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FMA219

X-BAND LNA MMIC

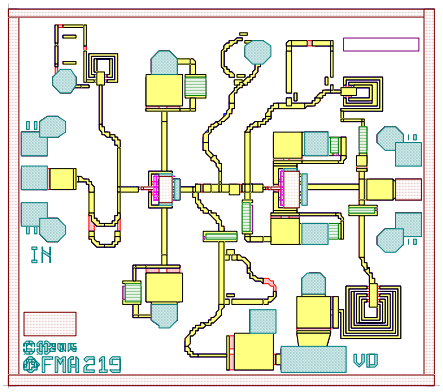
Package Style: Bare Die

Product Description

The FMA219 is a two-stage, reactively matched pHEMT low-noise MMIC amplifier designed for use over 7.0GHz to 11.0GHz. The amplifier requires a single +3V supply and one off-chip component for supply decoupling. Both the input and output ports are DC decoupled. Grounding of the amplifier is provided by plated thru-vias to the bottom of the die, no additional ground is required. The amplifier is unconditionally stable over all load states (-45°C to +85°C), and conditionally stable if the input port is open-circuited.

Optimum Technology Matching® Applied

- ☐ GaAs HBT
- ☐ GaAs MESFET
- ☐ InGaP HBT
- ☐ SiGe BiCMOS
- ☐ Si BiCMOS
- ☐ SiGe HBT
- ☑ GaAs pHEMT
- ☐ Si CMOS
- ☐ Si BJT
- ☐ GaN HEMT
- ☐ InP HBT
- ☐ RF MEMS
- ☐ LDMOS



Features

- 7.0GHz - 11.0GHz Operating Bandwidth
- 1.1dB Noise Figure
- 21dB Small-Signal Gain
- 12dBm Output Power
- +3V Single Bias Supply
- DC Decoupled Input and Output Ports

Applications

- Low Noise Front End Amplifiers
- General X-Band Gain Block

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Electrical Specifications					
Operating Frequency Bandwidth	7		11	GHz	V_{DD}=+3V, I_{DD}=I_{OP}
Small Signal Gain	19	21	23	dB	V_{DD}=+3V, I_{DD}=I_{OP}
Operating Current	50	65	80	mA	No RF input
Small Signal Gain Flatness		±0.5	±0.8		V_{DD}=+3V, I_{DD}=I_{OP}
Noise Figure		1.1	1.4	dB	V_{DD}=+3V, I_{DD}=I_{OP}
3rd Order Intermodulation Distortion		-47		dBc	V_{DD}=+3V, I_{DD}=I_{OP}, P_{OUT}=+1.5dBm SCL
Power at 1dB Compression	11.5	12.5		dBm	V_{DD}=+3V
Input Return Loss		-7	-3	dB	V_{DD}=+3V, I_{DD}=I_{OP}
Input Return Loss @ 9.5GHz and 10GHz			-4	dB	V_{DD}=+3V, I_{DD}=I_{OP}
Output Return Loss		-16	-10	dB	V_{DD}=+3V, I_{DD}=I_{OP}
Reverse Isolation		-40	-30	dB	V_{DD}=+3V, I_{DD}=I_{OP}

Note: $T_{AMBIENT}$=22°C

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Absolute Maximum Ratings[1]

Parameter	Rating	Unit
Source Voltage (V_{DD})	6	V
Supply Current (I_{DD})	100	mA
RF Input Power (P_{IN})[2] (For standard bias conditions)	5	dBm
Storage Temperature (T_{STG}) (Non-Operating Storage)	-40 to 150	°C
Total Power Dissipation (P_{TOT})[2, 3]	750	mW
Gain Compression (Under bias conditions)	5	dB
Thermal Resistance θJC (750mW dissipation, heatsink temp 22°C)	175	°C/W

Notes: [1]$T_{AMBIENT}$ = 22 °C unless otherwise noted; exceeding any one of these absolute maximum ratings may cause permanent damage to the device.

[2]Total Power Dissipation (P_{TOT}) defined as $(P_{DC}+P_{IN})-P_{OUT}$, where P_{DC}: DC Bias Power, P_{IN}: RF Input Power, P_{OUT}: RF Output Power.
Total Power Dissipation to be de-rated as follows above 22 °C:
$P_{TOT} = (150-T_{CASE})/\theta JC$, where T_{CASE} = temperature of the package or substrate.

[3]The quoted thermal resistance value is a worst-case figure assuming Gold/Tin attach onto a Copper substrate. The use of epoxy die attach and substrate materials of lower thermal conductivity will increase the Thermal Resistance. Further information and assistance is available on request.

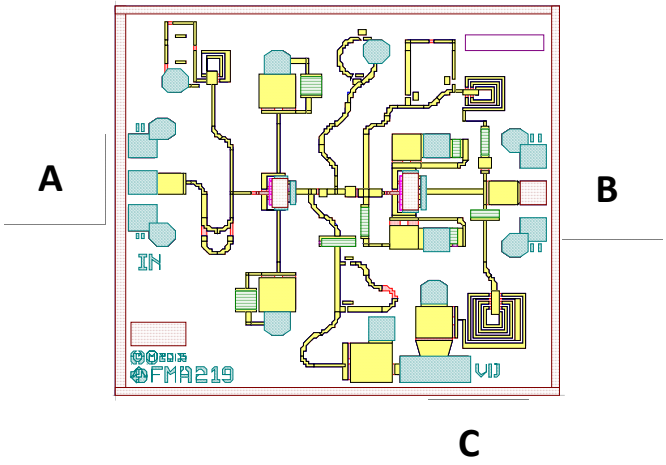
[4]θJC increases linearly from 175 °C/W at a T_{CASE} of 22 °C to 210 °C/W at a T_{CASE} of 145 °C.

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

Pad Layout



Pad	Name	Description	Pin Coordinates (μm)
A	IN	RF input	102, 888
B		RF output	1527, 843
C	VD	Drain voltage	1177, 103

Note: Coordinates are referenced from the bottom left corner of the die to the center of bond pad opening.

Die Size (μm)	Die Thickness (μm)	Min. Bond Pad Pitch (μm)	Min. Bond Pad Opening (μmxμm)
1624x1624	100	150	88x88

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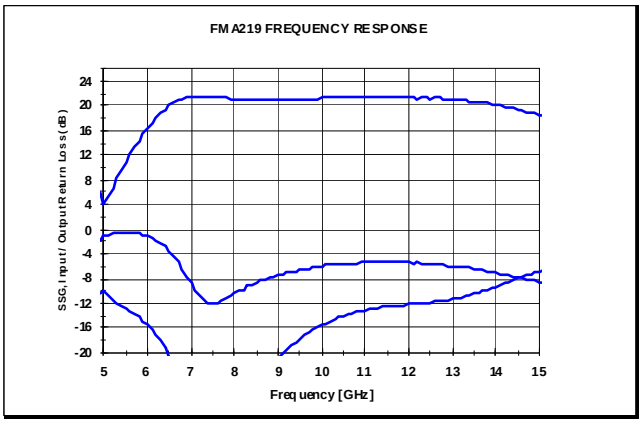
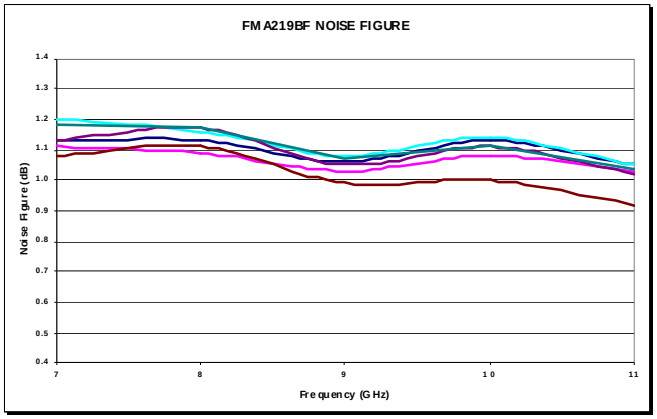
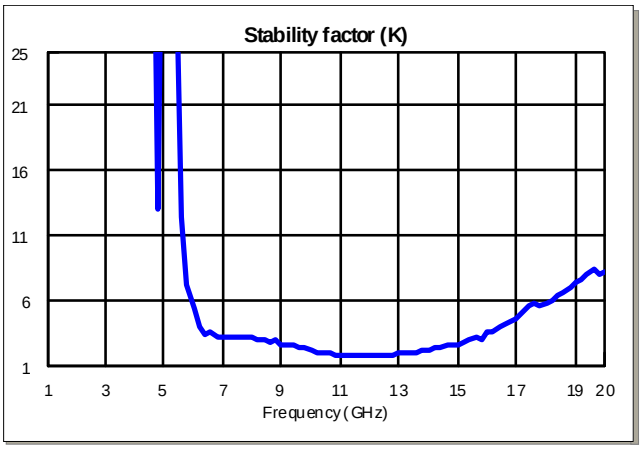
Typical Measured Performance On Wafer

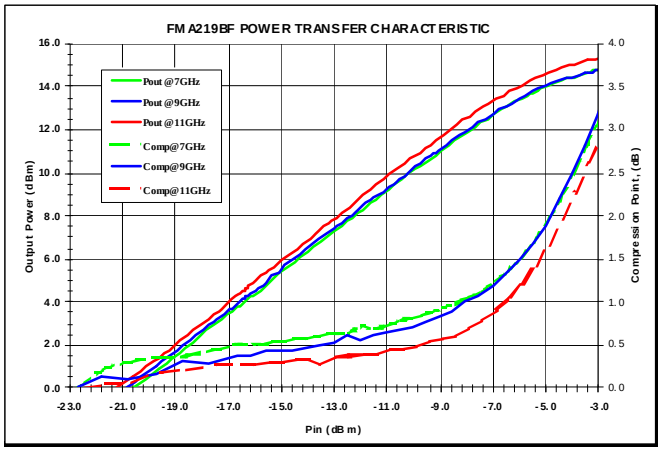
RF Performance (V_{DD}=+3V, I_{DD}=I_{OP}), $T_{AMBIENT}$=+22°C unless stated otherwise.

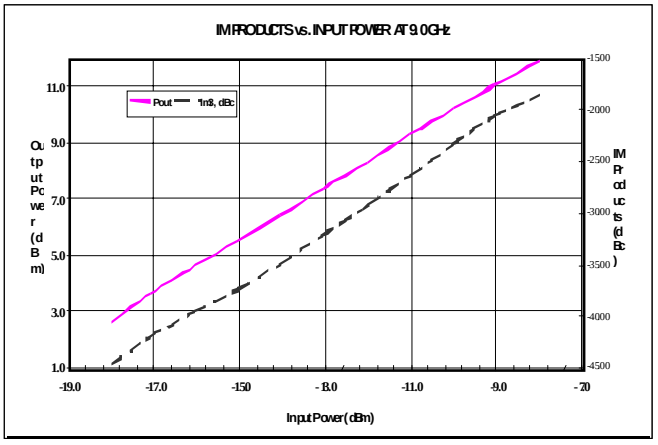






Note: Multiple traces show typical die variation across a 150mm (6") wafer. Effect of typical bond wire inductances (25µm diameter, 1mm length, two each on input and output ports) is >0.5dB decrease in S21 (at 11GHz), and no measurable effect on noise figure.





Note: Equivalent output IP3 performance exceeds 24dBm. Input IP3 is typically≥+2dBm.

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S-Parameters (V_{DD} = 3.0V, I_{DD} = 55mA)

Freq-MHz	S11 Mag	S11 Ang	S21 Mag	S21 Ang	S12 Mag	S12 Ang	S22 Mag	S22 Ang
1000	0.978	-107.6	0.044	-120.2	0.000	108.5	0.710	-121.3
1200	0.973	-121.6	0.048	-141.6	0.000	97.8	0.624	-135.2
1400	0.969	-133.8	0.057	-163.5	0.001	63.0	0.561	-145.5
1600	0.965	-144.5	0.060	177.8	0.000	51.2	0.510	-153.4
1800	0.963	-154.2	0.062	158.4	0.002	22.8	0.472	-159.4
2000	0.962	-162.9	0.062	143.1	0.001	16.1	0.443	-163.9
2200	0.960	-171.0	0.064	126.8	0.000	10.2	0.422	-167.7
2400	0.962	-178.6	0.067	110.3	0.001	17.6	0.407	-171.0
2600	0.964	174.1	0.075	93.1	0.001	6.8	0.397	-174.2
2800	0.966	166.6	0.085	71.4	0.001	-5.8	0.390	-177.1
3000	0.948	159.5	0.087	51.0	0.001	-14.0	0.386	179.9
3200	0.940	153.7	0.099	43.3	0.000	-21.3	0.380	177.2
3400	0.941	147.7	0.127	33.4	0.001	-30.3	0.374	173.9
3600	0.943	141.4	0.168	22.5	0.001	-37.9	0.376	170.8
3800	0.945	135.1	0.225	12.5	0.001	-42.5	0.370	167.8
4000	0.947	128.7	0.303	2.7	0.001	-47.5	0.366	164.4
4200	0.948	122.0	0.414	-7.1	0.001	-43.0	0.362	161.1
4400	0.952	115.1	0.568	-16.0	0.001	-55.6	0.358	157.7
4600	0.956	107.5	0.834	-26.0	0.001	-74.0	0.353	155.0
4800	0.933	97.6	1.406	-51.1	0.003	-98.8	0.368	153.6
5000	0.902	94.4	0.948	-69.7	0.002	173.5	0.364	142.3
5200	0.926	86.2	1.331	-63.3	0.001	142.7	0.345	137.6
5400	0.930	77.0	1.901	-70.9	0.001	92.2	0.331	132.2
5600	0.926	67.0	2.645	-82.2	0.002	65.8	0.317	125.6
5800	0.914	55.7	3.599	-95.9	0.003	56.0	0.295	117.6
6000	0.887	43.0	4.795	-111.3	0.004	35.1	0.260	109.1
6200	0.839	28.9	6.231	-128.7	0.006	25.7	0.214	101.6
6400	0.757	12.8	7.838	-147.7	0.008	4.6	0.161	97.6
6600	0.632	-3.7	9.388	-168.4	0.009	-23.7	0.118	105.0
6800	0.483	-18.4	10.563	170.6	0.011	-49.2	0.107	122.7
7000	0.341	-27.2	11.221	150.8	0.012	-65.1	0.126	130.4
7200	0.239	-28.6	11.488	133.0	0.013	-83.2	0.144	128.7
7400	0.192	-21.4	11.527	117.4	0.013	-97.6	0.153	121.6
7600	0.181	-15.2	11.504	103.5	0.013	-110.4	0.154	113.4
7800	0.191	-14.5	11.488	91.0	0.013	-121.3	0.150	104.2
8000	0.202	-19.0	11.513	79.4	0.013	-133.5	0.140	94.3
8200	0.213	-27.1	11.572	68.6	0.014	-140.7	0.130	84.4
8400	0.222	-37.2	11.661	58.3	0.014	-148.9	0.120	73.1
8600	0.233	-48.1	11.788	48.3	0.015	-158.1	0.109	60.1
8800	0.236	-59.4	11.926	38.6	0.014	-166.2	0.099	46.0
9000	0.245	-71.9	12.066	29.1	0.016	-174.1	0.092	30.5

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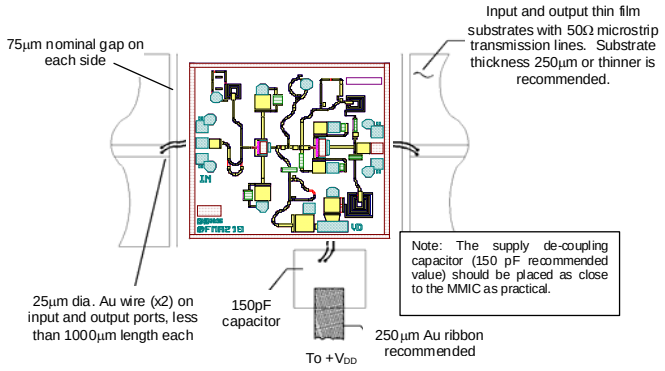
S-Parameters (V_{DD} = 3.0V, I_{DD} = 55mA)

Freq-MHz	S11 Mag	S11 Ang	S21 Mag	S21 Ang	S12 Mag	S12 Ang	S22 Mag	S22 Ang
9200	0.258	-82.3	12.205	19.9	0.015	177.5	0.088	14.6
9400	0.268	-93.8	12.347	10.9	0.015	172.9	0.086	-0.6
9600	0.281	-104.4	12.518	2.0	0.016	164.9	0.091	-15.4
9800	0.289	-113.9	12.666	-6.9	0.016	159.8	0.095	-29.6
10000	0.304	-123.7	12.791	-15.6	0.017	152.4	0.098	-42.1
10200	0.316	-132.4	12.935	-24.2	0.017	145.7	0.104	-50.3
10400	0.327	-140.9	13.005	-32.7	0.018	141.1	0.109	-59.2
10600	0.338	-148.4	13.087	-41.0	0.017	133.3	0.111	-66.2
10800	0.351	-155.6	13.173	-49.2	0.018	125.7	0.113	-72.0
11000	0.359	-161.9	13.234	-57.4	0.018	121.5	0.112	-75.5
11200	0.371	-168.3	13.295	-65.6	0.018	115.9	0.111	-78.3
11400	0.378	-174.0	13.317	-73.6	0.018	109.4	0.109	-78.6
11600	0.389	-179.6	13.337	-81.5	0.018	103.9	0.108	-77.0
11800	0.396	174.6	13.344	-89.5	0.018	97.5	0.109	-73.1
12000	0.406	170.3	13.269	-97.2	0.018	93.7	0.111	-69.1
12200	0.415	166.3	12.804	-104.2	0.018	88.4	0.120	-63.5
12400	0.422	160.5	13.211	-113.1	0.018	83.0	0.133	-57.9
12600	0.428	155.6	13.202	-121.3	0.018	78.2	0.154	-54.2
12800	0.433	151.0	13.133	-129.4	0.018	74.5	0.179	-52.2
13000	0.441	147.0	12.807	-136.8	0.017	68.3	0.208	-52.1
13200	0.446	142.1	12.820	-145.3	0.017	64.3	0.243	-53.1
13400	0.450	137.7	12.570	-153.2	0.017	59.5	0.278	-55.2
13600	0.451	133.0	12.357	-161.5	0.016	54.9	0.316	-57.9
13800	0.454	128.9	12.077	-169.5	0.015	50.5	0.355	-61.5
14000	0.453	124.3	11.698	-177.6	0.015	46.8	0.393	-65.4
14200	0.449	120.2	11.282	174.9	0.014	40.8	0.433	-69.4
14400	0.445	116.0	10.841	167.4	0.014	37.7	0.470	-74.2
14600	0.439	111.8	10.386	160.0	0.013	38.9	0.502	-78.6
14800	0.432	108.0	9.936	152.8	0.013	33.5	0.531	-83.1
15000	0.422	104.6	9.453	145.8	0.013	30.9	0.561	-87.4
15200	0.414	101.0	8.938	139.1	0.012	28.1	0.585	-91.8
15400	0.404	97.4	8.451	132.9	0.012	29.8	0.605	-95.8
15600	0.393	94.7	8.009	126.8	0.011	27.6	0.625	-99.9
15800	0.383	92.0	7.592	120.9	0.012	27.4	0.640	-103.7
16000	0.372	89.2	7.179	115.2	0.010	25.0	0.653	-107.4

Recommended Assembly Schematic



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Preferred Assembly Instructions

GaAs devices are fragile and should be handled with great care. Specially designed collets should be used where possible.

The back of the die is metallized and the recommended mounting method is by the use of conductive epoxy. Epoxy should be applied to the attachment surface uniformly and sparingly to avoid encroachment of epoxy onto the top face of the die, and ideally should not exceed half the chip height. For automated dispense Ablestick LMISR4 is recommended, and for manual dispense Ablestick 84-1 LMI or 84-1 LMIT are recommended. These should be cured at a temperature of 150 °C for 1 hour in an oven especially set aside for epoxy curing only. If possible the curing oven should be flushed with dry nitrogen. The gold-tin (80% Au 20% Sn) eutectic die attach has a melting point of approximately 280 °C but the absolute temperature being used depends on the leadframe material used and the particular application. The maximum time at used should be kept to a minimum.

This part has gold (Au) bond pads requiring the use of gold (99.99% pure) bondwire. It is recommended that 25.4µm diameter gold wire be used. Recommended lead bond technique is thermocompression wedge bonding with 0.001" (25µm) diameter wire. Bond force, time stage temperature, and ultrasonics are all critical parameters and the settings are dependent on the setup and application being used. Ultrasonic or thermosonic bonding is not recommended.

Bonds should be made from the die first and then to the mounting substrate or package. The physical length of the bondwires should be minimized especially when making RF or ground connections.

Handling Precautions

To avoid damage to the devices, care should be exercised during handling. Proper Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing.

ESD/MSL Rating

These devices should be treated as Class 0 (0V to 250V) using the human body model as defined in JEDEC Standard No. 22-A114. Further information on ESD control measures can be found in MIL-STD-1686 and MIL-HDBK-263. This is an unpackaged part and therefore no MSL rating applies.

Application Notes and Design Data

Application Notes and design data including S-parameters, noise parameters, and device model are available on request from www.rfmd.com.

Reliability

An MTTF of 4.2 million hours at a channel temperature of 150 °C is achieved for the process used to manufacture this device.

Disclaimers

This product is not designed for use in any space-based or life-sustaining/supporting equipment.

Ordering Information

Quantity	Ordering Code
Standard order quanity (waffle pack)	FMA219-000
Small quantity (25)	FMA219-000SQ
Sample quantity (3)	FMA219-000S3

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