STB8N65M5, STD8N65M5, STF8N65M5
STI8N65M5, STP8N65M5, STU8N65M5

N-channel 650 V, 0.56 Ω, 7 A MDmesh™ V Power MOSFET in D²PAK, I²PAK, TO-220, TO-220FP, DPAK and IPAK

Features

Type	V_{DSS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D
STB8N65M5 STD8N65M5 STF8N65M5 STI8N65M5 STP8N65M5 STU8N65M5	710 V	< 0.6 Ω	7 A

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

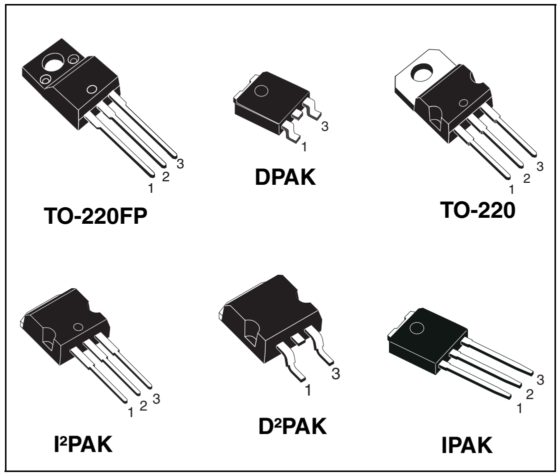
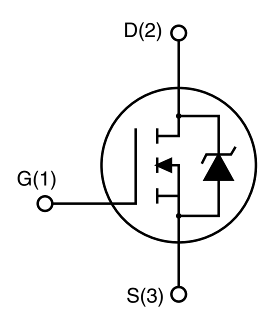


Figure 1. Internal schematic diagram



Application

Switching applications

Description

These devices are N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, 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 efficiency.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STB8N65M5	8N65M5	D²PAK	Tape and reel
STD8N65M5		DPAK	Tape and reel
STF8N65M5		TO-220FP	Tube
STI8N65M5		I²PAK	Tube
STP8N65M5		TO-220	Tube
STU8N65M5		IPAK	Tube

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Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220, D²PAK I²PAK	IPAK DPAK,	TO-220FP	
V_{GS}	Gate- source voltage	± 25			V
I_D	Drain current (continuous) at T_C = 25 °C	7		7 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	4.4		4.4 (1)	A
I_{DM} (2)	Drain current (pulsed)	28		28 (1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	70		25	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{JMAX})	2			A
E_{AS}	Single pulse avalanche energy (starting T_j = 25°C, I_D = I_{AR}, V_{DD} = 50V)	120			mJ
dv/dt (3)	Peak diode recovery voltage slope	15			V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)			2500	V
T_{stg}	Storage temperature	-55 to 150			°C
T_j	Max. operating junction temperature	150			°C

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq$ 7A, di/dt $\leq$ 400 A/µs, $V_{Peak} < V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value						Unit
		DPAK	IPAK	TO-220	I²PAK	D²PAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.79					5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max		100	62.5			62.5	°C/W
$R_{thj-pcb}$ (1)	Thermal resistance junction-pcb max	50				30		°C/W
T_l	Maximum lead temperature for soldering purpose		300				300	°C

1. When mounted on 1 inch² FR-4 board, 2oz Cu.

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2 Electrical characteristics

(T_C = 25 °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 mA, V_{GS} = 0	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = Max rating V_{DS} = Max rating, T_C=125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 3.5 A		0.56	0.6	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	690 18 2	-	pF pF pF
$C_{o(er)}$ (1)	Equivalent output capacitance energy related	V_{GS} = 0, V_{DS} = 0 to 520 V	-	17	-	pF
$C_{o(tr)}$ (2)	Equivalent output capacitance time related	V_{GS} = 0, V_{DS} = 0 to 520 V	-	52	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	2.4	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 520 V, I_D = 3.5 A, V_{GS} = 10 V (see *Figure 19*)	-	15 3.6 6	-	nC nC nC

1. $C_{o(er)}$ 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}
2. $C_{o(tr)}$ 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}

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Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_{r(V)}$ $t_{c(off)}$ $t_{f(i)}$	Turn-off delay time Rise time Cross time Fall time	V_{DD} = 400 V, I_D = 4A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 20*) (see *Figure 23*)	-	50 14 20 11	-	ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		7 28	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 7 A, V_{GS} = 0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 7 A, di/dt = 100 A/µs V_{DD} = 100 V (see *Figure 20*)	-	35 268 16		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 7 A, di/dt = 100 A/µs V_{DD} = 100 V, T_j = 150 °C (see *Figure 20*)	-	103 750 15		ns nC A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

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2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, I²PAK, D²PAK

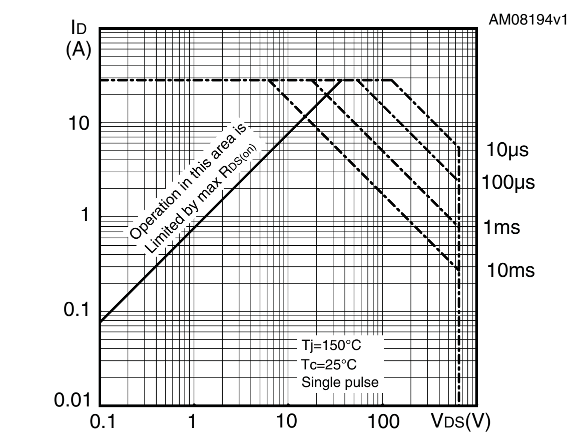

Figure 3. Thermal impedance for TO-220, I²PAK, D²PAK

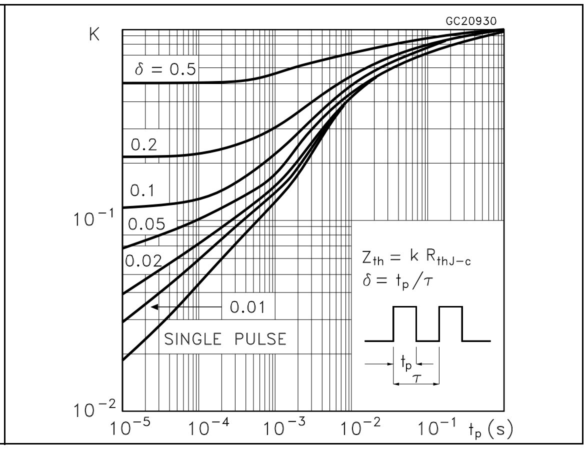

Figure 4. Safe operating area for DPAK, IPAK

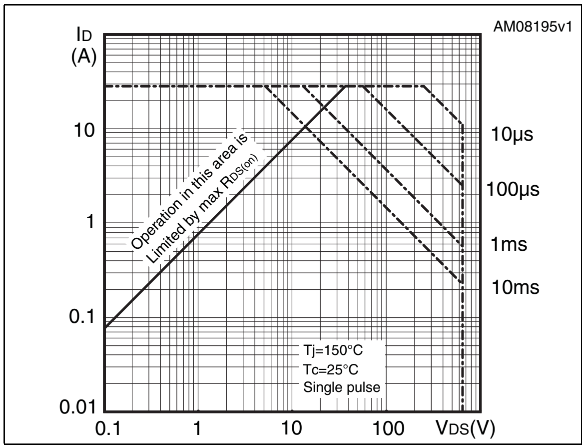

Figure 5. Thermal impedance for DPAK, IPAK

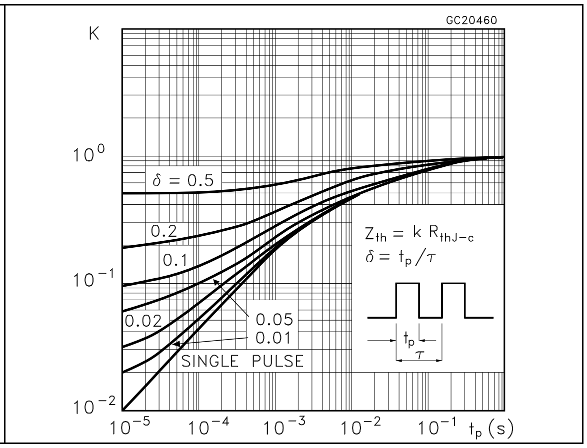

Figure 6. Safe operating area for TO-220FP

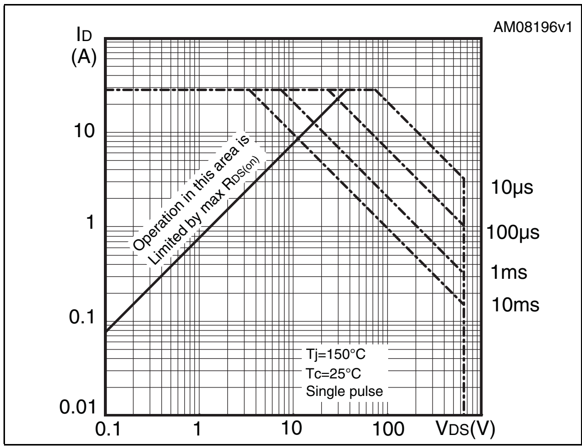

Figure 7. Thermal impedance for TO-220FP

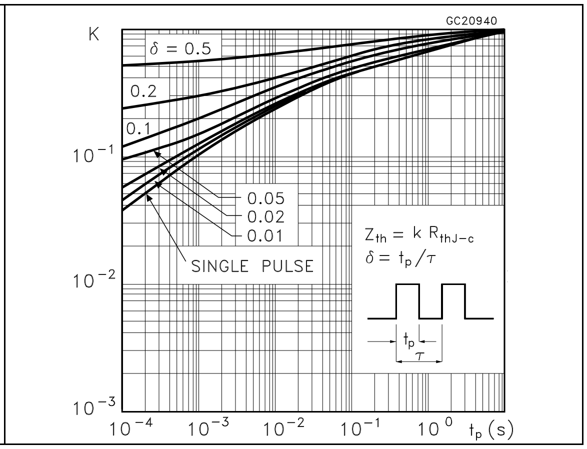

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Figure 8. Output characteristics

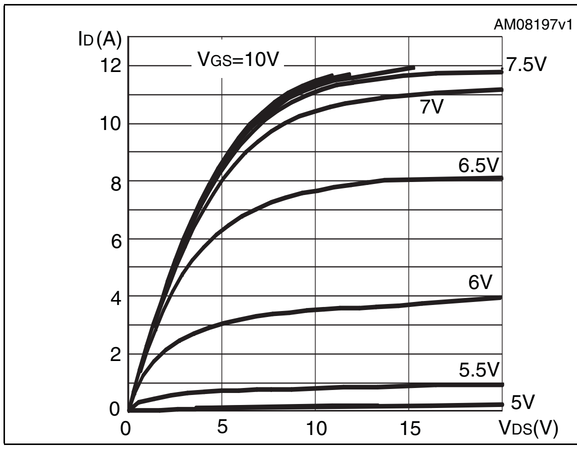

Figure 9. Transfer characteristics

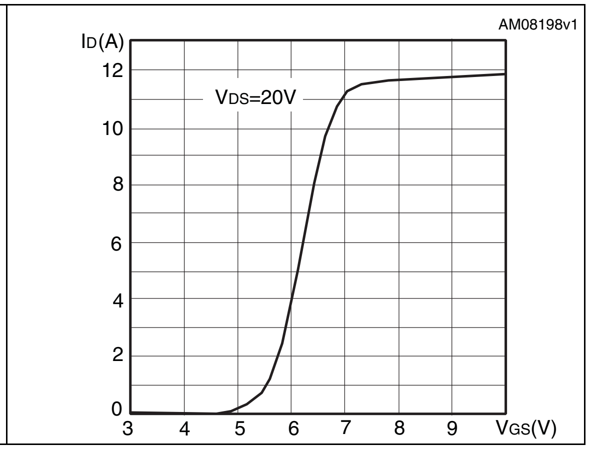

Figure 10. Gate charge vs gate-source voltage

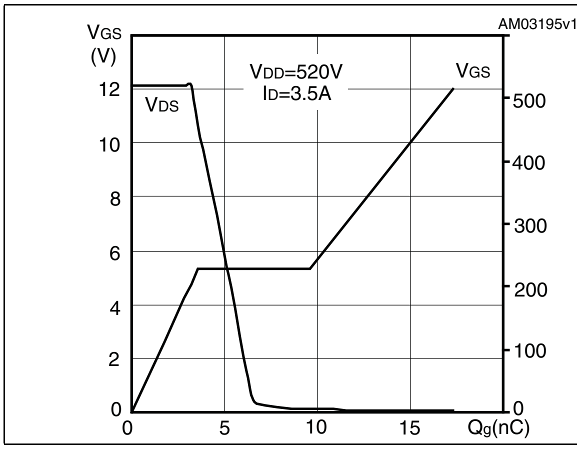

Figure 11. Static drain-source on resistance

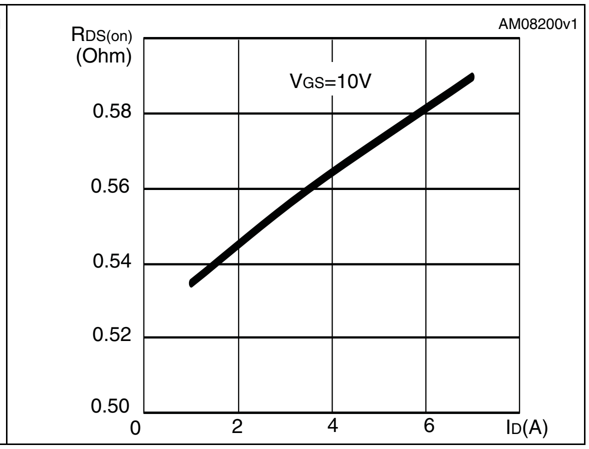

Figure 12. Capacitance variations

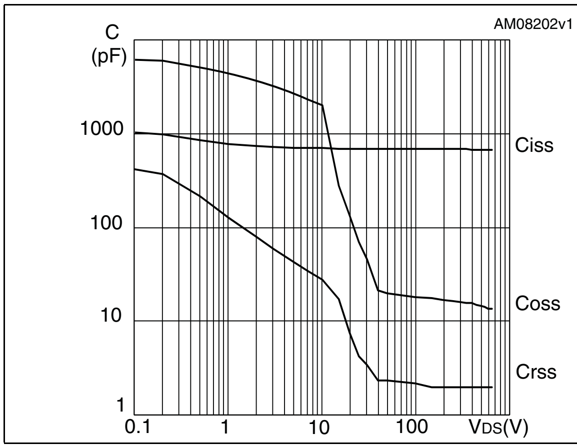

Figure 13. Output capacitance stored energy

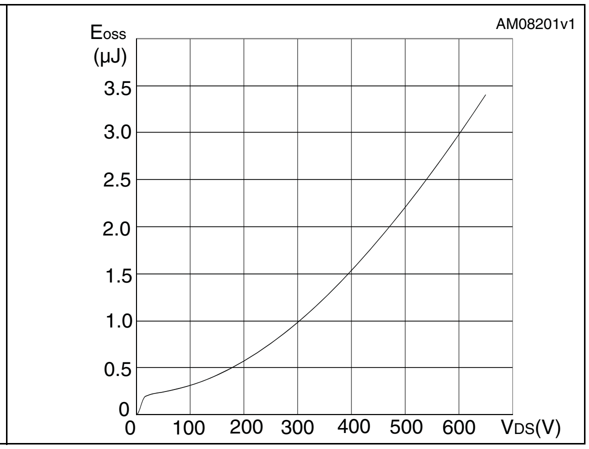

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Figure 14. Normalized gate threshold voltage vs temperature

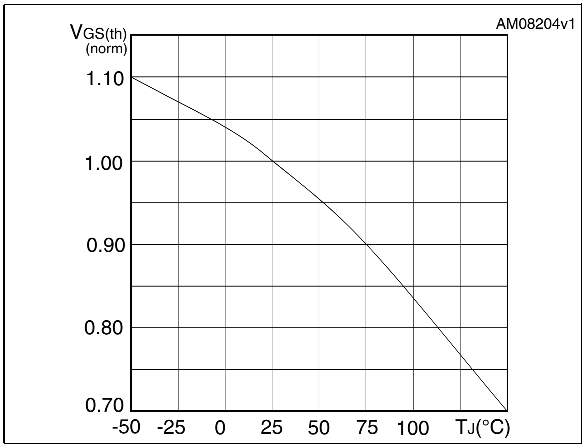


Figure 15. Normalized on resistance vs temperature

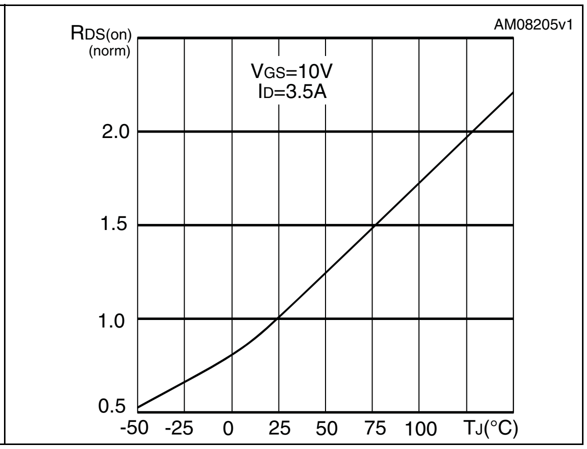


Figure 16. Switching losses vs gate resistance (1)

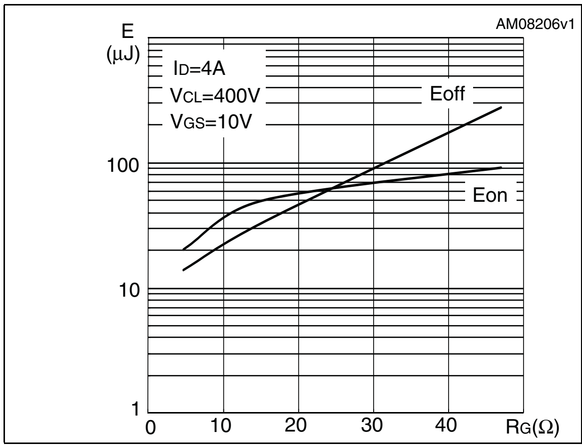
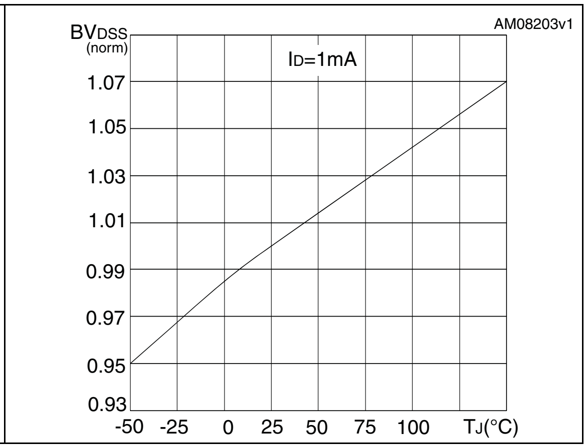


Figure 17. Normalized B_{VDSS} vs temperature



1. Eon including reverse recovery of a SiC diode

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3 Test circuits

Figure 18. Switching times test circuit for resistive load

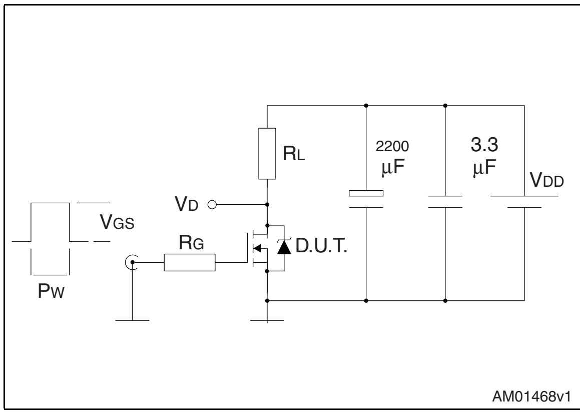


Figure 19. Gate charge test circuit

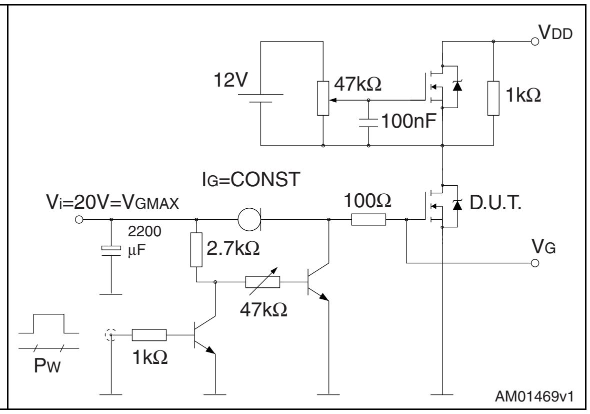


Figure 20. Test circuit for inductive load switching and diode recovery times

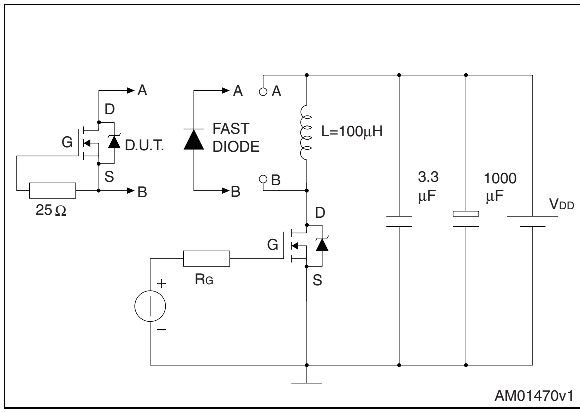


Figure 21. Unclamped inductive load test circuit

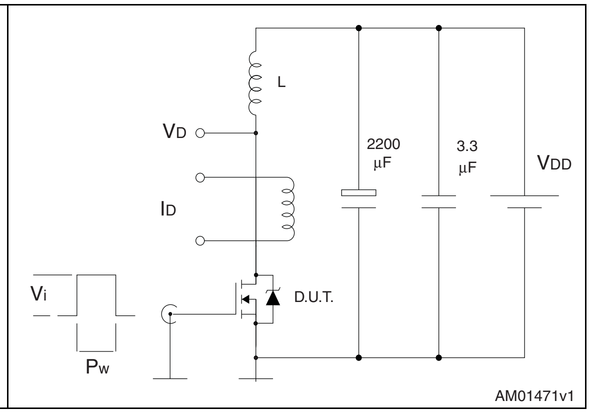


Figure 22. Unclamped inductive waveform

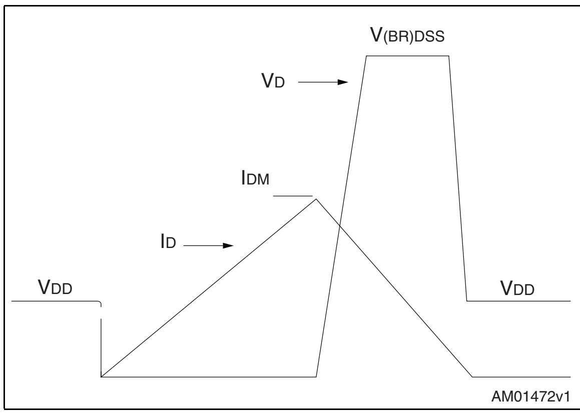
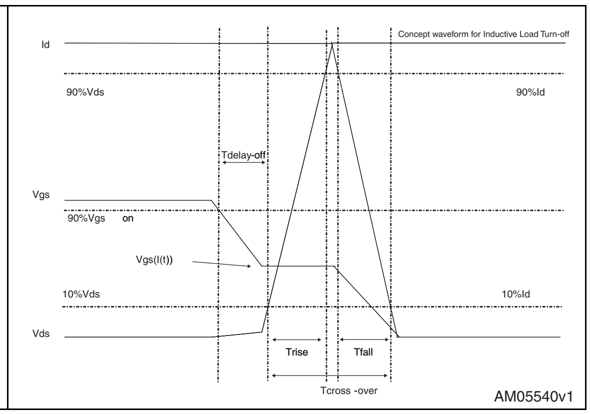


Figure 23. Switching time waveform



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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. ECOPACK is an ST trademark.

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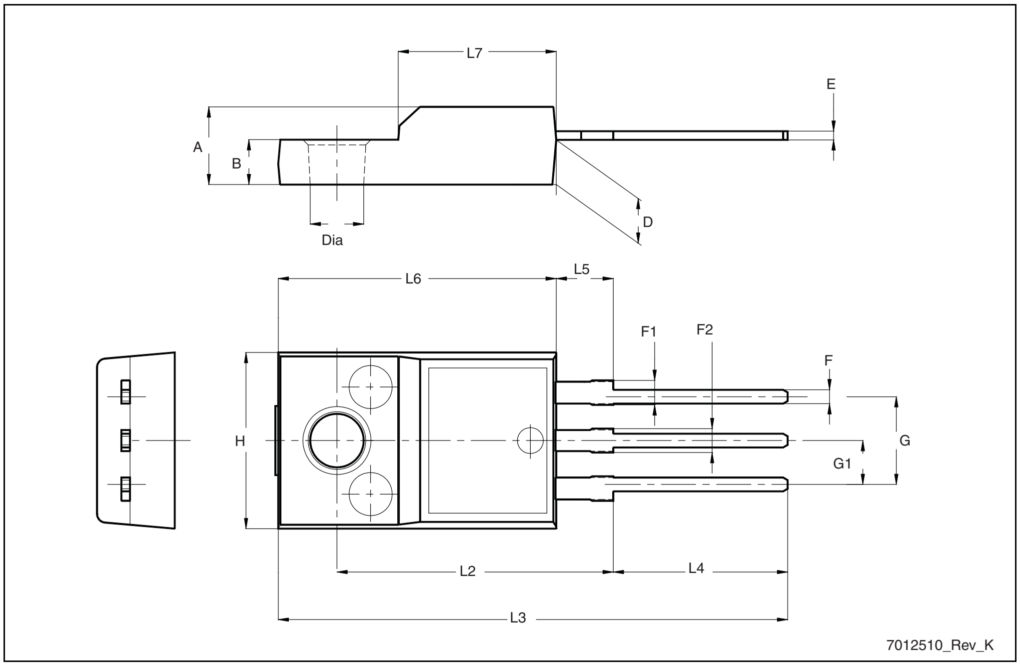
Table 8. TO-220FP mechanical data

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		1.70
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

Figure 24. TO-220FP drawing mechanical data



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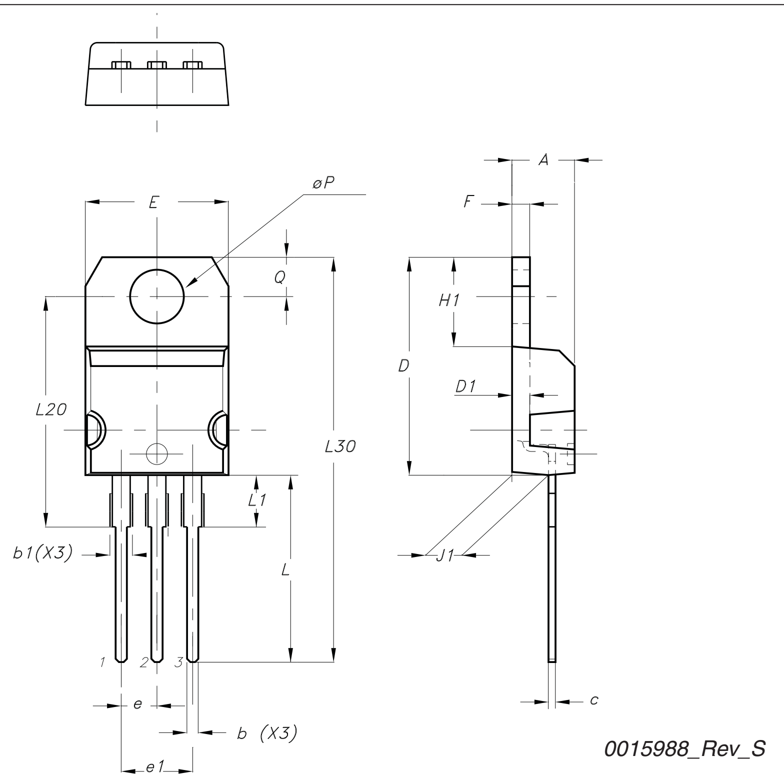
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



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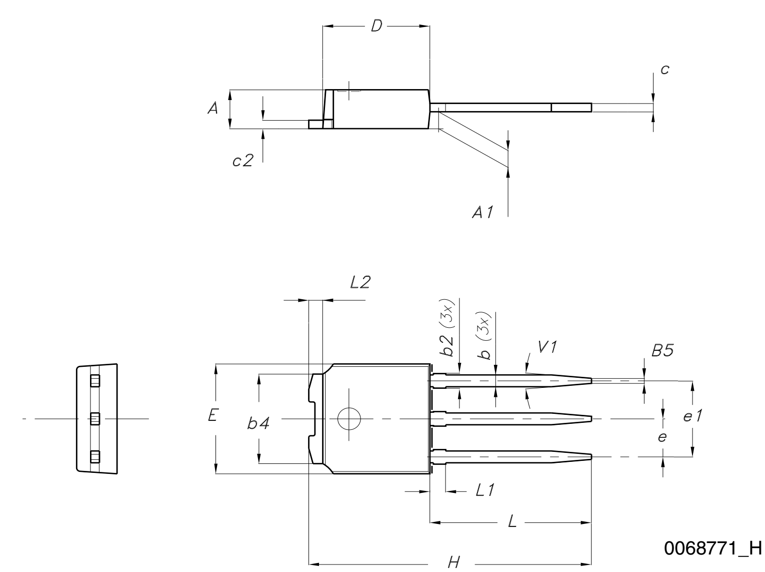
TO-251 (IPAK) mechanical data

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 °	



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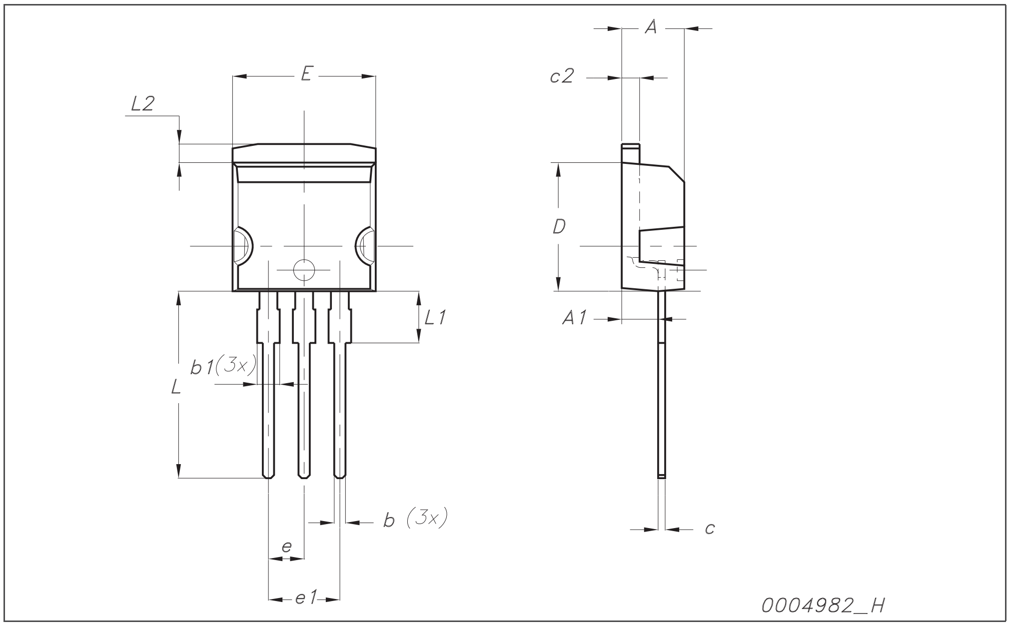
I²PAK (TO-262) mechanical data

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



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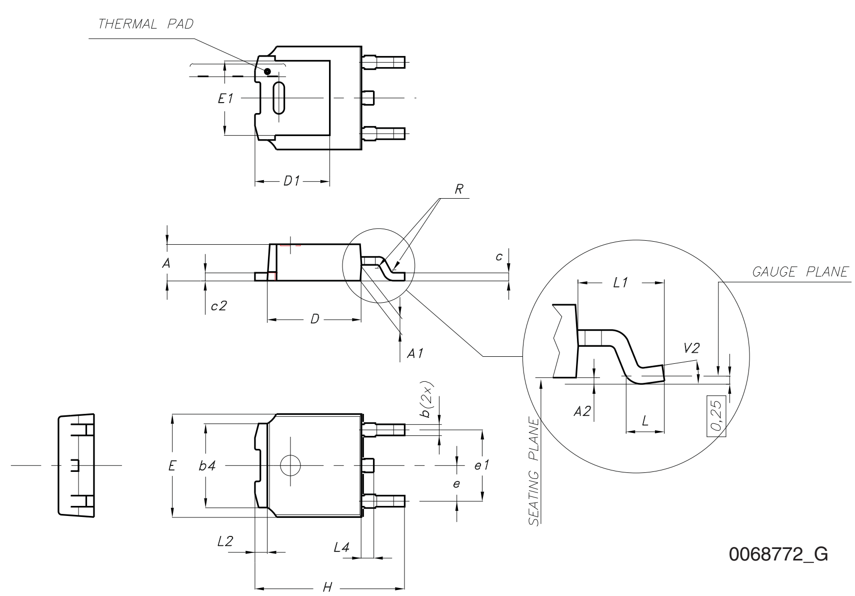
TO-252 (DPAK) mechanical data

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 °



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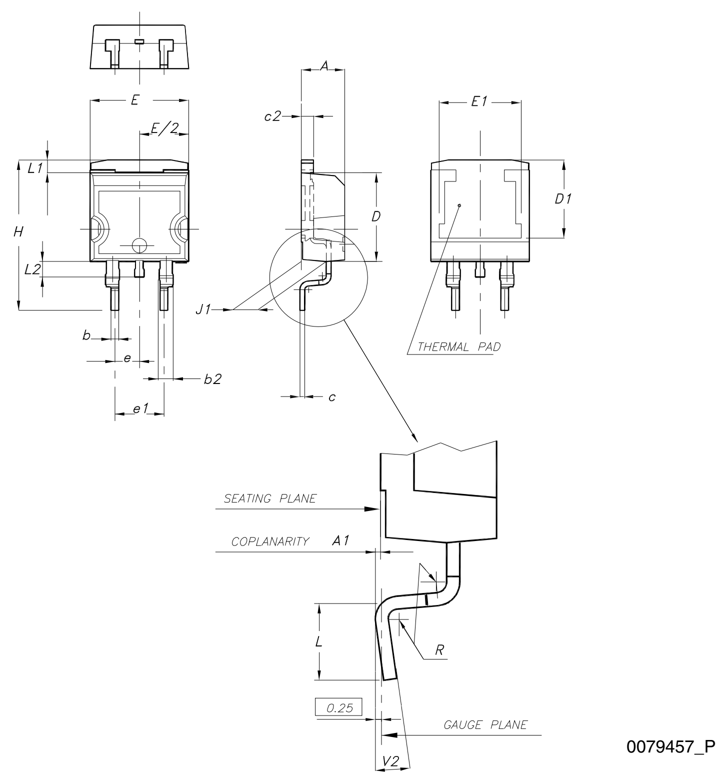
D²PAK (TO-263) mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°



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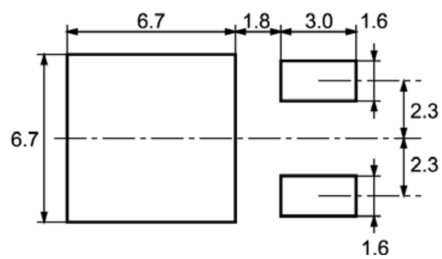
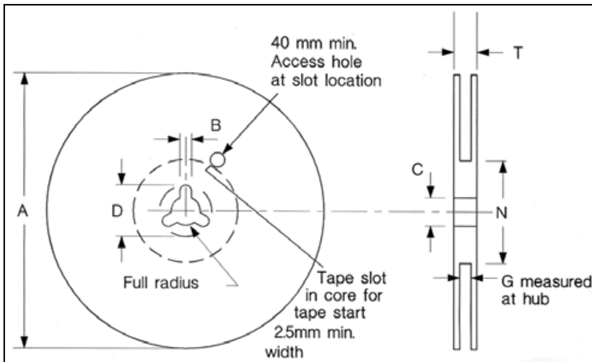
5 Packaging mechanical data

DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



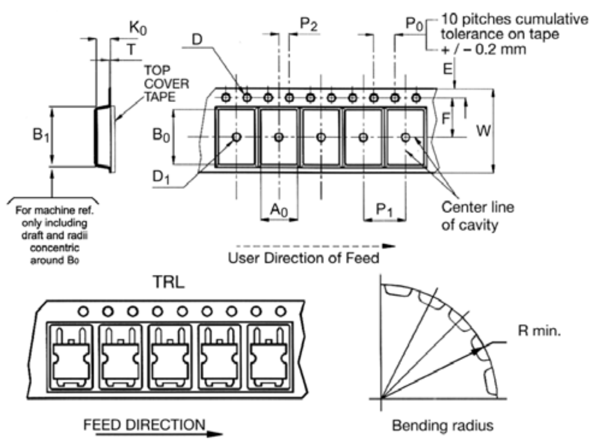
REEL MECHANICAL DATA

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

TAPE MECHANICAL DATA

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



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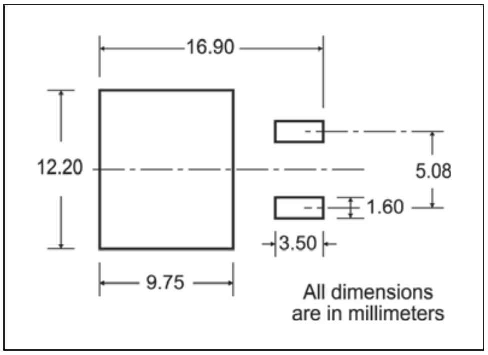
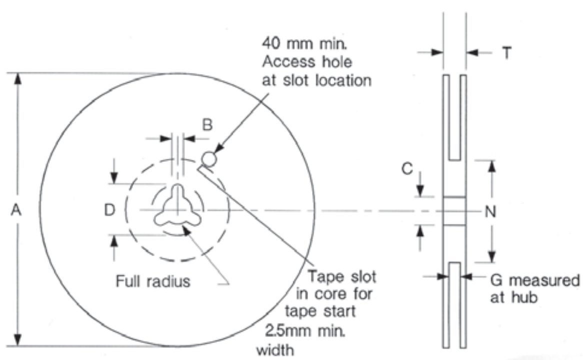
D^2PAK FOOTPRINT



TAPE AND REEL SHIPMENT



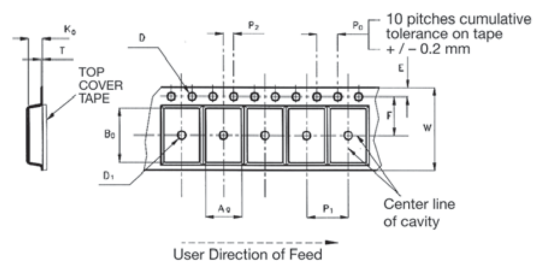
REEL MECHANICAL DATA

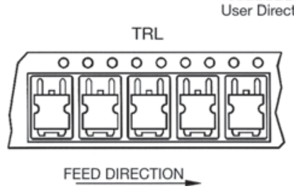
DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

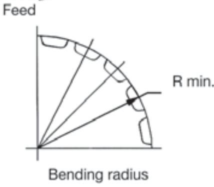
BASE QTY	BULK QTY
1000	1000

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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6 Revision history

Table 9. Document revision history

Date	Revision	Changes
23-Oct-2009	1	First release
14-Oct-2010	2	Document status promoted from preliminary data to datasheet.

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