



Welcome to [E-XFL.COM](#)

### 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](#)"

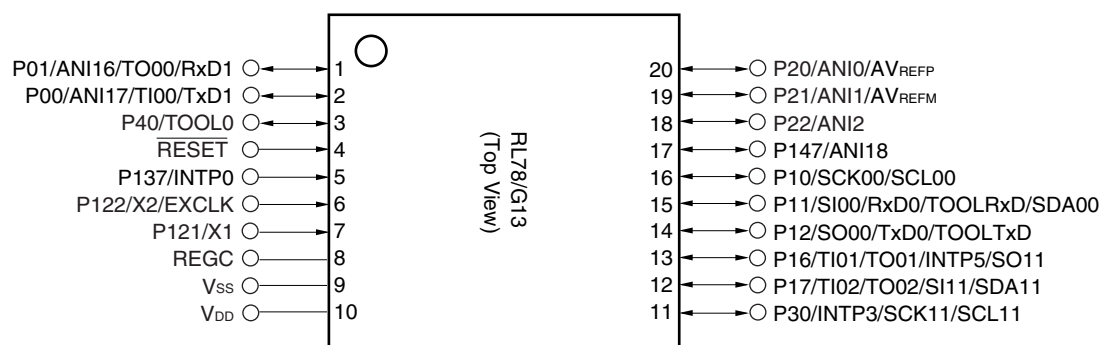
#### Details

|                            |                                                                                                                                                                               |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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              | 21                                                                                                                                                                            |
| Program Memory Size        | 48KB (48K x 8)                                                                                                                                                                |
| Program Memory Type        | FLASH                                                                                                                                                                         |
| EEPROM Size                | 4K x 8                                                                                                                                                                        |
| RAM Size                   | 3K x 8                                                                                                                                                                        |
| Voltage - Supply (Vcc/Vdd) | 1.6V ~ 5.5V                                                                                                                                                                   |
| Data Converters            | A/D 8x8/10b                                                                                                                                                                   |
| Oscillator Type            | Internal                                                                                                                                                                      |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                             |
| Mounting Type              | Surface Mount                                                                                                                                                                 |
| Package / Case             | 30-LSSOP (0.240", 6.10mm Width)                                                                                                                                               |
| Supplier Device Package    | 30-LSSOP                                                                                                                                                                      |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f100addsp-x0">https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f100addsp-x0</a> |

### 1.3 Pin Configuration (Top View)

#### 1.3.1 20-pin products

- 20-pin plastic LSSOP (7.62 mm (300), 0.65 mm pitch)

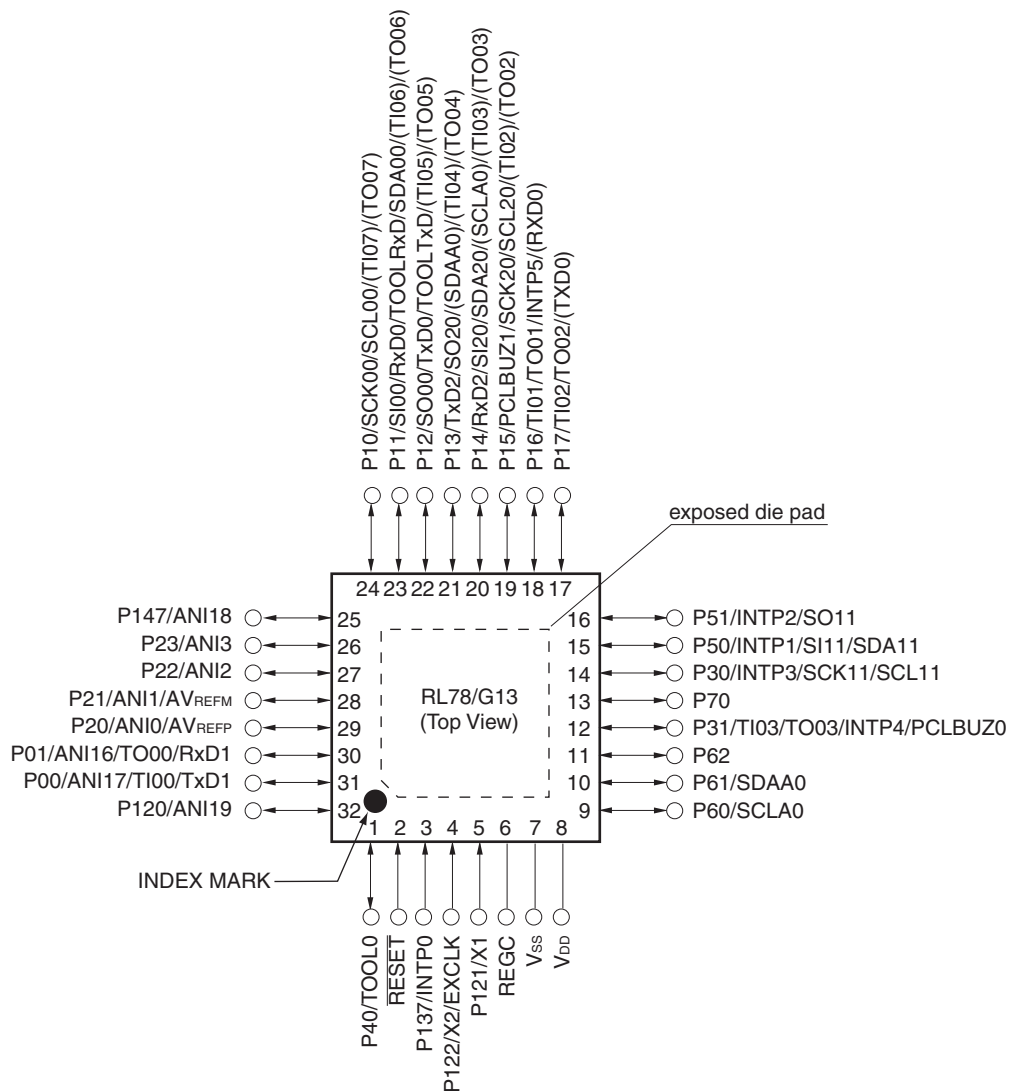


**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

**Remark** For pin identification, see 1.4 Pin Identification.

## 1.3.5 32-pin products

- 32-pin plastic HWQFN (5 × 5 mm, 0.5 mm pitch)

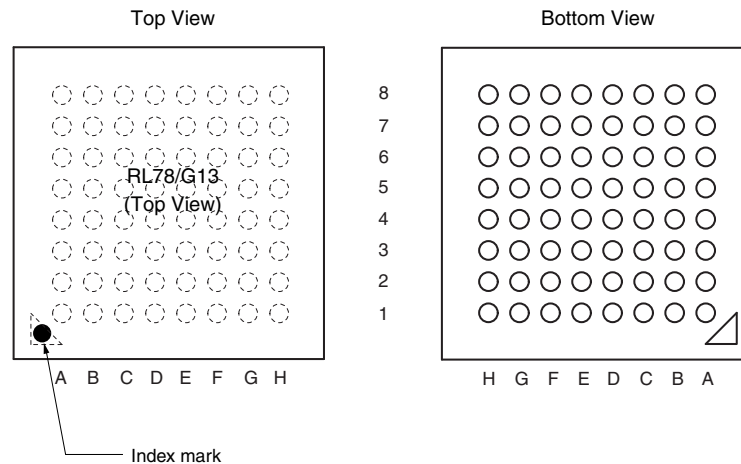


**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

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

- 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.
- It is recommended to connect an exposed die pad to V<sub>SS</sub>.

- 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).

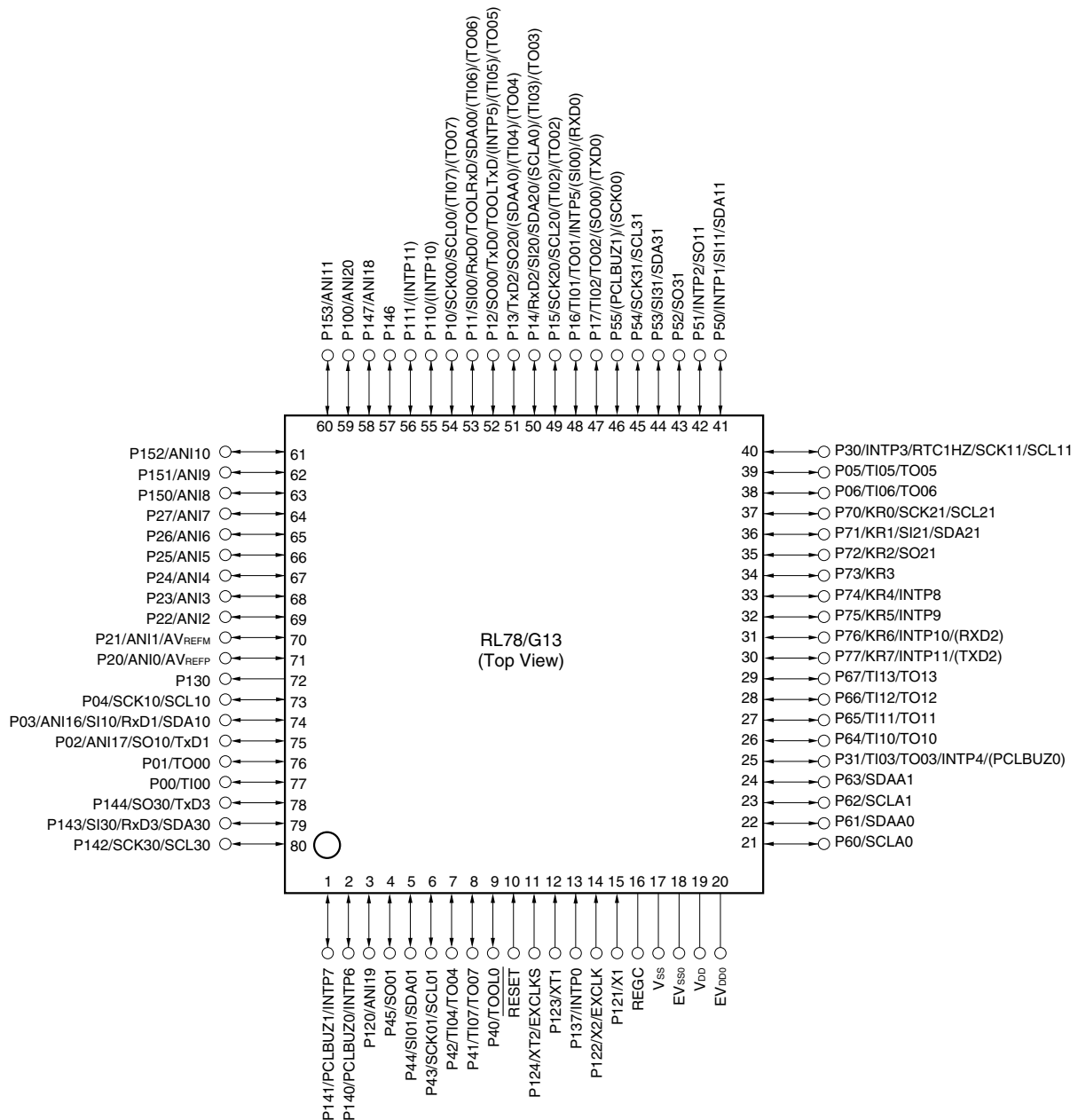
**Remarks** 1. For pin identification, see 1.4 Pin Identification.

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.

## 1.3.12 80-pin products

- 80-pin plastic LQFP (14 × 14 mm, 0.65 mm pitch)
- 80-pin plastic LFQFP (12 × 12 mm, 0.5 mm pitch)

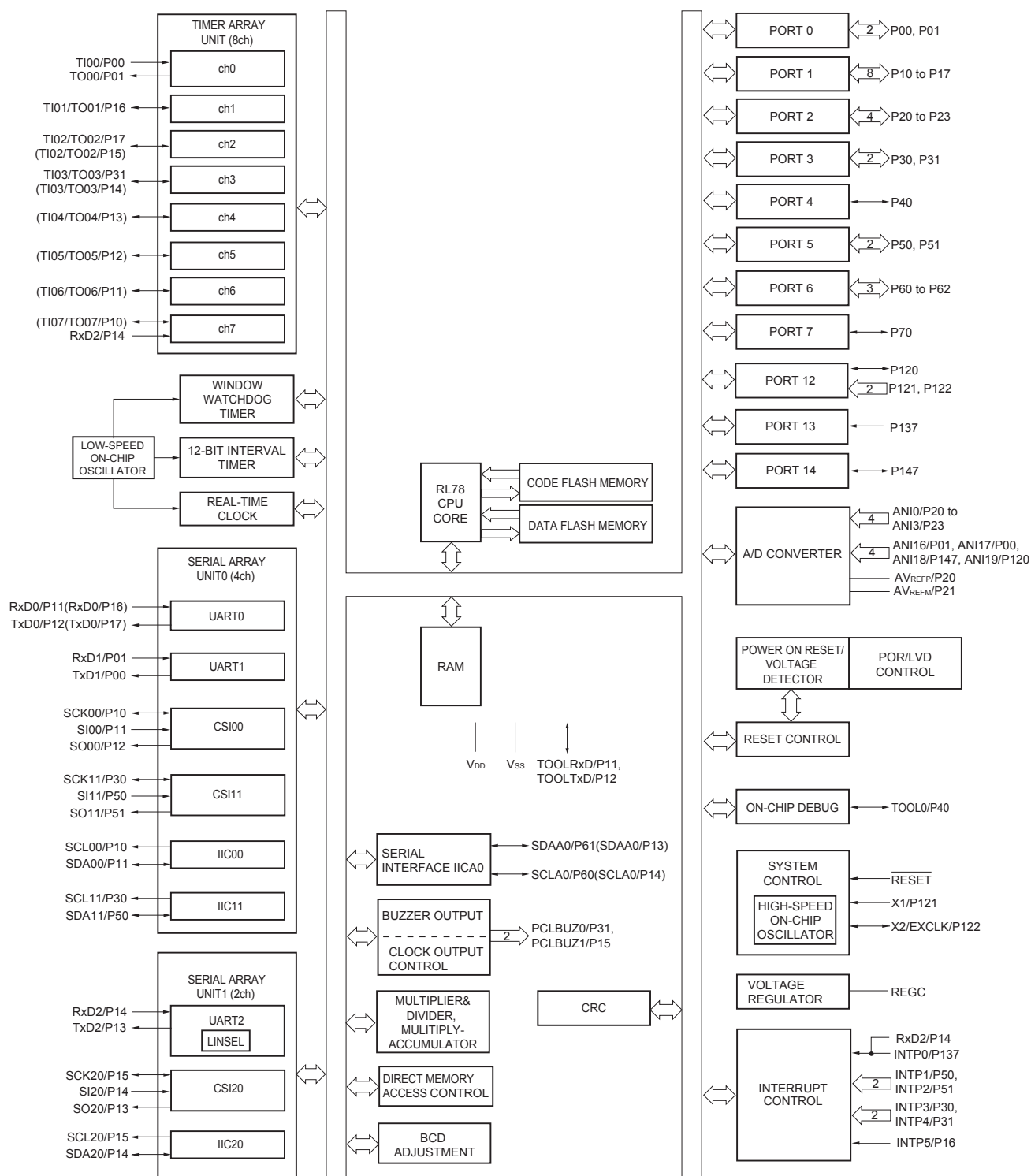


- Cautions**
1. Make EV<sub>SS0</sub> pin the same potential as V<sub>SS</sub> pin.
  2. Make V<sub>DD</sub> pin the potential that is higher than EV<sub>DD0</sub> pin.
  3. Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

**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.

## 1.5.5 32-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.

**Absolute Maximum Ratings (T<sub>A</sub> = 25°C) (2/2)**

| Parameter                     | Symbols                          | Conditions                   |                                                                                                                                                                                | Ratings                                                                                                                                                                        | Unit       |
|-------------------------------|----------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Output current, high          | I <sub>OH1</sub>                 | Per pin                      | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 | −40                                                                                                                                                                            | mA         |
|                               |                                  | Total of all pins<br>−170 mA | P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145                                                                                  | −70                                                                                                                                                                            | mA         |
|                               |                                  |                              | P05, P06, P10 to P17, P30, P31, P50 to P57, P64 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147                                               | −100                                                                                                                                                                           | mA         |
|                               | I <sub>OH2</sub>                 | Per pin                      | P20 to P27, P150 to P156                                                                                                                                                       | −0.5                                                                                                                                                                           | mA         |
|                               |                                  | Total of all pins            |                                                                                                                                                                                | −2                                                                                                                                                                             | mA         |
|                               | Output current, low              | I <sub>OL1</sub>             | Per pin                                                                                                                                                                        | P00 to P07, P10 to P17, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100 to P106, P110 to P117, P120, P125 to P127, P130, P140 to P147 | 40         |
| Total of all pins<br>170 mA   |                                  |                              | P00 to P04, P07, P32 to P37, P40 to P47, P102 to P106, P120, P125 to P127, P130, P140 to P145                                                                                  | 70                                                                                                                                                                             | mA         |
|                               |                                  |                              | P05, P06, P10 to P17, P30, P31, P50 to P57, P60 to P67, P70 to P77, P80 to P87, P90 to P97, P100, P101, P110 to P117, P146, P147                                               | 100                                                                                                                                                                            | mA         |
| I <sub>OL2</sub>              |                                  | Per pin                      | P20 to P27, P150 to P156                                                                                                                                                       | 1                                                                                                                                                                              | mA         |
|                               |                                  | Total of all pins            |                                                                                                                                                                                | 5                                                                                                                                                                              | mA         |
| Operating ambient temperature |                                  | T <sub>A</sub>               | In normal operation mode                                                                                                                                                       |                                                                                                                                                                                | −40 to +85 |
|                               | In flash memory programming mode |                              |                                                                                                                                                                                |                                                                                                                                                                                |            |
| Storage temperature           | T <sub>stg</sub>                 |                              |                                                                                                                                                                                | −65 to +150                                                                                                                                                                    | °C         |

**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.

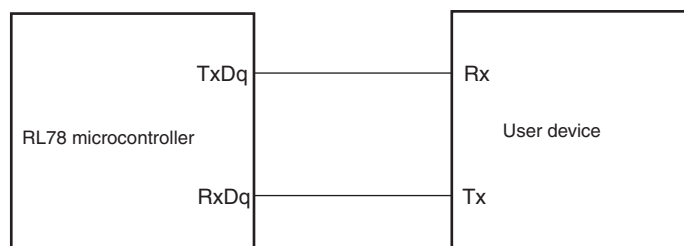
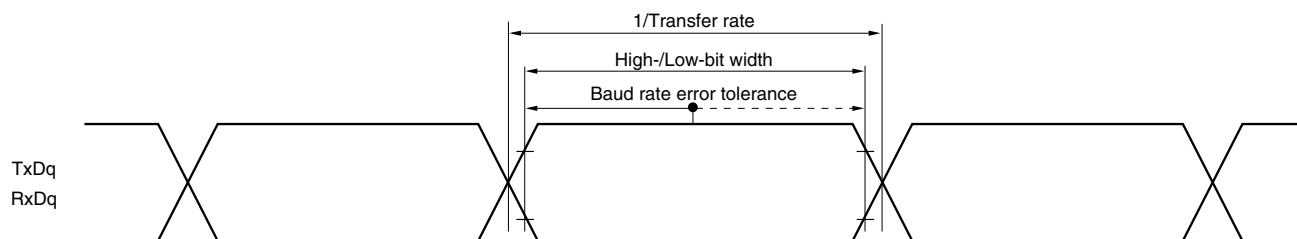
**Remark** Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port pins.

**(2) Flash ROM: 96 to 256 KB of 30- to 100-pin products****(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) (1/2)**

| Parameter                | Symbol           | Conditions     |                                      |                                                                   |                  |                         | MIN. | TYP. | MAX. | Unit |
|--------------------------|------------------|----------------|--------------------------------------|-------------------------------------------------------------------|------------------|-------------------------|------|------|------|------|
| Supply current<br>Note 1 | I <sub>DD1</sub> | Operating mode | HS (high-speed main) mode<br>Note 5  | f <sub>IH</sub> = 32 MHz<br>Note 3                                | Basic operation  | V <sub>DD</sub> = 5.0 V |      | 2.3  |      | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 3.0 V |      | 2.3  |      | mA   |
|                          |                  |                |                                      |                                                                   | Normal operation | V <sub>DD</sub> = 5.0 V |      | 5.2  | 8.5  | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 3.0 V |      | 5.2  | 8.5  | mA   |
|                          |                  |                |                                      | f <sub>IH</sub> = 24 MHz<br>Note 3                                | Normal operation | V <sub>DD</sub> = 5.0 V |      | 4.1  | 6.6  | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 3.0 V |      | 4.1  | 6.6  | mA   |
|                          |                  |                |                                      | f <sub>IH</sub> = 16 MHz<br>Note 3                                | Normal operation | V <sub>DD</sub> = 5.0 V |      | 3.0  | 4.7  | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 3.0 V |      | 3.0  | 4.7  | mA   |
|                          |                  |                | LS (low-speed main) mode<br>Note 5   | f <sub>IH</sub> = 8 MHz<br>Note 3                                 | Normal operation | V <sub>DD</sub> = 3.0 V |      | 1.3  | 2.1  | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 2.0 V |      | 1.3  | 2.1  | mA   |
|                          |                  |                | LV (low-voltage main) mode<br>Note 5 | f <sub>IH</sub> = 4 MHz<br>Note 3                                 | Normal operation | V <sub>DD</sub> = 3.0 V |      | 1.3  | 1.8  | mA   |
|                          |                  |                |                                      |                                                                   |                  | V <sub>DD</sub> = 2.0 V |      | 1.3  | 1.8  | mA   |
|                          |                  |                | HS (high-speed main) mode<br>Note 5  | f <sub>MX</sub> = 20 MHz<br>Note 2, V <sub>DD</sub> = 5.0 V       | Normal operation | Square wave input       |      | 3.4  | 5.5  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 3.6  | 5.7  | mA   |
|                          |                  |                |                                      | f <sub>MX</sub> = 20 MHz<br>Note 2, V <sub>DD</sub> = 3.0 V       | Normal operation | Square wave input       |      | 3.4  | 5.5  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 3.6  | 5.7  | mA   |
|                          |                  |                |                                      | f <sub>MX</sub> = 10 MHz<br>Note 2, V <sub>DD</sub> = 5.0 V       | Normal operation | Square wave input       |      | 2.1  | 3.2  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 2.1  | 3.2  | mA   |
|                          |                  |                |                                      | f <sub>MX</sub> = 10 MHz<br>Note 2, V <sub>DD</sub> = 3.0 V       | Normal operation | Square wave input       |      | 2.1  | 3.2  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 2.1  | 3.2  | mA   |
|                          |                  |                | LS (low-speed main) mode<br>Note 5   | f <sub>MX</sub> = 8 MHz<br>Note 2, V <sub>DD</sub> = 3.0 V        | Normal operation | Square wave input       |      | 1.2  | 2.0  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 1.2  | 2.0  | mA   |
|                          |                  |                |                                      | f <sub>MX</sub> = 8 MHz<br>Note 2, V <sub>DD</sub> = 2.0 V        | Normal operation | Square wave input       |      | 1.2  | 2.0  | mA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 1.2  | 2.0  | mA   |
|                          |                  |                | Subsystem clock operation            | f <sub>SUB</sub> = 32.768 kHz<br>Note 4<br>T <sub>A</sub> = -40°C | Normal operation | Square wave input       |      | 4.8  | 5.9  | μA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 4.9  | 6.0  | μA   |
|                          |                  |                |                                      | f <sub>SUB</sub> = 32.768 kHz<br>Note 4<br>T <sub>A</sub> = +25°C | Normal operation | Square wave input       |      | 4.9  | 5.9  | μA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 5.0  | 6.0  | μA   |
|                          |                  |                |                                      | f <sub>SUB</sub> = 32.768 kHz<br>Note 4<br>T <sub>A</sub> = +50°C | Normal operation | Square wave input       |      | 5.0  | 7.6  | μA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 5.1  | 7.7  | μA   |
|                          |                  |                |                                      | f <sub>SUB</sub> = 32.768 kHz<br>Note 4<br>T <sub>A</sub> = +70°C | Normal operation | Square wave input       |      | 5.2  | 9.3  | μA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 5.3  | 9.4  | μA   |
|                          |                  |                |                                      | f <sub>SUB</sub> = 32.768 kHz<br>Note 4<br>T <sub>A</sub> = +85°C | Normal operation | Square wave input       |      | 5.7  | 13.3 | μA   |
|                          |                  |                |                                      |                                                                   |                  | Resonator connection    |      | 5.8  | 13.4 | μA   |

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

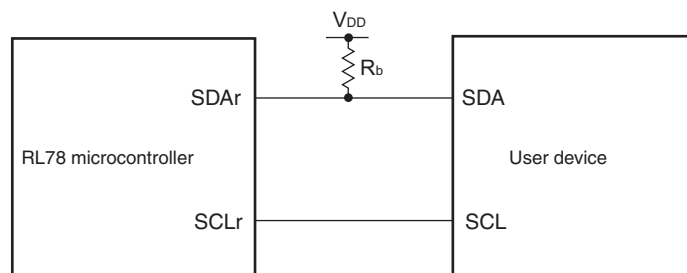
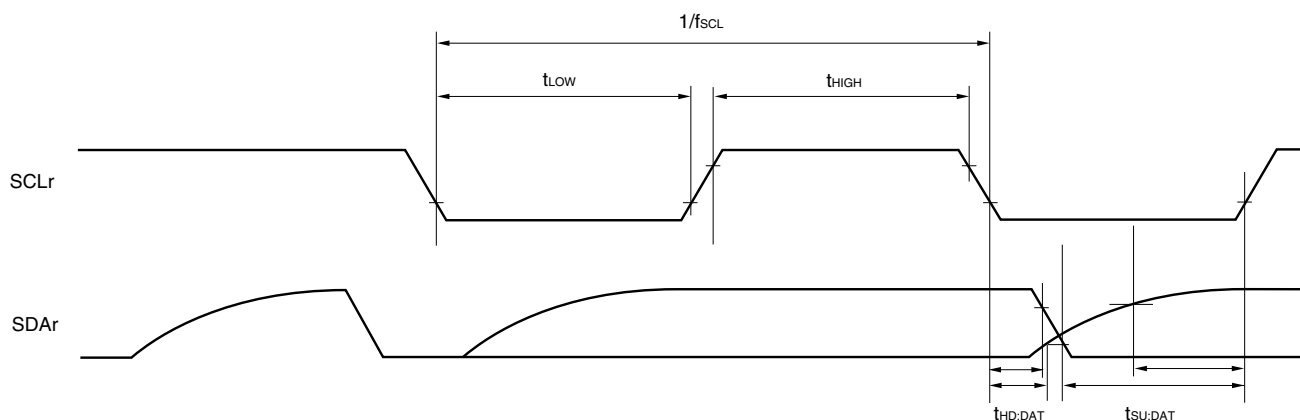


**UART mode connection diagram (during communication at same potential)****UART mode bit width (during communication at same potential) (reference)**

**Remarks 1.** q: UART number (q = 0 to 3), g: PIM and POM number (g = 0, 1, 8, 14)

**2.**  $f_{MCK}$ : 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 to 03, 10 to 13))

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

- Remarks**
1.  $R_b[\Omega]$ : Communication line (SDAr) pull-up resistance,  $C_b[F]$ : Communication line (SDAr, SCLr) load capacitance
  2. r: IIC number (r = 00, 01, 10, 11, 20, 21, 30, 31), g: PIM number (g = 0, 1, 4, 5, 8, 14),  
h: POM number (g = 0, 1, 4, 5, 7 to 9, 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 (m = 0, 1),  
n: Channel number (n = 0 to 3), mn = 00 to 03, 10 to 13)

**(10) Communication at different potential (1.8 V, 2.5 V, 3 V) (simplified I<sup>2</sup>C mode) (1/2)****(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.          |      |
| SCLr clock frequency      | f <sub>SCL</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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     |                           | 1000<br>Note 1 |                          | 300<br>Note 1 |                            | 300<br>Note 1 | kHz  |
|                           |                   | 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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     |                           | 1000<br>Note 1 |                          | 300<br>Note 1 |                            | 300<br>Note 1 | kHz  |
|                           |                   | 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> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    |                           | 400<br>Note 1  |                          | 300<br>Note 1 |                            | 300<br>Note 1 | kHz  |
|                           |                   | 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> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    |                           | 400<br>Note 1  |                          | 300<br>Note 1 |                            | 300<br>ote 1  | kHz  |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ |                           | 300<br>Note 1  |                          | 300<br>Note 1 |                            | 300<br>Note 1 | kHz  |
| Hold time when SCLr = "L" | t <sub>LOW</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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 475                       |                | 1550                     |               | 1550                       |               | 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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 475                       |                | 1550                     |               | 1550                       |               | ns   |
|                           |                   | 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> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 1150                      |                | 1550                     |               | 1550                       |               | 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> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 1150                      |                | 1550                     |               | 1550                       |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 1550                      |                | 1550                     |               | 1550                       |               | ns   |
| Hold time when SCLr = "H" | t <sub>HIGH</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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 245                       |                | 610                      |               | 610                        |               | 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> = 50 pF, R <sub>b</sub> = 2.7 kΩ                     | 200                       |                | 610                      |               | 610                        |               | ns   |
|                           |                   | 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> = 100 pF, R <sub>b</sub> = 2.8 kΩ                    | 675                       |                | 610                      |               | 610                        |               | 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> = 100 pF, R <sub>b</sub> = 2.7 kΩ                    | 600                       |                | 610                      |               | 610                        |               | ns   |
|                           |                   | 1.8 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V <sup>Note 2</sup> ,<br>C <sub>b</sub> = 100 pF, R <sub>b</sub> = 5.5 kΩ | 610                       |                | 610                      |               | 610                        |               | ns   |

&lt;R&gt;

- Notes**
1. The first clock pulse is generated after this period when the start/restart condition is detected.
  2. The maximum value (MAX.) of t<sub>HD:DAT</sub> is during normal transfer and a wait state is inserted in the ACK (acknowledge) timing.

**Caution** The values in the above table are applied even when bit 2 (PIOR2) in the peripheral I/O redirection register (PIOR) is 1. At this time, the pin characteristics (I<sub>OH1</sub>, I<sub>OL1</sub>, V<sub>OH1</sub>, V<sub>OL1</sub>) must satisfy the values in the redirect destination.

**Remark** The maximum value of C<sub>b</sub> (communication line capacitance) and the value of R<sub>b</sub> (communication line pull-up resistor) at that time in each mode are as follows.

Standard mode: C<sub>b</sub> = 400 pF, R<sub>b</sub> = 2.7 kΩ

## 2.6.2 Temperature sensor/internal reference voltage characteristics

(T<sub>A</sub> =  $-40$  to  $+85^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ , HS (high-speed main) mode)

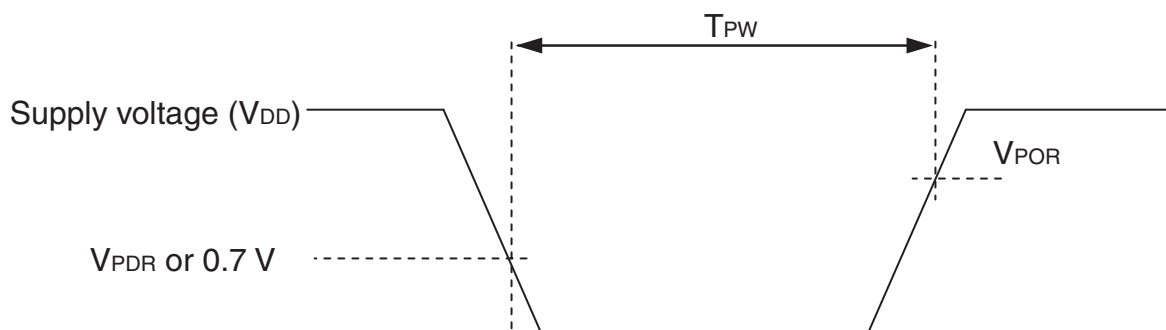
| Parameter                         | Symbol       | Conditions                                            | MIN. | TYP. | MAX. | Unit                 |
|-----------------------------------|--------------|-------------------------------------------------------|------|------|------|----------------------|
| Temperature sensor output voltage | $V_{TMPS25}$ | Setting ADS register = 80H, $T_A = +25^\circ\text{C}$ |      | 1.05 |      | V                    |
| Internal reference voltage        | $V_{BGR}$    | Setting ADS register = 81H                            | 1.38 | 1.45 | 1.5  | V                    |
| Temperature coefficient           | $F_{VTMPS}$  | Temperature sensor that depends on the temperature    |      | -3.6 |      | mV/ $^\circ\text{C}$ |
| Operation stabilization wait time | $t_{AMP}$    |                                                       | 5    |      |      | $\mu\text{s}$        |

## 2.6.3 POR circuit characteristics

(T<sub>A</sub> =  $-40$  to  $+85^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$ )

| Parameter                           | Symbol    | Conditions             | MIN. | TYP. | MAX. | Unit          |
|-------------------------------------|-----------|------------------------|------|------|------|---------------|
| Detection voltage                   | $V_{POR}$ | Power supply rise time | 1.47 | 1.51 | 1.55 | V             |
|                                     | $V_{PDR}$ | Power supply fall time | 1.46 | 1.50 | 1.54 | V             |
| Minimum pulse width <sup>Note</sup> | $T_{PW}$  |                        | 300  |      |      | $\mu\text{s}$ |

**Note** Minimum time required for a POR reset when  $V_{DD}$  exceeds below  $V_{PDR}$ . This is also the minimum time required for a POR reset from when  $V_{DD}$  exceeds below  $0.7\text{ V}$  to when  $V_{DD}$  exceeds  $V_{POR}$  while STOP mode is entered or the main system clock is stopped through setting bit 0 (HIOSSTOP) and bit 7 (MSTOP) in the clock operation status control register (CSC).



**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

## 3.2 Oscillator Characteristics

### 3.2.1 X1, XT1 oscillator characteristics

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Parameter                                                 | Resonator                               | Conditions                                   | MIN. | TYP.   | MAX. | Unit |
|-----------------------------------------------------------|-----------------------------------------|----------------------------------------------|------|--------|------|------|
| X1 clock oscillation frequency ( $f_x$ ) <sup>Note</sup>  | Ceramic resonator/<br>crystal resonator | $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ | 1.0  |        | 20.0 | MHz  |
|                                                           |                                         | $2.4\text{ V} \leq V_{DD} < 2.7\text{ V}$    | 1.0  |        | 16.0 | MHz  |
| XT1 clock oscillation frequency ( $f_x$ ) <sup>Note</sup> | Crystal resonator                       |                                              | 32   | 32.768 | 35   | kHz  |

**Note** Indicates only permissible oscillator frequency ranges. Refer to AC Characteristics for instruction execution time. Request evaluation by the manufacturer of the oscillator circuit mounted on a board to check the oscillator characteristics.

**Caution** Since the CPU is started by the high-speed on-chip oscillator clock after a reset release, check the X1 clock oscillation stabilization time using the oscillation stabilization time counter status register (OSTC) by the user. Determine the oscillation stabilization time of the OSTC register and the oscillation stabilization time select register (OSTS) after sufficiently evaluating the oscillation stabilization time with the resonator to be used.

**Remark** When using the X1 oscillator and XT1 oscillator, refer to 5.4 System Clock Oscillator.

### 3.2.2 On-chip oscillator characteristics

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Oscillators                                                         | Parameters | Conditions                    |                                              | MIN.   | TYP. | MAX.   | Unit |
|---------------------------------------------------------------------|------------|-------------------------------|----------------------------------------------|--------|------|--------|------|
| High-speed on-chip oscillator clock frequency <sup>Notes 1, 2</sup> | $f_{IH}$   |                               |                                              | 1      |      | 32     | MHz  |
| High-speed on-chip oscillator clock frequency accuracy              |            | $-20$ to $+85^\circ\text{C}$  | $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ | $-1.0$ |      | $+1.0$ | %    |
|                                                                     |            | $-40$ to $-20^\circ\text{C}$  | $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ | $-1.5$ |      | $+1.5$ | %    |
|                                                                     |            | $+85$ to $+105^\circ\text{C}$ | $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ | $-2.0$ |      | $+2.0$ | %    |
| Low-speed on-chip oscillator clock frequency                        | $f_{IL}$   |                               |                                              |        | 15   |        | kHz  |
| Low-speed on-chip oscillator clock frequency accuracy               |            |                               |                                              | $-15$  |      | $+15$  | %    |

**Notes 1.** High-speed on-chip oscillator frequency is selected by bits 0 to 3 of option byte (000C2H/010C2H) and bits 0 to 2 of HOCODIV register.

**2.** This indicates the oscillator characteristics only. Refer to AC Characteristics for instruction execution time.

## (5) Communication at different potential (1.8 V, 2.5 V, 3 V) (UART mode) (2/2)

(T<sub>A</sub> = -40 to +105°C, 2.4 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                                                                                                 |                       | Unit                   |
|---------------|--------|--------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|
|               |        |              | MIN.                                                                                                                      | MAX.                  |                        |
| Transfer rate |        | Transmission | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V,<br>2.7 V ≤ V <sub>b</sub> ≤ 4.0 V                                                      |                       |                        |
|               |        |              | Theoretical value of the maximum transfer rate<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 1.4 kΩ, V <sub>b</sub> = 2.7 V |                       |                        |
|               |        |              |                                                                                                                           | <b>Note 1</b>         | bps                    |
|               |        |              |                                                                                                                           | 2.6 <sup>Note 2</sup> | Mbps                   |
|               |        |              | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V,<br>2.3 V ≤ V <sub>b</sub> ≤ 2.7 V                                                      |                       |                        |
|               |        |              | Theoretical value of the maximum transfer rate<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 2.7 kΩ, V <sub>b</sub> = 2.3 V |                       |                        |
|               |        |              |                                                                                                                           |                       | <b>Note 3</b>          |
|               |        |              |                                                                                                                           |                       | 1.2 <sup>Note 4</sup>  |
|               |        |              |                                                                                                                           |                       | Mbps                   |
|               |        |              |                                                                                                                           |                       |                        |
|               |        |              | 2.4 V ≤ EV <sub>DD0</sub> < 3.3 V,<br>1.6 V ≤ V <sub>b</sub> ≤ 2.0 V                                                      |                       |                        |
|               |        |              | Theoretical value of the maximum transfer rate<br>C <sub>b</sub> = 50 pF, R <sub>b</sub> = 5.5 kΩ, V <sub>b</sub> = 1.6 V |                       |                        |
|               |        |              |                                                                                                                           |                       | <b>Note 5</b>          |
|               |        |              |                                                                                                                           |                       | 0.43 <sup>Note 6</sup> |

**Notes 1.** The smaller maximum transfer rate derived by using f<sub>MCK</sub>/12 or the following expression is the valid maximum transfer rate.

Expression for calculating the transfer rate when 4.0 V ≤ EV<sub>DD0</sub> ≤ 5.5 V and 2.7 V ≤ V<sub>b</sub> ≤ 4.0 V

$$\text{Maximum transfer rate} = \frac{1}{\{-C_b \times R_b \times \ln(1 - \frac{2.2}{V_b})\} \times 3} \text{ [bps]}$$

$$\text{Baud rate error (theoretical value)} = \frac{\frac{1}{\text{Transfer rate} \times 2} - \{-C_b \times R_b \times \ln(1 - \frac{2.2}{V_b})\}}{(\frac{1}{\text{Transfer rate}}) \times \text{Number of transferred bits}} \times 100 \text{ [%]}$$

\* This value is the theoretical value of the relative difference between the transmission and reception sides.

- This value as an example is calculated when the conditions described in the “Conditions” column are met. Refer to Note 1 above to calculate the maximum transfer rate under conditions of the customer.
- The smaller maximum transfer rate derived by using f<sub>MCK</sub>/12 or the following expression is the valid maximum transfer rate.

Expression for calculating the transfer rate when 2.7 V ≤ EV<sub>DD0</sub> < 4.0 V and 2.4 V ≤ V<sub>b</sub> ≤ 2.7 V

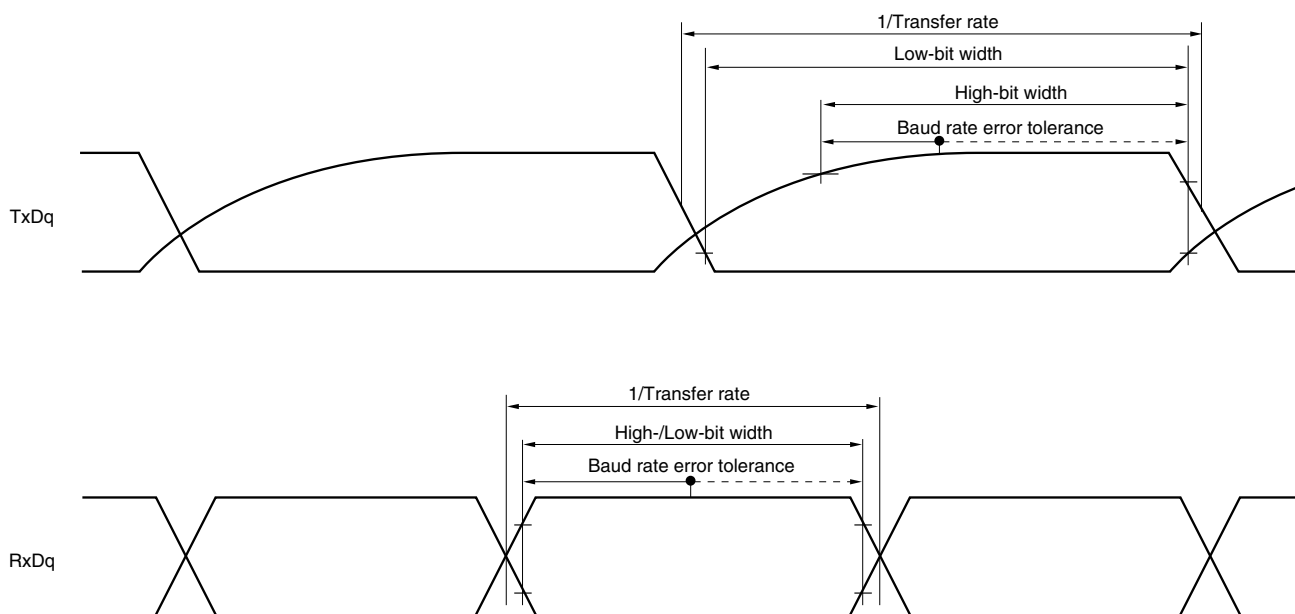
$$\text{Maximum transfer rate} = \frac{1}{\{-C_b \times R_b \times \ln(1 - \frac{2.0}{V_b})\} \times 3} \text{ [bps]}$$

$$\text{Baud rate error (theoretical value)} = \frac{\frac{1}{\text{Transfer rate} \times 2} - \{-C_b \times R_b \times \ln(1 - \frac{2.0}{V_b})\}}{(\frac{1}{\text{Transfer rate}}) \times \text{Number of transferred bits}} \times 100 \text{ [%]}$$

\* This value is the theoretical value of the relative difference between the transmission and reception sides.

- This value as an example is calculated when the conditions described in the “Conditions” column are met. Refer to Note 3 above to calculate the maximum transfer rate under conditions of the customer.



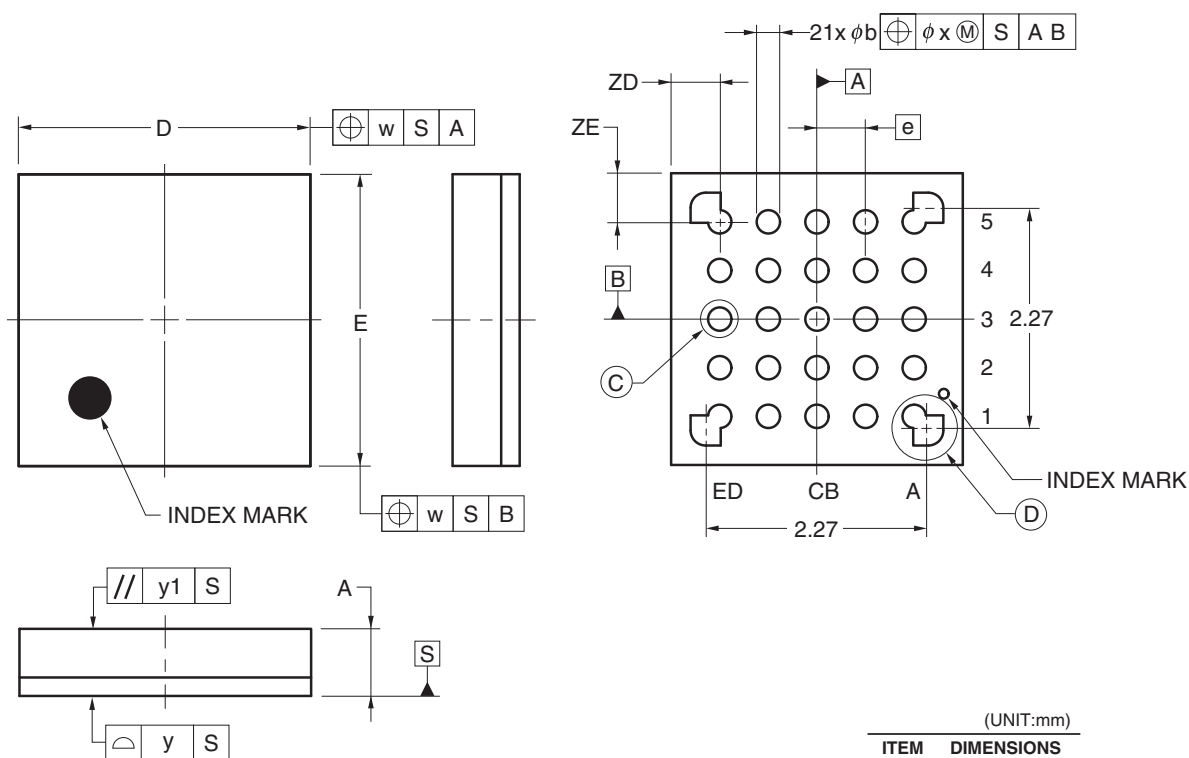
**UART mode bit width (during communication at different potential) (reference)**

- Remarks**
1.  $R_b[\Omega]$ : Communication line (TxDq) pull-up resistance,  
 $C_b[F]$ : Communication line (TxDq) load capacitance,  $V_b[V]$ : Communication line voltage
  2. q: UART number (q = 0 to 3), g: PIM and POM number (g = 0, 1, 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 to 03, 10 to 13))
  4. UART2 cannot communicate at different potential when bit 1 (PIOR1) of peripheral I/O redirection register (PIOR) is 1.

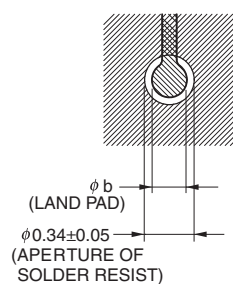
### 4.3 25-pin Products

R5F1008AALA, R5F1008CALA, R5F1008DALA, R5F1008EALA  
R5F1018AALA, R5F1018CALA, R5F1018DALA, R5F1018EALA  
R5F1008AGLA, R5F1008CGLA, R5F1008DGLA, R5F1008EGLA

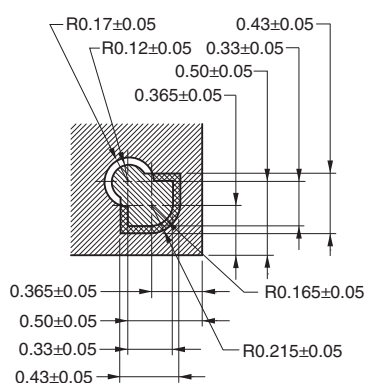
| JEITA Package Code | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|--------------------|--------------|----------------|-----------------|
| P-WFLGA25-3x3-0.50 | PWL0025KA-A  | P25FC-50-2N2-2 | 0.01            |



### DETAIL OF © PART



DETAIL OF (D) PART



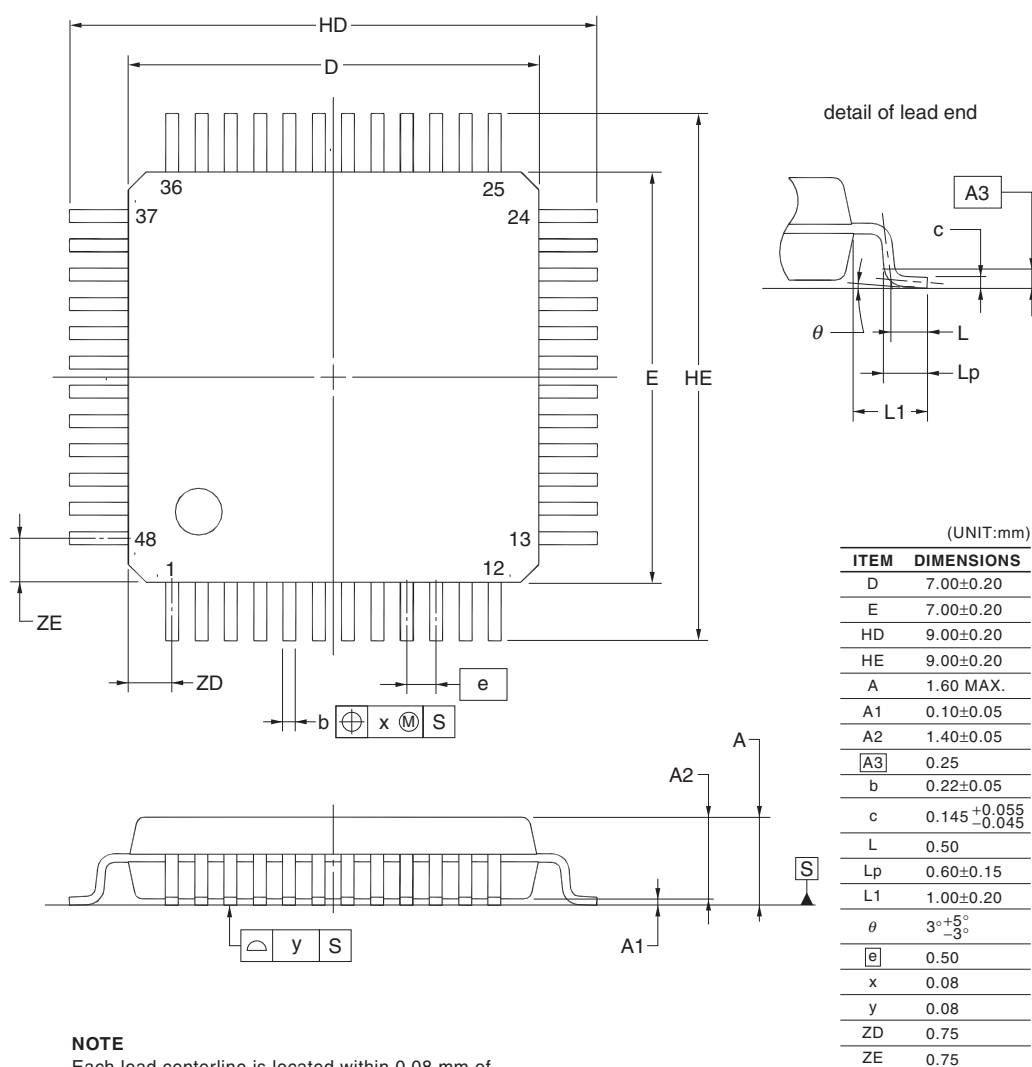
| (UNIT:mm) |            |
|-----------|------------|
| ITEM      | DIMENSIONS |
| D         | 3.00 ±0.10 |
| E         | 3.00 ±0.10 |
| w         | 0.20       |
| e         | 0.50       |
| A         | 0.69 ±0.07 |
| b         | 0.24 ±0.05 |
| x         | 0.05       |
| y         | 0.08       |
| y1        | 0.20       |
| ZD        | 0.50       |
| ZE        | 0.50       |

©2012 Renesas Electronics Corporation. All rights reserved.

## 4.9 48-pin Products

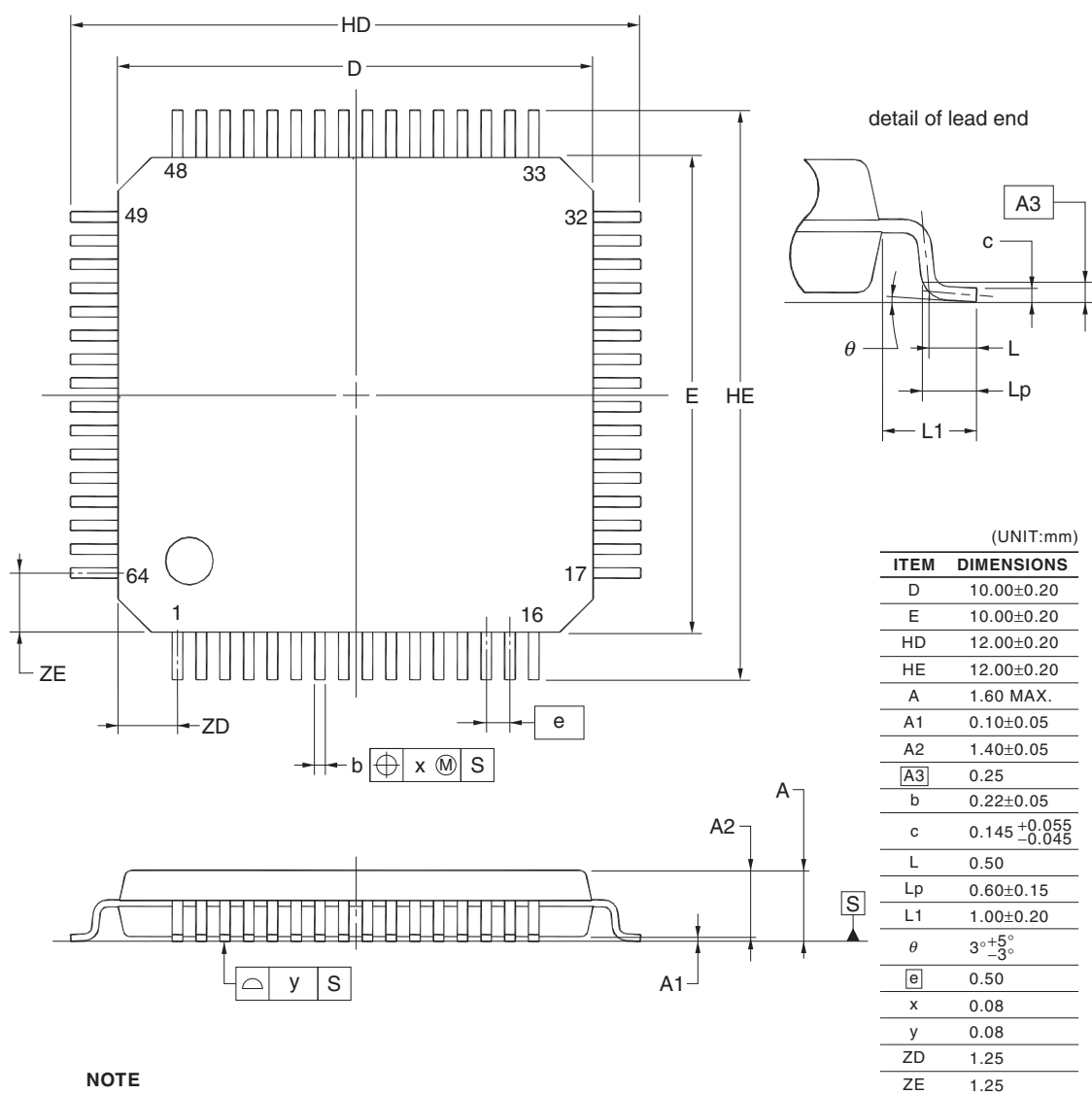
R5F100GAAFB, R5F100GCAFB, R5F100GDAFB, R5F100GEAFB, R5F100GFAFB, R5F100GGAFB,  
 R5F100GHAFB, R5F100GJAFB, R5F100GKAFB, R5F100GLAFB  
 R5F101GAAFB, R5F101GCAFB, R5F101GDAFB, R5F101GEAFB, R5F101GFAFB, R5F101GGAFB,  
 R5F101GHAFB, R5F101GJAFB, R5F101GKAFB, R5F101GLAFB  
 R5F100GADFB, R5F100GCDFB, R5F100GDDFB, R5F100GEDFB, R5F100GFDFB, R5F100GGDFB,  
 R5F100GHDFB, R5F100GJDFB, R5F100GKDFB, R5F100GLDFB  
 R5F101GADFB, R5F101GCDFB, R5F101GDDFB, R5F101GEDFB, R5F101GFDFB, R5F101GGDFB,  
 R5F101GHDFB, R5F101GJDFB, R5F101GKDFB, R5F101GLDFB  
 R5F100GAGFB, R5F100GCGFB, R5F100GDGFB, R5F100GEGFB, R5F100GFGFB, R5F100GGGFB,  
 R5F100GHGFB, R5F100GJGFB

| JEITA Package Code | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|--------------------|--------------|----------------|-----------------|
| P-LFQFP48-7x7-0.50 | PLQP0048KF-A | P48GA-50-8EU-1 | 0.16            |



R5F100LCAFB, R5F100LDAFB, R5F100LEAFB, R5F100LFAFB, R5F100LGAFB, R5F100LHAFB, R5F100LJAFB,  
 R5F100LKAFB, R5F100LLAFB  
 R5F101LCAFB, R5F101LDAFB, R5F101LEAFB, R5F101LFAFB, R5F101LGAFB, R5F101LHAFB,  
 R5F101LJAFB, R5F101LKAFB, R5F101LLAFB  
 R5F100LCDFB, R5F100LDDFB, R5F100LEDFB, R5F100LDFB, R5F100LGDFB, R5F100LHDFB, R5F100LJDFB,  
 R5F100LKDFB, R5F100LLDFB  
 R5F101LCDFB, R5F101LDDFB, R5F101LEDFB, R5F101LDFB, R5F101LGDFB, R5F101LHDFB,  
 R5F101LJDFB, R5F101LKDFB, R5F101LLDFB  
 R5F100LCGFB, R5F100LDGFB, R5F100LEGFB, R5F100LFGFB, R5F100LGGFB, R5F100LHGFB,  
 R5F100LJGFB

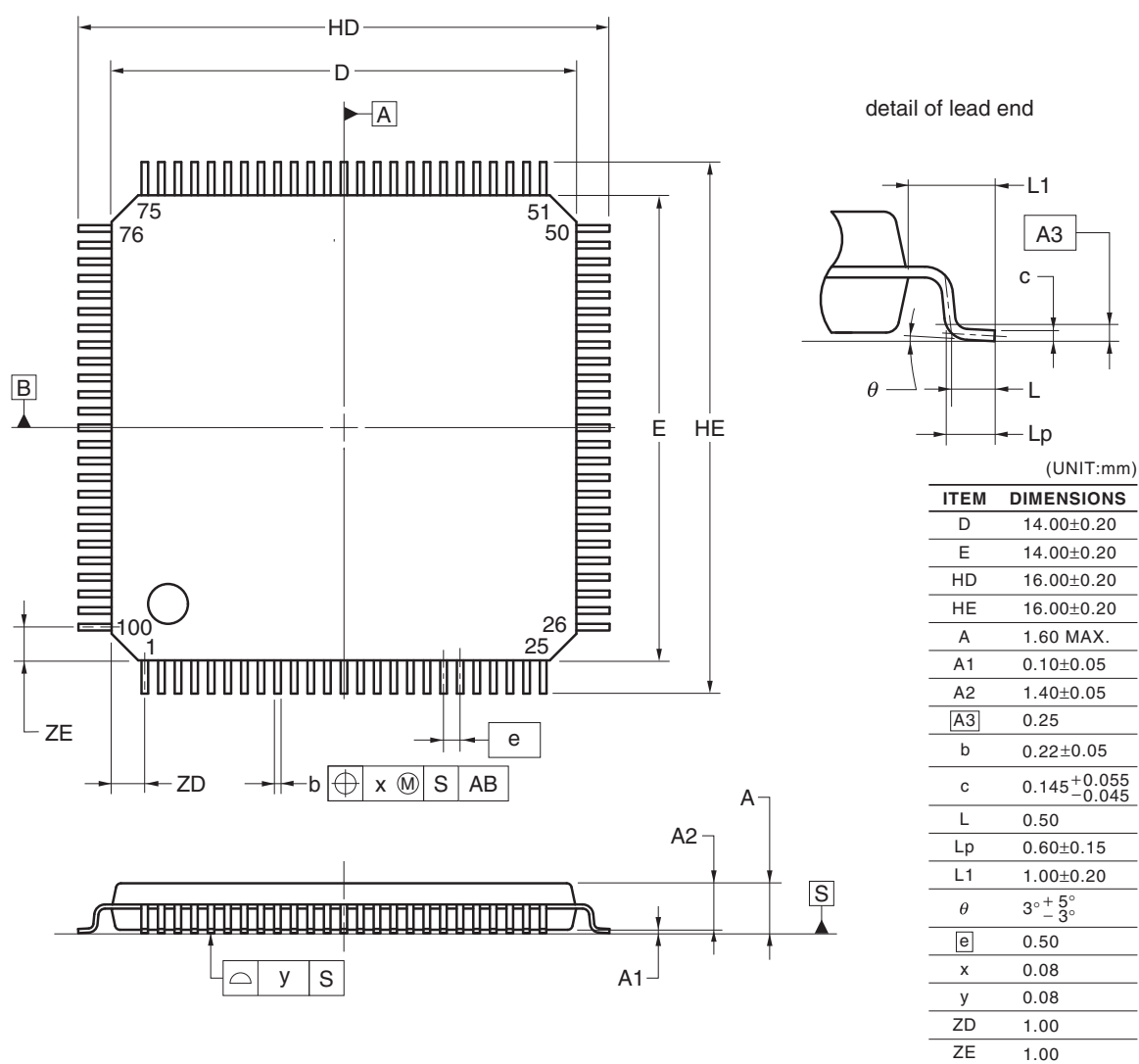
| JEITA Package Code   | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|----------------------|--------------|----------------|-----------------|
| P-LFQFP64-10x10-0.50 | PLQP0064KF-A | P64GB-50-UEU-2 | 0.35            |



## 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            |



© 2012 Renesas Electronics Corporation. All rights reserved.