

NEW PRODUCTS 4

**QUADRATURE MODULATOR ICs FOR
DIGITAL CELLULAR TELEPHONES
 μ PC8126K/ μ PC8158K**

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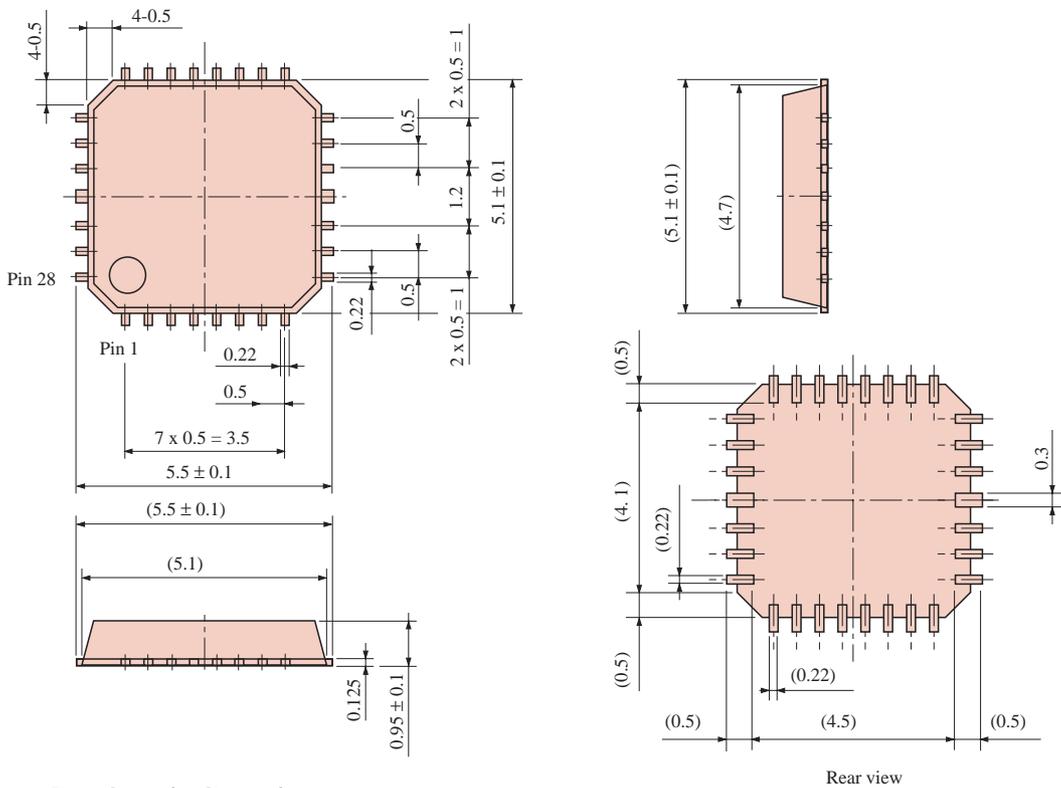


Fig. 1 Package Drawings (unit: mm)

Background

The total number of domestic cellular phones, also known as PDCs, stands at 35,720,000 units in Japan. In 1997, the number of cellular phones increased by 10,649,700 units, following an increase of more than 10,000,000 units in 1996. Because the total number of PHS's is 6,360,000 units, the total number of mobile

communication units had reached 42,080,000 units as of September 1998. This means that 33.3% of the population, or one in every three persons, owns a cellular phone in Japan. Against this background, there has been increasing demand for telephone terminals to have a long standby time and talking time, to be lightweight, and to have excellent operability. Consequently,

semiconductor devices employed in these cellular phones are required to be power-saving and compact.

To satisfy these requirements, NEC has developed quadrature modulator ICs, the μ PC8126K and μ PC8158K, for PDCs. These ICs are available in newly developed packages.

Product Lineup

Quadrature modulator ICs, which are key devices for PDCs, can be broadly classified into two types: The direct modulation type that is advantageous for reducing the number of components such as filters, and the indirect modulation type that can operate at high frequencies and consume less power. The direct modulation type is mainly used for 800-MHz PDCs and the indirect modulation type is employed for 1.5-GHz PDCs. Moreover, ICs housed in a non-lead package have increasingly become available in recent years. NEC this time has developed a direct quadrature modulator IC, the μ PC8126K, and an indirect quadrature modulator IC, the μ PC8158K, both in a non-lead package. Figure 1 shows the appearance of the package. Measuring 5.1 x 5.5 x 0.95 mm, this 28-pin plastic QFN package can be surface-mounted for higher density, contributing to reducing the mounting area by about 20% as compared with a 16-pin SSOP (6.2 x 5.5 x 1.8 mm) and about 40% as compared with a 20-pin SSOP (7 x 6.4 x 1.8 mm).

μ PC8126K

The μ PC8126K is a silicon monolithic IC developed as a transmission quadrature modulator for digital mobile communication systems. This IC integrates a local pre-mixer that operates at an RF frequency of 889 MHz to 960 MHz, and a quadrature modulator on a single chip. By packaging the same chip as that in the existing 20-pin SSOP (7 x 6.4 x 1.8 mm) model, the μ PC8126GR, into a 28-pin QFN (5.1 x 5.5 x 0.95 mm), the mounting area has been reduced by about 40%. In addition, the μ PC8126K operates at 2.7 to 3.6 V, and has a power-save function. Consequently the μ PC8126K is ideal for miniaturization and lower power consumption of digital cellular phones operating at 800 MHz. The features of this IC are listed below. Figure 2 shows the internal block diagram.

1. Features

- Direct modulation at 889 MHz to 960 MHz
- Built-in pre-mixer for local oscillator
- LO filter can be inserted: Pre-mixer output pin and quadrature modulator LO input pin are provided.
- Low current consumption: $I_{CC} = 35$ mA (TYP) @ $V_{CC} = 3$ V
- Power-save function

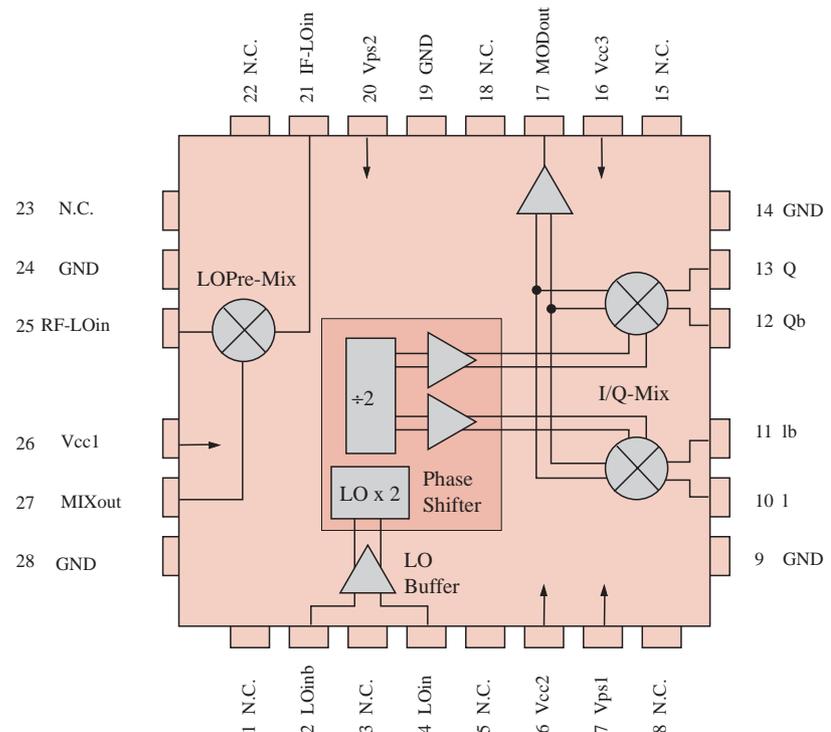


Fig. 2 Internal Block Diagram of μ PC8126K

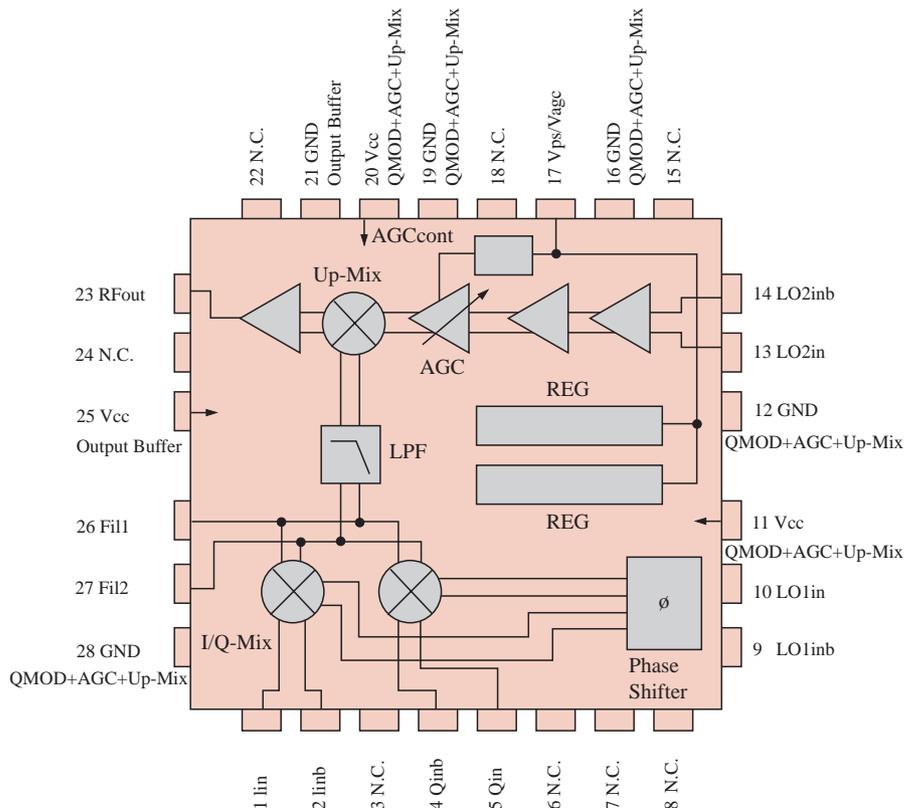


Fig. 3 Internal Block Diagram of μ PC8158K

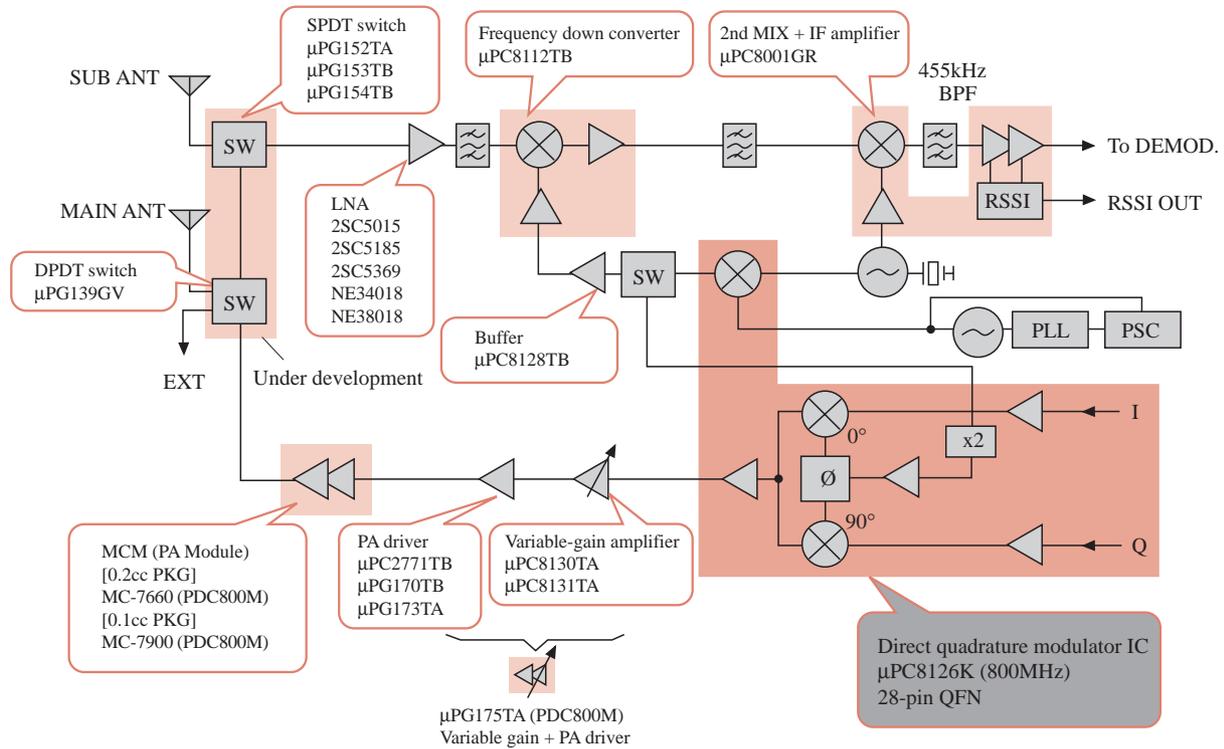


Fig. 4 Example of Configuration of Direct Modulation Devices for PDC

- Small package: 28-pin QFN package (5.1 x 5.5 x 0.95 mm)

μPC8158K

The μPC8158K is a silicon monolithic IC (Si-MMIC) developed as a transmission quadrature modulator for digital cellular phones. This product integrates a quadrature modulator of 100 MHz to 300 MHz, an up converter and an AGC amplifier that operate from 800 MHz to 1.5 GHz, on a single chip, and is best suited for indirect modulation systems. In addition, by employing NEC's original bipolar process, NESAT III ($f_T = 20$ GHz), and a CR phase shifter, a low current consumption (28 mA/@3 V) and a power-save function are realized. This IC is therefore suitable for producing power-saving digital cellular telephones. The features of the μPC8158K are as follows.

Figure 3 shows the block diagram.

1. Features

- Low-voltage operation/low current consumption: $V_{CC} = 2.7$ to 4.0 V, $I_{CC} = 28$ mA @ $V_{CC} = 3$ V
 - Built-in LPF suppressing spurious of transmission local oscillator (LO1) such as multiple-wave leakage
 - Spurious in vicinity of transmission band: -65 dBc (MAX)
 - AGC amplifier is installed in LO part of up converter: GCR = 35 dB (MIN)/@out = 1.5 GHz
 - High performance: $Padj = -65$ dBc (TYP)/@ $\Delta f = \pm 50$ kHz, EVM = 1.2% rms (TYP)
 - IF filter can be inserted.
- Quadrature modulator output pin and up converter input pin are provided.

- Small package: 28-pin QFN package (5.1 x 5.5 x 0.95 mm)

System Configuration Example

Figures 4 and 5 show examples of configuring a direct modulation system and an indirect modulation system using NEC's semiconductor devices. As can be seen in these figures, many high-frequency semiconductor devices are readily available from NEC.

Conclusion

NEC plans to develop more products to expand the lineup started by the μPC8126K and μPC8158K quadrature modulator ICs, introduced in this article.

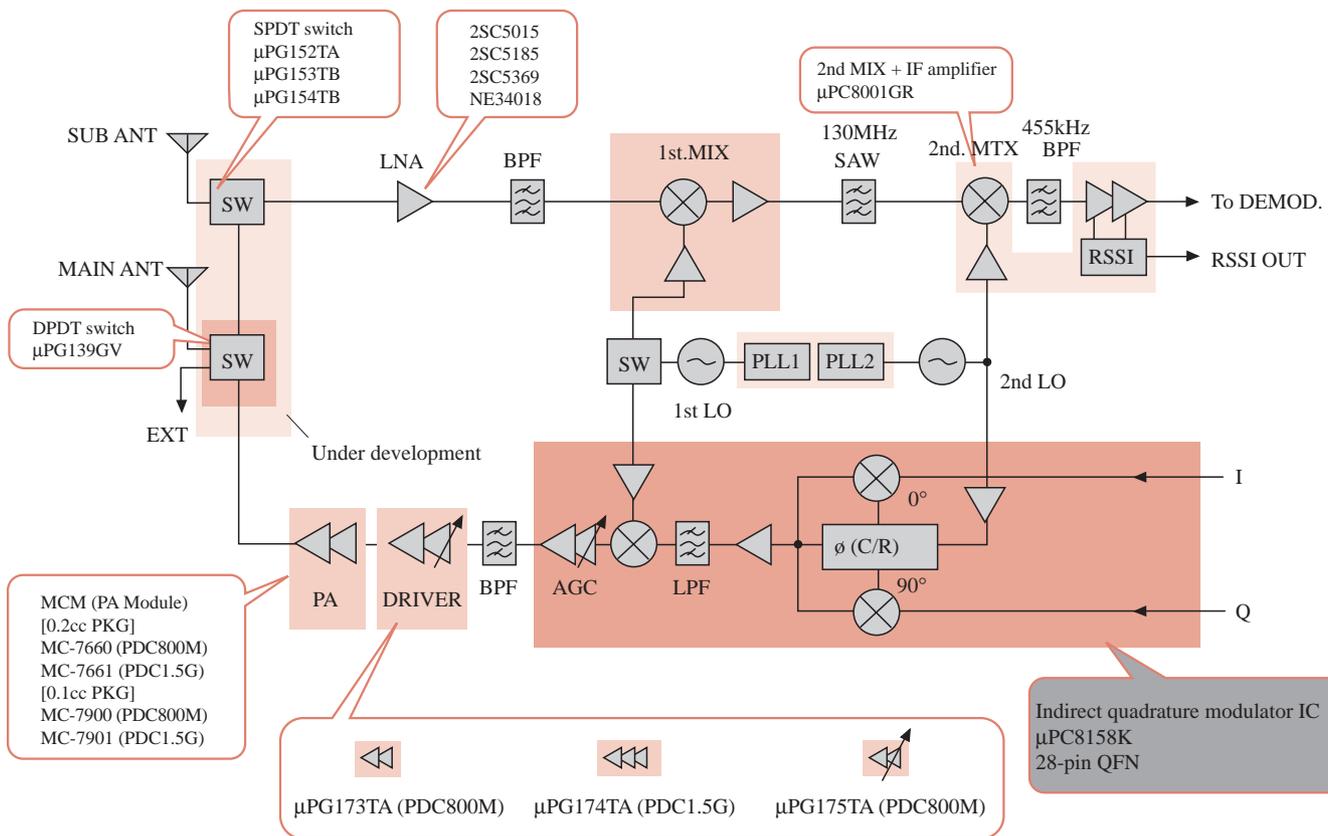


Fig. 5 Example of Configuration of Indirect Modulation Devices for PDC