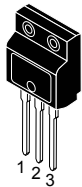
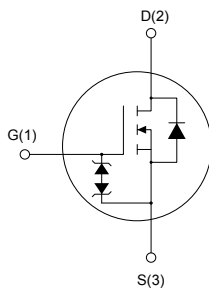


N-channel 600 V, 0.340 Ω typ., 11 A MDmesh™ M2 EP Power MOSFET in an I²PAKFP package


I²PAKFP (TO-281)


AM01476v1

Features

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

- Fully insulated and low profile package with increased creepage path from pin to heatsink plate
- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- 100% avalanche tested
- Zener-protected

Applications

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

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 enhanced performance (EP) technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance, optimized switching characteristics with very low turn-off switching losses, rendering it suitable for the most demanding very high frequency converters.

Product status

STFI15N60M2-EP

Product summary

Order code	STFI15N60M2-EP
Marking	15N60M2EP
Package	I ² PAKFP (TO-281)
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	11	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	7	A
$I_{DM}^{(2)}$	Drain current (pulsed)	44	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	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 ($t = 1\text{ s}, T_C = 25\text{ }^\circ\text{C}$)	2500	V
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_j	Operating junction temperature range		

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$
- $V_{DS} \leq 480\text{ V}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	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_{jmax})	2.8	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	125	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ }^\circ\text{C}^{(1)}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 5.5\text{ A}$		0.340	0.378	Ω

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	590	-	pF
C_{oss}	Output capacitance		-	30	-	pF
C_{rss}	Reverse transfer capacitance		-	1.1	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0\text{ V}$	-	148	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	7	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 11\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	17	-	nC
Q_{gs}	Gate-source charge		-	3.1	-	nC
Q_{gd}	Gate-drain charge		-	7.3	-	nC

1. $C_{oss\text{ eq.}}$ 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 6. Switching energy

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

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14. Test circuit for resistive load switching times 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 8. Source drain diode

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

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

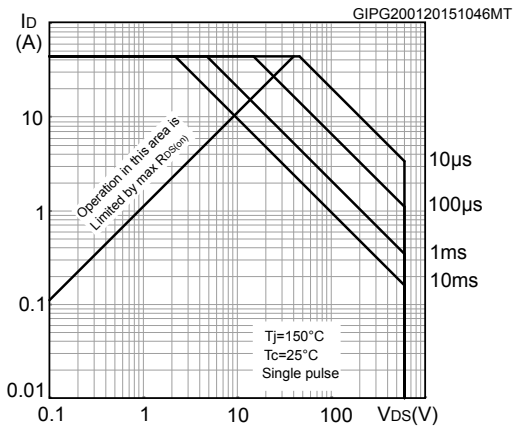


Figure 2. Thermal impedance

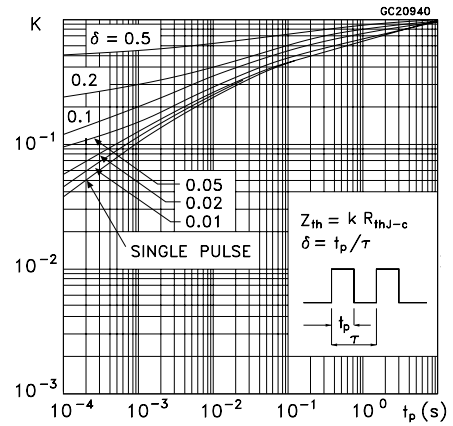


Figure 3. Output characteristics

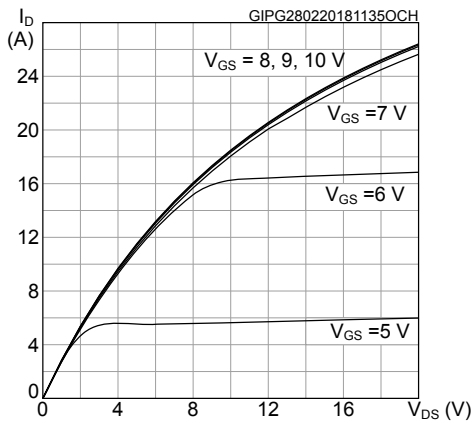


Figure 4. Transfer characteristics

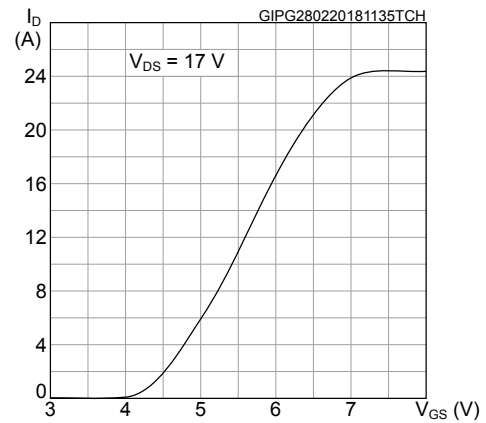


Figure 5. Normalized gate threshold voltage vs temperature

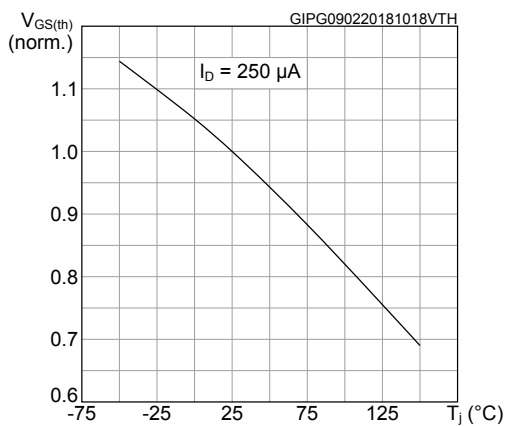


Figure 6. Normalized V(BR)DSS vs temperature

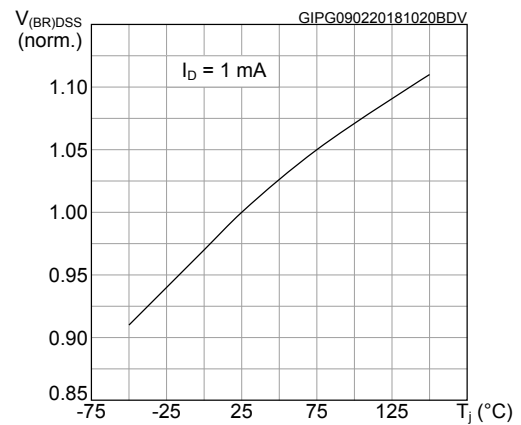


Figure 7. Static drain-source on-resistance

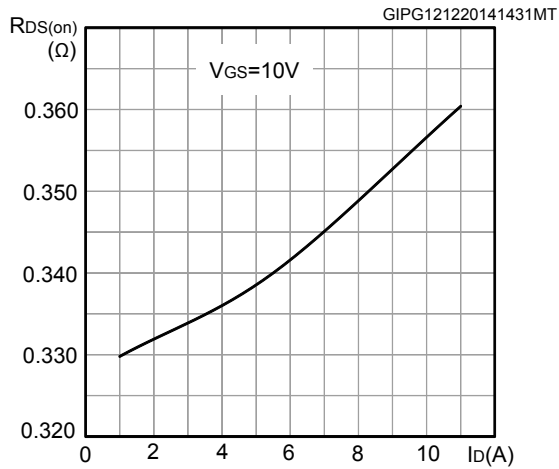


Figure 8. Normalized on-resistance vs temperature

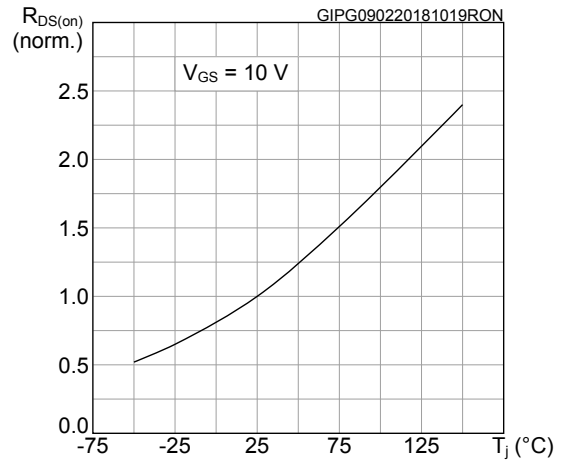


Figure 9. Gate charge vs gate-source voltage

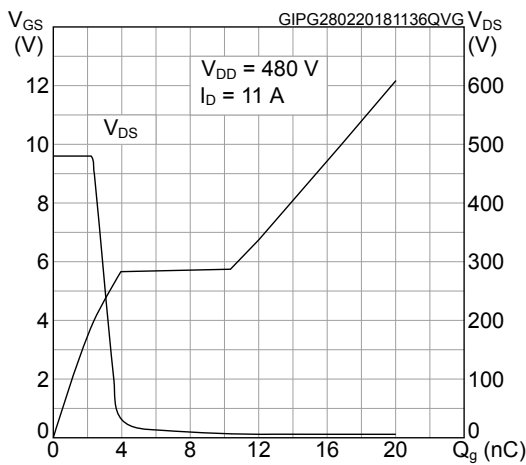


Figure 10. Capacitance variations

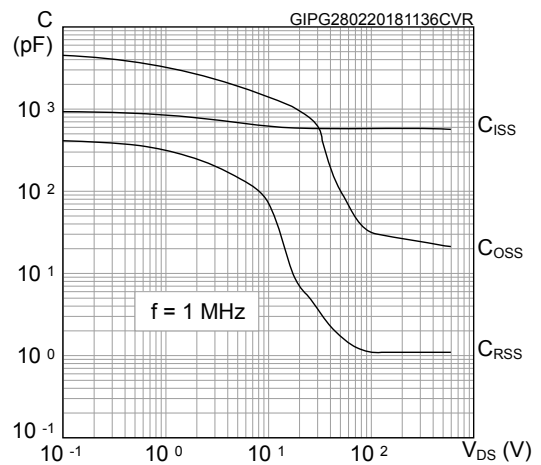


Figure 11. Turn-off switching loss vs drain current

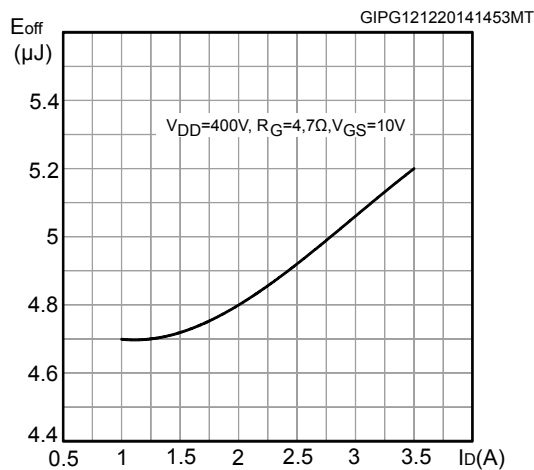


Figure 12. Source-drain diode forward characteristic

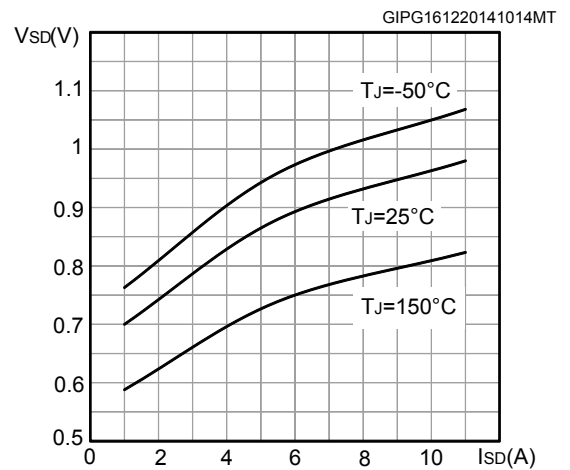
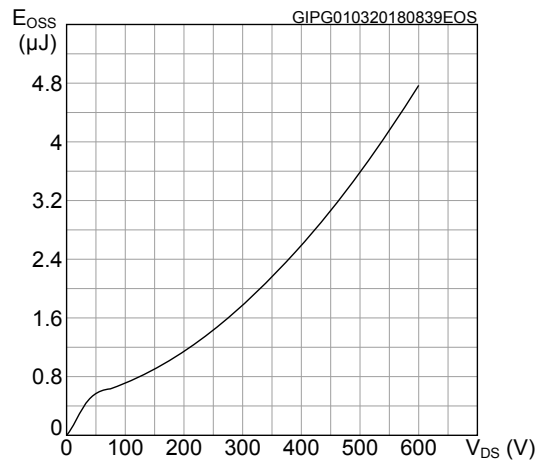
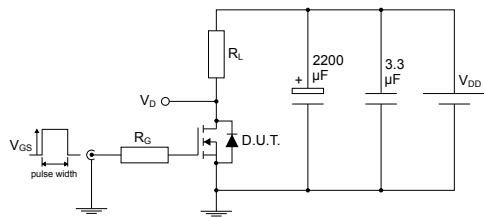


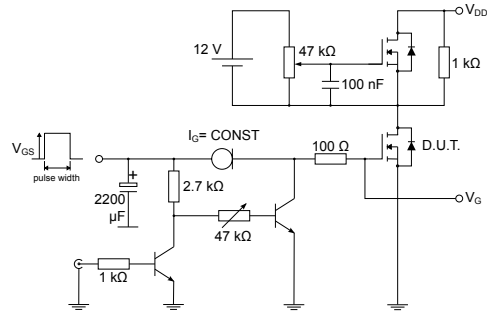
Figure 13. Output capacitance stored energy



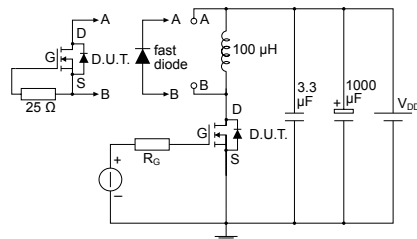
3 Test circuits

Figure 14. Test circuit for resistive load switching times


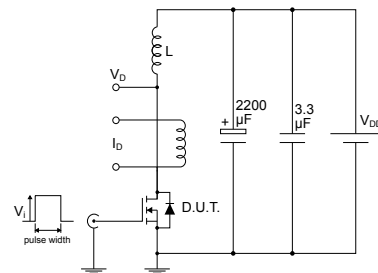
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Figure 15. Test circuit for gate charge behavior


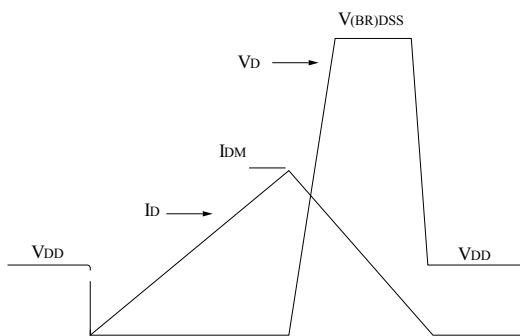
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Figure 16. Test circuit for inductive load switching and diode recovery times


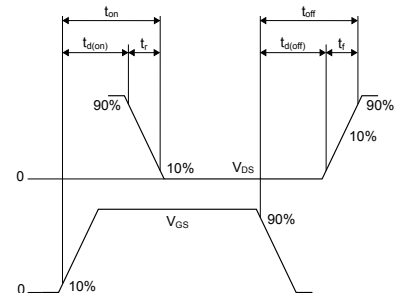
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Figure 17. Unclamped inductive load test circuit


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Figure 18. Unclamped inductive waveform


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Figure 19. Switching time waveform


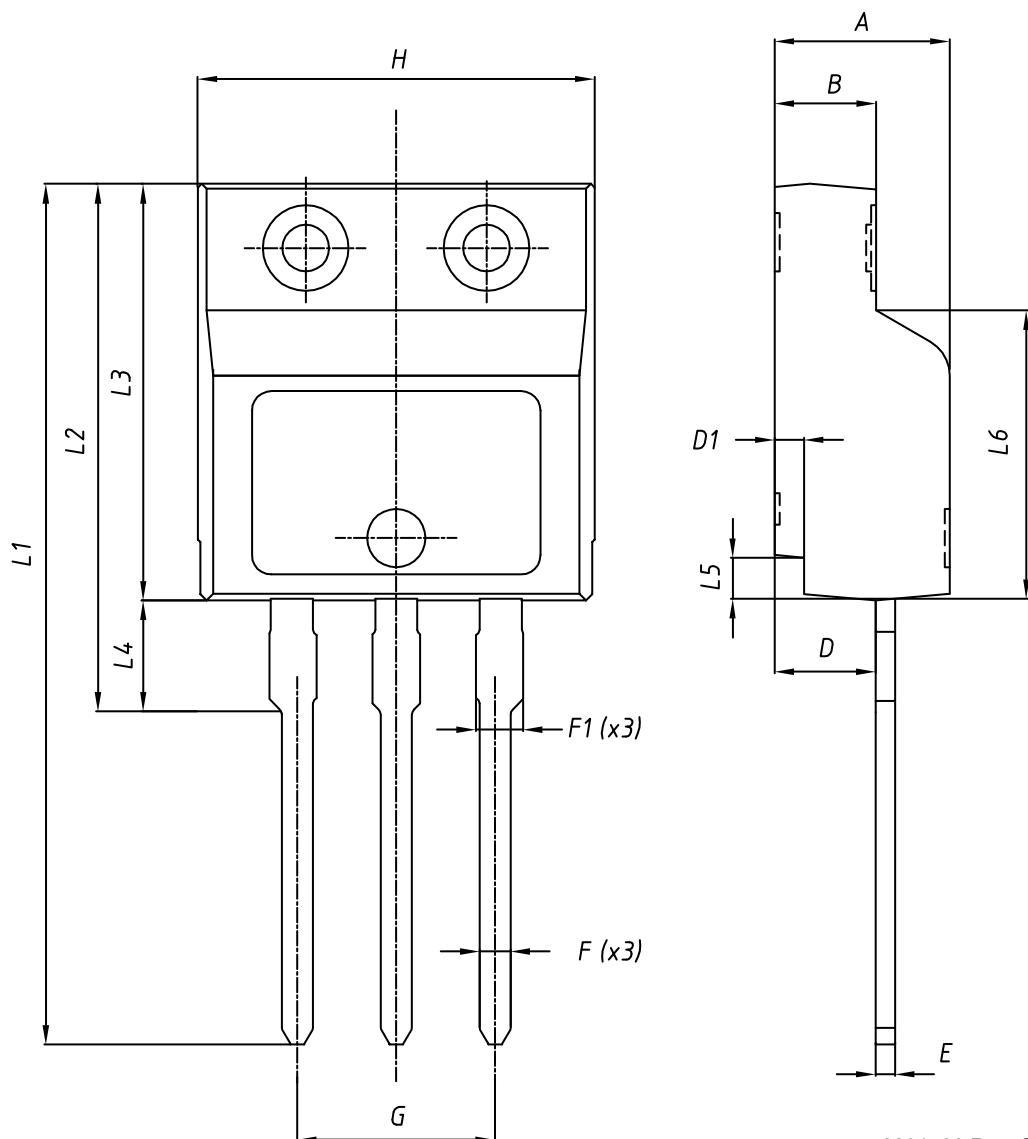
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4 Package mechanical data

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 I²PAKFP package information

Figure 20. I²PAKFP (TO-281) package outline



8291506 Rev. C

Table 9. 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

Revision history

Table 10. Document revision history

Date	Revision	Changes
09-Mar-2018	1	First release, part number previously included in datasheet DS10813.
05-Jun-2018	2	Updated Table 1. Absolute maximum ratings, Table 5. Dynamic, Table 6. Switching energy and Table 8. Source drain diode. Updated Figure 1. Safe operating area, Figure 2. Thermal impedance and Figure 11. Turn-off switching loss vs drain current. Minor text changes

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