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PSMN1R5-40PS,127

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PSMN1R5-40PS

N-channel 40 V 1.6 mΩ standard level MOSFET in TO220

15 July 2013 Product data sheet

1. General description

Standard level N-channel MOSFET in SOT78 (TO220) using TrenchMOS technology. Product design and manufacture has been optimized for use in battery operated power tools.

2. Features and benefits

- High efficiency due to low switching and conduction losses
- Robust construction for demanding applications
- Standard level gate

3. Applications

- Battery-powered tools
- Load switching
- Motor control
- Uninterruptible power supplies

4. Quick reference data

Table 1. Quick reference data

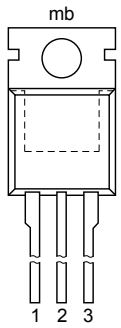
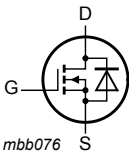
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	-	40	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; Fig. 1	[1]	-	-	150	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 2		-	-	338	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	1.9	2.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 14	[2]	-	1.3	1.6	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	V_{GS} = 10 V; I_D = 75 A; V_{DS} = 20 V; T_j = 25 °C; Fig. 15; Fig. 16		-	32	-	nC
$Q_{G(tot)}$	total gate charge			-	136	-	nC

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 = 150 A; $V_{sup} \leq$ 40 V; unclamped; R_{GS} = 50 Ω; t_p = 0.1 ms; Fig. 3		-	-	1.1	J

[1] Continuous current is limited by package
[2] Measured 3 mm from package.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 **TO-220AB (SOT78)**	
2	D	drain		
3	S	source		
mb	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN1R5-40PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN1R5-40PS	PSMN1R5-40PS

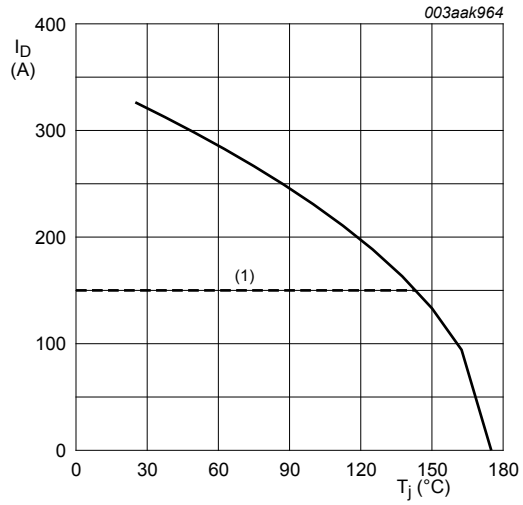
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	40	V
V_{DGR}	drain-gate voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C; R_{GS} = 20 kΩ		-	40	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 1	[1]	-	150	A
		V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 1	[1]	-	150	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10$ µs; T_{mb} = 25 °C; Fig. 4		-	1301	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 2		-	338	W
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	[1]	-	150	A
I_{SM}	peak source current	pulsed; $t_p \leq 10$ µs; T_{mb} = 25 °C		-	1301	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 150 A; $V_{sup} \leq 40$ V; unclamped; R_{GS} = 50 Ω; t_p = 0.1 ms; Fig. 3		-	1.1	J

[1] Continuous current is limited by package



(1) Capped at 150A due to package

Fig. 1. Normalized continuous drain current as a function of mounting base temperature

$V_{GS} \geq 10V$

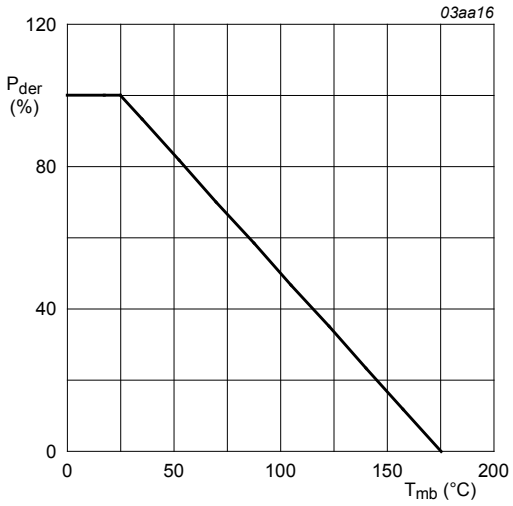


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

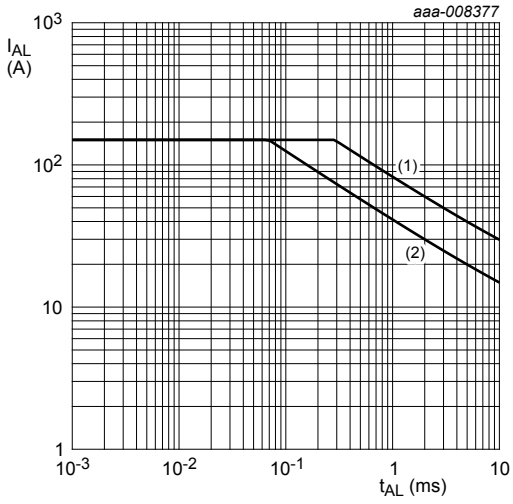


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

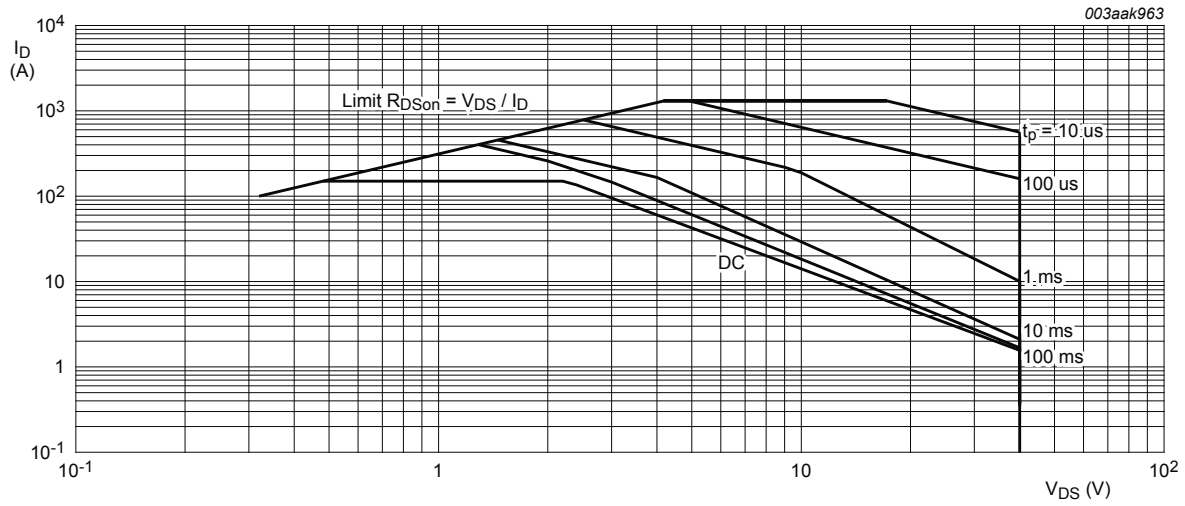


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25$ °C; I_{DM} is a single pulse; Capped at 150 A due to package

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	0.22	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Vertical in free air		-	60	-	K/W

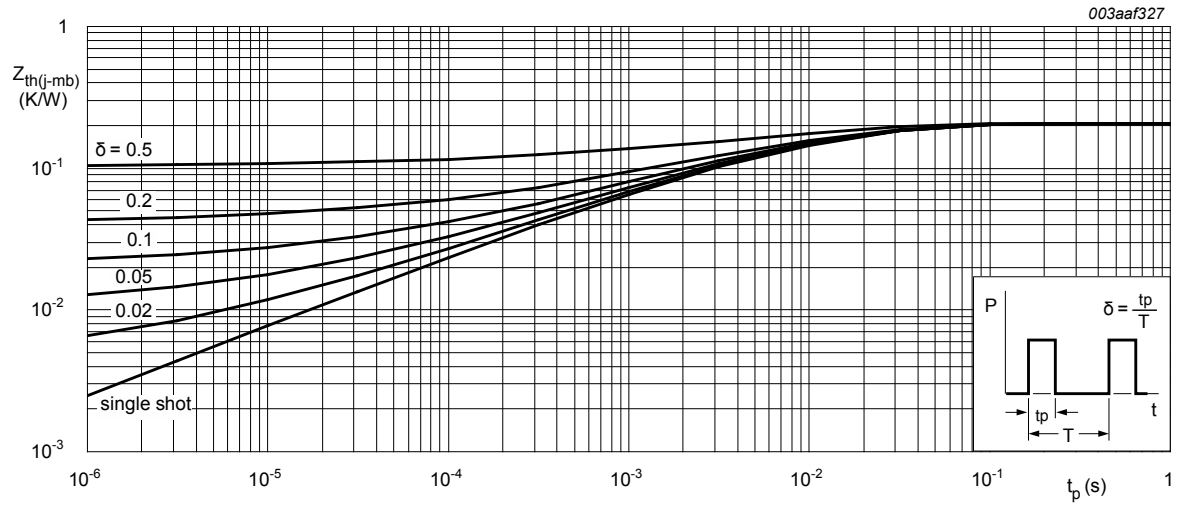


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

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		36	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; Fig. 11		-	-	4.6	V
		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 = 25 °C; Fig. 12; Fig. 11		2	3	4	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C		-	0.02	10	µA
		V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 °C		-	250	500	µA
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 = 100 °C; Fig. 13		-	1.9	2.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 13		-	2.6	3.2	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 14	[1]	-	1.3	1.6	mΩ
R_G	internal gate resistance (AC)	f = 1 MHz		-	1.1	-	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V		-	133	-	nC
		I_D = 75 A; V_{DS} = 20 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 15; Fig. 16		-	136	-	nC
Q_{GS}	gate-source charge			-	52	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	30	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	22.5	-	nC
Q_{GD}	gate-drain charge			-	32	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 75 A; V_{DS} = 20 V; T_j = 25 °C; Fig. 15; Fig. 16		-	6.1	-	V
C_{iss}	input capacitance	V_{DS} = 20 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 17		-	9710	-	pF
C_{oss}	output capacitance			-	2042	-	pF

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C_{rss}	reverse transfer capacitance			-	994	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 20 V; R_L = 0.8 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 4.7 Ω; T_j = 25 °C		-	45	-	ns
t_r	rise time			-	66	-	ns
$t_{d(off)}$	turn-off delay time			-	111	-	ns
t_f	fall time			-	53	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 18		-	0.8	1.2	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/μs; V_{GS} = 0 V; V_{DS} = 20 V; T_j = 25 °C		-	64	-	ns
Q_r	recovered charge	I_S = 25 A; dI_S/dt = -100 A/μs; V_{GS} = 0 V; V_{DS} = 20 V; T_j = 25 °C		-	117	-	nC

[1] Measured 3 mm from package.

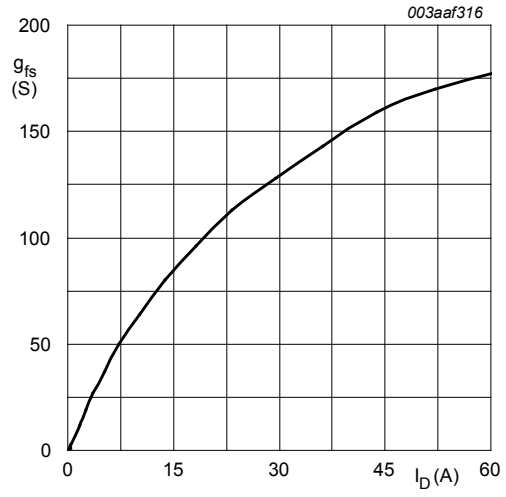


Fig. 6. Forward transconductance as a function of drain current; typical values

$$T_j = 25\,°C; V_{DS} = 25V$$

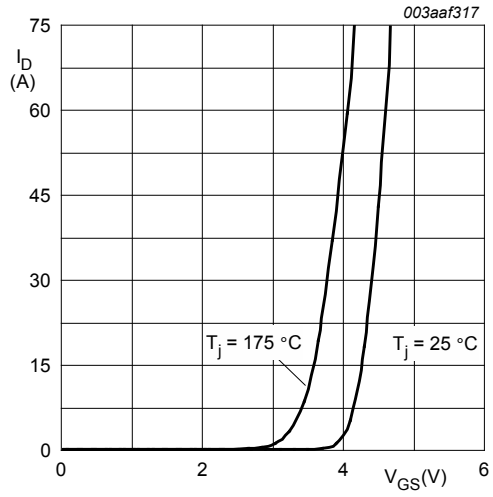


Fig. 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$$V_{DS} > I_D \times R_{DSon}$$

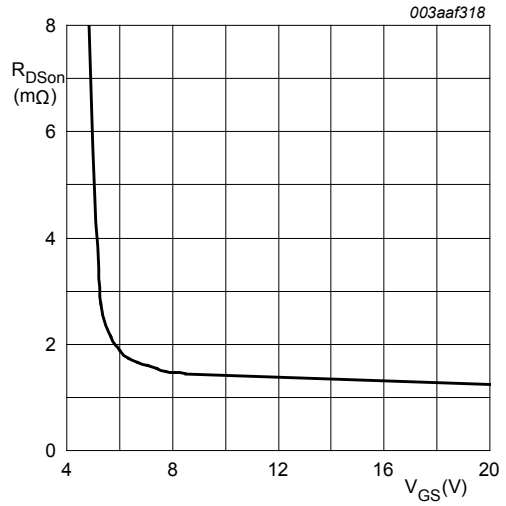


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values.

$T_j = 25\,°C; I_D = 25\,A$

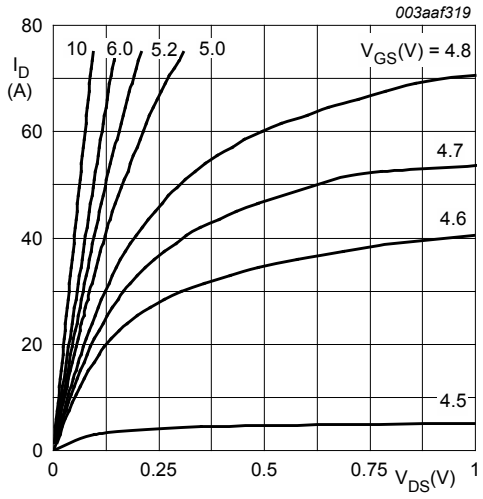


Fig. 9. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\,°C$

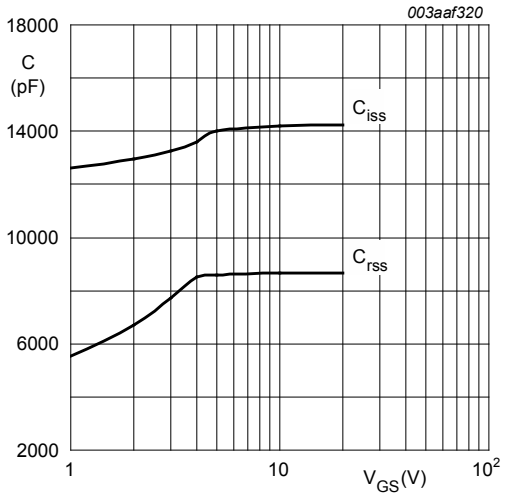


Fig. 10. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

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

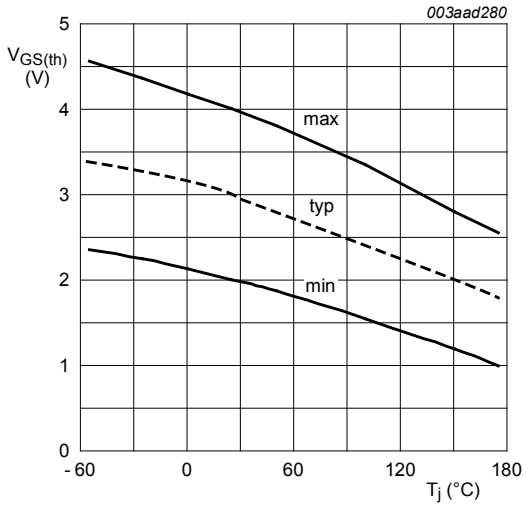


Fig. 11. Gate-source threshold voltage as a function of junction temperature

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

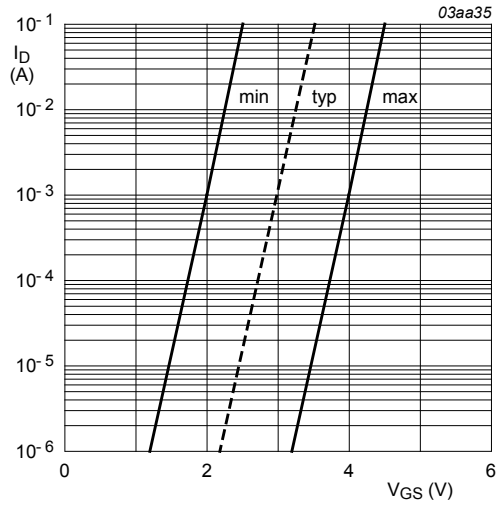


Fig. 12. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25\,°C; V_{DS} = 5V$

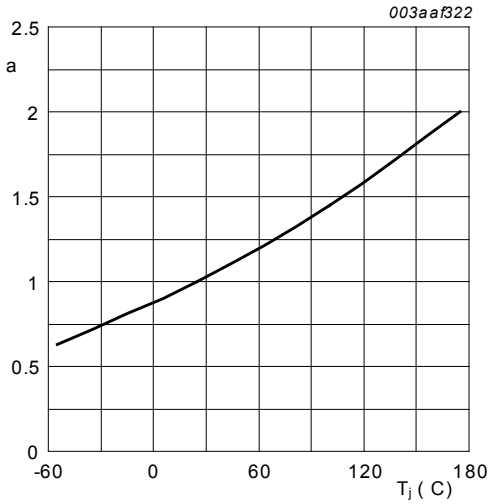


Fig. 13. Normalized drain-source on state resistance factor as a function of junction temperature

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

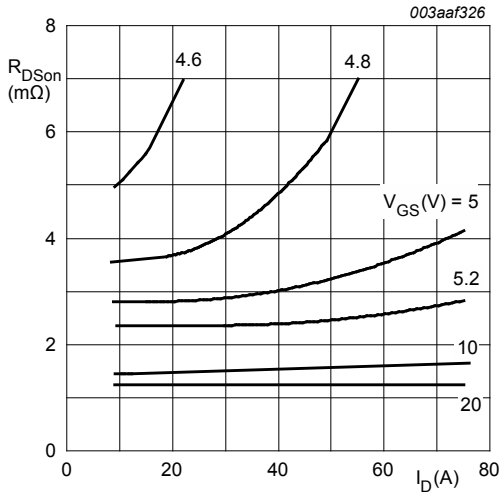


Fig. 14. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25\,°C$

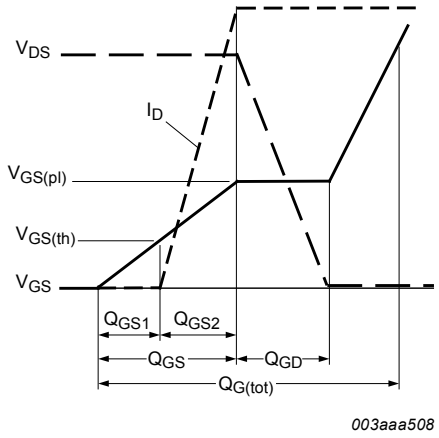


Fig. 15. Gate charge waveform definitions

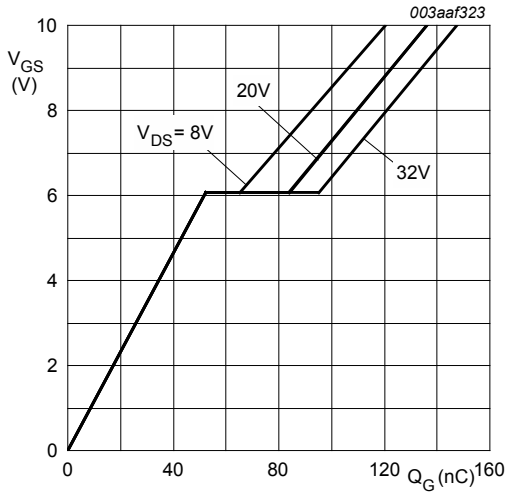


Fig. 16. Gate-source voltage as a function of gate charge; typical values

$I_D = 75A$

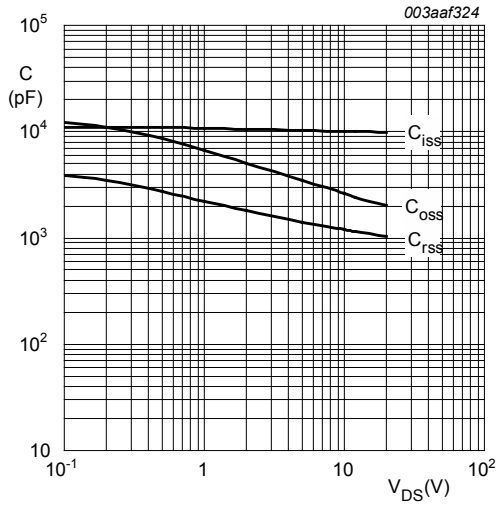


Fig. 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

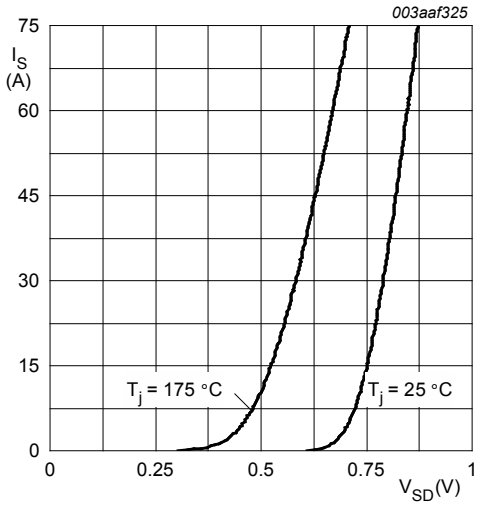
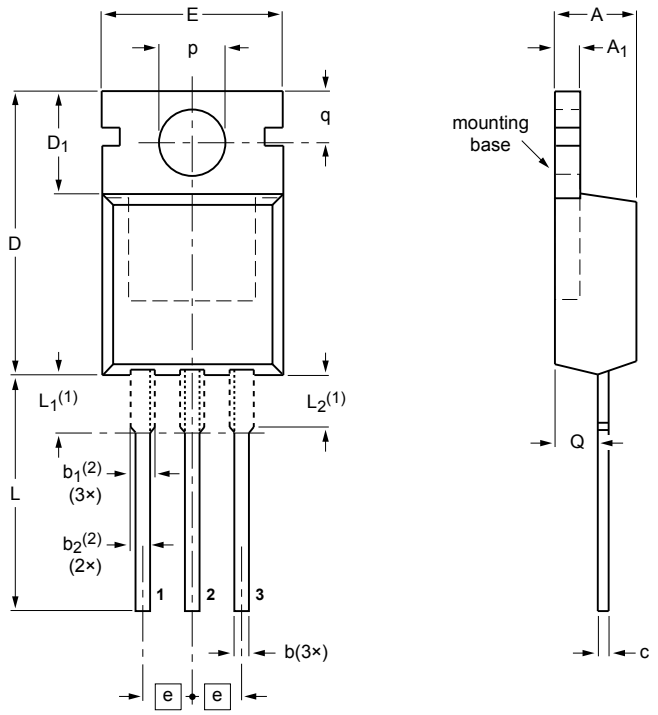


Fig. 18. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0V$

11. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB **SOT78**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1(2)	b_2(2)	c	D	D_1	E	e	L	L_1(1)	L_2(1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

Notes
1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

Fig. 19. Package outline TO-220AB (SOT78)

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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