R8C/27 Group

LED Digital Clock Application for R8C/27

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Introduction

This application note is to describe how to use the Renesas Starter Kit for R8C/27 to implement the digital clock on LED matrix display board. The solution composed of two portions, RSK R8C/27 and four LED matrix display boards. The board is controlled by GPIO of MCU and LED Display driver. The system uses R8C/27 MCU to implement LED Matrix Display function. You can be familiar with Renesas R8C series MCU from this evaluation board. It also provides many user interfaces, such as LCM, Key and Buzzer.

Target Device

The target device is R8C/27 series.

Contents

1. The Configuration of the System

The configuration of the system is shown in Figure 1. R8C/27 generates output signal for LED display board column control according to the 16-bit constant current LED driver (DM13A). Row control signal is generated from 4 to 16 line decoder (74HC138 X2) to reduce pin count, MOSFET (FET) provides stable output current.

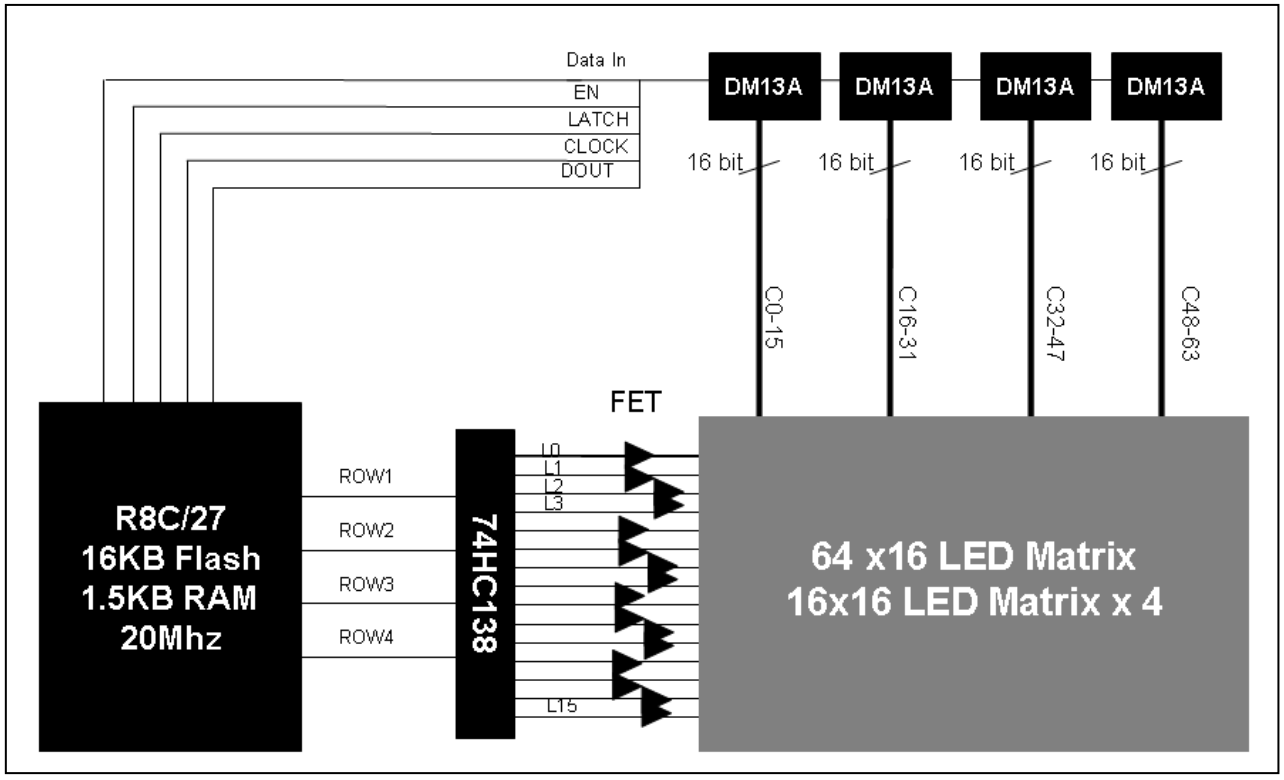

Figure 1 The configuration of the system

The block diagram shows about the LED digital clock function with Renesas R8C series MCU. It uses RTC and GPIO function to control LED constant current LED driver IC and two 74HC138 decoders. It can display two different time zones on LED matrix display board. The LED matrix display board is combined from four 16X16 LED Matrix. Thus the matrix board will include 64X16 dots for display. The 16-bit constant current LED driver incorporates shift register, data latches, and constant current circuitry on the silicon CMOS chip. The maximum output current value of all 16 channels is adjustable by single external resistor. Constant current value of each output channel is set by an external resistor connected to ground. Varying the resistor value can adjust the current scale ranging from 3mA to 60mA. The reference voltage is approximately 1.2V. In order to obtain a good performance of constant- current output, a suitable output voltage is necessary. User can get related information about the minimum output voltage as below.

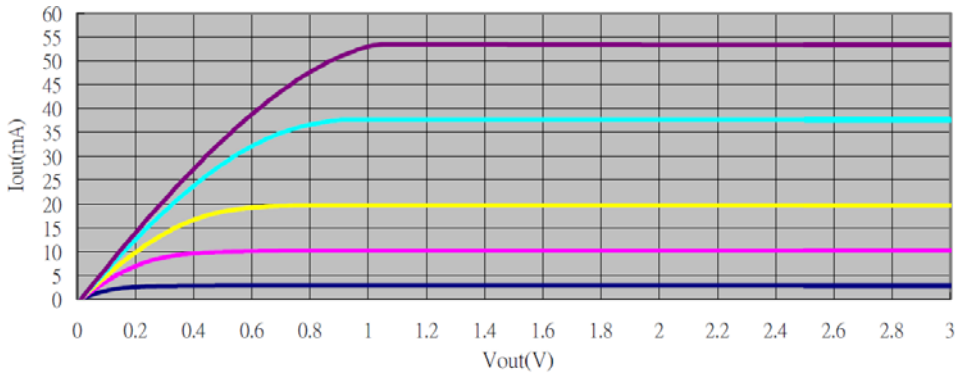

Figure 2 Output current as a function of output voltage

2. Hardware Specification

2.1 Implement LED table lighting application on Renesas Starter Kit for R8C/27

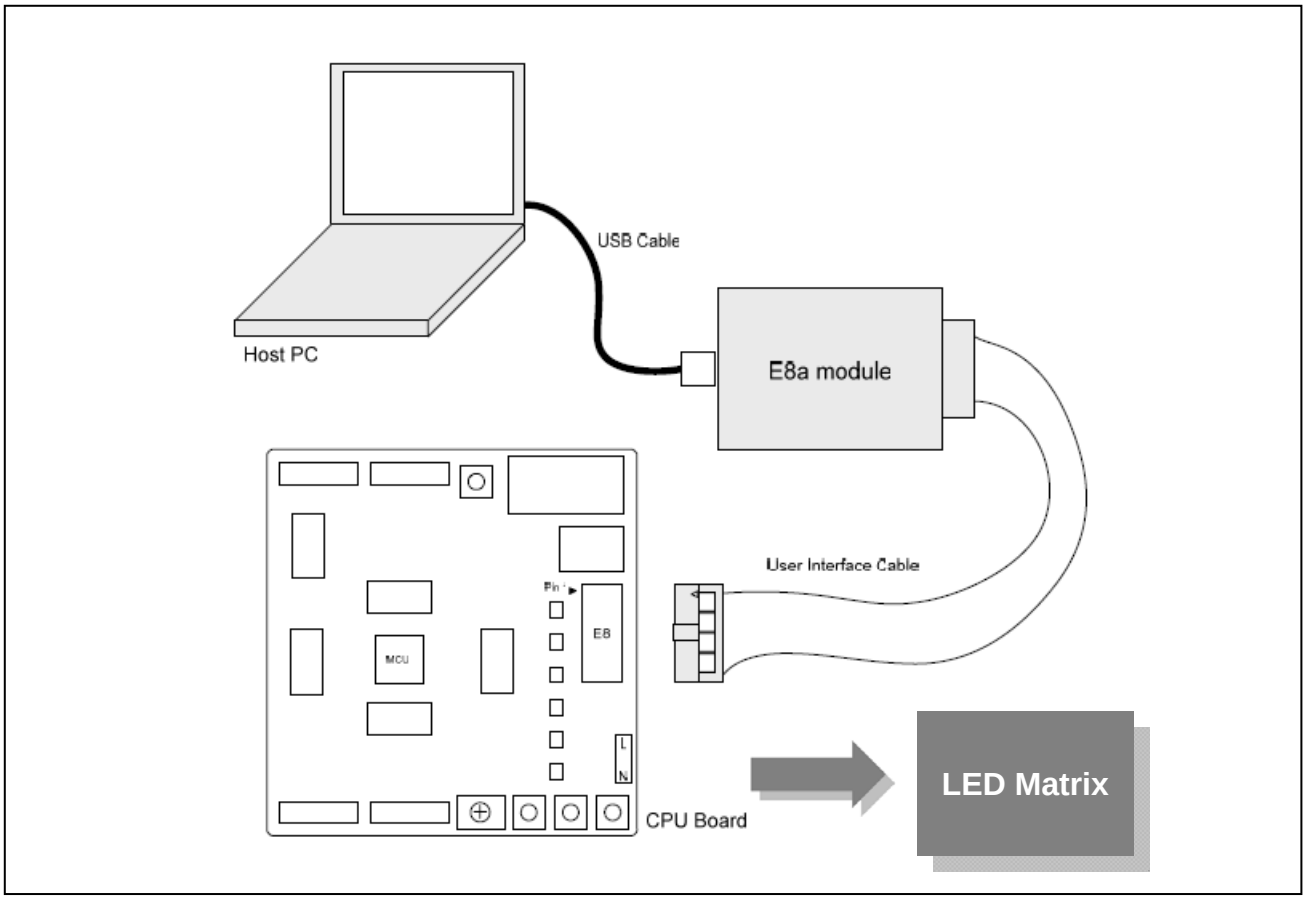

Figure 3 Implement LED digital clock application on RSK R8C/27

RSK (Renesas Starter Kit) CPU board for R8C/27 is a useful platform which can implement LED digital clock conveniently. Above block diagram illustrates the extra circuit block diagram for expansion on RSK. The detail schematics is shown in next chapter “Reference Schematics”. LED matrix board not only can be used on clock application but also good for any display, such as sign board and warning. Renesas also provide convenient development tool; HEW and E8/E8a emulator (sale with Renesas Starter Kit) for coding, debug and complier program. User can be easier to connect with PC for development and build up your system.

2.2 Column and ROW Data Shifter Timing

The serial-in data (LED_D0, LED_D1, LED_D2, LED_D3) is clocked into 16 bit shift register synchronize on the rising edge of the clock (LED_CLK). The data '1' represents the corresponding current output 'ON', while the data '0' stands for 'OFF'. The data is transferred into the 16 bit latch register when the strobe signal (LED_LAT) is 'H' (level trigger); otherwise, the data is held. The trigger timing of the serial-out data is shifted out in synchronization to the rising edge of the clock. All output are turned off while enable terminal (LED_ENn) is kept at high level. And they are active when LED_ENn shifts to low.

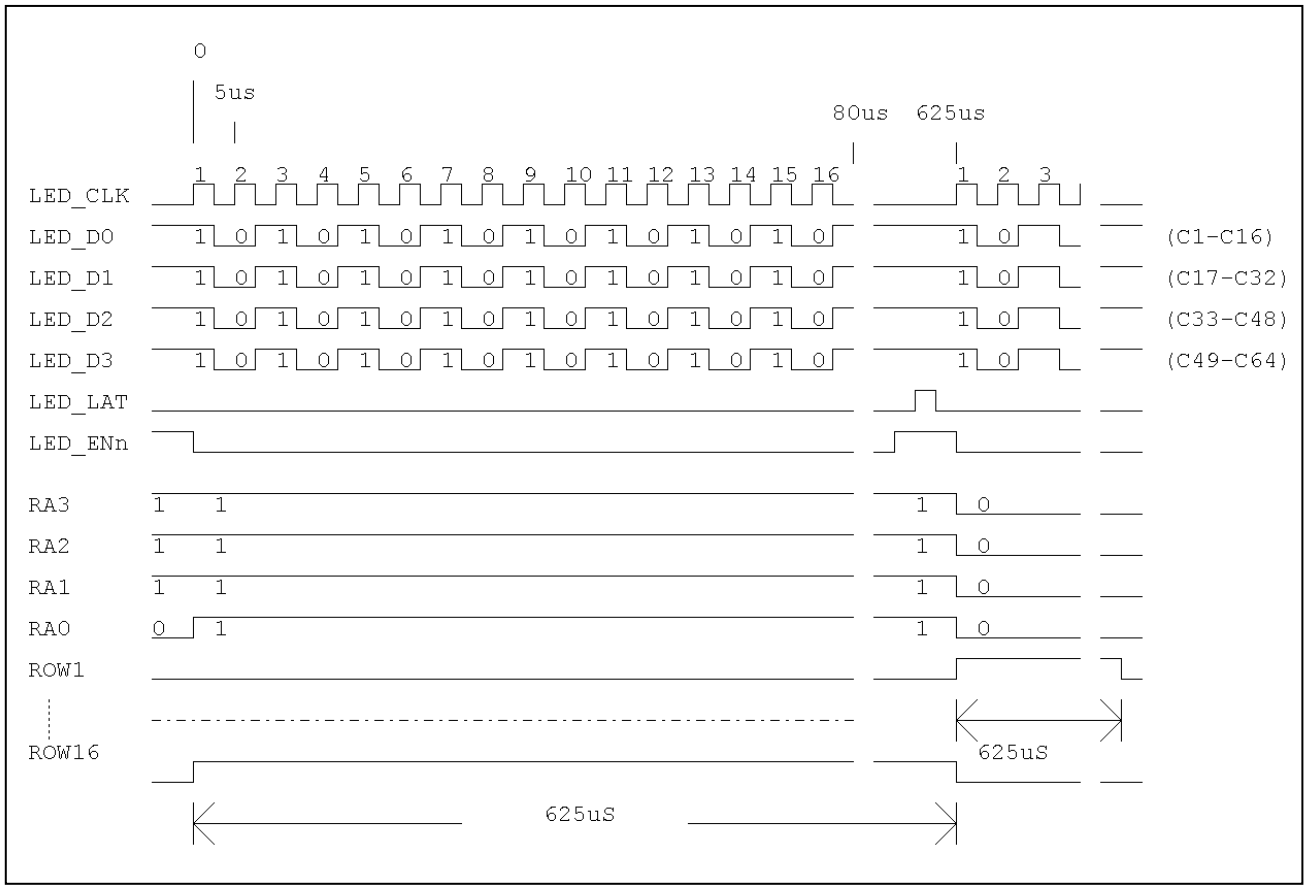

Figure 4 Column Data Shifter Timing

Row line is set as 'H' when the line is active, scan sequence is from ROW1 to ROW16. There is 10ms timing between in each frame. It is controlled by two 74HC138 decoders.

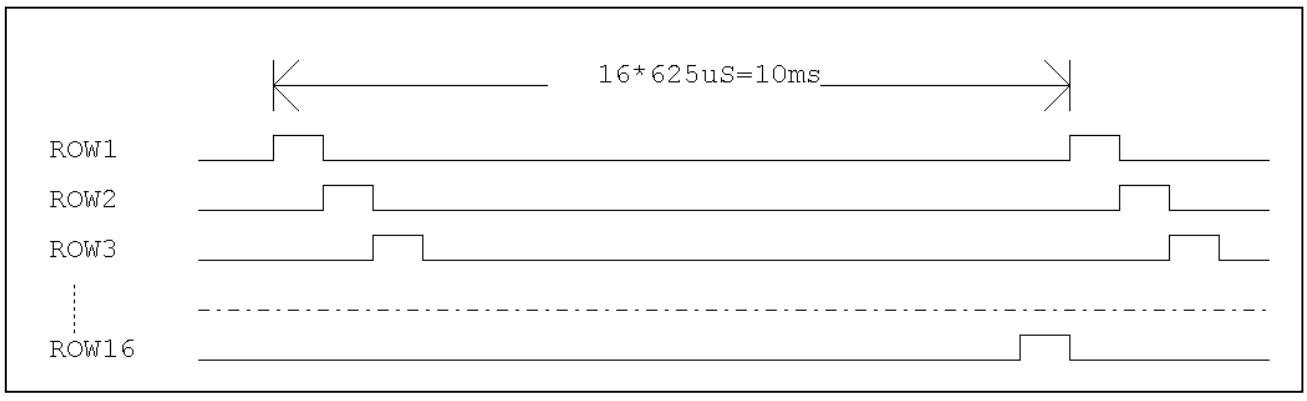

Figure 5 Row Scan Line Timing

2.3 RTC Function

LED digital clock application is base on RTC function and GPIO control LED driver. Please refer application note about RTC function of R8C in Renesas website detail.

■ Register usage definition on RTC function

Register Name	Function
sec	Read back sec value from RTC module of R8C/27
min	Read back minute value from RTC module of R8C/27
hr	Read back hour value from RTC module of R8C/27

Table 1 Register usage define on RTC function

2.4 Pin Usage on Renesas Starter Kit for R8C/27

■ **Pin usage on R8C/27**

Pin No.	Pin Label	Function
2	P3_7	LED Matrix Board Data Input Port 0
9	P4_5	LED Matrix Board Data Input Port 1
11	P3_6	Latch Pin for Serial to Parallel Shifter of Column Data
13	P5_4	LED Matrix Board Data Input Port 3
14	P5_3	LED Matrix Board Data Input Port 2
15	P1_6	Data Output Enable for LED Matrix Display Board
27	P0_5	Clock Signal Control for LED Matrix Display Board
29	P0_3	ROW Address Select Pin 3 (4-bit control for 16-row signal output)
30	P0_2	ROW Address Select Pin 2 (4-bit control for 16-row signal output)
31	P0_1	ROW Address Select Pin 1 (4-bit control for 16-row signal output)
32	P0_0	ROW Address Select Pin 0 (4-bit control for 16-row signal output)

Table 2 Pin Usage on R8C/27

■ **Pin reference connect point on Renesas Starter Kit for R8C/27**

Usage Pin Label	Connector on RSK R8C/27	Pin No. in Connector of RSK
P3_7	RSK R8C/27 CPU Board: J1	Pin 2
P4_5	RSK R8C/27 CPU Board: J2	Pin 1
P3_6	RSK R8C/27 CPU Board: J2	Pin 3
P5_4	RSK R8C/27 CPU Board: J2	Pin 5
P5_3	RSK R8C/27 CPU Board: J2	Pin 6
P1_6	RSK R8C/27 CPU Board: J2	Pin 7
P0_5	RSK R8C/27 CPU Board: J4	Pin 3
P0_3	RSK R8C/27 CPU Board: J2	Pin 5
P0_2	RSK R8C/27 CPU Board: J2	Pin 5
P0_1	RSK R8C/27 CPU Board: J2	Pin 5
P0_0	RSK R8C/27 CPU Board: J2	Pin 5

Table 3 Reference connect point on RSK

■ **Placement and layout on Renesas Starter Kit for R8C/27**

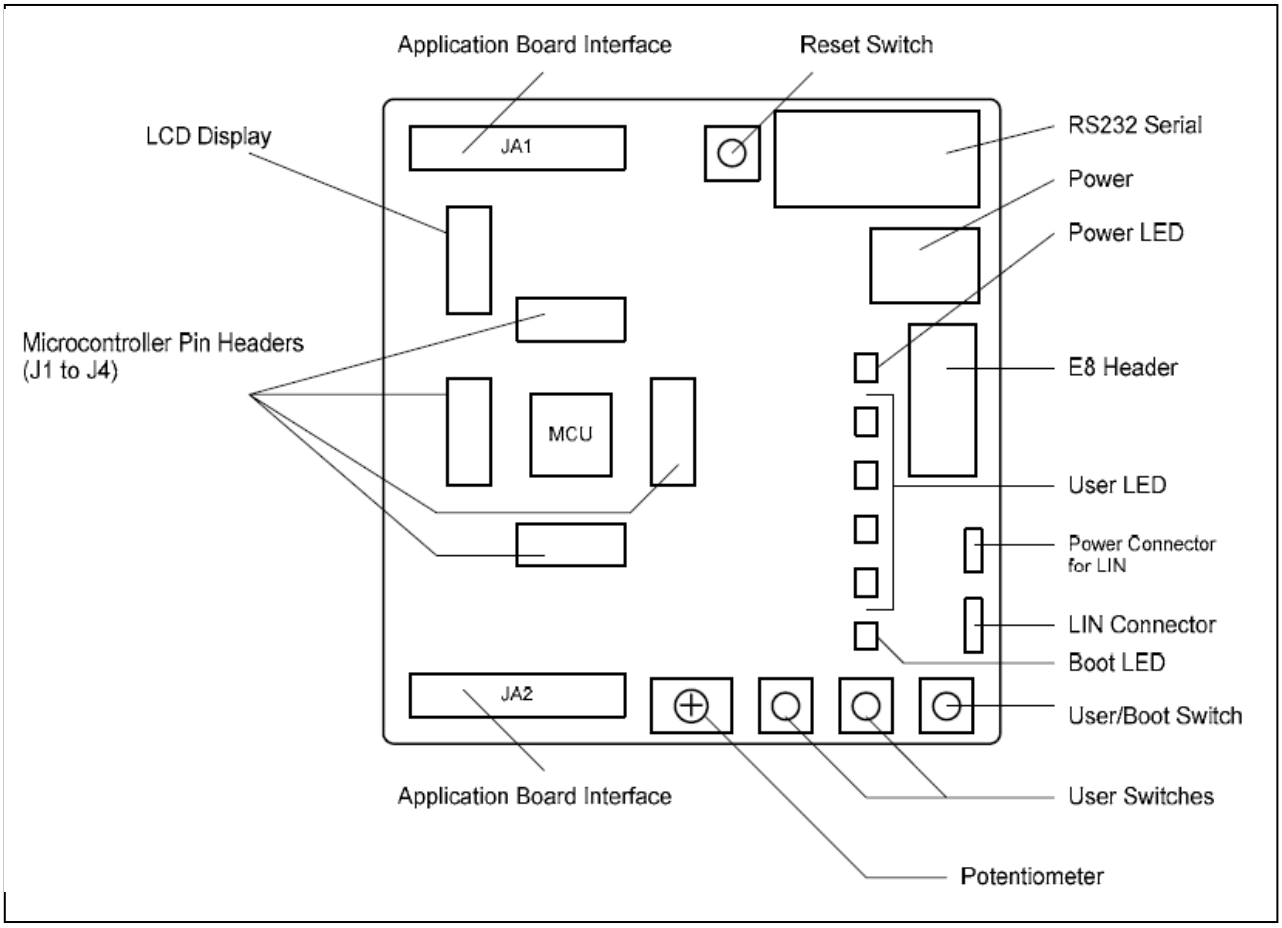

Figure 6 Connectors placement of Renesas Starter Kit CPU Board for R8C/27

3. Reference Schematics

3.1 R8C/27 Control Schematics

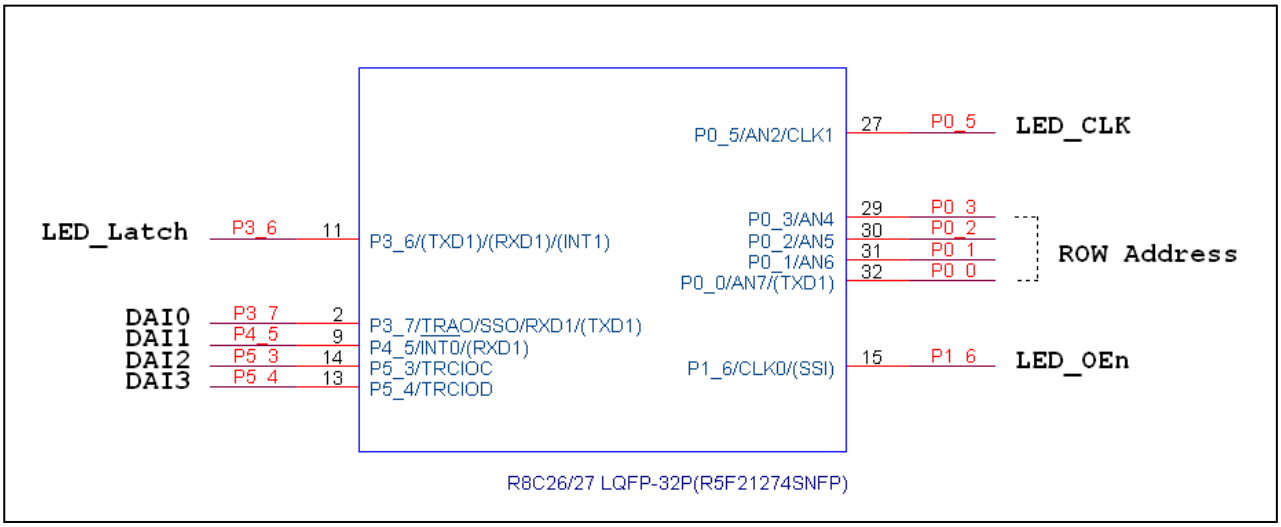

Figure 7 R8C/27 Control Schematics

3.2 Serial to Parallel Shifter of Column Data (1)

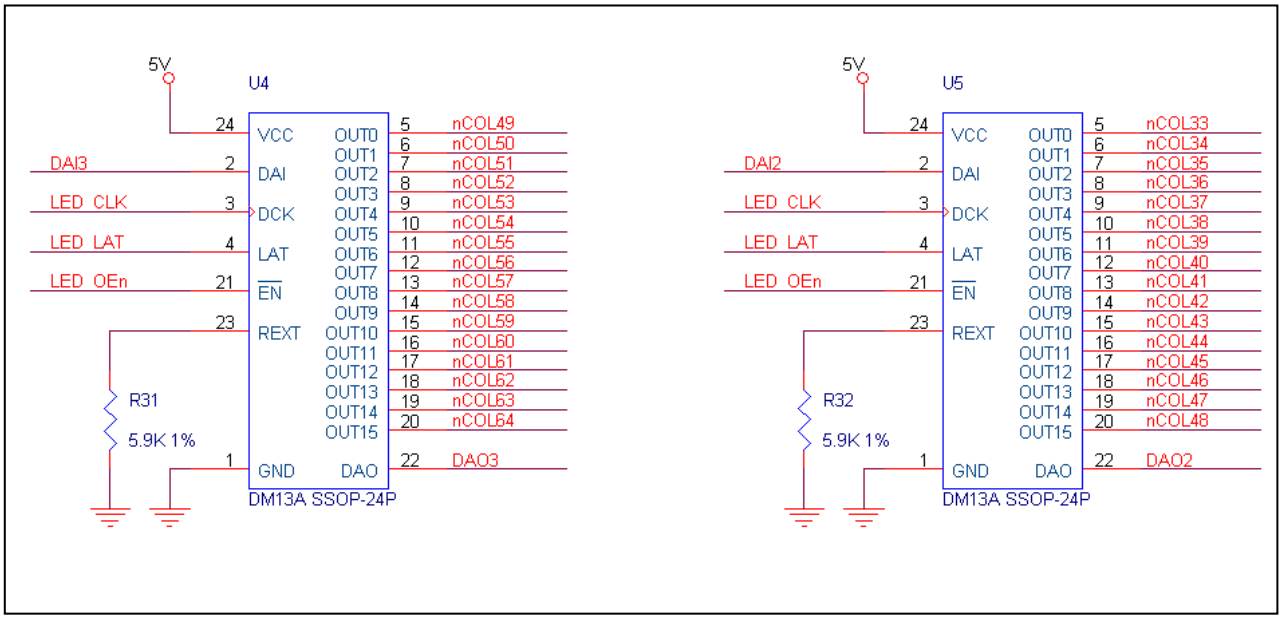

Figure 8 Serial to Parallel Shifter of Column Data (1)

3.3 Serial to Parallel Shifter of Column Data (2)

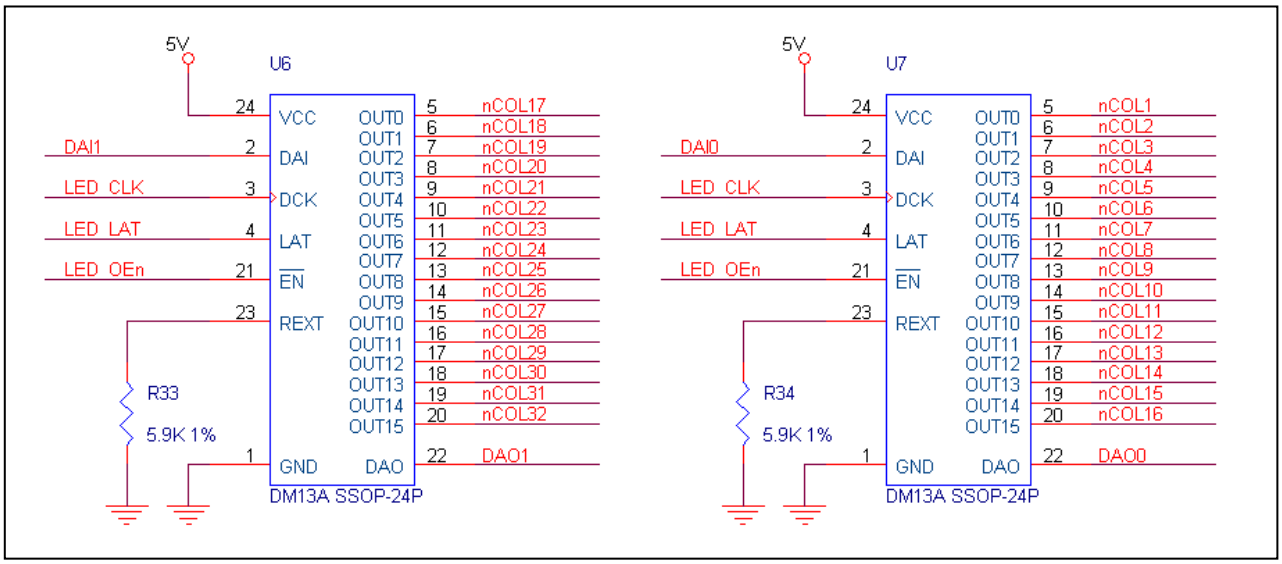

Figure 9 Serial to Parallel Shifter of Column Data (2)

3.4 Row Data Scan Line

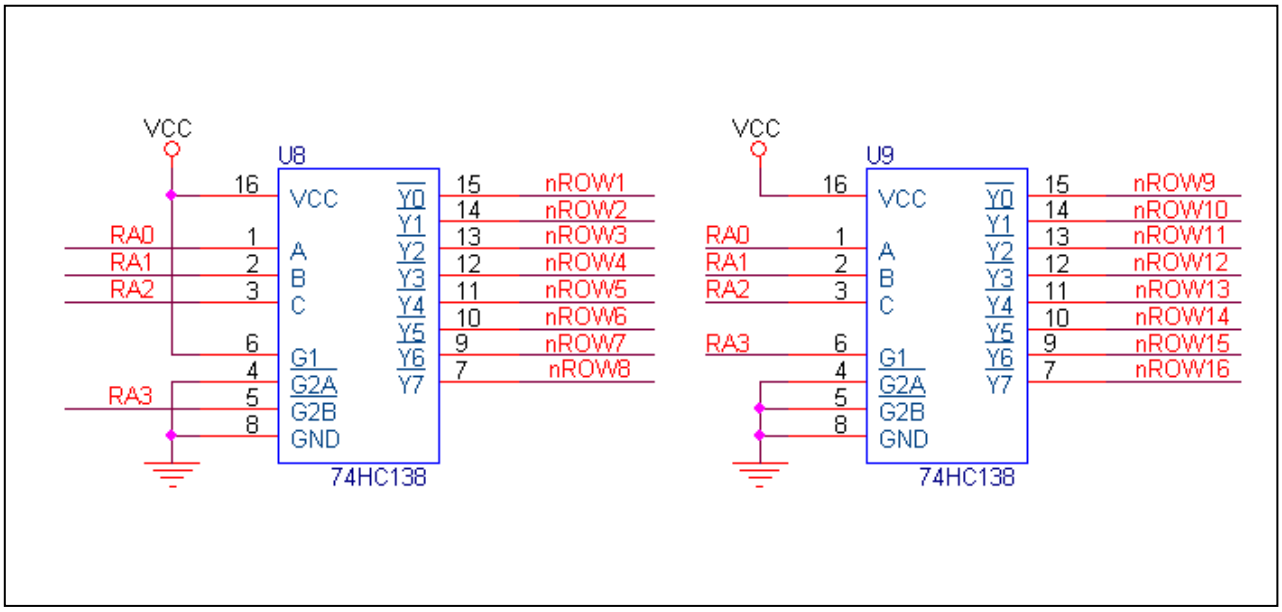

Figure 10 Row Data Scan Line

3.5 Row Scan Line Driver

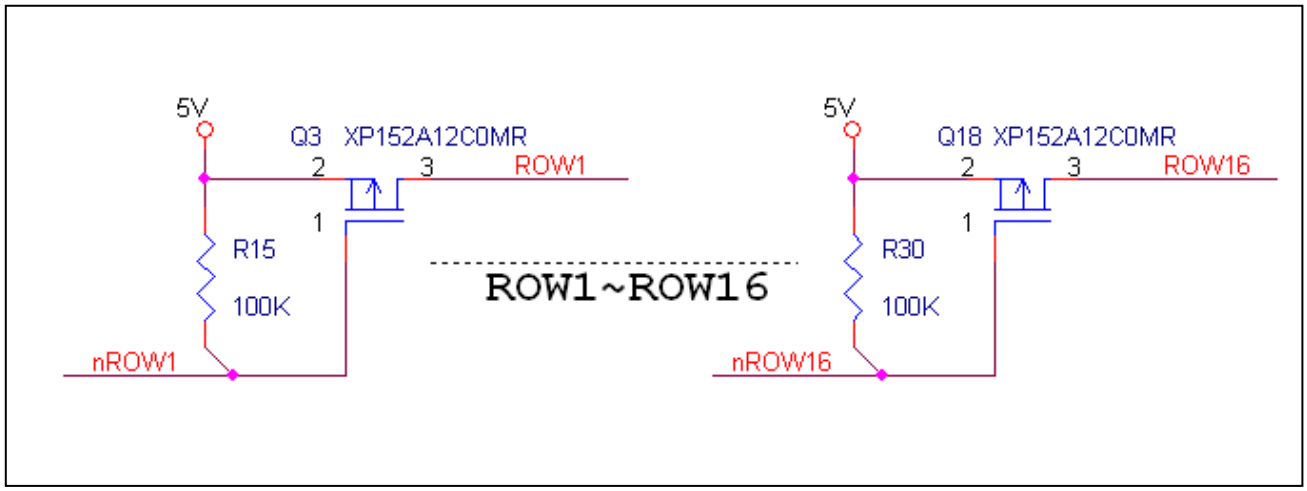

Figure 11 Row Scan Line Driver

3.6 LED Matrix 64*16(four 16*16) (1)

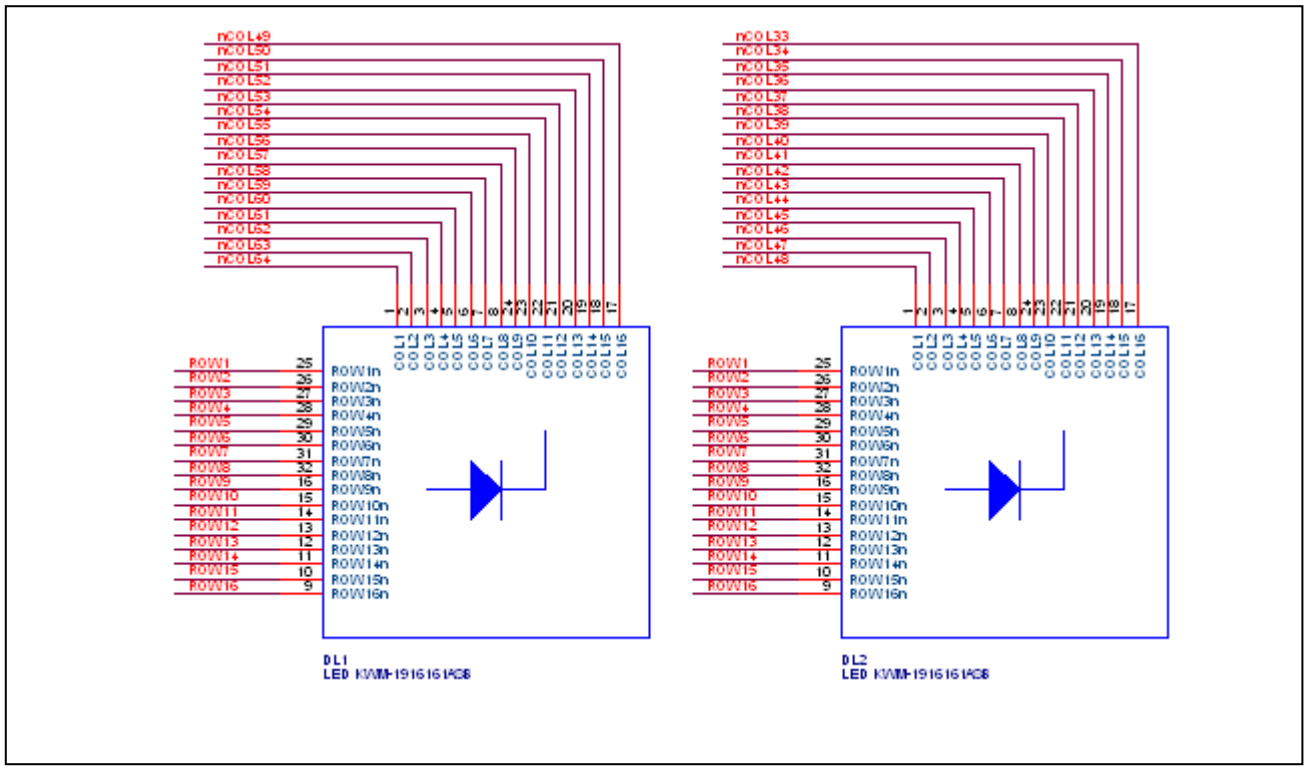

Figure 12 LED Matrix 64*16(four 16*16) (1)

3.7 LED Matrix 64*16(four 16*16) (2)

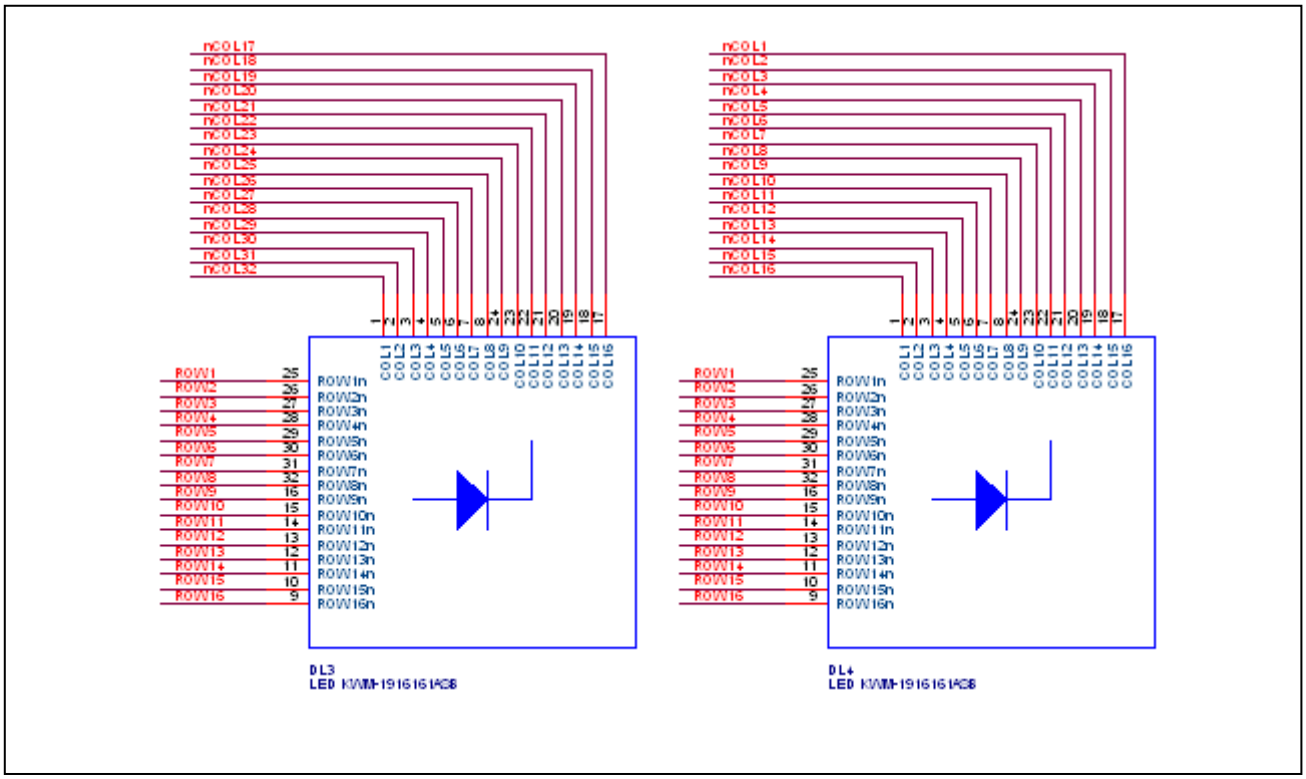

Figure 13 LED Matrix 64*16(four 16*16) (2)

4. Program Flow Chart

■ Demo flow chart of LED Digital Clock

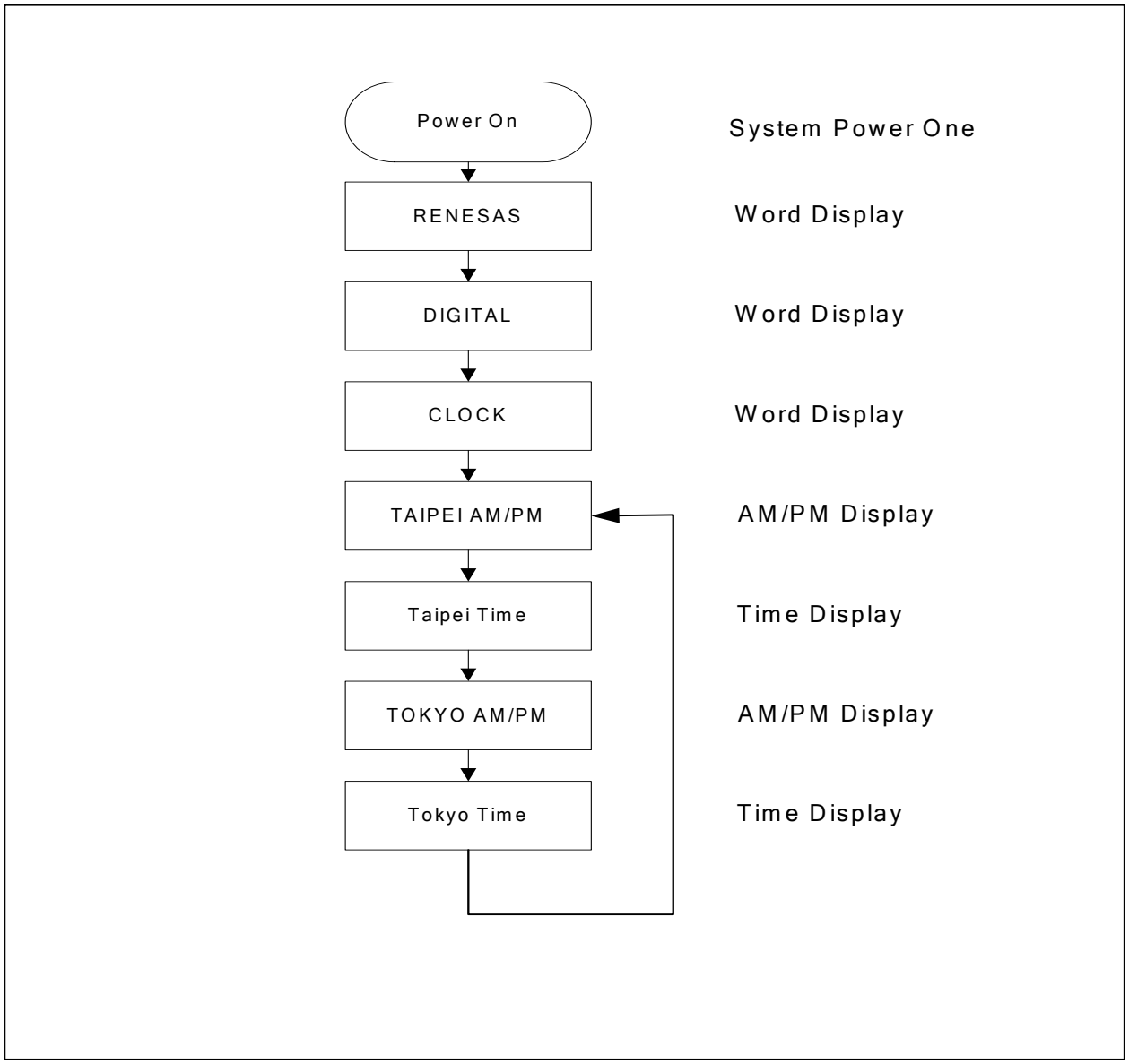

Figure 14 Demo flow chart of LED Digital Clock

Program flow chart of main( ) : System initial routine

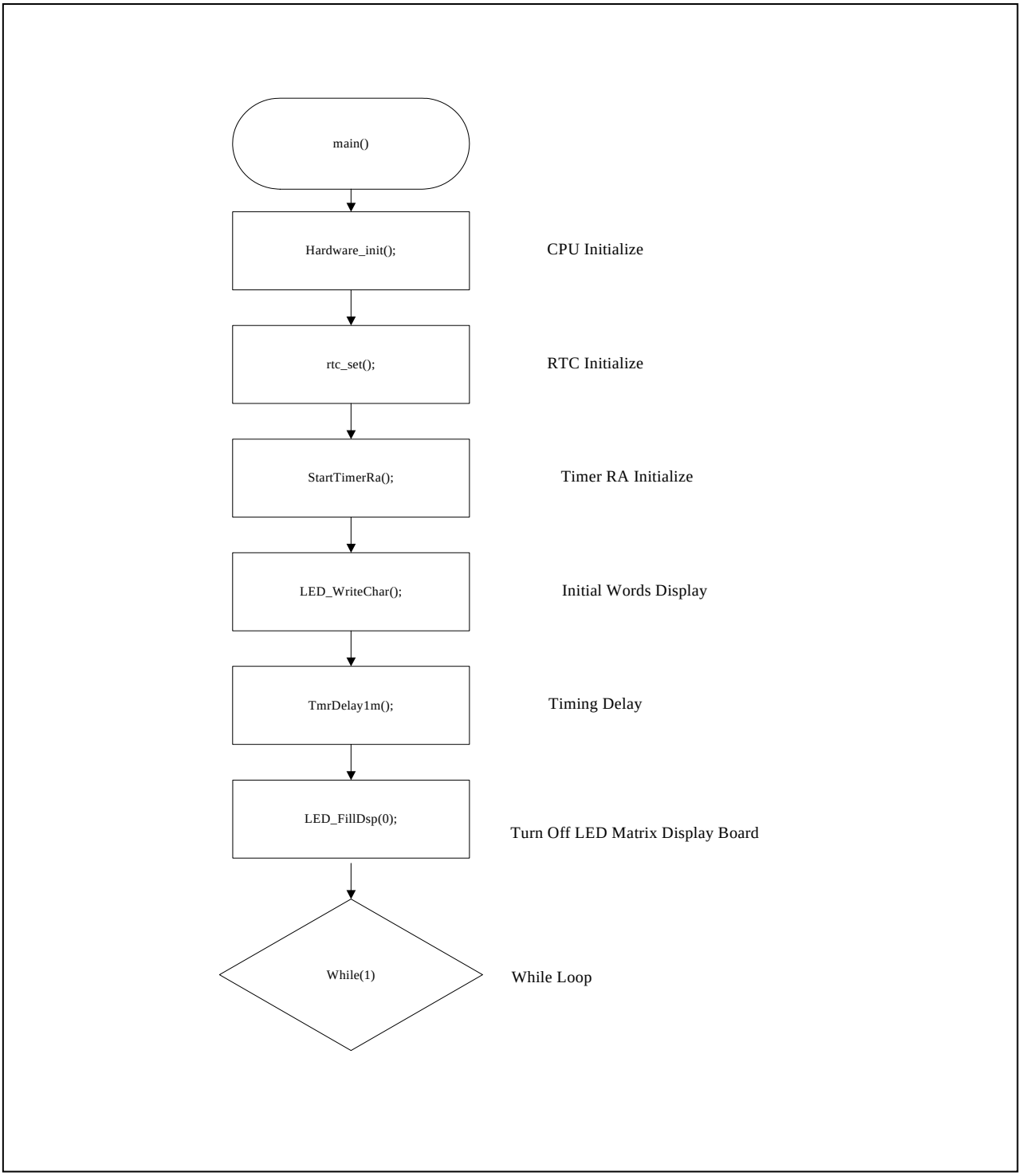

Figure 15 Program flow chart of main( )

■ Program flow chart of while(1) loop routine

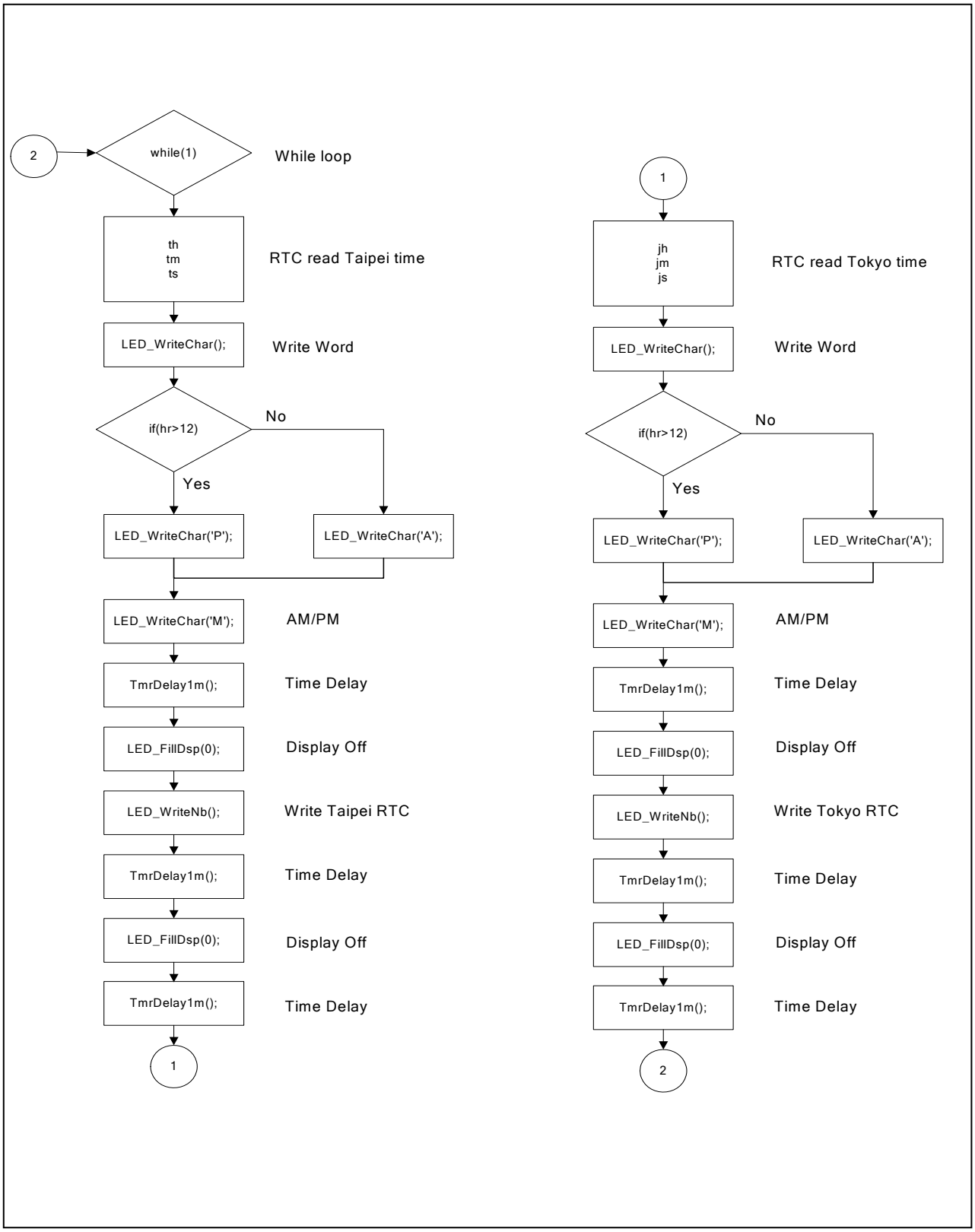

Figure 16 Program flow chart of while(1) loop routine

5. Website and Support

Renesas Electronics Website
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Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.0	Apr.30.10	—	First edition issued

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The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

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 one with a different type number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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