NEC

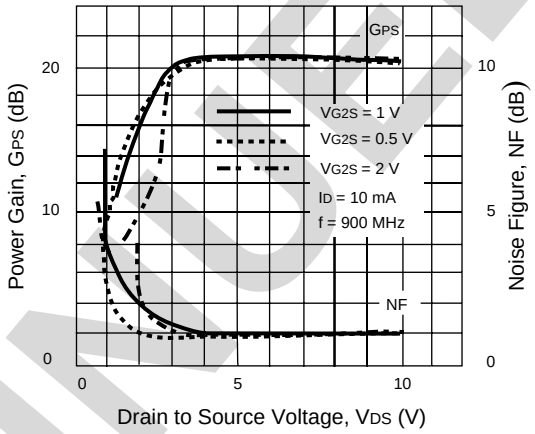
GENERAL PURPOSE DUAL-GATE GaAS MESFET

NE25139

FEATURES

- **SUITABLE FOR USE AS RF AMPLIFIER IN UHF TUNER**
- **LOW C_{RSS}:** 0.02 pF (TYP)
- **HIGH GPS:** 20 dB (TYP) AT 900 MHz
- **LOW NF:** 1.1 dB TYP AT 900 MHz
- **L_{G1} = 1.0 μm, L_{G2} = 1.5 μm, W_G = 400 μm**
- **ION IMPLANTATION**
- **AVAILABLE IN TAPE & REEL OR BULK**

POWER GAIN AND NOISE FIGURE vs. DRAIN TO SOURCE VOLTAGE



DESCRIPTION

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 a mini-mold (surface mount) package.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE25139 39		
SYMBOL	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**
NF	Noise Figure at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 900 MHz	dB		1.1	2.5
G_{PS}	Power Gain at V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA, f = 900 MHz	dB	16	20	
BV_{DSX}	Drain to Source Breakdown Voltage at V_{G1S} = -4 V, V_{G2S} = 0, I_D = 10 μA	V	13		
I_{DSS}	Saturated 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} = -4V, V_{G2S} = 0	μA			10
I_{G2SS}	Gate 2 Reverse Current at V_{DS} = 0, V_{G2S} = -4V, V_{G1S} = 0	μA			10
$\|Y_{FS}\|$	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

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	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	I_{DSS}
P_T	Total Power Dissipation	mW	200
T_{CH}	Channel Temperature	°C	125
T_{STG}	Storage Temperature	°C	-55 to +125

Note:
1. Operation in excess of anyone of these parameters may result in permanent damage.

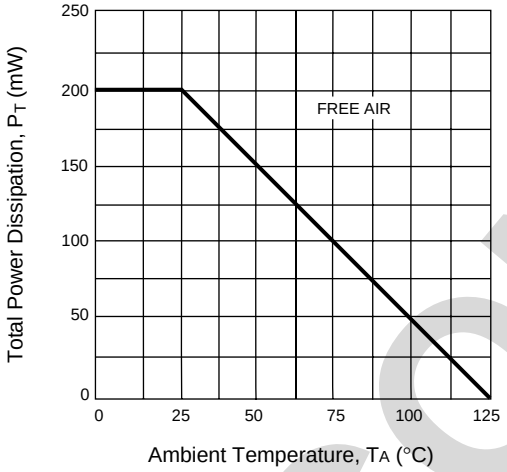
TYPICAL NOISE PARAMETERS (T_A = 25°C)

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

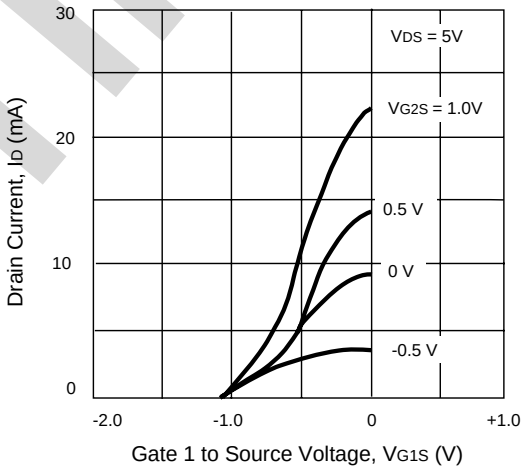
FREQ. (GHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
0.5	0.9	18.5	0.9	18	1.9
0.9	1.2	16.0	0.82	28	1.2
1.5	1.5	14.6	0.71	45	0.9
2.0	1.9	12.5	0.55	75	0.67
3.0	2.5	11.0	0.34	116	0.5
4.0	3.3	9.5	0.25	154	0.4

TYPICAL PERFORMANCE CURVES (T_A = 25 °C)

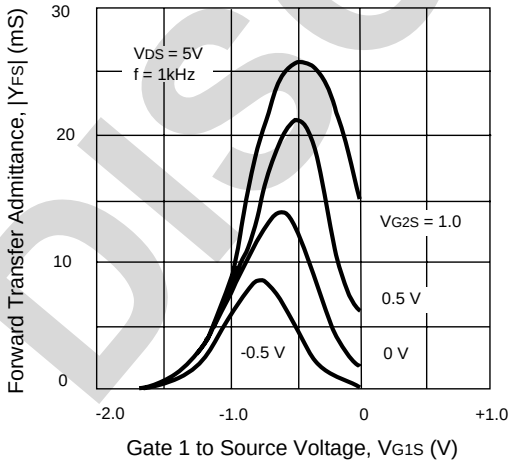
TOTAL POWER DISSIPATION VS. AMBIENT TEMPERATURE



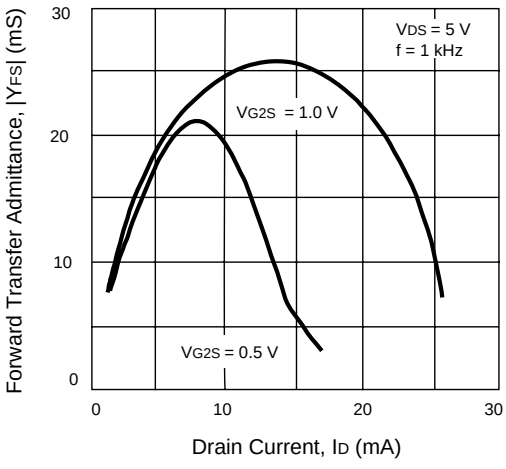
DRAIN CURRENT vs. GATE 1 TO SOURCE VOLTAGE



FORWARD TRANSFER ADMITTANCE vs. GATE 1 TO SOURCE VOLTAGE

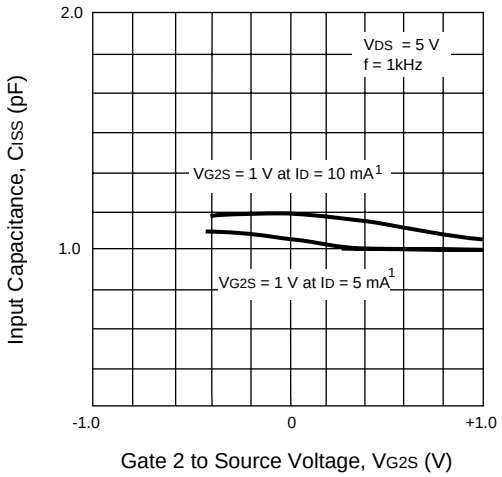


FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



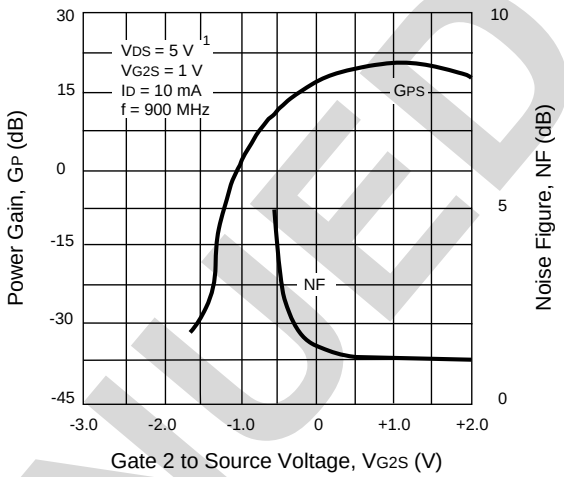
TYPICAL PERFORMANCE CURVES (T_A = 25°C)

INPUT CAPACITANCE vs. GATE 2 TO SOURCE VOLTAGE



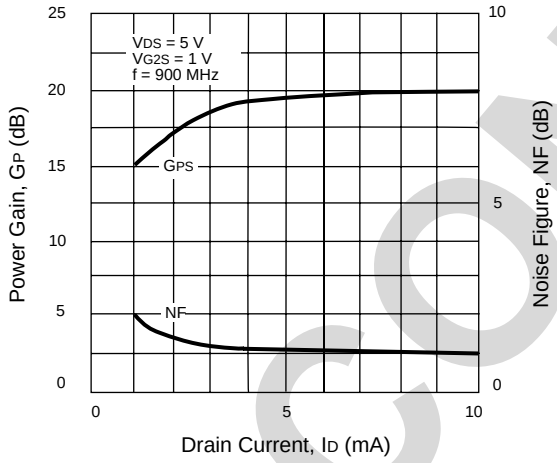
Note:
1. Initial bias conditions. V_{G1S} set to obtain specified drain current.

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



Note:
1. Initial bias conditions. V_{G1S} set to obtain specified drain current.

POWER GAIN AND NOISE FIGURE vs. DRAIN CURRENT



NONLINEAR MODEL

UNITS FOR MODEL PARAMETERS

Parameter	Units
time	seconds
capacitance	farads
inductance	henries
resistance	ohms
voltage	volts
current	amps

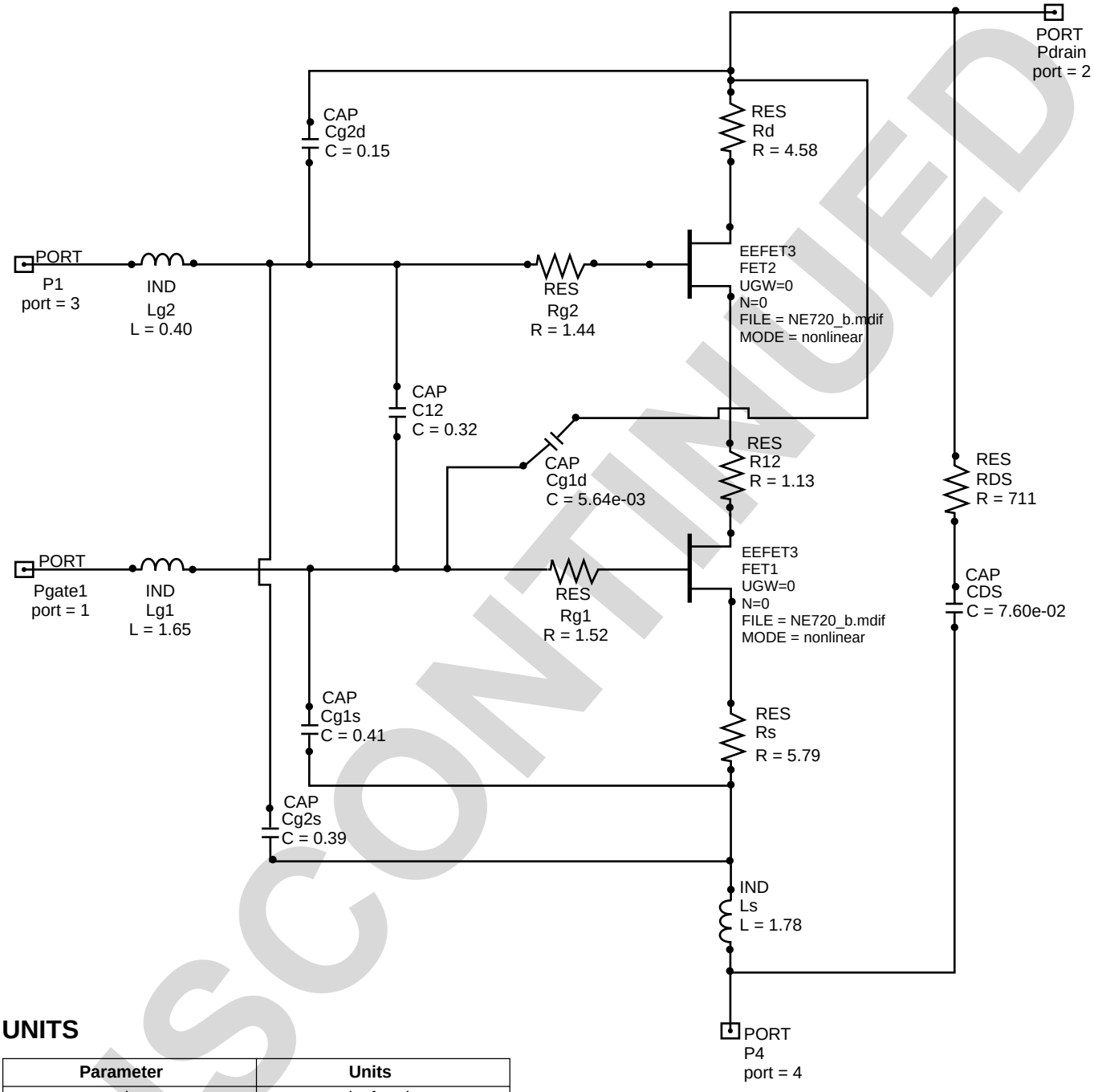
FET NONLINEAR MODEL PARAMETERS(1)

Parameters	FET1	FET2	Parameters	FET1	FET2
UGW	100e-6	100e-6	IDSOC	0.07	0.07
NGF	4	4	RDB	1.0e9	1.0e9
IS	8.78e-10	8.78e-10	CBS	0.16e-12	0.16e-12
N	1.33	1.33	GDBM	0.005	0.005
RG	0	0	KDB	11.1	11.1
RD	0	0	VDSM	7.1e-11	7.1e-11
RS	0	0	GMMAXAC	0.0475	0.0875
RIS	0	0	GAMMAAC	0.0107	0.0051
RID	0	0	KAPAAC	0.0001	0.0052
TAU	5.17e-12	5.17e-12	PEFFAC	44.9	44.9
CDSO	1.19e-13	1.19e-13	VTOAC	-1.584	-1.545
C11O	6.1e-13	6.1e-13	VTSOAC	-100	-100
C11TH	1.6e-13	1.6e-13	VDELTAC	0.062	0.062
VINFL	-1.1	-1.1	GMMAX	0.0554	0.0304
DELTGS	1.82	1.82	GAMMA	0.006	0.005
DELTDS	0.682	0.682	KAPA	0.046	0.0005
LAMBDA	\0.036	0.036	PEFF	1.636	1.636
C11DELT	0	0	VTO	-1.57	-1.5
C12O	0	0	VTSO	-100	-10
C12SAT	6.81e-14	6.81e-14	VDELT	0.135	0.1
CGDSAT	6.81e-14	6.81e-14	VCH	1	1
KBK	0.03	0.03	VSAT	1.119	1.119
VBR	6.5	6.5	VGO	-0.654	-0.0035
NBR	2	2	VDSO	3	10

(1) Libra EEFET3 Model

NONLINEAR MODEL

SCHEMATIC



UNITS

Parameter	Units
capacitance	picofarads
inductance	nanohenries
resistance	ohms

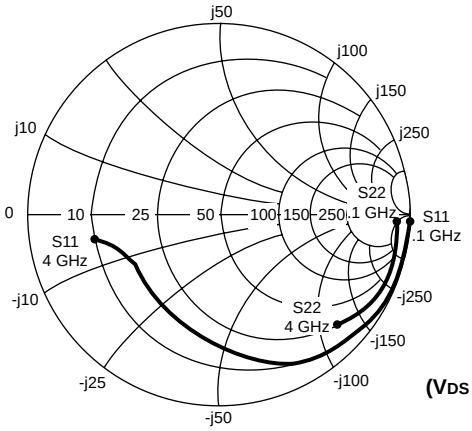
NOTES:
1. This UGW value scales the model parameters on page 1.
2. This N value is the number of gate fingers and scales the model parameters on page 1.

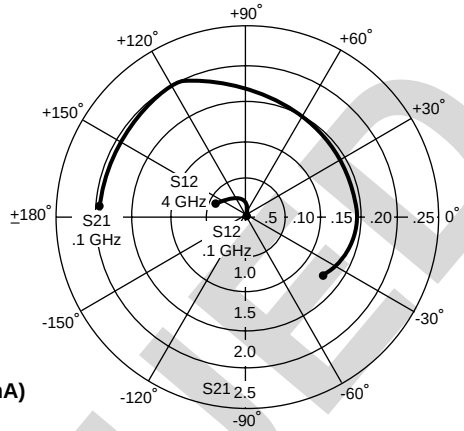
MODEL RANGE

Frequency: 0.1 to 4 GHz

Bias: V_{DS} = 5 V, V_{g1S}= -0.785 V, V_{g2S}= 0 V, I_D = 10 mA

TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)





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

NE25139
V_{DS} = 5 V, V_{G2S} = 0 V, I_{DS} = 10 mA

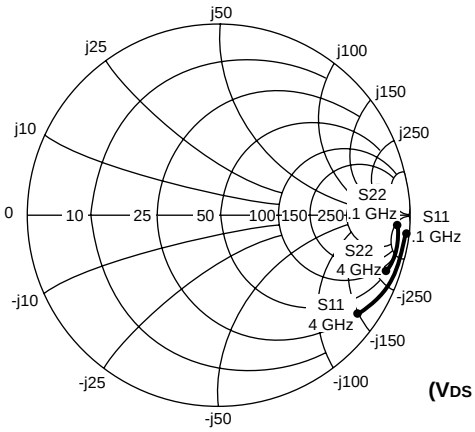
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	S_{21}	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)	(dB)
0.1	1.0	-4	1.96	174	0.001	87	0.96	-1	0.47	5.8	32.9
0.2	1.0	-8	1.92	169	0.001	85	0.96	-2	0.51	5.7	32.8
0.4	0.99	-15	1.91	158	0.001	82	0.95	-3	0.70	5.6	32.8
0.6	0.97	-23	1.90	148	0.002	81	0.94	-3	1.14	5.6	27.5
0.9	0.94	-35	1.90	132	0.004	80	0.94	-4	1.18	5.6	24.2
1.0	0.92	-39	1.90	126	0.004	79	0.94	-5	1.49	5.6	22.6
1.5	0.82	-61	1.88	99	0.006	78	0.94	-6	2.03	5.5	19.2
2.0	0.69	-86	1.52	71	0.008	95	0.95	-9	2.21	3.6	16.6
2.5	0.60	-110	1.41	45	0.012	118	0.96	-12	1.34	3.0	17.2
3.0	0.51	-131	1.39	19	0.023	153	0.97	-18	0.32	2.9	17.8
3.5	0.51	-147	1.37	-6	0.039	162	0.97	-27	0.04	2.1	15.1
4.0	0.63	-167	1.20	-47	0.042	157	0.96	-42	0.07	1.6	14.6

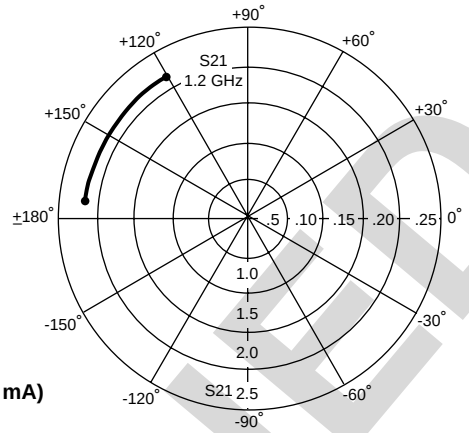
Note:
1. Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)





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

NE25139
V_{DS} = 5 V, V_{G2S} = 1 V, I_D = 10 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	S_{21} (dB)	MAG[1] (dB)
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG			
0.1	.99	-3	2.36	177	.001	87	.97	-1	0.47	5.83	2.9
0.2	.99	-7	2.39	169	.001	85	.98	-3	0.51	5.7	32.8
0.3	.99	-9	2.31	164	.002	82	.98	-3	0.70	5.6	32.8
0.4	.98	-13	2.23	160	.002	82	.97	-6	1.14	5.6	27.5
0.5	.97	-16	2.42	158	.003	81	.99	-6	1.18	5.6	24.2
0.6	.97	-19	2.30	150	.003	81	.96	-8	1.49	5.6	22.6
0.7	.96	-22	2.33	146	.004	80	.99	-9	2.03	5.5	19.2
0.8	.95	-25	2.23	142	.005	79	.96	-9	2.21	3.6	16.6
0.9	.94	-29	2.45	137	.005	79	.99	-13	1.34	3.0	17.2
1.0	.92	-29	2.30	131	.006	78	.97	-11	0.32	2.9	17.8
1.1	.91	-35	2.35	126	.006	78	.98	-15	0.04	2.1	15.1
1.2	.88	-35	2.37	124	.006	78	.99	-13	0.07	1.6	14.6

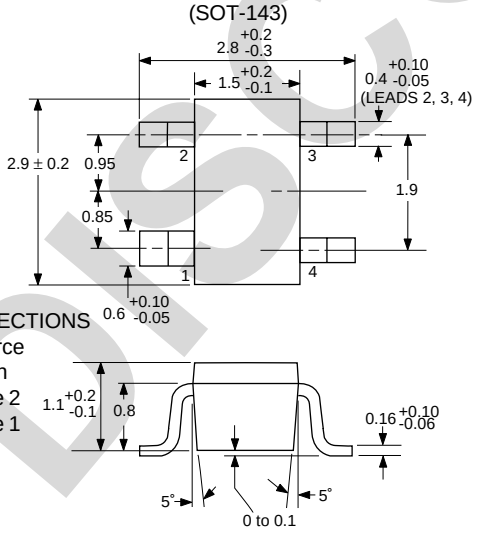
Note:
1. Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain, MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE 39
(SOT-143)



PIN CONNECTIONS
1. Source
2. Drain
3. Gate 2
4. Gate 1

Note: All dimensions are typical unless otherwise specified.

ORDERING INFORMATION

PART NUMBER	AVAILABILITY	I_{DSS} RANGE (mA)	MARKING
NE25139	Bulk up to 3K	5 - 40	
NE25139-T1	3K/Reel	5 - 40	
NE25139U71	Bulk up to 3K	5 - 15	U71
NE25139T1U71	3K/Reel	5 - 15	U71
NE25139U72	Bulk up to 3K	10 - 25	U72
NE25139T1U72	3K/Reel	10 - 25	U72
NE25139U73	Bulk up to 3K	20 - 35	U73
NE25139T1U73	3K/Reel	20 - 35	U73
NE25139U74	Bulk up to 3K	30 - 40	U74
NE25139T1U74	3K/Reel	30 - 40	U74