



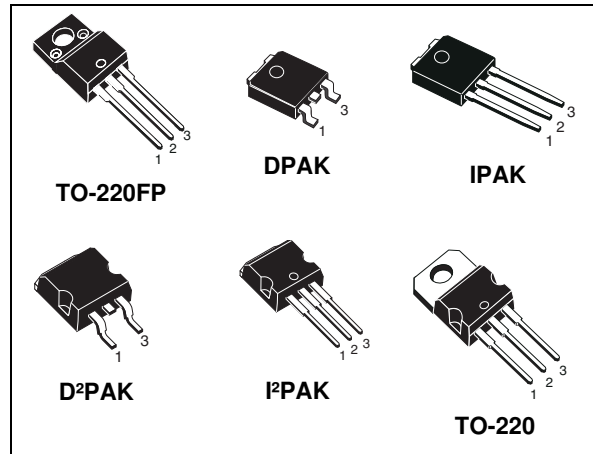
# STB60N55F3, STD60N55F3, STF60N55F3 STI60N55F3, STP60N55F3, STU60N55F3

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

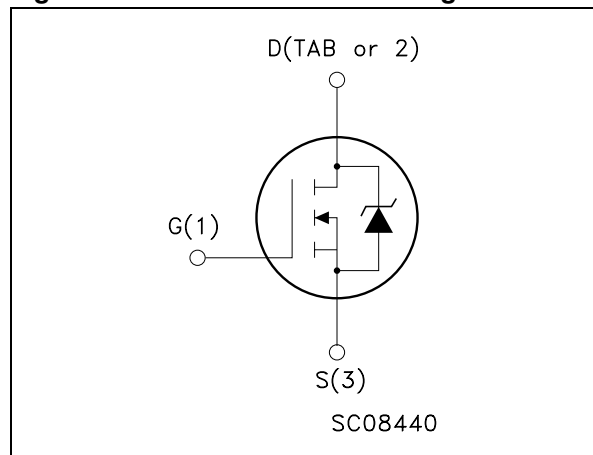


Table 1. Device summary

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 / IPAK / I<sup>2</sup>PAK / DPAK

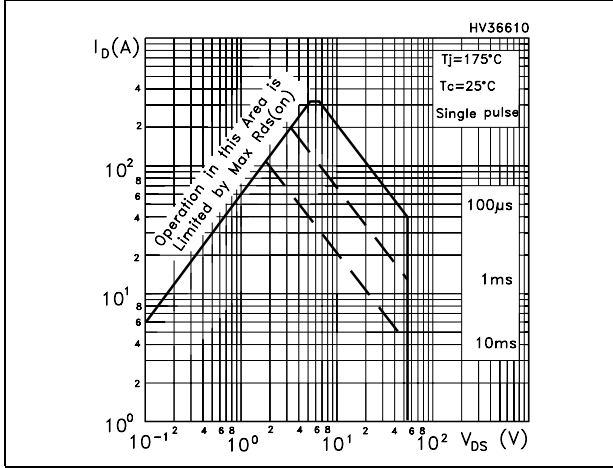


Figure 3. Thermal impedance for TO-220 D<sup>2</sup>PAK / IPAK / I<sup>2</sup>PAK / DPAK

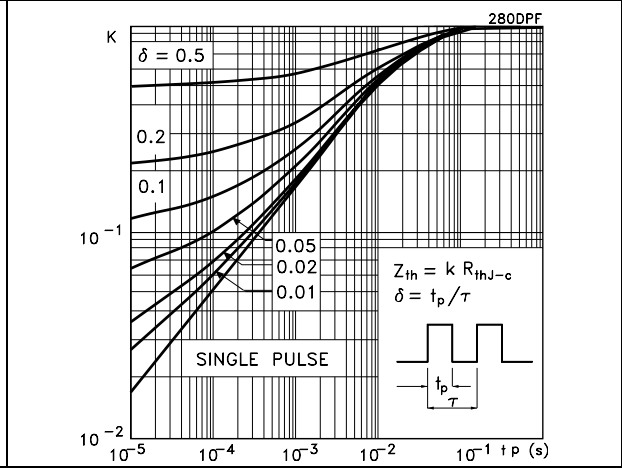


Figure 4. Safe operating area for TO-220FP

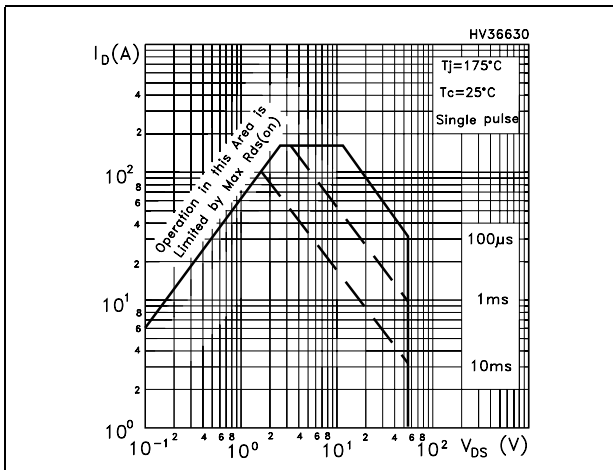


Figure 5. Thermal impedance for TO-220FP

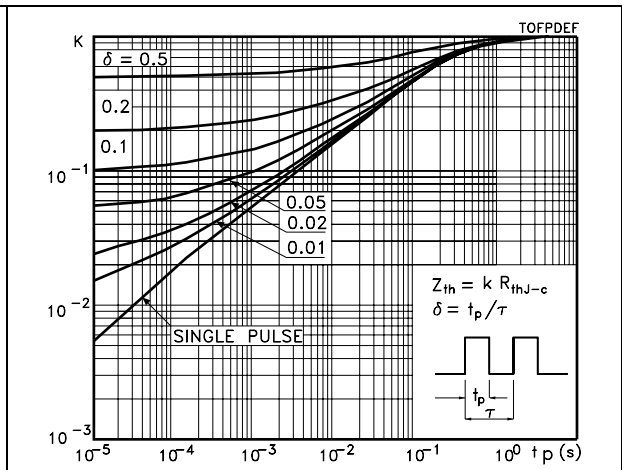


Figure 6. Output characteristics

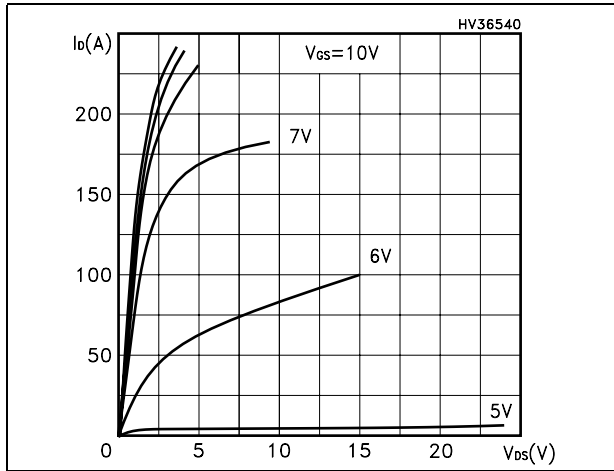


Figure 7. Transfer characteristics

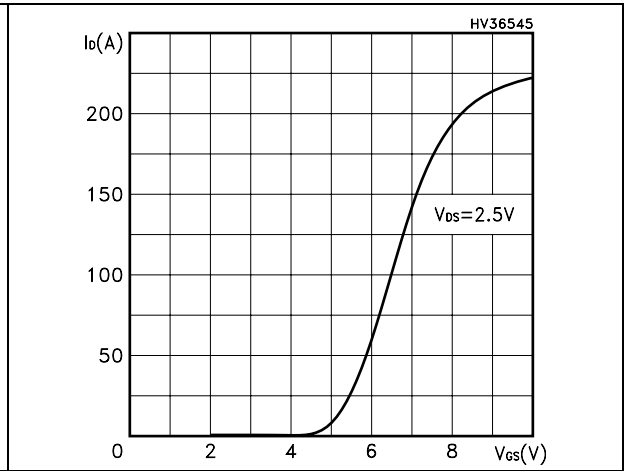


Figure 8. Normalized  $BV_{DSS}$  vs temperature

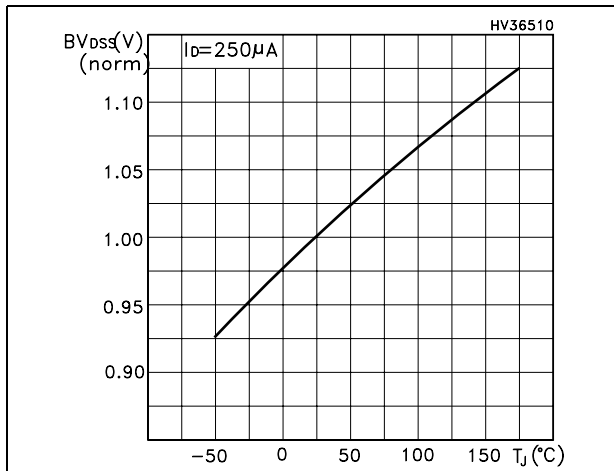


Figure 9. Static drain-source on resistance

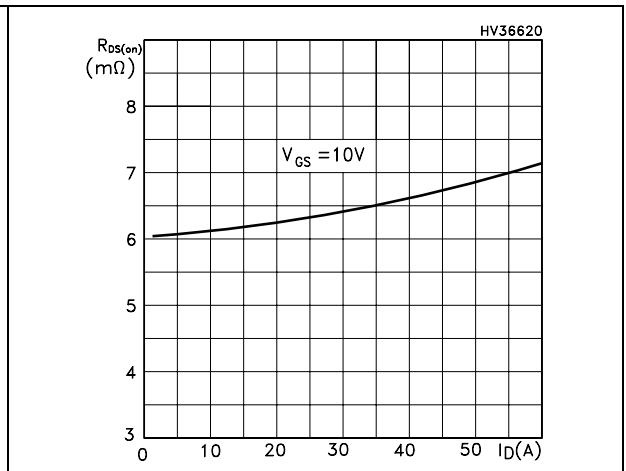


Figure 10. Gate charge vs gate-source voltage

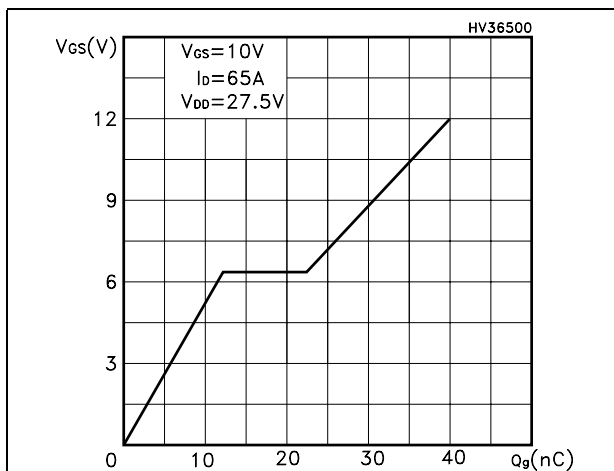


Figure 11. Capacitance variations

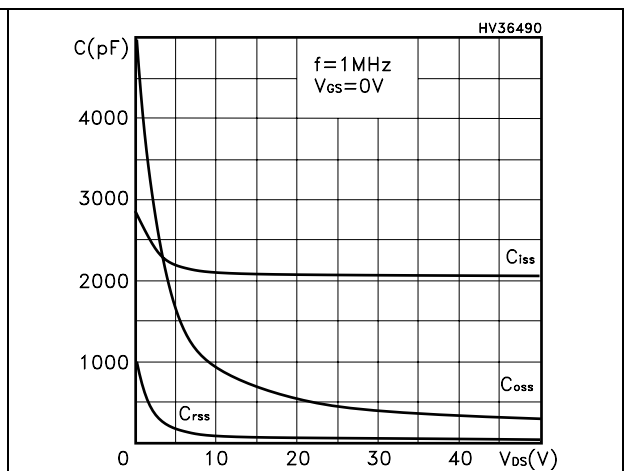


Figure 12. Normalized gate threshold voltage vs temperature

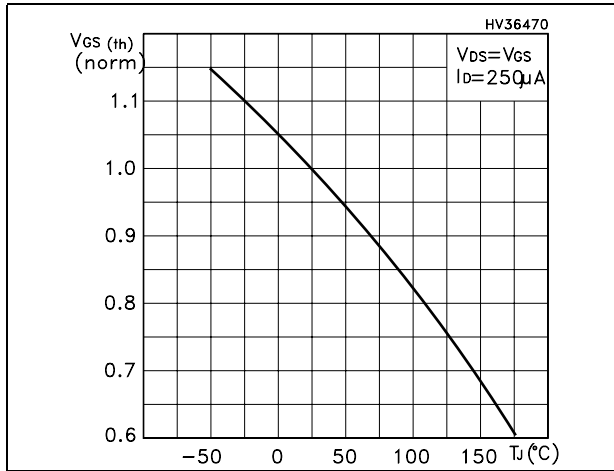


Figure 13. Normalized on resistance vs temperature

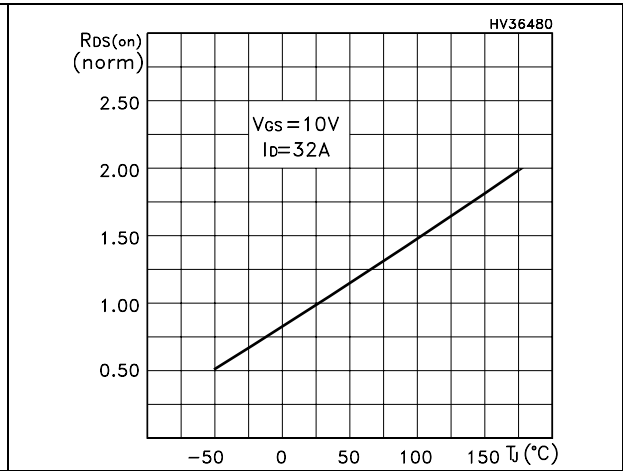
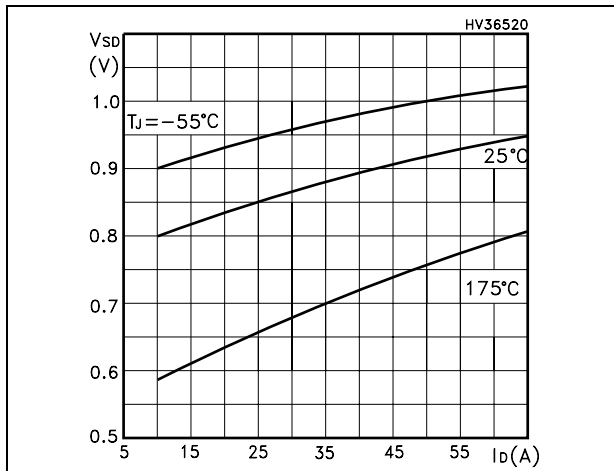


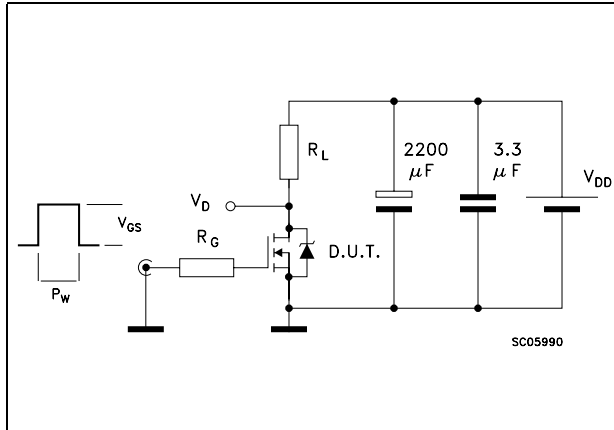
Figure 14. Source-drain diode forward characteristics



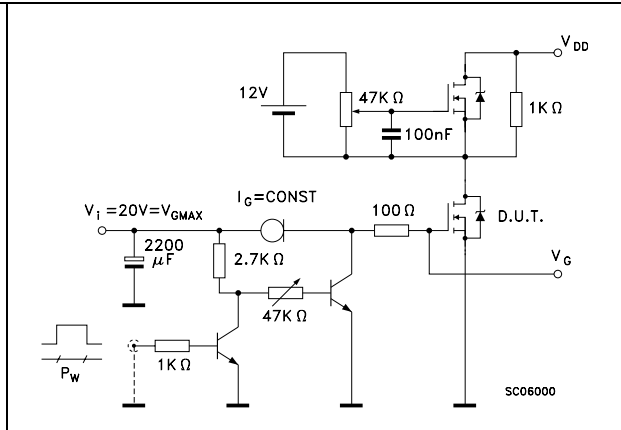


### 3 Test circuits

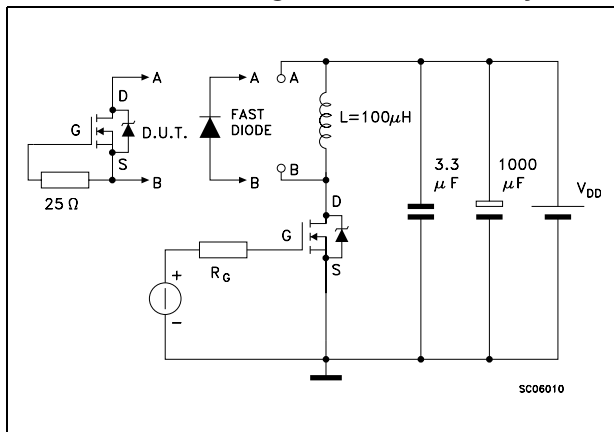
**Figure 15. Switching times test circuit for resistive load**



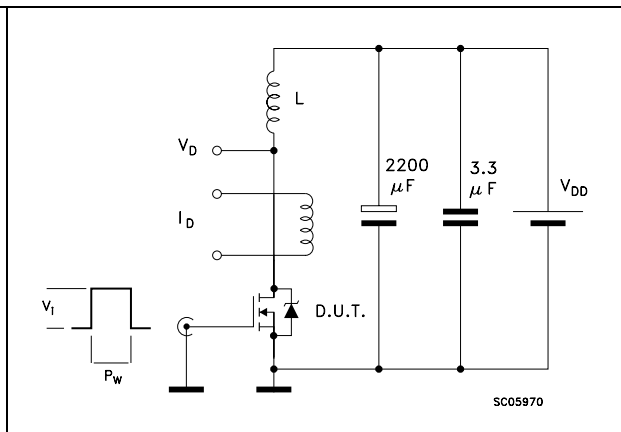
**Figure 16. Gate charge test circuit**



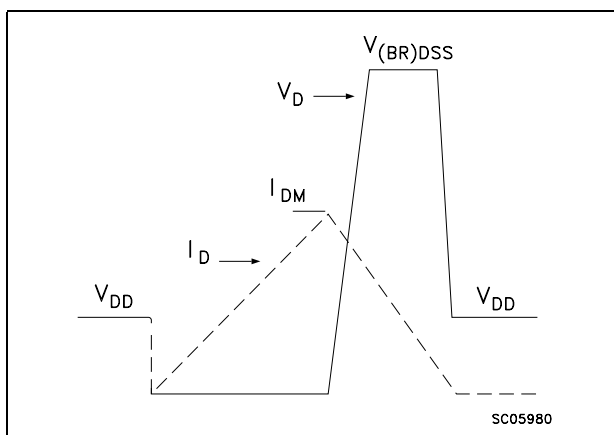
**Figure 17. Test circuit for inductive load switching and diode recovery times**



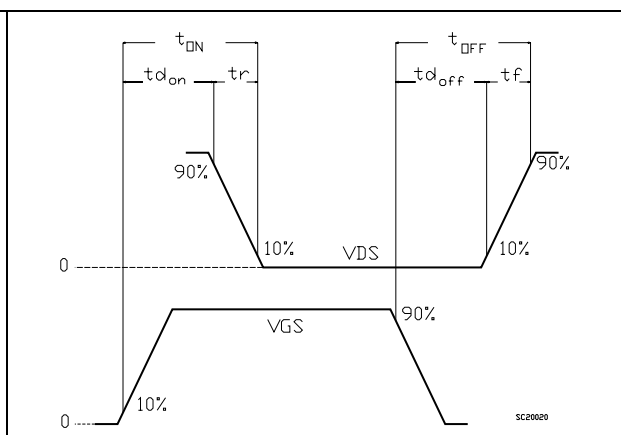
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**

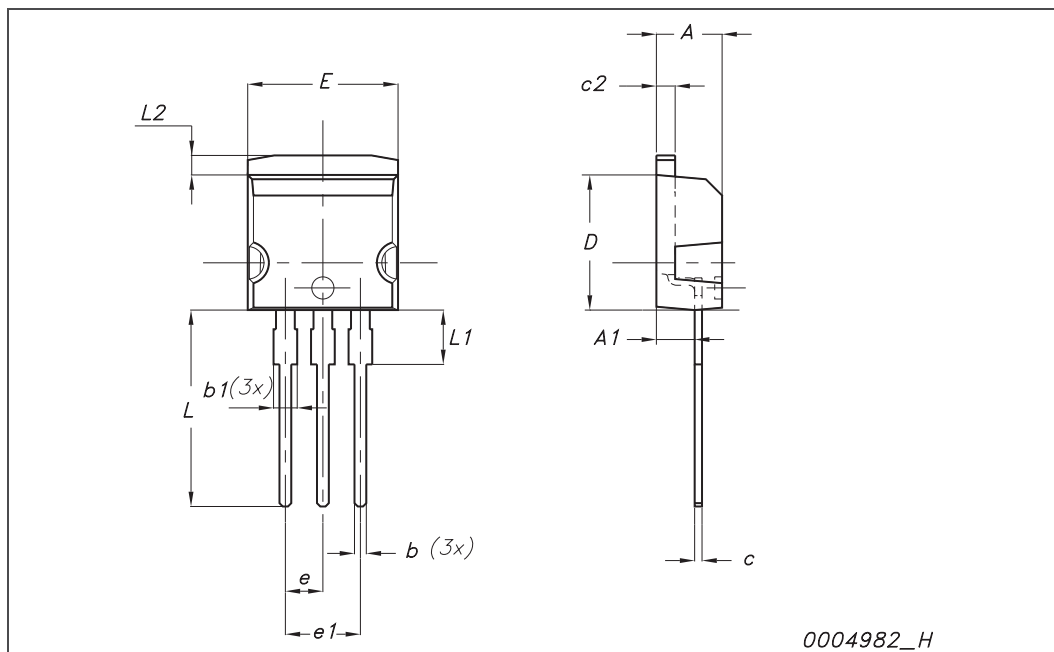


## 4 Package mechanical data

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

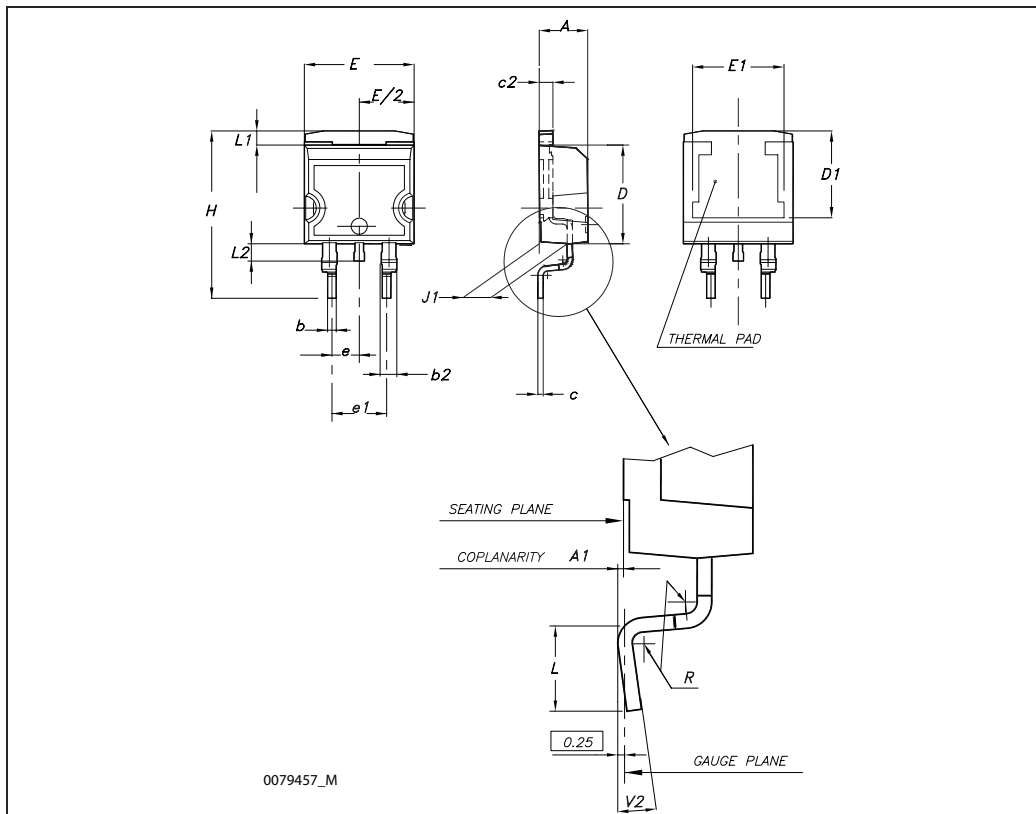
I<sup>2</sup>PAK (TO-262) mechanical data

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



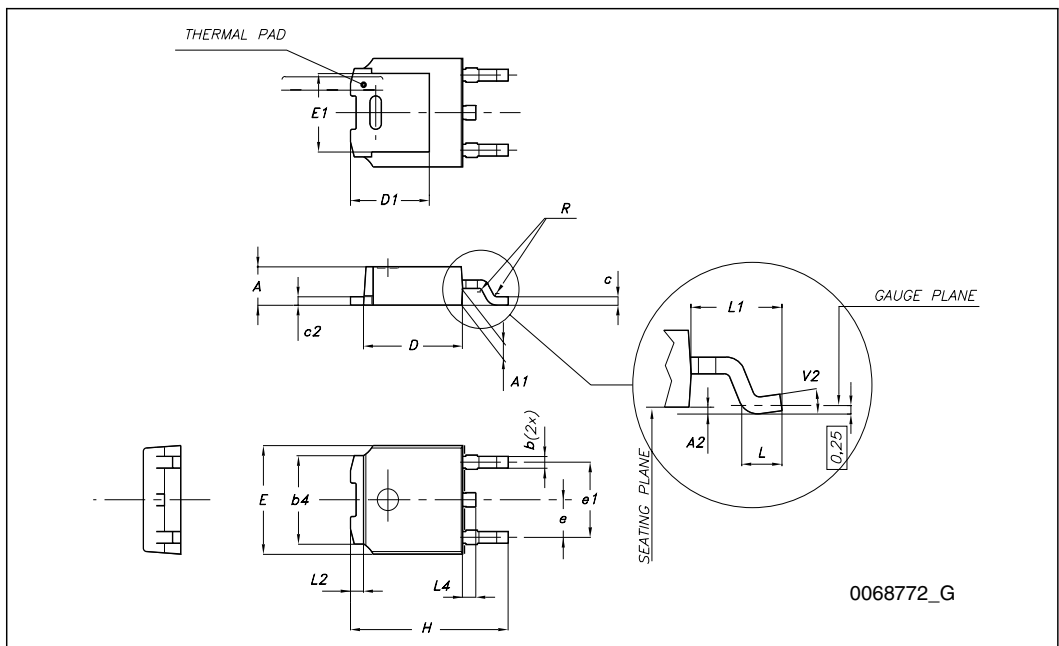
**D<sup>2</sup>PAK (TO-263) mechanical data**

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°



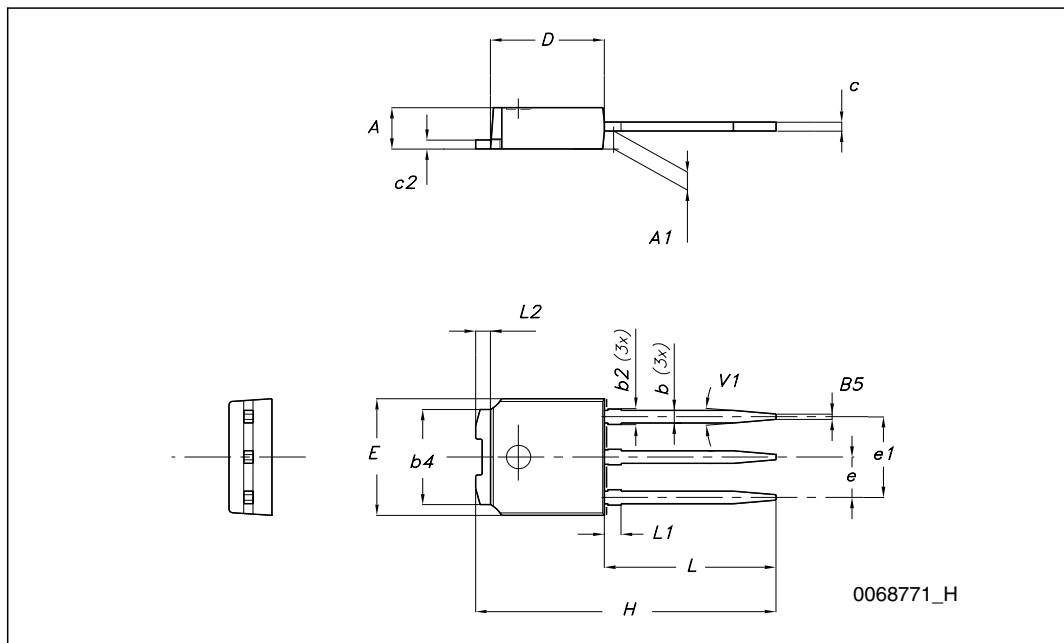
**TO-252 (DPAK) mechanical data**

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°



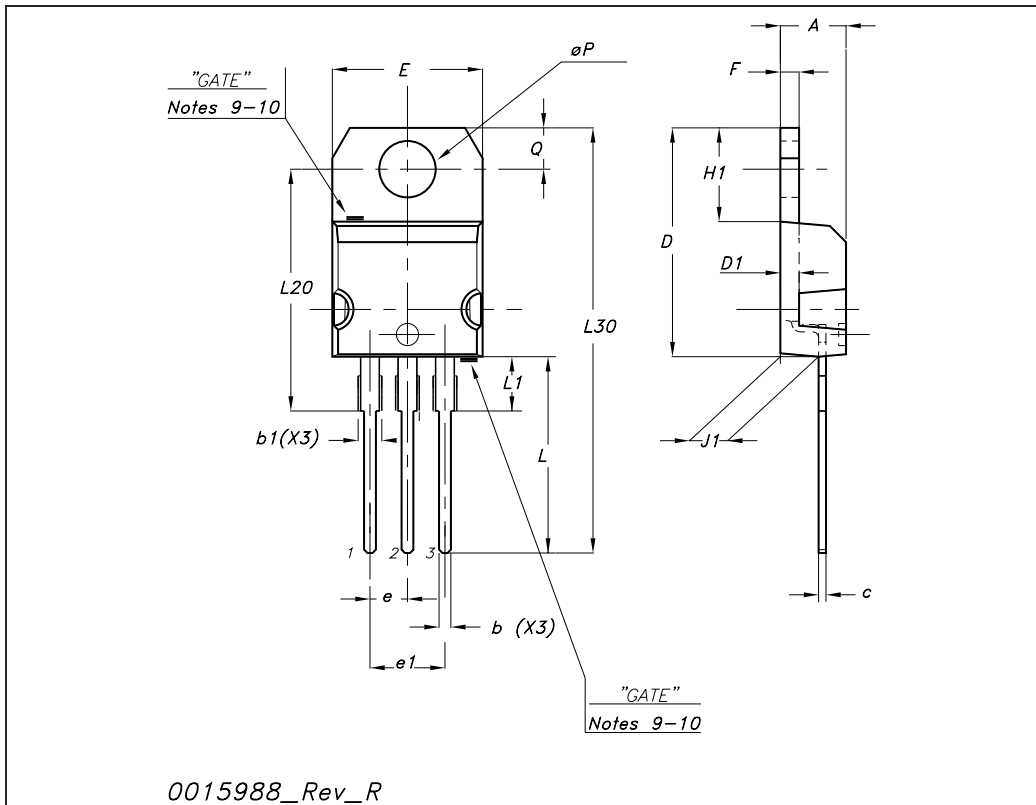
**TO-251 (IPAK) mechanical data**

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°	



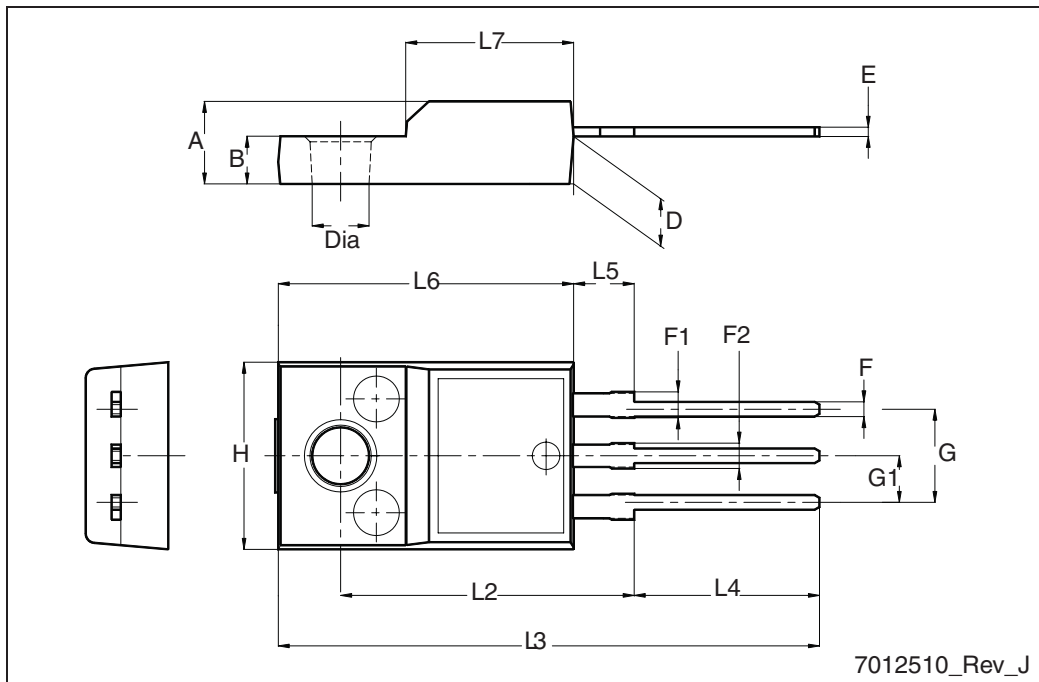
TO-220 mechanical data

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

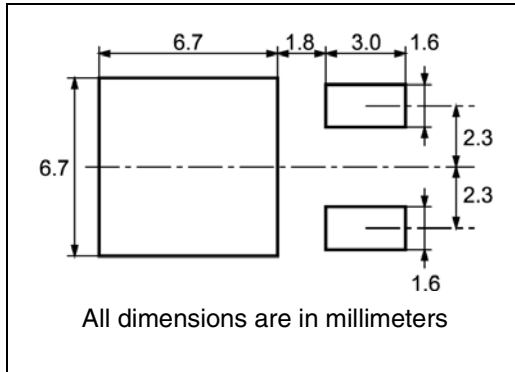
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2





# 5 Packaging mechanical data

## DPAK FOOTPRINT



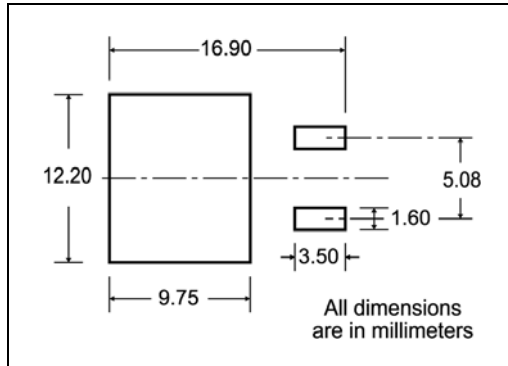
## TAPE AND REEL SHIPMENT

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

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

#### 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

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

\* 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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