N-channel field-effect transistor 2N4416; 2N4416A

FEATURES

- Low noise
- Interchangeability of drain and source connections
- High gain.

DESCRIPTION

N-channel symmetrical silicon junction FETs in a TO-72 envelope, with shield connected to the case. These devices are intended for use in VHF/UHF amplifiers, oscillators and mixers.

PINNING - TO-72.

PIN	DESCRIPTION
1	source
2	drain
3	gate
4	shield

CAUTION

The device is supplied in an antistatic package. The gate-source input must be protected against static charge during transport and handling.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage				
	2N4416		–	30	V
	2N4416A		–	35	V
I_{DSS}	drain current	V_{DS} = 15 V; V_{GS} = 0	5	15	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	250	mW
$V_{GS(off)}$	gate-source cut-off voltage	V_{DS} = 15 V; I_D = 1 nA			
	2N4416		–	–6	V
	2N4416A		–2.5	–6	V
$\|Y_{fs}\|$	common-source transfer admittance	V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz	4.5	7.5	mS



Marking codes:
2N4416.
2N4416A.

Fig.1 Simplified outline and symbol.

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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage				
	2N4416		–	30	V
	2N4416A		–	35	V
V_{GSO}	gate-source voltage				
	2N4416		–	–30	V
	2N4416A		–	–35	V
V_{GDO}	gate-drain voltage				
	2N4416		–	–30	V
	2N4416A		–	–35	V
I_G	DC forward gate current		–	10	mA
P_{tot}	total power dissipation	up to T_{amb} = 25 °C; note 1	–	250	mW
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient; note 1	590 K/W

Note

1. Mounted on a printed-circuit board, maximum lead length 4 mm, mounting pad for the drain lead 10 mm².

STATIC CHARACTERISTICS

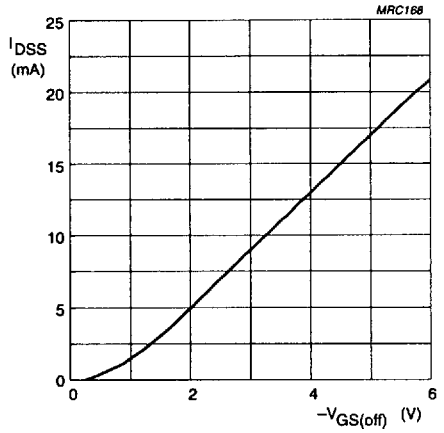
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)GSS}$	gate-source breakdown voltage	V_{DS} = 0; I_G = –1 μA			
	2N4416		–30	–	V
	2N4416A		–35	–	V
I_{GSS}	reverse gate leakage current	V_{DS} = 0; V_{GS} = –15 V	–	–0.1	nA
I_{DSS}	drain current	V_{DS} = 15 V; V_{GS} = 0	5	15	mA
V_{GSS}	gate-source forward voltage	V_{DS} = 0; I_G = 1 mA	–	1	V
$V_{GS(off)}$	gate-source cut-off voltage	V_{DS} = 15 V; I_D = 1 nA			
	2N4416		–	–6	V
	2N4416A		–2.5	–6	V
$\lvert Y_{fs}\rvert$	common source transfer admittance	V_{DS} = 15 V; V_{GS} = 0	4.5	7.5	mS
$\lvert Y_{os}\rvert$	common source output admittance	V_{DS} = 15 V; V_{GS} = 0			
	2N4416		–	50	μS
	2N4416A		–	50	μS

DYNAMIC CHARACTERISTICS

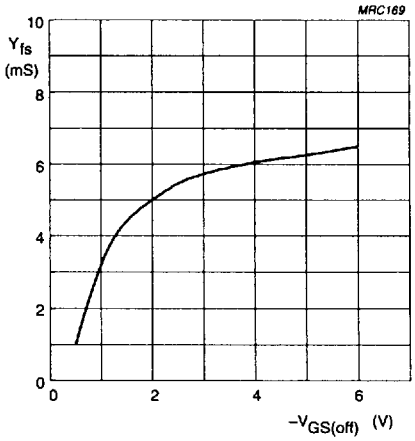
T_j = 25 °C; V_{DS} = 15 V; V_{GS} = 0.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{is}	input capacitance	f = 1 MHz	–	–	4	pF
C_{os}	output capacitance	f = 1 MHz	–	–	2	pF
C_{rs}	feedback capacitance	f = 1 MHz	–	–	0.8	pF
g_{is}	common source input conductance	f = 100 MHz	–	–	100	µS
		f = 400 MHz	–	–	1	mS
g_{fs}	common source transfer conductance	f = 100 MHz	–	5.2	–	mS
		f = 400 MHz	4	5	–	mS
g_{rs}	common source feedback conductance	f = 100 MHz	–	–8	–	µS
		f = 400 MHz	–	–100	–	µS
g_{os}	common source output conductance	f = 100 MHz	–	–	75	µS
		f = 400 MHz	–	–	100	µS
V_n	equivalent input noise voltage	f = 100 Hz	–	5	–	nV/√HZ



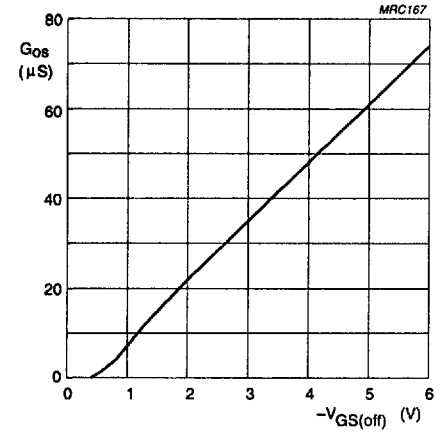
V_{DS} = 15 V; T_j = 25 °C.

Fig.2 Drain current as a function of gate-source cut-off voltage; typical values.



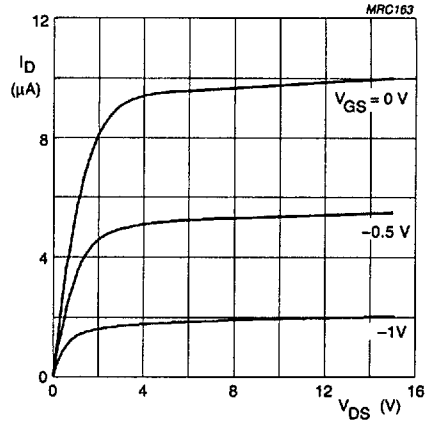
V_{DS} = 15 V; T_j = 25 °C.

Fig.3 Common source transfer admittance as a function of gate-source cut-off voltage; typical values.



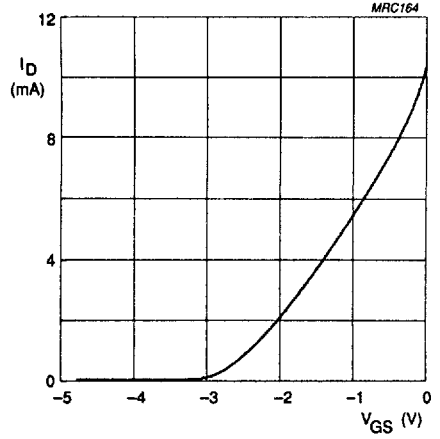
V_{DS} = 15 V; T_j = 25 °C.

Fig.4 Common source output conductance as a function of gate-source cut-off voltage; typical values.



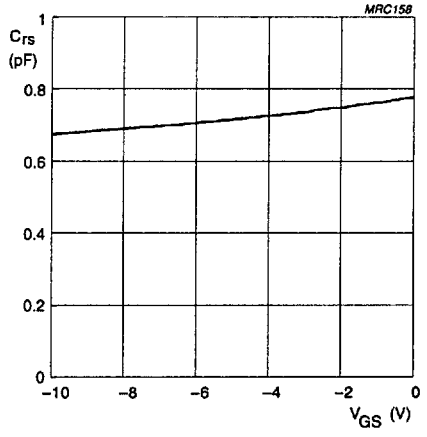
T_j = 25 °C.

Fig.5 Typical output characteristics.



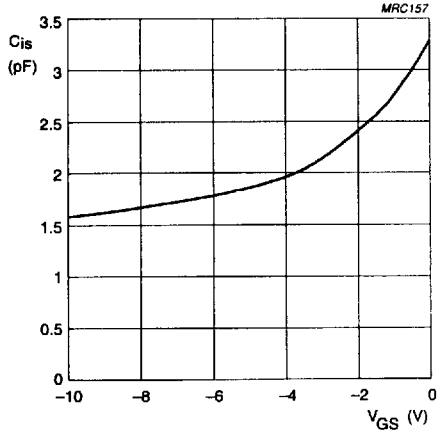
V_{DS} = 15 V; T_j = 25 °C.

Fig.6 Typical input characteristics.



V_{DS} = 15 V; T_j = 25 °C.

Fig.7 Typical feedback capacitance.



V_{DS} = 15 V; T_j = 25 °C.

Fig.8 Typical input capacitance.

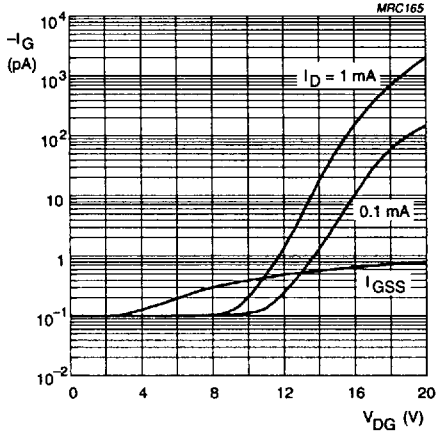


Fig.9 Gate current as a function of drain-gate voltage, typical values.

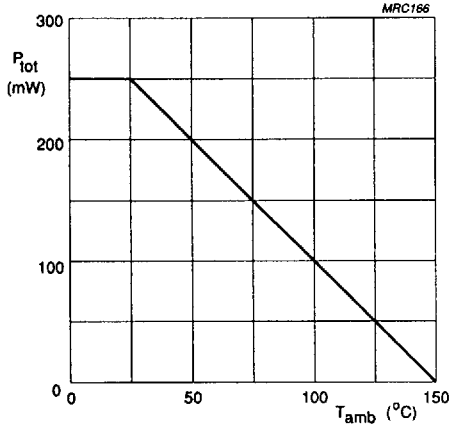
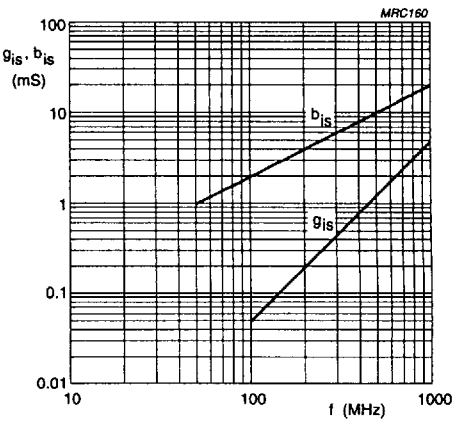


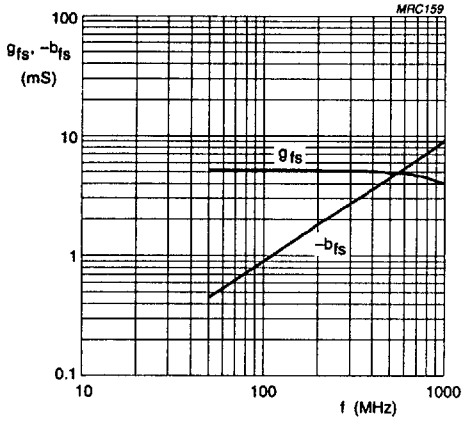
Fig.10 Power derating curve.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

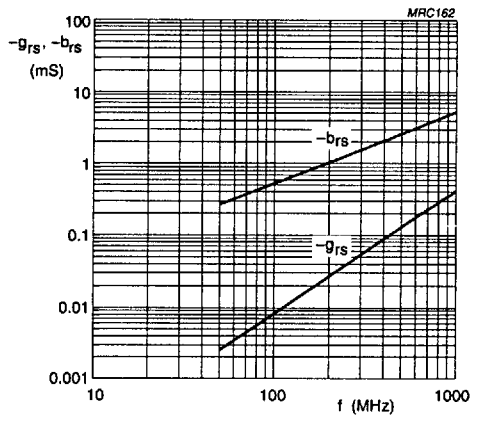
Fig.11 Common source input conductance; typical values.

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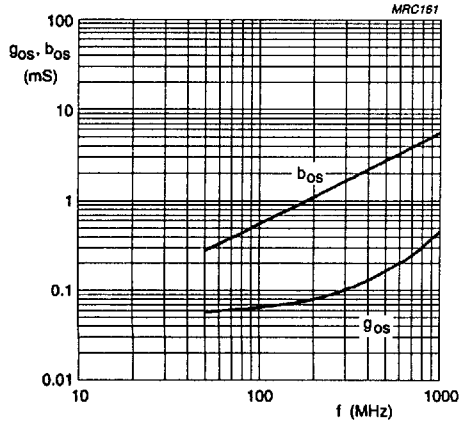
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.12 Common source transfer conductance; typical values.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.13 Common source feedback conductance; typical values.



V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C.

Fig.14 Common source output conductance; typical values.

SPICE parameters for 2N4416
September 1992; version 1.0.

1	VTO = −3.553	V
2	BETA = 792.6	μA/V²
3	LAMBDA = 18.46	m/V
4	RD = 7.671	Ω
5	RS = 7.671	Ω
6	IS = 333.4	aA
7	CGSO = 2.920	pF
8	CGDO = 2.261	pF
9	PB = 1.090	V
10 (note 1)	FC = 500.0	m

Note

1. Parameter not extracted; default value.