



PSMN1R0-25YLD

N-channel 25 V, 1.0 m Ω , 240 A logic level MOSFET in LPAK56 using NextPowerS3 Technology

23 June 2020

Product data sheet

1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LPAK56 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

- Avalanche rated, 100% tested at $I_{AS} = 190$ A
- Ultra low Q_G , Q_{GD} and Q_{OSS} for high system efficiency, especially at higher switching frequencies
- Superfast switching with soft-recovery
- 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 Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Wave solderable; 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
- Power OR-ing

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	25	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	240	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1	-	-	160	W
T_j	junction temperature		-55	-	175	°C
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10	-	0.89	1	m Ω

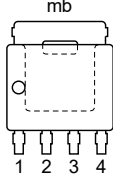
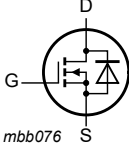
N-channel 25 V, 1.0 mΩ, 240 A logic level MOSFET in LFPAK56 using NextPowerS3 Technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_{GS} = 4.5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10	-	1.19	1.43	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 12\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12 ; Fig. 13	-	8	-	nC
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}$; $V_{DS} = 12\text{ V}$; $V_{GS} = 10\text{ V}$; Fig. 12 ; Fig. 13	-	71.8	-	nC
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 25\text{ A}$; $V_{sup} \leq 25\text{ V}$; $R_{GS} = 50\text{ Ω}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 4.34\text{ ms}$	[2] [3]	-	1762	mJ
Source-drain diode						
Q_r	recovered charge	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A/μs}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 12\text{ V}$; Fig. 16	[4]	36.7	-	nC

- [1] 240A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB thermal design and operating temperature.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.
- [4] includes capacitive recovery

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>LFPAK56; Power-SO8 (SOT669)</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
PSMN1R0-25YLD	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN1R0-25YLD	1D025L

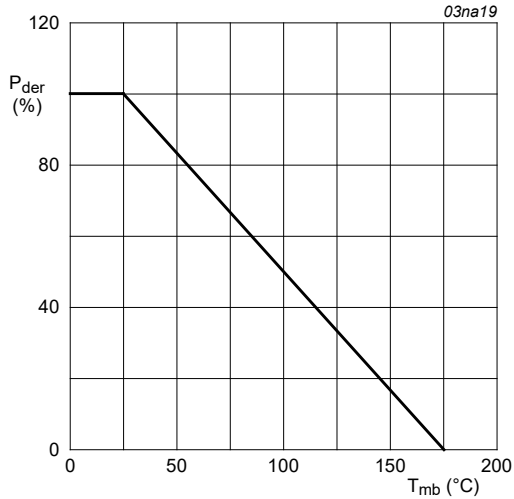
8. Limiting values

Table 5. Limiting values

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

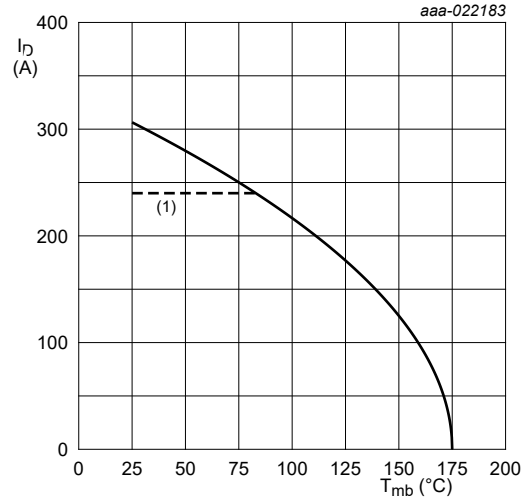
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	25	V
V_{DGR}	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$		-	25	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	160	W
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	240	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2		-	216	A
I_{DM}	peak drain current	$t_p \leq 10\text{ }\mu\text{s}$; Fig. 3		-	1226	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		1700	-	V
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$		-	133	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	1226	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 25\text{ A}$; $V_{sup} \leq 25\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 4.34\text{ ms}$	[2] [3]	-	1762	mJ
I_{AS}	non-repetitive avalanche current	$V_{sup} = 25\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; $R_{GS} = 50\text{ }\Omega$	[4]	-	190	A

- [1] 240A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB thermal design and operating temperature.
 [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
 [3] Refer to application note AN10273 for further information.
 [4] Protected by 100% test.



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

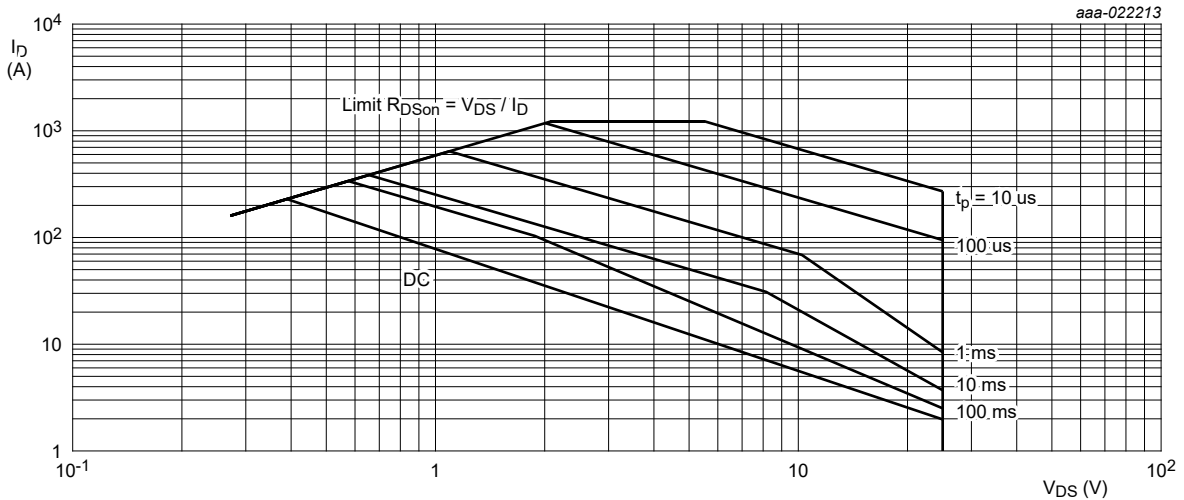
Fig. 1. Normalized total power dissipation as a function of mounting base temperature



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

(1) 240A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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



$T_{mb} = 25^\circ\text{C}$; 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	-	0.68	0.94	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	50	-	K/W
		Fig. 6	-	125	-	K/W

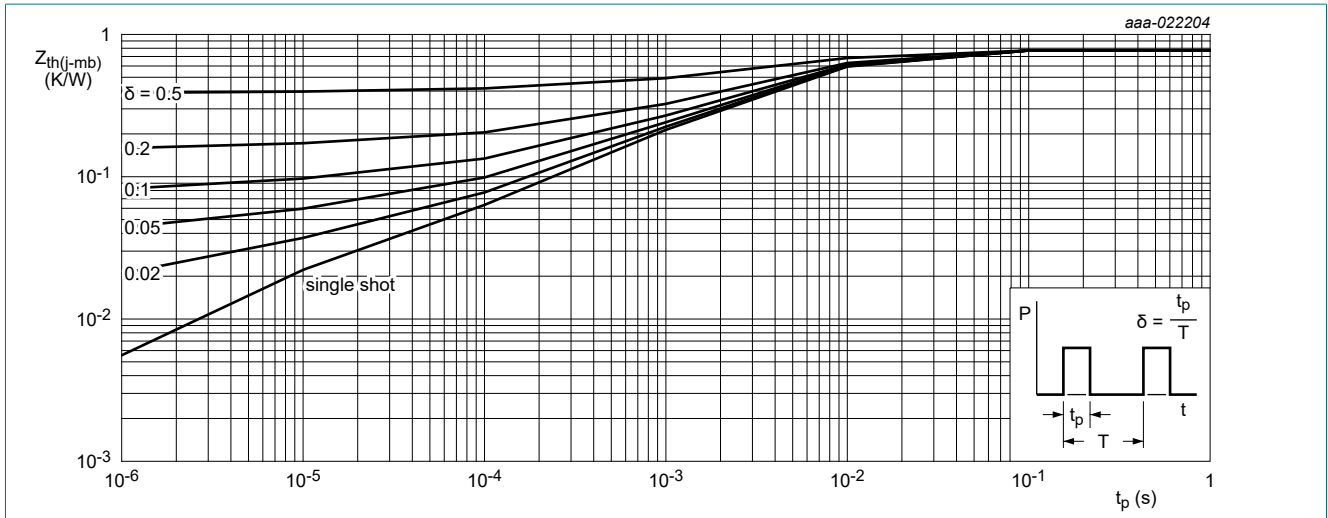


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

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aaa-005751

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	1.75	2.2	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 175 \text{ }^\circ C$	-	-5	-	mV/K
I_{DSS}	drain leakage current	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	1	μA
		$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	29.7	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 25 A; T _j = 25 °C; Fig. 10	-	0.89	1	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _j = 175 °C; Fig. 10 ; Fig. 11	-	-	1.7	mΩ
		V _{GS} = 4.5 V; I _D = 25 A; T _j = 25 °C; Fig. 10	-	1.19	1.43	mΩ
		V _{GS} = 4.5 V; I _D = 25 A; T _j = 175 °C; Fig. 10 ; Fig. 11	-	-	2.43	mΩ
R _G	gate resistance	f = 1 MHz	-	1.14	-	Ω
Dynamic characteristics						
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 12 V; V _{GS} = 10 V; Fig. 12 ; Fig. 13	-	71.8	-	nC
		I _D = 25 A; V _{DS} = 12 V; V _{GS} = 4.5 V; Fig. 12 ; Fig. 13	-	33.2	-	nC
		I _D = 0 A; V _{DS} = 0 V; V _{GS} = 10 V	-	39.7	-	nC
Q _{GS}	gate-source charge	I _D = 25 A; V _{DS} = 12 V; V _{GS} = 4.5 V; Fig. 12 ; Fig. 13	-	12.9	-	nC
Q _{GS(th)}	pre-threshold gate-source charge		-	7.8	-	nC
Q _{GS(th-pl)}	post-threshold gate-source charge		-	5.1	-	nC
Q _{GD}	gate-drain charge		-	8	-	nC
V _{GS(pl)}	gate-source plateau voltage	I _D = 25 A; V _{DS} = 12 V; Fig. 12 ; Fig. 13	-	2.7	-	V
C _{iss}	input capacitance	V _{DS} = 12 V; V _{GS} = 0 V; f = 1 MHz; T _j = 25 °C; Fig. 14	-	5308	-	pF
C _{oss}	output capacitance		-	1979	-	pF
C _{rss}	reverse transfer capacitance		-	342	-	pF
t _{d(on)}	turn-on delay time	V _{DS} = 12 V; R _L = 0.6 Ω; V _{GS} = 4.5 V; R _{G(ext)} = 5 Ω	-	30.3	-	ns
t _r	rise time		-	36	-	ns
t _{d(off)}	turn-off delay time		-	34	-	ns
t _f	fall time		-	24.5	-	ns
Q _{oss}	output charge	V _{GS} = 0 V; V _{DS} = 12 V; f = 1 MHz; T _j = 25 °C	-	36.4	-	nC
Source-drain diode						
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 15	-	0.79	1.2	V
t _{rr}	reverse recovery time	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 12 V; Fig. 16	-	36.9	-	ns
Q _r	recovered charge		[1]	36.7	-	nC
t _a	reverse recovery rise time		-	19.2	-	ns
t _b	reverse recovery fall time		-	17.7	-	ns
S	softness factor		-	0.9	-	

[1] includes capacitive recovery

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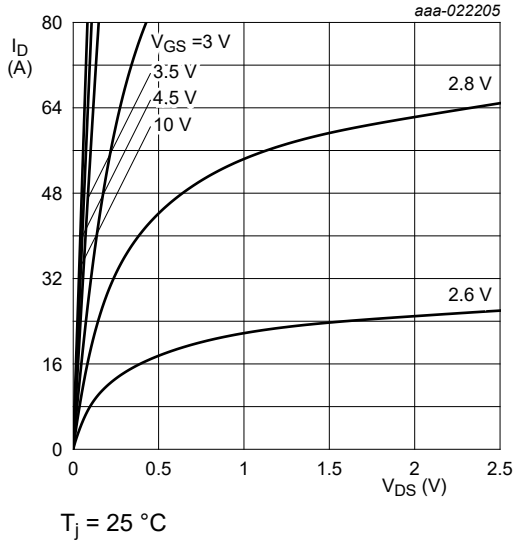


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

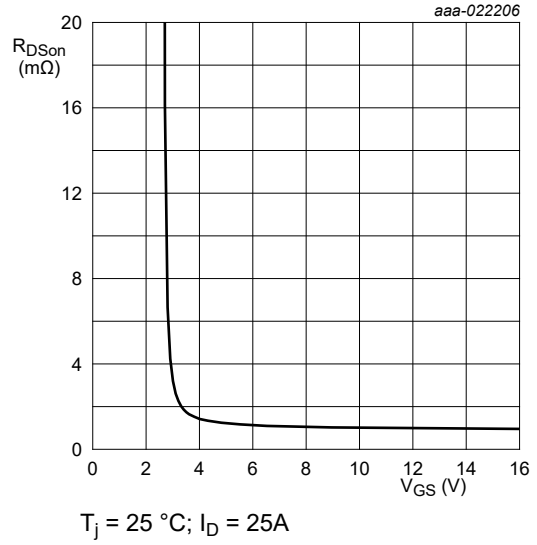


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

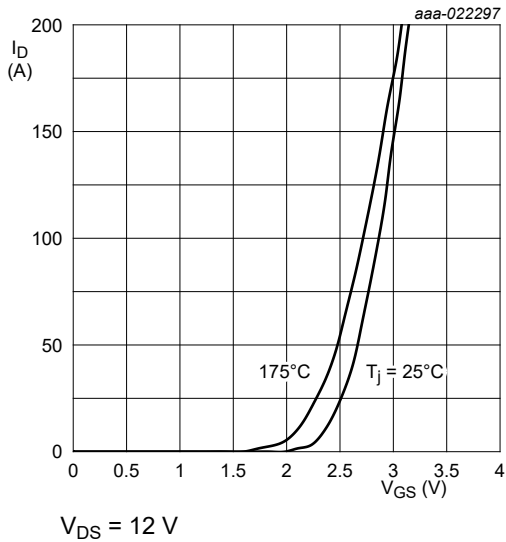


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

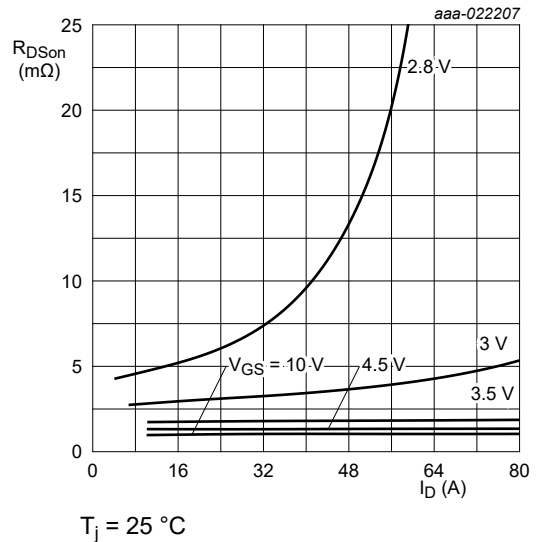
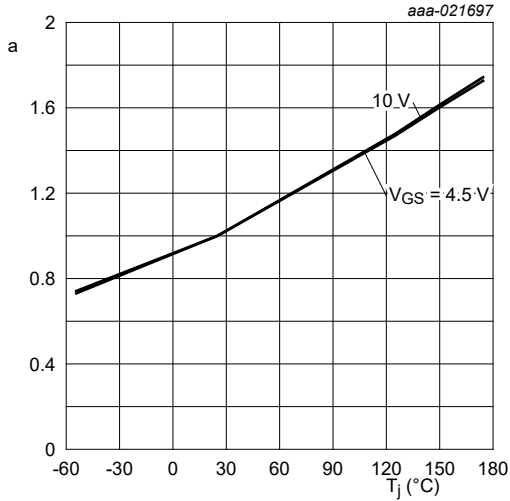
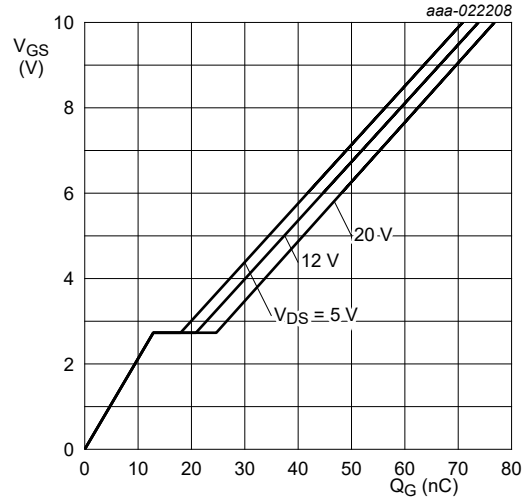


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values



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

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



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

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

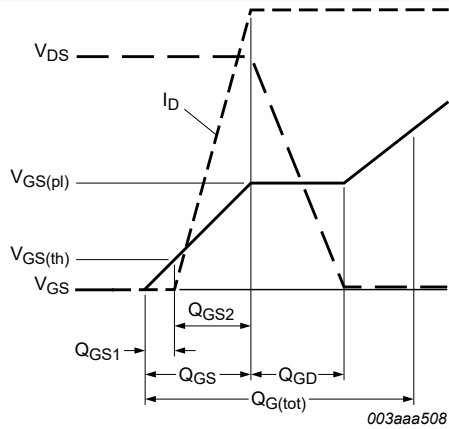
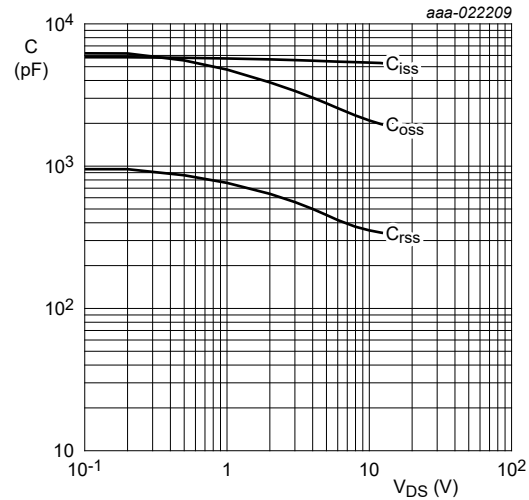
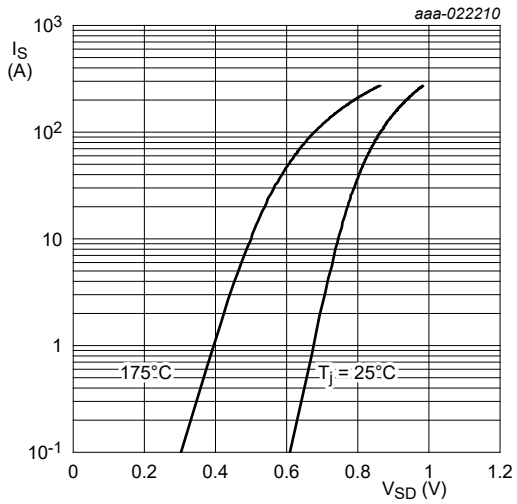


Fig. 13. Gate charge waveform definitions



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

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

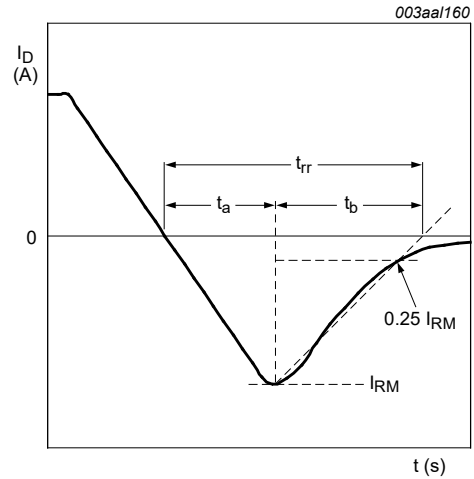


Fig. 16. Reverse recovery timing definition

11. Package outline

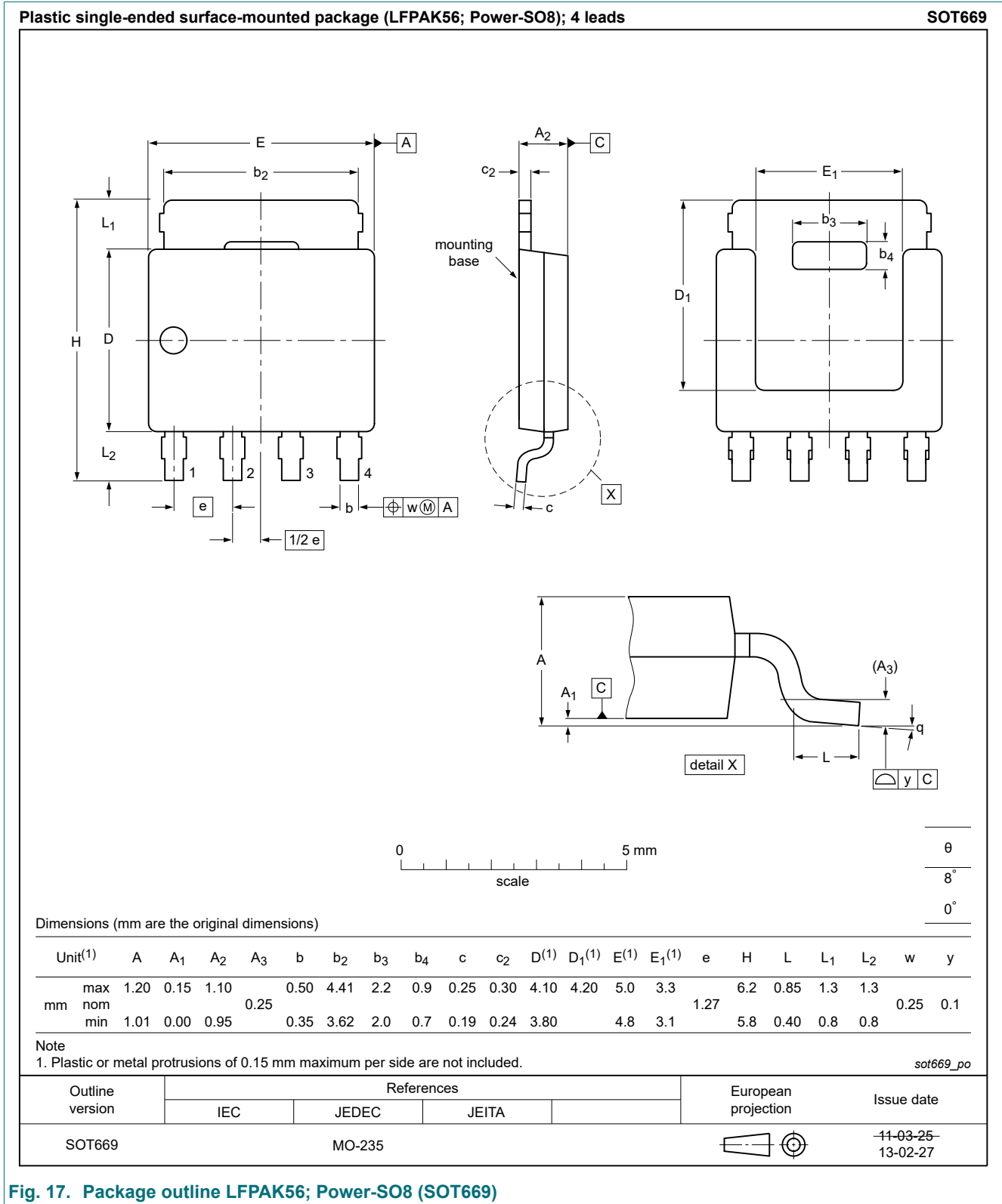


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

12. Soldering

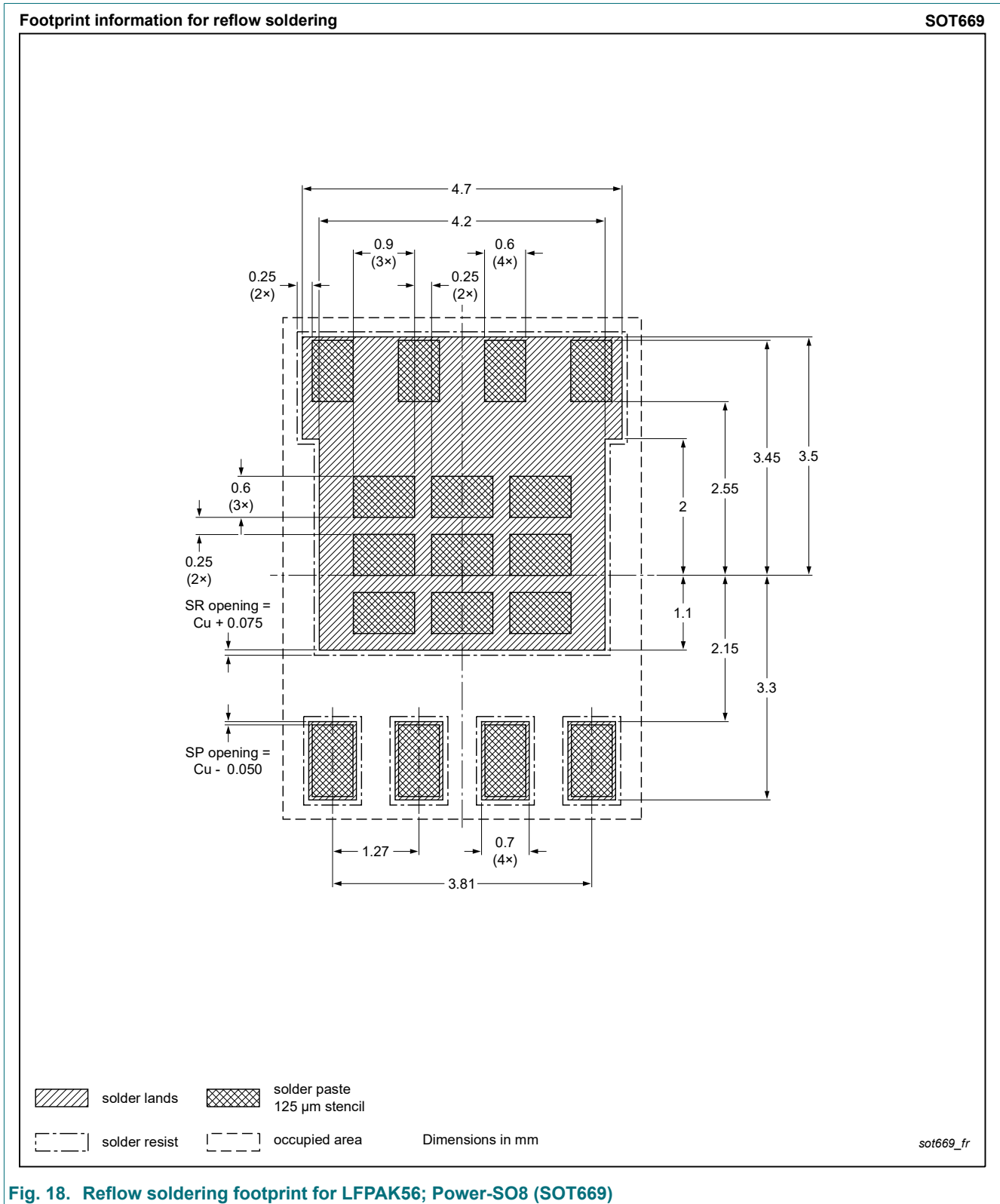
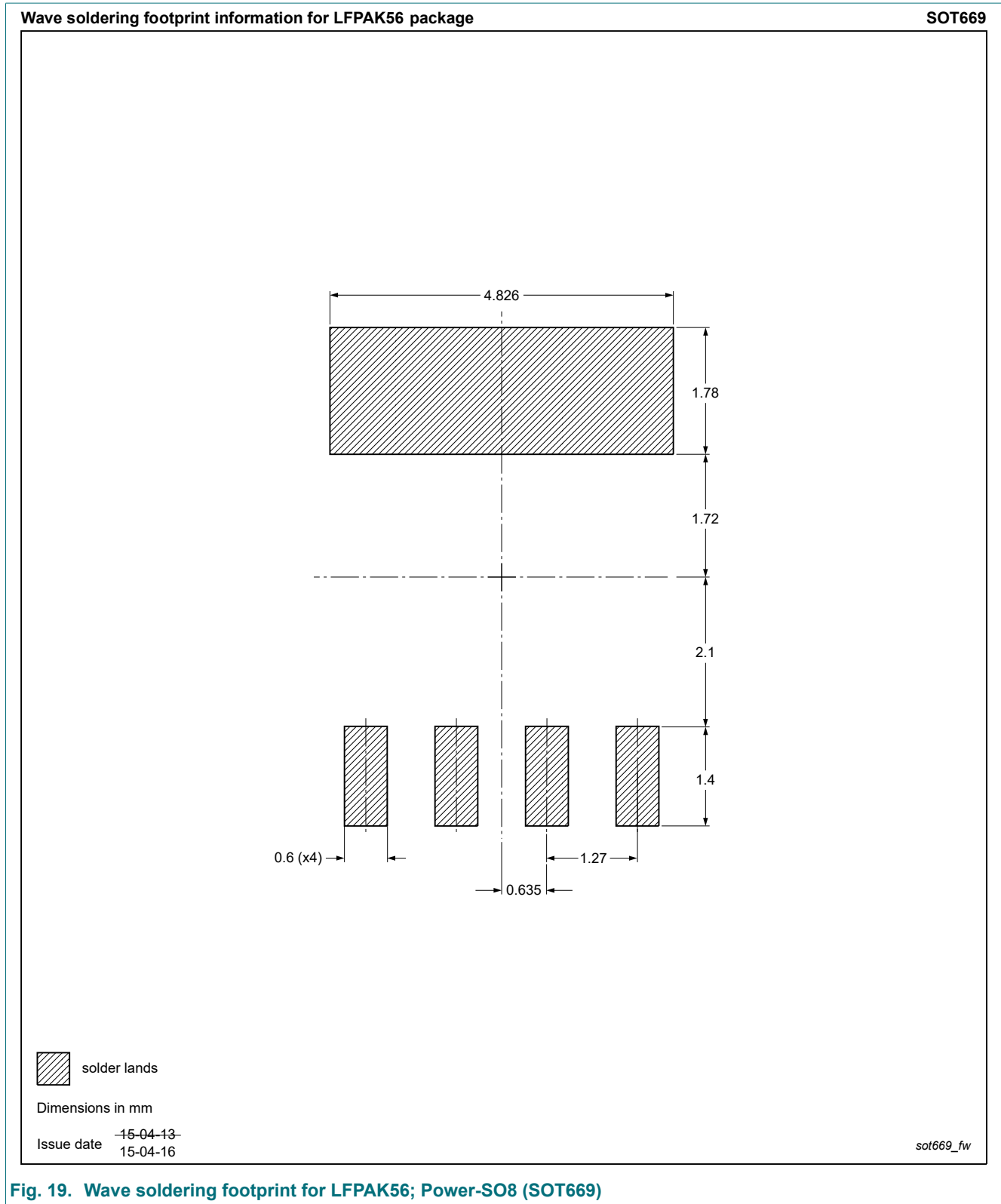


Fig. 18. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)



13. Legal information

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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