

To our customers,

---

## Old Company Name in Catalogs and Other Documents

---

On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

Send any inquiries to <http://www.renesas.com/inquiry>.

## Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.
  - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.
  - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.
  - "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

## 7542 Group

### Sample Program Serial I/O 1(UART)-LED Pattern Control

---

#### Introduction

This sample program uses the following functions:

- Timer X (Timer mode): The period of the main loop function.
- INT0 (Falling edge active): Transmit trigger.
- Serial I/O 1 (UART mode): Full duplex communication between two MCUs.
- Output Port (P30-P32, P03): LED0, LED1, LED2, LED3 control.

#### Target Device

The explanation of this issue is applied to the following condition:

- Target MCU: 7542 Group
- Oscillation frequency: 8MHz
- Memory size: ROM 32KB, RAM 1KB

#### Contents

1. Operation .....	2
2. Contents.....	3
3. Flow Chart.....	7
4. Sample Program .....	14
5. Reference.....	20

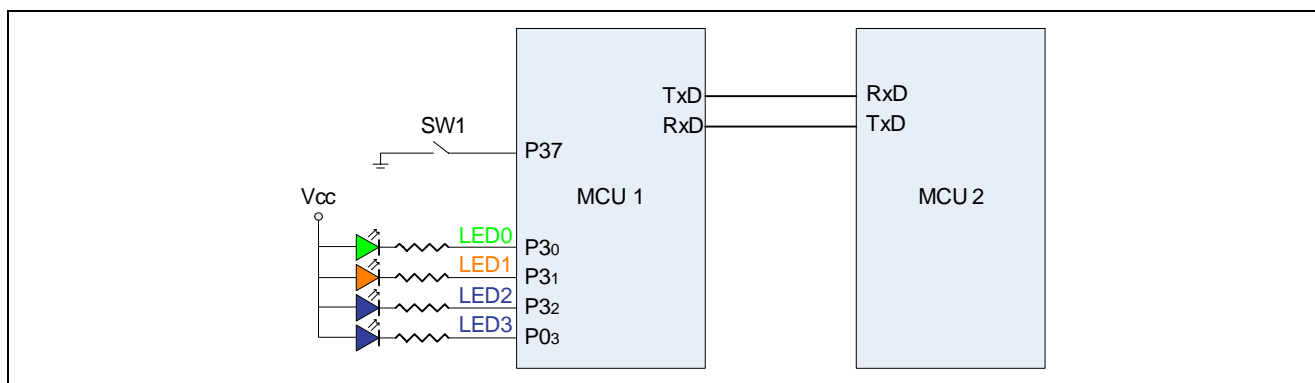
## 1. Operation

The program is explained in following.

- Serial I/O 1(UART) is used in this sample program, communication format is shown below:
  - Transfer Baud Rate: 9615bps;
  - Transfer Data Length: 8 bits;
  - Stop Bit: 1 bit;
  - Parity Bit: Even Parity.

One byte is transferred from the transmitter to the receiver when SW1 is pressed. Initial value of transmitting data is 00001111B. It decreases by one when SW1 pressed each time until the data equals 0, then initial value is reloaded.

Circuit diagram is shown in the figure 1.



**Figure 1 Circuit Diagram**

The receiver turns on corresponding LED according to received data.

Received data	LED3	LED2	LED1	LED0
0x0f	ON	ON	ON	ON
0x0e	ON	ON	ON	OFF
0x0d	ON	ON	OFF	ON
0x0c	ON	ON	OFF	OFF
0x0b	ON	OFF	ON	ON
0x0a	ON	OFF	ON	OFF
0x09	ON	OFF	OFF	ON
0x08	ON	OFF	OFF	OFF
0x07	OFF	ON	ON	ON
0x06	OFF	ON	ON	OFF
0x05	OFF	ON	OFF	ON
0x04	OFF	ON	OFF	OFF
0x03	OFF	OFF	ON	ON
0x02	OFF	OFF	ON	OFF
0x01	OFF	OFF	OFF	ON
0x00	OFF	OFF	OFF	OFF

● ● ● ON  
● OFF

**Figure 2 Received Data - LED Display Pattern**

## 2. Contents

### 2.1 Global Variables

Table 1. Global variable

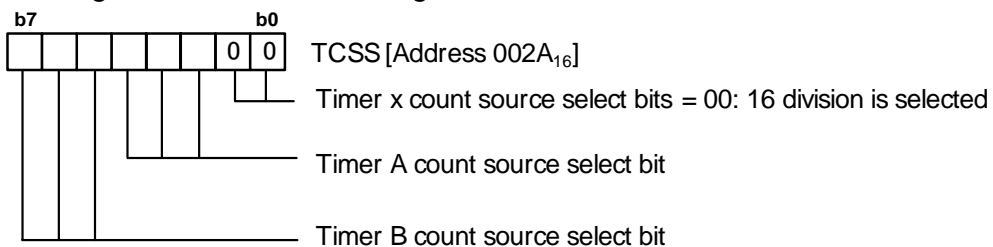
Name	Initial Value	Size (Byte)	Description	Min (H)	Max (H)	Flag
g_mode	00H	1	Mode flag: 0 Receive; 1 Transmit	00	01	
g_error	00H	1	Error flag	00	FF	
g_tr_data	0FH	1	Transmit data buffer	00	0F	
g_re_data	00H	1	Receive data buffer	00	FF	
g_key_state	00H	1	Key state flag	00	04	

### 2.2 Timer X (Timer mode)

Timer X is used in timer mode. The standard period of 20ms is used for main cycle. Interrupt of Timer X isn't being used.

$$8\text{MHz} \times f_{16} \times 250 \times 40 = 20\text{ms} \quad \text{Main cycle } 20\text{ms}$$

#### Setting timer count source register



#### Setting Timer X prescaler register



#### Setting Timer X count register



## Setting Timer X mode register

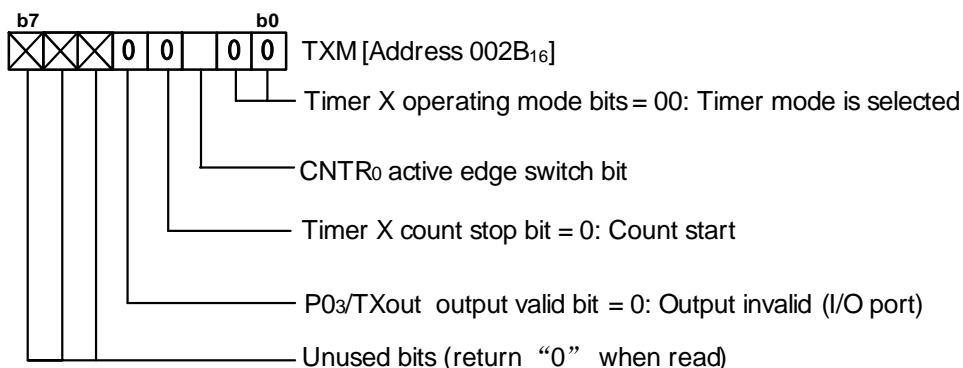
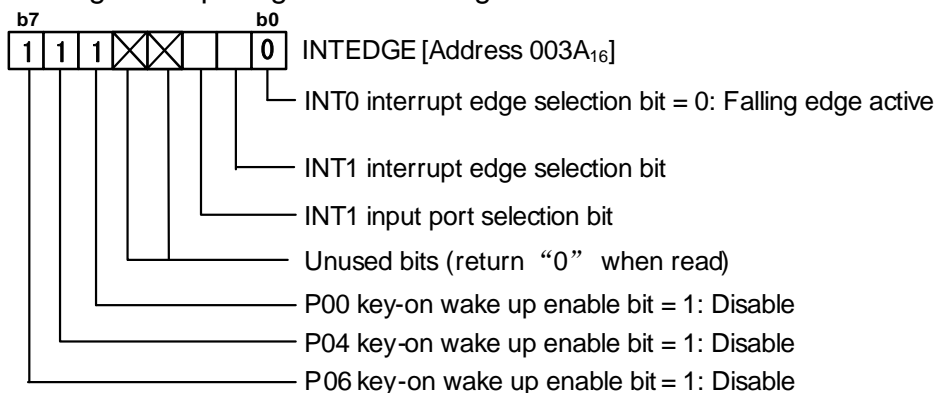


Figure 3 Setting of Timer X

## 2.3 INT0 (falling edge active)

Interrupt of INT0 is used. The setup of INT0 is shown in the following.

### Setting interrupt edge selection register



### Setting interrupt control register 1

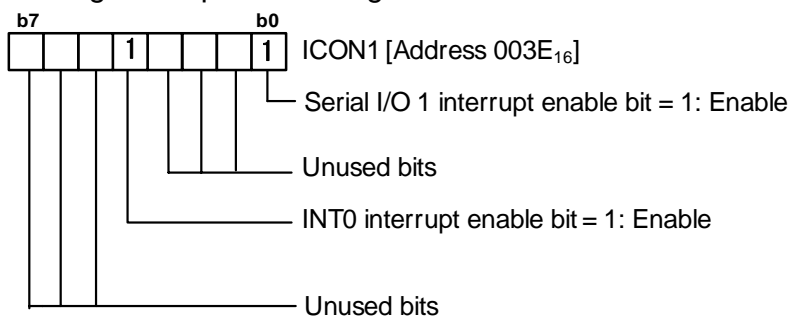


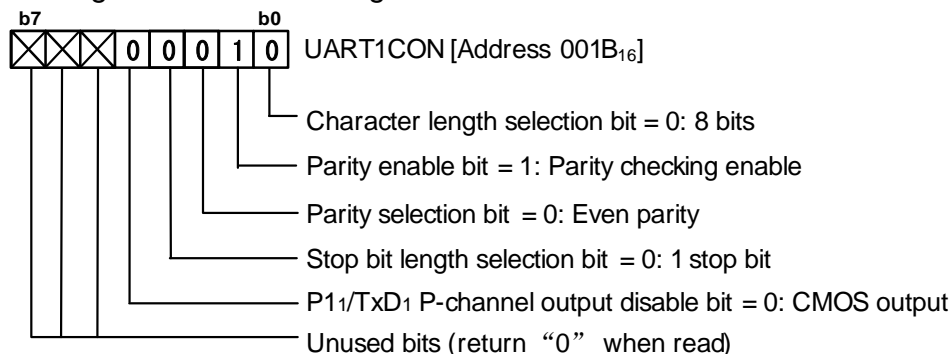
Figure 4 Setting of INT0

## 2.4 Serial I/O 1 (UART mode)

For clock asynchronous serial I/O (UART), the baud rate and transfer formats used by a transmitter and receiver must be identical. When a byte is received, an interrupt will happen.

The setup of Serial I/O 1 is shown in the following.

### Setting UART 1 control register



### Setting Baud rate generator register



### Setting Serial I/O 1 control register

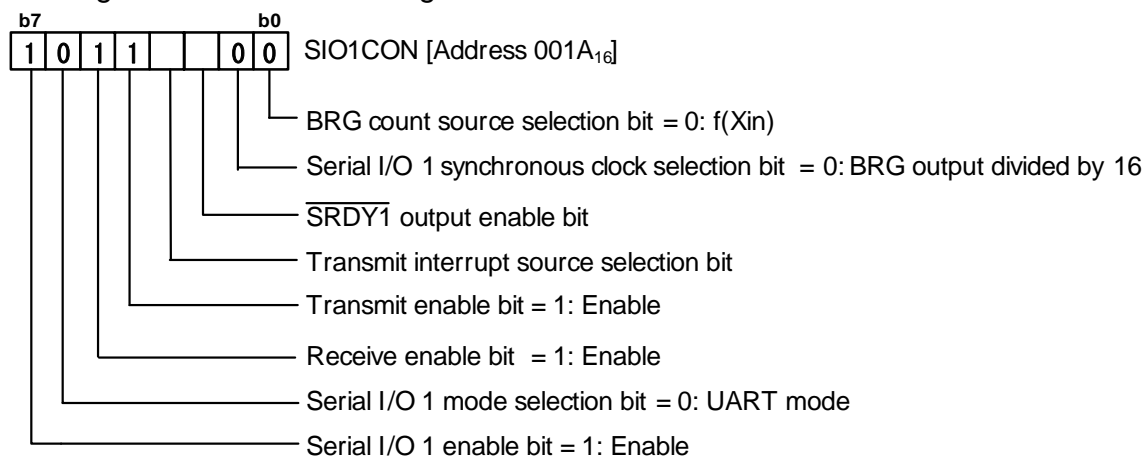


Figure 5 Setting of Serial I/O 1

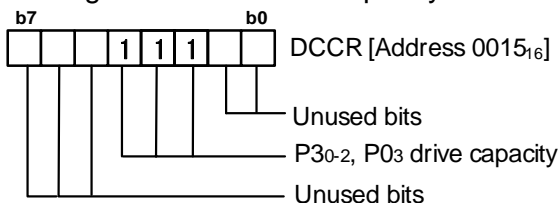
## 2.5 I/O Ports

LED0, LED1, LED2, LED3 are controlled by P30, P31, P32, P03.

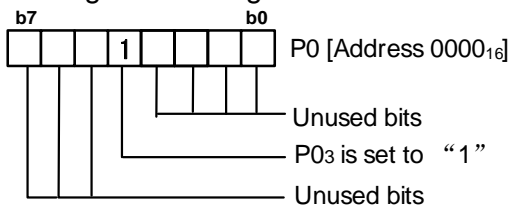
Output of the ports are refreshed every 20ms.

The setup of the ports is shown in the following.

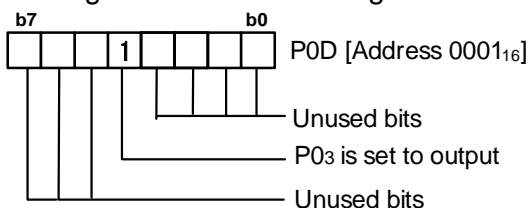
## Setting Port P0P3 drive capacity control register



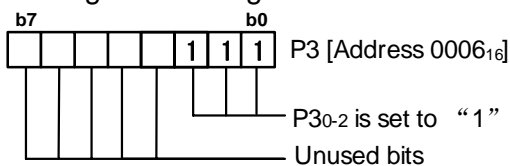
## Setting Port P0 register



## Setting Port P0 direction register



## Setting Port P3 register



## Setting Port P3 direction register

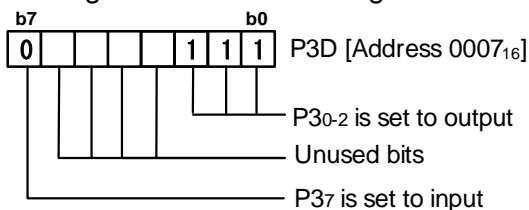


Figure 6 Setting of I/O Ports

## 3. Flow Chart

### 3.1 Initialize & Main Loop

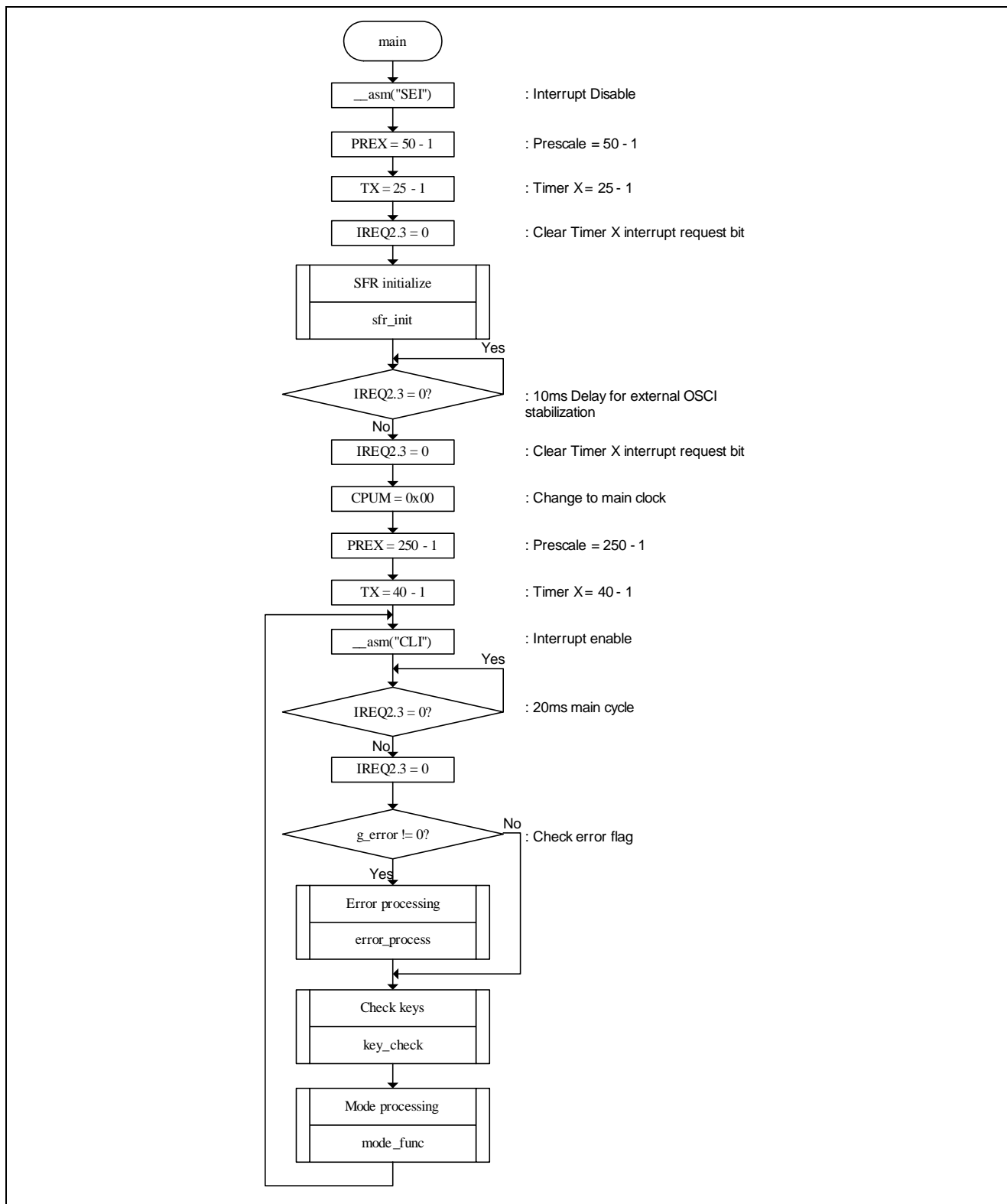


Figure 7 Initialize & Main Loop Flow Chat

## 3.2 SFR Initialize

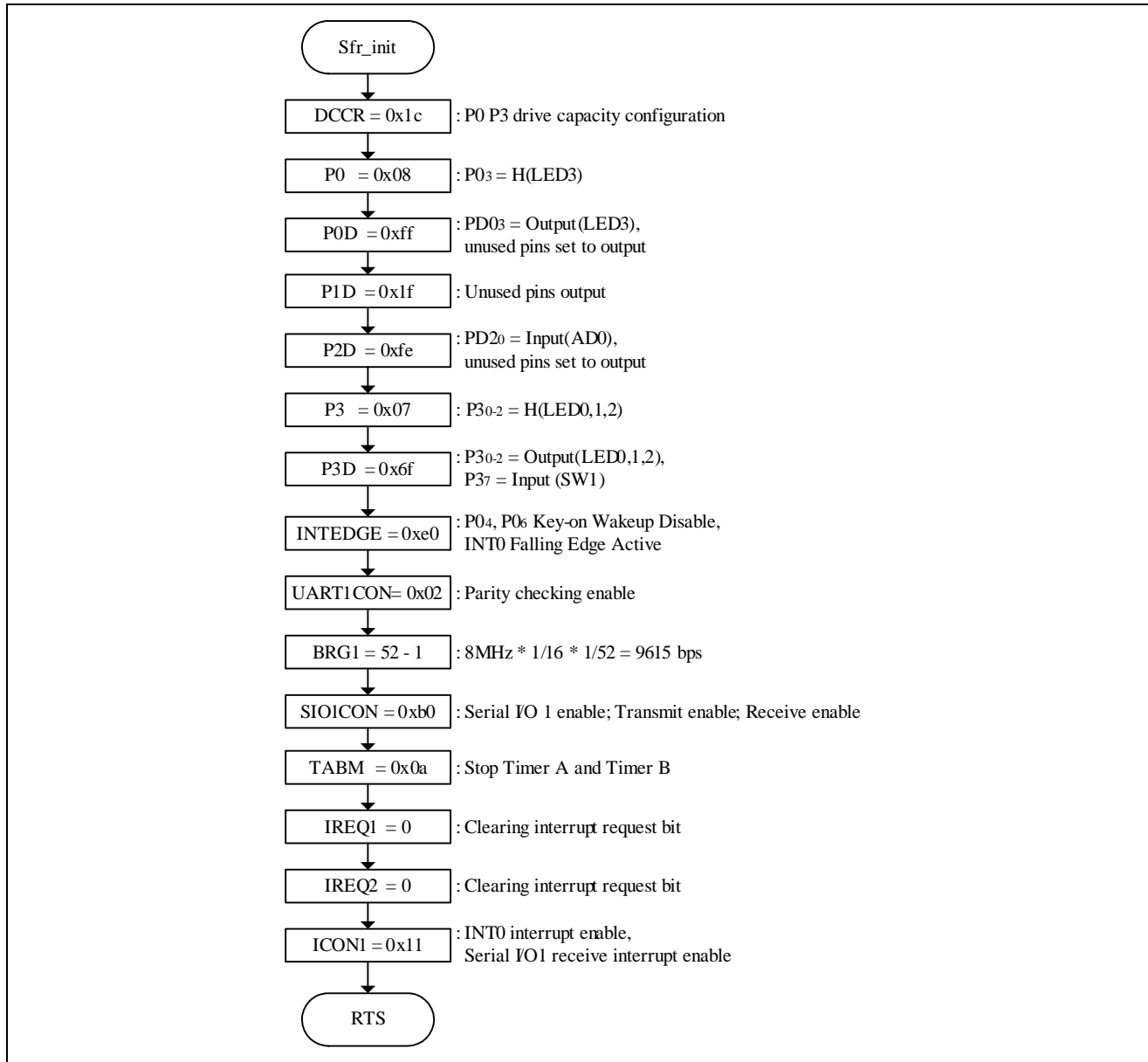


Figure 8 SFR Initialize Flow Chat

## 3.3 Mode Processing

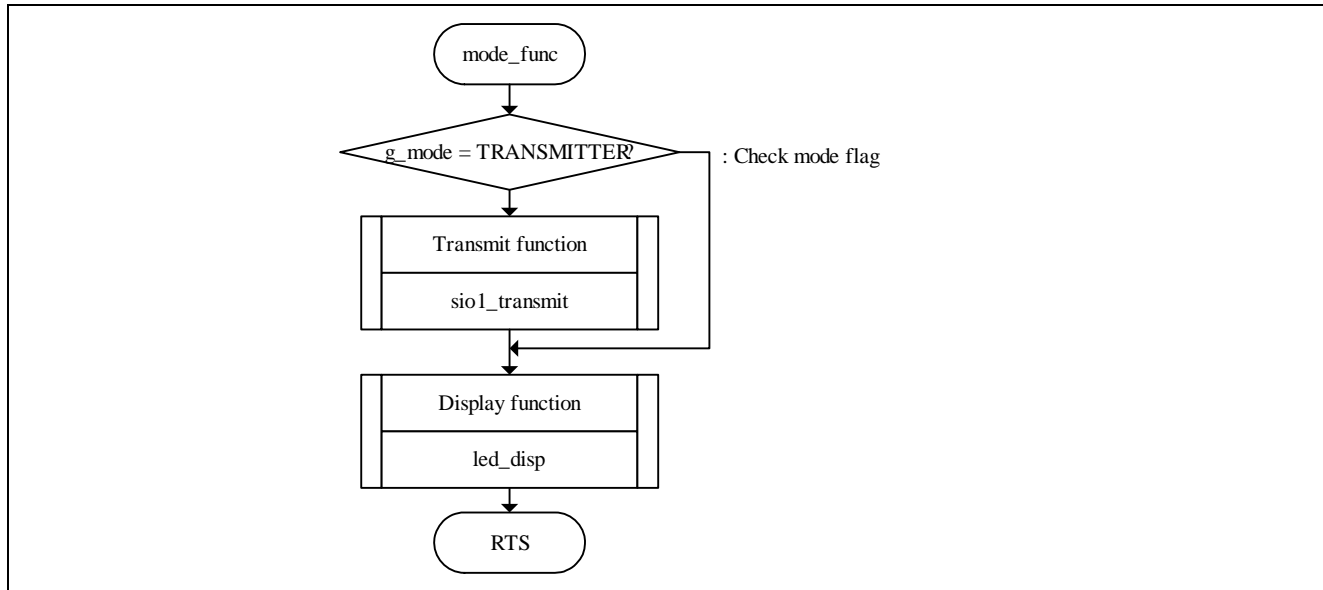


Figure 9 Mode Processing Flow Chat

## 3.4 Output Ports (P3<sub>0-2</sub>, P0<sub>3</sub>): LED Control

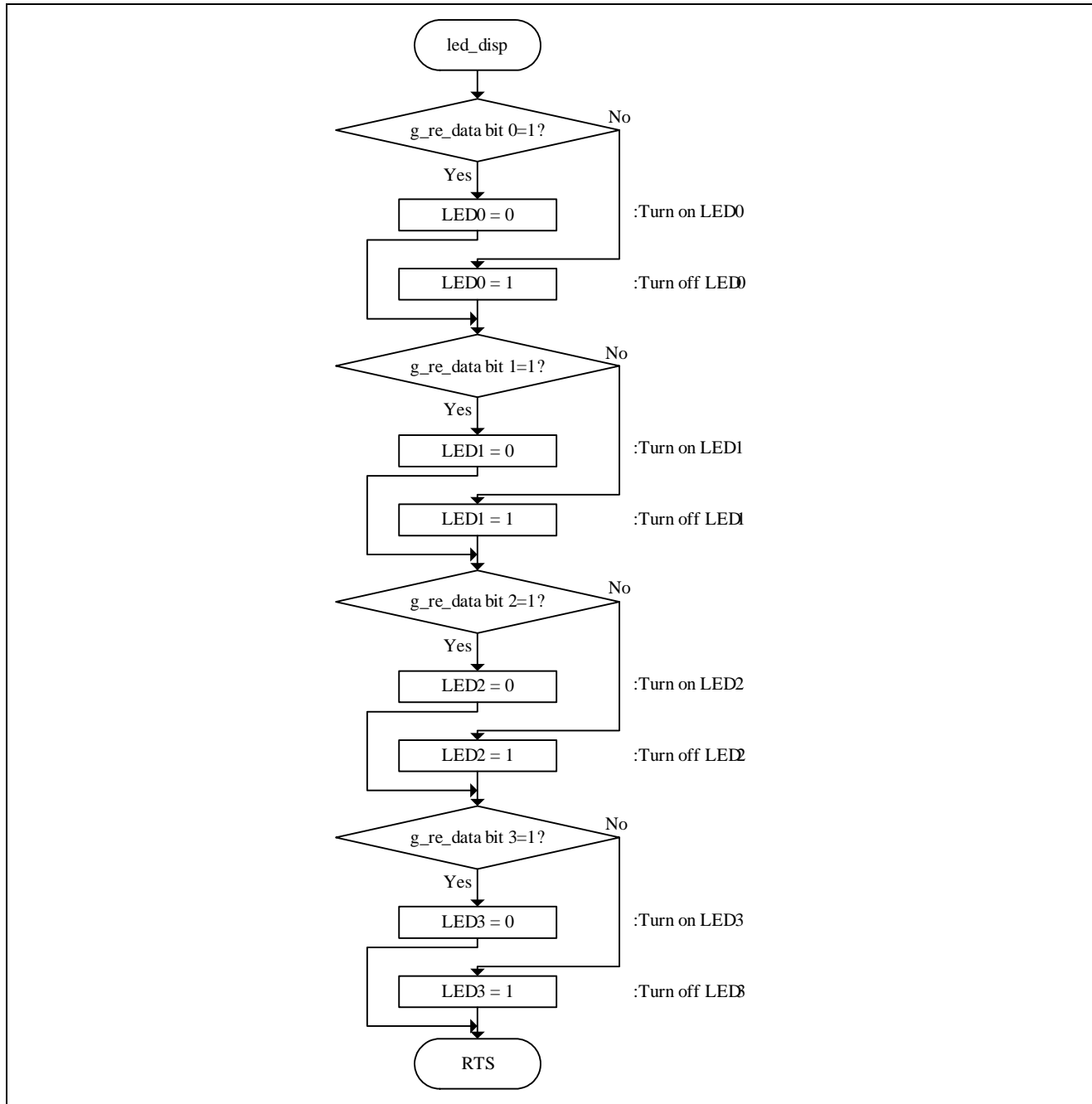


Figure 10 LED Control Flow Chat

### 3.5 Key Check

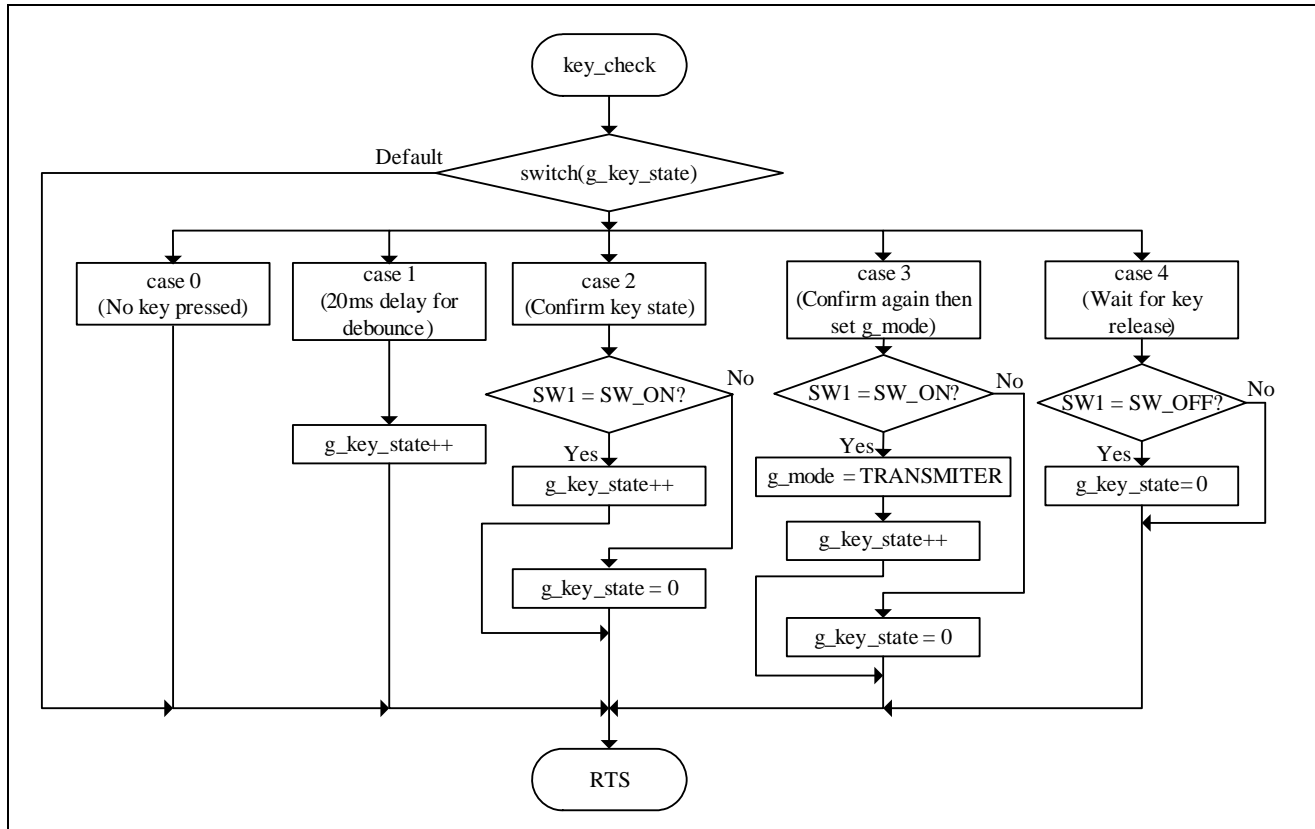


Figure 11 Key Check Flow Chat

## 3.6 Serial I/O 1 Transmit

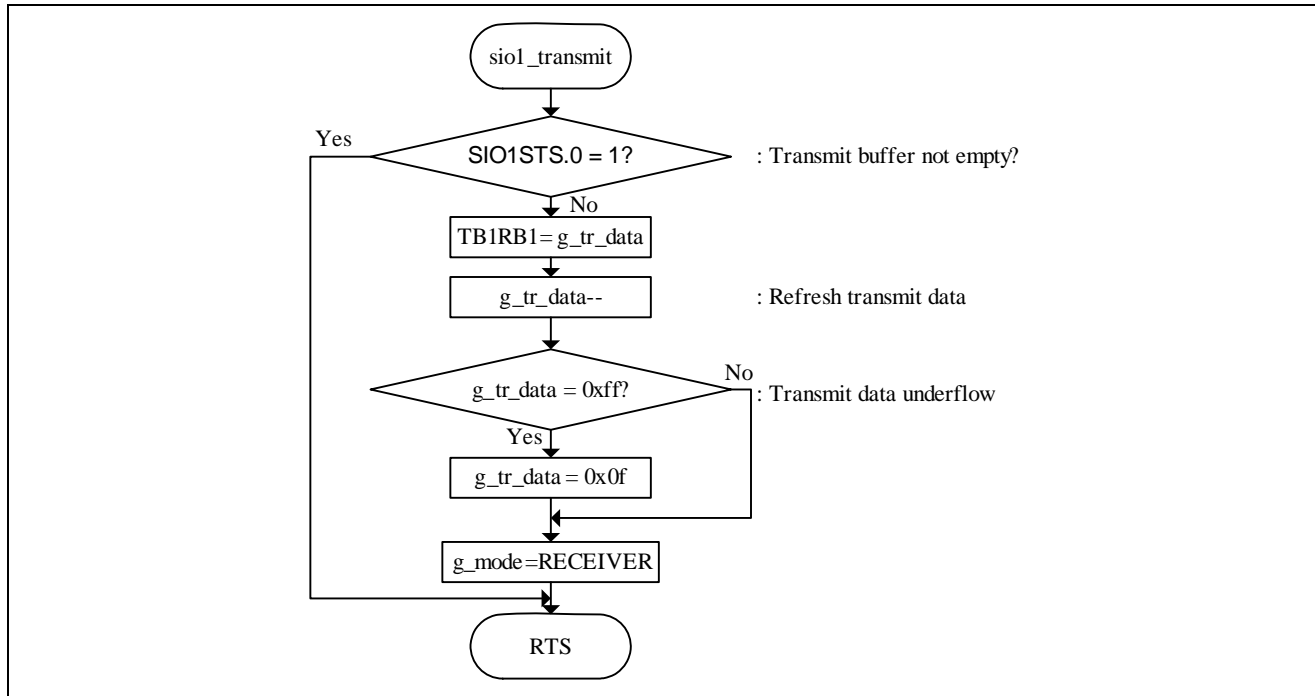


Figure 12 Serial I/O 1 Transmit Flow Chat

## 3.7 INT0 & Serial I/O 1 Interrupt Handler

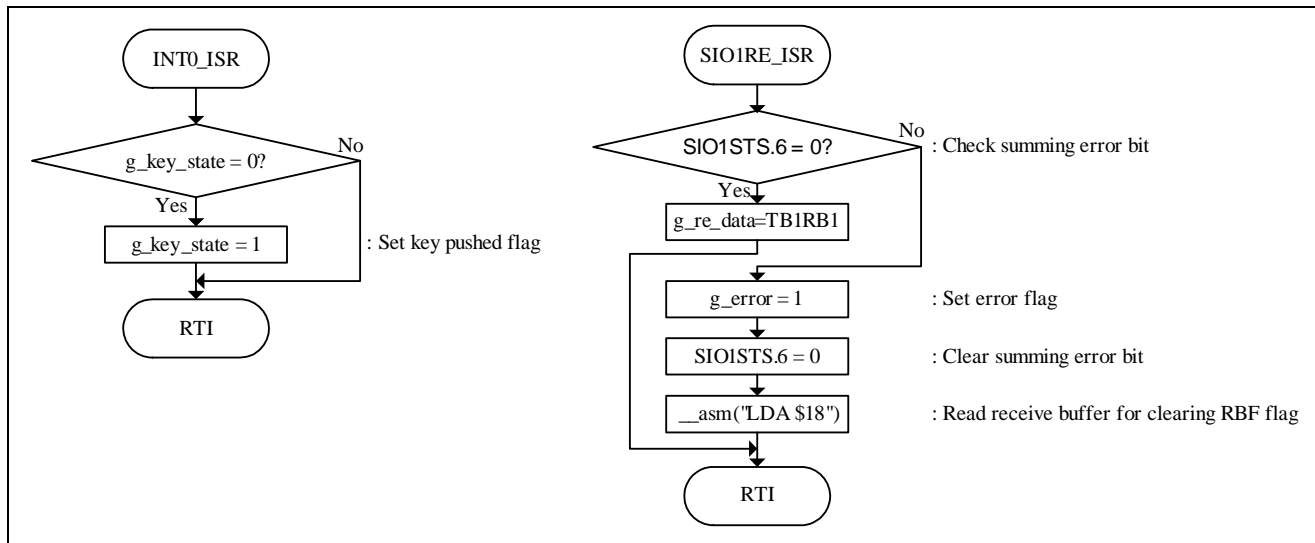


Figure 13 INT0 & Serial I/O 1 Interrupt Handler Flow Chat

## 3.8 Error Processing

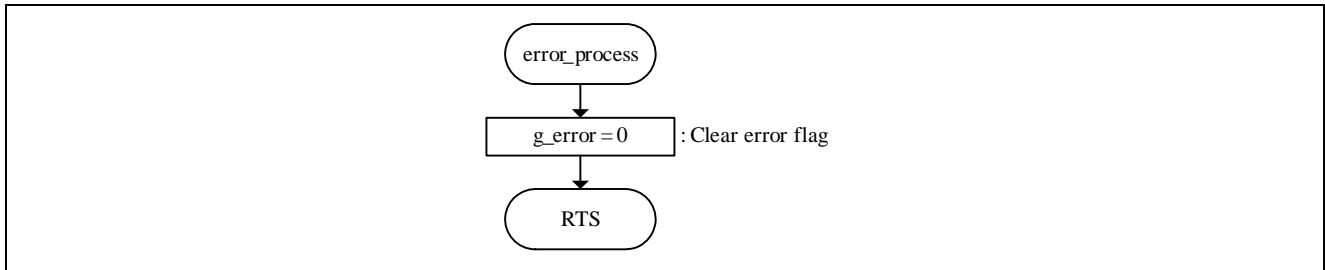


Figure 14 Error Processing Flow Chat

## 4. Sample Program

```

/*****
*
*   File Name: main.c
*   Contents  : Main program of serial I/O sample program
*   Copyright, 2005 RENESAS SYSTEM SOLUTIONS (BEIJING) CO.,LTD.
*
*   Version:   1.00
*
*****/

#include "sfr_7542.h"
#include "sio.h"

void main(void)
{
    __asm("SEI");          /* Interrupt Disable */

    /* Delay for external OSCI stabilization */
    PREX = 50 - 1;          /* 2MHz(On-chip) * 1/16 * 1/50 * 1/25 = 10ms */
    TX = 25 - 1;
    IREQ2.3 = 0;            /* Clear Timer X interrupt request bit */

    sfr_init();

    while (IREQ2.3 == 0){}   /* Wait for Timer X underflow */
    IREQ2.3 = 0;            /* Clear Timer X interrupt request bit */

    CPUM = 0x00;            /* Change to main clock */

    /* Setting main cycle timer */
    PREX = 250 - 1;         /* 8MHz * 1/16 * 1/250 * 1/40 = 20ms */
    TX = 40 - 1;

    while(1)
    {
        __asm("CLI");       /* Enable interrupt */

        while (IREQ2.3 == 0){} /* Waiting for Timer X underflow */
        IREQ2.3 = 0;        /* Clear Timer X interrupt request bit */

        if (g_error != 0)
        {
            error_process(); /* Error processing */
        }

        key_check();        /* Check keys */
        mode_func();        /* Mode processing */
    }
}

/*****
; Name:          sfr_init

```

```

; Parameter:   None
; Return:      None
; Description: Initial setting of SFR registers
;*****/

void sfr_init(void)
{
    DCCR = 0x1c;          /* P0 P3 drive capacity configuration for LED */
    P0 = 0x08;            /* P03 = H(LED3) */
    P0D = 0xff;           /* PD03 = Output(LED3), unused pins set to output */
    P1D = 0x1f;           /* Unused pins output */
    P2D = 0xfe;           /* PD20 = Input(AD0), unused pins set to output */
    P3 = 0x07;            /* P30-2 = H(LED0,1,2) */
    P3D = 0x6f;           /* P30-2 = Output(LED0,1,2), P37 = Input (SW1) */

    INTEDGE = 0xe0;       /* P04, P06 Key-on Wakeup Disable;
                          INTO Falling Edge Active */

    UART1CON = 0x02;      /* Even parity checking enable */
    BRG1 = 52 - 1;        /* 8MHz * 1/16 * 1/52 = 9615 bps */
    SIO1CON = 0xb0;       /* Serial I/O 1 enable;
                          Transmit enable; Receive enable */

    TABM = 0x0a;          /* Stop Timer A and Timer B */

    IREQ1 = 0;            /* Clearing interrupt request bit */
    IREQ2 = 0;

    ICON1 = 0x11;         /* INTO interrupt enable;
                          Serial I/O1 receive interrupt enable */
}

;*****/
; Name:        mode_func
; Parameter:   None
; Return:      None
; Description: Mode processing
;*****/
void mode_func(void)
{
    if (g_mode == TRANSMITTER)
    {
        sio1_transmit();    /* Call transmit function */
    }

    led_disp();            /* Call display function */
}

;*****/
; Name:        key_check
; Parameter:   None
; Return:      None
; Description: Confirm pressed key twice and change g_mode
;*****/

```

```
void key_check(void)
{
    switch (g_key_state)
    {
        case 0:
            break;

        case 1:
            /* 20ms delay */
            g_key_state++;
            break;

        case 2:
            if (SW1 == SW_ON)    /* Confirm key state */
            {
                g_key_state++;
            }
            else
            {
                g_key_state = 0;
            }
            break;

        case 3:
            if (SW1 == SW_ON)    /* Confirm key state again */
            {
                g_mode = TRANSMITER;

                g_key_state++;
            }
            else
            {
                g_key_state = 0;
            }
            break;

        case 4:
            if (SW1 == SW_OFF)    /* If key is released */
            {
                g_key_state = 0;    /* Set to no key pushed state */
            }
            break;

        default:
            break;
    }
}

/*****
; Name:      led_disp
; Parameter:  None
; Return:    None
; Description: Display receive data by LED
;*****/
void led_disp(void)
```

```

{
    if (g_re_data & 0x01)
    {
        LED0 = 0;                /* Turn on LED0 */
    }
    else
    {
        LED0 = 1;                /* Turn off LED0 */
    }

    if (g_re_data & 0x02)
    {
        LED1 = 0;                /* Turn on LED1 */
    }
    else
    {
        LED1 = 1;                /* Turn off LED0 */
    }

    if (g_re_data & 0x04)
    {
        LED2 = 0;                /* Turn on LED2 */
    }
    else
    {
        LED2 = 1;                /* Turn off LED2 */
    }

    if (g_re_data & 0x08)
    {
        LED3 = 0;                /* Turn on LED3 */
    }
    else
    {
        LED3 = 1;                /* Turn on LED3 */
    }
}

/*****
; Name:          siol_transmit
; Parameter:     None
; Return:        None
; Description:   Transmit g_tr_data by Serial I/O 1
; *****/
void siol_transmit(void)
{
    if (SIO1STS.0 == 1)          /* Check transmit buffer full flag */
    {
        TB1RB1 = g_tr_data;

        g_tr_data--;            /* Reduce transmit data by 1 */
        if (g_tr_data == 0xff)
        {

```

```

        g_tr_data = 0x0f;
    }

    g_mode = RECEIVER;          /* When complete return to receive mode */
}

/*****
; Name:          error_process
; Parameter:     None
; Return:        None
; Description:   Receive error processing
; *****/
void error_process(void)
{
    /* User define */

    g_error = 0;                /* Clear error flag */
}

/*****
; Name:          INT0_ISR
; Parameter:     None
; Return:        None
; Description:   INT0 interrupt handler
; *****/
interrupt void INT0_ISR(void)
{
    if (g_key_state == 0)       /* If no key pressed */
    {
        g_key_state = 1;
    }
}

/*****
; Name:          SIO1RE_ISR
; Parameter:     None
; Return:        None
; Description:   Serial I/O 1 receive interrupt handler
; *****/
interrupt void SIO1RE_ISR(void)
{
    if (SIO1STS.6 == 0)         /* Check summing error bit */
    {
        g_re_data = TB1RB1;
    }
    else
    {
        g_error = 1;           /* Set error flag */
        IO1STS.6 = 0;          /* Clear summing error bit */
        __asm("LDA $18");      /* Read receive buffer for clearing RBF flag*/
    }
}

```

```

/*****
*
*   File Name   : sio.h
*   Contents    : Definition of sample program
*   Copyright, 2005 RENESAS SYSTEM SOLUTIONS (BEIJING) CO.,LTD.
*
*   Version: 1.00
*
*****/

#ifndef SIO_H
#define SIO_H

/* Definition of globle variable */

unsigned char g_mode;           /* Mode flag */
unsigned char g_error;         /* Error flag */
unsigned char g_tr_data = 0x0f; /* Transmit data buffer (Initialized as 0x0f) */
unsigned char g_re_data;       /* Receive data buffer */
unsigned char g_key_state;      /* Key state */

/* Declaration of function prototype */

extern void sfr_init(void);      /* SFR initialize routine */
extern void mode_func(void);     /* Mode processing */
extern void key_check(void);     /* Check key input */
extern void led_disp(void);      /* LED control */
extern void sio1_transmit(void); /* Transmit routine */
extern void error_process(void); /* Error processing */

/* Definition of macros */
#define SW_ON      0
#define SW_OFF     1

#define RECEIVER    0
#define TRANSMITTER 1

#define LED0        P3_0
#define LED1        P3_1
#define LED2        P3_2
#define LED3        P0_3

#define SW1         P3_7

#endif                          /* SIO_H */

```

## 5. Reference

### **Renesas web-site**

<http://www.renesas.com/>

### **Contact for Renesas technical support**

E-mail: [csc@renesas.com](mailto:csc@renesas.com)

### **Data Sheet**

7542 Group Rev.3.00

(Use the latest version on the home page:<http://www.renesas.com>)

## Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Dec.28.05	—	First edition issued

Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.  
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.  
The information described here may contain technical inaccuracies or typographical errors.  
Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.  
Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.  
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.