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# BUK6Y15-40P

## 40 V, P-channel Trench MOSFET

7 June 2018 **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 | | - | - | -40 | V |
| $V_{GS}$ | gate-source voltage | | [1] | -20 | - | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = -10 V; $T_{mb}$ = 25 °C | | - | - | -63 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | - | 106 | W |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -10 V; $I_D$ = -11 A; $T_j$ = 25 °C | | - | 11 | 15 | 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

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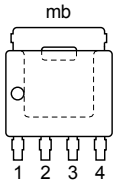
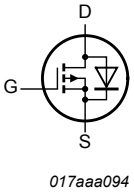
## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | S | source |  **LFPAK56; Power-SO8 (SOT669)** |  *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 |
| BUK6Y15-40P | LFPAK56; Power-SO8 | plastic, single-ended surface-mounted package; 4 terminals | SOT669 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| BUK6Y15-40P | 6Y1540P |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# 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 | | - | -40 | V |
| $V_{GS}$ | gate-source voltage | | [1] | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = -10 V; $T_{mb}$ = 25 °C | | - | -63 | A |
| | | $V_{GS}$ = -10 V; $T_{mb}$ = 100 °C | | - | -45 | A |
| $I_{DM}$ | peak drain current | single pulse; $t_p \leq$ 10 µs; $T_{mb}$ = 25 °C | | - | -252 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | 106 | 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 | | - | -63 | A |
| $I_{SM}$ | peak source current | single pulse; $t_p \leq$ 10 µs; $T_{mb}$ = 25 °C | | - | -252 | A |
| **ESD maximum rating** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | HBM | [2] | - | 1000 | V |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{sup} \leq$ -40 V; $V_{GS}$ = -10 V; $T_{j(init)}$ = 25 °C; $I_D$ = -10.8 A; DUT in avalanche (unclamped) | | - | 5.8 | 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.


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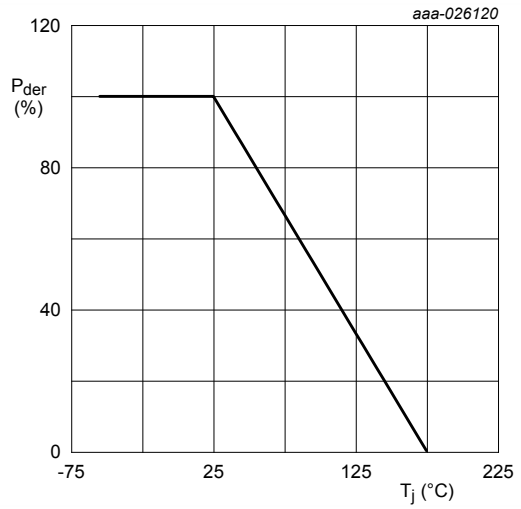
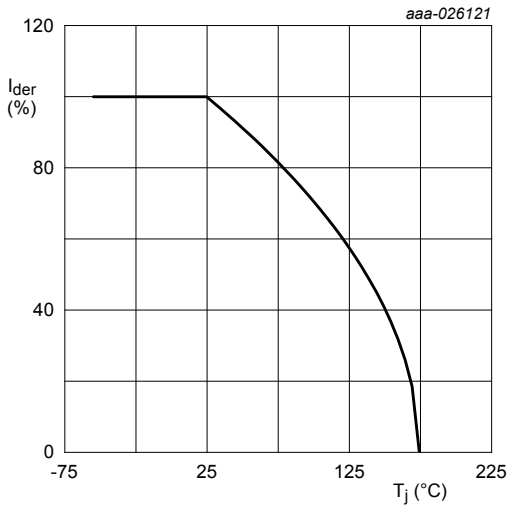



$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

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




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

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

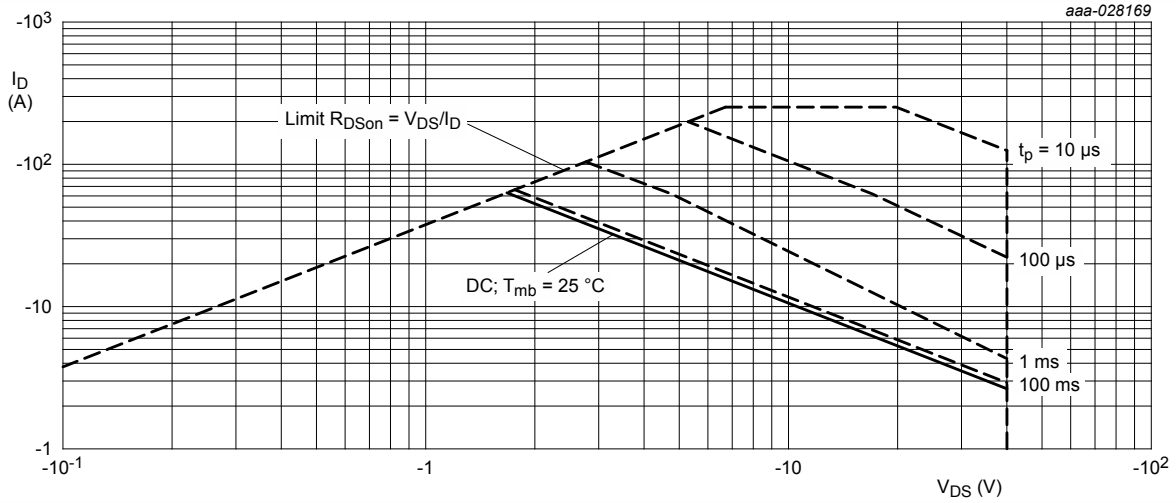



**Fig. 3. Safe operating area; junction to mounting base; continuous and peak drain currents as a function of drain-source voltage**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# 9. Thermal characteristics

**Table 6. Thermal characteristics**

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

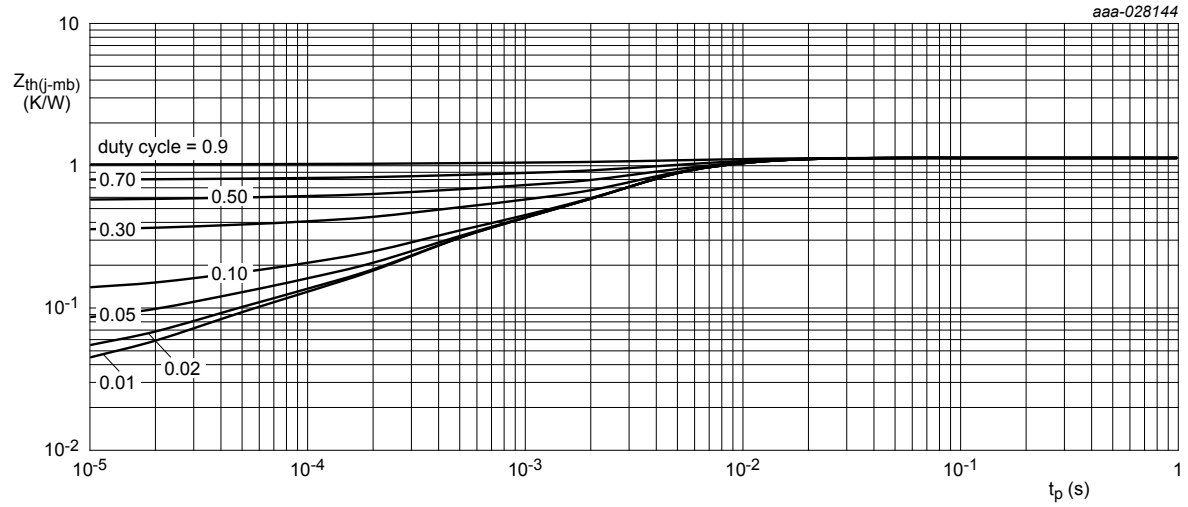


**Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values**


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# 10. Characteristics

**Table 7. Characteristics**

*$T_j$ = 25 °C unless otherwise specified*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = -250 µA; $V_{GS}$ = 0 V | | -40 | - | - | 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 | $V_{DS}$ = -40 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | -1 | µA |
| | | $V_{DS}$ = -40 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | | - | - | -50 | 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; $I_D$ = -11 A; $T_j$ = 25 °C | | - | 11 | 15 | mΩ |
| | | $V_{GS}$ = -10 V; $I_D$ = -11 A; $T_j$ = 175 °C | | - | 19 | 27 | mΩ |
| | | $V_{GS}$ = -4.5 V; $I_D$ = -8.4 A | | - | 16 | 24 | mΩ |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = -10 V; $I_D$ = -2 A; $T_j$ = 25 °C | | - | 55 | - | S |
| $R_G$ | gate resistance | f = 1 MHz | | - | 6.8 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS}$ = -20 V; $I_D$ = -10 A; $V_{GS}$ = -10 V | | - | 43.5 | 50 | nC |
| $Q_{GS}$ | gate-source charge | | | - | 7.9 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 9.2 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = -20 V; f = 1 MHz; $V_{GS}$ = 0 V | | - | 2470 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 330 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 199 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = -20 V; $I_D$ = -11 A; $V_{GS}$ = -10 V; $R_{G(ext)}$ = 6 Ω | | - | 9 | - | ns |
| $t_r$ | rise time | | | - | 31 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 71 | - | ns |
| $t_f$ | fall time | | | - | 37 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = -63 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | -0.7 | -1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = -11 A; $dI_S/dt$ = 100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = -20 V; $T_j$ = 25 °C | | - | 32 | - | ns |
| $Q_r$ | recovered charge | | | - | 18 | - | nC |


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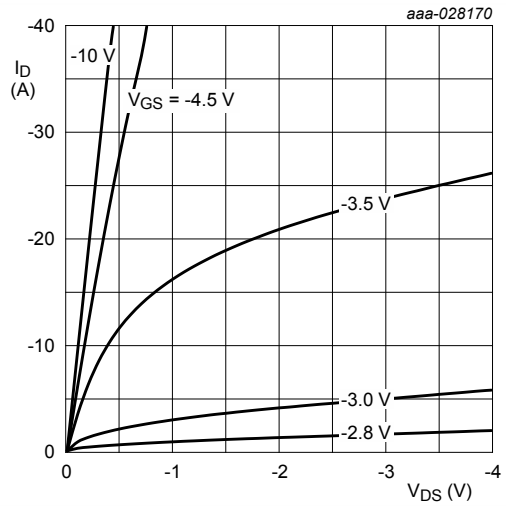
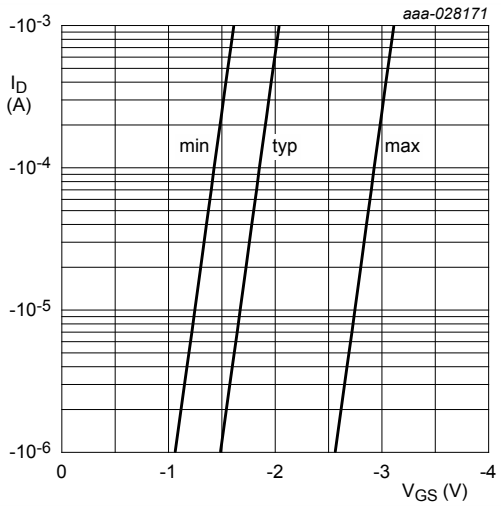


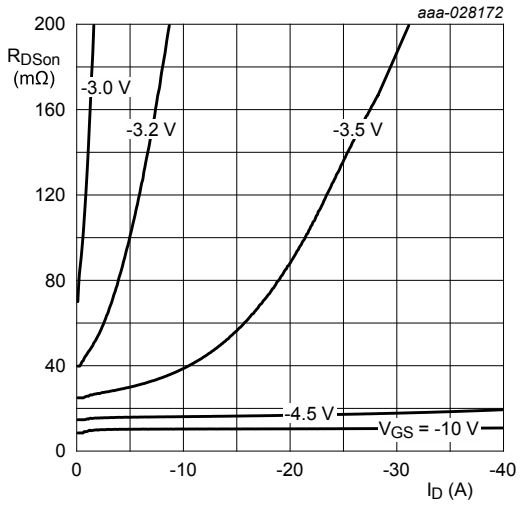

$T_j$ = 25 °C

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



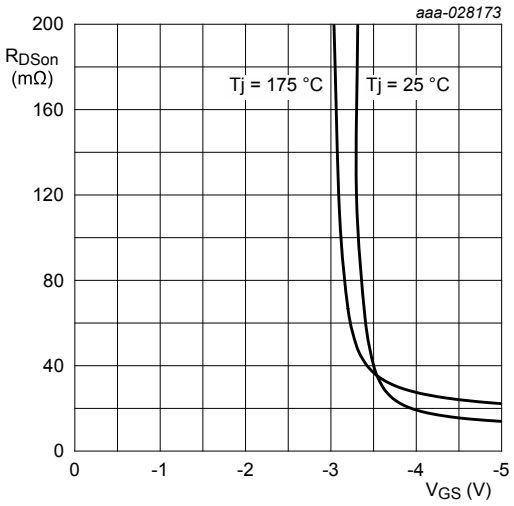

$V_{DS}$ = -5 V; $T_j$ = 25 °C

**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**




$I_D$ = -10 A

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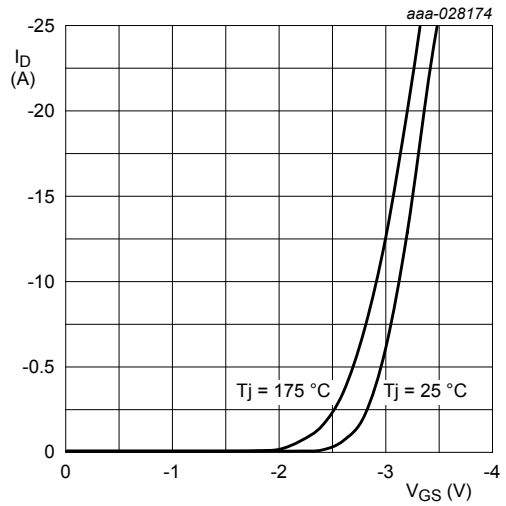
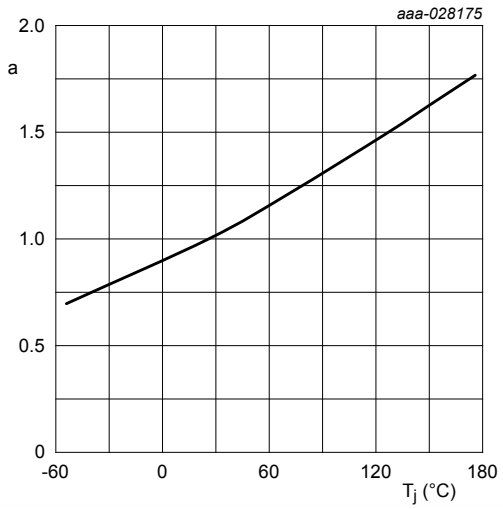


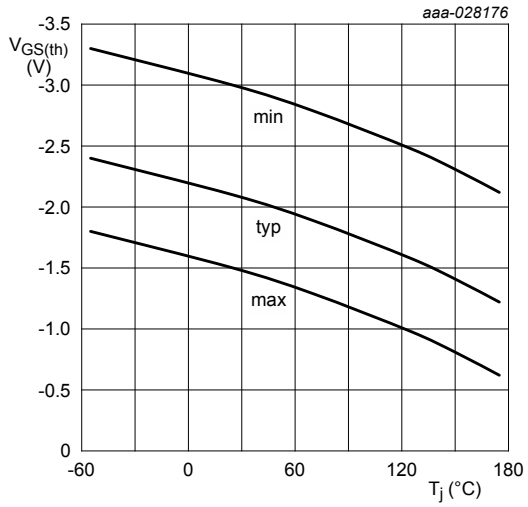

$V_{DS} > I_D \times R_{DSon}$

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



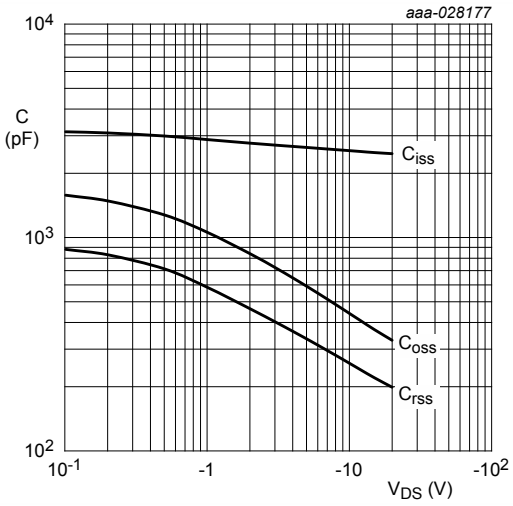

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

**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**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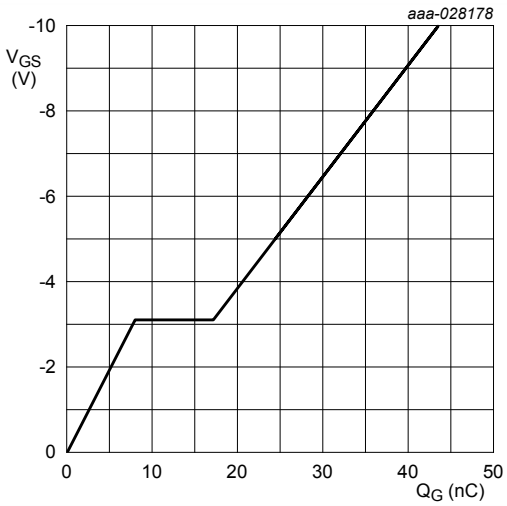



$V_{DS}$ = -20 V; $I_D$ = -10 A; $T_{amb}$ = 25 °C

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

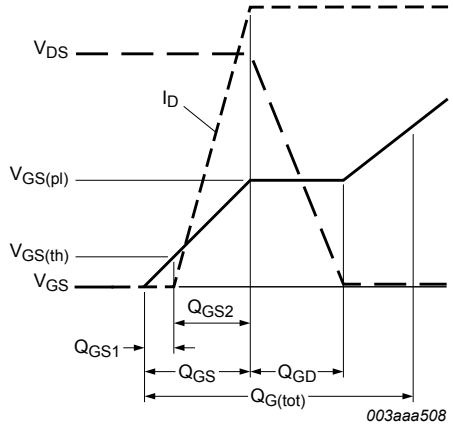
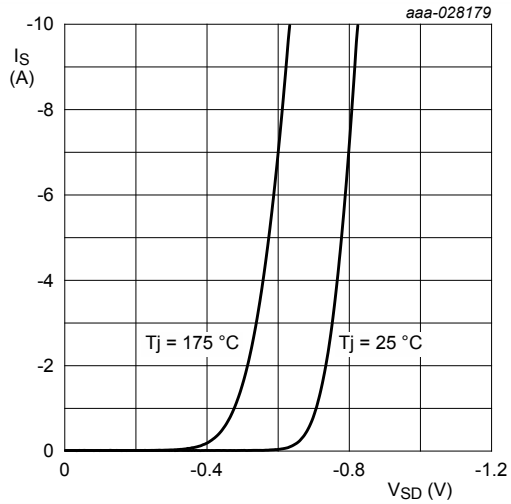



**Fig. 14. Gate charge waveform definitions**




$V_{GS}$ = 0 V

**Fig. 15. Source current as a function of source-drain voltage; typical values**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# 11. Test information

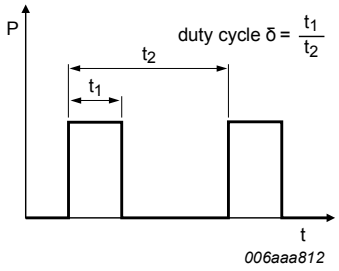


**Fig. 16. Duty cycle definition**

## 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.


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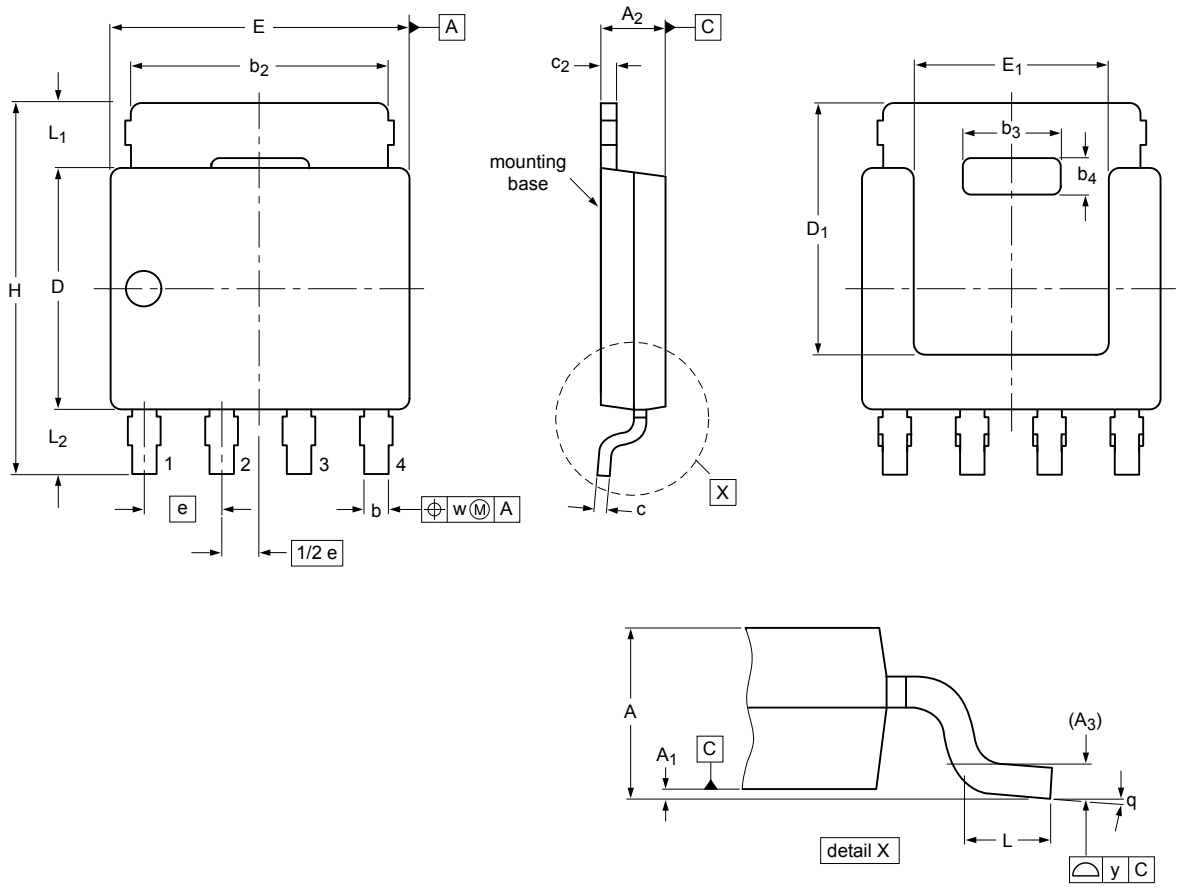
## 12. Package outline

**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | |
| | 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 | | |

| θ |
|---|
| 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)**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# 13. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUK6Y15-40P v.2 | 20180607 | Product data sheet | - | BUK6Y15-40P v.1 |
| Modifications: | • Package description updated. | | | |
| BUK6Y15-40P v.1 | 20180309 | Product data sheet | - | - |


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# 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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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