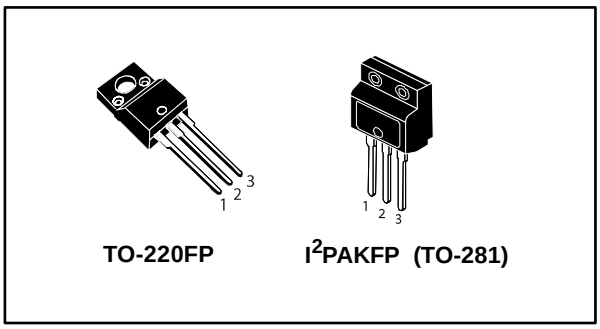
STF15N60M2-EP, STFI15N60M2-EP

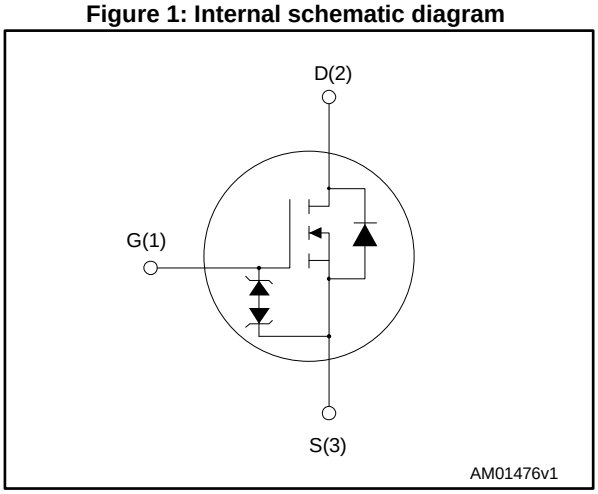
N-channel 600 V, 0.340 Ω typ., 11 A MDmesh™ M2 EP Power MOSFET in TO-220FP and I²PAKFP packages

Datasheet - production data



TO-220FP **I²PAKFP (TO-281)**

Figure 1: Internal schematic diagram



Features

Order code	V_{DS}@T_{Jmax}	$R_{DS(on)}$max.	I_D
STF15N60M2-EP	650 V	0.378 Ω	11 A
STFI15N60M2-EP			

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- Tailored for very high frequency converters (f > 150 kHz)

Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 EP enhanced performance technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics with very low turn-off switching loss, rendering them suitable for the most demanding very high frequency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STF15N60M2-EP	15N60M2EP	TO-220FP	Tube
STFI15N60M2-EP		I²PAKFP (TO-281)	

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D (1)	Drain current (continuous) at T_C = 25 °C	11	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	7	A
I_{DM} (2)	Drain current (pulsed)	44	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
dv/dt (3)	Peak diode recovery voltage slope	15	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	50	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	Operating junction temperature		

Notes:

(1)Limited by maximum junction temperature.

(2)Pulse width limited by safe operating area.

(3)I_{SD} ≤ 11 A, di/dt ≤ 400 A/µs; $V_{DS\ peak}$ < $V_{(BR)DSS}$, V_{DD} = 400 V.

(4)V_{DS} ≤ 480 V.

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, repetetive or not repetetive (pulse width limited by T_{jmax})	2.8	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}; V_{DD} = 50 V)	125	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 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V T_C = 125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, 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 = 5.5 A		0.340	0.378	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 V	-	590	-	pF
C_{oss}	Output capacitance		-	30	-	pF
C_{rss}	Reverse transfer capacitance		-	1.1	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	148	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 10 V (see *Figure 15: "Gate charge test circuit"*)	-	17	-	nC
Q_{gs}	Gate-source charge		-	3.1	-	nC
Q_{gd}	Gate-drain charge		-	7.3	-	nC

Notes:

(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 energy

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{(off)}$	Turn-off energy (from 90% V_{GS} to 0% I_D)	V_{DD} = 400 V, I_D = 1.5 A R_G = 4.7 Ω, V_{GS} = 10 V	-	4.7	-	µJ
		V_{DD} = 400 V, I_D = 3.5 A R_G = 4.7 Ω, V_{GS} = 10 V	-	5.2	-	µJ

Table 8: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 5.5 A R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 14: "Switching times test circuit for resistive load"* and *Figure 19: "Switching time waveform"*)	-	11	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off-delay time		-	40	-	ns
t_f	Fall time		-	15	-	ns

Table 9: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} (1)	Source-drain current		-		11	A
I_{SDM} (2)	Source-drain current (pulsed)		-		44	A
V_{SD} (3)	Forward on voltage	V_{GS} = 0 V, I = 11 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs, V_{DD} = 60 V (see *Figure 16: " Test circuit for inductive load switching and diode recovery times"*)	-	280		ns
Q_{rr}	Reverse recovery charge		-	2.7		µC
I_{RRM}	Reverse recovery current		-	19.5		A
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see *Figure 16: " Test circuit for inductive load switching and diode recovery times"*)	-	400		ns
Q_{rr}	Reverse recovery charge		-	3.8		µC
I_{RRM}	Reverse recovery current		-	19		A

Notes:

(1)Limited by maximum junction temperature.

(2)Pulse width is limited by safe operating area.

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

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

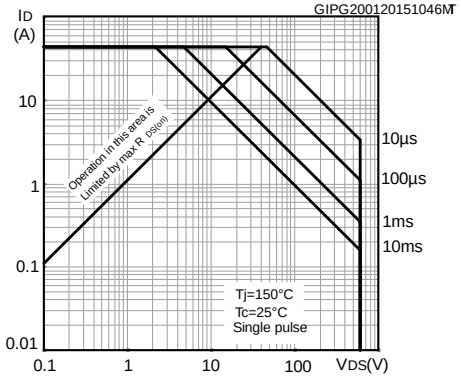


Figure 3: Thermal impedance

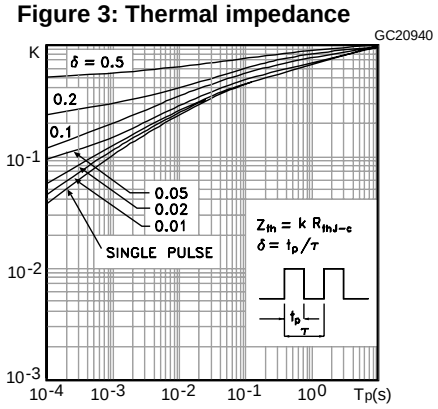


Figure 4: Output characteristics

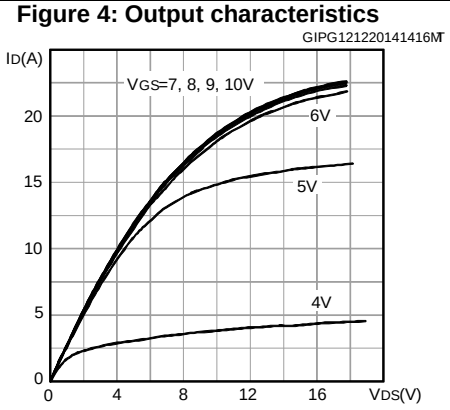


Figure 5: Transfer characteristics

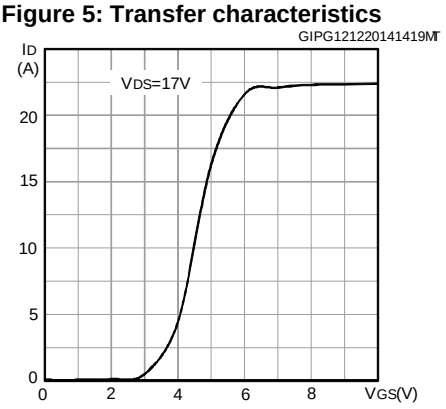


Figure 6: Normalized gate threshold voltage vs temperature

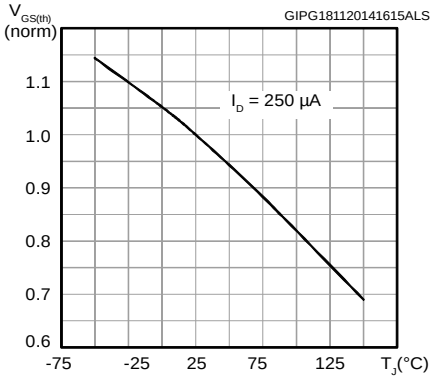


Figure 7: Normalized $V_{(BR)DSS}$ vs temperature

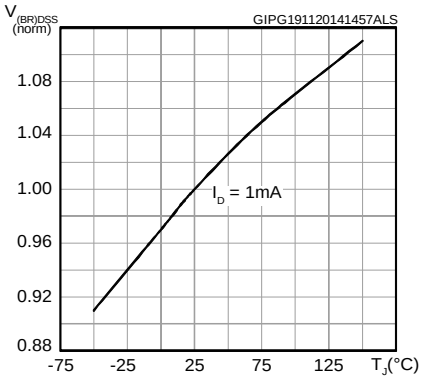


Figure 8: Static drain-source on-resistance

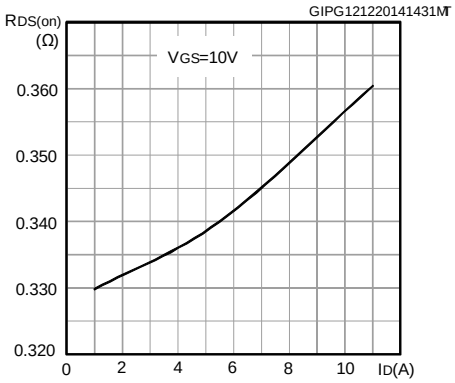


Figure 9: Normalized on-resistance vs temperature

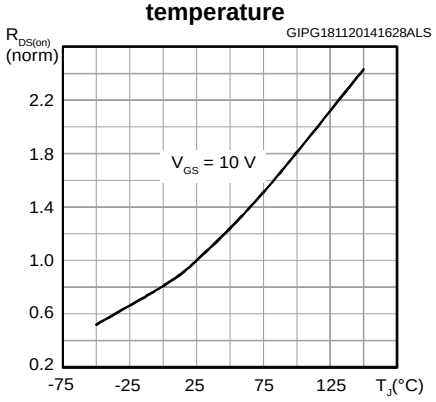


Figure 10: Gate charge vs gate-source voltage

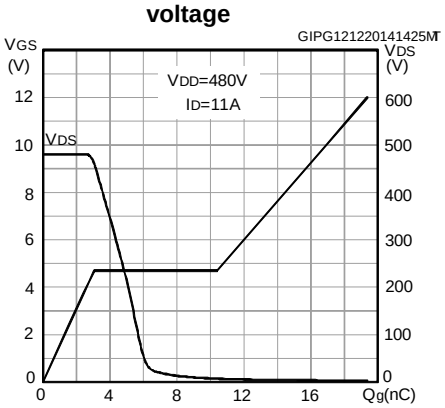


Figure 11: Capacitance variations

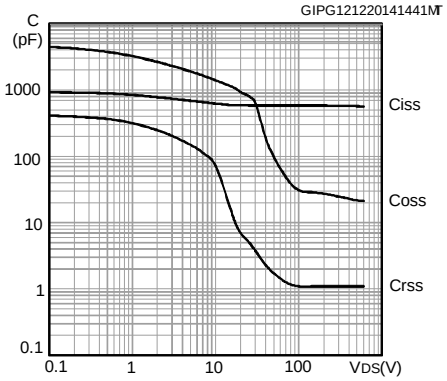


Figure 12: Turn-off switching loss vs drain current

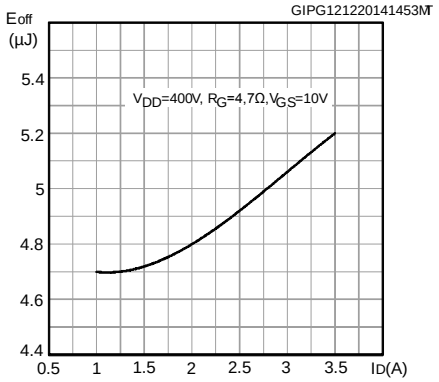
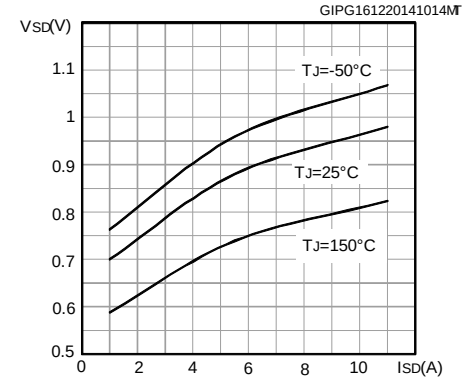


Figure 13: Source-drain diode forward characteristic



3 Test circuits

Figure 14: Switching times test circuit for resistive load

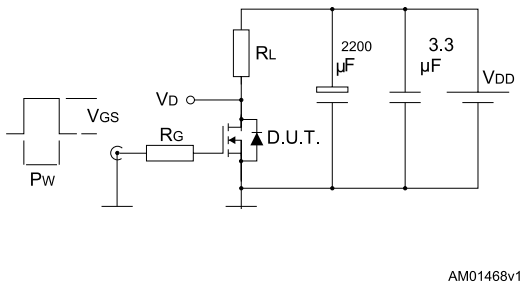


Figure 15: Gate charge test circuit

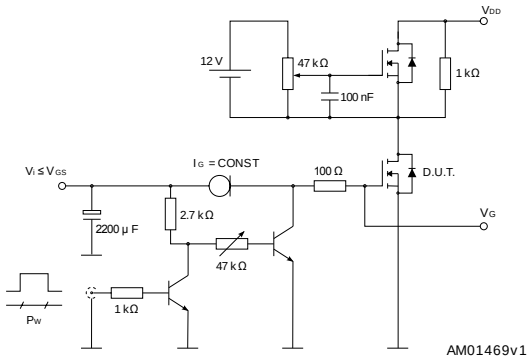


Figure 16: Test circuit for inductive load switching and diode recovery times

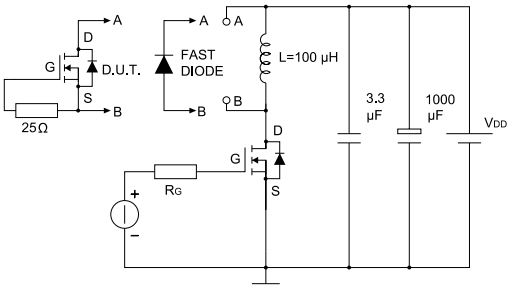


Figure 17: Unclamped inductive load test circuit

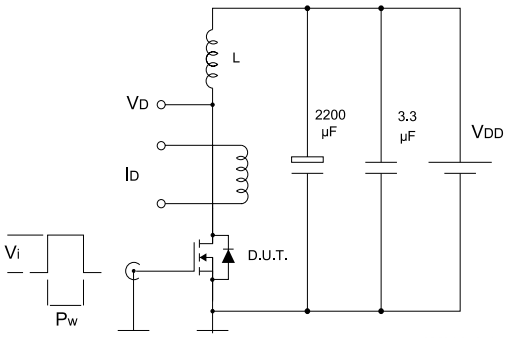


Figure 18: Unclamped inductive waveform

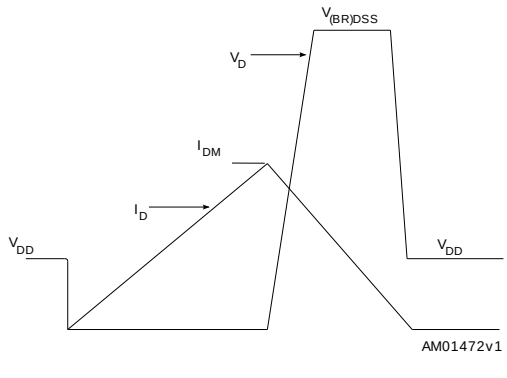
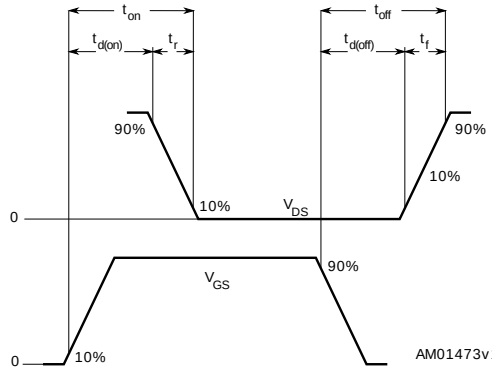


Figure 19: Switching time waveform



4 Package mechanical data

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4.1 TO-220FP package information

Figure 20: TO-220FP package outline

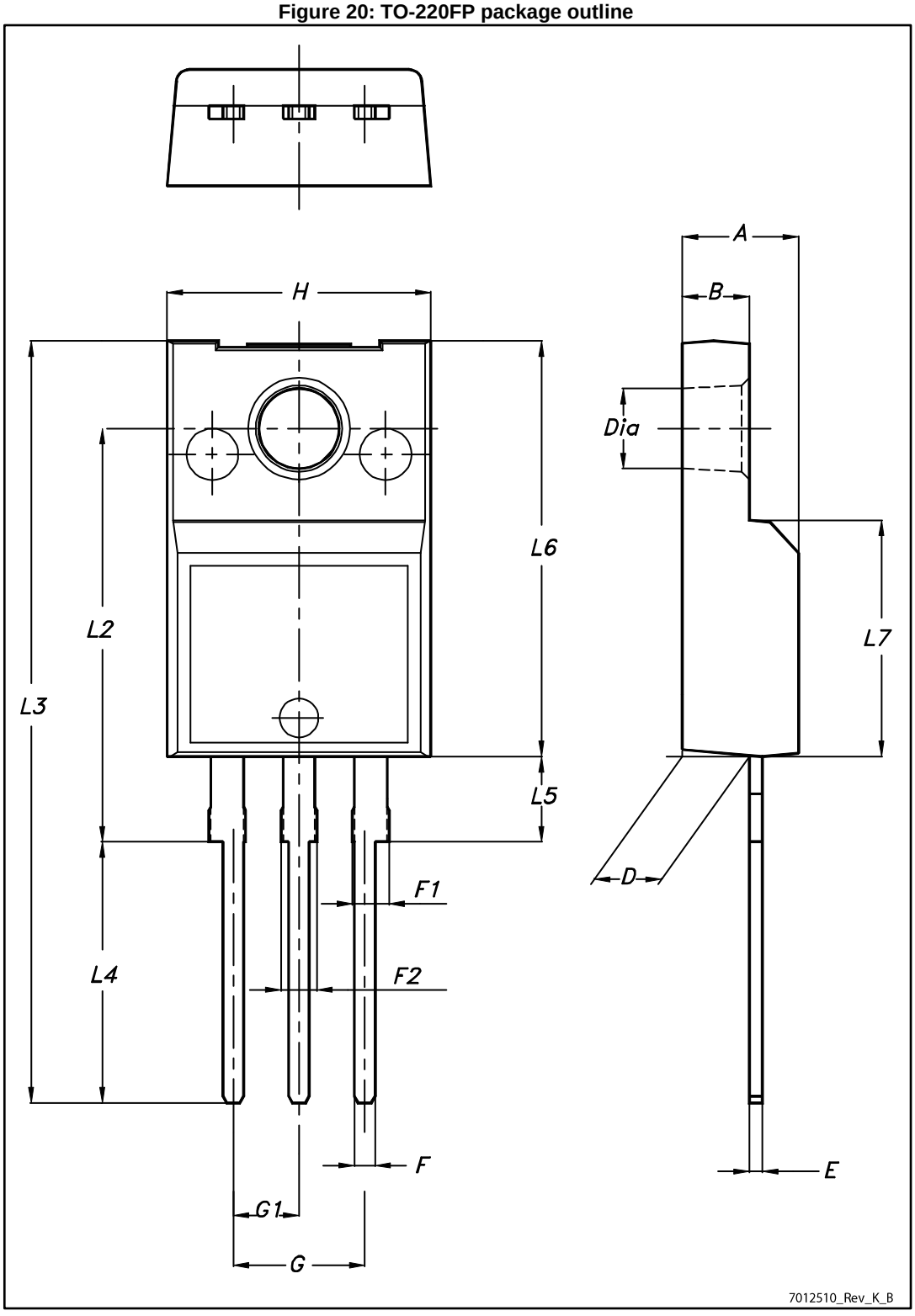

Table 10: TO-220FP mechanical data

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

4.2 I²PAKFP (TO-281) package information

Figure 21: I²PAKFP (TO-281) package outline

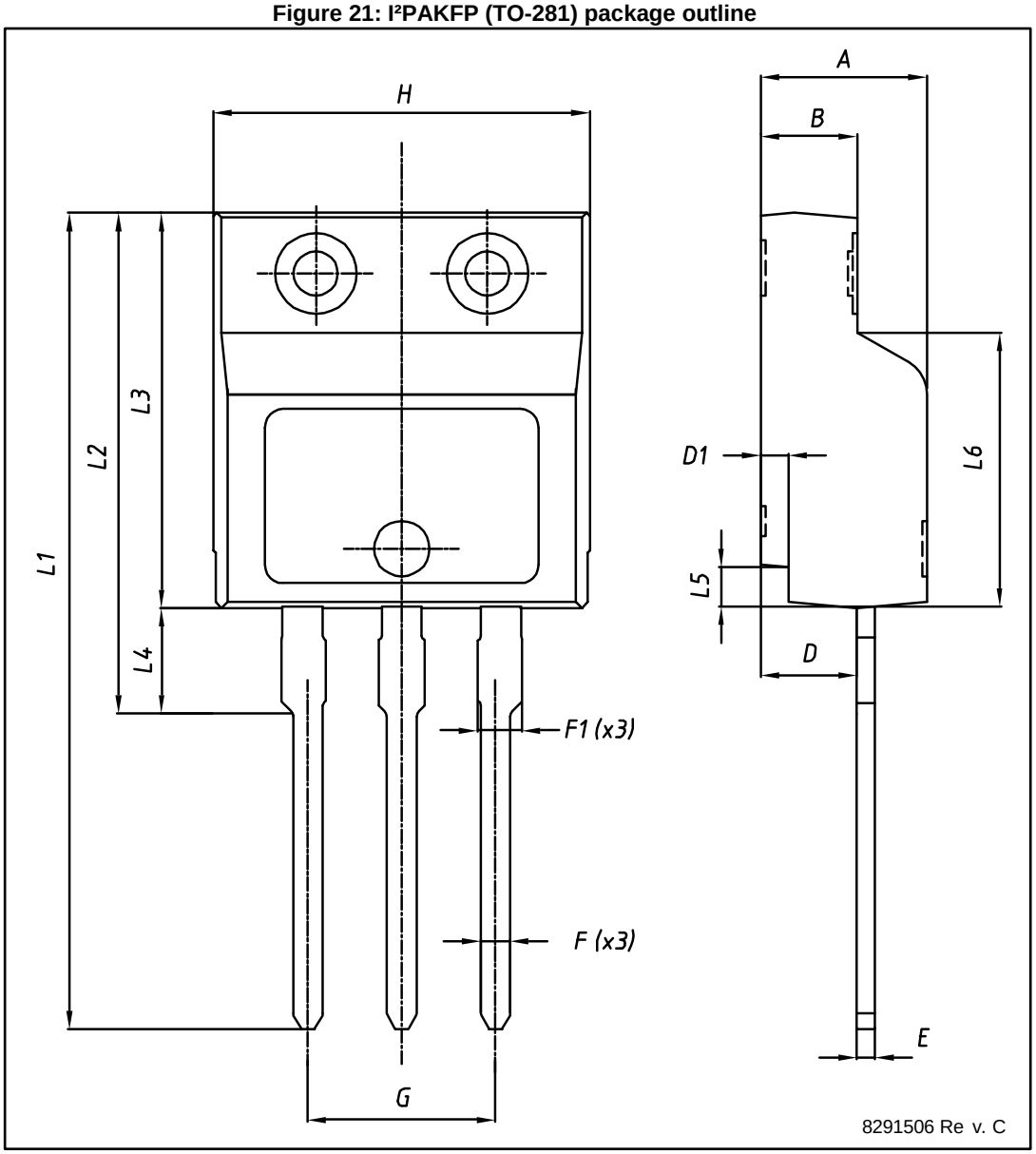

Table 11: I²PAKFP (TO-281) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	-	4.60
B	2.50		2.70
D	2.50		2.75
D1	0.65		0.85
E	0.45		0.70
F	0.75		1.00
F1			1.20
G	4.95		5.20
H	10.00		10.40
L1	21.00		23.00
L2	13.20		14.10
L3	10.55		10.85
L4	2.70		3.20
L5	0.85		1.25
L6	7.50	7.60	7.70

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
26-Jan-2015	1	First release.

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