NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC1658G

LOW NOISE, HIGH FREQUENCY Si MMIC AMPLIFIER

DESCRIPTION

The μPC1658G is a silicon monolithic integrated circuit designed as amplifier for high frequency system applications. Bandwidth and output power level can be determined according to external resistor constants of negative feedback and final stage collector. This IC is available in 8-pin plastic SOP.

This IC is manufactured using NEC's 10 GHz f_T NESAT™ II silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

FEATURES

- Low noise figure : NF ≤ 3 dB
- Due to the external negative feedback circuit, the power gain can be adjustable by selecting appropriate resistance constants.
  : G_P ≥ 40 dB @ Without negative feedback resistor
  : G_P ≥ 18 dB @ With negative feedback resistor
- Wideband response : f_{3dB} = 1.0 GHz @ G_P = 18 dB
- External resistor can vary the collector current of the final transistor in the IC to adjust the saturated output level.

APPLICATIONS

- IF buffer amplifier of high frequency system
- Measurement equipment

★ ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μPC1658G-E1	8-pin plastic SOP (225 mil)	1658	Embossed tape 12 mm wide. 1 pin is tape pull-out direction. Qty 2.5 kp/reel.

Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: μPC1658G)

Caution TO-99 CAN package (μPC1658A) and 8-pin plastic DIP package (μPC1658C) products are discontinued.

Caution Electro-static sensitive devices

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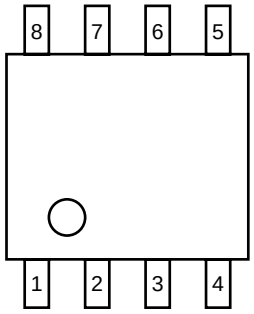
Printed in Japan

The mark ★ shows major revised points.

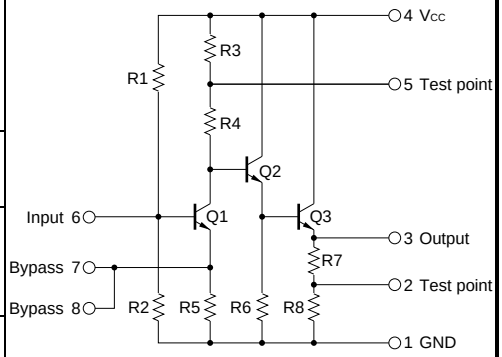
PIN CONNECTIONS

(Top View)



Pin No.	Pin Name
1	GND
2	Test Point
3	Output
4	V_{CC}
5	Test Point
6	Input
7	Bypass
8	Bypass

★ PIN EXPLANATION

Pin No.	Pin Name	Function and Applications	Internal Equivalent Circuit
1	GND	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as possible. All the ground pins must be connected together with wide ground pattern to decrease impedance difference.	
2	Test Point	Test Point pin. The collector current of Q_2 and Q_3 can be varied by connecting an appropriate external resistance between this pin and GND or by shorting this pin to GND. By increasing the collector current of Q_3, the output level improves and the IC can operate as a low-distortion amplifier.	
3	Output	Signal output pin. This pin must be coupled to signal source with capacitor for DC cut.	
4	V_{CC}	Power supply pin. This pin should be externally equipped with bypass capacitor to minimize its impedance.	
5	Test Point	By connecting this pin to the power supply through an appropriate external resistance or by shorting this pin directly to the power supply, the gain can be adjustable (when using pin 2, short the pin 5 to the power supply).	
6	Input	Signal input pin. Through negative feedback from output pin with an external circuit, the IC operates as a wideband amplifier.	
7 8	Bypass	Emitter bypass pins of Q_1. Bypass these pins to GND with a capacitor.	

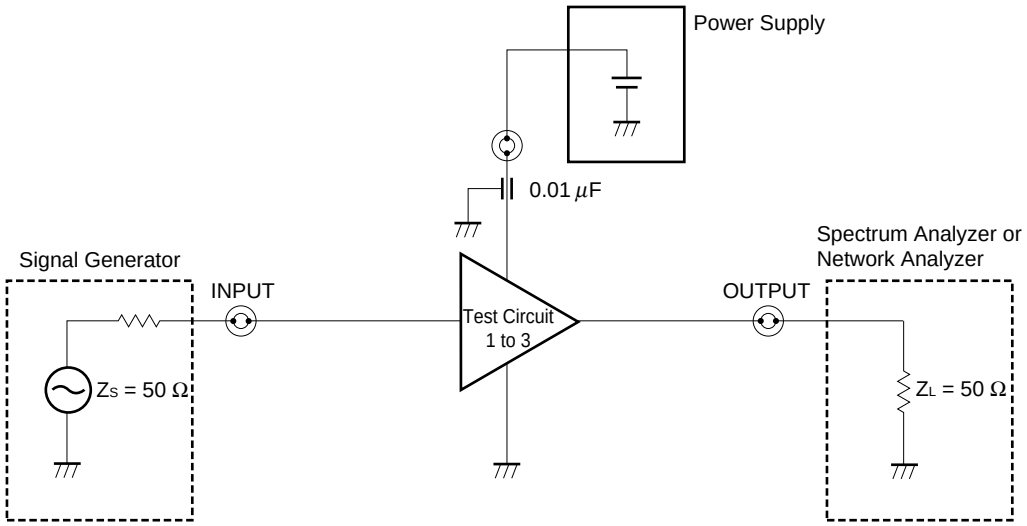
★ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{CC}	T_A = +25 °C	12	V
Output Transistor Current	I_{Q3}	T_A = +25 °C	40	mA
Power Dissipation	P_D	Mounted on double copper clad 50 × 50 × 1.6 mm epoxy glass PWB (T_A = +70 °C)	280	mW
Operating Ambient Temperature	T_A		–40 to +75	°C
Storage Temperature	T_{stg}		–55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = +25 °C, V_{CC} = 10.0 V, Z_S = Z_L = 50 Ω, Test circuit 1)

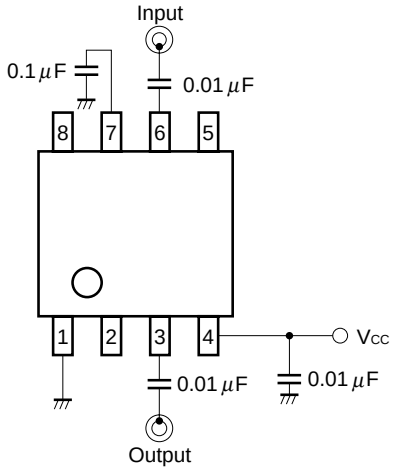
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No signal	9	–	18	mA
Power Gain 1	G_{P1}	f = 10 MHz	37	41	45	dB
Power Gain 2	G_{P2}	f = 100 MHz	28	31	34	dB
Power Gain 3	G_{P3}	f = 500 MHz	14	17	20	dB
Noise Figure 1	NF_1	f = 100 MHz	–	1.5	2.5	dB
Noise Figure 2	NF_2	f = 500 MHz	–	2.0	3.0	dB

TEST SET-UP

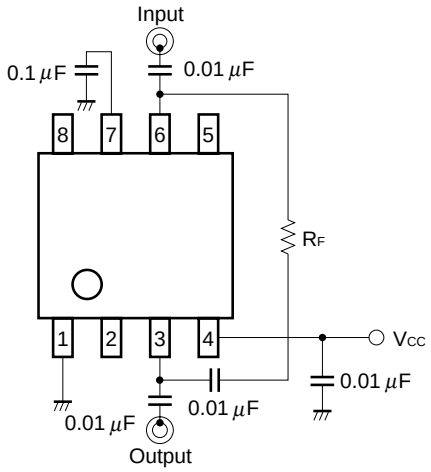


TEST CIRCUITS

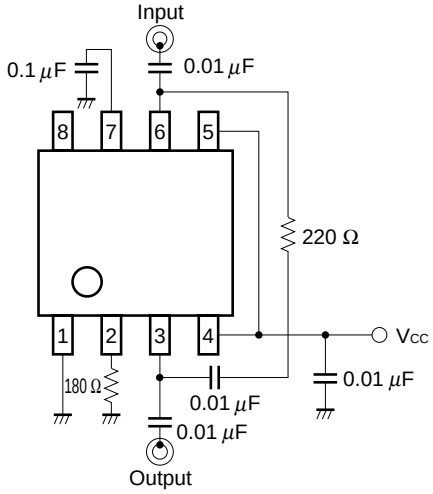
TEST CIRCUIT 1 (Low-noise amplifier)



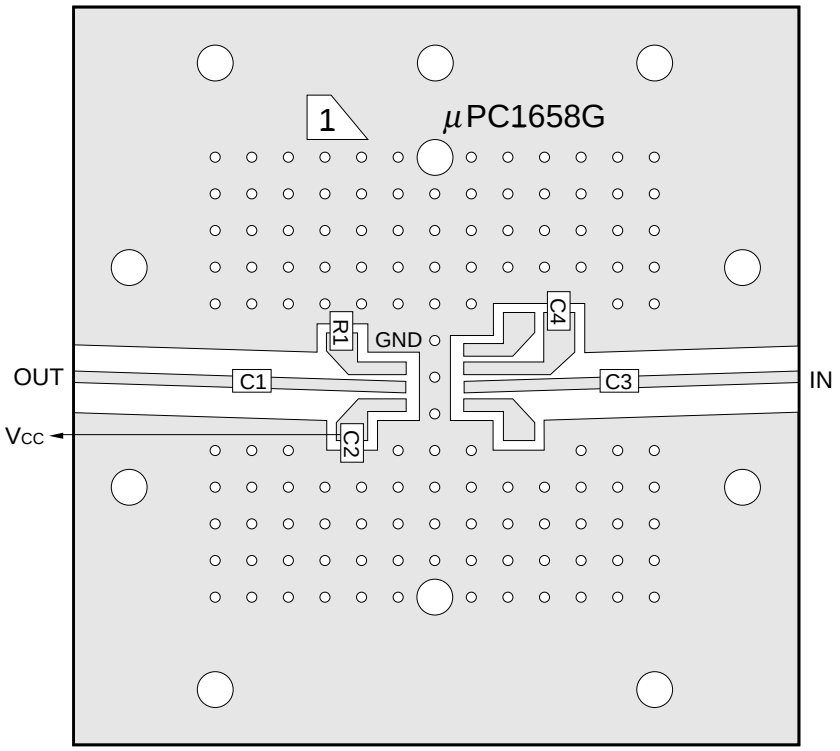
TEST CIRCUIT 2 (Wideband low-noise amplifier)



TEST CIRCUIT 3 (Wideband low-noise amplifier with improved output level)



★ ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



Notes 1. 50 × 50 × 0.4 mm double sided copper clad polyimide board.

2. Back side: GND pattern

3. Solder plated on pattern

4. ○ ◯ : Through holes

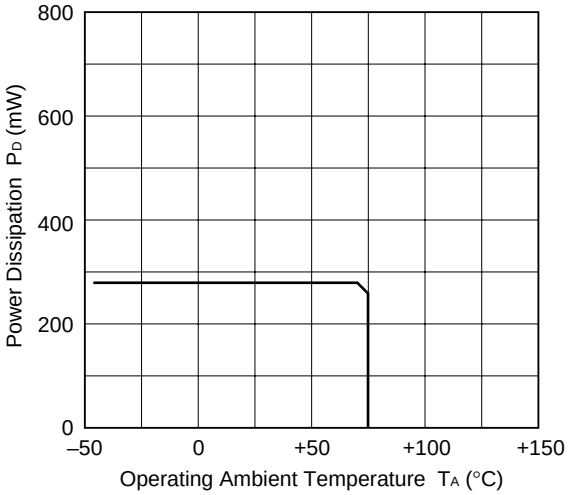
COMPONENT LIST

	Value	Remarks
C1 to C3	0.01 μF	Necessary to all the test circuits
C4	0.1 μF	
R1	Open[Note]	In the case of Low-noise Amplifier
	180 Ω	In the case of Wideband Low-noise Amplifier with improved output level

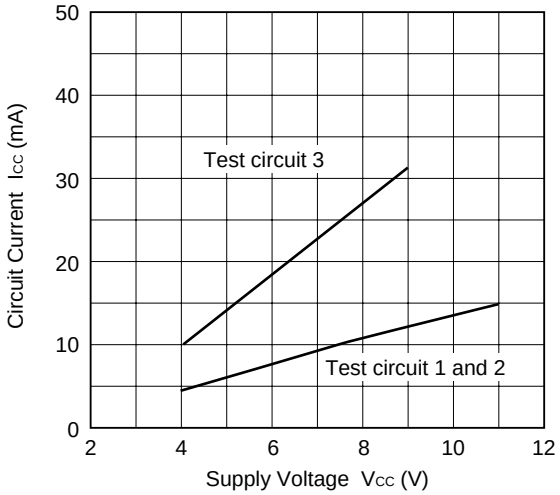
Note In the case of Low-noise Amplifier, R1 is not mounted.

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

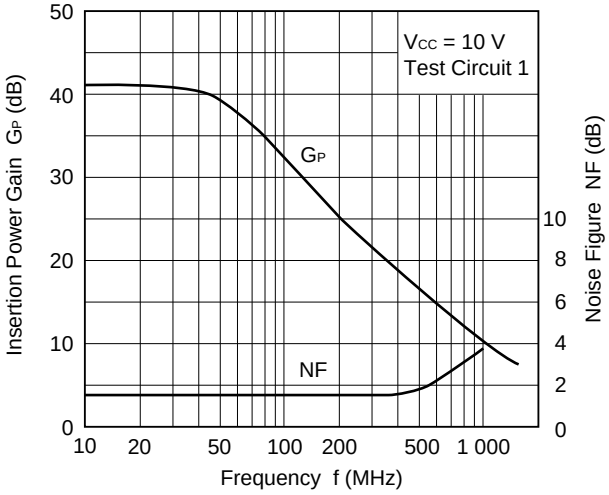
POWER DISSIPATION vs. OPERATING AMBIENT TEMPERATURE



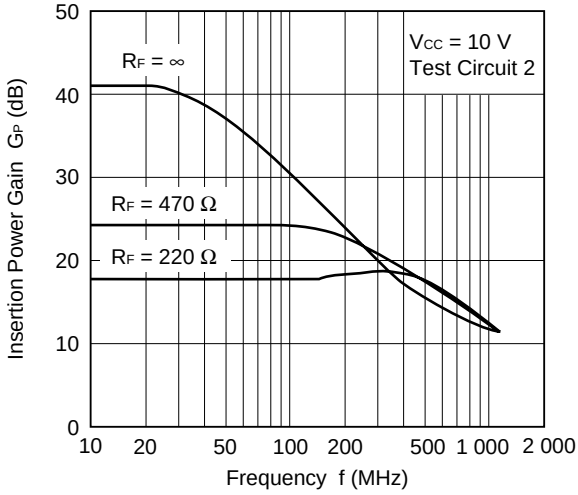
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



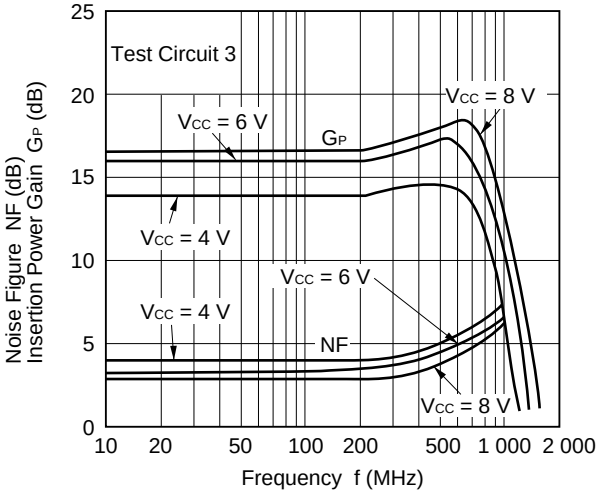
INSERTION POWER GAIN AND NOISE FIGURE vs. FREQUENCY



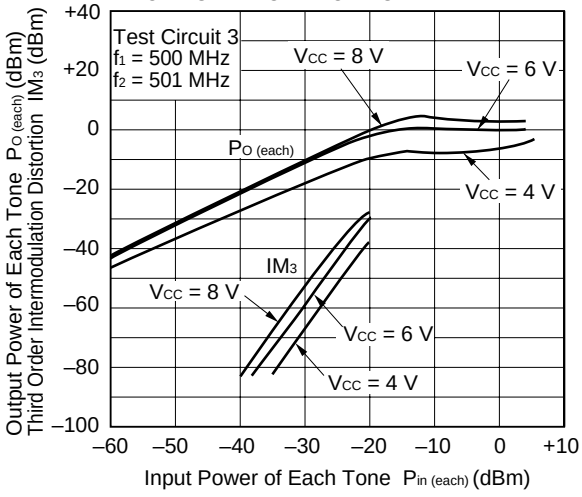
INSERTION POWER GAIN vs. FREQUENCY



NOISE FIGURE AND INSERTION POWER GAIN vs. FREQUENCY

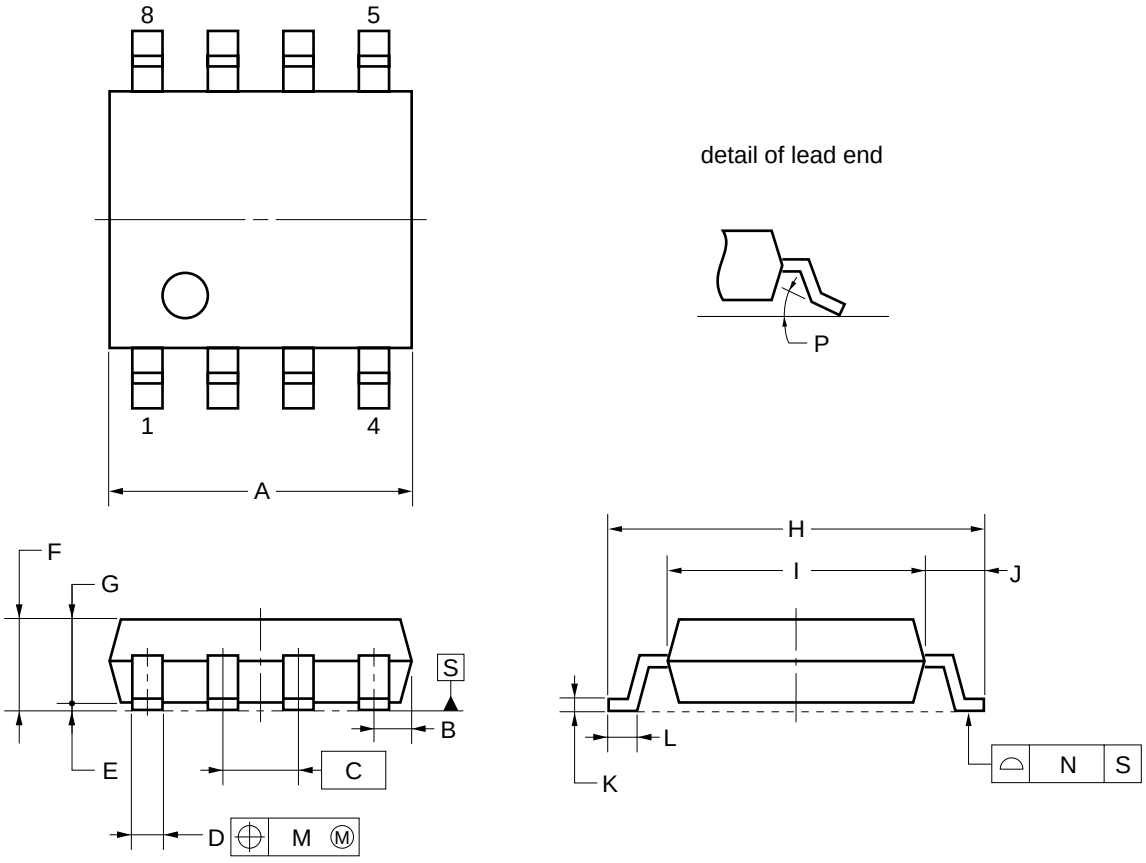


OUTPUT POWER OF EACH TONE AND THIRD ORDER INTERMODULATION DISTORTION vs. INPUT POWER OF EACH TONE



PACKAGE DIMENSIONS

8 PIN PLASTIC SOP (225 mil) (Unit: mm)



NOTE

Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	$5.2^{+0.17}_{-0.20}$
B	0.78 MAX.
C	1.27 (T.P.)
D	$0.42^{+0.08}_{-0.07}$
E	0.1±0.1
F	1.59±0.21
G	1.49
H	6.5±0.3
I	4.4±0.15
J	1.1±0.2
K	$0.17^{+0.08}_{-0.07}$
L	0.6±0.2
M	0.12
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

S8GM-50-225B-5

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) Because the components will operate at high frequencies, apply chip capacitors and chip resistors with low parasitic inductance.
(4) The DC capacitor must be attached to input pin and output pin.
(5) The bypass capacitor should be attached to V_{CC} line.
(6) In case of improved output level type application circuit, observe precaution not to exceed the power dissipation rating, especially in V_{CC} = 9 V or over.

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: None[Note]	IR35-00-3
VPS	Package peak temperature: 215 °C or below Time: 40 seconds or less (at 200 °C) Count: 3, Exposure limit: None[Note]	VP15-00-3
Wave Soldering	Soldering bath temperature: 260 °C or below Time: 10 seconds or less Count: 1, Exposure limit: None[Note]	WS60-00-1
Partial Heating	Pin temperature: 300 °C Time: 3 seconds or less (per side of device) Exposure limit: None[Note]	–

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).

[MEMO]

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  "Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.
  - Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots
  - Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
  - Specific: Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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