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Spec No: 002-04435

Spec Title: AN204435 - Application Of PWM For FM3 Microcontroller Simulator

Replaced by: None

AN204435

Application Of PWM For FM3 Microcontroller Simulator

Target Products: Refer to section 2

This document introduces a sample application program of sound input/output by PWM, for Cypress FM3 microcontroller simulator

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1 Preface

Greatly appreciation from Cypress for your continued use of our semiconductor products.

This document introduces a sample application program of sound input/output by PWM, using Cypress FM3 microcontroller simulator (fm3sim)

FM3 Microcontroller unit (MCU)'s model number：MB9BF516R

2 Target Products

The sample application works properly in the following Cypress MCUs.

(TYPE0)

Series	Part Number (without package suffix)
MB9B100A	MB9BF102NA,MB9BF104NA,MB9BF105NA,MB9BF106NA MB9BF102RA,MB9BF104RA,MB9BF105RA,MB9BF106RA
MB9B300B	MB9BF304NB,MB9BF305NB,MB9BF306NB MB9BF304RB,MB9BF305RB,MB9BF306RB
MB9B400A	MB9BF404NA,MB9BF405NA,MB9BF406NA MB9BF404RA,MB9BF405RA,MB9BF406RA
MB9B500B	MB9BF504NB,MB9BF505NB,MB9BF506NB MB9BF504RB,MB9BF505RB,MB9BF506RB

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(TYPE1)

Series	Part Number (without package suffix)
MB9A110A	MB9AF111LA,MB9AF112LA,MB9AF114LA MB9AF111MA,MB9AF112MA,MB9AF114MA,MB9AF115MA,MB9AF116MA MB9AF111NA,MB9AF112NA,MB9AF114NA,MB9AF115NA,MB9AF116NA
MB9A310A	MB9AF311LA,MB9AF312LA,MB9AF314LA MB9AF311MA,MB9AF312MA,MB9AF314MA,MB9AF315MA,MB9AF316MA MB9AF311NA,MB9AF312NA,MB9AF314NA,MB9AF315NA,MB9AF316NA

(TYPE2)

Series	Part Number (without package suffix)
MB9B110T	MB9BF116S,MB9BF117S,MB9BF118S MB9BF116T,MB9BF117T,MB9BF118T
MB9B210T	MB9BF216S,MB9BF217S,MB9BF218S MB9BF216T,MB9BF217T,MB9BF218T
MB9B310T	MB9BF316S,MB9BF317S,MB9BF318S MB9BF316T,MB9BF317T,MB9BF318T
MB9B410T	MB9BF416S,MB9BF417S,MB9BF418S MB9BF416T,MB9BF417T,MB9BF418T
MB9B510T	MB9BF516S,MB9BF517S,MB9BF518S MB9BF516T,MB9BF517T,MB9BF518T
MB9B610T	MB9BF616S,MB9BF617S,MB9BF618S MB9BF616T,MB9BF617T,MB9BF618T
MB9BD10T	MB9BFD16S,MB9BFD17S,MB9BFD18S MB9BFD16T,MB9BFD17T,MB9BFD18T

(TYPE3)

Series	Part Number (without package suffix)
MB9A130LB	MB9AF131KB,MB9AF132KB MB9AF131LB,MB9AF132LB

(TYPE4)

Series	Part Number (without package suffix)
MB9B110R	MB9BF112N,MB9BF114N,MB9BF115N,MB9BF116N MB9BF112R,MB9BF114R,MB9BF115R,MB9BF116R
MB9B310R	MB9BF312N,MB9BF314N,MB9BF315N,MB9BF316N MB9BF312R,MB9BF314R,MB9BF315R,MB9BF316R
MB9B410R	MB9BF412N,MB9BF414N,MB9BF415N,MB9BF416N MB9BF412R,MB9BF414R,MB9BF415R,MB9BF416R
MB9B510R	MB9BF512N,MB9BF514N,MB9BF515N,MB9BF516N MB9BF512R,MB9BF514R,MB9BF515R,MB9BF516R

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(TYPE5)

Series	Part Number (without package suffix)
MB9A110K	MB9AF111K,MB9AF112K
MB9A310K	MB9AF311K,MB9AF312K

(TYPE6)

Series	Part Number (without package suffix)
MB9A140NB	MB9AF141LB,MB9AF142LB,MB9AF144LB MB9AF141MB,MB9AF142MB,MB9AF144MB MB9AF141NB,MB9AF142NB,MB9AF144NB
MB9A340NB	MB9AF341LB,MB9AF342LB,MB9AF344LB MB9AF341MB,MB9AF342MB,MB9AF344MB MB9AF341NB,MB9AF342NB,MB9AF344NB
MB9AA40NB	MB9AFA41LB,MB9AFA42LB,MB9AFA44LB MB9AFA41MB,MB9AFA42MB,MB9AFA44MB MB9AFA41NB,MB9AFA42NB,MB9AFA44NB
MB9AB40NB	MB9AFB41LB,MB9AFB42LB,MB9AFB44LB MB9AFB41MB,MB9AFB42MB,MB9AFB44MB MB9AFB41NB,MB9AFB42NB,MB9AFB44NB

(TYPE7)

Series	Part Number (without package suffix)
MB9A130N	MB9AF131M,MB9AF132M MB9AF131N,MB9AF132N
MB9AA30N	MB9AFA31L,MB9AFA32L MB9AFA31M,MB9AFA32M MB9AFA31N,MB9AFA32N

(TYPE8)

Series	Part Number (without package suffix)
MB9A150RA	MB9AF154MA,MB9AF155MA,MB9AF156MA MB9AF154NA,MB9AF155NA,MB9AF156NA MB9AF154RA,MB9AF155RA,MB9AF156RA

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(TYPE9)

Series	Part Number (without package suffix)
MB9B120M	MB9BF121K,MB9BF122K,MB9BF124K MB9BF121L,MB9BF122L,MB9BF124L MB9BF121M,MB9BF122M,MB9BF124M
MB9B320M	MB9BF321K,MB9BF322K,MB9BF324K MB9BF321L,MB9BF322L,MB9BF324L MB9BF321M,MB9BF322M,MB9BF324M
MB9B520M	MB9BF521K,MB9BF522K,MB9BF524K MB9BF521L,MB9BF522L,MB9BF524L MB9BF521M,MB9BF522M,MB9BF524M

(TYPE10)

Series	Part Number (without package suffix)
MB9B120J	MB9BF121J

(TYPE11)

Series	Part Number (without package suffix)
MB9A120L	MB9AF121K,MB9AF121L
MB9A420L	MB9AF421K,MB9AF421L

(TYPE12)

Series	Part Number (without package suffix)
MB9B120T	MB9BF128S,MB9BF129S MB9BF128T,MB9BF129T
MB9B320T	MB9BF328S,MB9BF329S MB9BF328T,MB9BF329T
MB9B420T	MB9BF428S,MB9BF429S MB9BF428T,MB9BF429T
MB9B520T	MB9BF528S,MB9BF529S MB9BF528T,MB9BF529T

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3 Getting Started

This document introduces a sample application program of sound input/output by PWM, for Cypress FM3 microcontroller simulator

Various kinds of timer function are built in FM3 MCU

One of these timers is PWM(*1) which modulates the duty ratio. As a result of conversion of PCM(*2) sound data to PWM's data ratio, it is easy to output sound data

Creating digital sound for various kinds of digital devices (e.g operation sound of digital camera, remote controller (home appliance), sphygmomanometer, low frequency medical treatment device (medical heath care), announcement voice sound of vendor machine (industrial device)) is an import issue to be considered.

The content of the sample application of this document is a system which has a capability to create various kinds of digital sounds.

(*1) Pulse Width Modulation

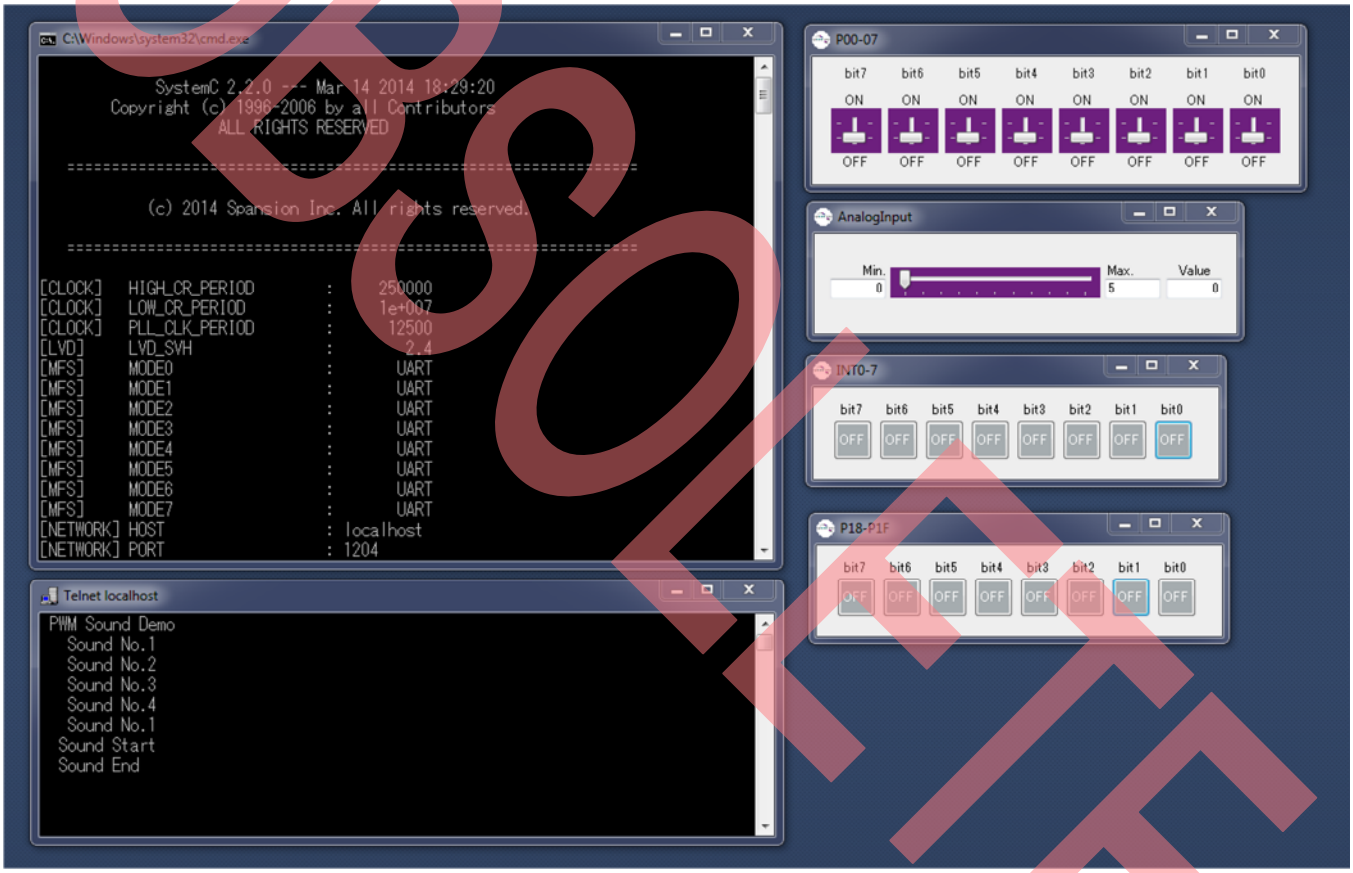
(*2) Pulse Code Modulation

4 Functions of Sample Application

The sample application has the following functions

- Using GUI DIP switches which are connected with FM3 MCU's GPIO pins to output sound wave form created by PWM
- The information of output sound including sound wave form's number as well as start and end of wave form output is displayed on terminal software

Figure 1. Function of Sample Application



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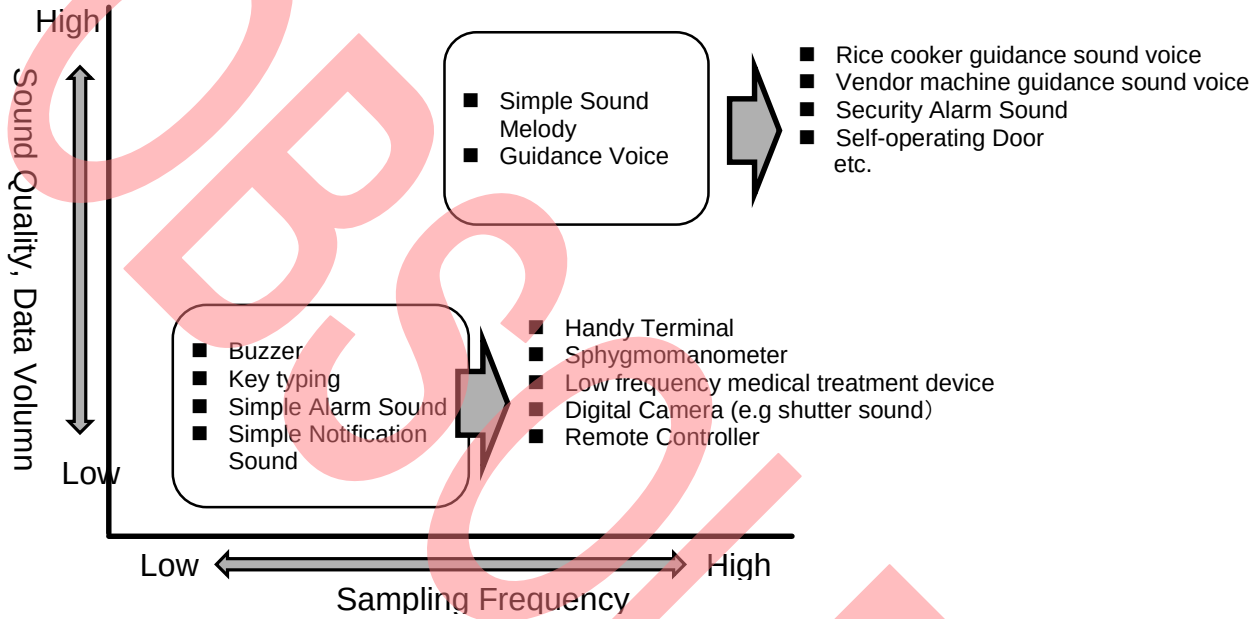
5 Applications

Depends on the sampling frequency, digital sound created by PWM is different, and thus its application is also different.

The relation between sampling frequency and sound quality, data volumn and its application are shown in Figure 2.

Figure 2. Sampling Frequency, Sound Quality, Data Volumn and Sound Applications



The applications of the document's sample program are shown in Table 1.

Table 1. Applications

Application	Detail
Home Appliance	
Digital Camera	Output shutter sound in case of taking a photograph
Remote Controller	Output key typing sound
Rice Cooker	Output guidance voice
Trespass Detection	Output alarm voice in case of detecting any object near the entrance
Medical Health Care Device	
Sphygmomanometer	Output key typing sound
Low frequency medical treatment device	Output key typing sound
Industrial Device	
Vendor Machine	Output Guidance voice of machine operation
Handy Terminal	Output key typing sound, notification sound in case of data reception

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6 How to use sample application

6.1 List of Components

The sample application is used in FM3 MCU simulator environment

The components used in FM3 MCU simulator environment are shown in Table 2. The capture picture of each component is shown in Figure 3 to Figure 8

Table 2. List of components

No.	Name	Executable File	Note
1	FM3 MCU Simulator	fm3sim.exe	FM3 MCU Simulator for MB9B510R series
2	Tactile Switch GUI	TactileSwitch.exe	
3	DIP Switch GUI	DIPSwitch.exe	
4	Analog Input GUI	AnalogInputHor.exe	
5	Terminal Emulator	Commercial Tools	Telnet which can connect to port 1204
6	VCD waveform viewer	Commercial Tools	

Figure 3. FM3 MCU Simulator's Result Display Window

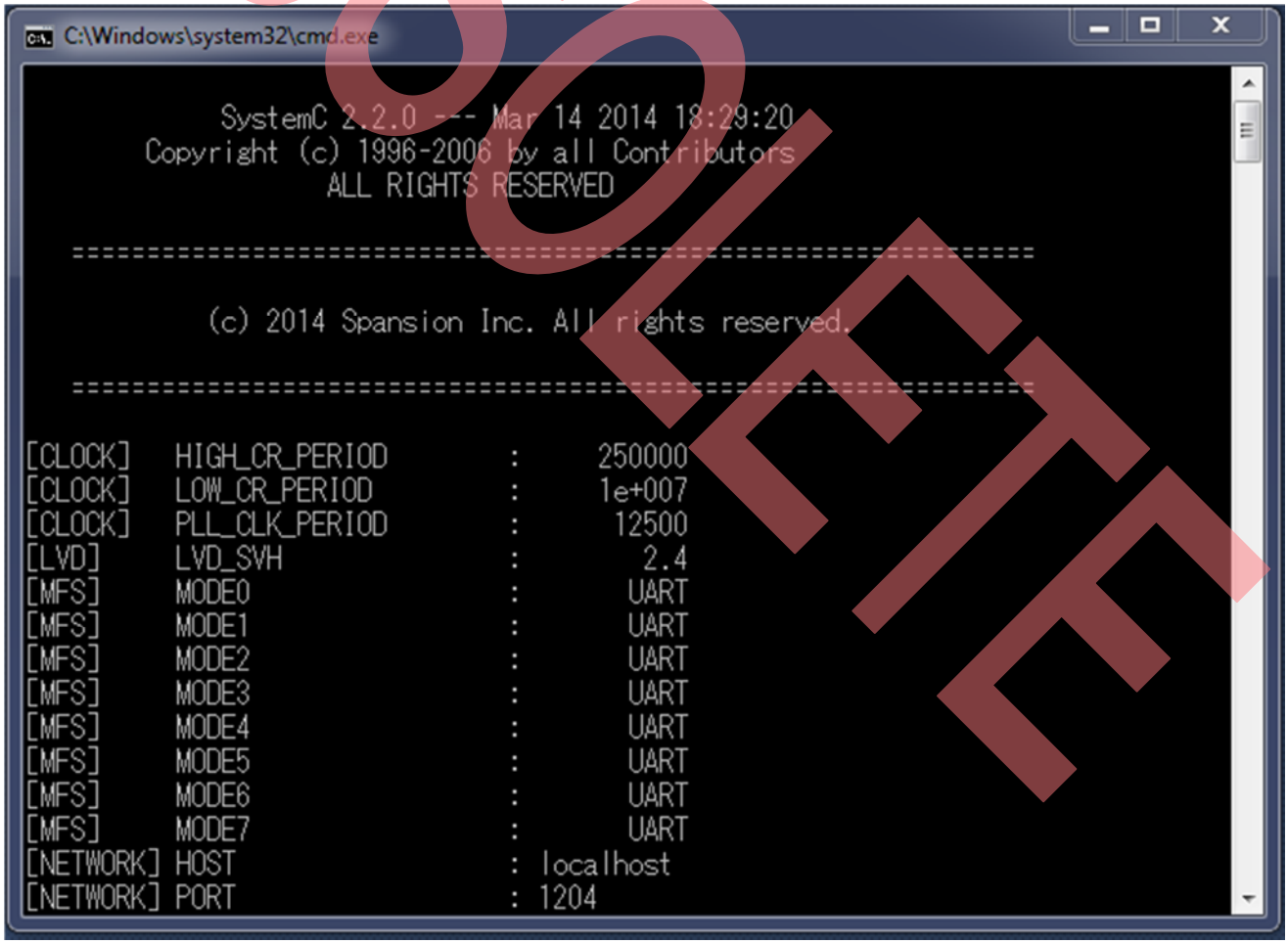

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Figure 4. Tactile Switch GUI



Figure 5. DIP Switch GUI

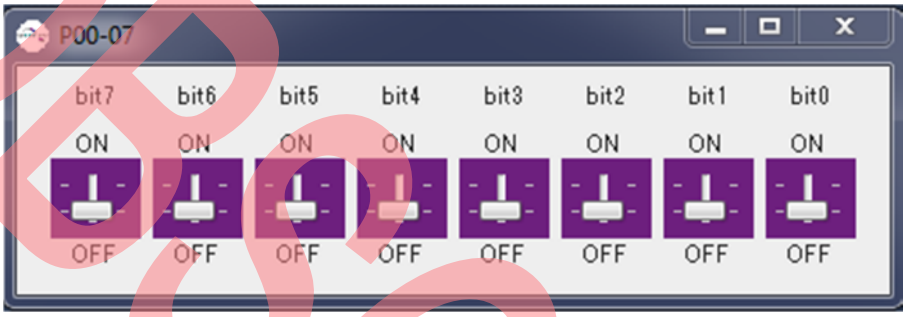

Figure 6. Analog Input GUI



Figure 7. Terminal Emulator



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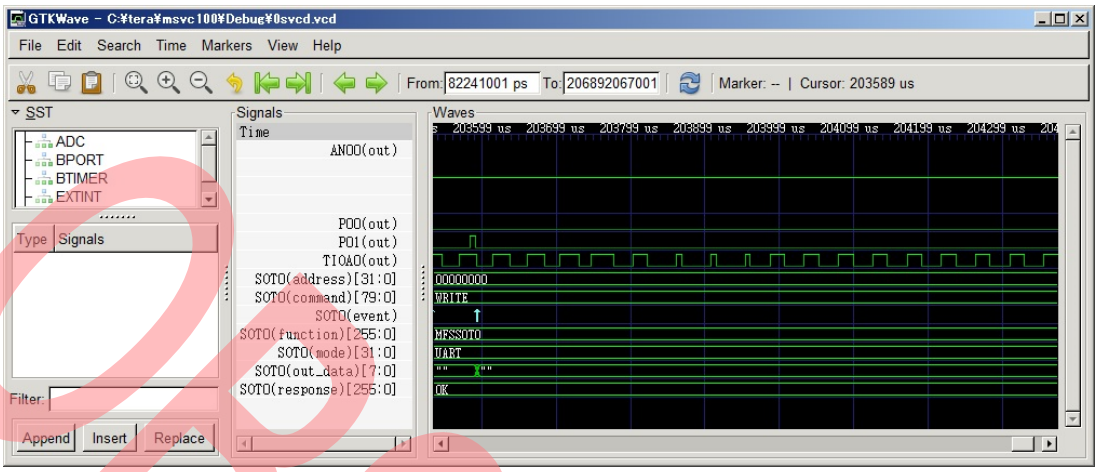
Figure 8. VCD Waveform Viewer



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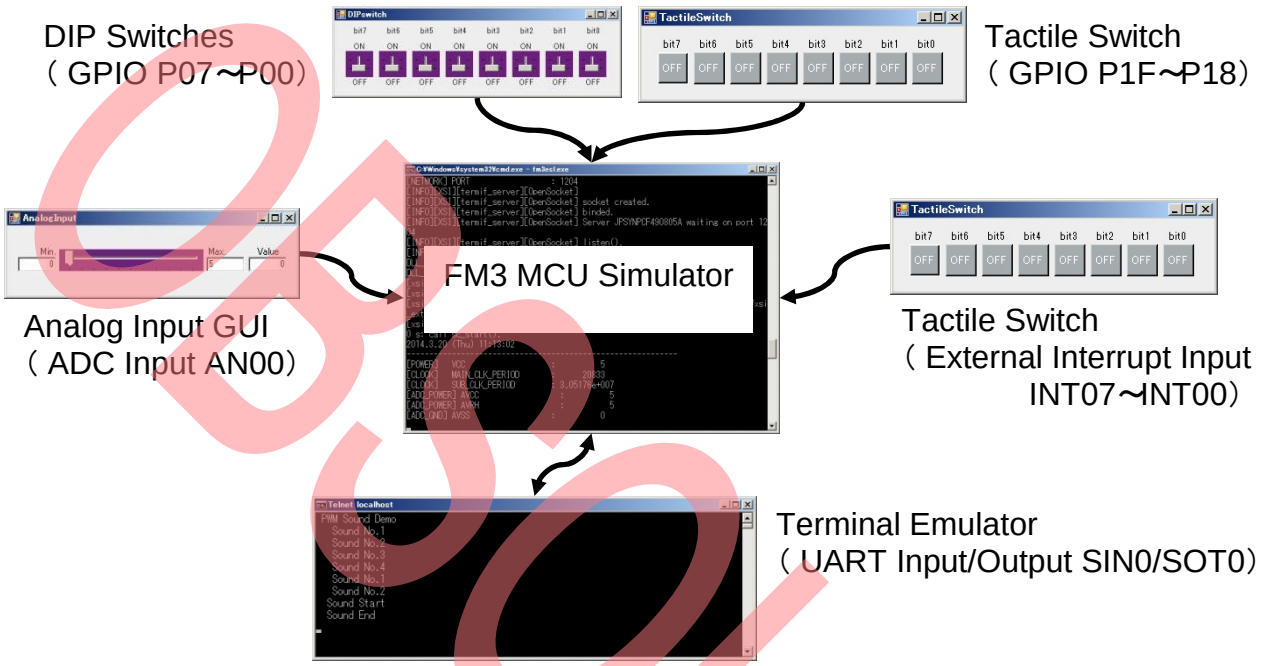
6.2 Connections

The connections inside FM3 MCU Simulator is shown Figure 9.

Figure 9. The connection of GUIs and FM3 MCU Simulator



6.3 Install

Refer to FM3 Microcontroller Simulator for the install instruction.

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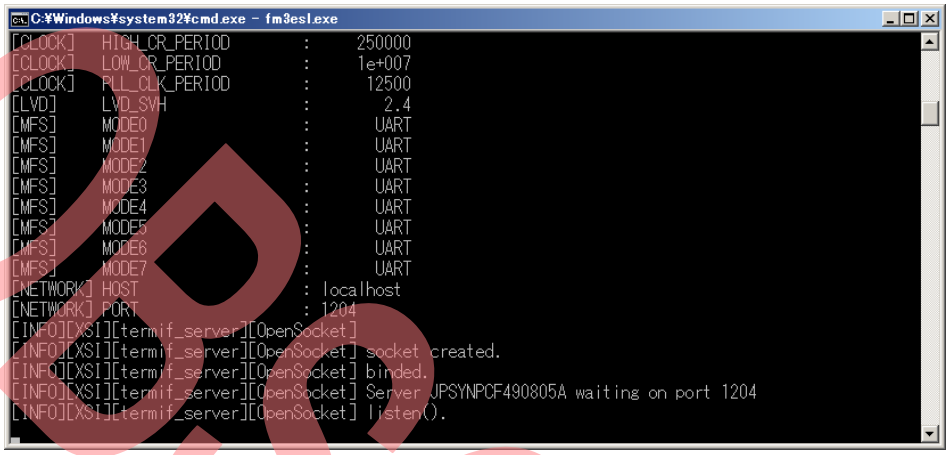
6.4 Operation

6.4.1 Start

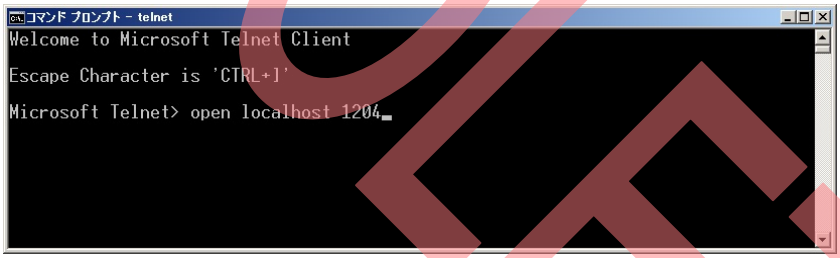
After starting as shown in Figure 10, the simulator will wait for telnet connection.

Figure 10. FM3 simulator after starting



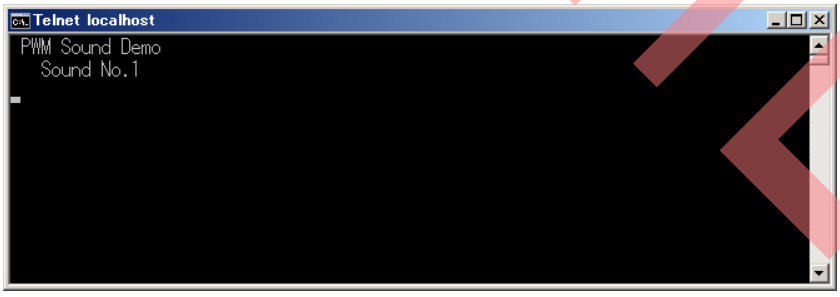
Connect telnet in port 1204

Figure 11. Telnet connection



If the connection with telnet is successful, the window will be shown in Figure 12.

Figure 12. Successful connection with telnet



Sound selection will be available with Sound No.1

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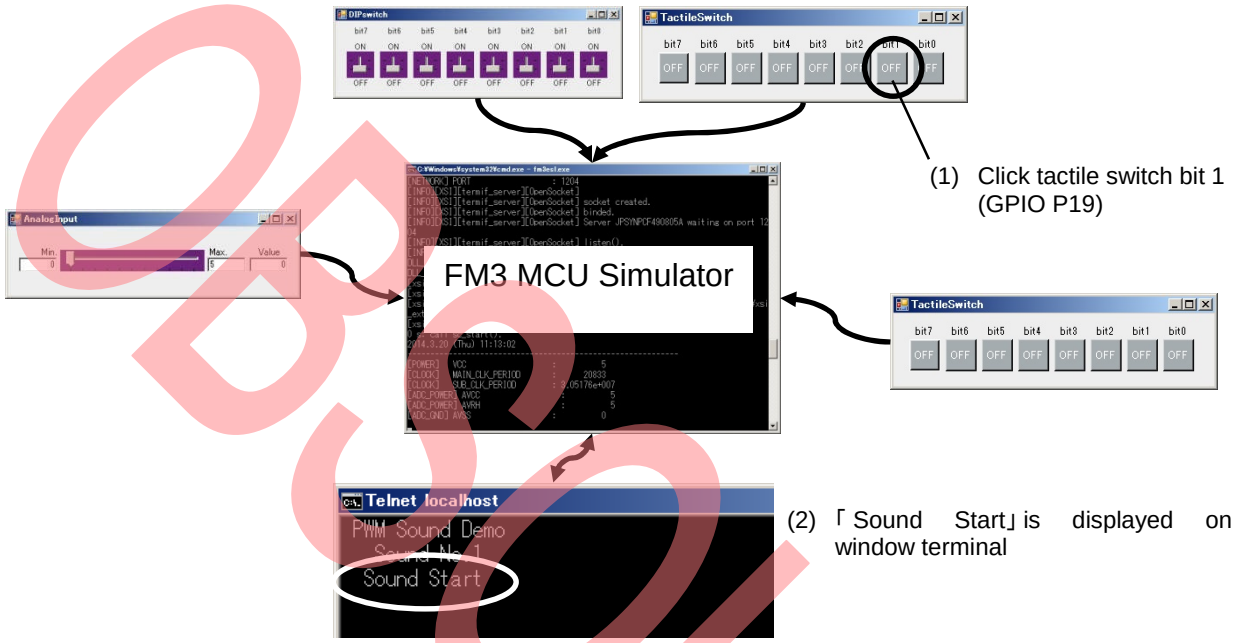
6.4.2 Output Sound

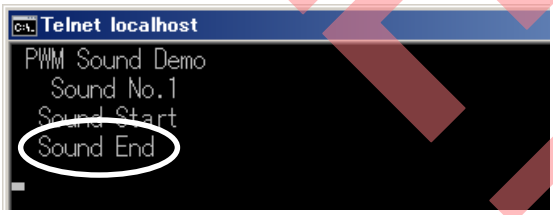
Click tactile switch bit 1 (GPIO P19) to output selected sound (1). Then, message “Sound Start” displayed in terminal window notifies that sound output begins (2)

Figure 13. Operation for Sound Output begins



After sound output finishes, message “Sound End” displayed in terminal widnow notifies that sound ouput finishes

Figure 14. Operation for Sound Output finishes



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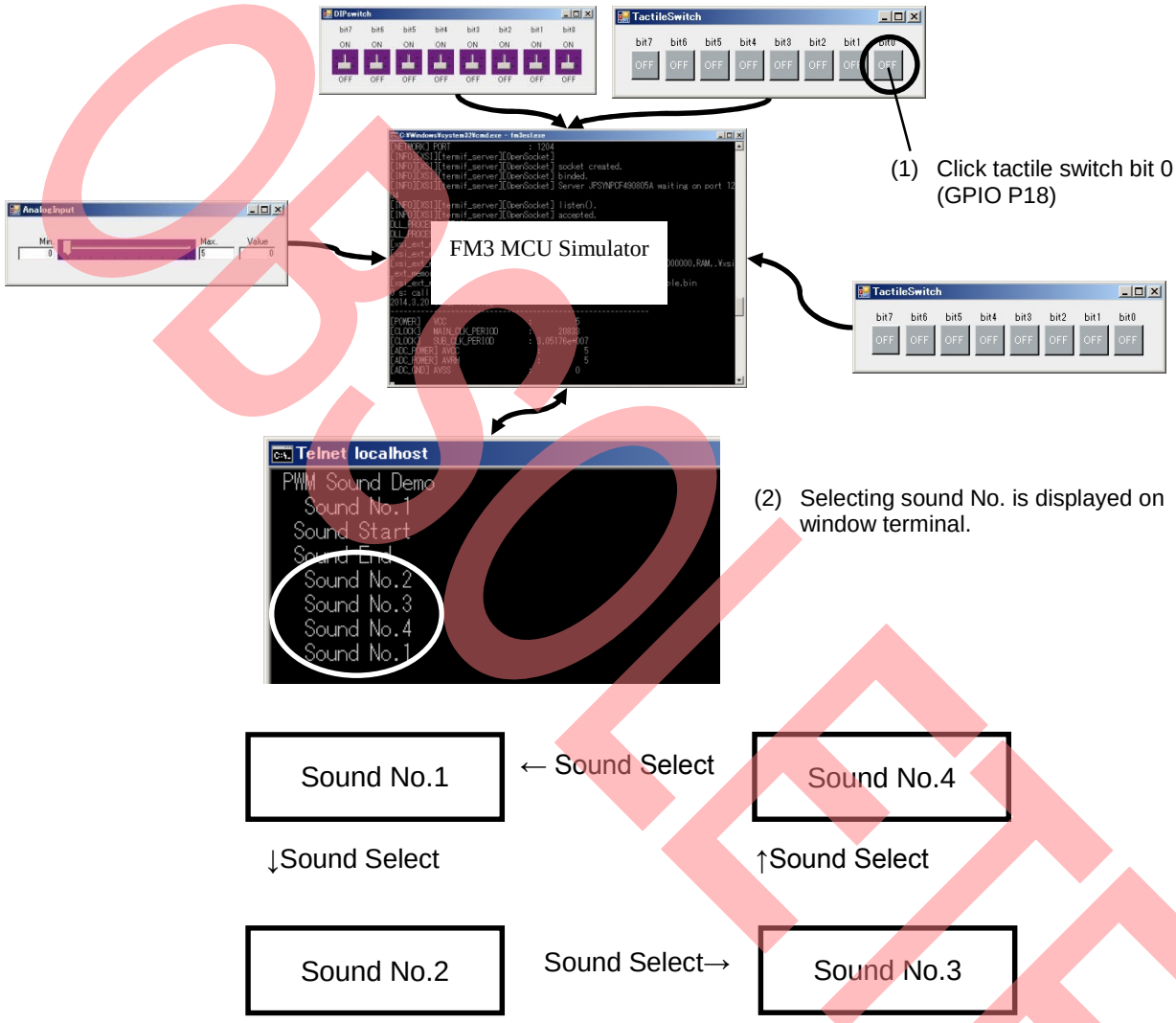
6.4.3 Input Sound

Click tactile switch bit 0 (GPIO P18) to select sound (1). Sound selection order is : Sound No.2 → No.3 → No.4 → No.1. Sound selection result is displayed in terminal (2)

Figure 15. Sound Select



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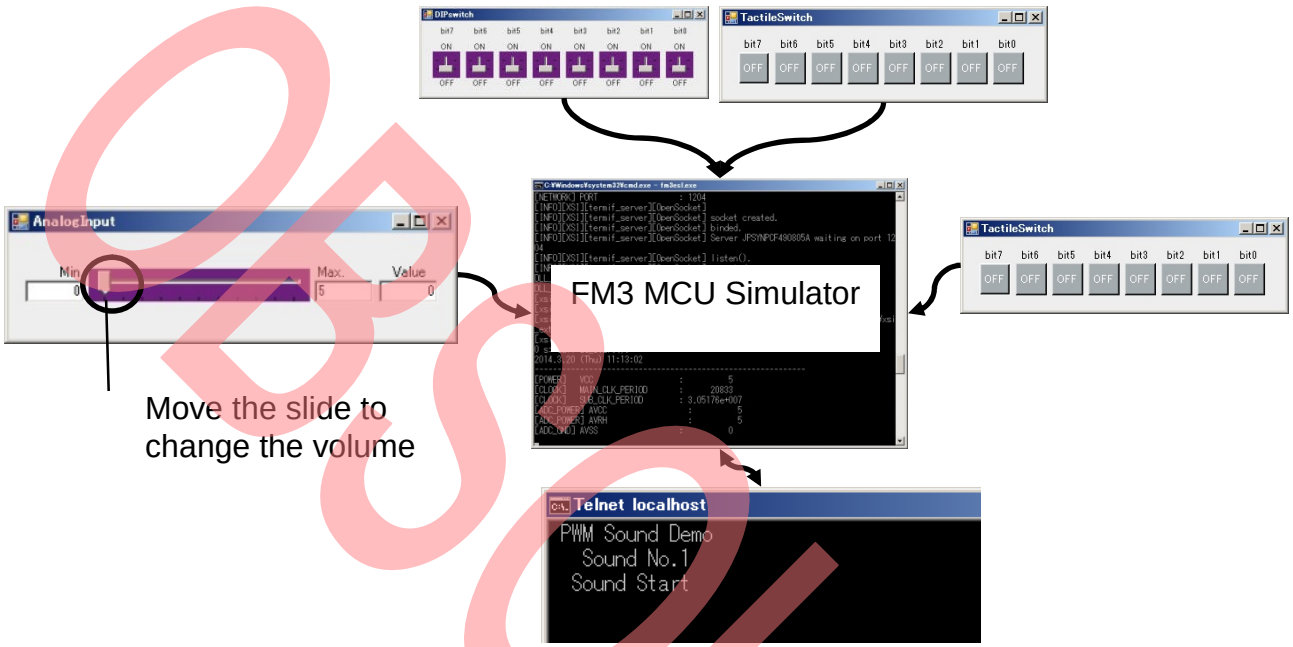
6.4.4 Volumn Tuning

By using the analog slide bar, it is able to tune volum of selected sound. Move the slide from left to right to increase the volumn.

Figure 16. Volumn Tuning



6.4.5 Sound Data

Sound data of 4 sound sources are as follows

- No.1 Jingle（0.5sec）
- No.2 Alarm（0.5sec）
- No.3 Shooting（0.25sec）
- No.4 Phone Ring（0.5sec）

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7 File Structure

File Structure of the sample application is as follows

```
├─common                          : Header file directory
│    mb9b510r.h                   : Peripheral definition header file
│    system_mb9bf51x.c            : system setting source file
│    system_mb9bf51x.h            : system setting header file
│
├─drivers                         : driver directory
│  ├─adc12                        : ADC driver directory
│  │    Adc12Dev.h                : ADC driver global reference header file
│  │    Adc12Dev_FM3.c            : ADC driver source file
│  │    Adc12Dev_FM3.h            : ADC driver local reference header file
│  │
│  ├─btimer                       : Base Timer driver directory
│  │  │  BtDev_FM3.c              : Base Timer driver channel control source file
│  │  │  BtDev_FM3.h              : Base Timer driver channel control header file
│  │  │
│  │  ├─ppg                       : PPG driver directory
│  │  │     PpgDev.h              : PPG driver global reference header file
│  │  │     PpgDev_FM3.c          : PPG driver source file
│  │  │     PpgDev_FM3.h          : PPG driver local reference header file
│  │  │
│  │  ├─pwc                       : PWC driver directory
│  │  │     PwcDev.h              : PWC driver global reference header file
│  │  │     PwcDev_FM3.c          : PWC driver source file
│  │  │     PwcDev_FM3.h          : PWC driver local reference header file
│  │  │
│  │  ├─pwm                       : PWM driver directory
│  │  │     PwmDev.h              : PWM driver global reference header file
│  │  │     PwmDev_FM3.c : PWM driver source file
│  │  │     PwmDev_FM3.h          : PWM driver local reference header file
│  │  │
│  │  └─rt                        : Reload Timer driver directory
│  │        RtDev.h               : Reload Timer driver global reference header file
│  │        RtDev_FM3.c           : Reload Timer source file
```

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```
│ │       RtDev_FM3.h          : Reload Timer local reference header file
│ │
│ └─mfserial                   : MFS driver directory
│   │ MfsDev_FM3.c             : MFS driver channel control source file
│   │ MfsDev_FM3.h             : MFS driver channel control header file
│   │
│   ├─i2c                      : I2C driver directory
│   │   I2cDev.h               : I2C driver global reference header file
│   │   I2cDev_FM3.c           : I2C driver source file
│   │   I2cDev_FM3.h           : I2C driver local reference header file
│   │
│   ├─sio                      : CSIO driver directory
│   │   SioDev.h               : CSIO driver global reference header file
│   │   SioDev_FM3.c           : CSIO driver source file
│   │   SioDev_FM3.h           : CSIO driver local reference header file
│   │
│   ├─spi                      : SPI driver directory
│   │   SpiDev.h               : SPI driver global reference header file
│   │   SpiDev_FM3.c           : SPI driver source file
│   │   SpiDev_FM3.h           : SPI driver local reference header file
│   │
│   └─uart                     : UART driver directory
│       UartDev.h              : UART driver global reference header file
│       UartDev_FM3.c          : UART driver source file
│       UartDev_FM3.h          : UART driver local reference header file
│
└─example                             : Sample Directory
  ├─IAR                       : IAR project file directory
  │ │ mb9bf51xr_pwmout.dep    : Compling info file
  │ │ mb9bf51xr_pwmout.ewd    : Project setting file
  │ │ mb9bf51xr_pwmout.ewp    : Project file
  │ │ mb9bf51xr_pwmout.eww    : Workspace file
  │ │ startup_mb9bf51x.s             : Starup Assembly file
  │ │
  │ └─config                   : Configuration file directory
  │     mb9bf512_ram.icf       : Linker Setting File
```

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```
|       mb9bf514_ram.icf          : Linker Setting File
|       mb9bf515_ram.icf          : Linker Setting File
|       mb9bf516_ram.icf          : Linker Setting File
|       Ram_VTOR_mb9bf512.mac     : Linker Setting File
|       Ram_VTOR_mb9bf514.mac     : Linker Setting File
|       Ram_VTOR_mb9bf515.mac     : Linker Setting File
|       Ram_VTOR_mb9bf516.mac     : Linker Setting File
|       reset.mac                 : Operation Macro File
|
└─source                          : Sample Source Directory
    clock_def.h                   : Clock Frequecy Setting HeaderFile
    debug.h                       : Debug I/O Setting Header File
    mcu.h                         : MCU Info Hearder File
    smpl_adc12.c                  : ADC Control Source File
    smpl_adc12.h                  : ADC Control Header File
    smpl_main.c                   : main program file
    smpl_pwm.c                    : PWM Control Source File
    smpl_pwm.h                    : PWM Control Header File
    smpl_uart.c                   : UART Control Source File
    smpl_uart.h                   : UART Control Header File
```

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8 Related Manuals

The content of the followings manuals is subject to change without notice. Please contact to us for the latest versions

Peripheral Manuals

- FM3 Family PERIPHERAL MANUAL
- FM3 Family PERIPHERAL MANUAL (Timer part)
- FM3 Family PERIPHERAL MANUAL (Analog Macro part)
- FM3 Family PERIPHERAL MANUAL (Communication Macro part)

Datasheet

Refer to the following document for Device specification, Electric Characteristic, size, order model number

- **Datasheet of 32-bit FM3 Family**

Please refer to the datasheet of appropriate product series.

CPU Programming Manual

The following document about details of ARM Cortex-M3 Core is available in http://www.arm.com

- Cortex-M3 Technical Reference Manual
- ARMv7-M Architecture Application Level Reference Manual

Flash Programming Manual

Refer to the following documents for details of the flash memory built-in inside FM3 MCU

- Flash Programming Manual of 32-bit FM3 Family

Please refer to the Flash programming manual of appropriate product series.

Application Note

- Application Note of FM3 Family：Sound input/output by using PWM

FM3 Microcontroller Simulator Manual

- FM3 Microcontroller Simulator Manual
- FM3 Microcontroller Simulator Peripheral Manual

Note: Please make sure to refer to the lasts version of the above documents

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9 Document History

Document Title: AN204435 - Application of PWM for FM3 microcontroller simulator

Document Number: 002-04435

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	–	–	06/10/2014	Initial release
*A	5035938	AESATMP6	12/06/2015	Converted Spansion Application Note “FM3_AN706-00086” to Cypress format Document content is no more valid. The AN should be obsoleted.

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