United Monolithic Semiconductors

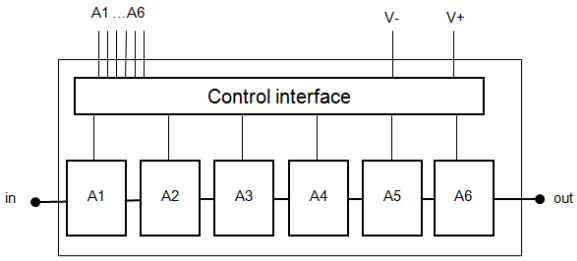
CHT4016-99F

4-16GHz 6-bit digital attenuator

GaAs Monolithic Microwave IC

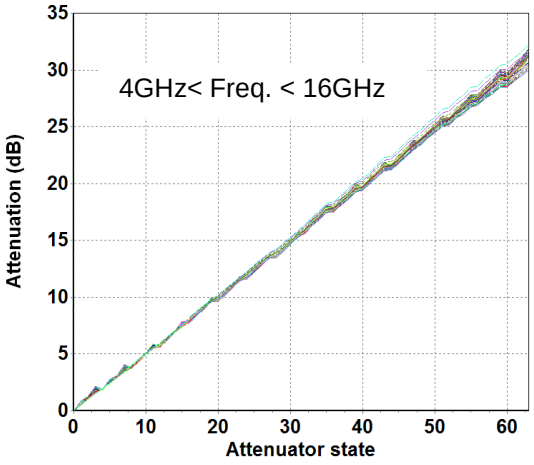
Description

The CHT4016-99F is a 4-16GHz 6-bit digital attenuator designed to address a dynamic of 31.5dB by 0.5dB step.
It is designed for a wide range of applications, from military 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 performances: 4-16GHz
- 6-bit digital control interface
- 0.5dB Attenuator step
- 31.5dB Dynamic
- 0.5dB RMS attenuation error
- Chip size 3.64x1.54x0.1mm



Main Electrical Characteristics

Tamb.= +25°C, 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		23		dBm

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Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	4		16	GHz
IL	Insertion Loss		6.5		dB
S11	Input Return Loss		-15		dB
S22	Output Return Loss		-15		dB
P1dB	Input power @1dB gain compression		23		dBm
Dyn	Dynamic		31.5		dB
LSB	Attenuator elementary step		0.5		dB
Att_err	**Attenuation error** Attenuation state 1-32 Attenuation state 33-50 Attenuation state 51-63		 ±0.5 ±0.8 -1.5/+1		dB
Rms_att	RMS attenuation error		0.5		dB
Phivar	**Phase variation** Attenuation state 1-32 Attenuation state 33-50 Attenuation state 51-63		 0/+8 +2.5/+11 +2.5/+20		°
Rms_phivar	RMS phase variation		4.5		°
Ts	Switching time		10		ns
V+	Positive supply voltage		5		V
V-	Negative supply voltage		-5		V
Vctrl_L	Control voltage low level	-1.5	0		V
Vctrl_L	Control voltage high level		-5	-3.5	V
I_V+	Positive supply DC current		6		mA
I_V-	Negative supply DC current		18		mA

Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
V+	Maximum positive bias voltage	6V	V
V-	Minimum negative bias voltage	-6	V
P_RF	Maximum peak input power overdrive (2)	+25	dBm
Ai	CTRL voltage (Vctrl_low, Vctrl_high)	-6, +2	V
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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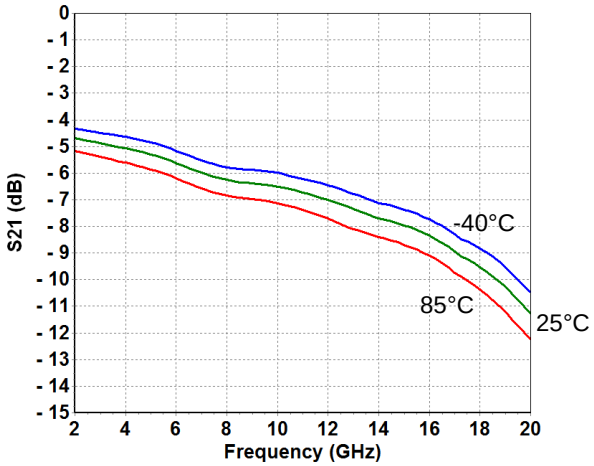
Typical Test Fixture Measurements

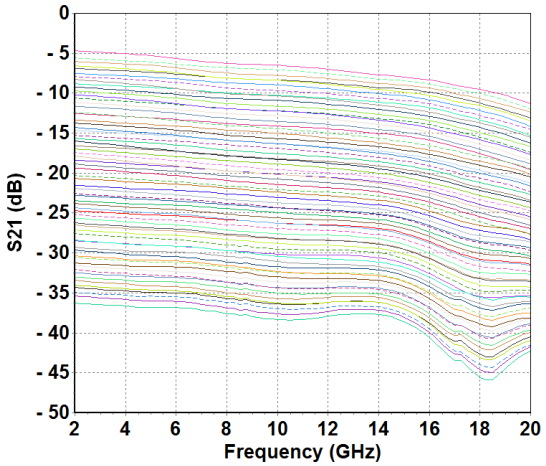
Tamb.= +25°C, V+ = 5V, V- = -5V

[S] parameters

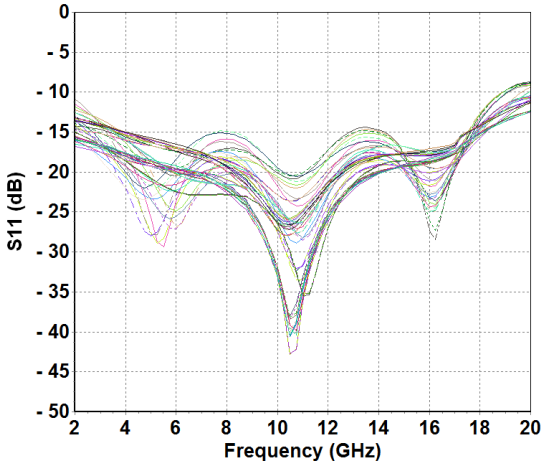
S21 versus frequency
Attenuator state 0



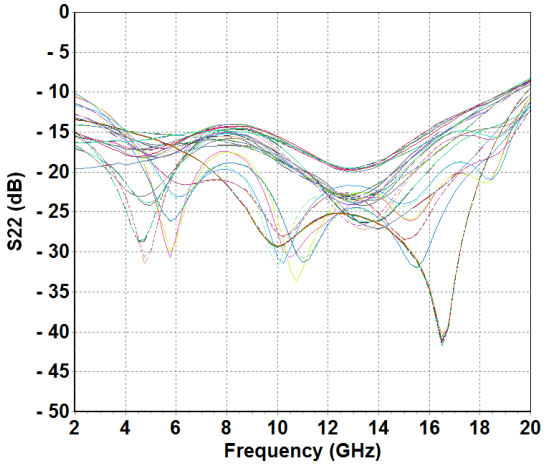
S21 versus frequency
All attenuator states



S11 versus frequency
All attenuator states



S22 versus frequency
All attenuator states



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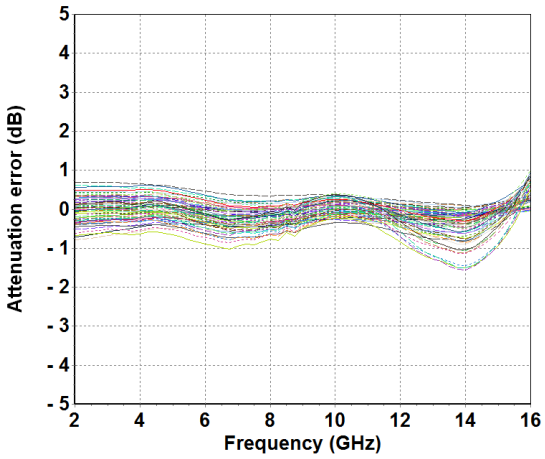
Typical Test Fixture Measurements

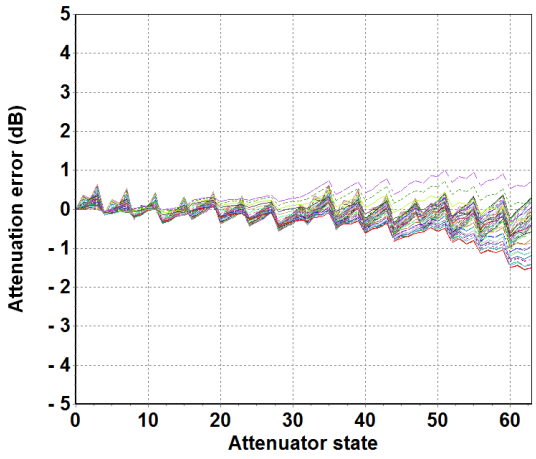
Tamb.= +25°C, V+ = 5V, V- = -5V

Attenuator performances: attenuation error

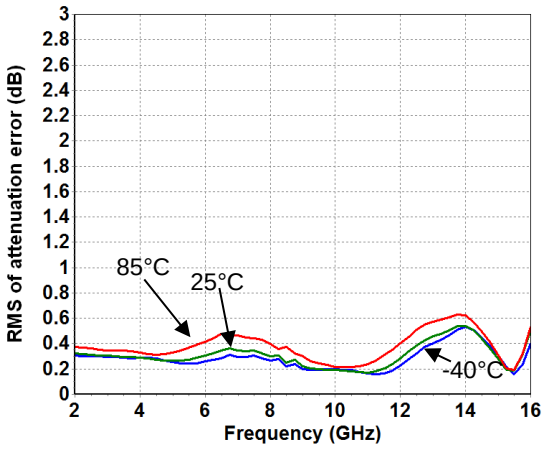
Attenuation error versus frequency
All attenuator states



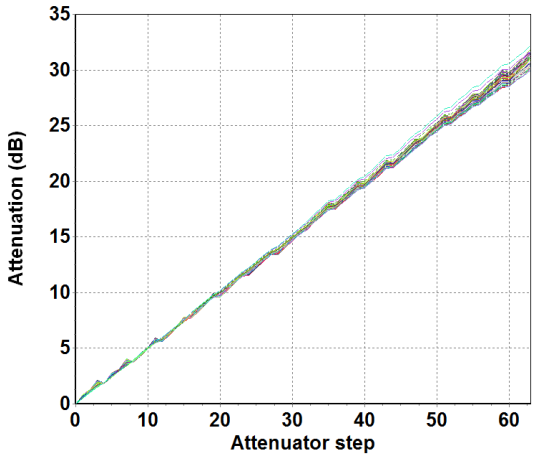
Attenuation error versus attenuator state
Frequency bandwidth 4-16GHz



RMS of attenuation error



Attenuation versus attenuator state
Frequency bandwidth 4-16GHz



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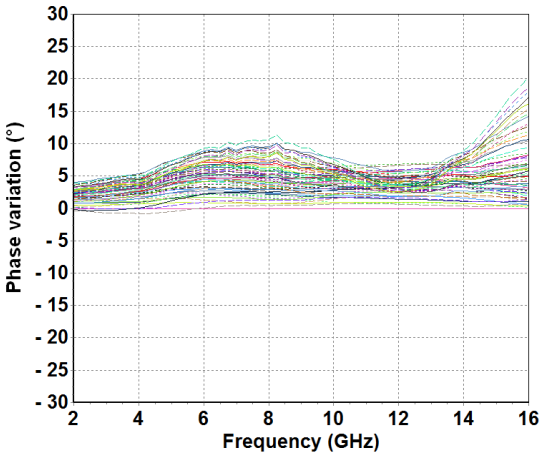
Typical Test Fixture Measurements

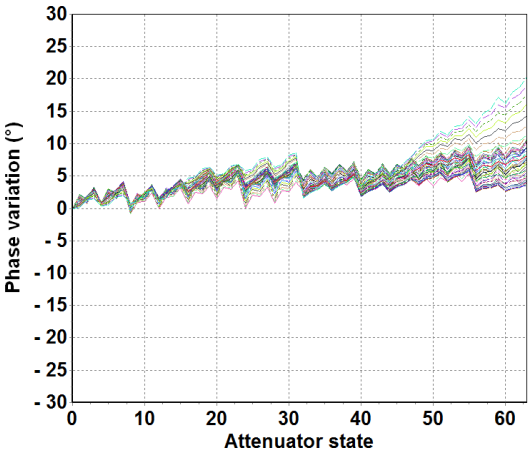
Tamb.= +25°C, V+ = 5V, V- = -5V

Attenuator performances: Phase variation

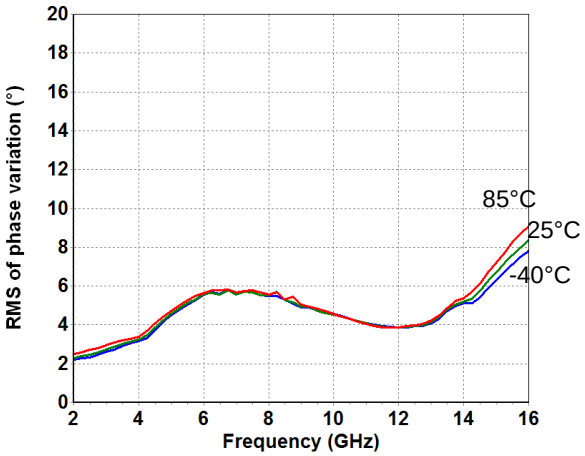
Phase variation versus frequency
All attenuator states



Phase variation versus attenuator state
Frequency bandwidth 4-16GHz



RMS of phase variation



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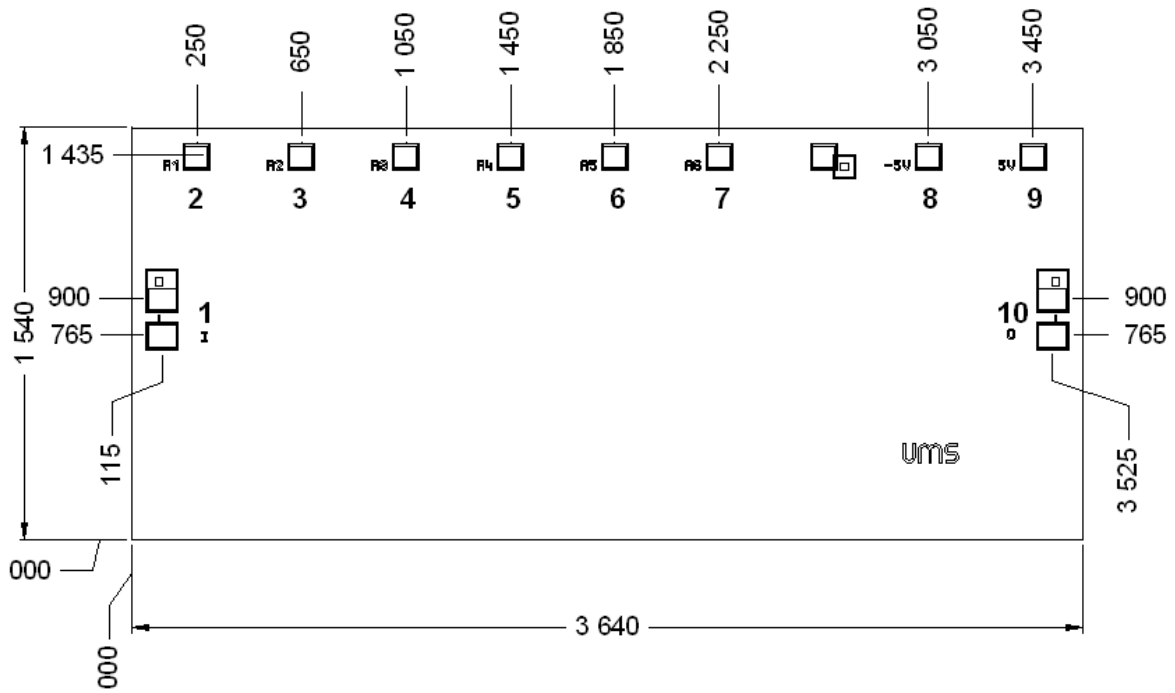
Mechanical data



Chip thickness: 100µm.
Chip size: 3640x1540 ±35µm
RF pads (1, 10) = 122x100µm
DC and control pads (2 to 9) = 100x100µm
All dimensions are in micrometers

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

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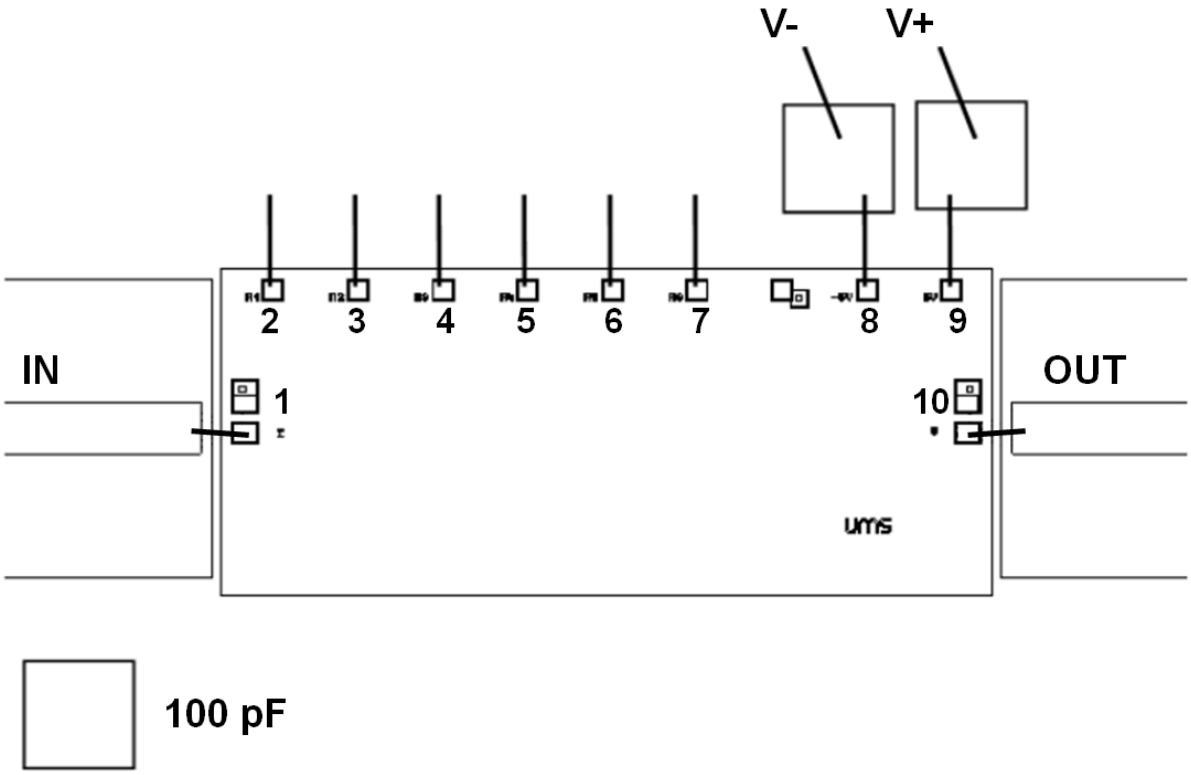
Bonding recommendations

Port	Connection
I (1) & O (10)	One wire: diameter 25µm as short as possible
DC and Interface pads	One wire: diameter 25µm, length 1mm

Recommended assembly diagram



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Biasing 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

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Attenuator control table

Voltage to apply on 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

State	Att (dB)	A6	A5	A4	A3	A2	A1
32	16	-5	0	0	0	0	0
33	16.5	-5	0	0	0	0	-5
34	17	-5	0	0	0	-5	0
35	17.5	-5	0	0	0	-5	-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

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Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.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 https://www.ums-rf.com.

Ordering Information

Chip form:	CHT4016-99F/00

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