

4-16GHz 6-BIT DIGITAL ATTENUATOR

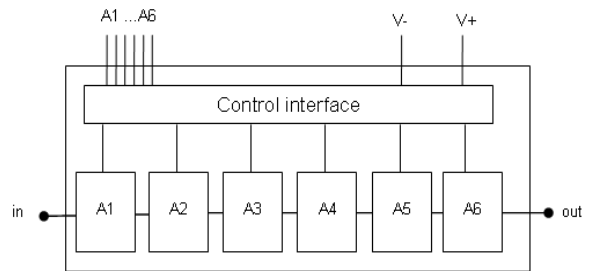
GaAs Monolithic Microwave IC

Preliminary

Description

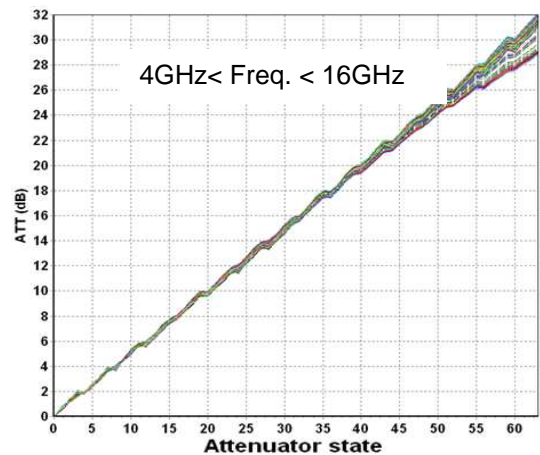
The CHT4016 is a 4-16GHz 6-bit digital attenuator designed to address a dynamic of 31.5dB by 0.5dB step.

This device is manufactured on pHEMT 0.25µm process, including via holes through the substrate.



Main Features

- Frequency range: 4 –16GHz
- 6-bit digital control interface
- 0.5dB Attenuator step
- 31.5dB Dynamic
- 0.5dB RMS attenuation error
- Chip dimensions: 3.64 x 1.54 x 0.1mm



Attenuation versus attenuator state from 4 to 16GHz

Main Characteristics

$V+ = 5V / V- = -5V$

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	4		16	GHz
Dyn	Dynamic		31.5		dB
IL	Insertion loss		6.5		dB
Rms_att	RMS attenuation error		0.5		dB
P1dB	Input power @ 1dB gain compression		18		dBm

ESD Protection: Electrostatic discharge sensitive device. Observe handling precautions!

Electrical Characteristics

T= +25°C

Preliminary

Symbol	Parameters	Min	Typ	Max	Unit
Freq	Operating frequency	4		16	GHz
IL	Insertion Loss		6.5		dB
S11	Input Return Loss		-15		dB
S22	Output Return Loss		-15		dB
P1dB	Input power at 1dB gain compression		18		dBm
Dyn	Dynamic		31.5		dB
LSB	Attenuator elementary step		0.5		dB
Att_err	Attenuation error				dB
	Attenuation state 1-32		±0.5		
	Attenuation state 33-50		±0.8		
	Attenuation state 51-63		-2.5 / +0.8		
Rms_att	RMS attenuation error		0.5		dB
Phivar	Phase variation				°
	Attenuation state 1-32		0 / +7		
	Attenuation state 33-50		-2.5 / +8		
	Attenuation state 51-63		-5 / +10		
Rms_phivar	RMS phase variation		4.5		°
V+	Positive supply voltage		5		V
V-	Negative supply voltage		-5	-4	V
Vctrl_L	Control voltage low level	-0.5	0		V
Vctrl_H	Control voltage high level		-5		V
I_V+	Positive supply DC current		6		mA
I_V-	Negative supply DC current		18		mA

*Preliminary***Absolute Maximum Ratings** (1)

T= +25°C

Symbol	Parameter	Values	Unit
V+	Maximum positive bias voltage	6	V
V-	Minimum negative bias voltage	-6	V
P_RF	Maximum peak input power overdrive	21	dBm
Ta	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-55 to +125	°C

(1) Operation of this device above anyone of these paramaters may cause permanent damage.

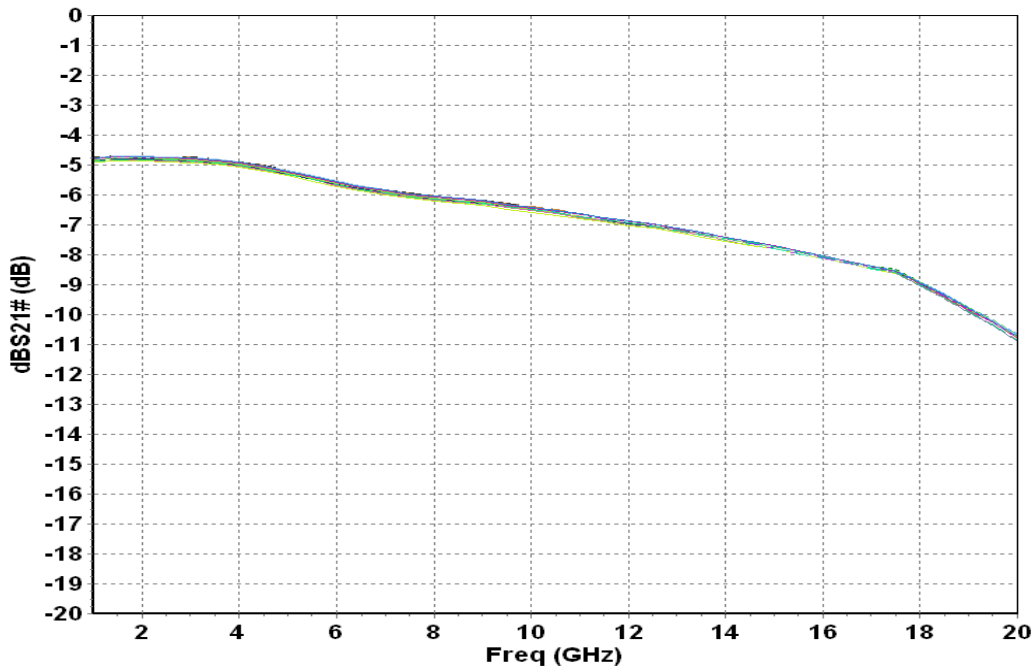
Preliminary

Typical Measurements

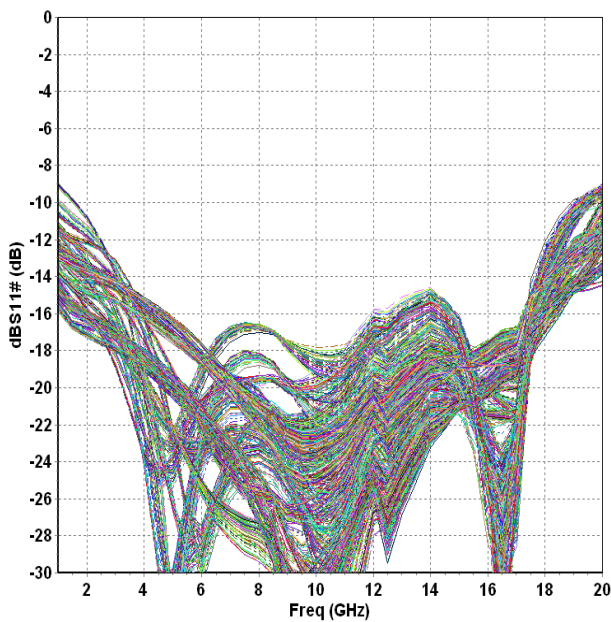
T= +25°C

[S] parameters

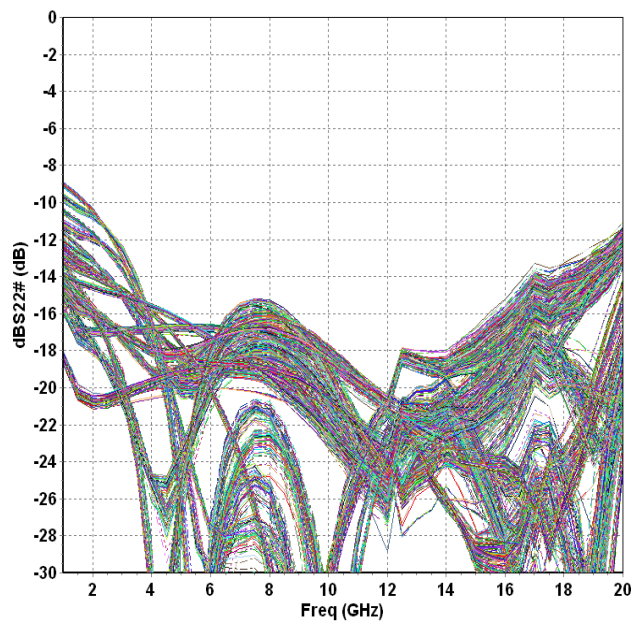
S21 vs. Frequency
Attenuator state 0



S11 vs. Frequency
All attenuator states

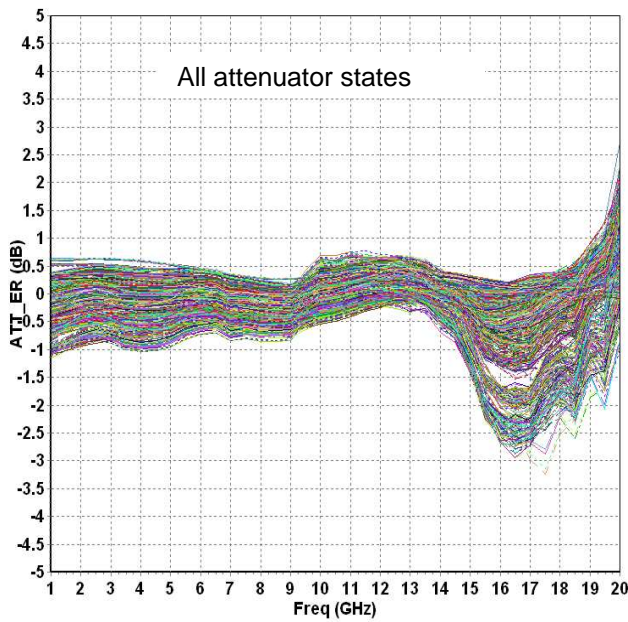


S22 vs. Frequency
All attenuator states

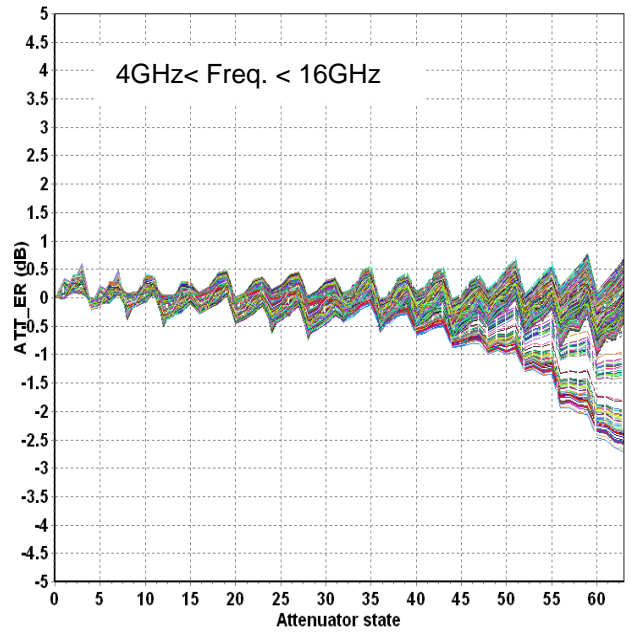


Attenuator performances: Attenuation error

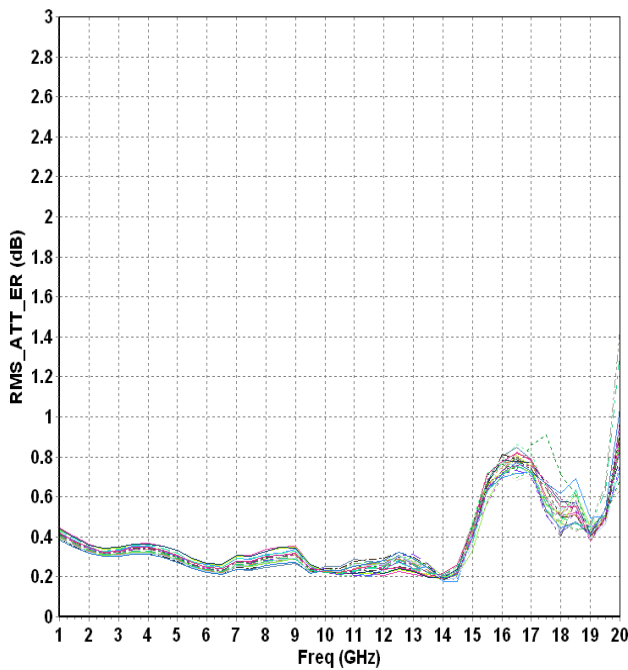
Attenuation error vs. frequency



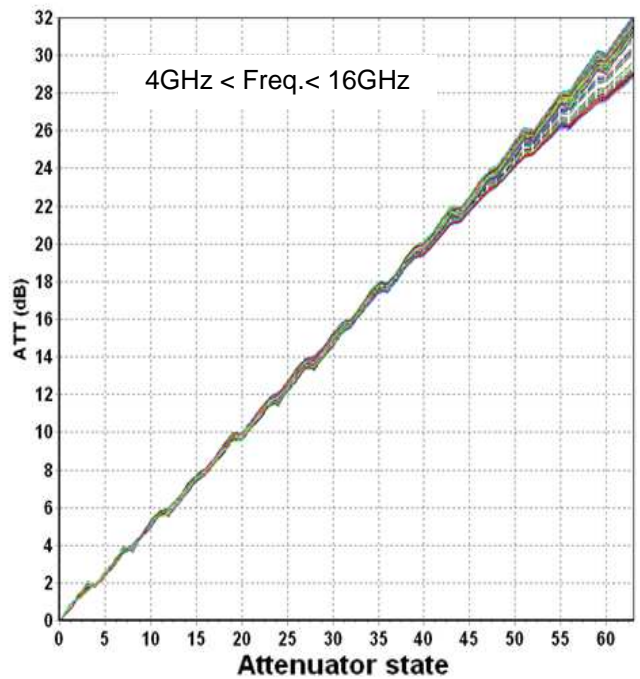
Attenuation error vs. Attenuator state



RMS of Attenuation error



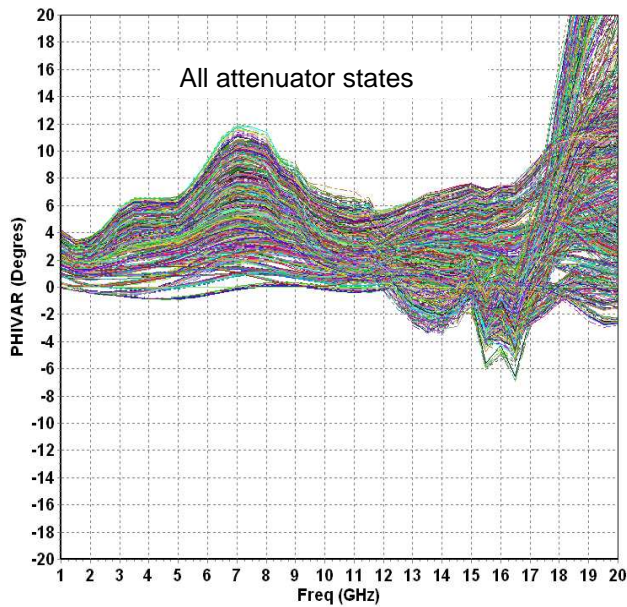
Attenuation vs. attenuator state



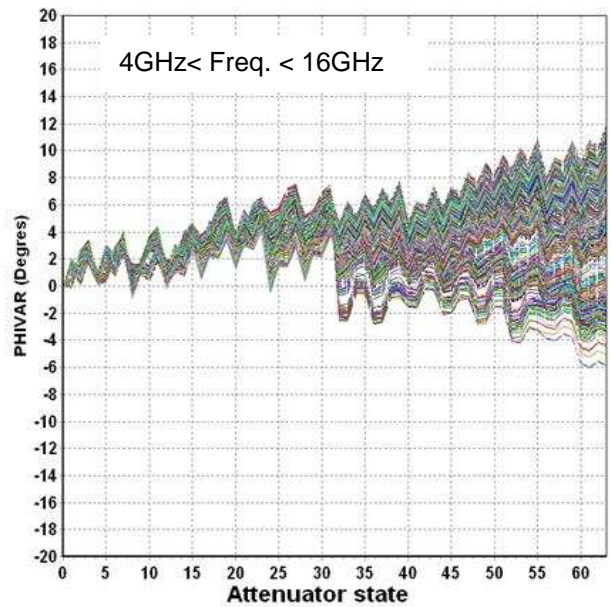
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Attenuator performances: Phase variation

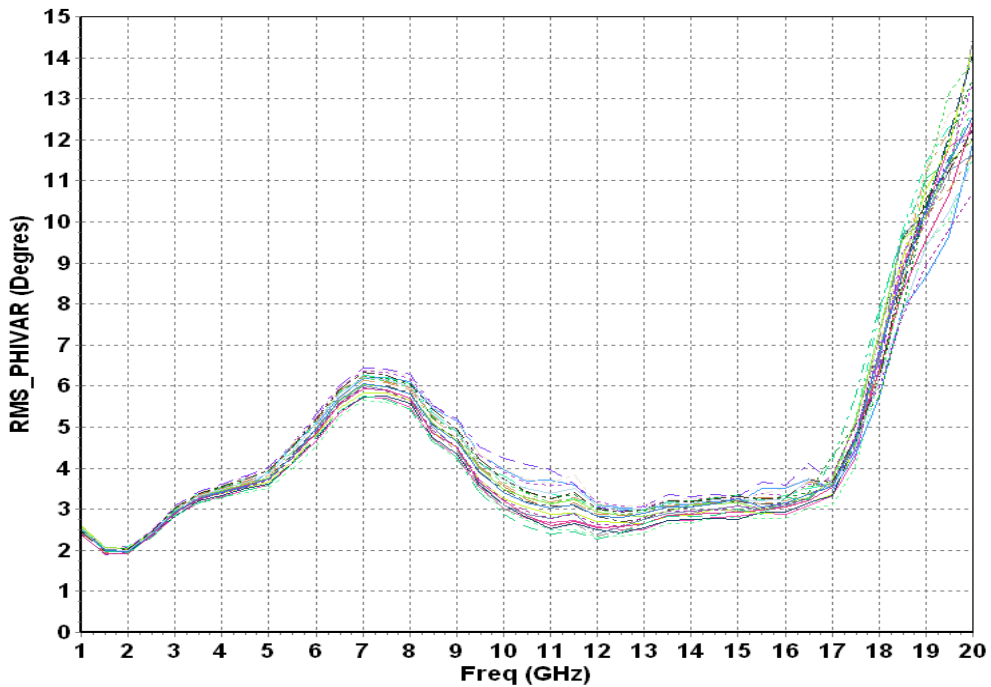
Phase variation vs. frequency



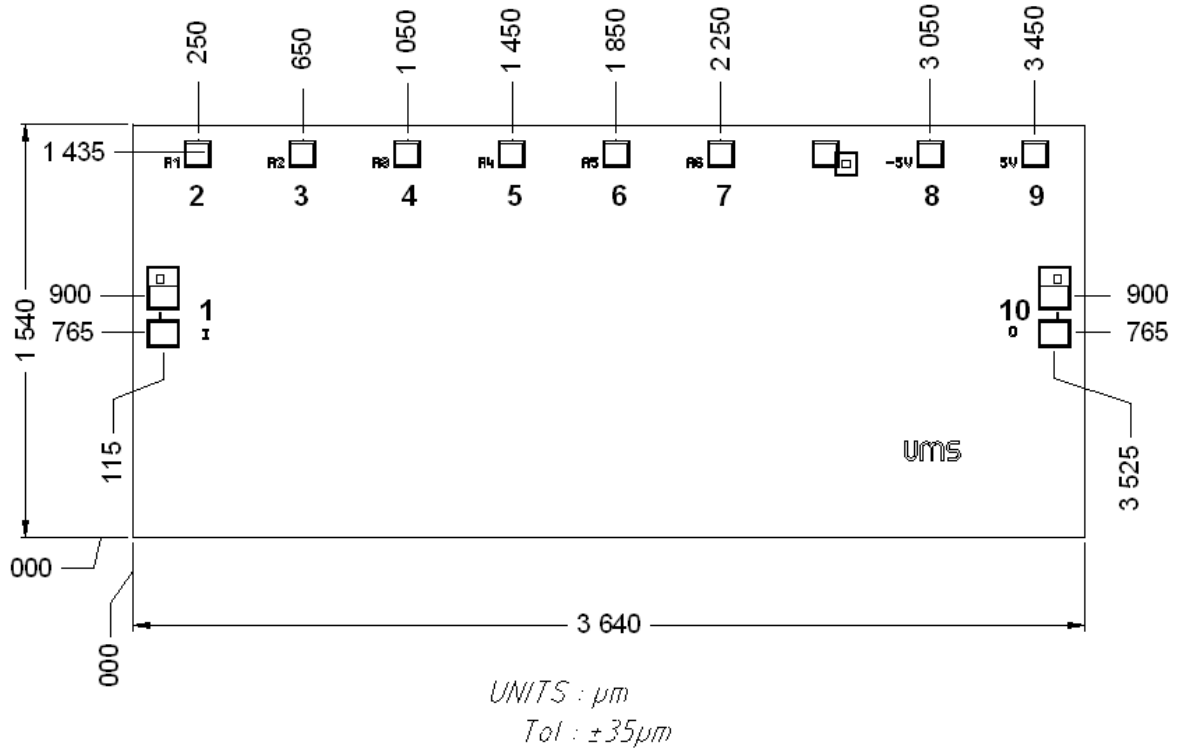
Phase variation vs. Attenuator state



RMS of Phase variation



Mechanical dimensions and pad allocation



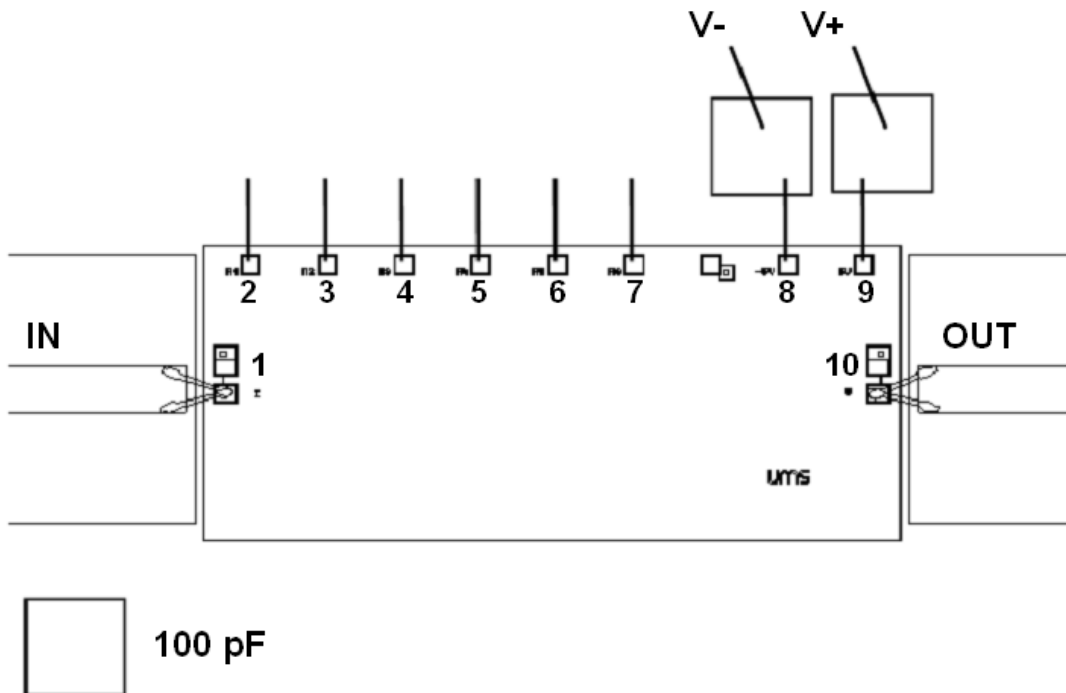
Chip thickness = $100\mu\text{m} \pm 10\mu\text{m}$.
 RF pads (1, 10) = $122 \times 100\mu\text{m}^2$
 DC and control pads (2 to 9) = $100 \times 100\mu\text{m}^2$

Pin number	Pad name	Description
1	I	Input RF:
2	A1	Attenuator bit 1
3	A2	Attenuator bit 2
4	A3	Attenuator bit 3
5	A4	Attenuator bit 4
6	A5	Attenuator bit 5
7	A6	Attenuator bit 6
8	-5V	-5V supply voltage: interface
9	+5V	+5V supply voltage: interface
10	O	Output RF

Bonding recommendations

Port	Connection
I (1) O (10)	Inductance (L _{bonding}) = 0.3nH two wires: diameter 25µm, length 0.5µm
DC and Interface pads	Inductance (L _{bonding}) = 0.8nH one wire: diameter 25µm, length 1mm

Recommended assembly diagram



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.

Biassing conditions

Pin number	Pad name	Value
2	A1	-5V or 0V
3	A2	-5V or 0V
4	A3	-5V or 0V
5	A4	-5V or 0V
6	A5	-5V or 0V
7	A6	-5V or 0V
8	-5V	-5V
9	+5V	+5V

Biassing conditions

Preliminary

Attenuator control table

Voltage to apply on the pads A1 to A6

state	Att (dB)	A6	A5	A4	A3	A2	A1
0	0	0	0	0	0	0	0
1	0.5	0	0	0	0	0	-5
2	1	0	0	0	0	-5	0
3	1.5	0	0	0	0	-5	-5
4	2	0	0	0	-5	0	0
5	2.5	0	0	0	-5	0	-5
6	3	0	0	0	-5	-5	0
7	3.5	0	0	0	-5	-5	-5
8	4	0	0	-5	0	0	0
9	4.5	0	0	-5	0	0	-5
10	5	0	0	-5	0	-5	0
11	5.5	0	0	-5	0	-5	-5
12	6	0	0	-5	-5	0	0
13	6.5	0	0	-5	-5	0	-5
14	7	0	0	-5	-5	-5	0
15	7.5	0	0	-5	-5	-5	-5
16	8	0	-5	0	0	0	0
17	8.5	0	-5	0	0	0	-5
18	9	0	-5	0	0	-5	0
19	9.5	0	-5	0	0	-5	-5
20	10	0	-5	0	-5	0	0
21	10.5	0	-5	0	-5	0	-5
22	11	0	-5	0	-5	-5	0
23	11.5	0	-5	0	-5	-5	-5
24	12	0	-5	-5	0	0	0
25	12.5	0	-5	-5	0	0	-5
26	13	0	-5	-5	0	-5	0
27	13.5	0	-5	-5	0	-5	-5
28	14	0	-5	-5	-5	0	0
29	14.5	0	-5	-5	-5	0	-5
30	15	0	-5	-5	-5	-5	0
31	15.5	0	-5	-5	-5	-5	-5
32	16	-5	0	0	0	0	0

33	16.5	-5	0	0	0	0	-5
34	17	-5	0	0	0	0	-5
35	17.5	-5	0	0	0	0	-5
36	18	-5	0	0	-5	0	0
37	18.5	-5	0	0	-5	0	-5
38	19	-5	0	0	-5	-5	0
39	19.5	-5	0	0	-5	-5	-5
40	20	-5	0	-5	0	0	0
41	20.5	-5	0	-5	0	0	-5
42	21	-5	0	-5	0	-5	0
43	21.5	-5	0	-5	0	-5	-5
44	22	-5	0	-5	-5	0	0
45	22.5	-5	0	-5	-5	0	-5
46	23	-5	0	-5	-5	-5	0
47	23.5	-5	0	-5	-5	-5	-5
48	24	-5	-5	0	0	0	0
49	24.5	-5	-5	0	0	0	-5
50	25	-5	-5	0	0	-5	0
51	25.5	-5	-5	0	0	-5	-5
52	26	-5	-5	0	-5	0	0
53	26.5	-5	-5	0	-5	0	-5
54	27	-5	-5	0	-5	-5	0
55	27.5	-5	-5	0	-5	-5	-5
56	28	-5	-5	-5	0	0	0
57	28.5	-5	-5	-5	0	0	-5
58	29	-5	-5	-5	0	-5	0
59	29.5	-5	-5	-5	0	-5	-5
60	30	-5	-5	-5	-5	0	0
61	30.5	-5	-5	-5	-5	0	-5
62	31	-5	-5	-5	-5	-5	0
63	31.5	-5	-5	-5	-5	-5	-5

Ordering Information

Chip form : CHT4016-99F/00

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