36-44GHz Variable Attenuator

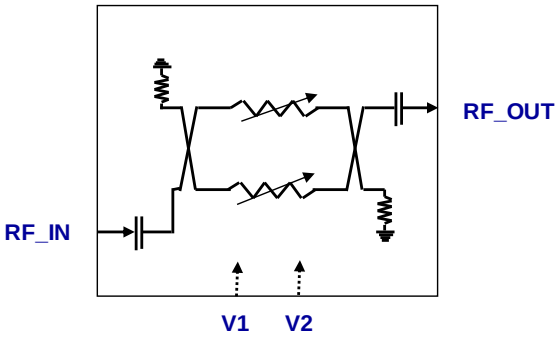
GaAs Monolithic Microwave IC

Description

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

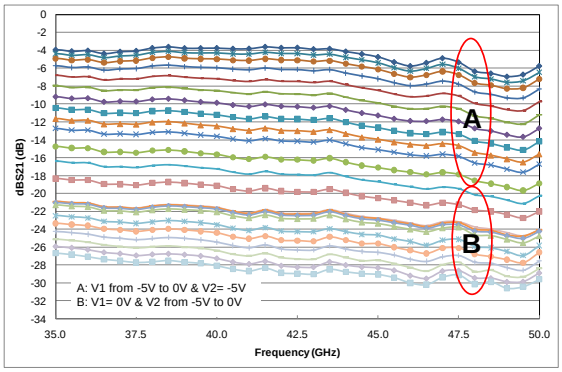
It is designed for a wide range of applications, from military to commercial communication systems.

The circuit is manufactured with a MESFET process, 0.7µm 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

United Monolithic Semiconductors S.A.S.
Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

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 3rd 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.

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

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

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

Typical on wafer Sij parameters

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

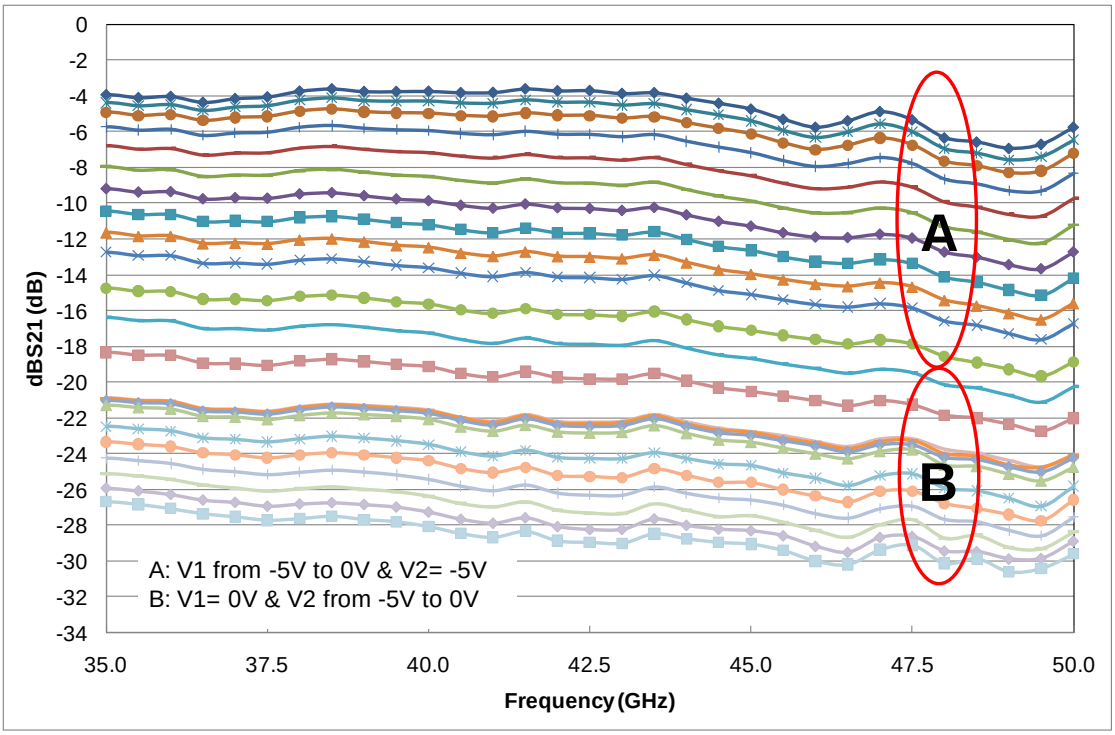
Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
25.0	-17.55	17.7	-28.64	56.7	-28.6	55.4	-17.34	19.2
25.5	-16.91	18.8	-28.62	49.3	-28.6	48.0	-16.66	22.3
26.0	-16.15	19.1	-28.90	42.3	-29.0	42.9	-16.32	21.3
26.5	-15.35	18.9	-29.24	36.9	-29.3	37.3	-16.28	18.8
27.0	-14.89	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

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

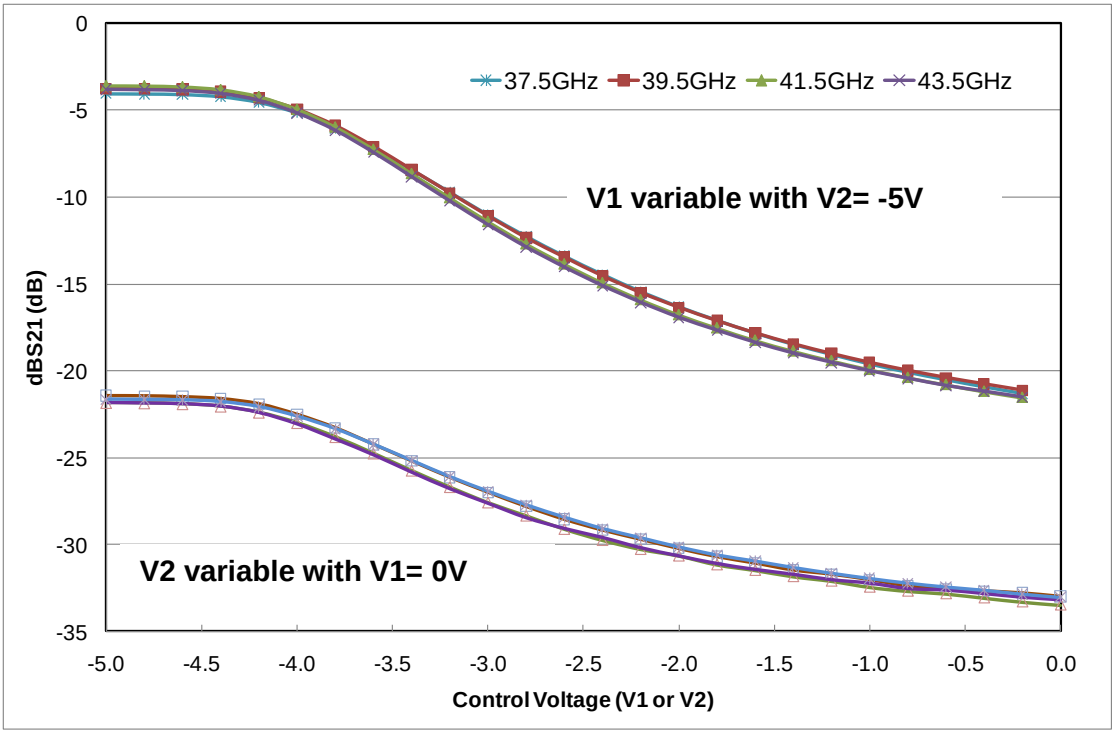
Typical on wafer Measurements

Tamb.= +25°C

Gain versus Control Voltage



Gain versus Control Voltage

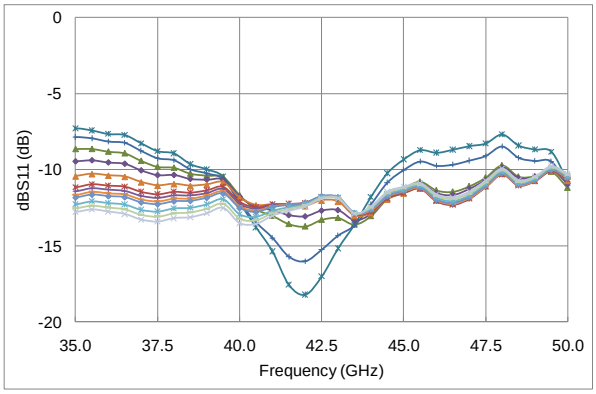


Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

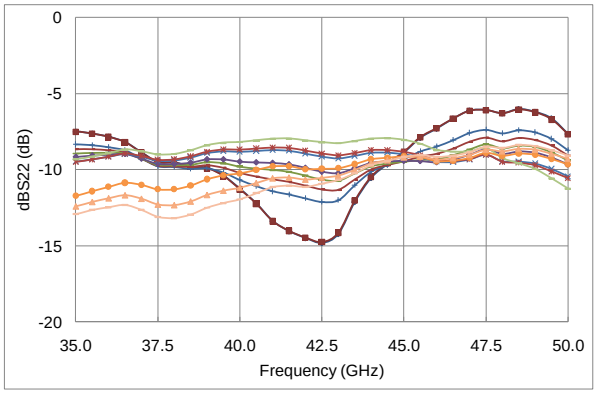
Typical on wafer Measurements

Tamb.= +25°C

S11 versus control voltage

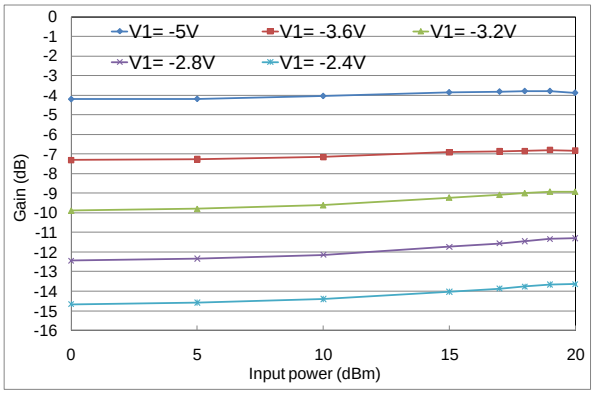


S22 versus control voltage

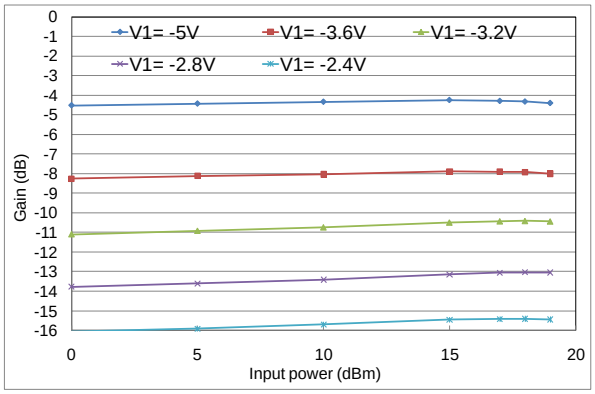


Gain versus input power & V1 control voltage with V2= -5V

38GHz



44GHz

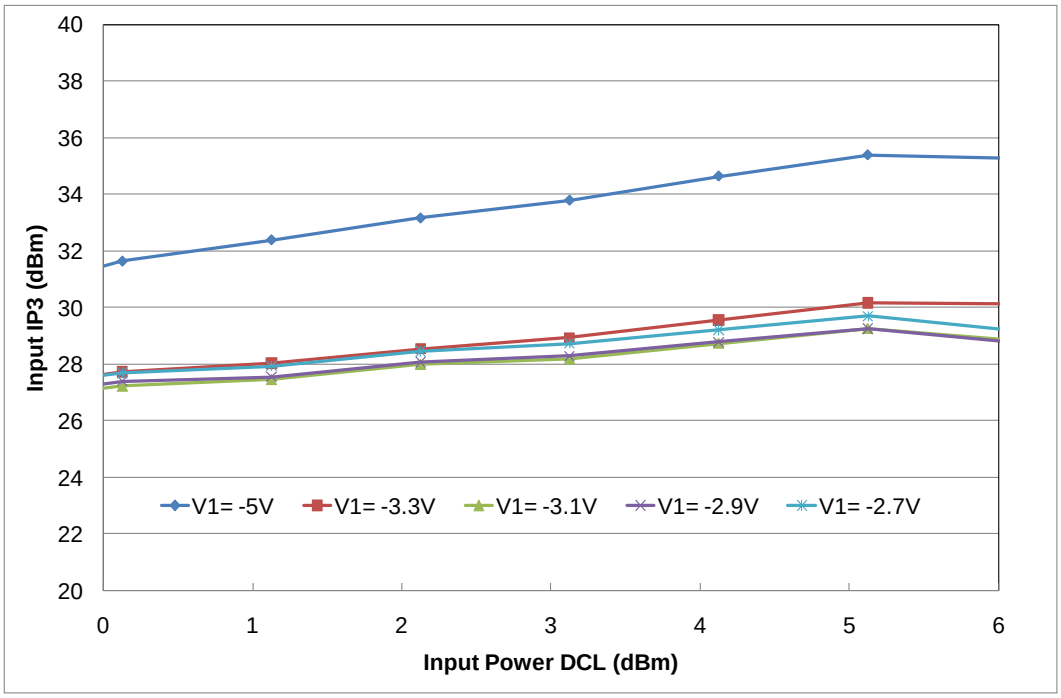


Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

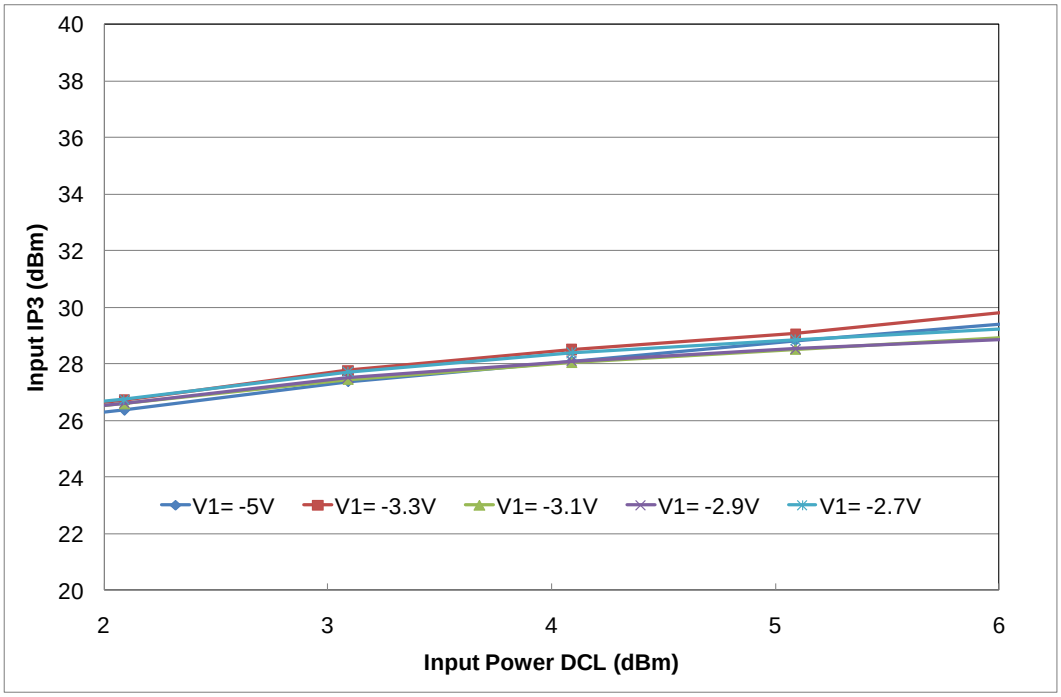
Typical Test Fixture Measurements

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



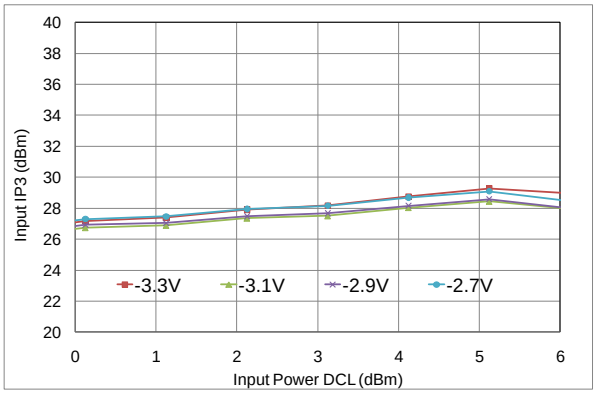
Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

Typical Test Fixture Measurements

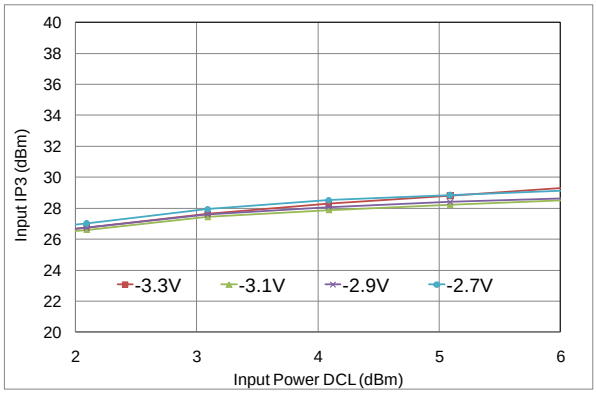
Tamb.= +25°C

Input IP3 versus input power with V1= V2

38GHz

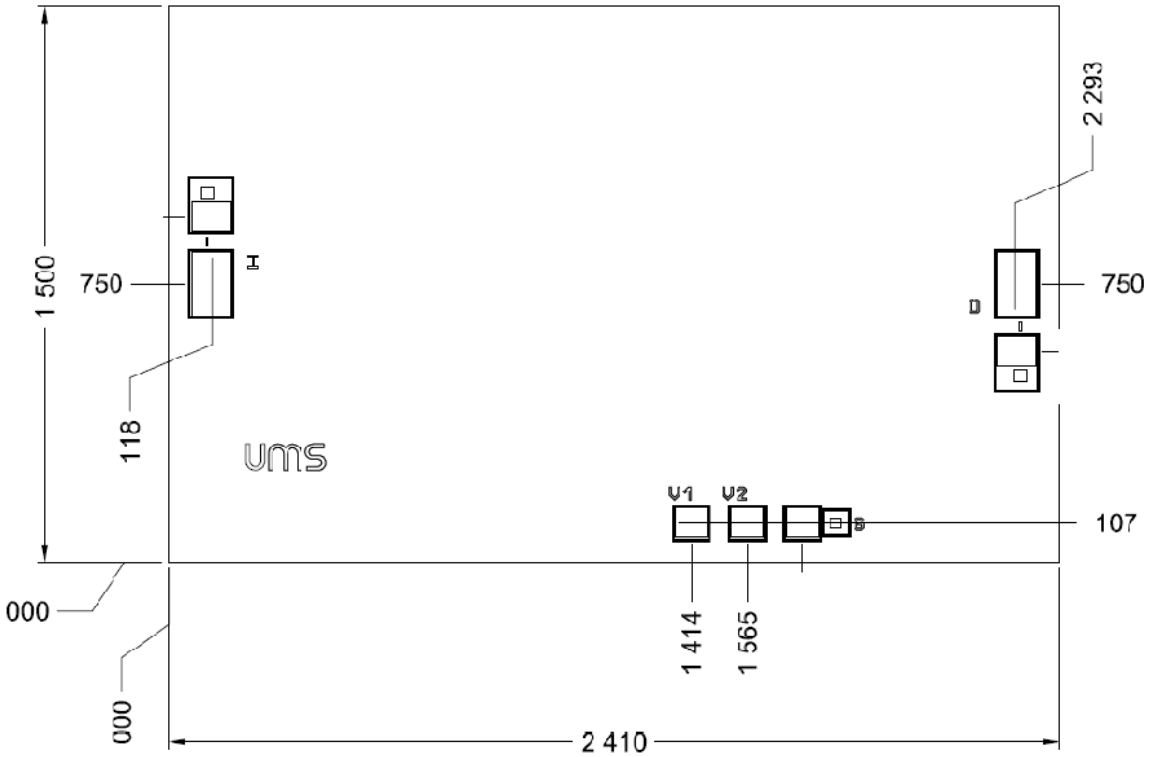


42GHz



Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

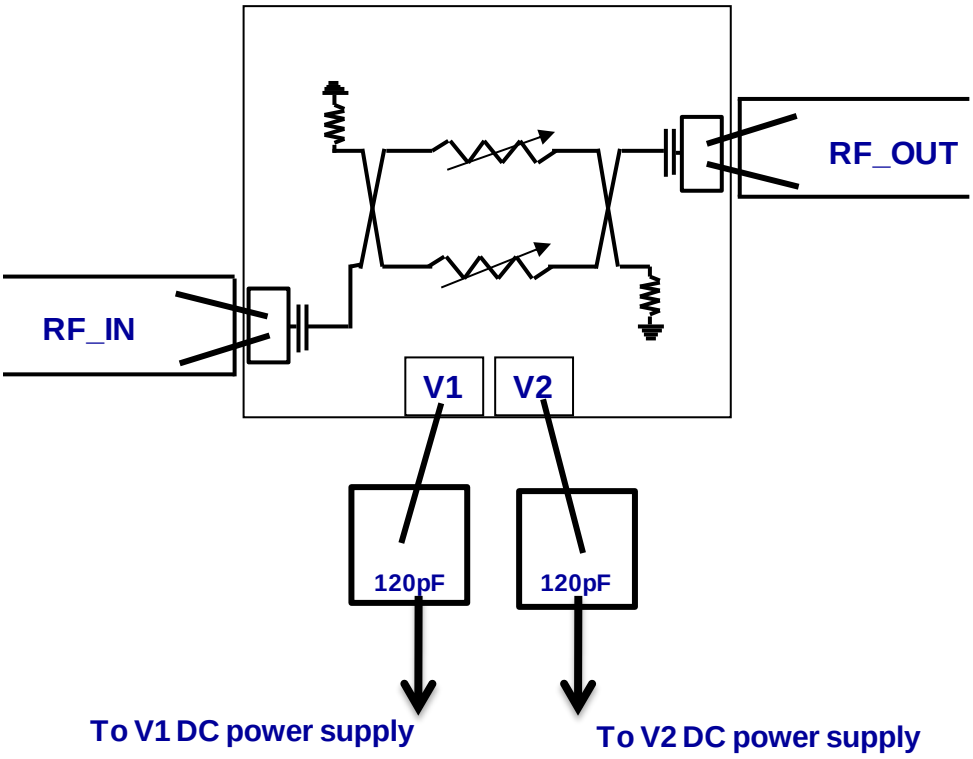
Mechanical data



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

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

Recommended assembly plan



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

Recommended circuit bonding table

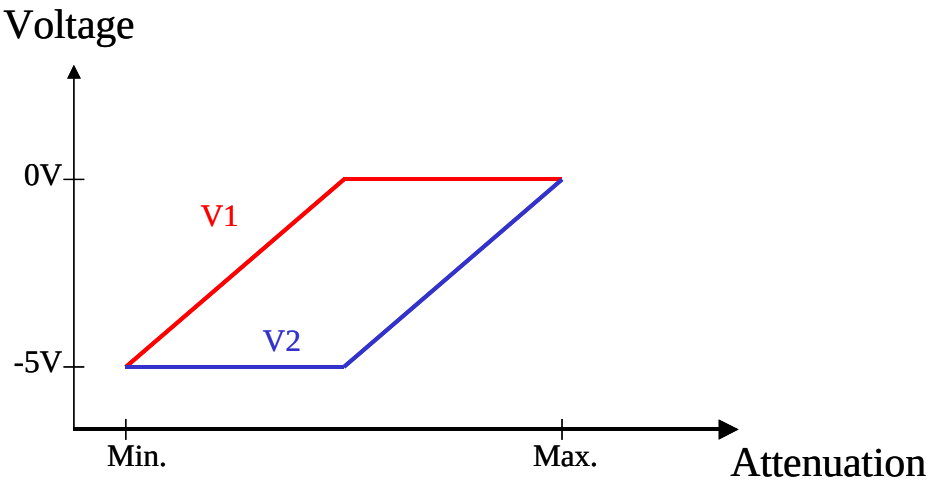
Label	Type	Decoupling	Comment
V1, V2	Vg	120pF	Gain control Supply

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

Biasing 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.

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34

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

Bât. Charmille - Parc SILIC - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34