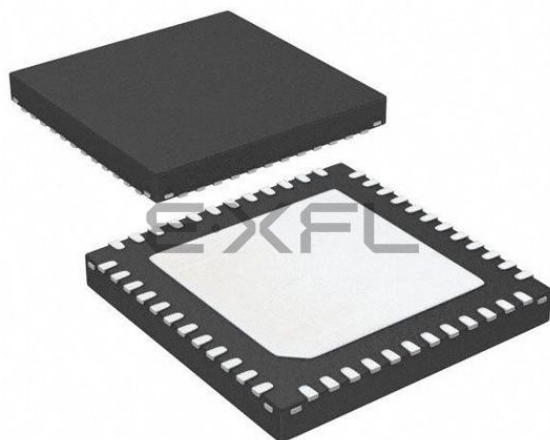




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### What is "[Embedded - Microcontrollers](#)"?

"[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             | Obsolete                                                                                                                                                                      |
| Core Processor             | RL78                                                                                                                                                                          |
| Core Size                  | 16-Bit                                                                                                                                                                        |
| Speed                      | 32MHz                                                                                                                                                                         |
| Connectivity               | CSI, I <sup>2</sup> C, LINbus, UART/USART                                                                                                                                     |
| Peripherals                | DMA, LVD, POR, PWM, WDT                                                                                                                                                       |
| Number of I/O              | 34                                                                                                                                                                            |
| Program Memory Size        | 384KB (384K x 8)                                                                                                                                                              |
| Program Memory Type        | FLASH                                                                                                                                                                         |
| EEPROM Size                | -                                                                                                                                                                             |
| RAM Size                   | 24K x 8                                                                                                                                                                       |
| Voltage - Supply (Vcc/Vdd) | 1.6V ~ 5.5V                                                                                                                                                                   |
| Data Converters            | A/D 10x8/10b                                                                                                                                                                  |
| Oscillator Type            | Internal                                                                                                                                                                      |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                             |
| Mounting Type              | Surface Mount                                                                                                                                                                 |
| Package / Case             | 48-WFQFN Exposed Pad                                                                                                                                                          |
| Supplier Device Package    | 48-HWQFN (7x7)                                                                                                                                                                |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f101gkana-u0">https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f101gkana-u0</a> |

Table 1-1. List of Ordering Part Numbers

(11/12)

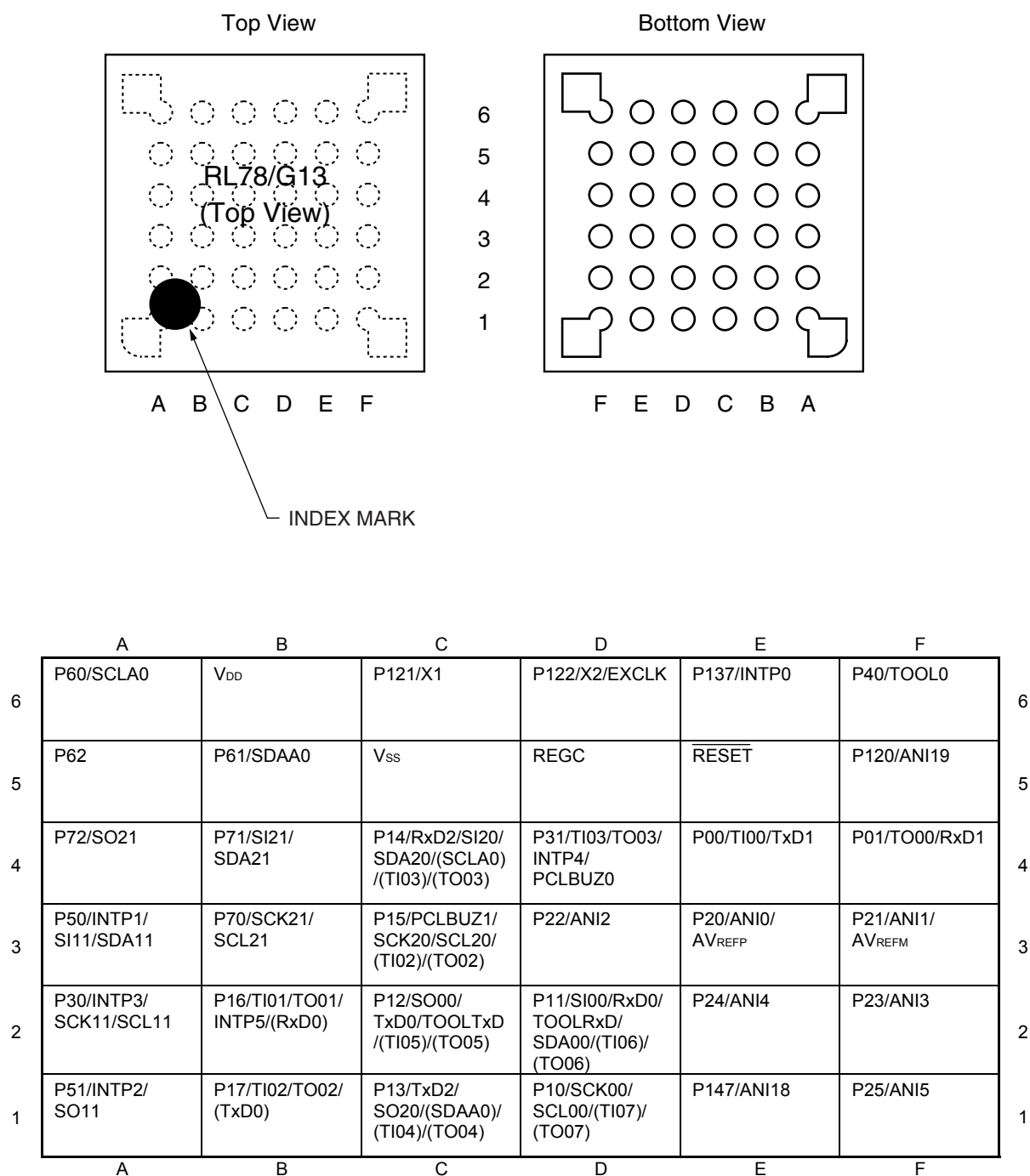
| Pin count | Package                                             | Data flash  | Fields of Application<br>Note | Ordering Part Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|-----------------------------------------------------|-------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 100 pins  | 100-pin plastic<br>LFQFP (14 × 14 mm, 0.5 mm pitch) | Mounted     | A                             | R5F100PFAFB#V0, R5F100PGAFA#V0, R5F100PHAFA#V0,<br>R5F100PJAFB#V0, R5F100PKAFB#V0, R5F100PLAFB#V0<br>R5F100PFAFB#X0, R5F100PGAFA#X0, R5F100PHAFA#X0,<br>R5F100PJAFB#X0, R5F100PKAFB#X0, R5F100PLAFB#X0<br>R5F100PFDFB#V0, R5F100PGDFB#V0, R5F100PHDFB#V0,<br>R5F100PJDFB#V0, R5F100PKDFB#V0, R5F100PLDFB#V0<br>R5F100PFDFB#X0, R5F100PGDFB#X0, R5F100PHDFB#X0,<br>R5F100PJDFB#X0, R5F100PKDFB#X0, R5F100PLDFB#X0<br>R5F100PFGFB#V0, R5F100PGGFB#V0, R5F100PHGFB#V0,<br>R5F100PJGFB#V0<br>R5F100PFGFB#X0, R5F100PGGFB#X0, R5F100PHGFB#X0,<br>R5F100PJGFB#X0 |
|           |                                                     | Not mounted | A                             | R5F101PFAFB#V0, R5F101PGAFA#V0, R5F101PHAFA#V0,<br>R5F101PJAFB#V0, R5F101PKAFB#V0, R5F101PLAFB#V0<br>R5F101PFAFB#X0, R5F101PGAFA#X0, R5F101PHAFA#X0,<br>R5F101PJAFB#X0, R5F101PKAFB#X0, R5F101PLAFB#X0<br>R5F101PFDFB#V0, R5F101PGDFB#V0, R5F101PHDFB#V0,<br>R5F101PJDFB#V0, R5F101PKDFB#V0, R5F101PLDFB#V0<br>R5F101PFDFB#X0, R5F101PGDFB#X0, R5F101PHDFB#X0,<br>R5F101PJDFB#X0, R5F101PKDFB#X0, R5F101PLDFB#X0                                                                                                                                           |
|           | 100-pin plastic<br>LQFP (14 × 20 mm, 0.65 mm pitch) | Mounted     | A                             | R5F100PFAFA#V0, R5F100PGAFA#V0, R5F100PHAFA#V0,<br>R5F100PJAFB#V0, R5F100PKAFA#V0, R5F100PLAFA#V0<br>R5F100PFAFA#X0, R5F100PGAFA#X0, R5F100PHAFA#X0,<br>R5F100PJAFB#X0, R5F100PKAFA#X0, R5F100PLAFA#X0<br>R5F100PFDFB#V0, R5F100PGDFB#V0, R5F100PHDFB#V0,<br>R5F100PJDFB#V0, R5F100PKDFB#V0, R5F100PLDFB#V0<br>R5F100PFDFB#X0, R5F100PGDFB#X0, R5F100PHDFB#X0,<br>R5F100PJDFB#X0, R5F100PKDFB#X0, R5F100PLDFB#X0<br>R5F100PFGFA#V0, R5F100PGGFA#V0, R5F100PHGFA#V0,<br>R5F100PJGFA#V0<br>R5F100PFGFA#X0, R5F100PGGFA#X0, R5F100PHGFA#X0,<br>R5F100PJGFA#X0 |
|           |                                                     | Not mounted | A                             | R5F101PFAFA#V0, R5F101PGAFA#V0, R5F101PHAFA#V0,<br>R5F101PJAFB#V0, R5F101PKAFA#V0, R5F101PLAFA#V0<br>R5F101PFAFA#X0, R5F101PGAFA#X0, R5F101PHAFA#X0,<br>R5F101PJAFB#X0, R5F101PKAFA#X0, R5F101PLAFA#X0<br>R5F101PFDFB#V0, R5F101PGDFB#V0, R5F101PHDFB#V0,<br>R5F101PJDFB#V0, R5F101PKDFB#V0, R5F101PLDFB#V0<br>R5F101PFDFB#X0, R5F101PGDFB#X0, R5F101PHDFB#X0,<br>R5F101PJDFB#X0, R5F101PKDFB#X0, R5F101PLDFB#X0                                                                                                                                           |

**Note** For the fields of application, refer to **Figure 1-1 Part Number, Memory Size, and Package of RL78/G13**.

**Caution** The ordering part numbers represent the numbers at the time of publication. For the latest ordering part numbers, refer to the target product page of the Renesas Electronics website.

## 1.3.6 36-pin products

- 36-pin plastic WFLGA (4 × 4 mm, 0.5 mm pitch)

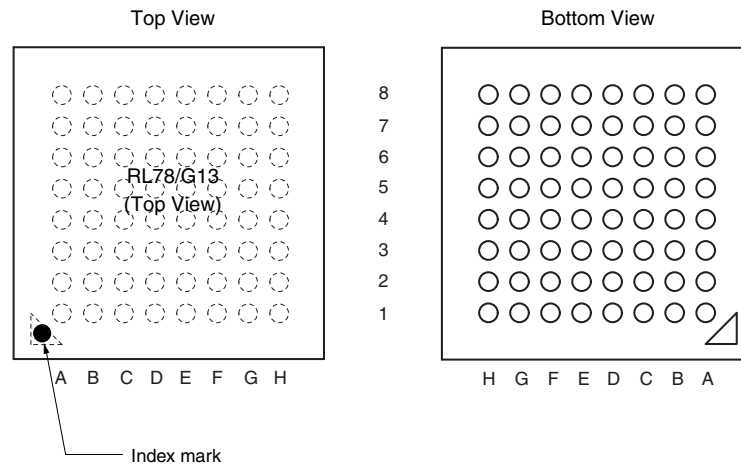


**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1 μF).

**Remarks 1.** For pin identification, see 1.4 Pin Identification.

- 2.** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4-8 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G13 User's Manual.

- 64-pin plastic VFBGA (4 × 4 mm, 0.4 mm pitch)



| Pin No. | Name                          | Pin No. | Name                        | Pin No. | Name                                        | Pin No. | Name                        |
|---------|-------------------------------|---------|-----------------------------|---------|---------------------------------------------|---------|-----------------------------|
| A1      | P05/TI05/TO05                 | C1      | P51/INTP2/SO11              | E1      | P13/TxD2/SO20/(SDAA0)/(TI04)/(TO04)         | G1      | P146                        |
| A2      | P30/INTP3/RTC1HZ/SCK11/SCL11  | C2      | P71/KR1/SI21/SDA21          | E2      | P14/RxD2/SI20/SDA20/(SCLA0)/(TI03)/(TO03)   | G2      | P25/ANI5                    |
| A3      | P70/KR0/SCK21/SCL21           | C3      | P74/KR4/INTP8/SI01/SDA01    | E3      | P15/SCK20/SCL20/(TI02)/(TO02)               | G3      | P24/ANI4                    |
| A4      | P75/KR5/INTP9/SCK01/SCL01     | C4      | P52/(INTP10)                | E4      | P16/TI01/TO01/INTP5/(SI00)/(RxD0)           | G4      | P22/ANI2                    |
| A5      | P77/KR7/INTP11/(TxD2)         | C5      | P53/(INTP11)                | E5      | P03/ANI16/SI10/RxD1/SDA10                   | G5      | P130                        |
| A6      | P61/SDAA0                     | C6      | P63                         | E6      | P41/TI07/TO07                               | G6      | P02/ANI17/SO10/TxD1         |
| A7      | P60/SCLA0                     | C7      | V <sub>SS</sub>             | E7      | RESET                                       | G7      | P00/TI00                    |
| A8      | EV <sub>DD0</sub>             | C8      | P121/X1                     | E8      | P137/INTP0                                  | G8      | P124/XT2/EXCLKS             |
| B1      | P50/INTP1/SI11/SDA11          | D1      | P55/(PCLBUZ1)/(SCK00)       | F1      | P10/SCK00/SCL00/(TI07)/(TO07)               | H1      | P147/ANI18                  |
| B2      | P72/KR2/SO21                  | D2      | P06/TI06/TO06               | F2      | P11/SI00/RxD0/TOOLRxD/SDA00/(TI06)/(TO06)   | H2      | P27/ANI7                    |
| B3      | P73/KR3/SO01                  | D3      | P17/TI02/TO02/(SO00)/(TxD0) | F3      | P12/SO00/TxD0/TOOLTxD/(INTP5)/(TI05)/(TO05) | H3      | P26/ANI6                    |
| B4      | P76/KR6/INTP10/(RxD2)         | D4      | P54                         | F4      | P21/ANI1/AV <sub>REFM</sub>                 | H4      | P23/ANI3                    |
| B5      | P31/TI03/TO03/INTP4/(PCLBUZ0) | D5      | P42/TI04/TO04               | F5      | P04/SCK10/SCL10                             | H5      | P20/ANI0/AV <sub>REFP</sub> |
| B6      | P62                           | D6      | P40/TOOL0                   | F6      | P43                                         | H6      | P141/PCLBUZ1/INTP7          |
| B7      | V <sub>DD</sub>               | D7      | REGC                        | F7      | P01/TO00                                    | H7      | P140/PCLBUZ0/INTP6          |
| B8      | EV <sub>SS0</sub>             | D8      | P122/X2/EXCLK               | F8      | P123/XT1                                    | H8      | P120/ANI19                  |

**Cautions** 1. Make EV<sub>SS0</sub> pin the same potential as V<sub>SS</sub> pin.

2. Make V<sub>DD</sub> pin the potential that is higher than EV<sub>DD0</sub> pin.

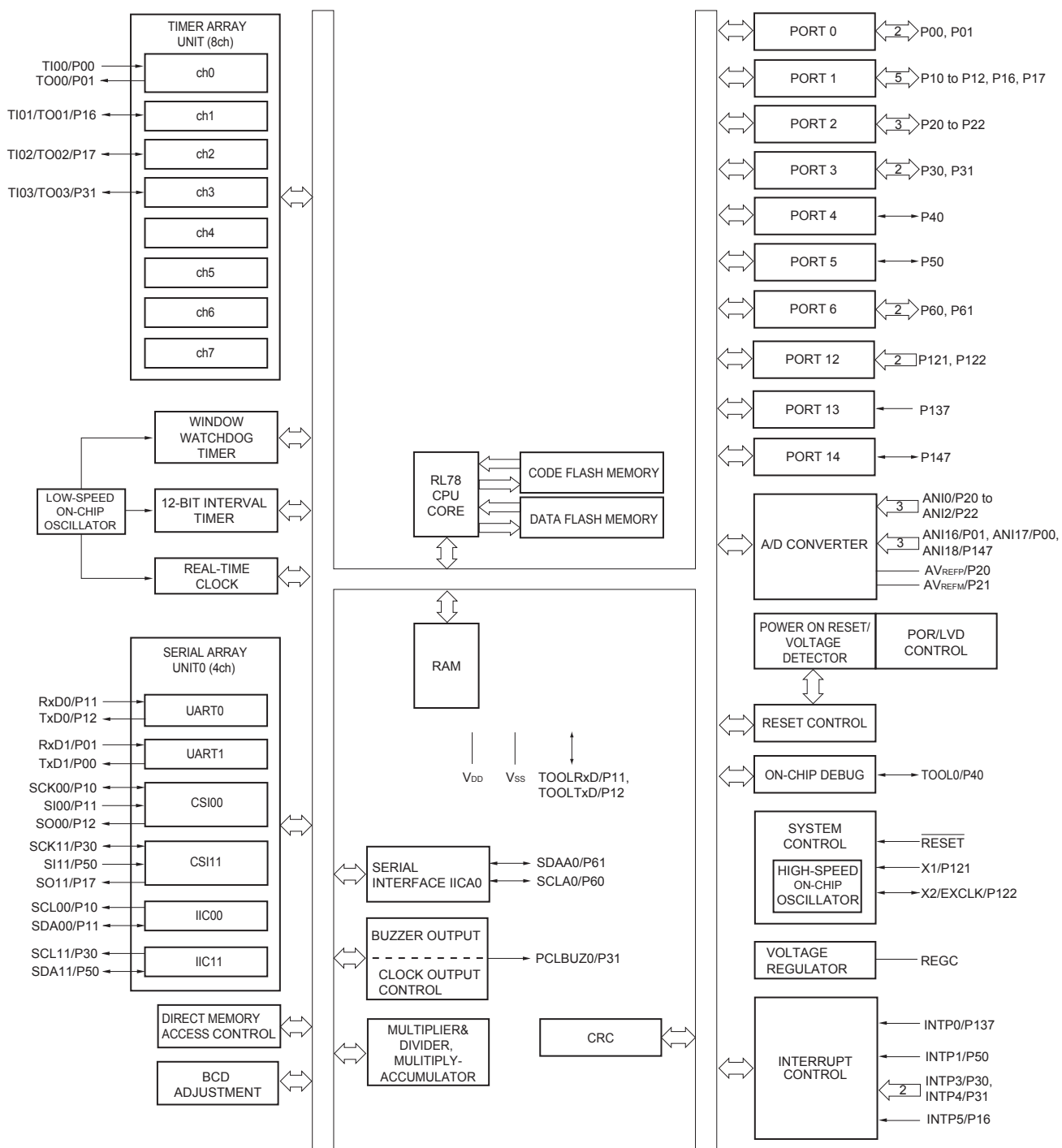
3. Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

**Remarks** 1. For pin identification, see 1.4 Pin Identification.

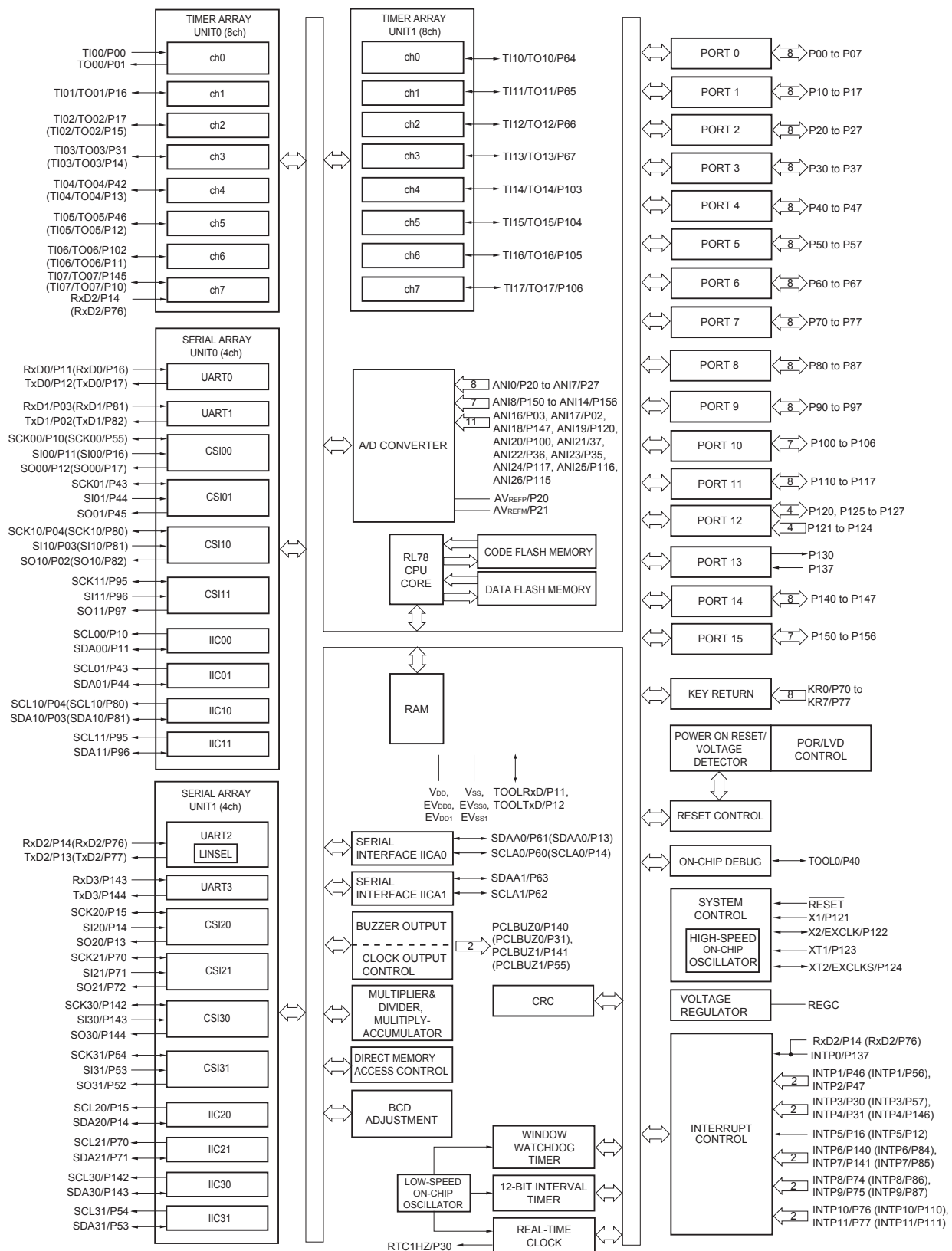
2. When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the V<sub>DD</sub> and EV<sub>DD0</sub> pins and connect the V<sub>SS</sub> and EV<sub>SS0</sub> pins to separate ground lines.

3. Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4-8 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G13 User's Manual.

## 1.5.2 24-pin products



## 1.5.14 128-pin products



**Remark** Functions in parentheses in the above figure can be assigned via settings in the peripheral I/O redirection register (PIOR). Refer to **Figure 4-8 Format of Peripheral I/O Redirection Register (PIOR)** in the RL78/G13 User's Manual.

(5) During communication at same potential (simplified I<sup>2</sup>C mode) (1/2)(T<sub>A</sub> = -40 to +85°C, 1.6 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

| Parameter                 | Symbol            | Conditions                                                                            | HS (high-speed main) Mode |                | LS (low-speed main) Mode |               | LV (low-voltage main) Mode |               | Unit |
|---------------------------|-------------------|---------------------------------------------------------------------------------------|---------------------------|----------------|--------------------------|---------------|----------------------------|---------------|------|
|                           |                   |                                                                                       | MIN.                      | MAX.           | MIN.                     | MAX.          | MIN.                       | MAX.          |      |
| SCLr clock frequency      | f <sub>SCL</sub>  | 2.7 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ |                           | 1000<br>Note 1 |                          | 400<br>Note 1 |                            | 400<br>Note 1 | kHz  |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 3 kΩ  |                           | 400<br>Note 1  |                          | 400<br>Note 1 |                            | 400<br>Note 1 | kHz  |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  |                           | 300<br>Note 1  |                          | 300<br>Note 1 |                            | 300<br>Note 1 | kHz  |
|                           |                   | 1.7 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  |                           | 250<br>Note 1  |                          | 250<br>Note 1 |                            | 250<br>Note 1 | kHz  |
|                           |                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  |                           | —              |                          | 250<br>Note 1 |                            | 250<br>Note 1 | kHz  |
| Hold time when SCLr = "L" | t <sub>LOW</sub>  | 2.7 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ | 475                       |                | 1150                     |               | 1150                       |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 3 kΩ  | 1150                      |                | 1150                     |               | 1150                       |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1550                      |                | 1550                     |               | 1550                       |               | ns   |
|                           |                   | 1.7 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1850                      |                | 1850                     |               | 1850                       |               | ns   |
|                           |                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | —                         |                | 1850                     |               | 1850                       |               | ns   |
| Hold time when SCLr = "H" | t <sub>HIGH</sub> | 2.7 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ | 475                       |                | 1150                     |               | 1150                       |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 3 kΩ  | 1150                      |                | 1150                     |               | 1150                       |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1550                      |                | 1550                     |               | 1550                       |               | ns   |
|                           |                   | 1.7 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | 1850                      |                | 1850                     |               | 1850                       |               | ns   |
|                           |                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5 kΩ  | —                         |                | 1850                     |               | 1850                       |               | ns   |

(Notes and Caution are listed on the next page, and Remarks are listed on the page after the next page.)

**(7) Communication at different potential (2.5 V, 3 V) (CSI mode) (master mode, SCKp... internal clock output, corresponding CSI00 only) (2/2)****(T<sub>A</sub> = -40 to +85°C, 2.7 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)**

| Parameter                                                   | Symbol            | Conditions                                                                                                               | HS (high-speed main) Mode |      | LS (low-speed main) Mode |      | LV (low-voltage main) Mode |      | Unit |
|-------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------|------|--------------------------|------|----------------------------|------|------|
|                                                             |                   |                                                                                                                          | MIN.                      | MAX. | MIN.                     | MAX. | MIN.                       | MAX. |      |
| Slp setup time<br>(to SCKp↓) <sup>Note 2</sup>              | t <sub>SIK1</sub> | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 1.4 kΩ | 23                        |      | 110                      |      | 110                        |      | ns   |
|                                                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 2.7 kΩ | 33                        |      | 110                      |      | 110                        |      | ns   |
| Slp hold time<br>(from SCKp↓) <sup>Note 2</sup>             | t <sub>KSI1</sub> | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 1.4 kΩ | 10                        |      | 10                       |      | 10                         |      | ns   |
|                                                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 2.7 kΩ | 10                        |      | 10                       |      | 10                         |      | ns   |
| Delay time from SCKp↑<br>to<br>SOp output <sup>Note 2</sup> | t <sub>KSO1</sub> | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 1.4 kΩ |                           | 10   |                          | 10   |                            | 10   | ns   |
|                                                             |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 20 pF, R <sub>b</sub> = 2.7 kΩ |                           | 10   |                          | 10   |                            | 10   | ns   |

**Notes** 1. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.

2. When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

**Caution** Select the TTL input buffer for the Slp pin and the N-ch open drain output (V<sub>DD</sub> tolerance (When 20- to 52-pin products)/EV<sub>DD</sub> tolerance (When 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V<sub>IH</sub> and V<sub>IL</sub>, see the DC characteristics with TTL input buffer selected.

**Remarks** 1. R<sub>b</sub>[Ω]: Communication line (SCKp, SOp) pull-up resistance, C<sub>b</sub>[F]: Communication line (SCKp, SOp) load capacitance, V<sub>b</sub>[V]: Communication line voltage

2. p: CSI number (p = 00), m: Unit number (m = 0), n: Channel number (n = 0),  
g: PIM and POM number (g = 1)

3. f<sub>MCK</sub>: Serial array unit operation clock frequency

(Operation clock to be set by the CKS<sub>mn</sub> bit of serial mode register mn (SMR<sub>mn</sub>). m: Unit number, n: Channel number (mn = 00))

4. This value is valid only when CSI00's peripheral I/O redirect function is not used.



(8) Communication at different potential (1.8 V, 2.5 V, 3 V) (CSI mode) (master mode, SCKp... internal clock output)  
(1/3)(T<sub>A</sub> = -40 to +85°C, 1.8 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

| Parameter             | Symbol            | Conditions                                                                                                                                                         | HS (high-speed main) Mode  |      | LS (low-speed main) Mode   |      | LV (low-voltage main) Mode |      | Unit |
|-----------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------|----------------------------|------|----------------------------|------|------|
|                       |                   |                                                                                                                                                                    | MIN.                       | MAX. | MIN.                       | MAX. | MIN.                       | MAX. |      |
| SCKp cycle time       | t <sub>KCY1</sub> | t <sub>KCY1</sub> ≥ 4/f <sub>CLK</sub><br>4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 1.4 kΩ | 300                        |      | 1150                       |      | 1150                       |      | ns   |
|                       |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 2.7 kΩ                                           | 500                        |      | 1150                       |      | 1150                       |      | ns   |
|                       |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note</sup> ,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 5.5 kΩ                          | 1150                       |      | 1150                       |      | 1150                       |      | ns   |
| SCKp high-level width | t <sub>KH1</sub>  | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 1.4 kΩ                                           | t <sub>KCY1</sub> /2 – 75  |      | t <sub>KCY1</sub> /2 – 75  |      | t <sub>KCY1</sub> /2 – 75  |      | ns   |
|                       |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 2.7 kΩ                                           | t <sub>KCY1</sub> /2 – 170 |      | t <sub>KCY1</sub> /2 – 170 |      | t <sub>KCY1</sub> /2 – 170 |      | ns   |
|                       |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note</sup> ,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 5.5 kΩ                          | t <sub>KCY1</sub> /2 – 458 |      | t <sub>KCY1</sub> /2 – 458 |      | t <sub>KCY1</sub> /2 – 458 |      | ns   |
| SCKp low-level width  | t <sub>KL1</sub>  | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 1.4 kΩ                                           | t <sub>KCY1</sub> /2 – 12  |      | t <sub>KCY1</sub> /2 – 50  |      | t <sub>KCY1</sub> /2 – 50  |      | ns   |
|                       |                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 2.7 kΩ                                           | t <sub>KCY1</sub> /2 – 18  |      | t <sub>KCY1</sub> /2 – 50  |      | t <sub>KCY1</sub> /2 – 50  |      | ns   |
|                       |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note</sup> ,<br>C <sub>b</sub> = 30 pF, R <sub>b</sub> = 5.5 kΩ                          | t <sub>KCY1</sub> /2 – 50  |      | t <sub>KCY1</sub> /2 – 50  |      | t <sub>KCY1</sub> /2 – 50  |      | ns   |

**Note** Use it with EV<sub>DD0</sub> ≥ V<sub>b</sub>.

**Caution** Select the TTL input buffer for the SIp pin and the N-ch open drain output (V<sub>DD</sub> tolerance (When 20- to 52-pin products)/EV<sub>DD</sub> tolerance (When 64- to 128-pin products)) mode for the SOp pin and SCKp pin by using port input mode register g (PIMg) and port output mode register g (POMg). For V<sub>IH</sub> and V<sub>IL</sub>, see the DC characteristics with TTL input buffer selected.

(Remarks are listed two pages after the next page.)

## 2.6 Analog Characteristics

### 2.6.1 A/D converter characteristics

Classification of A/D converter characteristics

| Input channel                                                      | Reference Voltage                                                                        |                                                                                    |                                                                                        |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
|                                                                    | Reference voltage (+) = AV <sub>REFP</sub><br>Reference voltage (-) = AV <sub>REFM</sub> | Reference voltage (+) = V <sub>DD</sub><br>Reference voltage (-) = V <sub>SS</sub> | Reference voltage (+) = V <sub>BGR</sub><br>Reference voltage (-) = AV <sub>REFM</sub> |
| ANI0 to ANI14                                                      | Refer to 2.6.1 (1).                                                                      | Refer to 2.6.1 (3).                                                                | Refer to 2.6.1 (4).                                                                    |
| ANI16 to ANI26                                                     | Refer to 2.6.1 (2).                                                                      |                                                                                    |                                                                                        |
| Internal reference voltage<br>Temperature sensor output<br>voltage | Refer to 2.6.1 (1).                                                                      |                                                                                    | –                                                                                      |

(1) When reference voltage (+) = AV<sub>REFP</sub>/ANI0 (ADREFP1 = 0, ADREFP0 = 1), reference voltage (-) = AV<sub>REFM</sub>/ANI1 (ADREFM = 1), target pin : ANI2 to ANI14, internal reference voltage, and temperature sensor output voltage

(T<sub>A</sub> = -40 to +85°C, 1.6 V ≤ AV<sub>REFP</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = 0 V, Reference voltage (+) = AV<sub>REFP</sub>, Reference voltage (-) = AV<sub>REFM</sub> = 0 V)

| Parameter                                      | Symbol            | Conditions                                                                                                                                    | MIN.                                                 | TYP.                                  | MAX.               | Unit |
|------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------|--------------------|------|
| Resolution                                     | RES               |                                                                                                                                               | 8                                                    |                                       | 10                 | bit  |
| Overall error <sup>Note 1</sup>                | AINL              | 10-bit resolution<br>AV <sub>REFP</sub> = V <sub>DD</sub> <sup>Note 3</sup>                                                                   | 1.8 V ≤ AV <sub>REFP</sub> ≤ 5.5 V                   | 1.2                                   | ±3.5               | LSB  |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ AV <sub>REFP</sub> ≤ 5.5 V <sup>Note 4</sup> | 1.2                                   | ±7.0               | LSB  |
| Conversion time                                | t <sub>CONV</sub> | 10-bit resolution<br>Target pin: ANI2 to ANI14                                                                                                | 3.6 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 2.125                                 | 39                 | μs   |
|                                                |                   |                                                                                                                                               | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 3.1875                                | 39                 | μs   |
|                                                |                   |                                                                                                                                               | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 17                                    | 39                 | μs   |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 57                                    | 95                 | μs   |
|                                                |                   | 10-bit resolution<br>Target pin: Internal<br>reference voltage, and<br>temperature sensor<br>output voltage<br>(HS (high-speed main)<br>mode) | 3.6 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 2.375                                 | 39                 | μs   |
|                                                |                   |                                                                                                                                               | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 3.5625                                | 39                 | μs   |
|                                                |                   |                                                                                                                                               | 2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V                      | 17                                    | 39                 | μs   |
|                                                |                   |                                                                                                                                               |                                                      |                                       |                    |      |
| Zero-scale error <sup>Notes 1, 2</sup>         | E <sub>zs</sub>   | 10-bit resolution<br>AV <sub>REFP</sub> = V <sub>DD</sub> <sup>Note 3</sup>                                                                   | 1.8 V ≤ AV <sub>REFP</sub> ≤ 5.5 V                   |                                       | ±0.25              | %FSR |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ AV <sub>REFP</sub> ≤ 5.5 V <sup>Note 4</sup> |                                       | ±0.50              | %FSR |
| Full-scale error <sup>Notes 1, 2</sup>         | E <sub>fs</sub>   | 10-bit resolution<br>AV <sub>REFP</sub> = V <sub>DD</sub> <sup>Note 3</sup>                                                                   | 1.8 V ≤ AV <sub>REFP</sub> ≤ 5.5 V                   |                                       | ±0.25              | %FSR |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ AV <sub>REFP</sub> ≤ 5.5 V <sup>Note 4</sup> |                                       | ±0.50              | %FSR |
| Integral linearity error <sup>Note 1</sup>     | ILE               | 10-bit resolution<br>AV <sub>REFP</sub> = V <sub>DD</sub> <sup>Note 3</sup>                                                                   | 1.8 V ≤ AV <sub>REFP</sub> ≤ 5.5 V                   |                                       | ±2.5               | LSB  |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ AV <sub>REFP</sub> ≤ 5.5 V <sup>Note 4</sup> |                                       | ±5.0               | LSB  |
| Differential linearity error <sup>Note 1</sup> | DLE               | 10-bit resolution<br>AV <sub>REFP</sub> = V <sub>DD</sub> <sup>Note 3</sup>                                                                   | 1.8 V ≤ AV <sub>REFP</sub> ≤ 5.5 V                   |                                       | ±1.5               | LSB  |
|                                                |                   |                                                                                                                                               | 1.6 V ≤ AV <sub>REFP</sub> ≤ 5.5 V <sup>Note 4</sup> |                                       | ±2.0               | LSB  |
| Analog input voltage                           | V <sub>AIN</sub>  | ANI2 to ANI14                                                                                                                                 | 0                                                    |                                       | AV <sub>REFP</sub> | V    |
|                                                |                   | Internal reference voltage<br>(2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V, HS (high-speed main) mode)                                                    |                                                      | V <sub>BGR</sub> <sup>Note 5</sup>    |                    | V    |
|                                                |                   | Temperature sensor output voltage<br>(2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V, HS (high-speed main) mode)                                             |                                                      | V <sub>TMPS25</sub> <sup>Note 5</sup> |                    | V    |

(Notes are listed on the next page.)

(4) When reference voltage (+) = Internal reference voltage (ADREFP1 = 1, ADREFP0 = 0), reference voltage (-) = AV<sub>REFM</sub>/ANI1 (ADREFM = 1), target pin : ANI0, ANI2 to ANI14, ANI16 to ANI26

(T<sub>A</sub> = -40 to +85°C, 2.4 V ≤ V<sub>DD</sub> ≤ 5.5 V, 1.6 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub>, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V, Reference voltage (+) = V<sub>BGR</sub><sup>Note 3</sup>, Reference voltage (-) = AV<sub>REFM</sub> = 0 V<sup>Note 4</sup>, HS (high-speed main) mode)

| Parameter                                      | Symbol            | Conditions       |                                 | MIN. | TYP. | MAX.                               | Unit |
|------------------------------------------------|-------------------|------------------|---------------------------------|------|------|------------------------------------|------|
| Resolution                                     | RES               |                  |                                 | 8    |      |                                    | bit  |
| Conversion time                                | t <sub>CONV</sub> | 8-bit resolution | 2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V | 17   |      | 39                                 | μs   |
| Zero-scale error <sup>Notes 1, 2</sup>         | E <sub>zs</sub>   | 8-bit resolution | 2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V |      |      | ±0.60                              | %FSR |
| Integral linearity error <sup>Note 1</sup>     | ILE               | 8-bit resolution | 2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V |      |      | ±2.0                               | LSB  |
| Differential linearity error <sup>Note 1</sup> | DLE               | 8-bit resolution | 2.4 V ≤ V <sub>DD</sub> ≤ 5.5 V |      |      | ±1.0                               | LSB  |
| Analog input voltage                           | V <sub>AIN</sub>  |                  |                                 | 0    |      | V <sub>BGR</sub> <sup>Note 3</sup> | V    |

**Notes** 1. Excludes quantization error (±1/2 LSB).

2. This value is indicated as a ratio (%FSR) to the full-scale value.

3. Refer to **2.6.2 Temperature sensor/internal reference voltage characteristics**.

4. When reference voltage (-) = V<sub>SS</sub>, the MAX. values are as follows.

Zero-scale error: Add ±0.35%FSR to the MAX. value when reference voltage (-) = AV<sub>REFM</sub>.

Integral linearity error: Add ±0.5 LSB to the MAX. value when reference voltage (-) = AV<sub>REFM</sub>.

Differential linearity error: Add ±0.2 LSB to the MAX. value when reference voltage (-) = AV<sub>REFM</sub>.

**Remark** The electrical characteristics of the products G: Industrial applications ( $T_A = -40$  to  $+105^\circ\text{C}$ ) are different from those of the products “A: Consumer applications, and D: Industrial applications”. For details, refer to 3.1 to 3.10.

### 3.1 Absolute Maximum Ratings

#### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ ) (1/2)

| Parameter              | Symbols                 | Conditions                                                                                                                                                                              | Ratings                                                                               | Unit |
|------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------|
| Supply voltage         | $V_{DD}$                |                                                                                                                                                                                         | $-0.5$ to $+6.5$                                                                      | V    |
|                        | $EV_{DD0}$ , $EV_{DD1}$ | $EV_{DD0} = EV_{DD1}$                                                                                                                                                                   | $-0.5$ to $+6.5$                                                                      | V    |
|                        | $EV_{SS0}$ , $EV_{SS1}$ | $EV_{SS0} = EV_{SS1}$                                                                                                                                                                   | $-0.5$ to $+0.3$                                                                      | V    |
| REGC pin input voltage | $V_{IREGC}$             | REGC                                                                                                                                                                                    | $-0.3$ to $+2.8$<br>and $-0.3$ to $V_{DD} + 0.3$ <sup>Note 1</sup>                    | V    |
| Input voltage          | $V_{I1}$                | P00 to P07, P10 to P17, P30 to P37, P40 to P47,<br>P50 to P57, P64 to P67, P70 to P77, P80 to P87,<br>P90 to P97, P100 to P106, P110 to P117, P120,<br>P125 to P127, P140 to P147       | $-0.3$ to $EV_{DD0} + 0.3$<br>and $-0.3$ to $V_{DD} + 0.3$ <sup>Note 2</sup>          | V    |
|                        | $V_{I2}$                | P60 to P63 (N-ch open-drain)                                                                                                                                                            | $-0.3$ to $+6.5$                                                                      | V    |
|                        | $V_{I3}$                | P20 to P27, P121 to P124, P137, P150 to P156,<br>EXCLK, EXCLKS, RESET                                                                                                                   | $-0.3$ to $V_{DD} + 0.3$ <sup>Note 2</sup>                                            | V    |
| Output voltage         | $V_{O1}$                | P00 to P07, P10 to P17, P30 to P37, P40 to P47,<br>P50 to P57, P60 to P67, P70 to P77, P80 to P87,<br>P90 to P97, P100 to P106, P110 to P117, P120,<br>P125 to P127, P130, P140 to P147 | $-0.3$ to $EV_{DD0} + 0.3$<br>and $-0.3$ to $V_{DD} + 0.3$ <sup>Note 2</sup>          | V    |
|                        | $V_{O2}$                | P20 to P27, P150 to P156                                                                                                                                                                | $-0.3$ to $V_{DD} + 0.3$ <sup>Note 2</sup>                                            | V    |
| Analog input voltage   | $V_{AI1}$               | ANI16 to ANI26                                                                                                                                                                          | $-0.3$ to $EV_{DD0} + 0.3$<br>and $-0.3$ to $AV_{REF(+)} + 0.3$ <sup>Notes 2, 3</sup> | V    |
|                        | $V_{AI2}$               | ANI0 to ANI14                                                                                                                                                                           | $-0.3$ to $V_{DD} + 0.3$<br>and $-0.3$ to $AV_{REF(+)} + 0.3$ <sup>Notes 2, 3</sup>   | V    |

**Notes 1.** Connect the REGC pin to  $V_{SS}$  via a capacitor (0.47 to 1  $\mu\text{F}$ ). This value regulates the absolute maximum rating of the REGC pin. Do not use this pin with voltage applied to it.

**2.** Must be 6.5 V or lower.

**3.** Do not exceed  $AV_{REF(+)} + 0.3$  V in case of A/D conversion target pin.

**Caution** Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

**Remarks 1.** Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port pins.

**2.**  $AV_{REF(+)}$  : + side reference voltage of the A/D converter.

**3.**  $V_{SS}$  : Reference voltage

**( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq \text{EV}_{\text{DD0}} = \text{EV}_{\text{DD1}} \leq \text{V}_{\text{DD}} \leq 5.5\text{ V}$ ,  $\text{V}_{\text{SS}} = \text{EV}_{\text{SS0}} = \text{EV}_{\text{SS1}} = 0\text{ V}$ ) (2/5)**

| Items                                                       | Symbol                  | Conditions                                                                                                                                                                                                | MIN.                                                         | TYP. | MAX.                   | Unit |
|-------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------|------------------------|------|
| Output current,<br>$\text{I}_{\text{OL}}$ <sup>Note 1</sup> | $\text{I}_{\text{OL1}}$ | Per pin for P00 to P07, P10 to P17,<br>P30 to P37, P40 to P47, P50 to P57,<br>P64 to P67, P70 to P77, P80 to P87,<br>P90 to P97, P100 to P106,<br>P110 to P117, P120, P125 to P127,<br>P130, P140 to P147 |                                                              |      | 8.5 <sup>Note 2</sup>  | mA   |
|                                                             |                         | Per pin for P60 to P63                                                                                                                                                                                    |                                                              |      | 15.0 <sup>Note 2</sup> | mA   |
|                                                             |                         | Total of P00 to P04, P07, P32 to<br>P37,<br>P40 to P47, P102 to P106, P120,<br>P125 to P127, P130, P140 to P145<br>(When duty $\leq 70\%$ <sup>Note 3</sup> )                                             | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ |      | 40.0                   | mA   |
|                                                             |                         |                                                                                                                                                                                                           | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$    |      | 15.0                   | mA   |
|                                                             |                         |                                                                                                                                                                                                           | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 2.7\text{ V}$    |      | 9.0                    | mA   |
|                                                             |                         | Total of P05, P06, P10 to P17, P30,<br>P31, P50 to P57, P60 to P67,<br>P70 to P77, P80 to P87, P90 to P97,<br>P100, P101, P110 to P117, P146,<br>P147<br>(When duty $\leq 70\%$ <sup>Note 3</sup> )       | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ |      | 40.0                   | mA   |
|                                                             |                         |                                                                                                                                                                                                           | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$    |      | 35.0                   | mA   |
|                                                             |                         |                                                                                                                                                                                                           | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 2.7\text{ V}$    |      | 20.0                   | mA   |
|                                                             |                         | Total of all pins<br>(When duty $\leq 70\%$ <sup>Note 3</sup> )                                                                                                                                           |                                                              |      | 80.0                   | mA   |
|                                                             | $\text{I}_{\text{OL2}}$ | Per pin for P20 to P27, P150 to P156                                                                                                                                                                      |                                                              |      | 0.4 <sup>Note 2</sup>  | mA   |
|                                                             |                         | Total of all pins<br>(When duty $\leq 70\%$ <sup>Note 3</sup> )                                                                                                                                           | $2.4\text{ V} \leq \text{V}_{\text{DD}} \leq 5.5\text{ V}$   |      | 5.0                    | mA   |

**Notes** 1. Value of current at which the device operation is guaranteed even if the current flows from an output pin to the  $\text{EV}_{\text{SS0}}$ ,  $\text{EV}_{\text{SS1}}$  and  $\text{V}_{\text{SS}}$  pin.

2. Do not exceed the total current value.

3. Specification under conditions where the duty factor  $\leq 70\%$ .

The output current value that has changed to the duty factor  $> 70\%$  the duty ratio can be calculated with the following expression (when changing the duty factor from 70% to  $n\%$ ).

- Total output current of pins =  $(\text{I}_{\text{OL}} \times 0.7)/(n \times 0.01)$

<Example> Where  $n = 80\%$  and  $\text{I}_{\text{OL}} = 10.0\text{ mA}$

$$\text{Total output current of pins} = (10.0 \times 0.7)/(80 \times 0.01) \cong 8.7\text{ mA}$$

However, the current that is allowed to flow into one pin does not vary depending on the duty factor.

A current higher than the absolute maximum rating must not flow into one pin.

**Remark** Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port pins.

**(1) Flash ROM: 16 to 64 KB of 20- to 64-pin products****( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD0} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = V_{SS0} = 0\text{ V}$ ) (2/2)**

| Parameter                | Symbol                 | Conditions                                                                 |                                     |                                                                         |                                                                           | MIN.                 | TYP. | MAX. | Unit  |    |
|--------------------------|------------------------|----------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------|------|------|-------|----|
| Supply current<br>Note 1 | IDD2<br>Note 2         | HALT mode                                                                  | HS (high-speed main) mode<br>Note 7 | f <sub>IH</sub> = 32 MHz <sup>Note 4</sup>                              | V <sub>DD</sub> = 5.0 V                                                   |                      | 0.54 | 2.90 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | V <sub>DD</sub> = 3.0 V                                                   |                      | 0.54 | 2.90 | mA    |    |
|                          |                        |                                                                            |                                     | f <sub>IH</sub> = 24 MHz <sup>Note 4</sup>                              | V <sub>DD</sub> = 5.0 V                                                   |                      | 0.44 | 2.30 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | V <sub>DD</sub> = 3.0 V                                                   |                      | 0.44 | 2.30 | mA    |    |
|                          |                        |                                                                            |                                     | f <sub>IH</sub> = 16 MHz <sup>Note 4</sup>                              | V <sub>DD</sub> = 5.0 V                                                   |                      | 0.40 | 1.70 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | V <sub>DD</sub> = 3.0 V                                                   |                      | 0.40 | 1.70 | mA    |    |
|                          |                        |                                                                            | HS (high-speed main) mode<br>Note 7 | f <sub>MX</sub> = 20 MHz <sup>Note 3</sup> ,<br>V <sub>DD</sub> = 5.0 V | Square wave input                                                         |                      | 0.28 | 1.90 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | Resonator connection                                                      |                      | 0.45 | 2.00 | mA    |    |
|                          |                        |                                                                            |                                     | f <sub>MX</sub> = 20 MHz <sup>Note 3</sup> ,<br>V <sub>DD</sub> = 3.0 V | Square wave input                                                         |                      | 0.28 | 1.90 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | Resonator connection                                                      |                      | 0.45 | 2.00 | mA    |    |
|                          |                        |                                                                            |                                     | f <sub>MX</sub> = 10 MHz <sup>Note 3</sup> ,<br>V <sub>DD</sub> = 5.0 V | Square wave input                                                         |                      | 0.19 | 1.02 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | Resonator connection                                                      |                      | 0.26 | 1.10 | mA    |    |
|                          |                        |                                                                            |                                     | f <sub>MX</sub> = 10 MHz <sup>Note 3</sup> ,<br>V <sub>DD</sub> = 3.0 V | Square wave input                                                         |                      | 0.19 | 1.02 | mA    |    |
|                          |                        |                                                                            |                                     |                                                                         | Resonator connection                                                      |                      | 0.26 | 1.10 | mA    |    |
|                          |                        |                                                                            |                                     | Subsystem clock operation                                               | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = −40°C | Square wave input    |      | 0.25 | 0.57  | μA |
|                          |                        |                                                                            |                                     |                                                                         |                                                                           | Resonator connection |      | 0.44 | 0.76  | μA |
|                          |                        |                                                                            |                                     |                                                                         | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = +25°C | Square wave input    |      | 0.30 | 0.57  | μA |
|                          |                        |                                                                            |                                     |                                                                         |                                                                           | Resonator connection |      | 0.49 | 0.76  | μA |
|                          |                        | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = +50°C  | Square wave input                   |                                                                         |                                                                           | 0.37                 | 1.17 | μA   |       |    |
|                          |                        |                                                                            | Resonator connection                |                                                                         |                                                                           | 0.56                 | 1.36 | μA   |       |    |
|                          |                        | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = +70°C  | Square wave input                   |                                                                         |                                                                           | 0.53                 | 1.97 | μA   |       |    |
|                          |                        |                                                                            | Resonator connection                |                                                                         |                                                                           | 0.72                 | 2.16 | μA   |       |    |
|                          |                        | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = +85°C  | Square wave input                   |                                                                         |                                                                           | 0.82                 | 3.37 | μA   |       |    |
|                          |                        |                                                                            | Resonator connection                |                                                                         |                                                                           | 1.01                 | 3.56 | μA   |       |    |
|                          |                        | f <sub>SUB</sub> = 32.768 kHz <sup>Note 5</sup><br>T <sub>A</sub> = +105°C | Square wave input                   |                                                                         | 3.01                                                                      | 15.37                | μA   |      |       |    |
|                          |                        |                                                                            | Resonator connection                |                                                                         | 3.20                                                                      | 15.56                | μA   |      |       |    |
|                          | IDD3 <sup>Note 6</sup> | STOP mode <sup>Note 8</sup>                                                | T <sub>A</sub> = −40°C              |                                                                         |                                                                           |                      |      | 0.18 | 0.50  | μA |
|                          |                        |                                                                            | T <sub>A</sub> = +25°C              |                                                                         |                                                                           |                      |      | 0.23 | 0.50  | μA |
|                          |                        |                                                                            | T <sub>A</sub> = +50°C              |                                                                         |                                                                           |                      |      | 0.30 | 1.10  | μA |
|                          |                        |                                                                            | T <sub>A</sub> = +70°C              |                                                                         |                                                                           |                      |      | 0.46 | 1.90  | μA |
|                          |                        |                                                                            | T <sub>A</sub> = +85°C              |                                                                         |                                                                           |                      |      | 0.75 | 3.30  | μA |
|                          |                        |                                                                            | T <sub>A</sub> = +105°C             |                                                                         |                                                                           |                      |      | 2.94 | 15.30 | μA |
|                          |                        |                                                                            |                                     |                                                                         |                                                                           |                      |      |      |       |    |

(Notes and Remarks are listed on the next page.)

**(3) Peripheral Functions (Common to all products)****( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq \text{EV}_{\text{DD}0} = \text{EV}_{\text{DD}1} \leq \text{V}_{\text{DD}} \leq 5.5\text{ V}$ ,  $\text{V}_{\text{SS}} = \text{EV}_{\text{SS}0} = \text{EV}_{\text{SS}1} = 0\text{ V}$ )**

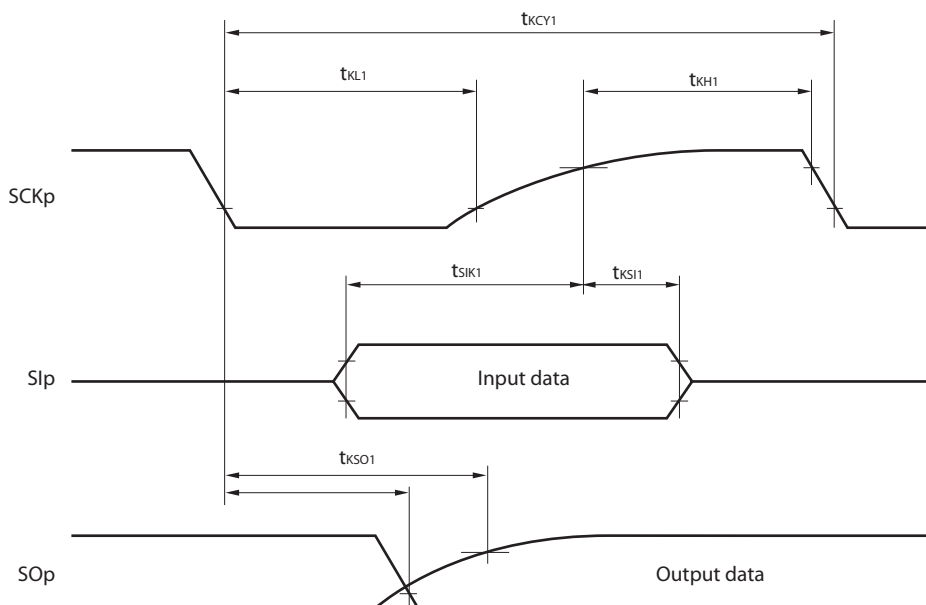
| Parameter                                      | Symbol                            | Conditions                       |                                                                                                                                | MIN. | TYP. | MAX.  | Unit          |
|------------------------------------------------|-----------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|-------|---------------|
| Low-speed on-chip oscillator operating current | $I_{\text{FIL}}$<br>Note 1        |                                  |                                                                                                                                |      | 0.20 |       | $\mu\text{A}$ |
| RTC operating current                          | $I_{\text{RTC}}$<br>Notes 1, 2, 3 |                                  |                                                                                                                                |      | 0.02 |       | $\mu\text{A}$ |
| 12-bit interval timer operating current        | $I_{\text{IT}}$<br>Notes 1, 2, 4  |                                  |                                                                                                                                |      | 0.02 |       | $\mu\text{A}$ |
| Watchdog timer operating current               | $I_{\text{WDT}}$<br>Notes 1, 2, 5 | $f_{\text{IL}} = 15\text{ kHz}$  |                                                                                                                                |      | 0.22 |       | $\mu\text{A}$ |
| A/D converter operating current                | $I_{\text{ADC}}$<br>Notes 1, 6    | When conversion at maximum speed | Normal mode, $\text{AV}_{\text{REFP}} = \text{V}_{\text{DD}} = 5.0\text{ V}$                                                   |      | 1.3  | 1.7   | $\text{mA}$   |
|                                                |                                   |                                  | Low voltage mode, $\text{AV}_{\text{REFP}} = \text{V}_{\text{DD}} = 3.0\text{ V}$                                              |      | 0.5  | 0.7   | $\text{mA}$   |
| A/D converter reference voltage current        | $I_{\text{ADREF}}$<br>Note 1      |                                  |                                                                                                                                |      | 75.0 |       | $\mu\text{A}$ |
| Temperature sensor operating current           | $I_{\text{TMPS}}$<br>Note 1       |                                  |                                                                                                                                |      | 75.0 |       | $\mu\text{A}$ |
| LVD operating current                          | $I_{\text{LVD}}$<br>Notes 1, 7    |                                  |                                                                                                                                |      | 0.08 |       | $\mu\text{A}$ |
| Self programming operating current             | $I_{\text{FSP}}$<br>Notes 1, 9    |                                  |                                                                                                                                |      | 2.50 | 12.20 | $\text{mA}$   |
| BGO operating current                          | $I_{\text{BGO}}$<br>Notes 1, 8    |                                  |                                                                                                                                |      | 2.50 | 12.20 | $\text{mA}$   |
| SNOOZE operating current                       | $I_{\text{SNOZ}}$<br>Note 1       | ADC operation                    | The mode is performed <sup>Note 10</sup>                                                                                       |      | 0.50 | 1.10  | $\text{mA}$   |
|                                                |                                   |                                  | The A/D conversion operations are performed, Low voltage mode, $\text{AV}_{\text{REFP}} = \text{V}_{\text{DD}} = 3.0\text{ V}$ |      | 1.20 | 2.04  | $\text{mA}$   |
|                                                |                                   | CSI/UART operation               |                                                                                                                                |      | 0.70 | 1.54  | $\text{mA}$   |

**Notes** 1. Current flowing to the  $\text{V}_{\text{DD}}$ .

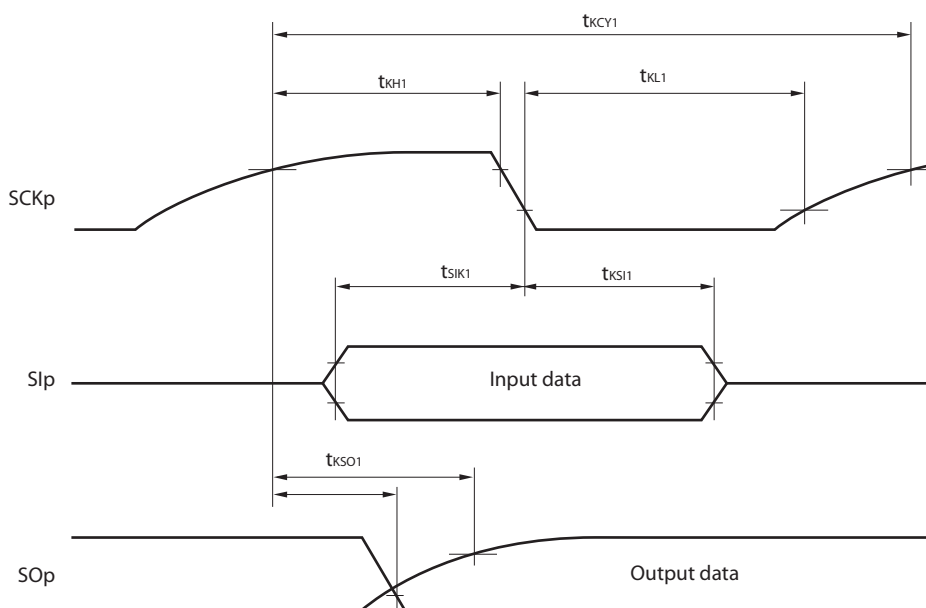
2. When high speed on-chip oscillator and high-speed system clock are stopped.

3. Current flowing only to the real-time clock (RTC) (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either  $I_{\text{DD}1}$  or  $I_{\text{DD}2}$ , and  $I_{\text{RTC}}$ , when the real-time clock operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected,  $I_{\text{FIL}}$  should be added.  $I_{\text{DD}2}$  subsystem clock operation includes the operational current of the real-time clock.4. Current flowing only to the 12-bit interval timer (excluding the operating current of the low-speed on-chip oscillator and the XT1 oscillator). The supply current of the RL78 microcontrollers is the sum of the values of either  $I_{\text{DD}1}$  or  $I_{\text{DD}2}$ , and  $I_{\text{IT}}$ , when the 12-bit interval timer operates in operation mode or HALT mode. When the low-speed on-chip oscillator is selected,  $I_{\text{FIL}}$  should be added.5. Current flowing only to the watchdog timer (including the operating current of the low-speed on-chip oscillator). The supply current of the RL78 is the sum of  $I_{\text{DD}1}$ ,  $I_{\text{DD}2}$  or  $I_{\text{DD}3}$  and  $I_{\text{WDT}}$  when the watchdog timer operates.

**CSI mode serial transfer timing (master mode) (during communication at different potential)**  
**(When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1.)**



**CSI mode serial transfer timing (master mode) (during communication at different potential)**  
**(When DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.)**



- Remarks**
1. p: CSI number (p = 00, 01, 10, 20, 30, 31), m: Unit number (m = 00, 01, 02, 10, 12, 13), n: Channel number (n = 0, 2), g: PIM and POM number (g = 0, 1, 4, 5, 8, 14)
  2. CSI01 of 48-, 52-, 64-pin products, and CSI11 and CSI21 cannot communicate at different potential. Use other CSI for communication at different potential.



## (7) Communication at different potential (1.8 V, 2.5 V, 3 V) (CSI mode) (slave mode, SCKp... external clock input)

(T<sub>A</sub> =  $-40$  to  $+105^{\circ}\text{C}$ ,  $2.4\text{ V} \leq \text{EV}_{\text{DD0}} = \text{EV}_{\text{DD1}} \leq \text{V}_{\text{DD}} \leq 5.5\text{ V}$ ,  $\text{V}_{\text{SS}} = \text{EV}_{\text{SS0}} = \text{EV}_{\text{SS1}} = 0\text{ V}$ )

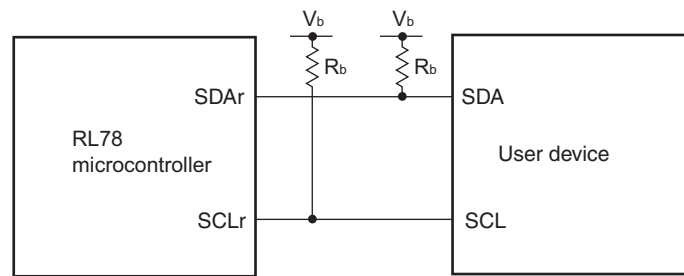
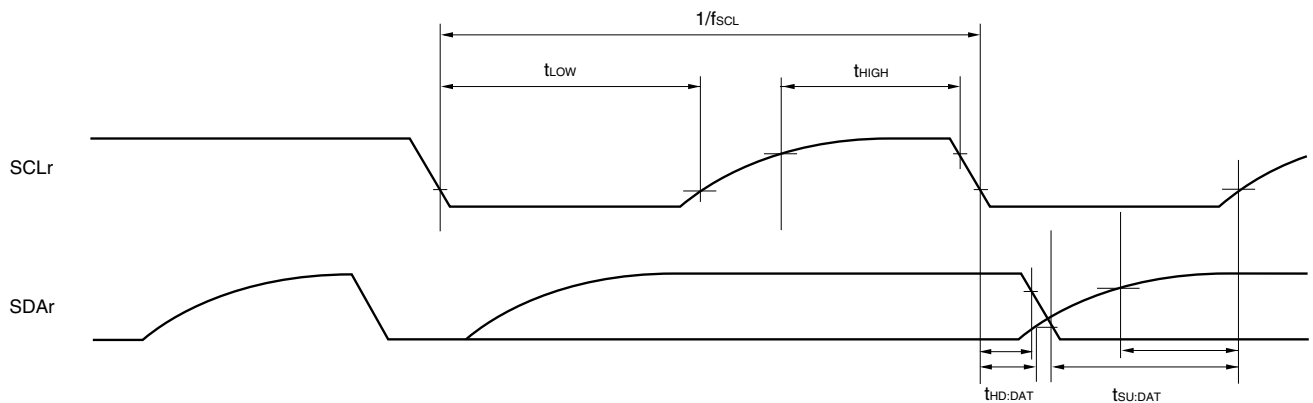
| Parameter                                                | Symbol                                 | Conditions                                                                                                                                                             |                                                     | HS (high-speed main) Mode |                           | Unit |
|----------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------|---------------------------|------|
|                                                          |                                        |                                                                                                                                                                        |                                                     | MIN.                      | MAX.                      |      |
| SCKp cycle time <sup>Note 1</sup>                        | t <sub>KCY2</sub>                      | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$                                                     | $24\text{ MHz} < f_{\text{MCK}}$                    | $28/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $20\text{ MHz} < f_{\text{MCK}} \leq 24\text{ MHz}$ | $24/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $8\text{ MHz} < f_{\text{MCK}} \leq 20\text{ MHz}$  | $20/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $4\text{ MHz} < f_{\text{MCK}} \leq 8\text{ MHz}$   | $16/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $f_{\text{MCK}} \leq 4\text{ MHz}$                  | $12/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$                                                        | $24\text{ MHz} < f_{\text{MCK}}$                    | $40/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $20\text{ MHz} < f_{\text{MCK}} \leq 24\text{ MHz}$ | $32/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $16\text{ MHz} < f_{\text{MCK}} \leq 20\text{ MHz}$ | $28/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $8\text{ MHz} < f_{\text{MCK}} \leq 16\text{ MHz}$  | $24/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $4\text{ MHz} < f_{\text{MCK}} \leq 8\text{ MHz}$   | $16/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $f_{\text{MCK}} \leq 4\text{ MHz}$                  | $12/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{V}_b \leq 2.0\text{ V}$                                                        | $24\text{ MHz} < f_{\text{MCK}}$                    | $96/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $20\text{ MHz} < f_{\text{MCK}} \leq 24\text{ MHz}$ | $72/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $16\text{ MHz} < f_{\text{MCK}} \leq 20\text{ MHz}$ | $64/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $8\text{ MHz} < f_{\text{MCK}} \leq 16\text{ MHz}$  | $52/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $4\text{ MHz} < f_{\text{MCK}} \leq 8\text{ MHz}$   | $32/f_{\text{MCK}}$       |                           | ns   |
|                                                          |                                        |                                                                                                                                                                        | $f_{\text{MCK}} \leq 4\text{ MHz}$                  | $20/f_{\text{MCK}}$       |                           | ns   |
| SCKp high-/low-level width                               | t <sub>KH2</sub> ,<br>t <sub>KL2</sub> | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$                                                     |                                                     | $t_{\text{KCY2}}/2 - 24$  |                           | ns   |
|                                                          |                                        | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$                                                        |                                                     | $t_{\text{KCY2}}/2 - 36$  |                           | ns   |
|                                                          |                                        | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{V}_b \leq 2.0\text{ V}$ <sup>Note 2</sup>                                      |                                                     | $t_{\text{KCY2}}/2 - 100$ |                           | ns   |
| Slp setup time<br>(to SCKp↑) <sup>Note 2</sup>           | t <sub>SIK2</sub>                      | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$                                                     |                                                     | $1/f_{\text{MCK}} + 40$   |                           | ns   |
|                                                          |                                        | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$                                                        |                                                     | $1/f_{\text{MCK}} + 40$   |                           | ns   |
|                                                          |                                        | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq \text{V}_b \leq 2.0\text{ V}$                                                        |                                                     | $1/f_{\text{MCK}} + 60$   |                           | ns   |
| Slp hold time<br>(from SCKp↑) <sup>Note 3</sup>          | t <sub>KSI2</sub>                      |                                                                                                                                                                        |                                                     | $1/f_{\text{MCK}} + 62$   |                           | ns   |
| Delay time from SCKp↓<br>to SOp output <sup>Note 4</sup> | t <sub>KSO2</sub>                      | $4.0\text{ V} \leq \text{EV}_{\text{DD0}} \leq 5.5\text{ V}$ , $2.7\text{ V} \leq \text{V}_b \leq 4.0\text{ V}$ ,<br>$C_b = 30\text{ pF}$ , $R_b = 1.4\text{ k}\Omega$ |                                                     |                           | $2/f_{\text{MCK}} + 240$  | ns   |
|                                                          |                                        | $2.7\text{ V} \leq \text{EV}_{\text{DD0}} < 4.0\text{ V}$ , $2.3\text{ V} \leq \text{V}_b \leq 2.7\text{ V}$ ,<br>$C_b = 30\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$    |                                                     |                           | $2/f_{\text{MCK}} + 428$  | ns   |
|                                                          |                                        | $2.4\text{ V} \leq \text{EV}_{\text{DD0}} < 3.3\text{ V}$ , $1.6\text{ V} \leq \text{V}_b \leq 2.0\text{ V}$ ,<br>$C_b = 30\text{ pF}$ , $R_b = 5.5\text{ k}\Omega$    |                                                     |                           | $2/f_{\text{MCK}} + 1146$ | ns   |

(Notes, Caution and Remarks are listed on the next page.)

**(8) Communication at different potential (1.8 V, 2.5 V, 3 V) (simplified I<sup>2</sup>C mode) (1/2)****( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq EV_{DD0} = EV_{DD1} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = EV_{SS0} = EV_{SS1} = 0\text{ V}$ )**

| Parameter                 | Symbol     | Conditions                                                                                                                                            | HS (high-speed main) Mode |                       | Unit |
|---------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------|------|
|                           |            |                                                                                                                                                       | MIN.                      | MAX.                  |      |
| SCLr clock frequency      | $f_{SCL}$  | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$  |                           | 400 <sup>Note 1</sup> | kHz  |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$     |                           | 400 <sup>Note 1</sup> | kHz  |
|                           |            | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.8\text{ k}\Omega$ |                           | 100 <sup>Note 1</sup> | kHz  |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$    |                           | 100 <sup>Note 1</sup> | kHz  |
|                           |            | $2.4\text{ V} \leq EV_{DD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq V_b \leq 2.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 5.5\text{ k}\Omega$    |                           | 100 <sup>Note 1</sup> | kHz  |
| Hold time when SCLr = "L" | $t_{LOW}$  | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$  | 1200                      |                       | ns   |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$     | 1200                      |                       | ns   |
|                           |            | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.8\text{ k}\Omega$ | 4600                      |                       | ns   |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$    | 4600                      |                       | ns   |
|                           |            | $2.4\text{ V} \leq EV_{DD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq V_b \leq 2.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 5.5\text{ k}\Omega$    | 4650                      |                       | ns   |
| Hold time when SCLr = "H" | $t_{HIGH}$ | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$  | 620                       |                       | ns   |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 50\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$     | 500                       |                       | ns   |
|                           |            | $4.0\text{ V} \leq EV_{DD0} \leq 5.5\text{ V}$ ,<br>$2.7\text{ V} \leq V_b \leq 4.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.8\text{ k}\Omega$ | 2700                      |                       | ns   |
|                           |            | $2.7\text{ V} \leq EV_{DD0} < 4.0\text{ V}$ ,<br>$2.3\text{ V} \leq V_b \leq 2.7\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 2.7\text{ k}\Omega$    | 2400                      |                       | ns   |
|                           |            | $2.4\text{ V} \leq EV_{DD0} < 3.3\text{ V}$ ,<br>$1.6\text{ V} \leq V_b \leq 2.0\text{ V}$ ,<br>$C_b = 100\text{ pF}$ , $R_b = 5.5\text{ k}\Omega$    | 1830                      |                       | ns   |

(Notes and Caution are listed on the next page, and Remarks are listed on the page after the next page.)

**Simplified I<sup>2</sup>C mode connection diagram (during communication at different potential)****Simplified I<sup>2</sup>C mode serial transfer timing (during communication at different potential)**

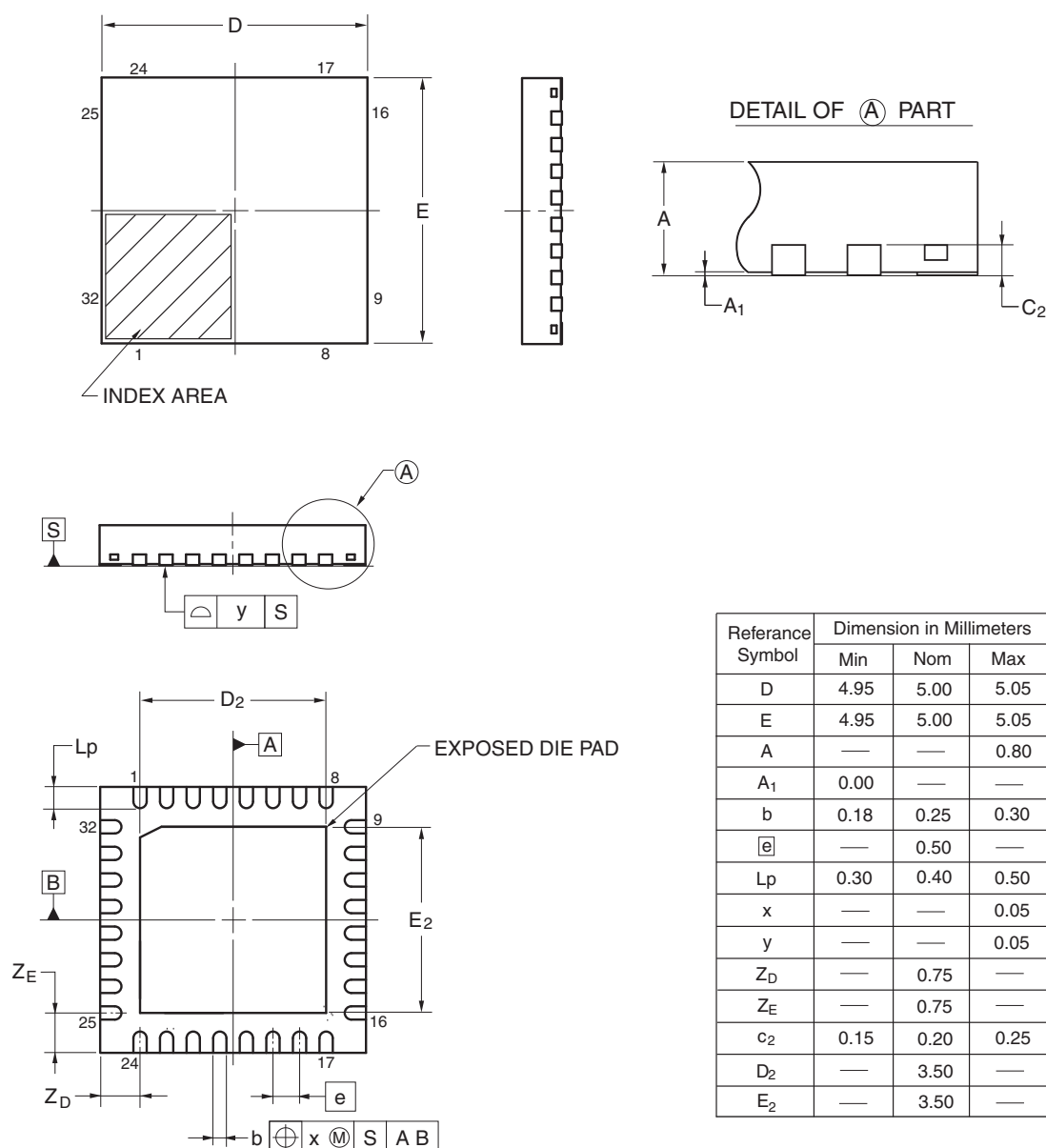
**Caution** Select the TTL input buffer and the N-ch open drain output ( $V_{DD}$  tolerance (for the 20- to 52-pin products)/ $EV_{DD}$  tolerance (for the 64- to 100-pin products)) mode for the SDAr pin and the N-ch open drain output ( $V_{DD}$  tolerance (for the 20- to 52-pin products)/ $EV_{DD}$  tolerance (for the 64- to 100-pin products)) mode for the SCLr pin by using port input mode register g (PIMg) and port output mode register g (POMg). For  $V_{IH}$  and  $V_{IL}$ , see the DC characteristics with TTL input buffer selected.

- Remarks**
1.  $R_b[\Omega]$ : Communication line (SDAr, SCLr) pull-up resistance,  $C_b[F]$ : Communication line (SDAr, SCLr) load capacitance,  $V_b[V]$ : Communication line voltage
  2. r: IIC number (r = 00, 01, 10, 20, 30, 31), g: PIM, POM number (g = 0, 1, 4, 5, 8, 14)
  3.  $f_{MCK}$ : Serial array unit operation clock frequency  
(Operation clock to be set by the CKSmn bit of serial mode register mn (SMRmn). m: Unit number, n: Channel number (mn = 00, 01, 02, 10, 12, 13))

## 4.5 32-pin Products

R5F100BAANA, R5F100BCANA, R5F100BDANA, R5F100BEANA, R5F100BFANA, R5F100BGANA  
 R5F101BAANA, R5F101BCANA, R5F101BDANA, R5F101BEANA, R5F101BFANA, R5F101BGANA  
 R5F100BADNA, R5F100BCDNA, R5F100BDDNA, R5F100BEDNA, R5F100BFDNA, R5F100BGDNA  
 R5F101BADNA, R5F101BCDNA, R5F101BDDNA, R5F101BEDNA, R5F101BFDNA, R5F101BGDNA  
 R5F100BAGNA, R5F100BCGNA, R5F100BDGNA, R5F100BEGNA, R5F100BFGNA, R5F100BGGNA

| JEITA Package code | RENESAS code | Previous code  | MASS (TYP.)[g] |
|--------------------|--------------|----------------|----------------|
| P-HWQFN32-5x5-0.50 | PWQN0032KB-A | P32K8-50-3B4-5 | 0.06           |

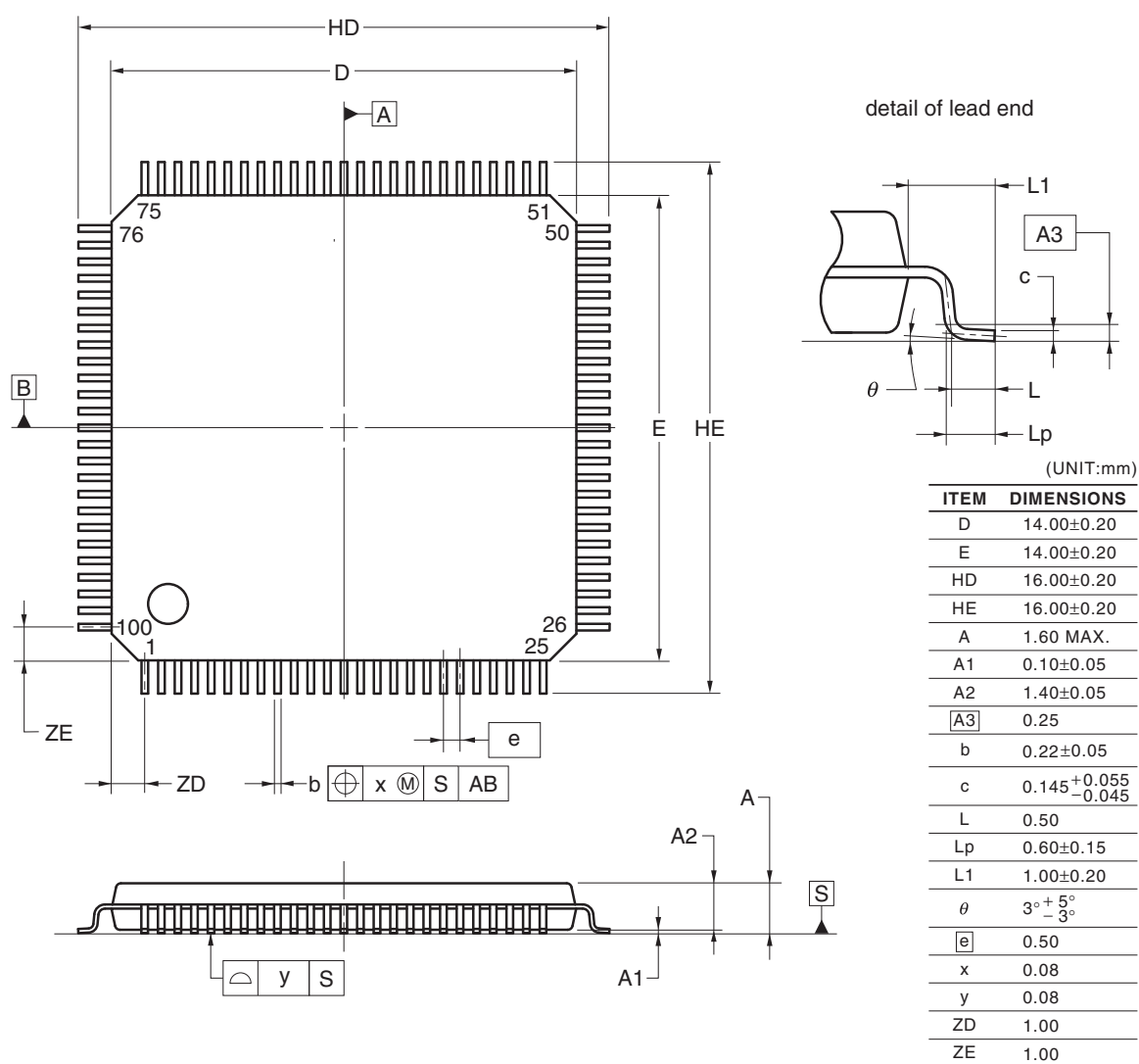


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## 4.13 100-pin Products

R5F100PFAFB, R5F100PGAFB, R5F100PHAFB, R5F100PJAFB, R5F100PKAFB, R5F100PLAFB  
 R5F101PFAFB, R5F101PGAFB, R5F101PHAFB, R5F101PJAFB, R5F101PKAFB, R5F101PLAFB  
 R5F100PFDDB, R5F100PGDFB, R5F100PHDFB, R5F100PJDFB, R5F100PKDFB, R5F100PLDFB  
 R5F101PFDDB, R5F101PGDFB, R5F101PHDFB, R5F101PJDFB, R5F101PKDFB, R5F101PLDFB  
 R5F100PFGFB, R5F100PGGFB, R5F100PHGFB, R5F100PJGFB

| JEITA Package Code    | RENESAS Code | Previous Code   | MASS (TYP.) [g] |
|-----------------------|--------------|-----------------|-----------------|
| P-LFQFP100-14x14-0.50 | PLQP0100KE-A | P100GC-50-GBR-1 | 0.69            |



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