MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF961
MRF962
MRF965
(See BFR96)

MRF966
MRFC966

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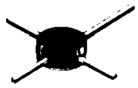
The RF Line

N-Channel Dual-Gate GaAs Field-Effect Transistor

. . . depletion mode dual-gate MES FET designed for high frequency amplifier and mixer applications.

- Excellent Receiver Front End
- Low Noise Figure — NF = 1.2 dB, 1 GHz (Typ)
- High Power Gain — G_p = 17 dB, 1 GHz (Typ)
- Low Reverse Transfer Capacitance — C_{rss} = 40 fF (Typ)
- High Transconductance — g_m = 20 mS (Typ)
- Fully Characterized
- Gold Metallization

N-CHANNEL DUAL-GATE GaAs FIELD-EFFECT TRANSISTOR



MRF966
CASE 317-01, STYLE 1

CHIP
MRFC966

MAXIMUM RATINGS

Rating	Symbol	MRFC966	MRF966	Unit
Drain-Source Voltage	V_{DS}	10	10	Vdc
Gate-Source Voltage — Reverse	V_{G1S} V_{G2S}	8 - 8	8 8	Vdc
Gate-Source Voltage — Forward	V_{G1S} V_{G2S}	+1 +1	+1 +1	Vdc
Drain Current — Continuous	I_D	80	80	mAdc
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	350 T_J = 125°C Max	350 3.5	mW mW/°C
Storage Channel Temperature Range	T_{stg}	-65 to +125	-65 to +125	°C
Junction Temperature Range	T_J	-65 to +125	-65 to +125	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (V_{G1S} = V_{G2S} = 4.5 Vdc, I_D = 100 μA)	$V_{(BR)DSX}$	10	—	—	Vdc
Gate 1-to-Source Cutoff Voltage (V_{DS} = 5 Vdc, V_{G2S} = 0, I_D = 500 μA)	$V_{G1S(off)}$	-2	—	4.5	Vdc
Gate 2-to-Source Cutoff Voltage (V_{DS} = 5 Vdc, V_{G1S} = 0, I_D = 500 μA)	$V_{G2S(off)}$	2	—	4.5	Vdc
Gate 1 Leakage Current (V_{G1S} = -5 Vdc, V_{G2S} = V_{DS} = 0)	I_{G1SS}	—	—	10	μAdc
Gate 2 Leakage Current (V_{G2S} = -5 Vdc, V_{G1S} = V_{DS} = 0)	I_{G2SS}	—	—	10	μAdc
ON CHARACTERISTICS					
Zero-Gate Voltage Drain Current (V_{DS} = 5 Vdc, V_{G1S} = V_{G2S} = 0)	I_{DSS}	30	50	80	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Transconductance (V_{DS} = 5 Vdc, V_{G2S} = 0, I_D = 10 mA, f = 1 kHz)	g_m	18	20	—	mS
Input Capacitance (V_{DS} = 5 Vdc, V_{G2S} = 0, I_D = 10 mA, f = 1 MHz)	C_{iss}	—	1.5	—	pF
Reverse Transfer Capacitance (V_{DS} = 5 Vdc, V_{G2S} = 0, I_D = 10 mA, f = 1 MHz)	C_{rss}	—	0.04	—	pF

Handling and Packaging — MES devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MES devices should be observed.

(continued)

ELECTRICAL CHARACTERISTICS — continued (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL CHARACTERISTICS					
Noise Figure(1) (V_{DS} = 5 Vdc, V_{G2S} = 0, I_{DS} = 10 mA, f = 1 GHz)	NF	—	1.2	1.5	dB
Common Source Power Gain(1) (V_{DS} = 5 Vdc, V_{G2S} = 0, I_{DS} = 10 mA, f = 1 GHz)	G_{ps}	15	17	—	dB
Intermodulation Distortion (V_{DS} = 5 Vdc, I_{DS} = 10 mA, f_1 = 995 MHz, f_2 = 1001 MHz, V_{G2} = 0, P_{in} = −40 dBm)	IMD_3	—	−65	—	dB
Linear Power Point(2) (V_{DS} = 5 Vdc, I_{DS} = 10 mA, f_1 = 995 MHz, f_2 = 1001 MHz, V_{G2} = 0)	P_L	—	+1	—	dBm
Output Power at 1 dB Compression Point (V_{DS} = 5 Vdc, I_{DS} = 10 mA, f = 1 GHz)	P_{out}	—	10	—	dBm

NOTES:
1. Data taken using a 50 Ω test fixture, Microlab SF31N slug tuners, HP11590B bias networks and the HP8970A or Eaton 2075 noise figure meter. Note: V_{G2S} = 0. Refer to Figure 11.
2. The linear power point is the output power level at which either the signal $2f_1 - f_2$ or $2f_2 - f_1$ are 30 dB below f_1 or f_2

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TYPICAL CHARACTERISTICS

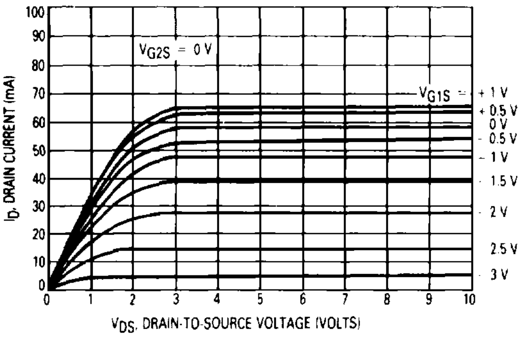


Figure 1. Drain Current versus Drain-To-Source Voltage

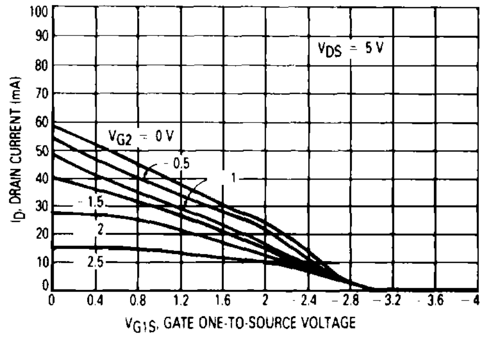


Figure 2. Drain Current versus Gate One-To-Source Voltage

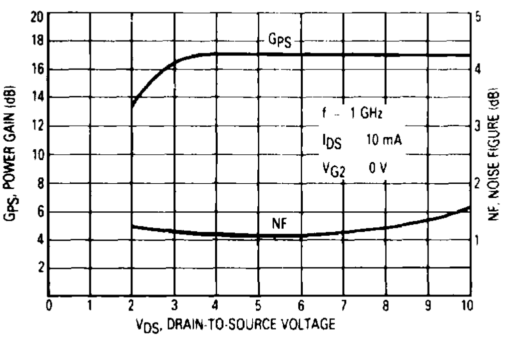


Figure 3. Power Gain and Noise Figure versus Drain-To-Source Voltage

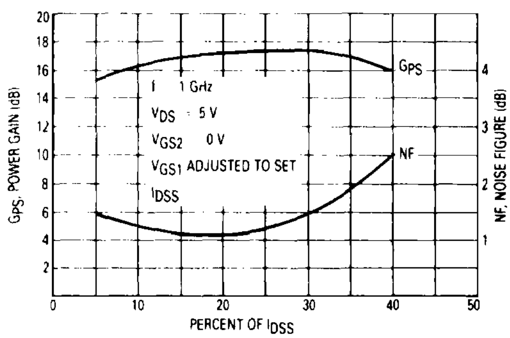


Figure 4. Power Gain and Noise Figure versus Percent of I_{DSS}

TYPICAL CHARACTERISTICS

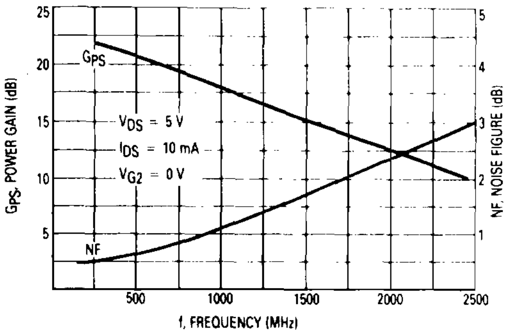


Figure 5. Power Gain and Noise Figure versus Frequency

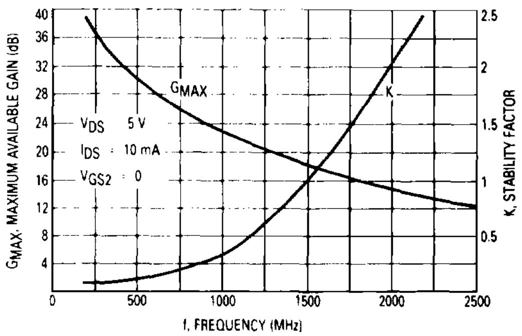


Figure 6. Maximum Available Gain and Stability Factor versus Frequency

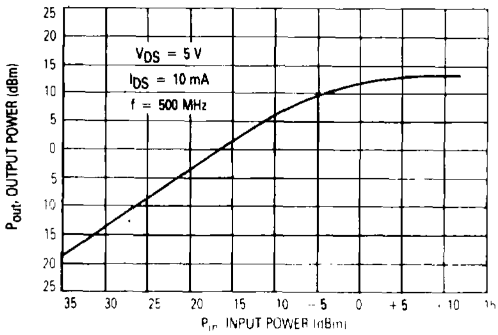


Figure 7. Output Power versus Input Power @ 500 MHz

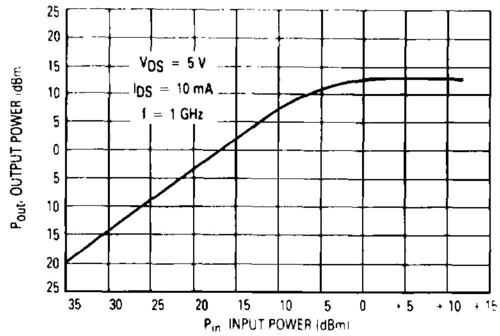


Figure 8. Output Power versus Input Power @ 1 GHz

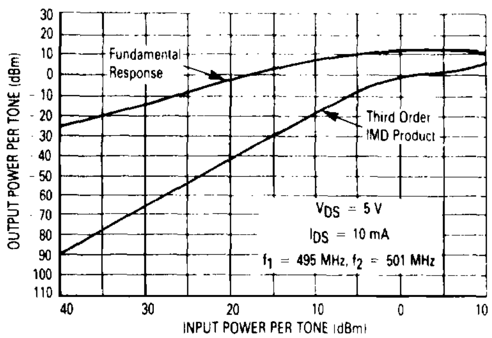


Figure 9. Third Order Intermodulation Distortion @ 500 MHz

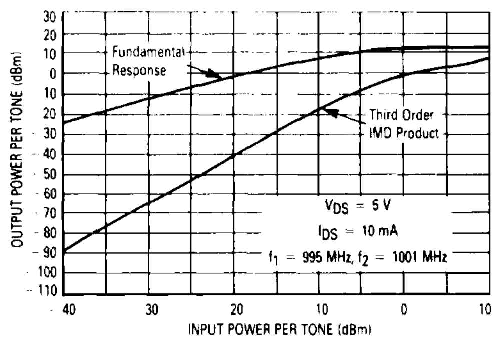


Figure 10. Third Order Intermodulation Distortion @ 1 GHz

COMMON SOURCE S-PARAMETERS

V_{DS} (Volts)	I_{DS} (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
3	5	200	0.997	-5.7	1.251	172.1	0.003	88.3	0.944	-6.4
		500	0.983	-14.3	1.23	161.2	0.007	84.6	0.931	-16
		1000	0.941	28.3	1.201	142.4	0.013	78.5	0.9	-32.2
		1500	0.866	42.3	1.133	122	0.016	70.4	0.836	-49.6
		2000	0.762	-55.4	1.011	101.1	0.018	56.2	0.744	-67.5
		2500	0.642	66.4	0.819	77.4	0.015	25.5	0.608	87.5
	10	200	0.995	6.2	1.60	172.0	0.002	84.1	0.93	-6.3
		500	0.981	15.1	1.58	161.3	0.007	82.5	0.92	15.8
		1000	0.928	29.9	1.55	142.9	0.013	81.5	0.90	-31.8
		1500	0.838	-44.4	1.46	122.3	0.016	74.7	0.84	49.4
		2000	0.716	-57.7	1.31	101.2	0.018	60.1	0.76	-68.4
		2500	0.584	-67.5	1.06	77.4	0.015	26.7	0.63	-89.8
	15	200	0.996	6.3	1.83	172.0	0.002	76.4	0.93	6.3
		500	0.979	-15.7	1.80	161.2	0.006	91.5	0.92	15.6
		1000	0.921	-30.9	1.76	142.3	0.012	82.3	0.90	31.6
		1500	0.820	45.9	1.66	121.7	0.016	76.1	0.85	-49.1
		2000	0.689	58.7	1.48	100.6	0.016	64.1	0.77	68.2
		2500	0.552	67.4	1.20	76.7	0.013	28.9	0.65	90.3
	20	200	0.995	6.5	1.97	171.9	0.003	85.7	0.92	-6.2
		500	0.977	-16.2	1.93	160.7	0.007	89.0	0.91	15.3
		1000	0.910	32.0	1.89	141.7	0.011	84.0	0.89	-31.0
		1500	0.804	47.1	1.79	120.9	0.016	78.3	0.85	-48.4
		2000	0.669	-59.7	1.59	99.6	0.017	66.2	0.78	67.4
		2500	0.531	-67.7	1.29	75.8	0.012	32.7	0.66	-89.2
5	5	200	0.997	-5.8	1.27	172.8	0.002	102.6	0.97	-3.8
		500	0.983	-14.3	1.26	162.6	0.004	82.3	0.97	-9.4
		1000	0.939	-28.4	1.24	146.0	0.006	93.4	0.96	-18.8
		1500	0.866	-42.6	1.21	128.4	0.008	102.6	0.95	28.3
		2000	0.765	-5.3	1.14	111.6	0.007	137.7	0.93	-37.6
		2500	0.642	-68.4	1.05	93.1	0.012	179.0	0.92	-47.0
	10	200	0.966	-6.0	1.61	172.8	0.002	88.1	0.97	-3.8
		500	0.982	-15.1	1.59	162.8	0.004	85.8	0.97	9.4
		1000	0.928	-29.9	1.57	146.1	0.006	94.6	0.96	-18.6
		1500	0.841	44.6	1.53	128.7	0.006	110.4	0.94	28.0
		2000	0.724	58.3	1.42	111.6	0.008	152.6	0.93	37.0
		2500	0.589	-69.4	1.30	93.3	0.014	179.1	0.92	-46.3
	15	200	0.997	6.2	1.82	172.6	0.001	103.2	0.97	3.7
		500	0.979	15.6	1.80	162.5	0.003	85.3	0.96	9.3
		1000	0.920	30.8	1.77	145.6	0.005	92.4	0.95	18.4
		1500	0.824	45.8	1.72	127.9	0.007	116.3	0.94	27.3
		2000	0.699	-59.2	1.59	110.8	0.008	154.1	0.93	-36.3
		2500	0.560	-69.6	1.44	92.6	0.017	176.2	0.92	45.4
	20	200	0.995	-6.5	1.96	172.4	0.002	85.9	0.97	-3.7
		500	0.977	-16.1	1.93	162.1	0.004	80.9	0.96	-9.1
		1000	0.913	31.7	1.90	144.9	0.005	92.1	0.95	-17.9
		1500	0.810	-47.0	1.83	126.9	0.007	121.4	0.94	-26.9
		2000	0.679	60.4	1.69	109.7	0.009	153.4	0.93	35.6
		2500	0.538	-70.0	1.53	91.4	0.017	176.0	0.93	44.6

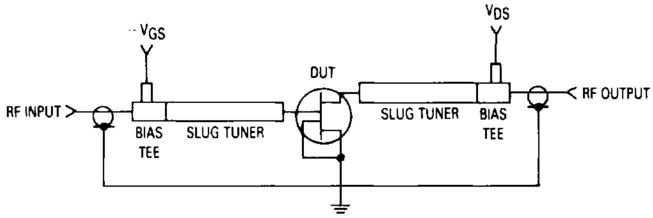
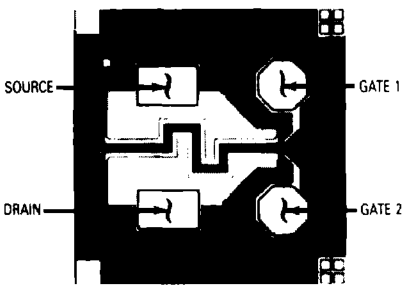


Figure 11. 1 GHz Test Circuit Schematic

TYPICAL CHARACTERISTICS

f (MHz)	G_{NF} (dB)	NF (dB)	Γ_{MS} NF_{opt}	Γ_{ML} NF_{opt}
450	20	0.6	0.82 ∠21°	0.80 ∠11°
1000	17	1.2	0.74 ∠21°	0.77 ∠12°

Figure 12. Source and Load Impedance for Optimum Noise Figure



MRFC966 Chip Topography

Nominal Chip Size: 0.017" x 0.020" x 0.005"
Drain/Source Bond Pad: 0.003" x 0.004"
Gate 1/Gate 2 Bond Pad: 0.0035" x 0.0035"