To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 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 1st, 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.

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M32C/83 Group

Clocked Serial I/O Function by using Intelligent I/O Group 0 and 1

1.0 Abstract

This app-note describes the clock serial I/O (synchronous serial I/O) operation of Intelligent I/O Group 0 and 1 (IIO Group 0 and 1).

2.0 Introduction

This application note is applied to the M32C/83 Group microcomputer only.

3.0 Detailed Description

This application example offers features of the serial I/O shown in Table 1. The transmit data is output from pin ISTxDi. The transfer clock is output from pin ISCLKi, the receive data is input from pin ISRxDi. Here symbol i represents the IIO Group number. When IIO Group 0 (and Group 1) is used, symbol i becomes 0 (and 1 respectively).

Table 1 Clocked Serial I/O Option Features and Selected Features

Item	Definition	Selection in this example
Transfer Clock Selection	Internal Clock	Yes
	External Clock	
Data Format	LSB First	Yes
	MSB First	
Polarity Selection of pins TxD and RxD	Non Reverse Output	Yes
	Reverse Output	
Transmit Interrupt Factor	When register GiTB becomes empty	
	When the transmission is completed	Yes

(1) Transfer speed definition when using Channel 0

This example uses Channel 0 in the wave generation function. Select “Use the output of the communication function” for this operation. Base Timer is reset when the set value of register GiP00 matches the content of Base Timer. The transfer speed (the period of the transfer clock) is defined by the following equation. Here “fBT” and “n” represents the count source of Base Timers and value of register GiP00 respectively. But “n” must be 1 or greater.

$$\text{Transfer Speed} = fBT / 2 \times (n + 2)$$

For example, when fBT = 30MHz, the max transfer speed is 5Mbps.

(2) How to generate the transfer clock by using Channel 3

This example uses Channel 3 in the inverted waveform output mode of the wave generation function. The set value of register GiP03 must be smaller than the set value of register GiP00.

3.1 Register setting

To enable the operation defined in “Section 3.0 Description”, the following register settings must be taken place step by step.

(1) Disabling the interrupt (Set I flag = 0)

Set I flag = 0. Or set bits ILV2 - 0 = 0b000 in register IIOkIC (k = 0 - 11) where the interrupt request of the Intelligent I/O is assigned.

(2) Set Register IPS = 0b000000xx (here x depends on user configuration)

Bit Position	Symbol	Bit Name & Function
Bits [7:2]	---	Not used (Set 0b000000 to the bits)
Bit 1	IPS1	Group 1 Input Pin Select Bit 0: assigns ISRxD1 to Port P75 1: assigns ISRxD1 to Port P112
Bit 0	IPS0	Group 0 Input Pin Select Bit 0: assigns ISRxD0 to Port P80 1: assigns ISRxD0 to Port P152

This setting enables use of the receive pin.

(3) Set Register G2BCR0 = 0b01111111

Bit Position	Symbol	Bit Name & Function
Bit 7	---	Not used (Set 0 to the bit)
Bits [6:2]	DIV4-0	Count Source Division Ratio Select Bits 0b11111: selects no division
Bits [1:0]	BCK1-0	Count Source Select Bits 0b11: selects clock f1

This setting enables use of register BTSR that will be configured in the next step.

(4) Set Register BTSR = 0b00000000

Bit Position	Symbol	Bit Name & Function
Bits [7:4]	---	Not used (Set the bits to 0b0000)
Bits [3:0]	BT3S-BT0S	Base Timer Count Start Bits 0b0000 resets Base Timers in Groups 3 – 0

This setting resets Base Timers in Groups 0 – 4. The Base Timer in Group i starts counting at 0x0000 when selecting the count source of the Base Timer with register GiBCR0 and then setting bit BTS = 1 in register GiBCR1. Here symbol i represents IIO Group number.

(5) Set Register G2BCR0 = 0b00000000

Bit Position	Symbol	Bit Name & Function
Bits [7:2]	---	Not used (Set the bits to 0b000000)
Bits [1:0]	BCK1-0	Count Source Select Bits 0b00: supplies no clock

If Group 2 and register BTSR are not used, disable supplying a clock to Group 2.

(6) Set Register GiBCR0 = 0b01111111

Bit Position	Symbol	Bit Name & Function
Bit 7	---	Not used (Set the bits to 0b0)
Bits [6:2]	DIV4-0	Count Source Division ratio Bits 0b00000 selects no division
Bits [1:0]	BCK1-0	Count Source Select Bits 0b00 selects clock f0

This setting enables use of registers that are defined in step (7) thru (15). Set 0b0111111 to this register before going to the following steps. In this way, following registers will hold valid values at the transfer operation.

(7) Set Register GiBCR1 = 0b00000010

Bit Position	Symbol	Bit Name & Function
Bit 7	---	Not used (Set the bit to 0b0) Set the bit to 0.
Bits [6:5]	UD1-0	Up-Down Control Bits 0b00 selects the up-count mode
Bit 4	BTS	Base Timer Start Bit 0b0 resets Base Timer.
Bits [3:2]	---	Not used (set the bit to 0b00)
Bit 1	RST1	Base Timer Reset Cause Select Bit 1 0b0 selects that the reload action occurs when the Base Timer content matches to the content of register GiPO0
Bit 0	---	Not used (set the bit to 0b0)

This register is used for generating the transfer clock. Set bit RTS1 = 1. (The Base Timer is reset when the Base Timer content matches to the content of register GiPO0)

(8) Set Register GiPOCR0 = 0b00000111

Bit Position	Symbol	Bit Name & Function
Bits [7:6]	---	Not used (Set the bits to 0b00)
Bit 5	RLD	Reload Timing Select Bit 0b0 selects the reload action occurs when the register is written.
Bits [4:3]	---	Not used (Set the bits to 0b00)
Bits [2:0]	MOD2-0	Operation Mode Select Bits 0x111 selects the output of the communication function.

The setting (bits MOD2 – 0 = 0b111) selects pin ISTxDi to transmit data. The setting (bit RLD = 0) configures the reload action to occur at the same time data is written to register GiPO0.

(9) Set Register GiPOCR1 = 0b00000111

Bit Position	Symbol	Bit Name & Function
Bits [7:3]	---	Not used (Set the bits to 0b00000)
Bits [2:0]	MOD2-0	Operation Mode Select Bits 0x111 selects the output of the communication function.

The setting (bits MOD2 –0 = 0b111) selects pin ISCLKi to generate the transfer clock.

(10) Set Register GiPOCR3 = 0b00000010

Bit Position	Symbol	Bit Name & Function
Bits [7:6]	---	Not used (Set the bits to 0b00)
Bit 5	RLD	Reload Timing Select Bit 0b0 selects the reload action occurs when the register is written.
Bits [4:3]	---	Not used (Set the bits to 0b00)
Bits [2:0]	MOD2-0	Operation Mode Select Bits 0x010 selects the inverted wave output.

The setting (bits MOD2 –0 = 0b010) selects pin ISCLKi to generate the transfer clock in the inverted wave generation mode. The setting (bit RLD = 0) configures the reload action occurs at the same time data is written to register GiPO0.

(11) Set Register GiPO0 = 0x0001 – 0xFFFD

Bit Position	Symbol	Bit Name & Function
Bits [15:0]	---	This register defines the transfer speed. The transfer speed (bps) is formulated by: bps = fBT / 2*(n+2) n (set-value) = 0x0001 – 0xFFFD

(12) Set Register GiPO3 = 0x0001

Bit Position	Symbol	Bit Name & Function
Bits [15:0]	---	must be set to 0x0001.

0x0001 enables that the transfer clock specified in section (27) is generated immediately after Base Timer starts.

(13) Set Register GiFS = 0b00000000

Bit Position	Symbol	Bit Name & Function
Bits [7:4]	---	Not used (Set the bits to 0b0000)
Bit 3	FSC3	Channel 3 Time Measurement/Wave Generation Select Bit 0b00 selects the wave generation function.
Bit 2	---	Not used (Set the bit to 0b0)
Bits [1:0]	FSC1-0	Channel 1 & 0 Time Measurement/Wave Generation Select Bits 0b00 selects the wave generation functions

(14) Set GiFE Register

Bit Position	Symbol	Bit Name & Function
Bits [7:4]	---	Not used (Set the bits to 0b0000)
Bit 3	IFE3	Channel 3 Function Enable Bit 0b1 enables the Channel 3 function.
Bit 2	---	Not used (Set the bit to 0b0)
Bits [1:0]	IFE1-0	Channel 1 and 0 Function Enable Bits 0b11 enables the Channel 1 & 0 functions.

Set 0 to bits respective to un-used Channels.

(15) Set Register GiBCR1 = 0b00010011

Bit Position	Symbol	Bit Name & Function
Bit 4	BTS	Base Timer Start Bit 0b1 enables Base Timer to start counting.

By setting bit BTS = 1, the transfer clock starts generating.

(16) Set Register GiCR = 0b00000000

Bit Position	Symbol	Bit Name & Function
Bit 7	OPOL	TxD Output Polarity Reverse Select Bit 0b0 selects no reversing.
Bit 6	IPOL	ISRxD Input Polarity Reverse Select Bit 0b0 selects no reversing.
Bit 5	RE	Receive Enable Bit 0b0 disable the receive.
Bit 4	TE	Transmit Enable Bit 0b0 disable the transmission.
Bit 3	---	Not used (Set the bit to 0b0)
Bit 2	RI	Receive Complete Flag (Read-Only)
Bit 1	TXEPT	Transmit Register Empty Flag (Read-Only)
Bit 0	TI	Transmit Buffer Empty Flag (Read-Only)

Bits TI, TXEPT, and RI are read-only bits. Write-action to these bits effect nothing.

Bits TE and RE (Transmission and Receive Enable Bits) must be set after setting the other communication related reregisters.

(17) Set Register GiMR = 0b10000001

Bit Position	Symbol	Bit Name & Function
Bit 7	IRS	Transfer Interrupt Cause Select Bit 0b1 selects “Transmission Complete (TXEPT = 1)”.
Bit 6	UFORM	Transfer Direction Select Bit 0b0 selects the LSB-first.
Bits [5:3]	---	Not used (Set the bits to 0b000)
Bit 2	CKDIR	Internal/External Clock Select Bit 0b0 selects the internal clock
Bits [1:0]	GMD1-0	Communication Mode Select Bits 0b01 selects the clocked serial I/O mode.

Selects the clocked serial I/O mode with bits GMD1-0 (= 0b00).

(18) Set Register GiERC =0b00100000

Bit Position	Symbol	Bit Name & Function
Bits [7:6]	---	Not used (Set the bits to 0b00).
Bit 5	RSTHE	Receive Shift Operation Enable Bit 0b1 enables the receive shift action.
Bits [4:0]	---	Not used (Set the bits to 0b00000).

Bit RSHTE = 1 enables supplying the clock generated in Channel 3 to the receive shift register. This bit must be set to 1 when using the clock serial I/O mode.

(19) Set Register GiBCR = 0b00000010

Bit Position	Symbol	Bit Name & Function
Bit 4	BTS	Base Timer Start Bit Clear the bit to 0b0

Clear bit BTS before setting fBT.

(20) Set Register GiBCR0 = 0b0*****11 (* indicates user's choice)

Bit Position	Symbol	Bit Name & Function
Bit 7	---	Not used (set 0b0 to the bit)
Bits [6:2]	DIV4-0	Count Source Division Ratio Select Bits Set your own value.
Bits [1:0]	BCK1-0	Count Source Select Bit 0b11 selects clock f1 (fBT).

Define your baud-rate with bits DIV4-0.

(21) Set Register GiBCR1 = 0b00010010

Bit Position	Symbol	Bit Name & Function
Bit 4	BTS	Base Timer Start Bit Set the bit to 0b1 for Base Timer to start counting.

(22) Set IIOkIE (k = 0 thru 3) = 0b00000001

Bit Position	Symbol	Bit Name & Function
Bit [7:1]	---	Interrupt Enable Bits 7 thru 1 Set the bits to 0b0000000
Bit 0	IRLT	Interrupt Request Latch Bit 0b1 enables that the request is used for the interrupt.

Bits [7:1] and bit IRLT must not be set to 1 at the same time.

(23) Set Register IIOkIR (k = 0 thru 3) = 0b00000000

Bit Position	Symbol	Bit Name & Function
Bits [7:1]	---	Clear the bits to 0b0000000
Bit 0	---	Not used (Set the bit to 0b0)

The register must be set 0x00 here. If the register holds a value other than 0x00, bit IR in register IIOkIC will not be set to "1" even when an interrupt request is generated. -- means no interrupt operation possible.

(24) Set Register IIOkIE (k = 0 thru 3) = 0b00*00001 (* depends on user configuration)

Bit Position	Symbol	Bit Name & Function
Bits [7:6]	---	Not used (Set the bits to 0b00)
Bit 5	SIOiTE	IIO Group i (i = 0 or 1) Transmit Interrupt Enable Bit Here, k must be 1 or 3 0b1 enables the request.
	SIOiRE	IIO Group i (i = 2 or 3) Receive Interrupt Enable Bit Here, k must be 0 or 3 0b1 enables the request.
Bits [4:1]	---	Not used (Set the bits to 0b0000)
Bit 0	IRLT	Interrupt Request Latch Bit 0b0 selects the request for the interrupt.

(25) Set Register IIOkIC (k = 0 thru 3) = 0b00000**** (* depends on k, user configuration)

Bit Position	Symbol	Bit Name & Function
Bits [7:5]	---	Not used (Set the bits to 0b0000)
Bit 4	IR	Interrupt Request Bit 0b0 sets no interrupt request.
Bits [2:0]	ILV2-0	Interrupt Priority Level Select Bits Set the values (k = 0 thru 3) based on your configuration.

(26) Set Registers PSC, PSLa (a = 0 thru 3), PSb (b = 0 thru 9)

This operation configures ports to be used for ISTxD and ISCLK functions.

(27) Set I flag = 1 (Set the prime interrupt for “Enable”)

(28) Set Register CiCR = 0b00110000

Set the register for enabling receive and transmit operations.

Bit Position	Symbol	Bit Name & Function
Bit 7	OPOL	ISTxD Output Polarity Select Bit 0b0 selects no reversing.
Bit 6	IPOL	ISRxD Input Polarity Reverse Select Bit 0b0 selects no reversing.
Bit 5	RE	Receive Enable Bit 0b1 enables the receive.
Bit 4	TE	Transmit Enable Bit 0b1 enable the transmission.
Bit 3	---	Not used (Set the bit to 0b0)
Bit 2	RI	Receive Complete Flag (Read-Only)
Bit 1	TXEPT	Transmit Register Empty Flag (Read-Only)
Bit 0	TI	Transmit Buffer Empty Flag (Read-Only)

(29) Set Register GiTB

Bit Position	Symbol	Bit Name & Function
Bits [7:0]	---	Set value to be transmitted

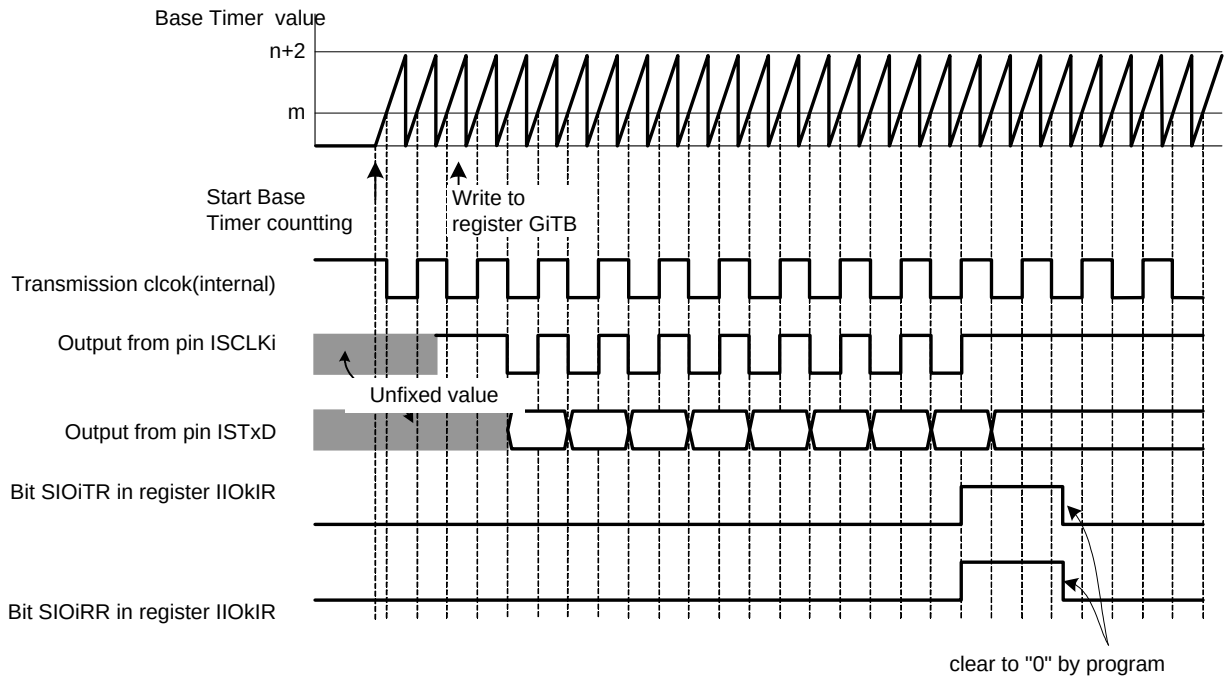
The write-action to the register starts the transmission.

3.2 Precaution on Interrupts

You must clear register IIOkIR to 0x00 during the respective interrupt routine. If you skip this procedure, bit IR in register IIOkIC will not be set to “1” when the respective IIO generates the interrupt request, resulting in no interrupt being invoked.

3.3. Timing Diagram

The following time chart shows the serial I/O operation in this example.



4.0 Sample Programming Code

```
/*****************************************************************/
/*   FILE NAME : apmc81.c                                        */
/*   Version    : 1.00                                           */
/*   CPU          : M32C/83                                      */
/*   FUNCTION   : Clocked Serial communication by using Intelligent I/O */
/*---------------------------------------------------------------*/
/*    Copyright (C) 2001 Mitsubishi Electric Corporation and     */
/*    Mitsubishi Electric Semiconductor Application              */
/*    Engineering Corporation                                    */
/*    All rights reserved.                                       */
/*****************************************************************/
/*******************************/
/*    include file             */
/*******************************/
#include <stdio.h>
#include "sfr83v101.h"

/*******************************/
/*    Function Definition      */
/*******************************/
void receive_int(void);
#pragma INTERRUPT receive_int
void trans_int(void);
#pragma INTERRUPT trans_int


/*******************************/
/*    Global Variable Definition */
/*******************************/
static char rec_buff;
static char cnt = 0;

/*******************************/
/*    main Function            */
/*******************************/
void main(void){
    _asm(" fclr   i");          /*   Disable the interrupt   */

    /*   main clock set      */
    prc0 = 1;                   /*   protect off   */
    mcd = 0x12;                 /*   main clock : no division   */
    prc0 = 0;                   /*   protect on   */

    ips = 0x00;                 /*   set P80 as ISRxD0   */
```

```
/*   base clock initial set   */
g2bcr0 = 0x7f;                  /*   Enable use of register BTSR   */
btsr = 0x00;                    /*   Reset the Base Timer   */
g2bcr0 = 0x00;                  /*   Stop the clock supply to Group 2   */

/*   iio Group0 initial set   */
g0bcr0 = 0x7f;                  /*   b0,b1: count source f1
                                    b2-b6: division rate of count source : no division */
g0bcr1 = 0x02;                  /*   Reset the Base Timer   */

        g0pocr0 = 0x07;             /*   select ISTxD   */
        g0pocr1 = 0x07;             /*   select ISCLK   */
        g0pocr3 = 0x02;             /*   transmit clock (reversal waveform output mode)   */

        g0po0 = 10;                 /*   BRG = fTB / [(10+2)*2]   */
        g0po3 = 1;

g0fs = 0x00;                    /*   ch0 ch1 ch3 select the waveform generation function   */
g0fe = 0x0b;                    /*   ch0 ch1 ch3 enable   */

g0bcr1 = 0x12;                  /*   start the Base Timer counting   */

g0cr = 0x00;                    /*   Disable the communications     */
g0mr = 0x81;                    /*   Clocked Serial, internal clock, LSB first   */

g0erc = 0x20;                   /*   transmit clock -> receive shift register   */

/*   iio Group0 interrupt initial set   */

iio0ie = 0x01;                  /*   Use the request use for interrupt     */
iio1ie = 0x01;                  /*   Use the request use for interrupt     */
iio0ir = 0x00;
iio1ir = 0x00;
iio0ie = 0x21;                  /*   Enable interrupt to gr1 sio recive   */
iio1ie = 0x21;                  /*   Enable interrupt to gr1 sio trans   */

iio0ic = 0x03;                  /*   Set the interrupt priority level   */
iio1ic = 0x03;                  /*   Set the interrupt priority level   */

/*   port set   */
psc = 0x00;
psl1 = 0x00;
ps1 = 0xc0;
ps2 = 0x00;

/* interrupt enable     */
_asm("fset      i");
```

```
    g0cr = 0x30;                    /*   transmit / receive     */

    g0tb = 0xD5;                    /*   Write the transmit data   */

    while(1);
}

/*   iio ch0 interrupt     */
void receive_int(void){
    iio0ir = 0x00;                  /*   Clear the interrupt request   */
        rec_buff = g0rb;                /*   Read the received data   */
}

void trans_int(void){
        int wait;
    iio1ir = 0x00;                  /*   Clear the interrupt request   */
        g0tb = 0x7A;                    /*   Write the transmit data   */
}

/*------------------------------ end program */
```

5.0 Example of Pulse width measuring

The following example shows the clocked serial data transmission with pin ISTxD0(P7$_6$) and pin ISCLK0(P7$_7$) by using the Intelligent I/O Group 0.

Conditions: Supply voltage = 5V

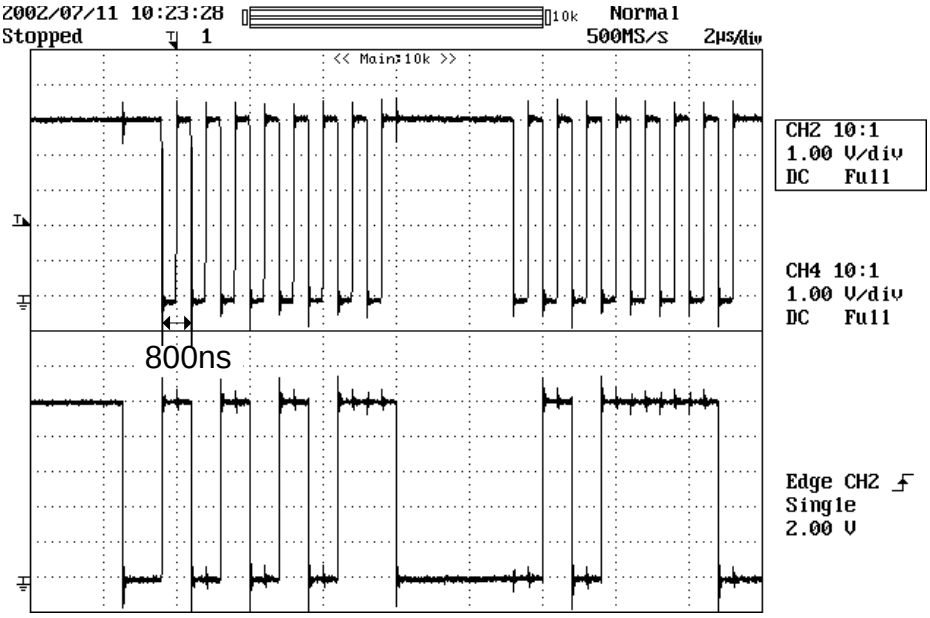
Main clock (X_{IN}) =30MHz

Base Timer count source (f_{BT}) = 30MHz

Transmission speed: 1.25 Mbps(30MHz /24 : register G0PO0 value is 10)

Data transmission spend 800 nsec every bit.

Transmission data: 1st byte “D5$_{16}$”. 2nd byte “7A$_{16}$”



The result of data transmit with Clocked Serial communication.

6.0 Reference

Data Sheet

M32C/83 Group Rev. B3

(Use the latest version on the web: http://www.infomicom.maec.co.jp/M16C/dsum/32c83dse.htm)

7.0 How to Contact Us

Mitsubishi MCU Technical Information:

http://www.infomicom.maec.co.jp/

Mitsubishi MCU Technical Support:

E-mail: support@apl.maec.co.jp

Keep safety first in your circuit designs!

- Mitsubishi Electric 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 non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor 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 Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric 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.
- 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 Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.
  The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric 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 Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (http://www.mitsubishichips.com).
- 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. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
- Mitsubishi Electric 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 Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor 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.
- The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
- 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.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.