



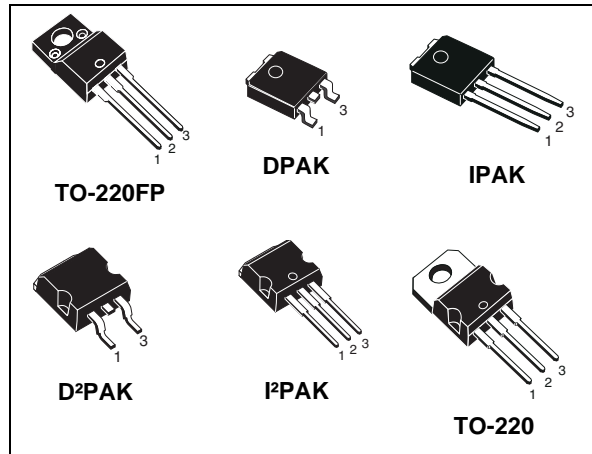
# STB60N55F3, STD60N55F3, STF60N55F3 STI60N55F3, STP60N55F3, STU60N55F3

N-channel 55 V, 6.5 mΩ, 80 A, DPAK, IPAK, D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220  
TO-220FP STripFET™ III Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STB60N55F3	55V	<8.5mΩ	80A	110W
STD60N55F3	55V	<8.5mΩ	80A	110W
STF60N55F3	55V	<8.5mΩ	42A	30W
STI60N55F3	55V	<8.5mΩ	80A	110W
STP60N55F3	55V	<8.5mΩ	80A	110W
STU60N55F3	55V	<8.5mΩ	80A	110W

- Standard threshold drive
- 100% avalanche tested



## Application

- Switching applications

## Description

This STripFET™ III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performances.

Figure 1. Internal schematic diagram

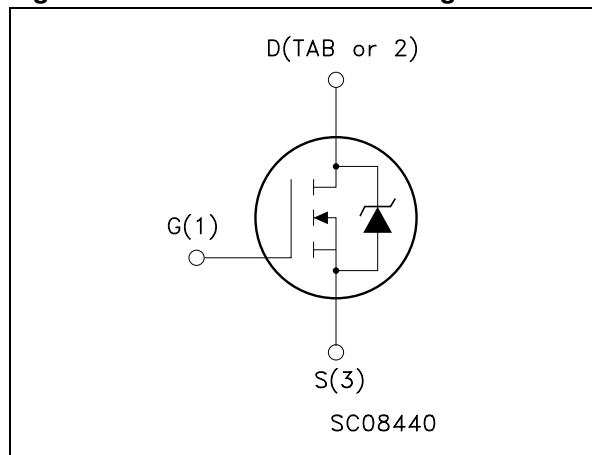


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB60N55F3	60N55F3	D <sup>2</sup> PAK	Tape and reel
STD60N55F3	60N55F3	DPAK	Tape and reel
STF60N55F3	60N55F3	TO-220FP	Tube
STI60N55F3	60N55F3	I <sup>2</sup> PAK	Tube
STP60N55F3	60N55F3	TO-220	Tube
STU60N55F3	60N55F3	IPAK	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK/D <sup>2</sup> PAK TO-220 IPAK/I <sup>2</sup> PAK	TO-220FP	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> =0)	55		V
V <sub>GS</sub>	Gate-source voltage	± 20		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25°C	80	42	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100°C	56	30	A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	320	168	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	110	30	W
	Derating factor	0.73	0.2	W/°C
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	11		V/ns
E <sub>AS</sub> <sup>(3)</sup>	Single pulse avalanche energy	390		mJ
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s; T <sub>C</sub> =25°C)		2500	V
T <sub>j</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-55 to 175		°C

1. Pulse width limited by safe operating area
2. I<sub>SD</sub> ≤ 80 A, di/dt ≤ 300A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>. T<sub>j</sub> ≤ T<sub>jmax</sub>
3. Starting T<sub>j</sub>=25°C, I<sub>d</sub>=32 A, V<sub>dd</sub>= 25 V

**Table 3. Thermal resistance**

Symbol	Parameter	Value					Unit
		DPAK	IPAK I <sup>2</sup> PAK	D <sup>2</sup> PAK	TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.36			5	°C/W	
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max	50		35		°C/W	
R <sub>thj-a</sub>	Thermal resistance junction-ambient max		100		62.5	°C/W	
T <sub>l</sub>	Maximum lead temperature for soldering purpose		275		300	°C	

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\mu A, V_{GS} = 0$	55			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating},$ $V_{DS} = \text{Max rating}, T_c = 125\text{ °C}$			10 100	$\mu A$ $\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 200$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 32A$		6.5	8.5	m $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 25V, I_D = 32A$	-	50		S
$C_{iss}$	Input capacitance	$V_{DS} = 25V, f = 1MHz, V_{GS} = 0$	-	2200		pF
$C_{oss}$	Output capacitance			500		pF
$C_{rss}$	Reverse transfer capacitance			25		pF
$Q_g$	Total gate charge	$V_{DD} = 27V, I_D = 65A$	-	33.5	45	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10V$		12.5		nC
$Q_{gd}$	Gate-drain charge	(see Figure 16)		9.5		nC

1. Pulsed: pulse duration = 300  $\mu s$ , duty cycle 1.5%

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 27V, I_D = 32A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 18)	-	20	-	ns
$t_r$	Rise time			50	-	ns
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 27V, I_D = 32A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 18)	-	35	-	ns
$t_f$	Fall time			11.5	-	ns

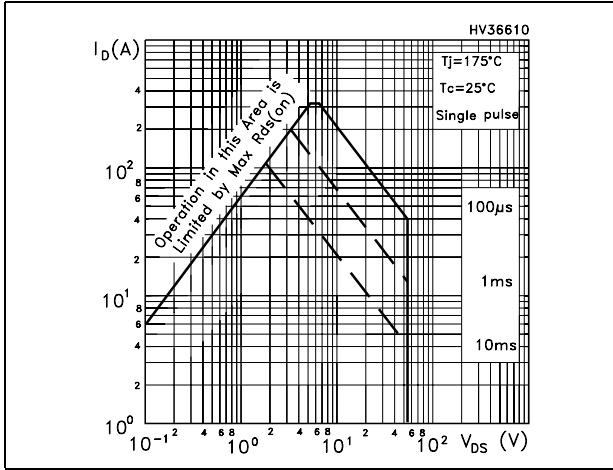
Table 7. Source drain diode

Symbol	Parameter	Test conditions	Packages	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)		DPAK-D <sup>2</sup> PAK- I <sup>2</sup> PAK-I <sup>2</sup> PAK- TO-220	-		80 320	A A
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)		TO-220FP	-		42 168	A A
$V_{SD}$	Forward on voltage	$I_{SD} = 65A, V_{GS} = 0$		-		1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 65A, V_{DD} = 30V$ $di/dt = 100A/\mu s,$ $T_j = 150^\circ C$ <i>(see Figure 17)</i>		-	47 87 3.7		ns nC A

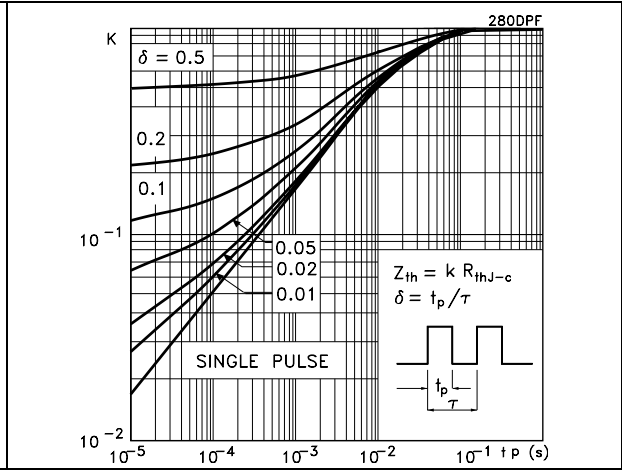
1. Pulsed: pulse duration = 300  $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

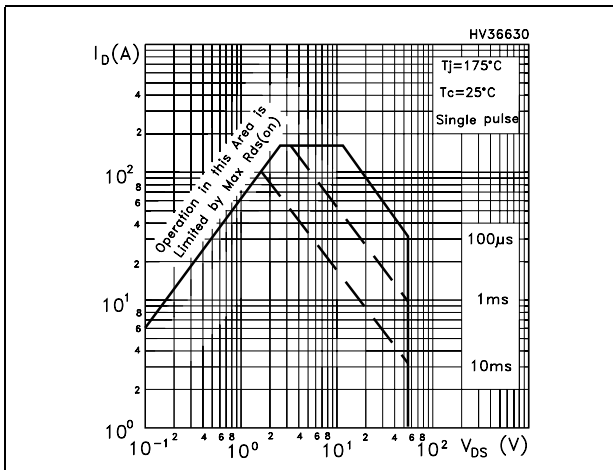
**Figure 2. Safe operating area for TO-220 D<sup>2</sup>PAK / I<sup>2</sup>PAK / DPAK**



**Figure 3. Thermal impedance for TO-220 D<sup>2</sup>PAK / I<sup>2</sup>PAK / DPAK**



**Figure 4. Safe operating area for TO-220FP**



**Figure 5. Thermal impedance for TO-220FP**

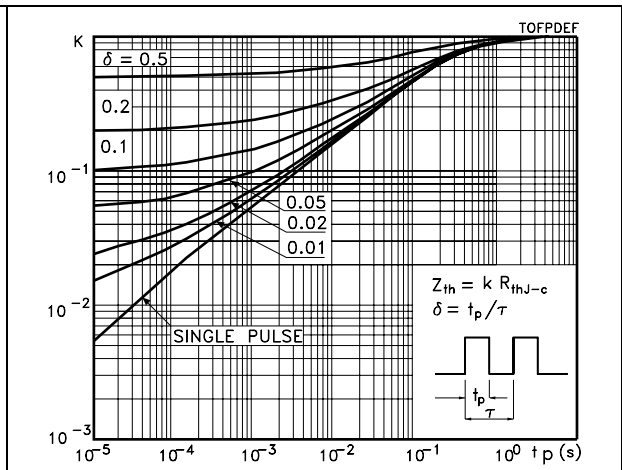


Figure 6. Output characteristics

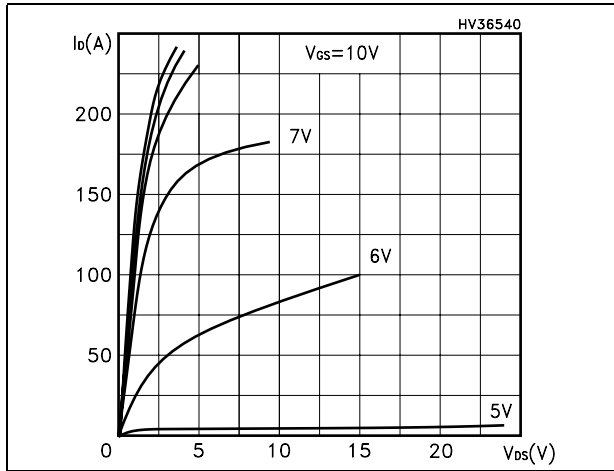


Figure 7. Transfer characteristics

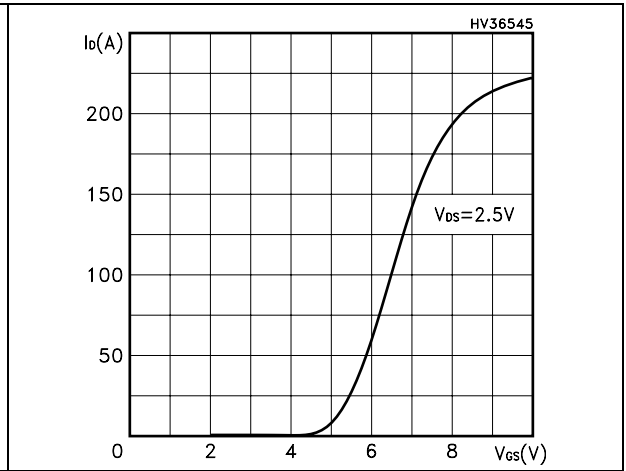


Figure 8. Normalized  $BV_{DSS}$  vs temperature

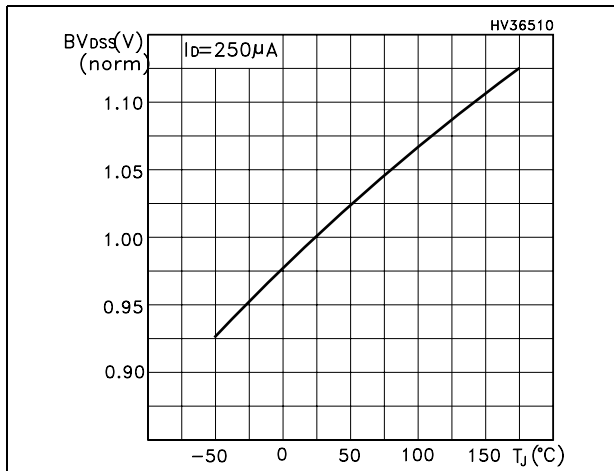


Figure 9. Static drain-source on resistance

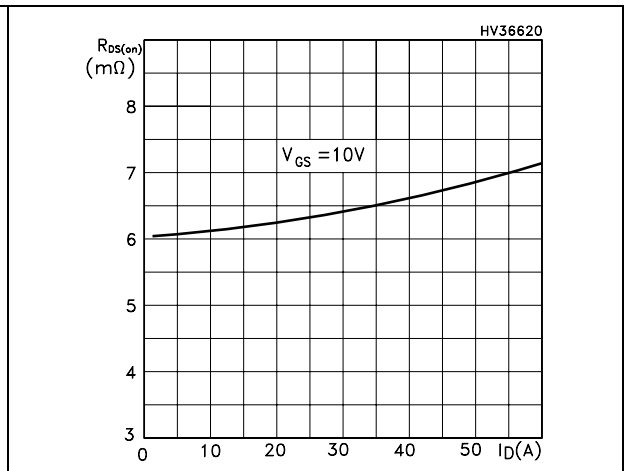


Figure 10. Gate charge vs gate-source voltage

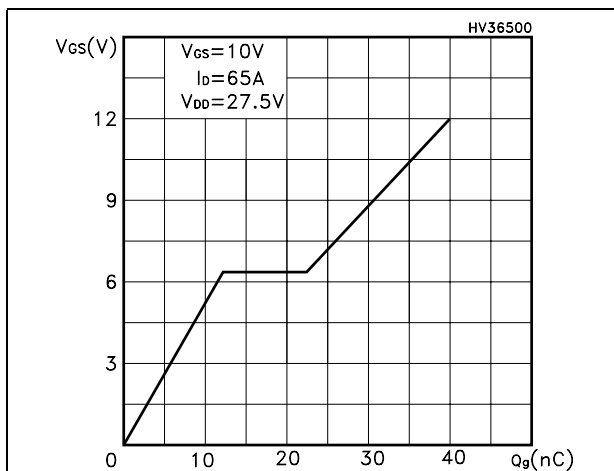


Figure 11. Capacitance variations

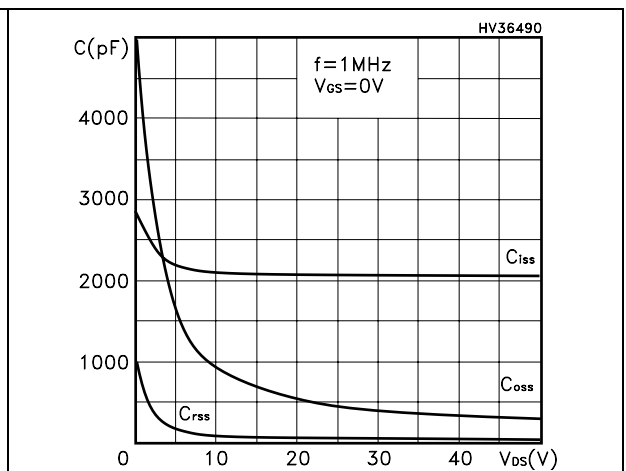


Figure 12. Normalized gate threshold voltage vs temperature

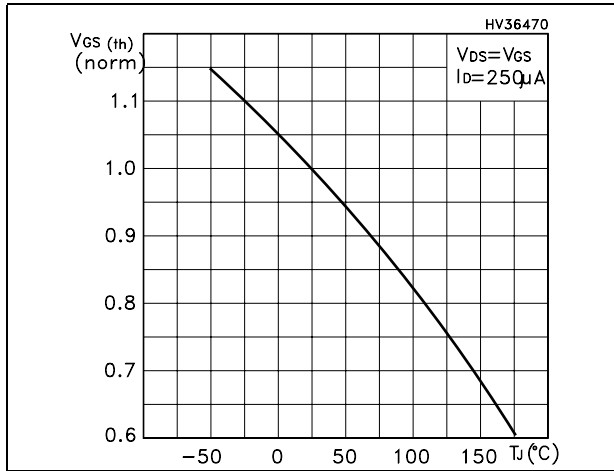


Figure 13. Normalized on resistance vs temperature

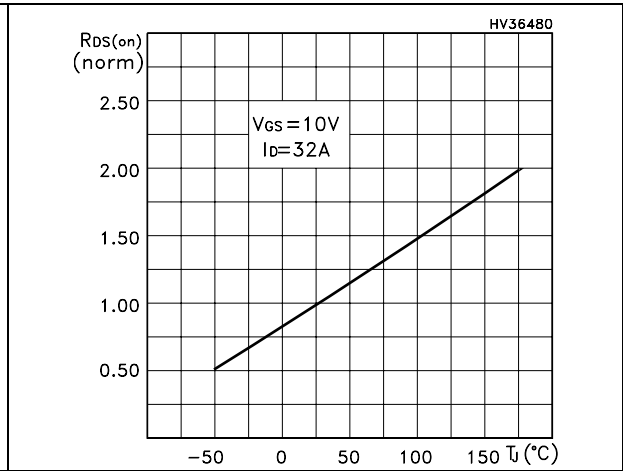
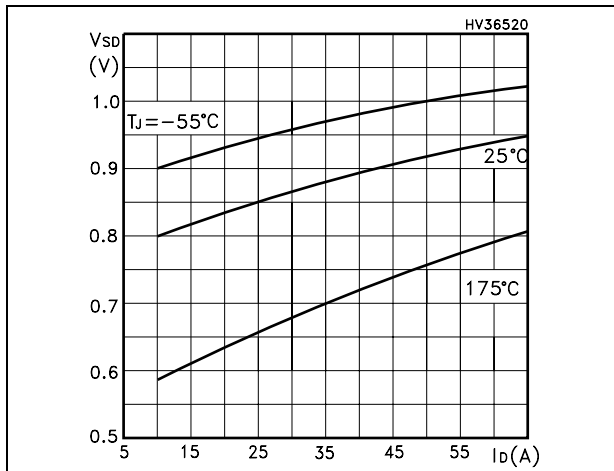


Figure 14. Source-drain diode forward characteristics





### 3 Test circuits

Figure 15. Switching times test circuit for resistive load

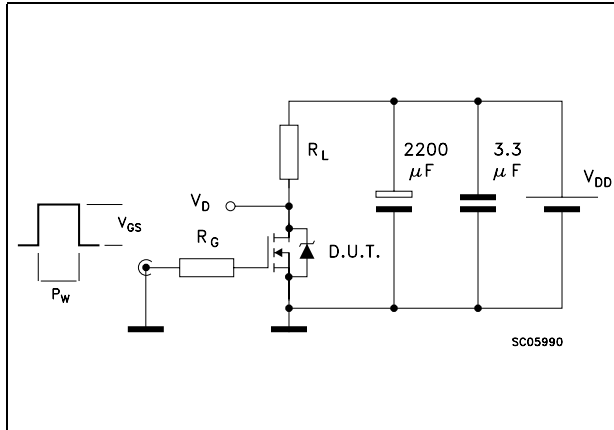


Figure 16. Gate charge test circuit

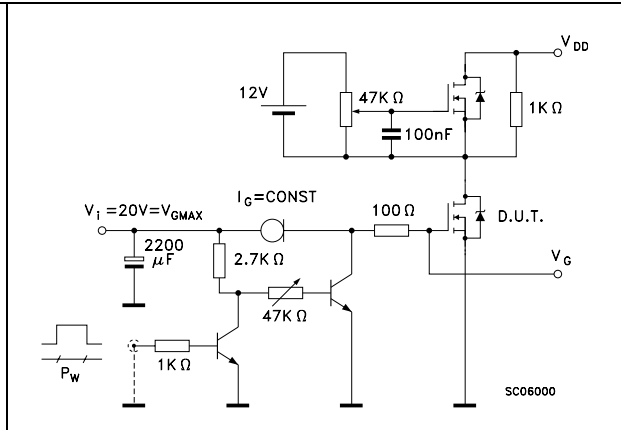


Figure 17. Test circuit for inductive load switching and diode recovery times

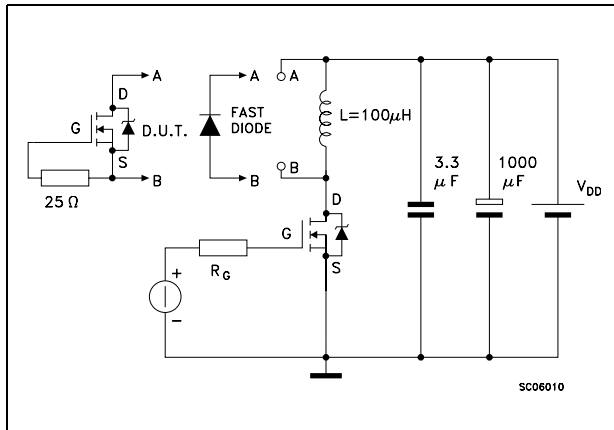


Figure 18. Unclamped inductive load test circuit

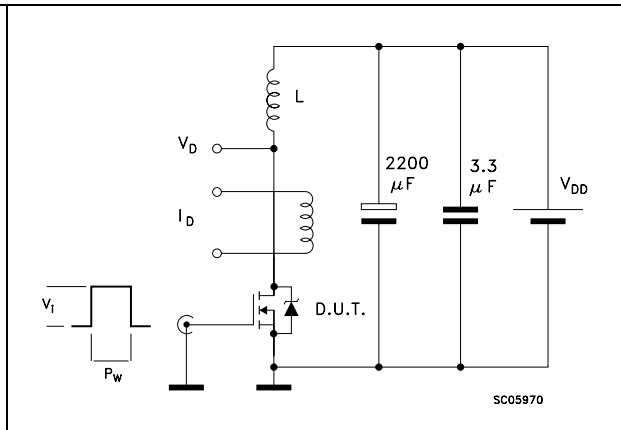


Figure 19. Unclamped inductive waveform

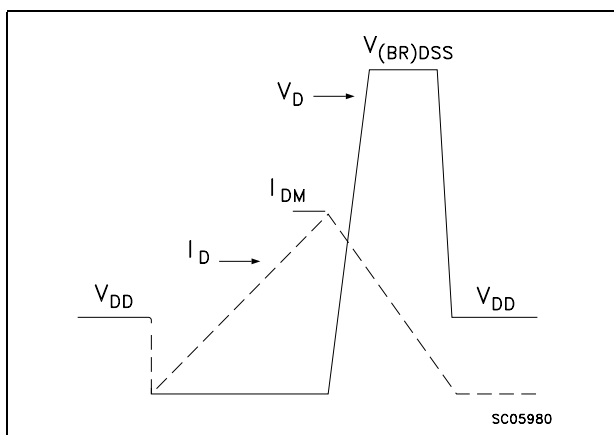
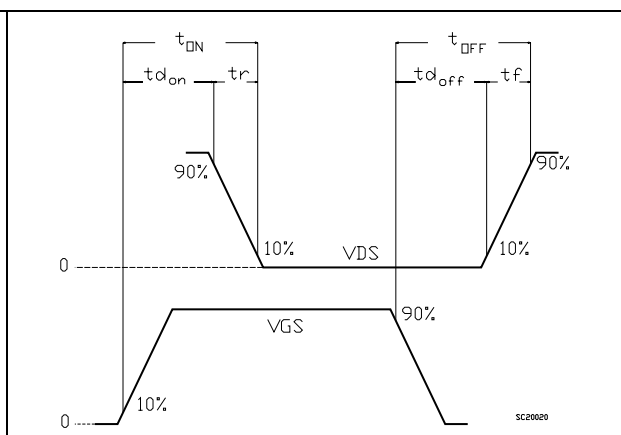


Figure 20. Switching time waveform

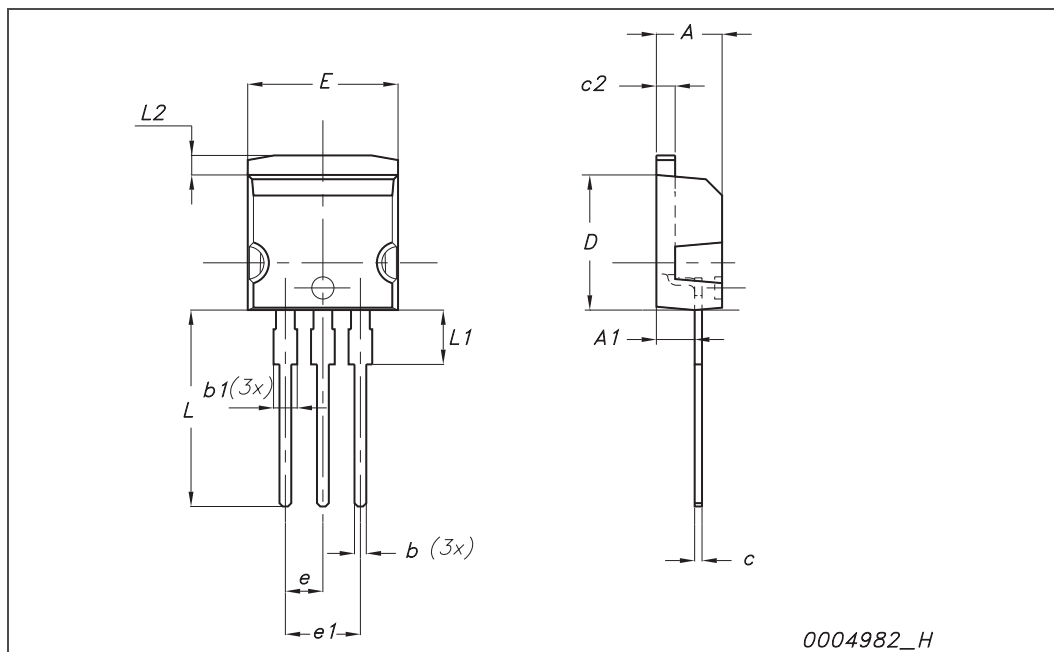


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

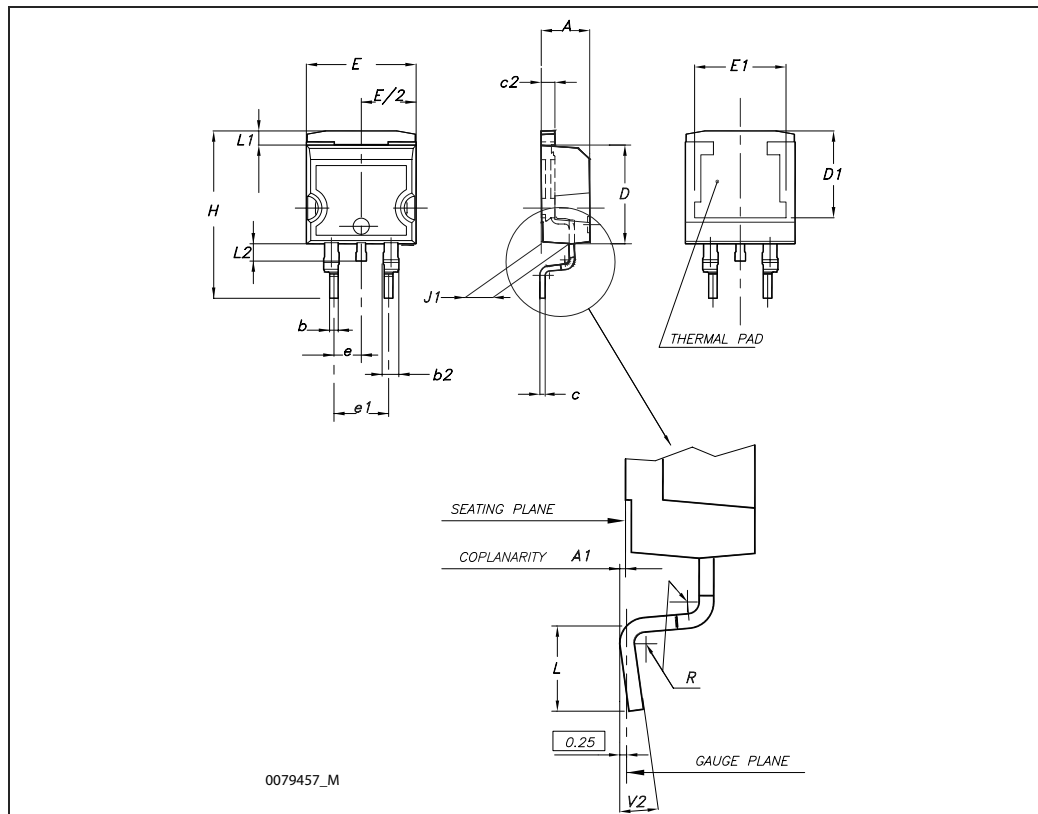
I<sup>2</sup>PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



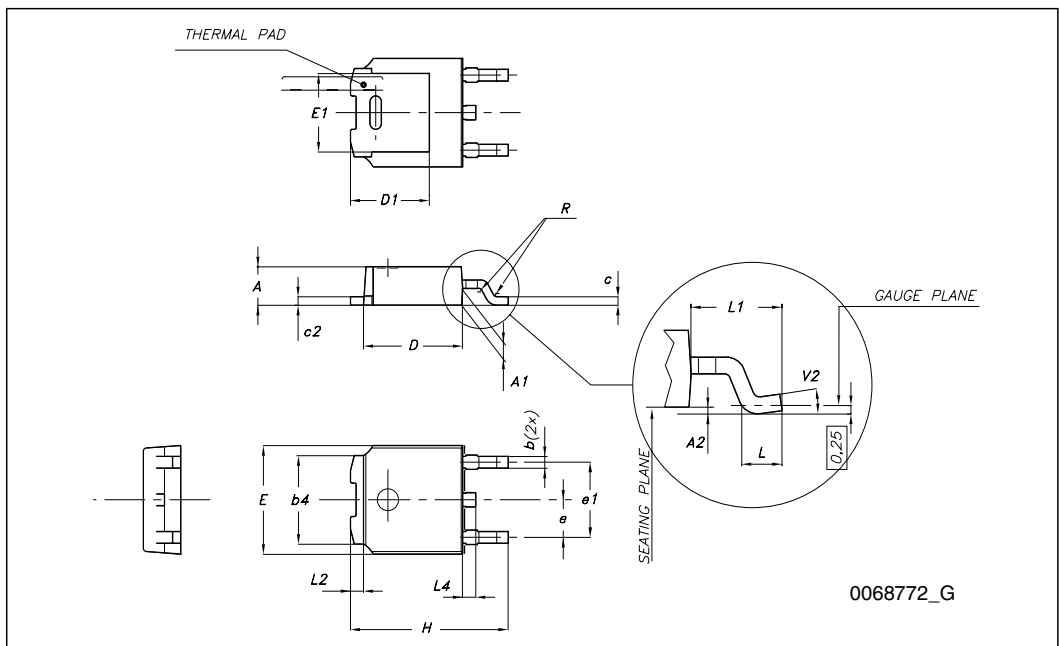
D<sup>2</sup>PAK (TO-263) mechanical data

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°



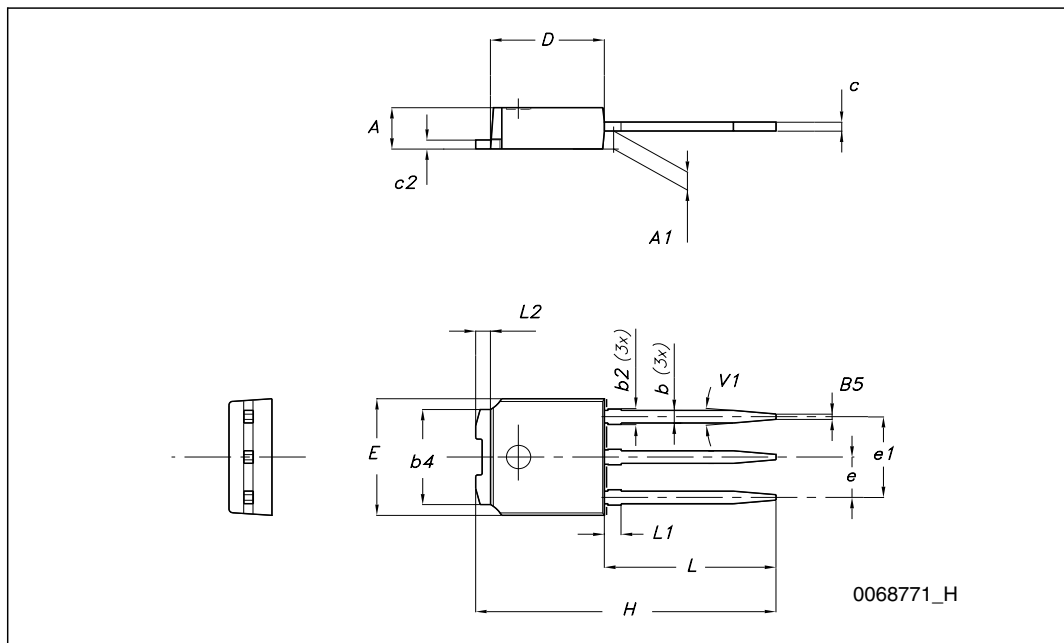
**TO-252 (DPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



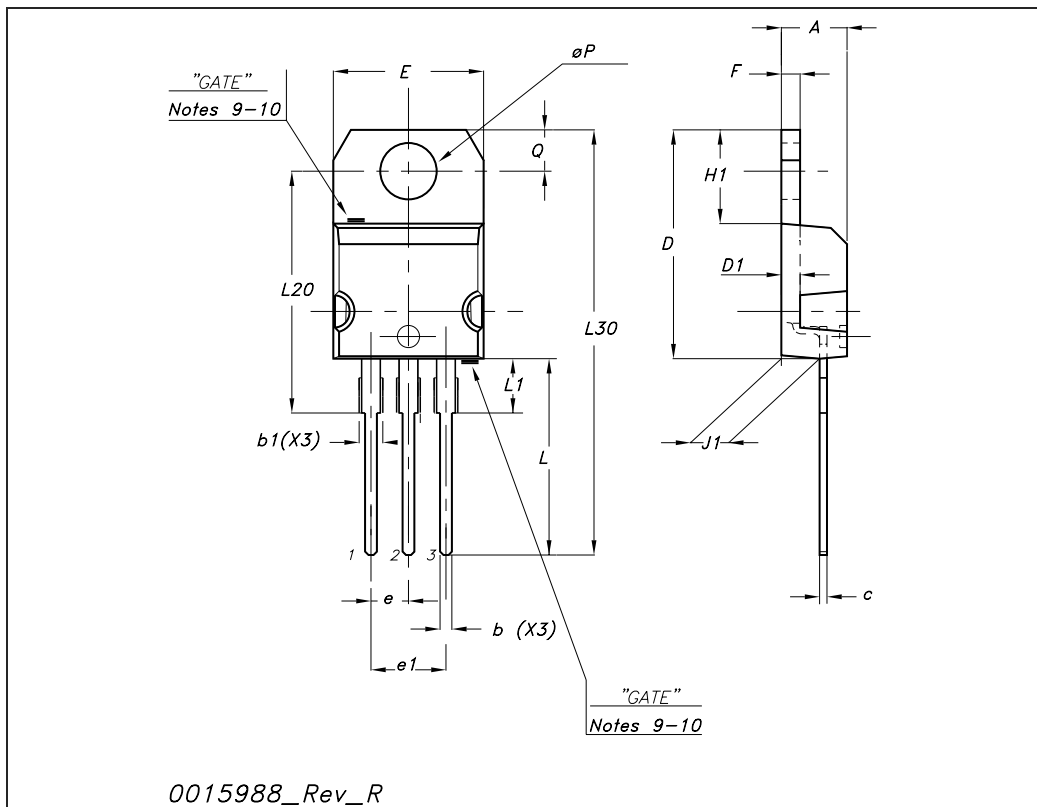
**TO-251 (IPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.80		1.20
L2		0.80	
V1		10°	



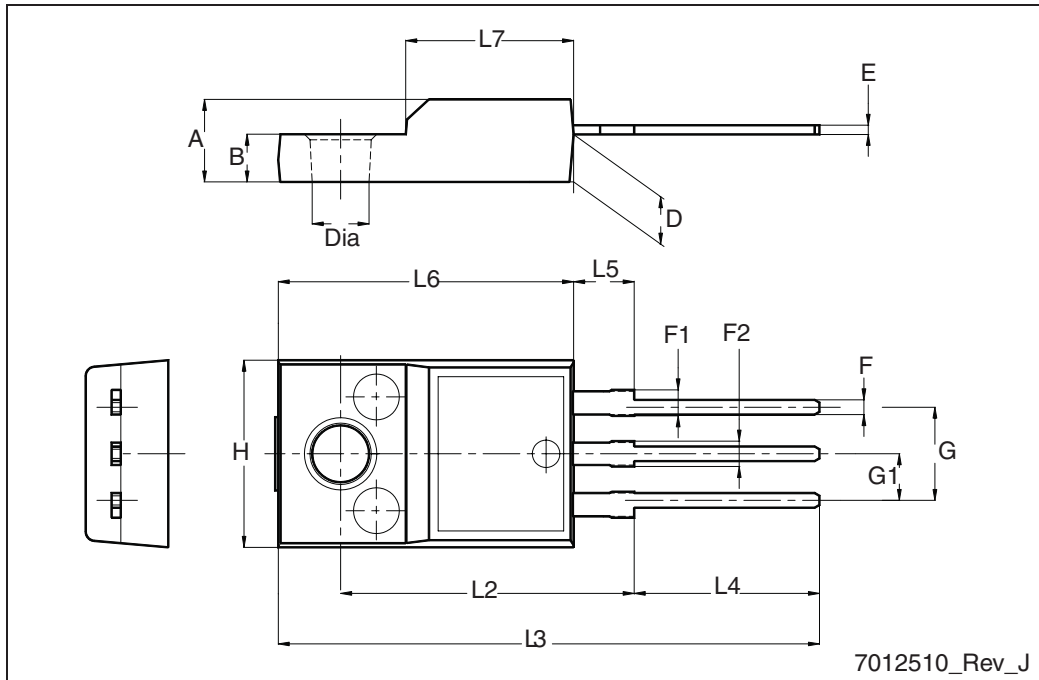
TO-220 mechanical data

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



TO-220FP mechanical data

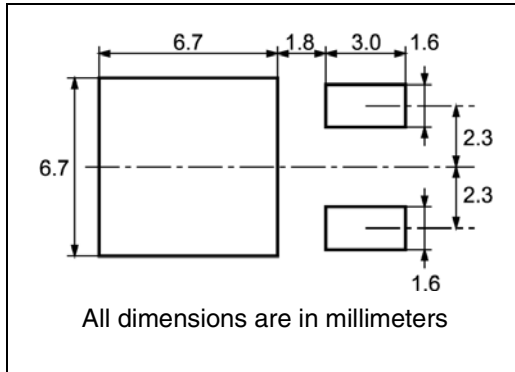
Dim.	mm		
	Mn.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2





# 5 Packaging mechanical data

## DPAK FOOTPRINT



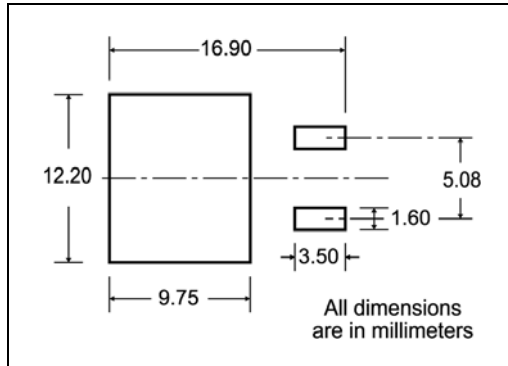
## TAPE AND REEL SHIPMENT

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		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

BASE QTY		BULK QTY	
2500		2500	

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

### 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

\* on sales type

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
09-Feb-2007	1	First release
22-Feb-2007	2	Description has been updated
07-Mar-2007	3	The <i>Figure 2</i> , <i>Figure 4</i> , <i>Figure 9</i> have been changed
17-Apr-2009	4	Added device in I <sup>2</sup> PAK Updated all mechanical data

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