



BUK953R2-40B

N-channel TrenchMOS logic level FET

17 April 2014

Product data sheet

1. General description

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

2. Features and benefits

- AEC Q101 compliant
- Low conduction losses due to low on-state resistance
- Suitable for logic level gate drive sources
- Suitable for thermally demanding environments due to 175 °C rating

3. Applications

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

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25^\circ\text{C}$; $T_j \leq 175^\circ\text{C}$		-	-	40	V
I_D	drain current	$V_{GS} = 5\text{ V}$; $T_{mb} = 25^\circ\text{C}$; Fig. 2 ; Fig. 3	[1]	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25^\circ\text{C}$; Fig. 1		-	-	300	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25^\circ\text{C}$		-	2.4	2.8	$\text{m}\Omega$
		$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25^\circ\text{C}$; Fig. 11 ; Fig. 12		-	2.7	3.2	$\text{m}\Omega$
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; $T_j = 25^\circ\text{C}$; Fig. 13		-	37	-	nC



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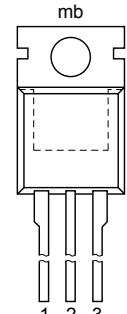
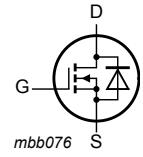


Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 100 \text{ A}$; $V_{sup} \leq 40 \text{ V}$; $R_{GS} = 50 \Omega$; $V_{GS} = 5 \text{ V}$; $T_{j(init)} = 25 \text{ }^\circ\text{C}$; unclamped		-	-	1.2	J

[1] All individual parts of device must be $\leq 175 \text{ }^\circ\text{C}$ to achieve maximum current rating.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain	 TO-220AB (SOT78A)	 mbb076

6. Ordering information

Table 3. Ordering information

Type number	Package			Version
	Name	Description	Version	
BUK953R2-40B	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB		SOT78A

7. 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	$T_j \geq 25^\circ\text{C}$; $T_j \leq 175^\circ\text{C}$		-	40	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	40	V
V_{GS}	gate-source voltage			-15	15	V
P_{tot}	total power dissipation	$T_{mb} = 25^\circ\text{C}$; Fig. 1		-	300	W
I_D	drain current	$T_{mb} = 25^\circ\text{C}$; $V_{GS} = 5\text{ V}$; Fig. 2 ; Fig. 3	[1]	-	222	A
		$T_{mb} = 100^\circ\text{C}$; $V_{GS} = 5\text{ V}$; Fig. 2	[2]	-	100	A
		$T_{mb} = 25^\circ\text{C}$; $V_{GS} = 5\text{ V}$; Fig. 2 ; Fig. 3	[2]	-	100	A
I_{DM}	peak drain current	$T_{mb} = 25^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 3		-	888	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	$T_{mb} = 25^\circ\text{C}$	[1]	-	222	A
			[2]	-	100	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25^\circ\text{C}$		-	888	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 100\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 5\text{ V}$; $T_{j(init)} = 25^\circ\text{C}$; unclamped		-	1.2	J

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

[2] All individual parts of device must be $\leq 175^\circ\text{C}$ to achieve maximum current rating.

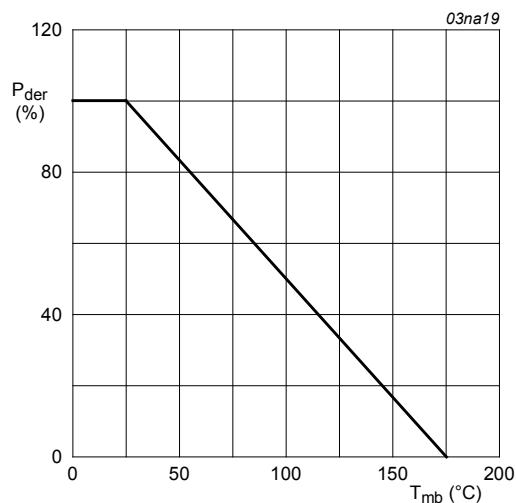


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

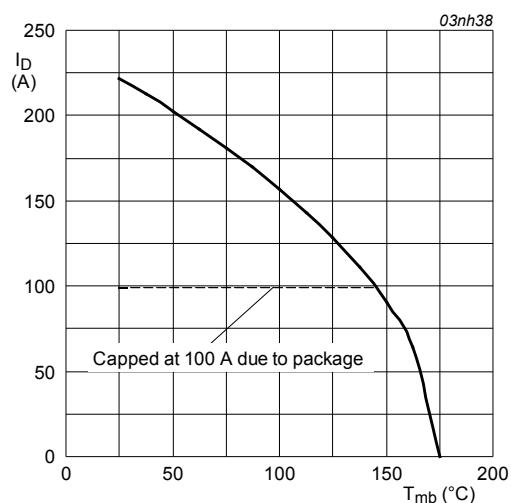


Fig. 2. Continuous drain current as a function of mounting base temperature

$V_{GS} \geq 5\text{V}$

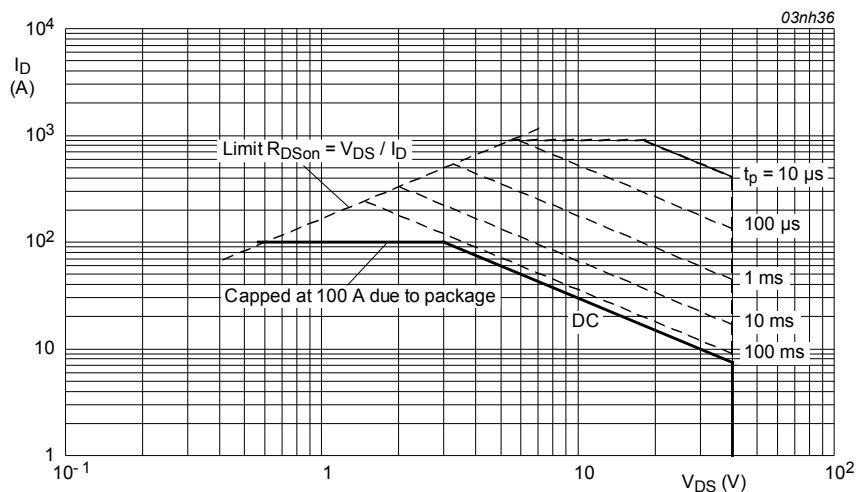


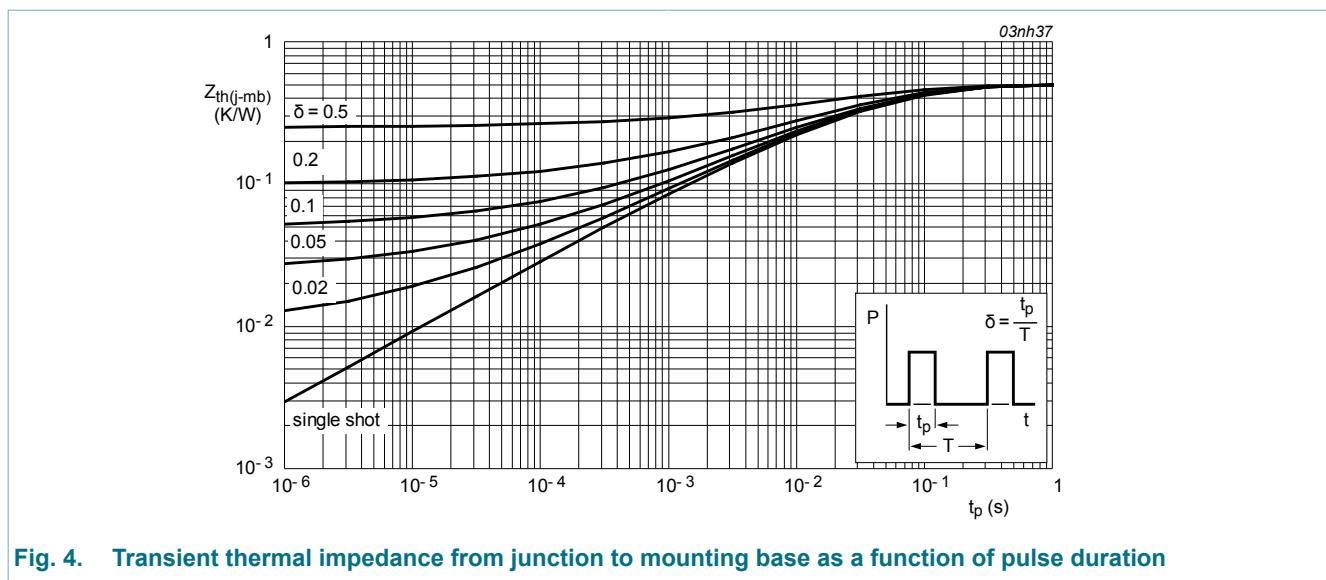
Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^{\circ}\text{C}$; I_{DM} is single pulse

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 4		-	-	0.5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air		-	60	-	K/W



9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$		36	-	-	V
		$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 10		1.1	1.5	2	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 10		0.5	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ Fig. 10		-	-	2.3	V
I_{DSS}	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	0.02	1	μA
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$		-	-	500	μA

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{GSS}	gate leakage current	$V_{GS} = 15 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	2	100	nA
		$V_{GS} = -15 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$		-	2.4	2.8	$\text{m}\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$		-	-	3.5	$\text{m}\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 11 ; Fig. 12		-	-	6	$\text{m}\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 11 ; Fig. 12		-	2.7	3.2	$\text{m}\Omega$

Dynamic characteristics

$Q_{G(\text{tot})}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 13		-	94	-	nC
Q_{GS}	gate-source charge			-	17	-	nC
Q_{GD}	gate-drain charge			-	37	-	nC
C_{iss}	input capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 14		-	7877	10502	pF
C_{oss}	output capacitance			-	1397	1676	pF
C_{rss}	reverse transfer capacitance			-	608	833	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ }\Omega; V_{GS} = 5 \text{ V};$ $R_{G(\text{ext})} = 10 \text{ }\Omega; T_j = 25 \text{ }^\circ\text{C}$		-	68	-	ns
t_r	rise time			-	268	-	ns
$t_{d(off)}$	turn-off delay time			-	257	-	ns
t_f	fall time			-	192	-	ns
L_D	internal drain inductance	from drain lead 6 mm from package to center of die; $T_j = 25 \text{ }^\circ\text{C}$		-	4.5	-	nH
		from contact screw on mounting base to center of die; $T_j = 25 \text{ }^\circ\text{C}$		-	3.5	-	nH
L_S	internal source inductance	from source lead to source bond pad; $T_j = 25 \text{ }^\circ\text{C}$		-	7.5	-	nH

Source-drain diode

V_{SD}	source-drain voltage	$I_S = 40 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 15		-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s};$ $V_{GS} = -10 \text{ V}; V_{DS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	70	-	ns
				-	127	-	nC

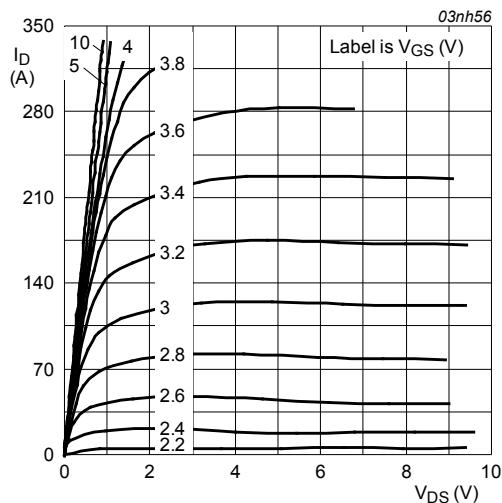


Fig. 5. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25^\circ C$

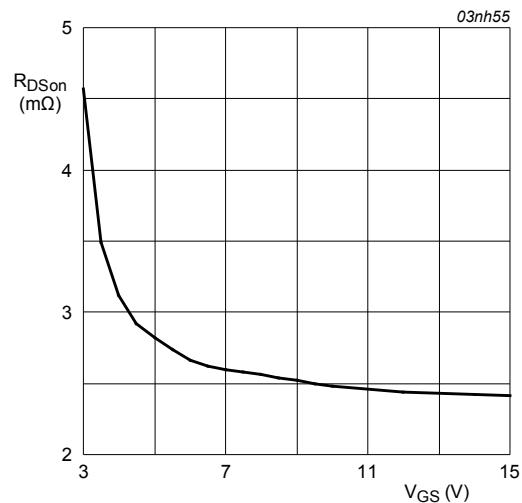


Fig. 6. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25^\circ C; I_D = 25A$

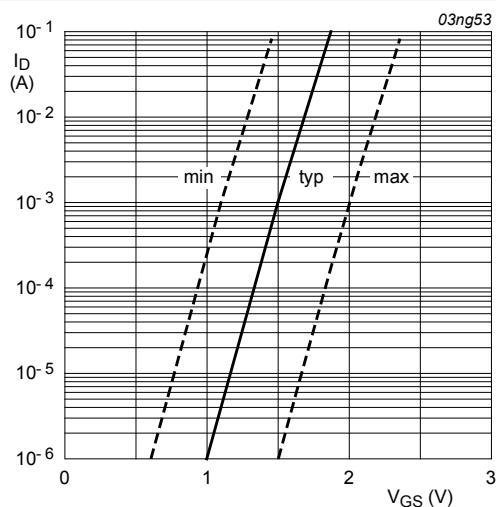


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25^\circ C; V_{DS} = V_{GS}$

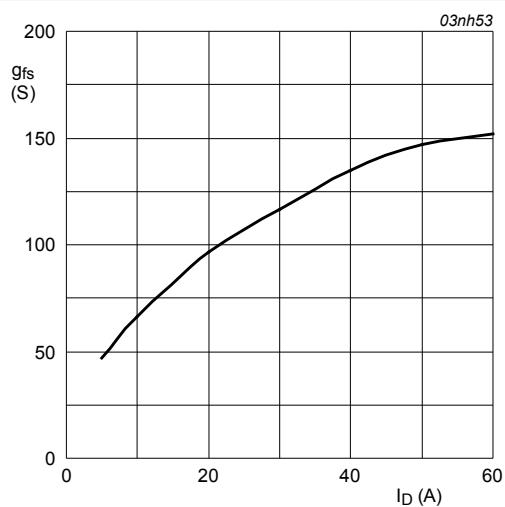


Fig. 8. Forward transconductance as a function of drain current; typical values

$T_j = 25^\circ C; V_{DS} = 25V$

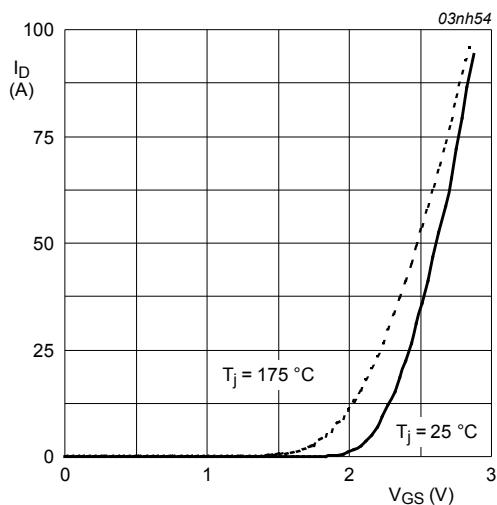


Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 25\text{ V}$

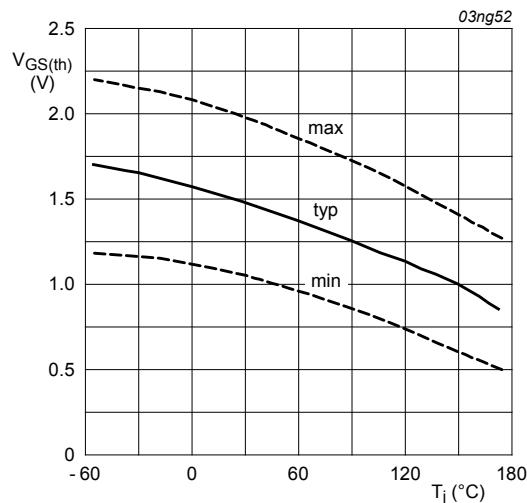


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

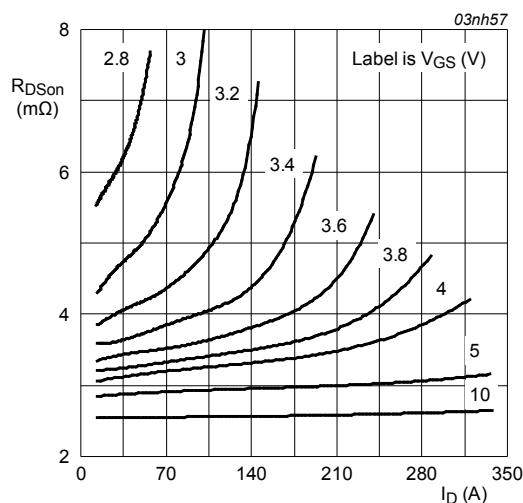


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25\text{ }^\circ\text{C}$

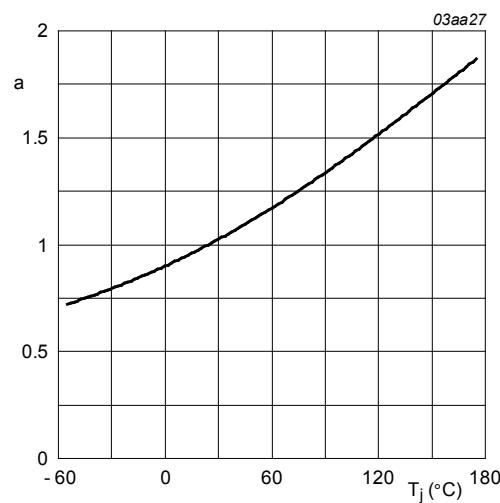


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DSon}}{R_{DSon}(25\text{ }^\circ\text{C})}$$

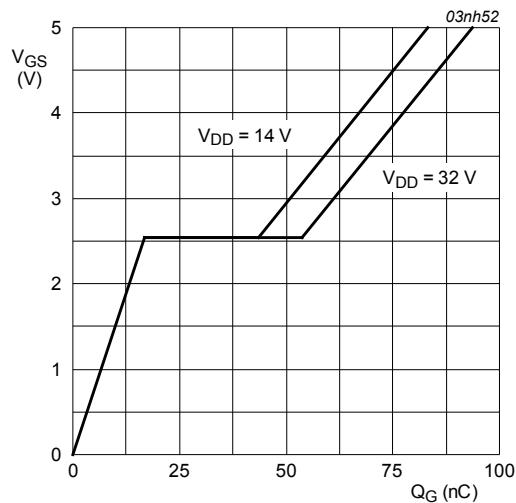


Fig. 13. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ\text{C}; V_{DS} = 25\text{V}$

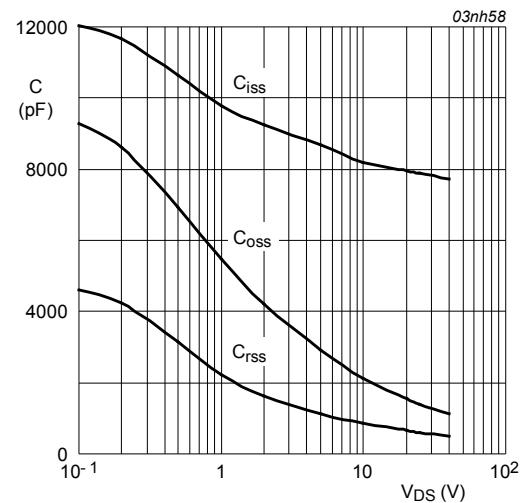


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

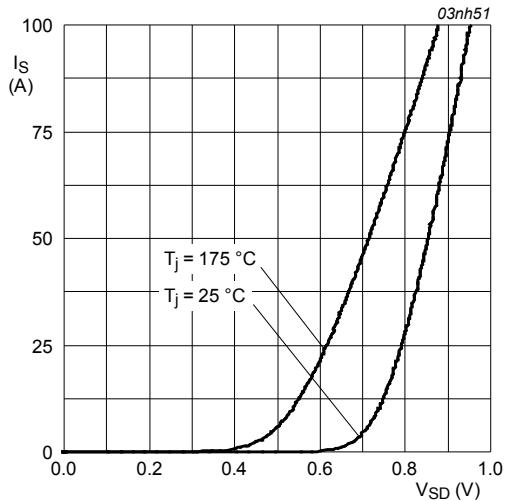


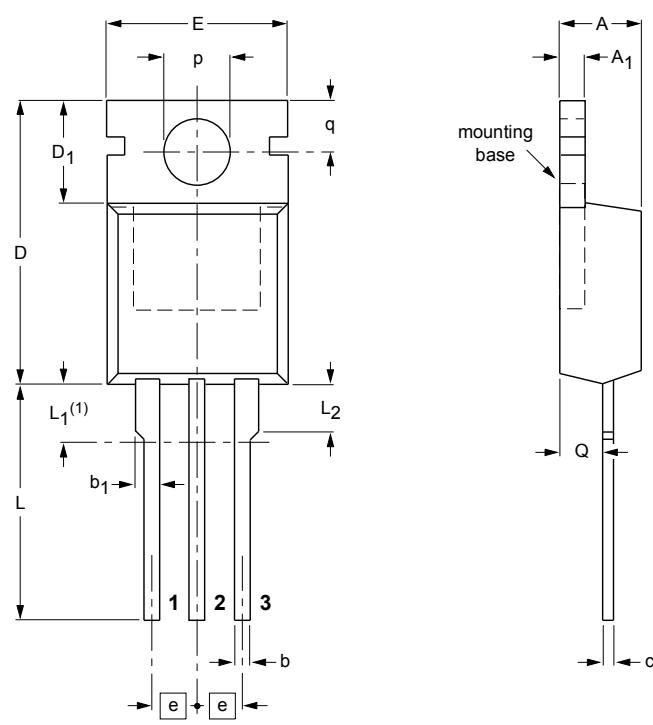
Fig. 15. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0\text{V}$

10. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78A



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	b	b ₁	c	D	D ₁	E	e	L	L ₁₍₁₎	L ₂ max.	p	q	Q
mm	4.5 4.1	1.39 1.27	0.9	1.3	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78A		3-lead TO-220AB	SC-46			03-01-22 05-03-14

Fig. 16. Package outline TO-220AB (SOT78A)

11. Legal information

11.1 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.
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