SONY

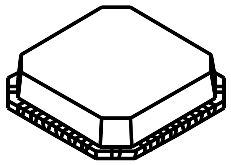
CXA3309ER

Analog Signal Processor TX-IF IC for W-CDMA Cellular Phones

Description

The CXA3309ER is an analog signal processor TX-IF IC for the W-CDMA cellular phones. This IC contains voltage-controlled gain control amplifier and quadrature modulator.

24 pin VQFN (Plastic)



Features

- Gain control amplifier with a linear and wide gain variable range
- I-Q quadrature modulator
- Power saving switch
- Low voltage operation (2.7 to 3.3V)
- Small package (24-pin VQFN)

Applications

Analog signal processor TX-IF IC for the W-CDMA cellular phones

Structure

Bipolar silicon monolithic IC

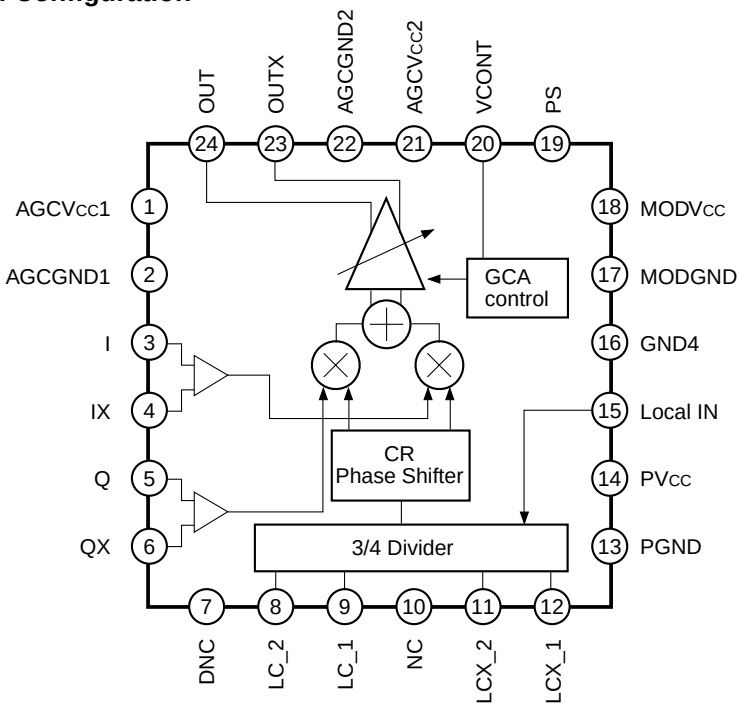
Absolute Maximum Ratings

• Supply voltage	Vcc	–0.3 to +5.5	V
• Operating temperature	Topr	–55 to +125	°C
• Storage temperature	Tstg	–65 to +150	°C

Recommended Operating Conditions

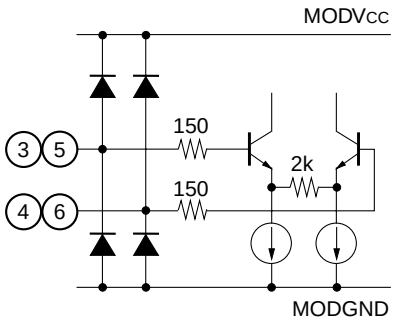
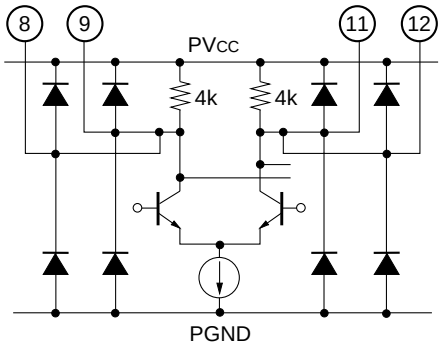
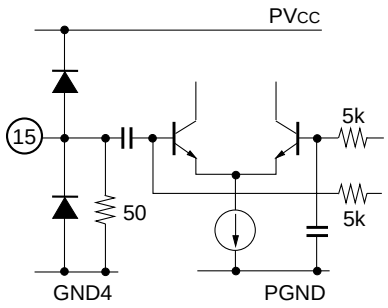
• Supply voltage	Vcc	2.7 to 3.3	V
• Operating temperature	Ta	–25 to +85	°C

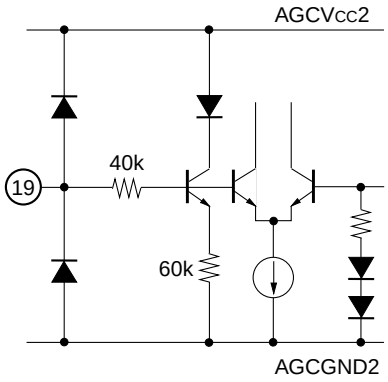
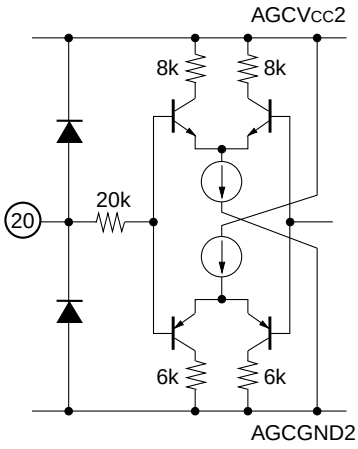
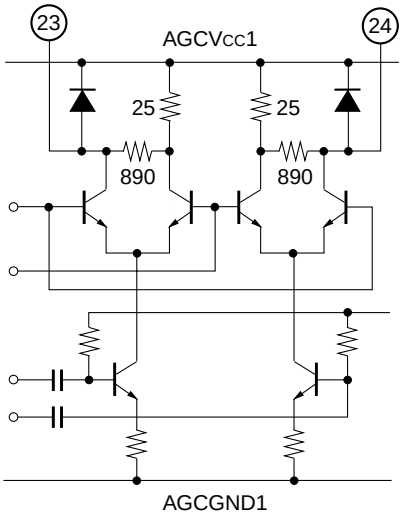
Block Diagram and Pin Configuration



E00706B24-PS

Pin Description

Pin No.	Symbol	Typical pin voltage [V]	Equivalent circuit	Description
1	AGCVCC1	2.85		Positive power supply.
2	AGCGND1	0		Ground.
3 4 5 6	I IX Q QX	—		I, Q inputs. Applies a bias voltage from the external source.
7	DNC	—		Don't connect.
8 9 11 12	LC_2 LC_1 LCX_2 LCX_1	2.25		Resonance filter. Forms a resonance filter by attaching the external LC parallel circuit.
10	NC	—		Not connect.
13	PGND	0		Ground.
14	PVCC	2.85		Positive power supply.
15	Local IN			Local input.

Pin No.	Symbol	Typical pin voltage [V]	Equivalent circuit	Description
16	GND4	0		Ground.
17	MODGND	0		Ground.
18	MODVcc	2.85		Positive power supply.
19	PS	—		Power saving mode switch input. High: Active mode Low: Power saving mode
20	VCONT	—		Gain control voltage input.
21	AGCVcc2	2.85		Positive power supply.
22	AGCGND2	0		Ground.
23 24	OUTX OUT	—		IF signal differential output.

Input Conditions for Each Pin

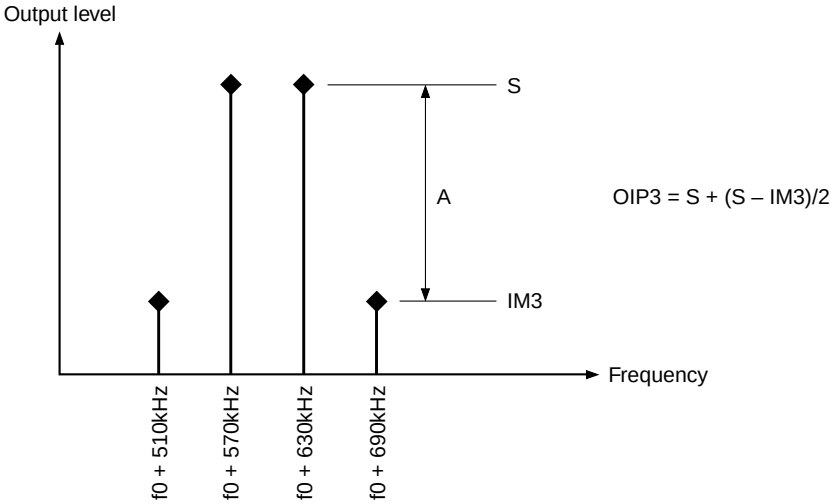
Item	Symbol	Conditions	Pin No.	Min.	Typ.	Max.	Unit
I/Q bias voltage	VB_{IQ}		3, 4, 5, 6	1.35	1.425	1.65	V
I/Q input voltage	V_{IQ}	Differential input	3, 4, 5, 6	—	0.4	1	Vp-p
I/Q band width	BW_{IQ}		3, 4, 5, 6	—	—	5	MHz
Local frequency	f_{LO}		15	—	760	—	MHz
Local input level	LO		15	–18	–15	–12	dBm
PS voltage-High	V_{PSH}		19	2.0		V_{CC}	V
PS voltage-Low	V_{PSL}		19	0		0.8	V
Control voltage range	V_{CN}		20	0		V_{CC}	V

Electrical Characteristics (V_{CC} = 2.85V, Ta = 27°C)

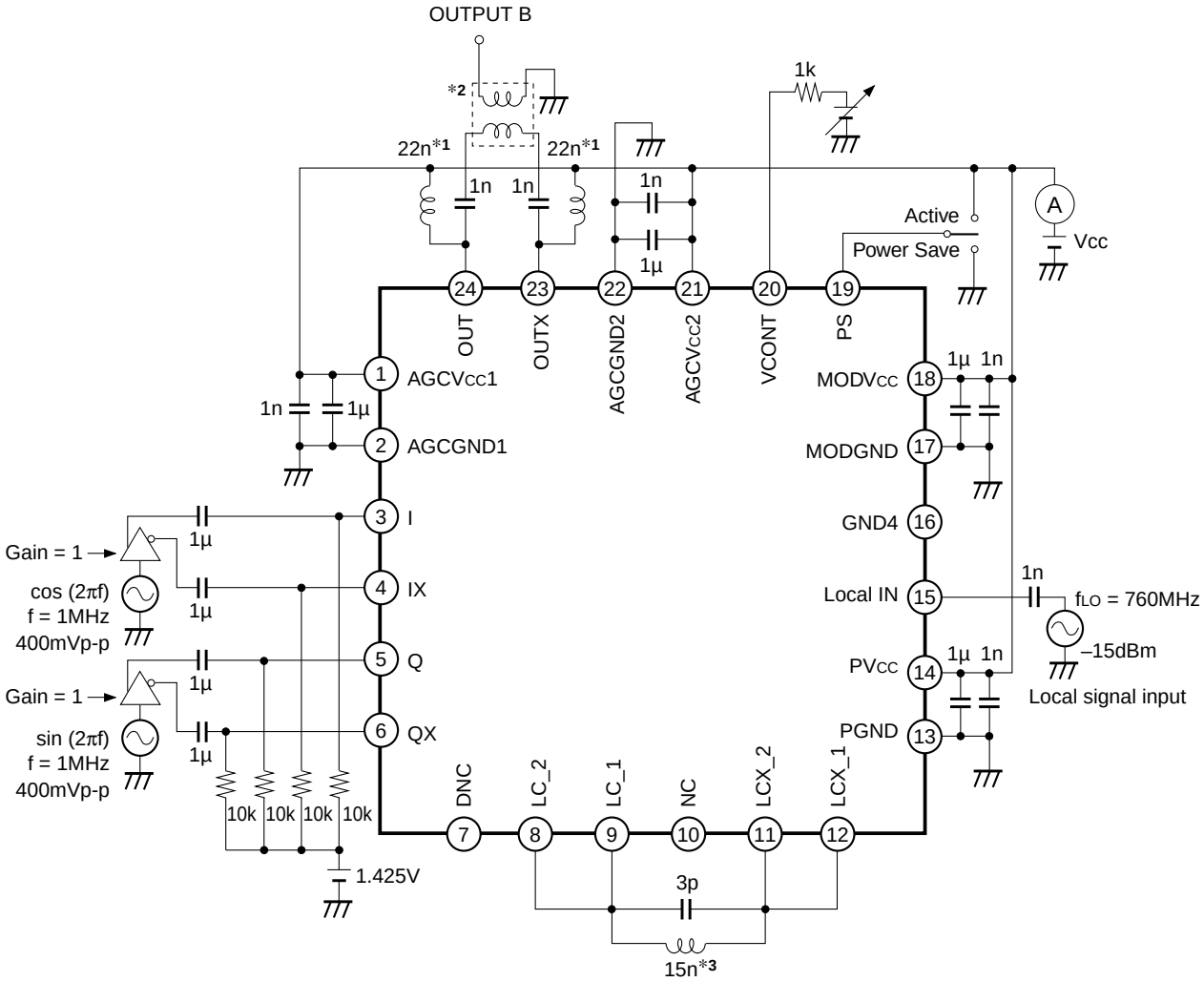
Item	Symbol	Conditions	Measurement point	Min.	Typ.	Max.	Unit
DC Characteristics							
Current consumption 1	Imax	VCONT = 2.85V	A	21.5	32	43	mA
Current consumption 2	Imin	VCONT = 0V	A	17.5	26	32.5	
Power saving current	Ips	PS = low (in power saving mode)	A	—	—	5	µA
AC Characteristics							
Output IP3	OIP3	Note1	B	8.5	—	—	dBm
Output power 1	P_{O1}	VCONT = 2.3V, differential output, f = 570MHz	B	–19	–15	–11	dBm
Output power 2	P_{O2}	VCONT = 0.3V, differential output, f = 570MHz	B	–83	–77	–73	
Gain control range	Gcr	VCONT = 0.3 to 2.3V, f = 570MHz	B	54	62	70	dB
Output noise power 1	N_{O1}	VCONT = 1.8V, I/Q inputs are no signal.	B	—	—	–147	dBm/Hz
I, Q residual sideband product	Img	Suppression ratio of desired signal (f = 570 + 1) MHz and image signal (f = 570 – 1) MHz	B	—	—	–25	dBc
Carrier leak	CL	Ratio of desired signal (f = 570 + 1) MHz and local leak (f = 570) MHz	B	—	—	–18	
Input I/Q phase error	IQ_{PE}	Input signal I/Q phase difference –90° when the output signal I/Q phase difference is 90°.	B	–3	0	3	deg
Input I/Q gain error	IQ_{GE}	I/Q input signal level difference when the output signal I/Q levels are the same.	B	–2.5	0	2.5	dB

- Unless otherwise specified, the I/Q baseband input signals and local input signal use the conditions shown in the Electrical Characteristics Measurement Circuit and the control voltage and power saving pins are set to VCONT = 2.3V, PS = high.
- IF output impedance is 1kΩ.
- Set the L, C values between Pins 8, 9 and 11, 12 to resonate at f = 570MHz.
- Values measured with a Sony evaluation board.

Note1) Set the control voltage so that the output power becomes –15dBm under the conditions shown in the Electrical Characteristics Measurement Circuit. Input the two tone signals of 570kHz, 200mVp-p and 630kHz, 200mVp-p to I-IX; and also input to Q-QX the two tone signals whose phases are deviated by 90 degrees from those signals.
The ratio of the desired component and the 3rd order harmonic component of the outputs resulted from the above is measured, and the power level that is made by adding the half ratio to the desired component power level is labeled as the output IP3. See the figure on the next page.

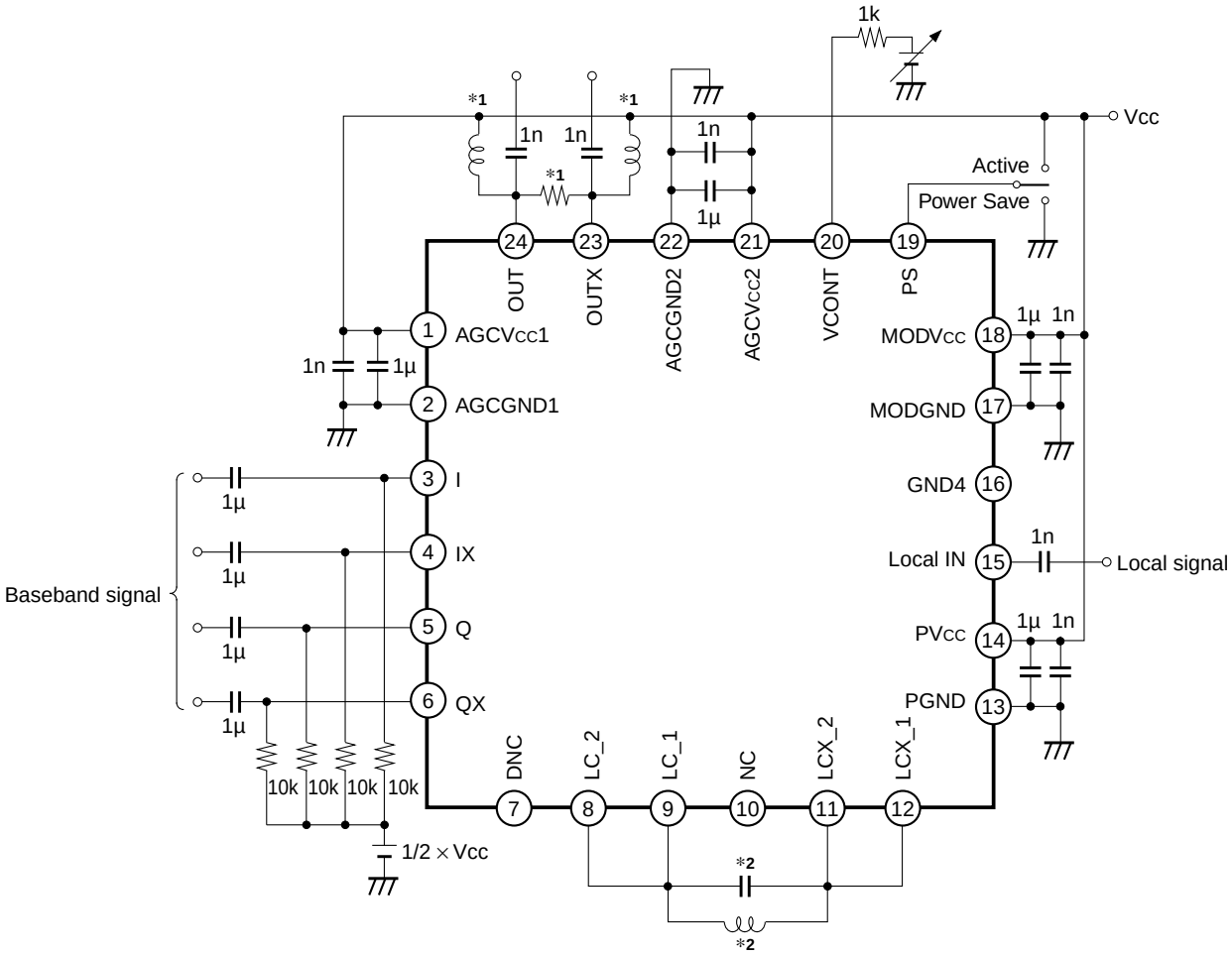

Output level
S
A
IM3
OIP3 = S + (S – IM3)/2
Frequency
f0 + 510kHz
f0 + 570kHz
f0 + 630kHz
f0 + 690kHz

Electrical Characteristics Measurement Circuit



*1 LQN21A22NJ(K)04 (MURATA MFG. CO., LTD.)
*2 B5FL 616DS-1135 (TOKO, Inc.)
*3 LQN21A15NJ(K)04 (MURATA MFG. CO., LTD.)

Application Circuit



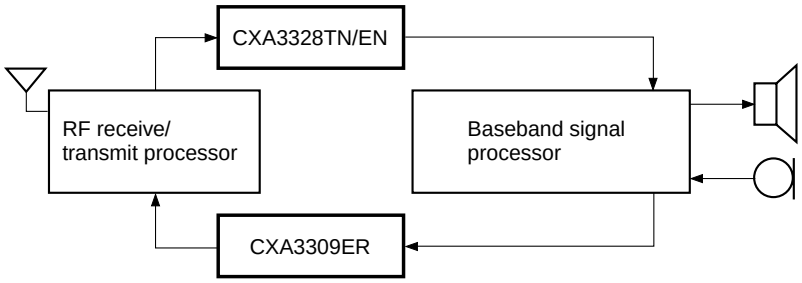
*1 Adjust this value so that the impedance matching with this IC is optimum.
*2 Adjust this value to resonate at the desired frequency.

Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

Description of Operation

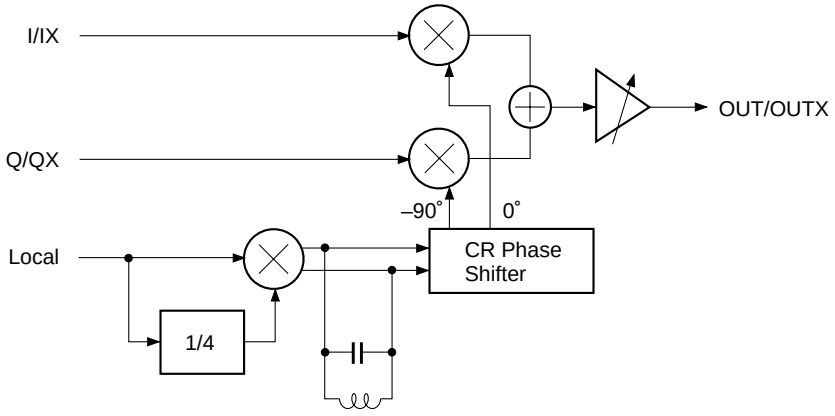
1. Outline of operation

This IC performs the signal processing between the analog transmit baseband processor block and the analog transmit RF processor block of the cellular phone. The figure below shows the general circuit block diagram for the portable cellular phones using this IC. The input for this IC is connected to the baseband signal processor block; the output is connected to the analog RF processor block.



2. IC Internal Signal Flow

Two baseband-processed signals I, Q and the local signal are input to this IC as shown in the figure below. The local signal itself and the local signal divided by 4 are multiplied, and then the unnecessary sideband products are eliminated using the external LC resonator. Also, that signal becomes the quadrature I/Q local signal via the CR phase shifter. The baseband I/Q signals are input to the quadrature modulatar, and baseband processing to IF upconversion is performed with the quadrature local signals, it is input to the gain control amplifier, and output after the gain controlled to the necessary level.



Notes on Operation

1. Baseband signal I/Q input

Pins 3 to 6, where the baseband signal is input, do not have a determined voltage internally on the IC. Therefore, a bias voltage equivalent to 1/2V_{CC} should be applied externally.

2. Local signal

The local signal is generated from the components of 3/4 and 5/4 with regard to the local frequency, so connect the inductor and capacitor in parallel from Pins 8 and 9 to Pins 11 and 12 as a resonance filter to remove the unnecessary 5/4 signals. Also, the inductor and capacitor should be located as close to the pins as possible to minimize the series inductance for the pin connections.

3. IF signal output

The IF signal outputs, OUT/OUTX, are differential outputs. The output impedance should be 1kΩ including the external resistance with differential. Also, it is necessary to connect the inductor to eliminate the parasitic capacitance in the IC.

4. Notes on power supplies

The CXA3309ER is designed to operate by a 2.85V stabilized power supply to allow use with the battery driven portable phones. Using the multiple voltage regulators throughout the phone is recommended to minimize the power supply noise in the CXA3309ER power supply unit. The recommended power supply range for the CXA3309ER is from 2.7V to 3.3V. Decouple the power supplies around the CXA3309ER using 1µF capacitor for each V_{CC} pin. Locate this capacitor as close to the pins as possible to minimize the series inductance. Using an additional 1nF decoupling capacitor in parallel to the 1µF capacitor is recommended to further reduce the high frequency noise in the power supply input to the CXA3309ER.

Design Materials (Design Guarantee)

Electrical Characteristics (V_{CC} = 2.7 to 3.8V, Ta = –25 to +85°C)

Item	Symbol	Conditions	Measurement point	Min.	Typ.	Max.	Unit
DC Characteristics							
Current consumption 1	Imax	VCONT = 2.85V	A	21.5	32	43	mA
Current consumption 2	Imin	VCONT = 0V	A	17.5	26	32.5	
Power saving current	Ips	PS = low (in power saving mode)	A	—	—	5	µA
AC Characteristics							
Output IP3	OIP3	Note1	B	8.5	—	—	dBm
Output power 1	P_{O1}	VCONT = 2.3V, differential output, f = 570MHz	B	–19	–15	–11	dBm
Output power 2	P_{O2}	VCONT = 0.3V, differential output, f = 570MHz	B	–83	–77	–73	
Gain control range	Gcr	VCONT = 0.3 to 2.3V, f = 570MHz	B	54	62	70	dB
Gain flatness	Gflat	IF ± 2.5MHz	B	–0.25	0	0.25	dB
Output noise power 1	N_{O1}	P_O = –25dB, I/Q inputs are no signal.	B	—	—	–147	dBm/Hz
Output noise power 2	N_{O2}	P_O = –65dBm, I/Q inputs are no signal.	B	—	—	–162	
I, Q residual sideband product	Img	Suppression ratio of desired signal (f = 570 + 1) MHz and image signal (f = 570 – 1) MHz	B	—	—	–25	dBc
Carrier leak	CL	Ratio of desired signal (f = 570 + 1) MHz and local leak (f = 570) MHz	B	—	—	–18	
Input I/Q phase error	IQ_{PE}	Input signal I/Q phase difference –90° when the output signal I/Q phase difference is 90°.	B	–3	0	3	deg
Input I/Q gain error	IQ_{GE}	I/Q input signal level difference when output signal I/Q levels are the same.	B	–2.5	0	2.5	dB
Error vector magnitude	EVM		B	—	—	3	%
Response time	Tr	Until output rise of 90% after the power is turned ON.	B	—	—	10	µs

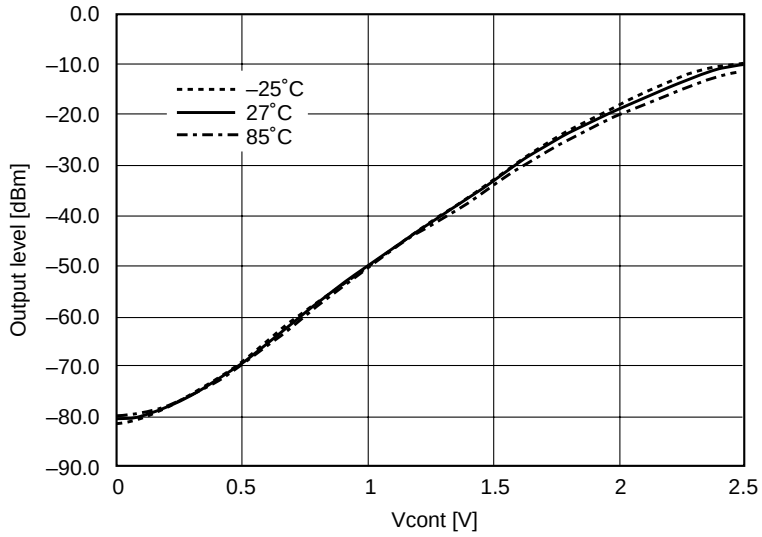
- Unless otherwise specified, the I/Q baseband input signals and local input signal use the conditions shown in the Electrical Characteristics Measurement Circuit and the control voltage and power saving pins are set to VCONT = 2.3V, PS = high.
- IF output impedance is 1kΩ.
- Set the L, C values between Pins 8, 9 and 11, 12 to resonate at f = 570MHz.
- Values measured with a Sony evaluation board.

Input Impedance

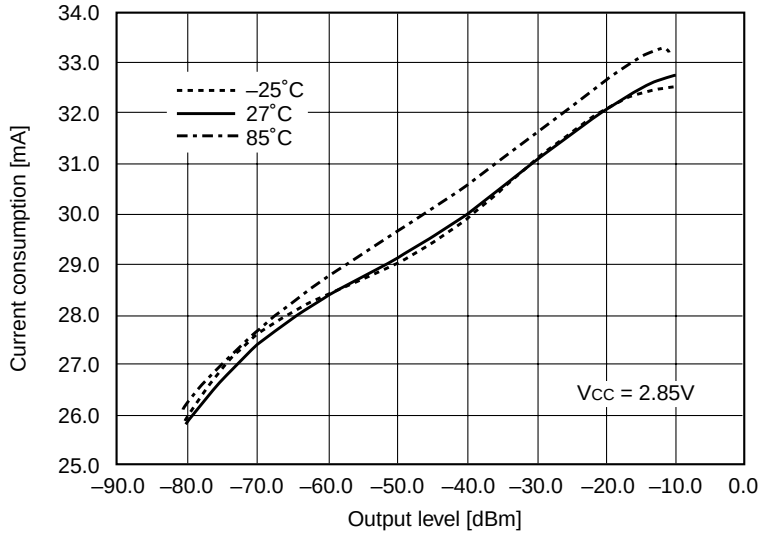
Item	Symbol	Conditions	Measurement point	Min.	Typ.	Max.	Unit
I/Q input resistance	R_{IQ}	Single	3, 4, 5, 6	60	85	—	kΩ
I/Q input capacitance	C_{IQ}	Single	3, 4, 5, 6	—	—	10	pF
VCONT pin input resistance	R_{VC}		20	10	—	—	kΩ
Local IN input resistance	R_L		15	37.5	50	62.5	Ω

Example of Representative Characteristics

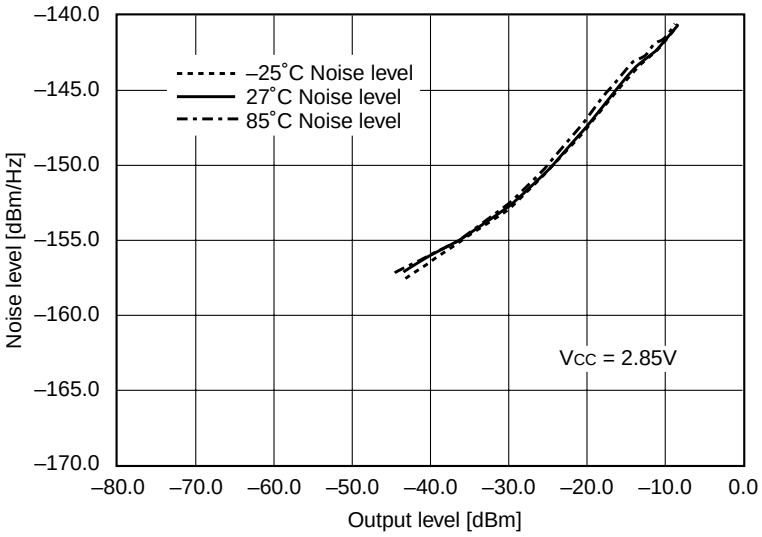
Ouput level vs. Vcont

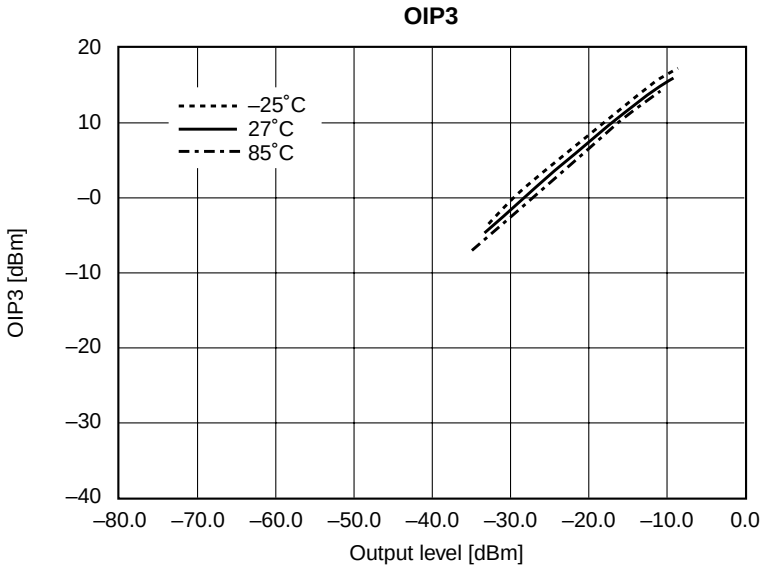


Current consumption vs. Output level



Output noise level vs. Output level

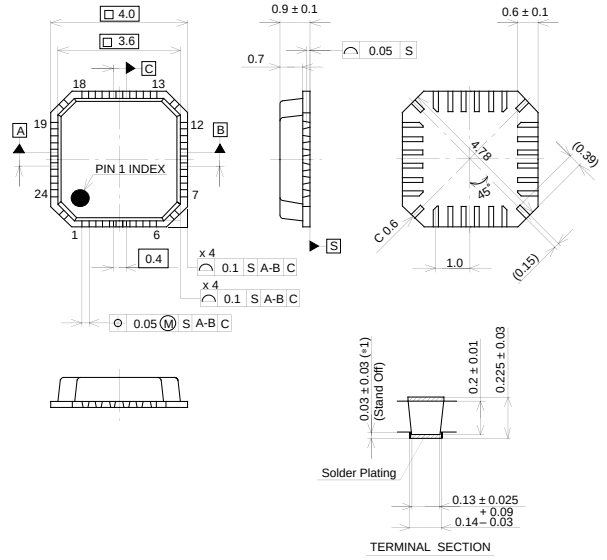



OIP3
20
10
–0
–10
–20
–30
–40
OIP3 [dBm]
–25˚C
27˚C
85˚C
–80.0
–70.0
–60.0
–50.0
–40.0
–30.0
–20.0
–10.0
0.0
Output level [dBm]

Package Outline

Unit: mm

24PIN VQFN(PLASTIC)



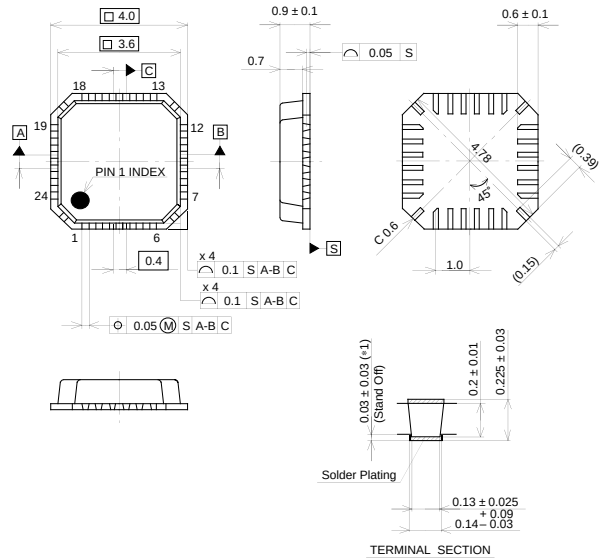
PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.04g

SONY CODE	VQFN-24P-03
EIAJ CODE	————
JEDEC CODE	————

Kokubu & SCT Ass'y

24PIN VQFN(PLASTIC)



PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.04g

SONY CODE	VQFN-24P-03
EIAJ CODE	————
JEDEC CODE	————

LEAD PLATING SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	COPPER ALLOY
SOLDER COMPOSITION	Sn-Bi Bi:1-4wt%
PLATING THICKNESS	5-18µm