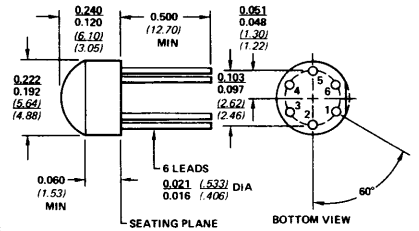
Performance Curves NP
See Page 4-37

MATCHED DUAL N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

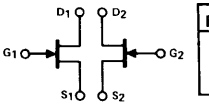
MATCHED DUAL FETS FOR WIDEBAND DIFFERENTIAL AMPLIFIERS

This series of epoxy-encapsulated FETs is characterized for low and medium frequency small-signal differential amplifiers requiring low gate-source voltage offset and drift.

- $|V_{GS1} - V_{GS2}| = 10$ mV Max (E400 and E401)
- $\frac{\Delta|V_{GS1} - V_{GS2}|}{\Delta T} = 10\ \mu V/°C$ Max (E400)



Si 200



PIN	OUT	PIN	OUT
1	S_1	4	S_2
2	D_1	5	D_2
3	G_1	6	G_2

ABSOLUTE MAXIMUM RATINGS (25°C)

Gate-To-Gate Voltage ..... ±50 V
Gate-Drain or Gate-Source Voltage ..... -40 V
Gate Current ..... 50 mA
Total Package Dissipation
(25°C Free-Air Temperature)..... 350 mW
Power Derating (to +125°C)..... 3.5 mW/°C
Storage Temperature Range..... -55 to +125°C
Operating Temperature Range ..... -55 to +125°C
Lead Temperature
(1/16" from case for 10 seconds)..... 300°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		E400			E401			E402			Unit	Test Conditions	
				Min	Typ	Max	Min	Typ	Max	Min	Typ	Max			
1	STATIC	I_{GSS}	Gate Reverse Current (Note 1)			-200			-200			-200	pA	$V_{DS} = 0$, $V_{GS} = -30$ V	
2	STATIC	$V_{GS(off)}$	Gate-Source Cutoff Voltage	-1.0		-4.5	-1.0		-4.5	-1.0		-4.5	V	$V_{DS} = 20$ V, $I_D = 1$ nA	
3	STATIC	BV_{GSS}	Gate-Source Breakdown Voltage	-40			-40			-40			V	$V_{DS} = 0$, $I_G = -1\ \mu A$	
4	STATIC	I_{DSS}	Saturation Drain Current (Note 2)	0.5		5.0	0.5		5.0	0.5		5.0	mA	$V_{DS} = 20$ V, $V_{GS} = 0$	
5	STATIC	I_G	Gate Current (Note 1)			-200			-200			-200	pA	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	
6	STATIC	V_{GS}	Gate-Source Voltage	-0.2		-4.0	-0.2		-4.0	-0.2		-4.0	V	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	
7	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	1,000		4,000	1,000		4,000	1,000		4,000	μmho	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 kHz
8	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	600		1,600	600		1,600	600		1,600	μmho	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	f = 1 kHz
9	DYNAMIC	g_{os}	Common-Source Output Conductance			35			35			35	μmho	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 kHz
10	DYNAMIC	g_{os}	Common-Source Output Conductance			10			10			10	μmho	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	f = 1 kHz
11	DYNAMIC	C_{iss}	Common-Source Input Capacitance		4.5			4.5			4.5		pF	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 MHz
12	DYNAMIC	C_{rss}	Common-Source Reverse Transfer Capacitance		1.2			1.2			1.2		pF	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 MHz
13	DYNAMIC	$\bar{e}_n$	Equivalent Short-Circuit Input Noise Voltage		50			50			50		$\frac{nV}{\sqrt{Hz}}$	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 100 Hz
14	MATCHING	$\lvert V_{GS1}-V_{GS2}\rvert$	Differential Gate-Source Voltage			10			10			20	mV	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	
15	MATCHING	$\frac{\Delta\lvert V_{GS1}-V_{GS2}\rvert}{\Delta T}$	Gate-Source Voltage Differential Drift			10			25			50	μV/°C	$V_{DG} = 20$ V, $I_D = 200\ \mu A$ $T_A = 25°C$ to $T_B = 85°C$	
16	MATCHING	CMRR	Common-Mode Rejection Ratio (Note 3)		70			70			70		dB	$V_{DD} = 10$ V to $V_{DD} = 20$ V, $I_D = 200\ \mu A$	

NP

NOTES:
1. Approximately doubles for every 10°C increase in T_A.
2. Pulse test duration = 300 μsec; duty cycle ≤ 3%.
3. $CMRR = 20\log_{10}\left[\frac{\Delta V_{DD}}{\Delta|V_{GS1}-V_{GS2}|}\right]$, $\Delta V_{DD} = 10$ V.

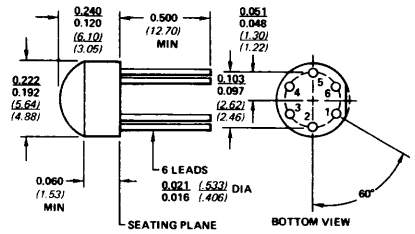
Performance Curves NQP
See Page 4-39

MONOLITHIC MATCHED DUAL N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

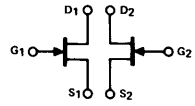
MATCHED MONOLITHIC DUAL FETS FOR DIFFERENTIAL AMPLIFIERS

This series of epoxy-encapsulated FETs is characterized for low and medium frequency small-signal differential amplifiers requiring matched gate-source voltage, high common-mode rejection ratio, and low output conductance.

- $|V_{GS1} - V_{GS2}| = 10$ mV Max (E410)
- $\frac{\Delta|V_{GS1} - V_{GS2}|}{\Delta T} = 10\ \mu V/°C$ Max (E410)
- CMRR - 70 dB Minimum (E410)
- $g_{oss} = 5\ \mu mho$ Max @ $I_D = 200\ \mu A$



Si 200



PIN	OUT	PIN	OUT
1	S_1	4	S_2
2	D_1	5	D_2
3	G_1	6	G_2

ABSOLUTE MAXIMUM RATINGS (25°C)

Gate-To-Gate Voltage	±40 V
Gate-Drain or Gate-Source Voltage	-40 V
Gate Current	50 mA
Total Package Dissipation (25°C Free-Air)	350 mW
Power Derating (to +125°C)	3.5 mW/°C
Storage Temperature Range	-55 to +125°C
Operating Temperature Range	-55 to +125°C
Lead Temperature (1/16" from case for 10 seconds)	300°C

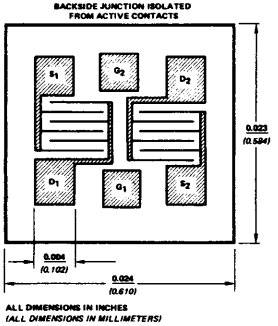
ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		E410 Min	E410 Typ	E410 Max	E411 Min	E411 Typ	E411 Max	E412 Min	E412 Typ	E412 Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current (Note 1)			-250			-250			-250	pA	$V_{DS} = 0$, $V_{GS} = -20$ V	
2	STATIC	$V_{GS(off)}$	Gate-Source Cutoff Voltage	-0.5		-3.5	-0.5		-3.5	-0.5		-3.5	V	$V_{DS} = 20$ V, $I_D = 1$ nA	
3	STATIC	BV_{GSS}	Gate-Source Breakdown Voltage	-40			-40			-40			V	$V_{DS} = 0$, $I_G = -1\ \mu A$	
4	STATIC	I_{DSS}	Saturation Drain Current (Note 2)	0.5		6.0	0.5		6.0	0.5		6.0	mA	$V_{DS} = 20$ V, $V_{GS} = 0$	
5	STATIC	I_G	Gate Current (Note 1)			-250			-250			-250	pA	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	
6	STATIC	V_{GS}	Gate-Source Voltage	-0.3		-4.0	-0.3		-4.0	-0.3		-4.0	V		
7	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	1,000		4,000	1,000		4,000	1,000		4,000	μmho	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 kHz
8	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	600		1,200	600		1,200	600		1,200	μmho	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	f = 1 kHz
9	DYNAMIC	g_{os}	Common-Source Output Conductance			20			20			20	μmho	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 kHz
10	DYNAMIC	g_{os}	Common-Source Output Conductance			5			5			5	μmho	$V_{DS} = 20$ V, $I_D = 200\ \mu A$	f = 1 kHz
11	DYNAMIC	C_{iss}	Common-Source Input Capacitance		4.5			4.5			4.5		pF	$V_{DS} = 20$ V, $V_{GS} = 0$	f = 1 MHz
12	DYNAMIC	C_{rss}	Common-Source Reverse Transfer Capacitance		1.2			1.2			1.2		pF		f = 1 MHz
13	DYNAMIC	$\bar{e}_n$	Equivalent Short-Circuit Input Noise Voltage		50			50			50		$\frac{nV}{\sqrt{Hz}}$	$V_{DS} = 20$ V, $I_D = 200\ \mu A$	f = 100 Hz
14	MATCHING	$\lvert V_{GS1}-V_{GS2}\rvert$	Differential Gate-Source Voltage			10			25			40	mV	$V_{DG} = 20$ V, $I_D = 200\ \mu A$	
15	MATCHING	$\frac{\Delta\lvert V_{GS1}-V_{GS2}\rvert}{\Delta T}$	Gate-Source Differential Drift			10			25			80	μV/°C	$V_{DG} = 20$ V, $I_D = 200\ \mu A$ $T_A = 25°C$ to $T_B = 85°C$	
16	MATCHING	CMRR	Common-Mode Rejection Ratio (Note 3)	70	80			70					dB	$V_{DD} = 10$ V to $V_{DD} = 20$ V $I_D = 200\ \mu A$	

NOTES:

1. Approximately doubles for every 10°C increase in T_A.
2. Pulse test duration = 300 μsec; duty cycle ≤ 3%.
3. $CMRR = 20\log_{10}\left[\frac{\Delta V_{DD}}{\Delta\lvert V_{GS1}-V_{GS2}\rvert}\right]$, $\Delta V_{DD} = 10$ V.

NQP



MONOLITHIC DUAL N-CHANNEL DEPLETION MODE SILICON JUNCTION FIELD-EFFECT TRANSISTOR

APPLICATIONS

- **General Purpose Differential Amplifiers**

PRINCIPAL DEVICES

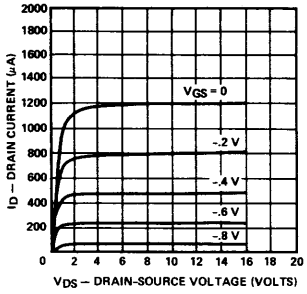
E410-412

PACKAGE TYPES

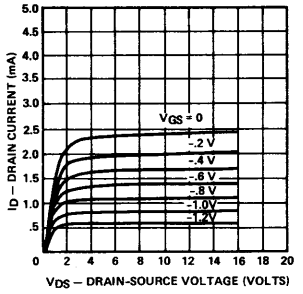
TO-71, SI-200

PERFORMANCE CURVES (25°C unless otherwise noted)

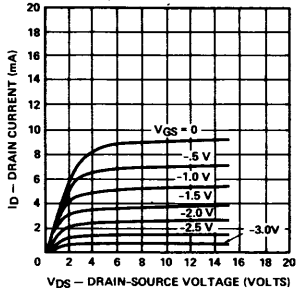
Output Characteristics
Low $V_{gs(off)}$ Unit



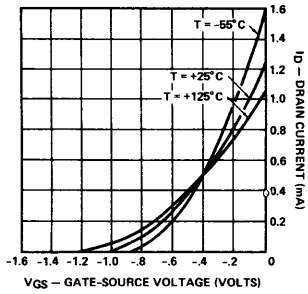
Output Characteristics
Medium $V_{gs(off)}$ Unit



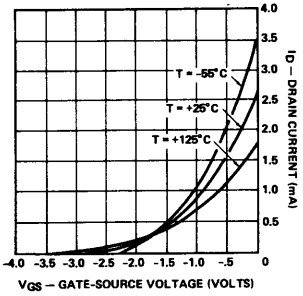
Output Characteristics
High $V_{gs(off)}$ Unit



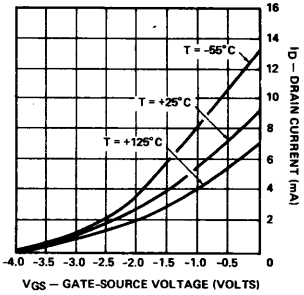
Transfer Characteristics
Low $V_{gs(off)}$



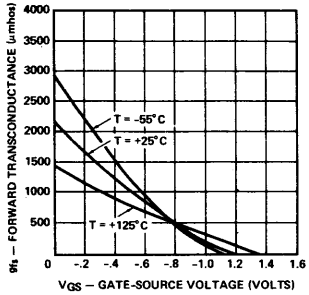
Transfer Characteristics
Medium $V_{gs(off)}$



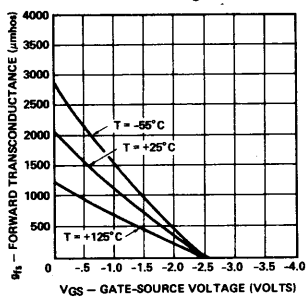
Transfer Characteristics
High $V_{gs(off)}$



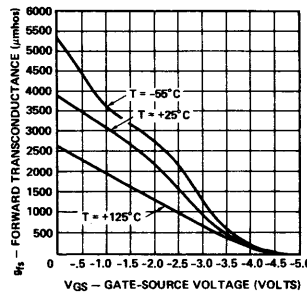
Transconductance Characteristics
Low $V_{gs(off)}$



Transconductance Characteristics
Medium $V_{gs(off)}$

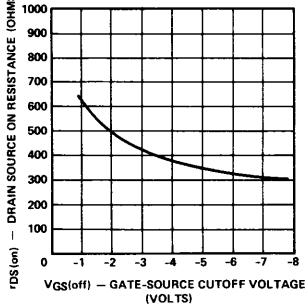


Transconductance Characteristics
High $V_{gs(off)}$

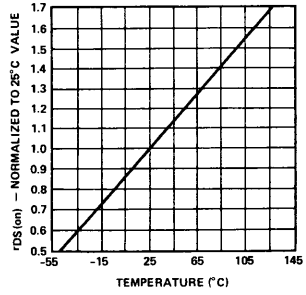


PERFORMANCE CURVES (Cont'd) (25°C unless otherwise noted)

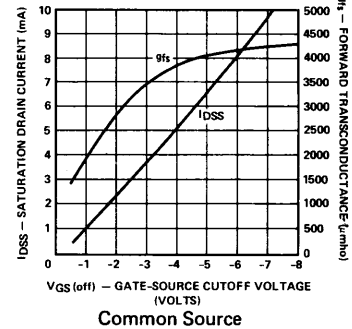
Static Drain Source ON Resistance vs Gate-Source Cutoff Voltage



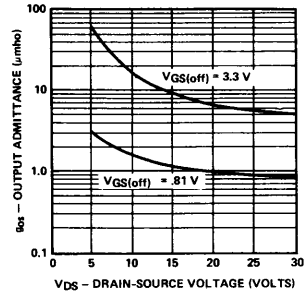
Normalized ON Resistance vs Ambient Temperature



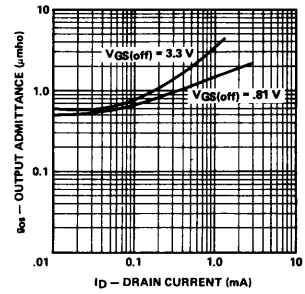
IDSS and gfs vs Gate-Source Cutoff Voltage



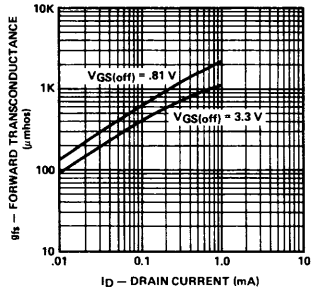
Common Source Output Admittance vs Drain-Source Voltage



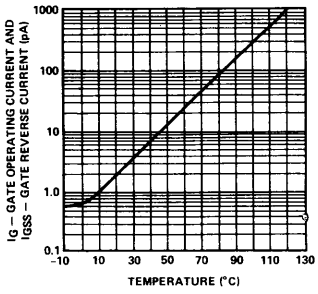
Common Source Output Admittance vs Drain Current



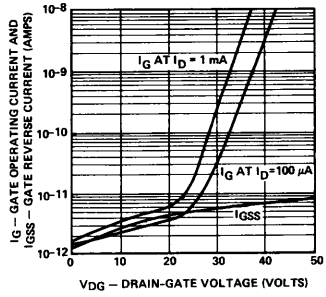
Common Source Forward Transconductance vs Drain Current



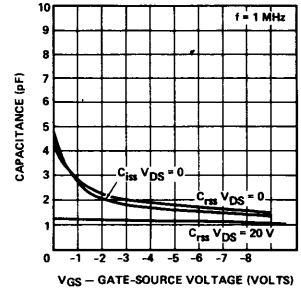
Gate Operating Current vs Ambient Temperature



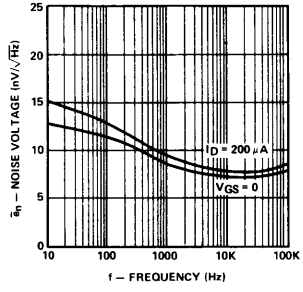
Gate Operating Current vs Drain-Gate Voltage



Capacitance vs Gate-Source Voltage



Equivalent Input Noise Voltage vs Frequency



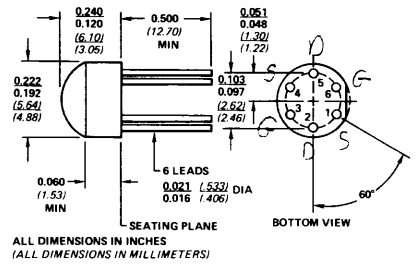
Performance Curves NZF
See Page 4-49

MATCHED DUAL N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

MATCHED DUAL FETS FOR WIDEBAND DIFFERENTIAL AMPLIFIERS

This series of epoxy-encapsulated FETs is characterized for medium and high frequency small and moderate signal amplifiers requiring high transconductance and low input capacitance.

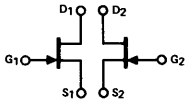
- g_{fs} = > 4500 μmho
- C_{iss} = 3.5 pF Typical
- Matched $|V_{GS1} - V_{GS2}|$ = 10 mV (E420)
- Dual Version of E300



Si 200

ABSOLUTE MAXIMUM RATINGS (25°C)

Gate-To-Gate Voltage	±50 V
Gate-Drain or Gate-Source Voltage	-25 V
Gate Current	50 mA
Total Package Dissipation (25°C Free-Air Temperature)	350 mW
Power Derating (to +125°C)	3.5 mW/°C
Storage Temperature Range	-55 to +125°C
Operating Temperature Range	-55 to +125°C
Lead Temperature (1/16" from case for 10 seconds)	300°C



PIN	OUT
1	S_1
2	D_1
3	G_1
4	S_2
5	D_2
6	G_2

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		E420 Min	E420 Typ	E420 Max	E421 Min	E421 Typ	E421 Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current (Note 1)			-500			-500	pA	V_{DS} = 0, V_{GS} = -15 V	
2	STATIC	$V_{GS(off)}$	Gate-Source Cutoff Voltage	-1		-6	-1		-6	V	V_{DS} = 10 V, I_D = 1 nA	
3	STATIC	BV_{GSS}	Gate-Source Breakdown Voltage	-25			-25				V_{DS} = 0, I_G = -1 μA	
4	STATIC	I_{DSS}	Saturation Drain Current (Note 2)	6		30	6		30	mA	V_{DS} = 10 V, V_{GS} = 0	
5	STATIC	I_G	Gate Current (Note 1)			-500			-500	pA	V_{DG} = 10 V, I_D = 5 mA	
6	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	4,500		9,000	4,500		9,000	μmho	V_{DG} = 10 V, I_D = 5 mA	f = 1 kHz
7	DYNAMIC	g_{os}	Common-Source Output Conductance			200			200	μmho	V_{DG} = 10 V, I_D = 5 mA	f = 1 kHz
8	DYNAMIC	C_{iss}	Common-Source Input Capacitance		3.5			3.5		pF	V_{DG} = 10 V, I_D = 5 mA	f = 1 MHz
9	DYNAMIC	C_{rss}	Common-Source Reverse Transfer Capacitance		0.8			0.8		pF	V_{DG} = 10 V, I_D = 5 mA	f = 1 MHz
10	MAT	$\|V_{GS1}-V_{GS2}\|$	Differential Gate-Source Voltage			10			20	mV	V_{DG} = 10 V, I_D = 5 mA	

NZF

NOTES:
1. Approximately doubles for every 10°C increase in T_A.
2. Pulse test duration = 300 μsec; duty cycle ≤ 3%.

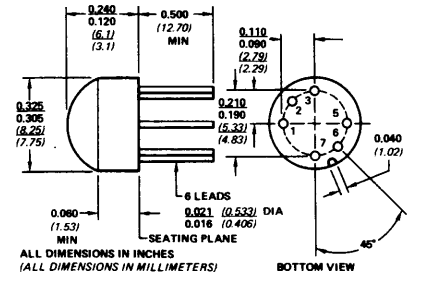
Performance Curves NZT
See Page 4-51

MATCHED DUAL N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

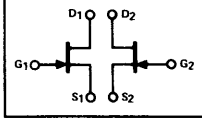
MATCHED DUAL FETS FOR CASCODE AMPLIFIERS AND BALANCED MIXERS

This series of epoxy-encapsulated FETs is similar in performance to two E310s. Applications include cascode amplifiers and balanced mixers.

- **Low noise figure**
- **+30 dBm intercept point**



TO-105



PIN	OUT	PIN	OUT
1	S_1	5	D_2
2	G_1	6	G_2
3	D_1	7	S_2

ABSOLUTE MAXIMUM RATINGS (25°C)

Drain-Gate or Gate-Source Voltage . . . . . -25 V
Gate Current . . . . . 10 mA
Total Device Dissipation
(25°C Free-Air Temperature) . . . . . 350 mW
Power Derating (to +125°C) . . . . . 3.5 mW/°C
Storage Temperature Range . . . . . -55 to +125°C
Operating Temperature Range . . . . . -55 to +125°C
Lead Temperature (1/16" from case for 10 seconds) . . . 300°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		E430 Min	E430 Typ	E430 Max	E431 Min	E431 Typ	E431 Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current			-150			-150	pA	V_{GS} = -15 V, V_{DS} = 0	T = 25°C
2						-150			-150	nA		T = 150°C
3		BV_{GSS}	Gate-Source Breakdown Voltage	-25			-25			V	I_G = -1 μA, V_{DS} = 0	
4		$V_{GS(off)}$	Gate-Source Cutoff Voltage	-1.0		-4.0	-2.0		-6.0		V_{DS} = 10 V, I_D = 1 nA	
5		I_{DSS}	Saturation Drain Current	12		30	24		60	mA	V_{DS} = 10 V, V_{GS} = 0	
6		$V_{GS(f)}$	Gate-Source Forward Voltage			1.0			1.0	V	V_{DS} = 0, I_G = 10 mA	
7	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	10		20	10		20	mmho	V_{DS} = 10 V, I_D = 10 mA	f = 1 kHz
8		g_{os}	Common-Source Output Conductance			150			150	μmho		
9		C_{gs}	Gate Source Capacitance			5.0			5.0	pF	V_{GS} = -10 V, V_{DS} = 0	f = 1 MHz
10		C_{gd}	Drain Gate Capacitance			2.5			2.5			
11		$\bar{e}_n$	Equivalent Short-Circuit Input Noise Voltage		10			10		$\frac{nV}{\sqrt{Hz}}$	V_{DS} = 10 V, I_D = 10 mA	f = 100 Hz
12	HIGH FREQ	g_{fs}	Common-Source Forward Transconductance		10			10		mmho	V_{DS} = 10 V, I_D = 10 mA	f = 100 MHz
13		g_{oss}	Common-Source Output Conductance		0.2			0.2				
14		g_{igs}	Power-Match Source Admittance		12			12				
15		G_c	Conversion Gain (See Note 1)		3.0			3.0		dB	V_{DS} = 20 V, V_{GS} = 1/2 V_p	f = 100 MHz
16		IMD	Intercept Point (See Notes 1 & 2)		+30			+30		dBm		
17	MATCH	$\frac{I_{DSS1}}{I_{DSS2}}$	Drain Current Ratio at Zero Gate Voltage (Note 3)	0.9		1.0	0.9		1.0		V_{DS} = 10 V	V_{GS} = 0
18		$\frac{V_{GS(off)1}}{V_{GS(off)2}}$	Gate-Source Cutoff Voltage Ratio (Note 3)	0.9		1.0	0.9		1.0			I_D = 1 nA
19		$\frac{g_{fs1}}{g_{fs2}}$	Transconductance Ratio (Note 3)	0.9		1.0	0.9		1.0			I_D = 10 mA

NOTES:
1. VHF single-balanced mixer drain load impedance 2K Ω.
2. 2-tone 3rd-order IMD.
3. The lower value is side 1.

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