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FMA246

HIGH GAIN X-BAND MMIC AMPLIFIER

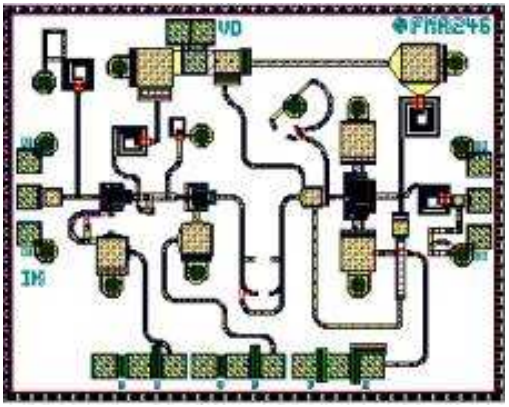
Package Style: Bare Die

Product Description

The FMA246 is a three-stage, reactively matched pHEMT high-gain MMIC amplifier designed for use over 8GHz to 14GHz. The supply voltage can be varied from +3V to +6V if needed. Operating current can be adjusted using the source resistor ladders located along the bottom edge by bonding a particular pad to ground. 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

- 8.0GHz - 14.0GHz Operating Bandwidth
- 2.5dB Noise Figure
- 30dB Small-Signal Gain
- 19dBm Output Power
- +6V Single Bias Supply
- Adjustable Operating Current
- 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[1]					
Operating Frequency Bandwidth	8		11	GHz	
Small Signal Gain	26.3	29	31	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}
Operating Current	105	150	195	mA	V_{DD} = +6V
Small Signal Gain Flatness		±0.6	±1.0	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]
Noise Figure		2.5	2.8	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]
3rd Order Intermodulation Distortion		-44		dBc	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2], P_{OUT}=+9dBm SCL
Power at 1dB Compression	18	20		dBm	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]
Input Return Loss		-10	-8	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]
Output Return Loss		-16	-8.3	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]
Reverse Isolation		-60	-50	dB	V_{DD}=+6V, I_{DD}≈60% I_{DSS}[2]

Note: [1]$T_{AMBIENT}$=22°C. Continuous operation at IDSS is not recommended.

[2]60% I_{DSS} is achieved by bonding pads D, G, and K to ground to drive the 1st, 2nd, and 3rd stage amplifiers at 50% I_{DSS}, 50% I_{DSS}, and 75% I_{DSS} respectively.

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Absolute Maximum Ratings[1]

Parameter	Rating	Unit
Source Voltage (V_{DD})	8	V
Supply Current (I_{DD})	75	% I_{DSS}
RF Input Power (P_{IN})[2] (For standard bias conditions)	-8	dBm
Storage Temperature (T_{STG}) (Non-Operating Storage)	-40 to 150	°C
Total Power Dissipation (P_{TOT})[2, 3]	1400	mW
Gain Compression (Under bias conditions)	5	dB
Simultaneous Combination of Limits (2 or more maximum limits)	80	%

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.

[3]Total Power Dissipation to be de-rated as follows above 22 °C: P_{TOT}= 1.4-(0.004W/°C)x$T_{CARRIER}$, where $T_{CARRIER}$=carrier or heatsink temperature above 22°C (coefficient of de-rating formula is the Thermal Connectivity). Example: For a 55°C carrier temperature: P_{TOT}=1.4-(0.004x(55-22))=1.26W.

[4]Users should avoid exceeding 80% of 2 or more limits simultaneously.

[5]For optimum heatsinking, eutectic die attach is recommended; conductive epoxy die attach is acceptable with some degradation in thermal de-rating performance (P_{TOT}=550mW).

[6]Thermal Resistivity: The nominal value of 250°C/W is stated for the input stage, which will reach temperature limits before the output stage. The aggregate MMIC thermal resistivity is approximately 80°C/W.

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).

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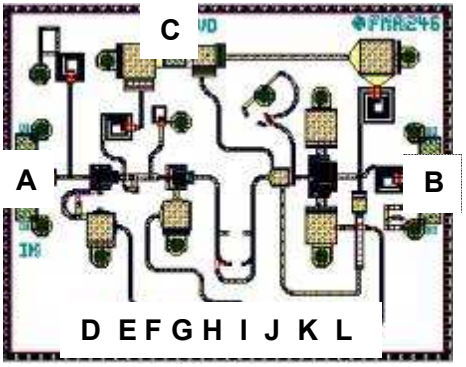
Pad Layout



Pad	Name	Description	Pin Coordinates (µm)
A	IN	RF input	104, 836
B		RF output	1962, 822
C	VD	Drain voltage	770, 1522
D-F		Stage 1: Source bias resisters	415/556/696, 143
G-I		Stage 2: Source bias resisters	821/962/1102, 143
J-L		Stage 3: Source bias resisters	1234/1374/1513, 143

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)
2050x1624	100	125	96x96

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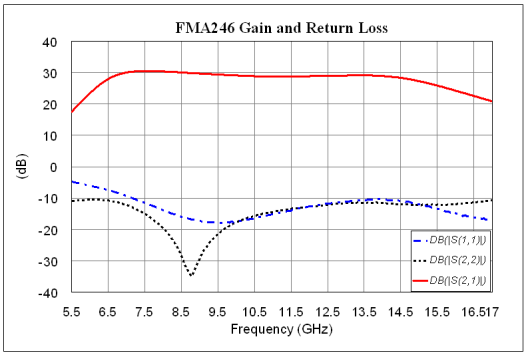
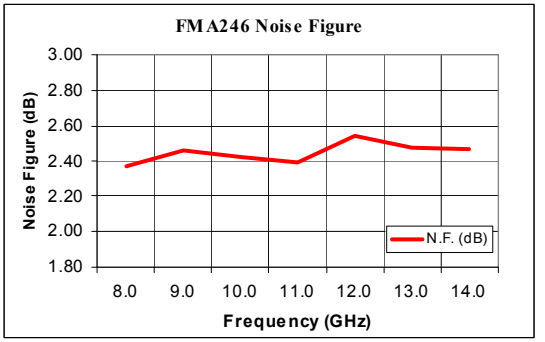
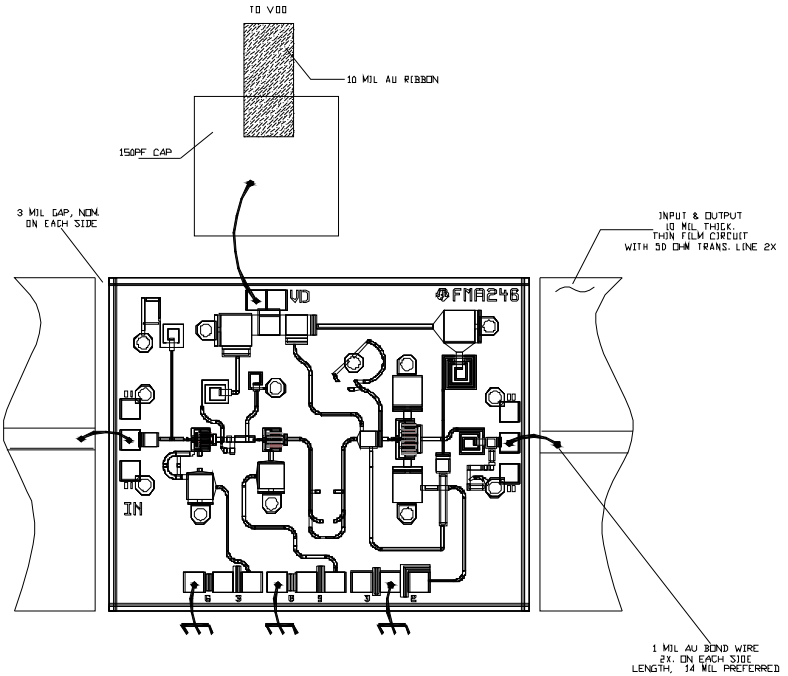
Typical Measured Performance On Wafer

$T_{AMBIENT}$=+22°C unless stated otherwise; (V_{DD}=+6V, I_{DD}=I_{OP}).





Recommended Assembly Schematic



Note: [1]The supply de-coupling capacitor (150pF recommended value) should be placed as close to the MMIC as practical.

[2]The configuration shown will result in operating current bias levels of approximately (for each stage, respectively) 50%, 50%, and 75%, which is the standard recommended bias setting for the MMIC. For lower current operation, the 3rd stage can be set to 50% by bonding to the pad (marked "3") just to the left of the pad that is bonded in the drawing, in the right-most set of three bias pads. These number markings are the resistor values (Ω) between the pads.

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 on to 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. The bond tool force shall be 35grams to 38grams. Bonding stage temperature shall be 230 °C to 240 °C, heated tool (150 °C to 160 °C) is recommended. 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 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 ata 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)	FMA246-000
Small quantity (25)	FMA246-000SQ
Sample quantity (3)	FMA246-000S3

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