BUK7Y1R0-40N

N-channel 40 V, 0.97 mOhm, Standard level MOSFET in LFPAK56

4 January 2024 — Product data sheet

1. General description

Automotive qualified N-channel MOSFET using the latest Trench 15 low ohmic enhanced-Trench Bottom Oxide (e-TBO) technology, providing high ruggedness at low R_{DSon}, housed in an LFPAK56 package. This product has been fully designed and qualified to meet AEC-Q101 requirements delivering high performance and endurance.

2. Features and benefits

- Fully automotive qualified to AEC-Q101:
  - 175 °C rating suitable for thermally demanding environments
- Trench 15 e-TBO technology:
  - Merging benefits of Superjunction technology (high ruggedness) and Split-Gate technology (low R_{DSon})
- Fast and efficient switching with high damping and low spiking
- Tight $V_{GS(th)}$ limits enable easy paralleling of MOSFETs
- LFPAK Gull Wing leads:
  - High Board Level Reliability absorbing mechanical stress during thermal cycling, unlike traditional QFN packages
  - Visual (AOI) soldering inspection, no need for expensive x-ray equipment
  - Easy solder wetting for good mechanical solder joints
- LFPAK copper clip technology:
  - Improved reliability, with reduced R_{th}, R_{DSon} and package inductance
  - Increases maximum current capability and improved current spreading

3. Applications

- 12 V automotive systems
- Motor, lighting and solenoid control
- Reverse battery protection
- Ultra high-performance power switching

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	40	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	-	320	A
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 12		0.57	0.81	0.97	mΩ

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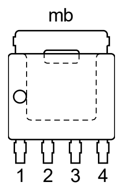
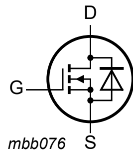
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 32 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		81	135	189	nC

[1] This current had been successfully demonstrated during product characterisation. In practical applications 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	S	source		
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain	**LFPAK56; Power-SO8 (SOT669)**	

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK7Y1R0-40N	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK7Y1R0-40N	71N040Y

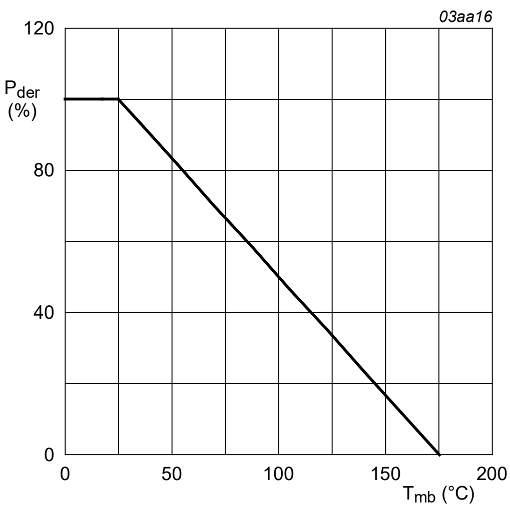
8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).T_j = 25 °C unless otherwise stated.

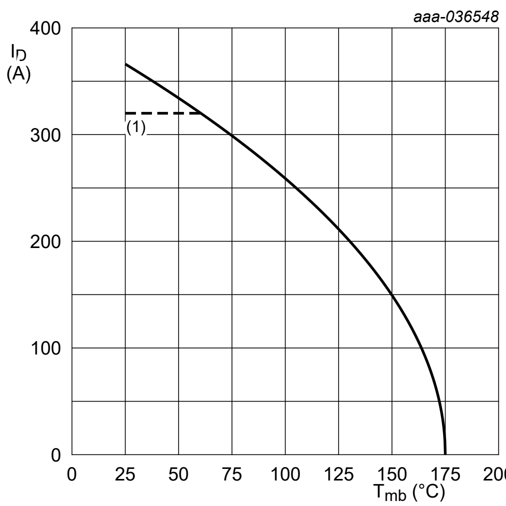
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	40	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	268	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	320	A
				-	262	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3; Fig. 4	[1]	-	1465	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 °C	[1]	-	268	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	1465	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 190 A; V_{sup} ≤ 40 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 5	[2] [3]	-	145	mJ
I_{AS}	non-repetitive avalanche current	V_{sup} ≤ 40 V; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; R_{GS} = 50 Ω	[4]	-	190	A

[1] This current had been successfully demonstrated during product characterisation. In practical applications 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.



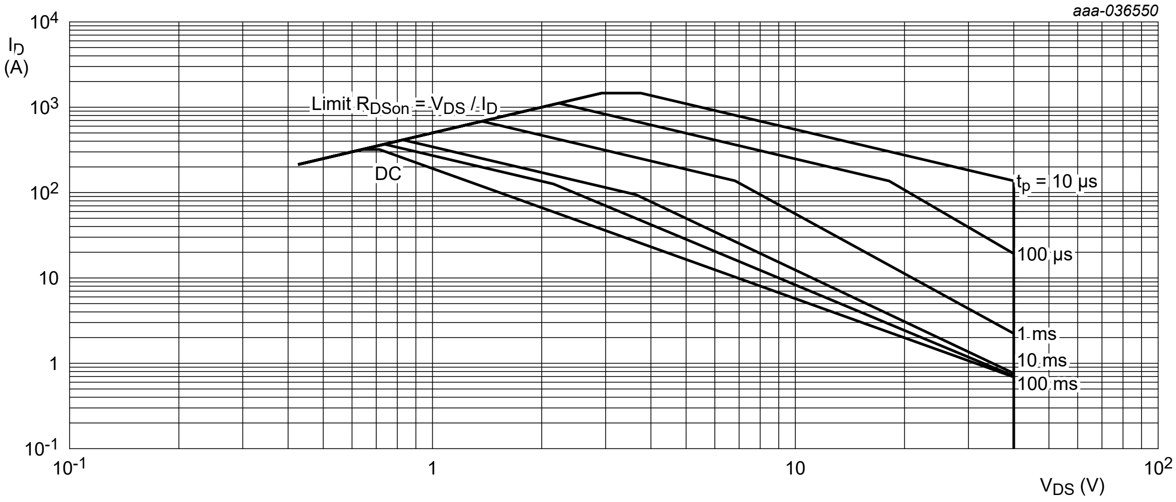
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



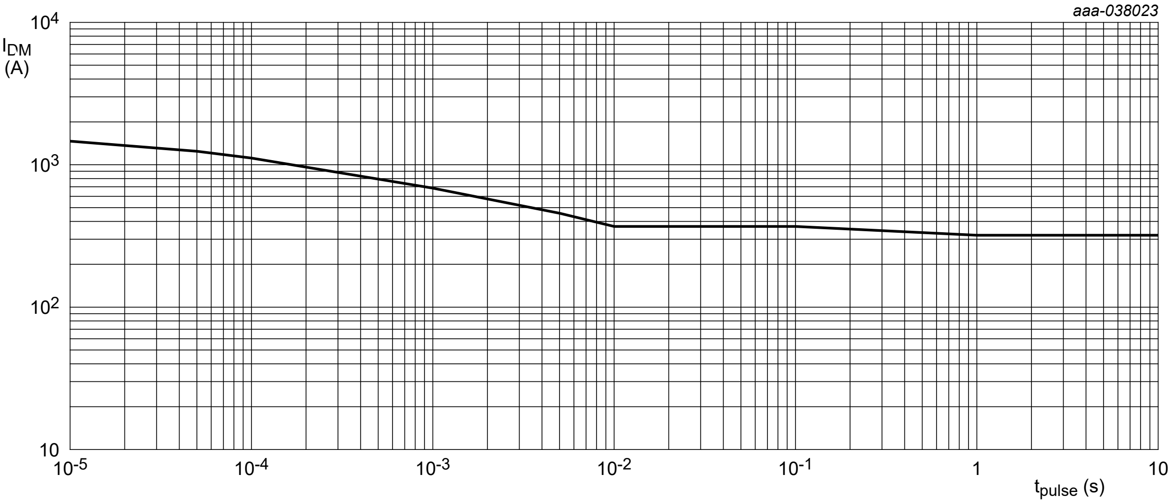
V_{GS} ≥ 10 V
(1) 320 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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



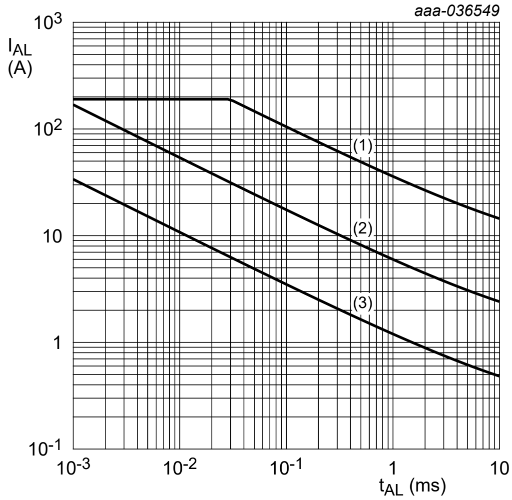
T_{mb} = 25 °C; I_{DM} is a single pulse

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



V_{GS} = 10V ; T_{mb} = 25 °C; I_{DM} is a single pulse

Fig. 4. Peak Current Capability



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

Fig. 5. 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. 6		-	0.48	0.56	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		[1]	-	24	-	K/W

[1] Device on 4 layer PCB. Refer to TN00008 for further information.

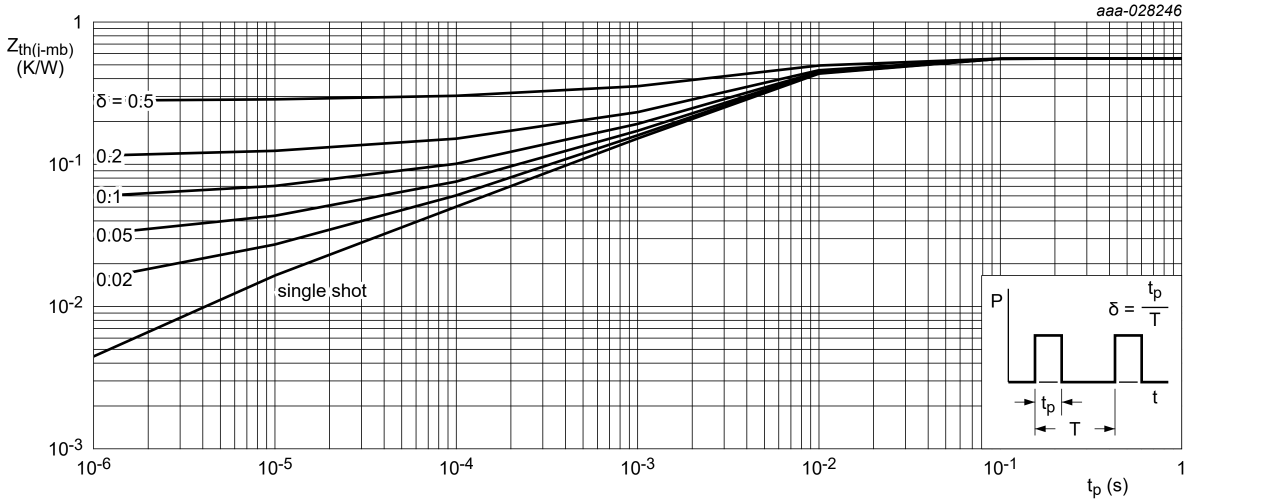


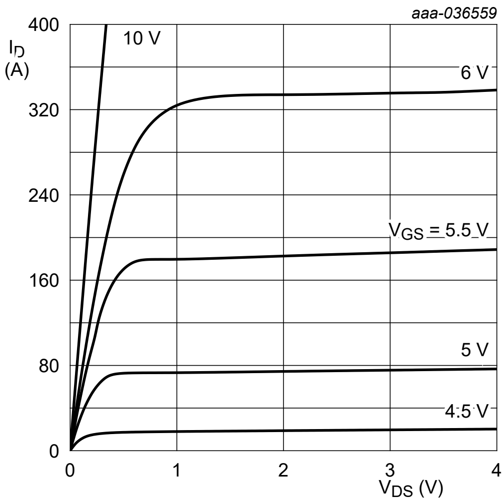
Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

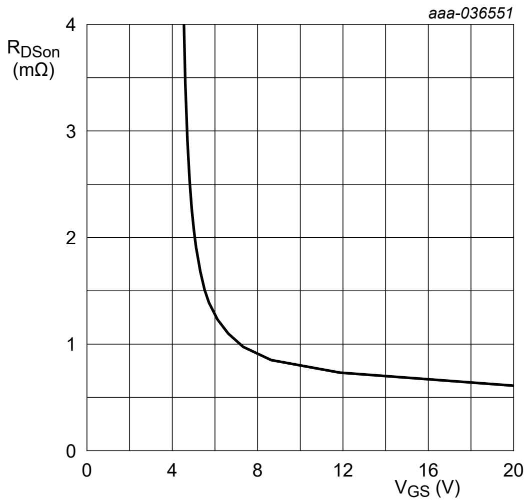
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		40	43	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -40 °C		-	40.5	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		36	40	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C; Fig. 10		2.4	3	3.6	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C; Fig. 11		-	-	4.3	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175 °C; Fig. 11		1	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C		-	0.1	1	µA
		V_{DS} = 16 V; V_{GS} = 0 V; T_j = 125 °C		-	1.1	10	µA
		V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 °C		-	80	500	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 12		0.57	0.81	0.97	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 105 °C; Fig. 13		0.77	1.15	1.46	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 125 °C; Fig. 13		0.84	1.25	1.6	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 13		1	1.52	2	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		0.2	0.63	1.6	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 32 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		81	135	189	nC
Q_{GS}	gate-source charge			14	26	38	nC
Q_{GD}	gate-drain charge			12	42	72	nC
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 16		4552	7587	10622	pF
C_{oss}	output capacitance			1166	1666	2166	pF
C_{rss}	reverse transfer capacitance			252	631	1010	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C		-	25	-	ns
t_r	rise time			-	49	-	ns
$t_{d(off)}$	turn-off delay time			-	79	-	ns
t_f	fall time			-	58	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	0.79	1	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 20 V; T_j = 25 °C; Fig. 18		-	34	-	ns
Q_r	recovered charge		[1]	-	24	-	nC

[1] includes capacitive recovery



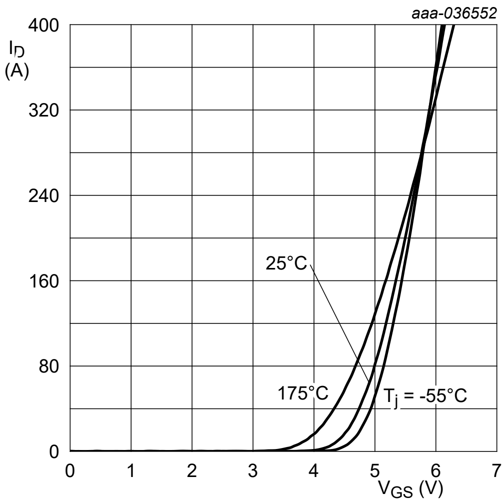
T_j = 25 °C

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



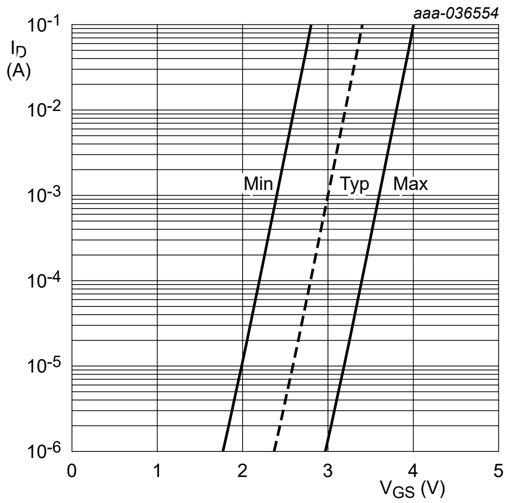
T_j = 25 °C; I_D = 25 A

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



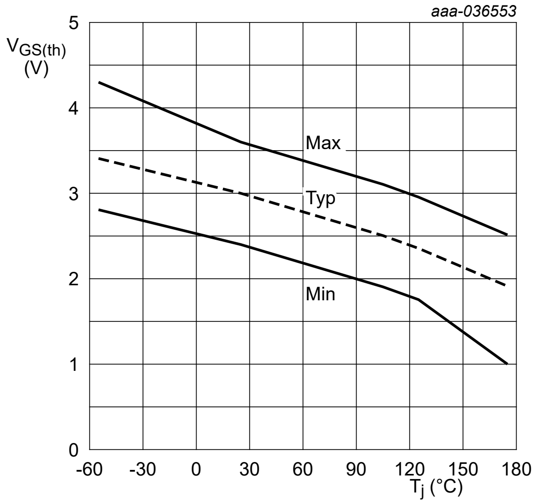
V_{DS} = 8 V

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



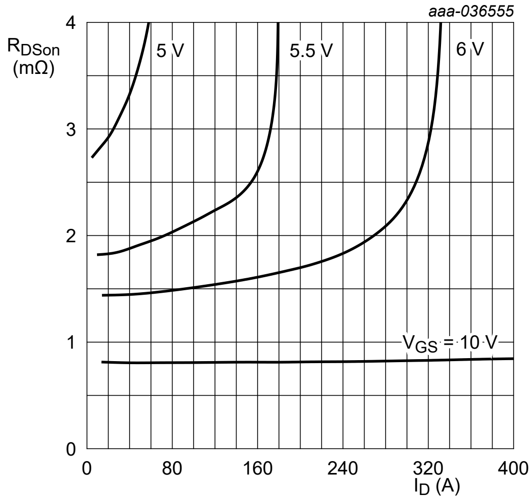
T_j = 25 °C; V_{DS} = 5 V

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



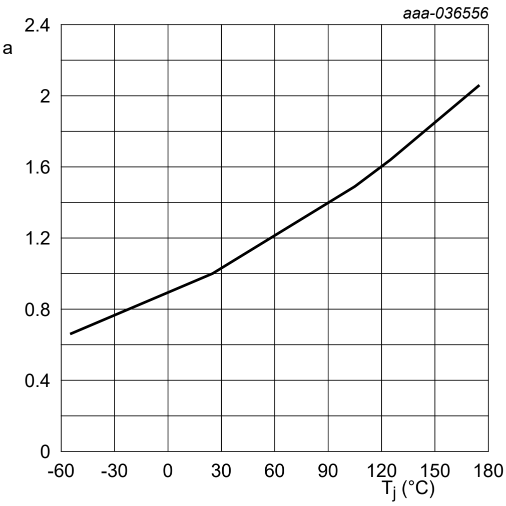
I_D = 1 mA ; $V_{DS} = V_{GS}$

Fig. 11. Gate-source threshold voltage as a function of junction temperature



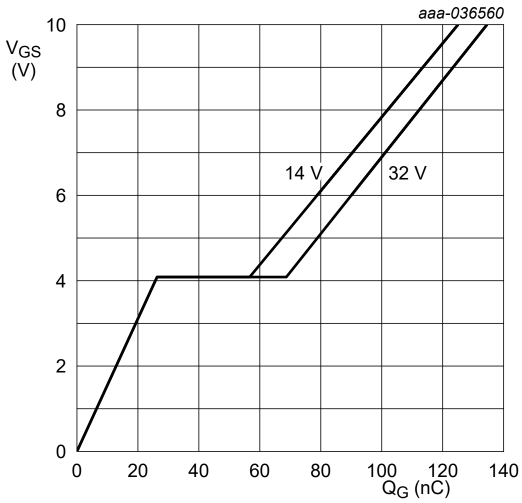
T_j = 25 °C

Fig. 12. Drain-source on-state resistance as a function of drain current; typical values



$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature



T_j = 25 °C; I_D = 25 A

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

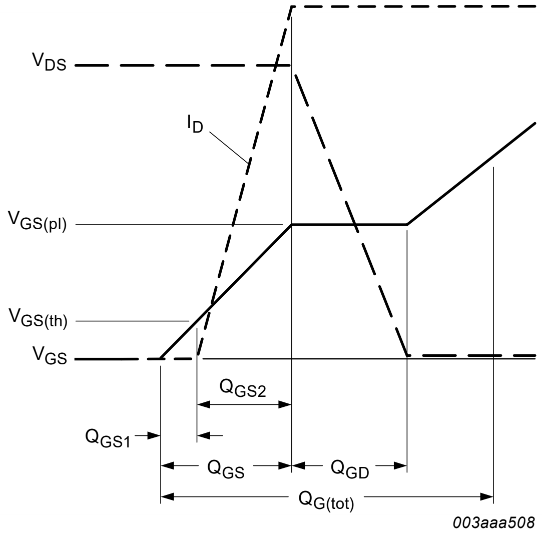
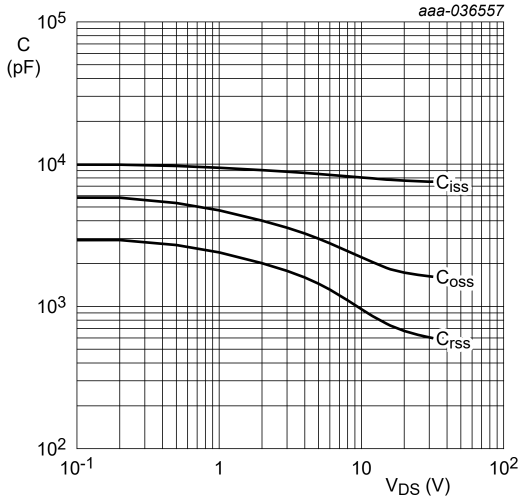
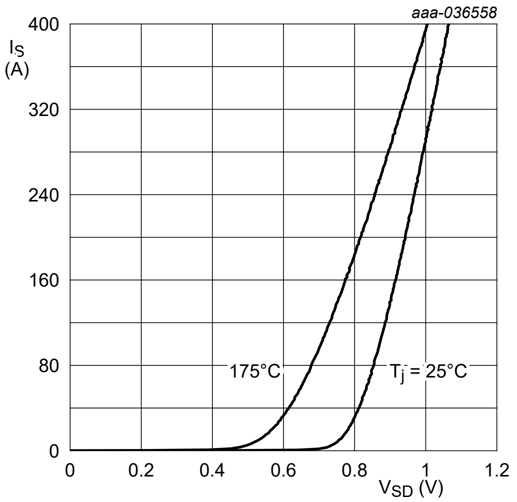


Fig. 15. Gate charge waveform definitions



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

Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



V_{GS} = 0 V

Fig. 17. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

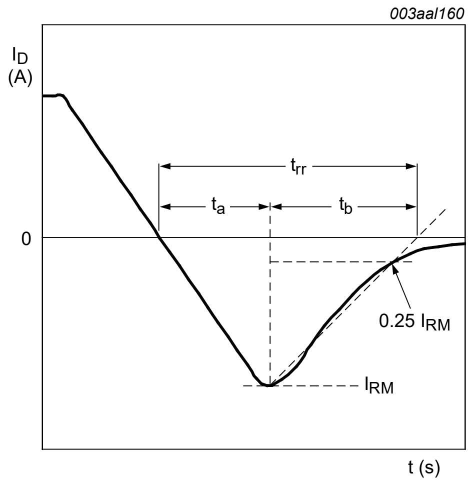
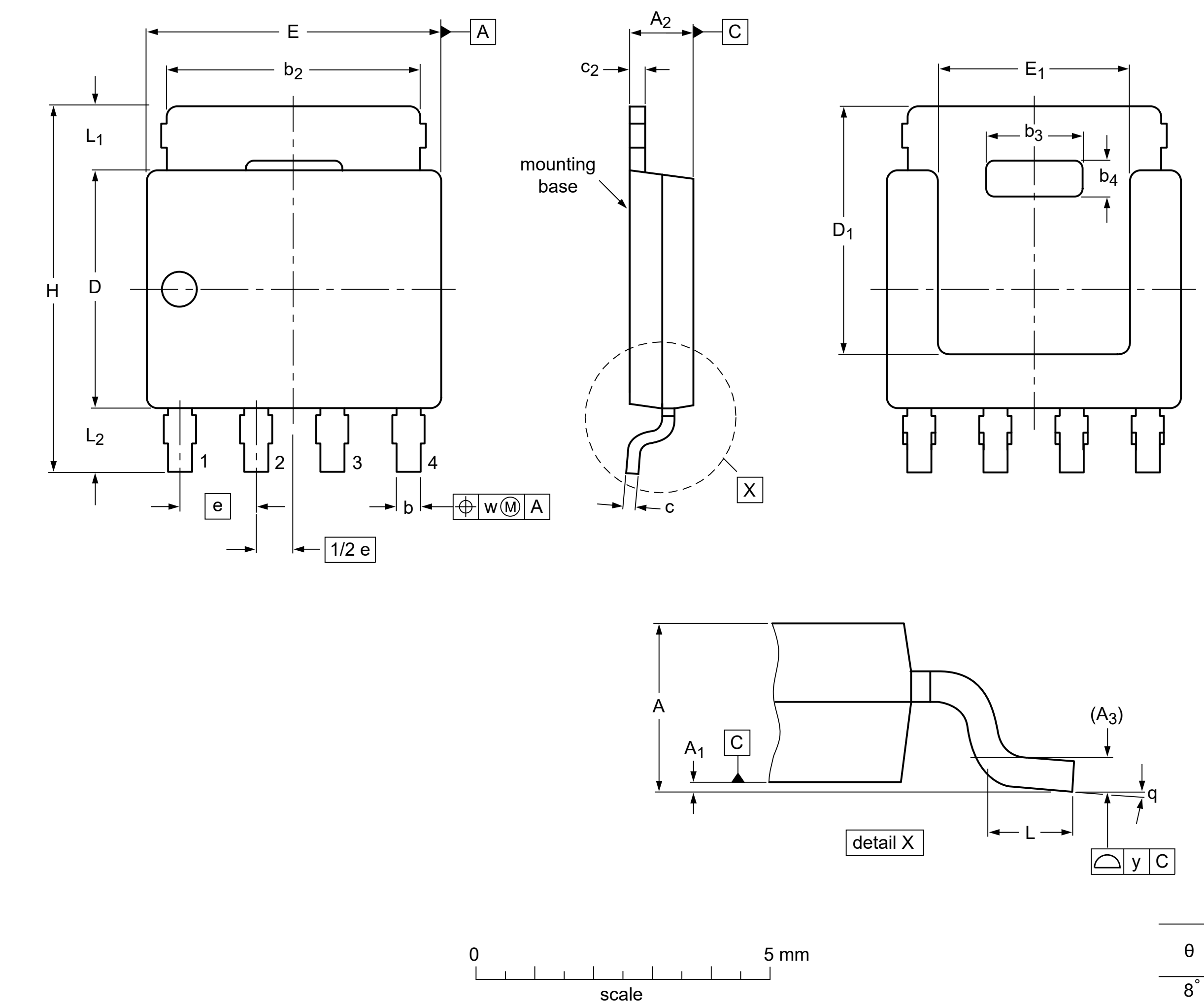


Fig. 18. Reverse recovery timing definition

11. Package outline

Plastic single-ended surface-mounted package (LFPAK56; Power-SO8); 4 leads **SOT669**



Dimensions (mm are the original dimensions)

Unit[1]		A	A_1	A_2	A_3	b	b_2	b_3	b_4	c	c_2	D[1]	D_1[1]	E[1]	E_1[1]	e	H	L	L_1	L_2	w	y	θ
mm	max	1.20	0.15	1.10		0.50	4.41	2.2	0.9	0.25	0.30	4.10	4.20	5.0	3.3		6.2	0.85	1.3	1.3			8°
	nom				0.25											1.27					0.25	0.1	
	min	1.01	0.00	0.95		0.35	3.62	2.0	0.7	0.19	0.24	3.80		4.8	3.1		5.8	0.40	0.8	0.8			0°

Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

sot669_po

Outline version	References: IEC	References: JEDEC	References: JEITA		European projection	Issue date
SOT669		MO-235				~~11-03-25~~ 13-02-27

Fig. 19. Package outline LFPAK56; Power-SO8 (SOT669)

12. Soldering

Footprint information for reflow soldering **SOT669**

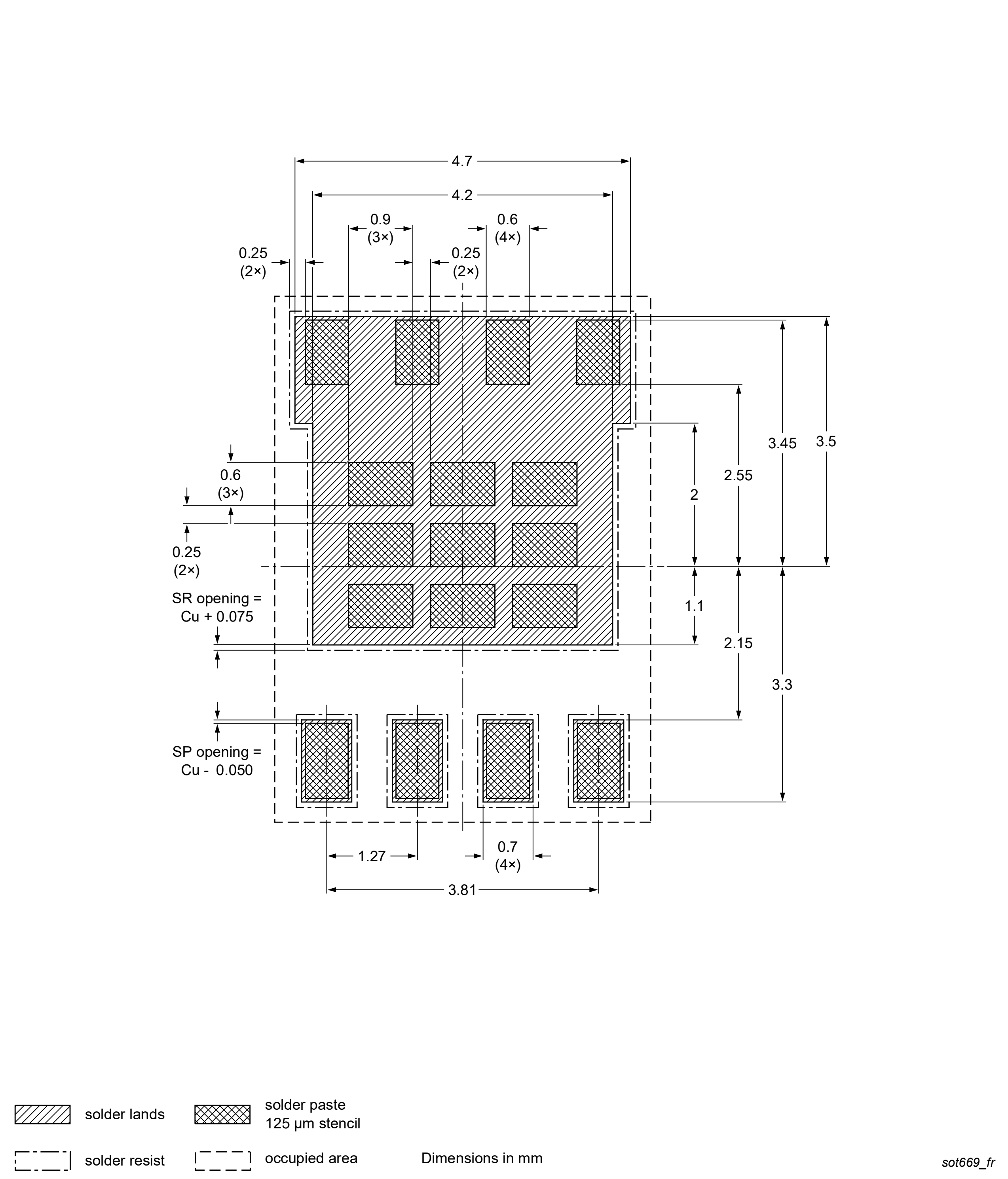


Fig. 20. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)

Wave soldering footprint information for LFPAK56 package **SOT669**

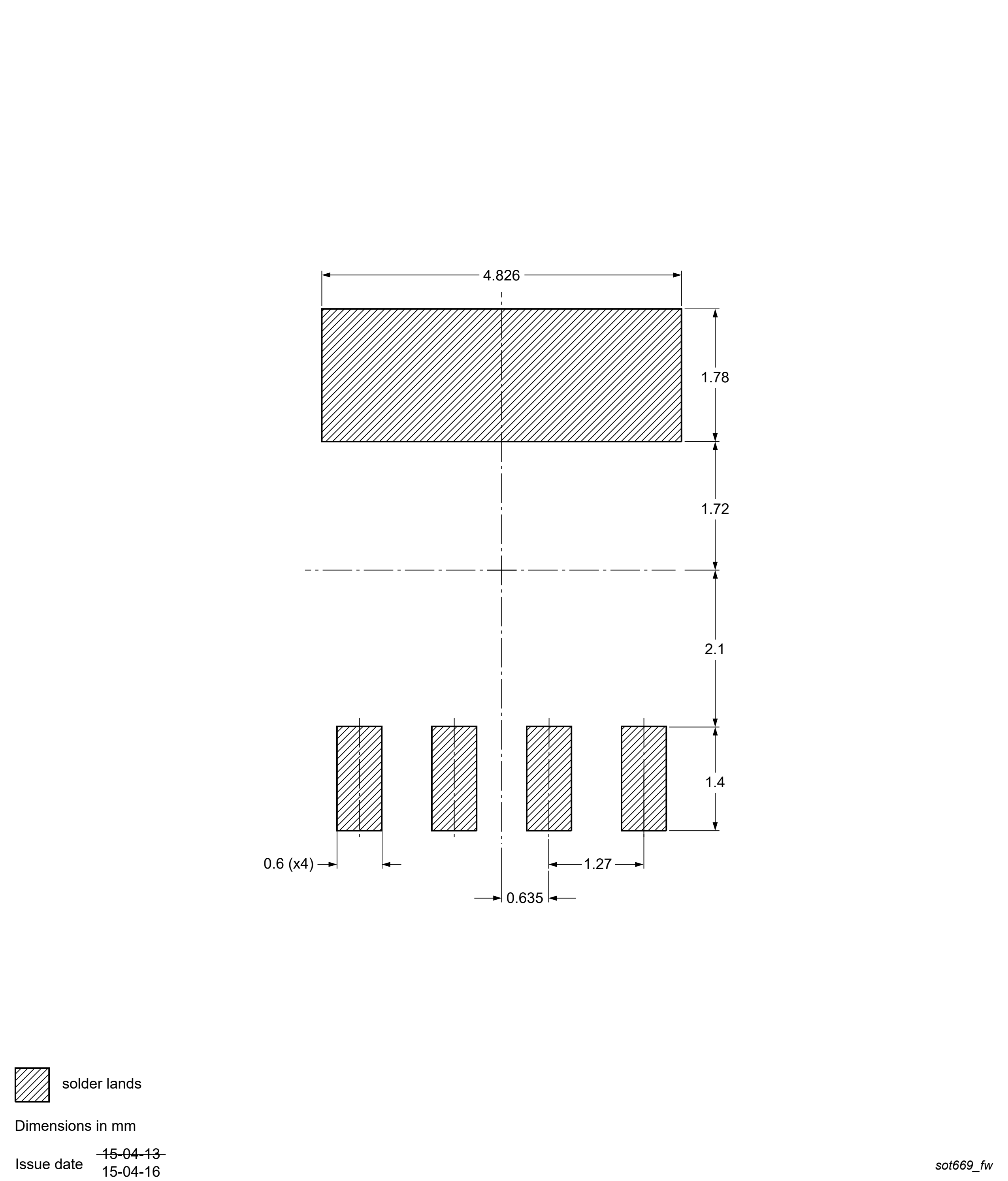


Fig. 21. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

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.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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