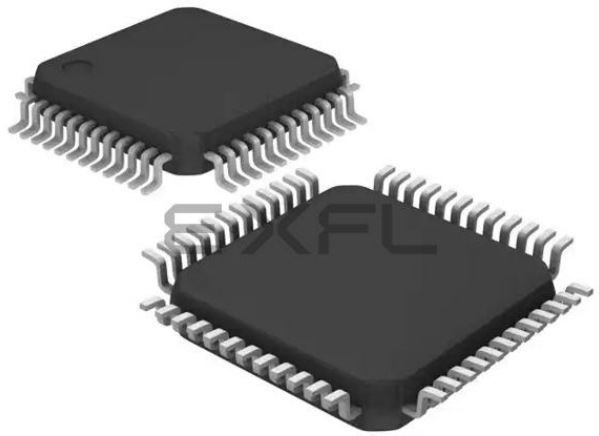
Renesas Electronics America Inc - DF71241AD50FPV Datasheet



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"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	SH-2
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	SCI
Peripherals	POR, PWM, WDT
Number of I/O	23
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	4V ~ 5.5V
Data Converters	A/D 8x10b
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/df71241ad50fpv

Classification	Symbol	I/O	Name	Function
A/D converter	AVss	I	Analog ground	Ground pin for the A/D converter Connect it to the system ground (0 V). Connect all AVss pins to the system ground (0 V) correctly.
I/O ports	PA15 to PA0 (SH7125)	I/O	General port	16-bit input/output port pins
	PA9 to PA6, PA4, PA3, PA1, PA0 (SH7124)			8-bit input/output port pins
	PB16, PB5, PB3 to PB1 (SH7125)	I/O	General port	5-bit input/output port pins
	PB5, PB3, PB1 (SH7124)			3-bit input/output port pins
	PE15 to PE0 (SH7125)	I/O	General port	16-bit input/output port pins
	PE15 to PE8, PE3 to PE0 (SH7124)			12-bit input/output port pins
	PF7 to PF0	I	General port	8-bit input port pins
User debugging interface (H-UDI)*[1]	TCK	I	Test clock	Test-clock input pin
	TMS	I	Test mode select	Inputs the test-mode select signal.
	TDI	I	Test data input	Serial input pin for instructions and data
	TDO	O	Test data output	Serial output pin for instructions and data
	$\overline{\text{TRST}}$	I	Test reset	Initialization-signal input pin

Type	Kinds of Instruction	Op Code	Function	Number of Instructions
Branch instructions	9	BF	Conditional branch, delayed conditional branch (T = 0)	11
		BT	Conditional branch, delayed conditional branch (T = 1)	
		BRA	Unconditional branch	
		BRAF	Unconditional branch	
		BSR	Branch to subroutine procedure	
		BSRF	Branch to subroutine procedure	
		JMP	Unconditional branch	
		JSR	Branch to subroutine procedure	
		RTS	Return from subroutine procedure	
System control instructions	11	CLRT	T bit clear	31
		CLRMAC	MAC register clear	
		LDC	Load into control register	
		LDS	Load into system register	
		NOP	No operation	
		RTE	Return from exception handling	
		SETT	T bit setting	
		SLEEP	Transition to power-down mode	
		STC	Store from control register	
		STS	Store from system register	
		TRAPA	Trap exception handling	
Total:	62			142

2.5.4 Logic Operation Instructions

Table 2.13 Logic Operation Instructions

Instruction		Operation	Code	Execution Cycles	T Bit
AND	Rm,Rn	Rn & Rm → Rn	0010nnnnmmmm1001	1	—
AND	#imm,R0	R0 & imm → R0	11001001iiiiiiii	1	—
AND.B	#imm,@(R0,GBR)	(R0 + GBR) & imm → (R0 + GBR)	11001101iiiiiiii	3	—
NOT	Rm,Rn	~Rm → Rn	0110nnnnmmmm0111	1	—
OR	Rm,Rn	Rn | Rm → Rn	0010nnnnmmmm1011	1	—
OR	#imm,R0	R0 | imm → R0	11001011iiiiiiii	1	—
OR.B	#imm,@(R0,GBR)	(R0 + GBR) | imm → (R0 + GBR)	11001111iiiiiiii	3	—
TAS.B	@Rn	If (Rn) is 0, 1 → T; 1 → MSB of (Rn)	0100nnnn00011011	4	Test result
TST	Rm,Rn	Rn & Rm; if the result is 0, 1 → T	0010nnnnmmmm1000	1	Test result
TST	#imm,R0	R0 & imm; if the result is 0, 1 → T	11001000iiiiiiii	1	Test result
TST.B	#imm,@(R0,GBR)	(R0 + GBR) & imm; if the result is 0, 1 → T	11001100iiiiiiii	3	Test result
XOR	Rm,Rn	Rn ^ Rm → Rn	0010nnnnmmmm1010	1	—
XOR	#imm,R0	R0 ^ imm → R0	11001010iiiiiiii	1	—
XOR.B	#imm,@(R0,GBR)	(R0 + GBR) ^ imm → (R0 + GBR)	11001110iiiiiiii	3	—

Table 9.14 TIOR_1 (Channel 1)

				Description	
Bit 7 IOB3	**Bit 6 IOB2**	**Bit 5 IOB1**	**Bit 4 IOB0**	**TGRB_1 Function**	**TIOC1B Pin Function*2**
0	0	0	0	Output compare register	Output retained*1
			1		Initial output is 0 0 output at compare match
		1	0		Initial output is 0 1 output at compare match
			1		Initial output is 0 Toggle output at compare match
	1	0	0		Output retained
			1		Initial output is 1 0 output at compare match
		1	0		Initial output is 1 1 output at compare match
			1		Initial output is 1 Toggle output at compare match
1	0	0	0	Input capture register	Input capture at rising edge
			1		Input capture at falling edge
		1	x		Input capture at both edges
	1	x	x		Input capture at generation of TGRC_0 compare match/input capture

[Legend]

x: Don't care

Notes: 1. After power-on reset, 0 is output until TIOR is set.

2. The TIOC1B pin input/output function is supported only by the SH7125.

Bit	Bit Name	Initial Value	R/W	Description
2	SYNC2	0	R/W	Timer Synchronous operation 2 to 0
1	SYNC1	0	R/W	These bits are used to select whether operation is independent of or synchronized with other channels.
0	SYNC0	0	R/W	When synchronous operation is selected, the TCNT synchronous presetting of multiple channels, and synchronous clearing by counter clearing on another channel, are possible. To set synchronous operation, the SYNC bits for at least two channels must be set to 1. To set synchronous clearing, in addition to the SYNC bit, the TCNT clearing source must also be set by means of bits CCLR0 to CCLR2 in TCR. 0: TCNT_2 to TCNT_0 operates independently (TCNT presetting /clearing is unrelated to other channels) 1: TCNT_2 to TCNT_0 performs synchronous operation TCNT synchronous presetting/synchronous clearing is possible

9.4.10 External Pulse Width Measurement

The pulse widths of up to three external input lines can be measured in channel 5.

Example of External Pulse Width Measurement Setting Procedure:

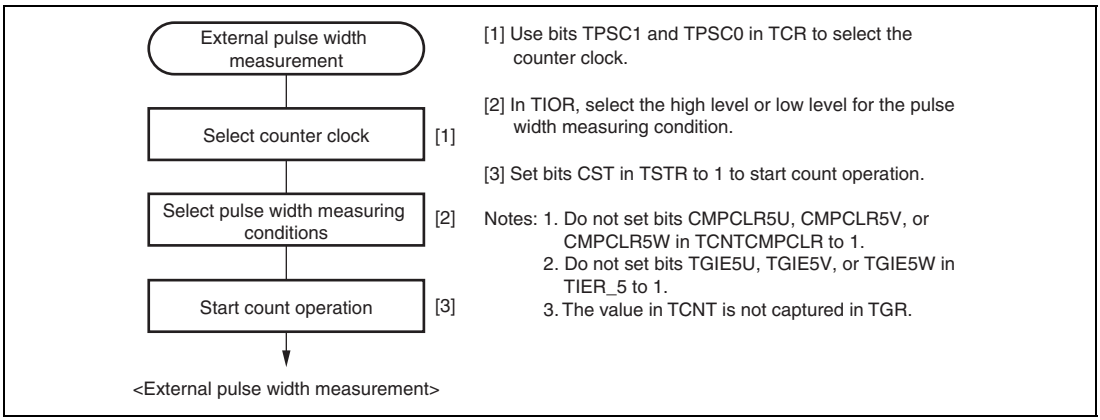

Figure 9.77 Example of External Pulse Width Measurement Setting Procedure

Example of External Pulse Width Measurement:

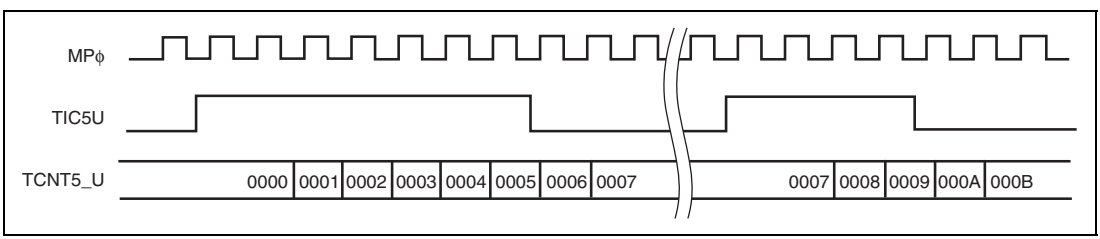

Figure 9.78 Example of External Pulse Width Measurement (Measuring High Pulse Width)

9.6.2 Interrupt Signal Timing

TGF Flag Setting Timing in Case of Compare Match: Figures 9.99 and 9.100 show the timing for setting of the TGF flag in TSR on compare match, and TGI interrupt request signal timing.

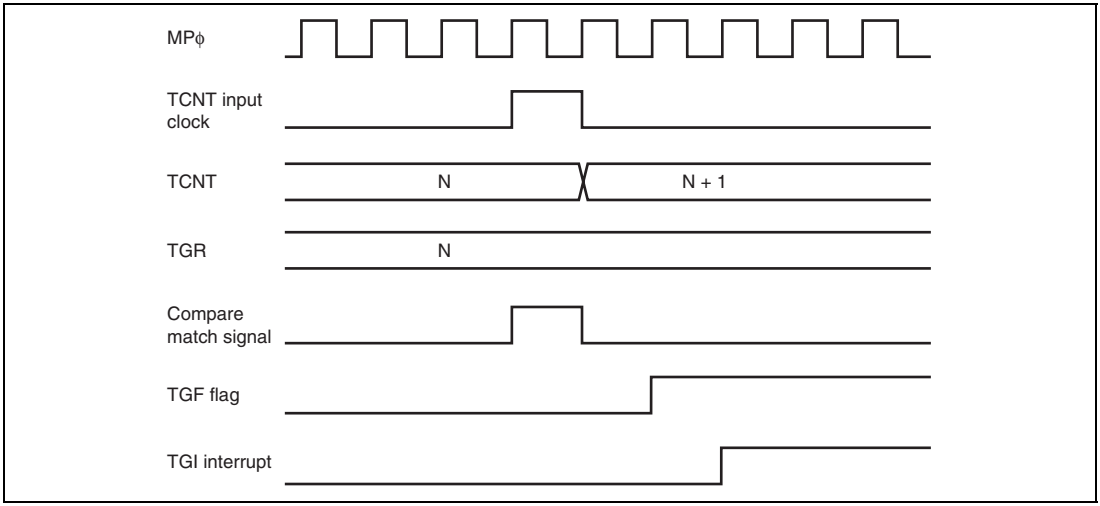

Figure 9.99 TGI Interrupt Timing (Compare Match) (Channels 0 to 4)

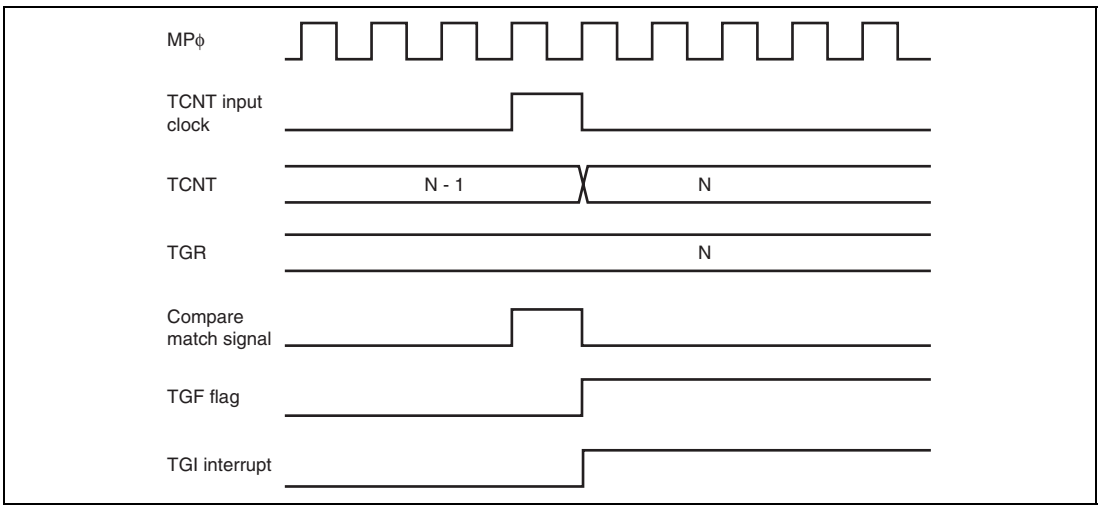

Figure 9.100 TGI Interrupt Timing (Compare Match) (Channel 5)

Operation when Error Occurs during PWM Mode 1 Operation, and Operation is Restarted in Phase Counting Mode: Figure 9.133 shows an explanatory diagram of the case where an error occurs in PWM mode 1 and operation is restarted in phase counting mode after re-setting.

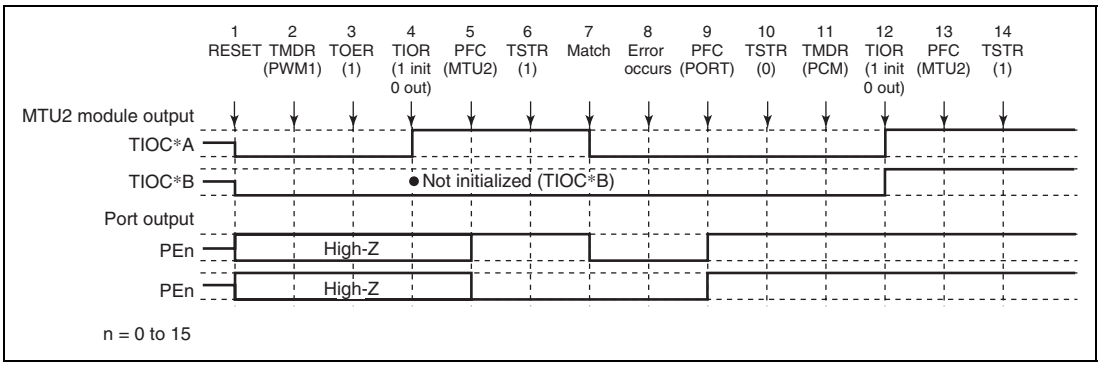

Figure 9.133 Error Occurrence in PWM Mode 1, Recovery in Phase Counting Mode

1 to 10 are the same as in figure 9.130.

11. Set phase counting mode.
12. Initialize the pins with TIOR.
13. Set MTU2 output with the PFC.
14. Operation is restarted by TSTR.

Note: Phase counting mode can only be set for channels 1 and 2, and therefore TOER setting is not necessary.

Operation when Error Occurs during Reset-Synchronized PWM Mode Operation, and Operation is Restarted in Reset-Synchronized PWM Mode: Figure 9.152 shows an explanatory diagram of the case where an error occurs in reset-synchronized PWM mode and operation is restarted in reset-synchronized PWM mode after re-setting.

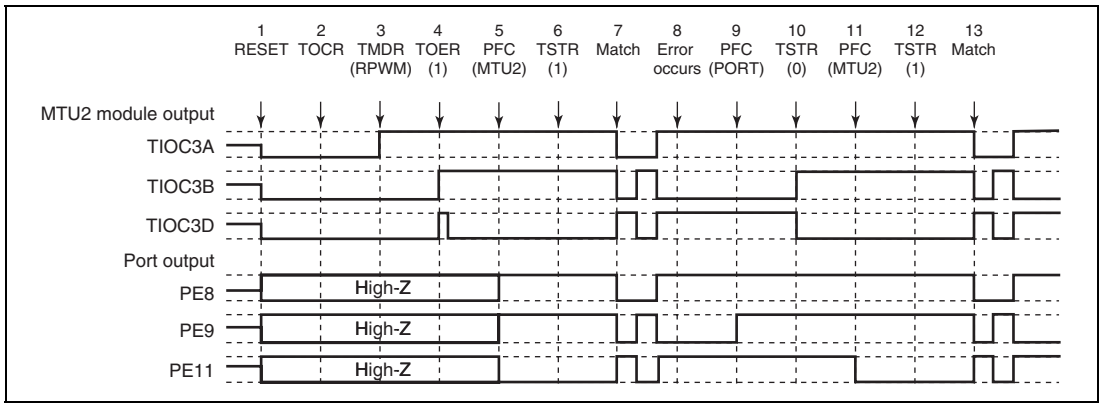

Figure 9.152 Error Occurrence in Reset-Synchronized PWM Mode, Recovery in Reset-Synchronized PWM Mode

1 to 10 are the same as in figure 9.149.

11. Set MTU2 output with the PFC.
12. Operation is restarted by TSTR.
13. The reset-synchronized PWM waveform is output on compare-match occurrence.

Bit	Bit Name	Initial value	R/W	Description
15 to 13	—	All 0	R	Reserved These bits are always read as 0. The write value should always be 0.
12	POE8F	0	R/(W)*[1]	POE8 Flag This flag indicates that a high impedance request has been input to the $\overline{\text{POE8}}$ pin. [Clearing conditions] • By writing 0 to POE8F after reading POE8F = 1 (when the falling edge is selected by bits 1 and 0 in ICSR3)· • By writing 0 to POE8F after reading POE8F = 1 after a high level input to POE8 is sampled at Pf/8, Pf/16, or Pf/128 clock (when low-level sampling is selected by bits 1 and 0 in ICSR3) [Setting condition] • When the input condition set by bits 1 and 0 in ICSR3 occurs at the $\overline{\text{POE8}}$ pin
11, 10	—	All 0	R	Reserved These bits are always read as 0. The write value should always be 0.
9	POE8E	0	R/W*[2]	POE8 High-Impedance Enable This bit specifies whether to place the pins in high-impedance state when the POE8F bit in ICSR3 is set to 1. 0: Does not place the pins in high-impedance state 1: Places the pins in high-impedance state
8	PIE3	0	R/W	Port Interrupt Enable 3 (Supported only by the SH7125. Write 0 to this bit in the SH7124.) This bit enables or disables interrupt requests when the POE8 bit in ICSR3 is set to 1. 0: Interrupt requests disabled 1: Interrupt requests enabled

Section 12 Serial Communication Interface (SCI)

This LSI has three independent serial communication interface (SCI) channels. The SCI can handle both asynchronous and clock synchronous serial communication. In asynchronous serial communication mode, serial data communication can be carried out with standard asynchronous communication chips such as a Universal Asynchronous Receiver/Transmitter (UART) or Asynchronous Communication Interface Adapter (ACIA). A function is also provided for serial communication between processors (multiprocessor communication function).

12.1 Features

- Choice of asynchronous or clock synchronous serial communication mode
- Asynchronous mode (channels 0 to 2 in the SH7125, channels 0 to 2 in the SH7124):
  - Serial data communication is performed by start-stop in character units. The SCIF can communicate with a universal asynchronous receiver/transmitter (UART), an asynchronous communication interface adapter (ACIA), or any other communications chip that employs a standard asynchronous serial system. There are twelve selectable serial data communication formats.
  - Data length: 7 or 8 bits
  - Stop bit length: 1 or 2 bits
  - Parity: Even, odd, or none
  - Multiprocessor communications
  - Receive error detection: Parity, overrun, and framing errors
  - Break detection: Break is detected by reading the RXD pin level directly when a framing error occurs.
- Clock synchronous mode (channels 0 to 2 in the SH7125, channels 0 and 2 in the SH7124):
  - Serial data communication is synchronized with a clock signal. The SCIF can communicate with other chips having a clock synchronous communication function.
  - Data length: 8 bits
  - Receive error detection: Overrun errors
- Full duplex communication: The transmitting and receiving sections are independent, so the SCI can transmit and receive simultaneously. Both sections use double buffering, so high-speed continuous data transfer is possible in both transmit and receive directions.
- On-chip baud rate generator with selectable bit rates
- Internal or external transmit/receive clock source: From either baud rate generator (internal clock) or SCK pin (external clock)
- Choice of LSB-first or MSB-first data transfer (except for 7-bit data in asynchronous mode)

Bit	Bit Name	Initial value	R/W	Description
6	RDRF	0	R/(W)*	Receive Data Register Full Indicates that the received data is stored in the receive data register (SCRDR). 0: Indicates that valid received data is not stored in SCRDR [Clearing conditions] • By a power-on reset or in standby mode • When 0 is written to RDRF after reading RDRF = 1 1: Indicates that valid received data is stored in SCRDR [Setting condition] • When serial reception ends normally and receive data is transferred from SCRSR to SCRDR Note: SCRDR and the RDRF flag are not affected and retain their previous states even if an error is detected during data reception or if the RE bit in the serial control register (SCSCR) is cleared to 0. If reception of the next data is completed while the RDRF flag is still set to 1, an overrun error will occur and the received data will be lost.

Figure 12.7 shows an example of the operation for reception.

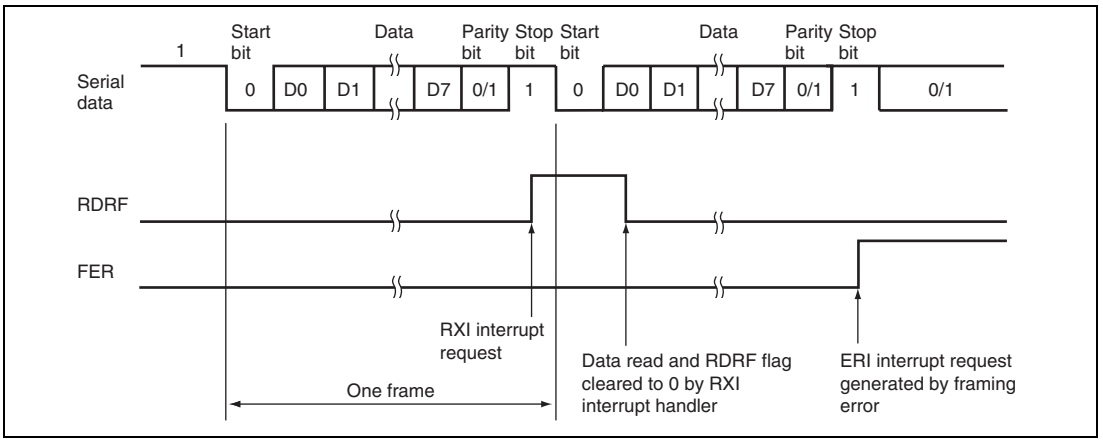

Figure 12.7 Example of SCI Receive Operation (8-Bit Data, Parity, One Stop Bit)

12.4.3 Clock Synchronous Mode (Channel 1 in the SH7124 is not Available)

In clock synchronous mode, the SCIF transmits and receives data in synchronization with clock pulses. This mode is suitable for high-speed serial communication.

The SCI transmitter and receiver are independent, so full-duplex communication is possible while sharing the same clock. Both the transmitter and receiver have a double-buffered structure so that data can be read or written during transmission or reception, enabling continuous data transfer.

Figure 12.8 shows the general format in clock synchronous serial communication.

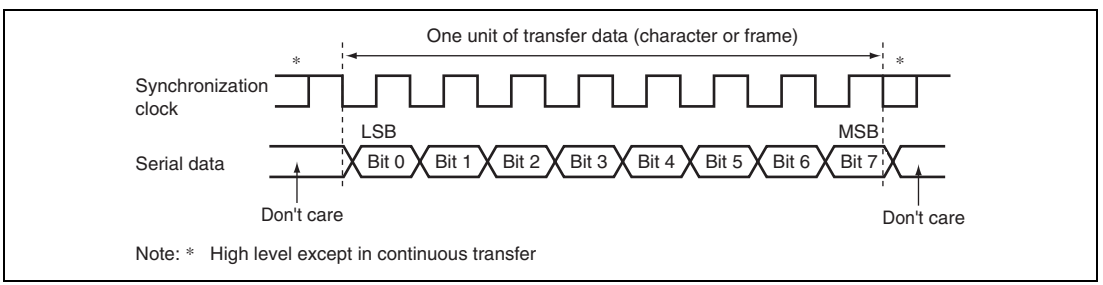

Figure 12.8 Data Format in Clock Synchronous Communication

12.5 SCI Interrupt Sources

The SCI has four interrupt sources: transmit end (TEI), receive error (ERI), receive-data-full (RXI), and transmit-data-empty (TXI) interrupt requests.

Table 12.17 shows the interrupt sources. The interrupt sources are enabled or disabled by means of the TIE, RIE, and TEIE bits in SCSCR and the EIO bit in SCSPTR. A separate interrupt request is sent to the interrupt controller for each of these interrupt sources.

When the TDRE flag in the serial status register (SCSSR) is set to 1, a TDR empty interrupt request is generated. When the RDRF flag in SCSSR is set to 1, an RDR full interrupt request is generated. When the ORER, FER, or PER flag in SCSSR is set to 1, an ERI interrupt request is generated. When the TEND flag in SCSSR is set to 1, a TEI interrupt request is generated.

The TXI interrupt indicates that transmit data can be written, and the TEI interrupt indicates that transmission has been completed.

Table 12.17 SCI Interrupt Sources

Interrupt Source	Description
ERI	Interrupt caused by receive error (ORER, FER, or PER)
RXI	Interrupt caused by receive data full (RDRF)
TXI	Interrupt caused by transmit data empty (TDRE)
TEI	Interrupt caused by transmit end (TENT)

Bit	Bit Name	Initial Value	R/W	Description
2 to 0	CH[2:0]	000	R/W	Channel Select 2 to 0 Select analog input channels. See table 13.3. When changing the operating mode, first clear the ADST bit to 0.

Note: * Writing 0 to this bit after reading it as 1 clears the flag and is the only allowed way.

13.3.3 A/D Control Registers_0 and _1 (ADCR_0 and ADCR_1)

ADCR for each module controls A/D conversion.

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	ADST	-	-	-	-	-	-	-	-	-	-	-	-	-
Initial value:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R/W:	R	R	R/W	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit	Bit Name	Initial Value	R/W	Description
15, 14	—	All 0	R	Reserved These bits are always read as 0. The write value should always be 0.
13	ADST	0	R/W	A/D Start Starts or stops A/D conversion. When this bit is set to 1, A/D conversion is started. When this bit is cleared to 0, A/D conversion is stopped and the A/D converter enters the idle state. In single or single-cycle scan mode, this bit is automatically cleared to 0 when A/D conversion ends on the selected single channel. In continuous scan mode, A/D conversion is continuously performed for the selected channels in sequence until this bit is cleared by a software, reset, or in software standby mode or module standby mode.
12 to 0	—	All 0	R	Reserved These bits are always read as 0. The write value should always be 0.

(3.3) Flash pass/fail parameter (FPFR: general register R0 of CPU)

This parameter indicates the return value of the program processing result.

Bit:	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Initial value:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R/W:	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	MD	EE	FK	-	WD	WA	SF
Initial value:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R/W:	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W

Bit	Bit Name	Initial Value	R/W	Description
31 to 7	—	Undefined	R/W	Unused Return 0.
6	MD	Undefined	R/W	Programming Mode Related Setting Error Detect Returns the check result of whether the signal input to the FWE pin is high and whether the error protection state is not entered. When a low-level signal is input to the FWE pin or the error protection state is entered, 1 is written to this bit. The input level to the FWE pin and the error protection state can be confirmed with the FWE bit (bit 7) and the FLER bit (bit 4) in FCCS, respectively. For conditions to enter the error protection state, see section 17.6.3, Error Protection. 0: FWE and FLER settings are normal (FWE = 1, FLER = 0) 1: FWE = 0 or FLER = 1, and programming cannot be performed

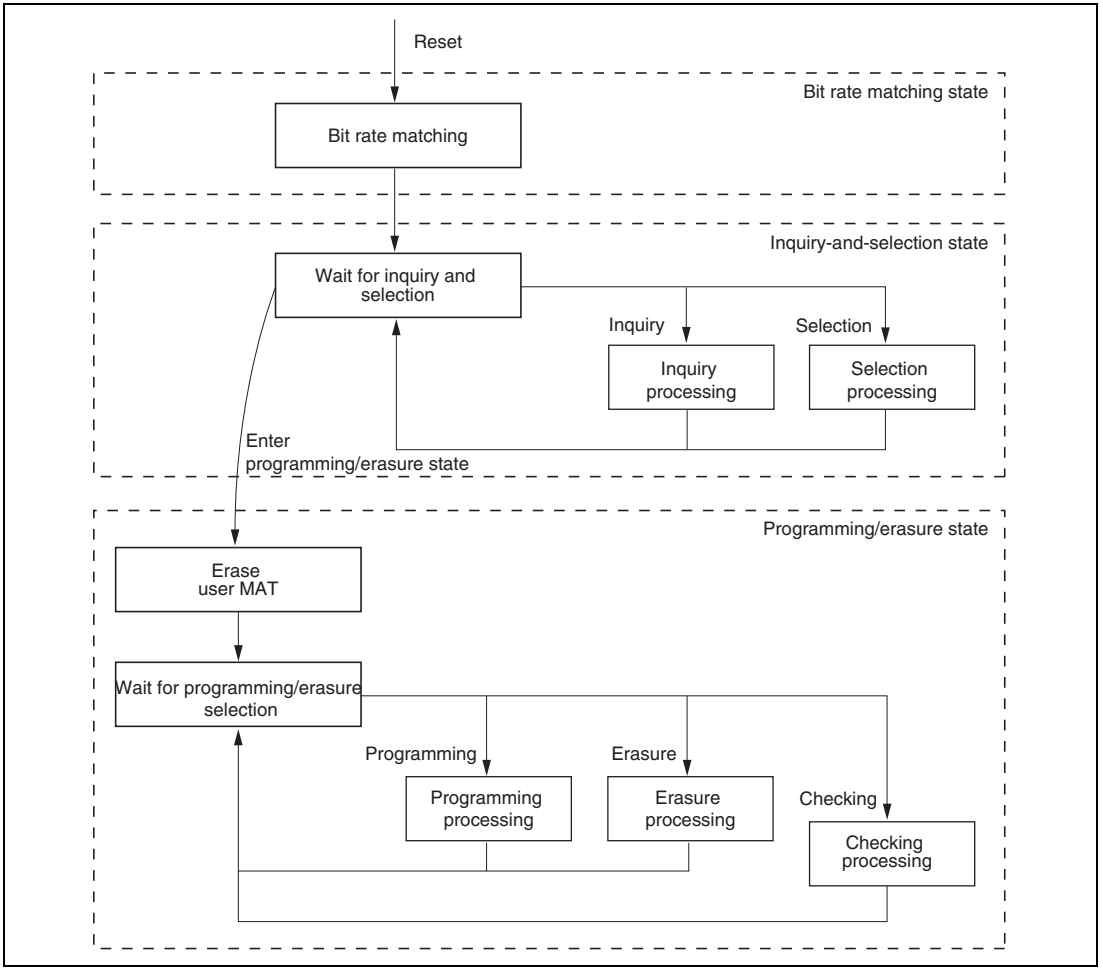

Figure 17.15 Flow of Processing by the Boot Program

- Bit-rate matching state

In bit-rate matching, the boot program measures the low-level intervals in a signal carrying H'00 data that is transmitted by the host, and calculates the bit rate from this. The bit rate can be changed by the new-bit-rate selection command. On completion of bit-rate matching, the boot program goes to the inquiry and selection state. The sequence of processing in bit-rate matching is shown in figure 17.16.

Register Abbreviation	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0	Module
TIORV_5	—	—	—	IOC[4:0]					MTU2
TCNTW_5									
TGRW_5									
TCRW_5	—	—	—	—	—	—	TPSC[1:0]		
TIORW_5	—	—	—	IOC[4:0]					
TSR_5	—	—	—	—	—	CMFU5	CMFV5	CMFW5	
TIER_5	—	—	—	—	—	TGIE5U	TGIE5V	TGIE5W	
TSTR_5	—	—	—	—	—	CSTU5	CSTV5	CSTW5	
TCNTCMPCLR	—	—	—	—	—	CMPCLR5U	CMPCLR5V	CMPCLR5W	
ADDR0	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	A/D (Channel 0)
	AD1	AD0	—	—	—	—	—	—	
ADDR1	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	
ADDR2	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	
ADDR3	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	
ADCSR_0	ADF	ADIE	—	—	TRGE	—	CONADF	STC	
	CKSL[1:0]		ADM[1:0]		ADCS	CH[2:0]			
ADCR_0	—	—	ADST	—	—	—	—	—	
	—	—	—	—	—	—	—	—	
ADDR4	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	A/D (Channel 1)
	AD1	AD0	—	—	—	—	—	—	
ADDR5	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	
ADDR6	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	
ADDR7	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	
	AD1	AD0	—	—	—	—	—	—	

SH7125 Group, SH7124 Group
Hardware Manual

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