



# 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

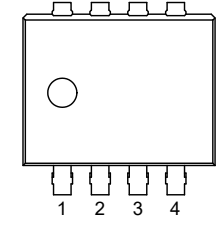
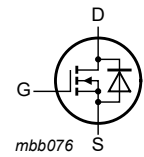
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	40	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	50	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	-	65	W
$T_j$	junction temperature		-55	-	175	°C
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$ ; $I_D = 15\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	7	8.6	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 20\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	5.5	6.7	mΩ
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate 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>	6.5	10	14	nC
$Q_{GD}$	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	 <p>LPAK33 (SOT1210)</p>	
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

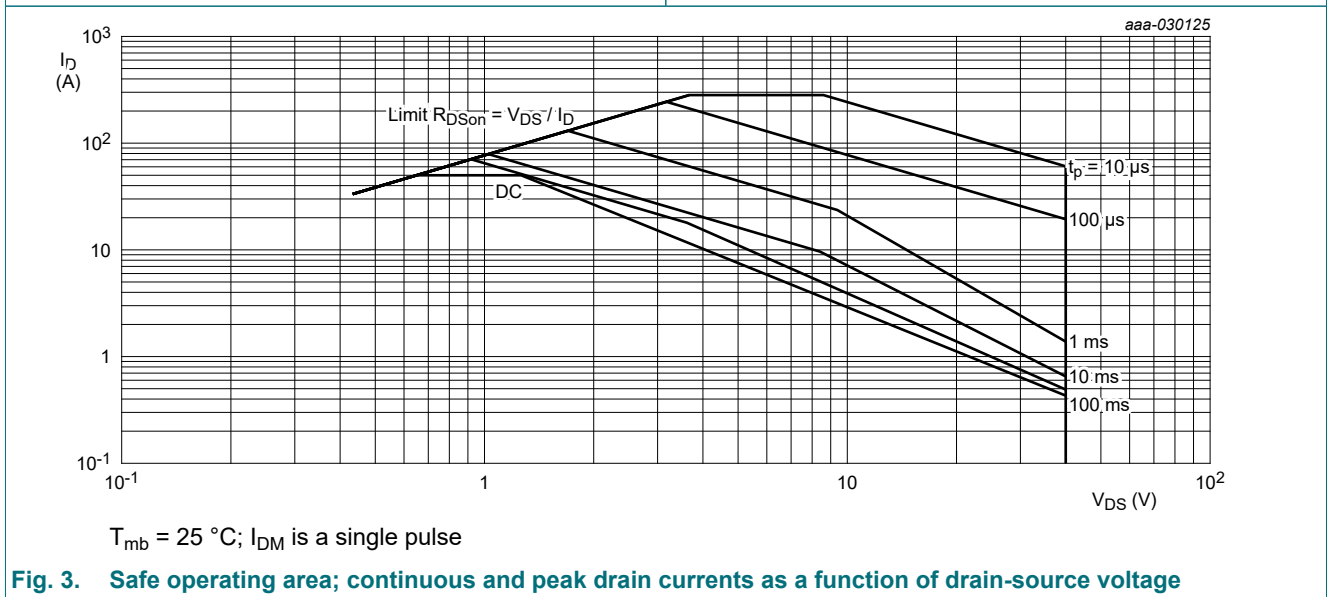
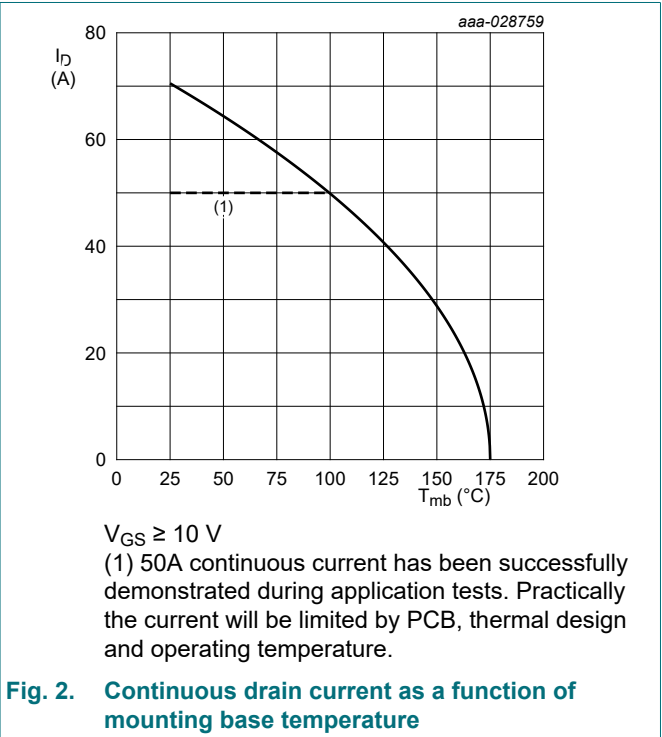
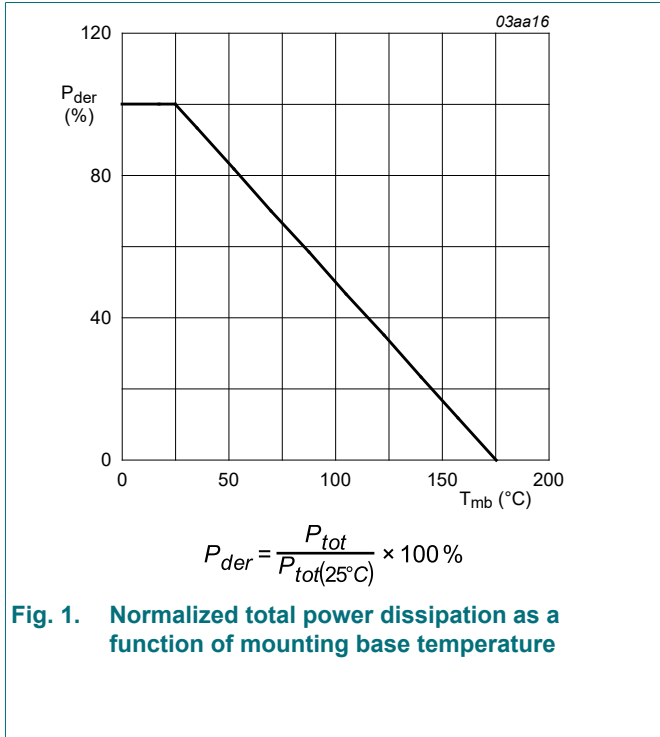
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	40	V
$V_{DSM}$	peak drain-source voltage	$t_p \leq 20\text{ ns}$ ; $f \leq 500\text{ kHz}$ ; $E_{DS(AL)} \leq 200\text{ nJ}$ ; pulsed	-	45	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	40	V
$V_{GS}$	gate-source voltage		-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	65	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	50	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>	-	50	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>	-	282	A
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
$T_{sld(M)}$	peak soldering temperature		-	260	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	50	A

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Symbol	Parameter	Conditions	Min	Max	Unit
$I_{SM}$	peak source current	pulsed; $t_p \leq 10 \mu s$ ; $T_{mb} = 25^\circ C$	-	282	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 25 A$ ; $V_{sup} \leq 40 V$ ; $R_{GS} = 50 \Omega$ ; $V_{GS} = 10 V$ ; $T_{j(init)} = 25^\circ C$ ; unclamped; $t_p = 89.4 \mu s$	[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	Fig. 4	-	2.09	2.32	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	50	-	K/W
		Fig. 6	-	130	-	K/W

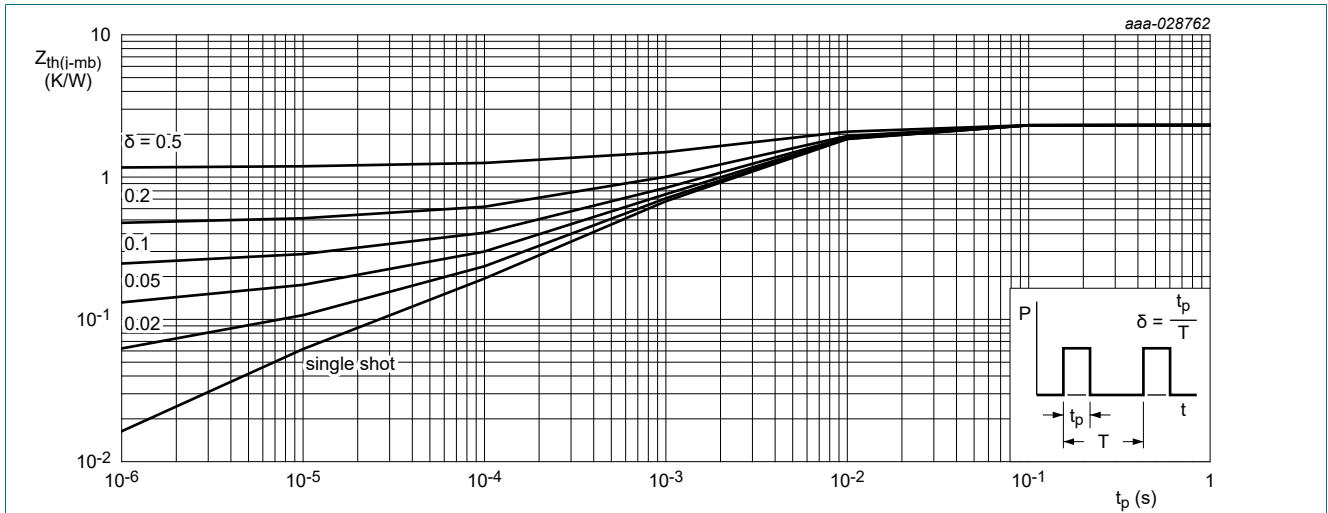


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

aaa-028026

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

aaa-028025

70 μm thick copper on FR4 board

Fig. 5. PCB layout for resistance from junction to ambient

Fig. 6. PCB layout with minimum footprint for thermal resistance from junction to ambient

### 10. Characteristics

Table 7. Characteristics

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

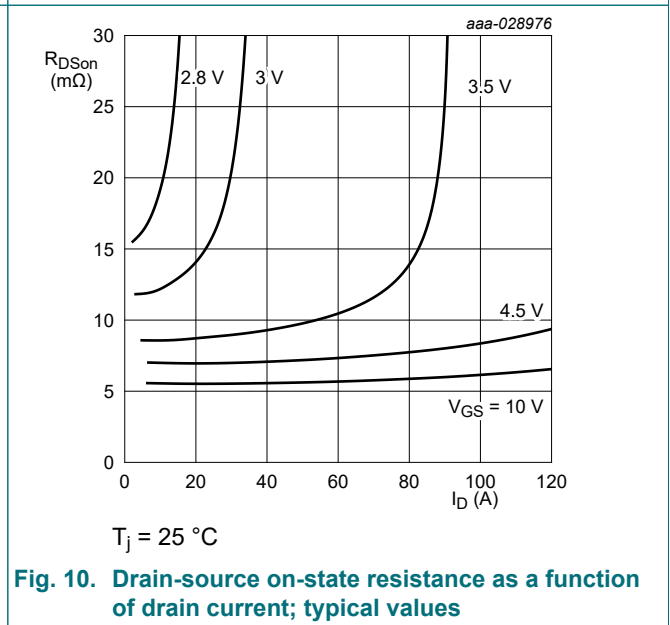
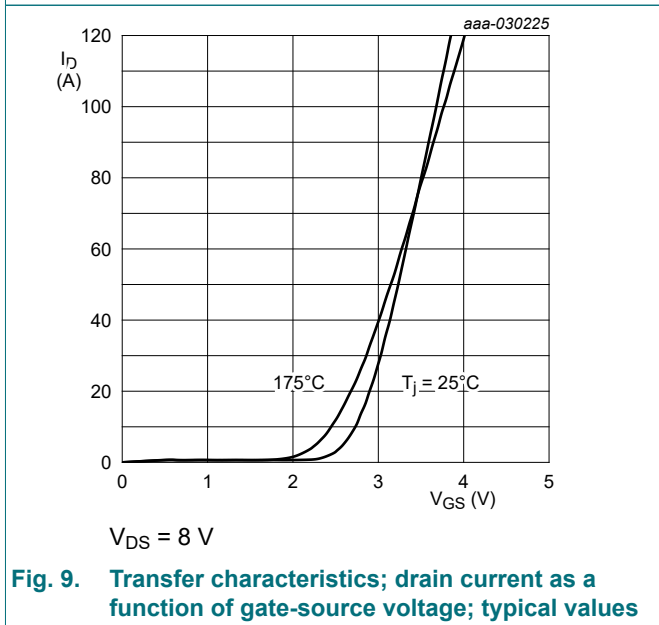
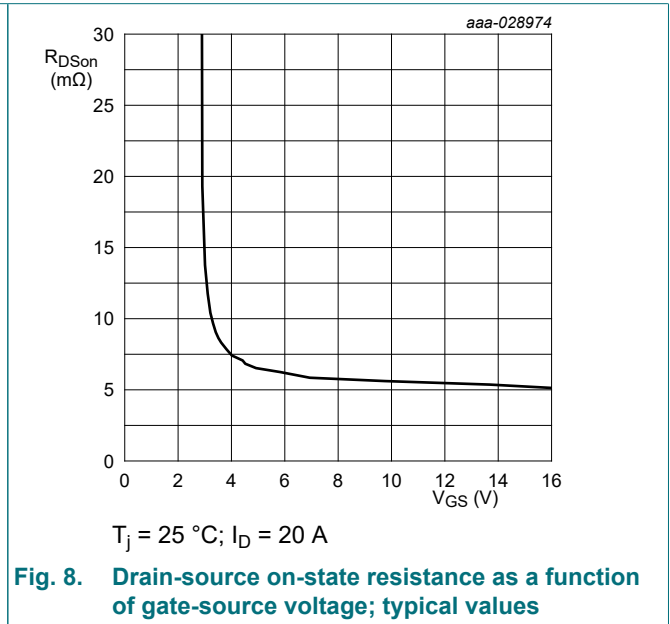
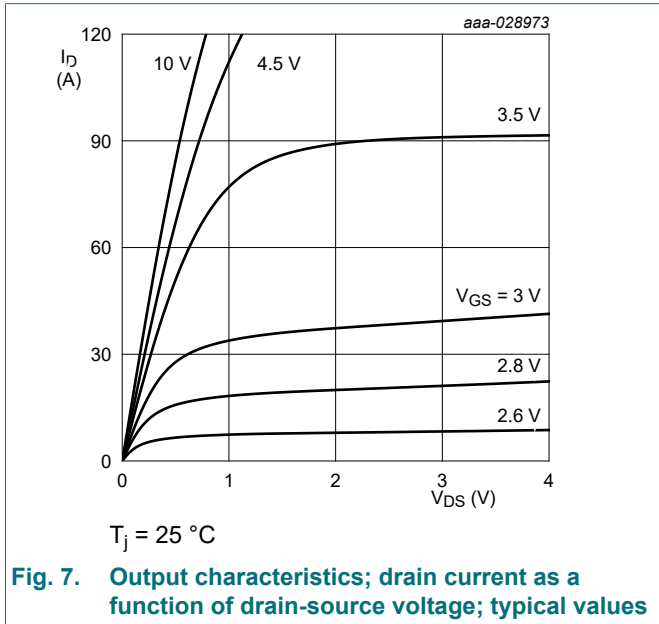
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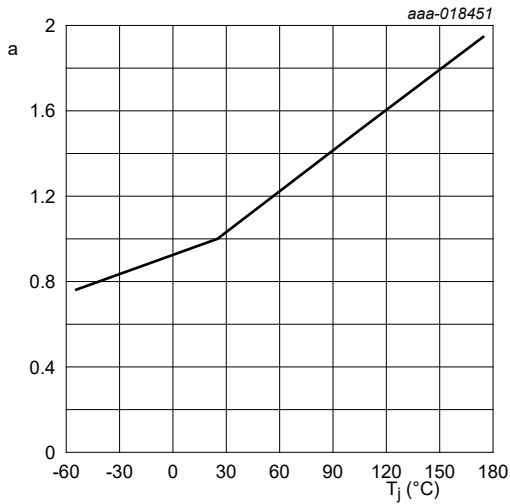
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ\text{C}$	1.45	1.77	2.15	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ\text{C} \leq T_j \leq 150 \text{ }^\circ\text{C}$	-	-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		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

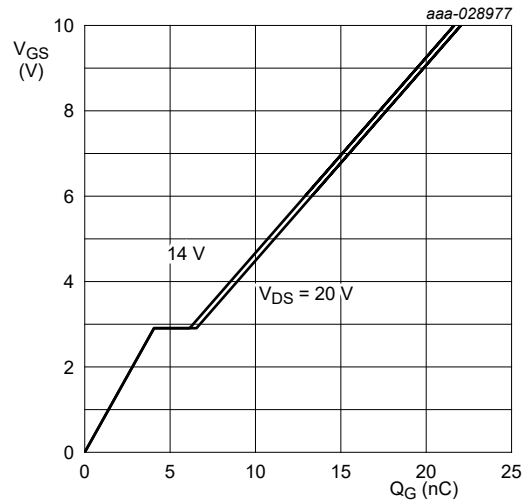
[1] includes capacitive recovery





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

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



$T_j = 25^\circ\text{C}; I_D = 20$  A

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

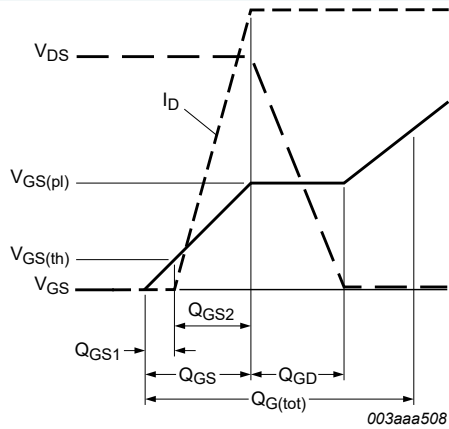
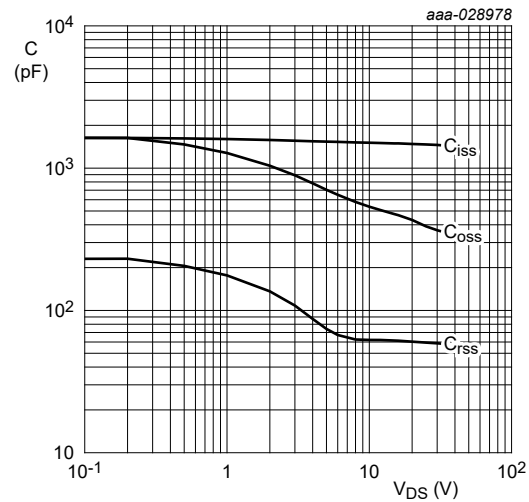
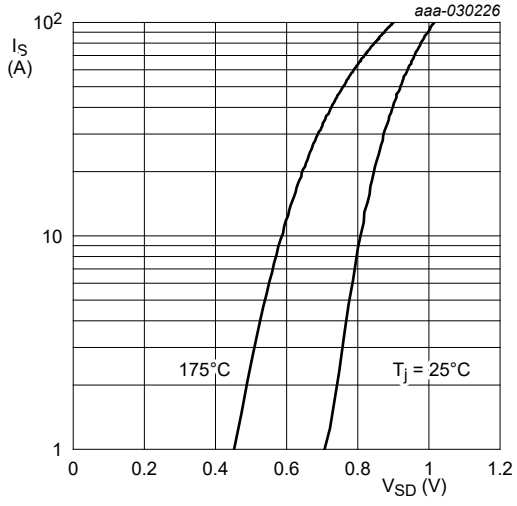


Fig. 13. Gate charge waveform definitions



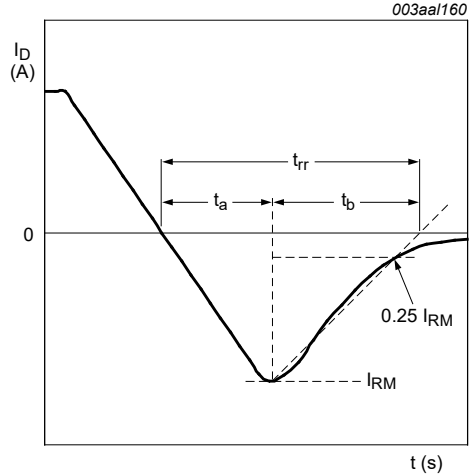
$V_{GS} = 0$  V;  $f = 1$  MHz

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

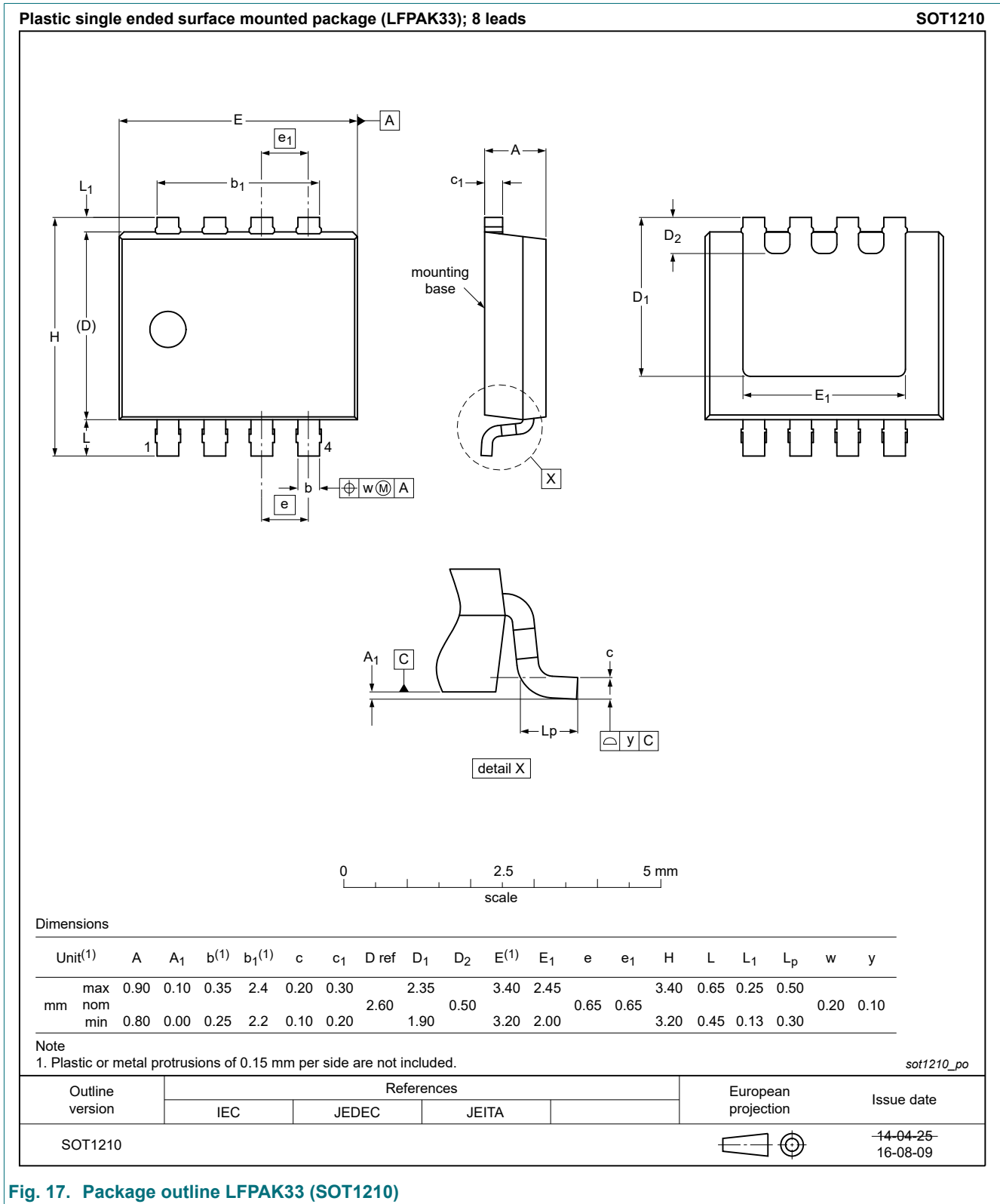
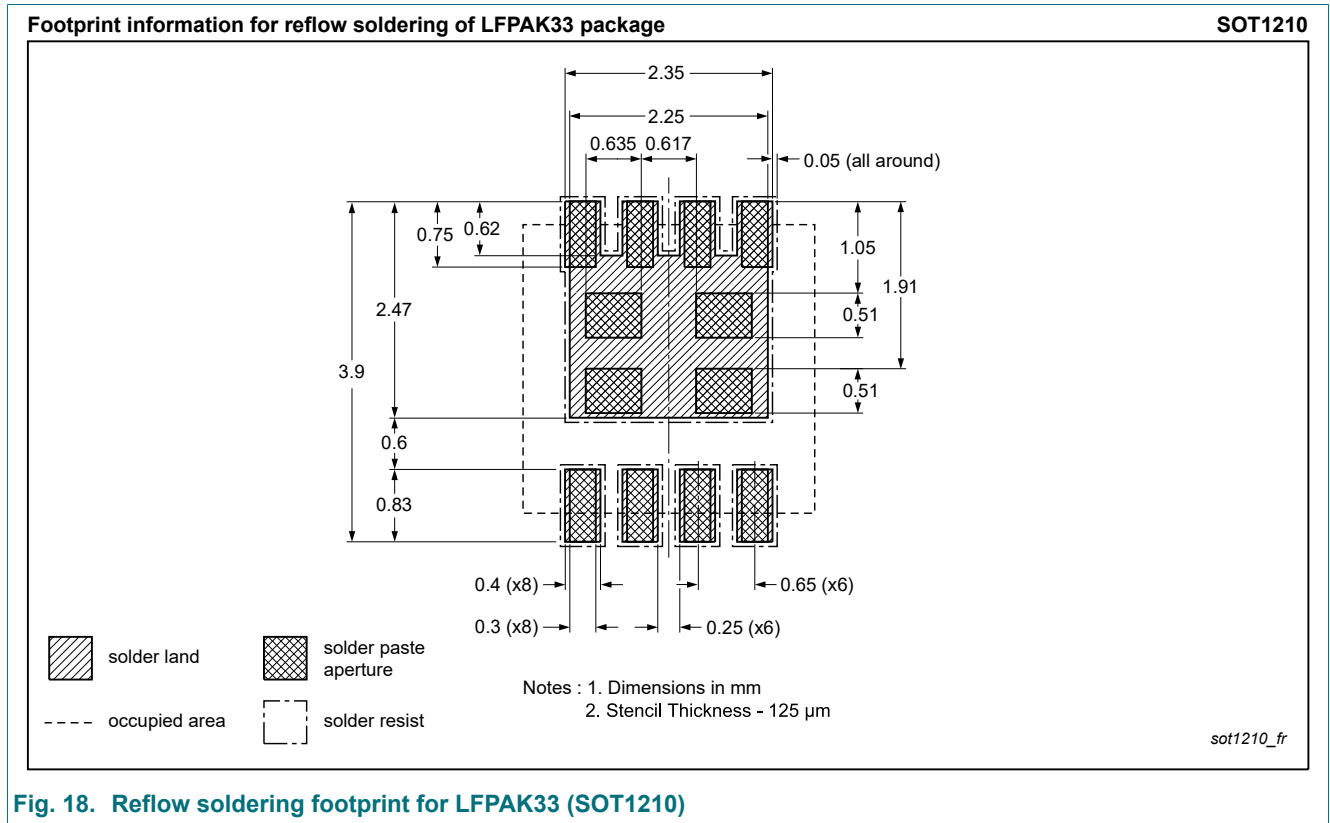


Fig. 17. Package outline LPAK33 (SOT1210)

## 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.
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