



PSMN9R3-60HS

N-channel 60 V, 9.3 mOhm, standard level MOSFET in LPAK56D using TrenchMOS technology

26 September 2022

Product data sheet

1. General description

Dual standard level N-channel MOSFET in an LPAK56D (Dual Power-SO8) package using TrenchMOS technology.

2. Features and benefits

- Dual MOSFET
- Repetitive avalanche rated
- High reliability LPAK56D package
- Copper-clip, solder die attach
- Qualified to 175 °C

3. Applications

- Brushless DC motor control
- DC-to-DC converters
- High-performance synchronous rectification
- High performance and high efficiency server power supply

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	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	40	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	68	W
T_j	junction temperature			-55	-	175	°C
Static characteristics FET1 and FET2							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 10\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11		-	7.64	9.3	mΩ
		$V_{GS} = 10\text{ V}$; $I_D = 10\text{ A}$; $T_j = 175\text{ °C}$; Fig. 11 ; Fig. 12		-	17.1	20.8	mΩ
Dynamic characteristics FET1 and FET2							
Q_{GD}	gate-drain charge	$I_D = 10\text{ A}$; $V_{DS} = 48\text{ V}$; $V_{GS} = 10\text{ V}$; $T_j = 25\text{ °C}$; Fig. 13 ; Fig. 14		-	11	-	nC
$Q_{G(tot)}$	total gate charge			-	34.2	-	nC
Avalanche ruggedness FET1 and FET2							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 40\text{ A}$; $V_{sup} \leq 60\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; Fig. 4	[2] [3]	-	-	103	mJ

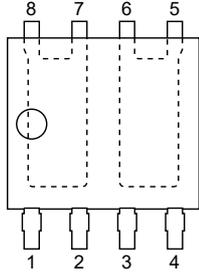
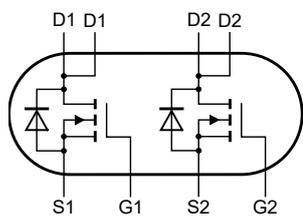
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode FET1 and FET2						
Q _r	recovered charge	I _S = 10 A; di _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 30 V; T _J = 25 °C	-	24	-	nC

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

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source1	 <p>LPAK56D; Dual LPAK (SOT1205)</p>	 <p>mbk725</p>
2	G1	gate1		
3	S2	source2		
4	G2	gate2		
5	D2	drain2		
6	D2	drain2		
7	D1	drain1		
8	D1	drain1		

6. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PSMN9R3-60HS	LPAK56D; Dual LPAK	plastic, single ended surface mounted package (LPAK56D); 8 leads	SOT1205

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN9R3-60HS	9R3S60H

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 °C ≤ T _J ≤ 175 °C	-	60	V
V _{DGR}	drain-gate voltage	R _{GS} = 20 kΩ	-	60	V
V _{GS}	gate-source voltage	DC; T _J ≤ 175 °C	-20	20	V
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 1	-	68	W
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C; Fig. 2	[1]	40	A
		V _{GS} = 10 V; T _{mb} = 100 °C; Fig. 2	[1]	40	A

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Symbol	Parameter	Conditions	Min	Max	Unit
I_{DM}	peak drain current	pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 3	-	228	A
T_{stg}	storage temperature		-55	175	$^\circ\text{C}$
T_j	junction temperature		-55	175	$^\circ\text{C}$
Source-drain diode FET1 and FET2					
I_S	source current	$T_{mb} = 25 \text{ }^\circ\text{C}$	[1]	40	A
I_{SM}	peak source current	pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25 \text{ }^\circ\text{C}$	-	228	A
Avalanche ruggedness FET1 and FET2					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 40 \text{ A}$; $V_{sup} \leq 60 \text{ V}$; $V_{GS} = 10 \text{ V}$; $T_{j(\text{init})} = 25 \text{ }^\circ\text{C}$; Fig. 4	[2] [3]	103	mJ

- [1] Continuous current is limited by package.
- [2] Refer to application note AN10273 for further information
- [3] Single-pulse avalanche rating limited by maximum junction temperature of 175 $^\circ\text{C}$

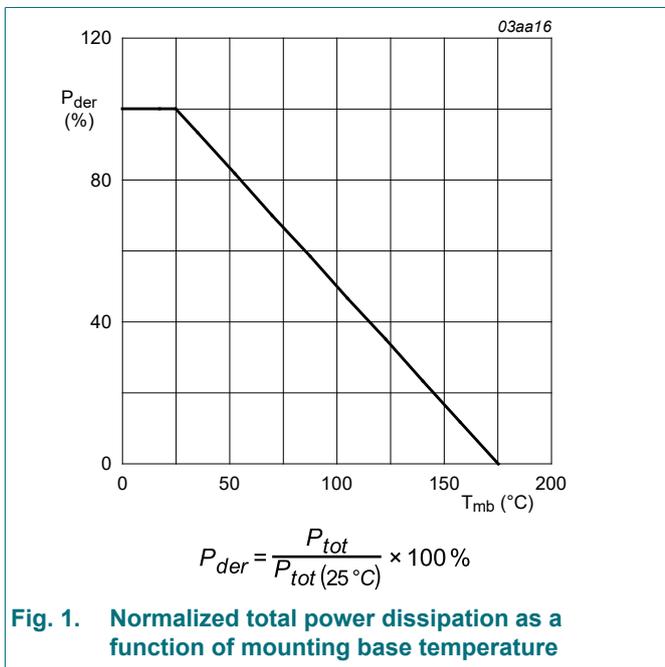


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

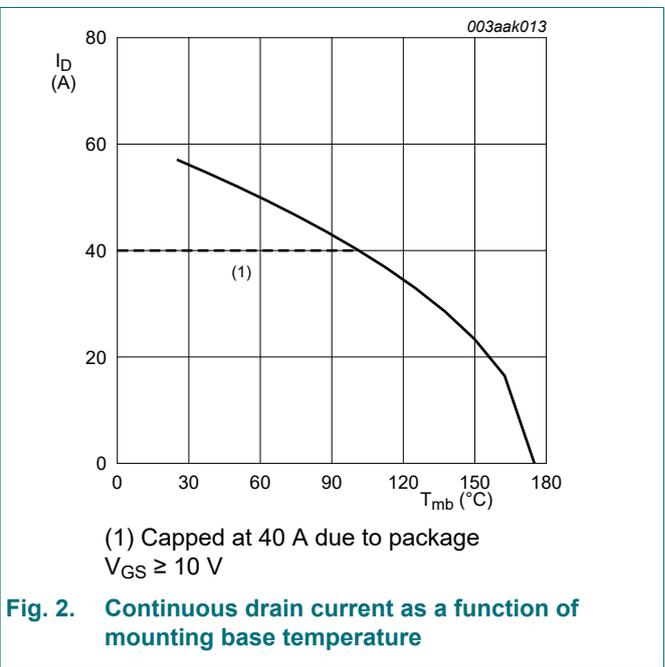


Fig. 2. Continuous drain current as a function of mounting base temperature

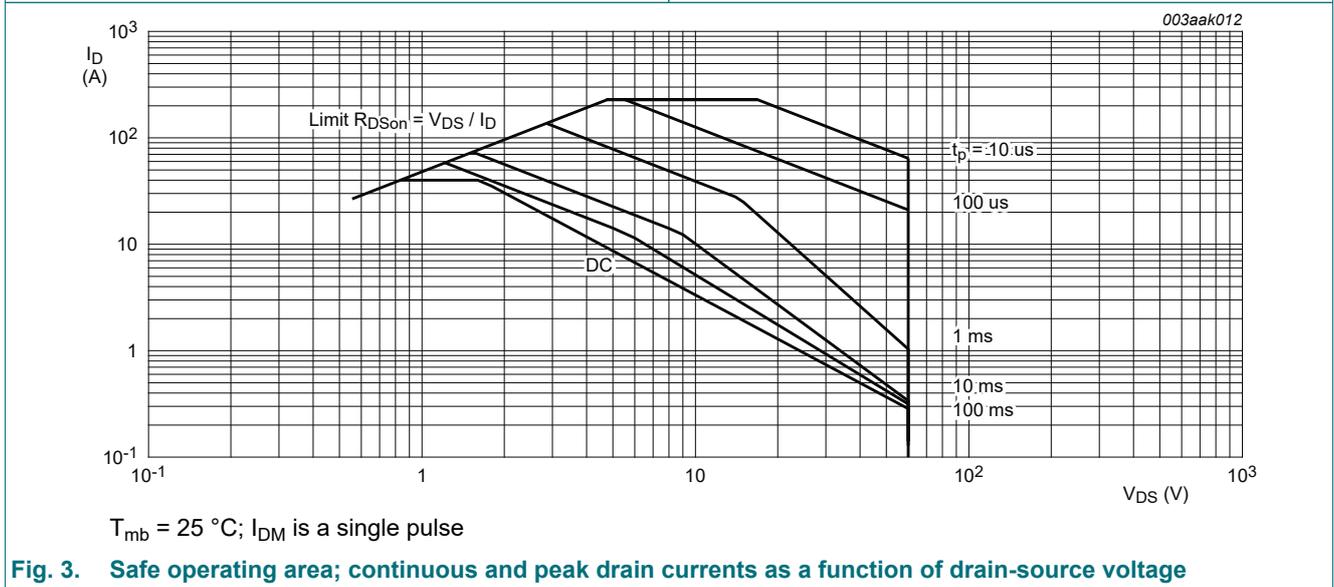
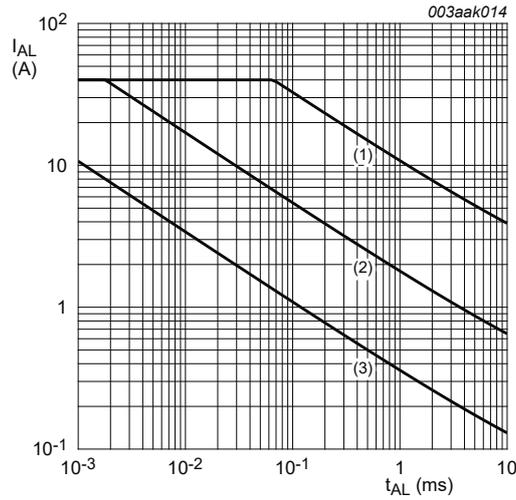


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage



(1) $T_{j(\text{init})} = 25\text{ °C}$; (2) $T_{j(\text{init})} = 150\text{ °C}$; (3) Repetitive Avalanche

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

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	-	-	2.21	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Minimum footprint; mounted on a printed circuit board	-	95	-	K/W

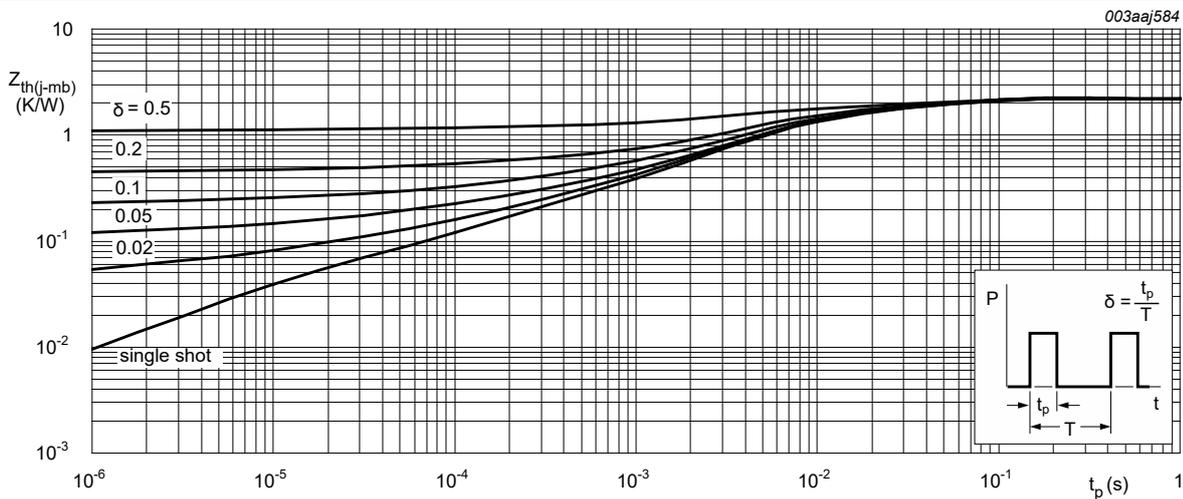


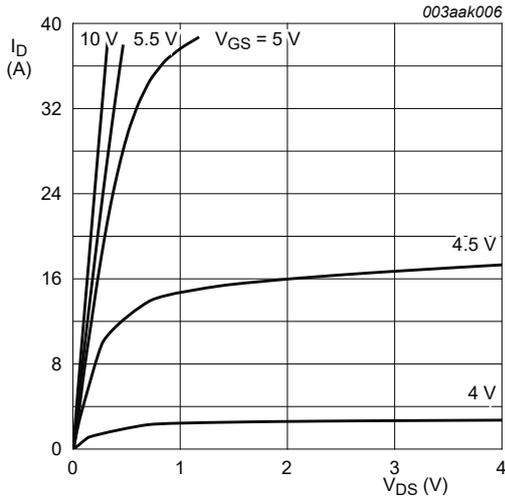
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

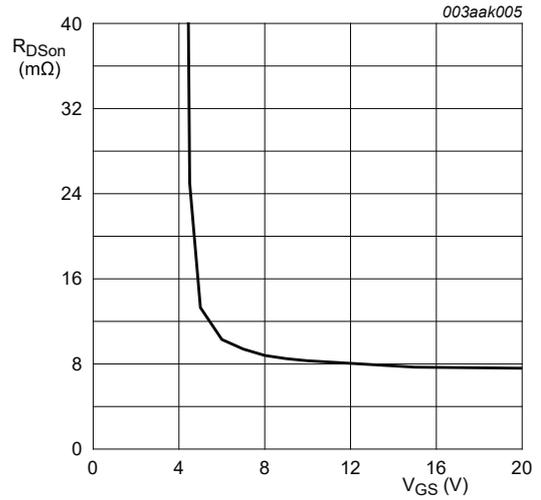
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics FET1 and FET2						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	54	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 9; Fig. 10	2.4	3	4	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 9; Fig. 10	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ Fig. 9; Fig. 10	-	-	4.5	V
I_{DSS}	drain leakage current	$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	1	μA
		$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 11	-	7.64	9.3	m Ω
		$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 11; Fig. 12	-	17.1	20.8	m Ω
Dynamic characteristics FET1 and FET2						
$Q_{G(tot)}$	total gate charge	$I_D = 10 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 13; Fig. 14	-	34.2	-	nC
Q_{GS}	gate-source charge		-	6.7	-	nC
Q_{GD}	gate-drain charge		-	11	-	nC
C_{iss}	input capacitance	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 15	-	1761	2348	pF
C_{oss}	output capacitance		-	247	297	pF
C_{rss}	reverse transfer capacitance		-	155	213	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = 48 \text{ V}; R_L = 5 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 5 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	9.1	-
t_r	rise time	-		12.5	-	ns
$t_{d(off)}$	turn-off delay time	-		23	-	ns
t_f	fall time	-		15	-	ns
Source-drain diode FET1 and FET2						
V_{SD}	source-drain voltage	$I_S = 10 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 16	-	0.78	1.2	V
t_{rr}	reverse recovery time	$I_S = 10 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V};$ $V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	25	-	ns
Q_r	recovered charge		-	24	-	nC

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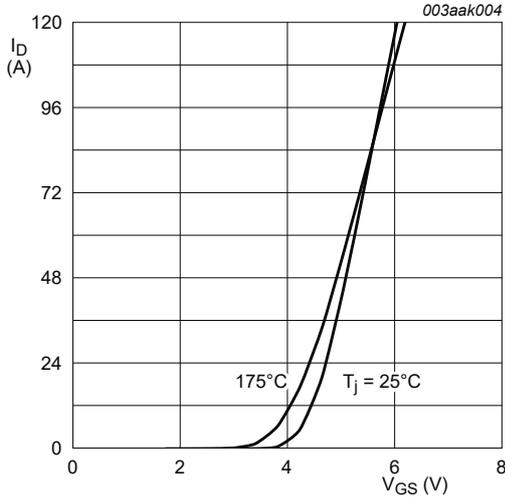
$T_j = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



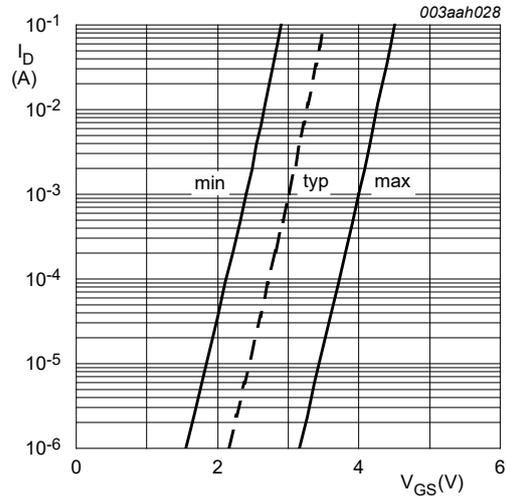
$T_j = 25\text{ }^\circ\text{C}$; $I_D = 10\text{ A}$

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



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

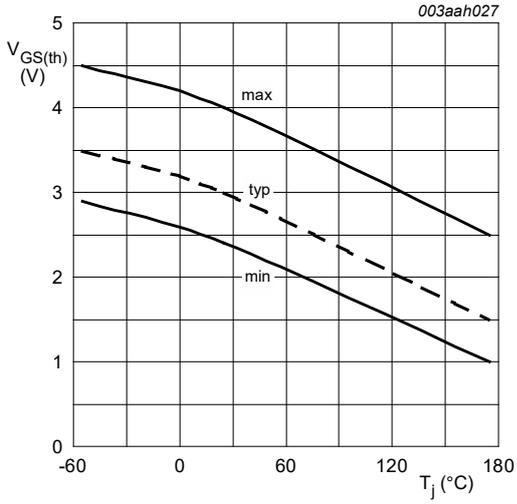
Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values



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

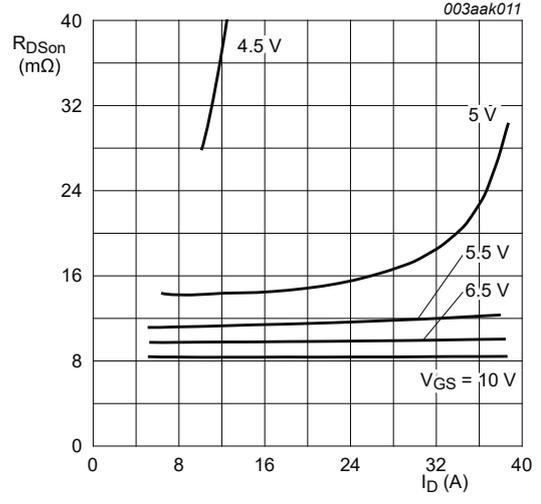
Fig. 9. Sub-threshold drain current as a function of gate-source voltage

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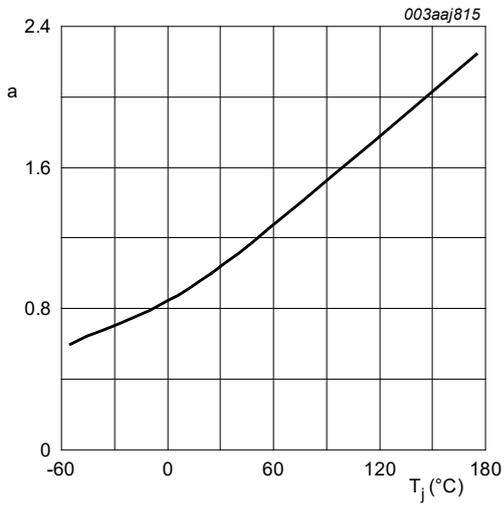
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



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

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



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

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

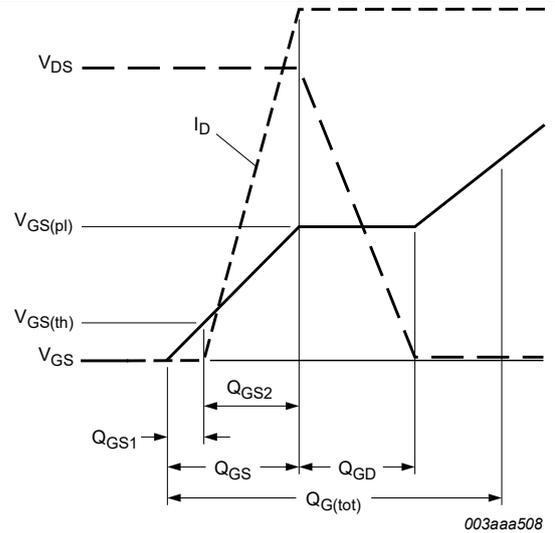
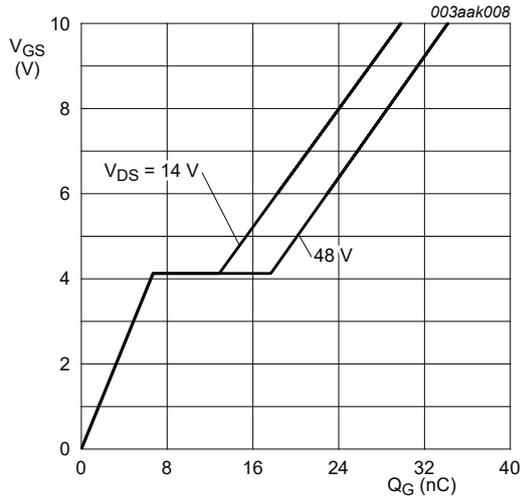


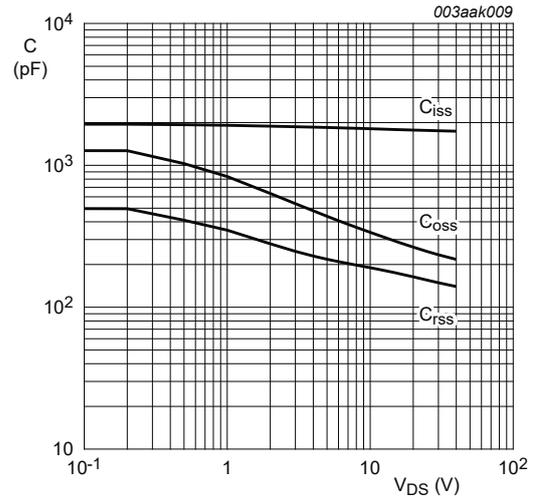
Fig. 13. Gate charge waveform definitions

N-channel 60 V, 9.3 mOhm, standard level MOSFET in LPAK56D using TrenchMOS technology



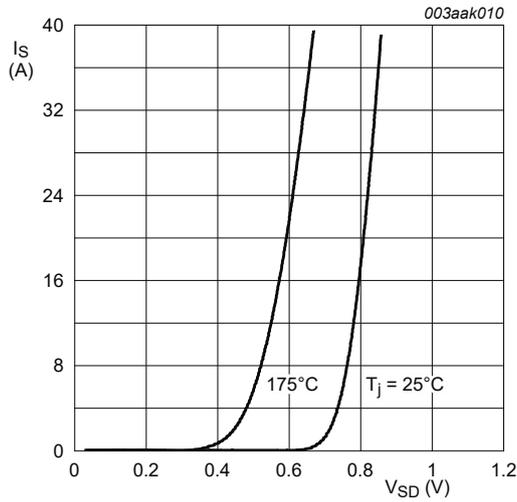
$T_j = 25\text{ }^\circ\text{C}$; $I_D = 10\text{ A}$

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



$V_{GS} = 0\text{ V}$; $I_D = 10\text{ A}$

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



$V_{GS} = 0\text{ V}$

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

11. Package outline

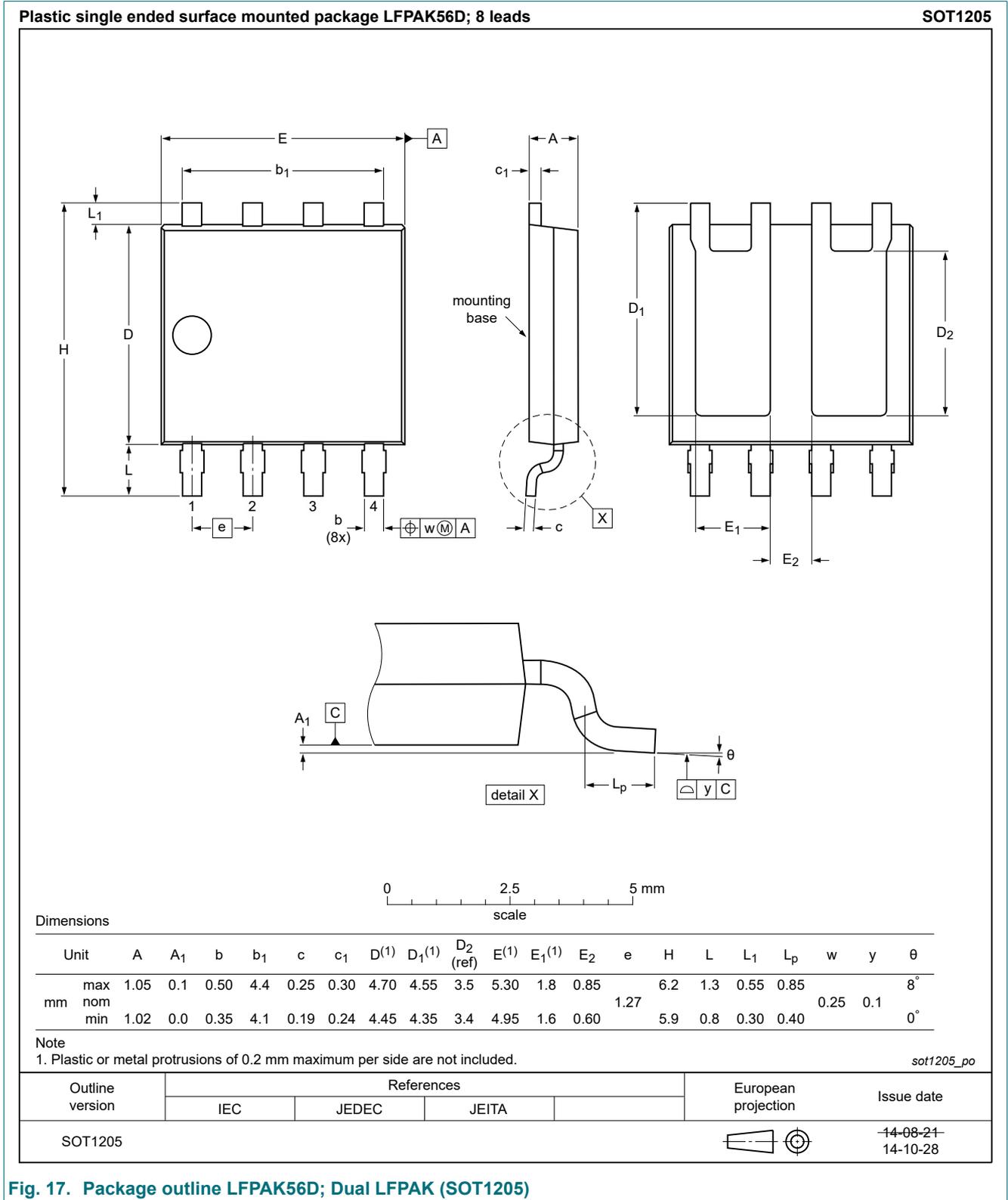


Fig. 17. Package outline LPAK56D; Dual LPAK (SOT1205)

12. Soldering

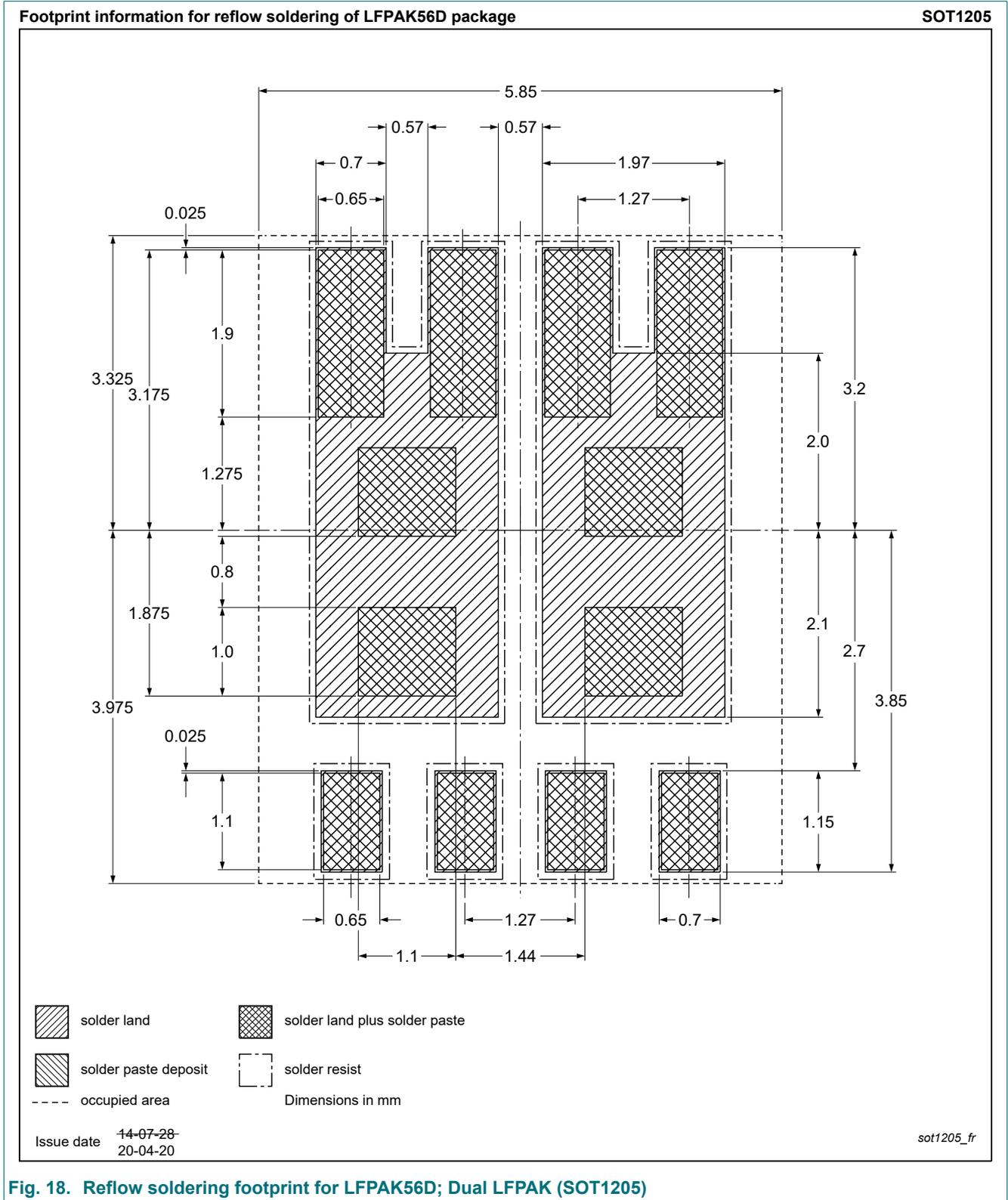


Fig. 18. Reflow soldering footprint for LPAK56D; Dual LPAK (SOT1205)

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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- [2] The term 'short data sheet' is explained in section "Definitions".
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