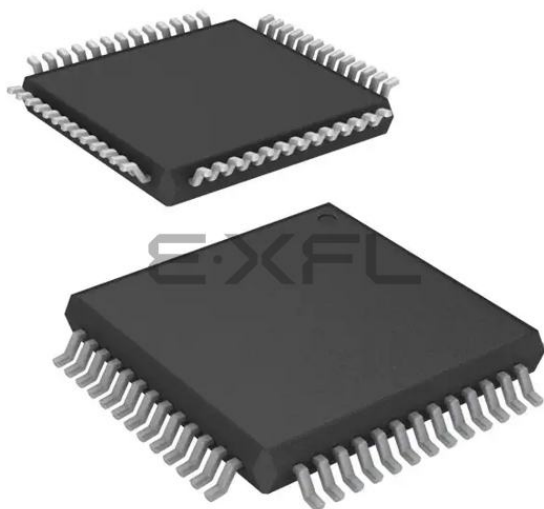




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### What is "[Embedded - Microcontrollers](#)"?

"[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              | 38                                                                                                                                                                            |
| Program Memory Size        | 64KB (64K x 8)                                                                                                                                                                |
| Program Memory Type        | FLASH                                                                                                                                                                         |
| EEPROM Size                | 4K x 8                                                                                                                                                                        |
| RAM Size                   | 4K x 8                                                                                                                                                                        |
| Voltage - Supply (Vcc/Vdd) | 1.6V ~ 5.5V                                                                                                                                                                   |
| Data Converters            | A/D 12x8/10b                                                                                                                                                                  |
| Oscillator Type            | Internal                                                                                                                                                                      |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                             |
| Mounting Type              | Surface Mount                                                                                                                                                                 |
| Package / Case             | 52-LQFP                                                                                                                                                                       |
| Supplier Device Package    | 52-LQFP (10x10)                                                                                                                                                               |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f100jedfa-x0">https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f100jedfa-x0</a> |

Table 1-1. List of Ordering Part Numbers

(10/12)

| Pin count | Package                                            | Data flash  | Fields of Application<br>Note | Ordering Part Number                                                                                                                                                                                 |
|-----------|----------------------------------------------------|-------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 80 pins   | 80-pin plastic LQFP<br>(14 × 14 mm, 0.65 mm pitch) | Mounted     | A                             | R5F100MFAFA#V0, R5F100MGFAFA#V0, R5F100MHAFA#V0, R5F100MJFAFA#V0, R5F100MKAFA#V0, R5F100MLAFA#V0<br>R5F100MFAFA#X0, R5F100MGFAFA#X0, R5F100MHAFA#X0, R5F100MJFAFA#X0, R5F100MKAFA#X0, R5F100MLAFA#X0 |
|           |                                                    |             | D                             | R5F100MFDFA#V0, R5F100MGDFA#V0, R5F100MHDFA#V0, R5F100MJDFA#V0, R5F100MKDFA#V0, R5F100MLDFA#V0<br>R5F100MFDFA#X0, R5F100MGDFA#X0, R5F100MHDFA#X0, R5F100MJDFA#X0, R5F100MKDFA#X0, R5F100MLDFA#X0     |
|           |                                                    |             | G                             | R5F100MFGFA#V0, R5F100MGGFA#V0, R5F100MHGFA#V0, R5F100MJGFA#V0<br>R5F100MFGFA#X0, R5F100MGGFA#X0, R5F100MHGFA#X0, R5F100MJGFA#X0                                                                     |
|           |                                                    | Not mounted | A                             | R5F101MFAFA#V0, R5F101MGFAFA#V0, R5F101MHAFA#V0, R5F101MJFAFA#V0, R5F101MKAFA#V0, R5F101MLAFA#V0<br>R5F101MFAFA#X0, R5F101MGFAFA#X0, R5F101MHAFA#X0, R5F101MJFAFA#X0, R5F101MKAFA#X0, R5F101MLAFA#X0 |
|           |                                                    |             | D                             | R5F101MFDFA#V0, R5F101MGDFA#V0, R5F101MHDFA#V0, R5F101MJDFA#V0, R5F101MKDFA#V0, R5F101MLDFA#V0<br>R5F101MFDFA#X0, R5F101MGDFA#X0, R5F101MHDFA#X0, R5F101MJDFA#X0, R5F101MKDFA#X0, R5F101MLDFA#X0     |
|           |                                                    |             | G                             | R5F101MFGFA#V0, R5F101MGGFA#V0, R5F101MHGFA#V0, R5F101MJGFA#V0<br>R5F101MFGFA#X0, R5F101MGGFA#X0, R5F101MHGFA#X0, R5F101MJGFA#X0                                                                     |
|           | 80-pin plastic LFQFP (12 × 12 mm, 0.5 mm pitch)    | Mounted     | A                             | R5F100MFAFB#V0, R5F100MGAFB#V0, R5F100MHAFB#V0, R5F100MJAFB#V0, R5F100MKAFB#V0, R5F100MLAFB#V0<br>R5F100MFAFB#X0, R5F100MGAFB#X0, R5F100MHAFB#X0, R5F100MJAFB#X0, R5F100MKAFB#X0, R5F100MLAFB#X0     |
|           |                                                    |             | D                             | R5F100MFDFA#V0, R5F100MGDFA#V0, R5F100MHDFA#V0, R5F100MJDFA#V0, R5F100MKDFA#V0, R5F100MLDFA#V0<br>R5F100MFDFA#X0, R5F100MGDFA#X0, R5F100MHDFA#X0, R5F100MJDFA#X0, R5F100MKDFA#X0, R5F100MLDFA#X0     |
|           |                                                    |             | G                             | R5F100MFGFA#V0, R5F100MGGFA#V0, R5F100MHGFA#V0, R5F100MJGFA#V0<br>R5F100MFGFA#X0, R5F100MGGFA#X0, R5F100MHGFA#X0, R5F100MJGFA#X0                                                                     |
|           |                                                    | Not mounted | A                             | R5F101MFAFB#V0, R5F101MGAFB#V0, R5F101MHAFB#V0, R5F101MJAFB#V0, R5F101MKAFB#V0, R5F101MLAFB#V0<br>R5F101MFAFB#X0, R5F101MGAFB#X0, R5F101MHAFB#X0, R5F101MJAFB#X0, R5F101MKAFB#X0, R5F101MLAFB#X0     |
|           |                                                    |             | D                             | R5F101MFDFA#V0, R5F101MGDFA#V0, R5F101MHDFA#V0, R5F101MJDFA#V0, R5F101MKDFA#V0, R5F101MLDFA#V0<br>R5F101MFDFA#X0, R5F101MGDFA#X0, R5F101MHDFA#X0, R5F101MJDFA#X0, R5F101MKDFA#X0, R5F101MLDFA#X0     |
|           |                                                    |             | G                             | R5F101MFGFA#V0, R5F101MGGFA#V0, R5F101MHGFA#V0, R5F101MJGFA#V0<br>R5F101MFGFA#X0, R5F101MGGFA#X0, R5F101MHGFA#X0, R5F101MJGFA#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.

Table 1-1. List of Ordering Part Numbers

(11/12)

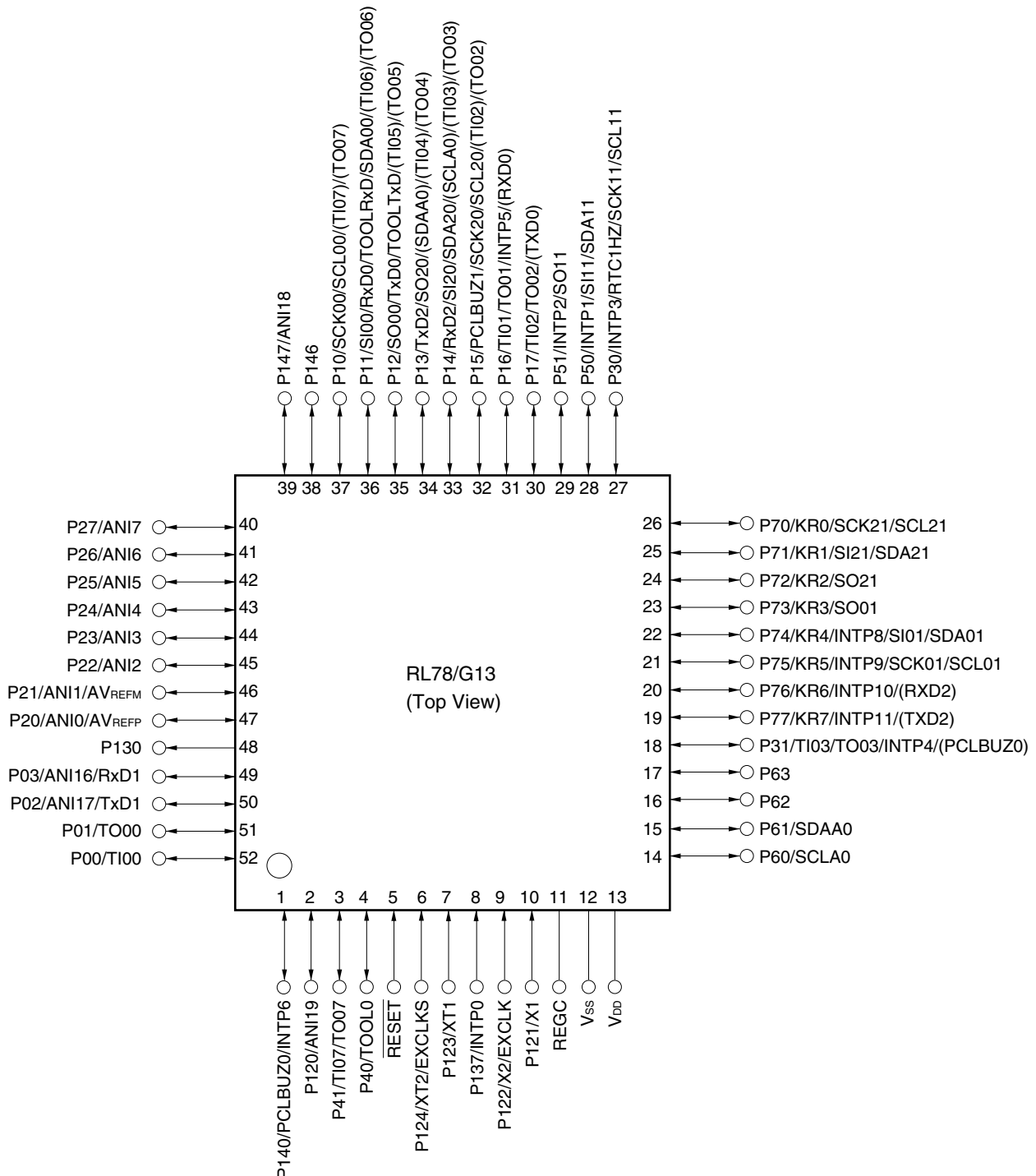
| Pin count | Package                                             | Data flash  | Fields of Application<br>Note | Ordering Part Number                                                                                                                                                                                   |
|-----------|-----------------------------------------------------|-------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 |
|           |                                                     |             | D                             | 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 |
|           |                                                     |             | G                             | 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 |
|           | 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 |
|           |                                                     |             | D                             | R5F100PFDA#V0, R5F100PGDA#V0, R5F100PHDA#V0,<br>R5F100PJDA#V0, R5F100PKDA#V0, R5F100PLDA#V0<br>R5F100PFDA#X0, R5F100PGDA#X0, R5F100PHDA#X0,<br>R5F100PJDA#X0, R5F100PKDA#X0, R5F100PLDA#X0             |
|           |                                                     |             | G                             | 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 |
|           |                                                     |             | D                             | R5F101PFDA#V0, R5F101PGDA#V0, R5F101PHDA#V0,<br>R5F101PJDA#V0, R5F101PKDA#V0, R5F101PLDA#V0<br>R5F101PFDA#X0, R5F101PGDA#X0, R5F101PHDA#X0,<br>R5F101PJDA#X0, R5F101PKDA#X0, R5F101PLDA#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.

## 1.3.10 52-pin products

- 52-pin plastic LQFP (10 × 10 mm, 0.65 mm pitch)

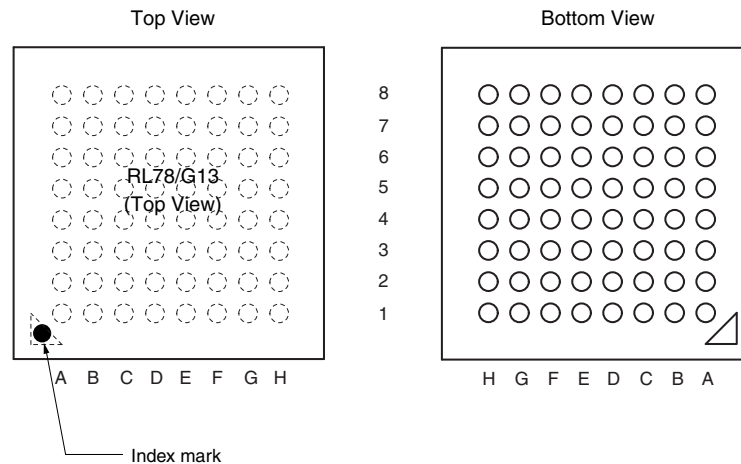


**Caution** Connect the REGC pin to V<sub>SS</sub> via a capacitor (0.47 to 1  $\mu$ F).

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

- 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.

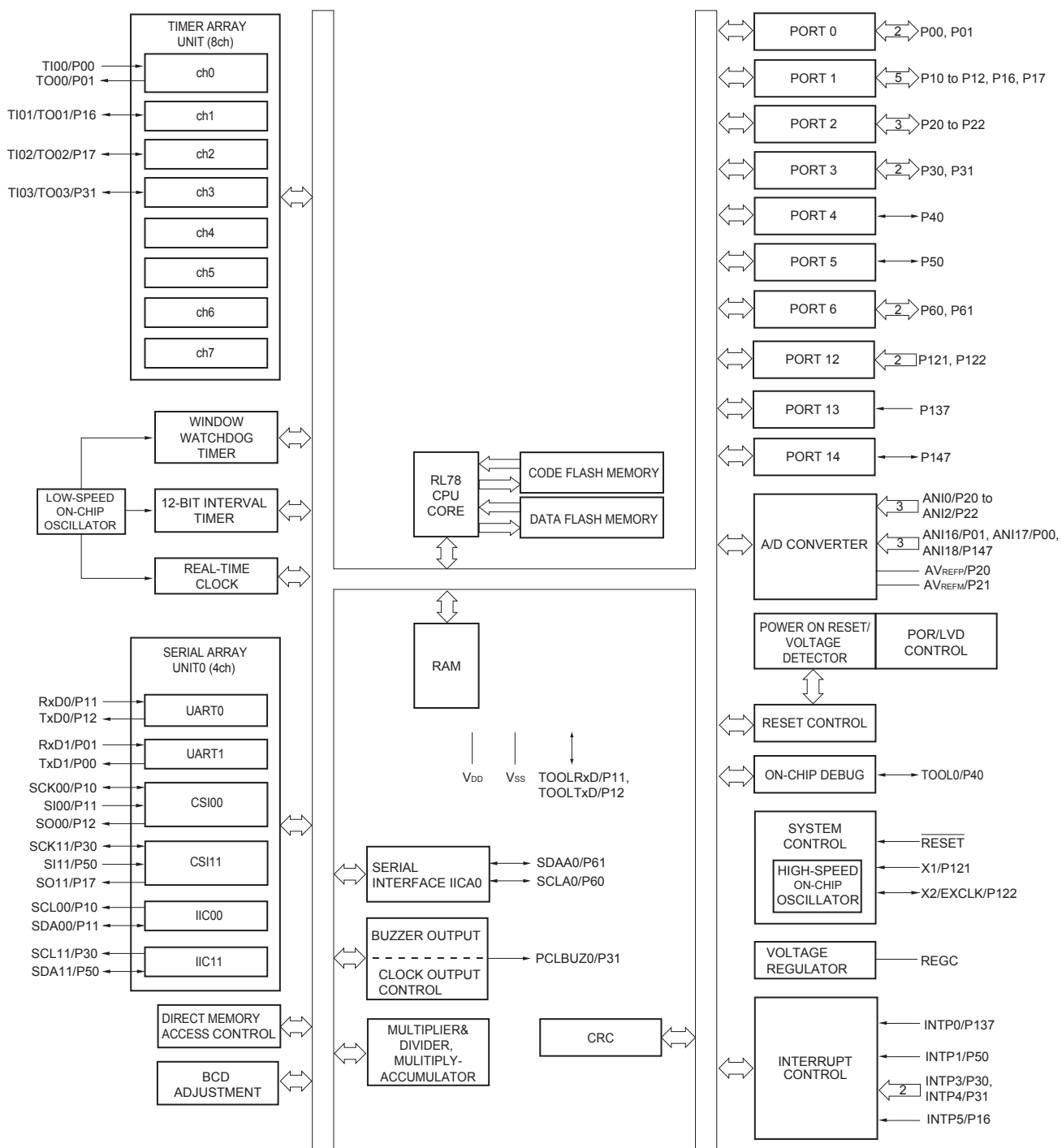
2. When using the microcontroller for an application where the noise generated inside the microcontroller must be reduced, it is recommended to supply separate powers to the V<sub>DD</sub> and EV<sub>DD0</sub> pins and connect the V<sub>SS</sub> and EV<sub>SS0</sub> pins to separate ground lines.

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.

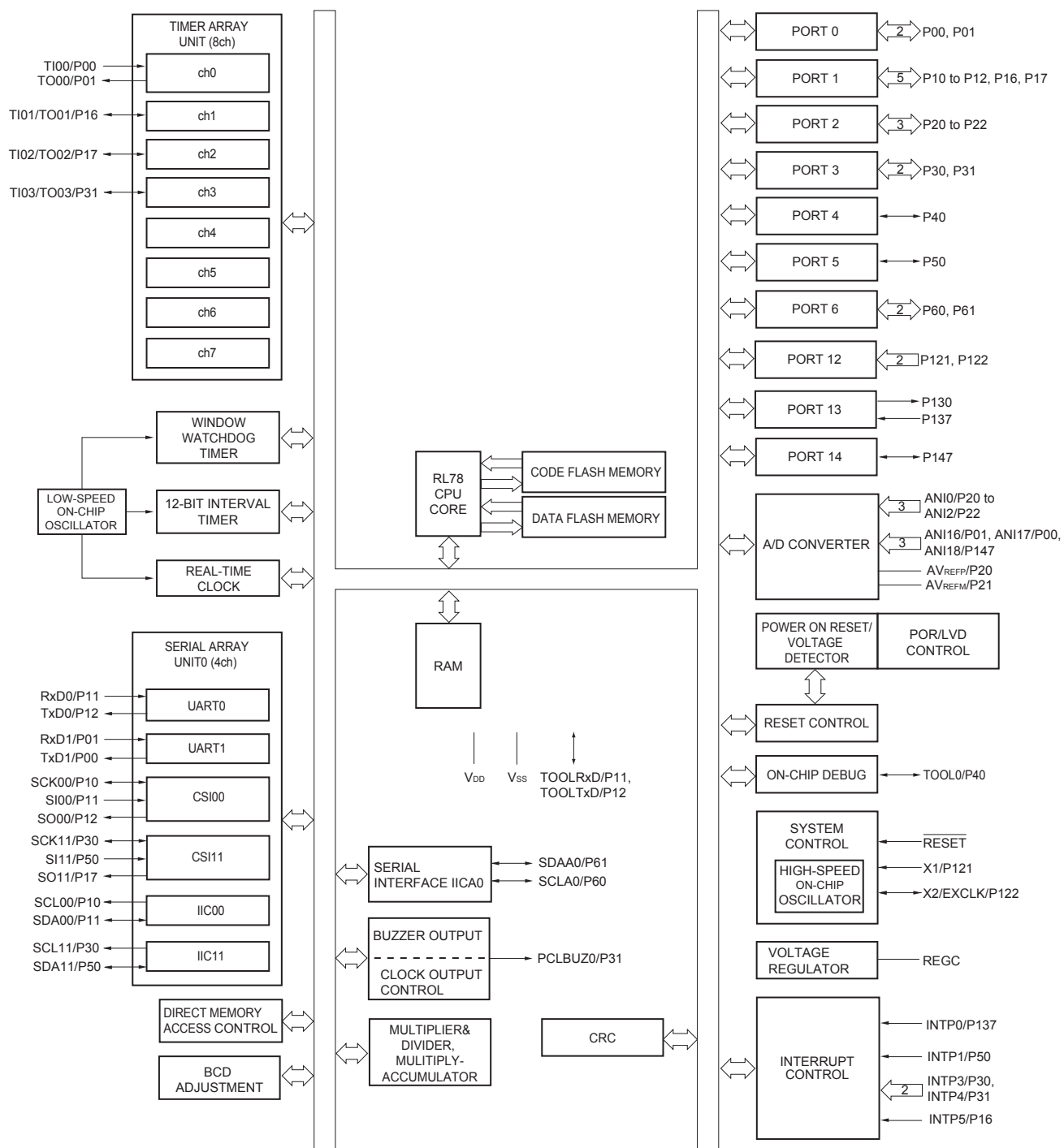
## 1.4 Pin Identification

|                   |                                                  |                                                                |                                                |
|-------------------|--------------------------------------------------|----------------------------------------------------------------|------------------------------------------------|
| ANI0 to ANI14,    |                                                  | REGC:                                                          | Regulator capacitance                          |
| ANI16 to ANI26:   | Analog input                                     | RESET:                                                         | Reset                                          |
| AVREFM:           | A/D converter reference potential (– side) input | RTC1HZ:                                                        | Real-time clock correction clock (1 Hz) output |
| AVREFP:           | A/D converter reference potential (+ side) input | RxD0 to RxD3:                                                  | Receive data                                   |
| EVDD0, EVDD1:     | Power supply for port                            | SCK00, SCK01, SCK10, SCK11, SCK20, SCK21,                      |                                                |
| EVSS0, EVSS1:     | Ground for port                                  | SCLA0, SCLA1:                                                  | Serial clock input/output                      |
| EXCLK:            | External clock input (Main system clock)         | SCLA0, SCLA1, SCL00, SCL01, SCL10, SCL11,                      |                                                |
| EXCLKS:           | External clock input (Subsystem clock)           | SCL20, SCL21, SCL30, SCL31:                                    | Serial clock output                            |
| INTP0 to INTP11:  | Interrupt request from peripheral                | SDAA0, SDAA1, SDA00, SDA01, SDA10, SDA11, SDA20, SDA21, SDA30, |                                                |
| KR0 to KR7:       | Key return                                       | SDA31:                                                         | Serial data input/output                       |
| P00 to P07:       | Port 0                                           | SI00, SI01, SI10, SI11,                                        |                                                |
| P10 to P17:       | Port 1                                           | SI20, SI21, SI30, SI31:                                        | Serial data input                              |
| P20 to P27:       | Port 2                                           | SO00, SO01, SO10,                                              |                                                |
| P30 to P37:       | Port 3                                           | SO11, SO20, SO21,                                              |                                                |
| P40 to P47:       | Port 4                                           | SO30, SO31:                                                    | Serial data output                             |
| P50 to P57:       | Port 5                                           | TI00 to TI07,                                                  |                                                |
| P60 to P67:       | Port 6                                           | TI10 to TI17:                                                  | Timer input                                    |
| P70 to P77:       | Port 7                                           | TO00 to TO07,                                                  |                                                |
| P80 to P87:       | Port 8                                           | TO10 to TO17:                                                  | Timer output                                   |
| P90 to P97:       | Port 9                                           | TOOL0:                                                         | Data input/output for tool                     |
| P100 to P106:     | Port 10                                          | TOOLRxD, TOOLTxD:                                              | Data input/output for external device          |
| P110 to P117:     | Port 11                                          | TxD0 to TxD3:                                                  | Transmit data                                  |
| P120 to P127:     | Port 12                                          | VDD:                                                           | Power supply                                   |
| P130, P137:       | Port 13                                          | VSS:                                                           | Ground                                         |
| P140 to P147:     | Port 14                                          | X1, X2:                                                        | Crystal oscillator (main system clock)         |
| P150 to P156:     | Port 15                                          | XT1, XT2:                                                      | Crystal oscillator (subsystem clock)           |
| PCLBUZ0, PCLBUZ1: | Programmable clock output/buzzer output          |                                                                |                                                |

## 1.5.2 24-pin products



## 1.5.3 25-pin products





## 2. ELECTRICAL SPECIFICATIONS ( $T_A = -40$ to $+85^\circ\text{C}$ )

This chapter describes the following electrical specifications.

Target products A: Consumer applications  $T_A = -40$  to  $+85^\circ\text{C}$

R5F100xxAxx, R5F101xxAxx

D: Industrial applications  $T_A = -40$  to  $+85^\circ\text{C}$

R5F100xxDxx, R5F101xxDxx

G: Industrial applications when  $T_A = -40$  to  $+105^\circ\text{C}$  products is used in the range of  $T_A = -40$  to  $+85^\circ\text{C}$

R5F100xxGxx

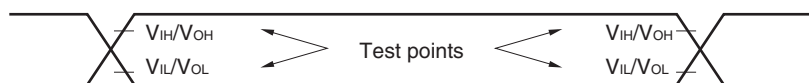
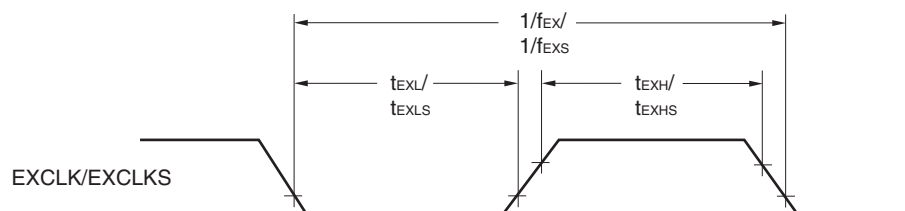
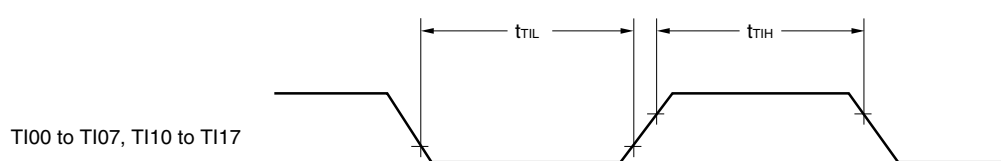
- Cautions**
1. The RL78 microcontrollers have an on-chip debug function, which is provided for development and evaluation. Do not use the on-chip debug function in products designated for mass production, because the guaranteed number of rewritable times of the flash memory may be exceeded when this function is used, and product reliability therefore cannot be guaranteed. Renesas Electronics is not liable for problems occurring when the on-chip debug function is used.
  2. With products not provided with an  $EV_{DD0}$ ,  $EV_{DD1}$ ,  $EV_{SS0}$ , or  $EV_{SS1}$  pin, replace  $EV_{DD0}$  and  $EV_{DD1}$  with  $V_{DD}$ , or replace  $EV_{SS0}$  and  $EV_{SS1}$  with  $V_{SS}$ .
  3. The pins mounted depend on the product. Refer to 2.1 Port Function to 2.2.1 Functions for each product.

## 2.4 AC Characteristics

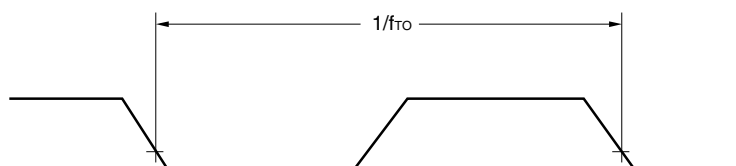
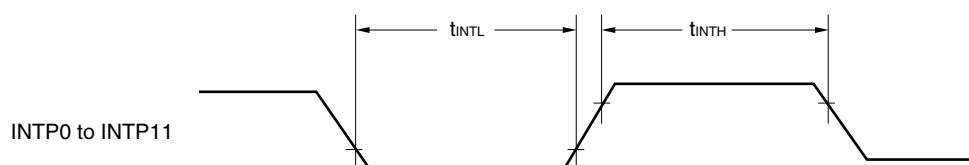
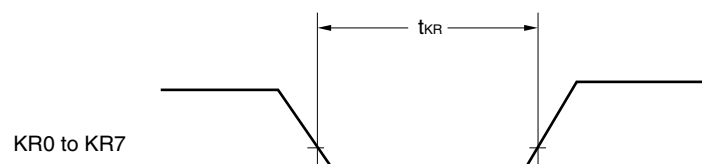
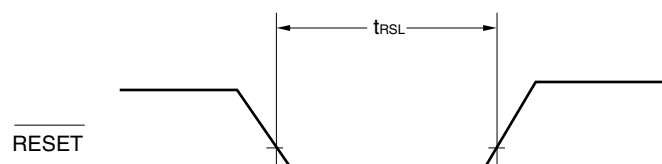
(T<sub>A</sub> = -40 to +85°C, 1.6 V ≤ EV<sub>DD0</sub> = EV<sub>DD1</sub> ≤ V<sub>DD</sub> ≤ 5.5 V, V<sub>SS</sub> = EV<sub>SS0</sub> = EV<sub>SS1</sub> = 0 V)

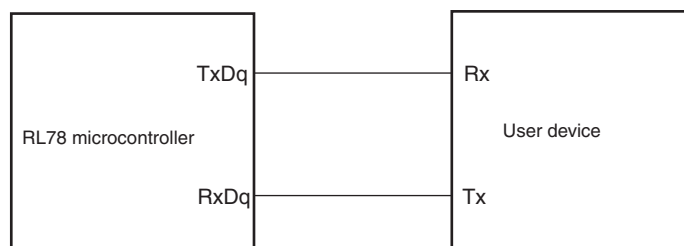
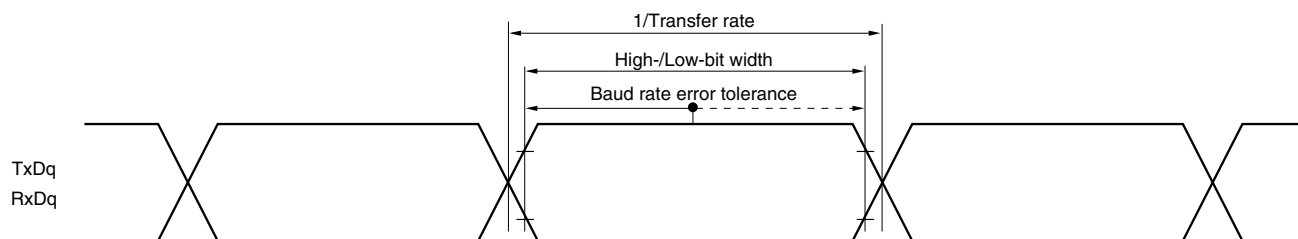
| Items                                                              | Symbol                                | Conditions                                       |                                   | MIN.                              | TYP.    | MAX. | Unit               |
|--------------------------------------------------------------------|---------------------------------------|--------------------------------------------------|-----------------------------------|-----------------------------------|---------|------|--------------------|
| Instruction cycle (minimum instruction execution time)             | T <sub>CY</sub>                       | Main system clock (f <sub>MAIN</sub> ) operation | HS (high-speed main) mode         | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.03125 | 1    | μs                 |
|                                                                    |                                       |                                                  |                                   | 2.4 V ≤ V <sub>DD</sub> < 2.7 V   | 0.0625  | 1    | μs                 |
|                                                                    |                                       |                                                  | LS (low-speed main) mode          | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.125   | 1    | μs                 |
|                                                                    |                                       |                                                  | LV (low-voltage main) mode        | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.25    | 1    | μs                 |
|                                                                    |                                       | Subsystem clock (f <sub>SUB</sub> ) operation    |                                   | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 28.5    | 30.5 | 31.3 μs            |
|                                                                    |                                       | In the self programming mode                     | HS (high-speed main) mode         | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.03125 | 1    | μs                 |
|                                                                    |                                       |                                                  |                                   | 2.4 V ≤ V <sub>DD</sub> < 2.7 V   | 0.0625  | 1    | μs                 |
|                                                                    |                                       |                                                  | LS (low-speed main) mode          | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.125   | 1    | μs                 |
|                                                                    |                                       |                                                  | LV (low-voltage main) mode        | 1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 0.25    | 1    | μs                 |
| External system clock frequency                                    | f <sub>EX</sub>                       | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V                  |                                   | 1.0                               |         | 20.0 | MHz                |
|                                                                    |                                       | 2.4 V ≤ V <sub>DD</sub> < 2.7 V                  |                                   | 1.0                               |         | 16.0 | MHz                |
|                                                                    |                                       | 1.8 V ≤ V <sub>DD</sub> < 2.4 V                  |                                   | 1.0                               |         | 8.0  | MHz                |
|                                                                    |                                       | 1.6 V ≤ V <sub>DD</sub> < 1.8 V                  |                                   | 1.0                               |         | 4.0  | MHz                |
|                                                                    | f <sub>EXS</sub>                      |                                                  |                                   | 32                                |         | 35   | kHz                |
| External system clock input high-level width, low-level width      | t <sub>EXH</sub> , t <sub>EXL</sub>   | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V                  |                                   | 24                                |         |      | ns                 |
|                                                                    |                                       | 2.4 V ≤ V <sub>DD</sub> < 2.7 V                  |                                   | 30                                |         |      | ns                 |
|                                                                    |                                       | 1.8 V ≤ V <sub>DD</sub> < 2.4 V                  |                                   | 60                                |         |      | ns                 |
|                                                                    |                                       | 1.6 V ≤ V <sub>DD</sub> < 1.8 V                  |                                   | 120                               |         |      | ns                 |
|                                                                    | t <sub>EXHS</sub> , t <sub>EXLS</sub> |                                                  |                                   | 13.7                              |         |      | μs                 |
| Ti00 to Ti07, Ti10 to Ti17 input high-level width, low-level width | t <sub>TIH</sub> , t <sub>TIL</sub>   |                                                  |                                   | 1/f <sub>MCK</sub> +10            |         |      | ns <sup>Note</sup> |
| TO00 to TO07, TO10 to TO17 output frequency                        | f <sub>TO</sub>                       | HS (high-speed main) mode                        |                                   | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 16   | MHz                |
|                                                                    |                                       |                                                  |                                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V |         | 8    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V |         | 4    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V |         | 2    | MHz                |
|                                                                    |                                       | LS (low-speed main) mode                         |                                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 4    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V |         | 2    | MHz                |
|                                                                    |                                       | LV (low-voltage main) mode                       |                                   | 1.6 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 2    | MHz                |
| PCLBUZ0, PCLBUZ1 output frequency                                  | f <sub>PCL</sub>                      | HS (high-speed main) mode                        |                                   | 4.0 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 16   | MHz                |
|                                                                    |                                       |                                                  |                                   | 2.7 V ≤ EV <sub>DD0</sub> < 4.0 V |         | 8    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.8 V ≤ EV <sub>DD0</sub> < 2.7 V |         | 4    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V |         | 2    | MHz                |
|                                                                    |                                       | LS (low-speed main) mode                         |                                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 4    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V |         | 2    | MHz                |
|                                                                    |                                       | LV (low-voltage main) mode                       |                                   | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V |         | 4    | MHz                |
|                                                                    |                                       |                                                  |                                   | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V |         | 2    | MHz                |
| Interrupt input high-level width, low-level width                  | t <sub>INTH</sub> , t <sub>INTL</sub> | INTP0                                            | 1.6 V ≤ V <sub>DD</sub> ≤ 5.5 V   | 1                                 |         |      | μs                 |
|                                                                    |                                       | INTP1 to INTP11                                  | 1.6 V ≤ EV <sub>DD0</sub> ≤ 5.5 V | 1                                 |         |      | μs                 |
| Key interrupt input low-level width                                | t <sub>KR</sub>                       | KR0 to KR7                                       | 1.8 V ≤ EV <sub>DD0</sub> ≤ 5.5 V | 250                               |         |      | ns                 |
|                                                                    |                                       |                                                  | 1.6 V ≤ EV <sub>DD0</sub> < 1.8 V | 1                                 |         |      | μs                 |
| RESET low-level width                                              | t <sub>RSL</sub>                      |                                                  |                                   | 10                                |         |      | μs                 |

(Note and Remark are listed on the next page.)

**AC Timing Test Points****External System Clock Timing****TI/TO Timing**

TO00 to TO07, TO10 to TO17

**Interrupt Request Input Timing****Key Interrupt Input Timing****RESET Input Timing**

**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))

## 2.8 Flash Memory Programming Characteristics

( $T_A = -40$  to  $+85^\circ\text{C}$ ,  $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ )

| Parameter                                                     | Symbol     | Conditions                                        | MIN.    | TYP.      | MAX. | Unit  |
|---------------------------------------------------------------|------------|---------------------------------------------------|---------|-----------|------|-------|
| CPU/peripheral hardware clock frequency                       | $f_{CLK}$  | $1.8\text{ V} \leq V_{DD} \leq 5.5\text{ V}$      | 1       |           | 32   | MHz   |
| Number of code flash rewrites<br><small>Notes 1, 2, 3</small> | $C_{erwr}$ | Retained for 20 years<br>$T_A = 85^\circ\text{C}$ | 1,000   |           |      | Times |
| Number of data flash rewrites<br><small>Notes 1, 2, 3</small> |            | Retained for 1 years<br>$T_A = 25^\circ\text{C}$  |         | 1,000,000 |      |       |
|                                                               |            | Retained for 5 years<br>$T_A = 85^\circ\text{C}$  | 100,000 |           |      |       |
|                                                               |            | Retained for 20 years<br>$T_A = 85^\circ\text{C}$ | 10,000  |           |      |       |

**Notes** 1. 1 erase + 1 write after the erase is regarded as 1 rewrite.

The retaining years are until next rewrite after the rewrite.

2. When using flash memory programmer and Renesas Electronics self programming library

3. These are the characteristics of the flash memory and the results obtained from reliability testing by Renesas Electronics Corporation.

## 2.9 Dedicated Flash Memory Programmer Communication (UART)

( $T_A = -40$  to  $+85^\circ\text{C}$ ,  $1.8\text{ V} \leq EV_{DD0} = EV_{DD1} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = EV_{SS0} = EV_{SS1} = 0\text{ V}$ )

| Parameter     | Symbol | Conditions                | MIN.    | TYP. | MAX.      | Unit |
|---------------|--------|---------------------------|---------|------|-----------|------|
| Transfer rate |        | During serial programming | 115,200 |      | 1,000,000 | bps  |

### 3.3.2 Supply current characteristics

#### (1) Flash ROM: 16 to 64 KB of 20- to 64-pin products

( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq V_{DD0} \leq V_{DD} \leq 5.5\text{ V}$ ,  $V_{SS} = V_{SS0} = 0\text{ V}$ ) (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 | $f_{IH} = 32\text{ MHz}$<br>Note 3                                    | Basic operation  | $V_{DD} = 5.0\text{ V}$ |      | 2.1  |      | mA            |
|                          |                  |                           |                                     |                                                                       |                  | $V_{DD} = 3.0\text{ V}$ |      | 2.1  |      | mA            |
|                          |                  |                           |                                     |                                                                       | Normal operation | $V_{DD} = 5.0\text{ V}$ |      | 4.6  | 7.5  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | $V_{DD} = 3.0\text{ V}$ |      | 4.6  | 7.5  | mA            |
|                          |                  |                           |                                     | $f_{IH} = 24\text{ MHz}$<br>Note 3                                    | Normal operation | $V_{DD} = 5.0\text{ V}$ |      | 3.7  | 5.8  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | $V_{DD} = 3.0\text{ V}$ |      | 3.7  | 5.8  | mA            |
|                          |                  |                           |                                     | $f_{IH} = 16\text{ MHz}$<br>Note 3                                    | Normal operation | $V_{DD} = 5.0\text{ V}$ |      | 2.7  | 4.2  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | $V_{DD} = 3.0\text{ V}$ |      | 2.7  | 4.2  | mA            |
|                          |                  |                           | HS (high-speed main) mode<br>Note 5 | $f_{MX} = 20\text{ MHz}$<br>Note 2,<br>$V_{DD} = 5.0\text{ V}$        | Normal operation | Square wave input       |      | 3.0  | 4.9  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 3.2  | 5.0  | mA            |
|                          |                  |                           |                                     | $f_{MX} = 20\text{ MHz}$<br>Note 2,<br>$V_{DD} = 3.0\text{ V}$        | Normal operation | Square wave input       |      | 3.0  | 4.9  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 3.2  | 5.0  | mA            |
|                          |                  |                           |                                     | $f_{MX} = 10\text{ MHz}$<br>Note 2,<br>$V_{DD} = 5.0\text{ V}$        | Normal operation | Square wave input       |      | 1.9  | 2.9  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 1.9  | 2.9  | mA            |
|                          |                  |                           |                                     | $f_{MX} = 10\text{ MHz}$<br>Note 2,<br>$V_{DD} = 3.0\text{ V}$        | Normal operation | Square wave input       |      | 1.9  | 2.9  | mA            |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 1.9  | 2.9  | mA            |
|                          |                  | Subsystem clock operation |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = -40^\circ\text{C}$  | Normal operation | Square wave input       |      | 4.1  | 4.9  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 4.2  | 5.0  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +25^\circ\text{C}$  | Normal operation | Square wave input       |      | 4.1  | 4.9  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 4.2  | 5.0  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +50^\circ\text{C}$  | Normal operation | Square wave input       |      | 4.2  | 5.5  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 4.3  | 5.6  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +70^\circ\text{C}$  | Normal operation | Square wave input       |      | 4.3  | 6.3  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 4.4  | 6.4  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +85^\circ\text{C}$  | Normal operation | Square wave input       |      | 4.6  | 7.7  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 4.7  | 7.8  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{SUB} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +105^\circ\text{C}$ | Normal operation | Square wave input       |      | 6.9  | 19.7 | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                       |                  | Resonator connection    |      | 7.0  | 19.8 | $\mu\text{A}$ |

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

**(2) Flash ROM: 96 to 256 KB of 30- to 100-pin products****( $T_A = -40$  to  $+105^\circ\text{C}$ ,  $2.4\text{ V} \leq \text{EV}_{\text{DD}0} = \text{EV}_{\text{DD}1} \leq \text{V}_{\text{DD}} \leq 5.5\text{ V}$ ,  $\text{V}_{\text{SS}} = \text{EV}_{\text{SS}0} = \text{EV}_{\text{SS}1} = 0\text{ V}$ ) (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 | $f_{\text{IH}} = 32\text{ MHz}$<br>Note 3                                        | Basic operation  | $\text{V}_{\text{DD}} = 5.0\text{ V}$ |      | 2.3  |      | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | $\text{V}_{\text{DD}} = 3.0\text{ V}$ |      | 2.3  |      | mA            |
|                          |                  |                           |                                     |                                                                                  | Normal operation | $\text{V}_{\text{DD}} = 5.0\text{ V}$ |      | 5.2  | 9.2  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | $\text{V}_{\text{DD}} = 3.0\text{ V}$ |      | 5.2  | 9.2  | mA            |
|                          |                  |                           |                                     | $f_{\text{IH}} = 24\text{ MHz}$<br>Note 3                                        | Normal operation | $\text{V}_{\text{DD}} = 5.0\text{ V}$ |      | 4.1  | 7.0  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | $\text{V}_{\text{DD}} = 3.0\text{ V}$ |      | 4.1  | 7.0  | mA            |
|                          |                  |                           |                                     | $f_{\text{IH}} = 16\text{ MHz}$<br>Note 3                                        | Normal operation | $\text{V}_{\text{DD}} = 5.0\text{ V}$ |      | 3.0  | 5.0  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | $\text{V}_{\text{DD}} = 3.0\text{ V}$ |      | 3.0  | 5.0  | mA            |
|                          |                  |                           | HS (high-speed main) mode<br>Note 5 | $f_{\text{MX}} = 20\text{ MHz}$<br>Note 2, $\text{V}_{\text{DD}} = 5.0\text{ V}$ | Normal operation | Square wave input                     |      | 3.4  | 5.9  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 3.6  | 6.0  | mA            |
|                          |                  |                           |                                     | $f_{\text{MX}} = 20\text{ MHz}$<br>Note 2, $\text{V}_{\text{DD}} = 3.0\text{ V}$ | Normal operation | Square wave input                     |      | 3.4  | 5.9  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 3.6  | 6.0  | mA            |
|                          |                  |                           |                                     | $f_{\text{MX}} = 10\text{ MHz}$<br>Note 2, $\text{V}_{\text{DD}} = 5.0\text{ V}$ | Normal operation | Square wave input                     |      | 2.1  | 3.5  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 2.1  | 3.5  | mA            |
|                          |                  |                           |                                     | $f_{\text{MX}} = 10\text{ MHz}$<br>Note 2, $\text{V}_{\text{DD}} = 3.0\text{ V}$ | Normal operation | Square wave input                     |      | 2.1  | 3.5  | mA            |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 2.1  | 3.5  | mA            |
|                          |                  | Subsystem clock operation |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = -40^\circ\text{C}$      | Normal operation | Square wave input                     |      | 4.8  | 5.9  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 4.9  | 6.0  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +25^\circ\text{C}$      | Normal operation | Square wave input                     |      | 4.9  | 5.9  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 5.0  | 6.0  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +50^\circ\text{C}$      | Normal operation | Square wave input                     |      | 5.0  | 7.6  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 5.1  | 7.7  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +70^\circ\text{C}$      | Normal operation | Square wave input                     |      | 5.2  | 9.3  | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 5.3  | 9.4  | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +85^\circ\text{C}$      | Normal operation | Square wave input                     |      | 5.7  | 13.3 | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 5.8  | 13.4 | $\mu\text{A}$ |
|                          |                  |                           |                                     | $f_{\text{SUB}} = 32.768\text{ kHz}$<br>Note 4<br>$T_A = +105^\circ\text{C}$     | Normal operation | Square wave input                     |      | 10.0 | 46.0 | $\mu\text{A}$ |
|                          |                  |                           |                                     |                                                                                  |                  | Resonator connection                  |      | 10.0 | 46.0 | $\mu\text{A}$ |

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

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

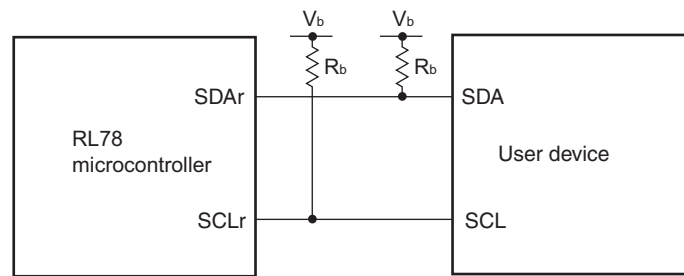
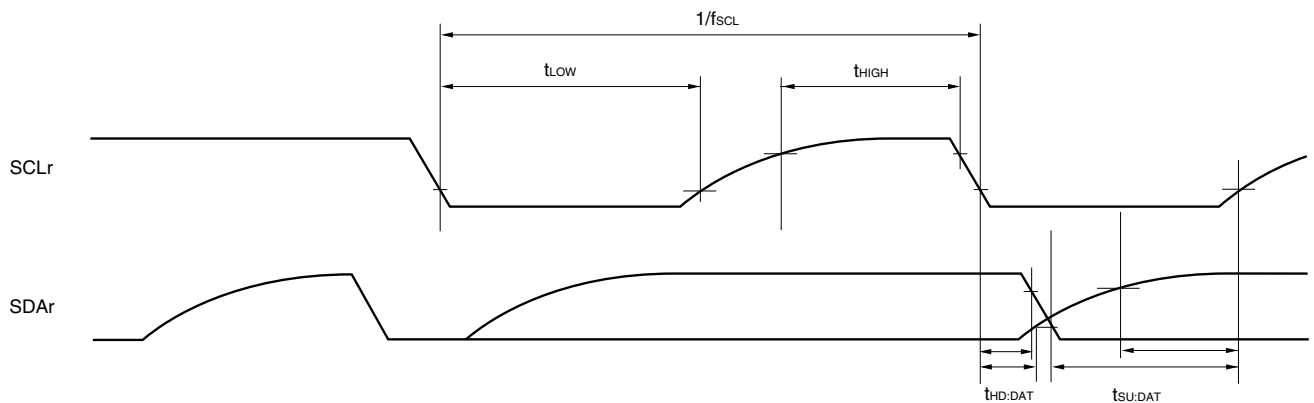
| Parameter                                      | Symbol                            | Conditions                       |                                                                                                                                | MIN. | TYP. | MAX.  | Unit          |
|------------------------------------------------|-----------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|-------|---------------|
| 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.



**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))

### 3.6 Analog Characteristics

#### 3.6.1 A/D converter characteristics

Classification of A/D converter characteristics

| Input channel                                                      | Reference Voltage                                                          |                                                                      |                                                                          |
|--------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------|
|                                                                    | Reference voltage (+) = $AV_{REFP}$<br>Reference voltage (-) = $AV_{REFM}$ | Reference voltage (+) = $V_{DD}$<br>Reference voltage (-) = $V_{SS}$ | Reference voltage (+) = $V_{BGR}$<br>Reference voltage (-) = $AV_{REFM}$ |
| ANI0 to ANI14                                                      | Refer to 3.6.1 (1).                                                        | Refer to 3.6.1 (3).                                                  | Refer to 3.6.1 (4).                                                      |
| ANI16 to ANI26                                                     | Refer to 3.6.1 (2).                                                        |                                                                      |                                                                          |
| Internal reference voltage<br>Temperature sensor output<br>voltage | Refer to 3.6.1 (1).                                                        |                                                                      | —                                                                        |

(1) When reference voltage (+) =  $AV_{REFP}/ANI0$  ( $ADREFP1 = 0$ ,  $ADREFP0 = 1$ ), reference voltage (-) =  $AV_{REFM}/ANI1$  ( $ADREFM = 1$ ), target pin : ANI2 to ANI14, internal reference voltage, and temperature sensor output voltage

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

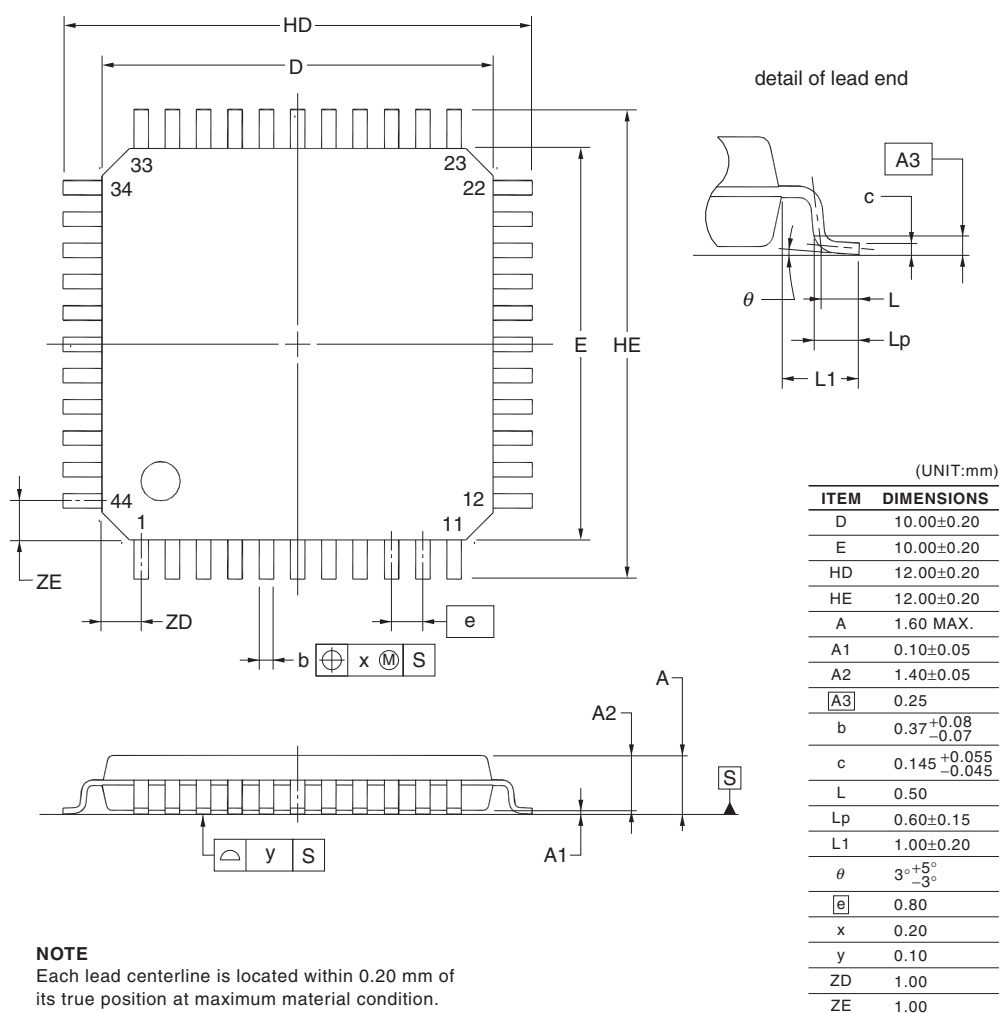
| Parameter                                         | Symbol     | Conditions                                                                                                                              |                                                 | MIN.                           | TYP. | MAX.        | Unit          |
|---------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------------------------------|------|-------------|---------------|
| Resolution                                        | RES        |                                                                                                                                         |                                                 | 8                              |      | 10          | bit           |
| Overall error <sup>Note 1</sup>                   | AINL       | 10-bit resolution<br>$AV_{REFP} = V_{DD}$ <sup>Note 3</sup>                                                                             | $2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ |                                | 1.2  | $\pm 3.5$   | LSB           |
| Conversion time                                   | $t_{CONV}$ | 10-bit resolution<br>Target pin: ANI2 to ANI14                                                                                          | $3.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 2.125                          |      | 39          | $\mu\text{s}$ |
|                                                   |            |                                                                                                                                         | $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 3.1875                         |      | 39          | $\mu\text{s}$ |
|                                                   |            |                                                                                                                                         | $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 17                             |      | 39          | $\mu\text{s}$ |
|                                                   |            | 10-bit resolution<br>Target pin: Internal reference<br>voltage, and temperature<br>sensor output voltage (HS<br>(high-speed main) mode) | $3.6\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 2.375                          |      | 39          | $\mu\text{s}$ |
|                                                   |            |                                                                                                                                         | $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 3.5625                         |      | 39          | $\mu\text{s}$ |
|                                                   |            |                                                                                                                                         | $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$    | 17                             |      | 39          | $\mu\text{s}$ |
| Zero-scale error <sup>Notes 1, 2</sup>            | $E_{ZS}$   | 10-bit resolution<br>$AV_{REFP} = V_{DD}$ <sup>Note 3</sup>                                                                             | $2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ |                                |      | $\pm 0.25$  | %FSR          |
| Full-scale error <sup>Notes 1, 2</sup>            | $E_{FS}$   | 10-bit resolution<br>$AV_{REFP} = V_{DD}$ <sup>Note 3</sup>                                                                             | $2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ |                                |      | $\pm 0.25$  | %FSR          |
| Integral linearity error<br><sup>Note 1</sup>     | ILE        | 10-bit resolution<br>$AV_{REFP} = V_{DD}$ <sup>Note 3</sup>                                                                             | $2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ |                                |      | $\pm 2.5$   | LSB           |
| Differential linearity error<br><sup>Note 1</sup> | DLE        | 10-bit resolution<br>$AV_{REFP} = V_{DD}$ <sup>Note 3</sup>                                                                             | $2.4\text{ V} \leq AV_{REFP} \leq 5.5\text{ V}$ |                                |      | $\pm 1.5$   | LSB           |
| Analog input voltage                              | $V_{AIN}$  | ANI2 to ANI14                                                                                                                           |                                                 | 0                              |      | $AV_{REFP}$ | V             |
|                                                   |            | Internal reference voltage output<br>( $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ , HS (high-speed main) mode)                        |                                                 | $V_{BGR}$ <sup>Note 4</sup>    |      |             | V             |
|                                                   |            | Temperature sensor output voltage<br>( $2.4\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ , HS (high-speed main) mode)                        |                                                 | $V_{TMPS25}$ <sup>Note 4</sup> |      |             | V             |

(Notes are listed on the next page.)

## 4.8 44-pin Products

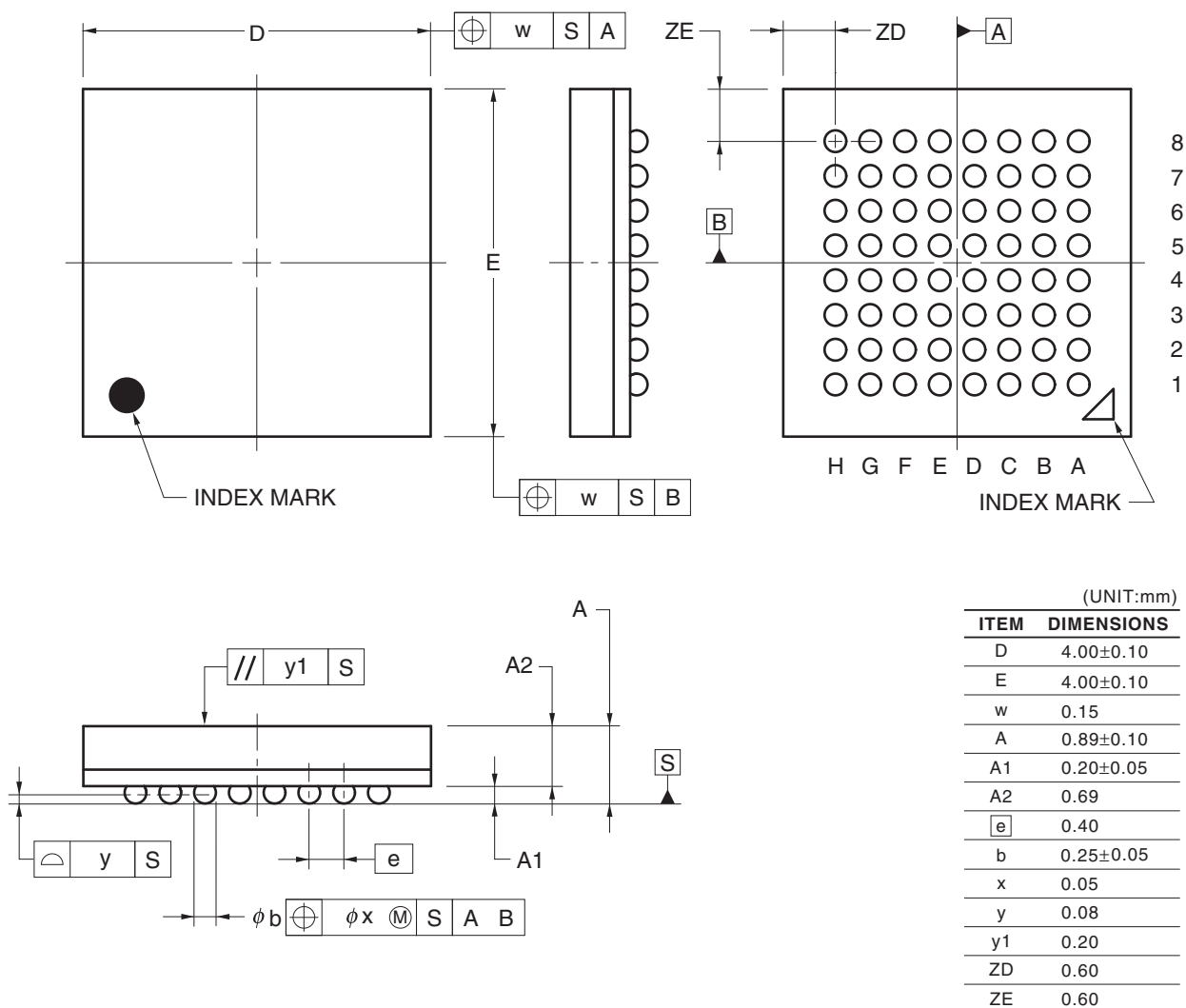
R5F100FAAFP, R5F100FCAFP, R5F100FDAFP, R5F100FEAFP, R5F100FFAFP, R5F100FGAFP,  
 R5F100FHAFP, R5F100FJAFP, R5F100FKAFP, R5F100FLAFP  
 R5F101FAAFP, R5F101FCAFP, R5F101FDAFP, R5F101FEAFP, R5F101FFAFP, R5F101FGAFP,  
 R5F101FHAFP, R5F101FJAFP, R5F101FKAFP, R5F101FLAFP  
 R5F100FADFP, R5F100FCDFP, R5F100FDDFP, R5F100FEDFP, R5F100FFDFP, R5F100FGDFP,  
 R5F100FHDFP, R5F100FJDFP, R5F100FKDFP, R5F100FLDFP  
 R5F101FADFP, R5F101FCDFP, R5F101FDDFP, R5F101FEDFP, R5F101FFDFP, R5F101FGDFP,  
 R5F101FHDFP, R5F101FJDFP, R5F101FKDFP, R5F101FLDFP  
 R5F100FAGFP, R5F100FCGFP, R5F100FDGFP, R5F100FEGFP, R5F100FFGFP, R5F100FGGFP,  
 R5F100FHGFP, R5F100FJGFP

| JEITA Package Code  | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|---------------------|--------------|----------------|-----------------|
| P-LQFP44-10x10-0.80 | PLQP0044GC-A | P44GB-80-UES-2 | 0.36            |



R5F100LCABG, R5F100LDABG, R5F100LEABG, R5F100LFABG, R5F100LGABG, R5F100LHABG,  
 R5F100LJABG  
 R5F101LCABG, R5F101LDABG, R5F101LEABG, R5F101LFABG, R5F101LGABG, R5F101LHABG,  
 R5F101LJABG  
 R5F100LCGBG, R5F100LDGBG, R5F100LEGBG, R5F100LFGBG, R5F100LGGBG, R5F100LHGBG,  
 R5F100LJGBG

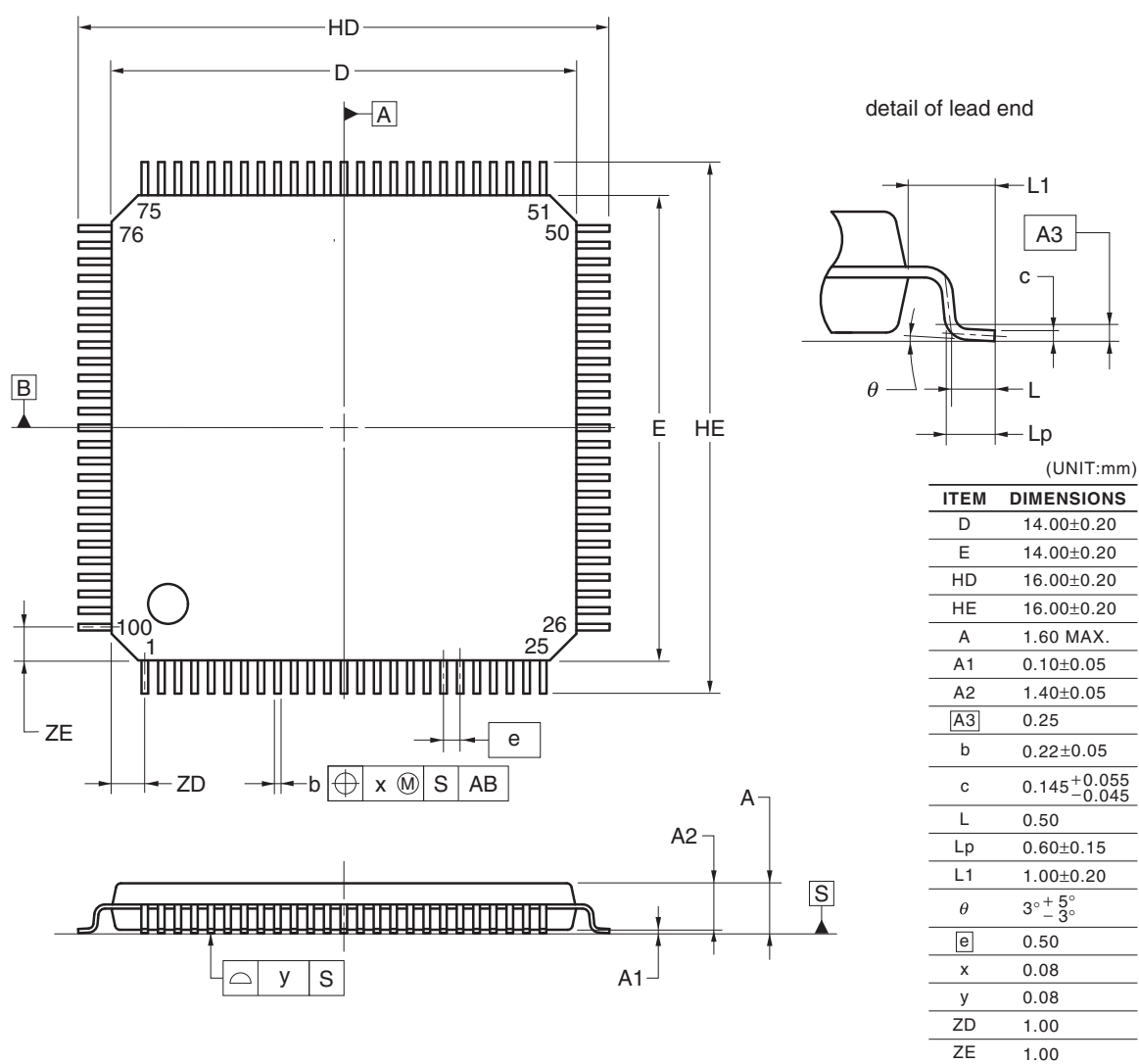
| JEITA Package Code | RENESAS Code | Previous Code  | MASS (TYP.) [g] |
|--------------------|--------------|----------------|-----------------|
| P-VFBGA64-4x4-0.40 | PVBG0064LA-A | P64F1-40-AA2-2 | 0.03            |



## 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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