



BUK7J1R0-40H

N-channel 40 V, 1.0 mΩ standard level MOSFET in LPAK56E

10 January 2025

Product data sheet

1. General description

Automotive qualified N-channel MOSFET using the latest Trench 9 low ohmic superjunction technology, housed in an enhanced LPAK56E 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 9 Superjunction technology:
 - Reduced cell pitch enables enhanced power density and efficiency with lower R_{DSon} in same footprint
 - Improved SOA and avalanche capability compared to standard TrenchMOS
 - Tight $V_{GS(th)}$ limits enable easy paralleling of MOSFETs
- LPAK 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 joint
- LPAK copper clip technology:
 - Improved reliability, with reduced R_{th} and R_{DSon}
 - Increases maximum current capability and improved current spreading

3. Applications

- 12 V automotive systems
- Motors, lamps and solenoid control
- Start-Stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

4. Quick reference data

Table 1. Quick reference data

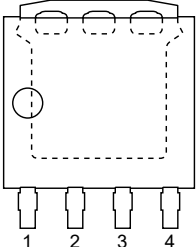
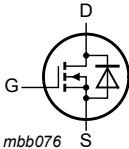
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	40	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	220	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	500	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11		0.6	0.85	1	mΩ

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
Q _{GD}	gate-drain charge	I _D = 25 A; V _{DS} = 32 V; V _{GS} = 10 V; Fig. 13; Fig. 14	-	17.7	35.5	nC
Source-drain diode						
Q _r	recovered charge	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V	-	53.2	-	nC
S	softness factor	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V; T _j = 25 °C	-	0.77	-	

[1] 220A 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	S	source	 LPAK56E; Power-SO8 (SOT1023)	 mbb076
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
BUK7J1R0-40H	LPAK56E; Power-SO8	plastic, single-ended surface-mounted package (LPAK56E); 4 leads; 1.27 mm pitch	SOT1023

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK7J1R0-40H	71H040E

8. Limiting values

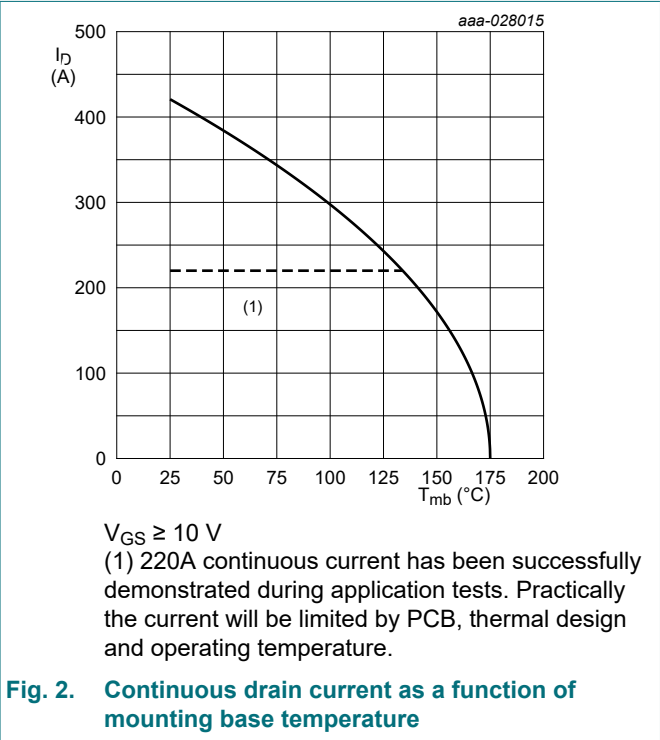
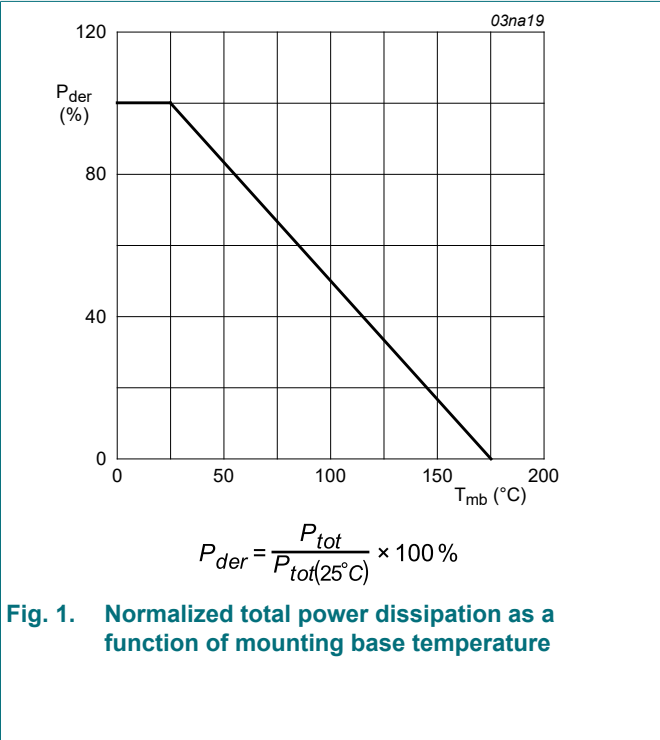
Table 5. Limiting values

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		[1]	-20	20 V

Symbol	Parameter	Conditions		Min	Max	Unit
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 1		-	500	W
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C; Fig. 2	[2]	-	220	A
		V _{GS} = 10 V; T _{mb} = 100 °C; Fig. 2	[2]	-	220	A
I _{DM}	peak drain current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C; Fig. 3		-	600	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	[3]	-	165	A
I _{SM}	peak source current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C		-	600	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. 4	[4] [5]	-	242	mJ

- [1] Refer to application note AN90001 for further information.
- [2] 220A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [3] 165A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [5] Refer to application note AN10273 for further information.



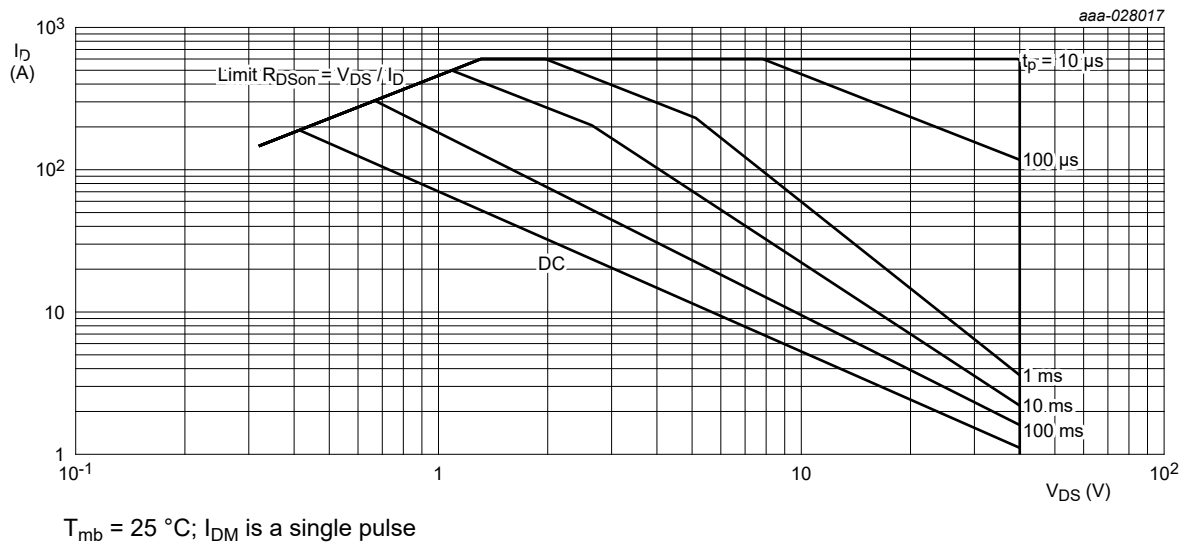
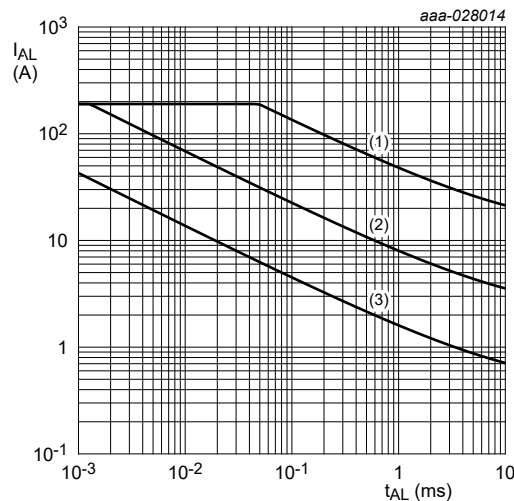


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage



(1) $T_{j\text{ (init)}} = 25\text{ }^{\circ}\text{C}$; (2) $T_{j\text{ (init)}} = 150\text{ }^{\circ}\text{C}$; (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	-	0.21	0.3	K/W



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. 9 ; Fig. 10	2.4	3	3.6	V
		I _D = 1 mA; V _{DS} =V _{GS} ; T _J = -55 °C; Fig. 9	-	-	4.3	V
		I _D = 1 mA; V _{DS} =V _{GS} ; T _J = 175 °C; Fig. 9	1	-	-	V
I _{DSS}	drain leakage current	V _{DS} = 40 V; V _{GS} = 0 V; T _J = 25 °C	-	0.07	1.5	μA
		V _{DS} = 16 V; V _{GS} = 0 V; T _J = 125 °C	-	3.2	25	μA
		V _{DS} = 40 V; V _{GS} = 0 V; T _J = 175 °C	-	0.34	1	mA
I _{GSS}	gate leakage current	V _{GS} = 20 V; V _{DS} = 0 V; T _J = 25 °C	-	2	100	nA
		V _{GS} = -16 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. 11	0.6	0.85	1	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _J = 105 °C; Fig. 12	0.84	1.27	1.6	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _J = 125 °C; Fig. 12	0.93	1.41	1.75	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _J = 175 °C; Fig. 12	1.17	1.76	2.18	mΩ
R _G	gate resistance	f = 1 MHz; T _J = 25 °C	0.47	1.17	2.9	Ω
Dynamic characteristics						
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 32 V; V _{GS} = 10 V; Fig. 13 ; Fig. 14	-	90.7	131	nC
Q _{GS}	gate-source charge		-	25.8	40	nC
Q _{GD}	gate-drain charge		-	17.7	35.5	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C _{iss}	input capacitance	V _{DS} = 25 V; V _{GS} = 0 V; f = 1 MHz; T _j = 25 °C; Fig. 15		-	6666	9340	pF
C _{oss}	output capacitance			-	1644	2300	pF
C _{rss}	reverse transfer capacitance			-	309	679	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		-	22.2	-	ns
t _r	rise time			-	18.9	-	ns
t _{d(off)}	turn-off delay time			-	51.7	-	ns
t _f	fall time			-	23.8	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 16		-	0.77	1.2	V
t _{rr}	reverse recovery time	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V		-	44.9	-	ns
Q _r	recovered charge			-	53.2	-	nC
S	softness factor	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V; T _j = 25 °C		-	0.77	-	
		I _S = 25 A; dI _S /dt = -500 A/μs; V _{GS} = 0 V; V _{DS} = 20 V; T _j = 25 °C		-	0.68	-	

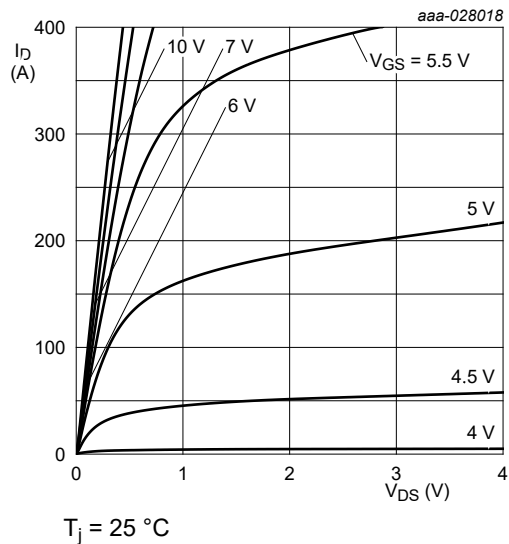


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

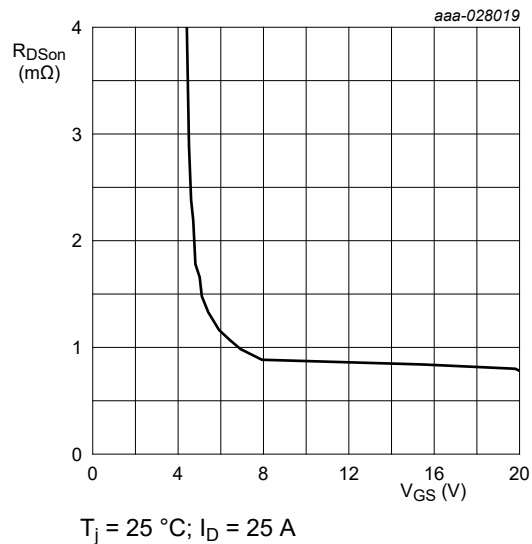


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

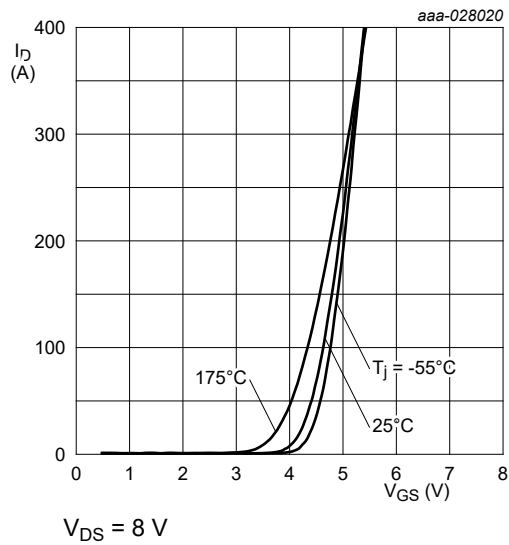


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

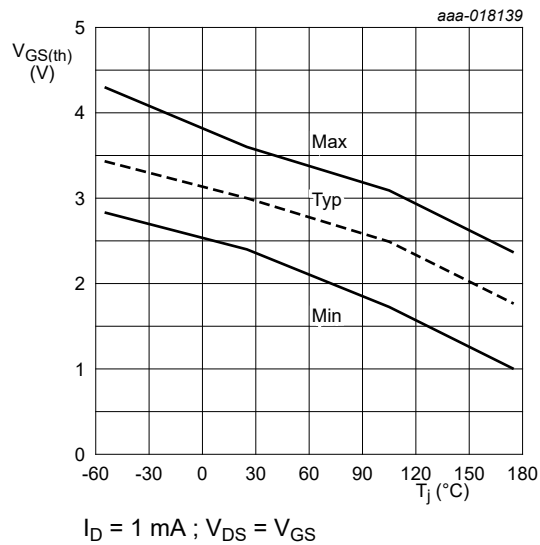


Fig. 9. Gate-source threshold voltage as a function of junction temperature

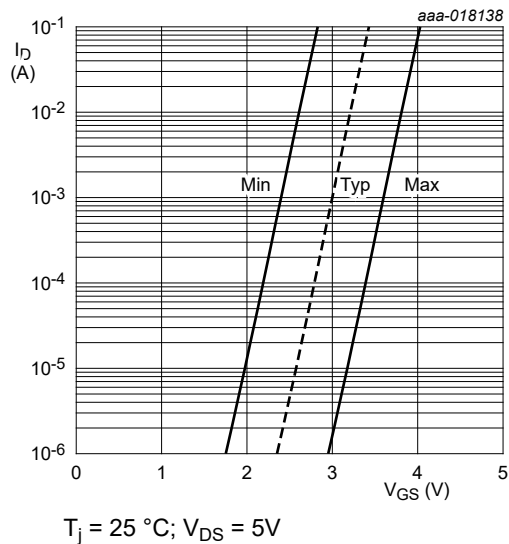


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

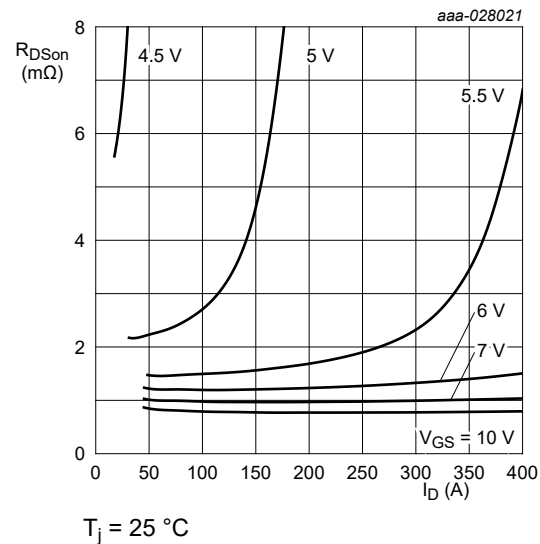


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

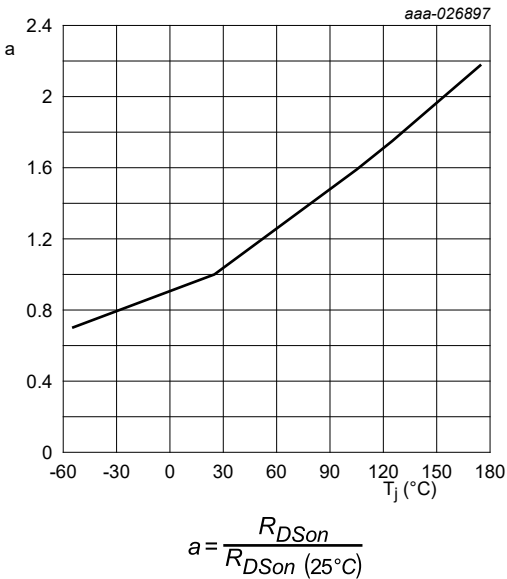


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

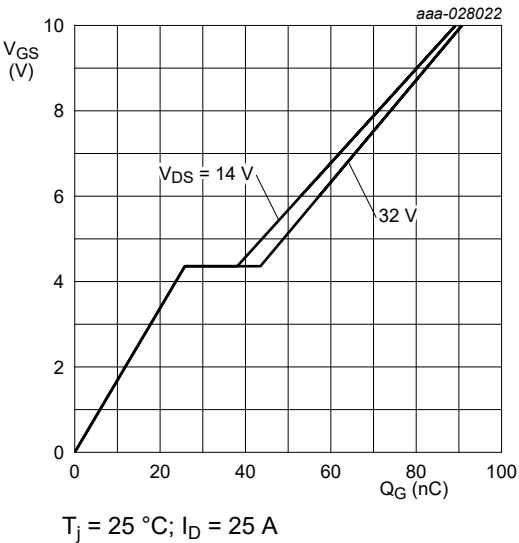


Fig. 13. Gate-source voltage as a function of gate charge; typical values

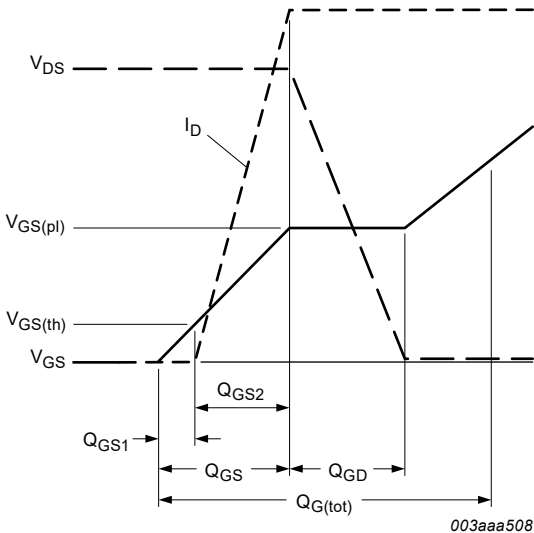


Fig. 14. Gate charge waveform definitions

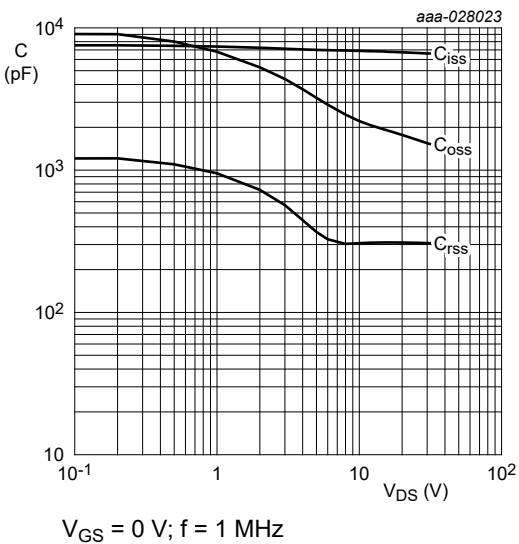
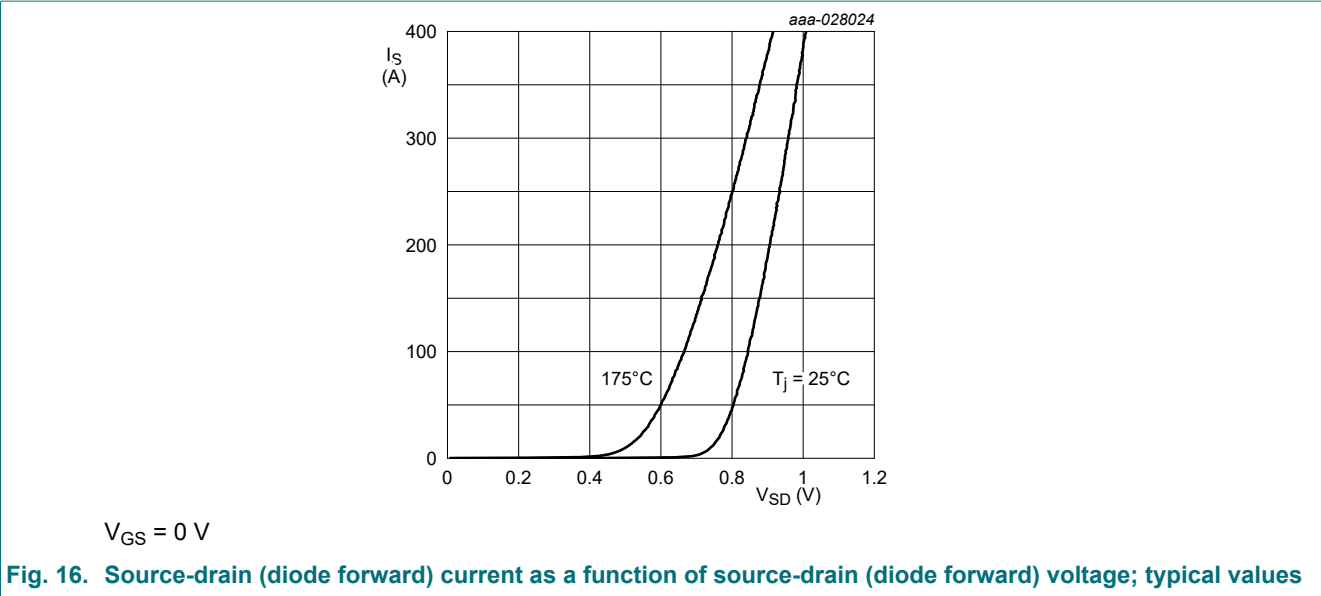


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



11. Package outline

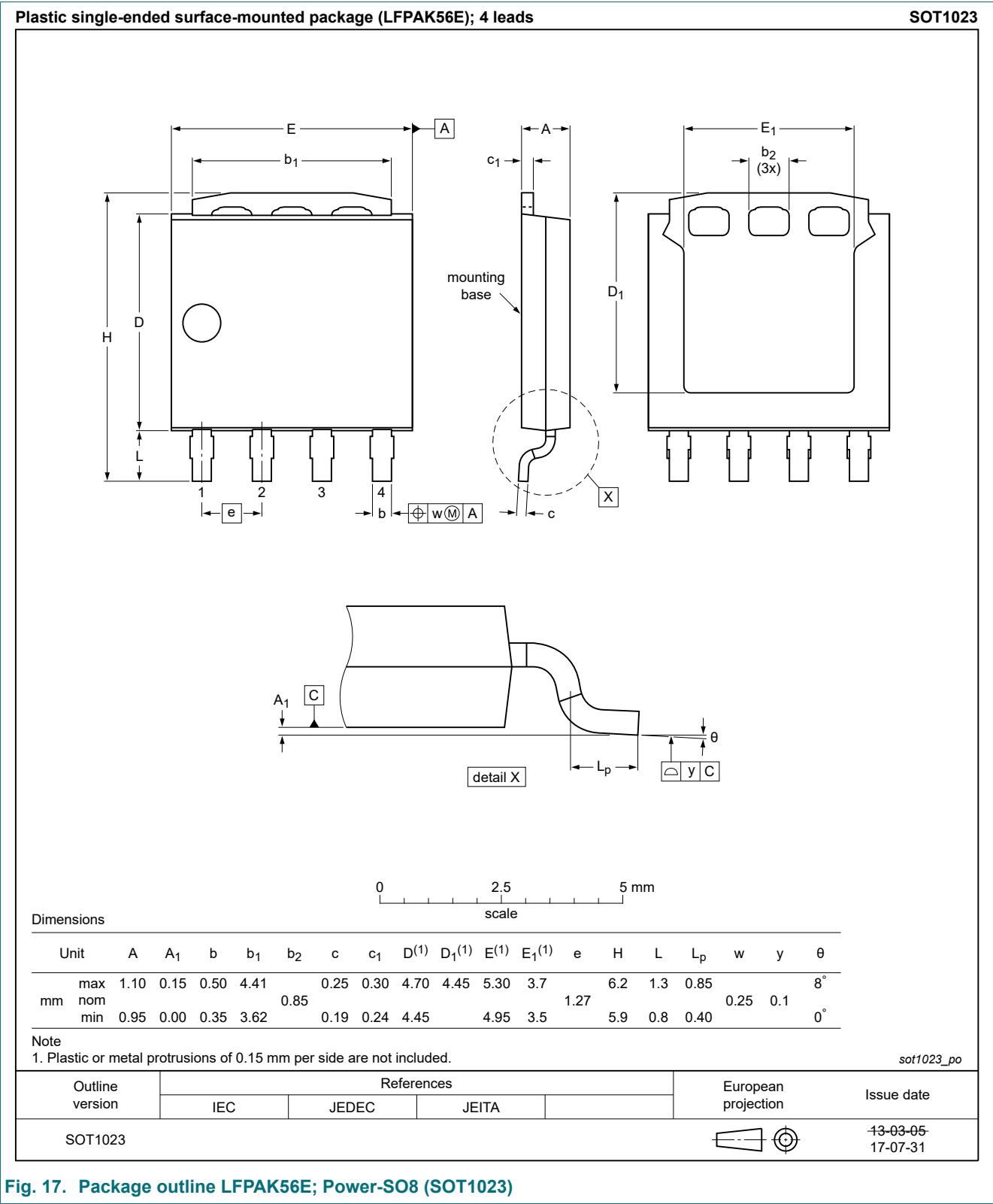
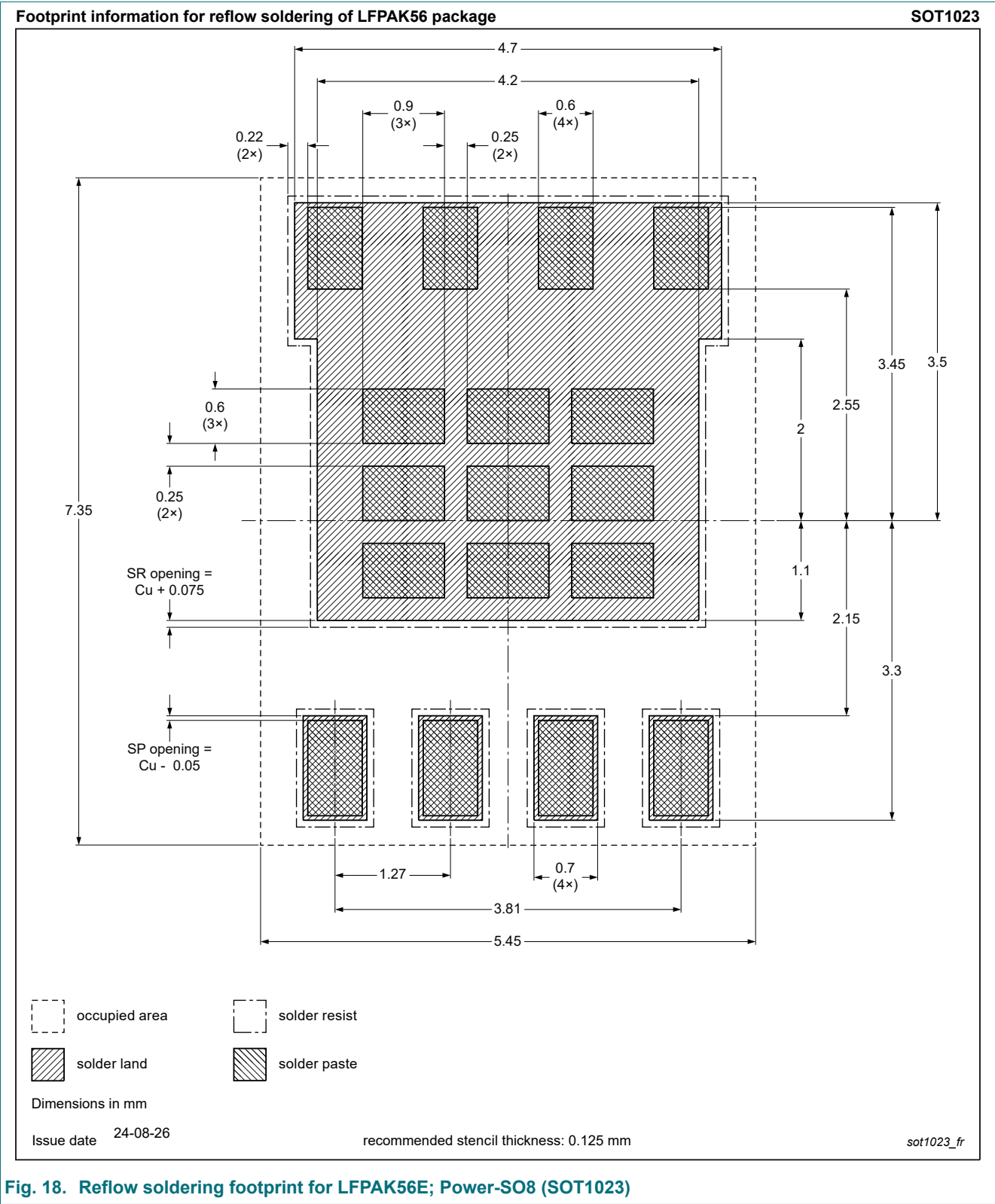


Fig. 17. Package outline LPAK56E; Power-SO8 (SOT1023)

12. Soldering



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.
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