NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC3206GR

50dB AGC AMP + VIDEO AMP

DESCRIPTION

The μPC3206GR is Silicon monolithic IC designed for Digital DBS and Digital CATV receivers. This IC consists of a two stage gain control amplifier and a wideband linear video amplifier.

This IC is packaged in 20-pin SSOP. Therefore, it can make RF block small.

FEATURES

- Broadband AGC dynamic range 50 dB (MIN.)
- Supply voltage 5 V
- Packaged in 20-pin SSOP suitable for high-density surface mount

APPLICATIONS

- Digital DBS receiver
- STB of digital CATV

ORDERING INFORMATION

Part Number	Package	Supplying Form
μPC3206GR-E1	20-pin plastic SSOP (225 mil)	Embossed tape 12 mm wide. Pin 1 indicates pull-out direction of tape. Qty 2.5 kp/reel.

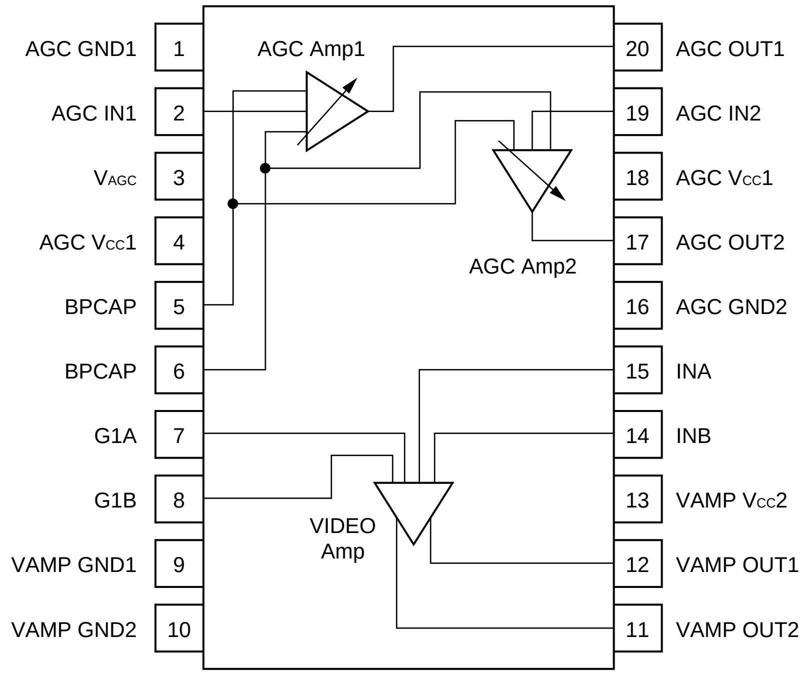
To order evaluation samples, please contact your local NEC office. (Part number for sample order : μPC3206GR)

Caution electro-static sensitive device

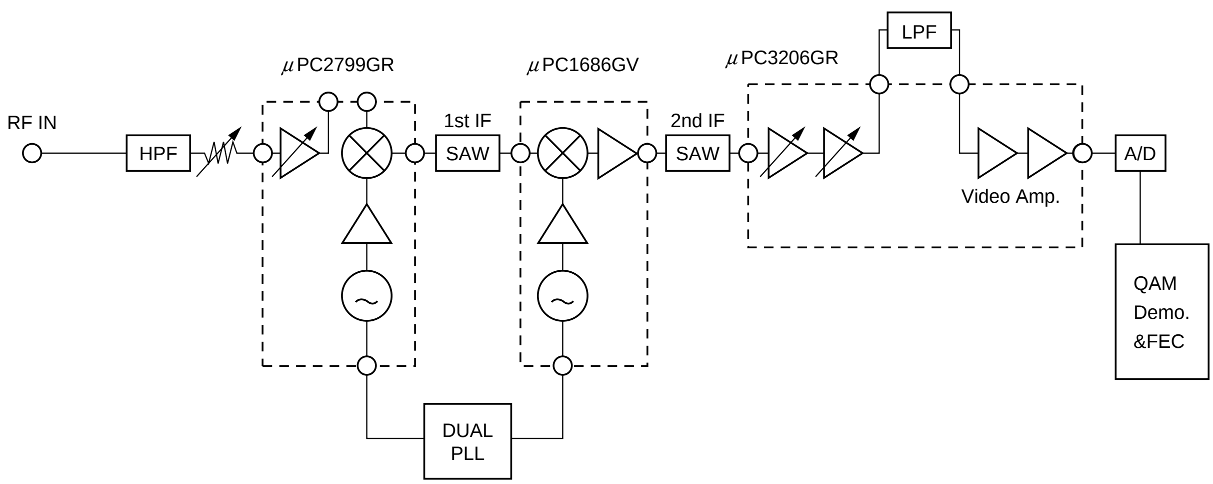
Document No. P13710EJ3V0DS00 (3rd edition)
Date Published October 1999 N CP(K)
Printed in Japan

The mark ★ shows major revised points.

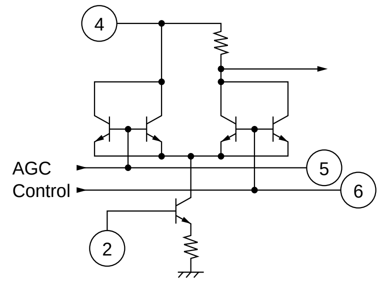
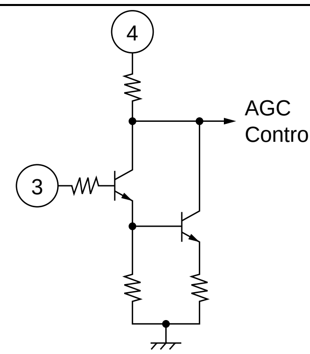
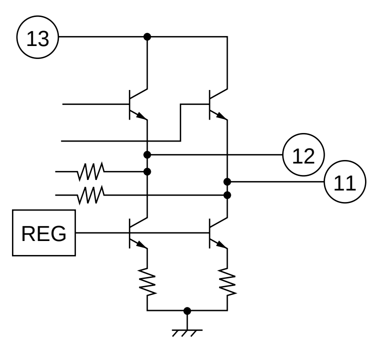
INTERNAL BLOCK DIAGRAM AND PIN CONFIGULATION (Top View)



TYPICAL APPLICATION

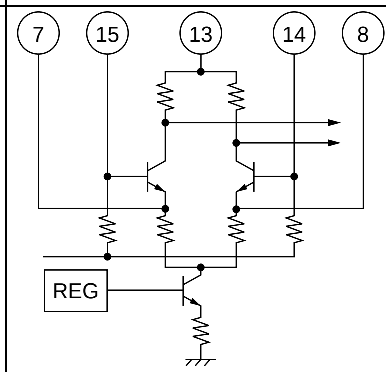
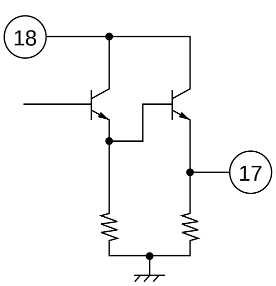
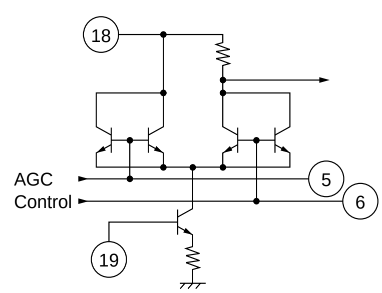
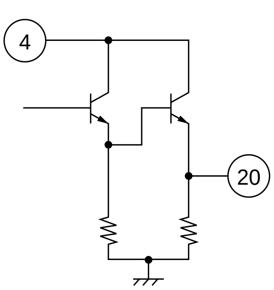


PIN FUNCTIONS

Pin No.	Pin Name	Pin Voltage TYP.(V)	Function and Explanation	Equivalent Circuit
1	AGC GND1	0	Ground pin of AGC amplifier1. Form a ground pattern as wide as possible to maintain the minimum impedance.	
2	AGC IN 1 Note 1	1.02 1.02	Signal input pin to AGC amplifier.	
3	VAGC	0 to 5	Gain control pin. This pin's bias govern the AGC output level. Minimum gain at V_{AGC} = 0 V Maximum gain at V_{AGC} = 5 V Recommended to use by dividing AGC voltage with externally resistor (ex.100 kΩ).	
4	AGC V_{CC}1	5	Power supply pin of AGC amplifier1. Must be connected bypass capacitor to minimize ground impedance.	
5	BPCAP4 Note 1	2.61 2.61	Bypass pin of AGC amplifier1 and 2.	Refer to Equivalent circuit of pin1 and pin2.
6	BPCAP2 Note 1	2.84 2.49		
7	G1A Note 2	1.72 3.34	Gain control pin of video amplifier. Maximum gain at G1A – G1B = short. Minimum gain at G1A – G1B = open. Gain is able to adjust by inserting arbitrary resistor between 7pin and 8pin.	Refer to Equivalent circuit of pin14 and pin15.
8	G1B Note 2	1.72 3.34		
9	VAMP GND1	0	Ground pin of video amplifier. Form a ground pattern as wide as possible to maintain the minimum impedance.	
10	VAMP GND2	0		
11	VAMP OUT2 Note 2	2.52 4.92	Signal output pin of video amplifier. In case of R_L = 1 kΩ, single-end output voltage equal 2V_{P-P}.	
12	VAMP OUT1 Note 2	2.52 4.92		

Notes 1. above : V_{AGC} = V_{CC}1 below : V_{AGC} = 0 V

2. above : V_{CC}2 = 5 V below : V_{CC}2 = 9 V

Pin No.	Pin Name	Pin Voltage TYP.(V)	Function and Explanation	Equivalent Circuit
13	VAMP $V_{CC}2$	5 to 9	Power supply pin of video amplifier. Must be connected bypass capacitor to minimize ground impedance.	
14	INB [Note 2]	2.49	Signal input pin to video amplifier.	
		4.13		
15	INA [Note 2]	2.49		
		4.13		
16	AGC GND2	0	Ground pin of AGC amplifier2. Form a ground pattern as wide as possible to maintain the minimum impedance.	
17	AGC OUT2 Note 1	1.69	Signal output pin of AGC amplifier2.	
		3.31		
18	AGC $V_{CC}1$	5	Power supply pin of AGC amplifier2. Must be connected bypass capacitor to minimize ground impedance.	
19	AGC IN2 Note 1	1.01	Signal input pin of AGC amplifier2.	
		1.01		
20	AGC OUT1 Note 1	1.71	Signal output pin of AGC amplifier1.	
		3.35		

Notes 1. above : $V_{AGC} = V_{CC}1$ below : $V_{AGC} = 0$ V

2. above : $V_{CC}2 = 5$ V below : $V_{CC}2 = 9$ V

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C unless otherwise specified)

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage 1	$V_{CC}1$	MIXER Block	6.0	V
Supply Voltage 2	$V_{CC}2$	Video Amp Block	6.0	V
AGC Control Voltage	V_{AGC}		6.0	V
Maximum Input Power	P_{in} (MAX.)		+10	dBm
Power Dissipation	P_D	T_A = 85 °C Note	433	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage 1	$V_{CC}1$	MIXER Block	6.0	V
Supply Voltage 2	$V_{CC}2$	Video Amp Block	11.0	V
AGC Control Voltage	V_{AGC}		6.0	V
Maximum Input Power	P_{in} (MAX.)		+10	dBm
Power Dissipation	P_D	T_A = 75 °C Note	500	mW
Operating Ambient Temperature	T_A		–40 to +75	°C
Storage Temperature	T_{stg}		–55 to +150	°C

Note Mounted on 50 × 50 × 1.6 mm double epoxy glass board.

RECOMMENDED OPERATING RANGE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage 1	$V_{CC}1$	4.5	5.0	5.5	V
Supply Voltage 2	$V_{CC}2$	4.5	9.0	10.0	V
Operating Ambient Temperature 1 Note 1	T_A1	–40	+25	+85	°C
Operating Ambient Temperature 2 Note 2	T_A2	–40	+25	+75	°C

Notes **1.** $V_{CC}1 = V_{CC}2$ = 4.5 to 5.5 V

2. $V_{CC}1$ = 4.5 to 5.5 V, $V_{CC}2$ = 4.5 to 10 V

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
AGC Amplifier Block ($V_{CC}1$ = 5 V, fin = 100 MHz, R_L = 560 Ω)						
Circuit Current 1	$I_{CC}1$	no input signal, V_{AGC} = 5 V **Note 1**	11	16	22	mA
Circuit Current 2	$I_{CC}2$	no input signal, V_{AGC} = 0 V **Note 1**	15	22	32	mA
Bandwidth 1	BW1	Maximum gain (V_{AGC} = 5 V), Pin = –60 dBm **Note 2, 3**	100	220	–	MHz
Bandwidth 2	BW2	Minimum gain (V_{AGC} = 0 V), Pin = –15 dBm **Note 3**	500	–	–	MHz
Maximum Gain 1	$G_{MAX}1$	Pin = –60 dBm, V_{AGC} = 5 V **Note 3**	36	38.5	41	dB
Minimum Gain 1	$G_{MIN}2$	Pin = –15 dBm, V_{AGC} = 0 V **Note 3**	–	–28	–15	dB
Gain Control Range	GCR	Pin = –35 dBm, V_{AGC} = 0 to 5V **Note 3**	50	–	–	dB
Maximum Output Power	$P_{o\,(sat)}$	V_{AGC} = 5 V, Pin = 0 dBm **Note 3**	0	2	–	dBm
Video Amplifier Block ($V_{CC}2$ = 9 V, fin = 100 MHz, R_L = 1 kΩ)						
Circuit Current 3	$I_{CC}3$	no input signal **Note 4**	16	24	34.5	mA
Differential Gain 1	G1	G1A-G1B pins:short **Note 5**	160	260	400	V/V
Differential Gain 2	G2	G1A-G1B pins:open **Note 5**	22	25	30	V/V
Video Amplifier Block ($V_{CC}2$ = 5 V, fin = 100 MHz, R_L = 1 kΩ)						
Circuit Current 4	$I_{CC}4$	no input signal **Note 4**	8	12.5	18	mA
Differential Gain 3	G3	G1A-G1B pins:short **Note 5**	80	140	230	V/V
Differential Gain 4	G4	G1A-G1B pins:open **Note 5**	16	22	30	V/V
Video Amplifier Block ($V_{CC}2$ = 5 V, 9 V Common, fin = 100 MHz, R_L = 1 kΩ, single-ended)						
Bandwidth 1	BW_{G1}	G1A-G1B pins:short **Note 2, 5**	–	100	–	MHz

Notes 1. By measurement circuit 1
2. –3 dB down from gain at 5 MHz
3. By measurement circuit 2
4. By measurement circuit 3
5. By measurement circuit 4

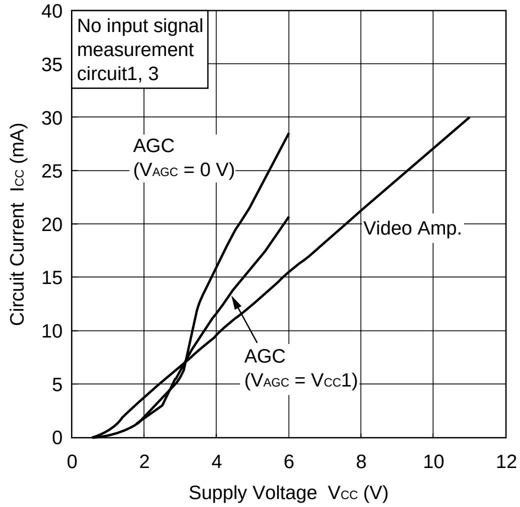
STANDARD CHARACTERISTICS (FOR REFERENCE) (T_A = 25 °C)

Parameter	Symbol	Test Conditions	Reference Values	Unit
AGC Amplifier Block ($V_{CC}1$ = 5 V, fin = 100 MHz, R_L = 560 Ω)				
Noise Figure	NF	Maximum Gain (V_{AGC} = 5 V) **Note 1**	5.5	dB
Output Intercept Point	OIP_3	fin2 = 106 MHz, Maximum Gain (V_{AGC} = 5 V) **Note 2**	+4.5	dBm
Video Amplifier Block ($V_{CC}2$ = 9 V, fin = 100 MHz, R_L = 1 kΩ)				
Output Voltage	Vout	single-ended **Note 3**	2	V_{P-P}
Single-end Gain 1	Avs1	G1A-G1B pins:short **Note 3**	130	V/V
Single-end Gain 2	Avs2	G1A-G1B pins:open **Note 3**	12	V/V
Input Intercept Point 1	IIP_31	fin2 = 106 MHz, G1A-G1B pins:short **Note 3**	–16	dBm
Input Intercept Point 2	IIP_32	fin2 = 106 MHz, G1A-G1B pins:open **Note 3**	4	dBm
Video Amplifier Block ($V_{CC}2$ = 5 V, fin = 100 MHz, R_L = 1 kΩ)				
Single-end Gain 3	Avs3	G1A-G1B pins:short **Note 3**	70	V/V
Single-end Gain 4	Avs4	G1A-G1B pins:open **Note 3**	11	V/V
Input Intercept Point 3	IIP_33	fin2 = 106 MHz, G1A-G1B pins:short **Note 3**	–15	dBm
Input Intercept Point 4	IIP_34	fin2 = 106 MHz, G1A-G1B pins:open **Note 3**	2	dBm
Total Block ($V_{CC}1$ = 5 V, fin = 100 MHz, R_L = 1 kΩ)				
Maximum Gain 2	$G_{MAX}2$	V_{AGC} = 5 V, $V_{CC}2$ = 5 V, G1A-G1B pins:short **Note 4**	76	dB
Maximum Gain 3	$G_{MAX}3$	V_{AGC} = 5 V, $V_{CC}2$ = 5 V, G1A-G1B pins:open **Note 4**	62	dB
Minimum Gain 2	$G_{MIN}2$	V_{AGC} = 0 V, $V_{CC}2$ = 5 V, G1A-G1B pins:short **Note 4**	10	dB
Maximum Gain 4	$G_{MAX}4$	V_{AGC} = 5 V, $V_{CC}2$ = 9 V, G1A-G1B pins:short **Note 4**	80	dB
Maximum Gain 5	$G_{MAX}5$	V_{AGC} = 5 V, $V_{CC}2$ = 9 V, G1A-G1B pins:open **Note 4**	63	dB
Minimum Gain 3	$G_{MIN}3$	V_{AGC} = 0 V, $V_{CC}2$ = 9 V, G1A-G1B pins:short **Note 4**	14	dB

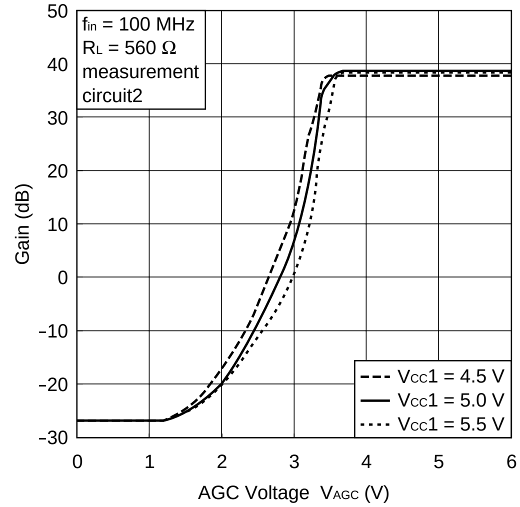
Notes 1. By measurement circuit 5
2. By measurement circuit 2
3. By measurement circuit 4
4. By measurement circuit 6

TYPICAL CHARACTERISTICS (T_A = 25 °C)

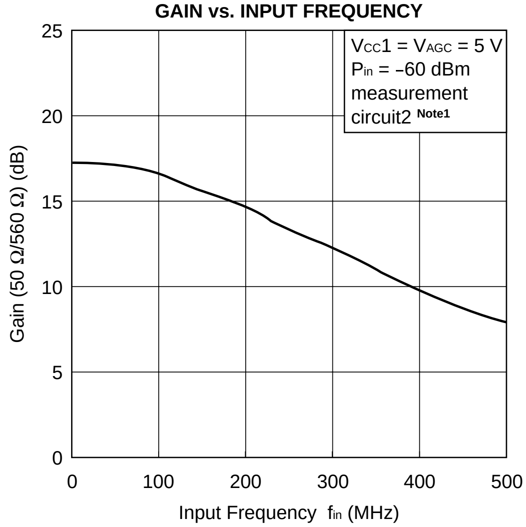
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



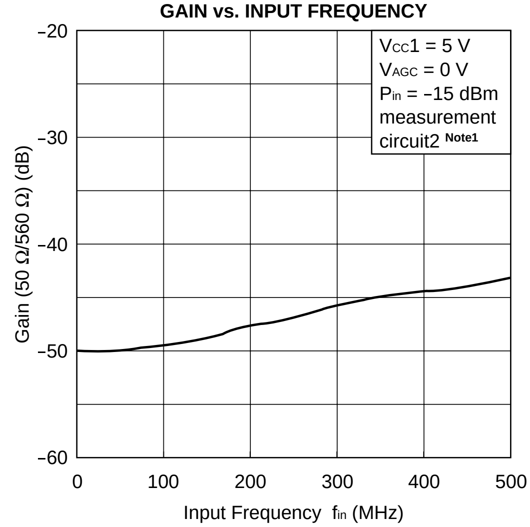
GAIN vs. AGC VOLTAGE



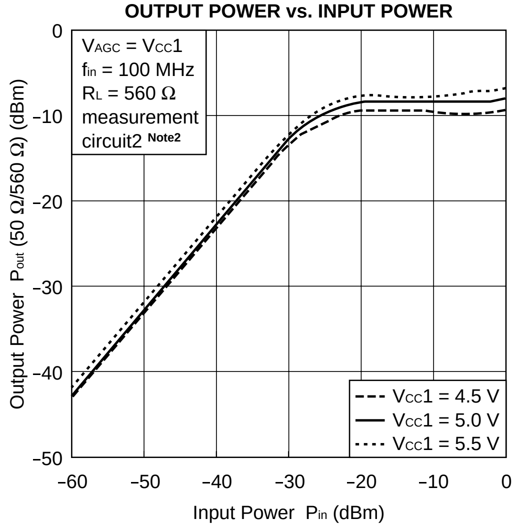
GAIN vs. INPUT FREQUENCY



GAIN vs. INPUT FREQUENCY



★ **OUTPUT POWER vs. INPUT POWER**



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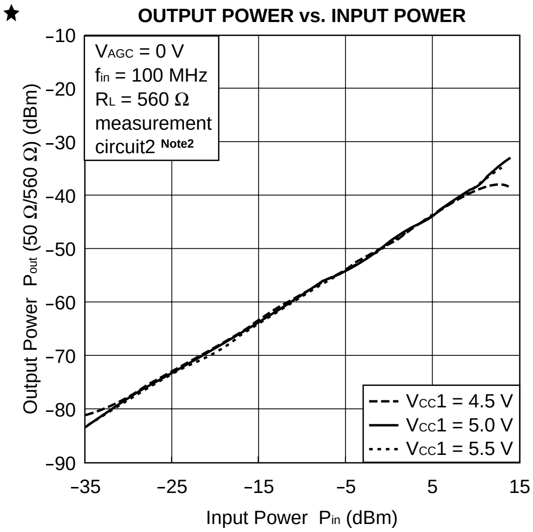
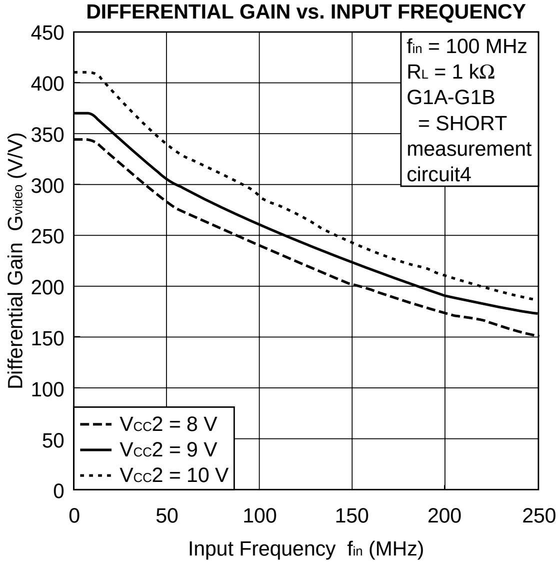


Notes 1. Gain = (Gain at Spectrum Analyzer) + 20 log (560 Ω/50 Ω)

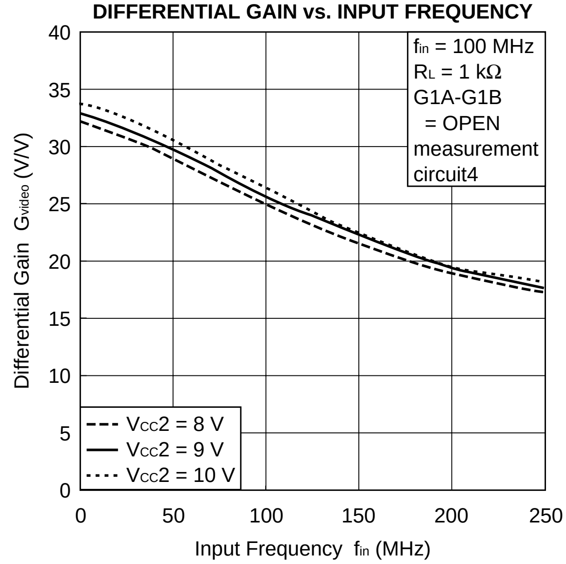
2. Output Power = (Output Power at Spectrum Analyzer) + 10 log (560 Ω/50 Ω)

TYPICAL CHARACTERISTICS (T_A = 25 °C)

DIFFERENTIAL GAIN vs. INPUT FREQUENCY



DIFFERENTIAL GAIN vs. INPUT FREQUENCY



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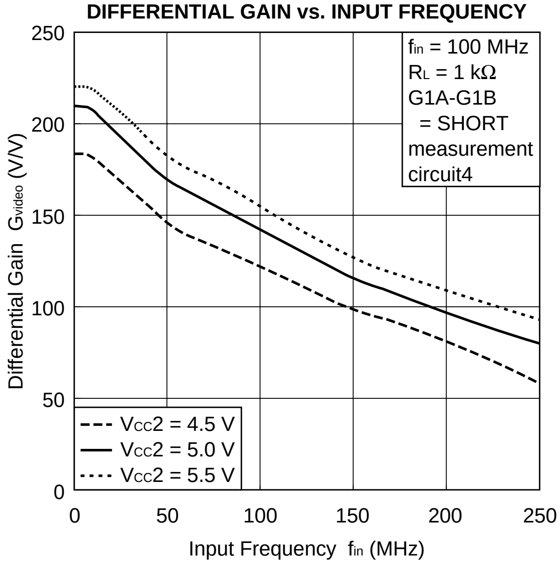

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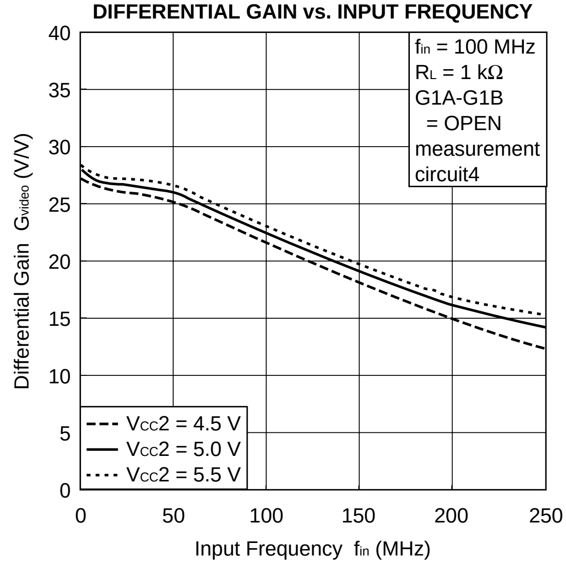
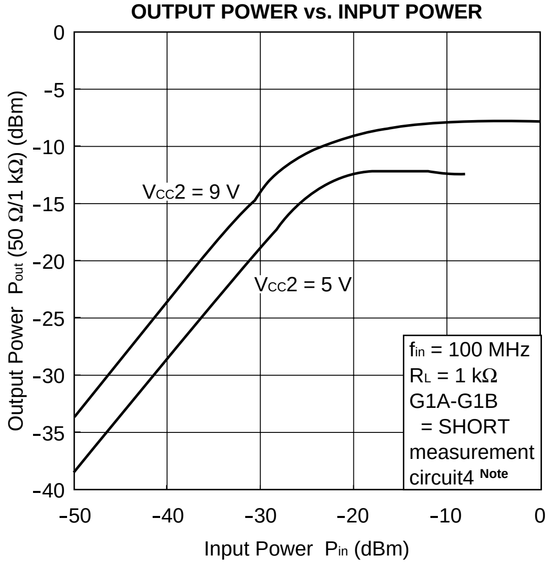


OUTPUT POWER vs. INPUT POWER



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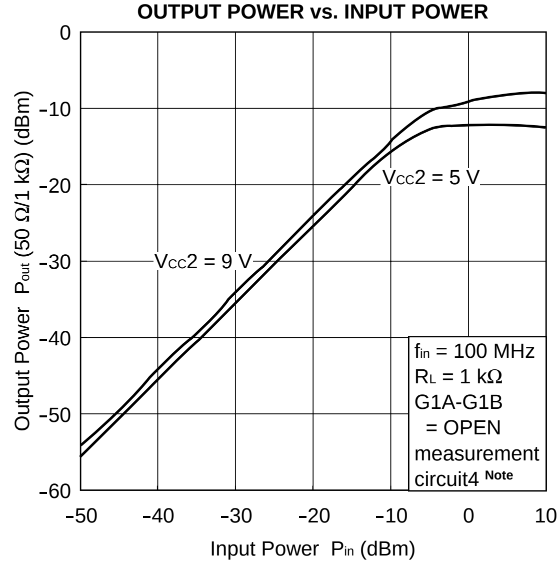

Note Output Power = (Output Power at Spectrum Analyzer) + 10 log (1 kΩ/50 Ω)

STANDARD CHARACTERISTICS (T_A = 25 °C)

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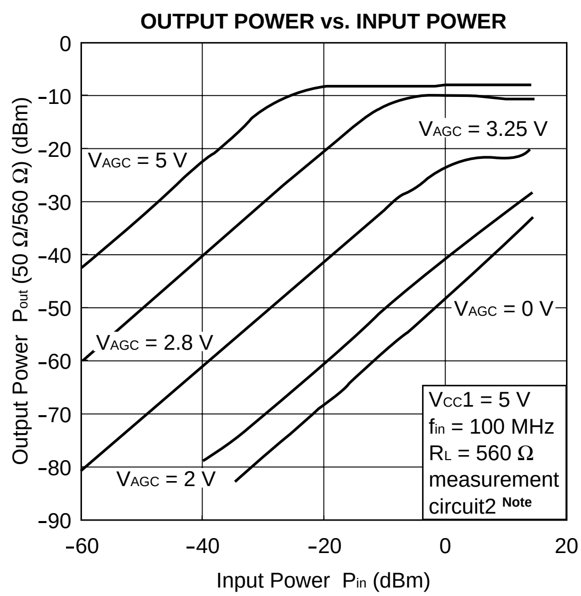
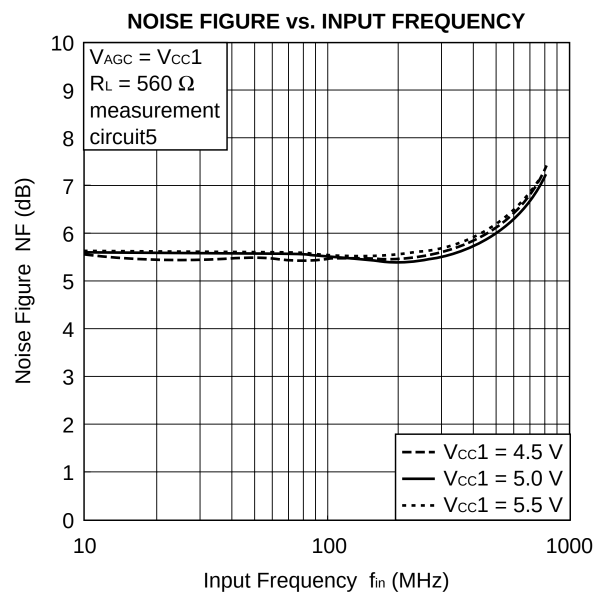
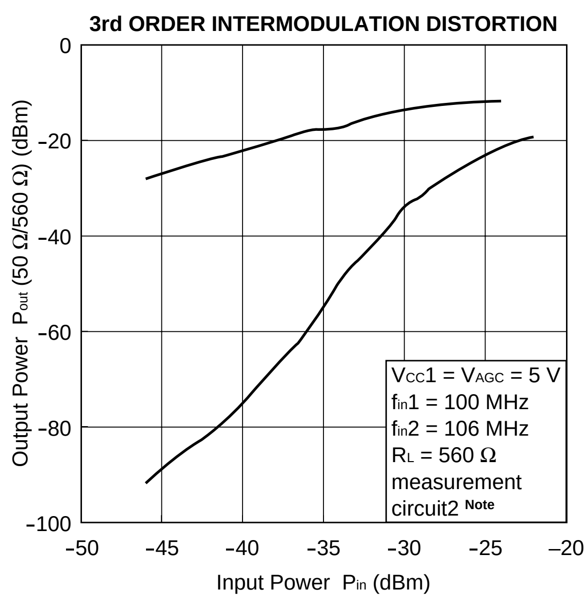
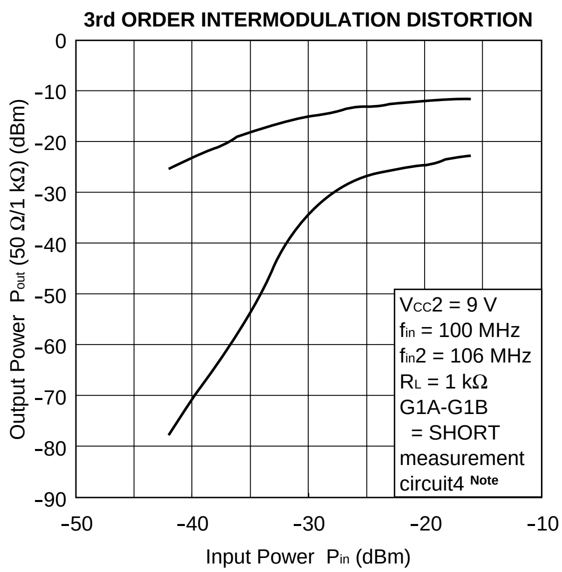


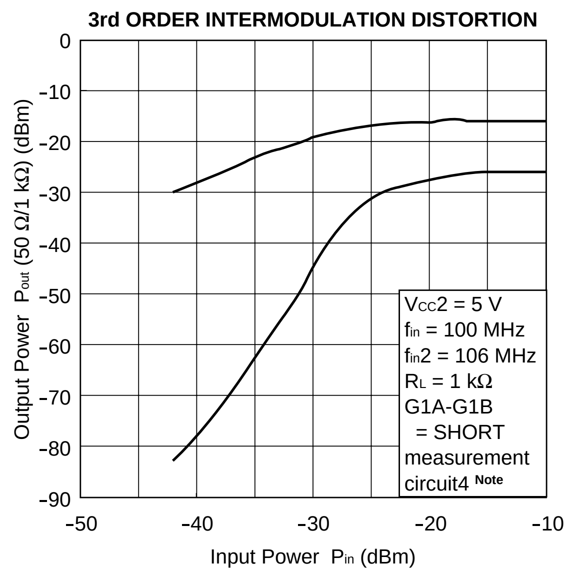


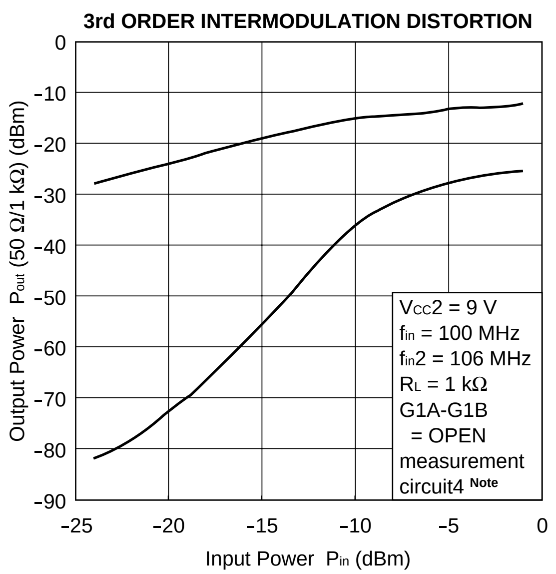


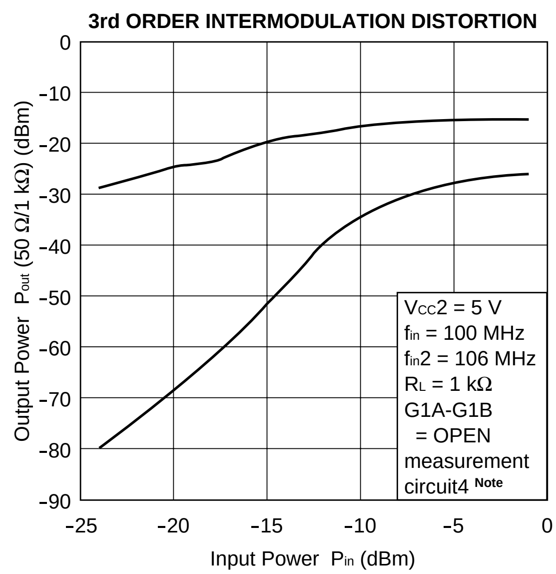
Note Output Power = (Output Power at Spectrum Analyzer) + 10 log (560 Ω/50 Ω)

STANDARD CHARACTERISTICS (T_A = 25 °C)





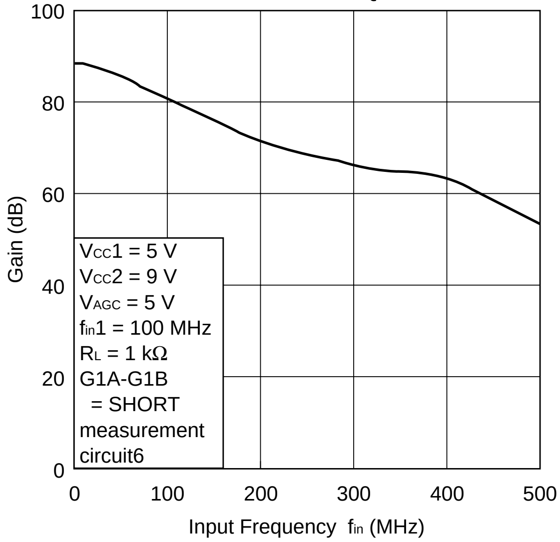




Note Output Power = (Output Power at Spectrum Analyzer) + 10 log (1 kΩ/50 Ω)

STANDARD CHARACTERISTICS (T_A = 25 °C)

GAIN vs. INPUT FREQUENCY



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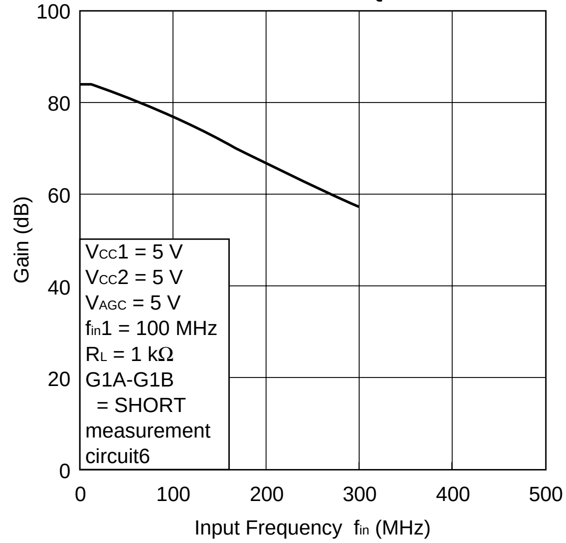

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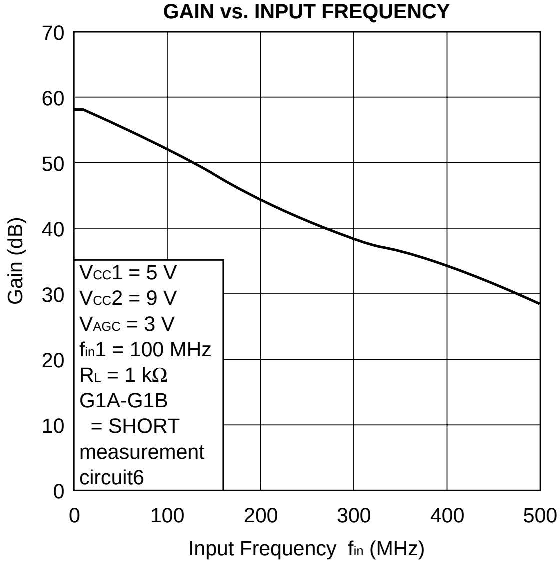

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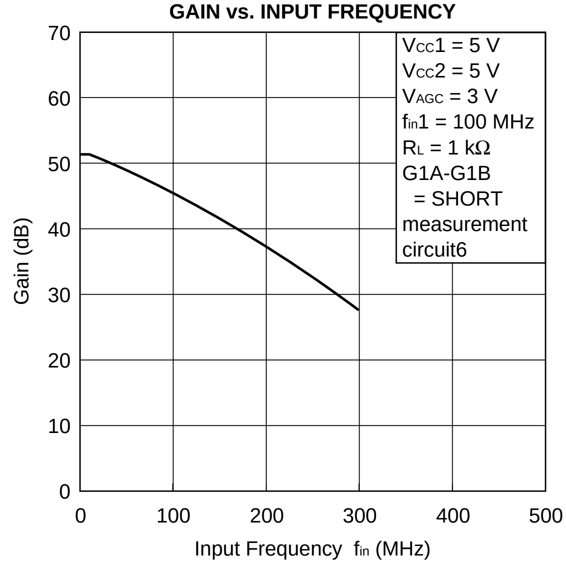

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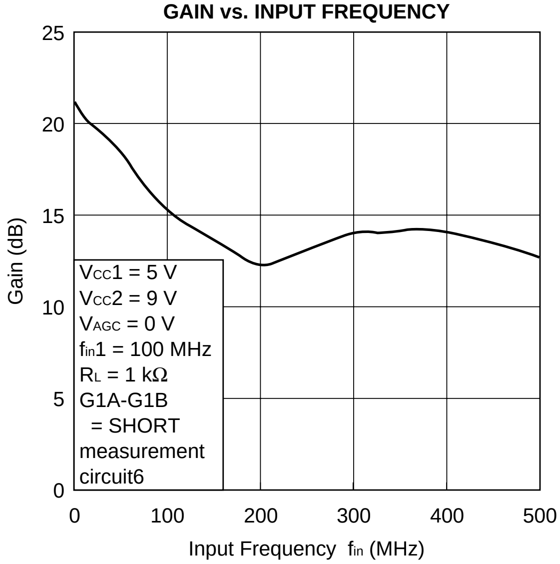

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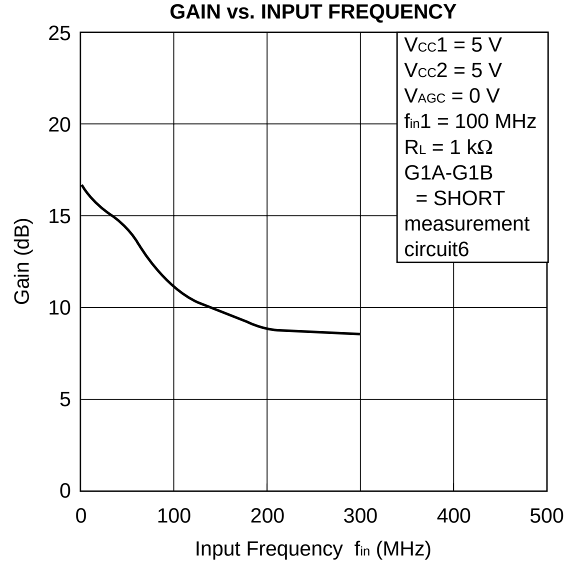
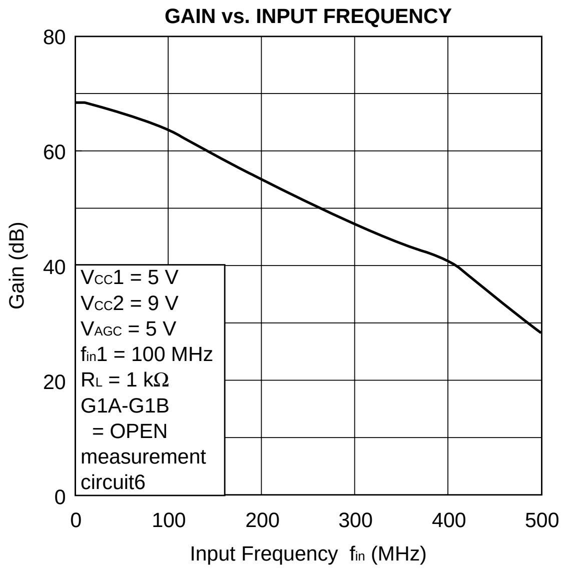
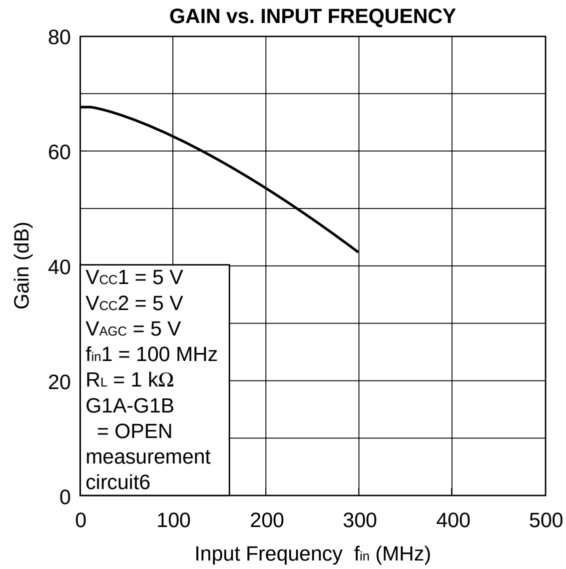
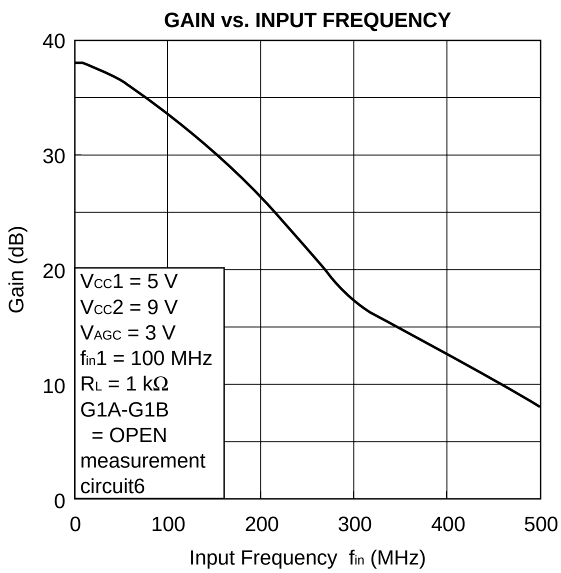
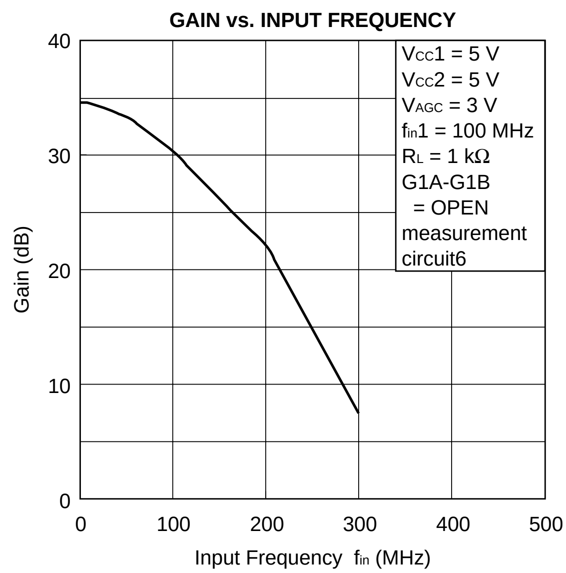


STANDARD CHARACTERISTICS (T_A = 25 °C)

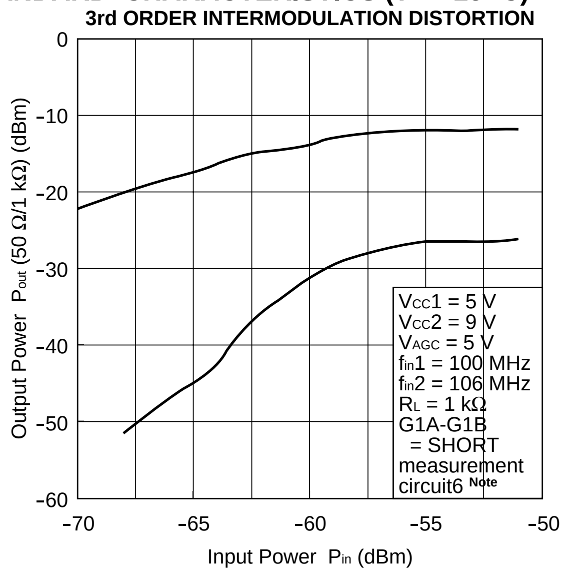


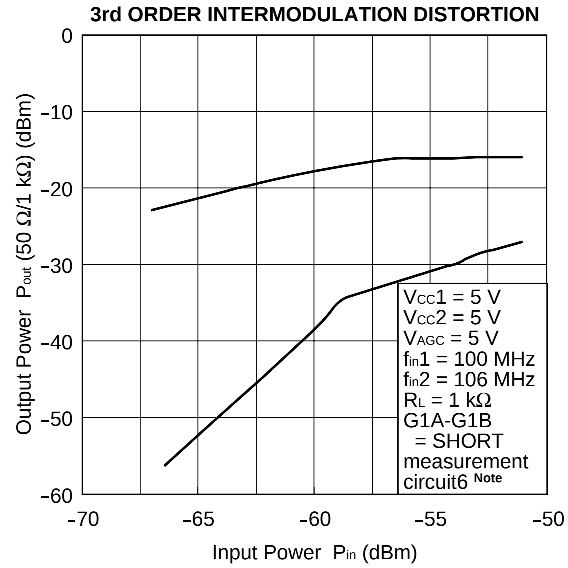


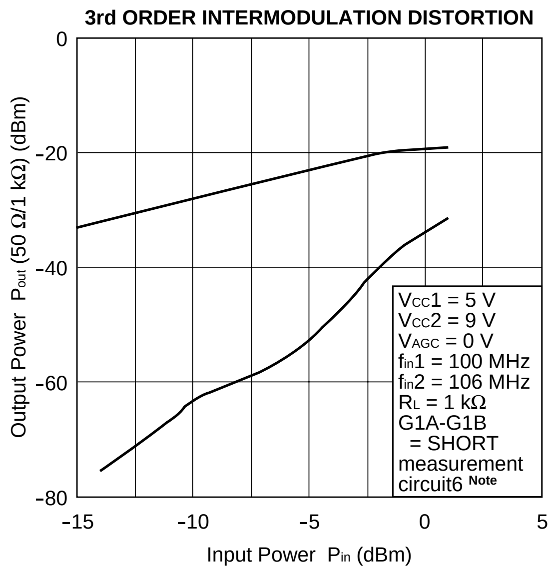


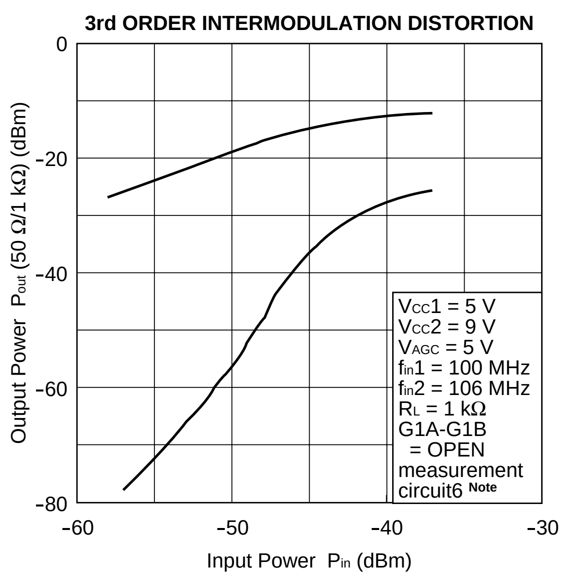


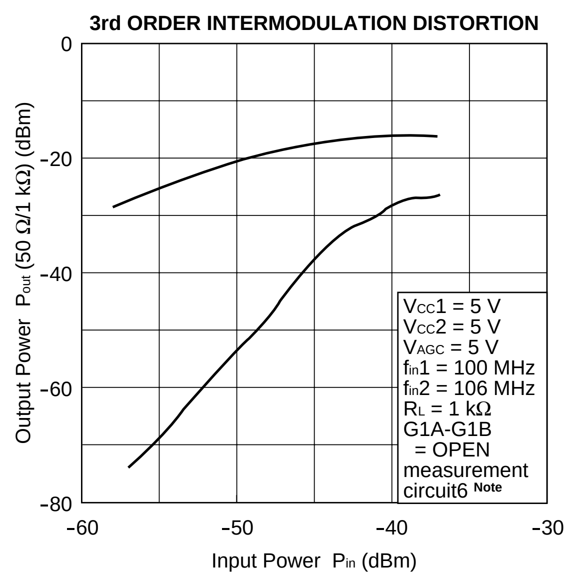
STANDARD CHARACTERISTICS (T_A = 25 °C)





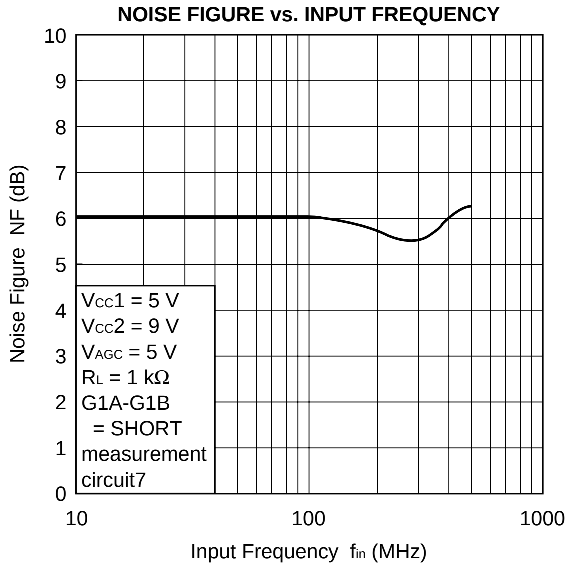


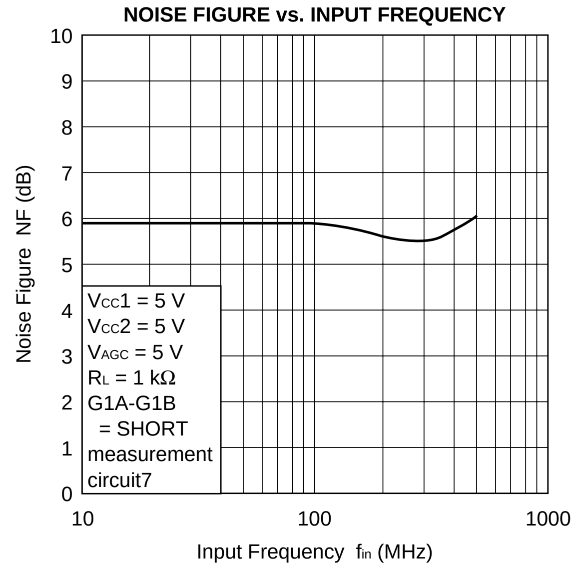


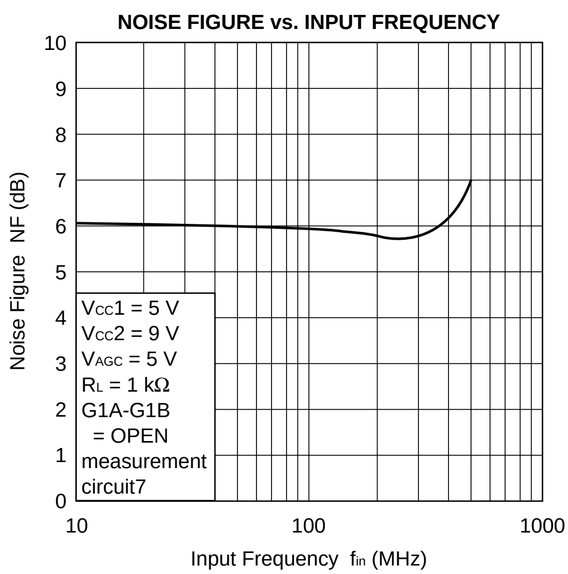


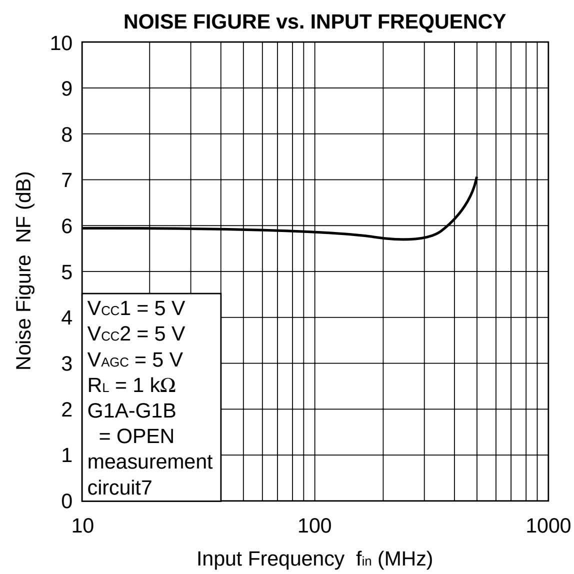
Note Output Power = (Output Power at Spectrum Analyzer) + 10 log (1 kΩ/50 Ω)

STANDARD CHARACTERISTICS (T_A = 25 °C)

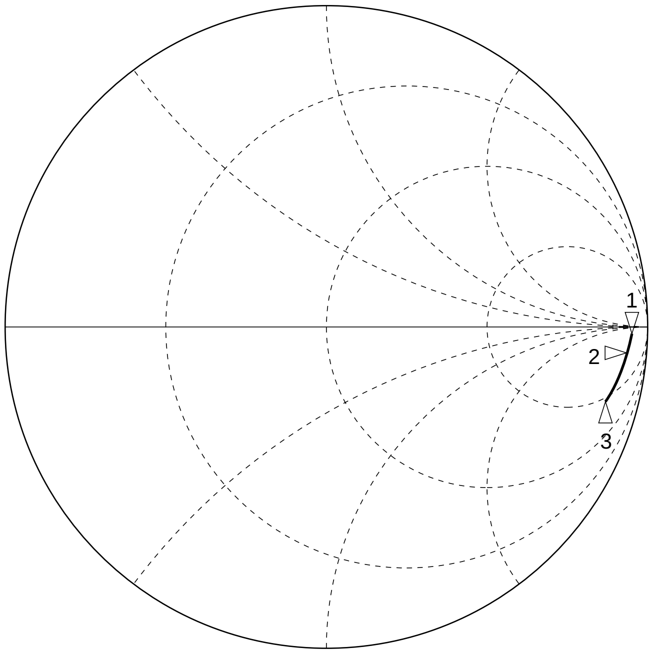








INPUT IMPEDANCE (2 PIN)

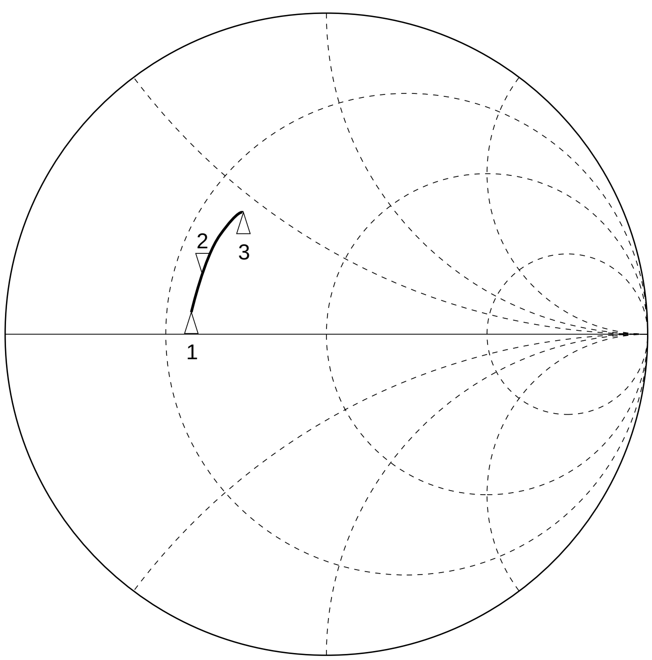


START 0.045000000 GHz
STOP 0.250000000 GHz

MARKER		Z_{in}
1	45 MHz	938.4 Ω – j604.8 Ω
2	100 MHz	434.7 Ω – j573.8 Ω
3	250 MHz	122.5 Ω – j324.9 Ω

Conditions T_A = 25°C
$V_{CC}1$ = 5 V

OUTPUT IMPEDANCE (20 PIN)

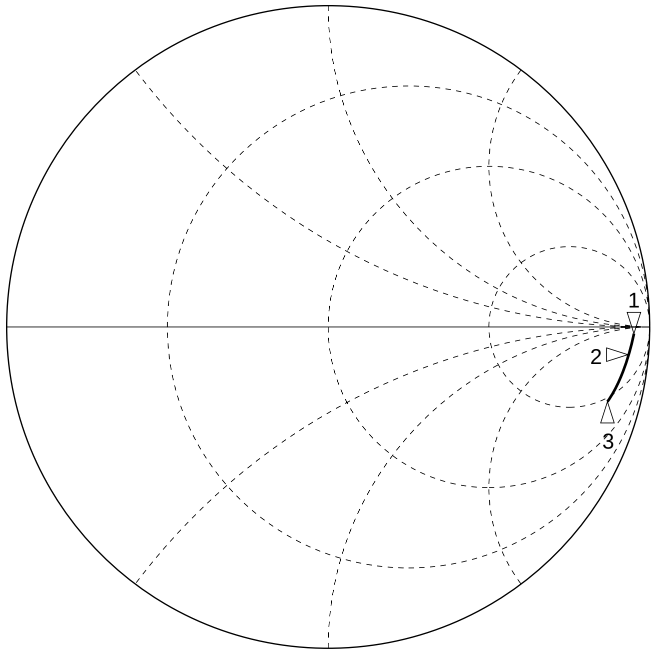


START 0.045000000 GHz
STOP 0.250000000 GHz

MARKER		Z_{out}
1	45 MHz	19.86 Ω + 3.83 Ω
2	100 MHz	20.28 Ω + 9.26 Ω
3	250 MHz	22.28 Ω + 22.48 Ω

Conditions T_A = 25°C
$V_{CC}1$ = 5 V

INPUT IMPEDANCE (19 PIN)

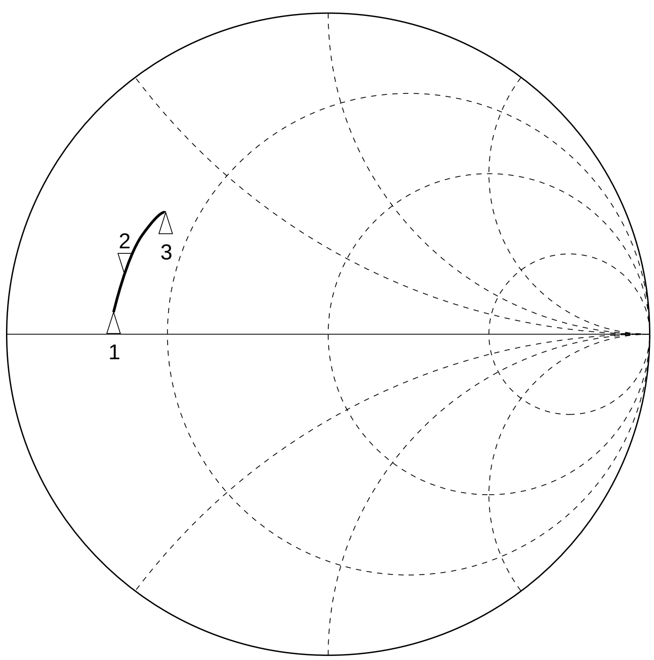


START 0.045000000 GHz
STOP 0.250000000 GHz

MARKER		Z_{in}
1	45 MHz	965.8 Ω – j601.2 Ω
2	100 MHz	446.6 Ω – j661.8 Ω
3	250 MHz	126.8 Ω – j312.4 Ω

Conditions T_A = 25°C
$V_{CC}1$ = 5 V

OUTPUT IMPEDANCE (17 PIN)



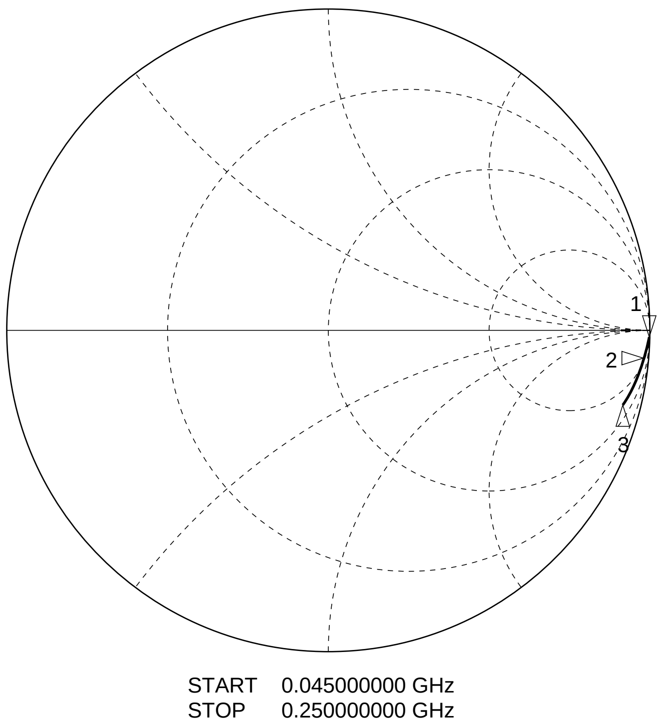
START 0.045000000 GHz
STOP 0.250000000 GHz

MARKER		Z_{OUT}
1	45 MHz	10.32 Ω + j2.88 Ω
2	100 MHz	10.86 Ω + j6.42 Ω
3	250 MHz	12.67 Ω + j15.39 Ω

Conditions T_A = 25°C
$V_{CC}1$ = 5 V

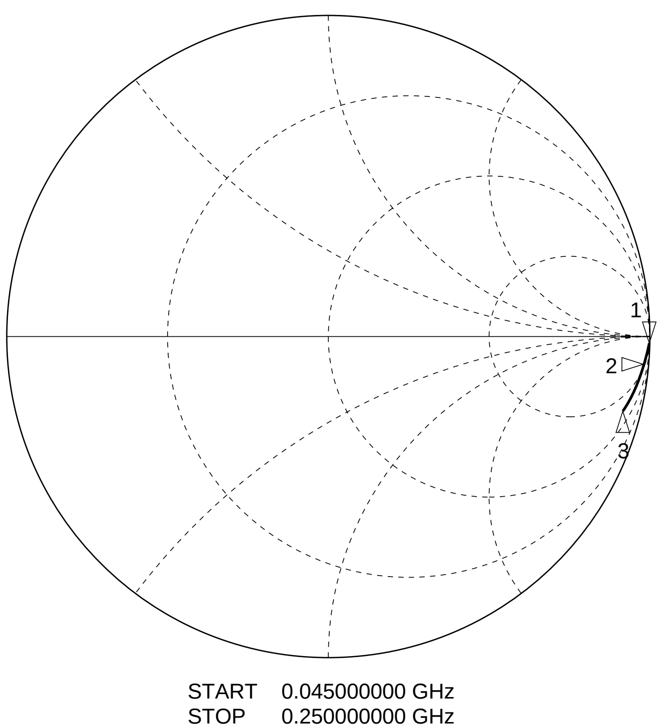
INPUT IMPEDANCE (15 PIN)

(i) T_A = 25°C, $V_{CC}2$ = 5 V



MARKER		Z_{in}
1	45 MHz	840.0 Ω – j2560 Ω
2	100 MHz	50.19 Ω – j1259 Ω
3	250 MHz	52.03 Ω – j475.6 Ω

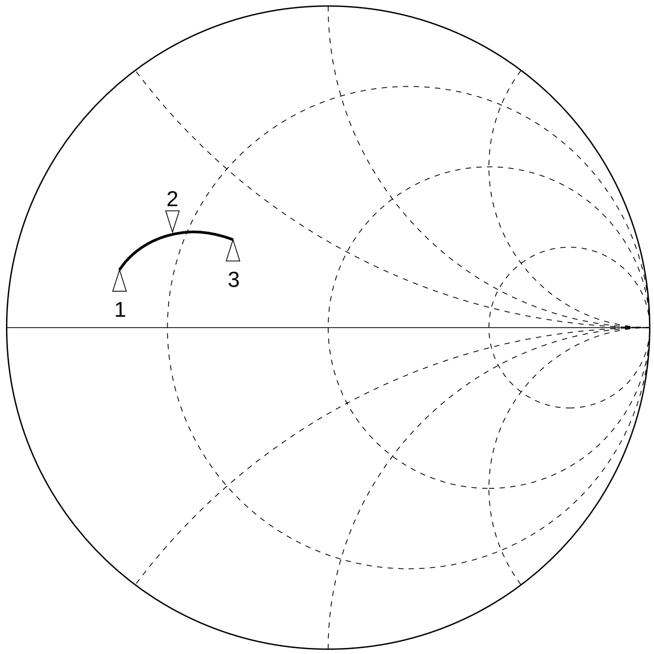
(ii) T_A = 25°C, $V_{CC}2$ = 9 V



MARKER		Z_{in}
1	45 MHz	478.3 Ω – j3091 Ω
2	100 MHz	106.13 Ω – j1368 Ω
3	250 MHz	55.11 Ω – j501.3 Ω

OUTPUT IMPEDANCE (12 PIN)

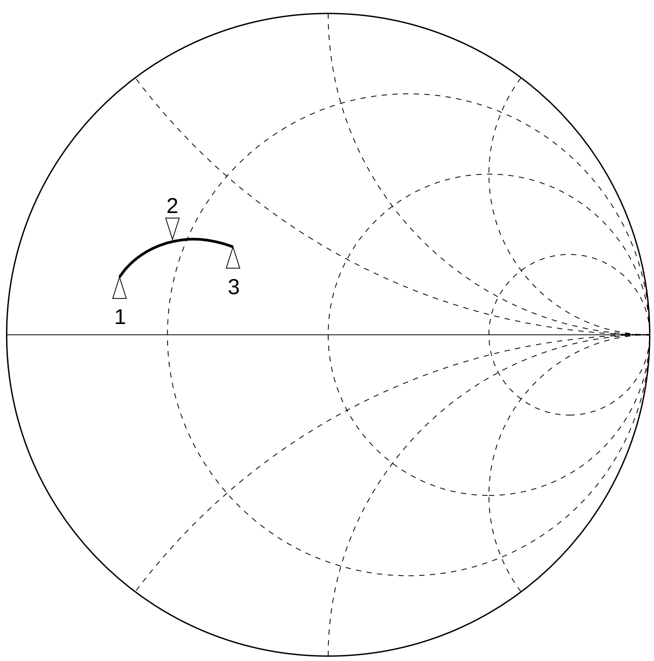
(i) T_A = 25°C, $V_{CC}2$ = 5 V, 11 pin is grounded through 50 Ω resistor.



START 0.045000000 GHz
STOP 0.250000000 GHz

MARKER		Z_{out}
1	45 MHz	9.88 Ω + j6.25 Ω
2	100 MHz	14.21 Ω + j11.78 Ω
3	250 MHz	23.64 Ω + j15.73 Ω

(ii) T_A = 25°C, $V_{CC}2$ = 9 V, 11 pin is grounded through 50 Ω resistor.

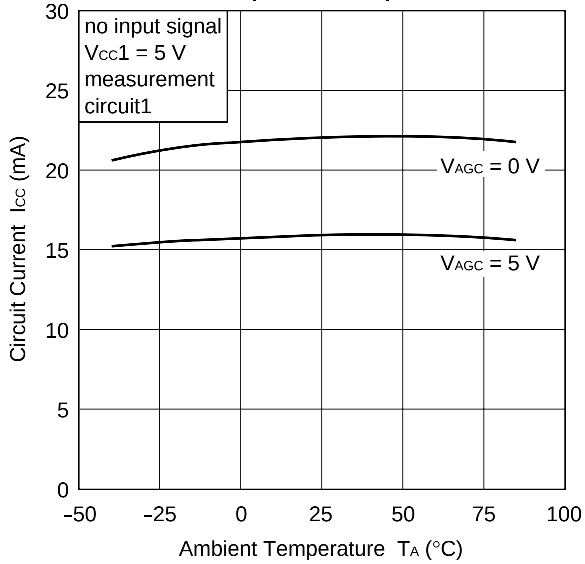


START 0.045000000 GHz
STOP 0.250000000 GHz

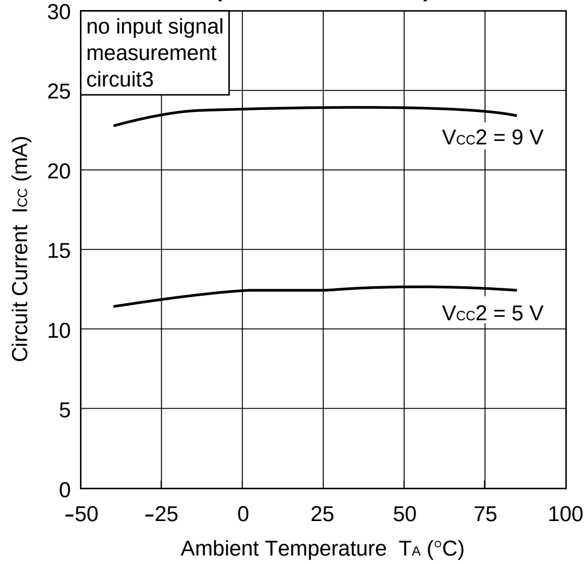
MARKER		Z_{out}
1	45 MHz	7.36 Ω + j4.85 Ω
2	100 MHz	10.50 Ω + j9.58 Ω
3	250 MHz	19.37 Ω + j13.70 Ω

THERMAL CHARACTERISTICS (FOR REFERENCE)

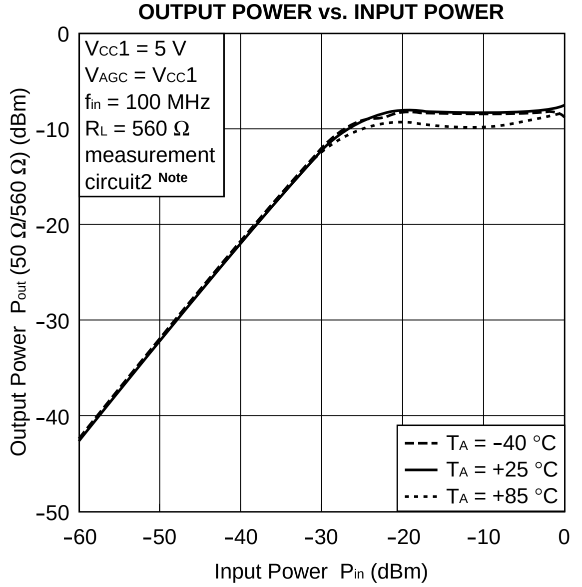
CIRCUIT CURRENT vs. AMBIENT TEMPERATURE (AGC BLOCK)



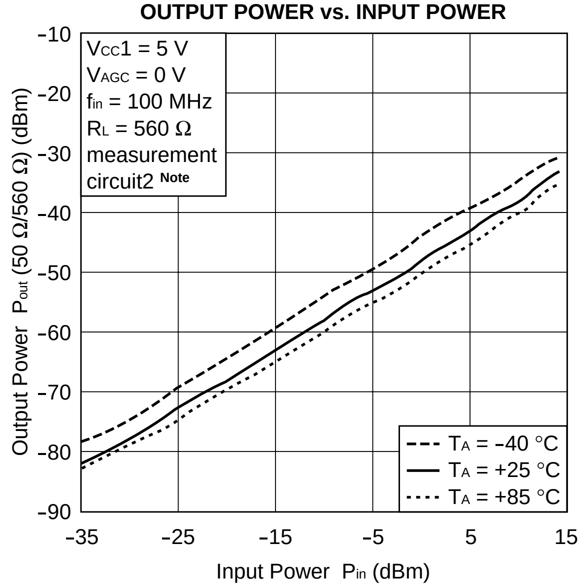
CIRCUIT CURRENT vs. AMBIENT TEMPERATURE (VIDEO AMP BLOCK)



★ **OUTPUT POWER vs. INPUT POWER**

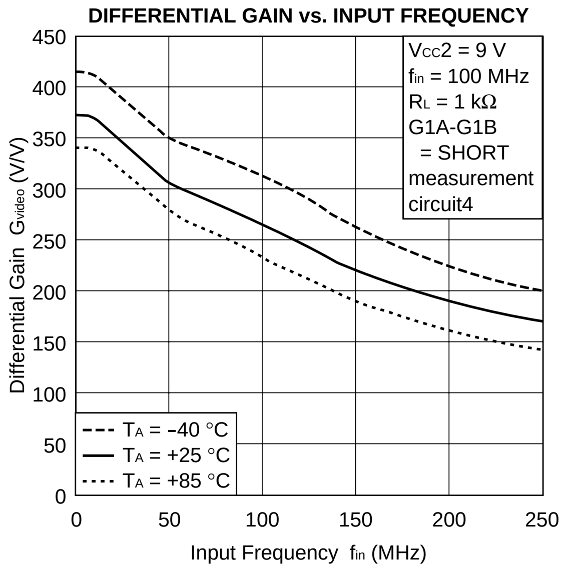


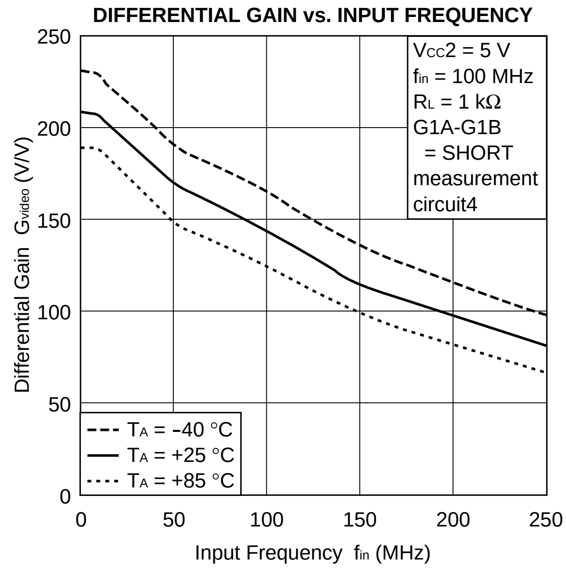
★ **OUTPUT POWER vs. INPUT POWER**

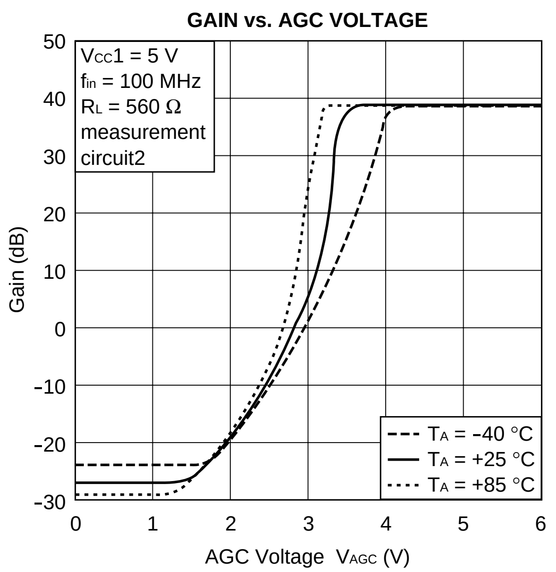


Note Output Power = (Output Power at Spectrum Analyzer) + 10 log (560 Ω/50 Ω)

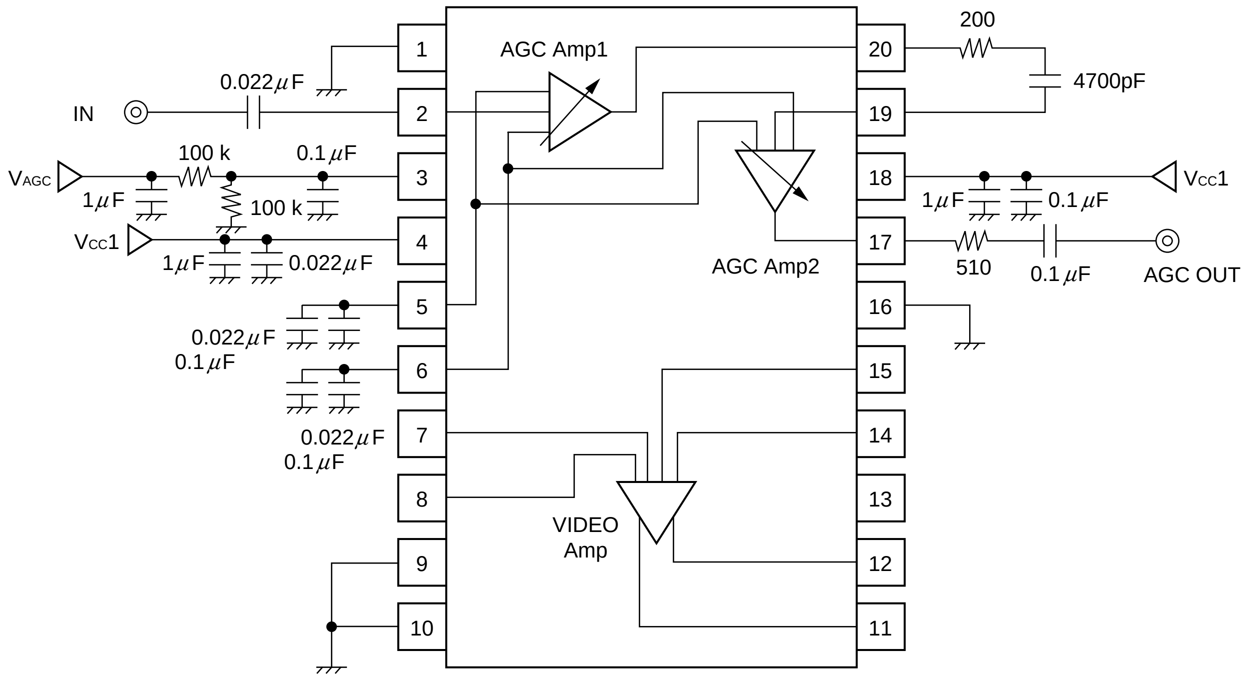
THERMAL CHARACTERISTICS (FOR REFERENCE)



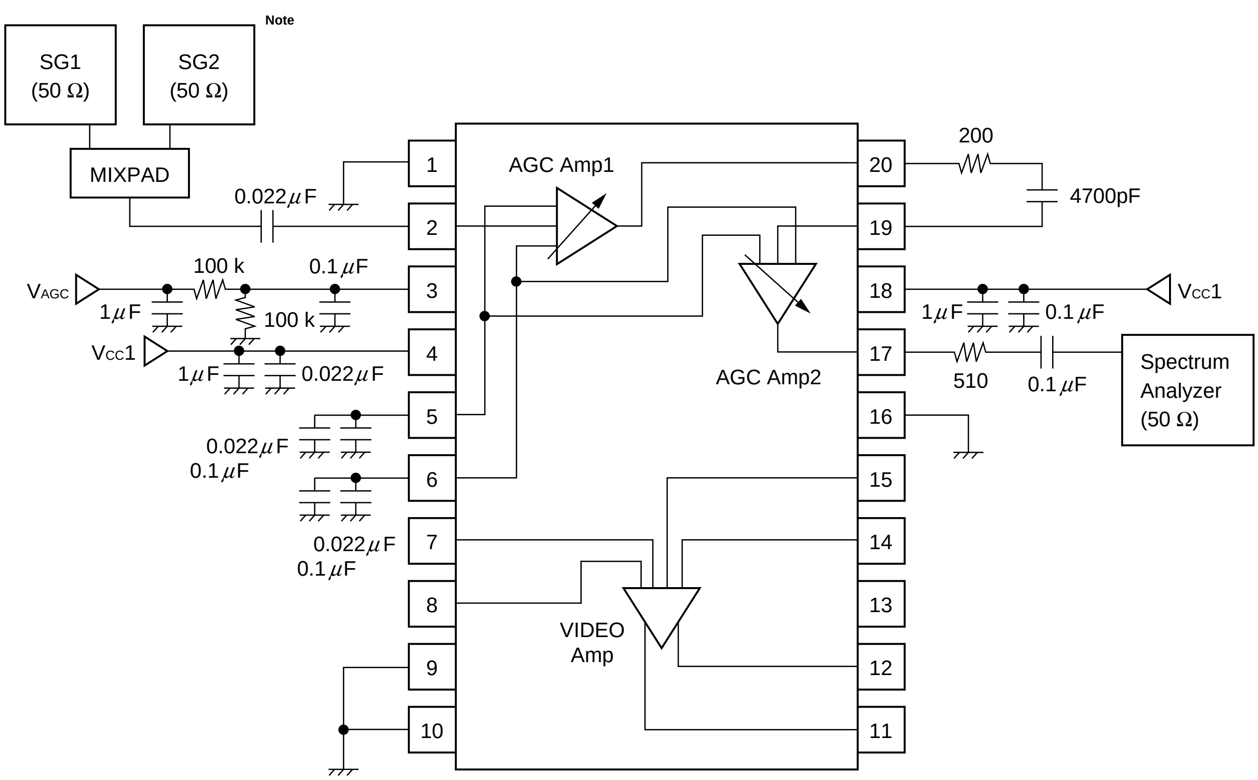




MEASUREMENT CIRCUIT 1

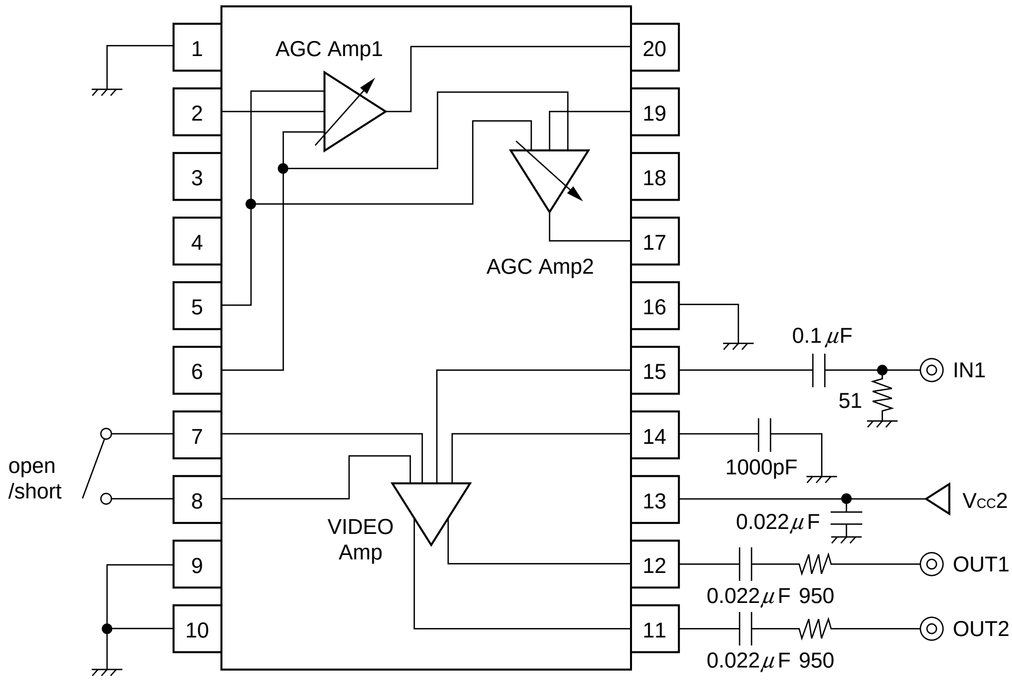


MEASUREMENT CIRCUIT 2

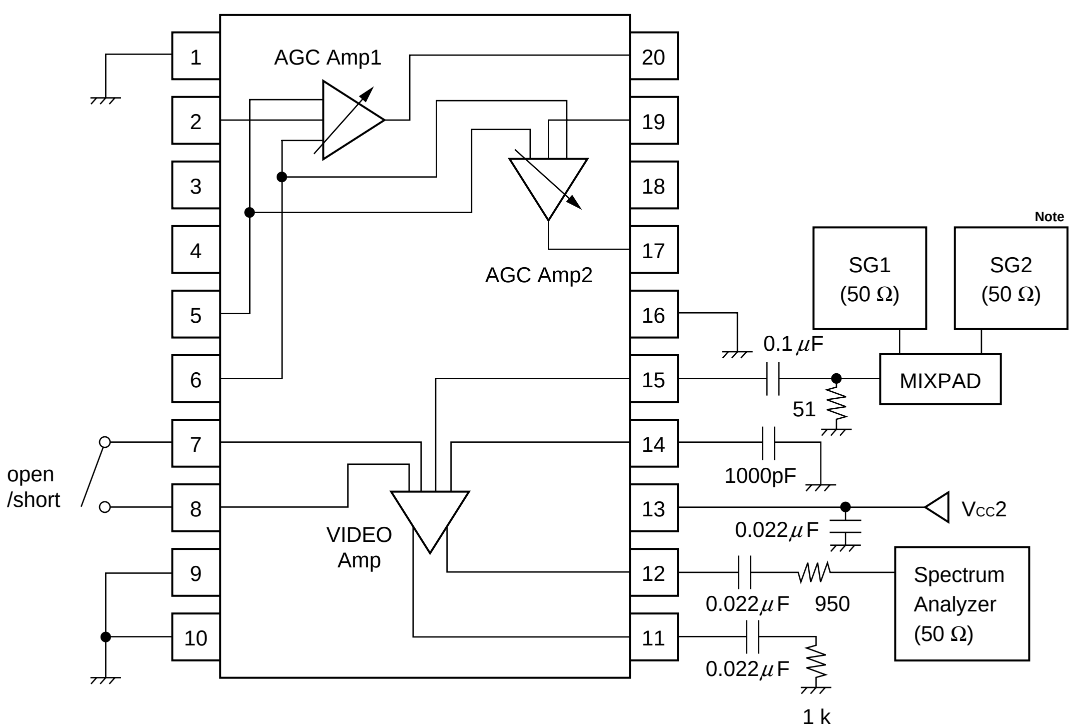


Note In the case of measurement of IM_3

MEASUREMENT CIRCUIT 3

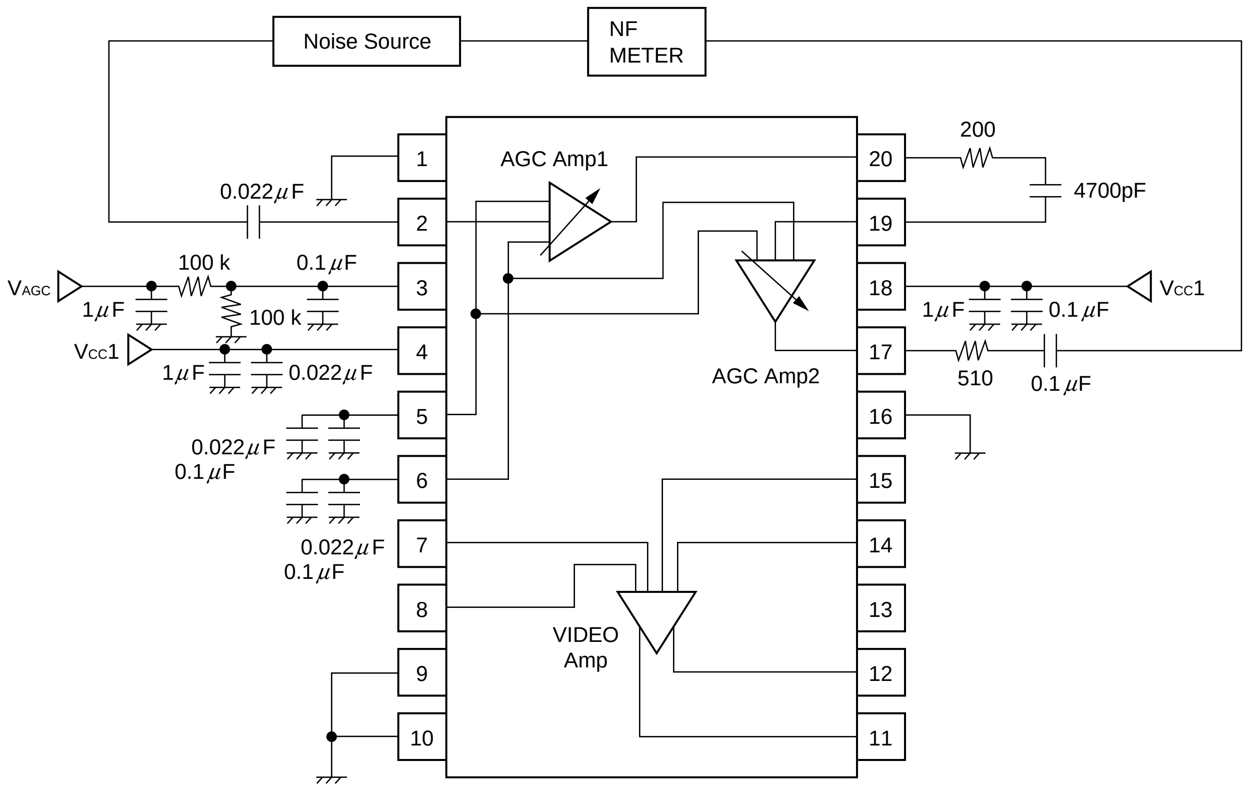


MEASUREMENT CIRCUIT 4

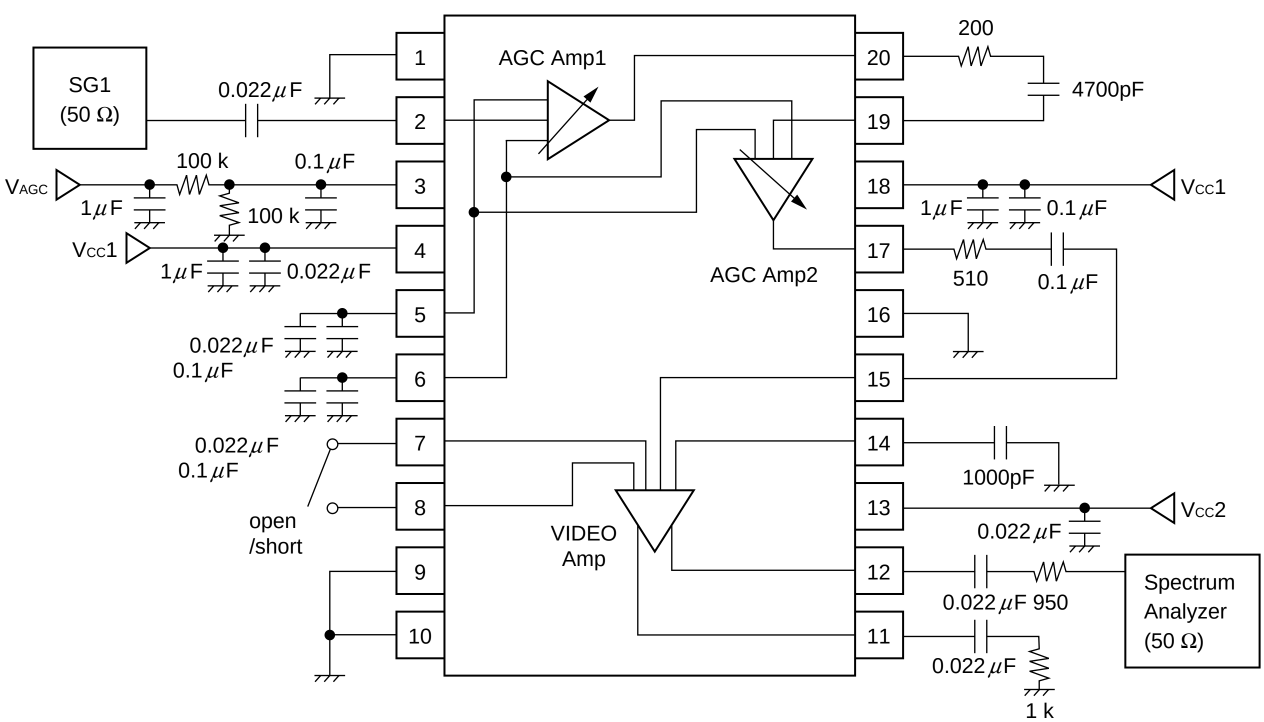


Note In the case of measurement of IM_3

MEASUREMENT CIRCUIT 5



MEASUREMENT CIRCUIT 6



MEASUREMENT CIRCUIT 7

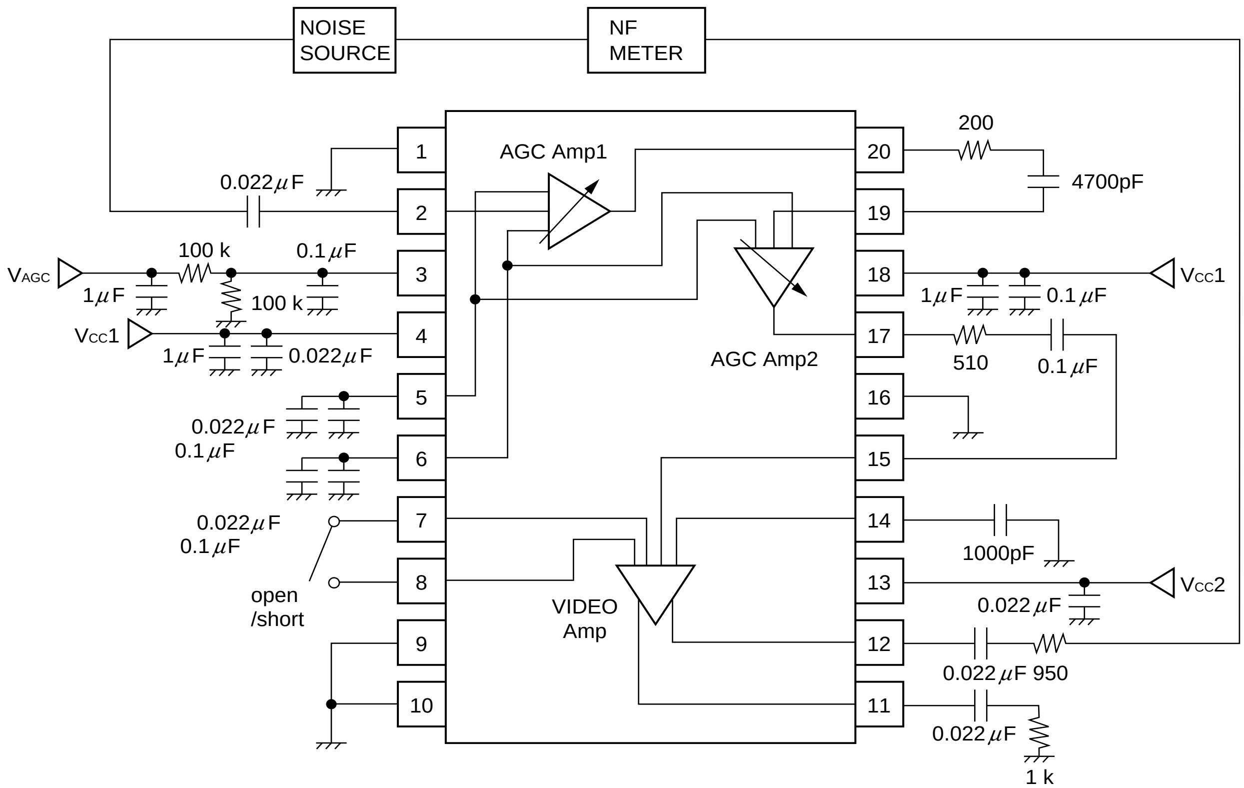
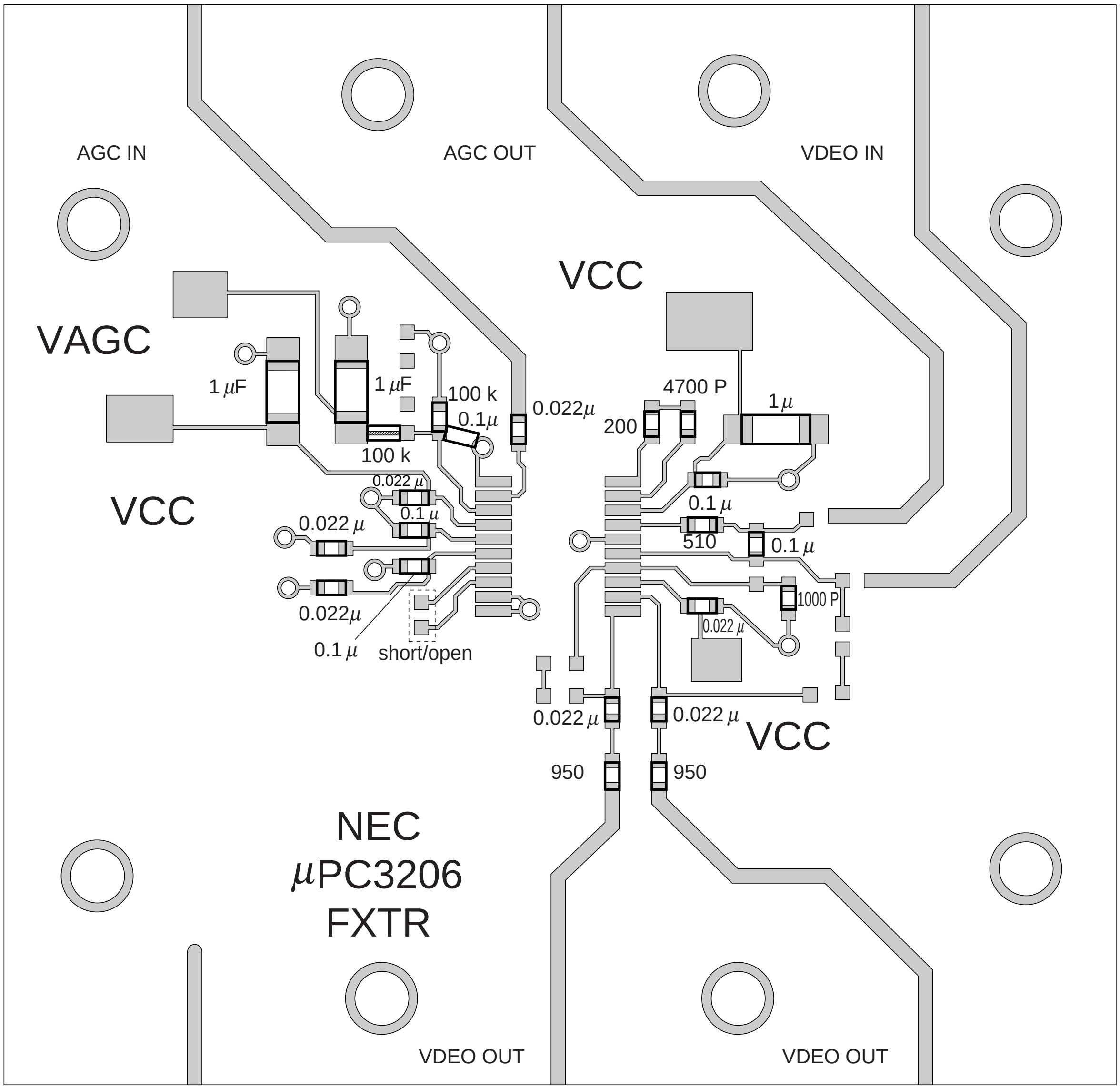


ILLUSTRATION OF THE EVALUATION BOARD FOR MEASUREMENT CIRCUIT6



Notes on evaluation board

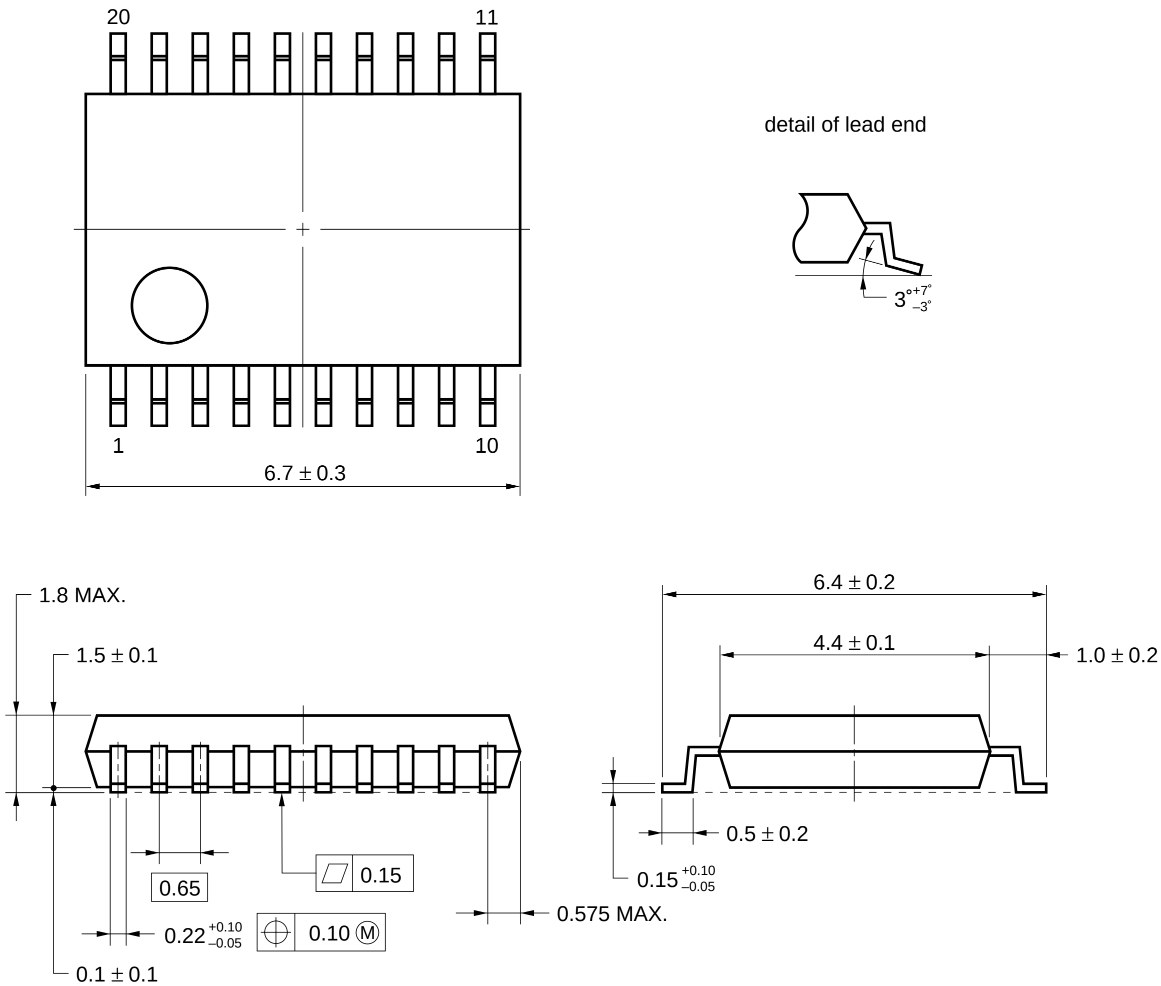
(1) GND pattern on rear side

(2) ◎ ◎: Through hole

(3) ▨: represents cutout

PACKAGE DIMENSIONS

★ **20 PIN PLASTIC SSOP (225 mil) (UNIT: mm)**



NOTE Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.

NOTE ON CORRECT USE

(1) Observe precautions for handling because of electro-static sensitive devices.

(2) Form a ground pattern as wide as possible to minimize ground impedance (to prevent undesires osillation).

(3) Keep the track length of the ground pins as short as possible.

(4) A low pass filter must be attached to V_{CC} line.

(5) A matching circuit must be externally attached to output port.

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 Condition Symbol
Infrared Reflow	Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit[Note]: None	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure limit[Note]: None	VP15-00-3
Partial Heating	Pin temperature: 300°C Time: 3 seconds or less (per side of device) Exposure limit[Note]: None	–

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

[MEMO]

[MEMO]

[MEMO]