

## N-channel 600 V, 0.092 $\Omega$ , 31.5 A MDmesh™ II Power MOSFET in a I<sup>2</sup>PAKFP package

Datasheet - production data

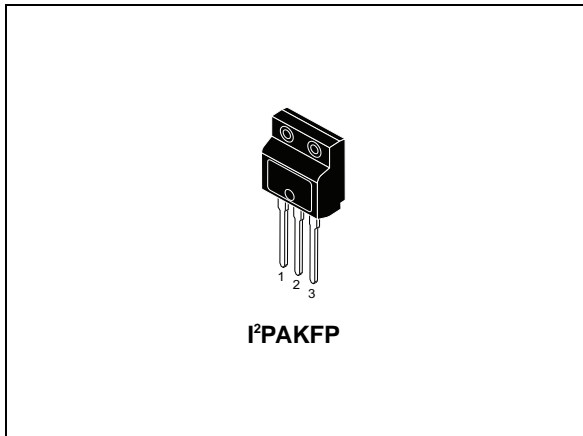
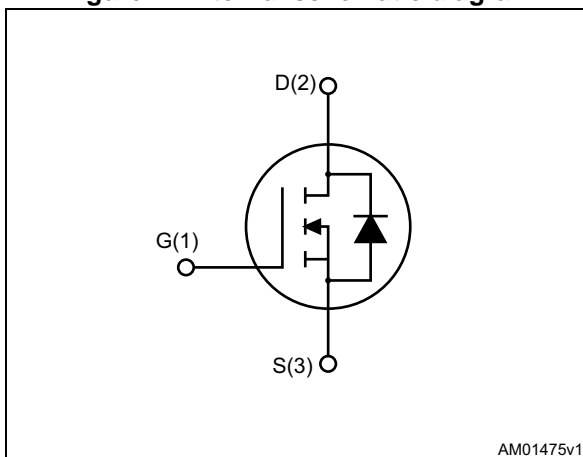


Figure 1. Internal schematic diagram



### Features

Order code	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STFI34NM60N	600 V	0.105 $\Omega$	31.5 A	40 W

- 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
STFI34NM60N	34NM60N	I <sup>2</sup> PAKFP (TO-281)	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	600	V
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	31.5 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	20 <sup>(1)</sup>	A
$I_{DM}$ <sup>(2)</sup>	Drain current (pulsed)	126	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	40	W
$I_{AR}$	Max current during repetitive or single pulse avalanche (pulse width limited by $T_{jmax}$ )	7	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	345	mJ
$V_{ISO}$	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
$dv/dt$ <sup>(3)</sup>	Peak diode recovery voltage slope	15	V/ns
$dv/dt$ <sup>(4)</sup>	MOSFET $dv/dt$ ruggedness	50	V/ns
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature	150	

- Limited by package.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 31.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$
- $V_{DS} \leq 480\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	3.1	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5	

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified).

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ( $V_{GS} = 0$ )	$I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}, T_c = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 14.5\text{ A}$		0.092	0.105	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	2722	-	pF
$C_{oss}$	Output capacitance		-	173	-	pF
$C_{rss}$	Reverse transfer capacitance		-	1.75	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}, I_D = 15.75\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 18</a> and <a href="#">14</a> )	-	18	-	ns
$t_r$	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	104	-	ns
$t_f$	Fall time		-	73	-	ns
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 31.5\text{ A}$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15</a> )	-	84	-	nC
$Q_{gs}$	Gate-source charge		-	14	-	nC
$Q_{gd}$	Gate-drain charge		-	45	-	nC
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz},$ gate DC Bias=0 test signal level=20 mV open drain	-	2.9	-	$\Omega$

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. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		31.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		126	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}= 31.5 \text{ A}, V_{GS}=0$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD}= 31.5 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , (see <a href="#">Figure 16</a> )	-	412		ns
$Q_{rr}$	Reverse recovery charge		-	8		nC
$I_{RRM}$	Reverse recovery current		-	39		A
$t_{rr}$	Reverse recovery time	$I_{SD}= 12 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt=100 \text{ A}/\mu\text{s}$ , $T_j=150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 16</a> )	-	490		ns
$Q_{rr}$	Reverse recovery charge		-	10		nC
$I_{RRM}$	Reverse recovery current		-	43		A

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

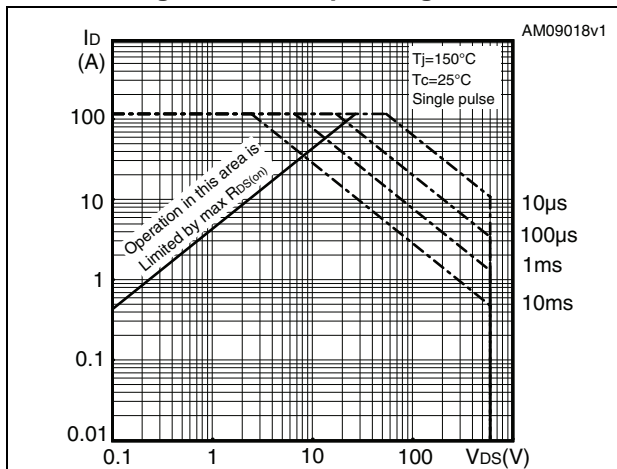


Figure 3. Thermal impedance

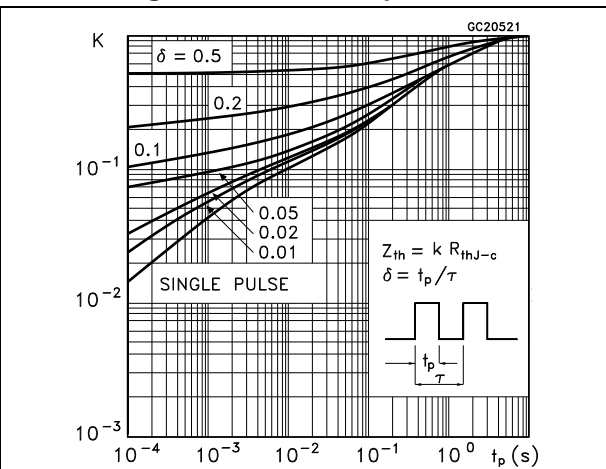


Figure 4. Output characteristics

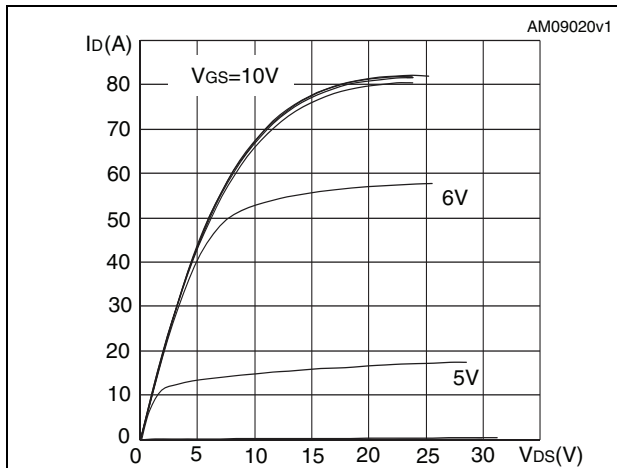


Figure 5. Transfer characteristics

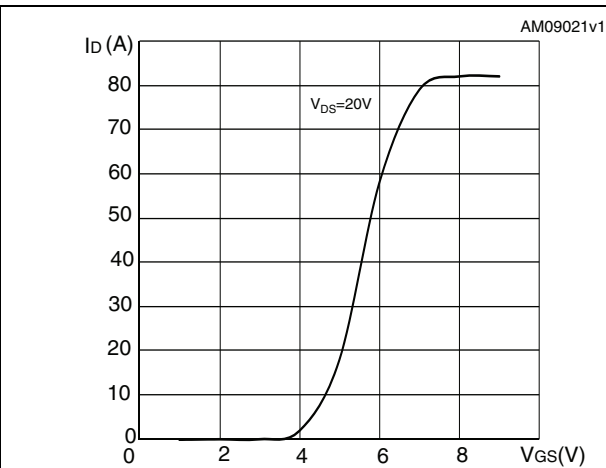


Figure 6. Gate charge vs gate-source voltage

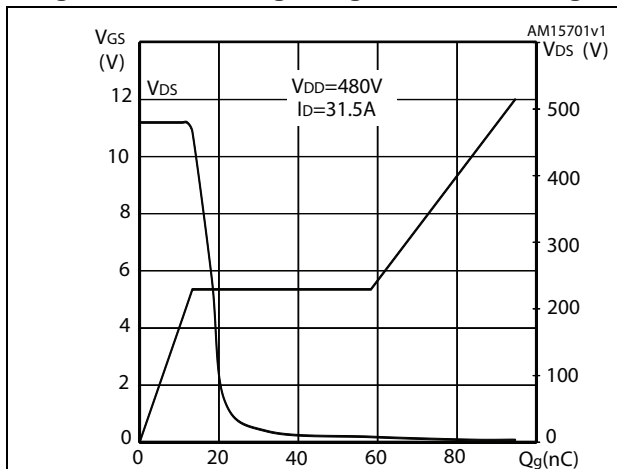


Figure 7. Static drain-source on-resistance

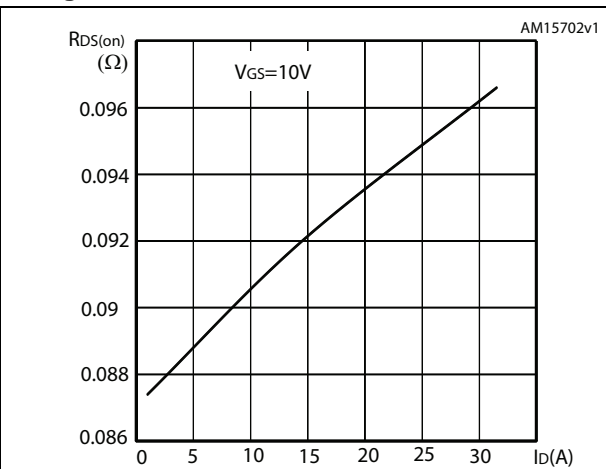


Figure 8. Capacitance variations

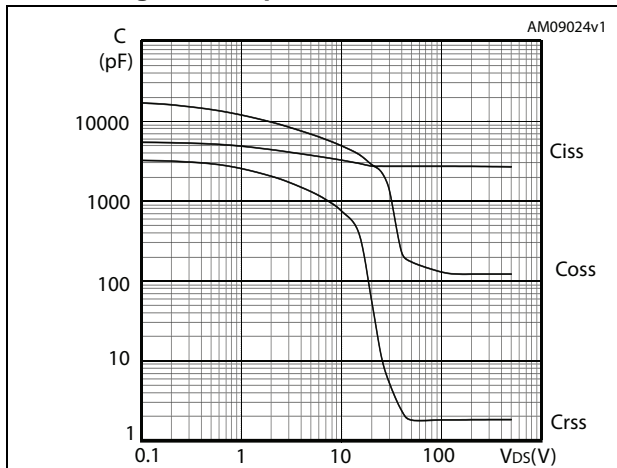


Figure 9. Output capacitance stored energy

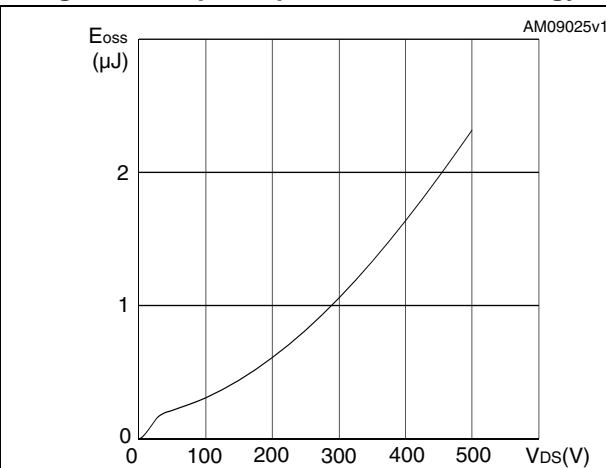


Figure 10. Normalized gate threshold voltage vs temperature

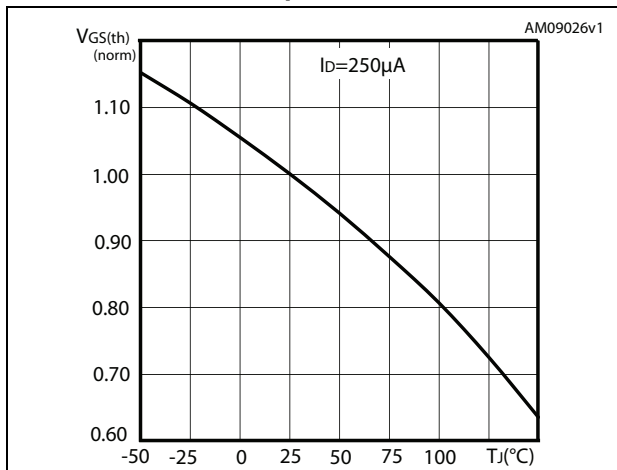


Figure 11. Normalized on-resistance vs temperature

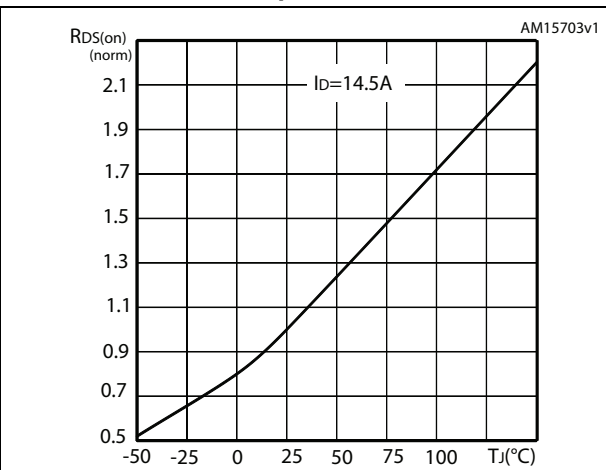


Figure 12. Normalized B<sub>VDS</sub> vs temperature

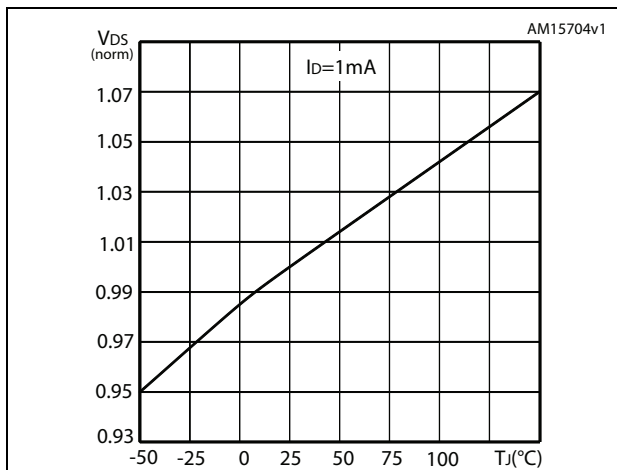
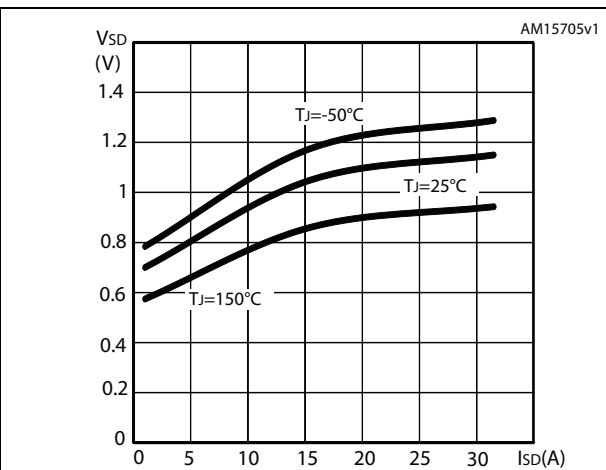


Figure 13. Source-drain diode forward characteristics



### 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

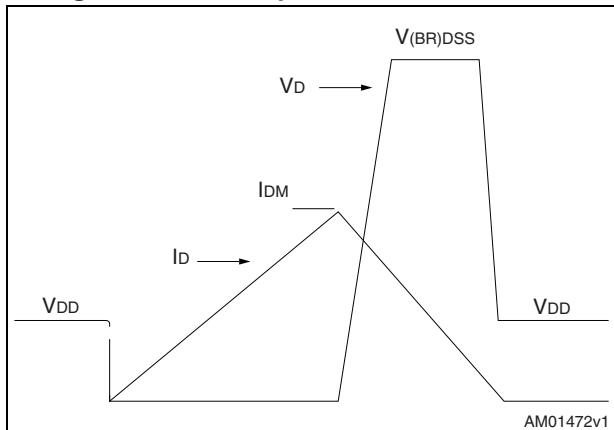
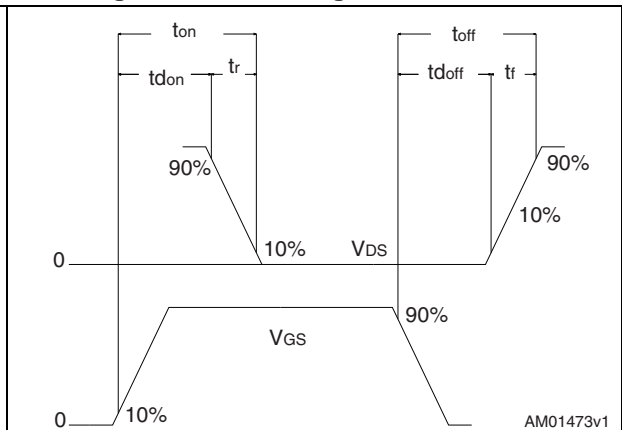


Figure 19. Switching time waveform





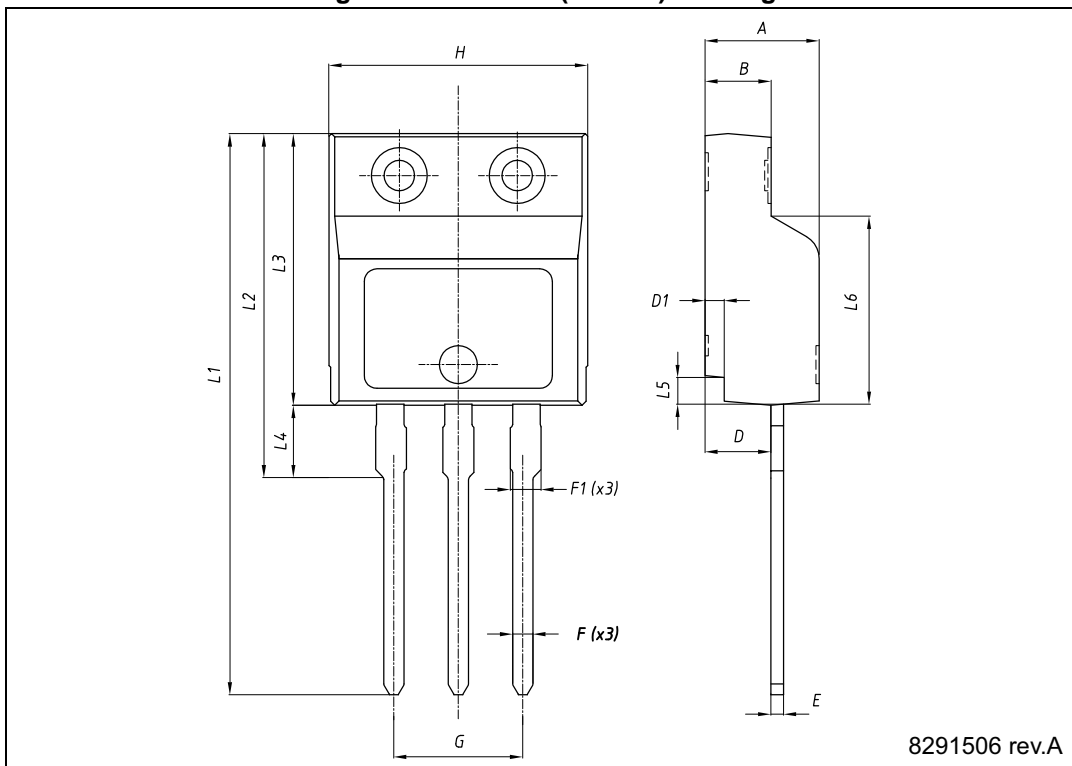
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Table 7. I<sup>2</sup>PAKFP (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

Figure 20. I<sup>2</sup>PAKFP (TO-281) drawing



## 5 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
07-Nov-2011	1	First release.
19-Apr-2012	2	<ul style="list-style-type: none"> <li>– Units in <a href="#">Table 6</a>: Source drain diode have been corrected.</li> <li>– <a href="#">Figure 6</a>: Gate charge vs. gate-source voltage has been updated.</li> <li>– Minor text changes.</li> </ul>
16-Jul-2013	3	<ul style="list-style-type: none"> <li>– Modified: title, <math>I_D</math> and <a href="#">Figure 1</a> in cover page</li> <li>– Modified: <math>I_D</math> for <math>T_C=20\text{ °C}</math> and for <math>T_C=100\text{ °C}</math>, <math>I_{DM}</math> in <a href="#">Table 2</a>, <a href="#">note 1</a>, <a href="#">note 3</a> in <a href="#">Table 2</a></li> <li>– Inserted: <math>dv</math> and <math>dt</math> in <a href="#">Table 2</a> and <a href="#">note 4</a> in <a href="#">Table 2</a></li> <li>– Modified: <math>I_{SD}</math>, <math>I_{SDM}</math> max values in <a href="#">Table 6</a> and <a href="#">Figure 14</a>, <a href="#">15</a>, <a href="#">16</a> and <a href="#">17</a></li> </ul>

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