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H8/300L Series

Serial Data Transmission in Synchronous Mode (H8/3644)

Introduction

Four bytes of 8-bit data is transmitted using the serial data transfer function in synchronous mode. Data is transmitted LSB first.

Target Device

H8/3644

Contents

1. Specifications

1. As shown in figure 1.1, four bytes of 8-bit data are transmitted using the serial data transfer function in synchronous mode.
2. Data is transmitted at a transfer clock cycle of 12.8 µs using an internal clock as a transmit clock.
3. The data length of transmit data is eight bits and data is transmitted LSB first, which means the lowest bit of data is transmitted first.

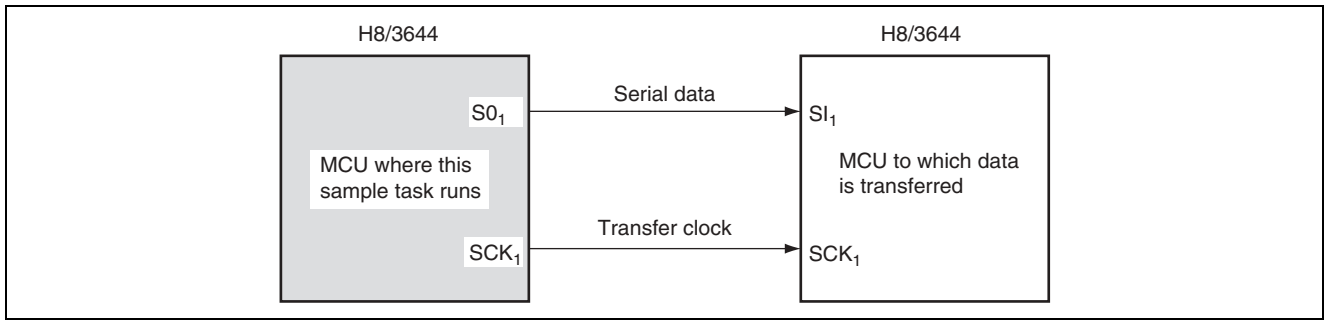


Figure 1.1 Serial Data Transmission in Synchronous Mode

2. Description of Functions

1. In this sample task, serial data is transmitted in synchronous mode via the serial communication interface (SCI). Figure 2.1 shows a block diagram of serial data transmission in synchronous mode, and the following is the description for the block diagram:

— The frequency of the system clock (ϕ) used as the basic clock for the CPU or peripheral-function operation is 5-MHz; this clock is obtained by dividing the 10-MHz OSC clock by 2.
— The prescaler S (PSS) is a 13-bit counter, to which ϕ is input. PSS counts up on each cycle.
— The serial control register 1 (SCR1) is an 8-bit readable/writable register that selects operating mode, transfer clock source, and prescaler division ratio.
— The serial control/status register 1 (SCSR1) is an 8-bit register that indicates operation status, error status, etc.
— The serial data register U (SDRU) is an 8-bit readable/writable register that functions as a data register for the upper 8 bits in 16-bit data transfer. Data written to SDRU is output to SDRL with the LSB first. Then, data is in turn input from the SI_1 pin with the LSB first, and data is shifted from the MSB to the LSB.
— The serial data register L (SDRL) is an 8-bit readable/writable register that functions as a data register in 8-bit data transfer and as a data register for the lower 8 bits in 16-bit data transfer. In 8-bit data transfer, data written to SDRL is output from the SO_1 pin with the LSB first. Then, data is in turn input from the SI_1 pin with the LSB first, and data is shifted from the MSB to the LSB. In 16-bit data transfer, operation is the same as that in 8-bit data transfer except that data is input from SDRU.
— SDRU and SDRL should be read or written to after data transmission or reception is complete. If they are read or written to during data transmission or reception, data may not be guaranteed.
— The transfer clock can be selected from eight internal clocks and external clocks. When an internal clock is selected, the SCK_1 pin is used as an output pin. The selected clock is continuously output from the SCK_1 pin if clock continuous output mode is set. When an external clock is selected, the SCK_1 pin is used as the clock input pin.
— In this sample task, settings are made so that the transfer clock source is PSS, the frequency of prescaler is divided by 64, and the transfer clock cycle is 12 µs.
— The SCI1 transfer data format can be selected from 8 bits and 12 bits. Data is transferred in the LSB first method that transmits or receives data from the lowest bit. Transmit data is output from the falling edge of the transfer clock to the next rising edge. Receive data is acquired on the rising edge of the transfer clock.
— In this sample task, the 8-bit operating mode is set to perform 8-bit data transmission.
— The SCI1 clock pin (SCK_1) functions as a clock input/output pin for SCI1.
— The SCI1 data input pin (SI_1) functions as a receive data input pin for SCI1.

— When the SCI1 completes data transfer, the SCI1 interrupt request flag bit (IRRS1) in the interrupt request register 2 (IRR2) is set to 1. SCI1 interrupt requests can be enabled/disabled with the SCI1 interrupt enable bit (IENS1) in the interrupt enable register 2 (IENR2).

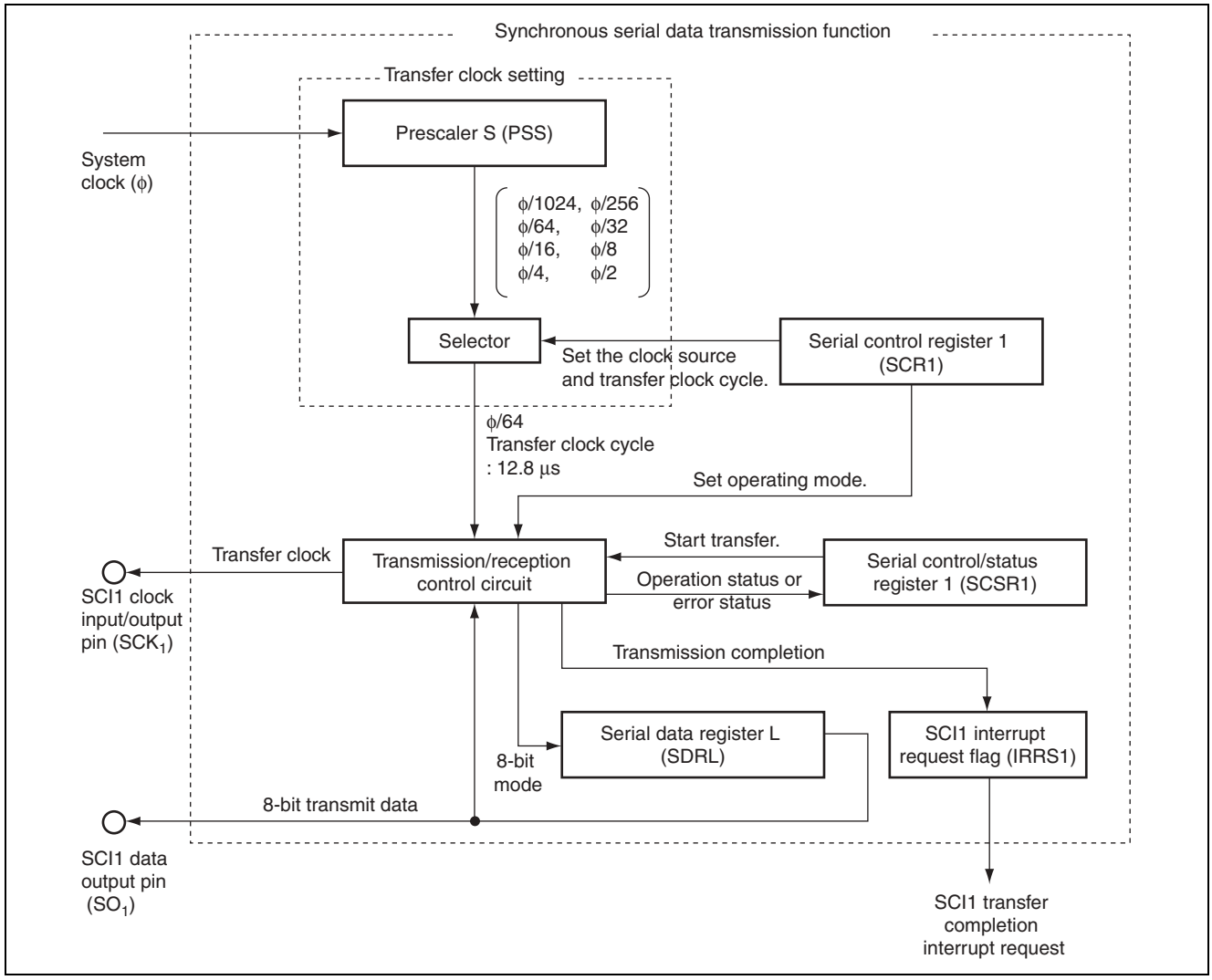


Figure 2.1 Block Diagram of Synchronous Serial Data Transmission Function

2. Table 2.1 shows the allocation of functions used in this sample task. Functions are allocated as shown in table 1 to perform serial data transmission in synchronous mode.

Table 2.1 Function Allocation

Function	Function Allocation
PSS	13-bit counter to which the system clock is input.
SCR1	Operating mode, transfer clock source and prescaler division ratio are set.
SCSR1	Operation status or error status is indicated.
SDRL	Data register for 8-bit transmit data
SCK_1	Transfer clock output pin of SCI1
SO_1	Transmit data output pin of SCI1
IRRS1	SCI1 transfer completion is indicated.
IENS1	Enabling/disabling of SCI1 interrupt requests is controlled.
PMR3	$P3_2/SO_1$ and $P3_0/SCK_1$ pin functions are set.
PMR7	Turning on/off of the $P3_2/SO_1$ pin output buffer PMOS is controlled.

3. Principle of Operation

1. Figure 3.1 illustrates the principle of operation of this sample task. Serial data transmission is performed in synchronous mode with the hardware and software processing shown in the figure.

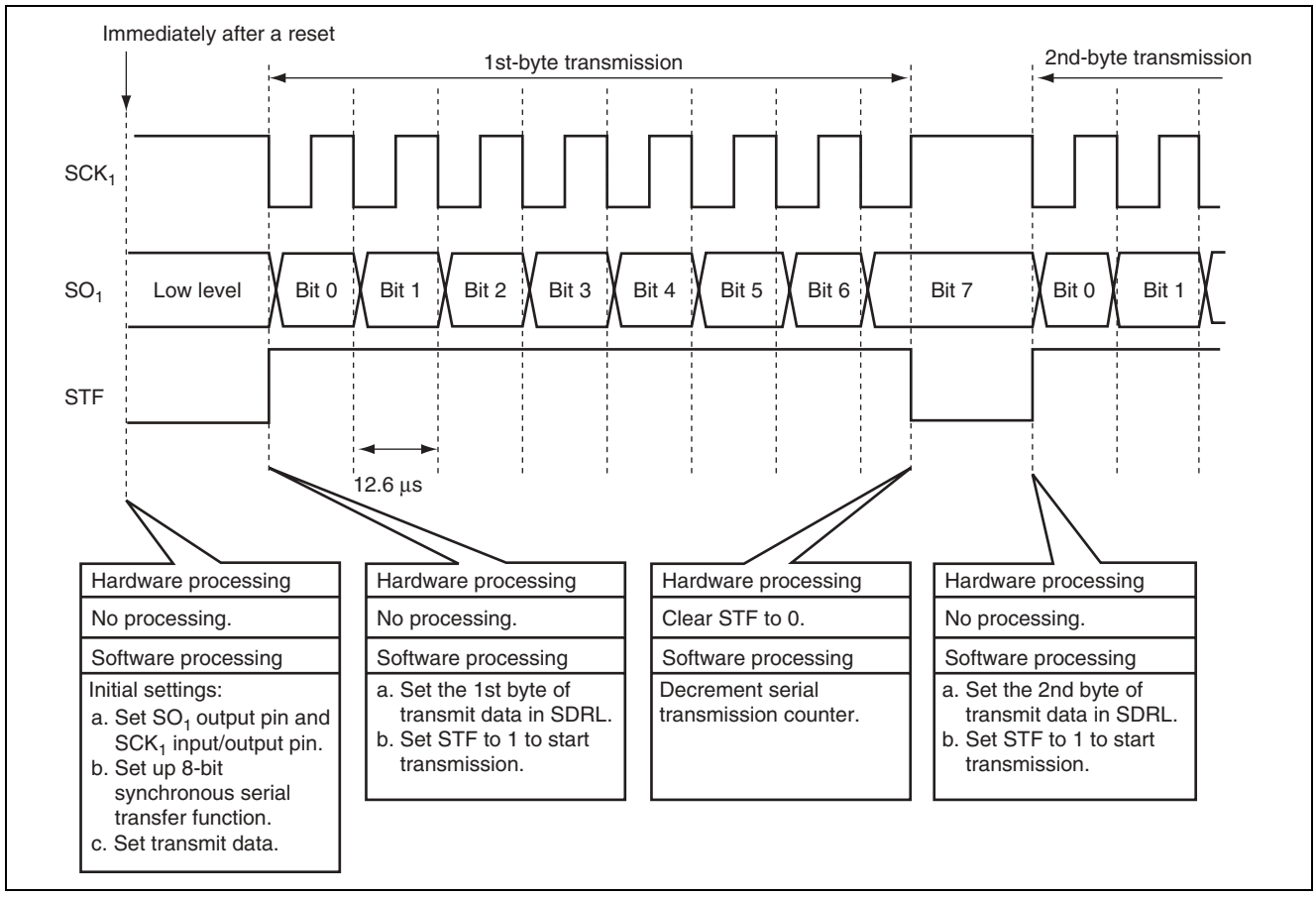


Figure 3.1 Operation Principle of Serial Data Transmission in Synchronous Mode

4. Description of Software

4.1 Module

Table 4.1 describes the module used in this sample task.

Table 4.1 Description of Modules

Module	Label	Function
Main routine	main	Initializes the stack pointer, sets transfer data, sets for synchronous serial data transmission, enables interrupts, and ends when 4 bytes of data have been transmitted.

4.2 Arguments

Table 4.2 describes the arguments used in this sample task.

Table 4.2 Description of Arguments

Argument	Function	Used in	Data Length	Input/ Output
STD0 to STD3	Data for synchronous serial transmission	Main routine	1 byte	Input

4.3 Internal Registers

The internal registers used in this sample task are described in table 4.3.

Table 4.3 Description of Internal Registers

Register		Function	Address	Setting
SCR1	SNC1 SNC0	Serial Control Register 1 (Operating Mode Select 1, 0) When SNC1 = 0 and SNC0 = 0, operating mode is set to 8-bit mode.	H'FFA0 Bit 7 Bit 6	SNC1 = 0 SNC0 = 0
	CKS3	Serial Control Register 1 (Clock Source Select 3) When CKS3 = 0, prescaler S is selected for the clock source and the SCK_1 pin is set to output.	H'FFA0 Bit 3	0
	CKS2 CKS1 CKS0	Serial Control Register 1 (Clock Source Select 2, 1, 0) When CKS2 = 0, CKS1 = 1 and CKS0 = 0, prescaler division ratio is set to 64 and the transfer clock cycle is set to 12.8 μs.	H'FFA0 Bit 2 Bit 1 Bit 0	CKS2 = 0 CKS1 = 1 CKS0 = 0
SCSR1	SOL	Serial Control/Status Register 1 (Expansion Data Bit) When SOL = 0, the SO_1 pin output level is changed to low. When SOL = 1, the SO_1 pin output level is changed to high.	H'FFA1 Bit 6	0
	STF	Serial Control/Status Register 1 (Start Flag) When STF = 0, transfer operation is complete. When SOL = 1, transfer operation starts.	H'FFA1 Bit 0	0
SDRL		Serial Data Register L Stores 8-bit transmit data during 8-bit transfer	H'FFA3	—

Register		Function	Address	Setting
IENR2	IENS1	Interrupt Enable Register 2 (SCI1 Interrupt Enable) When IENS1 = 0, SCI1 interrupt requests are disabled. When IENS1 = 1, SCI1 interrupt requests are enabled.	H'FFF5 Bit 4	0
IRR2	IRRS1	Interrupt Request Register 2 (SCI1 Interrupt Request Flag) When IRRS1 = 0, SCI1 interrupt requests are not requested. When IRRS1 = 1, SCI1 interrupt requests are requested.	H'FFF8 Bit 4	0
PMR3	SO1	Port Mode Register 3 ($P3_2$/SO_1 Pin Function Switch) When SO1 = 1, this pin functions as SO_1 output pin.	H'FFFD Bit 2	1
	SCK1	Port Mode Register 3 ($P3_0$/SCK_1 Pin Function Switch) When SCK1 = 1, this pin functions as SCK_1 input/output pin.	H'FFFD Bit 0	1
PMR7	PQF1	Port Mode Register 7 ($P3_2$/SO_1 Pin PMOS Control) When POF1 = 0, CMOS output is performed.	H'FFFF Bit 0	0

4.4 Description of RAM

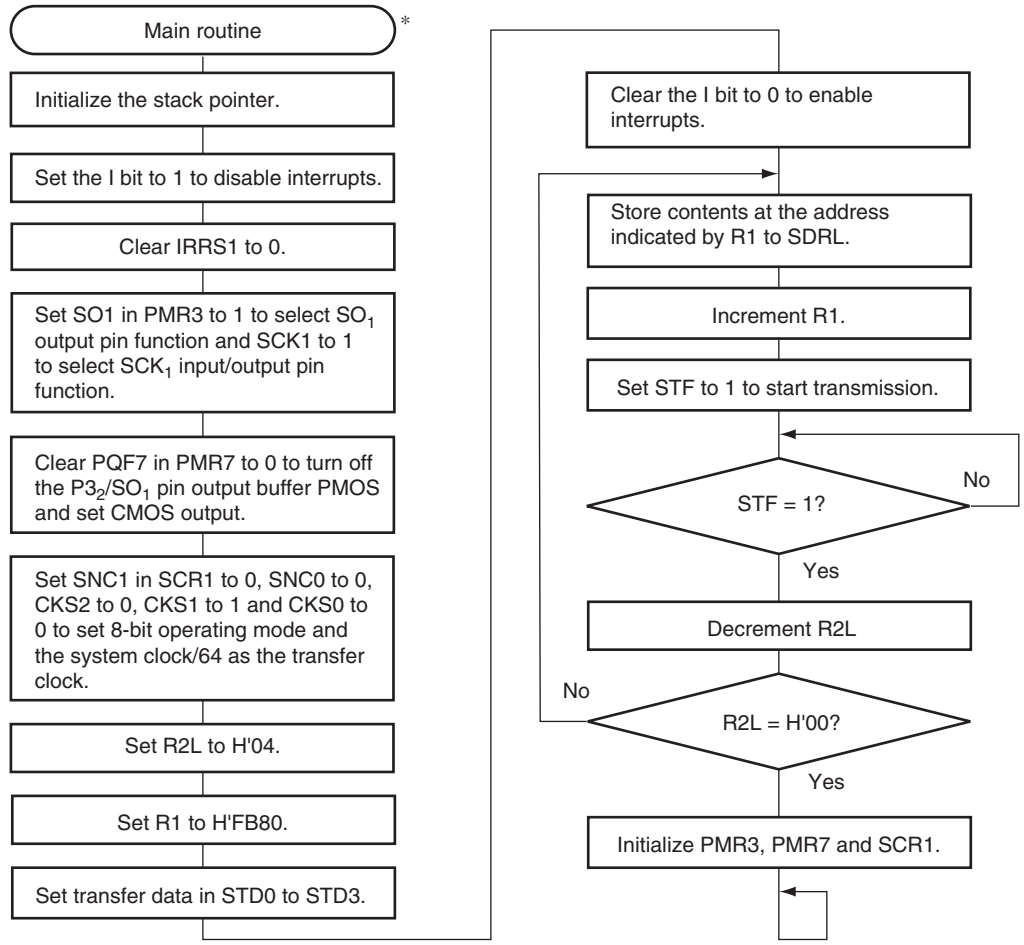
Table 4.4 describes the RAM used in this sample task.

Table 4.4 Description of RAM

Label	Function	Address	Used in
STD0	Stores the first byte of data for synchronous-mode serial transmission.	H'FB80	Main routine
STD1	Stores the second byte of data for synchronous-mode serial transmission.	H'FB81	Main routine
STD2	Stores the third byte of data for synchronous-mode serial transmission.	H'FB82	Main routine
STD3	Stores the fourth byte of data for synchronous-mode serial transmission.	H'FB83	Main routine

5. Flowchart

1. Main routine



Note: * In this sample task, the stack pointer is set in INIT.SRC (assembly language).

6. Program Listing

```
;*************************************************************************************
;*                                                                                   *
;*     H8/300L Series -H8/3644,H8/3657-                                              *
;*     Application Note                                                              *
;*                                                                                   *
;*     'Synchronous Serial Data Transmission'                                        *
;*                                                                                   *
;*     Function                                                                      *
;*     : Serial Communication Interface                                              *
;*       Synchronous Serial Interface                                                *
;*       -Transmitting                                                               *
;*                                                                                   *
;*     External Clock : 10MHz                                                        *
;*     Internal Clock :  5MHz                                                        *
;*     Sub Clock      : 32.768kHz                                                    *
;*                                                                                   *
;*************************************************************************************
;
          .cpu      300L
;
;*************************************************************************************
;*  Symbol Defnition                                                                 *
;*************************************************************************************
;
SCR1      .equ      H'FFA0        ;Serial Control Register 1
SNC1      .bequ     7,SCR1        ;Select the Operation Mode 1
SNC0      .bequ     6,SCR1        ;Select the Operation Mode 0
MRKON     .bequ     5,SCR1        ;TAIL MARK Control
LTCH      .bequ     4,SCR1        ;LATCH TAIL Select
CKS3      .bequ     3,SCR1        ;Clock Source Select 3
CKS2      .bequ     2,SCR1        ;Clock Select 2
CKS1      .bequ     1,SCR1        ;Clock Select 1
CKS0      .bequ     0,SCR1        ;Clock Select 0
SCSR1     .equ      H'FFA1        ;Serial Control Status Register 1
SOL       .bequ     6,SCSR1       ;Extended Data Bit
ORER      .bequ     5,SCSR1       ;Overrun Error Flag
MTRF      .bequ     1,SCSR1       ;TAIL MARK Transmit Flag
STF       .bequ     0,SCSR1       ;Start Flag
SDRU      .equ      H'FFA2        ;Serial Data Register U
SDRL      .equ      H'FFA3        ;Serial Data Register L
IENR2     .equ      H'FFF5        ;Interrupt Enable Register 2
IENS1     .bequ     4,IENR2       ;SCI1 Interrupt Enable
IRR2      .equ      H'FFF8        ;Interrupt Request Register 2
IRRS1     .bequ     4,IRR2        ;SCI1 Interrupt Request Flag
PMR3      .equ      H'FFFD        ;Port Mode Register 3
SO1       .bequ     2,PMR3        ;P32/SO1 Pin Function Switch
SI1       .bequ     1,PMR3        ;P31/SI1 Pin Function Switch
SCK1      .bequ     0,PMR3        ;P30/SCK1 Pin Function Switch
PMR7      .equ      H'FFFF        ;Port Mode Register 7
POF1      .bequ     0,PMR7        ;P32/SO1 Pin Function Switch
;
```

```
;*****************************************************************************
;*  RAM Allocation                                                           *
;*****************************************************************************
;
STACK     .equ         H'FF80        ;Stack Pointer
STD0      .equ         H'FB80        ;Serial Transmitting Data 0
STD1      .equ         H'FB81        ;Serial Transmitting Data 1
STD2      .equ         H'FB82        ;Serial Transmitting Data 2
STD3      .equ         H'FB83        ;Serial Transmitting Data 3
;
;*****************************************************************************
;*  Vector Address                                                           *
;*****************************************************************************
;
          .org         H'0000
          .data.w      MAIN          ;Reset Interrupt
;
          .org         H'0008
          .data.w      MAIN          ;IRQ0 Interrupt
          .data.w      MAIN          ;IRQ1 Interrupt
          .data.w      MAIN          ;IRQ2 Interrupt
          .data.w      MAIN          ;IRQ3 Interrupt
          .data.w      MAIN          ;INT0 - INT7 Interrupt
;
          .org         H'0014
          .data.w      MAIN          ;Timer A Interrupt
          .data.w      MAIN          ;Timer B1 Interrupt
;
          .org         H'0020
          .data.w      MAIN          ;Timer X Interrupt
          .data.w      MAIN          ;Timer V Interrupt
;
          .org         H'0026
          .data.w      MAIN          ;SCI1 Interrupt
;
          .org         H'002A
          .data.w      MAIN          ;SCI3 Interrupt
          .data.w      MAIN          ;A/D Converter Interrupt
          .data.w      MAIN          ;SLEEP Instruction Executed Interrupt
;
```

```
;*****************************************************************************
;*  Main Program                                                             *
;*****************************************************************************
;
          .org          H'1000
;
MAIN      .equ          $
          MOV.W         #STACK,SP     ;Initialize Stack Pointer
          ORC           #H'80,CCR     ;Interrupt Disable
;
          BCLR          IRRS1         ;Clear IRRS1
          BCLR          IENS1         ;SCI1 Interrupt Disable
;
          MOV.W         #H'05F8,R0
          MOV.B         R0H,@PMR3     ;Initialize SO1 & CKS1 Pin Function
          MOV.B         R0L,@PMR7     ;Initialize SO1 Pin Function
;
          MOV.B         #H'02,R0L
          MOV.B         R0L,@SCR1     ;Initialize Synchronous Serial Transfer Function
;
          MOV.W         #H'FB80,R1    ;Initialize Serial Transmitting Data Address
          MOV.B         #H'04,R2L     ;Initialize Serial Transmitting Data Counter
;
          MOV.W         #H'0055,R0
          MOV.B         R0H,@STD0     ;Set Serial Transfer Data 0
          MOV.B         R0L,@STD1     ;Set Serial Transfer Data 1
          MOV.W         #H'AAFF,R0
          MOV.B         R0H,@STD2     ;Set Serial Transfer Data 2
          MOV.B         R0L,@STD3     ;Set Serial Transfer Data 3
;
          ANDC          #H'7F,CCR     ;Interrupt Enable
;
MAIN1     .equ          $
          MOV.B         @R1,R0L       ;Load Serial Transmitting Data
          MOV.B         R0L,@SDRL     ;Save Serial Transmitting Data
          ADDS          #1,R1         ;Increment Serial Transmitting Data Address
;
          BSET          STF           ;Start Serial Transmitting
;
MAIN2     .equ          $
          BTST          STF           ;End Serial Transmitting ?
          BNE           MAIN2         ;No.
;
          DEC           R2L           ;Decrement Serial Transmitting Data Counter
          BNE           MAIN1         ;Serial Transmitting Data Counter = H'00 ? No.
;
          MOV.B         #H'00,R0L
          MOV.B         R0L,@PMR3     ;Initialize SO1 & SCK1 Pin Function
          MOV.B         R0L,@PMR7     ;Initialize SO1 Pin Function
          MOV.B         R0L,@SCR1     ;Initialize Synchronous Serial Transfer Function
;
MAIN9     .equ          $
          BRA           MAIN9
;
          .end
```

Revision Record

		Description	
Rev.	Date	Page	Summary
1.00	Dec.19.03	—	First edition issued

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