

15 W C-BAND POWER GaAs FET NEZ SERIES

**15 W C-BAND POWER GaAs FET
N-CHANNEL GaAs MES FET**

DESCRIPTION

The NEZ Series of microwave power GaAs FETs offer high output power, high gain and high efficiency at C-band for microwave and satellite communications.

Internal input and output circuits matched to 50 Ω are designed to provide good flatness of gain and output power in allocated band.

To reduce the thermal resistance, the device has a PHS (Plated Heat Sink) structure.

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

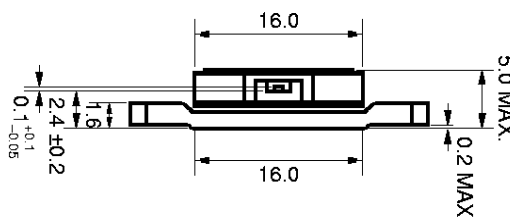
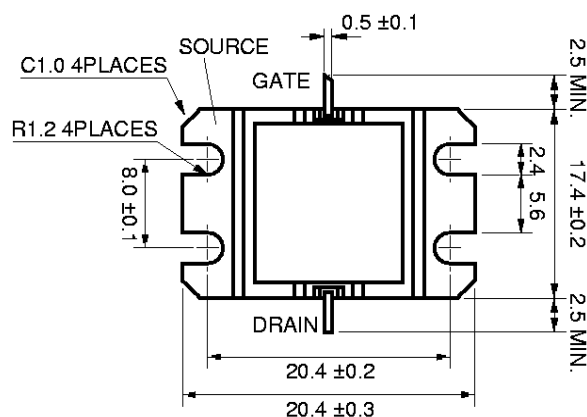
SELECTION CHART

NEZ PART NUMBER	FREQUENCY BAND (GHz)
NEZ3642-15D, 15DD	3.6 to 4.2
NEZ4450-15D, 15DD	4.4 to 5.0
NEZ5964-15D, 15DD	5.9 to 6.45
NEZ6472-15D, 15DD	6.4 to 7.2
NEZ7785-15D	7.7 to 8.5

FEATURES

- Internally matched to 50 Ω
- High power output
- High linear gain
- High reliability
- Low distortion

PACKAGE DIMENSIONS (unit: mm)



NEZ-15D/15DD

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

CHARACTERISTIC	SYMBOL	RATINGS	UNIT
Drain to Source Voltage	V _{DS}	15	V
Gate to Source Voltage	V _{GS}	-12	V
Gate to Drain Voltage	V _{GD}	-18	V
Drain Current	I _D	18	A
Gate Current	I _G	100	mA
Total Power Dissipation	P _T *	100	W
Channel Temperature	T _{ch}	175	°C
Storage Temperature	T _{stg}	-65 to +175	°C

* T_C = 25 °C

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

CHARACTERISTIC	SYMBOL	Part No.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Saturated Drain Current	I _{DSS}	NEZ-15D NEZ-15DD	4.0	9.2	14.0	A	V _{DS} = 2.5 V, V _{GS} = 0 V
Pinch-off Voltage	V _P	NEZ-15D NEZ-15DD	-3.5	-2.2	-0.5	V	V _{DS} = 2.5 V, I _{DS} = 60 mA
Trans-Conductance	gm	NEZ-15D NEZ-15DD	-	5200	-	mS	V _{DS} = 2.5 V, I _{DS} = 4 A
Gate to Drain Voltage	B _{V_{GD}O}	NEZ-15D NEZ-15DD	20	22	-	V	I _{GD} = 60 mA
Thermal Resistance	R _{th}	NEZ-15D NEZ15DD	-	1.3	1.5	°C/W	Channel to Case

15W PERFORMANCE SPECIFICATIONS (T_A = 25 °C, Z_s = Z_L = 50 Ω)

PART NUMBER	p1dB (dBm) *1		G _L (dB)		I _{DS} (A) *2		ΔG _L (dB) *3,4	IM ₃ (dBc) *4		η _{add} (%)	TEST CONDITIONS			
	MIN.	TYP.	MIN.	TYP.	TYP.	MAX.	MAX.	TYP.	MAX.	TYP.	V _{DS} (V)	I _{DS} *5 (A)	FREQUENCY BAND (GHz)	IM ₃ TEST FREQ. (GHz)*6
NEZ3642-15D	41.5	42.5	9.0	10.0	4.8	6.0	–	–	–	35	10	4.0	3.6 to 4.2	–
NEZ3642-15DD	41.5	42.5	9.0	10.0	4.8	6.0	1.0	–	–42	35	10	4.0	3.6 to 4.2	4.2
NEZ4450-15D	41.5	42.5	9.0	10.0	4.8	6.0	–	–	–	35	10	4.0	4.4 to 5.0	–
NEZ4450-15DD	41.5	42.5	9.0	10.0	4.8	6.0	1.0	–	–42	35	10	4.0	4.4 to 5.0	5.0
NEZ5964-15D	41.5	42.5	8.0	9.0	4.8	6.0	–	–	–	33	10	4.0	5.9 to 6.45	–
NEZ5964-15DD	41.5	42.5	8.0	9.0	4.8	6.0	1.0	–	–42	33	10	4.0	5.9 to 6.45	6.45
NEZ6472-15D	41.5	42.5	6.5	7.5	4.8	6.0	–	–	–	31	10	4.0	6.4 to 7.2	–
NEZ6472-15DD	41.5	42.5	6.5	7.5	4.8	6.0	1.0	–	–42	31	10	4.0	6.4 to 7.2	7.2
NEZ7785-15D	41.5	42.5	6.0	7.0	4.8	6.0	–	–	–	27	10	4.0	7.7 to 8.5	–

- Notes**
- *1 Output power at 1 dB gain compression point
 - *2 I_{DS} values are specified at P1dB point.
 - *3 Gain flatness
 - *4 Applies to –15DD option only
 - *5 RF OFF
 - *6 IM₃ test conditions: Δf = 10 MHz, 2 tones test, P_o = 31.5 dBm (single carrier level)

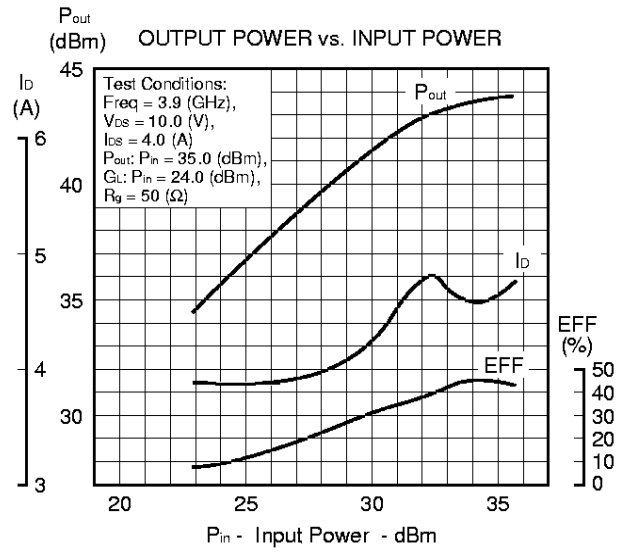
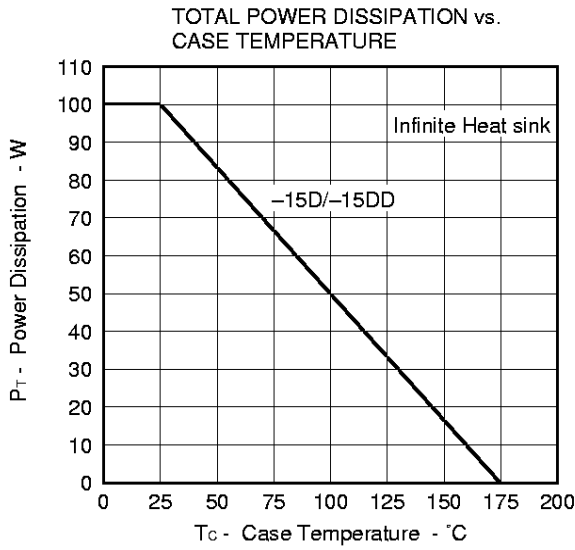
MAXIMUM OPERATING LIMITS

R _g max. (Ω)	V _{DS} max. (V)
50	10

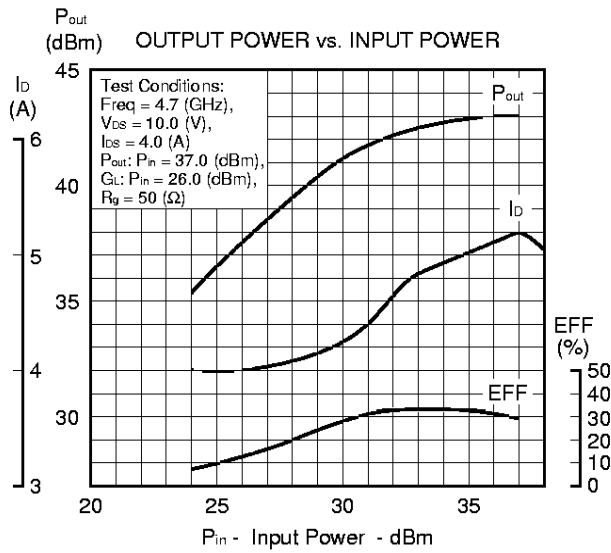
R_g max is the maximum series resistance between the gate supply and the FET gate.

TYPICAL CHARACTERISTICS (T_A = 25 °C)

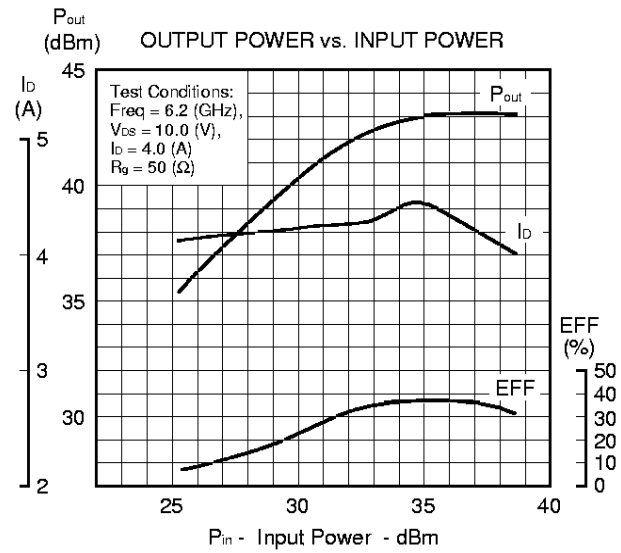
NEZ3642-15D/15DD



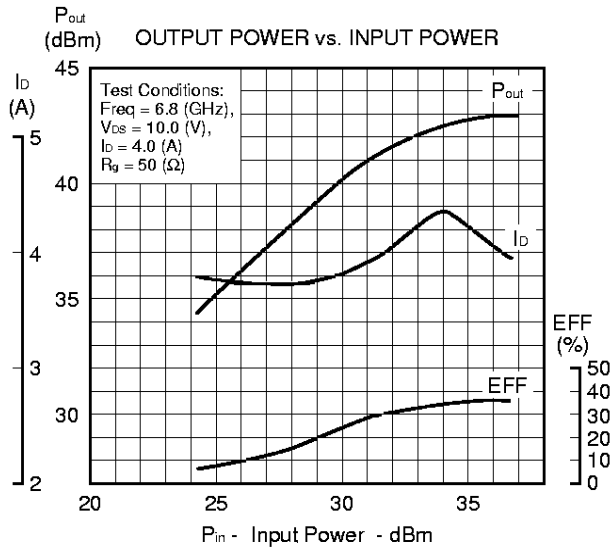
NEZ4450-15D/15DD



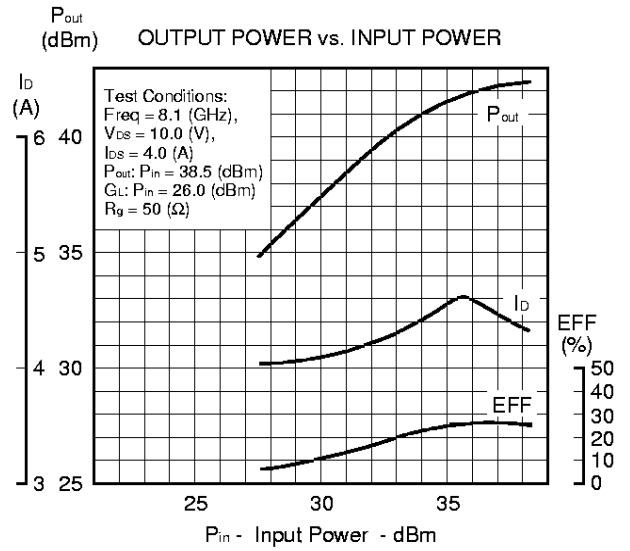
NEZ5964-15D/15DD



NEZ6472-15D/15DD



NEZ7785-15D/15DD



S-PARAMETER

NEZ3642-15D

V_{DS} = 10 V, I_{DS} = 4 000 mA, V_{GS} = -1.472 V, I_G = 0.0 mA, R_G = 50 Ω, I_{SS} = 10 900 mA

FREQUENCY GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1.000	0.966	143.9	0.721	23.4	0.009	26.6	0.875	148.4
1.100	0.957	139.5	0.692	12.2	0.009	15.6	0.861	140.4
1.200	0.959	135.3	0.680	4.6	0.009	11.4	0.853	136.6
1.300	0.953	130.8	0.672	-3.4	0.011	6.8	0.843	132.5
1.400	0.949	126.2	0.672	-11.6	0.012	0.9	0.833	128.6
1.500	0.943	121.3	0.679	-20.0	0.013	-1.0	0.824	124.4
1.600	0.936	116.3	0.695	-28.6	0.015	-8.9	0.813	120.2
1.700	0.929	111.0	0.715	-37.5	0.016	-16.6	0.800	115.8
1.800	0.919	105.4	0.743	-46.9	0.018	-22.5	0.786	110.9
1.900	0.912	99.5	0.780	-56.5	0.019	-31.3	0.775	106.3
2.000	0.901	93.3	0.827	-66.5	0.020	-38.1	0.760	101.3
2.100	0.889	86.7	0.879	-77.0	0.022	-48.2	0.743	95.8
2.200	0.877	79.6	0.945	-88.1	0.025	-57.8	0.727	90.1
2.300	0.865	71.9	1.023	-99.3	0.026	-66.8	0.713	84.5
2.400	0.850	63.6	1.106	-111.2	0.027	-78.8	0.693	78.8
2.500	0.833	54.8	1.209	-123.8	0.029	-89.2	0.676	72.4
2.600	0.816	45.1	1.336	-137.2	0.031	-102.8	0.662	65.8
2.700	0.797	34.4	1.486	-150.8	0.033	-113.9	0.650	59.1
2.800	0.775	22.7	1.650	-164.9	0.034	-127.8	0.630	52.0
2.900	0.749	9.4	1.846	-179.4	0.036	-144.5	0.611	43.7
3.000	0.721	-5.3	2.071	-162.8	0.038	-160.6	0.596	34.0
3.100	0.690	-21.9	2.351	-145.4	0.039	-178.0	0.578	23.5
3.200	0.653	-41.0	2.639	-126.8	0.042	-162.5	0.551	10.8
3.300	0.614	-62.8	2.950	-106.7	0.043	-139.9	0.517	-5.0
3.400	0.575	-87.3	3.264	-85.2	0.044	-115.2	0.484	-24.2
3.500	0.537	-114.4	3.537	-62.7	0.043	-88.3	0.450	-46.1
3.600	0.503	-142.4	3.741	-39.5	0.042	-59.5	0.419	-71.7
3.700	0.472	-170.7	3.855	-15.8	0.041	-29.2	0.404	-99.2
3.800	0.444	162.4	3.913	-7.6	0.040	-0.4	0.414	-126.1
3.900	0.414	137.3	3.904	-29.4	0.040	-31.9	0.433	-148.6
4.000	0.381	113.5	3.839	-50.9	0.040	-60.5	0.447	-168.1
4.100	0.349	89.3	3.843	-72.0	0.040	-89.4	0.459	-175.5
4.200	0.314	59.2	4.033	-93.8	0.043	-114.0	0.467	-163.2
4.300	0.253	30.7	4.105	-117.3	0.051	-142.5	0.488	-151.9
4.400	0.244	-12.2	4.236	-141.3	0.055	-169.7	0.449	-142.8
4.500	0.283	-62.8	4.309	-168.4	0.059	-160.8	0.384	-137.7
4.600	0.377	-109.7	4.223	-161.6	0.060	-130.2	0.327	-143.9
4.700	0.483	-149.4	3.910	-131.3	0.060	-100.3	0.363	-159.4
4.800	0.557	-176.1	3.382	-102.5	0.055	-72.4	0.474	-164.4
4.900	0.585	-145.1	2.809	-75.4	0.048	-45.5	0.577	-159.6
5.000	0.571	-115.5	2.332	-49.6	0.042	-19.0	0.666	-150.4
5.100	0.531	-84.8	1.946	-25.7	0.037	-6.9	0.746	-142.2
5.200	0.480	-50.6	1.604	-2.2	0.031	-31.8	0.804	-133.8
5.300	0.448	10.8	1.277	-21.7	0.022	-56.2	0.834	-123.7
5.400	0.458	-31.8	0.971	-47.7	0.017	-83.8	0.882	-110.5
5.500	0.518	-71.9	0.950	-33.8	0.010	-106.5	1.097	-100.3
5.600	0.602	-104.7	0.409	-164.5	0.004	-40.7	0.953	-140.5
5.700	0.674	-131.7	0.348	-99.5	0.004	-174.2	0.981	-112.7
5.800	0.735	-153.7	0.289	-124.1	0.003	-116.9	0.978	-91.9
5.900	0.780	-172.2	0.220	-143.3	0.006	-64.8	1.022	-78.7
6.000	0.810	-171.8	0.158	-159.7	0.003	-42.1	1.023	-71.5

NEZ4450-15D

$V_{DS} = 10 \text{ V}$, $I_{DS} = 4 \text{ 000 mA}$, $V_{GS} = -1.386 \text{ V}$, $I_G = 0.0 \text{ mA}$, $R_G = 50 \Omega$

FREQUENCY GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.100	0.978	-162.7	5.179	89.1	0.002	0.2	0.872	177.1
0.200	0.980	-176.5	2.446	74.6	0.002	21.8	0.879	174.5
0.500	0.984	167.3	0.926	42.1	0.002	12.8	0.892	164.2
0.700	0.982	158.9	0.646	23.2	0.003	14.9	0.895	156.9
1.000	0.983	146.9	0.453	-2.6	0.004	28.8	0.884	145.0
1.500	0.976	126.4	0.360	-42.2	0.006	6.7	0.894	121.3
2.000	0.963	104.2	0.395	-82.6	0.010	-19.4	0.864	95.3
2.500	0.945	77.9	0.611	-132.2	0.015	-57.0	0.777	53.6
2.600	0.944	71.7	0.688	-144.0	0.017	-71.0	0.739	43.2
2.700	0.939	65.0	0.778	-156.7	0.018	-80.4	0.690	30.8
2.800	0.937	58.1	0.891	-170.0	0.019	-91.4	0.638	17.5
2.900	0.935	50.2	1.019	175.1	0.021	-105.0	0.572	1.9
3.000	0.934	42.1	1.168	159.4	0.023	-116.4	0.502	-15.8
3.100	0.932	33.8	1.349	143.8	0.024	-132.0	0.441	-38.0
3.200	0.924	23.2	1.530	124.8	0.025	-147.8	0.379	-64.5
3.300	0.918	12.3	1.731	106.7	0.026	-159.7	0.355	-92.9
3.400	0.912	-0.7	1.963	87.4	0.027	171.9	0.354	-122.8
3.500	0.889	-15.3	2.195	67.8	0.025	150.0	0.371	-149.7
3.600	0.863	-31.5	2.444	47.3	0.024	126.3	0.392	-175.6
3.700	0.809	-50.2	2.683	26.0	0.020	91.7	0.423	160.5
3.800	0.750	-71.4	2.914	4.0	0.018	57.4	0.446	138.1
3.900	0.693	-93.9	3.131	-17.7	0.014	12.9	0.458	117.9
4.000	0.645	-118.4	3.351	-39.9	0.013	-34.2	0.456	97.2
4.100	0.613	-145.4	3.547	-62.9	0.014	-77.5	0.449	77.2
4.200	0.585	-173.2	3.630	-86.3	0.020	-106.0	0.439	53.9
4.300	0.565	160.5	3.716	-108.6	0.027	-146.6	0.403	32.8
4.400	0.550	135.6	3.826	-131.6	0.033	-172.4	0.373	8.8
4.500	0.521	111.2	3.918	-153.8	0.042	160.6	0.359	-15.5
4.600	0.476	87.8	3.990	-177.5	0.048	136.7	0.350	-47.1
4.700	0.412	63.2	3.963	159.4	0.054	112.3	0.337	-78.1
4.800	0.350	37.0	3.897	135.8	0.058	87.9	0.338	-107.2
4.900	0.293	4.5	3.808	112.6	0.060	66.1	0.334	-135.7
5.000	0.259	-32.6	3.679	89.8	0.061	43.4	0.330	-160.4
5.100	0.280	-71.7	3.539	67.4	0.062	23.2	0.326	175.6
5.200	0.326	-104.9	3.378	45.6	0.063	2.0	0.310	154.9
5.300	0.395	-130.2	3.226	23.3	0.062	-18.5	0.281	135.8
5.400	0.476	-151.3	3.098	1.2	0.062	-39.5	0.233	115.4
5.500	0.539	-170.0	2.922	-21.0	0.060	-60.4	0.173	92.0
5.600	0.600	172.9	2.764	-43.3	0.058	-81.8	0.105	57.4
5.700	0.643	157.2	2.597	-66.3	0.055	-103.6	0.081	-28.7
5.800	0.673	142.3	2.401	-88.9	0.052	-126.3	0.171	-87.6
5.900	0.688	129.0	2.184	-112.1	0.049	-149.4	0.296	-113.5
6.000	0.688	116.1	1.957	-134.7	0.044	-172.4	0.424	-133.5
6.100	0.681	105.5	1.729	-156.8	0.040	167.8	0.534	-150.4
6.200	0.665	95.4	1.506	-178.4	0.037	146.4	0.636	-165.8
6.300	0.649	86.1	1.304	160.7	0.032	125.5	0.718	179.9
6.400	0.634	78.6	1.124	141.3	0.030	106.7	0.789	166.9
6.500	0.611	71.5	0.968	123.0	0.028	89.4	0.835	155.4
7.000	0.522	49.0	0.518	40.6	0.018	14.3	0.975	110.1
7.500	0.549	43.4	0.322	-38.8	0.013	-44.0	0.948	79.3
8.000	0.635	4.8	0.224	-114.7	0.005	-121.1	0.935	52.0
8.100	0.625	-8.8	0.218	-131.3	0.006	-137.9	0.949	45.8
8.200	0.613	-24.9	0.213	-148.5	0.006	172.1	0.941	39.7
8.300	0.592	-44.9	0.211	-166.8	0.006	135.4	0.933	33.1
8.400	0.572	-67.8	0.208	174.0	0.007	104.2	0.932	25.7
8.500	0.575	-94.3	0.208	154.5	0.009	87.2	0.916	18.6
9.000	0.776	152.2	0.288	25.6	0.028	28.6	0.324	-82.4
9.500	0.906	86.8	0.058	-69.2	0.046	-36.2	0.950	27.2
10.000	0.896	34.5	0.065	-92.4	0.065	-85.2	0.960	-3.2

NEZ5964-15DD

V_{DS} = 10 V, I_{DS} = 4 000 mA, V_{GS} = -1.662 V, I_G = 0.0 mA

FREQUENCY GHZ	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.100	0.989	-155.7	5.839	95.3	0.001	30.9	0.901	177.3
0.200	0.989	-171.6	2.801	81.8	0.002	25.6	0.901	175.0
0.500	0.989	172.2	1.092	54.9	0.003	20.6	0.906	165.7
1.000	0.989	154.4	0.556	16.9	0.003	11.3	0.917	150.0
1.500	0.988	137.8	0.412	-16.7	0.007	10.9	0.927	131.6
2.000	0.986	119.0	0.379	-52.0	0.008	-5.4	0.922	108.4
2.500	0.983	99.0	0.421	-89.3	0.011	-28.2	0.884	78.9
3.000	0.977	77.9	0.556	-132.0	0.015	-62.4	0.771	40.9
3.200	0.972	68.2	0.642	-152.5	0.018	-81.2	0.681	20.8
3.400	0.967	59.2	0.748	-174.7	0.019	-100.8	0.560	-5.6
3.600	0.959	48.6	0.861	160.9	0.021	-123.9	0.435	-40.7
3.800	0.950	37.0	0.959	134.8	0.026	-153.2	0.354	-87.9
4.000	0.937	24.2	1.057	108.4	0.027	164.4	0.374	-138.1
4.200	0.921	10.5	1.134	82.2	0.019	126.5	0.438	-177.9
4.400	0.900	-4.2	1.243	57.3	0.017	104.2	0.510	150.9
4.600	0.874	-20.8	1.366	32.3	0.015	71.5	0.569	125.5
4.800	0.837	-40.5	1.551	5.9	0.013	28.2	0.602	101.2
5.000	0.787	-62.8	1.760	-22.0	0.015	-13.5	0.614	77.1
5.200	0.741	-88.4	2.020	-51.4	0.019	-59.4	0.609	52.1
5.400	0.687	-117.3	2.278	-82.4	0.026	-97.1	0.570	25.1
5.600	0.640	-149.4	2.548	-114.7	0.037	-139.6	0.521	-4.9
5.800	0.594	176.2	2.798	-148.3	0.048	-177.8	0.431	-39.0
6.000	0.546	140.6	3.061	177.3	0.059	144.6	0.344	-79.8
6.200	0.478	103.0	3.263	140.8	0.070	106.9	0.264	-130.2
6.400	0.389	60.7	3.425	103.3	0.079	69.4	0.251	170.4
6.600	0.298	8.6	3.373	63.5	0.085	32.1	0.272	114.4
6.800	0.266	-54.6	3.154	24.4	0.086	-6.6	0.268	62.9
7.000	0.317	-109.4	2.821	-12.4	0.082	-43.1	0.218	1.9

NEZ6472-15DD

$V_{DS} = 10 \text{ V}$, $I_{DS} = 4.000 \text{ mA}$, $V_{GS} = -1.452 \text{ V}$, $I_G = 0.0 \text{ mA}$, $R_G = 50 \Omega$

FREQUENCY GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.100	0.981	-154.0	6.310	96.6	0.004	21.8	0.886	175.4
0.200	0.980	-171.8	3.032	81.3	0.002	1.0	0.888	174.9
0.500	0.985	171.4	1.160	52.7	0.002	7.3	0.896	165.8
1.000	0.983	153.2	0.549	13.4	0.003	9.9	0.887	149.1
1.500	0.979	135.7	0.381	-19.5	0.005	8.7	0.904	132.5
2.000	0.974	119.1	0.327	-51.1	0.006	0.5	0.904	112.8
2.500	0.966	101.9	0.345	-82.8	0.010	-22.6	0.892	87.4
3.000	0.965	82.2	0.428	-118.9	0.012	-49.5	0.831	56.7
3.500	0.966	59.6	0.634	-163.3	0.019	-84.0	0.696	10.8
4.000	0.958	33.3	0.977	138.5	0.029	-149.1	0.512	-66.4
4.500	0.904	-3.9	1.354	69.6	0.019	131.6	0.503	-171.1
5.000	0.794	-59.9	1.838	-0.2	0.015	29.9	0.604	115.2
5.100	0.765	-74.8	1.953	-15.1	0.015	3.6	0.624	103.2
5.200	0.732	-91.1	2.066	-30.7	0.017	-24.9	0.637	91.6
5.300	0.701	-108.7	2.175	-46.3	0.020	-45.2	0.643	80.2
5.400	0.672	-127.3	2.266	-62.3	0.022	-67.6	0.645	68.8
5.500	0.645	-146.5	2.345	-78.5	0.026	-91.2	0.644	56.9
5.600	0.626	-166.4	2.419	-94.6	0.030	-110.9	0.634	45.3
5.700	0.616	174.0	2.480	-110.9	0.034	-131.5	0.619	33.0
5.800	0.608	154.7	2.519	-126.6	0.038	-150.6	0.588	20.9
5.900	0.604	136.4	2.547	-142.8	0.044	-170.3	0.564	7.7
6.000	0.604	119.4	2.562	-158.2	0.046	171.5	0.528	-5.3
6.100	0.608	103.7	2.576	-173.4	0.048	154.8	0.499	-17.7
6.200	0.606	88.5	2.609	171.6	0.050	139.1	0.461	-31.0
6.300	0.607	73.6	2.663	156.3	0.053	124.3	0.427	-44.4
6.400	0.604	59.5	2.748	141.0	0.056	109.8	0.390	-59.2
6.500	0.581	45.2	2.794	125.4	0.060	94.2	0.354	-75.9
6.600	0.553	31.3	2.859	109.2	0.064	79.6	0.319	-93.8
6.700	0.512	17.0	2.901	92.5	0.067	64.4	0.287	-114.5
6.800	0.463	1.5	2.935	75.5	0.071	49.1	0.263	-138.0
6.900	0.406	-15.0	2.947	58.9	0.074	32.5	0.247	-162.9
7.000	0.345	-33.9	2.950	41.7	0.077	16.9	0.238	171.2
7.100	0.288	-58.7	2.950	23.6	0.081	-0.1	0.233	147.2
7.200	0.255	-87.6	2.943	6.2	0.084	-18.8	0.216	124.5
7.300	0.256	-122.9	2.932	-11.3	0.083	-35.4	0.197	105.6
7.400	0.299	-154.8	2.882	-29.5	0.083	-53.1	0.160	84.7
7.500	0.371	179.6	2.826	-48.0	0.082	-70.5	0.113	67.2
7.600	0.455	159.1	2.723	-66.7	0.081	-90.3	0.050	41.9
7.700	0.537	141.6	2.605	-85.7	0.078	-107.0	0.036	-119.9
7.800	0.616	126.2	2.434	-104.9	0.073	-124.9	0.125	-147.9
7.900	0.678	113.0	2.251	-123.4	0.069	-143.6	0.224	-165.9
8.000	0.724	100.4	2.041	-142.1	0.064	-162.9	0.318	178.3
8.100	0.754	89.2	1.843	-160.1	0.059	179.4	0.416	162.7
8.200	0.775	79.2	1.637	-177.2	0.052	162.4	0.498	148.3
8.500	0.791	53.1	1.090	135.3	0.037	113.8	0.675	110.2
9.000	0.784	18.3	0.561	71.2	0.023	37.9	0.846	62.6
9.500	0.757	-16.4	0.324	19.8	0.017	-40.2	0.929	30.0
10.000	0.663	-55.1	0.221	-26.6	0.021	-152.9	0.921	1.8

NEZ7785-15D

$V_{DS} = 10 \text{ V}$, $I_{DS} = 4 \text{ 000 mA}$, $V_{GS} = -1.472 \text{ V}$, $I_G = 0.0 \text{ mA}$, $R_G = 50 \Omega$

FREQUENCY GHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
4.000	0.967	44.0	0.750	177.7	0.023	-125.5	0.438	3.8
4.500	0.956	19.9	0.963	125.3	0.024	174.9	0.136	-55.0
5.000	0.931	-9.3	1.167	69.9	0.023	109.5	0.217	120.5
5.500	0.878	-47.9	1.403	13.1	0.022	34.4	0.459	74.8
6.000	0.770	-99.3	1.707	-46.6	0.033	-50.7	0.574	34.2
6.200	0.706	-124.6	1.827	-71.9	0.037	-82.7	0.594	15.7
6.400	0.636	-152.7	1.932	-96.6	0.043	-111.8	0.596	-1.2
6.500	0.615	-168.0	1.983	-109.4	0.047	-129.6	0.952	-10.8
6.600	0.595	176.2	2.028	-122.2	0.050	-143.9	0.585	-19.2
6.800	0.570	144.7	2.112	-147.9	0.050	-166.2	0.559	-37.4
7.000	0.566	115.2	2.231	-173.6	0.056	166.7	0.551	-56.4
7.200	0.570	89.5	2.284	162.0	0.063	147.5	0.529	-77.5
7.400	0.545	64.6	2.322	135.7	0.069	120.8	0.494	-100.4
7.500	0.524	52.5	2.384	122.8	0.072	112.5	0.482	-113.0
7.600	0.512	40.9	2.398	109.7	0.073	95.4	0.459	-127.0
7.700	0.482	28.1	2.454	96.9	0.079	86.3	0.451	-140.7
7.800	0.456	16.3	2.474	83.2	0.079	71.9	0.427	-156.2
7.900	0.424	2.7	2.515	70.0	0.082	59.0	0.410	-171.6
8.000	0.389	-9.7	2.539	56.1	0.083	44.6	0.397	171.9
8.100	0.354	-27.6	2.573	42.4	0.086	33.3	0.385	154.9
8.200	0.320	-42.2	2.571	28.3	0.089	18.9	0.373	137.8
8.300	0.278	-63.1	2.568	13.4	0.086	5.6	0.368	120.0
8.400	0.250	-84.3	2.579	-0.3	0.086	-7.9	0.364	103.7
8.500	0.248	-111.0	2.571	-14.6	0.086	-20.7	0.364	88.4
8.600	0.239	-135.3	2.551	-29.6	0.087	-34.2	0.370	72.1
8.700	0.259	-162.1	2.492	-43.5	0.089	-50.7	0.365	58.2
8.800	0.289	175.8	2.467	-58.3	0.086	-62.5	0.365	43.6
8.900	0.325	156.2	2.393	-72.3	0.082	-75.7	0.355	32.1
9.000	0.369	136.3	2.313	-87.2	0.087	-92.2	0.329	18.2
9.200	0.455	106.0	2.157	-115.8	0.082	-120.0	0.264	-7.8
9.400	0.549	80.8	2.005	-142.4	0.078	-141.9	0.180	-37.0
9.500	0.587	70.4	1.962	-155.4	0.079	-155.5	0.143	-60.7
9.600	0.633	58.6	1.920	-169.5	0.079	-169.0	0.111	-98.3
9.800	0.714	37.2	1.763	161.5	0.076	162.2	0.151	-176.7
10.000	0.773	15.2	1.599	133.2	0.072	135.6	0.266	142.2

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