RX610 Group

RIIC Single-Master Communication

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Abstract

This application note presents an example of communication by a single master device using the I^2C bus interface of a Renesas MCU.

Note: I^2C bus is a registered trademark of NXP Semiconductors of the Netherlands.

Introduction

This application note applies to the following MCUs and conditions.

MCUs: RX610 Group

This program can be used with other RX Family MCUs that have the same internal I/O registers (peripheral device control registers) as the RX610 Group. Check the latest version of the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

The program works with an endian specification of big or little and with left or right specified as the bit order.

Target Device

RX610 Group

Contents

1. Overview

1.1 Functions Used

An overview of the functions used in this application example is shown below.

Single master (7-bit address format)

- Master transmit
- Master receive

Note: For details of the I^2C bus communication format, see the RX610 Group hardware manual or the I^2C bus specification.

1.2 Operation

First the master transmits data (10 bytes), then it receives data (10 bytes). The communication speed is 100 kbps. The slave address of the device being communicated with is assumed to be 0x20 (including R/W bits). In addition, the address of the master device is 0x10.

2. Connection Diagram

Figure 1 is a connection diagram.

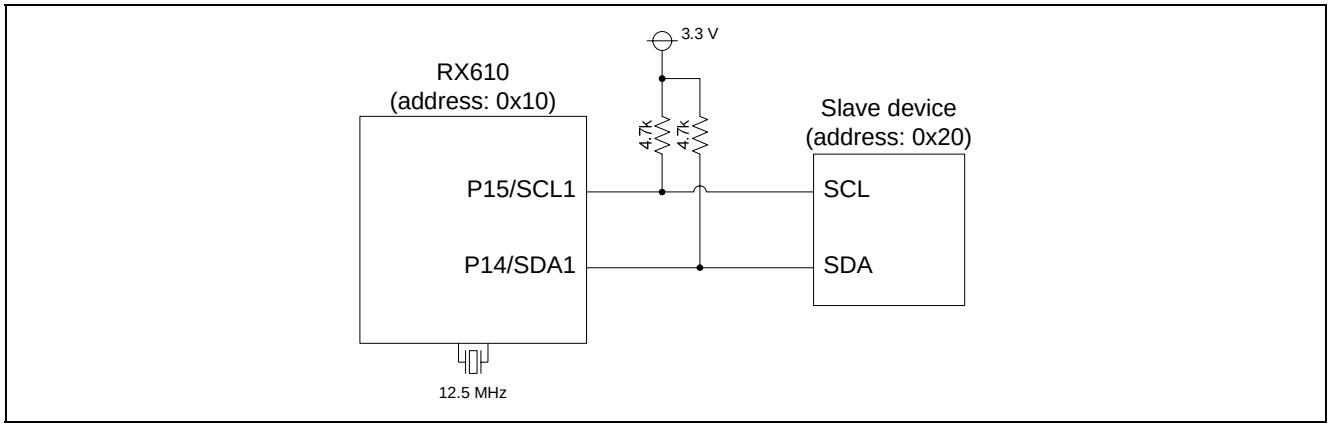

Figure 1 Connection Diagram

3. Details

3.1 Flowcharts

Flowcharts of the application example presented in this document are shown below.

3.1.1 Main Process

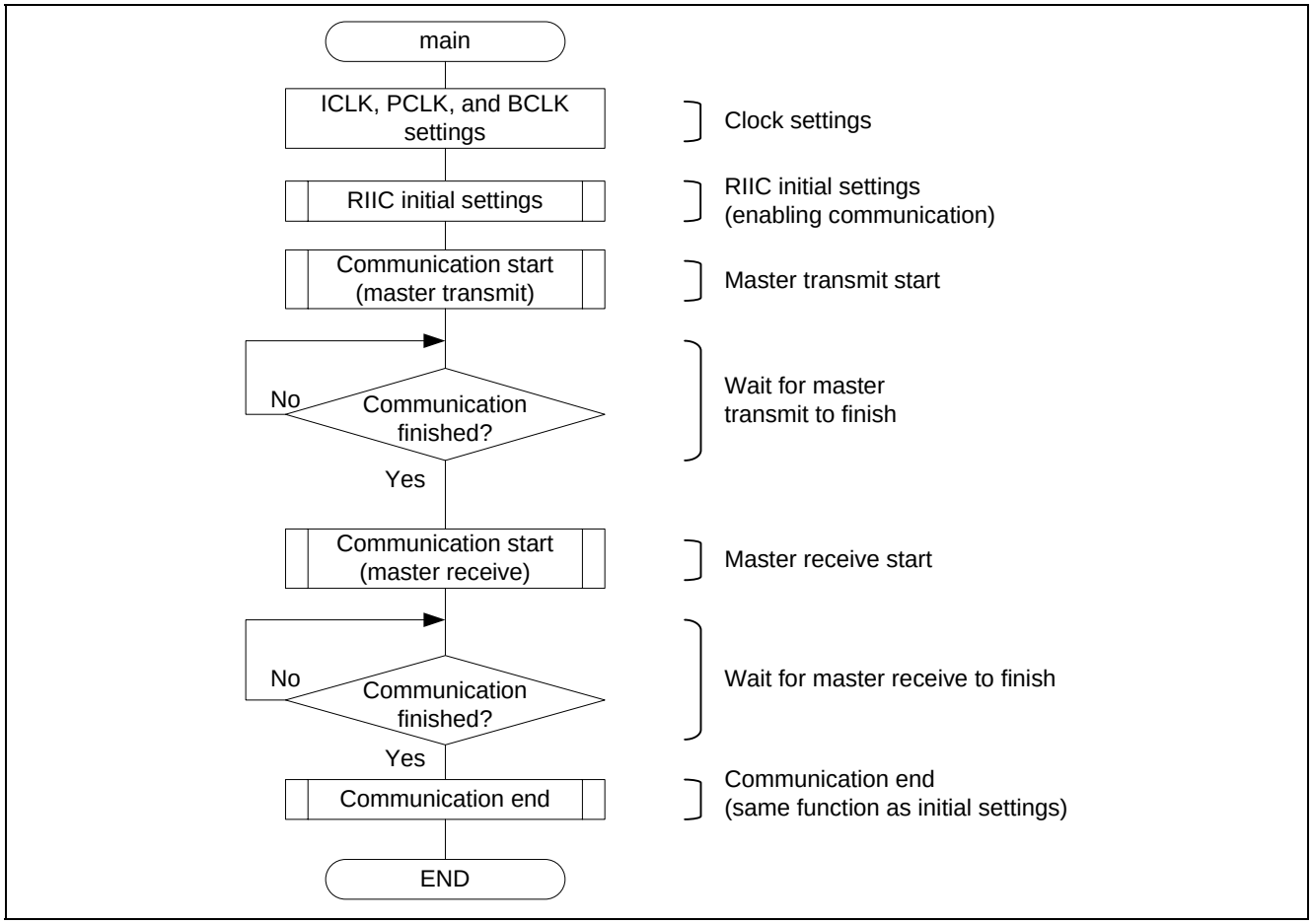

Figure 2 Main Function

3.1.2 RIIC Initial Settings

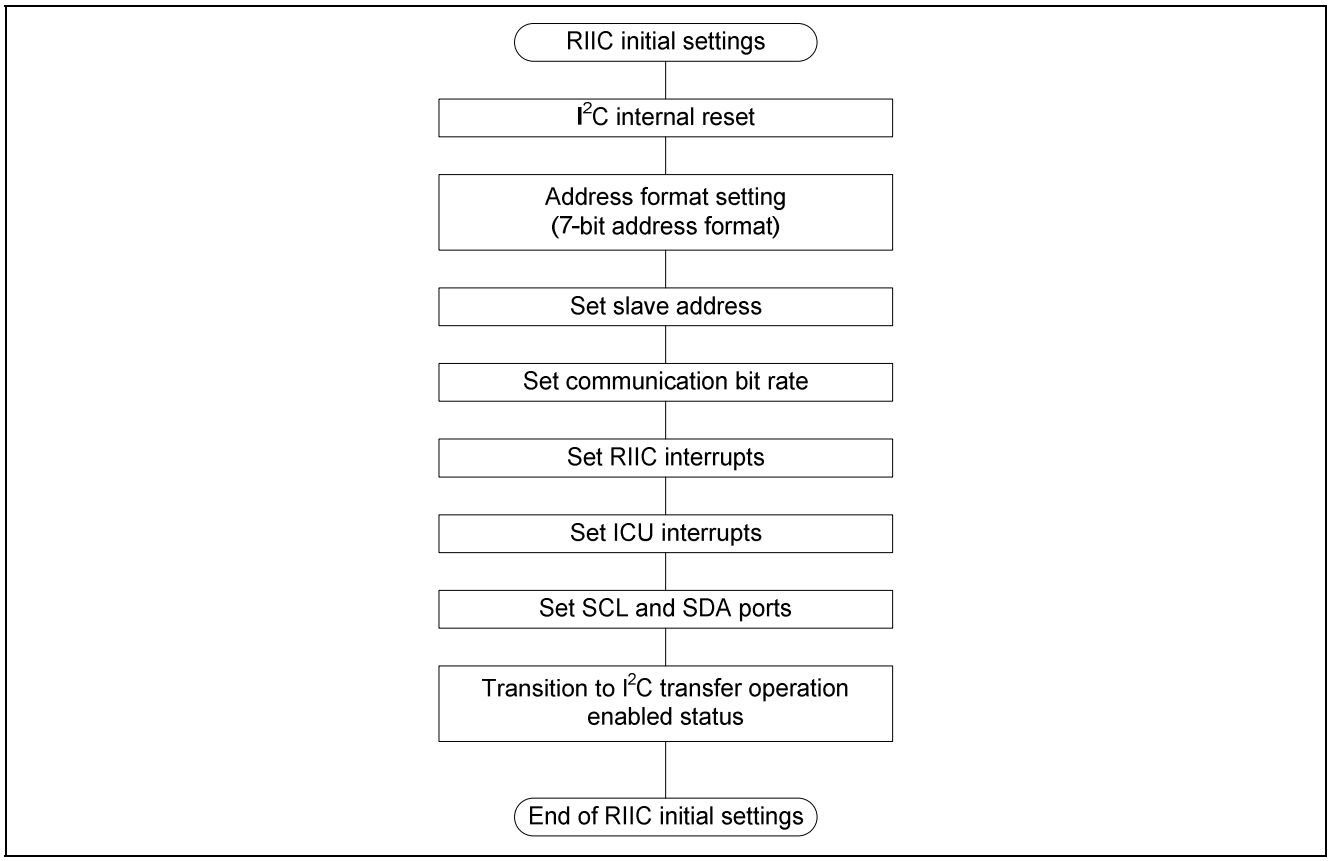

Figure 3 RIIC Initial Settings

3.1.3 Communication Start

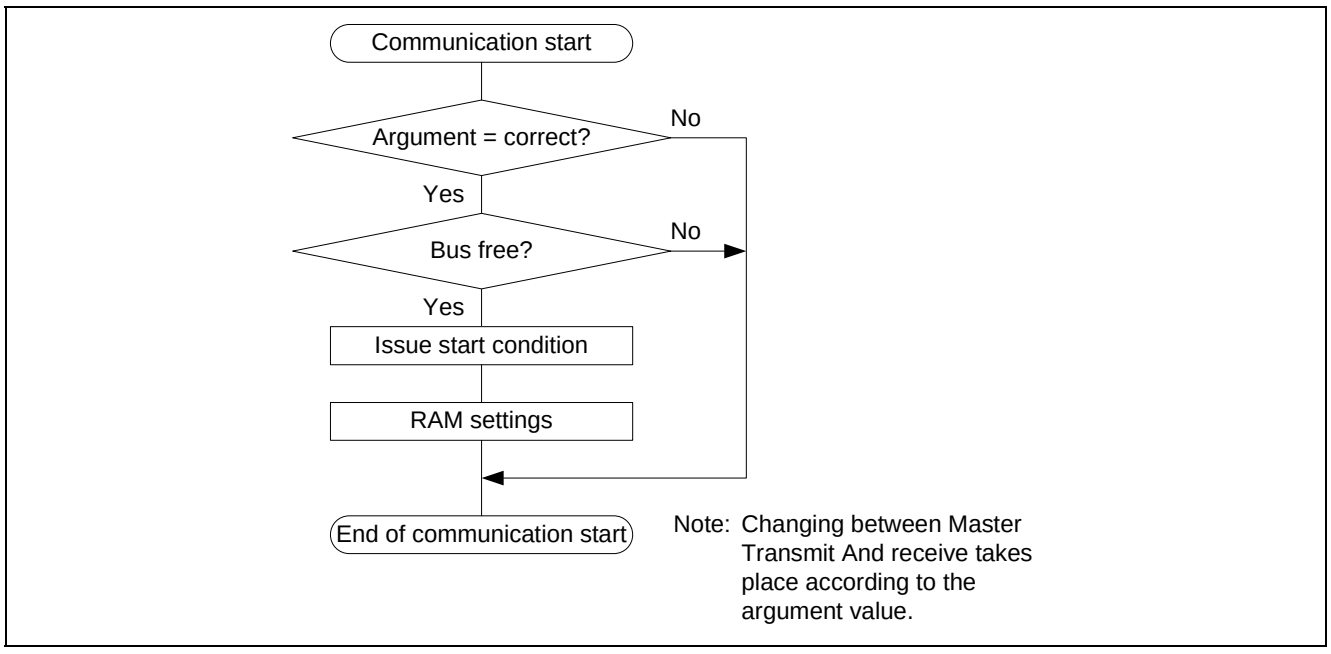

Figure 4 Communication Start

3.1.4 Transmit Data Empty Interrupt

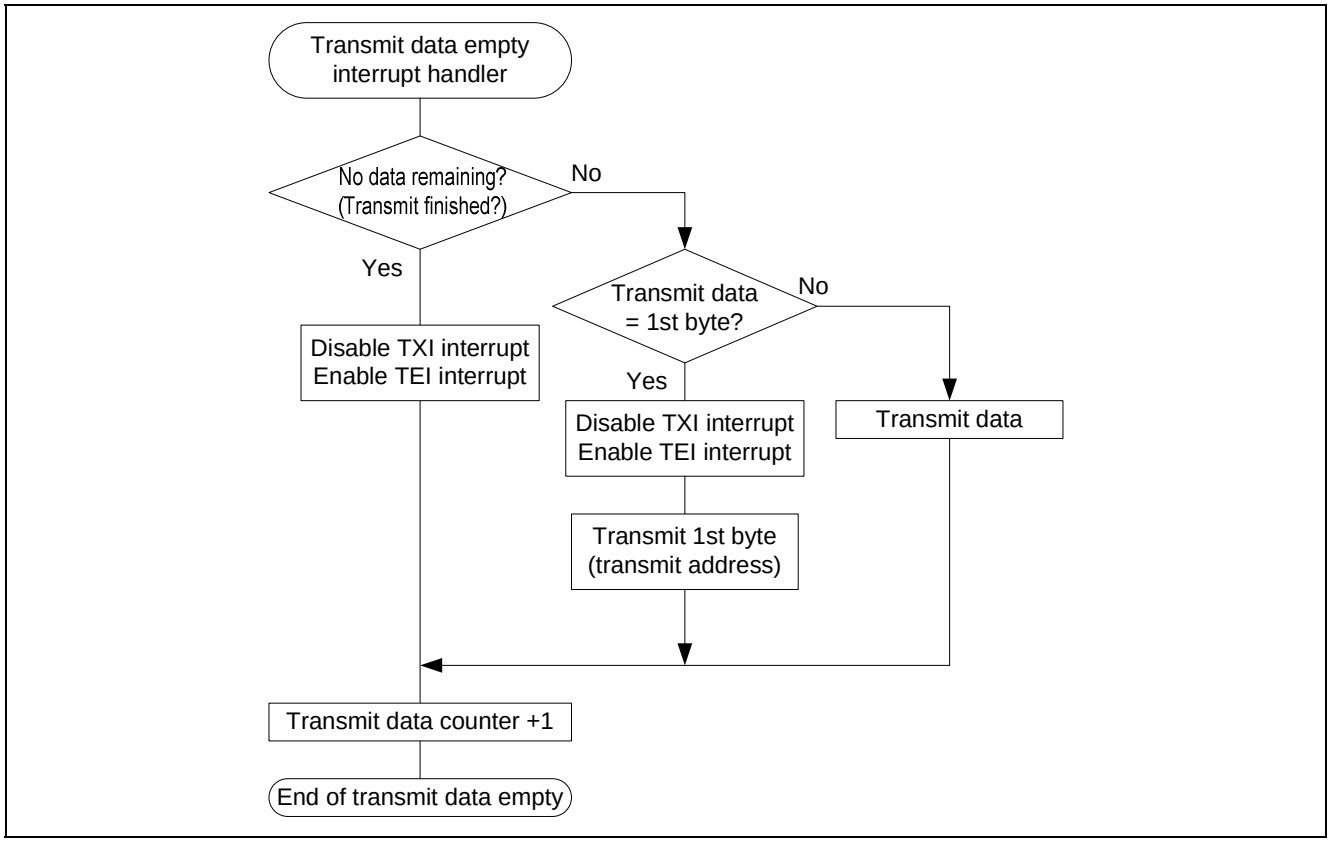

Figure 5 Transmit Data Empty Interrupt

3.1.5 Transmit Finished Interrupt

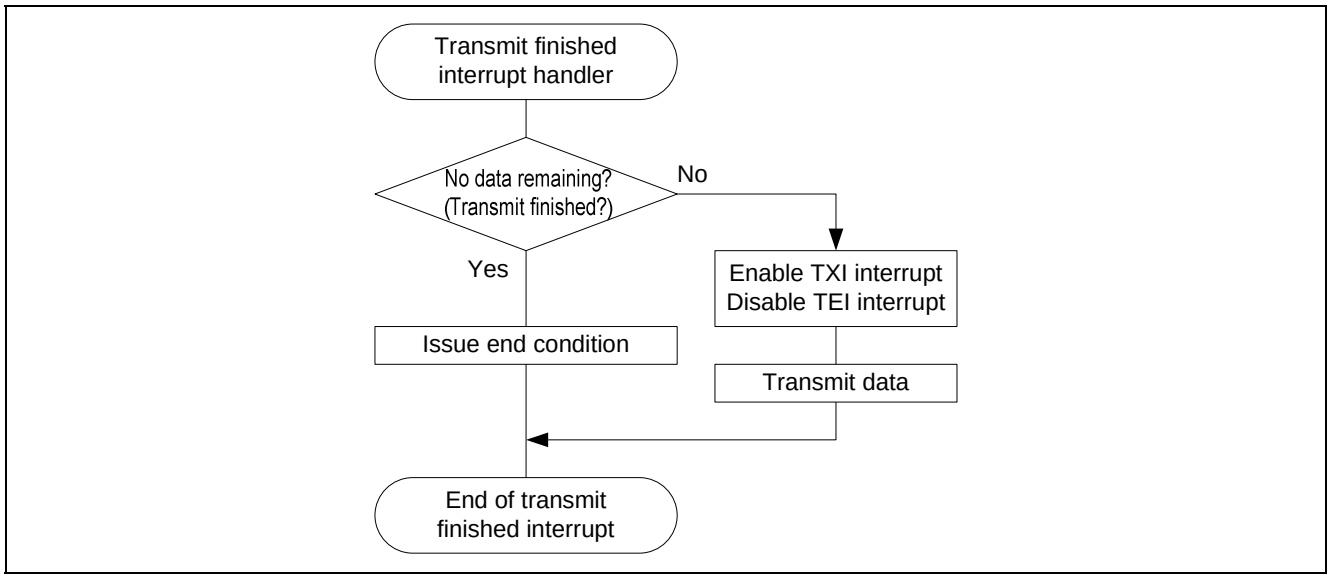

Figure 6 Transmit Finished Interrupt

3.1.6 Receive Data Full Interrupt

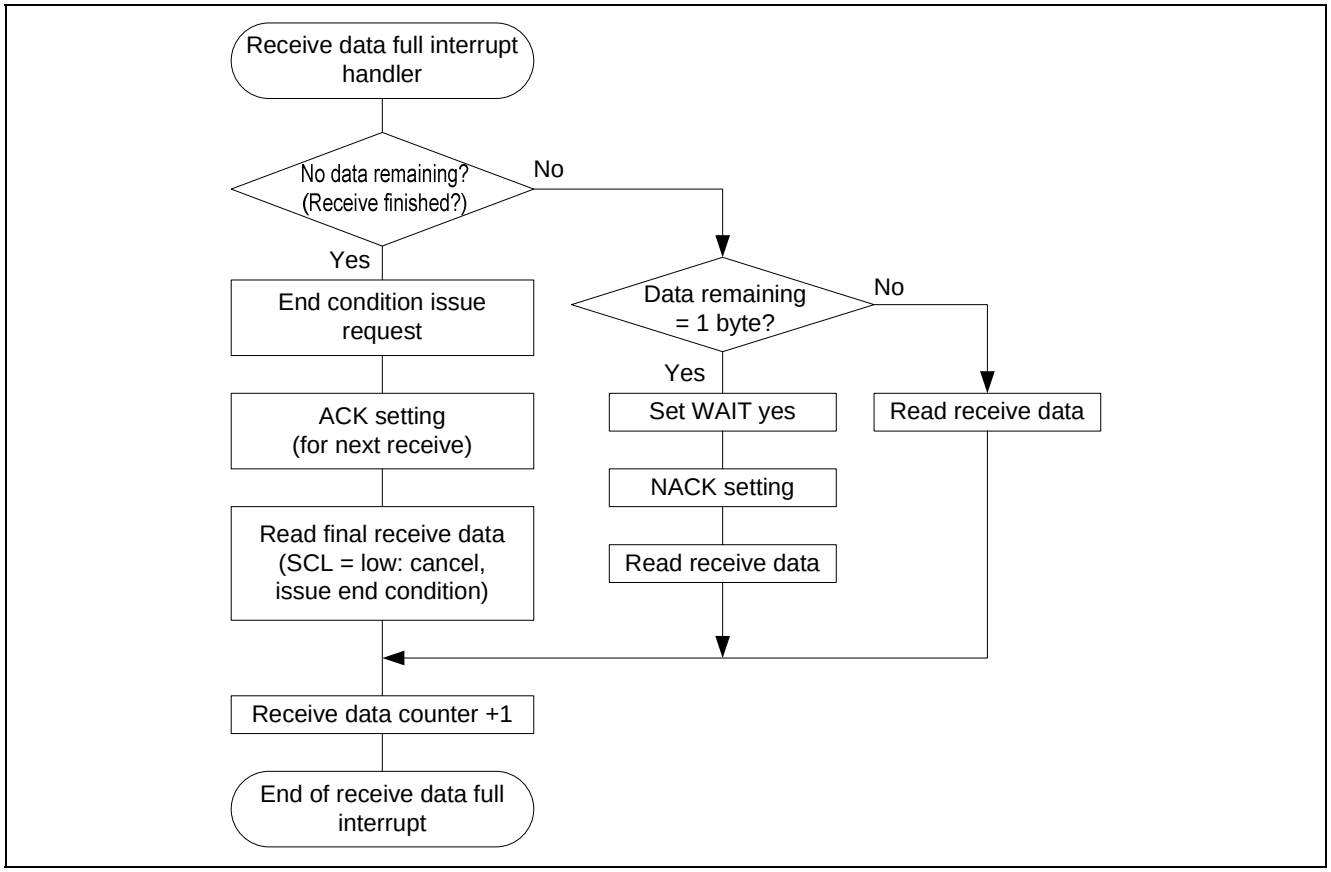

Figure 7 Receive Data Full Interrupt

3.1.7 Communication Error/Event Generation Interrupt

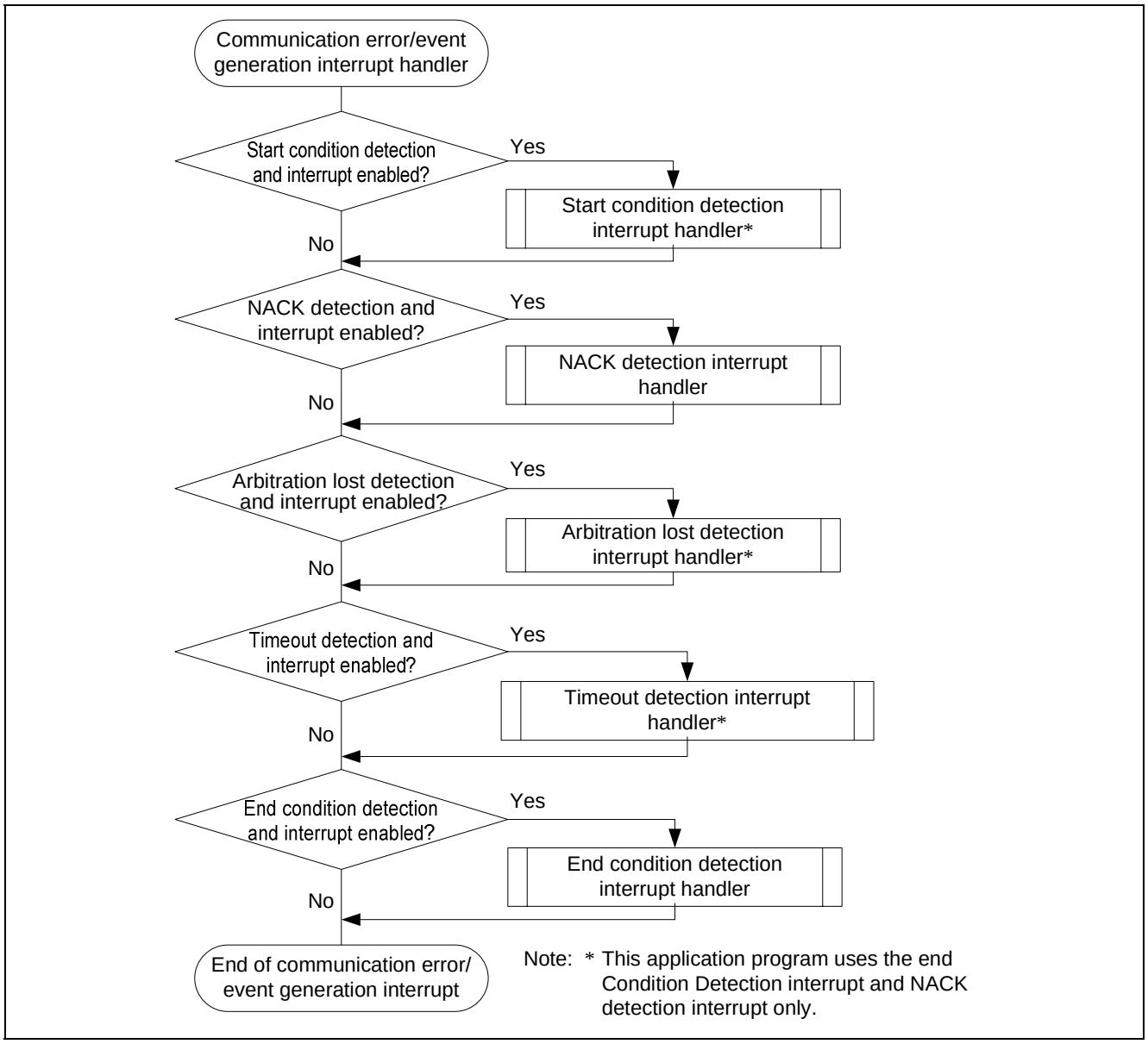

Figure 8 Communication Error/Event Generation Interrupt

3.1.8 End Condition Detection Interrupt

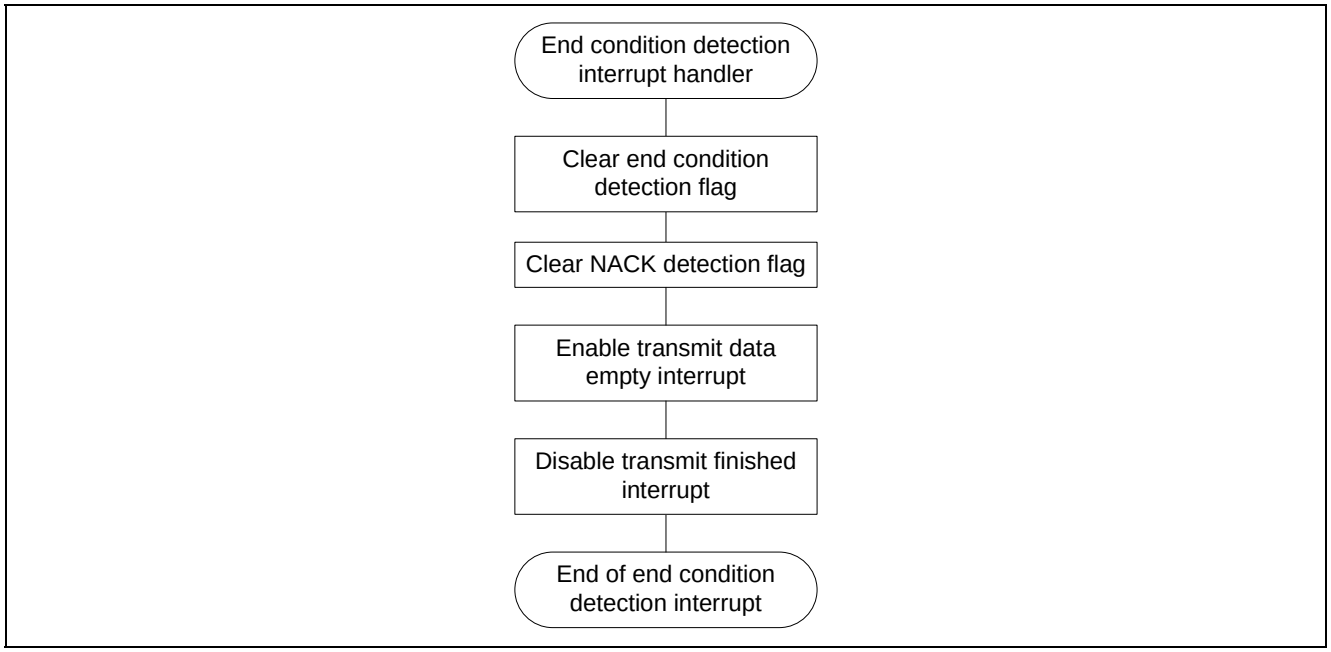

Figure 9 End Condition Detection Interrupt

3.1.9 NACK Detection Interrupt

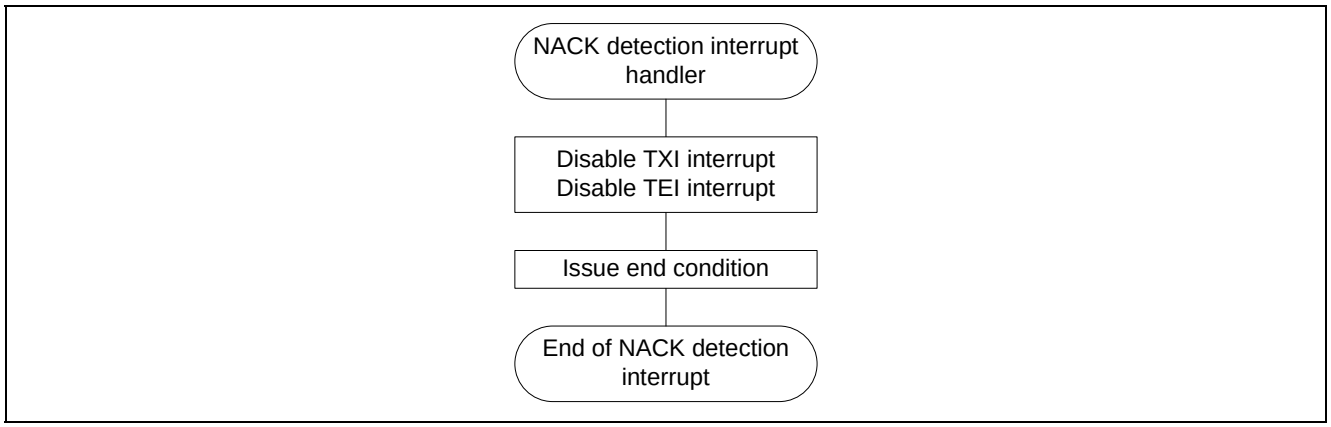

Figure 10 NACK Detection Interrupt

3.2 File Structure

Table 1 shows the file structure. In addition to the files listed in table 1, some files generated automatically by HEW are used as well.

Table 1 File Structure

File Name	Description
main.c	Main process
riic.c	RIIC control-related process
riic_int.c	RIIC interrupt handler
riic.h	RIIC-related header file (prototype declarations, etc.)
intprg.c	File generated automatically by HEW (Only RIIC interrupt functions used by the sample program have been deleted.)

3.3 Function Structure

The specifications of the functions are described below.

Table 2 List of Functions

Function Name	File Name	Description
main()	main.c	Main process.
RiicIni()	riic.c	**User I/F function**. RIIC initial settings. Communication enable/disable settings.
RiicStart()	riic.c	**User I/F function**. Communication start (master transmit/master receive).
RiicTDRE()	riic.c	Transmit data empty interrupt handler.
RiicTEND()	riic.c	Transmit finished interrupt handler.
RiicRDRF()	riic.c	Receive data full interrupt handler.
RiicSTOP()	riic.c	End condition detection interrupt handler.
RiicNACK()	riic.c	NACK detection interrupt handler.
Excep_RIIC0_EEI0 () Excep_RIIC0_RXI0 () Excep_RIIC0_TXI0 () Excep_RIIC0_TEI0 () Excep_RIIC1_EEI1 () Excep_RIIC1_RXI1 () Excep_RIIC1_TXI1 () Excep_RIIC1_TEI1 ()	riic_int.c	Functions set for interrupt vectors. Each interrupt calls a corresponding function. The functions called are RiicSTOP(), RiicRDRF(), RiicTDRE(), and RiicTEND().

3.3.1 User I/F Functions

- RIIC initial settings function
  - — Prototype declarations
    void RiicIni(unsigned char, unsigned char)
  - — Functions
    - RIIC initial settings
    - Master (own) address setting
    - RIIC communication enable/disable switching
  - — Arguments

Arguments	Type	Description
1st argument	unsigned char	Master (own) address. (Set the lowest bit to 0.)
2nd argument	unsigned char	0: RIIC communication disabled Other than 0: RIIC communication enabled

  - — Return values
    None

- Communication start function
  - — Prototype declarations
    unsigned char RiicStart(unsigned char, unsigned char *, unsigned long)
  - — Functions
    - RIIC communication start
    - Slave address setting of device to be communicated with
    - Pointer setting for transmit or receive buffer
    - Setting of number of data bytes to be transferred
  - — Arguments

Arguments	Type	Description
1st argument	unsigned char	Slave address **The master transmits** when the lowest bit is 0, and **the master receives** when the lowest bit is 1.
2nd argument	unsigned char*	Storage buffer for data to be transferred During master transmit operation, the data in the buffer indicated by this argument is transmitted. During master receive operation, data is stored in the buffer indicated by this argument. The transmit/receive buffer address is incremented by 1 after each byte of data is transmitted or received.
3rd argument	unsigned long	Transmit/receive data count Specifies the number of bytes of data to be transmitted or received. Also includes the transmitted address.

  - — Return values

Definition	Value	Description
RIIC_OK	0	Successful finish (communication start)
RIIC_NG	1	Argument error (when transmit/receive data count is less than 2)
RIIC_BUS_BUSY	2	Bus busy

3.4 Switching Between Channel 0 and Channel 1

The example application presented in this note uses RIIC channel 1, but this can be switched to channel 0 by changing the `define` declarations in the file **riic.h**. To switch the channel, make the following changes to the `define` declarations.

- To use channel 0:
  Make the define declaration for RIIC_CH0 **valid** and **invalidate** (comment out, etc.) the define declaration for RIIC_CH1.
- To use channel 1:
  Invalidate the define declaration for RIIC_CH0 and make the define declaration for RIIC_CH1 **valid**.

4. Operation Confirmation Environment

Table 3 shows the environment for confirming the operation of the example program.

Table 3 Operation Confirmation Environment

Item	Name
Device	RX610 (R5F56108VNFP)
Board	Evaluation board
Power supply voltage	5.0 V (CPU operating voltage: 3.3 V)
Input clock	12.5 MHz (ICLK = 100 MHz, PCLK = 50 MHz, BCLK = 25 MHz)
Operating temperature	Room temperature
HEW	Version 4.07.00.007
Toolchain	RX Standard Toolchain (V.1.0.0.0) RX Family C/C++ Compile Driver V.1.00.00.001 RX Family C/C++ Compiler V.1.00.00.001 RX Family Assembler V.1.00.00.001 Optimizing Linkage Editor V.10.00.00.001 RX Family C/C++ Standard Library Generator V.1.00.00.001
Debugger	RX E20 SYSTEM V.1.00.00.000

5. Reference Documents

- Hardware Manual
  RX610 Group Hardware Manual
  (The latest version can be downloaded from the Renesas Electronics Web site.)
- Development Environment Manual
  RX Family C/C++ Compiler Package User's Manual
  (The latest version can be downloaded from the Renesas Electronics Web site.)
- Technical Updates
  (The latest information can be downloaded from the Renesas Electronics Web site.)

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Dec.09.10	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of an MPU or MCU in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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