RX Family, SH Family

Points of Difference between HCAN2 (SH Family) and CAN (RX Family)

Summary

This application note is intended as a reference document for customers using the controller area network (HCAN2) module on the SH Family who are considering migrating to the RX Family. It details points of difference between the HCAN2 module of the SH Family and the CAN module of the RX Family.

Of the products listed as target devices, this application note compares the CAN modules of the groups listed in Table 1. For details of devices not listed in Table 1, refer to the applicable user's manual.

In addition, the RSCAN module of the RX200 Series is not covered in this application note because it completely lacks software compatibility with the CAN module used as the comparison source. Refer to section 5, Related Documents, regarding differences between RSCAN and CAN modules of RX Family MCUs.

Table 1 CAN Specification Comparison Target Devices

Subject of Comparison	Family	Group	CAN Module
Comparison source	SH Family	SH7047 Group	HCAN2
Comparison target	RX Family	RX65N Group and RX651 Group	CAN

Target Devices

Devices among the following products equipped with CAN modules.

Devices with HCAN2 modules

SH7047 Group

Devices with CAN modules

RX600 Series and RX700 Series

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1. Differences between Functions

Differences between functions are shown below. Items that exist only on one group but not the other or that exist on both groups but with points of difference are indicated in **red**.

Table 1.1 Differences between Functions of SH7047 (HCAN2) and RX65N (CAN)

Item		SH7047 (HCAN2)	RX65N (CAN)
Protocol		Bosch 2.0B active compatible (ISO 11898-1 standard)	
Bit rate	Communication speed	Max. 1 Mbps	
	Bit rate equation	fCLK / ((BRP + 1) × (1 + TSEG1 + TSEG2)) fCLK: System clock / 2 BRP: Baud rate prescaler (fCLK divided by setting value + 1) TSEG1 and TSEG2: Time segment 1 and time segment 2	fCAN / ((BRP + 1) × (1 + TSEG1 + TSEG2)) fCAN: Peripheral clock or main clock BRP: Baud rate prescaler (fCAN divided by (setting value + 1)) TSEG1 and TSEG2: Time segment 1 and time segment 2
Channels		1 channel	2 channels
ID Format		Specify standard ID or extended ID can be by the MBx.IDE bit of each mailbox.	• Specify ID format of all mailboxes with ID format mode bit (IDFM) • When Mixed ID mode is selected in ID format mode bit (IDFM), specify standard ID or extended ID by the MBj.IDE bit of each mailbox.
Mailboxes	Buffer configuration	32 buffers per channel (receive-only × 1, settable for transmission/reception × 31)	32 buffers per channel (settable for transmission/reception × 32)
	FIFO mailbox mode	No	Settable for transmission/reception × 24, ability to set 4 FIFO stages for transmission and 4 FIFO stages for reception
Data transmission	Transmission priority selection	Mailbox (buffer) number order (high-to-low) Message priority (identifier) high-to-low order	Mailbox (buffer) number order (low-to-high) Message priority (identifier) high-to-low order
	Ability to cancel transmission requests	Supported	Supported Note: The register manipulation method differs. Refer to 2.5, Mailbox Transmission/Reception Setting Details.
	One-shot transmission function	No	Single transmission only (no retransmission even in case of CAN bus error or arbitration lost)

Item		SH7047 (HCAN2)	RX65N (CAN)
Data reception	Data frame and remote frame reception	Ability to receive both data frames and remote frames	Ability to receive either data frames or remote frames Note: In FIFO mailbox mode, reception of both types of frames can be enabled by setting the FIDCR0.RTR and FIDCR1.RTR bits in combination.
	Message ID masking function	Ability to make masking settings per mailbox (has masking setting field in the mailbox)	Ability to make 8 masking settings (each affecting 4 mailboxes). All mailboxes are covered.
Data reception	Selectable between overwrite mode and overrun mode	Selectable	
	One-shot reception function	No	Single reception only (Mailbox does not operate for reception after reception completes.)
Transmission interrupts	Message transmission completion interrupt	Yes	
	Message transmission cancellation completion interrupt	Yes	No Note: It is possible to use the transmission abort complete flag (TRMABT) for confirmation.
	Transmit FIFO interrupt	No	Yes
Reception interrupts	Message reception interrupt	Yes	
	Remote frame reception interrupt	Yes	Yes Note: A message reception interrupt request is generated when a remote frame is received by a mailbox for which remote frame was selected by the remote transmission request bit (RTR).
	Reception FIFO interrupt	No	Yes
Error interrupts	Error passive interrupt (TEC ≥ 128 or REC ≥ 128)	Yes	
	Bus-off entry interrupt (TEC ≥ 256)	Yes	

Item		SH7047 (HCAN2)	RX65N (CAN)
	Bus-off recovery interrupt (normal recovery from bus-off state (detection of 11 consecutive recessive bits 128 times))	Yes	
Error interrupts	Error warning interrupt (TEC ≥ 96 or REC ≥ 96)	Yes (Separate interrupts are generated for transmission errors and reception errors.)	Yes (Combined interrupts are generated for transmission errors and reception errors.)
	Overload frame transmission interrupt	Yes	
	Unread message overwrite interrupt	Yes	No Note: It is possible to use the message lost flag (MSGLOST) for confirmation.
	Reception overrun interrupt	Yes	
	Bus lock interrupt (detection of 32 consecutive dominant bits on CAN bus)	No	Yes
	Bus error interrupt (detection of stuff error, form error, etc., on CAN bus)	No	Yes
Other interrupts	Reset processing interrupt	An interrupt is generated by a transition to reset mode due to a software reset or hardware reset.	No Note: It is possible to use the power-on reset detect flag (PORF) or deep software standby reset flag (DPSRSTF) to determine the reset type.
	Halt interrupt	An interrupt is generated by a transition to halt mode.	No
	Sleep interrupt	An interrupt is generated by a transition to sleep mode.	No
	Timer compare match interrupt	An interrupt is generated by a TCMR0 and TCMR1 compare match.	No
	Timer overflow interrupt	An interrupt is generated by a timer (TCNTR) overflow.	No

Item		SH7047 (HCAN2)	RX65N (CAN)
	CAN bus operation interrupt	An interrupt is generated when CAN bus operation (dominant bit detection) occurs when in sleep mode.	No
Hardware reset	Initialized registers	All registers except mailboxes	All registers except MKRk, FIDCR, MKIVLR, MIER, TFPCR, RFPCR, CSSR, AFSR, and mailboxes.
	State transition after reset	Configuration mode (reset mode)	Sleep mode
	Initial setting process after reset	Perform in configuration mode (reset mode).	Perform in reset mode after cancelling sleep mode.
Software reset	Initialized registers	TEC, REC	MCTLj, STR (except SLPST and TFST bits), EIFR, RECR, TECR, TSR, MSSR, MSMR, RFCR, TFCR, TCR, and ECSR (except EDPM bit)
Default state (error active or error passive)	Transition method	Transition by means of control register	
Bus-off state	Transition method	Transition when transmission error counter TEC ≥ 256	
	Mode transition after recovery	Transition to error active at detection of 11 consecutive recessive bits 128 times in bus-off state	Four selections are available: 1) Transition to error active at detection of 11 consecutive recessive bits 128 times in bus-off state 2) Switch to halt mode after transition to bus-off state (no interrupt) 3) Switch to halt mode when bus-off recovery occurs (interrupt generated) 4) Selection of manual transition (by a program) to error active state or halt mode from bus-off state
Configuration mode (reset mode)	Transition method	Transition after hardware reset or by means of control register	Transition by means of control register
Sleep mode	Transition method	Transition by means of control register	Transition by means of control register or after a reset
	Mode transition after cancellation	Transition to error active state by means of control register setting or CAN bus operation (dominant bit) detection	Transition to reset mode or halt mode by means of control register setting
Halt mode	Transition method	Transition by means of control register	
Error status monitoring	CAN bus error status monitoring	Not supported (no dedicated flags)	Ability to monitor generation of CAN bus errors such as stuff errors, form errors, and ACK errors
	Reading the error counter	Ability to read reception and transmission error counters	

Item		SH7047 (HCAN2)	RX65N (CAN)
DTC/DMAC transfer function		Ability to start the DTC when a message is received	No
Time stamp function		• Time stamp function using a 16-bit counter • Ability to set the source clock divisions to a maximum of 126 divisions • Interrupt using compare match Note: Cannot be used because there is a problem	• Time stamp function using a 16-bit counter • Ability to select reference clock among 1-, 2-, 4- and 8-bit time periods
Time trigger function		Yes Note: Cannot be used because there is a problem	No
Software support unit		No	• Acceptance filter support • Mailbox search support • Channel search support
Test control	Self-diagnostic function	Operation as the following test modes is possible by combination of control register settings • Listen-only mode • Self-test mode 1 (external loopback) • Self-test mode 2 (internal loopback) • Write error counter • Error passive mode	Operation in the following test modes is possible by control register settings • Listen-only mode • Self-test mode 0 (external loopback) • Self-test mode 1 (internal loopback)
Module stop	Clock supply by means of module stop register	Yes	

2. Differences between Registers

Differences between registers are shown below. Items that exist only on one group but not the other or that exist on both groups but with points of difference are indicated in **red**.

2.1 Registers

Table 2.1 SH7047 (HCAN2) and RX65N (CAN) Registers

Item	SH7047 (HCAN2)	RX65N (CAN)
Control register	Master control register (MCR)	Control register (CTLR)
Status flags	General status register (GSR)	• Status register (STR) • Error interrupt factor judge register (EIFR)
Bit timing and communication speed settings	Bit timing configuration register 0, 1 (HCAN2_BCR0, HCAN2_BCR1)	Bit configuration register (BCR)
Mailbox transmission/reception settings	MBC[2:0] bit in message control field (MBx[4] to [5]) for mailbox (MB0 to MB31)	RECREQ and TRMREQ bits in message control register j (MCTLj) (j = 0 to 31)
Transmit wait settings	Transmit wait register 0, 1 (TXPR0, TXPR1)	TRMREQ bit in message control register j (MCTLj) (j = 0 to 31)
Transmission completion status flags	Transmit acknowledge register 0, 1 (TXACK0, TXACK1)	SENTDATA bit in message control register j (MCTLj) (j = 0 to 31)
Transmit wait cancel settings	Transmit wait cancel register 0, 1 (TXCR0, TXCR1)	TRMREQ bit in message control register j (MCTLj) (j = 0 to 31)
Transmit message cancellation completion status flags	Abort acknowledge register 0, 1 (ABACK0, ABACK1)	SENTDATA and TRMABT bits in message control register j (MCTLj) (j = 0 to 31)
Receive complete status flags	Receive complete register 0, 1 (RXPR0, RXPR1)	NEWDATA bit in message control register j (MCTLj) (j = 0 to 31)
Remote frame receive complete status flags	Remote request register 0, 1 (RFPR0, RFPR1)	—
Interrupt source status flags	Interrupt request register (IRR) Note: Write 1 to clear a flag.	• RECREQ and TRMREQ bits in message control register j (MCTLj) (j = 0 to 31) • Error interrupt factor judge register (EIFR) Note: Write 0 to clear a flag.
Mailbox (buffer) interrupt request enable/disable flags	Mailbox interrupt mask register 0, 1 (MBIMR0, MBIMR1)	Mailbox interrupt enable register (MIER)
Interrupt source request enable/disable flags	Interrupt mask register (IMR)	• Interrupt request enable register m (IERm) • Error interrupt enable register (EIER)
Reception error counter	Receive error counter (REC)	Receive error count register (RECR)
Transmission error counter	Transmit error counter (TEC)	Transmit error count register (TECR)
Overwrite status flags	Unread message status register 0, 1 (UMSR0, UMSR1)	MSGLOST bit in message control register j (MCTLj) (j = 0 to 31)

Item	SH7047 (HCAN2)	RX65N (CAN)
Settings for filtering using receive message identifier	Local acceptance filter mask bits (STDID_LAFM[10:0] and EXTID_LAFM[17:0]) for mailboxes (MB0 to MB31)	• Mask register k (MKRk) (k = 0 to 7) • Mask invalid register (MKIVLR)
Mailboxes	Mailboxes (MB0 to MB31)	Mailbox register j (MBj) (j = 0 to 31)
Module stop control	Module standby control register 2 (MSTCR2)	Module stop control register B (MSTPCRB) Note: Settings must be made to the protect register (PRCR) before making settings to this register.
FIFO received ID compare settings	—	FIFO received ID compare registers 0 and 1 (FIDCR0 and FIDCR1)
Receive FIFO enable/disable settings	—	Receive FIFO control register (RFCR)
Receive FIFO pointer control settings	—	Receive FIFO pointer control register (RFPCR)
Transmit FIFO control settings	—	Transmit FIFO control register (TFCR)
Mailbox search mode settings	—	Mailbox search mode register (MSMR)
Mailbox search status register	—	Mailbox search status register (MSSR)
Channel search mode settings	—	Channel search support register (CSSR)
Multiple received ID masking function support	—	Acceptance filter support register (AFSR)
CAN bus error monitoring	—	Error code store register (ECSR)
CAN test mode control	TST0 to TST7 bits of master control register (MCR)	Test control register (TCR)
Timer control	Timer control register (TCR)	TSRC and TSPS[1:0] bits in control register (CTLR) Note: Counter reset and prescaler selection only
Timer status	Timer status register (TSR)	—
Timer counter	Timer counter register (TCNTR)	Time stamp register (TSR)
Local offset of timer (TCNTR)	Local offset register (LOSR)	—
Input capture	Input capture register 0, 1 (ICR0, HCAN2_ICR1)	—
Compare match with timer counter	Timer compare match register 0, 1 (TCMR0, TCMR1)	—

2.2 Control Register Details

Table 2.2 SH7047 (HCAN2) and RX65N (CAN) Control Registers (1/2)

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Master control register (MCR)			Control register (CTLR)		
MCR0	Reset request	0: Normal operating mode 1: Reset mode (initial value)	CANM [1:0]	CAN operating mode select bits	0 0: Normal operating mode 0 1: Reset mode (initial value) 1 0: Halt mode 1 1: Reset mode (forcible transition) Note: Forcible transition is a transition mode that does not wait for transmission to finish.
MCR1	HCAN2 halt mode	0: Normal operating mode (initial value) 1: Halt mode			
MCR2	Message transmission method	0: Message ID priority (initial value) 1: Mailbox number priority (high-to-low)	TPM	Transmission priority mode select bit	0: Message ID priority (initial value) 1: Mailbox number priority
MCR5	HCAN2 sleep mode	0: Sleep mode released (initial value) 1: Sleep mode	SLPM	CAN sleep mode bit	0: Sleep mode released 1: Sleep mode (initial value) Note: Automatic transition to sleep mode after a hardware reset.
MCR7	HCAN2 sleep mode release	0: Sleep mode release by CAN bus operation disabled (initial value) 1: Sleep mode release by CAN bus operation enabled	—	—	—
—	—	—	IDFM [1:0]	ID Format Mode Select bit	0 0: Standard ID mode 0 1: Extended ID mode 1 0: Mixed ID mode 1 1: (setting prohibited) Note: When Mixed ID mode is selected in IDFM bit, specify standard ID or extended ID by the MBj.IDE bit of each mailbox.

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Master control register (MCR)			Test control register (TCR)		
TST6	Write CAN error counters	0: Error counters (TEC, REC) are read-only (initial value) 1: Error counters (TEC, REC) can be written with same value	TSTM[1:0]	CAN test mode select bit	0 0: Other than test mode (initial value) 0 1: Listen-only mode 1 0: Self-test mode 0 (external loopback) 1 1: Self-test mode 1 (internal loopback)
TST5	Force to error passive	0: Normal operating mode (initial value) 1: Error passive transition			
TST4	Auto acknowledge mode	0: Do not create acknowledge bit for testing (initial value) 1: Create acknowledge bit for testing			
TST3	Disable error counters	0: Error counters (TEC, REC) operate normally (initial value) 1: Error counters (TEC, REC) are retained			
TST2	Disable Rx input	0: External Rx pin is connected 1: [TST=0] Rx is recessive [TST=0] Rx and Tx are connected internally			
TST1	Disable Tx output	0: External Tx pin is connected 1: [TST=0] Tx is recessive [TST=0] Rx and Tx are connected internally			
TST0	Enable internal loop	0: External Rx pin is connected 1: [TST=0] Tx is recessive [TST=0] Rx and Tx are connected internally			

2.3 Status Flag Details

Table 2.3 SH7047 (HCAN2) and RX65N (CAN) Status Flags

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
General status register (GSR)			Error interrupt factor judge register (EIFR)		
GSR0	Bus off flag	0: Not in bus-off state (initial value) 1: Bus-off state (when TEC ≥ 256) [Clearing condition] Recovery from bus off state	BOEIF	Bus-off entry detect flag	0: Not in bus-off state (initial value) 1: Bus-off state (when TEC ≥ 256) [Clearing condition] 0 is written.
GSR1	Transmit/ receive warning flag	0: Error warning not detected (initial value) 1: Error warning detected (when TEC ≥ 96 or REC ≥ 96)	EWIF	Error-warning detect flag	0: Error warning not detected (initial value) 1: Error warning detected (when TEC ≥ 96 or REC ≥ 96)
General status register (GSR)			Status register (STR)		
GSR2	Message transmission status flag	0: Transmission in progress 1: Bus idle (initial value)	TRMST	Transmit status flag (transmitter)	0: Bus idle or reception in progress (initial value) 1: Transmission in progress or bus-off state Note: The status can be checked by reading this bit in combination with RECST. Bus idle: TRMST = 0, RECST = 0 Transmission in progress: TRMST = 1, RECST = 0 Reception in progress: TRMST = 0, RECST = 1
			RECST	Receive status flag (receiver)	0: Bus idle or transmission in progress (initial value) 1: Reception in progress
GSR3	Reset status bit	0: Normal operating state 1: Configuration mode (reset mode) (initial value)	RSTST	CAN reset status flag	0: Not in CAN reset mode 1: CAN reset mode (initial value)

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
GSR4	Halt/sleep status bit	0: Not in halt mode or sleep mode (initial value) 1: Halt mode or sleep mode	HLTST	CAN halt status flag	0: Not in CAN halt mode (initial value) 1: CAN halt mode
			SLPST	CAN sleep status flag	0: Not in CAN sleep mode 1: CAN sleep mode (initial value)
GSR5	Error passive status bit	0: Not in error passive state (initial value) 1: Error passive state	EPST	Error-passive status flag	0: Not in error-passive state (initial value) 1: Error-passive state

2.4 Bit Timing and Communication Speed Setting Details

Table 2.4 SH7047 (HCAN2) and RX65N (CAN) Bit Timing and Communication Speed Settings

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Bit timing configuration register 1 (HCAN2_BCR1)			Bit configuration register (BCR)		
TSEG1 [3:0]	Time segment 1 bits	b15 b12 0 0 0 0: (setting prohibited) (initial value) 0 0 0 1: (setting prohibited) 0 0 1 0: (setting prohibited) 0 0 1 1: 4Tq 0 1 0 0: 5Tq : 1 1 1 1: 16Tq	TSEG1 [3:0]	Time segment 1 control bits	b31 b28 0 0 0 0: (setting prohibited) (initial value) 0 0 0 1: (setting prohibited) 0 0 1 0: (setting prohibited) 0 0 1 1: 4Tq 0 1 0 0: 5Tq : 1 1 1 1: 16Tq
TSEG2 [2:0]	Time segment 2 bits	b10 b8 0 0 0: (setting prohibited) (initial value) 0 0 1: 2Tq : 1 1 1: 8Tq	TSEG2 [2:0]	Time segment 2 control bits	b10 b8 0 0 0: (setting prohibited) (initial value) 0 0 1: 2Tq : 1 1 1: 8Tq
BSP	Bit sample point bit	0: Bit sampling at one point (initial value) 1: Bit sampling at three points	—	—	—
SJW [1:0]	Re-Synchronization Jump Width	b5 b4 0 0: 1Tq (initial value) 0 1: 2Tq 1 0: 3Tq 1 1: 4Tq	SJW [1:0]	Re-synchronization jump width control bits	b13 b12 0 0: 1Tq (initial value) 0 1: 2Tq 1 0: 3Tq 1 1: 4Tq
Bit timing configuration register 0 (HCAN2_BCR0)			Bit configuration register (BCR)		
BRP [7:0]	Baud rate prescaler bits	Division ratio of (setting value P + 1) Note: The initial value is 0 (division by 1)	BRP [9:0]	Prescaler division ratio select bits	Division ratio of (setting value P + 1) Note: The initial value is 0 (division by 1)

2.5 Mailbox Transmission/Reception Setting Details

Table 2.5 SH7047 (HCAN2) and RX65N (CAN) Mailbox Transmission/Reception Settings

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Mailboxes (MB0 to MB31)			Message control register j (MCTLj) (j = 0 to 31)		
MBC [2:0]	Mailbox configuration	Refer to Table 2.6	TRMREQ	Transmit mailbox request bit	0: Not configured for transmission (initial value) 1: Configured as transmit mailbox Note: The transmission and reception configuration settings are separate.
			RECREQ	Receive mailbox request bit	0: Not configured for reception (initial value) 1: Configured as receive mailbox Note: The transmission and reception configuration settings are separate.
Transmit wait register 0, 1 (TXPR0, TXPR1)			Message control register j (MCTLj) (j = 0 to 31)		
TXPR0 [15:1] TXPR1 [15:0]	Transmit wait register	0: Idle state (initial value) 1: Transmit wait (CAN bus arbitration) Notes: Transmission starts when TXPR is set to 1. The corresponding bit is cleared to 0 automatically after message transmission completion or cancellation completion.	TRMREQ	Transmit mailbox request bit	0: Not configured for transmission (initial value) 1: Configured as transmit mailbox Notes: Transmission starts when TRMREQ is set to 1. The corresponding bit is not cleared to 0 even after message transmission completion.
Transmit acknowledge register 0, 1 (TXACK0, TXACK1)			Message control register j (MCTLj) (j = 0 to 31)		
TXACK0 [15:1] TXACK1 [15:0]	Transmit acknowledge register	0: Transmission in progress or no transmission (initial value) 1: Transmission complete [Clearing condition] 1 is written.	SENTDATA	Transmission complete flag	0: Transmission in progress or no transmission (initial value) 1: Transmission complete [Clearing condition] 0 is written.

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Transmit wait cancel register 0, 1 (TXCR0, TXCR1)			Message control register j (MCTLj) (j = 0 to 31)		
TXCR0 [15:1] TXCR1 [15:0]	Transmit wait cancel register	0: Transmit message cancellation idle state (initial value) 1: Transmit message canceled [Clearing condition] 1 is written.	TRMREQ	Transmit mailbox request bit	0: Not configured for transmission (initial value) 1: Configured as transmit mailbox Note: Transmission is canceled when the value of TRMREQ changes from 1 to 0.
Abort acknowledge register 0, 1 (ABACK0, ABACK1)			Message control register j (MCTLj) (j = 0 to 31)		
ABACK0 [15:1] ABACK1 [15:0]	Abort acknowledge register	0: Cancellation failure due to transmission completion or no cancellation request (initial value) 1: Transmit message cancellation completion [Clearing condition] 1 is written.	TRMABT	Transmission abort complete flag	0: Cancellation failure due to transmission completion or no cancellation request (initial value) 1: Transmit message cancellation completion [Clearing condition] 0 is written.
Receive complete register 0, 1 (RXPR0, RXPR1)			Message control register j (MCTLj) (j = 0 to 31)		
RXPR0 [15:0] RXPR1 [15:0]	Receive complete register	0: Reception in progress or no reception (initial value) 1: Data frame receive complete [Clearing condition] 1 is written.	NEWDATA	Reception complete flag	0: Reception in progress or no reception (initial value) 1: Data frame or remote frame receive complete [Clearing condition] 0 is written.
Remote request register 0, 1 (RFPR0, RFPR1)			—		
RFPR0 [15:0] RFPR1 [15:0]	Remote request register	0: Reception in progress or no reception (initial value) 1: Remote frame receive complete [Clearing condition] 1 is written.	—	—	—

Table 2.6 Mailbox Configuration (MBC[2:0]) Settings

b2 b0	Data Frame Transmit	Remote Frame Transmit	Data Frame Receive	Remote Frame Receive	Remarks
0 0 0	Yes	Yes	No	No	Mailbox 0 cannot be used Time-trigger transmission can be used
0 0 1	Yes	Yes	No	Yes	Can be used with ATX Mailbox 0 cannot be used LAFM can be used
0 1 0	No	No	Yes	Yes	Mailbox 0 can be used LAFM can be used
0 1 1	Setting prohibited				
1 0 0	No	Yes	Yes	Yes	Mailbox 0 cannot be used LAFM can be used
1 0 1	No	Yes	Yes	No	Mailbox 0 cannot be used LAFM can be used
1 1 0	Setting prohibited				
1 1 1	Mailbox inactive (initial value)				

2.6 Interrupt Source Status Flag Details

Table 2.7 SH7047 (HCAN2) and RX65N (CAN) Interrupt Source Status Flags

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Interrupt request register (IRR)			Message control register j (MCTLj) (j = 0 to 31)		
IRR8	Mailbox empty interrupt flag	0: Transmission in progress or no transmission (initial value) 1: Transmission complete or transmission cancellation complete [Clearing condition] When all transmit acknowledge register (TXACK) and abort acknowledge register (ABACK) bits are cleared	SENTDATA	Transmission complete flag	0: Transmission in progress or no transmission (initial value) 1: Transmission complete [Clearing condition] 0 is written.
IRR1	Receive message interrupt flag	0: Reception in progress or no reception (initial value) 1: Data frame receive complete [Clearing condition] When all mailbox bits in receive complete register (RXPR) are cleared	NEWDATA	Reception complete flag	0: Reception in progress or no reception (initial value) 1: Data frame and remote frame receive complete [Clearing condition] 0 is written.
IRR2	Remote frame request interrupt flag	0: Reception in progress or no reception (initial value) 1: Remote frame receive complete [Clearing condition] When all mailbox bits in remote request register (RFPR) are cleared			

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
IRR12	Bus operation interrupt flag	0: CAN bus idle state (initial value) 1: CAN bus operation in HCAN sleep mode [Clearing condition] 1 is written.	—	—	—
Interrupt register (IRR)			Error interrupt factor judge register (EIFR)		
IRR3	Transmit error warning interrupt flag	0: Error warning not detected (initial value) 1: Error warning detected (when TEC ≥ 96) [Clearing condition] 1 is written.	EWIF	Error-warning detect flag	0: Error warning not detected (initial value) 1: Error warning detected (when TEC ≥ 96 or REC ≥ 96) [Clearing condition] 0 is written.
IRR4	Receive error warning interrupt flag	0: Error warning not detected (initial value) 1: Error warning detected (when REC ≥ 96) [Clearing condition] 1 is written.			
IRR5	Error passive interrupt flag	0: Error passive state not detected (initial value) 1: Error passive state detected (when TEC ≥ 128 or REC ≥ 128) [Clearing condition] 1 is written.	EPIF	Error-passive detect flag	0: Error passive state not detected (initial value) 1: Error passive state detected (when TEC ≥ 128 or REC ≥ 128) [Clearing condition] 0 is written.
IRR6	Bus off/bus off recovery interrupt flag	0: Not in bus-off state (initial value) 1: Bus-off state (when TEC ≥ 256) or 11 recessive bits received 128 times in bus-off state [Clearing condition] 1 is written.	BOEIF	Bus-off entry detect flag	0: Not in bus-off state (initial value) 1: Bus-off state (when TEC ≥ 256) [Clearing condition] 0 is written.

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
IRR7	Overload frame interrupt flag	0: Overload frame transmission not detected (initial value) 1: Overload frame transmission detected [Clearing condition] 1 is written.	OLIF	Overload frame transmission detect flag	0: Overload frame transmission not detected (initial value) 1: Overload frame transmission detected [Clearing condition] 0 is written.
IRR9	Unread message interrupt flag	0: No overrun/overwrite (initial value) 1: Discard received message/unread message overwrite [Clearing condition] All unread message status register (UMSR) bits are cleared	—	—	—
IRR13	Timer overflow interrupt flag	0: Timer overflow has not occurred 1: Timer overflow has occurred [Clearing condition] 1 is written.	—	—	—
IRR14	Timer compare match interrupt flag 0	0: TCMR0 timer compare match has not occurred 1: TCMR0 timer compare match has occurred (TCMR0 = TCNTR) [Clearing condition] 1 is written.	—	—	—
IRR15	Timer compare match interrupt flag 1	0: TCMR1 timer compare match has not occurred 1: TCMR1 timer compare match has occurred (TCMR1 = TCNTR) [Clearing condition] 1 is written.	—	—	—

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
IRR0	Reset/halt/sleep interrupt flag	0: No mode transition 1: Transition to reset mode, transition to halt mode, or transition to sleep mode [Clearing condition] 1 is written.	—	—	—

2.7 Interrupt Source Request Enable/Disable Flag Details

Table 2.8 SH7047 (HCAN2) and RX65N (CAN) Interrupt Source Request Enable/Disable Flags

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Interrupt mask register (IMR)			—		
IMR8	Mailbox empty interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR1	Receive message interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR12	Bus operation interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR2	Remote frame request interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR13	Timer overflow interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR14	Timer compare match interrupt 0 mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR15	Timer compare match interrupt 1 mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—
IMR0	Reset/halt/sleep interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	—	—	—

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Interrupt mask register (IMR)			Error interrupt enable register (EIER)		
IMR3	Transmit error warning interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	EWIE	Error-warning interrupt enable bit	0: Interrupt request disabled (initial value) 1: Interrupt request enabled
IMR4	Receive error warning interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)			
IMR5	Error passive interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	EPIE	Error-passive interrupt enable bit	0: Interrupt request disabled (initial value) 1: Interrupt request enabled
IMR6	Bus off/bus off recovery interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	BOEIE	Bus-off entry interrupt enable bit	0: Interrupt request disabled (initial value) 1: Interrupt request enabled
IMR7	Overload frame interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	OLIE	Overload frame transmit interrupt enable bit	0: Interrupt request disabled (initial value) 1: Interrupt request enabled
IMR9	Unread interrupt mask	0: Interrupt request enabled 1: Interrupt request disabled (initial value)	ORIE	Overrun interrupt enable bit	0: Interrupt request disabled (initial value) 1: Interrupt request enabled
Mailbox interrupt mask register 0, 1 (MBIMR0, MBIMR1)			Mailbox interrupt enable register (MIER)		
MBIMR0 [15:0] MBIMR1 [15:0]	Mailbox interrupt mask	0: Interrupt enabled 1: Interrupt disabled (initial value)	MB [31:0]	Interrupt enable bits	0: Interrupt disabled (initial value) 1: Interrupt enabled

The interrupt controller specifications differ on the SH7047 Group and RX65N Group. To control generation of interrupts on the RX65N Group it is necessary to make enable/disable settings for each interrupt in the interrupt controller. For details of the interrupt controller, refer to RX65N Group, RX651 Group User's Manual: Hardware (R01UH0590).

The CAN interrupts on the RX65N Group are listed below.

[Software configurable interrupt B]

CANi reception complete interrupt (mailboxes 0 to 31) [RXMi]

CANi transmission complete interrupt (mailboxes 0 to 31) [TXMi]

CANi receive FIFO interrupt [RXFi]

CANi transmit FIFO interrupt [TXFi]

[Group BE0 interrupts]

CANi error interrupts [ERSi] (error interrupt sources)

- Bus error
- Error-warning
- Error-passive
- Bus-off entry
- Bus-off recovery
- Receive overrun
- Overload frame transmission
- Bus lock

2.8 Details of Settings for Filtering Using Receive Message Identifier

Table 2.9 SH7047 (HCAN2) and RX65N (CAN) Settings for Filtering Using Receive Message Identifier

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Mailboxes (MB0 to MB31)			Mask register k (MKRk) (k = 0 to 7)		
STDID_LAFM [10:0]	Local acceptance filter mask for standard ID	0: Corresponding bits are compared 1: Corresponding bits are not compared (Initial values are undefined.)	SID[10:0]	Standard ID bits	0: Corresponding bits are not compared 1: Corresponding bits are compared Notes: The bit functions are the opposite of those on the HCAN2. Initial values are undefined.
EXTID_LAFM [17:16] EXTID_LAFM [15:0]	Local acceptance filter mask for extended ID	0: Corresponding bits are compared 1: Corresponding bits are not compared (initial value)	EID[17:0]	Extended ID bits	0: Corresponding bits are not compared 1: Corresponding bits are compared Notes: The bit functions are the opposite of those on the HCAN2. Initial values are undefined.
—			Mask invalid register (MKIVLR)		
—	—	—	MB[31:0]	Mask invalid bits	0: Mask valid for corresponding mailbox 1: Mask invalid for corresponding mailbox Note: Initial values are undefined.

2.9 Timer Control/Time Trigger Details

Table 2.10 Details on SH7047 (HCAN2) and RX65N (CAN) Time Stamps and Time Triggers

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
Time control register (TCR)			Control register (CTLR)		
TCR15	Enable timer	0: Stop timer 1: Start timer Note: There is a problem with the timer function. Always write 0 to prevent the timer from running.	—	—	Note: Start counting will transition to normal operating mode. Stop will transition to sleep mode or halt mode.
			TSRC	Time stamp counter reset command	0: Do not reset 1: Reset
TCR14	Disable ICR0	0: Disable input capture register 0 (ICR0) 1: Enable input capture register 0 (ICR0)	—	—	—
TCR13	Timestamp control for reception	0: Timestamp functions at every SOF 1: Timestamp functions at every EOF Note: Timestamps are not supported when every SOF is received. When using the timestamp in reception, write 1 to this bit.	—	—	—
TCR12	Timestamp control for transmission	0: Timestamp in TXPR bit 1: Timestamp in TXACK bit	—	—	—
TCR11	Timer clear/set control by TCMR0	0: Timer is not cleared by compare match with TCMR0 1: Timer is cleared and set to the value of the local offset register (LOSR) by compare match with TCMR0	—	—	—

SH7047 (HCAN2)			RX65N (CAN)		
Symbol	**Bit Name**	**Function**	**Symbol**	**Bit Name**	**Function**
TCR10	Timer clear/set control by CCM	0: Timer is not cleared by CAN-ID compare match 1: Timer is cleared and set to the value of the local offset register (LOSR) by CAN-ID compare match	—	—	—
TCR9	ICR0 automatic disable by CCM	0: TCR14 is not cleared by CAN-ID compare match 1: TCR14 is cleared by CAN-ID compare match	—	—	—
TPSC5 to TPSC0	HCAN2 timer prescaler	Division ratio of 2 × (setting value P + 1) Note: The initial value is 0 (division by 1)	TSPS[1:0]	Time stamp prescaler select bits	b1b0 0 0: Every bit time 0 1: Every 2-bit time 1 0: Every 4-bit time 1 1: Every 8-bit time

3. Differences between Mailboxes

Table 3.1 shows Mailbox Structure of RX65N (CAN), and Table 3.2 shows Mailbox Structure of SH7047 (HCAN2). Items that only exist on one group are indicated in **red**.

Table 3.1 Mailbox Structure of RX65N (CAN)

Register Name	b7	b6	b5	b4	b3	b2	b1	b0	Access Size*1	Field
MBj (j = 0 to 31)	IDE*2	RTR	—	SID[10:6]					8/16/32	Control
	SID[5:0]						EID[17:16]			
	EID[15:8]									
	EID[7:0]									
	—	—	—	—	—	—	—	—	8/16/32	
	—	—	—	—	DLC[3:0]					
	DATA0									Data
	DATA1									
	DATA2								8/16/32	
	DATA3									
	DATA4									
	DATA5									
	DATA6								8/16/32	
	DATA7									
	TSH									Time stamp
	TSL									

Note: 1. When accessing mailbox register j (MBj) (j = 0 to 31), access even addresses for 16-bit access and access addresses ending in 0h, 4h, 8h, or Ch for 32-bit access.

Note: 2. The IDE bit is enabled when the IDFM bit in CTLR register are mixed ID mode (10b). Write the IDE bits with 0 when the IDFM bits are not 10b. The value is 0 when it is read.

Table 3.2 Mailbox Structure of SH7047 (HCAN2)

Register Name	b7	b6	b5	b4	b3	b2	B1	b0	Access Size*1	Field
MBx (x = 0 to 31)	0	STDID[10:4]							16	Control
	STDID[3:0]				RTR	IDE	EXTID [17:16]			
	EXTID[15:8]								16	
	EXTID[7:0]									
	CCM	TTE	NMC	ATX	DART	MBC[2:0]			8/16	
	PTE	TCT	0	0	DLC[3:0]					
	TimeStamp[15:8]								16	Time stamp
	TimeStamp[7:0]									
	MSG_DATA_0								8/16	Data
	MSG_DATA_1									
	MSG_DATA_2								8/16	
	MSG_DATA_3									
	MSG_DATA_4								8/16	
	MSG_DATA_5									
	MSG_DATA_6								8/16	
	MSG_DATA_7									
	LAFM0 / TTT[15:8]								16	LAFM / Trigger time
	LAFM0 / TTT[7:0]									
	LAFM1 / TTT[15:8]								16	
	LAFM1 / TTT[7:0]									

Note: 1. When accessing message box (MBx) (x = 0 to 31), access even addresses for 16-bit access.

4. Other Differences

4.1 Sleep Mode Setting Procedure

The procedures for entering and clearing sleep mode differ between the SH7047 (HCAN2) and RX65N (CAN). The sleep mode setting procedure on each device is shown below. For more information on detailed differences, refer to the User's Manual: Hardware of each device.

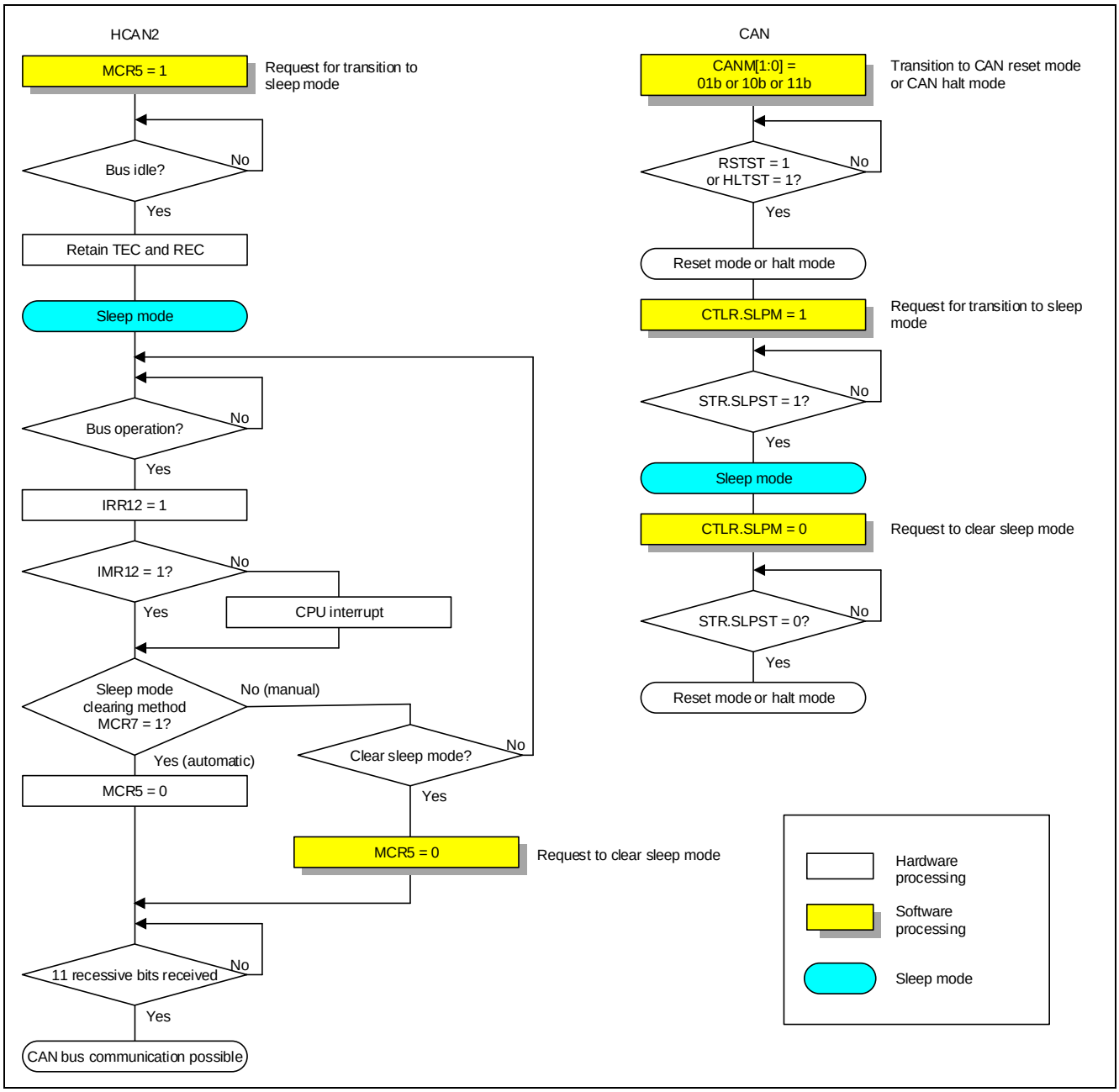

Figure 4.1 Sleep Mode Setting Procedure on SH7047 (HCAN2) and RX65N (CAN)

4.2 Initialization by CAN Reset

The register initialization operation and transition timing after a CAN software reset differ between the SH7047 (HCAN2) and RX65N (CAN). Table 4.1 lists the register initialization operation and transition timing differences between the two devices.

Table 4.1 Register Initialization Operation and Transition Timing after CAN Software Reset

Item	SH7047 (HCAN2)	RX65N (CAN)
Register initialization	Only TEC and REC registers are initialized.	The following registers are initialized and the initialized state while in reset mode is retained: MCTLj, STR (except SLPST and TFST flags), EIFR, RECR, TECR, TSR, MSSR, MSMR, RFCR, TFCR, TCR, and ECSR (except EDPM bit)
Transition timing	After the MCR0 is set to 1, transition occurs after message handling has finished completely.	After the CTLR.CANM[1:0] bits are set to 01b, transition occurs after message transmission finishes (without waiting for reception to complete). [Forcible transition] Transition to reset mode occurs immediately when the CTLR.CANM[1:0] bits are set to 11b.

4.3 Endianness

The RX Family supports both littleendian and bigendian byte order. The SH Family supports bigendian byte order only.

For details of endian settings for the RX Family, refer to the User's Manual: Hardware of the specific RX Family device.

5. Related Documents

Related documents are listed below. Consult them in conjunction with this application note.

Application Notes

- RX Family Using the CAN (R01AN1448)
- RX65N/RX651 Group, RX230/RX231 Group Points of Difference Between RX65N Group and RX231 Group (R01AN3377)

User's Manuals

- SH-2 SH7047 Group Hardware Manual (REJ09B0020)
- RX65N Group, RX651 Group User's Manual: Hardware (R01UH0590)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Sep.30.19	—	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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