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New 8FX 8-bit Microcontrollers

The MB95690K Series is a series of general-purpose, single-chip microcontrollers. In addition to a compact instruction set, the microcontrollers of this series contain a variety of peripheral functions.

Features

- F²MC-8FX CPU core
 - □ Instruction set optimized for controllers
 - · Multiplication and division instructions
 - · 16-bit arithmetic operations
 - · Bit test branch instructions
 - · Bit manipulation instructions, etc.

■ Clock

- □ Selectable main clock source
 - Main oscillation clock (up to 16.25 MHz, maximum machine clock frequency: 8.125 MHz)
 - External clock (up to 32.5 MHz, maximum machine clock frequency: 16.25 MHz)
 - Main CR clock (4 MHz ±2%)
 - · Main CR PLL clock
 - The main CR PLL clock frequency becomes 8 MHz $\pm 2\%$ when the PLL multiplication rate is 2.
 - The main CR PLL clock frequency becomes 10 MHz $\pm 2\%$ when the PLL multiplication rate is 2.5.
 - The main CR PLL clock frequency becomes 12 MHz $\pm 2\%$ when the PLL multiplication rate is 3.
 - The main CR PLL clock frequency becomes 16 MHz $\pm 2\%$ when the PLL multiplication rate is 4.
- □ Selectable subclock source
 - Suboscillation clock (32.768 kHz)
 - External clock (32.768 kHz)
 - Sub-CR clock (Typ: 100 kHz, Min: 50 kHz, Max: 150 kHz)

■ Timer

- $\ \ \,$ 8/16-bit composite timer \times 2 channels
- □ 8/16-bit PPG × 3 channels
- □ 16-bit PPG timer × 1 channel (can work independently or together with the multi-pulse generator)
- $\hfill \ensuremath{\square}$ 16-bit reload timer \times 1 channel (can work independently or together with the multi-pulse generator)
- □ Time-base timer × 1 channel
- □ Watch prescaler × 1 channel
- UART/SIO × 1 channel
 - □ Full duplex double buffer
 - Capable of clock asynchronous (UART) serial data transfer and clock synchronous (SIO) serial data transfer
- I²C bus interface × 1 channel
 - □ Built-in wake-up function
- Multi-pulse generator (MPG) (for DC motor control) × 1 channel
 - □ 16-bit reload timer × 1 channel
 - ☐ 16-bit PPG timer × 1 channel

 Waveform sequencer (including a 16-bit timer equipped with a buffer and a compare clear function)

■ LIN-UART

- □ Full duplex double buffer
- Capable of clock asynchronous serial data transfer and clock synchronous serial data transfer
- External interrupt
 - □ LQF044: 7 channels
 - □ LQA048, LQC052, WNR048: 8 channels
- □ Interrupt by edge detection (rising edge, falling edge, and both edges can be selected)
- Can be used to wake up the device from different low power consumption (standby) modes
- 8/10-bit A/D converter
 - LQF044: 8 channels
 - LQA048, LQC052, WNR048: 12 channels
 - □ 8-bit or 10-bit resolution can be selected.
- Low power consumption (standby) modes
 - There are four standby modes as follows:
 - Stop mode
 - Sleep mode
 - · Watch mode
 - · Time-base timer mode
 - In standby mode, two further options can be selected: normal standby mode and deep standby mode.
- I/O port
 - □ LQF044 (number of I/O ports: 41)
 - General-purpose I/O ports (CMOS I/O):37
 - General-purpose I/O ports (N-ch open drain):4
 - LQA048, LQC052, WNR048 (number of I/O ports: 45)
 - General-purpose I/O ports (CMOS I/O):41
 - General-purpose I/O ports (N-ch open drain):4
- On-chip debug
 - □ 1-wire serial control
 - Serial writing supported (asynchronous mode)
- Hardware/software watchdog timer
 - ☐ Built-in hardware watchdog timer
 - □ Built-in software watchdog timer
- Power-on reset
 - A power-on reset is generated when the power is switched on.
- Low-voltage detection (LVD) reset circuit
 - ☐ The LVD function is enabled by default. For details, see "20.2 Recommended Operating Conditions" in "Electrical Characteristics".
 - The LVD function can be controlled through software.



- □ The LVD reset circuit control register (LVDCC) enables or disables the LVD reset.
- ☐ The LVD reset circuit has an internal low-voltage detector. The combination of detection voltage and release voltage can be selected from four options.
- Comparator × 2 channels
 - □ Built-in dedicated BGR
 - ☐ The comparator reference voltage can be selected between the BGR voltage and the comparator pin.
- Clock supervisor counter
 - □ Built-in clock supervisor counter
- Dual operation Flash memory
 - □ The program/erase operation and the read operation can be executed in different banks (upper bank/lower bank) simultaneously.
- Flash memory security function
 - □ Protects the content of the Flash memory.



Contents

Features	1
1. Product Line-up	4
2. Packages And Corresponding Products	6
3. Differences Among Products And Notes On	
Product Selection	7
4. Pin Assignment	8
5. Pin Functions (LQF044	12
6. Pin Functions (LQA048, LQC052, WNR048	16
7. I/O Circuit Type	21
8. Handling Precautions	23
8.1 Precautions for Product Design	
8.2 Precautions for Package Mounting	
8.3 Precautions for Use Environment	
9. Notes On Device Handling	26
10. Pin Connection	27
11. Block Diagram (LQF044	29
12. Block Diagram (LQA048, LQC052, WNR048	30
13. CPU Core	31
14. Memory Space	32
14.1 I/O area (addresses: 0x0000 to 0x007F)	
14.2 Extended I/O area	
(addresses: 0x0F80 to 0x0FFF)	32
14.3 Data area	
14.4 Program area	32
14.5 Memory space map	

15. Areas For Specific Applications	. 34
16. I/O Map	. 35
17. I/O Ports	. 42
17.1 Port 0	. 43
17.2 Port 1	. 50
17.3 Port 4	. 55
17.4 Port 6	
17.5 Port 7	
17.6 Port F	
17.7 Port G	
18. Interrupt Source Table	. 80
19. Pin States In Each Mode	. 81
20. Electrical Characteristics	. 84
20.1 Absolute Maximum Ratings	. 84
20.2 Recommended Operating Conditions	
20.3 DC Characteristics	. 87
20.4 AC Characteristics	
20.5 A/D Converter	
20.6 Flash Memory Program/Erase Characteristics	
21. Sample Characteristics	114
22. Ordering Information	121
23. Package Dimension	122
24. Major Changes In This Edition	126
Document History Page	
, <u> </u>	129



1. Product Line-up

Part number Parameter	MB95F694K	MB95F696K	MB95F698K						
Туре		Flash memory product							
Clock supervisor counter	It supervises the main clock oscill	supervises the main clock oscillation and the subclock oscillation.							
Flash memory capacity	20 Kbyte	36 Kbyte	60 Kbyte						
RAM capacity	512 bytes	1 Kbyte	2 Kbyte						
Power-on reset		Yes							
Low-voltage detection reset		Controlled through software							
Reset input		Selected through software							
CPU functions	 Number of basic instructions Instruction bit length Instruction length Data bit length Minimum instruction execution t Interrupt processing time 	: 136 : 8 bits : 1 to 3 bytes : 1, 8 and 16 bits ime : 61.5 ns (machine clock freq : 0.6 μs (machine clock frequ							
General- purpose I/O	 LQF044 I/O port : 41 CMOS I/O : 37 N-ch open drain : 4 LQA048, LQC052, WNR048 I/O port : 45 CMOS I/O : 41 N-ch open drain : 4 								
Time-base timer	Interval time: 0.256 ms to 8.3 s (e	xternal clock frequency = 4 MHz)							
software	 Reset generation cycle Main oscillation clock at 10 MF The sub-CR clock can be used 		e watchdog timer.						
Wild register	It can be used to replace 3 bytes	of data.							
LIN-UART	 It has a full duplex double buffer 	ata transfer and clock asynchronou	cated reload timer. us serial data transfer are enabled.						
8/10-bit A/D converter	LQF044: 8 channelsLQA048, LQC052, WNR048: 12	2 channels							
. ID CONVOICE	8-bit or 10-bit resolution can be selected.								



Part number									
Parameter	MB95F694K	MB95F696K	MB95F698K						
· arameter	2 channels								
	 The timer can be configured as an "8-bit timer × 2 channels" or a "16-bit timer × 1 channel". It has the following functions: interval timer function, PWC function, PWM function and input function. Count clock: it can be selected from internal clocks (seven types) and external clocks. It can output square wave. 								
External	LQF044: 7 channelsLQA048, LQC052, WNR048: 8	channels							
interrupt	Interrupt by edge detection (TheIt can be used to wake up the de	e rising edge, falling edge, and bot evice from different standby mode							
On-chip debug	1-wire serial controlIt supports serial writing (asynch	nronous mode).							
	1 channel								
UART/SIO	 Data transfer with UART/SIO is enabled. It has a full duplex double buffer, variable data length (5/6/7/8 bits), an internal baud rate generato and an error detection function. It uses the NRZ type transfer format. LSB-first data transfer and MSB-first data transfer are available to use. Both clock asynchronous (UART) serial data transfer and clock synchronous (SIO) serial data transfe are enabled. 								
	1 channel								
I ² C bus interface	 Master/slave transmission and r It has the following functions: bu function, wake-up function, and 								
	3 channels								
	Each channel can be used as aThe counter operating clock can								
	1 channel								
16-bit PPG timer	 PWM mode and one-shot mode are available to use. The counter operating clock can be selected from eight clock sources. It supports external trigger start. It can work independently or together with the multi-pulse generator. 								
	1 channel								
16-bit reload timer	 Two clock modes and two counter operating modes are available to use. It can output square wave. Count clock: it can be selected from internal clocks (seven types) and external clocks. Two counter operating modes: reload mode and one-shot mode It can work independently or together with the multi-pulse generator. 								
Multi-pulse generator (for DC motor control)	 16-bit PPG timer: 1 channel 16-bit reload timer operations: to Event counter: 1 channel Waveform sequencer (including) 		ffer and a compare clear function)						



Part number Parameter	MB95F694K	MB95F6	96K		MB95F698K						
Watch prescaler	Eight different time intervals can b	pe selected.									
	2 channels										
Comparator	The reference voltage of each cha pin.	annel can be selecte	ed between the	e BGR volta	ge and the comparator						
Flash memory	 suspend/erase-resume commar It has a flag indicating the comp Flash security feature for protec 	It supports automatic programming (Embedded Algorithm), and program/erase/erase-suspend/erase-resume commands. It has a flag indicating the completion of the operation of Embedded Algorithm. Flash security feature for protecting the content of the Flash memory Number of program/erase cycles 1000 10000 100000									
Standby mode	There are four standby modes as Stop mode Sleep mode Watch mode Time-base timer mode	There are four standby modes as follows: Stop mode Sleep mode Watch mode									
Package		LQF04 LQA04 LQC05 WNR0	18 52								

2. Packages And Corresponding Products

Part number Package	MB95F694K	MB95F696K	МВ95F698К
LQF044	0	0	O
LQA048	0	0	0
LQC052	0	0	0
WNR048	0	0	0

O: Available



3. Differences Among Products And Notes On Product Selection

Current consumption

When using the on-chip debug function, take account of the current consumption of Flash memory program/erase. For details of current consumption, see "Electrical Characteristics".

Package

For details of information on each package, see "Packages And Corresponding Products" and "Package Dimension".

· Operating voltage

The operating voltage varies, depending on whether the on-chip debug function is used or not. For details of operating voltage, see "Electrical Characteristics".

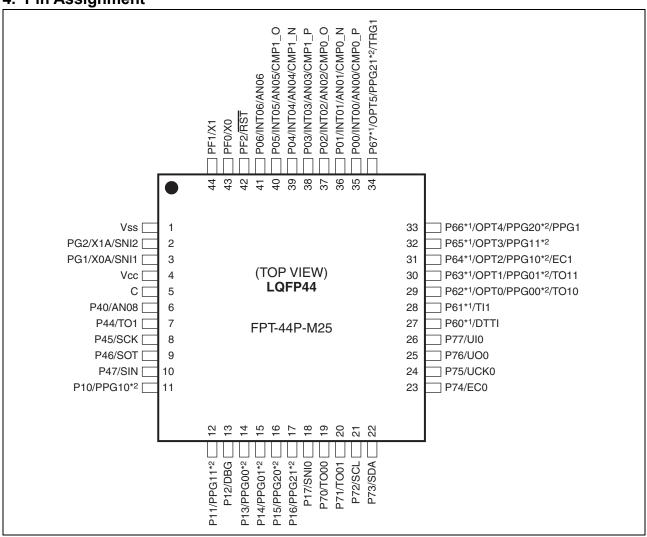
· On-chip debug function

The on-chip debug function requires that Vcc, Vss and one serial wire be connected to an evaluation tool. For details of the connection method, refer to "CHAPTER 25 EXAMPLE OF SERIAL PROGRAMMING CONNECTION" in "New 8FX MB95690K Series Hardware Manual".

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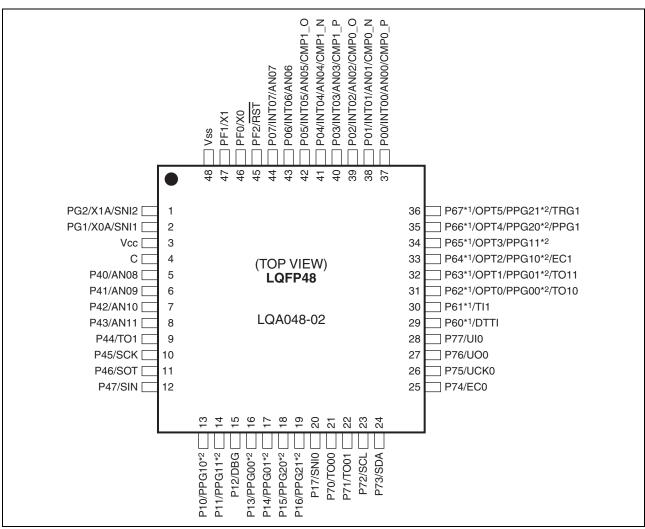
4. Pin Assignment



^{*1:} High-current pin (8 mA/12 mA)

^{*2:} The 8/16-bit PPG output pins are mapped to port 1 by default. To map the 8/16-bit PPG output pins to port 6, write "1" to the PPGSEL bit in the SYSC register.

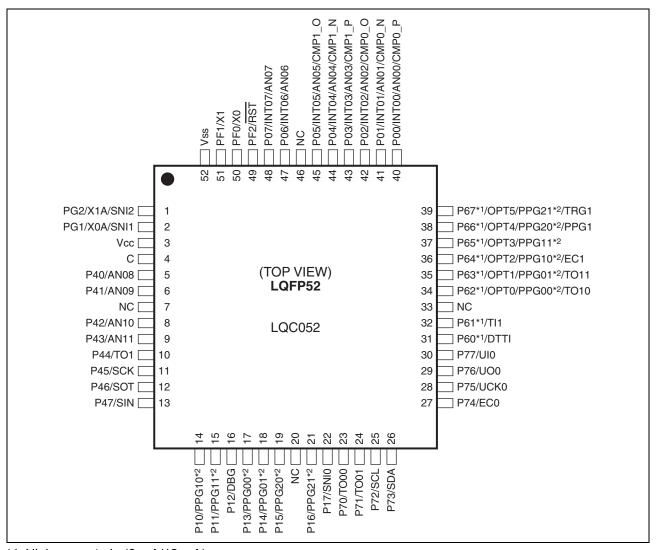




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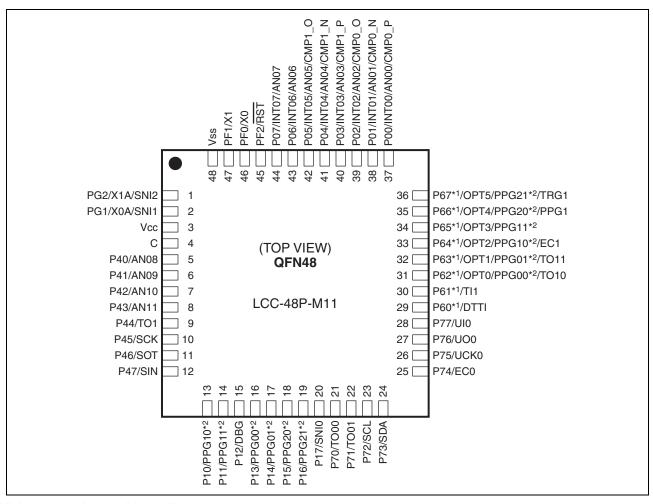




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5. Pin Functions (LQF044)

	Din no Din nome				I/O type				
Pin no.	Pin name	circuit type*1	Function	Input	Output	OD*2	PU*3		
1	Vss	_	Power supply pin (GND)	_					
	PG2		General-purpose I/O port						
2	X1A	С	Subclock I/O oscillation pin	Hysteresis	CMOS		О		
_	SNI2		Trigger input pin for the position detection function of the MPG waveform sequencer	11701010010	Civico				
	PG1		General-purpose I/O port						
3	X0A	С	Subclock input oscillation pin	Hysteresis	CMOS		О		
J	SNI1		Trigger input pin for the position detection function of the MPG waveform sequencer	11/310/03/3	OWICO		O		
4	Vcc	_	Power supply pin	_	_		_		
5	С		Decoupling capacitor connection pin	_					
	P40	_	General-purpose I/O port	Hysteresis/	01400	_			
6	AN08	Е	8/10-bit A/D converter analog input pin	analog	CMOS		О		
7	P44	F	General-purpose I/O port	I books as also	Liveteresia	Uvotorogia	CMOS		
7	TO1	F	16-bit reload timer ch. 1 output pin	Hysteresis	CIVIOS		О		
8	P45	F	General-purpose I/O port	Llyotoropio	CMOS				
0	SCK	Г	LIN-UART clock I/O pin	Hysteresis	CIVIOS		О		
9	P46	F	General-purpose I/O port	Hyetorogie	CMOS				
9	SOT	Г	LIN-UART data output pin	Hysteresis	CIVIOS	_	О		
10	P47	ı	General-purpose I/O port	CMOS	CMOS		0		
10	SIN	'	LIN-UART data input pin	CIVIOS	CIVIOS		U		
11	P10	F	General-purpose I/O port	Hysteresis	CMOS		О		
11	PPG10		8/16-bit PPG ch. 1 output pin	Tiysteresis	CIVIOS				
12	P11	F	General-purpose I/O port	Hysteresis	CMOS		0		
12	PPG11		8/16-bit PPG ch. 1 output pin	Tiysteresis	CIVIOS		U		
13	P12	G	General-purpose I/O port	- Hysteresis	CMOS	О			
10	DBG	J	DBG input pin	Tiyateresis	CIVICO	O			
14	P13	F	General-purpose I/O port	Hysteresis	CMOS		О		
17	PPG00		8/16-bit PPG ch. 0 output pin	Tiyotorcoio	Olvioo		O		
15	P14	F	General-purpose I/O port	Hysteresis	CMOS		О		
10	PPG01	'	8/16-bit PPG ch. 0 output pin	11931616313	CIVICO				
16	P15	F	General-purpose I/O port	Hysteresis	CMOS		О		
10	PPG20	'	8/16-bit PPG ch. 2 output pin	riyatereala	CIVICO		J		
17	P16	F	General-purpose I/O port	Hysteresis	CMOS		О		
17	PPG21	'	8/16-bit PPG ch. 2 output pin	riyotorcolo	CIVICO				



		I/O			I/O type		
Pin no.	Pin name	circuit type*1	Function	Input	Output	OD*2	PU*3
	P17		General-purpose I/O port				
18	SNI0	F	Trigger input pin for the position detection function of the MPG waveform sequencer	Hysteresis	CMOS		О
19	P70	F	General-purpose I/O port	Hysteresis	CMOS		О
19	TO00	Ī	8/16-bit composite timer ch. 0 output pin	Tiyoteresis	CIVIOS		O
20	P71	F	General-purpose I/O port	Hysteresis	CMOS		0
20	TO01	'	8/16-bit composite timer ch. 0 output pin	Tiysteresis	CIVIOS		
21	P72	Н	General-purpose I/O port	CMOS	CMOS	О	
21	SCL	''	I ² C bus interface ch. 0 clock I/O pin	CIVIOS	CIVIOS		
22	P73	Н	General-purpose I/O port	CMOS	CMOS		
22	SDA		I ² C bus interface ch. 0 data I/O pin	CIVIOS	CIVIOS	О	
00	P74	F	General-purpose I/O port	Lluctoropio	CMOS		
23	EC0	F	8/16-bit composite timer ch. 0 clock input pin	Hysteresis		_	О
0.4	P75	_	General-purpose I/O port	I li rata na alia	CMOS		
24	UCK0	F	UART/SIO ch. 0 clock I/O pin	Hysteresis			О
0.5	P76	F	General-purpose I/O port		01100		
25	UO0		UART/SIO ch. 0 data output pin	Hysteresis	CMOS		О
	P77		General-purpose I/O port		01100		
26	UI0	l	UART/SIO ch. 0 data input pin	Hysteresis	CMOS		О
27	P60	D	General-purpose I/O port High-current pin	Hysteresis	CMOS		О
	DTTI		MPG waveform sequencer input pin				
28	P61	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	_	0
	TI1		16-bit reload timer ch. 1 input pin				
	P62		General-purpose I/O port High-current pin				
29	OPT0	D	MPG waveform sequencer output pin	Hysteresis	CMOS		О
	PPG00		8/16-bit PPG ch. 0 output pin				
	TO10		8/16-bit composite timer ch. 1 output pin				
	P63		General-purpose I/O port High-current pin				
30	OPT1	D	MPG waveform sequencer output pin	Hysteresis	CMOS		О
	PPG01]	8/16-bit PPG ch. 0 output pin	-			
	TO11		8/16-bit composite timer ch. 1 output pin				



Pin no. Pin name		I/O		I/O type					
Pin no.	Pin name	circuit type*1	Function	Input	Output	OD*2	PU*3		
	P64		General-purpose I/O port High-current pin						
31	OPT2	D	MPG waveform sequencer output pin	Hysteresis	CMOS		О		
	PPG10		8/16-bit PPG ch. 1 output pin						
	EC1		8/16-bit composite timer ch. 1 clock input pin						
20	P65		General-purpose I/O port High-current pin		01100				
32	OPT3	D	MPG waveform sequencer output pin	Hysteresis	CMOS	_	О		
	PPG11		8/16-bit PPG ch. 1 output pin						
	P66		General-purpose I/O port High-current pin						
33	OPT4	D	MPG waveform sequencer output pin	Hysteresis	CMOS	_	О		
	PPG20		8/16-bit PPG ch. 2 output pin						
	PPG1		16-bit PPG timer ch. 1 output pin						
	P67		General-purpose I/O port High-current pin						
34	OPT5	D	MPG waveform sequencer output pin	Hysteresis	CMOS	_	О		
	PPG21		8/16-bit PPG ch. 2 output pin						
	TRG1		16-bit PPG timer ch. 1 trigger input pin						
	P00		General-purpose I/O port						
	INT00		External interrupt input pin	Uveterosia/	CMOS				
35	AN00	E	8/10-bit A/D converter analog input pin	Hysteresis/ analog		_	О		
	CMP0_P		Comparator ch. 0 non-inverting analog input (positive input) pin						
	P01		General-purpose I/O port						
	INT01		External interrupt input pin	Uvotorogio/					
36	AN01	E	8/10-bit A/D converter analog input pin	Hysteresis/ analog	CMOS	_	О		
	CMP0_N		Comparator ch. 0 inverting analog input (negative input) pin						
	P02		General-purpose I/O port						
37	INT02	E	External interrupt input pin	Hysteresis/	CMOS				
31	AN02		8/10-bit A/D converter analog input pin	analog	CIVIOS		О		
	CMP0_O	1	Comparator ch. 0 digital output pin						
	P03		General-purpose I/O port						
	INT03		External interrupt input pin	Uveteresis/					
38	AN03	E	8/10-bit A/D converter analog input pin	Hysteresis/ analog	CMOS	· —	О		
	CMP1_P		Comparator ch. 1 non-inverting analog input (positive input) pin						



Din no Din nome		I/O			I/O type			
Pin no.	Pin name	type*1	Function	Input	Output	OD*2	PU*3	
	P04		General-purpose I/O port					
	INT04		External interrupt input pin	CMOS/				
39	AN04	E	8/10-bit A/D converter analog input pin	analog	CMOS		О	
	CMP1_N		Comparator ch. 1 inverting analog input (negative input) pin					
	P05		General-purpose I/O port					
40	INT05	E	External interrupt input pin	Hysteresis/ analog	CMOS		0	
40	AN05	E	8/10-bit A/D converter analog input pin				О	
	CMP1_O		Comparator ch. 1 digital output pin					
	P06		General-purpose I/O port					
41	INT06	E	External interrupt input pin	Hysteresis/ analog	CMOS		О	
	AN06		8/10-bit A/D converter analog input pin	analog				
42	PF2	Α	General-purpose I/O port	Lluotorogia	CMOS			
42	RST	A	Reset pin	Hysteresis	CIVIOS	О		
42	PF0	В	General-purpose I/O port	Llyotorosis	CMOS			
43	43 X0		Main clock input oscillation pin	Hysteresis	CIVIOS			
44	PF1	В	General-purpose I/O port	Hyetorosia	CMOS			
44	X1		Main clock I/O oscillation pin	Hysteresis	CMOS			

O: Available

^{*1:} For the I/O circuit types, see "I/O Circuit Type".

^{*2:} N-ch open drain

^{*3:} Pull-up



6. Pin Functions (LQA048, LQC052, WNR048)

Pin	no.		I/O			I/O type			
LQFP48*1, QFN48*2	LQFP52*3	Pin name	circuit type*4	Function	Input	Output	OD*⁵	PU*6	
		PG2		General-purpose I/O port					
		X1A		Subclock I/O oscillation pin					
1	1	SNI2	С	Trigger input pin for the position detection function of the MPG waveform sequencer	Hysteresis	CMOS	_	О	
		PG1		General-purpose I/O port					
		X0A		Subclock input oscillation pin					
2	2	SNI1	С	Trigger input pin for the position detection function of the MPG waveform sequencer	Hysteresis	CMOS		О	
3	3	Vcc	_	Power supply pin	_	_		_	
4	4	С	_	Decoupling capacitor connection pin	_	_	_	_	
		P40		General-purpose I/O port	11	I books as also			
5	5	AN08	Е	8/10-bit A/D converter analog input pin	Hysteresis/ analog	CMOS	_	О	
		P41		General-purpose I/O port		CMOS			
6	6	AN09		8/10-bit A/D converter analog input pin	Hysteresis/ analog		_	О	
_	7	NC	_	It is an internally connected pin. Always leave it unconnected.	_	_	_	_	
		P42		General-purpose I/O port	Hysteresis/				
7	8	AN10		8/10-bit A/D converter analog input pin	analog	CMOS		О	
		P43		General-purpose I/O port	Hyatoropia/				
8	9	AN11		8/10-bit A/D converter analog input pin	Hysteresis/ analog	CMOS	_	О	
		P44		General-purpose I/O port					
9	10	TO1	F	16-bit reload timer ch. 1 output pin	Hysteresis	CMOS	_	О	
10	11	P45	Г	General-purpose I/O port	Llyotoroois	CMOS			
10	11	SCK	F	LIN-UART clock I/O pin	Hysteresis	CMOS		О	
11	12	P46	G F	General-purpose I/O port	Hysteresis	CMOS		О	
	14	SOT	I -	LIN-UART data output pin	11931616313	CIVIOS			
12	13	P47	I	General-purpose I/O port	01400	CMOS		0	
12	10	SIN		LIN-UART data input pin	CMOS	CIVIOS			
13	14	P10	F	General-purpose I/O port	Hysteresis	CMOS		О	
10	17	PPG10	ı	8/16-bit PPG ch. 1 output pin	1 Tyolor Gold	CIVICO			



Pin	no.		I/O			I/O type					
LQFP48*1, QFN48*2	LQFP52*3	Pin name	circuit type*4	Function	Input	Output	OD*⁵	PU*6			
4.4	45	P11	F	General-purpose I/O port	Lluctorosio	CMOC					
14	15	PPG11	F	8/16-bit PPG ch. 1 output pin	Hysteresis	CMOS		О			
15	16	P12	G	General-purpose I/O port	Llyotoropia	CMOS	О				
15	10	DBG	G	DBG input pin	Hysteresis	CIVIOS		_			
16	17	P13	F	General-purpose I/O port	Hysteresis	CMOS		0			
10	17	PPG00	Г	8/16-bit PPG ch. 0 output pin	TIYSICICSIS	CIVIOS					
17	18	P14	F	General-purpose I/O port	Llyotoropia	CMOS		0			
17	10	PPG01	Г	8/16-bit PPG ch. 0 output pin	Hysteresis	CIVIOS					
18	19	P15	F	General-purpose I/O port	Hysteresis	CMOS		О			
10	19	PPG20	Г	8/16-bit PPG ch. 2 output pin	TIYSICICSIS	CIVIOS					
_	20	NC	_	It is an internally connected pin. Always leave it unconnected.	_	_	_				
19	21	P16	F	General-purpose I/O port	Librataraaja (Uvotorogia	Hyptoropio	Hysteresis	CMOS		0
19	21	PPG21	Г	8/16-bit PPG ch. 2 output pin	пузістезіз	CIVIOS					
		P17		General-purpose I/O port		CMOS					
20	22	SNI0	F	Trigger input pin for the position detection function of the MPG waveform sequencer	Hysteresis		_	О			
		P70		General-purpose I/O port							
21	23	TO00	F	8/16-bit composite timer ch. 0 output pin	Hysteresis	CMOS	_	О			
		P71		General-purpose I/O port							
22	24	TO01	F	8/16-bit composite timer ch. 0 output pin	Hysteresis	CMOS	_	О			
		P72		General-purpose I/O port							
23	25	SCL	Н	I ² C bus interface ch. 0 clock I/O pin	CMOS	CMOS	О	_			
		P73		General-purpose I/O port							
24	26	SDA	Н	I ² C bus interface ch. 0 data I/O pin	CMOS	CMOS	О	_			
		P74		General-purpose I/O port							
25	27	EC0	F	8/16-bit composite timer ch. 0 clock input pin	Hysteresis	CMOS	_	О			
26	28	P75	F	General-purpose I/O port	Hysteresis	CMOS		0			
20	20	UCK0	<u>'</u>	UART/SIO ch. 0 clock I/O pin	11931515313	CIVIOS					
27	29	P76	F	General-purpose I/O port	Hysteresis	CMOS		0			
۷1	23	UO0	'	UART/SIO ch. 0 data output pin	11931010313	CIVIOS					



Pin no.			I/O		I/O type							
LQFP48*1, QFN48*2	LQFP52*3	Pin name circu type		Function	Input	Output	OD*⁵	PU*6				
28	30	P77	ı	General-purpose I/O port	Hysteresis	CMOS		0				
	30	UI0	1	UART/SIO ch. 0 data input pin	TIYSICICSIS	CIVIOS						
29	21	31	P60	D	General-purpose I/O port High-current pin	Hysteresis	CMOS		0			
20		DTTI		MPG waveform sequencer input pin	11,01010010	OMOG		Ü				
30	32	P61	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	_	0				
		TI1		16-bit reload timer ch. 1 input pin								
_	33	NC	_	It is an internally connected pin. Always leave it unconnected.	_	_	_	_				
		P62		General-purpose I/O port High-current pin		CMOS —	_					
31	34	ОРТ0		MPG waveform sequencer output pin	Hysteresis			0				
		PPG00		8/16-bit PPG ch. 0 output pin								
		TO10		8/16-bit composite timer ch. 1 output pin								
	35					P63		General-purpose I/O port High-current pin				
32		OPT1	D	MPG waveform sequencer output pin	Hysteresis	Hysteresis CMOS	_	0				
		PPG01		8/16-bit PPG ch. 0 output pin								
		TO11		8/16-bit composite timer ch. 1 output pin								
		P64		General-purpose I/O port High-current pin		eresis CMOS —						
33	36	OPT2		MPG waveform sequencer output pin	Hysteresis		О					
		PPG10 8/16-bit PPG ch. 1 output pin			1							
		EC1		8/16-bit composite timer ch. 1 clock input pin								
		P65		General-purpose I/O port High-current pin								
34	OPT3 D MPG waveform sequencer Hysteresis CM output pin	CMOS	_	О								
		PPG11		8/16-bit PPG ch. 1 output pin								



Pin	no.		I/O		I/O type						
LQFP48*1, QFN48*2	LQFP52*3	Pin name	circuit type*4			Output	OD*⁵	PU*6			
35	38	38	38	38	P66		General-purpose I/O port High-current pin				
					OPT4		MPG waveform sequencer output pin	Hysteresis	CMOS	_	О
		PPG20		8/16-bit PPG ch. 2 output pin							
		PPG1		16-bit PPG timer ch. 1 output pin							
		P67		General-purpose I/O port High-current pin							
36	39	OPT5		MPG waveform sequencer output pin	Hysteresis	CMOS	_	0			
		PPG21		8/16-bit PPG ch. 2 output pin							
		TRG1		16-bit PPG timer ch. 1 trigger input pin							
		P00		General-purpose I/O port		CMOS					
	40	INT00		External interrupt input pin	Hysteresis/ analog			О			
37		AN00		8/10-bit A/D converter analog input pin							
		CMP0_P		Comparator ch. 0 non-inverting analog input (positive input) pin							
	41	INT01 E	General-purpose I/O port								
			 E	External interrupt input pin	analog	CMOS	_	О			
38				8/10-bit A/D converter analog input pin							
		CMP0_N		Comparator ch. 0 inverting analog input (negative input) pin							
		P02		General-purpose I/O port		s/ cmos —					
		INT02		External interrupt input pin							
39	42	AN02		8/10-bit A/D converter analog input pin	Hysteresis/ analog		_	О			
		CMP0_O		Comparator ch. 0 digital output pin							
40	P03 INT03 General-purpose I/O port External interrupt input pin 8/10-bit A/D converter analog input pin	P03		General-purpose I/O port							
		INT03		External interrupt input pin]						
		Hysteresis/ analog	CMOS	_	О						
		CMP1_P		Comparator ch. 1 non-inverting analog input (positive input) pin							



Pin no.			I/O		I/O type				
LQFP48*1, QFN48*2	LQFP52*3	Pin name circu type		Function	Input	Output	OD*5	PU*6	
		P04		General-purpose I/O port	CMOS/ analog	CMOS	_		
		INT04		External interrupt input pin					
41	44	AN04	Е	8/10-bit A/D converter analog input pin				О	
		CMP1_N		Comparator ch. 1 inverting analog input (negative input) pin					
		P05		General-purpose I/O port					
		INT05		External interrupt input pin			_		
42	45	AN05	AN05 E 8/10-bit A/D converter analoginput pin	8/10-bit A/D converter analog input pin	Hysteresis/ analog	CMOS		О	
		CMP1_O		Comparator ch. 1 digital output pin					
_	46	NC	_	It is an internally connected pin. Always leave it unconnected.	_	_	_		
	47	P06		General-purpose I/O port					
43		47 INT06	INT06] E	External interrupt input pin	Hysteresis/	CMOS	_	0
.0		AN06		8/10-bit A/D converter analog input pin	analog			O	
		P07		General-purpose I/O port		CMOS	_		
44	48	INT07	Е	External interrupt input pin	Hysteresis/			0	
	.0	AN07		8/10-bit A/D converter analog input pin	analog			O	
45	49	PF2	Α	General-purpose I/O port	Hyetorosis	steresis CMOS O	0		
4 5	49	RST	^	Reset pin	TIYSICICSIS				
46	50	PF0 B	В	General-purpose I/O port	Hysteresis	CMOS			
		X0		Main clock input oscillation pin	Tysicicsis	CIVICO			
47	51 PF1 X1	В	General-purpose I/O port	Hysteresis	CMOS				
71		X1		Main clock I/O oscillation pin	TIYSICICSIS	, CIVIOS			
48	52	Vss		Power supply pin (GND)		_	_	_	

O: Available

^{*1:} LQA048

^{*2:} WNR048

^{*3:} LQC052

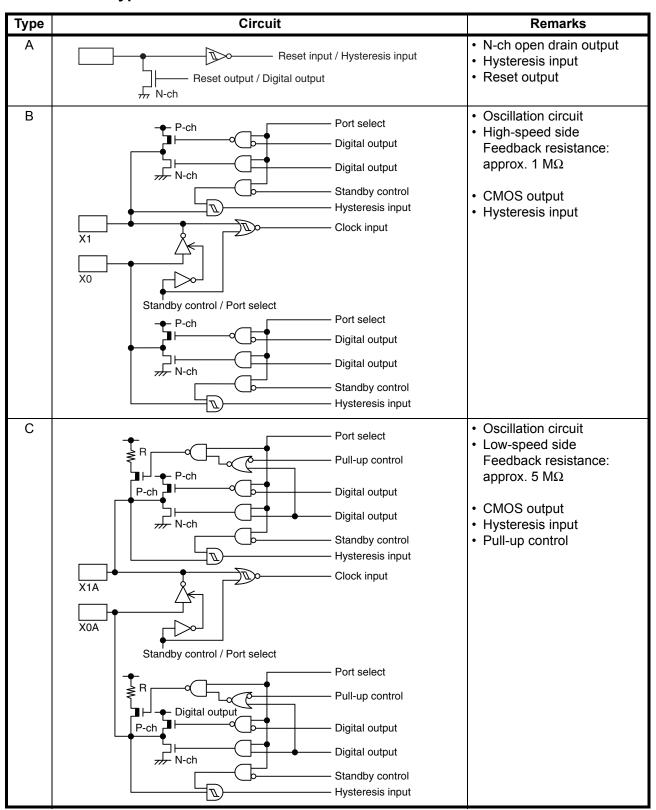
^{*4:} For the I/O circuit types, see "I/O Circuit Type".

^{*5:} N-ch open drain

^{*6:} Pull-up



7. I/O Circuit Type





Type	Circuit		Remarks
D	₹R	Pull-up control	CMOS output Hysteresis input Pull-up control
	P-ch	— Digital output	High current output
	N-ch	Digital output Standby control	
		Hysteresis input	
E	₹R C	—— Pull-up control	CMOS outputHysteresis inputPull-up control
	P-ch	—— Digital output	Analog input
	N-ch	—— Digital output	
	<u></u>	—— Analog input	
		—— A/D control —— Standby control —— Hysteresis input	
F	₹R	Pull-up control	CMOS output Hysteresis input Pull-up control
	P-ch	— Digital output	run-up control
	N-ch	— Digital output	
	- P	Standby controlHysteresis input	
G		Standby control	N-ch open drain output Hysteresis input
		——— Hysteresis input	Trysteresis iriput
	Digital output		
Н		—— Digital output	N-ch open drain output CMOS input
	N-ch	—— Standby control	
		—— CMOS input	



Type	Circuit	Remarks
I	Pull-up control	CMOS outputCMOS inputPull-up control
	P-ch Digital output	
	Digital output	
	Standby control	
	CMOS input	

8. Handling Precautions

Any semiconductor devices have inherently a certain rate of failure. The possibility of failure is greatly affected by the conditions in which they are used (circuit conditions, environmental conditions, etc.). This page describes precautions that must be observed to minimize the chance of failure and to obtain higher reliability from your Cypress semiconductor devices.

8.1 Precautions for Product Design

This section describes precautions when designing electronic equipment using semiconductor devices.

Absolute Maximum Ratings

Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of certain established limits, called absolute maximum ratings. Do not exceed these ratings.

Recommended Operating Conditions

Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their sales representative beforehand.

Processing and Protection of Pins

These precautions must be followed when handling the pins which connect semiconductor devices to power supply and input/output functions.

(1) Preventing Over-Voltage and Over-Current Conditions

Exposure to voltage or current levels in excess of maximum ratings at any pin is likely to cause deterioration within the device, and in extreme cases leads to permanent damage of the device. Try to prevent such overvoltage or over-current conditions at the design stage.

(2) Protection of Output Pins

Shorting of output pins to supply pins or other output pins, or connection to large capacitance can cause large current flows. Such conditions if present for extended periods of time can damage the device.

Therefore, avoid this type of connection.

(3) Handling of Unused Input Pins



Unconnected input pins with very high impedance levels can adversely affect stability of operation. Such pins should be connected through an appropriate resistance to a power supply pin or ground pin.

• Latch-up

Semiconductor devices are constructed by the formation of P-type and N-type areas on a substrate. When subjected to abnormally high voltages, internal parasitic PNPN junctions (called thyristor structures) may be formed, causing large current levels in excess of several hundred mA to flow continuously at the power supply pin. This condition is called latch-up.

CAUTION: The occurrence of latch-up not only causes loss of reliability in the semiconductor device, but can cause injury or damage from high heat, smoke or flame. To prevent this from happening, do the following:

- (1) Be sure that voltages applied to pins do not exceed the absolute maximum ratings. This should include attention to abnormal noise, surge levels, etc.
- (2) Be sure that abnormal current flows do not occur during the power-on sequence.

Observance of Safety Regulations and Standards

Most countries in the world have established standards and regulations regarding safety, protection from electromagnetic interference, etc. Customers are requested to observe applicable regulations and standards in the design of products.

Fail-Safe Design

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

Precautions Related to Usage of Devices

Cypress semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION: Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

8.2 Precautions for Package Mounting

Package mounting may be either lead insertion type or surface mount type. In either case, for heat resistance during soldering, you should only mount under Cypress's recommended conditions. For detailed information about mount conditions, contact your sales representative.

Lead Insertion Type

Mounting of lead insertion type packages onto printed circuit boards may be done by two methods: direct soldering on the board, or mounting by using a socket.

Direct mounting onto boards normally involves processes for inserting leads into through-holes on the board and using the flow soldering (wave soldering) method of applying liquid solder. In this case, the soldering process usually causes leads to be subjected to thermal stress in excess of the absolute ratings for storage temperature. Mounting processes should conform to Cypress recommended mounting conditions.

If socket mounting is used, differences in surface treatment of the socket contacts and IC lead surfaces can lead to contact deterioration after long periods. For this reason it is recommended that the surface treatment of socket contacts and IC leads be verified before mounting.



Surface Mount Type

Surface mount packaging has longer and thinner leads than lead-insertion packaging, and therefore leads are more easily deformed or bent. The use of packages with higher pin counts and narrower pin pitch results in increased susceptibility to open connections caused by deformed pins, or shorting due to solder bridges.

You must use appropriate mounting techniques. Cypress recommends the solder reflow method, and has established a ranking of mounting conditions for each product. Users are advised to mount packages in accordance with Cypress ranking of recommended conditions.

Lead-Free Packaging

CAUTION: When ball grid array (BGA) packages with Sn-Ag-Cu balls are mounted using Sn-Pb eutectic soldering, junction strength may be reduced under some conditions of use.

Storage of Semiconductor Devices

Because plastic chip packages are formed from plastic resins, exposure to natural environmental conditions will cause absorption of moisture. During mounting, the application of heat to a package that has absorbed moisture can cause surfaces to peel, reducing moisture resistance and causing packages to crack. To prevent, do the following:

- (1) Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product. Store products in locations where temperature changes are slight.
- (2) Use dry boxes for product storage. Products should be stored below 70% relative humidity, and at temperatures between 5°C and 30°C.
 - When you open Dry Package that recommends humidity 40% to 70% relative humidity.
- (3) When necessary, Cypress packages semiconductor devices in highly moisture-resistant aluminum laminate bags, with a silica gel desiccant. Devices should be sealed in their aluminum laminate bags for storage.
- (4) Avoid storing packages where they are exposed to corrosive gases or high levels of dust.

Baking

Packages that have absorbed moisture may be de-moisturized by baking (heat drying). Follow the Cypress recommended conditions for baking.

Condition: 125°C/24 h

Static Electricity

Because semiconductor devices are particularly susceptible to damage by static electricity, you must take the following precautions:

- (1) Maintain relative humidity in the working environment between 40% and 70%. Use of an apparatus for ion generation may be needed to remove electricity.
- (2) Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.
- (3) Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 M Ω).
 - Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.
- (4) Ground all fixtures and instruments, or protect with anti-static measures.
- (5) Avoid the use of styrofoam or other highly static-prone materials for storage of completed board assemblies.



8.3 Precautions for Use Environment

Reliability of semiconductor devices depends on ambient temperature and other conditions as described above.

For reliable performance, do the following:

(1) Humidity

Prolonged use in high humidity can lead to leakage in devices as well as printed circuit boards. If high humidity levels are anticipated, consider anti-humidity processing.

(2) Discharge of Static Electricity

When high-voltage charges exist close to semiconductor devices, discharges can cause abnormal operation. In such cases, use anti-static measures or processing to prevent discharges.

(3) Corrosive Gases, Dust, or Oil

Exposure to corrosive gases or contact with dust or oil may lead to chemical reactions that will adversely affect the device. If you use devices in such conditions, consider ways to prevent such exposure or to protect the devices.

(4) Radiation, Including Cosmic Radiation

Most devices are not designed for environments involving exposure to radiation or cosmic radiation. Users should provide shielding as appropriate.

(5) Smoke, Flame

CAUTION: Plastic molded devices are flammable, and therefore should not be used near combustible substances. If devices begin to smoke or burn, there is danger of the release of toxic gases.

Customers considering the use of Cypress products in other special environmental conditions should consult with sales representatives.

9. Notes On Device Handling

· Preventing latch-ups

When using the device, ensure that the voltage applied does not exceed the maximum voltage rating.

In a CMOS IC, if a voltage higher than Vcc or a voltage lower than Vss is applied to an input/output pin that is neither a medium-withstand voltage pin nor a high-withstand voltage pin, or if a voltage out of the rating range of power supply voltage mentioned in "20.1 Absolute Maximum Ratings" of "Electrical Characteristics" is applied to the Vcc pin or the Vss pin, a latch-up may occur.

When a latch-up occurs, power supply current increases significantly, which may cause a component to be thermally destroyed.

· Stabilizing supply voltage

Supply voltage must be stabilized.

A malfunction may occur when power supply voltage fluctuates rapidly even though the fluctuation is within the guaranteed operating range of the Vcc power supply voltage.

As a rule of voltage stabilization, suppress voltage fluctuation so that the fluctuation in Vcc ripple (p-p value) at the commercial frequency (50 Hz/60 Hz) does not exceed 10% of the standard Vcc value, and the transient fluctuation rate does not exceed 0.1 V/ms at a momentary fluctuation such as switching the power supply.

· Notes on using the external clock

When an external clock is used, oscillation stabilization wait time is required for power-on reset, wake-up from subclock mode or stop mode.



10. Pin Connection

· Treatment of unused pins

If an unused input pin is left unconnected, a component may be permanently damaged due to malfunctions or latchups. Always pull up or pull down an unused input pin through a resistor of at least $2 \text{ k}\Omega$. Set an unused input/output pin to the output state and leave it unconnected, or set it to the input state and treat it the same as an unused input pin. If there is an unused output pin, leave it unconnected.

Power supply pins

To reduce unnecessary electro-magnetic emission, prevent malfunctions of strobe signals due to an increase in the ground level, and conform to the total output current standard, always connect the Vcc pin and the Vss pin to the power supply and ground outside the device. In addition, connect the current supply source to the Vcc pin and the Vss pin with low impedance.

It is also advisable to connect a ceramic capacitor of approximately 0.1 μF as a bypass capacitor between the Vcc pin and the Vss pin at a location close to this device.

DBG pin

Connect the DBG pin to an external pull-up resistor of 2 k Ω or above.

After power-on, ensure that the DBG pin does not stay at "L" level until the reset output is released.

The DBG pin becomes a communication pin in debug mode. Since the actual pull-up resistance depends on the tool used and the interconnection length, refer to the tool document when selecting a pull-up resistor.

• RST pin

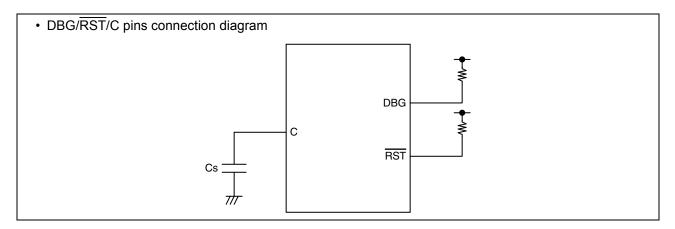
Connect the \overline{RST} pin to an external pull-up resistor of 2 k Ω or above.

To prevent the device from unintentionally entering the reset mode due to noise, minimize the interconnection length between a pull-up resistor and the RST pin and that between a pull-up resistor and the Vcc pin when designing the layout of the printed circuit board.

The PF2/RST pin functions as the reset input/output pin after power-on. In addition, the reset output of the PF2/RST pin can be enabled by the RSTOE bit in the SYSC register, and the reset input function and the general purpose I/O function can be selected by the RSTEN bit in the SYSC register.

• C pin

Use a ceramic capacitor or a capacitor with equivalent frequency characteristics. The decoupling capacitor for the Vcc pin must have a capacitance equal to or larger than the capacitance of Cs. For the connection to a decoupling capacitor Cs, see the diagram below. To prevent the device from unintentionally entering a mode to which the device is not set to transit due to noise, minimize the distance between the C pin and Cs and the distance between Cs and the Vss pin when designing the layout of a printed circuit board.



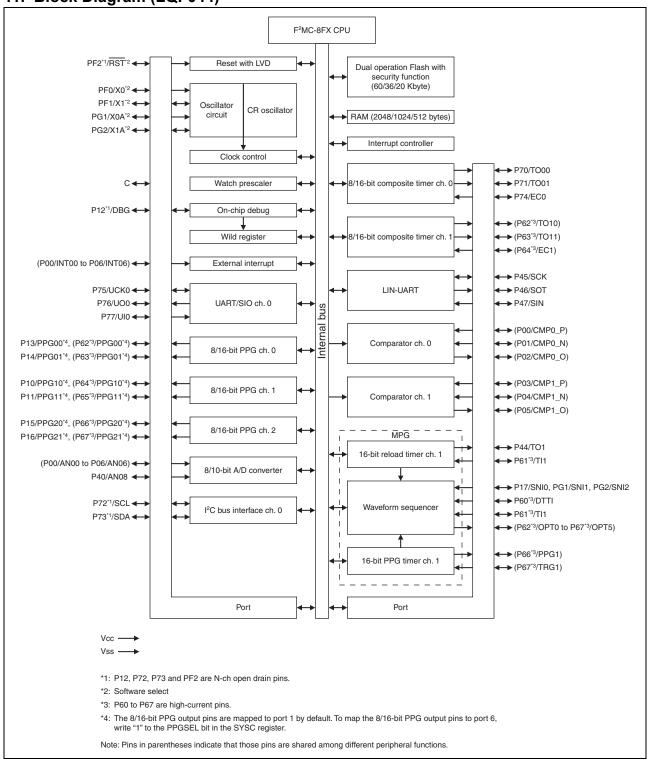


· Note on serial communication

In serial communication, reception of wrong data may occur due to noise or other causes. Therefore, design a printed circuit board to prevent noise from occurring. Taking account of the reception of wrong data, take measures such as adding a checksum to the end of data in order to detect errors. If an error is detected, retransmit the data.

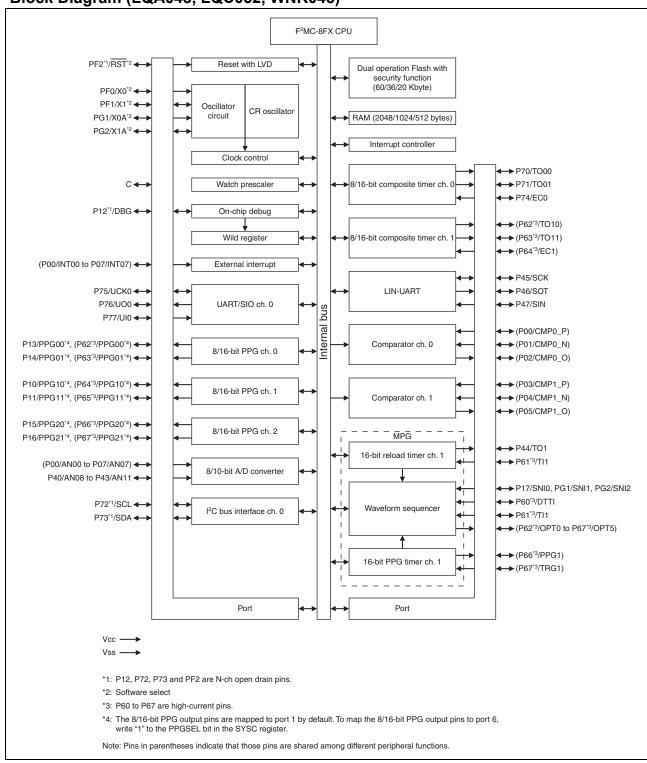


11. Block Diagram (LQF044)





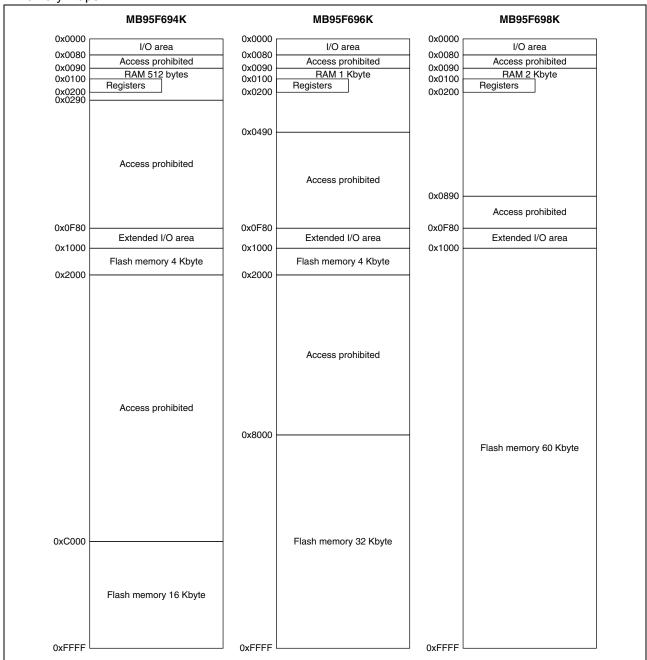
12. Block Diagram (LQA048, LQC052, WNR048)





13. CPU Core

- Memory space
 - The memory space of the MB95690K Series is 64 Kbyte in size, and consists of an I/O area, an extended I/O area, a data area, and a program area. The memory space includes areas intended for specific purposes such as general-purpose registers and a vector table. The memory maps of the MB95690K Series are shown below.
- · Memory maps





14. Memory Space

The memory space of the MB95690K Series is 64 Kbyte in size, and consists of an I/O area, an extended I/O area, a data area, and a program area. The memory space includes areas for specific applications such as general-purpose registers and a vector table.

14.1 I/O area (addresses: 0x0000 to 0x007F)

- This area contains the control registers and data registers for built-in peripheral functions.
- As the I/O area forms part of the memory space, it can be accessed in the same way as the memory. It can also be accessed at high-speed by using direct addressing instructions.

14.2 Extended I/O area (addresses: 0x0F80 to 0x0FFF)

- This area contains the control registers and data registers for built-in peripheral functions.
- As the extended I/O area forms part of the memory space, it can be accessed in the same way as the memory.

14.3 Data area

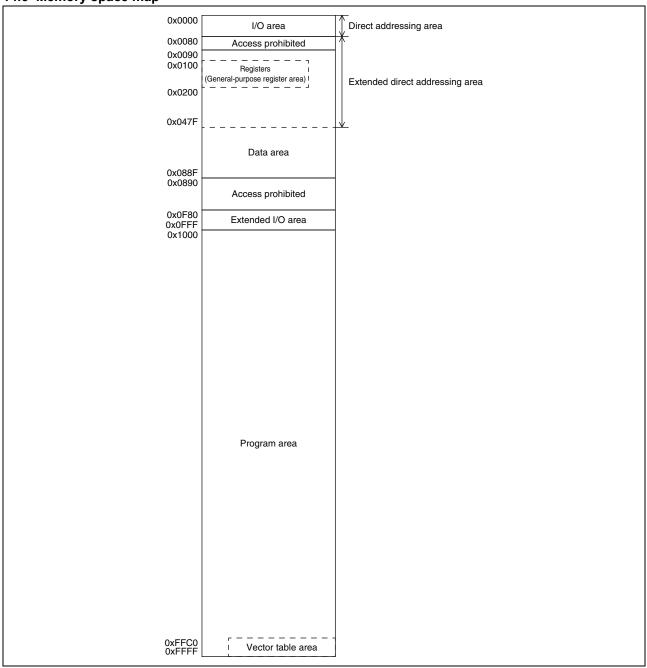
- Static RAM is incorporated in the data area as the internal data area.
- The internal RAM size varies according to product.
- The RAM area from 0x0090 to 0x00FF can be accessed at high-speed by using direct addressing instructions.
- In MB95F698K, the area from 0x0090 to 0x047F is an extended direct addressing area. It can be accessed at highspeed by direct addressing instructions with a direct bank pointer set.
- In MB95F696K, the area from 0x0090 to 0x047F is an extended direct addressing area. It can be accessed at high-speed by direct addressing instructions with a direct bank pointer set.
- In MB95F694K, the area from 0x0090 to 0x028F is an extended direct addressing area. It can be accessed at highspeed by direct addressing instructions with a direct bank pointer set.
- In MB95F694K/F696K/F698K, the area from 0x0100 to 0x01FF can be used as a general-purpose register area.

14.4 Program area

- The Flash memory is incorporated in the program area as the internal program area.
- The Flash memory size varies according to product.
- The area from 0xFFC0 to 0xFFFF is used as the vector table.
- The area from 0xFFBB to 0xFFBF is used to store data of the non-volatile register.



14.5 Memory space map





15. Areas For Specific Applications

The general-purpose register area and vector table area are used for the specific applications.

- General-purpose register area (Addresses: 0x0100 to 0x01FF)
 - This area contains the auxiliary registers used for 8-bit arithmetic operations, transfer, etc.
 - As this area forms part of the RAM area, it can also be used as conventional RAM.
 - When the area is used as general-purpose registers, general-purpose register addressing enables high-speed access with short instructions.
- Non-volatile register data area (Addresses: 0xFFBB to 0xFFBF)
 - The area from 0xFFBB to 0xFFBF is used to store data of the non-volatile register. For details, refer to "CHAPTER 27 NON-VOLATILE REGISTER (NVR) INTERFACE" in "New 8FX MB95690K Series Hardware Manual".
- Vector table area (Addresses: 0xFFC0 to 0xFFFF)
 - This area is used as the vector table for vector call instructions (CALLV), interrupts, and resets.
 - The top of the Flash memory area is allocated to the vector table area. The start address of a service routine is set to an address in the vector table in the form of data.

"Interrupt Source Table" lists the vector table addresses corresponding to vector call instructions, interrupts, and resets.

For details, refer to "CHAPTER 4 RESET", "CHAPTER 5 INTERRUPTS" and "A.2 Special Instruction ■ Special Instruction ■ CALLV #vct" in "APPENDIX" in "New 8FX MB95690K Series Hardware Manual".

Direct bank pointer and access area

Direct bank pointer (DP[2:0])	Operand-specified dir	Access area
0bXXX (It does not affect mapping.)	0x0000 to 0x007F	0x0000 to 0x007F
0b000 (initial value)	0x0090 to 0x00FF	0x0090 to 0x00FF
0b001		0x0100 to 0x017F
0b010]	0x0180 to 0x01FF
0b011		0x0200 to 0x027F
0b100	0x0080 to 0x00FF	0x0280 to 0x02FF*1
0b101		0x0300 to 0x037F
0b110]	0x0380 to 0x03FF
0b111		0x0400 to 0x047F*2

^{*1:} Due to the memory size limit, the available access area is up to "0x028F" in MB95F694K.

^{*2:} Due to the memory size limit, the available access area is up to "0x047F" in MB95F696K/F698K.



16. I/O Map

Address	Register abbreviation	Register name	R/W	Initial value
0x0000	PDR0	Port 0 data register	R/W	0b00000000
0x0001	DDR0	Port 0 direction register	R/W	0b00000000
0x0002	PDR1	Port 1 data register	R/W	0b00000000
0x0003	DDR1	Port 1 direction register	R/W	0b00000000
0x0004	_	(Disabled)	_	_
0x0005	WATR	Oscillation stabilization wait time setting register	R/W	0b11111111
0x0006	PLLC	PLL control register	R/W	0b000X0000
0x0007	SYCC	System clock control register	R/W	0bXXX11011
0x0008	STBC	Standby control register	R/W	0b00000000
0x0009	RSRR	Reset source register	R/W	0b000XXXXX
0x000A	TBTC	Time-base timer control register	R/W	0b00000000
0x000B	WPCR	Watch prescaler control register	R/W	0b00000000
0x000C	WDTC	Watchdog timer control register	R/W	0b00XX0000
0x000D	SYCC2	System clock control register 2	R/W	0bXXXX0011
0x000E	STBC2	Standby control register 2	R/W	0b00000000
0x000F to 0x0011	_	(Disabled)	_	_
0x0012	PDR4	Port 4 data register	R/W	0b00000000
0x0013	DDR4	Port 4 direction register	R/W	0b00000000
0x0014, 0x0015	_	(Disabled)	_	_
0x0016	PDR6	Port 6 data register	R/W	0b00000000
0x0017	DDR6	Port 6 direction register	R/W	0b00000000
0x0018	PDR7	Port 7 data register	R/W	0b00000000
0x0019	DDR7	Port 7 direction register	R/W	0b00000000
0x001A to 0x0027	_	(Disabled)	_	_
0x0028	PDRF	Port F data register	R/W	0b00000000
0x0029	DDRF	Port F direction register	R/W	0b00000000
0x002A	PDRG	Port G data register		0b00000000
0x002B	DDRG	Port G direction register	R/W	0b00000000
0x002C	PUL0	Port 0 pull-up register	R/W	0b00000000
0x002D	PUL1	Port 1 pull-up register	R/W	0b00000000
0x002E, 0x002F	_	(Disabled)	_	_



Address	Register abbreviation	Register name	R/W	Initial value
0x0030	PUL4	Port 4 pull-up register	R/W	0b00000000
0x0031	PUL6	Port 6 pull-up register	R/W	0b00000000
0x0032	PUL7	Port 7 pull-up register	R/W	0b00000000
0x0033, 0x0034	_	(Disabled)		_
0x0035	PULG	Port G pull-up register	R/W	0b00000000
0x0036	T01CR1	8/16-bit composite timer 01 status control register 1	R/W	0b00000000
0x0037	T00CR1	8/16-bit composite timer 00 status control register 1	R/W	0b00000000
0x0038	T11CR1	8/16-bit composite timer 11 status control register 1	R/W	0b00000000
0x0039	T10CR1	8/16-bit composite timer 10 status control register 1	R/W	0b00000000
0x003A	PC01	8/16-bit PPG timer 01 control register	R/W	0b00000000
0x003B	PC00	8/16-bit PPG timer 00 control register	R/W	0b00000000
0x003C	PC11	8/16-bit PPG timer 11 control register	R/W	0b00000000
0x003D	PC10	8/16-bit PPG timer 10 control register	R/W	0b00000000
0x003E	PC21	8/16-bit PPG timer 21 control register	R/W	0b00000000
0x003F	PC20	8/16-bit PPG timer 20 control register		0b00000000
0x0040	TMCSRH1	16-bit reload timer control status register (upper) ch. 1		0b00000000
0x0041	TMCSRL1	16-bit reload timer control status register (lower) ch. 1	R/W	0b00000000
0x0042	CMR0	Comparator control register ch. 0	R/W	0b11000101
0x0043	CMR1	Comparator control register ch. 1	R/W	0b11000101
0x0044	PCNTH1	16-bit PPG status control register (upper)	R/W	0b00000000
0x0045	PCNTL1	16-bit PPG status control register (lower)	R/W	0b00000000
0x0046, 0x0047	_	(Disabled)	_	_
0x0048	EIC00	External interrupt circuit control register ch. 0/ch. 1	R/W	0b00000000
0x0049	EIC10	External interrupt circuit control register ch. 2/ch. 3	R/W	0b00000000
0x004A	EIC20	External interrupt circuit control register ch. 4/ch. 5	R/W	0b00000000
0x004B	EIC30	External interrupt circuit control register ch. 6/ch. 7	R/W	0b00000000
0x004C, 0x004D	_	(Disabled)	_	_
0x004E	LVDR	LVD reset voltage selection ID register	R/W	0b00000000
0x004F	LVDCC	LVD reset circuit control register	R/W	0b00000001
0x0050	SCR	LIN-UART serial control register	R/W	0b00000000
0x0051	SMR	LIN-UART serial mode register		0b00000000
0x0052	SSR	LIN-UART serial status register		0b00001000
0.00=0	RDR	LIN-UART receive data register	D. 7.4.	01.00000000
0x0053	TDR	LIN-UART transmit data register	R/W	0b00000000
0x0054	ESCR	LIN-UART extended status control register	R/W	0b00000100



Address	Register abbreviation	Register name	R/W	Initial value
0x0055	ECCR	LIN-UART extended communication control register	R/W	0b000000XX
0x0056	SMC10	UART/SIO serial mode control register 1 ch. 0	R/W	0b00000000
0x0057	SMC20	UART/SIO serial mode control register 2 ch. 0	R/W	0b00100000
0x0058	SSR0	UART/SIO serial status and data register ch. 0	R/W	0b00000001
0x0059	TDR0	UART/SIO serial output data register ch. 0	R/W	0b00000000
0x005A	RDR0	UART/SIO serial input data register ch. 0	R	0b00000000
0x005B to 0x005F	_	(Disabled)	_	_
0x0060	IBCR00	I ² C bus control register 0 ch. 0	R/W	0b00000000
0x0061	IBCR10	I ² C bus control register 1 ch. 0	R/W	0b00000000
0x0062	IBSR0	I ² C bus status register ch. 0	R/W	0b00000000
0x0063	IDDR0	I ² C data register ch. 0	R/W	0b00000000
0x0064	IAAR0	I ² C address register ch. 0	R/W	0b00000000
0x0065	ICCR0	² C clock control register ch. 0		0b00000000
0x0066	OPCUR	16-bit MPG output control register (upper)	R/W	0b00000000
0x0067	OPCLR	16-bit MPG output control register (lower)		0b00000000
0x0068	IPCUR	16-bit MPG input control register (upper)	R/W	0b00000000
0x0069	IPCLR	16-bit MPG input control register (lower)	R/W	0b00000000
0x006A	NCCR	16-bit MPG noise cancellation control register	R/W	0b00000000
0x006B	TCSR	16-bit MPG timer control status register	R/W	0b00000000
0x006C	ADC1	8/10-bit A/D converter control register 1	R/W	0b00000000
0x006D	ADC2	8/10-bit A/D converter control register 2	R/W	0b00000000
0x006E	ADDH	8/10-bit A/D converter data register (upper)	R/W	0b00000000
0x006F	ADDL	8/10-bit A/D converter data register (lower)	R/W	0b00000000
0x0070	_	(Disabled)	_	_
0x0071	FSR2	Flash memory status register 2	R/W	0b00000000
0x0072	FSR	Flash memory status register	R/W	0b000X0000
0x0073	SWRE0	Flash memory sector write control register 0	R/W	0b00000000
0x0074	FSR3	Flash memory status register 3	R	0b000XXXXX
0x0075	FSR4	Flash memory status register 4	R/W	0b00000000
0x0076	WREN	Wild register address compare enable register	R/W	0b00000000
0x0077	WROR	Wild register data test setting register	R/W	0b00000000
0x0078	_	Mirror of register bank pointer (RP) and direct bank pointer (DP)	_	_
0x0079	ILR0	Interrupt level setting register 0	R/W	0b11111111
0x007A	ILR1	Interrupt level setting register 1	R/W	0b11111111
0x007B	ILR2	Interrupt level setting register 2	R/W	0b11111111



Address	Register abbreviation	Register name	R/W	Initial value	
0x007C	ILR3	Interrupt level setting register 3	R/W	0b11111111	
0x007D	ILR4	Interrupt level setting register 4	R/W	0b11111111	
0x007E	ILR5	Interrupt level setting register 5	R/W	0b11111111	
0x007F	_	(Disabled)	_	_	
0x0F80	WRARH0	Wild register address setting register (upper) ch. 0	R/W	0b00000000	
0x0F81	WRARL0	Wild register address setting register (lower) ch. 0	R/W	0b00000000	
0x0F82	WRDR0	Wild register data setting register ch. 0	R/W	0b00000000	
0x0F83	WRARH1	Wild register address setting register (upper) ch. 1	R/W	0b00000000	
0x0F84	WRARL1	Wild register address setting register (lower) ch. 1	R/W	0b00000000	
0x0F85	WRDR1	Wild register data setting register ch. 1	R/W	0b00000000	
0x0F86	WRARH2	Wild register address setting register (upper) ch. 2	R/W	0b00000000	
0x0F87	WRARL2	Wild register address setting register (lower) ch. 2	R/W	0b00000000	
0x0F88	WRDR2	Wild register data setting register ch. 2	R/W	0b00000000	
0x0F89					
to 0x0F91	_	(Disabled)		_	
0x0F91	T01CR0	0/46 bit composite times 04 status control register 0		0b00000000	
		8/16-bit composite timer 01 status control register 0	R/W		
0x0F93 0x0F94	T00CR0 T01DR	8/16-bit composite timer 00 status control register 0	R/W R/W	0b00000000 0b00000000	
0x0F94	T01DR T00DR	8/16-bit composite timer 01 data register 8/16-bit composite timer 00 data register	R/W	0b00000000	
0X0F95	TOODR		R/VV	000000000	
0x0F96	TMCR0	8/16-bit composite timer 00/01 timer mode control register	R/W	0b00000000	
0x0F97	T11CR0	8/16-bit composite timer 11 status control register 0	R/W	0b00000000	
0x0F98	T10CR0	8/16-bit composite timer 10 status control register 0	R/W	0b00000000	
0x0F99	T11DR	8/16-bit composite timer 11 data register	R/W	0b00000000	
0x0F9A	T10DR	8/16-bit composite timer 10 data register	R/W	0b00000000	
0x0F9B	TMCR1	8/16-bit composite timer 10/11 timer mode control register	R/W	0b00000000	
0x0F9C	PPS01	8/16-bit PPG01 cycle setting buffer register	R/W	0b11111111	
0x0F9D	PPS00	8/16-bit PPG00 cycle setting buffer register	R/W	0b11111111	
0x0F9E	PDS01	8/16-bit PPG01 duty setting buffer register	R/W	0b11111111	
0x0F9F	PDS00	8/16-bit PPG00 duty setting buffer register	R/W	0b11111111	
0x0FA0	PPS11	8/16-bit PPG11 cycle setting buffer register	R/W	0b11111111	
0x0FA1	PPS10	8/16-bit PPG10 cycle setting buffer register		0b11111111	
0x0FA2	PDS11	8/16-bit PPG11 duty setting buffer register	R/W	0b11111111	
0x0FA3	PDS10	8/16-bit PPG10 duty setting buffer register	R/W	0b11111111	
0x0FA4	PPGS	8/16-bit PPG start register	R/W	0b00000000	
0x0FA5	REVC	8/16-bit PPG output inversion register	R/W	0b00000000	



Address	Register abbreviation	Register name	R/W	Initial value
0x0FA6	PPS21	8/16-bit PPG21 cycle setting buffer register		0b11111111
0x0FA7	PPS20	8/16-bit PPG20 cycle setting buffer register	R/W	0b11111111
00540	TMRH1	16-bit reload timer timer register (upper) ch. 1	R/W	
0x0FA8	TMRLRH1	16-bit reload timer reload register (upper) ch. 1		0b00000000
0.0540	TMRL1	16-bit reload timer timer register (lower) ch. 1	DAA	050000000
0x0FA9	TMRLRL1	16-bit reload timer reload register (lower) ch. 1	R/W	0b00000000
0x0FAA	PDS21	8/16-bit PPG21 duty setting buffer register	R/W	0b11111111
0x0FAB	PDS20	8/16-bit PPG20 duty setting buffer register	R/W	0b11111111
0x0FAC				
to 0x0FAF	_	(Disabled)	-	_
0x0FB0	PDCRH1	16-bit PPG downcounter register (upper) ch. 1	R	0b00000000
0x0FB0	PDCRH1	16-bit PPG downcounter register (lower) ch. 1	R	0b00000000
0x0FB1	PCSRH1	<u> </u>	R/W	0b00000000 0b11111111
0x0FB3	PCSRL1	16-bit PPC cycle setting buffer register (upper) ch. 1		0b11111111 0b111111111
0x0FB4	PDUTH1	16-bit PPG cycle setting buffer register (lower) ch. 1	R/W R/W	0b11111111 0b111111111
0x0FB5	PDUTH1 PDUTL1	16-bit PPG duty setting buffer register (upper) ch. 1		
	PDUILI	16-bit PPG duty setting buffer register (lower) ch. 1		0b11111111
0x0FB6 to 0x0FBB	_	(Disabled)		_
0x0FBC	BGR1	LIN-UART baud rate generator register 1	R/W	0b00000000
0x0FBD	BGR0	LIN-UART baud rate generator register 0	R/W	0b00000000
0x0FBE	PSSR0	UART/SIO dedicated baud rate generator prescaler select register ch. 0	R/W	0b00000000
0x0FBF	BRSR0	UART/SIO dedicated baud rate generator baud rate setting register ch. 0	R/W	0b00000000
0x0FC0, 0x0FC1		(Disabled)		_
0x0FC2	AIDRH	A/D input disable register (upper)	R/W	0b00000000
0x0FC3	AIDRL	A/D input disable register (lower)	R/W	0b00000000
0x0FC4	OPDBRH0	16-bit MPG output data buffer register (upper) ch. 0	R/W	0b00000000
0x0FC5	OPDBRL0	16-bit MPG output data buffer register (lower) ch. 0	R/W	0b00000000
0x0FC6	OPDBRH1	16-bit MPG output data buffer register (upper) ch. 1	R/W	0b00000000
0x0FC7	OPDBRL1	16-bit MPG output data buffer register (lower) ch. 1	R/W	0b00000000
0x0FC8	OPDBRH2	16-bit MPG output data buffer register (upper) ch. 2		0b00000000
0x0FC9	OPDBRL2	16-bit MPG output data buffer register (lower) ch. 2	R/W	0b00000000
0x0FCA	OPDBRH3	16-bit MPG output data buffer register (upper) ch. 3	R/W	0b00000000
0x0FCB	OPDBRL3	16-bit MPG output data buffer register (lower) ch. 3	R/W	0b00000000
0x0FCC	OPDBRH4	16-bit MPG output data buffer register (upper) ch. 4	R/W	0b00000000



Address	Register abbreviation	Register name	R/W	Initial value
0x0FCD	OPDBRL4	16-bit MPG output data buffer register (lower) ch. 4	R/W	0b00000000
0x0FCE	OPDBRH5	16-bit MPG output data buffer register (upper) ch. 5	R/W	0b00000000
0x0FCF	OPDBRL5	16-bit MPG output data buffer register (lower) ch. 5	R/W	0b00000000
0x0FD0	OPDBRH6	16-bit MPG output data buffer register (upper) ch. 6	R/W	0b00000000
0x0FD1	OPDBRL6	16-bit MPG output data buffer register (lower) ch. 6	R/W	0b00000000
0x0FD2	OPDBRH7	16-bit MPG output data buffer register (upper) ch. 7	R/W	0b00000000
0x0FD3	OPDBRL7	16-bit MPG output data buffer register (lower) ch. 7	R/W	0b00000000
0x0FD4	OPDBRH8	16-bit MPG output data buffer register (upper) ch. 8	R/W	0b00000000
0x0FD5	OPDBRL8	16-bit MPG output data buffer register (lower) ch. 8	R/W	0b00000000
0x0FD6	OPDBRH9	16-bit MPG output data buffer register (upper) ch. 9	R/W	0b00000000
0x0FD7	OPDBRL9	16-bit MPG output data buffer register (lower) ch. 9	R/W	0b00000000
0x0FD8	OPDBRHA	16-bit MPG output data buffer register (upper) ch. A	R/W	0b00000000
0x0FD9	OPDBRLA	16-bit MPG output data buffer register (lower) ch. A	R/W	0b00000000
0x0FDA	OPDBRHB	16-bit MPG output data buffer register (upper) ch. B		0b00000000
0x0FDB	OPDBRLB	16-bit MPG output data buffer register (lower) ch. B		0b00000000
0x0FDC	OPDUR	16-bit MPG output data register (upper)		0b0000XXXX
0x0FDD	OPDLR	16-bit MPG output data register (lower)		0bXXXXXXXX
0x0FDE	CPCUR	16-bit MPG compare clear register (upper)	R/W	0bXXXXXXXX
0x0FDF	CPCLR	16-bit MPG compare clear register (lower)	R/W	0bXXXXXXXX
0x0FE0	LVDPW	LVD reset circuit password register	R/W	0b00000000
0x0FE1	_	(Disabled)	_	
0x0FE2	TMBUR	16-bit MPG timer buffer register (upper)	R	0bXXXXXXXX
0x0FE3	TMBLR	16-bit MPG timer buffer register (lower)	R	0bXXXXXXXX
0x0FE4	CRTH	Main CR clock trimming register (upper)	R/W	0b000XXXXX
0x0FE5	CRTL	Main CR clock trimming register (lower)	R/W	0b000XXXXX
0x0FE6	_	(Disabled)		
0x0FE7	CRTDA	Main CR clock temperature dependent adjustment register	R/W	0b000XXXXX
0x0FE8	SYSC	System configuration register	R/W	0b11000011
0x0FE9	CMCR	Clock monitoring control register	R/W	0b00000000
0x0FEA	CMDR	Clock monitoring data register		0b00000000
0x0FEB	WDTH	Watchdog timer selection ID register (upper)		0bXXXXXXXX
0x0FEC	WDTL	Watchdog timer selection ID register (lower)		0bXXXXXXXX
0x0FED, 0x0FEE	_	(Disabled)		_
0x0FEF	WICR	Interrupt pin selection circuit control register	R/W	0b01000000



Address	Register abbreviation	Register name	R/W	Initial value
0x0FF0 to 0x0FFF	_	(Disabled)	_	_

R/W access symbols

R/W : Readable/Writable

R : Read onlyInitial value symbols

0 : The initial value of this bit is "0".1 : The initial value of this bit is "1".

X : The initial value of this bit is undefined.

Note: Do not write to an address that is "(Disabled)". If a "(Disabled)" address is read, an indeterminate value is returned.



17. I/O Ports

· List of port registers

Register name	Read/Write	Initial value	
Port 0 data register	PDR0	R, RM/W	0b00000000
Port 0 direction register	DDR0	R/W	0b00000000
Port 1 data register	PDR1	R, RM/W	0b00000000
Port 1 direction register	DDR1	R/W	0b00000000
Port 4 data register	PDR4	R, RM/W	0b00000000
Port 4 direction register	DDR4	R/W	0b00000000
Port 6 data register	PDR6	R, RM/W	0b00000000
Port 6 direction register	DDR6	R/W	0b00000000
Port 7 data register	PDR7	R, RM/W	0b00000000
Port 7 direction register	DDR7	R/W	0b00000000
Port F data register	PDRF	R, RM/W	0b0000000
Port F direction register	DDRF	R/W	0b00000000
Port G data register	PDRG	R, RM/W	0b00000000
Port G direction register	DDRG	R/W	0b00000000
Port 0 pull-up register	PUL0	R/W	0b00000000
Port 1 pull-up register	PUL1	R/W	0b00000000
Port 4 pull-up register	PUL4	R/W	0b00000000
Port 6 pull-up register	PUL6	R/W	0b00000000
Port 7 pull-up register	PUL7	R/W	0b0000000
Port G pull-up register	PULG	R/W	0b0000000
A/D input disable register (upper)	AIDRH	R/W	0b0000000
A/D input disable register (lower)	AIDRL	R/W	0b0000000

R/W : Readable/writable (The read value is the same as the write value.)

R, RM/W: Readable/writable (The read value is different from the write value. The write value is read by the read-modify-write (RMW) type of instruction.)



17.1 Port 0

Port 0 is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.1.1 Port 0 configuration

Port 0 is made up of the following elements.

- General-purpose I/O pins/peripheral function I/O pins
- Port 0 data register (PDR0)
- Port 0 direction register (DDR0)
- Port 0 pull-up register (PUL0)
- A/D input disable register (lower) (AIDRL)

17.1.2 Block diagrams of port 0

• P00/INT00/AN00/CMP0_P pin

This pin has the following peripheral functions:

- External interrupt input pin (INT00)
- 8/10-bit A/D converter analog input pin (AN00)
- Comparator ch. 0 non-inverting analog input (positive input) pin (CMP0 P)

• P01/INT01/AN01/CMP0_N pin

This pin has the following peripheral functions:

- External interrupt input pin (INT01)
- 8/10-bit A/D converter analog input pin (AN01)
- Comparator ch. 0 inverting analog input (negative input) pin (CMP0 N)

• P03/INT03/AN03/CMP1 P pin

This pin has the following peripheral functions:

- External interrupt input pin (INT03)
- 8/10-bit A/D converter analog input pin (AN03)
- Comparator ch. 1 non-inverting analog input (positive input) pin (CMP1_P)

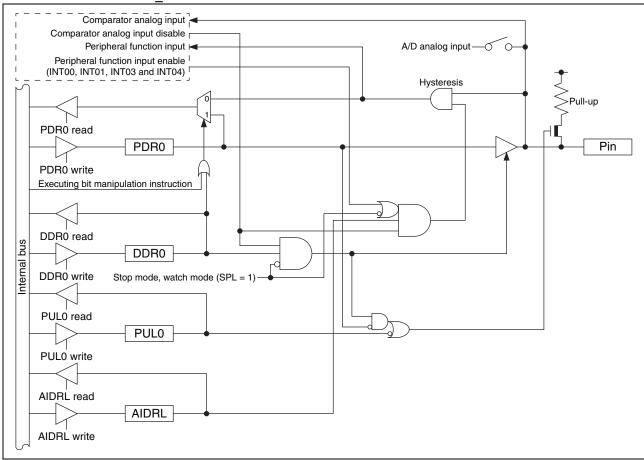
• P04/INT04/AN04/CMP1 N pin

This pin has the following peripheral functions:

- External interrupt input pin (INT04)
- 8/10-bit A/D converter analog input pin (AN04)
- Comparator ch. 1 inverting analog input (negative input) pin (CMP1_N)



 Block diagram of P00/INT00/AN00/CMP0_P, P01/INT01/AN01/CMP0_N, P03/INT03/AN03/CMP1_P and P04/INT04/AN04/CMP1 N





• P02/INT02/AN02/CMP0_O pin

This pin has the following peripheral functions:

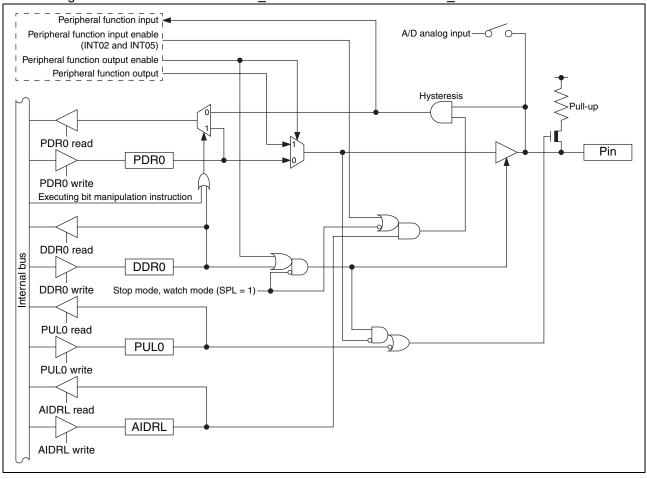
- External interrupt input pin (INT02)
- 8/10-bit A/D converter analog input pin (AN02)
- Comparator ch. 0 digital output pin (CMP0_O)

• P05/INT05/AN05/CMP1_O pin

This pin has the following peripheral functions:

- External interrupt input pin (INT05)
- 8/10-bit A/D converter analog input pin (AN05)
- Comparator ch. 1 digital output pin (CMP1_O)

• Block diagram of P02/INT02/AN02/CMP0 O and P05/INT05/AN05/CMP1 O





• P06/INT06/AN06 pin

This pin has the following peripheral functions:

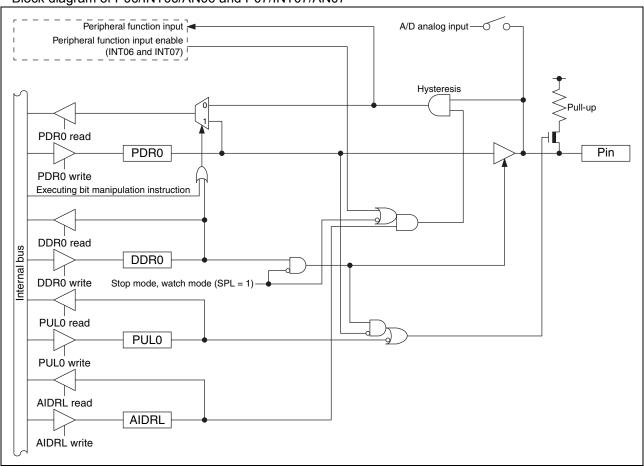
- External interrupt input pin (INT06)
- 8/10-bit A/D converter analog input pin (AN06)

• P07/INT07/AN07 pin

This pin has the following peripheral functions:

- External interrupt input pin (INT07)
- 8/10-bit A/D converter analog input pin (AN07)

Block diagram of P06/INT06/AN06 and P07/INT07/AN07





17.1.3 Port 0 registers
• Port 0 register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write				
PDR0	0	Pin state is "L" level.	PDR0 value is "0".	As output port, outputs "L" level.				
FDRU	1	Pin state is "H" level.	PDR0 value is "1".	As output port, outputs "H" level.				
DDR0	0		Port input enabled					
DDRO	1		Port output enabled					
PUL0	0	Pull-up disabled						
FOLO	1	Pull-up enabled						
AIDRL	0		Analog input enabled					
AIDKL	1		Port input enabled					

• Correspondence between registers and pins for port 0

		Correspondence between related register bits and pins							
Pin name	P07	P06	P05	P04	P03	P02	P01	P00	
PDR0									
DDR0	h:47 h:40	hit hit	h:44 h:40	bit2	hi+1	p:+0			
PUL0	bit7	bit6	bit5	bit4	bit3	DILZ	bit1	bit0	
AIDRL									



17.1.4 Port 0 operations

- Operation as an output port
 - A pin becomes an output port if the bit in the DDR0 register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDR0 register to external pins.
 - If data is written to the PDR0 register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDR0 register returns the PDR0 register value.

· Operation as an input port

- A pin becomes an input port if the bit in the DDR0 register corresponding to that pin is set to "0".
- For a pin shared with other peripheral functions, disable the output of such peripheral functions.
- When using a pin shared with the analog input function as an input port, set the corresponding bit in the A/D input disable register (lower) (AIDRL) to "1".
- If data is written to the PDR0 register, the value is stored in the output latch but is not output to the pin set as an input port.
- Reading the PDR0 register returns the pin value. However, if the read-modify-write (RMW) type of instruction is used to read the PDR0 register, the PDR0 register value is returned.

Operation as a peripheral function output pin

- A pin becomes a peripheral function output pin if the peripheral output function is enabled by setting the output enable bit of a peripheral function corresponding to that pin.
- The pin value can be read from the PDR0 register even if the peripheral function output is enabled. Therefore, the
 output value of a peripheral function can be read by the read operation on the PDR0 register. However, if the readmodify-write (RMW) type of instruction is used to read the PDR0 register, the PDR0 register value is returned.

· Operation as a peripheral function input pin

- To set a pin as an input port, set the bit in the DDR0 register corresponding to the input pin of a peripheral function to "0".
- When using a pin shared with the analog input function as another peripheral function input pin, configure it as an input port by setting the bit in the AIDRL register corresponding to that pin to "1".
- Reading the PDR0 register returns the pin value, regardless of whether the peripheral function uses that pin as its
 input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDR0 register, the PDR0
 register value is returned.

Operation at reset

If the CPU is reset, all bits in the DDR0 register are initialized to "0" and port input is enabled. As for a pin shared with the analog input function, its port input is disabled because the AIDRL register is initialized to "0".

Operation in stop mode and watch mode

- If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop
 mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDR0 register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open. However, if the interrupt input is enabled for the external interrupt (INT00 to INT07), the input is enabled and not
 blocked.
- If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.

Operation as an analog input pin

- Set the bit in the DDR0 register bit corresponding to the analog input pin to "0" and the bit corresponding to that pin in the AIDRL register to "0".
- For a pin shared with other peripheral functions, disable the output of such peripheral functions. In addition, set the



corresponding bit in the PUL0 register to "0".

- Operation as an external interrupt input pin
 - Set the bit in the DDR0 register corresponding to the external interrupt input pin to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - The pin value is always input to the external interrupt circuit. When using a pin for a function other than the interrupt, disable the external interrupt function corresponding to that pin.
- · Operation of the pull-up register

Setting the bit in the PUL0 register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PUL0 register.

- Operation as a comparator input pin (only for P00 and P03)
 - Set the bit in the AIDRL register corresponding to the comparator input pin to "0".
 - Regardless of the value of the PDR0 register and that of the DDR0 register, if the comparator analog input enable
 bit in the comparator control register ch. 0/ch. 1 (CMR0/CMR1:VCID) is set to "0", the comparator input function is
 enabled.
 - To disable the comparator input function, set the VCID bit to "1".
 - For details of the comparator, refer to "CHAPTER 28 COMPARATOR" in "New 8FX MB95690K Series Hardware Manual".
- Operation as a comparator input pin (only for P01 and P04)
 - Set the bit in the AIDRL register corresponding to the comparator input pin to "0".
 - Regardless of the value of the PDR0 register and that of the DDR0 register, if the comparator analog input enable bit (VCID) and the negative analog input voltage source select bit (BGRS) in the comparator control register ch. 0/ch. 1 (CMR0/CMR1) are both set to "0", the comparator input function is enabled.
 - To disable the comparator input function, set the VCID bit or the BGRS bit to "1".
 - For details of the comparator, refer to "CHAPTER 28 COMPARATOR" in "New 8FX MB95690K Series Hardware Manual".

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17.2 Port 1

Port 1 is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.2.1 Port 1 configuration

Port 1 is made up of the following elements.

- General-purpose I/O pins/peripheral function I/O pins
- Port 1 data register (PDR1)
- Port 1 direction register (DDR1)
- Port 1 pull-up register (PUL1)

17.2.2 Block diagrams of port 1

P10/PPG10* pin

This pin has the following peripheral function:

- 8/16-bit PPG ch. 1 output pin (PPG10)
- P11/PPG11* pin

This pin has the following peripheral function:

- 8/16-bit PPG ch. 1 output pin (PPG11)
- P13/PPG00* pin

This pin has the following peripheral function:

- 8/16-bit PPG ch. 0 output pin (PPG00)
- P14/PPG01* pin

This pin has the following peripheral function:

- 8/16-bit PPG ch. 0 output pin (PPG01)
- P15/PPG20* pin

This pin has the following peripheral function:

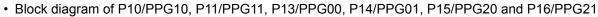
- 8/16-bit PPG ch. 2 output pin (PPG20)
- P16/PPG21* pin

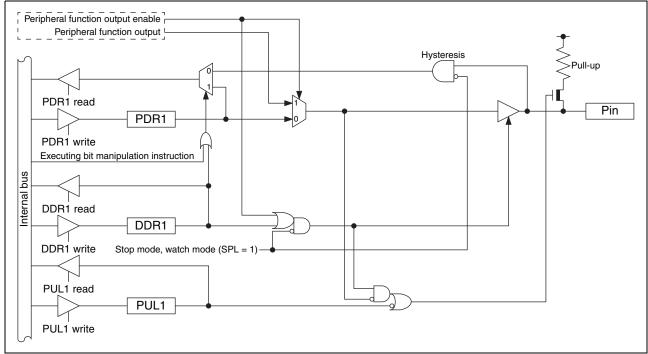
This pin has the following peripheral function:

- 8/16-bit PPG ch. 2 output pin (PPG21)
- *: The 8/16-bit PPG output pins are mapped to pins according to the setting of the PPGSEL bit in the SYSC register. See the table below for details.

8/16-bit PPG output pin	SYSC:PPGSEL = 0	SYSC:PPGSEL = 1		
o/ 10-bit PPG output piii	Pin			
PPG00	P13	P62		
PPG01	P14	P63		
PPG10	P10	P64		
PPG11	P11	P65		
PPG20	P15	P66		
PPG21	P16	P67		

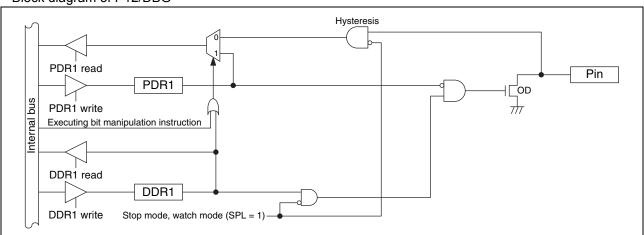






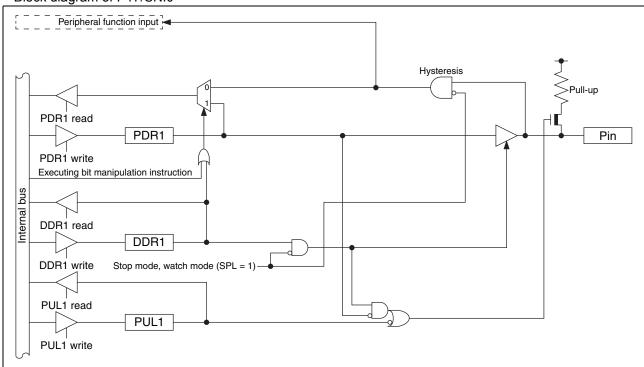
- P12/DBG pin
 - This pin has the following peripheral function:
 - DBG input pin (DBG)

· Block diagram of P12/DBG





- P17/SNI0 pin
 - This pin has the following peripheral function:
 - Trigger input pin for the position detection function of the MPG waveform sequencer (SNI0)
- Block diagram of P17/SNI0





17.2.3 Port 1 registers

Port 1 register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write			
PDR1	0	Pin state is "L" level.	PDR1 value is "0".	As output port, outputs "L" level.			
PDIXI	1	Pin state is "H" level.	PDR1 value is "1".	As output port, outputs "H" level.*			
DDR1	0		Port input enabled				
DDK1	1		Port output enabled				
PUL1	0		Pull-up disabled				
PULI	1		Pull-up enabled				

^{*:} If the pin is an N-ch open drain pin, the pin state becomes Hi-Z.

· Correspondence between registers and pins for port 1

		Correspondence between related register bits and pins						
Pin name	P17	P16	P15	P14	P13	P12	P11	P10
PDR1								
DDR1	bit7	bit6	bit5	bit4	bit3	bit2*	bit1	bit0
PUL1								

^{*:} Though P12 has no pull-up function, bit2 in the PUL1 register can still be accessed. The operation of P12 is not affected by the setting of bit2 in the PUL1 register.



17.2.4 Port 1 operations

- · Operation as an output port
 - A pin becomes an output port if the bit in the DDR1 register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDR1 register to external pins.
 - If data is written to the PDR1 register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDR1 register returns the PDR1 register value.
- Operation as an input port
 - A pin becomes an input port if the bit in the DDR1 register corresponding to that pin is set to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - If data is written to the PDR1 register, the value is stored in the output latch but is not output to the pin set as an
 input port.
 - Reading the PDR1 register returns the pin value. However, if the read-modify-write (RMW) type of instruction is
 used to read the PDR1 register, the PDR1 register value is returned.
- Operation as a peripheral function output pin
 - A pin becomes a peripheral function output pin if the peripheral output function is enabled by setting the output enable bit of a peripheral function corresponding to that pin.
 - The pin value can be read from the PDR1 register even if the peripheral function output is enabled. Therefore, the
 output value of a peripheral function can be read by the read operation on the PDR1 register. However, if the readmodify-write (RMW) type of instruction is used to read the PDR1 register, the PDR1 register value is returned.
- Operation as a peripheral function input pin
 - To set a pin as an input port, set the bit in the DDR1 register corresponding to the input pin of a peripheral function to "0".
 - Reading the PDR1 register returns the pin value, regardless of whether the peripheral function uses that pin as its
 input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDR1 register, the PDR1
 register value is returned.
- Operation at reset

If the CPU is reset, all bits in the DDR1 register are initialized to "0" and port input is enabled.

- Operation in stop mode and watch mode
 - If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDR1 register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open.
 - If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.
- Operation of the pull-up register

Setting the bit in the PUL1 register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PUL1 register.



17.3 Port 4

Port 4 is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.3.1 Port 4 configuration

Port 4 is made up of the following elements.

- General-purpose I/O pins/peripheral function I/O pins
- Port 4 data register (PDR4)
- Port 4 direction register (DDR4)
- Port 4 pull-up register (PUL4)
- A/D input disable register (upper) (AIDRH)

17.3.2 Block diagrams of port 4

• P40/AN08 pin

This pin has the following peripheral function:

- 8/10-bit A/D converter analog input pin (AN08)
- P41/AN09 pin

This pin has the following peripheral function:

- 8/10-bit A/D converter analog input pin (AN09)
- P42/AN10 pin

This pin has the following peripheral function:

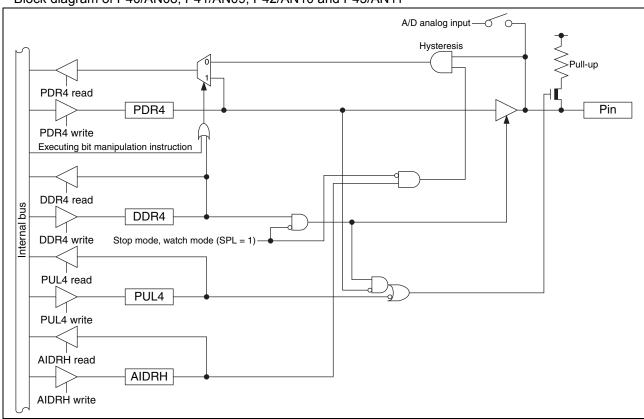
- 8/10-bit A/D converter analog input pin (AN10)
- P43/AN11 pin

This pin has the following peripheral function:

8/10-bit A/D converter analog input pin (AN11)



Block diagram of P40/AN08, P41/AN09, P42/AN10 and P43/AN11





• P44/TO1 pin

This pin has the following peripheral function:

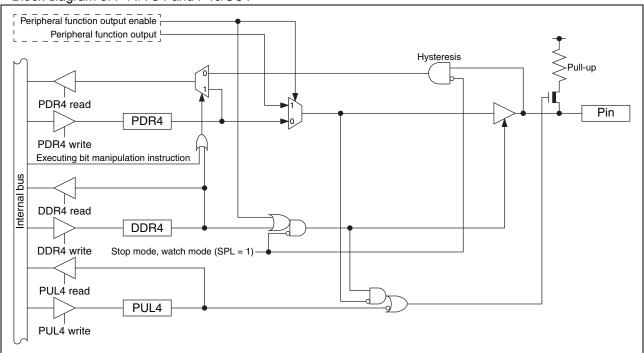
• 16-bit reload timer ch. 1 output pin (TO1)

• P46/SOT pin

This pin has the following peripheral function:

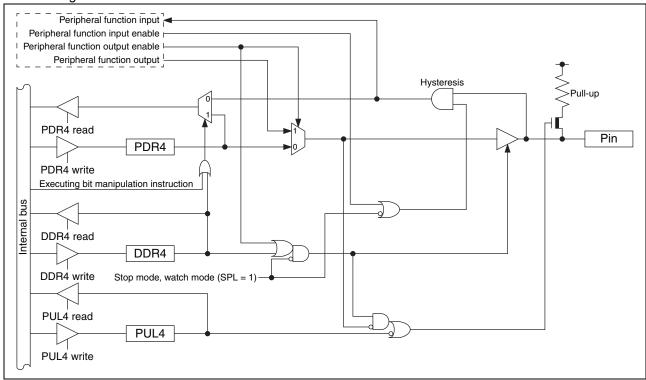
LIN-UART data output pin (SOT)

• Block diagram of P44/TO1 and P46/SOT





- P45/SCK pin
 - This pin has the following peripheral functions:
 - LIN-UART clock I/O pin (SCK)
- · Block diagram of P45/SCK



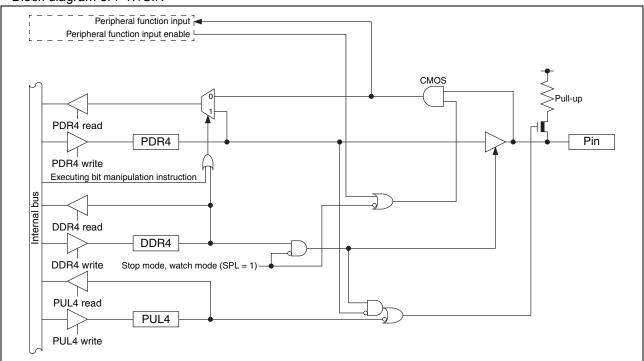
• P47/SIN pin

This pin has the following peripheral function:

• LIN-UART data input pin (SIN)



• Block diagram of P47/SIN





17.3.3 Port 4 registersPort 4 register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write			
PDR4	0	Pin state is "L" level.	PDR4 value is "0".	As output port, outputs "L" level.			
	1	Pin state is "H" level.	PDR4 value is "1".	As output port, outputs "H" level.			
DDR4	0	Port input enabled					
	1	Port output enabled					
PUL4	0	Pull-up disabled					
	1	Pull-up enabled					
AIDRH	0	Analog input enabled					
	1	Port input enabled					

• Correspondence between registers and pins for port 4

	Correspondence between related register bits and pins							
Pin name	P47	P46	P45	P44	P43	P42	P41	P40
PDR4	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
DDR4								
PUL4								
AIDRH	-	-	-	-				



17.3.4 Port 4 operations

- Operation as an output port
 - A pin becomes an output port if the bit in the DDR4 register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDR4 register to external pins.
 - If data is written to the PDR4 register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDR4 register returns the PDR4 register value.

· Operation as an input port

- A pin becomes an input port if the bit in the DDR4 register corresponding to that pin is set to "0".
- For a pin shared with other peripheral functions, disable the output of such peripheral functions.
- When using a pin shared with the analog input function as an input port, set the corresponding bit in the A/D input disable register (upper) (AIDRH) to "1"
- If data is written to the PDR4 register, the value is stored in the output latch but is not output to the pin set as an input port.
- Reading the PDR4 register returns the pin value. However, if the read-modify-write (RMW) type of instruction is used to read the PDR4 register, the PDR4 register value is returned.

Operation as a peripheral function output pin

- A pin becomes a peripheral function output pin if the peripheral output function is enabled by setting the output enable bit of a peripheral function corresponding to that pin.
- The pin value can be read from the PDR4 register even if the peripheral function output is enabled. Therefore, the output value of a peripheral function can be read by the read operation on the PDR4 register. However, if the read-modify-write (RMW) type of instruction is used to read the PDR4 register, the PDR4 register value is returned.

· Operation as a peripheral function input pin

- To set a pin as an input port, set the bit in the DDR4 register corresponding to the input pin of a peripheral function to "0".
- When using a pin shared with the analog input function as another peripheral function input pin, configure it as an input port by setting the bit in the AIDRH register corresponding to that pin to "1".
- Reading the PDR4 register returns the pin value, regardless of whether the peripheral function uses that pin as its input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDR4 register, the PDR4 register value is returned.

Operation at reset

If the CPU is reset, all bits in the DDR4 register are initialized to "0" and port input is enabled. As for a pin shared with the analog input function, its port input is disabled because the AIDRH register is initialized to "0".

Operation in stop mode and watch mode

- If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDR4 register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open. However, if the interrupt input of P45/SCK and P47/SIN is enabled by the external interrupt control register ch. 0 (EIC00) of the external interrupt circuit and the interrupt pin selection circuit control register (WICR) of the interrupt pin selection circuit, the input is enabled and is not blocked.
- If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.

Operation as an analog input pin

• Set the bit in the DDR4 register bit corresponding to the analog input pin to "0" and the bit corresponding to that pin in the AIDRH register to "0".



- For a pin shared with other peripheral functions, disable the output of such peripheral functions. In addition, set the corresponding bit in the PUL4 register to "0".
- · Operation of the pull-up register

Setting the bit in the PUL4 register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PUL4 register.

17.4 Port 6

Port 6 is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.4.1 Port 6 configuration

Port 6 is made up of the following elements.

- General-purpose I/O pins/peripheral function I/O pins
- Port 6 data register (PDR6)
- Port 6 direction register (DDR6)
- Port 6 pull-up register (PUL6)

17.4.2 Block diagrams of port 6

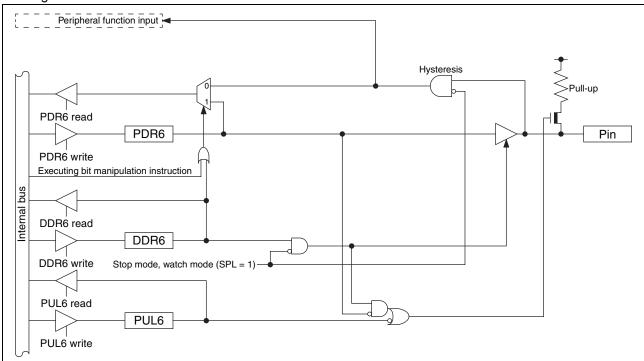
• P60/DTTI pin

This pin has the following peripheral function:

- MPG waveform sequencer input pin (DTTI)
- P61/TI1 pin

This pin has the following peripheral function:

- 16-bit reload timer ch. 1 input pin (TI1)
- Block diagram of P60/DTTI and P61/TI1





P62/OPT0/PPG00/TO10 pin

This pin has the following peripheral functions:

- MPG waveform sequencer output pin (OPT0)
- 8/16-bit PPG ch. 0 output pin (PPG00)
- 8/16-bit composite timer ch. 1 output pin (TO10)

• P63/OPT1/PPG01/TO11 pin

This pin has the following peripheral functions:

- MPG waveform sequencer output pin (OPT1)
- 8/16-bit PPG ch. 0 output pin (PPG01)
- 8/16-bit composite timer ch. 1 output pin (TO11)

• P65/OPT3/PPG11 pin

This pin has the following peripheral functions:

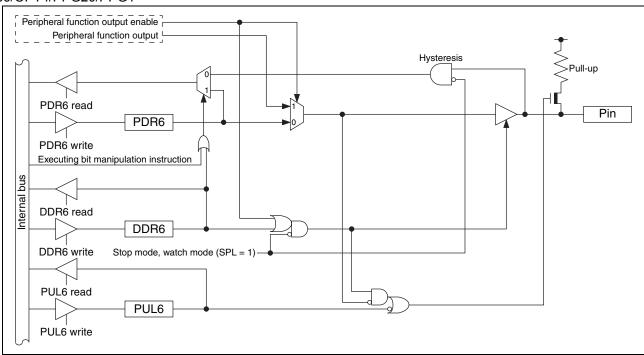
- MPG waveform sequencer output pin (OPT3)
- 8/16-bit PPG ch. 1 output pin (PPG11)

• P66/OPT4/PPG20/PPG1 pin

This pin has the following peripheral functions:

- MPG waveform sequencer output pin (OPT4)
- 8/16-bit PPG ch. 2 output pin (PPG20)
- 16-bit PPG timer ch. 1 output pin (PPG1)

Block diagram of P62/OPT0/PPG00/TO10, P63/OPT1/PPG01/TO11, P65/OPT3/PPG11 and P66/OPT4/PPG20/PPG1





• P64/OPT2/PPG10/EC1 pin

This pin has the following peripheral functions:

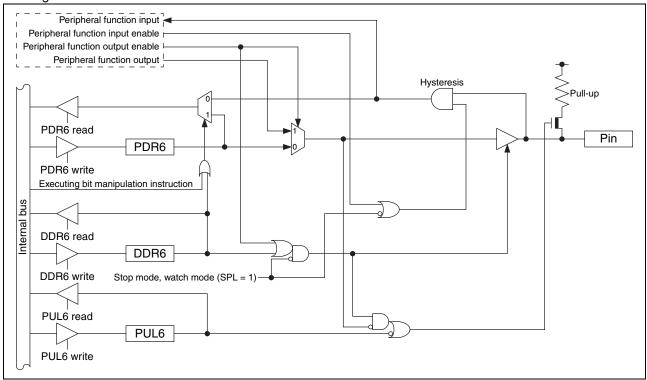
- MPG waveform sequencer output pin (OPT2)
- 8/16-bit PPG ch. 1 output pin (PPG10)
- 8/16-bit composite timer ch. 1 clock input pin (EC1)

• P67/OPT5/PPG21/TRG1 pin

This pin has the following peripheral functions:

- MPG waveform sequencer output pin (OPT5)
- 8/16-bit PPG ch. 2 output pin (PPG21)
- 16-bit PPG timer ch. 1 trigger input pin (TRG1)

• Block diagram of P64/OPT2/PPG10/EC1 and P67/OPT5/PPG21/TRG1





17.4.3 Port 6 registersPort 6 register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write		
PDR6	0	Pin state is "L" level.	PDR6 value is "0".	As output port, outputs "L" leve		
	1	Pin state is "H" level.	PDR6 value is "1".	As output port, outputs "H" level.		
DDR6	0	Port input enabled				
	1	Port output enabled				
PUL6	0	Pull-up disabled				
	1	Pull-up enabled				

• Correspondence between registers and pins for port 6

		Correspondence between related register bits and pins						
Pin name	P67	P66	P65	P64	P63	P62	P61	P60
PDR6								
DDR6	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
PUL6								



17.4.4 Port 6 operations

- · Operation as an output port
 - A pin becomes an output port if the bit in the DDR6 register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDR6 register to external pins.
 - If data is written to the PDR6 register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDR6 register returns the PDR6 register value.
- · Operation as an input port
 - A pin becomes an input port if the bit in the DDR6 register corresponding to that pin is set to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - If data is written to the PDR6 register, the value is stored in the output latch but is not output to the pin set as an
 input port.
 - Reading the PDR6 register returns the pin value. However, if the read-modify-write (RMW) type of instruction is
 used to read the PDR6 register, the PDR6 register value is returned.
- Operation as a peripheral function output pin
 - A pin becomes a peripheral function output pin if the peripheral output function is enabled by setting the output enable bit of a peripheral function corresponding to that pin.
 - The pin value can be read from the PDR6 register even if the peripheral function output is enabled. Therefore, the
 output value of a peripheral function can be read by the read operation on the PDR6 register. However, if the readmodify-write (RMW) type of instruction is used to read the PDR6 register, the PDR6 register value is returned.
- Operation as a peripheral function input pin
 - To set a pin as an input port, set the bit in the DDR6 register corresponding to the input pin of a peripheral function to "0".
 - Reading the PDR6 register returns the pin value, regardless of whether the peripheral function uses that pin as its
 input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDR6 register, the PDR6
 register value is returned.
- Operation at reset

If the CPU is reset, all bits in the DDR6 register are initialized to "0" and port input is enabled.

- Operation in stop mode and watch mode
 - If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDR6 register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open. However, if the interrupt input of P64/EC1 and P67/TRG1 is enabled by the external interrupt control register ch. 0 (EIC00) of the external interrupt circuit and the interrupt pin selection circuit control register (WICR) of the interrupt pin selection circuit, the input is enabled and is not blocked.
 - If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.
- · Operation of the pull-up register

Setting the bit in the PUL6 register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PUL6 register.



17.5 Port 7

Port 7 is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.5.1 Port 7 configuration

Port 7 is made up of the following elements.

- · General-purpose I/O pins/peripheral function I/O pins
- Port 7 data register (PDR7)
- Port 7 direction register (DDR7)
- Port 7 pull-up register (PUL7)

17.5.2 Block diagrams of port 7

P70/TO00 pin

This pin has the following peripheral function:

• 8/16-bit composite time ch. 0 output pin (TO00)

• P71/TO01 pin

This pin has the following peripheral function:

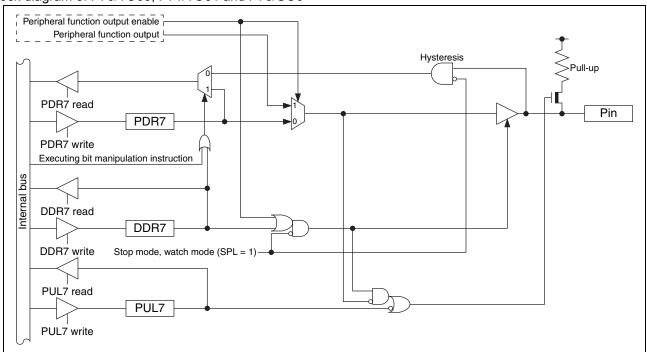
• 8/16-bit composite timer ch. 0 output pin (TO01)

• P76/UO0 pin

This pin has the following peripheral function:

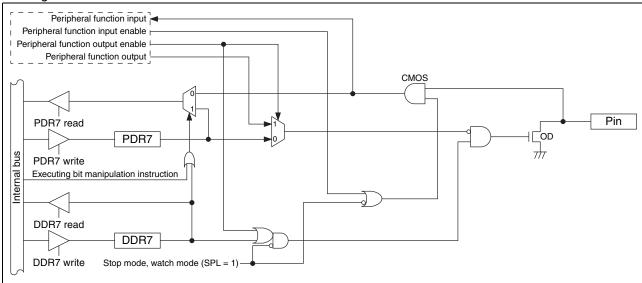
• UART/SIO ch. 0 data output pin (UO0)

Block diagram of P70/TO00, P71/TO01 and P76/UO0





- P72/SCL pin
 - This pin has the following peripheral function:
 - I2C bus interface ch. 0 clock I/O pin (SCL)
- P73/SDA pin
 - This pin has the following peripheral function:
 - I²C bus interface ch. 0 data I/O pin (SDA)
- Block diagram of P72/SCL and P73/SDA



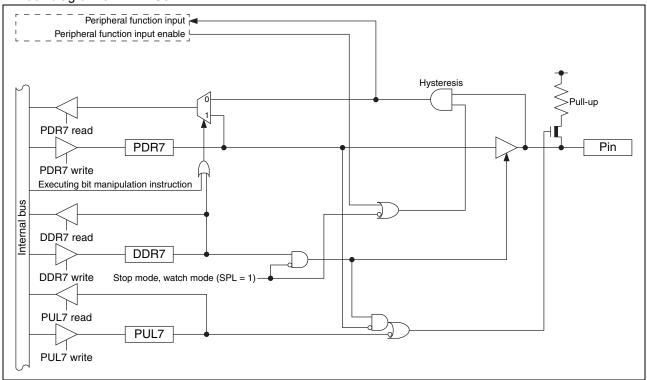
• P74/EC0 pin

This pin has the following peripheral functions:

• 8/16-bit composite timer ch. 0 clock input pin (EC0)

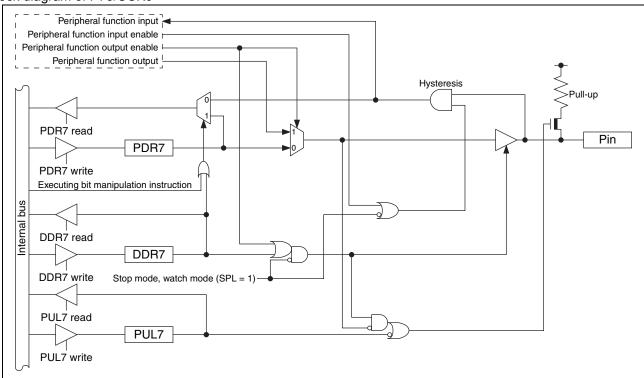


• Block diagram of P74/EC0



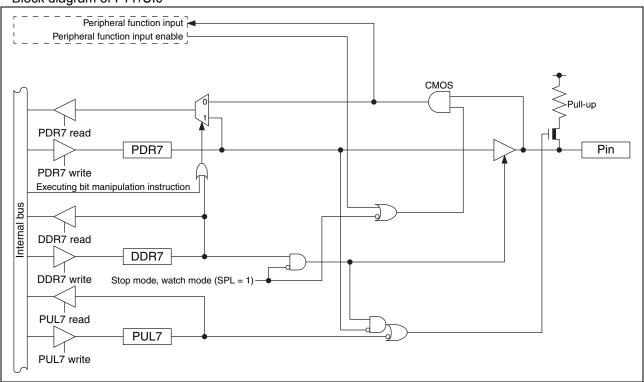


- P75/UCK0 pin
 - This pin has the following peripheral function:
 - UART/SIO ch. 0 clock I/O pin (UCK0)
- Block diagram of P75/UCK0





- P77/UI0 pin
 - This pin has the following peripheral function:
 - UART/SIO ch. 0 data input pin (UI0)
- Block diagram of P77/UI0





17.5.3 Port 7 registersPort 7 register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write				
PDR7	0	Pin state is "L" level.	PDR7 value is "0".	As output port, outputs "L" level.				
PDRI	1	Pin state is "H" level.	PDR7 value is "1".	As output port, outputs "H" level.*				
DDR7	0		Port input enabled					
DDRI	1		Port output enable	d				
PUL7	0		Pull-up disabled					
FULT	1		Pull-up enabled					

^{*:} If the pin is an N-ch open drain pin, the pin state becomes Hi-Z.

• Correspondence between registers and pins for port 7

		Correspondence between related register bits and pins								
Pin name	P77	P76	P75	P74	P73	P72	P71	P70		
PDR7					bit3	bit2				
DDR7	bit7	bit6	bit5	bit4	มแจ	DILZ	bit1	bit0		
PUL7					-	-				



17.5.4 Port 7 operations

- Operation as an output port
 - A pin becomes an output port if the bit in the DDR7 register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDR7 register to external pins.
 - If data is written to the PDR7 register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDR7 register returns the PDR7 register value.
- · Operation as an input port
 - A pin becomes an input port if the bit in the DDR7 register corresponding to that pin is set to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - If data is written to the PDR7 register, the value is stored in the output latch but is not output to the pin set as an input port.
 - Reading the PDR7 register returns the pin value. However, if the read-modify-write (RMW) type of instruction is
 used to read the PDR7 register, the PDR7 register value is returned.
- Operation as a peripheral function output pin
 - A pin becomes a peripheral function output pin if the peripheral output function is enabled by setting the output enable bit of a peripheral function corresponding to that pin.
 - The pin value can be read from the PDR7 register even if the peripheral function output is enabled. Therefore, the
 output value of a peripheral function can be read by the read operation on the PDR7 register. However, if the readmodify-write (RMW) type of instruction is used to read the PDR7 register, the PDR7 register value is returned.
- Operation as a peripheral function input pin
 - To set a pin as an input port, set the bit in the DDR7 register corresponding to the input pin of a peripheral function to "0".
 - Reading the PDR7 register returns the pin value, regardless of whether the peripheral function uses that pin as its
 input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDR7 register, the PDR7
 register value is returned.
- Operation at reset

If the CPU is reset, all bits in the DDR7 register are initialized to "0" and port input is enabled.

- Operation in stop mode and watch mode
 - If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDR7 register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open. However, if the interrupt input of P74/EC0, P75/UCK0 and P77/UI0 is enabled by the external interrupt control register ch. 0 (EIC00) of the external interrupt circuit and the interrupt pin selection circuit control register (WICR) of the interrupt pin selection circuit, the input is enabled and is not blocked.
 - If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.
- · Operation of the pull-up register

Setting the bit in the PUL7 register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PUL7 register.



17.6 Port F

Port F is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.6.1 Port F configuration

Port F is made up of the following elements.

- · General-purpose I/O pins/peripheral function I/O pins
- Port F data register (PDRF)
- Port F direction register (DDRF)

17.6.2 Block diagrams of port F

• PF0/X0 pin

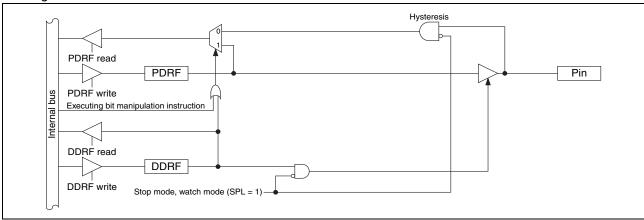
This pin has the following peripheral function:

- Main clock input oscillation pin (X0)
- PF1/X1 pin

This pin has the following peripheral function:

• Main clock I/O oscillation pin (X1)

· Block diagram of PF0/X0 and PF1/X1



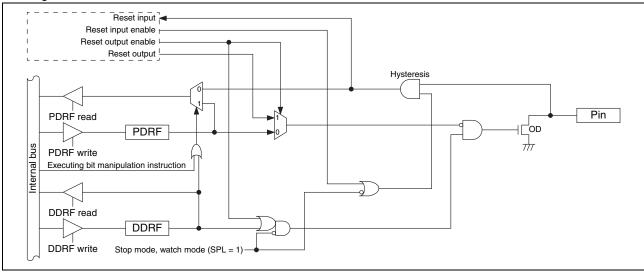
• PF2/RST pin

This pin has the following peripheral function:

• Reset pin (RST)



Block diagram of PF2/RST



17.6.3 Port F registers

Port F register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write				
PDRF	0	Pin state is "L" level.	PDRF value is "0".	As output port, outputs "L" level.				
FURF	1	Pin state is "H" level.	PDRF value is "1".	As output port, outputs "H" level.*				
DDRF	0		Port input enabled					
DDRF	1		Port output enable	d				

^{*:} If the pin is an N-ch open drain pin, the pin state becomes Hi-Z.

· Correspondence between registers and pins for port F

		Correspondence between related register bits and pins								
Pin name	-	-	-	-	-	PF2	PF1	PF0		
PDRF						bit2*	bit1	bit0		
DDRF	-	-	-	-	-	DILZ	DILI	טונט		

^{*:} When the external reset is selected (SYSC:RSTEN = 1), the port function cannot be used.



17.6.4 Port F operations

- · Operation as an output port
 - · A pin becomes an output port if the bit in the DDRF register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDRF register to external pins.
 - If data is written to the PDRF register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDRF register returns the PDRF register value.
- · Operation as an input port
 - A pin becomes an input port if the bit in the DDRF register corresponding to that pin is set to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - If data is written to the PDRF register, the value is stored in the output latch but is not output to the pin set as an input port.
 - Reading the PDRF register returns the pin value. However, if the read-modify-write (RMW) type of instruction is
 used to read the PDRF register, the PDRF register value is returned.
- Operation at reset

If the CPU is reset, all bits in the DDRF register are initialized to "0" and port input is enabled.

- · Operation in stop mode and watch mode
 - If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDRF register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open.
 - If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.



17.7 Port G

Port G is a general-purpose I/O port. This section focuses on its functions as a general-purpose I/O port. For details of peripheral functions, refer to their respective chapters in "New 8FX MB95690K Series Hardware Manual".

17.7.1 Port G configuration

Port G is made up of the following elements.

- · General-purpose I/O pins/peripheral function I/O pins
- Port G data register (PDRG)
- Port G direction register (DDRG)
- Port G pull-up register (PULG)

17.7.2 Block diagram of port G

PG1/X0A/SNI1 pin

This pin has the following peripheral functions:

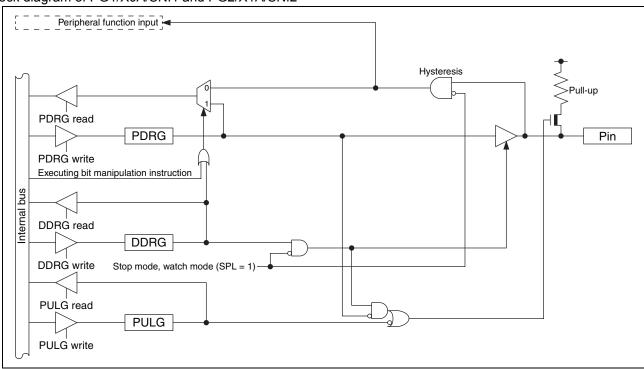
- Subclock input oscillation pin (X0A)
- Trigger input pin for the position detection function of the MPG waveform sequencer (SNI1)

• PG2/X1A/SNI2 pin

This pin has the following peripheral functions:

- Subclock I/O oscillation pin (X1A)
- Trigger input pin for the position detection function of the MPG waveform sequencer (SNI2)

Block diagram of PG1/X0A/SNI1 and PG2/X1A/SNI2





17.7.3 Port G registersPort G register functions

Register abbreviation	Data	Read	Read by read-modify-write (RMW) instruction	Write					
PDRG	0	Pin state is "L" level.	PDRG value is "0".	As output port, outputs "L" level.					
FDRG	1	Pin state is "H" level.	PDRG value is "1".	As output port, outputs "H" level.					
DDRG	0		Port input enabled						
DDRG	1		Port output enable	d					
PULG	0		Pull-up disabled						
FOLG	1		Pull-up enabled						

• Correspondence between registers and pins for port G

		Correspondence between related register bits and pins								
Pin name	-	-	-	-	-	PG2	PG1	-		
PDRG										
DDRG	-	-	-	-	-	bit2	bit1	-		
PULG										



17.7.4 Port G operations

- Operation as an output port
 - A pin becomes an output port if the bit in the DDRG register corresponding to that pin is set to "1".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - When a pin is used as an output port, it outputs the value of the PDRG register to external pins.
 - If data is written to the PDRG register, the value is stored in the output latch and is output to the pin set as an output port as it is.
 - Reading the PDRG register returns the PDRG register value.
- · Operation as an input port
 - A pin becomes an input port if the bit in the DDRG register corresponding to that pin is set to "0".
 - For a pin shared with other peripheral functions, disable the output of such peripheral functions.
 - If data is written to the PDRG register, the value is stored in the output latch but is not output to the pin set as an input port.
 - Reading the PDRG register returns the pin value. However, if the read-modify-write (RMW) type of instruction is
 used to read the PDRG register, the PDRG register value is returned.
- Operation as a peripheral function input pin
 - To set a pin as an input port, set the bit in the DDRG register corresponding to the input pin of a peripheral function to "0".
 - Reading the PDRG register returns the pin value, regardless of whether the peripheral function uses that pin as its
 input pin. However, if the read-modify-write (RMW) type of instruction is used to read the PDRG register, the PDRG
 register value is returned.
- Operation at reset

If the CPU is reset, all bits in the DDRG register are initialized to "0" and port input is enabled.

- · Operation in stop mode and watch mode
 - If the pin state setting bit in the standby control register (STBC:SPL) is set to "1" and the device transits to stop mode or watch mode, the pin is compulsorily made to enter the high impedance state regardless of the DDRG register value. The input of that pin is locked to "L" level and blocked in order to prevent leaks due to input open.
 - If the pin state setting bit is "0", the state of the port I/O or that of the peripheral function I/O remains unchanged and the output level is maintained.
- Operation of the pull-up register

Setting the bit in the PULG register to "1" makes the pull-up resistor be internally connected to the pin. When the pin output is "L" level, the pull-up resistor is disconnected regardless of the value of the PULG register.

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18. Interrupt Source Table

	Interrupt		r table ress		pt level register	Priority order of interrupt sources
Interrupt source	request number	Upper	Lower	Register	Bit	of the same level (occurring simultaneously)
External interrupt ch. 0	IRQ00	0xFFFA	0xFFFB	ILR0	L00 [1:0]	High
External interrupt ch. 4	iitQoo	OXITIA	OXITID	ILIXO	200 [1.0]	A
External interrupt ch. 1	IRQ01	0xFFF8	0xFFF9	ILR0	L01 [1:0]	T
External interrupt ch. 5	IIIQUI	OXITIO	OXI I I 3	ILINO	L01[1.0]	
External interrupt ch. 2	IRQ02	0xFFF6	0xFFF7	ILR0	L02 [1:0]	
External interrupt ch. 6	IIIQUZ	OXITIO	OXI I I I	ILINO	L02 [1.0]	
External interrupt ch. 3	IRQ03	0xFFF4	0xFFF5	ILR0	L03 [1:0]	
External interrupt ch. 7	IIXQUS	021114	UXITIS	ILINU	L03 [1.0]	
UART/SIO ch. 0	IRQ04	0xFFF2	0xFFF3	ILR1	L04 [1:0]	
MPG (DTTI)	IKQ04	UXFFFZ	UXFFF3	ILIXI	L04 [1.0]	
8/16-bit composite timer ch. 0	IRQ05	0xFFF0	0xFFF1	ILR1	L05 [1:0]	
(lower)	IRQUS	UXFFFU	UXFFFI	ILKI	LU3 [1.0]	
8/16-bit composite timer ch. 0	IRQ06	٥٧٢٢٢	0xFFEF	ILR1	1.06 [1:0]	
(upper)	IRQUO	0xFFEE	UXFFEF	ILKI	L06 [1:0]	
LIN-UART (reception)	IRQ07	0xFFEC	0xFFED	ILR1	L07 [1:0]	
LIN-UART (transmission)	IRQ08	0xFFEA	0xFFEB	ILR2	L08 [1:0]	
8/16-bit PPG ch. 1 (lower)	IRQ09	0xFFE8	0xFFE9	ILR2	L09 [1:0]	
8/16-bit PPG ch. 1 (upper)	IRQ10	0xFFE6	0xFFE7	ILR2	L10 [1:0]	
8/16-bit PPG ch. 2 (upper)	IRQ11	0xFFE4	0xFFE5	ILR2	L11 [1:0]	
8/16-bit PPG ch. 0 (upper)	IRQ12	0xFFE2	0xFFE3	ILR3	L12 [1:0]	
8/16-bit PPG ch. 0 (lower)	IRQ13	0xFFE0	0xFFE1	ILR3	L13 [1:0]	
8/16-bit composite timer ch. 1	10044	0. FEDE	0.5555	II D0		
(upper)	IRQ14	0xFFDE	0xFFDF	ILR3	L14 [1:0]	
8/16-bit PPG ch. 2 (lower)	IRQ15	0xFFDC	0xFFDD	ILR3	L15 [1:0]	
16-bit reload timer ch. 1						
MPG (write timing/compare clear)	IRQ16	0xFFDA	0xFFDB	ILR4	L16 [1:0]	
I ² C bus interface ch. 0						
16-bit PPG timer ch. 1						
MPG (position detection/compare	IRQ17	0xFFD8	0xFFD9	ILR4	L17 [1:0]	
interrupt)						
8/10-bit A/D converter	IRQ18	0xFFD6	0xFFD7	ILR4	L18 [1:0]	
Time-base timer	IRQ19	0xFFD4	0xFFD5	ILR4	L19 [1:0]	
Watch prescaler						
Comparator ch. 0	IRQ20	0xFFD2	0xFFD3	ILR5	L20 [1:0]	
Comparator ch. 1	IRQ21	0xFFD0	0xFFD1	ILR5	L21 [1:0]	
8/16-bit composite timer ch. 1						
(lower)	IRQ22	0xFFCE	0xFFCF	ILR5	L22 [1:0]	
Flash memory	IRQ23	0xFFCC	0xFFCD	ILR5	L23 [1:0]	♥ Low



19. Pin States In Each Mode

I	Normal		Stop	mode	Watch	mode	
Pin name	operation	Sleep mode	SPL=0	SPL=1	SPL=0	SPL=1	On reset
	Oscillation input	Oscillation input	Hi-Z	Hi-Z	Hi-Z	Hi-Z	_
PF0/X0	I/O port*1	I/O port*1	- Previous state kept - Input blocked*1,*2	- Hi-Z - Input blocked*1,*2	- Previous state kept - Input blocked*1,*2	- Hi-Z - Input blocked* ^{1,*2}	- Hi-Z - Input enabled* ³ (However, it does not function.)
	Oscillation input	Oscillation input	Hi-Z	Hi-Z	Hi-Z	Hi-Z	_
PF1/X1	I/O port*1	I/O port*1	- Previous state kept - Input blocked*1, *2	- Hi-Z - Input blocked*1, *2	- Previous state kept - Input blocked*1,*2	- Hi-Z - Input blocked*1, *2	- Hi-Z - Input enabled* ³ (However, it does not function.)
	Reset input*4	Reset input*4	Reset input	Reset input	Reset input	Reset input	Reset input*4
PF2/RST	I/O port	I/O port	- Previous state kept - Input blocked*1,*2	- Hi-Z - Input blocked*1.*2	- Previous state kept - Input blocked*1.*2	- Hi-Z - Input blocked*1. *2	- Hi-Z - Input enabled* ³ (However, it does not function.)
	Oscillation input	Oscillation input	Hi-Z	Hi-Z	Hi-Z	Hi-Z	
PG1/X0A/ SNI1	I/O port*1	I/O port*1	- Previous state kept - Input blocked*1,*2	- Hi-Z* ⁵ - Input blocked* ^{1, *2}	- Previous state kept - Input blocked*1.*2	- Hi-Z* ⁵ - Input blocked* ^{1, *2}	- Hi-Z - Input enabled* ³ (However, it does not function.)
	Oscillation input	Oscillation input	Hi-Z	Hi-Z	Hi-Z	Hi-Z	
PG2/X1A/ SNI2	I/O port*1	I/O port*1	- Previous state kept - Input blocked*1,*2	- Hi-Z* ⁵ - Input blocked* ^{1,*2}	- Previous state kept - Input blocked*1,*2	- Hi-Z*5 - Input blocked*1,*2	- Hi-Z - Input enabled* ³ (However, it does not function.)
CMP0_N P03/INT03/ AN03/ CMP1_P P04/INT04/ AN04/ CMP1_N	I/O port/ peripheral function I/O/ analog input	I/O port/ peripheral function I/O/ analog input	- Previous state kept - Input blocked* ² .* ⁶	- Hi-Z* ⁵ - Input blocked* ^{2,*6}	- Previous state kept - Input blocked*2,*6	- Hi-Z* ⁵ - Input blocked* ^{2,*6}	- Hi-Z - Input blocked* ²
CMP0_O P05/INT05/ AN05/ CMP1_O	I/O port/ peripheral function I/O/ analog input	I/O port/ peripheral function I/O/ analog input	- Previous state kept*8 - Input blocked*2,*7	- Hi-Z*5 - Input blocked*2,*7	- Previous state kept*8 - Input blocked*2,*7	- Hi-Z*5 - Input blocked*2,*7	- Hi-Z - Input blocked* ²
AN06 P07/INT07/	I/O port/ peripheral function I/O/ analog input	I/O port/ peripheral function I/O/ analog input	 Previous state kept Input blocked*2, *7 	- Hi-Z*5 - Input blocked*2,*7	 Previous state kept Input blocked*2,*7 	- Hi-Z* ⁵ - Input blocked* ^{2, *7}	- Hi-Z - Input blocked*2



.	Normal		Stop	mode	Watch	mode	
Pin name	operation	Sleep mode	SPL=0	SPL=1	SPL=0	SPL=1	On reset
P12/DBG	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	- Previous state kept - Input blocked*2	- Hi-Z - Input blocked*²	- Previous state kept - Input blocked*2	- Hi-Z - Input blocked*²	- Hi-Z - Input enabled*3 (However, it does not function.)
	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	- Previous state kept - Input blocked*2	- Hi-Z*5 - Input blocked*2	- Previous state kept - Input blocked*2	- Hi-Z*5 - Input blocked*2	- Hi-Z - Input enabled* ³ (However, it does not function.)
	I/O port/ analog input	I/O port/ analog input	 Previous state kept Input blocked*2 	- Hi-Z*5 - Input blocked*2	 Previous state kept Input blocked*2 	- Hi-Z - Input blocked*2	- Hi-Z - Input blocked* ²
P44/TO1	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	 Previous state kept Input blocked*2 	- Hi-Z*5 - Input blocked*2	 Previous state kept Input blocked*2 	- Hi-Z*5 - Input blocked*2	- Hi-Z - Input enabled* ³ (However, it
P46/SOT	iunction //O	lunction //O	- Input blocked 2		- Input blocked 2	•	does not function.)
P45/SCK	I/O port/ peripheral	I/O port/ peripheral	Previous statekeptInput	- Hi-Z*5	Previous statekeptInput	- Hi-Z* ⁵ - Input	- Hi-Z - Input enabled* ³ (However, it
P47/SIN	function I/O	function I/O	blocked* ^{2, *7}	- Input blocked*7	blocked* ^{2,*7}	blocked*2, *7	does not function.)
P60/DTTI							
P61/TI1 P62/TO10/ PPG00/ OPT0 P63/TO11/ PPG01/ OPT1	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	 Previous state kept Input blocked*² 	- Hi-Z* ⁵ - Input blocked* ²	- Previous state kept - Input blocked*2	- Hi-Z* ⁵ - Input blocked* ²	- Hi-Z - Input enabled*3 (However, it does not function.)
P65/PPG11/ OPT3 P66/PPG1/ PPG20/							
D67/TDC1/	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	- Previous state kept - Input blocked*2,*7	- Hi-Z*5 - Input blocked* ^{2,*7}	- Previous state kept - Input blocked*2,*7	- Hi-Z* ⁵ - Input blocked* ^{2,*7}	- Hi-Z - Input enabled* ³ (However, it does not function.)



(Continued)

Din nama	Normal	Clean made	Stop	mode	Watch	mode	On recet
Pin name	operation	Sleep mode	SPL=0	SPL=1	SPL=0	SPL=1	On reset
P72/SCL	I/O port/ peripheral	I/O port/ peripheral	- Previous state kept	- Hi-Z - Input	- Previous state kept	- Hi-Z - Input	- Hi-Z - Input enabled* ³
P73/SDA	function I/O	function I/O	Input blocked*2. *9 blocked*2. *9		- Input blocked* ^{2,*9}	blocked*2, *9	(However, it does not function.)
P70/TO00	I/O port/	I/O port/	- Previous state		- Previous state		- Hi-Z - Input
P71/TO01	peripheral function I/O	peripheral function I/O	kept - Input blocked*2	- HI-Z*°	kont	- Hi-Z*5 - Input blocked*2	,
P76/UO0							does not function.)
P74/EC0	I/O port/	I/O port/	- Previous state	- Hi-Z* ⁵	- Previous state	- Hi-Z* ⁵	- Hi-Z - Input
P75/UCK0	I/O port/ peripheral function I/O	I/O port/ peripheral function I/O	kept - Input	- Input blocked*2,*7	kept - Input	- Input blocked*2,*7	enabled* ³ (However, it
P77/UI0		blocked*2, *7		blocked*2,*7		does not function.)	

SPL: Pin state setting bit in the standby control register (STBC:SPL)

Hi-Z: High impedance

- *1: The pin stays at the state shown when configured as a general-purpose I/O port.
- *2: "Input blocked" means direct input gate operation from the pin is disabled.
- *3: "Input enabled" means that the input function is enabled. While the input function is enabled, execute a pull-up or pull-down operation in order to prevent leaks due to external input. If a pin is used as an output port, its pin state is the same as that of other ports.
- *4: The PF2/RST pin stays at the state shown when configured as a reset pin.
- *5: The pull-up control setting is still effective.
- *6: Though input is blocked, an external interrupt can be input when the external interrupt request is enabled, and an analog signal can also be input to generate a comparator interrupt when the comparator interrupt is enabled.
- *7: Though input is blocked, an external interrupt can be input when the external interrupt request is enabled.
- *8: The output function of the comparator is still in operation in stop mode and watch mode.
- *9: The I²C bus interface can wake up the MCU in stop mode or watch mode when its MCU standby mode wakeup function is enabled. For details of the MCU standby mode wakeup function, refer to "New 8FX MB95690K Series Hardware Manual".



20. Electrical Characteristics

20.1 Absolute Maximum Ratings

Danamatan	Ob. a.l.	Rat	ing	11	Powerder.
Parameter	Symbol	Min	Max	Unit	Remarks
Power supply voltage*1	Vcc	Vss - 0.3	Vss + 6	V	
Input voltage*1	Vı	Vss - 0.3	Vss + 6	V	*2
Output voltage*1	Vo	Vss - 0.3	Vss + 6	V	*2
Maximum clamp current	ICLAMP	-2	+2	mA	Applicable to specific pins*3
Total maximum clamp current	Σ ICLAMP	_	20	mA	Applicable to specific pins*3
"L" level maximum output current	Ю	_	15	mA	
"L" level average current	lolav1		4	mA	Other than P60 to P67 Average output current = operating current × operating ratio (1 pin)
L level average current	lolav2		12	IIIA	P60 to P67 Average output current = operating current × operating ratio (1 pin)
"L" level total maximum output current	Σ loL	_	100	mA	
"L" level total average output current	Σ lolav	_	37	mA	Total average output current = operating current × operating ratio (Total number of pins)
"H" level maximum output current	Іон	_	-15	mA	
"H" level average	Iонаv1		-4	mA	Other than P60 to P67 Average output current = operating current × operating ratio (1 pin)
current	Iонаv2		-8	IIIA	P60 to P67 Average output current = operating current × operating ratio (1 pin)
"H" level total maximum output current	Σ Іон	_	-100	mA	
"H" level total average output current	Σ Iohav	_	–47	mA	Total average output current = operating current × operating ratio (Total number of pins)
Power consumption	Pd	_	320	mW	
Operating temperature	Та	-40	+85	°C	
Storage temperature	Tstg	-55	+150	°C	

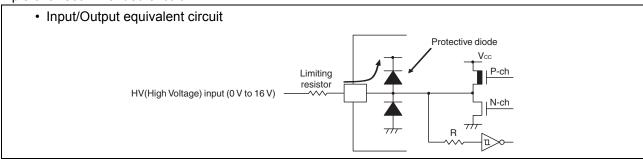
^{*1:} These parameters are based on the condition that Vss is 0.0 V.

^{*2:} V₁ and V₀ must not exceed Vcc + 0.3 V. V₁ must not exceed the rated voltage. However, if the maximum current to/from an input is limited by means of an external component, the Iclamp rating is used instead of the V₁ rating.

^{*3:} Specific pins: P00 to P07, P10, P11, P13 to P17, P40 to P47, P60 to P67, P70, P71, P74 to P77, PF0, PF1, PG1, PG2



- · Use under recommended operating conditions.
- · Use with DC voltage (current).
- The HV (High Voltage) signal is an input signal exceeding the Vcc voltage. Always connect a limiting resistor between the HV (High Voltage) signal and the microcontroller before applying the HV (High Voltage) signal.
- The value of the limiting resistor should be set to a value at which the current to be input to the microcontroller pin when the HV (High Voltage) signal is input is below the standard value, irrespective of whether the current is transient current or stationary current.
- When the microcontroller drive current is low, such as in low power consumption modes, the HV (High Voltage) input potential may pass through the protective diode to increase the potential of the Vcc pin, affecting other devices.
- If the HV (High Voltage) signal is input when the microcontroller power supply is off (not fixed at 0 V), since power is supplied from the pins, incomplete operations may be executed.
- If the HV (High Voltage) input is input after power-on, since power is supplied from the pins, the voltage of power supply may not be sufficient to enable a power-on reset.
- Do not leave the HV (High Voltage) input pin unconnected.
- Example of a recommended circuit:



WARNING: Semiconductor devices may be permanently damaged by application of stress (including, without limitation, voltage, current or temperature) in excess of absolute maximum ratings.

Do not exceed any of these ratings.

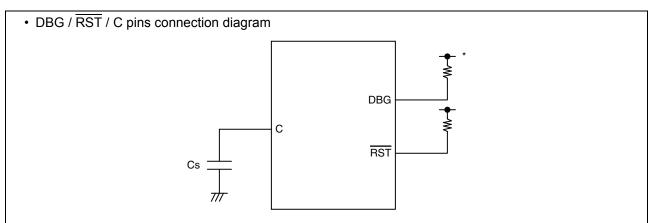


20.2 Recommended Operating Conditions

(Vss = 0.0 V)

Parameter	Symbol	Va	lue	Unit	Remarks
r arameter	Syllibol	Min	Max	Oilit	Kemarks
Power supply voltage	Vcc	2.88	5.5	V	
Decoupling capacitor	Cs	0.022	1	μF	*
Operating temperature	Та	-40	+85	°C	Other than on-chip debug mode
Operating temperature		+5	+35	C	On-chip debug mode

*: Use a ceramic capacitor or a capacitor with equivalent frequency characteristics. The decoupling capacitor for the Vcc pin must have a capacitance equal to or larger than the capacitance of Cs. For the connection to a decoupling capacitor Cs, see the diagram below. To prevent the device from unintentionally entering an unknown mode due to noise, minimize the distance between the C pin and Cs and the distance between Cs and the Vss pin when designing the layout of a printed circuit board.



*: Connect the DBG pin to an external pull-up resistor of 2 k Ω or above. After power-on, ensure that the DBG pin does not stay at "L" level until the reset output is released. The DBG pin becomes a communication pin in debug mode. Since the actual pull-up resistance depends on the tool used and the interconnection length, refer to the tool document when selecting a pull-up resistor.

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated under these conditions.

Any use of semiconductor devices will be under their recommended operating condition.

Operation under any conditions other than these conditions may adversely affect reliability of device and could result in device failure.

No warranty is made with respect to any use, operating conditions or combinations not represented on this data sheet. If you are considering application under any conditions other than listed herein, please contact sales representatives beforehand.



20.3 DC Characteristics

(Vcc = 5.0 V \pm 10%, Vss = 0.0 V, TA = -40 °C to +85 °C)

Danamatan	Ols al	Din nome	O a maliti a m		Value		11:4	Demonto
Parameter	Symbol	Pin name	Condition	Min	Тур	Max	Unit	Remarks
(I 12 I I	VIHI	P47, P72, P73, P77	_	0.7 Vcc	_	Vcc + 0.3	V	CMOS input level
"H" level input voltage	Vihs	Other than P47, P72, P73, P77, PF2	_	0.8 Vcc		Vcc + 0.3	V	Hysteresis input
	Vінм	PF2	_	0.8 Vcc	_	Vcc + 0.3	V	Hysteresis input
" 1." 1	VILI	P47, P72, P73, P77	_	Vss - 0.3	_	0.3 Vcc	٧	CMOS input level
"L" level input voltage	VILS	Other than P47, P72, P73, P77, PF2	_	Vss - 0.3	_	0.2 Vcc	V	Hysteresis input
	VILM	PF2	_	Vss - 0.3	_	0.2 Vcc	V	Hysteresis input
Open-drain output application voltage	VD	P12, P72, P73, PF2	_	Vss - 0.3	_	Vss + 5.5	V	
"H" level output voltage	Vон1	Output pins other than P12, P60 to P67, PF2	Iон = − 4 m A	Vcc – 0.5	_	_	V	
	V _{OH2}	P60 to P67	Iон = -8 mA	Vcc - 0.5	_	_	V	
"L" level output voltage	V _{OL1}	Output pins other than P60 to P67	IoL = 4 mA	_	_	0.4	V	
voitage	V _{OL2}	P60 to P67	IoL = 12 mA	_	_	0.4	V	
Input leak current(Hi-Z output leak current)	lu	All input pins	0.0 V < Vı < Vcc	-5	_	+5	μA	When the internal pull-up resistor is disabled
Internal pull-up resistor	Rpull	Other than P12, P72, P73, PF0, PF1, PF2	V _I = 0 V	25	50	100	kΩ	When the internal pull-up resistor is enabled
Input capacitance	Cin	Other than Vcc and Vss	f = 1 MHz	_	5	15	pF	



 $(Vcc = 5.0 V\pm 10\%, Vss = 0.0 V, TA = -40 °C to +85 °C)$

				- 0.0 \	· [
Parameter	Symbol	Pin name	Condition	Min	Value Typ*1	Max*2	Unit	Remarks	
			Fcн = 32 MHz	_	4.9	5.8	mA	Except during Flash memory programming and erasing	
	Icc		FMP = 16 MHz Main clock mode (divided by 2)	_	10.5	13.8	mA	During Flash memory programming and erasing	
					6.5	9.1	mΑ	At A/D conversion	
	Iccs	Vcc	F _{CH} = 32 MHz F _{MP} = 16 MHz Main sleep mode (divided by 2)	_	2	3	mA		
	Iccl	(External clock operation)	F _{MPL} = 16 kHz Subclock mode (divided by 2) T _A = +25 °C	_	75.9	145	μΑ		
Power	Iccls		F _{CL} = 32 kHz F _{MPL} = 16 kHz Subsleep mode (divided by 2) T _A = +25 °C	_	12.7	16	μΑ	In deep standby mode	
supply current*3	Ісст		F _{CL} = 32 kHz Watch mode Main stop mode T _A = +25 °C	_	11	13	μA	In deep standby mode	
	Іссмріі		FMCRPLL = 16 MHz FMP = 16 MHz Main CR PLL clock mode (multiplied by 4) TA = +25 °C	_	5.2	6.8	mA		
	Іссмск	Vcc	FCRH = 4 MHz FMP = 4 MHz Main CR clock mode	_	1.4	4.6	mA		
	Iccscr		Sub-CR clock mode (divided by 2) T _A = +25 °C	_	76.9	230	μA		
	Ісстѕ	Vcc (External clock	F _{CH} = 32 MHz Time-base timer mode T _A = +25 °C	_	387	455	μΑ	In deep standby mode	
	Іссн	operation)	Substop mode T _A = +25 °C	_	10.8	13	μΑ	In deep standby mode	



 $(V_{CC} = 5.0 \text{ V} \pm 10\%, \text{ Vss} = 0.0 \text{ V}, \text{ TA} = -40 \,^{\circ}\text{C to} + 85 \,^{\circ}\text{C})$

Parameter	Symbol	Pin name	Condition		Value		Unit	Remarks
Parameter	Syllibol	Pili lialile	Condition	Min	Typ*1 Max*2		Ullit	Remarks
Power supply current*3	lv		Current consumption of the comparator	_	60	160	μΑ	
	ILVD		Current consumption of the low-voltage detection reset circuit	_	4	7	μΑ	With the LVD reset already enabled by the LVD reset circuit control register (LVDCC)
	Icrh		Current consumption of the main CR oscillator	_	240	320	μA	
	Vcc	Current consumption of the sub-CR oscillator oscillating at 100 kHz		7	20	μΑ		
	Імѕтву		Current consumption difference between normal standby mode and deep standby mode T _A = +25 °C	_	18	30	μΑ	

^{*1:} Vcc = 5.0 V, T_A = +25 °C

- See "4. AC Characteristics Clock Timing" for Fch, Fch, Fch, Fch and Fmcrpll.
- See "4. AC Characteristics Source Clock/Machine Clock" for FMP and FMPL.
- The power supply current value in standby mode is measured in deep standby mode. The current consumption in normal standby mode is higher than that in deep standby mode. The power supply current value in normal standby mode can be found by adding the current consumption difference between normal standby mode and deep standby mode (Instray) to the power supply current value in deep standby mode. For details of normal standby mode and deep standby mode, refer to "CHAPTER 3 CLOCK CONTROLLER" in "New 8FX MB95690K Series Hardware Manual".

^{*2:} Vcc = 5.5 V, TA = +85 °C (unless otherwise specified)

^{*3: •} The power supply current is determined by the external clock. When the low-voltage detection reset circuit is selected, the power supply current is the sum of adding the current consumption of the low-voltage detection reset circuit (ILVD) to one of the values from Icc to Icch. In addition, when both the low-voltage detection option and a CR oscillator are selected, the power supply current is the sum of adding up the current consumption of the low-voltage detection reset circuit (ILVD), the current consumption of the CR oscillators (ICRH or ICRL) and one of the values from Icc to Icch. In on-chip debug mode, the main CR oscillator (ICRH) and the low-voltage detection reset circuit are always in operation, and current consumption therefore increases accordingly.



20.4 AC Characteristics

20.4.1 Clock Timing

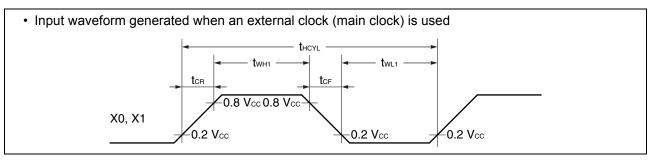
 $(V_{CC} = 2.88 \text{ V to } 5.5 \text{ V}, \text{Vss} = 0.0 \text{ V}, \text{TA} = -40 ^{\circ}\text{C to } +85 ^{\circ}\text{C})$

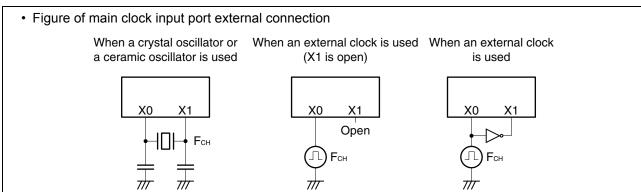
			Value					Vss = 0.0 V, TA = -40 °C to +85	
Parameter	Symbol	Pin name	Condition	Min	Тур	Max	Unit	Remarks	
	F	X0, X1	_	1	_	16.25	MHz	When the main oscillation circuit is used	
	Fсн	X0	X1: open	1	_	12	MHz	When the main external clock	
		X0, X1	*	1	_	32.5	MHz	is used	
				3.92	4	4.08	MHz	 Operating conditions The main CR clock is used. 0 °C ≤ T_A ≤ +70 °C 	
	Fcrh	_	_	3.8	4	4.2	MHz	Operating conditions • The main CR clock is used. • − 40 °C ≤ T _A < 0 °C, + 70 °C < T _A ≤ + 85 °C	
				7.84	8	8.16	MHz	Operating conditions • PLL multiplication rate: 2 • 0 °C ≤ T _A ≤ +70 °C	
	FMCRPLL				7.6	8	8.4	MHz	Operating conditions • PLL multiplication rate: 2 • − 40 °C ≤ TA < 0 °C, + 70 °C < TA ≤ + 85 °C
		_		9.8	10	10.2	MHz	Operating conditions • PLL multiplication rate: 2.5 • 0 °C ≤ T _A ≤ +70 °C	
Clock frequency				9.5	10	10.5	MHz	 Operating conditions PLL multiplication rate: 2.5 - 40 °C ≤ TA < 0 °C, + 70 °C < TA ≤ + 85 °C 	
				11.76	12	12.24	MHz	Operating conditions • PLL multiplication rate: 3 • 0 °C ≤ T _A ≤ +70 °C	
				11.4	12	12.6	MHz	 Operating conditions PLL multiplication rate: 3 - 40 °C ≤ TA < 0 °C, + 70 °C < TA ≤ + 85 °C 	
				15.68	16	16.32	MHz	Operating conditions • PLL multiplication rate: 4 • 0 °C ≤ T _A ≤ +70 °C	
				15.2	16	16.8	MHz	Operating conditions • PLL multiplication rate: 4 • − 40 °C ≤ TA < 0 °C, + 70 °C < TA ≤ + 85 °C	
	FcL	X0A, X1A		_	32.768	_	kHz	When the sub-oscillation circuit is used	
	FCL	AUA, AIA	_	_	32.768	_	kHz	When the sub-external clock is used	
	FCRL	_	_	50	100	150	kHz	When the sub-CR clock is used	



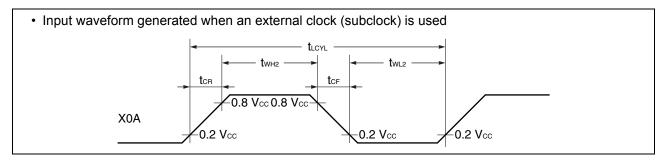
Parameter	Symbol	Din namo	Condition		Value		Unit	Remarks
Parameter	Syllibol	Fill Hallie	Condition	Min	Тур	Max	Offic	Remarks
		X0, X1	_	61.5		1000	ns	When the main oscillation circuit is used
Clock cycle	t HCYL	X0	X1: open	83.4		1000	ns	When an external clock is
time		X0, X1	*	30.8		1000	ns	used
	t LCYL	X0A, X1A			30.5		μs	When the subclock is used
Input algale	tania tana	X0	X1: open	33.4			ns	When an external clock is
Input clock pulse width	twh1, twl1	X0, X1	*	12.4			ns	used, the duty ratio should
puise width	twh2, twl2			_	15.2		μs	range between 40% and 609
Input clock		X0, X0A	X1: open			5	ns	When an external clock is
rising time and falling time	tcr, tcf	X0, X1, X0A, X1A	*	_	_	5		used
CR oscillation	tcrhwk	_	_	_	_	50	μs	When the main CR clock is used
start time	t CRLWK	_	_	_	_	30	μs	When the sub-CR clock is used
PLL oscillation start time	t MCRPLLWK	_	_	_		100	μs	When the main CR PLL clock is used

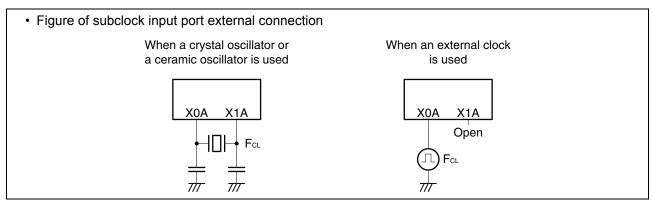
*: The external clock signal is input to X0 and the inverted external clock signal to X1.

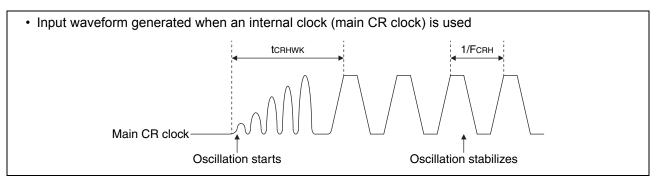


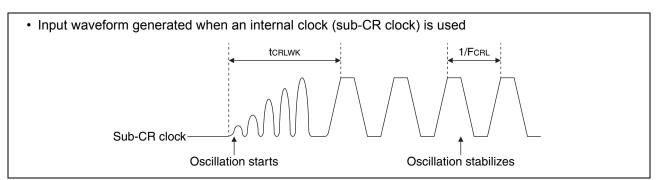




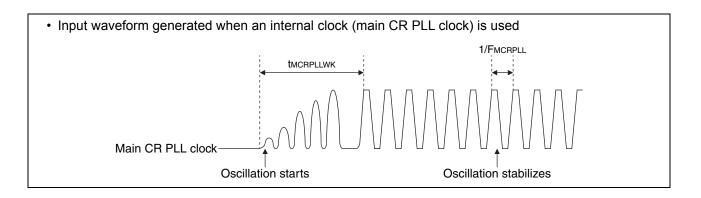












20.4.2 Source Clock/Machine Clock

 $(Vcc = 5.0 V\pm 10\%, Vss = 0.0 V, T_A = -40 °C to +85 °C)$

Parameter	Cymbol	Pin		Value		Unit	Remarks
Parameter	Symbol	name	Min	Тур	Max	Unit	Remarks
			61.5	_	2000	ns	When the main external clock is used Min: FcH = 32.5 MHz, divided by 2 Max: FcH = 1 MHz, divided by 2
Source clock cycle time*1	tsclк	_	62.5	_	1000	ns	When the main CR clock is used Min: Fcrh = 4 MHz, multiplied by 4 Max: Fcrh = 4 MHz, divided by 4
			_	61	_	μs	When the suboscillation clock is used FcL = 32.768 kHz, divided by 2
				20		μs	When the sub-CR clock is used FcL = 100 kHz, divided by 2
	Fsp		0.5	_	16.25		When the main oscillation clock is used
Source clock	1 55			4	12.5		When the main CR clock is used
frequency		_	_	16.384	_	kHz	When the suboscillation clock is used
requeries	FSPL		_	50	_	kHz	When the sub-CR clock is used FCRL = 100 kHz, divided by 2
			61.5	_	32000	ns	When the main oscillation clock is used Min: Fsp = 16.25 MHz, no division Max: Fsp = 0.5 MHz, divided by 16
Machine clock cycle time*2 (minimum	tmclk		250	_	4000	ns	When the main CR clock is used Min: Fsp = 4 MHz, no division Max: Fsp = 4 MHz, divided by 16
instruction execution time)	IMCLK		61	_	976.5	μs	When the suboscillation clock is used Min: F _{SPL} = 16.384 kHz, no division Max: F _{SPL} = 16.384 kHz, divided by 16
			20	_	320	μs	When the sub-CR clock is used Min: Fspl = 50 kHz, no division Max: Fspl = 50 kHz, divided by 16
	Fмp		0.031	_	16.25		When the main oscillation clock is used
Machine clock	INP		0.25		16		When the main CR clock is used
frequency		-	1.024	_	16.384	kHz	When the suboscillation clock is used
печиенсу	FMPL		3.125	_	50	kHz	When the sub-CR clock is used FCRL = 100 kHz

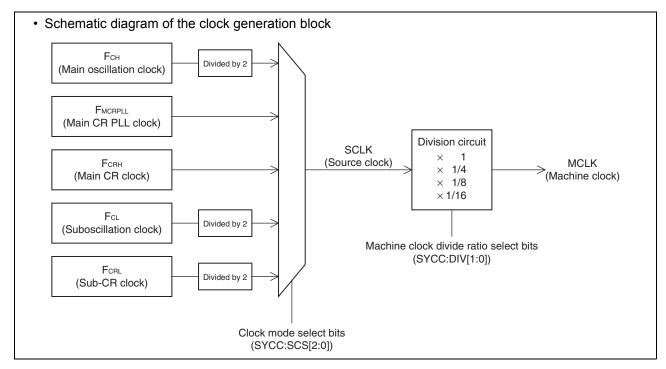
^{*1:} This is the clock before it is divided according to the division ratio set by the machine clock division ratio select bits (SYCC:DIV[1:0]). This source clock is divided to become a machine clock according to the division ratio set by the

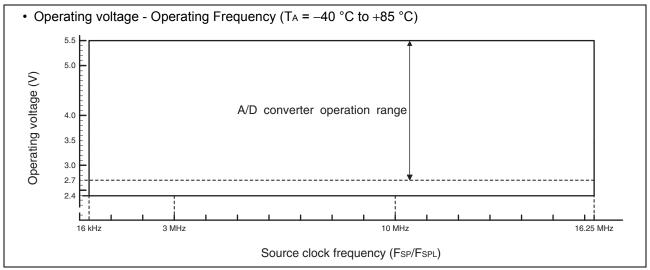
Document Number: 002-04692 Rev. *E



machine clock division ratio select bits (SYCC:DIV[1:0]). In addition, a source clock can be selected from the following.

- · Main clock divided by 2
- · Main CR clock
- PLL multiplication of main CR clock (Select a multiplication rate from 2, 2.5, 3 and 4.)
- Subclock divided by 2
- Sub-CR clock divided by 2
- *2: This is the operating clock of the microcontroller. A machine clock can be selected from the following.
 - · Source clock (no division)
 - · Source clock divided by 4
 - · Source clock divided by 8
 - · Source clock divided by 16



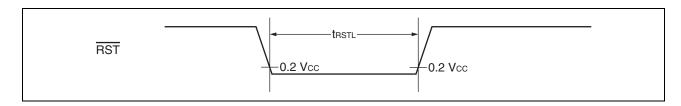




20.4.3 External Reset

Parameter	Symbol	Value		Unit	Remarks
Parameter	Syllibol	Min	Max	Oilit	Remarks
RST "L" level pulse width	t RSTL	2 t mcLK*		ns	

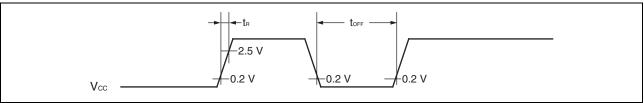
^{*:} See "Source Clock/Machine Clock" for tmclk.



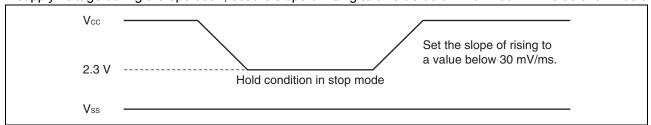
20.4.4 Power-on Reset

$$(V_{SS} = 0.0 \text{ V}, T_A = -40 ^{\circ}\text{C to } +85 ^{\circ}\text{C})$$

Parameter	Symbol	Condition	Va	lue	Unit	Remarks
Farameter	Syllibol	Condition	Min	Max	Oilit	Nemarks
Power supply rising time	t R	_		50	ms	
Power supply cutoff time	toff	_	1	_	ms	Wait time until power-on



Note: A sudden change of power supply voltage may activate the power-on reset function. When changing the power supply voltage during the operation, set the slope of rising to a value below within 30 mV/ms as shown below.

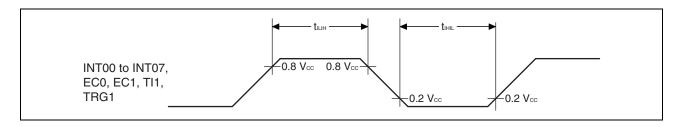




20.4.5 Peripheral Input Timing

Parameter	Symbol	Pin name	Va	Unit	
Faranietei	Syllibol	Fili liame	Min	Max	Onit
Peripheral input "H" pulse width	tılıH	INT00 to INT07, EC0, EC1, TI1,	2 t мськ*		ns
Peripheral input "L" pulse width	t ıнı∟	TRG1	2 t мськ*	_	ns

*: See "Source Clock/Machine Clock" for tmclk.



20.4.6 LIN-UART Timing

Sampling is executed at the rising edge of the sampling clock*1, and serial clock delay is disabled*2. (ESCR register : SCES bit = 0, ECCR register : SCDE bit = 0)

$$(V_{CC} = 5.0 V \pm 10\%, V_{SS} = 0.0 V, T_{A} = -40 ^{\circ}C to +85 ^{\circ}C)$$

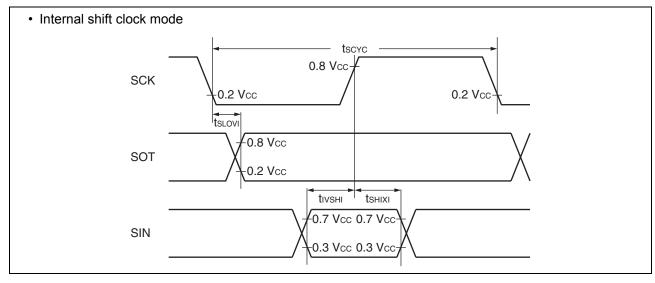
Parameter	Symbol	ymbol Pin name Condition		Va	lue	Unit	
Parameter	Symbol	Pili lialile	Condition	Min	Max		
Serial clock cycle time	tscyc	SCK		5 t мськ* ³	_	ns	
$SCK{\downarrow} o SOT$ delay time	tslovi	SCK, SOT	Internal clock operation output pin:	-50	+50	ns	
Valid SIN \rightarrow SCK $↑$	t ıvshı	SCK, SIN	C _L = 80 pF + 1 TTL	tмськ*3 + 80	_	ns	
$SCK^{\uparrow} \rightarrow valid SIN hold time$	t shixi	SCK, SIN		0	_	ns	
Serial clock "L" pulse width	t slsh	SCK		3 tмськ*3—tr	_	ns	
Serial clock "H" pulse width	t shsl	SCK		tмськ*3 + 10	_	ns	
$SCK{\downarrow} o SOT$ delay time	tslove	SCK, SOT	External clock	_	2 tмськ*3 + 60	ns	
Valid SIN \rightarrow SCK $↑$	tivshe	SCK, SIN	operation output pin:	30	_	ns	
$SCK^{\uparrow} \rightarrow valid SIN hold time$	t shixe	SCK, SIN	C∟ = 80 pF + 1 TTL	tмськ*3 + 30	_	ns	
SCK fall time	t⊧	SCK		_	10	ns	
SCK rise time	tr	SCK		_	10	ns	

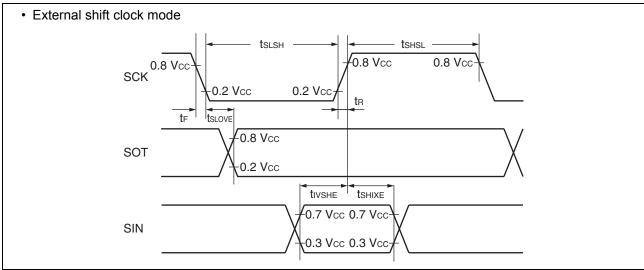
^{*1:} There is a function used to choose whether the sampling of reception data is performed at a rising edge or a falling edge of the serial clock.

^{*2:} The serial clock delay function is a function used to delay the output signal of the serial clock for half the clock.

^{*3:} See "Source Clock/Machine Clock" for tMCLK.









Sampling is executed at the falling edge of the sampling $clock^{*1}$, and serial clock delay is disabled*². (ESCR register : SCES bit = 1, ECCR register : SCDE bit = 0)

 $^{\prime}$ (Vcc = 5.0 V±10%, Vss = 0.0 V, T_A = -40 °C to +85 °C)

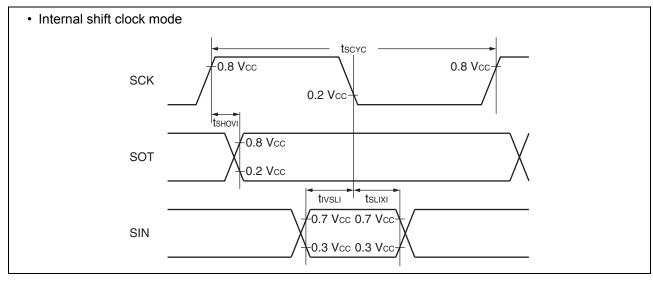
Parameter	Symbol	Pin name	Condition	Va	lue	Unit
Parameter	Syllibol	Fill Hallie	Condition	Min	Max	OIIII
Serial clock cycle time	tscyc	SCK		5 t мськ* ³	_	ns
$SCK \uparrow \rightarrow SOT$ delay time	t shovi	SCK, SOT	Internal clock operation output pin:	-50	+50	ns
Valid SIN \rightarrow SCK↓	tıvslı	SCK, SIN	C _L = 80 pF + 1 TTL	tmcLK*3 + 80	_	ns
SCK↓→ valid SIN hold time	t slixi	SCK, SIN	'	0	_	ns
Serial clock "H" pulse width	t shsl	SCK		3 tмсLк*3 − tR	_	ns
Serial clock "L" pulse width	t slsh	SCK		tmclk*3 + 10	_	ns
$SCK \uparrow \rightarrow SOT$ delay time	t shove	SCK, SOT	External clock	_	2 tmcLK*3 + 60	ns
Valid SIN \rightarrow SCK↓	tivsle	SCK, SIN	operation output pin:	30	_	ns
SCK↓→ valid SIN hold time	tslixe	SCK, SIN	C∟ = 80 pF + 1 TTL	tmcLK*3 + 30	_	ns
SCK fall time	tғ	SCK		_	10	ns
SCK rise time	t R	SCK			10	ns

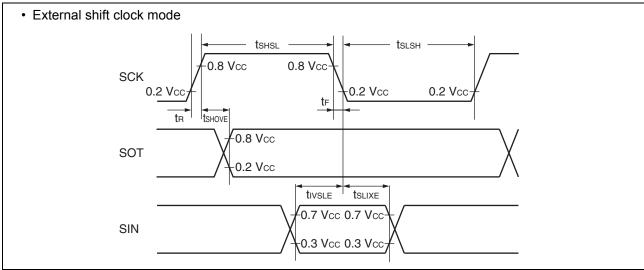
^{*1:} There is a function used to choose whether the sampling of reception data is performed at a rising edge or a falling edge of the serial clock.

^{*2:} The serial clock delay function is a function used to delay the output signal of the serial clock for half the clock.

^{*3:} See "Source Clock/Machine Clock" for tmclk.









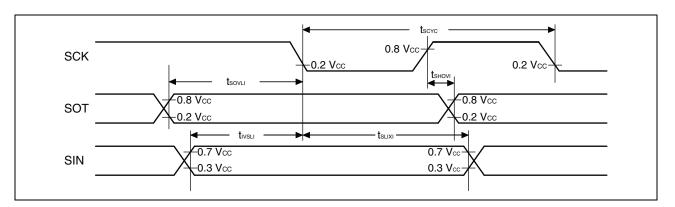
Sampling is executed at the rising edge of the sampling clock*1, and serial clock delay is enabled*2. (ESCR register : SCES bit = 0, ECCR register : SCDE bit = 1)

 $(Vcc = 5.0 V \pm 10\%, Vss = 0.0 V, T_A = -40 °C to +85 °C)$

Parameter	Symbol	Pin name	Condition	Va	Unit	
Parameter	Symbol	Fill Hallie	Condition	Min	Max	Oilit
Serial clock cycle time	tscyc	SCK		5 t мськ* ³	_	ns
$SCK \uparrow \rightarrow SOT$ delay time	t shovi	SCK, SOT	Internal clock	-50	+50	ns
Valid SIN $→$ SCK $↓$	tıvslı		operation output pin:	tmcLK*3 + 80	_	ns
SCK↓→ valid SIN hold time	t slixi	SCK, SIN	C∟ = 80 pF + 1 TTL	0	_	ns
SOT → SCK↓delay time	tsovli	SCK, SOT		3tмськ*3 - 70	_	ns

^{*1:} There is a function used to choose whether the sampling of reception data is performed at a rising edge or a falling edge of the serial clock.

^{*3:} See "Source Clock/Machine Clock" for tmclk.



Sampling is executed at the falling edge of the sampling $clock^{*1}$, and serial clock delay is enabled*². (ESCR register : SCES bit = 1, ECCR register : SCDE bit = 1)

$$(V_{CC} = 5.0 \text{ V} \pm 10\%, \text{ Vss} = 0.0 \text{ V}, \text{ Ta} = -40 ^{\circ}\text{C to} +85 ^{\circ}\text{C})$$

Parameter	Symbol	Pin name	Condition	Val	Unit	
Parameter	Symbol	Fili Ilaille	Condition	Min	Max	Oilit
Serial clock cycle time	tscyc	SCK		5 t mclk*3	_	ns
$SCK{\downarrow} o SOT$ delay time	tslovi	SCK, SOT	Internal clock	-50	+50	ns
Valid SIN \rightarrow SCK $↑$	tıvsнı		operation output pin:	tмськ*3 + 80	_	ns
$SCK^{\uparrow} \rightarrow valid SIN hold time$	t shixi	SCK, SIN	C∟ = 80 pF + 1 TTL	0	_	ns
SOT → SCK [↑] delay time	t sovнı	SCK, SOT		3tмськ*3 – 70	_	ns

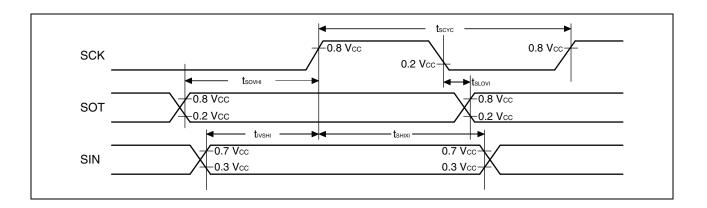
^{*1:} There is a function used to choose whether the sampling of reception data is performed at a rising edge or a falling edge of the serial clock.

^{*2:} The serial clock delay function is a function used to delay the output signal of the serial clock for half the clock.

^{*2:} The serial clock delay function is a function used to delay the output signal of the serial clock for half the clock.

^{*3:} See "Source Clock/Machine Clock" for tmclk.





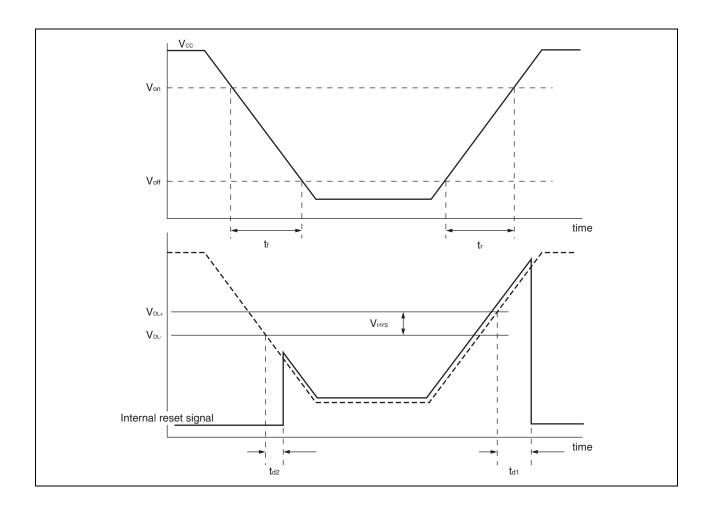
20.4.7 Low-voltage Detection

 $(V_{SS} = 0.0 \text{ V}, T_A = -40 ^{\circ}\text{C to } +85 ^{\circ}\text{C})$

Doromotor	Symbol		Value		Unit	Domarka
Parameter	Symbol	Min	Тур	Max	Unit	Remarks
		2.52	2.7	2.88		
Release voltage*	V _{DL+}	2.61	2.8	2.99	V	At power supply rise
Telease voltage	V DLT	2.89	3.1	3.31]	At power supply rise
		3.08	3.3	3.52		
		2.43	2.6	2.77		
Detection voltage*	V _{DL} -	2.52	2.7	2.88	V	At power supply fall
Detection voltage	V DL—	2.80	3	3.20	T *	At power supply fall
		2.99	3.2	3.41		
Hysteresis width	VHYS	_		100	mV	
Power supply start	Voff			2.3	V	
voltage	ν οπ	_		2.3	V	
Power supply end	Von	4.9			V	
voltage	v on	4.9		_	V	
Power supply voltage						Slope of power supply that the reset
change time	tr	650		_	μs	release signal generates within the
(at power supply rise)						rating (V _{DL+})
Power supply voltage						Slope of power supply that the reset
change time	tf	650		_	μs	release signal generates within the
(at power supply fall)						rating (V _{DL-})
Reset release delay	t d1			30		
time	L a1	_		30	μs	
Reset detection delay	4			30		
time	t d2	_		30	μs	
LVD reset threshold						
voltage transition	t stb	10	_	_	μs	
stabilization time						

^{*:} After the LVD reset is enabled by the LVD reset circuit control register (LVDCC), the release voltage and the detection voltage can be selected by using the LVD reset voltage selection ID register (LVDR) in the low-voltage detection reset circuit. For details of the LVDCC register and the LVDR register, refer to "CHAPTER 16 LOW-VOLTAGE DETECTION RESET CIRCUIT" in "New 8FX MB95690K Series Hardware Manual".







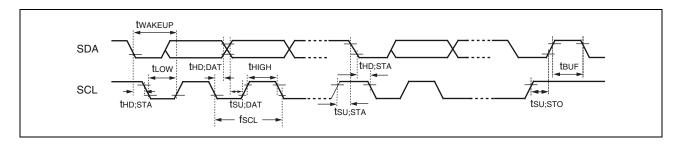
20.4.8 I2C Bus Interface Timing

 $(Vcc = 5.0 V\pm 10\%, Vss = 0.0 V, T_A = -40 °C to +85 °C)$

Parameter	Symbol	Pin name	Condition	Standard- mode		Fast-mode		Unit
				Min	Max	Min	Max	
SCL clock frequency	fscL	SCL		0	100	0	400	kHz
(Repeated) START condition hold time SDA $\downarrow \rightarrow$ SCL \downarrow	thd;sta	SCL, SDA		4.0	_	0.6	_	μs
SCL clock "L" width	tLOW	SCL		4.7	_	1.3	_	μs
SCL clock "H" width	t HIGH	SCL		4.0	_	0.6	_	μs
(Repeated) START condition setup time SCL $\uparrow \rightarrow$ SDA \downarrow	tsu;sta	SCL, SDA	R = 1.7 kΩ, C = 50 pF*1	4.7	_	0.6	_	μs
Data hold time SCL \downarrow \rightarrow SDA \downarrow \uparrow	thd;dat	SCL, SDA	00 pi	0	3.45*2	0	0.9*3	μs
Data setup time SDA $\downarrow\uparrow$ \rightarrow SCL \uparrow	tsu;dat	SCL, SDA		0.25		0.1	_	μs
STOP condition setup time SCL $\uparrow \rightarrow$ SDA \uparrow	tsu;sто	SCL, SDA		4	_	0.6	_	μs
Bus free time between STOP condition and START condition	t BUF	SCL, SDA		4.7	_	1.3	_	μs

^{*1:} R represents the pull-up resistor of the SCL and SDA lines, and C the load capacitor of the SCL and SDA lines.

^{*3:} A Fast-mode I²C-bus device can be used in a Standard-mode I²C-bus system, provided that the condition of tsu;DAT ≥ 250 ns is fulfilled.



^{*2:} The maximum thd; DAT in the Standard-mode is applicable only when the time during which the device is holding the SCL signal at "L" (tLow) does not extend.



 $(Vcc = 5.0 V\pm 10\%, Vss = 0.0 V, TA = -40 °C to +85 °C)$

D	0	Pin	0 1'4'		ue*2		
Parameter	Symbol	name	Condition	Min	Max	Unit	Remarks
SCL clock "L" width	tLOW	SCL		(2 + nm/2)tmclk - 20	_	ns	Master mode
SCL clock "H" width	t HIGH	SCL		(nm/2)tмсLк – 20	(nm/2)tмсLк + 20	ns	Master mode
START condition hold time	thd;sta	SCL, SDA		(-1 + nm/2)tмсLк – 20	(-1 + nm)tмсLк + 20	ns	Master mode Maximum value is applied when m, n = 1, 8. Otherwise, the minimum value is applied.
STOP condition setup time	t su;sto	SCL, SDA		(1 + nm/2)tмсLк – 20	(1 + nm/2)tmcLK + 20	ns	Master mode
START condition setup time	tsu;sta	SCL, SDA		(1 + nm/2)tмсLк – 20	(1 + nm/2)tmcLK + 20	ns	Master mode
Bus free time between STOP condition and START condition	t BUF	SCL, SDA	-R = 1.7 kΩ,	(2 nm + 4) tмсLк – 20	_	ns	
Data hold time	thd;dat	SCL, SDA	$C = 50 \text{ pF}^{*1}$	3 tмськ — 20	_	ns	Master mode
Data setup time	tsu;dat	SCL, SDA		(-2 + nm/2) tмсLк — 20	(-1 + nm/2) tмсLк + 20		Master mode It is assumed that "L" of SCL is not extended. The minimum value is applied to the first bit of continuous data. Otherwise, the maximum value is applied.
Setup time between clearing interrupt and SCL rising	tsu;ınt	SCL		(nm/2) tмсLк — 20	(1 + nm/2) tмсLк + 20	ns	The minimum value is applied to the interrupt at the ninth SCL↓. The maximum value is applied to the interrupt at the eighth SCL↓.
SCL clock "L" width	t LOW	SCL		4 tмськ — 20	_	ns	At reception
SCL clock "H" width	t HIGH	SCL		4 tmclk - 20	_	ns	At reception



 $(Vcc = 5.0 V\pm 10\%, Vss = 0.0 V, TA = -40 °C to +85 °C)$

Parameter	Symbol	Pin	Condition	Value* ²		Unit	Remarks						
Faranietei	Syllibol	name	Condition	Min	Max	Oilit	Remarks						
START condition detection	thd;sta	SCL, SDA		2 tмськ — 20	_	ns	No START condition is detected when 1 tmclk is used at reception.						
STOP condition detection	t su;sto	SCL, SDA		2 tмсLк — 20	I	ns	No STOP condition is detected when 1 tmclk is used at reception.						
RESTART condition detection condition	tsu;sta	SCL, SDA	R = 1.7 kΩ, C = 50 pF*1	2 tмс∟к – 20	-	ns	No RESTART condition is detected when 1 tmclk is used at reception.						
Bus free time	t BUF	SCL, SDA	-C = 50 pr	,	2 tмськ — 20	_	ns	At reception					
Data hold time	thd;dat	SCL, SDA									2 tмськ — 20	_	ns
Data setup time	tsu;dat	SCL, SDA		tLow - 3 tмсLк - 20	_	ns	At slave transmission mode						
Data hold time	thd;dat	SCL, SDA		0	_	ns	At reception						
Data setup time	tsu;dat	SCL, SDA		tмсLк — 20	_	ns	At reception						
SDA↓ → SCL↑ (with wakeup function in use)	twakeup	SCL, SDA		Oscillation stabilization wait time +2 tmclk – 20	_	ns							

^{*1:} R represents the pull-up resistor of the SCL and SDA lines, and C the load capacitor of the SCL and SDA lines.

- m represents the CS[4:3] bits in the I²C clock control register ch. 0 (ICCR0).
- n represents the CS[2:0] bits in the I²C clock control register ch. 0 (ICCR0).
- The actual timing of the I²C bus interface is determined by the values of m and n set by the machine clock (tmclk) and the CS[4:0] bits in the ICCR0 register.
- · Standard-mode:

m and n can be set to values in the following range: 0.9 MHz < tmcLk (machine clock) < 16.25 MHz.

The usable frequencies of the machine clock are determined by the settings of m and n as shown below.

 $\begin{array}{lll} \text{(m, n)} = (1, 8) & \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 1 \text{ MHz} \\ \text{(m, n)} = (1, 22), (5, 4), (6, 4), (7, 4), (8, 4) & \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 2 \text{ MHz} \\ \text{(m, n)} = (1, 38), (5, 8), (6, 8), (7, 8), (8, 8) & \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 4 \text{ MHz} \\ \text{(m, n)} = (1, 98), (5, 22), (6, 22), (7, 22) & \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 10 \text{ MHz} \\ \text{(m, n)} = (8, 22) & \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \le 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \ge 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} < \text{tmclk} \ge 16.25 \text{ MHz} \\ \text{: } 0.9 \text{ MHz} <$

· Fast-mode:

m and n can be set to values in the following range: 3.3 MHz < tmcLk (machine clock) < 16.25 MHz.

The usable frequencies of the machine clock are determined by the settings of m and n as shown below.

 $\begin{array}{lll} (m,\,n) = (1,\,8) & : 3.3 \; \text{MHz} < \text{tmclk} \le 4 \; \text{MHz} \\ (m,\,n) = (1,\,22),\,(5,\,4) & : 3.3 \; \text{MHz} < \text{tmclk} \le 8 \; \text{MHz} \\ (m,\,n) = (1,\,38),\,(6,\,4),\,(7,\,4),\,(8,\,4) & : 3.3 \; \text{MHz} < \text{tmclk} \le 10 \; \text{MHz} \\ (m,\,n) = (5,\,8) & : 3.3 \; \text{MHz} < \text{tmclk} \le 16.25 \; \text{MHz} \end{array}$

^{*2: •} See "Source Clock/Machine Clock" for tmclk.

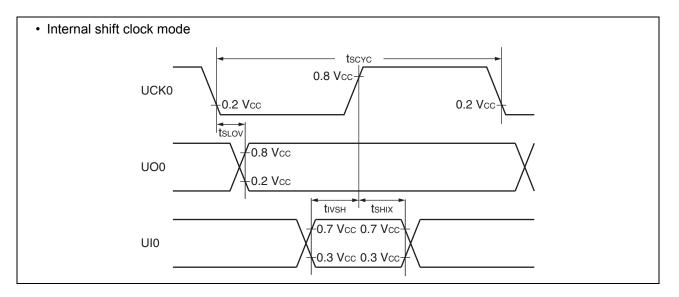


20.4.9 UART/SIO, Serial I/O Timing

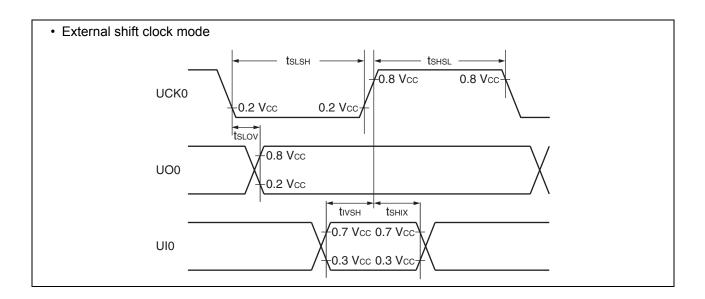
 $(V_{CC} = 5.0 \text{ V} \pm 10\%, \text{ Vss} = 0.0 \text{ V}, \text{ T}_{A} = -40 \,^{\circ}\text{C to} + 85 \,^{\circ}\text{C})$

Parameter	Symbol	Pin name	Condition	Value		Unit
raidilletei	Syllibol	Filitialile	Condition	Min	Max	Onit
Serial clock cycle time	tscyc	UCK0		4 t мськ*	_	ns
$UCK \downarrow \to UO$ time	tslov	UCK0, UO0	Internal clock operation	-190	+190	ns
Valid UI → UCK \uparrow	t ıvsh	UCK0, UI0	internal clock operation	2 t мськ*	_	ns
$UCK \uparrow \to valid \; UI \; hold \; time$	t sнıx	UCK0, UI0		2 t мськ*	_	ns
Serial clock "H" pulse width	t shsl	UCK0		4 t mclk*	_	ns
Serial clock "L" pulse width	t slsh	UCK0		4 t mclk*	_	ns
$UCK \downarrow \to UO \ time$	tslov	UCK0, UO0	External clock operation	_	190	ns
Valid UI → UCK \uparrow	t ıvsh	UCK0, UI0		2 t мськ*	_	ns
$UCK \uparrow \to valid \; UI \; hold \; time$	t sнıx	UCK0, UI0		2 tmclk*	_	ns

^{*:} See "Source Clock/Machine Clock" for tmclk.



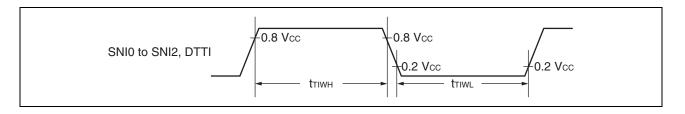




20.4.10 MPG Input Timing

 $(V_{CC} = 5.0 V \pm 10\%, V_{SS} = 0.0 V, T_{A} = -40 ^{\circ}C to +85 ^{\circ}C)$

Parameter	Symbol Pin name		rmbol Pin name Condition —		lue	Unit	Remarks
Parameter	Symbol Fill hame	Condition	Min	Max	Oilit	Keillaiks	
Input pulse width	ttiwh, ttiwl	SNI0 to SNI2, DTTI	_	4 tmclk	_	ns	





20.4.11 Comparator Timing

 $(Vcc = 2.88 \text{ V to } 5.5 \text{ V}, \text{ Vss} = 0.0 \text{ V}, \text{ TA} = -40 ^{\circ}\text{C to } +85 ^{\circ}\text{C})$

Parameter	Pin name		Value		Unit	Remarks
raiailletei	Fili liaille	Min	Тур	Max		Kemarks
Voltage range	CMP0_P, CMP0_N, CMP1_P, CMP1_N	0	_	Vcc – 1.3	V	
Offset voltage	CMP0_P, CMP0_N, CMP1_P, CMP1_N	-15		+15	mV	
Delay time	CMP0_O,		650	1200	ns	Overdrive 5 mV
Delay time	CMP1_O		140	420	ns	Overdrive 50 mV
Power down delay	CMP0_O, CMP1_O	_	_	1200	ns	Power down recovery PD: $1 \rightarrow 0$
Power up stabilization wait time	CMP0_O, CMP1_O	_	_	1200	ns	Output stabilization wait time at power up

20.4.12 BGR for Comparator

(Vcc = 2.88 V to 5.5 V, Vss = 0.0 V, TA = $-40 \,^{\circ}\text{C}$ to $+85 \,^{\circ}\text{C}$)

Parameter	Symbol	Value			Unit	Remarks	
Parameter	Syllibol	Min	Тур	Max	Oilit	Remarks	
Power up stabilization wait time	_	_	_	150	μs	Load: 10 pF	
Output voltage	VBGR	1.1495	1.21	1.2705	V		



20.5 A/D Converter

20.5.1 A/D Converter Electrical Characteristics

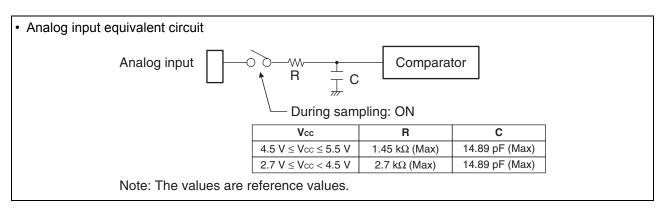
 $(Vcc = 2.7 V to 5.5 V, Vss = 0.0 V, T_A = -40 °C to +85 °C)$

Parameter	Symbol		Value		Unit	Remarks
Parameter	Symbol	Min	Тур	Max	5	Remarks
Resolution		_	_	10	bit	
Total error		-3	_	+3	LSB	
Linearity error	_	-2.5	_	+2.5	LSB	
Differential linearity error		-1.9	_	+1.9	LSB	
Zero transition voltage	Vот	Vss – 7.2 LSB	Vss + 0.5 LSB	Vss + 8.2 LSB	V	
Full-scale transition voltage	VFST	Vcc – 6.2 LSB	Vcc – 1.5 LSB	Vcc + 9.2 LSB	V	
Compare time	_	3	_	10	μs	$2.7 \text{ V} \le \text{Vcc} \le 5.5 \text{ V}$
Sampling time	_	0.941	_	∞	μs	$2.7 \text{ V} \le \text{Vcc} \le 5.5 \text{ V},$ with external impedance $< 3.3 \text{ k}\Omega$ and external capacitance = 10 pF
Analog input current	lain	-0.3	_	+0.3	μΑ	
Analog input voltage	Vain	Vss		Vcc	V	

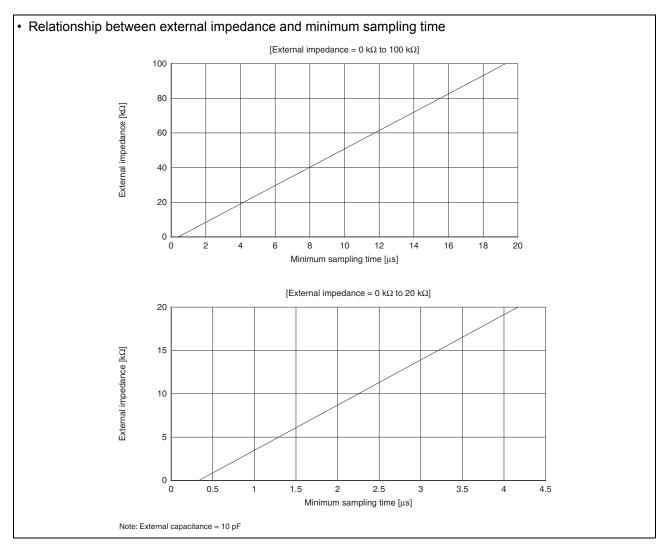
20.5.2 Notes on Using A/D Converter

External impedance of analog input and its sampling time

The A/D converter of the MB95690K Series has a sample and hold circuit. If the external impedance is too high to keep sufficient sampling time, the analog voltage charged to the capacitor of the internal sample and hold circuit is insufficient, adversely affecting A/D conversion precision. Therefore, to satisfy the A/D conversion precision standard, considering the relationship between the external impedance and minimum sampling time, either adjust the register value and operating frequency or decrease the external impedance so that the sampling time is longer than the minimum value. In addition, if sufficient sampling time cannot be secured, connect a capacitor of about 0.1 μ F to the analog input pin.







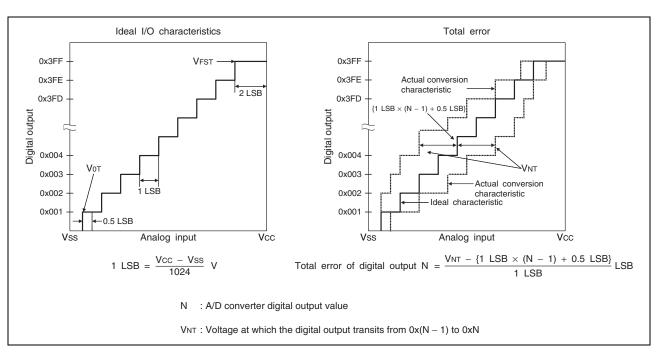
• A/D conversion error

As |Vcc - Vss| decreases, the A/D conversion error increases proportionately.

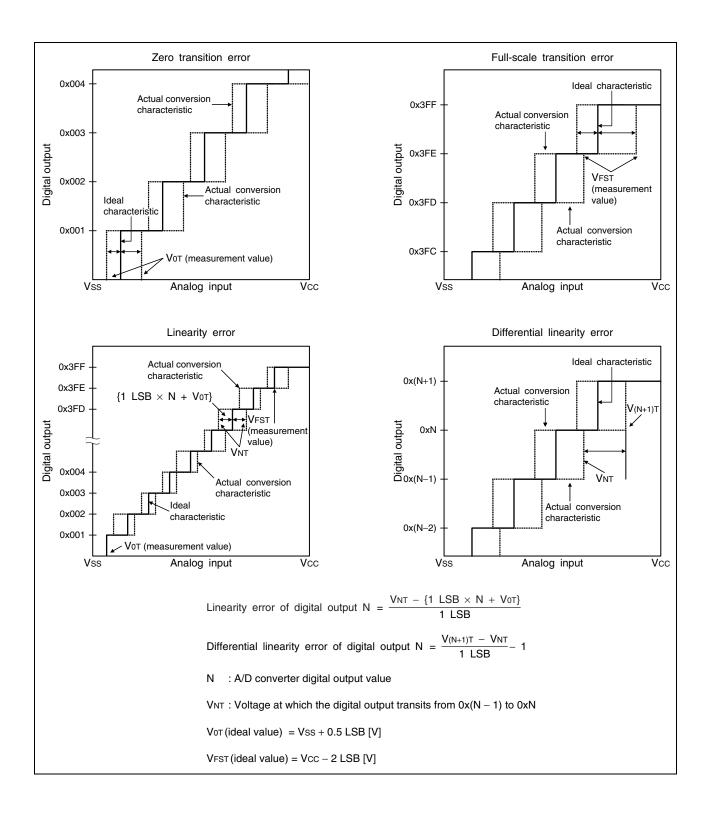


20.5.3 Definitions of A/D Converter Terms

- Resolution
 - It indicates the level of analog variation that can be distinguished by the A/D converter.
- When the number of bits is 10, analog voltage can be divided into $2^{10} = 1024$.
- Linearity error (unit: LSB)
 - It indicates how much an actual conversion value deviates from the straight line connecting the zero transition point ("000000000" $\leftarrow \rightarrow$ "0000000001") of a device to the full-scale transition point ("1111111111") of the same device.
- Differential linear error (unit: LSB)
 - It indicates how much the input voltage required to change the output code by 1 LSB deviates from an ideal value.
- · Total error (unit: LSB)
 - It indicates the difference between an actual value and a theoretical value. The error can be caused by a zero transition error, a full-scale transition errors, a linearity error, a quantum error, or noise.









20.6 Flash Memory Program/Erase Characteristics

Parameter	Value		Unit	Remarks	
Parameter	Min	Тур	Max	Unit	Remarks
Sector erase time (2 Kbyte sector)		0.3*1	1.6*2	s	The time of writing "0x00" prior to erasure is excluded.
Sector erase time (32 Kbyte sector)		0.6*1	3.1*2	s	The time of writing "0x00" prior to erasure is excluded.
Byte writing time	_	17	272	μs	System-level overhead is excluded.
Program/erase cycle	100000	_		cycle	
Power supply voltage at program/erase	2.4	_	5.5	V	
	20*3	_	_		Average T _A = +85 °C Number of program/erase cycles: 1000 or below
Flash memory data retention time	10*3	_	_	year	Average T _A = +85 °C Number of program/erase cycles: 1001 to 10000 inclusive
	5* ³	_	_		Average T _A = +85 °C Number of program/erase cycles: 10001 or above

^{*1:} Vcc = 5.5 V, IA = +25 °C, 0 cycle

^{*2:} Vcc = 2.4 V, T_A = +85 °C, 100000 cycles

^{*3:} These values were converted from the result of a technology reliability assessment. (These values were converted from the result of a high temperature accelerated test using the Arrhenius equation with the average temperature being +85 °C.)

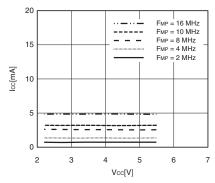


21. Sample Characteristics

Power supply current temperature characteristics

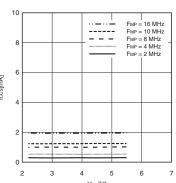
Icc - Vcc

 $T_A = +25$ °C, $F_{MP} = 2, 4, 8, 10, 16$ MHz (divided by 2) Main clock mode with the external clock operating



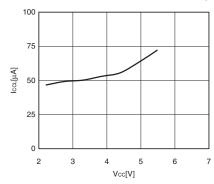
Iccs - Vcc

 $T_A = +25$ °C, $F_{MP} = 2, 4, 8, 10, 16$ MHz (divided by 2) Main sleep mode with the external clock operating



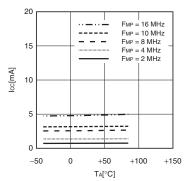
Iccl – Vcc

 $T_A = +25$ °C, $F_{MPL} = 16$ kHz (divided by 2) Subclock mode with the external clock operating



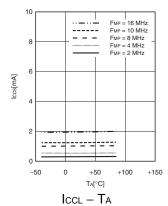
Icc - Ta

 $V_{CC} = 5.5 \text{ V}$, $F_{MP} = 2, 4, 8, 10, 16 \text{ MHz}$ (divided by 2) Main clock mode with the external clock operating

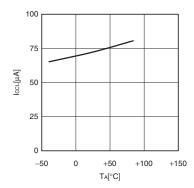


Iccs - Ta

Vcc = 5.5 V, Fmp = 2, 4, 8, 10, 16 MHz (divided by 2) Main sleep mode with the external clock operating



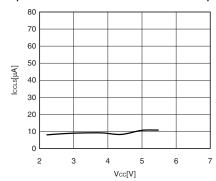
 $V_{CC} = 5.5 \text{ V}$, $F_{MPL} = 16 \text{ kHz}$ (divided by 2) Subclock mode with the external clock operating





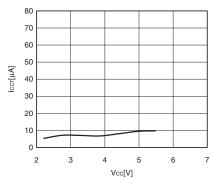


 $T_A = +25$ °C, $F_{MPL} = 16$ kHz (divided by 2) Subsleep mode with the external clock operating



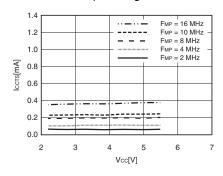
ICCT - VCC

 $T_A = +25$ °C, $F_{MPL} = 16$ kHz (divided by 2) Watch mode with the external clock operating



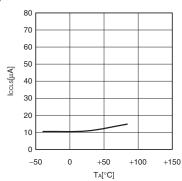
Iccts - Vcc

T_A = +25 °C, F_{MP} = 2, 4, 8, 10, 16 MHz (divided by 2) Time-base timer mode with the external clock operating



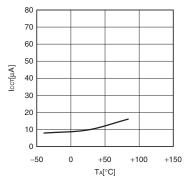
Iccls - Ta

 $V_{CC} = 5.5 \text{ V}$, $F_{MPL} = 16 \text{ kHz}$ (divided by 2) Subsleep mode with the external clock operating



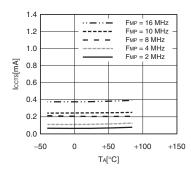
ICCT - TA

Vcc = 5.5 V, $F_{MPL} = 16 \text{ kHz}$ (divided by 2) Watch mode with the external clock operating

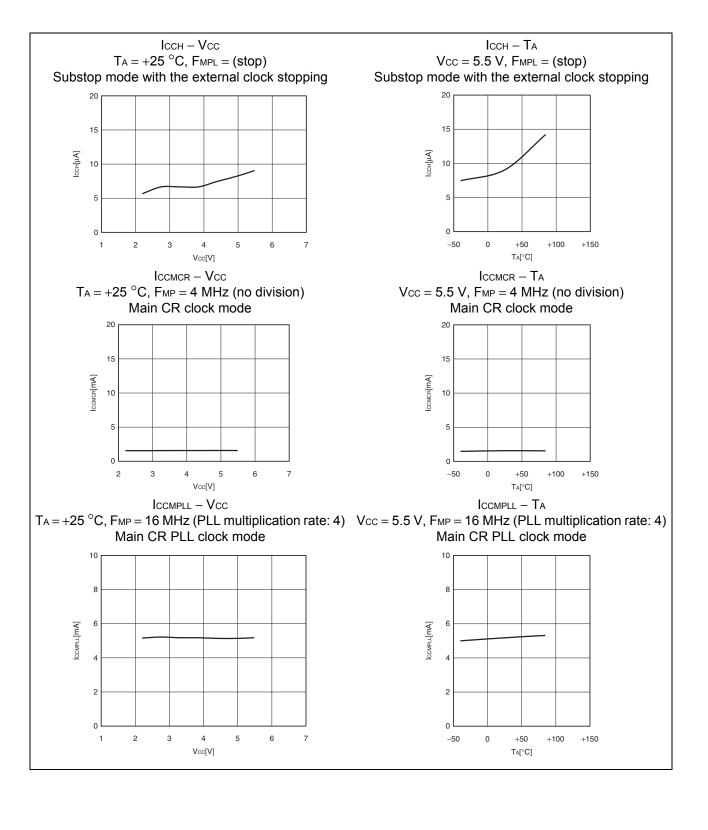


Iccts - Ta

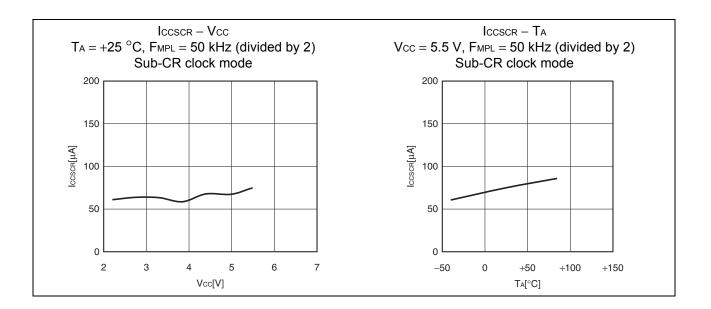
Vcc = 5.5 V, FMP = 2, 4, 8, 10, 16 MHz (divided by 2) Time-base timer mode with the external clock operating



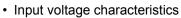


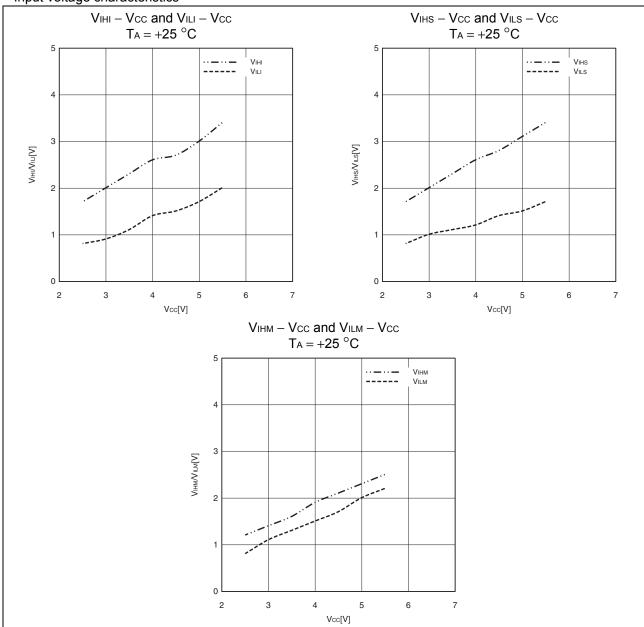






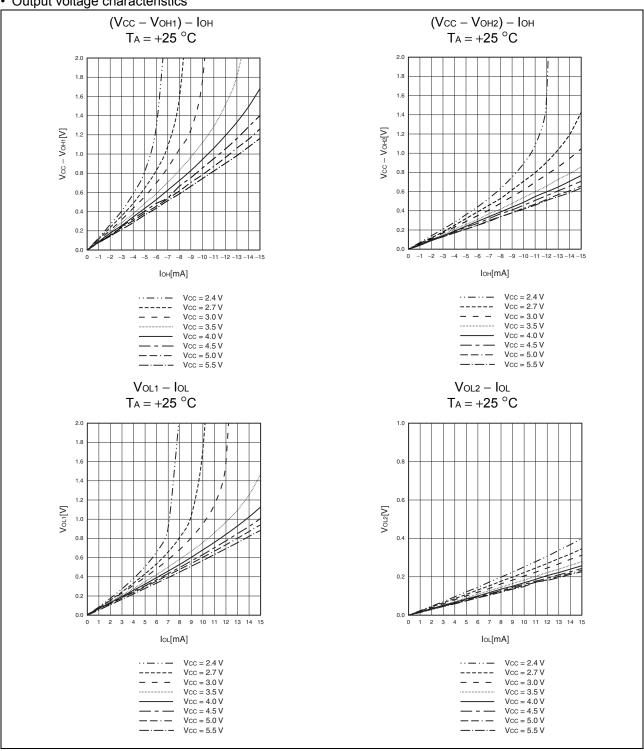




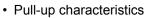


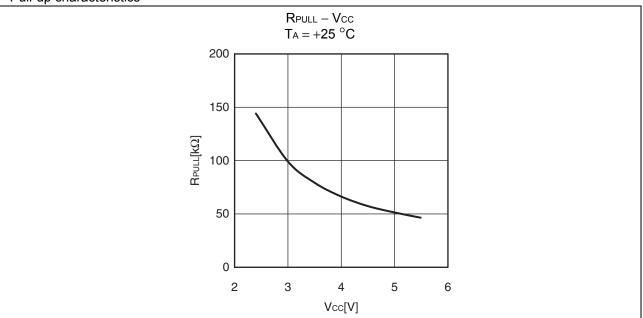


Output voltage characteristics











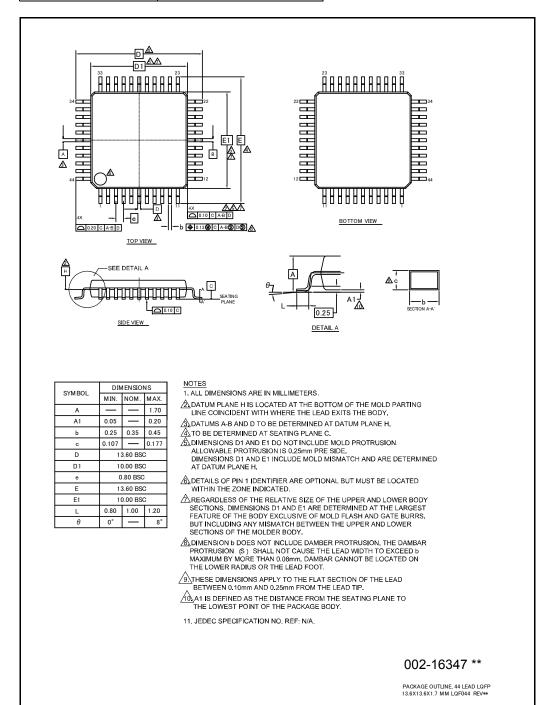
22. Ordering Information

Part number	Package	Packing
MB95F694KPMC2-G-SNE2 MB95F696KPMC2-G-SNE2 MB95F698KPMC2-G-UNE2	44-pin plastic LQFP (LQF044)	Tray
MB95F694KPMC-G-UNE2 MB95F696KPMC-G-SNE2 MB95F698KPMC-G-UNE2	48-pin plastic LQFP (LQA048)	Tray
MB95F694KPMC1-G-SNE2 MB95F696KPMC1-G-SNE2 MB95F698KPMC1-G-UNE2	52-pin plastic LQFP (LQC052)	Tray
MB95F694KWQN-G-SNE1 MB95F696KWQN-G-SNE1 MB95F698KWQN-G-SNE1	48-pin plastic QFN	Tray
MB95F694KWQN-G-SNERE1 MB95F696KWQN-G-SNERE1 MB95F698KWQN-G-SNERE1	(WNR048)	Reel



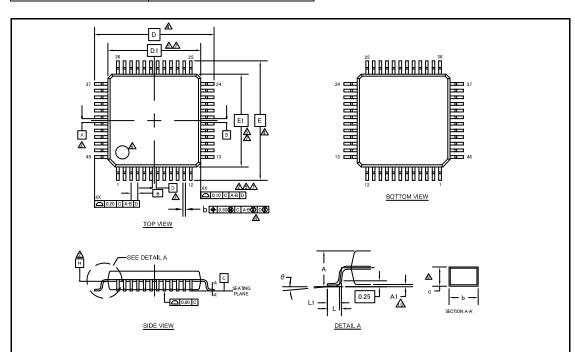
23. Package Dimension

Package Type	Package Code
LQFP 44	LQF044





Package Type	Package Code		
LQFP 48	LQA048		



SYMBOL	DIM	I EN SIOI	81		
STWIBOL	MIN. NOM.		MAX.		
Α		l	1.70		
A1	0.00		0.20		
b	0.15	l	0.27		
С	0.09	1	0.20		
D	9.00 BSC				
D1	7.00 BSC				
е	0.50 BSC				
E	9.00 BSC				
E1	7.00 BSC				
L	0.45	0.60	0.75		
L1	0.30	0.50	0.70		
θ	0°		8°		

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.

⚠ DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.

 $frac{\Delta}{\Delta}$ DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.

TO BE DETERMINED AT SEATING PLANE C.

ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE.
DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.

⚠ DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.

REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.

⚠ DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (6) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.

⚠ THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.

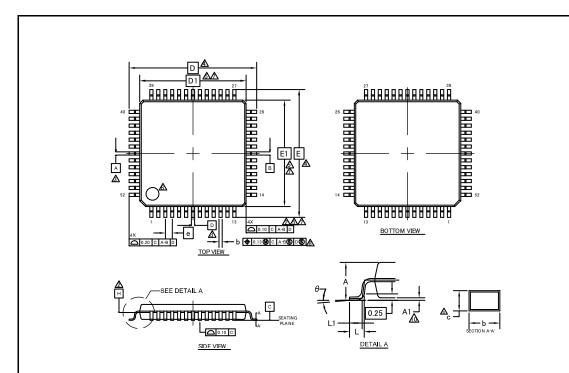
A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-13731 **

PACKAGE OUTLINE, 48 LEAD LQFP 7.0X7.0X1.7 MM LQA048 REV**



Package Type	Package Code	
LQFP 52	LQC052	



DIMENSION					
SYMBOL	DIMENSION				
STWIBOL	MIN.	NOM.	MAX.		
Α	_		1.70		
A1	0.00		0.20		
b	0.265	0.30	0.365		
С	0.09	_	0.20		
D	12.00 BSC				
D1	10.00 BSC				
е	0.65 BSC				
E	12.00 BSC				
E1	10.00 BSC				
L	0.45	0.60	0.75		
L1	0.30	0.50	0.70		
θ	0°	_	8°		

NOTES

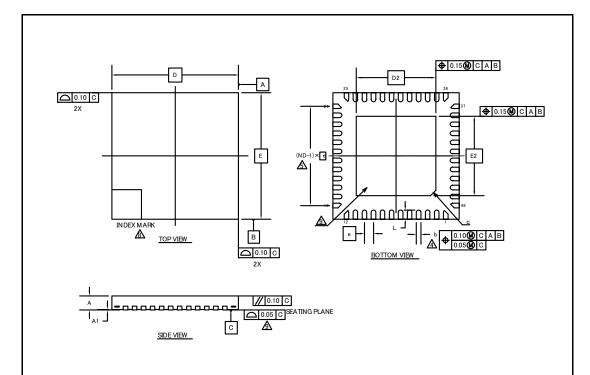
- 1. ALL DIMENSIONS ARE IN MILLIMETERS.
- ADATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
- ⚠DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
- TO BE DETERMINED AT SEATING PLANE C.
- ⚠ DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION.
 ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE.
 DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
- ⚠DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
- REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
- ⚠ DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (\$) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
- ⚠ THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
- A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

002-13880 **

PACKAGE OUTLINE, 52 LEAD LQFP 10.0X10.0X1.7 MM LQC052 REV**



Package Type	Package Code	
QFN 48	WNR048	



	DIMENSIONS				
SYMBOL	DIMENSION2				
OTHIBOL	MIN. NOM.		MAX.		
А	1	-	0.80		
Α1	0.00	1	0.05		
D	7.00 BSC				
E	7.00 BSC				
b	0.18	0.30			
D ₂	4.40 BSC				
E ₂	4.40 BSC				
е	0.50 BSC				
С	0.30 REF				
L	0.45 0.50 0.55				

NOTE

- 1. ALL DIMENSIONS ARE IN MILLIMETERS.
- 2. DIMENSIONING AND TOLERANCIN C CONFORMS TO ASME Y14.5–1994.
- 3. N IS THE TOTAL NU MBER OF TERMINALS.

⚠DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIPJE THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b"SHO ULD NOT BE MEASURED IN THAT RADIUS AREA.

⚠ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.

- 6. M AX. PACKAGE W ARPAGE IS $0.05\,\mathrm{m}\,\mathrm{m}$.
- 7. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
- ⚠PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
- ⚠BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
- 10. JEDEC SPECIFICATION NO. REF: N/A

002-15162 **

PACKAGE OUTLINE, 48 LEAD QFN
7.0X7.0X0.8 M M WNF048 4.4X4.4 M M EPAD (SAWN) REV++



24. Major Changes In This Edition

Spansion Publication Number: DS702-00014-2v0-E

Page	Section	Details	
2	■ FEATURES	Added information on FPT-44P-M25.	
4	■ PRODUCT LINE-UP	Added information on FPT-44P-M25 to the parameters "General-purpose I/O" and "8/10-bit A/D converter".	
5		Added information on FPT-44P-M25 to the parameter "External interrupt".	
6		Added FPT-44P-M25 to the parameter "Package".	
7	■ PACKAGES AND CORRESPONDING PRODUCTS	Added information on FPT-44P-M25.	
9	■ PIN ASSIGNMENT	Added the pin assignment diagram of FPT-44P-M25.	
13 to 16	■ PIN FUNCTIONS (FPT-44P-M25)	New section	
17	■ PIN FUNCTIONS (FPT-48P-M49, FPT-52P-M02, LCC-48P-M11)	Renamed the section "■ PIN FUNCTIONS" to "■ PIN FUNCTIONS (FPT-48P-M49, FPT-52P-M02, LCC-48P-M11).	
29	■ PIN CONNECTION • DBG pin	Revised details of "• DBG pin".	
	RST pin	Revised details of "• RST pin".	
30	• C pin	Corrected the following statement. The bypass capacitor for the Vcc pin must have a capacitance larger than Cs. → The decoupling capacitor for the Vcc pin must have a capacitance equal to or larger than the capacitance of Cs.	
31	■ BLOCK DIAGRAM (FPT-44P-M25)	New section	
32	■ BLOCK DIAGRAM (FPT-48P-M49, FPT-52P-M02, LCC-48P-M11)	Renamed the section "■ BLOCK DIAGRAM" to "■ BLOCK DIAGRAM (FPT-48P-M49, FPT-52P-M02, LCC-48P-M11).	
75	I/O PORTS6. Port F(4) Port F operationsOperation as an input port	Added the following statement. For a pin shared with other peripheral functions, disable the output of such peripheral functions.	
78	7. Port G(4) Port G operationsOperation as an input port	Added the following statement. For a pin shared with other peripheral functions, disable the output of such peripheral functions.	



Page	Section	Details
85	■ ELECTRICAL CHARACTERISTICS 2. Recommended Operating Conditions	Corrected the following statement in the remark of the parameter "Decoupling capacitor". The bypass capacitor for the Vcc pin must have a capacitance larger than Cs. → The decoupling capacitor for the Vcc pin must have a capacitance equal to or larger than the capacitance of Cs.
		Revised the remark in "• DBG/RST/C pins connection diagram".
86	3. DC Characteristics	Revised the remark of the parameter "Input leak current (Hi-Z output leak current)". When pull-up resistance is disabled → When the internal pull-up resistor is disabled
		Renamed the parameter "Pull-up resistance" to "Internal pull-up resistor".
		Revised the remark of the parameter "Internal pull-up resistor". When pull-up resistance is enabled → When the internal pull-up resistor is enabled
90	AC Characteristics (1) Clock Timing	Corrected the pin names of the parameter "Input clock rising time and falling time". $X0 \to X0, X0A\\ X0, X1 \to X0, X1, X0A, X1A$
125	■ ORDERING INFORMATION	Added the part numbers of FPT-44P-M25.
126	■ PACKAGE DIMENSION	Added the package diagram of FPT-44P-M25.

NOTE: Please see "Document History" about later revised information.



Document History Page

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	AKIH	06/17/2013	Migrated to Cypress and assigned document number 002-08453. No change to document contents or format.
*A	5193921	AKIH	03/29/2016	Updated to Cypress template Added MB95F698KPMC2-G-UNE2, MB95F698KPMC1-G-UNE2 in "Ordering Information".
*B	5421818	YUTT	09/01/2016	Changed package code as the following in 1.Product Line-up (Page4 to 6), 2.Packages And Corresponding Products (Page 7), 4.Pin Assignment (Page 9 to 10), 6.Pin Functions (Page16 20), 12.Block Diagram(Page30), 27.Ordering Information (Page 121) and 28.Package Dimensions (Page 77 to 83). "FPT-48P-M49" to "LQA048-02" and "FPT-52P-M02" to "LQC052" Added Part number "MB95F698KPMC-G-UNE2" in 22.Ordering Information (Page 121).
ث	5633433	HTER	02/17/2017	Changed the package codes as the following from "FPT-44P-M25" to "LQF044" from "LQA048-02" to "LQA048" from "LCC-48P-M11" to "WNR048" in chapter: Features (Page 1) 1.Product Line-up (Page 4 to 6) 2.Packages And Corresponding Products (Page 6) 4.Pin Assignment (Page 8 to 11) 5.Pin Functions (Page 12) 6.Pin Functions (Page 16, 20) 11.Block Diagram (Page 29) 12.Block Diagram (Page 30) 22.Ordering Information (Page 121) 23.Package Dimensions (Page 122 to 125). Deleted the Part numbers - MB95F698KPMC2-G-SNE2 - MB95F698KPMC1-G-SNE2 in chapter 22.Ordering Information (Page 121).
*D	5725083	AESATMP8	05/16/2017	Updated logo and Copyright
*E	5896506	HUAL	09/27/2017	Added Packing information Modified from "MB95F694KPMC-G-SNE2" to "MB95F694KPMC-G-UNE2" in 22.Ordering Information (Page 121)



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Document Number: 002-04692 Rev. *E Revised September 27, 2017 Page 129 of 129



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