
# BUK6Y61-60P

## 60 V, P-channel Trench MOSFET

16 March 2020 — Product data sheet

## 1. General description

P-channel enhancement mode MOSFET in an LFPAK56 (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 loadswitch
- Motor drive

## 4. Quick reference data

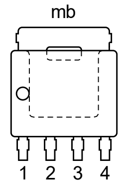
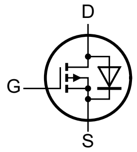
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | - | -60 | V |
| $V_{GS}$ | gate-source voltage | | [1] | -20 | - | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = -10 V; $T_{mb}$ = 25 °C | | - | - | -25 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | - | 66 | W |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -10 V; $I_D$ = -4.7 A; $T_j$ = 25 °C | | - | 48 | 61 | mΩ |

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

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | S | source |   **LFPAK56; Power-SO8 (SOT669)** |   |
| 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 |
| BUK6Y61-60P | LFPAK56; Power-SO8 | plastic, single-ended surface-mounted package; 4 terminals | SOT669 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| BUK6Y61-60P | 6Y6160P |

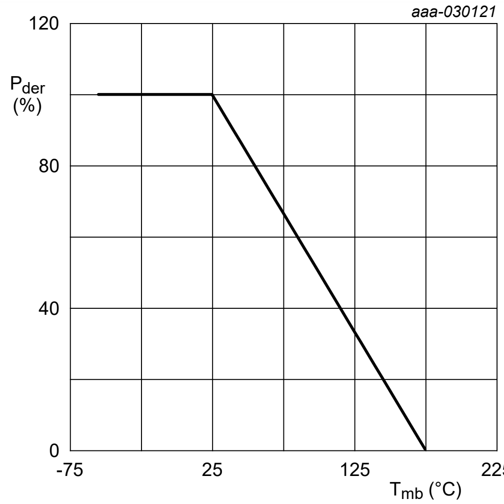
## 8. Limiting values

**Table 5. Limiting values**

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

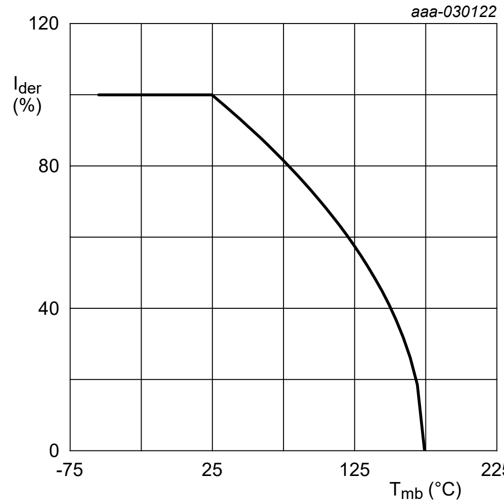
| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | -60 | V |
| $V_{GS}$ | gate-source voltage | | [1] | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = -10 V; $T_{mb}$ = 25 °C | | - | -25 | A |
| | | $V_{GS}$ = -10 V; $T_{mb}$ = 100 °C | | - | -17.7 | A |
| $I_{DM}$ | peak drain current | single pulse; $t_p \leq$ 10 µs; $T_{mb}$ = 25 °C | | - | -100 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | 66 | W |
| $T_j$ | junction temperature | | | -55 | 175 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 175 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 175 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | | - | -25 | A |
| $I_{SM}$ | peak source current | single pulse; $t_p \leq$ 10 µs; $T_{mb}$ = 25 °C | | - | -100 | A |
| **ESD maximum rating** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | HBM | [2] | - | 800 | V |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $T_{j(init)}$ = 25 °C; $I_D$ = -4.6 A; DUT in avalanche (unclamped) | | - | 61 | mJ |

[1] $V_{GS}$ = -20 V/+5 V according AEC-Q101 at $T_j$ = 175 °C; $V_{GS}$ = -20 V/+20 V according AEC-Q101 at $T_j$ = 150 °C
[2] Measured between all pins.




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

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




$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\ \%$$

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

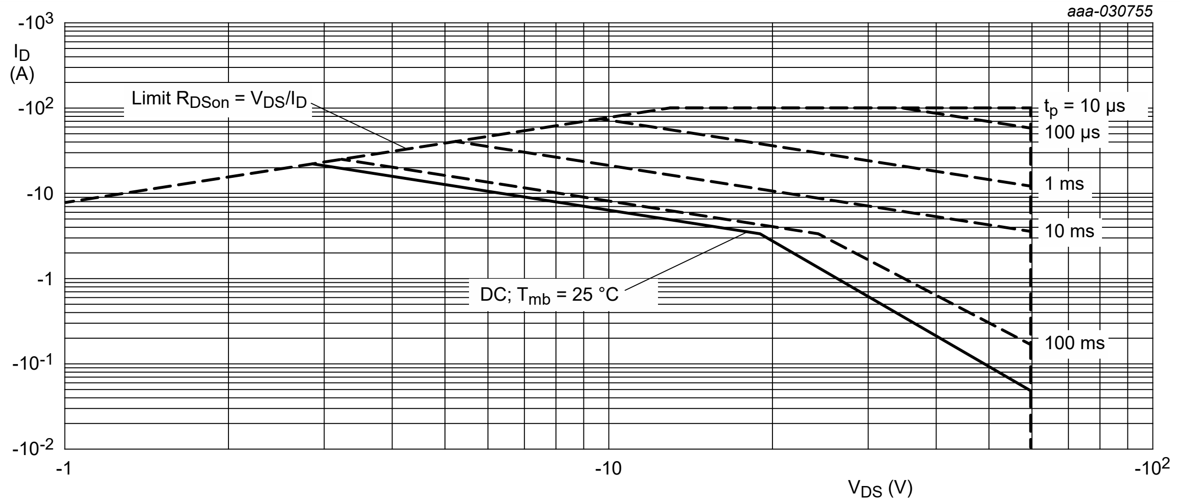



**Fig. 3. Safe operating area; junction to mounting base; continuous and peak drain currents as a function of drain-source voltage**

## 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j\text{-}mb)}$ | thermal resistance from junction to mounting base | | | - | 1.8 | 2.3 | K/W |

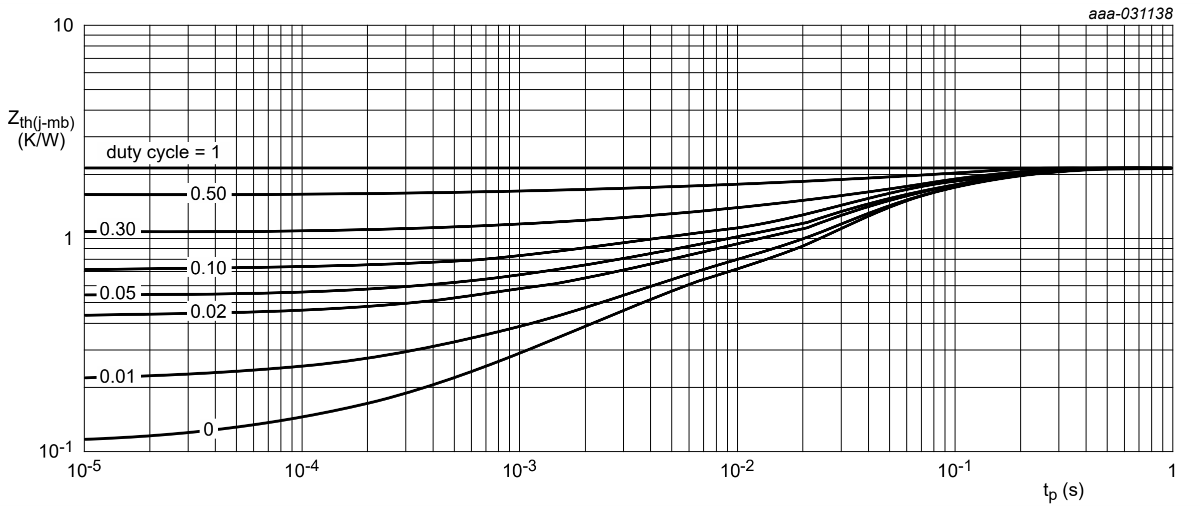
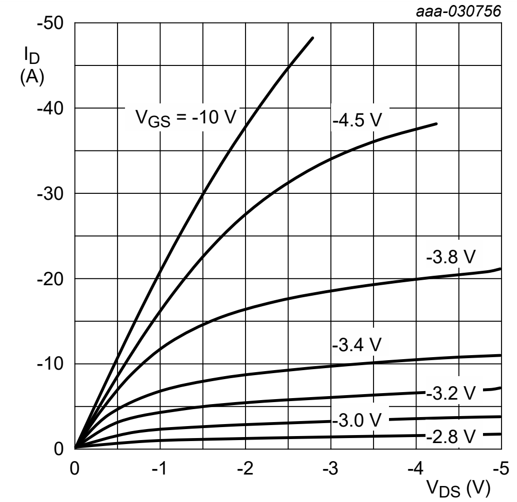



**Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 10. Characteristics

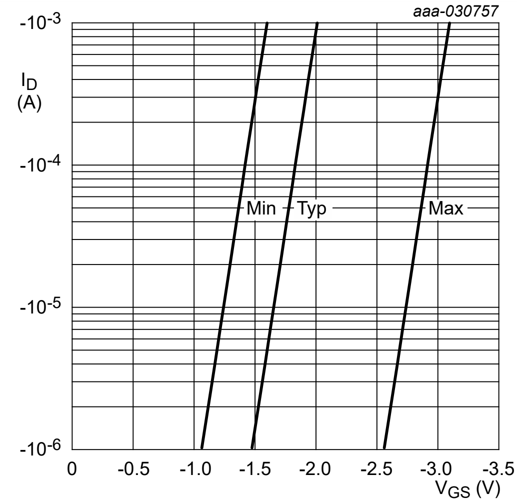
**Table 7. Characteristics**

| 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 | | -60 | - | - | V |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = -250 μA; $V_{DS}$=$V_{GS}$; $T_j$ = 25 °C | | -1.5 | -2 | -3 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = -60 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | -1 | μA |
| | | $V_{DS}$ = -60 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | | - | - | -10 | μA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | -100 | nA |
| | | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -10 V; $I_D$ = -4.7 A; $T_j$ = 25 °C | | - | 48 | 61 | mΩ |
| | | $V_{GS}$ = -10 V; $I_D$ = -4.7 A; $T_j$ = 175 °C | | - | 100 | 130 | mΩ |
| | | $V_{GS}$ = -4.5 V; $I_D$ = -3.8 A; $T_j$ = 25 °C | | - | 62 | 93 | mΩ |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = -10 V; $I_D$ = -4 A; $T_j$ = 25 °C | | - | 65 | - | S |
| $R_G$ | gate resistance | f = 1 MHz; $T_j$ = 25 °C | | - | 12 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS}$ = -30 V; $I_D$ = -4.7 A; $V_{GS}$ = -10 V; $T_j$ = 25 °C | | - | 20 | 30 | nC |
| $Q_{GS}$ | gate-source charge | | | - | 3.3 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 4.3 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = -30 V; f = 1 MHz; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 1060 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 85 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 49 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = -30 V; $I_D$ = -4.7 A; $V_{GS}$ = -10 V; $R_{G(ext)}$ = 6 Ω; $T_j$ = 25 °C | | - | 12 | - | ns |
| $t_r$ | rise time | | | - | 58 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 21 | - | ns |
| $t_f$ | fall time | | | - | 204 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = -22.4 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | -0.7 | -1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = -22.4 A; $dI_S/dt$ = 100 A/μs; $V_{GS}$ = -10 V; $V_{DS}$ = -30 V; $T_j$ = 25 °C | | - | 30 | - | ns |
| $Q_r$ | recovered charge | | | - | 37 | - | nC |



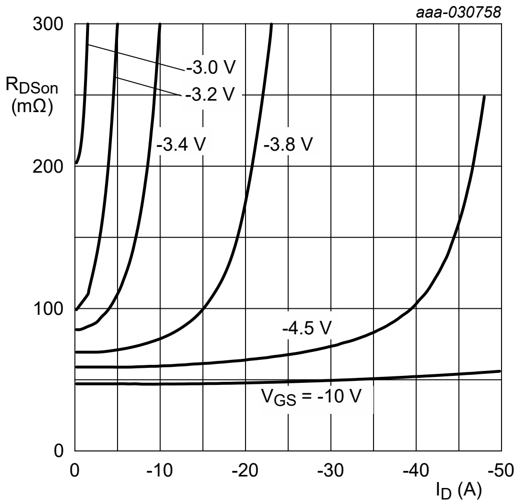

$T_j$ = 25 °C

**Fig. 5. Output characteristics: drain current as a function of drain-source voltage; typical values**



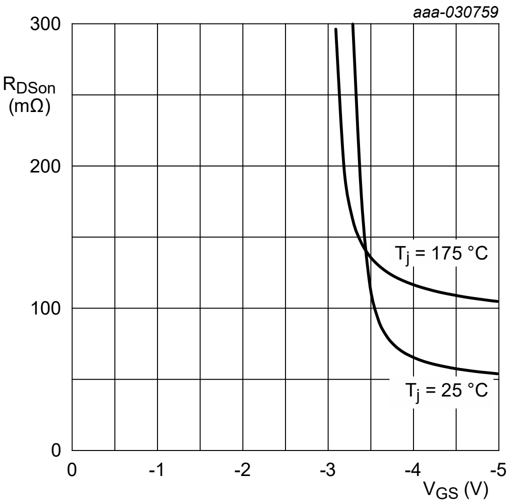

$V_{DS}$ = -5 V; $T_j$ = 25 °C

**Fig. 6. Sub-threshold drain current as a function of gate-source voltage**



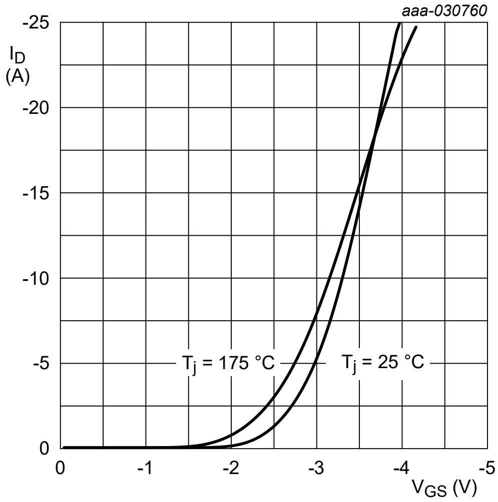

$T_j$ = 25 °C

**Fig. 7. Drain-source on-state resistance as a function of drain current; typical values**



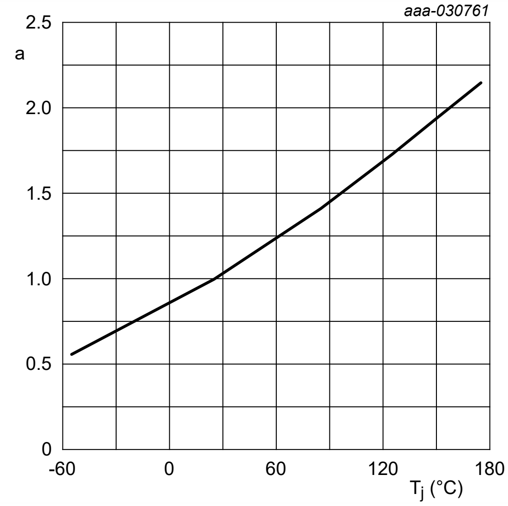

$I_D$ = -4.8 A

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



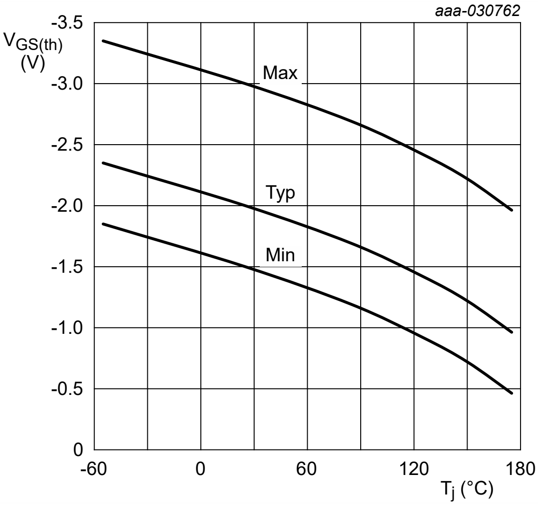

$V_{DS}$ = -10 V

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



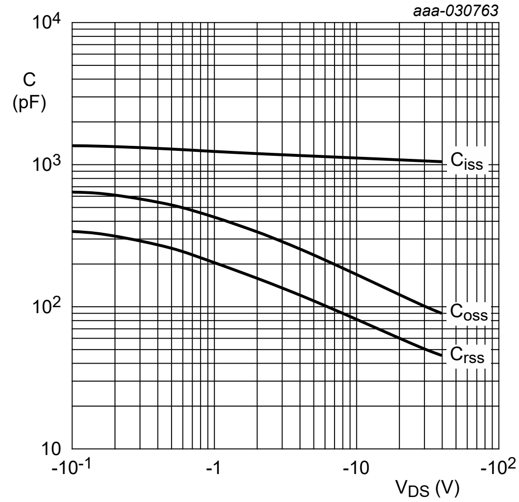

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



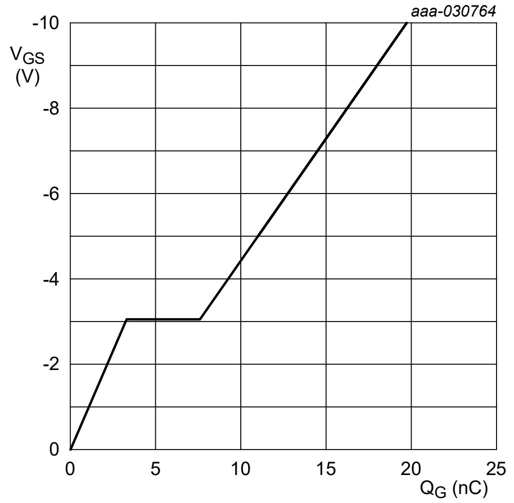

$I_D$ = -250 µA; $V_{DS}$ = $V_{GS}$

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




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

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




$V_{DS}$ = -30 V; $I_D$ = -4.8 A; $T_{amb}$ = 25 °C

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

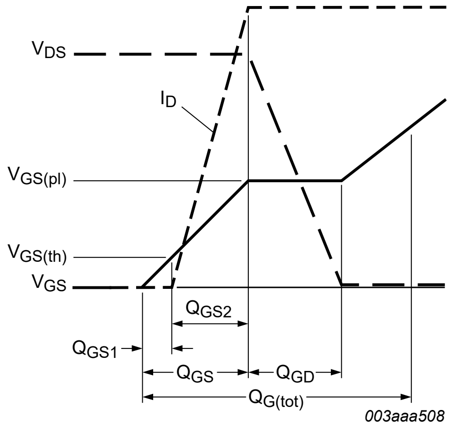
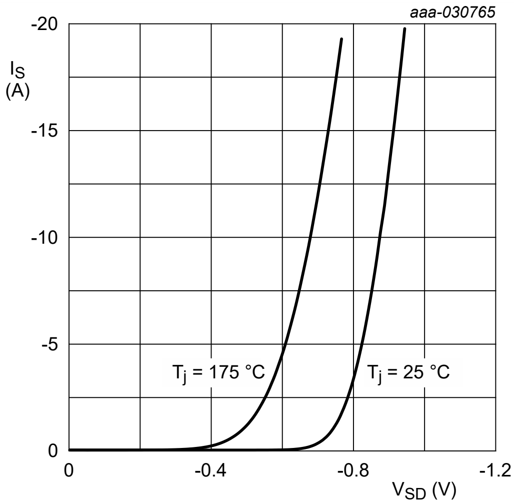



**Fig. 14. Gate charge waveform definitions**




$V_{GS}$ = 0 V

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

# 11. Test information

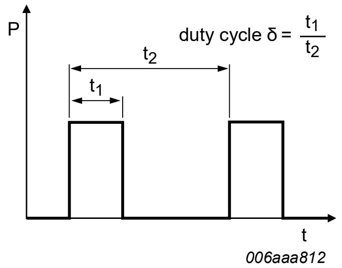


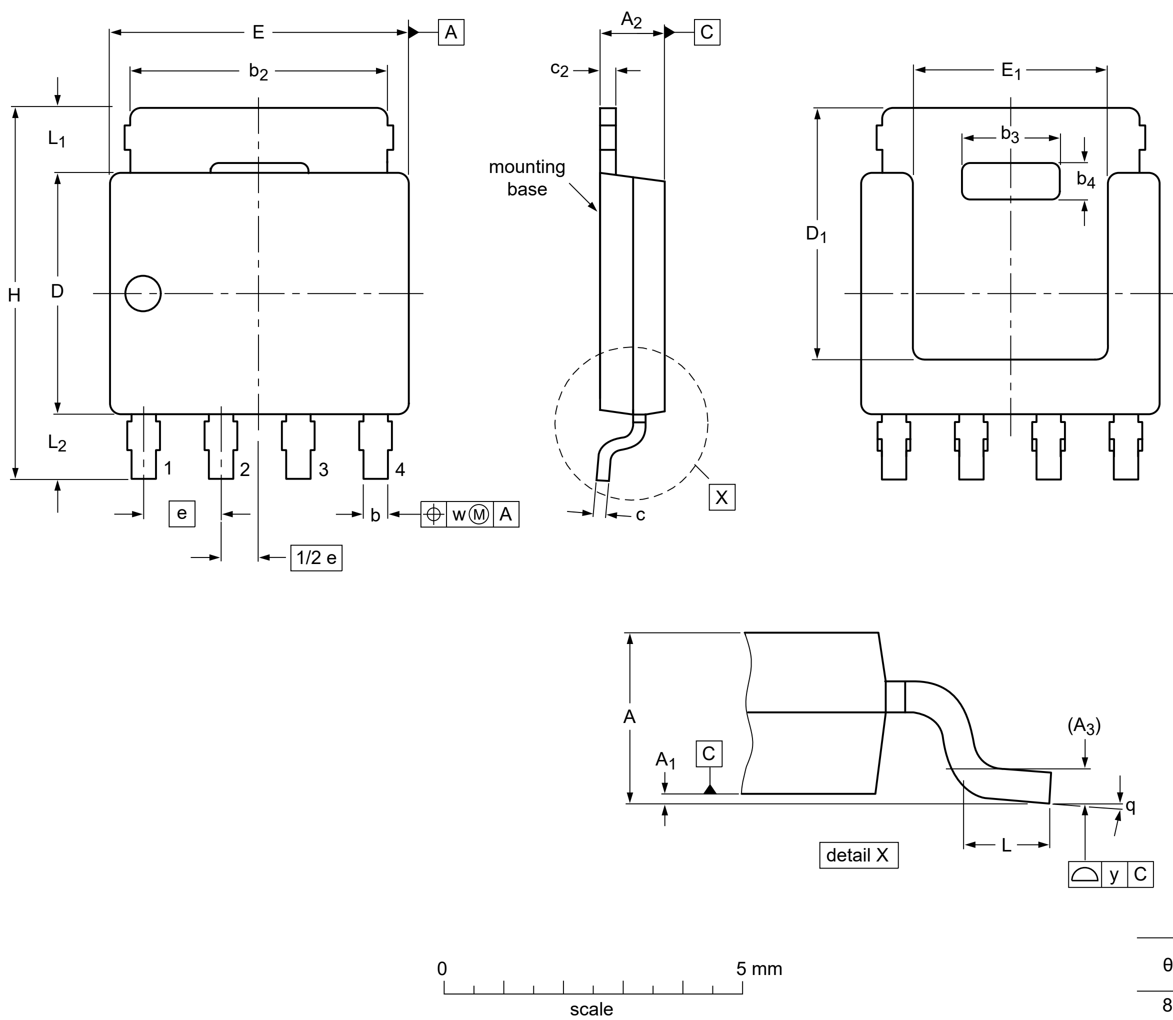

**Fig. 16. Duty cycle definition**

## 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

**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 | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT669 | | MO-235 | | | | ~~11-03-25~~ 13-02-27 |

**Fig. 17. Package outline LFPAK56; Power-SO8 (SOT669)**

# 13. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUK6Y61-60P v.1 | 20200316 | Product data sheet | - | - |

# 14. 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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**Date of release: 16 March 2020**