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Kind regards,

Team Nexperia



# PSMN7R6-60XS

N-channel 60 V 7.8 m $\Omega$  standard level MOSFET in TO220F (SOT186A)

16 December 2014

Product data sheet

## 1. General description

Standard level N-channel MOSFET in a TO-220F (SOT186A) package qualified to 175 °C. This product is designed and qualified for use in a wide range of industrial, communications and power supply equipment.

## 2. Features and benefits

- High efficiency due to low switching and conduction losses
- Isolated TO220F package
- Suitable for standard level gate drive

## 3. Applications

- AC-to-DC power supply equipment
- Synchronous rectification
- Motor control

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C	-	-	60	V
I <sub>D</sub>	drain current	T <sub>mb</sub> = 25 °C; V <sub>GS</sub> = 10 V; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	-	51.5	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>	-	-	46	W
T <sub>j</sub>	junction temperature		-55	-	175	°C
<b>Static characteristics</b>						
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 10</a>	-	5.9	7.8	m $\Omega$
<b>Dynamic characteristics</b>						
Q <sub>GD</sub>	gate-drain charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 30 V; <a href="#">Fig. 16</a> ; <a href="#">Fig. 15</a>	-	10.6	-	nC
Q <sub>G(tot)</sub>	total gate charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 30 V; <a href="#">Fig. 15</a> ; <a href="#">Fig. 16</a>	-	38.7	-	nC



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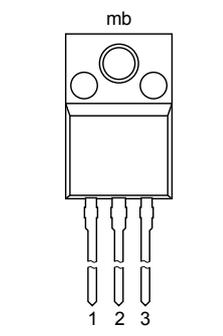
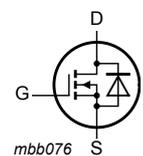
N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 51.5\text{ A}$ ; $V_{\text{sup}} \leq 60\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped; <a href="#">Fig. 4</a>	[1]	-	-	191.5 mJ

[1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.

### 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>TO-220F (SOT186A)</p>	 <p>mbb076</p>
2	D	drain		
3	S	source		
mb		mounting base; isolated		

### 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN7R6-60XS	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

### 7. Limiting values

Table 4. Limiting values

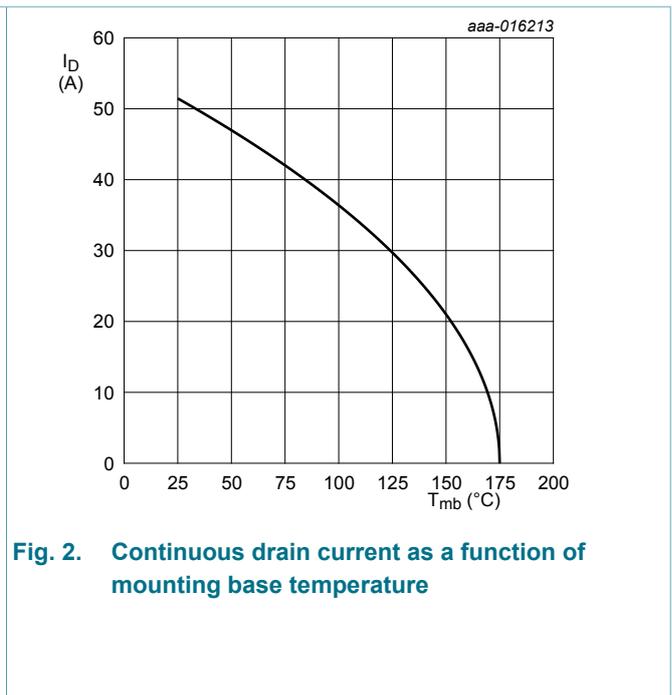
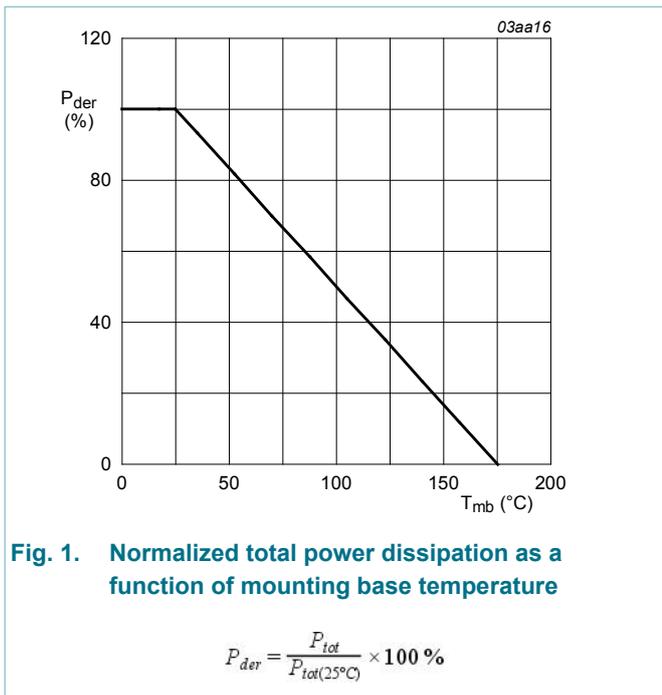
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	60	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	60	V
$V_{GS}$	gate-source voltage		-20	20	V
$P_{\text{tot}}$	total power dissipation	$T_{\text{mb}} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	46	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{\text{mb}} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>	-	36.4	A
		$V_{GS} = 10\text{ V}$ ; $T_{\text{mb}} = 25\text{ °C}$ ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	51.5	A

N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

Symbol	Parameter	Conditions	Min	Max	Unit
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 3</a>	-	206	A
T <sub>stg</sub>	storage temperature		-55	175	°C
T <sub>j</sub>	junction temperature		-55	175	°C
T <sub>slid(M)</sub>	peak soldering temperature		-	260	°C
<b>Source-drain diode</b>					
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	-	38.7	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C	-	206	A
<b>Avalanche ruggedness</b>					
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; I <sub>D</sub> = 51.5 A; <a href="#">[1]</a> V <sub>sup</sub> ≤ 60 V; R <sub>GS</sub> = 50 Ω; unclamped; <a href="#">Fig. 4</a>	-	191.5	mJ

[1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.



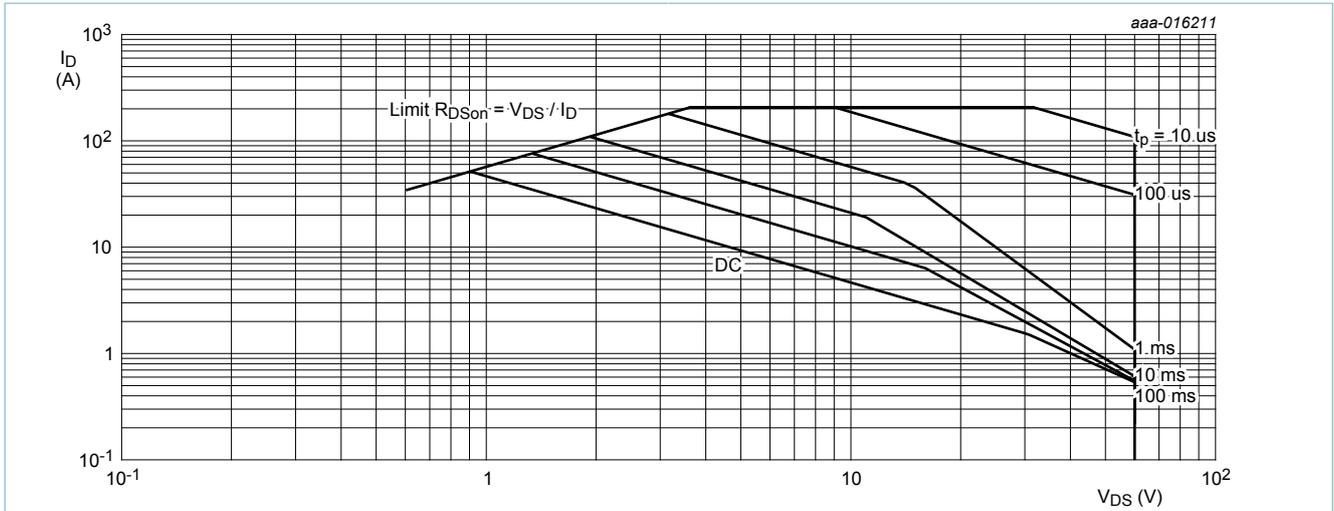


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^\circ\text{C}$ ;  $I_{DM}$  is a single pulse

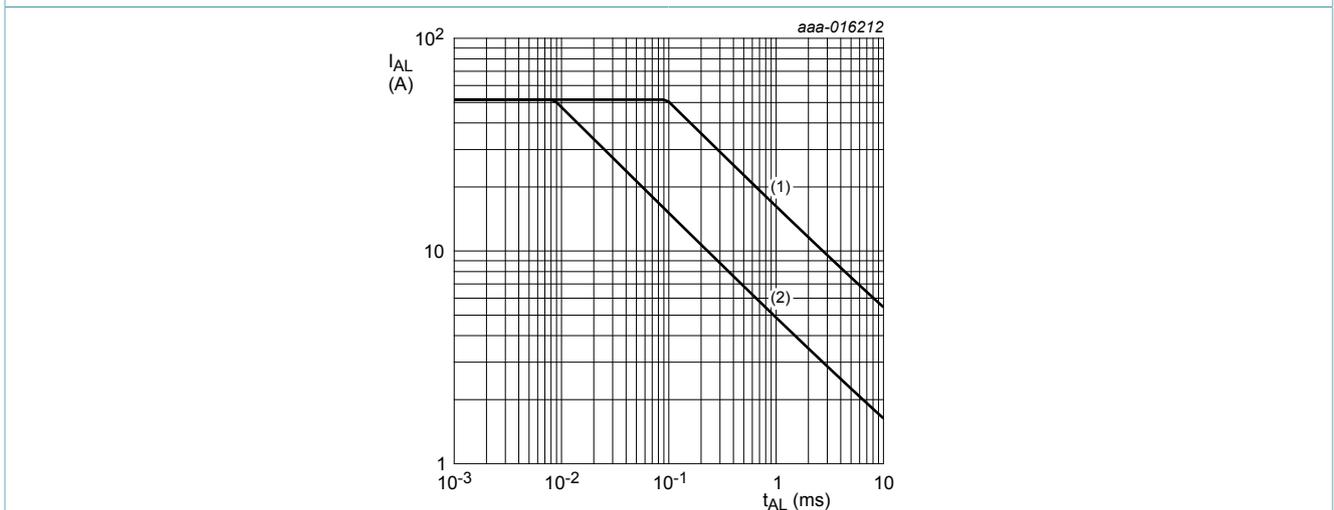


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

(1)  $T_{j (init)} = 25^\circ\text{C}$ ; (2)  $T_{j (init)} = 130^\circ\text{C}$

## 8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5	-	3.01	3.23	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in free air	-	55	-	K/W

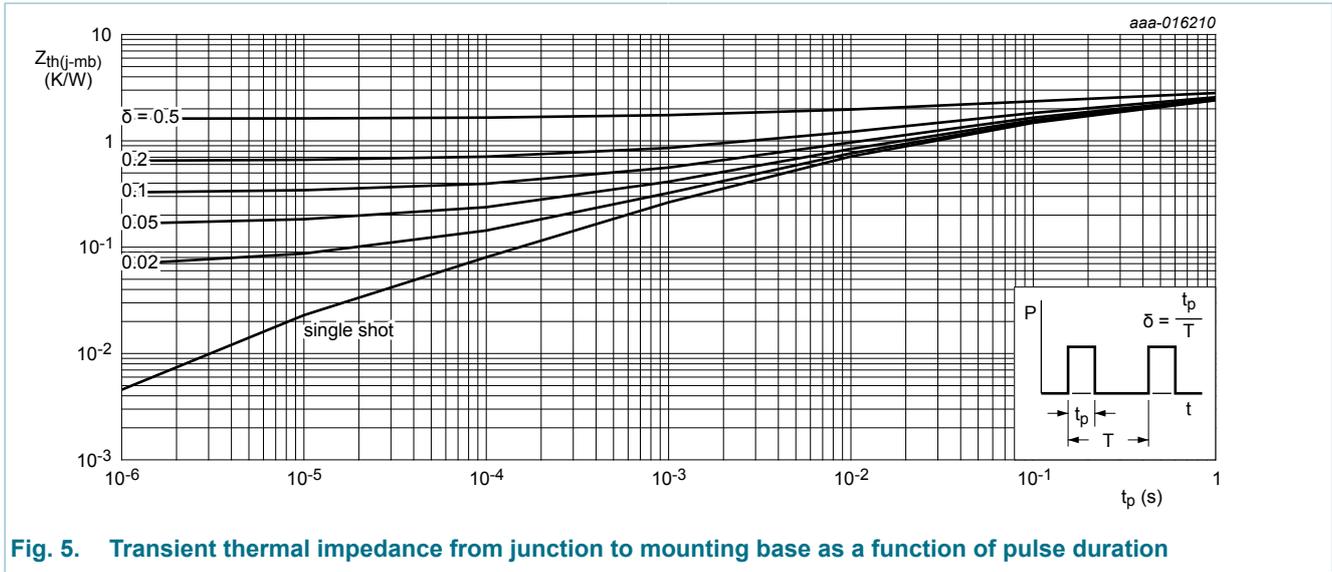


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

### 9. Isolation characteristics

Table 6. Isolation characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{isol}$	isolation capacitance	$f = 1 \text{ MHz}$	-	10	-	pF
$V_{isol(RMS)}$	RMS isolation voltage	$50 \text{ Hz} \leq f \leq 60 \text{ Hz}$ ; $RH \leq 65 \%$ ; sinusoidal waveform; clean and dust free	-	-	2500	V

### 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_J = -55 \text{ }^\circ\text{C}$	54	-	-	V
		$I_D = 250 \mu\text{A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_J = 25 \text{ }^\circ\text{C}$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_J = 175 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>	1	-	-	V
		$I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_J = -55 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>	-	-	4.6	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_J = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 11</a>	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_J = 25 \text{ }^\circ\text{C}$	-	0.05	10	$\mu\text{A}$
		$V_{DS} = 60 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_J = 125 \text{ }^\circ\text{C}$	-	-	100	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_J = 25 \text{ }^\circ\text{C}$	-	2	100	nA

N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_{GS} = -20\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 175\text{ }^\circ\text{C};$ <a href="#">Fig. 13</a>	-	13.3	18	mΩ
		$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 14</a> ; <a href="#">Fig. 10</a>	-	5.9	7.8	mΩ
$R_G$	gate resistance	$f = 1\text{ MHz}$	-	0.98	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}; V_{DS} = 30\text{ V}; V_{GS} = 10\text{ V};$ <a href="#">Fig. 15</a> ; <a href="#">Fig. 16</a>	-	38.7	-	nC
$Q_{GS}$	gate-source charge		-	12.9	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	6.9	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	6	-	nC
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}; V_{DS} = 30\text{ V}; V_{GS} = 10\text{ V};$ <a href="#">Fig. 16</a> ; <a href="#">Fig. 15</a>	-	10.6	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\text{ A}; V_{DS} = 30\text{ V};$ <a href="#">Fig. 15</a> ; <a href="#">Fig. 16</a>	-	5.6	-	V
$C_{iss}$	input capacitance	$V_{DS} = 30\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 17</a> ; <a href="#">Fig. 9</a>	-	2651	-	pF
$C_{oss}$	output capacitance	$V_{DS} = 30\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 17</a>	-	342	-	pF
$C_{riss}$	reverse transfer capacitance	$V_{DS} = 30\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 17</a> ; <a href="#">Fig. 9</a>	-	183	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}; R_L = 1.2\text{ }^\Omega; V_{GS} = 10\text{ V};$ $R_{G(ext)} = 4.7\text{ }^\Omega$	-	19	-	ns
$t_r$	rise time		-	21	-	ns
$t_{d(off)}$	turn-off delay time		-	37	-	ns
$t_f$	fall time		-	13	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 18</a>	-	0.86	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}; dI_S/dt = 100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 30\text{ V}$	-	40.4	-	ns
$Q_r$	recovered charge	$V_{DS} = 30\text{ V}$	-	56	-	nC

N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

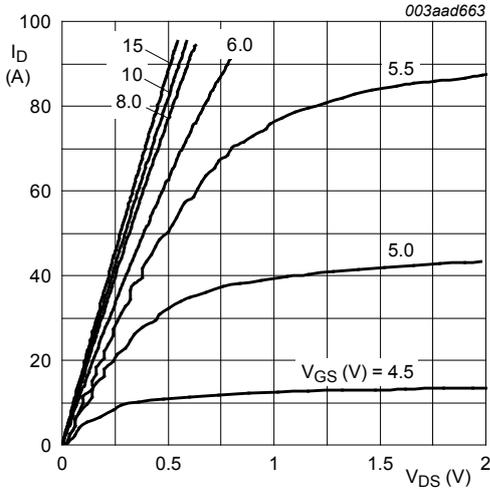


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\text{ }^\circ\text{C}; t_p = 300\text{ }\mu\text{s}$

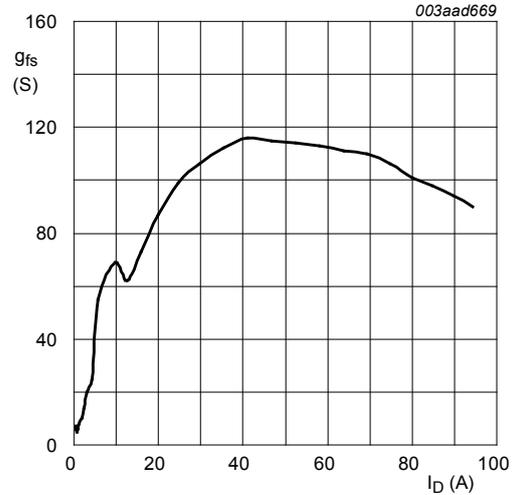


Fig. 7. Forward transconductance as a function of drain current; typical values

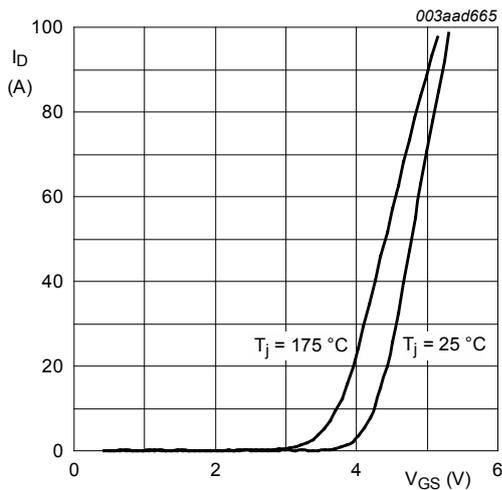


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 25\text{ V}$

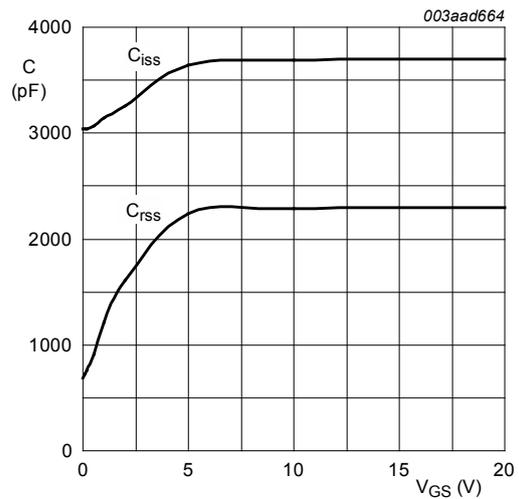


Fig. 9. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

$V_{DS} = 0\text{ V}; f = 1\text{ MHz}$

N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

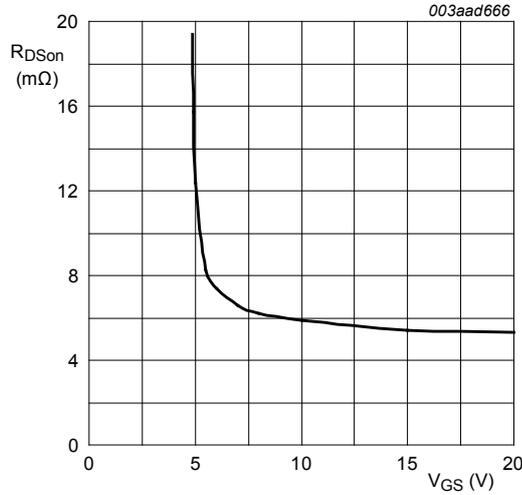


Fig. 10. Drain-source on-state resistance as a function of gate-source voltage; typical values

$$T_j = 25^\circ\text{C}$$

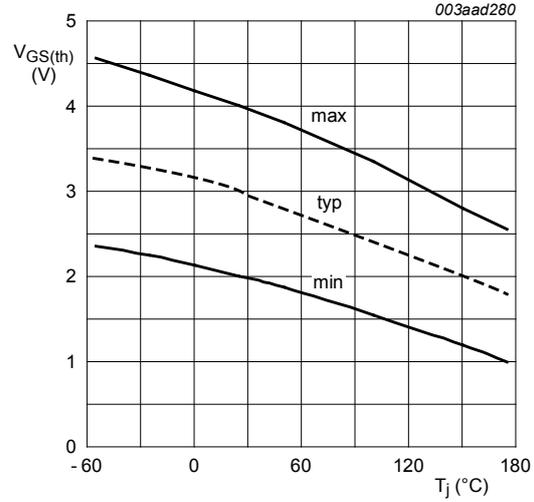


Fig. 11. Gate-source threshold voltage as a function of junction temperature

$$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$$

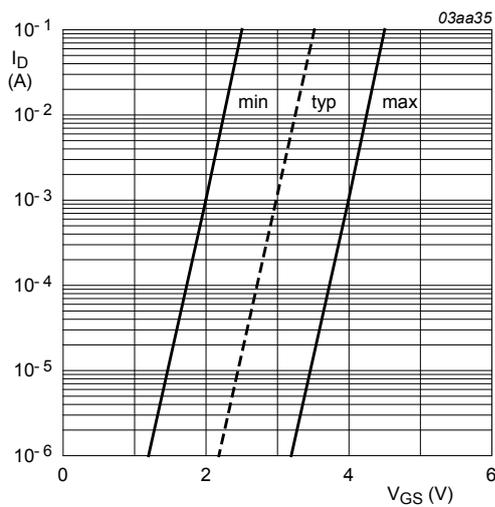


Fig. 12. Sub-threshold drain current as a function of gate-source voltage

$$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$$

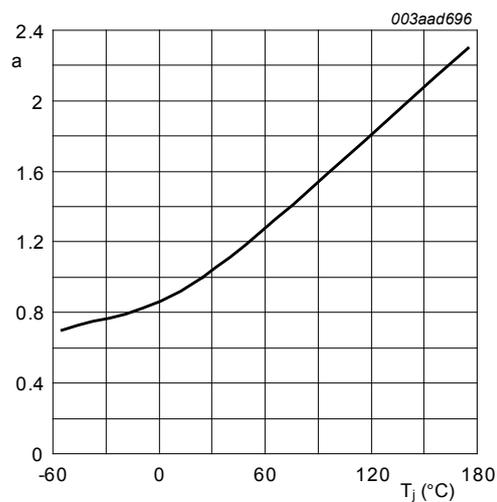


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature.

$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$

N-channel 60 V 7.8 mΩ standard level MOSFET in TO220F (SOT186A)

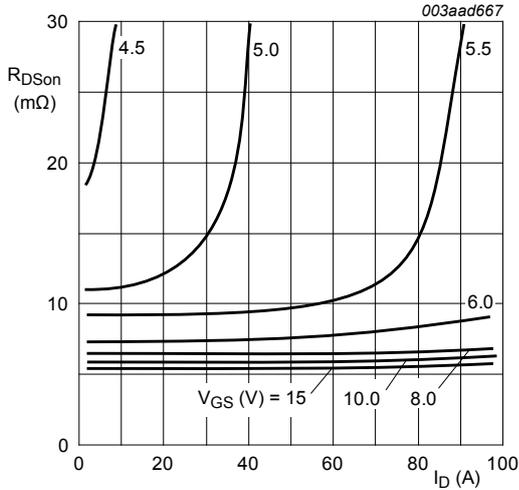


Fig. 14. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25^\circ\text{C}; t_p = 300\mu\text{s}$

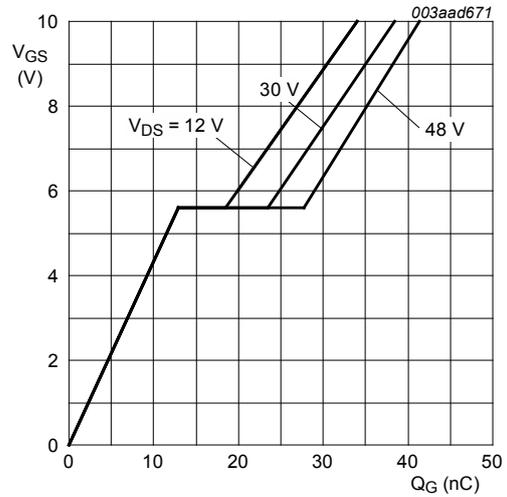


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ\text{C}; I_D = 25\text{ A}$

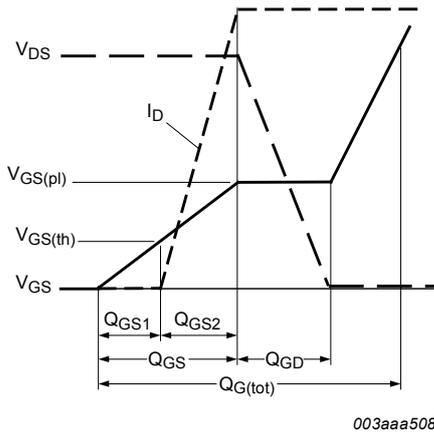


Fig. 16. Gate charge waveform definitions

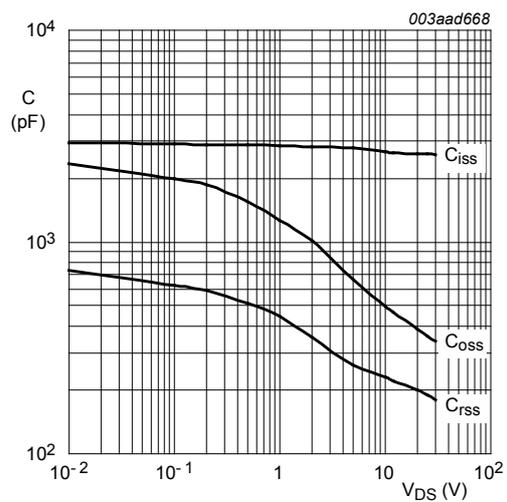


Fig. 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

$V_{DS} = 0\text{ V}; f = 1\text{ MHz}$

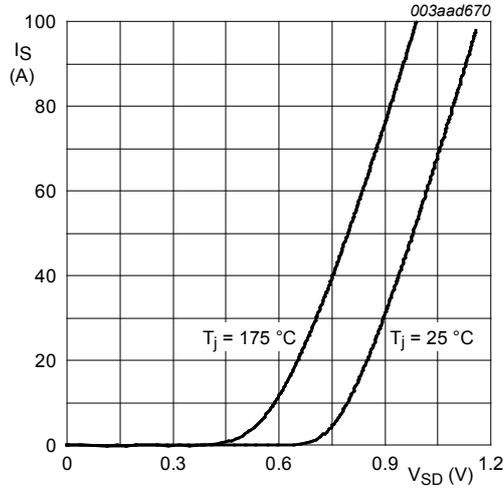


Fig. 18. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

### 11. Package outline

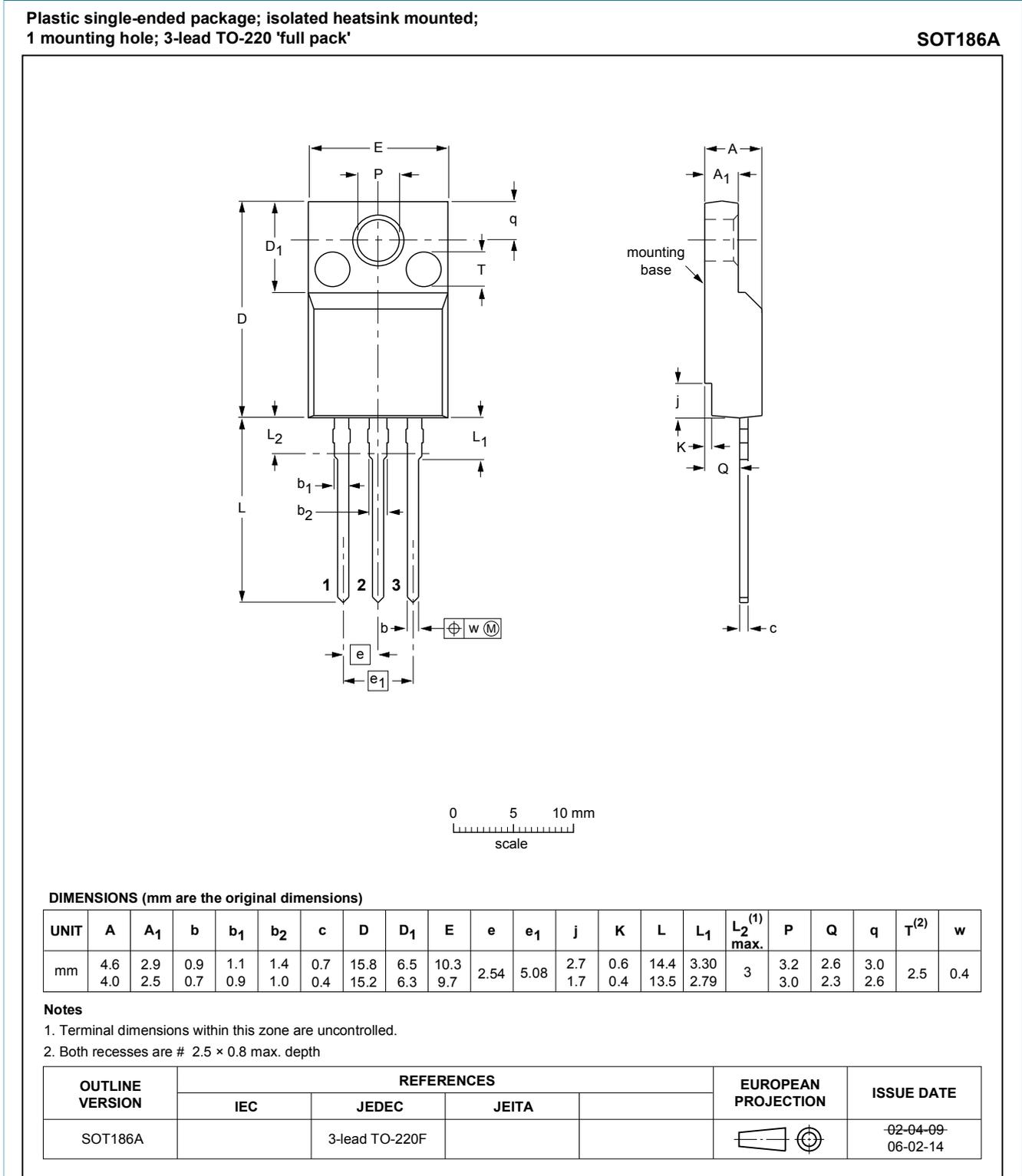


Fig. 19. Package outline TO-220F (SOT186A)

## 12. Legal information

### 12.1 Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 16 December 2014