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User's Manual

Renesas Starter Kit2+ for SH7216

Software Manual

RENESAS SINGLE-CHIP MICROCOMPUTER
SuperH FAMILY

Renesas Electronics
www.renesas.com

Rev.1.00 2010.02

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Chapter 1. Preface

Cautions

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Glossary

ADC	Analogue / Digital Converter	HEW	High performance Embedded Workshop
API	Application Programming Interface	I/O	Input / Output
CMT	Compare Match Timer	RSK	Renesas Starter Kit
CPG	Clock Pulse Generator	WDT	Watchdog Timer
DMAC	Direct Memory Access Controller		

Chapter 2. Introduction

This document explains the sample code for the RSK Renesas Starter Kit.

It explains by text and diagrams the outline functionality of the sample code.

Chapter 3. RSK Sample Code Concept

The diagram below shows the basic structure of all the RSK sample code:

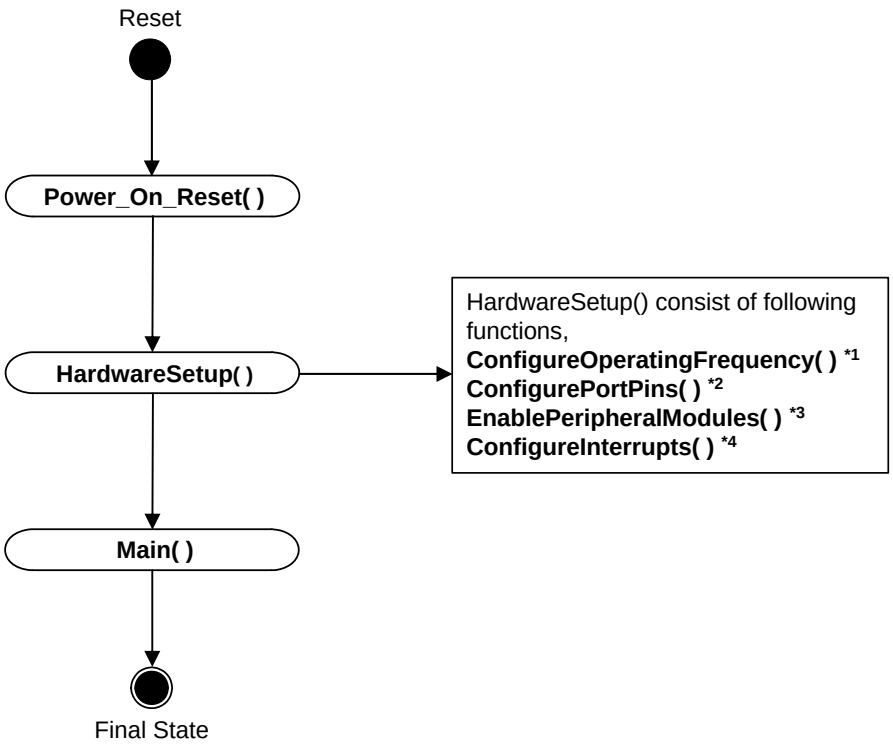

Figure 1 RSK Sample Code

Note:

1- This function initialises the CPU main clock, the real time clock and the PLL.

2- This function configures the CPU port pins as input and output. It also determines the initial state of the output port pin.

3- This function enables or disables the peripheral modules of the CPU.

4- This function configures the CPU interrupts.

3.1. List of Sample code

You can click on the sample code title for more description.

	Sample Code	Description
1	Tutorial	Demonstrates the use of debugger and hardware
2	ADC_OneShot	Demonstration of the on-chip ADC module for one shot conversion.
3	ADC_Repeat	Demonstration of the on-chip ADC module for repeat conversion.
4	Async_Serial	Demonstration of the on-chip Serial Interface module for asynchronous serial communication.
5	Watchdog_Timer	Demonstration of the on-chip watchdog timer.
6	DMAC	Demonstration of the on-chip Direct Memory Access Controller.
7	Timer_Mode	Demonstration of the on-chip Timer module to generate square waveform.
8	Timer_Event	Demonstrates of on-chip MTU2 module in event counter mode
9	Timer_Capture	Demonstrates on-chip MTU2 module in input capture mode.
10	Timer_Compare	Demonstrates on-chip CMT module in output compare mode.
11	BSC	Demonstrates the configuration of external SDRAM using Bus state control.
12	DTC	Demonstrates the use of on-chip DTC module.
13	Flash API	Demonstrates write and erase operations in flash memory.
14	Flash Suspend	Demonstrates the flash suspend operation.
15	Sync_Serial	Demonstration of the on-chip Serial Interface module for synchronous serial communication

Table 3-1 List of sample code

3.1.1. Tutorial

The tutorial demonstrates the use of the debugger and the hardware. The tutorial code is common for all RSK's.

This code will call three main functions to demonstrate port pin control, interrupt usage and C variable initialization. These functions are shown below,

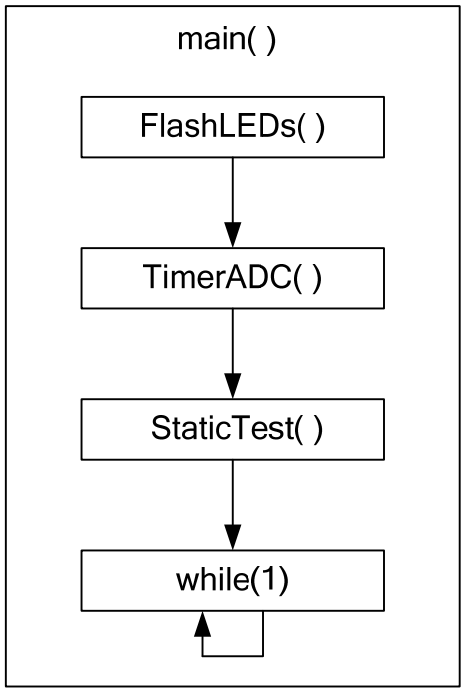

Figure 2 Functions used in Tutorial code

3.1.1.1. Sequence Diagram

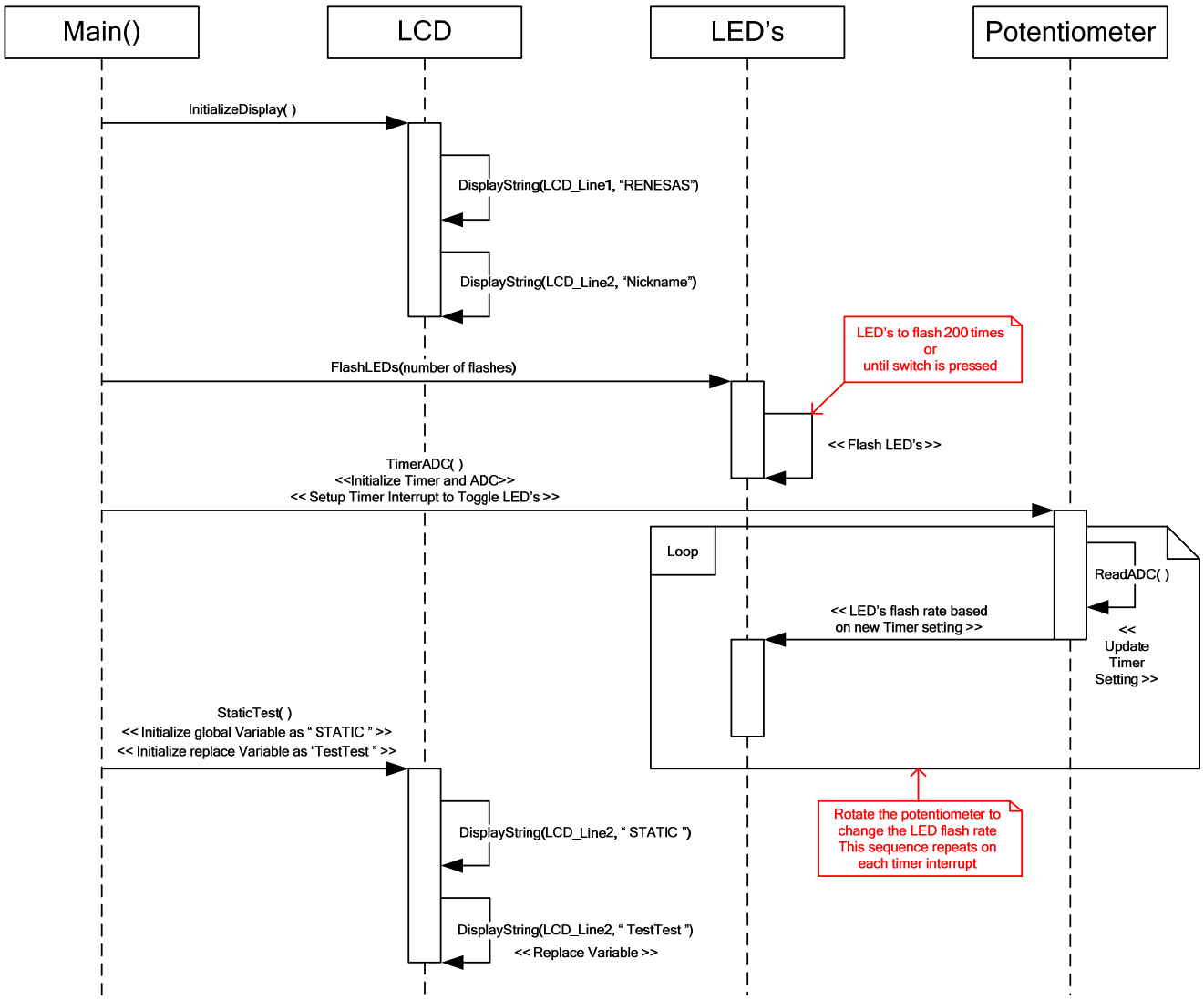

Figure 3 Tutorial Sequence Diagram

3.1.1.2. Description

1- The tutorial code initializes the LCD module and displays “Renesas” on Line-1 and the RSK nickname on Line-2.

2- All the LED’s start flashing. The LED’s flash 200 times or until switch is pressed.

3- After initial 200 flashes LED’s flashing, the flash rate is now controlled by the potentiometer (RV1).

4- At the same time the LCD will display a variable “STATIC” which is then replaced by “TESTTEST” to demonstrate the static variable test.

5- The RSK nickname is displayed on the LCD after the completion of static test (step 4).

3.1.2. ADC_OneShot

This sample code demonstrates the use of on-chip ADC module for one shot conversion.

3.1.2.1. Sequence Diagram

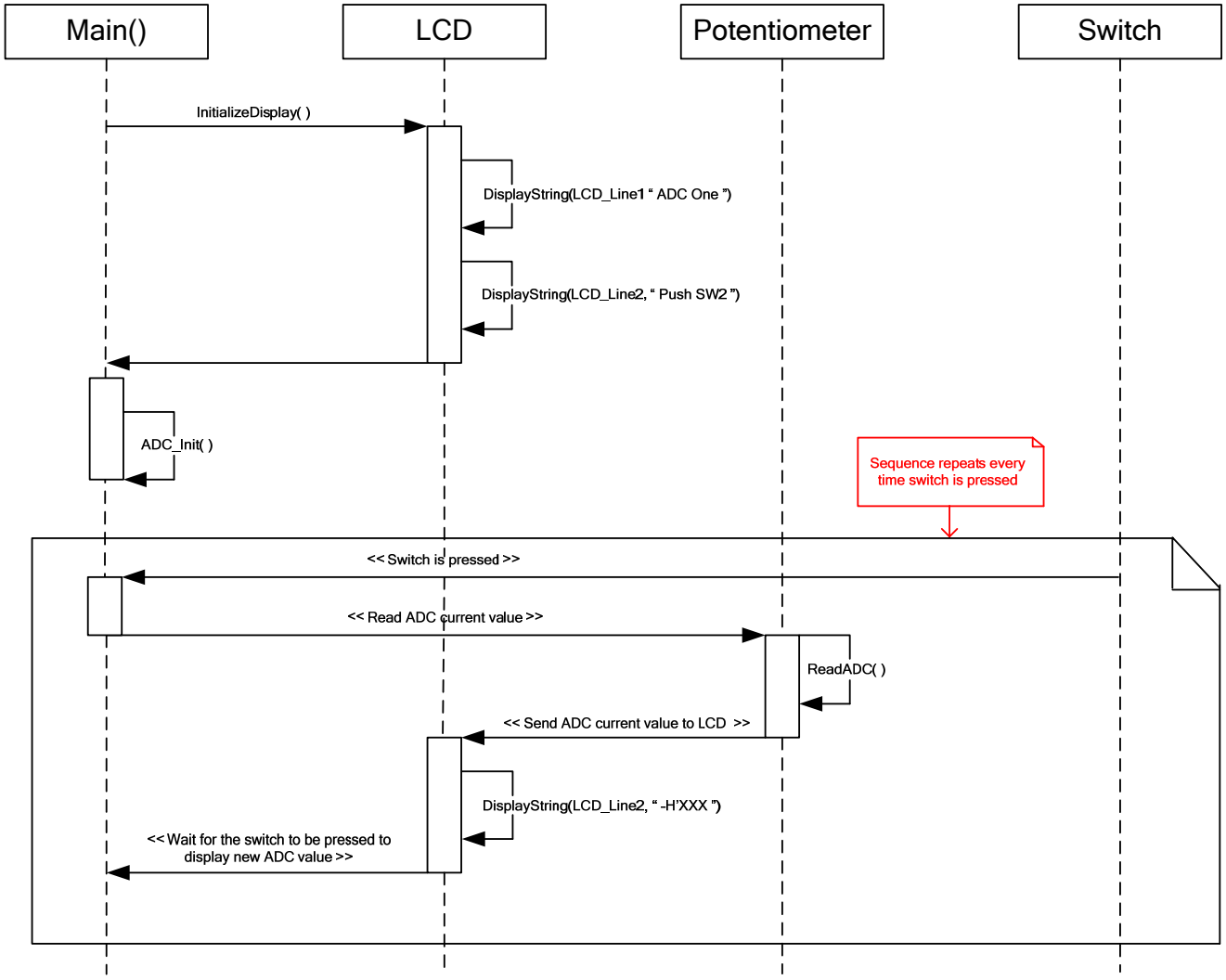

Figure 4 ADC_OneShot Sequence Diagram

3.1.2.2. Description

1- ADC_OneShot sample code initializes the LCD module and display “ADCOne” on Line-1 and “PushSW2” on Line-2.

2- The ADC channel is configured for one shot conversion.

3- The result is stored in the “usADC_Result” variable and user may examine the AD conversion result in “usADC_Result” using HEW C watch window.

4- The debug LCD also displays the result of AD conversion in hex format.

5- The AD conversion result is shown on LCD when switch is pressed.

3.1.3. ADC_Repeat

This sample code demonstrates the use of on-chip ADC module for repeat conversion.

3.1.3.1. Sequence Diagram

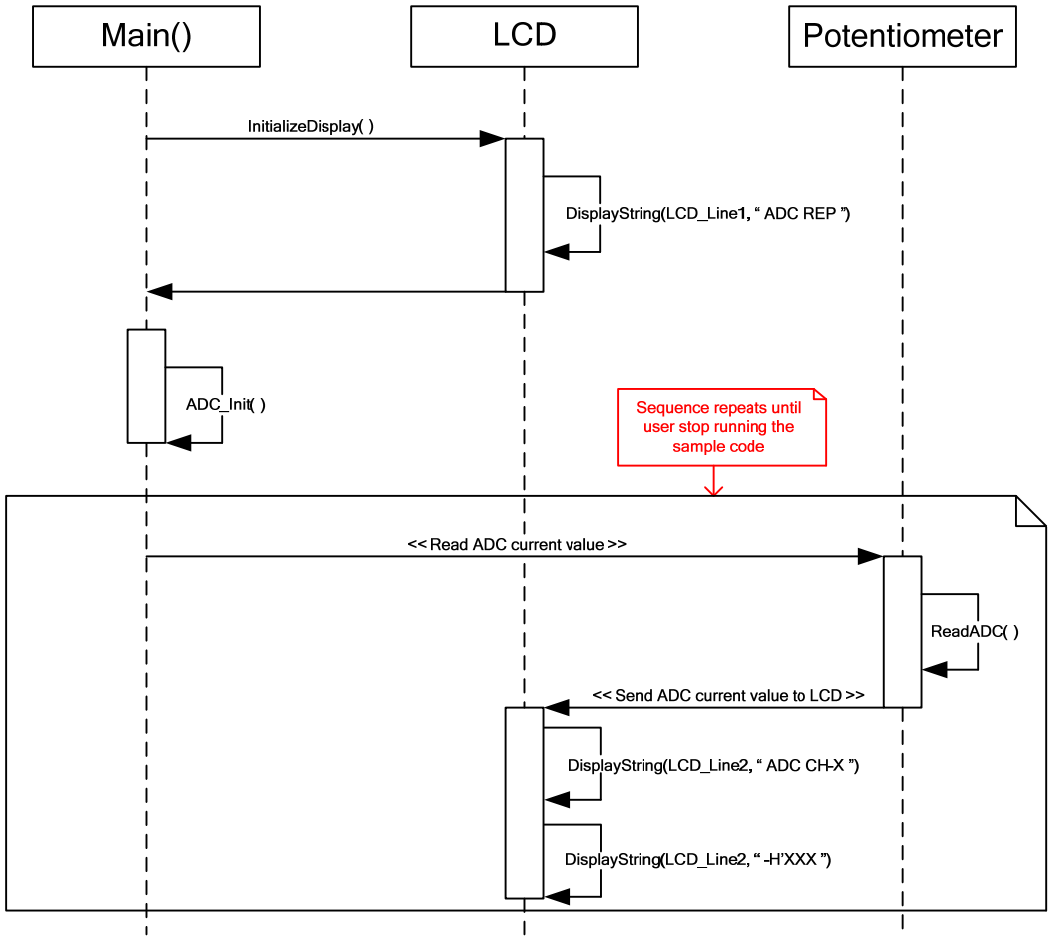

Figure 5 ADC_Repeat Sequence Diagram

3.1.3.2. Description

1- The ADC_Repeat sample code initializes the LCD module and displays “ADC REP” on Line-1 and AD conversion result on Line-2.

2- The ADC channel is configured for AD repeat conversion.

3- The result is stored in the “usADC_Result” variable and user may examine the AD conversion result in “usADC_Result” using HEW C watch window.

4- The debug LCD also displays the result of last AD conversion in hex format.

3.1.4. Async_Serial

This sample code demonstrates an asynchronous serial communication using the on-chip serial interface module.

3.1.4.1. Sequence Diagram

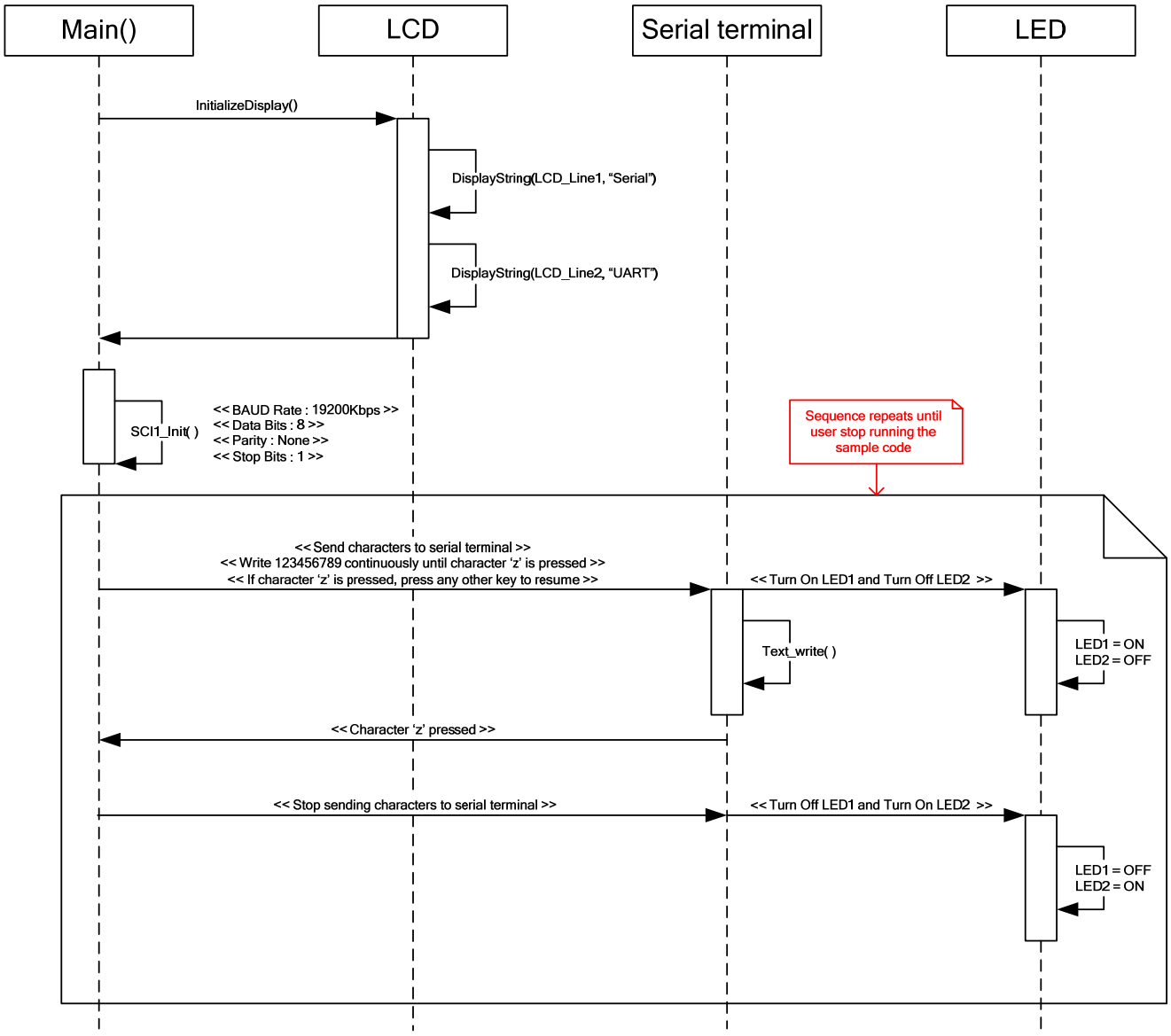

Figure 6 Serial_Uart Sequence Diagram

3.1.4.2. Description

1- The Serial_Uart sample code initializes the LCD module and displays “Serial” on Line-1 and “UART” on Line-2.

2- The serial channel is configured as: 19200bps baud rate, 8 data bits, 1 stop bit and no parity.

3- This code communicates with the terminal software on the PC (e.g. Hyper Terminal on Windows).

4- Incrementing data (0 to 9) is sent to the terminal window repeatedly.

5- Sending data can be stopped by pressing ‘z’ on the PC keyboard.

6- To resume, press any key other than ‘z’.

3.1.5. Watchdog_Timer

This sample code demonstrates the usage of watchdog timer. The watchdog timeout period can be adjusted using the on-board analog POT (RV1).

3.1.5.1. Sequence Diagram

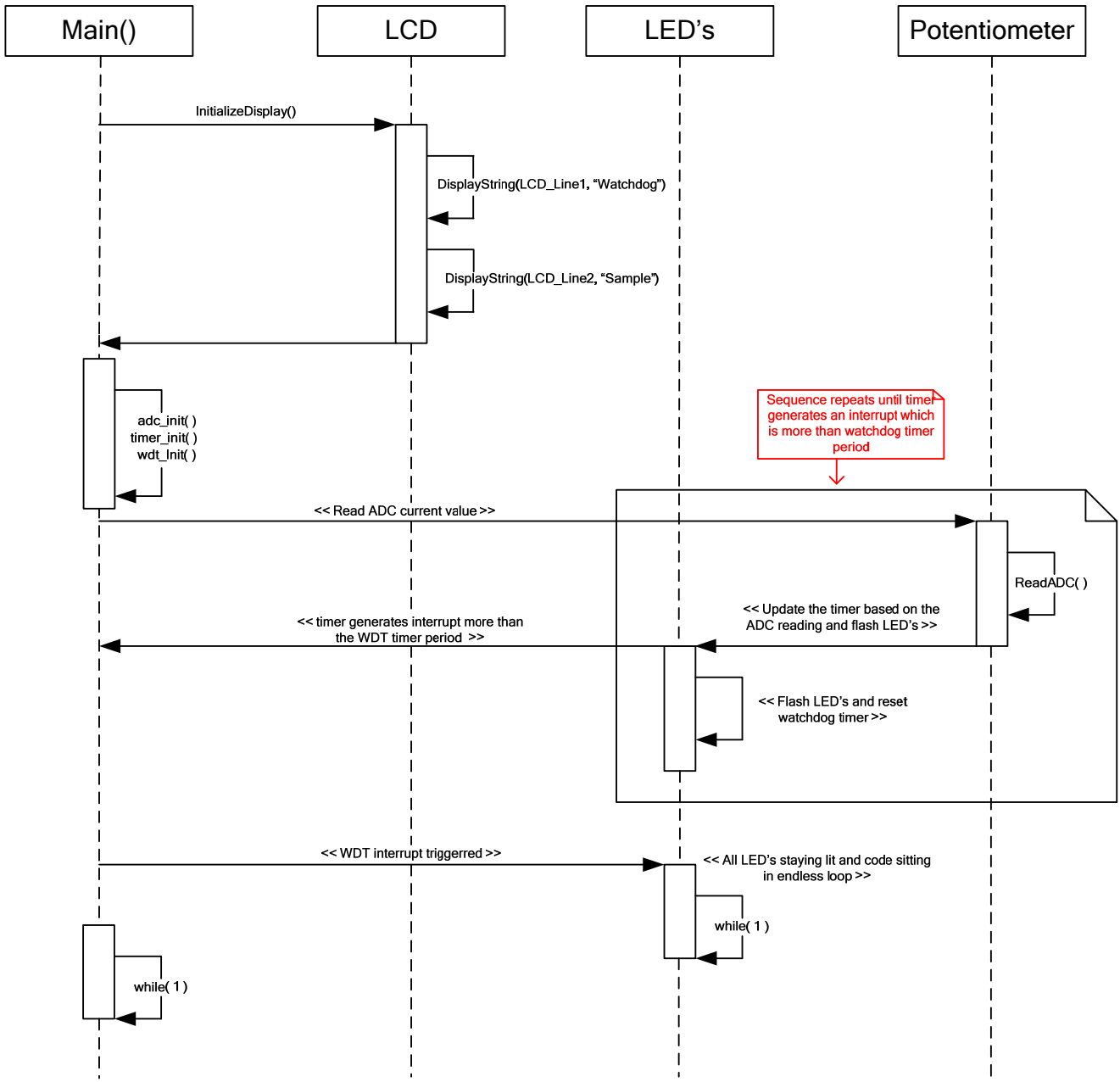

Figure 7 Watchdog_Timer Sequence Diagram

3.1.5.2. Description

1- The Watchdog_Timer sample code initializes the LCD module and displays “Watchdog” on Line-1 and “Sample” on Line-2.

2- Timer is initialised in output compare mode, and AD channel is initialised in scan mode.

3- The LED’s will start flashing sequentially. Flash rate can be controlled by the analogue potentiometer (RV1).

4- Turning the analogue potentiometer clockwise or anti-clockwise will vary the speed of LED flashing and how often the watchdog timer is accessed (to prevent it from timing out).

5- At almost full clockwise position of analogue POT, the watchdog timer interrupt will be generated to make all LED’s staying ON and code sitting in an endless loop.

3.1.6. DMAC

This sample demonstrates the direct memory access using on-chip DMA Controller.

3.1.6.1. Sequence Diagram

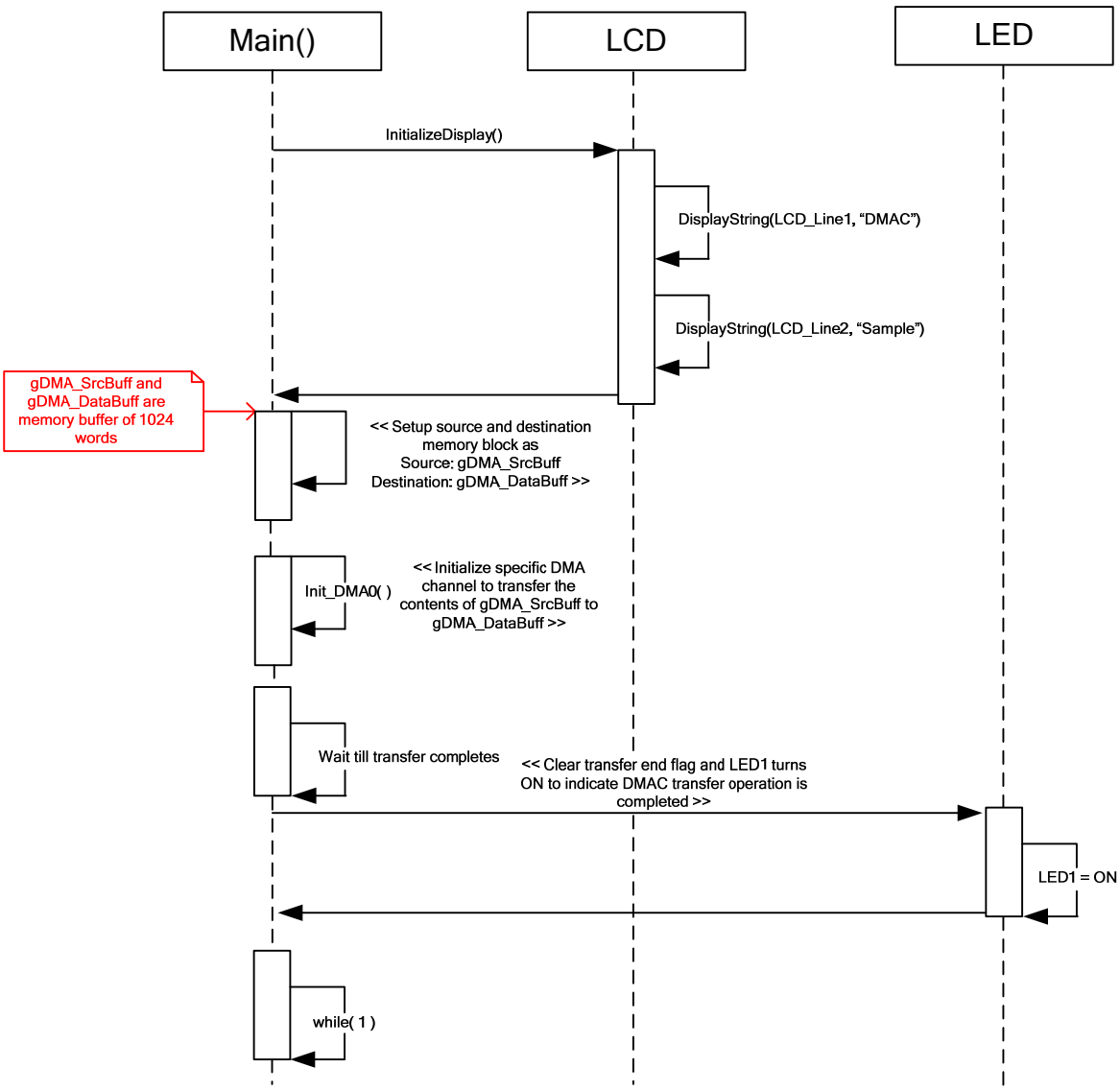

Figure 8 DMAC Sequence Diagram

3.1.6.2. Description

1- The DMAC sample code initializes the LCD module and displays “DMAC” on Line-1 and “Sample” on Line-2.

2- The source & destination buffers to default values..

3- This application configures DMAC with source 'gDMA_SrcBuff' and destination 'gDMA_DataBuff' as two different memory blocks of 1024 words and initializes the DMA controller for the transfer operation.

4- LED1 turns ON when the DMAC transfer completes.

5- The DMAC transfer operation result can be seen in a variable 'gDMA_DataBuff' using HEW C watch window, once LED1 turns ON.

3.1.7. Timer_Mode

This sample code configures the timer to generate 1 KHz waveform. The waveform can be seen on the oscilloscope.

3.1.7.1. Sequence Diagram

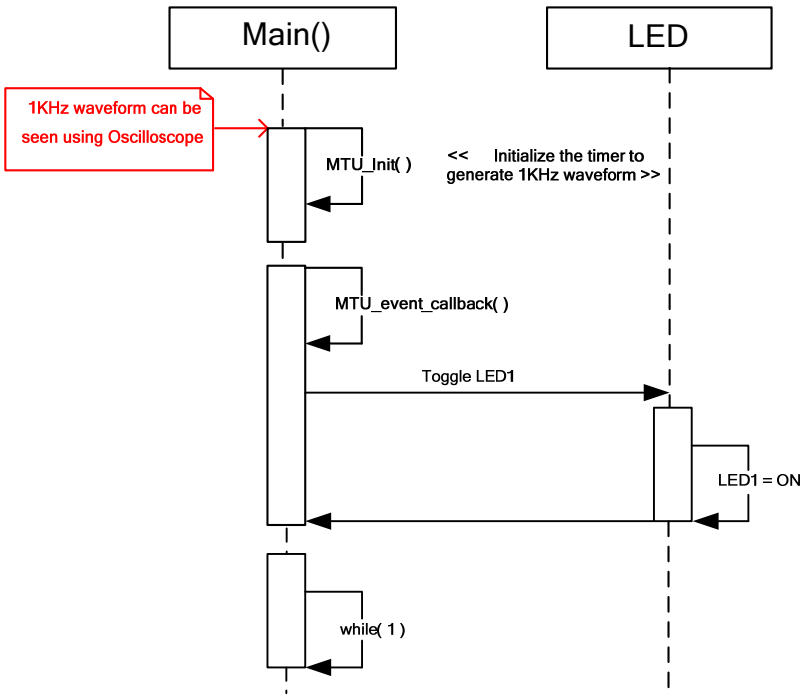

Figure 9 Timer_Mode Sequence Diagram

3.1.7.2. Description

1- The Timer_Mode sample code application initializes the timer to generate 1 KHz waveform on the respective timer port pin.

2- On every timeout, LED1-5 toggled.

3- The waveform can be seen using an oscilloscope.

3.1.8. Timer_Event

This sample code configures the timer to count the number of input signal events.

3.1.8.1. Sequence Diagram

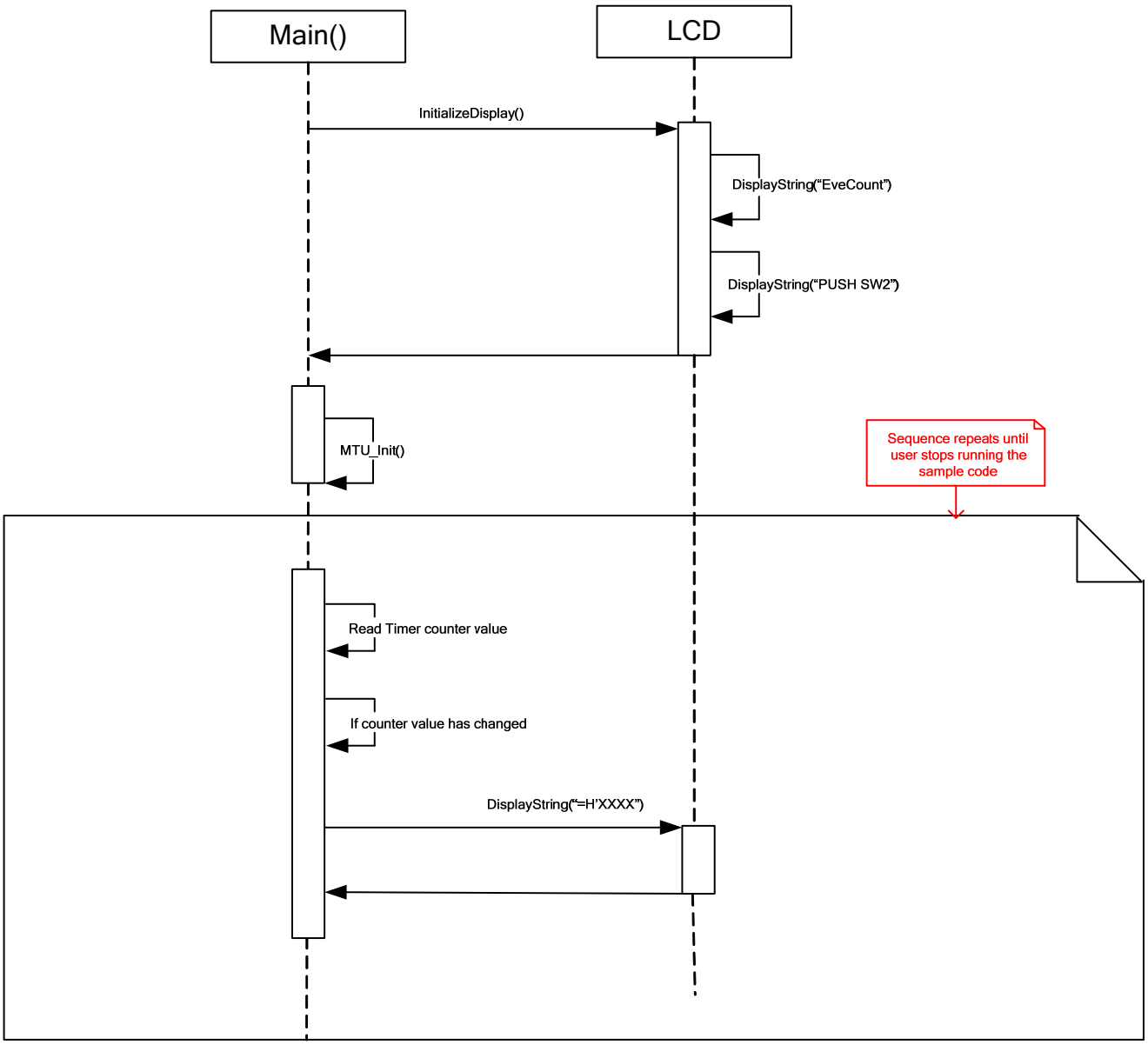

Figure 10: Timer_Event Sequence Diagram

3.1.8.2. Description

1- The Timer_Event initializes the timer to count user switch (SW2) press events.

2- On every switch (SW2) press event, the counter increments value by one unit & it is displayed on LCD.

3.1.9. Timer_Capture

This sample code configures the timer to capture timer counter's value in one of the general purpose registers, on reception of input signal at one of timer's pins.

3.1.9.1. Sequence Diagram

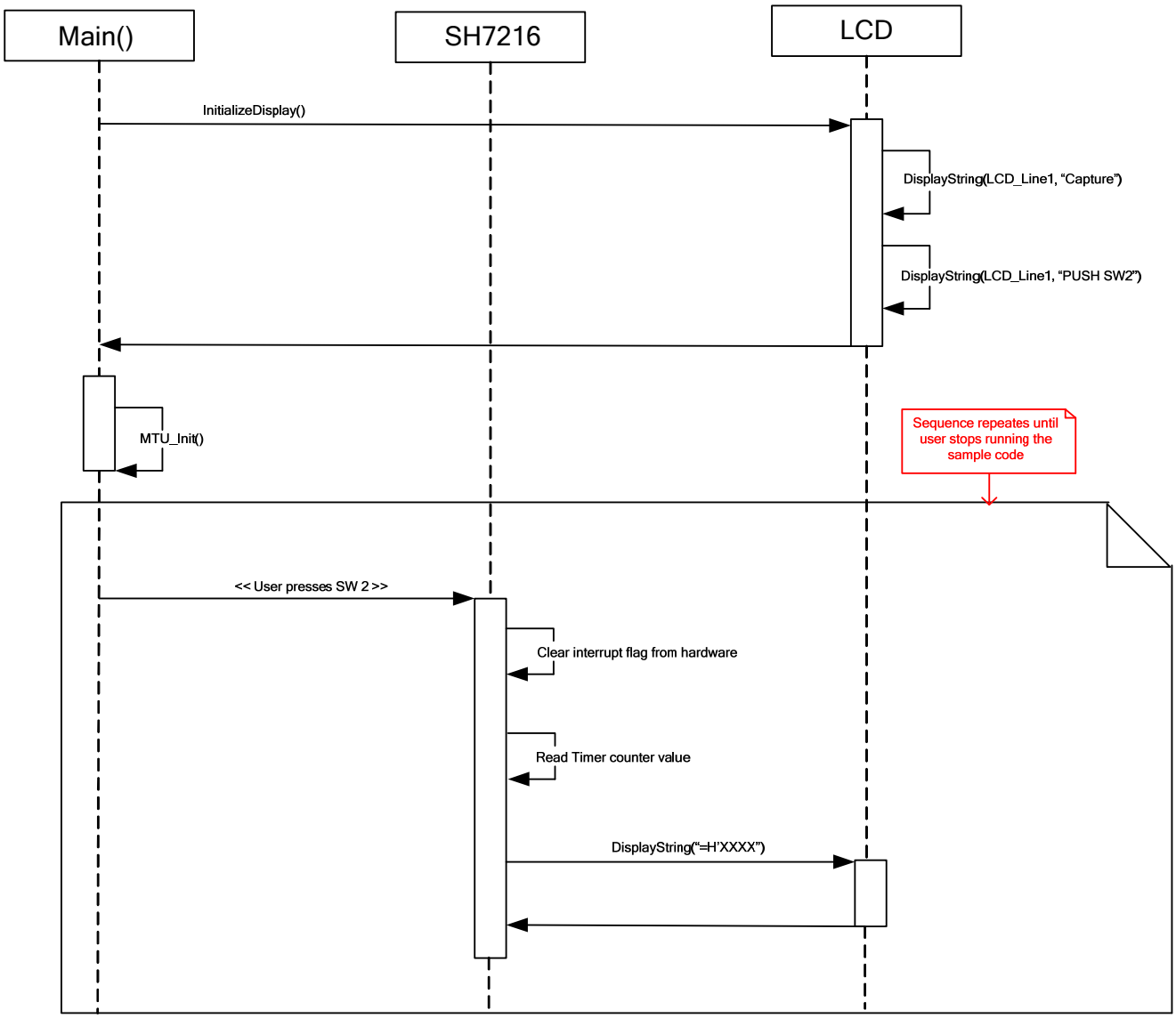

Figure 11: Timer_Capture Sequence Diagram

3.1.9.2. Description

1- The Timer_Capture initializes the timer to capture value of timer's counter in a general purpose register at the instant the user presses switch (SW2).

2- On every switch (SW2) press, it displays value of timer counter register at that instant on LCD.

3.1.10. Timer_Compare

This sample code configures the compare match timer to generate an interrupt when timer counter value matches with the one in compare match constant register.

3.1.10.1. Sequence Diagram

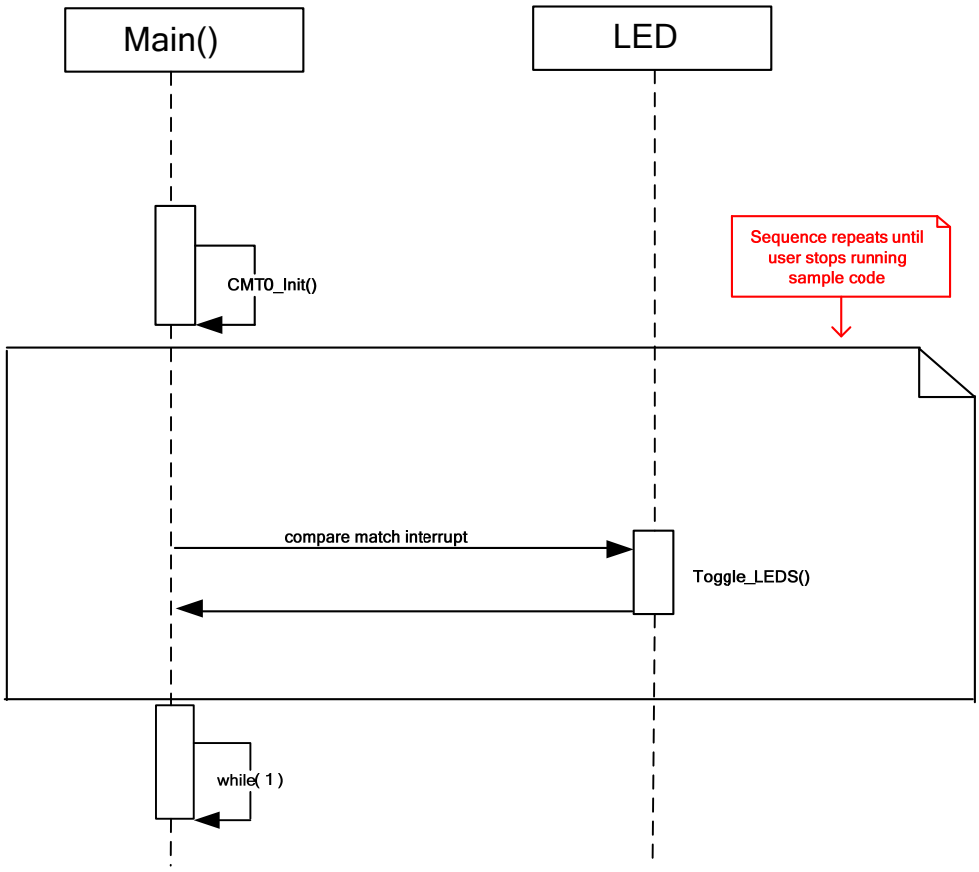

Figure 12: Timer_Compare Sequence Diagram

3.1.10.2. Description

1- The Timer_Compare initializes the compare match timer to generate an interrupt when timer counter value matches the value in compare match constant register.

2- The interrupt service routine toggles LED's whenever it is executed.

3.1.11. BSC

This sample code uses Bus State Controller to transfer data from RAM to SDRAM.

3.1.11.1. Sequence Diagram

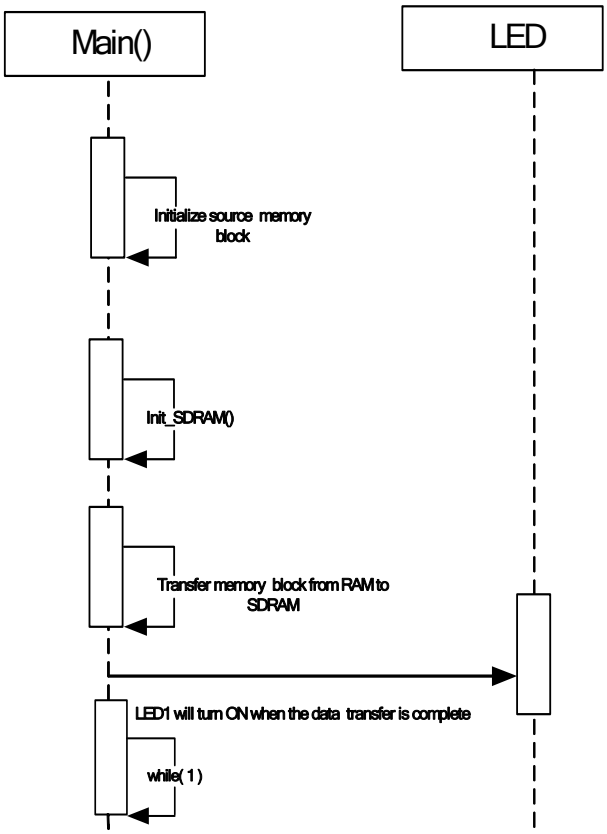

Figure 13: BSC Sequence Diagram

3.1.11.2. Description

1- The BSC sample application initializes SDRAM interface.

2- The application transfers data initialized in RAM to SDRAM.

3- Once the transfer is complete, LED1 turns ON. The transferred block can be verified using HEW C watch window after LED1 is turned ON.

3.1.12. DTC

This sample code demonstrates the use of on-chip DTC module.

3.1.12.1.Sequence Diagram

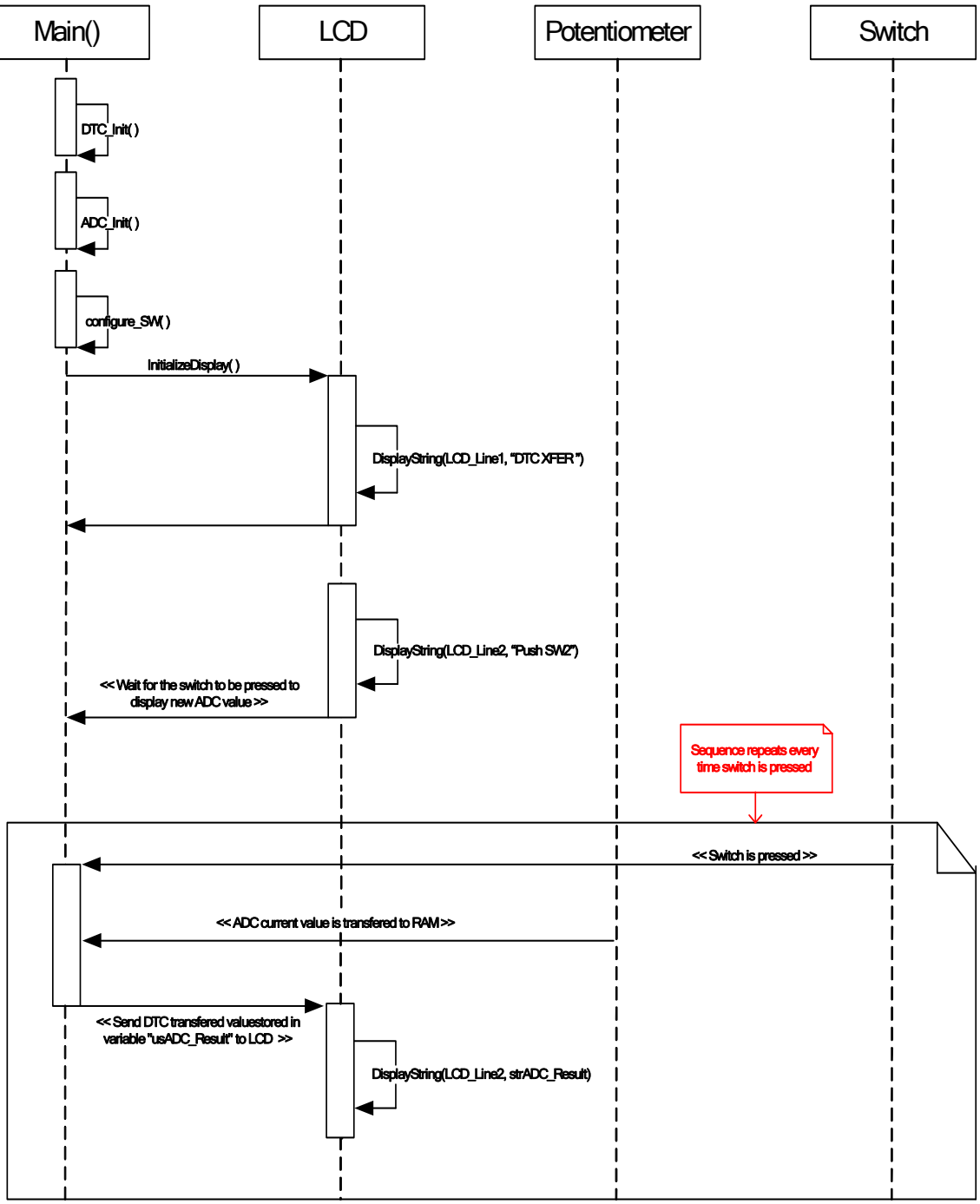

Figure 14: DTC Sequence Diagram

3.1.12.2.Description

1- DTC sample code initializes the LCD module and displays “DTC XFER” on Line-1 and “PushSW2” on Line-2.

2- The ADC channel is configured for one shot conversion.

3- If switch is pressed DTC trigger is generated.

4- The ADC result is transferred to the destination address in “usADC_Result_arr” variable and user may examine the AD conversion result in “usADC_Result_arr” using HEW C watch window.

5- The debug LCD also displays the result of DTC transfer in hex format.

6- The DTC transfer result is shown on LCD when switch is pressed.

3.1.13. Flash API

The application demonstrates write and erase operations in flash memory.

3.1.13.1.Sequence Diagram

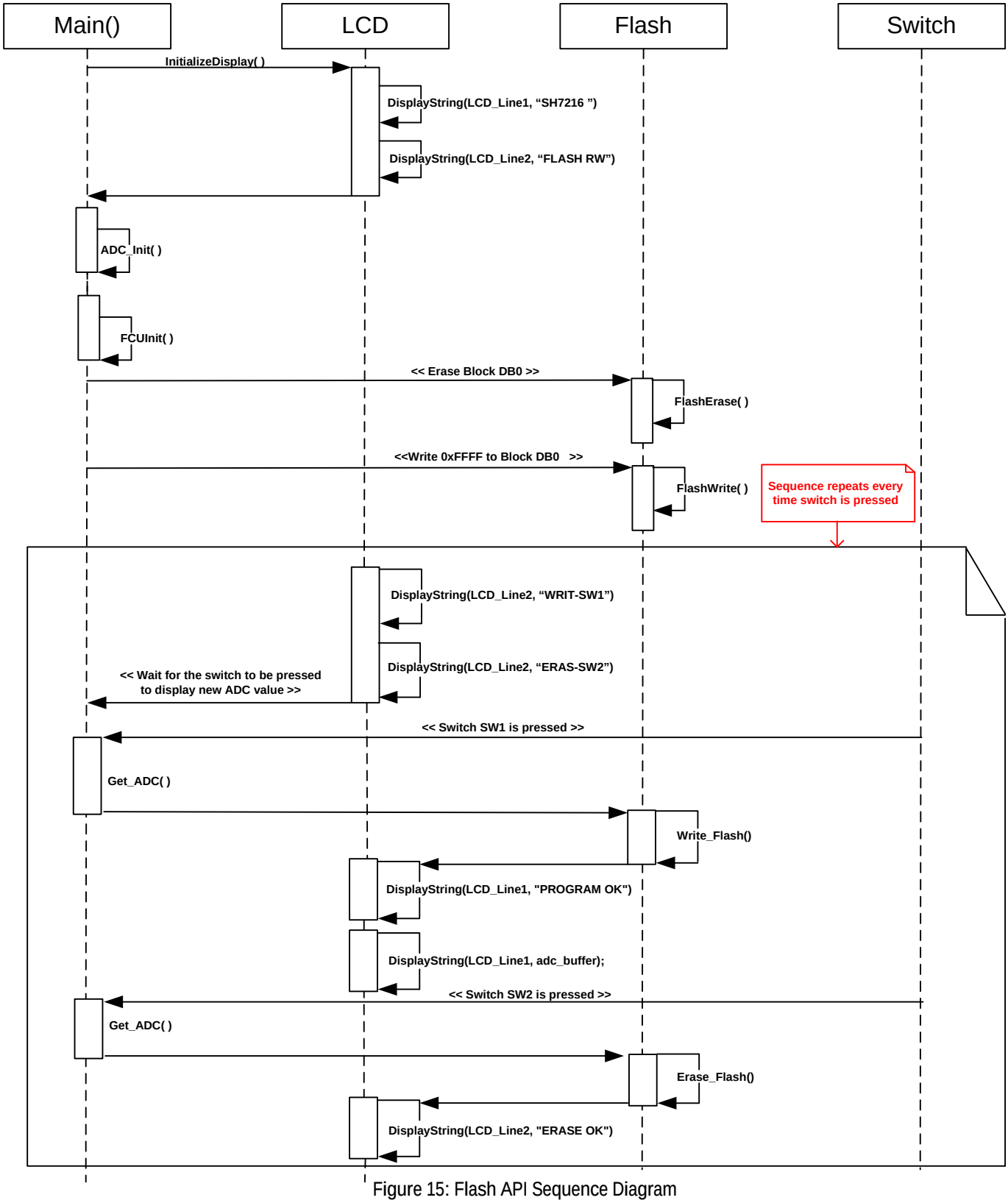

Figure 15: Flash API Sequence Diagram

3.1.13.2.Description

1- Flash API sample code initializes the LCD module and displays “FLASH RW ” on Line-2.

2- The ADC is configured in one shot mode and Flash is initialised.

3- Flash erase and Flash write with H’FFFF data is executed.

4- If SW1 is pressed, the Flash write operation is executed and ADC value read is written to Block DB1.

5- If SW2 is pressed, the Flash erase operation is executed on Block DB1.

3.1.14. Flash Suspend

The application demonstrates the flash suspend operation.

3.1.14.1.Sequence Diagram

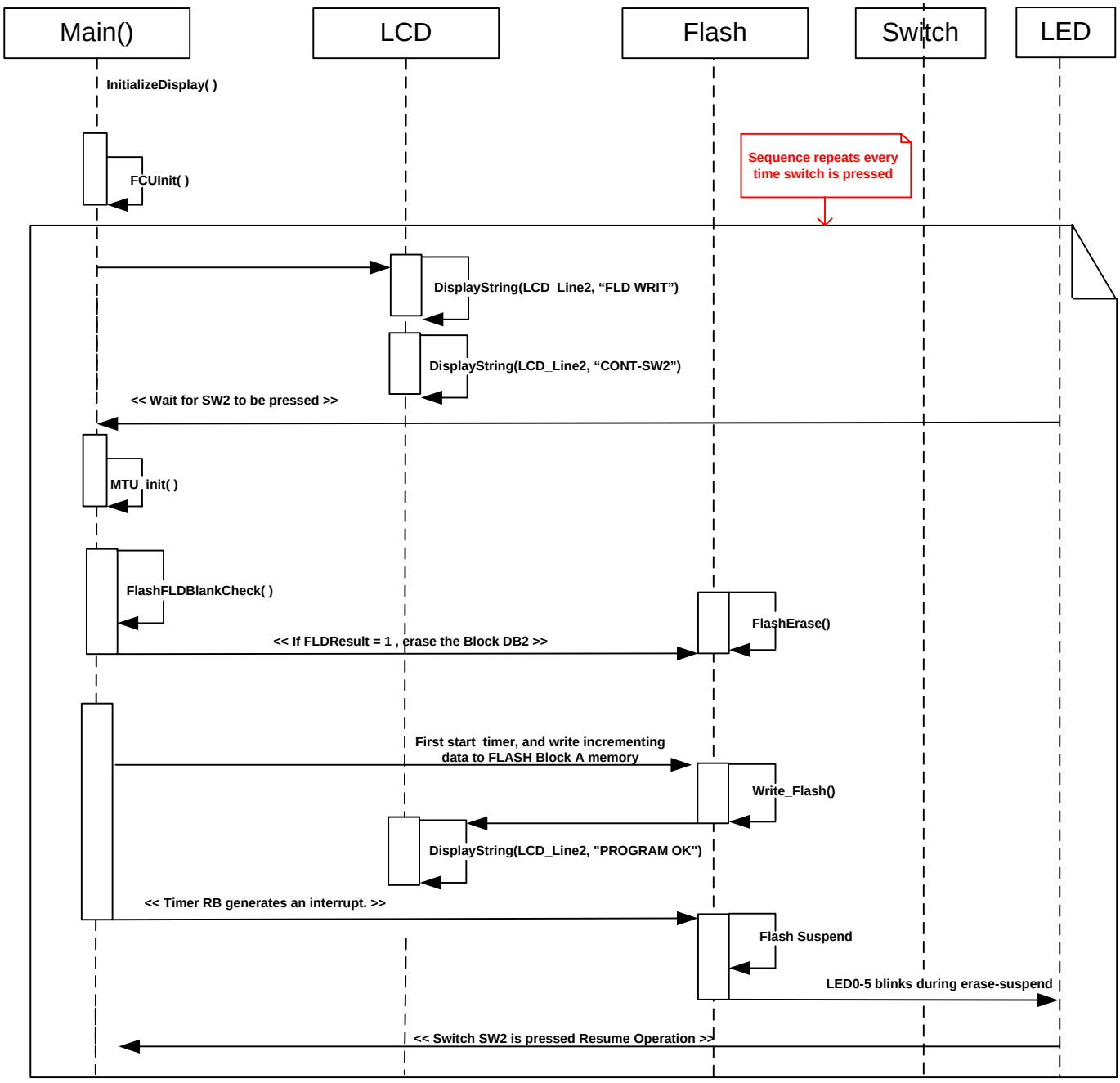

Figure 16: Flash Suspend Sequence Diagram

3.1.14.2. Description

1- Flash suspend sample code initializes the LCD module and displays “FLD WRIT” on Line-1 and “CONT-SW2” on Line-2.

2- The Flash is initialised.

3- When SW2 is pressed, the MTU is configured in timer mode and a blank check on the block is performed.

4- If blank check fails, the block is erased.

5- The block is initialised by writing an incrementing data to the block.

6- Flash write suspend occurs once the timer interrupt occurs and partial block remains blank due to suspend.

7- When user presses switch SW2, the write operation is resumed again.

3.1.15. Sync_Serial

This sample code demonstrates a synchronous serial communication using on-chip serial interface module.

3.1.15.1.Sequence Diagram

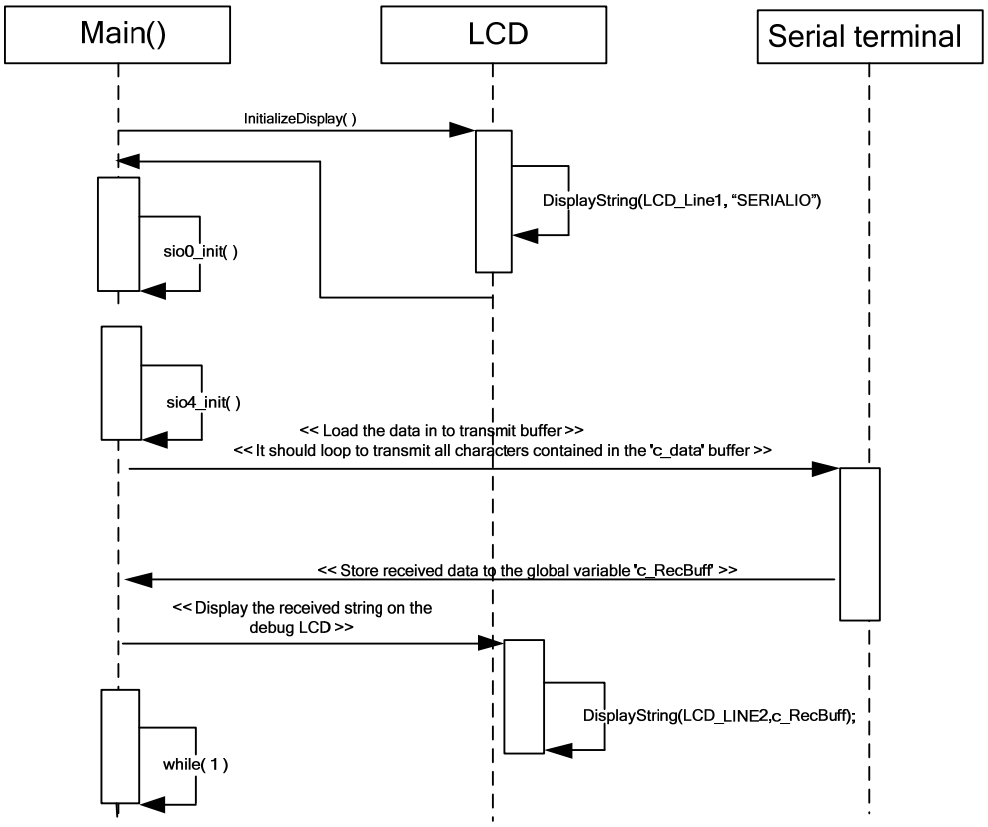

Figure 17: Sync_Serial Sequence Diagram

3.1.15.2. Description

1- The Sync_serial sample code initializes LCD module and displays "SERIALIO" on Line-1.

2- The serial channel is configured for synchronous data communication.

   a. SCI4 is configured as transmitter and

   b. SCI0 is configured as receiver.

3- Transmitter sends the serial data to the receiver port, synchronised with the clock.

4- The received data should match with the transmitted data string.

5- Successful reception is displayed on the LCD.

Chapter 4. Additional Information

For details on how to use High-performance Embedded Workshop (HEW), refer to the HEW manual available on the CD or installed in the Manual Navigator.

For information about the SH7216 microcontrollers refer to the *SH7216 Group Hardware Manual*

For information about the SH7216 assembly language, refer to the *SH-2A SH2A-FPU Software Manual*

For information about the E10A Emulator, please refer to the *E10A-USB Emulator User's Manual*

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