

## 퍼지로직을 이용한 CDMA 중계기의 High Power Amp 설계

### Designing High Power Amp for CDMA-Repeater used Fuzzy Logic

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#### ABSTRACT

Generally, the repeater in CDMA(Code Division Multiple Access) included HPA(HI-Power Amplifier) to amplifier communication signals. Also, HPA contained PD(Predistortor) to maintain the linearization of amplifier characteristics. A configuration component of PD have been used electricity nonlinear devices such that diode. But this diode takes many influences at the circumstance temperature. Consequently, it can't maintain output linearization, and drop the communication quality. The manufacturer set bias of the circuit to the manual at the first out of ware-house low. But the Q-point changes according to the change of the high temperature or low temperature. Therefore, we designed a system to maintain the Q-point by FDM(Fuzzy Decision Maker) in this paper.

**Key words** : PD(Predistortor), HPA, The third harmonic-wave, FDM(Fuzzy Decision Maker)

#### 1. Introduction

About CDMA, A circumstance technique is showing proper development. But in the CDMA-Repeater, One of issneunguss does the key point role and is the HPA. It raise the distortion if Two tone CDMA input signal through the HPA and are amplified by the nonlinear-element (Transistor, Diode and etc...) characteristic.[1]

Immediately, It create Harmonic at the output, Among they The Third-Order Wave(The 3<sup>rd</sup> IMD) are not eliminated with

BPF(Band Pass Filter). It caused serious problem at the broadband digital communications.

In the broadband channel of the CDMA, Magnificently it has deal with many frequency-tone at a time, and many 3<sup>rd</sup> IMD components consist band, and they form dangerous noise group.

It drops the quality with the call capacity. We do harmonic termination to solve such problem. Feed-Forward, Negative-Feedback, Pre-Distortion are in the method to do harmonic termination. [2]

In this paper, We will try to present at the CDMA about a linear method to be

utilized by Pre-Distortion type. Also, we present the problem and present FDM model to solve this.

## 2. Problem Presentation

A linear method which explains in the introduction parts, There is Pre-Distortion type using Diode It is make with the distortion of the input signal and direct opposition signal and input. It compensates the distortion of the topology delay with the degrade of the amplitude. Also it means the method to make a distortion ingredient. This method is composed of small size and simple circuit relatively. Also it has a high competitive price, so we have been used in the industry much.[3]

But, the important problem of Pre-Distortion type which time present is developed. Because, the price to produce a complete cure distortion ingredient becomes the fix. A active action is impossible about an environment factor. That is the defect. Again we say, present time case of HPA goods which PD[4] is combined with the circuit. They set suitable signal to an output signal and do the taking goods out of ware-house. The temperature of the place is changed which goods become the install. So an output wave of HPA is changed. Because, they adjust and can not give an output wave value as the automatic. The finally they bring with the capacity of the call they do me of the quality.

Fuzzy theory can makes high efficiency of the linear of HPA. Because, it is not do the modeling so that it's correct a non-linear characteristic. And it makes an experience knowledge as a fuzzy assignment function. Also it can implement a language control strategy efficiency.

This research it makes a distortion of frequency ingredient be adapted to the activity using fuzzy logic. Also a supplementation's system to order the

defect development is the purpose.

## 3. Designing for an intelligent Q-points system

There are we like a hardware configuration's Figure 1 and Figure 2 with a total circuit.

It do the voltage value of the output parts(Vpd) with the thermistor. And output value of FDM to HPA.

And that signal is A/D converting, by the PIC Chips programmed Fuzzy logic. The last, that signal return to HPA.

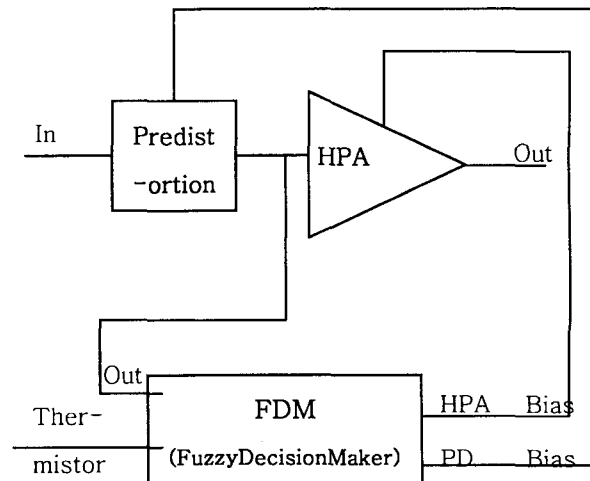


Figure 1. All system configuration

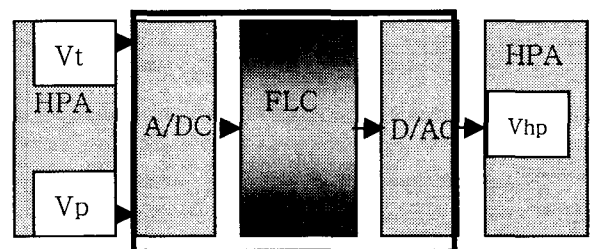


Figure 2. Hardware configuration

## 4. The Experiment and Simulation

In the showing Fig 3. the Generator using an input source of HPA. The center frequency is 870MHz and -10dB signal input.

In the showing Fig 4. The Spectrum analyzer using authentication output characteristic of HPA. And The measurement for the experiment To protector spectrum analyzer connected attenuator[5].

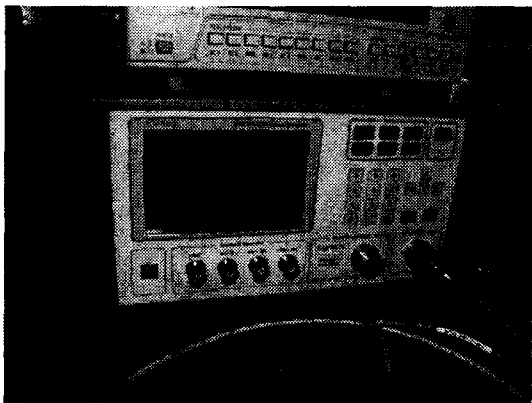


Figure 3. CDMA Generator

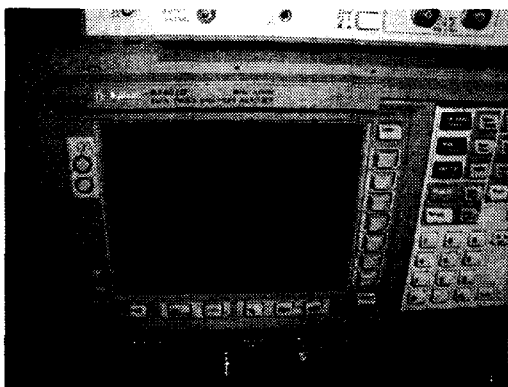
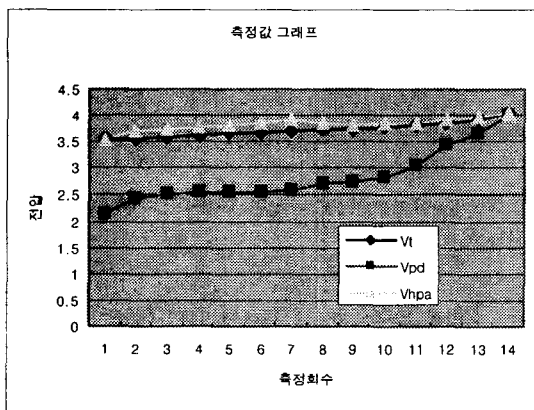


Figure 4. Spectrum Analyzer

Graph 1. A best points measurement which follows a temperature change



In figure 4. The 3<sup>rd</sup> IMD become minimum of the output and the signal

ingredient does not fall off and then recoded Vpd, Vt, Vhpa value.

A measurement result of the graph footing. We organized a adaptive FDM of the program.

Fuzzifications using isosceles triangle. The approximation inference using Max-Min method of Mamdani.[6]

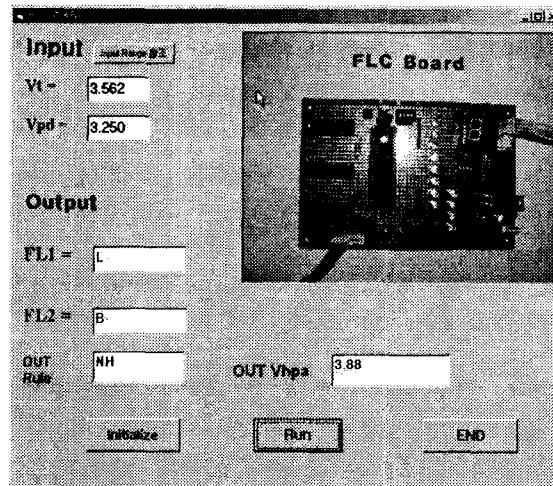


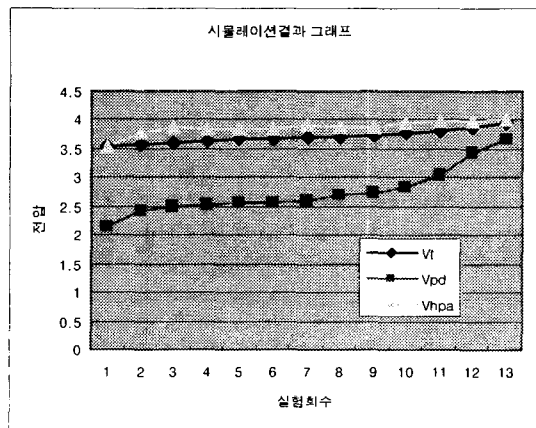
Figure 5. A simulation program output screen

In figure 5. we fill in FDM program and are the screen to do the simulation.

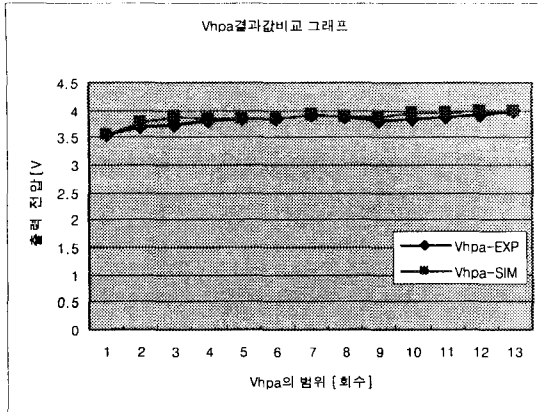
We marked results at the graph 2. Also we compared the simulation with the measurement and marked at the graph 3. The simulation value and measurement value are approximate in the showing graph 3.

Consequently, we refer to algorithm of this program and made hardware in figure 5.

Graph 2. Simulation result Value



Graph 3. A measurement comparison with the simulation



We made hardware as PIC processor. And to convert a binary data using A/D converter in PIC16F877.[7] And output value to D/A converting using DAC0800.

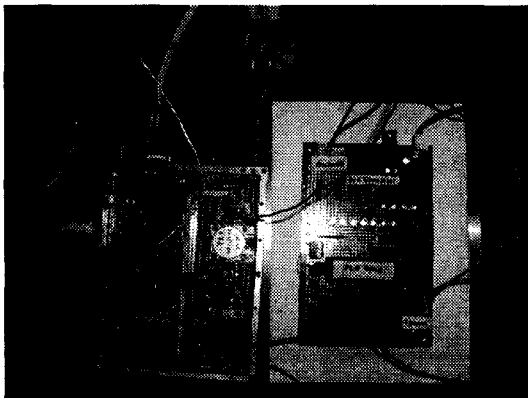


Figure 5. FDM manufacture using PIC Processor

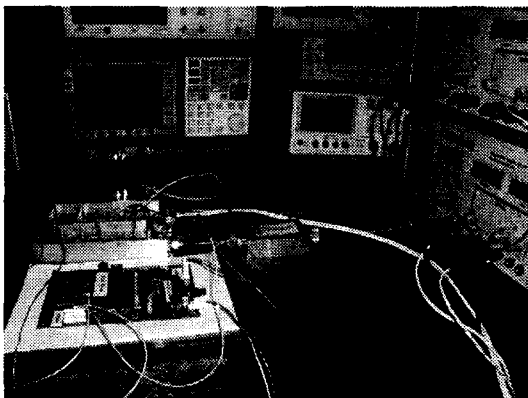


Figure6. A hardware linking measurement screen

We connected to goods to organized the

hardware with the figure 6. Circumstance environment the temperature is changed namely. That  $V_t$  and  $V_{pd}$  Value store and 8bit A/D Converter to binary data and then PIC board processing. It changed Vhpa binary data by Fuzzy logic. And again Vhpa value output using D/A Converter. Then feedback to HPA for maintain linear characteristic

The test did the program which Fuzzy Algorithm is applied. We could get result which we map out.

Now, to make Fuzzy Set which the output is ideal. We continuously the measurement

Next times we try to using private used chip or the approach of different method from Pre-Distorter. And tries to high output HPA.

## 5. 참고문헌

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