NEC

N-CHANNEL GaAs MES FET
NE960R5 SERIES

0.5 W X, Ku-BAND POWER GaAs MES FET

DESCRIPTION

The NE960R5 Series are 0.5 W GaAs MES FETs designed for middle power transmitter applications for X, Ku-band microwave communication systems. It is capable of delivering 0.5 watt of output power (CW) with high linear gain, high efficiency and low distortion and are suitable as driver amplifiers for our X, Ku-band NEZ Series amplifiers etc. The NE961R500 and the NE960R500 are available in chip form. The NE960R500 has a via hole source grounding and PHS (Plated Heat Sink) for superior RF performance. The NE960R575 and the NE962R575 are available in a hermetically sealed ceramic package. The NE962R575 is suitable for oscillator application. Reliability and performance uniformity are assured by NEC's stringent quality and control procedures.

FEATURES

- High Output Power : $P_{o\ (1\ dB)}$ = +27.5 dBm TYP.
- High Linear Gain : 9.0 dB TYP.
- High Power Added Efficiency: 30 % TYP. @V_{DS} = 9 V, I_{Dset} = 180 mA, f = 14.5 GHz

ORDERING INFORMATION

Part Number	Package	Supplying Form
NE960R500	00 (CHIP)	ESD protective envelope
NE961R500		
NE960R575	75	
NE962R575		

Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: NE960R500, NE960R575, NE961R500, NE962R575)

Caution Please handle this device at static-free workstation, because this is an electrostatic sensitive device.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

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ABSOLUTE MAXIMUM RATINGS (T_A = +25°C)

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

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V_{DS}	15	V
Gate to Source Voltage	V_{GSO}	–7 (–9[Note 1])	V
Drain Current	I_D	0.7	A
Gate Forward Current	I_{GF}	+5.0	mA
Gate Reverse Current	I_{GR}	–5.0	mA
Total Power Dissipation	P_T	5.0 (4.2[Note 2])	W
Channel Temperature	T_{ch}	175	°C
Storage Temperature	T_{stg}	–65 to +175	°C

Notes 1. NE962R575
2. NE961R500

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Test Condition	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V_{DS}		–	9.0	9.0	V
Gain Compression	Gcomp		–	–	3.0	dB
Channel Temperature	T_{ch}		–	–	+130	°C

ELECTRICAL CHARACTERISTICS

(T_A = +25°C, unless otherwise specified, using NEC standard test fixture.)

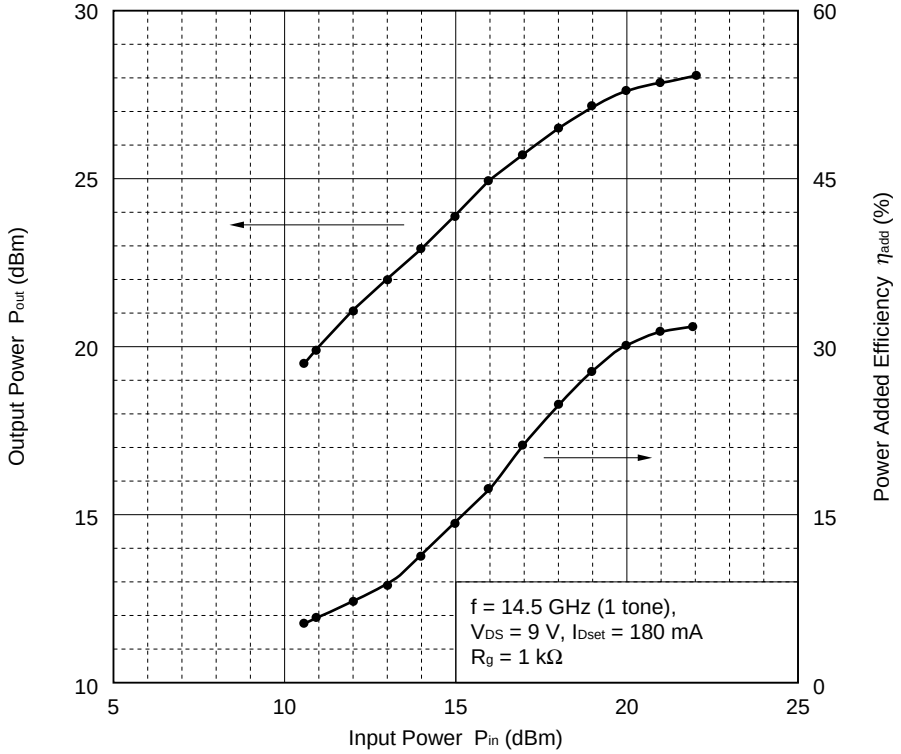
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	I_{DSS}	V_{DS} = 1.5 V, V_{GS} = 0 V	0.18	0.4	0.7	A
Pinch-off Voltage	V_p	V_{DS} = 2.5 V, I_D = 2 mA	–2.5	–1.8	–0.5	V
Gate to Drain Break Down Voltage[Note 1]	BV_{gd}	I_{gd} = 2 mA	15	–	–	V
Gate to Source Break Down Voltage[Note 2]	BV_{gs}	I_{gs} = 2 mA	9.0	–	–	V
Thermal Resistance	R_{th}	Channel to Case	–	–	30 (35[Note 3])	°C/W
Output Power at P_{in} = +19 dBm	P_{out}	f = 14.5 GHz, V_{DS} = 9.0 V R_g = 1 kΩ I_{Dset} = 180 mA (RF OFF)	25.5	26.5	–	dBm
Output Power at 1 dB Gain Compression Point[Note 1]	$P_{o\ (1\ dB)}$		–	27.5	–	dBm
Power Added Efficiency at $P_{o\ (1dB)}$[Note 1]	η_{add}		–	30	–	%
Linear Gain[Note 1]	G_L		8.0	9.0	–	dB

Notes 1. Except NE962R575
2. NE962R575 only
3. NE961R500

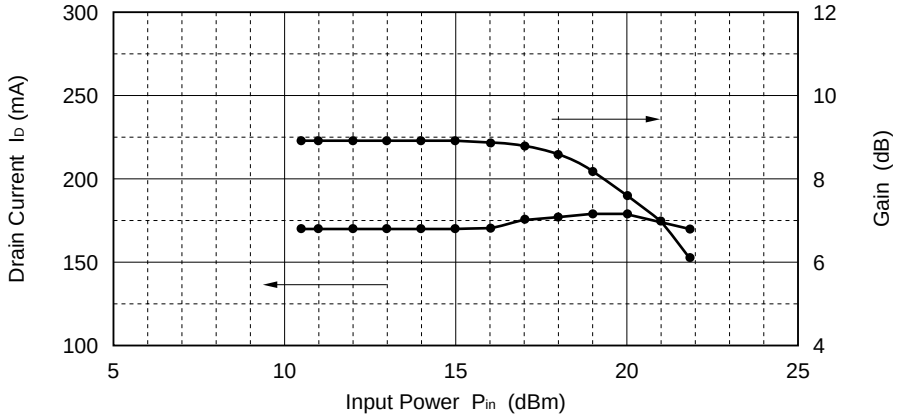
Remark DC and RF performance is 100 % testing.

TYPICAL CHARACTERISTICS (T_A = +25°C)

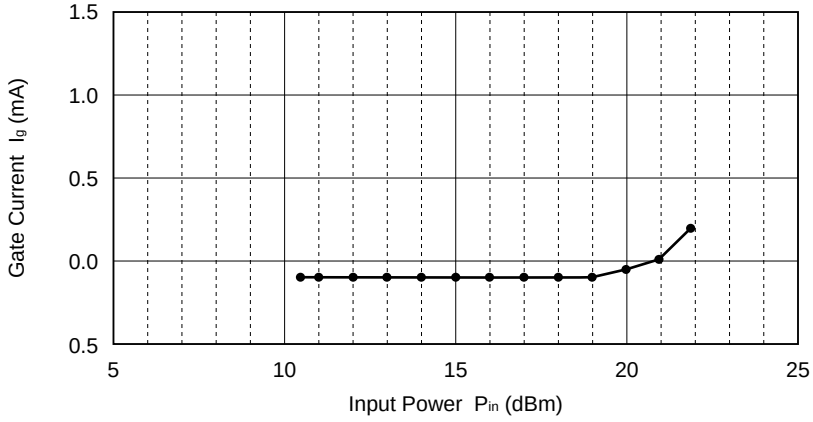
OUTPUT POWER AND POWER ADDED EFFICIENCY vs. INPUT POWER



DRAIN CURRENT AND GAIN vs. INPUT POWER



GATE CURRENT vs. INPUT POWER

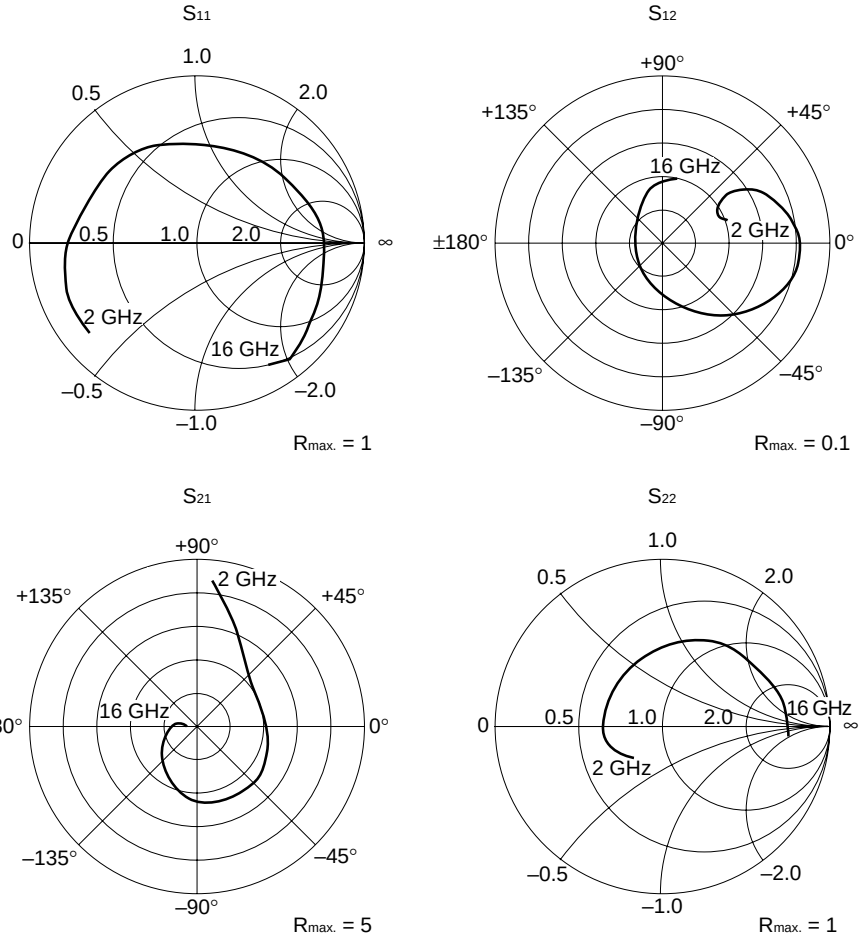


TYPICAL S-PARAMETER
[NE960R575]

TEST CONDITIONS: V_{DS} = 9 V, I_{Dset} = 180 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
2.0	0.87	–140	4.36	85	0.042	23	0.23	–131
3.0	0.84	–154	2.98	68	0.040	19	0.25	–143
4.0	0.84	–160	2.36	54	0.040	22	0.30	–149
5.0	0.82	–163	2.08	42	0.043	32	0.32	–154
6.0	0.81	–167	1.99	33	0.047	34	0.34	–160
7.0	0.79	–175	1.96	18	0.055	35	0.36	–168
8.0	0.73	171	2.02	1	0.066	30	0.36	178
9.0	0.69	147	2.20	–20	0.076	18	0.37	159
10.0	0.62	109	2.30	–51	0.083	–4	0.38	136
11.0	0.63	47	2.22	–88	0.063	–41	0.45	95
12.0	0.76	0	1.62	–124	0.032	–82	0.57	65
13.0	0.79	–21	1.30	–144	0.017	–141	0.61	49
14.0	0.87	–45	0.90	–172	0.022	128	0.66	27
15.0	0.87	–53	0.60	166	0.034	101	0.73	11
16.0	0.83	–60	0.43	150	0.037	82	0.75	–2

START 2 GHz, STOP 16 GHz, STEP 1 GHz



[NE960R500]

TEST CONDITIONS: V_{DS} = 9 V, I_{Dset} = 180 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
2.0	0.87	–132	6.53	160	0.038	90	0.23	–105
3.0	0.85	–146	4.06	–168	0.037	120	0.25	–118
4.0	0.85	–155	2.74	–148	0.038	155	0.29	–124
5.0	0.86	–158	2.24	–121	0.038	–177	0.34	–131
6.0	0.86	–161	1.89	–93	0.037	–137	0.39	–133
7.0	0.85	–162	1.62	–66	0.033	–109	0.44	–135
8.0	0.84	–163	1.32	–40	0.032	–64	0.48	–137
9.0	0.85	–165	1.24	–11	0.039	–35	0.53	–138
10.0	0.86	–170	1.12	16	0.032	5	0.56	–139
11.0	0.86	–174	1.04	43	0.032	47	0.58	–142
12.0	0.85	179	0.94	64	0.041	78	0.61	–146
13.0	0.85	172	0.83	86	0.025	108	0.63	–149
14.0	0.87	172	0.65	114	0.038	153	0.65	–153
15.0	0.86	170	0.60	152	0.028	171	0.65	–157
16.0	0.87	167	0.57	–178	0.032	–142	0.68	–159
17.0	0.87	167	0.54	–150	0.032	–98	0.67	–164
18.0	0.87	163	0.40	–122	0.045	–80	0.67	–175

Caution S-parameters include bond wires.

Gate : Total 2 wires, 1 per bond pad, 300 μm long each wire.

Drain : Total 2 wires, 1 per bond pad, 300 μm long each wire.

Source : No bond wires.

Wire : 25 μm diameter, gold.

[NE961R500]

TEST CONDITIONS: V_{DS} = 9 V, I_{Dset} = 180 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
2.0	0.81	–134	6.37	163	0.040	105	0.17	–90
3.0	0.79	–149	3.73	–170	0.042	140	0.18	–107
4.0	0.78	–159	2.64	–151	0.047	–176	0.20	–118
5.0	0.79	–164	2.18	–125	0.053	–140	0.24	–127
6.0	0.78	–168	1.83	–97	0.060	–99	0.29	–132
7.0	0.77	–168	1.58	–69	0.061	–67	0.34	–136
8.0	0.76	–171	1.32	–43	0.072	–18	0.38	–138
9.0	0.76	–175	1.24	–14	0.098	6	0.43	–139
10.0	0.76	178	1.14	13	0.097	49	0.47	–139
11.0	0.77	171	1.03	40	0.112	85	0.50	–141
12.0	0.77	164	0.94	65	0.153	113	0.53	–145
13.0	0.79	160	0.87	89	0.111	146	0.56	–149
14.0	0.81	155	0.69	116	0.189	–178	0.57	–156
15.0	0.81	153	0.68	153	0.145	–161	0.58	–161
16.0	0.81	151	0.64	–176	0.192	–119	0.58	–166
17.0	0.80	148	0.62	–149	0.205	–81	0.58	–174
18.0	0.81	144	0.47	–114	0.267	–69	0.58	175

Caution S-parameters include bond wires.

Gate : Total 2 wires, 1 per bond pad, 300 μm long each wire.

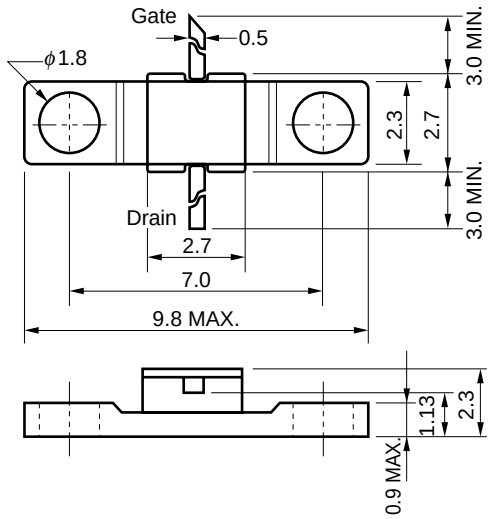
Drain : Total 2 wires, 1 per bond pad, 300 μm long each wire.

Source : Total 4 wires, 1 per bond pad, 300 μm long each wire.

Wire : 25 μm diameter, gold.

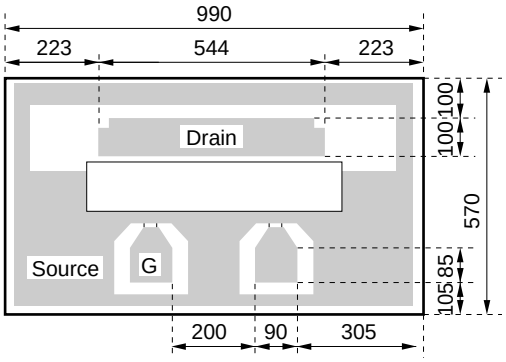
PACKAGE DIMENSIONS

PACKAGE CODE-75 (Unit: mm)



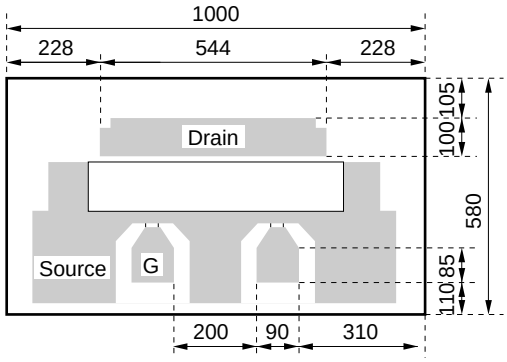
PHYSICAL DIMENSIONS

NE960R500 (CHIP) (Unit: μm)



Remark Chip thickness: 100 μm
G : Gate
Source is grounded through via hole.

NE961R500 (CHIP) (Unit: μm)



Remark Chip thickness: 140 μm
G : Gate

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Partial Heating	Pin temperature: 260°C Time: 5 seconds or less (per pin row) Exposure limit: None[Note]	–

Note After opening the dry pack, keep it in a place below 25°C and 65 % RH for the allowable storage period.

Caution Do not use different soldering methods together (except for partial heating).

CHIP HANDLING

DIE ATTACHMENT

Die attach can be accomplished with a Au-Sn (300 ±10°C) performs in a forming gas environment. Epoxy die attach is not recommended.

BONDING

Gate and drain bonding wires should be minimum length, semi-hard gold wire (3 to 8 % elongation) 30 microns or less in diameter.

Bonding should be performed with a wedge tip that has a taper of approximately 15 %.

Die attach and bonding time should be kept to a minimum. As a general rule, the bonding operation should be kept within a 280°C_5 minute curve. 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.

[MEMO]

[MEMO]

[MEMO]

Caution

The Great Care must be taken in dealing with the devices in this guide.
The reason is that the material of the devices is GaAs (Gallium Arsenide), which is designated as harmful substance according to the law concerned.
Keep the law concerned and so on, especially in case of removal.

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