



# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC3231GV

## GENERAL PURPOSE 5 V 100 MHz AGC AMPLIFIER

### DESCRIPTION

The  $\mu$ PC3231GV is a silicon monolithic IC designed for use as AGC amplifier for digital CATV, cable modem and digital terrestrial systems. This IC consists of gain control amplifier and video amplifier.

The package is 8-pin SSOP (Shrink Small Outline Package) suitable for surface mount.

This IC is manufactured using our 30 GHz  $f_{max}$  UHS0 (Ultra High Speed Process) silicon bipolar process.

This process uses silicon nitride passivation film. This material can protect chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

### FEATURES

- Low distortion :  $IM_3 = 53.5$  dBc TYP. @ single-ended output,  $V_{out} = 105$  dB $\mu$ V (0.5  $V_{p-p}$ ) /tone
- Low noise figure : NF = 5.0 dB TYP. @ maximum gain
- Wide AGC dynamic range :  $GCR_{in} = 61$  dB TYP. @ input prescribe
- On-chip video amplifier :  $V_{out} = 1.0$   $V_{p-p}$  TYP. @ single-ended output
- Supply voltage :  $V_{CC} = 5.0$  V TYP.
- Packaged in 8-pin SSOP suitable for surface mounting

### APPLICATION

- Digital terrestrial TV/Digital CATV/Cable modem receivers

### ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
$\mu$ PC3231GV-E1	$\mu$ PC3231GV-E1-A	8-pin plastic SSOP (4.45 mm (175)) (Pb-Free)	3231	<ul style="list-style-type: none"><li>• Embossed tape 8 mm wide</li><li>• Pin 1 indicates pull-out direction of tape</li><li>• Qty 1 kpcs/reel</li></ul>

**Remark** To order evaluation samples, contact your nearby sales office.

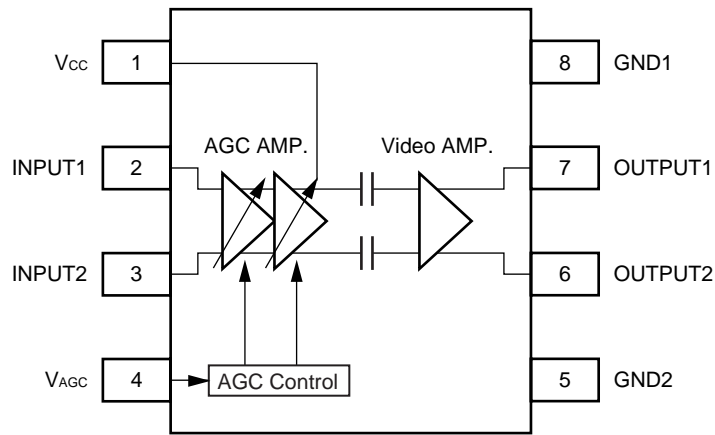
Part number for sample order:  $\mu$ PC3231GV-A

**Caution** Observe precautions when handling because these devices are sensitive to electrostatic discharge.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**INTERNAL BLOCK DIAGRAM AND PIN CONNECTIONS**

**(Top View)**



**PRODUCT LINE-UP OF 5 V AGC AMPLIFIER**

Part Number	I <sub>CC</sub> (mA)	G <sub>MAX</sub> (dB)	G <sub>MIN</sub> (dB)	G <sub>CR</sub> (dB)	NF (dB)	IM <sub>3</sub> (dBc)	Package
$\mu$ PC3217GV	23	53	0	53	6.5	50 <sup>Note1</sup>	8-pin SSOP (4.45 mm (175))
$\mu$ PC3218GV	23	63	10	53	3.5	50 <sup>Note1</sup>	
$\mu$ PC3219GV	36.5	42.5	0	42.5	9.0	58 <sup>Note1</sup>	
$\mu$ PC3221GV	33	60	10	50	4.2	56 <sup>Note1</sup>	
$\mu$ PC3231GV	36	65	4	61	5.0	53.5 <sup>Note2</sup>	

**Notes 1.** f<sub>1</sub> = 44 MHz, f<sub>2</sub> = 45 MHz, V<sub>out</sub> = 0.7 V<sub>p-p</sub>/tone, single-ended output

**2.** f<sub>1</sub> = 44 MHz, f<sub>2</sub> = 45 MHz, V<sub>out</sub> = 0.5 V<sub>p-p</sub>/tone, single-ended output

**PIN EXPLANATIONS**

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) <small>Note</small>	Function and Application	Internal Equivalent Circuit
1	V <sub>CC</sub>	4.5 to 5.5	–	Power supply pin. This pin should be externally equipped with bypass capacitor to minimize ground impedance.	—
2	INPUT1	–	1.32	Signal input pins to AGC amplifier. This pin should be coupled with capacitor for DC cut.	
3	INPUT2	–	1.32		
4	V <sub>AGC</sub>	0 to V <sub>CC</sub>	–	Gain control pin. This pin's bias govern the AGC output level. Minimum Gain at V <sub>AGC</sub> : 0 to 0.1 V Maximum Gain at V <sub>AGC</sub> : 2.7 to 3.3 V Recommended to use AGC voltage with externally resistor (example: 1 kΩ).	
5	GND2	0	–	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible.	—
6	OUTPUT2	–	1.91	Signal output pins of video amplifier. This pin should be coupled with capacitor for DC cut.	
7	OUTPUT1	–	1.91		
8	GND1	0	–	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All ground pins must be connected together with wide ground pattern to decrease impedance difference.	—

**Note** Pin voltage is measured at V<sub>CC</sub> = 5.0 V.

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V <sub>CC</sub>	T <sub>A</sub> = +25°C	6.0	V
Gain Control Voltage Range	V <sub>AGC</sub>	T <sub>A</sub> = +25°C	0 to V <sub>CC</sub>	V
Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = +85°C <b>Note</b>	250	mW
Storage Temperature	T <sub>stg</sub>		-55 to +150	°C

**Note** Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

**RECOMMENDED OPERATING RANGE**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>		4.5	5.0	5.5	V
Operating Ambient Temperature	T <sub>A</sub>	V <sub>CC</sub> = 4.5 to 5.5 V	-40	+25	+85	°C
Gain Control Voltage Range	V <sub>AGC</sub>		0	-	3.3	V
Operating Frequency Range	f <sub>BW</sub>		30	-	90	MHz

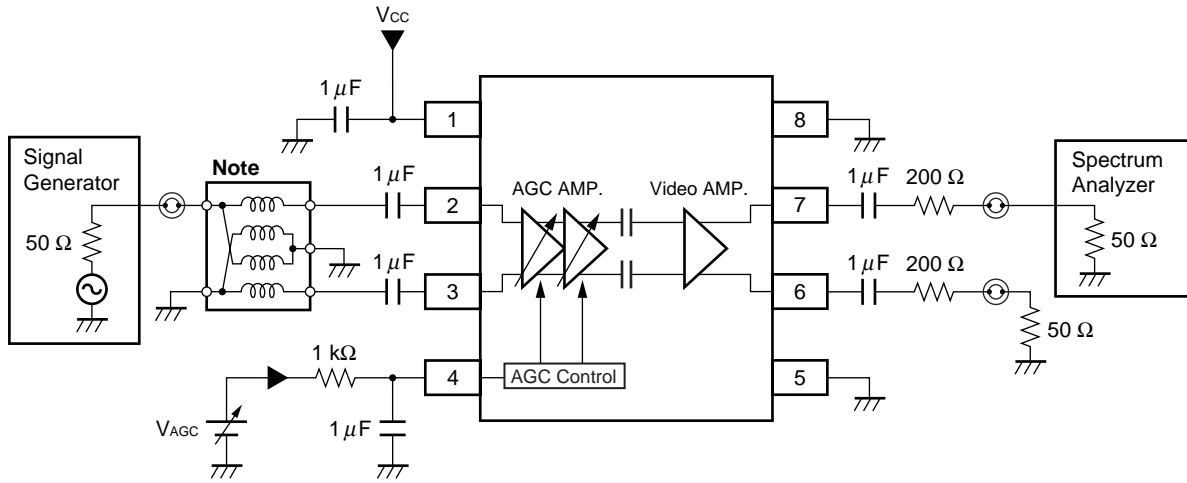
**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5 V, f = 45 MHz, Z<sub>s</sub> = 50 Ω, Z<sub>L</sub> = 250 Ω, single-ended output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Circuit Current	I <sub>CC</sub>	V <sub>CC</sub> = 5 V, No input signal <b>Note 1</b>	28	36	44	mA
AGC Voltage High Level	V <sub>AGC (H)</sub>	@ Maximum gain <b>Note 1</b>	2.7	–	3.3	V
AGC Voltage Low Level	V <sub>AGC (L)</sub>	@ Minimum gain <b>Note 1</b>	0	–	0.1	V
RF Characteristics						
IF Input Voltage Range	f <sub>IFin</sub>	f <sub>c</sub> = –3 dB <b>Note 1</b>	30	–	90	MHz
Maximum Voltage Gain	G <sub>MAX</sub>	V <sub>AGC</sub> = 2.7 V, P <sub>in</sub> = –60 dBm <b>Note 1</b>	62.5	65	67.5	dB
Minimum Voltage Gain	G <sub>MIN</sub>	V <sub>AGC</sub> = 0.1 V, P <sub>in</sub> = –30 dBm <b>Note 1</b>	0	4	7	dB
Gain Control Range (input prescribe)	GCR <sub>in</sub>	V <sub>AGC</sub> = 0.1 to 2.7 V <b>Note 1</b>	55.5	61	–	dB
Gain Control Range (output prescribe)	GCR <sub>out</sub>	V <sub>out</sub> = 1.0 V <sub>p-p</sub> <b>Note 1</b>	45	55	–	dB
Output Voltage	V <sub>out</sub>	P <sub>in</sub> = –61 to –6 dBm <b>Note 1</b>	–	1.0	–	V <sub>p-p</sub>
Maximum Output Voltage	V <sub>oclip</sub>	V <sub>AGC</sub> = 3.0 V <b>Note 1</b>	2.0	3.3	–	V <sub>p-p</sub>
Noise Figure	NF	V <sub>AGC</sub> = 3.0 V <b>Note 2</b>	–	5.0	6.5	dB
3rd Order Intermodulation Distortion	IM <sub>3</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz, P <sub>in</sub> = –20 dBm/tone, V <sub>out</sub> = 105 dB <sub>μV</sub> (0.5 V <sub>p-p</sub> ) /tone <b>Note 1</b>	50	53.5	–	dBc
Input Impedance	Z <sub>in</sub>	V <sub>AGC</sub> = 0 V <b>Note 3</b>	–	1.35//6	–	kΩ//pF

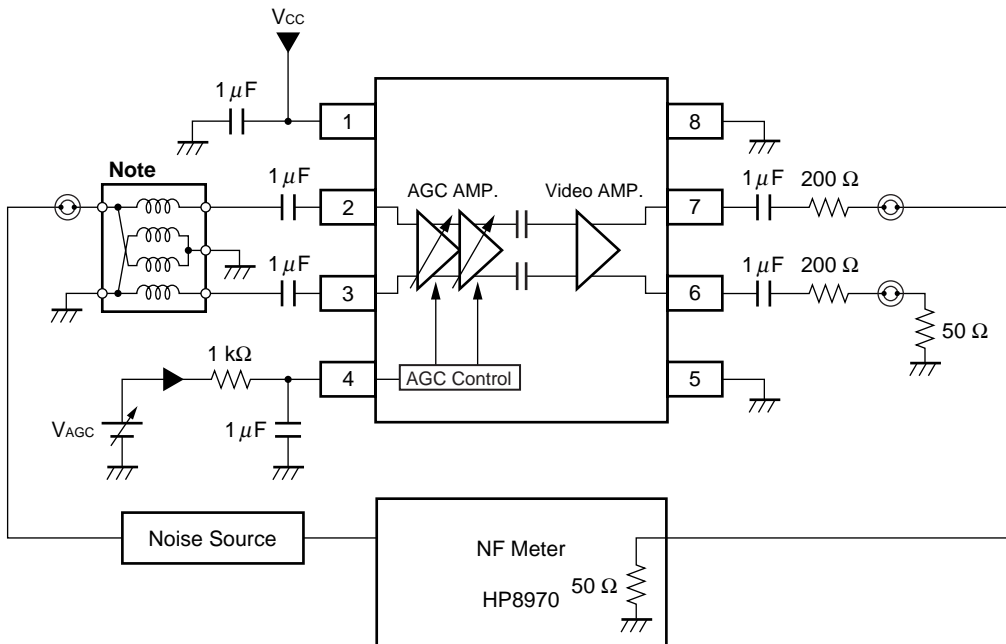
- Notes 1.** By measurement circuit 1
- 2.** By measurement circuit 2
- 3.** By measurement circuit 3

**MEASUREMENT CIRCUIT 1**



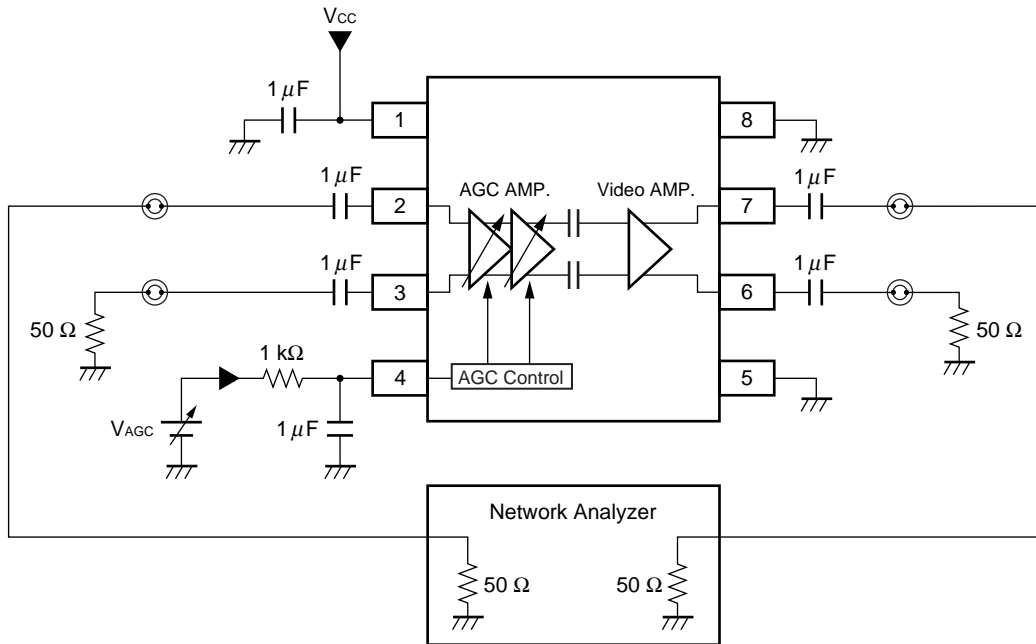
**Note** Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

**MEASUREMENT CIRCUIT 2**

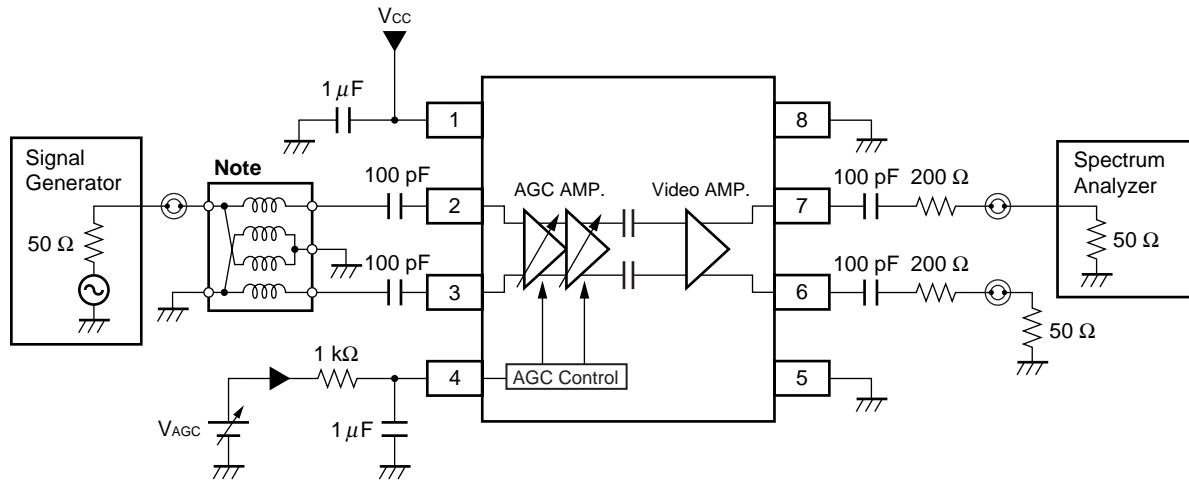


**Note** Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

**MEASUREMENT CIRCUIT 3**

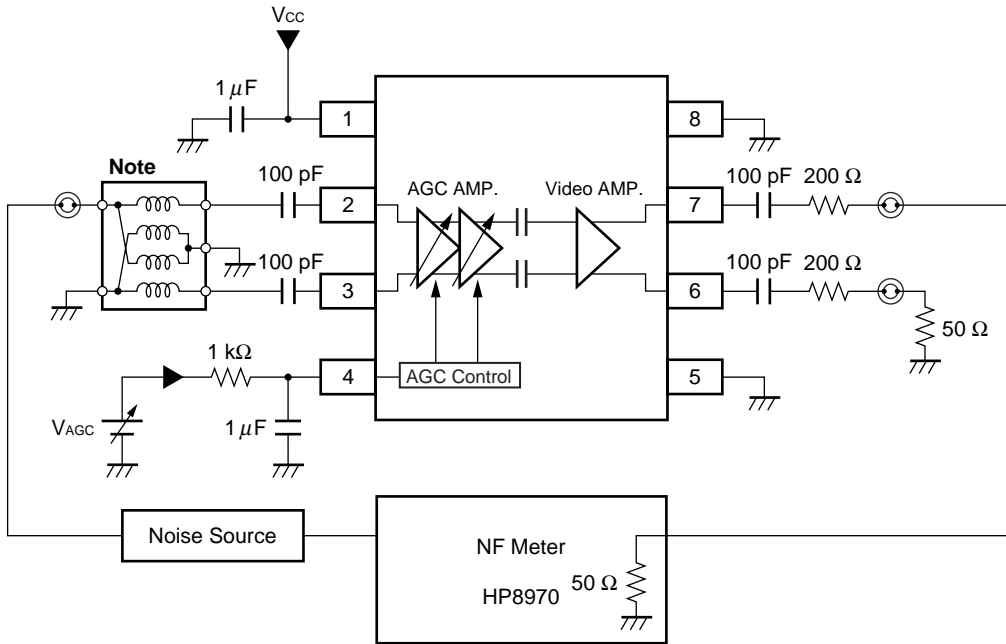


**MEASUREMENT CIRCUIT 4 (PRESSURE IMPROVEMENT RECOMMENDATION CIRCUIT)**



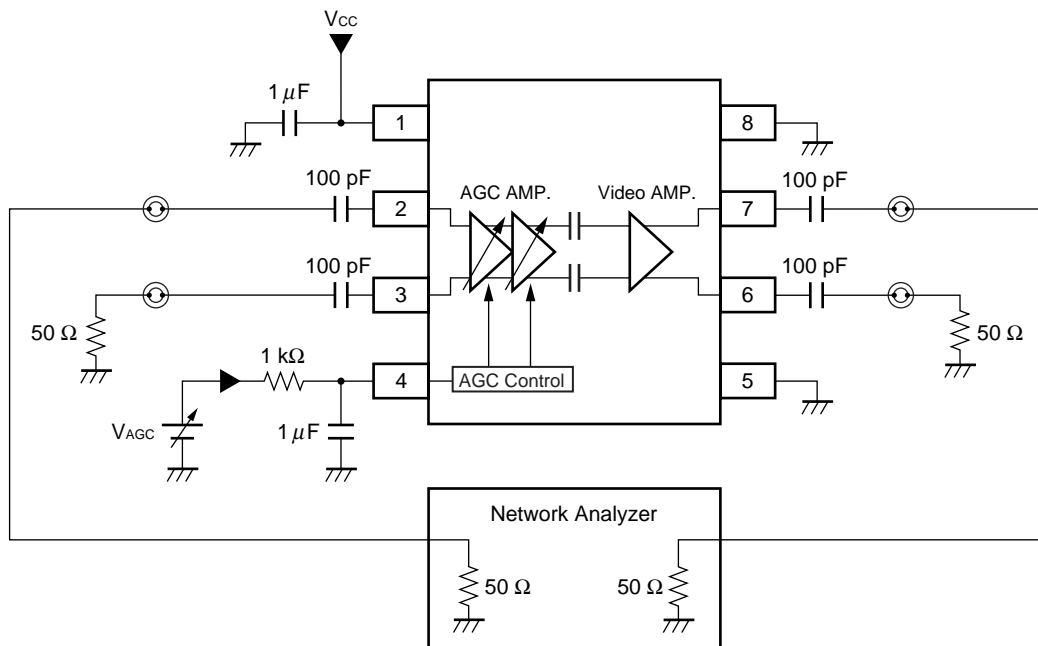
**Note** Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

**MEASUREMENT CIRCUIT 5 (PRESSURE IMPROVEMENT RECOMMENDATION CIRCUIT)**



**Note** Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

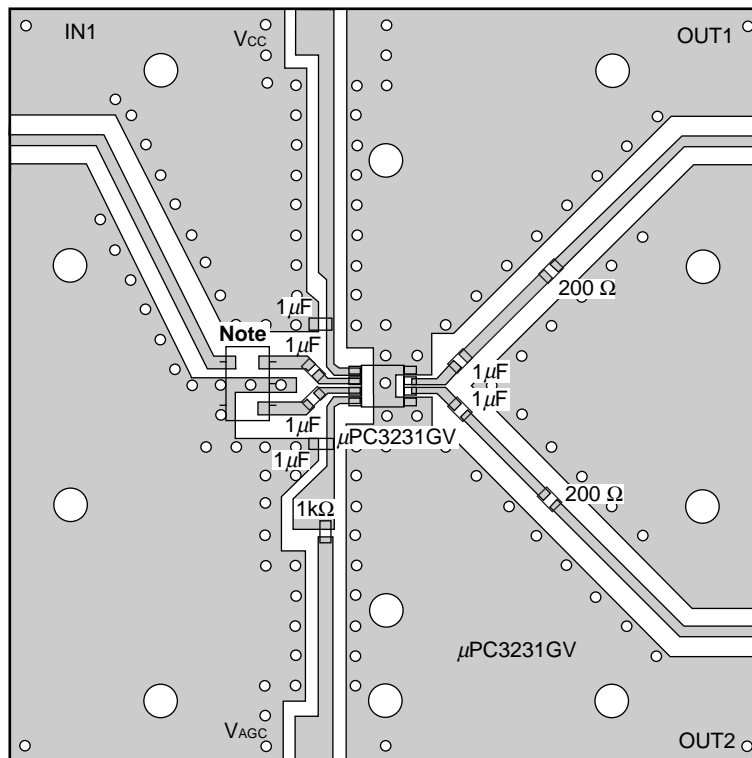
**MEASUREMENT CIRCUIT 6 (PRESSURE IMPROVEMENT RECOMMENDATION CIRCUIT)**



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.



ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD  
(MEASUREMENT CIRCUIT 1)



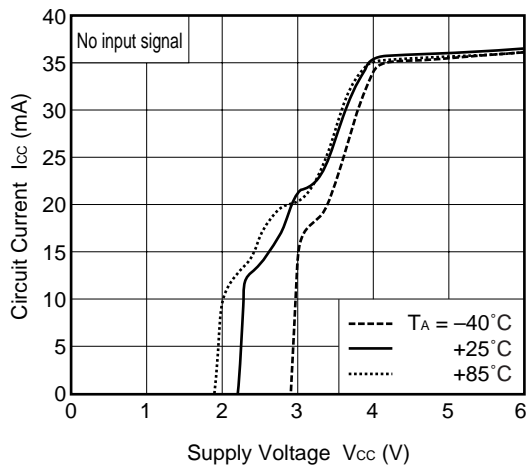
**Note** Balun Transformer

**Remarks**

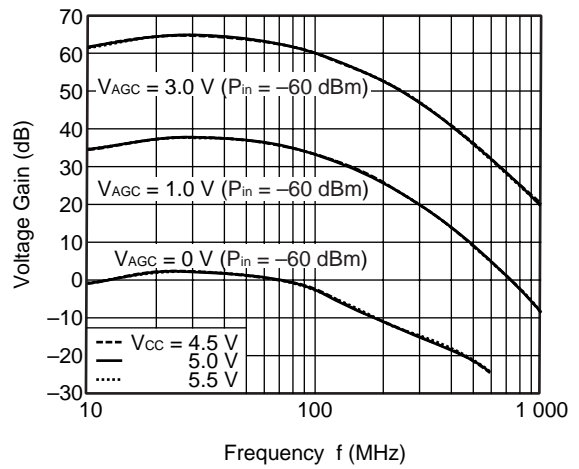
1. Back side: GND pattern
2. Au plated on pattern
3. ○: Through hole

**TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$  , unless otherwise specified)**

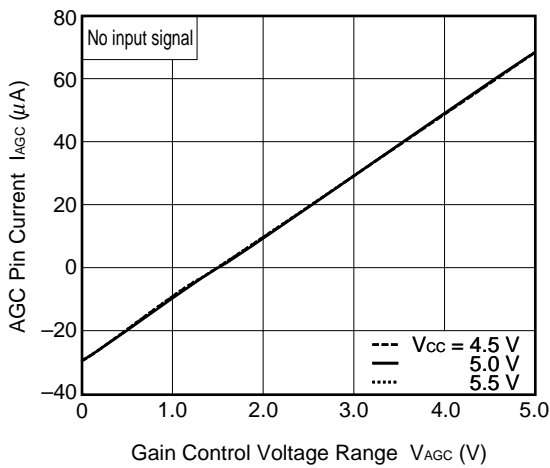
**CIRCUIT CURRENT vs. SUPPLY VOLTAGE**



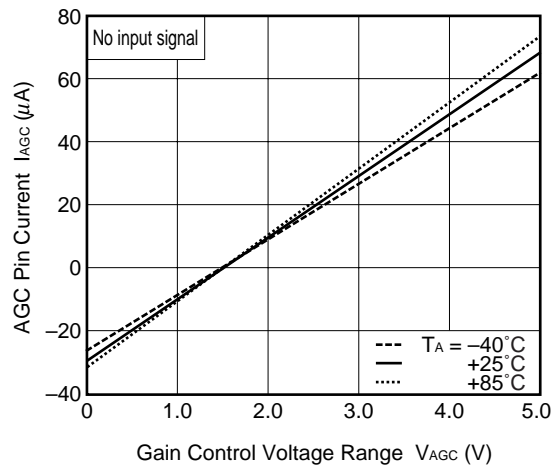
**VOLTAGE GAIN vs. FREQUENCY**



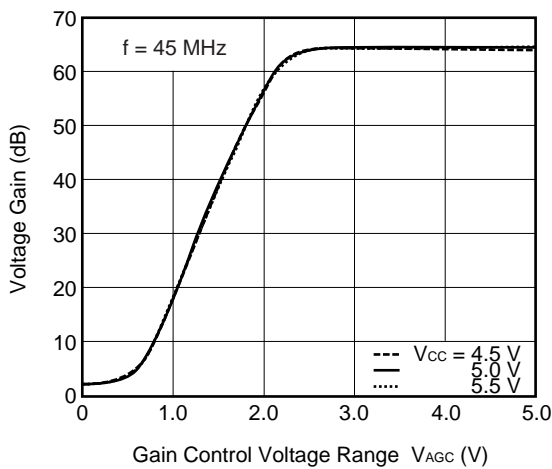
**AGC PIN CURRENT vs. GAIN CONTROL VOLTAGE RANGE**



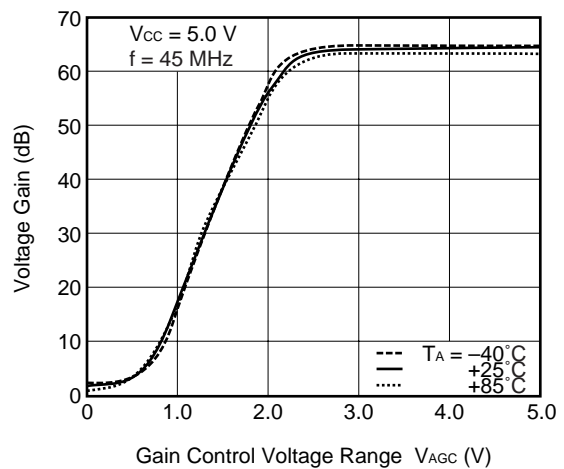
**AGC PIN CURRENT vs. GAIN CONTROL VOLTAGE RANGE**



**VOLTAGE GAIN vs. GAIN CONTROL VOLTAGE RANGE**

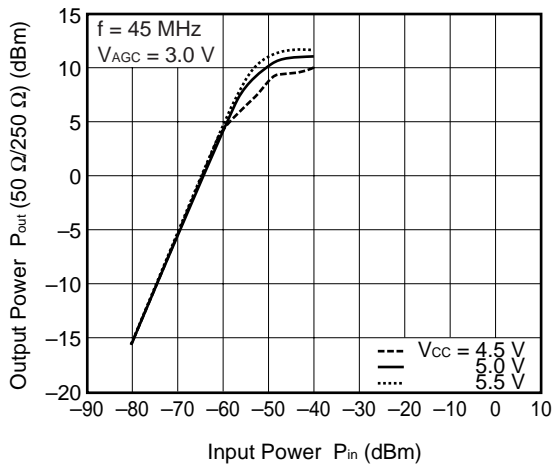


**VOLTAGE GAIN vs. GAIN CONTROL VOLTAGE RANGE**

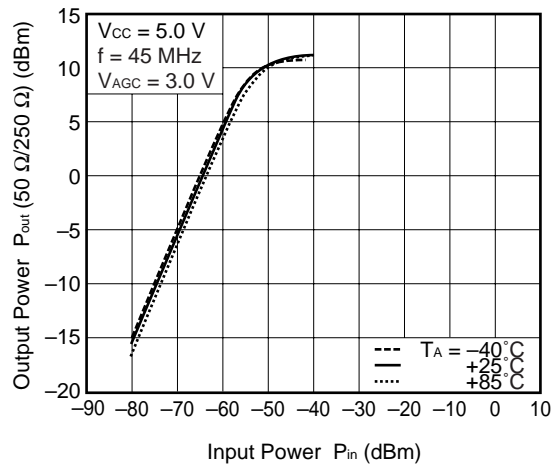


**Remark** The graphs indicate nominal characteristics.

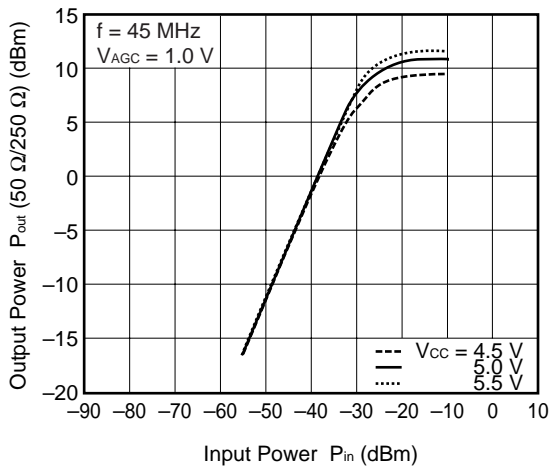
OUTPUT POWER vs. INPUT POWER



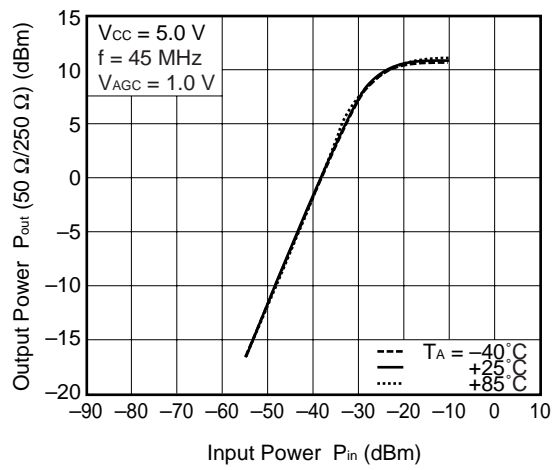
OUTPUT POWER vs. INPUT POWER



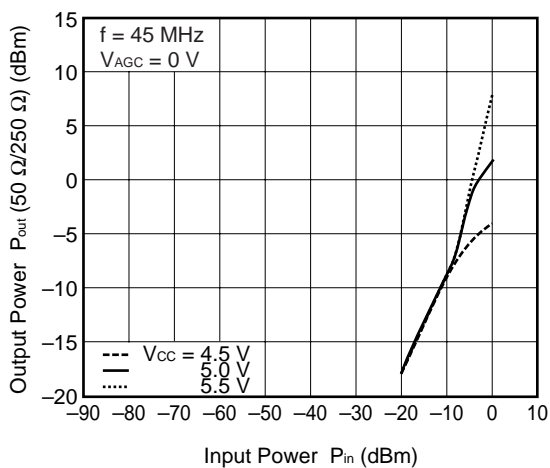
OUTPUT POWER vs. INPUT POWER



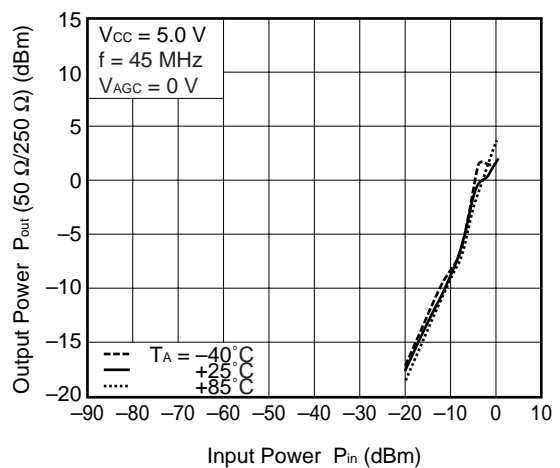
OUTPUT POWER vs. INPUT POWER



OUTPUT POWER vs. INPUT POWER

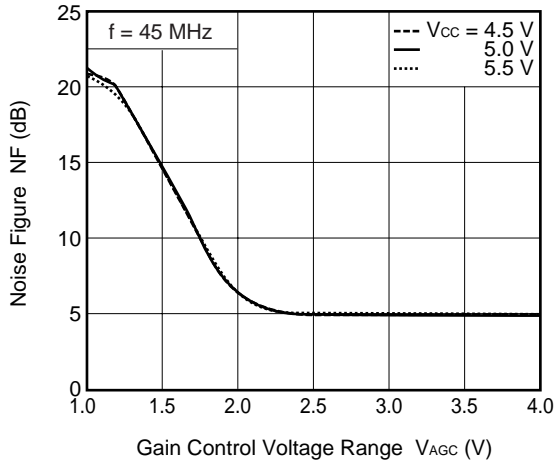


OUTPUT POWER vs. INPUT POWER

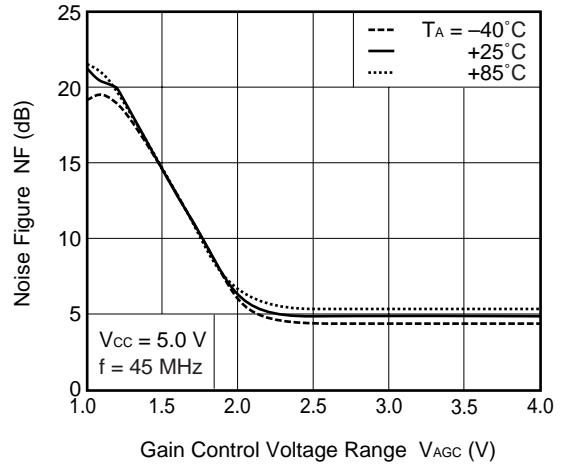


**Remark** The graphs indicate nominal characteristics.

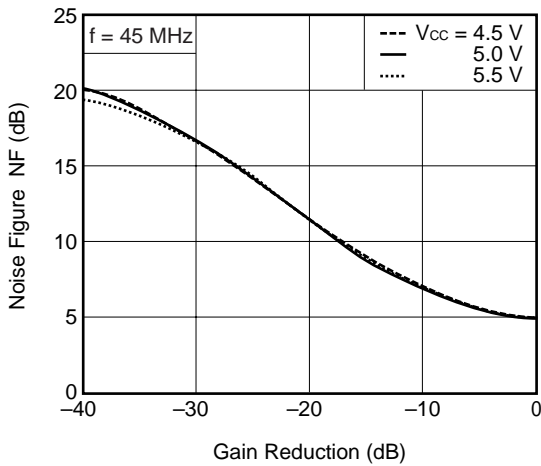
NOISE FIGURE vs. GAIN CONTROL VOLTAGE RANGE



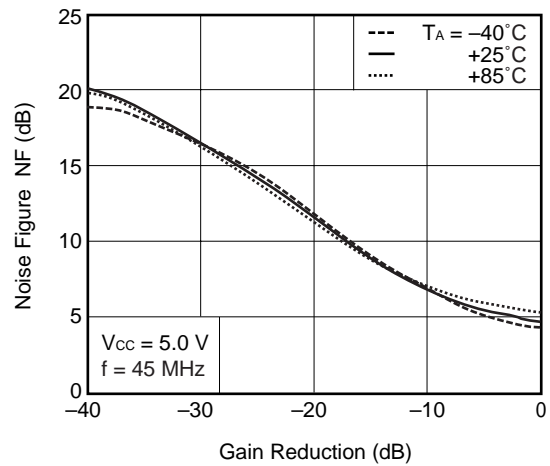
NOISE FIGURE vs. GAIN CONTROL VOLTAGE RANGE



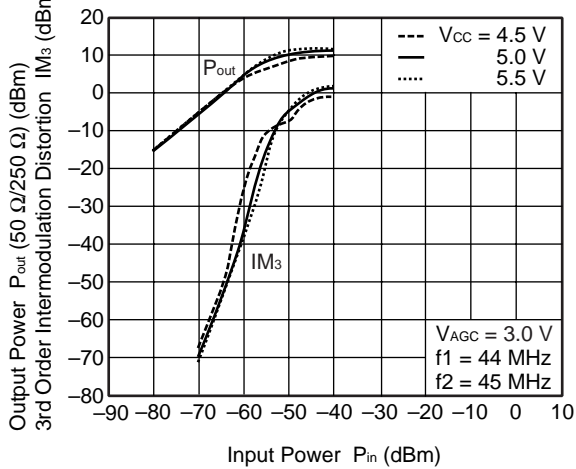
NOISE FIGURE vs. GAIN REDUCTION



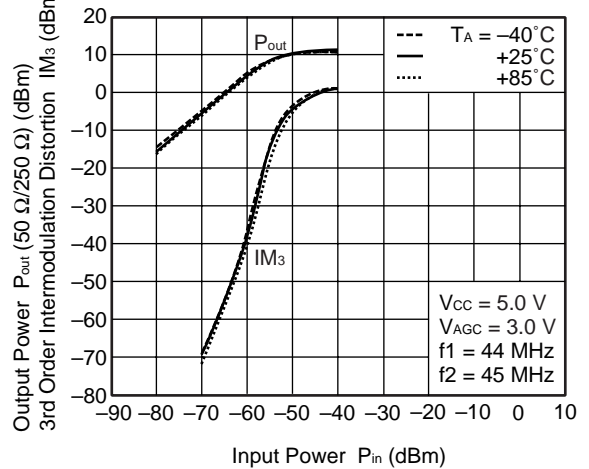
NOISE FIGURE vs. GAIN REDUCTION



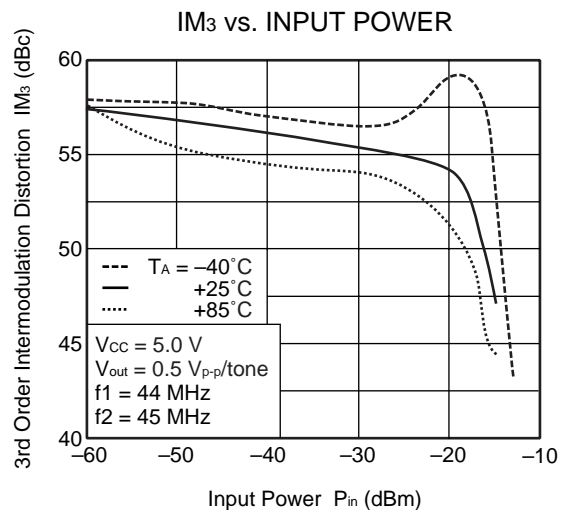
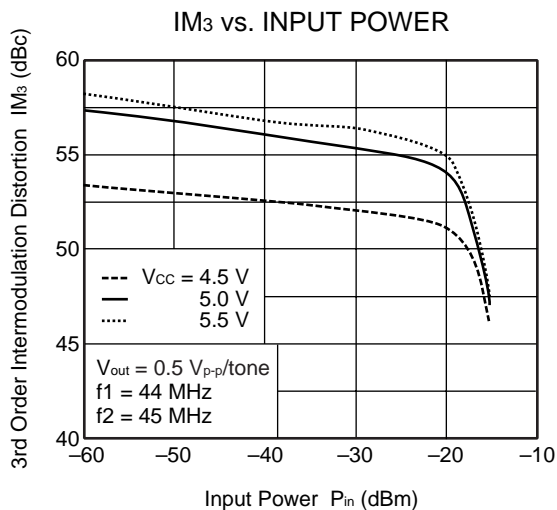
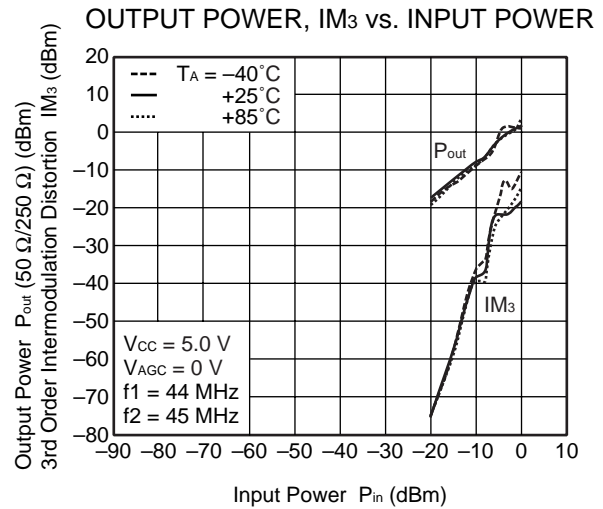
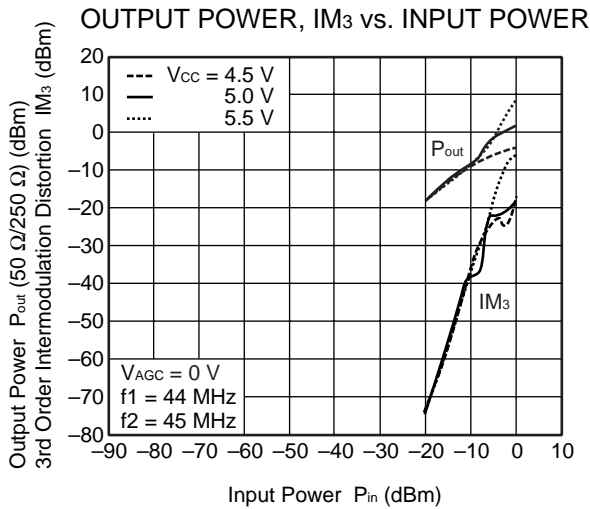
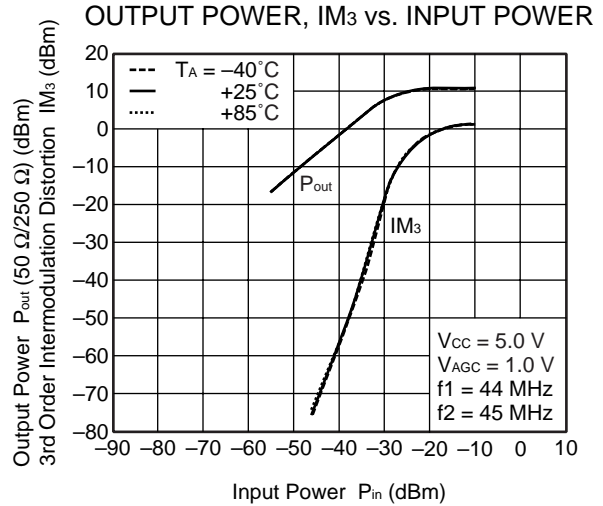
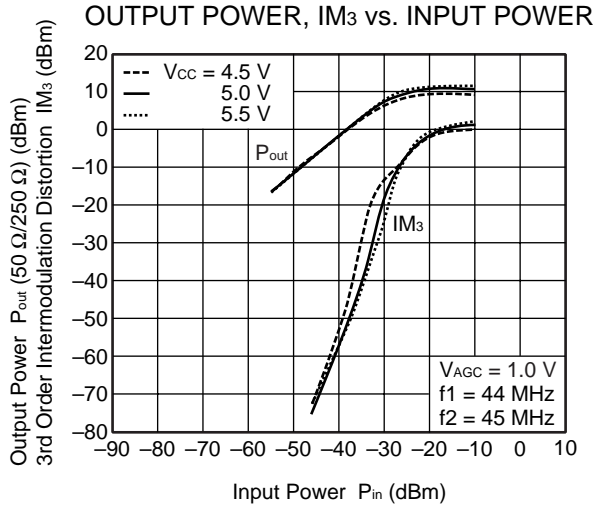
OUTPUT POWER,  $IM_3$  vs. INPUT POWER



OUTPUT POWER,  $IM_3$  vs. INPUT POWER



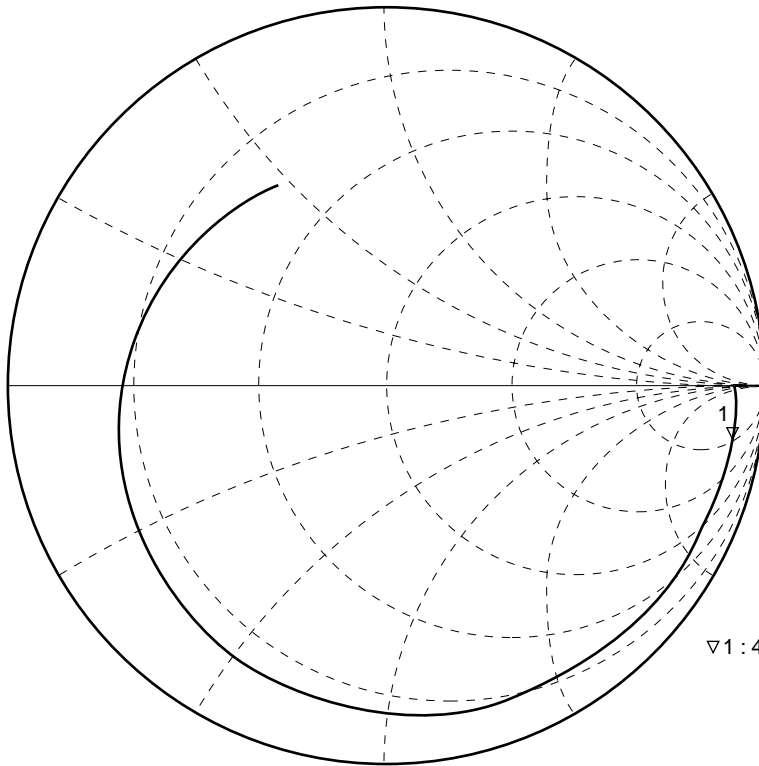
**Remark** The graphs indicate nominal characteristics.



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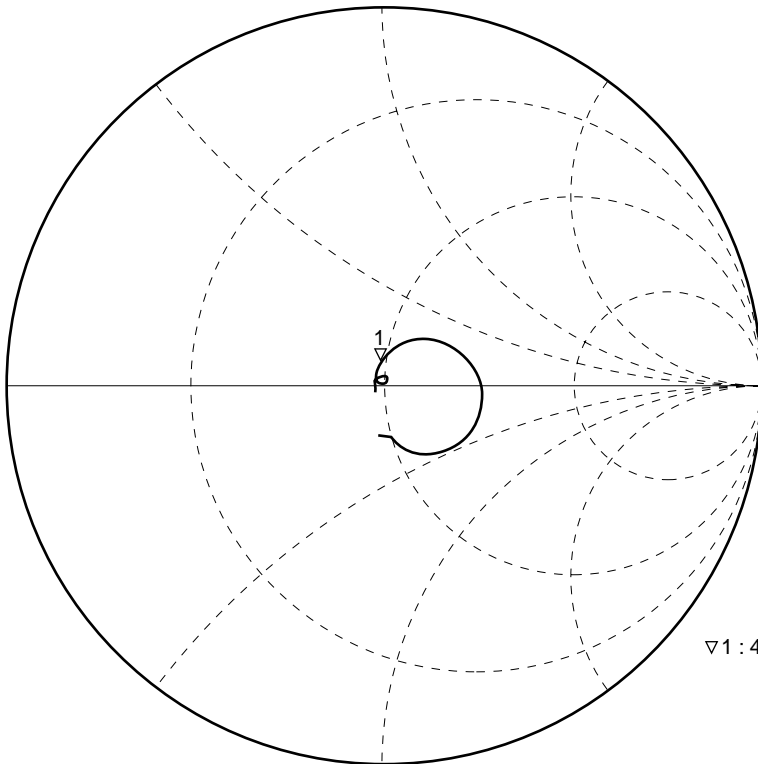
S-PARAMETERS ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ ,  $V_{AGC} = 0\text{ V}$ )

S<sub>11</sub>-FREQUENCY



▽1 : 45 MHz    223.93  $\Omega$     -506.44  $\Omega$     6.98 pF

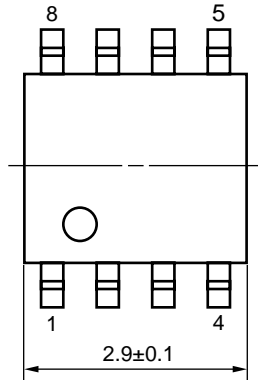
S<sub>22</sub>-FREQUENCY



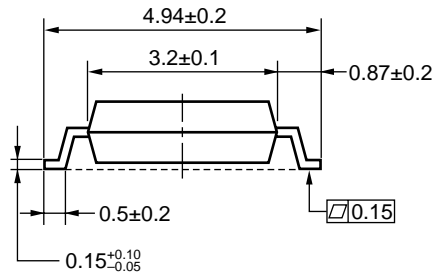
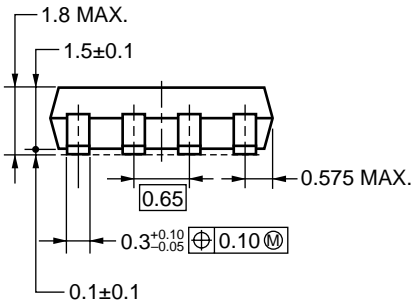
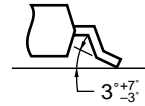
▽1 : 45 MHz    49.68  $\Omega$     5.39  $\Omega$     19.86 nH

PACKAGE DIMENSIONS

8-PIN PLASTIC SSOP (4.45 mm (175)) (UNIT: mm)



detail of lead end



**NOTES ON CORRECT USE**

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).  
All the ground pins must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to Vcc line.

**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions	Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Wave Soldering	Peak temperature (molten solder temperature) : 260°C or below Time at peak temperature : 10 seconds or less Preheating temperature (package surface temperature) : 120°C or below Maximum number of flow processes : 1 time Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (pin temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	HS350

**Caution Do not use different soldering methods together (except for partial heating).**



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"Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

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CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

Important Information and Disclaimer: Information provided by CEL on its website or in other communications concerning the substance content of its products represents knowledge and belief as of the date that it is provided. CEL bases its knowledge and belief on information provided by third parties and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. CEL has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. CEL and CEL suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall CEL’s liability arising out of such information exceed the total purchase price of the CEL part(s) at issue sold by CEL to customer on an annual basis.

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