



PSMN4R1-60YL

N-channel 60 V, 4.1 mΩ logic level MOSFET in LPAK56

20 October 2016

Product data sheet

1. General description

Logic level N-channel MOSFET in an LPAK56 (Power SO8) package using TrenchMOS technology. This product is designed and qualified for use in a wide range of power supply & motor control equipment.

2. Features and benefits

- Advanced TrenchMOS provides low $R_{DS(on)}$ and low gate charge
- Logic level gate operation
- Avalanche rated, 100% tested
- LPAK provides maximum power density in a Power SO8 package

3. Applications

- Synchronous rectifier in LLC topology
- Chargers & adaptors with $V_{out} < 10\text{ V}$
- Fast charge & USB-PD applications
- Battery powered motor control
- LED lighting & TV backlight

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	60	V
I_D	drain current	$V_{GS} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	238	W
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11		-	3.3	4.8	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 48\text{ V}$; $V_{GS} = 5\text{ V}$; $T_j = 25\text{ °C}$; Fig. 13 ; Fig. 14		-	18.1	-	nC

[1] Continuous current is limited by package.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 LPAK56; Power-SO8 (SOT669)	
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
PSMN4R1-60YL	LPAK56; Power-SO8	Plastic single-ended surface-mounted package (LPAK56; Power-SO8); 4 leads	SOT669

7. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	60	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	238	W
I_D	drain current	$V_{GS} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	100	A
		$V_{GS} = 5\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2	[1]	-	100	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3		-	593	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$	[1]	-	100	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	593	A

Symbol	Parameter	Conditions		Min	Max	Unit
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 100\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped; Fig. 4	[2][3]	-	199	mJ

- [1] Continuous current is limited by package.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.

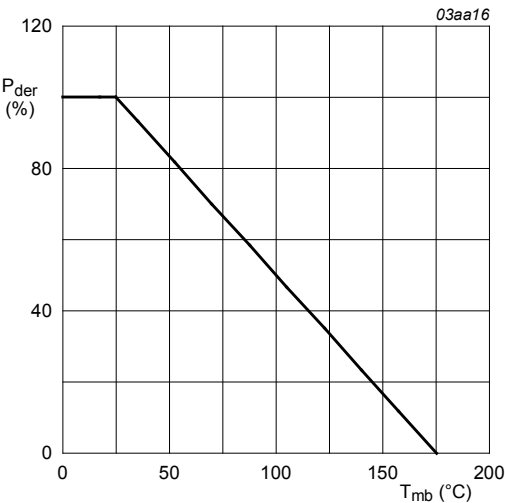


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

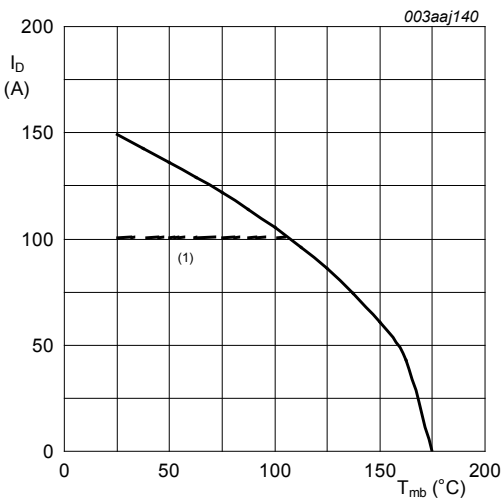


Fig. 2. Continuous drain current as a function of mounting base temperature

$$V_{GS} \geq 5\text{ V}$$

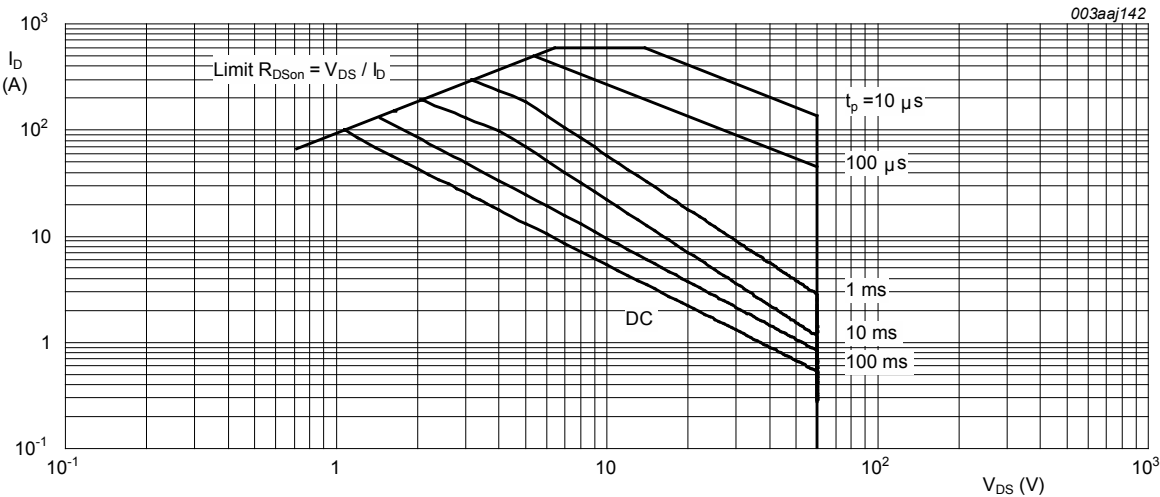


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

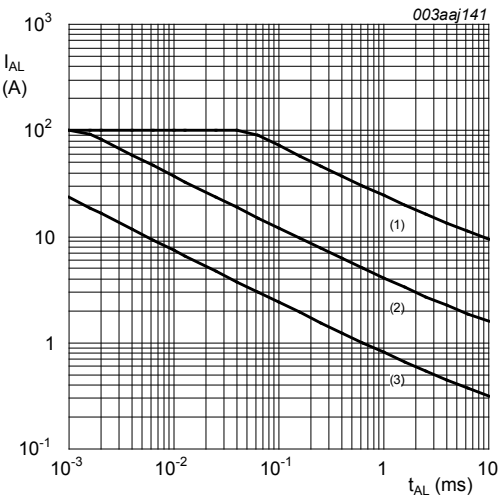


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

(1) $T_j(\text{init}) = 25^{\circ}\text{C}$; (2) $T_j(\text{init}) = 150^{\circ}\text{C}$; (3) Repetitive Avalanche

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{\text{th(j-mb)}}$	thermal resistance from junction to mounting base	Fig. 5	-	-	0.63	K/W

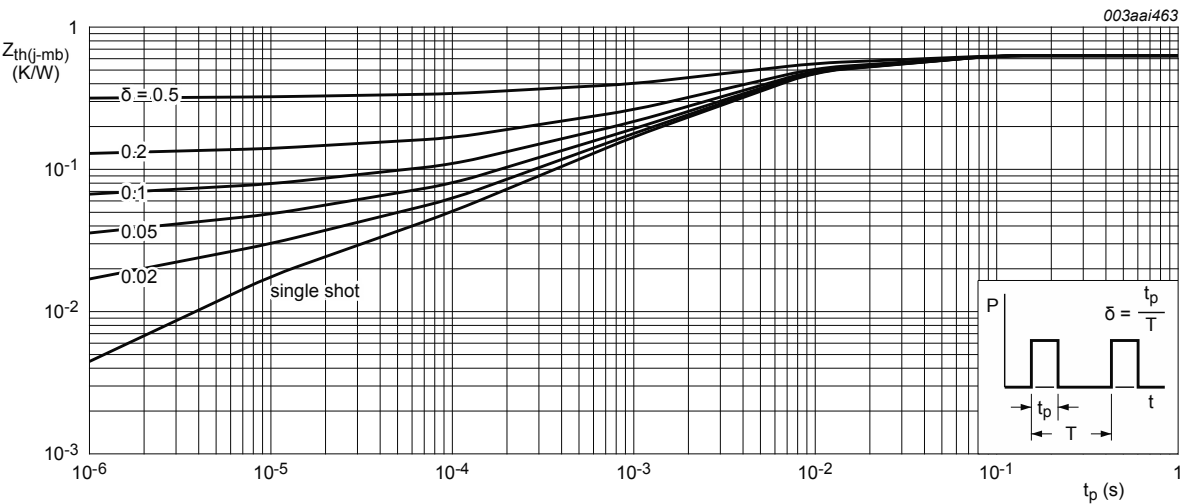


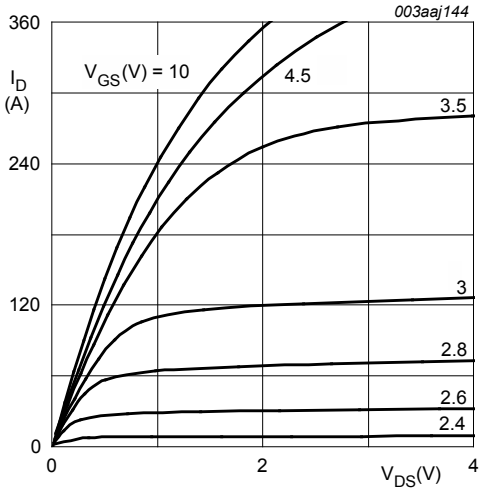
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Characteristics

Table 6. 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 = 25 °C		60	-	-	V
		I _D = 250 μA; V _{GS} = 0 V; T _j = -55 °C		54	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 1 mA; V _{DS} =V _{GS} ; T _j = 25 °C; Fig. 9 ; Fig. 10		1.4	1.7	2.1	V
		I _D = 1 mA; V _{DS} =V _{GS} ; T _j = -55 °C; Fig. 9		-	-	2.45	V
		I _D = 1 mA; V _{DS} =V _{GS} ; T _j = 175 °C; Fig. 9		0.5	-	-	V
I _{DSS}	drain leakage current	V _{DS} = 60 V; V _{GS} = 0 V; T _j = 175 °C		-	-	500	μA
		V _{DS} = 60 V; V _{GS} = 0 V; T _j = 25 °C		-	0.12	10	μA
I _{GSS}	gate leakage current	V _{GS} = 16 V; V _{DS} = 0 V; T _j = 25 °C		-	2	100	nA
		V _{GS} = -16 V; V _{DS} = 0 V; T _j = 25 °C		-	2	100	nA
R _{DSon}	drain-source on-state resistance	V _{GS} = 5 V; I _D = 25 A; T _j = 25 °C; Fig. 11		-	3.3	4.8	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _j = 25 °C; Fig. 11		-	2.9	4.1	mΩ
		V _{GS} = 5 V; I _D = 25 A; T _j = 175 °C; Fig. 11 ; Fig. 12		-	-	10.8	mΩ
Dynamic characteristics							
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 48 V; V _{GS} = 10 V; T _j = 25 °C; Fig. 13 ; Fig. 14		-	103	-	nC
		I _D = 25 A; V _{DS} = 48 V; V _{GS} = 5 V; T _j = 25 °C; Fig. 13 ; Fig. 14		-	54.8	-	nC
Q _{GS}	gate-source charge	T _j = 25 °C; Fig. 13 ; Fig. 14		-	13.6	-	nC
Q _{GD}	gate-drain charge			-	18.1	-	nC
C _{iss}	input capacitance	V _{DS} = 25 V; V _{GS} = 0 V; f = 1 MHz; T _j = 25 °C; Fig. 15		-	5890	7853	pF
C _{oss}	output capacitance			-	506	607	pF
C _{rss}	reverse transfer capacitance			-	276	378	pF
t _{d(on)}	turn-on delay time	V _{DS} = 45 V; R _L = 1.8 Ω; V _{GS} = 5 V; R _{G(ext)} = 5 Ω; T _j = 25 °C		-	28	-	ns
t _r	rise time			-	53	-	ns
t _{d(off)}	turn-off delay time			-	80	-	ns
t _f	fall time			-	47	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 16		-	0.78	1.2	V

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t _{rr}	reverse recovery time	I _S = 20 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V;		-	29	-	ns
Q _r	recovered charge	V _{DS} = 25 V; T _j = 25 °C		-	28	-	nC



T_j = 25 °C; t_p = 300 μs

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

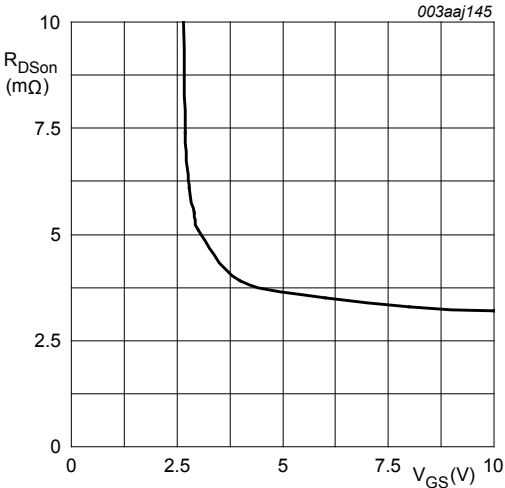


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

T_j = 25 °C; I_D = 25 A

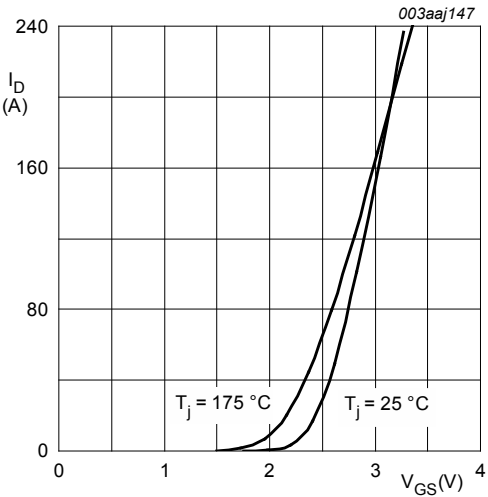


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

V_{DS} = 10 V

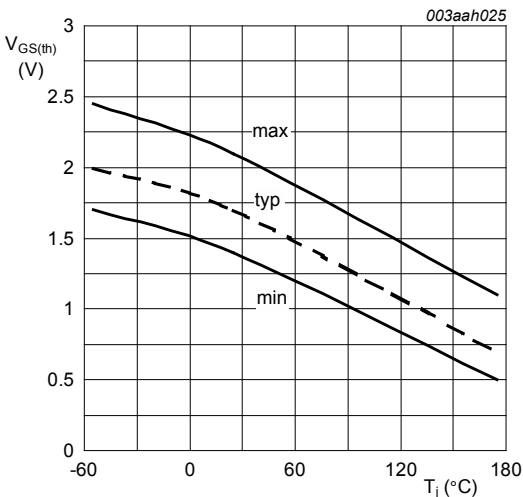


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

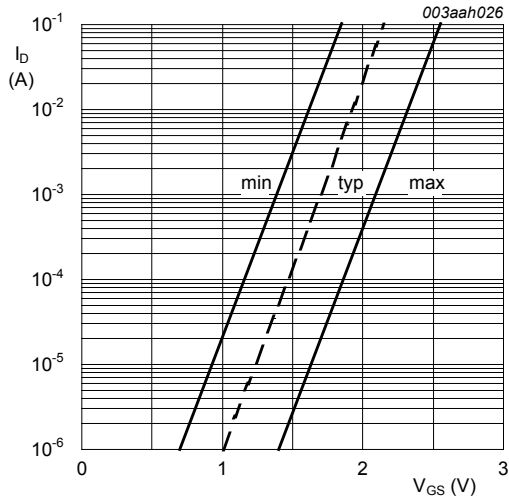
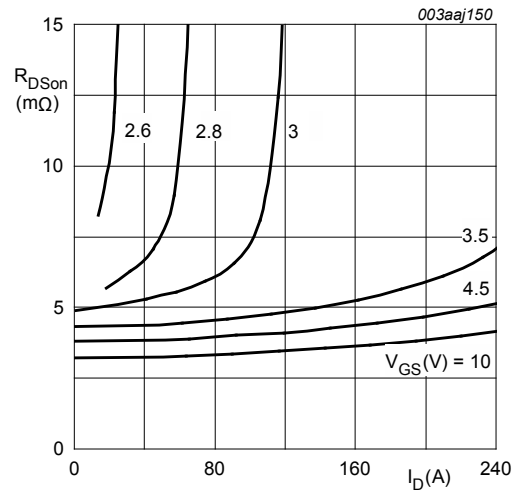


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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



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

Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

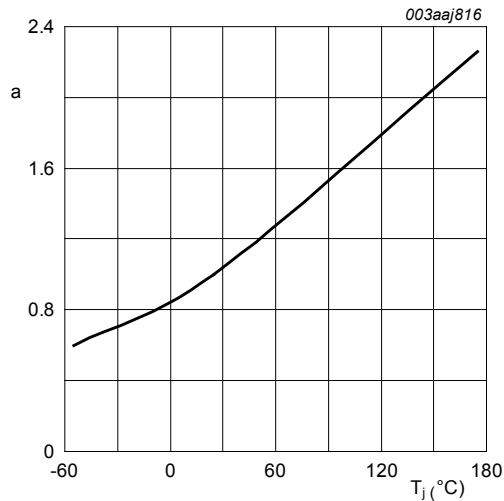


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

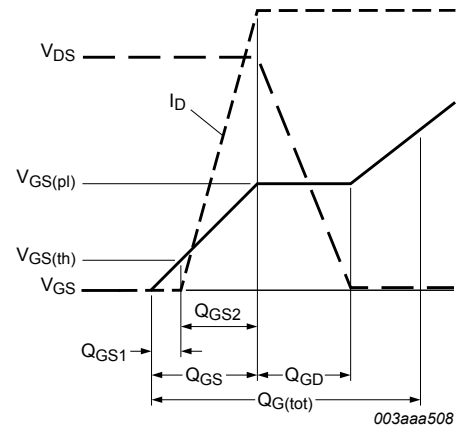


Fig. 13. Gate charge waveform definitions

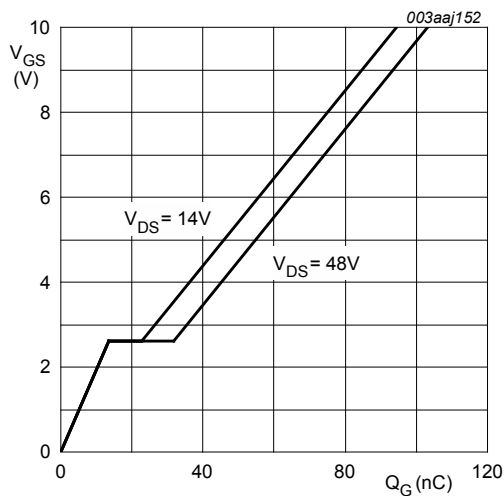


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

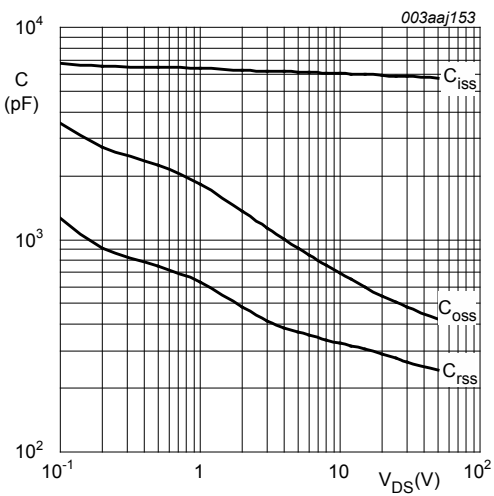


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

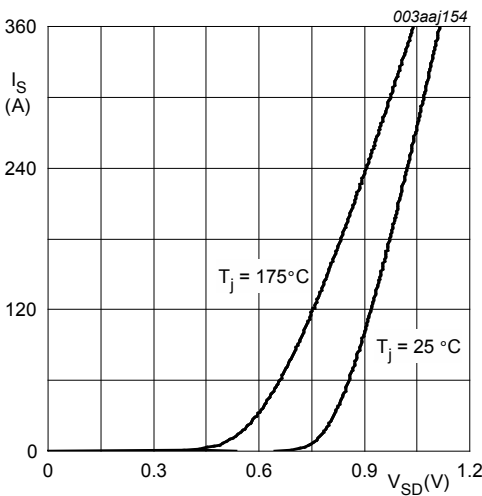


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

10. Package outline

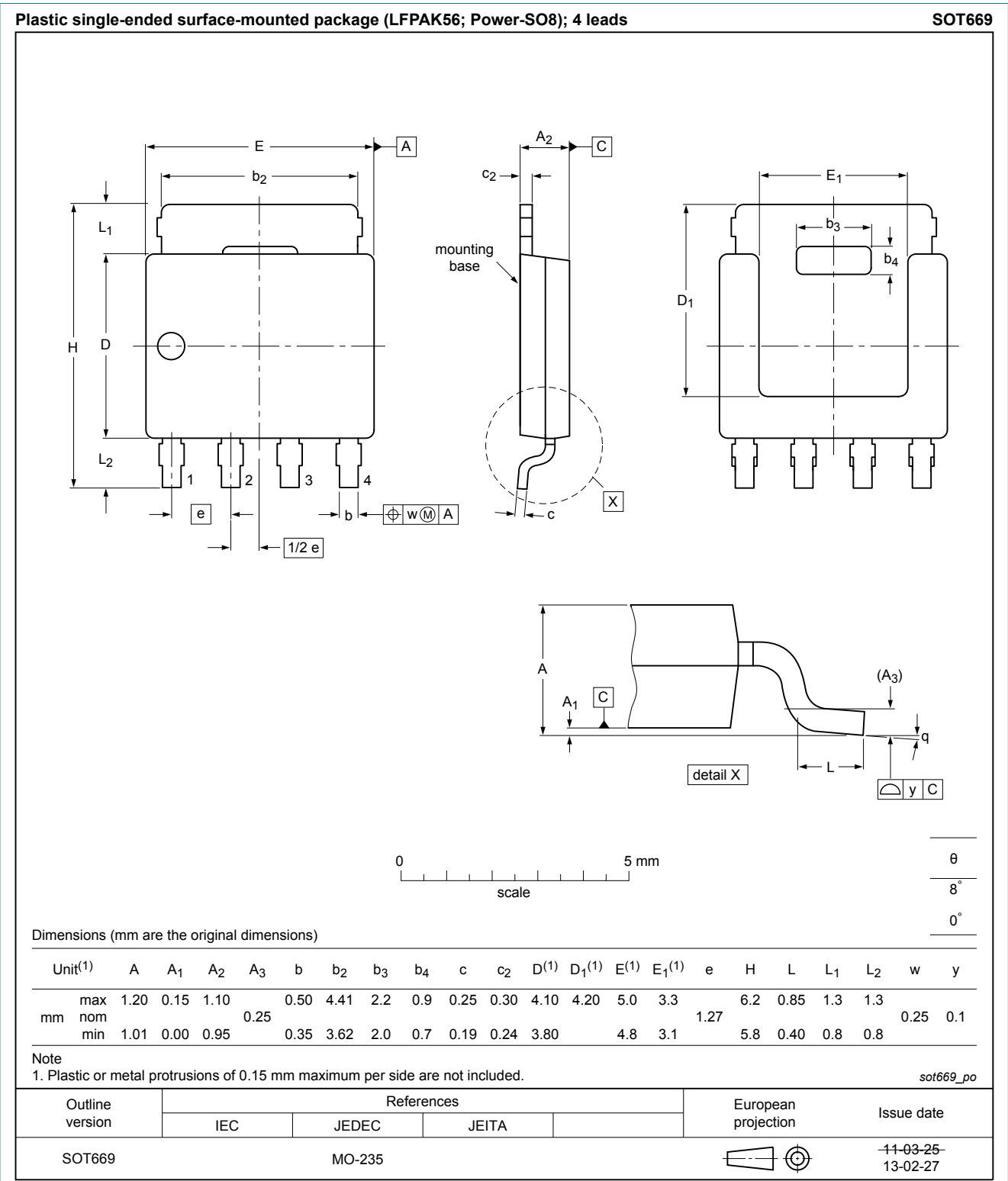


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

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