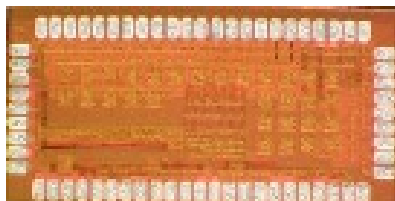


## Press backgrounder

(Attachment)

### Features of the newly developed digital RF transmission system



Digital modulator IC



Digital amplifier module

#### 1. Improved both the efficiency of power use and the variability of frequency with a new 1-bit digital modulation scheme

The new NEC system separates wireless signals into amplitude information and phase information. NEC's new modulation system digitizes the amplitude information and expresses it in 1-bit pulse density, while the phase information is expressed in pulse position without being digitized. This reduces the quantization noise and heat generated by half in comparison to the conventional modulation system, which digitizes both amplitude and phase information, contributing to improved signal conversion efficiency.

NEC has developed a digital RF transmission system that combines the integrated (\*1) digital modulation function in compliance with this system with a digital amplifier (\*2) that uses a gallium nitride (GaN) transistor. With this development, the company has achieved a high level of power efficiency and frequency variability (400 MHz to 3 GHz) at a practical level for the first time.

#### 2. Improved efficiency in low output power with a digital Doherty architecture

The new system introduces digital signal processing to the Doherty power amplifier, which is more commonly used by mobile base stations at present. The method lowers power consumption by activating plural amplifiers only when necessary. By inputting digital signals that are coded according to the amplitude of the input signal to each of the two digital amplifiers, the system amplifies signals only with a single amplifier when the amplitude is small. Thanks to digital features, the digital Doherty amplifier can be precisely operated and easily implemented into small modules.

As a result, power efficiency is increased when outputting signals with small power. Moreover, the system is capable of amplifying even signals with a large peak-to-average power ratio, such as LTE, with high power efficiency, contributing to smaller sized base stations.

### 3. Simplified correction of distorted signals thanks to the digital control

With conventional analog wireless transmission systems, signal distortions are generated both in the amplitude and phase inside the system by the analog amplifier which both need to be corrected. Since the newly developed system digitizes the amplitude information, the signals are scarcely distorted in the amplitude and only phase information needs to be corrected, which reduces the computational workload by around 50% compared with conventional systems. As a result, the size of the correction circuit is halved, contributing to the smaller sized base stations.

Notes:

\*1) Implemented with CMOS IC

\*2) The GaN FET (transistor) digital amplifier was developed jointly by NEC and Ferdinand Braun Institute (FBH, Germany).