CEL

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC3231GV

GENERAL PURPOSE 5 V 100 MHz AGC AMPLIFIER

DESCRIPTION

The μPC3231GV 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 dBμV (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
μPC3231GV-E1	μPC3231GV-E1-A	8-pin plastic SSOP (4.45 mm (175)) (Pb-Free)	3231	• Embossed tape 8 mm wide • Pin 1 indicates pull-out direction of tape • Qty 1 kpcs/reel

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC3231GV-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.

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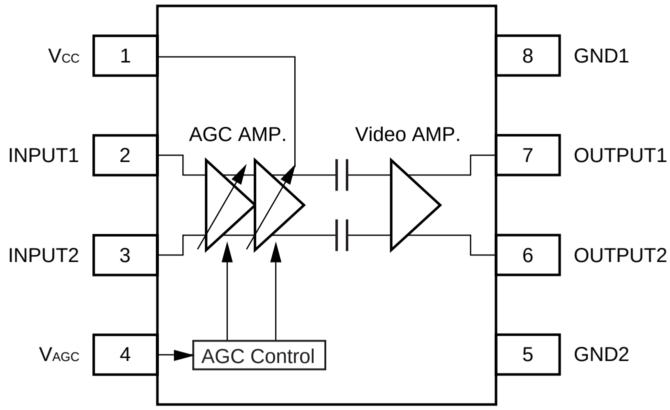
Date Published May 2007 NS CP(N)

INTERNAL BLOCK DIAGRAM AND PIN CONNECTIONS

(Top View)



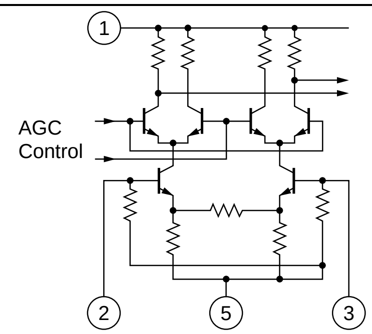
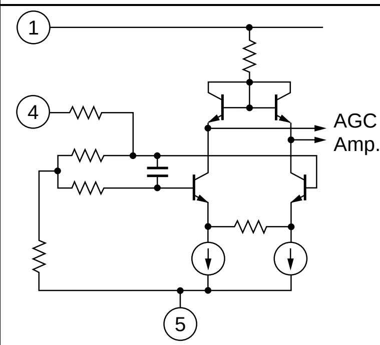
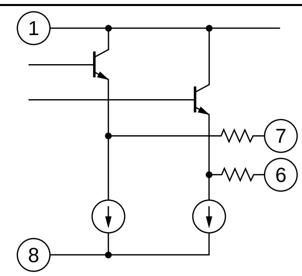
PRODUCT LINE-UP OF 5 V AGC AMPLIFIER

Part Number	I_{CC} (mA)	G_{MAX} (dB)	G_{MIN} (dB)	GCR (dB)	NF (dB)	IM_3 (dBc)	Package
μPC3217GV	23	53	0	53	6.5	50 Note1	8-pin SSOP (4.45 mm (175))
μPC3218GV	23	63	10	53	3.5	50 Note1	
μPC3219GV	36.5	42.5	0	42.5	9.0	58 Note1	
μPC3221GV	33	60	10	50	4.2	56 Note1	
μPC3231GV	36	65	4	61	5.0	53.5 Note2	

Notes 1. f1 = 44 MHz, f2 = 45 MHz, V_{out} = 0.7 V_{p-p}/tone, single-ended output

2. f1 = 44 MHz, f2 = 45 MHz, V_{out} = 0.5 V_{p-p}/tone, single-ended output

PIN EXPLANATIONS

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) Note	Function and Application	Internal Equivalent Circuit
1	V_{CC}	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_{AGC}	0 to V_{CC}	–	Gain control pin. This pin's bias govern the AGC output level. Minimum Gain at V_{AGC} : 0 to 0.1 V Maximum Gain at V_{AGC} : 2.7 to 3.3 V Recommended to use AGC voltage with externally resister (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_{CC} = 5.0 V.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V_{CC}	T_A = +25°C	6.0	V
Gain Control Voltage Range	V_{AGC}	T_A = +25°C	0 to V_{CC}	V
Power Dissipation	P_D	T_A = +85°C **Note**	250	mW
Storage Temperature	T_{stg}		–55 to +150	°C

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

RECOMMENDED OPERATING RANGE

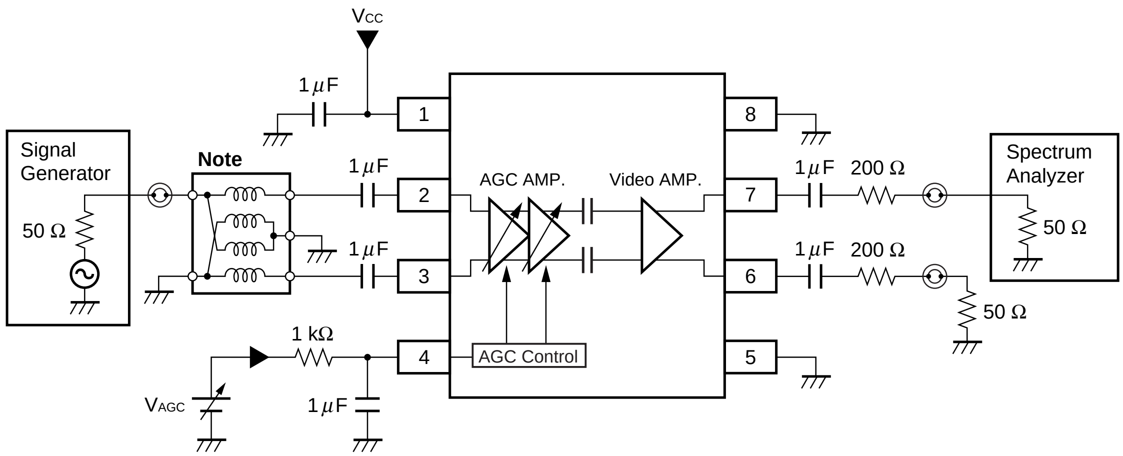
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Operating Ambient Temperature	T_A	V_{CC} = 4.5 to 5.5 V	–40	+25	+85	°C
Gain Control Voltage Range	V_{AGC}		0	–	3.3	V
Operating Frequency Range	f_{BW}		30	–	90	MHz

ELECTRICAL CHARACTERISTICS
(T_A = +25°C, V_{CC} = 5 V, f = 45 MHz, Z_S = 50 Ω, Z_L = 250 Ω, single-ended output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Circuit Current	I_{CC}	V_{CC} = 5 V, No input signal **Note 1**	28	36	44	mA
AGC Voltage High Level	$V_{AGC (H)}$	@ Maximum gain **Note 1**	2.7	–	3.3	V
AGC Voltage Low Level	$V_{AGC (L)}$	@ Minimum gain **Note 1**	0	–	0.1	V
RF Characteristics						
IF Input Voltage Range	f_{IFin}	f_C = –3 dB **Note 1**	30	–	90	MHz
Maximum Voltage Gain	G_{MAX}	V_{AGC} = 2.7 V, P_{in} = –60 dBm **Note 1**	62.5	65	67.5	dB
Minimum Voltage Gain	G_{MIN}	V_{AGC} = 0.1 V, P_{in} = –30 dBm **Note 1**	0	4	7	dB
Gain Control Range (input prescribe)	GCR_{in}	V_{AGC} = 0.1 to 2.7 V **Note 1**	55.5	61	–	dB
Gain Control Range (output prescribe)	GCR_{out}	V_{out} = 1.0 V_{p-p} **Note 1**	45	55	–	dB
Output Voltage	V_{out}	P_{in} = –61 to –6 dBm **Note 1**	–	1.0	–	V_{p-p}
Maximum Output Voltage	V_{oclip}	V_{AGC} = 3.0 V **Note 1**	2.0	3.3	–	V_{p-p}
Noise Figure	NF	V_{AGC} = 3.0 V **Note 2**	–	5.0	6.5	dB
3rd Order Intermodulation Distortion	IM_3	f1 = 44 MHz, f2 = 45 MHz, P_{in} = –20 dBm/tone, V_{out} = 105 dBμV (0.5 V_{p-p}) /tone **Note 1**	50	53.5	–	dBc
Input Impedance	Z_{in}	V_{AGC} = 0 V **Note 3**	–	1.35//6	–	kΩ//pF

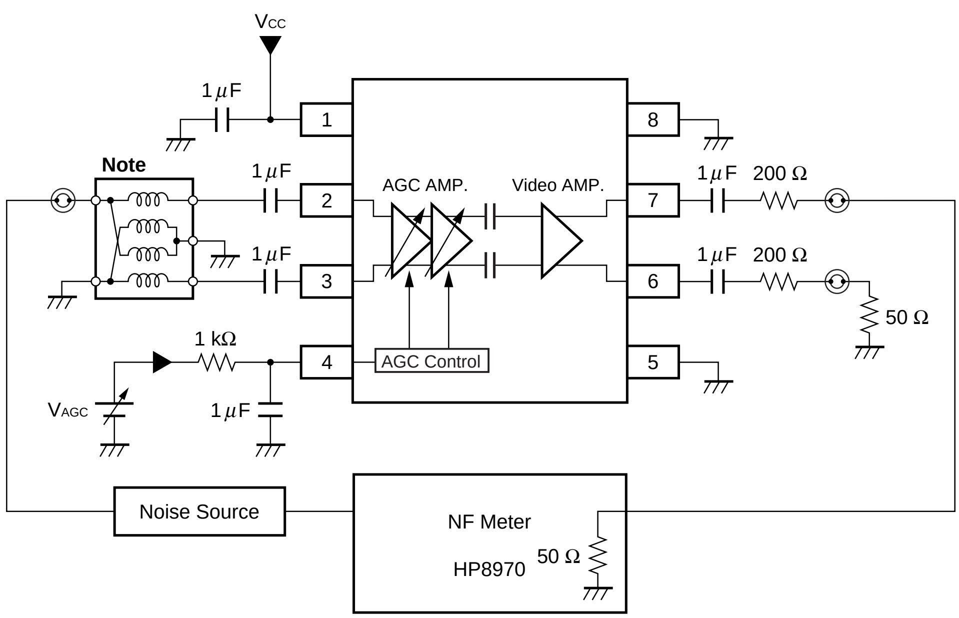
Notes 1. By measurement circuit 1
2. By measurement circuit 2
3. By measurement circuit 3

MEASUREMENT CIRCUIT 1



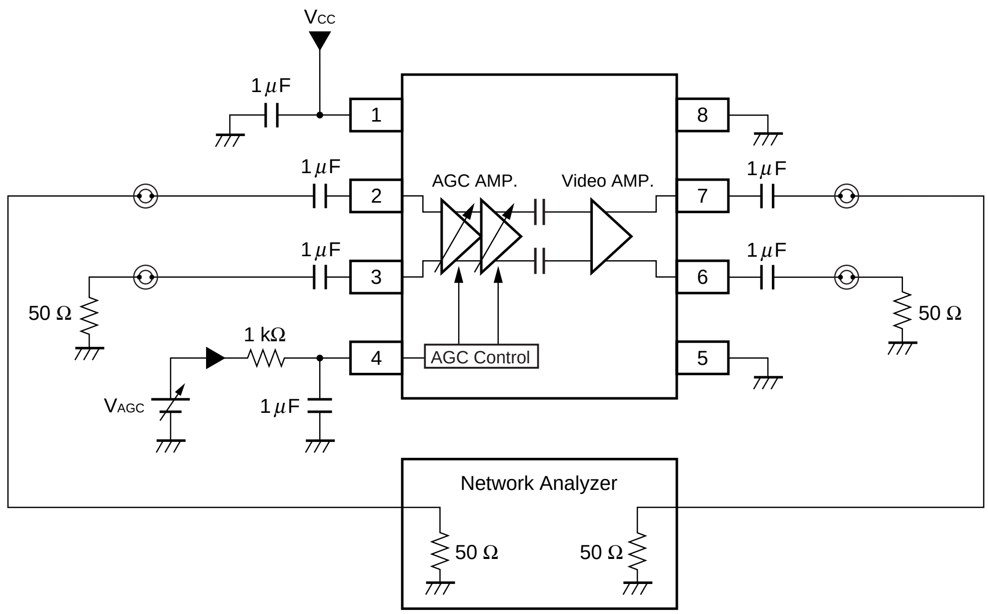
Note Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 2

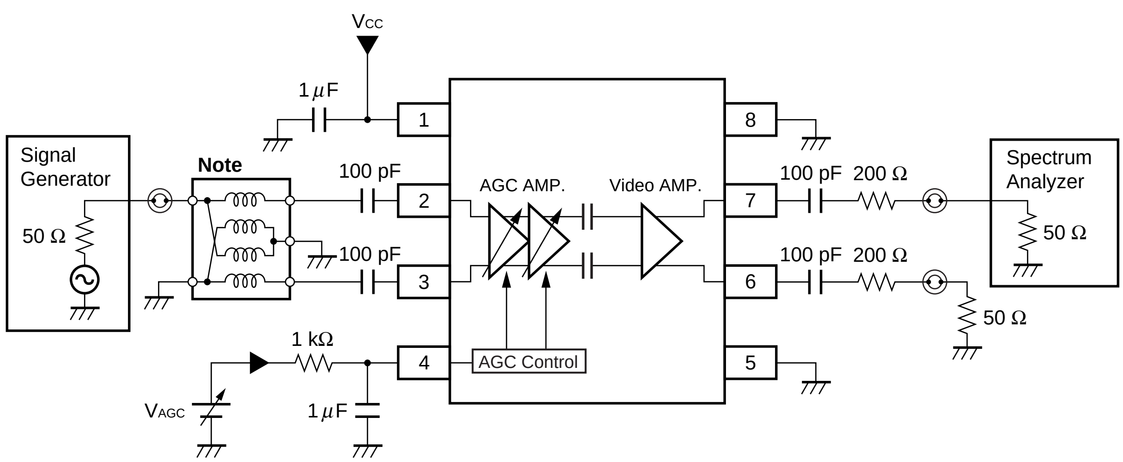


Note Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 3

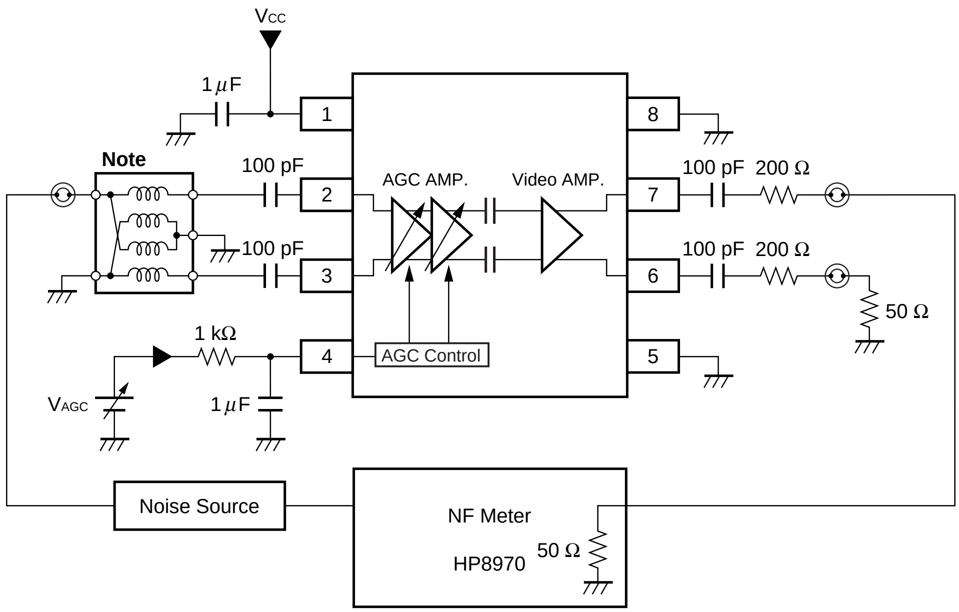


MEASUREMENT CIRCUIT 4 (PRESSURE IMPROVEMENT RECOMMENDATION CIRCUIT)



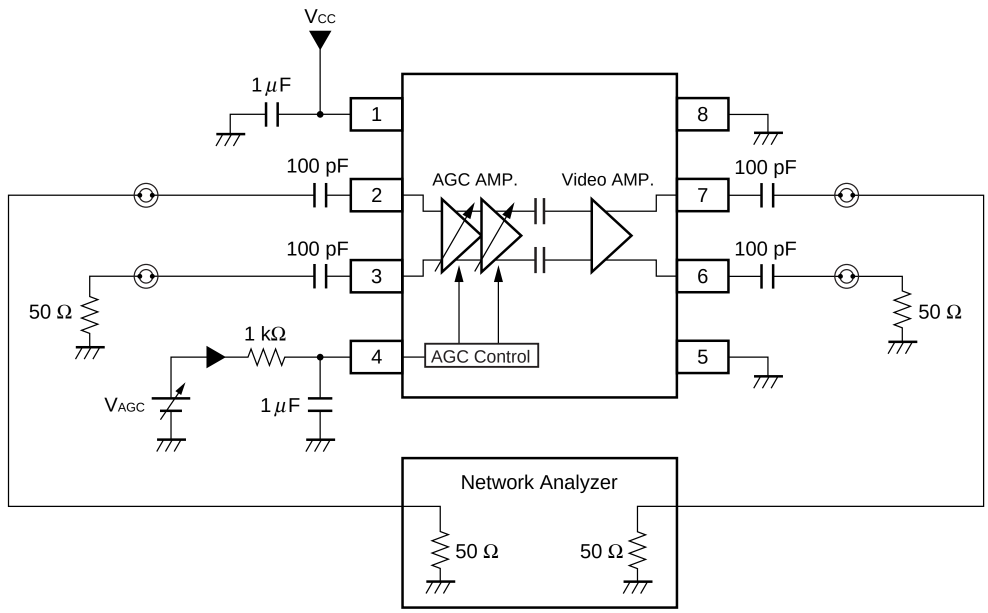
Note Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 5 (PRESSURE IMPROVEMENT RECOMMENDATION CIRCUIT)



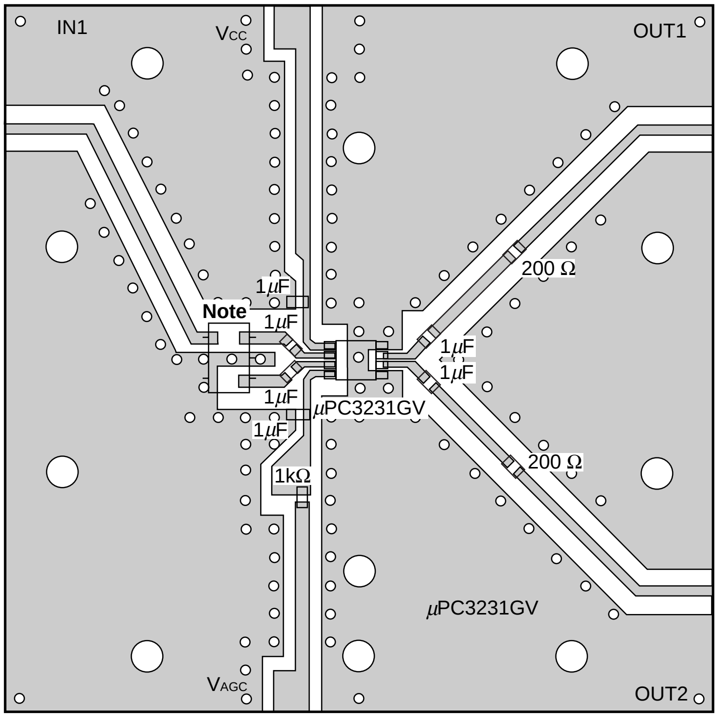
Note Balun Transformer: TOKO 617DB-1674 B4F (Double balanced type)

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)



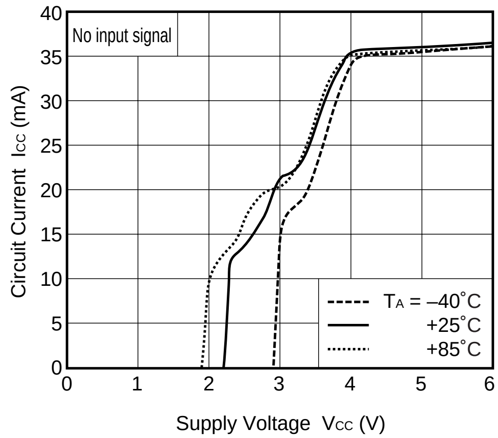
Note Balun Transformer

Remarks

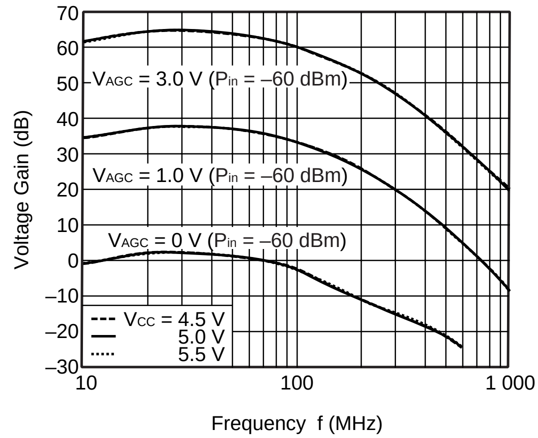
1. Back side: GND pattern
2. Au plated on pattern
3. ○◯: Through hole

TYPICAL CHARACTERISTICS (T_A = +25°C , unless otherwise specified)

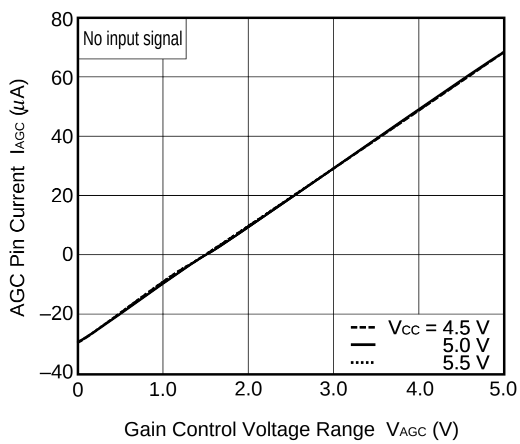
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



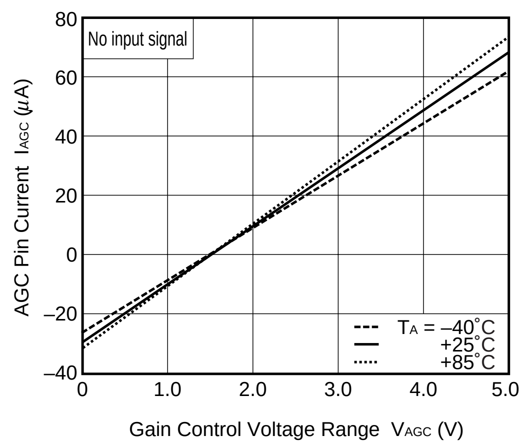
VOLTAGE GAIN vs. FREQUENCY



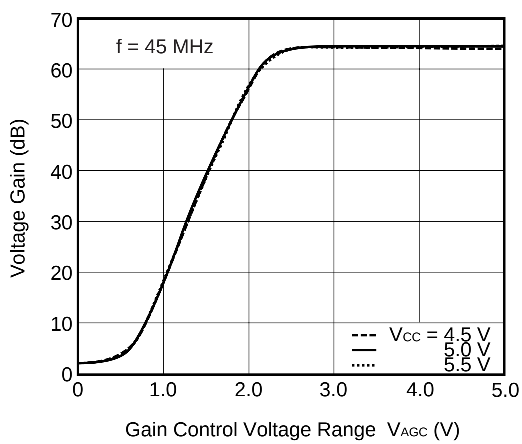
AGC PIN CURRENT vs.
GAIN CONTROL VOLTAGE RANGE



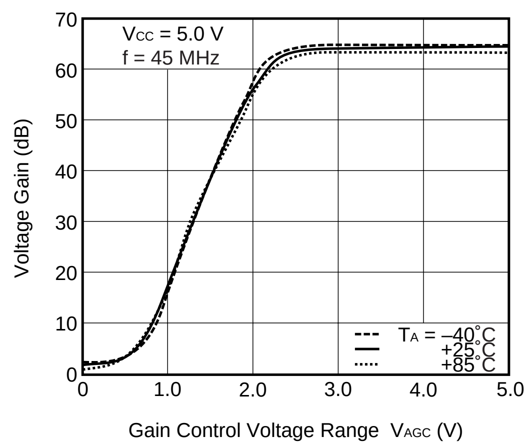
AGC PIN CURRENT vs.
GAIN CONTROL VOLTAGE RANGE



VOLTAGE GAIN vs.
GAIN CONTROL VOLTAGE RANGE

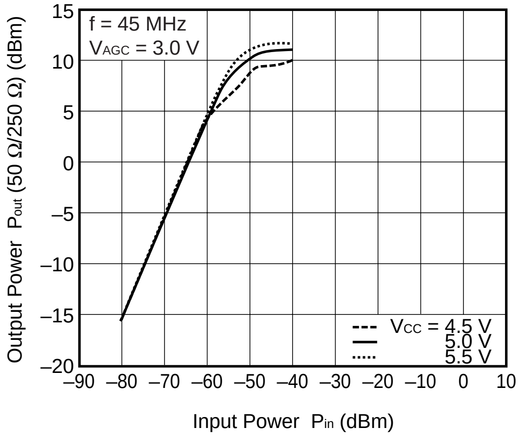


VOLTAGE GAIN vs.
GAIN CONTROL VOLTAGE RANGE

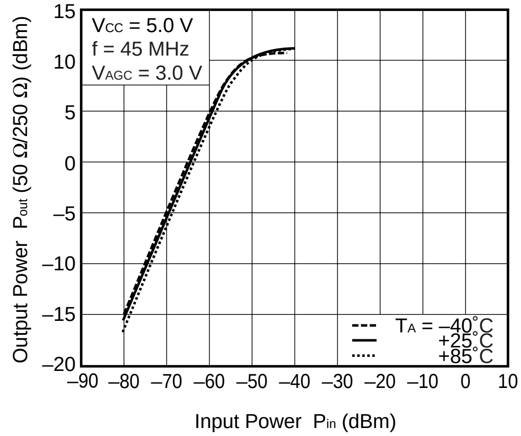


Remark The graphs indicate nominal characteristics.

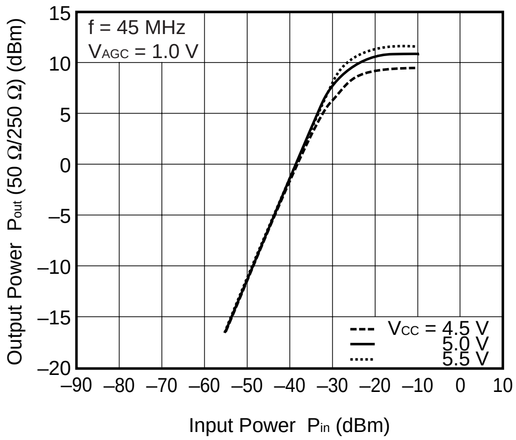
OUTPUT POWER vs. INPUT POWER



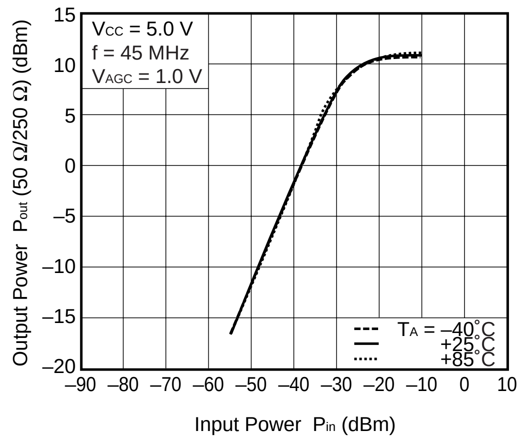
OUTPUT POWER vs. INPUT POWER



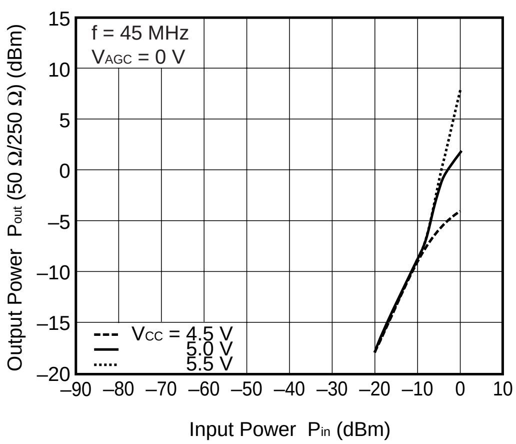
OUTPUT POWER vs. INPUT POWER



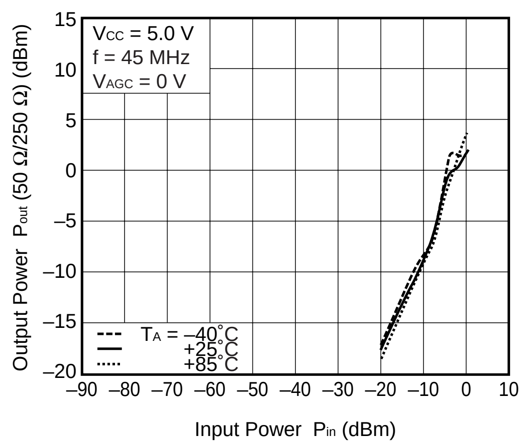
OUTPUT POWER vs. INPUT POWER



OUTPUT POWER vs. INPUT POWER

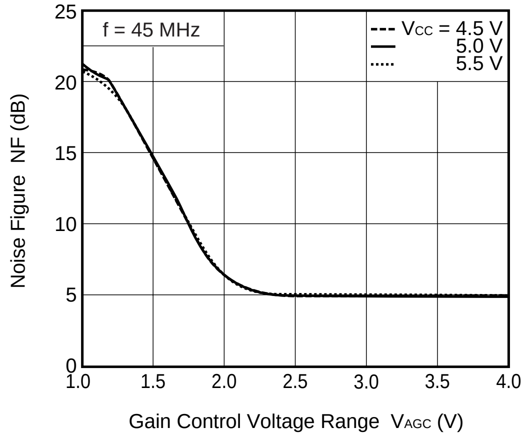


OUTPUT POWER vs. INPUT POWER

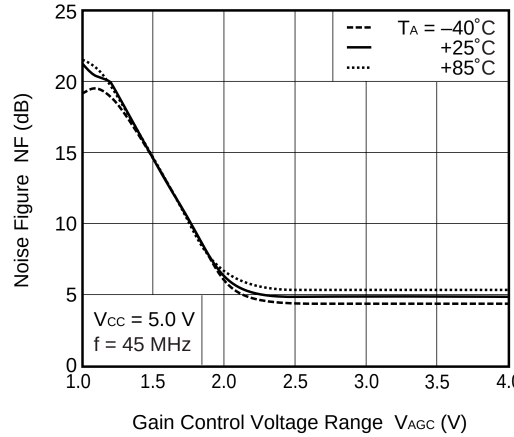


Remark The graphs indicate nominal characteristics.

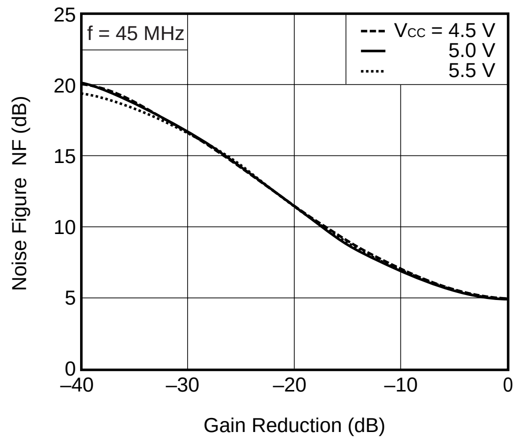
NOISE FIGURE vs. GAIN CONTROL VOLTAGE RANGE



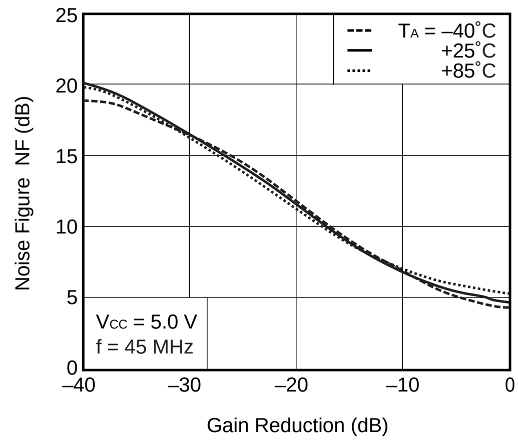
NOISE FIGURE vs. GAIN CONTROL VOLTAGE RANGE



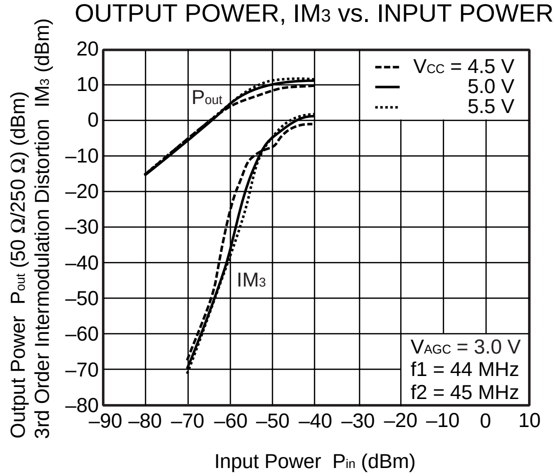
NOISE FIGURE vs. GAIN REDUCTION



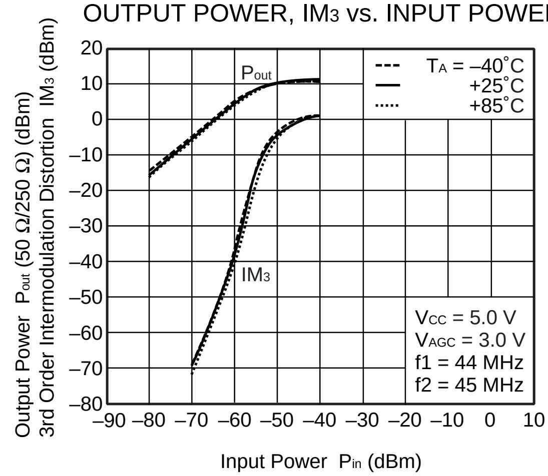
NOISE FIGURE vs. GAIN REDUCTION



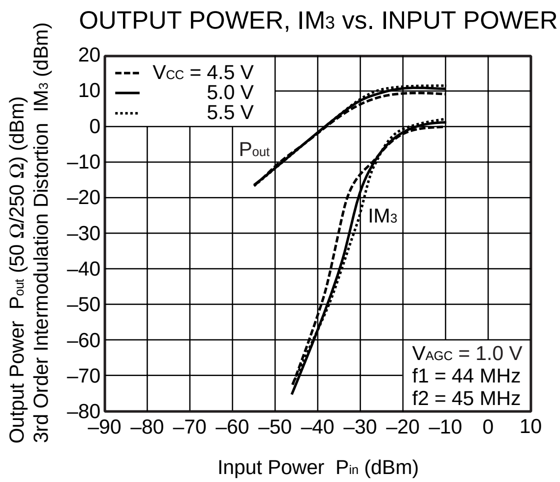
OUTPUT POWER, IM3 vs. INPUT POWER

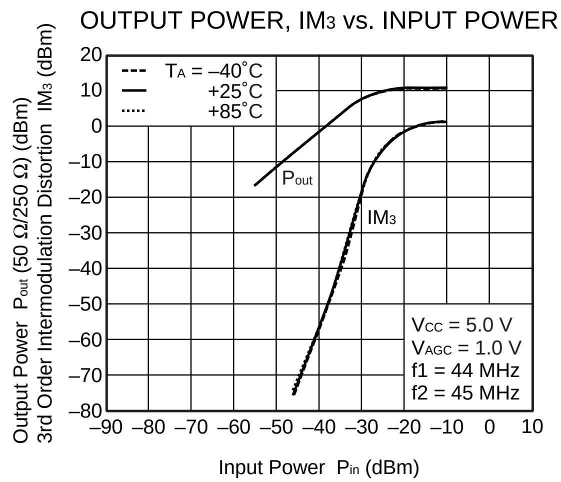


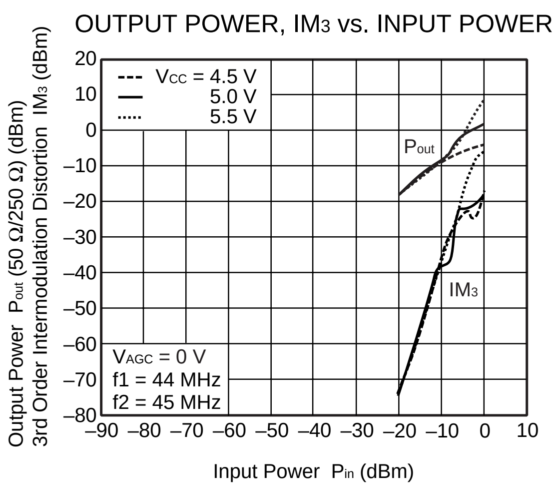
OUTPUT POWER, IM3 vs. INPUT POWER

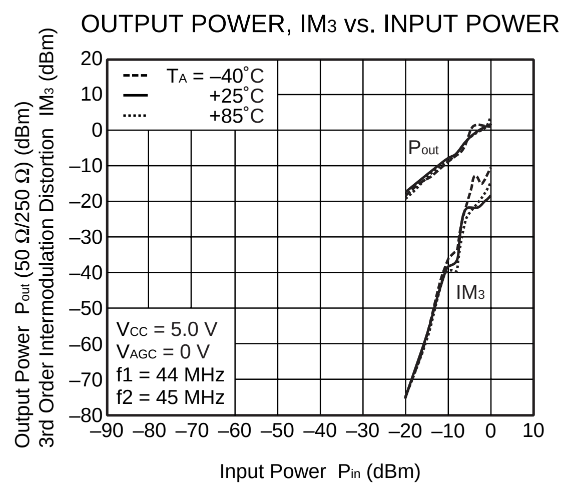


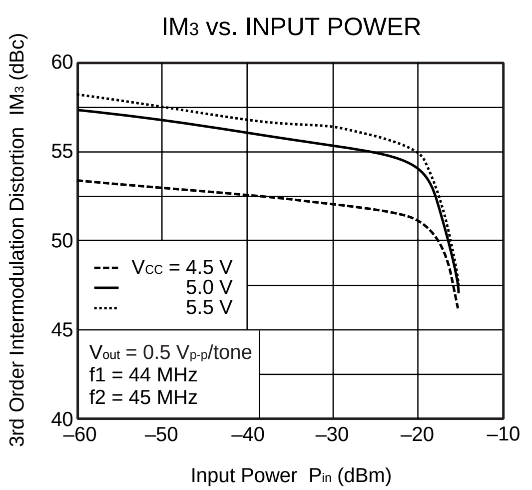
Remark The graphs indicate nominal characteristics.

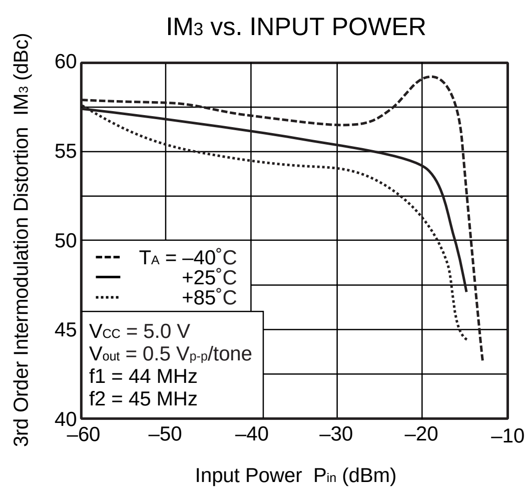








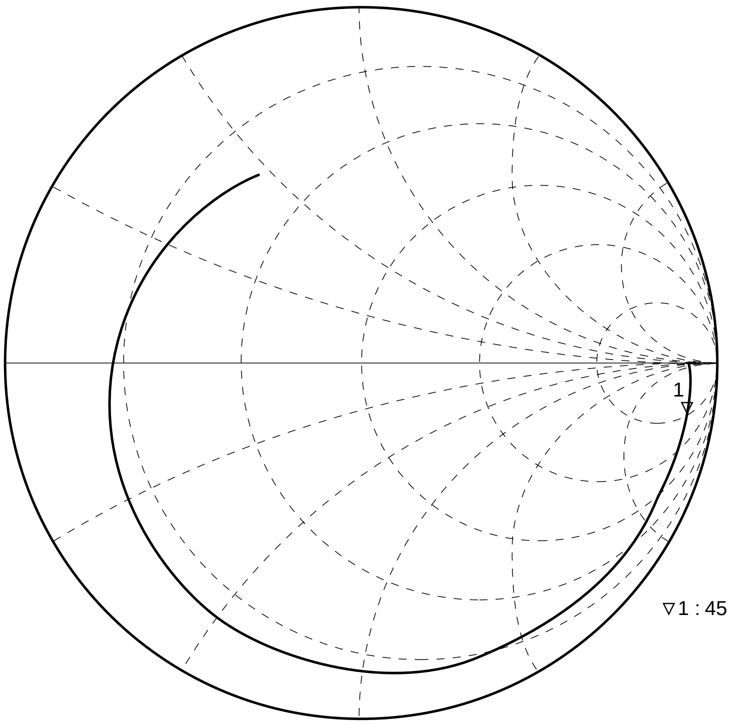




Remark The graphs indicate nominal characteristics.

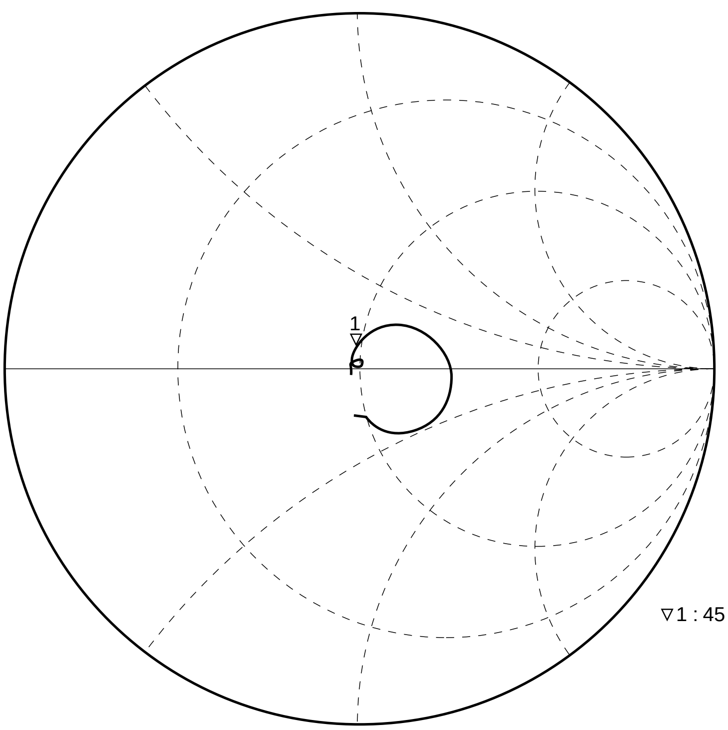
S-PARAMETERS (T_A = +25°C, V_{CC} = 5.0 V, V_{AGC} = 0 V)

S_{11}–FREQUENCY



∇1 : 45 MHz   223.93 Ω –506.44 Ω   6.98 pF

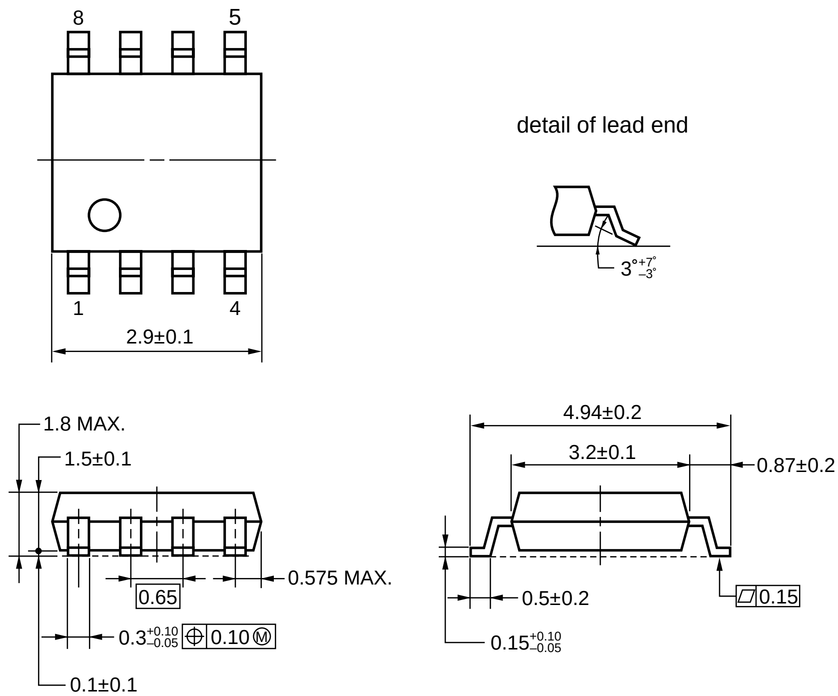
S_{22}–FREQUENCY



∇1 : 45 MHz   49.68 Ω   5.39 Ω   19.86 nH

PACKAGE DIMENSIONS

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



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

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

- **The information in this document is current as of May, 2007. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.**
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M8E 02.11-1

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

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.
See CEL Terms and Conditions for additional clarification of warranties and liability.