

Demo 15 - Serial Port Study - Multi Processor Communication Mode (Master)

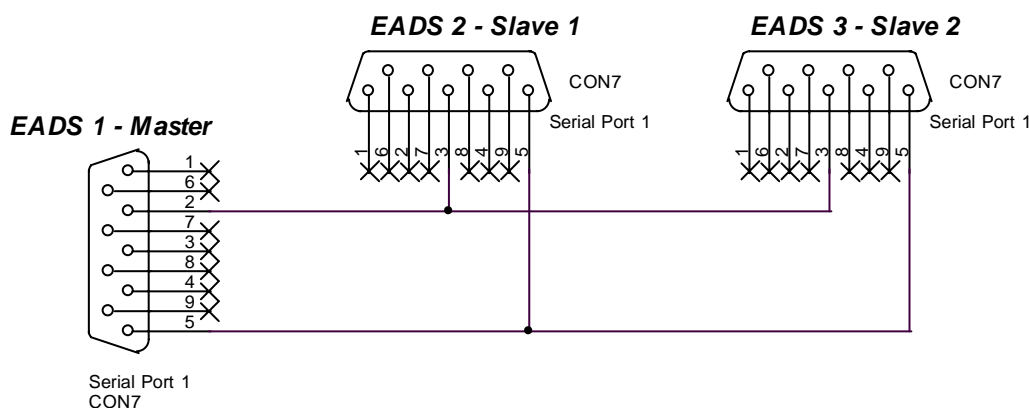
Introduction:

Gives an idea about using the serial port in multi processor communication mode with one master and two slaves. The pressed key value is sent to a particular slave using the TXD line of the serial port 1.

Hardware:

For studying the serial port in multi processor communication mode, three EADS are required as minimum. One micron acts as master and other two act as slaves. Two slaves have individual IDs. The master will send the data to the slaves by sending the IDs first and the data next.

The RXD lines of the both slaves are connected to the same TXD line of master.



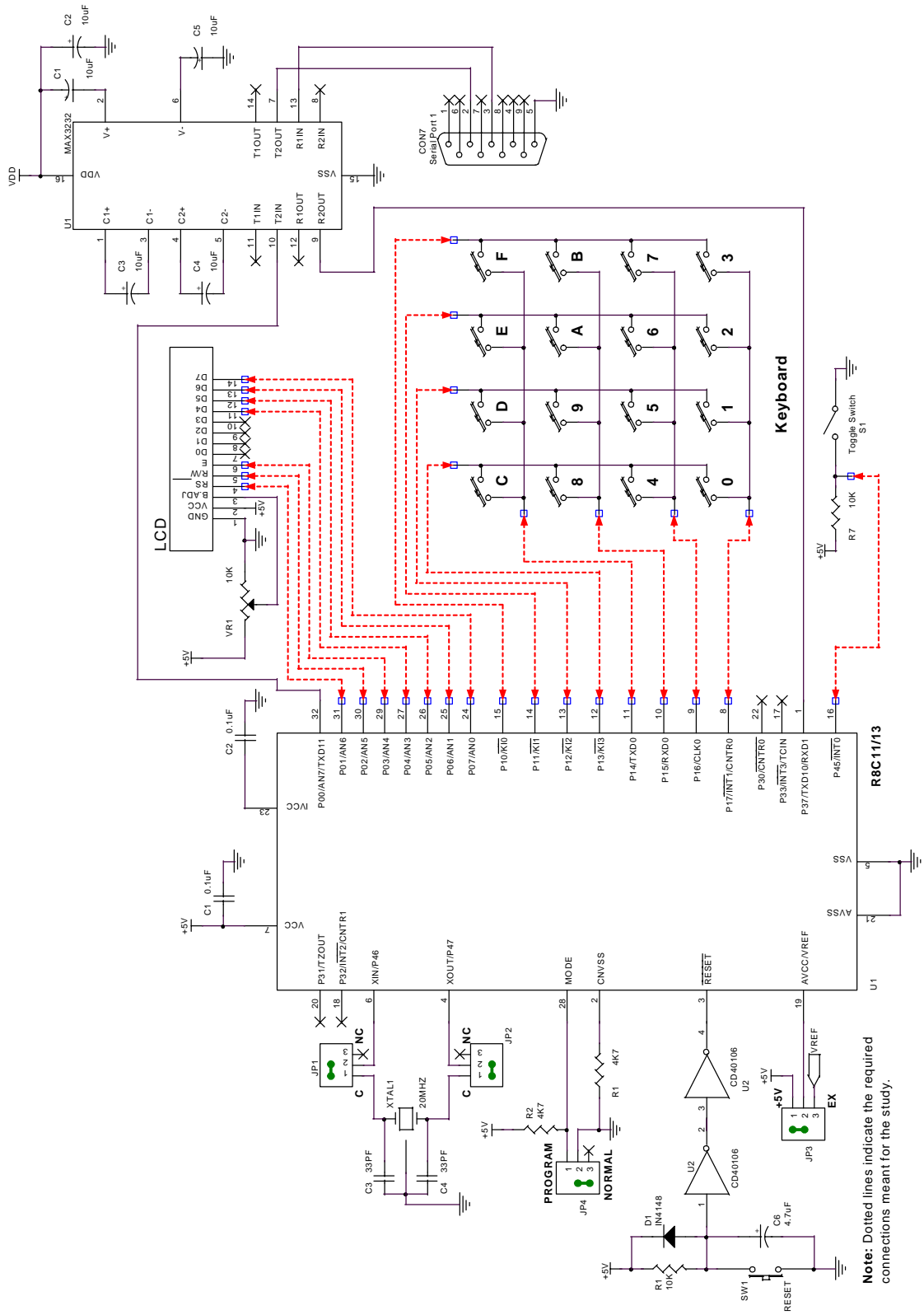
A 2 line by 16 characters LCD is used for the display purpose. 4 X 4 matrix keyboard is used for selecting the data. The slave is selected using a toggle switch.

Port lines P01 to P03 are used to control LCD and connected to RS, R/W and E pins of LCD. The port lines P04 to P07 are connected to upper data bus D4 to D7 of LCD to send data and command.

Port lines P10 to P13 are connected to the column lines and port lines P14 to P17 are connected to the row lines of the matrix keyboard.

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Circuit:



Note: Dotted lines indicate the required connections meant for the study.

Connections:

LCD Connection:-

RS - P01
RW - P02
E - P03
D4 - P04
D5 - P05
D6 - P06
D7 - P07

Keyboard Connection:-

Row0 - P14
Row1 - P15
Row2 - P16
Row3 - P17
Column0 - P10 (KI0)
Column1 - P11 (KI1)
Column2 - P12 (KI2)
Column3 - P13 (KI3)

Toggle Switch Connection for Selecting Slave:-

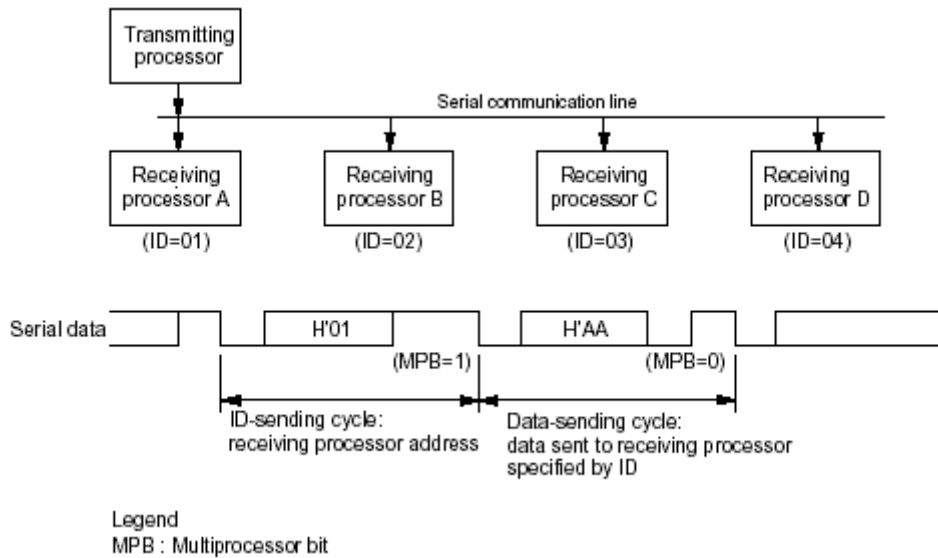
Toggle Switch - P45 (0 level for Slave 1 and 1 level for Slave 2)

Functional Description:

The multiprocessor communication function enables several processors to share a single serial communication line. The processors communicate in asynchronous mode using a format with an additional multiprocessor bit (multiprocessor format).

In multiprocessor communication, each receiving processor (Slave) is addressed by an ID. A serial communication cycle consists of an ID-sending cycle that identifies the receiving processor, and then a data-sending cycle. The multiprocessor bit distinguishes ID-sending cycles from data-sending cycles.

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The transmitting processor (Master) starts by sending the ID of the receiving processor with which it wants to communicate as data with the multiprocessor bit set to 1. Next the master sends the transmit data with the multiprocessor bit cleared to 0.

Slaves skip incoming data until they receive data with the multiprocessor bit set to 1. When they receive data with the multiprocessor bit set to 1, slaves compare the data with their IDs. Processors with IDs not matching the received data skip further incoming data until they again receive data with the multiprocessor bit set to 1. Multiple processors can send and receive data in this way.

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Registers Used:

- U1MR - UART1 transmit/receive mode register
- U1C0 - UART1 transmit/receive control register 0
- U1C1 - UART1 transmit/receive control register 1
- UCON - UART transmit/receive control register 2

U1MR - UART1 Transmit/Receive Mode Register:

	b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	0	0	0	0	0	0
	Symbol		Address		After reset			
	U0MR		00A016		0016			
	U1MR		00A816		0016			
	Bit symbol	Bit name	Function					RW
SMD0	Serial interface mode select bit ²		0 0 0 : Serial interface disabled 0 0 1 : Clock synchronous serial I/O mode 1 0 0 : UART mode transfer data 7 bits long 1 0 1 : UART mode transfer data 8 bits long 1 1 0 : UART mode transfer data 9 bits long Do not set except above					RW
SMD1								RW
SMD2								RW
CKDIR	Internal/external clock select bit ³		0 : Internal clock 1 : External clock ¹					RW
STPS	Stop bit length select bit		0 : 1 stop bit 1 : 2 stop bits					RW
PRY	Odd/even parity select bit		Effective when PRYE = 1 0 : Odd parity 1 : Even parity					RW
PRYE	Parity enable bit		0 : Parity disabled 1 : Parity enabled					RW
(b7)	Reserved bit		Set to "0"					RW

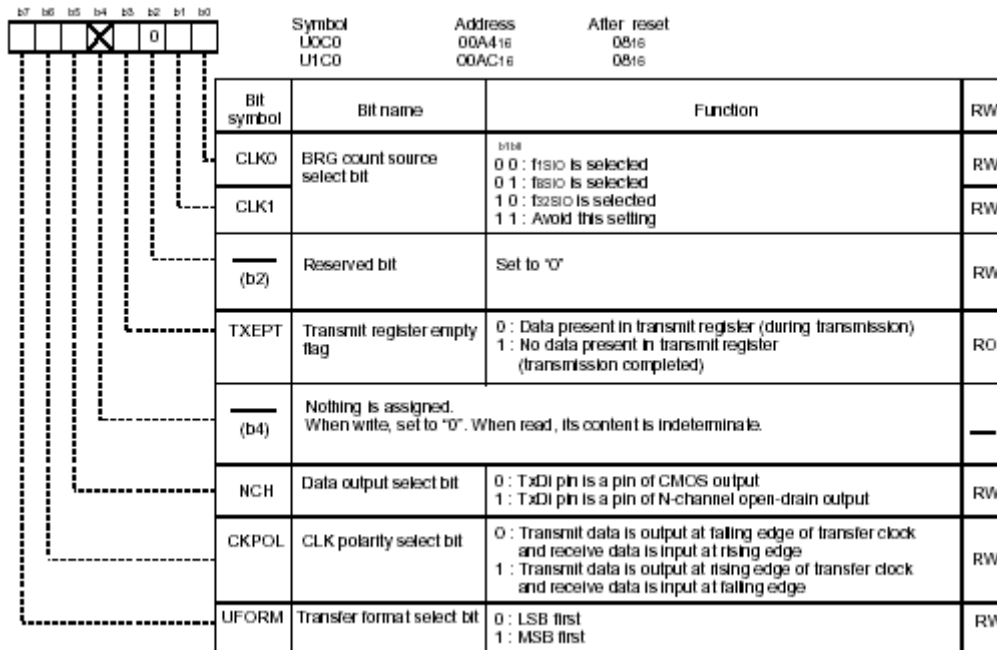
Notes:

1. Must set the P1_6 bit in the PD1 register to "0" (input).
2. For the U1MR register, the SMD2 to SMD0 bits must not be set except the followings: "000", "100", "101", or "110".
3. Must set the CKDIR bit to "0" (internal clock) in UART1.

U1MR register is initialized with the data H'06 to select following options:

1. UART mode transfer data 9 bits long,
2. Internal clock,
3. 1 Stop bit,
4. No parity.

U1C0 - UART1 Transmit/Receive Control Register 0:

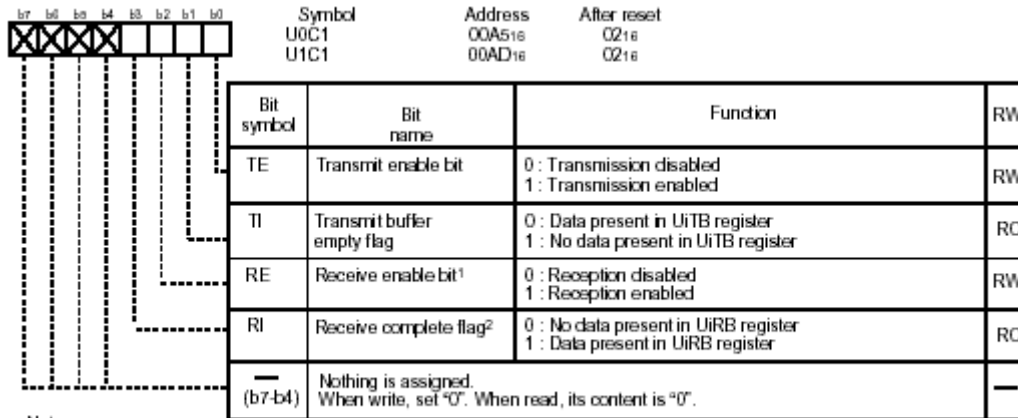


Data H'00 is set to register U1C0 register to select following options:

1. f1SIO clock is selected,
2. TXD1 pin is a pin of CMOS,
3. Transmit data is output at falling edge of transfer clock and receive data is input at rising edge,
4. LSB First.

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U1C1 - UART1 Transmit/Receive Control Register 1:

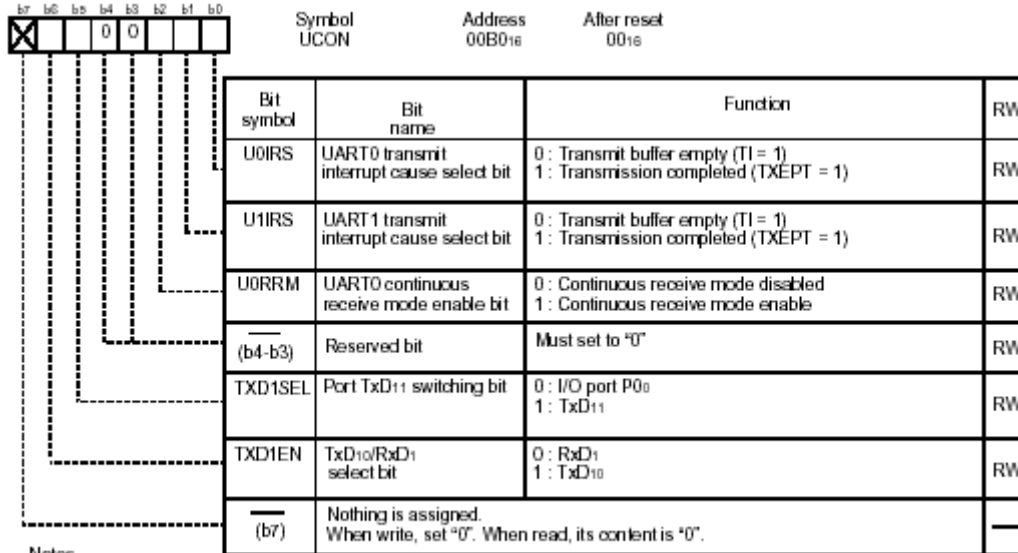


Notes:

1. As for the UART1, set the TXD1EN bit in the UCON register before setting this bit to reception enabled.
2. The RI bit is set to "0" when the higher byte of the UiRB register is read.

Bits TE and RE are set 1 to enable transmission and reception.

UCON - UART Transmit/Receive Control Register 2:



Notes:

1. For P3₇, select "0" (RxD1) for data receive, and "1" (TxD10) for data transfer.
Set the PD3_7 bit in the PD3 register to "0" (input mode) when receiving.

Bit TXD1SEL is set 1 to select P00 as TXD11 line.

Software Description:

Data from H'00 to H'0F is sent through serial port 1 in multi processor mode to the selected slave. The slave can be selected as either 1 or 2 by the toggle switch level. A 2 Line X 16 characters LCD is used to display the selected slave and 4 X 4 matrix keyboard is used to enter data. The serial port 1 is configured to send data at 9600 baud rate @ 20MHZ.

After reset,

1. The external crystal oscillator is selected as clock source for MCU and other peripherals.
2. Serial port 1 is initialized in 9 bits mode at 9600.
3. LCD is initialized in 4 bit mode.
4. Keyboard is initialized.
5. The Message "Srl Port-Master " is displayed on first line of LCD.

After the initialization, in a continuous loop, the keyboard and toggle switch levels are scanned. The pressed key value is send to the selected slave through serial port by sending the ID of the selected slave first and then the key value. The selected slave and the pressed key value are displayed in the second line of LCD.

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The files used in this module are listed below:

<i>Files</i>	<i>Description</i>
Demo15.C	Main file for this module, will read key value and send the same to the slaves through serial port 1. Displays the key value and the selected slave on the LCD.
R8C1113_FE_LCD_4Bit.C	LCD routines to initialize LCD, cursor on/off, display a message etc.
R8C1113_FE_LCD_4Bit.H	Declarations of functions in R8C1113_FE_LCD_4Bit.C
R8C1113_FE_Keyboard.C	Keyboard routines to initialize Key input interrupts, I/O lines used by keyboard and key input interrupt service routine.
R8C1113_FE_Keyboard.H	Declarations of functions in R8C1113_FE_Keyboard.C

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The functions in the file "Demo15.C" and short descriptions are listed below:

<i>Functions</i>	<i>Description</i>
main	Reads the pressed key value and sends to slave through serial port1. Input: None. Output : None.
MCUInitialize	Selects the external crystal oscillator as clock source for the CPU and other peripherals. Input: None. Output : None.
InitializeSerialPort1	Initializes the serial port 1 in 9 bit mode at 9600 baud rate. Input: None. Output : None.
SendByteSlave	Sends a byte to the given slave Input: Selected slave and data. Output : None.

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The functions in the file "R8C1113_FE_LCD_4Bit.C" and short descriptions are listed below:

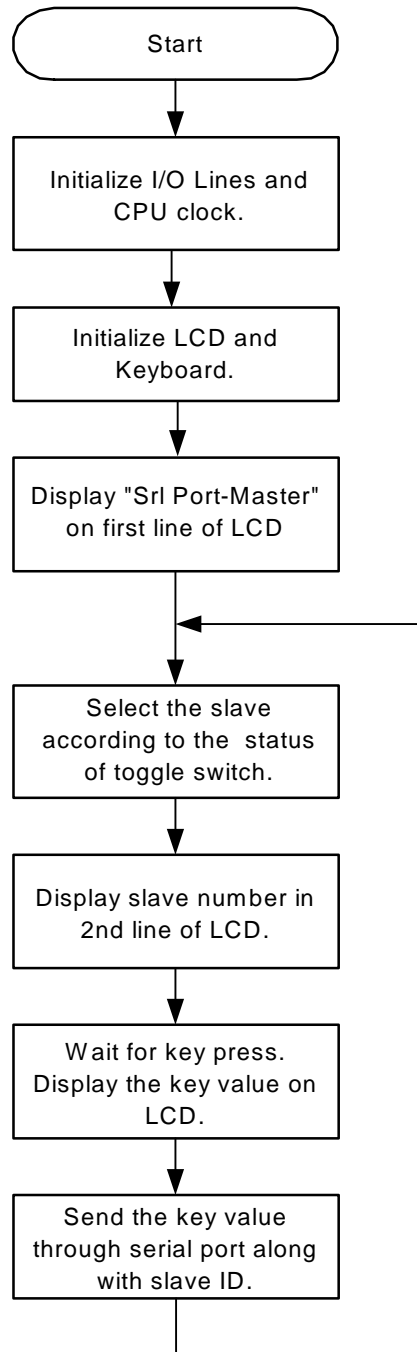
Files	Description
DisplayLCD	Displays a message (16 Characters) on LCD on the given line number. Input: Line number and message string. Output : None.
DisplayLCD2Digit	Displays the given 2 digit number on LCD at given location. Input: Line number, character position and data. Output : None.
CursorON	Makes the cursor visible on LCD. Input: None. Output : None.
CursorOFF	Hides the cursor. Input: None. Output : None.
InitializeLCD	Initializes the I/O lines used by LCD and LCD in 4 bit mode. Clears the LCD. Input: None. Output : None.
WriteDataLCD	Write a data byte to LCD. Input: Data Byte. Output : None.
WriteCommandLCD	Write a command byte to LCD. Input: Command Byte. Output : None.

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The functions in the file "R8C1113_FE_Keyboard.c" and short descriptions are listed below:

<i>Files</i>	<i>Description</i>
ReadKeyboardStatus	Returns the keyboard Input: None. Output : Keyboard Status.
WaitForKeyPress	Waits for a key press and returns the key code of the pressed key. Input: None. Output : Key Code.
ReadKeyCode	Reads and returns the last pressed key code without waiting for a key press. Input: None. Output : Key Code.
InitializeKeyboard	Initializes the I/O lines used by keyboard and enables Key input (K10 to K13) interrupts. Input: None. Output : None.
ProcessKey_Int	Interrupt service routine for key input interrupt. Input: None. Output : None.

Program Flow:



Execute Study:

After you get the message,
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Slave-x Data: "

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is displayed on the LCD. Where 'x' is the selected slave. It may be either 1 or 2.

The pressed key value (H'00 to H'0F) is sent through serial port line TXD11 after displaying the key value on LCD as shown below:

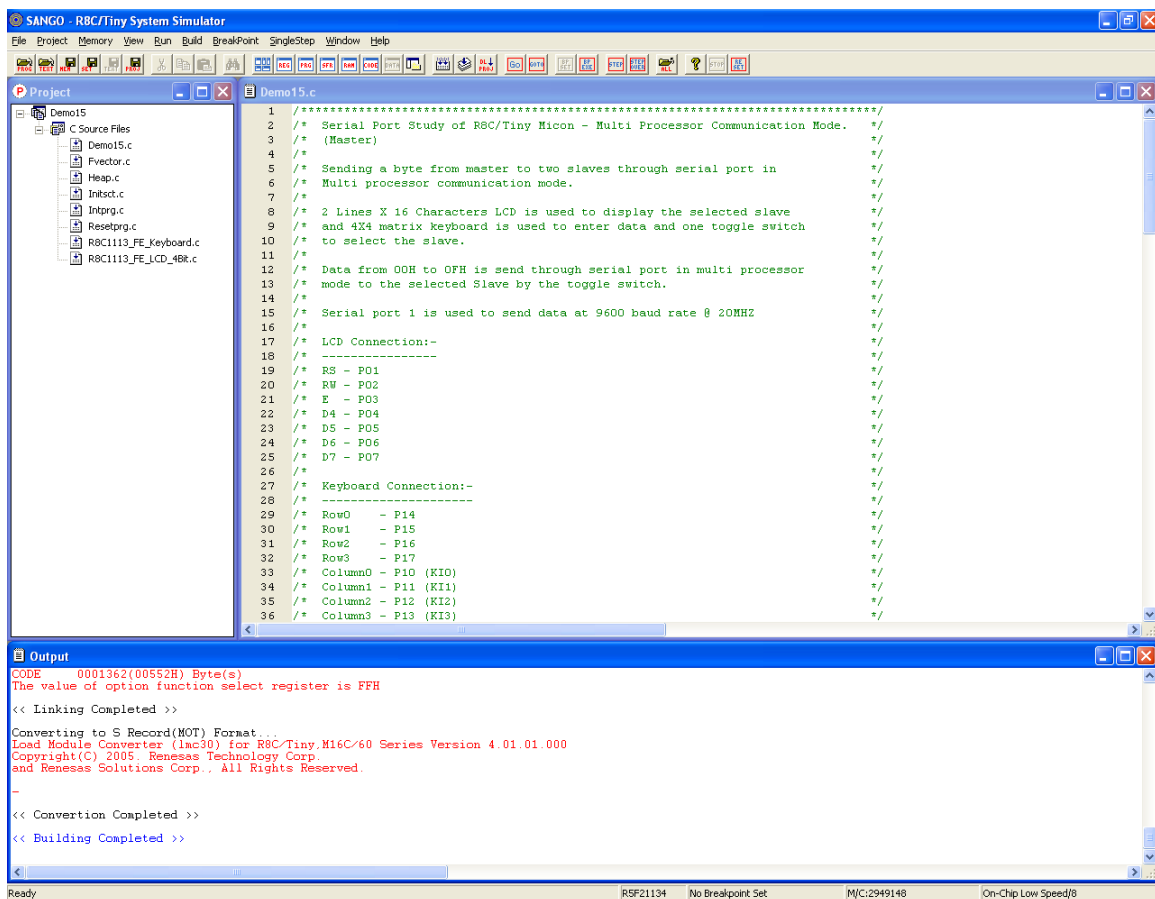
```
"Srl Port-Master  
Slave-2 Data:03 "
```

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Use Topview Simulator to Verify the Design.

Open the project Demo15 in the R8C/Tiny System Simulator using **Open Project** option from **Project** menu. The project window opens up along with the Demo15.c file. Use **Build** option from **Build** menu to compile the project. An output window captures the compiler output.

Use **Project -> Download Project** from main menu to download the .mot file into the simulator's memory for simulation.

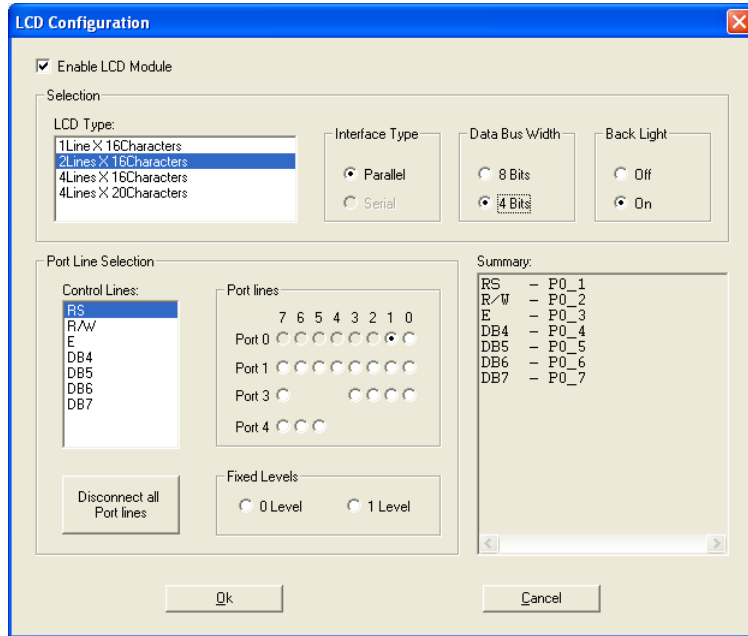


```
1 /*****  
2 /* Serial Port Study of R8C/Tiny Micon - Multi Processor Communication Mode. */  
3 /* (Master) */  
4 /* */  
5 /* Sending a byte from master to two slaves through serial port in */  
6 /* Multi processor communication mode. */  
7 /* */  
8 /* 2 Lines X 16 Characters LCD is used to display the selected slave */  
9 /* and 4X4 matrix keyboard is used to enter data and one toggle switch */  
10 /* to select the slave. */  
11 /* */  
12 /* Data from 00H to 0FH is send through serial port in multi processor */  
13 /* mode to the selected Slave by the toggle switch. */  
14 /* */  
15 /* Serial port 1 is used to send data at 9600 baud rate @ 20MHZ */  
16 /* */  
17 /* LCD Connection:- */  
18 /* ----- */  
19 /* RS - P01 */  
20 /* RW - P02 */  
21 /* E - P03 */  
22 /* D4 - P04 */  
23 /* D5 - P05 */  
24 /* D6 - P06 */  
25 /* D7 - P07 */  
26 /* */  
27 /* Keyboard Connection:- */  
28 /* ----- */  
29 /* Row0 - P14 */  
30 /* Row1 - P15 */  
31 /* Row2 - P16 */  
32 /* Row3 - P17 */  
33 /* Column0 - P10 (KI0) */  
34 /* Column1 - P11 (KI1) */  
35 /* Column2 - P12 (KI2) */  
36 /* Column3 - P13 (KI3) */  
37 /* */
```

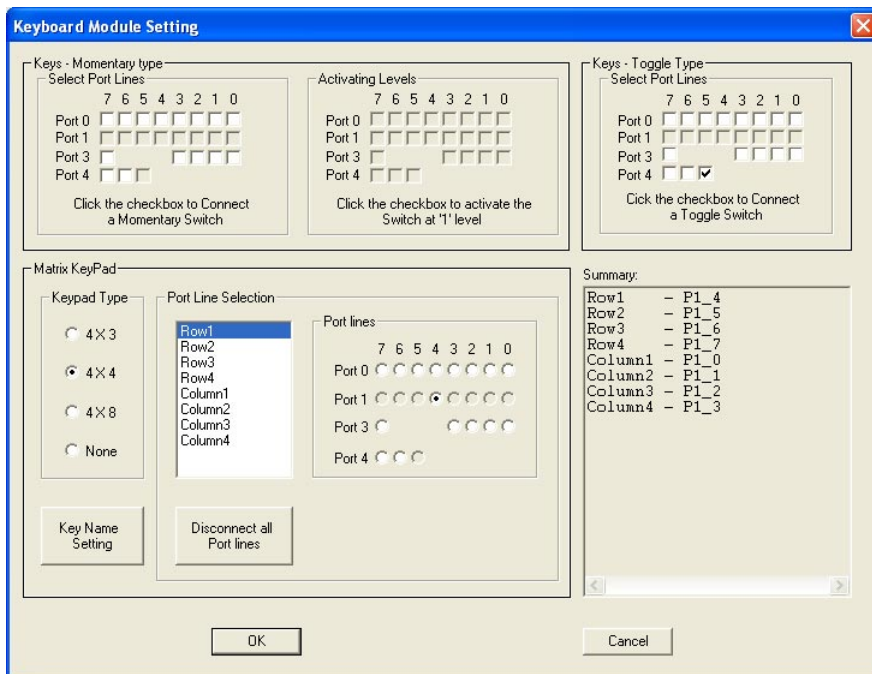
```
CODE 0001362(00552H) Byte(s)  
The value of option function select register is FFH  
  
<< Linking Completed >>  
  
Converting to S Record(MOT) Format ...  
Load Module Converter (lmc30) for R8C/Tiny.M16C/60 Series Version 4.01.01.000  
Copyright(C) 2005 Renesas Technology Corp.  
and Renesas Solutions Corp., All Rights Reserved.  
-  
  
<< Conversion Completed >>  
<< Building Completed >>
```

Do the settings to the LCD module as shown. Select 2 lines by 16 characters LCD module and connect the control and data lines of LCD as shown in the screen shot.

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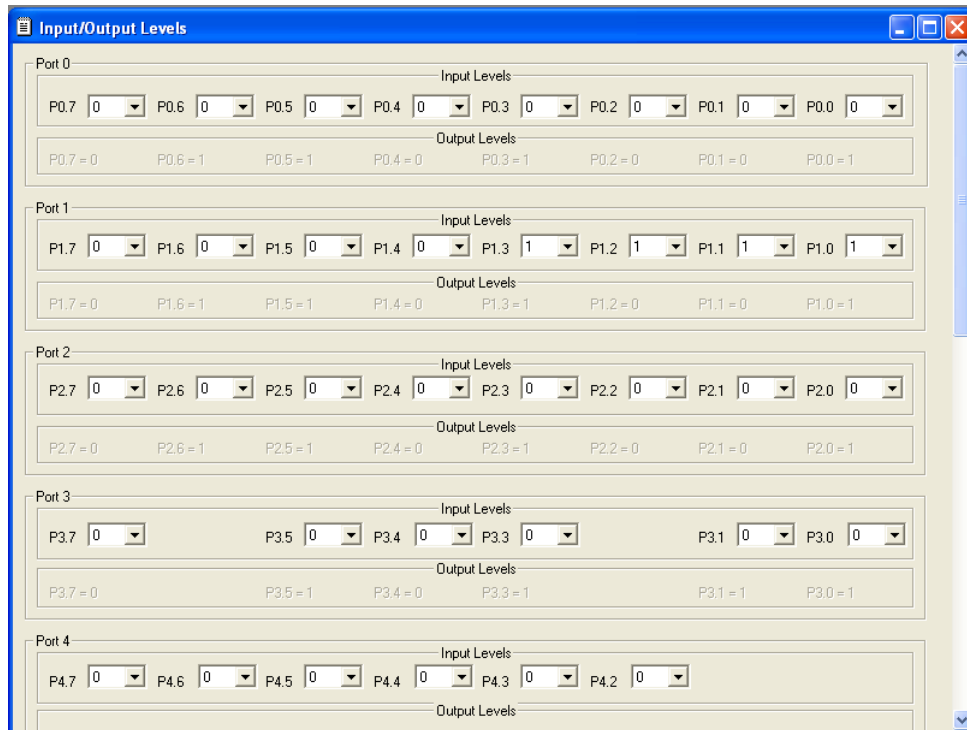


Then open the keyboard module setting and connect row and column lines to port lin P10 to P17. Connect a toggle switch to port line P45 to select the slave.



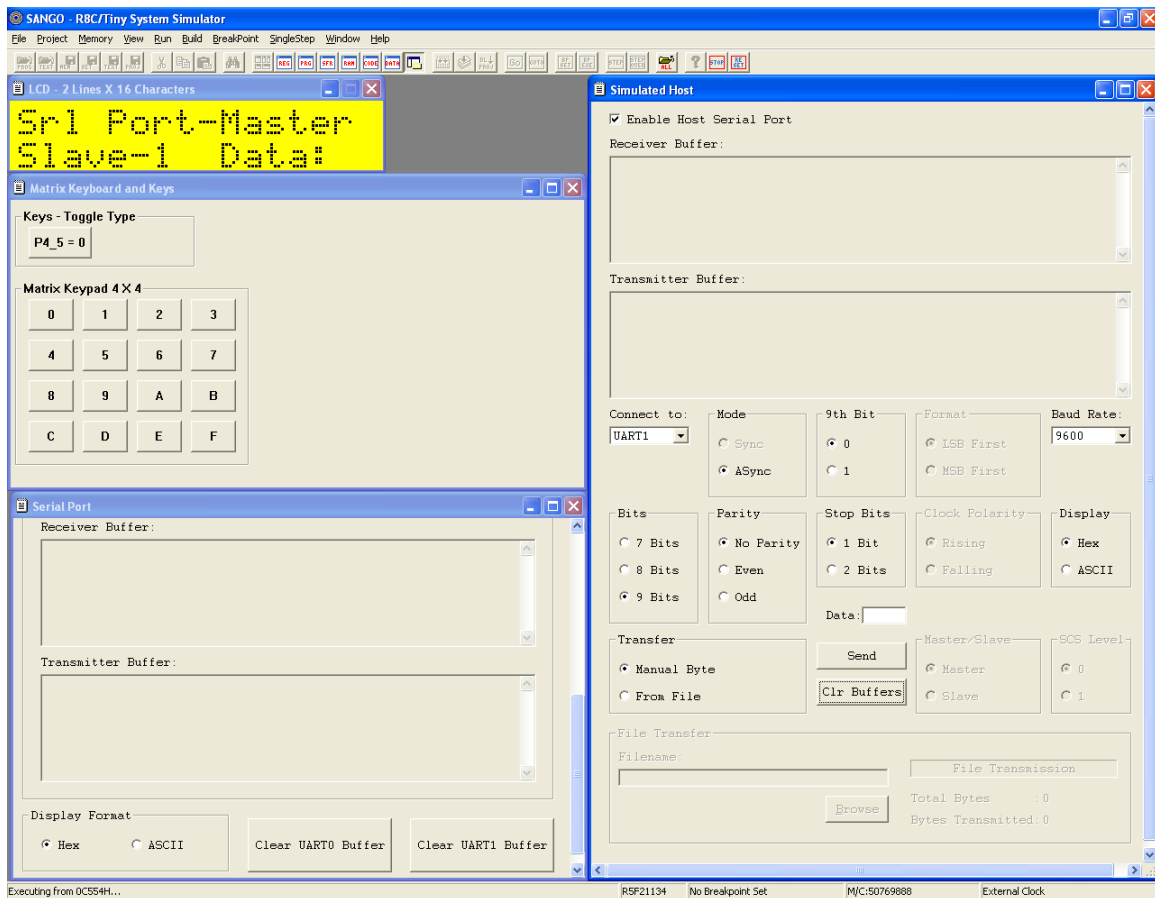
Open the I/O window and set the input levels of P10 to P13 to 1.

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Then open the LCD, Keyboard, Serial port and Simulated host windows and arrange them as shown below.

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Download the program using **Download Project** command in **Project** menu.

Run the program using **Go** command in **Run** menu. The message,

```
Srl Port-Master  
Salve:1 Data: "
```

will be displayed in LCD.

Now press any key in the 4X4 matrix keyboard and the key value is sent to the selected slave through serial port 1.

Format used in multi processor communication mode:

1-13 0-02

Here "1-13" is the Slave ID with the 9th bit as 1 and "0-02" is the key value with 9th bit as 0.