

17-24GHz Down Converter

GaAs Monolithic Microwave IC in SMD leadless package

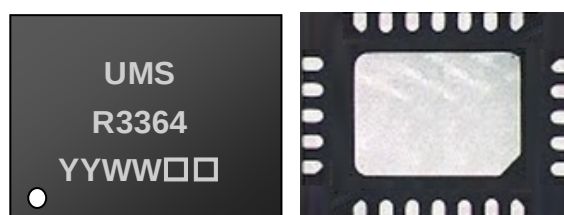
Description

The CHR3364-QEG is a multifunction monolithic receiver, which integrates a balanced cold FET mixer, a LO chain with buffers associated to a time two multiplier, and a RF low noise amplifier including gain control.

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 μ m gate length, via holes through the substrate, air bridges and electron beam gate lithography.

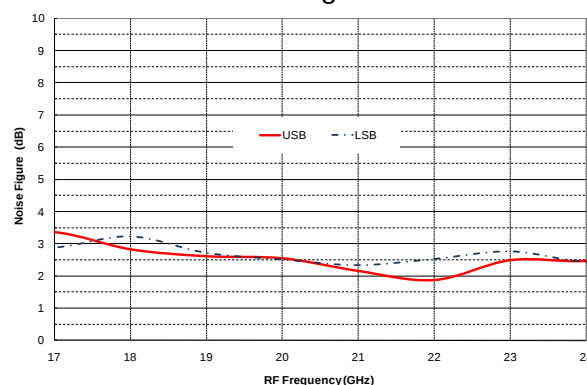
It is supplied in RoHS compliant SMD package.



Main Features

- Broadband performances: 17-24GHz
- 11dB Conversion gain
- 17dBc Image Rejection
- 1dBm Input IP3
- 2.7dB Noise Figure for IF>0.1GHz
- 0dBm LO input Power
- DC bias: Vd=4V @ Id=320mA
- 24L-QFN4x5
- MSL1

Noise figure



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F _{RF}	RF frequency range	17.0		24.0	GHz
F _{LO}	LO frequency range	6.5		14.0	GHz
F _{IF}	IF frequency range	DC		3.5	GHz
C _G	Conversion gain		11.0		dB

Specifications

Tamb.= +25°C, VD = VDL = 4.0V

Symbol	Parameter	Min	Typ	Max	Unit
F _{RF}	RF frequency range	17		24	GHz
F _{LO}	LO frequency range	6.5		14	GHz
F _{IF}	IF frequency range	DC		3.5	GHz
C _G	Conversion Gain		11		dB
NF	Noise Figure for IF>0.1GHz		2.7		dB
Im_rej	Image rejection ⁽¹⁾		17		dBc
P _{LO}	LO Input power		0		dBm
IIP3	Input IP3		1		dBm
2LO/RF	2LO leakage at RF port		-40		dBc
VD, VDL	DC drain voltage		4.0		V
ID	Drain current on VD pin for LO buffer		245		mA
IDL	Drain current on VDL pin for LNA		75		mA
VGL	LNA DC gate voltage ⁽²⁾		-0.5		V
VGM	Mixer DC gate voltage		-0.7		V

These values are representative of onboard measurements as defined on the drawing in paragraph "Evaluation mother board".

⁽¹⁾ An external combiner 90° is required on I / Q.

⁽²⁾ Typical VGL value for IDL = 75mA

See in paragraph " biasing option" other possibility to optimise differently the performances

Absolute Maximum Ratings ⁽¹⁾

Tamb.= +25°C

Symbol	Parameter	Values	Unit
VD, VDL	Drain bias voltage	5	V
ID+IDL	Drain bias current	430	mA
VGL	LNA Gate bias voltage	-2 to +0.4	V
VGM	Mixer Gate bias voltage	-2 to +0.4	V
P _{RF}	Maximum peak RF input power overdrive ⁽²⁾	+10	dBm
P _{LO}	Maximum peak LO input power overdrive ⁽²⁾	+10	dBm
T _j	Junction temperature ⁽³⁾	175	°C

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

⁽²⁾ Duration < 1s.

⁽³⁾ Thermal Resistance channel to ground paddle

Temperature Range

Ta	Operating temperature range	-40 to +95	°C
Tstg	Storage temperature range	-55 to +155	°C

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 (see the curve Pdiss. Max) in order to guarantee the nominal device life time (MTTF).

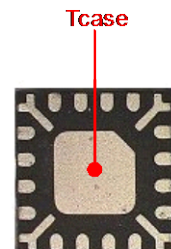
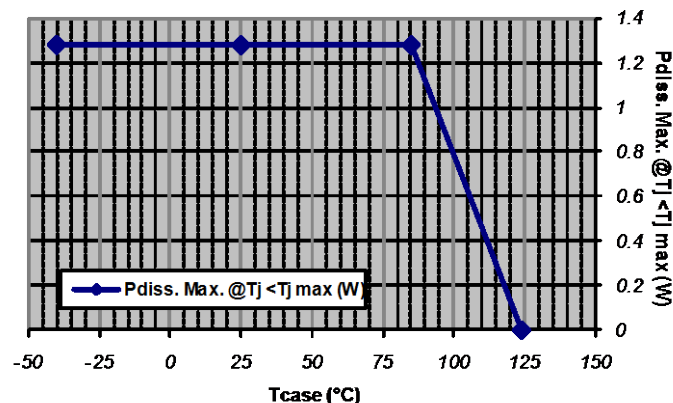
DEVICE THERMAL SPECIFICATION : CHR3364-QEG

Recommended max. junction temperature (Tj max)	: 124 °C
Junction temperature absolute maximum rating	: 175 °C
Max. continuous dissipated power (Pdiss. Max.)	: 1.3 W
=> Pdiss. Max. derating above Tcase ⁽¹⁾ = 85 °C	: 33 mW/°C
Junction-Case thermal resistance (Rth J-C) ⁽²⁾	: <30 °C/W
Minimum Tcase operating temperature ⁽³⁾	: -40 °C
Maximum Tcase operating temperature ⁽³⁾	: 85 °C
Minimum storage temperature	: -55 °C
Maximum storage temperature	: 150 °C

(1) Derating at junction temperature constant = Tj max.

(2) Rth J-C is calculated for a worst case considering the hottest junction of the MM IC and all the devices biased.

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



Example: QFN 16L 3x3
Location of temperature reference point (Tcase) on package's bottom side

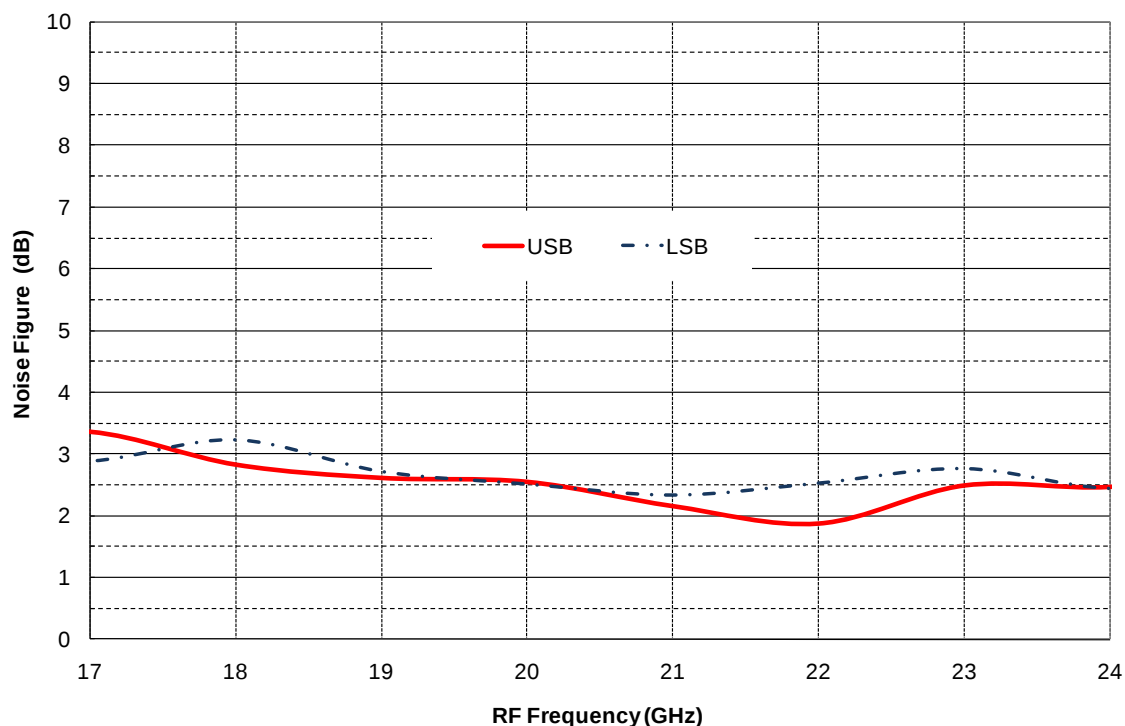
Typical Board Measurements

Tamb = +25°C, VD = VDL = 4.0V, VGL = -0.5V, VGM = -0.7V, P_{LO} = 0dBm

The values shown on the following pages are representative of on-board measurements where results are given on package access planes.

Noise Figure in Supradyne and Infradyne Mode versus RF Frequency

$$F_{RF} = 2 \times F_{LO} \pm F_{IF}, F_{IF} = 2.0\text{GHz}$$



Typical Board Measurements

Tamb = +25°C, VD = VDL = 4.0V, VGL = -0.5V, VGM = -0.7V, P_{LO} = 0dBm

Conversion Gain in Supradyné and Infradyne Mode versus RF Frequency

$$F_{RF} = 2xF_{LO} \pm F_{IF}, F_{IF} = 3.5\text{GHz}$$

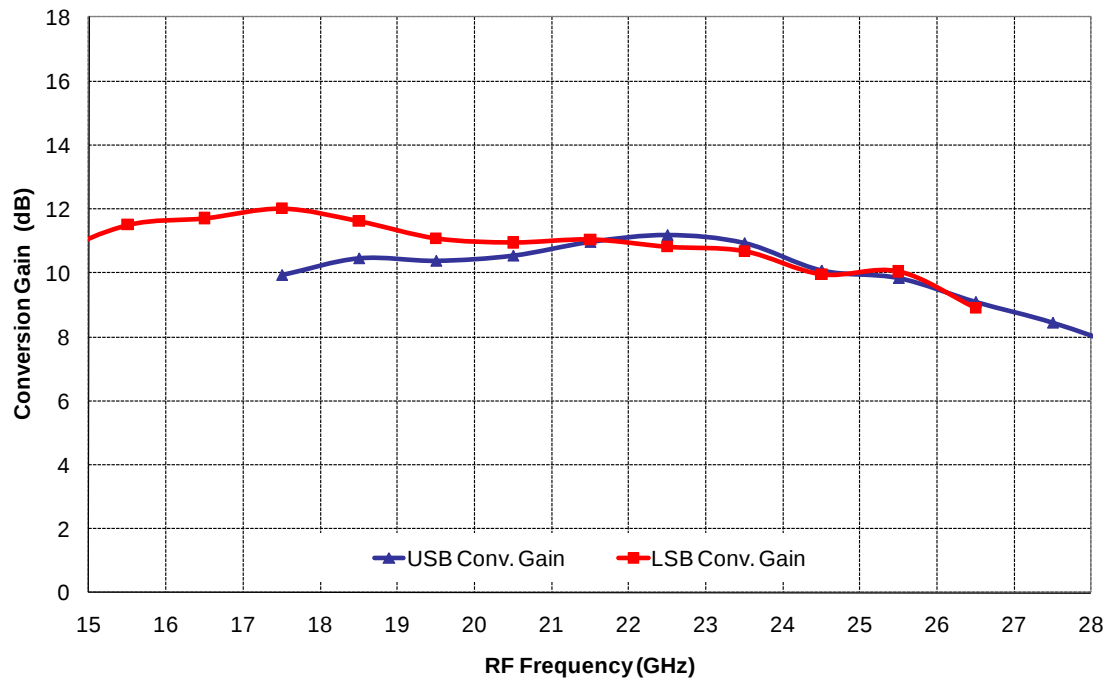
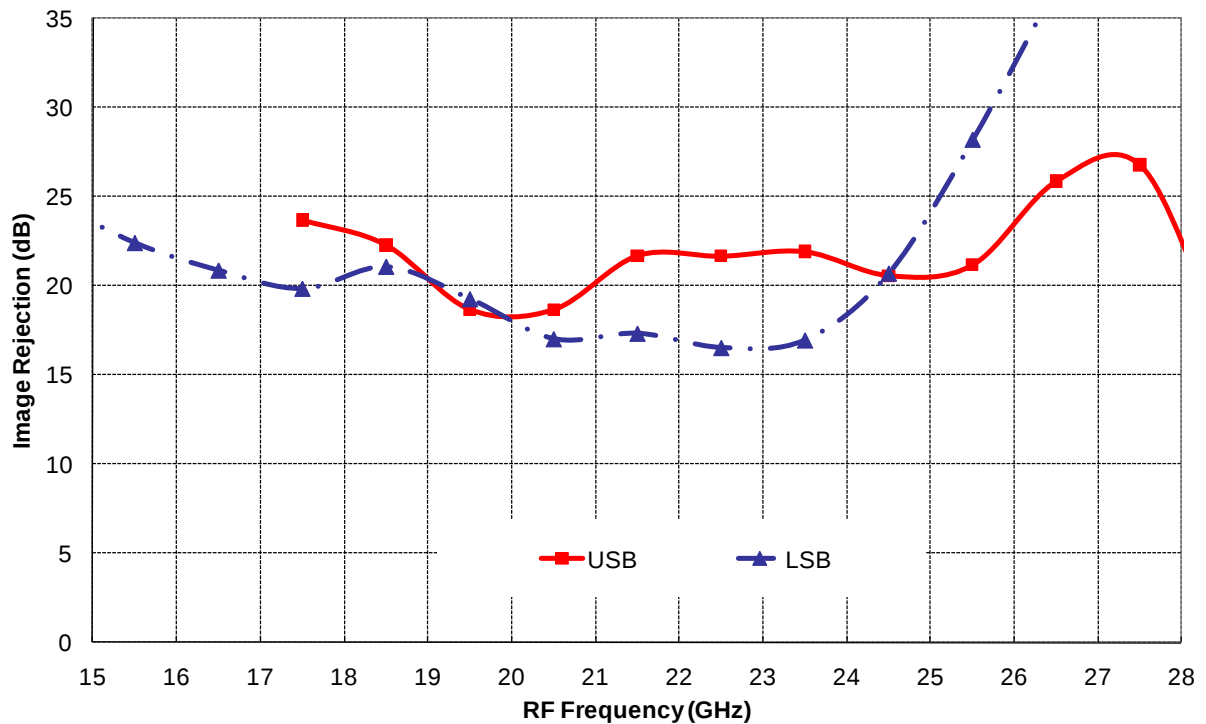


Image Rejection versus RF Frequency

$$F_{RF} = 2xF_{LO} \pm F_{IF}, F_{IF} = 3.5\text{GHz}$$

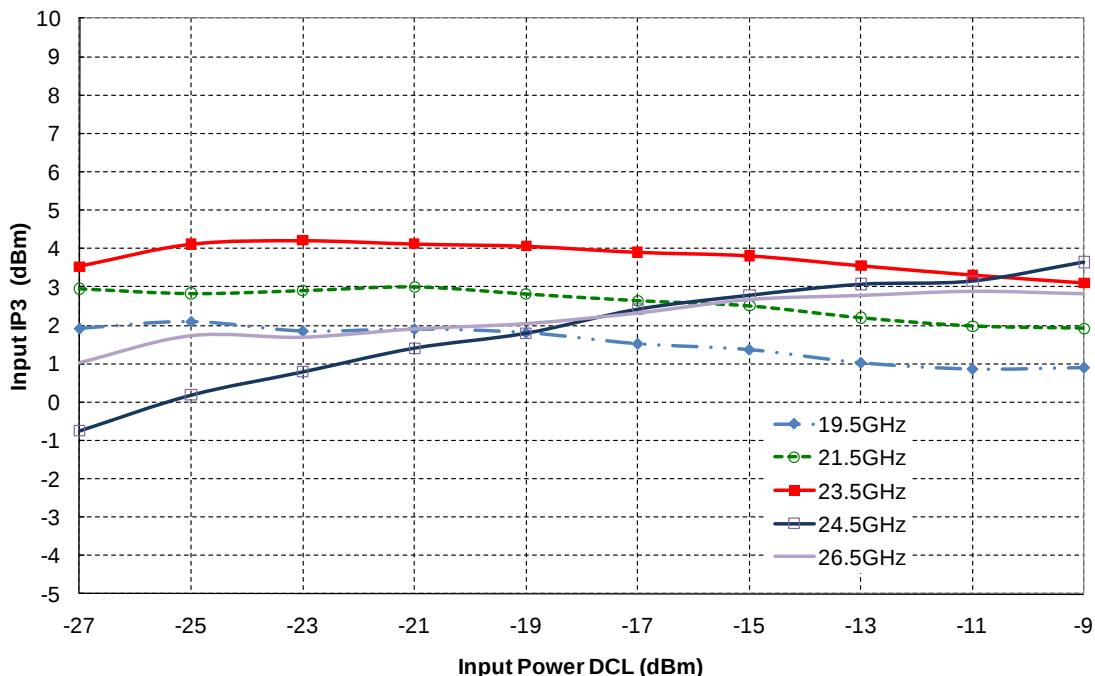


Typical Board Measurements

Tamb = +25°C, VD = VDL = 4.0V, VGL = -0.5V, VGM = -0.7V, P_{LO} = 0dBm

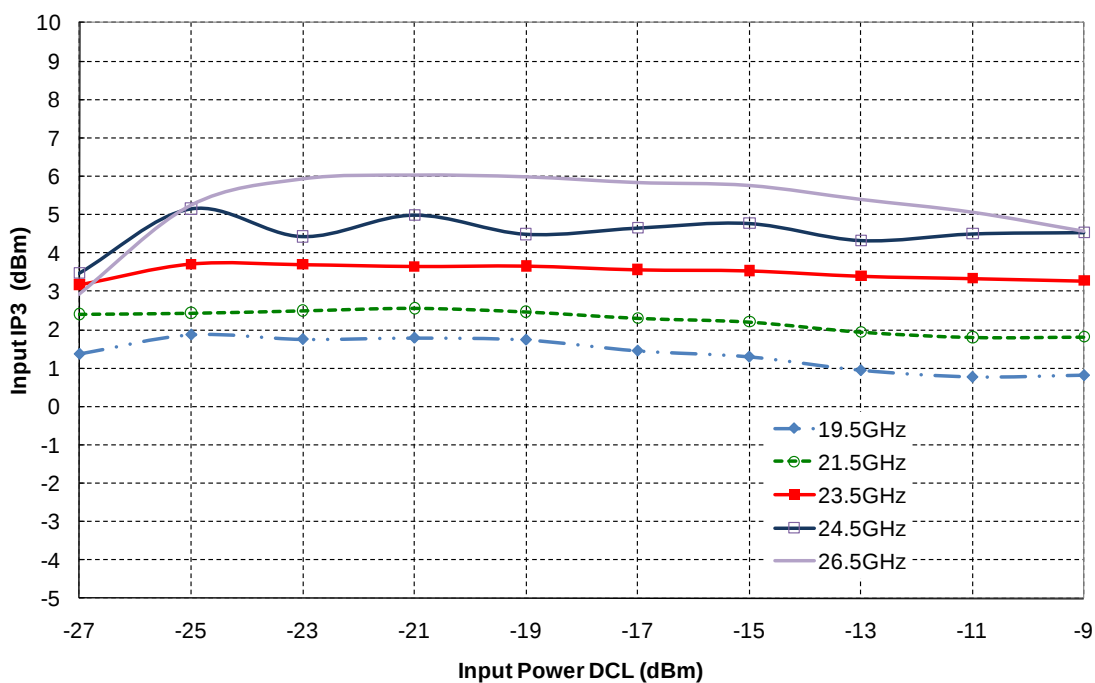
Input IP3 in Supradyne Mode versus RF Frequency

$$F_{RF} = 2F_{LO} + F_{IF}, F_{IF} = 3.5\text{GHz}$$



Input IP3 in Infradyne Mode versus RF Frequency

$$F_{RF} = 2F_{LO} - F_{IF}, F_{IF} = 3.5\text{GHz}$$

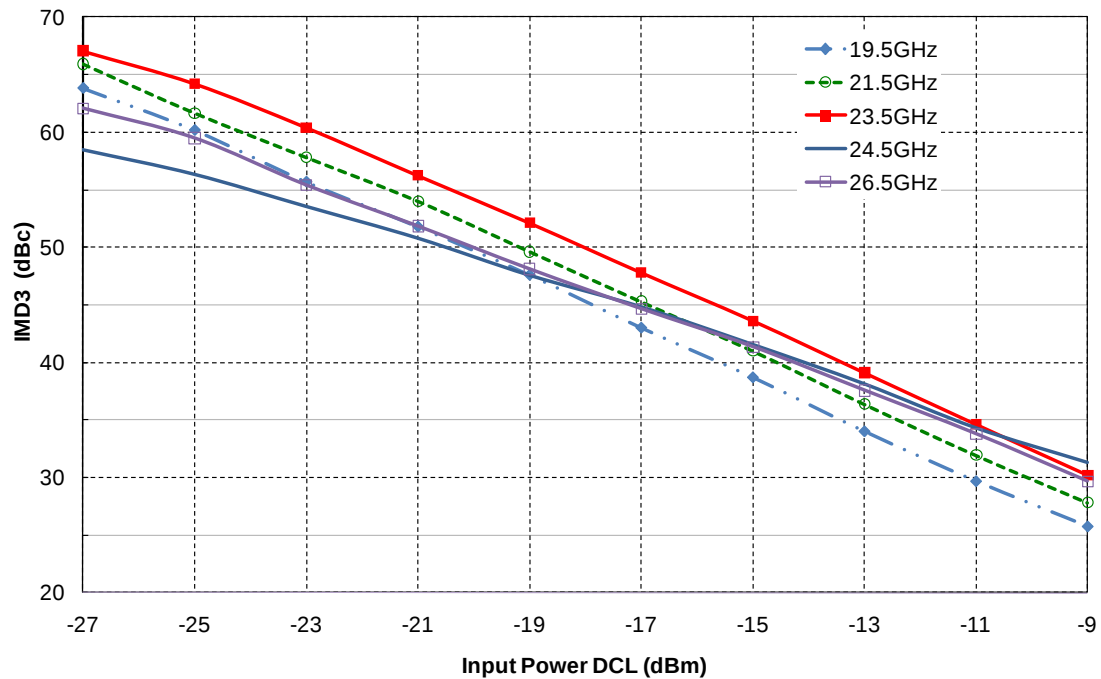


Typical Board Measurements

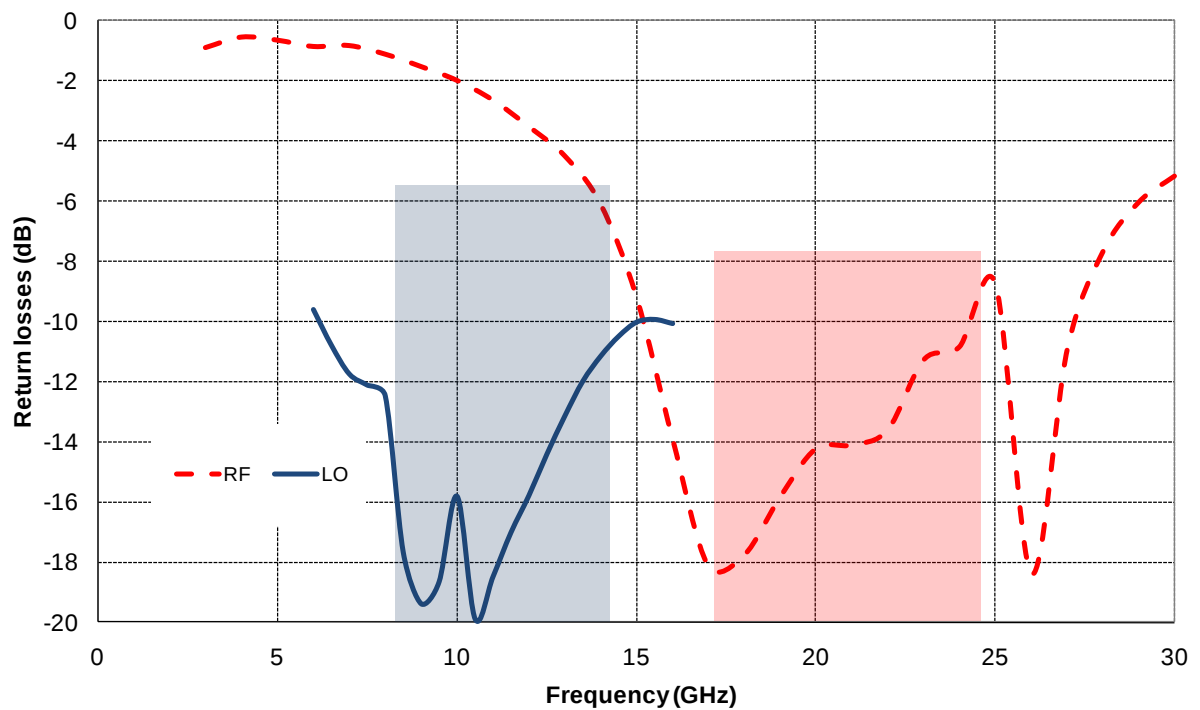
Tamb = +25°C, VD = VDL = 4.0V, VGL = -0.5V, VGM = -0.7V, P_{LO} = 0dBm

IMD3 in Supradyn Mode versus RF Frequency

$$F_{RF} = 2 \times F_{LO} + F_{IF}, F_{IF} = 3.5\text{GHz}$$



LO & RF return loss versus frequency

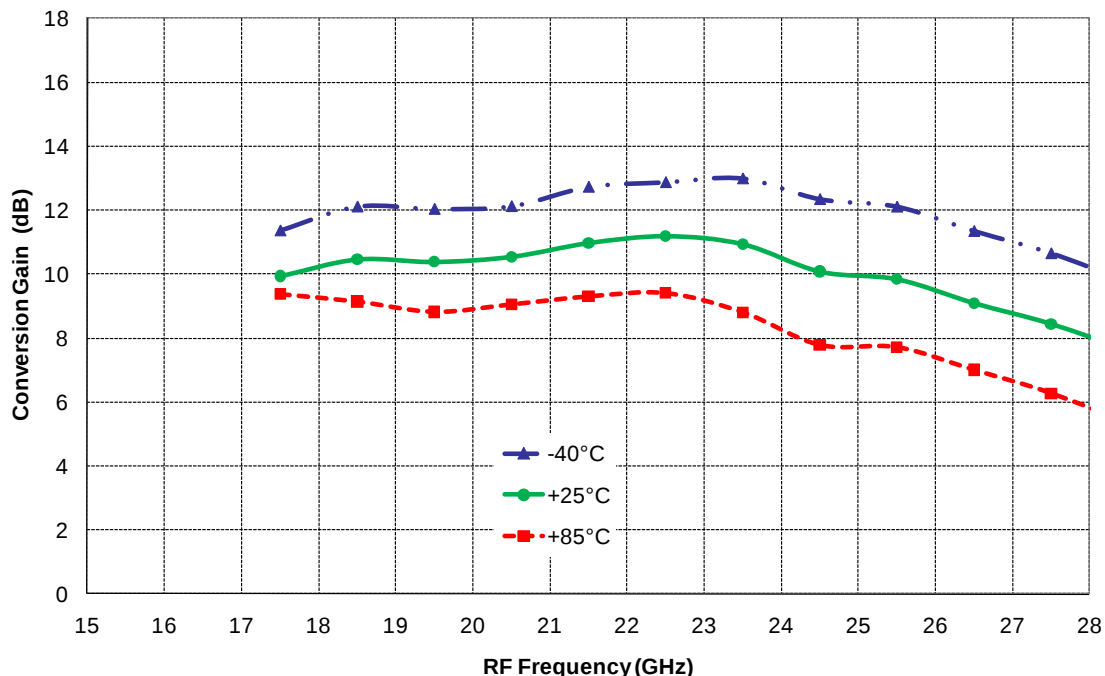


Temperature Board Measurements

T = [-40, +25, +85] °C, VD = VDL = 4.0V, VGL = -0.5V, VGM = -0.7V, P_{LO} = 0dBm

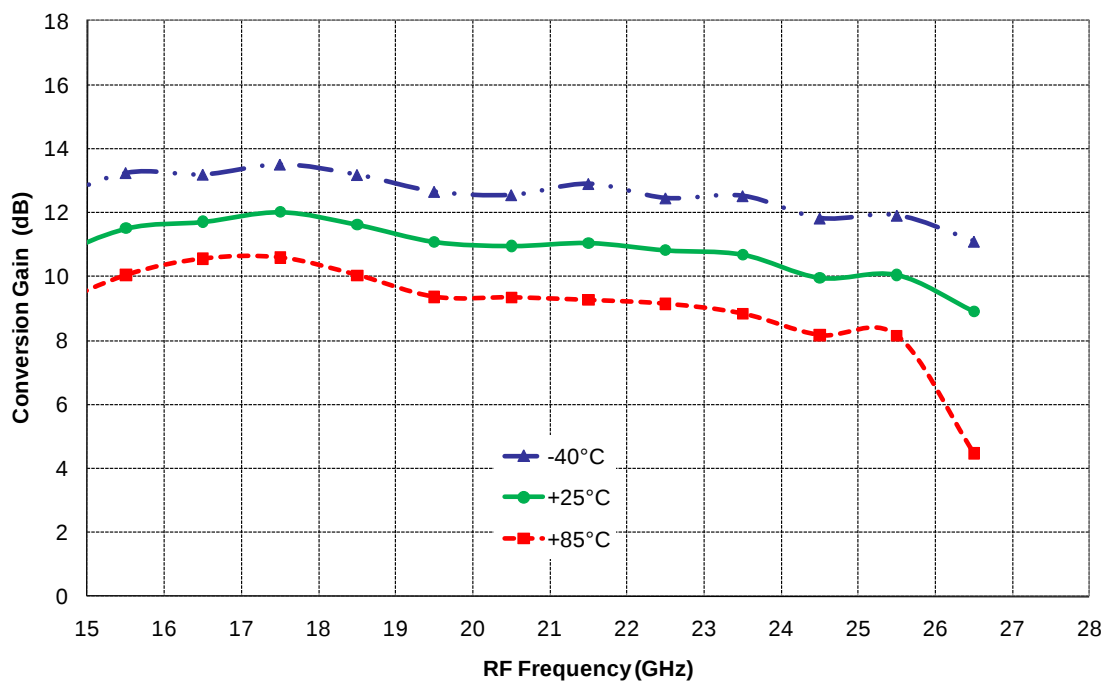
Conversion Gain in Supradyn Mode versus RF Frequency

$$F_{RF} = 2F_{LO} + F_{IF}, F_{IF} = 3.5\text{GHz}$$



Conversion Gain in Infradyne Mode versus RF Frequency

$$F_{RF} = 2F_{LO} - F_{IF}, F_{IF} = 3.5\text{GHz}$$

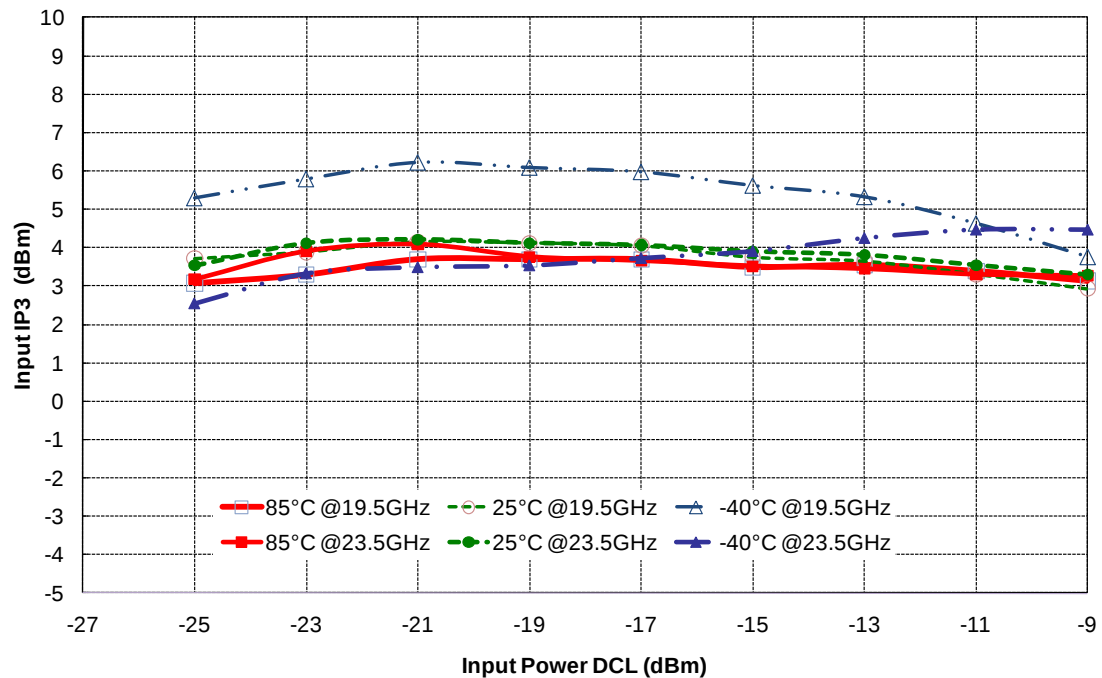


Temperature Board Measurements

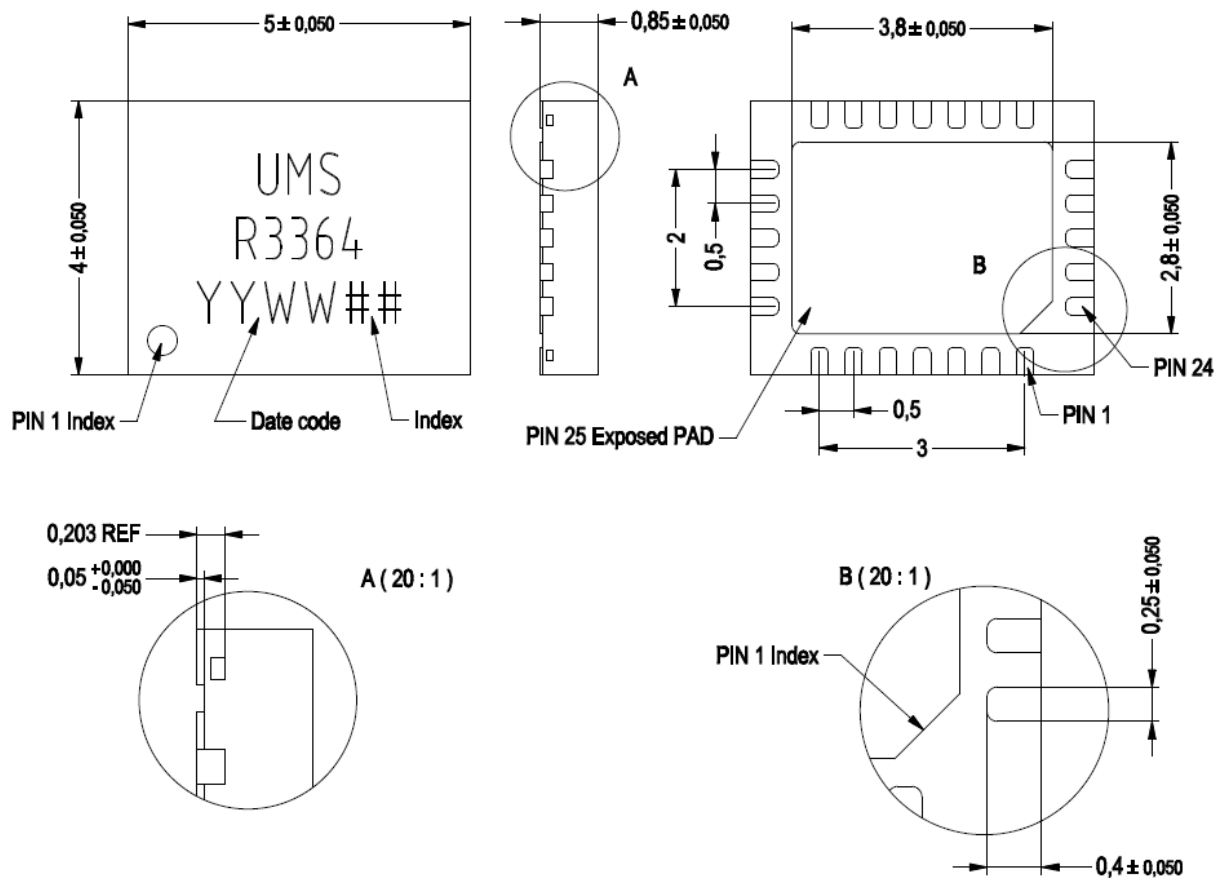
$T = [-40, +25, +85] ^\circ\text{C}$, $V_D = V_{DL} = 4.0\text{V}$, $V_{GL} = -0.5\text{V}$, $V_{GM} = -0.7\text{V}$, $P_{LO} = 0\text{dBm}$

Input IP3 in Supradyn Mode versus RF Frequency

$$F_{RF} = 2F_{LO} + F_{IF}, F_{IF} = 3.5\text{GHz}$$



Package outline ⁽¹⁾



Units : mm
Finish : Matt tin
Lead free (Green)



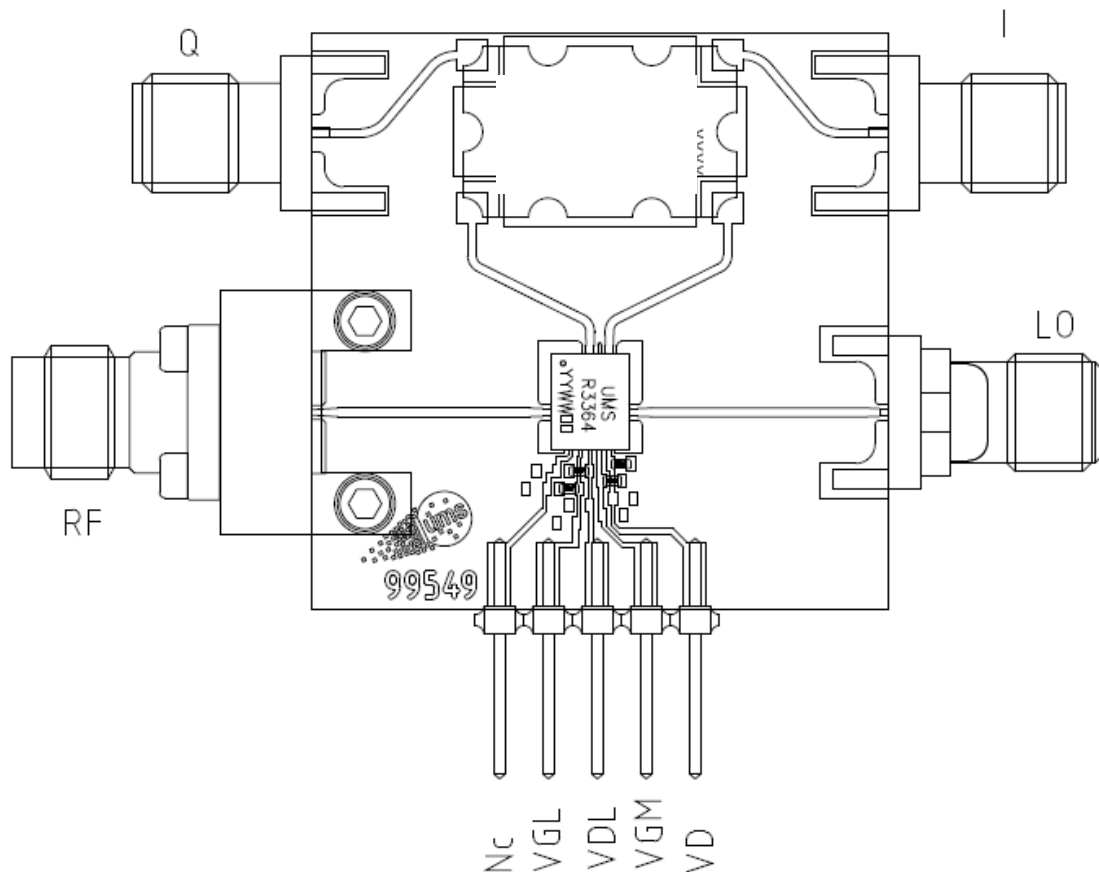
Matt tin, Lead Free (Green)	1- Nc	9- VGL	17- Nc
Units : mm	2- Nc	10- VDL	18- Nc
From the standard : JEDEC MO-220 (VGGD)	3- Nc	11- VGM	19- Nc
	4- Gnd ⁽²⁾	12- VD	20- IF_I out
25- GND	5- RF in	13- Nc	21- Gnd ⁽²⁾
	6- Gnd ⁽²⁾	14- Gnd ⁽²⁾	22- IF_Q out
	7- Nc	15- LO in	23- Nc
	8- Nc	16- Gnd ⁽²⁾	24- Nc

⁽¹⁾ The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (<https://www.ums-rf.com>) for exact package dimensions.

⁽²⁾ It is strongly recommended to ground all pins marked "Gnd" through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

Evaluation mother board

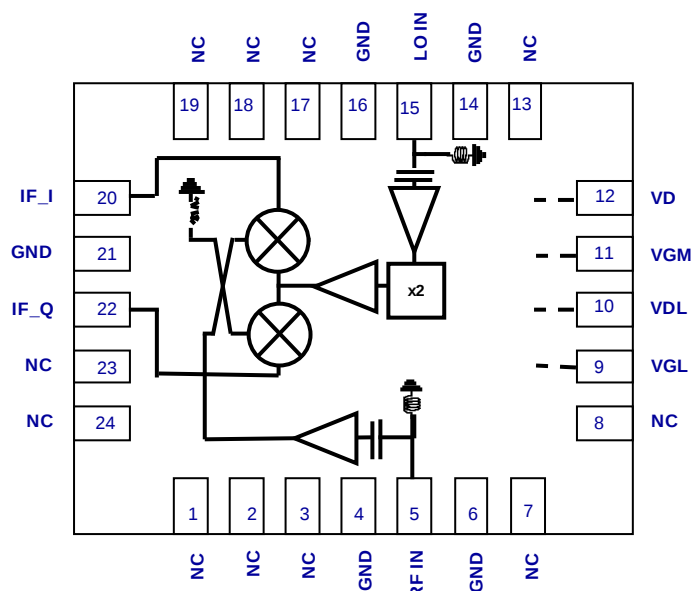
- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 10nF $\pm 10\%$ are recommended for all DC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



Hybrid coupler 90° 2-4GHz

Notes

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



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 (10nF) on the PC board, as close as possible to the package.

Biasing Options

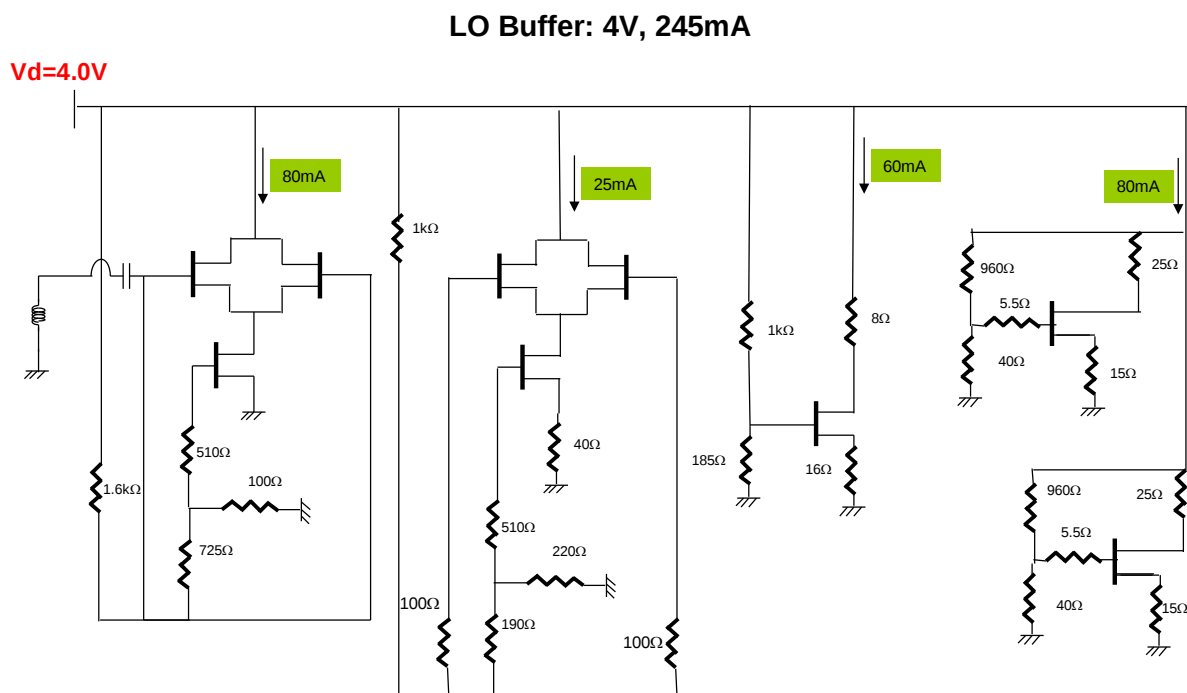
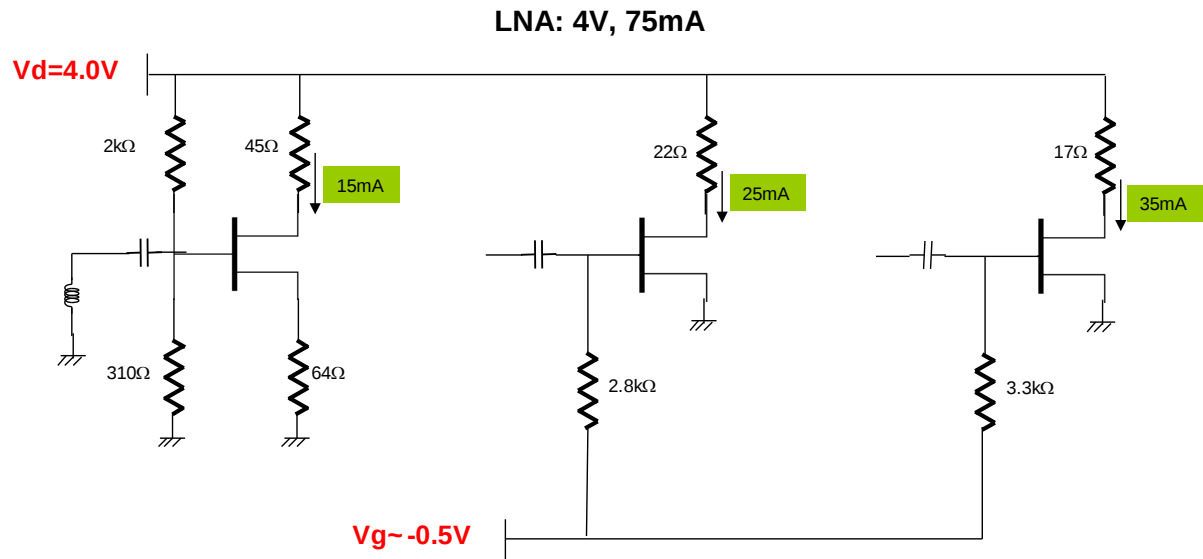
In order to improve the conversion gain or the input IP3, the biasing could be tuned.

VGL voltage allows controlling IDL current.

Table below gives the typical value for main characteristics

	VD=VDL= 4.0V IDL= 75mA	VD=VDL= 4.5V IDL= 110mA
Conversion Gain (dB)	11	12.5
Noise Figure (dB)	2.7	2.6
Input IP3 (dBm)	+1	+3
VGL (V)	-0.5	-0.4
ID (mA)	245	250
ID +IDL (mA)	320	360
Total DC power consumption (mW)	1280	1620

DC Schematic



Recommended package footprint

Refer to the application note AN0017 available at <https://www.ums-rf.com> for package footprint recommendations.

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

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>.

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 package products.

Ordering Information

QFN 4x5 package:

CHR3364-QEG/XY

Stick: XY = 20

Tape & reel: XY = 21

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