Power MOS transistor

BUZ78

May 1987

GENERAL DESCRIPTION

N-channel enchancement mode field-effect power transistor in a plastic envelope.

The device is intended for use in Switched Mode Power Supplies (SMPS), motor control, welding, DC/DC and DC/AC converters, and in general purpose switching applications.

QUICK REFERENCE DATA

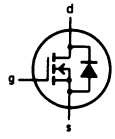
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	800	V
I_D	Drain current (d.c.)	1,5	A
P_{tot}	Total power dissipation	40	W
$R_{DS(ON)}$	Drain-source on-state resistance	8,0	Ω

MECHANICAL DATA

Dimensions in mm

Net mass: 2 g

Pinning:
1 = Gate
2 = Drain
3 = Source



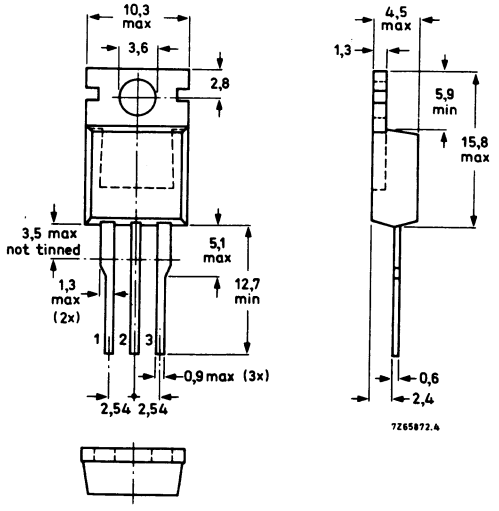


Fig.1 TO220AB; drain connected to mounting base.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Accessories supplied on request: refer to Mounting instructions for TO220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	–	–	800	V
V_{DGR}	Drain-gate voltage	R_{GS} = 20 kΩ	–	800	V
$\pm V_{GS}$	Gate-source voltage	–	–	20	V
I_D	Drain current (d.c.)	T_{mb} = 25 °C	–	1,5	A
I_D	Drain current (d.c.)	T_{mb} = 100 °C	–	0,9	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 °C	–	6,0	A
P_{tot}	Total power dissipation	T_{mb} = 25 °C	–	40	W
T_{stg}	Storage temperature	–	−55	150	°C
T_j	Junction temperature	–	–	150	°C

THERMAL RESISTANCES

From junction to mounting base	$R_{th\ j\text{-}mb}$ = 3,1 K/W
From junction to ambient	$R_{th\ j\text{-}a}$ = 75 K/W

STATIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0,25 mA	800	–	–	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	2,1	3,0	4,0	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 800 V; V_{GS} = 0 V; T_j = 25 °C	–	20	250	μA
I_{DSS}	Zero gate voltage drain current	V_{DS} = 800 V; V_{GS} = 0 V; T_j = 125 °C	–	0,1	1,0	mA
I_{GSS}	Gate source leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	–	10	100	nA
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 10 V; I_D = 1,0 A	–	7,0	8,0	Ω

DYNAMIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 1,0 A	1,0	2,3	–	S
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	–	450	750	pF
C_{oss}	Output capacitance		–	42	70	pF
C_{rss}	Feedback capacitance		–	15	30	pF
$t_{d\ on}$	Turn-on delay time	V_{DD} = 30 V; I_D = 1,7 A; V_{GS} = 10 V; R_{GS} = 50 Ω; R_{gen} = 50 Ω	–	15	20	ns
t_r	Turn-on rise time		–	25	40	ns
$t_{d\ off}$	Turn-off delay time		–	50	65	ns
t_f	Turn-off fall time		–	30	40	ns
L_d	Internal drain inductance	Measured from contact screw on tab to centre of die	–	3,5	–	nH
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	–	4,5	–	nH
L_s	Internal source inductance	Measured from source lead 6 mm from package to source bond pad	–	7,5	–	nH

REVERSE DIODE RATINGS AND CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current	T_{mb} = 25 °C	–	–	1,5	A
I_{DRM}	Pulsed reverse drain current	T_{mb} = 25 °C	–	–	6,0	A
V_{SD}	Diode forward on-voltage	I_F = 3,0 A; V_{GS} = 0 V	–	1,0	1,4	V
t_{rr}	Reverse recovery time	I_F = 1,5 A; $-dI_F/dt$ = 100 A/μs; V_{GS} = 0 V; V_R = 100 V	–	230	–	ns
Q_{rr}	Reverse recovery charge		–	1,9	–	μC

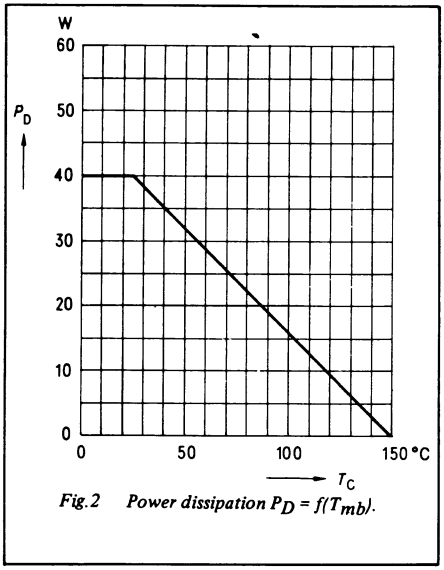


Fig.2 Power dissipation $P_D = f(T_{mb})$.

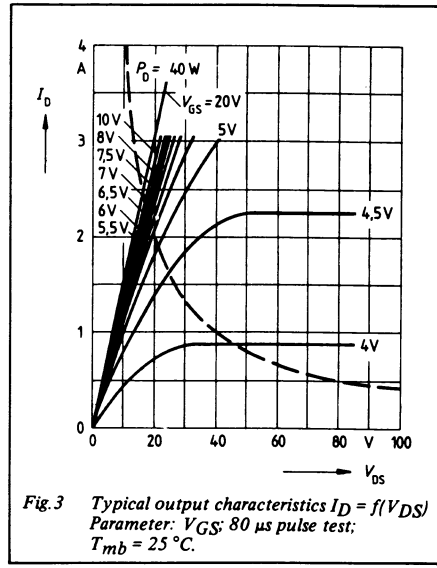


Fig.3 Typical output characteristics $I_D = f(V_{DS})$ Parameter: V_{GS}; 80 µs pulse test; T_{mb} = 25 °C.

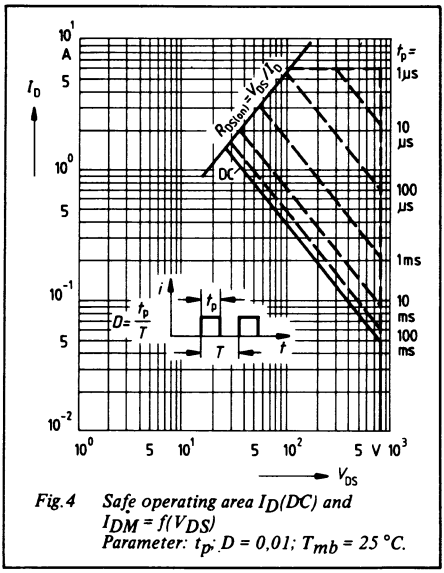


Fig.4 Safe operating area $I_D(DC)$ and $I_{DM} = f(V_{DS})$ Parameter: t_p; D = 0,01; T_{mb} = 25 °C.

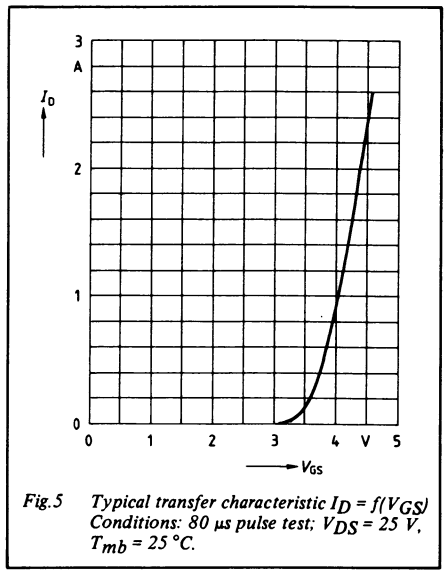


Fig.5 Typical transfer characteristic $I_D = f(V_{GS})$ Conditions: 80 µs pulse test; V_{DS} = 25 V, T_{mb} = 25 °C.

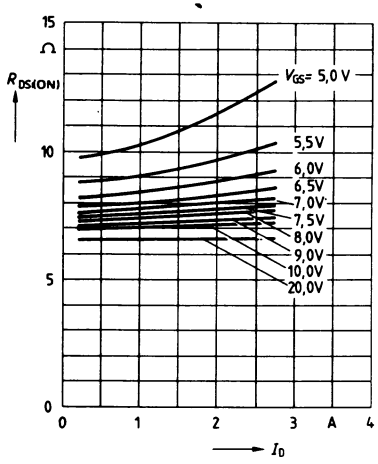


Fig. 6 Typical drain-source on-state resistance $R_{DS(ON)} = f(I_D)$ Parameter: V_{GS}; T_j = 25 °C.

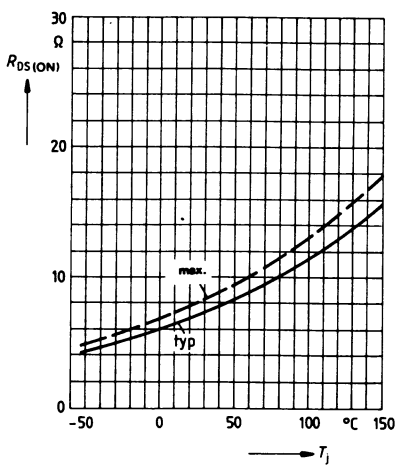


Fig. 7 Drain-source on-state resistance $R_{DS(ON)} = f(T_j)$ Conditions: I_D = 1,5 A; V_{GS} = 10 V.

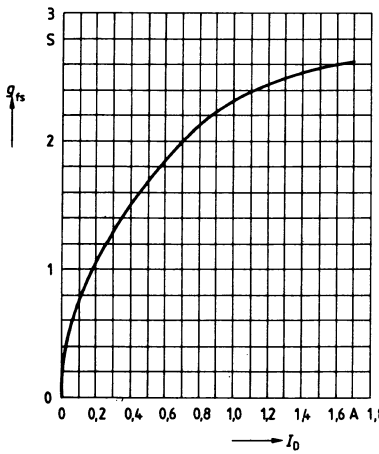


Fig. 8 Typical transconductance $g_{fs} = f(I_D)$ Conditions: 80 µs pulse test; V_{DS} = 25 V; T_j = 25 °C.

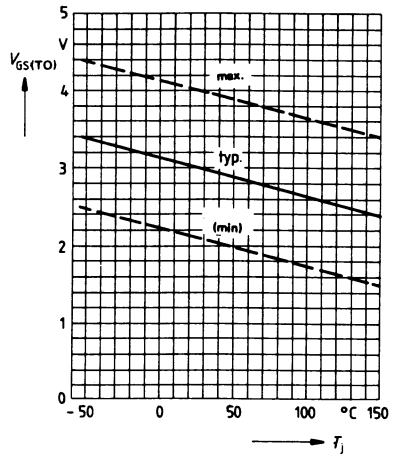


Fig. 9 Gate threshold voltage $V_{GS(TO)} = f(T_j)$ Conditions: $V_{DS} = V_{GS}$; I_D = 1 mA.

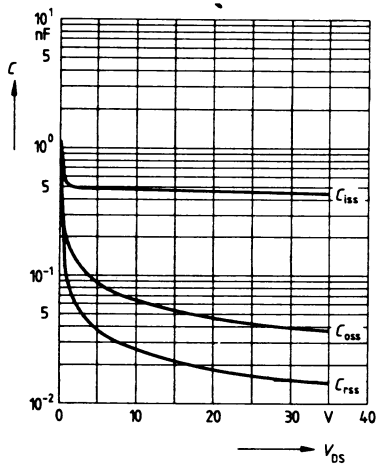


Fig.10 Typical capacitances $C = f(V_{DS})$
Conditions: $V_{GS} = 0$; $f = 1$ MHz.

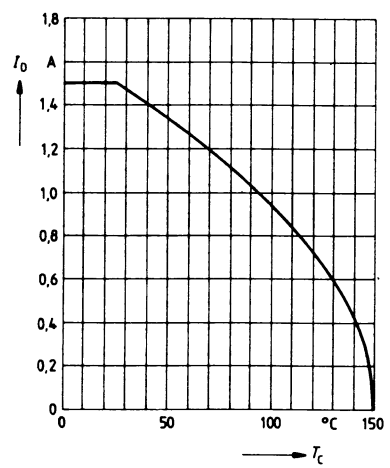


Fig.11 Continuous drain current $I_D = f(T_{mb})$
Conditions: $V_{GS} \geq 10$ V.

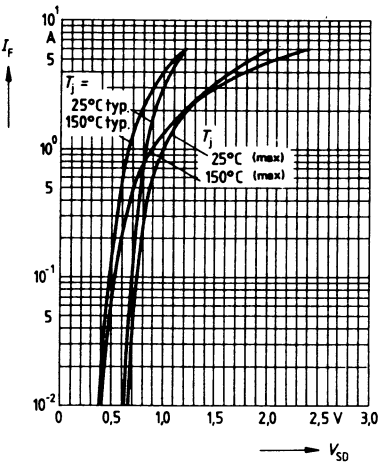


Fig.12 Forward characteristics of reverse diode $I_F = f(V_{SD})$
Parameter: T_j; $t_p = 80$ µs.

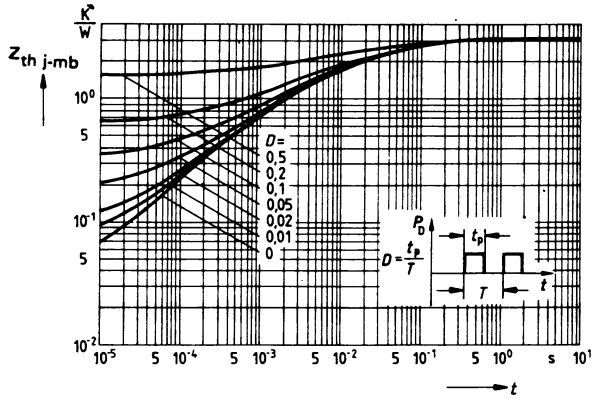


Fig.13 Transient thermal impedance $Z_{th\ j\text{-}mb} = f(t)$
Parameter: $D = t_p/T$.

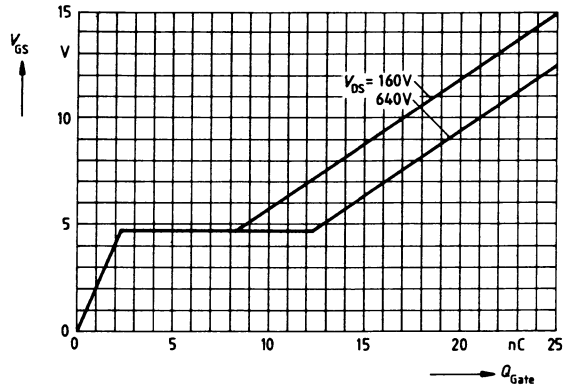


Fig.14 Typical gate-charge $V_{GS} = f(Q_{Gate})$
Parameter: V_{DS}; I_{DM} = 2,25 A.

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GENERAL DESCRIPTION

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The device is intended for use in Switched Mode Power Supplies (SMPS), motor control, welding, DC/DC and DC/AC converters, and in general purpose switching applications.

QUICK REFERENCE DATA

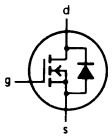
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	600	V
I_D	Drain current (d.c.)	4,0	A
P_{tot}	Total power dissipation	75	W
$R_{DS(ON)}$	Drain-source on-state resistance	2,0	Ω

MECHANICAL DATA

Dimensions in mm

Net mass: 2 g

Pinning:
1 = Gate
2 = Drain
3 = Source



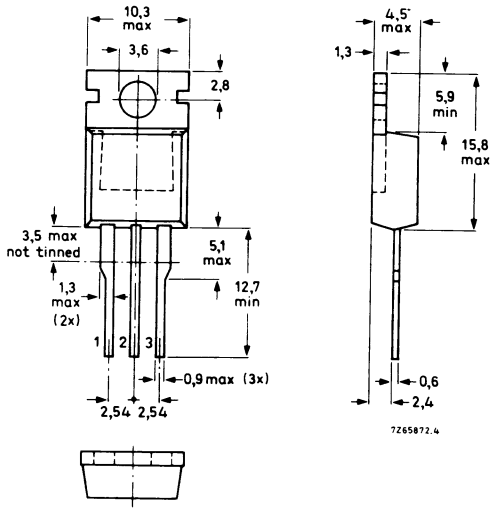


Fig. 1 TO220AB; drain connected to mounting base.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Accessories supplied on request: refer to Mounting instructions for TO220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	–	–	600	V
V_{DGR}	Drain-gate voltage	R_{GS} = 20 kΩ	–	600	V
$\pm V_{GS}$	Gate-source voltage	–	–	20	V
I_D	Drain current (d.c.)	T_{mb} = 30 °C	–	4,0	A
I_D	Drain current (d.c.)	T_{mb} = 100 °C	–	2,6	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 °C	–	16	A
P_{tot}	Total power dissipation	T_{mb} = 25 °C	–	75	W
T_{stg}	Storage temperature	–	–55	150	°C
T_j	Junction temperature	–	–	150	°C

THERMAL RESISTANCES

From junction to mounting base	$R_{th\ j\text{-}mb}$ = 1,67 K/W
From junction to ambient	$R_{th\ j\text{-}a}$ = 75 K/W

STATIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0,25 mA	600	–	–	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	2,1	3,0	4,0	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 600 V; V_{GS} = 0 V; T_j = 25 °C	–	20	250	μA
I_{DSS}	Zero gate voltage drain current	V_{DS} = 600 V; V_{GS} = 0 V; T_j = 125 °C	–	0,1	1,0	mA
I_{GSS}	Gate source leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	–	10	100	nA
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 10 V; I_D = 2,5 A	–	1,8	2,0	Ω

DYNAMIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 2,5 A	1,5	2,5	–	S
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	–	1500	2000	pF
C_{oss}	Output capacitance		–	110	170	pF
C_{rss}	Feedback capacitance		–	40	70	pF
$t_{d\ on}$	Turn-on delay time	V_{DD} = 30 V; I_D = 2,5 A; V_{GS} = 10 V; R_{GS} = 50 Ω; R_{gen} = 50 Ω	–	30	45	ns
t_r	Turn-on rise time		–	40	60	ns
$t_{d\ off}$	Turn-off delay time		–	110	140	ns
t_f	Turn-off fall time		–	50	60	ns
L_d	Internal drain inductance	Measured from contact screw on tab to centre of die	–	3,5	–	nH
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	–	4,5	–	nH
L_s	Internal source inductance	Measured from source lead 6 mm from package to source bond pad	–	7,5	–	nH

REVERSE DIODE RATINGS AND CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current	T_{mb} = 25 °C	–	–	4,0	A
I_{DRM}	Pulsed reverse drain current	T_{mb} = 25 °C	–	–	16	A
V_{SD}	Diode forward on-voltage	I_F = 8,0 A; V_{GS} = 0 V	–	0,95	1,2	V
t_{rr}	Reverse recovery time	I_F = 4,0 A; $-dI_F/dt$ = 100 A/μs; V_{GS} = 0 V; V_R = 100 V	–	1,2	–	μs
Q_{rr}	Reverse recovery charge		–	6,0	–	μC

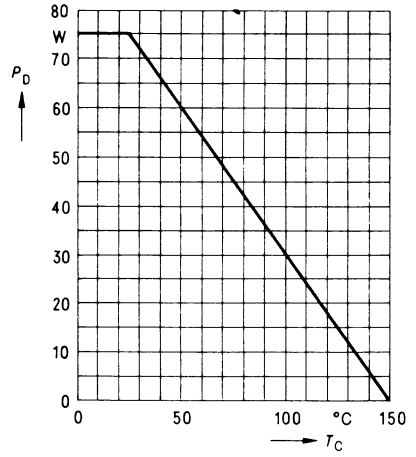


Fig.2 Power dissipation $P_D = f(T_{mb})$.

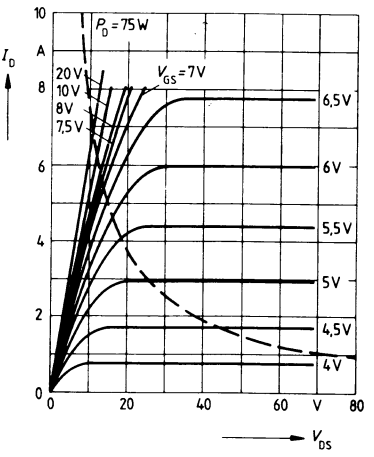


Fig.3 Typical output characteristics $I_D = f(V_{DS})$ Parameter: V_{GS}; 80 µs pulse test; T_{mb} = 25 °C.

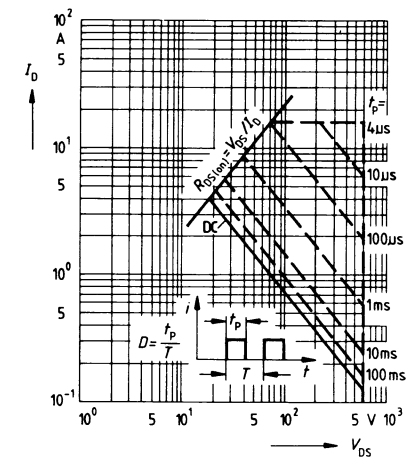


Fig.4 Safe operating area $I_D(DC)$ and $I_{DM} = f(V_{DS})$ Parameter: t_p; D = 0,01; T_{mb} = 25 °C.

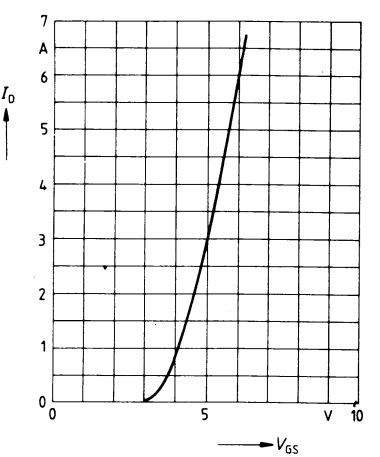


Fig.5 Typical transfer characteristic $I_D = f(V_{GS})$ Conditions: 80 µs pulse test; V_{DS} = 25 V, T_{mb} = 25 °C.

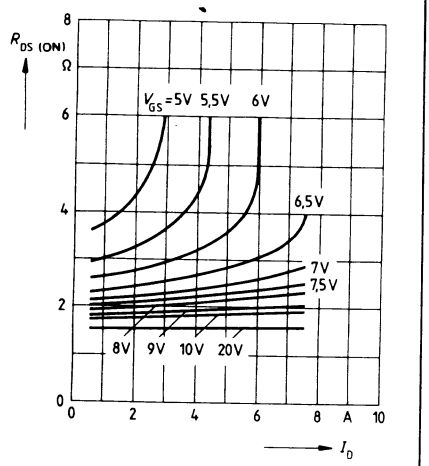


Fig. 6 Typical drain-source on-state resistance $R_{DS(ON)} = f(I_D)$ Parameter: V_{GS}; T_j = 25 °C.

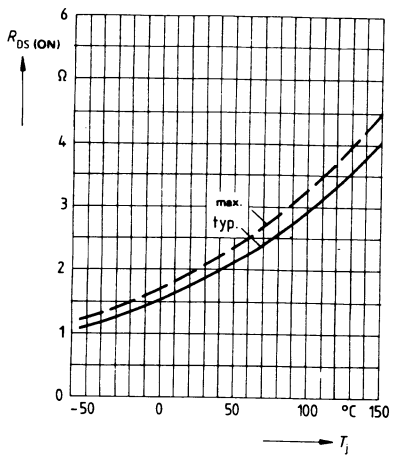


Fig. 7 Drain-source on-state resistance $R_{DS(ON)} = f(T_j)$ Conditions: I_D = 2,5 A; V_{GS} = 10 V.

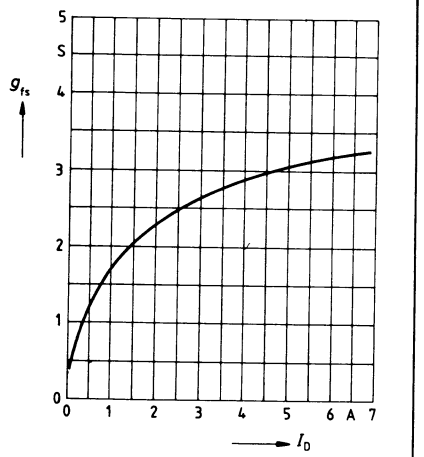


Fig. 8 Typical transconductance $g_{fs} = f(I_D)$ Conditions: 80 µs pulse test; V_{DS} = 25 V; T_j = 25 °C.

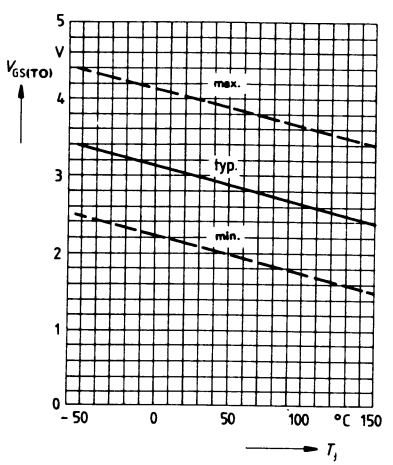


Fig. 9 Gate threshold voltage $V_{GS(TO)} = f(T_j)$ Conditions: $V_{DS} = V_{GS}$; I_D = 1 mA.

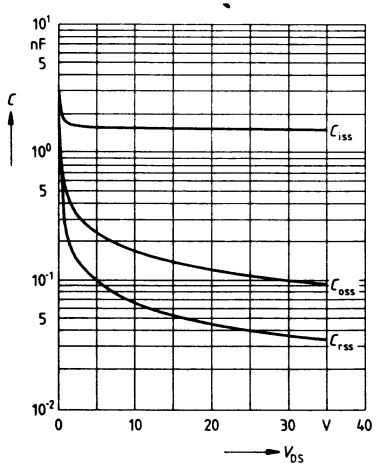


Fig.10 Typical capacitances $C = f(V_{DS})$ Conditions: $V_{GS} = 0$; $f = 1$ MHz.

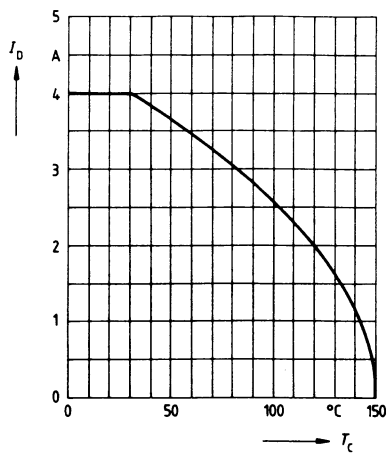


Fig.11 Continuous drain current $I_D = f(T_{mb})$ Conditions: $V_{GS} \geq 10$ V.

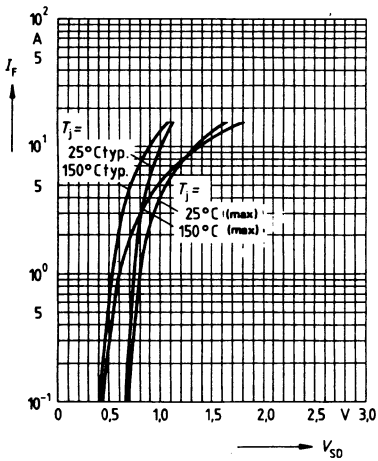


Fig.12 Forward characteristics of reverse diode $I_F = f(V_{SD})$ Parameter: T_j; $t_p = 80$ µs.

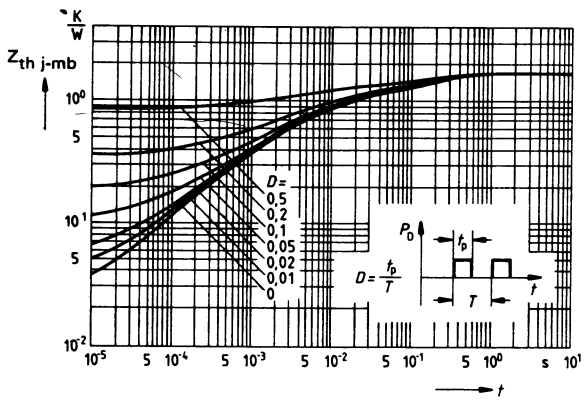


Fig. 13 Transient thermal impedance $Z_{th\ j\text{-}mb} = f(t)$
Parameter: $D = t_p/T$.

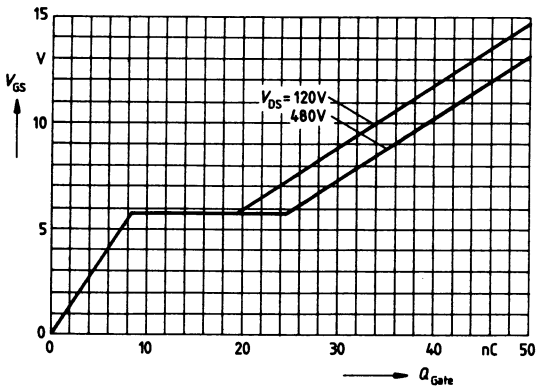


Fig. 14 Typical gate-charge $V_{GS} = f(Q_{Gate})$
Parameter: V_{DS}; $I_{DM} = 39{,}9$ A.

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QUICK REFERENCE DATA

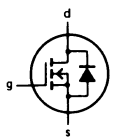
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	600	V
I_D	Drain current (d.c.)	3,5	A
P_{tot}	Total power dissipation	75	W
$R_{DS(ON)}$	Drain-source on-state resistance	2,5	Ω

MECHANICAL DATA

Dimensions in mm

Net mass: 2 g

Pinning:
1 = Gate
2 = Drain
3 = Source



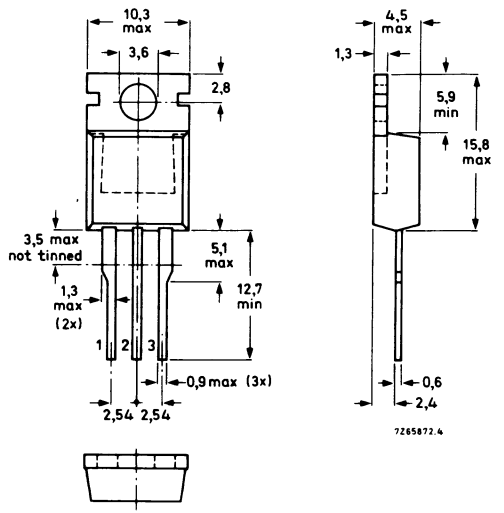


Fig. 1 TO220AB; drain connected to mounting base.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Accessories supplied on request: refer to Mounting instructions for TO220 envelopes.

VALVO

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	–	–	600	V
V_{DGR}	Drain-gate voltage	R_{GS} = 20 kΩ	–	600	V
$\pm V_{GS}$	Gate-source voltage	–	–	20	V
I_D	Drain current (d.c.)	T_{mb} = 35 °C	–	3,5	A
I_D	Drain current (d.c.)	T_{mb} = 100 °C	–	2,3	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 °C	–	14	A
P_{tot}	Total power dissipation	T_{mb} = 25 °C	–	75	W
T_{stg}	Storage temperature	–	−55	150	°C
T_j	Junction temperature	–	–	150	°C

THERMAL RESISTANCES

From junction to mounting base	$R_{th\ j\text{-}mb}$ = 1,67 K/W
From junction to ambient	$R_{th\ j\text{-}a}$ = 75 K/W

STATIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0,25 mA	600	–	–	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	2,1	3,0	4,0	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 600 V; V_{GS} = 0 V; T_j = 25 °C	–	20	250	μA
I_{DSS}	Zero gate voltage drain current	V_{DS} = 600 V; V_{GS} = 0 V; T_j = 125 °C	–	0,1	1,0	mA
I_{GSS}	Gate source leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	–	10	100	nA
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 10 V; I_D = 2,5 A	–	2,2	2,5	Ω

DYNAMIC CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
gfs	Forward transconductance	V_{DS} = 25 V; I_D = 2,5 A	1,5	2,5	–	S
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	–	1500	2000	pF
C_{oss}	Output capacitance		–	110	170	pF
C_{rss}	Feedback capacitance		–	40	70	pF
$t_{d\ on}$	Turn-on delay time	V_{DD} = 30 V; I_D = 2,4 A; V_{GS} = 10 V; R_{GS} = 50 Ω; R_{gen} = 50 Ω	–	30	45	ns
t_r	Turn-on rise time		–	40	60	ns
$t_{d\ off}$	Turn-off delay time		–	110	140	ns
t_f	Turn-off fall time		–	50	65	ns
L_d	Internal drain inductance	Measured from contact screw on tab to centre of die	–	3,5	–	nH
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	–	4,5	–	nH
L_s	Internal source inductance	Measured from source lead 6 mm from package to source bond pad	–	7,5	–	nH

REVERSE DIODE RATINGS AND CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current	T_{mb} = 25 °C	–	–	3,5	A
I_{DRM}	Pulsed reverse drain current	T_{mb} = 25 °C	–	–	14	A
V_{SD}	Diode forward on-voltage	I_F = 7,0 A; V_{GS} = 0 V	–	1,1	1,5	V
t_{rr}	Reverse recovery time	I_F = 3,5 A; $-dI_F/dt$ = 100 A/μs; V_{GS} = 0 V; V_R = 100 V	–	1,2	–	μs
Q_{rr}	Reverse recovery charge		–	6,0	–	μC

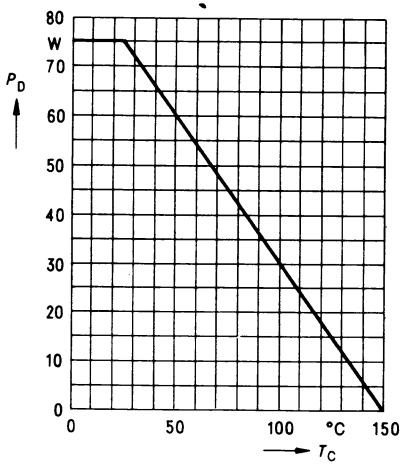


Fig.2 Power dissipation $P_D = f(T_{mb})$.

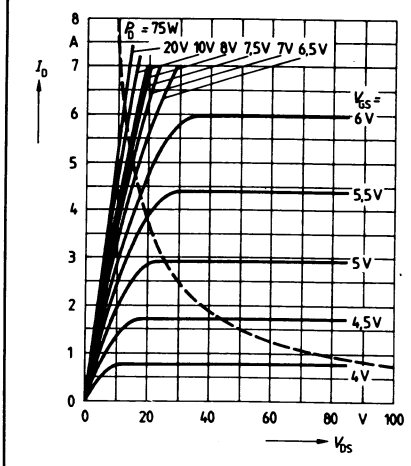


Fig.3 Typical output characteristics $I_D = f(V_{DS})$ Parameter: V_{GS}; 80 µs pulse test; T_{mb} = 25 °C.

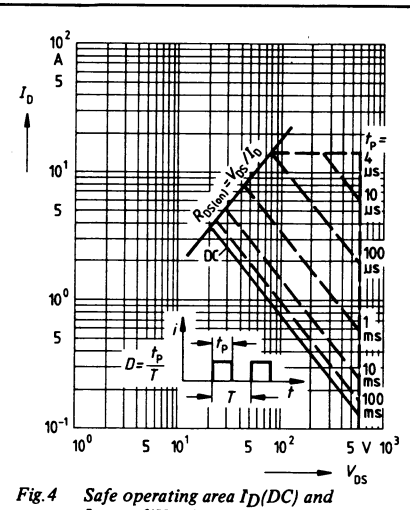


Fig.4 Safe operating area $I_D(DC)$ and $I_{DM} = f(V_{DS})$ Parameter: t_p; D = 0,01; T_{mb} = 25 °C.

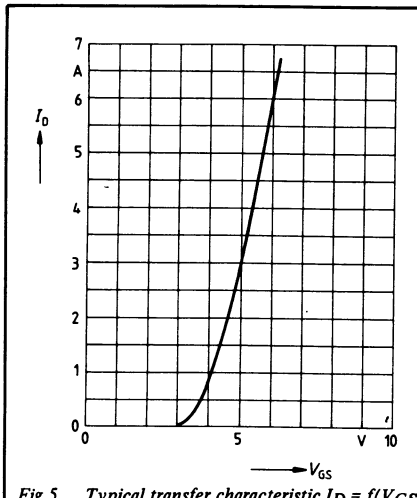


Fig.5 Typical transfer characteristic $I_D = f(V_{GS})$ Conditions: 80 µs pulse test; V_{DS} = 25 V, T_{mb} = 25 °C.

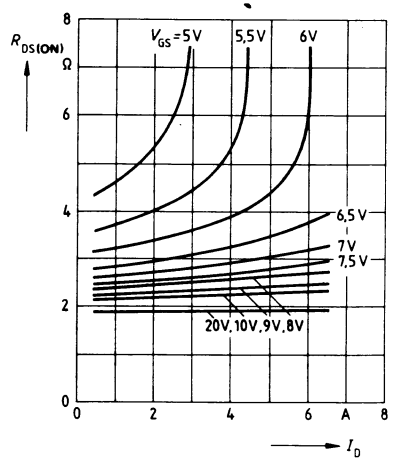


Fig.6 Typical drain-source on-state resistance $R_{DS(ON)} = f(I_D)$ Parameter: V_{GS}; T_j = 25 °C.

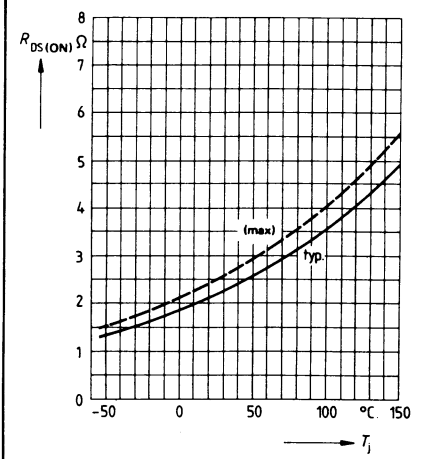


Fig.7 Drain-source on-state resistance $R_{DS(ON)} = f(T_j)$ Conditions: I_D = 2,5 A; V_{GS} = 10 V.

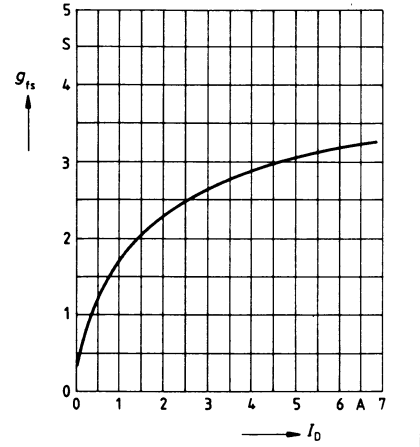


Fig.8 Typical transconductance $g_{fs} = f(I_D)$ Conditions: 80 µs pulse test; V_{DS} = 25 V; T_j = 25 °C.

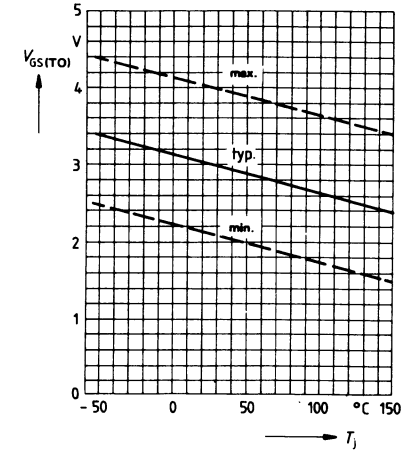


Fig.9 Gate threshold voltage $V_{GS(TO)} = f(T_j)$ Conditions: $V_{DS} = V_{GS}$; I_D = 1 mA.

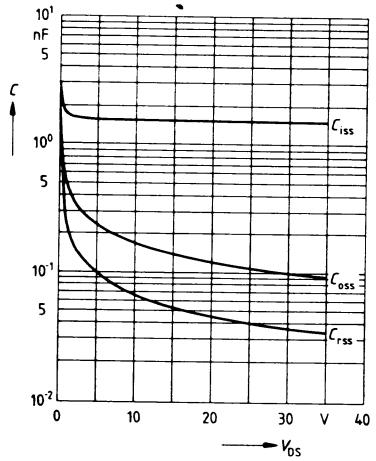


Fig.10 Typical capacitances C = f(V_{DS}) Conditions: V_{GS} = 0; f = 1 MHz.

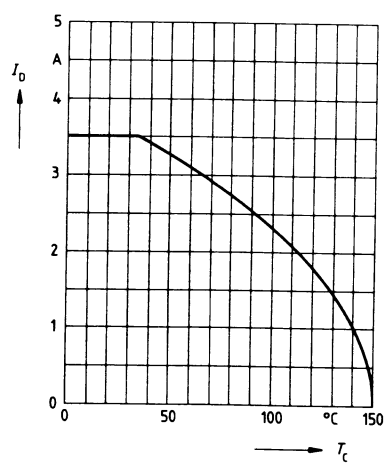


Fig.11 Continuous drain current I_D = f(T_{mb}) Conditions: V_{GS} ≥ 10 V.

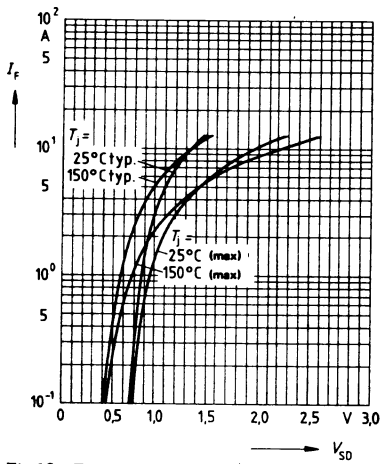


Fig.12 Forward characteristics of reverse diode I_F = f(V_{SD}) Parameter: T_j; t_p = 80 μs.

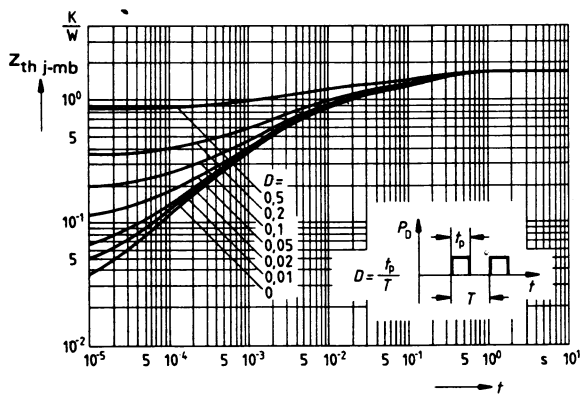


Fig.13 Transient thermal impedance $Z_{th\ j\text{-}mb} = f(t)$
Parameter: $D = t_p/T$.

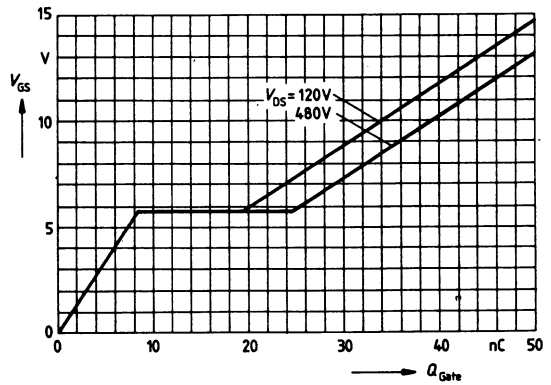


Fig.14 Typical gate-charge $V_{GS} = f(Q_{Gate})$
Parameter: V_{DS}; I_{DM} = 39,9 A.