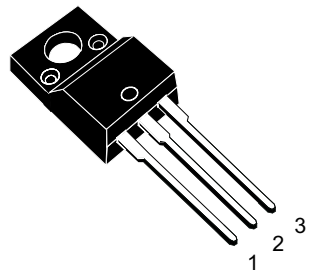
STF11NM50N

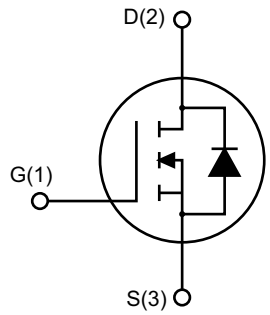
N-channel 500 V, 0.40 Ω typ., 8.5 A MDmesh™ II Power MOSFET in a TO-220FP package

Datasheet - production data



TO-220FP

Figure 1. Internal schematic diagram



Features

Order code	V_{DS} @ T_J max	$R_{DS(on)}$ max	I_D
STF11NM50N	550 V	0.47 Ω	8.5 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order code	Marking	Package	Packaging
STF11NM50N	11NM50N	TO-220FP	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	500	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	8.5(1)	A
I_D	Drain current (continuous) at T_C = 100 °C	6(1)	A
I_{DM} (2)	Drain current (pulsed)	34(1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
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 by maximum junction temperature
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 8.5$ A, di/dt $\leq$ 400 A/µs, $V_{DSpeak} \leq V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	5	°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 $T_{j\ max}$)	3	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AR}, V_{DD}=50 V)	150	mJ

2 Electrical characteristics

(T_{CASE} = 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	I_D = 1 mA, V_{GS} = 0	500			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 500 V V_{DS} = 500 V, T_C= 125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±100	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 = 4.5 A		0.40	0.47	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	547	-	pF
C_{oss}	Output capacitance		-	42	-	pF
C_{rss}	Reverse transfer capacitance		-	2	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 400 V	-	210	-	pF
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 8.5 A, V_{GS} = 10 V (see *Figure 14*)	-	19	-	nC
Q_{gs}	Gate-source charge		-	3.7	-	nC
Q_{gd}	Gate-drain charge		-	10	-	nC
R_G	Gate input resistance	f=1 MHz, I_D=0	-	5.8	-	Ω

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_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 250 V, I_D = 4.25 A R_G = 4.7 Ω V_{GS} = 10 V (see *Figure 15* and *Figure 18*)	-	8	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	33	-	ns
t_f	Fall time		-	10	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		8.5 34	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 8.5 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 8.5 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 15*)	-	230		ns
Q_{rr}	Reverse recovery charge		-	2.1		µC
I_{RRM}	Reverse recovery current		-	18		A
t_{rr}	Reverse recovery time	I_{SD} = 8.5 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 15*)	-	275		ns
Q_{rr}	Reverse recovery charge		-	2.5		µC
I_{RRM}	Reverse recovery current		-	18		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

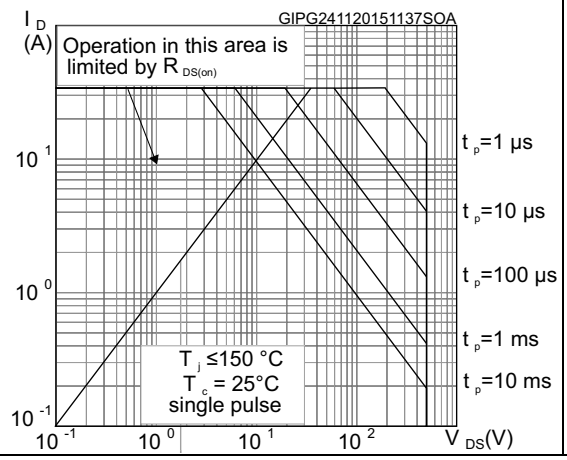


Figure 3. Thermal impedance

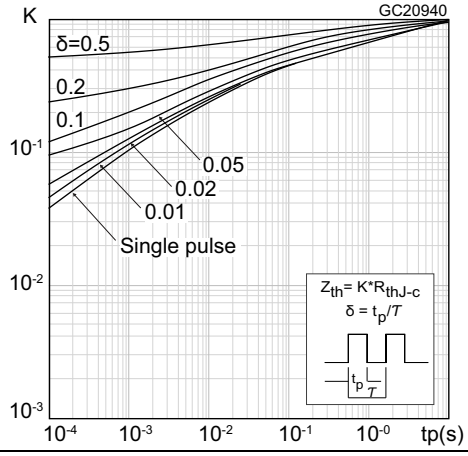


Figure 4. Output characteristics

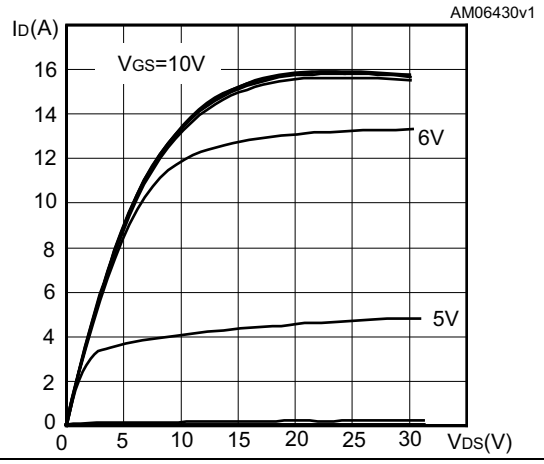


Figure 5. Transfer characteristics

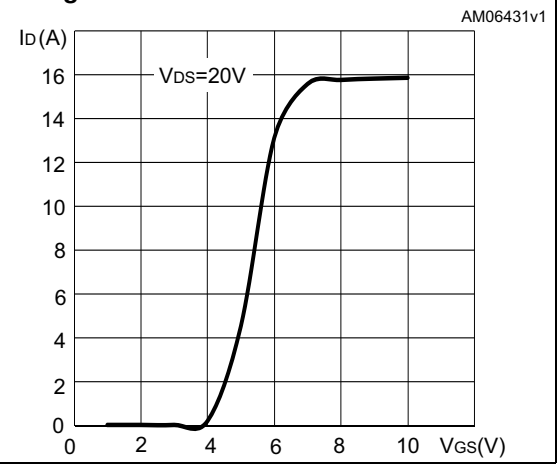


Figure 6. Gate charge vs gate-source voltage

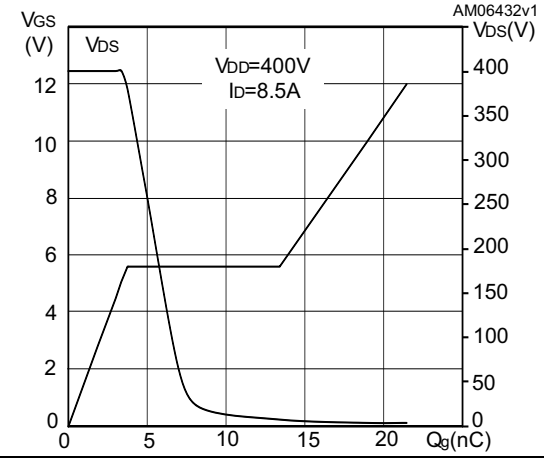


Figure 7. Static drain-source on resistance

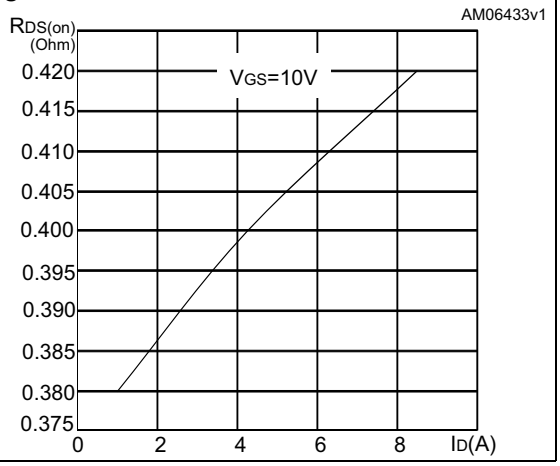


Figure 8. Capacitance variations

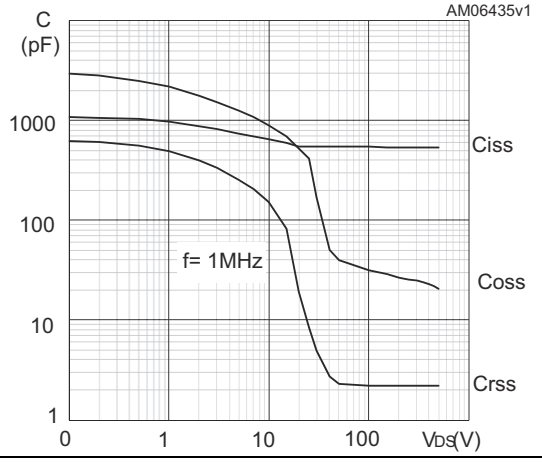


Figure 9. Output capacitance stored energy

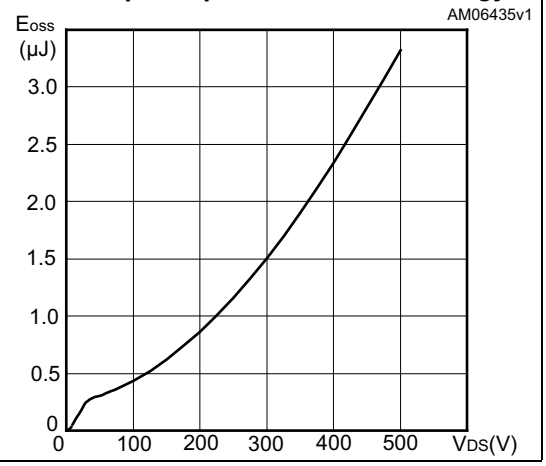


Figure 10. Normalized gate threshold voltage vs temperature

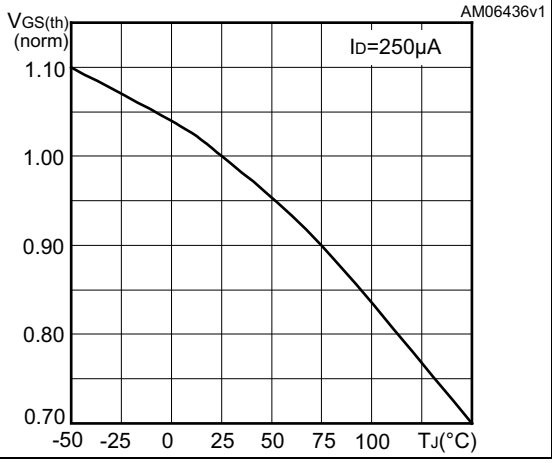


Figure 11. Normalized on-resistance vs temperature

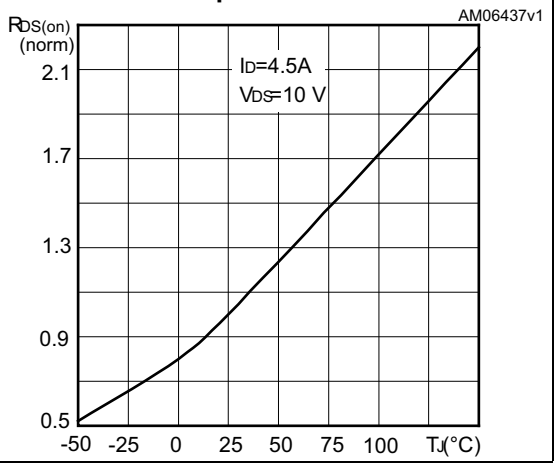
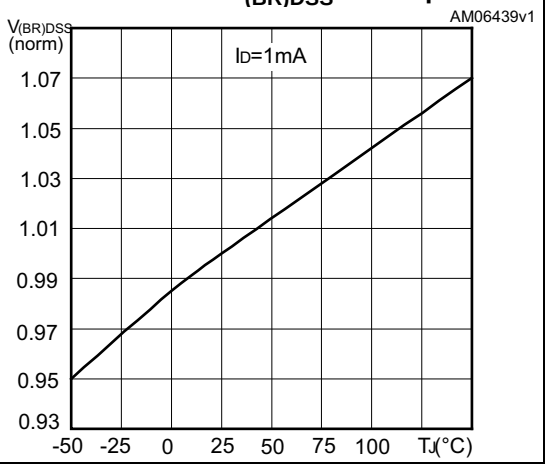


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature



3 Test circuits

Figure 13. Test circuit for resistive load switching times

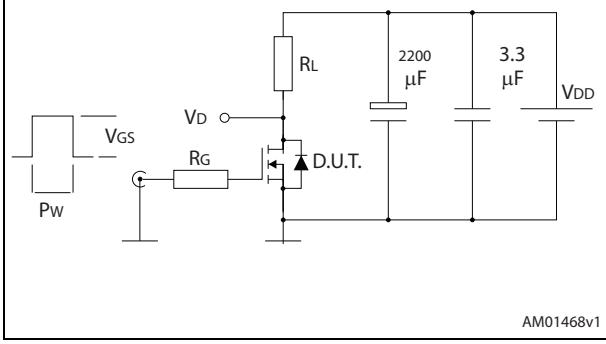


Figure 14. Test circuit for gate charge behavior

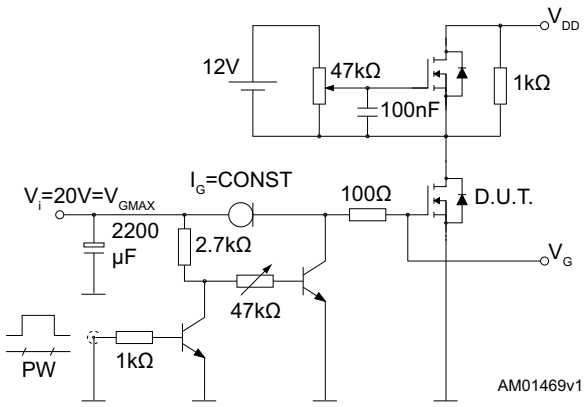


Figure 15. Test circuit for inductive load switching and diode recovery times

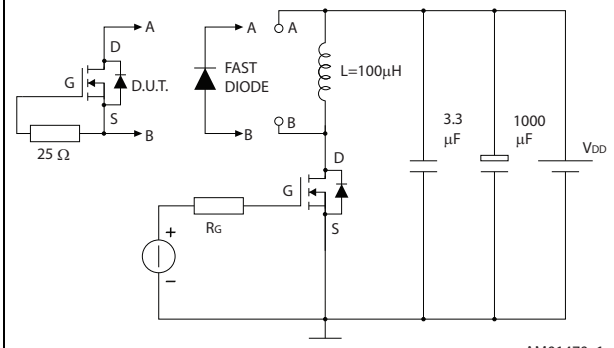


Figure 16. Unclamped inductive load test circuit

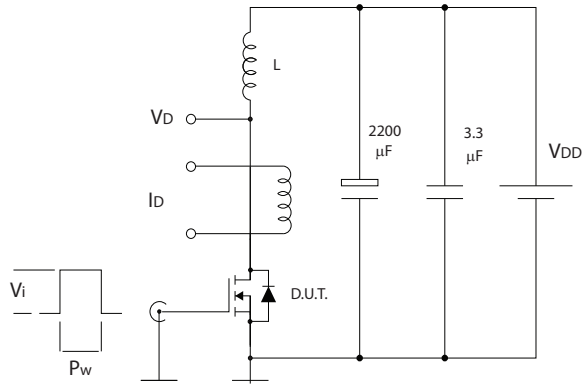


Figure 17. Unclamped inductive waveform

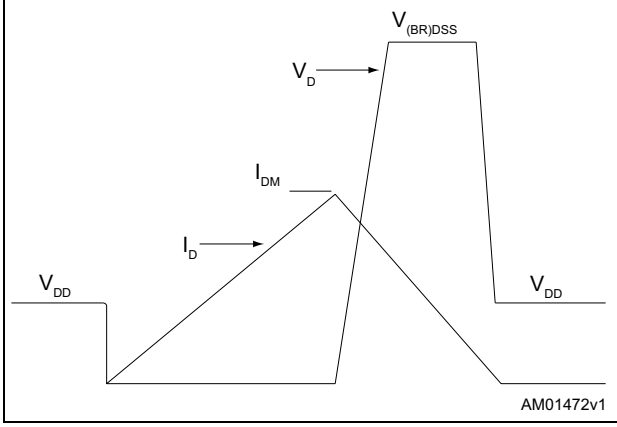
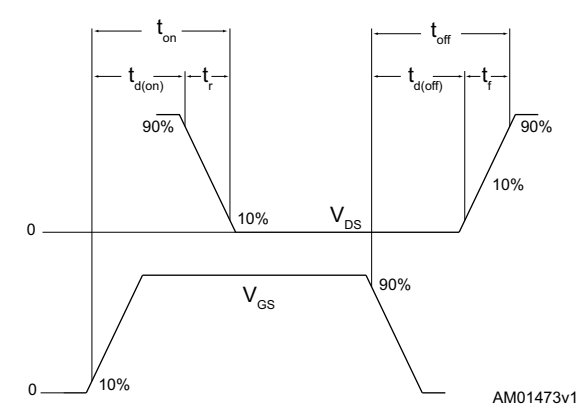


Figure 18. Switching time waveform



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

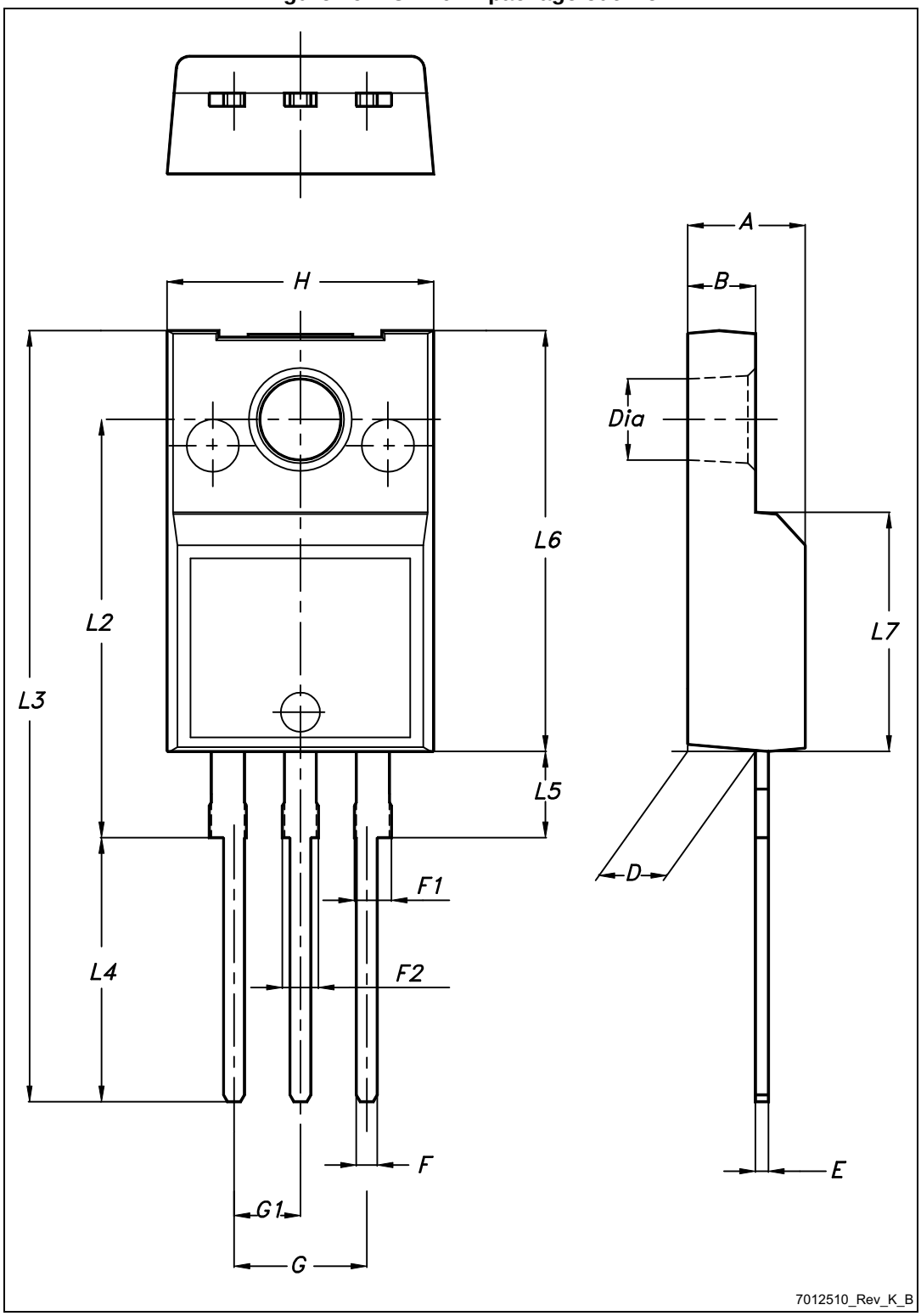


Table 9. TO-220FP mechanical data

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
25-Nov-2015	1	First release. Part number previously included in datasheet DocID17156