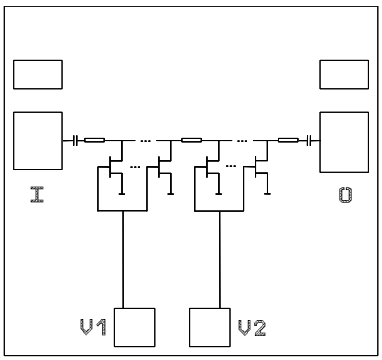
25-45 GHz Attenuator

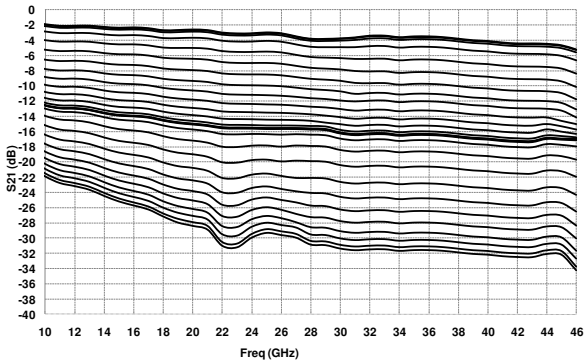
GaAs Monolithic Microwave IC

Description

The CHT4694 is a variable 25-45GHz attenuator designed for a wide range of applications, from military to commercial communication systems. The backside of the chip is both RF and DC grounded. This helps to simplify the assembly process.
The circuit is manufactured with a MESFET process, 0.7µm gate length, via holes through the substrate and air bridges.
It is supplied in chip form.



Attenuation versus Frequency & V1, V2



Main Features

- Broadband performance: 25-45GHz
- 22dBm typical input 1dB compression point (any attenuation)
- 25dB dynamic range
- DC bias: -5V<V1<0V ; -5V<V2<0V
- Chip size: 1.5x1.39x0.1mm

Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Fin	Input frequency range	25		45	GHz
Min Att.	|S21| (V1=-5V;V2=-5V) (25 to 30GHz)		3	4	dB
	|S21| (V1=-5V;V2=-5V) (30 to 40GHz)		4	5.5	dB
	|S21| (V1=-5V;V2=-5V) (40 to 45GHz)		4	7	dB
Max Att.	|S21| (V1=0V;V2=0V) (25 to 30GHz)	20	23		dB
	|S21| (V1=0V;V2=0V) (30 to 45GHz)	25	28		dB
Pin1dB	Input 1dB compression point (any attenuation) (25-40 GHz)	20	22		dBm
	Input 1dB compression point (any attenuation) (40-45 GHz)	18	20		dBm

ESC Protections: Electrostatic discharge sensitive device observe handling precautions!

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Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Fin	Input frequency range	25		45	GHz
Min Att.	|S21| (V1=-5V;V2=-5V) (25 to 30GHz)		3	4	dB
	|S21| (V1=-5V;V2=-5V) (30 to 40GHz)		4	5.5	dB
	|S21| (V1=-5V;V2=-5V) (40 to 45GHz)		4	7	dB
Max Att.	|S21| (V1=0V;V2=0V) (25 to 30GHz)	20	23		dB
	|S21| (V1=0V;V2=0V) (30 to 45GHz)	25	28		dB
RLin	Input Return loss (any attenuation) (25 to 30GHz)			-10	dB
	Input Return loss (any attenuation) (30 to 45GHz)			-6	dB
RLout	Ouput Return loss (any attenuation) (25 to 30GHz)			-5	dB
	Ouput Return loss (any attenuation) (30 to 45GHz)			-3	dB
Pin1dB	Input 1dB compression point (any attenuation) (25 to 40 GHz)	20	22		dBm
	Input 1dB compression point (any attenuation) (40 to 45 GHz)	18	*20*		dBm
I IP3	Input 3rd order Intercept Point (any attenuation)(25 to 40 GHz, Pin DCL > -4dBm)	25	30		dBm
	Input 3rd order Intercept Point (any attenuation)(25 to 40 GHz, Pin DCL > -4dBm)	23	26		dBm

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

Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
V1	V1 control voltage	-6V to +0.6V	V
V2	V2 control voltage	-6V to +0.6V	V
Pin	RF input power	30	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.

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Typical Bias Conditions

Tamb.= +25°C

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

Typical on-wafer Sij parameters

Tamb = +25°C - V1 = -5V & V2= -5V – Minimum attenuation

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
25.0	-17.8	-45.3	-2.4	67.5	-2.3	69	-18.8	-15.8
26.0	-17.0	-45.6	-2.7	55.6	-2.5	55.5	-17.0	-29.5
27.0	-16.2	-47.6	-2.6	43.3	-2.7	41.6	-15.5	-40.1
28.0	-16.0	-57.3	-2.6	28.2	-2.8	28.6	-15.1	-50.7
29.0	-16.4	-61.1	-2.8	15.2	-2.9	15.2	-14.5	-61.3
30.0	-16.9	-69.0	-2.9	1.1	-3.0	1.8	-14.6	-68.0
31.0	-18.8	-81.3	-3.4	-12.0	-3.3	-11.9	-14.1	-73.2
32.0	-23.2	-88.2	-3.6	-24.1	-3.6	-25.5	-14.8	-81.6
33.0	-33.0	-68.8	-3.6	-36.8	-3.7	-37.8	-16.3	-88.2
34.0	-23.5	46.0	-3.7	-51.2	-3.8	-51.3	-17.8	-83.1
35.0	-16.9	30.8	-4.1	-64.7	-4.3	-67.0	-19.3	-66.4
36.0	-13.2	23.6	-3.9	-78.0	-4.8	-78.1	-19.8	-55.3
37.0	-10.6	6.1	-4.1	-94.8	-4.3	-92.3	-16.5	-40.0
38.0	-9.2	-6.2	-4.8	-109.5	-4.8	-108.0	-15.3	-38.1
39.0	-8.0	-19.3	-4.6	-121.1	-5.0	-116.4	-12.9	-53.0
40.0	-8.2	-31.8	-5.1	-137.5	-5.3	-135.8	-12.8	-58.6
41.0	-8.2	-44.3	-4.8	-149.6	-5.5	-146.6	-11.2	-64.6
42.0	-9.9	-46.2	-5.3	-170.7	-5.7	-167.3	-12.3	-70.1
43.0	-10.3	-48.9	-5.9	177.1	-5.9	178.5	-12.9	-69.6
44.0	-11.1	-50.0	-6.0	162.5	-6.4	163.8	-13.6	-70.6
45.0	-11.4	-44.1	-6.6	145.4	-6.9	150.5	-14.6	-60.8

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Typical on-wafer Sij parameters

Tamb = +25°C - V1 = 0V & V2= 0V – Maximum attenuation

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
25.0	-12.9	10.5	-26.0	76.7	-25.5	78.9	-5.6	45.8
26.0	-12.5	7.3	-26.5	67.6	-26.0	67.8	-5.7	36.8
27.0	-12.1	5.3	-26.9	57.3	-26.3	54.2	-5.5	29.0
28.0	-11.8	1.8	-27.5	45.0	-27.3	42.6	-5.5	21.2
29.0	-11.5	0.7	-27.9	35.9	-27.7	-33.9	-5.4	13.7
30.0	-10.8	-2.1	-28.5	21.6	-28.5	19.8	-5.3	6.6
31.0	-10.5	-5.0	-30.2	8.6	-29.9	10.9	-5.1	-0.5
32.0	-10.2	-6.7	-30.8	0.9	-30.5	-2.8	-5.0	-7.7
33.0	-9.5	-9.8	-31.9	-9.3	-31.6	-14.1	-4.9	-13.8
34.0	-9.0	-12.0	-33.0	-23.7	-32.5	-26.4	-4.8	-21.0
35.0	-8.3	-15.4	-34.5	-31.0	-34.0	-40.9	-4.7	-25.7
36.0	-7.8	-20.1	-33.8	-44.4	-34.8	-50.3	-4.9	-38.5
37.0	-7.5	-25.3	-34.5	-71.3	-34.5	-75.6	-4.9	-35.0
38.0	-7.2	-28.5	-36.9	-96.1	-36.8	-97.7	-4.9	-38.5
39.0	-6.8	-34.2	-34.7	-109.6	-35.1	-110.2	-4.7	-46.4
40.0	-6.7	-38.0	-36.0	-134.7	-36.5	-137.6	-4.9	-57.3
41.0	-6.6	-44.1	-33.6	-152.7	-35.5	-154.5	-4.9	-54.3
42.0	-6.9	-44.6	-34.4	176.6	-35.3	176.5	-4.7	-57.3
43.0	-6.5	-48.5	-34.3	174.4	-34.3	170.7	-4.8	-59.6
44.0	-6.5	-54.8	-32.7	151.7	-33.8	151.2	-4.3	-64.3
45.0	-6.7	-57.8	-33.7	129.3	-33.6	134.7	-4.9	-69.7

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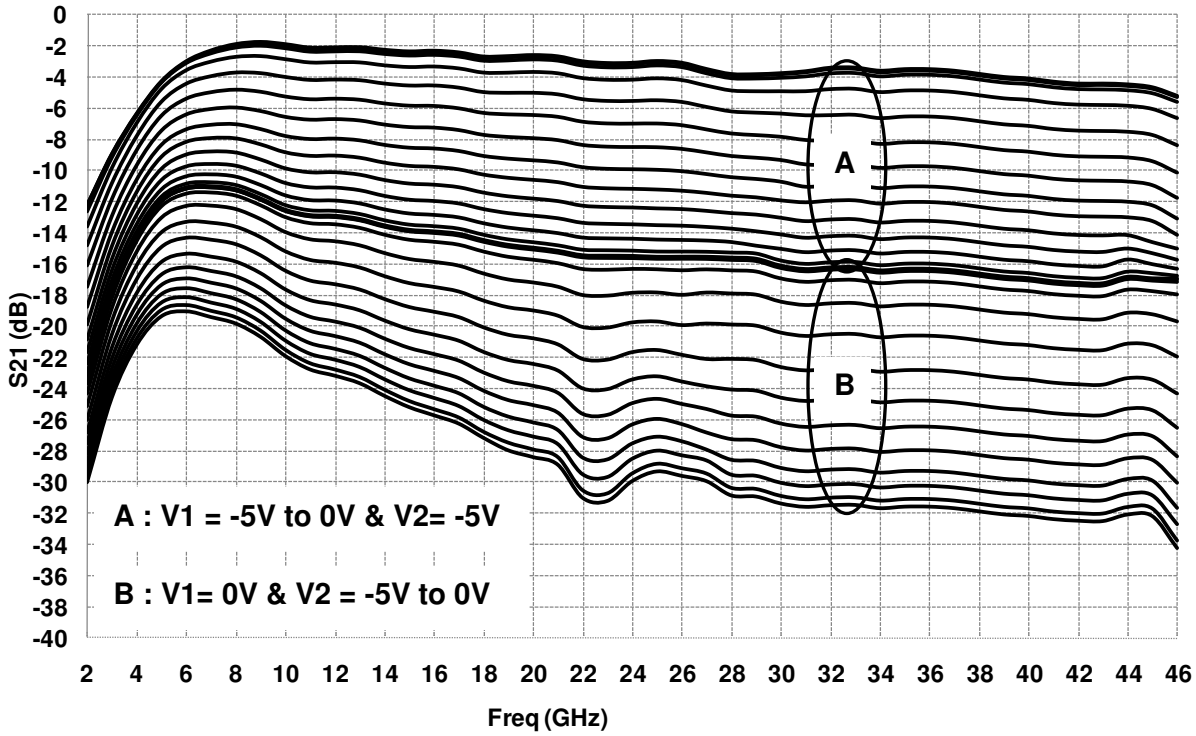
Typical on test fixture measurements

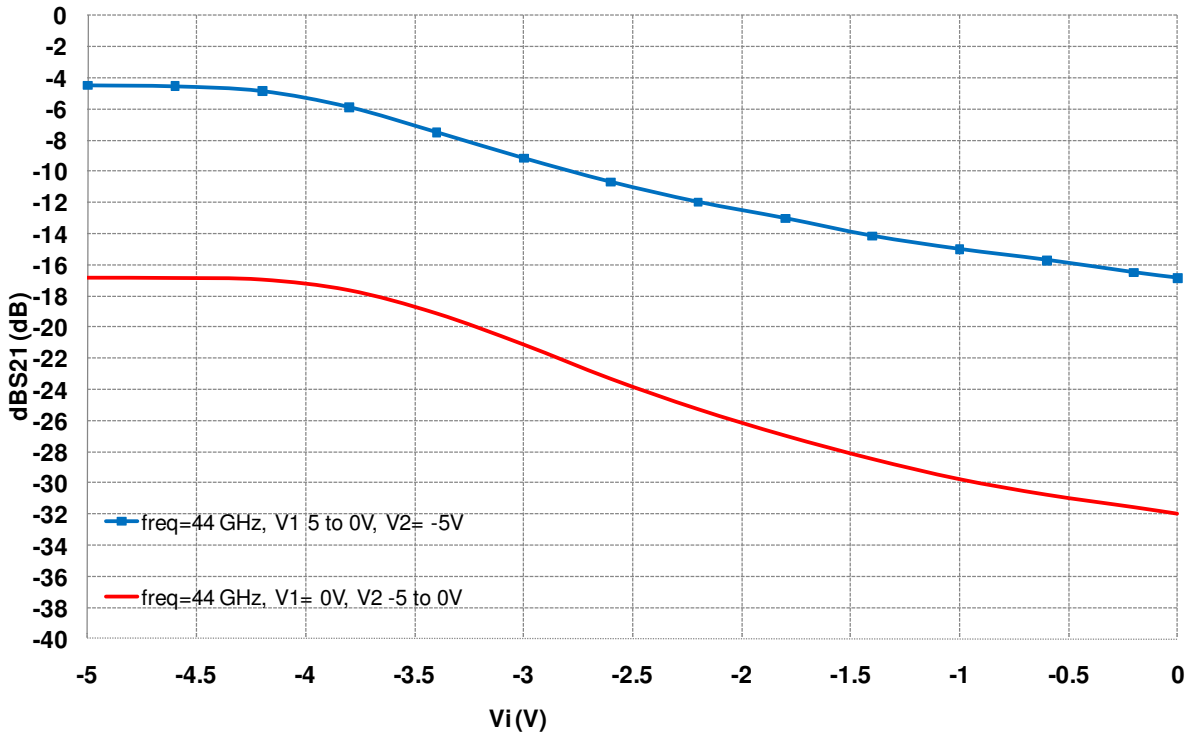
Tamb.= +25°C

Attenuation versus frequency

V1 = -5V to 0V & V2= -5V and after V1= 0V & V2 = -5V to 0V



Attenuation versus voltage @ 44GHz



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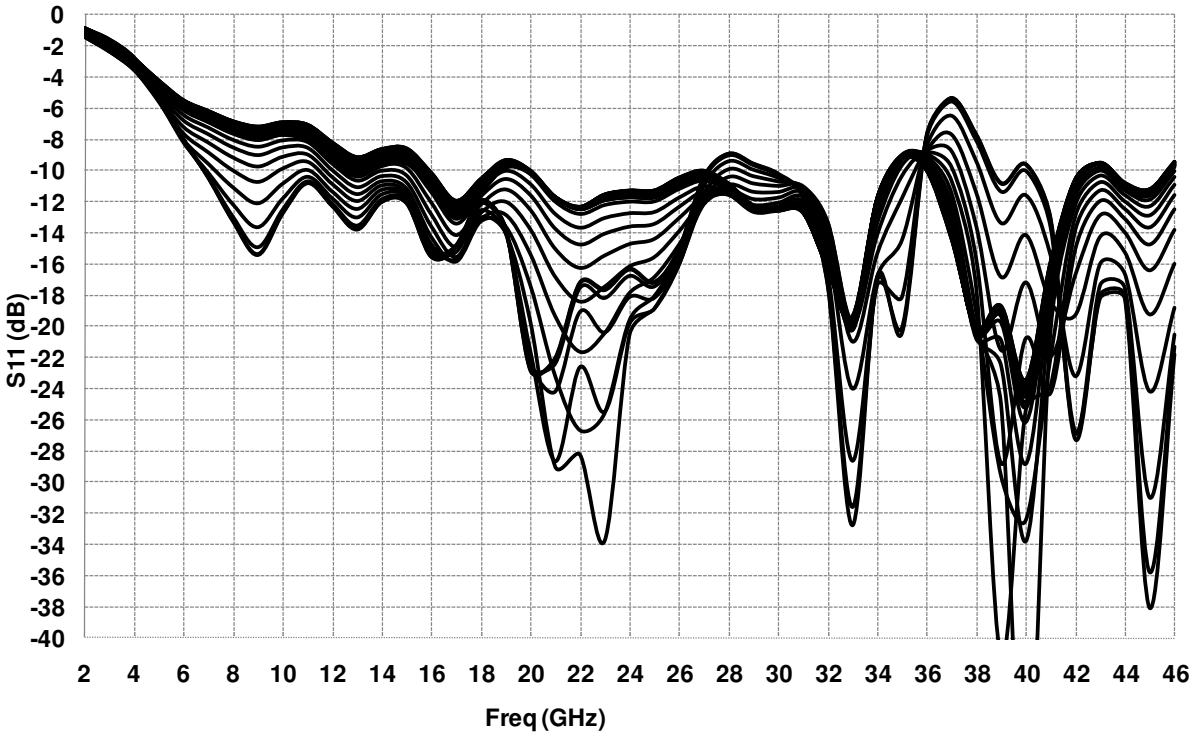
Typical on test fixture measurements

Tamb.= +25°C

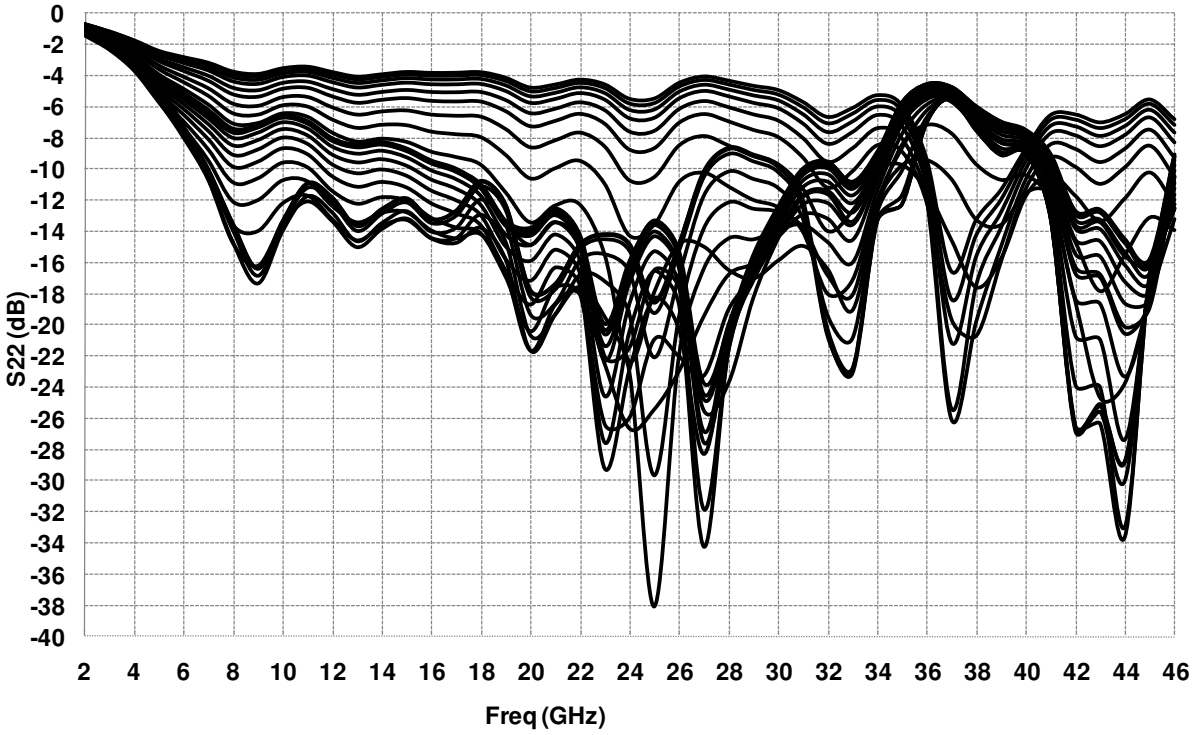
Input return loss versus frequency

V1 = -5V to 0V & V2= -5V and after V1= 0V & V2 = -5V to 0V



Output return loss versus frequency

V1 = -5V to 0V & V2= -5V and after V1= 0V & V2 = -5V to 0V



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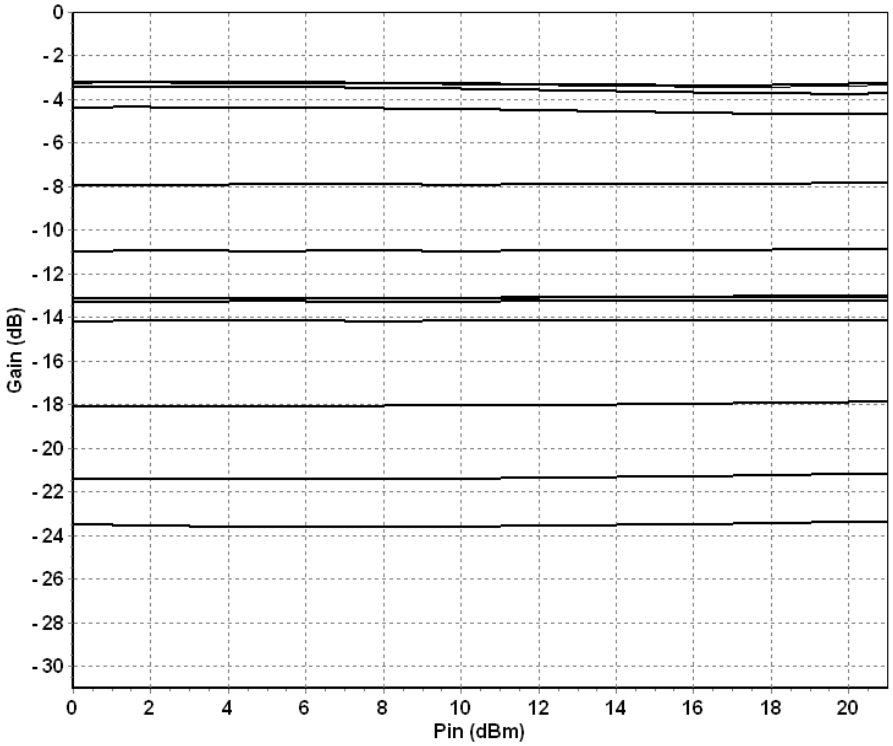
Typical on test fixture measurements

Tamb.= +25°C

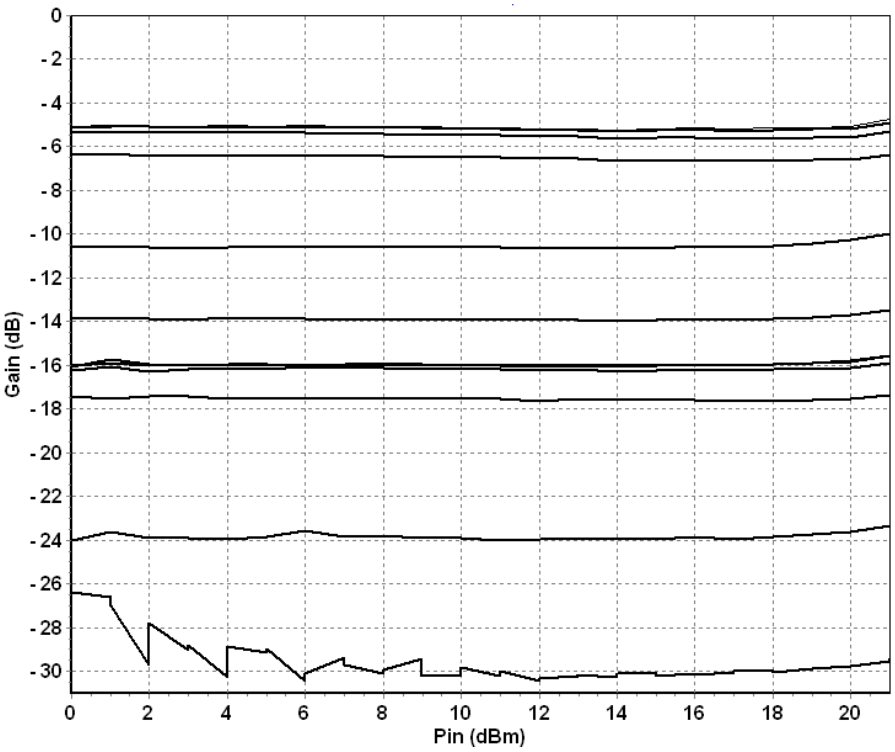
Attenuation versus input power @ 26GHz

V1 = -5V to 0V & V2= -5V and after V1= 0V & V2 = -5V to 0V



Attenuation versus input power @ 40GHz

V1 = -5V to 0V & V2= -5V and after V1= 0V & V2 = -5V to 0V



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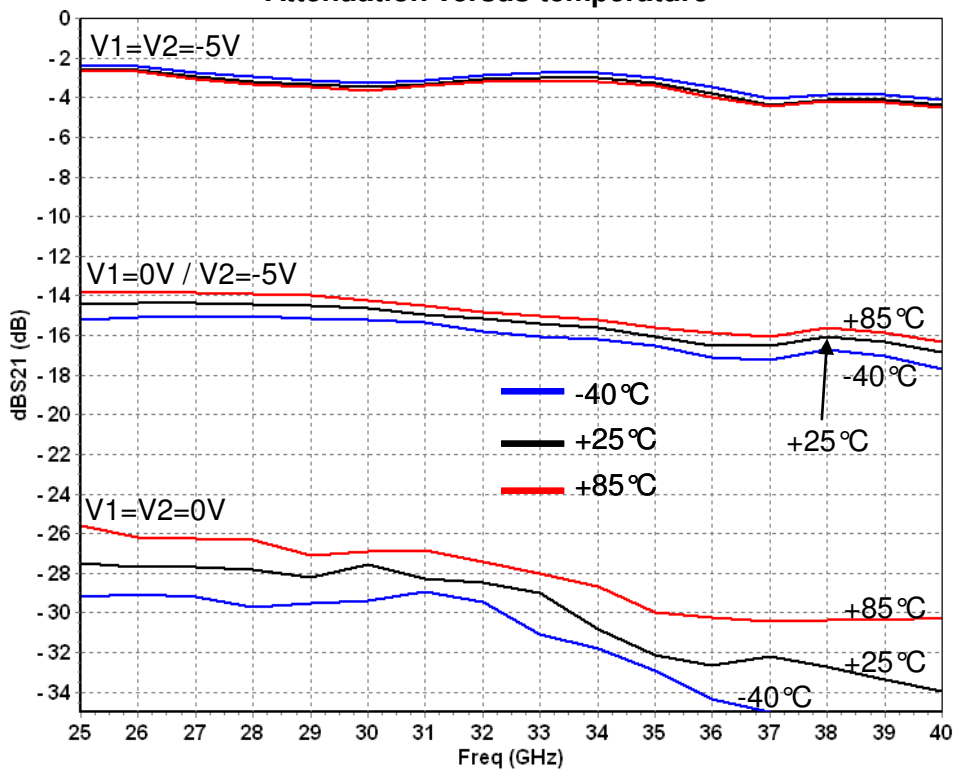
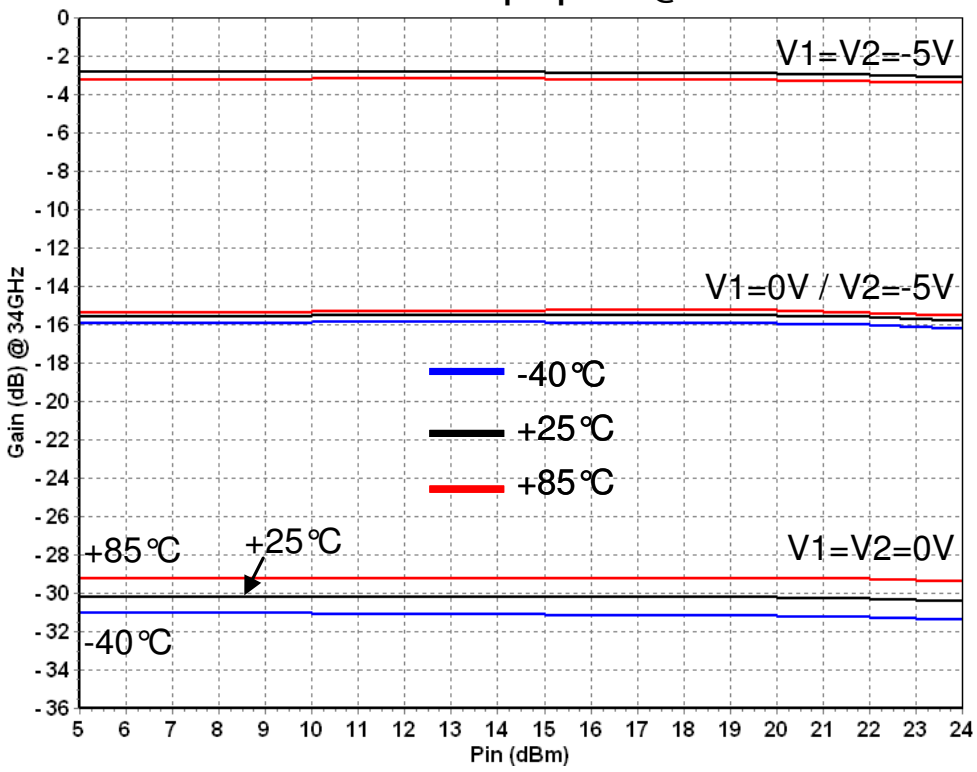
Typical on test fixture measurements

Attenuation versus temperature



Attenuation versus input power @ 34 GHz



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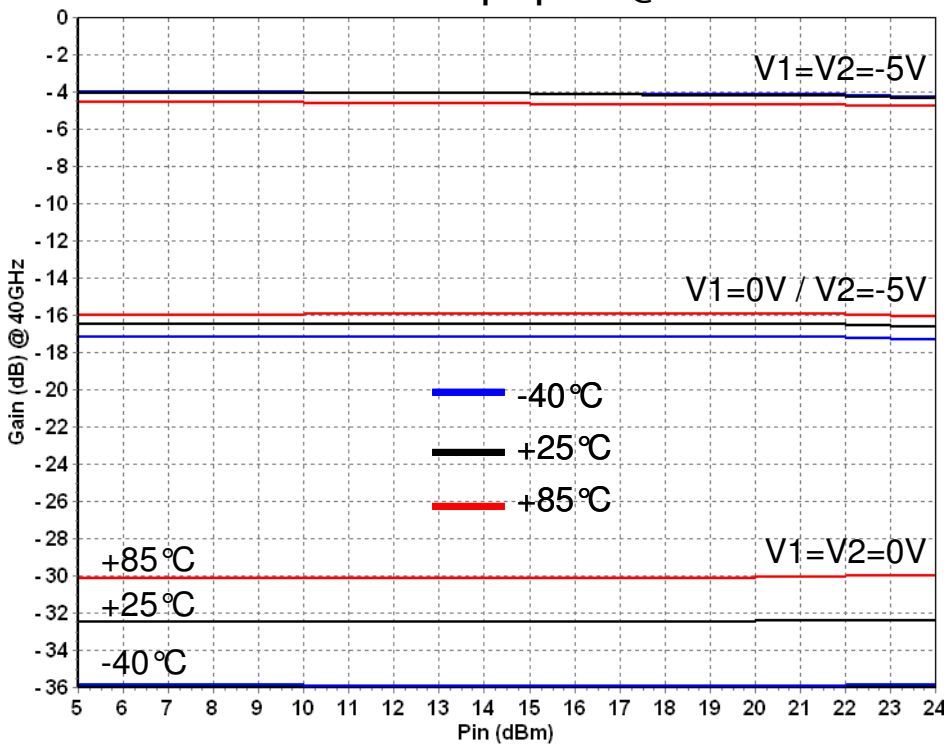
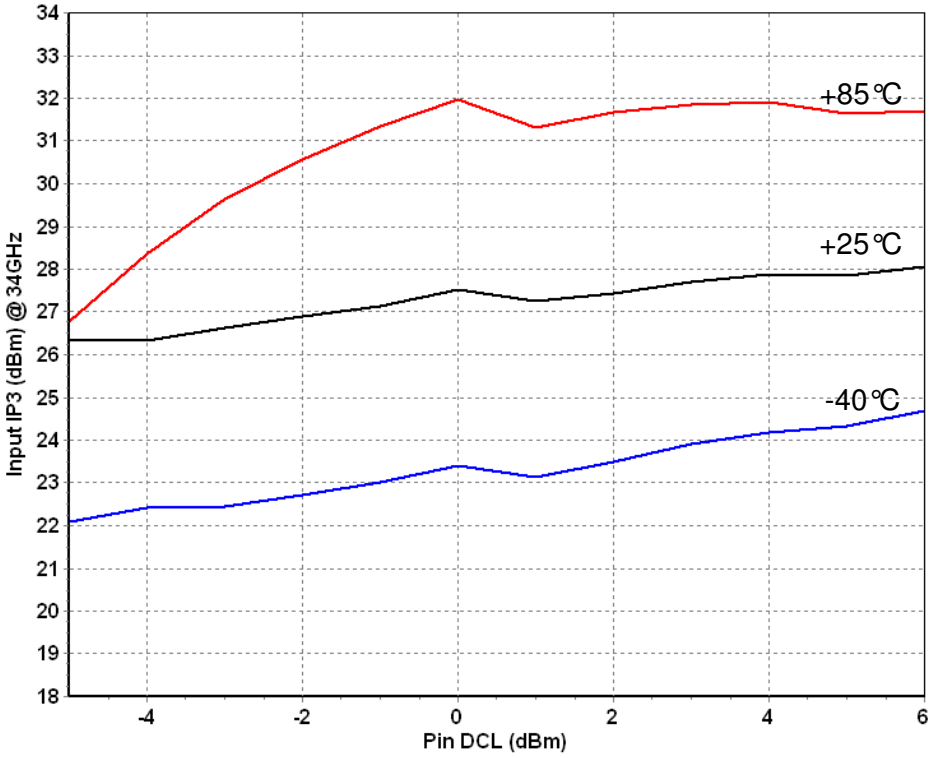
Typical on test fixture measurements

Attenuation versus input power @ 40 GHz



Input IP3 versus temperature @ 34GHz

V1=-3.5V / V2=-5V (worst case in terms of linearity)



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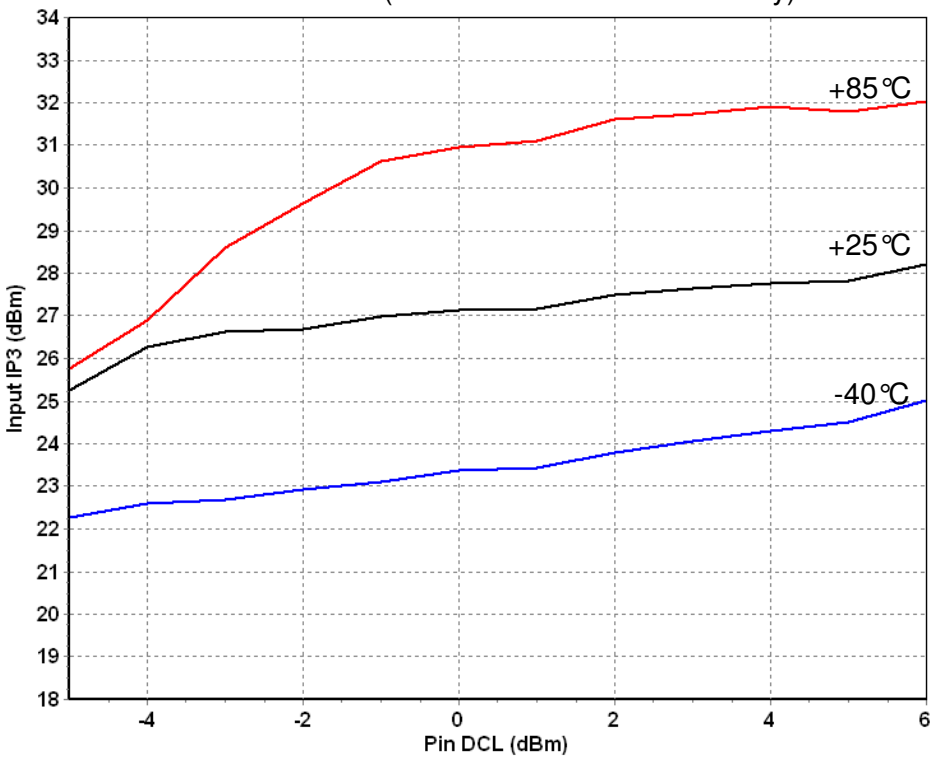
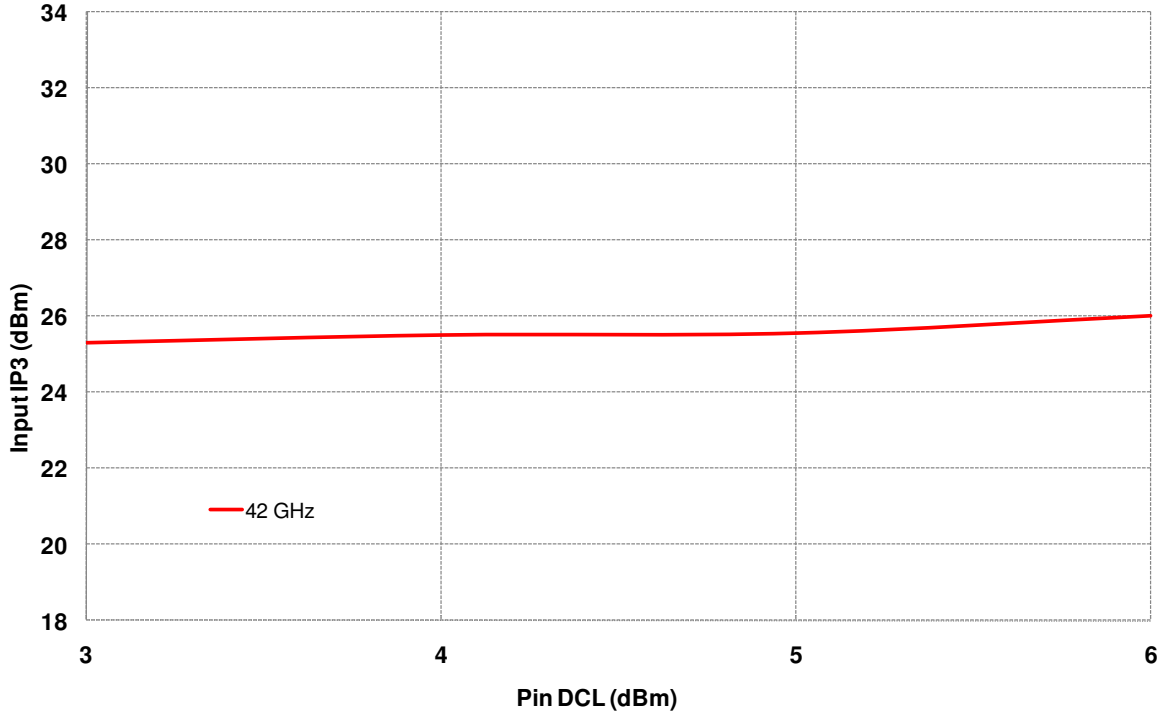
Typical on test fixture measurements

Input IP3 versus temperature @ 39GHz
V1=-3.5V / V2=-5V (worst case in terms of linearity)



Input IP3 versus input power @ 42GHz
V1= -2.7V / V2= -5V



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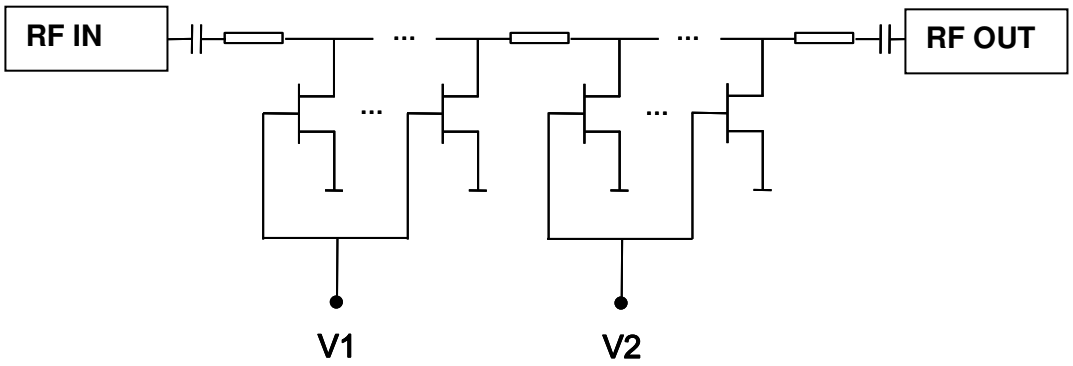
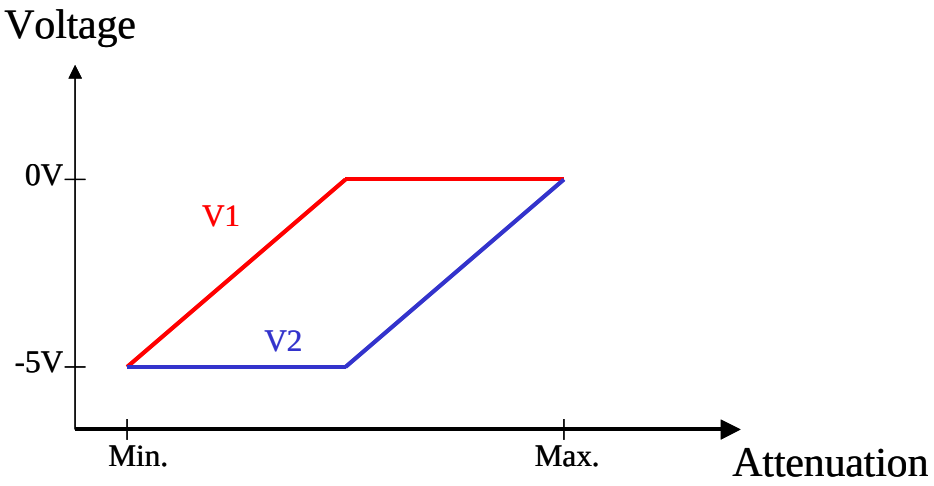
Biasing sequence

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, leading to lower linearity performances

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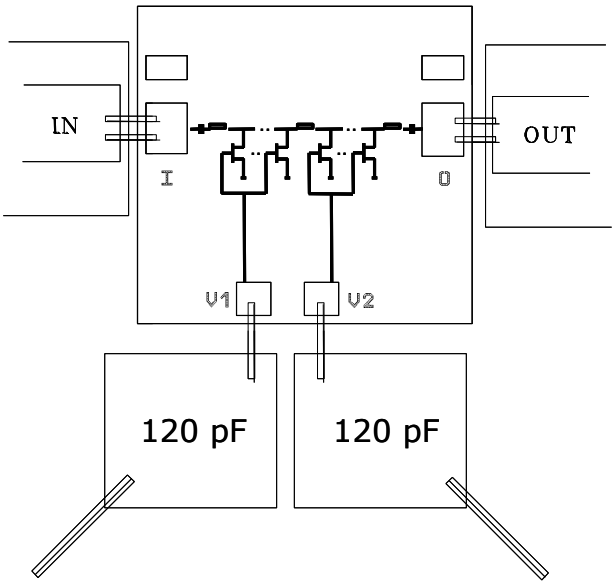
Chip Assembly and Mechanical Data



to V1 DC gate supply feed to V2 DC gate supply feed

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

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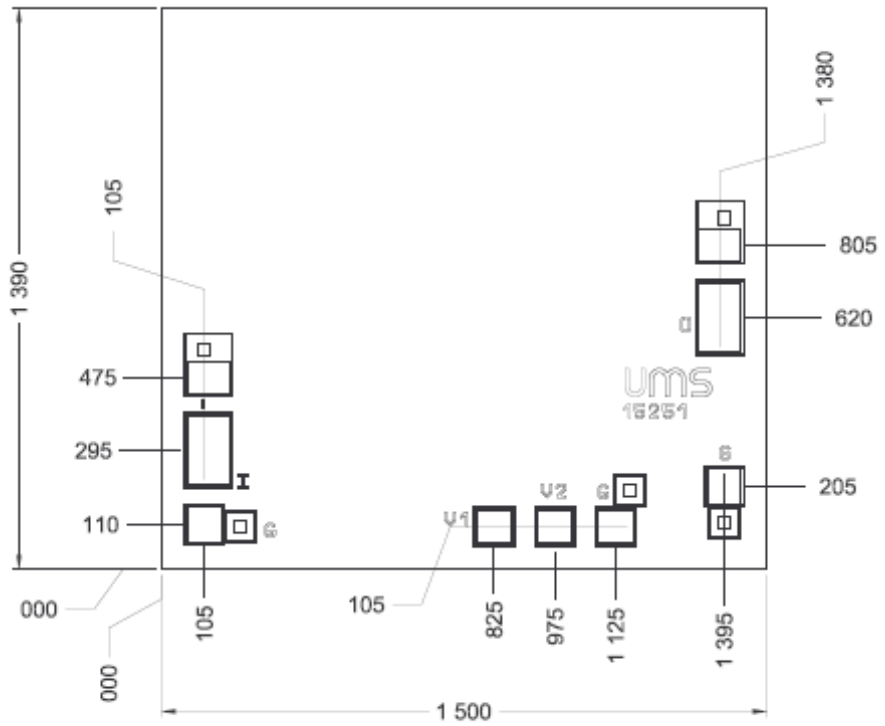
Bonding pad positions



UNITS µm
Tol ± 35µm

(Chip thickness: 100µm. All dimensions are in micrometers)

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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:	CHT4694-99F/00

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