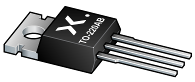


PSMN2R0-60PS

N-channel 60 V 2.2 mΩ standard level MOSFET in TO-220

26 October 2020 **Product data sheet**

1. General description

Standard level N-channel MOSFET in a TO-220 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
- Robust construction for demanding applications
- Standard level gate

3. Applications

- DC-to-DC converters
- Load switching
- Motor control
- Server power supplies

4. Quick reference data

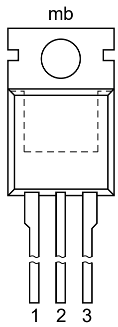
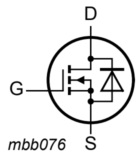
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	60	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2	[1]	-	-	120	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	338	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. 12	[2]	-	1.8	2.2	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 12; Fig. 13		-	3	3.5	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 75 A; V_{DS} = 30 V; V_{GS} = 10 V; Fig. 14; Fig. 15		-	32	45	nC
$Q_{G(tot)}$	total gate charge			-	137	192	nC
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 120 A; V_{sup} ≤ 60 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; Unclamped		-	-	913	mJ

[1] Continuous current 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	mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN2R0-60PS	TO-220AB	plastic, single-ended package (heatsink mounted, 1 mounting hole); 3 leads; 2.54 mm pitch; 15.6 mm x 10 mm x 4.4 mm body	SOT78

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R0-60PS	PSMN2R0 60PS

8. Limiting values

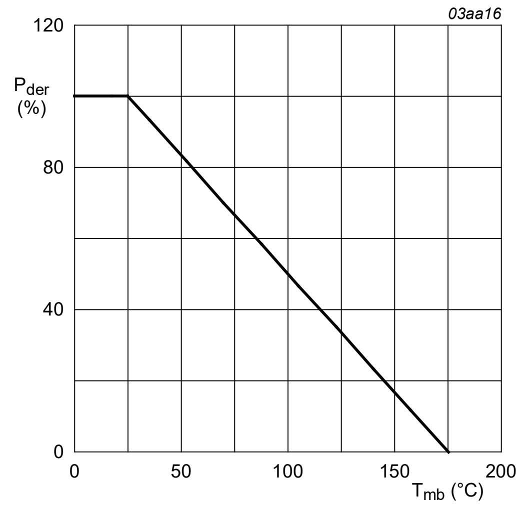
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	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		-	338	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2	[1]	-	120	A
		V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	120	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3		-	1135	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C

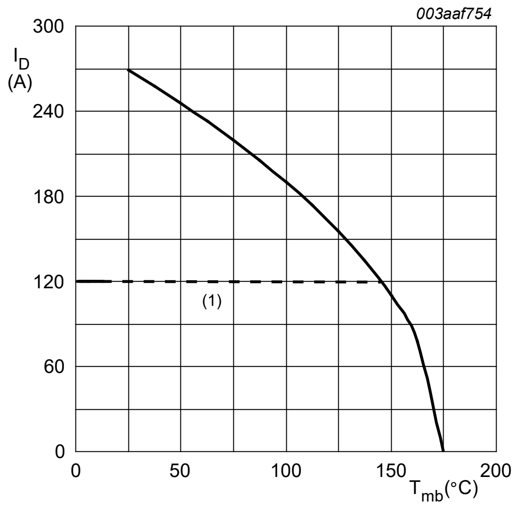
Symbol	Parameter	Conditions		Min	Max	Unit
Source-drain diode						
I_S	source current	T_{mb} = 25 °C	[1]	-	120	A
I_{SM}	peak source current	pulsed; $t_p \leq$ 10 μs; T_{mb} = 25 °C		-	1135	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 120 A; $V_{sup} \leq$ 60 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; Unclamped		-	913	mJ

[1] Continuous current limited by package



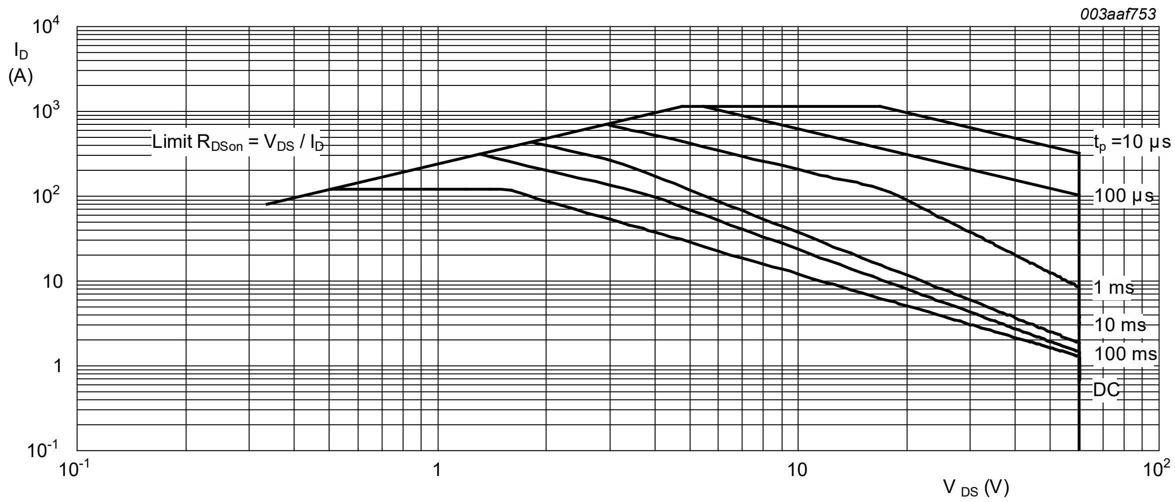
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



$V_{GS} \geq$ 10 V; (1) Capped at 120 A due to package

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



T_{mb} = 25 °C; I_{DM} is a single pulse; Capped at 120 A due to package

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

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. 4		-	0.22	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Vertical in free air		-	60	-	K/W

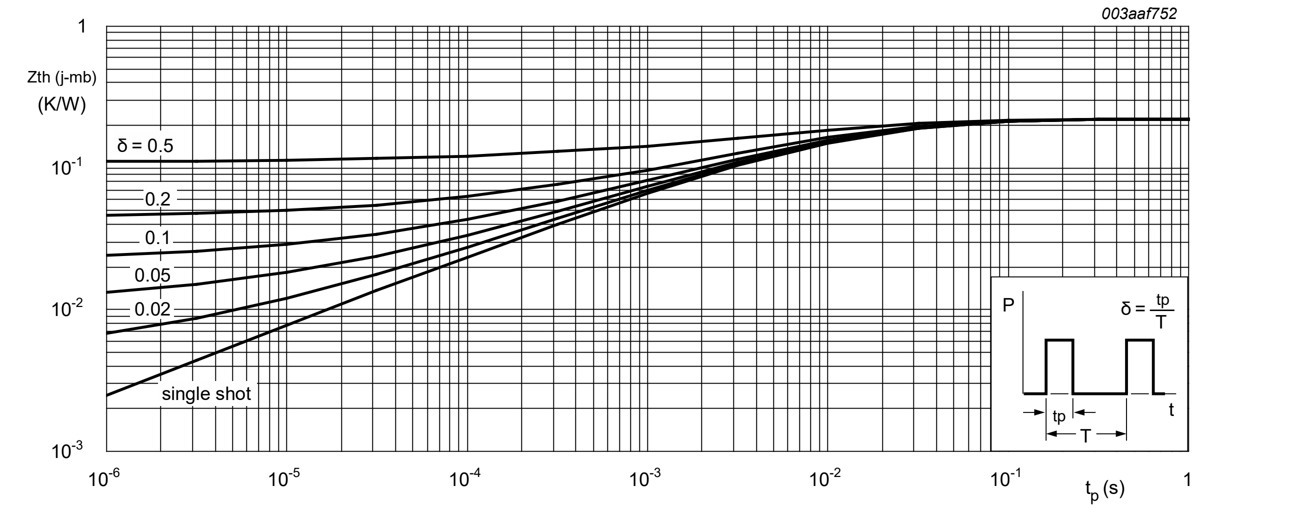


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

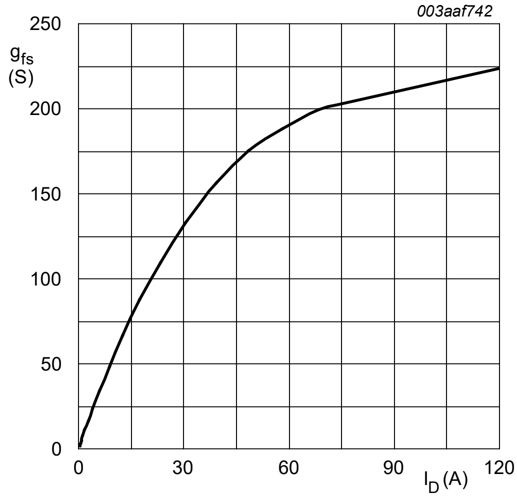
10. Characteristics

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		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. 10		1	-	-	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C; Fig. 10; Fig. 11		2	3	4	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C; Fig. 10		-	-	4.6	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	0.03	10	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 °C		-	-	1000	µA
I_{GSS}	gate leakage current	V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
		V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 12	[1]	-	1.8	2.2	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 12; Fig. 13		-	4.3	5.1	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 12; Fig. 13		-	3	3.5	mΩ

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R_G	gate resistance	f = 1 MHz		0.45	0.9	1.8	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 75 A; V_{DS} = 30 V; V_{GS} = 10 V; Fig. 14; Fig. 15		-	137	192	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V; Fig. 14; Fig. 15		-	129	181	nC
Q_{GS}	gate-source charge	I_D = 75 A; V_{DS} = 30 V; V_{GS} = 10 V; Fig. 14; Fig. 15		-	48	68	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	29	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	19	-	nC
Q_{GD}	gate-drain charge			-	32	45	nC
$V_{GS(pl)}$	gate-source plateau voltage	V_{DS} = 30 V; Fig. 14; Fig. 15		-	5.7	-	V
C_{iss}	input capacitance	V_{DS} = 30 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 16		-	9997	13500	pF
C_{oss}	output capacitance			-	1210	1640	pF
C_{rss}	reverse transfer capacitance			-	594	835	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 0.4 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 4.7 Ω		-	42	63	ns
t_r	rise time			-	56	84	ns
$t_{d(off)}$	turn-off delay time			-	115	173	ns
t_f	fall time			-	49	74	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	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} = 30 V		-	57	75	ns
Q_r	recovered charge			-	80	104	nC

[1] Measured 3 mm from package.



T_j = 25 °C; V_{DS} = 30 V

Fig. 5. Forward transconductance as a function of drain current; typical values

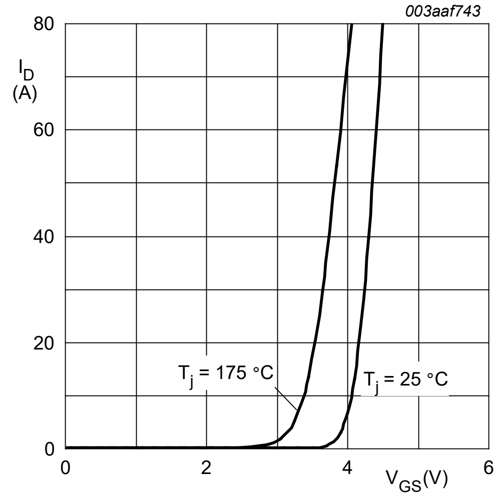
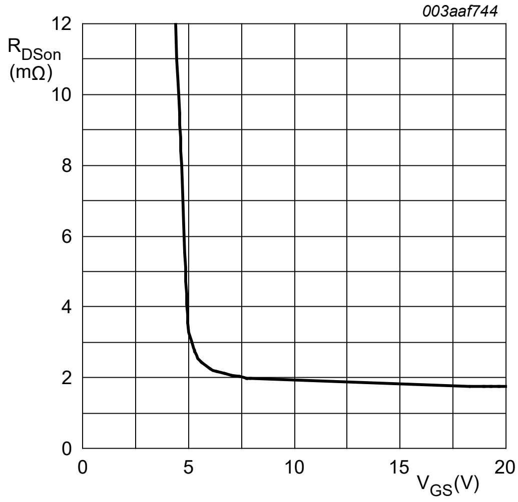
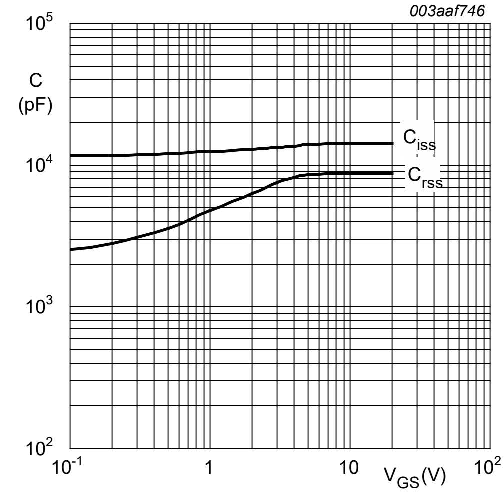


Fig. 6. Transfer characteristics: drain current as a function of gate-source voltage; typical values



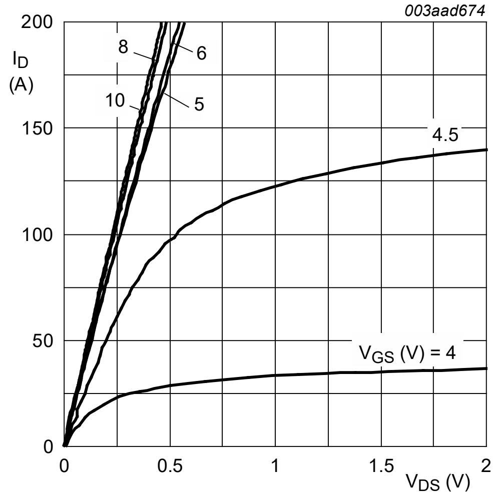
T_j = 25 °C; I_D = 25 A

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



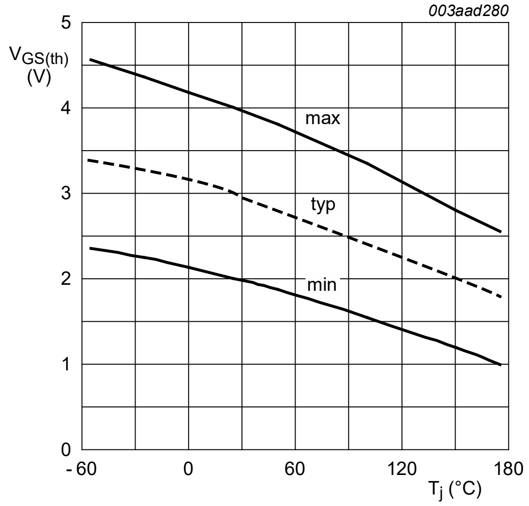
V_{DS} = 0 V; f = 1 MHz

Fig. 8. Input and reverse transfer capacitances as a function of gate-source voltage, typical values



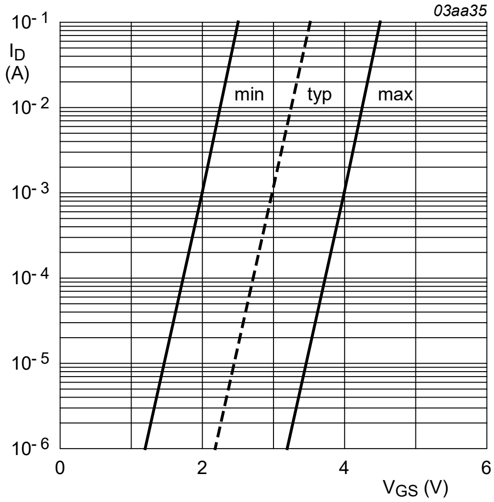
T_j = 25 °C

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



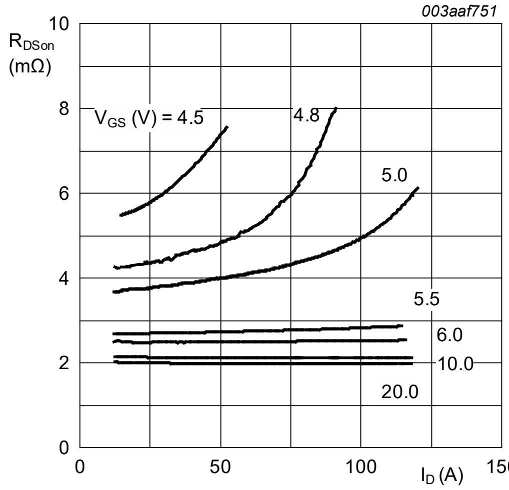
I_D = 1 mA; V_{DS} = V_{GS}

Fig. 10. Gate-source threshold voltage as a function of junction temperature



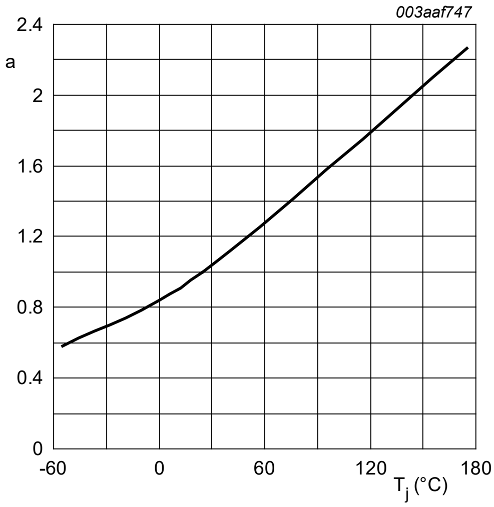
$T_j = 25\ °C$; $V_{DS} = 5\ V$

Fig. 11. Sub-threshold drain current as a function of gate-source voltage



$T_j = 25\ °C$

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



$T_j = 25\ °C$; $I_D = 25\ A$

Fig. 13. Drain-source on-state resistance as a function of gate-source voltage; typical values

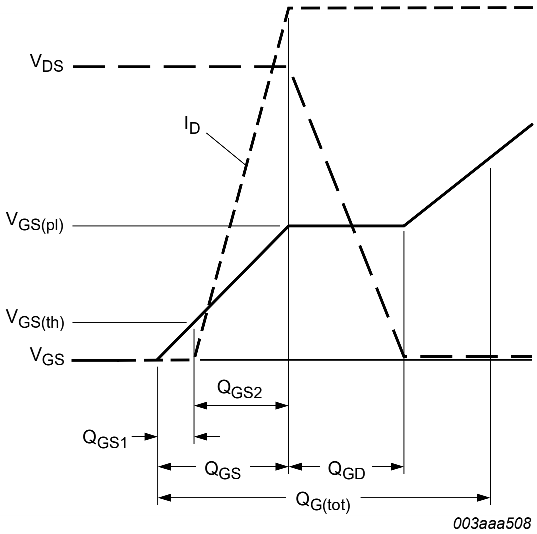
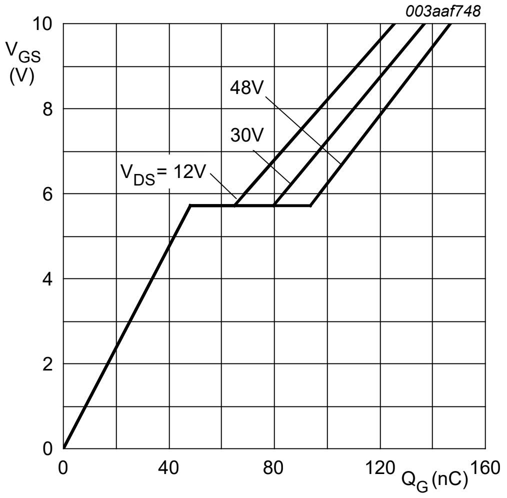
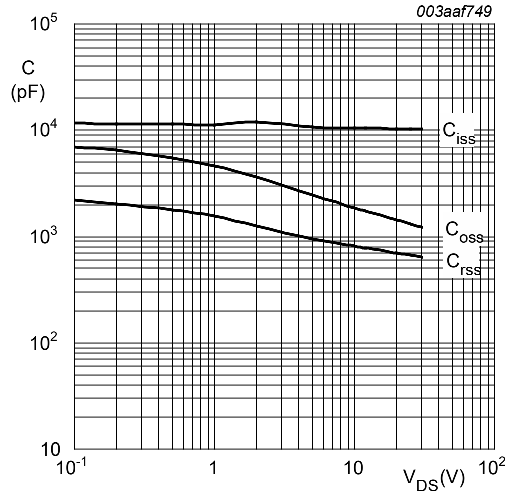


Fig. 14. Gate charge waveform definitions



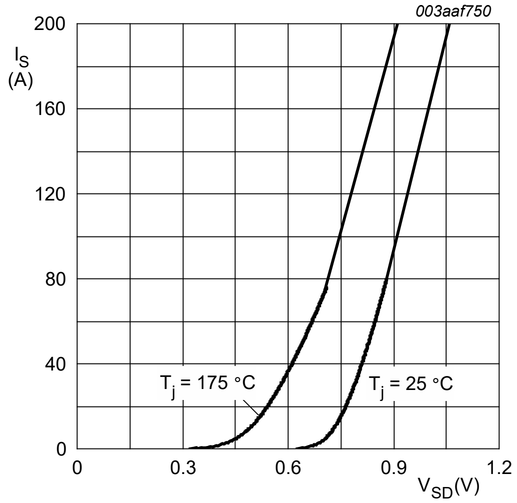
$T_j = 25$ °C; $I_D = 75$ A

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



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

Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

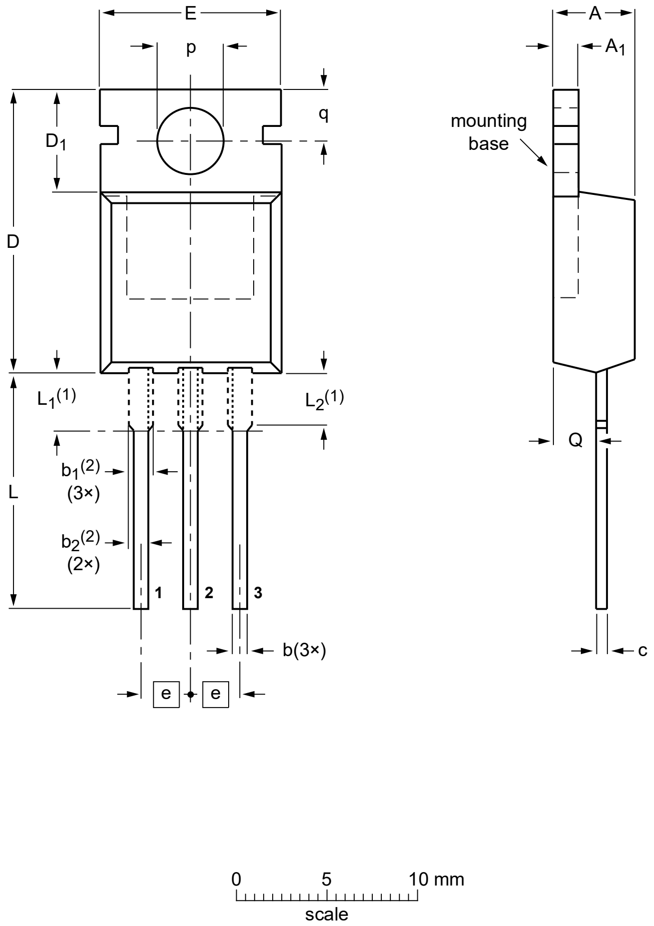


$V_{GS} = 0$ V

Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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. 18. Package outline TO-220AB (SOT78)

12. Legal information

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: 26 October 2020