STF7N65M2

N-channel 650 V, 0.98 Ω typ., 5 A MDmesh™ M2 Power MOSFET in a TO-220FP package

Datasheet - preliminary data
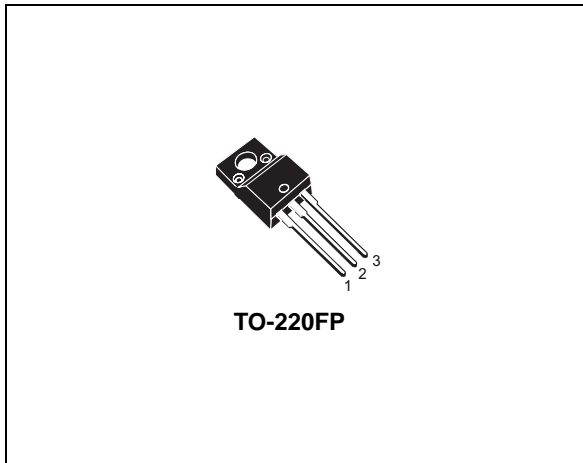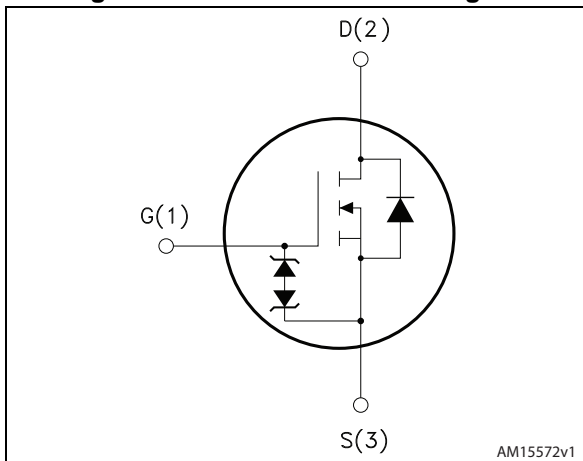

TO-220FP

Figure 1. Internal schematic diagram

Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D
STF7N65M2	650 V	1.15 Ω	5 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the MDmesh™ M2 technology. Thanks to the strip layout associated to an improved vertical structure, the device exhibits both low on-resistance and optimized switching characteristics. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order code	Marking	Package	Packaging
STF7N65M2	7N65M2	TO-220FP	Tube

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Contents

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	5[1]	A
I_D	Drain current (continuous) at T_C = 100 °C	3.2[1]	A
I_{DM}[2]	Drain current (pulsed)	20[1]	A
P_{TOT}	Total dissipation at T_C = 25 °C	20	W
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	15	V/ns
dv/dt [4]	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Max. operating junction temperature	- 55 to 150	°C

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. $I_{SD} \leq$ 5 A, di/dt $\leq$ 400 A/μs; $V_{DS\,peak} < V_{(BR)DSS}$, V_{DD}=400 V

4. $V_{DS} \leq$ 520 V

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	6.25	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5	°C/W

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)	103	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 5. 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	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 650 V			1	µA
		V_{GS} = 0, V_{DS} = 650 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 2.5 A		0.98	1.15	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	270	-	pF
C_{oss}	Output capacitance		-	14.5	-	pF
C_{rss}	Reverse transfer capacitance		-	0.8	-	pF
$C_{oss\ eq.}$ [1]	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0	-	108	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 5 A, V_{GS} = 10 V (see *Figure 15*)	-	9	-	nC
Q_{gs}	Gate-source charge		-	2.3	-	nC
Q_{gd}	Gate-drain charge		-	4.3	-	nC

1. $C_{oss\ eq.}$ 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 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 14* and *19*)	-	8	-	ns
t_r	Rise time		-	20	-	ns
$t_{d(off)}$	Turn-off delay time		-	30	-	ns
t_f	Fall time		-	20	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM} [1]	Source-drain current (pulsed)		-		20	A
V_{SD} [2]	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 19*)	-	275		ns
Q_{rr}	Reverse recovery charge		-	1.62		µC
I_{RRM}	Reverse recovery current		-	11.8		A
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 19*)	-	430		ns
Q_{rr}	Reverse recovery charge		-	2.54		µC
I_{RRM}	Reverse recovery current		-	11.9		A

1. Pulse width limited by safe operating area.

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area
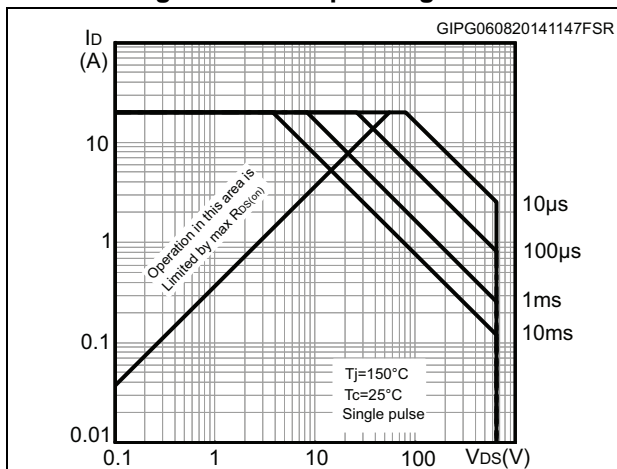
Figure 3. Thermal impedance
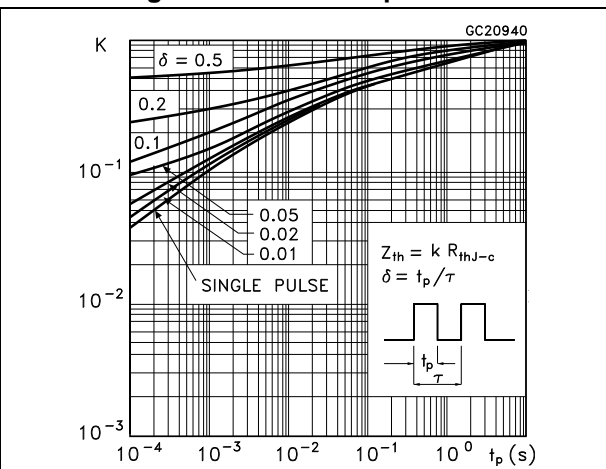
Figure 4. Output characteristics
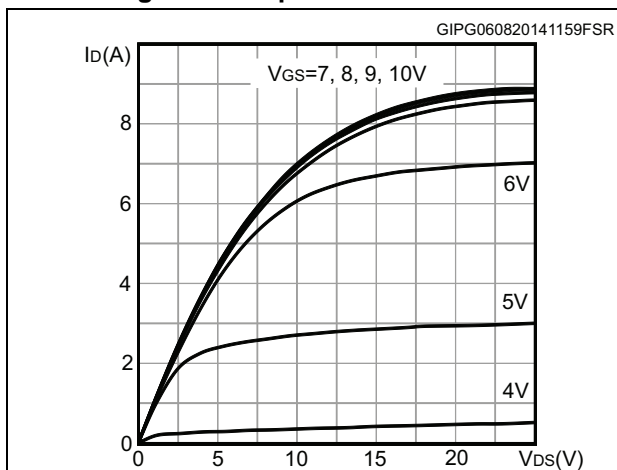
Figure 5. Transfer characteristics
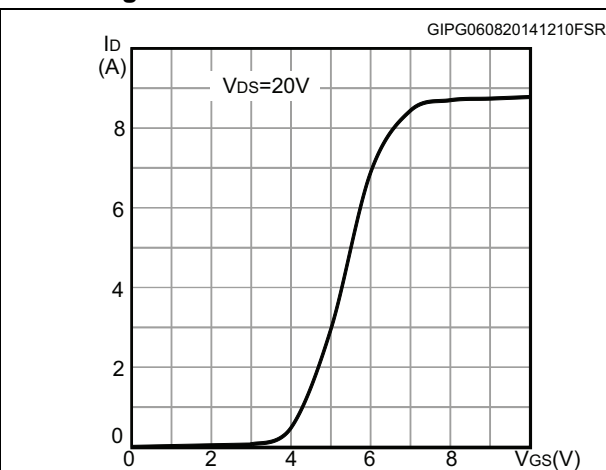
Figure 6. Gate charge vs gate-source voltage
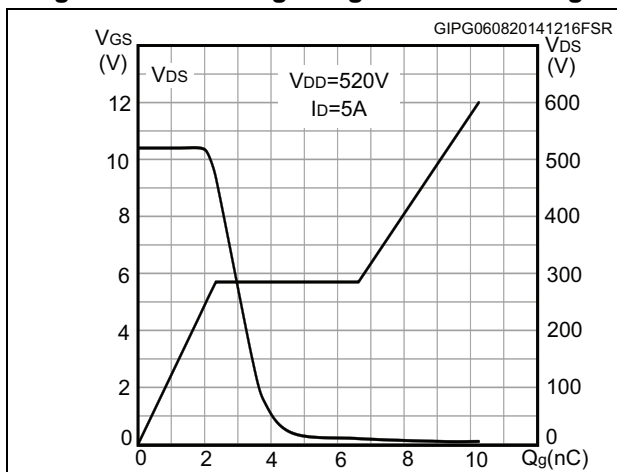
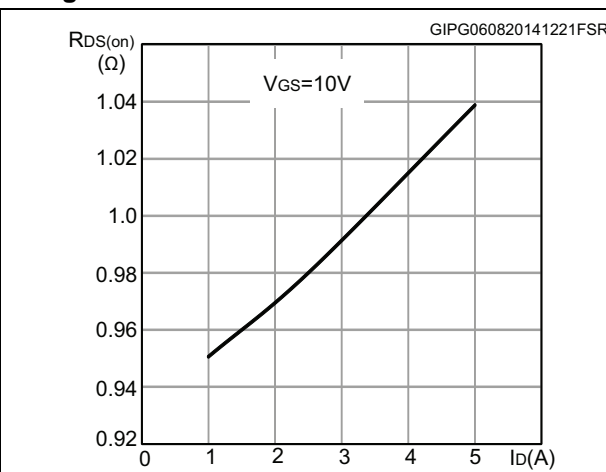

Figure 7. Static drain-source on-resistance
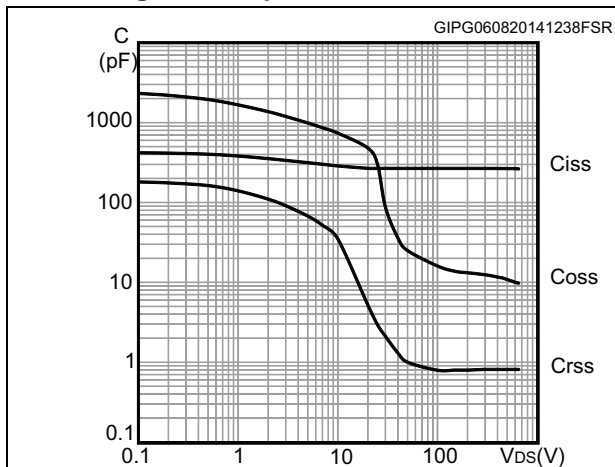
Figure 8. Capacitance variations

Figure 9. Output capacitance stored energy

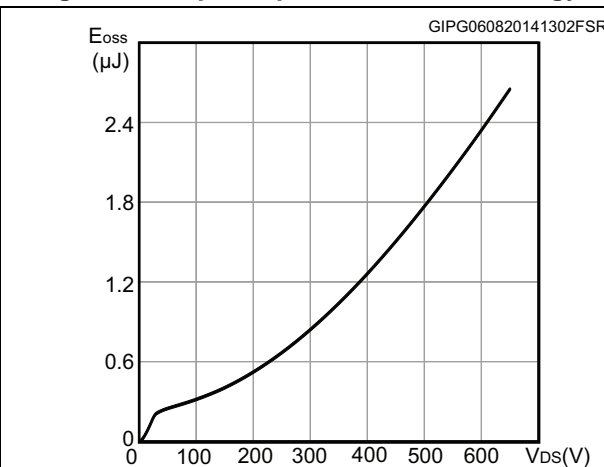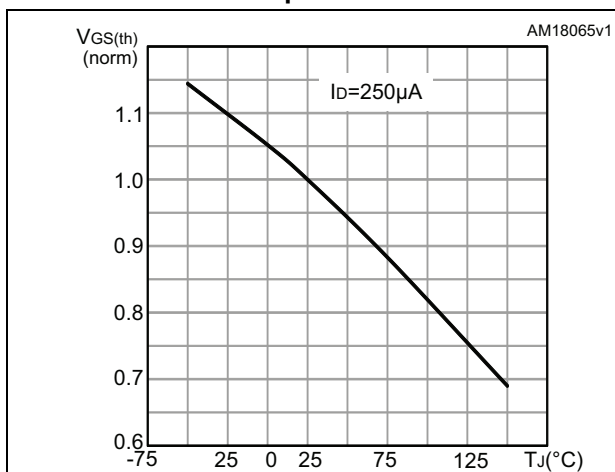**Figure 10. Normalized gate threshold voltage vs temperature**
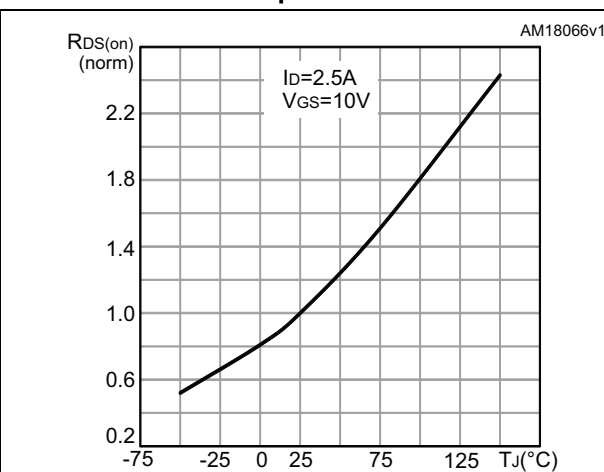

Figure 11. Normalized on-resistance vs temperature

Figure 12. Source-drain diode forward characteristics
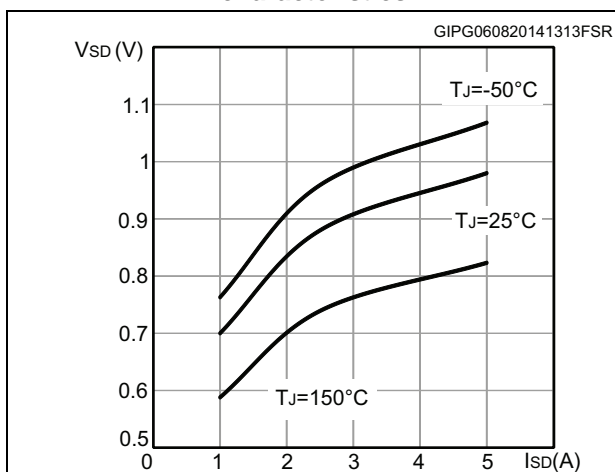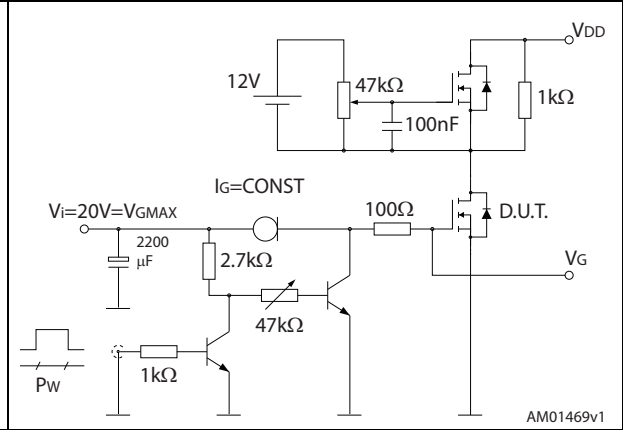

Figure 13. Normalized V$_{(BR)DSS}$ vs temperature
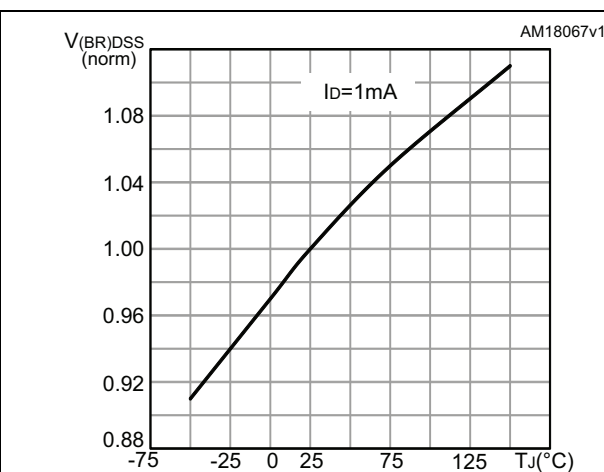
3 Test circuits

Figure 14. Switching times test circuit for resistive load
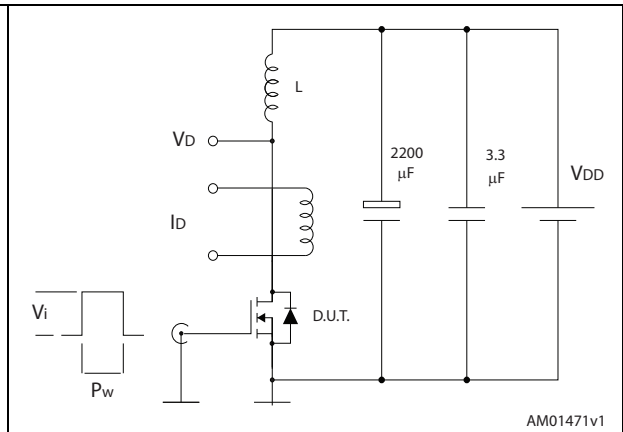

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Figure 15. Gate charge test circuit

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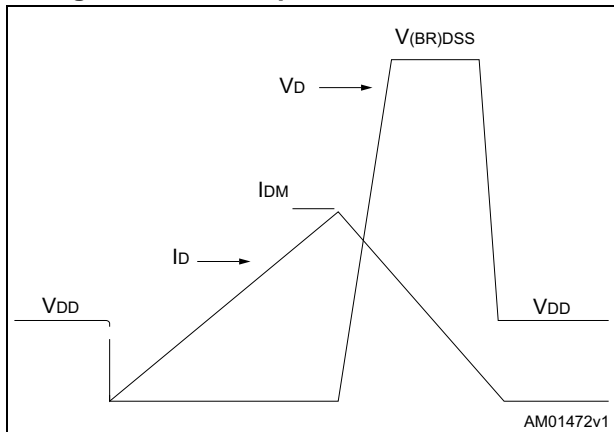**Figure 16. Test circuit for inductive load switching and diode recovery times**

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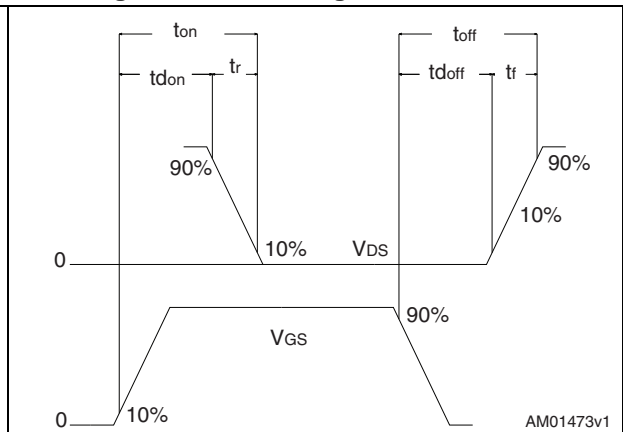**Figure 17. Unclamped inductive load test circuit**

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Figure 18. Unclamped inductive waveform

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**Figure 19. Switching time waveform**

AM01473v1

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.

Figure 20. TO-220FP drawing
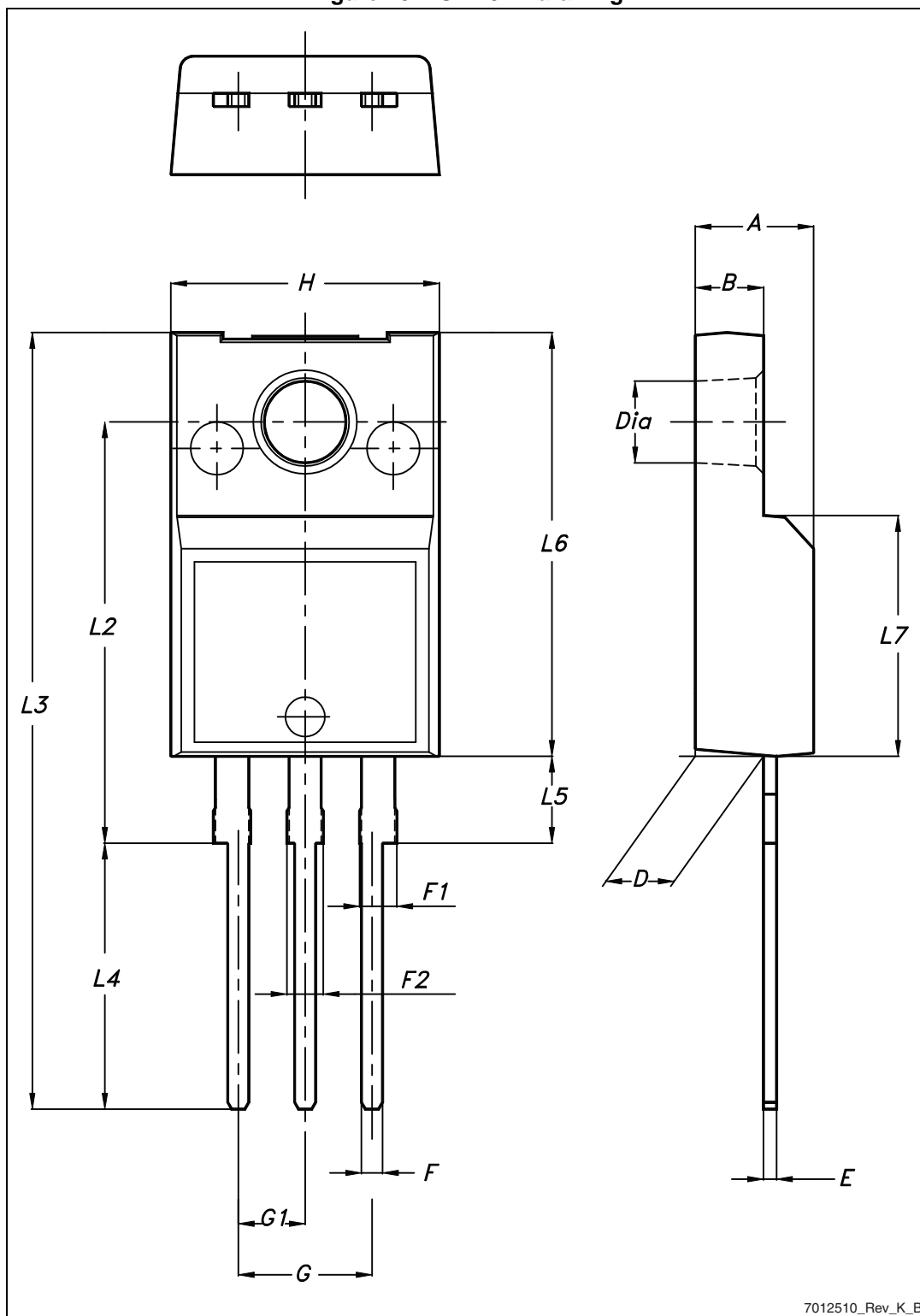
7012510_Rev_K_B

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
θ	3		3.2

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
29-Jul-2014	1	First release.
07-Aug-2014	2	Updated $R_{DS(on)}$ and typical values in *Table 5: On /off states*, *Table 6: Dynamic*, *Table 7: Switching times* and *Table 8: Source drain diode*. Added *Section 2.1: Electrical characteristics (curves)*.

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