

# RF Wireless Communication On TMS320C6713 DSP

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**Abstract:** In this paper we've got conferred a wireless frequency (RF) communication that relies on digital signal processor (DSP) TMS 320C6713. System will method information mistreatment DSP processor and transmits processed information mistreatment wireless RF module CM2025 that has the programmable carrier frequency within the vary a pair of.3 GHz to 2.5 GHz. this method will use to modulate signals digitally and transmit information, audio and video signals over the wireless medium mistreatment wireless RF module. Binary section Shift Keying (BPSK) technique or Direct Sequence unfold Spectrum (DS/SS -BPSK) technique is employed to for the modulation purpose.

**Keywords—** - carrier; radio frequency; DSP STAR personal; RF module; modulation;

## I. INTRODUCTION

In the past years, we have a tendency to were used the wired technologies for the communication. These wired technologies have the best drawbacks of victimization cable. to beat these drawbacks, we've got been affected to the wireless one. By victimization the wireless communication technologies, we have a tendency to create our communication as cable free and reliable. The RF wireless communication, because the name suggests, operates at oftenness (30 kc - 300GHz), these area unit magnetic attraction signal will travel through air medium and doesn't would like line of sight communication. In wireless transmission of information, audio and video signals, in several cases the info that must be self-addressed and transmitted, these signals needs huge amount of information and sophisticated process algorithms [1]. to fulfill this demand we've got used digital signal processor, which might method giant knowledge victimization data processing mechanism. Additionally DSP will perform mounted or floating purpose operations among fraction of seconds.

In this system ND Tech's DSP STAR Personal Board used as basic process and dominant unit wherever, as ND Tech's RF wireless communication module CM2025 is employed as wireless transceiver which might outwardly interfaced to DSP STAR Personal board via central processor enlargement board. This board incorporated with TMS320C6713 that is TX Instrument's DSP processor. it's complete management on wireless knowledge module at an equivalent time it will simply mix processing and wireless transmission along. during this system knowledge signals area unit digitally modulated victimization BPSK technique or its spectrum is spreaded the usage of DS/SS BPSK technique. we can use programmable carrier frequency for modulation in range the 2.3GHz to 2.5GHz. best advantage of this gadget is that we can use unlicensed ISM band (2.4GHz – 2.5GHz).

## II. CIRCUIT layout and Hardware

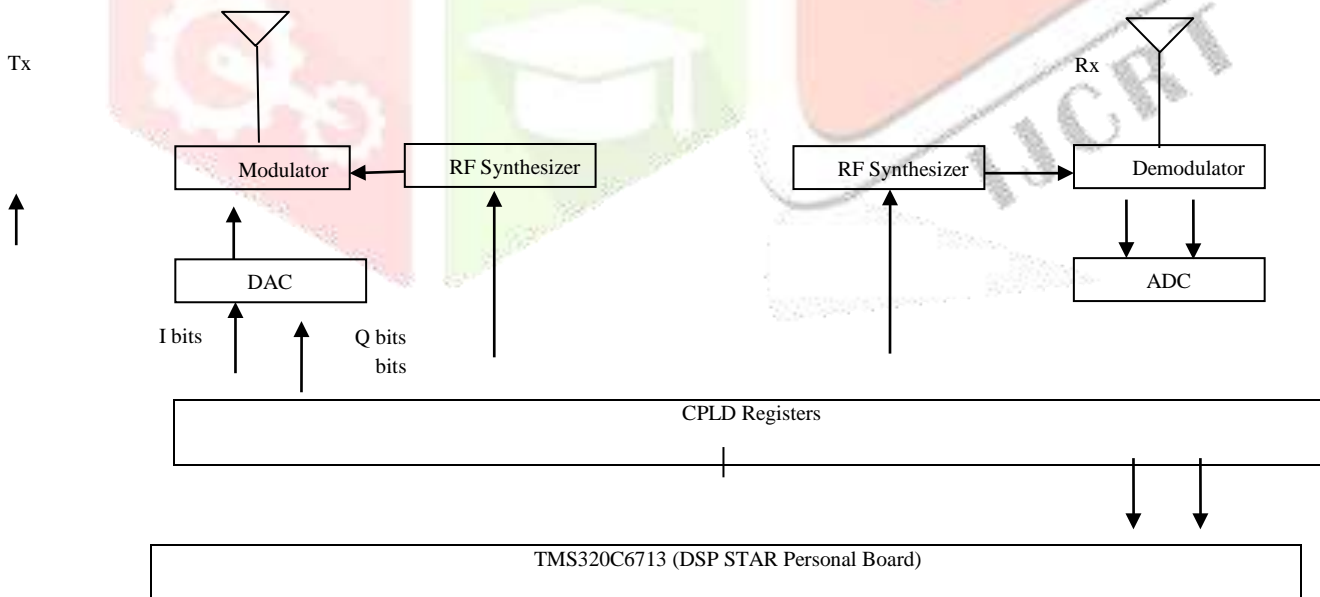
### A. principle Block Diagram

The block diagrams of wireless RF verbal exchange system is as shown in discern 1. On this machine TMS320C6713 DSP processor is that is 32 bit floating point. Processor plays simple operation and controls the transmission of information, voice and video signal with the help of plug in RF wireless verbal exchange module which has two separate antennas for transmitter and receiver. The DSP processor controls or accesses the RF module via CPLD registers. CPLD sign in act as interface between processor and RF module, extensively utilized to save transient records. Each section of block diagram is explained in element in the next section.

### B. DSP star personal hardware Board

DSP big name private hardware includes two hardware components: DSP processor module and enter Output (I/O) board. Each DSP processor module is hooked up with the I/O board [4]. The C6713 is high performance, advanced very- lengthy-coaching-phrase (VLIW) structure it's far awesome for multichannel and multifunction programs. It operates at 225MHz, the C6713 promises as much as 1350 million floating- point operations per 2nd (MFLOPS).

The 2 I2C ports at the C6713 permit the DSP to without difficulty manage peripheral devices and speak with a host processor. Similarly, the same old multichannel buffered serial port (McBSP) may be used to speak with serial peripheral interface (SPI) mode peripheral devices [6]. I/O board has CPU expansion port carries sixteen bit information and copes with bus which is used to attach RF wireless module. Additionally I/O board has audio codec which is used to transform analog enter at line in pin into thirteen bit digital records, ADC, DAC, serial port and LCD display.



### C. RF WI-FI COMMUNICATION MODULE

The RF wi-fi Communications Module (CM2025) is a small electronics circuit used for radio communications, which lets in users to use radio frequency from 2.3GHz to two.5GHz. It has the Silicon Laboratories's RF synthesizer Si4136. The RF module carries each transmitter and receiver hardware inclusive of separate manages logics in a single hardware board. The module is a plug-in for DSP famous person private expansion port. It has 8 bit ADC and eight bit DAC for each I and Q channel [3].

### D. INTERFACE AMONG DSP SUPERSTAR NON-PUBLIC BOARD AND RF CONVERSATION

The RF module is attached to DSP hardware through CPU expansion port. four address pins A0 ~ A3 are used as shown in table I.

TABLE I. CM2025 REGISTER ADDRESS MAP

A3-A0	Byte Address	Name	Description
0	EIOBASE1 + 0x0	CONTL	RF Synthesizer Control Register
1	EIOBASE + 0x4	RXADJ	Receive Carrier Frequency Adjust
2	EIOBASE + 0x 8	CONFIG	Receive / Transmit Configuration Register
3	EIOBASE + 0x C	IQDAT	I/Q channel Data Register
4	EIOBASE + 0x 10	LEDCS	LED Chip Select
5~15	Reserved	.	.

There are 5 CPLD registers that manipulate and access the RF wi-fi module. Registers CONTL, RXADJ, and CONFIG are used to installation the RF synthesizer frequency, the ADC/DAC sampling price, and the interrupt behavior. The IQDAT register is used for I and Q channel facts transmissions [5].

### III. RUNNING PRECEPT

DSP processor is used as primary processing and controlling unit on this syetem. Processor shops program for special algorithmes in its memory and technique the information primarily based on set of rules witch is to be enforce. Processed records is transmitted through the RF module's transmitting section and received via receiver section. Transmitter and receiver sections are defined in element in following sections.

#### A. TRANSMITTER

first of all DSP processor units up the parameters of the RF synthesizer (Si4136) at a transmitter facet by placing the values of N and R sign in in conjunction with phase detector advantage check in (Kb) and their corresponding values are given in desk II. Generated service is mathematically given as follows.

$$RF_{out} = (19.2\text{MHz})2N / R \quad (1)$$

TABLE II.SET UP VALUES OF KP AND R REGISTERS

N Value	Kp	R
991 ~ 4085	0	6.9 ~ 8188
4085 ~ 8190	1	7.9 ~ 8188
8190 ~ 16386	2	10 ~ 8188
16386 ~ 262141	3	14 ~ 8188

virtual statistics is separated into 8 bit I and Q channels, then every channel sign is converted into analog sign using at DAC converter (AD9763) and fed into RF modulator (AD8346). The RF modulator generates an orthogonal sign

similar to a carrier signal generated from the RF synthesizer, and multiplies those two orthogonal provider alerts by way of I and Q channel records. these indicators are delivered and output is transmitted thru TX antenna. AD9763 used is dual channel, 8 bit CMOS DAC.

#### A) RF SYNTHESIZER SI4136

The Si4136 is a monolithic included circuit that plays both IF and RF synthesis for wireless communications programs. The Si4136 consists of three Voltage managed Oscillators (VCO), loop filters, reference and VCO dividers, and section detectors. Divider and strength down settings are programmable through a three-cord serial interface.

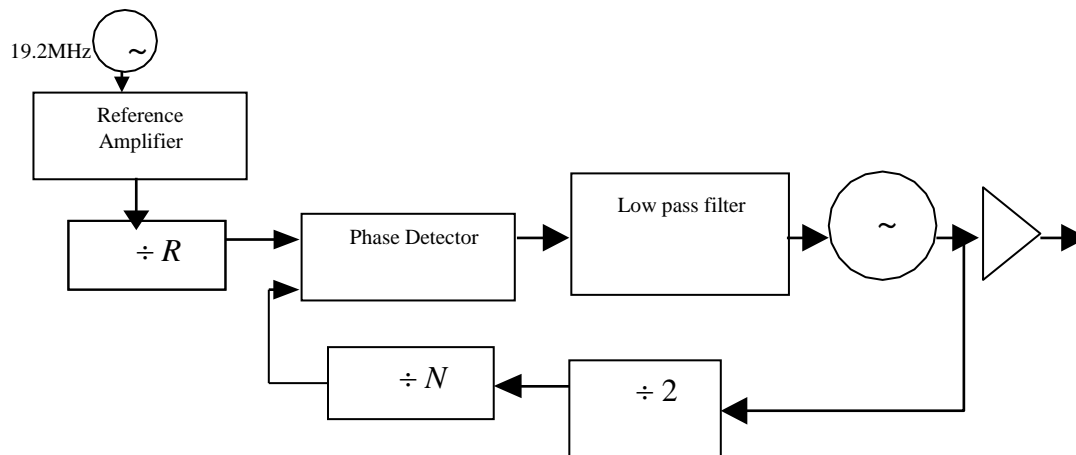


Fig.2. RF synthesizer

Temperature Compensated Crystal Oscillator (TCXO) clock enter to phase locked loop generates a carrier signal in frequency variety of 2.three ~ 2.5 GHz. two values R and N of inner sign in can be used to change a frequency. An output frequency is fed returned and in comparison with a reference frequency for greater correct provider sign. The reference frequency is divided by using R and the divided frequency is split again by means of 2N. The resulting clock inputs to segment detector. The phase detector computes a difference of two

frequencies to generate a pulse. The generated pulse is handed thru a low skip filter and converted into voltage. Then the transformed voltage inputs to the VC port of RF1 to generate an output radio frequency [3].

#### B) QUADRATURE MODULATOR AD8346

The AD8346 is silicon RFIC I/Q modulator for use from zero. Eight GHz to two.5 GHz. Its extremely good segment accuracy and amplitude stability permit high performance direct modulation to RF. Modulator generates a signal orthogonal to receiving carrier sign from RF synthesizer. Then, multiplies two analog alerts coming from I and Q channels by means of two orthogonal provider indicators, respectively.

#### B. RECEIVER

The DSP processor drives the receiver RF synthesizer (Si4136) to generate a provider signal. Receiver RF synthesizer is identical as transmitter one. The received signal at RX antenna enters RF demodulator (AD8347). The RF demodulator generates an orthogonal signal to a provider sign coming from

The RF synthesizer, and multiplies each of these two carrier sign by a acquired signal. Elevated alerts are separated into I and Q channels. After that separated I and Q alerts are converted into digital statistics the use of ADC (AD9281) converter, which is eight bit ADC. The resulting virtual statistics is saved at the CPLD information sign in known as IQDAT. The DSP reads statistics from the CPLD register. The CPLD check in RXADJ is used to change a using voltage on the VC port of the receiver TCXO. Exchange in voltage reasons change in an input clock of RF synthesizer and in service frequency [3].

#### A) QUADRATURE DEMODULATOR AD8347

The AD8347 is a broadband direct quadrature demodulator with RF and baseband automatic advantage manage (AGC) amplifiers. it is appropriate for use in lots of communications receivers, performing quadrature demodulation directly to baseband frequencies. The enter frequency range is 800 MHz to two.7 GHz. It generates signal orthogonal to incoming carrier after which two orthogonal carrier indicators increased to incoming RF sign. It generates I and Q channel output indicators, respectively.

### IV. MATHEMATICAL MODELLING

#### A. BPSK Transmitter

BPSK is the digital modulation method in which section of service sign changes in line with enter binary information sign. Transmitter segment modulates the signal using BPSK approach and transmits through transmitting antenna as given in (2). feet is the trasmitter provider frequency.

$$S(t) = A \left\{ m_I(t) \cos(2\pi f_c t) + m_Q(t) \cos(2\pi f_c t - \pi) \right\} \quad (2)$$

wherein,  $S_m(t)$  is the BPSK modulated message signal,  $A_T$  is amplitude of modulated sign,  $m_I(t)$  and  $m_Q(t)$  are quadrature shifted components.

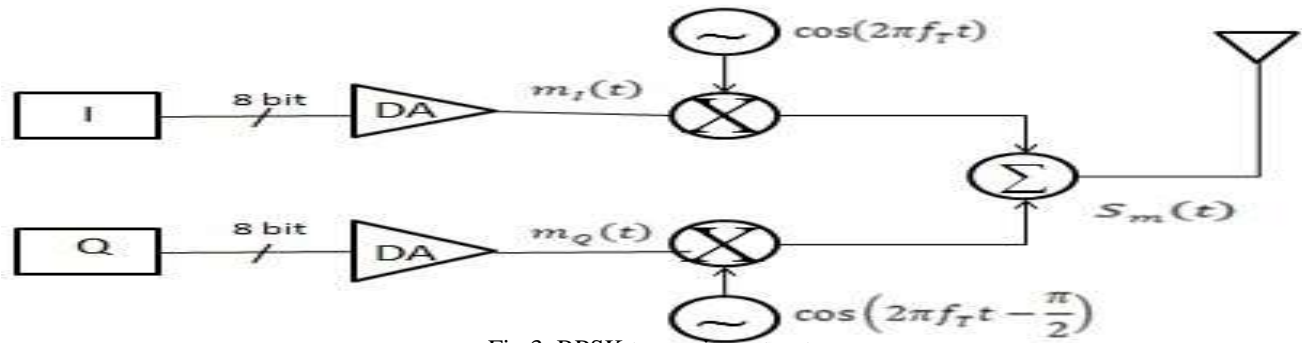


Fig.3. BPSK transmitter structure

**B. BPSK RECEIVER**

Coherent detection is used for demodulation.

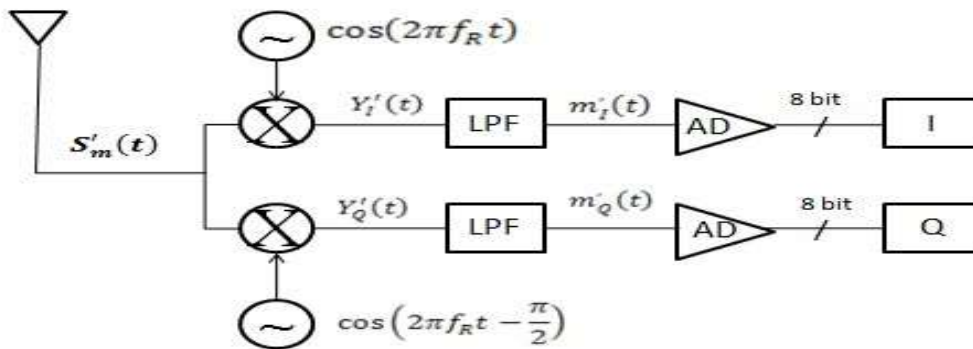


Fig. 4. BPSK receiver structure

**V. software program INTERFACE**

Code Builder is a compiler that lets in the user to put in writing code, compile/hyperlink, debug, execute on DSP famous person personal board and manipulate the hardware. The Code Builder also presents environments for code technology and a number of gear C supply smash point, symbol view, watch window, disassembly view, memory view, edit, reproduction, fill, sign in view, flash memory examine/write, and graphical view that assist the consumer debug the programs and manage the hardware [4].

**A. Reception of RF provider sign(2.4 GHz)**

sets of DSP star hardware with RF antenna, one set as transmitter and other as receiver is used. At transmitter set pllN to 120000, pllR to 1920 and Kp to a few. At receiver side we use frequency tuning, for different frequency tuning time graph of received sign are shown in determine five and 6.

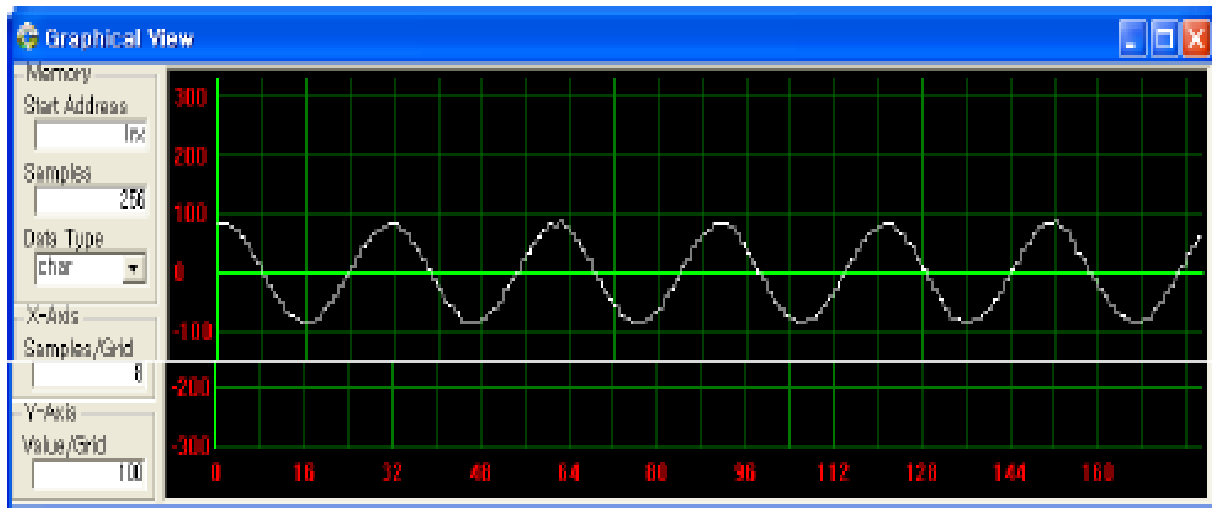


Fig. 5. Time graph of received data after frequency tuning at 20 KHz

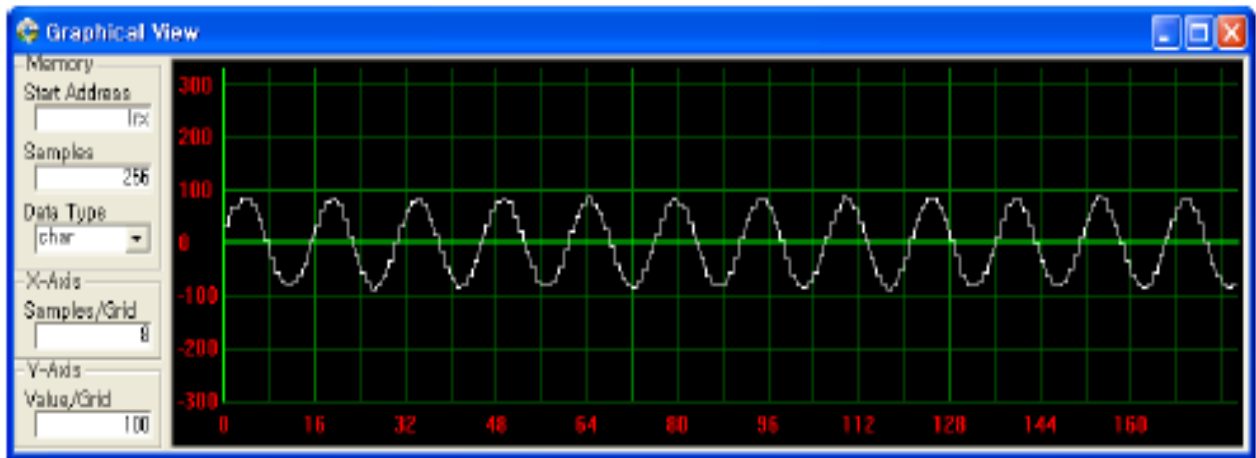


Fig. 6. Time graph of received data after frequency tuning at 40 KHz

## B. BEST TUNING OF RECEIVER SERVICE

We will best tune a receiver provider frequency by way of selecting foremost cost of RXADJ sign in such that frequency difference between two modules is minimised.

Waveforms for extraordinary values of RXADJ are as proven in determine 7. for 2.4 GHz provider we get exceptional tuning at cost 15 of RXADJ sign in.

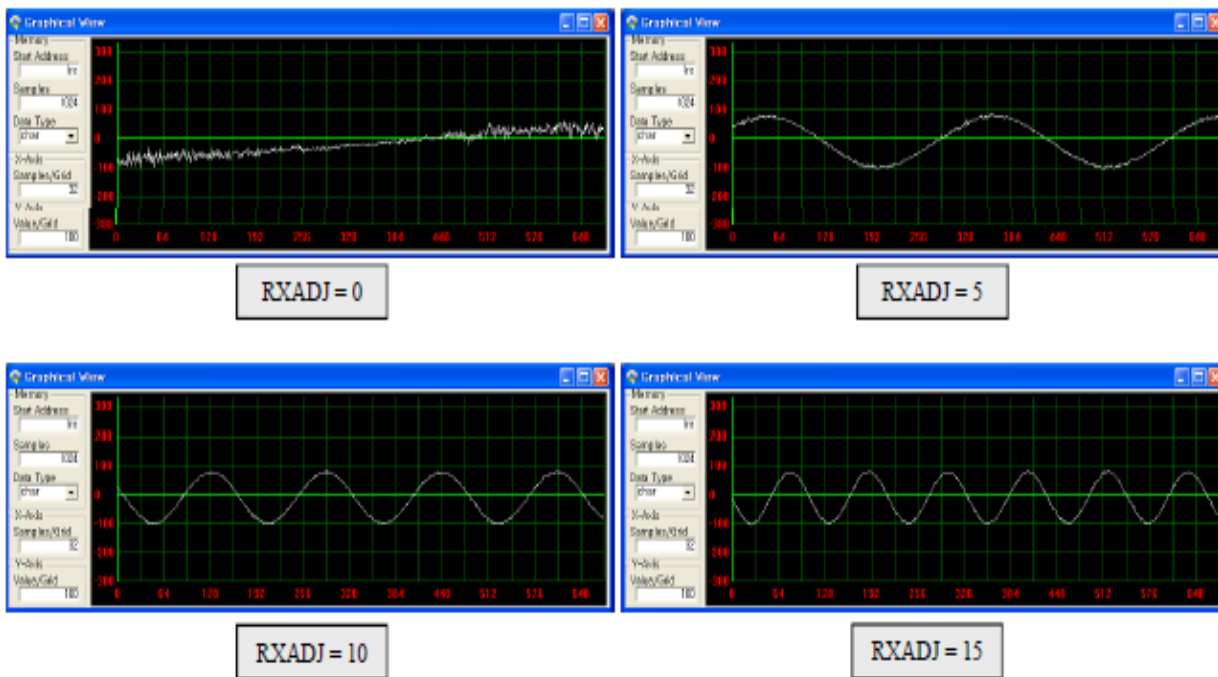
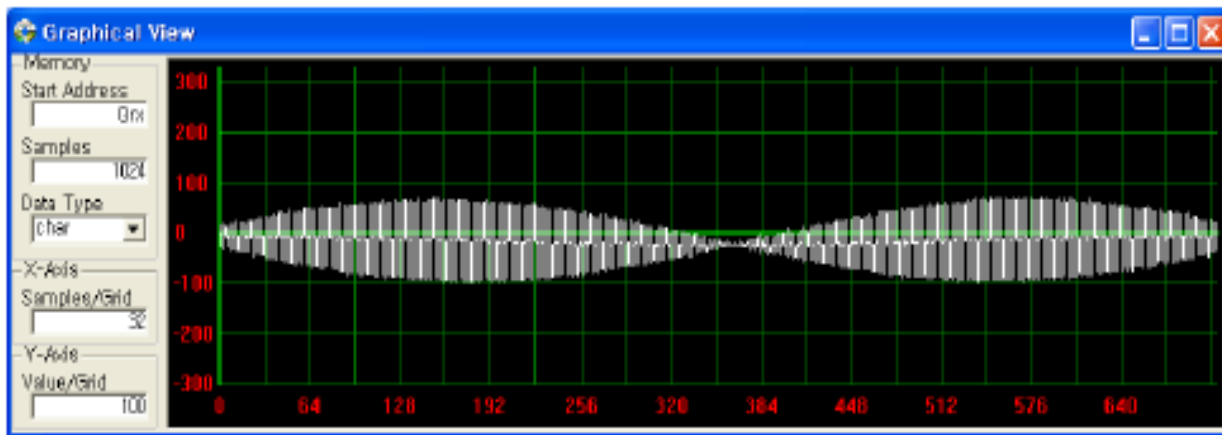


Fig. 7. Change in waveforms according to RXADJ register

C. Reception of BPSK signal

Records is binary in BPSK and segment of carrier signal vary consistent with data cost. Coherent detection is used for demodulation. Acquired BPSK sign graph is as proven in parent 8.

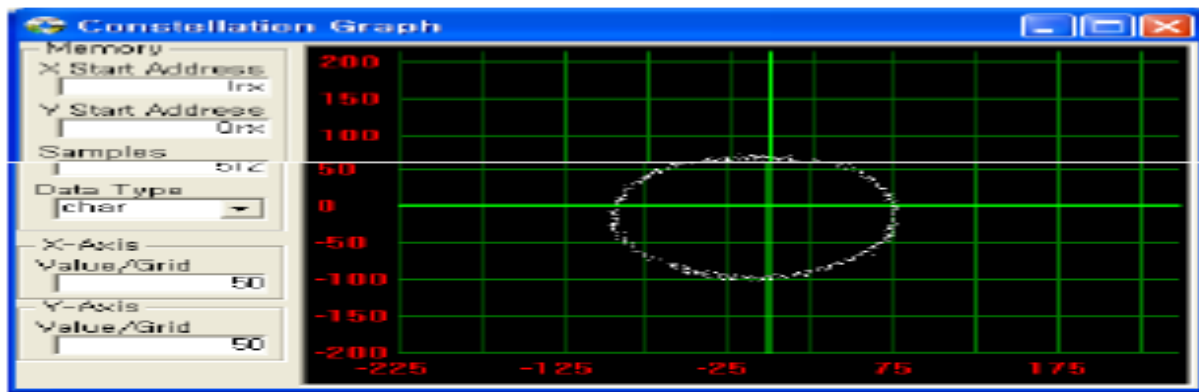


111Fig. 8. Received BPSK signal

D. Constellation Diagram for obtained BPSK signal

A constellation diagram represents a virtual-modulated sign in a -dimensional complex plane. Modulated carrier  $S_m(t)$  is divided into in-phase (I) and quadrature (Q) additives, expressed as complex sign.





Before  
Compensation

Fig. 9. Constellation diagram before compensation

On x-axis I additives and y-axis Q components are offered. signal constellation rotates because of service synchronization among boards. Offset of obtained sign is because of AD8347 demodulator and AD9281 advert converter. After compensating offset we get optimized effects. Before and after compensation graphs are as shown in figure 9 and 10 respectively.

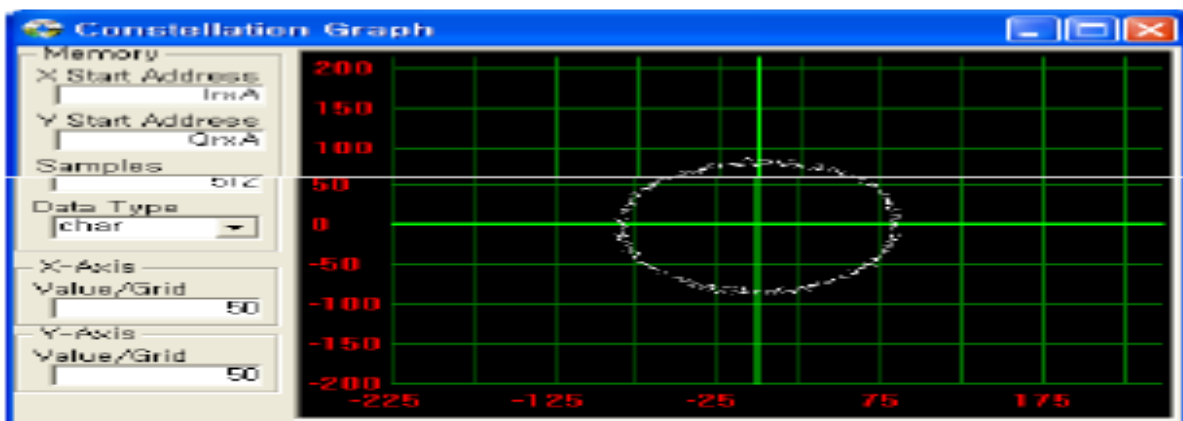


Fig. 10. Constellation diagram after compensation

## Conclusion

This paper has supplied an alternative answer for RF conversation the usage of DSP celebrity non-public board and plugged in RF module. RF verbal exchange does now not require direct transmission course as IR. This paper has provided extensive evaluation of RF wireless communicate the usage of DSP processor. Floating factor DSP processor reduces basic computation time, device complexity and enhances performance of device with accelerated reliability. using DS/SS -BPSK modulation method we will make communication extra at ease.

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