



BUK7M5R0-40H

N-channel 40 V, 5.0 mΩ standard level MOSFET in LFPAK33

13 March 2020

Product data sheet

1. General description

Automotive qualified standard level N-channel MOSFET in an LFPAK33 package using Trench 9 TrenchMOS technology. This product has been designed and qualified to AEC-Q101 for use in high performance automotive applications.

2. Features and benefits

- Fully automotive qualified to AEC-Q101 at 175 °C
- Trench 9 superjunction technology:
 - Low power losses, high power density
- LFPAK copper clip package technology:
 - High robustness and reliability
 - Gull wing leads for high manufacturability and AOI
- Repetitive avalanche rated

3. Applications

- 12 V automotive systems
- Powertrain, chassis, body and infotainment applications
- Medium/Low power motor drive
- DC-DC systems
- LED lighting

4. Quick reference data

Table 1. Quick reference data

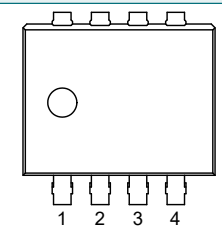
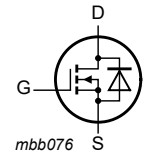
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	40	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C};$ Fig. 2	[1]	-	-	85	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Fig. 1		-	-	83	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 20\text{ A}; T_j = 25\text{ °C};$ Fig. 11		2.7	3.9	5	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$I_D = 20\text{ A}; V_{DS} = 32\text{ V}; V_{GS} = 10\text{ V};$ Fig. 13; Fig. 14		-	4	8	nC
Source-drain diode							
Q_r	recovered charge	$I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}$		-	18	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
S	softness factor	$I_S = 20 \text{ A}$; $di_S/dt = -100 \text{ A}/\mu\text{s}$; $V_{GS} = 0 \text{ V}$; $V_{DS} = 20 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$; Fig. 17	-	0.66	-	

[1] 85A 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	 <p>LFAK33 (SOT1210)</p>	 <p>mbb076</p>
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
BUK7M5R0-40H	LFAK33	Plastic, single ended surface mounted package (LFAK33); 8 leads; 0.65 mm pitch	SOT1210

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK7M5R0-40H	75H040

8. Limiting values

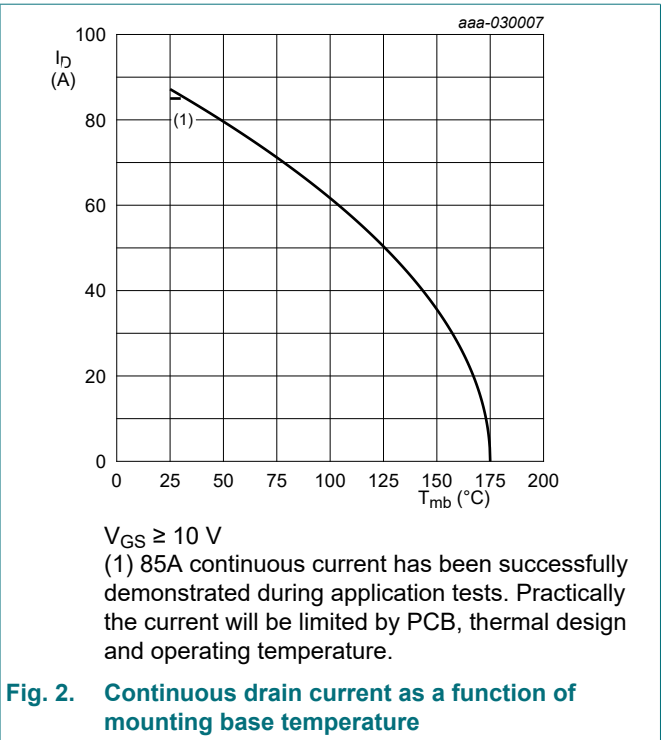
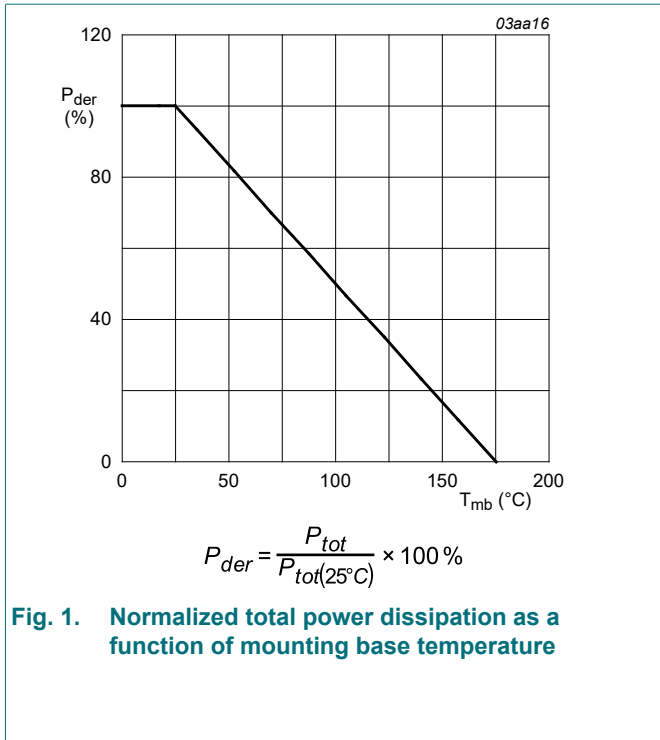
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$25 \text{ }^\circ\text{C} \leq T_j \leq 175 \text{ }^\circ\text{C}$	-	40	V
V_{GS}	gate-source voltage	DC; $T_j \leq 175 \text{ }^\circ\text{C}$	-10	20	V
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 1	-	83	W
I_D	drain current	$V_{GS} = 10 \text{ V}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 2	[1]	85	A
		$V_{GS} = 10 \text{ V}$; $T_{mb} = 100 \text{ }^\circ\text{C}$; Fig. 2	-	61.7	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10 \mu\text{s}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 3	-	349	A
T_{stg}	storage temperature		-55	175	$^\circ\text{C}$
T_j	junction temperature		-55	175	$^\circ\text{C}$

Symbol	Parameter	Conditions	Min	Max	Unit
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	85	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	349	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 70\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; unclamped; Fig. 4	[2] [3]	33	mJ
I_{AS}	non-repetitive avalanche current	$V_{sup} \leq 40\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $R_{GS} = 50\text{ }\Omega$	[4]	70	A

- [1] 85A continuous current has been successfully demonstrated during application tests. Practically 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.



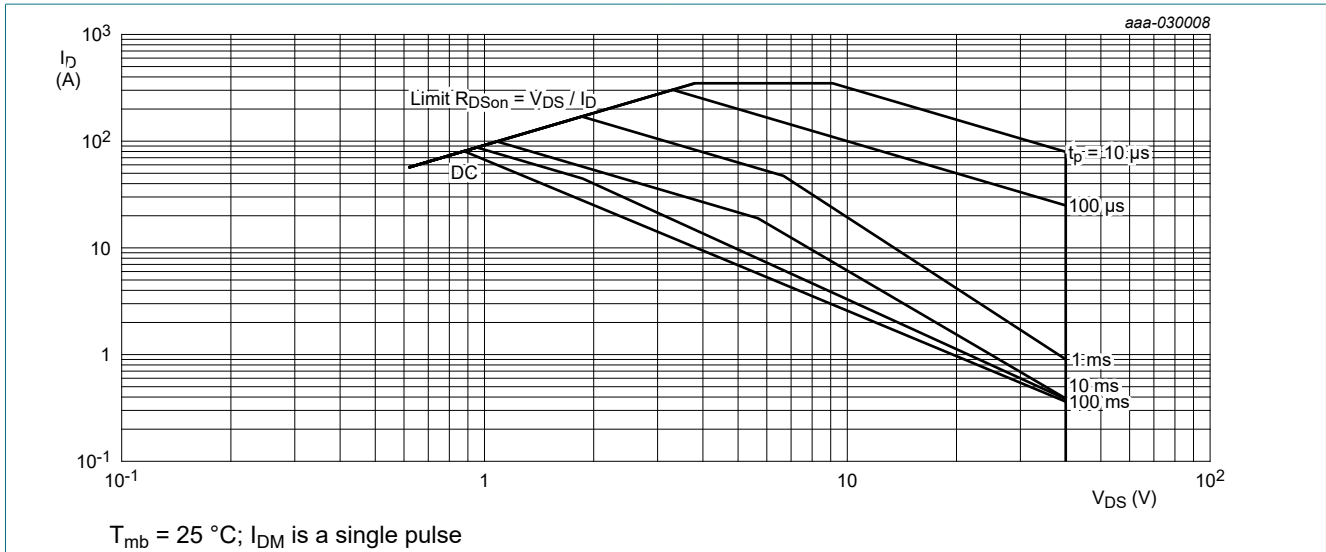


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

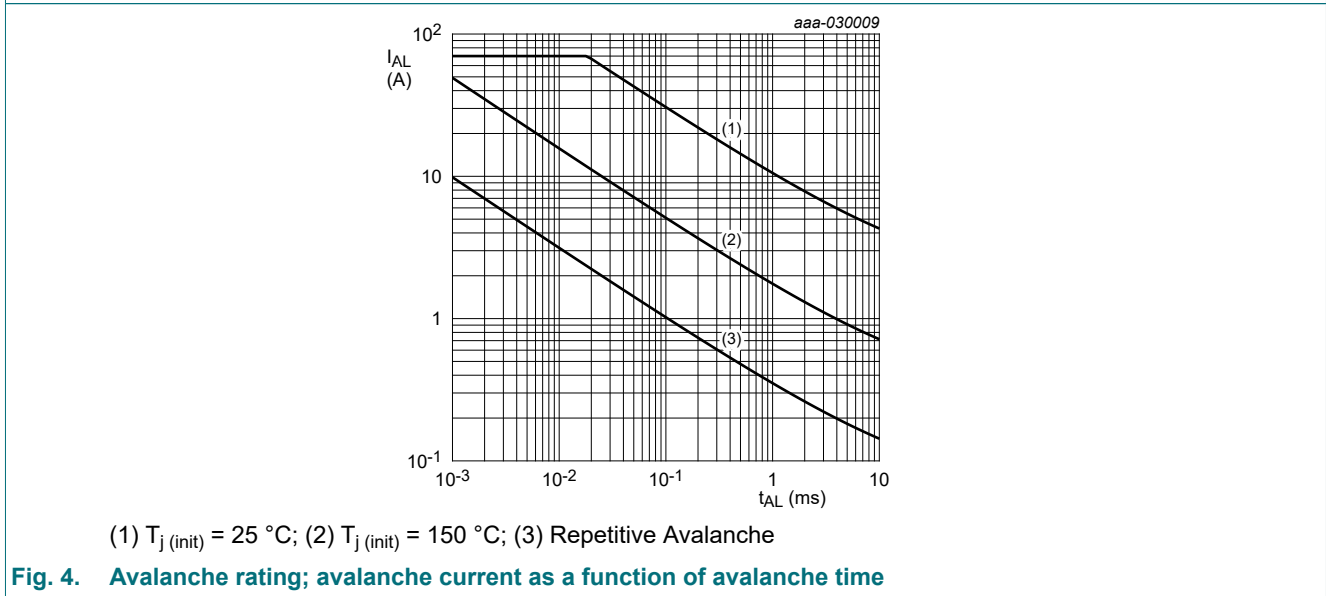


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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	-	1.61	1.81	K/W

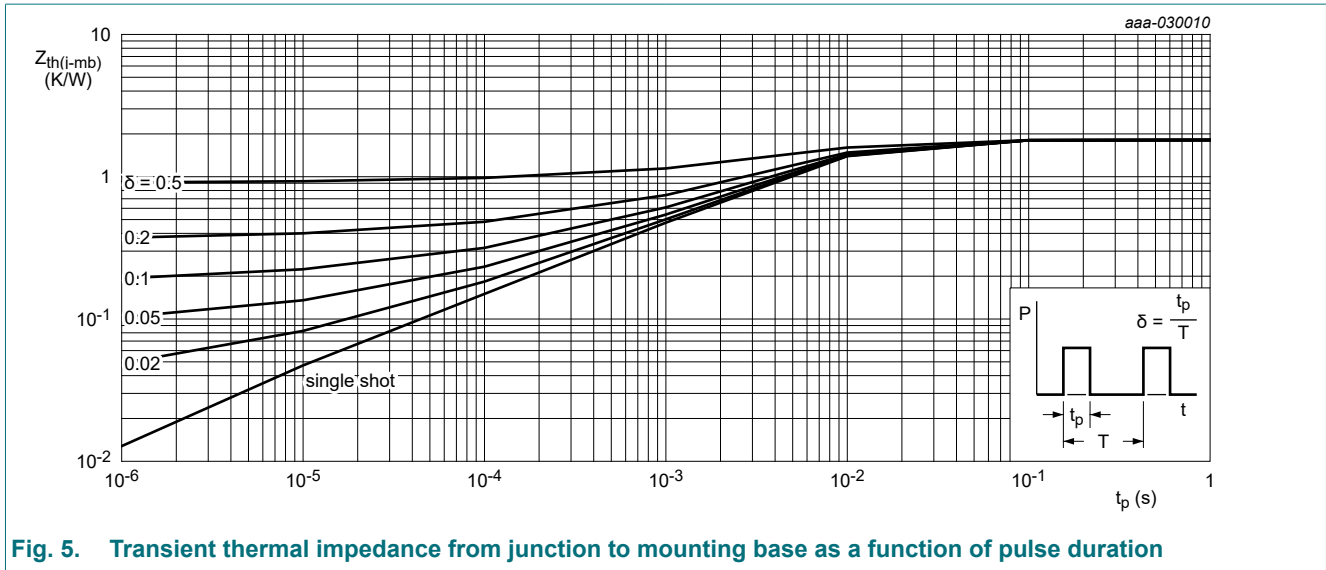


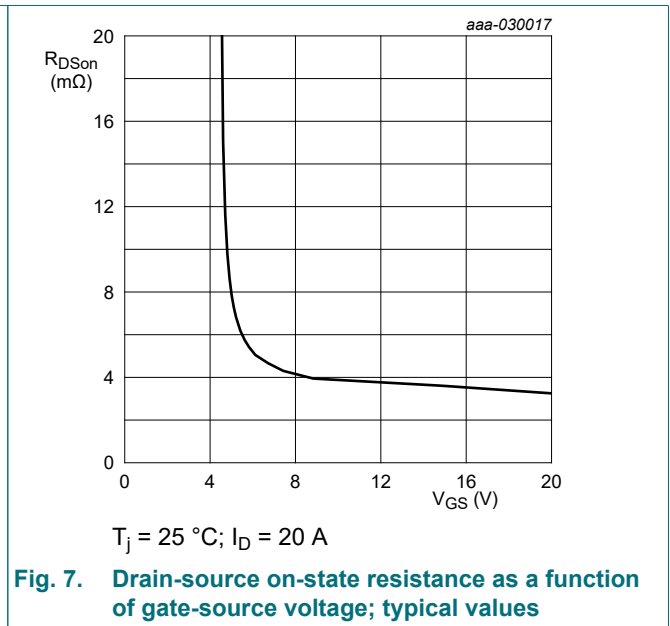
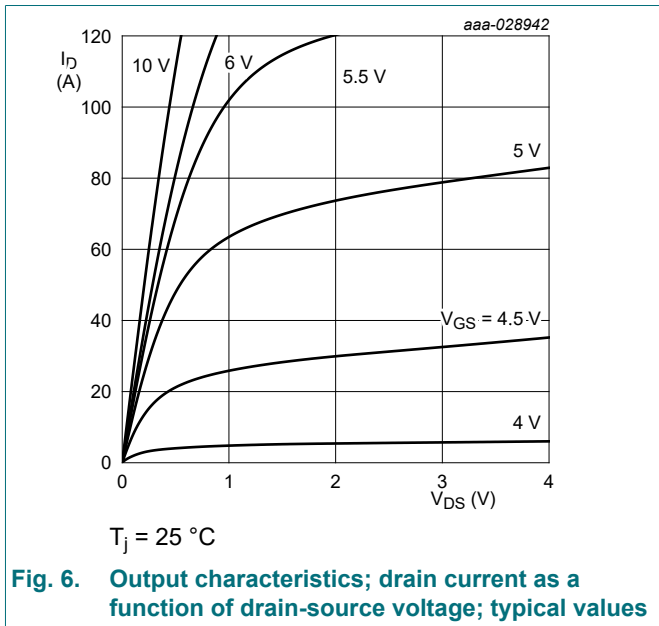
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	40	43	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -40 \text{ }^\circ C$	-	40.5	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	36	40	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ C; \text{ Fig. 9}; \text{ Fig. 10}$	2.4	3	3.6	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ C; \text{ Fig. 10}$	-	-	4.3	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ C; \text{ Fig. 10}$	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.03	1	μA
		$V_{DS} = 16 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	0.66	10	μA
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$	-	43	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ C; \text{ Fig. 11}$	2.7	3.9	5	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 105 \text{ }^\circ C; \text{ Fig. 12}$	3.8	5.9	8	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 125 \text{ }^\circ C; \text{ Fig. 12}$	4.2	6.6	8.8	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 175 \text{ }^\circ C; \text{ Fig. 12}$	5.3	8.1	10.9	mΩ
R_G	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	0.3	0.8	2	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 20 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V}; \text{ Fig. 13}; \text{ Fig. 14}$	-	22	31	nC
Q_{GS}	gate-source charge		-	6.3	9.5	nC
Q_{GD}	gate-drain charge		-	4	8	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{iss}	input capacitance	$V_{DS} = 25\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$	-	1494	2092	pF
C_{oss}	output capacitance	$T_j = 25\text{ °C};$ Fig. 15	-	460	644	pF
C_{rss}	reverse transfer capacitance		-	69	152	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}; R_L = 1.5\text{ }\Omega; V_{GS} = 10\text{ V};$	-	6.4	-	ns
t_r	rise time	$R_{G(ext)} = 5\text{ }\Omega$	-	4.5	-	ns
$t_{d(off)}$	turn-off delay time		-	13	-	ns
t_f	fall time		-	5.5	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 20\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C};$ Fig. 16	-	0.82	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V};$ Fig. 17	-	25	-	ns
Q_r	recovered charge	$I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}$	-	18	-	nC
S	softness factor	$I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ °C};$ Fig. 17	-	0.66	-	
		$I_S = 20\text{ A}; di_S/dt = -500\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ °C};$ Fig. 17	-	0.47	-	



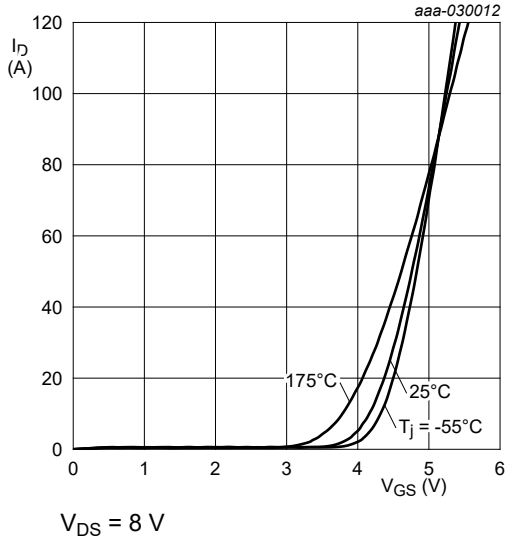


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

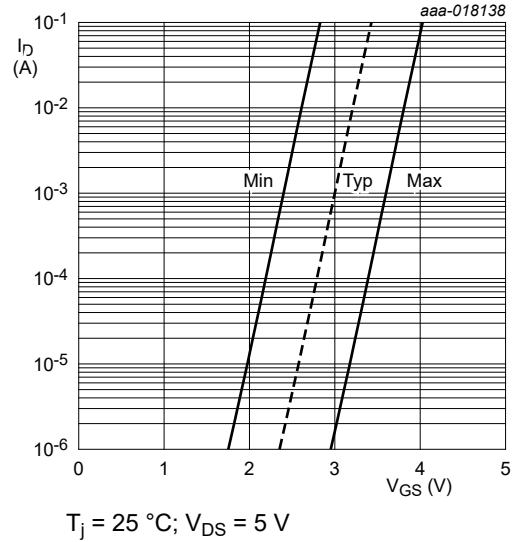


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

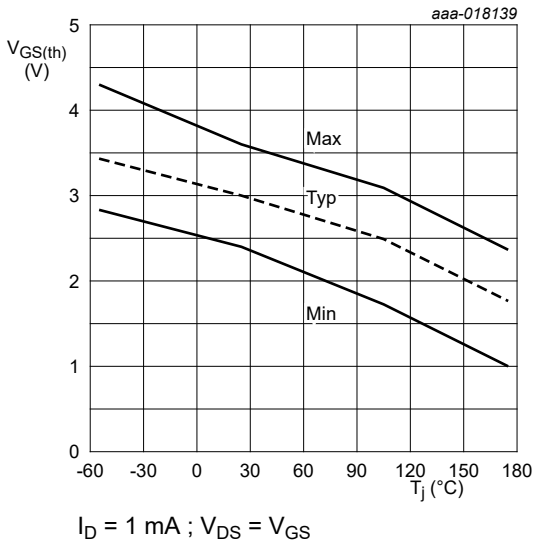


Fig. 10. Gate-source threshold voltage as a function of junction temperature, FET1 and FET2

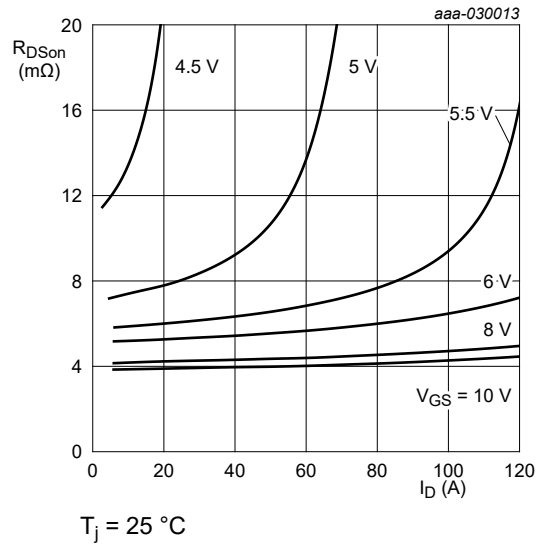
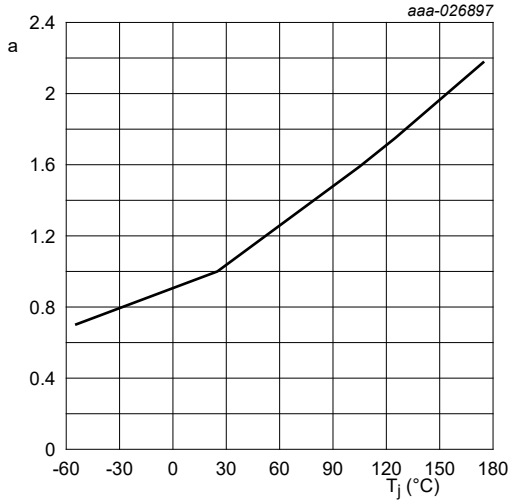
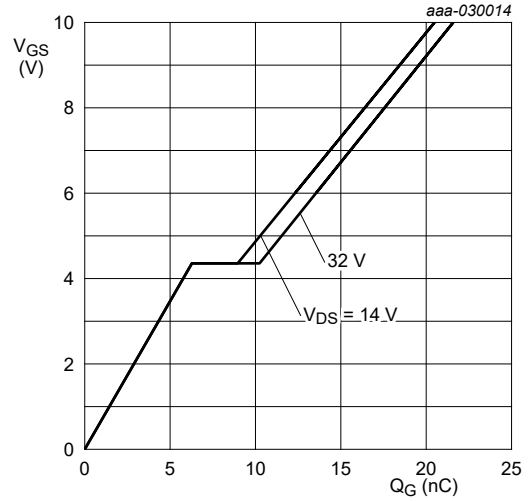


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values



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

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



$T_j = 25^{\circ}\text{C}; I_D = 20\text{ A}$

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

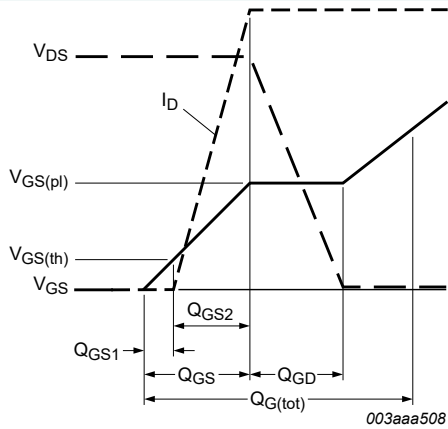
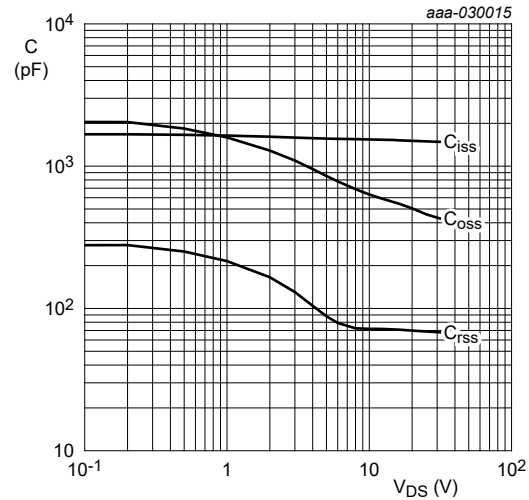
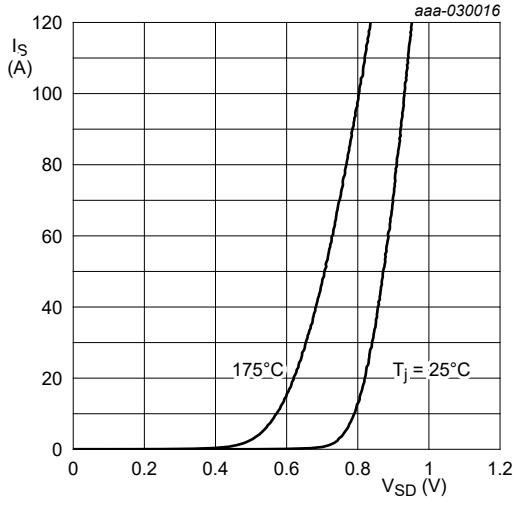


Fig. 14. Gate charge waveform definitions



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

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

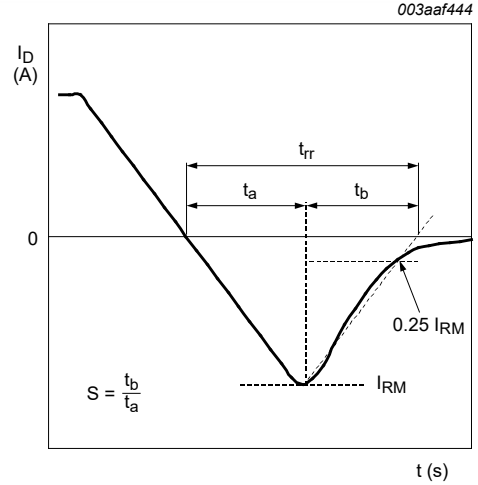


Fig. 17. Reverse recovery timing definition

11. Package outline

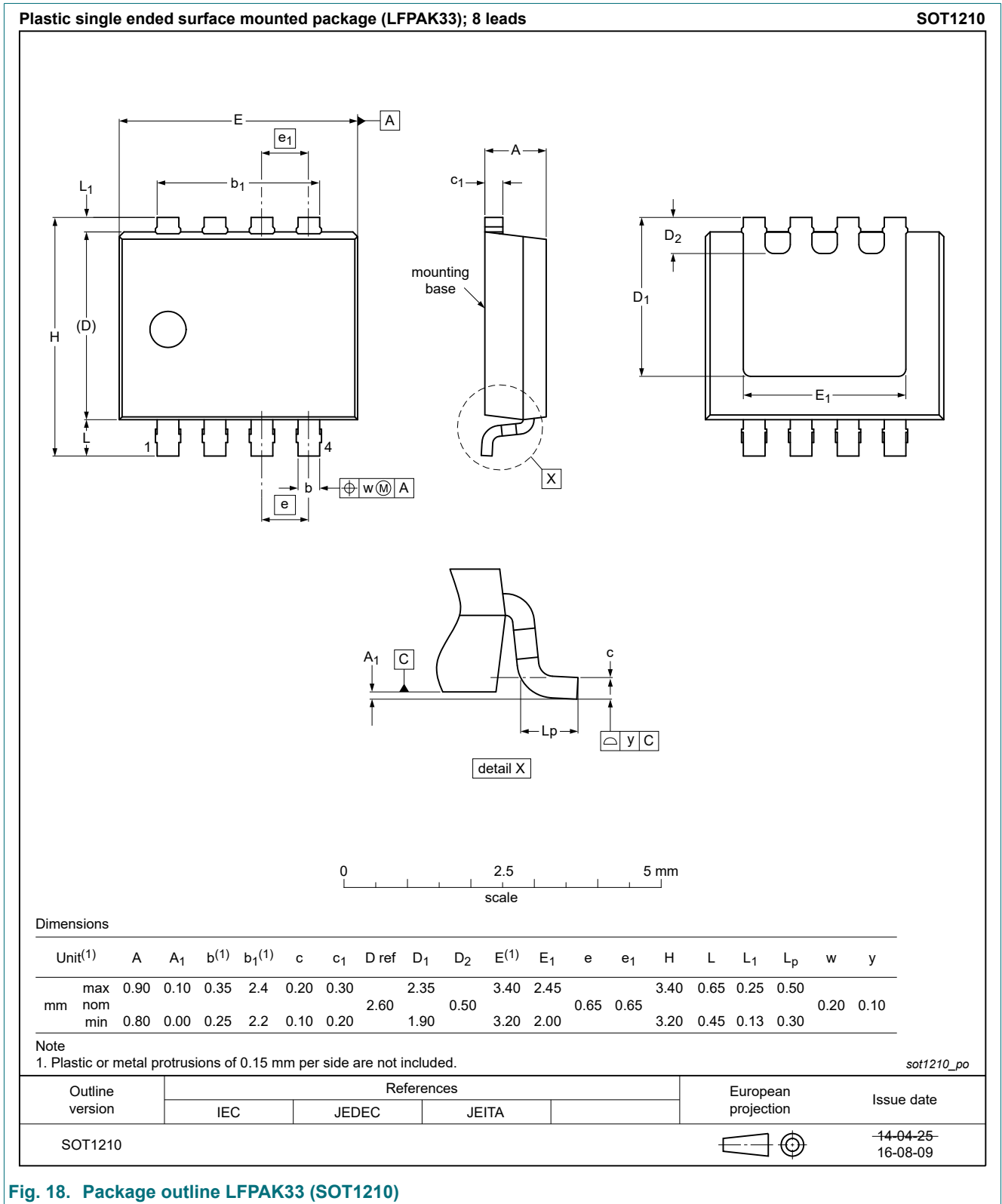


Fig. 18. Package outline LPAK33 (SOT1210)

12. Soldering

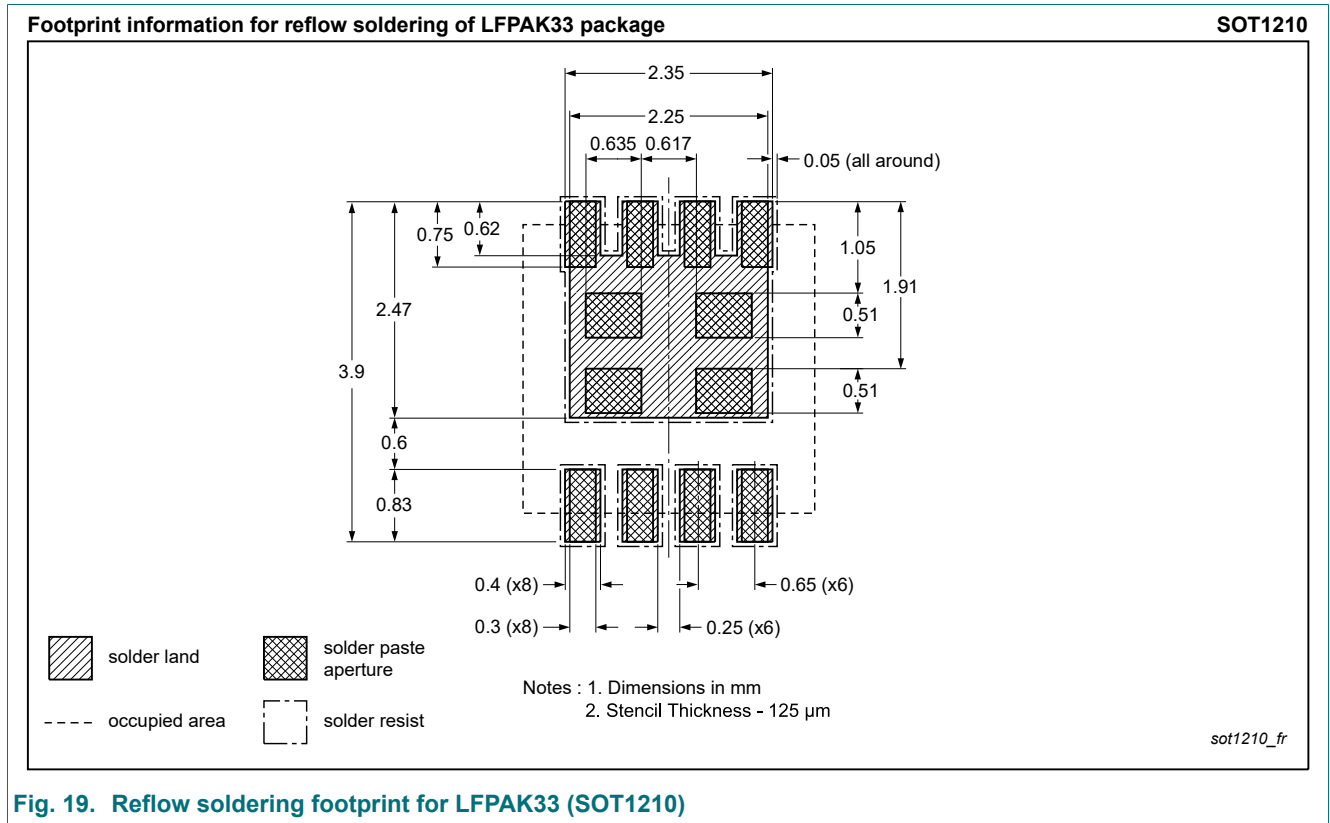


Fig. 19. Reflow soldering footprint for LFPAK33 (SOT1210)

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.
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