



# BUK6Y33-60P

60 V, P-channel Trench MOSFET

21 January 2021

Product data sheet

## 1. General description

P-channel enhancement mode MOSFET in an LFPK56 (Power SO8) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

This product has been designed and qualified to AEC-Q101 standard for use in high-performance automotive applications such as reverse battery protection.

## 2. Features and benefits

- High thermal power dissipation capability
- Suitable for thermally demanding environments due to 175 °C rating
- Trench MOSFET technology
- AEC-Q101 qualified

## 3. Applications

- Reverse battery protection
- Power management
- High-side load switch
- Motor drive

## 4. Quick reference data

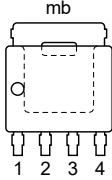
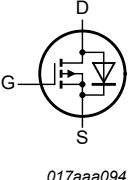
Table 1. Quick reference data

| Symbol                        | Parameter                        | Conditions                                                     |     | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|----------------------------------------------------------------|-----|-----|-----|-----|------|
| $V_{DS}$                      | drain-source voltage             | $T_j = 25\text{ °C}$                                           |     | -   | -   | -60 | V    |
| $V_{GS}$                      | gate-source voltage              |                                                                | [1] | -20 | -   | 20  | V    |
| $I_D$                         | drain current                    | $V_{GS} = -10\text{ V}; T_{mb} = 25\text{ °C}$                 |     | -   | -   | -30 | A    |
| $P_{tot}$                     | total power dissipation          | $T_{mb} = 25\text{ °C}$                                        |     | -   | -   | 110 | W    |
| <b>Static characteristics</b> |                                  |                                                                |     |     |     |     |      |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = -10\text{ V}; I_D = -7\text{ A}; T_j = 25\text{ °C}$ |     | -   | 26  | 33  | mΩ   |

[1]  $V_{GS} = -20\text{ V}/+5\text{ V}$  according AEC-Q101 at  $T_j = 175\text{ °C}$ ;  $V_{GS} = -20\text{ V}/+20\text{ V}$  according AEC-Q101 at  $T_j = 150\text{ °C}$

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                                                      | Graphic symbol                                                                                   |
|-----|--------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1   | S      | source                            | <br><b>LFPAK56; Power-SO8 (SOT669)</b> | <br>017aaa094 |
| 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 |
| BUK6Y33-60P | LFPAK56; Power-SO8 | plastic, single-ended surface-mounted package; 4 terminals | SOT669  |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BUK6Y33-60P | 6Y3360P      |

## 8. Limiting values

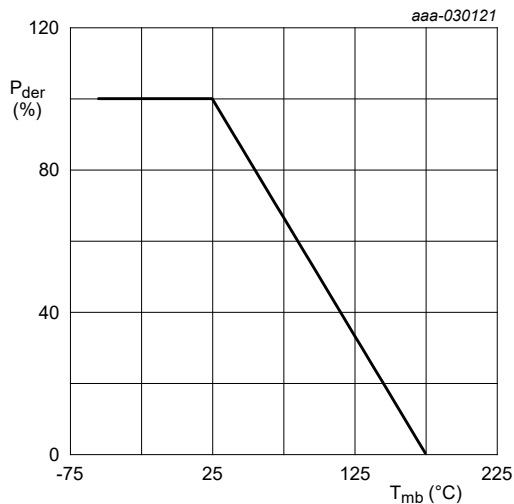
**Table 5. Limiting values**

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

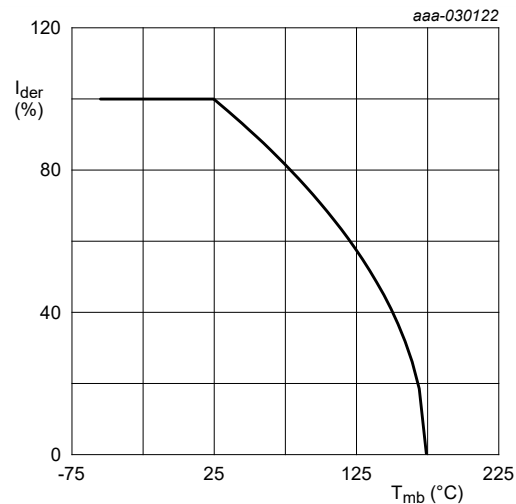
| Symbol                      | Parameter                                    | Conditions                                                                             |     | Min | Max  | Unit |
|-----------------------------|----------------------------------------------|----------------------------------------------------------------------------------------|-----|-----|------|------|
| V <sub>DS</sub>             | drain-source voltage                         | T <sub>j</sub> = 25 °C                                                                 |     | -   | -60  | V    |
| V <sub>GS</sub>             | gate-source voltage                          |                                                                                        | [1] | -20 | 20   | V    |
| I <sub>D</sub>              | drain current                                | V <sub>GS</sub> = -10 V; T <sub>mb</sub> = 25 °C                                       |     | -   | -30  | A    |
|                             |                                              | V <sub>GS</sub> = -10 V; T <sub>mb</sub> = 100 °C                                      |     | -   | -21  | A    |
| I <sub>DM</sub>             | peak drain current                           | single pulse; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C                          |     | -   | -120 | A    |
| P <sub>tot</sub>            | total power dissipation                      | T <sub>mb</sub> = 25 °C                                                                |     | -   | 110  | W    |
| T <sub>j</sub>              | junction temperature                         |                                                                                        |     | -55 | 175  | °C   |
| T <sub>amb</sub>            | ambient temperature                          |                                                                                        |     | -55 | 175  | °C   |
| T <sub>stg</sub>            | storage temperature                          |                                                                                        |     | -65 | 175  | °C   |
| <b>Source-drain diode</b>   |                                              |                                                                                        |     |     |      |      |
| I <sub>S</sub>              | source current                               | T <sub>mb</sub> = 25 °C                                                                |     | -   | -30  | A    |
| I <sub>SM</sub>             | peak source current                          | single pulse; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C                          |     | -   | -120 | A    |
| <b>ESD maximum rating</b>   |                                              |                                                                                        |     |     |      |      |
| V <sub>ESD</sub>            | electrostatic discharge voltage              | HBM                                                                                    | [2] | -   | 1000 | V    |
| <b>Avalanche ruggedness</b> |                                              |                                                                                        |     |     |      |      |
| E <sub>DS(AL)S</sub>        | non-repetitive drain-source avalanche energy | T <sub>j(initial)</sub> = 25 °C; I <sub>D</sub> = -2.8 A; DUT in avalanche (unclamped) |     | -   | 85   | mJ   |

[1] V<sub>GS</sub> = -20 V/+5 V according AEC-Q101 at T<sub>j</sub> = 175 °C; V<sub>GS</sub> = -20 V/+20 V according AEC-Q101 at T<sub>j</sub> = 150 °C

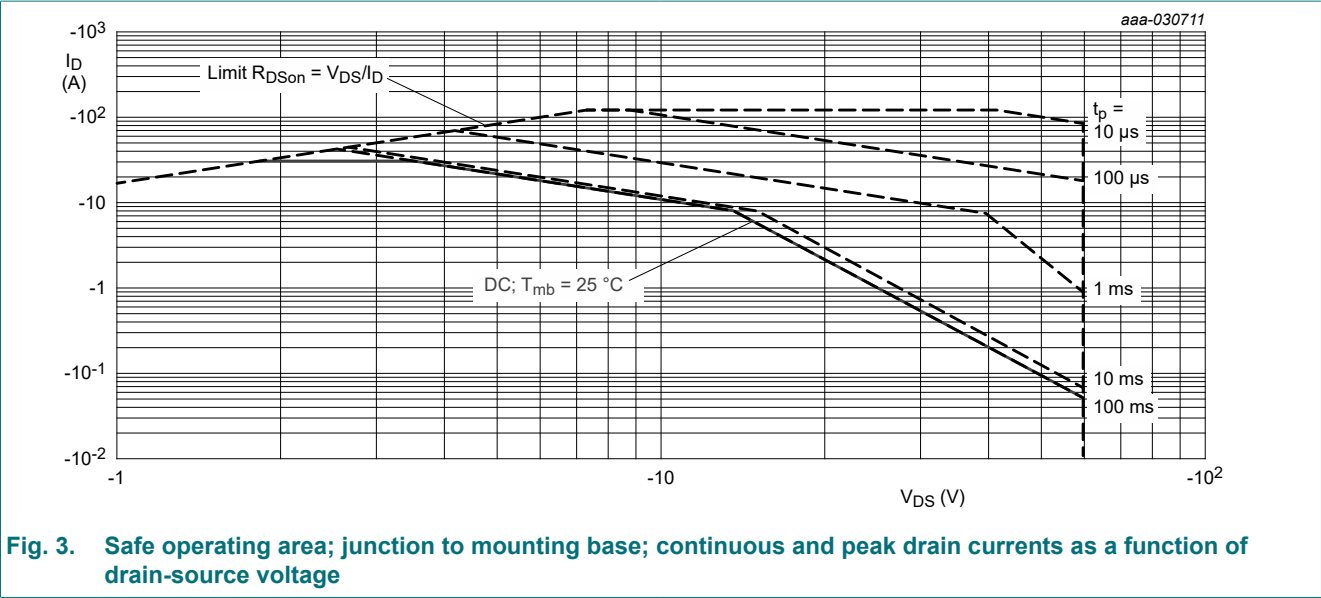
[2] Measured between all pins.



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



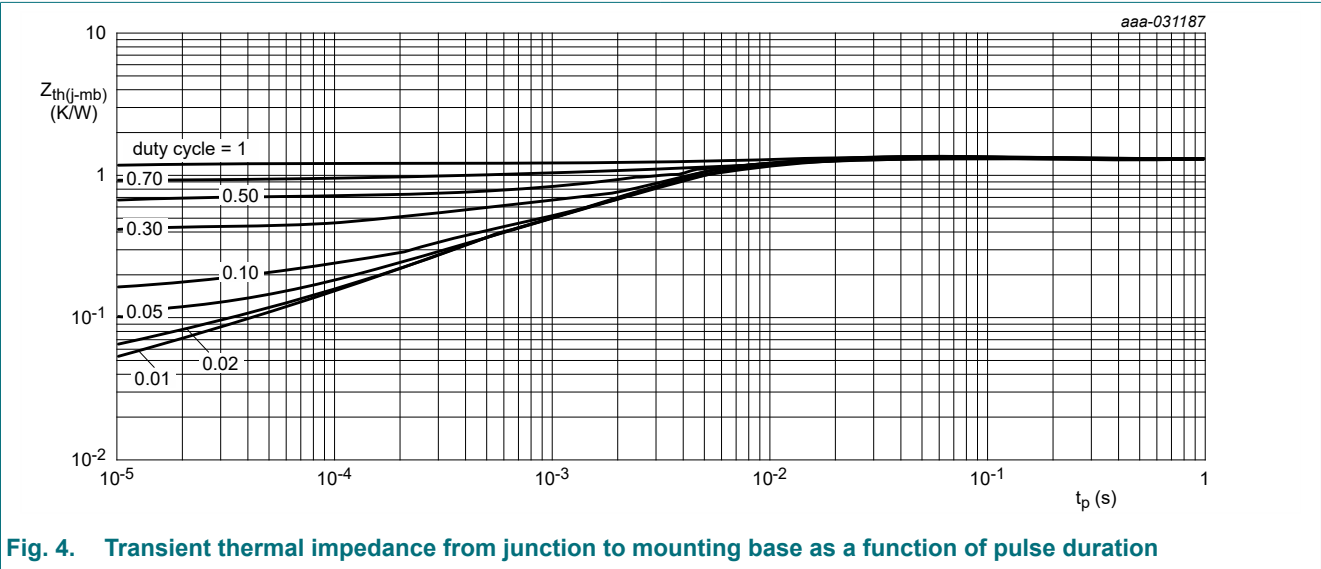
**Fig. 2. Normalized continuous drain current as a function of mounting base temperature**



9. Thermal characteristics

Table 6. Thermal characteristics

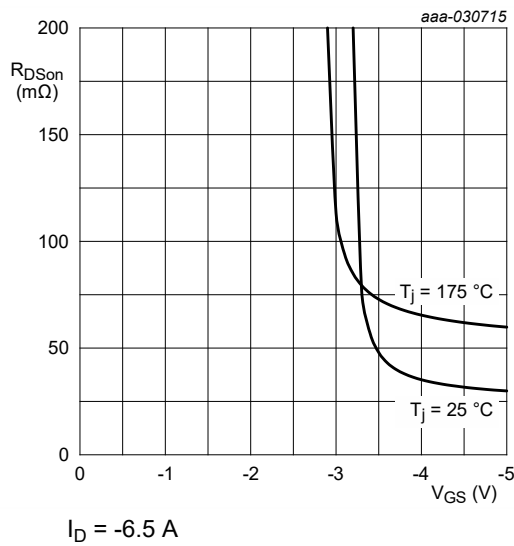
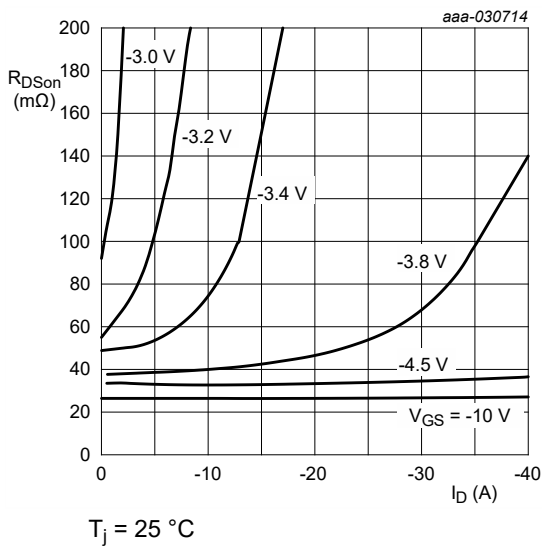
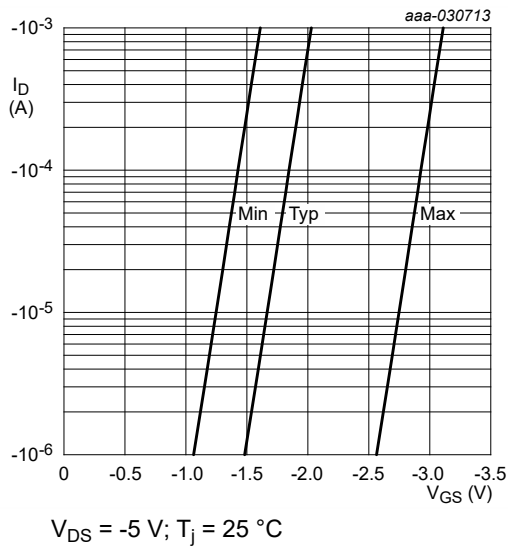
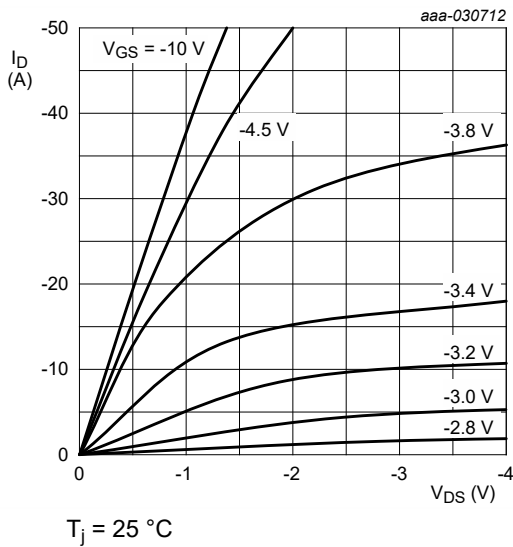
| Symbol         | Parameter                                         | Conditions | Min | Typ | Max | Unit |
|----------------|---------------------------------------------------|------------|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base |            | -   | 1.1 | 1.4 | K/W  |



## 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                                                    |  | -60  | -    | -    | V    |
| V <sub>GSth</sub>       | gate-source threshold voltage    | I <sub>D</sub> = -250 μA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>j</sub> = 25 °C                                        |  | -1.5 | -2   | -3   | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = -60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                     |  | -    | -    | -1   | μA   |
|                         |                                  | V <sub>DS</sub> = -60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 125 °C                                                    |  | -    | -    | -10  | 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                                                     |  | -    | -    | -100 | nA   |
|                         |                                  | V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                      |  | -    | -    | 100  | nA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = -10 V; I <sub>D</sub> = -7 A; T <sub>j</sub> = 25 °C                                                     |  | -    | 26   | 33   | mΩ   |
|                         |                                  | V <sub>GS</sub> = -10 V; I <sub>D</sub> = -7 A; T <sub>j</sub> = 175 °C                                                    |  | -    | 55   | 69   | mΩ   |
|                         |                                  | V <sub>GS</sub> = -4.5 V; I <sub>D</sub> = -6.7 A; T <sub>j</sub> = 25 °C                                                  |  | -    | 30   | 36   | mΩ   |
| g <sub>fs</sub>         | forward transconductance         | V <sub>DS</sub> = -10 V; I <sub>D</sub> = -4.8 A; T <sub>j</sub> = 25 °C                                                   |  | -    | 99   | -    | S    |
| R <sub>G</sub>          | gate resistance                  | f = 1 MHz                                                                                                                  |  | -    | 6.1  | -    | Ω    |
| Dynamic characteristics |                                  |                                                                                                                            |  |      |      |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | V <sub>DS</sub> = -30 V; I <sub>D</sub> = -7 A; V <sub>GS</sub> = -10 V; T <sub>j</sub> = 25 °C                            |  | -    | 46   | 69   | nC   |
| Q <sub>GS</sub>         | gate-source charge               |                                                                                                                            |  | -    | 7.3  | -    | nC   |
| Q <sub>GD</sub>         | gate-drain charge                |                                                                                                                            |  | -    | 9.4  | -    | nC   |
| C <sub>iss</sub>        | input capacitance                | V <sub>DS</sub> = -30 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                          |  | -    | 2590 | -    | pF   |
| C <sub>oss</sub>        | output capacitance               |                                                                                                                            |  | -    | 202  | -    | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |                                                                                                                            |  | -    | 118  | -    | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = -30 V; I <sub>D</sub> = -7 A; V <sub>GS</sub> = -10 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C |  | -    | 9    | -    | ns   |
| t <sub>r</sub>          | rise time                        |                                                                                                                            |  | -    | 16   | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |                                                                                                                            |  | -    | 81   | -    | ns   |
| t <sub>f</sub>          | fall time                        |                                                                                                                            |  | -    | 310  | -    | ns   |
| Source-drain diode      |                                  |                                                                                                                            |  |      |      |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = -30 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                      |  | -    | -0.7 | -1.2 | V    |
| t <sub>rr</sub>         | reverse recovery time            | I <sub>S</sub> = -30 A; dI <sub>S</sub> /dt = 100 A/μs;                                                                    |  | -    | 32   | -    | ns   |
| Q <sub>r</sub>          | recovered charge                 | V <sub>GS</sub> = -10 V; V <sub>DS</sub> = -30 V; T <sub>j</sub> = 25 °C                                                   |  | -    | 18   | -    | nC   |



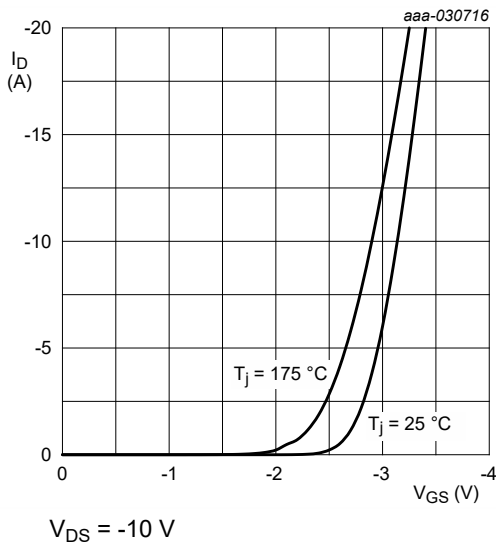


Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

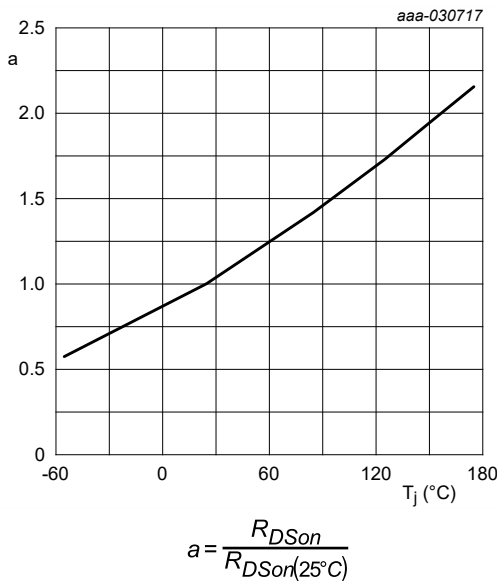


Fig. 10. Normalized drain-source on-state resistance as a function of junction temperature; typical values

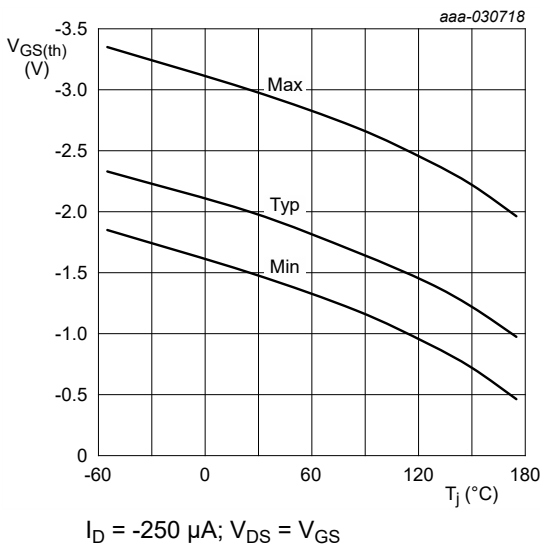


Fig. 11. Gate-source threshold voltage as a function of junction temperature

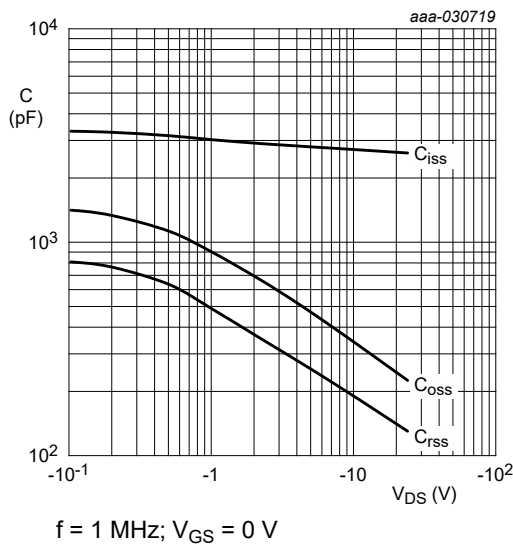


Fig. 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

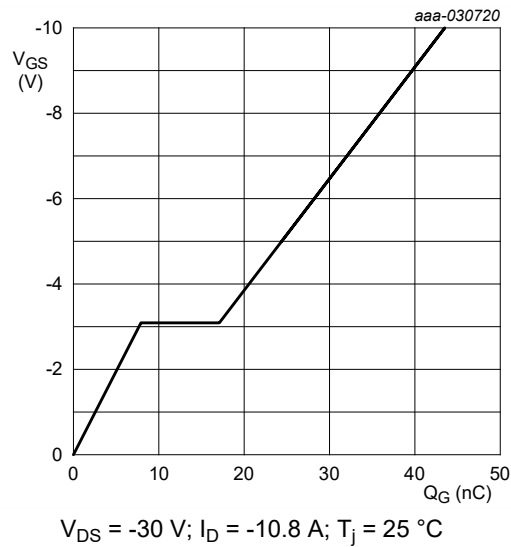


Fig. 13. Gate-source voltage as a function of gate charge; typical values

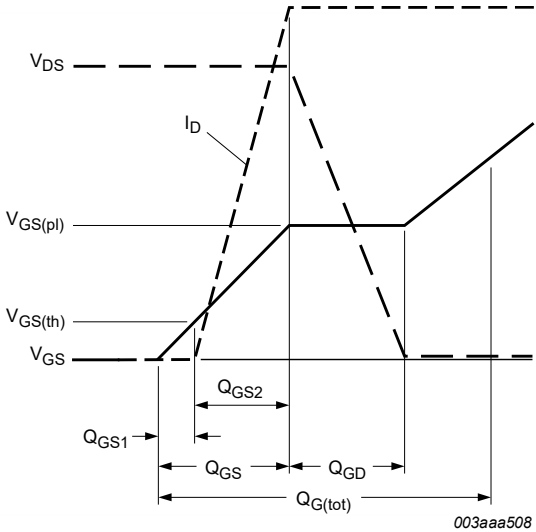


Fig. 14. Gate charge waveform definitions

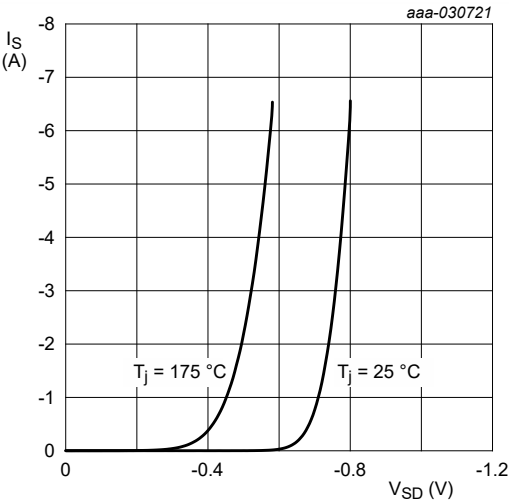
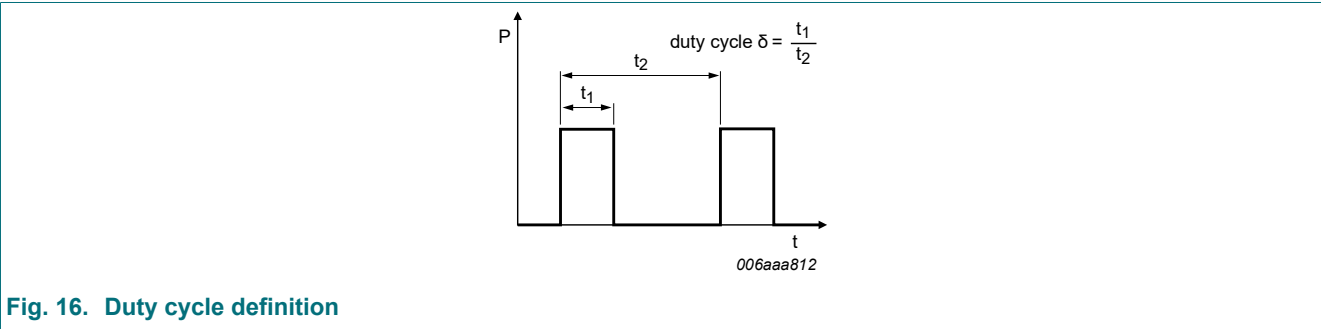


Fig. 15. Source current as a function of source-drain voltage; typical values



11. Test information



Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

12. Package outline

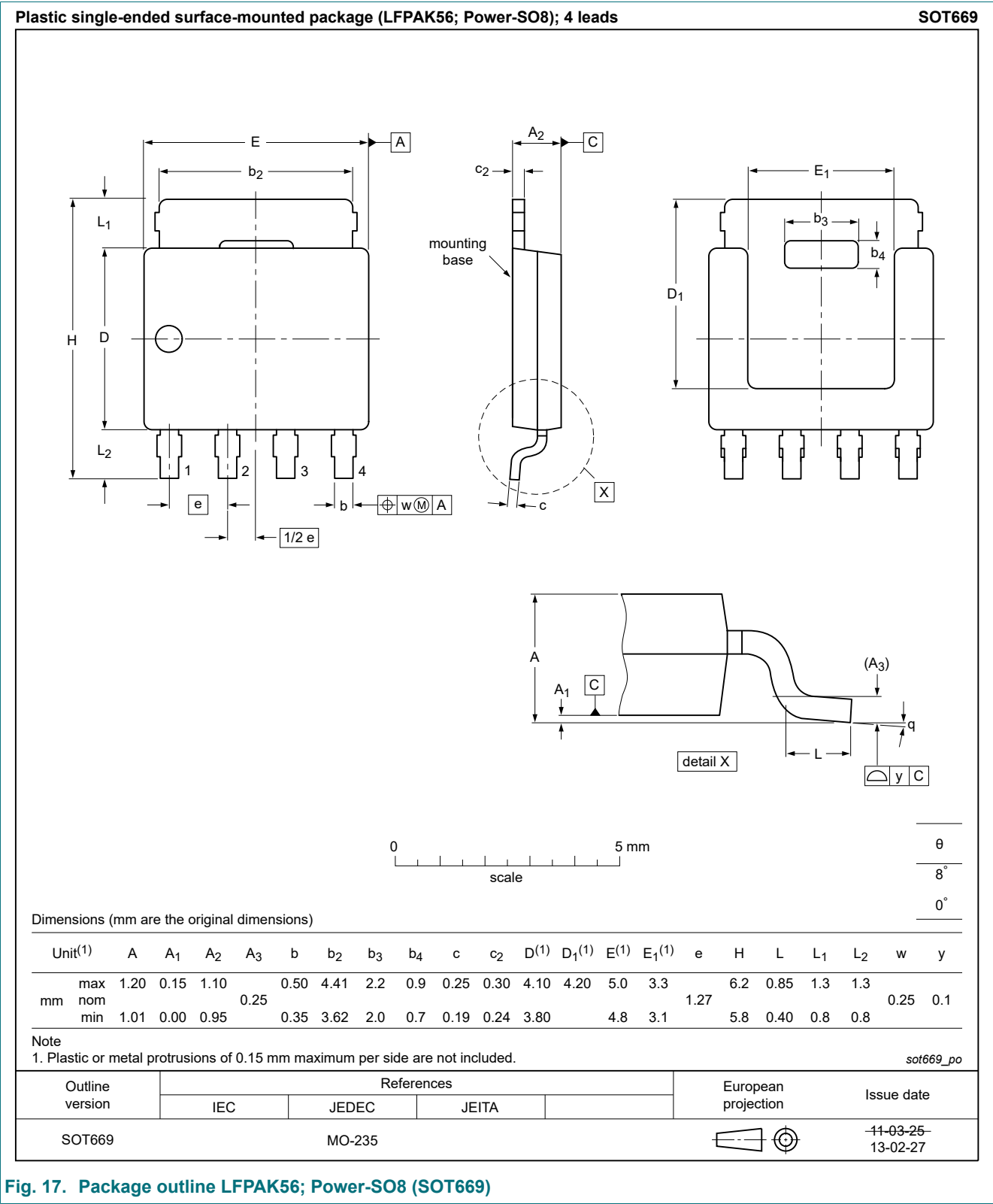


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

## 13. Revision history

**Table 8. Revision history**

| Data sheet ID   | Release date                                                                                                                                                                                                                                             | Data sheet status  | Change notice | Supersedes      |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-----------------|
| BUK6Y33-60P v.3 | 20210121                                                                                                                                                                                                                                                 | Product data sheet | -             | BUK6Y33-60P v.2 |
| Modifications:  | <ul style="list-style-type: none"><li>Chapter "Characteristics": Typo correction at parameter <math>t_f</math>. Correction of the conditions for the source-drain diode parameters <math>V_{SD}</math>, <math>t_{rr}</math>, <math>Q_r</math>.</li></ul> |                    |               |                 |
| BUK6Y33-60P v.2 | 20200318                                                                                                                                                                                                                                                 | Product data sheet | -             | BUK6Y33-60P v.1 |
| BUK6Y33-60P v.1 | 20200316                                                                                                                                                                                                                                                 | Product data sheet | -             | -               |

## 14. 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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Contents

1. General description..... 1

2. Features and benefits..... 1

3. Applications..... 1

4. Quick reference data..... 1

5. Pinning information.....2

6. Ordering information.....2

7. Marking.....2

8. Limiting values..... 3

9. Thermal characteristics..... 4

10. Characteristics..... 5

11. Test information..... 9

12. Package outline..... 10

13. Revision history..... 11

14. Legal information..... 12

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Date of release: 21 January 2021

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