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### What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

### Applications of "[Embedded - Microcontrollers](#)"

#### Details

|                            |                                                                                                                                                                                 |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status             | Not For New Designs                                                                                                                                                             |
| Core Processor             | R8C                                                                                                                                                                             |
| Core Size                  | 16-Bit                                                                                                                                                                          |
| Speed                      | 20MHz                                                                                                                                                                           |
| Connectivity               | I <sup>2</sup> C, LINbus, SIO, SSU, UART/USART                                                                                                                                  |
| Peripherals                | LCD, POR, PWM, Voltage Detect, WDT                                                                                                                                              |
| Number of I/O              | 56                                                                                                                                                                              |
| Program Memory Size        | 32KB (32K x 8)                                                                                                                                                                  |
| Program Memory Type        | FLASH                                                                                                                                                                           |
| EEPROM Size                | 2K x 8                                                                                                                                                                          |
| RAM Size                   | 2K x 8                                                                                                                                                                          |
| Voltage - Supply (Vcc/Vdd) | 1.8V ~ 5.5V                                                                                                                                                                     |
| Data Converters            | A/D 8x10b                                                                                                                                                                       |
| Oscillator Type            | Internal                                                                                                                                                                        |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                               |
| Mounting Type              | Surface Mount                                                                                                                                                                   |
| Package / Case             | 64-LQFP                                                                                                                                                                         |
| Supplier Device Package    | 64-LFQFP (10x10)                                                                                                                                                                |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f2la66adfp-30">https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f2la66adfp-30</a> |

### 1.1.2 Differences between Groups

Table 1.1 lists the Differences between Groups, Tables 1.2 and 1.3 list the Programmable I/O Ports Provided for Each Group, and Tables 1.4 and 1.5 list the LCD Display Function Pins Provided for Each Group.

Figures 1.9 to 1.12 show the pin assignment for each group, and Tables 1.9 to 1.12 list product information.

The explanations in the chapters which follow apply to the R8C/LA8A Group only. Note the differences shown below.

**Table 1.1 Differences between Groups**

| Item                      | Function                               | R8C/LA3A Group       | R8C/LA5A Group | R8C/LA6A Group | R8C/LA8A Group |
|---------------------------|----------------------------------------|----------------------|----------------|----------------|----------------|
| I/O Ports                 | Programmable I/O ports                 | 26 pins              | 44 pins        | 56 pins        | 72 pins        |
|                           | High current drive ports               | 8 pins               | 8 pins         | 8 pins         | 10 pins        |
| Interrupts                | $\overline{\text{INT}}$ interrupt pins | 5 pins               | 6 pins         | 8 pins         | 8 pins         |
| Timer RJ                  | Timer RJ0 output pin                   | None                 | None           | None           | 1 pin          |
|                           | Timer RJ1 output pin                   | None                 | None           | None           | 1 pin          |
|                           | Timer RJ2 I/O pin                      | None                 | None           | None           | 1 pin          |
|                           | Timer RJ2 output pin                   | None                 | None           | None           | 1 pin          |
| Timer RH                  | Timer RH output pin                    | None                 | 1 pin          | 1 pin          | 1 pin          |
| Serial interface          | UART2                                  | None                 | None           | 1 pin          | 1 pin          |
| A/D Converter             | Analog input pins                      | 5 pins               | 7 pins         | 8 pins         | 12 pins        |
| LCD Drive Control Circuit | Segment output pins                    | Max. 11 pins         | Max. 27 pins   | Max. 32 pins   | Max. 40 pins   |
| Comparator B              | Analog input voltage                   | 1 pin                | 2 pins         | 2 pins         | 2 pins         |
|                           | Reference input voltage                | 1 pin                | 2 pins         | 2 pins         | 2 pins         |
| Clock                     | XCIN pin                               | Shared with XIN pin  | Dedicated pin  | Dedicated pin  | Dedicated pin  |
|                           | XCOUT pin                              | Shared with XOUT pin | Dedicated pin  | Dedicated pin  | Dedicated pin  |
| Packages                  |                                        | 32-pin LQFP          | 52-pin LQFP    | 64-pin LQFP    | 80-pin LQFP    |

Note:

1. I/O ports are shared with I/O functions, such as interrupts or timers.  
Refer to Tables 1.13 to 1.17, Pin Name Information by Pin Number, for details.

**Table 1.2 Programmable I/O Ports Provided for Each Group (R8C/LA3A Group, R8C/LA5A Group)**

| Programmable I/O Port | R8C/LA3A Group<br>Total: 26 I/O pins |       |       |       |       |       |       |       | R8C/LA5A Group<br>Total: 44 I/O pins |       |       |       |       |       |       |       |
|-----------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|                       | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| P0                    | —                                    | —     | —     | —     | —     | —     | —     | —     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P2                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P3                    | —                                    | —     | —     | —     | —     | —     | —     | —     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P5                    | —                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | —                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P7                    | —                                    | —     | —     | —     | —     | —     | ✓     | —     | —                                    | —     | —     | —     | —     | ✓     | ✓     | ✓     |
| P8                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P9                    | —                                    | —     | —     | —     | —     | —     | ✓     | ✓     | —                                    | —     | —     | —     | —     | —     | ✓     | ✓     |

Notes:

1. The symbol “✓” indicates a programmable I/O port.
2. The symbol “—” indicates the settings should be made as follows:
  - Set 0 to the corresponding bits in the PDi (i = 0, 3, 5, 7, 9) register. When read, the content is 0.
  - Set 0 to the corresponding bits in the Pi (i = 0, 3, 5, 7, 9) register. When read, the content is 0.

**Table 1.3 Programmable I/O Ports Provided for Each Group (R8C/LA6A Group, R8C/LA8A Group)**

| Programmable I/O Port | R8C/LA6A Group<br>Total: 56 I/O pins |       |       |       |       |       |       |       | R8C/LA8A Group<br>Total: 72 I/O pins |       |       |       |       |       |       |       |
|-----------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|                       | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| P0                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P1                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | —     | —     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P2                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P3                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P4                    | ✓                                    | ✓     | —     | —     | —     | —     | —     | —     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P5                    | —                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | —                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P6                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | —     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P7                    | —                                    | —     | —     | —     | —     | —     | —     | —     | —                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P8                    | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓                                    | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| P9                    | —                                    | —     | —     | —     | —     | —     | ✓     | ✓     | —                                    | —     | —     | —     | —     | —     | ✓     | ✓     |

Notes:

1. The symbol “✓” indicates a programmable I/O port.
2. The symbol “—” indicates the settings should be made as follows:
  - Set 0 to the corresponding bits in the PDi (i = 1, 4 to 7, 9) register. When read, the content is 0.
  - Set 0 to the corresponding bits in the Pi (i = 1, 4 to 7, 9) register. When read, the content is 0.
  - Set 0 to the corresponding bits in the P7DRR register. When read, the content is 0.

### 1.1.3 Specifications

Tables 1.6 to 1.8 list the specifications.

**Table 1.6 Specifications (1)**

| Item                                 | Function                  |                | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------|---------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CPU                                  | Central processing unit   |                | R8C CPU core <ul style="list-style-type: none"><li>• Number of fundamental instructions: 89</li><li>• Minimum instruction execution time:<br/>50 ns (f(XIN) = 20 MHz, VCC = 2.7 V to 5.5 V)<br/>125 ns (f(XIN) = 8 MHz, VCC = 1.8 V to 5.5 V)</li><li>• Multiplier: 16 bits × 16 bits → 32 bits</li><li>• Multiply-accumulate instruction: 16 bits × 16 bits + 32 bits → 32 bits</li><li>• Operating mode: Single-chip mode (address space: 1 Mbyte)</li></ul>                                                                                                                                                                  |
| Memory                               | ROM/RAM<br>Data flash     |                | Refer to Tables 1.9 to 1.12 Product Lists.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Power Supply<br>Voltage<br>Detection | Voltage detection circuit |                | <ul style="list-style-type: none"><li>• Power-on reset</li><li>• Voltage detection 3 (detection level of voltage detection 0 and voltage detection 1 selectable)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| I/O Ports                            | Programmable I/O ports    | R8C/LA3A Group | <ul style="list-style-type: none"><li>• CMOS I/O ports: 26, selectable pull-up resistor <sup>(1)</sup></li><li>• High current drive ports: 8</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                      |                           | R8C/LA5A Group | <ul style="list-style-type: none"><li>• CMOS I/O ports: 44, selectable pull-up resistor <sup>(1)</sup></li><li>• High current drive ports: 8</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                      |                           | R8C/LA6A Group | <ul style="list-style-type: none"><li>• CMOS I/O ports: 56, selectable pull-up resistor <sup>(1)</sup></li><li>• High current drive ports: 8</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                      |                           | R8C/LA8A Group | <ul style="list-style-type: none"><li>• CMOS I/O ports: 72, selectable pull-up resistor <sup>(1)</sup></li><li>• High current drive ports: 10</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Clock                                | Clock generation circuits |                | 4 circuits: XIN clock oscillation circuit<br>XCIN clock oscillation circuit (32 kHz)<br>High-speed on-chip oscillator (with frequency adjustment function)<br>Low-speed on-chip oscillator <ul style="list-style-type: none"><li>• Oscillation stop detection:<br/>XIN clock oscillation stop detection function</li><li>• Frequency divider circuit:<br/>Division ratio selectable from 1, 2, 4, 8, and 16</li><li>• Low-power-consumption modes:<br/>Standard operating mode (high-speed clock, low-speed clock, high-speed on-chip oscillator, low-speed on-chip oscillator), wait mode, stop mode, power-off mode</li></ul> |
|                                      |                           |                | Real-time clock (timer RH)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Interrupts                           |                           | R8C/LA3A Group | <ul style="list-style-type: none"><li>• Number of interrupt vectors: 69</li><li>• External Interrupt: 13 (INT × 5, key input × 8)</li><li>• Priority levels: 7 levels</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                      |                           | R8C/LA5A Group | <ul style="list-style-type: none"><li>• Number of interrupt vectors: 69</li><li>• External Interrupt: 14 (INT × 6, key input × 8)</li><li>• Priority levels: 7 levels</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                      |                           | R8C/LA6A Group | <ul style="list-style-type: none"><li>• Number of interrupt vectors: 69</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                      |                           | R8C/LA8A Group | <ul style="list-style-type: none"><li>• External Interrupt: 16 (INT × 8, key input × 8)</li><li>• Priority levels: 7 levels</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Watchdog Timer                       |                           |                | <ul style="list-style-type: none"><li>• 14 bits × 1 (with prescaler)</li><li>• Selectable reset start function</li><li>• Selectable low-speed on-chip oscillator for watchdog timer</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Note:

1. No pull-up resistor is provided in the pins P5\_4 to P5\_6.

## 1.4 Pin Assignments

Figures 1.9 to 1.12 show pin assignments (top view). Tables 1.13 to 1.17 list the pin name information by pin number.

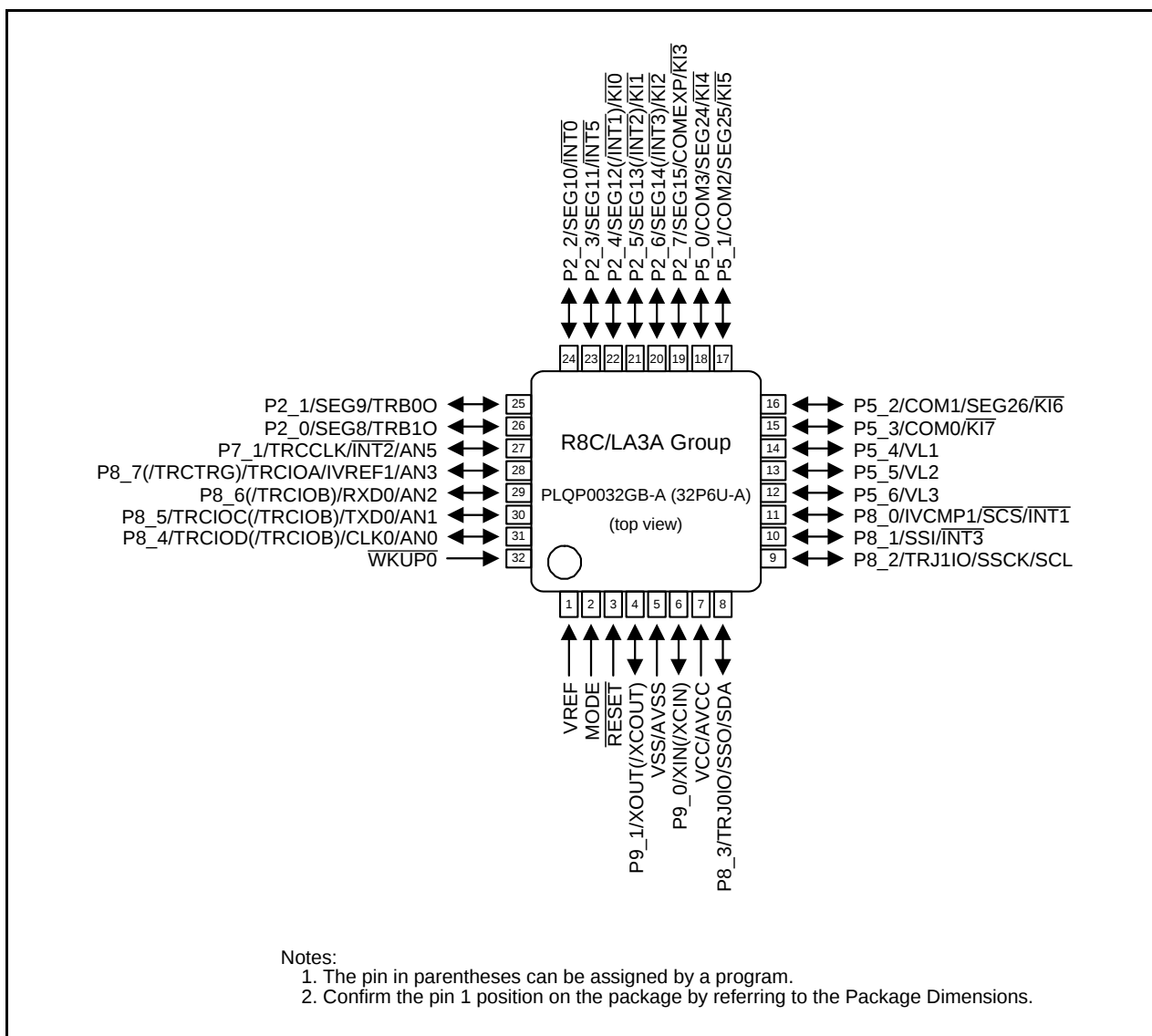


Figure 1.9 Pin Assignment (Top View) of PLQP0032GB-A Package

**Table 1.14 Pin Name Information by Pin Number (R8C/LA3A Group, R8C/LA5A Group)(2)**

| Pin Number |      | Control Pin        | Port | I/O Pin Functions for Peripheral Modules |                     |                  |                  |                      |                             |                           |
|------------|------|--------------------|------|------------------------------------------|---------------------|------------------|------------------|----------------------|-----------------------------|---------------------------|
| LA5A       | LA3A |                    |      | Interrupt                                | Timer               | Serial Interface | SSU              | I <sup>2</sup> C bus | A/D Converter, Comparator B | LCD drive Control Circuit |
| 31         |      |                    | P3_0 |                                          |                     |                  |                  |                      |                             | SEG16                     |
| 32         | 19   |                    | P2_7 | $\overline{KI3}$                         |                     |                  |                  |                      |                             | SEG15/<br>COMEXP          |
| 33         | 20   |                    | P2_6 | $\overline{(INT3)/KI2}$                  |                     |                  |                  |                      |                             | SEG14                     |
| 34         | 21   |                    | P2_5 | $\overline{(INT2)/KI1}$                  |                     |                  |                  |                      |                             | SEG13                     |
| 35         | 22   |                    | P2_4 | $\overline{(INT1)/KI0}$                  |                     |                  |                  |                      |                             | SEG12                     |
| 36         | 23   |                    | P2_3 | $\overline{INT5}$                        |                     |                  |                  |                      |                             | SEG11                     |
| 37         | 24   |                    | P2_2 | $\overline{INT0}$                        |                     |                  |                  |                      |                             | SEG10                     |
| 38         | 25   |                    | P2_1 |                                          | TRB0O               |                  |                  |                      |                             | SEG9                      |
| 39         | 26   |                    | P2_0 |                                          | TRB1O               |                  |                  |                      |                             | SEG8                      |
| 40         |      |                    | P0_7 |                                          | TRHO                |                  |                  |                      |                             | SEG7                      |
| 41         |      |                    | P0_6 |                                          |                     |                  | $\overline{SCS}$ |                      |                             | SEG6                      |
| 42         |      |                    | P0_5 |                                          |                     |                  | SSI              |                      |                             | SEG5                      |
| 43         |      |                    | P0_4 |                                          |                     |                  | SSCK             | SCL                  |                             | SEG4                      |
| 44         |      |                    | P0_3 |                                          |                     |                  | SSO              | SDA                  |                             | SEG3                      |
| 45         |      |                    | P0_2 |                                          |                     |                  |                  |                      |                             | SEG2                      |
| 46         |      |                    | P0_1 |                                          |                     |                  |                  |                      |                             | SEG1                      |
| 47         |      |                    | P0_0 | $\overline{INT7}$                        | (TRCTRG)            |                  |                  |                      | $\overline{ADTRG}$          | SEG0                      |
| 48         |      |                    | P7_2 |                                          | (TRCTRG)            |                  |                  |                      | AN6                         |                           |
| 49         | 27   |                    | P7_1 | $\overline{INT2}$                        | TRCCLK              |                  |                  |                      | AN5                         |                           |
| 50         |      | $\overline{WKUP1}$ | P7_0 |                                          |                     |                  |                  |                      | AN4/IVREF3                  |                           |
| 51         | 28   |                    | P8_7 |                                          | TRCIOA/<br>(TRCTRG) |                  |                  |                      | AN3/IVREF1                  |                           |
| 52         | 29   |                    | P8_6 |                                          | (TRCIOB)            | RXD0             |                  |                      | AN2                         |                           |

Note:

1. The pin in parentheses can be assigned by a program.

## 1.5 Pin Functions

Tables 1.18 and 1.19 list Pin Functions for R8C/LA5A Group, and Tables 1.20 and 1.21 list Pin Functions for R8C/LA8A Group.

**Table 1.18 Pin Functions for R8C/LA5A Group (1)**

| Item                                    | Pin Name                                                                                                      | I/O Type | Description                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power supply input                      | VCC, VSS                                                                                                      | —        | Apply 1.8 V to 5.5 V to the VCC pin.<br>Apply 0 V to the VSS pin.                                                                                                                                                                                                                                                                              |
| Analog power supply input               | AVCC, AVSS                                                                                                    | —        | Power supply for the A/D converter.<br>Connect a capacitor between AVCC and AVSS.                                                                                                                                                                                                                                                              |
| Reset input                             | $\overline{\text{RESET}}$                                                                                     | I        | Driving this pin low resets the MCU.                                                                                                                                                                                                                                                                                                           |
| MODE                                    | MODE                                                                                                          | I        | Connect this pin to VCC via a resistor.                                                                                                                                                                                                                                                                                                        |
| Power-off 0 mode exit input             | WKUP0                                                                                                         | I        | This pin is provided for input to exit the mode used in power-off 0 mode. Connect to VSS when not using power-off 0 mode.                                                                                                                                                                                                                      |
|                                         | $\overline{\text{WKUP1}}$                                                                                     | I        | This pin is provided for input to exit the mode used in power-off 0 mode.                                                                                                                                                                                                                                                                      |
| XIN clock input                         | XIN                                                                                                           | I        | These pins are provided for XIN clock generation circuit I/O.<br>Connect a ceramic oscillator or a crystal oscillator between pins XIN and XOUT. <sup>(1)</sup> To use an external clock, input it to the XIN pin and set XOUT as the I/O port P9_1. When the pin is not used, treat it as an unassigned pin and use the appropriate handling. |
| XIN clock output                        | XOUT                                                                                                          | O        |                                                                                                                                                                                                                                                                                                                                                |
| XCIN clock input                        | XCIN                                                                                                          | I        | These pins are provided for XCIN clock generation circuit I/O.<br>Connect a crystal oscillator between pins XCIN and XCOU. <sup>(1)</sup> To use an external clock, input it to the XCIN pin and leave the XCOU pin open.                                                                                                                      |
| XCIN clock output                       | XCOU                                                                                                          | O        |                                                                                                                                                                                                                                                                                                                                                |
| $\overline{\text{INT}}$ interrupt input | $\overline{\text{INT0}}$ to $\overline{\text{INT3}}$ ,<br>$\overline{\text{INT5}}$ , $\overline{\text{INT7}}$ | I        | $\overline{\text{INT}}$ interrupt input pins.                                                                                                                                                                                                                                                                                                  |
| Key input interrupt                     | $\overline{\text{KI0}}$ to $\overline{\text{KI7}}$                                                            | I        | Key input interrupt input pins.                                                                                                                                                                                                                                                                                                                |
| Timer RB                                | TRB0O, TRB1O                                                                                                  | O        | Timer RB output pins.                                                                                                                                                                                                                                                                                                                          |
| Timer RC                                | TRCCLK                                                                                                        | I        | External clock input pin.                                                                                                                                                                                                                                                                                                                      |
|                                         | TRCTRG                                                                                                        | I        | External trigger input pin.                                                                                                                                                                                                                                                                                                                    |
|                                         | TRCIOA, TRCIOB,<br>TRCIOC, TRCIOD                                                                             | I/O      | Timer RC I/O pins.                                                                                                                                                                                                                                                                                                                             |
| Timer RH                                | TRHO                                                                                                          | O        | Timer RH output pin.                                                                                                                                                                                                                                                                                                                           |
| Timer RJ                                | TRJ0IO, TRJ1IO                                                                                                | I/O      | Timer RJ I/O pins.                                                                                                                                                                                                                                                                                                                             |
| Serial interface                        | CLK0                                                                                                          | I/O      | Transfer clock I/O pin.                                                                                                                                                                                                                                                                                                                        |
|                                         | RXD0                                                                                                          | I        | Serial data input pin.                                                                                                                                                                                                                                                                                                                         |
|                                         | TXD0                                                                                                          | O        | Serial data output pin.                                                                                                                                                                                                                                                                                                                        |

I: Input      O: Output      I/O: Input and output

Note:

1. Contact the oscillator manufacturer for oscillation characteristics.

## 2. Central Processing Unit (CPU)

Figure 2.1 shows the CPU Registers. The CPU contains 13 registers. R0, R1, R2, R3, A0, A1, and FB configure a register bank. There are two sets of register banks.

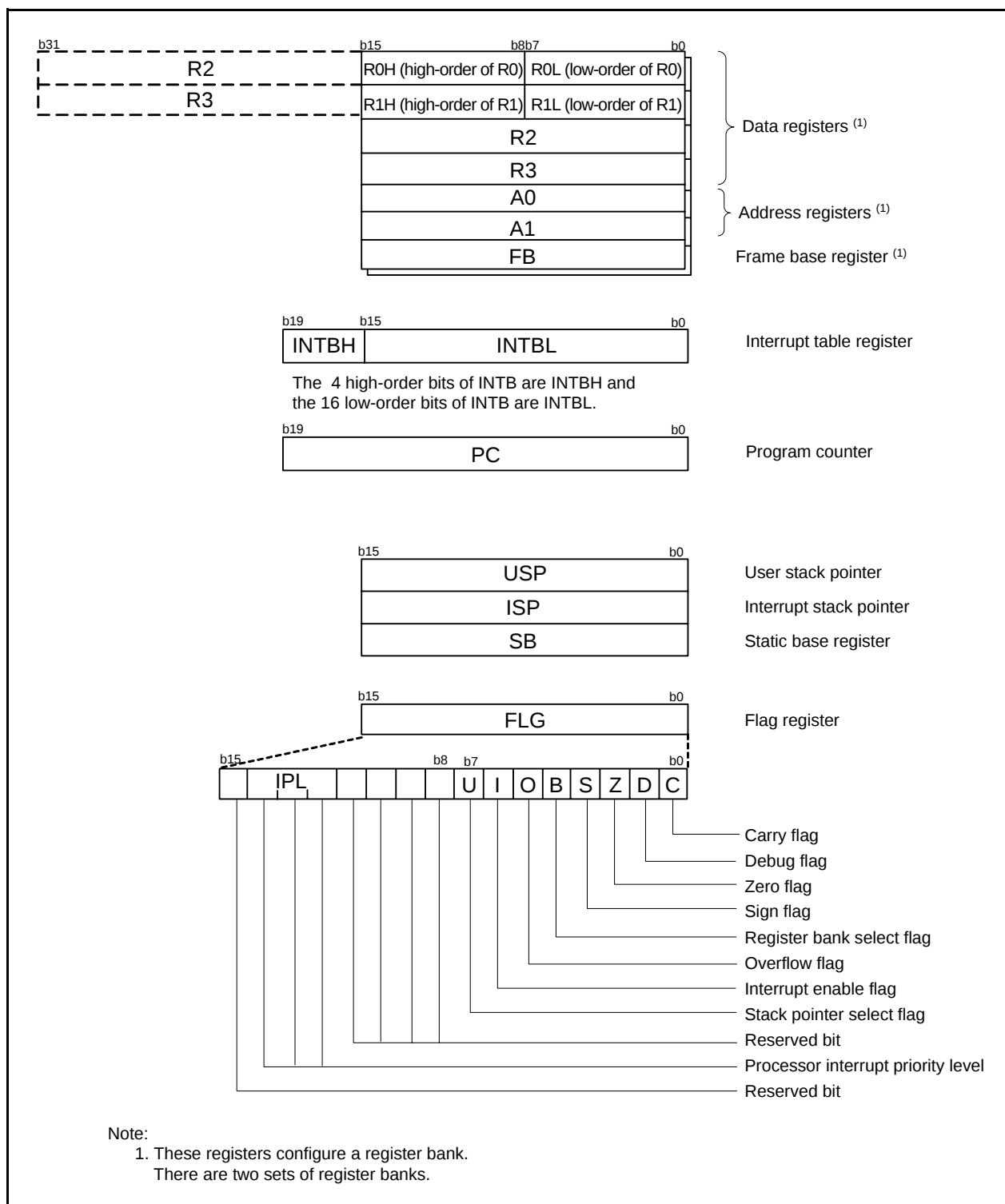


Figure 2.1 CPU Registers

### **2.8.7 Interrupt Enable Flag (I)**

The I flag enables maskable interrupts.

Interrupts are disabled when the I flag is set to 0, and are enabled when the I flag is set to 1. The I flag is set to 0 when an interrupt request is acknowledged.

### **2.8.8 Stack Pointer Select Flag (U)**

ISP is selected when the U flag is set to 0; USP is selected when the U flag is set to 1.

The U flag is set to 0 when a hardware interrupt request is acknowledged or the INT instruction of software interrupt numbers 0 to 31 is executed.

### **2.8.9 Processor Interrupt Priority Level (IPL)**

IPL is 3 bits wide and assigns processor interrupt priority levels from level 0 to level 7.

If a requested interrupt has higher priority than IPL, the interrupt is enabled.

### **2.8.10 Reserved Bit**

If necessary, set to 0. When read, the content is undefined.

**Table 4.2 SFR Information for R8C/LA5A Group (2) <sup>(1)</sup>**

| Address | Register                                                                           | Symbol      | After Reset |
|---------|------------------------------------------------------------------------------------|-------------|-------------|
| 003Ah   | Voltage Monitor 2 Circuit Control Register                                         | VW2C        | 10000010b   |
| 003Bh   |                                                                                    |             |             |
| 003Ch   |                                                                                    |             |             |
| 003Dh   |                                                                                    |             |             |
| 003Eh   |                                                                                    |             |             |
| 003Fh   |                                                                                    |             |             |
| 0040h   |                                                                                    |             |             |
| 0041h   | Flash Memory Ready Interrupt Control Register                                      | FMRDYIC     | XXXXX000b   |
| 0042h   |                                                                                    |             |             |
| 0043h   | INT7 Interrupt Control Register                                                    | INT7IC      | XX00X000b   |
| 0044h   |                                                                                    |             |             |
| 0045h   | INT5 Interrupt Control Register                                                    | INT5IC      | XX00X000b   |
| 0046h   |                                                                                    |             |             |
| 0047h   | Timer RC Interrupt Control Register                                                | TRCIC       | XXXXX000b   |
| 0048h   |                                                                                    |             |             |
| 0049h   |                                                                                    |             |             |
| 004Ah   | Timer RH Interrupt Control Register                                                | TRHIC       | XXXXX000b   |
| 004Bh   |                                                                                    |             |             |
| 004Ch   |                                                                                    |             |             |
| 004Dh   | Key Input Interrupt Control Register                                               | KUPIC       | XXXXX000b   |
| 004Eh   | A/D Conversion Interrupt Control Register                                          | ADIC        | XXXXX000b   |
| 004Fh   | SSU Interrupt Control Register / IIC bus Interrupt Control Register <sup>(2)</sup> | SSUIC/IICIC | XXXXX000b   |
| 0050h   |                                                                                    |             |             |
| 0051h   | UART0 Transmit Interrupt Control Register                                          | S0TIC       | XXXXX000b   |
| 0052h   | UART0 Receive Interrupt Control Register                                           | S0RIC       | XXXXX000b   |
| 0053h   |                                                                                    |             |             |
| 0054h   |                                                                                    |             |             |
| 0055h   | INT2 Interrupt Control Register                                                    | INT2IC      | XX00X000b   |
| 0056h   | Timer RJ0 Interrupt Control Register                                               | TRJ0IC      | XXXXX000b   |
| 0057h   | Timer RB1 Interrupt Control Register                                               | TRB1IC      | XXXXX000b   |
| 0058h   | Timer RB0 Interrupt Control Register                                               | TRB0IC      | XXXXX000b   |
| 0059h   | INT1 Interrupt Control Register                                                    | INT1IC      | XX00X000b   |
| 005Ah   | INT3 Interrupt Control Register                                                    | INT3IC      | XX00X000b   |
| 005Bh   | Timer RJ1 Interrupt Control Register                                               | TRJ1IC      | XXXXX000b   |
| 005Ch   |                                                                                    |             |             |
| 005Dh   | INT0 Interrupt Control Register                                                    | INT0IC      | XX00X000b   |
| 005Eh   |                                                                                    |             |             |
| 005Fh   |                                                                                    |             |             |
| 0060h   |                                                                                    |             |             |
| 0061h   |                                                                                    |             |             |
| 0062h   |                                                                                    |             |             |
| 0063h   |                                                                                    |             |             |
| 0064h   |                                                                                    |             |             |
| 0065h   |                                                                                    |             |             |
| 0066h   |                                                                                    |             |             |
| 0067h   |                                                                                    |             |             |
| 0068h   |                                                                                    |             |             |
| 0069h   |                                                                                    |             |             |
| 006Ah   | LCD Interrupt Control Register                                                     | LCDIC       | XXXXX000b   |
| 006Bh   |                                                                                    |             |             |
| 006Ch   |                                                                                    |             |             |
| 006Dh   |                                                                                    |             |             |
| 006Eh   |                                                                                    |             |             |
| 006Fh   |                                                                                    |             |             |
| 0070h   |                                                                                    |             |             |
| 0071h   |                                                                                    |             |             |
| 0072h   | Voltage monitor 1 Interrupt Control Register                                       | VCMP1IC     | XXXXX000b   |
| 0073h   | Voltage monitor 2 Interrupt Control Register                                       | VCMP2IC     | XXXXX000b   |
| 0074h   |                                                                                    |             |             |
| 0075h   |                                                                                    |             |             |
| 0076h   |                                                                                    |             |             |
| 0077h   |                                                                                    |             |             |
| 0078h   |                                                                                    |             |             |
| 0079h   |                                                                                    |             |             |
| 007Ah   |                                                                                    |             |             |
| 007Bh   |                                                                                    |             |             |
| 007Ch   |                                                                                    |             |             |
| 007Dh   |                                                                                    |             |             |
| 007Eh   |                                                                                    |             |             |
| 007Fh   |                                                                                    |             |             |

X: Undefined

Notes:

- Blank spaces are reserved. No access is allowed.
- Selectable by the IICSEL bit in the SSUIICSR register.

**Table 4.5 SFR Information for R8C/LA5A Group (5) <sup>(1)</sup>**

| Address | Register                                              | Symbol  | After Reset                           |
|---------|-------------------------------------------------------|---------|---------------------------------------|
| 0100h   |                                                       |         |                                       |
| 0101h   |                                                       |         |                                       |
| 0102h   |                                                       |         |                                       |
| 0103h   |                                                       |         |                                       |
| 0104h   |                                                       |         |                                       |
| 0105h   |                                                       |         |                                       |
| 0106h   |                                                       |         |                                       |
| 0107h   |                                                       |         |                                       |
| 0108h   | Timer RB0 Control Register                            | TRB0CR  | 00h                                   |
| 0109h   | Timer RB0 One-Shot Control Register                   | TRB0OCR | 00h                                   |
| 010Ah   | Timer RB0 I/O Control Register                        | TRB0IOC | 00h                                   |
| 010Bh   | Timer RB0 Mode Register                               | TRB0MR  | 00h                                   |
| 010Ch   | Timer RB0 Prescaler Register                          | TRB0PRE | FFh                                   |
| 010Dh   | Timer RB0 Secondary Register                          | TRB0SC  | FFh                                   |
| 010Eh   | Timer RB0 Primary Register                            | TRB0PR  | FFh                                   |
| 010Fh   |                                                       |         |                                       |
| 0110h   | Timer RH Second Data Register / Counter Data Register | TRHSEC  | XXh<br>00h <sup>(2)</sup>             |
| 0111h   | Timer RH Minute Data Register / Compare Data Register | TRHMIN  | XXh<br>00h <sup>(2)</sup>             |
| 0112h   | Timer RH Hour Data Register                           | TRHHR   | 00XXXXXXb<br>00h <sup>(2)</sup>       |
| 0113h   | Timer RH Day-of-the-Week Data Register                | TRHWK   | 00000XXXb<br>00h <sup>(2)</sup>       |
| 0114h   | Timer RH Date Data Register                           | TRHDY   | 00XXXXXXb<br>00000001b <sup>(2)</sup> |
| 0115h   | Timer RH Month Data Register                          | TRHMON  | 000XXXXXb<br>00000001b <sup>(2)</sup> |
| 0116h   | Timer RH Year Data Register                           | TRHYR   | XXh<br>00h <sup>(2)</sup>             |
| 0117h   | Timer RH Control Register                             | TRHCR   | XX0000Xb<br>000XX1X0b <sup>(2)</sup>  |
| 0118h   | Timer RH Count Source Select Register                 | TRHCSR  | X0001000b<br>0XXXXXXXb <sup>(2)</sup> |
| 0119h   | Timer RH Clock Error Correction Register              | TRHADJ  | XXh<br>00h <sup>(2)</sup>             |
| 011Ah   | Timer RH Interrupt Flag Register                      | TRHIFR  | 00000XXXb<br>000XX000b <sup>(2)</sup> |
| 011Bh   | Timer RH Interrupt Enable Register                    | TRHIER  | XXh<br>00h <sup>(2)</sup>             |
| 011Ch   | Timer RH Alarm Minute Register                        | TRHAMN  | XXh<br>00h <sup>(2)</sup>             |
| 011Dh   | Timer RH Alarm Hour Register                          | TRHAHR  | XXh<br>00h <sup>(2)</sup>             |
| 011Eh   | Timer RH Alarm Day-of-the-Week Register               | TRHAWK  | X0000XXXb<br>00h <sup>(2)</sup>       |
| 011Fh   | Timer RH Protect Register                             | TRHPRC  | 00h<br>X0000000b <sup>(2)</sup>       |
| 0120h   | Timer RC Mode Register                                | TRCMR   | 01001000b                             |
| 0121h   | Timer RC Control Register 1                           | TRCCR1  | 00h                                   |
| 0122h   | Timer RC Interrupt Enable Register                    | TRCIER  | 01110000b                             |
| 0123h   | Timer RC Status Register                              | TRCSR   | 01110000b                             |
| 0124h   | Timer RC I/O Control Register 0                       | TRCIOR0 | 10001000b                             |
| 0125h   | Timer RC I/O Control Register 1                       | TRCIOR1 | 10001000b                             |
| 0126h   | Timer RC Counter                                      | TRC     | 00h<br>00h                            |
| 0127h   |                                                       |         |                                       |
| 0128h   | Timer RC General Register A                           | TRCGRA  | FFh<br>FFh                            |
| 0129h   |                                                       |         |                                       |
| 012Ah   | Timer RC General Register B                           | TRCGRB  | FFh<br>FFh                            |
| 012Bh   |                                                       |         |                                       |
| 012Ch   | Timer RC General Register C                           | TRCGRC  | FFh<br>FFh                            |
| 012Dh   |                                                       |         |                                       |
| 012Eh   | Timer RC General Register D                           | TRCGRD  | FFh<br>FFh                            |
| 012Fh   |                                                       |         |                                       |
| 0130h   | Timer RC Control Register 2                           | TRCCR2  | 00011000b                             |
| 0131h   | Timer RC Digital Filter Function Select Register      | TRCDF   | 00h                                   |
| 0132h   | Timer RC Output Master Enable Register                | TRCOER  | 01111111b                             |
| 0133h   | Timer RC Trigger Control Register                     | TRCADCR | 00h                                   |
| 0134h   |                                                       |         |                                       |
| 0135h   |                                                       |         |                                       |
| 0136h   |                                                       |         |                                       |
| 0137h   |                                                       |         |                                       |
| 0138h   |                                                       |         |                                       |
| 0139h   |                                                       |         |                                       |
| 013Ah   |                                                       |         |                                       |
| 013Bh   |                                                       |         |                                       |
| 013Ch   |                                                       |         |                                       |
| 013Dh   |                                                       |         |                                       |
| 013Eh   |                                                       |         |                                       |
| 013Fh   |                                                       |         |                                       |

X: Undefined

Notes:

- Blank spaces are reserved. No access is allowed.
- This is the reset value after reset by RTCRST bit in TRHCR register.

**Table 4.13 SFR Information for R8C/LA8A Group (4) <sup>(1)</sup>**

| Address | Register                   | Symbol  | After Reset |
|---------|----------------------------|---------|-------------|
| 00C0h   | A/D Register 0             | AD0     | XXh         |
| 00C1h   |                            |         | 000000XXb   |
| 00C2h   | A/D Register 1             | AD1     | XXh         |
| 00C3h   |                            |         | 000000XXb   |
| 00C4h   | A/D Register 2             | AD2     | XXh         |
| 00C5h   |                            |         | 000000XXb   |
| 00C6h   | A/D Register 3             | AD3     | XXh         |
| 00C7h   |                            |         | 000000XXb   |
| 00C8h   | A/D Register 4             | AD4     | XXh         |
| 00C9h   |                            |         | 000000XXb   |
| 00CAh   | A/D Register 5             | AD5     | XXh         |
| 00CBh   |                            |         | 000000XXb   |
| 00CCh   | A/D Register 6             | AD6     | XXh         |
| 00CDh   |                            |         | 000000XXb   |
| 00CEh   | A/D Register 7             | AD7     | XXh         |
| 00CFh   |                            |         | 000000XXb   |
| 00D0h   |                            |         |             |
| 00D1h   |                            |         |             |
| 00D2h   |                            |         |             |
| 00D3h   |                            |         |             |
| 00D4h   | A/D Mode Register          | ADMOD   | 00h         |
| 00D5h   | A/D Input Select Register  | ADINSEL | 11000000b   |
| 00D6h   | A/D Control Register 0     | ADCON0  | 00h         |
| 00D7h   | A/D Control Register 1     | ADCON1  | 00h         |
| 00D8h   |                            |         |             |
| 00D9h   |                            |         |             |
| 00DAh   |                            |         |             |
| 00DBh   |                            |         |             |
| 00DCh   |                            |         |             |
| 00DDh   | A/D Control Register 2     | ADCON2  | 00h         |
| 00DEh   |                            |         |             |
| 00DFh   |                            |         |             |
| 00E0h   | Port P0 Register           | P0      | XXh         |
| 00E1h   | Port P1 Register           | P1      | XXh         |
| 00E2h   | Port P0 Direction Register | PD0     | 00h         |
| 00E3h   | Port P1 Direction Register | PD1     | 00h         |
| 00E4h   | Port P2 Register           | P2      | XXh         |
| 00E5h   | Port P3 Register           | P3      | XXh         |
| 00E6h   | Port P2 Direction Register | PD2     | 00h         |
| 00E7h   | Port P3 Direction Register | PD3     | 00h         |
| 00E8h   | Port P4 Register           | P4      | XXh         |
| 00E9h   | Port P5 Register           | P5      | XXh         |
| 00EAh   | Port P4 Direction Register | PD4     | 00h         |
| 00EBh   | Port P5 Direction Register | PD5     | 00h         |
| 00ECh   | Port P6 Register           | P6      | XXh         |
| 00EDh   | Port P7 Register           | P7      | XXh         |
| 00EEh   | Port P6 Direction Register | PD6     | 00h         |
| 00EFh   | Port P7 Direction Register | PD7     | 00h         |
| 00F0h   | Port P8 Register           | P8      | XXh         |
| 00F1h   | Port P9 Register           | P9      | XXh         |
| 00F2h   | Port P8 Direction Register | PD8     | 00h         |
| 00F3h   | Port P9 Direction Register | PD9     | 00h         |
| 00F4h   |                            |         |             |
| 00F5h   |                            |         |             |
| 00F6h   |                            |         |             |
| 00F7h   |                            |         |             |
| 00F8h   |                            |         |             |
| 00F9h   |                            |         |             |
| 00FAh   |                            |         |             |
| 00FBh   |                            |         |             |
| 00FCh   |                            |         |             |
| 00FDh   |                            |         |             |
| 00FEh   |                            |         |             |
| 00FFh   |                            |         |             |

X: Undefined

Note:

- Blank spaces are reserved. No access is allowed.

**Table 4.14 SFR Information for R8C/LA8A Group (5) <sup>(1)</sup>**

| Address | Register                                              | Symbol  | After Reset                           |
|---------|-------------------------------------------------------|---------|---------------------------------------|
| 0100h   |                                                       |         |                                       |
| 0101h   |                                                       |         |                                       |
| 0102h   |                                                       |         |                                       |
| 0103h   |                                                       |         |                                       |
| 0104h   |                                                       |         |                                       |
| 0105h   |                                                       |         |                                       |
| 0106h   |                                                       |         |                                       |
| 0107h   |                                                       |         |                                       |
| 0108h   | Timer RB0 Control Register                            | TRB0CR  | 00h                                   |
| 0109h   | Timer RB0 One-Shot Control Register                   | TRB0OCR | 00h                                   |
| 010Ah   | Timer RB0 I/O Control Register                        | TRB0IOC | 00h                                   |
| 010Bh   | Timer RB0 Mode Register                               | TRB0MR  | 00h                                   |
| 010Ch   | Timer RB0 Prescaler Register                          | TRB0PRE | FFh                                   |
| 010Dh   | Timer RB0 Secondary Register                          | TRB0SC  | FFh                                   |
| 010Eh   | Timer RB0 Primary Register                            | TRB0PR  | FFh                                   |
| 010Fh   |                                                       |         |                                       |
| 0110h   | Timer RH Second Data Register / Counter Data Register | TRHSEC  | XXh<br>00h <sup>(2)</sup>             |
| 0111h   | Timer RH Minute Data Register / Compare Data Register | TRHMIN  | XXh<br>00h <sup>(2)</sup>             |
| 0112h   | Timer RH Hour Data Register                           | TRHHR   | 00XXXXXXb<br>00h <sup>(2)</sup>       |
| 0113h   | Timer RH Day-of-the-Week Data Register                | TRHWK   | 00000XXXb<br>00h <sup>(2)</sup>       |
| 0114h   | Timer RH Date Data Register                           | TRHDY   | 00XXXXXXb<br>00000001b <sup>(2)</sup> |
| 0115h   | Timer RH Month Data Register                          | TRHMON  | 000XXXXXb<br>00000001b <sup>(2)</sup> |
| 0116h   | Timer RH Year Data Register                           | TRHYR   | XXh<br>00h <sup>(2)</sup>             |
| 0117h   | Timer RH Control Register                             | TRHCR   | XX0000Xb<br>000XX1X0b <sup>(2)</sup>  |
| 0118h   | Timer RH Count Source Select Register                 | TRHCSR  | X0001000b<br>0XXXXXXXb <sup>(2)</sup> |
| 0119h   | Timer RH Clock Error Correction Register              | TRHADJ  | XXh<br>00h <sup>(2)</sup>             |
| 011Ah   | Timer RH Interrupt Flag Register                      | TRHIFR  | 00000XXXb<br>000XX000b <sup>(2)</sup> |
| 011Bh   | Timer RH Interrupt Enable Register                    | TRHIER  | XXh<br>00h <sup>(2)</sup>             |
| 011Ch   | Timer RH Alarm Minute Register                        | TRHAMN  | XXh<br>00h <sup>(2)</sup>             |
| 011Dh   | Timer RH Alarm Hour Register                          | TRHAHR  | XXh<br>00h <sup>(2)</sup>             |
| 011Eh   | Timer RH Alarm Day-of-the-Week Register               | TRHAWK  | X0000XXXb<br>00h <sup>(2)</sup>       |
| 011Fh   | Timer RH Protect Register                             | TRHPRC  | 00h<br>X0000000b <sup>(2)</sup>       |
| 0120h   | Timer RC Mode Register                                | TRCMR   | 01001000b                             |
| 0121h   | Timer RC Control Register 1                           | TRCCR1  | 00h                                   |
| 0122h   | Timer RC Interrupt Enable Register                    | TRCIER  | 01110000b                             |
| 0123h   | Timer RC Status Register                              | TRCSR   | 01110000b                             |
| 0124h   | Timer RC I/O Control Register 0                       | TRCIOR0 | 10001000b                             |
| 0125h   | Timer RC I/O Control Register 1                       | TRCIOR1 | 10001000b                             |
| 0126h   | Timer RC Counter                                      | TRC     | 00h<br>00h                            |
| 0127h   |                                                       |         |                                       |
| 0128h   | Timer RC General Register A                           | TRCGRA  | FFh<br>FFh                            |
| 0129h   |                                                       |         |                                       |
| 012Ah   | Timer RC General Register B                           | TRCGRB  | FFh<br>FFh                            |
| 012Bh   |                                                       |         |                                       |
| 012Ch   | Timer RC General Register C                           | TRCGRC  | FFh<br>FFh                            |
| 012Dh   |                                                       |         |                                       |
| 012Eh   | Timer RC General Register D                           | TRCGRD  | FFh<br>FFh                            |
| 012Fh   |                                                       |         |                                       |
| 0130h   | Timer RC Control Register 2                           | TRCCR2  | 00011000b                             |
| 0131h   | Timer RC Digital Filter Function Select Register      | TRCDF   | 00h                                   |
| 0132h   | Timer RC Output Master Enable Register                | TRCOER  | 01111111b                             |
| 0133h   | Timer RC Trigger Control Register                     | TRCADCR | 00h                                   |
| 0134h   |                                                       |         |                                       |
| 0135h   |                                                       |         |                                       |
| 0136h   |                                                       |         |                                       |
| 0137h   |                                                       |         |                                       |
| 0138h   |                                                       |         |                                       |
| 0139h   |                                                       |         |                                       |
| 013Ah   |                                                       |         |                                       |
| 013Bh   |                                                       |         |                                       |
| 013Ch   |                                                       |         |                                       |
| 013Dh   |                                                       |         |                                       |
| 013Eh   |                                                       |         |                                       |
| 013Fh   |                                                       |         |                                       |

X: Undefined

Notes:

- Blank spaces are reserved. No access is allowed.
- This is the reset value after reset by RTCRST bit in TRHCR register.

**Table 4.15 SFR Information for R8C/LA8A Group (6) <sup>(1)</sup>**

| Address | Register | Symbol | After Reset |
|---------|----------|--------|-------------|
| 0140h   |          |        |             |
| 0141h   |          |        |             |
| 0142h   |          |        |             |
| 0143h   |          |        |             |
| 0144h   |          |        |             |
| 0145h   |          |        |             |
| 0146h   |          |        |             |
| 0147h   |          |        |             |
| 0148h   |          |        |             |
| 0149h   |          |        |             |
| 014Ah   |          |        |             |
| 014Bh   |          |        |             |
| 014Ch   |          |        |             |
| 014Dh   |          |        |             |
| 014Eh   |          |        |             |
| 014Fh   |          |        |             |
| 0150h   |          |        |             |
| 0151h   |          |        |             |
| 0152h   |          |        |             |
| 0153h   |          |        |             |
| 0154h   |          |        |             |
| 0155h   |          |        |             |
| 0156h   |          |        |             |
| 0157h   |          |        |             |
| 0158h   |          |        |             |
| 0159h   |          |        |             |
| 015Ah   |          |        |             |
| 015Bh   |          |        |             |
| 015Ch   |          |        |             |
| 015Dh   |          |        |             |
| 015Eh   |          |        |             |
| 015Fh   |          |        |             |
| 0160h   |          |        |             |
| 0161h   |          |        |             |
| 0162h   |          |        |             |
| 0163h   |          |        |             |
| 0164h   |          |        |             |
| 0165h   |          |        |             |
| 0166h   |          |        |             |
| 0167h   |          |        |             |
| 0168h   |          |        |             |
| 0169h   |          |        |             |
| 016Ah   |          |        |             |
| 016Bh   |          |        |             |
| 016Ch   |          |        |             |
| 016Dh   |          |        |             |
| 016Eh   |          |        |             |
| 016Fh   |          |        |             |
| 0170h   |          |        |             |
| 0171h   |          |        |             |
| 0172h   |          |        |             |
| 0173h   |          |        |             |
| 0174h   |          |        |             |
| 0175h   |          |        |             |
| 0176h   |          |        |             |
| 0177h   |          |        |             |
| 0178h   |          |        |             |
| 0179h   |          |        |             |
| 017Ah   |          |        |             |
| 017Bh   |          |        |             |
| 017Ch   |          |        |             |
| 017Dh   |          |        |             |
| 017Eh   |          |        |             |
| 017Fh   |          |        |             |

X: Undefined

Note:

1. Blank spaces are reserved. No access is allowed.

### 5.1.3 Peripheral Function Characteristics

**Table 5.3 A/D Converter Characteristics**  
( $V_{CC}/AV_{CC} = V_{ref} = 1.8$  to  $5.5$  V,  $V_{SS} = 0$  V, and  $T_{opr} = -20$  to  $85$  °C (N version)/  
 $-40$  to  $85$  °C (D version), unless otherwise specified.)

| Symbol | Parameter                 |             | Conditions                                                |                  | Standard |      |                  | Unit |
|--------|---------------------------|-------------|-----------------------------------------------------------|------------------|----------|------|------------------|------|
|        |                           |             |                                                           |                  | Min.     | Typ. | Max.             |      |
| —      | Resolution                |             | V <sub>ref</sub> = AV <sub>CC</sub>                       |                  | —        | —    | 10               | Bit  |
| —      | Absolute accuracy (2)     | 10-bit mode | V <sub>ref</sub> = AV <sub>CC</sub> = 5.0 V               | AN0 to AN6 input | —        | —    | ±3               | LSB  |
|        |                           |             | V <sub>ref</sub> = AV <sub>CC</sub> = 2.2 V               | AN0 to AN6 input | —        | —    | ±5               | LSB  |
|        |                           |             | V <sub>ref</sub> = AV <sub>CC</sub> = 1.8 V               | AN0 to AN6 input | —        | —    | ±5               | LSB  |
|        |                           | 8-bit mode  | V <sub>ref</sub> = AV <sub>CC</sub> = 5.0 V               | AN0 to AN6 input | —        | —    | ±2               | LSB  |
|        |                           |             | V <sub>ref</sub> = AV <sub>CC</sub> = 2.2 V               | AN0 to AN6 input | —        | —    | ±2               | LSB  |
|        |                           |             | V <sub>ref</sub> = AV <sub>CC</sub> = 1.8 V               | AN0 to AN6 input | —        | —    | ±2               | LSB  |
| φAD    | A/D conversion clock      |             | 4.0 ≤ V <sub>ref</sub> = AV <sub>CC</sub> ≤ 5.5 V (1)     |                  | 1        | —    | 20               | MHz  |
|        |                           |             | 3.2 ≤ V <sub>ref</sub> = AV <sub>CC</sub> ≤ 5.5 V (1)     |                  | 1        | —    | 16               | MHz  |
|        |                           |             | 2.7 ≤ V <sub>ref</sub> = AV <sub>CC</sub> ≤ 5.5 V (1)     |                  | 1        | —    | 10               | MHz  |
|        |                           |             | 1.8 ≤ V <sub>ref</sub> = AV <sub>CC</sub> ≤ 5.5 V (1)     |                  | 1        | —    | 8                | MHz  |
| —      | Tolerance level impedance |             |                                                           |                  | —        | 3    | —                | kΩ   |
| tCONV  | Conversion time           | 10-bit mode | V <sub>ref</sub> = AV <sub>CC</sub> = 5.0 V, φAD = 20 MHz |                  | 2.2      | —    | —                | μs   |
|        |                           | 8-bit mode  | V <sub>ref</sub> = AV <sub>CC</sub> = 5.0 V, φAD = 20 MHz |                  | 2.2      | —    | —                | ms   |
| tsAMP  | Sampling time             |             | φAD = 20 MHz                                              |                  | 0.8      | —    | —                | μs   |
| Ivref  | V <sub>ref</sub> current  |             | V <sub>CC</sub> = 5 V, XIN = f1 = φAD = 20 MHz            |                  | —        | 45   | —                | μA   |
| Vref   | Reference voltage         |             |                                                           |                  | 1.8      | —    | AV <sub>CC</sub> | V    |
| VIA    | Analog input voltage (3)  |             |                                                           |                  | 0        | —    | V <sub>ref</sub> | V    |
| OCVREF | On-chip reference voltage |             | 2 MHz ≤ φAD ≤ 4 MHz                                       |                  | 1.53     | 1.70 | 1.87             | V    |

Notes:

1. The A/D conversion result will be undefined in wait mode, stop mode, power-off mode, when the flash memory stops, and in low-current-consumption mode. Do not perform A/D conversion in these states or transition to these states during A/D conversion.
2. This applies when the peripheral functions are stopped.
3. When the analog input voltage is over the reference voltage, the A/D conversion result will be 3FFh in 10-bit mode and FFh in 8-bit mode.

**Table 5.4 Temperature Sensor Characteristics**  
( $V_{SS} = 0$  V and  $T_{opr} = -20$  to  $85$  °C (N version)/  $-40$  to  $85$  °C (D version), unless  
otherwise specified.)

| Symbol    | Parameter                         | Conditions                                                                                                                                      | Standard |        |      | Unit    |
|-----------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|------|---------|
|           |                                   |                                                                                                                                                 | Min.     | Typ.   | Max. |         |
| $V_{TMP}$ | Temperature sensor output voltage | $1.8 \text{ V} \leq V_{ref} = AV_{CC} \leq 5.5 \text{ V}$<br>$\phi_{AD} = 1.0 \text{ MHz to } 5.0 \text{ MHz}$<br>Ambient temperature = $25$ °C | 550      | 600    | 650  | mV      |
| —         | Temperature coefficient           | $1.8 \text{ V} \leq V_{ref} = AV_{CC} \leq 5.5 \text{ V}$<br>$\phi_{AD} = 1.0 \text{ MHz to } 5.0 \text{ MHz}$<br>Ambient temperature = $25$ °C | —        | $-2.1$ | —    | mV/°C   |
| —         | Start-up time                     | $1.8 \text{ V} \leq V_{ref} = AV_{CC} \leq 5.5 \text{ V}$<br>$\phi_{AD} = 1.0 \text{ MHz to } 5.0 \text{ MHz}$                                  | —        | —      | 200  | $\mu$ s |
| $I_{TMP}$ | Operating current                 | $1.8 \text{ V} \leq V_{ref} = AV_{CC} \leq 5.5 \text{ V}$<br>$\phi_{AD} = 1.0 \text{ MHz to } 5.0 \text{ MHz}$                                  | —        | 100    | —    | $\mu$ A |

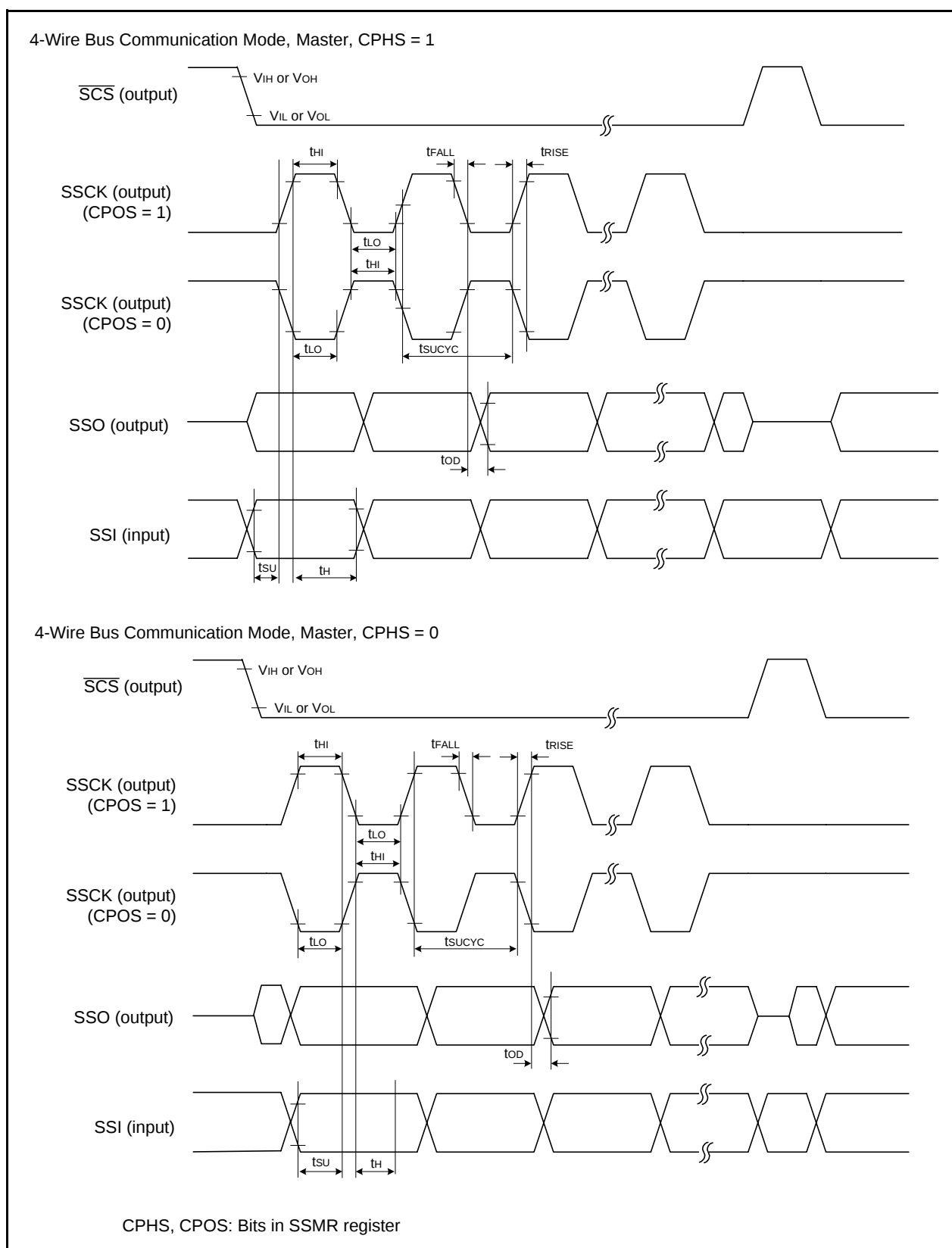
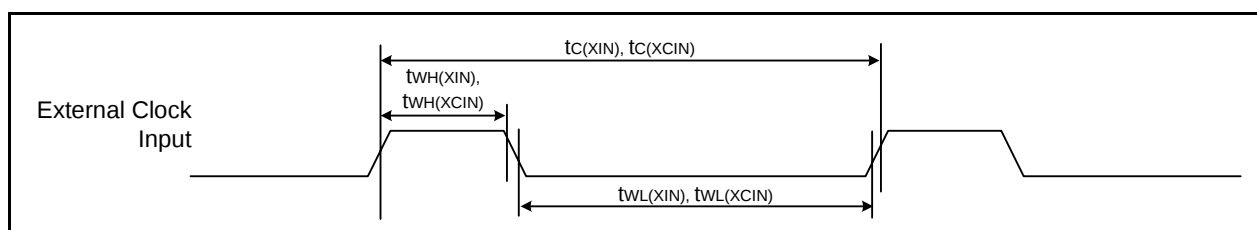


Figure 5.4 I/O Timing of Synchronous Serial Communication Unit (SSU) (Master)

**Table 5.26 Timing Requirements of External Clock Input (XIN, XCIN)**  
(V<sub>SS</sub> = 0 V and T<sub>opr</sub> = –20 to 85 °C (N version)/ –40 to 85 °C (D version), unless otherwise specified.)

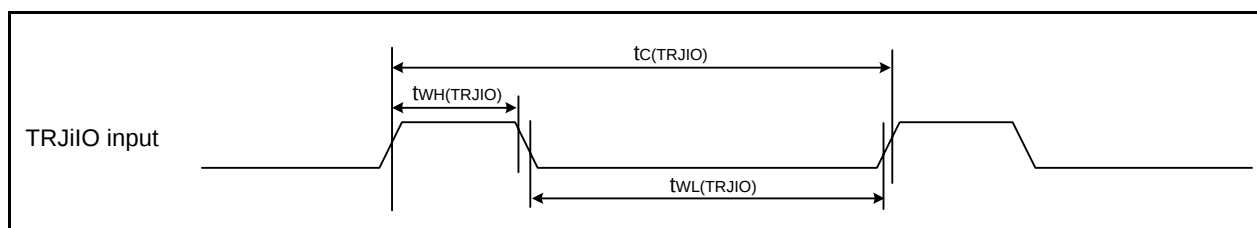
| Symbol    | Parameter             | Standard                |      |                       |      |                       |      | Unit |
|-----------|-----------------------|-------------------------|------|-----------------------|------|-----------------------|------|------|
|           |                       | VCC = 2.2V, Topr = 25°C |      | VCC = 3V, Topr = 25°C |      | VCC = 5V, Topr = 25°C |      |      |
|           |                       | Min.                    | Max. | Min.                  | Max. | Min.                  | Max. |      |
| tC(XIN)   | XIN input cycle time  | 200                     | —    | 50                    | —    | 50                    | —    | ns   |
| tWH(XIN)  | XIN input “H” width   | 90                      | —    | 24                    | —    | 24                    | —    | ns   |
| tWL(XIN)  | XIN input “L” width   | 90                      | —    | 24                    | —    | 24                    | —    | ns   |
| tC(XCIN)  | XCIN input cycle time | 20                      | —    | 20                    | —    | 20                    | —    | μs   |
| tWH(XCIN) | XCIN input “H” width  | 10                      | —    | 10                    | —    | 10                    | —    | μs   |
| tWL(XCIN) | XCIN input “L” width  | 10                      | —    | 10                    | —    | 10                    | —    | μs   |



**Figure 5.8 External Clock Input Timing**

**Table 5.27 Timing Requirements of TRJiIO (i = 0 or 1)**  
(V<sub>SS</sub> = 0 V and T<sub>opr</sub> = –20 to 85 °C (N version)/ –40 to 85 °C (D version), unless otherwise specified.)

| Symbol                  | Parameter              | Standard                |      |                       |      |                       |      | Unit |
|-------------------------|------------------------|-------------------------|------|-----------------------|------|-----------------------|------|------|
|                         |                        | Vcc = 2.2V, Topr = 25°C |      | Vcc = 3V, Topr = 25°C |      | Vcc = 5V, Topr = 25°C |      |      |
|                         |                        | Min.                    | Max. | Min.                  | Max. | Min.                  | Max. |      |
| t <sub>c</sub> (TRJiO)  | TRJiO input cycle time | 500                     | —    | 300                   | —    | 100                   | —    | ns   |
| t <sub>WH</sub> (TRJiO) | TRJiO input “H” width  | 200                     | —    | 120                   | —    | 40                    | —    | ns   |
| t <sub>WL</sub> (TRJiO) | TRJiO input “L” width  | 200                     | —    | 120                   | —    | 40                    | —    | ns   |



**Figure 5.9 Input Timing of TRJiIO**

**Table 5.40 Voltage Detection 2 Circuit Characteristics**  
**(V<sub>CC</sub> = 1.8 to 5.5 V and T<sub>opr</sub> = –20 to 85°C (N version)/ –40 to 85°C (D version), unless otherwise specified.)**

| Symbol              | Parameter                                                                        | Condition                          | Standard |      |      | Unit |
|---------------------|----------------------------------------------------------------------------------|------------------------------------|----------|------|------|------|
|                     |                                                                                  |                                    | Min.     | Typ. | Max. |      |
| V <sub>det2</sub>   | Voltage detection level V <sub>det2_0</sub> <sup>(1)</sup>                       | At the falling of V <sub>CC</sub>  | 3.70     | 4.0  | 4.30 | V    |
| –                   | Hysteresis width at the rising of V <sub>CC</sub> in voltage detection 2 circuit |                                    | –        | 0.10 | –    | V    |
| –                   | Voltage detection 2 circuit response time <sup>(2)</sup>                         | In operation                       |          | 20   | 150  | μs   |
|                     |                                                                                  | In stop mode                       |          | 200  | 500  | μs   |
| –                   | Voltage detection circuit self power consumption                                 | VCA27 = 1, V <sub>CC</sub> = 5.0 V | –        | 1.7  | –    | μA   |
| t <sub>d(E-A)</sub> | Waiting time until voltage detection circuit operation starts <sup>(3)</sup>     |                                    | –        | –    | 100  | μs   |

Notes:

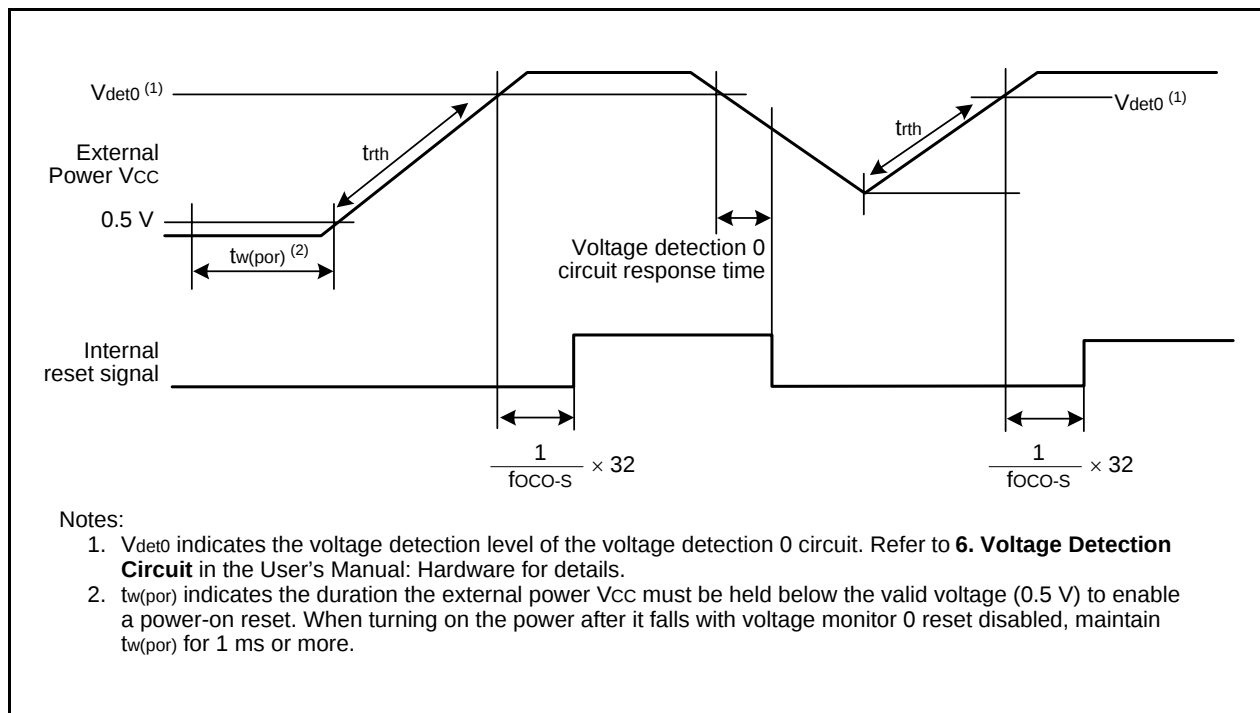
1. The voltage detection level varies with detection targets. Select the level with the VCA24 bit in the VCA2 register.
2. Time until the voltage monitor 2 interrupt request is generated after the voltage passes V<sub>det2</sub>.
3. Necessary time until the voltage detection circuit operates after setting to 1 again after setting the VCA27 bit in the VCA2 register to 0.

**Table 5.41 Power-on Reset Circuit Characteristics <sup>(1)</sup>**  
**(T<sub>opr</sub> = –20 to 85°C (N version)/ –40 to 85°C (D version), unless otherwise specified.)**

| Symbol           | Parameter                                    | Condition | Standard |      |       | Unit  |
|------------------|----------------------------------------------|-----------|----------|------|-------|-------|
|                  |                                              |           | Min.     | Typ. | Max.  |       |
| t <sub>rth</sub> | External power V <sub>CC</sub> rise gradient |           | 0        | –    | 50000 | mV/ms |

Note:

1. To use the power-on reset function, enable voltage monitor 0 reset by setting the LVDAS bit in the OFS register to 0.



**Figure 5.14 Power-on Reset Circuit Characteristics**

**Table 5.51 DC Characteristics (5) [ $1.8\text{ V} \leq V_{CC} < 2.7\text{ V}$ ]**  
**( $T_{opr} = -20\text{ to }85^{\circ}\text{C}$  (N version)/  $-40\text{ to }85^{\circ}\text{C}$  (D version), unless otherwise specified.)**

| Symbol  | Parameter           |                                                                                                                                                                                                                                                       | Condition               |             | Standard  |      |      | Unit |
|---------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------|-----------|------|------|------|
|         |                     |                                                                                                                                                                                                                                                       |                         |             | Min.      | Typ. | Max. |      |
| VOH     | Output “H” voltage  |                                                                                                                                                                                                                                                       | Port P7_0, P7_1, P8 (1) | IOH = −2 mA | Vcc − 0.5 | −    | Vcc  | V    |
|         |                     |                                                                                                                                                                                                                                                       | Other pins              | IOH = −1 mA | Vcc − 0.5 | −    | Vcc  | V    |
| VOL     | Output “L” voltage  |                                                                                                                                                                                                                                                       | Port P7_0, P7_1, P8 (1) | IOL = 2 mA  | −         | −    | 0.5  | V    |
|         |                     |                                                                                                                                                                                                                                                       | Other pins              | IOL = 1 mA  | −         | −    | 0.5  | V    |
| VT+-VT- | Hysteresis          | INT0, INT1, INT2,<br>INT3, INT4, INT5,<br>INT6, INT7,<br>KI0, KI1, KI2, KI3,<br>KI4, KI5, KI6, KI7,<br>TRCIOA, TRCIOB,<br>TRCIOC, TRCIOD,<br>TRJ0IO, TRJ1IO,<br>TRJ2IO, TRCTRG,<br>TRCCLK, ADTRG,<br>RXD0, RXD2, CLK0,<br>CLK2, SSI, SCL,<br>SDA, SSO |                         |             | 0.05      | 0.4  | −    | V    |
|         |                     | RESET, WKUP0                                                                                                                                                                                                                                          |                         |             | 0.1       | 0.8  | −    | V    |
| IIH     | Input “H” current   |                                                                                                                                                                                                                                                       | VI = 1.8 V, Vcc = 1.8 V |             | −         | −    | 4.0  | μA   |
| IIL     | Input “L” current   |                                                                                                                                                                                                                                                       | VI = 0 V, Vcc = 1.8 V   |             | −         | −    | −4.0 | μA   |
| RPULLUP | Pull-up resistance  |                                                                                                                                                                                                                                                       | VI = 0 V, Vcc = 1.8 V   |             | 85        | 220  | 500  | kΩ   |
| RfXIN   | Feedback resistance | XIN                                                                                                                                                                                                                                                   |                         |             | −         | 2.0  | −    | MΩ   |
| RfXCIN  | Feedback resistance | XCIN                                                                                                                                                                                                                                                  |                         |             | −         | 14   | −    | MΩ   |
| VRAM    | RAM hold voltage    |                                                                                                                                                                                                                                                       | During stop mode        |             | 1.8       | −    | −    | V    |

Note:

1. This applies when the drive capacity of the output transistor is set to High by registers P7DDR and P8DDR. When the drive capacity is set to Low, the value of any other pin applies.

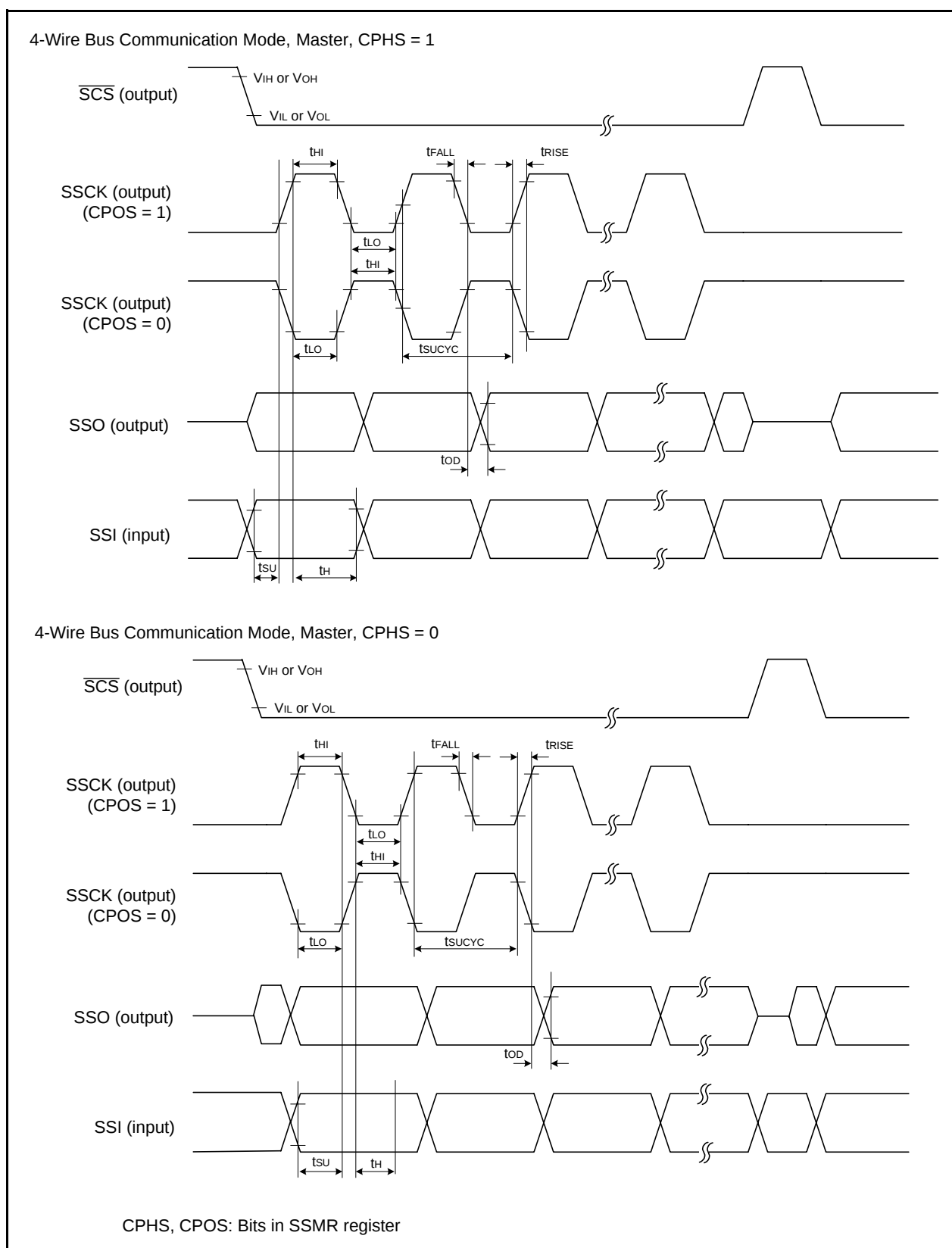


Figure 5.15 I/O Timing of Synchronous Serial Communication Unit (SSU) (Master)

