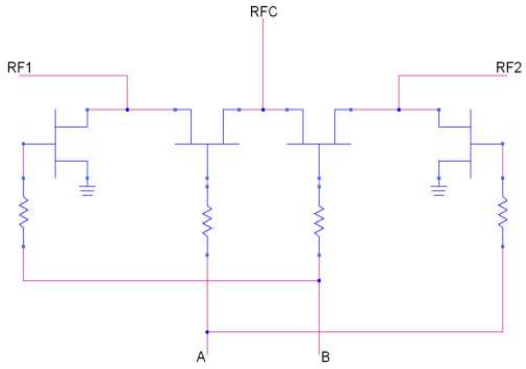
DC-4GHz reflective SPDT

GaAs Monolithic Microwave IC

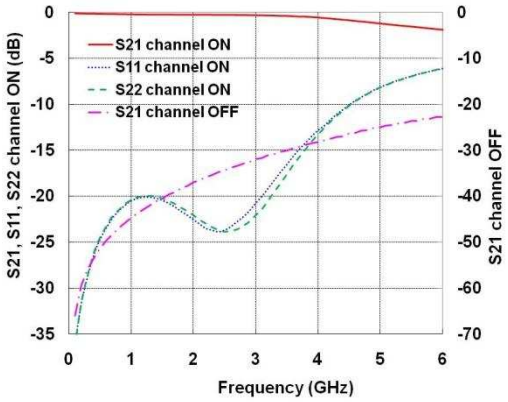
Description

The CHS5104-99F is a monolithic FET based reflective switch.
It is designed for a wide range of applications, from defense to commercial communication systems.
The circuit is manufactured with a pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.
It is available in chip form.



Main Features

- Broadband performance: DC-4GHz
- Low insertion loss: 0.5dB@4GHz
- Isolation: 38dB@2GHz
  30dB@4GHz
- Return loss: 20dB@2GHz
  13dB@4GHz
- Input P1dB: 30dBm
- Chip size: 0.8x0.8x0.07mm^3



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	DC		4	GHz
IL	On state insertion loss		0.5		dB
ISOL	Off state isolation		35		dB
RL	On state return loss		20		dB
IP1dB	Input Power @1dB gain compression		30		dBm

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Electrical Characteristics [1]

Tamb.= +25°C, specifications are given for 50Ω source and load impedances.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
Freq	Frequency range		DC		4	GHz
IL	On state insertion loss [2]	DC - 2GHz DC - 4GHz		0.25 0.5		dB
ISOL	Off state isolation	DC - 2GHz DC - 4GHz		38 30		dB
RL	On state input and output return losses	DC - 2GHz DC - 4GHz		20 13		dB
VH	Control voltage high level			0	0.5	
VL	Control voltage low level		-8	-5		V
IP1dB	Input Power @1dB gain compression.	Freq. >0.5GHz VL=-5V/VH=0V VL=-8V/VH=0V		 30 33		dBm
Ton / Toff	Switching time	50% control to 90% RF, and 50% control to 10% RF		10		ns
Ic_L	Current consumption on the control supply voltage	VH= 0V VL=-5V VL=-8V		40 20 200		µA

[1] These values are representative of on-board measurements with a typically bonding wire of 1nH at each RF ports.
[2] Variation rate of insertion loss with temperature in the range -55°C to +125°C: -0.002dB/°C

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Absolute Maximum Ratings [1]

Tamb.= +25°C

Symbol	Parameter	Values	Unit
VH	High level control voltage	0.8	V
VL	Low level control voltage	-10	V
Pin	Maximum peak input power overdrive [2]	38	dBm
Tj	Junction temperature	175	°C
Ta	Operating temperature range	-55 to +125	°C
Tstg	Storage temperature range	-55 to +150	°C

[1] Operation of this device above anyone of these parameters may cause permanent damage.
[2] Duration < 1s.

SPDT truth table (complementary logic)

PAD A	PAD B	Electrical path RFC to RF1	Electrical path RFC to RF2
VH	VL	ON	OFF
VL	VH	OFF	ON

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Typical on-wafer Sij parameters

Tamb.= +25°C, Bias Conditions : VL = -5V, VH = 0V, **ON-state** (RFC-RF1 path or RFC-RF2 path)

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
0.2	-31.10	-105.7	-0.18	-2.0	-0.19	-2.0	-31.06	-105.2
0.4	-25.37	-101.3	-0.20	-3.8	-0.20	-3.8	-25.40	-101.0
0.6	-21.97	-100.9	-0.22	-5.7	-0.22	-5.7	-21.97	-100.5
0.8	-19.55	-102.1	-0.24	-7.6	-0.24	-7.6	-19.51	-101.1
1.0	-17.68	-103.4	-0.27	-9.4	-0.28	-9.4	-17.62	-102.2
1.2	-16.21	-105.0	-0.31	-11.2	-0.32	-11.2	-16.15	-103.7
1.4	-14.82	-106.1	-0.34	-13.1	-0.35	-13.1	-14.81	-104.7
1.6	-13.70	-107.5	-0.38	-15.0	-0.39	-15.0	-13.75	-106.1
1.8	-12.72	-109.3	-0.43	-16.9	-0.44	-16.9	-12.69	-107.4
2.0	-11.86	-111.2	-0.50	-18.6	-0.50	-18.7	-11.84	-109.2
2.2	-11.04	-113.6	-0.56	-20.2	-0.56	-20.2	-10.96	-110.1
2.4	-10.51	-114.9	-0.61	-22.4	-0.62	-22.3	-10.36	-113.1
2.6	-9.83	-116.4	-0.71	-24.0	-0.71	-24.0	-9.78	-114.3
2.8	-9.27	-118.3	-0.79	-25.7	-0.79	-25.7	-9.21	-115.8
3.0	-8.84	-119.9	-0.88	-27.3	-0.88	-27.3	-8.69	-117.4
3.2	-8.30	-120.8	-0.95	-29.0	-0.96	-29.0	-8.22	-119.0
3.4	-7.80	-122.7	-1.04	-30.6	-1.04	-30.6	-7.78	-120.6
3.6	-7.37	-125.0	-1.14	-32.2	-1.14	-32.2	-7.38	-121.9
3.8	-6.99	-126.7	-1.24	-33.8	-1.24	-33.8	-7.01	-123.4
4.0	-6.67	-128.2	-1.33	-35.3	-1.33	-35.3	-6.67	-125.0
4.2	-6.33	-129.7	-1.41	-36.9	-1.42	-36.9	-6.30	-126.0
4.4	-6.06	-131.2	-1.52	-38.5	-1.52	-38.5	-5.97	-127.7
4.6	-5.74	-132.4	-1.63	-40.0	-1.62	-40.0	-5.72	-129.0
4.8	-5.47	-134.0	-1.74	-41.5	-1.74	-41.5	-5.43	-130.5
5.0	-5.22	-135.7	-1.86	-42.9	-1.86	-42.9	-5.18	-131.9
5.2	-4.98	-137.1	-1.98	-44.2	-1.98	-44.3	-4.96	-133.2
5.4	-4.75	-138.6	-2.09	-45.7	-2.09	-45.6	-4.74	-134.4
5.6	-4.56	-140.0	-2.21	-47.0	-2.21	-47.0	-4.52	-135.8
5.8	-4.30	-141.8	-2.36	-48.7	-2.37	-48.7	-4.29	-137.4
6.0	-4.11	-143.4	-2.50	-50.0	-2.50	-50.0	-4.12	-138.6
6.2	-3.96	-144.9	-2.61	-51.3	-2.62	-51.3	-3.90	-139.5
6.4	-3.81	-146.2	-2.75	-52.7	-2.75	-52.7	-3.73	-141.2
6.6	-3.62	-147.7	-2.90	-53.9	-2.90	-53.9	-3.64	-142.3
6.8	-3.48	-149.2	-3.03	-55.0	-3.03	-55.0	-3.51	-143.2
7.0	-3.36	-150.6	-3.14	-56.1	-3.14	-56.1	-3.31	-144.0
7.2	-3.25	-151.8	-3.24	-57.2	-3.24	-57.2	-3.08	-145.2
7.4	-3.16	-153.0	-3.32	-58.6	-3.33	-58.6	-2.84	-146.8
7.6	-3.05	-154.1	-3.47	-60.1	-3.48	-60.1	-2.76	-148.5
7.8	-2.93	-155.2	-3.63	-61.4	-3.64	-61.3	-2.70	-149.7
8.0	-2.79	-156.4	-3.84	-62.6	-3.84	-62.6	-2.70	-150.9

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Typical on-wafer Sij parameters

Tamb.= +25°C, Bias Conditions : VL = -5V, VH = 0V, **OFF-state** (RFC-RF1 path or RFC-RF2 path)

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
0.2	-30.73	100.9	-64.80	106.1	-64.19	106.1	-0.43	179.2
0.4	-30.14	-92.1	-54.91	99.1	-54.97	99.7	-0.44	178.8
0.6	-22.46	-96.0	-52.98	102.6	-53.03	103.3	-0.45	178.4
0.8	-19.43	-103.5	-50.24	104.5	-50.29	105.0	-0.45	177.9
1.0	-17.33	-107.1	-48.14	107.7	-48.13	108.1	-0.46	177.4
1.2	-16.19	-111.2	-46.26	110.0	-46.21	109.9	-0.46	176.9
1.4	-15.12	-113.1	-44.41	109.5	-44.42	109.4	-0.47	176.4
1.6	-14.10	-117.4	-43.16	110.2	-43.19	110.4	-0.48	175.9
1.8	-13.98	-119.5	-41.95	114.5	-41.95	114.3	-0.47	175.5
2.0	-13.77	-117.1	-40.51	115.3	-40.52	115.3	-0.47	175.0
2.2	-12.85	-115.3	-40.03	118.2	-40.04	118.1	-0.43	175.3
2.4	-11.97	-113.6	-38.27	118.0	-38.25	118.1	-0.42	173.5
2.6	-11.31	-116.5	-37.16	118.6	-37.14	118.6	-0.49	173.3
2.8	-10.70	-116.0	-36.12	118.8	-36.12	118.7	-0.49	172.8
3.0	-9.79	-115.2	-34.96	119.9	-34.99	119.9	-0.53	172.3
3.2	-9.13	-118.1	-33.68	116.7	-33.70	116.8	-0.54	172.1
3.4	-8.40	-119.8	-32.97	114.4	-33.00	114.5	-0.50	171.7
3.6	-7.48	-121.1	-32.56	112.2	-32.55	112.3	-0.48	171.2
3.8	-7.16	-124.3	-31.96	114.5	-31.96	114.5	-0.51	170.7
4.0	-6.50	-128.4	-31.25	112.2	-31.25	112.1	-0.51	170.1
4.2	-6.61	-131.8	-30.79	113.1	-30.79	113.0	-0.51	169.7
4.4	-6.58	-133.9	-30.10	114.0	-30.08	114.0	-0.51	168.9
4.6	-6.52	-133.8	-29.37	113.0	-29.37	113.0	-0.54	168.6
4.8	-6.45	-133.8	-28.69	113.5	-28.68	113.5	-0.54	168.0
5.0	-5.99	-133.8	-27.96	111.8	-27.96	111.9	-0.55	167.5
5.2	-5.83	-133.9	-27.30	111.4	-27.30	111.4	-0.56	167.1
5.4	-5.25	-133.8	-26.64	109.2	-26.62	109.2	-0.57	166.6
5.6	-4.82	-135.6	-26.15	107.5	-26.15	107.6	-0.56	166.0
5.8	-4.59	-137.3	-25.72	106.5	-25.71	106.5	-0.58	165.5
6.0	-4.47	-139.5	-25.31	106.1	-25.31	106.0	-0.58	165.0
6.2	-4.13	-139.8	-24.72	104.6	-24.73	104.6	-0.58	164.6
6.4	-3.79	-142.2	-24.32	102.5	-24.33	102.4	-0.58	163.9
6.6	-3.42	-143.8	-23.93	100.4	-23.93	100.4	-0.62	163.4
6.8	-3.53	-146.2	-23.66	100.6	-23.64	100.6	-0.63	163.0
7.0	-3.29	-148.5	-23.38	99.2	-23.38	99.2	-0.59	162.8
7.2	-3.39	-151.1	-23.18	99.6	-23.17	99.7	-0.53	162.2
7.4	-3.36	-150.2	-22.48	98.9	-22.48	98.8	-0.44	161.3
7.6	-3.33	-151.7	-22.15	98.5	-22.15	98.5	-0.52	160.0
7.8	-3.06	-153.3	-21.81	95.9	-21.80	95.9	-0.61	159.4
8.0	-2.91	-153.4	-21.50	94.1	-21.51	94.1	-0.73	159.1

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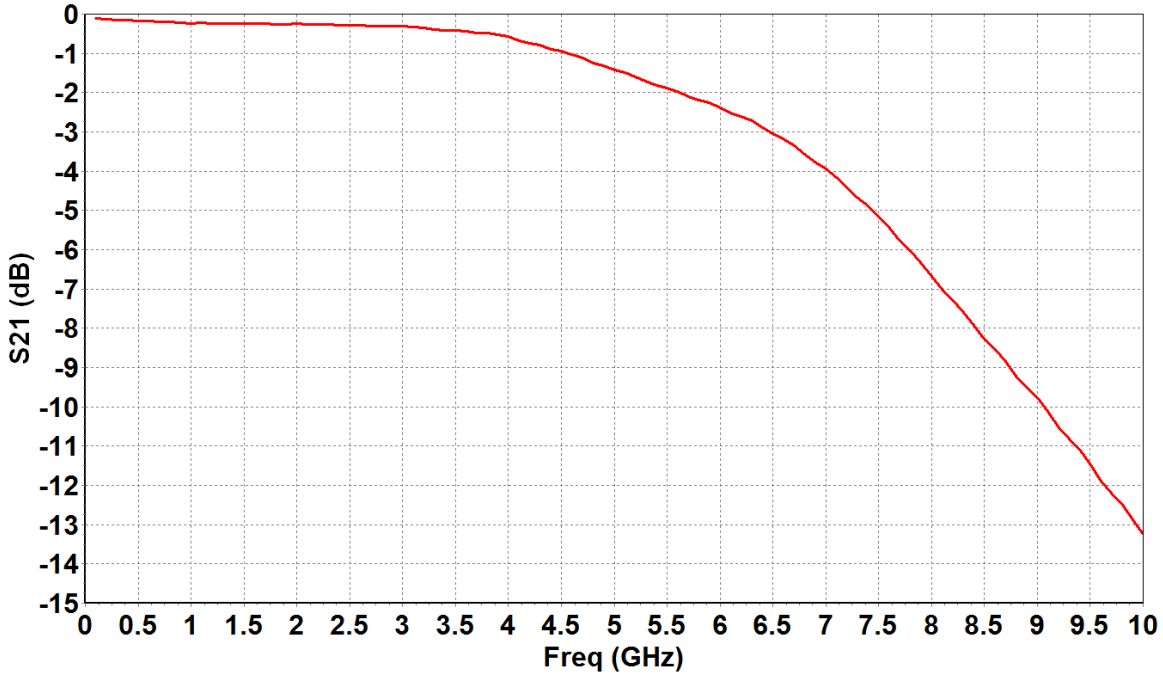
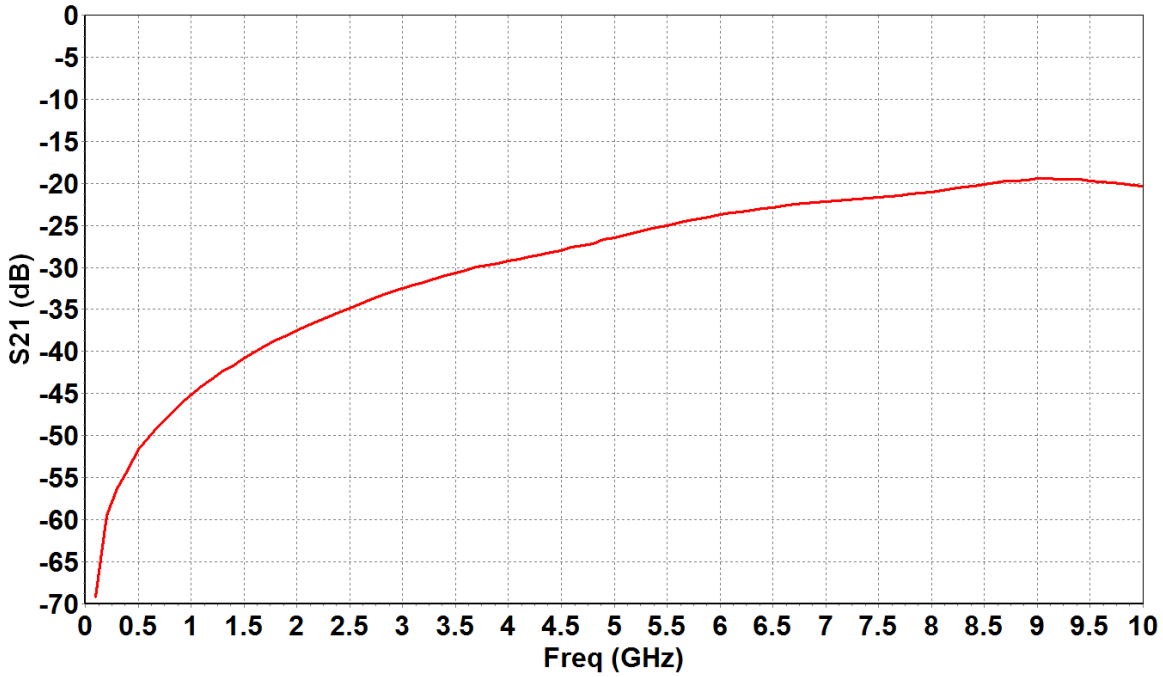
Typical Test Fixture Measurements

Tamb.= +25°C, VL=-5V, VH=0V

ON state: S21 versus Frequency



OFF state: S21 versus Frequency



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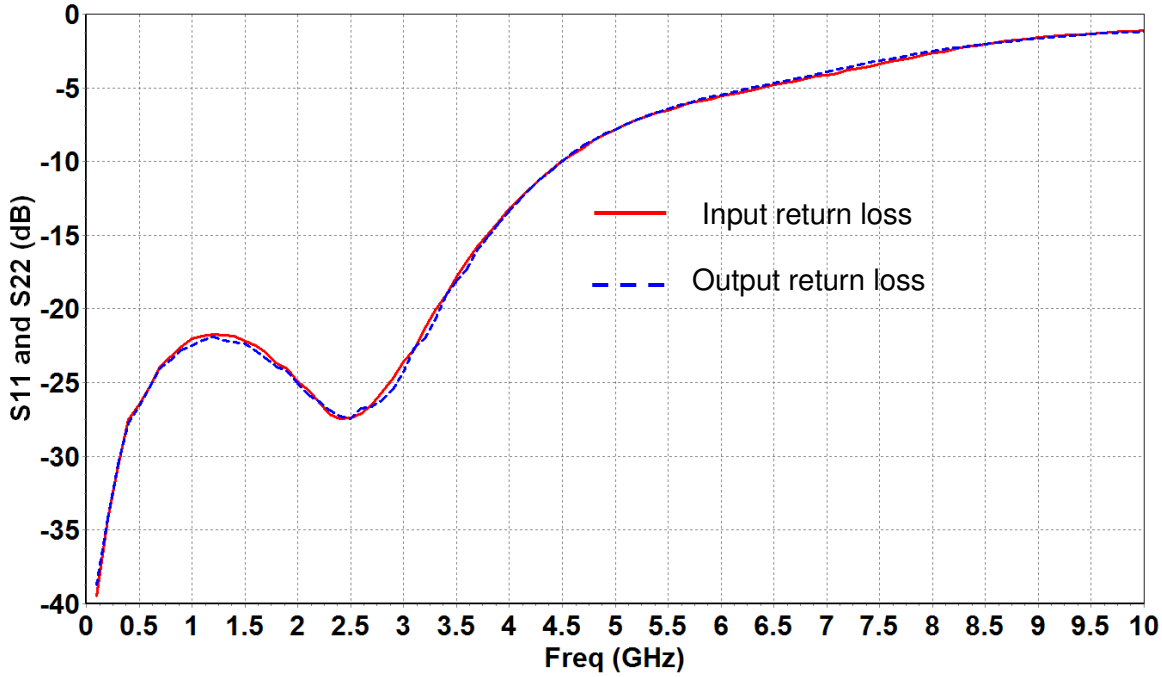
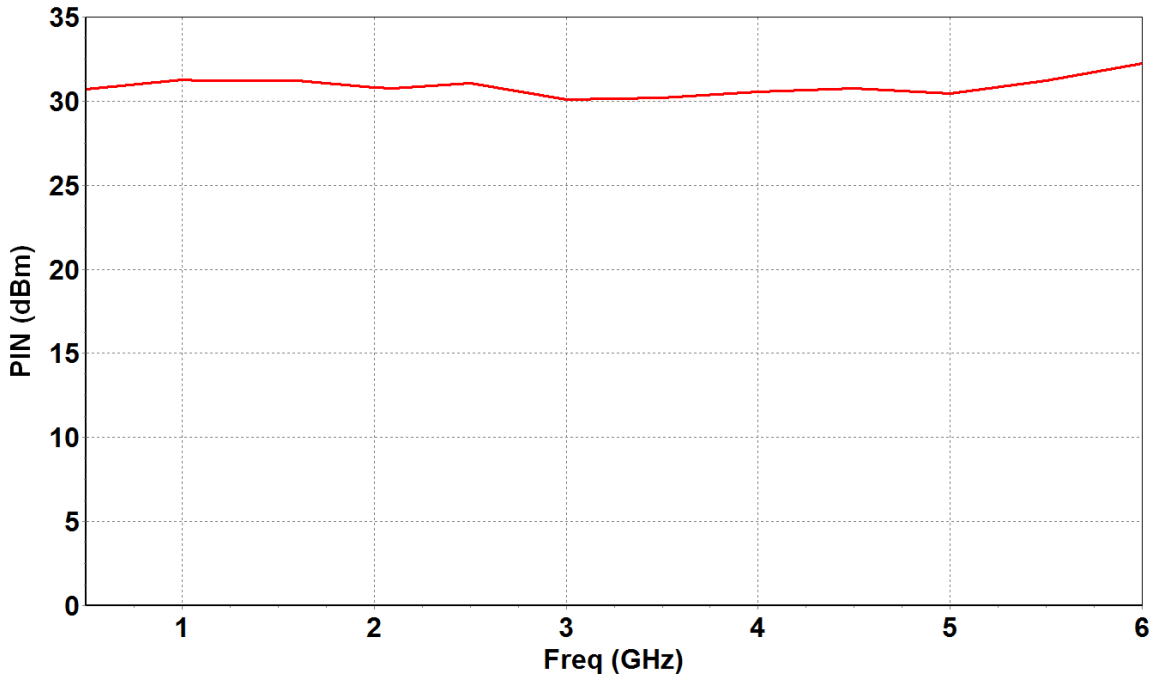
Typical Test Fixture Measurements

Tamb.= +25°C, VL=-5V, VH=0V

ON state: Input and output return loss versus Frequency



ON state: Input power at 1dB gain compression (VL=-5V / VH=0V)



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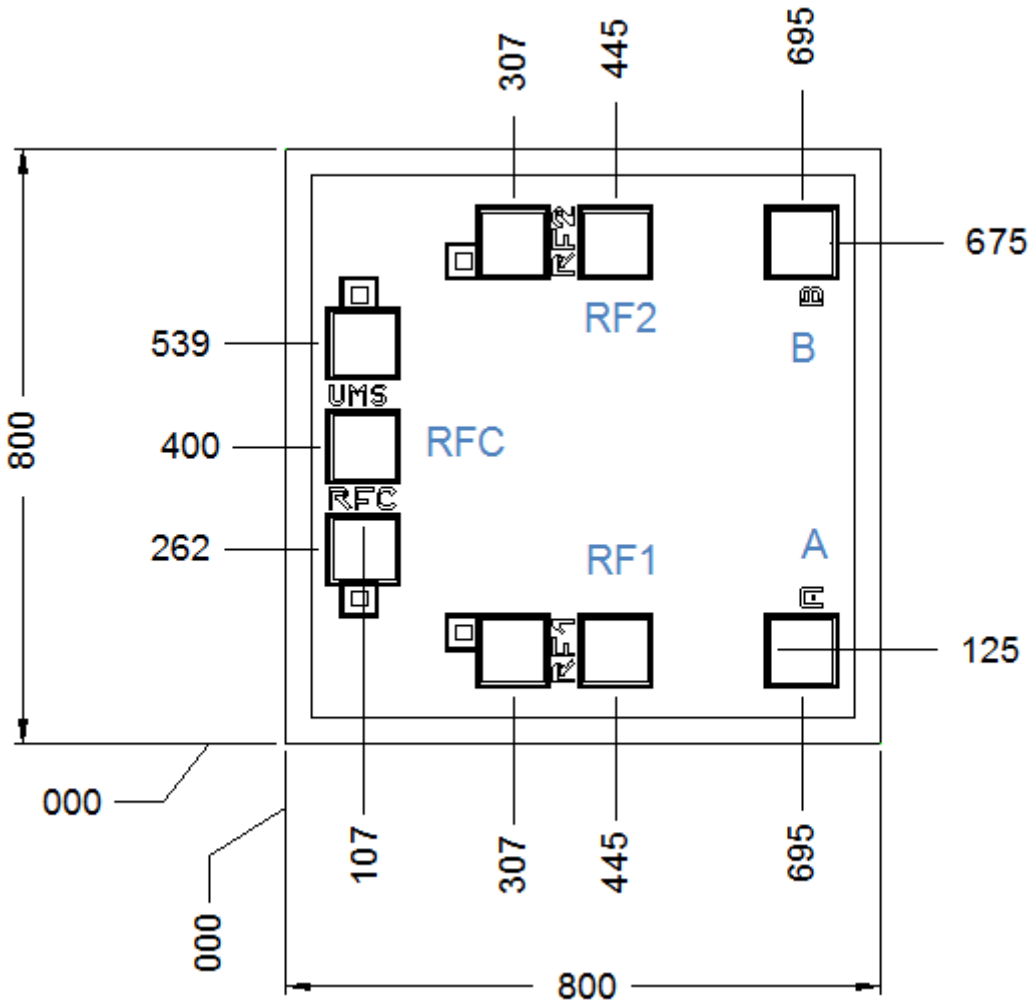
Mechanical data



Chip thickness: 70µm.
Chip size: 800x800 ±35µm
All dimensions are in micrometers

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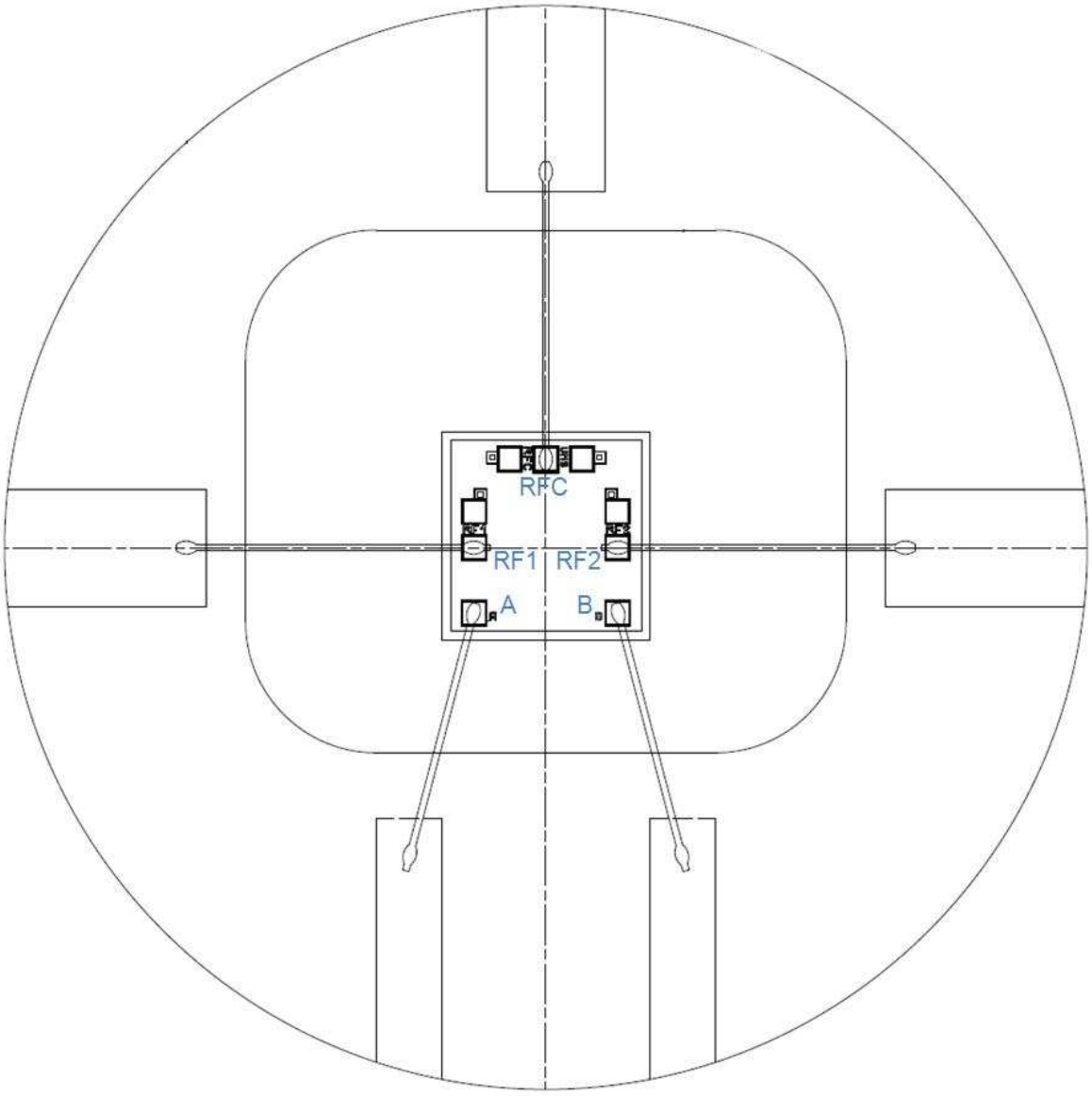
Recommended assembly plan



Recommended RF bonding wires: length=1.1mm / Ø25µm

Recommended circuit bonding table

Label	Type	Decoupling	Comment
A, B	Control voltage	Not required	SPDT switch pad control
RFC, RF1, RF2	RF access	External DC block must be used to ensure DC decoupling	The MMIC is DC coupled

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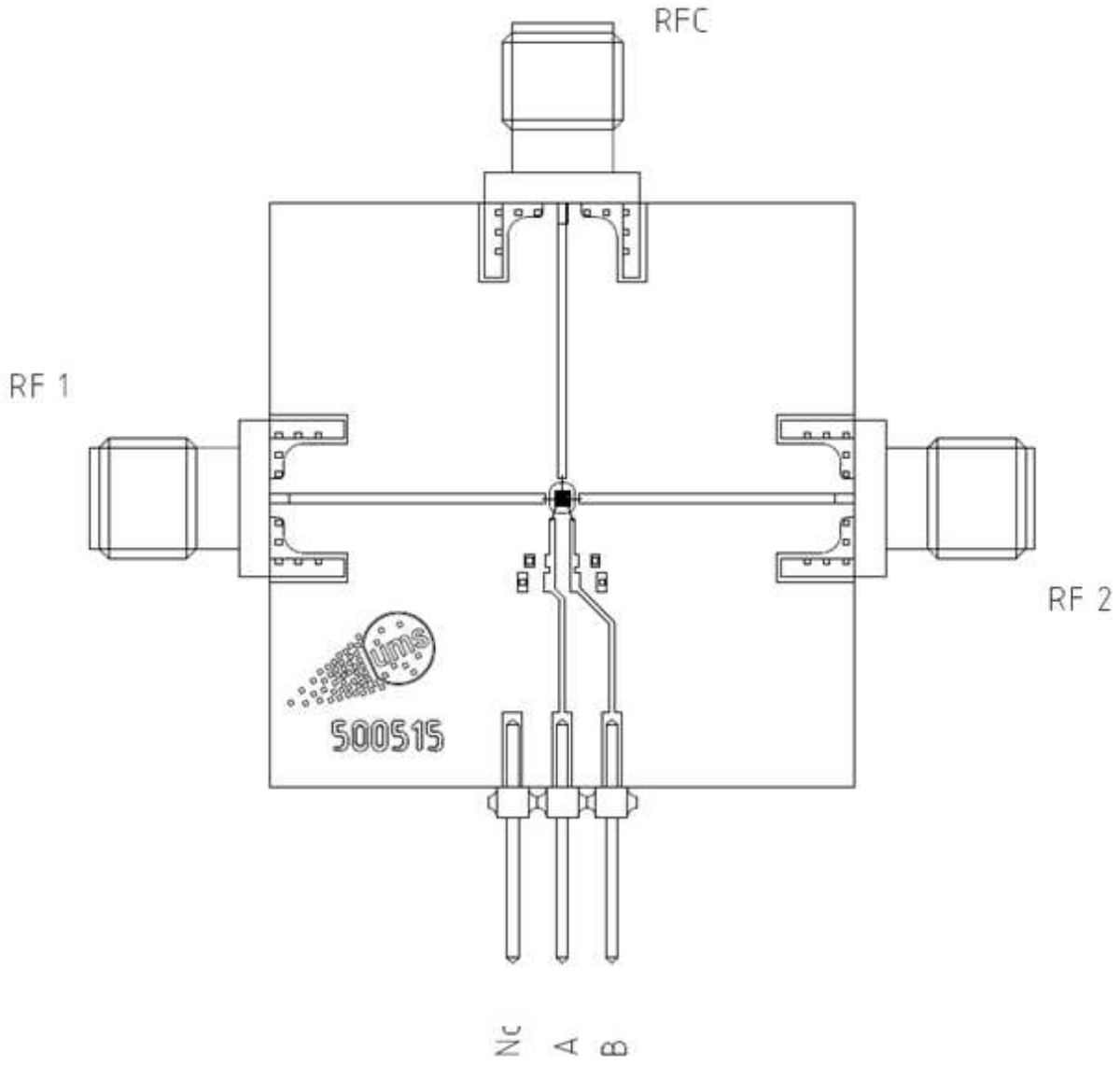
Evaluation mother board

- Based on typically Ro4003 / 8mils or equivalent.
- No decoupling capacitor used on control access



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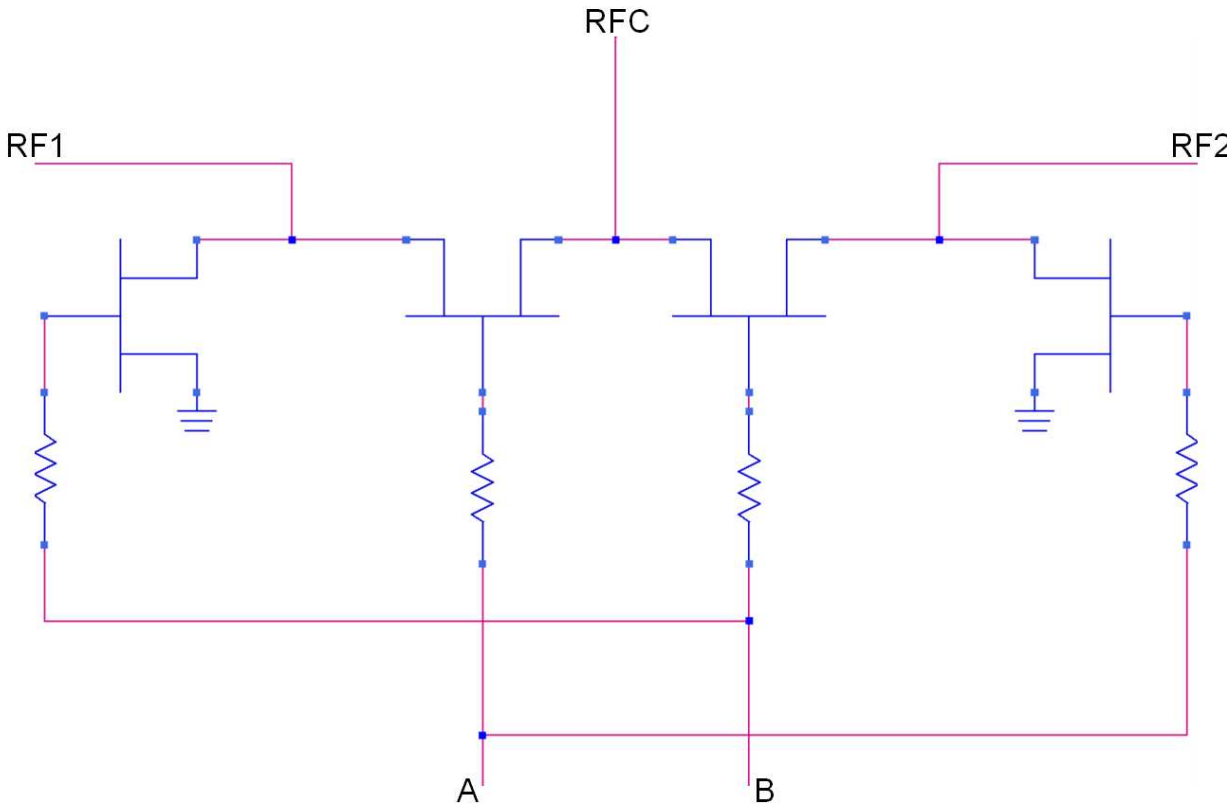
DC Schematic



Note: to ensure DC decoupling on RF accesses, DC block must be added outside the MMIC

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Recommended ESD management

Refer to the application note AN0020 available at http://www.ums-gaas.com for ESD sensitivity and handling recommendations for the UMS products.

Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at http://www.ums-gaas.com.

Ordering Information

Chip form:	CHS5104-99F/00

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