



PSMN011-60ML

N-channel 60 V 11.3 mΩ logic level MOSFET in LPAK33

4 June 2013

Product data sheet

1. General description

Logic level enhancement mode N-channel MOSFET in LPAK33 package. 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
- Suitable for standard level gate drive sources
- LPAK33 package is footprint compatible with other 3.3mm types
- Qualified to 175 °C

3. Applications

- AC-to-DC converters
- Synchronous rectification
- DC-DC converters

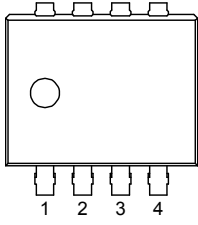
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V _{DS}	drain-source voltage	T _j = 25 °C		-	-	60	V
I _D	drain current	T _{mb} = 25 °C; V _{GS} = 10 V; Fig. 1		-	-	61	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2		-	-	91	W
T _j	junction temperature			-55	-	175	°C
Static characteristics							
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 15 A; T _j = 25 °C; Fig. 12		-	9.35	11.3	mΩ
		V _{GS} = 4.5 V; I _D = 15 A; T _j = 25 °C; Fig. 12		-	11	13.1	mΩ
Dynamic characteristics							
Q _{GD}	gate-drain charge	V _{GS} = 4.5 V; I _D = 15 A; V _{DS} = 30 V; T _j = 25 °C; Fig. 14 ; Fig. 15		-	5.1	-	nC

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
PSMN011-60ML	LPAK33	Plastic single ended surface mounted package (LPAK33); 4 leads	SOT1210

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN011-60ML	M11L60

8. Limiting values

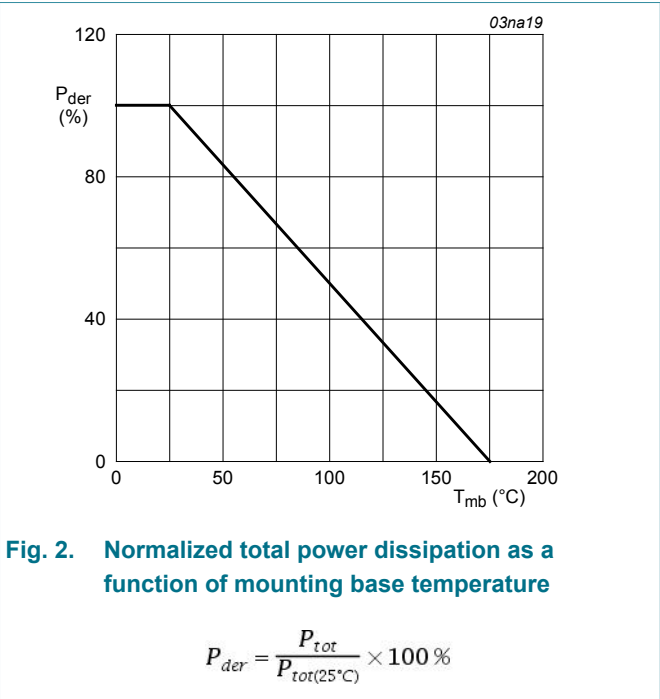
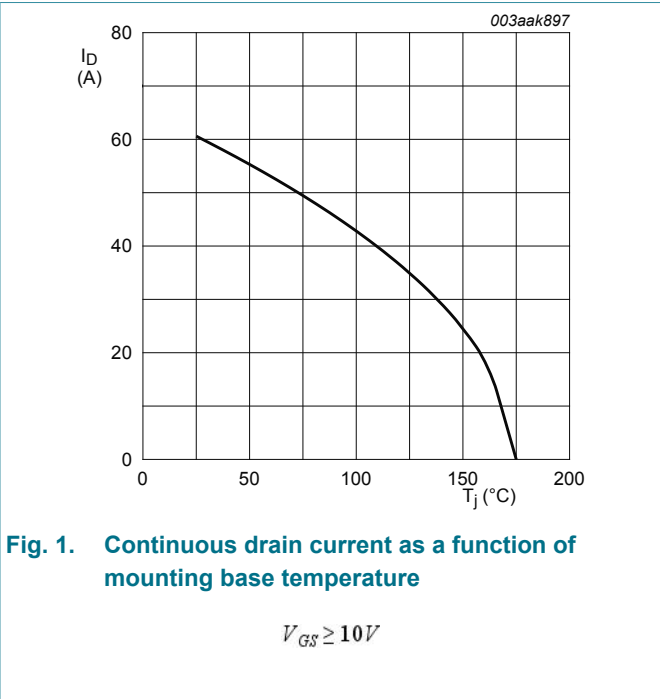
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ }^{\circ}\text{C}$	-	60	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$; Fig. 1	-	61	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ }^{\circ}\text{C}$; Fig. 1	-	43	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$; Fig. 4	-	242	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$; Fig. 2	-	91	W
T_{stg}	storage temperature		-55	175	$^{\circ}\text{C}$
T_j	junction temperature		-55	175	$^{\circ}\text{C}$

Symbol	Parameter	Conditions		Min	Max	Unit
$T_{\text{slid(M)}}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_{S}	source current	$T_{\text{mb}} = 25\text{ °C}$	[1]	-	70	A
I_{SM}	peak source current	pulsed; $t_{\text{p}} \leq 10\text{ }\mu\text{s}$; $T_{\text{mb}} = 25\text{ °C}$		-	242	A
Avalanche ruggedness						
$E_{\text{DS(AL)S}}$	non-repetitive drain-source avalanche energy	$V_{\text{GS}} = 10\text{ V}$; $T_{\text{J(init)}} = 25\text{ °C}$; $I_{\text{D}} = 61\text{ A}$; $V_{\text{sup}} \leq 60\text{ V}$; $R_{\text{GS}} = 50\text{ }\Omega$; unclamped; Fig. 3		-	48.5	mJ

[1] Continuous current is limited by package



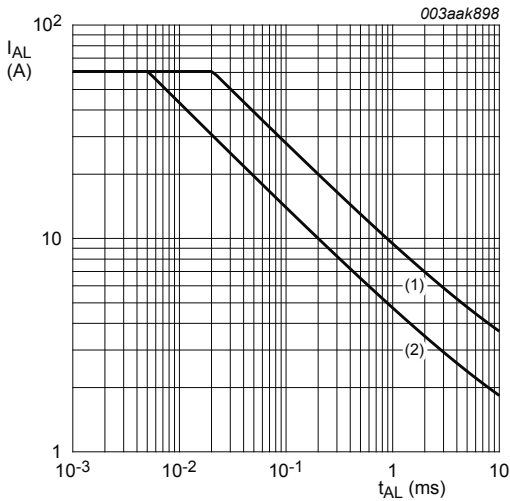


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

(1) $T_j = 25^\circ\text{C}$; (2) $T_j = 100^\circ\text{C}$

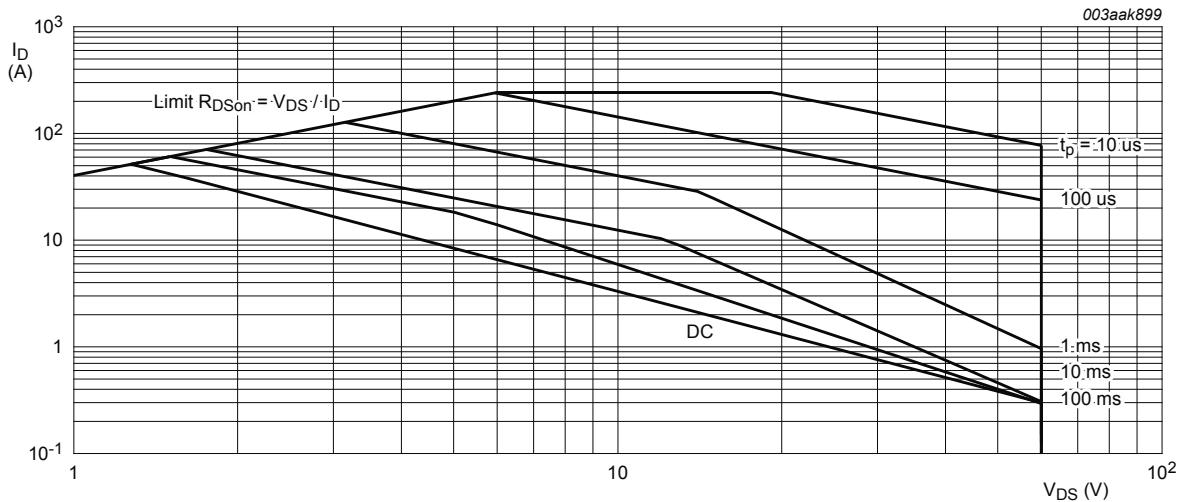


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^\circ\text{C}$; I_{DM} is a single pulse

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	-	1.44	1.65	K/W

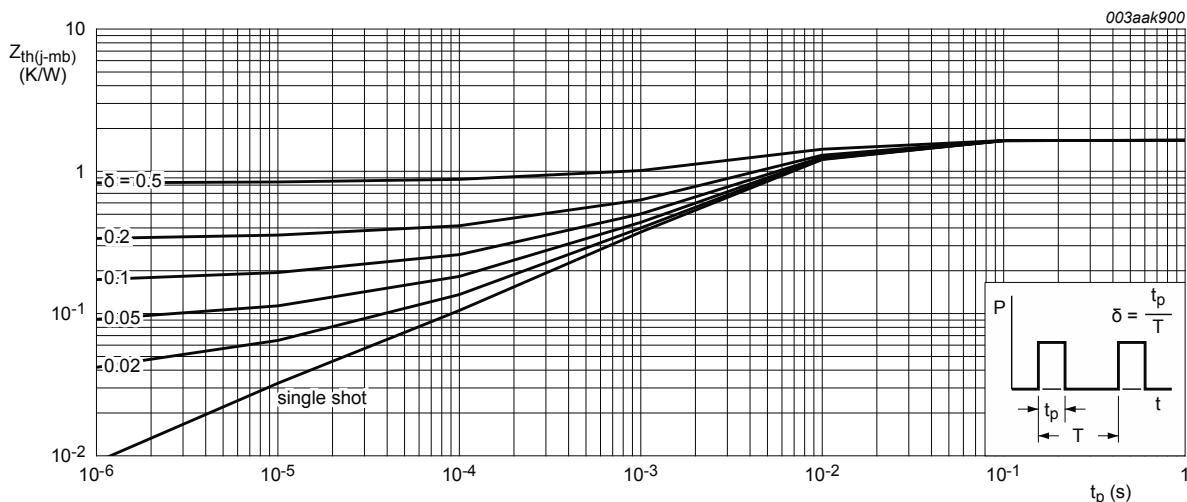


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_J = 25 ^\circ C$	60	-	-	V
		$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_J = -55 ^\circ C$	54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = -55 ^\circ C$; Fig. 10	-	-	2.45	V
		$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = 25 ^\circ C$; Fig. 11 ; Fig. 10	1.3	1.7	2.15	V
		$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = 175 ^\circ C$; Fig. 10	0.5	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_J = 25 ^\circ C$	-	0.03	1	μA
		$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_J = 175 ^\circ C$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 16 V$; $V_{DS} = 0 V$; $T_J = 25 ^\circ C$	-	-	100	nA
		$V_{GS} = -16 V$; $V_{DS} = 0 V$; $T_J = 25 ^\circ C$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V$; $I_D = 15 A$; $T_J = 25 ^\circ C$; Fig. 12	-	9.35	11.3	mΩ
		$V_{GS} = 4.5 V$; $I_D = 15 A$; $T_J = 25 ^\circ C$; Fig. 12	-	11	13.1	mΩ
		$V_{GS} = 10 V$; $I_D = 15 A$; $T_J = 175 ^\circ C$; Fig. 12 ; Fig. 13	-	-	24.8	mΩ
		$V_{GS} = 4.5 V$; $I_D = 15 A$; $T_J = 175 ^\circ C$; Fig. 12 ; Fig. 13	-	-	28.8	mΩ
R_G	gate resistance	$f = 1 MHz$	-	1.86	-	Ω

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 15\text{ A}$; $V_{DS} = 30\text{ V}$; $V_{GS} = 10\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 14 ; Fig. 15	-	37.2	-	nC
Q_{GS}	gate-source charge	$I_D = 15\text{ A}$; $V_{DS} = 30\text{ V}$; $V_{GS} = 4.5\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 14 ; Fig. 15	-	16.6	-	nC
Q_{GD}	gate-drain charge		-	5	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 15\text{ A}$; $V_{DS} = 30\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 14 ; Fig. 15	-	5.1	-	nC
C_{iss}	input capacitance	$V_{DS} = 30\text{ V}$; $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 16	-	2.75	-	V
C_{oss}	output capacitance	$V_{DS} = 30\text{ V}$; $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 16	-	2191	-	pF
C_{rss}	reverse transfer capacitance	$V_{DS} = 30\text{ V}$; $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 16	-	199	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}$; $R_L = 2\text{ }\Omega$; $V_{GS} = 4.5\text{ V}$; $R_{G(ext)} = 5\text{ }\Omega$; $T_J = 25\text{ }^\circ\text{C}$	-	111	-	pF
t_r	rise time		-	13.3	-	ns
$t_{d(off)}$	turn-off delay time		-	20.2	-	ns
t_f	fall time		-	27.7	-	ns
			-	15.5	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 15\text{ A}$; $V_{GS} = 0\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 17	-	0.84	1.2	V
t_{rr}	reverse recovery time	$I_S = 15\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 30\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$	-	20.7	-	ns
Q_r	recovered charge		-	15.7	-	nC

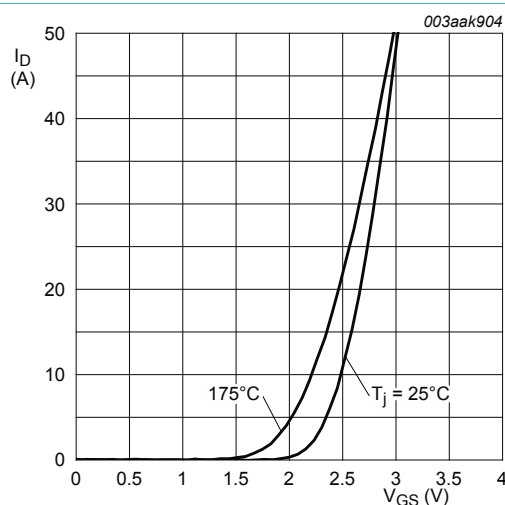
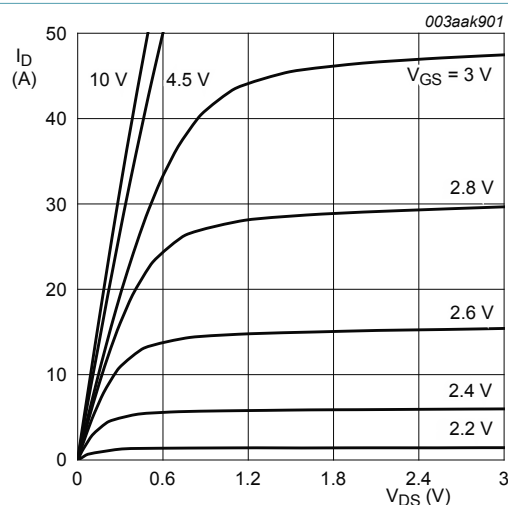


Fig. 6. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{ V}$



$T_J = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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

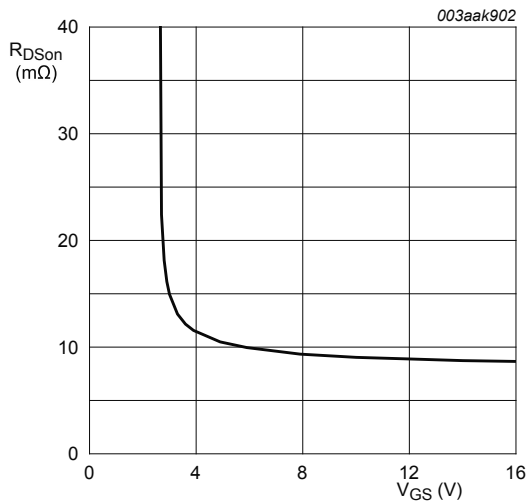


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25^{\circ}\text{C}; I_D = 15\text{ A}$

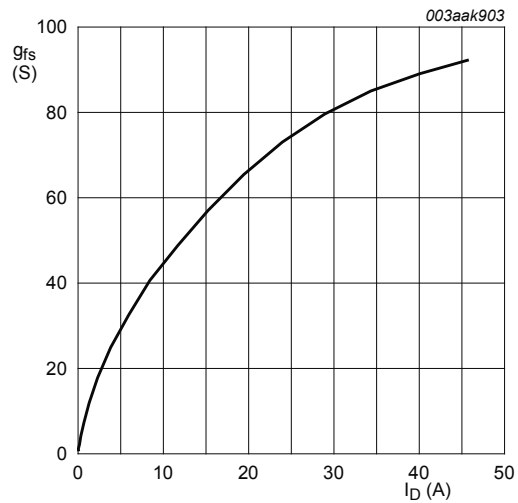


Fig. 9. Forward transconductance as a function of drain current; typical values

$T_j = 25^{\circ}\text{C}; V_{DS} = 10\text{ V}$

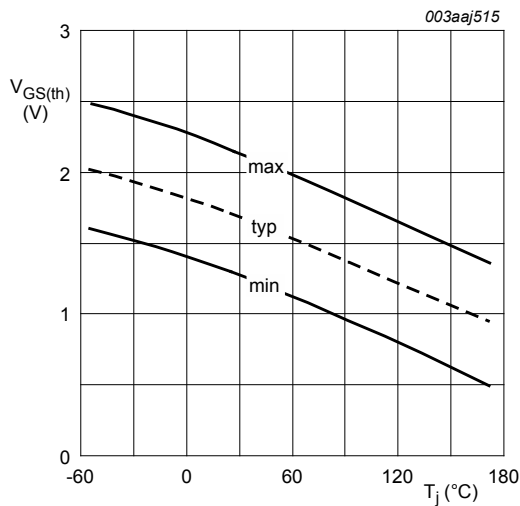


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

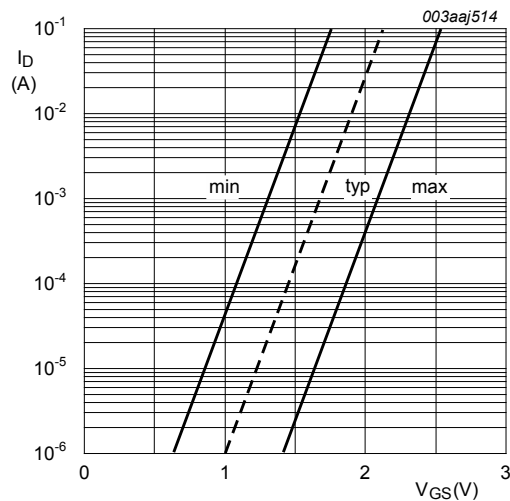
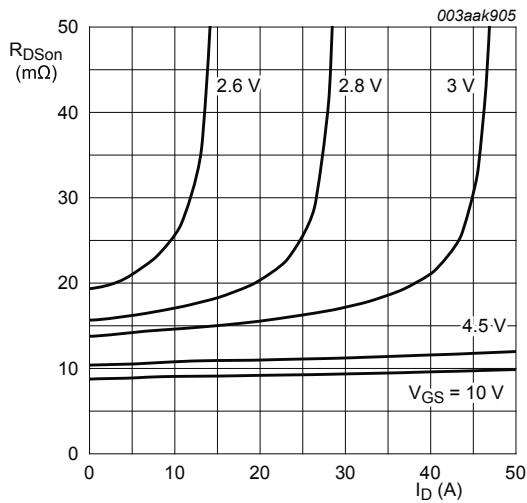


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25^{\circ}\text{C}; V_{DS} = 5\text{ V}$



$T_j = 25\text{ }^{\circ}\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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

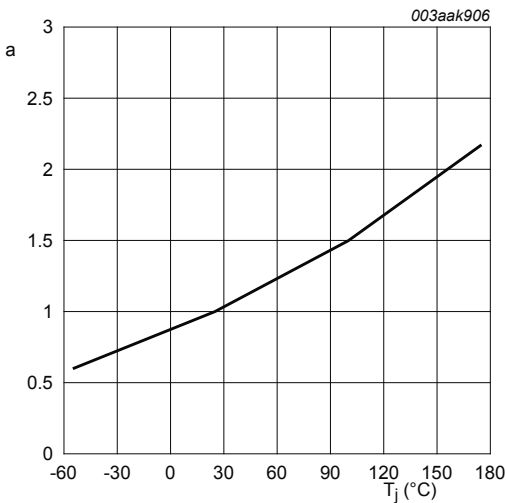


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

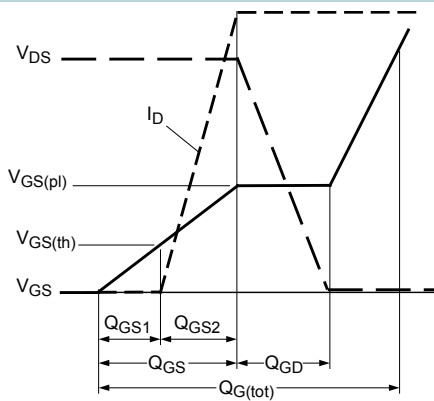


Fig. 14. Gate charge waveform definitions

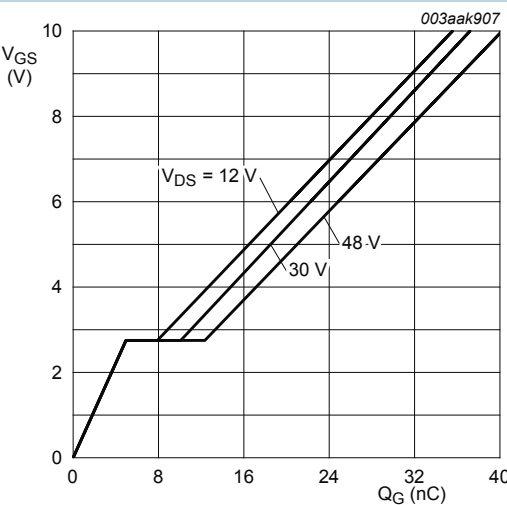


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25\text{ }^{\circ}\text{C}$; $I_D = 15\text{ A}$

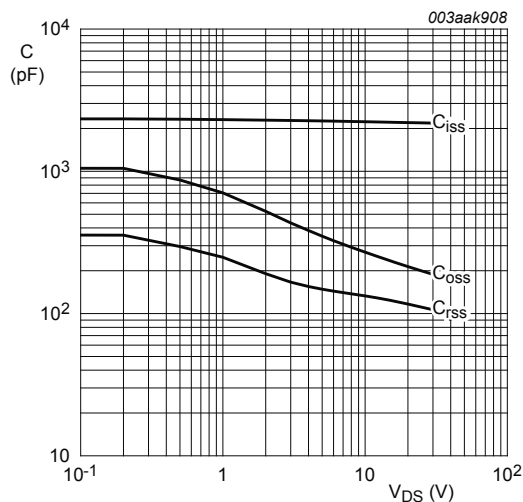


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

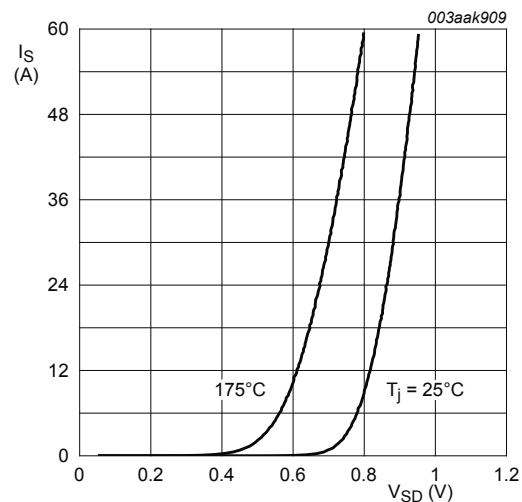


Fig. 17. Source current as a function of source-drain voltage; typical values

$V_{GS}=0V$

11. Package outline

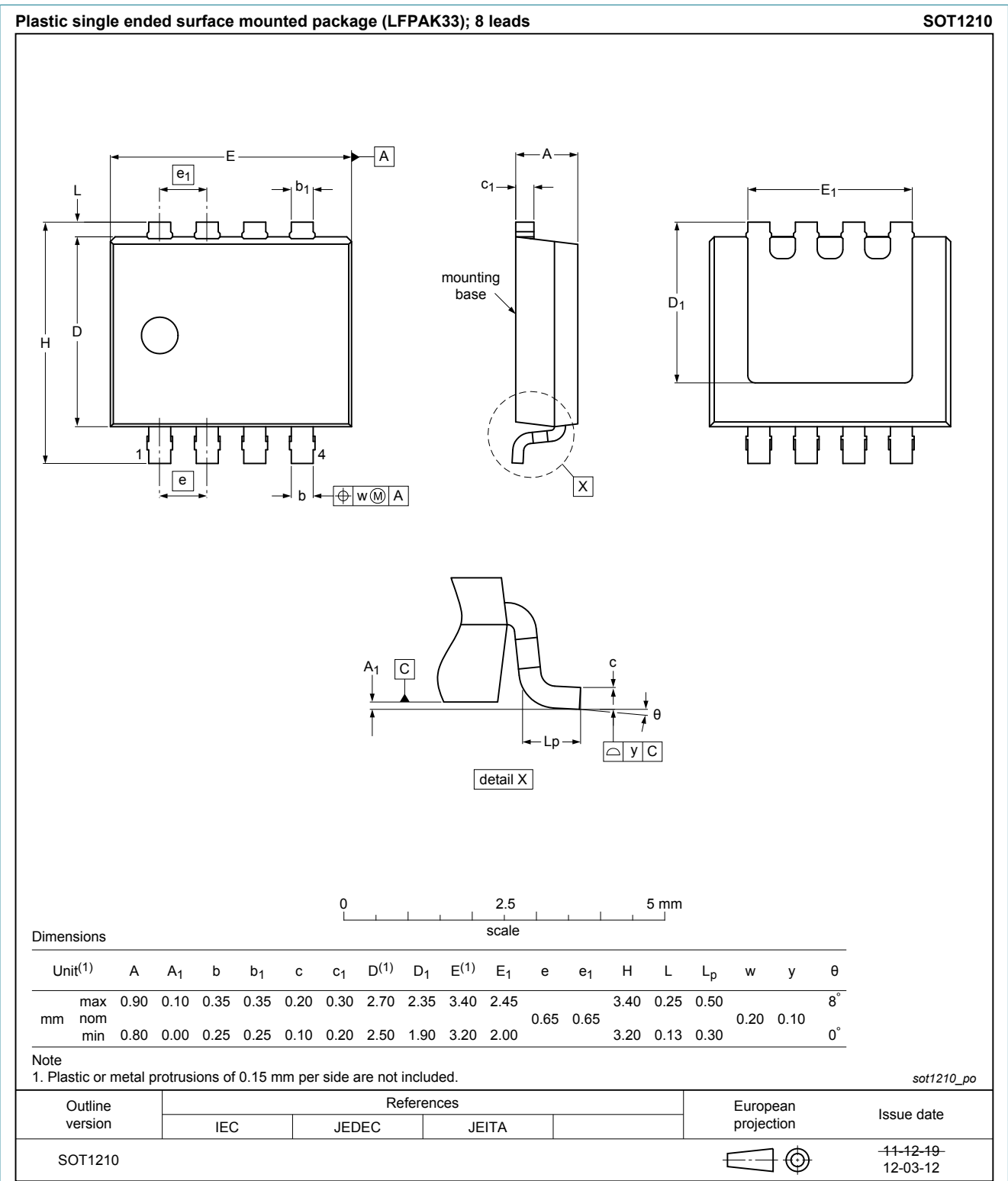


Fig. 18. Package outline LPAK33 (SOT1210)

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.
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Product [short] data sheet	Production	This document contains the product specification.

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Date of release: 04 June 2013