



# BUK7Y3R1-80M

N-channel 80 V, 3.1 mOhm, Standard level MOSFET in LFPAK56

13 February 2024

Product data sheet

## 1. General description

Automotive qualified N-channel MOSFET using the latest Trench 14 low ohmic split-gate technology, for ultra-low  $R_{DSon}$  capability, housed in a 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 14 split-gate technology:
  - Reduced cell pitch enables enhanced power density and efficiency with lower  $R_{DSon}$  in same footprint
  - Fast and efficient switching with optimal damping and low spiking
- 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, 24 V and 48 V automotive systems
- Motor, lighting and solenoid control
- Ultra high-performance power switching

## 4. Quick reference data

Table 1. Quick reference data

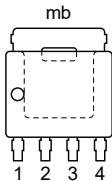
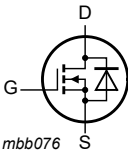
| Symbol                        | Parameter                        | Conditions                                                                                   |     | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|-----|------|
| $V_{DS}$                      | drain-source voltage             | $25\text{ °C} \leq T_j \leq 175\text{ °C}$                                                   |     | -   | -   | 80  | V    |
| $I_D$                         | drain current                    | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>                    | [1] | -   | -   | 160 | A    |
| $P_{tot}$                     | total power dissipation          | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>                                             |     | -   | -   | 254 | W    |
| $T_j$                         | junction temperature             |                                                                                              |     | -55 | -   | 175 | °C   |
| <b>Static characteristics</b> |                                  |                                                                                              |     |     |     |     |      |
| $R_{DSon}$                    | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a> |     | 1.7 | 2.5 | 3.1 | mΩ   |

| Symbol                  | Parameter         | Conditions                                                                                                                   | Min | Typ | Max | Unit |
|-------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| Dynamic characteristics |                   |                                                                                                                              |     |     |     |      |
| $Q_{G(tot)}$            | total gate charge | $I_D = 25\text{ A}$ ; $V_{DS} = 40\text{ V}$ ; $V_{GS} = 10\text{ V}$ ;<br><a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> | 35  | 70  | 105 | nC   |

[1] 160 A 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                            | <br><b>LPAK56; Power-SO8 (SOT669)</b> | <br><i>mbb076</i> |
| 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 |
| BUK7Y3R1-80M | LPAK56; Power-SO8 | plastic, single-ended surface-mounted package; 4 terminals | SOT669  |

7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| BUK7Y3R1-80M | 73M180Y      |

8. Limiting values

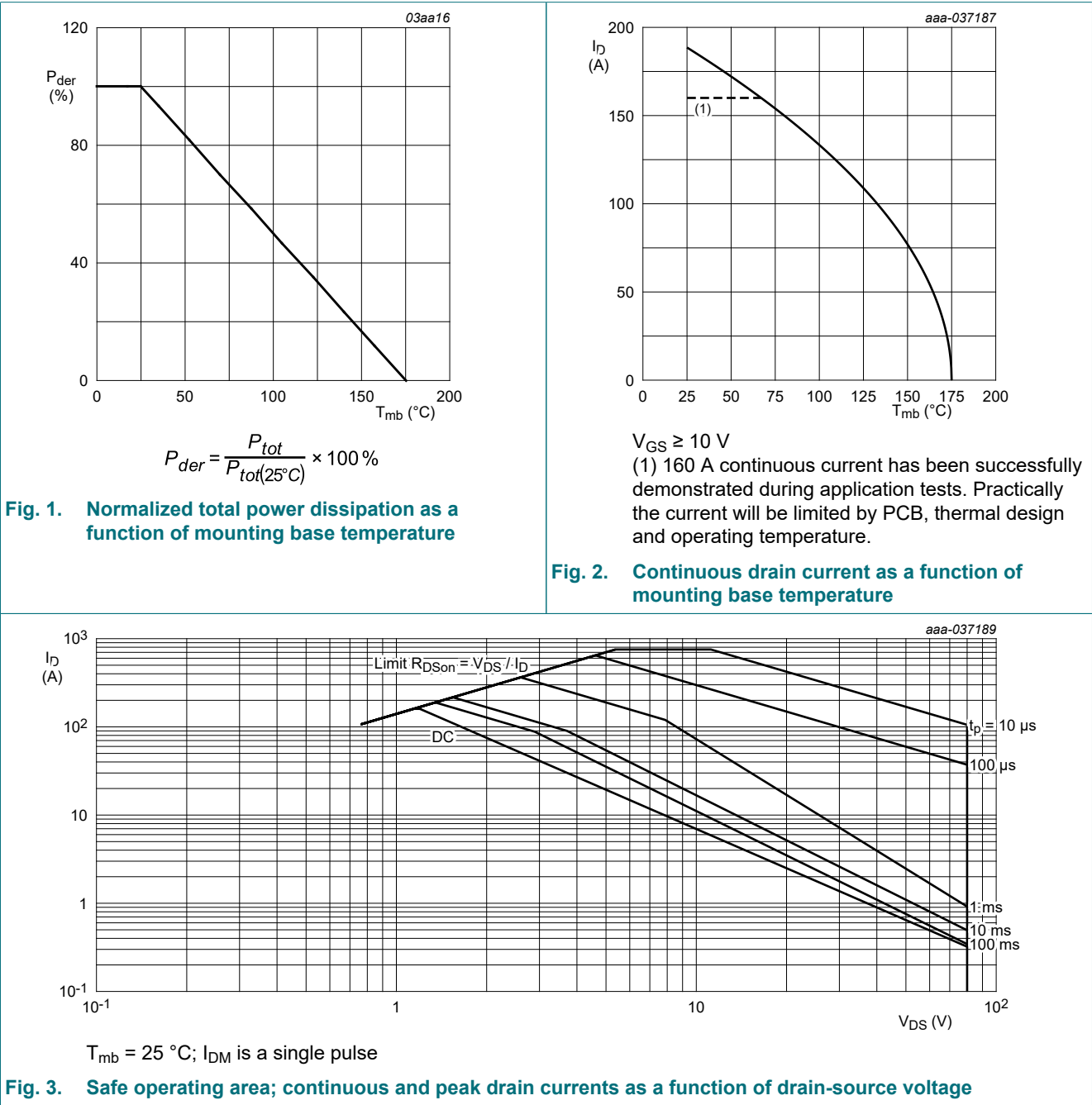
Table 5. Limiting values

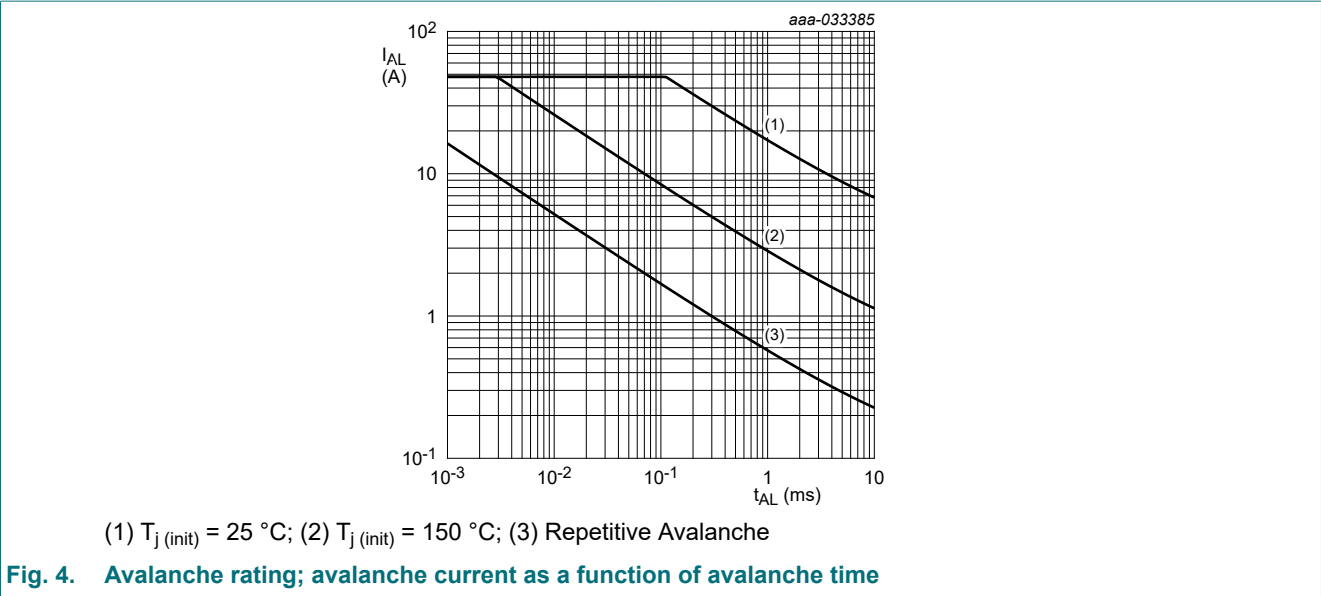
In accordance with the Absolute Maximum Rating System (IEC 60134).  $T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise stated.

| Symbol    | Parameter               | Conditions                                                                                                | Min | Max | Unit               |
|-----------|-------------------------|-----------------------------------------------------------------------------------------------------------|-----|-----|--------------------|
| $V_{DS}$  | drain-source voltage    | $25\text{ }^{\circ}\text{C} \leq T_j \leq 175\text{ }^{\circ}\text{C}$                                    | -   | 80  | V                  |
| $V_{GS}$  | gate-source voltage     |                                                                                                           | -20 | 20  | V                  |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 1</a>                                            | -   | 254 | W                  |
| $I_D$     | drain current           | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 2</a>                   | [1] | 160 | A                  |
|           |                         | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 2</a>                  | -   | 133 | A                  |
| $I_{DM}$  | peak drain current      | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 3</a> | -   | 754 | 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 <sub>S</sub>       | source current                               | T <sub>mb</sub> = 25 °C                                                                                                                         |             | -   | 160 | A    |
| I <sub>SM</sub>      | peak source current                          | pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C                                                                                         |             | -   | 754 | A    |
| Avalanche ruggedness |                                              |                                                                                                                                                 |             |     |     |      |
| E <sub>DS(AL)S</sub> | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 49 A; V <sub>sup</sub> ≤ 80 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; Fig. 4 | [2] [3] [4] | -   | 289 | mJ   |

- [1] 160 A 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
- [3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [4] Refer to application note AN10273 for further information.



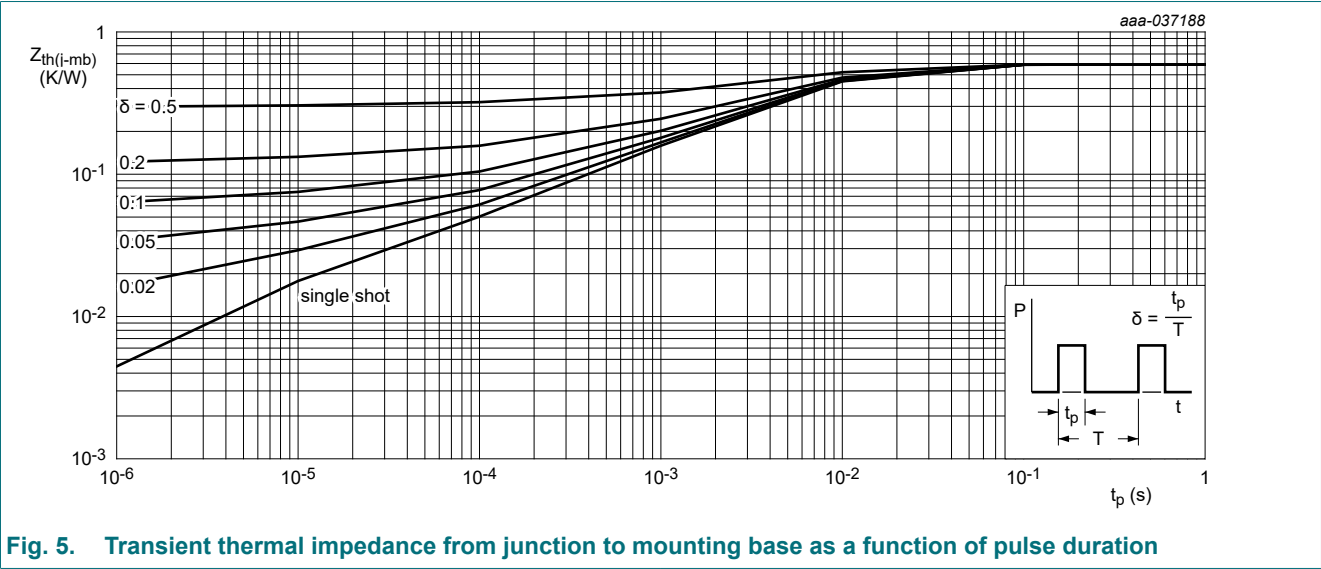


9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter                                         | Conditions |     | Min | Typ  | Max  | Unit |
|----------------|---------------------------------------------------|------------|-----|-----|------|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5     |     | -   | 0.43 | 0.59 | 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.



10. Characteristics

Table 7. Characteristics

| Symbol                  | Parameter                        | Conditions                                                                                                                     |  | Min  | Typ  | Max  | Unit |
|-------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--|------|------|------|------|
| Static characteristics  |                                  |                                                                                                                                |  |      |      |      |      |
| V <sub>(BR)DSS</sub>    | drain-source breakdown voltage   | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                         |  | 80   | 89   | -    | V    |
|                         |                                  | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = -40 °C                                                        |  | -    | 86   | -    | V    |
|                         |                                  | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = -55 °C                                                        |  | 72   | 85   | -    | V    |
| V <sub>GS(th)</sub>     | gate-source threshold voltage    | I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>J</sub> = 25 °C; <a href="#">Fig. 10</a>                      |  | 2    | 3    | 4    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>J</sub> = 175 °C; <a href="#">Fig. 11</a>                     |  | 1    | 2    | -    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>J</sub> = -55 °C; <a href="#">Fig. 11</a>                     |  | -    | 3.4  | 4.6  | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = 80 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                          |  | -    | 0.07 | 1    | μA   |
|                         |                                  | V <sub>DS</sub> = 80 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 125 °C                                                         |  | -    | 2    | 100  | μA   |
|                         |                                  | V <sub>DS</sub> = 80 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 175 °C                                                         |  | -    | 50   | 500  | μA   |
| I <sub>GSS</sub>        | gate leakage current             | V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                          |  | -    | 2    | 100  | nA   |
|                         |                                  | V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                         |  | -    | 2    | 100  | nA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>J</sub> = 25 °C; <a href="#">Fig. 9</a>                                  |  | 1.7  | 2.5  | 3.1  | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>J</sub> = 105 °C; <a href="#">Fig. 12</a>                                |  | 2.6  | 4    | 5    | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>J</sub> = 125 °C; <a href="#">Fig. 12</a>                                |  | 2.9  | 4.5  | 5.5  | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>J</sub> = 175 °C; <a href="#">Fig. 12</a>                                |  | 3.7  | 5.8  | 7.1  | mΩ   |
| R <sub>G</sub>          | gate resistance                  | f = 1 MHz; T <sub>J</sub> = 25 °C                                                                                              |  | 0.35 | 0.7  | 1.4  | Ω    |
| Dynamic characteristics |                                  |                                                                                                                                |  |      |      |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 40 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>       |  | 35   | 70   | 105  | nC   |
| Q <sub>GS</sub>         | gate-source charge               |                                                                                                                                |  | 8    | 20   | 32   | nC   |
| Q <sub>GD</sub>         | gate-drain charge                |                                                                                                                                |  | 5    | 14   | 32   | nC   |
| C <sub>iss</sub>        | input capacitance                | V <sub>DS</sub> = 40 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>J</sub> = 25 °C; <a href="#">Fig. 15</a>                      |  | 2938 | 4896 | 6854 | pF   |
| C <sub>oss</sub>        | output capacitance               |                                                                                                                                |  | 448  | 1121 | 2018 | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |                                                                                                                                |  | 11   | 53   | 122  | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = 40 V; R <sub>L</sub> = 1.6 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 5 Ω                              |  | -    | 20   | -    | ns   |
| t <sub>r</sub>          | rise time                        |                                                                                                                                |  | -    | 19   | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |                                                                                                                                |  | -    | 38   | -    | ns   |
| t <sub>f</sub>          | fall time                        |                                                                                                                                |  | -    | 22   | -    | ns   |
| Source-drain diode      |                                  |                                                                                                                                |  |      |      |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C; <a href="#">Fig. 16</a>                                  |  | -    | 0.81 | 1    | V    |
| t <sub>rr</sub>         | reverse recovery time            | I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 40 V; <a href="#">Fig. 17</a> |  | -    | 38   | -    | ns   |
| Q <sub>r</sub>          | recovered charge                 |                                                                                                                                |  | -    | 36   | -    | nC   |

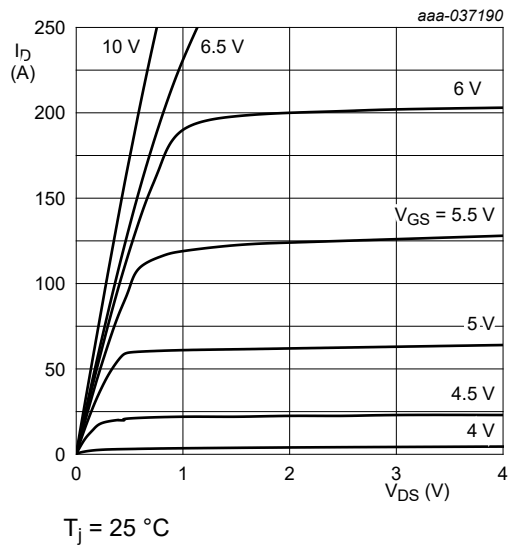


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

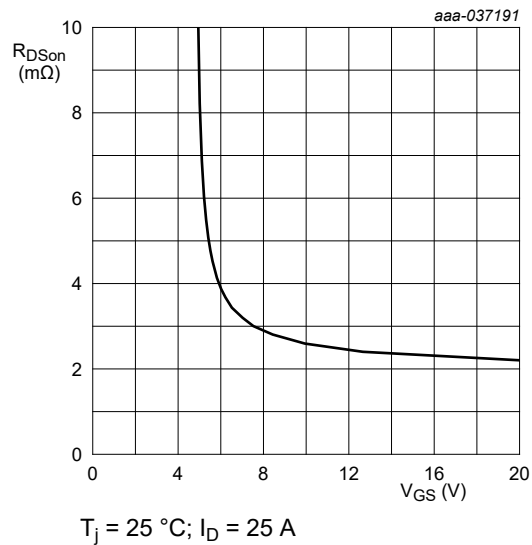


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

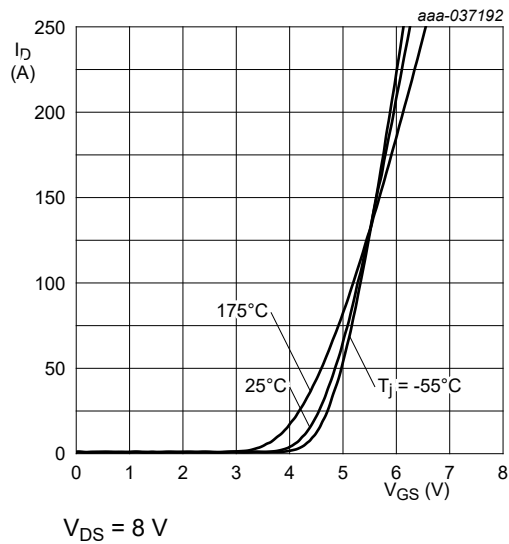


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

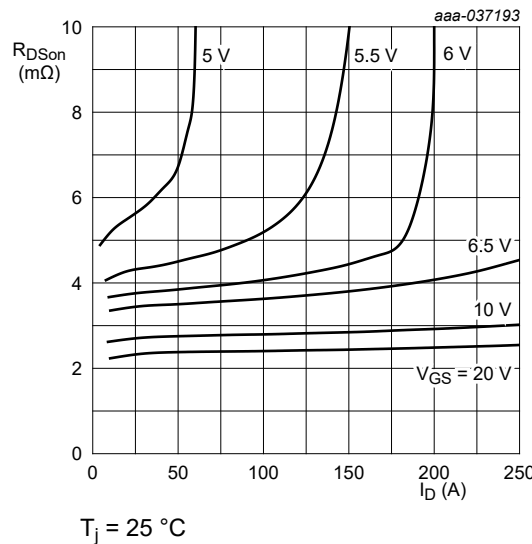


Fig. 9. Drain-source on-state resistance as a function of drain current; typical values

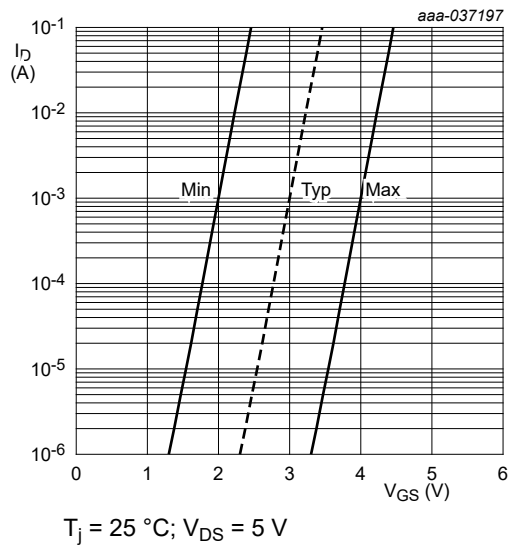


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

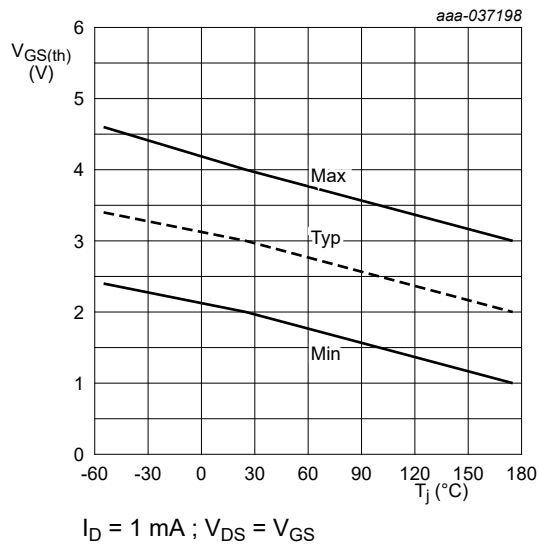


Fig. 11. Gate-source threshold voltage as a function of junction temperature

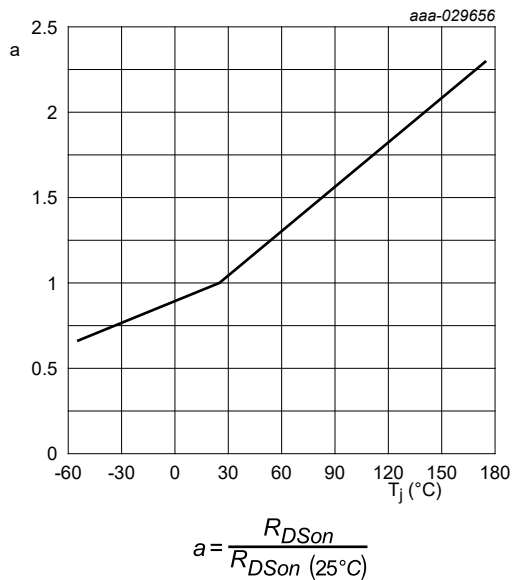


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

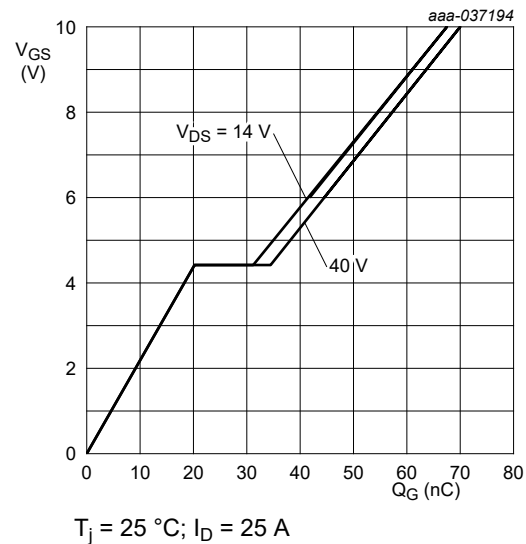


Fig. 13. Gate-source voltage as a function of gate charge; typical values

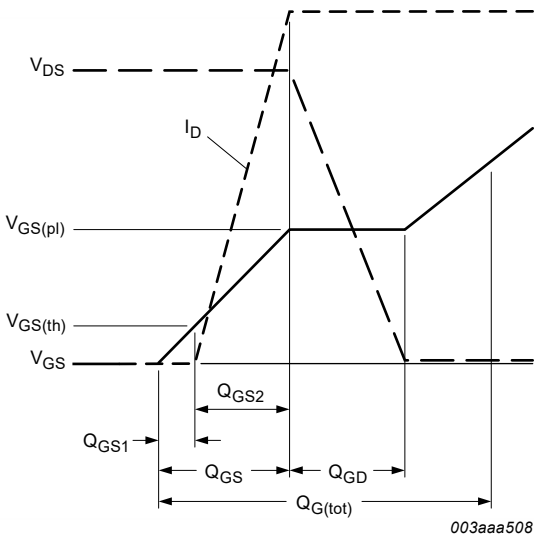


Fig. 14. Gate charge waveform definitions

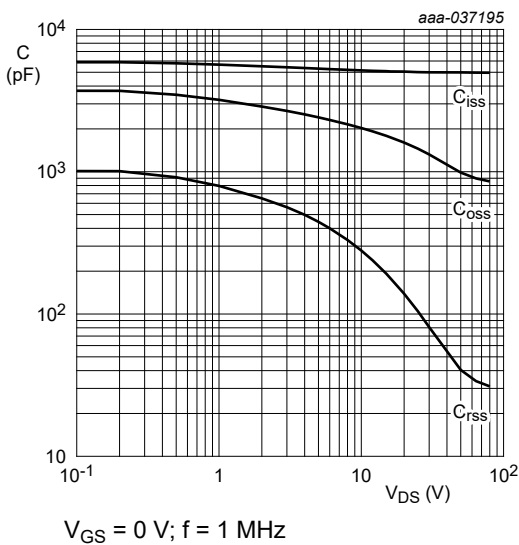


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

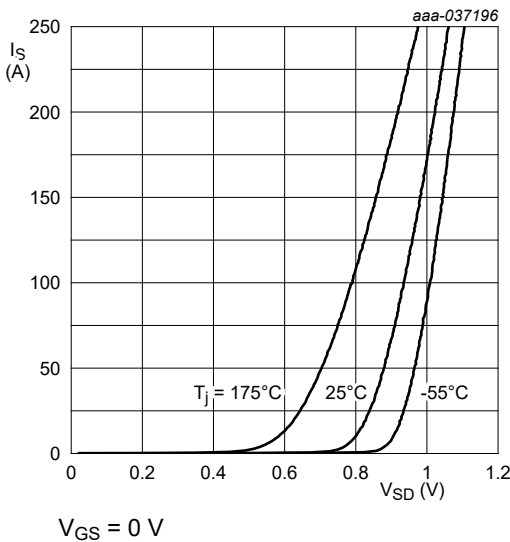


Fig. 16. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

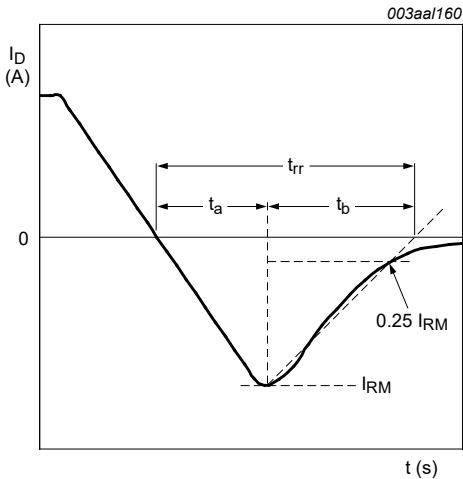


Fig. 17. Reverse recovery timing definition



11. Package outline

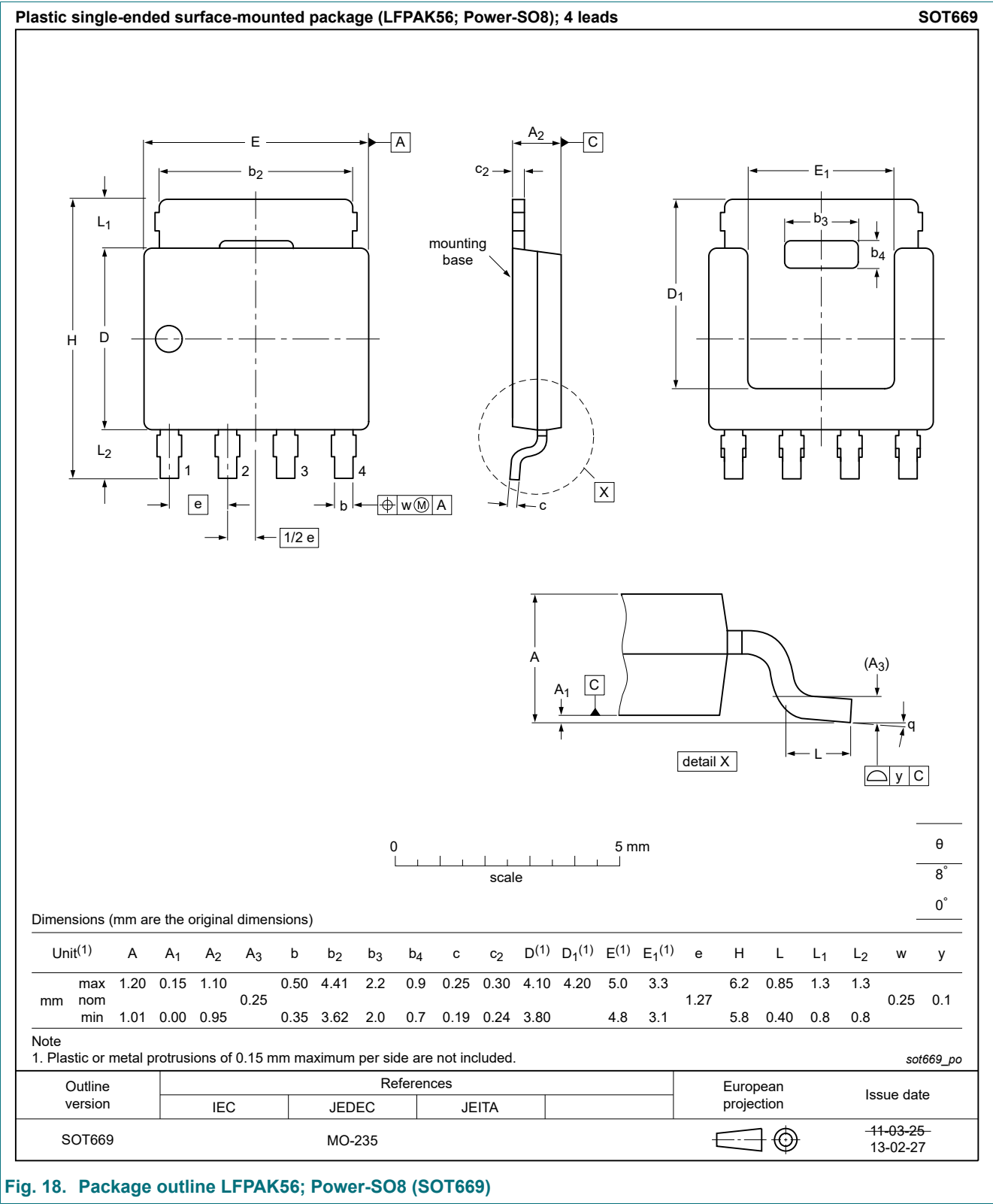


Fig. 18. Package outline LPAK56; Power-SO8 (SOT669)

12. Soldering

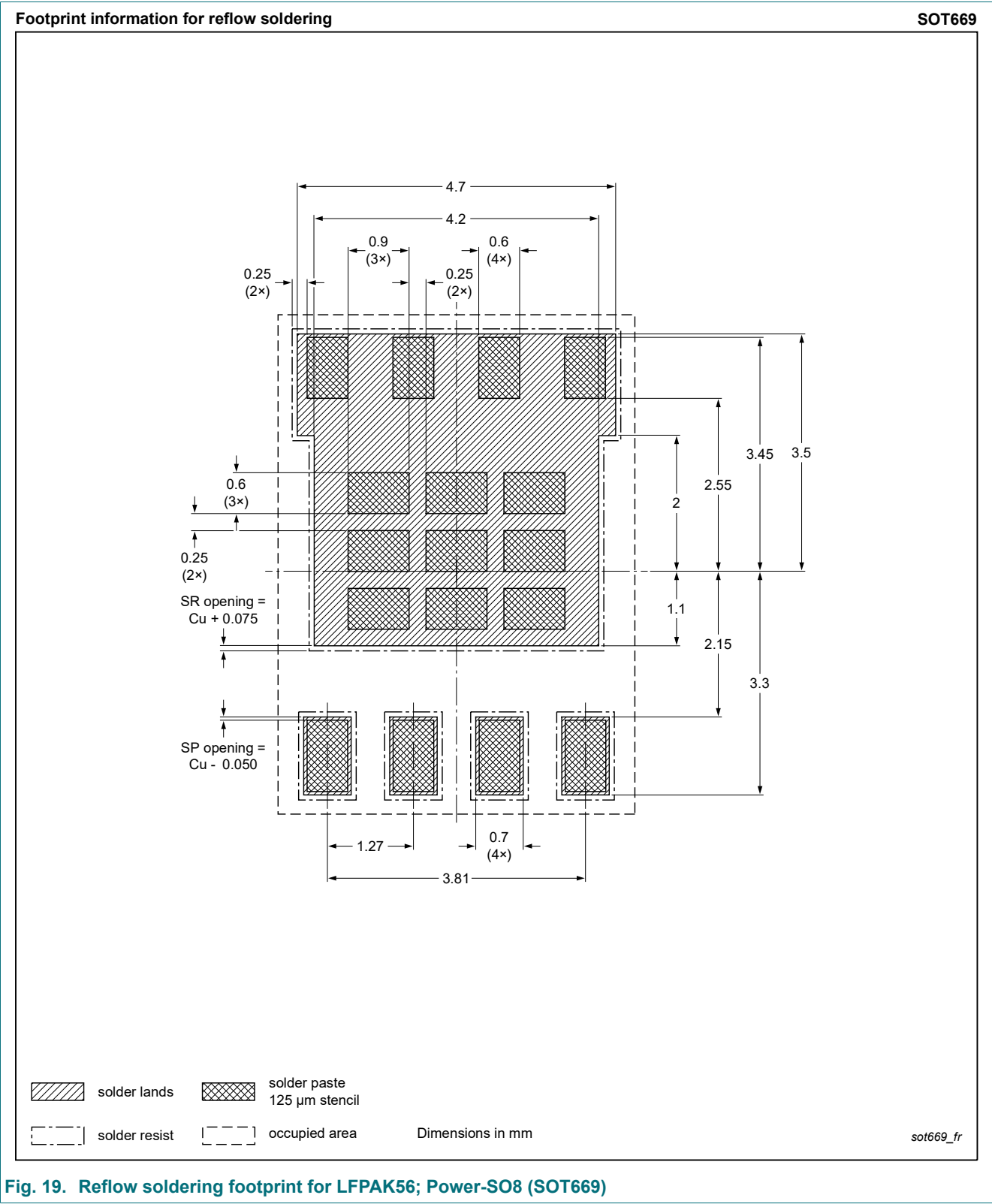


Fig. 19. Reflow soldering footprint for LPAK56; Power-SO8 (SOT669)

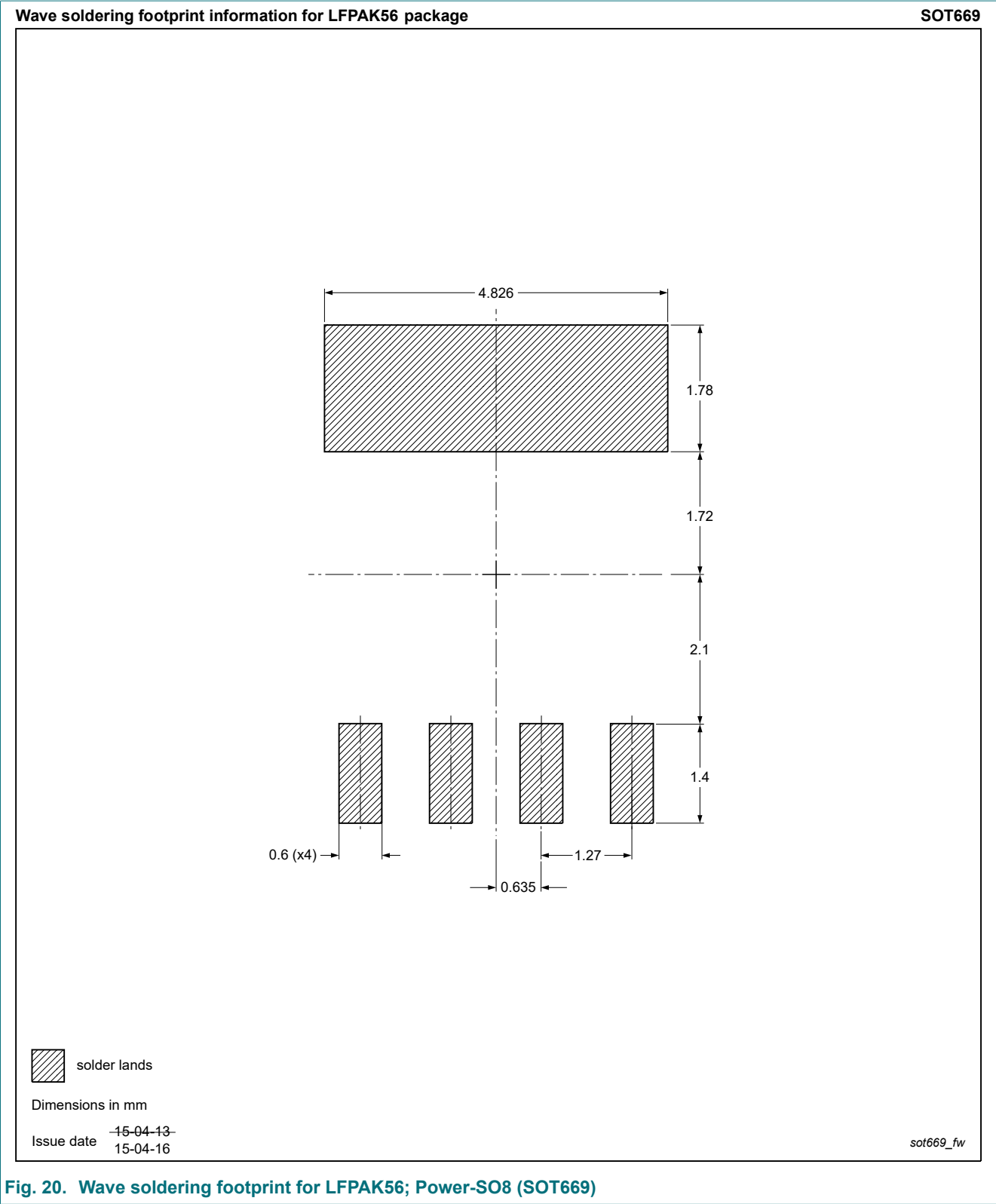


Fig. 20. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

13. Legal information

Data sheet status

| Document status<br>[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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