- Dual-Gate FETs

NEC®

HIGH PERFORMANCE DUAL-GATE GaAs MESFET

NE25000

FEATURES

- **VERY HIGH f_{MAX}:** 60 GHz
- **TWO INDEPENDENT GATES FOR DESIGN FLEXIBILITY**
- **USES RECESSED GATE TECHNOLOGY**
- **ALL GOLD BONDING PADS**
- **SILICON NITRIDE PASSIVATION FOR LONG-TERM STABILITY**
- **HIGH GAIN**
- **LOW NOISE FIGURE**

DESCRIPTION AND APPLICATIONS

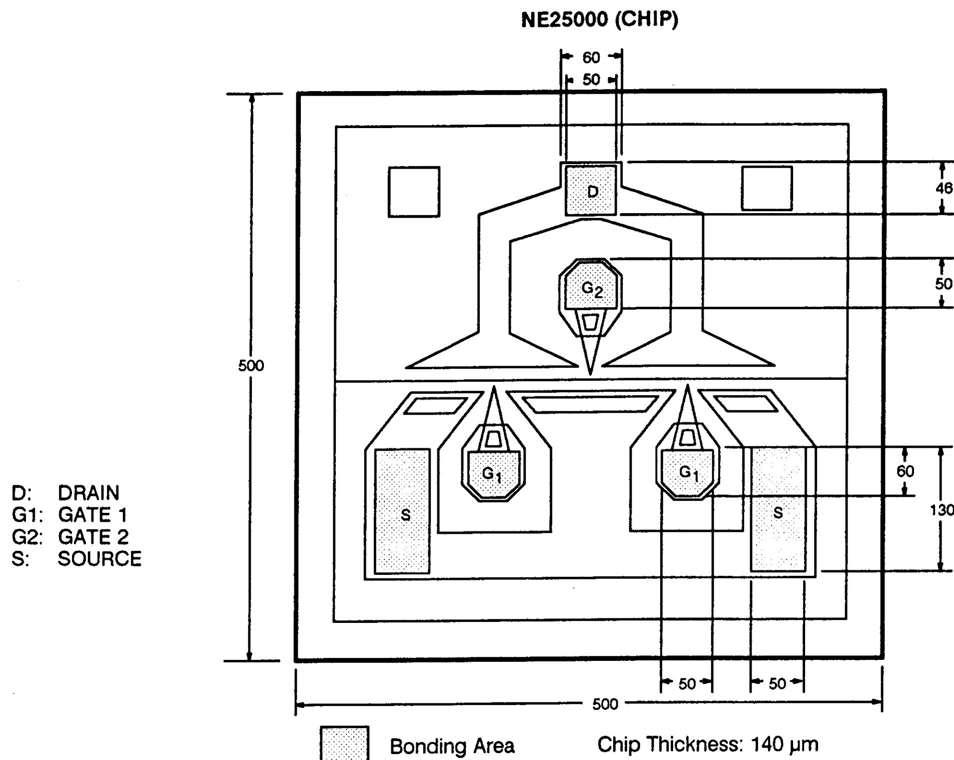
The NE250 is a Dual-Gate GaAs MESFET with a .5 µm gate length. The device is designed for automatic gain control and fast switching. Applications include amplifiers with switching capability for signal routing, mixers and other complex signal processing applications.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	8
$V_{G1S, 2S}$	Gate to Source Voltage	V	-6
I_D	Drain Current	mA	100
P_T*	Total Power Dissipation	mW	300
$T_{C(OP)}$	Operating Case Temperature	°C	125
T_{STG}	Storage Temperature	°C	-65 to +175
I_{G1}, I_{G2}	Gate Current	mA	1

*P_T for chip mounted on an Alumina heatsink (size 3x3x0.6 mm)

CHIP DIMENSIONS (Units in µm)



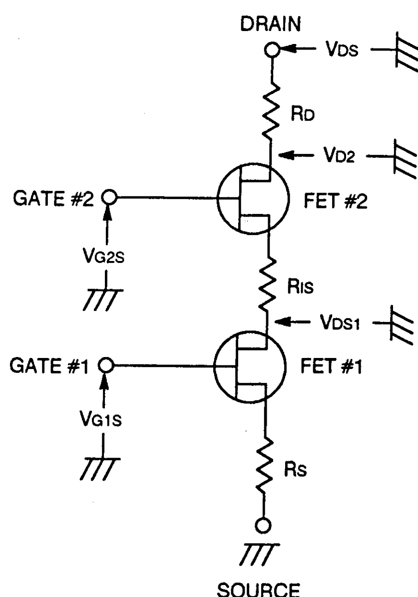
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER			NE25000		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
I_{DSX}	Drain to Source Leakage Current at V_{DS} = 4 V, V_{G1S} = -5 V, V_{G2S} = 0	μA			100
I_{G1SO}	Gate 1 to Source Leakage Current at V_{G1S} = -5 V	μA		1	10
I_{G2SO}	Gate 2 to Source Leakage Current at V_{G2S} = -5 V	μA		0.2	10
I_{DSS}	Drain Current at V_{DS} = 4 V, V_{G2S} = 0	mA	20	50	100
V_{G1S} (off)	Gate 1 to Source Cutoff Voltage at V_{DS} = 4 V, I_{DS} = 100 μA, V_{G2S} = 0	V	-3.5	-1.6	-0.5
V_{G2S} (off)	Gate 2 to Source Cutoff Voltage at V_{DS} = 4 V, I_{DS} = 100 μA, V_{G1S} = 0	V	-3.5	-1.6	-0.5
g_m	Transconductance at V_{DS} = 4 V, I_{DS} = 10 mA, V_{G2S} = 0	mS	25	35	
NF	Noise Figure at V_{DS} = 4 V, I_{DS} = 10 mA	dB		2.7	3.5
G_A	Associated Gain at V_{G2S} = 0, f = 12 GHz	dB	12	15	
AGC	AGC Range at f = 12 GHz, V_{G2S} = -3.5 V to 1.0 V, I_{DS} = 10 mA at V_{G2S} = 0	dB		35	

RECOMMENDED OPERATING CONDITIONS (T_A = 25°C)

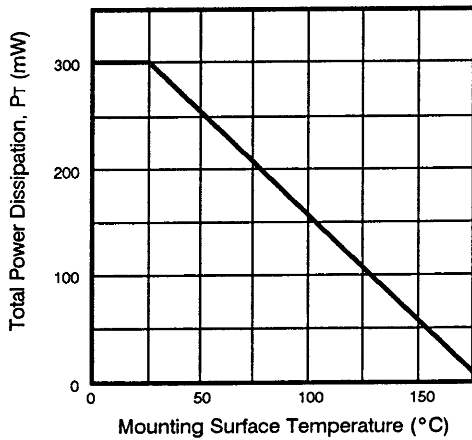
PART NUMBER			NE25000		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
V_{DS}	Drain to Source Voltage	V	3	4	5
I_D	Drain Current	mA	5	10	20
$T_{C(OP)}$	Operating Case Temperature	°C	-55		+110

DEVICE CONFIGURATION

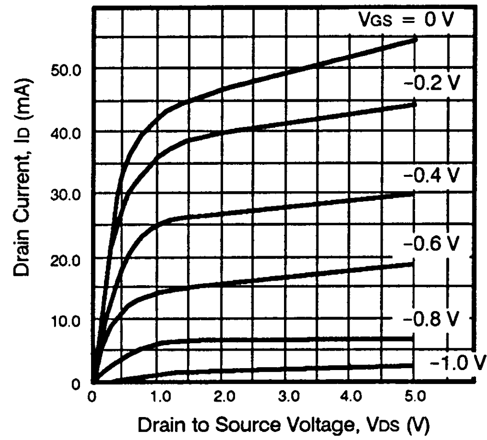


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

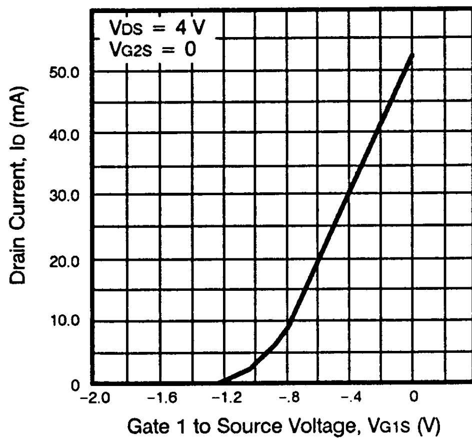
TOTAL POWER DISSIPATION vs. MOUNTING SURFACE TEMPERATURE



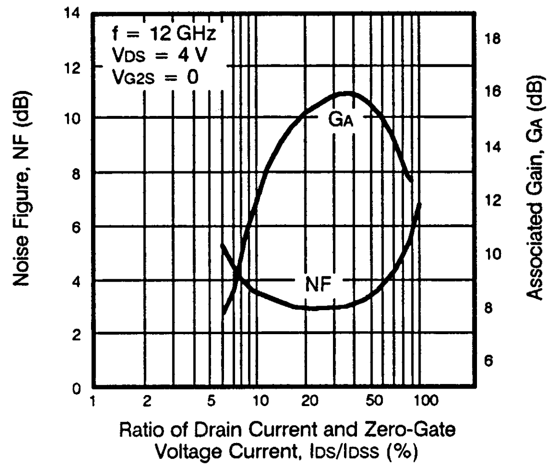
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



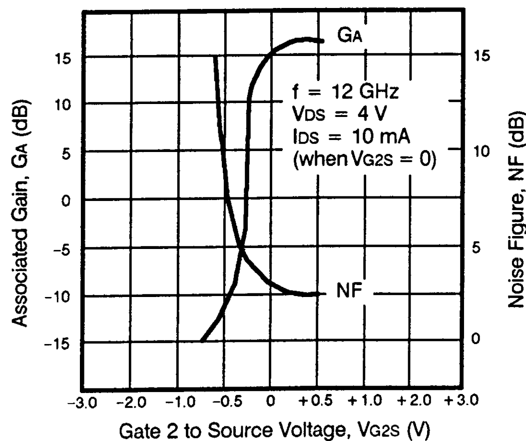
DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



NOISE FIGURE, ASSOCIATED GAIN vs. RATIO OF DRAIN CURRENT AND ZERO-GATE VOLTAGE CURRENT



NOISE FIGURE, ASSOCIATED GAIN vs. GATE 2 TO SOURCE VOLTAGE



S-PARAMETERS

Complete S-Parameter data for the NE25000 is too voluminous for inclusion in this data sheet. S-Parameter data can be readily obtained by calling CEL headquarters (408) 988-3500, or your local sales office.

HANDLING PRECAUTIONS

DIE ATTACHMENT

Die attach operations can be accomplished with Au-Ge preforms (at 380°C within 10 seconds) in a forming gas environment. Epoxy die attachment is not recommended.

BONDING

Bonding wires should be minimum length, half hard gold wire (3 to 8% elongation) 20 microns in diameter. Bonding should be performed with a wedge tip that has a taper of approximately 15°. Bonding time should be kept to a minimum. As a general rule, the bonding operation should be kept within 290°C - 2 minutes. If longer periods are required, the temperature should be lowered.

PRECAUTIONS

The user must operate in a clean, dry environment. The chip channel is glassivated for mechanical protection only and does not preclude the necessity of a clean environment. The bonding equipment should be periodically checked for sources of surge voltage and should be properly grounded at all times. In fact, all test and handling equipment should be grounded to minimize the possibilities of static discharge.

NEC®

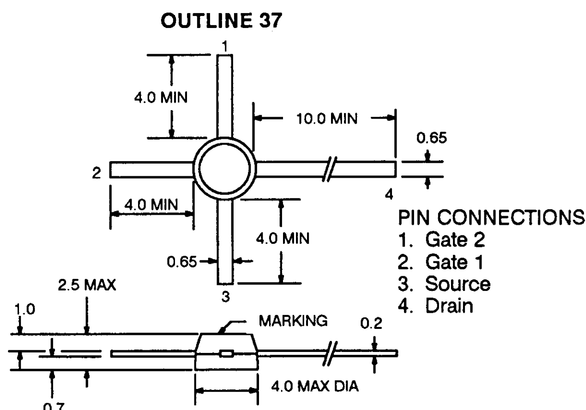
GENERAL PURPOSE DUAL-GATE GaAs MESFET

NE25137 NE25139

FEATURES

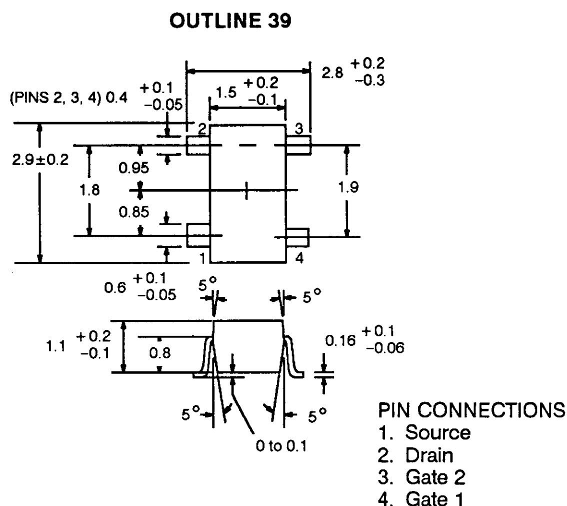
- SUITABLE FOR USE AS RF AMPLIFIER IN UHF TUNER
- LOW CRSS: 0.02 pF (TYP)
- HIGH GPS: 20 dB (TYP) AT 900 MHz
- LOW NF: 1.1 dB TYP AT 900 MHz
- GATE WIDTH: WG = 400 MICRONS
- ION IMPLANTATION
- AVAILABLE IN TAPE & REEL OR BULK

OUTLINE DIMENSIONS (Units in mm)



DESCRIPTION AND APPLICATIONS

The NE251 is a dual gate GaAs FET designed to provide flexibility in its application as a mixer, AGC amplifier, or low noise amplifier. As an example, by shorting the second gate to the source, higher gain can be realized than with single gate MESFETs. This device is available in disk-mold and mini-mold (surface mount).



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DSX}	Drain to Source Voltage	V	13
V_{G1S}	Gate 1 to Source Voltage	V	-4.5
V_{G2S}	Gate 2 to Source Voltage	V	-4.5
I_D	Drain Current	mA	40
P_T	Total Power Dissipation	mW	200
T_{CH}	Channel Temperature	°C	125
T_{STG}	Storage Temperature	°C	-55 to +125

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

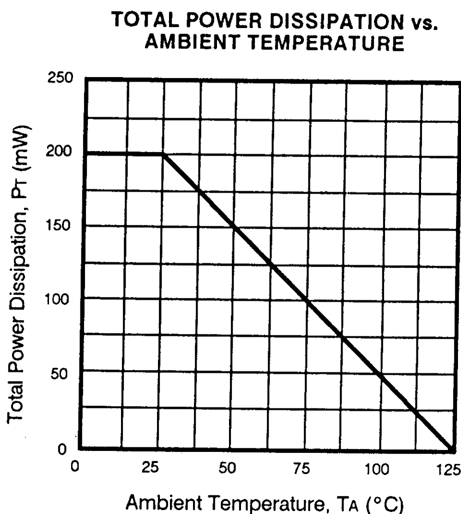
PART NUMBERS PACKAGE OUTLINE			NE25137, NE25139 37, 39		
SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
BV_{DSX}	Drain to Source Breakdown Voltage at V_{G1S} = −4 V, V_{G2S} = 0, I_D = 10 μA	V	13		
I_{DSS}	Drain Current at V_{DS} = 5 V, V_{G2S} = 0 V, V_{G1S} = 0 V	mA	5	20	40
$V_{G1S\,(OFF)}$	Gate 1 to Source Cutoff Voltage at V_{DS} = 5 V, V_{G2S} = 0 V, I_D = 100 μA	V	-3.5		
$V_{G2S\,(OFF)}$	Gate 2 to Source Cutoff Voltage at V_{DS} = 5 V, V_{G1S} = 0 V, I_D = 100 μA	V	-3.5		
I_{G1SS}	Gate 1 Reverse Current at V_{DS} = 0, V_{G1S} = −4 V, V_{G2S} = 0	μA			10
I_{G2SS}	Gate 2 Reverse Current at V_{DS} = 0, V_{G2S} = −4 V, V_{G1S} = 0	μA			10
$\lvert Y_{FS} \rvert$	Forward Transfer Admittance at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 1.0 kHz	mS	18	25	35
C_{ISS}	Input Capacitance at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 1 MHz	pF	0.5	1.0	1.5
C_{RSS}	Reverse Transfer Capacitance at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 1 MHz	pF		0.02	0.03
G_{PS}	Power Gain at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 900 MHz	dB	16	20	
NF	Noise Figure at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 900 MHz	dB		1.1	2.5

IDSS CLASSIFICATION (Units in mA)

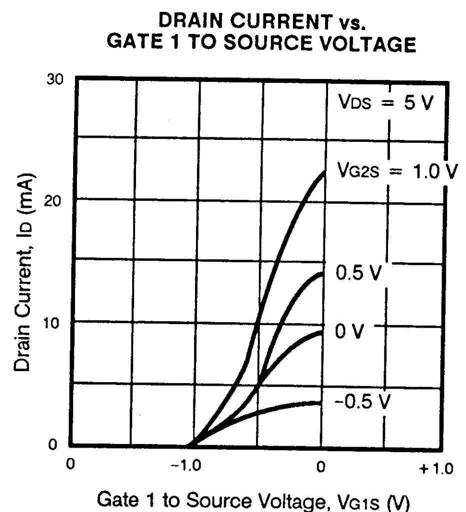
I_{DSS}	5 TO 15	10 TO 25	20 TO 35	30 TO 40
NE25137 Marking	N	M	L	K
NE25139 Marking	U71	U72	U73	U74

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

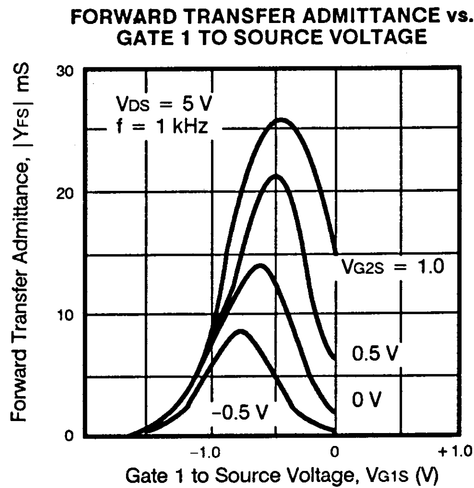
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE

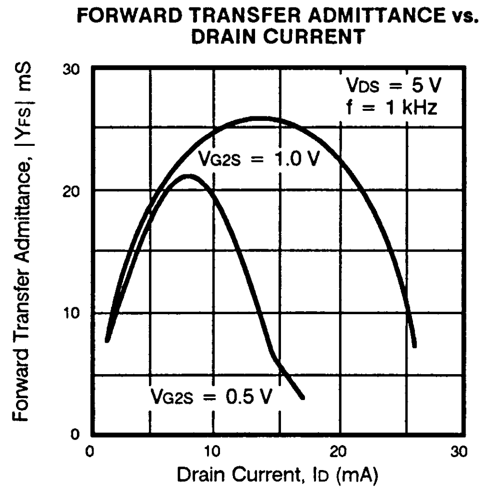


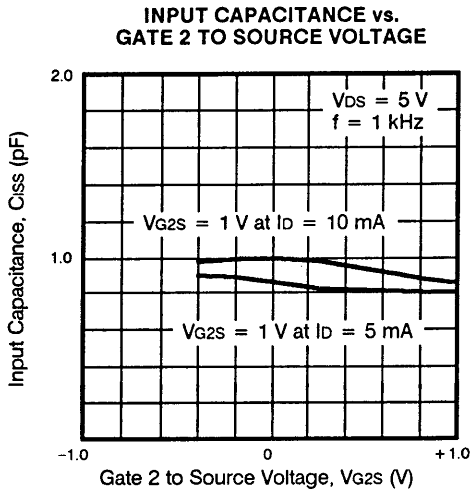
DRAIN CURRENT vs. GATE 1 TO SOURCE VOLTAGE

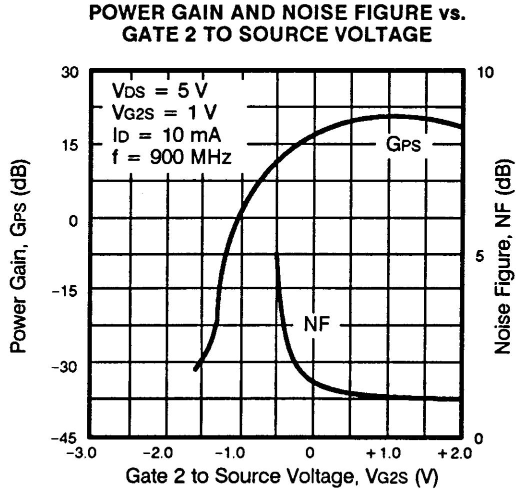


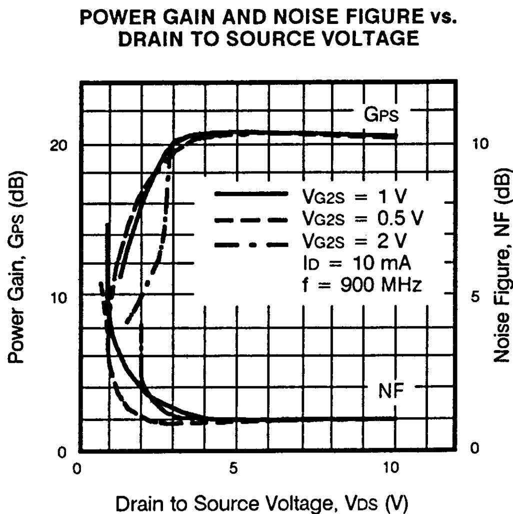
TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

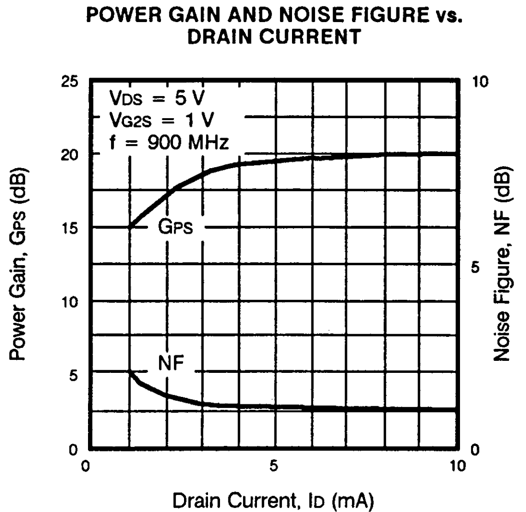




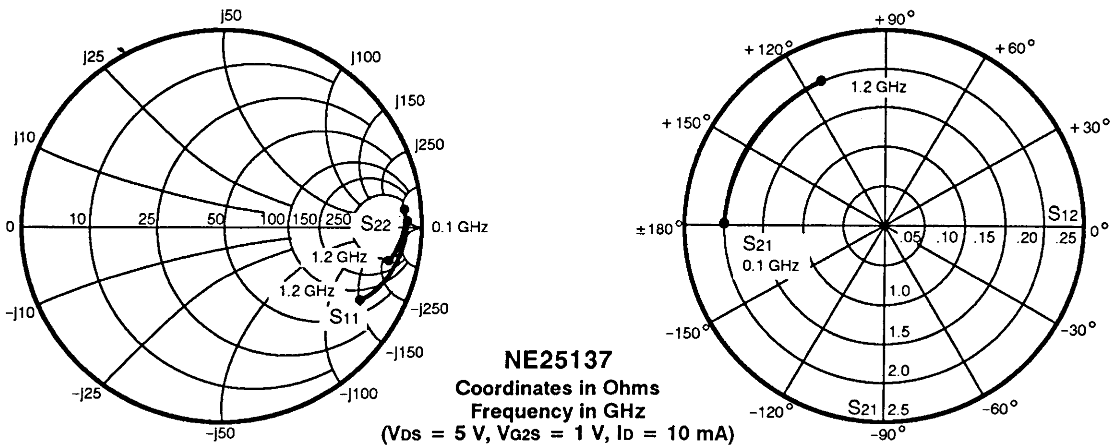








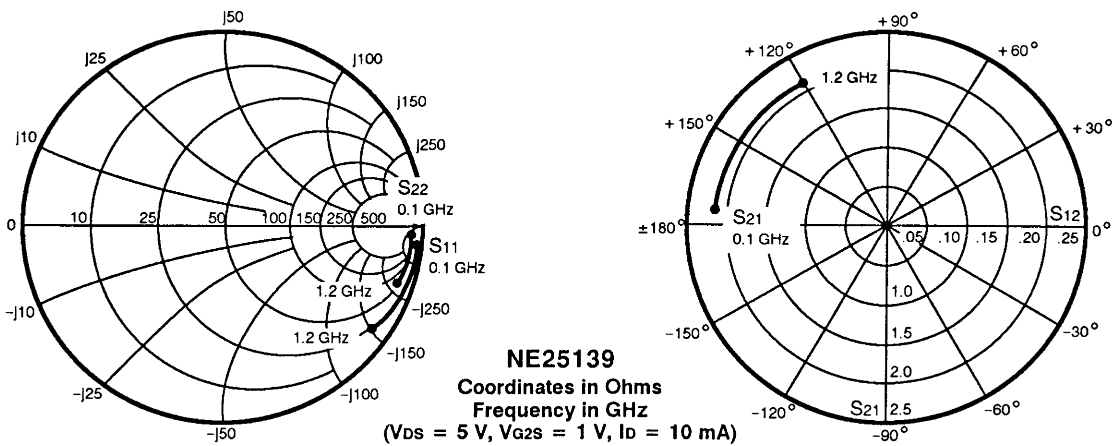
TYPICAL SCATTERING PARAMETERS



NE25137
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA)

S-MAGN AND ANGLES:
VDS = 5 V, VG2S = 1 V, ID = 10 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
100	.99	-3	2.10	177	.001	87	.97	-2
200	.99	-6	2.14	170	.001	86	.98	-4
300	.99	-9	2.09	163	.001	86	.98	-4
400	.98	-13	2.07	158	.002	85	.97	-6
500	.97	-15	2.12	157	.002	85	.98	-6
600	.95	-19	2.12	148	.003	84	.96	-9
700	.96	-20	2.07	144	.003	82	.98	-8
800	.93	-25	2.08	138	.004	81	.95	-11
900	.93	-26	2.16	136	.004	81	.98	-11
1000	.88	-30	2.12	126	.005	80	.95	-15
1100	.90	-31	2.15	123	.005	80	.98	-14
1200	.85	-35	2.19	116	.005	79	.95	-18

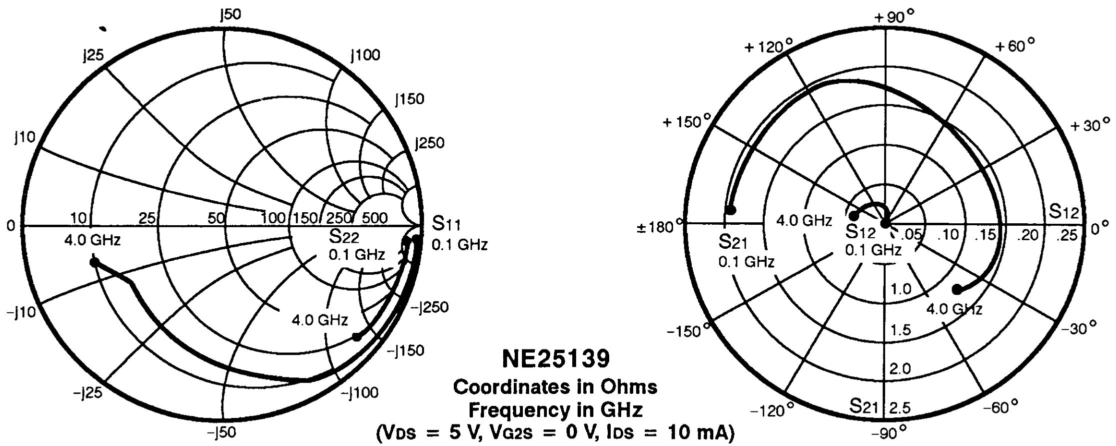


NE25139
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA)

S-MAGN AND ANGLES:
VDS = 5 V, VG2S = 1 V, ID = 10 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
100	.99	-3	2.36	177	.001	87	.97	-1
200	.99	-7	2.39	169	.001	85	.98	-3
300	.99	-9	2.31	164	.002	82	.98	-3
400	.98	-13	2.23	160	.002	82	.97	-6
500	.97	-16	2.42	158	.003	81	.99	-6
600	.97	-19	2.30	150	.003	81	.96	-8
700	.96	-22	2.33	146	.004	80	.99	-9
800	.95	-25	2.23	142	.005	79	.96	-9
900	.94	-29	2.45	137	.005	79	.99	-13
1000	.92	-29	2.30	131	.006	78	.97	-11
1100	.91	-35	2.35	126	.006	78	.98	-15
1200	.88	-35	2.37	124	.006	78	.99	-13

TYPICAL SCATTERING PARAMETERS



NE25139
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 5 V, V_{G2S} = 0 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:
VDS = 5 V, VG2S = 0 V, IDS = 10 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		k	Gma dB
100	1.0	-4	1.96	174	0.001	87	0.96	-1	-0.03	29.0
200	1.0	-8	1.92	169	0.001	85	0.96	-2	0.15	31.2
400	0.99	-15	1.91	158	0.001	82	0.95	-3	1.30	27.3
600	0.97	-23	1.90	148	0.002	81	0.94	-3	1.75	22.3
900	0.94	-35	1.90	132	0.004	80	0.94	-4	2.18	18.2
1000	0.92	-39	1.90	126	0.004	79	0.94	-5	2.35	17.2
1500	0.82	-61	1.88	99	0.006	78	0.94	-6	3.22	14.8
2000	0.69	-86	1.52	71	0.008	95	0.95	-9	2.97	14.6
2500	0.60	-110	1.41	45	0.012	118	0.96	-12	1.41	17.0
3000	0.51	-131	1.39	19	0.023	153	0.97	-18	0.43	17.8
3500	0.51	-147	1.37	-6	0.039	162	0.97	-27	0.08	15.45
4000	0.63	-167	1.20	-47	0.042	157	0.96	-42	0.01	14.56

NE25139 TYPICAL NOISE PARAMETERS

(V_{DS} = 5 V, V_{G2S} = 0 V, I_{DS} = 10 mA)

FREQ. (GHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} (MAG)	Γ_{OPT} (ANG)	Rn/50
0.5	0.9	18.5	0.9	18	1.9
0.9	1.2	16.0	0.82	28	1.2
1.5	1.5	14.6	0.71	45	0.9
2.0	1.9	12.5	0.55	75	0.67
3.0	2.5	11.0	0.34	116	0.5
4.0	3.3	9.5	0.25	154	0.4

NEC®

GENERAL PURPOSE DUAL-GATE GaAs MESFET

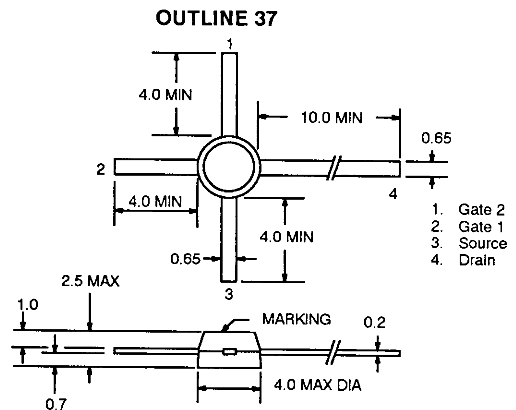
NE25337 NE25339

FEATURES

- SUITABLE FOR USE AS RF AMPLIFIER AND MIXER IN UHF APPLICATIONS
- LOW C_{RSS}: 0.02 pF (TYP)
- HIGH G_{PS}: 20 dB (TYP)
- LOW NF : 1.1 dB (TYP)
- GATE WIDTH: W_G = 800 Microns
- ION IMPLANTATION
- AVAILABLE IN TAPE & REEL OR BULK

OUTLINE DIMENSIONS (Units in mm)

OUTLINE 37



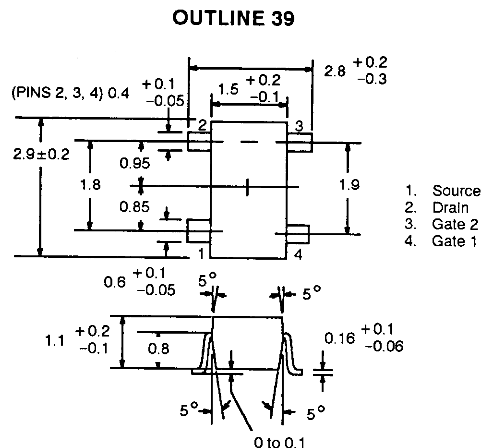
DESCRIPTION AND APPLICATIONS

The NE253 is an 800 μm dual gate GaAs FET designed to provide flexibility in its application as a mixer, AGC amplifier, or low noise amplifier. As an example, by shorting the second gate to the source, higher gain can be realized than with single gate MESFETs. This device is available in disk mold and minimold (surface mount).

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DSX}	Drain to Source Voltage	V	10
V_{G1S}	Gate 1 to Source Voltage	V	-4.5
V_{G2S}	Gate 2 to Source Voltage	V	-4.5
I_D	Drain Current	mA	80
P_T	Total Power Dissipation	mW	200
T_{CH}	Channel Temperature	°C	125
T_{STG}	Storage Temperature	°C	-55 to +125

OUTLINE 39



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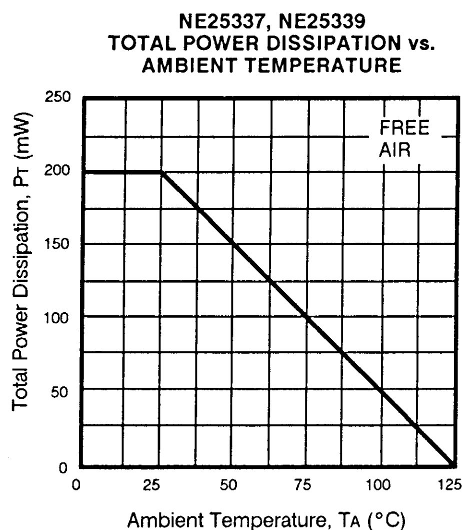
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

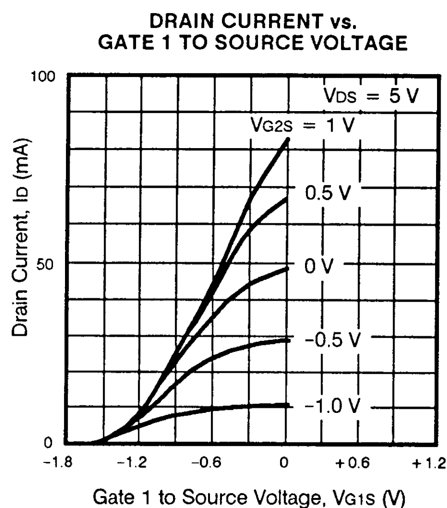
PART NUMBER PACKAGE OUTLINE			NE25337, NE25339 37, 39		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
BV_{DSX}	Drain to Source Breakdown Voltage at V_{G1S} = −4 V, V_{G2S} = 0, I_{DS} = 20 μA	V	10		
I_{DSS}	Drain Current at V_{DS} = 5 V, V_{G2S} = 0 V, V_{G1S} = 0 V	mA	10	40	80
$V_{G1S\,(off)}$	Gate 1 to Source Cutoff Voltage at V_{DS} = 5 V, V_{G2S} = 0 V, I_{DS} = 100 μA	V			-3.5
$V_{G2S\,(off)}$	Gate 2 to Source Cutoff Voltage at V_{DS} = 5 V, V_{G1S} = 0 V, I_{DS} = 100 μA	V			-3.5
I_{G1SS}	Gate 1 Reverse Current at V_{DS} = 0, V_{G1S} = −4 V, V_{G2S} = 0	μA			10
I_{G2SS}	Gate 2 Reverse Current at V_{DS} = 0, V_{G2S} = −4 V, V_{G1S} = 0	μA			10
$\|Y_{FS}\|$	Forward Transfer Admittance at V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA, f = 1.0 kHz	mS	25	35	
C_{ISS}	Input Capacitance at V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA, f = 1 MHz	pF	1.0	1.5	2.0
C_{RSS}	Reverse Transfer Capacitance at V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA, f = 1 MHz	pF		0.02	0.035
G_{PS}	Power Gain at V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA, f = 900 MHz	dB	16	20	
NF	Noise Figure at V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA, f = 900 MHz	dB		1.1	2.5

IDSS CLASSIFICATION (Units in mA)

IDSS	10 TO 25	20 TO 35	30 TO 50	45 TO 80
NE25337 Marking	N	M	L	K
NE25339 Marking	U76	U77	U78	U79

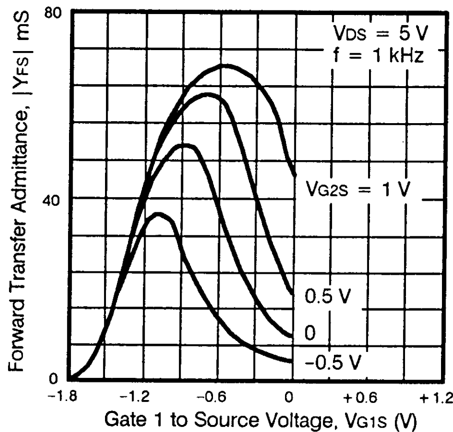
TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)



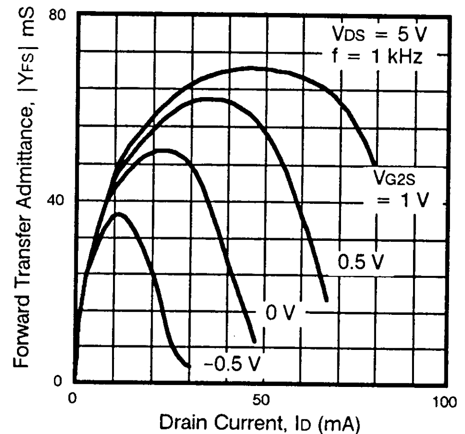


TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

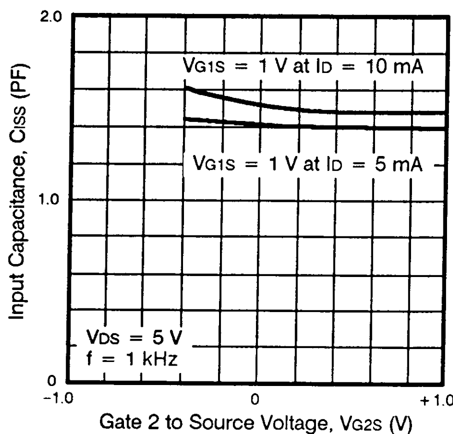
FORWARD TRANSFER ADMITTANCE vs. GATE 1 TO SOURCE VOLTAGE



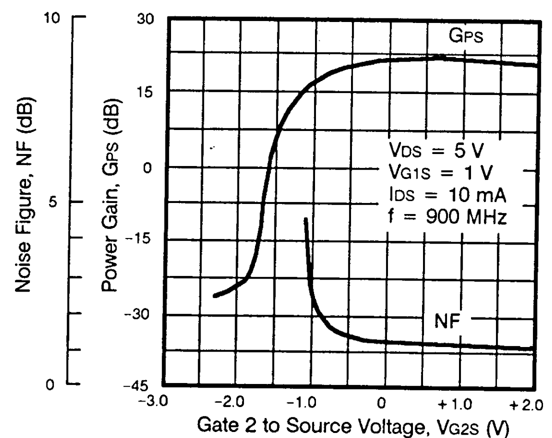
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



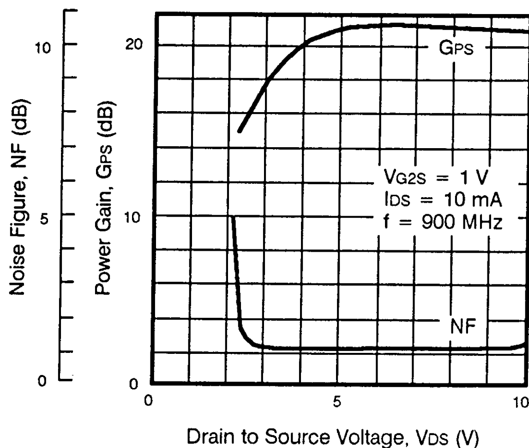
INPUT CAPACITANCE vs. GATE 2 TO SOURCE VOLTAGE



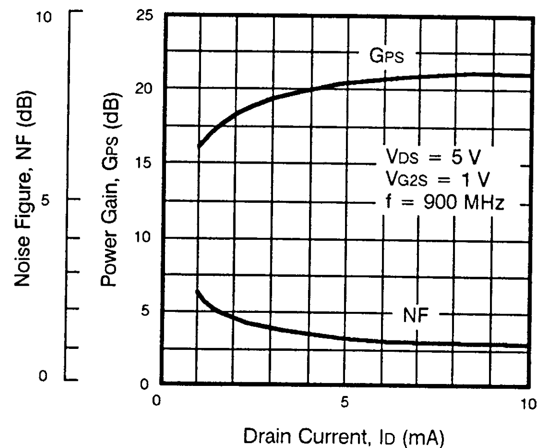
POWER GAIN AND NOISE FIGURE vs. GATE 2 TO SOURCE VOLTAGE



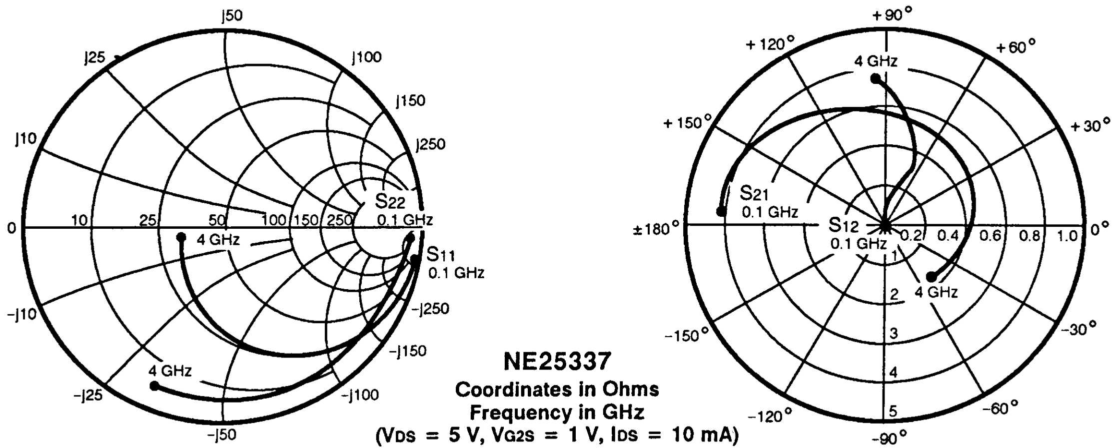
POWER GAIN AND NOISE FIGURE vs. DRAIN TO SOURCE VOLTAGE



POWER GAIN AND NOISE FIGURE vs. DRAIN CURRENT



TYPICAL SMALL SIGNAL COMMON SOURCE SCATTERING PARAMETERS



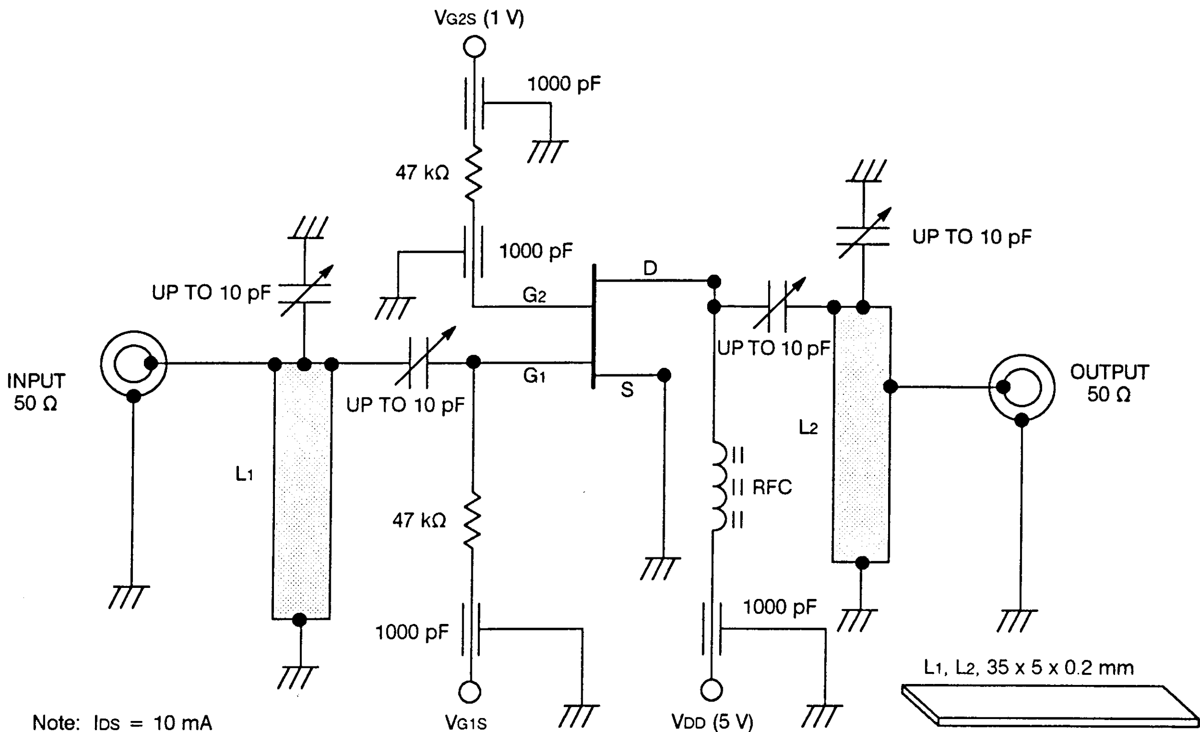
NE25337
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:
V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		k	MAG (dB)
100	1.00	-6	4.23	174	.001	98	.95	-2	-.12	35.5
200	.99	-12	4.15	165	.002	97	.95	-5	.02	33.6
400	.98	-23	4.08	149	.004	95	.94	11	.06	30.1
600	.92	-34	3.84	136	.006	93	.92	-15	.45	28.1
800	.86	-47	3.57	121	.012	91	.90	-19	.50	24.9
1000	.80	-57	3.36	111	.019	85	.89	-23	.58	22.6
1200	.72	-65	3.20	100	.022	79	.86	-27	.89	21.5
1400	.66	-76	3.05	89	.024	76	.87	-30	.99	21.0
1600	.60	-86	2.97	78	.028	72	.86	-35	1.01	19.6
1800	.53	-95	2.82	68	.028	74	.86	-39	1.18	17.5
2000	.45	-102	2.65	56	.032	72	.86	-43		
2500	.33	-123	2.38	32	.039	78	.88	-55		
3000	.24	-144	2.21	7	.049	82	.91	-69		
3500	.20	-159	2.09	-21	.059	88	.95	-89		
4000	.22	-168	1.96	-50	.078	93	.94	-115		

TEST CIRCUIT DIAGRAM

900 MHz GPS AND NF TEST CIRCUIT



NE25337 TYPICAL NOISE PARAMETERS

FREQ. (GHz)	NF_{MIN} (dB)	G_A (dB)	Γ_{OPT} (MAG)	(ANG)	Rn/50
0.5	.65	23.5	0.80	15	0.49
0.9	.79	19.5	0.63	40	0.40
1.0	.81	19.2	0.61	46	0.38
2.0	1.25	14.8	0.39	95	0.28
3.0	2.10	11.9	0.29	150	0.20
4.0	3.20	9.9	0.25	170	0.18

(V_{DS} = 5 V, V_{G2S} = 1 V, I_{DS} = 10 mA)

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