CHM1080-98F

71-86GHz Single Side Band Mixer

GaAs Monolithic Microwave IC

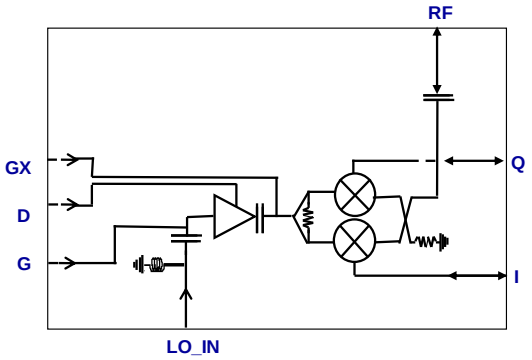
Description

The CHM1080-98F is a multifunction monolithic mixer, which integrates a balanced sub-harmonic cold FET mixer, with a LO buffer. It is usable both for up-conversion and down-conversion and also compatible with Baseband configuration.

It is designed for the E-band telecommunication application, particularly well suited for the new generation of high capacity backhaul.

The circuit is manufactured with a pHEMT process, 0.10µm gate length.

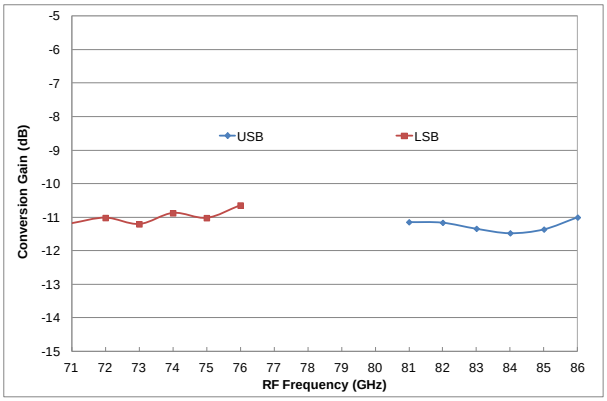
It is available in chip form.



Main Features

- Broadband RF performances: 71-86GHz
- -11dB Conversion Gain
- 40dB 2LO isolation
- 10dBm Input Power at 1dB compression
- DC bias: Vd=3.5V @Id=90mA
- Chip size 3.43x1.5x0.07mm

Conversion Gain



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F_{RF}	RF Frequency	71		86	GHz
F_{IF}	IF frequency	DC		12	GHz
Gc	Conversion gain		-11		dB
RFin P1dB	RF input power @1dB comp.		10		dBm

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Electrical Characteristics

Tamb.= +25°C, Vd = 3.5V

Symbol	Parameter	Min	Typ	Max	Unit
F_{RF}	RF Frequency range	71		86	GHz
F_{LO}	LO Frequency range	34.5		44	GHz
F_{IF}	IF output Frequency	DC	6	12	GHz
P_{LO}	LO Input Power		2		dBm
Gc	Conversion Gain (1)		-11		dB
R_LO	LO Input return loss		10		dB
LO/ RF	LO Isolation on RF port		17		dB
2LO/ RF	2LO Isolation on RF port		16		dB
2LO/ RF	2LO Isolation on RF port with DC voltage on I/ Q (V_I & V_Q) (2)		40		dB
Im_rej	Image rejection (1)		15		dBc
IFin P1dB	IF Input power @1dB comp.		0		dBm
RFin P1dB	RF input power @1dB comp.		10		dBm
V_I & V_Q	DC voltage on I & Q (3)	-500		500	mV
Id	Drain current (Id LO Buffer) (4)		90		mA
D	DC drain voltage (LO Buffer)		3.5		V
G	DC gate voltage (LO Buffer)		-2.2		V
GX	Mixer DC gate voltage		-2		V

(1) An external combiner 90° is required on I / Q.
(2) In baseband configuration, a DC voltage on I & Q could be applied to cancel the 2LO leakage
(3) V_I & V_Q should be tuned independently for each frequency, temperature
(4) LO Buffer quiescent current 85mA
These values are representative of on-wafer measurements that are made without bonding wires at the RF & LO ports.
A ribbon (75 µm wide) connection at the RF and LO inputs (see chapter recommended chip assembly) could improve the results.

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Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	4V	V
Id	Drain bias quiescent current	120	mA
VG, VGx	Gate bias voltage	-3 to -0.2	V
Pin_LO	Maximum LO peak input power overdrive (2)	+10	dBm
Tj	Junction temperature	175	°C
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

Pad name	Pad Nº	Parameter	Typical Values	Unit
G	9	LO Buffer DC gate voltage (1)	-2.2	V
D	7	LO Buffer DC drain voltage (85mA)	3.5	V
GX	8	Mixer DC gate voltage	-2	V
	6, 7	Not connected		

(1) Gate voltage should be adjusted to reach 85mA through pad D.

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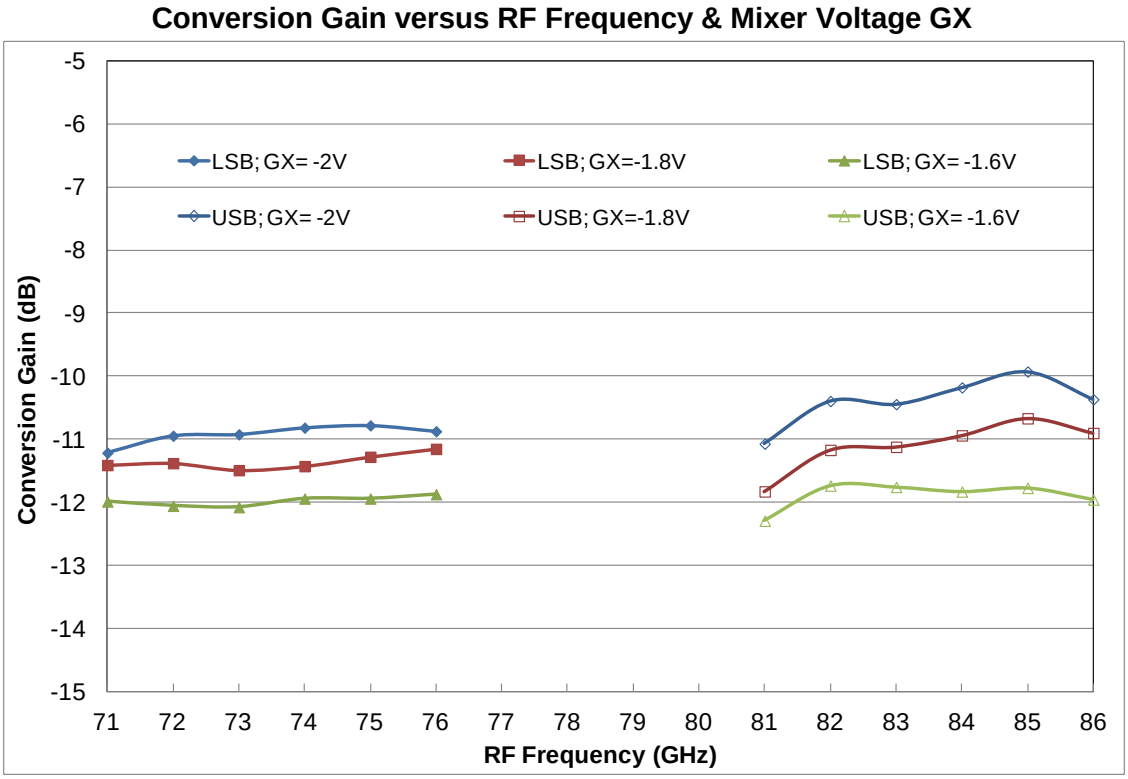
Typical on wafer Measurements as Down converter

Tamb.= +25°C, Vd = +3.5V

Measurement conditions, base line:
GX= -2V, Pin_RF= -15dBm, Pin_LO= 2dBm, IF Frequency = 10GHz
G tuned for Id_LO= 85mA (G close to -2.2V)
USB: RF= 2LO+ IF; LSB: RF= 2LO-IF
Measure with external IF 90° hybrid



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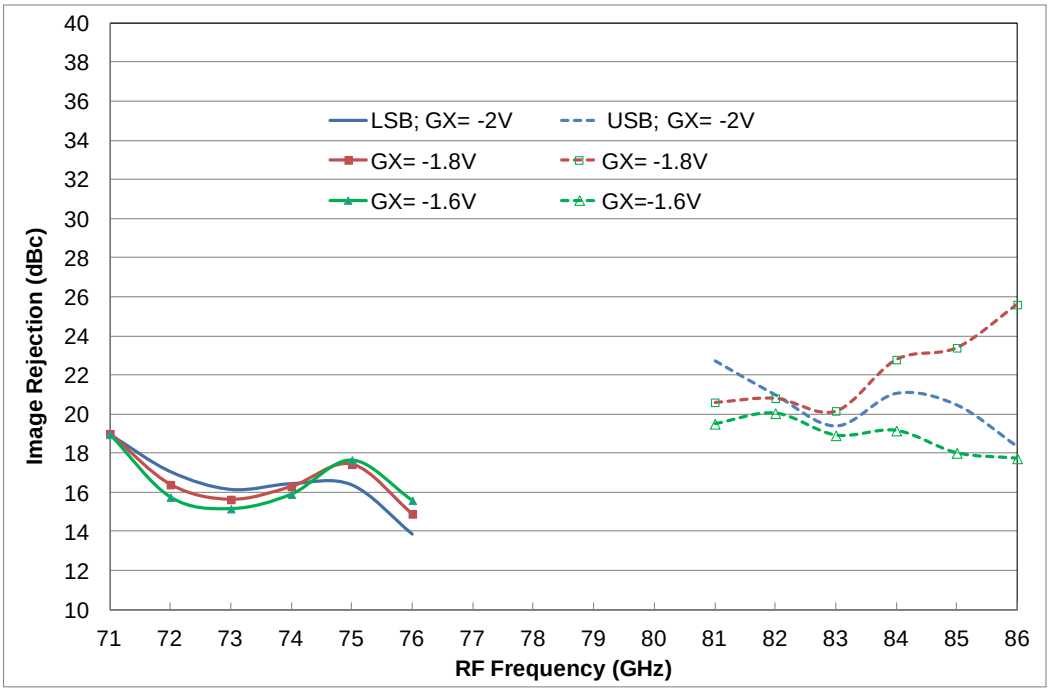
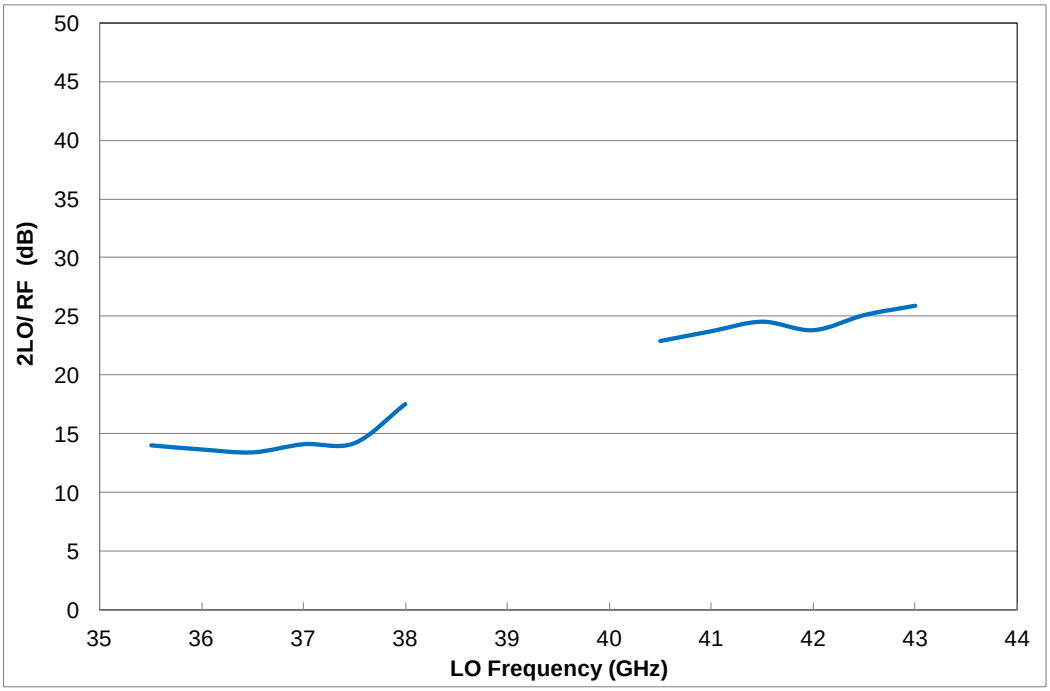
Typical on wafer Measurements as Down converter

Tamb.= +25°C, Vd = +3.5V

Image rejection versus RF Frequency & Mixer Voltage GX



LO Isolation versus LO Frequency



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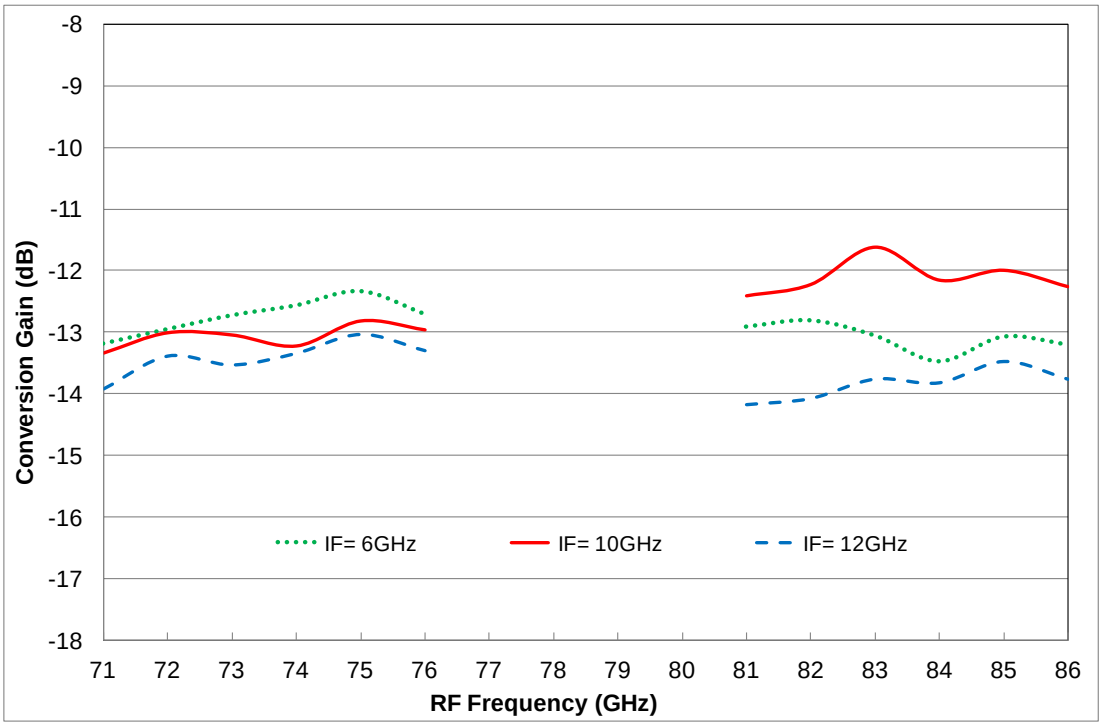
Typical on wafer Measurements as Down converter

Tamb.= +25°C, Vd = +3.5V
Note: measured without external IF 90° hybrid

Conversion Gain versus RF frequency & IF Frequency



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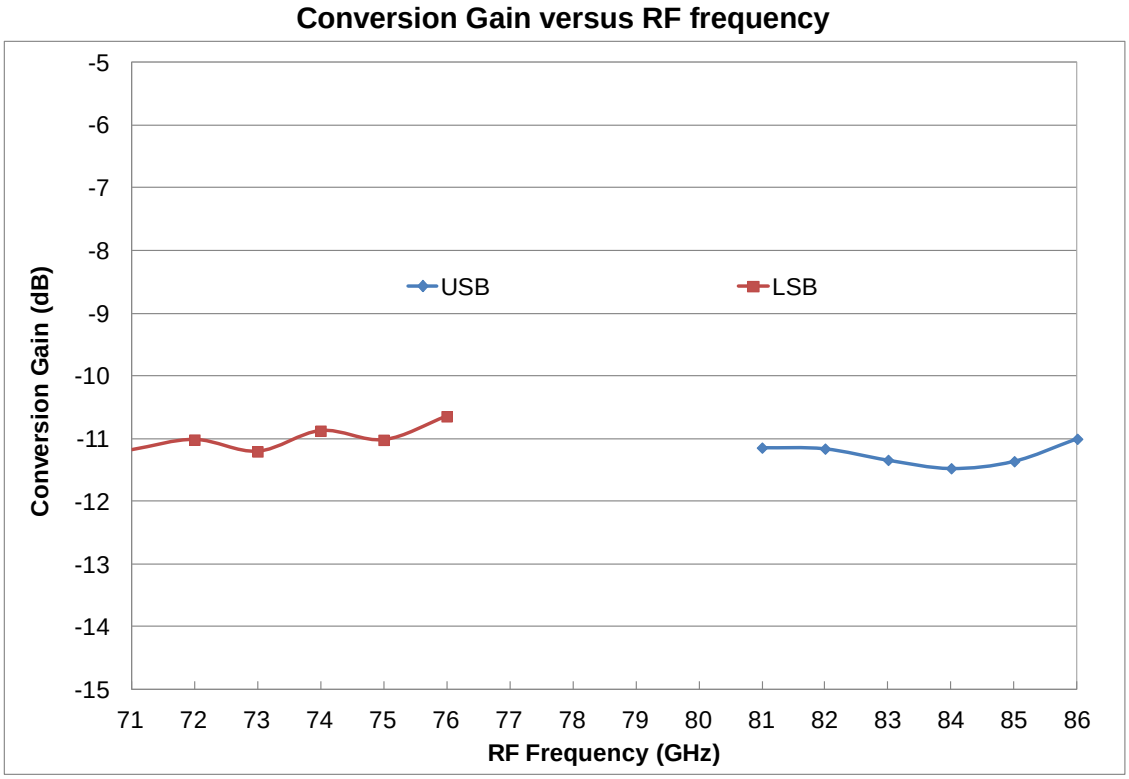
Typical on wafer Measurements as Up converter

Tamb.= +25°C, Vd = +3.5V

Measurement conditions, base line:
GX= -2V, Pin_IF= -10dBm, Pin_LO= 2dBm, IF Frequency = 6GHz
G tuned for Id_LO= 85mA (G close to -2.2V)
USB: RF= 2LO+ IF; LSB: RF= 2LO-IF
Measure with external IF 90° hybrid



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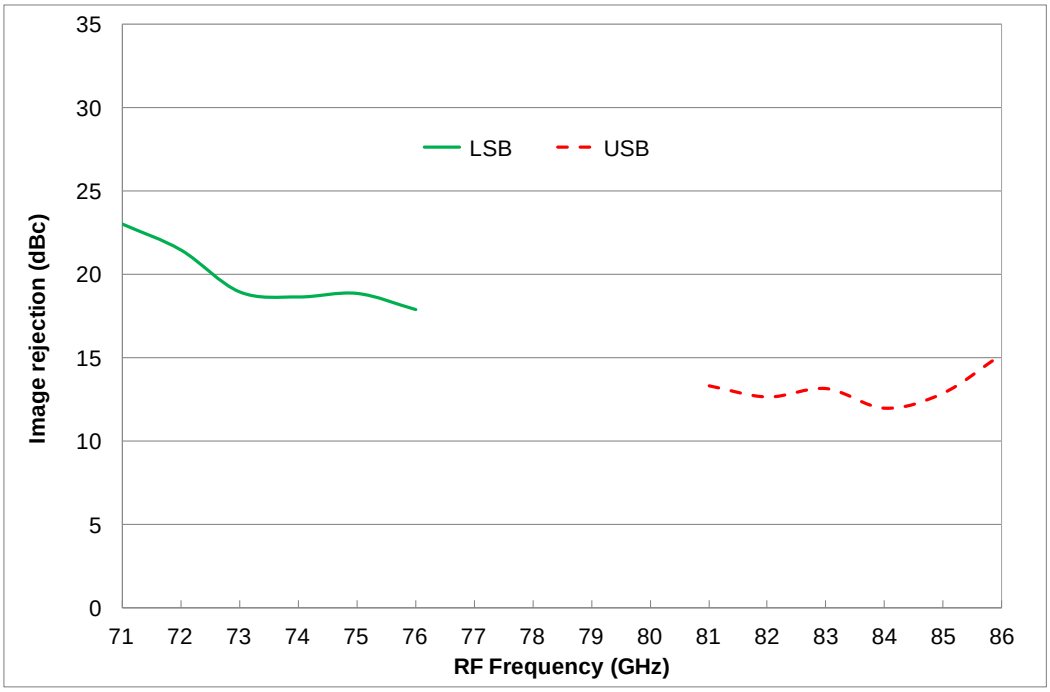
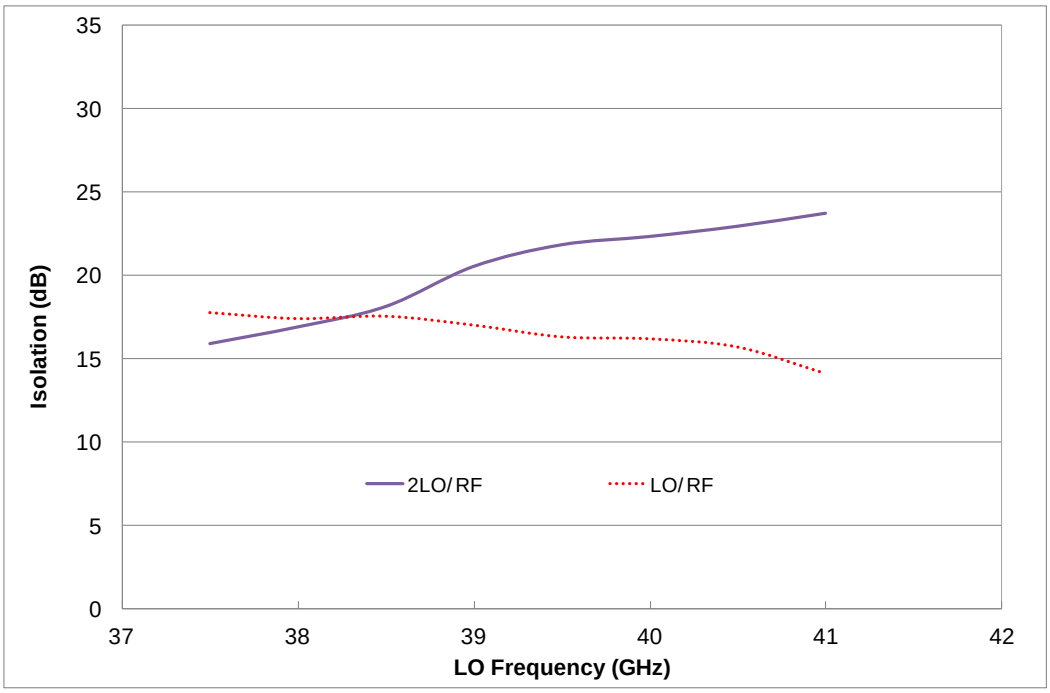
Typical on wafer Measurements as Up converter

Tamb.= +25°C, Vd = +3.5V

Image rejection versus RF frequency



Isolation versus LO Frequency



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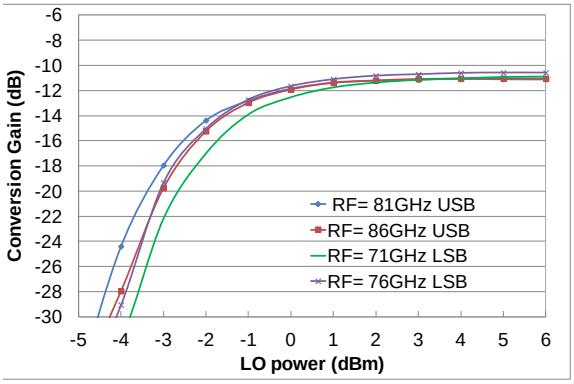
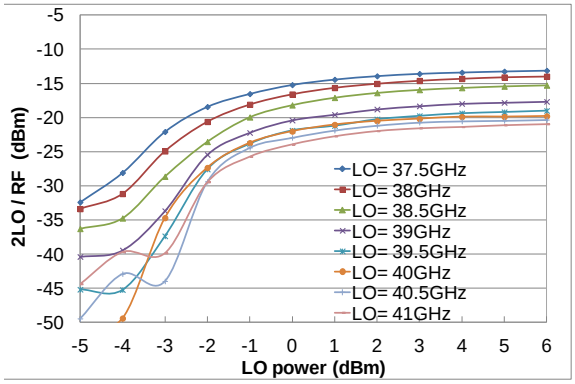
Typical on wafer Measurements as Up converter

Tamb.= +25°C, Vd = +3.5V

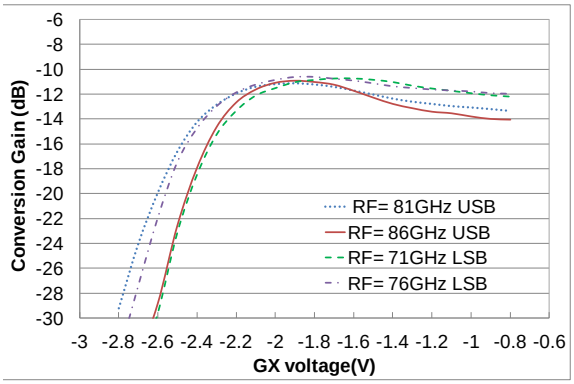
Conversion Gain versus LO power



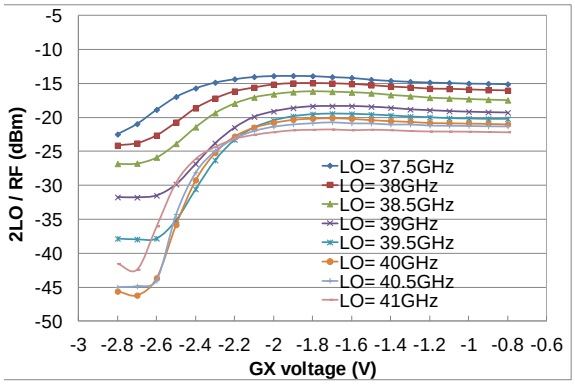
2LO leakage versus LO power



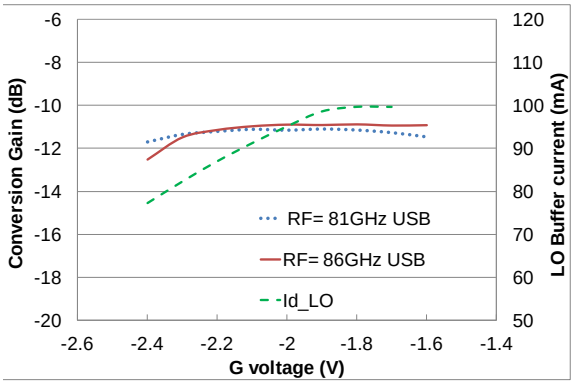
Conversion Gain versus Mixer Voltage



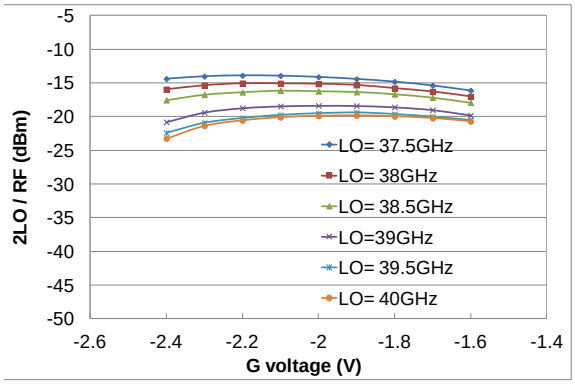
2LO leakage versus Mixer Voltage



Conversion Gain & LO buffer current versus LO Buffer Voltage G



2LO leakage vs LO Buffer Voltage



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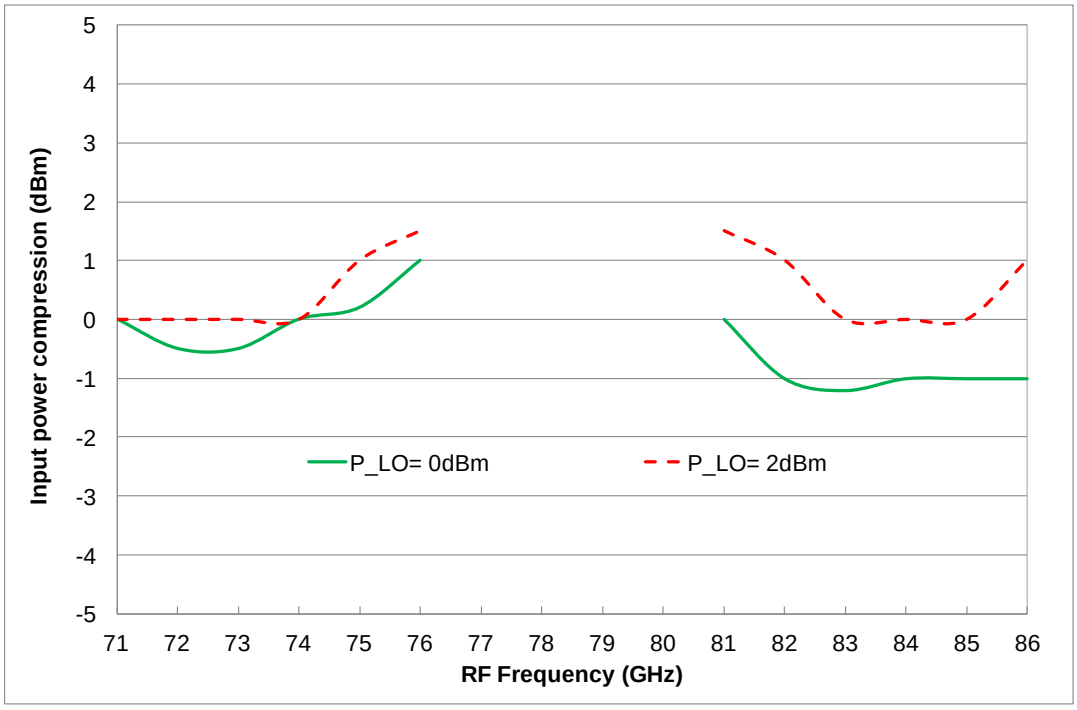
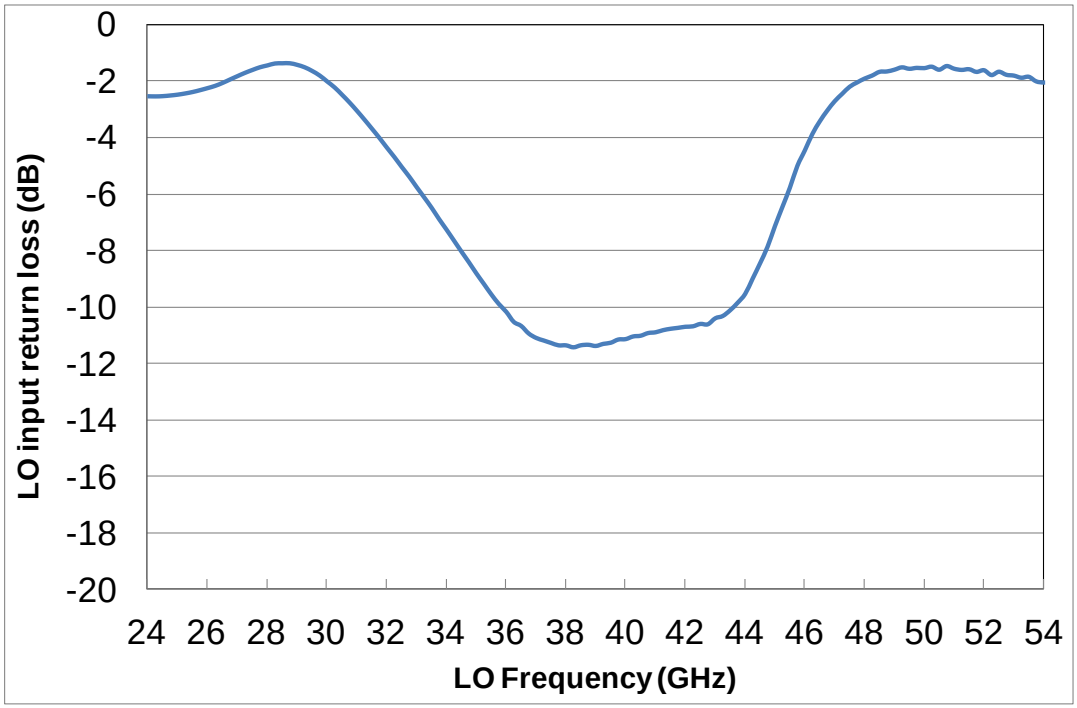
Typical on wafer Measurements as Up converter

Tamb.= +25°C, Vd = +3.5V

Input power compression versus RF Frequency



LO return loss versus Frequency



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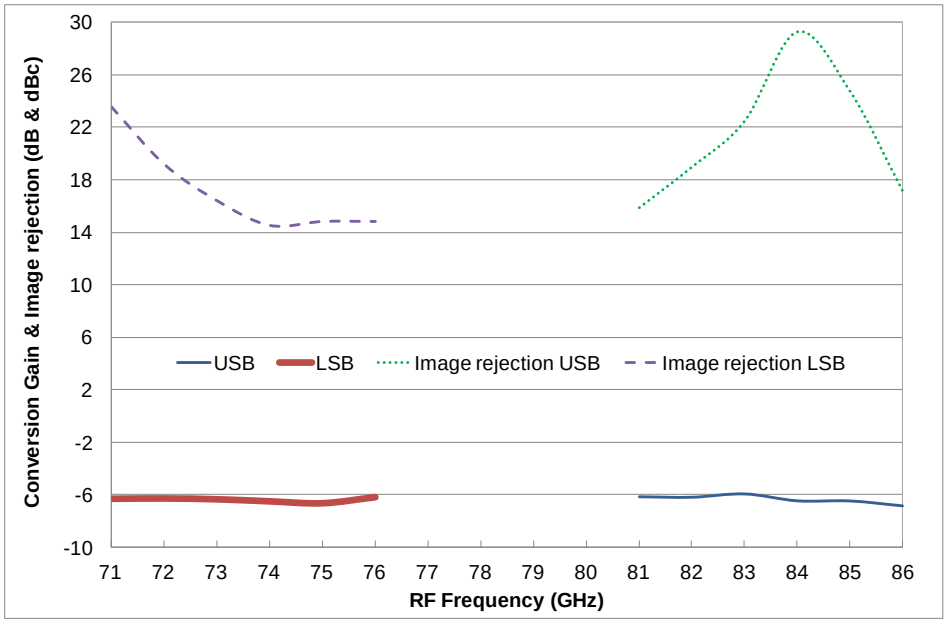
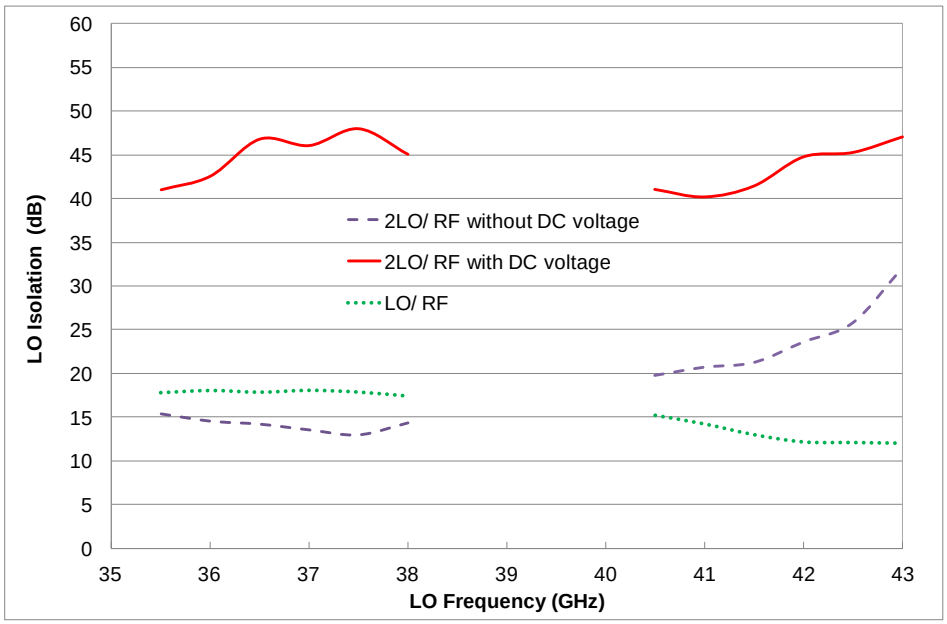
Typical on wafer Measurements in Baseband configuration

Tamb.= +25°C, Vd = +3.5V
Measure with low IF at 10MHz, with 90° between I and Q signal
GX= -2V, Pin_IF= -10dBm, Pin_LO= 2dBm
G tuned for Id_LO= 85mA (G close to -2.2V)

Conversion Gain & Image Rejection versus RF Frequency



Isolation versus LO Frequency (1)



(1) In baseband configuration, a DC voltage on I & Q could be applied to cancel the 2LO leakage. V_I & V_Q should be tuned independently for each frequency and temperature.

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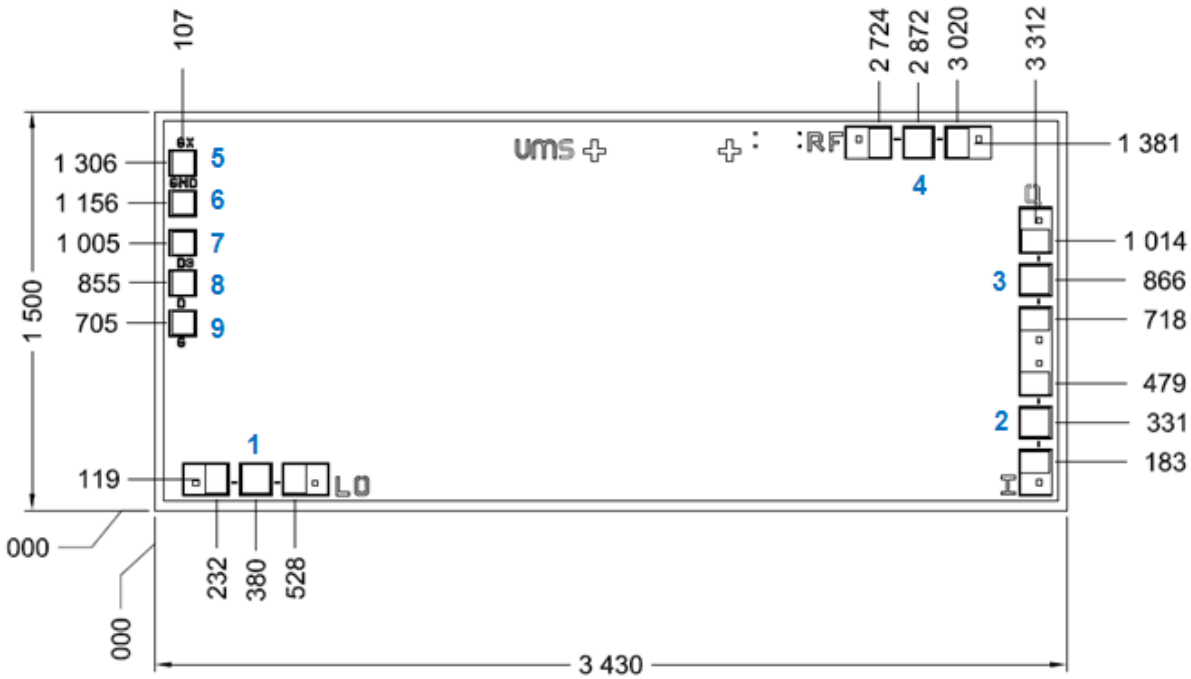
Mechanical data



Chip thickness: 70µm.
Chip size: 3430x1500 ±35µm
All dimensions are in micrometers

RF Pads = 108 x 106 (BCB opening)
DC Pads = 86 x 83 (BCB opening)

Recommended circuit bonding table

Pin number	Pin name	Description	Decoupling
1	**LO**	LO In	
2	**I**	IF (I)	
3	**Q**	IF (Q)	
4	**RF**	RF in-out	
5	**GX**	DC Mixer Gate Voltage (-2V)	120pF, 10nF
6, 7		Not connected	
8	**D**	DC LO Buffer Drain Voltage (3.5V)	120pF, 10nF
9	**G**	DC LO Buffer Gate Voltage (-2.2V)	120pF, 10nF

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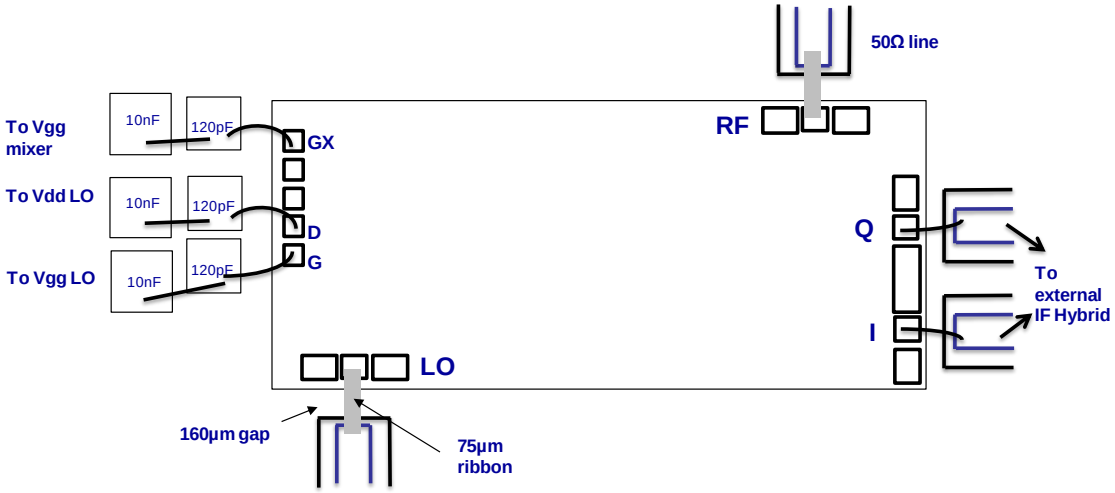
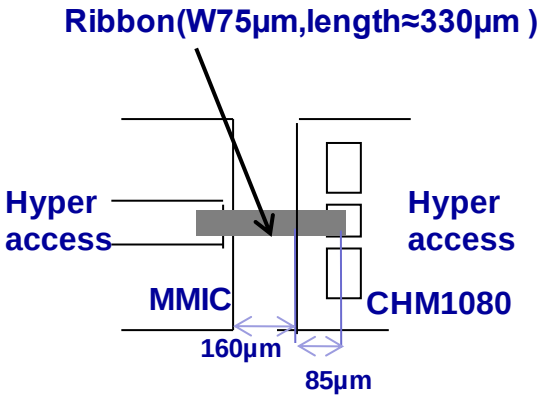
Recommended assembly plan



The design integrates a half ribbon (75µm wide) connection at the RF and LO input of the MMIC amplifier compliant with a 50Ohm line on GaAs MMIC.

Circuits having to be as close as possible to each other, the ribbon length must be reduced to the achievable minimum (160µm gap between two chips is considered) and the loop height must also be the smallest realizable (80µm).



A second solution is the use of double wires (Ø 25µm). In this case, a minimum of two wires and the same chip to chip distance than ribbon solution are necessary to reduce the inductance effect. Nevertheless, simulations have demonstrated an improvement of RF performance for E-band frequency range with the use of ribbon connection instead of wire.

Regarding the connection of the DC pads, a 25µm wedge bonding is preferred.

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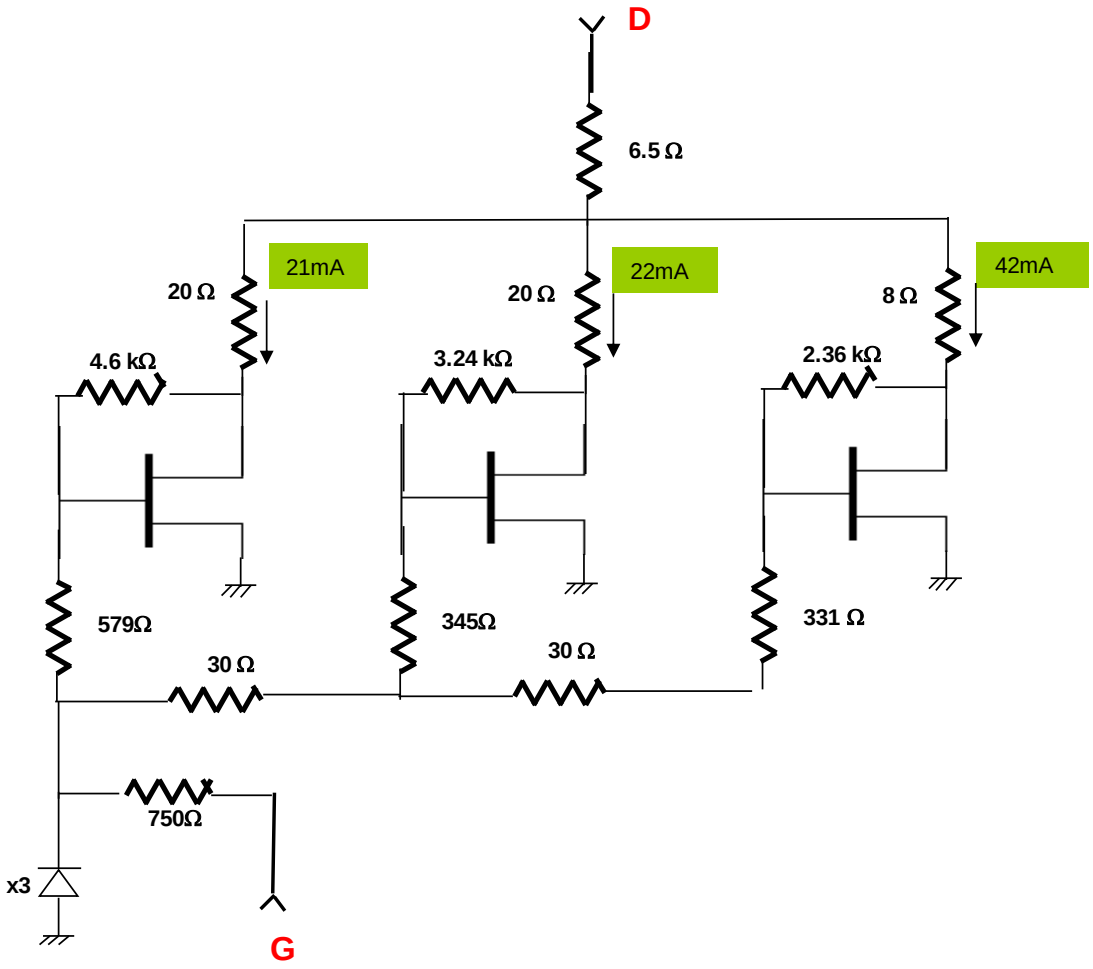
DC Schematic

LO Buffer: 3.5V, 85mA



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Notes

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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:	CHM1080-98F/00

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