GaAs MULTI-FUNCTION IC for PHS

■ GENERAL DESCRIPTION

NJG1701V is a GaAs multi-function MMIC composed of power amplifier, SPDT switch and LNA for PHS in Japan. SSOP20 package is adopted and it's effective for down-sizing of handsets.

The PA features low current and low distortion, the switch does low loss and the LNA does low noise and high gain. And all parts operate at low voltage.

■ PACKAGE OUTLINE

NJG1701V

■ APPLICATIONS

- PHS, Digital cordless phone

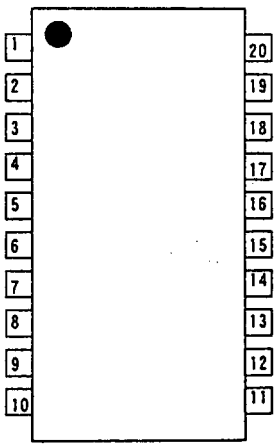
■ FEATURES

(Operating frequency f=1.9GHz)

- Transmitting Mode Operation
  V_{DD}(PA)=3.0V(Typ.)
  Gain=32dB(Typ.)
  Current consumption=160mA(Typ.) @P_{OUT}=20dBm
  Gain variable range=33dB(Typ.)
- Receiving Mode Operation
  V_{DD}(LNA)=3.0(Typ.)
  Gain=14dB(Typ.)
  Current consumption=2.8mA(Typ.)
  NF=2.7dB(Typ.)
- SW : V_{DD}=2.7V(Typ.)
- Package : SSOP20

■ PIN CONFIGURATION

V Type
(Top View)



Pin Connection

1. ANT	11.GND
2. GND	12.GND
3. V_{SW2}	13.V_{DD3}
4. GND	14.V_{DD2}
5. V_{DD1}	15.GND
6. V_{GG1}	16.LNAOUT
7. V_{CONT}	17.GND
8. V_{GG2}	18.EXTIND
9. GND	19.GND
10.PA_{in}	20.V_{SW1}

■ ABSOLUTE MAXIMUM RATINGS

(Z_s=Z_l=50ohm, T_a=25℃)

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNIT
Drain Voltage1	V_{DD1}		6.0	V
Drain Vpltage2	$V_{DD2,3}$	$V_{GG1,2}$=-0.9V	6.0	V
Gate Voltage	$V_{GG1,2}$	$V_{DD2,3}$=3.0V	-4.0	V
Gain Control Voltage	V_{cont}	$V_{DD2,3}$=3.0V	-4.0	V
Control Voltage	$V_{SW1,2}$		6.0	V
Input Power1	ANT	V_{DD1}=3.0V,V_{SW1}=0V,V_{SW2}=2.7V	0	dBm
Input Power2	PA_{in}	$V_{DD2,3}$=3.0V,$V_{GG1,2}$=-0.9V	3	dBm
Power Dissipation	P_D	24*30*1.0mm PCB : FR4, T_j=150℃	800	mW
Operating Temperature	T_{opr}		-30～+85	℃
Storage Temperature	T_{stg}		-40～+150	℃

■ ELECTRICAL CHARACTERISTICS 1(TRANSMITTING MODE ; PA_{in}－ANT)

(f=1.90GHz,V_{SW1}=2.7V,V_{SW2}=0V,V_{CONT}=0V,Z_s=Z_l=50ohm,V_{DD1}=0V,Ta=25℃)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq	$V_{DD2,3}$=3.0V	1.89	1.90	1.92	GHz
Drain Voltage	$V_{DD2,3}$		2.9	3.0	5.2	V
Gate Voltage	$V_{GG1,2}$	$V_{DD2,3}$=3.0V,I_{idle}=150mA	-1.3	-0.9	-0.5	V
Idle Current *1	I_{idle}	$V_{DD2,3}$=3.0V, No RF Signal	145	150	155	mA
Operating Current *1	$I_{DD2,3}$	P_{out}=20dBm,$V_{DD2,3}$=3.0V	145	160	175	mA
Gate Current *2	I_{GG}	P_{out}=20dBm,$V_{DD2,3}$=3.0V	-50.0	-10.0	0.0	uA
Gain Control Terminal Current	I_{CONT}	P_{out}=20dBm,$V_{DD2,3}$=3.0V -2.0<V_{CONT}<0.0V	-5.0	-2.0	0.0	uA
Gain Control Voltage	V_{CONT}		-2.0	0.0	0.0	V
Control Voltage1	V_{SW1}	P_{out}=20dBm,$V_{DD2,3}$=3.0V	2.5	2.7	5.2	V
Control Voltage2	V_{SW2}	P_{out}=20dBm,$V_{DD2,3}$=3.0V	-0.2	0.0	0.2	V
Control Current	I_{SW1}	P_{out}=20dBm,$V_{DD2,3}$=3.0V	-	4.0	12.0	uA
Small Signal Gain	Gain1	$V_{DD2,3}$=3.0V,I_{idle}=150mA	29	32	35	dB
Gain Flatness	G_{flat1}	$V_{DD2,3}$=3.0V,I_{idle}=150mA	-	0.5	1.0	dB
Gain Control Range	G_{CONT}	$V_{DD2,3}$=3.0V,I_{idle}=150mA -2.0V<V_{CONT}<0.0V	29	33	37	dB
Output Power at 1dB Compression	P_{-1dB}	$V_{DD2,3}$=3.0V,I_{idle}=150mA	20	22	-	dBm
Adjacent Channel Leakage Power ①	P_{acp1}	P_{out}=20dBm,offset=600kHz, I_{idle}=150mA P_{in}; π/4 QPSK,$V_{DD2,3}$=3.0V	-	-60	-55	dBc
Adjacent Channel Leakage Power ②	P_{acp2}	P_{out}=20dBm,offset=900kHz, I_{idle}=150mA, P_{in}; π/4 QPSK,$V_{DD2,3}$=3.0V	-	-65	-60	dBc

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Harmonics	P_{hm}	P_{out}=20dBm, $V_{DD2,3}$=3.0V I_{idle}=150mA	-	-40	-30	dBc
PA_{in} Port VSWR	VSWR1	$V_{DD2,3}$=3.0V, I_{idle}=150mA	-	1.7	2.2	
ANT-LNAOUT Isolation	I_{SL}	V_{DD1}=0V, V_{SW1}=2.7V, V_{SW2}=0V	35	40	-	dB
ANT Port Load VSWR Tolerance	—	P_{out}=20dBm, $V_{DD2,3}$=3.0V I_{idle}=150mA, Load VSWR=4:1, All phase	Parasitic Oscillation for Fundamental Signal Level : ≦ -60dBc			
Switching Speed	T_{SW1}		-	15	-	nS

■ ELECTRICAL CHARACTERISTICS 2(RECEIVING MODE ; ANT−LNAOUT)

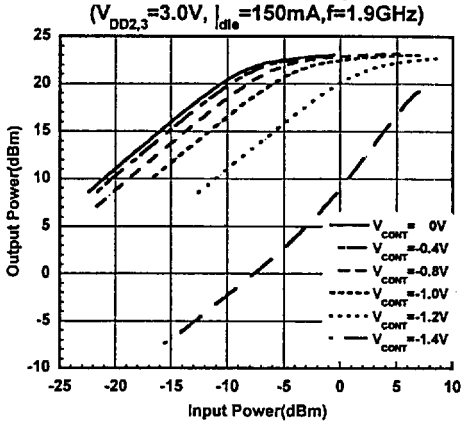
(f=1.90GHz, V_{SW1}=0V, V_{SW2}=2.7V, Z_s=Z_l=50ohm, $V_{DD2,3}$=$V_{GG1,2}$=V_{CONT}=0V, Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq	V_{DD1}=3.0V	1.89	1.90	1.92	GHz
Drain Voltage	V_{DD1}		2.7	3.0	5.2	V
Operating Current *3	I_{DD1}	V_{DD1}=3.0V	2	2.8	4.2	mA
Control Voltage1	V_{SW1}		-0.2	0.0	0.2	V
Control Voltage2	V_{SW2}		2.5	2.7	5.2	
Control Current	I_{SW2}		-	4.0	12.0	uA
Small Signal Gain	Gain2	V_{DD1}=3.0V	12	13	16	dB
Gain Flatness	G_{flat2}	V_{DD1}=3.0V	-	0.5	1.0	dB
Noise Figure	NF	V_{DD1}=3.0V	-	2.7	3.3	dB
ANT Port VSWR	VSWR2	V_{DD1}=3.0V	-	1.7	2.2	
LNAOUT Port VSWR	VSWR3	V_{DD1}=3.0V	-	2.0	2.5	
Output 3rd Intercept Point	IP3	V_{DD1}=3.0V	-10	0	-	dBm
Switching Speed	T_{SW2}		-	15	-	nS

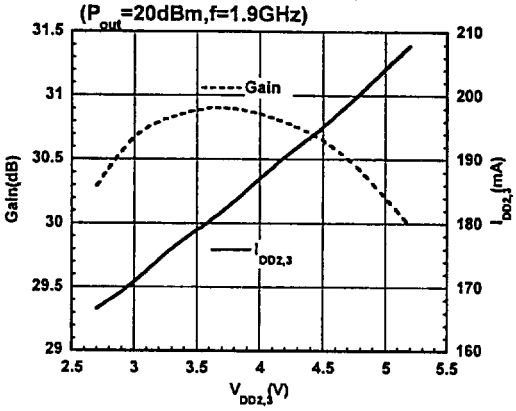
*1 ; Total current of V_{DD2} terminal and V_{DD3} terminal.
*2 ; Total current of V_{GG1} terminal and V_{GG2} terminal.
*3 ; Current of V_{DD1} terminal.

■TYPICAL CHARACTERISTICS
TRANSMITTING MODE

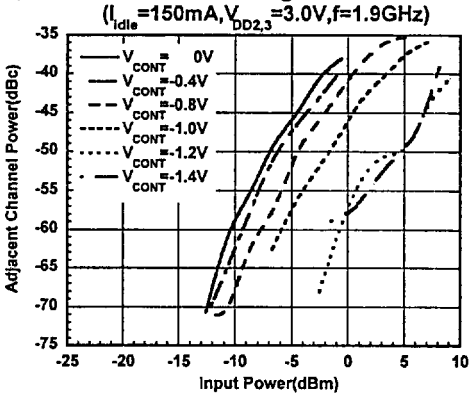
Output Power vs. Input Power ,Gain Controled Voltage
($V_{DD2,3}$=3.0V, I_{idle}=150mA,f=1.9GHz)



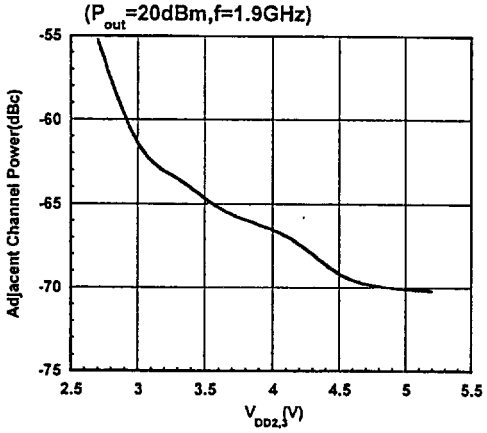
Gain,$I_{DD2,3}$ vs. $V_{DD2,3}$
(V_{CONT}=0V,I_{idle}=150mA at $V_{DD2,3}$=3V)
(P_{out}=20dBm,f=1.9GHz)



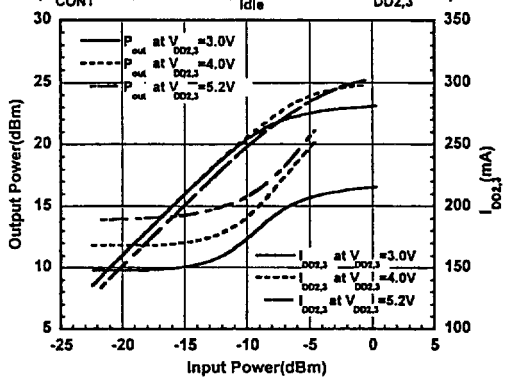
Adjacent Channel Power vs. Input Power ,Gain Controled Voltage
(I_{idle}=150mA,$V_{DD2,3}$=3.0V,f=1.9GHz)



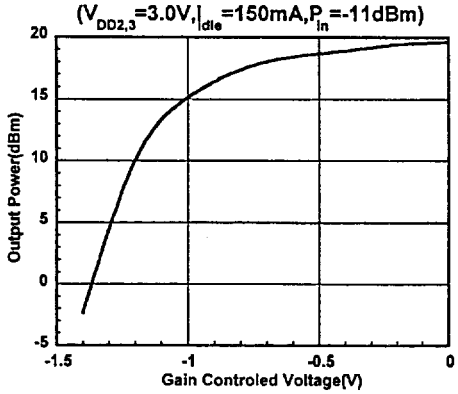
Adjacent Channel Power vs. $V_{DD2,3}$
(V_{CONT}=0V,I_{idle}=150mA at $V_{DD2,3}$=3V)
(P_{out}=20dBm,f=1.9GHz)



Output Power,$I_{DD2,3}$ vs. Input Power,$V_{DD2,3}$
(V_{CONT}=0V,f=1.9GHz,I_{idle}=150mA at $V_{DD2,3}$=3V)

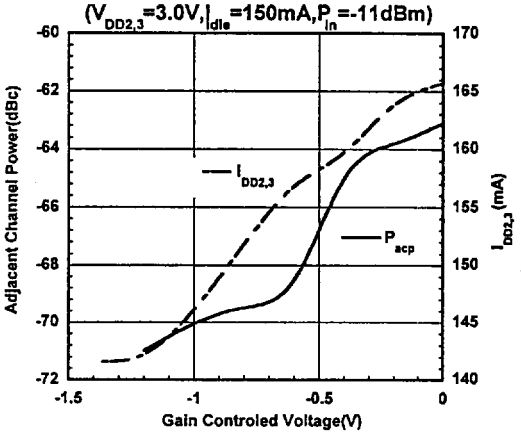


Output Power vs. Gain Controled Voltage
($V_{DD2,3}$=3.0V,I_{idle}=150mA,P_{in}=-11dBm)

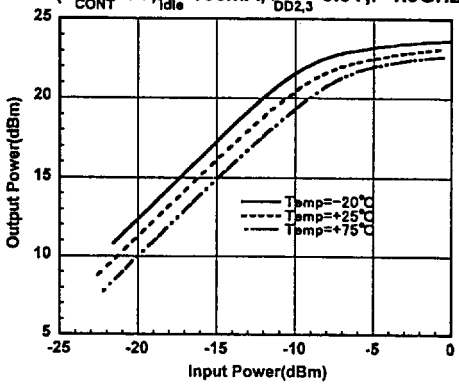


■TYPICAL CHARACTERISTICS
TRANSMITTING MODE

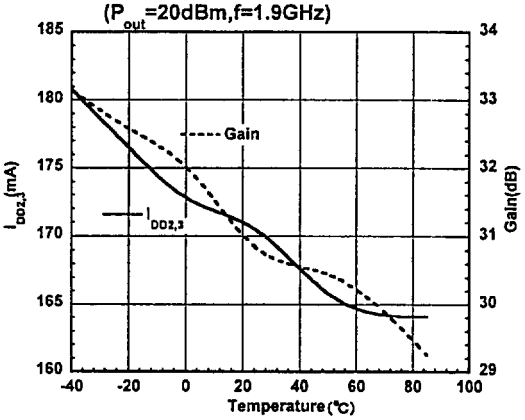
Adjacent Channel Power vs. $I_{DD2,3}$,Gain Controled Voltage
($V_{DD2,3}$=3.0V,I_{idle}=150mA,P_{in}=-11dBm)



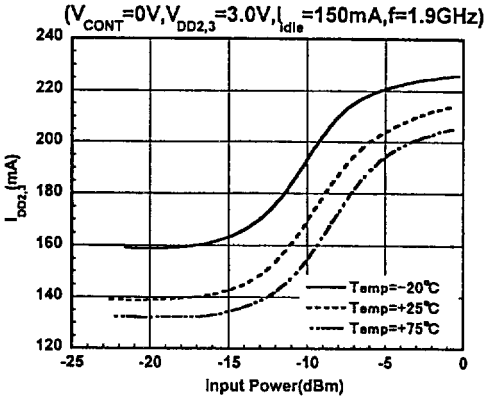
Output Power vs. Input Power,Temperature
(V_{CONT}=0V,I_{idle}=150mA,$V_{DD2,3}$=3.0V,f=1.9GHz)



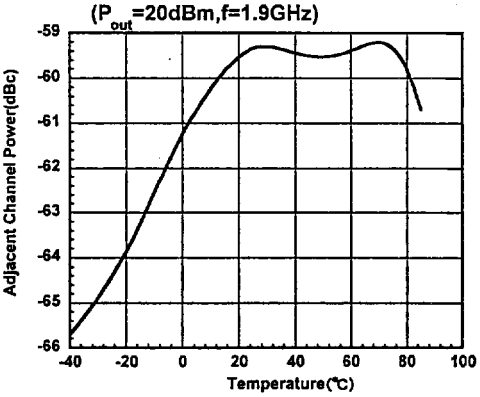
$I_{DD2,3}$ Gain vs.Temperature
(V_{CONT}=0V,I_{idle}=150mA,$V_{DD2,3}$=3.0V)
(P_{out}=20dBm,f=1.9GHz)



$I_{DD2,3}$ vs. Input Power,Temperature
(V_{CONT}=0V,$V_{DD2,3}$=3.0V,I_{idle}=150mA,f=1.9GHz)

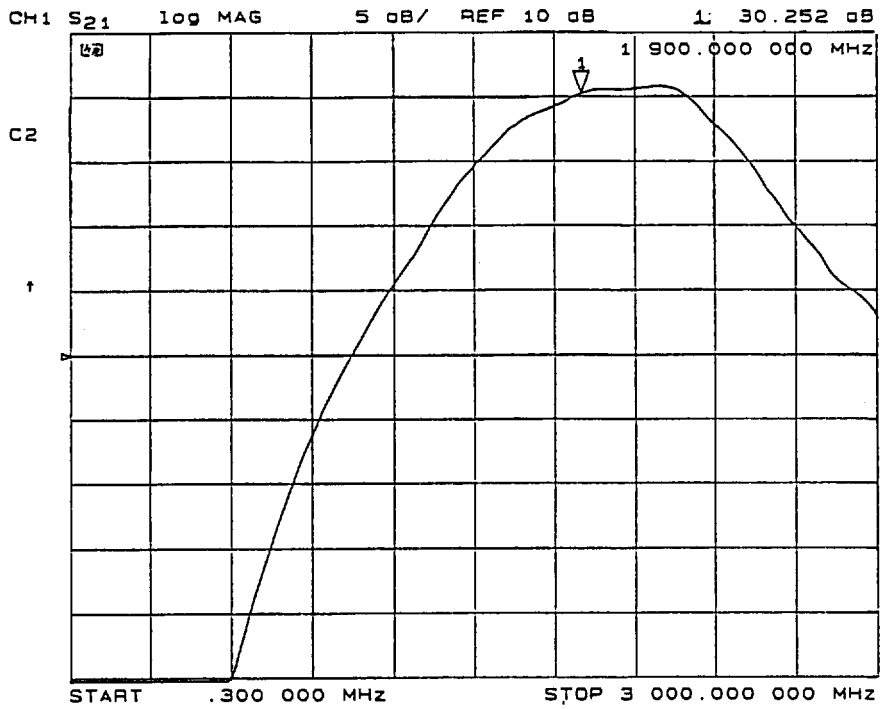


Adjacent Channel Power vs. Temperature
(V_{CONT}=0V,I_{idle}=150mA,$V_{DD2,3}$=3.0V)
(P_{out}=20dBm,f=1.9GHz)



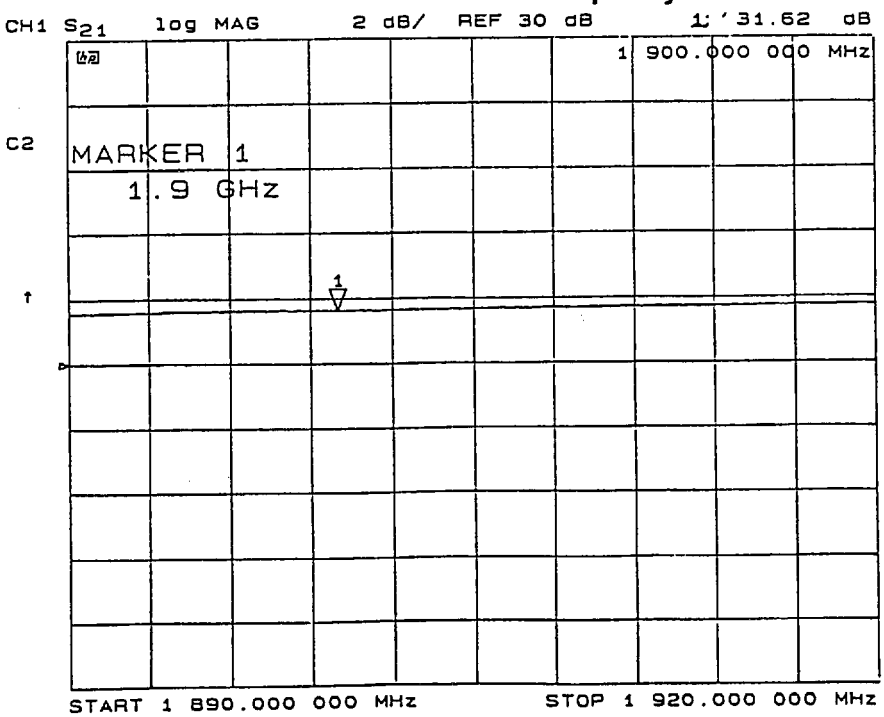
■ TYPICAL CHARACTERISTICS
TRANSMITTING MODE

Gain vs. Frequency



V_{SW1}=2. 7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2, 3}$=3. 0V
I_{idle}=150mA

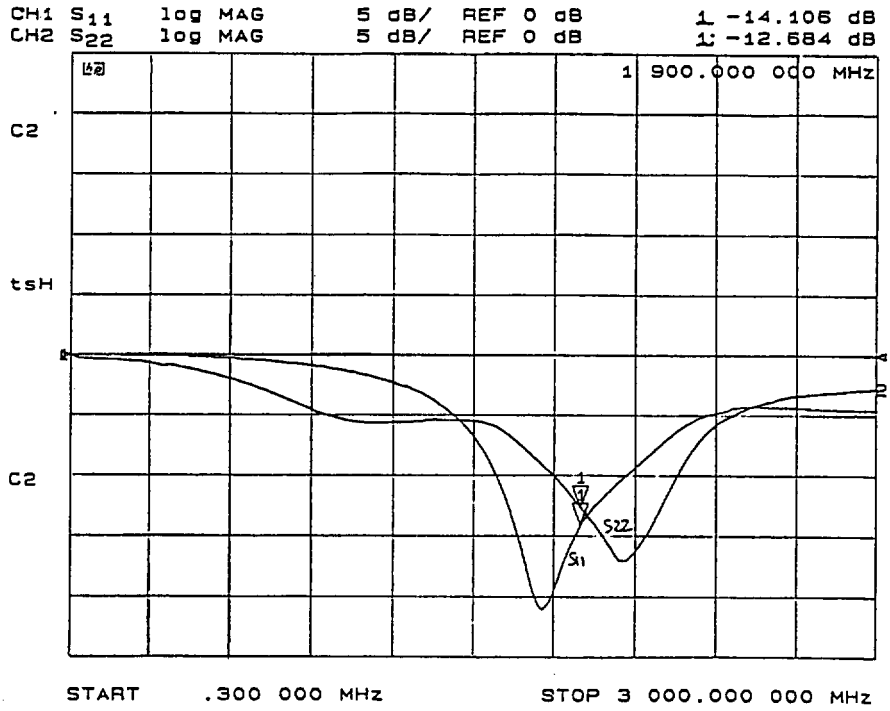
Gain vs. Frequency



V_{SW1}=2. 7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2, 3}$=3. 0V
I_{idle}=150mA

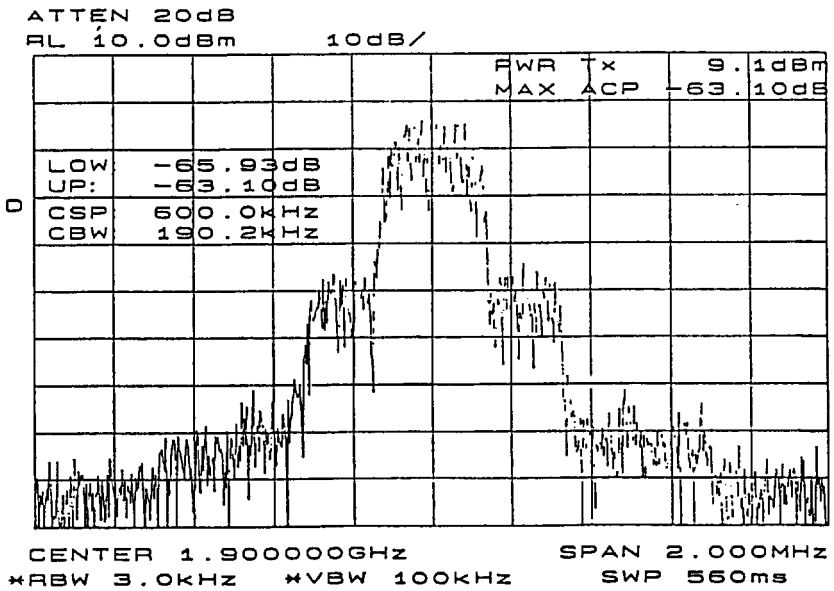
■ TYPICAL CHARACTERISTICS
TRANSMITTING MODE

Return loss vs. Frequency



V_{SW1}=2. 7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2, 3}$=3. 0V
I_{idle}=150mA

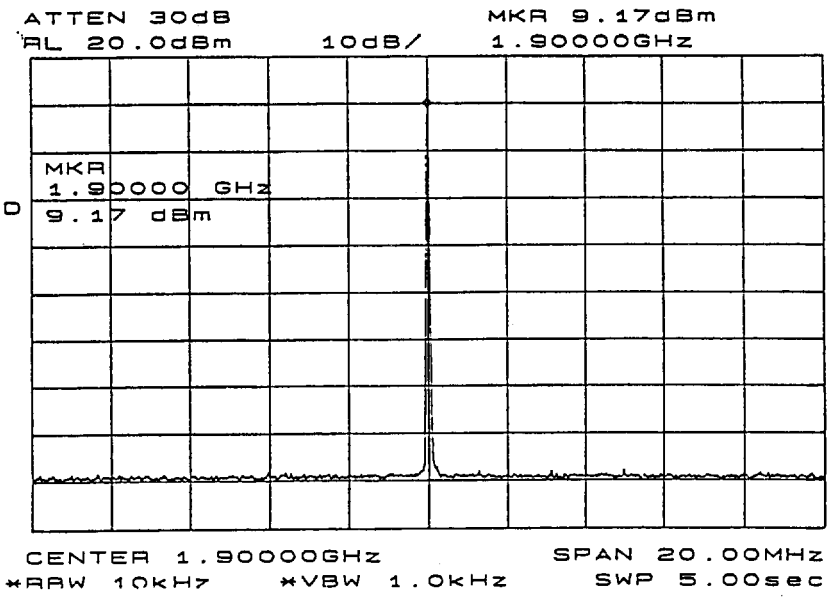
Adjacent Channel Power Spectrum



V_{SW1}=2. 7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2, 3}$=3. 0V
I_{idle}=150mA
P_{out}=20dBm

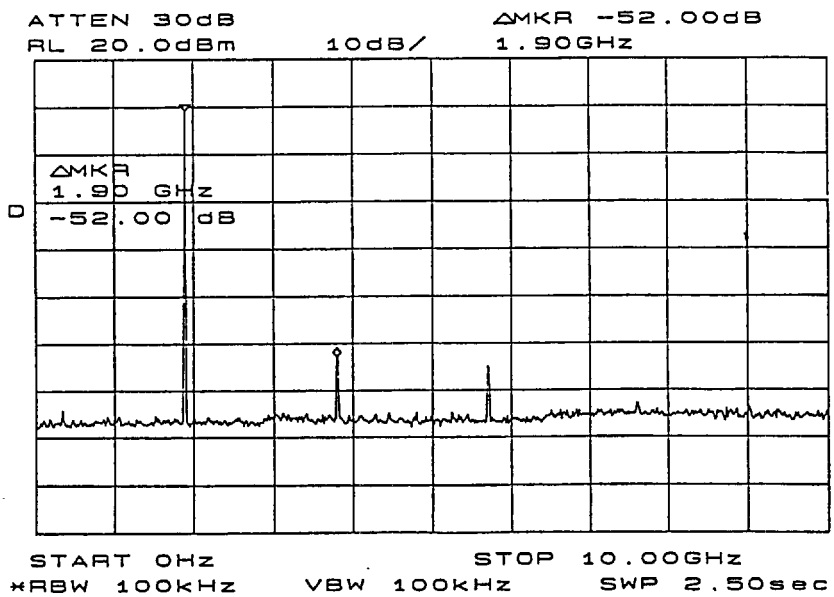
■ TYPICAL CHARACTERISTICS
TRANSMITTING MODE

Spectrum



V_{SW1}=2.7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2,3}$=3.0V
I_{idle}=150mA
P_{out}=20dBm

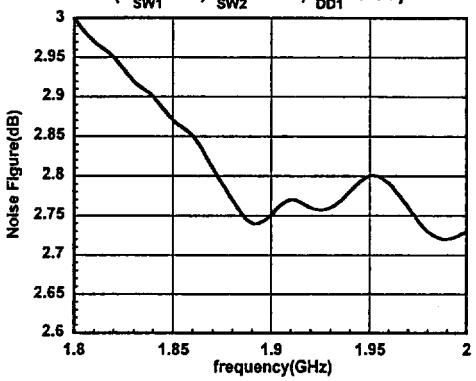
Spectrum



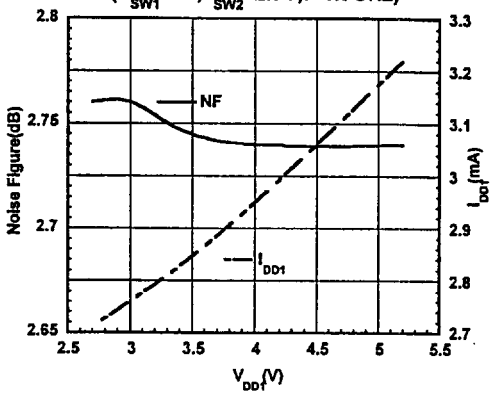
V_{SW1}=2.7V
V_{SW2}=0V
V_{CONT}=0V
V_{DD1}=0V
$V_{DD2,3}$=3.0V
I_{idle}=150mA
P_{out}=20dBm

■TYPICAL CHARACTERISTICS
RECEIVING MODE

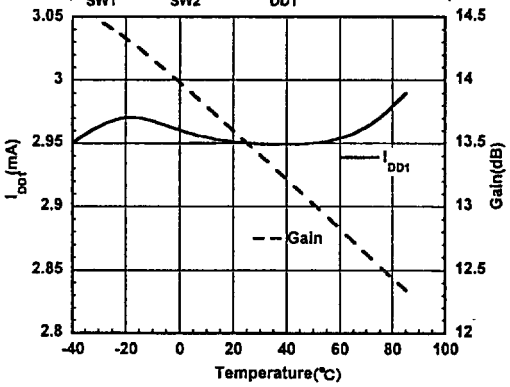
Noise Figure vs. Frequency
(V_{SW1}=0V,V_{SW2}=2.7V,V_{DD1}=3.0V)



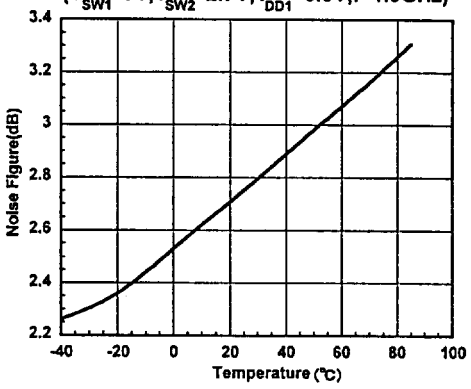
Noise Figure,I_{DD1} vs. V_{DD1}
(V_{SW1}=0V,V_{SW2}=2.7V,f=1.9GHz)



I_{DD1},Gain vs Temperature
(V_{SW1}=0V,V_{SW2}=2.7V,V_{DD1}=3.0V,f=1.9GHz)

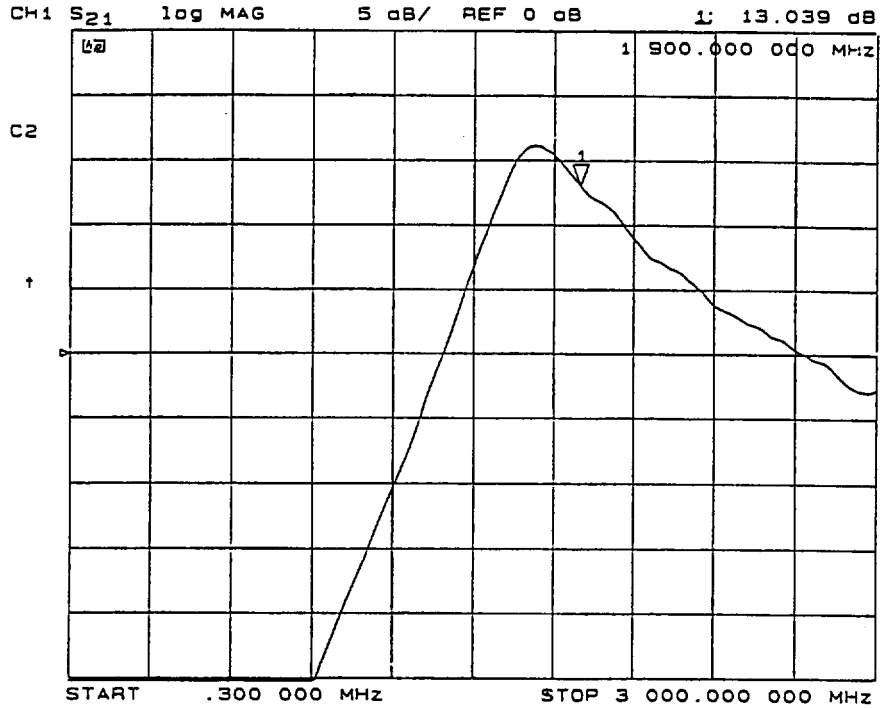


Noise Figure vs. Temperature
(V_{SW1}=0V,V_{SW2}=2.7V,V_{DD1}=3.0V,f=1.9GHz)



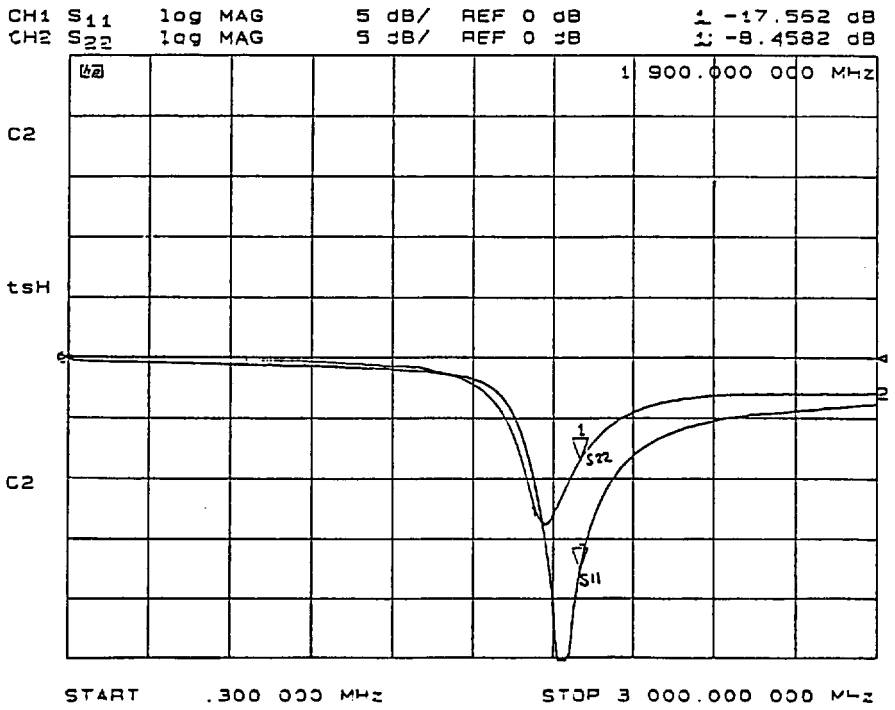
■ TYPICAL CHARACTERISTICS
RECEIVING MODE

Gain vs. Frequency



V_{SW1}=0V
V_{SW2}=2. 7V
V_{DD1}=3. 0V
$V_{DD2, 3}$=0V

Return loss vs. Frequency



V_{SW1}=0V
V_{SW2}=2. 7V
V_{DD1}=3. 0V
$V_{DD2, 3}$=0V

■TYPICAL CHARACTERISTICS

TRANSMITTING MODE

Scattering parameter

V_{SW1}=2.7V, V_{SW2}=0V, V_{CONT}=0V, $V_{DD2.3}$=3.0V, I_{idle}=150mA

Freq	S11		S21		S12		S22	
[GHz]	mag [U]	ang [deg]	mag [U]	ang [deg]	mag [U]	ang [deg]	mag [U]	ang [deg]
0.10	0.984	-25.5	0.0014	-115.8	0.0002	179.8	0.962	-6.2
0.20	0.981	-49.5	0.0030	-44.1	0.0002	-75.8	0.954	-13.0
0.30	0.976	-75.2	0.0070	-127.1	0.0002	-46.6	0.931	-18.9
0.40	0.965	-99.5	0.0200	-135.3	0.0003	-159.3	0.908	-25.1
0.50	0.960	-124.4	0.0810	-179.6	0.0004	-167.4	0.858	-30.5
0.60	0.939	-148.7	0.2281	140.0	0.0007	175.0	0.806	-37.4
0.70	0.925	-174.3	0.5201	101.0	0.0010	149.8	0.744	-40.7
0.80	0.901	161.5	1.0599	61.5	0.0015	130.7	0.675	-45.7
0.90	0.871	136.2	1.9032	23.2	0.0019	108.2	0.618	-45.1
1.00	0.836	111.1	3.1884	-15.8	0.0023	85.2	0.578	-45.9
1.10	0.789	86.0	4.8575	-52.9	0.0028	66.7	0.569	-43.1
1.20	0.731	59.2	7.1517	-89.4	0.0032	45.7	0.568	-45.6
1.30	0.664	32.8	9.8763	-123.7	0.0034	28.9	0.576	-47.1
1.40	0.575	4.4	15.1324	-159.4	0.0038	12.3	0.579	-51.5
1.50	0.458	-24.2	20.2683	161.7	0.0041	-6.7	0.571	-57.3
1.60	0.291	-54.0	26.9543	119.7	0.0039	-28.2	0.513	-68.0
1.70	0.141	-76.4	31.9275	78.3	0.0034	-43.7	0.425	-73.8
1.80	0.060	6.2	36.4196	37.6	0.0030	-62.4	0.318	-73.5
1.89	0.153	10.7	39.8900	2.2	0.0026	-63.1	0.254	-67.9
1.90	0.165	8.9	40.2071	-1.8	0.0025	-63.9	0.246	-67.1
1.91	0.175	6.7	40.5122	-5.7	0.0024	-68.3	0.238	-66.1
1.92	0.187	4.9	40.9092	-9.8	0.0024	-68.0	0.231	-64.9
2.00	0.263	-4.4	43.9007	-40.9	0.0023	-64.0	0.185	-54.7
2.10	0.339	-26.2	48.4188	-82.2	0.0023	-65.5	0.142	-30.4
2.20	0.465	-44.1	50.0754	-128.9	0.0027	-70.3	0.196	13.3
2.30	0.577	-72.8	44.1354	-178.6	0.0030	-85.2	0.375	20.5
2.40	0.619	-100.2	32.6524	136.9	0.0027	-98.9	0.535	8.3
2.50	0.614	-126.2	22.5856	100.2	0.0026	-107.9	0.610	-2.2
2.60	0.593	-147.4	15.6441	70.2	0.0021	-122.9	0.670	-10.7
2.70	0.577	-166.4	11.2877	44.3	0.0020	-113.7	0.690	-15.9
2.80	0.569	174.5	8.2112	20.5	0.0017	-118.4	0.720	-20.9
2.90	0.548	156.9	6.2537	-1.0	0.0023	-114.8	0.724	-24.0
3.00	0.550	136.9	4.7160	-22.3	0.0019	-146.3	0.744	-29.2

■TYPICAL CHARACTERISTICS

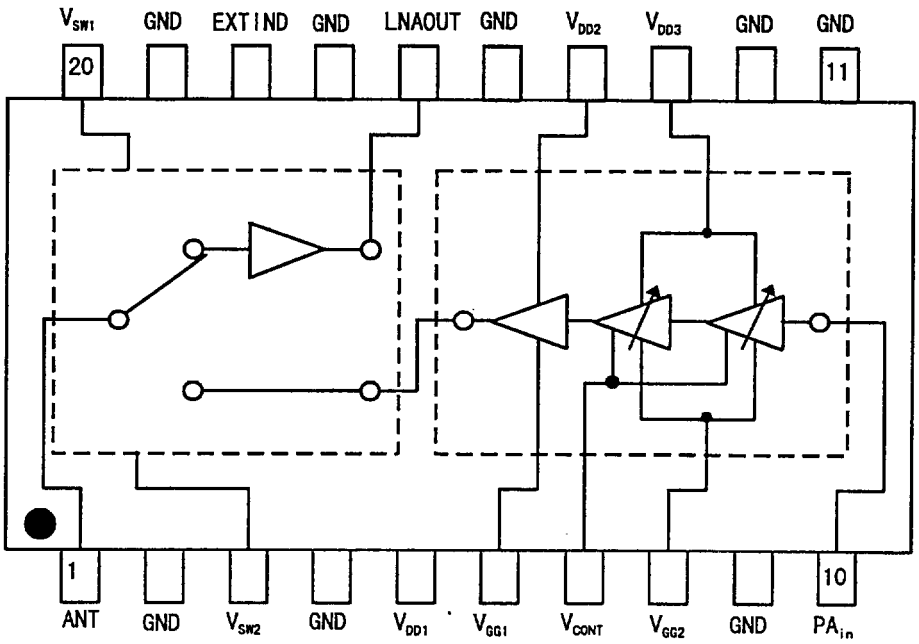
RECEIVING MODE

Scattering parameter

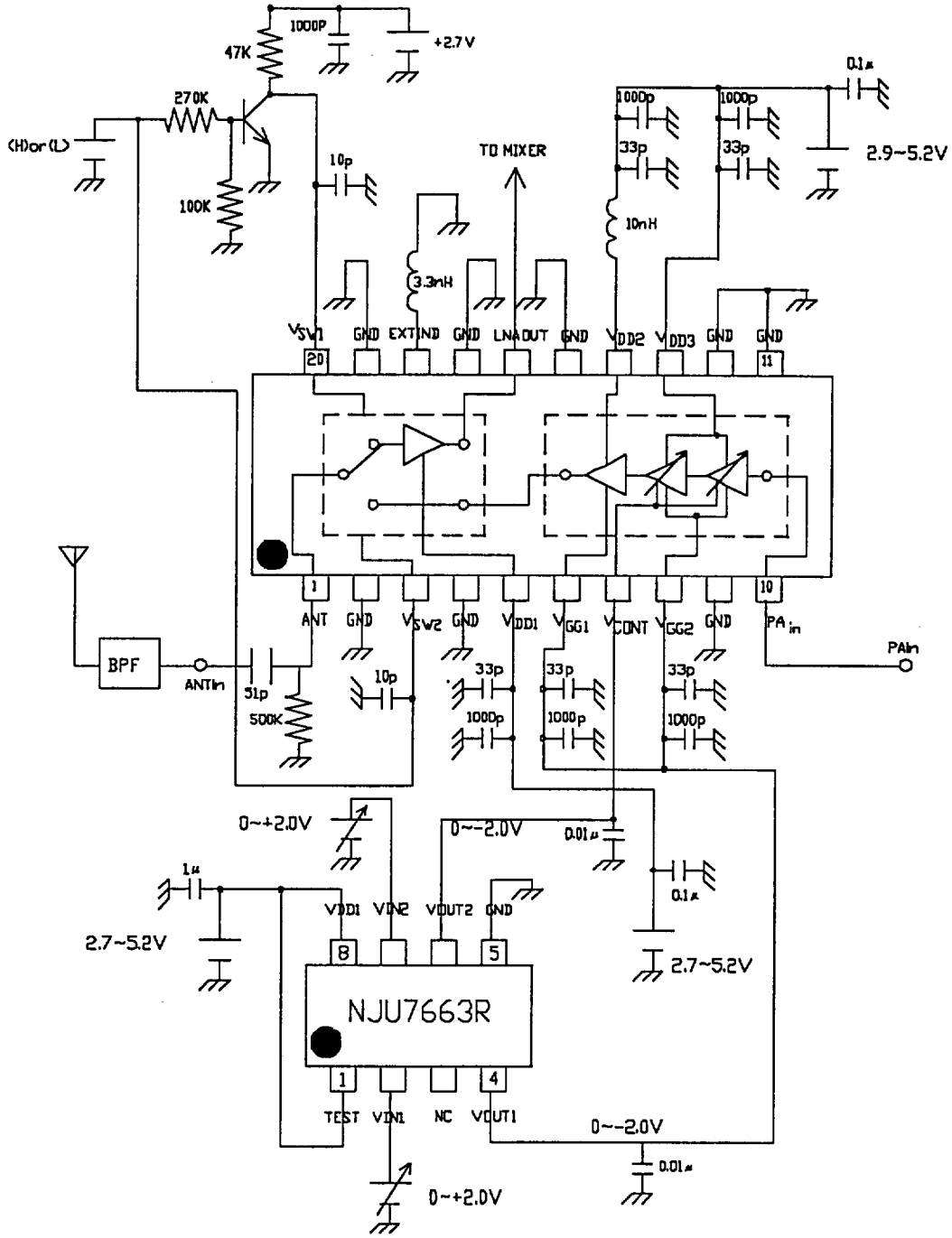
V_{SW1}=0V,V_{SW2}=2.7V,V_{DD1}=3.0V

Freq	S11		S21		S12		S22	
[GHz]	mag [U]	ang [deg]	mag [U]	ang [deg]	mag [U]	ang [deg]	mag [U]	ang [deg]
0.10	0.949	-24.5	0.0007	-22.3	0.0001	-13.8	1.005	0.8
0.20	0.937	-47.2	0.0005	-94.2	0.0000	38.9	1.006	1.2
0.30	0.931	-71.7	0.0007	42.4	0.0003	49.0	1.001	2.6
0.40	0.924	-94.6	0.0012	56.9	0.0002	157.5	1.006	3.3
0.50	0.925	-118.2	0.0032	-12.0	0.0002	118.5	1.001	4.6
0.60	0.909	-141.3	0.0048	4.8	0.0002	42.3	0.994	4.3
0.70	0.903	-165.9	0.0122	-43.4	0.0001	51.9	0.988	6.1
0.80	0.896	171.2	0.0268	-74.1	0.0002	27.7	0.979	6.0
0.90	0.886	146.7	0.0507	-101.9	0.0003	-8.5	0.970	7.4
1.00	0.878	122.6	0.0945	-129.9	0.0008	-27.8	0.961	7.6
1.10	0.867	98.2	0.1660	-155.6	0.0012	-49.7	0.949	9.1
1.20	0.851	72.1	0.3007	177.2	0.0021	-71.0	0.932	8.2
1.30	0.841	45.4	0.5265	149.1	0.0035	-99.1	0.915	7.9
1.40	0.823	16.7	1.0462	119.6	0.0055	-119.6	0.880	4.5
1.50	0.795	-15.1	2.0399	81.6	0.0087	-151.5	0.813	0.3
1.60	0.699	-56.4	4.2567	28.6	0.0098	175.6	0.638	-9.5
1.70	0.442	-106.2	6.4879	-41.7	0.0104	158.5	0.339	-12.7
1.80	0.096	-154.7	6.2827	-111.1	0.0134	151.3	0.210	50.8
1.89	0.100	1.8	5.0324	-159.6	0.0184	133.0	0.363	76.3
1.90	0.119	-3.0	4.8886	-164.3	0.0190	130.5	0.381	77.2
1.91	0.140	-6.0	4.7393	-168.9	0.0198	128.9	0.399	78.0
1.92	0.160	-8.3	4.6134	-173.7	0.0200	126.9	0.415	78.6
2.00	0.272	-29.6	3.6972	154.5	0.0239	107.3	0.523	80.8
2.10	0.383	-62.5	2.8789	120.2	0.0275	83.8	0.614	81.7
2.20	0.460	-87.8	2.2786	90.7	0.0301	63.0	0.675	81.0
2.30	0.508	-113.9	1.8558	64.5	0.0322	43.6	0.712	83.0
2.40	0.532	-138.1	1.5508	40.2	0.0345	26.4	0.726	84.1
2.50	0.555	-162.4	1.3178	18.0	0.0365	9.2	0.736	88.3
2.60	0.566	174.6	1.1358	-4.1	0.0379	-7.0	0.733	90.1
2.70	0.575	152.2	0.9882	-24.6	0.0397	-22.0	0.744	95.7
2.80	0.587	129.6	0.8661	-45.3	0.0413	-38.1	0.737	99.0
2.90	0.584	106.3	0.7524	-64.4	0.0423	-53.3	0.756	105.4
3.00	0.609	84.3	0.6545	-83.0	0.0433	-67.8	0.754	110.5

■ BLOCK DIAGRAM



■ RECOMMENDED CIRCUIT



The reflow method is recommended to install this device to PCB.

■RECOMMENDED PCB

(TOP VIEW)

PCB:FR4 t=0.2mm
50 Ω Micro Strip Line W=0.4mm
PCB SIZE 18.5×19mm

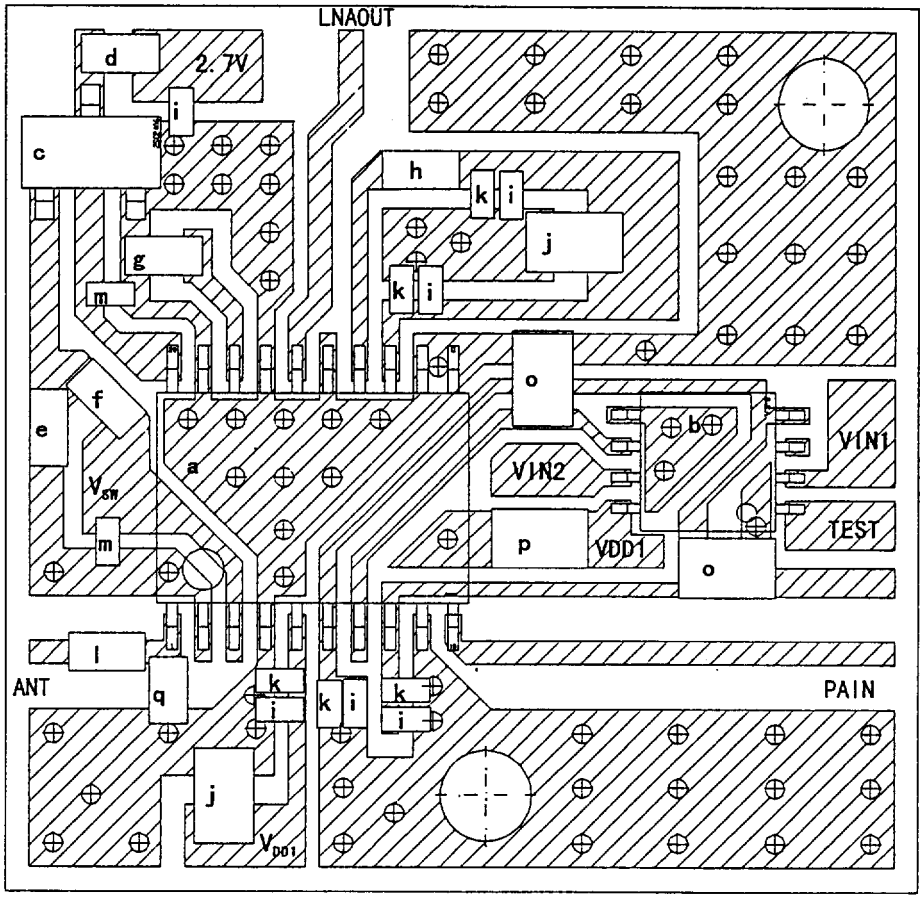


Table.1 Chip parts list

Parts ID	Constant	Comment	Parts ID	Contant	Comment
a	NJG1701V		i	1000pF	MURATA(GRM36)
b	NJU7663R		j	0.1 μ F	MURATA(GRM40)
c	2SC4713K		k	33pF	MURATA(GRM36)
d	47K Ω	TAMA Electronics(CRG16G)	l	51pF	MURATA(GRM36)
e	100K Ω	TAMA Electronics(CRG16G)	m	10pF	MURATA(GRM36)
f	270K Ω	TAMA Electronics(CRG16G)	o	0.01 μ F	MURATA(GRM40)
g	3.3nH	TAIYO-YUDEN(HK1608)	p	1 μ F	MURATA(GRM40)
h	10nH	TAIYO-YUDEN(HK1608)	q	500K Ω	TAMA Electronics(CRG16G)

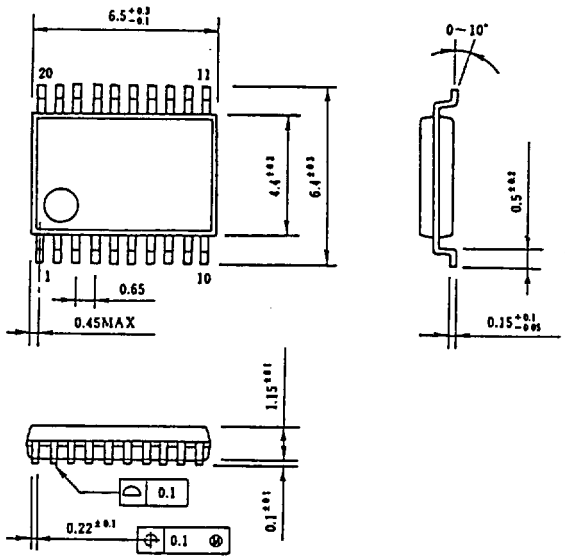
Note

Chip parts as follows should be connected to the leads of IC as near as possible.

5pin−k,i 13pin−k,i
6pin−k,i
8pin−k,i

■PACKAGE OUTLINE

SSOP20



UNIT:mm

Caution on using the products

A GaAs is used in this product. A GaAs is a harmful material.

- Don't eat or in the mouth.
- Don't dispose in fire or break up the products.
- Don't make a gas or a powdered with the chemical reaction.
- In the case of wasting the products, please obey the relation rule in the each country.

This product may be broken with static electric discharge or serge voltage.Therefore,please note a handling.

The other caution item

- The product specifications and descriptions listed in this catalog are subject to change at any time, without notice.
- We don't take upon ourselves the responsibilities that infringe on other people's rights of a patents bringing about the information and drawing in this catalog.
- It is not purpose to be equipped with the system needs a high reliability as air system, submarine cable system, atomic energy control system and medical instrument for keeping life.
- If you think the above system, please ask for the sales office before.