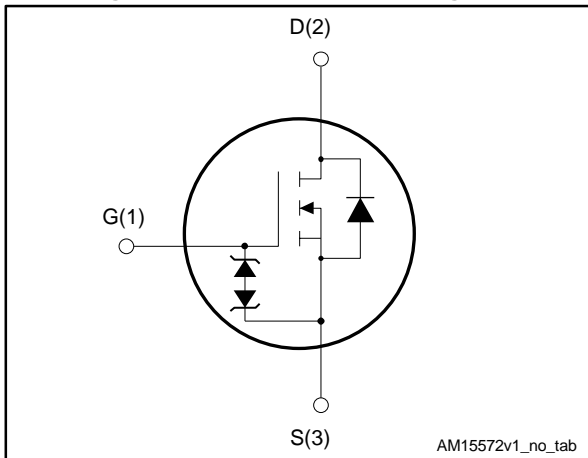


N-channel 650 V, 1.15 Ω typ., 4 A MDmesh™ M6 Power MOSFET in a TO-220FP package

Datasheet - production data



Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STF5N65M6	650 V	1.3 Ω	4 A

- Reduced switching losses
- Lower R_{DS(on)} x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent R_{DS(on)} * area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

Table 1: Device summary

Order code	Marking	Package	Packing
STF5N65M6	5N65M6	TO-220FP	Tube

Contents

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V _{GS}	Gate-source voltage	± 25	V
I _D	Drain current (continuous) at T _C = 25 °C	4	A
I _D	Drain current (continuous) at T _C = 100 °C	2.5	A
I _{DM} ⁽¹⁾	Drain current (pulsed)	16	A
P _{TOT}	Total dissipation at T _C = 25 °C	20	W
dv/dt ⁽²⁾	Peak diode recovery voltage slope	5	V/ns
dv/dt ⁽³⁾	MOSFET dv/dt ruggedness	50	
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T _C = 25 °C)	2.5	kV
T _J	Operating junction temperature range	-55 to 150	°C
T _{stg}	Storage temperature range		

Notes:

⁽¹⁾Pulse width limited by safe operating area

⁽²⁾I_{SD} ≤ 4 A, di/dt = 400 A/μs; V_{DS peak} < V_{(BR)DSS}, V_{DD} = 400 V

⁽³⁾V_{DS} ≤ 520 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R _{thj-case}	Thermal resistance junction-case	6.25	°C/W
R _{thj-amb}	Thermal resistance junction-ambient	62.5	

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T _{Jmax})	1	A
E _{as}	Single pulse avalanche energy (starting T _J =25°C, I _D = I _{AR} , V _{DD} =50 V)	90	mJ

2 Electrical characteristics

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

Table 5: On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0, I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}; T_C = 125\text{ °C}^{(1)}$			100	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$			± 5	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.25	3	3.75	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 2\text{ A}$		1.15	1.3	Ω

Notes:

⁽¹⁾Defined by design, not subject to production test.

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	170	-	pF
C_{oss}	Output capacitance		-	20	-	pF
C_{rss}	Reverse transfer capacitance		-	1	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }520\text{ V}, V_{GS} = 0\text{ V}$	-	35	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	5	-	Ω
Q_g	Total gate charge	$V_{DD} = 350\text{ V}, I_D = 1\text{ A}, V_{GS} = 10\text{ V},$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 15: "Test circuit for gate charge behavior")	-	5.1	-	nC
Q_{gs}	Gate-source charge		-	0.8	-	nC
Q_{gd}	Gate-drain charge		-	2	-	nC

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}, I_D = 2\text{ A}, R_G = 4.7\text{ }\Omega,$ $V_{GS} = 10\text{ V}$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform")	-	6.5	-	ns
t_r	Rise time		-	5.9	-	ns
$t_{d(off)}$	Turn-off delay time		-	17.4	-	ns
t_f	Fall time		-	15.2	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		16	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4 \text{ A}$, $V_{GS} = 0 \text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, (see Figure 19 : "Switching time waveform")	-	222		ns
Q_{rr}	Reverse recovery charge		-	1.24		μC
I_{RRM}	Reverse recovery current		-	11.2		A
t_{rr}	Reverse recovery time	$I_{SD} = 4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 19 : "Switching time waveform")	-	264		ns
Q_{rr}	Reverse recovery charge		-	1.39		μC
I_{RRM}	Reverse recovery current		-	10.5		A

Notes:

(1) Pulse width limited by safe operating area

(2) Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

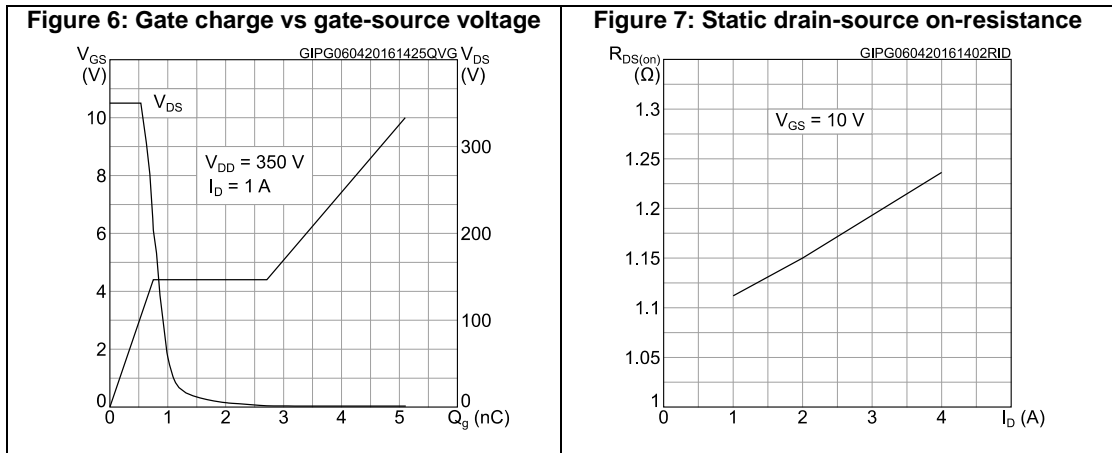
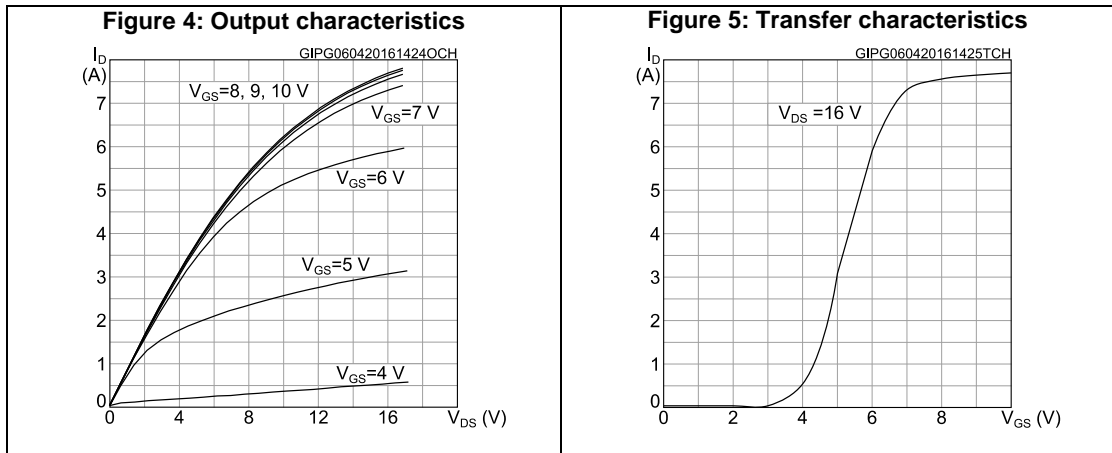
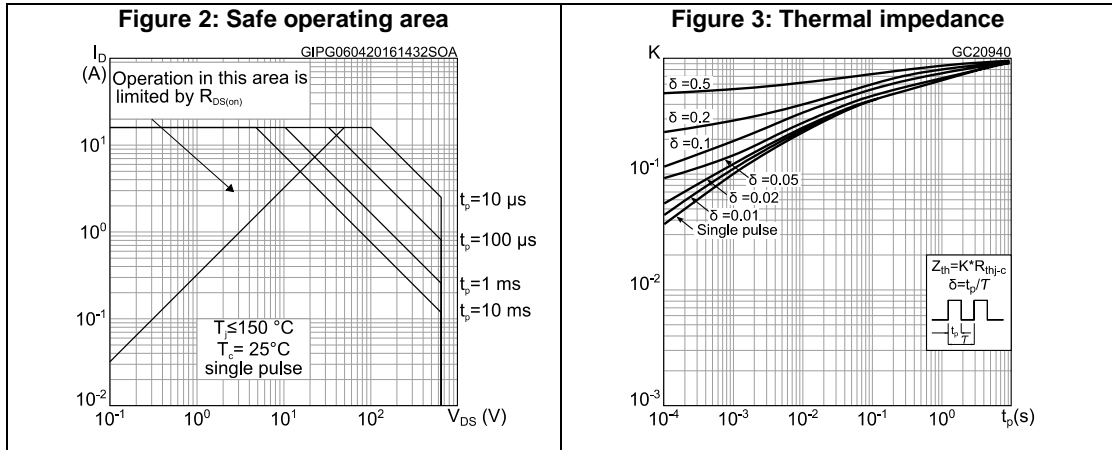


Figure 8: Capacitance variations

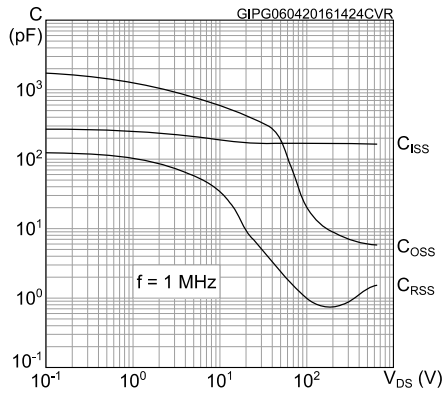


Figure 9: Normalized gate threshold voltage vs temperature

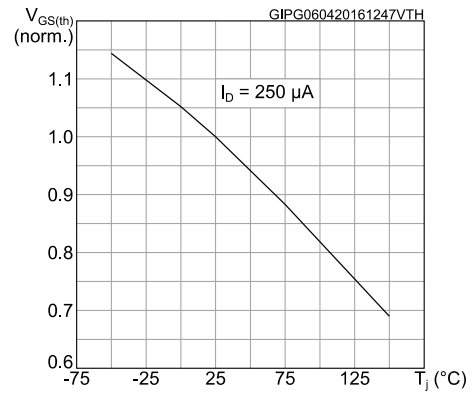


Figure 10: Normalized on-resistance vs temperature

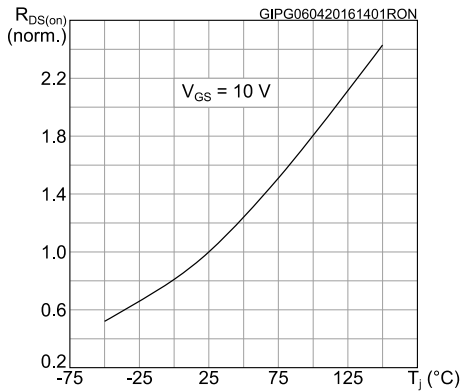


Figure 11: Normalized V(BR)DSS vs temperature

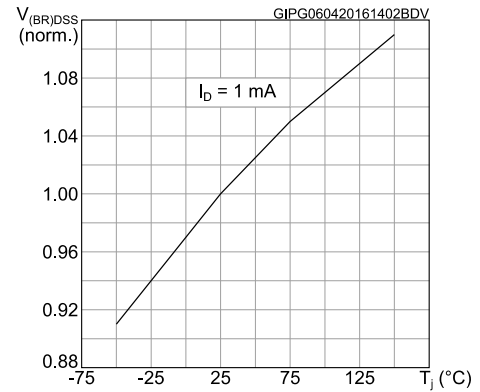


Figure 12: Output capacitance stored energy

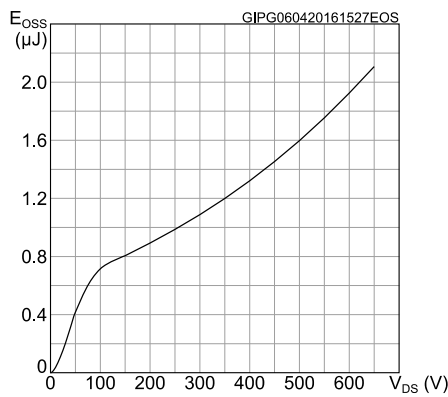
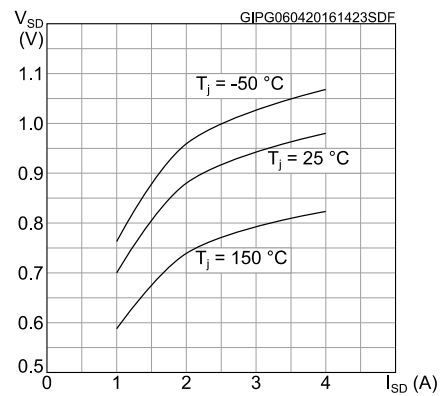


Figure 13: Source-drain diode forward characteristics



3 Test circuits

Figure 14: Test circuit for resistive load switching times



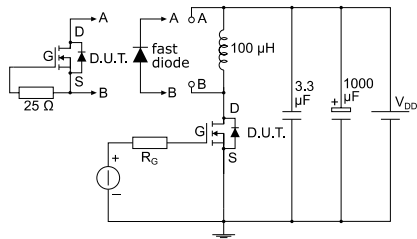
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Figure 15: Test circuit for gate charge behavior



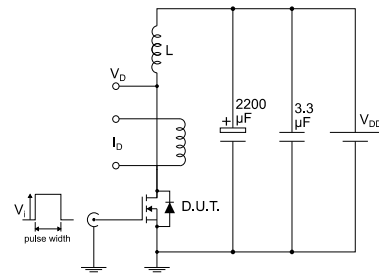
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Figure 16: Test circuit for inductive load switching and diode recovery times



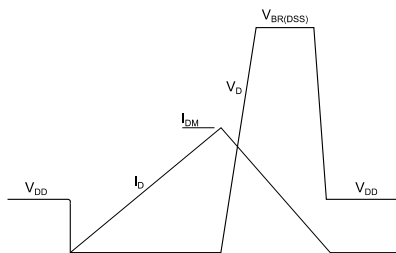
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Figure 17: Unclamped inductive load test circuit



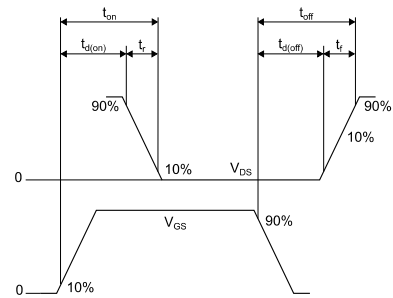
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Figure 18: Unclamped inductive waveform



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Figure 19: Switching time waveform



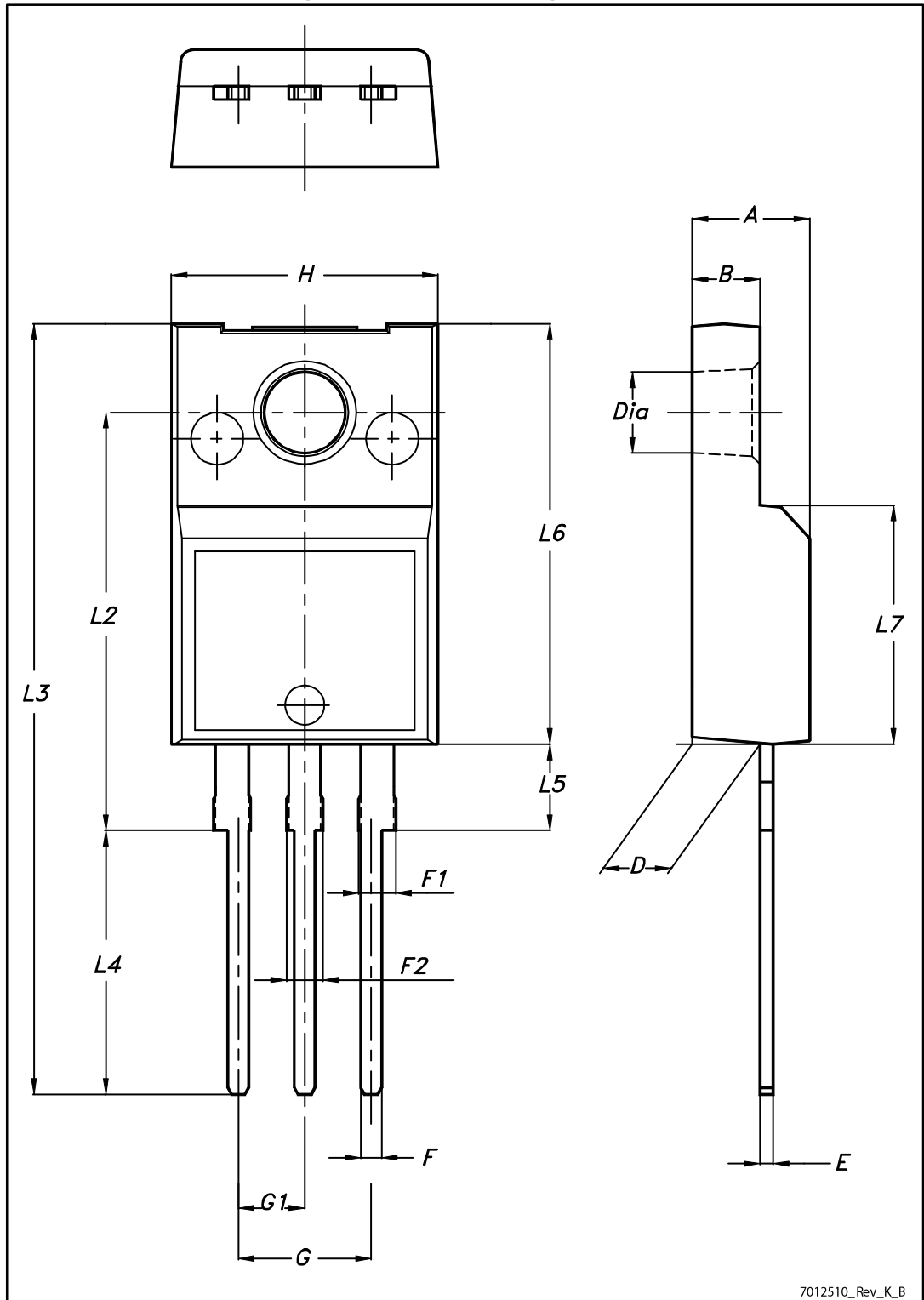
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4 Package information

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.

4.1 TO-220FP package information

Figure 20: TO-220FP package outline



7012510_Rev_K_B

Table 9: TO-220FP package 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

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
05-May-2016	1	Initial release.

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