AN11551

IR remote controller/receiver solution for Windows Media Center

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Document information

Info	Content
Keywords	LPC812, LPC1343, Windows Media Center
Abstract	This application note describes the IR remote controller/receiver solution for Windows Media Center (WMC) based on LPC812 and LPC1343.

Revision history

Rev	Date	Description
1	20140813	Initial version

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1. Introduction

Windows Media Center (WMC) is a home entertainment application developed by Microsoft to enjoy various digital entertainment programs on the computer or TV, browse pictures, organize and play music and videos, view and record live videos, and download movies.

This application note describes an IR remote controller/receiver system for WMC, based on LPC1343 and LPC812 microcontrollers. The LPC1343 is an ARM Cortex-M3 based microcontroller that can run up to a frequency of 72 MHz. The data communication with the host PC is easy because of the on-chip full-speed USB device controller. The LPC812 is an ARM Cortex-M0+ based microcontroller that can run up to a frequency of 30 MHz. The advanced State Configurable Timer (SCTimer/PWM) module can be flexibly used to produce PWM to drive the IR signal emission.

2. System overview

2.1 Overview

There are two boards included in the WMC IR remote controller/receiver system:

- IR receiver module based on LPC1343.
- Remote controller based on LPC812.

The IR receiver module transmits/receives IR data to/from Windows through a USB connection. The IR data transmission between the remote controller and the IR receiver is based on RC-6 protocol. The transmission of data from LPC1343 IR receiver to Windows is based on USB HID class. Fig 1 shows the diagram of the IR remote controller/receiver system.

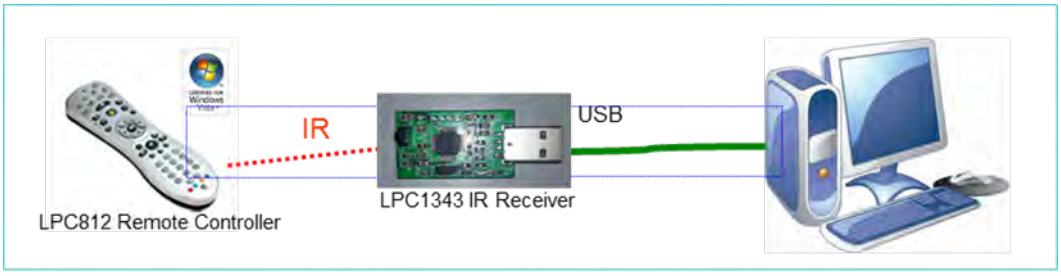

Fig 1. **IR remote controller/receiver system for WMC**

2.2 Features

The LPC812 based remote controller has the following features:

- Compatible with WMC IR remote controller functions.
- Based on the Philips RC-6 protocol.
- On-chip IRC as clock source.
- Active current (transmitter off): 2.1 mA at 3.0 V.
- Standby (power-down) current: 1.6 uA at 3.0 V.

The LPC1343 based IR-USB receiver has the following features:

- Compatible with WMC IR receiver functions.
- Acts only as IR receiver.
- Based on the Philips RC-6 protocol.
- Wake up Windows from S1-standby or S3-suspend to RAM state.
- Plug and Play USB interface.

3. Hardware description

3.1 Hardware for LPC812 IR remote controller

Fig 2 shows the block diagram of the remote controller. The main function of this circuit is to capture the key-press event and emit the IR data. Some functions are restricted because an off-the-shelf remote controller was used where the LPC812 microcontroller was used to replace the MCU directly on the PCB board. However, the main functions remain unaffected.

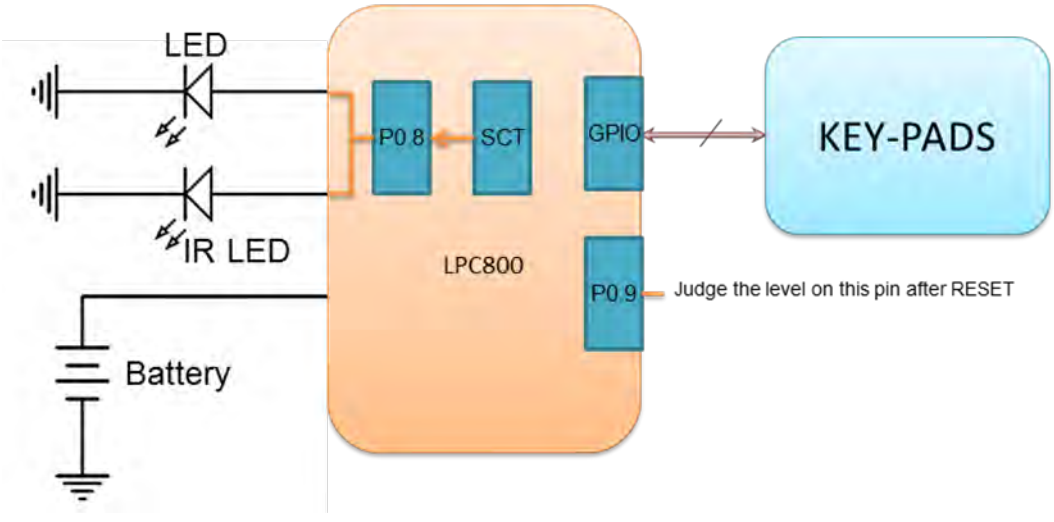

Fig 2. **Block diagram of the remote controller**

3.2 Hardware for LPC1343 IR-USB receiver

Fig 3 shows the LPC1343 IR-USB receiver schematic and Fig 4 shows the block diagram. Pin P3_0 of LPC1343 senses the pulses from the IR receiver module while P2_7 is used to control an LED to indicate the status of the received data. RST/P0_0 pin and P0_1 pin are connected to P1 header that can be used to make LPC1343 enter the USB ISP mode for programming or firmware update.

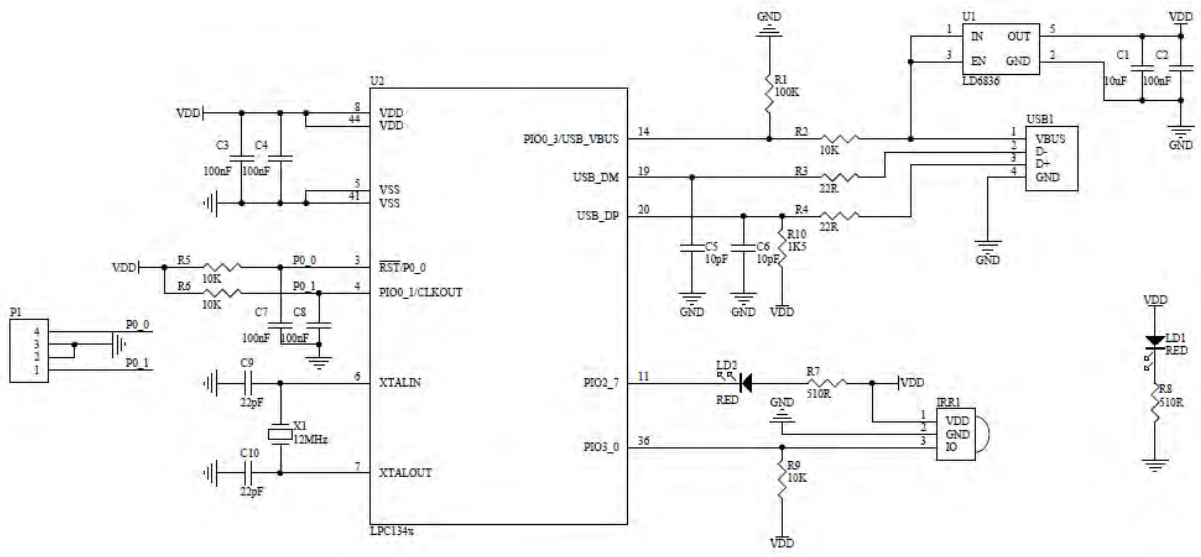

Fig 3. Schematic of LPC1343 IR-USB receiver

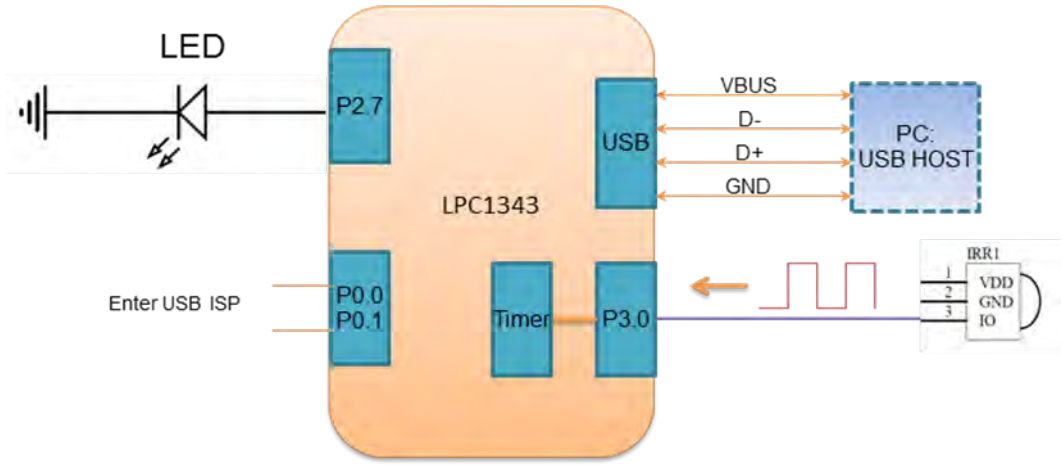

Fig 4. Block diagram of LPC1343 IR-USB receiver

4. Software description

4.1 Introduction of RC-6 protocol

Philips has defined the RC-6 protocol to be a versatile follow-on to the RC-5 protocol. RC-6 carrier frequency stays at 36 kHz and the duty cycle ranges from 25% to 50%. Normally, 1/3 is used as duty cycle.

Fig 5, Fig 6, and Fig 7 show three different data symbols defined in the RC-6 protocol.

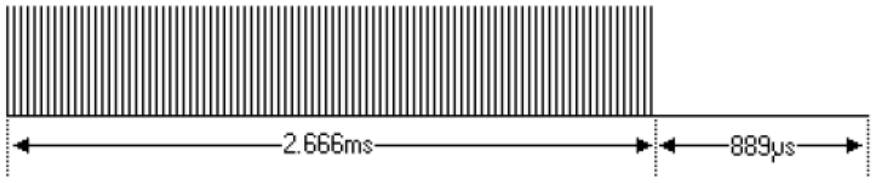

Fig 5. Leader signal

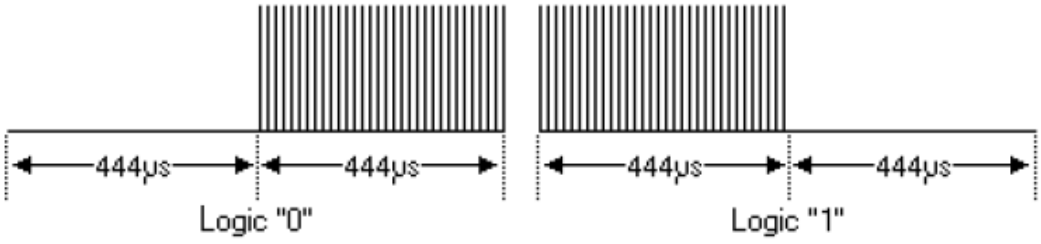

Fig 6. Logic signal

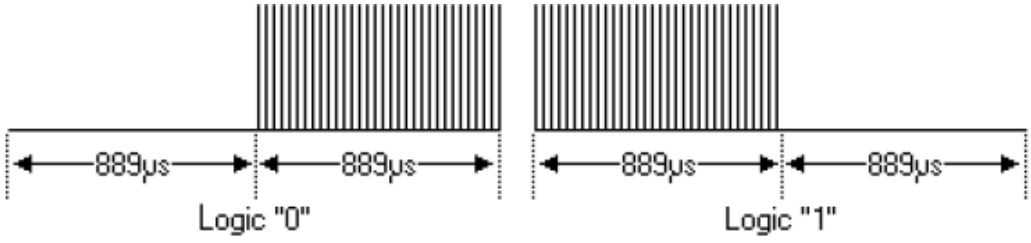

Fig 7. Trailer signal

The waveforms are obtained by probing pin P0_8 of LPC812. Data is modulated using Manchester coding. Each bit has a mark and a space in the output signal. If the bit is a '1', the first half of the bit time is a mark and the second half is a space. For bit '0', the first half of the bit is a space and the second half is a mark.

The leader pulse in Fig 5 has a mark time of 2.666 ms and a space time of 0.889 ms. The leader pulse is used to set the gain of the IR receiver unit. The logic signal in Fig 6 has a mark time of 0.444 ms and a space time of 0.444 ms. The trailer signal has a space and mark time of 0.889 ms. '0' and '1' are encoded by the position of the mark and space in the bit time.

RC-6 protocol uses different operating modes. Mode 6A, also called OEM mode, is the most popular. Fig 8 shows the definition of mode 6A. This mode is subdivided into two modes:

- Short Customer Code mode with 8-bit length of customer code and up to 24 bits of data length.
- Long Customer Code mode with 16-bit length of customer code and up to 128 bits of data length.

The Long Customer Code mode is used in this application and the customer code is specified as 0x800F. The data length is set to 16 bits.

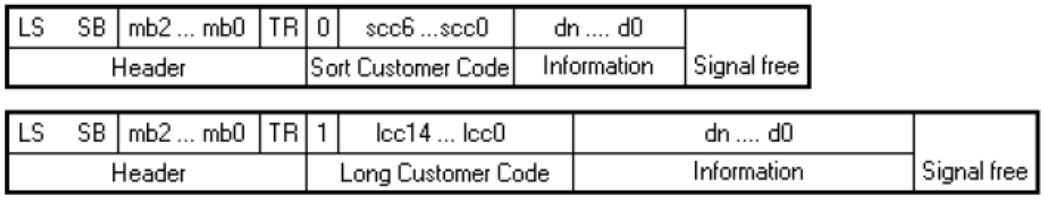

Fig 8. Definition of Mode 6A

The IR signal is filtered from the IR receiver module when the signal with the same carrier frequency as the module is received. Fig 9 shows an example of the RC-6 waveform that has been filtered from the receiver module.

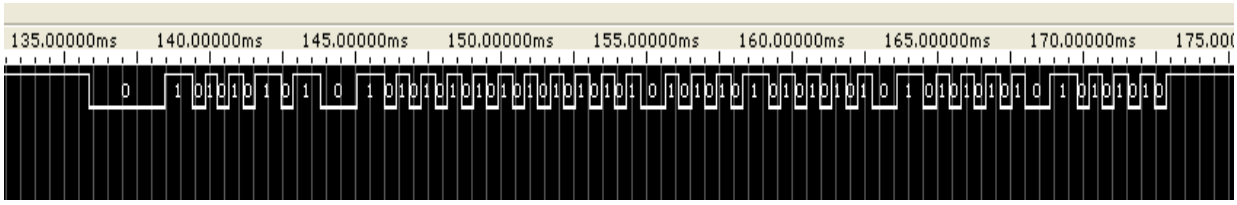

Fig 9. Waveform from receiver module

4.2 Software description of remote controller

In this application, the SWD debug port is also used as a GPIO because of the limited pin-count in LPC812. The level on pin P0_9 is used to re-enable SWD function of these pins. Set pin P0_9 to LOW during reset to re-enable SWD.

In this application, SCTimer/PWM is used to generate PWM with 1/3 duty cycle as the IR signal carrier. SCTimer/PWM also serves as a timer with a configurable status feature. SCTimer/PWM can be used in many applications. For more examples on SCTimer/PWM, see the Cookbook released by NXP [7].

Fig 10 shows the flow chart of the software in LPC812 remote controller.

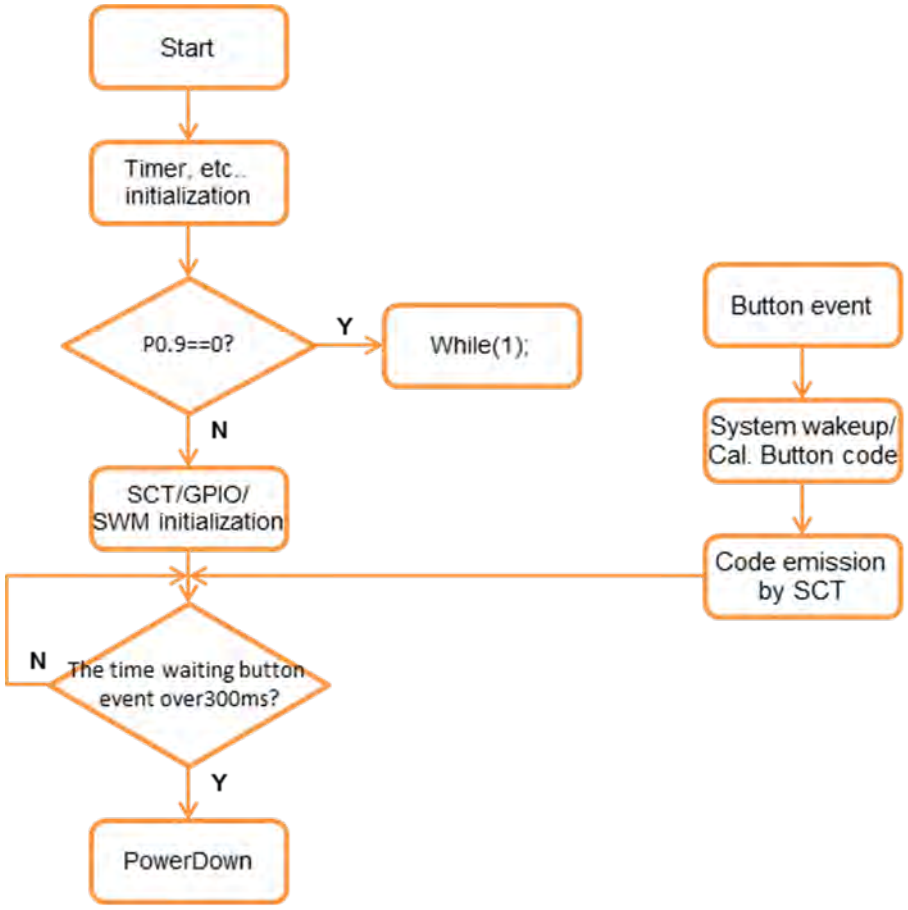

Fig 10. **Flow chart of LPC812 remote controller operations**

4.3 Software description of LPC1343 IR receiver

The primary function of the IR-USB receiver is to receive the correct IR data from the remote controller and send the data to Windows through a USB connection. The GPIO connected with the IR receiver module, pin P0_3, senses the signal using the interrupt function and the timer is used to measure the width of the pulse. The correct data is then sent to Windows.

Fig 11 shows the flow chart of the LPC1343 IR-USB receiver module.

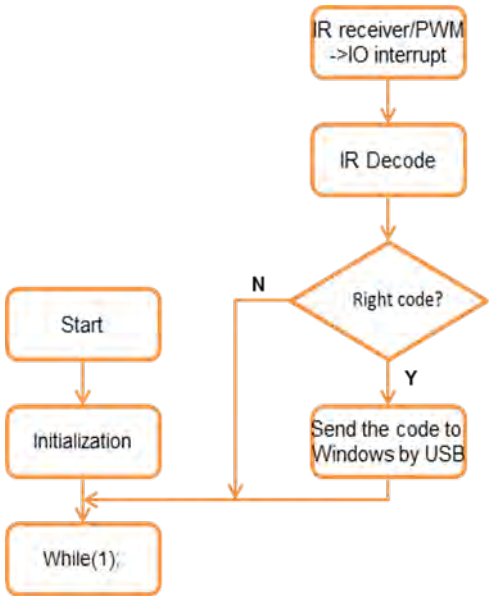

Fig 11. **Flow chart of LPC1343 IR-USB receiver module**

5. Operation

Windows automatically installs the driver when the IR-USB receiver board is plugged into the USB port of the PC. After the driver is installed successfully, a new HID device appears in Windows Computer Management. See Fig 12.

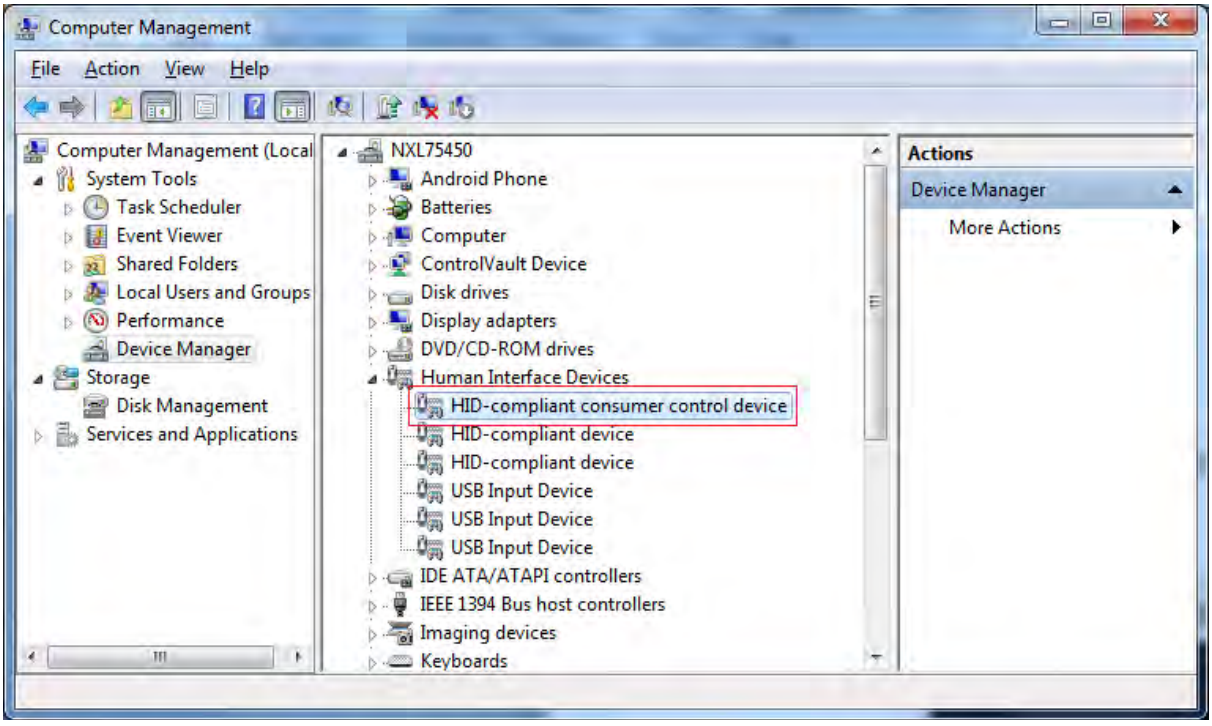

Fig 12. New HID device in Computer Management

Press the “Green Start” key with a Windows icon to start Windows Media Center application. See Fig 13. The remote controller can then be used to control the application.

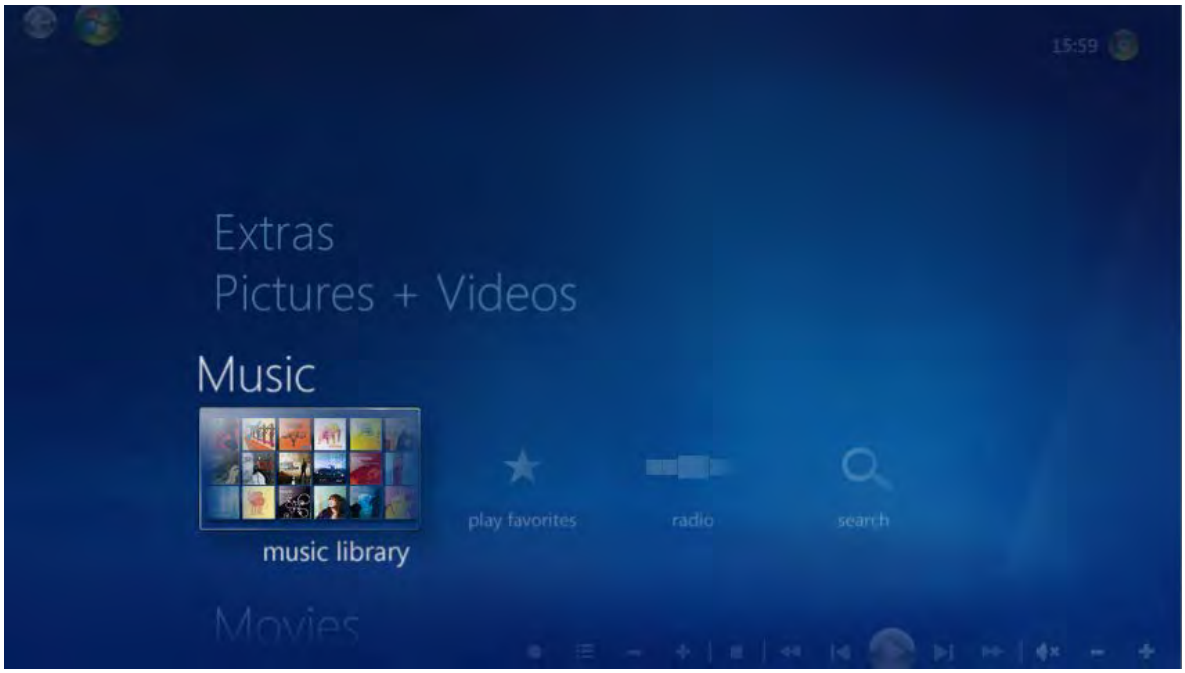

Fig 13. Startup window of WMC

You can use the remote controller to control the volume of the PC, move the cursor, flip the slides, and input some simple information like the numerals and symbols. See Fig 14.

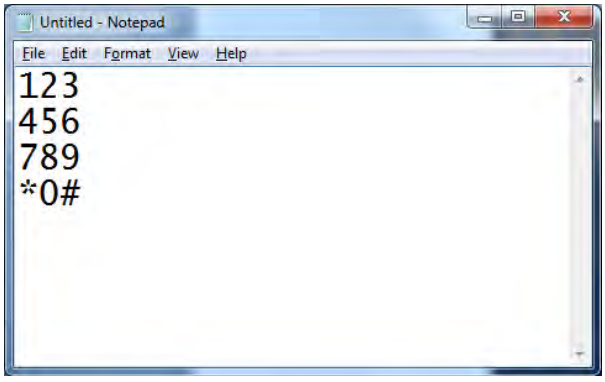

Fig 14. Example of numeral input by the remote controller

6. Conclusion

This application note uses an IR controller/receiver system based on LPC812 and LPC1343 for Windows Media Center home entertainment. The LPC812 is compatible with WMC IR remote controller and has low power consumption. LPC1343 is compatible with WMC IR receiver functions. Both MCUs use the versatile RC-6 protocol for communication.

7. References

[1] UM10601; LPC800 User Manual Rev. 1.6 — 2 April 2014.

[2] UM10375; LPC1311/13/42/43 User Manual Rev. 5 — 21 June 2012.

[3] Universal Serial Bus Revision 3.0 Specification.

[4] Device Class Definition for Human Interface Devices (HID) Version 1.11.

[5] Universal Serial Bus HID usage tables V1.2.

[6] Philips RC-6 Protocol.

[7] LPC800 SCT Cookbook Rev 1.0 —09 August 2013.

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