



# PSMN013-40VLD

Dual N-channel 40 V, 13 mOhm logic level MOSFET in LFAK56D (half-bridge configuration)

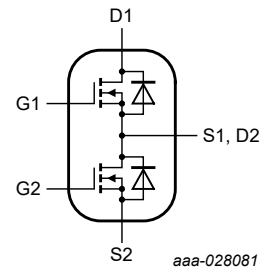
14 December 2023

Product data sheet

## 1. General description

Dual, logic level N-channel MOSFET in an LFAK56D package (half-bridge configuration), using NextpowerS3 technology.

An internal connection is made between the source (S1) of the high-side FET to the drain (D2) of the low-side FET, making the device ideal to use as a half-bridge switch in high-performance PWM and space constrained motor drive applications



## 2. Features and benefits

- LFAK56D package with half-bridge configuration enables:
  - Reduced PCB layout complexity
  - Module shrinkage through reduced component count
  - Improved system level  $R_{th(j-amb)}$  due to optimized package design
  - Lower parasitic inductance to support higher efficiency
  - Footprint compatibility with LFAK56D Dual package
- NextpowerS3 technology
- Low power losses, high power density
- Superior avalanche performance
- Repetitive avalanche rated
- LFAK copper clip packaging provides high robustness and reliability
- Gull wing leads support high manufacturability and Automated Optical Inspection (AOI)

## 3. Applications

- Handheld power tools, portable appliance and space constrained applications
- Brushless or brushed DC motor drive
- DC-to-DC systems
- LED lighting

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Limiting values FET1 and FET2</b>						
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	40	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}; \text{Fig. 2}$	[1]	-	42	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 1}$	-	-	46	W

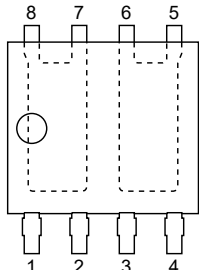
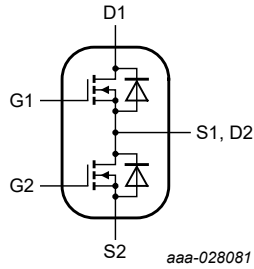
Dual N-channel 40 V, 13 mOhm logic level MOSFET in LFPAK56D (half-bridge configuration)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 10\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	11.35	13.6	mΩ
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{GD}$	gate-drain charge	$I_D = 10\text{ A}$ ; $V_{DS} = 32\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	0.6	2.1	4.2	nC
<b>Source-drain diode FET1 and FET2</b>						
$Q_r$	recovered charge	$I_S = 10\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$ ; <a href="#">Fig. 14</a>	-	16.2	-	nC

[1] 43A Continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

### 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S2	source2	 <p>LFPAK56D; Dual LFPAK (SOT1205)</p>	 <p>aaa-028081</p>
2	G2	gate2		
3	S1	source1		
4	G1	gate1		
5	D1	drain1		
6	D1	drain1		
7	S1, D2	source1, drain2		
8	S1, D2	source1, drain2		

### 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN013-40VLD	LFPAK56D; Dual LFPAK	plastic, single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

### 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN013-40VLD	13DL40V

## 8. Limiting values

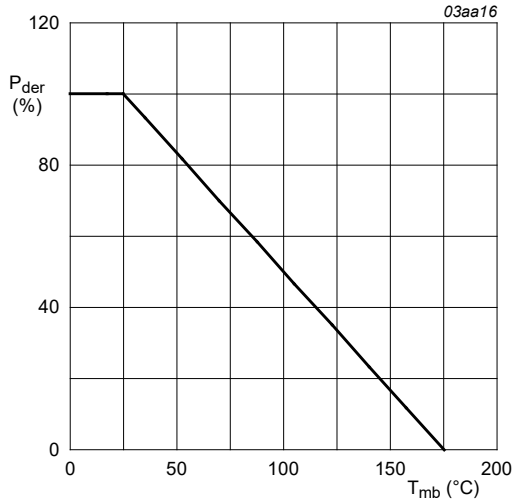
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Limiting values FET1 and FET2</b>						
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	40	V
$V_{DSM}$	peak drain-source voltage	$t_p = 20\text{ ns}$ ; $f = 500\text{ kHz}$ ; $E_{DS(AL)} = 200\text{ nJ}$ ; pulsed		-	45	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$		-	40	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	46	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	42	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$		-	30	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>		-	169	A
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
<b>Source-drain diode FET1 and FET2</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$		-	42	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$		-	169	A
<b>Avalanche ruggedness FET1 and FET2</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 39.9\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; unclamped; $t_p = 9\text{ }\mu\text{s}$		-	10.6	mJ
$I_{AS}$	non-repetitive avalanche current	$V_{sup} = 40\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; $R_{GS} = 50\text{ }\Omega$	[2]	-	39.9	A

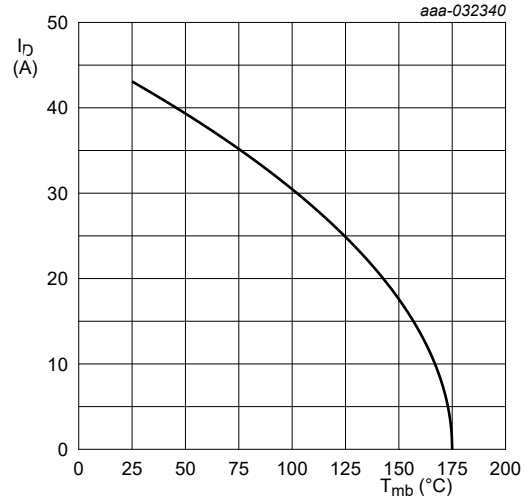
[1] 43A Continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

[2] Protected by 100% test



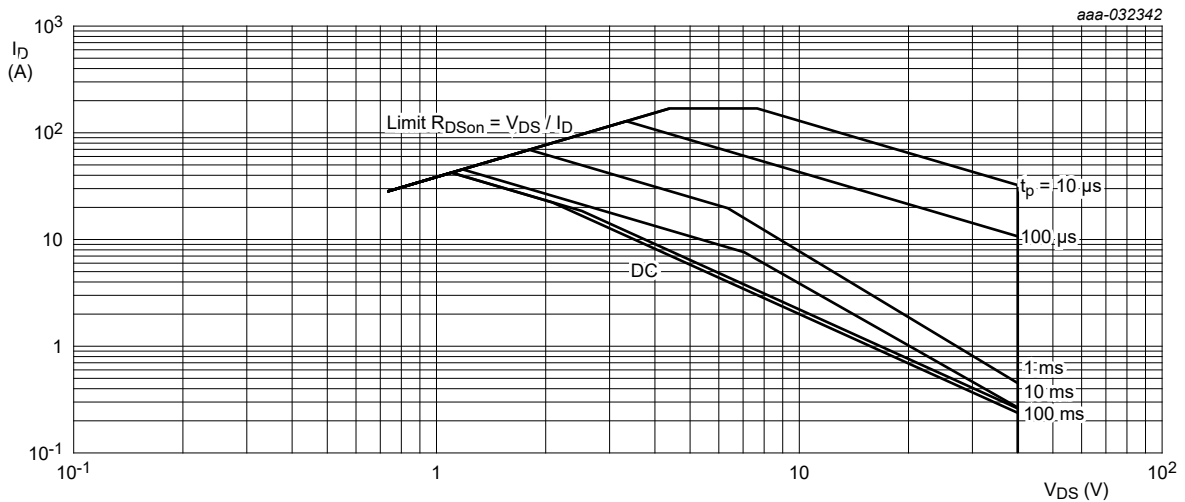
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



$V_{GS} \geq 5\text{ V}$   
 42A 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, FET1 and FET2**



**Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage, FET1 and FET2**

## 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	3.23	K/W

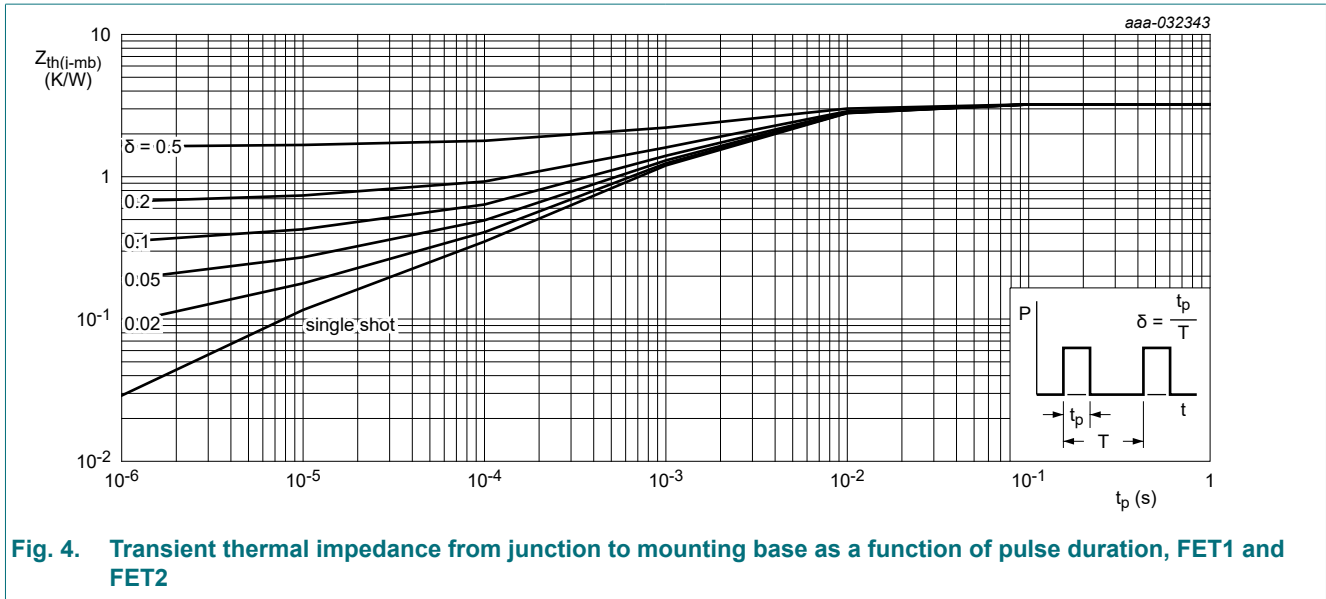


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration, FET1 and FET2

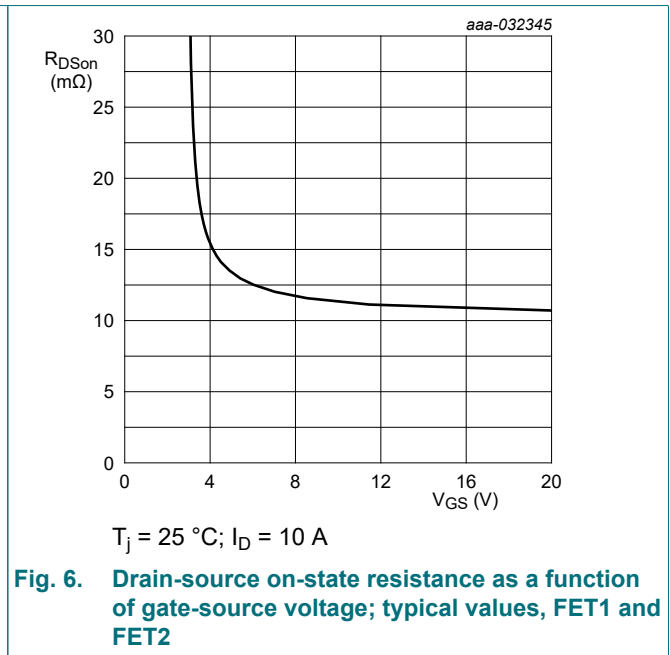
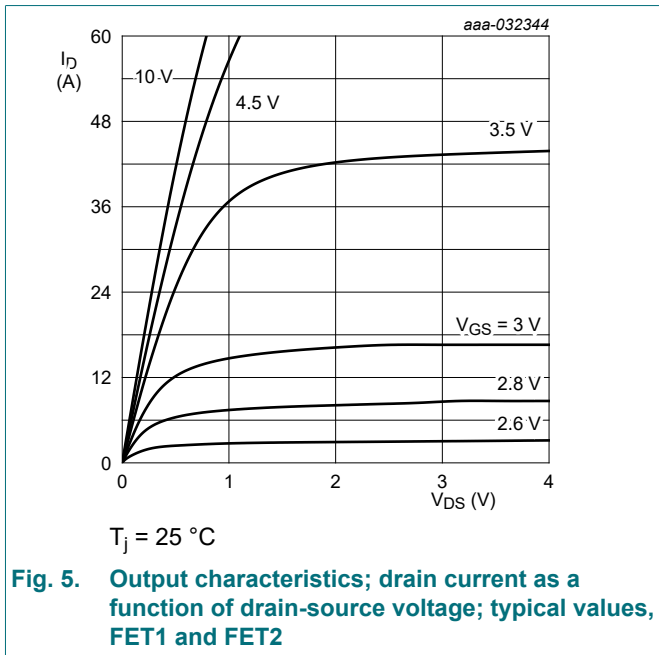
## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	40	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	1.5	1.85	2.2	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 150 \text{ }^\circ C$	-	-4.2	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.01	5	$\mu A$
		$V_{DS} = 16 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	0.14	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = -16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ C; \text{ Fig. 8}$	-	11.35	13.6	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ C; \text{ Fig. 9}$	-	-	26.4	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ C; \text{ Fig. 8}$	-	14.04	16.9	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ C; \text{ Fig. 9}$	-	-	32.8	m $\Omega$
$R_G$	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	0.7	1.7	4.2	$\Omega$
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 10 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 5 \text{ V}; \text{ Fig. 10; Fig. 11}$	4.7	7.3	10.2	nC
		$I_D = 10 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V}; \text{ Fig. 10; Fig. 11}$	9	13.9	19.4	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	7.3	-	nC

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Q_{GS}$	gate-source charge	$I_D = 10\text{ A}; V_{DS} = 32\text{ V}; V_{GS} = 5\text{ V};$ <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	1.5	2.5	3.8	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		0.8	1.4	2.1	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		0.7	1.1	1.6	nC
$Q_{GD}$	gate-drain charge		0.6	2.1	4.2	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 10\text{ A}; V_{DS} = 32\text{ V};$ <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	-	2.9	-	V
$C_{iss}$	input capacitance	$V_{DS} = 25\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	539	829	1160	pF
$C_{oss}$	output capacitance		182	280	420	pF
$C_{riss}$	reverse transfer capacitance		11.4	38	84	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}; R_L = 3\text{ }\Omega; V_{GS} = 5\text{ V};$ $R_{G(ext)} = 5\text{ }\Omega$	-	5.6	-	ns
$t_r$	rise time		-	8.1	-	ns
$t_{d(off)}$	turn-off delay time		-	9.1	-	ns
$t_f$	fall time		-	6.5	-	ns
$Q_{oss}$	output charge		-	11.5	-	nC
<b>Source-drain diode FET1 and FET2</b>						
$V_{SD}$	source-drain voltage	$I_S = 10\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 13</a>	-	0.84	1	V
$t_{rr}$	reverse recovery time	$I_S = 10\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V};$ <a href="#">Fig. 14</a>	-	21.5	-	ns
$Q_r$	recovered charge		-	16.2	-	nC
$t_a$	reverse recovery rise time		-	9.1	-	ns
$t_b$	reverse recovery fall time		-	6.3	-	ns



Dual N-channel 40 V, 13 mOhm logic level MOSFET in LPAK56D (half-bridge configuration)

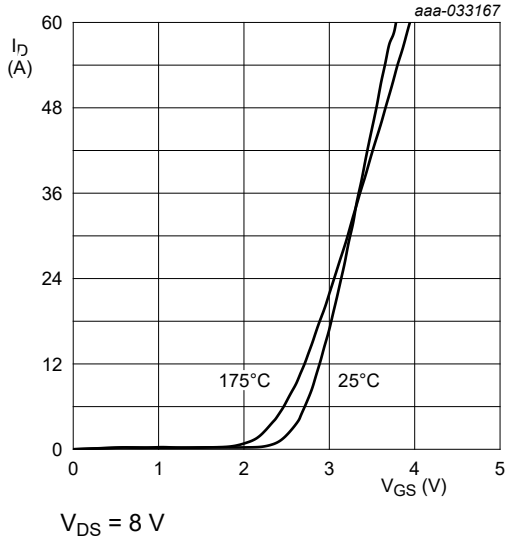


Fig. 7. Transfer characteristics; drain current as a function of gate-source voltage; typical values, FET1 and FET2

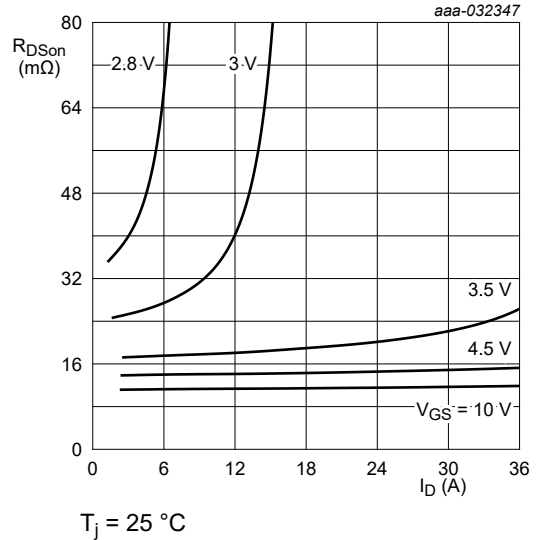


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values, FET1 and FET2

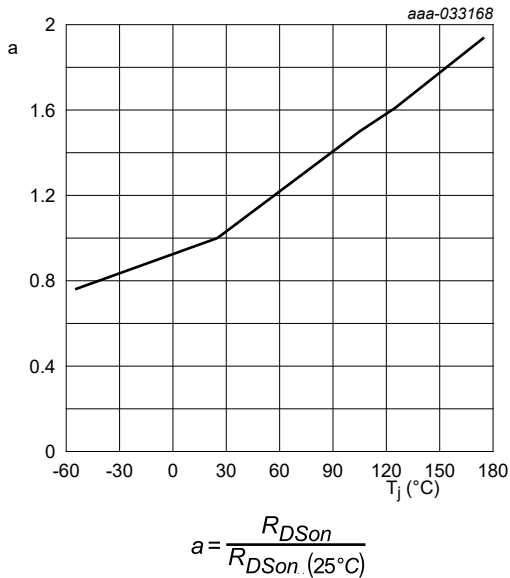


Fig. 9. Normalized drain-source on-state resistance factor as a function of junction temperature, FET1 and FET2

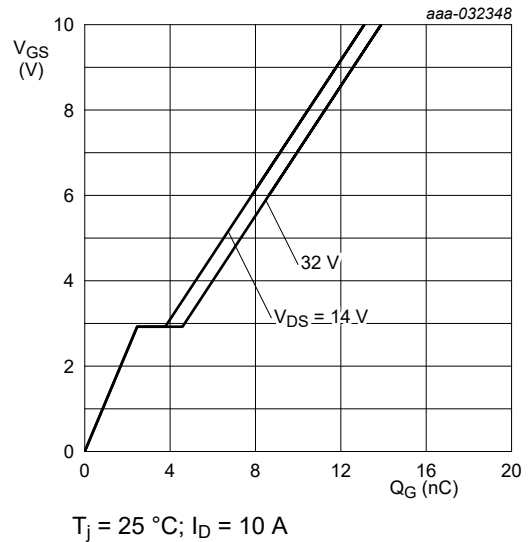


Fig. 10. Gate-source voltage as a function of gate charge; typical values, FET1 and FET2

Dual N-channel 40 V, 13 mOhm logic level MOSFET in LPAK56D (half-bridge configuration)

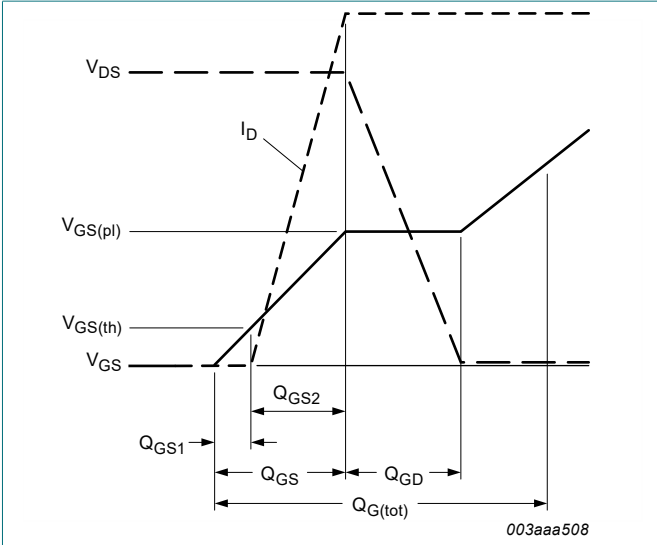


Fig. 11. Gate charge waveform definitions

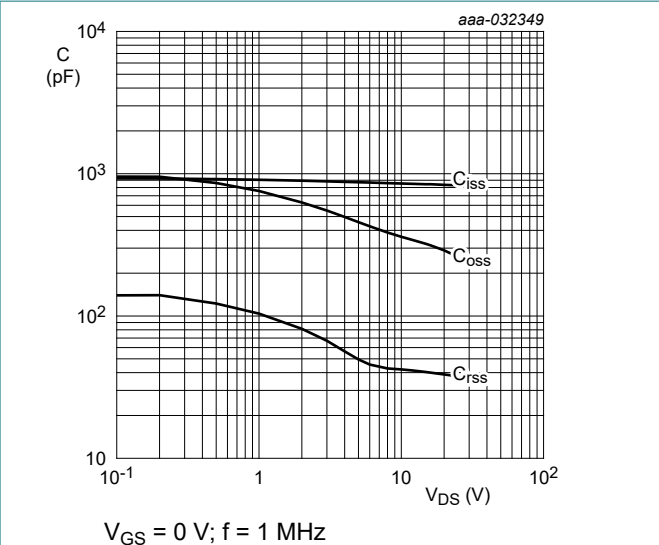


Fig. 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values, FET1 and FET2

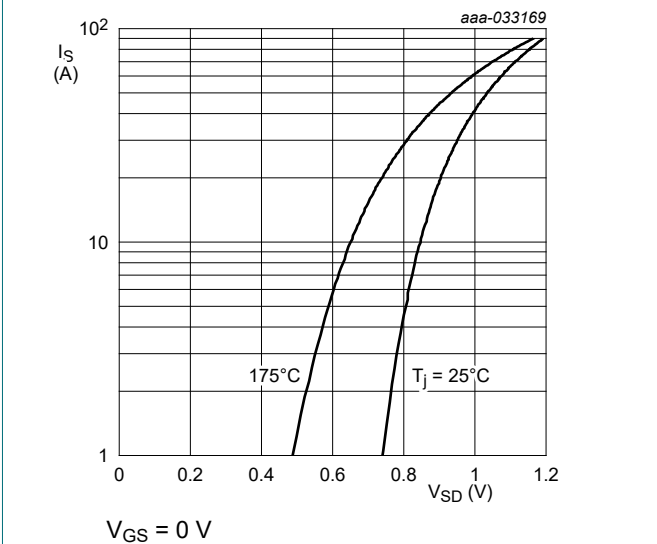


Fig. 13. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values, FET1 and FET2

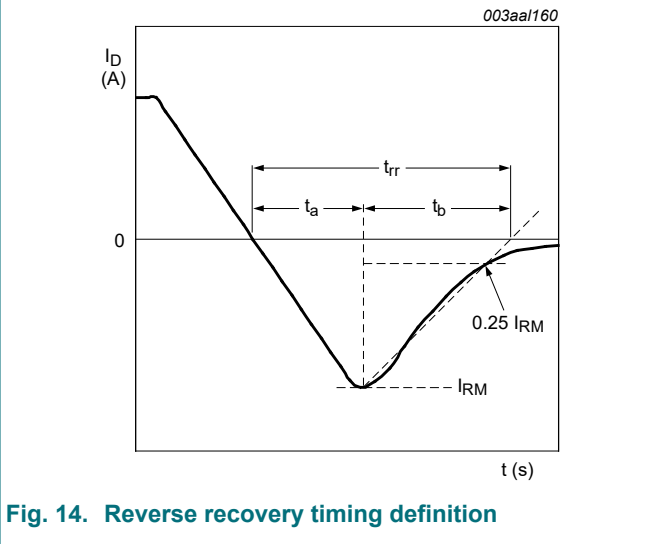


Fig. 14. Reverse recovery timing definition



11. Package outline

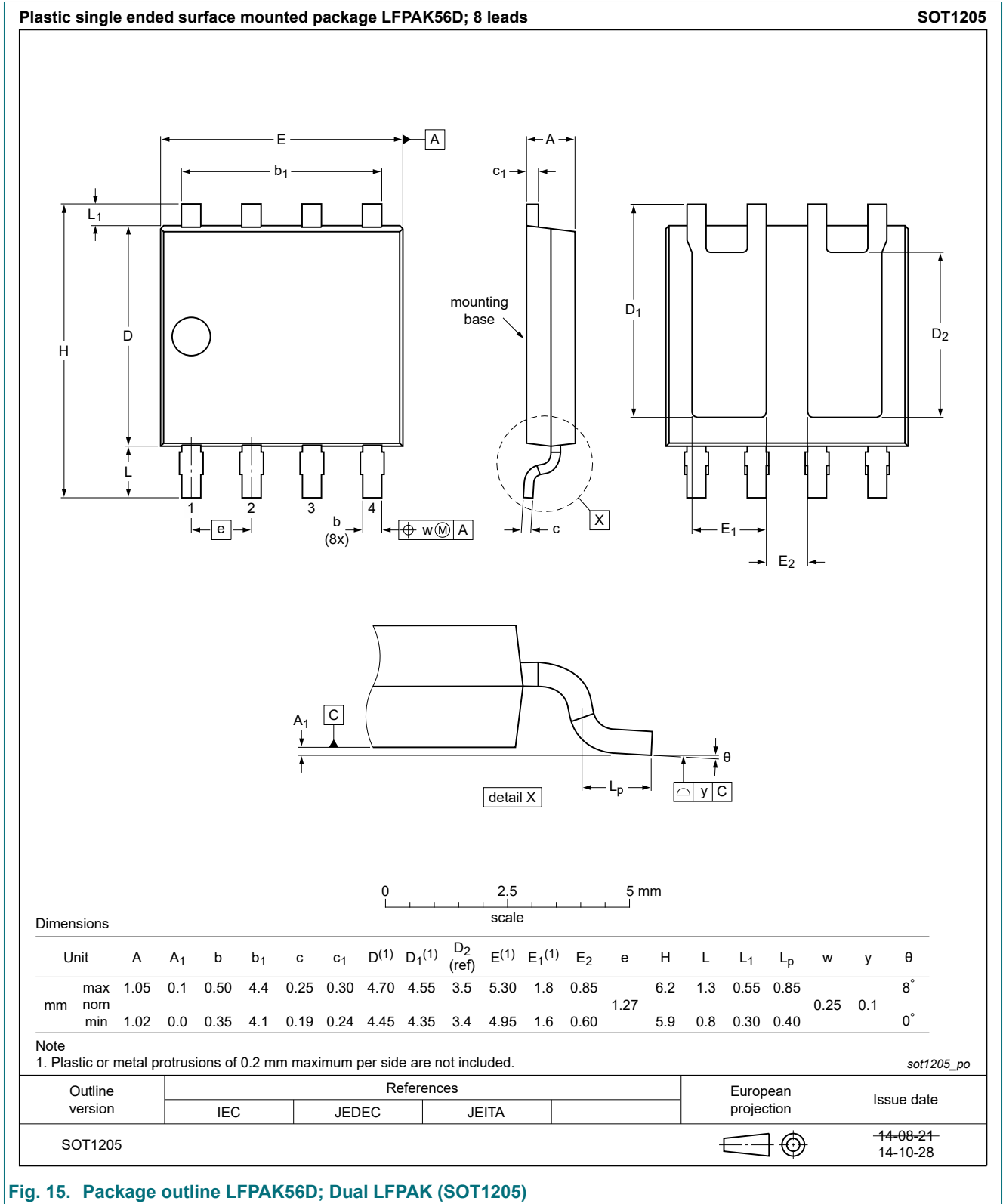


Fig. 15. Package outline LPAK56D; Dual LPAK (SOT1205)

## 12. Soldering

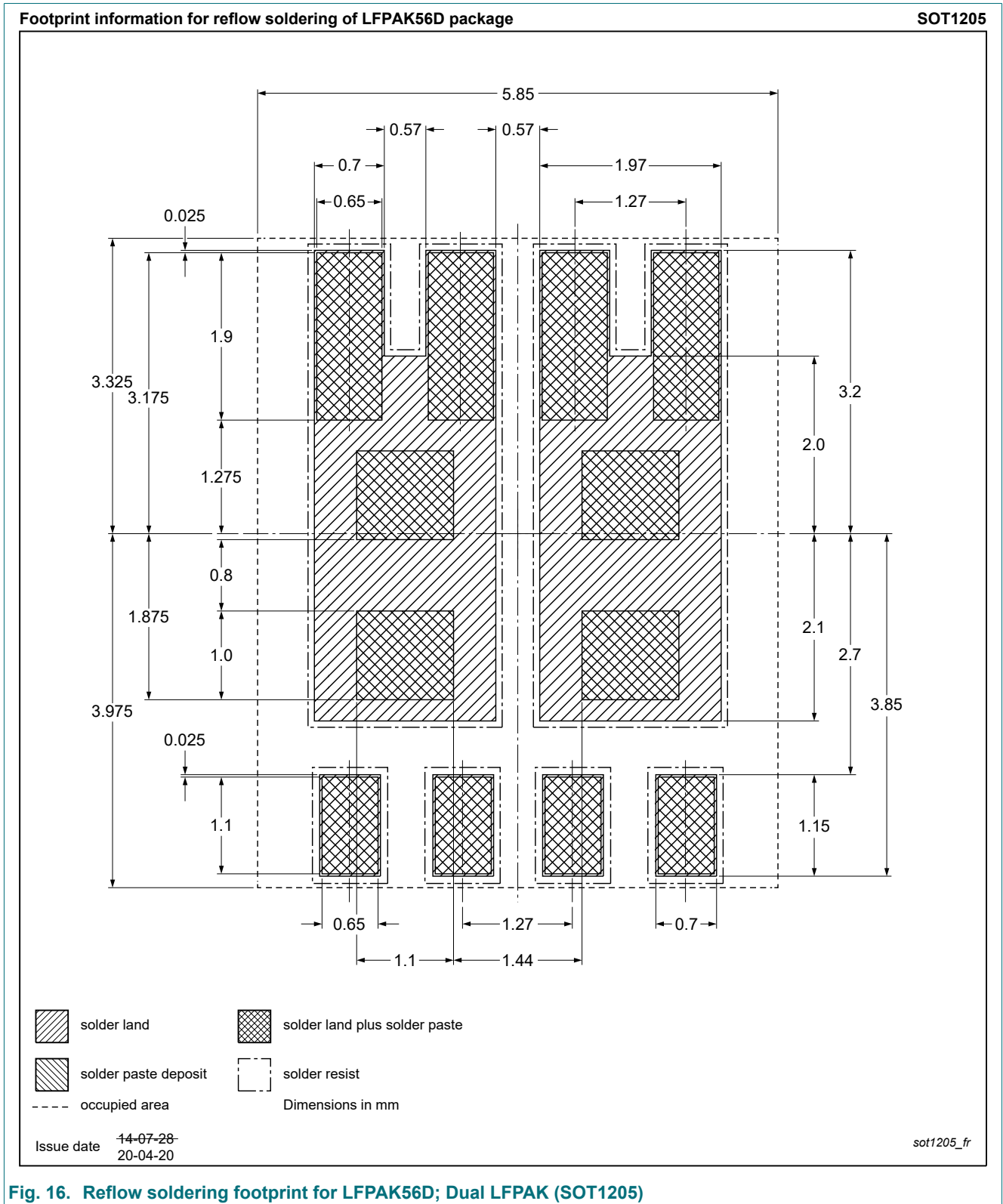


Fig. 16. Reflow soldering footprint for LPAK56D; Dual LPAK (SOT1205)

## 13. Legal information

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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.
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