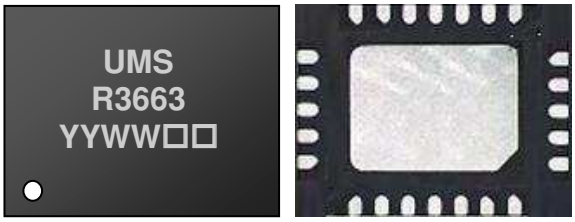
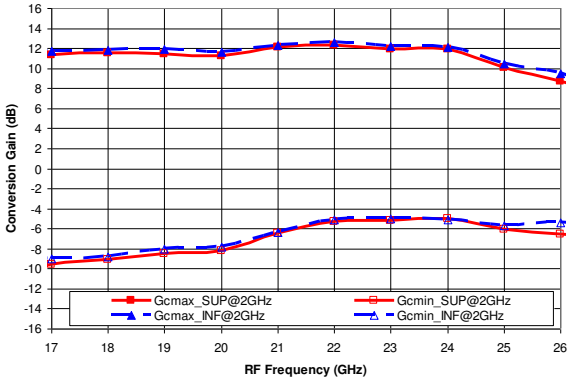
17-24GHz Integrated Down Converter

GaAs Monolithic Microwave IC in SMD package

Description

The CHR3663-QEG is a multifunction part, which integrates a balanced cold FET mixer, a multiplier by two, and a RF LNA including gain control.
It is designed for a wide range of applications, typically commercial communication systems and ISM.
The circuit is manufactured with a robust high volume pHEMT process, 0.25µm gate length.
It is available in lead-free SMD package.





Main Features

- Broadband RF performance 17-24GHz
- 11dB conversion gain
- 15dBc Image Rejection
- 3dBm Input IP3
- 15dB Gain control
- 24LQFN4x5
- MSL1

Main Characteristics

Tamb = +25°C, Vd = 4.5V

Symbol	Parameter	Min	Typ	Max	Unit
F_{RF}	RF frequency range	17.0		24.0	GHz
F_{LO}	LO frequency range	7.0		14.0	GHz
F_{IF}	IF frequency range	DC		3.5	GHz
G_c	Conversion gain		11		dB

ESD Protections: Electrostatic discharge sensitive device observe handling precautions!

United Monolithic Semiconductors S.A.S.
Route Départementale 128 - BP46 - 91401 Orsay Cedex France
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Electrical Characteristics

Tamb = +25°C, VD = VDL = 4.5V

Symbol	Parameter	Min	Typ	Max	Unit
F_{RF}	RF frequency range	17.0		24.0	GHz
F_{LO}	LO frequency range	7.0		14.0	GHz
F_{IF}	IF frequency range	DC		3.5	GHz
G_c	Conversion gain@ min. attenuation (1)	8.5	11.0		dB
ΔG	Gain control range		15		dB
NF	Noise Figure@ min. attenuation, for IF>0.1GHz		3.5	4.5	dB
Im_rej	Image rejection (1)		15		dBc
P_{LO}	LO Input power		0		dBm
IIP3	Input IP3@ min. att.	0	3		dBm
2LO/RF	2LO leakage at RF port @ max. gain		-40		dBm
VD, VDL	DC drain voltage		4.5		V
Id	Drain current		380		mA
VGL	LNA DC gate voltage		-0.4		V
GC2, GC3	Gain control DC voltage	-2.0		+0,6	V
VGM	Mixer DC gate voltage		-0.7		V

These values are representative of onboard measurements as defined on the drawing at paragraph “Evaluation mother board”.
(1) An external combiner 90° is required on I / Q.
Note: Id not affected by GC2, GC3.

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Absolute Maximum Ratings (1)

Tamb = +25°C

Symbol	Parameter	Values	Unit
Vd	Maximum drain bias voltage	5	V
Id	Maximum drain bias current	450	mA
VGL,VGM	LNA, mixer DC gate voltage	-2.0 to +0.4	V
GC1, 2	Gain control voltage	-2.5 to + 0.8	V
P_RF	Maximum peak input power overdrive	10	dBm
P_LO	Maximum LO input power	10	dBm
Tch	Maximum channel temperature	175	°C
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.

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Device thermal performances

All the figures given in this section are obtained assuming that the QFN device is cooled down only by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase) as shown below.
The system maximum temperature must be adjusted in order to guarantee that Tcase remains below than the maximum value specified in the next table. So, the system PCB must be designed to comply with this requirement.

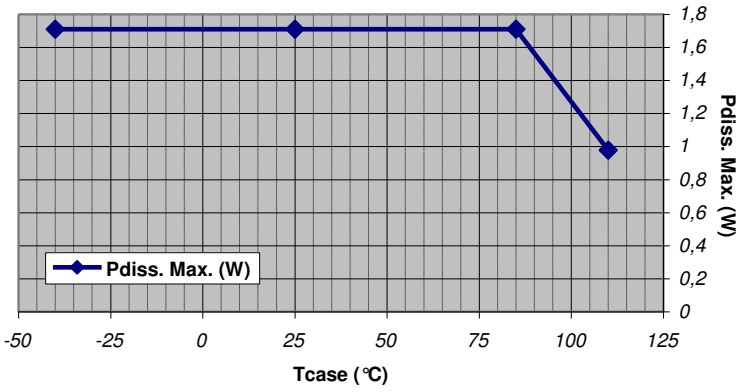
A derating must be applied on the dissipated power if the Tcase temperature can not be maintained below than the maximum temperature specified in order to guarantee the nominal device life time (MTTF) (see the curve Pdiss. Max).

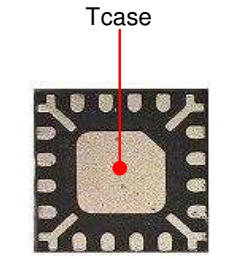
DEVICE THERMAL SPECIFICATION : CHR3663-QEG				
Recommanded max. junction temperature (Tj max)			:	143 ℃
Junction temperature absolute maximum rating			:	175 ℃
Max. continuous dissipated power @ Tcase=	85	℃	:	1,71 W
=> Pdiss derating above Tcase(1)=	85	℃	:	29 mW/℃
Junction-Case thermal resistance (Rth J-C)(2)			:	<34 ℃/W
Min. package back side operating temperature(3)			:	-40 ℃
Max. package back side operating temperature(3)			:	85 ℃
Min. storage temperature			:	-55 ℃
Max. storage temperature			:	125 ℃

(1) Derating at junction temperature constant = Tj max

*(2) Rth J-C is calculated for a worst case where the **hotter junction** of the MMIC is considered.*

(3) Tcase=Package back side temperature measured under the die-attach-pad (see the drawing below).





Example of QFN 16L 3x3 back-side view, temperature reference point (Tcase) location.

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Typical Measured Performances

Tamb = +25°C, VD = VDL = 4.5V, VGL = -0.4V, VGM = -0.7V, P_LO = 0dBm

These values are representative of onboard measurements (on connector access planes) as defined on the drawing 97625 page 16. The board losses are estimated from 1.5 to 2.0dB in the frequency range.

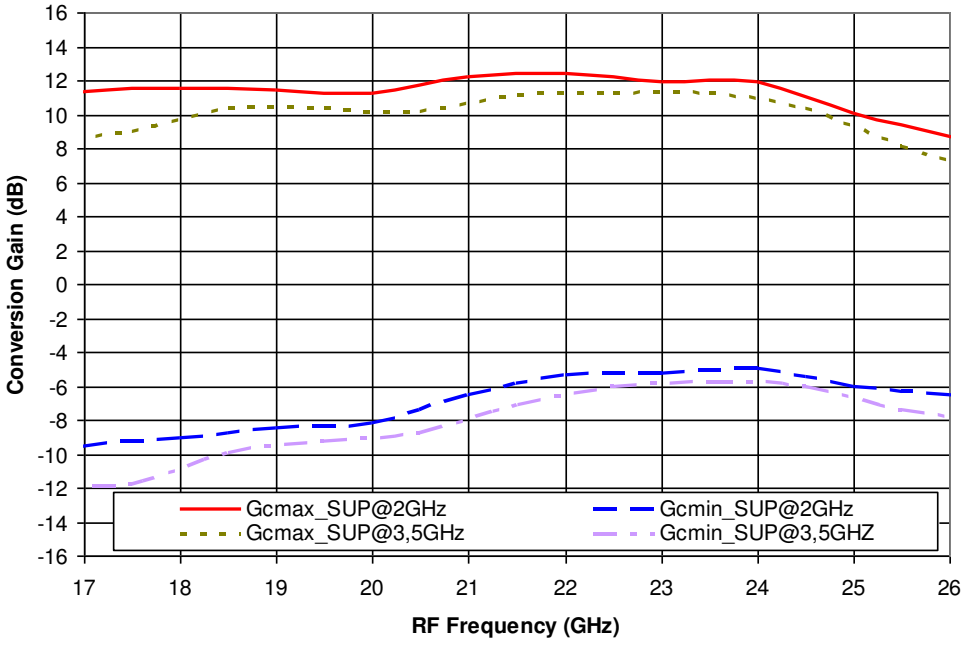


Figure 1: Conversion Gain in Supradyne Mode versus Frequency

F_RF = 2xF_LO+F_IF, F_IF = 2.0 & 3.5GHz, GC2 = GC3 = -1.5 & 0.5V

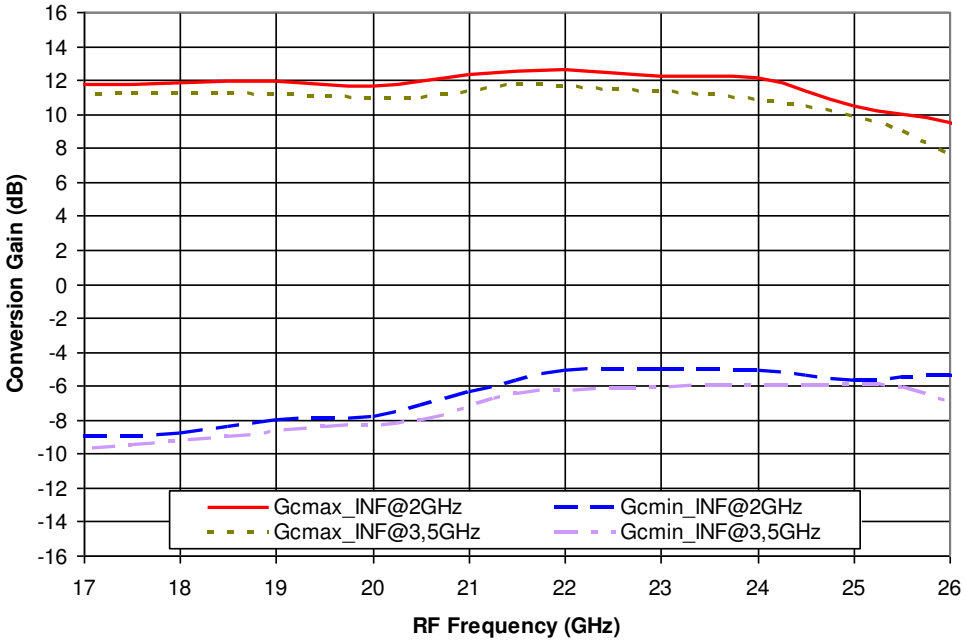


Figure 2: Conversion Gain in Infradyne Mode versus Frequency

F_RF = 2xF_LO-F_IF, F_IF = 2.0 & 3.5GHz, GC2 = GC3 = -1.5 & 0.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

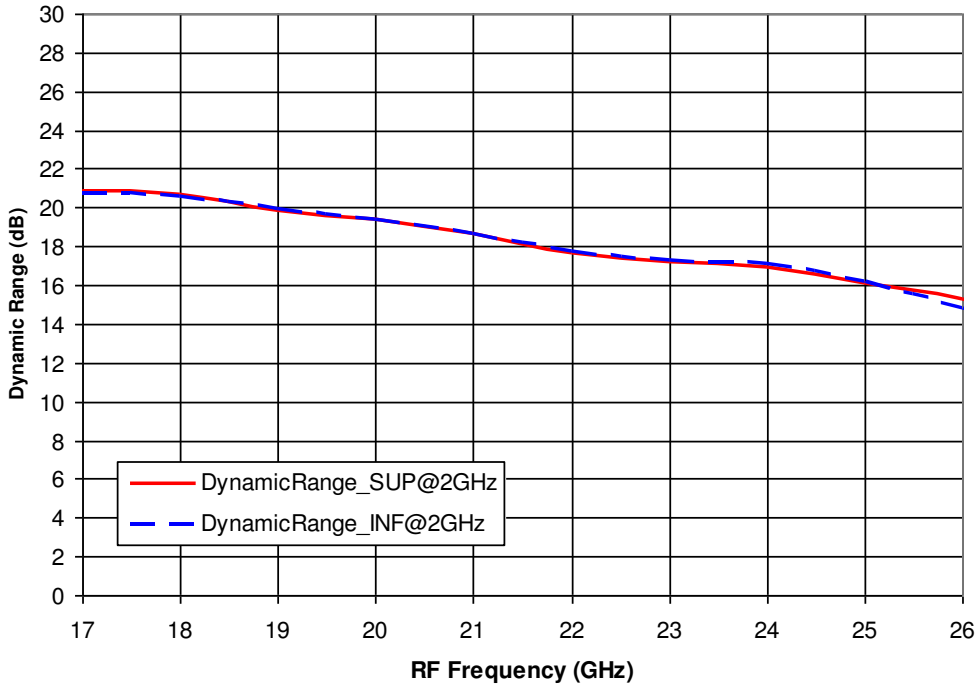


Figure 3: Dynamic Range (Gcmax – Gcmin) versus Frequency
F_RF = 2xF_LO-F_IF & F_RF = 2xF_LO+F_IF, F_IF = 2.0GHz

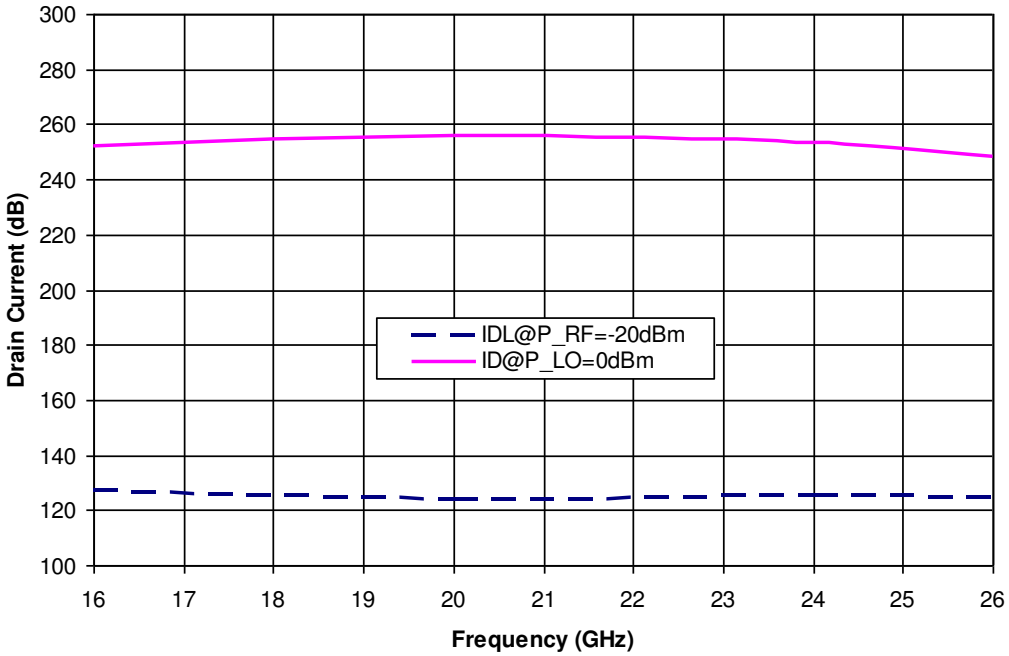


Figure 4: Drain Currents versus Frequency
F_RF = 2xF_LO-F_IF, Freq_IF = 2.0GHz, GC2 = GC3 = -1.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

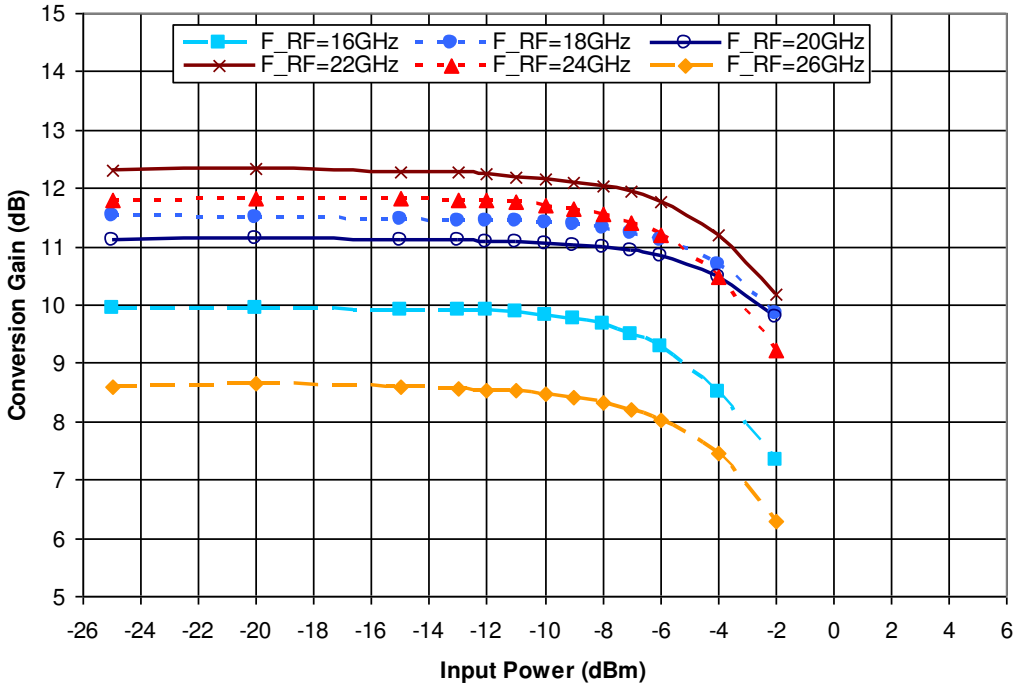


Figure 5 : Conversion Gain versus RF Power & Frequency
F_RF = 2xF_LO+F_IF, F_IF = 2.0GHz, GC2 = GC3 = -1.5V

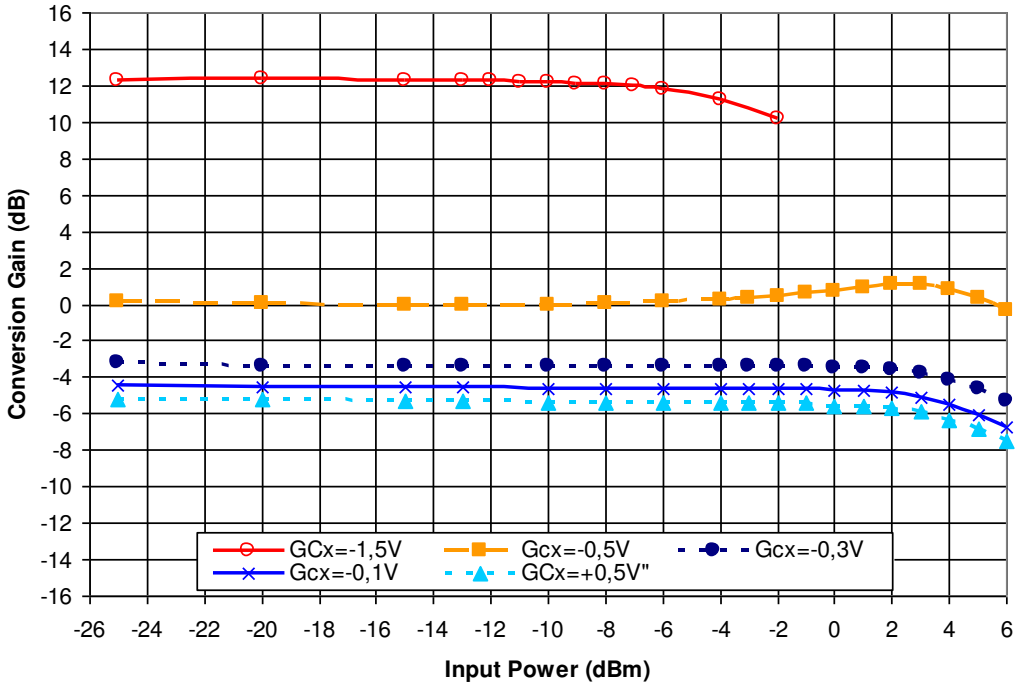


Figure 6: Conversion Gain versus RF Power & Gain control
F_RF = 2xF_LO+F_IF, F_RF = 20GHz, F_IF = 2.0GHz

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

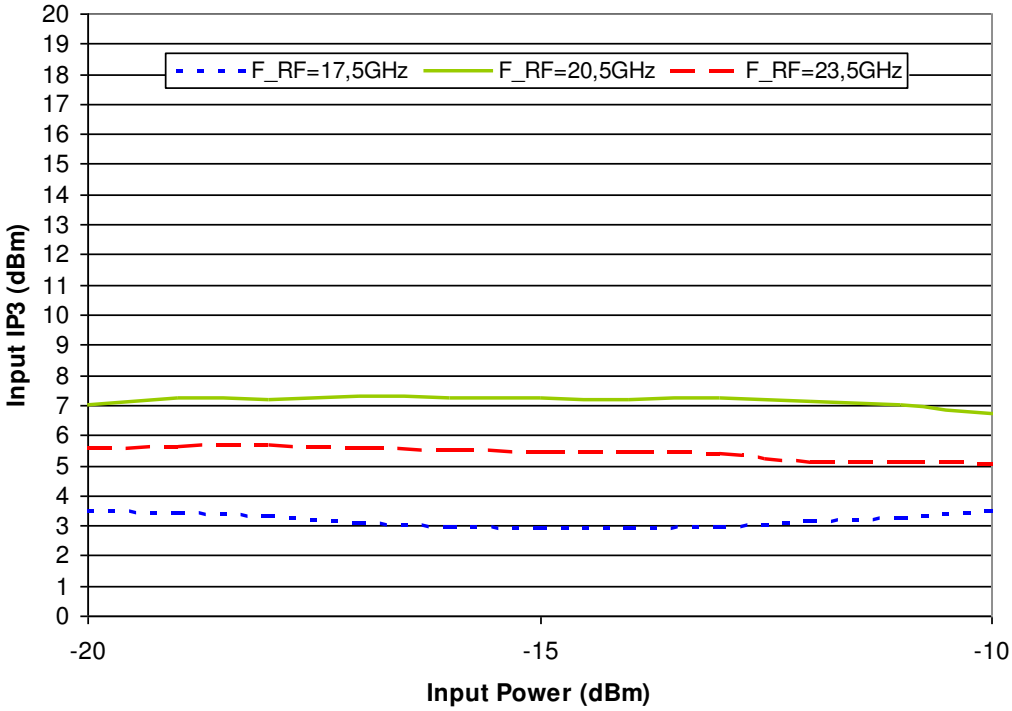


Figure 7: Input IP3 versus RF Frequency & RF Power (Double Carrier)
F_RF = 2xF_LO-F_IF, F_IF = 3.5GHz, GC2 = GC3 = -1.5V

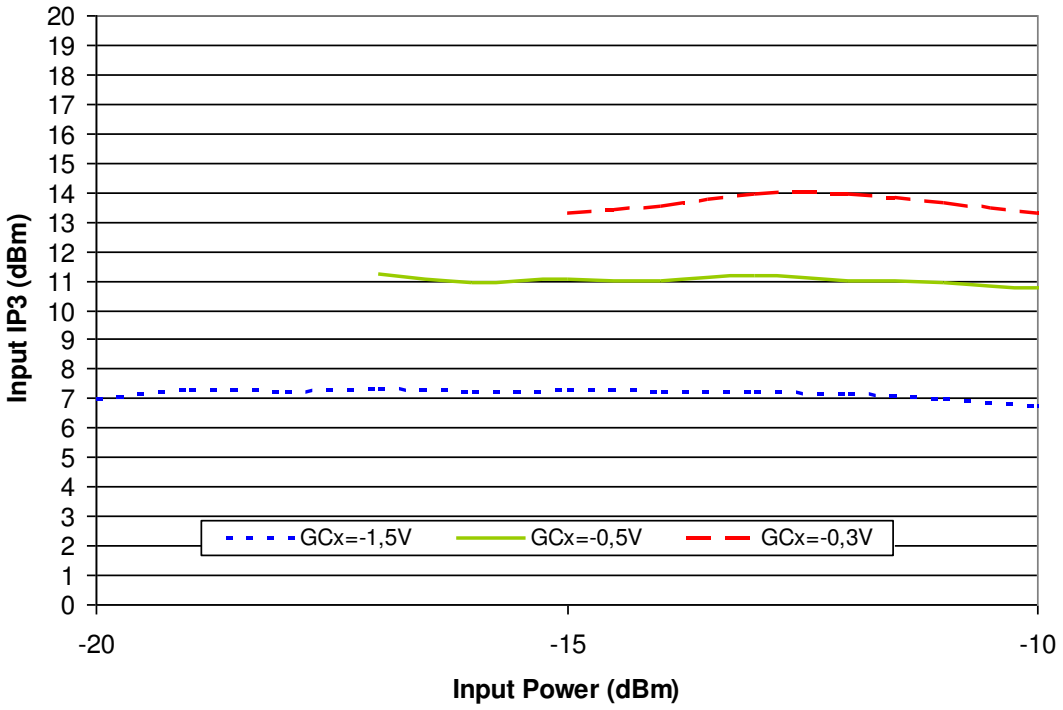


Figure 8: Input IP3 versus Gain Control & RF Power (Double Carrier)
F_RF = 2xF_LO-F_IF, F_RF = 20.5GHz, F_IF = 3.5GHz

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Temperature Measurements

T = [-40, +25, 85] °C, VD = VDL = 4.5V, VGL = -0.4V, VGM = -0.7V, P_LO = 0dBm

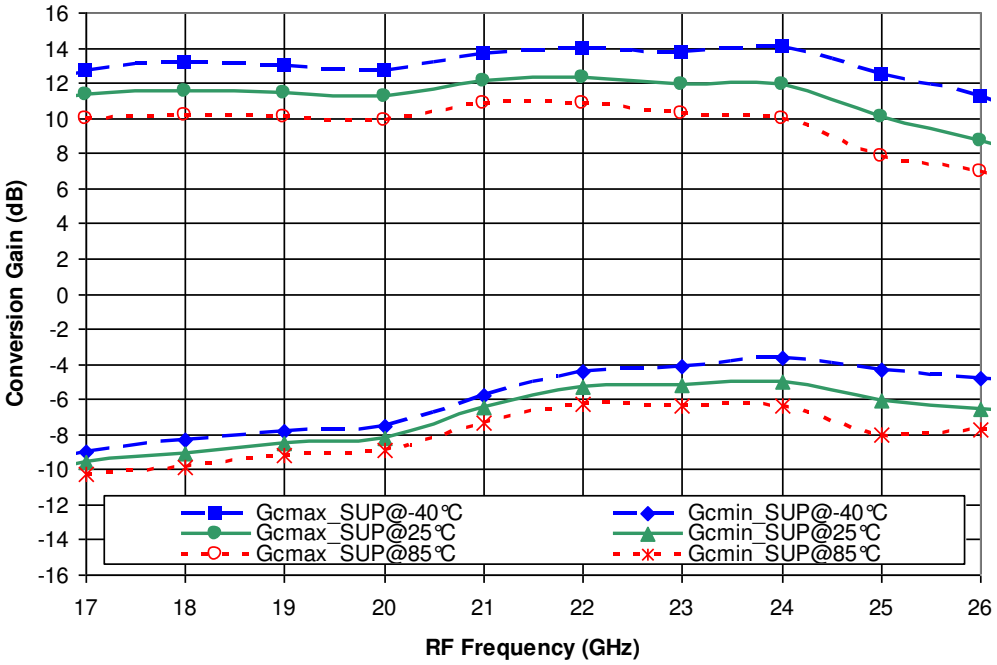


Figure 9: Conversion Gain in Supradyne Mode versus Temperature & Frequency
F_RF = 2xF_LO+F_IF, F_IF = 2.0GHz, GC2 = GC3 = -1.5 & 0.5V

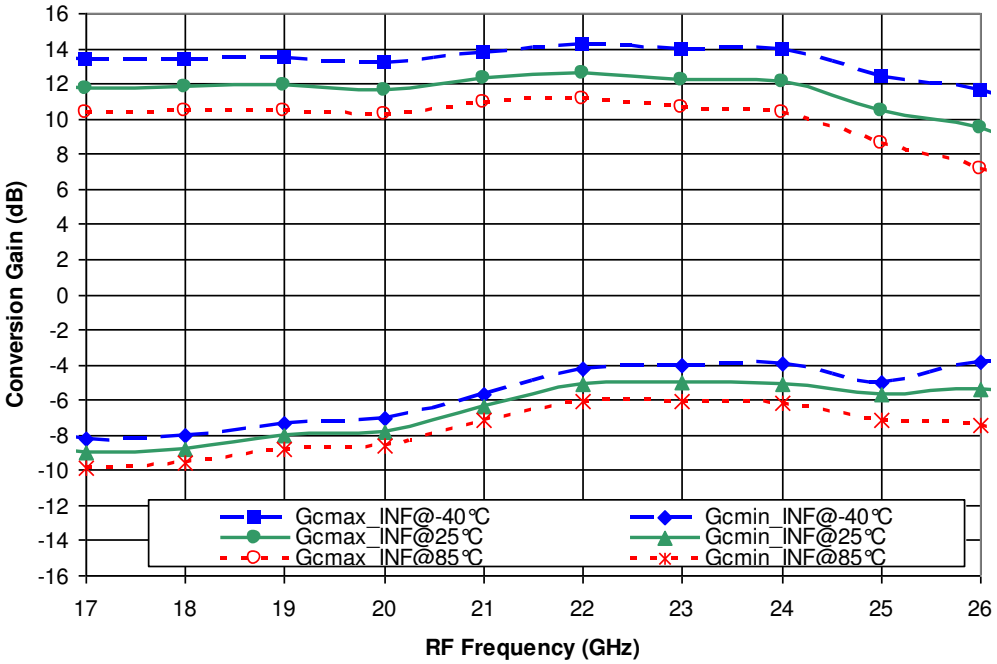


Figure 10: Conversion Gain in Infradyne Mode versus Temperature & Frequency
F_RF = 2xF_LO-F_IF, F_IF = 2.0GHz, GC2 = GC3 = -1.5 & 0.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

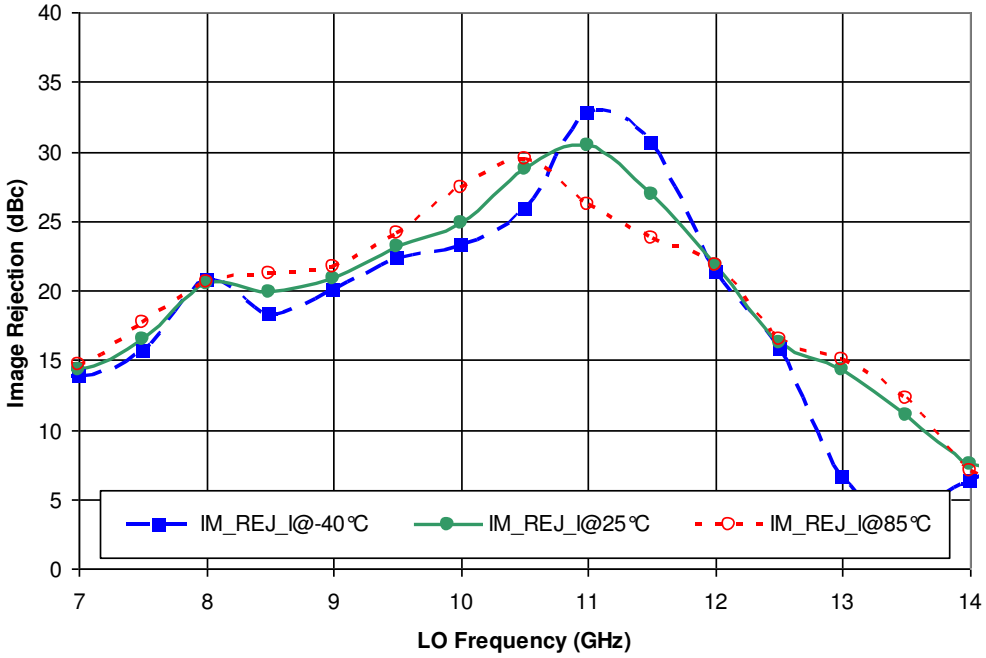


Figure 11: Image Rejection on Output I
F_IF = 2.0GHz, GC2 = GC3 = -1.5V

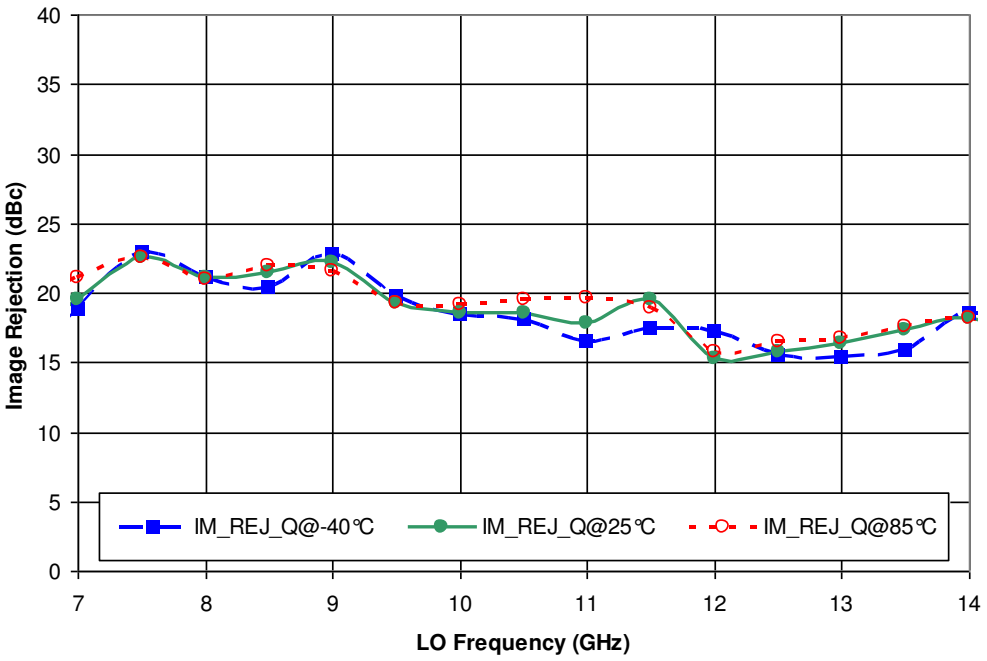


Figure 12: Image Rejection on Output Q
F_IF = 2.0GHz, GC2 = GC3 = -1.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

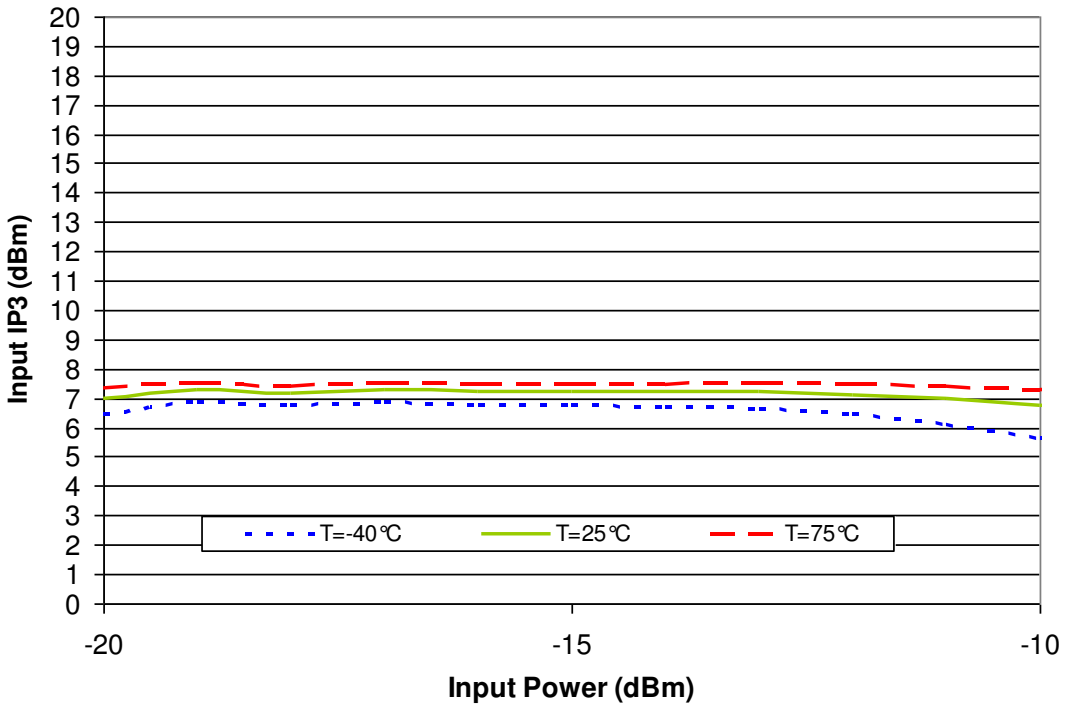


Figure 13: Input IP3 versus Temperature & RF Power (Double Carrier)
F_RF = 2xF_LO-F_IF, F_RF = 20.5GHz, F_IF = 3.5GHz, GC2 = GC3 = -1.5V

The following values are representative of onboard measurements of the Noise Figure where board losses have been deembedded (result given on package access planes).

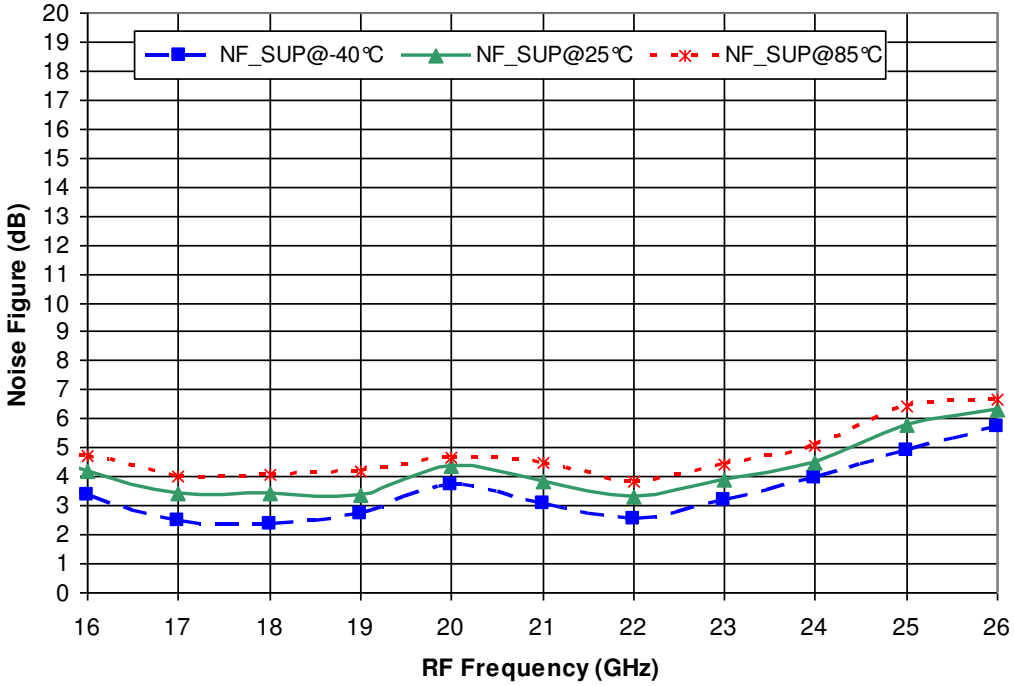


Figure 14: Noise Figure in Supradyne Mode vs Temperature & Frequency
F_RF = 2xF_LO+F_IF, F_IF = 2.0GHz, GC2 = GC3 = -1.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

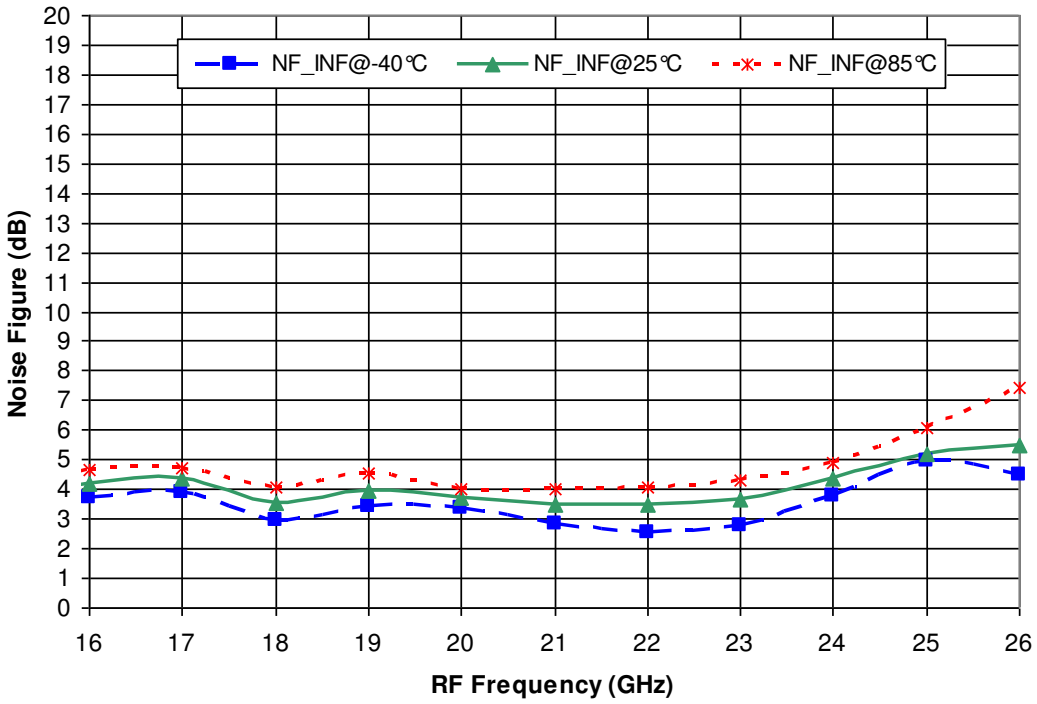
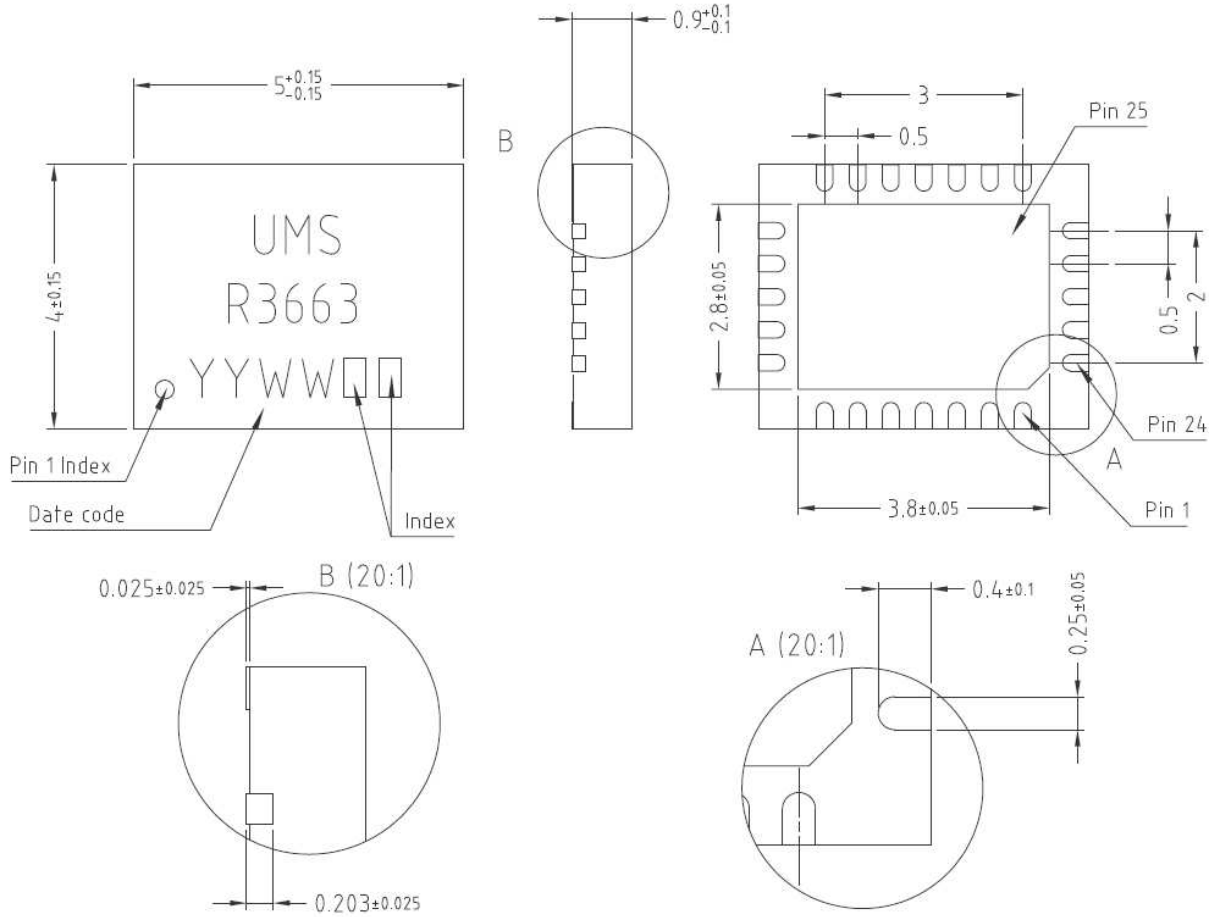


Figure 15: Noise Figure in Infradyne Mode vs Temperature & Frequency
F_RF = 2xF_LO-F_IF, F_IF = 2.0GHz, GC2 = GC3 = -1.5V

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Package outline [1]



1- Nc	9- VGL	17- Nc	25- GND Exposed pad
2- Nc	10- VDL	18- Nc	
3- Nc	11- VGM	19- Nc	
4- GND[2]	12- VD	20- IF_I out	
5- RF in	13- Nc	21- GND[2]	
6- GND[2]	14- GND[2]	22- IF_Q out	
7- GC3	15- LO in	23- Nc	
8- GC2	16- GND[2]	24- Nc	

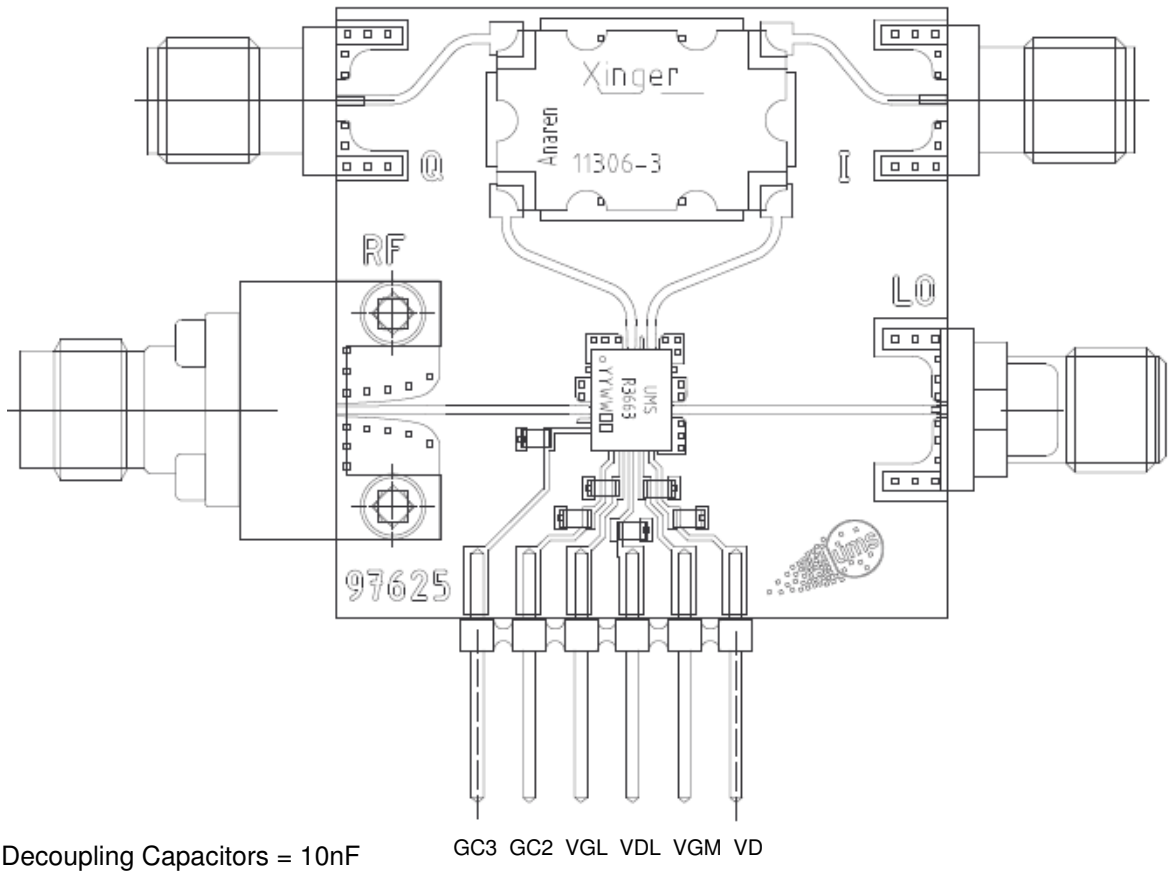
[1]The package outline drawing included to this data-sheet is given for indication. Refere to the application note AN0017 available at http://www.ums-gaas.com for exact package dimensions.

[2]It is strongly recommended to ground on the PCB board all the pins referenced as GND.

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Evaluation mother board

- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a microstrip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 10nF ±10% are recommended for all DC accesses.
- (See application note AN0017 for details).

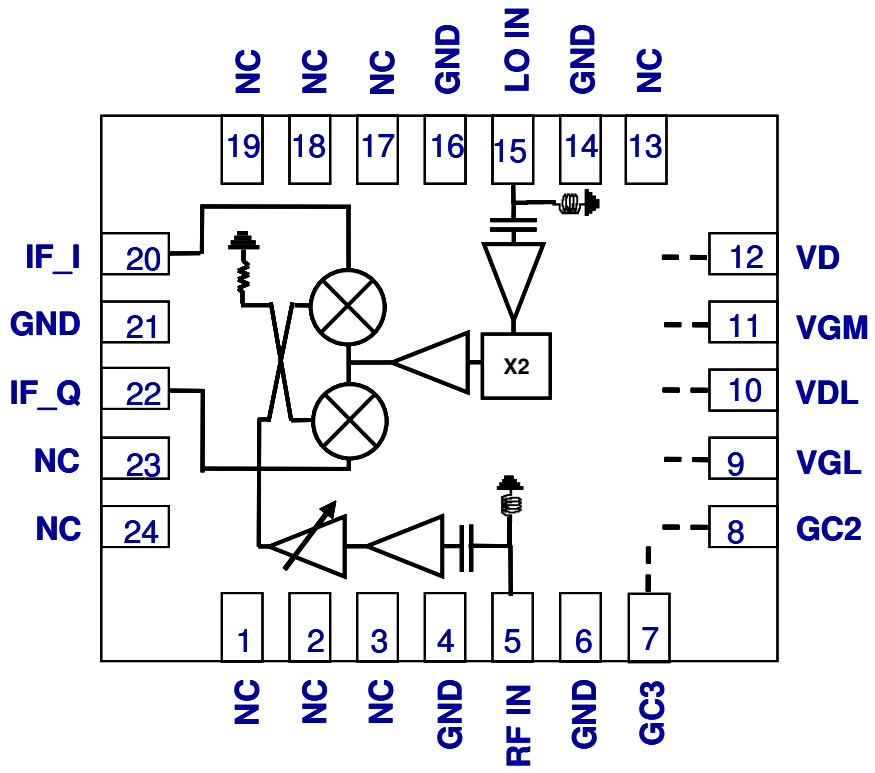


Decoupling Capacitors = 10nF
Hybrid coupler Anaren 90° 2-4GHz

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Notes

Due to ESD protection circuits on RF and LO inputs, an external capacitance might be requested to isolate the product from external voltage that could be present on these accesses in the application.



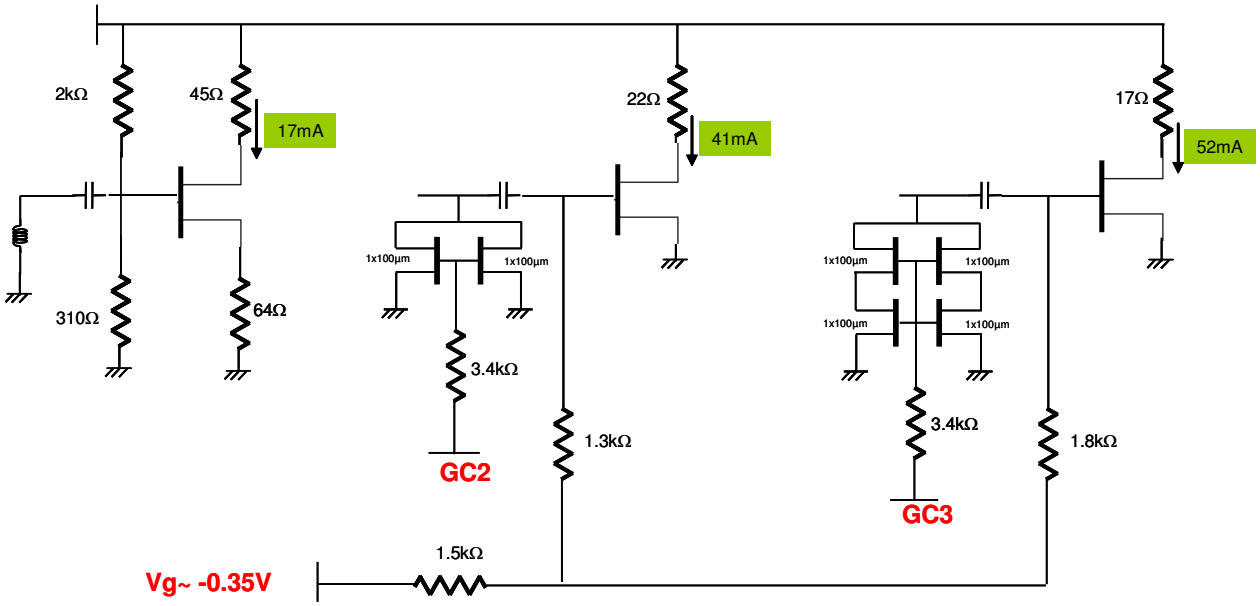
ESD protections are also implemented on gate accesses.
The DC connections do not include any decoupling capacitor in package, therefore it is mandatory to provide a good external DC decoupling on the PC board, as close as possible to the package.

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

DC Schematic

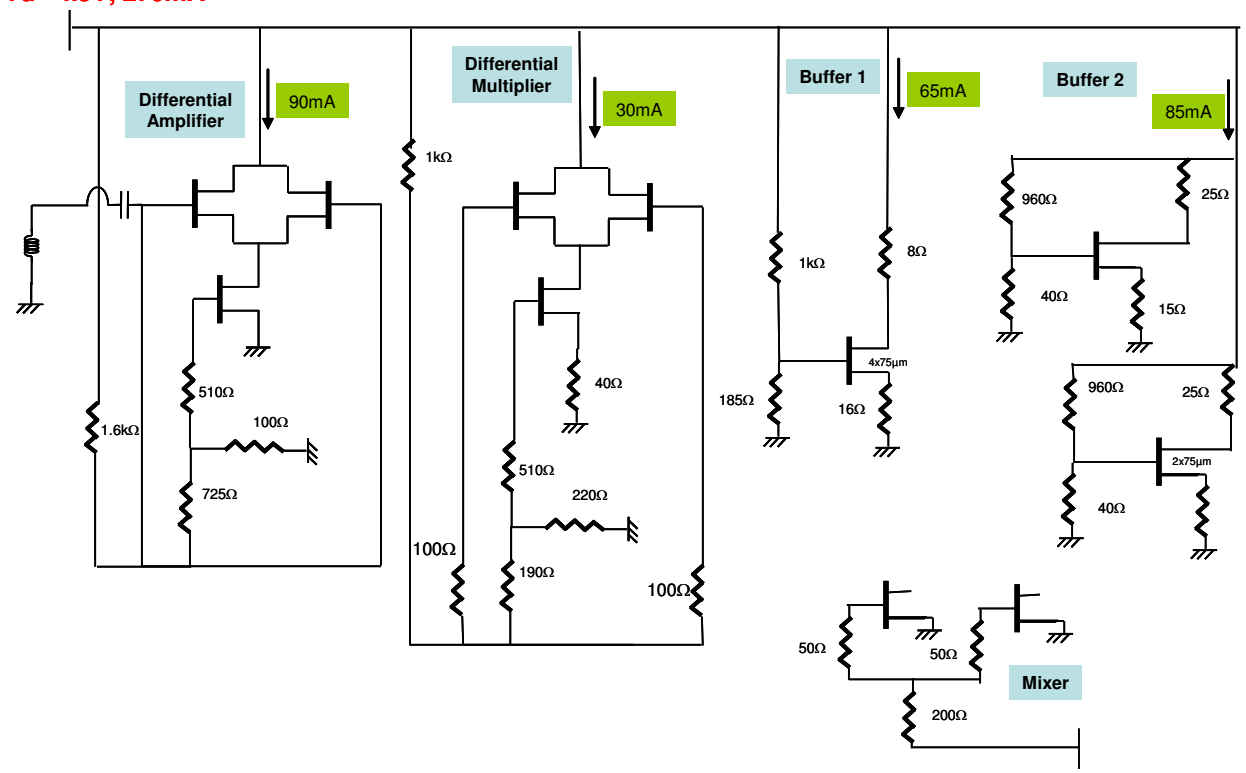
LNA: 4.5V, 110mA

Vd=4.5V, 110mA



LO Buffer: 4.5V, 270mA

Vd= 4.5V, 270mA



Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Notes:

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09

Recommended package footprint

Refer to the application note AN0017 available at http://www.ums-gaas.com for package foot print recommendations and exact package dimensions.

SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017.

Recommended environmental management

Refer to the application note AN0019 available at http://www.ums-gaas.com for environmental data on UMS package products.

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 package products.

Ordering Information

QFN 4x5 RoHS compliant package: CHR3663-QEG/XY
Stick: XY = 20 Tape & reel: XY = 21

Route Départementale 128, BP46 - 91401 ORSAY Cedex - FRANCE
Tel.: +33 (0) 1 69 33 03 08 - Fax: +33 (0) 1 69 33 03 09