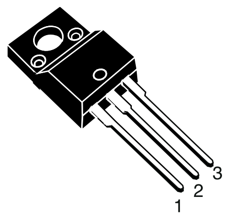
STF5N105K5

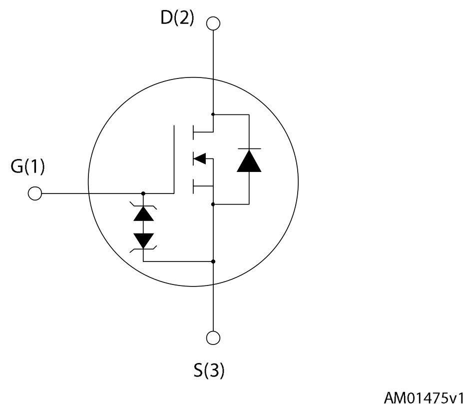
N-channel 1050 V, 2.9 Ω typ., 3 A MDmesh™ K5 Power MOSFET in a TO-220FP package

Datasheet - production data



TO-220FP

Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STF5N105K5	1050 V	3.5 Ω	3 A	25 W

- Worldwide best FOM (figure of merit)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This N-channel Zener-protected Power MOSFET is designed using ST's revolutionary avalanche-rugged very high voltage 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 which require superior power density and high efficiency.

Table 1: Device summary

Part number	Marking	Package	Packaging
STF5N105K5	5N105K5	TO-220FP	Tube

This is information on a product in full production. www.st.com

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	3 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	2 (1)	A
I_{DM} (2)	Drain current (pulsed)	12	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
I_{AR}	Max current during repetitive or single pulse avalanche	1	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D=I_{AS}, V_{DD}= 50 V)	85	mJ
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T_C=25 °C)	2500	V
dv/dt (3)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	50	V/ns
T_j	Operating junction temperature	- 55 to 150	°C
T_{stg}	Storage temperature		

Notes:

(1)Limited only by maximum junction temperature

(2)Pulse width limited by safe operating area.

(3)I_{SD} ≤ 3 A, di/dt ≤ 100 A/μs, $V_{DS(peak)}$ ≤ $V_{(BR)DSS}$

(4)V_{DS} ≤ 840 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	5	°C/W
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5	°C/W

2 Electrical characteristics

(T_{CASE} = 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	V_{GS}= 0, I_D = 1 mA	1050			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 1050 V			1	µA
		V_{GS} = 0, V_{DS} = 1050 V, T_C=125 °C			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0, V_{GS} = ± 20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D= 1.5 A		2.9	3.5	Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS}=0, V_{DS} =100 V, f=1 MHz	-	210	-	pF
C_{oss}	Output capacitance		-	16	-	pF
C_{rss}	Reverse transfer capacitance		-	0.5	-	pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0, V_{DS} = 0 to 840 V	-	26	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	10	-	pF
R_G	Intrinsic gate resistance	f = 1MHz open drain	-	9	-	Ω
Q_g	Total gate charge	V_{DD} = 840 V, I_D = 3 A V_{GS} =10 V *Figure 16: "Gate charge test circuit"*	-	12.5	-	nC
Q_{gs}	Gate-source charge		-	2	-	nC
Q_{gd}	Gate-drain charge		-	9.5	-	nC

Notes:

(1)Time related 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}

(2)energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases 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} = 525V, I_D = 1.5 A, R_G=4.7 Ω, V_{GS}=10 V *Figure 18: " Unclamped inductive load test circuit"*	-	15.5	-	ns
t_r	Rise time		-	8.5	-	ns
$t_{d(off)}$	Turn-off delay time		-	31	-	ns
t_f	Fall time		-	24	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3	A
I_{SDM}	Source-drain current (pulsed)		-		12	A
V_{SD}[(1)]	Forward on voltage	V_{GS}=0, I_{SD}= 3 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD}= 3 A, V_{DD}= 60 V di/dt = 100 A/µs, *Figure 17: " Test circuit for inductive load switching and diode recovery times"*	-	400		ns
Q_{rr}	Reverse recovery charge		-	2.3		µC
I_{RRM}	Reverse recovery current		-	12		A
t_{rr}	Reverse recovery time	I_{SD}= 3 A,V_{DD}= 60 V di/dt=100 A/µs, Tj=150 °C *Figure 17: " Test circuit for inductive load switching and diode recovery times"*	-	560		ns
Q_{rr}	Reverse recovery charge		-	3.1		µC
I_{RRM}	Reverse recovery current		-	11		A

Notes:

(1)Pulsed: pulse duration = 300µs, 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} = ± 1mA, I_D=0	30	-	-	V

The built-in back-to-back Zener diodes have specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

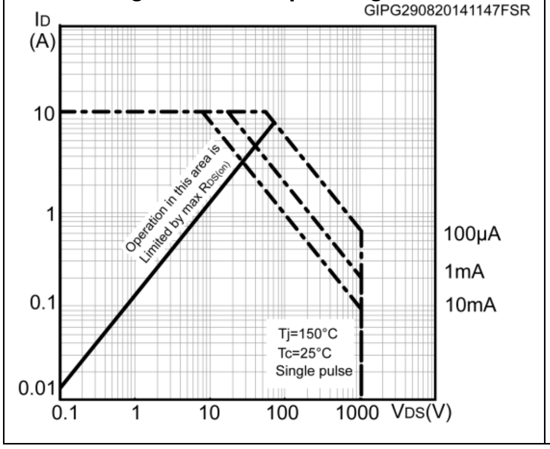


Figure 3: Thermal impedance

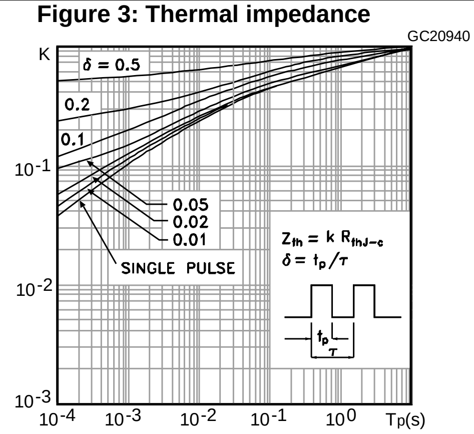


Figure 4: Output characteristics

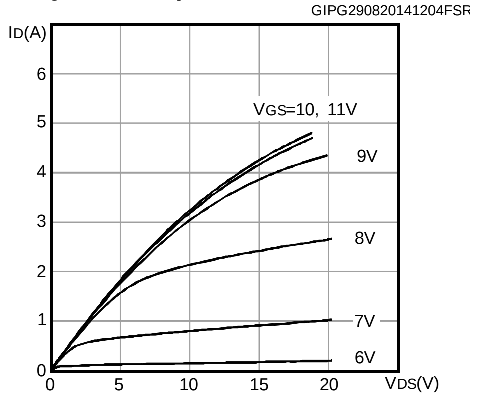


Figure 5: Transfer characteristics

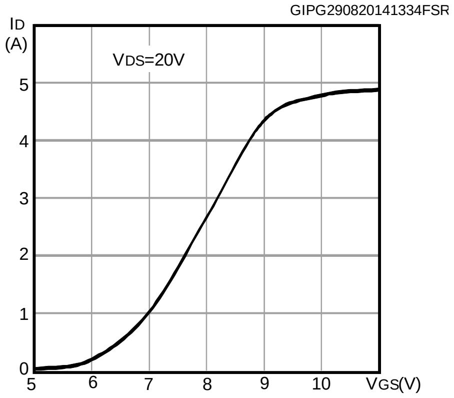


Figure 6: Gate charge vs gate-source voltage

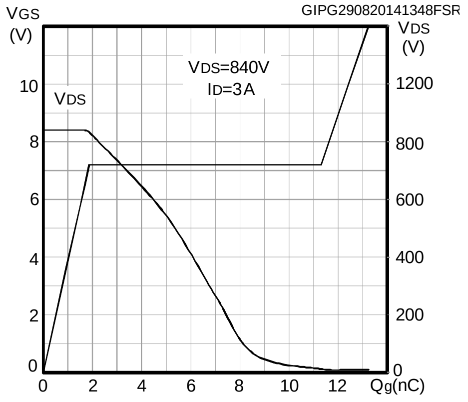


Figure 7: Static drain-source on-resistance

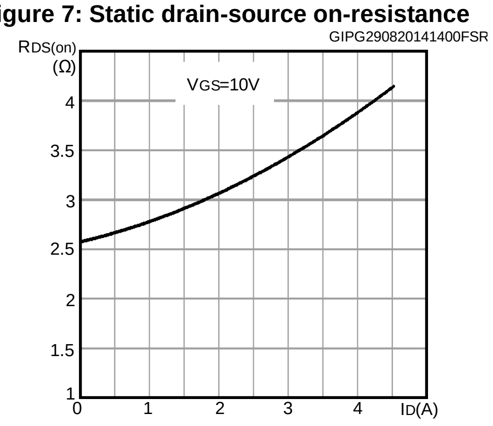


Figure 8: Capacitance variations

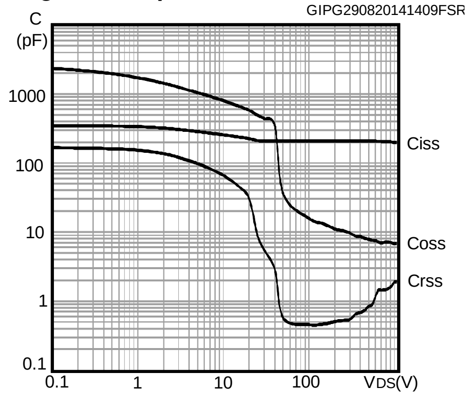


Figure 9: Maximum avalanche energy

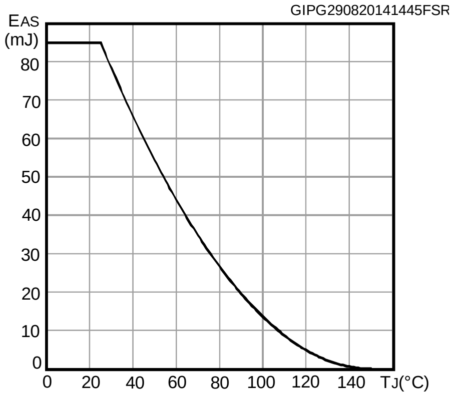


Figure 10: Normalized gate threshold voltage vs temperature

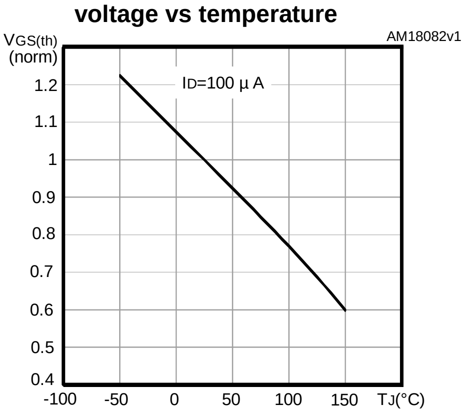


Figure 11: Normalized on-resistance vs temperature

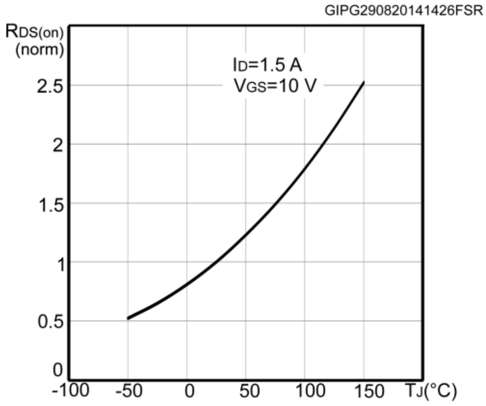


Figure 12: Normalized V(BR)DSS vs temperature

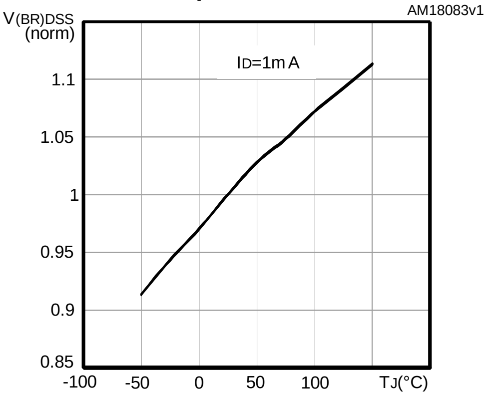


Figure 13: Source-drain diode forward characteristics

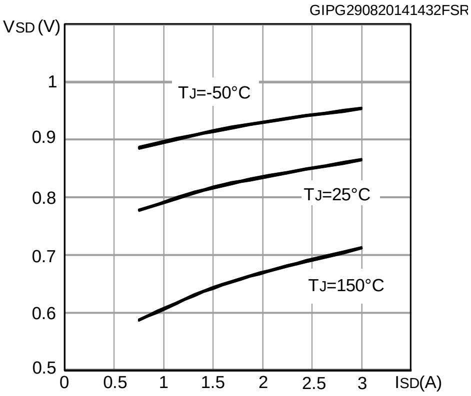
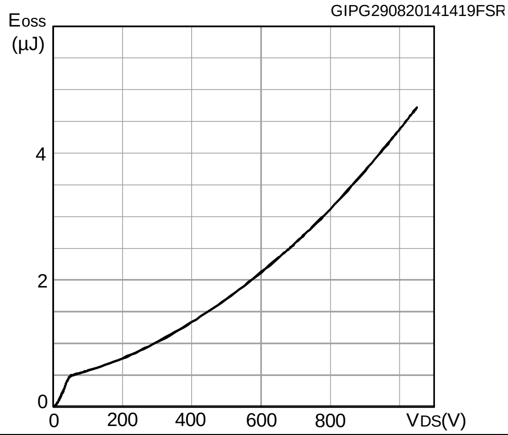


Figure 14: Output capacitance stored energy vs temperature



3 Test circuits

Figure 15: Switching times test circuit for resistive load

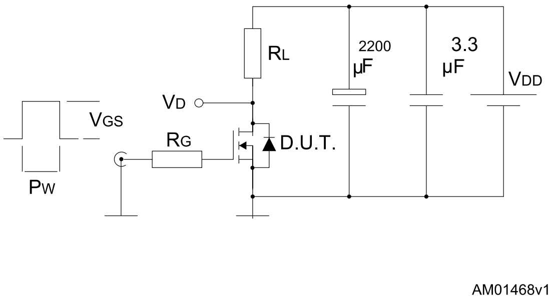


Figure 16: Gate charge test circuit

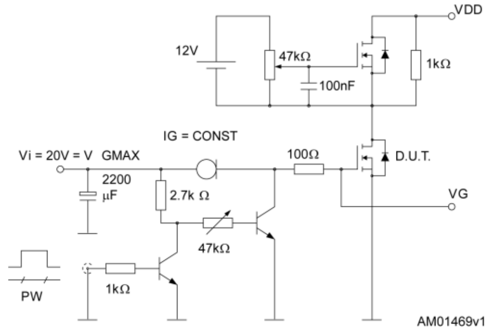


Figure 17: Test circuit for inductive load switching and diode recovery times

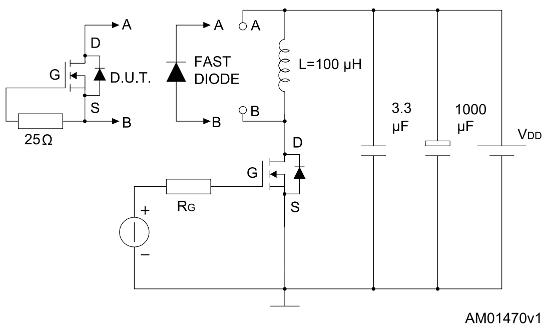


Figure 18: Unclamped inductive load test circuit

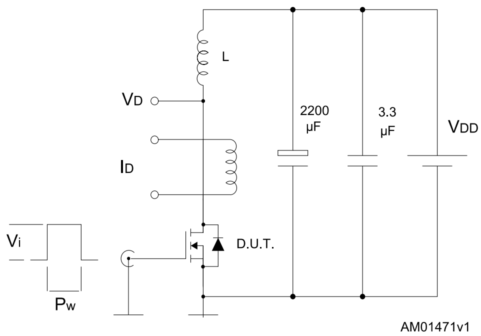


Figure 19: Unclamped inductive waveform

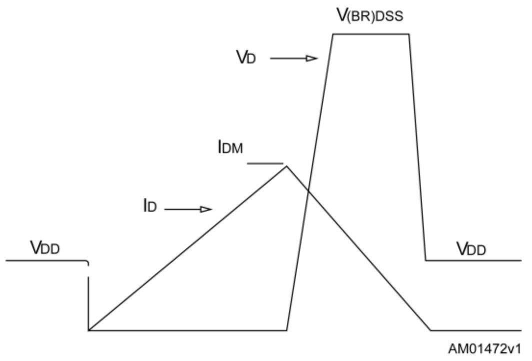
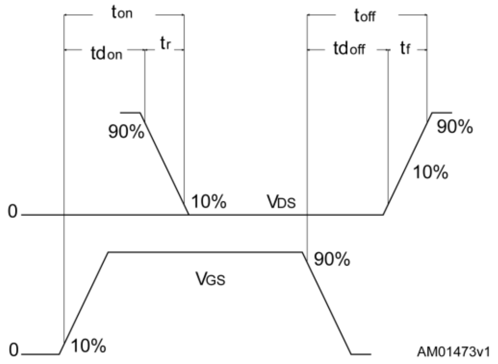


Figure 20: Switching time waveform



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***. ECOPACK® is an ST trademark.

4.1 TO-220FP package mechanical data

Figure 21: TO-220FP package outline

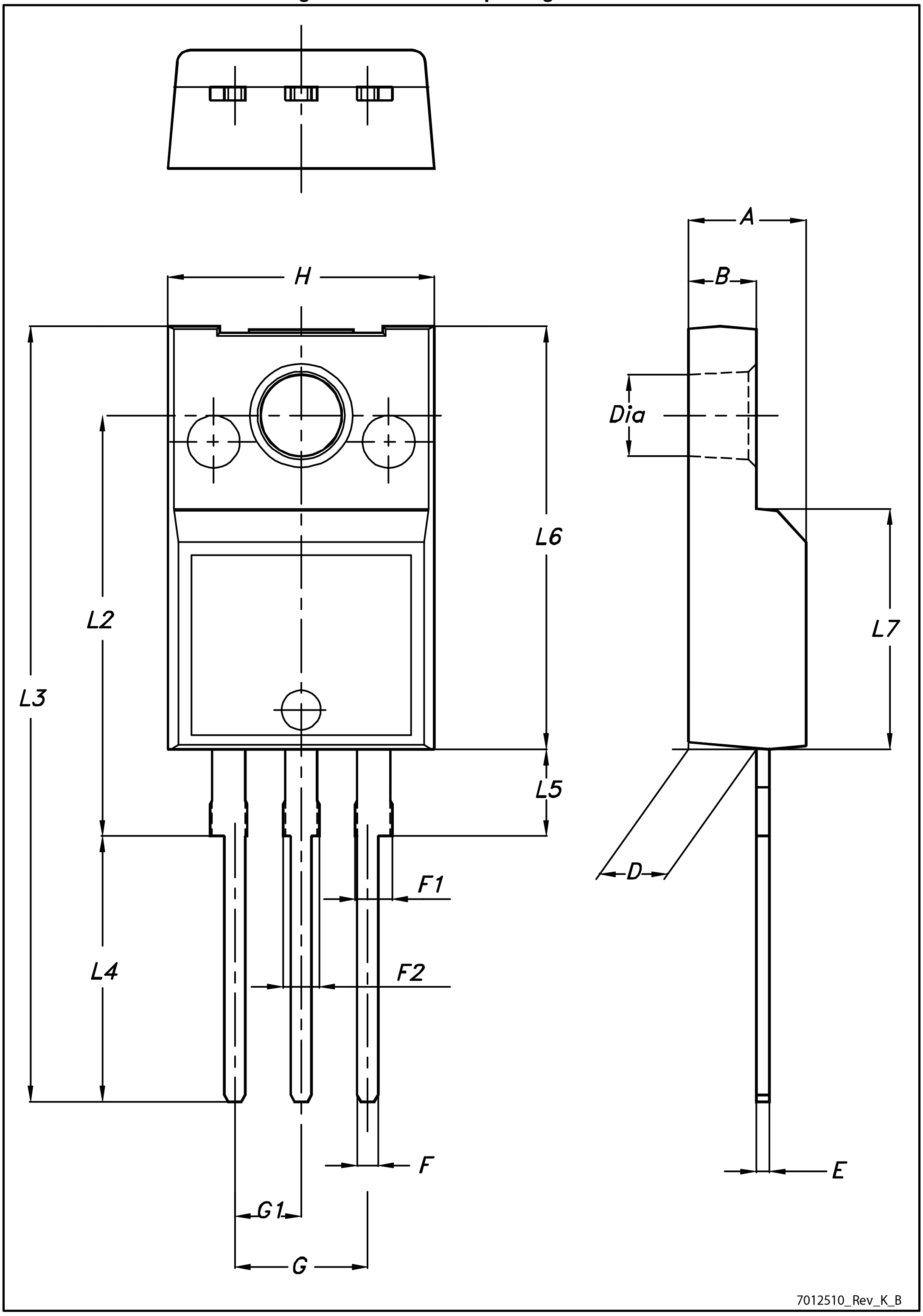


Table 9: TO-220FP mechanical data

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

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
17-Jul-2014	1	First release.
01-Sep-2014	2	Document status promoted from preliminary to production data. Inserted *Section 3.1: "Electrical characteristics (curves)"*. Minor text changes.
02-Sep-2014	3	Updated title in cover page.
03-Oct-2014	4	Updated: *Figure 3: "Thermal impedance"*, *Figure 6: "Gate charge vs gate-source voltage"* and *Figure 8: "Capacitance variations"*
15-Oct-2014	5	Updated *Table 2: "Absolute maximum ratings"*