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32-BIT MICROCONTROLLER
FM3 family Application Note

Wireless System Solution

(Wireless Control, Sensor Control, LCD Control)

Application Note

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Revision History

Rev	Date	Remark
1.0	Aug.23,2011	First Edition
2.0	Feb.6,2012	Updated to latest format Deleted about FW and GUI part

Table of Contents

Target products

This application note is described about below products;

(TYPE0)

Series	Product Number (not included Package suffix)
MB9B500B	MB9BF504NB,MB9BF505NB,MB9BF506NB MB9BF504RB,MB9BF505RB,MB9BF506RB
MB9B400B	MB9BF404NB,MB9BF405NB,MB9BF406NB MB9BF404RB,MB9BF405RB,MB9BF406RB
MB9B300B	MB9BF304NB,MB9BF305NB,MB9BF306NB MB9BF304RB,MB9BF305RB,MB9BF306RB
MB9B100B	MB9BF102NB,MB9BF104NB,MB9BF105NB,MB9BF106NB MB9BF102RB,MB9BF104RB,MB9BF105RB,MB9BF106RB

1 INTRODUCTION

This application note is for people who are considering designing a wireless system using a Fujitsu Semiconductor FM3 family microcontroller.

It gives specific examples of a system that performs wireless transceiver control via the SPI interface and sensor control and LCD control via the I^2C interface with the FM3 family.

2 ABOUT THE WIRELESS SYSTEM BOARD

The evaluation system that was used to measure the performance described in this application note performs the following operation. Refer to the wireless system board user's manual for details on the operation.

① Controls various sensors (hygro-thermometer, illumination sensor, accelerometer)

② Sends and receives data by wireless communication of the various sensor measurement values

③ Sends the various sensor measurement values that were acquired by wireless communication to a PC from the microcontroller via RS232C communication and displays them on the PC monitor

④ Displays the various measurement values, etc. on the LCD on the board

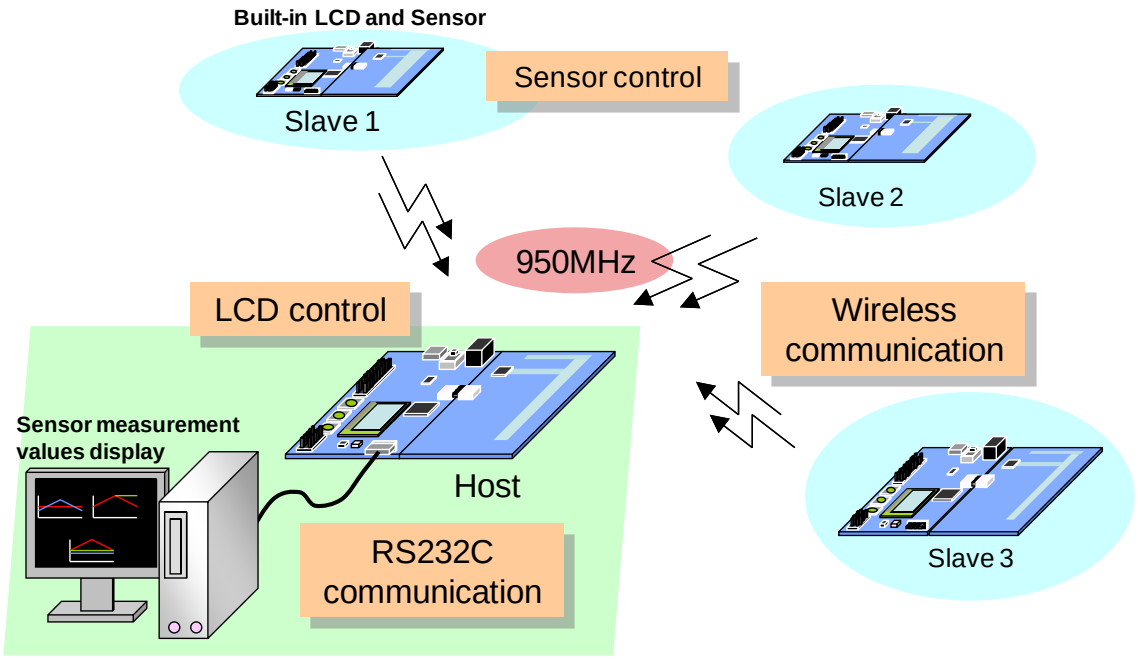

Figure 1 Wireless system overview diagram

2.1 System Operation

This system has two operation modes. The network is made up of one host device and either one or multiple slave devices depending on the mode. Refer to the wireless system board user's manual for details on the operation modes. The following describes the system operation.

(1) The microcontroller on the slave device reads the sensor measurement values at fixed time intervals.

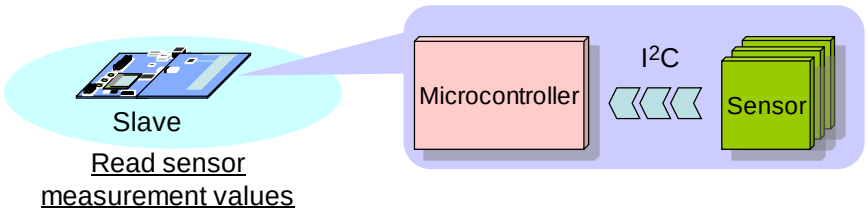

Figure 2 Reading the sensor measurement values on the slave device

(2) The slave device displays the sensor measurement values, etc. on the LCD.

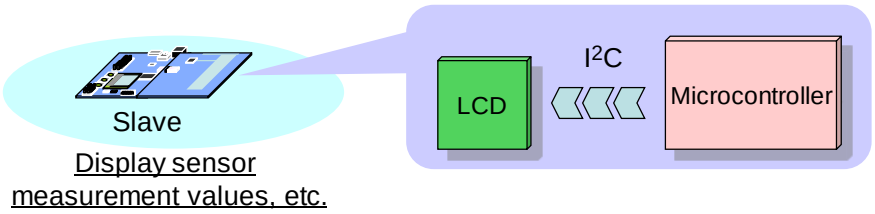

Figure 3 Displaying the sensor measurement values, etc. on the LCD

(3) The slave device performs wireless control to send the sensor measurement values to the host device after reading the sensor measurement values. The host device receives the sensor measurement values sent from the slave device.

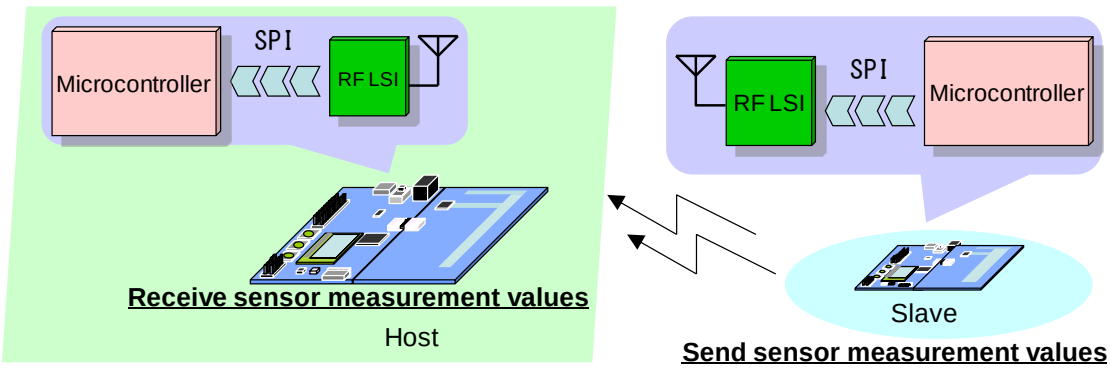

Figure 4 Sending the sensor measurement values from the slave device

(4) The host device sends the received sensor measurement values to the PC via RS232C communication. The PC displays the sensor measurement values received from the host device on the PC screen.

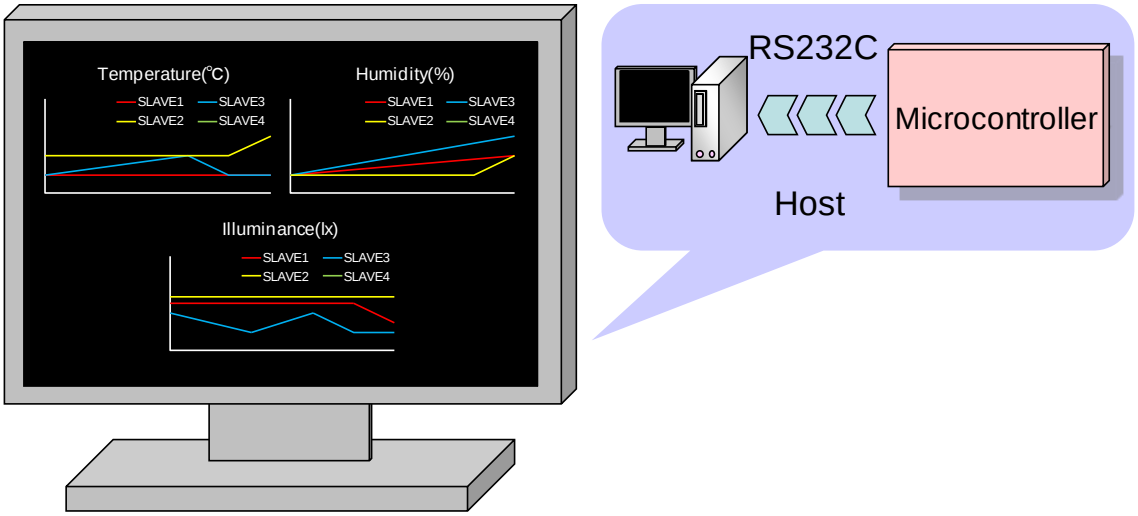

Figure 5 PC screen display of sensor measurement values

2.2 Hardware

2.2.1 External Appearance of the Microcontroller Board and Wireless Board

Photographs of the external appearance of the microcontroller board and wireless board are shown in Figure 6 and Figure 7.

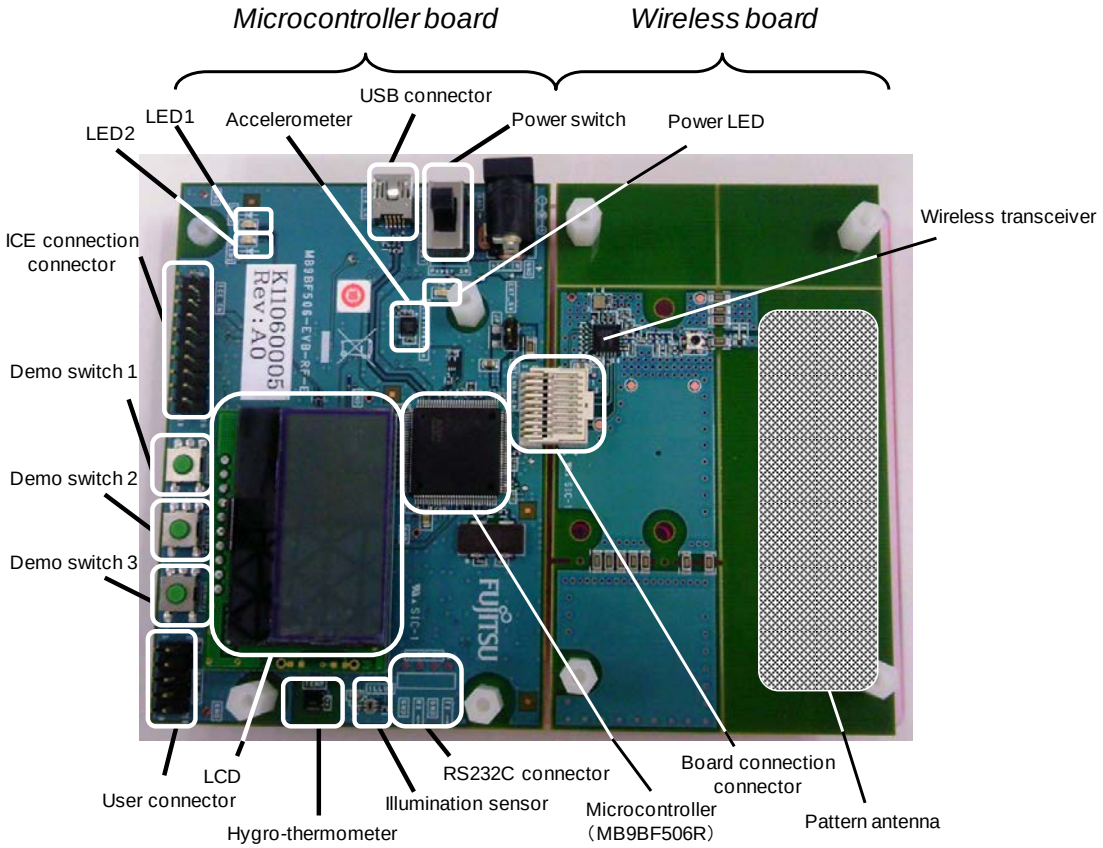

Figure 6 Photograph of external appearance of microcontroller board and wireless board (front surface)

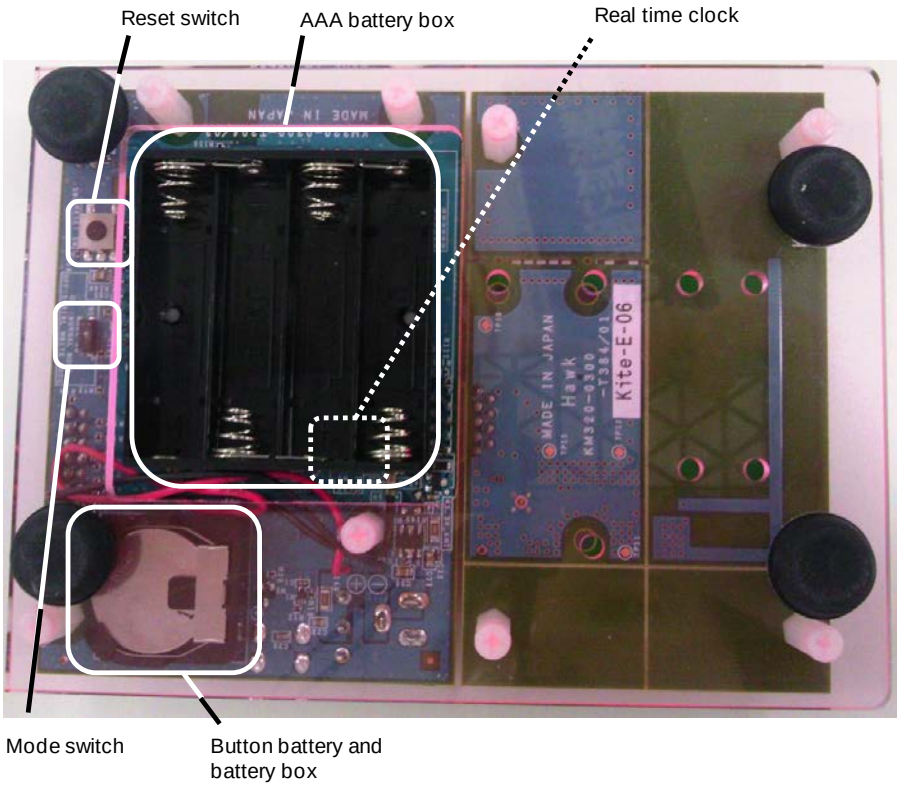

Figure 7 Photograph of external appearance of microcontroller board and wireless board (rear surface)

2.2.2 Hardware Block Diagram

A hardware block diagram of this system is shown in Figure 8.

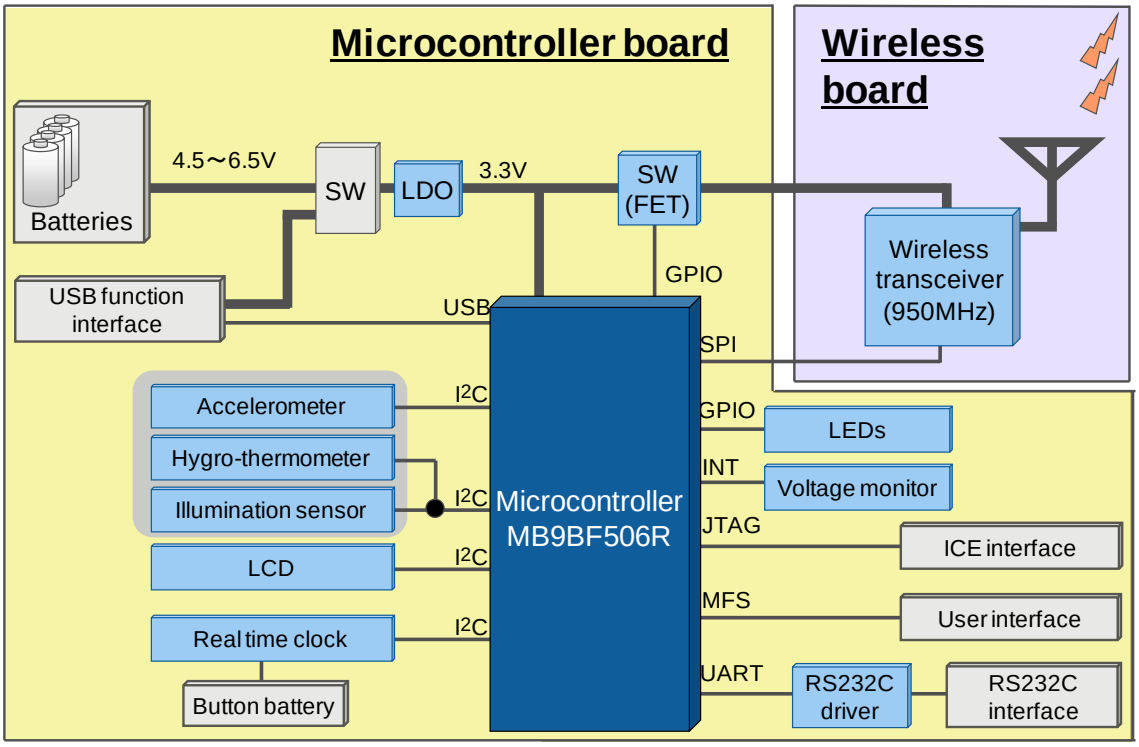

Figure 8 Hardware block diagram

2.3 Software

2.3.1 Software Block Diagram

A software block diagram of this system is shown in Figure 9.

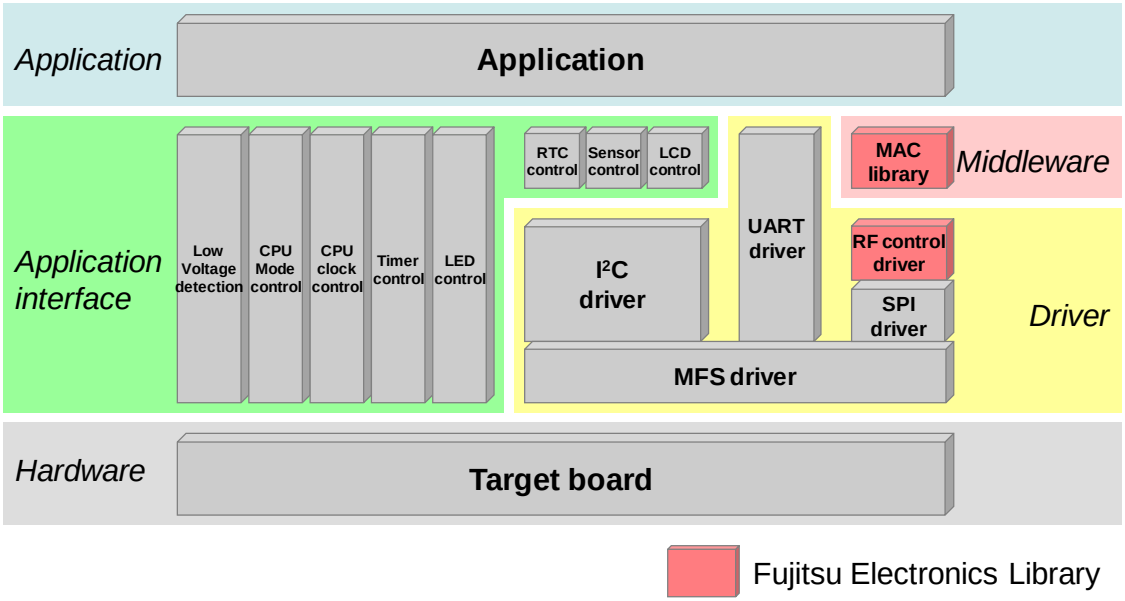

Figure 9 Software block diagram

#Note:

"Fujitsu Electronics Library" is developed for only this demonstration, not for business.

So it is not given to the customers. When they want to make the same system, they will prepare the programs for their hardware system by themselves.

2.3.2 Overall Application Operating Flow

2.3.2.1 Operation from Startup to Demo Mode Selected

① When the power is turned on, the pressed status of demo switch 1 is detected.

② If demo switch 1 was not pressed, the device enters sensor logger mode (*).

③ If demo switch 1 was pressed, the device enters remote control mode (*).

The operation up to this point is common to the host device and slave device.

The above flow is shown in Figure 10.

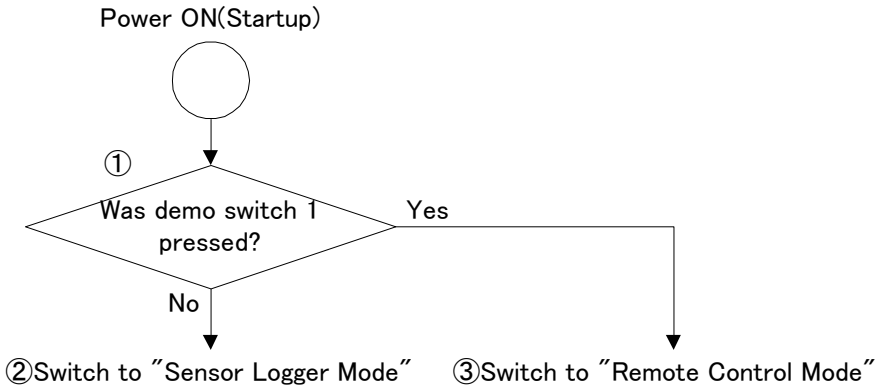

Figure 10 Operation from startup to demo mode selected

(*) Refer to the wireless system user's manual for details on sensor logger mode and remote control mode.

2.3.2.2 Operation of Host Device in Sensor Logger Mode and Remote Control Mode

The host device has the same operation in both sensor logger mode and remote control mode.

① Presses of demo switch 1 are detected.

② If a press of demo switch 1 is detected, the CPU operation mode changes.
The CPU operation mode is initially mode 1, and toggles between mode 1 and mode 2.
Refer to the wireless system board user's manual for details on the CPU operation modes.

③ A check is performed for whether there is a valid wireless reception from a slave device.

④ If there is a valid wireless reception from a slave device, the received data is sent to the PC via RS232C.

The above flow is shown in Figure 11.

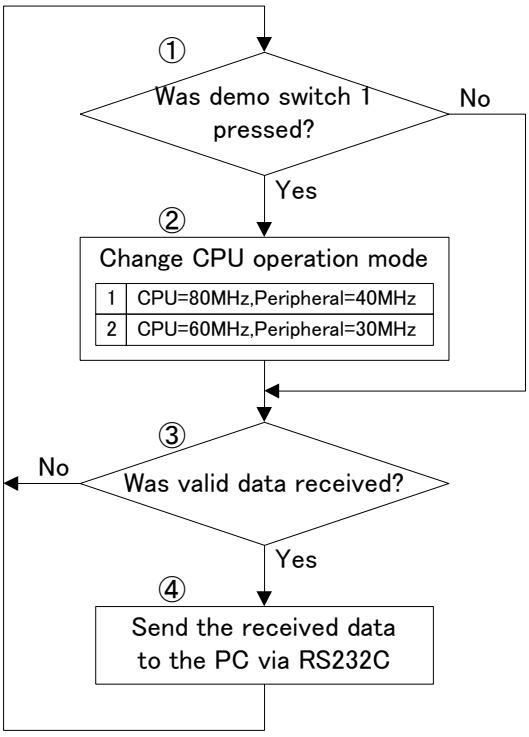

Figure 11 Operation of host device in sensor logger mode and remote control mode

2.3.2.3 Operation of Slave Devices in Sensor Logger Mode

① Presses of demo switch 1 are detected.

② If a press of demo switch 1 is detected, the CPU operation mode changes.
The CPU operation mode is initially mode 1, and changes cyclically as mode 1 -> mode 2 -> mode 3 -> mode 1 ···. Refer to the wireless system board user's manual for details on the CPU operation modes.

③ A check is performed of whether it is the periodic time to acquire the sensor measurement values.

④ If it is the periodic time to get the sensor measurement values, the measurement values are got from the hygro-thermometer and illumination sensor, and the got measurement values are sent by wireless. The program then waits for the sending to finish.

⑤ Once the sending is complete, a check is performed for whether the standby conditions are met. The standby condition is that the CPU operation mode is mode 3.

⑥ For the standby conditions, the CPU clock changes to the CR oscillator (4MHz).

⑦ A check is performed for whether the standby time has elapsed. The standby time is the value of the sensor measurement value getting period minus the time taken to get the measurement values from the sensors and the time to send by wireless.

⑧ Once the standby time has elapsed, the CPU clock is changed to the PLL oscillator (80MHz).

The above flow is shown in Figure 12.

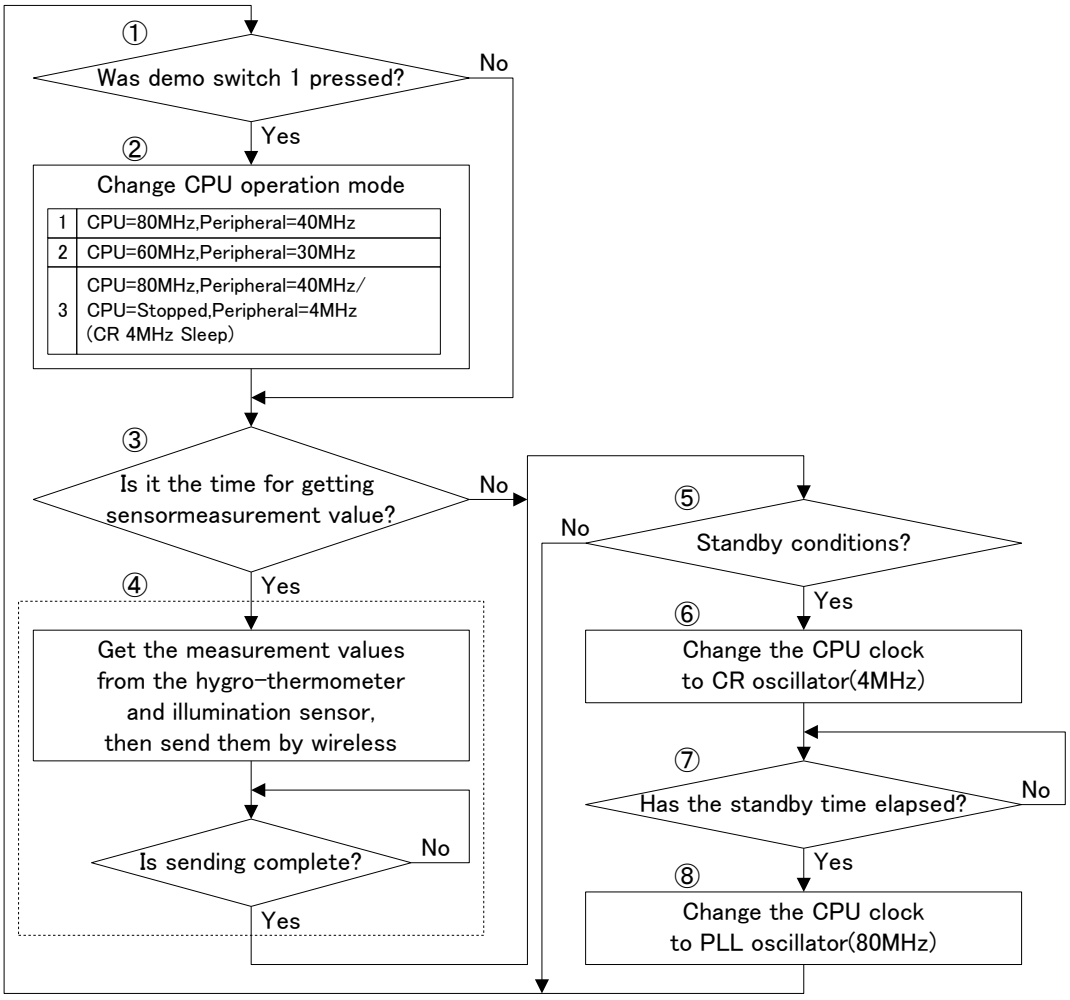

Figure 12 Operation of slave devices in sensor logger mode

2.3.2.4 Operation of Slave Devices in Remote Control Mode

① Presses of demo switch 1 are detected.

② If a press of demo switch 1 is detected, the CPU operation mode changes.
The CPU operation mode is initially mode 1, and changes cyclically as mode 1 -> mode 2 -> mode 3 -> mode 1 ⋯. Note that in remote control mode, the operation of mode 3 is the same as mode 1. Refer to the wireless system board user's manual for details on the CPU operation modes.

③ A check is performed of whether it is the periodic time to acquire the sensor measurement values.

④ If it is the periodic time to get the sensor measurement values, the measurement values are got from the accelerometer, the got measurement values are sent by wireless, and the program then waits for the sending to finish.

The above flow is shown in Figure 13.

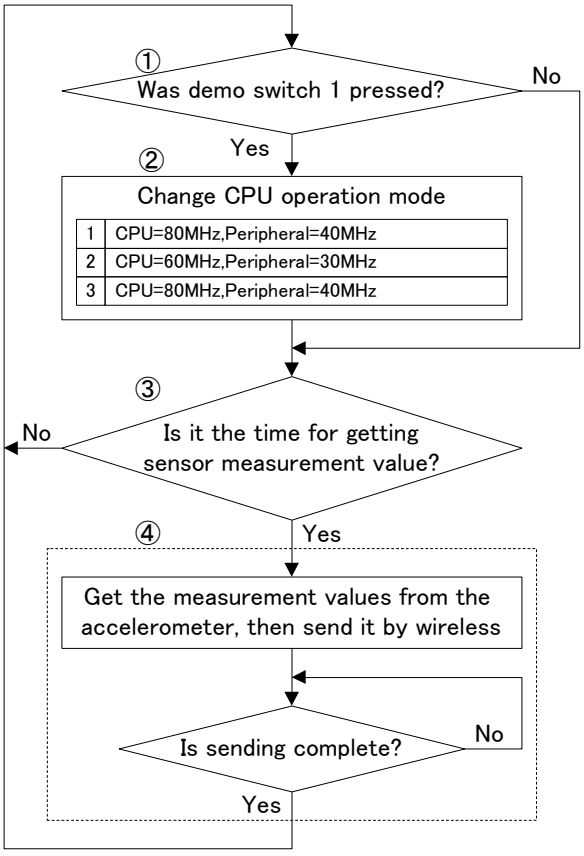

Figure 13 Operation of slave devices in remote control mode

2.3.3 About MFS

This software provides a driver for operating each of the 8 channels of MFS built into the MB9BF506R as each of the I2C, SPI, and UART functions. A block diagram of the MFS-related drivers is shown in Figure 14.

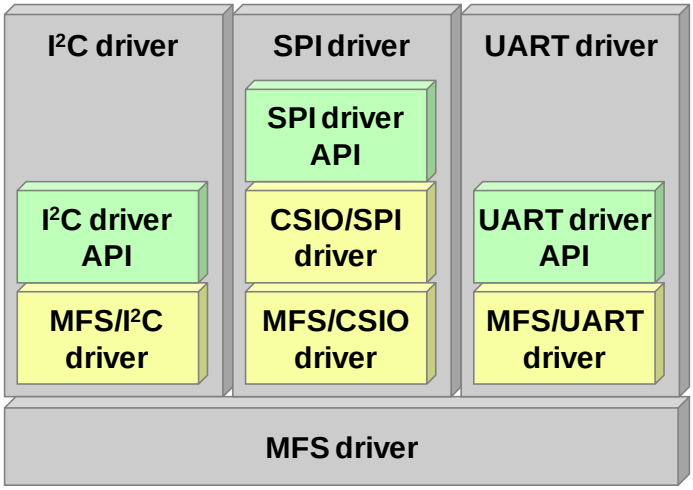

Figure 14 Block diagram of MFS related drivers

Each of the I^{2}C driver, SPI driver, and UART driver shown in the software block diagram in Figure 9 are divided into an API block and a driver block.

For the SPI driver, since the MFS is used as CSIO, the driver block consists of a CSIO/SPI driver and a MFS/CSIO driver.

Table 1 Functions of Each Block of the MFS Related Drivers

Block		Function
I^{2}C driver	I^{2}C driver API	API of I^{2}C driver
	MFS/I^{2}C driver	Driver that operates MFS as I^{2}C
SPI driver	SPI driver API	API of SPI driver
	CSIO/SPI driver	Driver that operates CSIO as SPI
	MFS/CSIO driver	Driver that operates MFS as CSIO
UART driver	UART driver API	API of UART driver
	MFS/UART driver	Driver that operates MFS as UART
MFS driver		MFS management driver Performs interrupt control.

In this software, six of the eight MFS channels are used to control the various sensors (hygro-thermometer, illumination sensor, and accelerometer), LCD, real time clock, RS232C, and wireless transceiver.

The functions of each channel are as shown in Table 2.

Table 2 MFS Allocation and Functions

Channel no.	Function	Baud rate	Remarks
0	UART	115.2kbps	Used for RS232C communication for sending the sensor data received by wireless to the PC
1	—	—	Not used
2	SPI	1Mbps	Used for wireless transceiver control
3	I^2C	400kbps	Used for LCD
4	I^2C	400kpbs	Used for accelerometer sensor control
5	—	—	Not used
6	I^2C	400kbps	Used for real time clock control
7	I^2C	400kbps	Used for hygro-thermometer and illumination sensor control

Refer to the “FM3 32-bit Microcontroller MB9Axxx/MB9Bxxx Series Peripheral Manual” for details on how to use the MFS.

- End -