PSMN7R6-60XS

N-channel 60 V 7.8 mΩ 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_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	60	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; Fig. 2; Fig. 3		-	-	51.5	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	46	W
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 14; Fig. 10		-	5.9	7.8	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	V_{GS} = 10 V; I_D = 25 A; V_{DS} = 30 V; Fig. 16; Fig. 15		-	10.6	-	nC
$Q_{G(tot)}$	total gate charge	V_{GS} = 10 V; I_D = 25 A; V_{DS} = 30 V; Fig. 15; Fig. 16		-	38.7	-	nC

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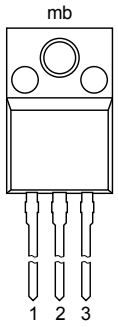
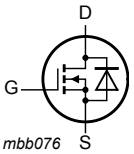
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 51.5 A; $V_{sup} \leq$ 60 V; R_{GS} = 50 Ω; unclamped; Fig. 4	[1]	-	-	191.5	mJ

[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	 TO-220F (SOT186A)	
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 °C ≤ T_j ≤ 175 °C		-	60	V
V_{DGR}	drain-gate voltage	25 °C ≤ T_j ≤ 175 °C; R_{GS} = 20 kΩ		-	60	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	46	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	36.4	A
		V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2; Fig. 3		-	51.5	A

Symbol	Parameter	Conditions		Min	Max	Unit
I_{DM}	peak drain current	pulsed; $t_p \leq 10$ µs; T_{mb} = 25 °C; Fig. 3		-	206	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C		-	38.7	A
I_{SM}	peak source current	pulsed; $t_p \leq 10$ µs; T_{mb} = 25 °C		-	206	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 51.5 A; $V_{sup} \leq 60$ V; R_{GS} = 50 Ω; unclamped; Fig. 4	[1]	-	191.5	mJ

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

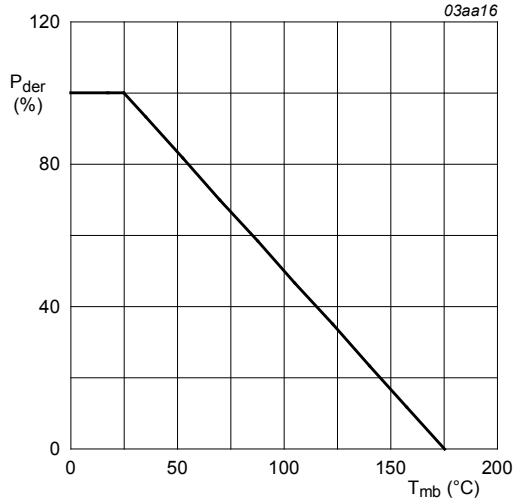


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

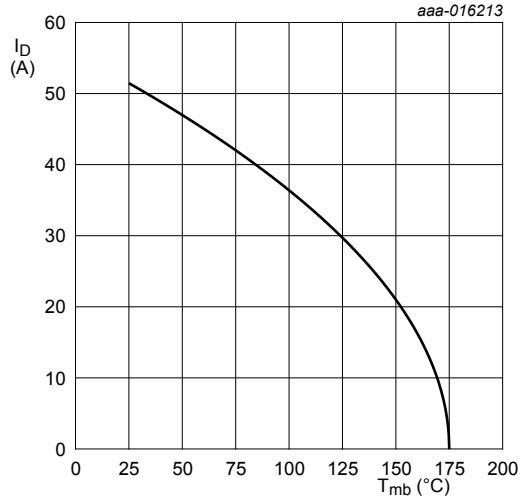


Fig. 2. Continuous drain current as a function of mounting base temperature

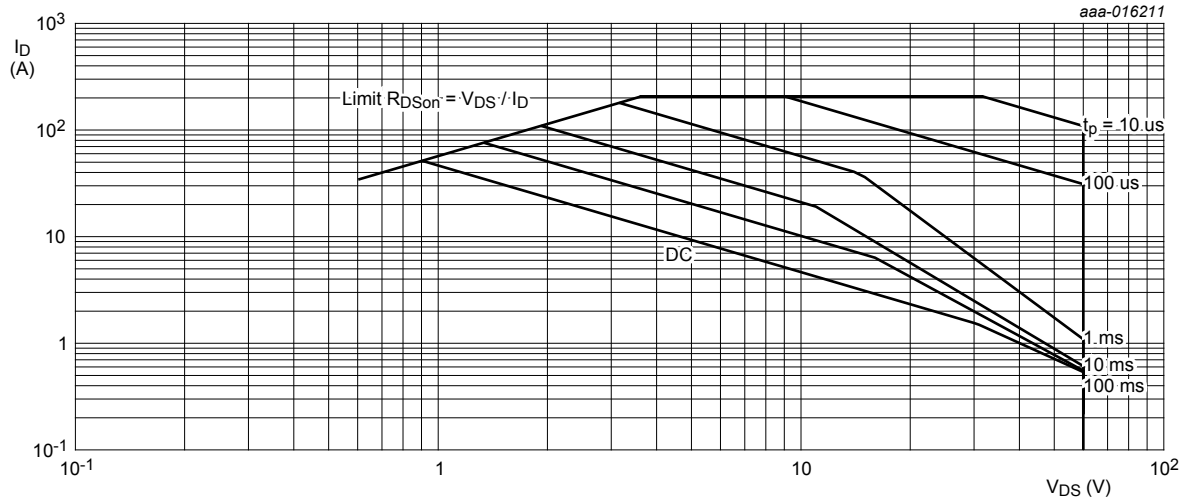


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

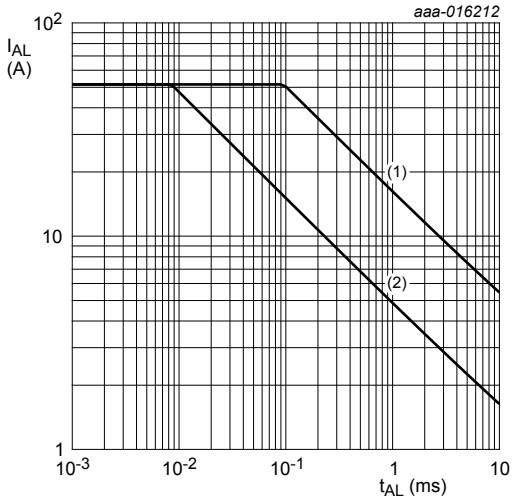


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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

8. Thermal characteristics

Table 5. Thermal characteristics

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

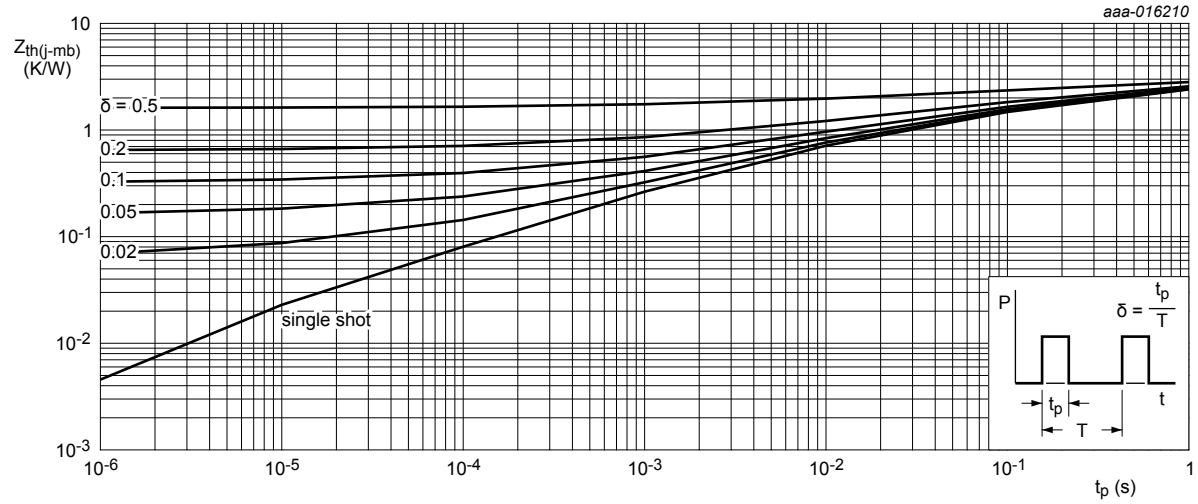


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Isolation characteristics

Table 6. Isolation characteristics

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

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		54	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; Fig. 11		1	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; Fig. 11		-	-	4.6	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; Fig. 12; Fig. 11		2	3	4	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	0.05	10	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 125 °C		-	-	100	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
		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. 13		-	13.3	18	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 14; Fig. 10		-	5.9	7.8	mΩ
R_G	gate resistance	f = 1 MHz		-	0.98	-	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 30 V; V_{GS} = 10 V; Fig. 15; Fig. 16		-	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 A; V_{DS} = 30 V; V_{GS} = 10 V; Fig. 16; Fig. 15		-	10.6	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 30 V; Fig. 15; Fig. 16		-	5.6	-	V
C_{iss}	input capacitance	V_{DS} = 30 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 17; Fig. 9		-	2651	-	pF
C_{oss}	output capacitance	V_{DS} = 30 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 17		-	342	-	pF
C_{rss}	reverse transfer capacitance	V_{DS} = 30 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 17; Fig. 9		-	183	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 4.7 Ω		-	19	-	ns
t_r	rise time			-	21	-	ns
$t_{d(off)}$	turn-off delay time			-	37	-	ns
t_f	fall time			-	13	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 18		-	0.86	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		-	40.4	-	ns
Q_r	recovered charge			-	56	-	nC

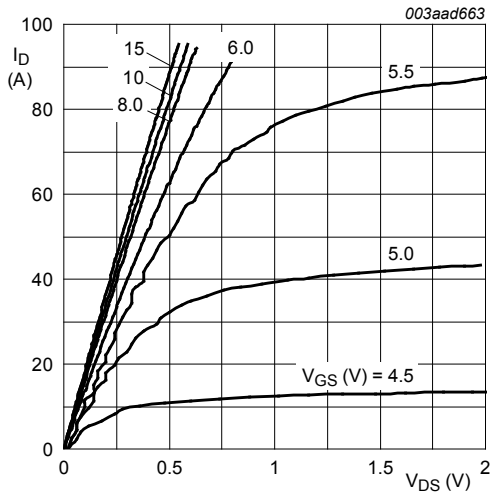


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\ °C;\ t_p = 300\ \mu s$

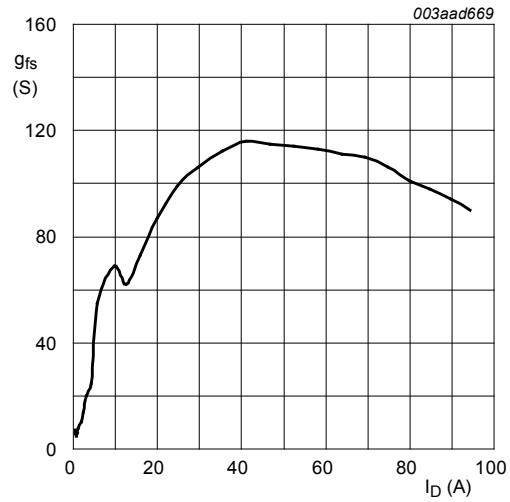


Fig. 7. Forward transconductance as a function of drain current; typical values

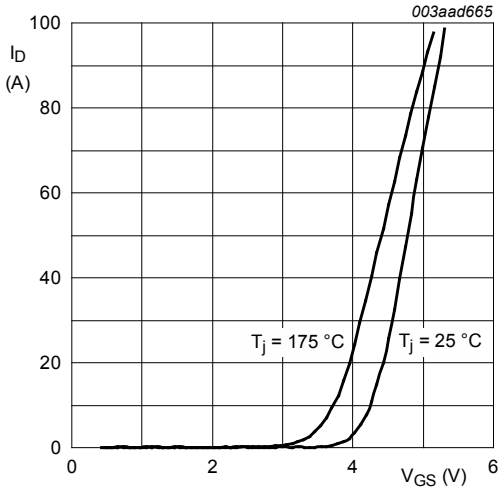


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 25\ V$

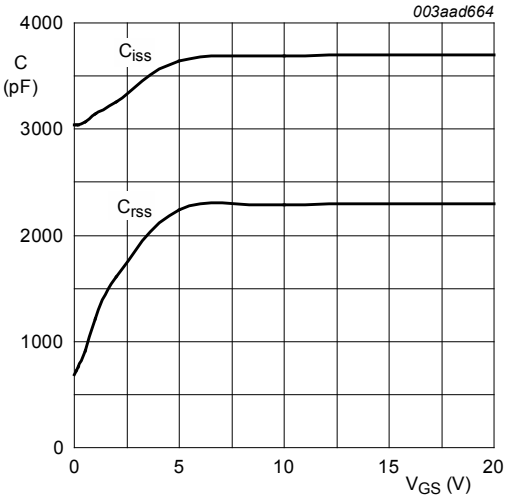


Fig. 9. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

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

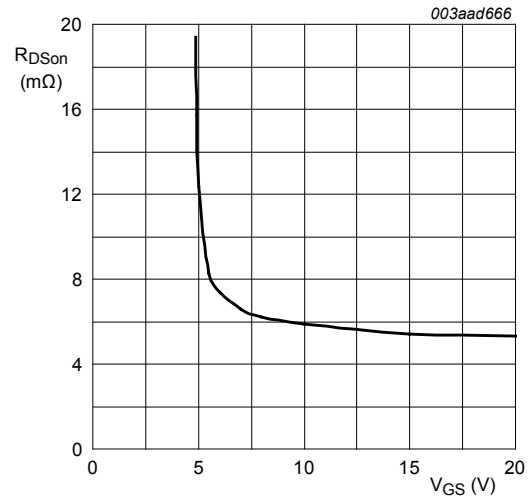


Fig. 10. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25°C$

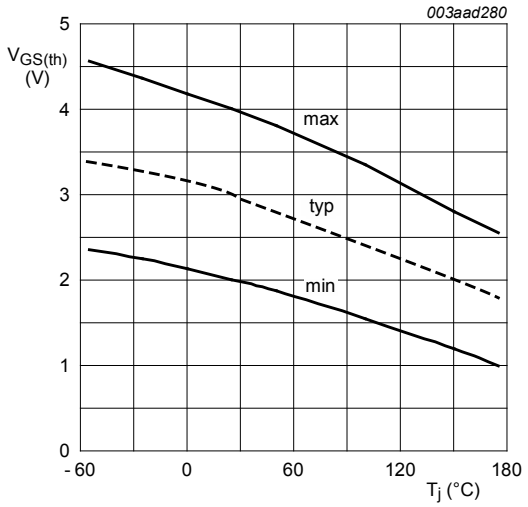


Fig. 11. Gate-source threshold voltage as a function of junction temperature

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

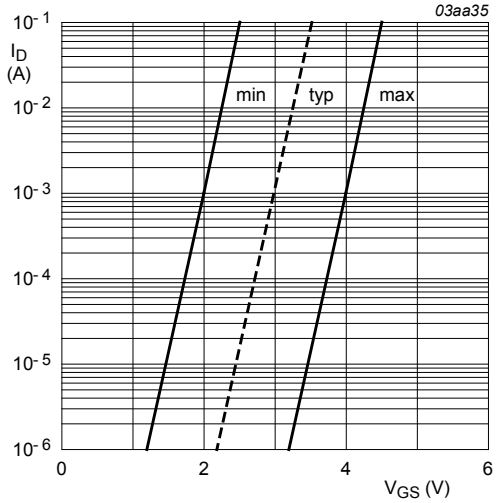


Fig. 12. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25\,°C; V_{DS} = 5V$

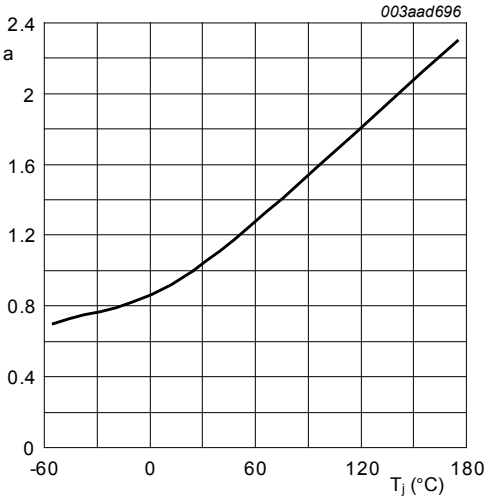


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature.

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

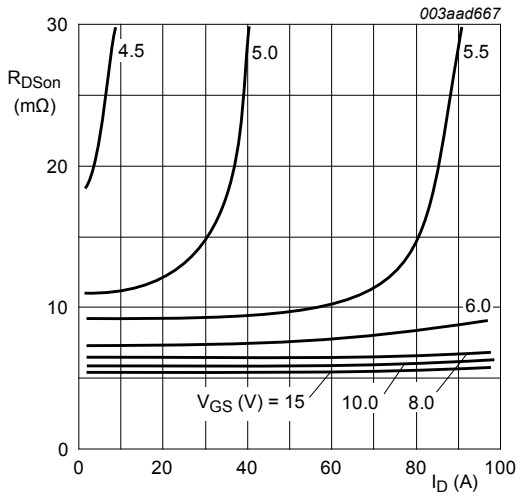


Fig. 14. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25\,°C;\ t_p = 300\mu s$

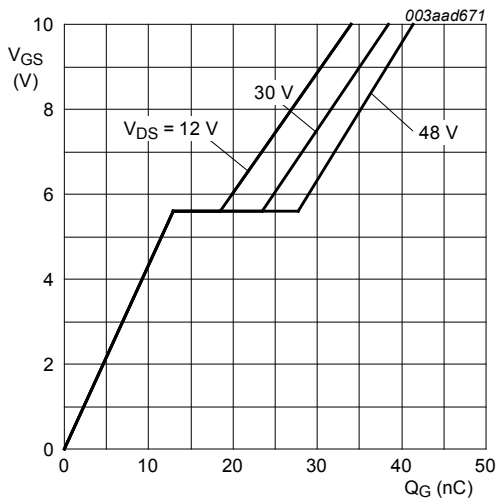


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25°C; I_D = 25\,A$

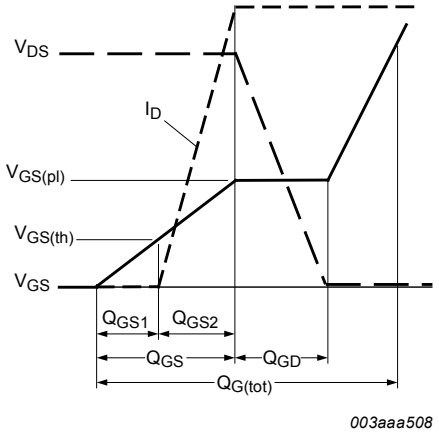


Fig. 16. Gate charge waveform definitions

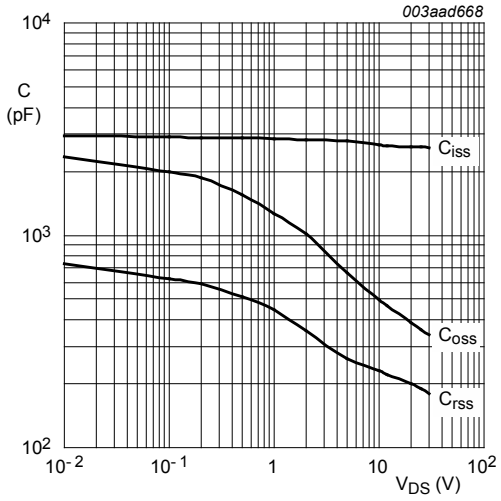


Fig. 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

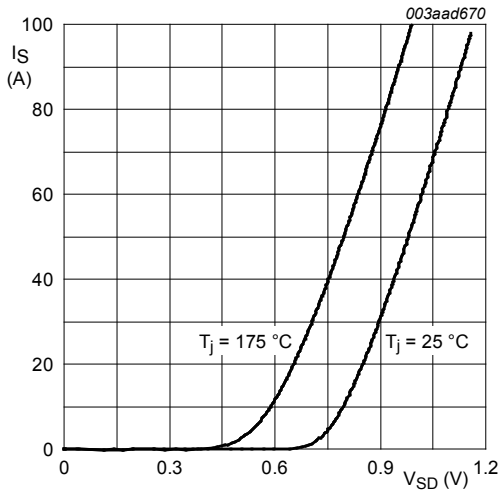


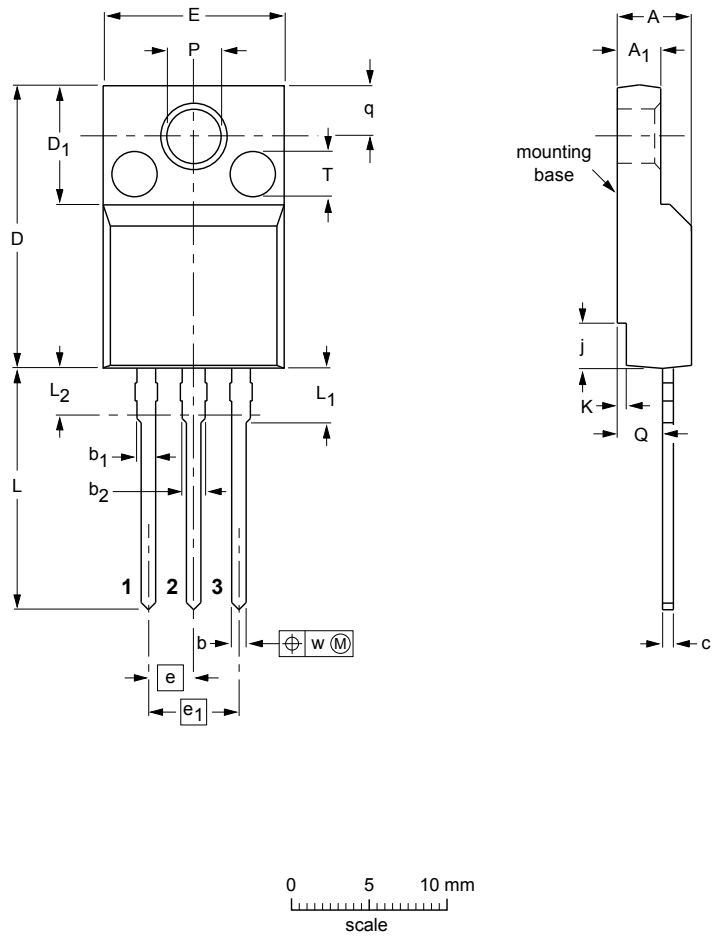
Fig. 18. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0\,V$$

11. Package outline

Plastic single-ended package; isolated heatsink mounted;
1 mounting hole; 3-lead TO-220 'full pack'

SOT186A



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1	E	e	e_1	j	K	L	L_1	L_2 (1) max.	P	Q	q	T (2)	w
mm	4.6 4.0	2.9 2.5	0.9 0.7	1.1 0.9	1.4 1.0	0.7 0.4	15.8 15.2	6.5 6.3	10.3 9.7	2.54	5.08	2.7 1.7	0.6 0.4	14.4 13.5	3.30 2.79	3	3.2 3.0	2.6 2.3	3.0 2.6	2.5	0.4

Notes

1. Terminal dimensions within this zone are uncontrolled.
2. Both recesses are # 2.5 × 0.8 max. depth

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT186A		3-lead TO-220F				~~02-04-09~~ 06-02-14

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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13. Contents

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