## 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: $\pm 3 \mathrm{~dB}$
- Temperature dependency: $\pm 3 \mathrm{~dB}$


## Applications

- Cellular telephone (IS-95)


Block Diagram


## - Pin Descriptions

| Pin No. | Description | Pin No. | Description |
| :---: | :--- | :---: | :--- |
| 1 | GND (GCA) | 9 | I output |
| 2 | I, Q output operating point adjustment | 10 | GND (base band) |
| 3 | Q operating point offset adjustment | 11 | Local signal input |
| 4 | I operating point offset adjustment | 12 | Sleep |
| 5 | $\overline{\text { Q output }}$ | 13 | Gain adjustment |
| 6 | Q output | 14 | Supply voltage (GCA) |
| 7 | Supply voltage (base band) | 15 | Signal input (+) |
| 8 | $\overline{\text { I }}$ output | 16 | Signal input $(-)$ |

- Absolute Maximum Ratings

| Parameter | Symbol | Rating | Unit |
| :--- | :---: | :---: | :---: |
| Supply voltage | $\mathrm{V}_{\mathrm{CC}}$ | 4.2 | V |
| Supply current | $\mathrm{I}_{\mathrm{CC}}$ | 24 | mA |
| Power dissipation ${ }^{* 2}$ | $\mathrm{P}_{\mathrm{D}}$ | 100 | mW |
| Operating ambient temperature $^{* 1}$ | $\mathrm{~T}_{\mathrm{opr}}$ | -30 to +85 | ${ }^{\circ} \mathrm{C}$ |
| Storage temperature ${ }^{* 1}$ | $\mathrm{~T}_{\mathrm{stg}}$ | -55 to +125 | ${ }^{\circ} \mathrm{C}$ |

Note) $* 1$ : Except for the operating ambient temperature and storage temperature, all ratings are for $\mathrm{T}_{\mathrm{a}}=25^{\circ} \mathrm{C}$.
*2: $\mathrm{P}_{\mathrm{D}}$ is the value at $\mathrm{T}_{\mathrm{a}}=85^{\circ} \mathrm{C}$ without a heatsink. Use this device within the range of allowable power dissipation referring to "■ Technical Data • $\mathrm{P}_{\mathrm{D}}-\mathrm{T}_{\mathrm{a}}$ curves of QFN016-P-0304".

Recommended Operating Range

| Parameter | Symbol | Range | Unit |
| :---: | :---: | :---: | :---: |
| Supply voltage | $\mathrm{V}_{\mathrm{CC}}$ | 2.55 to 4.00 | V |

Electrical Characteristics at $\mathrm{T}_{\mathrm{a}}=25^{\circ} \mathrm{C}$
Unless otherwise specified, $\mathrm{V}_{\mathrm{CC}}=2.8 \mathrm{~V}, \mathrm{~V}_{\text {SLP }}=2.8 \mathrm{~V}, \mathrm{~V}_{\mathrm{GC}}=2.5 \mathrm{~V}, \mathrm{~V}_{\mathrm{LO}}=-10 \mathrm{dBm}: \mathrm{f}=223.7 \mathrm{MHz}, \mathrm{V}_{\mathrm{IN}}: \mathrm{f}=112.35$ $\mathrm{MHz}, \mathrm{V}_{\mathrm{I}}, \mathrm{V}_{\mathrm{IX}}, \mathrm{V}_{\mathrm{Q}}, \mathrm{V}_{\mathrm{QX}}: \mathrm{f}=500 \mathrm{kHz}$, a measurement in high impedance be made for $\mathrm{V}_{\mathrm{I}}, \mathrm{V}_{\mathrm{IX}}, \mathrm{V}_{\mathrm{Q}}$ and $\mathrm{V}_{\mathrm{QX}}$.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
| :--- | :---: | :--- | :---: | :---: | :---: | :---: |
| Current consumption | $\mathrm{I}_{\mathrm{TOT}}$ | $\mathrm{V}_{\mathrm{IN}}, \mathrm{V}_{\mathrm{LO}}:$ No input | 6 | 11 | 15 | mA |
| Current consumption (sleep) | $\mathrm{I}_{\mathrm{SLP}}$ | $\mathrm{V}_{\mathrm{IN}}, \mathrm{V}_{\mathrm{LO}}:$ No input, $\mathrm{V}_{12}=0 \mathrm{~V}$ | - | 0 | 10 | $\mu \mathrm{~A}$ |
| Conversion gain 1 | $\mathrm{G}_{\mathrm{C}(1)}$ | Conversion gain between $\mathrm{V}_{\mathrm{IN}}$ and $\mathrm{V}_{\mathrm{I}}$ <br> $\mathrm{V}_{\mathrm{GC}}=2.5 \mathrm{~V}, \mathrm{~V}_{\mathrm{IN}}=5 \mathrm{~dB} \mu \mathrm{~V}$ | 80 | 85 | 90 | dB |
| Conversion gain 2 | $\mathrm{G}_{\mathrm{C}(2)}$ | Conversion gain between $\mathrm{V}_{\mathrm{IN}}$ and $\mathrm{V}_{\mathrm{I}}$ <br> $\mathrm{V}_{\mathrm{GC}}=0.1 \mathrm{~V}, \mathrm{~V}_{\mathrm{IN}}=85 \mathrm{~dB} \mu \mathrm{~V}$ | -18 | -12 | -9 | dB |
| IQ maximum output | $\mathrm{V}_{\mathrm{IQ}}$ | Output level of $\mathrm{V}_{\mathrm{I}}, \mathrm{V}_{\mathrm{IX}}, \mathrm{V}_{\mathrm{Q}}$ and $\mathrm{V}_{\mathrm{QX}}$ <br> $\mathrm{V}_{\mathrm{GC}}=2.5 \mathrm{~V}, \mathrm{~V}_{\mathrm{IN}}=40 \mathrm{~dB} \mu \mathrm{~V}$ | 1 | 1.8 | - | $\mathrm{V}[\mathrm{p}-\mathrm{p}]$ |
| Noise figure | NF | $\mathrm{V}_{\mathrm{GC}}=2.5 \mathrm{~V}$ | - | 7 | 8.5 | dB |

Electrical Characteristics at $\mathrm{T}_{\mathrm{a}}=25^{\circ} \mathrm{C}$ (continued)
Unless otherwise specified, $\mathrm{V}_{\mathrm{CC}}=2.8 \mathrm{~V}, \mathrm{~V}_{\text {SLP }}=2.8 \mathrm{~V}, \mathrm{~V}_{\mathrm{GC}}=2.5 \mathrm{~V}, \mathrm{~V}_{\mathrm{LO}}=-10 \mathrm{dBm}: \mathrm{f}=223.7 \mathrm{MHz}, \mathrm{V}_{\text {IN }}: \mathrm{f}=112.35$ $\mathrm{MHz}, \mathrm{V}_{\mathrm{I}}, \mathrm{V}_{\mathrm{IX}}, \mathrm{V}_{\mathrm{Q}}, \mathrm{V}_{\mathrm{QX}}: \mathrm{f}=500 \mathrm{kHz}$, a measurement for high impedance be made for $\mathrm{V}_{\mathrm{I}}, \mathrm{V}_{\mathrm{IX}}, \mathrm{V}_{\mathrm{Q}}$ and $\mathrm{V}_{\mathrm{QX}}$.

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

## - Design reference data

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

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
| :--- | :---: | :--- | :---: | :---: | :---: | :---: |
| IQ output deviation | $\Delta \mathrm{V}_{\text {IQ }}$ | Level ratio between IQ signals <br> (differential), <br> $\mathrm{V}_{\mathrm{GC}}=1.5 \mathrm{~V}, \mathrm{~V}_{\text {IN }}=47 \mathrm{~dB} \mu \mathrm{~V}$ | -0.8 | 0 | 0.8 | dB |
| IQ output phase difference | $\Delta \theta_{\mathrm{IQ}}$ | Phase difference between IQ signals <br> $($ differential $)$, <br> $\mathrm{V}_{\mathrm{GC}}=1.5 \mathrm{~V}, \mathrm{~V}_{\mathrm{IN}}=47 \mathrm{~dB} \mu \mathrm{~V}$ | 85 | 90 | 95 | deg |

Terminal Equivalent Circuits

| Pin No. | Equivalent circuit | Description | DC voltage (V) |
| :---: | :---: | :---: | :---: |
| 1 |  | GND (GCA): <br> Ground pin of GCA system. | - |
| 2, 3, 4 |  | Pin 2: I, Q output operating point adjustment: Pin to adjust an operating point voltage of IQ output (pin 5, pin 6, pin 8 and pin 9).; Pin3: Q operating point offset adjustment: Pin to adjust an offset voltage between Q , $\overline{\mathrm{Q}}$ output (pin 5, pin 6).; <br> Pin 4: I operating point offset adjustment: Pin to adjust an offset voltage between I, Ī output (pin 8, pin 9). | 1.9 |

Terminal Equivalent Circuits (continued)
Pin No.

Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit | Description | DC voltage (V) |
| :---: | :---: | :---: | :---: |
| 13 |  | Gain adjustment: <br> Adjusts gain. Possible to apply voltage from 0 to a supply voltage. | 0 |
| 14 | - | Supply voltage (GCA): <br> Supply voltage pin of GCA system. | - |
| 15, 16 |  | Pin 15: Signal input (+): <br> Pin to input IF signal. <br> Impedance matching is required.; <br> Pin 16: Signal input ( - ): <br> AC grounding with a capacitor. | 1.2 |

## 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

- $\mathrm{P}_{\mathrm{D}}-\mathrm{T}_{\mathrm{a}}$ curves of QFN016-P-0304A


Application Circuit Example


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