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Research Paper

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Designing Handheld Programmer for Controlling the Parameteres on Two Channel Data Generator

Jyothsna.Undrakonda — M.E final year Student, college of Engineering, Andhra University, Visakhapatnam

Prof.Yenamandra. Gopala Rao — Professor in Department of Electronics & Communication Engineering, College of Engineering, Andhra University, Visakhapatnam

ABSTRACT

A hand held programmer for a two channel data generator development is the main goal of this paper. The controlling of the parameters of the two channel data generator can be done by using the handheld programmer. Texas Instruments MSP 430 series Mixed Signal Microcontroller, RF system (transceiver unit) and a Pulse Generator with amplifying and switching units (Electronic Device) be contained in Handheld unit. Through chip antenna the signal transmission is done in between the handheld and pulse generator. The handheld device is programmed to depicted pulse characteristics of a pulse generator that can be controlled by pressing the dedicated keys on the hand held device. Command from the microcontroller through RF system (transceiver unit) via Chip antenna reaches the pulse generator when we press keys on the hand held device as it is completely a dedicated handheld device for the particular Pulse generator. According to the Key pressed on the handheld device, the command alternates the pulse Characteristics. Embedded 'C' program is the programming language that is used in development of handheld unit for two channel data generator.

INTRODUCTION

Electronics deals with electrical circuits that involve active electrical components such as vacuum tubes, transistors, diodes and integrated circuits, and associated passive interconnection technologies. In this paper we are going to propose a hand held programmer for two channel data generator for controlling parameters of electronic device using wireless hand held device in which RF communication between handheld device and electronic device (pulse generator) is established. The device includes a ultra low power mixed signal Microcontroller (MSP430F169) and an ultra low power RF Transceiver (CC2500) adding with few passive components.

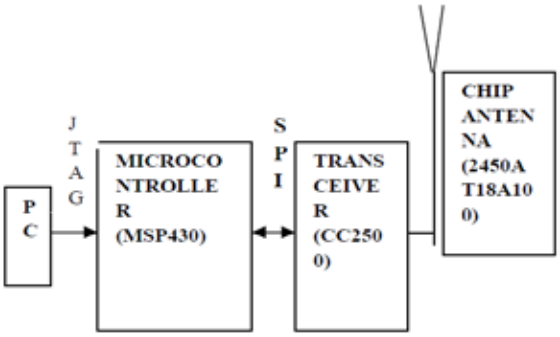

Fig.1: Micro controller & transceiver interface

By pressing some dedicated keys the wireless communication plays important role for controlling some parameters.

Considering the above example the microcontroller (MSP430) is interfaced with transceiver (CC2500) by using Synchronous Peripheral Interface (SPI) Protocol and Universal Asynchronous Receive / Transmit (UART). Initial microcontroller is connected with PC through JTAG with MSP-FET430 debugger. Wireless handheld device is interfaced with electronic devices like pulse generator. Signal transmission between handheld unit and Pulse generator unit is through chip antenna (2450AT18A100), which has frequency range 2400-2500 MHz and operating temperature range -40c to 85c with good gain and radiation diversity performance.

CONCEPT OF INTERFACING

Interfacing Steps:

For interfacing we used below devices along with wireless handled device.

1. Texas Instruments MSP 430 series Mixed Signal Microcontroller
2. RF system (transceiver unit-CC2500)
3. Pulse Generator with amplifying and switching Circuits (Electronic Device).

- Programming language used in development of handheld unit for two channel data generator is Embedded C program.
- The programming is done in IAR embedded workbench. Program code is debugged using MSPFET 430 debugger.

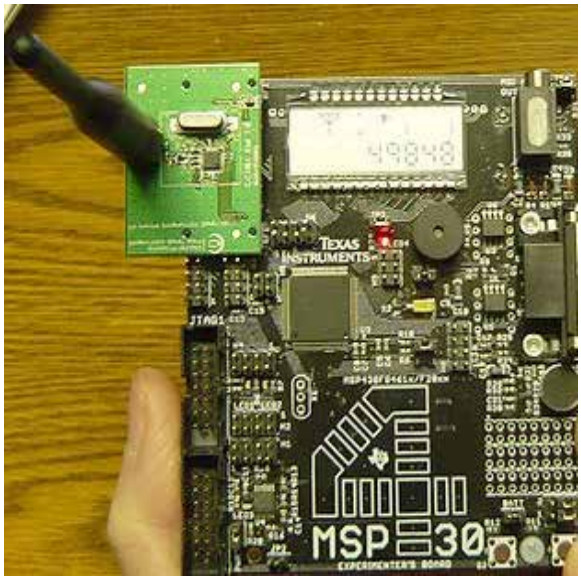

Fig.2: MSP430-experimenter board

Interfacing Procedure:

Handheld device is connected to MSP-FET 430 debugger for dumping the code. Chip antenna is used for the signal transmission between the handheld and pulse generator. By pressing the dedicated keys on the hand held device the described pulse characteristics of a pulse generator can be controlled. So when pressing keys on the handheld device the command from the microcontroller through RF system (transceiver unit) via Chip antenna reaches the pulse generator. This command varies the pulse Characteristics like (Amplitude, Pulse width, Pulse rate) according to the Key pressed on the handheld device. By this way the parameters like amplitude, pulse width and pulse amplitude are varied within the ranges as given below Fig.3. Simple by pressing dedicated keys Wireless handheld device also allows the user to turn the pulse generator ON/ OFF.

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PROGRAMMABLE PARAMETERS (PROG1 & PROG 2)	VALUES
Pulse amplitude	0-10.5v(0.1steps) [105] 0-6.35v (0.05steps)[127]
Pulse width	60,90....420,450used[14]
Pulse Rate	3 to 250 pps [66] Values

Fig.3: Programmable parameters table

ARCHITECTURE OF HANDHELD DEVICE
The Handheld unit mainly consists of an MSP430F169 device and external peripherals as shown in the block diagram below.

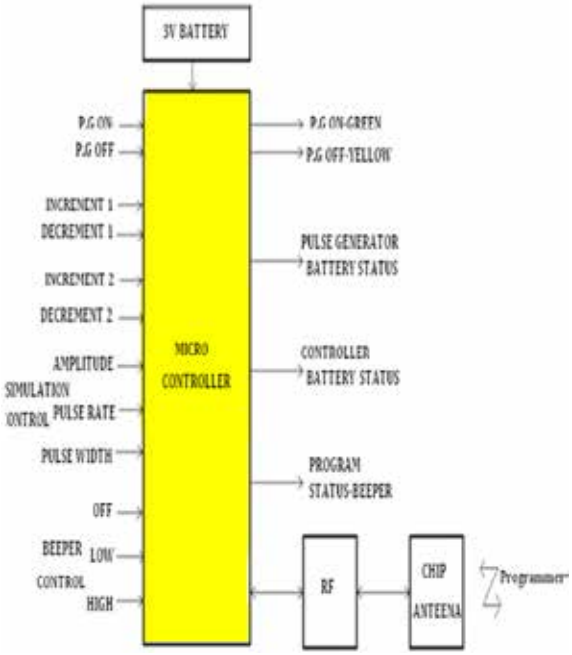

Fig.4: Handheld Unit Block Diagram

Below are the units that are present in the above handheld block diagram.

Micro controller section:
Micro controller performs the below actions.
1. Powering the device
2. Crystal
3. Digital I/O

Where,
Powering the device requires +3.3 V DC supply. Voltage can be applied either internally (via JTAG) or externally. Applying both the voltages will damage the system. A Hardware jumper is provided to overcome this problem so that only one voltage at a time can be used.

A 32.768 KHz watch crystal is provided to generate the basic clock. The micro controller has a provision to get different clocks.

MSP430 devices have up to 6 digital I/O ports implemented, P1 - P6. Each port has eight I/O pins. Every I/O pin is individually configurable for input or output direction, and also can be individually read/write. Ports P1 and P2 have interrupt capability. Each interrupts for the P1, P2 I/O lines can be individually enabled and configured to provide an interrupt on a rising edge or falling edge of an input signal. All P1 I/O lines source a single (first) interrupt vector, and all P2 I/O lines source a second interrupt vector. Which includes.

a) Independently programmable individual I/Os with any input/output combination.
b) Individually configurable for ports P1 and P2 with interrupt.
c) Independent input and output data registers.

Keypad section:
Keypad consists 6 tactile switches interfaced to the micro controller. All the switches are connected using SN74LV14A (Hex Schmitt-Trigger Inverter). The output of the key is '0' when no key is pressed and '1' when any key is pressed. The input from the key is read by the micro controller. When a pin is configured as input it is observed that the pin is READ only accordingly the register setting is to be done (either 0 or 1).

LED's and Buzzer:
MSP is interfaced with LED'S and a buzzer. Default output for both led's and buzzer is zero. LED can be Set/Reset via software. Buzzer can also be made on/ off using software.

MAX 232:
TI MSP has internal UART module but require an external MAX-232(level converter) to communicate with PC. A level converter is interfaced to the UART pins of the micro controller.

RF section:
RF section consists of a CC2500 RF device used to generate 2.4 GHz. This device is interfaced to the micro controller using SPI protocol. Commands can be sent and response can be received from the device.

Fig.5: The inner view of Handheld Device

IMPLEMENTATION & TECHNIQUES
MSP430F169:
We used MSP430F169 as an application for the microcontroller. The Texas Instruments MSP430 family of ultra low power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low power modes is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digital controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 6ms. The MSP430F169 microcontroller configurations with two built-in 16-bit timers, a fast 12-bit A/D converter, dual 12-bit D/A converter, one or two universal serial synchronous/asynchronous communication interfaces (USART), I2C, DMA, and 48 I/O pins. Typical applications include sensor systems, industrial control applications, hand-held meters, etc.

CC2500:

The new CC2500 RF transceivers from Texas Instruments are the industry's lowest system cost, multi-channel radios for low-power wireless applications. Operating in the 2.4 GHz (CC2500) and sub-1 GHz (CC1100) frequency bands, the devices include several useful digital features like full packet handling, FIFO buffers, clear channel assessment, wake-on-radio and more.

Using IAR embedded Workbench version 5.4.6 we can dump the code into MSP430F169. The PC is connected to the Microcontroller (PCB board/handheld unit) through the MSPF-ET Debugger unit. The MSP-FET debugger is connected to the MSP430F169 microcontroller through JTAG pins. The Graphical User Interface (GUI) is created for the front end application of handheld to modify the settings from the transmitter by using Visual Basic 6.0. The application program initializes UART0 in SPI mode in data simulation unit and establishes communication with CC2500 through SPI. Micro controller initializes the CC2500 by filling its configuration registers for required settings. Here dummy data from CC2500 is ignored.CC2500 is initialized in low power and interrupt mode, where interrupt is generated on its GDO pins. After CC2500 initialization, DACs and ADCs are initialized for data simulation and feedback measurement, battery voltage monitoring. Timer A is initialized in interrupt mode so as to generate interrupt for every 30microseconds.This time is used for controlling pulse width and pulse rate of simulated data. Then program enters into infinite loop with preset values of simulated data.

The transmitting (TX) unit is programmed in the same manner as data simulation unit except for initialization of ADCs and DACs, which are not required for control unit. UART1 is initialized in serial communication mode at 9600baud rate for communication with PC based GUI developed in Visual Basic. Each command starts with "$" and ends with "%" and command data is four Bytes for identifying different commands. The commands received from GUI will be transmitted by transmitter in low power mode. The received command generates interrupt, which wakes up the micro controller from low power mode. The command will be processed and decoded. Based on the command data simulation will be varied for pulse width, amplitude and rate. The total program is implemented in low power mode in addition to low power consumption of MSP430F169 and CC2500.

DESIGNING OF TRANSMITTER AND RECEIVER

Based on keys from handheld unit transmitter receives command and after checking the validity of commands transmits via CC2500 and waits for receive acknowledgement from receiver unit for confirmation of command reception.

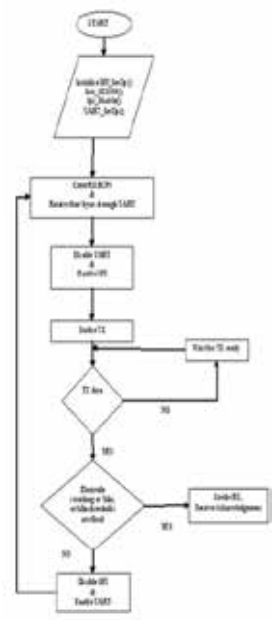

Fig.6: Graphical Representation of Transmitter

Based on keys from handheld unit Receiver unit processes the commands received for their validity and then decodes the commands for identifying action to be performed i.e. varying pulse width, amplitude and pulse rate of simulated data.

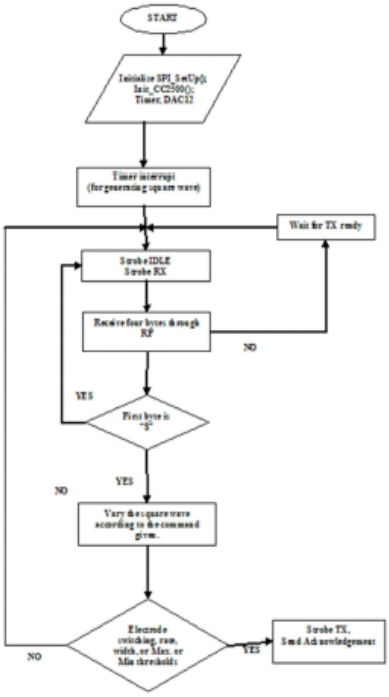

Fig.7: Graphical Representation of Receiver

APPLICATION AREAS

These devices can be used in various areas among which below are some of the examples.

1. Majorly used at pulse stimulation in medical applications such as continuous stimulation at prescribed amplitude & pulse rate at affected areas of human organs. This circuit provides long battery life as it uses ultra low power microcontroller (MSP430F169) & low power RF communication chip (CC2500) and also consumes ultra low power in the order of milli watts, which best suites medical application and robotic applications.
2. In aerospace & defense application to calculate precise wireless control of digital motors. Ultra low power communication between transmitting unit & controlling circuit like controlling large machines from some distance where a person cannot reach the machine. Ultra low power wireless applications where battery life requirement is long such as remote control for cars & other vehicles.

RESULTS

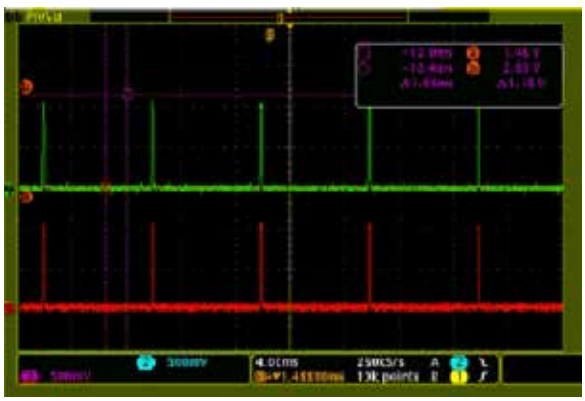

Fig.8: Output waveform at DAC 0, DAC 1 (A, R, W FOR 2 channels)

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CONCLUSION

For two channel data generator the handheld programmer is developed for controlling the parameters like amplitude , pulse rate and pulse width of an electronic device (pulse generator) using wireless handheld device. MSP430F169 ultra low power mixed signal microcontroller and CC2500 low power RF transceiver are present in between the wireless communication of handheld device and pulse generator. By sending the commands from the Transmitter (handheld unit), we can control the receiver (pulse generator).The commands are sent by the Transmitter to the receiver through chip antenna, the operation performed by the receiver according to the given commands like variable amplitude, pulse width and pulse rate. We can also turn pulse generator ON and OFF by using this handheld unit. So for wireless communication and ultra low power applications like medical implant devices and robotic applications, this handheld unit is used.

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