STGP14NC60KD - STGF14NC60KD
STGB14NC60KD

N-CHANNEL 14A - 600V - TO-220/TO-220FP/D²PAK SHORT CIRCUIT RATED PowerMESH™ IGBT

Table 1: General Features

TYPE	V_{CES}	$V_{CE(sat)}$ (Max) @25°C	I_C (#) @100°C
STGB14NC60KD STGF14NC60KD STGP14NC60KD	600 V 600 V 600 V	< 2.5 V < 2.5 V < 2.5 V	14 A 7 A 14 A

- LOWER ON-VOLTAGE DROP (V_{cesat})
- OFF LOSSES INCLUDE TAIL CURRENT
- LOWER C_{RES} / C_{IES} RATIO
- SWITCHING LOSSES INCLUDE DIODE RECOVERY ENERGY
- VERY SOFT ULTRA FAST RECOVERY ANTIPARALLEL DIODE
- NEW GENERATION PRODUCTS WITH TIGHTER PARAMETER DISTRUBUTION

Figure 1: Package

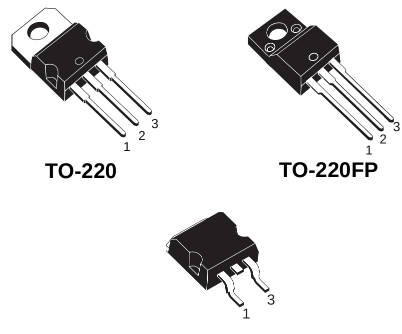
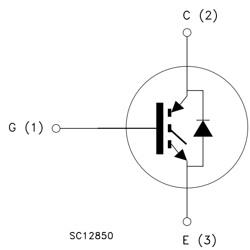


Figure 2: Internal Schematic Diagram



DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “K” identifies a family optimized for high frequency motor control applications with short circuit withstand capability.

APPLICATIONS

- HIGH FREQUENCY INVERTERS
- SMPS and PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES
- MOTOR DRIVERS

Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STGB14NC60KDT4	GB14NC60KD	D²PAK	TAPE & REEL
STGF14NC60KD	GF14NC60KD	TO-220FP	TUBE
STGP14NC60KD	GP14NC60KD	TO-220	TUBE

Rev.2

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		STGB14NC60KD STGP14NC60KD	STGF14NC60KD	
V_{CES}	Collector-Emitter Voltage (V_{GS} = 0)	600		V
V_{ECR}	Emitter-Collector Voltage	20		V
V_{GE}	Gate-Emitter Voltage	±20		V
I_C	Collector Current (continuous) at T_C = 25°C (#)	25	11	A
I_C	Collector Current (continuous) at T_C = 100°C (#)	14	7	A
I_{CM} (■)	Collector Current (pulsed)	50		A
I_F	Diode RMS Forward Current at T_C = 25°C	20		A
P_{TOT}	Total Dissipation at T_C = 25°C	80	25	W
	Derating Factor	0.64	0.20	W/°C
V_{ISO}	Insulation Withstand Voltage A.C.(t = 1 sec; Tc = 25°C)	--	2500	V
T_{stg}	Storage Temperature	– 55 to 150		°C
T_j	Operating Junction Temperature			

(■) Pulse width limited by Max Junction Temperature.

Table 4: Thermal Data

			Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case	**TO-220 D²PAK**			1.56	°C/W
		TO-220FP			5.0	°C/W
Rthj-amb	Thermal Resistance Junction-ambient				62.5	°C/W
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)			300		°C

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

Table 5: Main Parameters

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	I_C= 1 mA, V_{GE}= 0	600			V
I_{CES}	Collector cut-off Current (V_{GE} = 0)	V_{CE}= Max Rating, T_C= 25°C V_{CE}= Max Rating, T_C= 125°C			10 1	µA mA
I_{GES}	Gate-Emitter Leakage Current (V_{CE} = 0)	V_{GE}= ±20V , V_{CE}= 0			±100	nA
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE}= V_{GE}, I_C= 250 µA	5		7	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}= 15V, I_C= 7A V_{GE}= 15V, I_C= 7A, Tc= 125°C		2.0 1.8	2.5	V V

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 6: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{CE} = 15 V , I_C = 7 A		3		S
C_{ies} C_{oes} C_{res}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{CE} = 25 V, f= 1 MHz, V_{GE} = 0		760 86 15.5		pF pF pF
Q_g Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	V_{CE} = 390 V, I_C = 7 A, V_{GE} = 15 V (see Figure 21)		34.4 8.1 16.4		nC nC nC
t_{scw}	Short Circuit Withstand Time	V_{CE} = 0.5 $V_{BR(CES)}$,T_j = 125°C, R_G = 10 Ω, V_{GE} = 12 V	10			µs

Table 7: Switching On

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} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 25°C (see Figure 19)		22.5 8.5 700		ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Current Slope	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 125°C (see Figure 19)		22 9.5 680		ns ns A/µs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off Voltage Rise Time Turn-off Delay Time Current Fall Time	V_{cc} = 390 V, I_C = 7 A, R_{GE} = 10 Ω , V_{GE} = 15 V T_J = 25 °C (see Figure 19)		60 116 75		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} = 390 V, I_C = 7 A, R_{GE} = 10 Ω , V_{GE} = 15 V Tj = 125 °C (see Figure 19)		24 196 144		ns ns ns

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Losses Total Switching Losses	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 25°C (see Figure 19)		82 155 237		µJ µJ µJ
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Losses Total Switching Losses	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 125°C (see Figure 19)		131 370 501		µJ µJ µJ

(1) Pulsed: Pulse duration = 300 µs, duty cycle 1.5%
(2) Eon is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)
(3)Turn-off losses include also the tail of the collector current.

Table 10: Collector-Emitter Diode

Symbol	Parameter	Test Condiction	Min.	Typ.	Max.	Unit
V_f	Forward On-Voltage	If = 3.5 A If = 3.5 A, Tj = 125 °C		1.3 1.1	1.9	V V
t_{rr} t_a Q_{rr} I_{rrm} S	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	If = 7 A, V_R = 40 V, T_j = 25 °C, di/dt = 100 A/µs		37 22 40 2.1 0.68		ns ns nC A
t_{rr} t_a Q_{rr} I_{rrm} S	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	If = 7 A, V_R = 40 V, T_j = 125 °C, di/dt = 100 A/µs		61 34 98 3.2 0.79		ns ns nC A

Figure 3: Output Characteristics

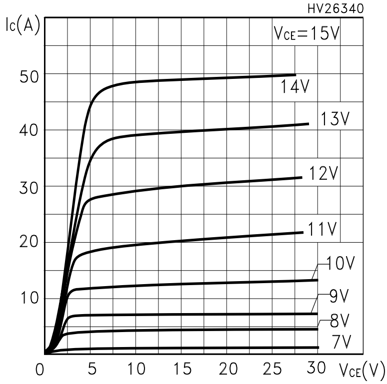


Figure 6: Transfer Characteristics

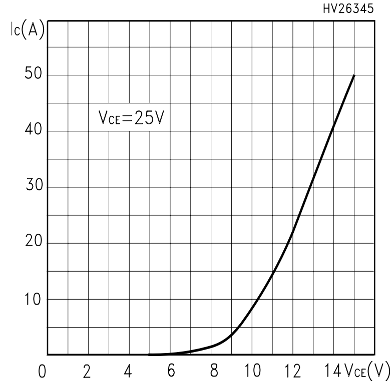


Figure 4: Transconductance

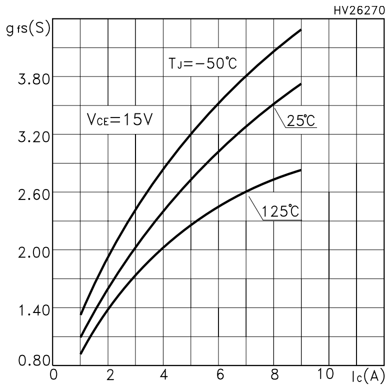


Figure 7: Collector-Emitter On Voltage vs Temperature

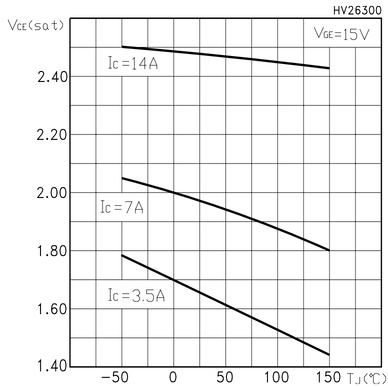


Figure 5: Collector-Emitter On Voltage vs Collector Current

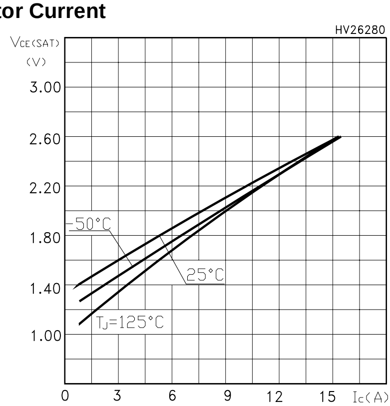


Figure 8: Normalized Gate Threshold vs Temperature

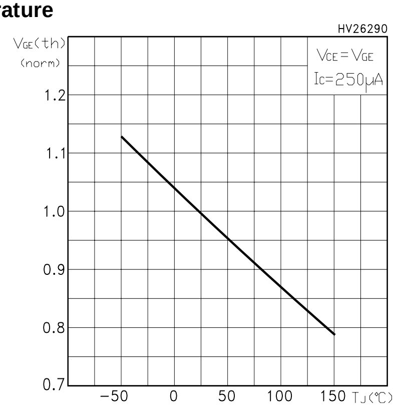


Figure 9: Normalized Breakdown Voltage vs Temperature

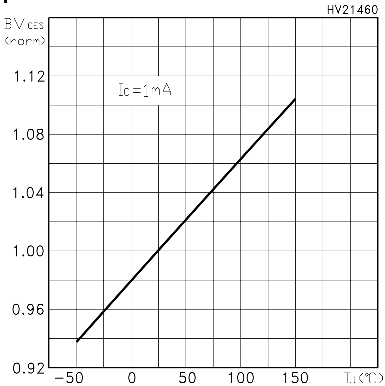


Figure 12: Gate Charge vs Gate-Emitter Voltage

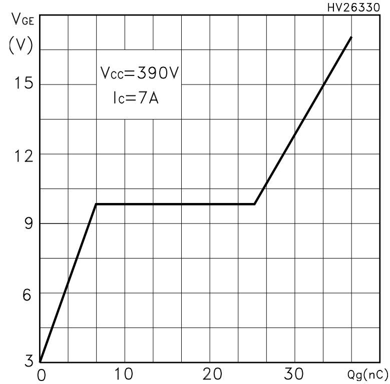


Figure 10: Capacitance Variations

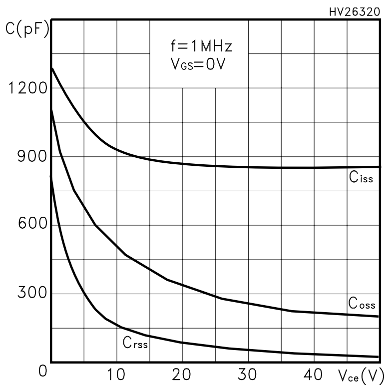


Figure 13: Total Switching Losses vs Temperature

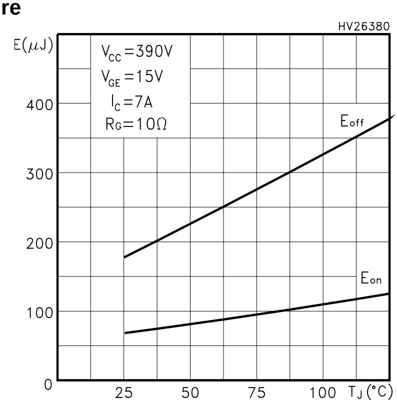


Figure 11: Total Switching Losses vs Gate Resistance

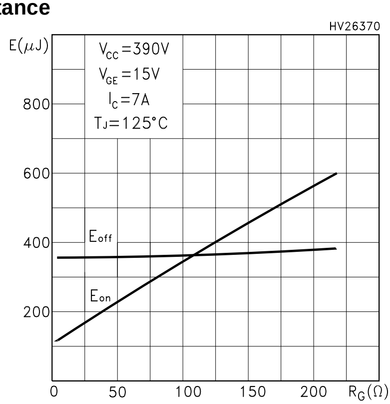


Figure 14: Total Switching Losses vs Collector Current

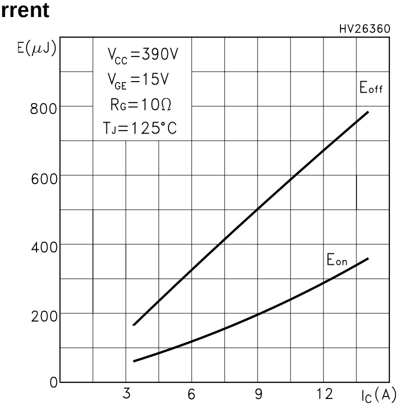


Figure 15: Thermal Impedance For TO-220/ D²PAK

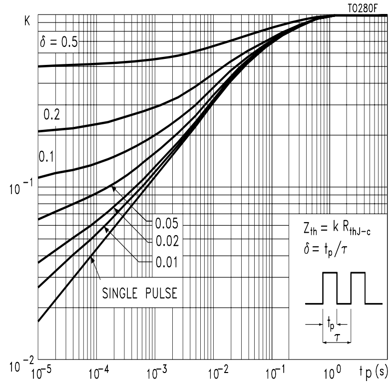


Figure 16: Thermal Impedance For TO-220FP

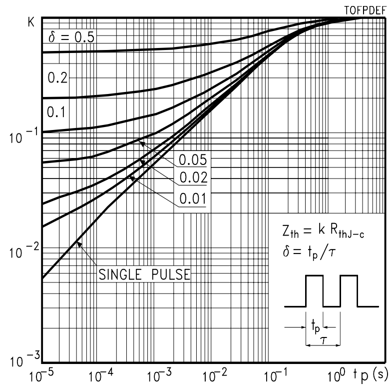


Figure 17: Turn-Off SOA

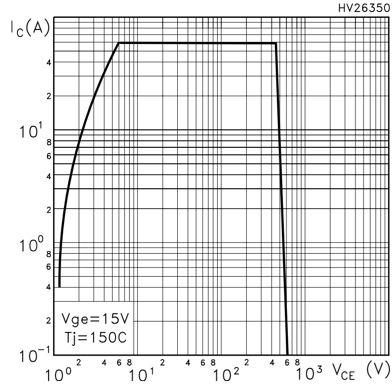


Figure 18: Emitter-Collector Diode Characteristics

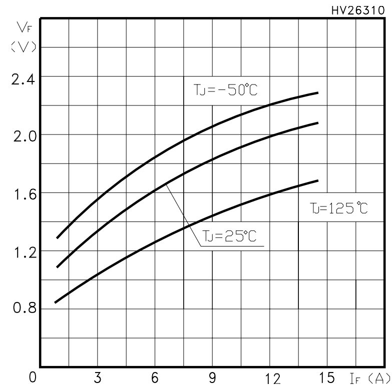


Figure 19: Test Circuit for Inductive Load Switching

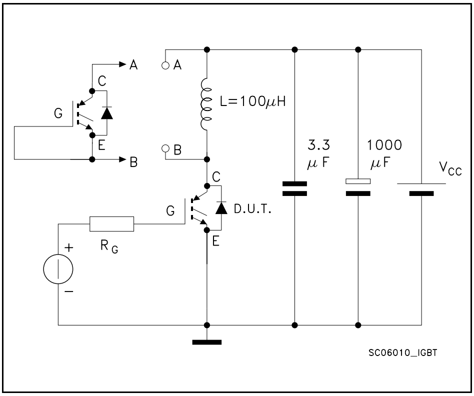


Figure 21: Gate Charge Test Circuit

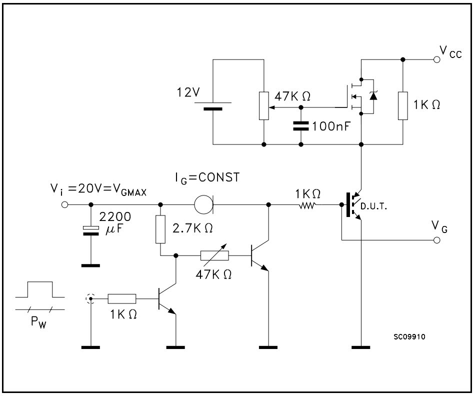


Figure 20: Switching Waveforms

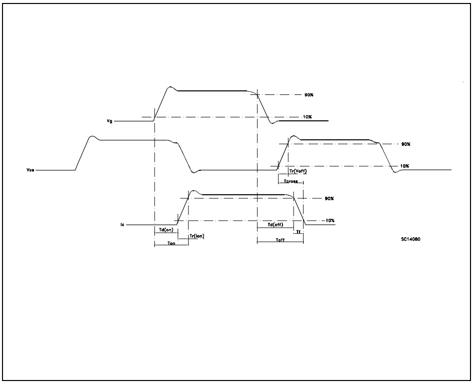
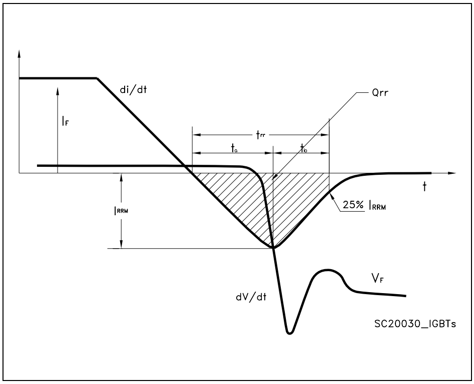
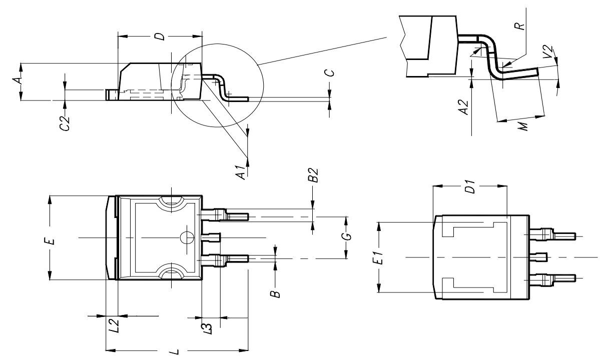


Figure 22: Diode Recovery Times Waveform



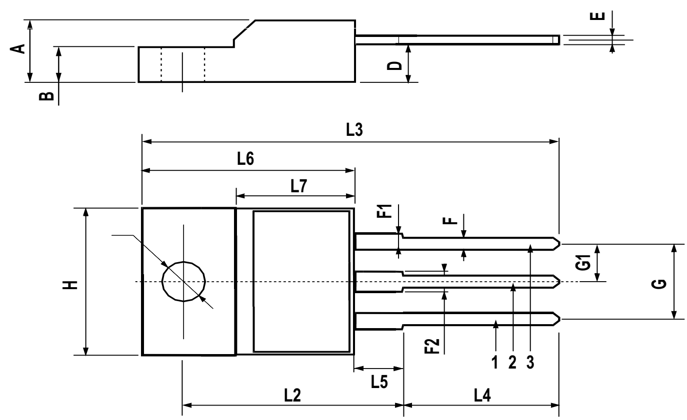
D^2PAK MECHANICAL DATA

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	0º		4º			



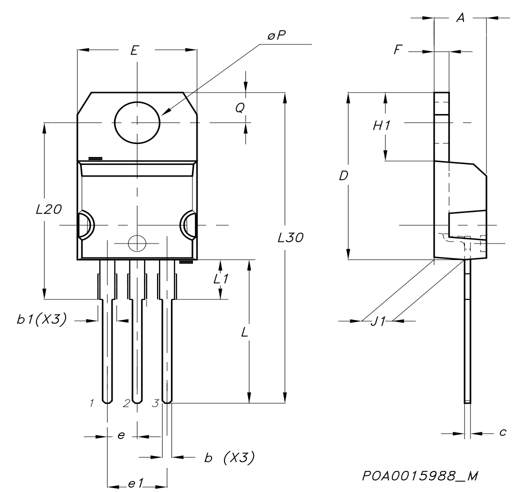
TO-220FP MECHANICAL DATA

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

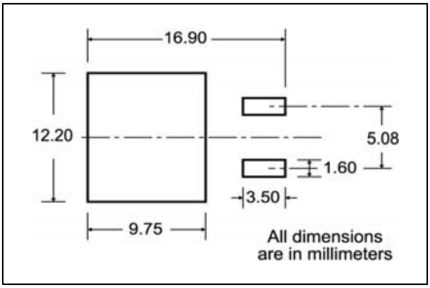


TO-220 MECHANICAL DATA

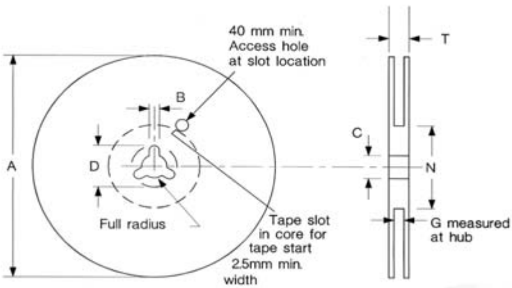
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		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



D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



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		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

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

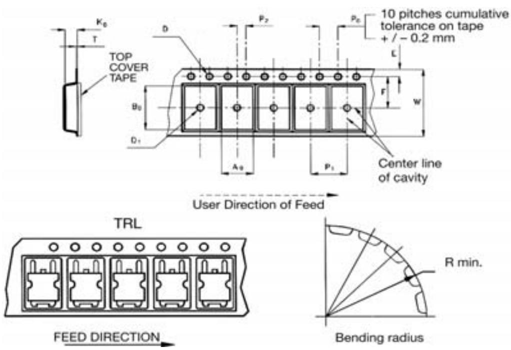


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Table 11: Revision History

Date	Revision	Description of Changes
14-Jun-2005	1	New release
22-Jul-2005	2	Complete version