Freescale Semiconductor
Application Note

AN2963
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A Simple 2-way RF Link Using MC33695 (Echo) and MC9S08RG60 MCU

Introduction

This document describes the setup and use of a simple RF link using the MC33695 RF transceiver (code name ‘Echo’). The MC9S08RG60 8-bit MCU demo board and the Echo software drivers are described in application note AN2961.

The demo allows the user to set up a simple RF link between two transceivers. One transceiver sends a message to the second transceiver when the user presses a button. The second transceiver flashes an LED to indicate correct reception of the message, and then sends a reply to the first board. The first transceiver flashs an LED to acknowledge the reply.

The link uses OOK modulation with a data rate of 2400 baud. It can be configured for different frequency bands (315 MHz or 434 MHz at the time of publication). Full source code is supplied, so the program can modified, or used as a basis for other projects.

The reader should be familiar with the Echo device data sheet.

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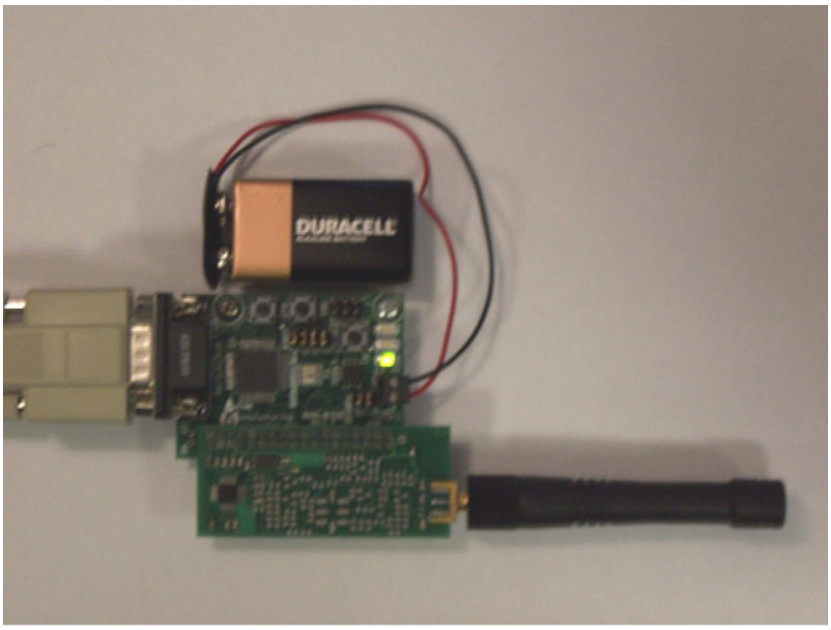

Figure 1. MC9S08RG60 MCU Board and Echo RF Module

Requirements

To set up the link the following hardware and software are required:

- 2 x MC9S08RG60 demo board (part no. DEMO9S08RG60)
- 2 x Echo RF module (part no. MC33695MOD315 or MC33695MOD434)
- Metrowerks CodeWarrior, version 3.0 or later
- AN2963SW.zip, which contains the software files that are programmed into the MCU boards.

Programming the Demo into the MC9S08RG60 Demo Board

The demo program must be programmed into the Flash memory of the MC9S08RG60 demo boards before they can be used. Programming tools are available for the HC(S)08 MCU families that can be used for this purpose. This application note describes how to program the MC9S08RG60 using a free evaluation copy of the CodeWarrior development environment and the MC9S08RG60 demo boards' built in serial monitor.

To program the demo into the MC9S08RG60 MCU, do the following.

1. Install CodeWarrior. You must have a copy of the CodeWarrior development tool for HC(S)08 installed. A copy of CodeWarrior is supplied with the MC9S08RG60 demo board. Follow the instructions supplied with the MC9S08RG60 demo board.

NOTE

You must register CodeWarrior after installation. You will be sent a license file by email after registering. This file must be installed correctly. Refer to the installation documentation supplied with the CodeWarrior CD.

2. Unzip file AN2963SW.zip. This unzips a CodeWarrior project called 'EchoRG60Demo', which contains the programming file for the demo.
3. Install power select (PWR_SEL) jumpers 1 and 2 on the MC9S08RG60 evaluation board. Both jumpers must be installed.
4. Install all USER jumpers
5. Connect the serial port connector on the MC9S08RG60 demo board to a PC communication port using a 9-pin straight-through serial cable.
6. Connect a 9-V power supply or battery to the power connector on the MC9S08RG60 demo board
7. Start CodeWarrior (Start menu->Metrowerks->CodeWarrior->CodeWarrior IDE).
8. Select File->Open, navigate to the directory where AN2963SW.zip was unzipped, and open the file EchoRG60Demo.mcp. This opens a CodeWarrior project.
9. Press and hold the reset and SW1 switches on the MC9S08RG60 demo board. Release the reset switch while continuing to hold SW1. Then release SW1. This puts the demo board into 'serial monitor mode', ready to receive data from CodeWarrior.
10. In CodeWarrior, click on file 'main.c' in the Files window. Then press key F5 or select Project->Debug from the menu bar. This launches a debugger which communicates with the MC9S08RG60 demo board and attempts to burn the Echo demo program into Flash memory on the MCU.
11. If the MCU's Flash memory is blank, the debugger will program the Echo demo into memory. You should see the screen shot shown in Figure 2 when programming completes. Go to step 15.
12. If the MCU's Flash memory is not blank, the debugger will report an error. Click OK in any error windows that appear, then select MONITOR-HCS08->Erase Flash from the menu bar.
13. Now select MONITOR-HCS08->Load from the menu bar. Select file 'EchoRG60Demo.abs' from the project directory.
14. The debugger will program the demo into the MCU's Flash memory. You should see the screen shot shown in Figure 2 when programming completes.
15. The demo program has now been programmed into the MCU demo board. CodeWarrior is no longer required. Shut down all CodeWarrior windows and exit the program.

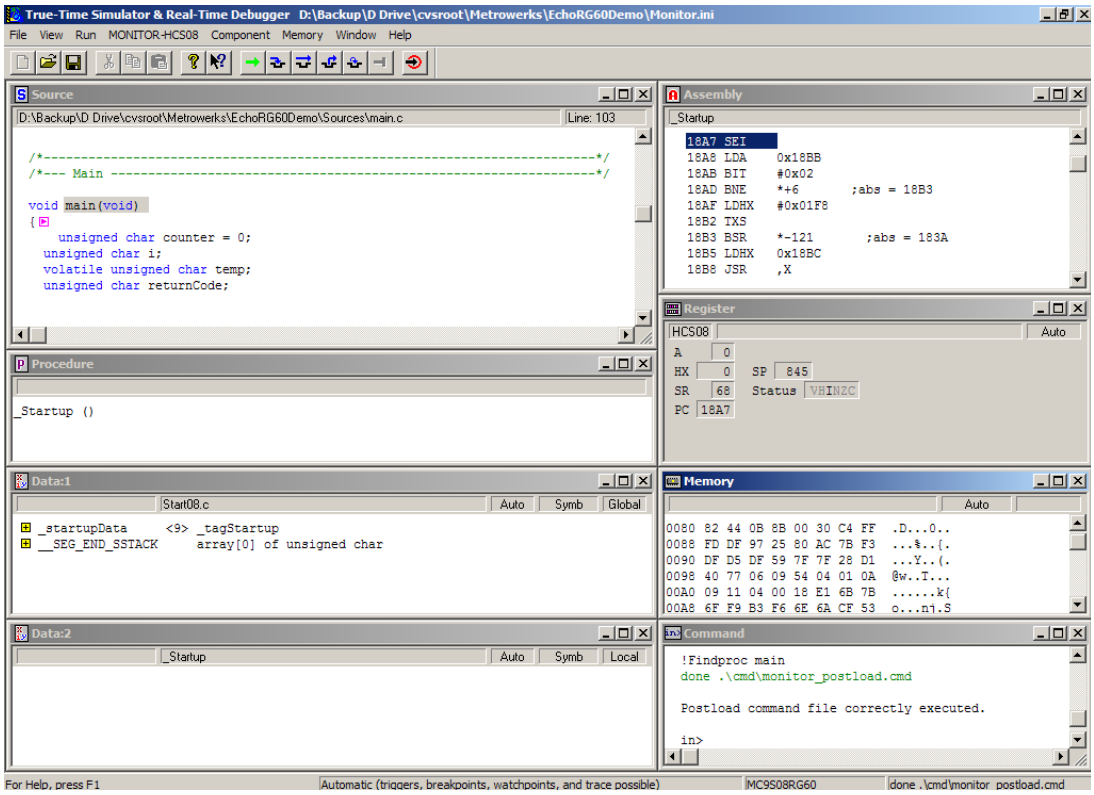

Figure 2. Screen Shot of Debugger After Programming

Using the Demo

Hardware Setup

The Echo RF module and the MC9S08RG60 demo board form a RF transceiver. For this simple demo, you need to construct two transceivers. You can use more than two if required.

The hardware should be set up as follows:

1. Connect the Echo RF module to connector J1 on the MC9S08RG60 evaluation board. Pin 1 on each board must be aligned.
2. Connect an antenna to the Echo RF module.

NOTE

Echo RF modules are available in a range of frequencies; each is supplied with an appropriate antenna. Make sure you use RF modules that are all of the same frequency.

3. Install power select (PWR_SEL) jumpers 1 and 2 on the MC9S08RG60 evaluation board. Both jumpers must be installed.
4. Connect a 9-V power supply or battery to the power connector on the MC9S08RG60 demo board.

See Figure 1 for a reference setup.

Configuring the RF Link Frequency Band

The Echo RF modules are available for various frequency bands (315 MHz and 434 MHz versions are available at the time of publication, 868 and 916 MHz may be available later). Each module is hard-wired to one frequency band.

CAUTION

Ensure that the RF modules used are both for the same frequency band.

Each transceiver requires a configuration step to correctly set up Echo's internal registers for a specific frequency band. When the MC9S08RG60 board powers up, it flashes LED2 to show the user the current frequency configuration. The number of flashes determines the selected frequency band (see Table 1).

NOTE

At the time of publication, the 868 MHz and 916 MHz RF modules have not been released.

Table 1. Frequency Band Selection

Number of Flashes	Frequency Band (MHz)[1]
1	315
2	434
3	868[2]
4	916[2]

1. The default value is 1 – 315 MHz.
2. Not released at time of publication.

To change the frequency setup to another band:

1. Press and hold the reset button.
2. While holding the reset button, hold down SW2.
3. Release the reset button while holding SW2.
4. Let the LED flash for the number of times required.
5. Release the SW2 key during the last flash.

For example, if you wish to choose the 434-MHz band, LED2 should flash two times. During the second flash, release SW2.

The frequency band value is held in Flash memory on the MC9S08RG60, so it will be kept even after removing power to the board.

LED2 will flash to indicate the chosen frequency band each time the board is reset.

RF Link Description

Summary

Pressing switch SW1 on the first transceiver will cause Echo to transmit a message. The second Echo transceiver receives the message, checks the message for errors, then toggles LED2 and sends a reply if there are no errors. The first Echo transceiver acknowledges correct reception of the reply by toggling LED2.

With this simple demo, the user can perform simple range tests and have visual feedback of the integrity of the link in both directions. The RF link uses OOK modulated data at 2400 baud. The data bits are Manchester encoded. Refer to the the Echo device data sheet for full details of the modulation types and baud rates supported by Echo.

Detailed Description

Pressing switch SW1 on the MC9S08RG60 demo board will cause Echo to transmit a message. The message uses the ‘Header’ format described in application note AN2707 and in the Echo data sheet. The message structure is shown in Figure 3.

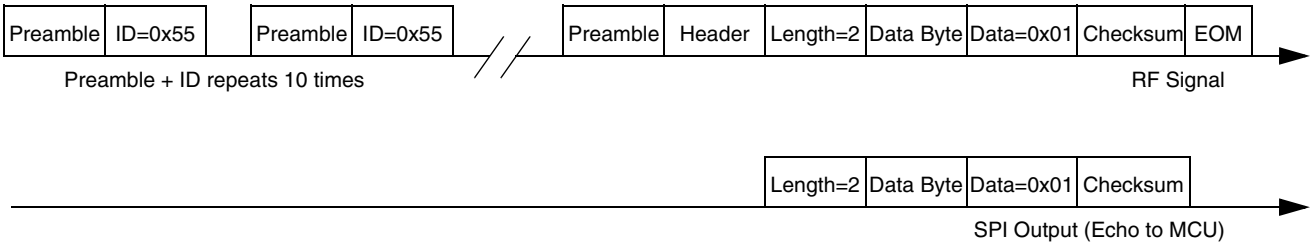

Figure 3. Message Frame

The message consists of a stream of ten preamble and ID fields followed by the preamble, a header field, a length byte (with a fixed value of 2), two data bytes, a checksum byte, and an end of message (EOM) field.

The ID byte is fixed at 0x55.

The first data byte of the message increments when SW1 is pressed.

The second data byte is always 0x01.

LED1 on the MC9S08RG60 demo board is lit when SW1 is pressed.

The second Echo transceiver receives the message, strips off the preamble, ID, header, and EOM fields, and passes the rest to the MC9S08RG60 via its SPI interface. See Figure 3.

The Echo software driver then checks the message for errors. If there is no error, the message is passed to the MCU (note that the checksum byte is removed by the driver). The MCU then compares the first data byte in the message with the first data byte received in the previous message. If the values are different,

it toggles LED2 and sends a reply message to the first Echo transceiver. If the values match, the LED is not toggled.

The reply message has the same format as the received message, but the second data byte is set to 0x02.

If the first Echo transceiver receives the reply, it toggles LED2.

Figure 4 shows the relationship between Echo, the MCU, and the software drivers

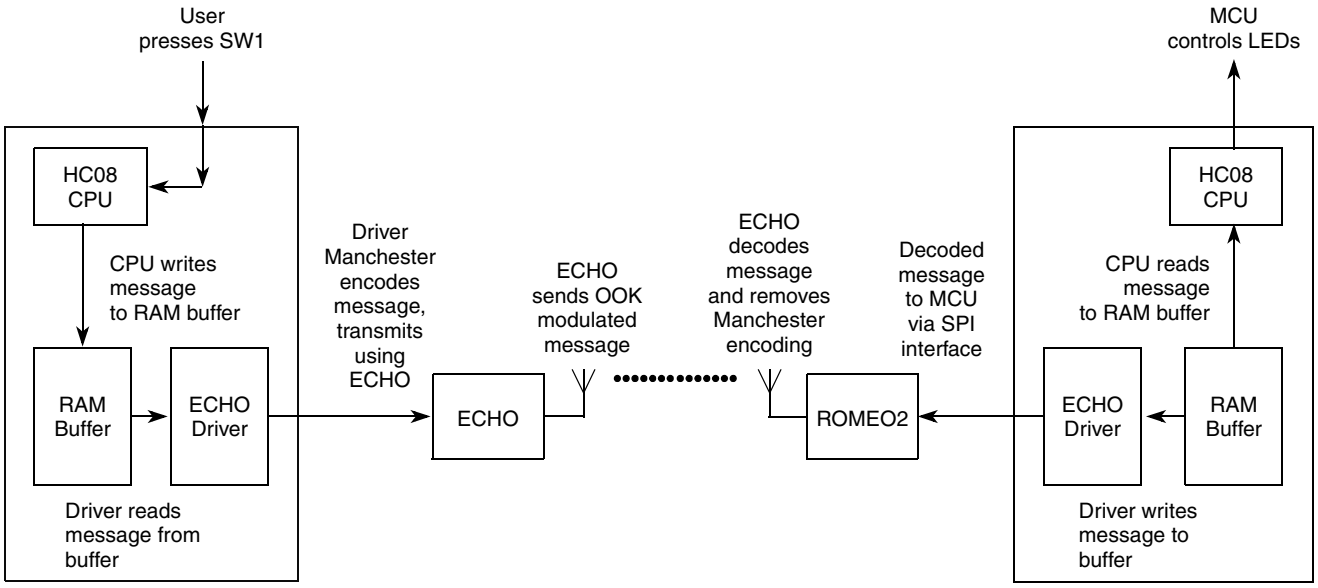

Figure 4. Block Diagram of RF Link

Modifying the Demo

The Echo demo program uses a simple structure. It uses the RF software drivers described in AN2961, and Freescale's Standard Software Driver for HCS08 Split Gate Flash, to allow storage of the carrier frequency settings in Flash memory (these drivers and their documentation can be downloaded from www.freescale.com).

Full source code is supplied for the demo. It is liberally commented and should be easy to understand.

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