Filtronic

FMA3009

Pre-Production Datasheet v2.5

2-20GHz Broadband MMIC Amplifier

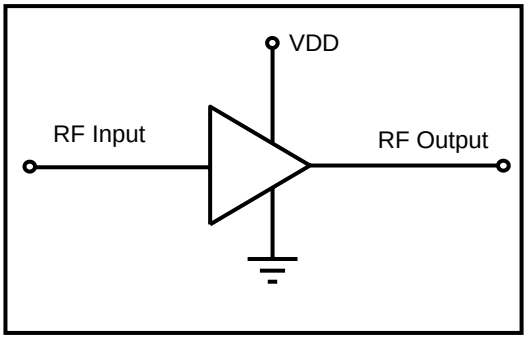
Features:

- 10dB Gain
- Single Supply (Self Biased)
- 26dBm P_{1dB} Output Power at 8.0V
- pHEMT Technology
- Bias Control
- Input Return Loss <-9dB
- Output Return Loss <-8dB

General Description:

The FMA3009 is a high performance 2-20GHz Gallium Arsenide monolithic travelling wave amplifier. It is suitable for use in broadband communication, instrumentation and electronic warfare applications. The die is fabricated using the Filtronic 0.25µm process. The Circuit is DC blocked at both the RF input and the RF output. Bias control is achieved using a combination of three on chip bias resistors connected to ground, using the bond wires.

Functional Schematic:



Typical Applications:

- Test Instrumentation
- Electronic Warfare
- Broadband Communication Infrastructure

Electrical Specifications:

Parameter	Conditions	Min	Typ	Max	Units
Small Signal Gain	2-20GHz	8.0	10	12	dB
Gain Ripple	2-20GHz		±1		dB
Input Return Loss	2-20GHz		-10	-8	dB
Output Return Loss	2-20GHz		-9	-8	dB
Reverse Isolation	2-20GHz		-30	-25	dB
Output Power at 1dB compression point	2 GHz 10GHz 20GHz	24 20 19	26.3 26 21.5		dBm
Drain Current	8.0V		250		mA
Noise Figure		4	5	6.5	dB

Note: $T_{AMBIENT}$ = +25°C, Z_0 = 50Ω
Performances for on-wafer measurements
All Bias resistors bonded to ground.

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Absolute Maximum Ratings:

Parameter	Symbol	Absolute Maximum
Max Input Power	Pin	+20dBm
Drain Voltage	VDD	+10V
Total Power Dissipation	Ptot	3 W
Thermal Resistivity	θJC	32°C/W
Operating Temp	Toper	-40°C to +85°C
Storage Temp	Tstor	-55°C to +150°C

Note: Exceeding any one of these absolute maximum ratings may cause permanent damage to the device.



Note: Co-ordinates are referenced from the bottom left hand corner of the die to the centre of bond pad opening

Pad Layout:

Pad Ref	Pad Name	Description	Pin Coordinates (µm)
A	IN	RF in	(100,396)
B	R1	Enable Different Source Resistors to be grounded	(1896,100)
C	R2		(2046, 100)
D	R3		(2196, 100)
E	Source	Test Pad (Resistor bypass)	(2027, 337)
F	OUT	RF Output	(2200, 650)
G	VDD	Drain Voltage	(2156, 1000)
H	GND	Ground	(1738, 995)
I	R5	Cascode Resistors: Enable Different Voltages across the Cascode devices	(245, 1000)
J	R4		(95, 1000)

Die Size (µm)	Die Thickness (µm)	Min. Bond Pad Pitch (µm)	Min. Bond pad Opening (µm x µm)
2300 x 1100	100	150	100 x 100

Different Bias Configurations:

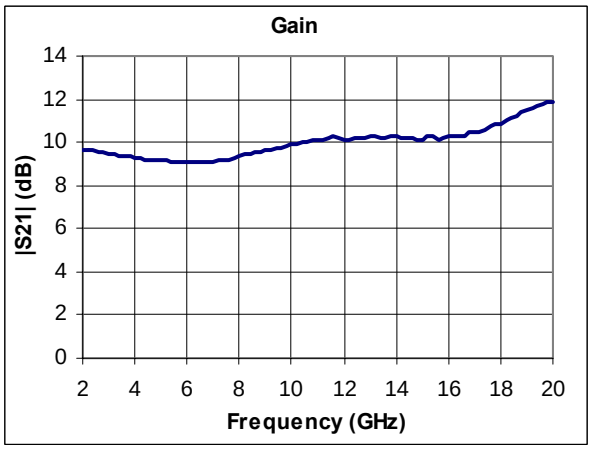
The Pads B, C and D can be bonded to ground or left unbonded to achieve different performances, as shown on the following table (see also page 5 for more information).

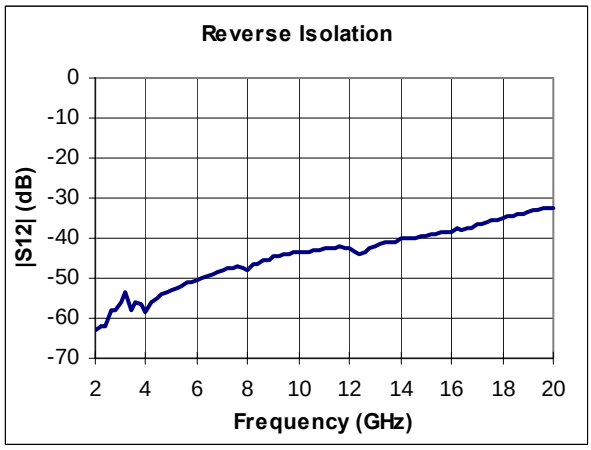
Pads Grounded			Typical Bias current (mA)	Typical Gain at 10 GHz (dB)
B	C	D		
√	√	√	230	9.9
	√	√	210	9.8
√		√	200	9.7
√	√		179	9.4
		√	178	9.4
	√		145	9.1
√			112	8.7

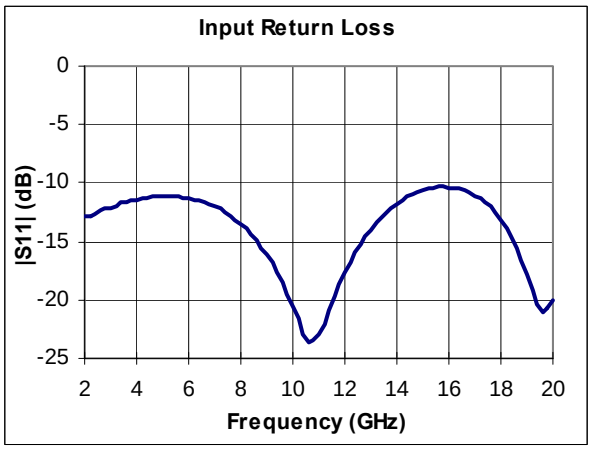
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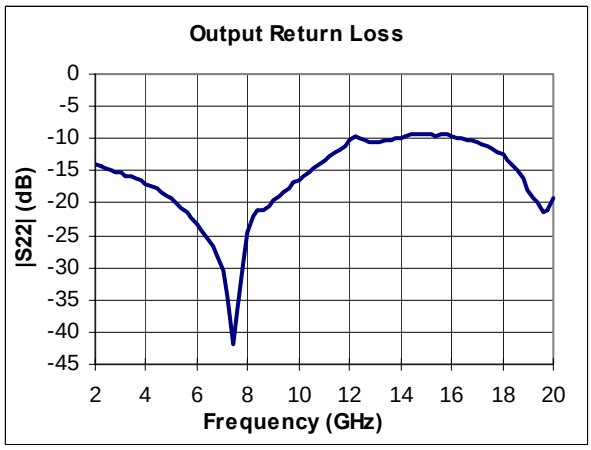
TYPICAL PERFORMANCE FOR ON WAFER MEASUREMENTS:

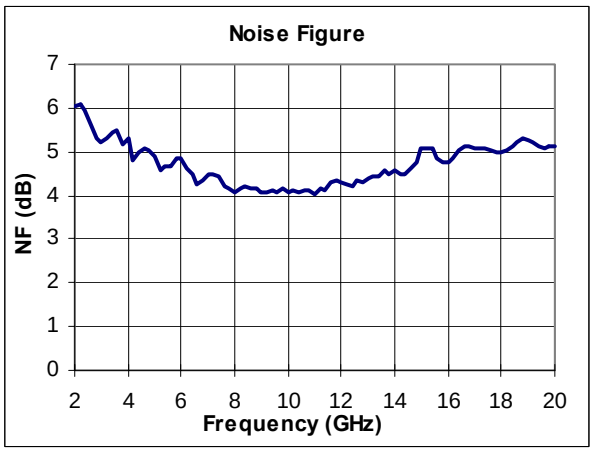
All Bias resistors bonded to ground.
Note: Measurement Conditions I_D= 230mA, V_{DD}= 8V, $T_{AMBIENT}$ = 25°C.

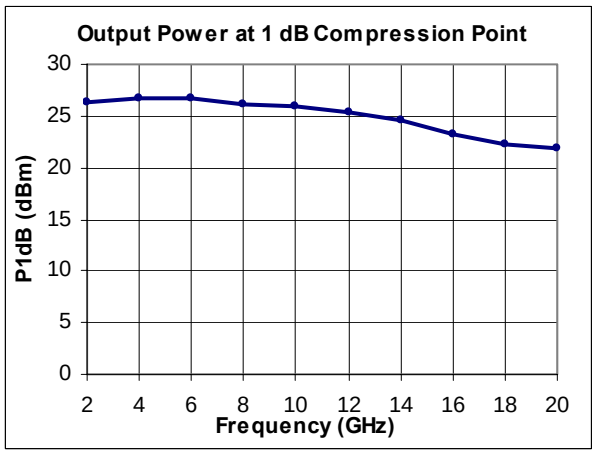








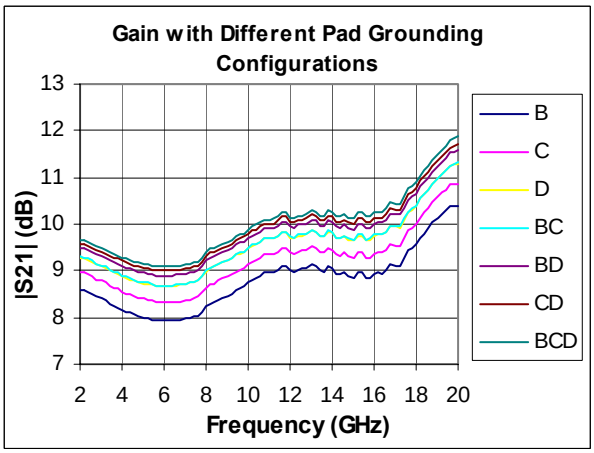


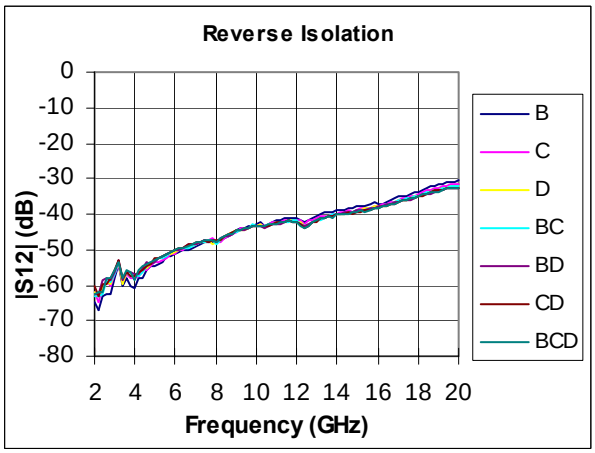


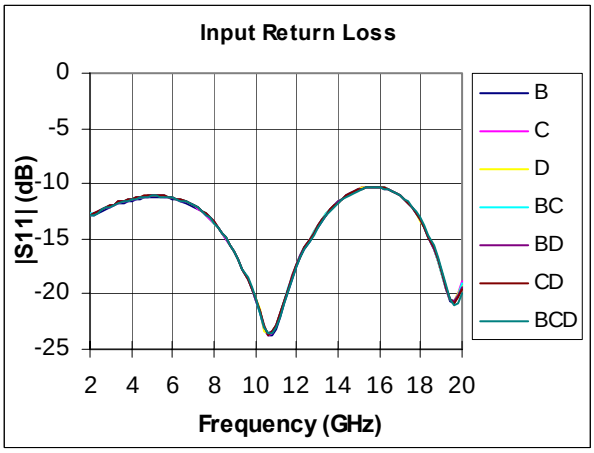
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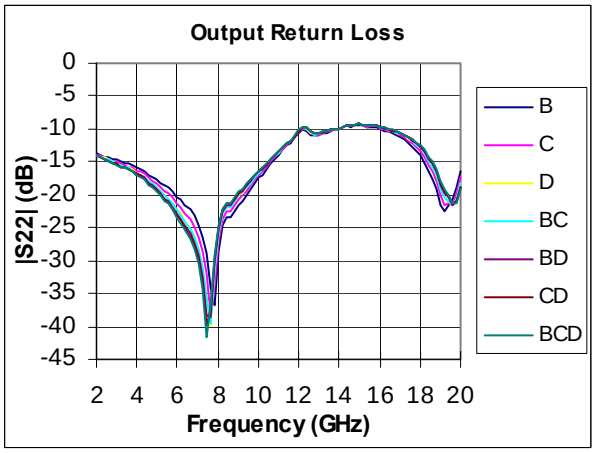
TYPICAL PERFORMANCE FOR ON WAFER MEASUREMENTS WITH DIFFERENT PADS CONFIGURATIONS (PADS B, C AND D GROUNDED OR UNBONDED):

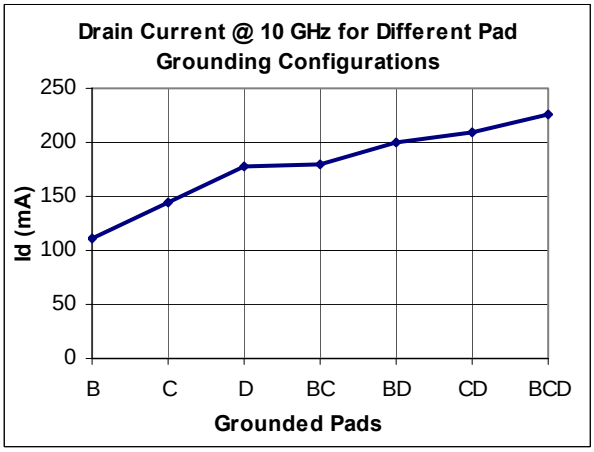
Note: V_{DD}= 8V, $T_{AMBIENT}$ = 25°C.
Letters or Group of Letters indicate which Bias resistors are bonded to ground

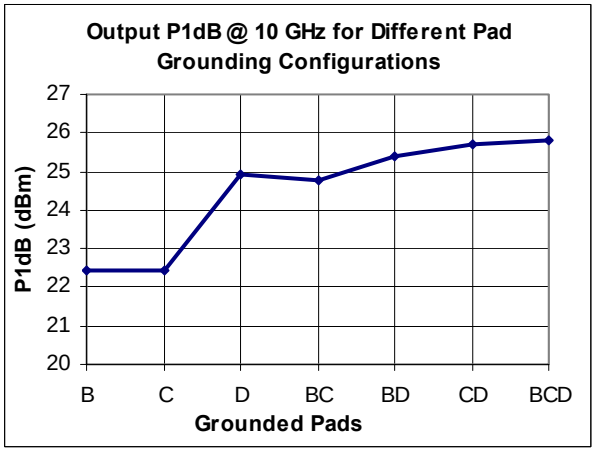










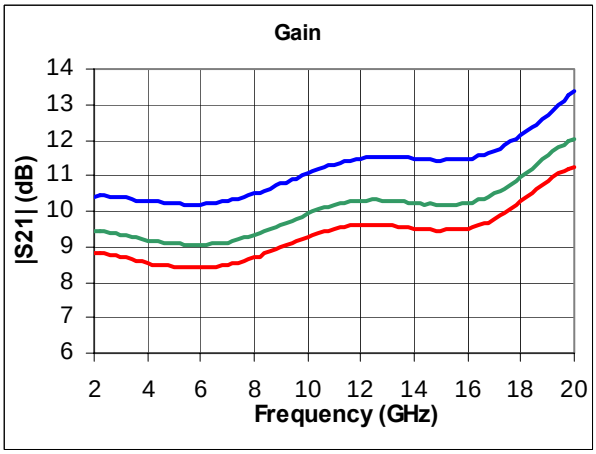


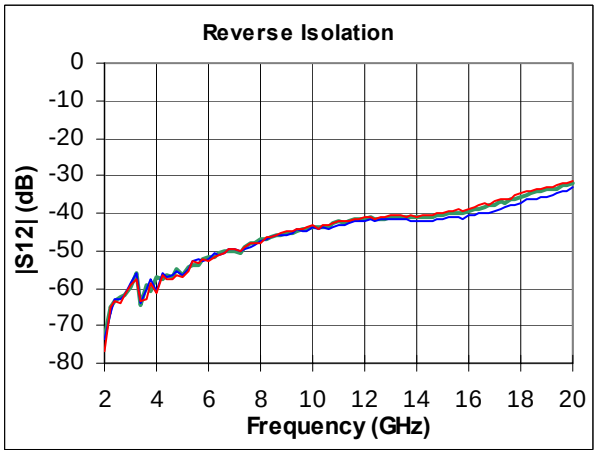
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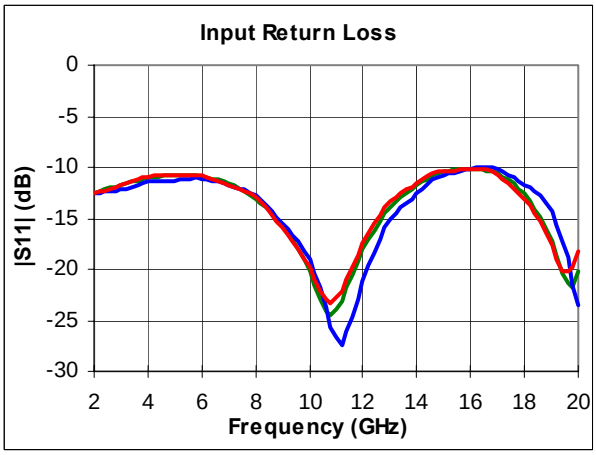
TYPICAL PERFORMANCE FOR ON WAFER MEASUREMENTS OVER TEMPERATURE:

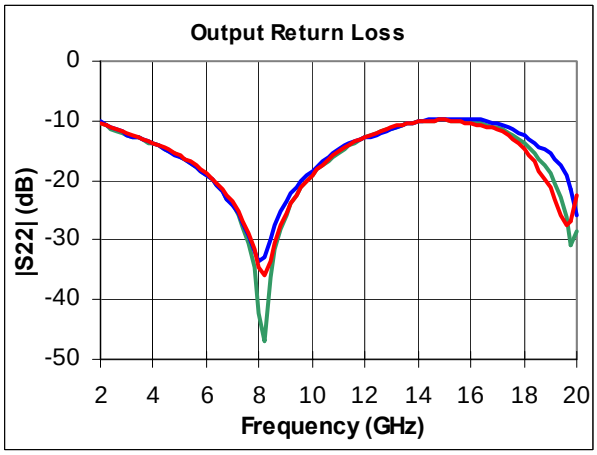
Note: Measurement Conditions I_D= 230mA, V_{DD}= 8V. All Bias resistors bonded to ground.

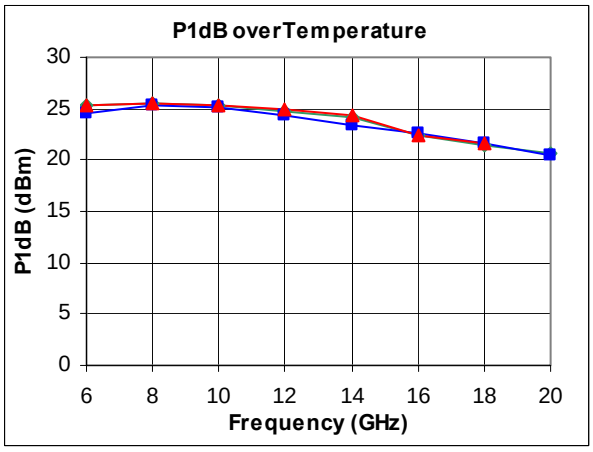
$T_{AMBIENT}$ = 25°C T_{COLD} = -40°C T_{HOT} = +85°C











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S-PARAMETERS FOR ON-WAFER MEASUREMENTS:

Note: Measurement Conditions I_D= 230mA, V_{DD}= 8V and $T_{AMBIENT}$ = 25°C
Units: GHZ (Frequency), dB (S-parameters magnitude), radian (S-parameters angle)

	S11		S21		S12		S22	
Frequency	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
1.85	-12.85	1.23	9.61	-0.32	-58.57	0.26	-13.78	-0.25
2.05	-12.87	1.18	9.65	-0.44	-62.80	0.35	-14.07	-0.26
2.25	-12.78	1.12	9.64	-0.56	-62.11	0.41	-14.32	-0.29
2.45	-12.59	1.06	9.62	-0.68	-61.89	0.61	-14.55	-0.33
2.65	-12.34	1.00	9.58	-0.79	-57.78	0.28	-14.85	-0.34
2.85	-12.20	0.92	9.52	-0.89	-57.97	0.53	-15.13	-0.38
3.05	-12.08	0.86	9.49	-0.99	-56.03	0.51	-15.36	-0.41
3.25	-11.94	0.80	9.45	-1.08	-53.36	0.25	-15.75	-0.43
3.45	-11.72	0.73	9.39	-1.18	-57.90	-0.19	-15.93	-0.45
3.65	-11.64	0.67	9.35	-1.27	-55.80	0.04	-16.21	-0.49
3.85	-11.56	0.61	9.33	-1.36	-56.38	-0.22	-16.54	-0.50
4.05	-11.42	0.55	9.29	-1.45	-58.71	0.00	-17.02	-0.54
4.25	-11.34	0.49	9.25	-1.53	-55.81	-0.02	-17.26	-0.57
4.45	-11.26	0.44	9.22	1.52	-54.83	-0.07	-17.67	-0.58
4.65	-11.20	0.38	9.20	1.44	-54.10	-0.12	-18.40	-0.61
4.85	-11.16	0.32	9.17	1.36	-53.61	-0.21	-18.88	-0.64
5.05	-11.13	0.27	9.15	1.27	-53.06	-0.20	-19.35	-0.63
5.25	-11.12	0.21	9.13	1.19	-52.56	-0.36	-20.20	-0.66
5.45	-11.15	0.15	9.11	1.11	-51.79	-0.42	-20.90	-0.68
5.65	-11.17	0.10	9.09	1.03	-51.11	-0.43	-21.37	-0.65
5.85	-11.23	0.05	9.09	0.95	-50.95	-0.57	-22.35	-0.65
6.05	-11.31	-0.01	9.09	0.87	-50.29	-0.64	-23.38	-0.68
6.25	-11.39	-0.06	9.09	0.79	-49.78	-0.72	-24.17	-0.65
6.45	-11.51	-0.12	9.09	0.71	-49.40	-0.75	-25.38	-0.60
6.65	-11.66	-0.17	9.10	0.63	-49.24	-0.89	-26.82	-0.67
6.85	-11.82	-0.22	9.11	0.56	-48.49	-0.94	-28.32	-0.63
7.05	-12.01	-0.27	9.13	0.48	-47.97	-1.06	-30.53	-0.41
7.25	-12.23	-0.33	9.15	0.40	-47.71	-1.15	-34.49	-0.40
7.45	-12.49	-0.37	9.17	0.32	-47.37	-1.24	-41.79	-0.06
7.65	-12.77	-0.43	9.20	0.25	-47.14	-1.35	-36.69	-1.52
7.85	-13.12	-0.48	9.28	0.17	-47.30	-1.41	-29.12	-1.22
8.05	-13.53	-0.52	9.41	0.09	-48.02	-1.42	-24.56	-1.44
8.25	-13.94	-0.56	9.47	0.01	-46.62	-1.48	-22.10	1.44
8.45	-14.43	-0.60	9.49	-0.08	-46.47	-1.51	-21.21	1.35
8.65	-14.93	-0.64	9.54	-0.17	-45.51	1.54	-21.18	1.29
8.85	-15.52	-0.67	9.58	-0.25	-45.61	1.46	-20.39	1.28
9.05	-16.13	-0.70	9.62	-0.33	-44.75	1.34	-19.58	1.33
9.25	-16.86	-0.73	9.67	-0.41	-44.60	1.27	-19.05	1.28

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S-PARAMETERS CONTINUED

	S11		S21		S12		S22	
Frequency	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
9.45	-17.68	-0.74	9.75	-0.49	-43.92	1.16	-18.35	1.26
9.65	-18.55	-0.74	9.78	-0.58	-44.02	1.07	-17.66	1.29
9.85	-19.45	-0.72	9.81	-0.67	-43.32	0.97	-16.90	1.27
10.05	-20.51	-0.69	9.88	-0.75	-43.38	0.90	-16.33	1.23
10.25	-21.65	-0.63	9.95	-0.83	-43.53	0.77	-15.87	1.25
10.45	-22.95	-0.50	9.98	-0.92	-43.32	0.70	-15.32	1.23
10.65	-23.58	-0.29	10.03	-1.01	-43.10	0.67	-14.49	1.18
10.85	-23.52	-0.08	10.10	-1.10	-42.82	0.54	-13.89	1.16
11.05	-22.97	0.10	10.11	-1.18	-42.71	0.50	-13.44	1.16
11.25	-22.03	0.24	10.11	-1.27	-42.47	0.41	-12.67	1.13
11.45	-20.90	0.34	10.16	-1.37	-42.44	0.33	-12.07	1.08
11.65	-19.77	0.40	10.25	-1.45	-41.96	0.19	-11.75	1.04
11.85	-18.62	0.42	10.24	-1.54	-42.27	0.08	-11.09	0.99
12.05	-17.64	0.43	10.14	1.50	-42.51	0.00	-10.19	0.93
12.25	-16.75	0.42	10.12	1.41	-43.34	-0.06	-9.70	0.82
12.45	-15.97	0.39	10.19	1.34	-43.82	-0.06	-9.81	0.67
12.65	-15.23	0.37	10.19	1.26	-43.35	-0.01	-10.32	0.62
12.85	-14.58	0.33	10.22	1.16	-42.38	-0.04	-10.65	0.61
13.05	-13.97	0.29	10.30	1.07	-41.92	-0.11	-10.67	0.57
13.25	-13.41	0.24	10.27	0.98	-41.40	-0.24	-10.45	0.58
13.45	-12.93	0.20	10.17	0.90	-41.13	-0.29	-10.33	0.58
13.65	-12.48	0.14	10.18	0.80	-40.78	-0.35	-10.11	0.52
13.85	-12.12	0.09	10.29	0.72	-40.86	-0.42	-9.99	0.50
14.05	-11.80	0.04	10.27	0.64	-39.83	-0.50	-9.95	0.49
14.25	-11.47	-0.02	10.16	0.54	-39.91	-0.58	-9.67	0.43
14.45	-11.19	-0.08	10.15	0.44	-39.98	-0.65	-9.38	0.38
14.65	-10.97	-0.14	10.22	0.36	-39.88	-0.74	-9.46	0.35
14.85	-10.80	-0.20	10.15	0.29	-39.46	-0.77	-9.39	0.31
15.05	-10.60	-0.26	10.12	0.20	-39.37	-0.87	-9.19	0.27
15.25	-10.50	-0.32	10.25	0.10	-39.02	-0.93	-9.39	0.21
15.45	-10.41	-0.38	10.25	0.02	-39.17	-1.00	-9.52	0.16
15.65	-10.35	-0.45	10.15	-0.06	-38.70	-1.11	-9.33	0.13
15.85	-10.34	-0.51	10.16	-0.15	-38.29	-1.16	-9.38	0.09
16.05	-10.38	-0.58	10.25	-0.24	-38.37	-1.22	-9.71	0.03
16.25	-10.44	-0.64	10.27	-0.31	-37.69	-1.25	-9.87	-0.01
16.45	-10.51	-0.70	10.27	-0.40	-37.81	-1.34	-9.95	-0.04
16.65	-10.68	-0.77	10.33	-0.50	-37.37	-1.46	-10.17	-0.11
16.85	-10.85	-0.83	10.47	-0.58	-37.44	-1.49	-10.34	-0.15
17.05	-11.05	-0.90	10.44	-0.66	-36.70	-1.57	-10.54	-0.14
17.25	-11.34	-0.96	10.44	-0.75	-36.30	1.52	-10.81	-0.19

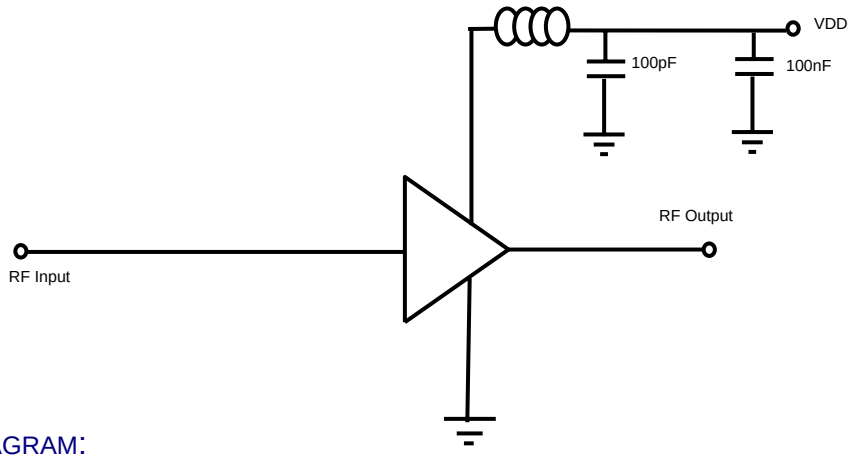
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S-PARAMETERS CONTINUED

Frequency	S11		S21		S12		S22	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
17.45	-11.67	-1.02	10.60	-0.85	-35.91	1.43	-11.13	-0.25
17.65	-12.06	-1.08	10.76	-0.93	-35.58	1.33	-11.61	-0.27
17.85	-12.56	-1.14	10.81	-1.02	-35.39	1.23	-12.09	-0.30
18.05	-13.13	-1.20	10.89	-1.12	-35.00	1.15	-12.46	-0.37
18.25	-13.80	-1.25	11.04	-1.22	-34.55	1.06	-13.22	-0.40
18.45	-14.60	-1.29	11.14	-1.31	-34.35	0.97	-14.20	-0.42
18.65	-15.56	-1.32	11.23	-1.41	-34.03	0.90	-14.94	-0.44
18.85	-16.63	-1.32	11.37	-1.52	-33.85	0.80	-16.16	-0.44
19.05	-17.87	-1.29	11.50	1.52	-33.73	0.70	-18.02	-0.42
19.25	-19.21	-1.21	11.59	1.41	-33.08	0.60	-19.15	-0.32
19.45	-20.43	-1.06	11.67	1.30	-32.79	0.48	-19.93	-0.15
19.65	-21.00	-0.85	11.78	1.18	-32.69	0.34	-21.30	0.09
19.85	-20.78	-0.61	11.83	1.08	-32.53	0.24	-21.17	0.44
20.05	-19.99	-0.42	11.88	0.96	-32.70	0.11	-19.15	0.73

Specifications subject to change without notice
Filtronic Compound Semiconductors Ltd
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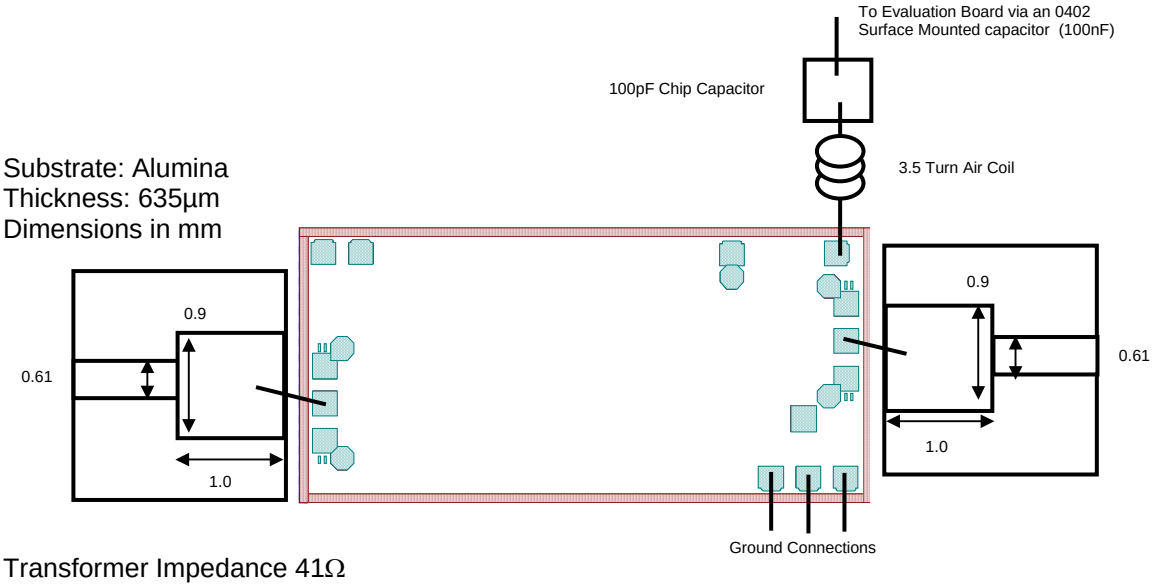
BIASING CIRCUIT SCHEMATIC:



ASSEMBLY DIAGRAM:

It is recommended that the RF connections be made using bond wires with 25µm diameter and a maximum length of 300µm. Optimum input and output return loss can be achieved, to compensate for bond wire inductance, with the addition of a microstrip transformer, shown in the diagram below. Ground connections should be made according to the required bias conditions.

Substrate: Alumina
Thickness: 635µm
Dimensions in mm



Transformer Impedance 41Ω
Electrical Length 32º at 10GHz

BILL OF MATERIALS:

COMPONENT
All RF tracks should be 50Ω characteristic material
Capacitor, 100pF, chip capacitor
Capacitor, 100nF, 0402
6 nH – 3.5 Turn Air Coil (Manufacturer: Sycopel, model: HMG/3.5/500/50/100)

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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 recommended die attach is gold/tin eutectic solder under a nitrogen atmosphere. Stage temperature should be 280-290°C; maximum time at temperature is one minute. The recommended wire bond method is thermo-compression wedge bonding with 0.7 or 1.0 mil (0.018 or 0.025 mm) gold wire. Stage temperature should be 250-260°C.

Bonds should be made from the die first and then to the mounting substrate or package. The physical length of the bondwires should be minimised 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. These devices should be treated as Class 0 (0-250 V) 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.

APPLICATION NOTES & DESIGN DATA:

Application Notes and design data including S-parameters available on request.

DISCLAIMERS:

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

ORDERING INFORMATION:

PART NUMBER	DESCRIPTION
FMA3009	Die in Waffle-pack (Gel-pak available on request)

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