FMA3010

X-BAND 5W HIGH POWER AMPLIFIER GaAs MMIC

Package Style: Bare Die

Product Description

The FMA3010 is a high performance X-Band Gallium Arsenide monolithic amplifier. It is suitable for use in communication, instrumentation and electronic warfare applications. The die is fabricated using RFMD's 0.5μm process.

Features

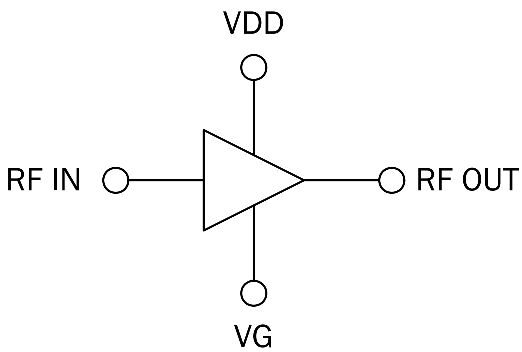
- 15dB Gain
- 5W Saturated Output Power at 9V
- pHEMT Technology

Applications

- Test Instrumentation
- Electronic Warfare
- Communication Infrastructure

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



Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Electrical Specifications					$T_{AMBIENT}$=25°C, Z_0=50Ω
Gain		15		dB	9GHz to 10GHz, V_D=9V, V_G=-0.5V
Input Return Loss		-10		dB	9GHz to 10GHz, V_D=9V, V_G=-0.5V
Output Return Loss		-10		dB	9GHz to 10GHz, V_D=9V, V_G=-0.5V
Reverse Isolation		-35		dB	9GHz to 10GHz, V_D=9V, V_G=-0.5V
Output Saturated Power		37		dBm	Drain voltage and input power pulsed at a prf of 1kHz, 5% duty cycle. V_D=9V, V_G=-0.5V, frequency=9.5GHz
Drain Current		80		mA	Drain voltage and input power pulsed at a prf of 1kHz, 5% duty cycle. V_D=9V, V_G=-0.5V, input power=0dBm

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Absolute Maximum Ratings

Parameter	Rating	Unit
Maximum Input Power (P_{IN})	+25	dBm
Drain Voltage (V_{DD})	+12	V
Operating Temperature (T_{OPER})	-40 to 85	°C
Storage Temperature (T_{STOR})	-55 to 150	°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 EU Directive 2002/95/EC (at time of this document revision).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Electrical Characteristics					
Typical Electrical Characteristics on Carrier (as per Recommended Assembly)					T_{AMB}=25°C, V_{DRAIN}=+9V, V_{GATE}=-0.5V)
Frequency Range	9		10	GHz	
Drain Current at 0dBm P_{IN}		1.6		A	
Small Signal Gain		20		dB	
Input Return Loss			-4	dB	
Output Return Loss			-4	dB	
Saturated Output Power at 23dBm P_{IN} and 15% Duty Cycle		36.5		dBm	
Power Added Efficiency at 23dBm P_{IN} and 15% Duty Cycle		30		%	
Small Signal Gain Temperature Coefficient at 9.0GHz, V_D=9V		-0.028	-0.05	dB/°C	
Saturated Output Power Temperature Coefficient at 9.0GHz, V_D=9V		-0.01	-0.015	dB/°C	
Gate Current		6	10	mA	
RF On Wafer Testing: Electrical Die Sorting Criteria at Controlled Ambient Temperature 21±2°C					
Small Signal RFOW Parameters (100% Test) (Note 1) V_D=3V					
Linear Gain at 9GHz	11		18	dB	
Linear Gain at 9.5GHz	14		21	dB	
Linear Gain at 10GHz	11		20	dB	
Input Return Loss at 9GHz			-4	dB	
Input Return Loss 9.5GHz			-4	dB	
Input Return Loss at 10GHz			-2	dB	
Output Return Loss at 9GHz			-6	dB	
Output Return Loss 9.5GHz			-2.5	dB	
Output Return Loss at 10GHz			-1	dB	
Reverse Isolation at 9GHz to 10GHz	31			dB	
Pulsed Large Signal Parameters (100% test) (Note 2) V_D=9V					
Saturated Output Power at 9GHz, P_{IN}=+21dBm	35.5	37.2		dBm	
Saturated Output Power at 9.5GHz, P_{IN}=+21dBm	36.0	37.2		dBm	

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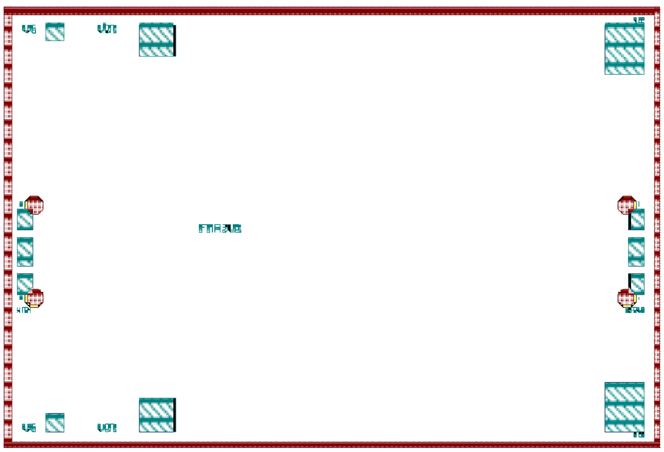
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Saturated Output Power at 10GHz, P_{IN}=+21dBm	36.0	37.4		dBm	
Power Gain at 9GHz, P_{IN}=+10dBm	17	20		dB	
Power Gain at 9.5GHz, P_{IN}=+10dBm	17.5	20.5		dB	
Power Gain at 10GHz, P_{IN}=+10dBm	17	20		dB	
Power Supply Current at 9GHz to 10GHz (0dBm RF Input)		1.6	2.0	A	
Power Supply Current at 9GHz to 10GHz (21dBm RF Input)		1.65	2.0	A	

Note 1: 21°C ambient temperature, 3.0V drain power supply voltage (V_{DD}), -0.5V Gate Supply voltage (V_G) (nominal, adjustable in proportion to pinch-off voltage variation wafer to wafer), CW small signal operation with P_{IN}=-20dBm.
Note 2: 21°C ambient temperature, 9.0V drain power supply voltage (V_{DD}), -0.5V Gate Supply voltage (V_G) (nominal, adjustable in proportion to pinch-off voltage variation wafer to wafer), and with drain voltage modulation with 50µs pulse width, 1kHz P.R.F.

Pad Layout



Pad	Name	Description
A	IN	RF input
B	VG	South gate voltage 1
C	VD1	South drain voltage 1
D	VD2	South drain voltage 2
E	OUT	RF output
F	VD2	North drain voltage 2
G	VD1	North drain voltage 1
H	VG	North gate voltage 2

Die Size (µm)	Die Thickness (µm)	Min. Bond Pad Pitch (µm)	Min. Bond Pad Opening (µmxµm)
4521x3048	100	200	88x138

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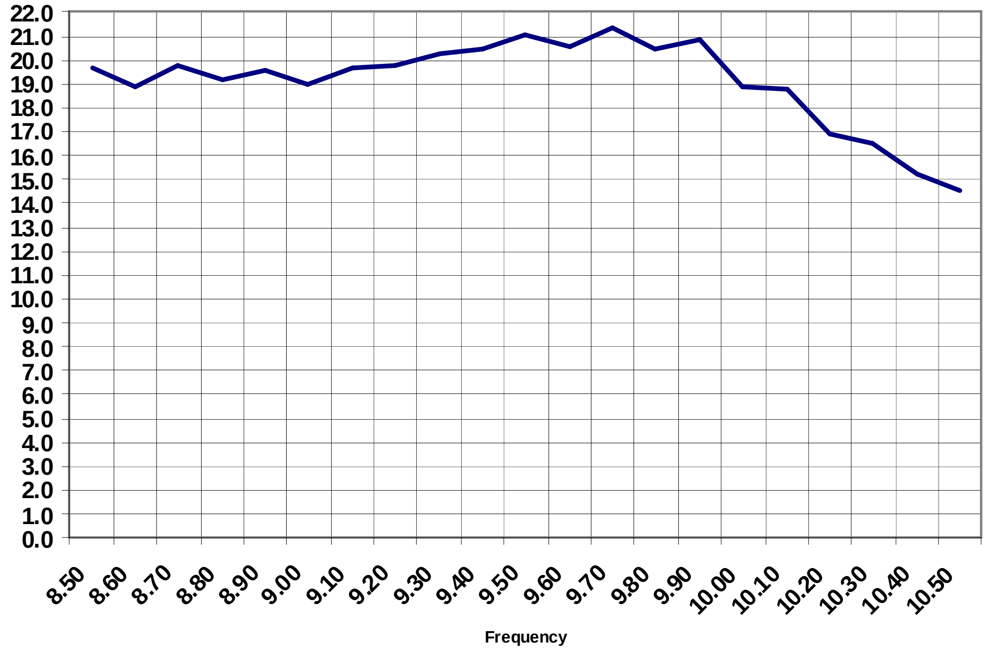
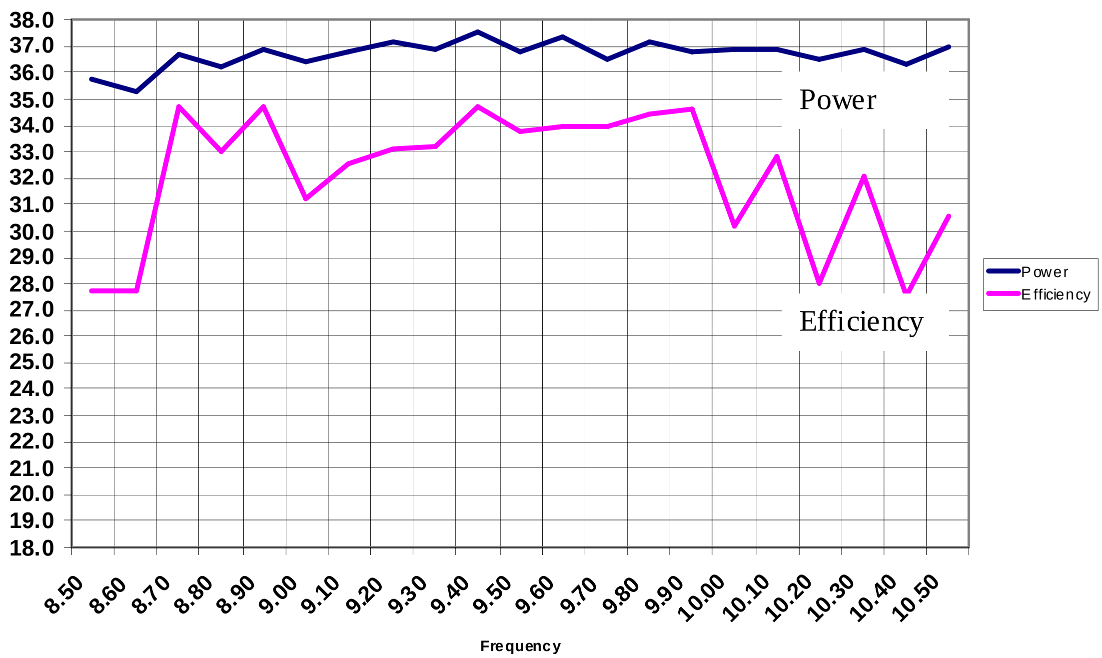
Typical Performance of FMA3010 MMIC Mounted on Carrier



Small Signal Power Gain (Including bondwire and jig losses) P_{IN}=0dBm, V_D=9V, V_G=-0.5V 10% Duty, 10µs Pulse 30°C Sample Die #1



Saturated Output Power and Efficiency (Including bondwire and jig losses) P_{IN}=23dBm, V_D=9V, V_G=-0.5V 10% Duty, 30°C Sample Die #1

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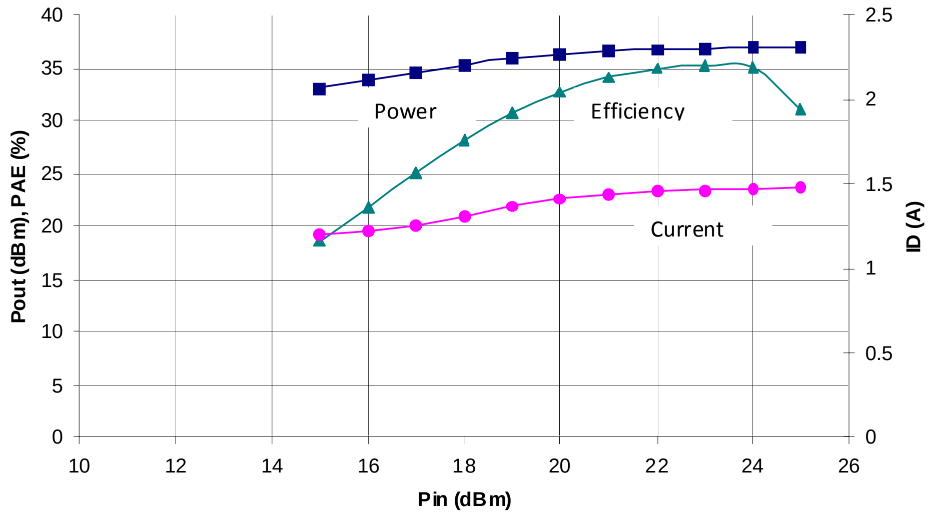
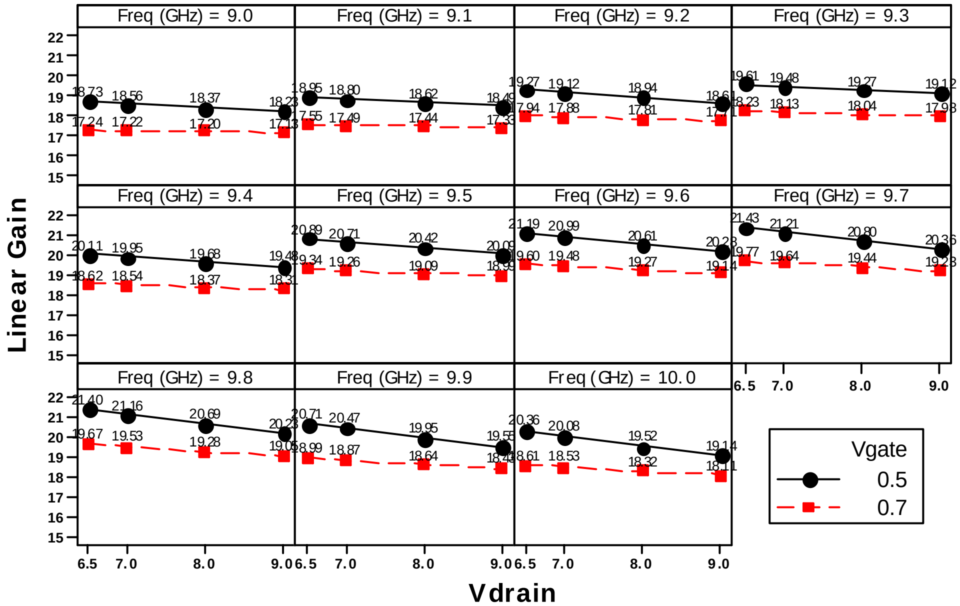


Power Compression Curves and Efficiency (excluding bondwire) V_D=9V, V_G=-0.5V 10% Duty, 30°C Sample Die #1

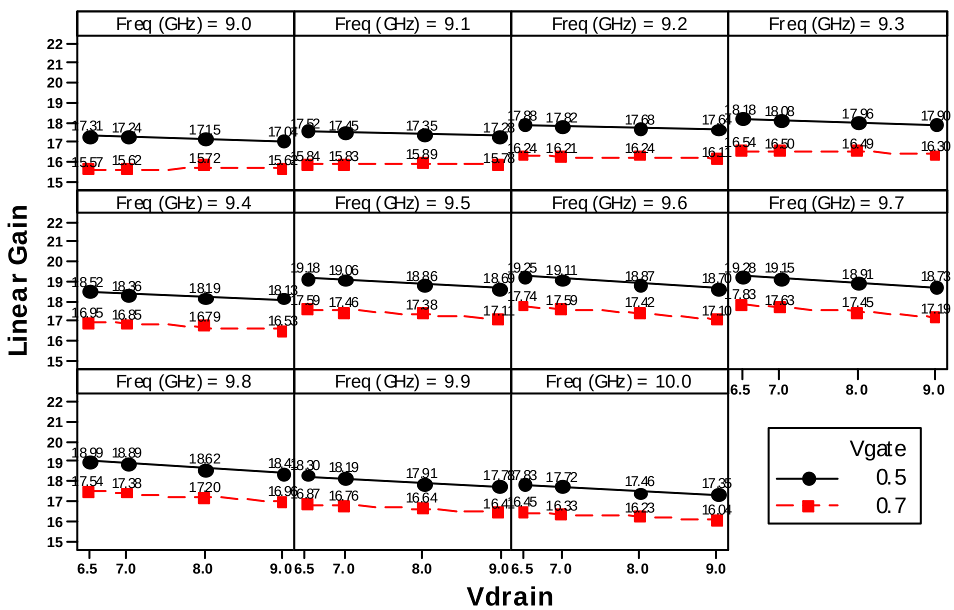
Variation of Performance with Bias Voltage and Temperature

All measurements taken on carrier/jig and include jig losses



LInear Gain at 30°C with Variable Gate Bias and Drain Voltage.

P_{IN}=4dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2



LInear Gain at 80°C with Variable Gate Bias and Drain Voltage.

P_{IN}=4dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width

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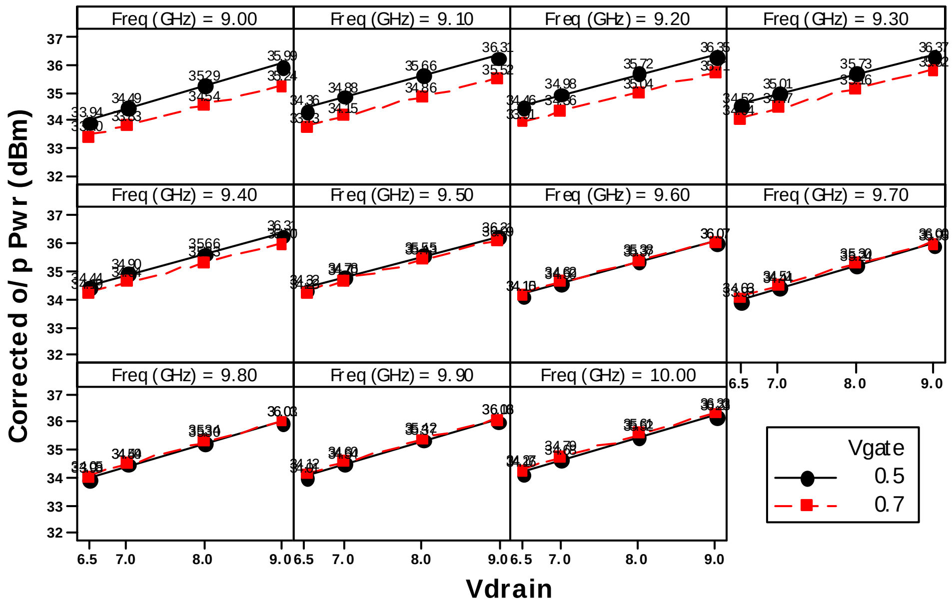
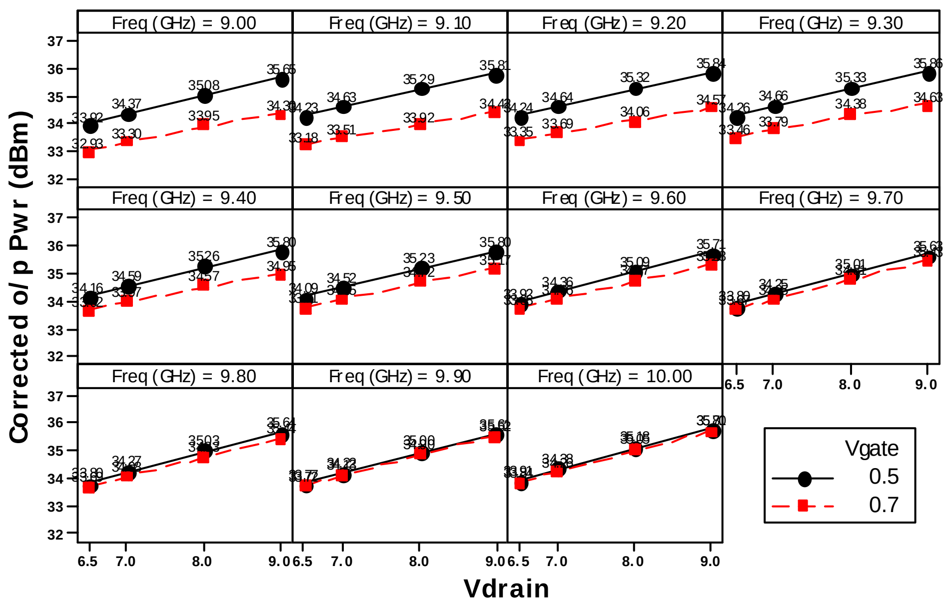


Saturated Power Output at 30°C with Variable Gate and Drain Bias.
P_{IN}=23dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2



Saturated Power Output at 80°C with Variable Gate and Drain Bias.
P_{IN}=23dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2

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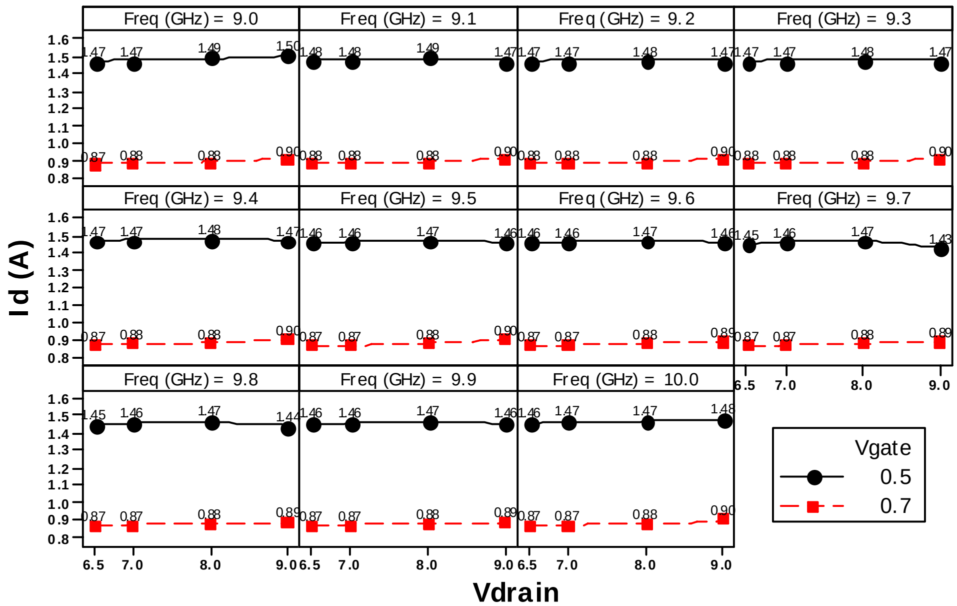
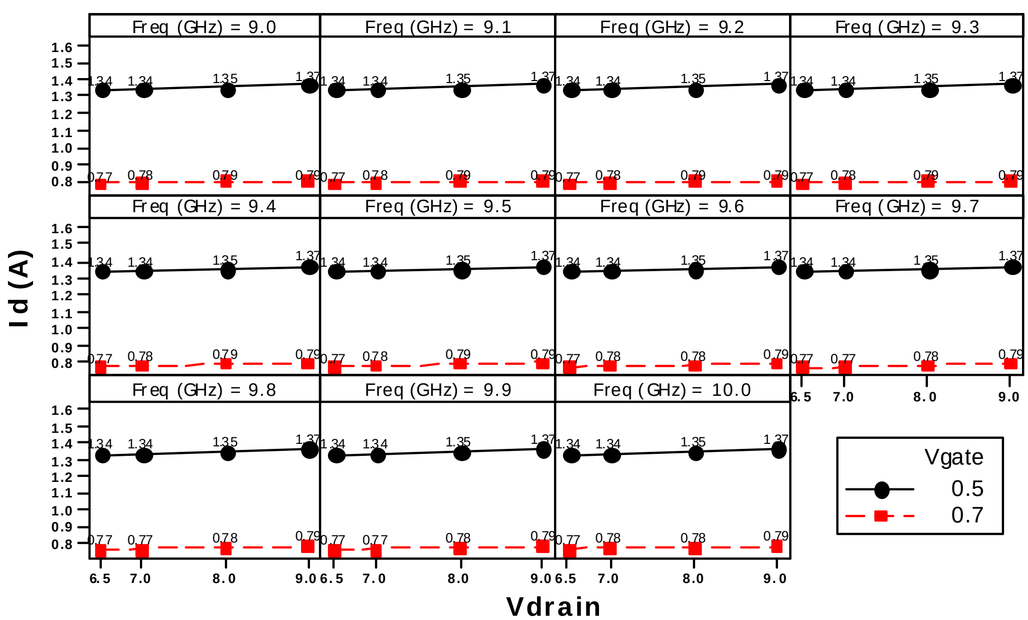
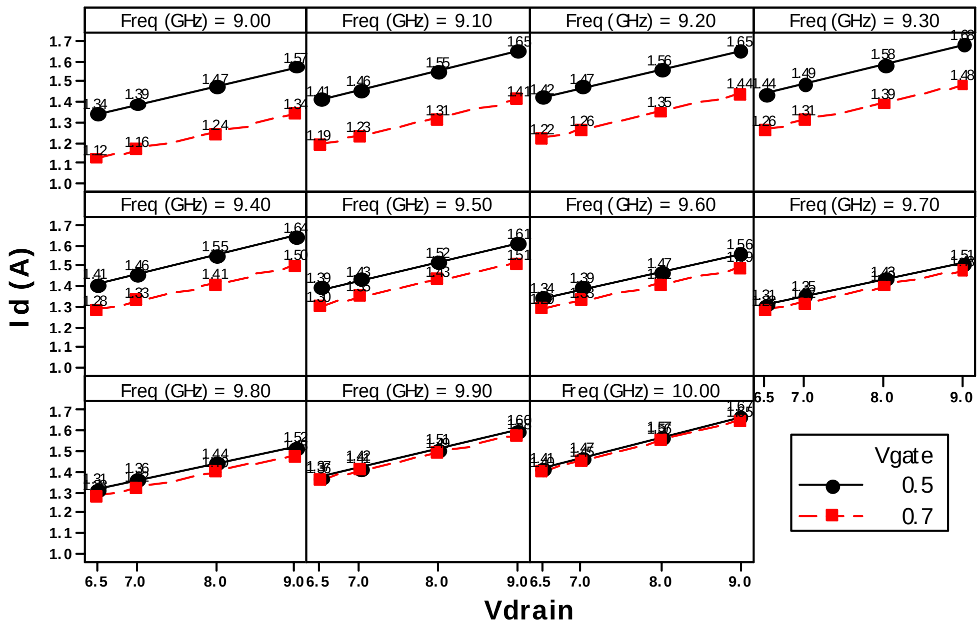


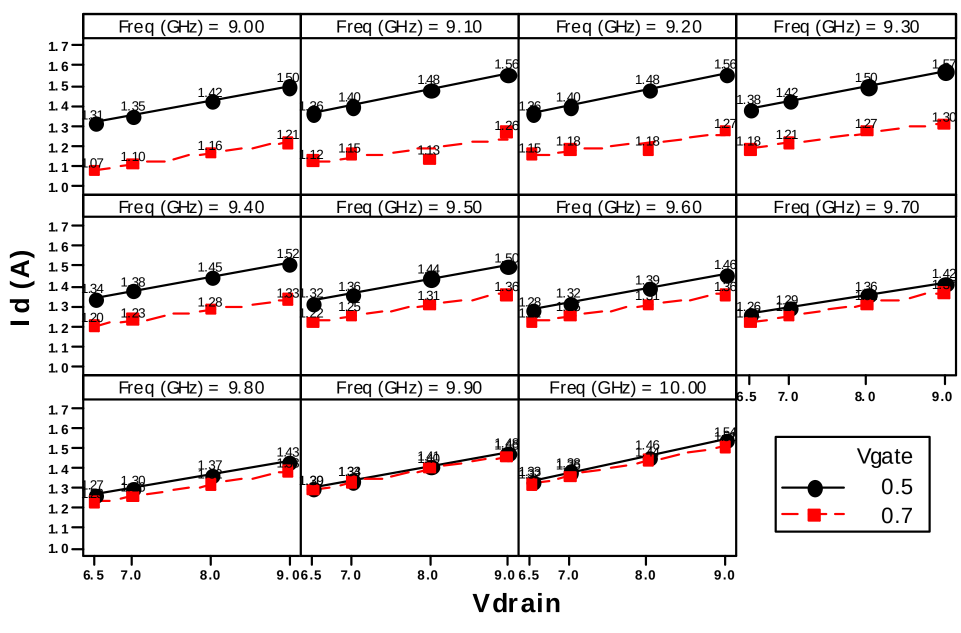
I_D in Linear Mode at 30°C as a function of Gate Bias and Drain Bias.
P_{IN}=4dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2



I_D in Linear Mode at 80°C as a function of Gate Bias and Drain Bias.
P_{IN}=4dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2



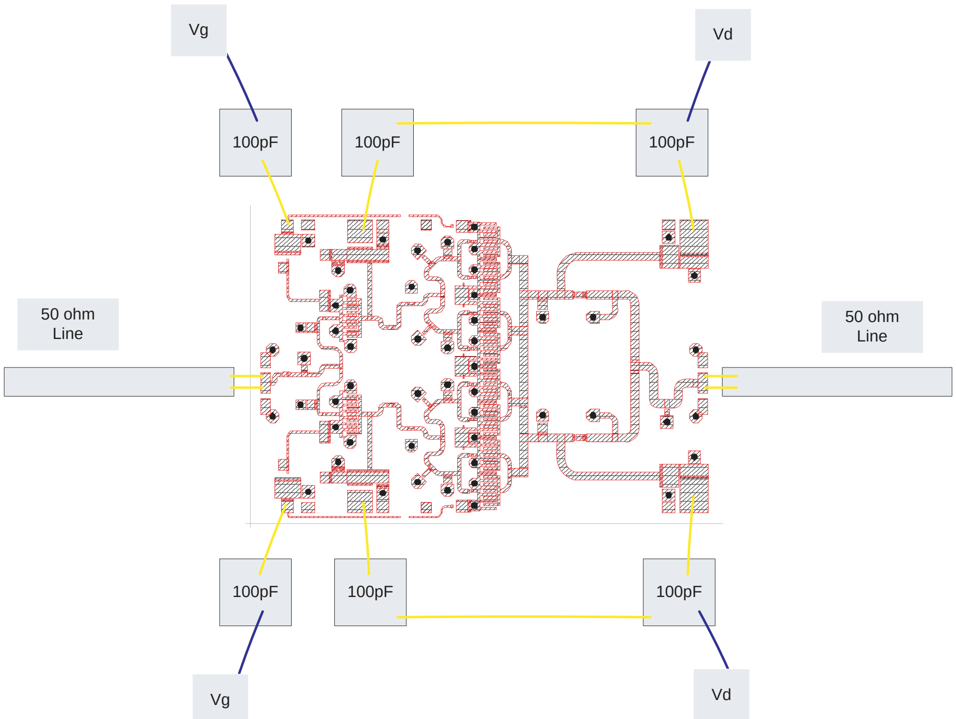
I_D in Saturated Mode at 30°C as a function of Gate Bias and Drain Bias.
P_{IN}=23dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2



I_D in Saturated Mode at 80°C as a function of Gate Bias and Drain Bias.
P_{IN}=23dBm, V_D=6.5V, 7V, 8V, 9V, V_G=-0.5V/-0.7V, 10% Duty Cycle, 10µs Pulse Width Sample Die #2

Preferred Assembly Instructions

Recommended Assembly



Bonding arrangement for RF connections and decoupling capcitors. Capcitor value 100pF recommended (e.g. DiLabs D20BT470K1EX)

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. Ideally it 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 one 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 25.4mm 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.

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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 are available on request 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
Full Pack (100)	FMA3010-000
Small quantity (25)	FMA3010-000SQ
Sample quantity (3)	FMA3010-000S3