

# PRELIMINARY

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MITSUBISHI SEMICONDUCTOR <GaAs FET>

# MGFC4419G

InGaAs HEMT Chip

## DESCRIPTION

The MGFC4419G low-noise HEMT(High electron Mobility Transistor) is designed for use in X to K band amplifiers.

## FEATURES (TARGET)

- Low noise figure  
NF<sub>min</sub>=0.5 dB (MAX.) @ f=12GHz
- High associated gain  
G<sub>s</sub>=12.0 dB (MIN.) @ f=12GHz

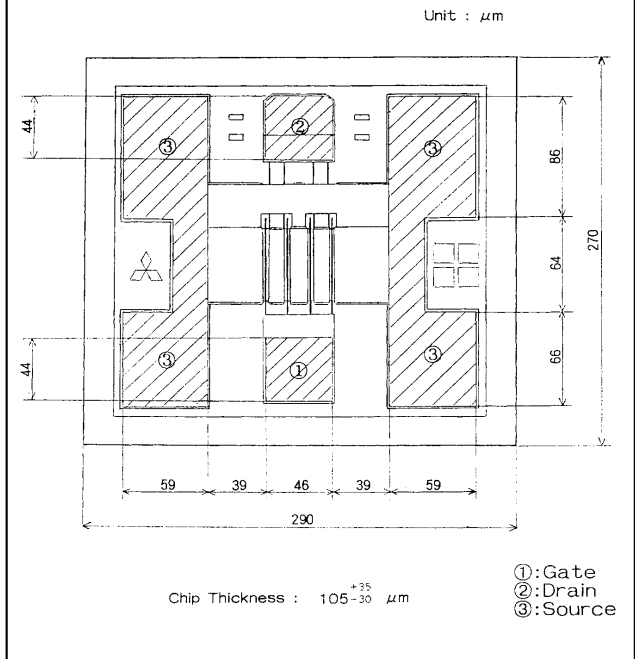
## APPLICATION

X to K band amplifiers.

## RECOMMENDED BIAS CONDITIONS

- V<sub>DS</sub>=2V , I<sub>D</sub>=10mA  
Refer to Bias Procedure

## OUTLINE DRAWING



## ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Symbol	Parameter	Ratings	Unit
V <sub>GDO</sub>	Gate to drain voltage	-4	V
V <sub>GSO</sub>	Gate to source voltage	-4	V
I <sub>D</sub>	Drain current	60	mA
P <sub>T</sub>	Total power dissipation	50	mW
T <sub>ch</sub>	Channel temperature	125	°C
T <sub>stg</sub>	Storage temperature	-65 ~ +125	°C

< Keep safety first in your circuit designs! >

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

## ELECTRICAL CHARACTERISTICS (Ta=25°C)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max	
V <sub>(BR)GDO</sub>	Gate to drain breakdown voltage	I <sub>G</sub> = -10μA	-3	—	—	V
I <sub>GSS</sub>	Gate to source leakage current	V <sub>GS</sub> =2V, V <sub>DS</sub> =0V	—	—	50	μA
I <sub>DSS</sub>	Saturated drain current	V <sub>DS</sub> =2V, V <sub>GS</sub> =0V	—	—	60	mA
V <sub>GS(off)</sub>	Gate to Source cut-off voltage	V <sub>DS</sub> =2V, I <sub>D</sub> =500μA	-0.1	—	-1.5	V
gm	Transconductance	V <sub>DS</sub> =2V, I <sub>D</sub> =10mA	—	75	—	mS
G <sub>s</sub>	Associated gain	V <sub>DS</sub> =2V, I <sub>D</sub> =10mA f=12GHz	12	13.5	—	dB
N <sub>Fmin</sub>	Minimum noise figure		—	—	0.5	dB

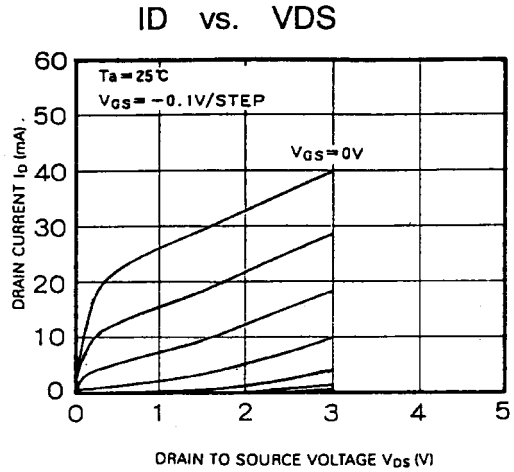
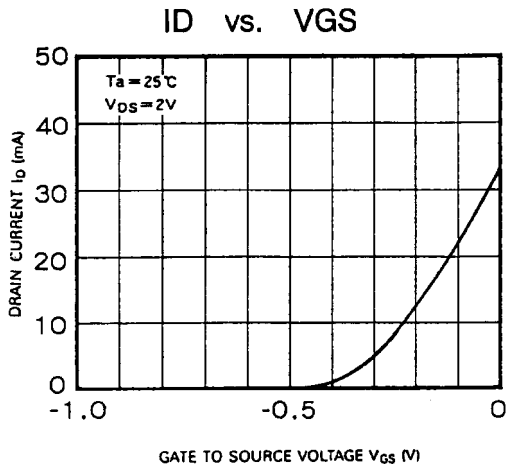
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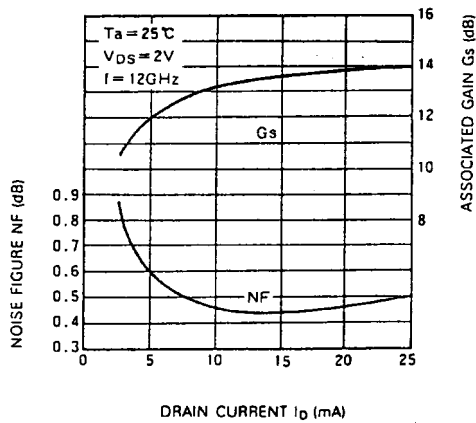
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**Typical Characteristics**



**NF & Gs vs. ID  
(f=12GHz)**



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## Typical Characteristics

### S Parameters (Ta=25 deg.C , VDS=2V , ID=10mA )

f (GHz)	S11		S21		S12		S22		MSG/MAG (dB)	K
	Magn.	Angle	Magn.	Angle	Magn.	Angle	Magn.	Angle		
1	0.994	-12.2	5.908	169.6	0.019	82.3	0.660	-8.9	24.9	0.017
2	0.976	-24.3	5.790	159.4	0.037	74.9	0.645	-17.6	21.9	0.038
3	0.950	-36.0	5.608	149.5	0.054	67.7	0.623	-26.0	20.1	0.065
4	0.917	-47.3	5.380	140.0	0.069	61.1	0.595	-34.0	18.9	0.100
5	0.880	-58.1	5.123	131.1	0.083	54.9	0.564	-41.6	17.9	0.143
6	0.842	-68.4	4.854	122.7	0.094	49.3	0.531	-48.7	17.1	0.192
7	0.805	-78.2	4.585	114.8	0.103	44.2	0.498	-55.5	16.5	0.246
8	0.771	-87.6	4.324	107.3	0.111	39.6	0.466	-61.9	15.9	0.304
9	0.739	-96.5	4.076	100.3	0.117	35.4	0.436	-68.1	15.4	0.364
10	0.711	-104.9	3.843	93.7	0.122	31.7	0.407	-74.1	15.0	0.425
11	0.687	-113.1	3.626	87.4	0.127	28.3	0.381	-79.9	14.6	0.486
12	0.666	-120.9	3.426	81.4	0.130	25.3	0.357	-85.6	14.2	0.546
13	0.648	-128.3	3.241	75.7	0.133	22.5	0.335	-91.4	13.9	0.604
14	0.634	-135.5	3.071	70.2	0.136	20.0	0.316	-97.2	13.6	0.660
15	0.622	-142.3	2.914	64.9	0.138	17.7	0.298	-103.0	13.3	0.713
16	0.613	-148.9	2.770	59.8	0.139	15.6	0.283	-109.0	13.0	0.763
17	0.607	-155.2	2.636	54.8	0.141	13.8	0.270	-115.1	12.7	0.810
18	0.603	-161.3	2.513	50.0	0.143	12.0	0.259	-121.4	12.5	0.853
19	0.600	-167.0	2.398	45.3	0.144	10.5	0.250	-127.8	12.2	0.892
20	0.600	-172.6	2.292	40.7	0.145	9.0	0.243	-134.3	12.0	0.927
21	0.601	-177.9	2.193	36.3	0.146	7.7	0.238	-140.9	11.8	0.958
22	0.603	177.0	2.100	31.9	0.148	6.4	0.235	-147.5	11.5	0.984
23	0.606	172.2	2.013	27.7	0.149	5.3	0.234	-154.1	10.8	1.006
24	0.610	167.5	1.931	23.5	0.151	4.2	0.235	-160.6	10.1	1.024
25	0.616	163.0	1.855	19.4	0.152	3.1	0.238	-166.9	9.7	1.037
26	0.621	158.7	1.782	15.4	0.154	2.1	0.242	-173.0	9.3	1.045

### Noise Parameters (Ta=25 deg.C , VDS=2V , ID=10mA )

f (GHz)	Gopt.		Rn (W)	NFmin. (dB)	Gs (dB)
	Magn.	Angle			
4	0.71	33.0	18.0	0.24	18.3
8	0.62	61.1	14.6	0.35	15.9
12	0.55	87.0	12.2	0.45	13.5
18	0.48	123.8	10.3	0.63	9.9
22	0.45	148.1	11.0	0.78	7.5
26	0.45	173.2	12.4	0.98	5.1

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## TECHNICAL NOTE

### 1. Characteristics and quality assurance

#### 1.1 Electrical characteristics

- a. DC characteristics on spec. sheet show the test conditions and values using wafer-prober. DC characteristics are tested 100% devices.
- b. RF characteristics are tested using the corresponding packaged FET. When more than 80% of the samples satisfy the value of RF characteristics on spec. sheet, that wafer is accepted for shipment.

#### 1.2 Quality assurance and reliability

- a. Mechanical characteristics are tested using corresponding package with sampling test.
- b. Visual inspection is complied with MITSUBISHI's technical note.
- c. The electrical characteristics and the quality assurance test are sampling test. And so the shipped chips are contained some sub-standard articles.
- d. After opening the packing, the quality of chips are influenced with storage conditions. Our recommended storage conditions and period is as follows:

$$T_a = 25 \pm 3 \text{ deg.C}$$

MITSUBISHI's packing + Desiccator      6 months

Opened packing + Desiccator            2 months

In the desiccator, leave the chips in the pack keeping up-side-up and store in a clean and dry environment, preferable dry N<sub>2</sub>.

#### e. Packing quantity

Standard : 400 pcs. or 50 pcs. / each waffle pack

Custom order : 25~400 pcs. / each waffle pack by 25 pcs. step

In case of long storage exceeding 2 months at customer after opening the packing, total quantity of order shall be separated and small unit quantity of each orders shall be custom ordered. In this case, we may prepare special spec. No. for each customer. (ex. -21,-22)

#### 1.3 Others

The device shall not be returned in the following case.

- a. Inadequate storage
- b. Mishandling
- c. Incorrect die/wire bonding
- d. RF characteristics failure rate less than 30%.

### 2. Ordering information

The classification with Visual grade & packing quantity is listed in Table.1.

Table.1. Standard specifications

Spec.No.	Visual Grade	Unit quantity for each waffle pack
-A01	A	400 pcs
-A02	B	
-A03	C	
-A11	A	25 pcs
-A12	B	
-A13	C	

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## S Parameters for MGFC4419G (Simulated Value)

(Conditions:VDS=2V,IDS=10mA,Ta=25C)

f (GHz)	S11		S21		S12		S22		K	GMAX (dB)
	Mag.	Angle	Mag.	Angle	Mag.	Angle	Mag.	Angle		
1	0.994	-12.1	5.823	169.7	0.019	82.3	0.666	-8.8	0.05	24.8
2	0.977	-24.1	5.709	159.5	0.037	74.8	0.652	-17.4	0.10	21.8
3	0.951	-35.8	5.534	149.6	0.054	67.5	0.630	-25.7	0.16	20.1
4	0.918	-47.0	5.314	140.2	0.070	60.8	0.602	-33.7	0.21	18.8
5	0.882	-57.8	5.066	131.3	0.083	54.5	0.570	-41.2	0.26	17.9
6	0.844	-68.1	4.804	122.9	0.094	48.8	0.536	-48.3	0.31	17.1
7	0.808	-77.9	4.542	114.9	0.103	43.5	0.502	-55.1	0.36	16.4
8	0.773	-87.2	4.286	107.4	0.111	38.8	0.469	-61.6	0.41	15.9
9	0.742	-96.2	4.043	100.4	0.117	34.5	0.438	-67.7	0.46	15.4
10	0.713	-104.7	3.813	93.7	0.123	30.6	0.408	-73.7	0.51	14.9
11	0.688	-112.9	3.599	87.4	0.127	27.0	0.380	-79.6	0.56	14.5
12	0.667	-120.7	3.401	81.3	0.130	23.8	0.355	-85.5	0.61	14.2
13	0.649	-128.2	3.218	75.6	0.133	20.9	0.332	-91.3	0.66	13.8
14	0.634	-135.4	3.049	70.0	0.135	18.2	0.311	-97.3	0.71	13.5
15	0.623	-142.4	2.893	64.7	0.137	15.8	0.293	-103.4	0.75	13.2
16	0.614	-149.0	2.750	59.5	0.139	13.5	0.277	-109.6	0.80	13.0
17	0.607	-155.4	2.616	54.5	0.140	11.5	0.263	-116.0	0.84	12.7
18	0.603	-161.5	2.493	49.6	0.141	9.6	0.251	-122.6	0.88	12.5
19	0.600	-167.3	2.379	44.9	0.142	7.9	0.242	-129.4	0.92	12.2
20	0.599	-172.9	2.272	40.3	0.143	6.3	0.235	-136.3	0.95	12.0
21	0.600	-178.3	2.173	35.8	0.144	4.9	0.230	-143.3	0.99	11.8
22	0.602	176.6	2.080	31.4	0.145	3.5	0.227	-150.4	1.02	10.8
23	0.606	171.7	1.993	27.1	0.146	2.2	0.227	-157.3	1.04	10.1
24	0.610	167.0	1.911	22.8	0.147	1.1	0.228	-164.2	1.07	9.5
25	0.615	162.5	1.833	18.7	0.148	-0.1	0.232	-170.8	1.09	9.1
26	0.621	158.2	1.760	14.6	0.150	-1.1	0.237	-177.2	1.11	8.7
27	0.627	154.0	1.691	10.7	0.151	-2.1	0.243	176.8	1.13	8.3
28	0.634	150.1	1.626	6.8	0.152	-3.1	0.251	171.0	1.14	8.0
29	0.641	146.3	1.564	3.0	0.154	-4.1	0.261	165.6	1.15	7.7
30	0.649	142.6	1.504	-0.8	0.155	-5.1	0.271	160.5	1.15	7.5
31	0.657	139.1	1.448	-4.5	0.157	-6.0	0.281	155.7	1.16	7.2
32	0.664	135.8	1.394	-8.1	0.159	-7.0	0.293	151.1	1.16	7.0
33	0.672	132.5	1.343	-11.6	0.161	-8.0	0.305	146.9	1.16	6.8
34	0.680	129.4	1.293	-15.0	0.163	-9.0	0.317	142.8	1.15	6.6
35	0.688	126.4	1.246	-18.4	0.166	-10.0	0.330	139.0	1.15	6.4
36	0.696	123.4	1.201	-21.7	0.168	-11.0	0.343	135.4	1.14	6.3
37	0.703	120.6	1.158	-24.9	0.170	-12.1	0.356	132.0	1.13	6.1
38	0.710	117.9	1.117	-28.1	0.173	-13.2	0.369	128.7	1.12	6.0
39	0.717	115.3	1.078	-31.2	0.175	-14.3	0.382	125.6	1.11	5.8
40	0.724	112.8	1.040	-34.2	0.178	-15.4	0.394	122.6	1.10	5.7