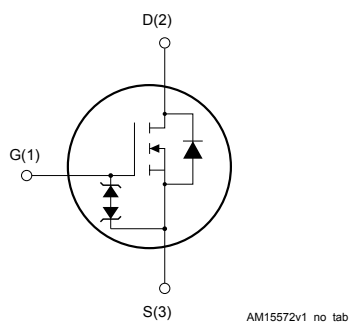


N-channel 900 V, 280 mΩ typ., 15 A MDmesh K5 Power MOSFET in a TO-220FP package



TO-220FP



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STF16N90K5	900 V	330 mΩ	15 A

- Industry's lowest R_{DS(on)} x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.



Product status link

[STF16N90K5](#)

Product summary

Order code	STF16N90K5
Marking	16N90K5
Package	TO-220FP
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	15	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	9	A
$I_{DM}^{(1)}$	Drain current (pulsed)	60	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	30	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^{\circ}\text{C}$)	2.5	kV
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
T_J	Operating junction temperature range	-55 to 150	$^{\circ}\text{C}$
T_{stg}	Storage temperature range		

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 15\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$; $V_{DS}(\text{peak}) \leq V_{(BR)DSS}$, $V_{DD} = 450\text{ V}$.
3. $V_{DS} \leq 720\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	4.1	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb	62.5	$^{\circ}\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_J max)	5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	380	mJ

2 Electrical characteristics

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

Table 4. On/off state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	900			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 900\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 900\text{ V}$			50	μA
		$T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾				
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 7.5\text{ A}$		280	330	$\text{m}\Omega$

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1027	-	pF
C_{oss}	Output capacitance		-	106	-	pF
C_{rss}	Reverse transfer capacitance		-	1.6	-	pF
$C_{o(er)}^{(1)}$	Equivalent capacitance energy related	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }720\text{ V}$	-	51	-	pF
$C_{o(tr)}^{(2)}$	Equivalent capacitance time related			141	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	1	4.9	9	Ω
Q_g	Total gate charge	$V_{DD} = 720\text{ V}$, $I_D = 15\text{ A}$	-	29.7	-	nC
Q_{gs}	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	7.3	-	nC
Q_{gd}	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	17.7	-	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} .

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 450\text{ V}$, $I_D = 7.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	28.8	-	ns
t_r	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	46	-	ns
t_f	Fall time		-	9.8	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		15	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		60	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 15\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 15\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	458		ns
Q_{rr}	Reverse recovery charge		-	8.13		μC
I_{RRM}	Reverse recovery current		-	35.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 15\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	546		ns
Q_{rr}	Reverse recovery charge		-	9.2		μC
I_{RRM}	Reverse recovery current		-	33.7		A

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$	30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

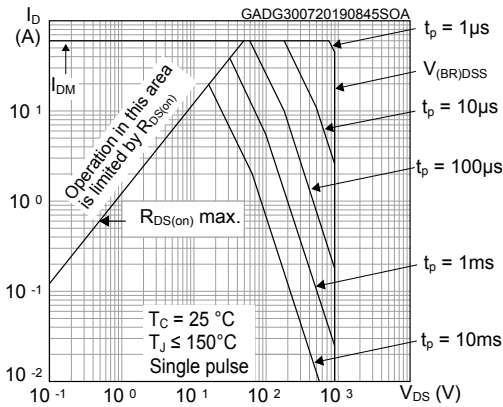


Figure 2. Maximum transient thermal impedance

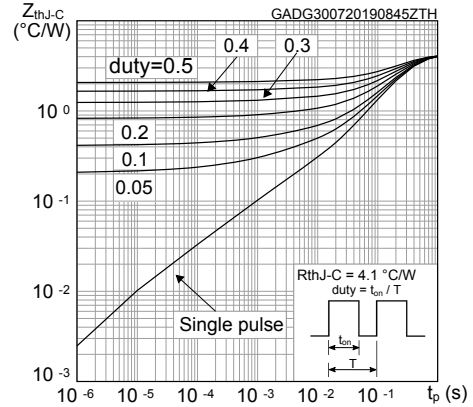


Figure 3. Typical output characteristics

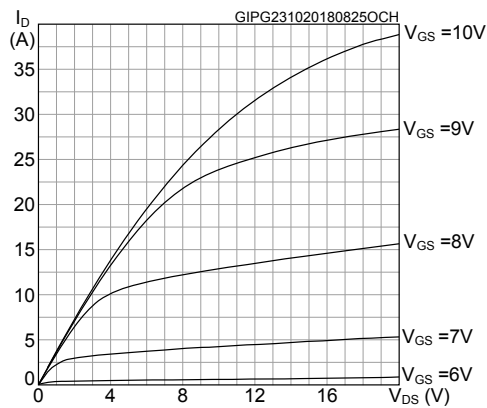


Figure 4. Typical transfer characteristics

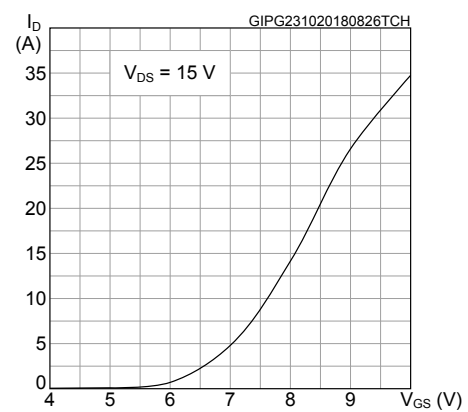


Figure 5. Normalized breakdown voltage vs temperature

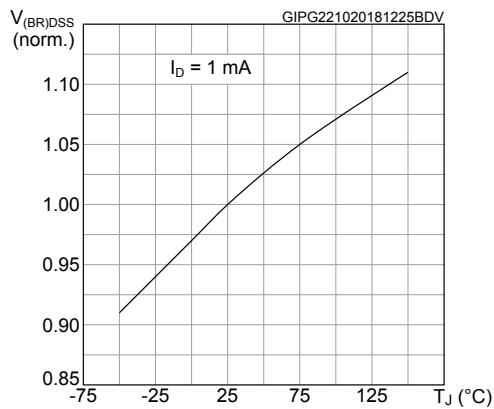


Figure 6. Typical drain-source on-resistance

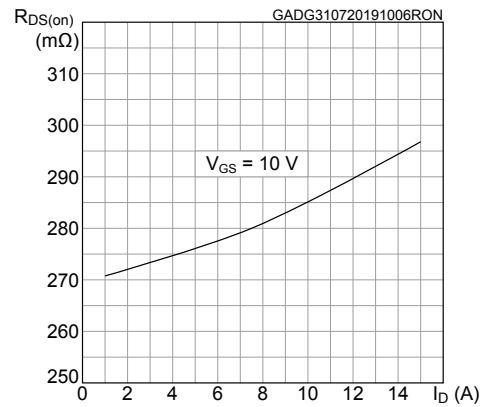
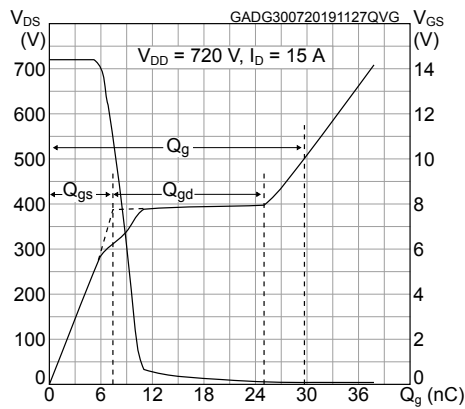
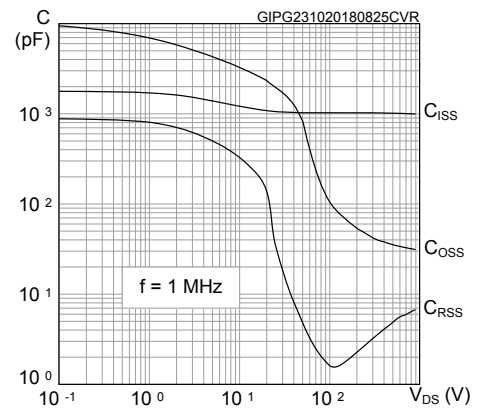
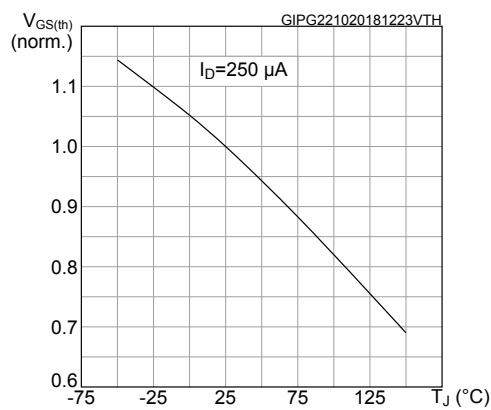
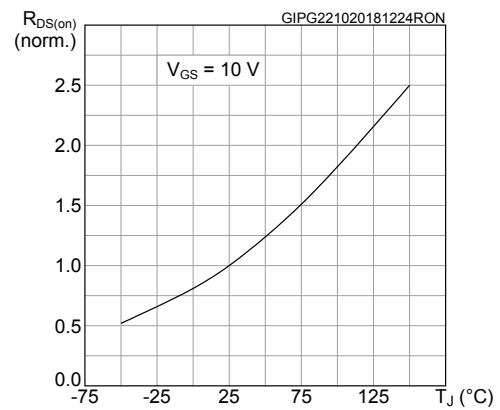
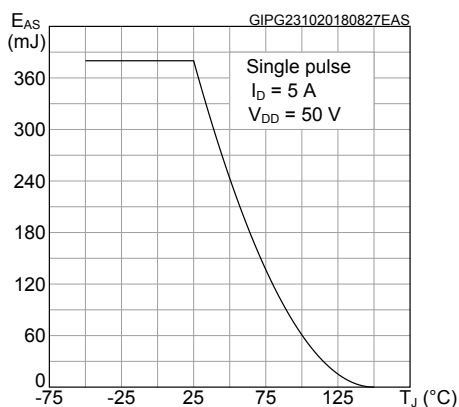
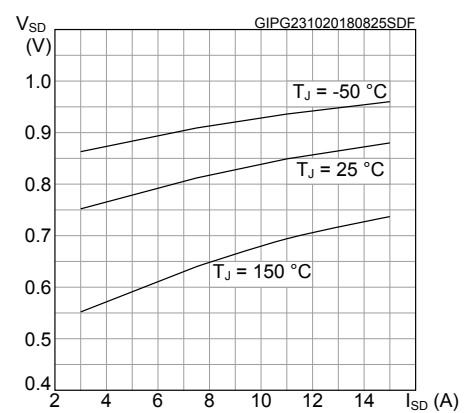
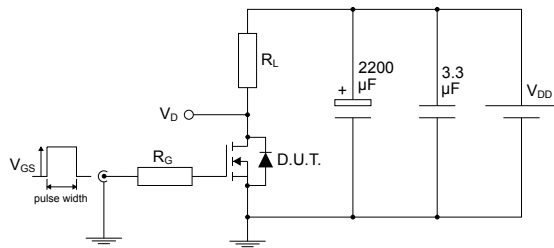
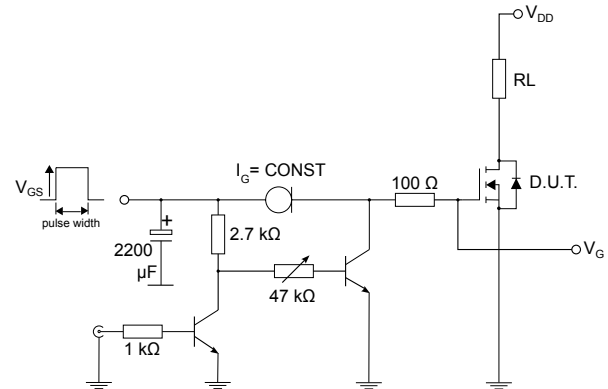


Figure 7. Typical gate charge characteristics

Figure 8. Typical capacitances vs voltage

Figure 9. Normalized gate threshold voltage vs temperature

Figure 10. Normalized on-resistance vs temperature

Figure 11. Maximum avalanche energy vs temperature

Figure 12. Typical source-drain diode forward characteristics


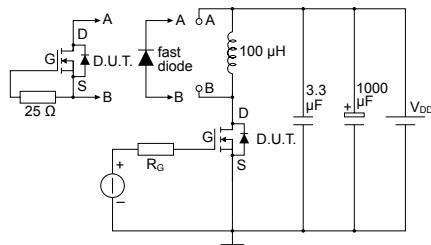
3 Test circuits

Figure 13. Test circuit for resistive load switching times


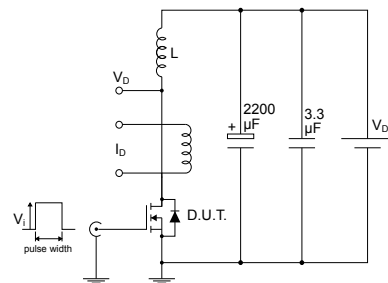
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Figure 14. Test circuit for gate charge behavior


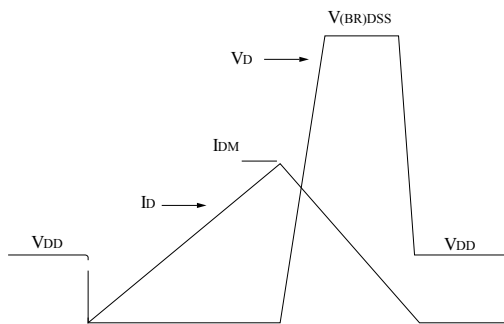
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Figure 15. Test circuit for inductive load switching and diode recovery times


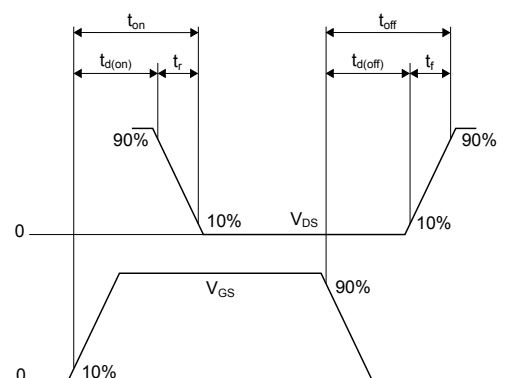
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform


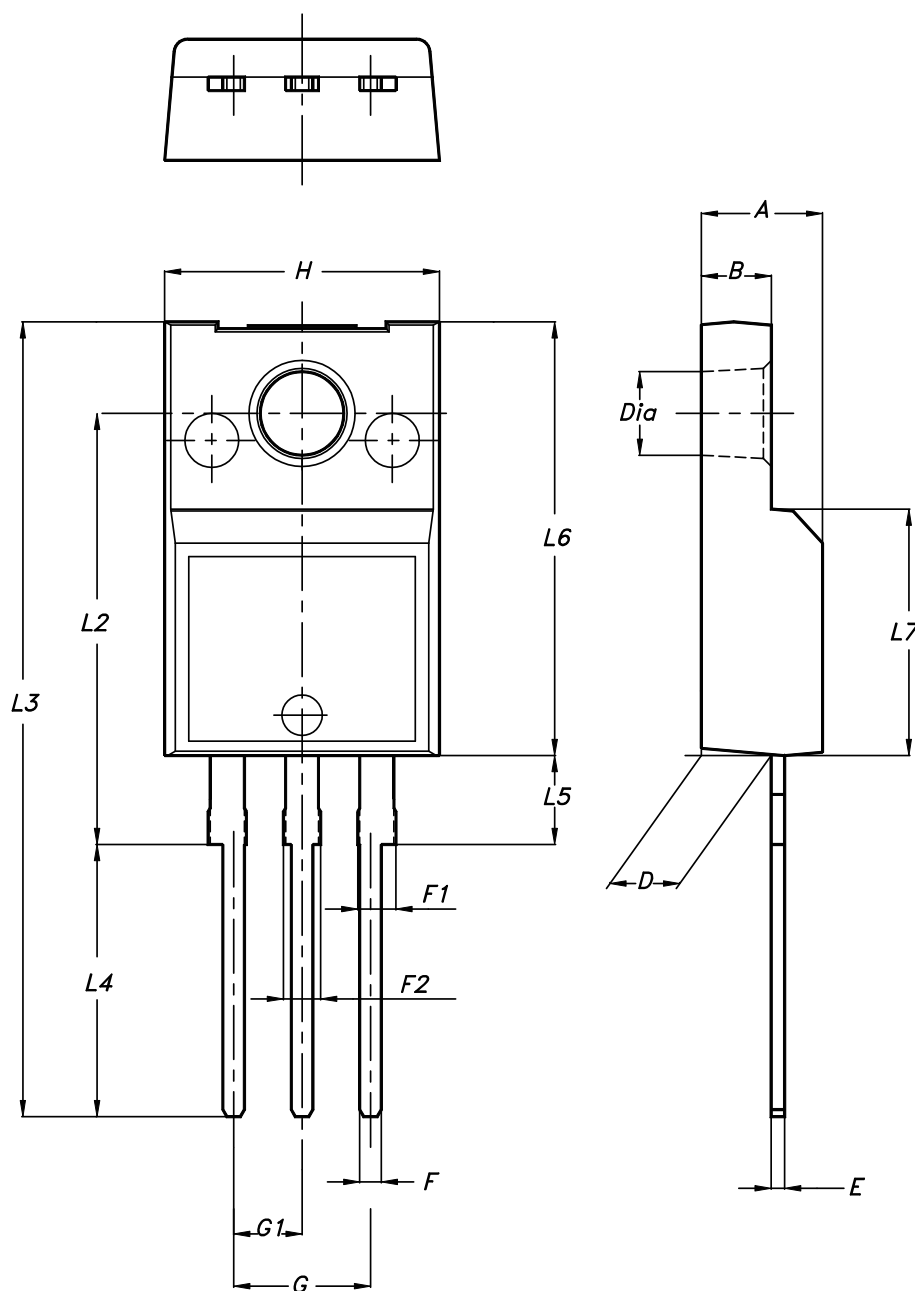
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4 Package information

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 19. TO-220FP package outline



7012510_Rev_13_B

Table 9. TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

Revision history

Table 10. Document revision history

Date	Revision	Changes
01-Aug-2019	1	First release.

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