

# AN6095SH

Reception IF + transmission quadrature modulation IC for PHS and cellular telephone

## Overview

The AN6095SH is a single chip IC for PHS reception IF block and transmission block.

Reception IF block is incorporating a 2nd down-mixer and a limiter/RSSI circuit which can operate for up to 300 MHz of input frequency. Transmission block is incorporating a quadrature modulator, a phase shifter, an up-mixer for 1.9 GHz and output level control functions.

It contributes to realization of small package and small size of equipment.

## Features

- Operating supply voltage range: 2.7 V to 4.0 V

- Current consumption

Transmission block: 28 mA

Reception block: 5.3 mA

Sleep mode: 10  $\mu$ A or less

(Transmission block)

- Output level: -8 dBm
- Output frequency: up to 2 GHz
- Transmission IF frequency: 100 MHz to 300 MHz

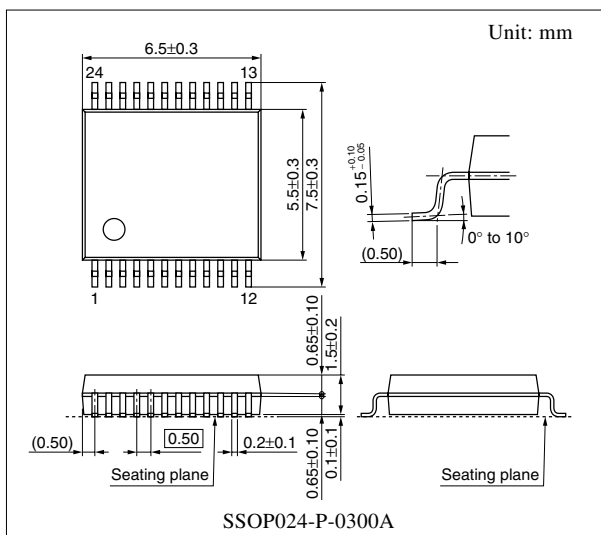
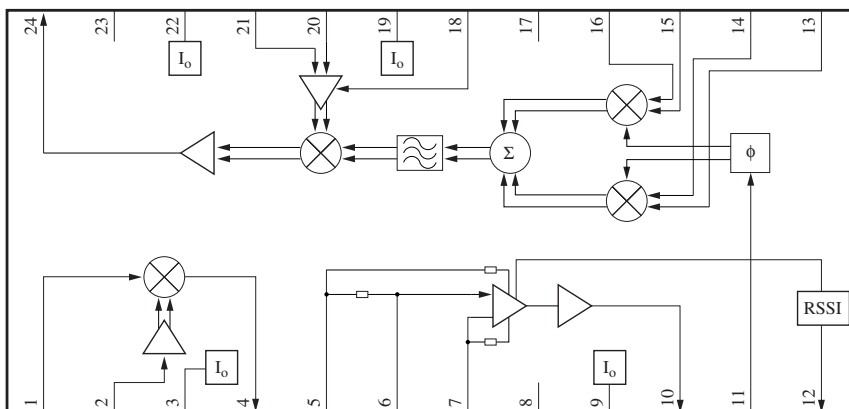
(Reception block)

- RSSI input D range: 80 dB
- Mixer conversion gain: 16 dB
- Limiter voltage gain: 70 dB
- 2nd down-mixer NF: 6 dB

## Applications

- PHS

## Block Diagram



## ■ Pin Descriptions

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	RXMXIN	RX-mixer-in	13	Q-IN	Q-input
2	RXLOIN	RX-local-in	14	$\overline{Q}$ -IN	$\overline{Q}$ -input
3	VCCM	V <sub>CC</sub> -mixer	15	I-IN	I-input
4	MXO	Mixer-out	16	$\overline{I}$ -IN	$\overline{I}$ -input
5	LMDEC1	Limiter-decouple 1	17	GNDM	GND-TX-modulator
6	LMIN	Limiter-in	18	APC/BS	APC/BS
7	LMDEC2	Limiter-decouple 2	19	VCCM	V <sub>CC</sub> -TX-modulator
8	GNDR	GND-RX	20	TXLO2R	TX-local 2-REF
9	VCCL	V <sub>CC</sub> -limiter	21	TXLO2	TX-local 2
10	LMO	Limiter-out	22	VCCO	V <sub>CC</sub> -TX-out
11	TXLO1	TX-local 1-in	23	GNDO	GND-TX-out
12	RSO	RSSI-out	24	TXO	TX-output

## ■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	4.2	V
Supply current	I <sub>CC</sub>	60	mA
Power dissipation	P <sub>D</sub>	252	mW
Operating ambient temperature *	T <sub>opr</sub>	-20 to +60	°C
Storage temperature *	T <sub>stg</sub>	-55 to +125	°C

Note) 1. \*: Except for the operating ambient temperature and storage temperature, all ratings are for T<sub>a</sub> = 25°C.

2. For the main characteristics, refer to "■ Technical Data".

## ■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage	V <sub>CC</sub>	2.7 to 4.0	V

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Current consumption (reception)	$I_{\text{CCRX}}$	No signal	—	5.3	6.8	mA
Mixer conversion gain	$G_{\text{MX}}$	$V_{\text{MI}} = 70 \text{ dB}\mu$ Except for filter loss, SW1 = a	13	16	19	dB
Mixer maximum output level	$V_{\text{MX}}$	$V_{\text{MI}} = 105 \text{ dB}\mu$ Except for filter loss, SW1 = a	105	110	—	dB $\mu$
Limiter voltage gain	$G_{\text{LM}}$	$V_{\text{LI}} = 20 \text{ dB}\mu$ , SW1 = b	63	68	73	dB
Limiter maximum output amplitude	$V_{\text{LM}}$	$V_{\text{LI}} = 80 \text{ dB}\mu$ , SW1 = b	300	360	—	mV[p-p]
RSSI output voltage 1	$V_{\text{S}(1)}$	No signal, SW1 = b	0	0.2	0.5	V
RSSI output voltage 2	$V_{\text{S}(2)}$	$V_{\text{LI}} = 115 \text{ dB}\mu$ , SW1 = b	1.60	1.80	—	V
RSSI output slope	$D_{\text{S}}$	$V_{\text{S}} (V_{\text{IS}}) = V_{\text{S}(1)} + 0.15 \text{ V}$ $D_{\text{S}(1)} = V_{\text{S}} (V_{\text{IS}} + 65 \text{ dB}\mu) - V_{\text{S}} (V_{\text{IS}})$ SW1 = b	1.0	1.25	1.5	V
RSSI output slope variation	$\Delta D_{\text{S}(n)}$	$\Delta D_{\text{S}(n)} = 5 \{ V_{\text{S}} (V_{\text{IS}} + n13 \text{ dB}\mu) - V_{\text{S}} (V_{\text{IS}} + (n-1) 13 \text{ dB}\mu) \} / D_{\text{S}(1)}$ $n = 1 \text{ to } 5$ , SW1 = b	0.75	1.0	1.25	—
Current consumption (transmission)	$I_{\text{CCTX}}$	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{\text{APC}} = 2.75 \text{ V}$	—	28	37	mA
Sleep current at transmission	$I_{\text{SL}}$	No signal, $V_{\text{APC}} = 0 \text{ V}$	—	0	10	$\mu\text{A}$
Transmission output level 1	$P_{\text{O1}}$	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 660 MHz, -10 dBm $V_{\text{APC}} = 2.75 \text{ V}$	-12	-8	—	dBm
Transmission output level 2	$P_{\text{O2}}$	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 685 MHz, -10 dBm $V_{\text{APC}} = 2.75 \text{ V}$	-12	-8	—	dBm

Note) 1. Refer to the "● Test circuit" for the SW1.

2. Unless otherwise specified :

At reception,  $V_{\text{CC2}} = 3.0 \text{ V}$ ,  $V_{\text{LO3}} = -10 \text{ dBm}$ :  $f = 233.15 \text{ MHz}$ ,  $V_{\text{MI}}$ :  $f = 243.95 \text{ MHz}$ , SW1 = a

$V_{\text{LI}}$ :  $f = 10.8 \text{ MHz}$  (Input level of pin 6 except for attenuation of the matching circuit and filter.)

$V_{\text{MO}}$  and  $V_{\text{LO}}$  are in high impedance measurement. ( $V_{\text{LM}}$  is measured with probe load of 27 pF and 1 M $\Omega$ .)

$V_{\text{IS}}$  is an input level  $V_{\text{LI}}$  at which RSSI output voltage becomes  $V_{\text{S}(1)} + 0.15 \text{ V}$ .

At transmission,  $V_{\text{CC1}} = 3.0 \text{ V}$ , IQ signal amplitude: 0.4 V (both phases), DC bias: 1.5 V, SW1 = a

$I_{\text{CCTX}}$ :  $\pi/4$  QPSK-modulated,  $P_{\text{O1}}$  and  $P_{\text{O2}}$ : PN9 stages modulated wave

Output frequency of  $P_{\text{O1}}$ : 1 893.174 MHz

Output frequency of  $P_{\text{O2}}$ : 1 918.174 MHz

# ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
1st local leak suppression amount	CL1	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$	—	-25	—	dBc
2nd local leak suppression amount	CL2	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$	—	-15	—	dBc
In-band output level deviation	$\Delta P$	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 660 to 1 685 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$	—	$\pm 1.6$	—	dB
Adjacent channel leak power suppression (600 kHz detuning)	BL1	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$	—	-65	-60	dBc
Modulation precision	EVM	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$	—	3	5	%[rms]
Minimum output level	$P_{\min}$	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 1.0\text{ V}$	—	-45	-40	dBm
Image leak suppression	IL1	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$ IQ: Level is of no adjustment	—	-35	—	dBc
$f_{LO1} + f_{LO2}$ local leak suppression amount	CL	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm $V_{APC} = 2.75\text{ V}$ IQ: DC offset is of no adjustment	—	-35	—	dBc
Proximity spurious suppression	DU	Lo1 = 233.15 MHz, -10 dBm Lo2 = 1 672.5 MHz, -10 dBm Adjust $V_{APC}$ so as to get $P_O = -12\text{ dBm}$	—	-55	-51	dBc

Note) Unless otherwise specified:

At transmission,  $V_{CC1} = 3.0\text{ V}$ ,  $SW1 = a$

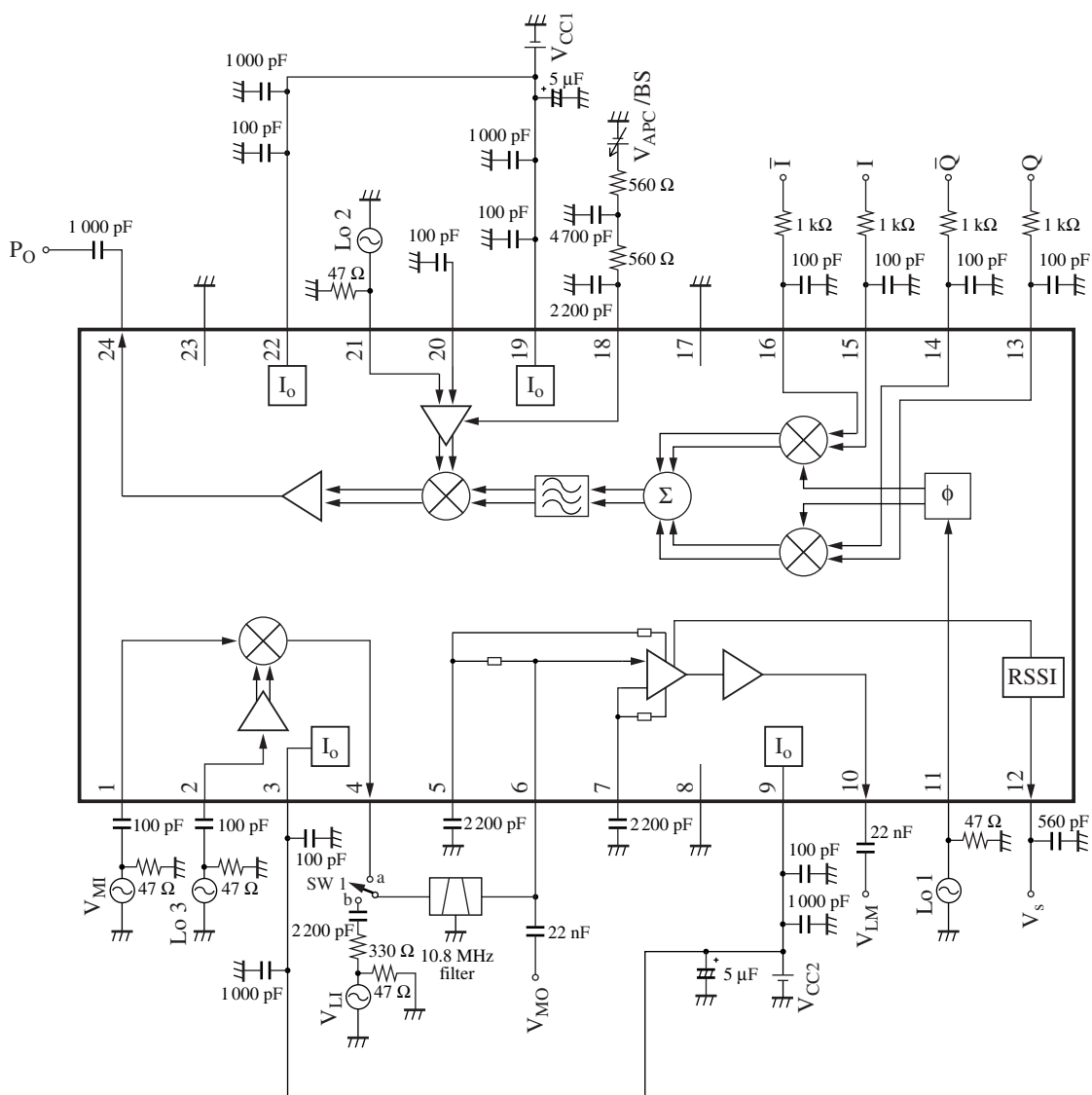
IQ signal: 0.4 V[p-p] (both phases), DC bias: 1.5 V

CL1, CL2,  $\Delta P$ , BL1, EVM,  $P_{\min}$ , DU: PN9 stages modulated wave

IL1, CL:  $\pi/4$  QPSK-modulated

### ■ Electrical Characteristics (continued)

- Test circuit



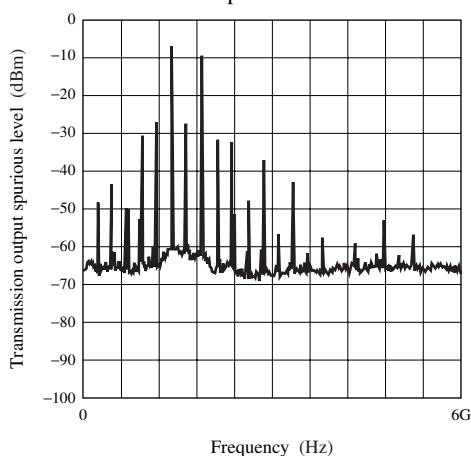
## ■ Technical Data

Unless otherwise specified, the test condition is the same as "■ Electrical Characteristics".

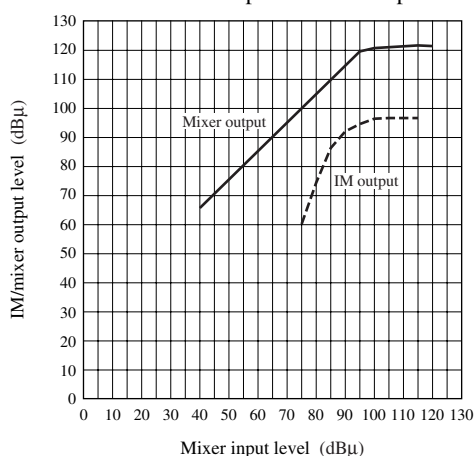
Characteristics are the theoretical values and not guaranteed ones.

### • Main characteristics (application circuit)

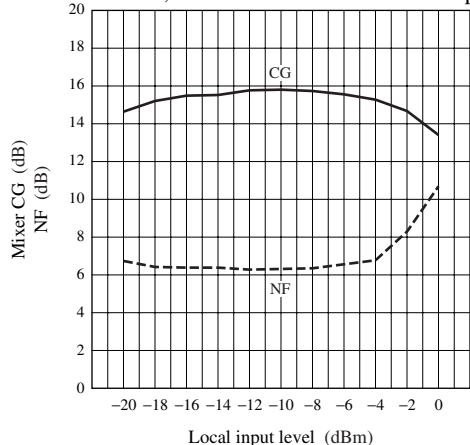
Wide band spurious characteristic



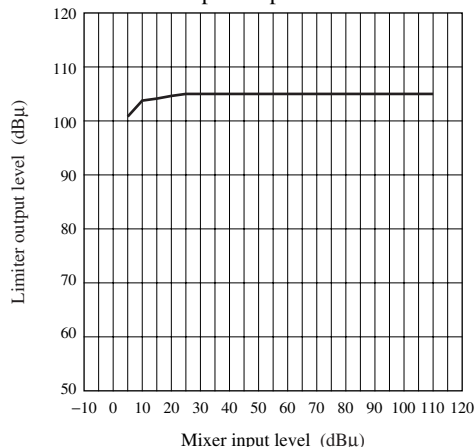
IM/mixer output — Mixer input



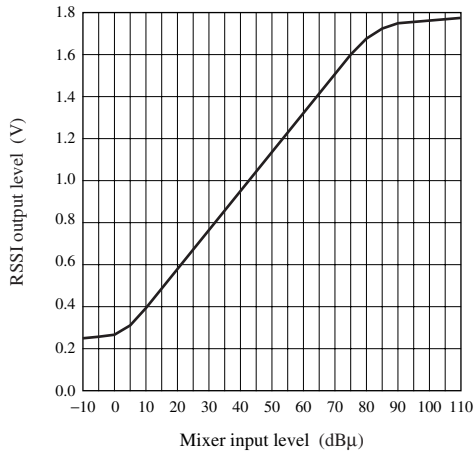
Mixer CG, NF characteristics — Local input



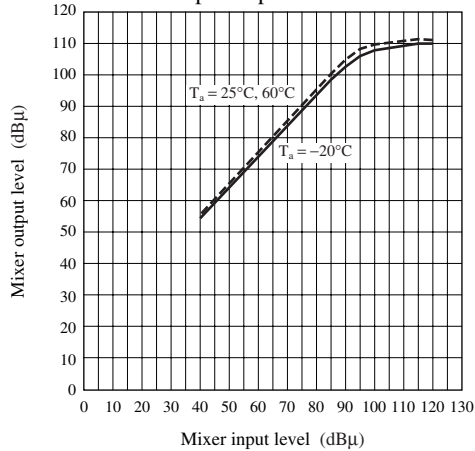
Limiter input/output characteristic



RSSI characteristic



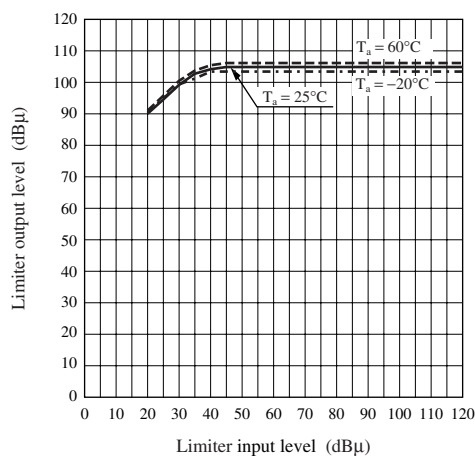
Mixer input/output characteristics



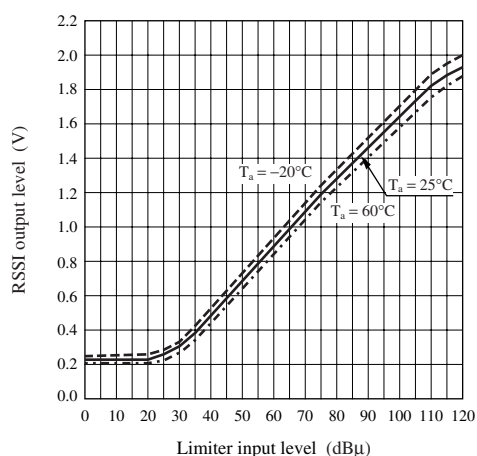
# ■ Technical Data (continued)

## • Main characteristics (application circuit) (continued)

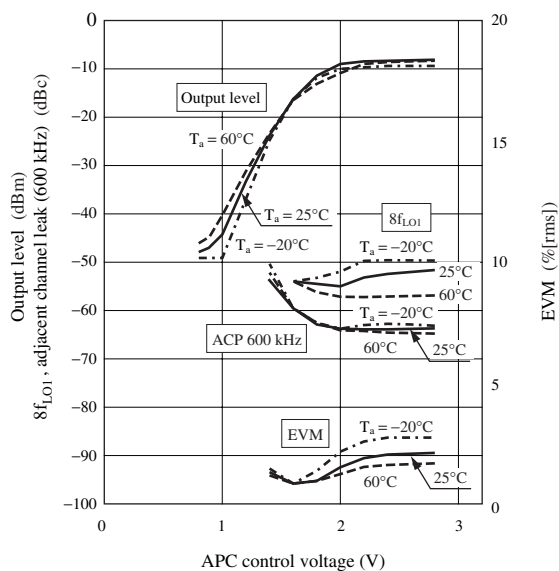
Limiter characteristics



RSSI characteristics



APC control voltage characteristics



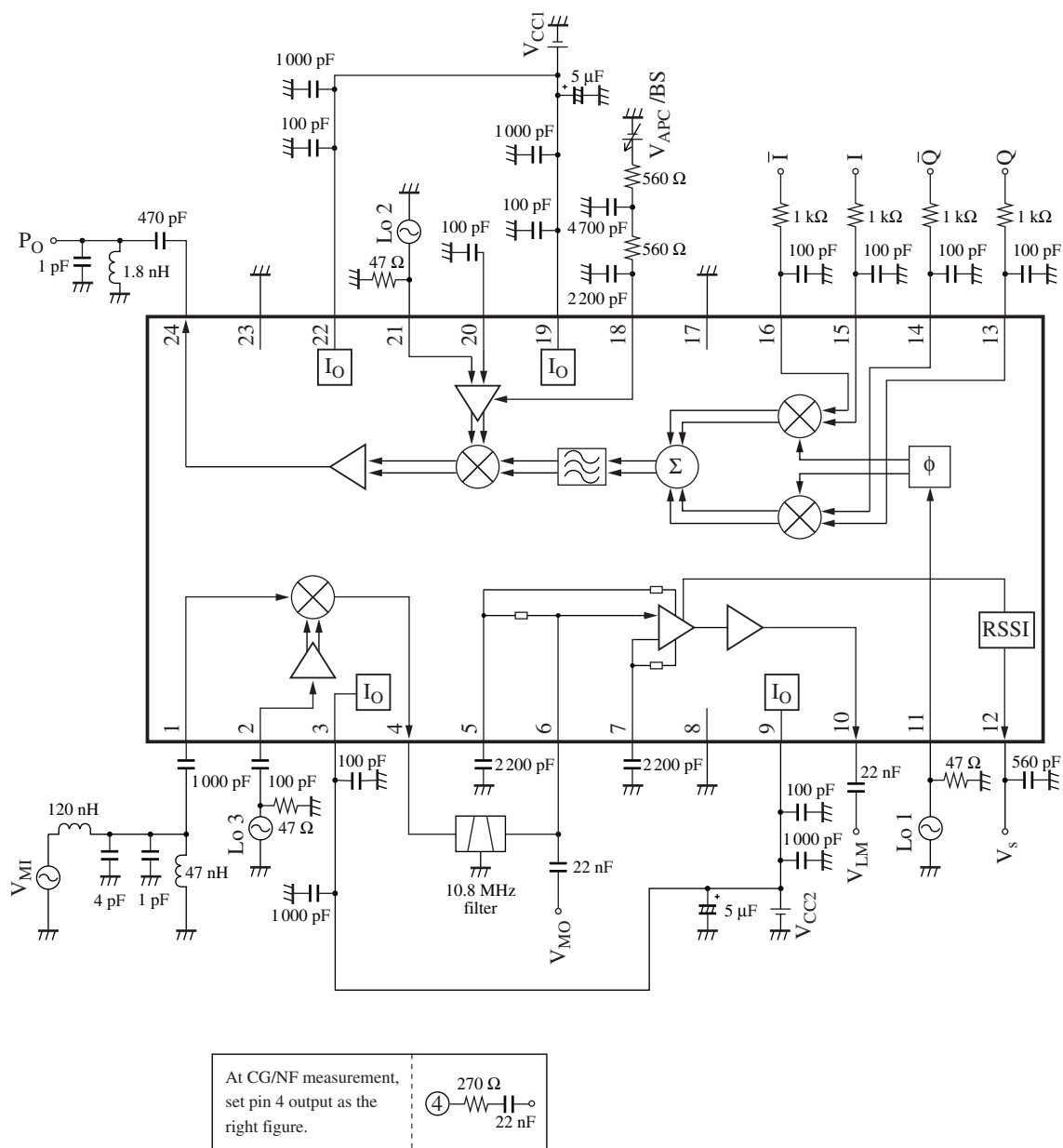
$V_{CC} = 3.0\text{ V}$

Lo1: 233.15 MHz, -10 dBm

Lo2: 1 672.5 MHz, -10 dBm

IQ: 0.4 V[p-p] (double phase), 1.5 V<sub>DC</sub>,  
using PN9 stages continuous wave

# Application Circuit Example





## Request for your special attention and precautions in using the technical information and semiconductors described in this material

- (1) An export permit needs to be obtained from the competent authorities of the Japanese Government if any of the products or technologies described in this material and controlled under the "Foreign Exchange and Foreign Trade Law" is to be exported or taken out of Japan.
- (2) The technical information described in this material is limited to showing representative characteristics and applied circuit examples of the products. It does not constitute the warranting of industrial property, the granting of relative rights, or the granting of any license.
- (3) The products described in this material are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).  
Consult our sales staff in advance for information on the following applications:
  - Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
  - Any applications other than the standard applications intended.
- (4) The products and product specifications described in this material are subject to change without notice for reasons of modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.
- (5) When designing your equipment, comply with the guaranteed values, in particular those of maximum rating, the range of operating power supply voltage and heat radiation characteristics. Otherwise, we will not be liable for any defect which may arise later in your equipment.  
Even when the products are used within the guaranteed values, redundant design is recommended, so that such equipment may not violate relevant laws or regulations because of the function of our products.
- (6) When using products for which dry packing is required, observe the conditions (including shelf life and after-unpacking standby time) agreed upon when specification sheets are individually exchanged.
- (7) No part of this material may be reprinted or reproduced by any means without written permission from our company.

## Please read the following notes before using the datasheets

- A. These materials are intended as a reference to assist customers with the selection of Panasonic semiconductor products best suited to their applications.  
Due to modification or other reasons, any information contained in this material, such as available product types, technical data, and so on, is subject to change without notice.  
Customers are advised to contact our semiconductor sales office and obtain the latest information before starting precise technical research and/or purchasing activities.
- B. Panasonic is endeavoring to continually improve the quality and reliability of these materials but there is always the possibility that further rectifications will be required in the future. Therefore, Panasonic will not assume any liability for any damages arising from any errors etc. that may appear in this material.
- C. These materials are solely intended for a customer's individual use.  
Therefore, without the prior written approval of Panasonic, any other use such as reproducing, selling, or distributing this material to a third party, via the Internet or in any other way, is prohibited.