



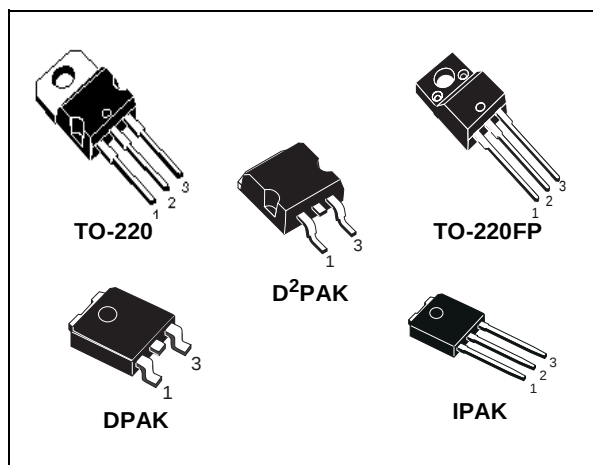
STP3NK60Z - STP3NK60ZFP STB3NK60Z-STD3NK60Z-STD3NK60Z-1

N-CHANNEL 600V - 3.3Ω - 2.4A TO-220/FP/D2PAK/DPAK/IPAK

Zener-Protected SuperMESH™ Power MOSFET

TYPE	V _{DSS}	R _{DS(on)}	I _D	P _w
STP3NK60Z	600 V	< 3.6 Ω	2.4 A	45 W
STP3NK60ZFP	600 V	< 3.6 Ω	2.4 A	20 W
STB3NK60Z	600 V	< 3.6 Ω	2.4 A	45 W
STD3NK60Z	600 V	< 3.6 Ω	2.4 A	45 W
STD3NK60Z-1	600 V	< 3.6 Ω	2.4 A	45 W

- TYPICAL R_{DS(on)} = 3.3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY



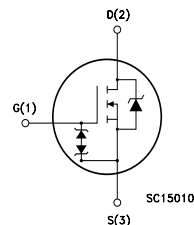
DESCRIPTION

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. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

APPLICATIONS

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

INTERNAL SCHEMATIC DIAGRAM



ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP3NK60Z	P3NK60Z	TO-220	TUBE
STP3NK60ZFP	P3NK60ZFP	TO-220FP	TUBE
STB3NK60ZT4	B3NK60Z	D ² PAK	TAPE & REEL
STD3NK60Z-1	D3NK60Z	IPAK	TUBE
STD3NK60ZT4	D3NK60Z	DPAK	TAPE & REEL

STP3NK60Z /FP - STB3NK60Z - STD3NK60Z - STD3NK60Z-1

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		STP3NK60Z STB3NK60Z	STP3NK60ZFP	STD3NK60Z STD3NK60Z-1	
V_{DS}	Drain-source Voltage ($V_{GS} = 0$)	600			V
V_{DGR}	Drain-gate Voltage ($R_{GS} = 20\text{ k}\Omega$)	600			V
V_{GS}	Gate- source Voltage	± 30			V
I_D	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	2.4	2.4 (*)	2.4 (*)	A
I_D	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	1.51	1.51 (*)	1.51 (*)	A
$I_{DM}(\bullet)$	Drain Current (pulsed)	9.6	9.6 (*)	9.6 (*)	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	45	20	45	W
	Derating Factor	0.36	0.16	0.36	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5K Ω)	2100			V
$dv/dt(1)$	Peak Diode Recovery voltage slope	4.5			V/ns
V_{ISO}	Insulation Withstand Voltage (DC)	-	2500	-	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150			$^\circ\text{C}$

(●) Pulse width limited by safe operating area

(1) $I_{SD} \leq 2.4\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

(*) Limited only by maximum temperature allowed

THERMAL DATA

		TO-220 D ² PAK	TO-220FP	DPAK IPAK	
$R_{thj-case}$	Thermal Resistance Junction-case Max	2.78	6.25	2.78	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient Max	62.5		100	$^\circ\text{C}/\text{W}$
T_I	Maximum Lead Temperature For Soldering Purpose	300			$^\circ\text{C}$

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	2.4	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	150	mJ

GATE-SOURCE ZENER DIODE

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

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

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.

STP3NK60Z /FP - STB3NK60Z - STD3NK60Z - STD3NK60Z-1

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED) ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source Breakdown Voltage	I _D = 1 mA, V _{GS} = 0	600			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} = ± 20 V			±10	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 50 μA	3	3.75	4.5	V
R _{DS(on)}	Static Drain-source On Resistance	V _{GS} = 10 V, I _D = 1.2 A		3.3	3.6	Ω

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g _{fs} (1)	Forward Transconductance	V _{DS} = 20 V, I _D = 1.2 A		1.8		S
C _{iss} C _{oss} C _{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V _{DS} = 25 V, f = 1 MHz, V _{GS} = 0		311 43 8		pF pF pF
C _{oss} eq. (3)	Equivalent Output Capacitance	V _{GS} = 0, V _{DS} = 0 to 400 V		26		pF

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t _{d(on)} t _r	Turn-on Delay Time Rise Time	V _{DD} = 300 V, I _D = 1.5 A R _G = 4.7Ω V _{GS} = 10 V (Resistive Load see, Figure 3)		9 14		ns ns
Q _g Q _{gs} Q _{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V _{DD} = 400 V, I _D = 2.4 A, V _{GS} = 10 V		11.8 2.6 6.4		nC nC nC

SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t _{d(off)} t _f	Turn-off Delay Time Fall Time	V _{DD} = 480 V, I _D = 3 A R _G = 4.7Ω V _{GS} = 10 V (Resistive Load see, Figure 3)		19 14		ns ns
t _{r(Voff)} t _f t _c	Off-voltage Rise Time Fall Time Cross-over Time	V _{DD} = 480 V, I _D = 3 A, R _G = 4.7Ω, V _{GS} = 10 V (Inductive Load see, Figure 5)		11 14 24		ns ns ns

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I _{SD} I _{SDM} (2)	Source-drain Current Source-drain Current (pulsed)				2.4 9.6	A A
V _{SD} (1)	Forward On Voltage	I _{SD} = 2.4 A, V _{GS} = 0			1.6	V
t _{rr} Q _{rr} I _{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I _{SD} = 3 A, di/dt = 100A/μs V _{DD} = 35V, T _J = 150°C (see test circuit, Figure 5)		306 948 6.2		ns nC A

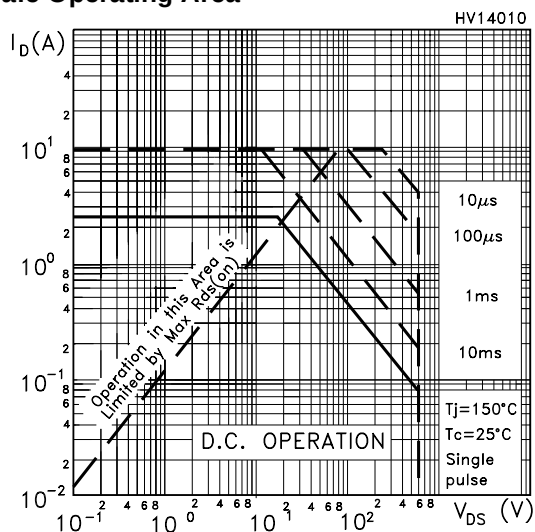
Note: 1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

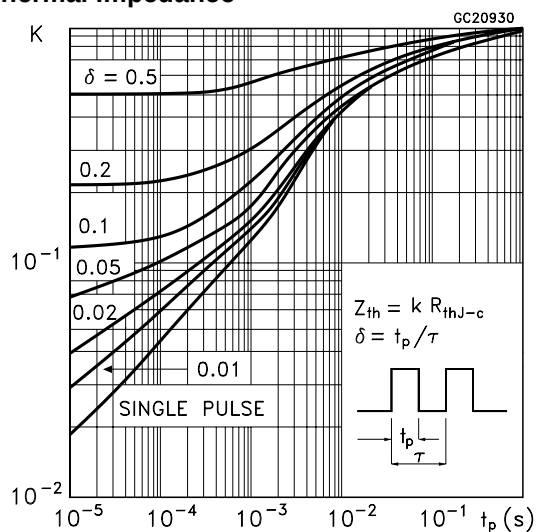
3. C_{oss} eq. is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.



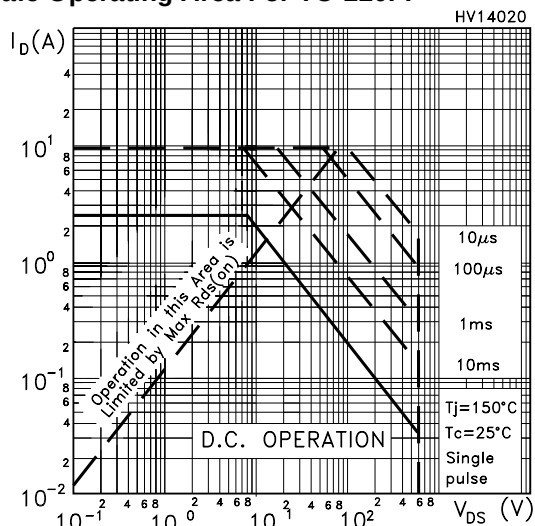
Safe Operating Area



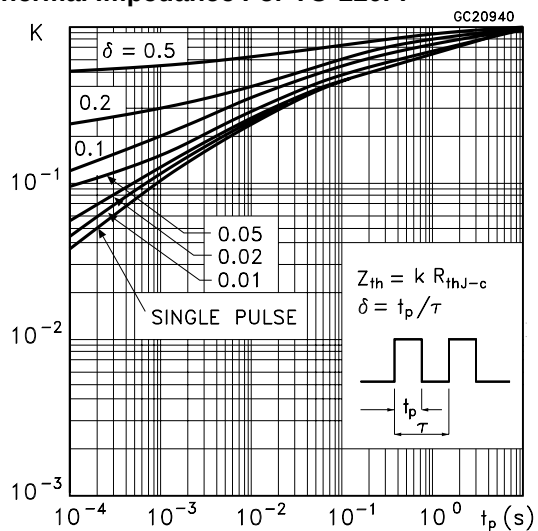
Thermal Impedance



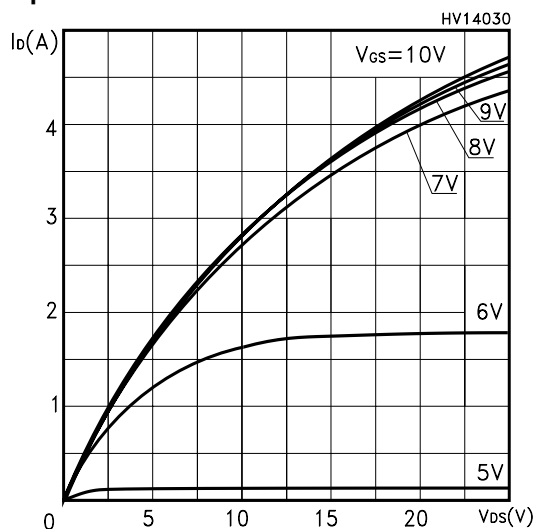
Safe Operating Area For TO-220FP



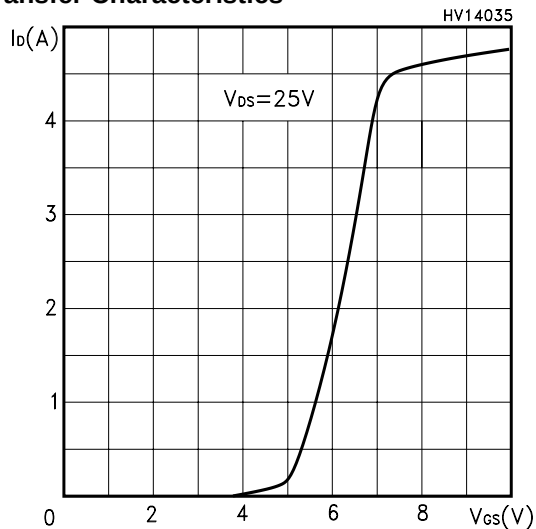
Thermal Impedance For TO-220FP



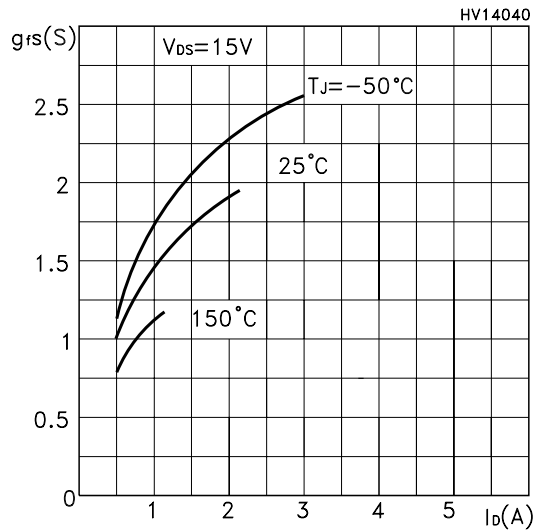
Output Characteristics



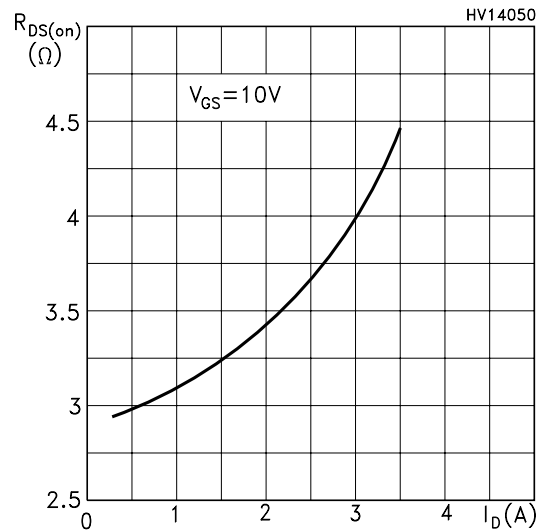
Transfer Characteristics



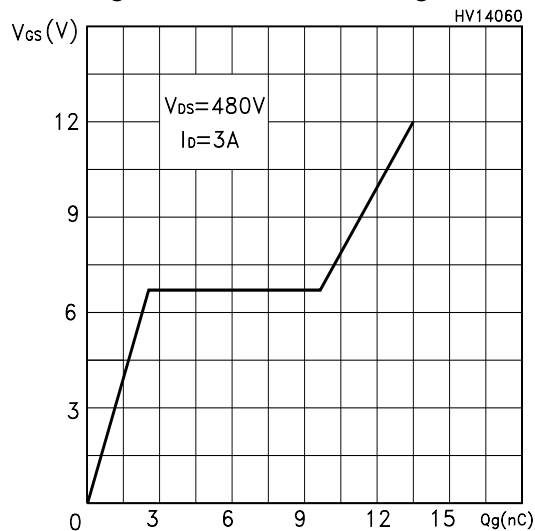
Transconductance



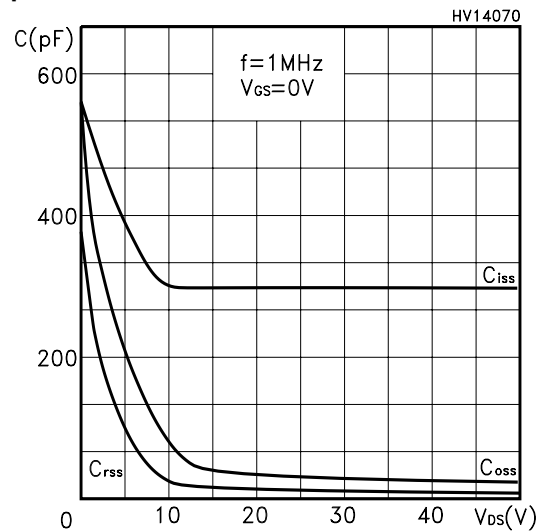
Static Drain-source On Resistance



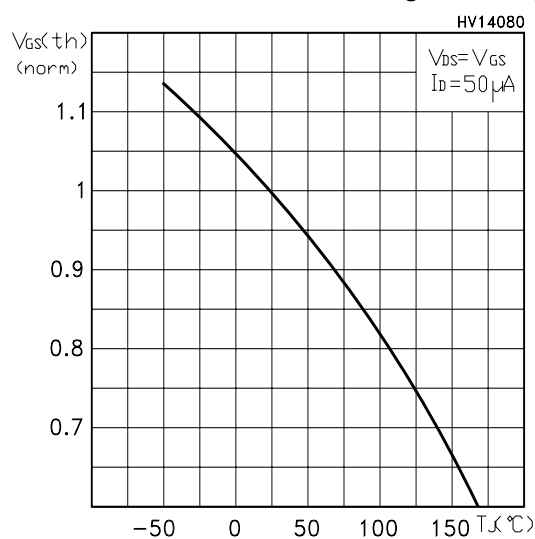
Gate Charge vs Gate-source Voltage



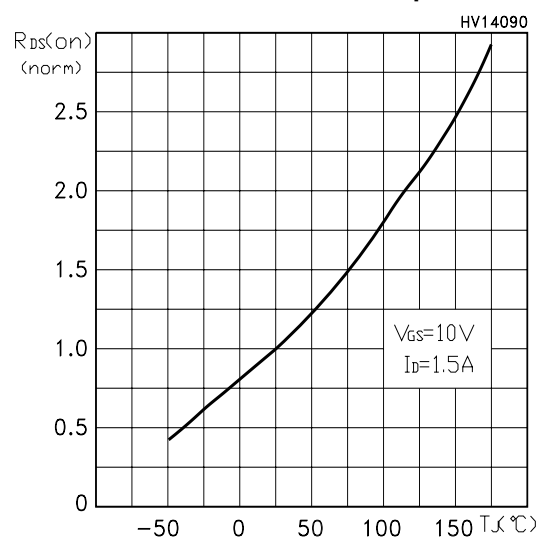
Capacitance Variations



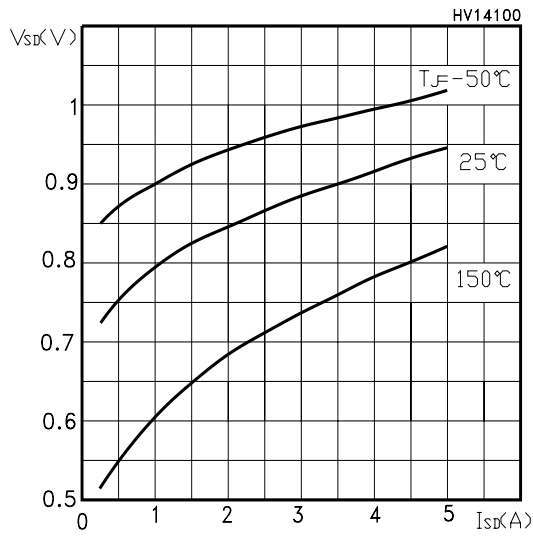
Normalized Gate Threshold Voltage vs Temp.



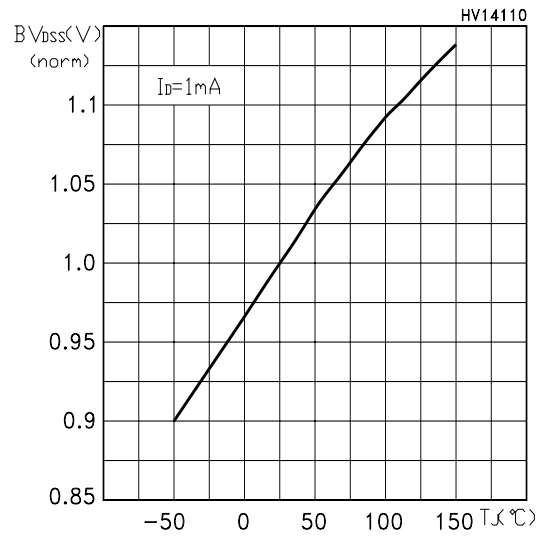
Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics



Normalized BVDSS vs Temperature



Maximum Avalanche Energy vs Temperature

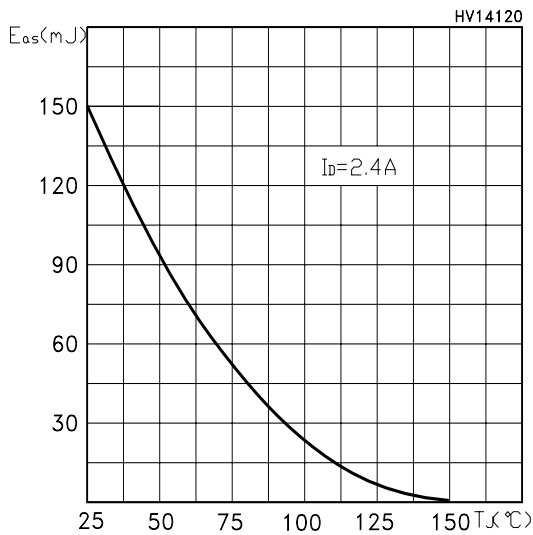


Fig. 1: Unclamped Inductive Load Test Circuit

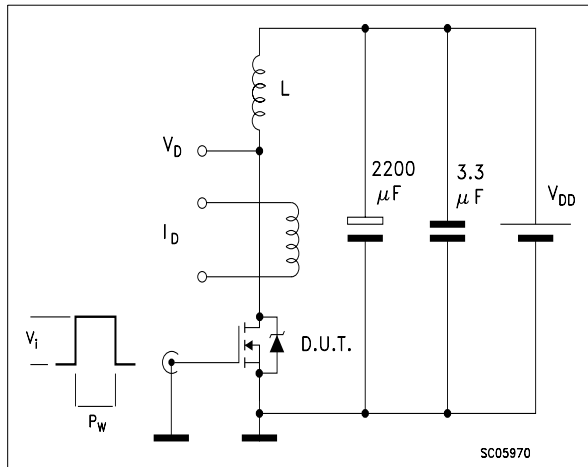


Fig. 2: Unclamped Inductive Waveform

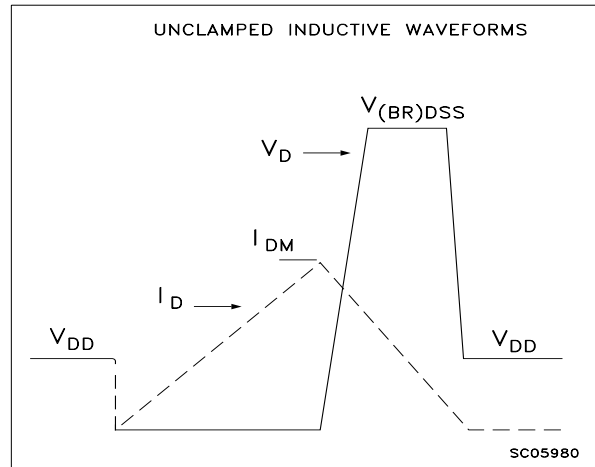


Fig. 3: Switching Times Test Circuit For Resistive Load

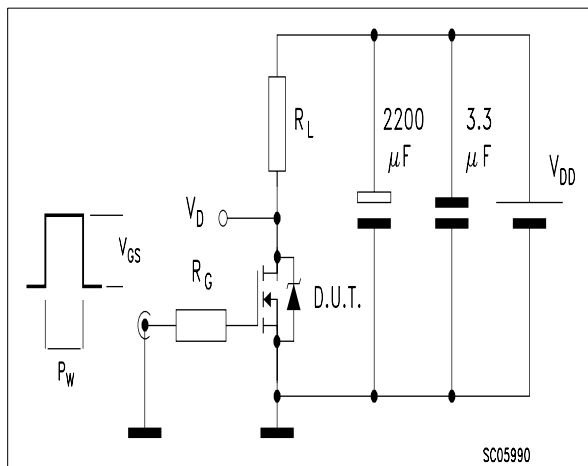


Fig. 4: Gate Charge test Circuit

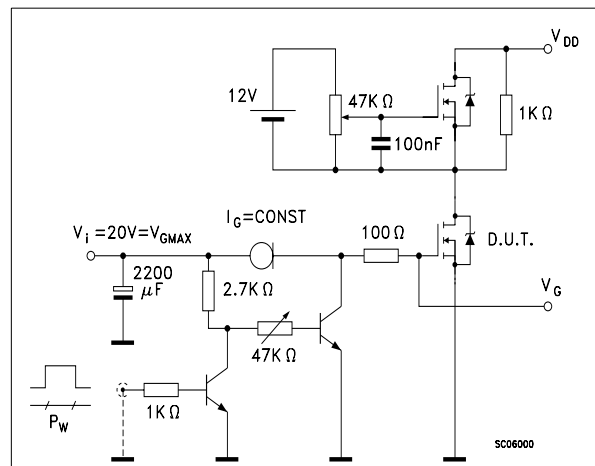
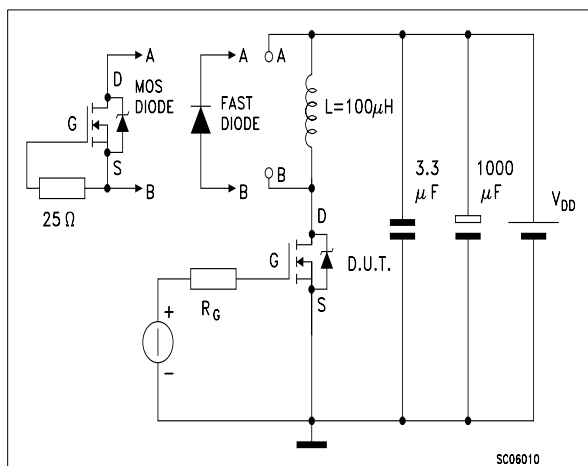
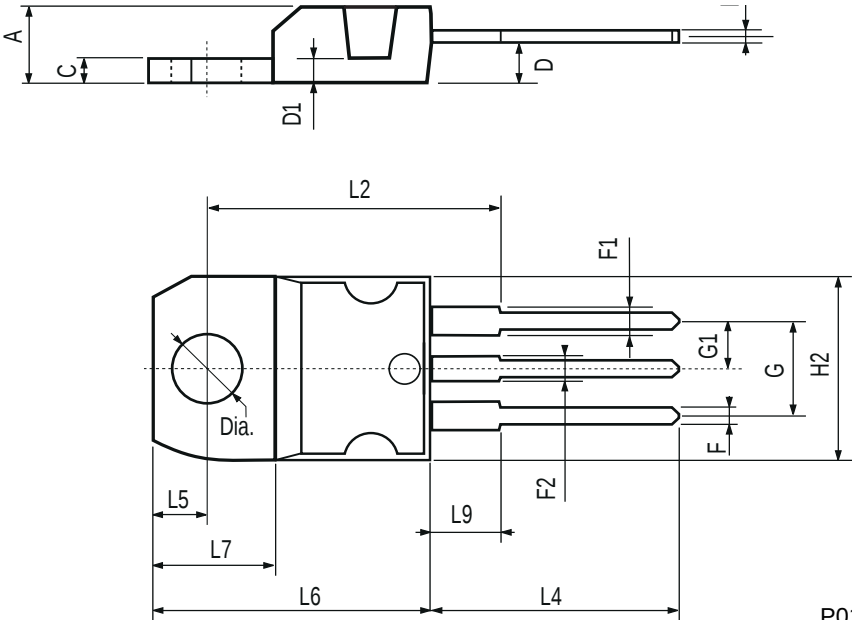


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



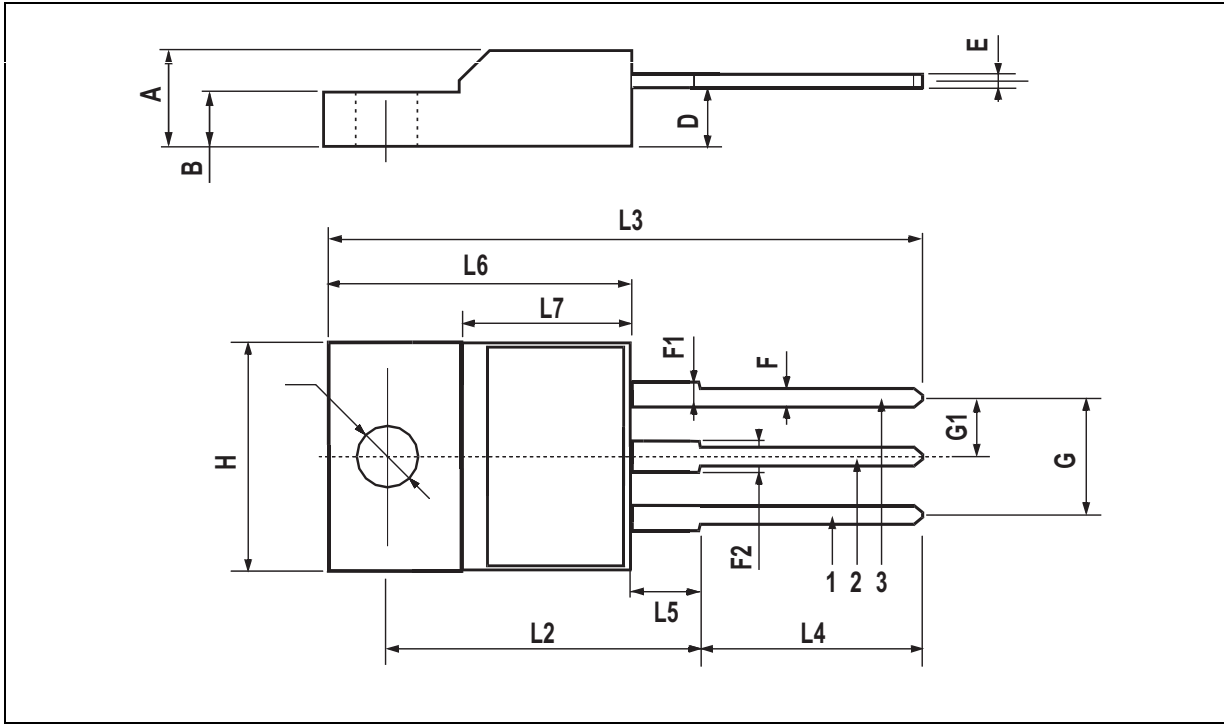
TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



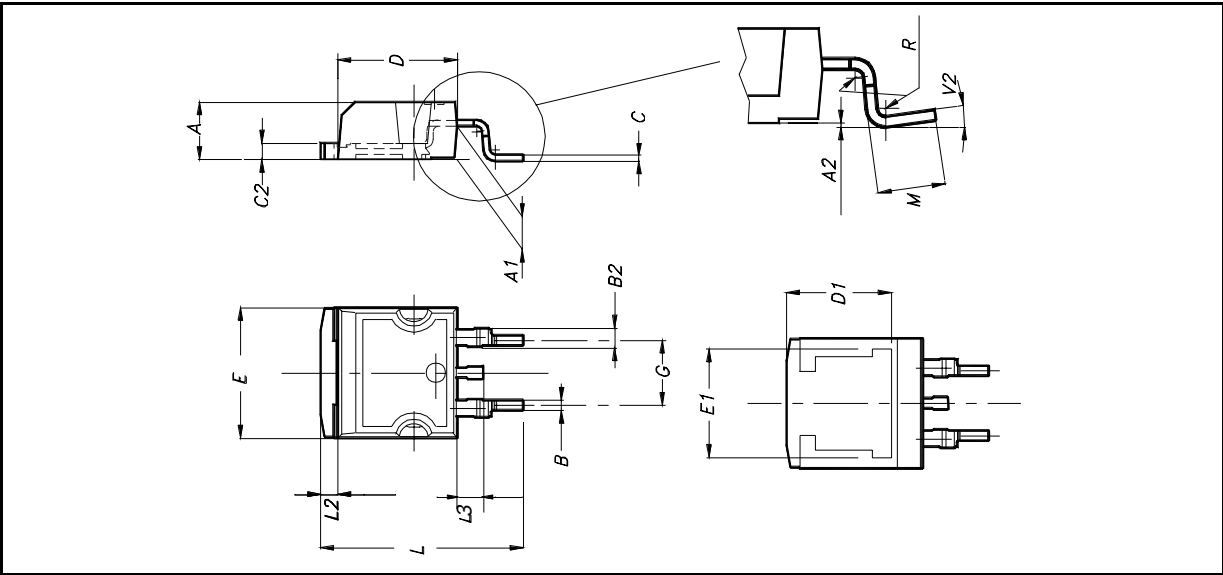
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	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		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



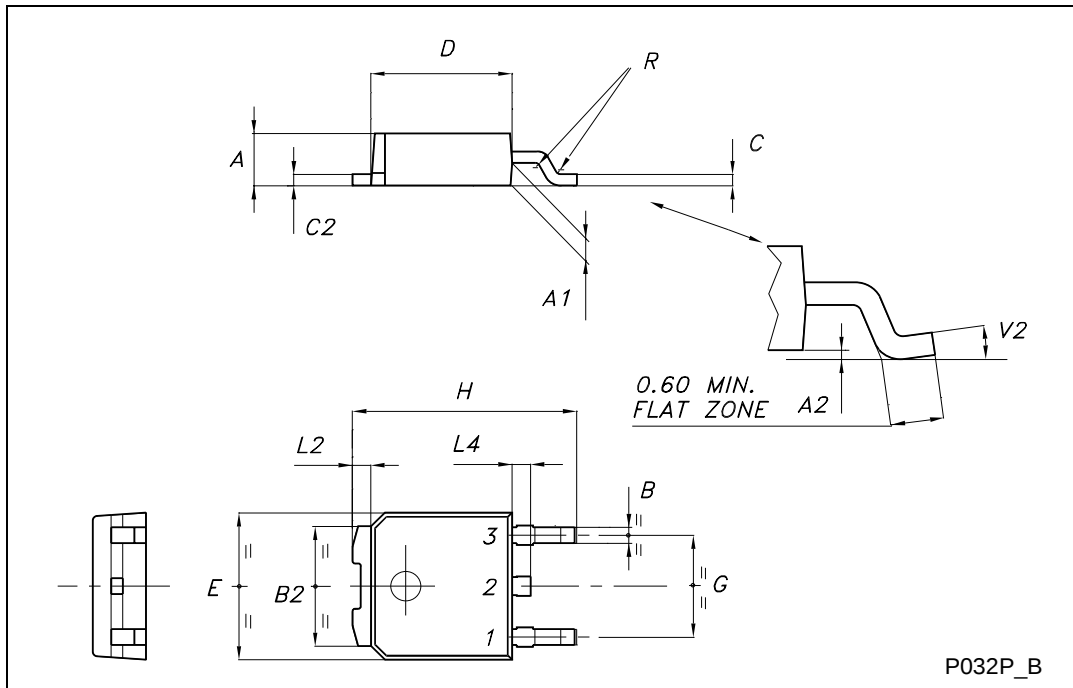
D²PAK MECHANICAL DATA

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°			



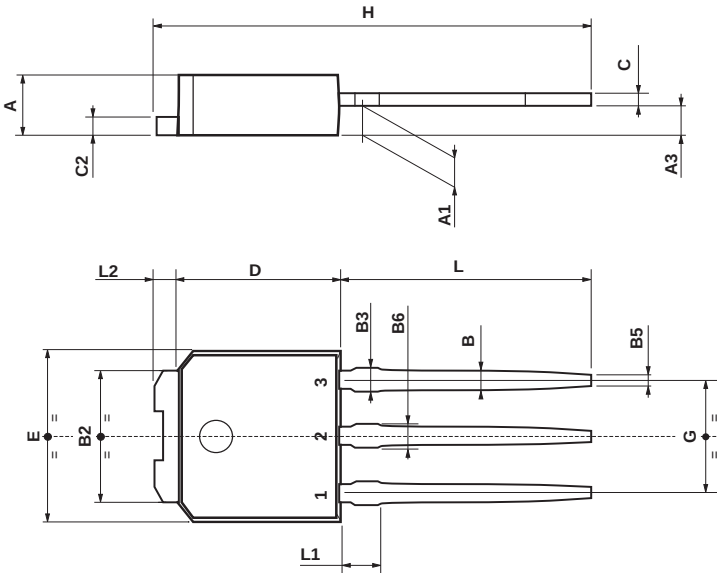
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°



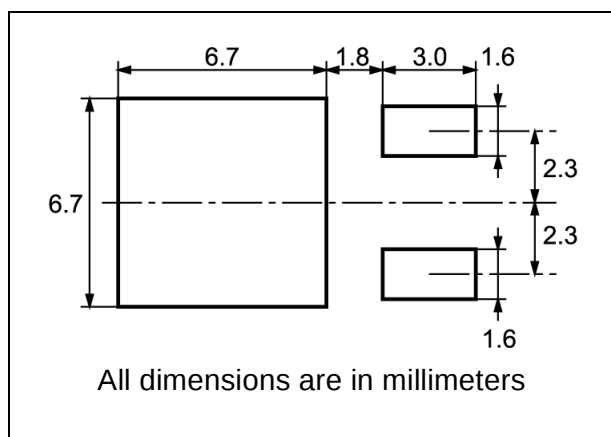
TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039

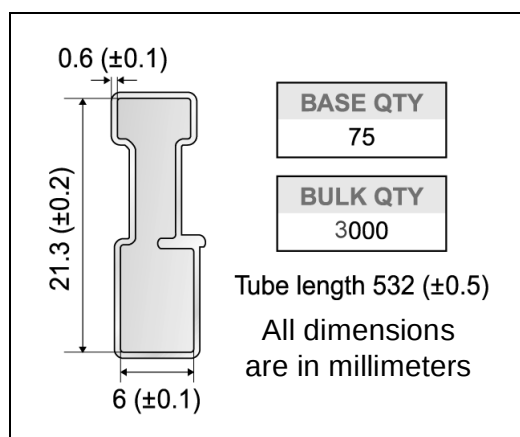


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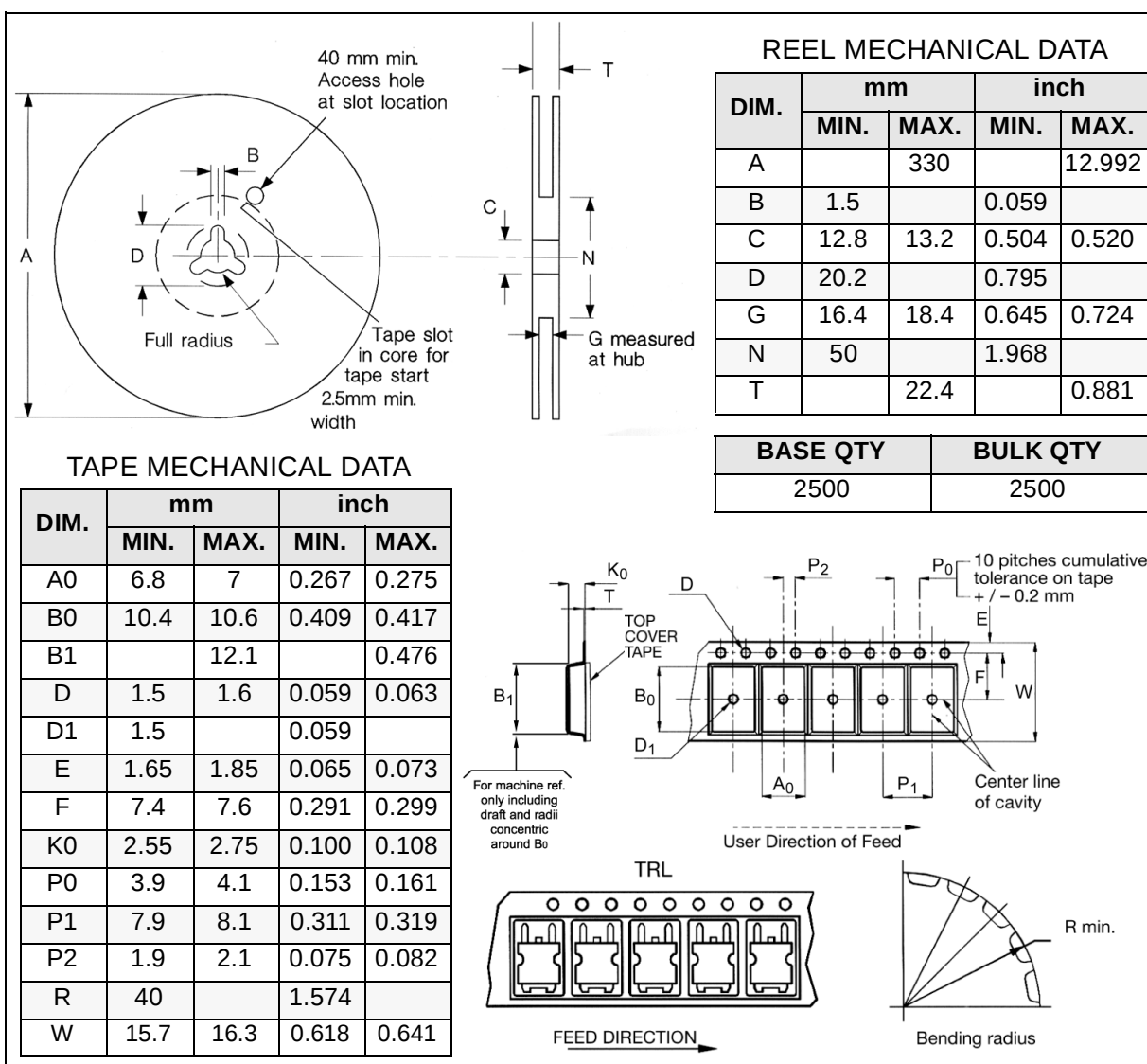
DPAK FOOTPRINT



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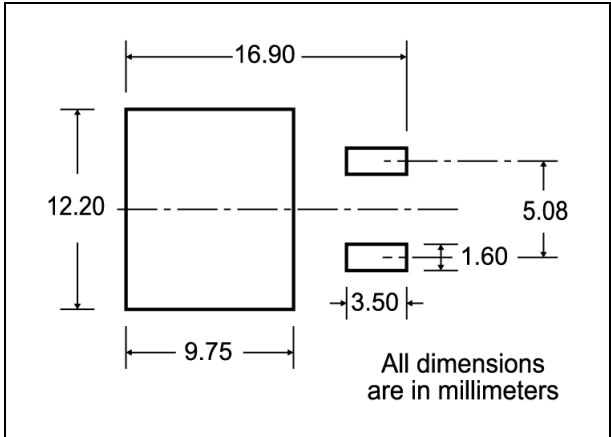
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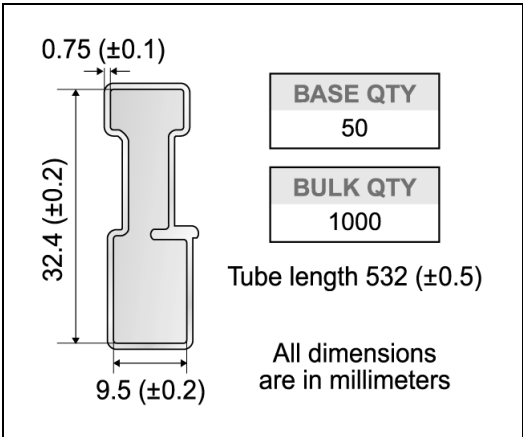
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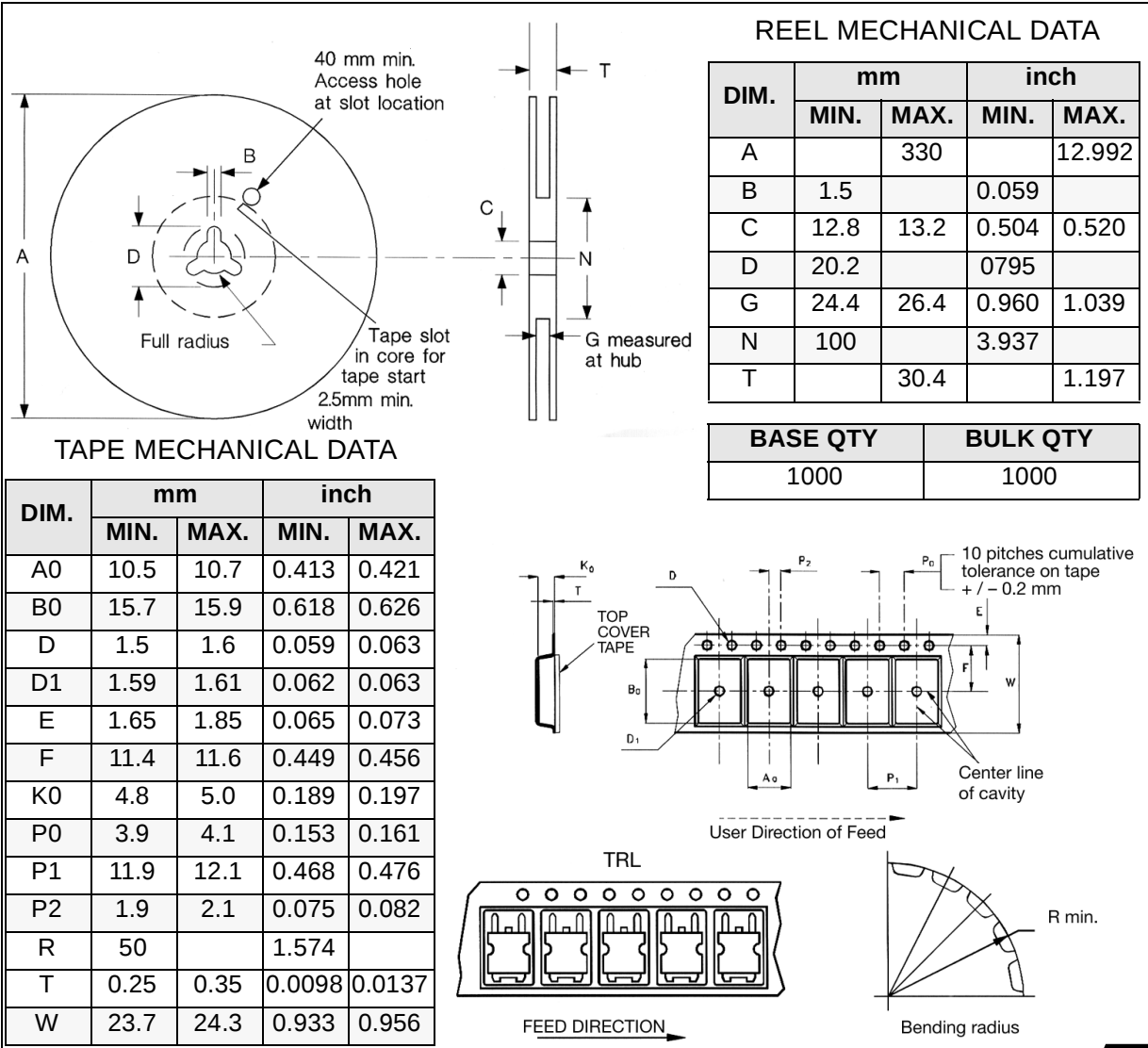
D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*



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