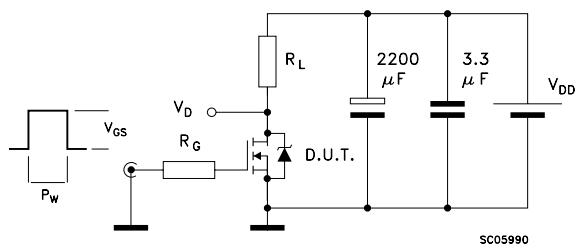


Figure 17. Gate Charge Test Circuit

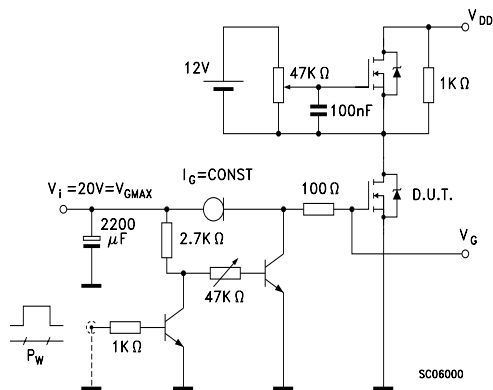


Figure 18. Test Circuit For Inductive Load Switching and Diode Recovery Times

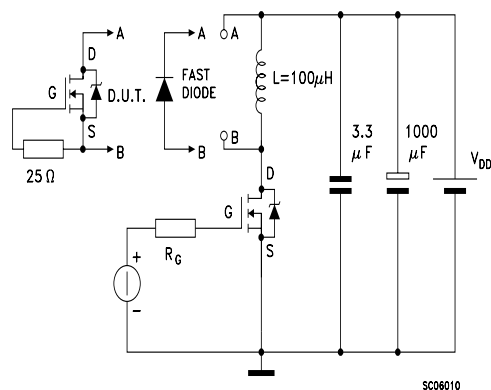


Figure 20. Unclamped Inductive Load Test Circuit

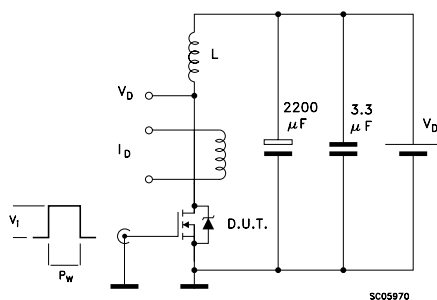
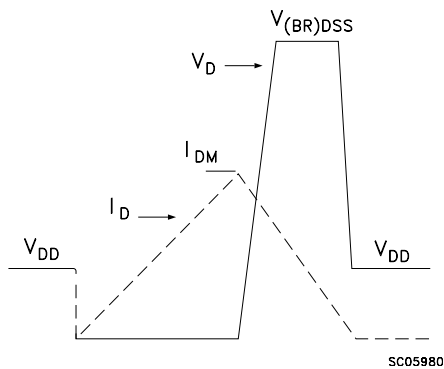


Figure 19. Unclamped Inductive Waveform



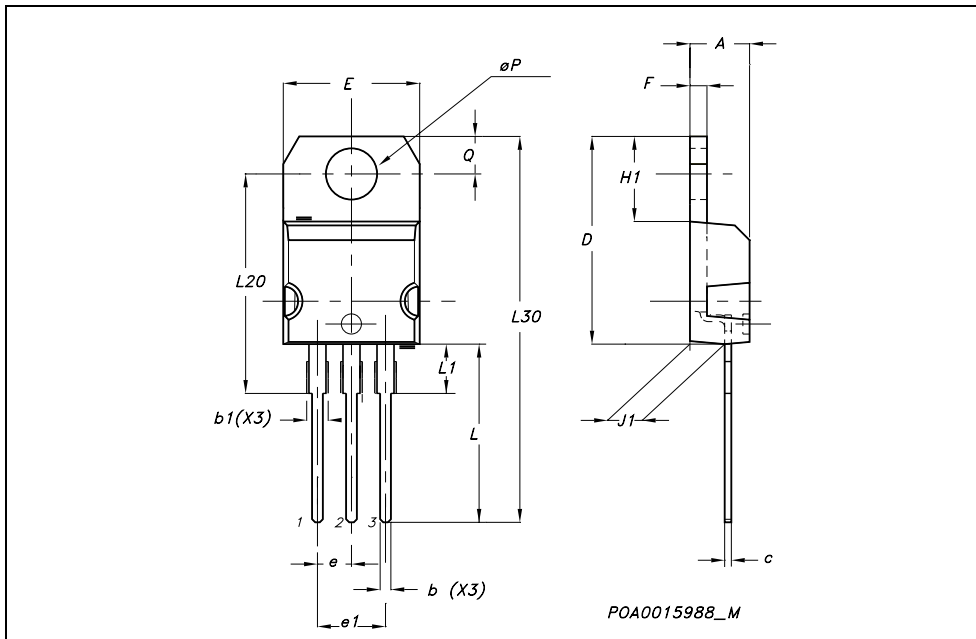


## 4 Package mechanical data

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

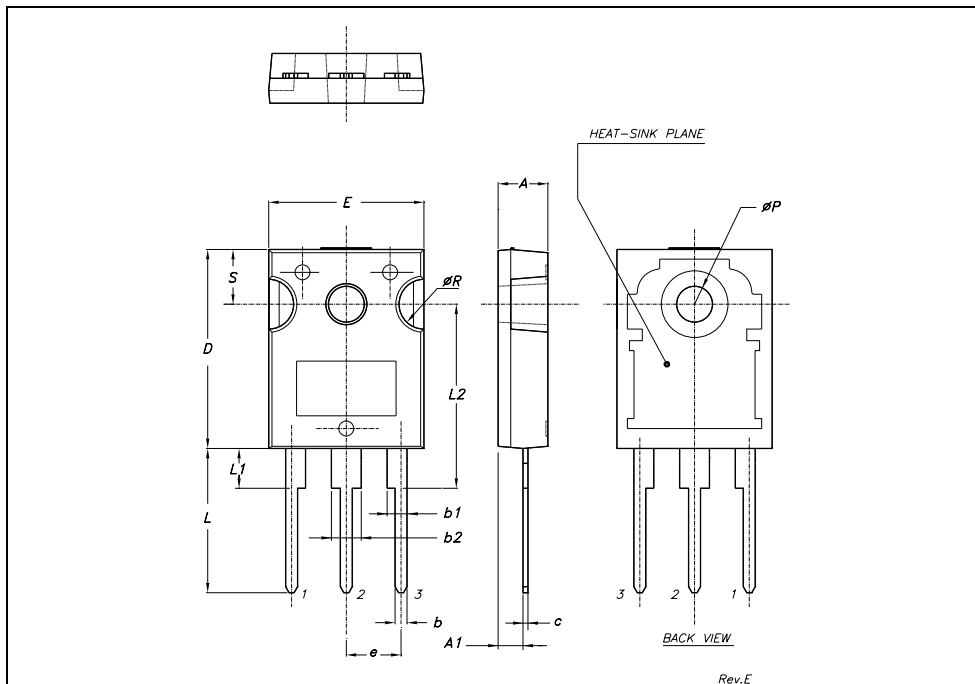
**TO-220 MECHANICAL DATA**

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	1.15		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



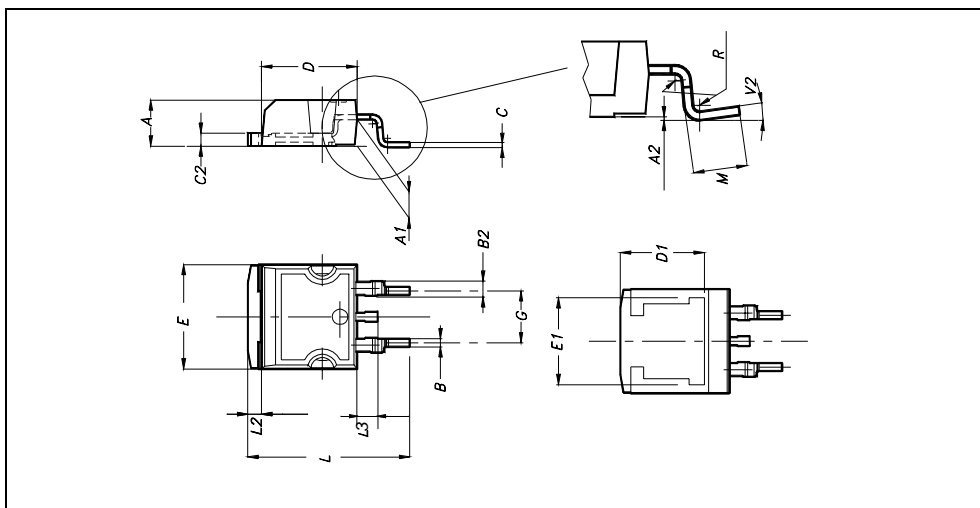
**TO-247 MECHANICAL DATA**

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	



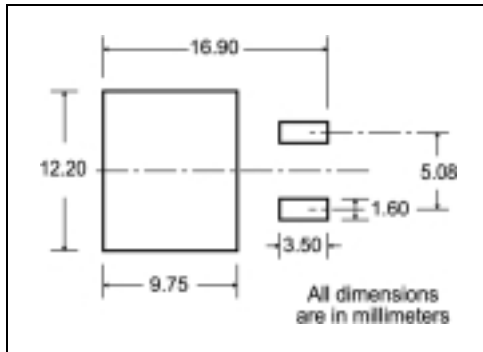
**D<sup>2</sup>PAK MECHANICAL DATA**

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

## 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

\* on sales type

## 6 Revision History

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

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