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RENESAS TECHNICAL UPDATE

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Product Category	MPU/MCU		Document No.	TN-RL*-A0105A/E	Rev.	1.00
Title	Correction for Incorrect Description Notice RL78/G13A Descriptions in the User's Manual: Hardware Rev. 1.10 Changed		Information Category	Technical Notification		
Applicable Product	RL78/G13A Group	Lot No. All lots	Reference Document	RL78/G13A User's Manual: Hardware Rev. 1.10 R01UH0856EJ0110 (Sep. 2020)		

This document describes misstatements found in the RL78/G13A User's Manual: Hardware Rev. 1.10 (R01UH0856EJ0110).

Corrections

Applicable Item	Applicable Page	Contents
7.3.4 Real-time clock control register 1 (RTCC1)	Page 312	Incorrect descriptions revised
Figure 7-21. Procedure for Reading Real-time Clock	Page 324	Incorrect descriptions revised
Figure 7-22. Procedure for Writing Real-time Clock	Page 325	Incorrect descriptions revised
29.3.2 Supply current characteristics	Page 866 to Page 869	Incorrect descriptions revised
30.3.2 Supply current characteristics	Page 927 to Page 930	Incorrect descriptions revised

Document Improvement

The above corrections will be made for the next revision of the User's Manual: Hardware.

Corrections in the User's Manual: Hardware

No.	Corrections and Applicable Items			Pages in this document for corrections
	Document No.	English	R01UH0856EJ0110	
1	7.3.4 Real-time clock control register 1 (RTCC1)		Page 312	Page 3
2	Figure 7-21. Procedure for Reading Real-time Clock		Page 324	Page 4
3	Figure 7-22. Procedure for Writing Real-time Clock		Page 325	Page 4
4	29.3.2 Supply current characteristics		Page 866 to Page 869	Page 5 to Page 7
5	30.3.2 Supply current characteristics		Page 927 to Page 930	Page 8 to Page 10

Incorrect: Bold with underline; Correct: Gray hatched

Revision History

RL78/G13A Correction for incorrect description notice

Document Number	Issue Date	Description
TN-RL*-A0105A/E	Jan. 19, 2023	First edition issued Corrections No.1 to No.5 revised (this document)

1. 7.3.4 Real-time clock control register 1 (RTCC1) (Page 312)

Incorrect:

Figure 7-5. Format of Real-time Clock Control Register 1 (RTCC1) (2/2)

RIFG	Constant-period interrupt status flag
0	Constant-period interrupt is not generated.
1	Constant-period interrupt is generated.
This flag indicates the status of generation of the constant-period interrupt. When the constant-period interrupt is generated, it is set to “1”. This flag is cleared when “0” is written to it. Writing “1” to it is invalid.	

RWST	Wait status flag of real-time clock
0	Counter is operating.
1	Mode to read or write counter value
This status flag indicates whether the setting of the RWAIT bit is valid. Before reading or writing the counter value, confirm that the value of this flag is 1.	

RWAIT	Wait control of real-time clock
0	Sets counter operation.
1	Stops SEC to YEAR counters. Mode to read or write counter value
This bit controls the operation of the counter. Be sure to write “1” to it to read or write the counter value. As the internal counter (16-bit) is continuing to run, complete reading or writing within one second and turn back to 0. When RWAIT = 1, it takes up to one cycle of f_{RTC} until the counter value can be read or written (RWST = 1).Notes 1, 2 When the internal counter (16-bit) overflowed while RWAIT = 1, it keeps the event of overflow until RWAIT = 0, then counts up. However, when it wrote a value to second count register, it will not keep the overflow event.	

Correct:

Figure 7-5. Format of Real-time Clock Control Register 1 (RTCC1) (2/2)

RIFG	Constant-period interrupt status flag
0	Constant-period interrupt is not generated.
1	Constant-period interrupt is generated.
This flag indicates the status of generation of the constant-period interrupt. When the constant-period interrupt is generated, it is set to “1”. This flag is cleared when “0” is written to it. Writing “1” to it is invalid.	

RWST	Wait status flag of real-time clock
0	Counter is operating.
1	Mode to read or write counter value
This status flag indicates whether the setting of the RWAIT bit is valid. Before reading or writing the counter value, confirm that the value of this flag is 1.	

RWAIT	Wait control of real-time clock
0	Sets counter operation.
1	Stops SEC to YEAR counters. Mode to read or write counter value
This bit controls the operation of the counter. Be sure to write “1” to it to read or write the counter value. As the internal counter (16-bit) is continuing to run, complete reading or writing within one second and turn back to 0. When reading or writing to the counter is required while generation of the alarm interrupt is enabled, first set the CT2 to CT0 bits to 010B (generating the constant-period interrupt once per 1 second). Then, complete the processing from setting the RWAIT bit to 1 to setting it to 0 before generation of the next constant-period interrupt. When RWAIT = 1, it takes up to one cycle of f_{RTC} until the counter value can be read or written (RWST = 1).Notes 1, 2 When the internal counter (16-bit) overflowed while RWAIT = 1, it keeps the event of overflow until RWAIT = 0, then counts up. However, when it wrote a value to second count register, it will not keep the overflow event.	

2. Figure 7-21. Procedure for Reading Real-time Clock (Page 324)

Incorrect:

Note Be sure to confirm that RWST = 0 before setting STOP mode.

Caution Complete the series of process of setting the RWAIT bit to 1 to clearing the RWAIT bit to 0 within 1 second.

Remark The second count register (SEC), minute count register (MIN), hour count register (HOUR), week count register (WEEK), day count register (DAY), month count register (MONTH), and year count register (YEAR) may be read in any sequence. All the registers do not have to read and only some registers may be read.

Correct:

Note Be sure to confirm that RWST = 0 before setting STOP mode.

Caution Complete the series of process of setting the RWAIT bit to 1 to clearing the RWAIT bit to 0 within 1 second. When reading to the counter is required while generation of the alarm interrupt is enabled, first set the CT2 to CT0 bits to 010B (generating the constant-period interrupt once per 1 second). Then, complete the processing from setting the RWAIT bit to 1 to setting it to 0 before generation of the next constant-period interrupt.

Remark The second count register (SEC), minute count register (MIN), hour count register (HOUR), week count register (WEEK), day count register (DAY), month count register (MONTH), and year count register (YEAR) may be read in any sequence. All the registers do not have to read and only some registers may be read.

3. Figure 7-22. Procedure for Writing Real-time Clock (Page 325)

Incorrect:

Note Be sure to confirm that RWST = 0 before setting STOP mode.

Cautions 1. Complete the series of operations of setting the RWAIT bit to 1 to clearing the RWAIT bit to 0 within 1 second.

2. When changing the values of the SEC, MIN, HOUR, WEEK, DAY, MONTH, and YEAR register while the counter operates (RTCE = 1), rewrite the values of the MIN register after disabling interrupt servicing INTRTC by using the interrupt mask flag register. Furthermore, clear the WAFG, RIFG and RTCIF flags after rewriting the MIN register.

Remark The second count register (SEC), minute count register (MIN), hour count register (HOUR), week count register (WEEK), day count register (DAY), month count register (MONTH), and year count register (YEAR) may be written in any sequence. All the registers do not have to be set and only some registers may be written.

Correct:

Note Be sure to confirm that RWST = 0 before setting STOP mode.

Cautions 1. Complete the series of operations of setting the RWAIT bit to 1 to clearing the RWAIT bit to 0 within 1 second. When writing to the counter is required while generation of the alarm interrupt is enabled, first set the CT2 to CT0 bits to 010B (generating the constant-period interrupt once per 1 second). Then, complete the processing from setting the RWAIT bit to 1 to setting it to 0 before generation of the next constant-period interrupt.

2. When changing the values of the SEC, MIN, HOUR, WEEK, DAY, MONTH, and YEAR register while the counter operates (RTCE = 1), rewrite the values of the MIN register after disabling interrupt servicing INTRTC by using the interrupt mask flag register. Furthermore, clear the WAFG, RIFG and RTCIF flags after rewriting the MIN register.

Remark The second count register (SEC), minute count register (MIN), hour count register (HOUR), week count register (WEEK), day count register (DAY), month count register (MONTH), and year count register (YEAR) may be written in any sequence. All the registers do not have to be set and only some registers may be written.

4. 29.3.2 Supply current characteristics (Page 866 to Page 869)

Incorrect:

29.3.2 Supply current characteristics

(T_A = –40 to +85°C, 1.6 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions					MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD1}	Operating mode	HS (high-speed main) mode Note 5	f_{IH} = 32 MHz Note 3	Basic operation	V_{DD} = 5.0 V		1.5		mA
						V_{DD} = 3.0 V		1.5		mA
					Normal operation	V_{DD} = 5.0 V		3.4	6.8	mA
						V_{DD} = 3.0 V		3.4	6.8	mA
				f_{SUB} = 32.768 kHz Note 4	Normal operation	Square wave input		6.6	25.8	μA
				T_A = +85°C		Resonator connection		7.1	26	μA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. **The values below the MAX. column include the peripheral operation current. However, not including the current flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors and the current flowing during data flash rewrite.**

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

3. When high-speed system clock and subsystem clock are stopped.

4. When high-speed on-chip oscillator and high-speed system clock are stopped. When AMPHS1 = 1 (Ultra-low power consumption oscillation). **However, not including the current flowing into the RTC, 12-bit interval timer, and watchdog timer.**

5. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.

HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz
LS (low-speed main) mode: 1.8 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 8 MHz
LV (low-voltage main) mode: 1.6 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 4 MHz

Remarks 1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

2. f_{IH}: High-speed on-chip oscillator clock frequency

3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

4. Except subsystem clock operation, temperature condition of the TYP. value is T_A = 25°C

Correct:

29.3.2 Supply current characteristics

(T_A = –40 to +85°C, 1.6 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions					MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD1}	Operating mode	HS (high-speed main) mode Note 5	f_{IH} = 32 MHz Note 3	Basic operation	V_{DD} = 5.0 V		1.5		mA
						V_{DD} = 3.0 V		1.5		mA
					Normal operation	V_{DD} = 5.0 V		3.4	6.8	mA
						V_{DD} = 3.0 V		3.4	6.8	mA
				f_{SUB} = 32.768 kHz Note 4	Normal operation	Square wave input		6.6	25.8	μA
				T_A = +85°C		Resonator connection		7.1	26	μA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. The following points apply in the HS (high-speed main), LS (low-speed main), and LV (low-voltage main) modes.
- The currents in the “TYP.” column do not include the operating currents of the peripheral modules.
- The currents in the “MAX.” column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

In the subsystem clock operation, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules. However, in HALT mode, including the current flowing into the RTC.

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

3. When high-speed system clock and subsystem clock are stopped.

4. When high-speed on-chip oscillator and high-speed system clock are stopped. When AMPHS1 = 1 (Ultra-low power consumption oscillation).

5. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.

HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz
LS (low-speed main) mode: 1.8 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 8 MHz
LV (low-voltage main) mode: 1.6 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 4 MHz

Remarks 1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

2. f_{IH}: High-speed on-chip oscillator clock frequency

3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

4. Except subsystem clock operation, temperature condition of the TYP. value is T_A = 25°C

(T_A = –40 to +85°C, 1.6 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (2/2)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD2} Note 2	HALT mode	HS (high-speed main) mode Note 7	f_{IH} = 32 MHz Note 4	V_{DD} = 5.0 V		0.41	1.71	mA
					V_{DD} = 3.0 V		0.41	1.71	mA
				f_{IH} = 24 MHz Note 4	V_{DD} = 5.0 V		0.34	1.35	mA
					V_{DD} = 3.0 V		0.34	1.35	mA
				f_{IH} = 16 MHz Note 4	V_{DD} = 5.0 V		0.33	1.04	mA
					V_{DD} = 3.0 V		0.33	1.04	mA
			LS (low-speed main) mode Note 7	f_{IH} = 8 MHz Note 4	V_{DD} = 3.0 V		290	650	µA
					V_{DD} = 2.0 V		290	650	µA
			LV (low-voltage main) mode Note 7	f_{IH} = 4 MHz Note 4	V_{DD} = 3.0 V		270	540	µA
					V_{DD} = 2.0 V		270	540	µA
			HS (high-speed main) mode Note 7	f_{MX} = 20 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 20 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
			LS (low-speed main) mode Note 7	f_{MX} = 8 MHz Note 3, V_{DD} = 3.0 V	Square wave input		100	410	µA
					Resonator connection		200	520	µA
				f_{MX} = 8 MHz Note 3, V_{DD} = 2.0 V	Square wave input		100	410	µA
					Resonator connection		200	520	µA
	Note 6 I_{DD3}	STOP mode Note 8	T_A = –40°C				0.26	0.7	µA
			T_A = +25°C				0.42	1.9	µA
			T_A = +50°C				0.85	4.5	µA
			T_A = +70°C				1.60	11	µA
			T_A = +85°C				2.60	21	µA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. **The values below the MAX. column include the peripheral operation current. However, not including the current flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors and the current flowing during data flash rewrite.**

2. During HALT instruction execution by flash memory.

3. When high-speed on-chip oscillator and subsystem clock are stopped.

4. When high-speed system clock and subsystem clock are stopped.

(T_A = –40 to +85°C, 1.6 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (2/2)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD2} Note 2	HALT mode	HS (high-speed main) mode Note 6	f_{IH} = 32 MHz Note 4	V_{DD} = 5.0 V		0.41	1.71	mA
					V_{DD} = 3.0 V		0.41	1.71	mA
				f_{IH} = 24 MHz Note 4	V_{DD} = 5.0 V		0.34	1.35	mA
					V_{DD} = 3.0 V		0.34	1.35	mA
				f_{IH} = 16 MHz Note 4	V_{DD} = 5.0 V		0.33	1.04	mA
					V_{DD} = 3.0 V		0.33	1.04	mA
			LS (low-speed main) mode Note 6	f_{IH} = 8 MHz Note 4	V_{DD} = 3.0 V		290	650	µA
					V_{DD} = 2.0 V		290	650	µA
			LV (low-voltage main) mode Note 6	f_{IH} = 4 MHz Note 4	V_{DD} = 3.0 V		270	540	µA
					V_{DD} = 2.0 V		270	540	µA
			HS (high-speed main) mode Note 6	f_{MX} = 20 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 20 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
			LS (low-speed main) mode Note 6	f_{MX} = 8 MHz Note 3, V_{DD} = 3.0 V	Square wave input		100	410	µA
					Resonator connection		200	520	µA
				f_{MX} = 8 MHz Note 3, V_{DD} = 2.0 V	Square wave input		100	410	µA
					Resonator connection		200	520	µA
	I_{DD3}	STOP mode Note 7	T_A = –40°C				0.26	0.7	µA
			T_A = +25°C				0.42	1.9	µA
			T_A = +50°C				0.85	4.5	µA
			T_A = +70°C				1.60	11	µA
			T_A = +85°C				2.60	21	µA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. The following points apply in the HS (high-speed main), LS (low-speed main), and LV (low-voltage main) modes.

- The currents in the “TYP.” column do not include the operating currents of the peripheral modules.
- The currents in the “MAX.” column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

In the subsystem clock operation, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules. However, in HALT mode, including the current flowing into the RTC.

5. When high-speed on-chip oscillator and high-speed system clock are stopped. When RTCLPC = 1 and setting ultra-low current consumption (AMPHS1 = 1). **The current flowing into the RTC is included. However, not including the current flowing into the 12-bit interval timer and watchdog timer.**
6. **Not including the current flowing into the RTC, 12-bit interval timer, and watchdog timer.**
7. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.
   HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
   2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz
   LS (low-speed main) mode: 1.8 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 8 MHz
   LV (low-voltage main) mode: 1.6 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 4 MHz
8. Regarding the value for current to operate the subsystem clock in STOP mode, refer to that in HALT mode.

Remarks
1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)
2. f_{IH}: High-speed on-chip oscillator clock frequency
3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)
4. Except subsystem clock operation and STOP mode, temperature condition of the TYP. value is T_A = 25°C

In the STOP mode, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules.

2. During HALT instruction execution by flash memory.
3. When high-speed on-chip oscillator and subsystem clock are stopped.
4. When high-speed system clock and subsystem clock are stopped.
5. When high-speed on-chip oscillator and high-speed system clock are stopped. When RTCLPC = 1 and setting ultra-low current consumption (AMPHS1 = 1).
6. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.
   HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
   2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz
   LS (low-speed main) mode: 1.8 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 8 MHz
   LV (low-voltage main) mode: 1.6 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 4 MHz
7. Regarding the value for current to operate the subsystem clock in STOP mode, refer to that in HALT mode.

Remarks
1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)
2. f_{IH}: High-speed on-chip oscillator clock frequency
3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)
4. Except subsystem clock operation and STOP mode, temperature condition of the TYP. value is T_A = 25°C

5. 30.3.2 Supply current characteristics (Page 927 to Page 930)

Incorrect:

30.3.2 Supply current characteristics

(T_A = –40 to +105°C, 2.4 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions					MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD1}	Operating mode	HS (high-speed main) mode Note 5	f_{IH} = 32 MHz Note 3	Basic operation	V_{DD} = 5.0 V		1.5		mA
						V_{DD} = 3.0 V		1.5		mA
					Normal operation	V_{DD} = 5.0 V		3.4	6.8	mA
						V_{DD} = 3.0 V		3.4	6.8	mA
				f_{SUB} = 32.768 kHz Note 4 T_A = +85°C	Normal operation	Square wave input		6.6	25.8	μA
						Resonator connection		7.1	26	μA
				f_{SUB} = 32.768 kHz Note 4 T_A = +105°C	Normal operation	Square wave input		10.6	54.8	μA
						Resonator connection		11.4	55	μA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. **The values below the MAX. column include the peripheral operation current. However, not including the current flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors and the current flowing during data flash rewrite.**

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

3. When high-speed system clock and subsystem clock are stopped.

4. When high-speed on-chip oscillator and high-speed system clock are stopped. When AMPHS1 = 1 (Ultra-low power consumption oscillation). **However, not including the current flowing into the RTC, 12-bit interval timer, and watchdog timer.**

5. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.

HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz

Remarks 1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

2. f_{IH}: High-speed on-chip oscillator clock frequency

3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

4. Except subsystem clock operation, temperature condition of the TYP. value is T_A = 25°C

Correct:

30.3.2 Supply current characteristics

(T_A = –40 to +105°C, 2.4 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions					MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD1}	Operating mode	HS (high-speed main) mode Note 5	f_{IH} = 32 MHz Note 3	Basic operation	V_{DD} = 5.0 V		1.5		mA
						V_{DD} = 3.0 V		1.5		mA
					Normal operation	V_{DD} = 5.0 V		3.4	6.8	mA
						V_{DD} = 3.0 V		3.4	6.8	mA
				f_{SUB} = 32.768 kHz Note 4 T_A = +85°C	Normal operation	Square wave input		6.6	25.8	μA
						Resonator connection		7.1	26	μA
				f_{SUB} = 32.768 kHz Note 4 T_A = +105°C	Normal operation	Square wave input		10.6	54.8	μA
						Resonator connection		11.4	55	μA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. The following points apply in the HS (high-speed main) mode.

- The currents in the “TYP.” column do not include the operating currents of the peripheral modules.
- The currents in the “MAX.” column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

In the subsystem clock operation, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules. However, in HALT mode, including the current flowing into the RTC.

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

3. When high-speed system clock and subsystem clock are stopped.

4. When high-speed on-chip oscillator and high-speed system clock are stopped. When AMPHS1 = 1 (Ultra-low power consumption oscillation).

5. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.

HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz

Remarks 1. f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)

2. f_{IH}: High-speed on-chip oscillator clock frequency

3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)

4. Except subsystem clock operation, temperature condition of the TYP. value is T_A = 25°C

(T_A = –40 to +105°C, 2.4 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD2} Note 2	HALT mode	HS (high-speed main) mode Note 7	f_{IH} = 32 MHz Note 4	V_{DD} = 5.0 V		0.41	1.71	mA
					V_{DD} = 3.0 V		0.41	1.71	mA
				f_{IH} = 24 MHz Note 4	V_{DD} = 5.0 V		0.34	1.35	mA
					V_{DD} = 3.0 V		0.34	1.35	mA
				f_{IH} = 16 MHz Note 4	V_{DD} = 5.0 V		0.33	1.04	mA
					V_{DD} = 3.0 V		0.33	1.04	mA
			HS (high-speed main) mode Note 7	f_{MX} = 20 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 20 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
	I_{DD3} Note 6	STOP mode Note 8	T_A = –40°C				0.26	0.7	µA
			T_A = +25°C				0.42	1.9	µA
			T_A = +50°C				0.85	4.5	µA
			T_A = +70°C				1.6	11	µA
			T_A = +85°C				2.6	21	µA
			T_A = +105°C				5.2	50	µA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. **The values below the MAX. column include the peripheral operation current. However, not including the current flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors and the current flowing during data flash rewrite.**

2. During HALT instruction execution by flash memory.

3. When high-speed on-chip oscillator and subsystem clock are stopped.

4. When high-speed system clock and subsystem clock are stopped.

5. When high-speed on-chip oscillator and high-speed system clock are stopped. When RTCLPC = 1 and setting ultra-low current consumption (AMPHS1 = 1). **The current flowing into the RTC is included. However, not including the current flowing into the 12-bit interval timer and watchdog timer.**

6. **Not including the current flowing into the RTC, 12-bit interval timer, and watchdog timer.**

7. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.

HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz

8. Regarding the value for current operate the subsystem clock in STOP mode, refer to that in HALT mode.

(T_A = –40 to +105°C, 2.4 V ≤ EV_{DD0} = EV_{DD1} ≤ V_{DD} ≤ 5.5 V, V_{SS} = EV_{SS0} = EV_{SS1} = 0 V) (1/2)

Parameter	Symbol	Conditions				MIN.	TYP.	MAX.	Unit
Supply current Note 1	I_{DD2} Note 2	HALT mode	HS (high-speed main) mode Note 6	f_{IH} = 32 MHz Note 4	V_{DD} = 5.0 V		0.41	1.71	mA
					V_{DD} = 3.0 V		0.41	1.71	mA
				f_{IH} = 24 MHz Note 4	V_{DD} = 5.0 V		0.34	1.35	mA
					V_{DD} = 3.0 V		0.34	1.35	mA
				f_{IH} = 16 MHz Note 4	V_{DD} = 5.0 V		0.33	1.04	mA
					V_{DD} = 3.0 V		0.33	1.04	mA
			HS (high-speed main) mode Note 6	f_{MX} = 20 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 20 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.19	1.05	mA
					Resonator connection		0.37	1.26	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 5.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
				f_{MX} = 10 MHz Note 3, V_{DD} = 3.0 V	Square wave input		0.12	0.62	mA
					Resonator connection		0.22	0.73	mA
	I_{DD3}	STOP mode Note 7	T_A = –40°C				0.26	0.7	µA
			T_A = +25°C				0.42	1.9	µA
			T_A = +50°C				0.85	4.5	µA
			T_A = +70°C				1.6	11	µA
			T_A = +85°C				2.6	21	µA
			T_A = +105°C				5.2	50	µA

Notes 1. Total current flowing into V_{DD}, EV_{DD0}, and EV_{DD1}, including the input leakage current flowing when the level of the input pin is fixed to V_{DD}, EV_{DD0}, EV_{DD1} or V_{SS}, EV_{SS0}, EV_{SS1}. The following points apply in the HS (high-speed main) mode.

- The currents in the “TYP.” column do not include the operating currents of the peripheral modules.
- The currents in the “MAX.” column include the operating currents of the peripheral modules, except for those flowing into the A/D converter, LVD circuit, I/O port, and on-chip pull-up/pull-down resistors, and those flowing while the data flash memory is being rewritten.

In the subsystem clock operation, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules. However, in HALT mode, including the current flowing into the RTC.

In the STOP mode, the currents in both the “TYP.” and “MAX.” columns do not include the operating currents of the peripheral modules.

2. During HALT instruction execution by flash memory.

3. When high-speed on-chip oscillator and subsystem clock are stopped.

4. When high-speed system clock and subsystem clock are stopped.

5. When high-speed on-chip oscillator and high-speed system clock are stopped. When RTCLPC = 1 and setting ultra-low current consumption (AMPHS1 = 1).

Remarks **1.** f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)
2. f_{IH}: High-speed on-chip oscillator clock frequency
3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)
4. Except subsystem clock operation and STOP mode, temperature condition of the TYP. value is T_A = 25°C

6. Relationship between operation voltage width, operation frequency of CPU and operation mode is as below.
HS (high-speed main) mode: 2.7 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 32 MHz
2.4 V ≤ V_{DD} ≤ 5.5 V@1 MHz to 16 MHz
7. Regarding the value for current operate the subsystem clock in STOP mode, refer to that in HALT mode.

Remarks **1.** f_{MX}: High-speed system clock frequency (X1 clock oscillation frequency or external main system clock frequency)
2. f_{IH}: High-speed on-chip oscillator clock frequency
3. f_{SUB}: Subsystem clock frequency (XT1 clock oscillation frequency)
4. Except subsystem clock operation and STOP mode, temperature condition of the TYP. value is T_A = 25°C