NEC

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# μPC3211GR

## AGC AMPLIFIER FOR DIGITAL CATV RETURN PASS

### DESCRIPTION

The μPC3211GR is a silicon monolithic integrated circuit designed as AGC amplifier for digital CATV systems. This IC is the AGC amplifier with 55 dB gain control range which is packaged in 20-pin SSOP. The device is able to use for digital QPSK system, therefore it contributes to make design of transmission system simplicity.

### FEATURES

- Wide gain control range 55 dB TYP.
- Low distortion $IM_3$ = 57 dBc TYP. @$P_{out}$ = –10 dBm
  $IM_2$ = 44 dBc TYP. @$P_{out}$ = –10 dBm
- Supply Voltage 9 V
- Packaged in 20-pin SSOP suitable for high-density surface mount.

### ORDERING INFORMATION

| Part Number | Package | Supplying Form |
|---|---|---|
| μPC3211GR-E1 | 20-pin plastic SSOP (225 mil) | Embossed tape 12 mm wide.<br>Pin 1 indicates pull-out direction of tape.<br>Qty 2.5 kp/reel |

To order evaluation samples, please contact your local NEC office. (Part number for sample order: μPC3211GR)

**Caution electro-static sensitive device**



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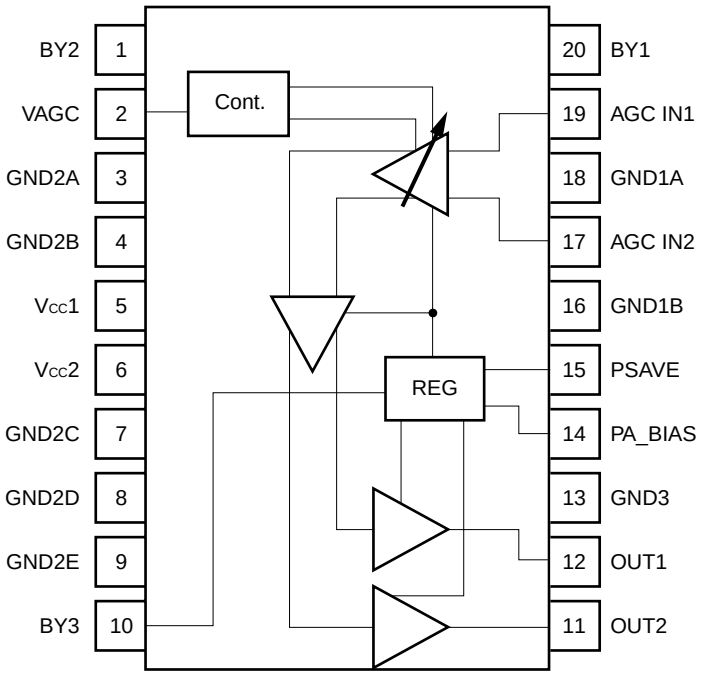
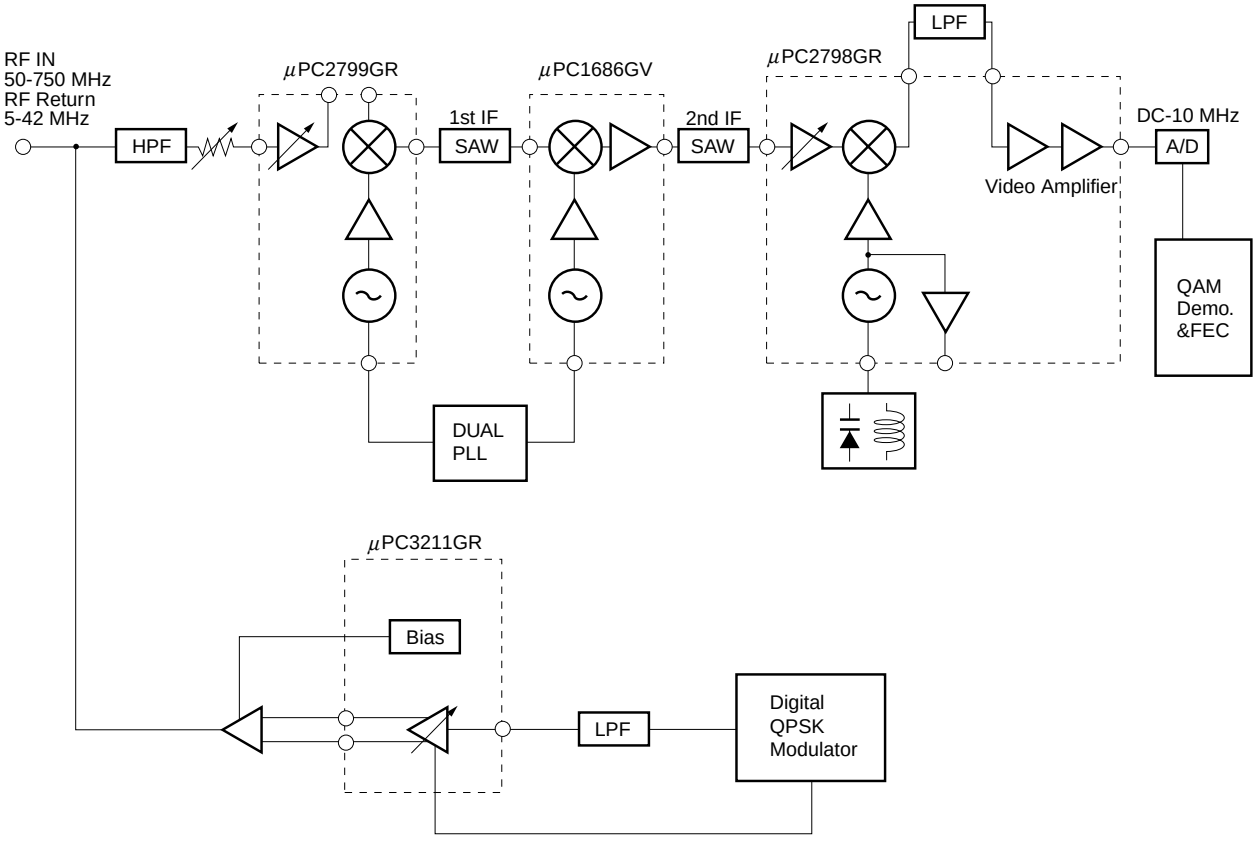
**The mark ★ shows major revised points.**

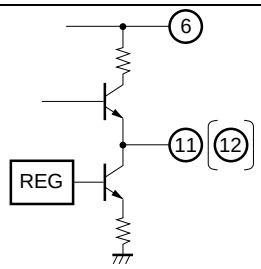
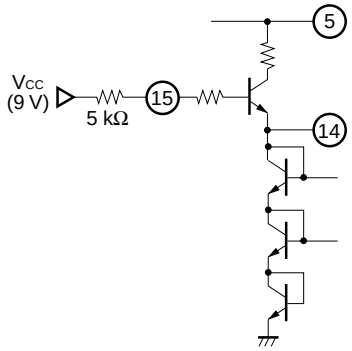
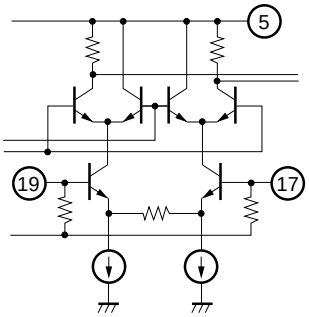
## INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION (TOP VIEW)




## TYPICAL APPLICATION



**PIN FUNCTIONS**

| Pin No. | Pin Name | Pin Voltage TYP. (V) | Function and Explanation | Equivalent Circuit |
|---|---|---|---|---|
| 1 | BY2 | – | Non Connection pin.<br>This pin should be opened. | |
| 2 | VAGC | 0 to 3 | Automatic gain control pin. | |
| 3 | GND2A | 0.0 | Ground pins of differential amplifier. | |
| 4 | GND2B | 0.0 | | |
| 5 | $V_{cc}1$ | 9.0 | Power supply pin of AGC amplifier block. | |
| 6 | $V_{cc}2$ | 9.0 | Power supply pin of differential amplifier and output block. | |
| 7 | GND2C | 0.0 | Ground pins of differential amplifier. | |
| 8 | GND2D | 0.0 | | |
| 9 | GND2E | 0.0 | | |
| 10 | BY3 | 1.64 | Bypass pin of regulator block. | |
| 11 | OUT2 | 6.9 | Signal output pins.<br>This pins feature low-impedance because of its emitter-follower output port.<br>The pin that is not used should be grounded through 50 ohm resistor. |  |
| 12 | OUT1 | 6.9 | | |
| 13 | GND3 | 0.0 | Ground pin of output block. | |
| 14 | PA_BIAS | 2.45 | This is the pin to feed base bias in case of connection to transistor as power amplifier. |  |
| 15 | Psave | 9.0<br>(+5 kΩ) | Power-save pin.<br>$V_{cc}$ : ON<br>GND : SLEEP<br>The 5 kΩ resistor should be connected between 15 pin and $V_{cc}$. | |
| 16 | GND1B | 0.0 | Ground pin of AGC amplifier block. | |
| 18 | GND1A | 0.0 | | |
| 17 | AGC IN2 | 2.43 | Signal input pin.<br>In the case of single input, 17 or 19 pin should be grounded through capacitor. |  |
| 19 | AGC IN1 | 2.43 | | |
| 20 | BY1 | – | Non Connection pin.<br>This pin should be opened. | |

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

| Parameter | Symbol | Test Condition | Rating | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 11.0 | V |
| Power-save Voltage | V (Psave) | **Note 1** | 11.0 | V |
| AGC Voltage | $V_{AGC}$ | | 3.6 | V |
| Power Dissipation | $P_D$ | $T_A$ = +75°C **Note 2** | 500 | mW |
| Operating Ambient Temperature | $T_A$ | | –40 to +75 | °C |
| Storage Temperature | $T_{stg}$ | | –55 to +150 | °C |
| Maximum Input Level | $P_{in}$ (MAX) | | +5 | dBm |

**Notes 1.** Bias to 15 pin through 5 kΩ resistor.

**2.** Mounted on 50 mm × 50 mm × 1.6 mm double epoxy glass board.

**RECOMMENDED OPERATING RANGE**

| Parameter | Symbol | Test Condition | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 8.0 | 9.0 | 10.0 | V |
| Power-save Voltage | V (Psave) | **Note** | 0 | – | 10.0 | V |
| AGC Control Voltage | $V_{AGC}$ | | 0 | – | 3.3 | V |
| Operating Ambient Temperature | $T_A$ | | –40 | +25 | +75 | °C |
| Input Frequency | $f_{in}$ | | 5 | – | 100 | MHz |
| Maximum Input Level | $P_{in}$ (MAX) | | – | – | 0 | dBm |

**Note** Bias to 15 pin through 5 kΩ resistor.

**ELECTRICAL CHARACTERISTICS ($T_A$ = +25°C, $V_{CC}$ = 9 V, $V_{AGC}$ = 0 V, V (Psave) = 9 V (+5 kΩ), unless otherwise specified)**

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Circuit Current 1 | $I_{CC}1$ | No input signal **Note 1** | 29 | 38 | 51 | mA |
| Maximum Gain | $G_{MAX}$ | $f_{in}$ = 65 MHz, $P_{in}$ = –20 dBm **Note 2** | 14 | 16 | 18 | dB |
| Gain Control Range | GCR | $f_{in}$ = 65 MHz, $P_{in}$ = –20 dBm, $V_{AGC}$ = 0 to 3 V **Note 2** | 47 | 55 | – | dB |
| Isolation at sleep mode | Isol | $f_{in}$ = 65 MHz, $P_{in}$ = –20 dBm, V (Psave) = 0 V (+5 kΩ) **Note 2** | 60 | 65 | – | dB |
| 2nd order intermodulation distortion | $IM_2$ | $f_{in}1$ = 65 MHz, $f_{in}2$ = 66.8 MHz, $P_{out}$ = –10 dBm **Note 2** | – | –44 | –40 | dBc |
| 3rd order intermodulation distortion | $IM_3$ | $f_{in}1$ = 65 MHz, $f_{in}2$ = 66.8 MHz, $P_{out}$ = –10 dBm **Note 2** | – | –57 | –50 | dBc |

**Notes 1.** By measurement circuit 1

**2.** By measurement circuit 2

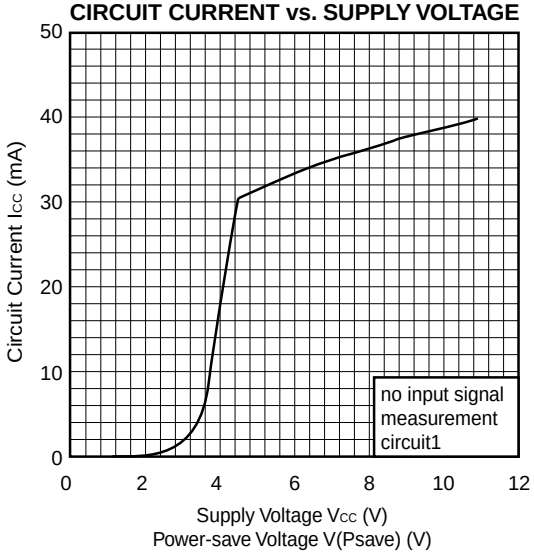
**STANDARD CHARACTERISTICS ($T_A$ = +25°C, $V_{CC}$ = 9 V, $V_{AGC}$ = 0 V, V (Psave) = 9 V (+5 kΩ), unless otherwise specified)**

| Parameter | Symbol | Test Conditions | Reference Value | Unit |
|---|---|---|---|---|
| Maximum Output Power | $P_{O\ (sat)}$ | $f_{in}$ = 65 MHz, $P_{in}$ = –5 dBm **Note 1** | +5 | dBm |
| Circuit Current at Power-save mode | $I_{CC}$ (P/S) | No input signal, V (Psave) = 0 V (+5 kΩ) **Note 2** | 3 | mA |
| Noise Figure | NF | $f_{in}$ = 65 MHz **Note 3** | 10 | dB |
| Output Intercept Point | $OIP_3$ | $f_{in}1$ = 65 MHz, $f_{in}2$ = 66.8 MHz **Note 1** | +16 | dBm |
| Gain Flatness | $G_{flat}$ | $f_{in}$ = 5 to 100 MHz, 6 MHz Band width<br>$P_{in}$ = –20 dBm **Note 1** | ±0.1 | dB |
| Circuit Current 2 | $I_{CC}2$ | No input signal, $V_{AGC}$ = 3 V **Note 2** | 43 | mA |
| ON Time | $t_{ON}$ | $f_{in}$ = 65 MHz,<br>V (Psave) = 0 → 9 V (+5 kΩ) **Note 4** | 200 | μsec |
| OFF Time | $t_{OFF}$ | $f_{in}$ = 65 MHz,<br>V (Psave) = 9 → 0 V (+5 kΩ) **Note 4** | 1.7 | msec |

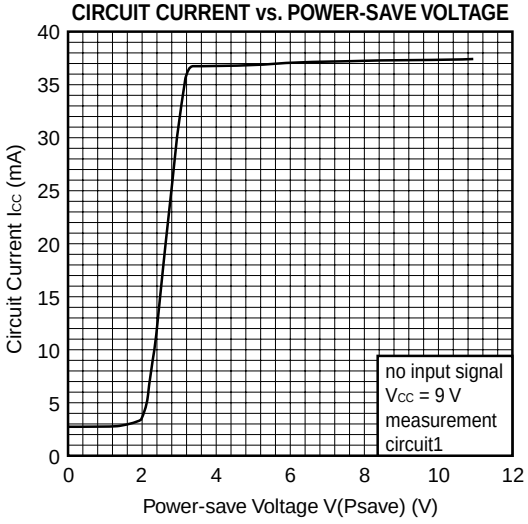
**Notes 1.** By measurement circuit 2
**2.** By measurement circuit 1
**3.** By measurement circuit 3
**4.** By measurement circuit 4

## TYPICAL CHARACTERISTICS ($T_A$ = +25°C)

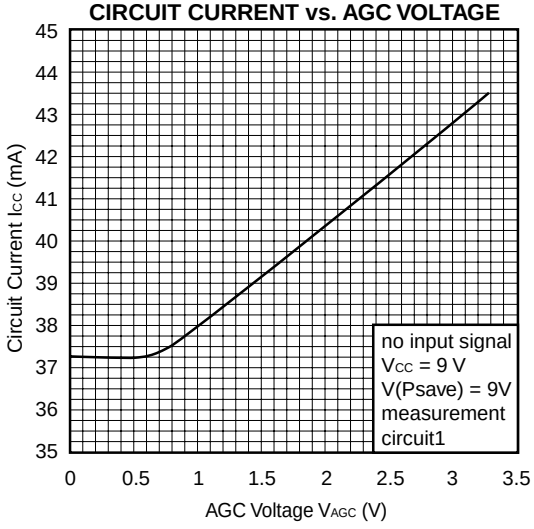
**CIRCUIT CURRENT vs. SUPPLY VOLTAGE**



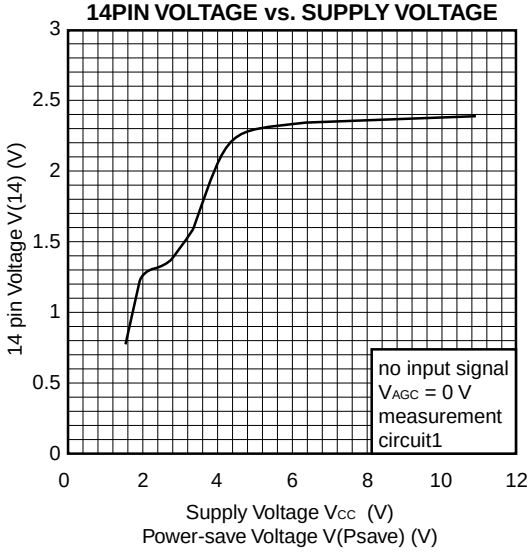

**CIRCUIT CURRENT vs. POWER-SAVE VOLTAGE**



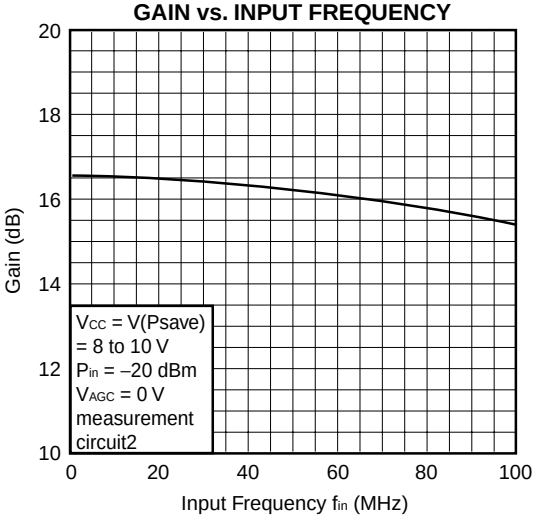

**CIRCUIT CURRENT vs. AGC VOLTAGE**



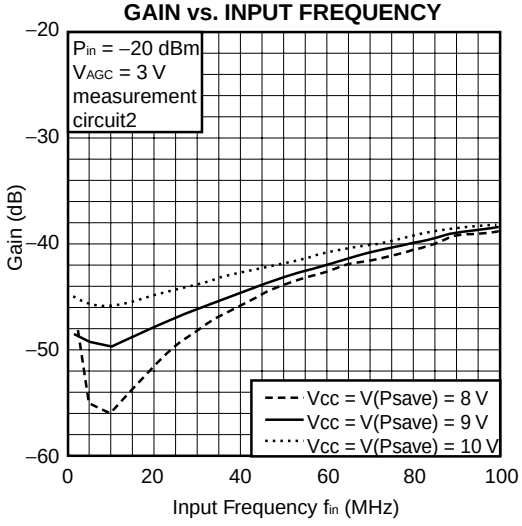

**14PIN VOLTAGE vs. SUPPLY VOLTAGE**



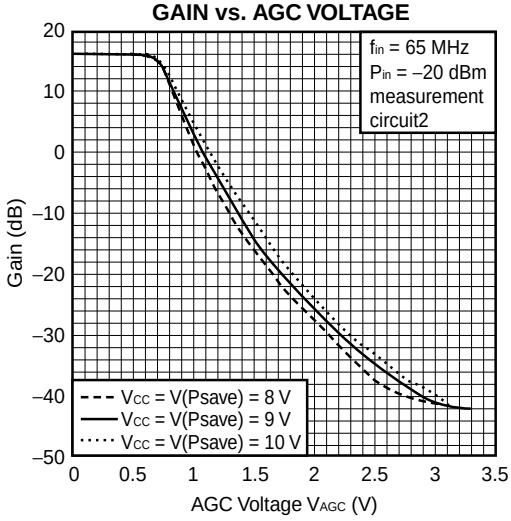

**GAIN vs. INPUT FREQUENCY**



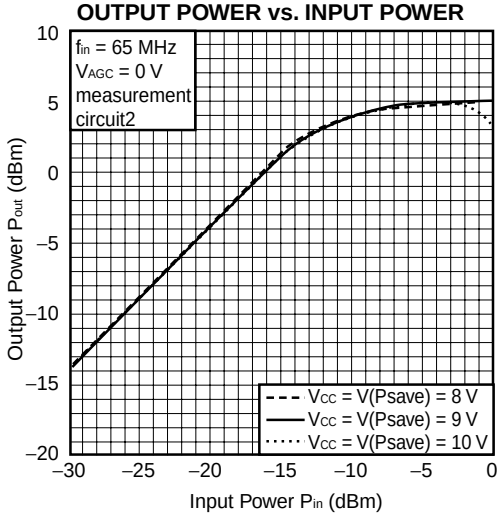

**GAIN vs. INPUT FREQUENCY**



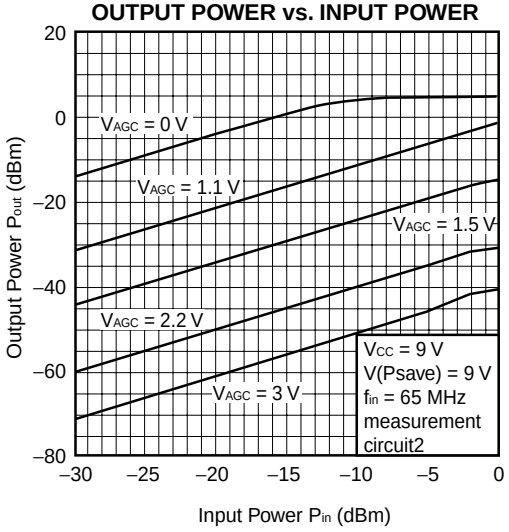
**GAIN vs. AGC VOLTAGE**



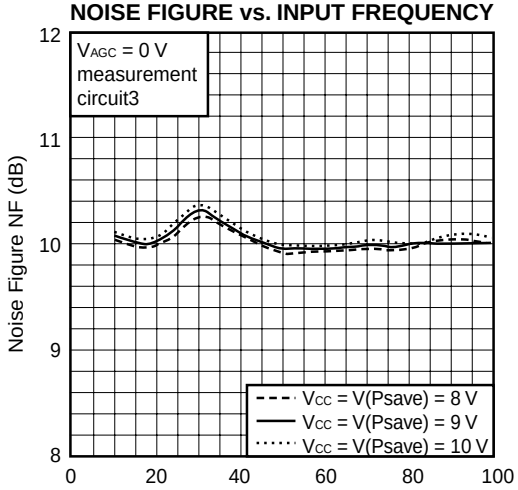

**OUTPUT POWER vs. INPUT POWER**



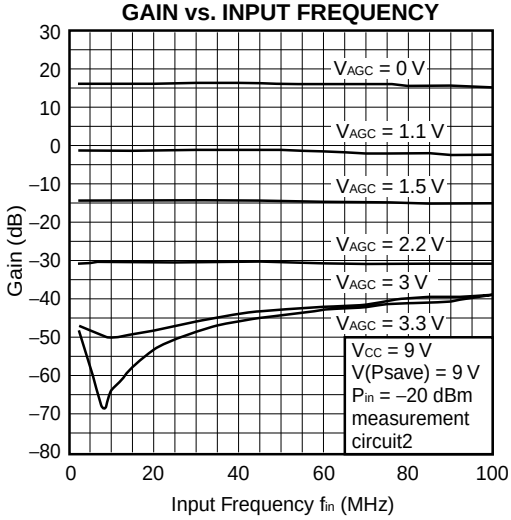

**OUTPUT POWER vs. INPUT POWER**




**NOISE FIGURE vs. INPUT FREQUENCY**

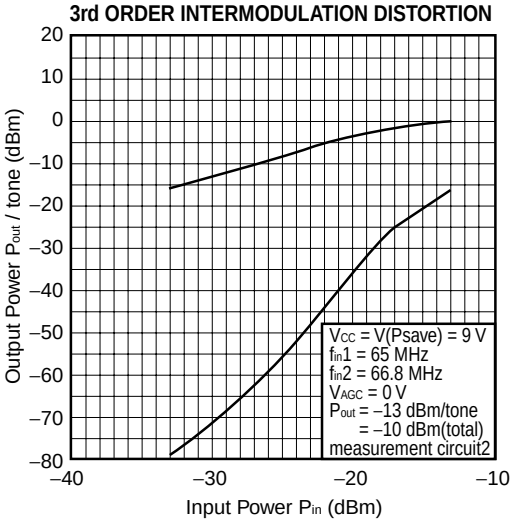



**GAIN vs. INPUT FREQUENCY**

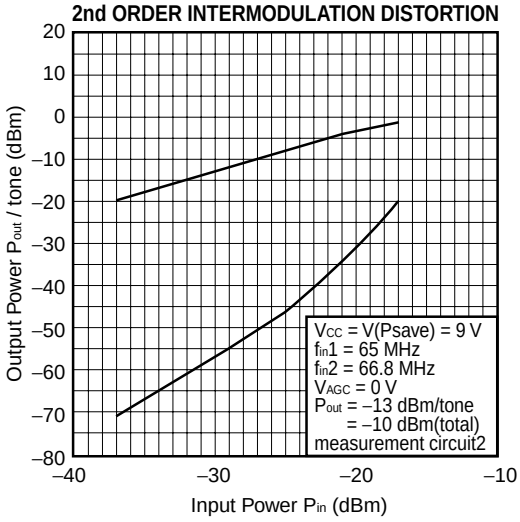


## STANDARD CHARACTERISTICS ($T_A$ = +25°C)

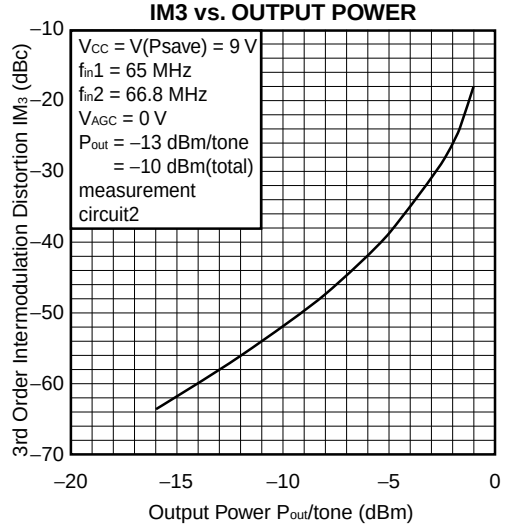
3rd ORDER INTERMODULATION DISTORTION



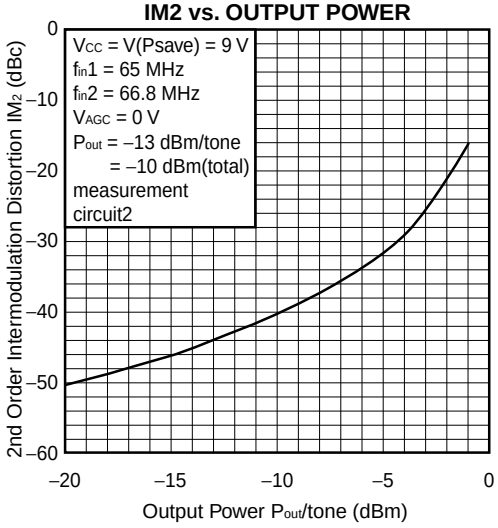

2nd ORDER INTERMODULATION DISTORTION



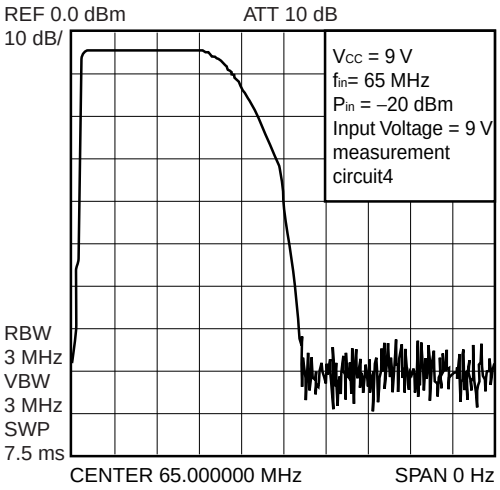

IM3 vs. OUTPUT POWER



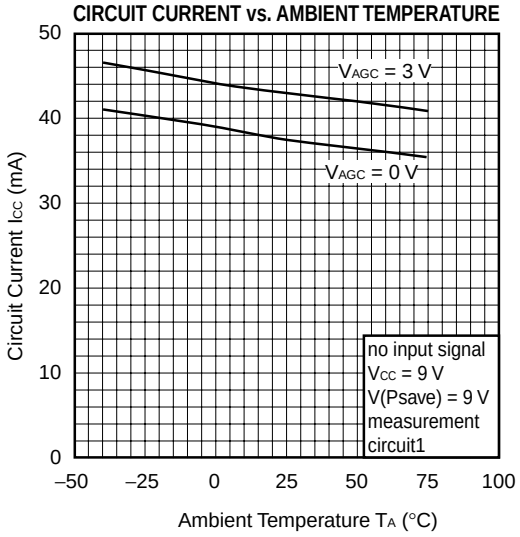

IM2 vs. OUTPUT POWER

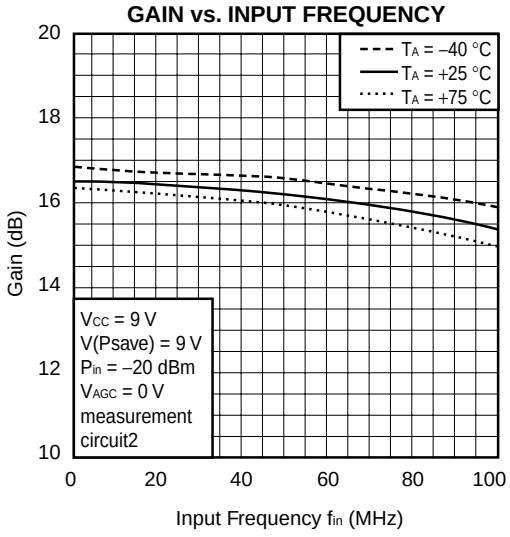


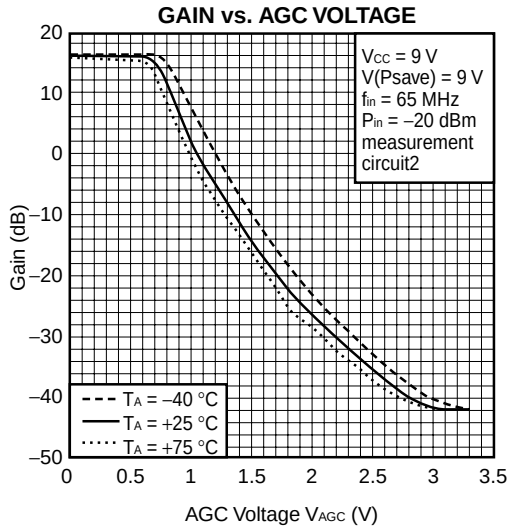

ON/OFF TIME OF POWERSAVE



## THERMAL CHARACTERISTICS (FOR REFERENCE)

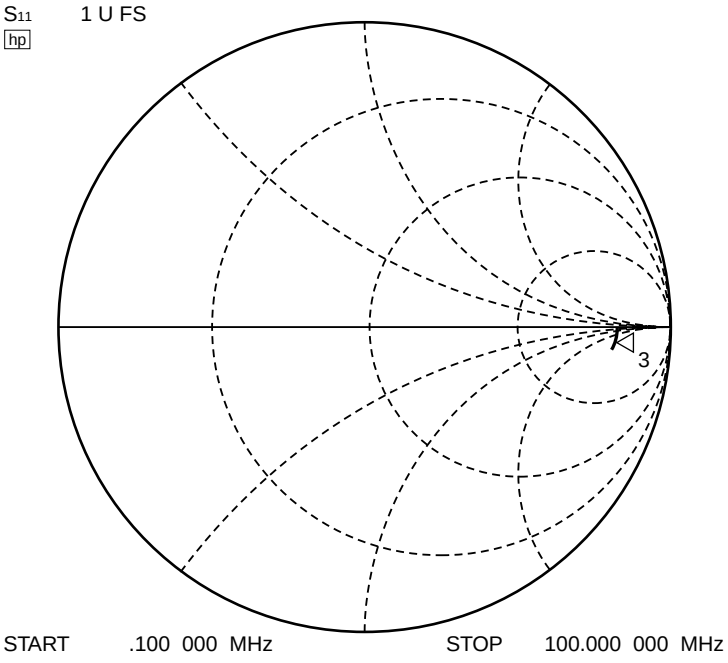


## STANDARD CHARACTERISTICS

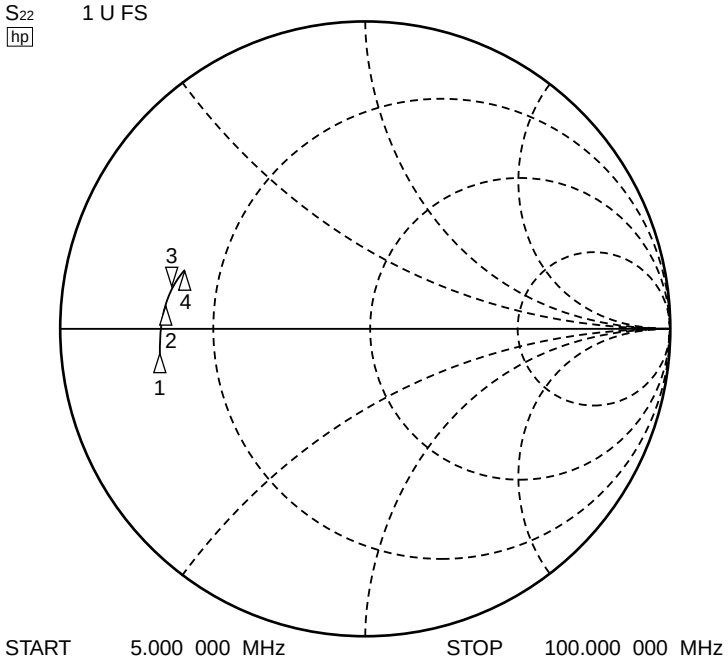
### INPUT IMPEDANCE (19 PIN)




Δ 1: 5 MHz
533.6 Ω
–16.4 Ω
Δ 2: 40 MHz
515.2 Ω
–81.4 Ω
Δ 3: 65 MHz
493.7 Ω
–123.3 Ω
Δ 4: 100 MHz
455.9 Ω
–190.3 Ω

$T_A$ = +25°C
$V_{CC}$ = 9 V
V (Psave) = 9 V
$P_{in}$ = –20 dBm

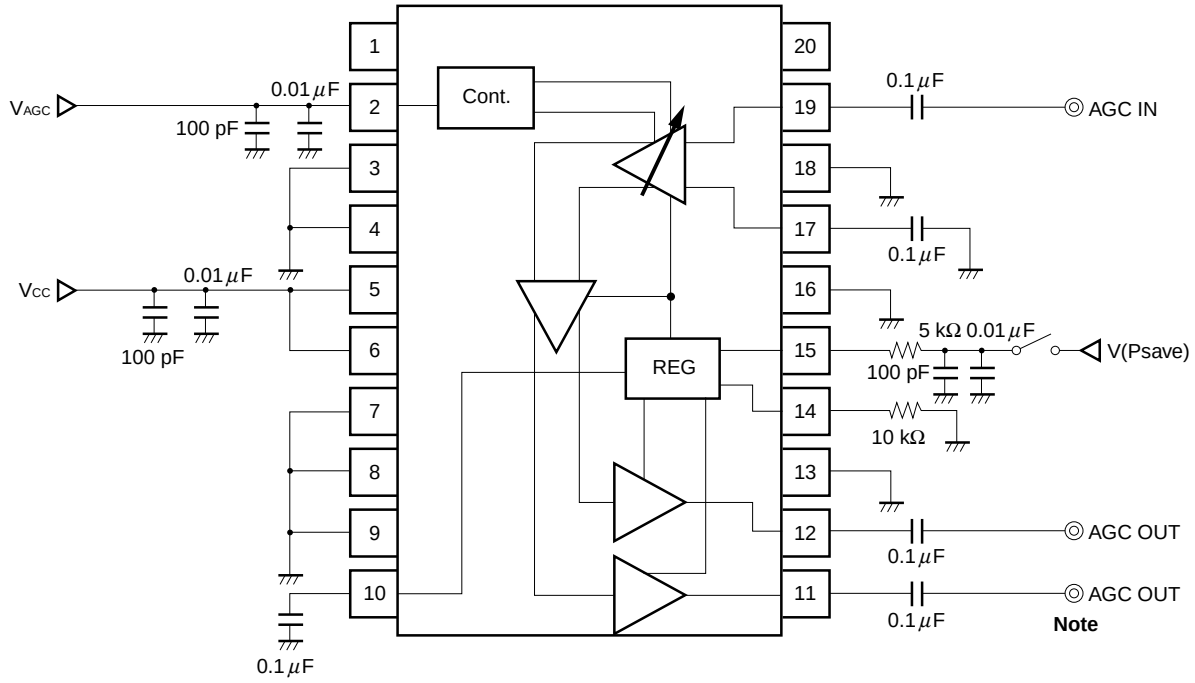
### OUTPUT IMPEDANCE (11 PIN)




Δ 1: 5 MHz
9.779 Ω
–2.306 Ω
Δ 2: 40 MHz
10.066 Ω
3.033 Ω
Δ 3: 65 MHz
10.574 Ω
5.237 Ω
Δ 4: 100 MHz
11.88 Ω
7.805 Ω

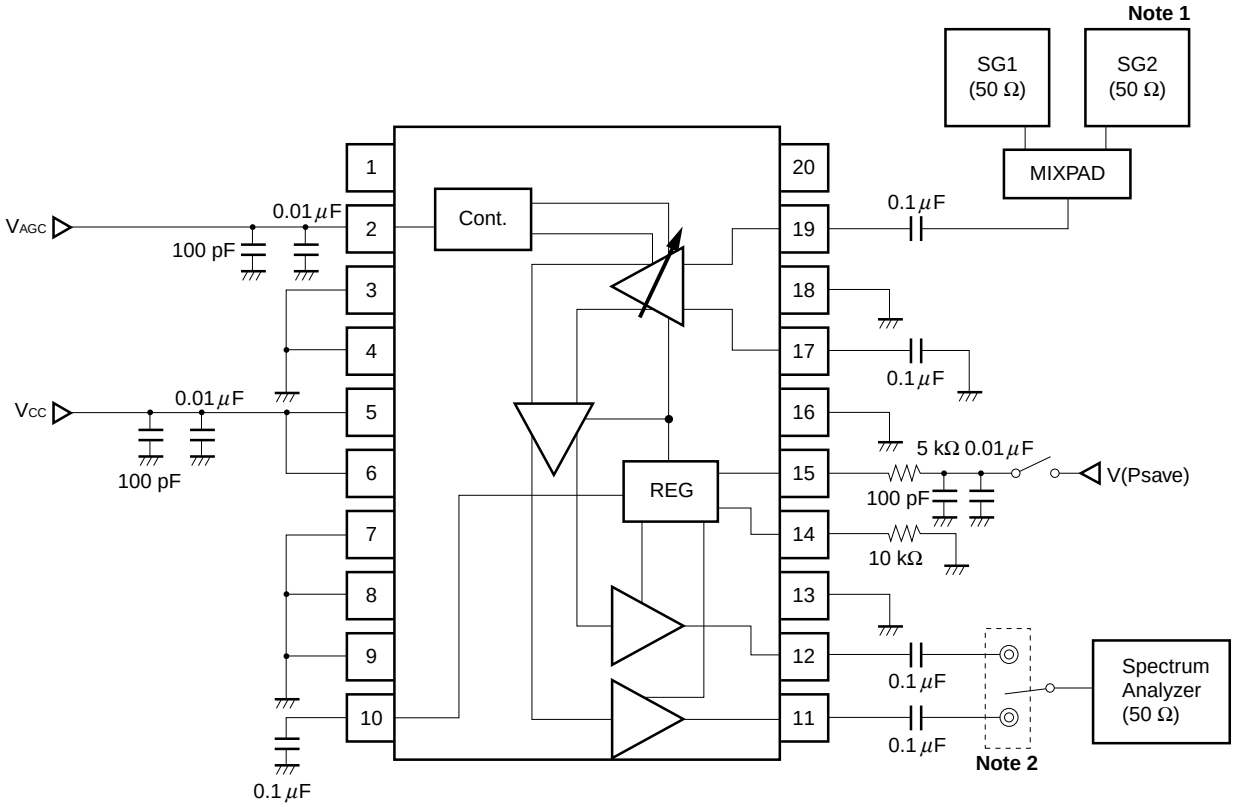
$T_A$ = +25°C
$V_{CC}$ = 9 V
V (Psave) = 9 V
$P_{in}$ = –20 dBm

**MEASUREMENT CIRCUIT 1**




**Note** The pin that is not connected to Spectrum Analyzer should be grounded through 50 Ω resistor.

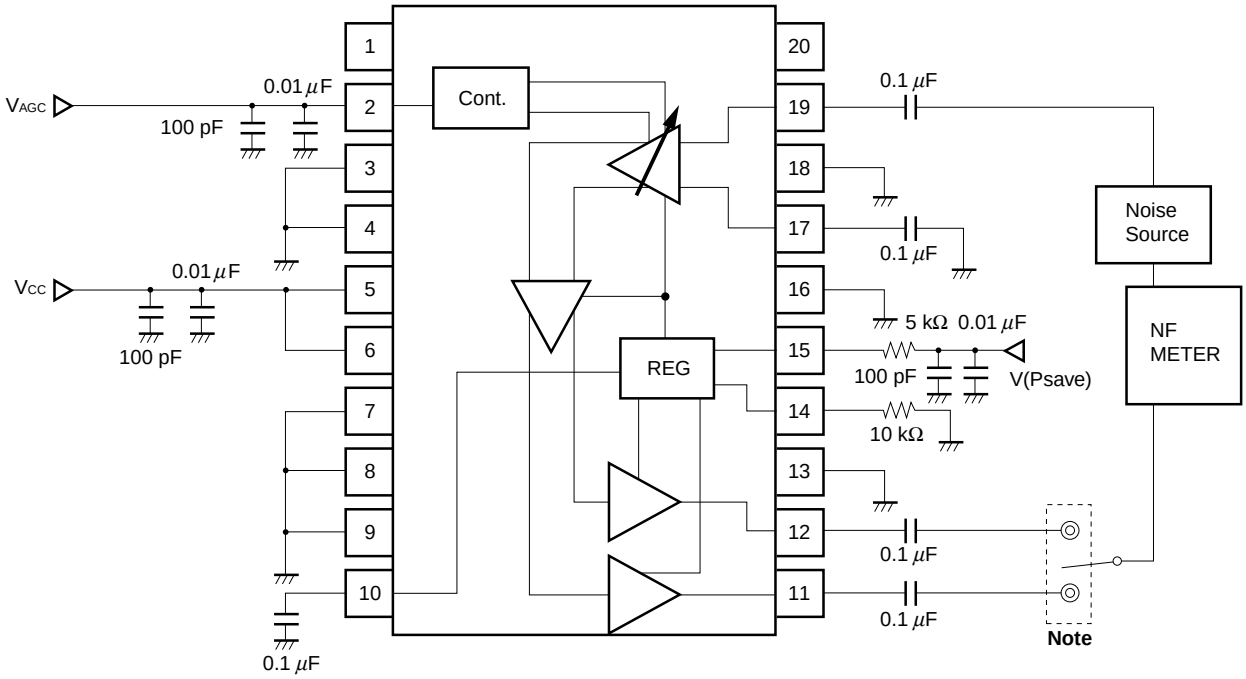
**MEASUREMENT CIRCUIT 2**




**Notes 1.** Connect in the case of measurement of $IM_2$/$IM_3$

**2.** The pin that is not connected to Spectrum Analyzer should be grounded through 50 Ω resistor.

**MEASUREMENT CIRCUIT 3**




**Note** The pin that is not connected to Spectrum Analyzer should be grounded through 50 Ω resistor.

**MEASUREMENT CIRCUIT 4**

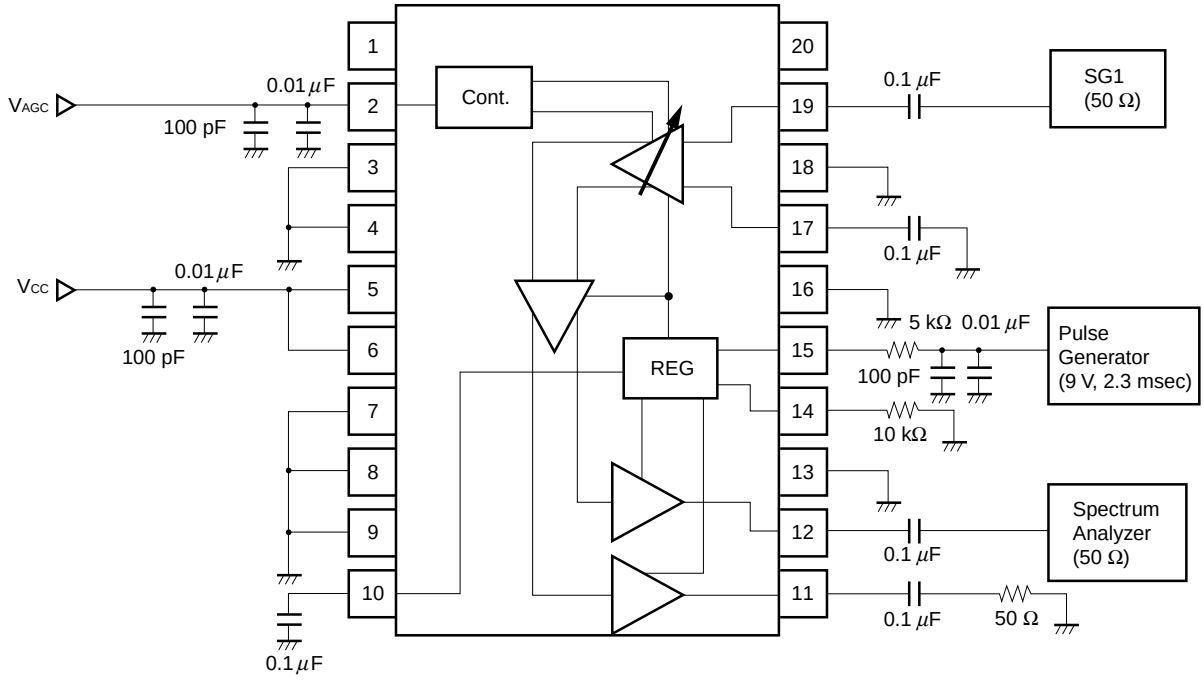
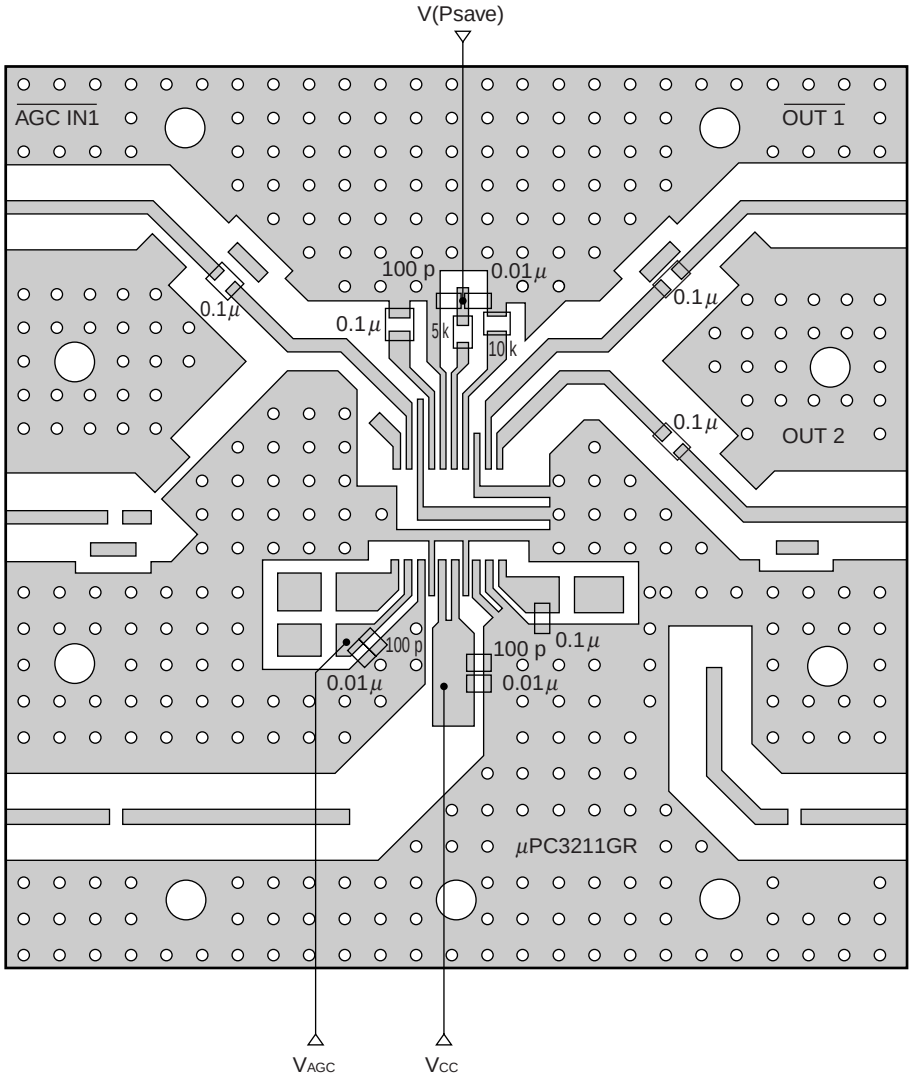


**ILLUSTRATION OF THE EVALUATION BOARD FOR MEASUREMENT CIRCUIT**




**Notes 1.** 50 × 50 × 1.6 mm double sided copper clad polyimide board.

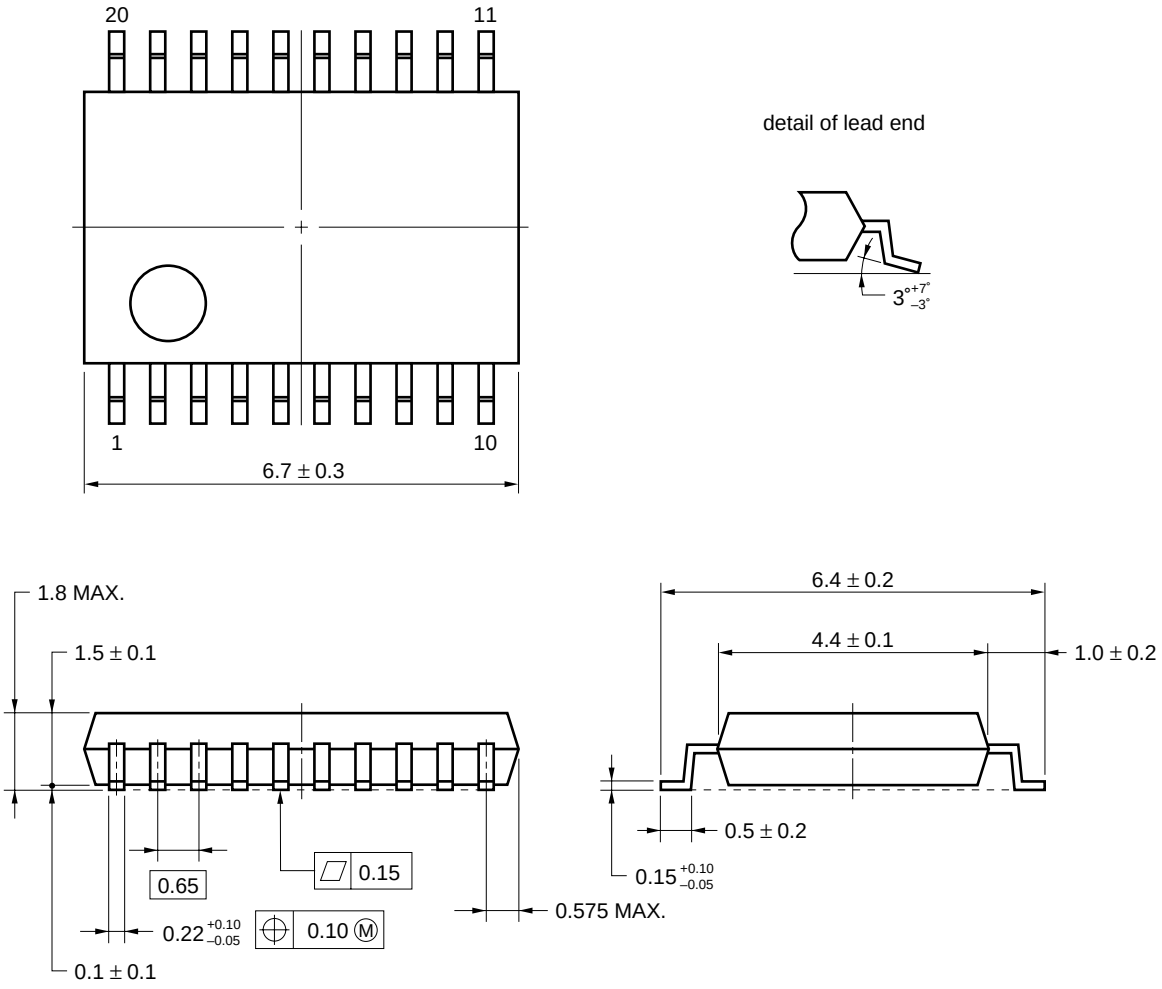
**2.** Back side: GND pattern

**3.** Solder plated on pattern

**4.** ○◯: Through holes

## 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.

## 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<br>Time: 30 seconds or less (at 210°C)<br>Count: 3, Exposure limit[Note]: None | IR35-00-3 |
| VPS | Package peak temperature: 215°C or below<br>Time: 40 seconds or less (at 200°C)<br>Count: 3, Exposure limit[Note]: None | VP15-00-3 |
| Partial Heating | Pin temperature: 300°C<br>Time: 3 seconds or less (per side of device)<br>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)**.

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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.

  The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

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