

## 4-16GHz 6-bit digital attenuator

### GaAs Monolithic Microwave IC

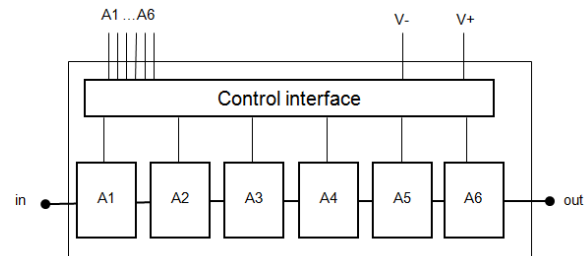
#### Description

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.

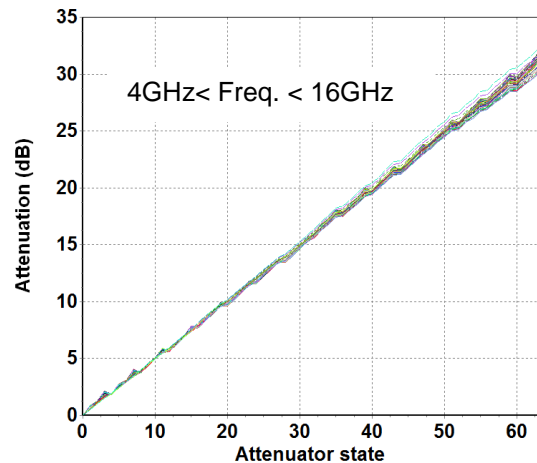
The circuit is manufactured with a pHEMT process, 0.25 $\mu$ m gate length, via holes through the substrate, air bridges and electron beam gate lithography.

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

## 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	<b>Attenuation error</b>				
	Attenuation state 1-32		±0.5		dB
	Attenuation state 33-50		±0.8		dB
	Attenuation state 51-63		-1.5/+1		dB
Rms_att	RMS attenuation error		0.5		dB
Phivar	<b>Phase variation</b>				
	Attenuation state 1-32		0/+8		°
	Attenuation state 33-50		+2.5/+11		°
	Attenuation state 51-63		+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_H	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 <sup>(1)</sup>

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 <sup>(2)</sup>	+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

<sup>(1)</sup> Operation of this device above anyone of these parameters may cause permanent damage.

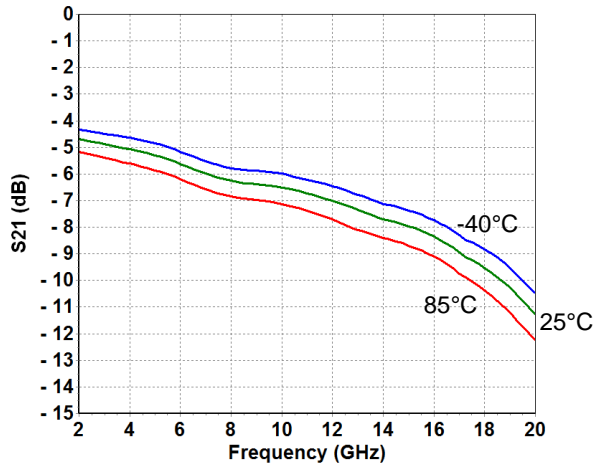
<sup>(2)</sup> Duration < 1s.

**Typical Test Fixture Measurements**

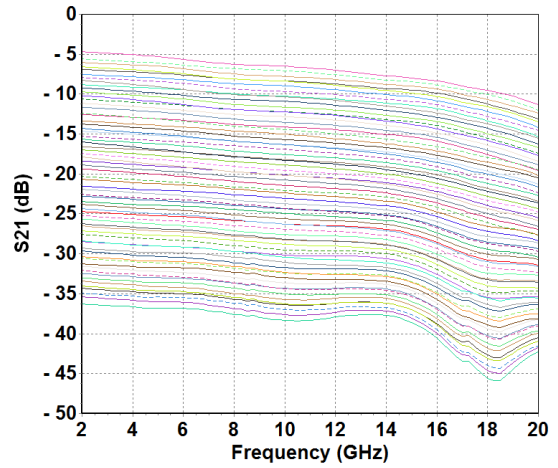
Tamb.= +25°C, V+ = 5V, V- = -5V

[S] parameters

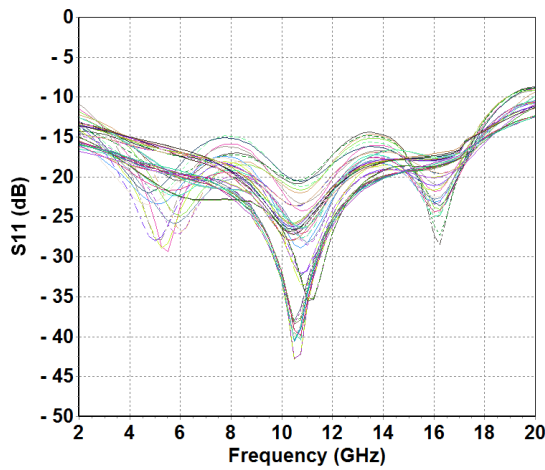
**S21 versus frequency  
Attenuator state 0**



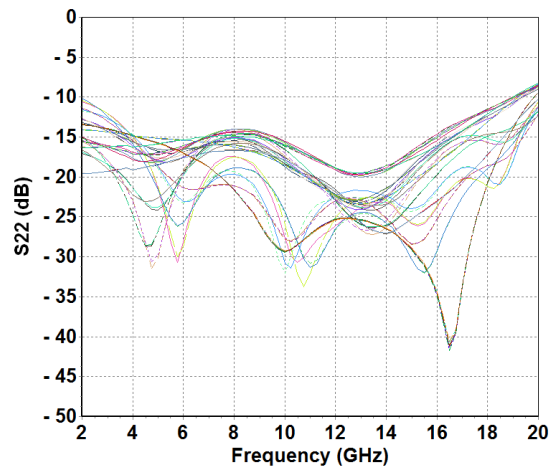
**S21 versus frequency  
All attenuator states**



**S11 versus frequency  
All attenuator states**



**S22 versus frequency  
All attenuator states**

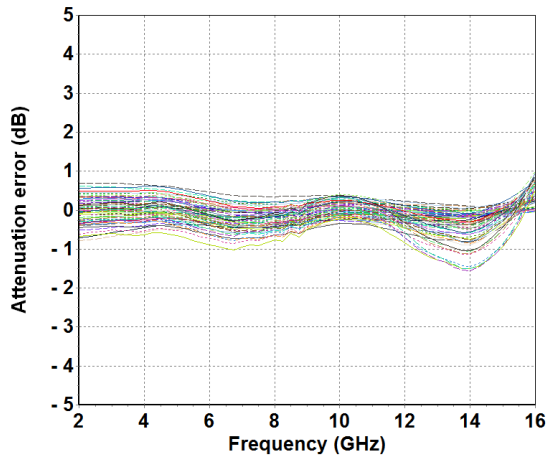


## Typical Test Fixture Measurements

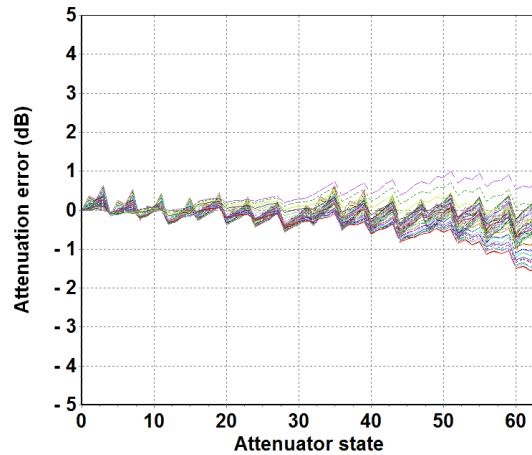
Tamb.= +25°C, V+ = 5V, V- = -5V

Attenuator performances: attenuation error

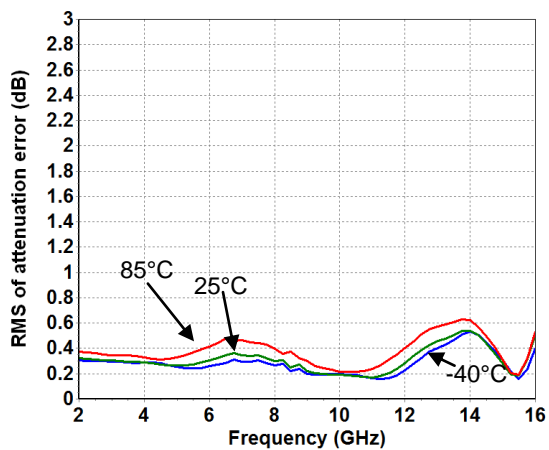
**Attenuation error versus frequency**  
All attenuator states



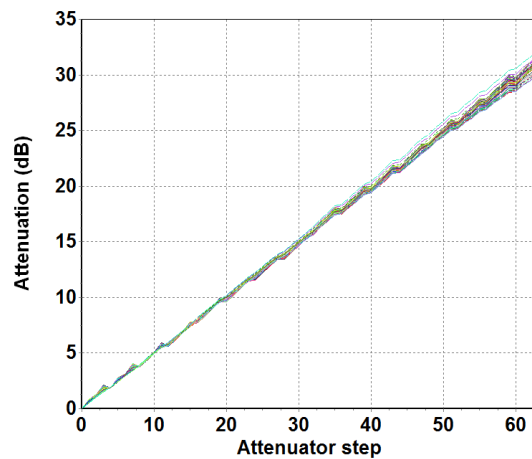
**Attenuation error versus attenuator state**  
Frequency bandwidth 4-16GHz



**RMS of attenuation error**



**Attenuation versus attenuator state**  
Frequency bandwidth 4-16GHz

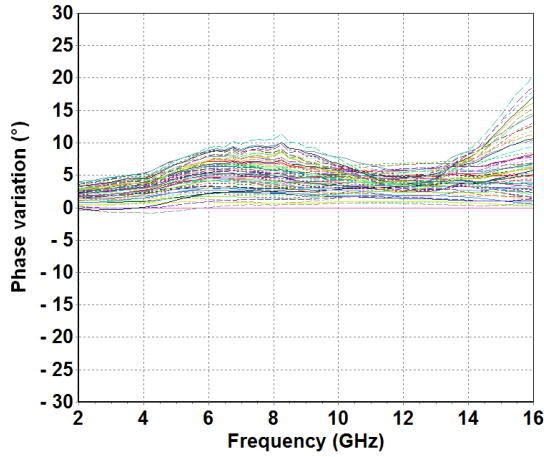


**Typical Test Fixture Measurements**

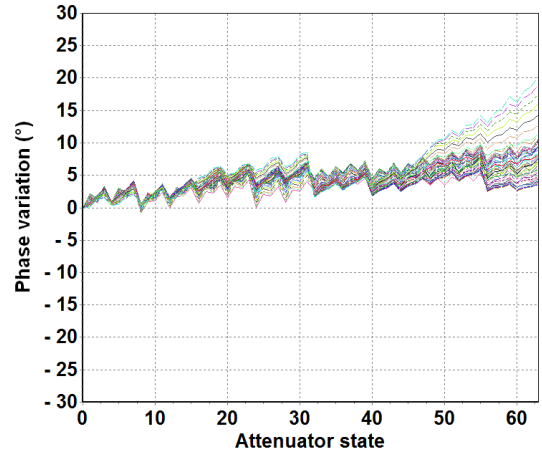
Tamb.= +25°C, V+ = 5V, V- = -5V

**Attenuator performances: Phase variation**

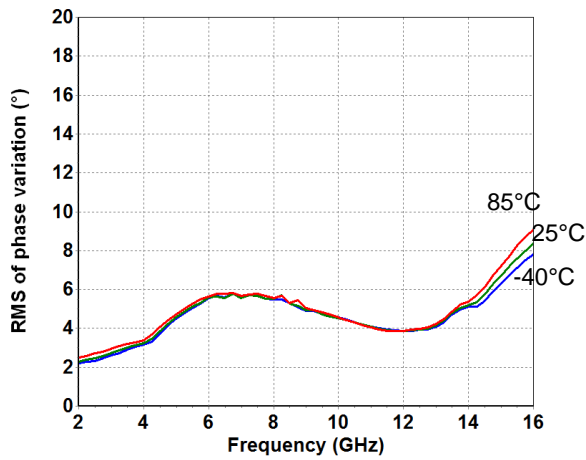
**Phase variation versus frequency  
All attenuator states**



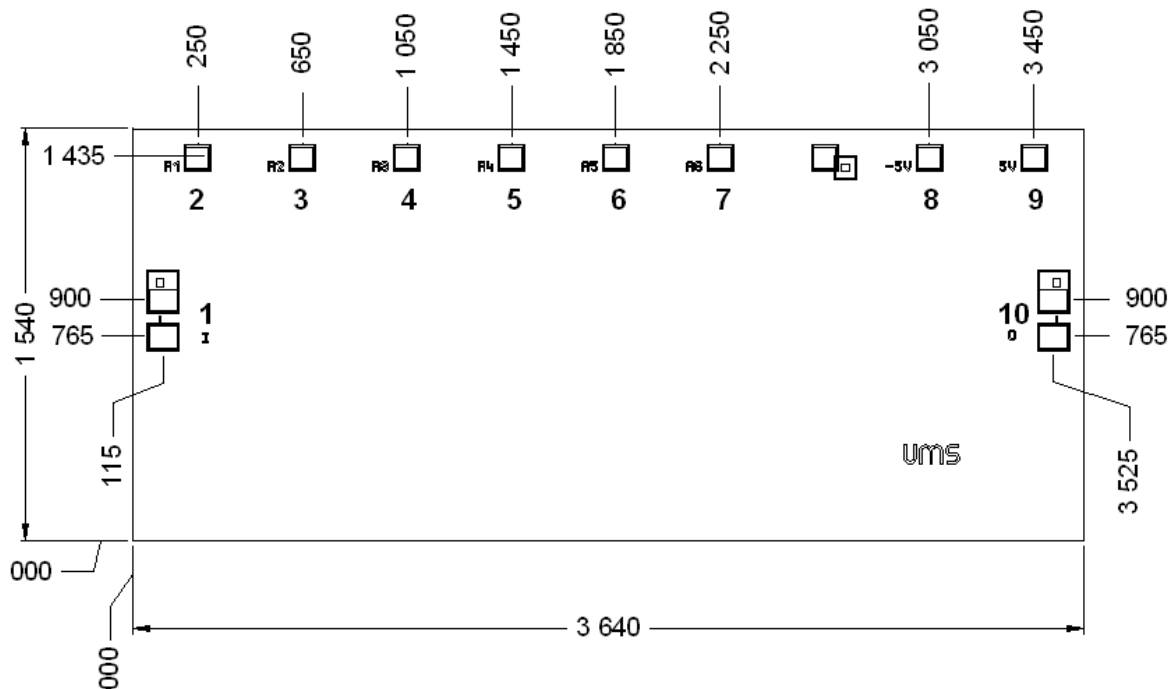
**Phase variation versus attenuator state  
Frequency bandwidth 4-16GHz**



**RMS of phase variation**



## Mechanical data



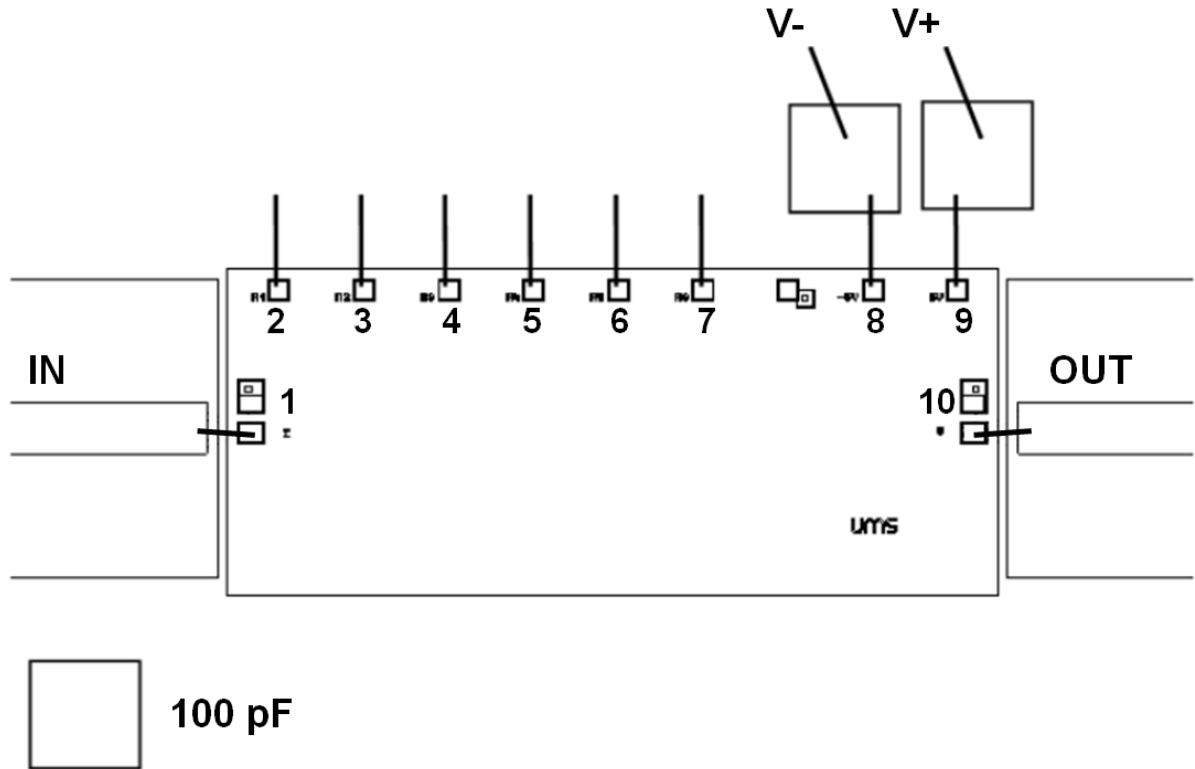
Chip thickness: 100µm.  
 Chip size: 3640x1540 ±35µm  
 RF pads (1, 10) = 122x100µm  
 DC and control pads (2 to 9) = 100x100µm  
 All dimensions are in micrometers

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

**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**



**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



**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

## 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:

CHT4016-99F/00

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