

# BIPOLAR ANALOG INTEGRATED CIRCUITS

# $\mu$ PC3217GV, $\mu$ PC3218GV

### GENERAL PURPOSE 5 V AGC AMPLIFIER

#### DESCRIPTION

The  $\mu$ PC3217GV,  $\mu$ PC3218GV are silicon monolithic ICs designed for use as AGC amplifier for digital CATV, cable modem systems. These ICs consist of gain control amplifier and video amplifier.

The package is 8-pin SSOP suitable for surface mount.

These ICs are manufactured using NEC's 10 GHz fr NESAT™II AL silicon bipolar process. This process uses silicon nitride passivation film. This material can protect chip surface from external pollution and prevent corrosion/migration. Thus, these ICs have excellent performance, uniformity and reliability.

#### FEATURES

- Low distortion IM<sub>3</sub> = 50 dBc TYP. @single-ended output, V<sub>out</sub> = 0.7 V<sub>P-P</sub>/tone
- Wide AGC dynamic range GCR = 53 dB TYP.
- On-chip video amplifier V<sub>out</sub> = 1.0 V<sub>P-P</sub> TYP. @single-ended output
- Supply voltage: 5 V
- Packaged in 8-pin SSOP suitable for surface mounting

#### APPLICATIONS

- Digital CATV/Cable modem receivers

#### ORDERING INFORMATION

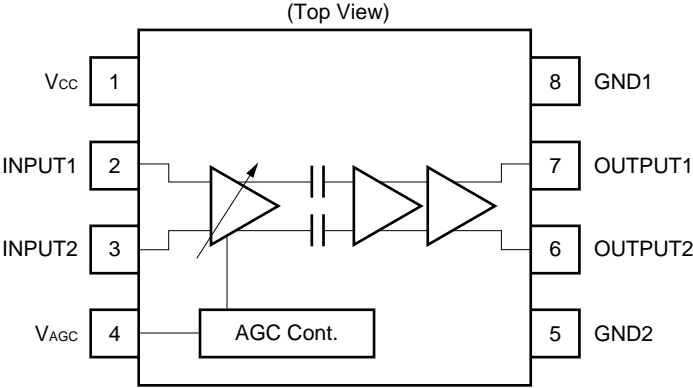
Part Number	Package	Supplying Form
$\mu$ PC3217GV-E1	8-pin plastic SSOP (4.45 mm (175))	Embossed tape 8 mm wide. Pin 1 indicates pull-out direction of tape. Qty 1 kpcs/reel.
$\mu$ PC3218GV-E1		

**Remark** To order evaluation samples, please contact your local NEC sales office (Part number for sample order:  $\mu$ PC3217GV,  $\mu$ PC3218GV).

**Caution** electro-static sensitive devices

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.  
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION ( $\mu$ PC3217GV,  $\mu$ PC3218GV common)



**PIN EXPLANATIONS ( $\mu$ PC3217GV,  $\mu$ PC3218GV common)**

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) <sup>Note</sup>	Function and Applications	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	–	1.45	Signal input pins to AGC amplifier.	
3	INPUT2	–	1.45		
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> < 0.5 V Maximum gain at V <sub>AGC</sub> > 4.5 V Recommended to use by dividing AGC voltage with externally resistor (example: 100 k $\Omega$ ).	
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	–	2.2	Signal output pins of video amplifier.	
7	OUTPUT1	–	2.2		
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 V.

**ABSOLUTE MAXIMUM RATINGS ( $\mu$ PC3217GV,  $\mu$ PC3218GV common)**

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V <sub>CC</sub>	T <sub>A</sub> = +25°C	6.0	V
Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = +85°C <sup>Note</sup>	250	mW
Operating Ambient Temperature	T <sub>A</sub>		-40 to +85	°C
Storage Temperature	T <sub>stg</sub>		-55 to +150	°C

**Note** Mounted on 50 × 50 × 1.6 mm epoxy glass PWB, with copper patterning on both sides.

**RECOMMENDED OPERATING RANGE ( $\mu$ PC3217GV,  $\mu$ PC3218GV common)**

Parameter	Symbol	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	-	V <sub>CC</sub>	V
Operating Frequency Range	f <sub>bw</sub>		10	45	100	MHz

– $\mu$ PC3217GV–

**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>	No input signal <b>Note 1</b>	15	23	34	mA
AGC Voltage High Level	V <sub>AGC(H)</sub>	@Maximum gain <b>Note 1</b>	4.5	–	V <sub>CC</sub>	V
AGC Voltage Low Level	V <sub>AGC(L)</sub>	@Minimum gain <b>Note 1</b>	0	–	0.5	V
RF Characteristics						
Maximum Voltage Gain	G <sub>MAX</sub>	V <sub>AGC</sub> = 4.5 V, P <sub>in</sub> = –50 dBm <b>Note 1</b>	50	53	56	dB
Minimum Voltage Gain	G <sub>MIN</sub>	V <sub>AGC</sub> = 0.5 V, P <sub>in</sub> = –20 dBm <b>Note 1</b>	–4.5	0	3.5	dB
Gain Control Range	GCR	V <sub>AGC</sub> = 0.5 to 4.5 V <b>Note 1</b>	46.5	53	–	dB
Output Voltage	V <sub>out</sub>	P <sub>in</sub> = –49 to –10 dBm <b>Note 1</b>	–	1.0	–	V <sub>P-P</sub>
Maximum Output Voltage	V <sub>oclip</sub>	V <sub>AGC</sub> = 4.5 V @Maximum gain <b>Note 1</b>	1.6	2.8	–	V <sub>P-P</sub>
Noise Figure	NF	V <sub>AGC</sub> = 4.5 V @Maximum gain <b>Note 2</b>	–	6.5	8.0	dB

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

**STANDARD CHARACTERISTICS (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5 V, Z<sub>s</sub> = 50 Ω)**

Parameter	Symbol	Test Conditions	Reference Value	Unit
Input Impedance	Z <sub>in</sub>	V <sub>AGC</sub> = 0.5 V, f = 45 MHz <b>Note 1</b>	1.3k – j1.5k	Ω
Output Impedance	Z <sub>out</sub>	V <sub>AGC</sub> = 0.5 V, f = 45 MHz <b>Note 1</b>	9.5 + j4	Ω
3rd Order Input Intercept Point	IIP <sub>3</sub>	V <sub>AGC</sub> = 0.5 V @Minimum gain f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz Z <sub>L</sub> = 250 Ω @single-ended output <b>Note 2</b>	+5	dBm
3rd Order Intermodulation Distortion 1	IM <sub>31</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –50 to –20 dBm/tone, V <sub>out</sub> = 0.7 V <sub>P-P</sub> /tone @single-ended output, Z <sub>L</sub> = 250 Ω <b>Note 2</b>	50	dBc
3rd Order Intermodulation Distortion 2	IM <sub>32</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –50 to –20 dBm/tone, Z <sub>L</sub> = 500 Ω V <sub>out</sub> = 1.4 V <sub>P-P</sub> /tone@differential output <b>Note 3</b>	50	dBc
2nd Order Intermodulation Distortion	IM <sub>2</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –50 to –20 dBm/tone, Z <sub>L</sub> = 500 Ω V <sub>out</sub> = 1.4 V <sub>P-P</sub> /tone@differential output <b>Note 3</b>	50	dBc

- Notes** 1. By measurement circuit 3  
 2. By measurement circuit 1  
 3. By measurement circuit 4

– $\mu$ PC3218GV–

**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>	No input signal <b>Note 1</b>	15	23	34	mA
AGC Voltage High Level	V <sub>AGC(H)</sub>	@Maximum gain <b>Note 1</b>	4.5	–	V <sub>CC</sub>	V
AGC Voltage Low Level	V <sub>AGC(L)</sub>	@Minimum gain <b>Note 1</b>	0	–	0.5	V
RF Characteristics						
Maximum Voltage Gain	G <sub>MAX</sub>	V <sub>AGC</sub> = 4.5 V, P <sub>in</sub> = –60 dBm <b>Note 1</b>	60	63	66	dB
Minimum Voltage Gain	G <sub>MIN</sub>	V <sub>AGC</sub> = 0.5 V, P <sub>in</sub> = –30 dBm <b>Note 1</b>	4.5	10	13.5	dB
Gain Control Range	GCR	V <sub>AGC</sub> = 0.5 to 4.5 V <b>Note 1</b>	46.5	53	–	dB
Output Voltage	V <sub>out</sub>	P <sub>in</sub> = –59 to –15 dBm <b>Note 1</b>	–	1.0	–	V <sub>P-P</sub>
Maximum Output Voltage	V <sub>oclip</sub>	V <sub>AGC</sub> = 4.5 V @Maximum gain <b>Note 1</b>	1.6	2.8	–	V <sub>P-P</sub>
Noise Figure	NF	V <sub>AGC</sub> = 4.5 V @Maximum gain <b>Note 2</b>	–	3.5	4.5	dB

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

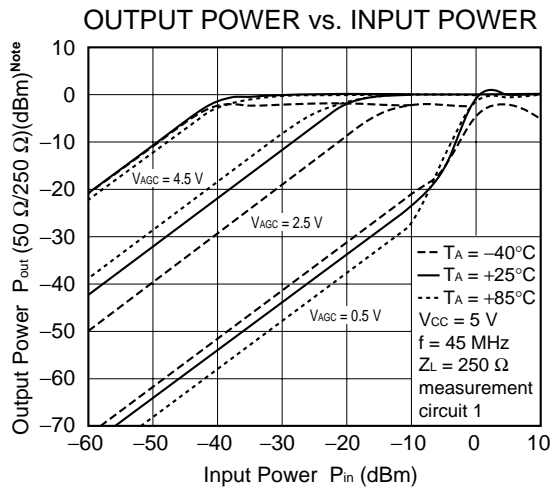
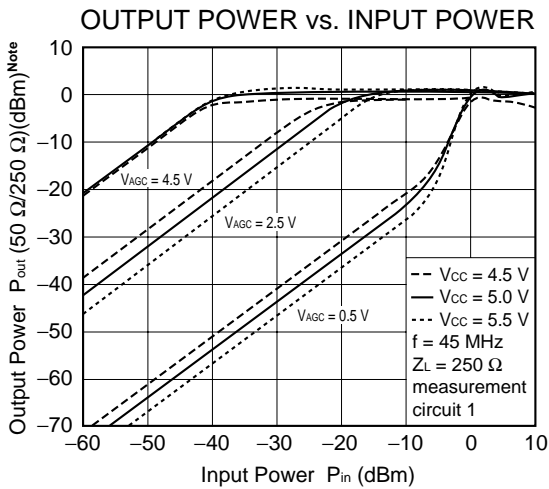
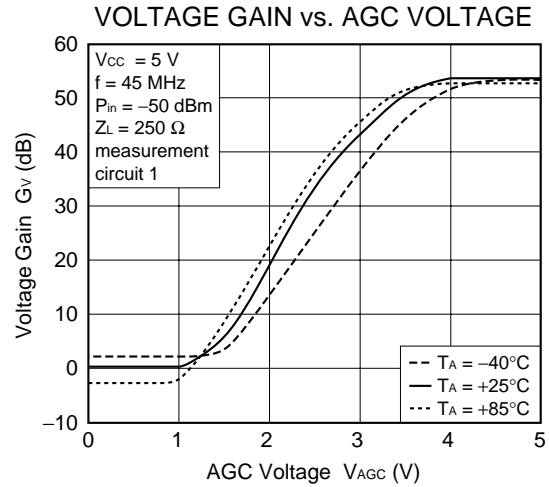
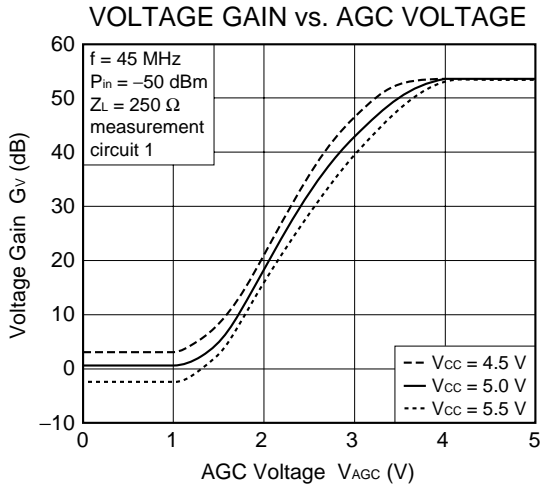
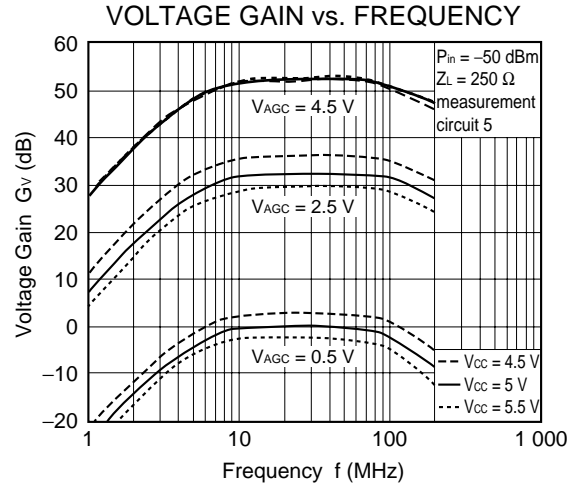
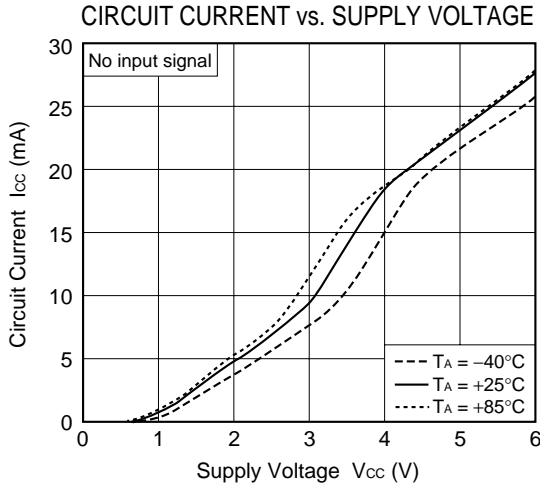
**STANDARD CHARACTERISTICS (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5 V, Z<sub>s</sub> = 50 Ω)**

Parameter	Symbol	Test Conditions	Reference Value	Unit
Input Impedance	Z <sub>in</sub>	V <sub>AGC</sub> = 0.5 V, f = 45 MHz <b>Note 1</b>	1.0k – j1.1k	Ω
Output Impedance	Z <sub>out</sub>	V <sub>AGC</sub> = 0.5 V, f = 45 MHz <b>Note 1</b>	9.5 + j4	Ω
3rd Order Input Intercept Point	IIP <sub>3</sub>	V <sub>AGC</sub> = 0.5 V @Minimum gain f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz Z <sub>L</sub> = 250 Ω @single-ended output <b>Note 2</b>	–7	dBm
3rd Order Intermodulation Distortion 1	IM <sub>31</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –60 to –30 dBm, V <sub>out</sub> = 0.7 V <sub>P-P</sub> /tone @single-ended output <b>Note 2</b>	50	dBc
3rd Order Intermodulation Distortion 2	IM <sub>32</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –60 to –30 dBm/tone, Z <sub>L</sub> = 500 Ω, V <sub>out</sub> = 1.4 V <sub>P-P</sub> /tone@differential output <b>Note 3</b>	50	dBc
2nd Order Intermodulation Distortion	IM <sub>2</sub>	f <sub>1</sub> = 44 MHz, f <sub>2</sub> = 45 MHz P <sub>in</sub> = –50 to –20 dBm/tone, Z <sub>L</sub> = 500 Ω, V <sub>out</sub> = 1.4 V <sub>P-P</sub> /tone@differential output <b>Note 3</b>	50	dBc

- Notes** 1. By measurement circuit 3  
 2. By measurement circuit 1  
 3. By measurement circuit 4

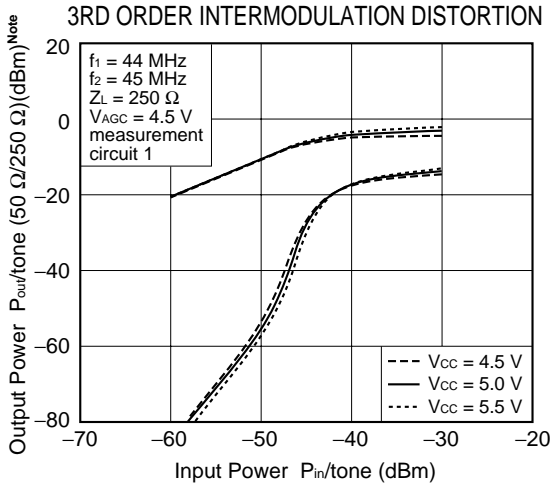
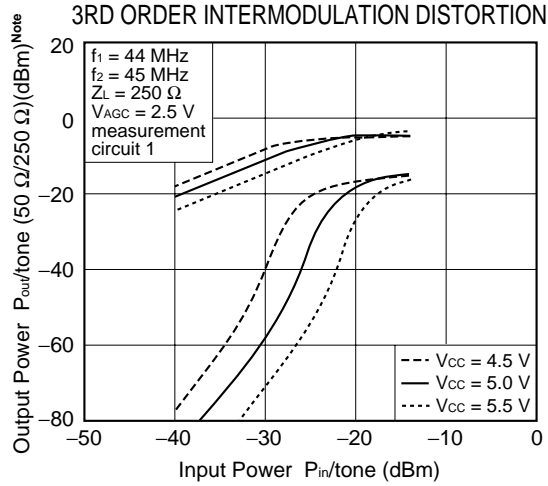
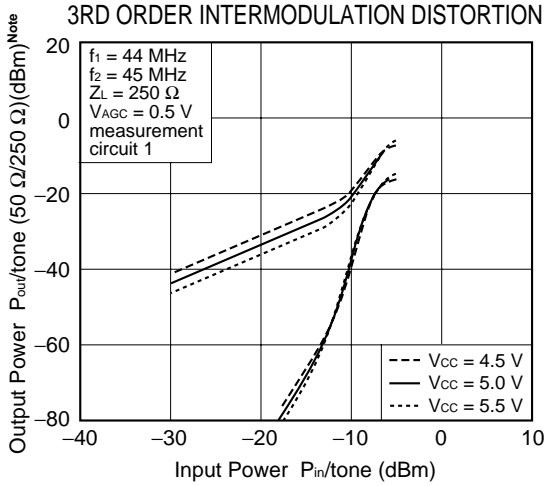
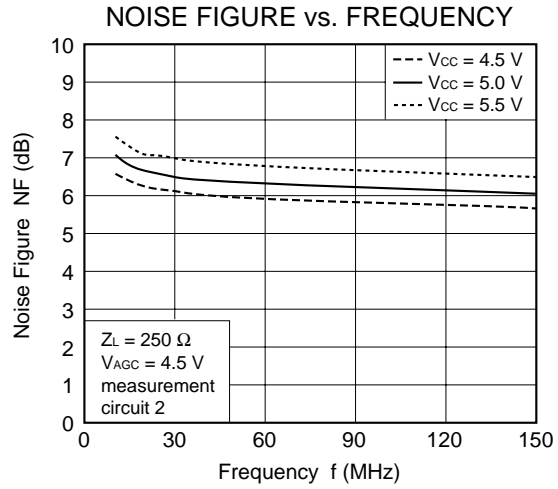
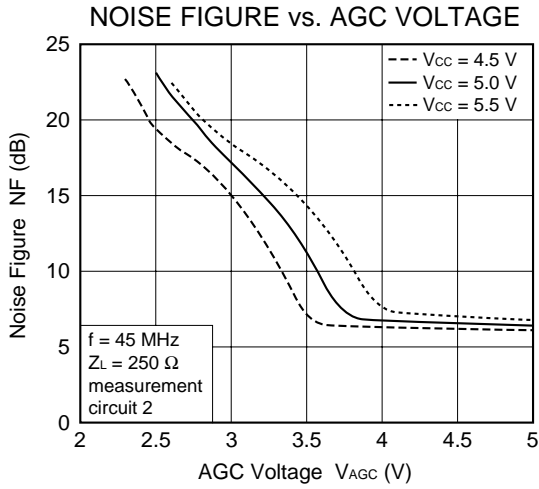
TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )

— $\mu$ PC3217GV—



**Note** Measurement value with spectrum analyzer.

– $\mu$ PC3217GV–

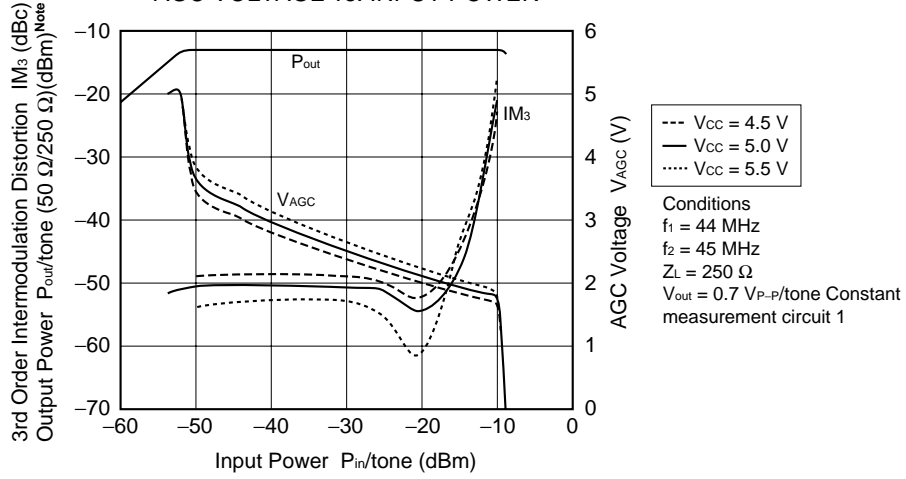


**Note** Measurement value with spectrum analyzer.

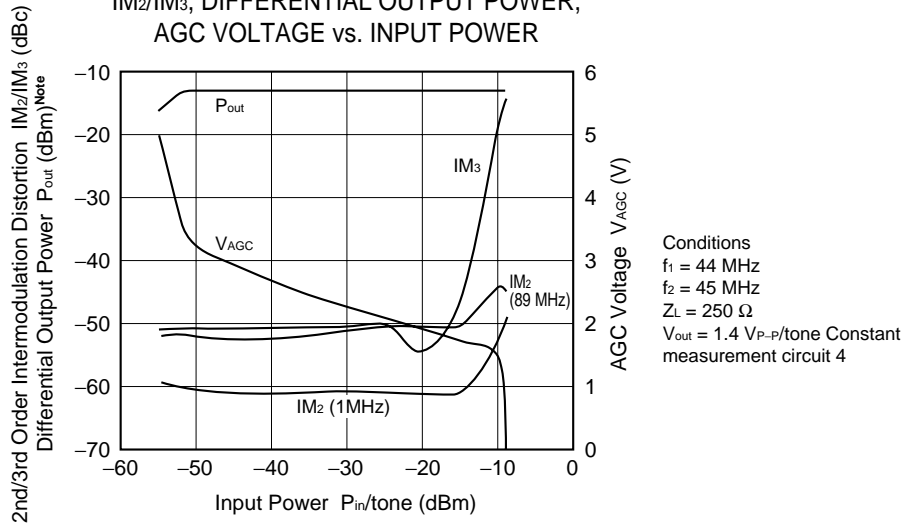


- $\mu$ PC3217GV-

IM<sub>3</sub>, OUTPUT POWER, AGC VOLTAGE vs. INPUT POWER



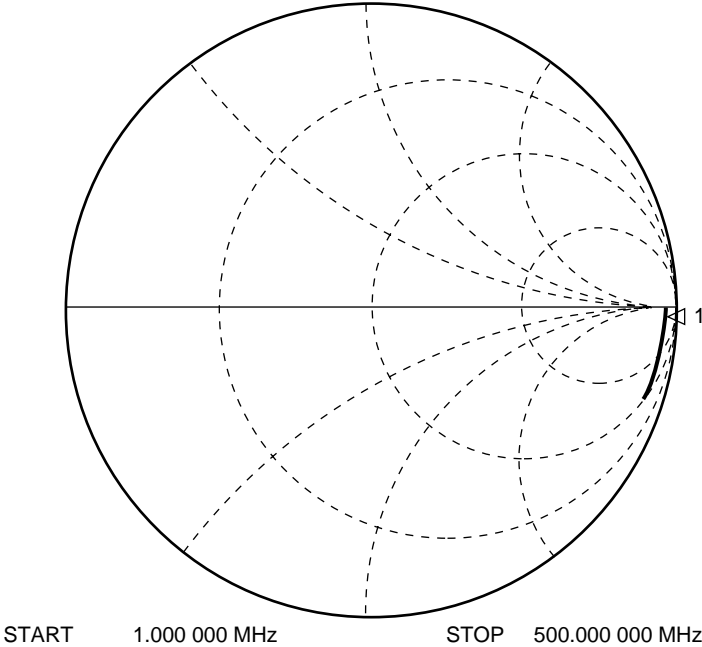
IM<sub>2</sub>/IM<sub>3</sub>, DIFFERENTIAL OUTPUT POWER, AGC VOLTAGE vs. INPUT POWER



**Note** Measurement value with spectrum analyzer.

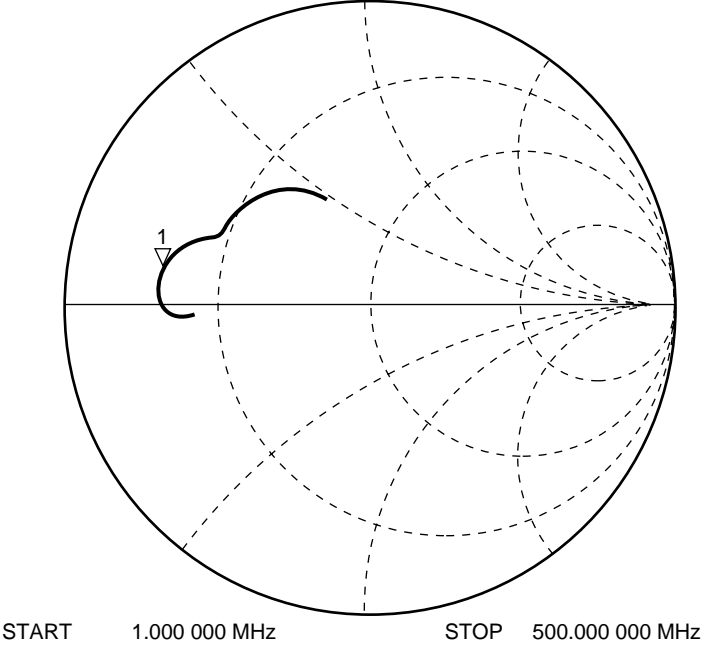
S-PARAMETERS

S<sub>11</sub>-FREQUENCY



Marker 1  
1.339 k - j 1.556 k $\Omega$

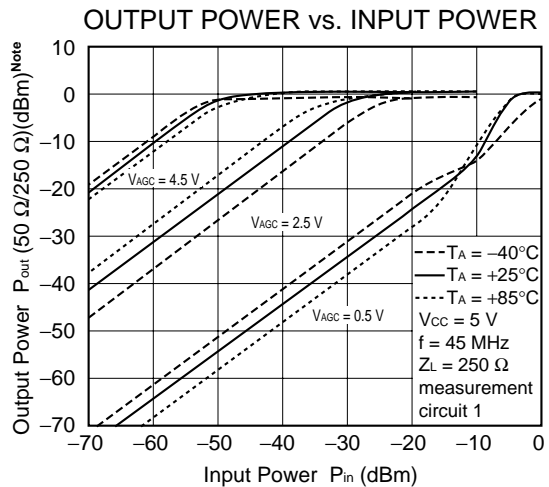
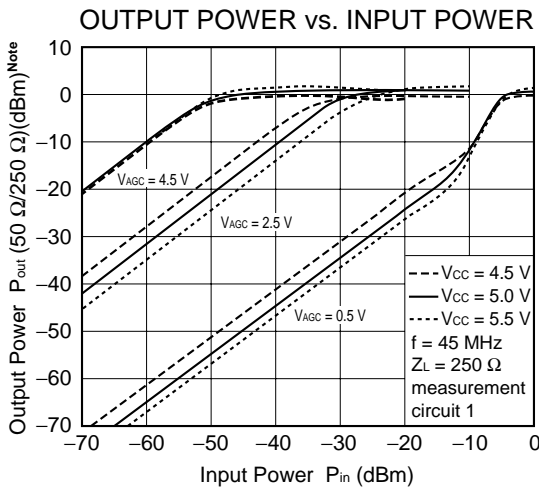
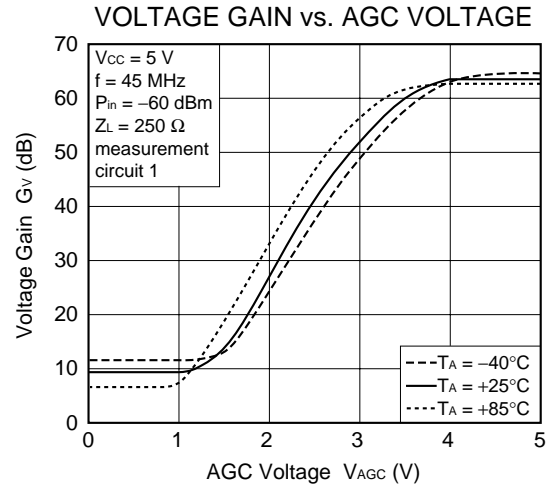
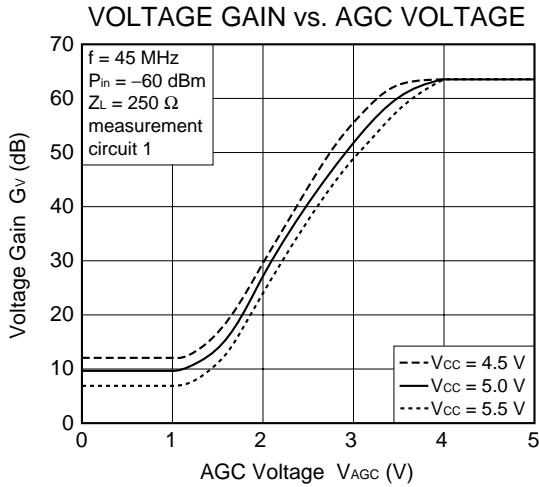
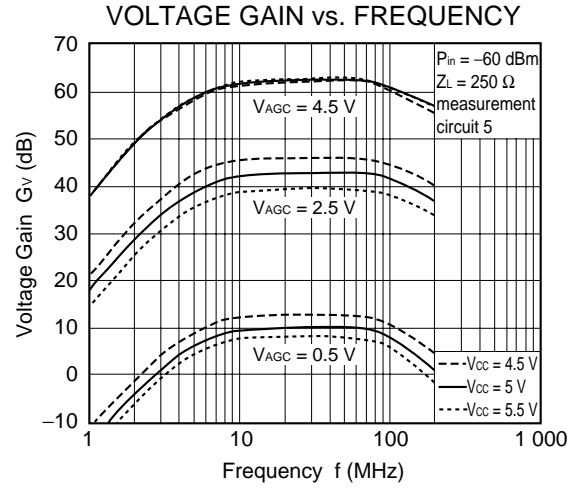
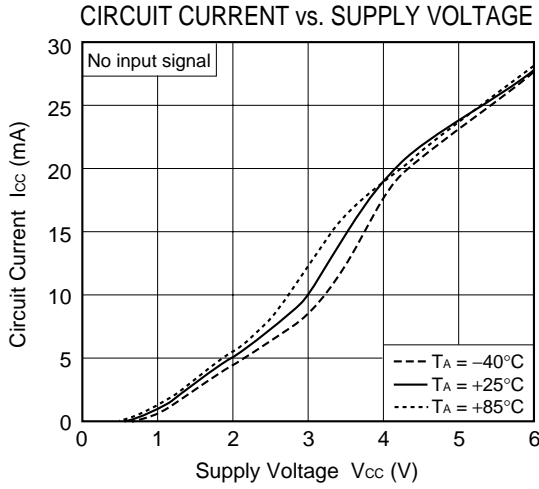
S<sub>22</sub>-FREQUENCY



Marker 1  
9.511 + j 3.869  $\Omega$

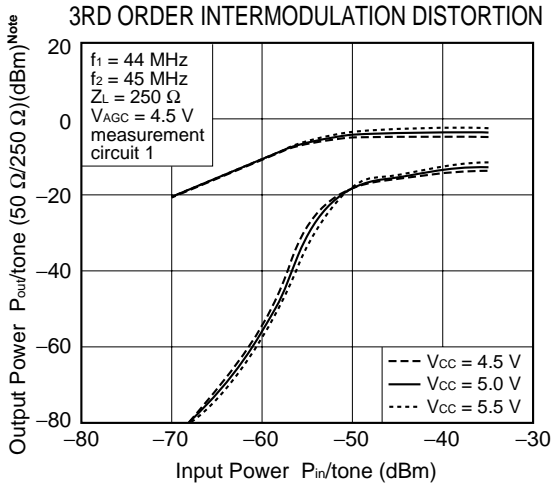
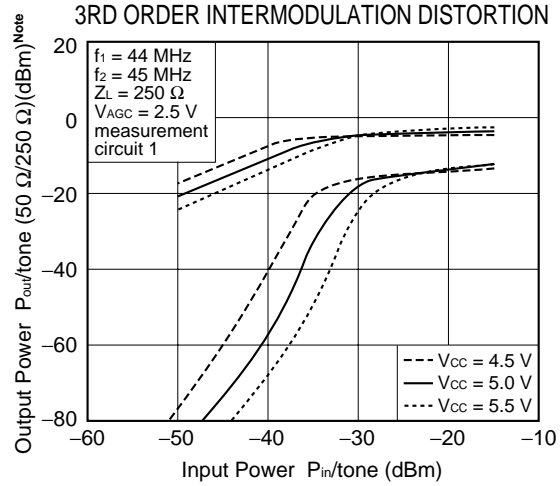
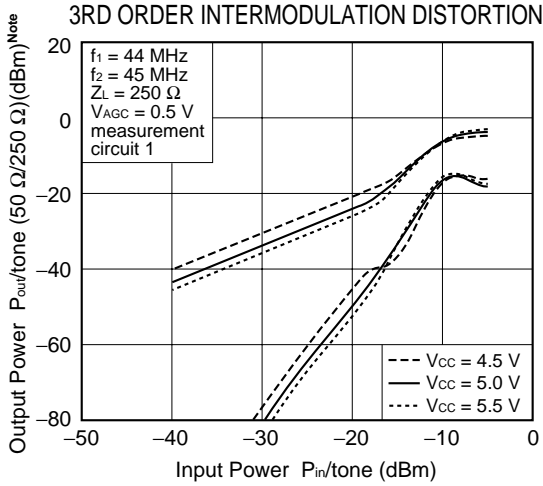
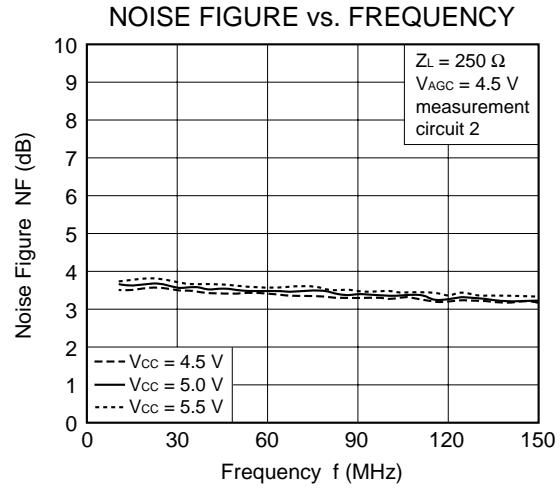
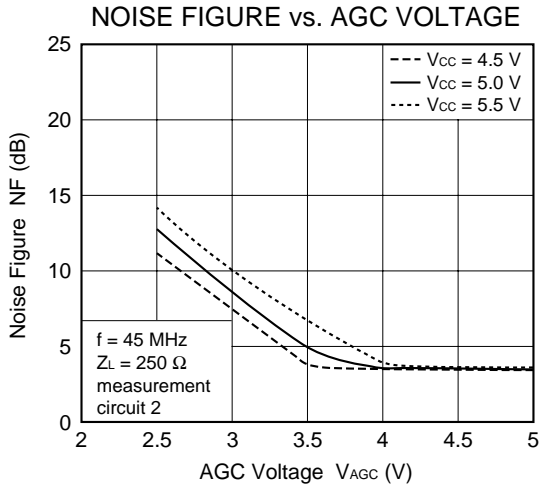
TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )

— $\mu$ PC3218GV—



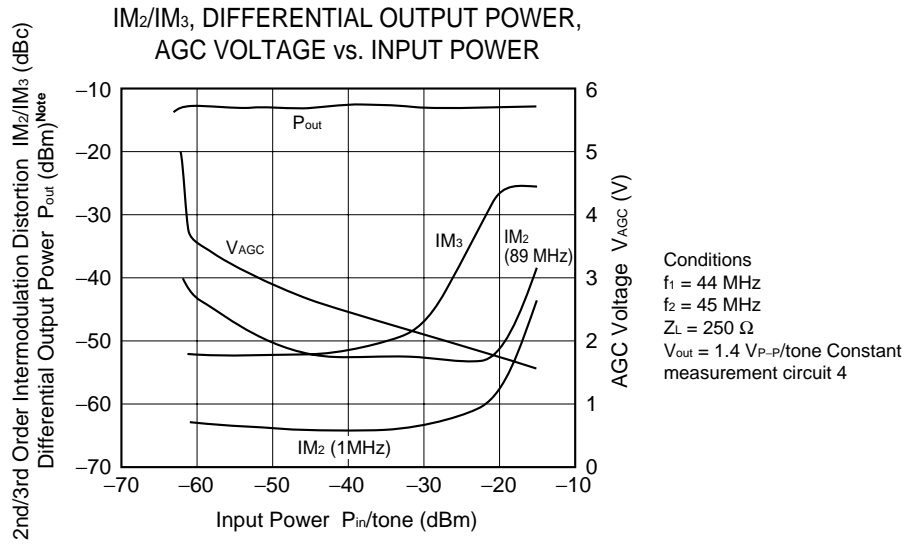
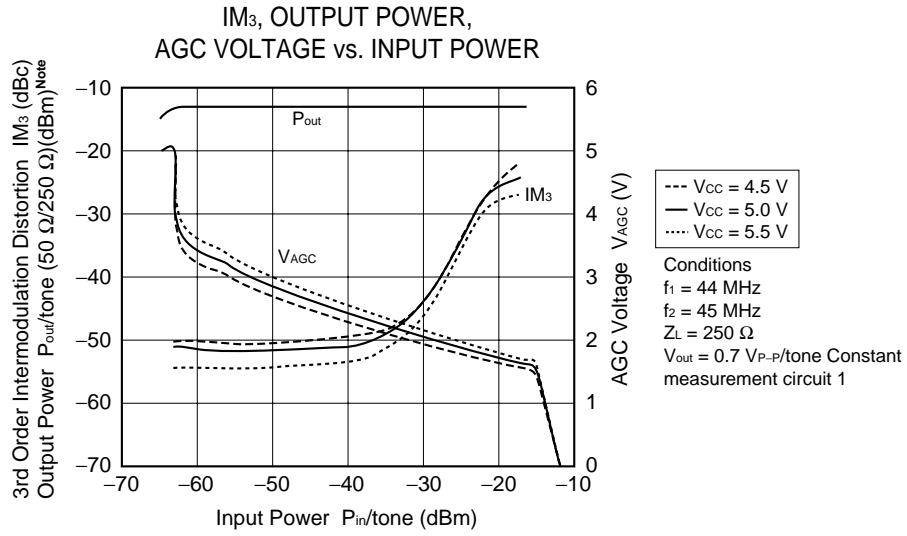
**Note** Measurement value with spectrum analyzer.

– $\mu$ PC3218GV–



**Note** Measurement value with spectrum analyzer.

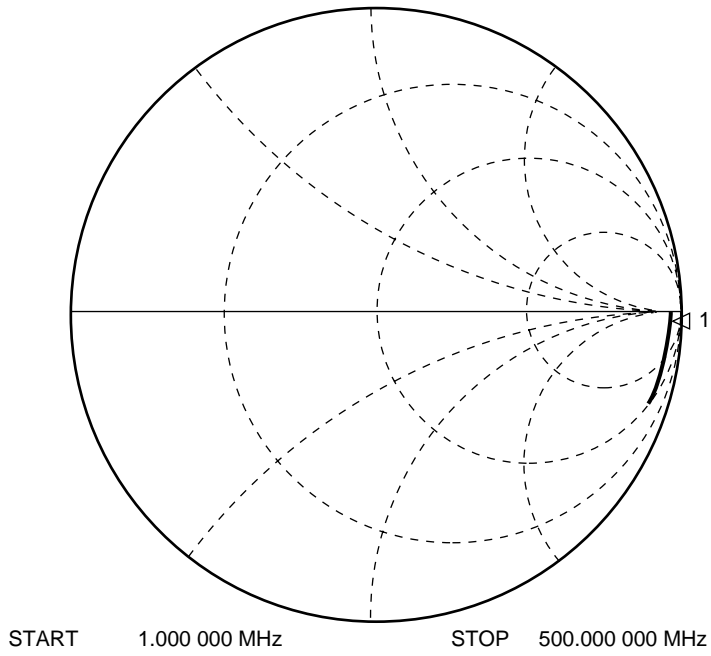
- $\mu$ PC3218GV-



**Note** Measurement value with spectrum analyzer.

S-PARAMETERS

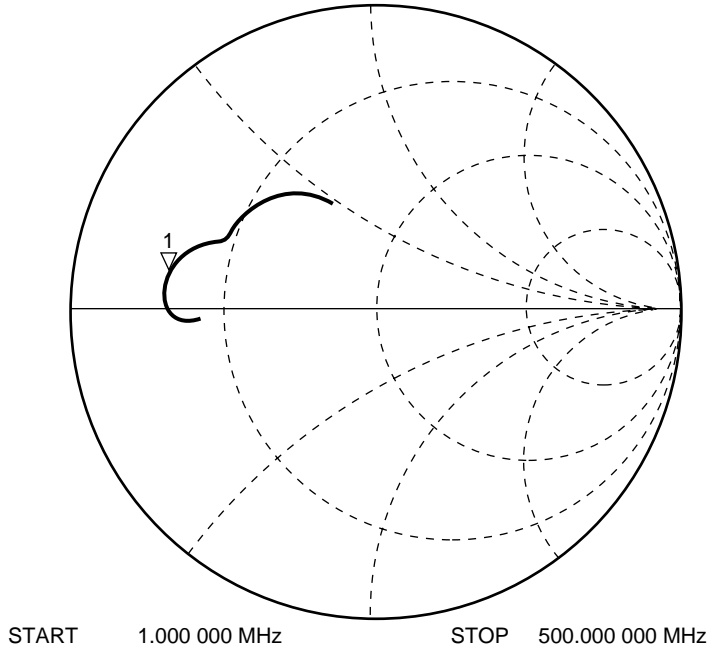
S<sub>11</sub>-FREQUENCY



Marker 1

$1.024\text{ k} - j\ 1.124\text{ k}\Omega$

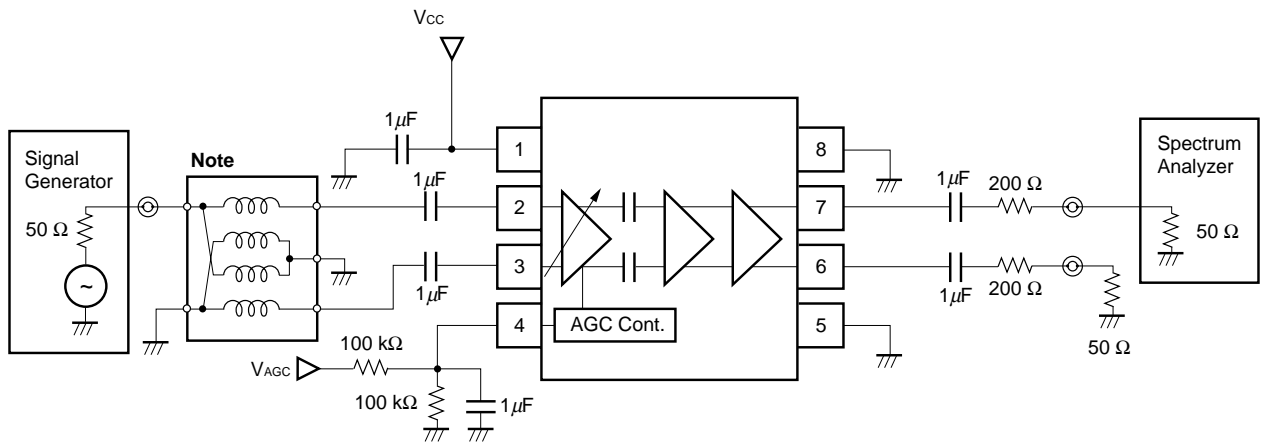
S<sub>22</sub>-FREQUENCY



Marker 1

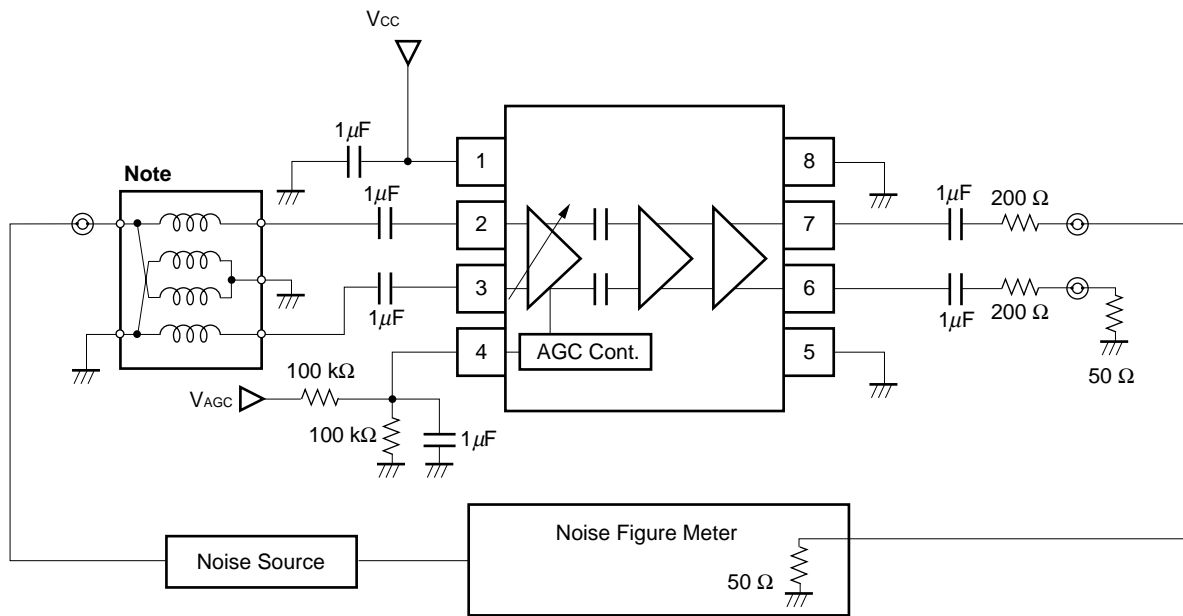
$9.493 + j\ 4.317\ \Omega$

MEASUREMENT CIRCUIT 1



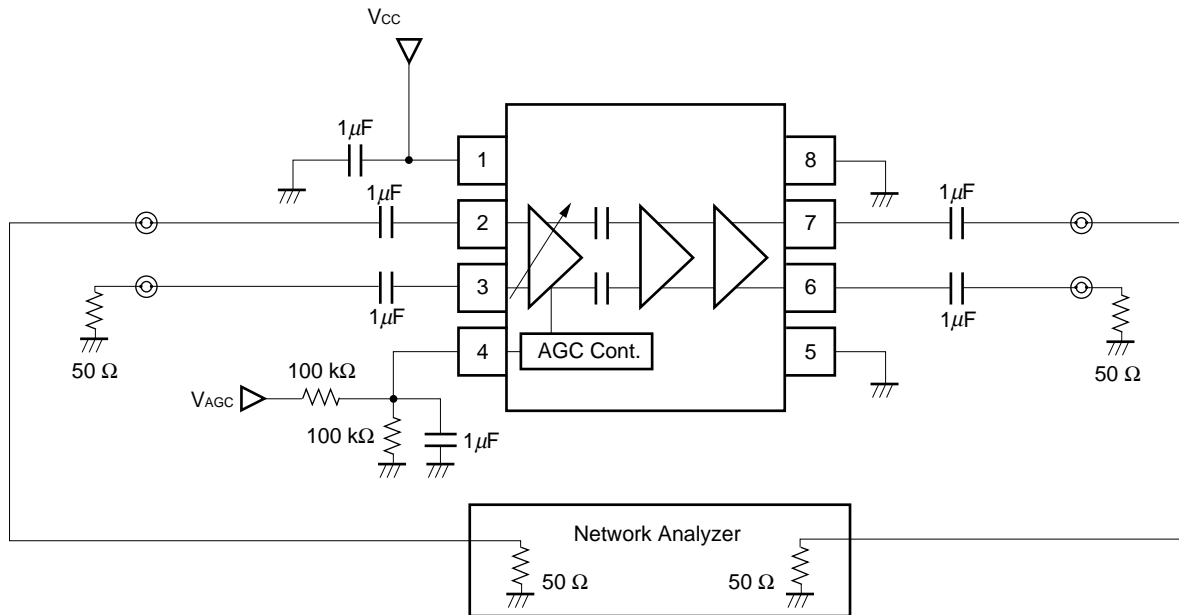
**Note** Balun Transformer: TOKO 617DB-1010 B4F (Double balanced type)

MEASUREMENT CIRCUIT 2

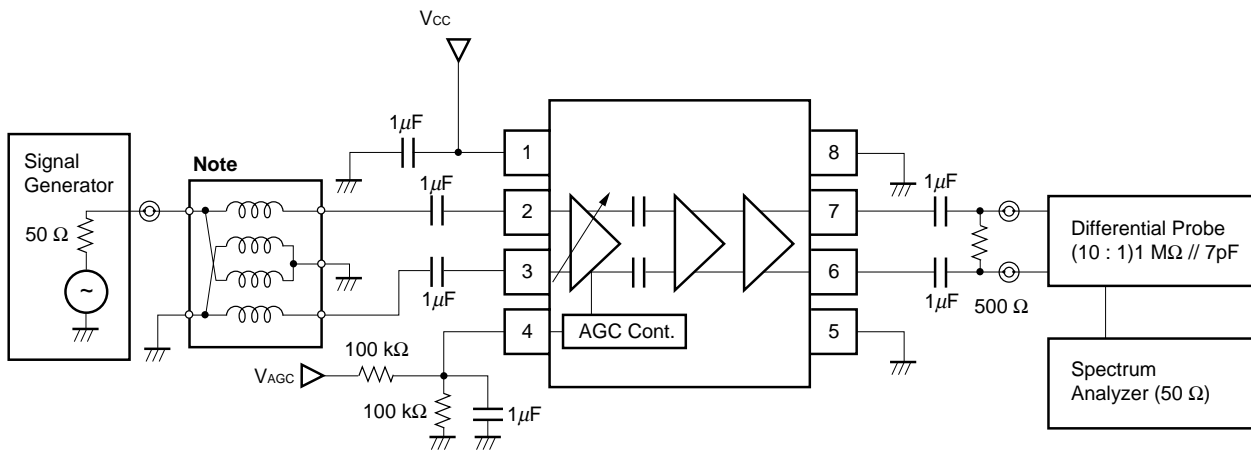


**Note** Balun Transformer: TOKO 617DB-1010 B4F (Double balanced type)

MEASUREMENT CIRCUIT 3



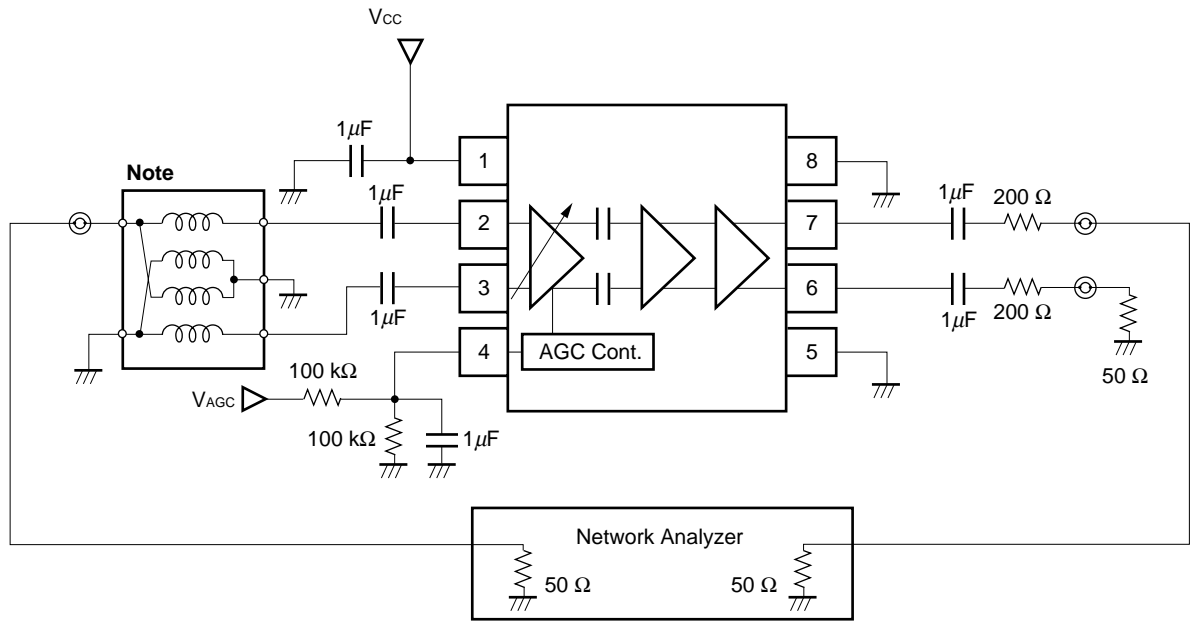
MEASUREMENT CIRCUIT 4



**Note** Balun Transformer: TOKO 617DB-1010 B4F (Double balanced type)

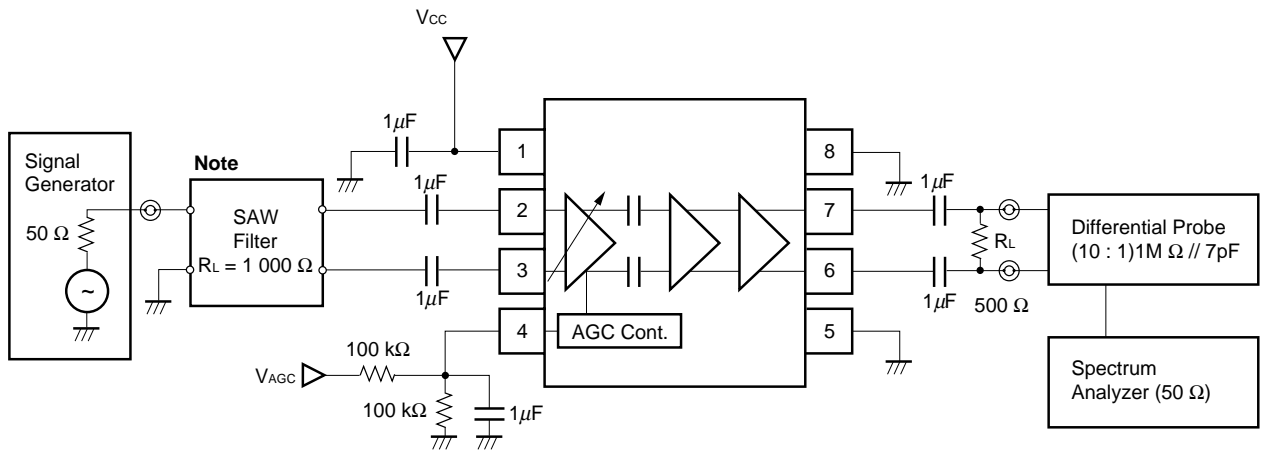


MEASUREMENT CIRCUIT 5



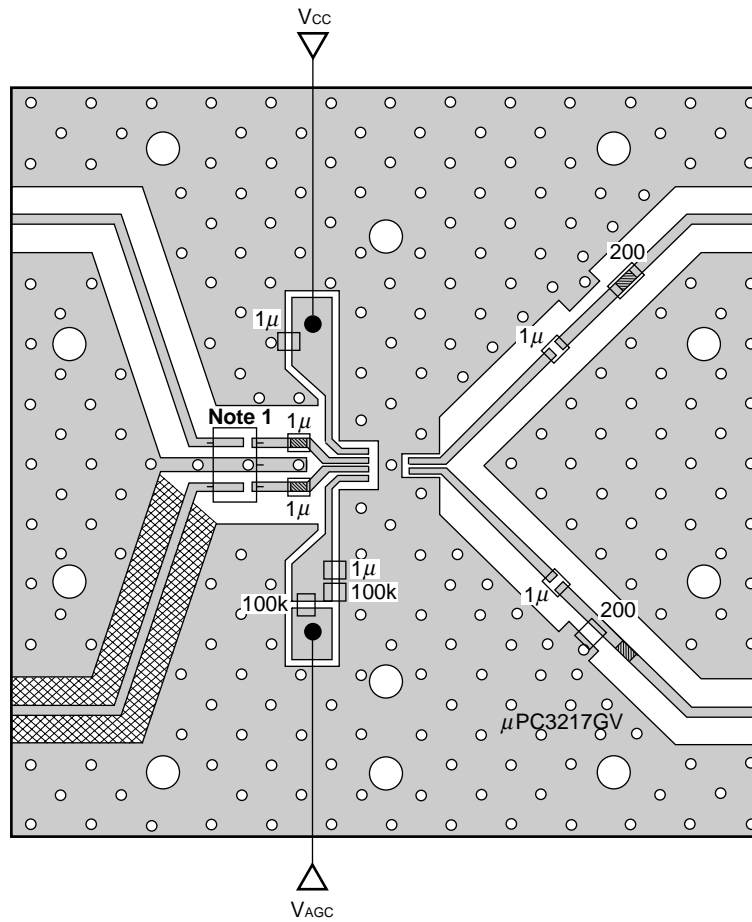
**Note** Balun Transformer: TOKO 617DB-1010 B4F (Double balanced type)



APPLICATION CIRCUIT EXAMPLE



**Note** Balun Transformer: TOKO 617DB-1010 B4F (Double balanced type)

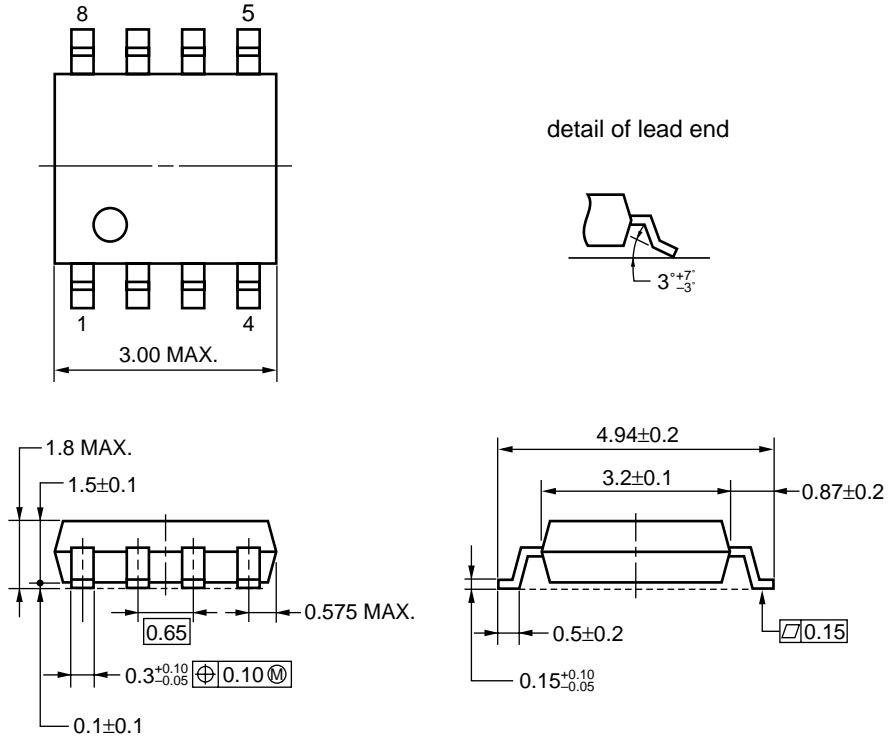
ILLUSTRATION OF THE EVALUATION BOARD FOR MEASUREMENT CIRCUIT 1



- Notes**
1. Balun Transformer
  2. Back side: GND pattern
  3. Solder plated on pattern
  4. ○○: Through holes
  5.  represents cutout
  6.  represents short-circuit strip

PACKAGE DIMENSIONS

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



**NOTE 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 undesires oscillation).
- (3) Keep the track length of the ground pins as short as possible.
- (4) Bypass capacitance must be attached to Vcc line.

**RECOMMENDED SOLDERING CONDITIONS**

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

Soldering Method	Soldering Conditions	Recommended Conditions Symbol
Infrared Reflow	Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit: None <sup>Note</sup>	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure limit: None <sup>Note</sup>	VP15-00-3
Partial Heating	Pin temperature: 300°C Time: 3 seconds or less (per side of device) Exposure limit: None <sup>Note</sup>	—

**Note** After opening the dry pack, keep it in a place below 25°C and 65% RH for the allowable storage period.

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

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

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