



# PSMN6R7-40MLD

N-channel 40 V, 6.7 mΩ, logic level MOSFET in LPAK33 using NextPower-S3 technology

14 August 2019

Product data sheet

## 1. General description

50 A, logic level N-channel enhancement mode MOSFET in 175 °C LPAK33 package using advanced TrenchMOS Superjunction technology. This product has been designed and qualified for high efficiency applications operating at high switching frequencies.

## 2. Features and benefits

- Avalanche rated, 100% tested
- NextPower-S3 technology delivers 'superfast switching with soft body-diode recovery'
- Low  $Q_{RR}$ ,  $Q_G$  and  $Q_{GD}$  for high efficiency, especially at higher switching frequencies
- Low spiking and ringing for low EMI designs
- High reliability clip bond and solder die attach Mini Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Exposed leads can be wave soldered; visual solder joint inspection and high quality solder joints
- Low parasitic inductance and resistance

## 3. Applications

- Secondary side synchronous rectification
- DC-to-DC converters
- Brushless DC motor drive
- LED lighting

## 4. Quick reference data

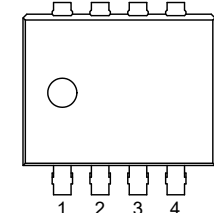
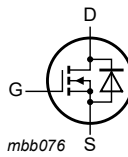
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C		-	-	40	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>	[1]	-	-	50	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>		-	-	65	W
T <sub>j</sub>	junction temperature			-55	-	175	°C
Static characteristics							
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>		-	7	8.6	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 20 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>		-	5.5	6.7	mΩ
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 20 V; V <sub>GS</sub> = 4.5 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>		6.5	10	14	nC
Q <sub>GD</sub>	gate-drain charge			0.7	2.5	5	nC

[1] 50A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 LPAK33 (SOT1210)	 mbb076
2	S	source		
3	S	source		
4	G	gate		
mb	D	Mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN6R7-40MLD	LPAK33	Plastic, single ended surface mounted package (LPAK33); 8 leads; 0.65 mm pitch	SOT1210

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN6R7-40MLD	6H7L40

8. Limiting values

Table 5. Limiting values

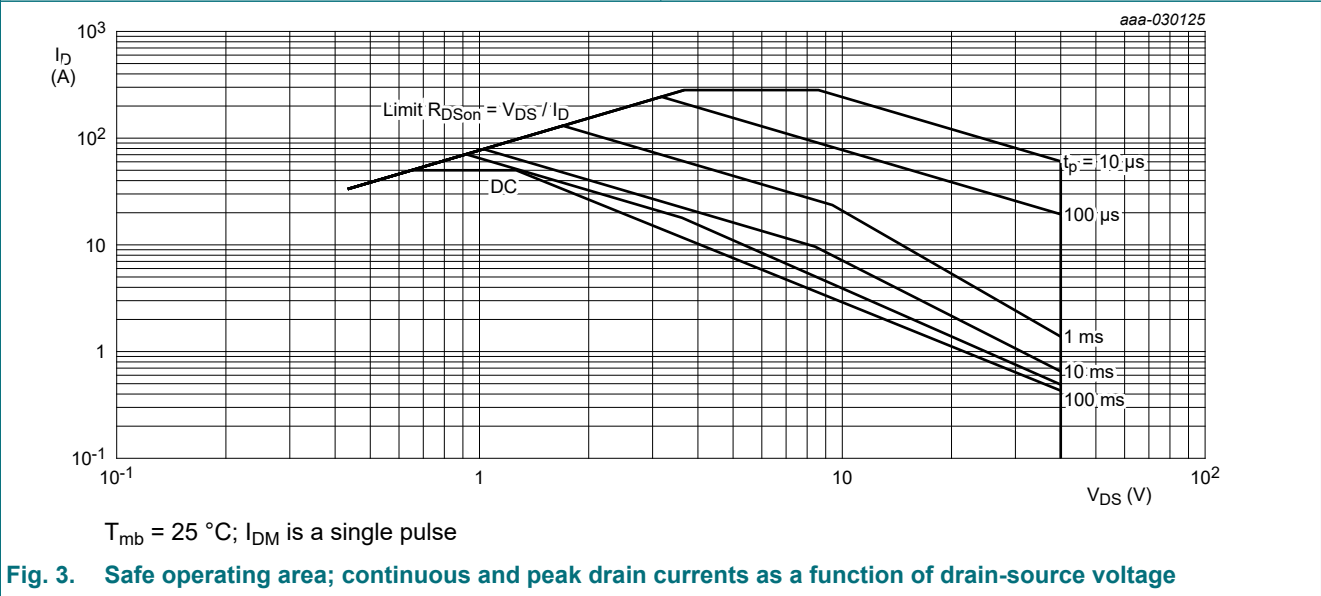
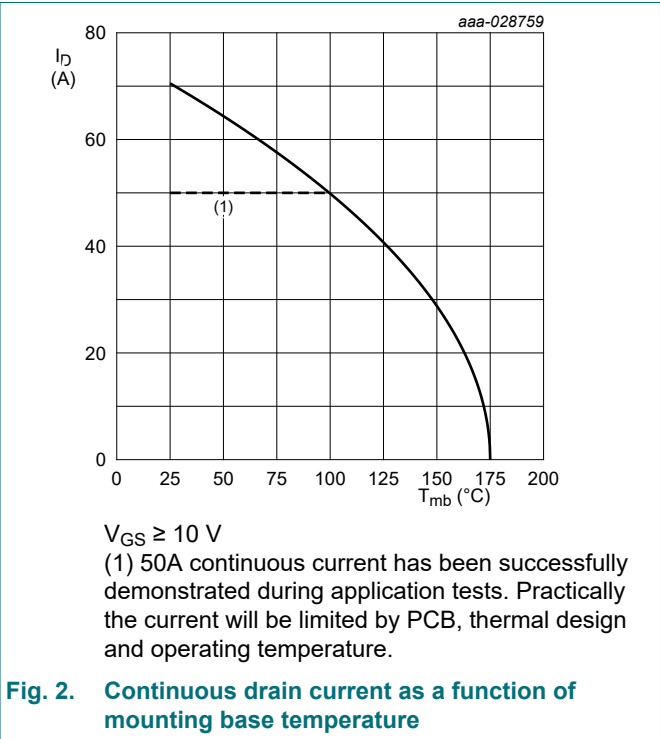
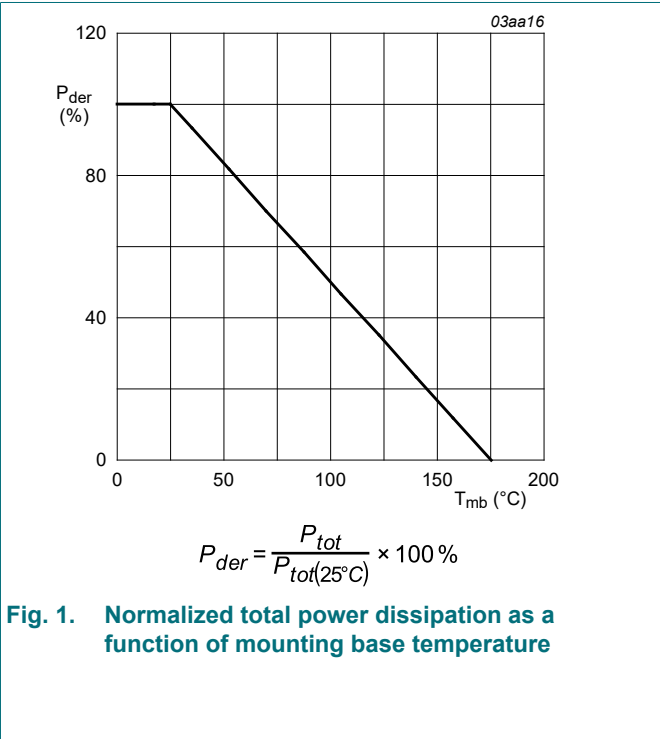
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C		-	40	V
V <sub>DSM</sub>	peak drain-source voltage	t <sub>p</sub> ≤ 20 ns; f ≤ 500 kHz; E <sub>DS(AL)</sub> ≤ 200 nJ; pulsed		-	45	V
V <sub>DGR</sub>	drain-gate voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C; R <sub>GS</sub> = 20 kΩ		-	40	V
V <sub>GS</sub>	gate-source voltage			-20	20	V
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; Fig. 1		-	65	W
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; Fig. 2	[1]	-	50	A
		V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C; Fig. 2		-	50	A
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; Fig. 3		-	282	A
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
T <sub>sld(M)</sub>	peak soldering temperature			-	260	°C
Source-drain diode						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C		-	50	A

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Symbol	Parameter	Conditions		Min	Max	Unit
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^\circ\text{C}$		-	282	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 25\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; unclamped; $t_p = 89.4\text{ }\mu\text{s}$	[2]	-	58	mJ

- [1] 50A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [2] Protected by 100% test



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	<a href="#">Fig. 4</a>	-	2.09	2.32	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	<a href="#">Fig. 5</a>	-	50	-	K/W
		<a href="#">Fig. 6</a>	-	130	-	K/W

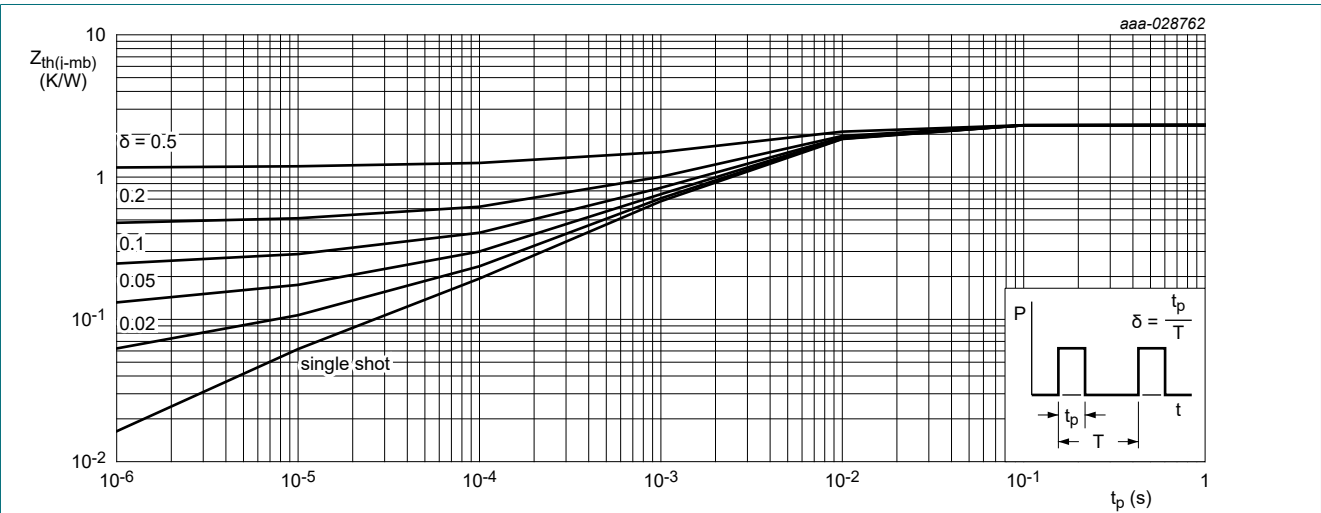
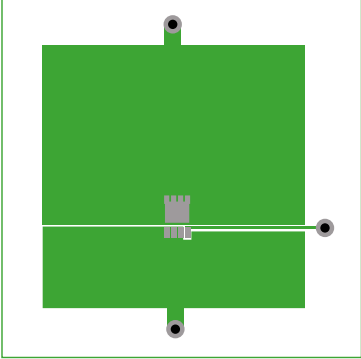
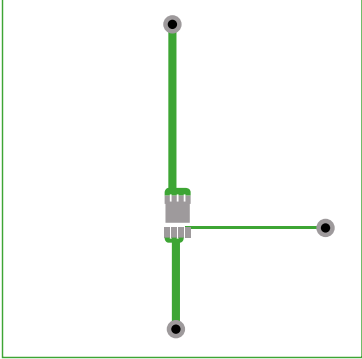


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration



aaa-028026

Copper square 25.4 mm square; 70 μm thick on FR4 board



aaa-028025

70 μm thick copper on FR4 board

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	40	-	-	V
		$I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}; T_j = -55\text{ }^\circ\text{C}$	36	-	-	V

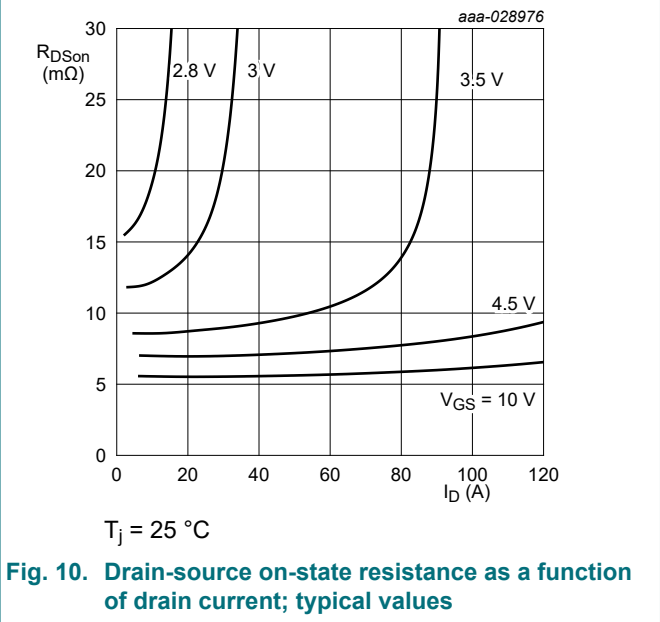
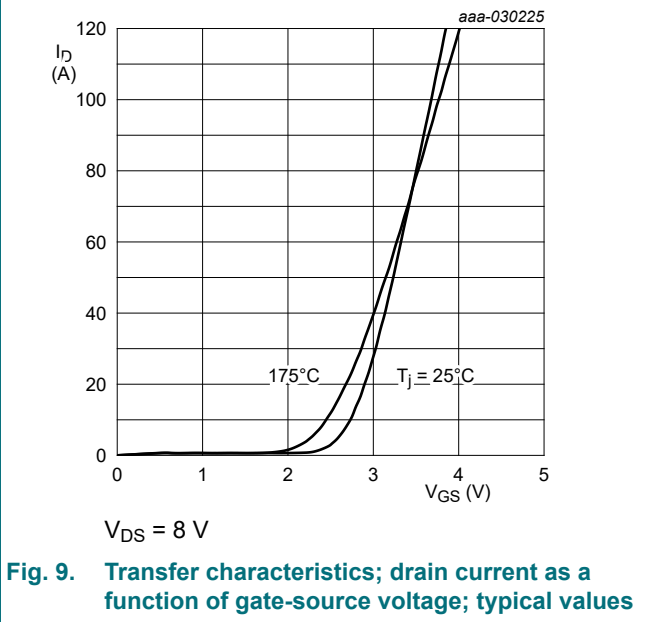
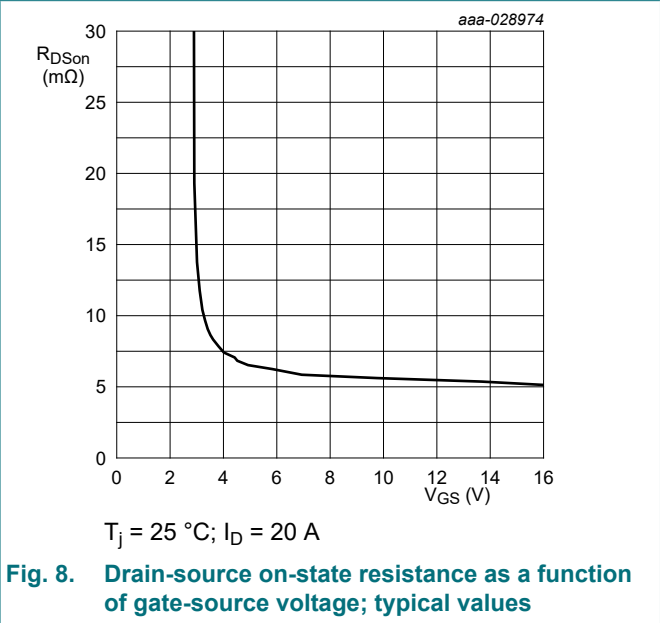
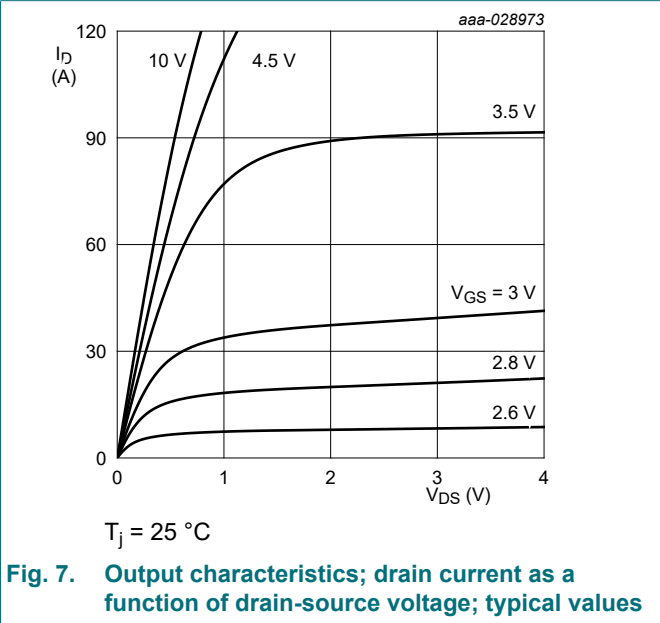
## N-channel 40 V, 6.7 mΩ, logic level MOSFET in LPAK33 using NextPower-S3 technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ\text{C}$	1.45	1.77	2.15	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ\text{C} \leq T_j \leq 150 \text{ }^\circ\text{C}$	-	-4.3	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 32 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	0.002	1	$\mu\text{A}$
		$V_{DS} = 32 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$	-	0.77	-	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 16 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{GS} = -16 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}$ ; $I_D = 20 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>	-	5.5	6.7	mΩ
		$V_{GS} = 10 \text{ V}$ ; $I_D = 20 \text{ A}$ ; $T_j = 175 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>	-	-	13	mΩ
		$V_{GS} = 4.5 \text{ V}$ ; $I_D = 15 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>	-	7	8.6	mΩ
		$V_{GS} = 4.5 \text{ V}$ ; $I_D = 15 \text{ A}$ ; $T_j = 175 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>	-	-	16.7	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$	0.3	0.8	1.9	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 20 \text{ A}$ ; $V_{DS} = 20 \text{ V}$ ; $V_{GS} = 10 \text{ V}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	14	22	31	nC
		$I_D = 20 \text{ A}$ ; $V_{DS} = 20 \text{ V}$ ; $V_{GS} = 4.5 \text{ V}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	6.5	10	14	nC
$Q_{GS}$	gate-source charge	$I_D = 20 \text{ A}$ ; $V_{DS} = 20 \text{ V}$ ; $V_{GS} = 4.5 \text{ V}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	2.4	4.1	6.2	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		1.38	2.3	3.45	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		1.1	1.8	2.7	nC
$Q_{GD}$	gate-drain charge		0.7	2.5	5	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 20 \text{ A}$ ; $V_{DS} = 20 \text{ V}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	2.9	-	V
$C_{iss}$	input capacitance	$V_{DS} = 20 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 14</a>	961	1479	2071	pF
$C_{oss}$	output capacitance		280	432	605	pF
$C_{rss}$	reverse transfer capacitance		18	60	132	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 \text{ V}$ ; $R_L = 1 \text{ } \Omega$ ; $V_{GS} = 4.5 \text{ V}$ ; $R_{G(ext)} = 5 \text{ } \Omega$	-	15	-	ns
$t_r$	rise time		-	21	-	ns
$t_{d(off)}$	turn-off delay time		-	14	-	ns
$t_f$	fall time		-	10	-	ns
$Q_{oss}$	output charge	$V_{GS} = 0 \text{ V}$ ; $V_{DS} = 20 \text{ V}$ ; $f = 1 \text{ Hz}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	13	-	nC
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 20 \text{ A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 15</a>	-	0.85	1.2	V

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Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$t_{rr}$	reverse recovery time	$I_S = 20\text{ A}$ ; $dI_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$ ; $T_J = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 16</a>		-	23	-	ns
$Q_r$	recovered charge		[1]	-	16	-	nC
$t_a$	reverse recovery rise time			-	14	-	ns
$t_b$	reverse recovery fall time			-	8.5	-	ns

[1] includes capacitive recovery



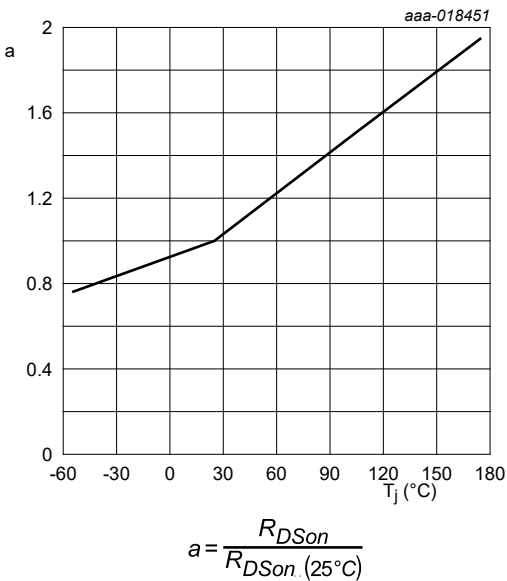


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

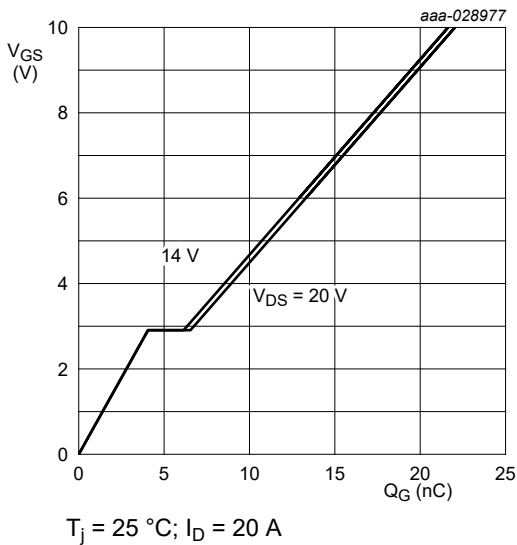


Fig. 12. Gate-source voltage as a function of gate charge; typical values

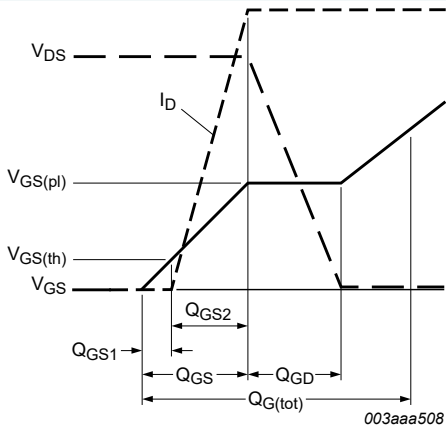


Fig. 13. Gate charge waveform definitions

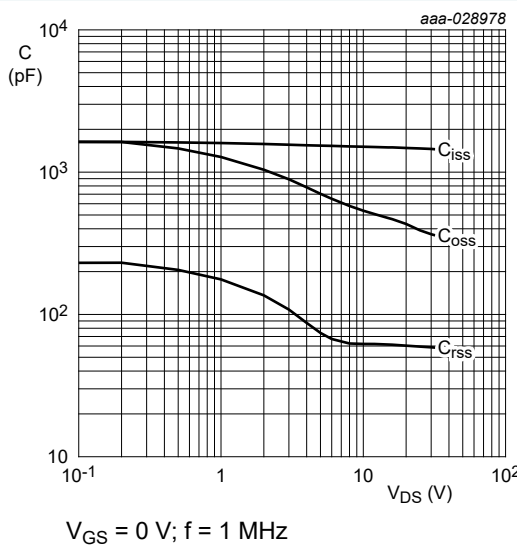
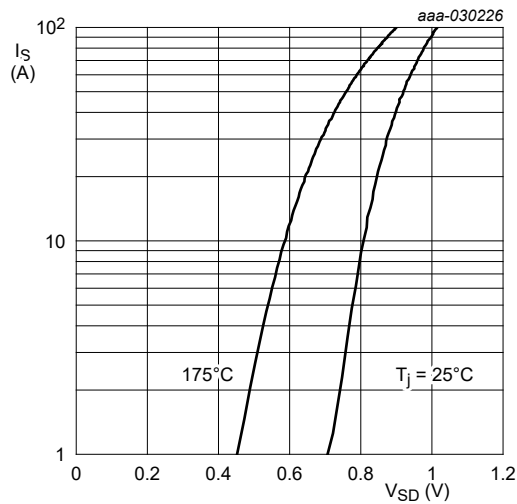


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



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

Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

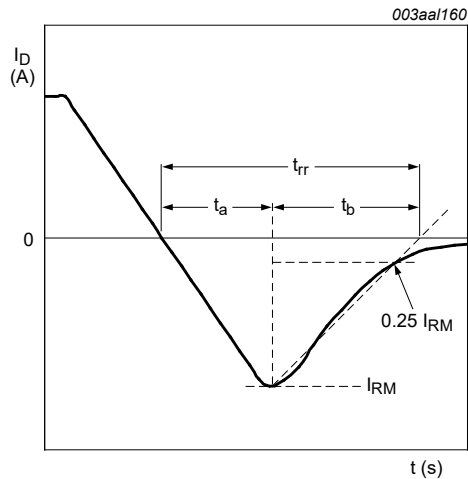


Fig. 16. Reverse recovery timing definition



11. Package outline

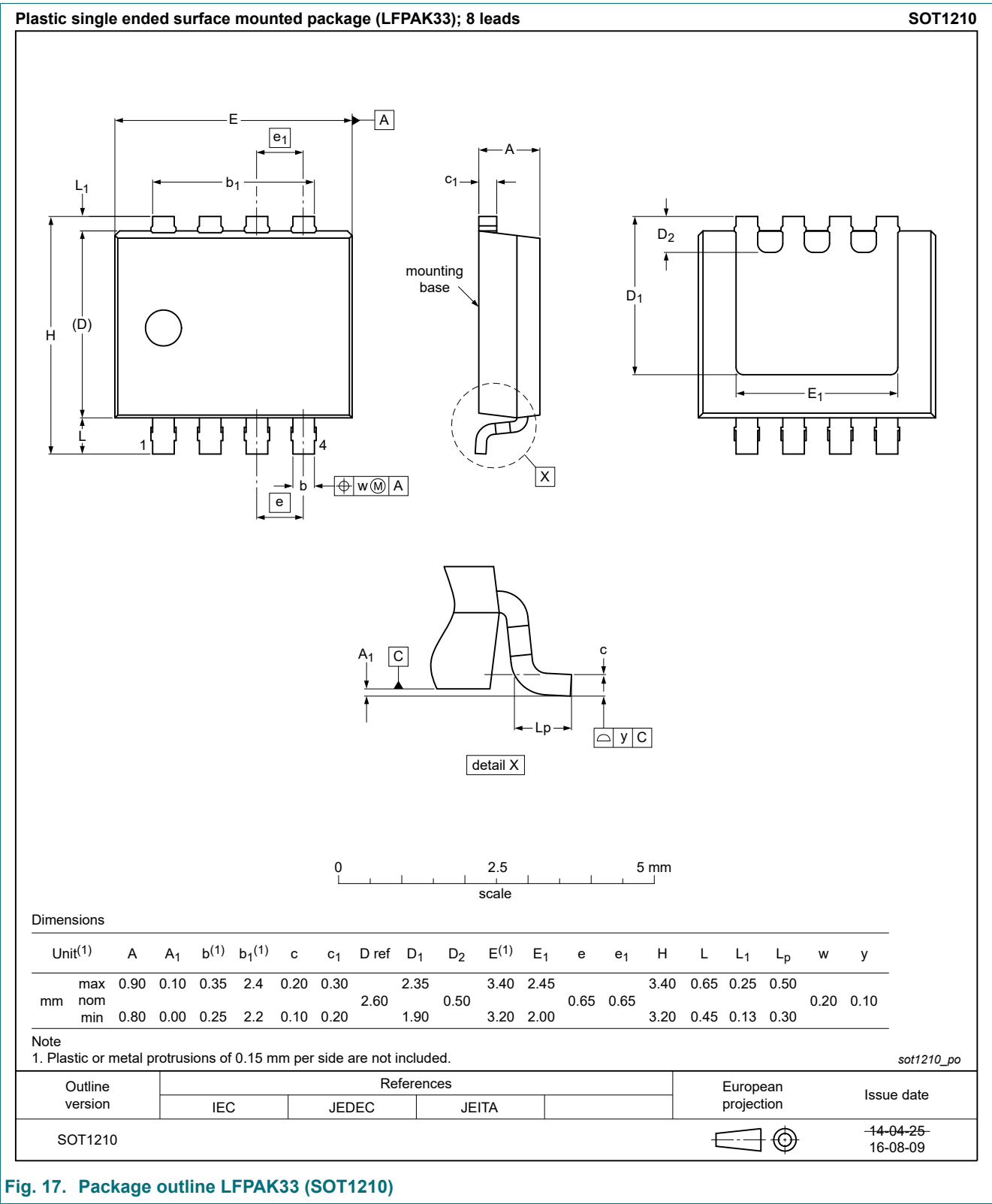


Fig. 17. Package outline LPAK33 (SOT1210)

12. Soldering

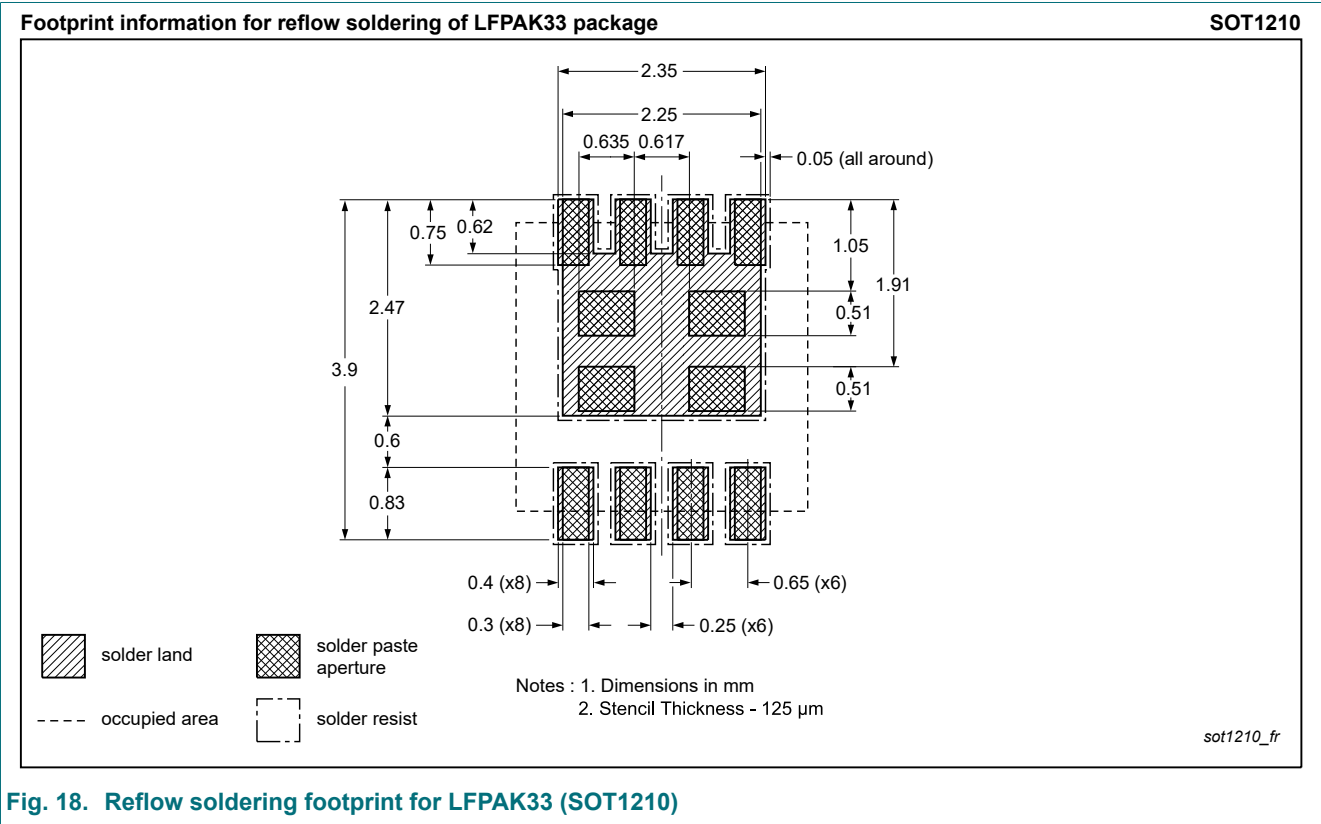


Fig. 18. Reflow soldering footprint for LPAK33 (SOT1210)

## 13. Legal information

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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.

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