

High-Efficiency Cellular Phone Power Amplifier Module for the Japanese CDMA 2000 1x System

CXG1178K

Third generation cellular phones have rapidly become widespread since the start of CDMA 2000 1x service in April 2002; the number of subscribers exceeded 10 million in a mere 18 months.

While Sony already provides an extensive lineup of low-distortion, high-efficiency power amplifier modules, Sony has now developed the CXG1178K power amplifier module that features even further miniaturization based on Sony's low-distortion, high-efficiency technologies that have been nurtured through Sony's extensive experience in this area.

- High efficiency, low distortion
- Low Rx band noise
- Single positive power supply operation
- Miniature package
- Built-in temperature compensation circuit

■ Miniature Package, High Efficiency, and Low Distortion

Sony has developed a new low on-resistance miniature JPHEMT* device to achieve higher performance and further miniaturization of the IC chip. Based on the low-loss matching circuit technologies Sony has cultivated up to now, Sony has also made the module matching circuits even more compact by reducing the number of components and using even smaller components. The result has been the creation of a miniature power amplifier module with an area, 4.5 mm square, that is about 1/2 that of earlier Sony power amplifier modules. Since CDMA uses output power control during transmission,

distortion and efficiency are important not only in high output power mode, but in low-voltage low output power mode as well. The JPHEMT device developed by Sony exhibits superlative low distortion and high efficiency characteristics not only in high output mode but in low-voltage low output power mode as well. Taking advantage of these characteristics, the CXG1178K achieves, in high output power mode, an operating voltage of 3.5 V, an output power of 27.5 dBm, an ACPR1 of -52 dBc, and an efficiency of 40.5%. In low-voltage low output power mode, the CXG1178K achieves an efficiency of 17.6% at an operating voltage of 1.5 V and an output power of 14 dBm, and at an operating voltage of 1.5 V and an output power of 18 dBm, it achieves an ACPR1 of -55 dBc. Thus the CXG1178K achieves the industry's top level of device characteristics in all the modes required by the CDMA system. (See table 1 and figure 1.)

■ Low Rx Band Noise

Due to the excellent low noise characteristic of JPHEMT, the CXG1178K achieves the -140 dBm/Hz Rx band noise of the industry's top level.

■ Single Positive Power Supply Operation

Sony's unique JPHEMT device has a high built-in voltage, and that makes it possible to implement a power amplifier module that operates on a positive power supply. This obviates the need for peripheral circuits such as a negative power supply generator circuit, and contributes to further miniaturization and lower costs in portable terminals.

■ Miniature Package

A miniature package with a volume of only 0.03 cc (4.5 mm × 4.5 mm × 1.35 mm) was adopted for the CXG1178K. This contributes to reduced mounting areas and further miniaturization in portable terminals. (See figure 2.)

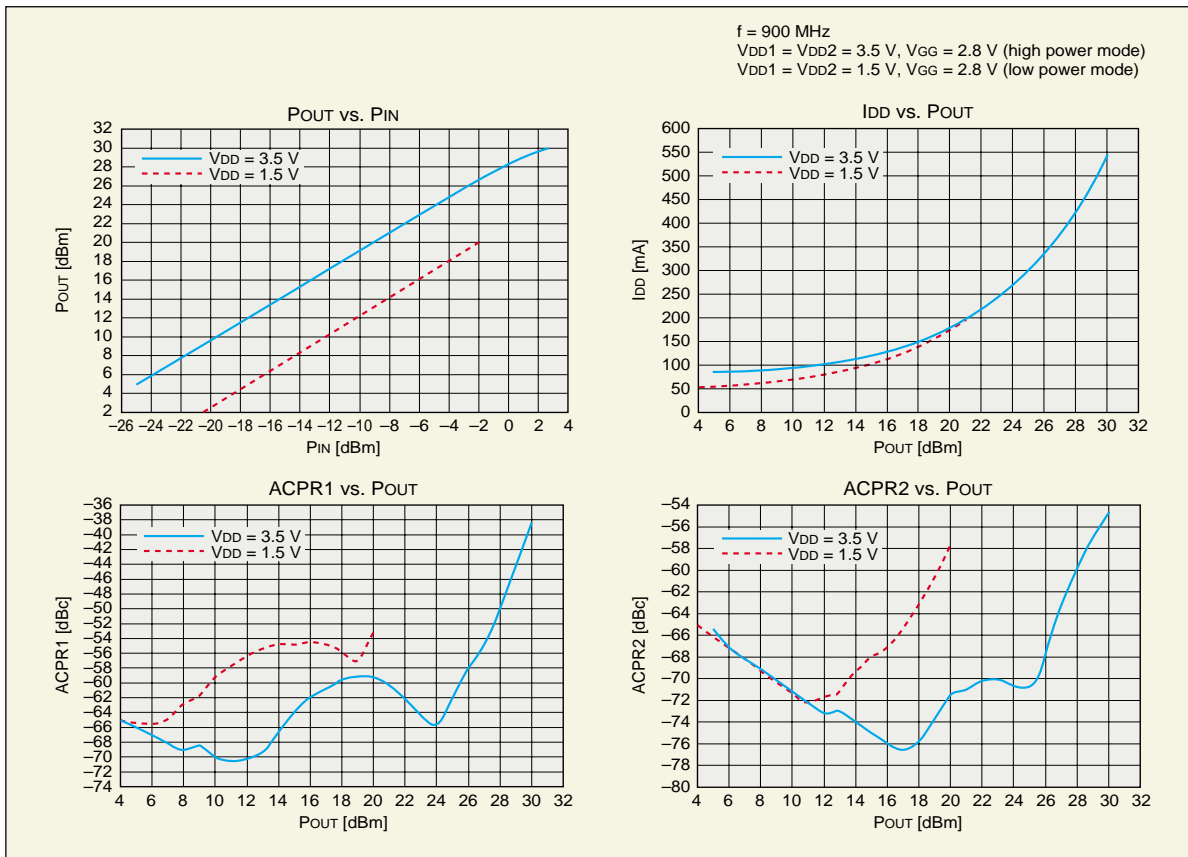
■ Built-in Temperature Compensation Circuit

The power amplifier bias current varies widely with changes in temperature, and that can result in a corresponding degradation of device characteristics. The CXG1178K includes a built-in temperature compensation circuit that controls the bias current to be optimal for the temperature as the temperature changes. This minimizes the degradation in device characteristics at both high and low temperatures.

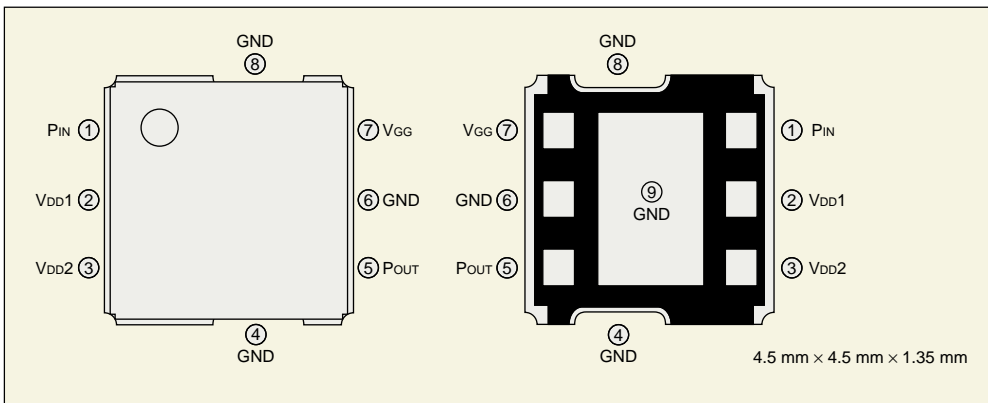
V O I C E

The CXG1178K was developed with miniaturization and high performance as the targets. We started by developing a miniature high-performance transistor, and we then found the optimal circuit from a large number of circuit patterns by repeatedly evaluating actual circuits. We are proud of this device, which was completed due to the united efforts of the whole development team. I hope you will be able to discover for yourself how good this device really is.

* JPHEMT: Junction Pseudomorphic High Electron Mobility Transistor



■ Figure 1 CXG1178K I/O Characteristics



■ Figure 2 CXG1178K Package Dimensions

■ Table 1 CXG1178K Main Characteristics

High power mode	
Output power	P _{OUT} = 27.5 dBm
Operating voltage	V _{DD} = 3.5 V, V _{GG} = 2.8 V
Current consumption	397 mA (Efficiency: 40.5%)
Gain	28.5 dB
ACPR1*1	-52 dBc
ACPR2*2	-62 dBc
Rx band noise	-140 dBm/Hz

Low power mode	
Operating voltage	V _{DD} = 1.5 V, V _{GG} = 2.8 V
Current consumption	95mA (Efficiency: 17.6%)@P _{OUT} = 14 dBm
Gain	22.5 dB @P _{OUT} = 18 dBm
ACPR1*1	-55 dBc @P _{OUT} = 18 dBm
ACPR2*2	-62 dBc @P _{OUT} = 18 dBm

f = 887 to 925 MHz, T_a = 25°C

*1: Conditions: ±900 kHz offset, 30 kHz bandwidth

*2: Conditions: ±1.98 MHz offset, 30 kHz bandwidth