



PSMN6R1-25MLD

N-channel 25 V, 6.8 mΩ logic level MOSFET in LFPAK33 using NextPowerS3 Technology

6 April 2016

Product data sheet

1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LFPAK33 package. NextPowerS3 portfolio utilising Nexperia's unique "SchottkyPlus" technology delivers high efficiency, low spiking performance usually associated with MOSFETS with an integrated Schottky or Schottky-like diode but without problematic high leakage current. NextPowerS3 is particularly suited to high efficiency applications at high switching frequencies.

2. Features and benefits

- Ultra low Q_G , Q_{GD} and Q_{OSS} for high system efficiency, especially at higher switching frequencies
- Superfast switching with soft-recovery; s-factor > 1
- Low spiking and ringing for low EMI designs
- Unique "SchottkyPlus" technology; Schottky-like performance with < 1 μ A leakage at 25 °C
- Optimised for 4.5 V gate drive
- Low parasitic inductance and resistance
- High reliability clip bonded and solder die attach Mini Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Exposed leads for optimal visual solder inspection

3. Applications

- On-board DC:DC solutions for server and telecommunications
- Secondary-side synchronous rectification in telecommunication applications
- Voltage regulator modules (VRM)
- Point-of-Load (POL) modules
- Power delivery for V-core, ASIC, DDR, GPU, VGA and system components
- Brushed and brushless motor control

4. Quick reference data

Table 1. Quick reference data

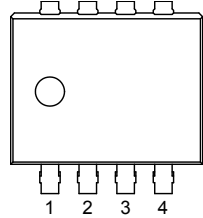
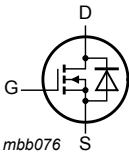
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C $\leq T_j \leq$ 175 °C	-	-	25	V
I_D	drain current	$V_{GS} = 10$ V; $T_{mb} = 25$ °C; Fig. 2	-	-	60	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 1	-	-	42	W

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NextPowerS3 Technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_j	junction temperature		-55	-	175	°C
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C};$ Fig. 10	-	8.98	10.3	mΩ
		$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C};$ Fig. 10	-	6.46	7.24	mΩ
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 10\text{ V};$ Fig. 12; Fig. 13	-	10.7	-	nC
		$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13	-	4.9	-	nC
		$I_D = 0\text{ A}; V_{DS} = 0\text{ V}; V_{GS} = 10\text{ V}$	-	5.6	-	nC
Q_{GD}	gate-drain charge	$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13	-	1.1	-	nC
Source-drain diode						
S	softness factor	$I_S = 15\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 12\text{ V};$ Fig. 16	-	1.3	-	

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p style="text-align: center;">LFAK33 (SOT1210)</p>	 <p style="text-align: center;"><i>mbb076</i></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
PSMN6R1-25MLD	LFAK33	Plastic single ended surface mounted package (LFAK33); 8 leads	SOT1210

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN6R1-25MLD	6D125L

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	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	25	V
V_{DGR}	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	25	V
V_{GS}	gate-source voltage		-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1	-	42	W
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	-	60	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2	-	41	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3	-	235	A
T_{stg}	storage temperature		-55	175	°C
T_j	junction temperature		-55	175	°C
$T_{sld(M)}$	peak soldering temperature		-	260	°C
V_{ESD}	electrostatic discharge voltage	HBM	400	-	V
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	38	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	241	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 15\text{ A}$; $V_{sup} \leq 25\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 210\text{ }\mu\text{s}$	[1]	-	51.3 mJ

[1] Protected by 100% test

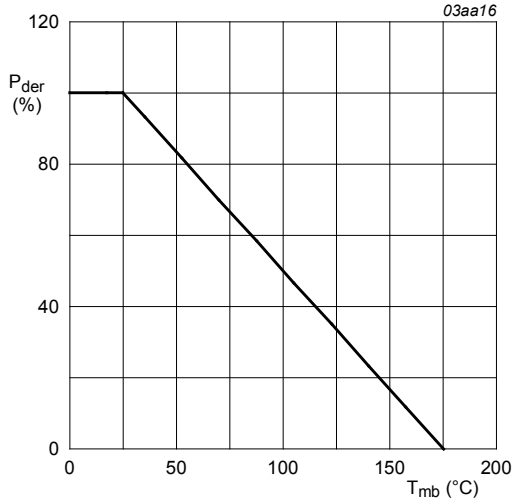
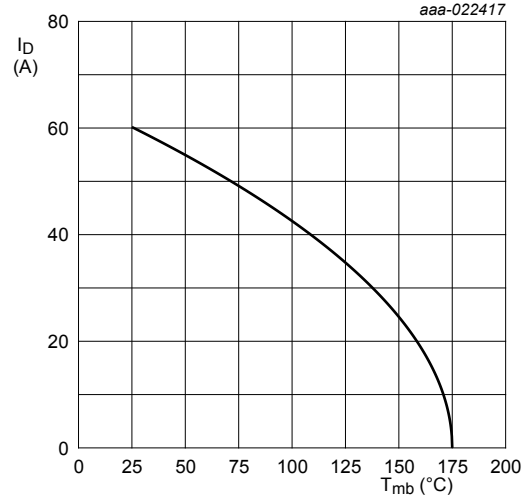


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

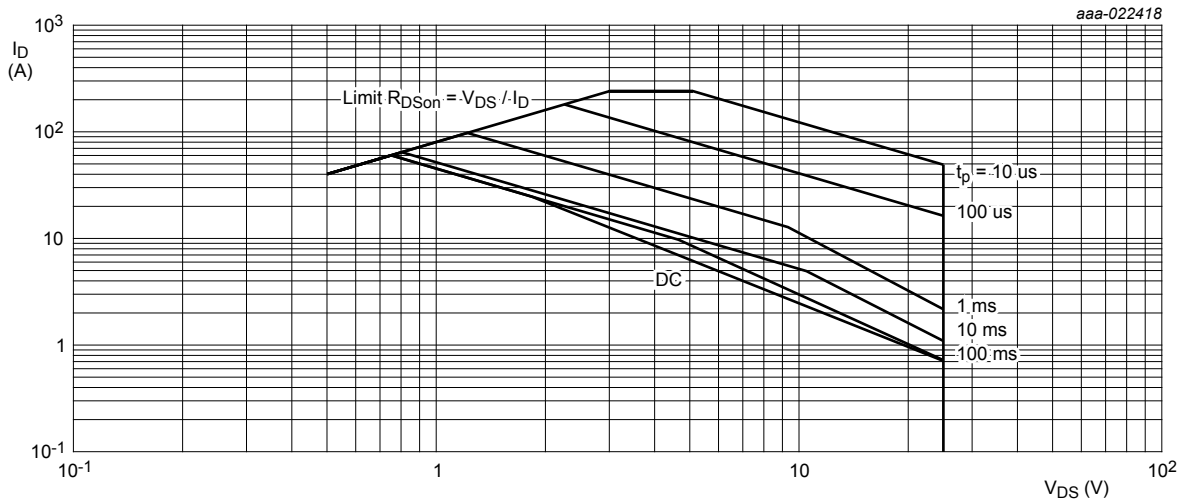
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$



$V_{GS} \geq 10\text{ V}$

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

$$I_D = 58A \times \sqrt{\frac{175^{\circ}C - T_{mb}}{150^{\circ}C}} \text{ for } T_{mb} \geq 25^{\circ}C$$



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

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	-	3.04	3.32	K/W

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	57	-	K/W
		Fig. 6	-	178	-	K/W

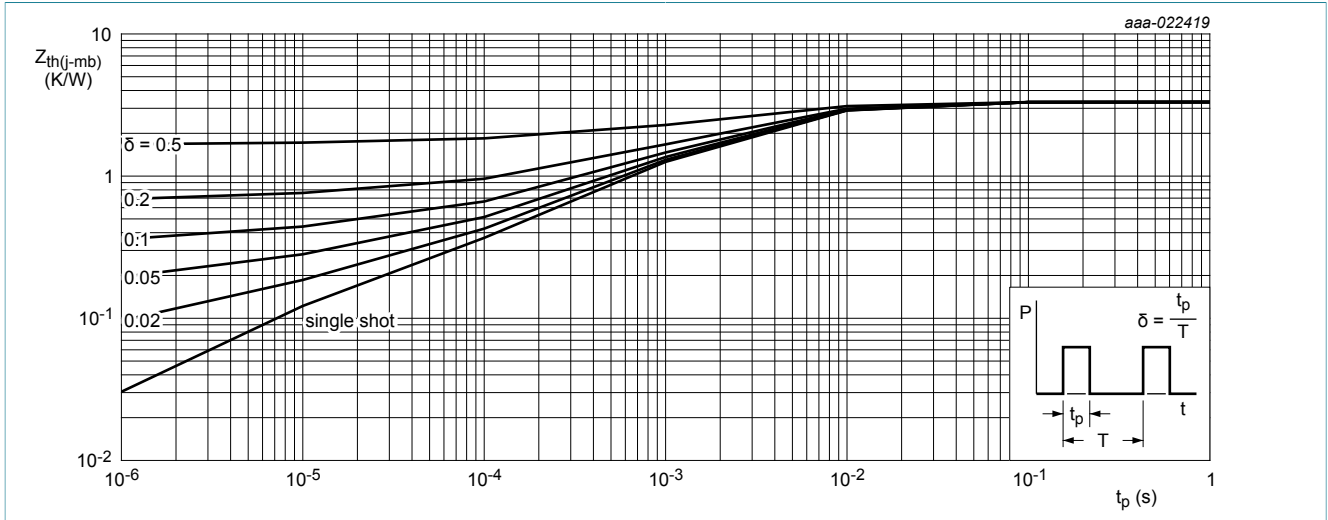


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

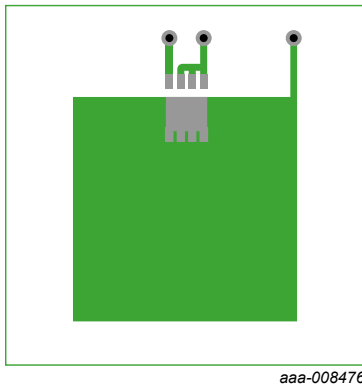


Fig. 5. PCB layout for thermal resistance junction to ambient 1" square pad; FR4 Board; 2oz copper

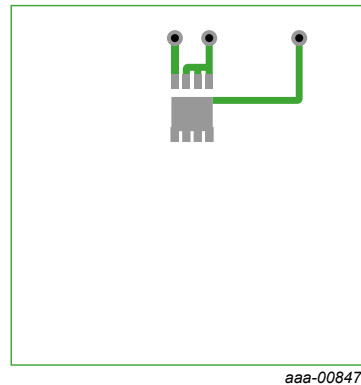


Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	25	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	22.5	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	1.2	1.76	2.2	V

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-4.1	-	mV/K
I_{DSS}	drain leakage current	$V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C}$	-	-	1	μA
		$V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; T_j = 125\text{ °C}$	-	0.8	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 20\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ °C}$	-	-	100	nA
		$V_{GS} = -20\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ °C}$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C};$ Fig. 10	-	8.98	10.3	mΩ
		$V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}; T_j = 175\text{ °C};$ Fig. 10; Fig. 11	-	-	17.51	mΩ
		$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C};$ Fig. 10	-	6.46	7.24	mΩ
		$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 175\text{ °C};$ Fig. 10; Fig. 11	-	-	12.48	mΩ
R_G	gate resistance	$f = 1\text{ MHz}$	-	0.66	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 10\text{ V};$ Fig. 12; Fig. 13	-	10.7	-	nC
		$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13	-	4.9	-	nC
		$I_D = 0\text{ A}; V_{DS} = 0\text{ V}; V_{GS} = 10\text{ V}$	-	5.6	-	nC
Q_{GS}	gate-source charge	$I_D = 15\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13	-	2.3	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	1.2	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	1	-	nC
Q_{GD}	gate-drain charge		-	1.1	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 15\text{ A}; V_{DS} = 12\text{ V};$ Fig. 12; Fig. 13	-	3	-	V
C_{iss}	input capacitance	$V_{DS} = 12\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ °C};$ Fig. 14	-	702	-	pF
C_{oss}	output capacitance		-	590	-	pF
C_{rss}	reverse transfer capacitance		-	45	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 12\text{ V}; R_L = 1\text{ }\Omega; V_{GS} = 4.5\text{ V};$ $R_{G(ext)} = 5\text{ }\Omega$	-	7.7	-	ns
t_r	rise time		-	7.9	-	ns
$t_{d(off)}$	turn-off delay time		-	7.8	-	ns
t_f	fall time		-	4.7	-	ns

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Q_{oss}	output charge	$V_{GS} = 0\text{ V}; V_{DS} = 12\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C}$	-	9.2	-	nC
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 10\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C}; \text{Fig. 15}$	-	0.83	1.2	V
t_{rr}	reverse recovery time	$I_S = 15\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 12\text{ V}; \text{Fig. 16}$	-	19.3	-	ns
Q_r	recovered charge		[1]	8.1	-	nC
t_a	reverse recovery rise time		-	8.6	-	ns
t_b	reverse recovery fall time		-	10.7	-	ns
S	softness factor		-	1.3	-	

[1] includes capacitive recovery

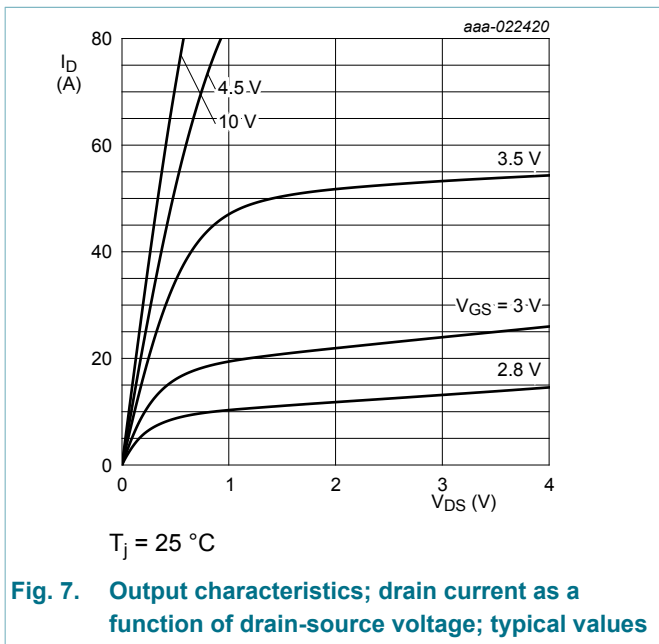


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

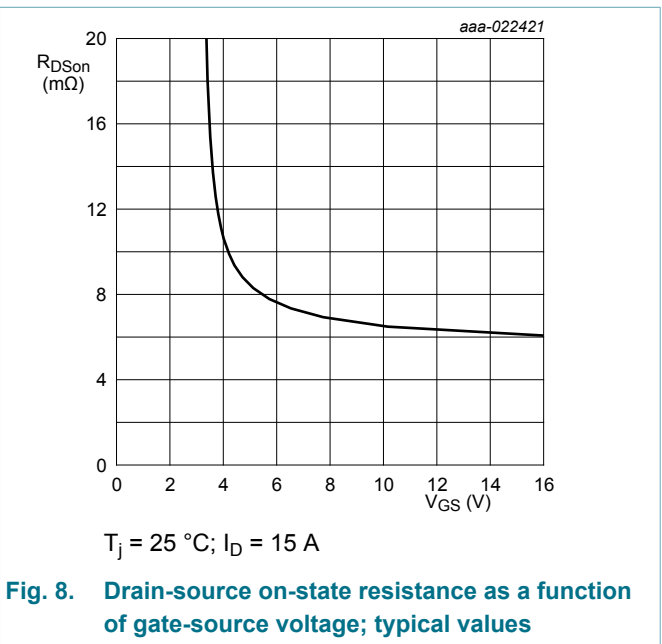


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

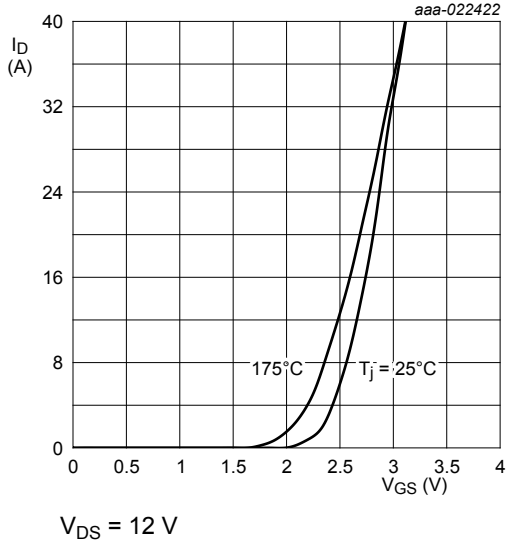


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

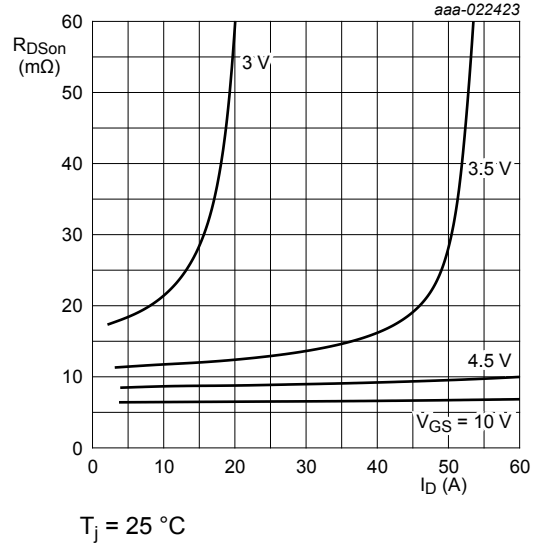


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

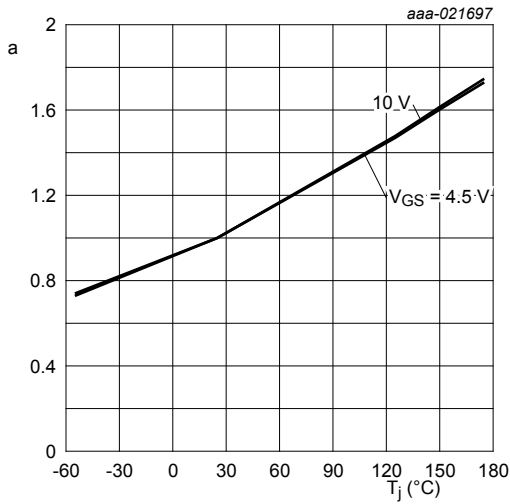


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

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

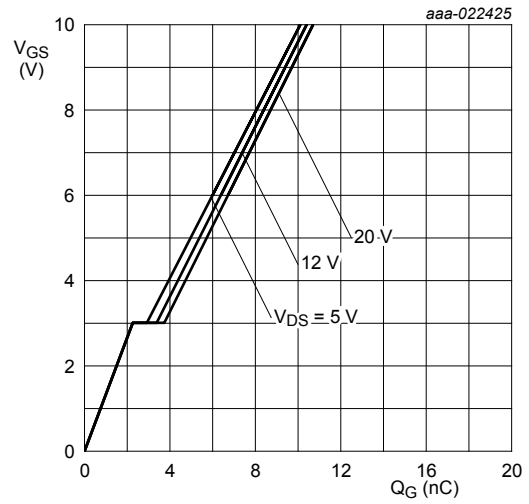


Fig. 12. Gate-source voltage as a function of gate charge; typical values

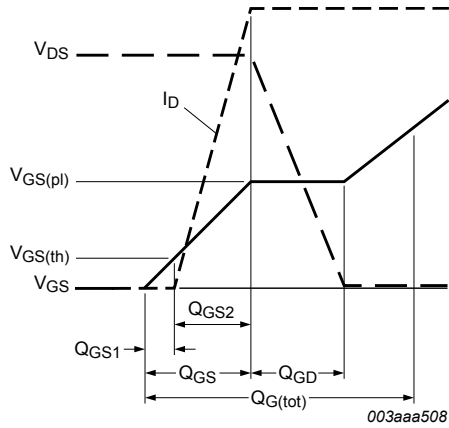
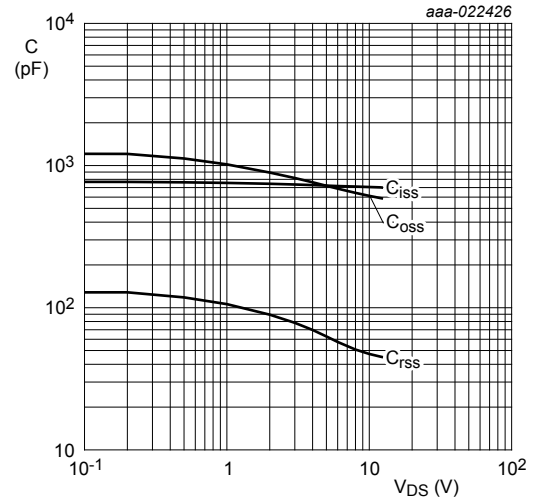
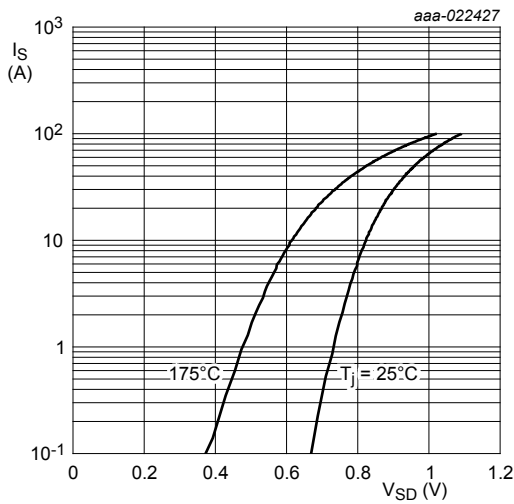


Fig. 13. Gate charge waveform definitions



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

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



$V_{GS} = 0$ V

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

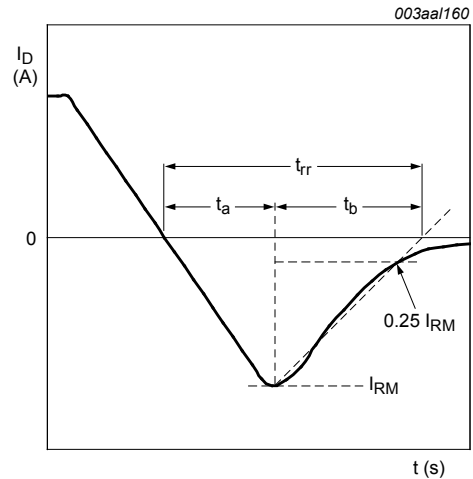


Fig. 16. Reverse recovery timing definition

11. Package outline

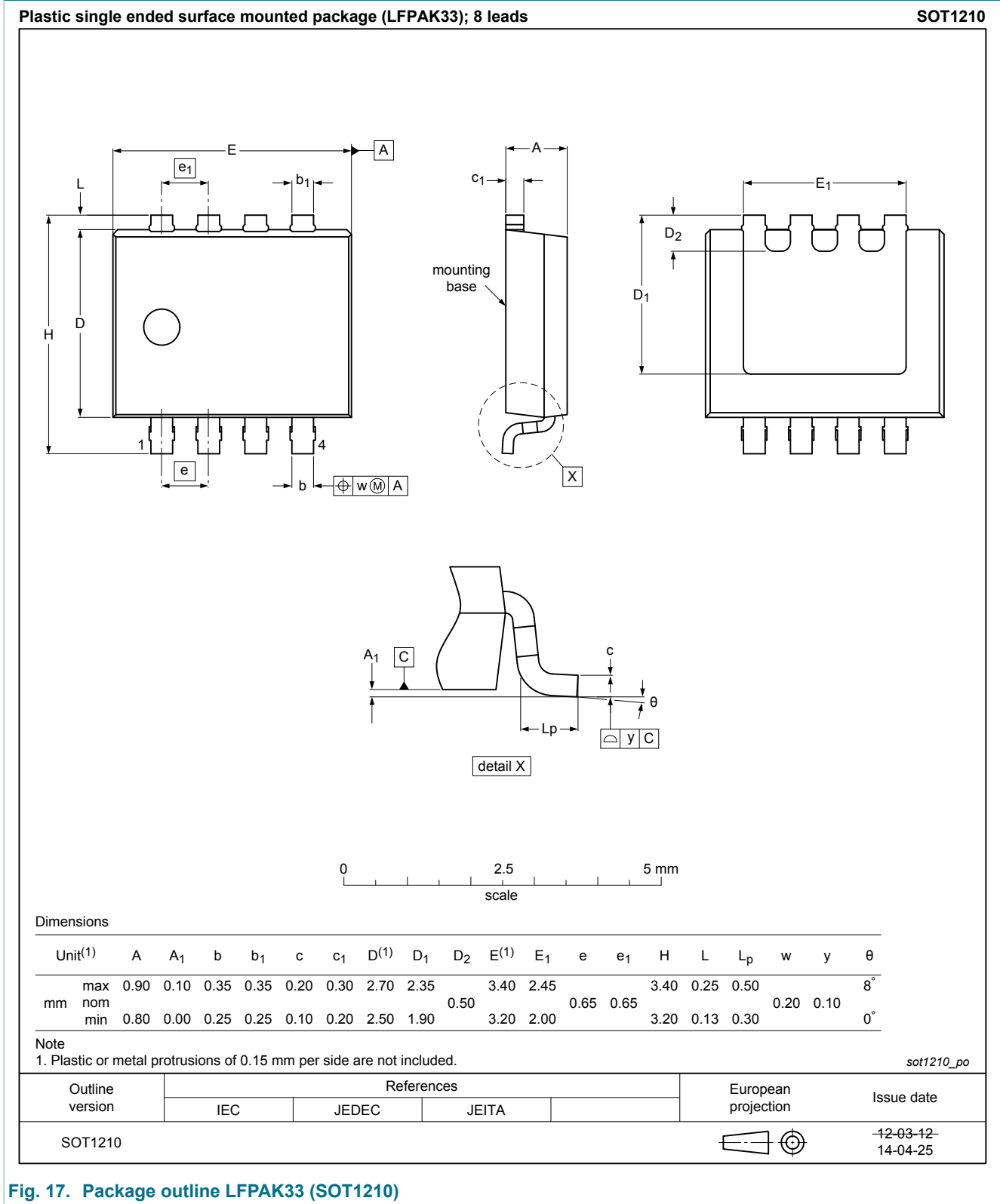


Fig. 17. Package outline LFAK33 (SOT1210)

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.
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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