



# STx42N65M5

N-channel 650 V, 0.070  $\Omega$ , 33 A MDmesh™ V Power MOSFET  
in I<sup>2</sup>PAK, TO-220, TO-220FP, D<sup>2</sup>PAK and TO-247

## Features

Type	V <sub>DSS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STB42N65M5	710 V	< 0.079 $\Omega$	33 A
STF42N65M5	710 V	< 0.079 $\Omega$	33 A <sup>(1)</sup>
STI42N65M5	710 V	< 0.079 $\Omega$	33 A
STP42N65M5	710 V	< 0.079 $\Omega$	33 A
STW42N65M5	710 V	< 0.079 $\Omega$	33 A

1. Limited only by maximum temperature allowed

- TO-220 worldwide best R<sub>DS(on)</sub>
- Higher V<sub>DSS</sub> rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

## Application

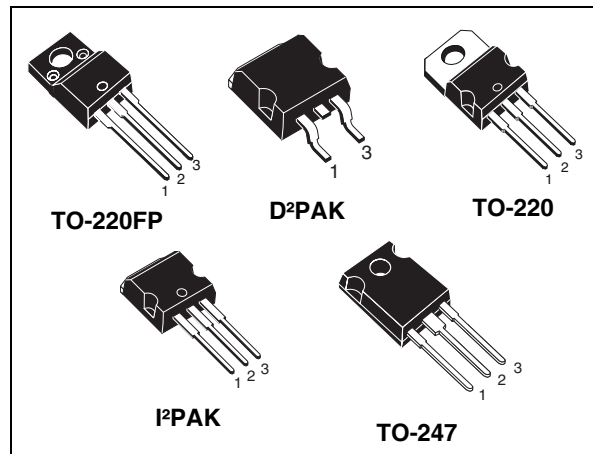
- Switching applications

## Description

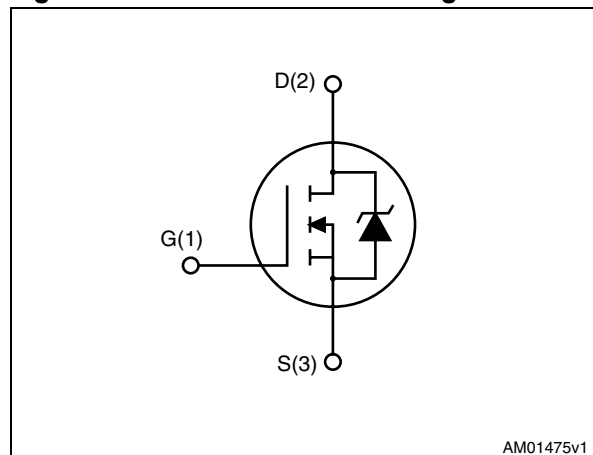
MDmesh™ V is a revolutionary Power MOSFET technology based on an innovative proprietary vertical process, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiencies.

**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STB42N65M5	42N65M5	D <sup>2</sup> PAK	Tape and reel
STF42N65M5	42N65M5	TO-220FP	Tube
STI42N65M5	42N65M5	I <sup>2</sup> PAK	Tube
STP42N65M5	42N65M5	TO-220	Tube
STW42N65M5	42N65M5	TO-247	Tube



**Figure 1. Internal schematic diagram**



# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220, TO-247 D <sup>2</sup> PAK, I <sup>2</sup> PAK	TO-220FP	
V <sub>GS</sub>	Gate- source voltage	± 25		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	33	33 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	20.8	20.8 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	132	132 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	190	40	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>JMAX</sub> )	11		A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25°C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50V)	950		mJ
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15		V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)	--	2500	V
T <sub>stg</sub>	Storage temperature	-55 to 150		°C
T <sub>j</sub>	Max. operating junction temperature	150		°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. I<sub>SD</sub> ≤ 33 A, di/dt ≤ 400 A/μs, V<sub>Peak</sub> < V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

Symbol	Parameter	Value					Unit
		D <sup>2</sup> PAK	I <sup>2</sup> PAK	TO-220	TO-247	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.66			3.1	°C/W	
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	--	62.5	50	62.5	°C/W	
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb max	30	--	--	--	°C/W	
T <sub>l</sub>	Maximum lead temperature for soldering purpose	300					°C

## 2 Electrical characteristics

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

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	650			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$ , $T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 16.5\text{ A}$		0.070	0.079	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	4650	-	pF
$C_{oss}$	Output capacitance			110		pF
$C_{rss}$	Reverse transfer capacitance			3.2		pF
$C_{o(er)}^{(1)}$	Equivalent output capacitance energy related	$V_{GS} = 0$ , $V_{DS} = 0$ to 80% $V_{(BR)DSS}$	-	100	-	pF
$C_{o(tr)}^{(2)}$	Equivalent output capacitance time related	$V_{GS} = 0$ , $V_{DS} = 0$ to 80% $V_{(BR)DSS}$	-	285	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.1	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 16.5\text{ A}$ ,	-	100	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\text{ V}$		26		nC
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 20</a> )		38		nC

- $C_{o(er)}^{(1)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- $C_{o(tr)}^{(2)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 19</a> )		61		ns	
$t_r$	Rise time			24		ns	
$t_{d(off)}$	Turn-off-delay time				65		ns
$t_f$	Fall time				13		ns

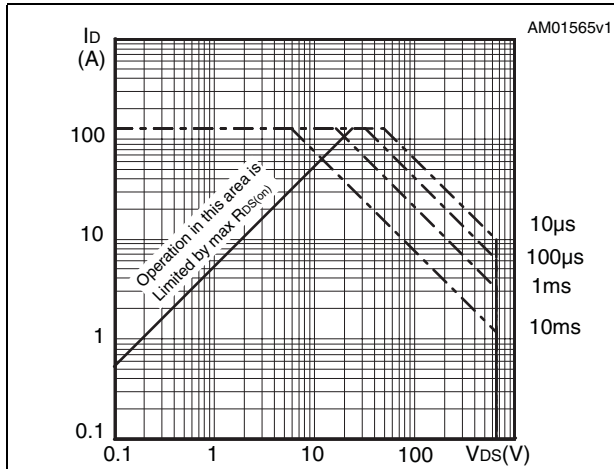
**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				33	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		132	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 33\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 33\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see <a href="#">Figure 24</a> )		400		ns
$Q_{rr}$	Reverse recovery charge			7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			35		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 33\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 24</a> )		532		ns
$Q_{rr}$	Reverse recovery charge			10		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			38		A

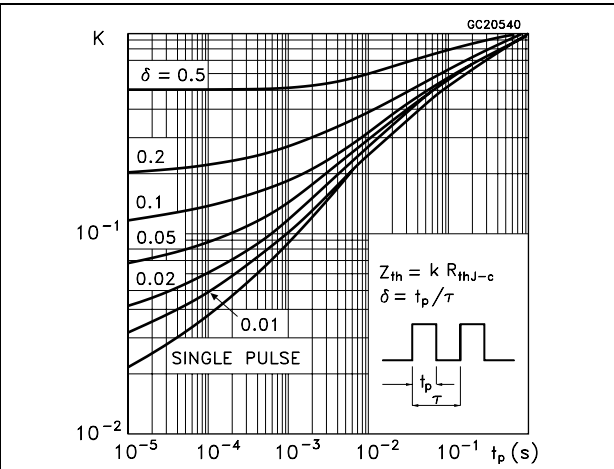
1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

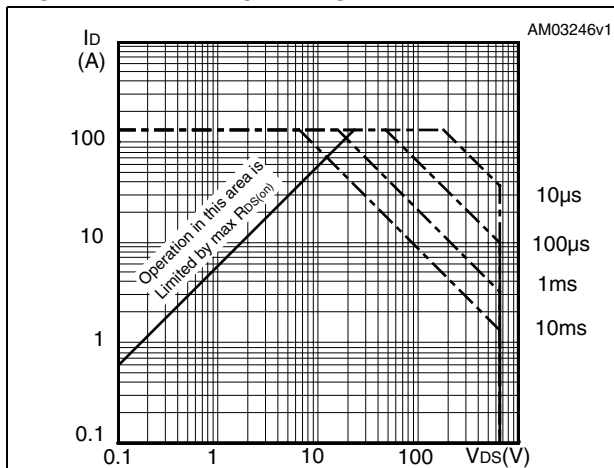
**Figure 2. Safe operating area for TO-220, D<sup>2</sup>PAK, I<sup>2</sup>PAK**



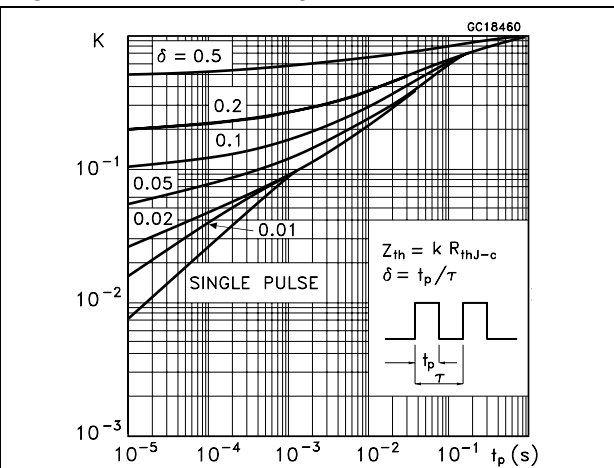
**Figure 3. Thermal impedance for TO-220, D<sup>2</sup>PAK, I<sup>2</sup>PAK**



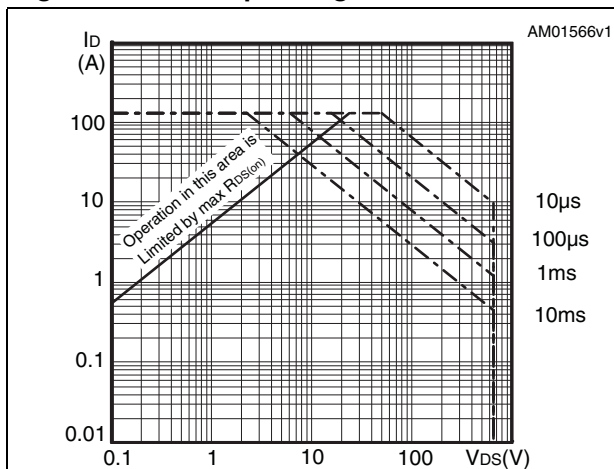
**Figure 4. Safe operating area for TO-247**



**Figure 5. Thermal impedance for TO-247**



**Figure 6. Safe operating area for TO-220FP**



**Figure 7. Thermal impedance for TO-220FP**

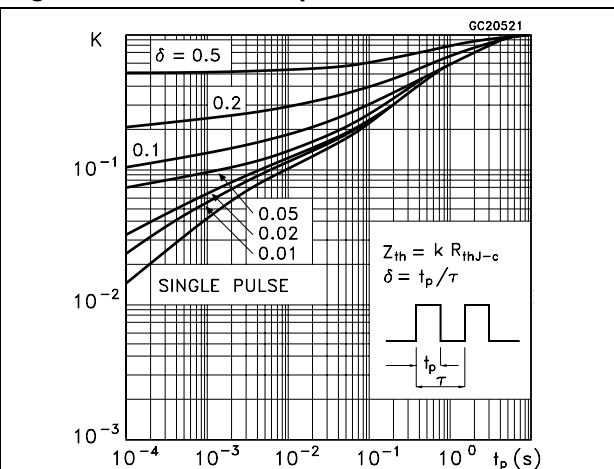


Figure 8. Output characteristics

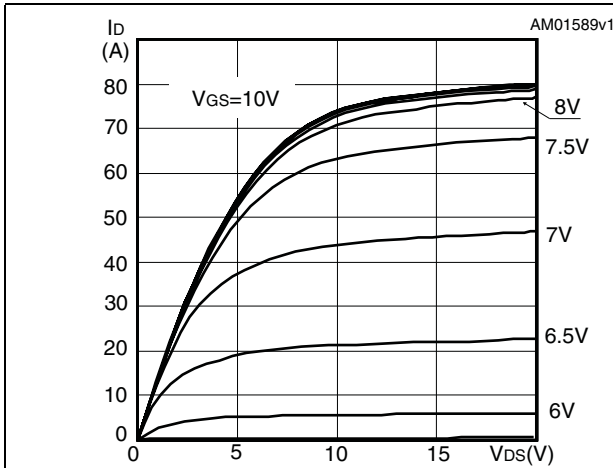


Figure 9. Transfer characteristics

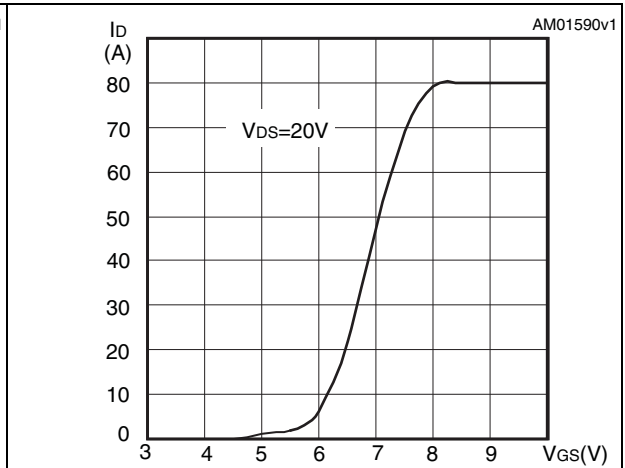


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on resistance

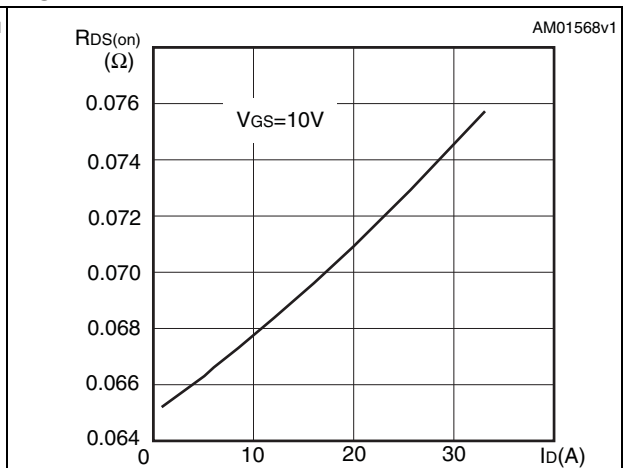
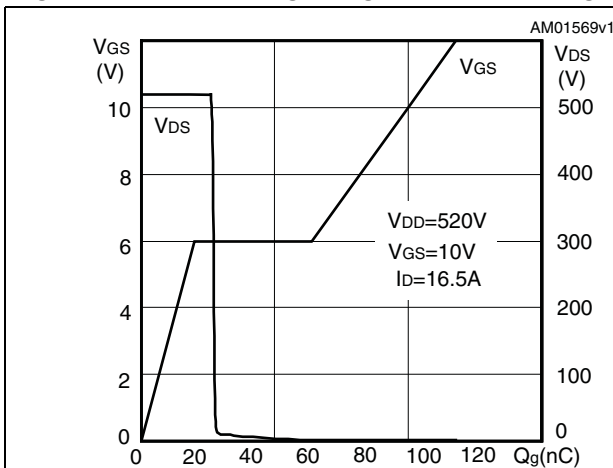


Figure 12. Capacitance variations

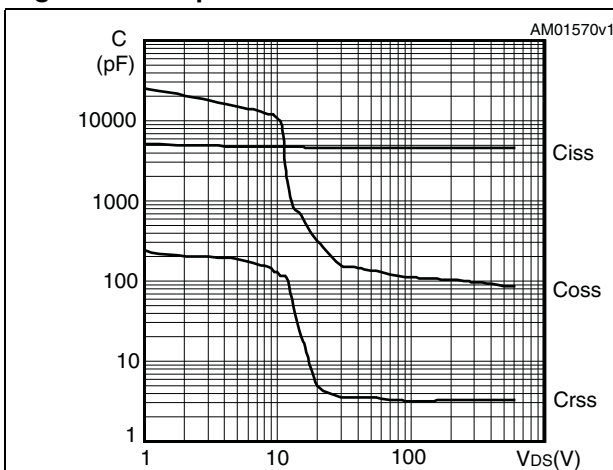


Figure 13. Output capacitance stored energy

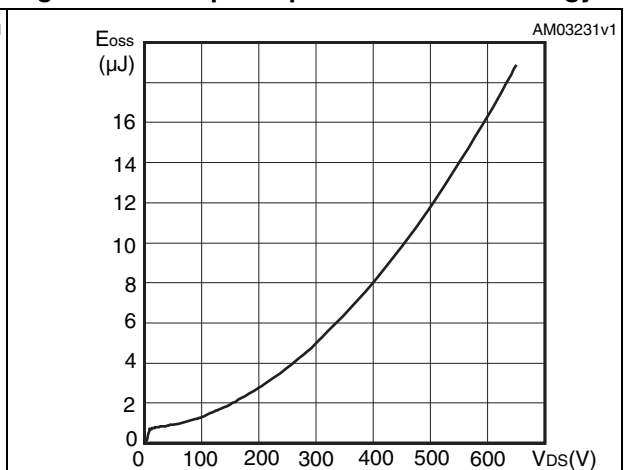


Figure 14. Normalized gate threshold voltage vs temperature

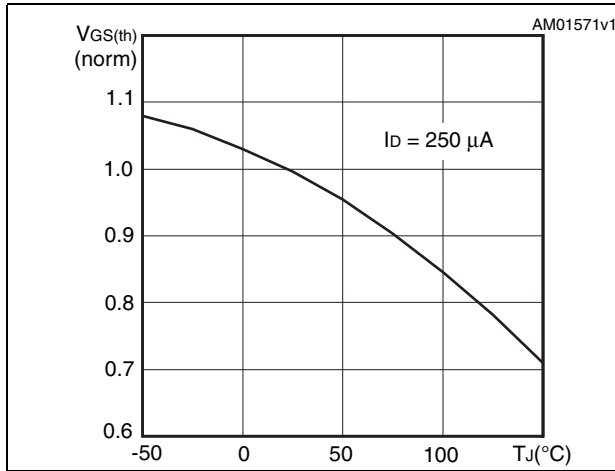


Figure 15. Normalized on resistance vs temperature

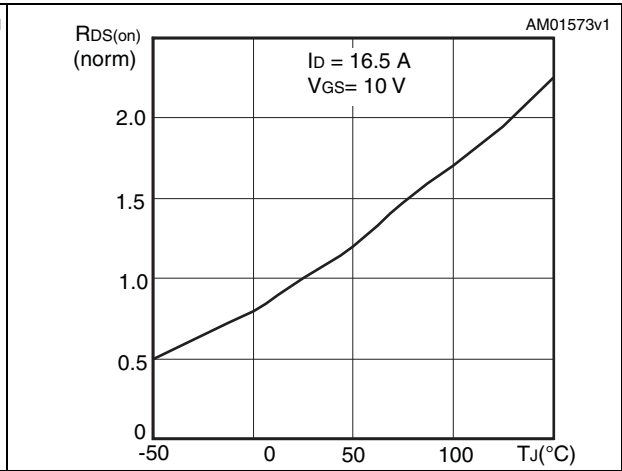


Figure 16. Source-drain diode forward characteristics

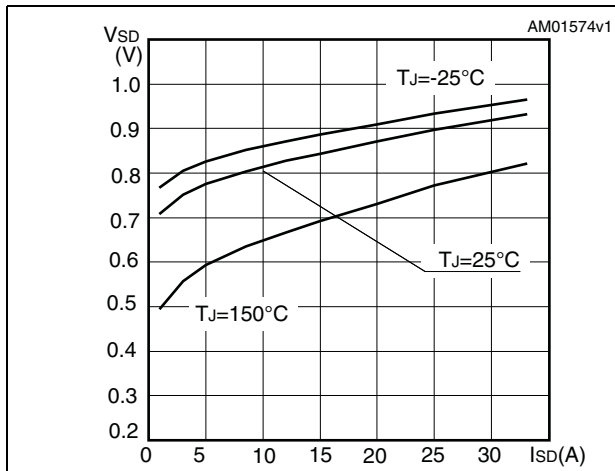


Figure 17. Normalized B<sub>VDSS</sub> vs temperature

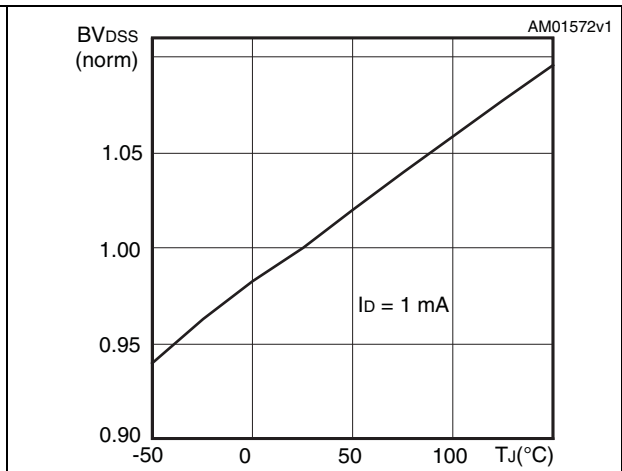
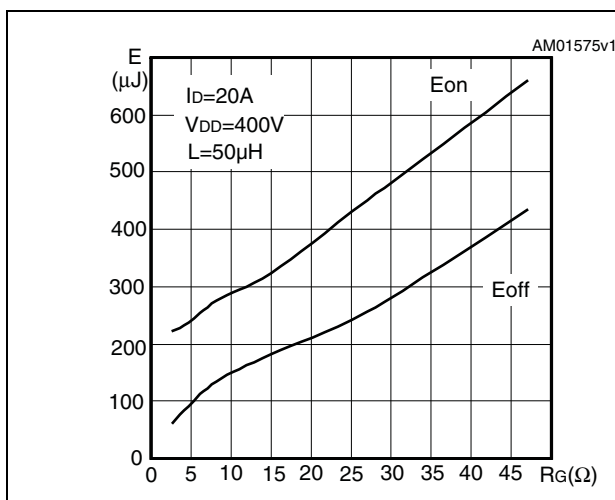


Figure 18. Switching losses vs gate resistance (1)

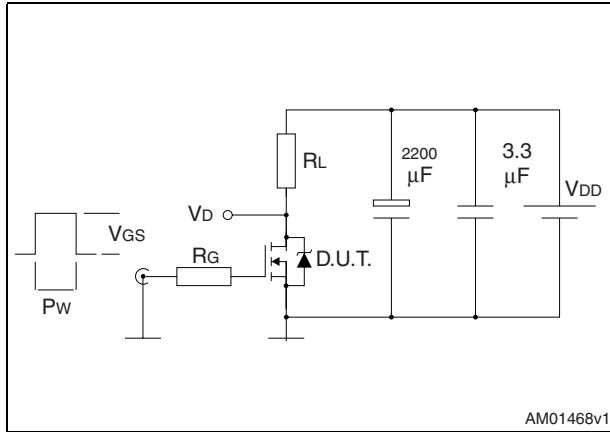


1. Eon including reverse recovery of a SiC diode

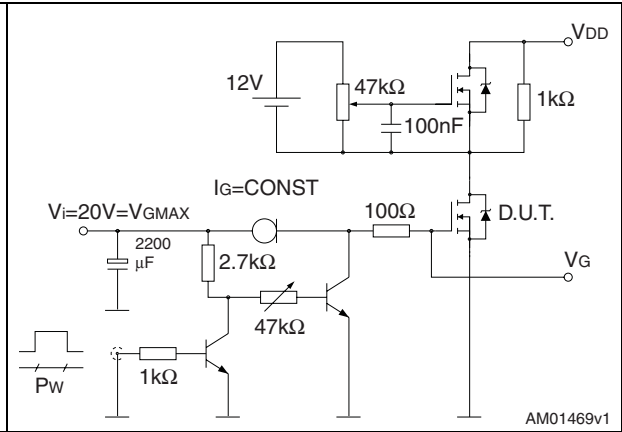


### 3 Test circuits

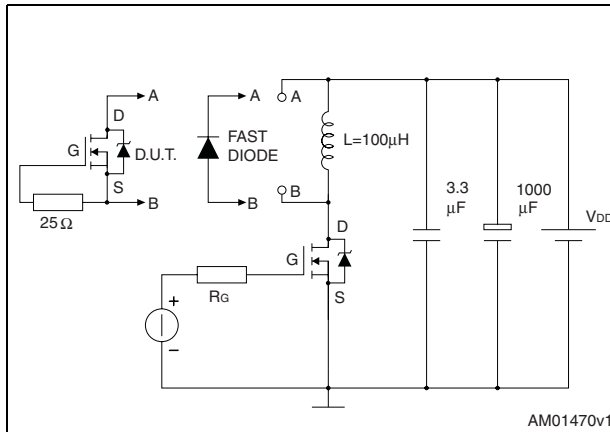
**Figure 19. Switching times test circuit for resistive load**



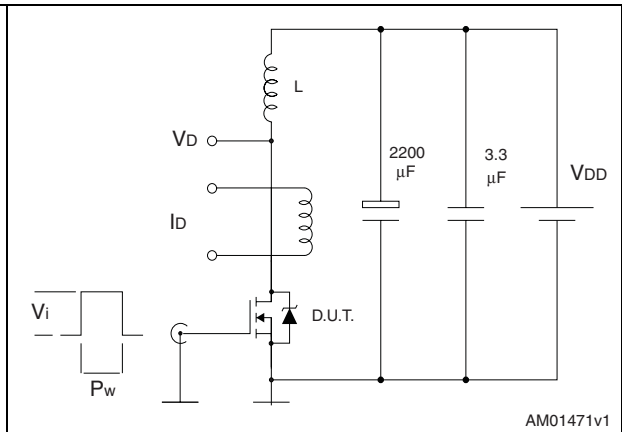
**Figure 20. Gate charge test circuit**



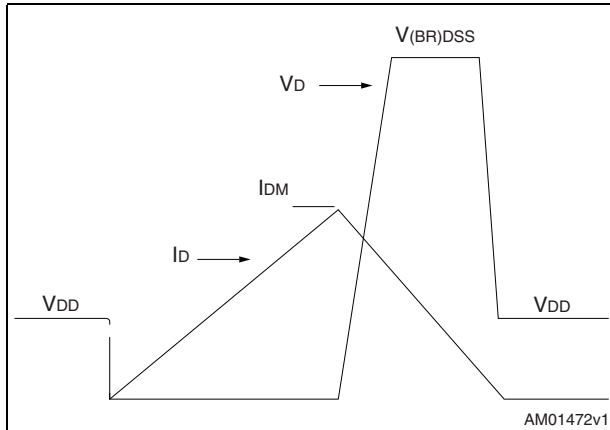
**Figure 21. Test circuit for inductive load switching and diode recovery times**



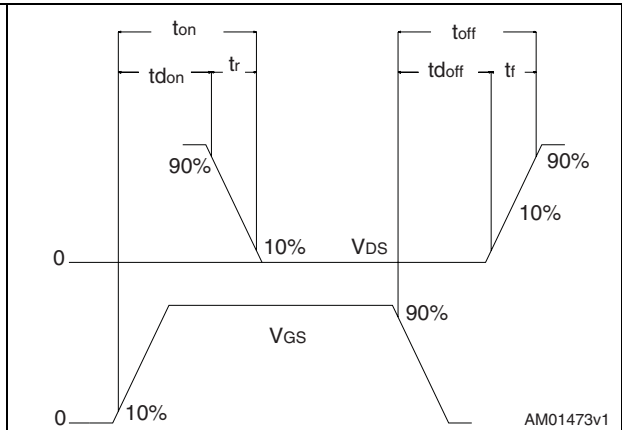
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching time waveform**

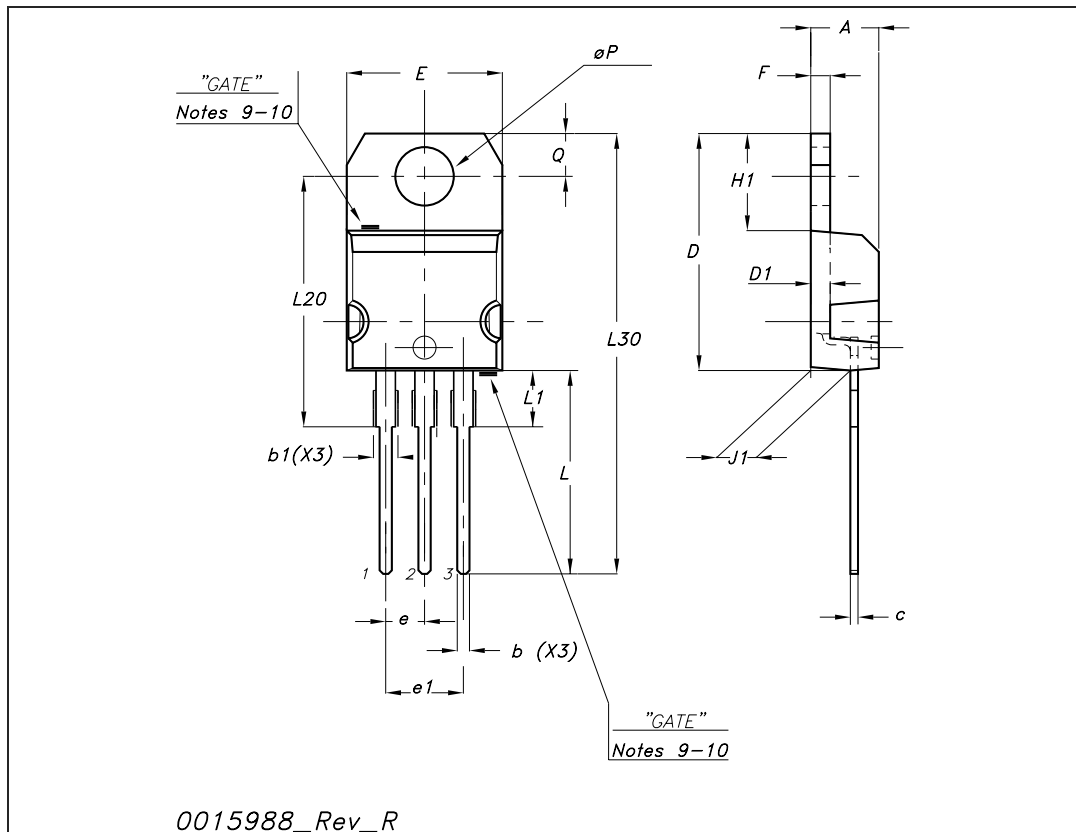


## 4 Package mechanical data

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.

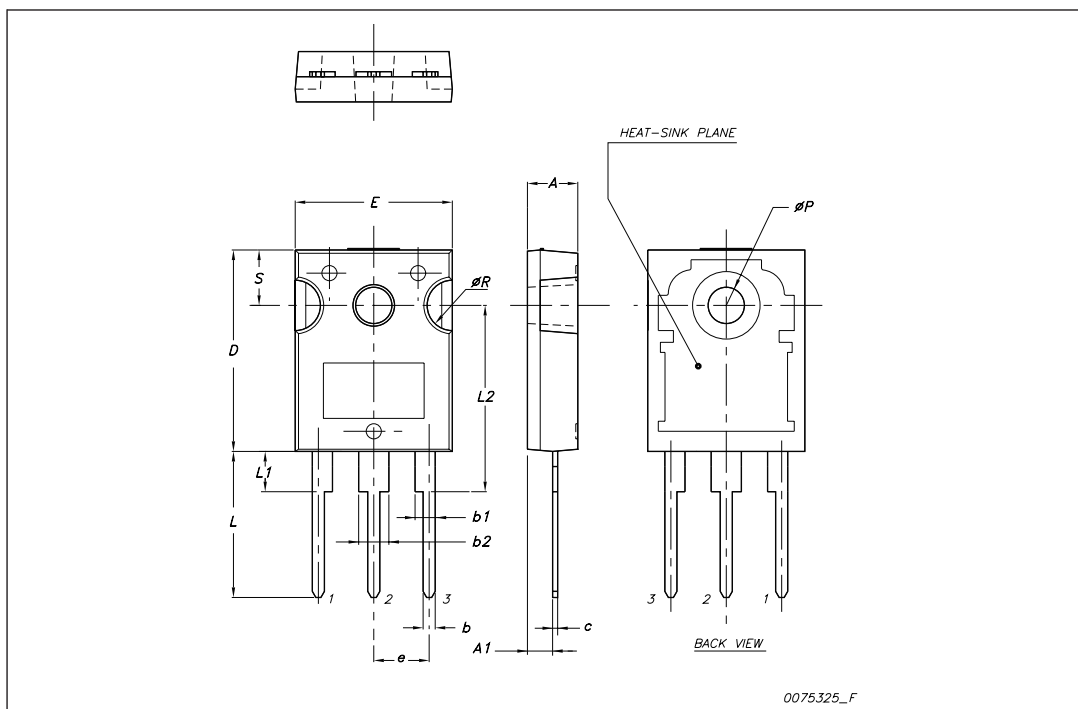
TO-220 mechanical data

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



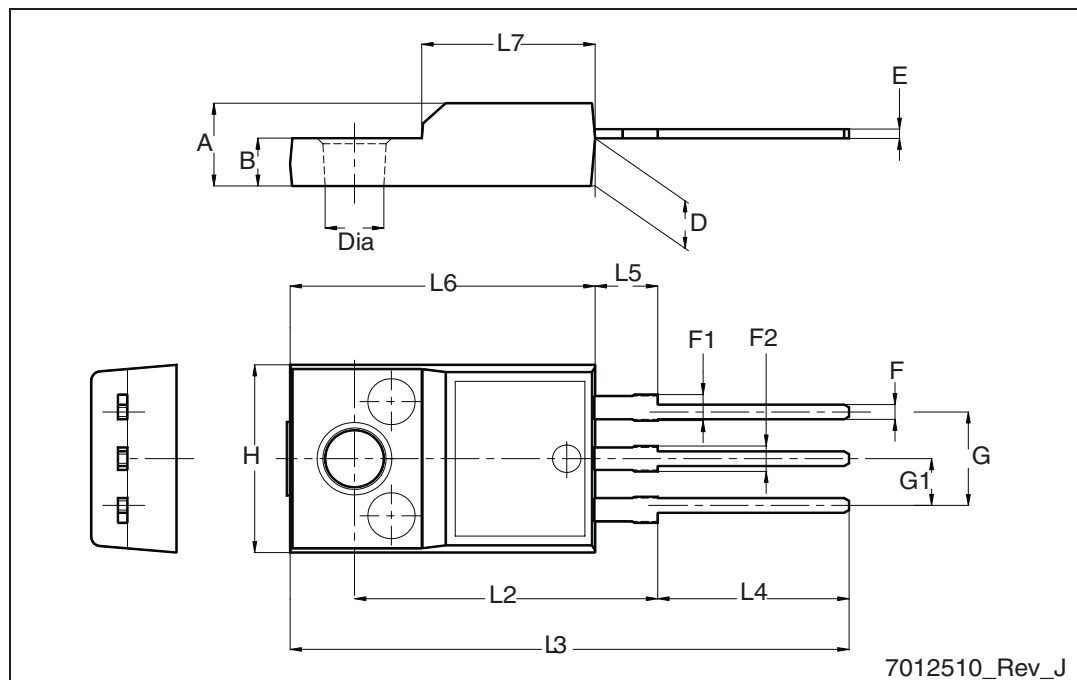
**TO-247 mechanical data**

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



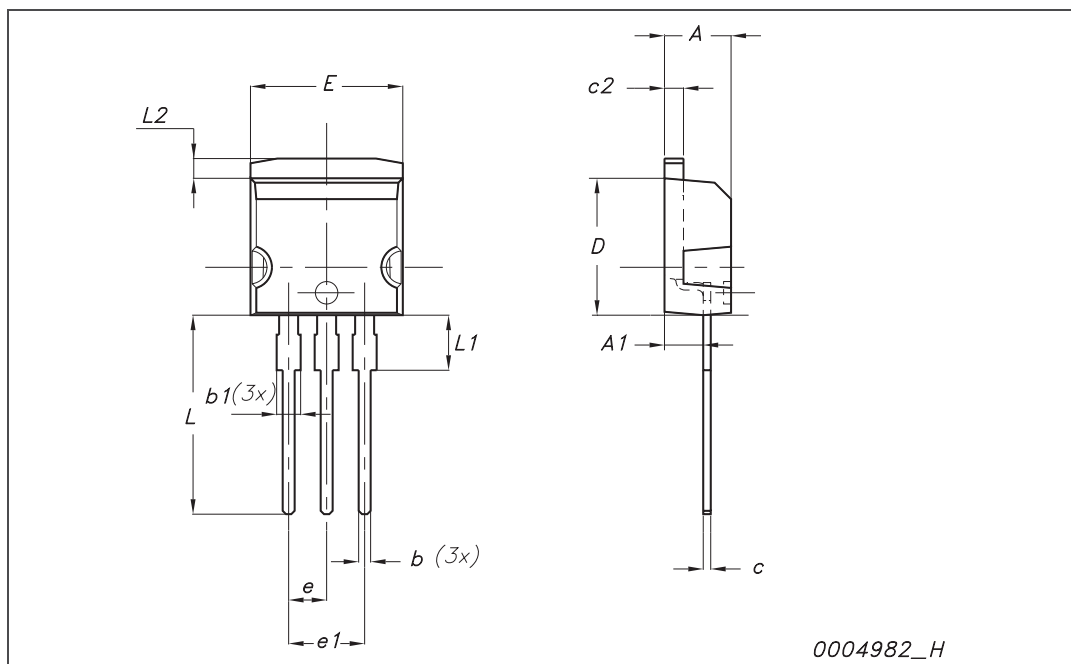
## TO-220FP mechanical data

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



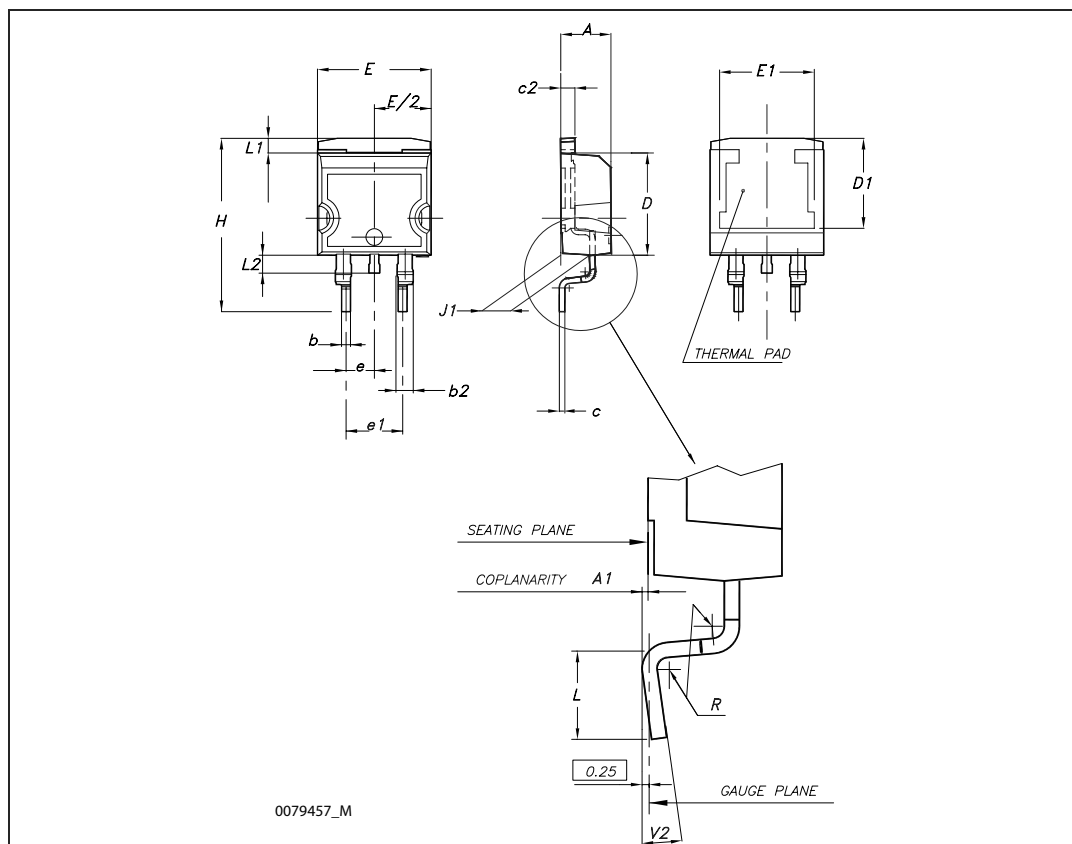
I<sup>2</sup>PAK (TO-262) mechanical data

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



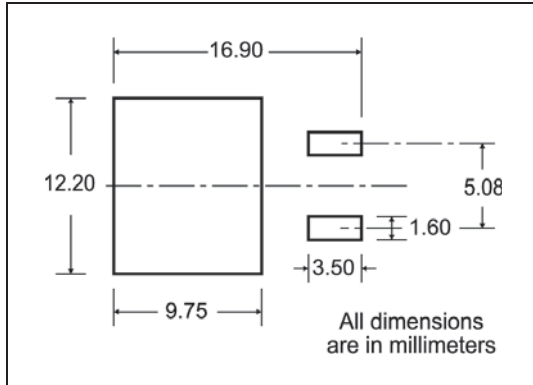
D<sup>2</sup>PAK (TO-263) mechanical data

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°



# 5 Packaging 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



## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
16-Jan-2009	1	First release
15-May-2009	2	Updated figures <a href="#">9</a> , <a href="#">10</a> , <a href="#">11</a> and <a href="#">17</a>
12-Jun-2009	3	<a href="#">Figure 15</a> has been updated

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