

FEATURES

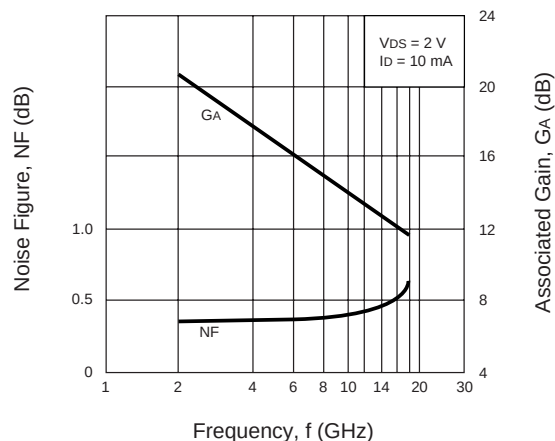
- **SUPER LOW NOISE FIGURE:**
0.35 dB Typ at $f = 12$ GHz
- **HIGH ASSOCIATED GAIN:**
13.0 dB Typ at $f = 12$ GHz
- **GATE LENGTH:** 0.2 μm
- **GATE WIDTH:** 200 μm

DESCRIPTION

The NE329S01 is a Hetero-Junction FET that utilizes the junction to create high electron mobility. Its excellent low noise figure and high associated gain make it suitable for DBS and commercial systems.

NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

NOISE FIGURE & ASSOCIATED GAIN vs. FREQUENCY



RECOMMENDED

OPERATING CONDITIONS ($T_A = 25^\circ\text{C}$)

PART NUMBER			NE329S01		
SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V_{DS}	Drain to Source Voltage	V		2	3
I_{DS}	Drain Current	mA		10	20
P_{IN}	Input Power	dBm			0

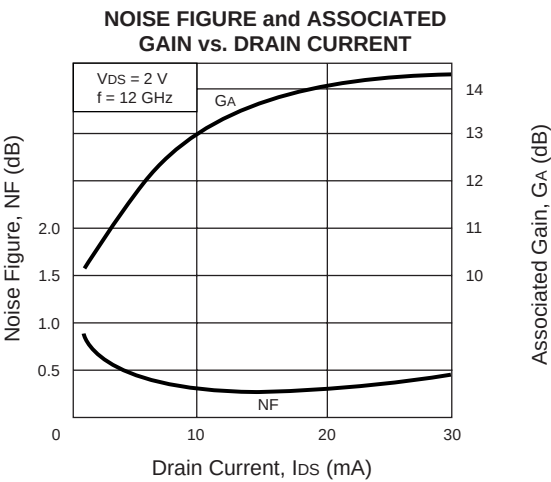
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

PART NUMBER PACKAGE OUTLINE			NE329S01		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
NF	Noise Figure, $V_{DS} = 2$ V, $I_D = 10$ mA, $f = 12$ GHz	dB		0.35	0.45
GA	Associated Gain, $V_{DS} = 2$ V, $I_D = 10$ mA, $f = 12$ GHz	dB	11.5	13.0	
I_{DSS}	Saturated Drain Current, $V_{DS} = 2$ V, $V_{GS} = 0$ V	mA	20	60	90
V_P	Pinch-off Voltage, $V_{DS} = 2$ V, $I_D = 100$ μA	V	-0.2	-0.7	-2.0
g_m	Transconductance, $V_{DS} = 2$ V, $I_D = 10$ mA	mS	45	60	
I_{GSO}	Gate to Source Leakage Current, $V_{GS} = -3$ V	μA		0.5	10

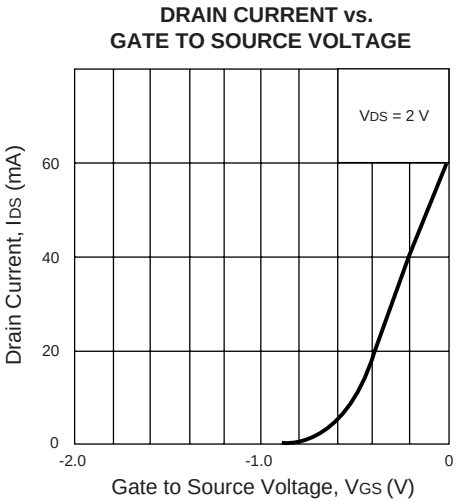
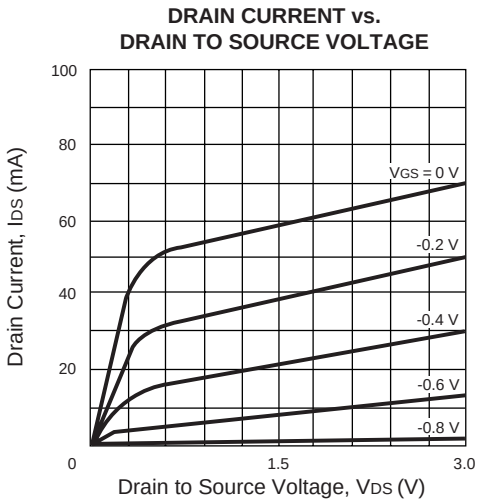
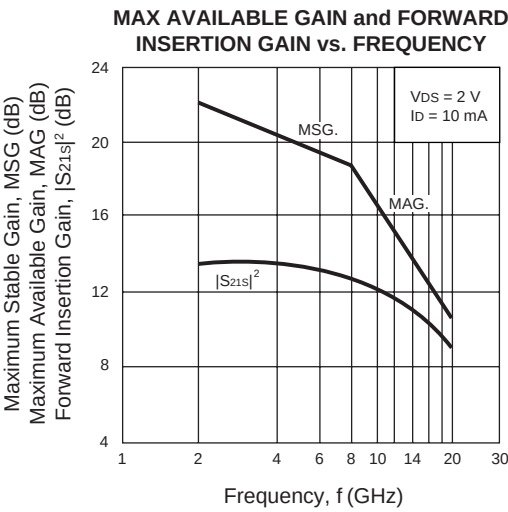
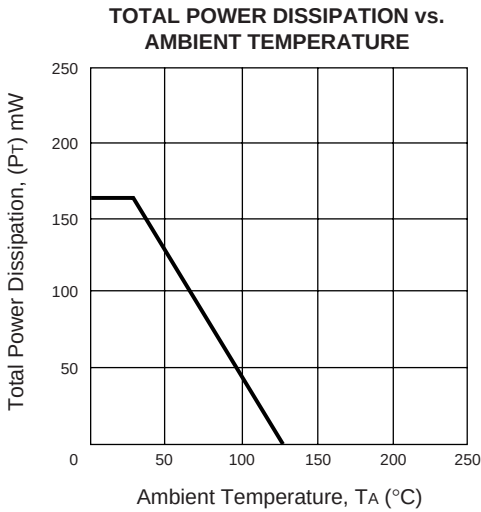
ABSOLUTE MAXIMUM RATINGS¹ (T_A = 25°C)

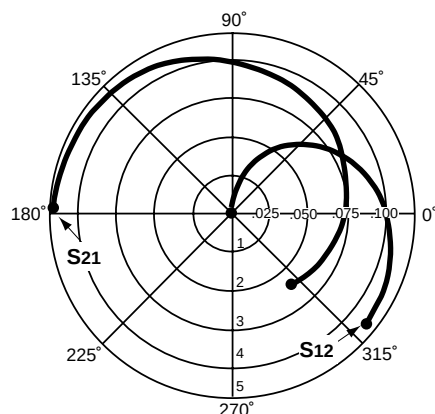
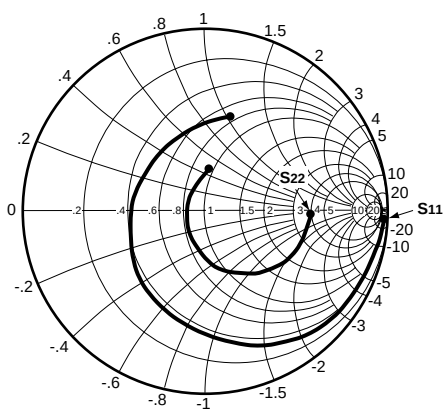
SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{DS}	Drain to Source Voltage	V	4.0
V _{GS}	Gate to Source Voltage	V	-3.0
I _{DS}	Drain Current	mA	I _{DSS}
I _{GS}	Gate Current	μA	100
P _T	Total Power Dissipation	mW	165
T _{CH}	Channel Temperature	°C	125
T _{STG}	Storage Temperature	°C	-65 to +125

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



TYPICAL PERFORMANCE CURVES (T_A = 25°C)



TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE329S01

V_D = 2 V, I_{DS} = 10 mA

FREQUENCY	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG ¹
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.000	-1.34	5.070	178.39	0.001	82.80	0.593	-0.78	0.072	37.050
0.20	1.000	-2.69	5.067	177.00	0.003	87.97	0.594	-1.82	0.013	32.276
0.30	0.999	-4.02	5.056	175.63	0.004	86.19	0.594	-2.70	0.057	31.017
0.40	0.998	-5.29	5.056	174.08	0.005	85.45	0.593	-3.55	0.081	30.048
0.50	0.997	-6.60	5.053	172.66	0.007	85.50	0.593	-4.44	0.081	28.585
0.70	0.993	-9.19	5.035	169.79	0.009	83.91	0.591	-6.14	0.133	27.478
1.00	0.988	-13.05	5.016	165.63	0.013	81.32	0.588	-8.79	0.165	25.864
1.50	0.977	-19.28	4.977	158.93	0.019	77.30	0.583	-13.04	0.220	24.182
2.00	0.963	-25.51	4.953	152.17	0.026	73.15	0.576	-17.26	0.271	22.799
2.50	0.950	-31.67	4.905	145.44	0.032	68.98	0.567	-21.49	0.312	21.855
3.00	0.934	-37.85	4.872	138.82	0.037	65.21	0.557	-25.68	0.356	21.195
3.50	0.914	-44.17	4.834	131.99	0.043	61.16	0.544	-29.97	0.406	20.508
4.00	0.891	-50.60	4.790	125.20	0.049	57.16	0.530	-34.15	0.457	19.901
4.50	0.866	-56.85	4.716	118.43	0.054	53.13	0.514	-38.47	0.513	19.412
5.00	0.832	-63.39	4.628	111.50	0.058	49.35	0.494	-42.63	0.590	19.020
5.50	0.796	-69.77	4.545	104.84	0.063	45.44	0.472	-46.90	0.660	18.582
6.00	0.761	-76.11	4.460	98.62	0.067	41.94	0.451	-51.18	0.723	18.233
6.50	0.726	-82.61	4.358	92.38	0.070	38.39	0.430	-55.44	0.791	17.942
7.00	0.694	-89.02	4.274	86.10	0.074	34.95	0.409	-59.78	0.841	17.616
7.50	0.665	-95.47	4.200	80.04	0.077	31.58	0.389	-63.86	0.889	17.368
8.00	0.637	-102.09	4.122	74.14	0.080	28.48	0.371	-68.19	0.930	17.120
8.50	0.609	-108.49	4.056	67.84	0.083	25.46	0.355	-72.15	0.970	16.890
9.00	0.587	-115.36	4.003	61.81	0.086	22.36	0.337	-76.05	0.997	16.679
9.50	0.560	-122.47	3.946	55.69	0.089	19.30	0.319	-79.94	1.030	15.400
10.00	0.535	-130.35	3.874	49.27	0.091	16.14	0.296	-83.82	1.074	14.635
10.50	0.502	-138.39	3.807	43.03	0.093	12.95	0.273	-87.69	1.126	13.963
11.00	0.468	-147.06	3.739	37.14	0.096	9.81	0.246	-92.41	1.169	13.414
11.50	0.442	-155.92	3.614	30.95	0.098	6.61	0.218	-97.93	1.224	12.813
12.00	0.423	-166.06	3.532	24.92	0.099	3.30	0.191	-104.13	1.268	12.413
12.50	0.409	-176.32	3.462	19.08	0.100	0.29	0.162	-112.46	1.303	12.091
13.00	0.400	173.15	3.395	13.38	0.102	-2.97	0.139	-122.93	1.320	11.835
13.50	0.395	162.77	3.328	7.08	0.103	-6.09	0.119	-135.87	1.343	11.593
14.00	0.395	152.37	3.267	0.80	0.105	-9.36	0.104	-150.27	1.348	11.404
14.50	0.397	141.88	3.203	-5.59	0.106	-12.69	0.093	-167.29	1.363	11.206
15.00	0.403	131.65	3.128	-12.10	0.108	-16.23	0.089	-172.18	1.367	11.003
15.50	0.410	121.32	3.047	-18.65	0.109	-20.11	0.095	-151.88	1.381	10.784
16.00	0.424	111.01	2.965	-25.00	0.110	-23.71	0.107	-130.77	1.390	10.585
16.50	0.443	101.07	2.875	-31.15	0.111	-27.68	0.129	-112.85	1.395	10.389
17.00	0.467	91.58	2.800	-37.42	0.112	-31.47	0.156	-99.34	1.386	10.277
17.50	0.499	82.67	2.727	-43.75	0.112	-35.38	0.190	-89.08	1.369	10.241
18.00	0.539	73.88	2.646	-50.17	0.113	-39.47	0.227	-80.76	1.328	10.268

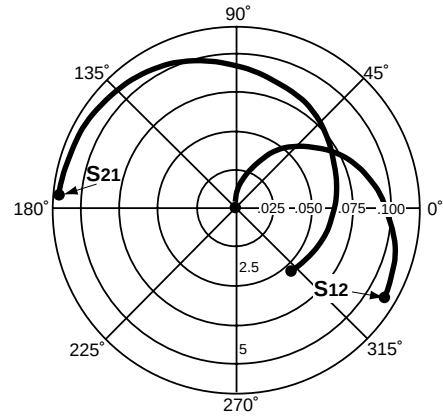
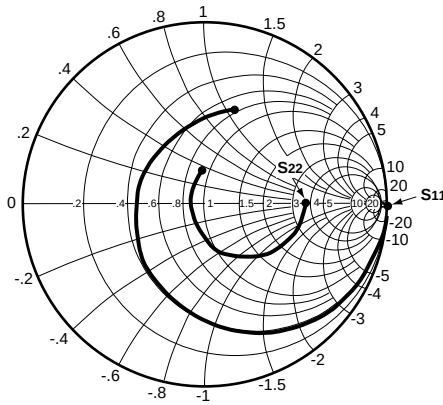
Notes:

1. Gain Calculations:

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

MAG = Maximum Available gain

MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE329S01

V_D = 3 V, I_{DS} = 20 mA

FREQUENCY	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG ¹
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.000	-1.43	6.362	178.29	0.001	80.28	0.552	-1.03	0.089	38.036
0.20	1.000	-2.87	6.363	176.75	0.002	88.14	0.551	-1.89	0.010	35.026
0.30	0.999	-4.29	6.351	175.24	0.003	86.13	0.551	-2.63	0.062	33.257
0.40	0.998	-5.65	6.348	173.64	0.005	85.72	0.550	-3.43	0.075	31.037
0.50	0.997	-7.04	6.342	172.12	0.006	85.84	0.549	-4.26	0.081	30.241
0.70	0.992	-9.82	6.311	169.07	0.008	84.30	0.548	-5.86	0.145	28.970
1.00	0.985	-13.94	6.277	164.63	0.011	81.94	0.545	-8.32	0.197	27.564
1.50	0.972	-20.58	6.211	157.43	0.017	78.26	0.539	-12.33	0.251	25.627
2.00	0.956	-27.22	6.155	150.26	0.022	74.46	0.532	-16.27	0.311	24.468
2.50	0.938	-33.75	6.065	143.17	0.027	70.54	0.524	-20.22	0.368	23.515
3.00	0.918	-40.24	5.987	136.17	0.032	67.22	0.514	-24.07	0.417	22.721
3.50	0.892	-46.86	5.899	129.03	0.037	63.47	0.502	-28.02	0.480	22.026
4.00	0.864	-53.54	5.803	121.97	0.042	59.93	0.490	-31.79	0.538	21.404
4.50	0.834	-60.02	5.676	115.00	0.046	56.34	0.474	-35.65	0.603	20.913
5.00	0.795	-66.72	5.532	107.97	0.050	53.10	0.456	-39.33	0.683	20.439
5.50	0.756	-73.21	5.393	101.25	0.054	49.63	0.436	-43.09	0.758	19.994
6.00	0.717	-79.63	5.250	95.02	0.058	46.64	0.418	-46.88	0.820	19.567
6.50	0.680	-86.22	5.096	88.74	0.061	43.58	0.399	-50.57	0.887	19.219
7.00	0.645	-92.67	4.967	82.47	0.064	40.70	0.381	-54.35	0.943	18.899
7.50	0.614	-99.19	4.854	76.46	0.067	37.83	0.365	-57.84	0.988	18.600
8.00	0.585	-105.82	4.733	70.65	0.070	35.25	0.350	-61.59	1.025	17.333
8.50	0.555	-112.21	4.630	64.48	0.073	32.68	0.337	-64.99	1.062	16.499
9.00	0.532	-119.07	4.541	58.59	0.077	30.02	0.323	-68.27	1.075	16.032
9.50	0.506	-126.13	4.453	52.68	0.080	27.40	0.309	-71.52	1.102	15.514
10.00	0.481	-134.04	4.353	46.48	0.083	24.68	0.290	-74.63	1.131	14.997
10.50	0.450	-142.17	4.260	40.50	0.086	21.80	0.273	-77.77	1.164	14.492
11.00	0.418	-151.07	4.171	34.84	0.088	18.95	0.249	-81.55	1.209	13.999
11.50	0.395	-160.09	4.025	28.84	0.091	15.97	0.225	-85.94	1.245	13.474
12.00	0.379	-170.49	3.929	23.02	0.093	12.87	0.201	-90.72	1.272	13.121
12.50	0.369	-179.06	3.845	17.39	0.096	10.03	0.173	-97.07	1.283	12.833
13.00	0.365	168.37	3.767	11.92	0.098	6.89	0.149	-105.17	1.294	12.596
13.50	0.363	157.93	3.687	5.81	0.100	3.87	0.127	-114.98	1.304	12.360
14.00	0.367	147.64	3.614	-0.27	0.102	0.62	0.109	-126.05	1.307	12.174
14.50	0.372	137.28	3.543	-6.47	0.105	-2.68	0.092	-139.12	1.300	11.995
15.00	0.382	127.29	3.460	-12.78	0.108	-6.32	0.080	-157.43	1.292	11.812
15.50	0.392	117.21	3.374	-19.18	0.110	-10.23	0.077	-180.00	1.294	11.615
16.00	0.409	107.29	3.287	-25.32	0.112	-13.98	0.079	153.10	1.292	11.433
16.50	0.432	97.83	3.189	-31.33	0.114	-18.14	0.095	127.63	1.287	11.252
17.00	0.460	88.72	3.114	-37.48	0.116	-22.13	0.120	109.28	1.268	11.176
17.50	0.495	80.22	3.037	-43.73	0.117	-26.18	0.152	96.24	1.246	11.158
18.00	0.537	71.82	2.950	-50.00	0.118	-30.51	0.192	86.36	1.212	11.198

Notes:

1. Gain Calculations:

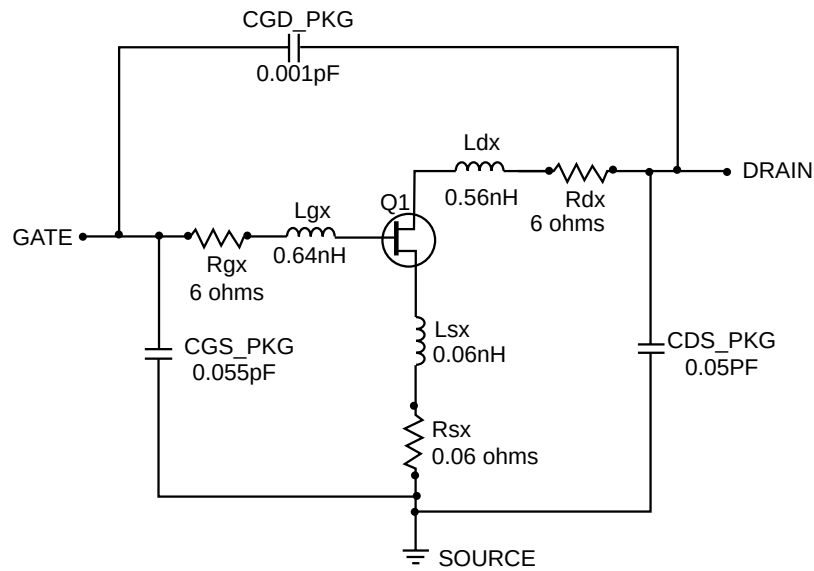
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} \left(K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12} S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available gain

MSG = Maximum Stable Gain

NONLINEAR MODEL

SCHEMATIC



FET NONLINEAR MODEL PARAMETERS ⁽¹⁾

Parameters	Q1	Parameters	Q1
VTO	-0.825	RG	7
VTOSC	0	RD	4
ALPHA	7	RS	4
BETA	0.148	RGMET	0
GAMMA	0.083	KF	0
GAMMADC	0.05	AF	1
Q	2.5	TNOM	27
DELTA	0.7	XTI	3
VBI	0.6	EG	1.43
IS	1e-14	VTOTC	0
N	1	BETATCE	0
RIS	0	FFE	1
RID	0		
TAU	3e-12		
CDS	0.13e-12		
RDB	5000		
CBS	1e-9		
CGSO	0.42e-12		
CGDO	0.023e-12		
DELTA1	0.3		
DELTA2	0.6		
FC	0.5		
VBR	Infinity		

UNITS

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

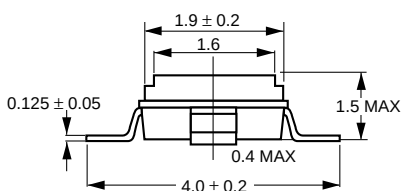
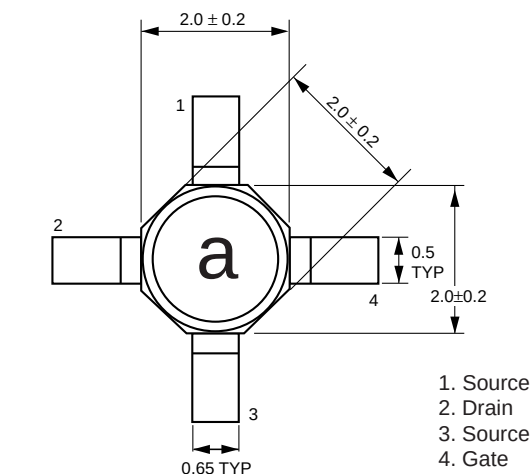
MODEL RANGE

Frequency: 0.1 to 12 GHz
 Bias: $V_{DS} = 1\text{ V to }3\text{ V}$, $I_D = 5\text{ mA to }30\text{ mA}$
 Date: 1/98

(1) Series IV Libra TOM Model

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE S01

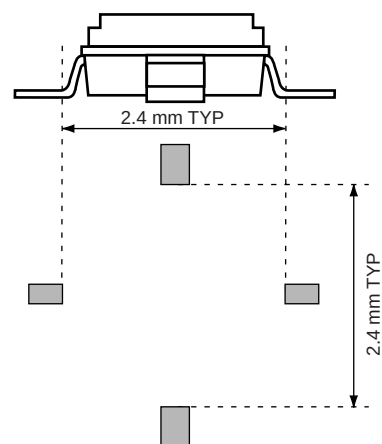


TYPICAL NOISE PARAMETERS ($T_A = 25^\circ\text{C}$)

 $V_{DS} = 2\text{ V}, I_{DS} = 10\text{ mA}$

FREQ. (GHz)	NF _{OPT} (dB)	G _A (dB)	Γ_{OPT}		Rn/50
			MAG	ANG	
2.0	0.26	20.7	0.93	14	0.38
4.0	0.27	19.0	0.80	29	0.33
6.0	0.29	17.3	0.65	48	0.25
8.0	0.31	15.7	0.49	72	0.18
10.0	0.33	14.2	0.36	102	0.11
12.0	0.35	13.0	0.27	139	0.08
14.0	0.43	12.4	0.24	-176	0.07
16.0	0.57	12.1	0.30	-122	0.10
18.0	0.73	11.8	0.47	-58	0.22

TYPICAL MOUNTING PAD LAYOUT



ORDERING INFORMATION

PART NUMBER	SUPPLY FORM	MARKING
NE329S01	Bulk	a
NE329S01-T1	Tape & Reel 1000 pcs/reel	
NE329S01-T1B	Tape & Reel 4000 pcs/reel	

EXCLUSIVE NORTH AMERICAN AGENT FOR **NEC** RF, MICROWAVE & OPTOELECTRONIC SEMICONDUCTORS

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