AN6105FHN
Quadrature demodulation IC for CDMA system mobile telephone

**Overview**

The AN6105FHN is a quadrature demodulation IC for a CDMA system mobile telephone, incorporating a reception IF for IS-95 and GCA plus quadrature demodulator.

**Features**

- Current consumption: 11 mA typ.
- Gain control range: +85 dB to −5 dB
- High linearity control characteristic: ±3 dB
- Temperature dependency: ±3 dB

**Applications**

- Cellular telephone (IS-95)

**Block Diagram**
## Pin Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
<th>Pin No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND (GCA)</td>
<td>9</td>
<td>I output</td>
</tr>
<tr>
<td>2</td>
<td>I, Q output operating point adjustment</td>
<td>10</td>
<td>GND (base band)</td>
</tr>
<tr>
<td>3</td>
<td>Q operating point offset adjustment</td>
<td>11</td>
<td>Local signal input</td>
</tr>
<tr>
<td>4</td>
<td>I operating point offset adjustment</td>
<td>12</td>
<td>Sleep</td>
</tr>
<tr>
<td>5</td>
<td>Q output</td>
<td>13</td>
<td>Gain adjustment</td>
</tr>
<tr>
<td>6</td>
<td>Q output</td>
<td>14</td>
<td>Supply voltage (GCA)</td>
</tr>
<tr>
<td>7</td>
<td>Supply voltage (base band)</td>
<td>15</td>
<td>Signal input (+)</td>
</tr>
<tr>
<td>8</td>
<td>I output</td>
<td>16</td>
<td>Signal input (–)</td>
</tr>
</tbody>
</table>

## Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_{CC}$</td>
<td>4.2</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>$I_{CC}$</td>
<td>24</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation $^*$</td>
<td>$P_D$</td>
<td>100</td>
<td>mW</td>
</tr>
<tr>
<td>Operating ambient temperature $^*$</td>
<td>$T_{opr}$</td>
<td>−30 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature $^*$</td>
<td>$T_{sig}$</td>
<td>−55 to +125</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note) $^*$1: Except for the operating ambient temperature and storage temperature, all ratings are for $T_a = 25^\circ$C.

$^*$2: $P_D$ is the value at $T_a = 85^\circ$C without a heatsink. Use this device within the range of allowable power dissipation referring to Technical Data $\bullet P_D = T_a$ curves of QFN016-P-0304$^*$.

## Recommended Operating Range

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_{CC}$</td>
<td>2.55 to 4.00</td>
<td>V</td>
</tr>
</tbody>
</table>

## Electrical Characteristics at $T_a = 25^\circ$C

Unless otherwise specified, $V_{CC} = 2.8$ V, $V_{SLP} = 2.8$ V, $V_{GC} = 2.5$ V, $V_{LO} = −10$ dBm: $f = 223.7$ MHz, $V_{IN}$: $f = 112.35$ MHz, $V_{I}$, $V_{IX}$, $V_{Q}$, $V_{QX}$: $f = 500$ kHz, a measurement in high impedance be made for $V_{I}$, $V_{IX}$, $V_{Q}$ and $V_{QX}$.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>$I_{TOT}$</td>
<td>$V_{IN}$, $V_{LO}$: No input</td>
<td>6</td>
<td>11</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>Current consumption (sleep)</td>
<td>$I_{SLP}$</td>
<td>$V_{IN}$, $V_{LO}$: No input, $V_{I2} = 0$ V</td>
<td></td>
<td>0</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>Conversion gain 1</td>
<td>$G_{GC(1)}$</td>
<td>Conversion gain between $V_{IN}$ and $V_{I}$ $V_{GC} = 2.5$ V, $V_{IN} = 5$ dBμV</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>dB</td>
</tr>
<tr>
<td>Conversion gain 2</td>
<td>$G_{GC(2)}$</td>
<td>Conversion gain between $V_{IN}$ and $V_{I}$ $V_{GC} = 0.1$ V, $V_{IN} = 85$ dBμV</td>
<td>−18</td>
<td>−12</td>
<td>−9</td>
<td>dB</td>
</tr>
<tr>
<td>IQ maximum output</td>
<td>$V_{IQ}$</td>
<td>Output level of $V_{I}$, $V_{IX}$, $V_{Q}$ and $V_{QX}$ $V_{GC} = 2.5$ V, $V_{IN} = 40$ dBμV</td>
<td>1</td>
<td>1.8</td>
<td>—</td>
<td>V[p–p]</td>
</tr>
<tr>
<td>Noise figure</td>
<td>NF</td>
<td>$V_{GC} = 2.5$ V</td>
<td></td>
<td>7</td>
<td>8.5</td>
<td>dB</td>
</tr>
</tbody>
</table>
Electrical Characteristics at $T_a = 25^\circ C$ (continued)

Unless otherwise specified, $V_{CC} = 2.8 \text{ V}$, $V_{SLP} = 2.8 \text{ V}$, $V_{GC} = 2.5 \text{ V}$, $V_{LO} = -10 \text{ dBm}$: $f = 223.7 \text{ MHz}$, $V_{IN}$: $f = 112.35 \text{ MHz}$, $V_{I}$, $V_{IX}$, $V_{Q}$, $V_{QX}$: $f = 500 \text{ kHz}$, a measurement for high impedance be made for $V_{I}$, $V_{IX}$, $V_{Q}$ and $V_{QX}$.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input IP3</td>
<td>IIP3</td>
<td>Input IP3 value at 60 dB ± 1 dB of conversion gain</td>
<td>65</td>
<td>69</td>
<td>—</td>
<td>dBμV</td>
</tr>
<tr>
<td>Gain adjustment sensitivity</td>
<td>$\beta_{GCA}$</td>
<td>Gain variation at $V_{GC} = 0.5 \text{ V}$ to 2.5 $\text{ V}$</td>
<td>42</td>
<td>45</td>
<td>48</td>
<td>dB/V</td>
</tr>
<tr>
<td>Quadrature demodulation error</td>
<td>IQERR</td>
<td>$V_{GC} = 1.5 \text{ V}$, $V_{IN} = 47 \text{ dBμV}$</td>
<td>—</td>
<td>-25</td>
<td>-20.5</td>
<td>dB</td>
</tr>
<tr>
<td>Local signal input level</td>
<td>$V_{LO}$</td>
<td>Voltage to get $I_{TOT}$ of 10 $\mu\text{A}$ and less</td>
<td>-20</td>
<td>-10</td>
<td>-7</td>
<td>dBm</td>
</tr>
<tr>
<td>Sleep control (low)</td>
<td>$V_{SLP(1)}$</td>
<td>Voltage to get $I_{TOT}$ of 10 $\mu\text{A}$ and less</td>
<td>—</td>
<td>—</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>Sleep control (high)</td>
<td>$V_{SLP(2)}$</td>
<td>Voltage for an operating mode</td>
<td>2.3</td>
<td>—</td>
<td>—</td>
<td>V</td>
</tr>
<tr>
<td>Gain adjustment voltage</td>
<td>$V_{GC}$</td>
<td>0.1 — 2.6 $\text{ V}$</td>
<td>1.2</td>
<td>1.5</td>
<td>1.7</td>
<td>V</td>
</tr>
<tr>
<td>IQ operating point voltage</td>
<td>$V_{IQ}$</td>
<td>DC operating point voltage at no adjustment for IQ output (pin 5, pin 6, pin 8 and pin 9)</td>
<td>1.2</td>
<td>1.5</td>
<td>1.7</td>
<td>V</td>
</tr>
<tr>
<td>IQ operating point deviation</td>
<td>$\Delta V_{IQ}$</td>
<td>DC operating point voltage difference between $V_{I}, V_{IX}$ and $V_{Q}, V_{QX}$ (at no adjustment)</td>
<td>-250</td>
<td>0</td>
<td>250</td>
<td>mV</td>
</tr>
</tbody>
</table>

- **Design reference data**

  Note: The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ output deviation</td>
<td>$\Delta V_{IQ}$</td>
<td>Level ratio between IQ signals (differential), $V_{GC} = 1.5 \text{ V}$, $V_{IN} = 47 \text{ dBμV}$</td>
<td>-0.8</td>
<td>0</td>
<td>0.8</td>
<td>dB</td>
</tr>
<tr>
<td>IQ output phase difference</td>
<td>$\Delta \theta_{IQ}$</td>
<td>Phase difference between IQ signals (differential), $V_{GC} = 1.5 \text{ V}$, $V_{IN} = 47 \text{ dBμV}$</td>
<td>85</td>
<td>90</td>
<td>95</td>
<td>deg</td>
</tr>
</tbody>
</table>

Terminal Equivalent Circuits

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Equivalent circuit</th>
<th>Description</th>
<th>DC voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND (GCA): Ground pin of GCA system.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>2, 3, 4</td>
<td><img src="#" alt="Circuit Diagram" /></td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

Maintenance/Discontinued

Maintenance/Discontinued includes following four Product lifecycle stage. (planned maintenance type, maintenance type, planned discontinued type, discontinued type)
### Terminal Equivalent Circuits (continued)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Equivalent circuit</th>
<th>Description</th>
<th>DC voltage (V)</th>
</tr>
</thead>
</table>
| 5, 6    | ![Equivalent Circuit 5, 6](image1) | Pin 5: $\bar{Q}$ output: Pin to output the $\bar{Q}$ signal.  
Pin 6: Q output: Pin to output the Q signal. | 1.5            |
| 7       | —                  | Supply voltage (base band): Supply voltage pin of base band system.        | 2.8            |
| 8, 9    | ![Equivalent Circuit 8, 9](image2) | Pin 8: $I$ output: Pin to output the $I$ signal.  
Pin 9: I output: Pin to output the I signal. | 1.5            |
| 10      | —                  | GND (base band): Ground pin of base band system.                            | —              |
| 11      | ![Equivalent Circuit 11](image3) | Local signal input: Input pin of local signal for IQ demodulation.         | 2.7            |
| 12      | ![Equivalent Circuit 12](image4) | Sleep: Operating mode: Connect this pin to supply voltage pin.  
Sleep mode: Connect to GND. | —              |
### Terminal Equivalent Circuits (continued)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Equivalent circuit</th>
<th>Description</th>
<th>DC voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td><img src="image1" alt="Gain adjustment" /></td>
<td>Gain adjustment: Adjusts gain. Possible to apply voltage from 0 to a supply voltage.</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>—</td>
<td>Supply voltage (GCA): Supply voltage pin of GCA system.</td>
<td>—</td>
</tr>
</tbody>
</table>

### Usage Note

There are two systems of a supply voltage pin for this device. (Pin 7, pin 14) Apply the same voltage simultaneously to these two pins on use. (Keep either of them from being off.)

### Technical Data

- $P_D$ — $T_a$ curves of QFN016-P-0304A

![Power dissipation vs. ambient temperature](image3)

- Mount on standard board (glass epoxy: 50 mm $\times$ 50 mm $\times$ 0.8 mm) $\theta_{ja}=171.2{^\circ}C/W$
- Independent IC without a heat shink $\theta_{ja}=397.4{^\circ}C/W$
Application Circuit Example

Gain control
GCA VCC
IF in
IF in X
Gain control
GCA VCC
IF in
IF in X
GCA control
1/2 π/2
Offset adjustment
I-IX adjustment
Q-QX adjustment
IX out
Q out
QX out

Sleep
2nd local
B.B GND
B.B VCC
VREF (I, Q)
GCA GND

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(planed maintenance type, maintenance type, planed discontinued typed, discontinued type)
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