

36-44GHz Variable Attenuator

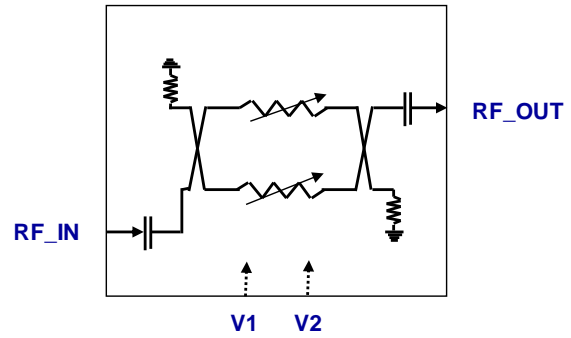
GaAs Monolithic Microwave IC

Description

The CHT4699-99F is a monolithic 36- 44GHz Variable Voltage Attenuator.

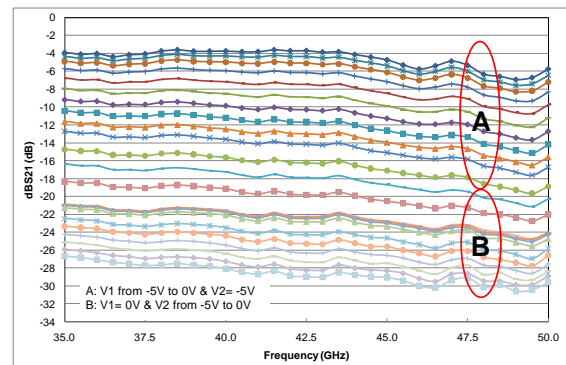
It is designed for a wide range of applications, from military to commercial communication systems.

The circuit is manufactured with a MESFET process, 0.7 μ m gate length, via holes through the substrate, air bridges. It is available in chip form.



Main Features

- Broadband performances: 36-44GHz
- Minimum attenuation: 4dB
- 30dB dynamic range
- 27dBm input IP3
- DC bias: -5 to 0V
- Chip size 2.41x1.5x0.1mm



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	36.0		44.0	GHz
Min Att	Minimum attenuation with V1=V2= -5V		-4		dB
Dyn Att	Dynamic range of attenuation		30		dB
IIP3	Input IP3 all attenuation		27		dBm

Electrical Characteristics

Tamb.= +25°C,

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	36		44	GHz
Min Att.	S21 (V1=-5V;V2=-5V)		-4		dB
Dyn	Attenuation dynamic		30		dB
RLin	Input Return loss (any attenuation)		-10		dB
RLout	Output Return loss (any attenuation)		-8		dB
Pin1dB	Input 1dB compression point (any attenuation)		20		dBm
I IP3	Input 3 rd order Intercept Point (any attenuation)		27		dBm

These values are representative of on-wafer measurements that are made without bonding wires at the RF ports.

A bonding wire of typically 0.1 to 0.15nH will improve the matching at the accesses.

Absolute Maximum Ratings ⁽¹⁾

Tamb.= +25°C

Symbol	Parameter	Values	Unit
V1	V1 control voltage	-6 to +0.6	V
V2	V2 control voltage	-6 to +0.6	V
Pin	RF input power overdrive ⁽²⁾	+33	dBm
Ta	Operating temperature range	-40 to +85	°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.

Typical Bias Conditions

Tamb.= +25°C

Symbol	Pad N°	Parameter	Values	Unit
V1	V1	V1 control voltage	-5 to 0	V
V2	V2	V2 control voltage	-5 to 0	V

For optimum linearity V1& V2 should be tuned in sequence.

Typical on wafer Sij parameters

Tamb.= +25°C, V1= -5 V, V2=-5 V, Minimum attenuation

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
25.0	-19.46	-17.4	-3.02	53.8	-3.13	53.5	-20.13	-10.5
25.5	-21.44	-10.3	-3.03	45.6	-3.04	45.9	-21.81	4.0
26.0	-22.65	10.1	-3.09	37.9	-3.13	38.6	-22.83	23.7
26.5	-21.57	28.1	-3.14	30.8	-3.14	31.4	-22.67	36.9
27.0	-20.47	41.5	-3.11	23.6	-3.06	23.4	-21.34	47.5
27.5	-18.31	50.0	-3.05	15.3	-3.06	15.8	-18.76	53.5
28.0	-16.03	52.0	-3.12	7.1	-3.18	7.4	-15.88	53.7
28.5	-14.38	49.4	-3.35	-1.0	-3.31	-0.6	-13.89	50.9
29.0	-13.17	46.0	-3.51	-8.7	-3.33	-6.9	-12.59	49.1
29.5	-11.99	42.3	-3.61	-15.9	-3.52	-15.1	-11.73	48.0
30.0	-11.29	39.0	-3.78	-22.1	-3.56	-21.6	-10.82	44.0
30.5	-10.46	33.2	-3.98	-29.8	-3.56	-28.6	-10.07	37.6
31.0	-9.95	28.5	-4.02	-36.6	-3.69	-34.9	-9.46	31.2
31.5	-9.70	24.5	-4.04	-43.0	-3.68	-42.3	-8.83	25.0
32.0	-9.26	21.6	-4.00	-49.9	-3.83	-50.3	-8.46	20.4
32.5	-8.57	18.5	-4.32	-58.7	-3.67	-57.9	-7.98	16.8
33.0	-8.24	12.5	-4.37	-63.5	-4.15	-65.6	-7.66	12.1
33.5	-8.09	8.8	-4.39	-70.1	-4.30	-69.3	-7.69	7.7
34.0	-7.59	5.0	-4.32	-76.6	-4.08	-76.2	-7.68	2.1
34.5	-7.42	-0.6	-4.36	-82.9	-3.88	-80.2	-7.69	-2.8
35.0	-7.14	-8.2	-3.92	-90.0	-3.49	-89.4	-7.50	-11.1
35.5	-7.28	-12.8	-4.09	-97.7	-3.71	-98.4	-7.63	-15.5
36.0	-7.51	-18.2	-4.02	-105.9	-3.42	-108.0	-7.84	-19.7
36.5	-7.56	-24.6	-4.35	-111.6	-4.08	-116.3	-8.18	-22.1
37.0	-8.09	-28.7	-4.14	-118.8	-4.11	-120.9	-8.86	-23.3
37.5	-8.60	-31.7	-4.04	-125.2	-4.05	-128.0	-9.49	-24.4
38.0	-8.73	-36.7	-3.72	-132.8	-3.64	-133.5	-9.52	-27.7
38.5	-9.43	-40.2	-3.59	-141.2	-3.47	-143.8	-9.77	-31.1
39.0	-9.77	-43.1	-3.75	-150.8	-3.73	-151.5	-9.88	-34.0
39.5	-10.25	-50.9	-3.75	-157.6	-3.83	-161.0	-10.39	-38.3
40.0	-11.94	-55.1	-3.73	-165.3	-4.07	-167.0	-11.25	-38.5
40.5	-13.58	-55.1	-3.80	-173.6	-3.89	-173.3	-12.21	-39.6
41.0	-15.22	-53.3	-3.79	178.5	-3.73	178.7	-13.36	-34.3
41.5	-17.80	-43.2	-3.59	170.1	-3.65	169.1	-14.03	-28.1
42.0	-18.88	-23.1	-3.70	161.7	-3.73	161.0	-14.48	-25.3
42.5	-17.78	-6.7	-3.68	153.2	-3.72	152.2	-14.80	-14.9
43.0	-15.78	5.7	-3.84	143.8	-3.79	144.0	-14.21	-4.5
43.5	-13.90	7.5	-3.80	136.7	-3.73	134.1	-12.11	0.3
44.0	-11.87	9.1	-4.10	126.2	-3.96	122.6	-10.53	-0.5
44.5	-10.25	5.3	-4.38	116.9	-4.65	114.1	-9.63	-2.0
45.0	-9.30	-1.2	-4.71	108.1	-5.34	106.2	-8.86	-2.7
45.5	-8.64	-8.3	-5.28	102.0	-5.54	101.1	-7.90	-3.5
46.0	-8.75	-13.8	-5.73	96.8	-5.46	95.0	-7.30	-9.1
46.5	-8.46	-18.1	-5.37	89.9	-5.51	84.7	-6.64	-17.6
47.0	-8.19	-22.3	-4.85	82.1	-5.86	78.0	-6.12	-25.3
47.5	-8.02	-25.5	-5.30	68.6	-6.14	69.2	-6.08	-32.7
48.0	-7.44	-31.5	-6.30	64.2	-6.66	60.2	-6.29	-35.3
48.5	-8.08	-39.7	-6.56	56.0	-7.14	56.5	-6.02	-38.2
49.0	-8.32	-41.1	-6.92	52.3	-7.72	50.4	-6.20	-45.0
49.5	-8.44	-48.7	-6.66	49.4	-7.18	47.2	-6.63	-51.7
50.0	-10.43	-58.0	-5.71	37.4	-7.01	36.4	-7.65	-56.9

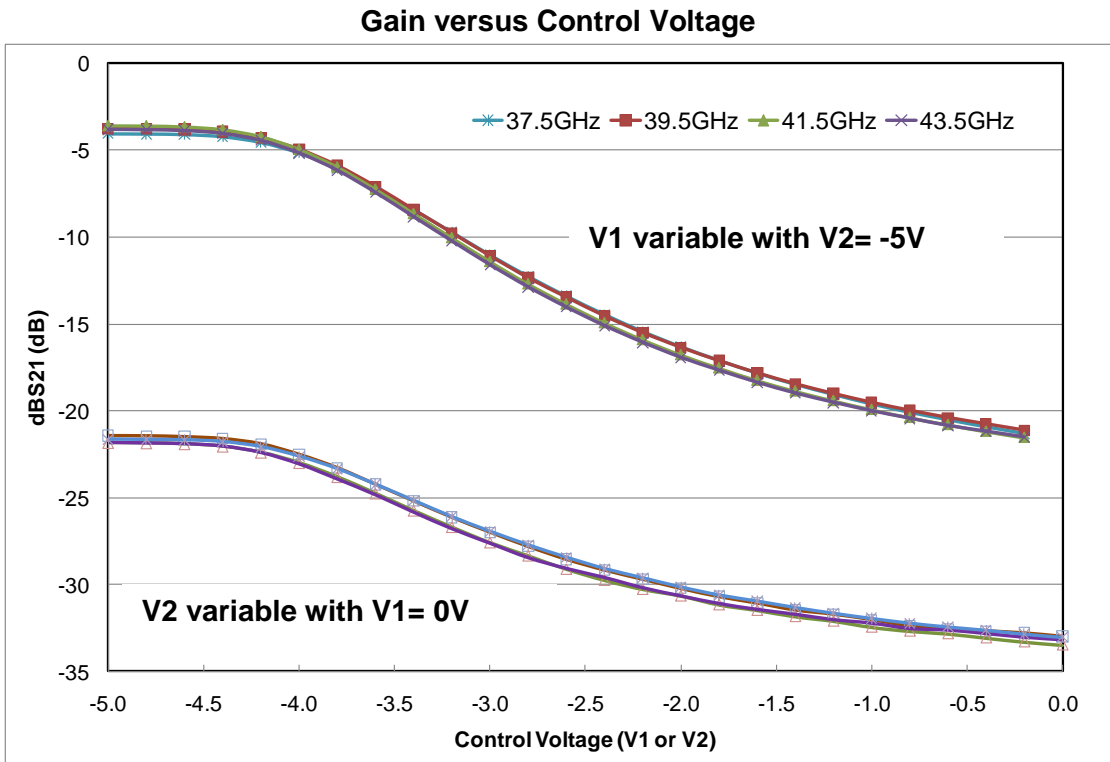
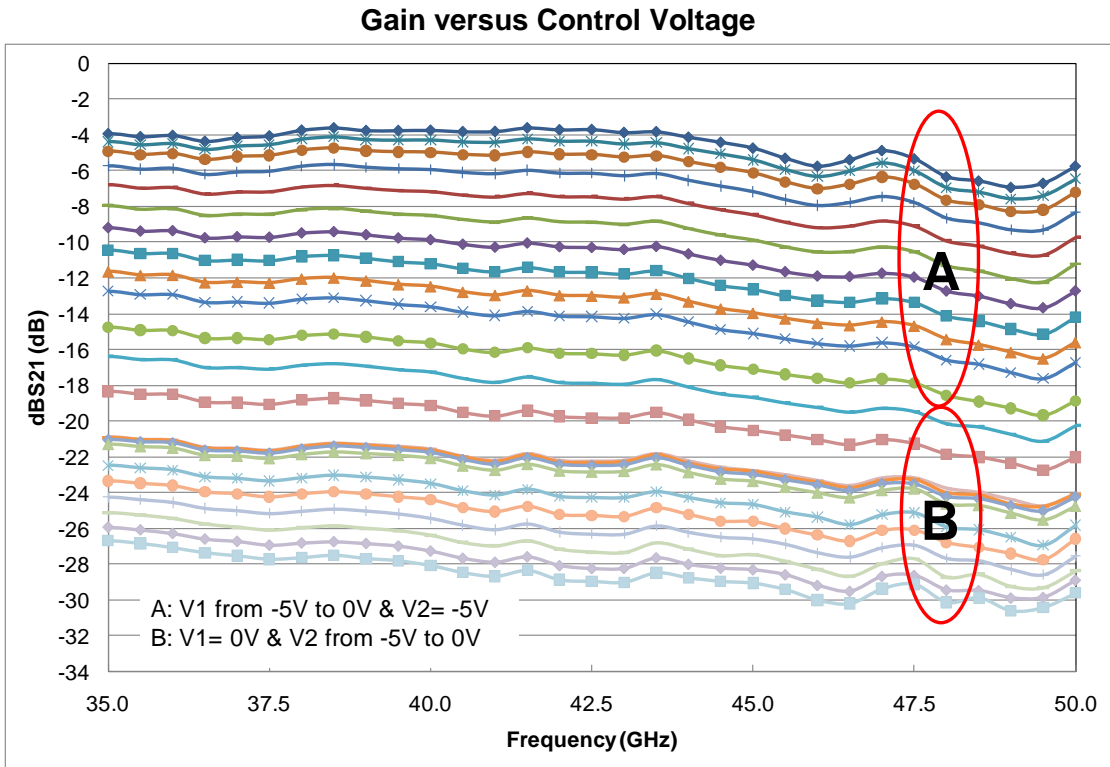
Typical on wafer Sij parameters

Tamb.= +25°C, V1= 0 V, V2= 0 V, Maximum attenuation

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
25.0	-17.55	17.7	-28.64	56.7	-28.6	55.4	-17.34	19.2
25.5	-16.91	18.8	-28.62	49.3	-28.6	48.0	-16.66	22.3
26.0	-16.15	19.1	-28.90	42.3	-29.0	42.9	-16.32	21.3
26.5	-15.35	18.9	-29.24	36.9	-29.3	37.3	-16.28	18.8
27.0	-14.89	16.8	-29.43	32.3	-29.3	32.4	-15.72	16.4
27.5	-14.38	14.8	-29.38	25.2	-29.2	26.1	-14.80	13.8
28.0	-13.86	13.8	-29.69	18.8	-29.8	18.6	-14.05	12.9
28.5	-13.49	11.4	-30.15	13.2	-30.2	13.5	-13.44	12.9
29.0	-13.14	8.6	-30.22	8.5	-30.2	9.3	-13.23	12.7
29.5	-12.81	6.2	-30.35	1.2	-30.4	3.3	-13.41	11.0
30.0	-12.92	2.8	-30.98	-1.8	-30.8	-2.0	-13.37	10.0
30.5	-12.82	-0.1	-31.26	-6.6	-31.0	-5.9	-13.14	6.7
31.0	-12.88	-2.0	-31.03	-9.2	-30.5	-8.6	-12.83	3.4
31.5	-13.10	-3.6	-30.72	-16.1	-30.5	-16.0	-12.33	0.2
32.0	-13.15	-3.2	-31.06	-24.6	-30.9	-25.1	-12.19	-1.9
32.5	-12.85	-2.7	-31.52	-31.0	-31.2	-31.3	-12.18	-2.8
33.0	-12.74	-5.1	-31.93	-34.9	-31.8	-35.0	-12.29	-3.5
33.5	-12.76	-6.4	-32.27	-39.0	-32.0	-38.8	-12.57	-4.4
34.0	-12.64	-6.8	-31.83	-42.9	-31.7	-42.8	-13.01	-7.0
34.5	-12.70	-10.0	-31.91	-49.5	-31.4	-48.0	-13.21	-8.9
35.0	-12.78	-11.4	-31.87	-56.0	-31.7	-57.1	-13.09	-11.6
35.5	-12.64	-11.5	-31.90	-63.3	-31.6	-63.2	-12.83	-12.1
36.0	-12.79	-13.8	-32.40	-69.8	-32.2	-71.6	-12.67	-11.1
36.5	-12.93	-16.2	-32.44	-76.1	-32.2	-77.4	-12.58	-9.6
37.0	-13.33	-14.5	-32.64	-80.2	-32.5	-82.6	-12.92	-7.9
37.5	-13.44	-12.5	-33.05	-87.2	-32.9	-87.7	-13.41	-6.7
38.0	-13.22	-13.0	-32.97	-90.5	-33.0	-92.6	-13.49	-6.9
38.5	-13.16	-11.6	-32.83	-96.4	-32.7	-98.4	-13.27	-6.0
39.0	-12.89	-11.9	-33.05	-104.5	-33.1	-105.4	-12.81	-6.9
39.5	-12.53	-17.0	-33.00	-111.2	-32.9	-111.0	-12.48	-7.5
40.0	-13.51	-16.7	-33.45	-115.2	-33.4	-119.4	-12.23	-4.7
40.5	-13.56	-11.2	-33.72	-121.8	-33.7	-123.1	-11.79	-4.3
41.0	-13.02	-9.7	-33.80	-127.7	-33.6	-129.5	-11.35	-5.1
41.5	-12.68	-8.8	-33.50	-133.4	-33.9	-137.1	-11.23	-5.4
42.0	-12.38	-8.1	-34.22	-140.3	-34.3	-139.6	-11.29	-7.6
42.5	-11.85	-12.6	-34.43	-144.0	-34.6	-143.0	-11.03	-7.6
43.0	-11.83	-16.8	-34.17	-144.9	-33.8	-143.1	-10.75	-9.0
43.5	-12.80	-17.8	-33.22	-149.1	-32.9	-154.7	-10.28	-10.7
44.0	-12.37	-10.2	-33.58	-161.4	-33.7	-166.5	-9.72	-11.1
44.5	-11.43	-9.5	-33.53	-163.7	-33.9	-168.3	-9.42	-12.1
45.0	-11.08	-12.8	-33.53	-175.4	-34.3	-173.8	-9.12	-12.8
45.5	-10.84	-17.1	-33.97	-178.0	-34.1	-177.5	-8.99	-14.3
46.0	-11.59	-19.8	-34.65	177.1	-34.5	177.2	-9.11	-17.2
46.5	-11.81	-15.5	-34.77	-176.9	-34.3	175.6	-8.99	-20.0
47.0	-11.48	-14.3	-33.32	177.6	-33.9	171.7	-8.76	-23.5
47.5	-10.75	-12.7	-32.97	165.9	-33.8	163.0	-8.44	-28.1
48.0	-9.95	-17.7	-34.11	160.8	-34.4	157.4	-8.48	-27.5
48.5	-10.79	-21.1	-33.76	156.1	-35.0	157.6	-8.29	-27.2
49.0	-10.52	-16.2	-34.41	151.4	-34.2	151.0	-8.36	-30.6
49.5	-9.83	-16.5	-33.76	159.8	-34.7	155.2	-8.67	-31.9
50.0	-10.36	-23.6	-32.84	151.0	-33.6	148.2	-8.95	-32.4

Typical on wafer Measurements

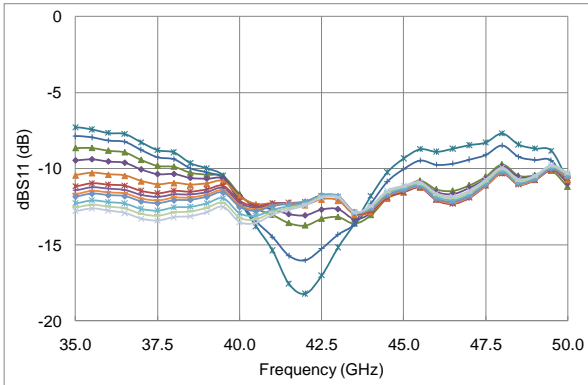
Tamb.= +25°C



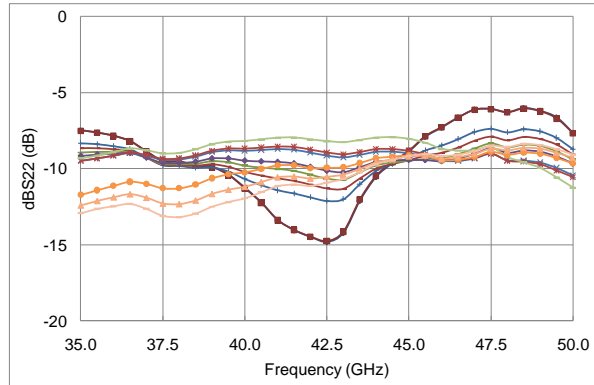
Typical on wafer Measurements

Tamb.= +25°C

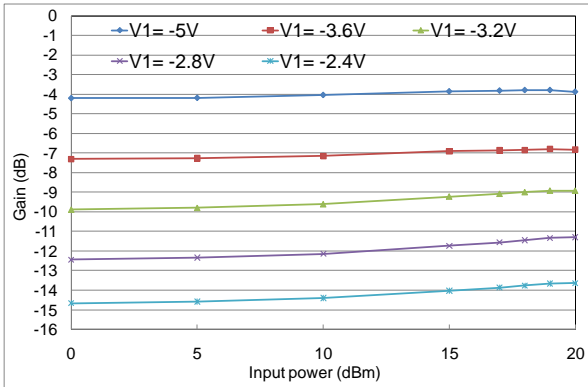
S11 versus control voltage



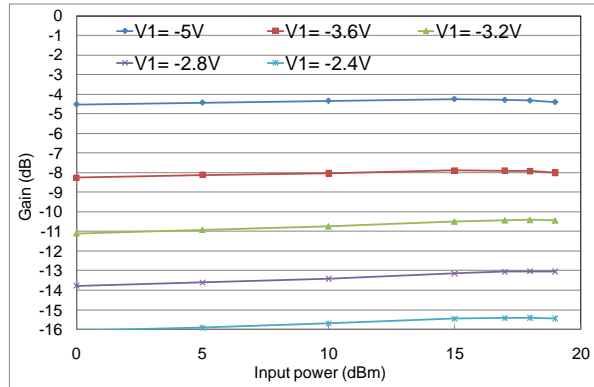
S22 versus control voltage



Gain versus input power & V1 control voltage with V2= -5V
38GHz



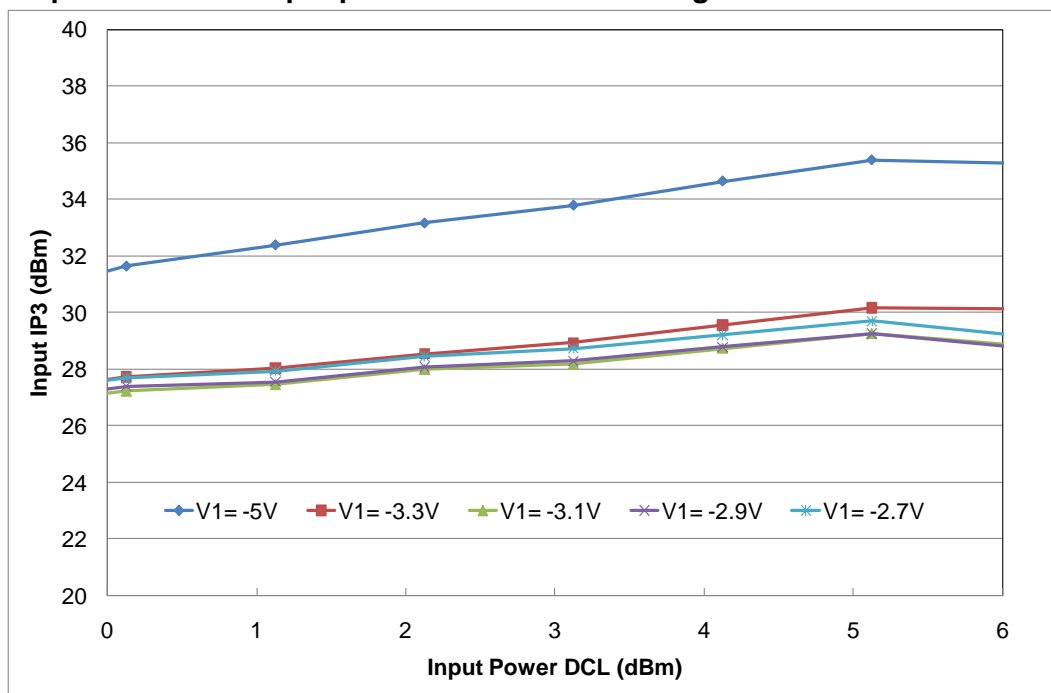
44GHz



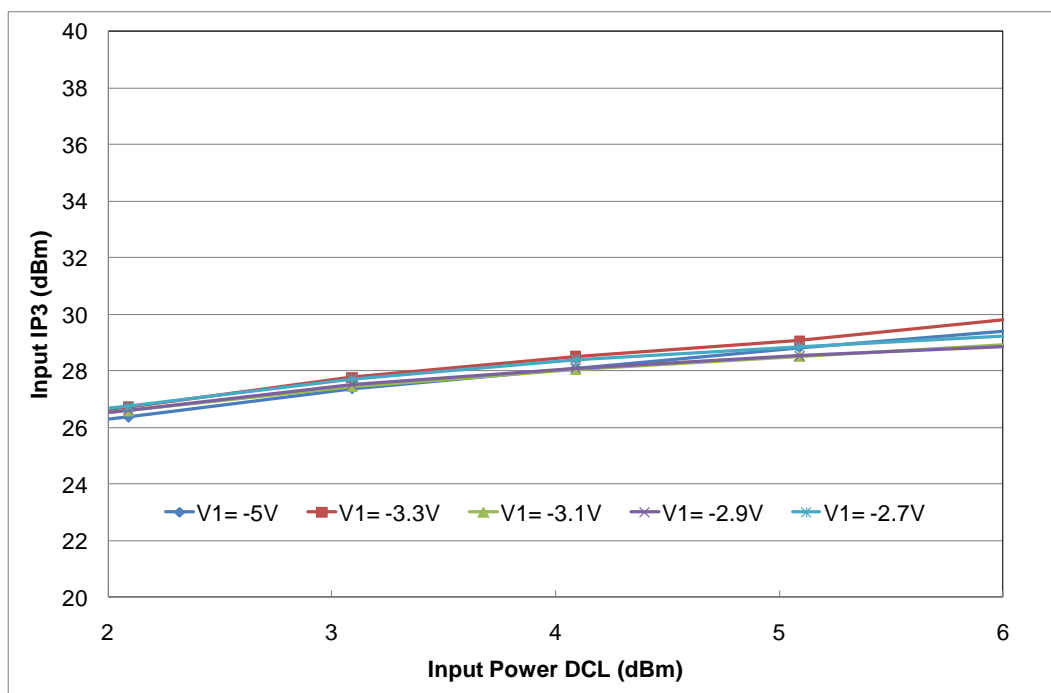
Typical Test Fixture Measurements

Tamb.= +25°C

Input IP3 versus input power & V1 control voltage at 38GHz with V2= -5V



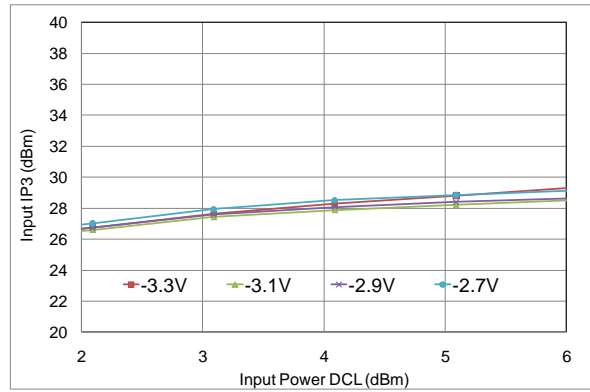
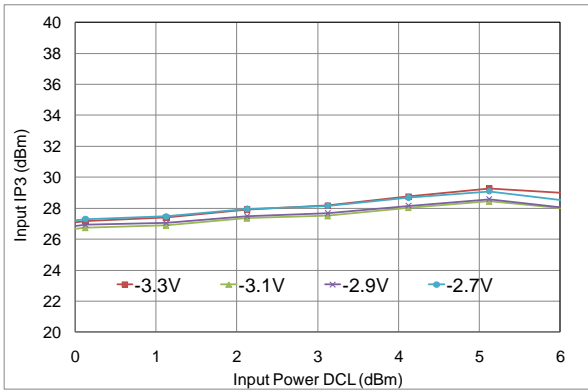
Input IP3 versus input power & V1 control voltage at 42GHz with V2= -5V



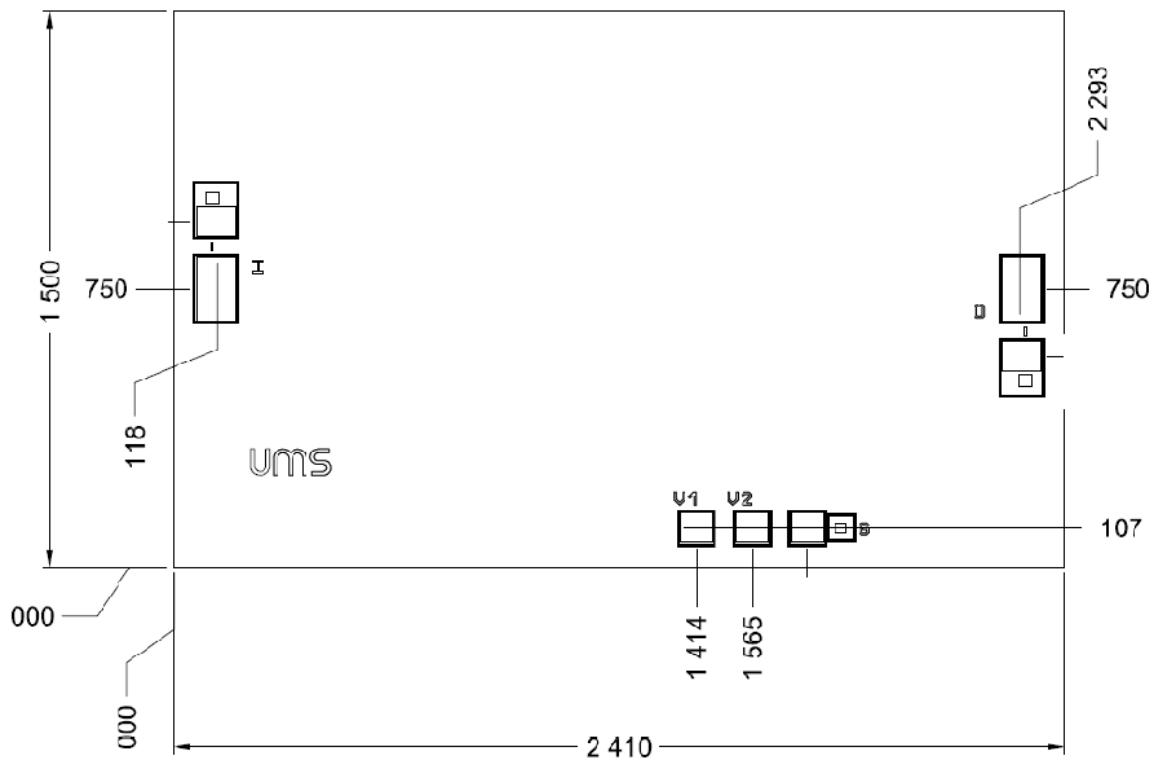
Typical Test Fixture Measurements

Tamb.= +25°C

Input IP3 versus input power with V1= V2
38GHz 42GHz

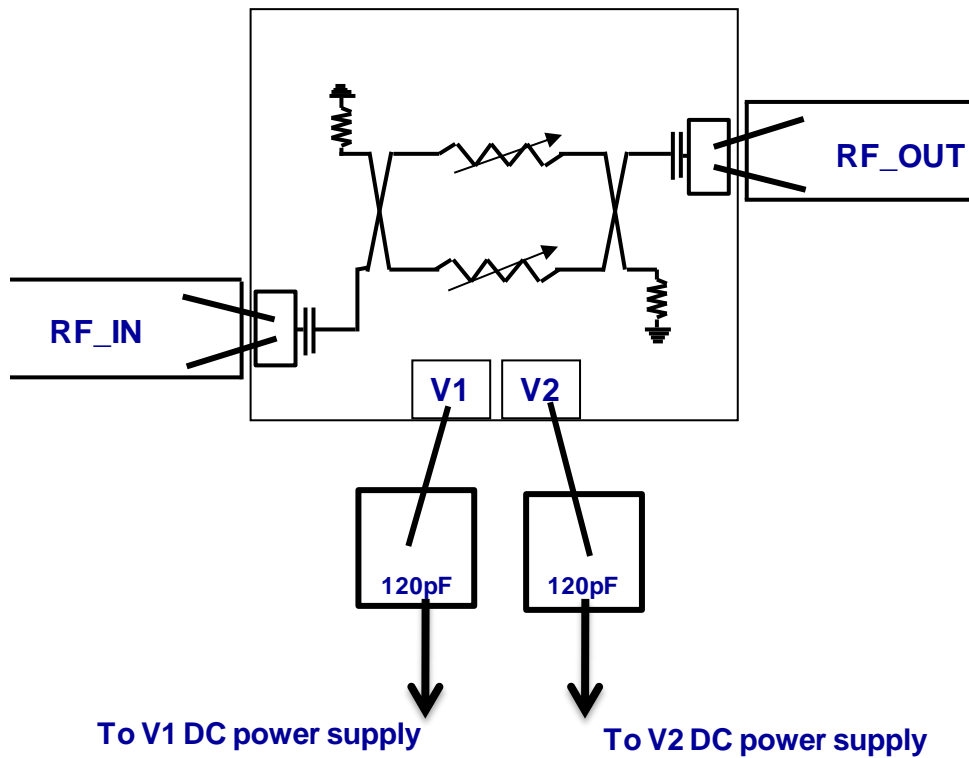


Mechanical data



Chip thickness: 100µm.
 Chip size: 2410x1500 ±35µm
 All dimensions are in micrometers

Recommended assembly plan



Note: Supply feed should be bypassed. 25 μ m diameter gold wire is to be preferred.

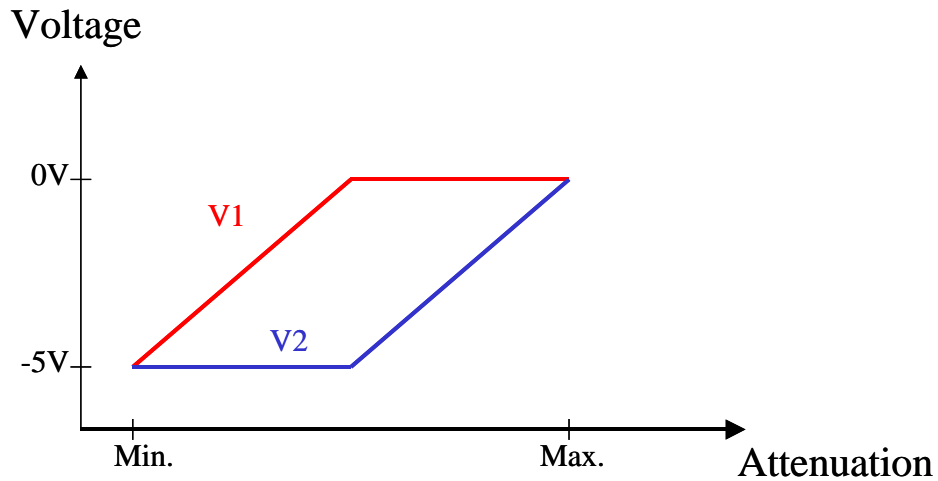
Recommended circuit bonding table

Label	Type	Decoupling	Comment
V1, V2	Vg	120pF	Gain control Supply

Biassing sequence

To obtain good performances in linearity, biasing voltage should be applied as following:

- Control of 1st stage attenuation with V1 from -5V to 0V, with V2 fixed at -5V
- Control of 2nd stage with V2 from -5V to 0V, with V1 fixed at 0V



This part could be also driven in Single Voltage Control, applying the same voltage from -5V to 0V on V1 and V2.

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:

CHT4699-99F/00

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