



# PSMN013-40VLD

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

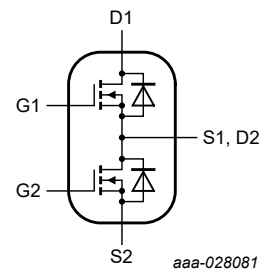
11 February 2021

Product data sheet

## 1. General description

Dual, standard 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
$T_j$	junction temperature		-55	-	175	°C

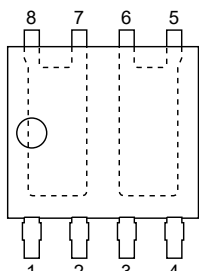
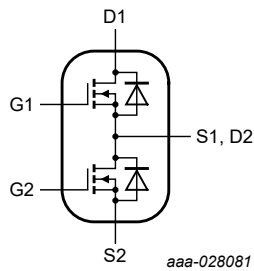
Dual N-channel 40 V, 13 mOhm standard level MOSFET in LFPAK56D (half-bridge configuration)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 10 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>	-	11.35	13.6	mΩ
		V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 10 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>	-	14.04	16.9	mΩ
<b>Dynamic characteristics FET1 and FET2</b>						
Q <sub>GD</sub>	gate-drain charge	I <sub>D</sub> = 10 A; V <sub>DS</sub> = 32 V; V <sub>GS</sub> = 5 V; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	0.6	2.1	4.2	nC
Q <sub>G(tot)</sub>	total gate charge		4.7	7.3	10.2	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	V13DL40

## 8. Limiting values

Table 5. Limiting values

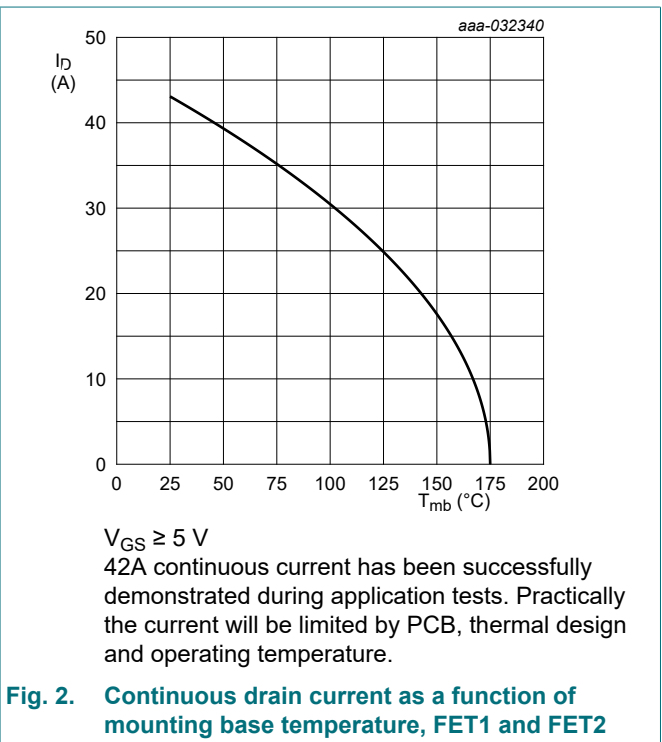
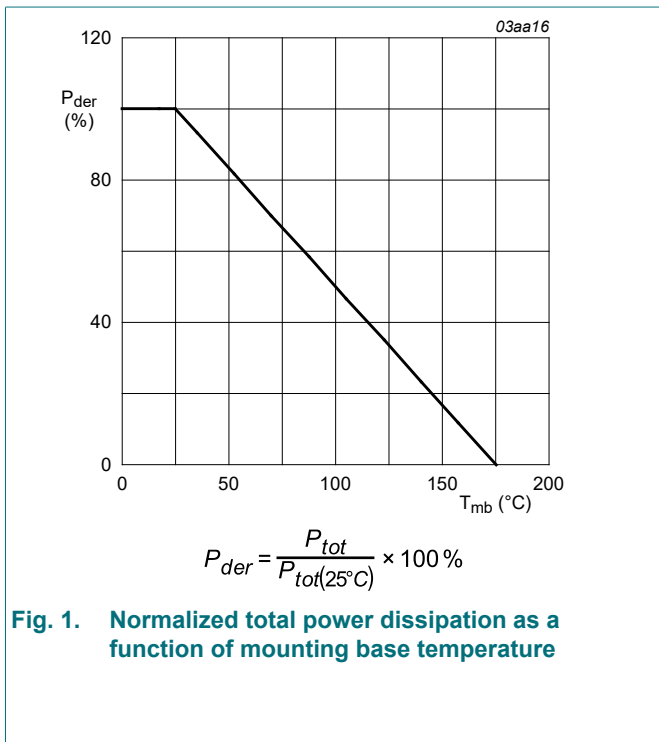
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
<b>Limiting values FET1 and FET2</b>					
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C	-	40	V

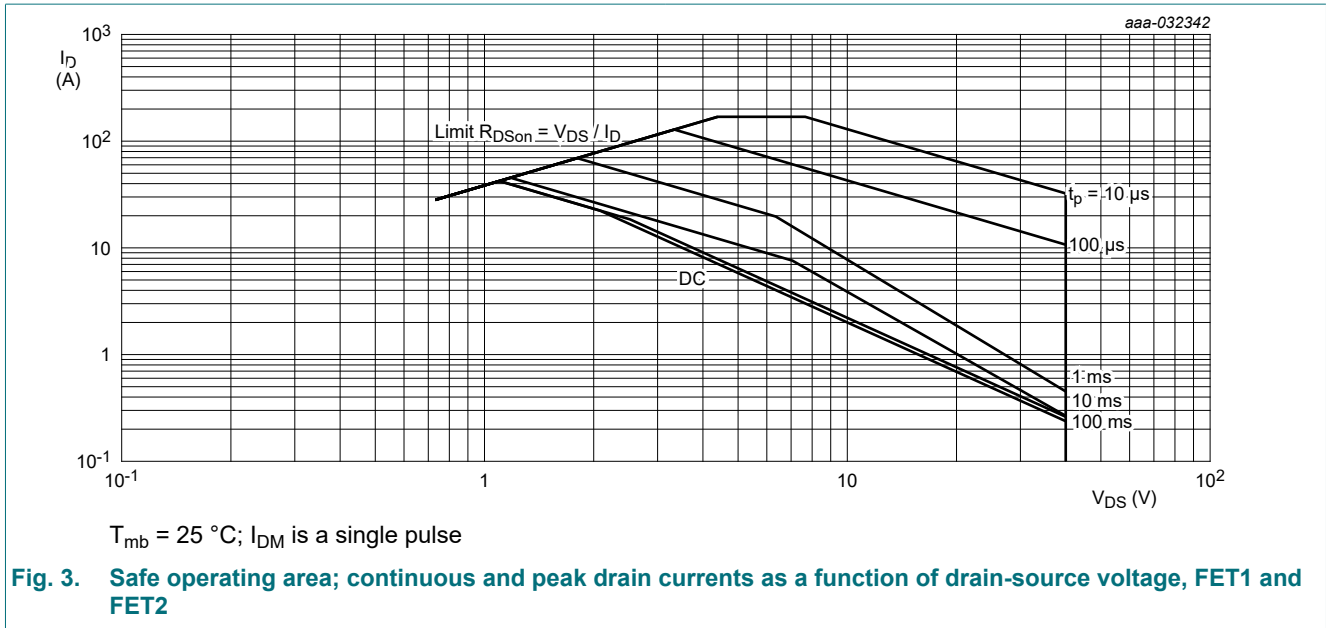
Dual N-channel 40 V, 13 mOhm standard level MOSFET in LPAK56D (half-bridge configuration)

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DSM</sub>	peak drain-source voltage	t <sub>p</sub> = 20 ns; f = 500 kHz; E <sub>DS(AL)</sub> = 200 nJ; pulsed	-	45	V
V <sub>DGR</sub>	drain-gate voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C; R <sub>GS</sub> = 20 kΩ	-	40	V
V <sub>GS</sub>	gate-source voltage		-20	20	V
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; Fig. 1	-	46	W
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; Fig. 2	[1]	42	A
		V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C	-	30	A
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; Fig. 3	-	169	A
T <sub>stg</sub>	storage temperature		-55	175	°C
T <sub>j</sub>	junction temperature		-55	175	°C
T <sub>sld(M)</sub>	peak soldering temperature		-	260	°C
<b>Source-drain diode FET1 and FET2</b>					
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	-	42	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C	-	169	A
<b>Avalanche ruggedness FET1 and FET2</b>					
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 39.9 A; V <sub>sup</sub> ≤ 40 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; t <sub>p</sub> = 9 μs	-	10.6	mJ
I <sub>AS</sub>	non-repetitive avalanche current	V <sub>sup</sub> = 40 V; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; R <sub>GS</sub> = 50 Ω	[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



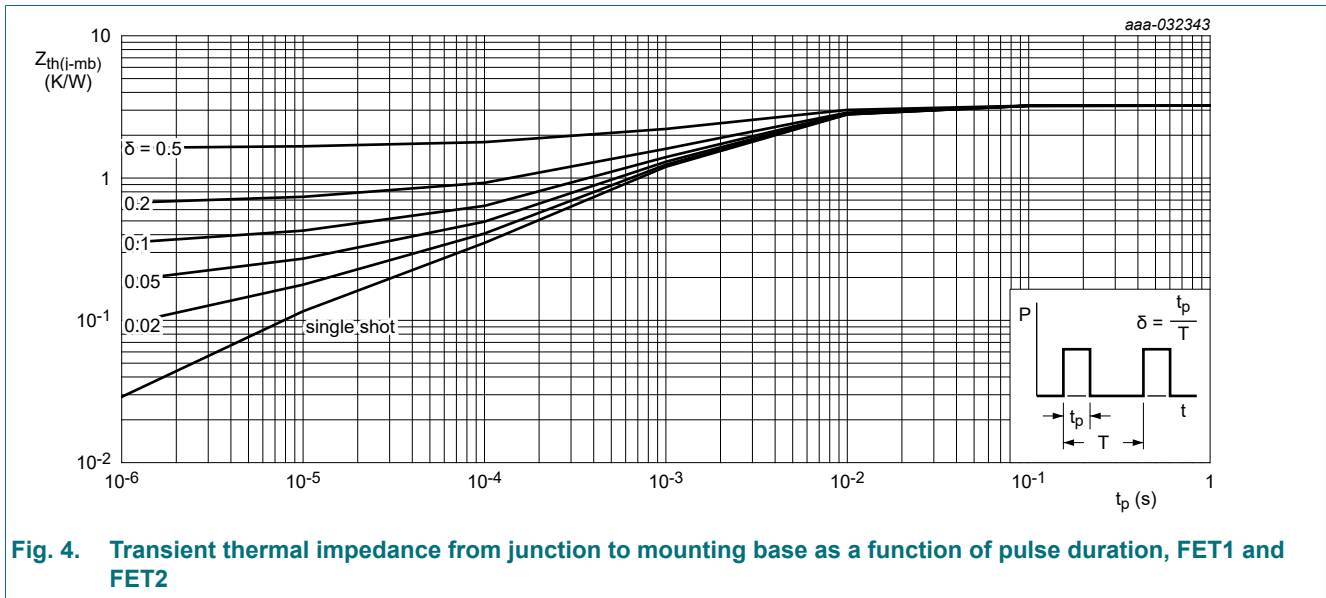
Dual N-channel 40 V, 13 mOhm standard level MOSFET in LPAK56D (half-bridge configuration)



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



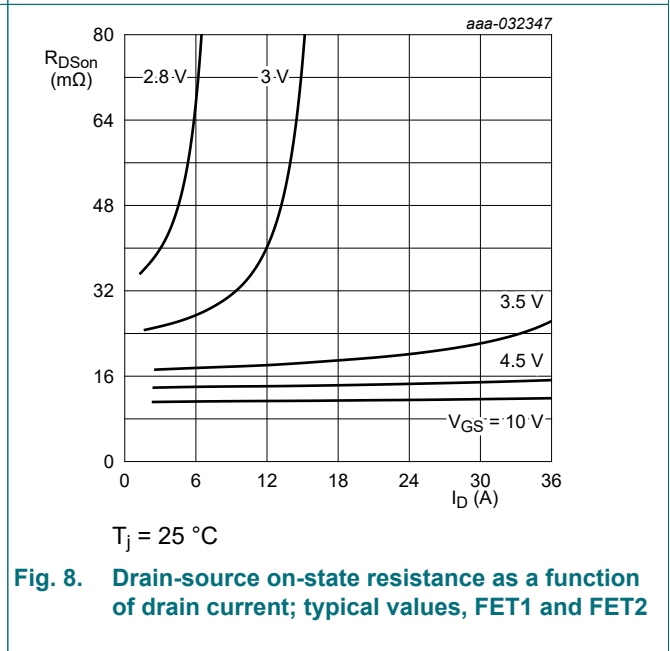
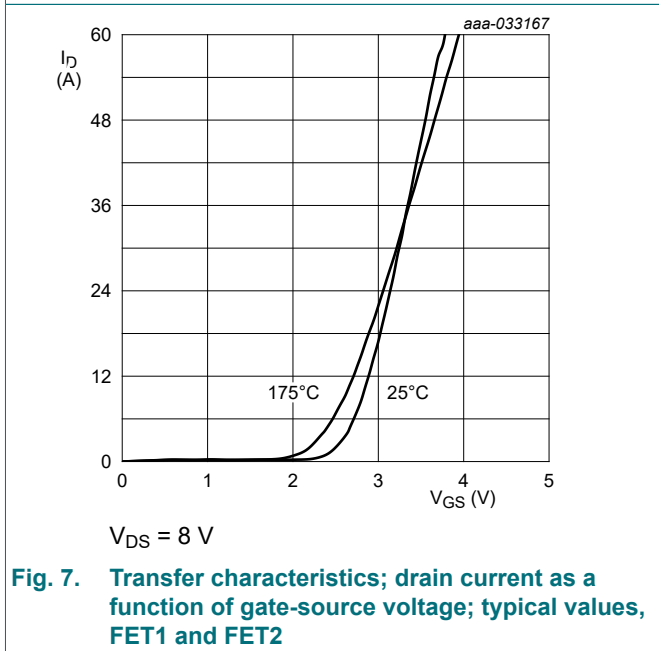
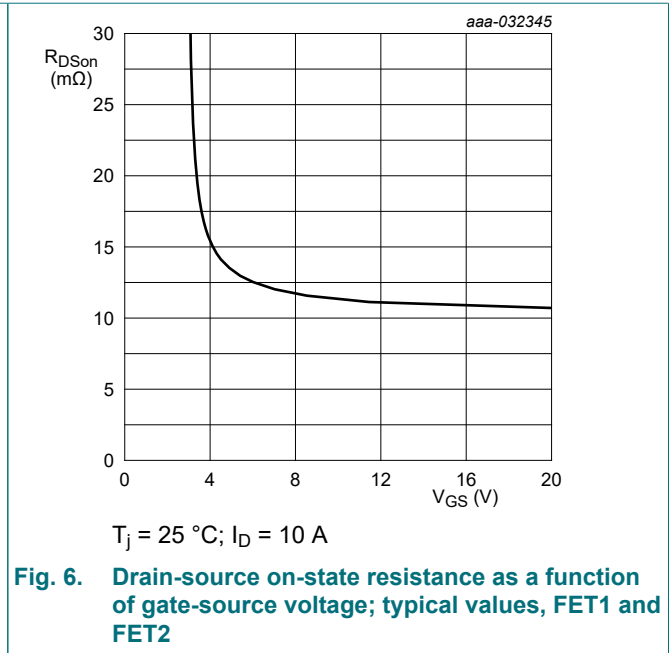
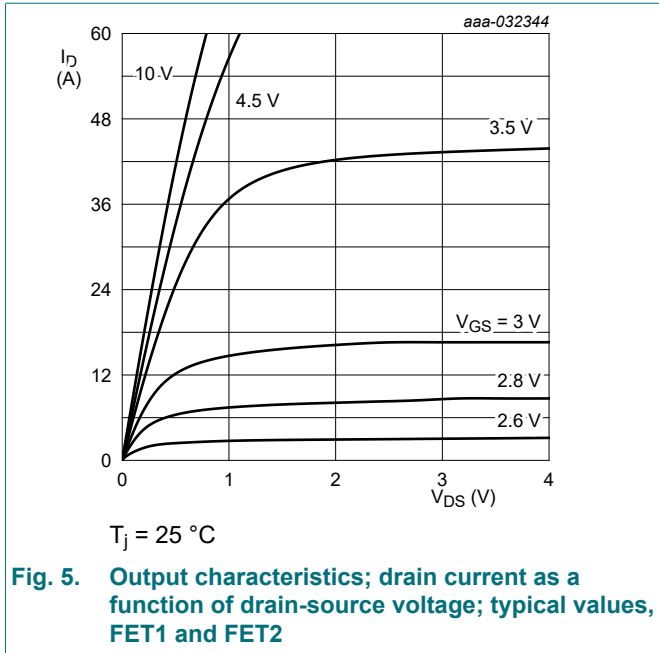
## 10. Characteristics

**Table 7. Characteristics**

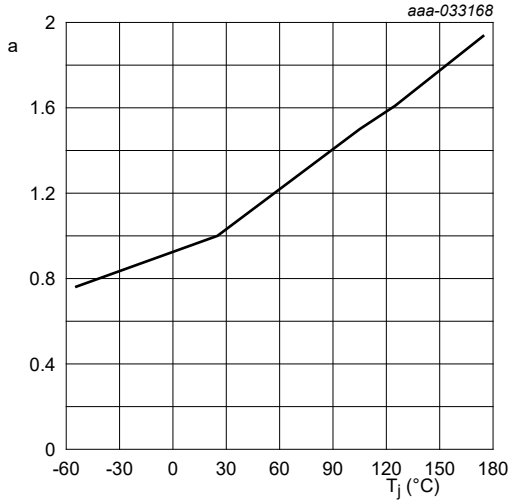
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	40	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	36	-	-	V
$V_{GS(th)}$	gate-source 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	$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ C$ ; <a href="#">Fig. 8</a>	-	11.35	13.6	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ C$ ; <a href="#">Fig. 9</a>	-	-	26.4	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ C$ ; <a href="#">Fig. 8</a>	-	14.04	16.9	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ C$ ; <a href="#">Fig. 9</a>	-	-	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	$I_D = 10 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 5 \text{ V}$ ; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	4.7	7.3	10.2	nC
		$I_D = 10 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V}$ ; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	9	13.9	19.4	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	7.3	-	nC
$Q_{GS}$	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	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$ ; <a href="#">Fig. 12</a>	539	829	1160	pF
$C_{oss}$	output capacitance		182	280	420	pF
$C_{rss}$	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	$I_S = 10 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ ; <a href="#">Fig. 13</a>	-	0.84	1	V

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{rr}$	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

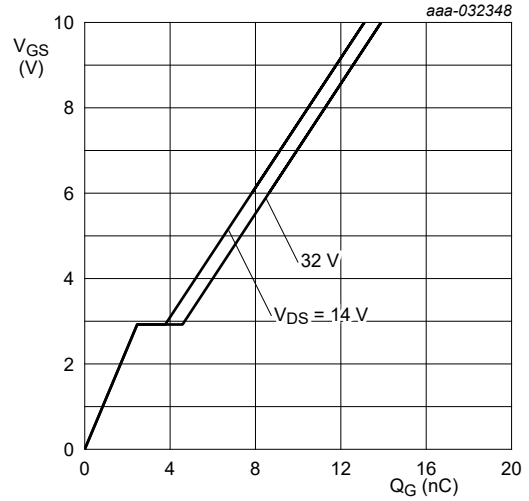


Dual N-channel 40 V, 13 mOhm standard level MOSFET in LPAK56D (half-bridge configuration)



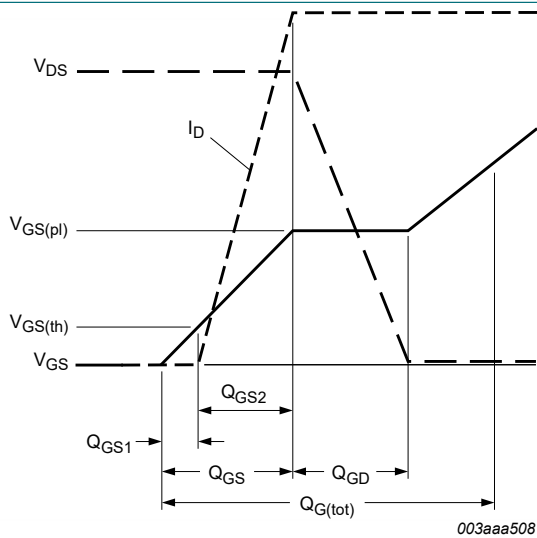
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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

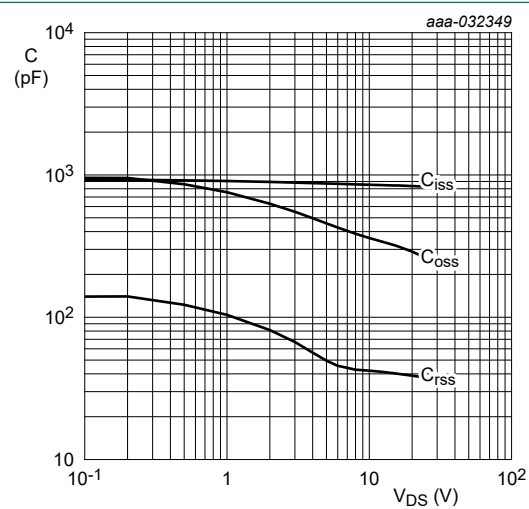


$T_j = 25^\circ\text{C}; I_D = 10$  A

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



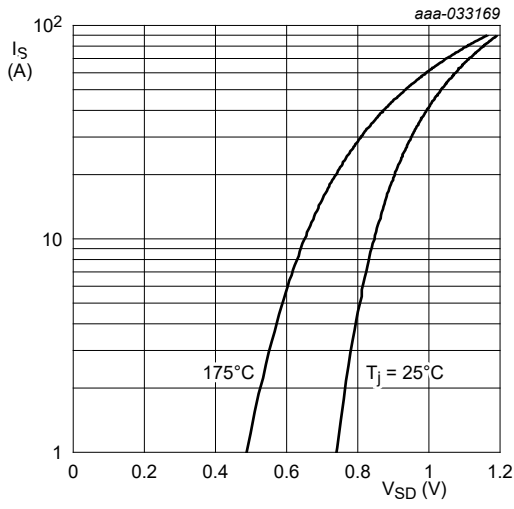
**Fig. 11. Gate charge waveform definitions**



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

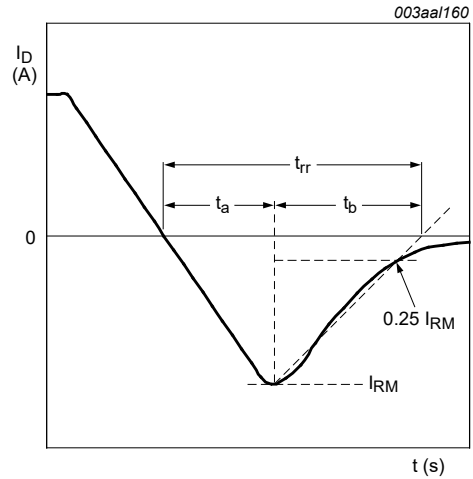
**Fig. 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values, FET1 and FET2**

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



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

**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

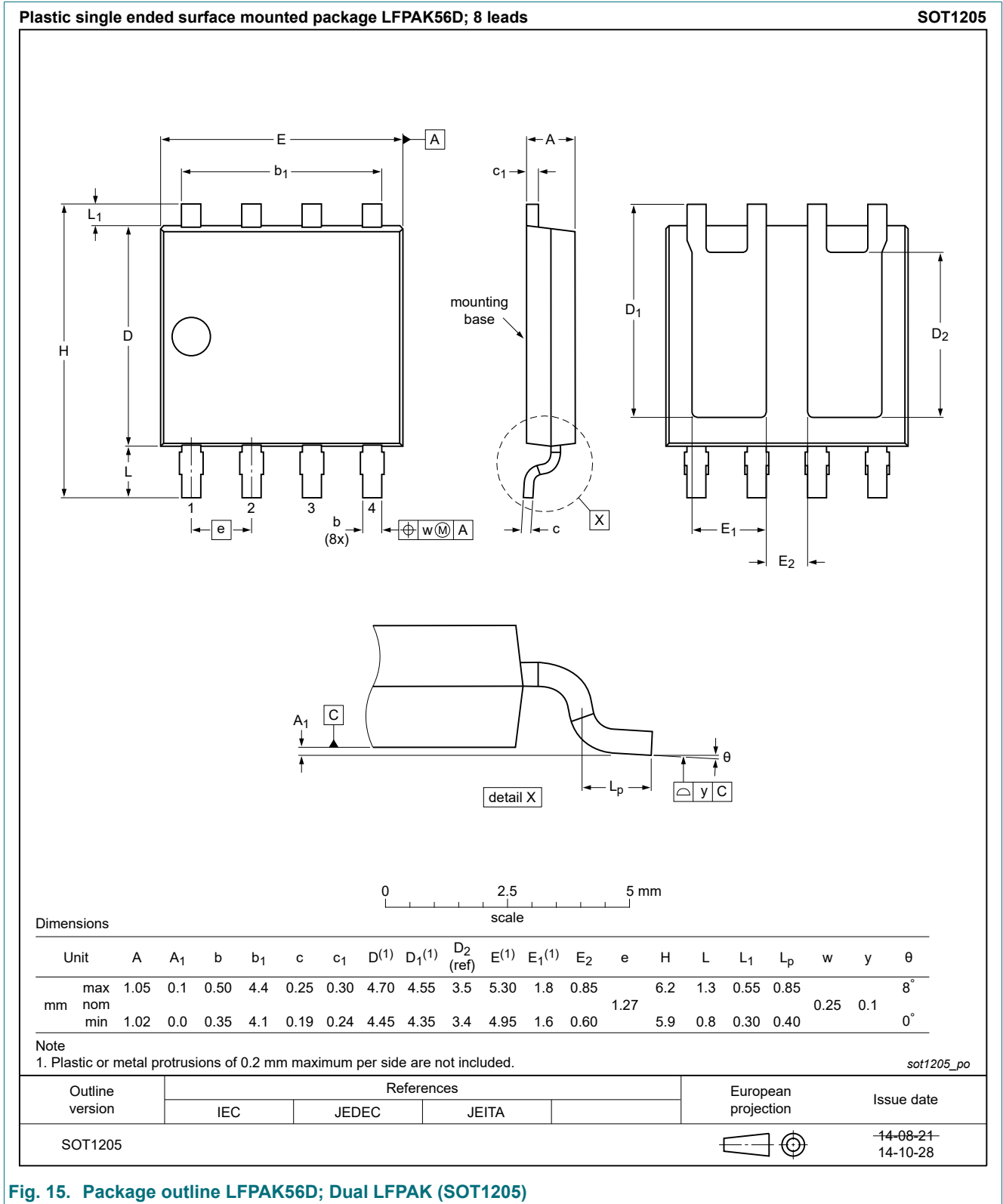


Fig. 15. Package outline LPAK56D; Dual LPAK (SOT1205)

## 12. Soldering

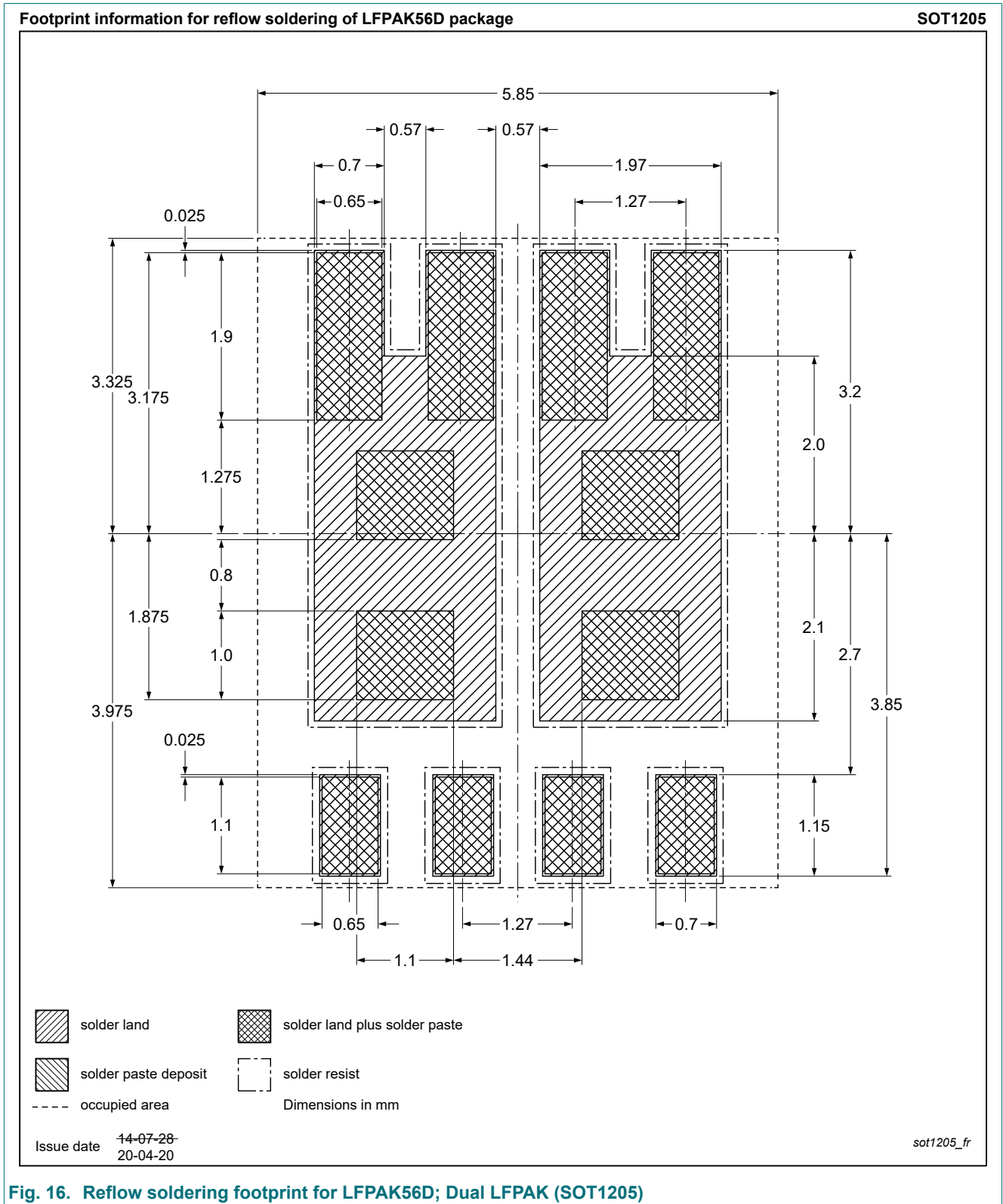


Fig. 16. Reflow soldering footprint for LPAK56D; Dual LPAK (SOT1205)

## 13. Legal information

### 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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