

N-channel 600 V, 0.168 Ω typ., 17 A MDmesh™ II Power MOSFET in a I²PAKFP package

Datasheet — production data

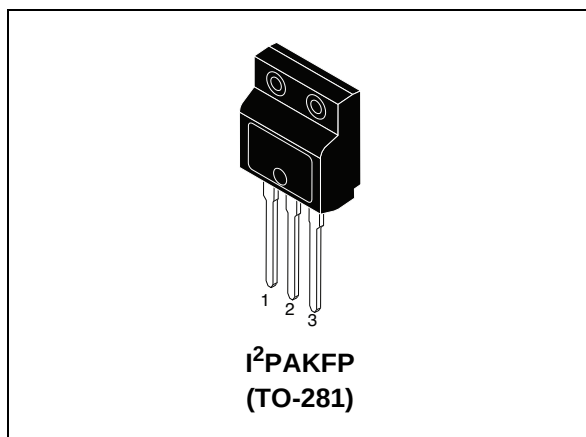
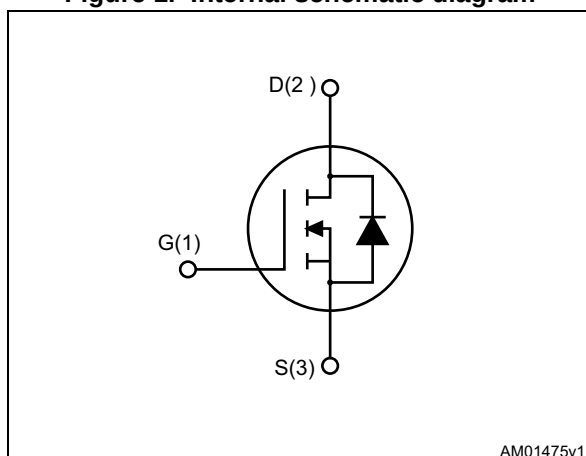


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS} @T _{jmax}	R _{DS(on)} max.	I _D
STFI24NM60N	650 V	0.19 Ω	17 A

- Fully insulated and low profile package with increased creepage path from pin to heatsink plate
- 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	Packages	Packaging
STFI24NM60N	24NM60N	I ² PAKFP (TO-281)	Tube

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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 $T_C = 25\text{ }^{\circ}\text{C}$	17 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	11 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	68 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	30	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; $T_C=25\text{ }^{\circ}\text{C}$)	2500	V
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150	$^{\circ}\text{C}$

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. $I_{SD} \leq 17\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, peak $V_{DS} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	4.17	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.5	$^{\circ}\text{C}/\text{W}$

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max)	6	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	300	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	$V_{GS} = 0, I_D = 1 \text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0, V_{DS} = 600 \text{ V}$			1	μA
		$V_{GS} = 0, V_{DS} = 600 \text{ V}, T_C = 125^\circ\text{C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0, V_{GS} = \pm 25 \text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 10 \text{ V}, I_D = 8 \text{ A}$		0.168	0.19	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$	-	1330	-	pF
C_{oss}	Output capacitance		-	80	-	pF
C_{rss}	Reverse transfer capacitance		-	3.2	-	pF
$C_{oss \text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0 \text{ to } 480 \text{ V}, V_{GS} = 0$	-	182	-	pF
R_g	Gate input resistance	$f = 1 \text{ MHz}$ open drain	-	5	-	Ω
Q_g	Total gate charge	$V_{DD} = 480 \text{ V}, I_D = 17 \text{ A}, V_{GS} = 10 \text{ V}$ (see Figure 15)	-	44	-	nC
Q_{gs}	Gate-source charge		-	7	-	nC
Q_{gd}	Gate-drain charge		-	24	-	nC

1. $C_{o(eff)}$ 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	$V_{DD} = 300\text{ V}$, $I_D = 8.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14)	-	11.5	-	ns
$t_{r(v)}$	Voltage rise time		-	16.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	73	-	ns
$t_{f(l)}$	Fall time		-	37	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current		-		17	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		68	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 17\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 16)	-	340		ns
Q_{rr}	Reverse recovery charge		-	4.6		μC
I_{RRM}	Reverse recovery current		-	27		A
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 16)	-	404		ns
Q_{rr}	Reverse recovery charge		-	5.7		μC
I_{RRM}	Reverse recovery current		-	28		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

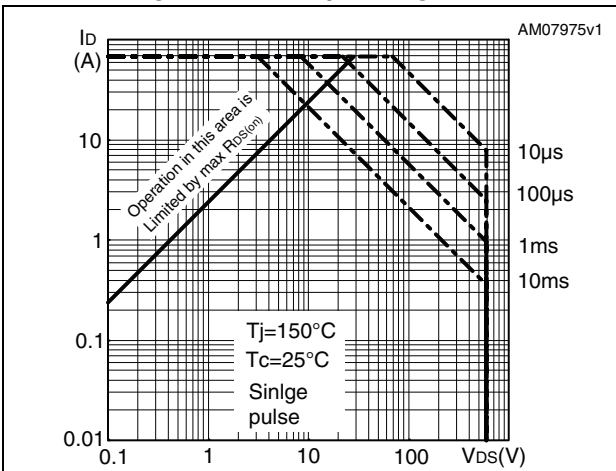


Figure 3. Thermal impedance

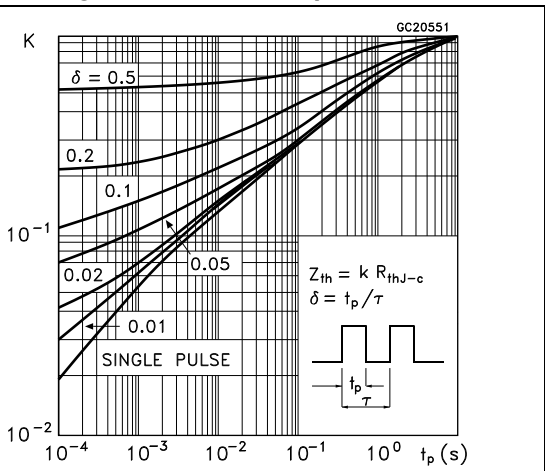


Figure 4. Output characteristics

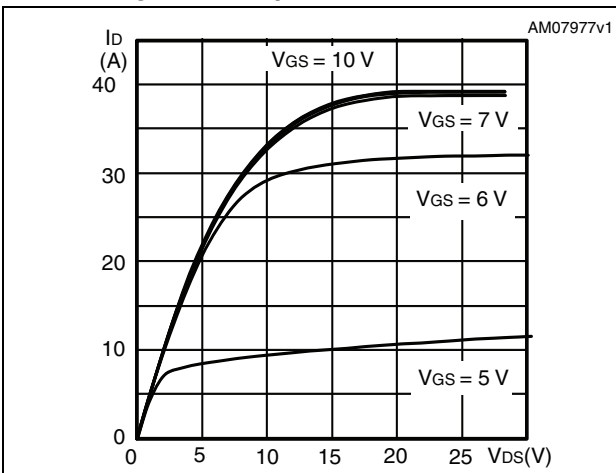


Figure 5. Transfer characteristics

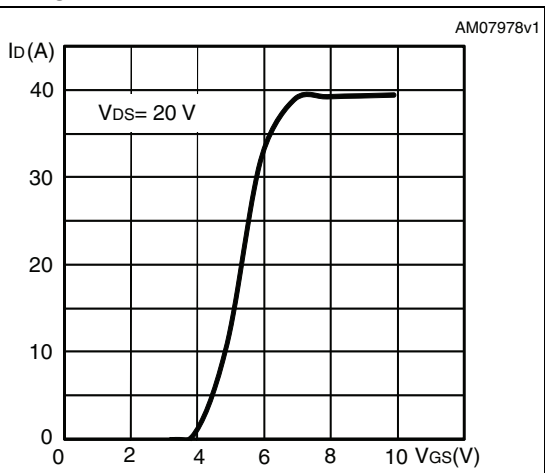


Figure 6. Gate charge vs gate-source voltage

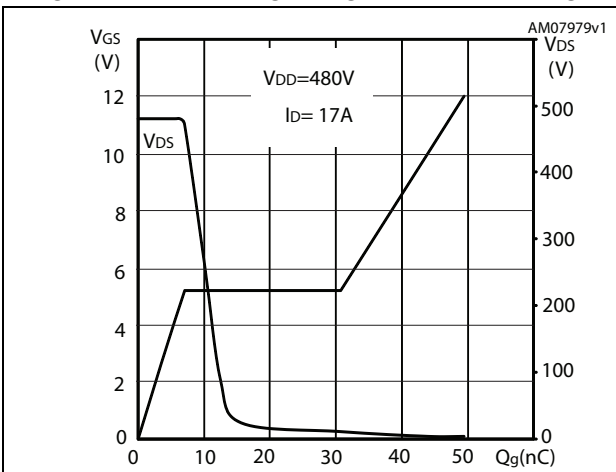


Figure 7. Static drain-source on-resistance

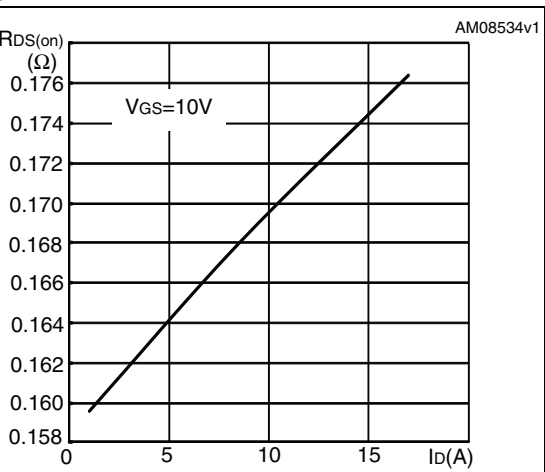


Figure 8. Capacitance variations

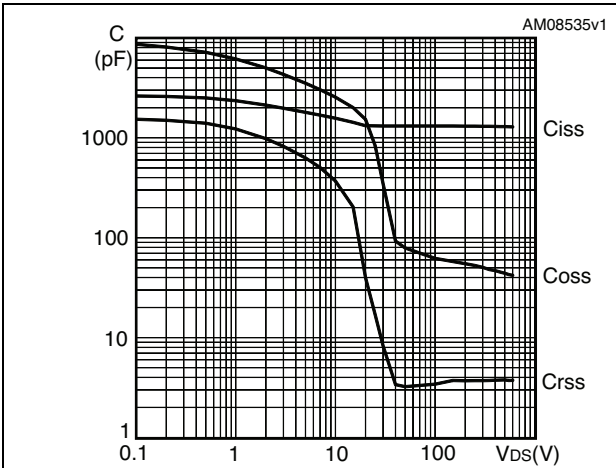


Figure 9. Output capacitance stored energy

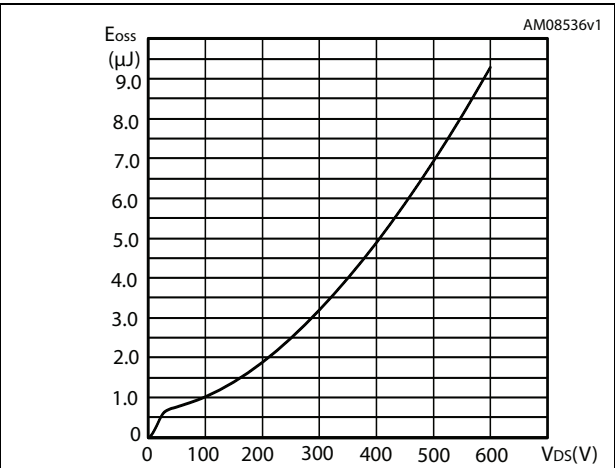


Figure 10. Normalized gate threshold voltage vs temperature

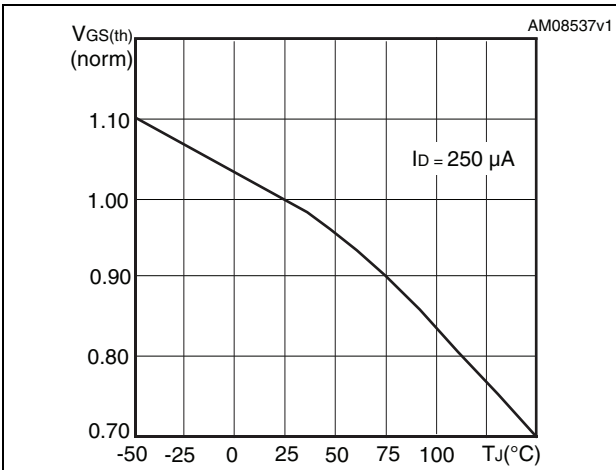


Figure 11. Normalized on-resistance vs temperature

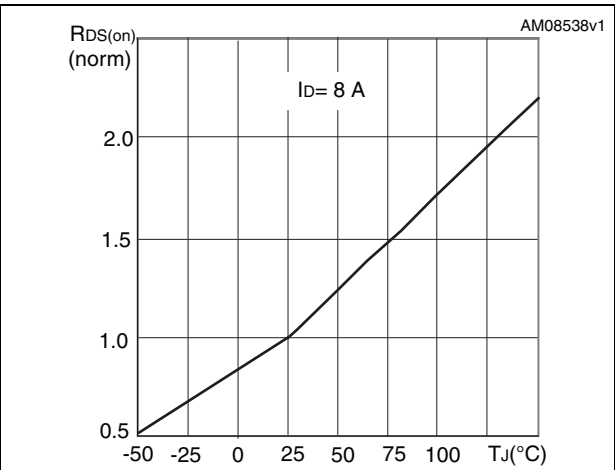


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

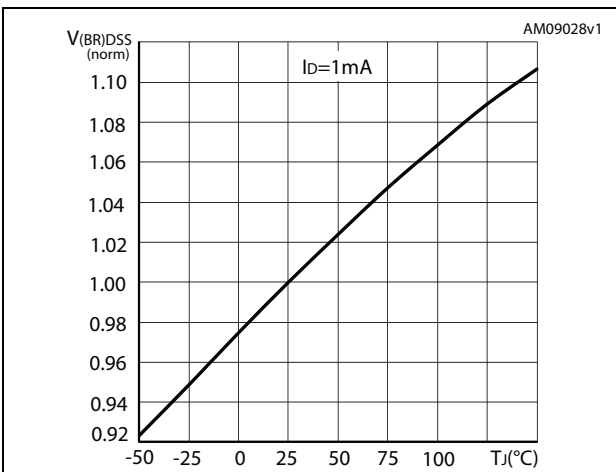
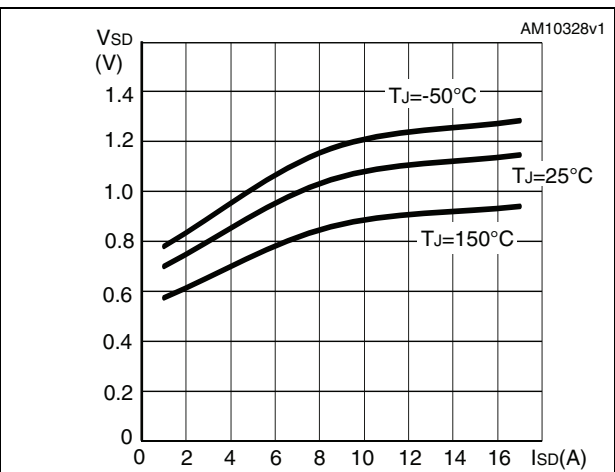
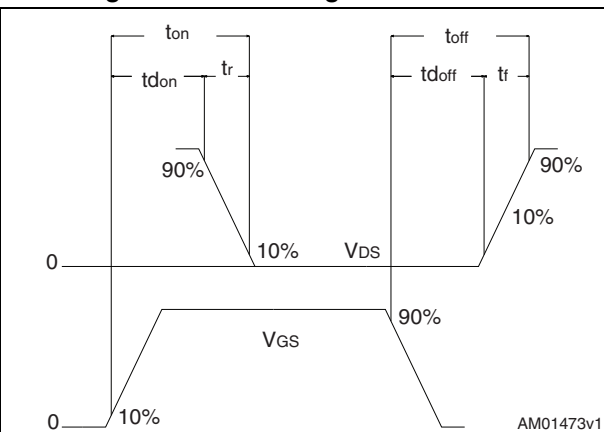
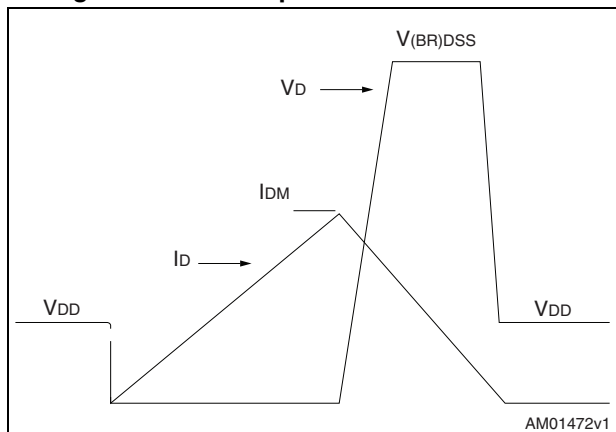
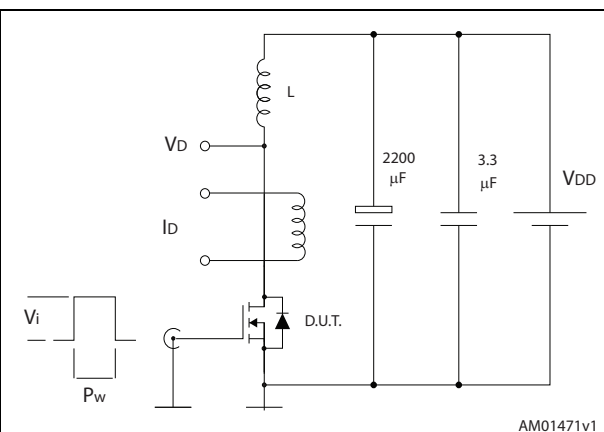
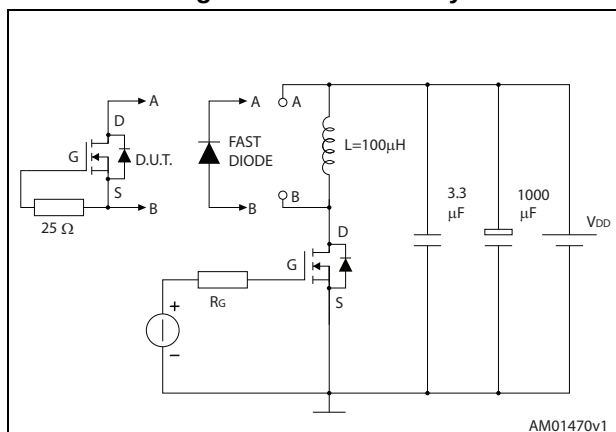
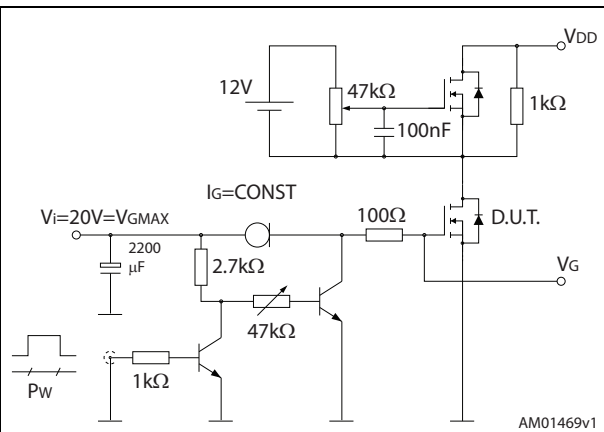
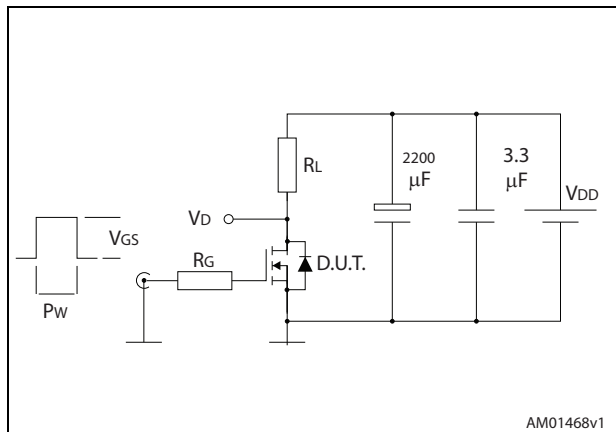


Figure 13. Source-drain diode forward characteristics

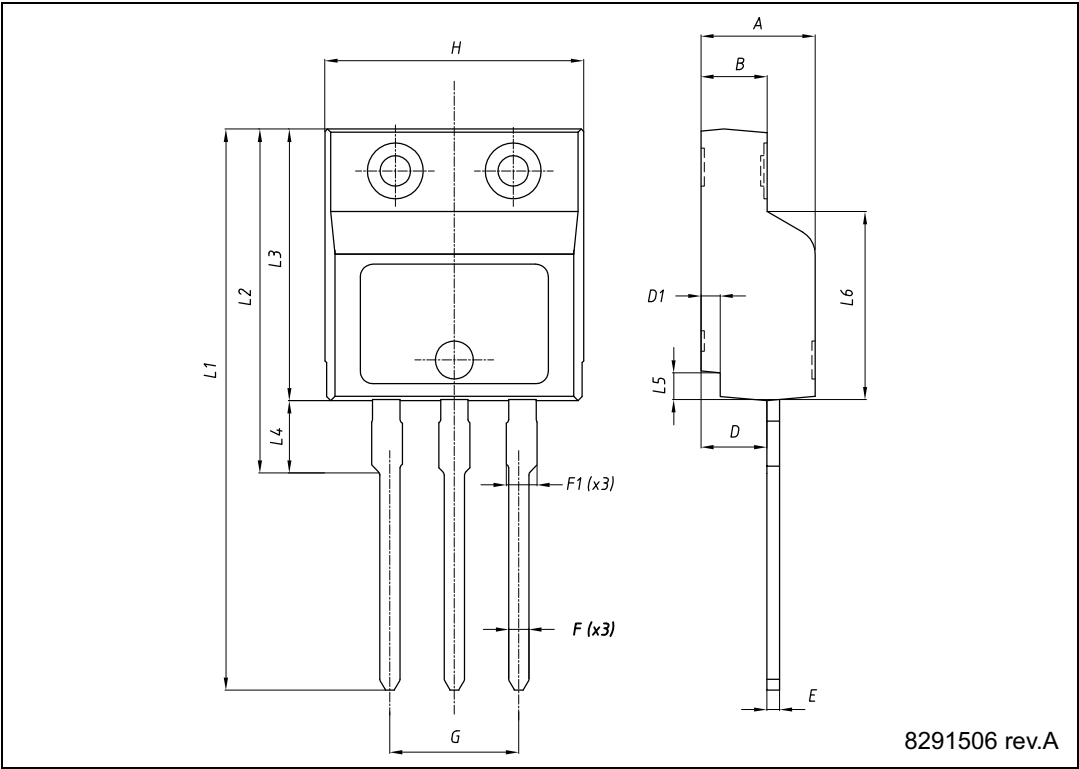




4 Package mechanical data

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. I²PAKFP (TO-281) drawing



8291506 rev.A

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	7.30		7.50

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
07-Nov-2011	1	First release.
20-Mar-2012	2	– Document status promoted from preliminary data to production data. – Package name has been updated. – Minor text changes.
24-Jul-2014	3	– Modified: the entire typical values in Table 6 – Minor text changes

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