



PSMN3R9-60XS

N-channel 60 V, 4.0 mΩ standard level MOSFET in TO220F (SOT186A)

12 September 2013

Product data sheet

1. General description

Standard level N-channel MOSFET in TO220F (SOT186A) package qualified to 175 °C. This product is designed and qualified for use in a wide range of industrial, communications and domestic equipment.

2. Features and benefits

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

3. Applications

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

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	60	V	
I_D	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ Fig. 1	[1]	-	75	A	
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Fig. 2	-	-	55	W	
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ Fig. 12	-	3.25	4	mΩ	
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; V_{DS} = 48\text{ V};$ Fig. 13; Fig. 14	-	34.7	-	nC	
$Q_{G(tot)}$	total gate charge		-	103	-	nC	
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}; I_D = 75\text{ A}; V_{sup} \leq 60\text{ V}; R_{GS} = 50\text{ Ω};$ unclamped; Fig. 3	-	-	478	mJ	



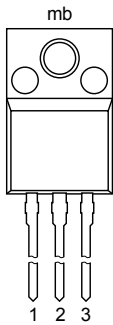
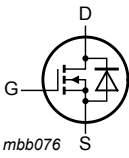
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[1] Continuous current is limited by package

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
PSMN3R9-60XS	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

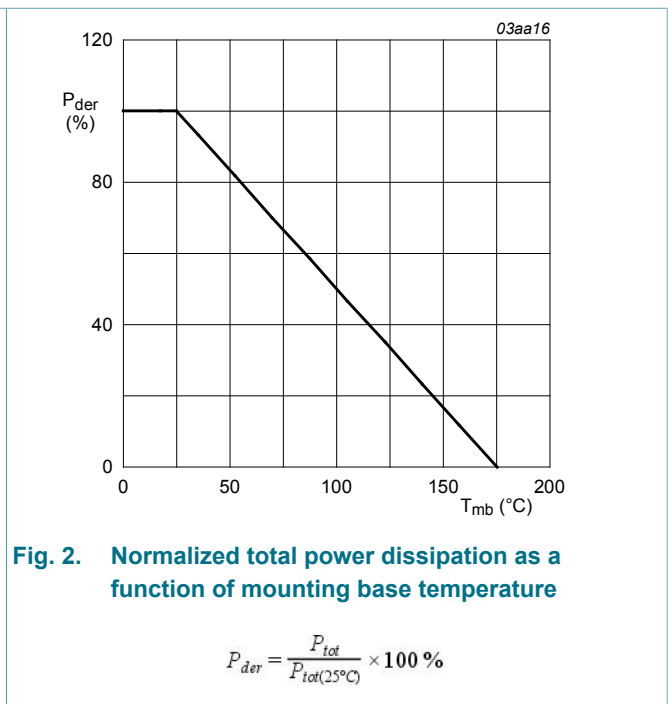
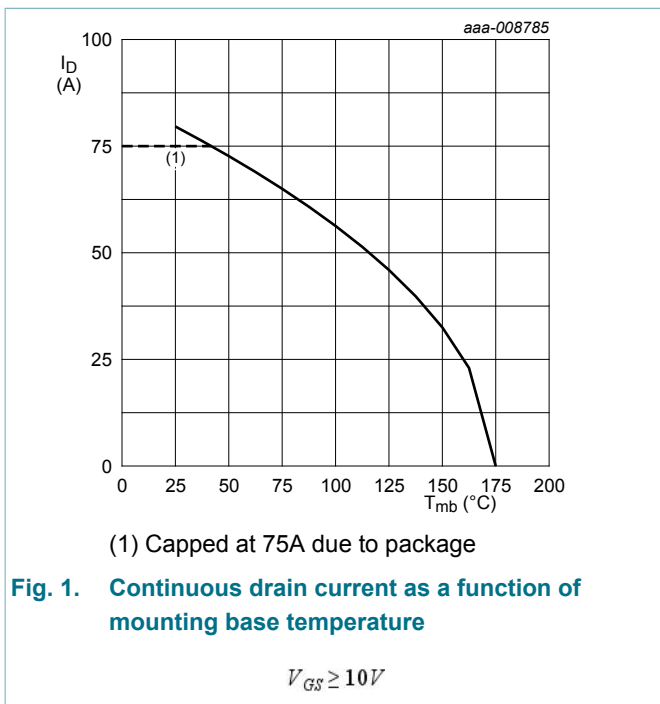
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ °C}; \text{Fig. 1}$	-	56	A
		$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}; \text{Fig. 1}$ [1]	-	75	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}; \text{Fig. 4}$	-	318	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 2}$	-	55	W
T_{stg}	storage temperature		-55	175	°C
T_j	junction temperature		-55	175	°C
$T_{sld(M)}$	peak soldering temperature		-	260	°C

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Symbol	Parameter	Conditions	Min	Max	Unit
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	46	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	318	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 75\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\text{ }\Omega$; unclamped; Fig. 3	-	478	mJ

[1] Continuous current is limited by package



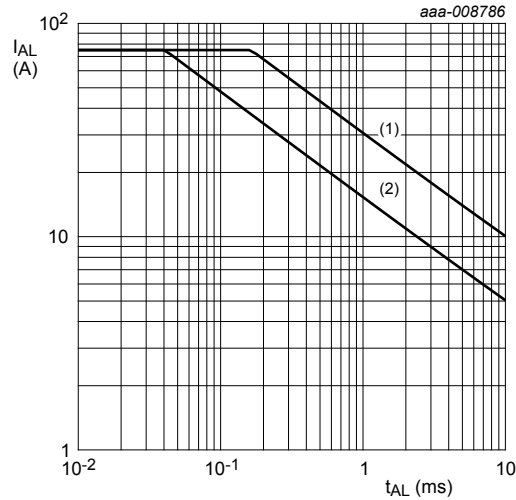


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

(1) $T_{j (init)} = 25^{\circ}C$; (2) $T_{j (init)} = 100^{\circ}C$

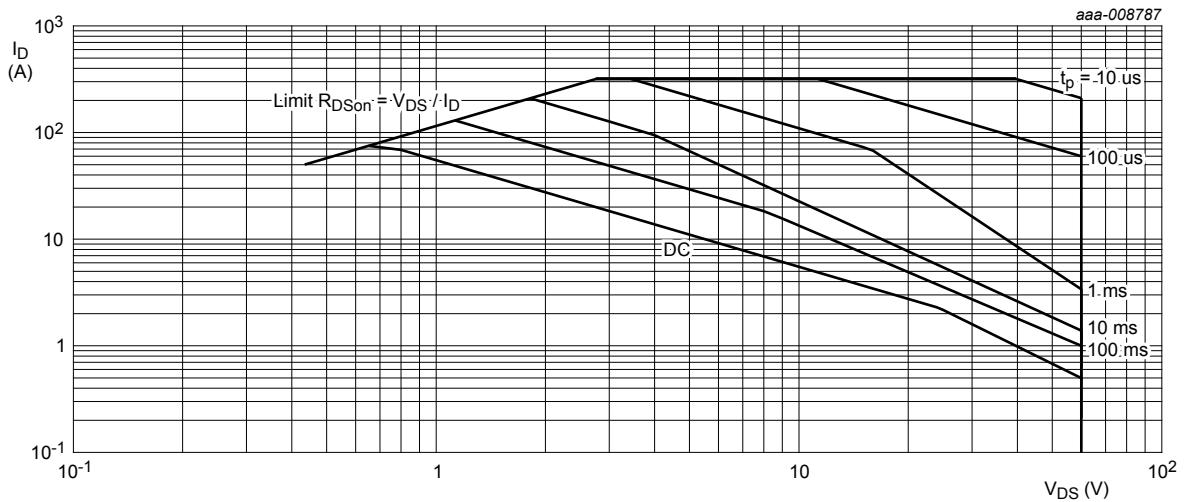


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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	-	2.5	2.73	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in free air	-	55	-	K/W

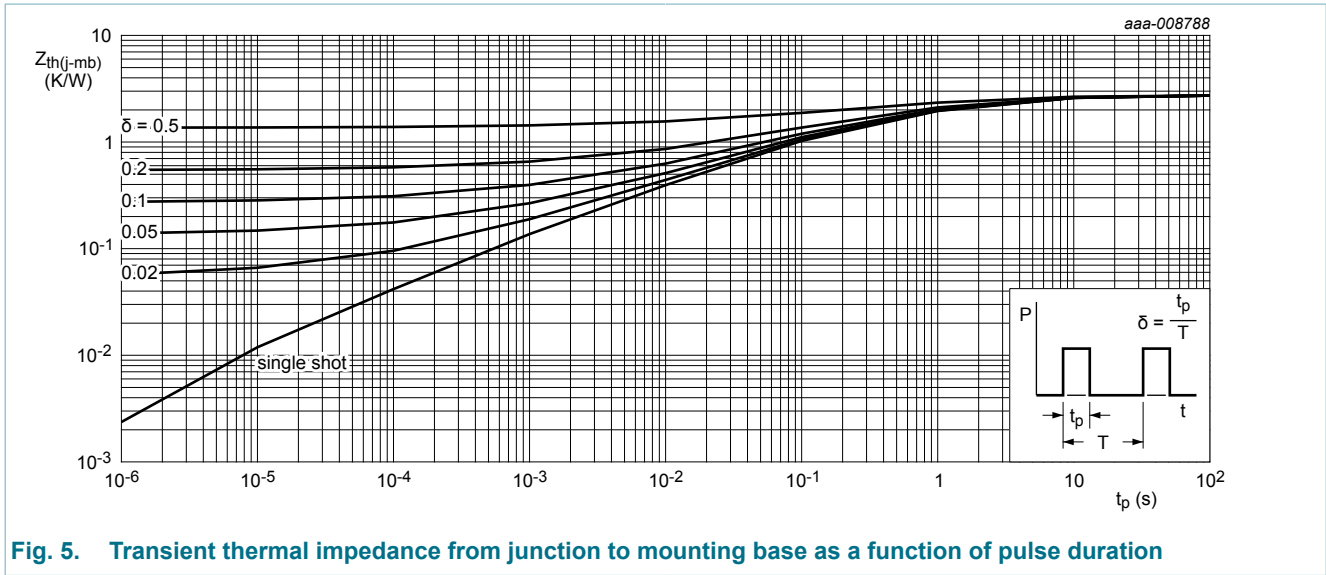


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Isolation characteristics

Table 6. Isolation characteristics

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

[1] f = 1 MHz

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	54	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$; Fig. 9 ; Fig. 10	2.4	3	4	V
V_{GSth}	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C$; Fig. 9	-	-	4.5	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$; Fig. 9	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.07	1	μA
		$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$	-	-	500	μA

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{GSS}	gate leakage current	V _{GS} = 20 V; V _{DS} = 0 V; T _j = 25 °C	-	2	100	nA
		V _{GS} = -20 V; V _{DS} = 0 V; T _j = 25 °C	-	2	100	nA
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 25 A; T _j = 175 °C; Fig. 11	-	-	8.7	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _j = 25 °C; Fig. 12	-	3.25	4	mΩ
R _G	gate resistance	f = 1 MHz	-	0.71	-	Ω
Dynamic characteristics						
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 48 V; V _{GS} = 10 V; Fig. 13 ; Fig. 14	-	103	-	nC
Q _{GS}	gate-source charge		-	25.1	-	nC
Q _{GD}	gate-drain charge		-	34.7	-	nC
C _{iss}	input capacitance	V _{DS} = 25 V; V _{GS} = 0 V; f = 1 MHz; T _j = 25 °C; Fig. 15	-	5494	-	pF
C _{oss}	output capacitance		-	743	-	pF
C _{rss}	reverse transfer capacitance		-	455	-	pF
t _{d(on)}	turn-on delay time	V _{DS} = 30 V; R _L = 1 Ω; V _{GS} = 10 V; R _{G(ext)} = 5 Ω	-	30.6	-	ns
t _r	rise time		-	71.2	-	ns
t _{d(off)}	turn-off delay time		-	63.7	-	ns
t _f	fall time		-	64.4	-	ns
Source-drain diode						
V _{SD}	source-drain voltage	I _S = 10 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 16	-	0.76	1.2	V
t _{rr}	reverse recovery time	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 30 V	-	40.5	-	ns
Q _r	recovered charge		-	53	-	nC

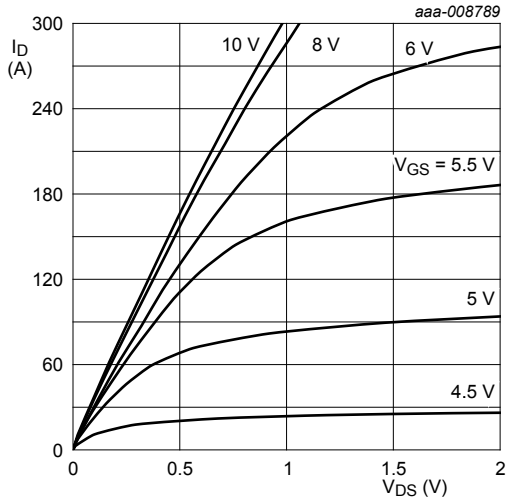


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

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

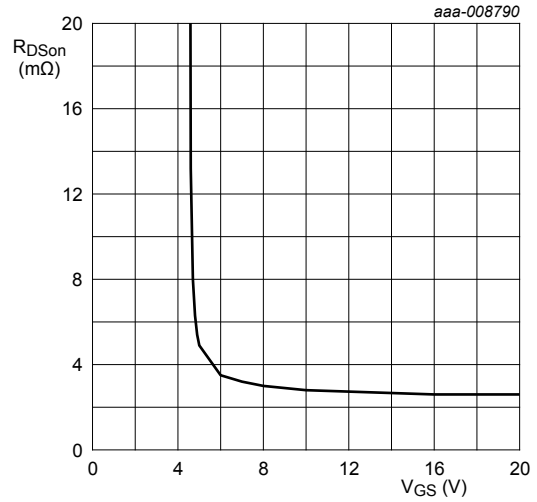


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

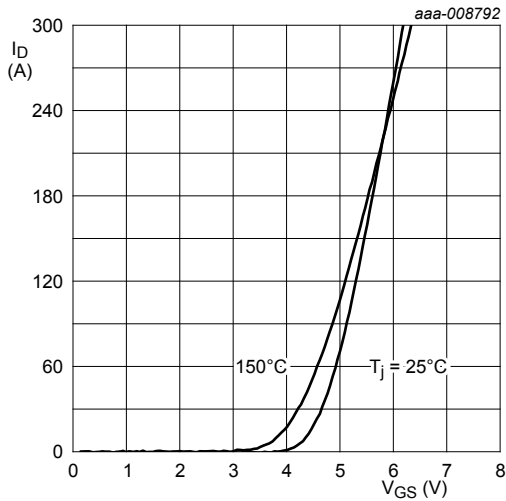


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{ V}$

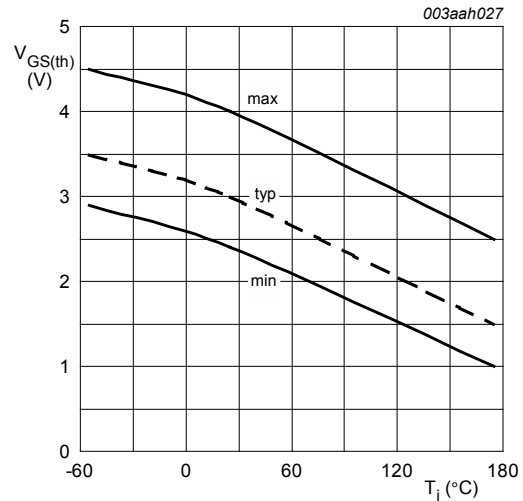


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

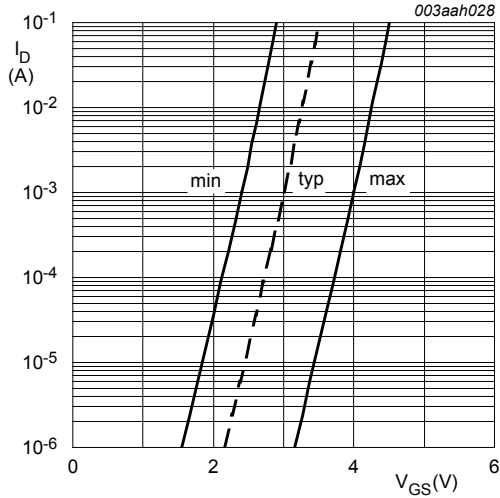


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

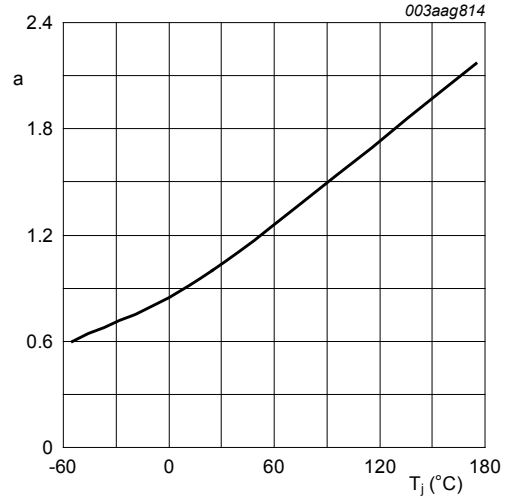


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

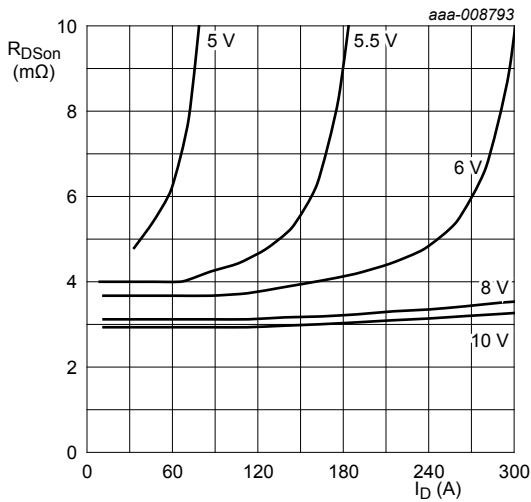


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

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

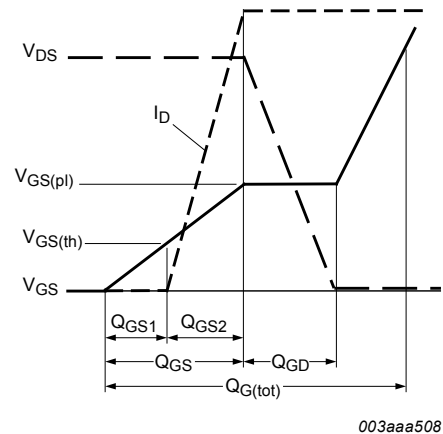


Fig. 13. Gate charge waveform definitions

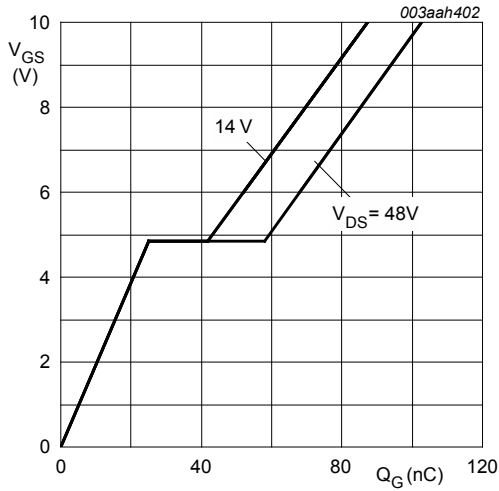


Fig. 14. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ C; I_D = 25A$

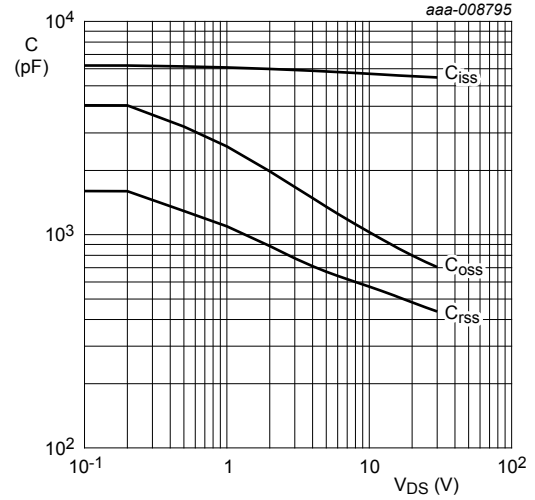


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

$V_{GS} = 0V; f = 1MHz$

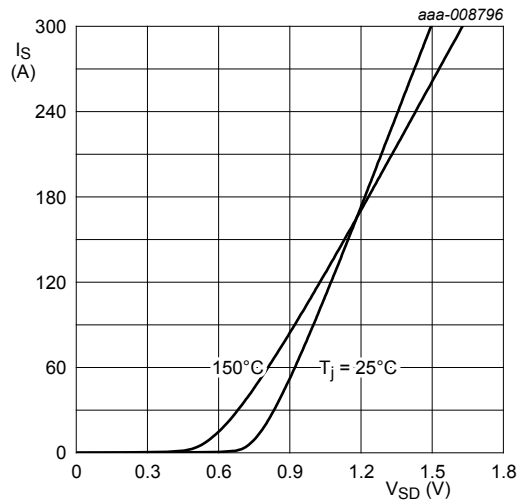


Fig. 16. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0V$

11. Package outline

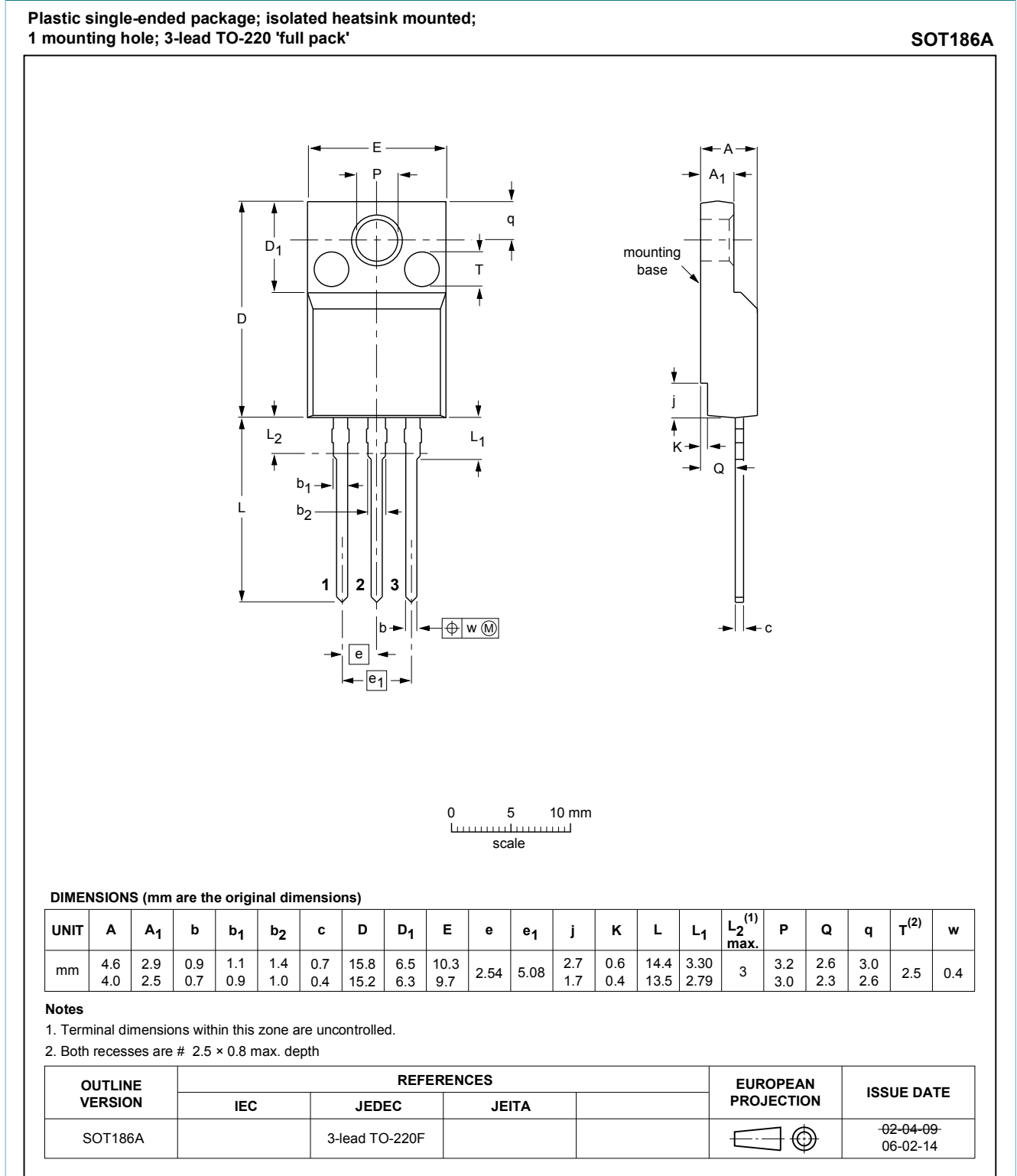


Fig. 17. Package outline TO-220F (SOT186A)

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