**DESCRIPTION**

The \( \mu \)PC3219GV is a silicon monolithic IC designed for use as AGC amplifier for digital CATV, cable modem systems. This IC consists of gain control amplifier and video amplifier.

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

This IC is manufactured using our 10 GHz f_{T} 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, this IC has excellent performance, uniformity and reliability.

**FEATURES**

- Low distortion: \( IM_3 = 58 \text{ dBc TYP.} \) @ single-ended output, \( V_{out} = 0.7 \text{ Vp-p/tone} \)
- Wide AGC dynamic range: \( \text{GCR} = 42.5 \text{ dB TYP.} \)
- On-chip video amplifier: \( V_{out} = 1.0 \text{ Vp-p TYP.} \) @ single-ended output
- Supply voltage: \( V_{CC} = 5.0 \text{ V TYP.} \)
- Packaged in 8-pin SSOP suitable for surface mounting

**APPLICATION**

- Digital CATV/Cable modem receivers

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Marking</th>
<th>Supplying Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu )PC3219GV-E1</td>
<td>8-pin plastic SSOP (4.45 mm (175))</td>
<td>3219</td>
<td>• Embossed tape 8 mm wide</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Pin 1 indicates pull-out direction of tape</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Qty 1 kpcs/reel</td>
</tr>
</tbody>
</table>

**Remark**

To order evaluation samples, contact your nearby sales office.

Part number for sample order: \( \mu \)PC3219GV

---

**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.

Not all devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

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INTERNAL BLOCK DIAGRAM AND PIN CONNECTIONS

(Top View)

VCC 1

INPUT1 2

INPUT2 3

VAGC 4

AGC Cont.

8 GND1

7 OUTPUT1

6 OUTPUT2

5 GND2

PRODUCT LINE-UP OF 5 V AGC AMPLIFIER

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Icc (mA)</th>
<th>GMAX (dB)</th>
<th>GMIN (dB)</th>
<th>GCR (dB)</th>
<th>NF (dB)</th>
<th>IM3 (dBc)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>µPC3217GV</td>
<td>23</td>
<td>53</td>
<td>0</td>
<td>53</td>
<td>6.5</td>
<td>50</td>
<td>8-pin SSOP (4.45 mm (175))</td>
</tr>
<tr>
<td>µPC3218GV</td>
<td>23</td>
<td>63</td>
<td>10</td>
<td>53</td>
<td>3.5</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>µPC3219GV</td>
<td>36.5</td>
<td>42.5</td>
<td>0</td>
<td>42.5</td>
<td>9.0</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

Note  f1 = 44 MHz, f2 = 45 MHz, Vout = 0.7 Vp-p/tone, single-ended output
### PIN EXPLANATIONS

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Applied Voltage (V)</th>
<th>Pin Voltage (V)</th>
<th>Function and Application</th>
<th>Internal Equivalent Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vcc</td>
<td>4.5 to 5.5</td>
<td>–</td>
<td>Power supply pin. This pin should be externally equipped with bypass capacitor to minimize ground impedance.</td>
<td><img src="image1" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>2</td>
<td>INPUT1</td>
<td>–</td>
<td>1.45</td>
<td>Signal input pins to AGC amplifier. This pin should be coupled with capacitor for DC cut.</td>
<td><img src="image2" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>3</td>
<td>INPUT2</td>
<td>–</td>
<td>1.45</td>
<td></td>
<td><img src="image3" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>4</td>
<td>VAGC</td>
<td>0 to Vcc</td>
<td>–</td>
<td>Gain control pin. This pin’s bias govern the AGC output level. Minimum Gain at VAGC &lt; 0.5 V Maximum Gain at VAGC &gt; 4.5 V Recommended to use AGC voltage with externally resistor (example:100 kΩ).</td>
<td><img src="image4" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>5</td>
<td>GND2</td>
<td>0</td>
<td>–</td>
<td>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.</td>
<td><img src="image5" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>6</td>
<td>OUTPUT2</td>
<td>–</td>
<td>2.2</td>
<td>Signal output pins of video amplifier. This pin should be coupled with capacitor for DC cut.</td>
<td><img src="image6" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>7</td>
<td>OUTPUT1</td>
<td>–</td>
<td>2.2</td>
<td></td>
<td><img src="image7" alt="Internal Equivalent Circuit" /></td>
</tr>
<tr>
<td>8</td>
<td>GND1</td>
<td>0</td>
<td>–</td>
<td>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.</td>
<td><img src="image8" alt="Internal Equivalent Circuit" /></td>
</tr>
</tbody>
</table>

**Note** Pin voltage is measured at Vcc = 5.0 V.
### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>( V_{CC} )</td>
<td>( T_A = +25^\circ C )</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>( P_D )</td>
<td>( T_A = +85^\circ C )</td>
<td>Note</td>
<td>250 mW</td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>( T_A )</td>
<td></td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>( T_{stg} )</td>
<td></td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

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

### RECOMMENDED OPERATING RANGE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>( V_{CC} )</td>
<td>( V_{CC} = 4.5 ) to ( 5.5 ) V</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>( T_A )</td>
<td>( V_{CC} = 4.5 ) to ( 5.5 ) V</td>
<td>-40</td>
<td>+25</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>Gain Control Voltage Range</td>
<td>( V_{AGC} )</td>
<td></td>
<td>0</td>
<td>–</td>
<td>( V_{CC} )</td>
<td>V</td>
</tr>
<tr>
<td>Operating Frequency Range</td>
<td>( f_{BW} )</td>
<td></td>
<td>10</td>
<td>45</td>
<td>100</td>
<td>MHz</td>
</tr>
</tbody>
</table>
### ELECTRICAL CHARACTERISTICS
(T\(\text{A} = +25^\circ\text{C}, \ V_{\text{CC}} = 5 \ \text{V}, \ f = 45 \ \text{MHz}, \ Z_s = 50 \ \Omega, \ Z_L = 250 \ \Omega, \ \text{single-ended output})

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit Current</td>
<td>(I_{\text{CC}})</td>
<td>No input signal (\text{Note 1})</td>
<td>27.5</td>
<td>36.5</td>
<td>43.5</td>
<td>mA</td>
</tr>
<tr>
<td>AGC Voltage High Level</td>
<td>(V_{\text{AGC (H)}})</td>
<td>@ Maximum gain (\text{Note 1})</td>
<td>4.5</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>AGC Voltage Low Level</td>
<td>(V_{\text{AGC (L)}})</td>
<td>@ Minimum gain (\text{Note 1})</td>
<td>0</td>
<td>–</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>RF Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Voltage Gain</td>
<td>(G_{\text{MAX}})</td>
<td>(V_{\text{AGC}} = 4.5 \ \text{V}, \ P_n = -40 \ \text{dBm} \ \text{Note 1})</td>
<td>39</td>
<td>42.5</td>
<td>45</td>
<td>dB</td>
</tr>
<tr>
<td>Minimum Voltage Gain</td>
<td>(G_{\text{MIN}})</td>
<td>(V_{\text{AGC}} = 0.5 \ \text{V}, \ P_n = -20 \ \text{dBm} \ \text{Note 1})</td>
<td>–4</td>
<td>0</td>
<td>4</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Control Range</td>
<td>(G_{\text{CR}})</td>
<td>(V_{\text{AGC}} = 0.5 \ \text{to} \ 4.5 \ \text{V} \ \text{Note 1})</td>
<td>35</td>
<td>42.5</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>(V_{\text{out}})</td>
<td>(P_n = -38 \ \text{to} \ -13 \ \text{dBm} \ \text{Note 1})</td>
<td>–</td>
<td>1.0</td>
<td>–</td>
<td>(V_{\text{pp}})</td>
</tr>
<tr>
<td>Maximum Output Voltage</td>
<td>(V_{\text{clip}})</td>
<td>(V_{\text{AGC}} = 4.5 \ \text{V} @ \text{Maximum gain} \ \text{Note 1})</td>
<td>2.5</td>
<td>3.4</td>
<td>–</td>
<td>(V_{\text{pp}})</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>(NF)</td>
<td>(V_{\text{AGC}} = 4.5 \ \text{V} @ \text{Maximum gain} \ \text{Note 2})</td>
<td>–</td>
<td>9.0</td>
<td>10.5</td>
<td>dB</td>
</tr>
</tbody>
</table>

**Notes**
1. By measurement circuit 1
2. By measurement circuit 2
## STANDARD CHARACTERISTICS (TA = +25°C, Vcc = 5 V, Zs = 50 Ω)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Reference Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Impedance</td>
<td>Zin</td>
<td>VAGC = 0.5 V, f = 45 MHz</td>
<td>1.2 k – j1.5 k</td>
<td>Ω</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>Zout</td>
<td>VAGC = 0.5 V, f = 45 MHz</td>
<td>6.0 + j3.2</td>
<td>Ω</td>
</tr>
<tr>
<td>3rd Order Input Intercept Point</td>
<td>IIP3</td>
<td>VAGC = 0.5 V @ Minimum gain, f1 = 44 MHz, f2 = 45 MHz, ZL = 250 Ω @ single-ended output</td>
<td>-1</td>
<td>dBm</td>
</tr>
<tr>
<td>3rd Order Intermodulation</td>
<td>IM31</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 250 Ω, Pn = -37 to -20 dBm/tone, Vout = 1.0 Vp-p/tone @ single-ended output</td>
<td>52</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Order Intermodulation</td>
<td>IM32</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 250 Ω, Pn = -40 to -23 dBm/tone, Vout = 0.7 Vp-p/tone @ single-ended output</td>
<td>58</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Order Intermodulation</td>
<td>IM33</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 500 Ω, Pn = -37 to -20 dBm/tone, Vout = 2.0 Vp-p/tone @ differential output</td>
<td>52</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Order Intermodulation</td>
<td>IM34</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 500 Ω, Pn = -40 to -23 dBm/tone, Vout = 1.4 Vp-p/tone @ differential output</td>
<td>58</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Order Intermodulation</td>
<td>IM1</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 500 Ω, Pn = -37 to -22 dBm/tone, Vout = 2.0 Vp-p/tone @ differential output</td>
<td>45</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Order Intermodulation</td>
<td>IM2</td>
<td>f1 = 44 MHz, f2 = 45 MHz, ZL = 500 Ω, Pn = -40 to -23 dBm/tone, Vout = 1.4 Vp-p/tone @ differential output</td>
<td>47</td>
<td>dBC</td>
</tr>
<tr>
<td>Distortion 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**
1. By measurement circuit 3
2. By measurement circuit 1
3. By measurement circuit 4
TYPICAL CHARACTERISTICS (TA = +25°C, unless otherwise specified)

CIRCUIT CURRENT vs. SUPPLY VOLTAGE

VOLTAGE GAIN vs. FREQUENCY

VOLTAGE GAIN vs. AGC VOLTAGE

OUTPUT POWER vs. INPUT POWER

**Note**  Measurement value with spectrum analyzer.

**Remark**  The graphs indicate nominal characteristics.
NOISE FIGURE vs. AGC VOLTAGE

- $V_{CC} = 4.5\,\text{V}$
- $V_{CC} = 5.0\,\text{V}$
- $V_{CC} = 5.5\,\text{V}$

$f = 45\,\text{MHz}$
$Z_l = 250\,\Omega$

VAGC = 0.5 V
measurement circuit 2

VAGC = 4.5 V
measurement circuit 1

VAGC = 2.5 V
measurement circuit 1

NOISE FIGURE vs. FREQUENCY

- $V_{CC} = 4.5\,\text{V}$
- $V_{CC} = 5.0\,\text{V}$
- $V_{CC} = 5.5\,\text{V}$

$Z_l = 250\,\Omega$
$V_{AGC} = 4.5\,\text{V}$
measurement circuit 2

3RD ORDER INTERMODULATION DISTORTION

- $f_1 = 44\,\text{MHz}$
- $f_2 = 45\,\text{MHz}$
- $Z_l = 250\,\Omega$

**measurement circuit 1**

3RD ORDER INTERMODULATION DISTORTION

- $f_1 = 44\,\text{MHz}$
- $f_2 = 45\,\text{MHz}$
- $Z_l = 250\,\Omega$

**measurement circuit 2**

Note  Measurement value with spectrum analyzer.

Remark  The graphs indicate nominal characteristics.
**IM₃, OUTPUT POWER, AGC VOLTAGE vs. INPUT POWER**

- **Conditions**
  - \( f_1 = 44 \text{ MHz} \)
  - \( f_2 = 45 \text{ MHz} \)
  - \( Z_L = 250 \Omega \)
  - \( V_{out} = 0.7 \text{ Vp-p/tone} \)
  - Measurement circuit 1

- **Note** Measurement value with spectrum analyzer.

**Remark** The graphs indicate nominal characteristics.
IM₃, OUTPUT POWER, AGC VOLTAGE vs. INPUT POWER

- Conditions
  - f₁ = 44 MHz
  - f₂ = 45 MHz
  - Z_L = 250 Ω
  - V_OUT = 1.0 Vp-p/tone Constant

- Measurement circuit 1

Note: Measurement value with spectrum analyzer.

Remark: The graphs indicate nominal characteristics.
S-PARAMETERS (TA = +25°C, VCC = 5.0 V)

**S11—FREQUENCY**

Marker 1 45 MHz

1.229 kΩ – j1.522 kΩ

START 0.100 000 MHz STOP 1000.000 000 MHz

**S22—FREQUENCY**

Marker 1 45 MHz

6.035 + j3.157 Ω

START 0.100 000 MHz STOP 1000.000 000 MHz
**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

VCC

1 µF

1 µF

1 µF

10 kΩ

13 kΩ

10 kΩ

1 µF

Network Analyzer

50 Ω 50 Ω

MEASUREMENT CIRCUIT 4

VCC

1 µF

1 µF

1 µF

1 µF

Signal Generator

50 Ω

50 Ω

10 kΩ

13 kΩ

10 kΩ

1 µF

Differential Probe

(10 : 1) 1 MΩ // 7pF

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

The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.
ILLUSTRATION OF THE EVALUATION BOARD FOR MEASUREMENT CIRCUIT 1

Note  Balun Transformer

Remarks  1. Back side: GND pattern
2. Solder plated on pattern
3. \( \sigma \): Through holes
4. \( \square \) represents cutout
5. \( \Box \Box \Box \Box \) represents short-circuit strip
**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 Vcc 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.

<table>
<thead>
<tr>
<th>Soldering Method</th>
<th>Soldering Conditions</th>
<th>Condition Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrared Reflow</td>
<td>Peak temperature (package surface temperature) : 260°C or below</td>
<td>IR260</td>
</tr>
<tr>
<td></td>
<td>Time at peak temperature : 10 seconds or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time at temperature of 220°C or higher : 60 seconds or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preheating time at 120 to 180°C : 120±30 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum number of reflow processes : 3 times</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below</td>
<td></td>
</tr>
<tr>
<td>VPS max</td>
<td>Peak temperature (package surface temperature) : 215°C or below</td>
<td>VP215</td>
</tr>
<tr>
<td></td>
<td>Time at temperature of 200°C or higher : 25 to 40 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preheating time at 120 to 150°C : 30 to 60 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum number of reflow processes : 3 times</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below</td>
<td></td>
</tr>
<tr>
<td>Wave Soldering</td>
<td>Peak temperature (molten solder temperature) : 260°C or below</td>
<td>WS260</td>
</tr>
<tr>
<td></td>
<td>Time at peak temperature : 10 seconds or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preheating temperature (package surface temperature) : 120°C or below</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum number of flow processes : 1 time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below</td>
<td></td>
</tr>
<tr>
<td>Partial Heating</td>
<td>Peak temperature (pin temperature) : 350°C or below</td>
<td>HS350</td>
</tr>
<tr>
<td></td>
<td>Soldering time (per side of device) : 3 seconds or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below</td>
<td></td>
</tr>
</tbody>
</table>

Note  Excluding lead-free products

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

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