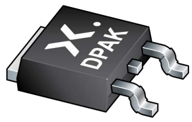



# BUK7210-55B

## N-channel TrenchMOS standard level FET

Rev. 01 — 11 December 2008 Product data sheet

# 1. Product profile

## 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using Nexperia High-Performance Automotive (HPA) TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

## 1.2 Features and benefits

- 185 °C rated
- Q101 compliant
- Standard level compatible
- Very low on-state resistance

## 1.3 Applications

- 12 V and 24 V loads
- Automotive systems
- General purpose power switching
- Motors, lamps and solenoids

## 1.4 Quick reference data

**Table 1. Quick reference**

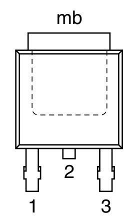
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 185$ °C | | - | - | 55 | V |
| $I_D$ | drain current | $V_{GS}$ = 10 V; $T_{mb}$ = 25 °C; see Figure 1; see Figure 3; | [1] | - | - | 75 | A |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; see Figure 10; see Figure 9 | | - | 8.5 | 10 | mΩ |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 75 A; $V_{sup} \leq 55$ V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; unclamped inductive load | | - | - | 173 | mJ |

[1] Continuous current is limited by package.

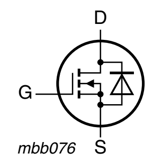
## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | | Simplified outline | Graphic symbol |
|---|---|---|---|---|---|
| 1 | G | gate | | | |
| 2 | D | drain | [1] | | |
| 3 | S | source | | | |
| mb | D | mounting base; connected to drain | | | |




**SOT428 (SC-63; DPAK)**




[1] It is not possible to make connection to pin 2 of the SOT428 package.

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BUK7210-55B | SC-63; DPAK | plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) | SOT428 |

# 4. Limiting values

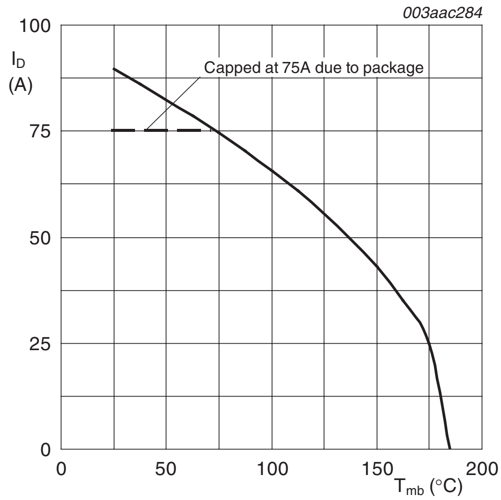
**Table 4. Limiting values**
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 185$ °C | | - | 55 | V |
| $V_{DGR}$ | drain-gate voltage | $R_{GS} = 20$ kΩ; 25 °C ≤ $T_j \leq 185$ °C | | - | 55 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $T_{mb} = 25$ °C; $V_{GS} = 10$ V; see Figure 1; see Figure 3; | [1] | - | 89.6 | A |
| | | $T_{mb} = 100$ °C; $V_{GS} = 10$ V; see Figure 1 | | - | 65.5 | A |
| | | $T_{mb} = 25$ °C; $V_{GS} = 10$ V; see Figure 1; see Figure 3; | [2] | - | 75 | A |
| $I_{DM}$ | peak drain current | $T_{mb} = 25$ °C; $t_p \leq 10$ µs; pulsed | | - | 335 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; see Figure 2 | | - | 167 | W |
| $T_{stg}$ | storage temperature | | | -55 | 185 | °C |
| $T_j$ | junction temperature | | | -55 | 185 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb} = 25$ °C; | [2] | - | 75 | A |
| | | $T_{mb} = 25$ °C; | [3] | - | 89.6 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C | | - | 335 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 75$ A; $V_{sup} \leq 55$ V; $R_{GS} = 50$ Ω; $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; unclamped inductive load | | - | 173 | mJ |

[1] Current is limited by power dissipation chip rating.

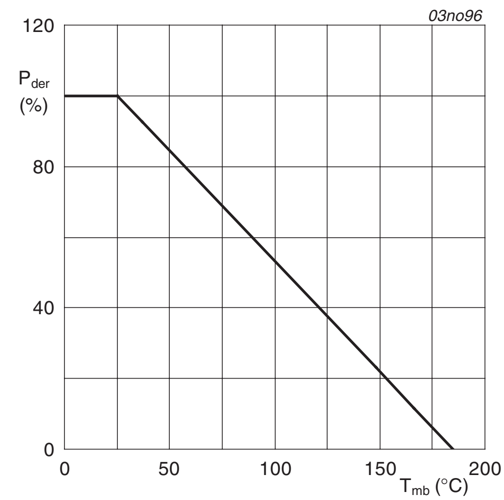
[2] Continuous current is limited by package.

[3] Current is limited by power dissipation chip rating.



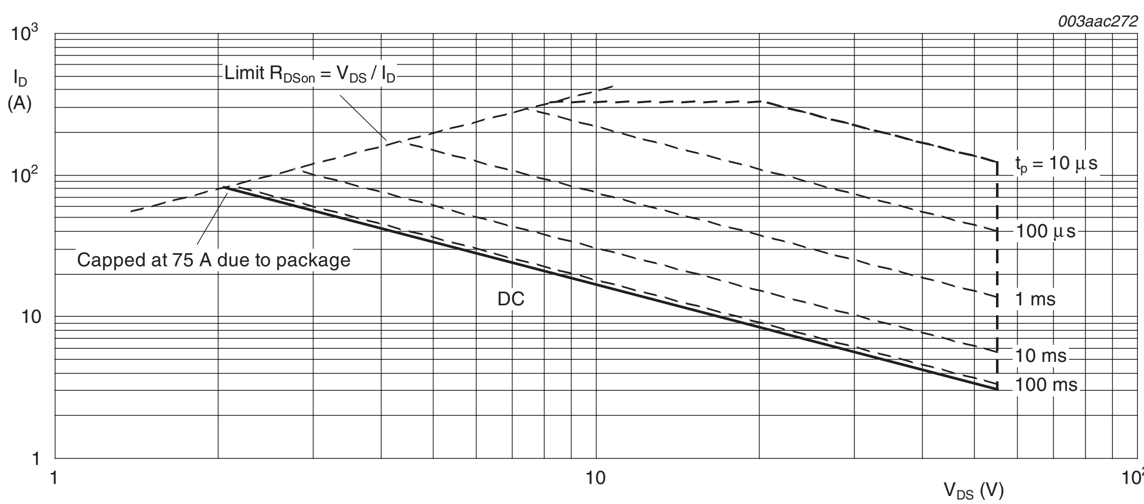

$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\,\%$$

**Fig 1. Normalized continuous drain current as a function of mounting base temperature**




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

**Fig 2. Normalized total power dissipation as a function of mounting base temperature**




$T_{mb} = 25\,°C; I_{DM}$ is single pulse

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

# 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see Figure 4 | - | - | 0.95 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | Mounted on a printed circuit board; vertical in still air.; minimum footprint | - | 75 | - | K/W |

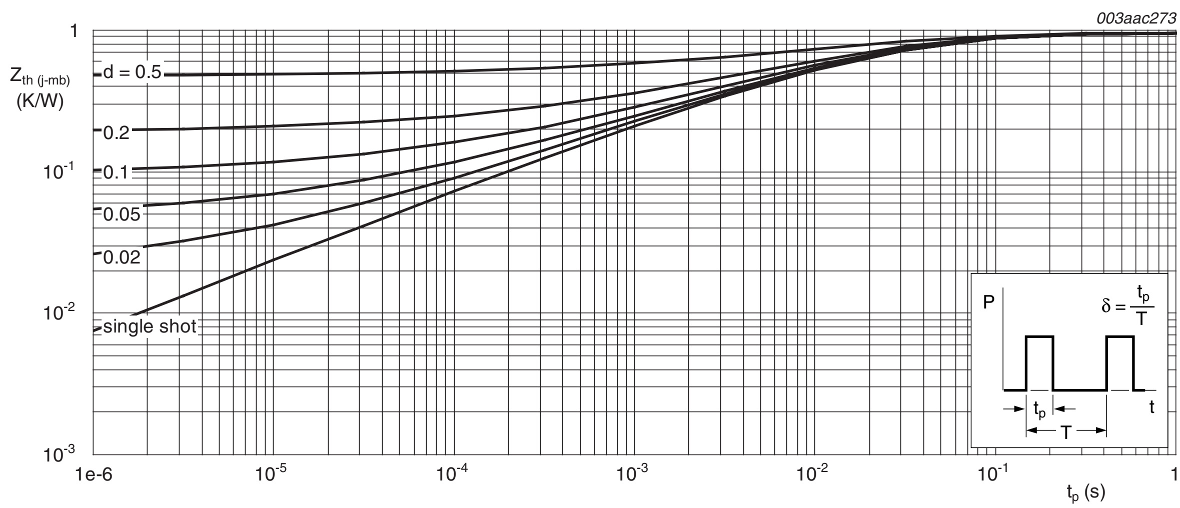



**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

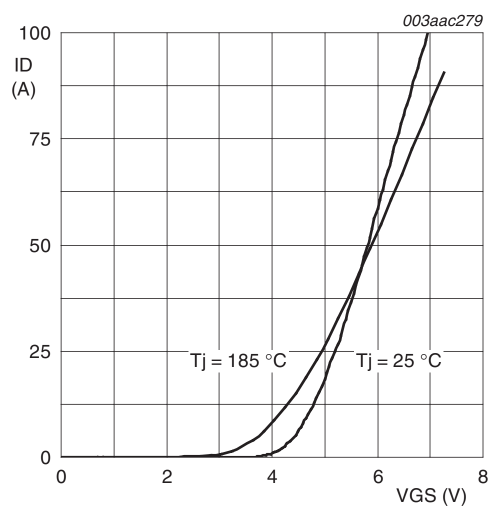
# 6. Characteristics

**Table 6. 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 | 55 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | 50 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; see Figure 7 | - | 1.75 | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; see Figure 7; see Figure 8 | 2 | 3 | 4 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 185 °C; see Figure 7 | 0.9 | - | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -40 °C; see Figure 7 | - | 2.8 | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; see Figure 7 | - | - | 4.4 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | - | 1.5 | 500 | µA |
| | | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | - | 0.1 | 90 | µA |
| | | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 0.02 | 1 | µA |
| | | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 185 °C | - | 3 | 800 | µA |
| $I_{GSS}$ | gate leakage current | $V_{DS}$ = 0 V; $V_{GS}$ = 20 V; $T_j$ = 25 °C | - | 2 | 100 | nA |
| | | $V_{DS}$ = 0 V; $V_{GS}$ = -20 V; $T_j$ = 25 °C | - | 2 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 185 °C; see Figure 9 | - | - | 20.8 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; see Figure 10; see Figure 9 | - | 8.5 | 10 | mΩ |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 44 V; $V_{GS}$ = 10 V; $T_j$ = 25 °C; see Figure 12; see Figure 13 | - | 35 | - | nC |
| $Q_{GS}$ | gate-source charge | | - | 9 | - | nC |
| $Q_{GD}$ | gate-drain charge | | - | 12 | - | nC |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 14 | - | 1840 | 2453 | pF |
| $C_{oss}$ | output capacitance | | - | 379 | 455 | pF |
| $C_{rss}$ | reverse transfer capacitance | | - | 165 | 226 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 25 V; $R_L$ = 1.2 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 10 Ω; $T_j$ = 25 °C | - | 18 | - | ns |
| $t_r$ | rise time | | - | 91 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 48 | - | ns |
| $t_f$ | fall time | | - | 45 | - | ns |
| $L_D$ | internal drain inductance | measured from drain to center of die; $T_j$ = 25 °C | - | 2.5 | - | nH |
| $L_S$ | internal source inductance | measured from source lead to source bond pad; $T_j$ = 25 °C | - | 7.5 | - | nH |

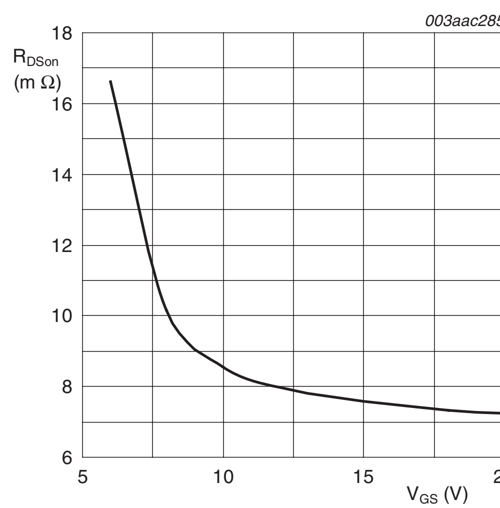
**Table 6. Characteristics** *…continued*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 150 °C | - | 0.76 | - | V |
| | | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 175 °C | - | 0.74 | - | V |
| | | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 100 °C | - | 0.8 | - | V |
| | | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; see Figure 11 | - | 0.85 | 1.2 | V |
| | | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 125 °C | - | 0.78 | - | V |
| | | $I_S$ = 18 A; $V_{GS}$ = 0 V; $T_j$ = 185 °C; see Figure 11 | - | 0.73 | - | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 20 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = -10 V; $V_{DS}$ = 30 V; $T_j$ = 25 °C | - | 67 | - | ns |
| $Q_r$ | recovered charge | | - | 65 | - | nC |



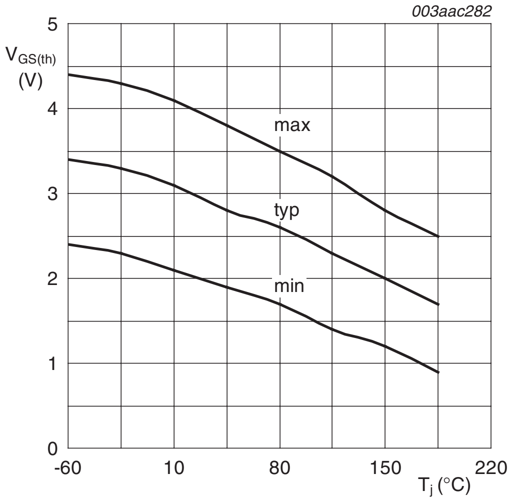

$V_{DS} > I_D \times R_{DSon}$

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



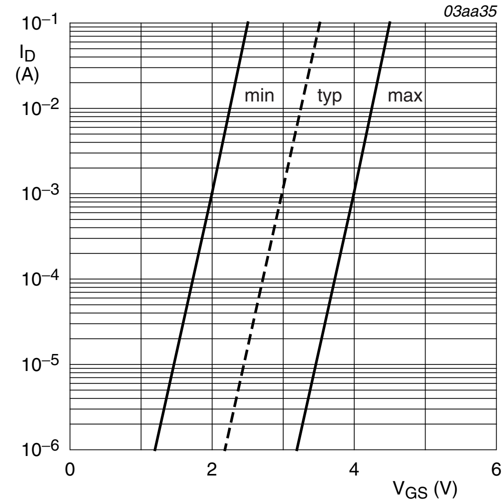

$T_j = 25\,°C; V_{DS} = 25\,V$

**Fig 6. Drain-source on-state resistance as a function of gate-source voltage; typical values.**



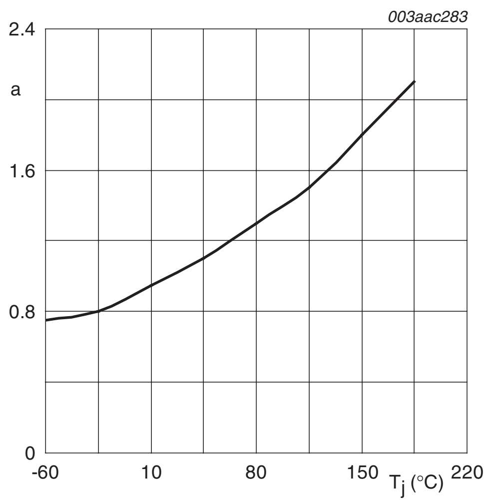

$I_D = 1 mA; V_{DS} = V_{GS}$

**Fig 7. Gate-source threshold voltage as a function of junction temperature**



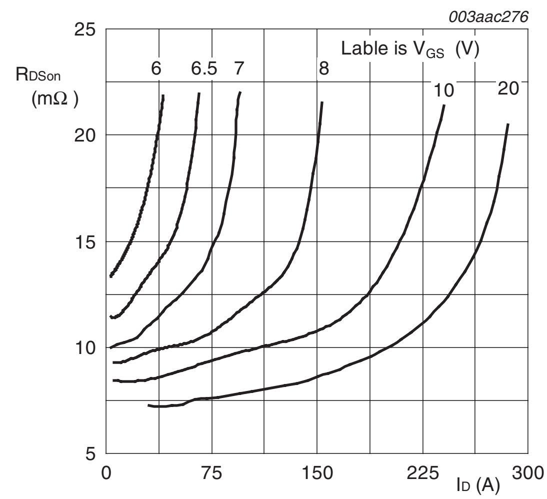

$T_j = 25 °C; V_{DS} = 5 V$

**Fig 8. Sub-threshold drain current as a function of gate-source voltage**



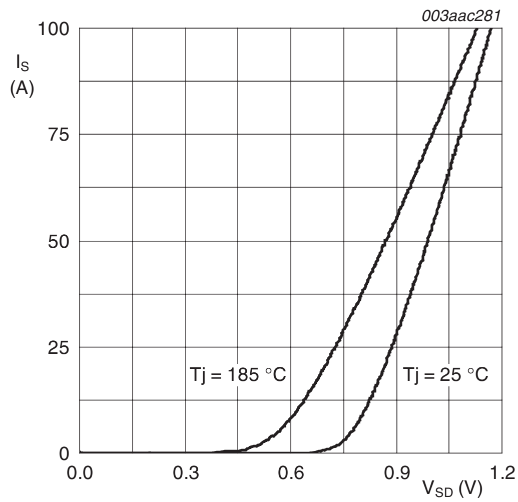

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

**Fig 9. Normalized drain-source on-state resistance factor as a function of junction temperature**




$T_j = 25 °C$

**Fig 10. Drain-source on-state resistance as a function of drain current; typical values**




$V_{GS} = 0V$

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

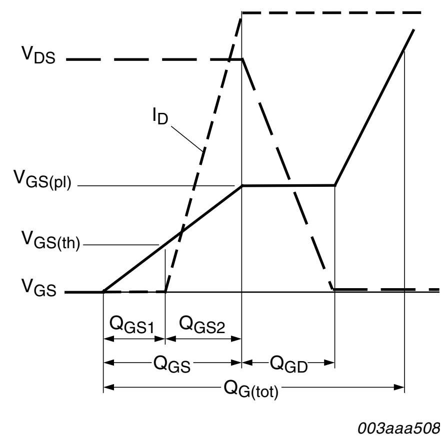
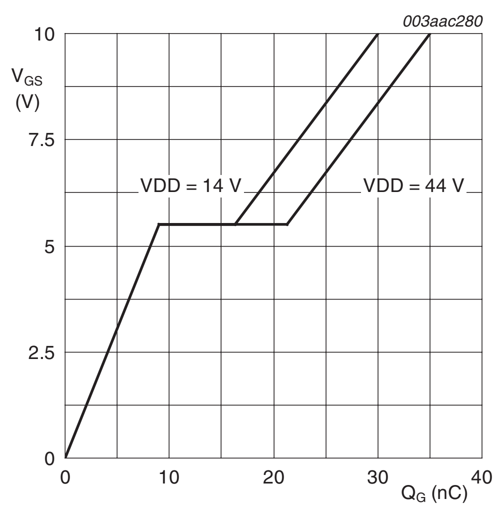
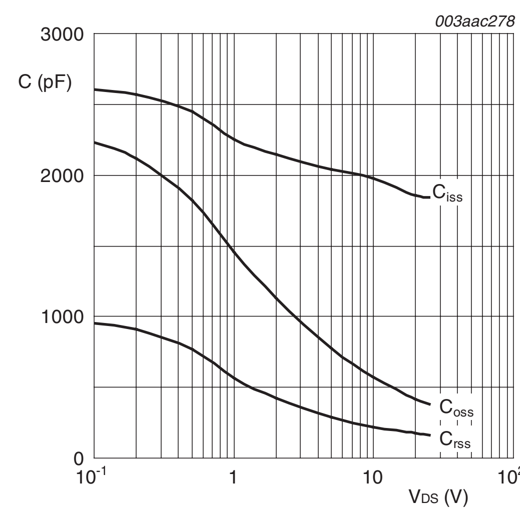



**Fig 12. Gate charge waveform definitions**



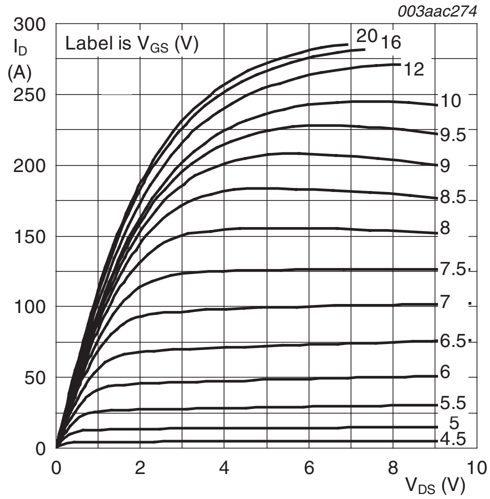

$I_D = 25A$

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




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

**Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

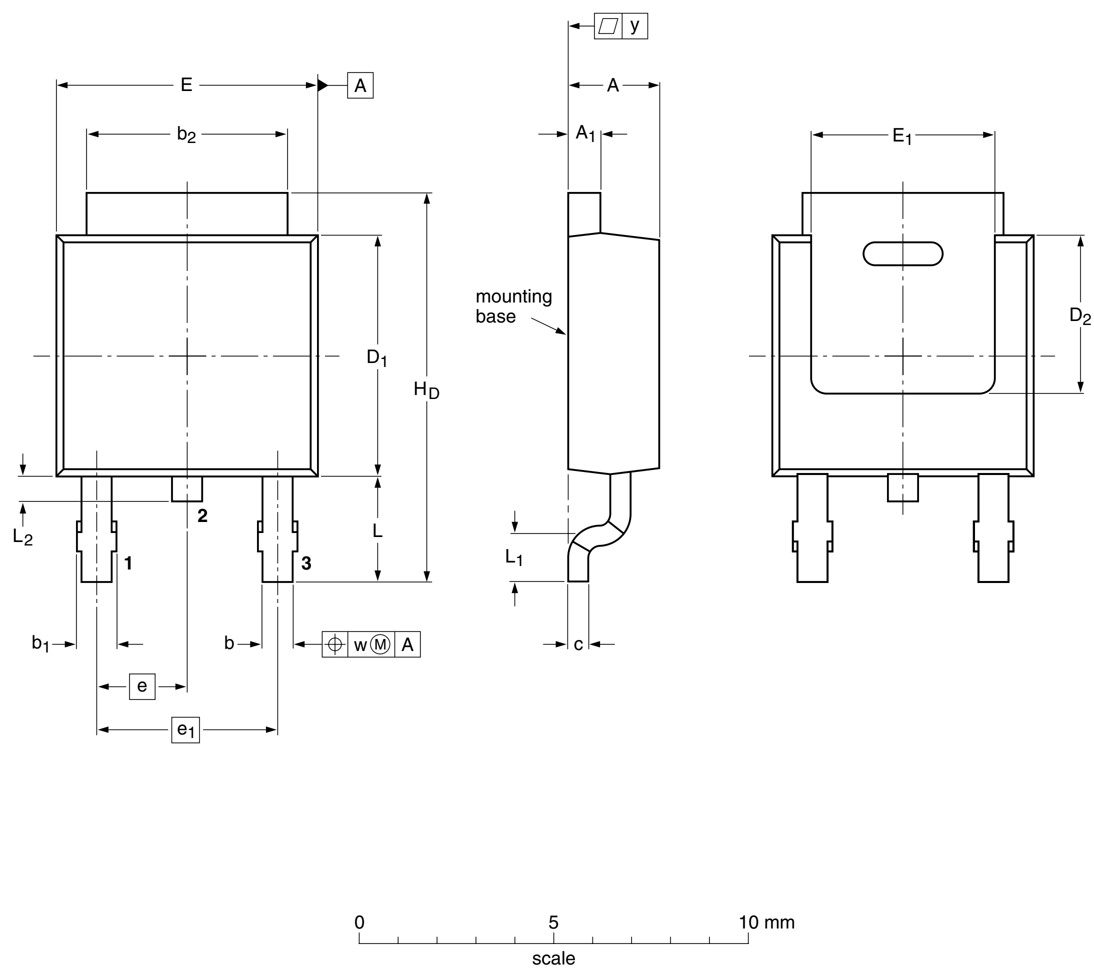



$T_j = 25\,°C$

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

## 7. Package outline

**Plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)** **SOT428**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | b | $b_1$ | $b_2$ | c | $D_1$ | $D_2$ min | E | $E_1$ min | e | $e_1$ | $H_D$ | L | $L_1$ min | $L_2$ | w | y max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.38<br>2.22 | 0.93<br>0.46 | 0.89<br>0.71 | 1.1<br>0.9 | 5.46<br>5.00 | 0.56<br>0.20 | 6.22<br>5.98 | 4.0 | 6.73<br>6.47 | 4.45 | 2.285 | 4.57 | 10.4<br>9.6 | 2.95<br>2.55 | 0.5 | 0.9<br>0.5 | 0.2 | 0.2 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT428 | | TO-252 | SC-63 | | | ~~06-02-14~~<br>06-03-16 |

**Fig 16. Package outline SOT428 (DPAK)**

## 8. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUK7210-55B_1 | 20081211 | Product data sheet | - | - |

# 9. Legal information

## 9.1 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 URL http://www.nexperia.com.

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## 11. Contents





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**Date of release: 11 December 2008**

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