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The following document contains information on Cypress products. The document has the series name, product name, and ordering part numbering with the prefix “MB”. However, Cypress will offer these products to new and existing customers with the series name, product name, and ordering part number with the prefix “CY”.

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2. Enter the keyword (for example, ordering part number) in the **SEARCH PCNS** field and click **Apply**.
3. Click the corresponding title from the search results.
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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

- F<sup>2</sup>MC-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 ±2% when the PLL multiplication rate is 2.
      - The main CR PLL clock frequency becomes 10 MHz ±2% when the PLL multiplication rate is 2.5.
      - The main CR PLL clock frequency becomes 12 MHz ±2% when the PLL multiplication rate is 3.
      - The main CR PLL clock frequency becomes 16 MHz ±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 × 2 channels
  - 8/16-bit PPG × 3 channels
  - 16-bit PPG timer × 1 channel (can work independently or together with the multi-pulse generator)
  - 16-bit reload timer × 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
- I<sup>2</sup>C 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.

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## 1. Product Line-up

Part number	MB95F694K	MB95F696K	MB95F698K
<b>Parameter</b>			
Type	Flash memory product		
Clock supervisor counter	It 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	<ul style="list-style-type: none"> <li>• Number of basic instructions : 136</li> <li>• Instruction bit length : 8 bits</li> <li>• Instruction length : 1 to 3 bytes</li> <li>• Data bit length : 1, 8 and 16 bits</li> <li>• Minimum instruction execution time : 61.5 ns (machine clock frequency = 16.25 MHz)</li> <li>• Interrupt processing time : 0.6 μs (machine clock frequency = 16.25 MHz)</li> </ul>		
General-purpose I/O	<ul style="list-style-type: none"> <li>• LQF044               <ul style="list-style-type: none"> <li>- I/O port : 41</li> <li>- CMOS I/O : 37</li> <li>- N-ch open drain : 4</li> </ul> </li> <li>• LQA048, LQC052, WNR048               <ul style="list-style-type: none"> <li>- I/O port : 45</li> <li>- CMOS I/O : 41</li> <li>- N-ch open drain : 4</li> </ul> </li> </ul>		
Time-base timer	Interval time: 0.256 ms to 8.3 s (external clock frequency = 4 MHz)		
Hardware/software watchdog timer	<ul style="list-style-type: none"> <li>• Reset generation cycle Main oscillation clock at 10 MHz: 105 ms (Min)</li> <li>• The sub-CR clock can be used as the source clock of the software watchdog timer.</li> </ul>		
Wild register	It can be used to replace 3 bytes of data.		
LIN-UART	<ul style="list-style-type: none"> <li>• A wide range of communication speed can be selected by a dedicated reload timer.</li> <li>• It has a full duplex double buffer.</li> <li>• Both clock synchronous serial data transfer and clock asynchronous serial data transfer are enabled.</li> <li>• The LIN function can be used as a LIN master or a LIN slave.</li> </ul>		
8/10-bit A/D converter	<ul style="list-style-type: none"> <li>• LQF044: 8 channels</li> <li>• LQA048, LQC052, WNR048: 12 channels</li> </ul> 8-bit or 10-bit resolution can be selected.		

Part number	MB95F694K	MB95F696K	MB95F698K
<b>Parameter</b>			
8/16-bit composite timer	2 channels <ul style="list-style-type: none"> <li>The timer can be configured as an “8-bit timer × 2 channels” or a “16-bit timer × 1 channel”.</li> <li>It has the following functions: interval timer function, PWC function, PWM function and input capture function.</li> <li>Count clock: it can be selected from internal clocks (seven types) and external clocks.</li> <li>It can output square wave.</li> </ul>		
External interrupt	<ul style="list-style-type: none"> <li>LQF044: 7 channels</li> <li>LQA048, LQC052, WNR048: 8 channels</li> <li>Interrupt by edge detection (The rising edge, falling edge, and both edges can be selected.)</li> <li>It can be used to wake up the device from different standby modes.</li> </ul>		
On-chip debug	<ul style="list-style-type: none"> <li>1-wire serial control</li> <li>It supports serial writing (asynchronous mode).</li> </ul>		
UART/SIO	1 channel <ul style="list-style-type: none"> <li>Data transfer with UART/SIO is enabled.</li> <li>It has a full duplex double buffer, variable data length (5/6/7/8 bits), an internal baud rate generator and an error detection function.</li> <li>It uses the NRZ type transfer format.</li> <li>LSB-first data transfer and MSB-first data transfer are available to use.</li> <li>Both clock asynchronous (UART) serial data transfer and clock synchronous (SIO) serial data transfer are enabled.</li> </ul>		
I <sup>2</sup> C bus interface	1 channel <ul style="list-style-type: none"> <li>Master/slave transmission and reception</li> <li>It has the following functions: bus error function, arbitration function, transmission direction detection function, wake-up function, and functions of generating and detecting repeated START conditions.</li> </ul>		
8/16-bit PPG	3 channels <ul style="list-style-type: none"> <li>Each channel can be used as an “8-bit timer × 2 channels” or a “16-bit timer × 1 channel”.</li> <li>The counter operating clock can be selected from eight clock sources.</li> </ul>		
16-bit PPG timer	1 channel <ul style="list-style-type: none"> <li>PWM mode and one-shot mode are available to use.</li> <li>The counter operating clock can be selected from eight clock sources.</li> <li>It supports external trigger start.</li> <li>It can work independently or together with the multi-pulse generator.</li> </ul>		
16-bit reload timer	1 channel <ul style="list-style-type: none"> <li>Two clock modes and two counter operating modes are available to use.</li> <li>It can output square wave.</li> <li>Count clock: it can be selected from internal clocks (seven types) and external clocks.</li> <li>Two counter operating modes: reload mode and one-shot mode</li> <li>It can work independently or together with the multi-pulse generator.</li> </ul>		
Multi-pulse generator (for DC motor control)	<ul style="list-style-type: none"> <li>16-bit PPG timer: 1 channel</li> <li>16-bit reload timer operations: toggle output, one-shot output</li> <li>Event counter: 1 channel</li> <li>Waveform sequencer (including a 16-bit timer equipped with a buffer and a compare clear function)</li> </ul>		

Part number	MB95F694K	MB95F696K	MB95F698K	
Parameter				
Watch prescaler	Eight different time intervals can be selected.			
Comparator	2 channels			
	The reference voltage of each channel can be selected between the BGR voltage and the comparator pin.			
Flash memory	<ul style="list-style-type: none"> <li>It supports automatic programming (Embedded Algorithm), and program/erase/erase-suspend/erase-resume commands.</li> <li>It has a flag indicating the completion of the operation of Embedded Algorithm.</li> <li>Flash security feature for protecting the content of the Flash memory</li> </ul>			
	Number of program/erase cycles	1000	10000	100000
	Data retention time	20 years	10 years	5 years
Standby mode	<p>There are four standby modes as follows:</p> <ul style="list-style-type: none"> <li>Stop mode</li> <li>Sleep mode</li> <li>Watch mode</li> <li>Time-base timer mode</li> </ul> <p>In standby mode, two further options can be selected: normal standby mode and deep standby mode.</p>			
Package	LQF044 LQA048 LQC052 WNR048			

## 2. Packages And Corresponding Products

Part number	MB95F694K	MB95F696K	MB95F698K
Package			
LQF044	O	O	O
LQA048	O	O	O
LQC052	O	O	O
WNR048	O	O	O

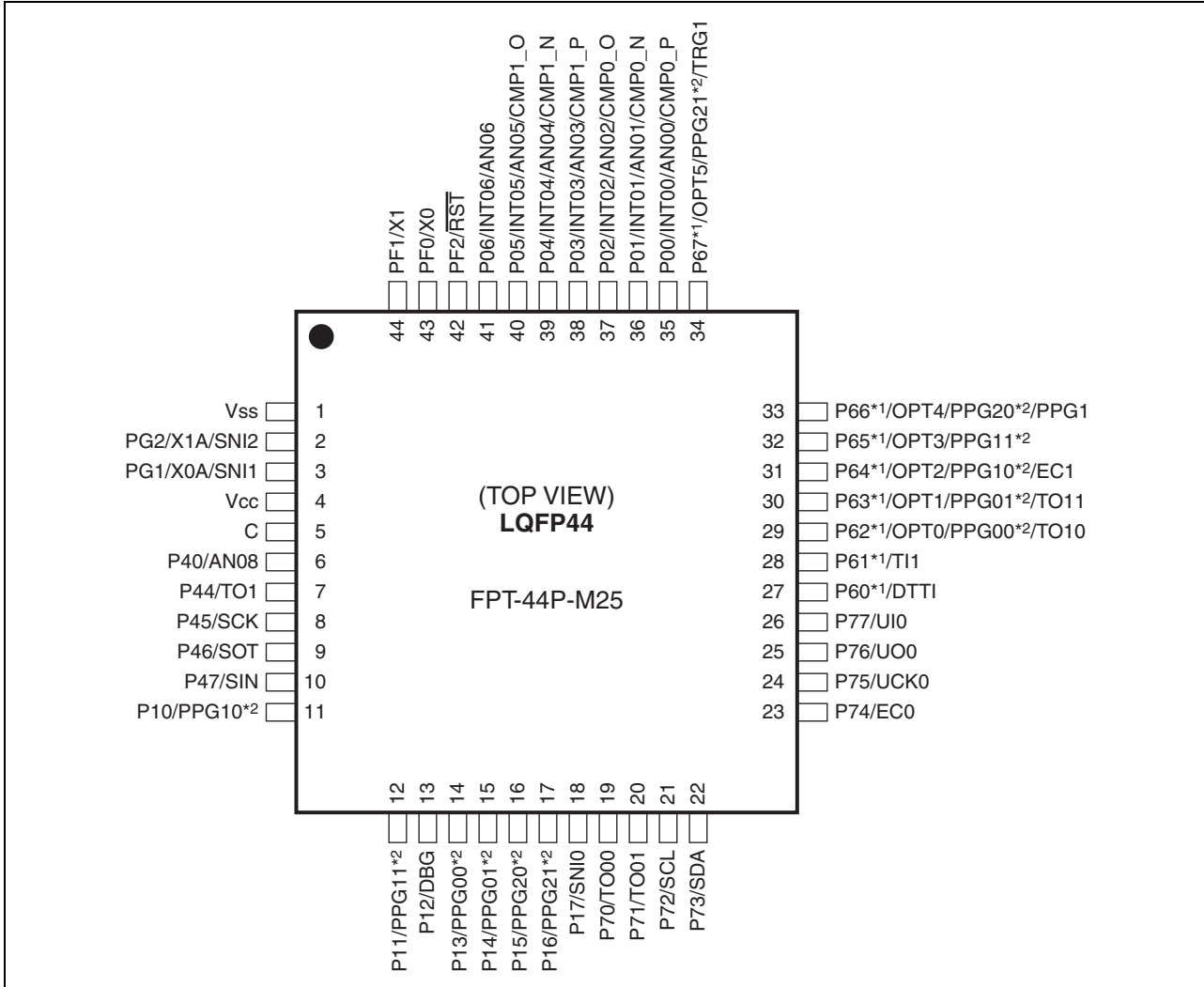
O: Available



### 3. Differences Among Products And Notes On Product Selection

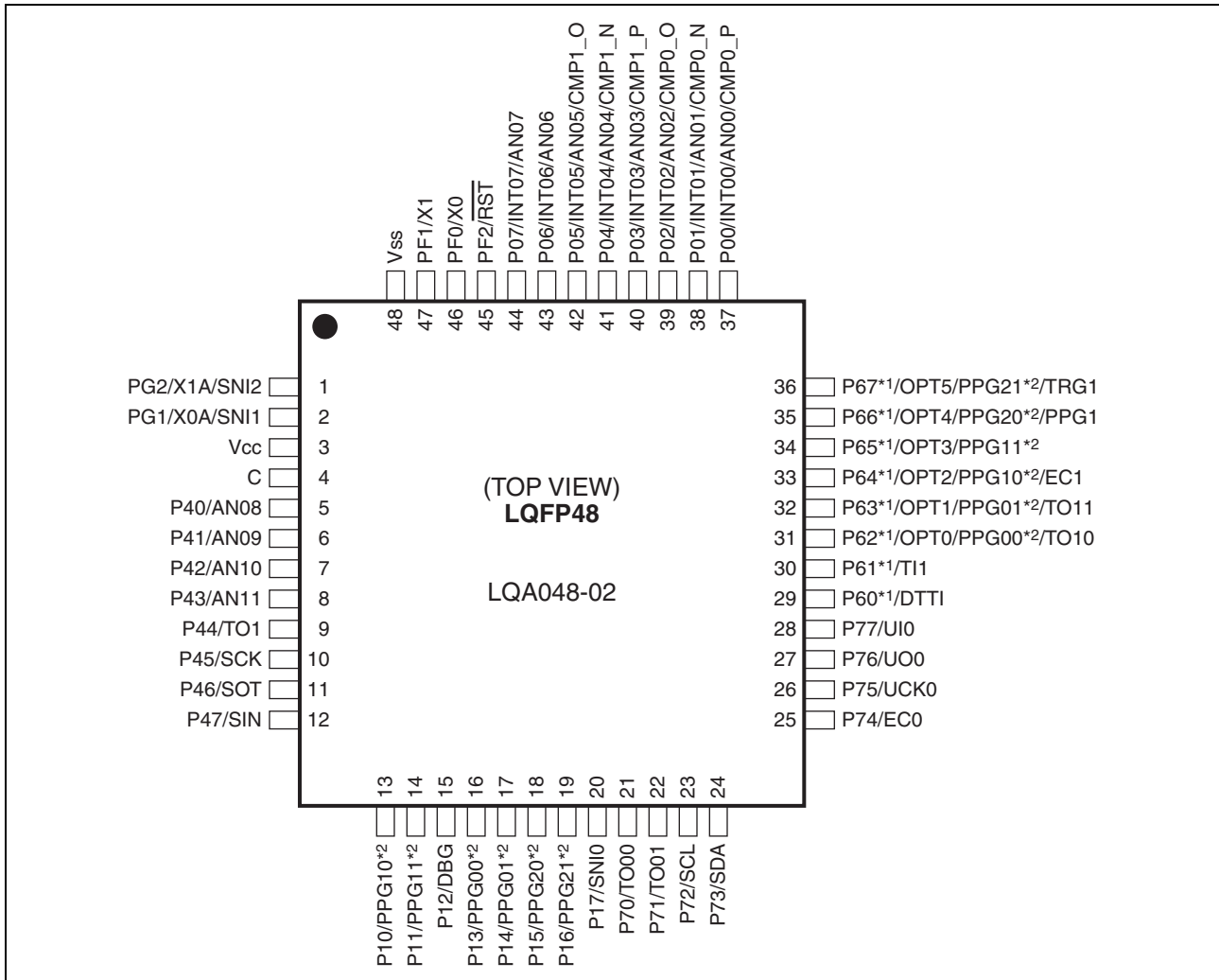
- Current consumption  
When using the on-chip debug function, take account of the current consumption of Flash memory program/erase.  
For details of current consumption, see “Electrical Characteristics”.
- Package  
For details of information on each package, see “Packages And Corresponding Products” 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  $V_{CC}$ ,  $V_{SS}$  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”.

### 4. Pin Assignment



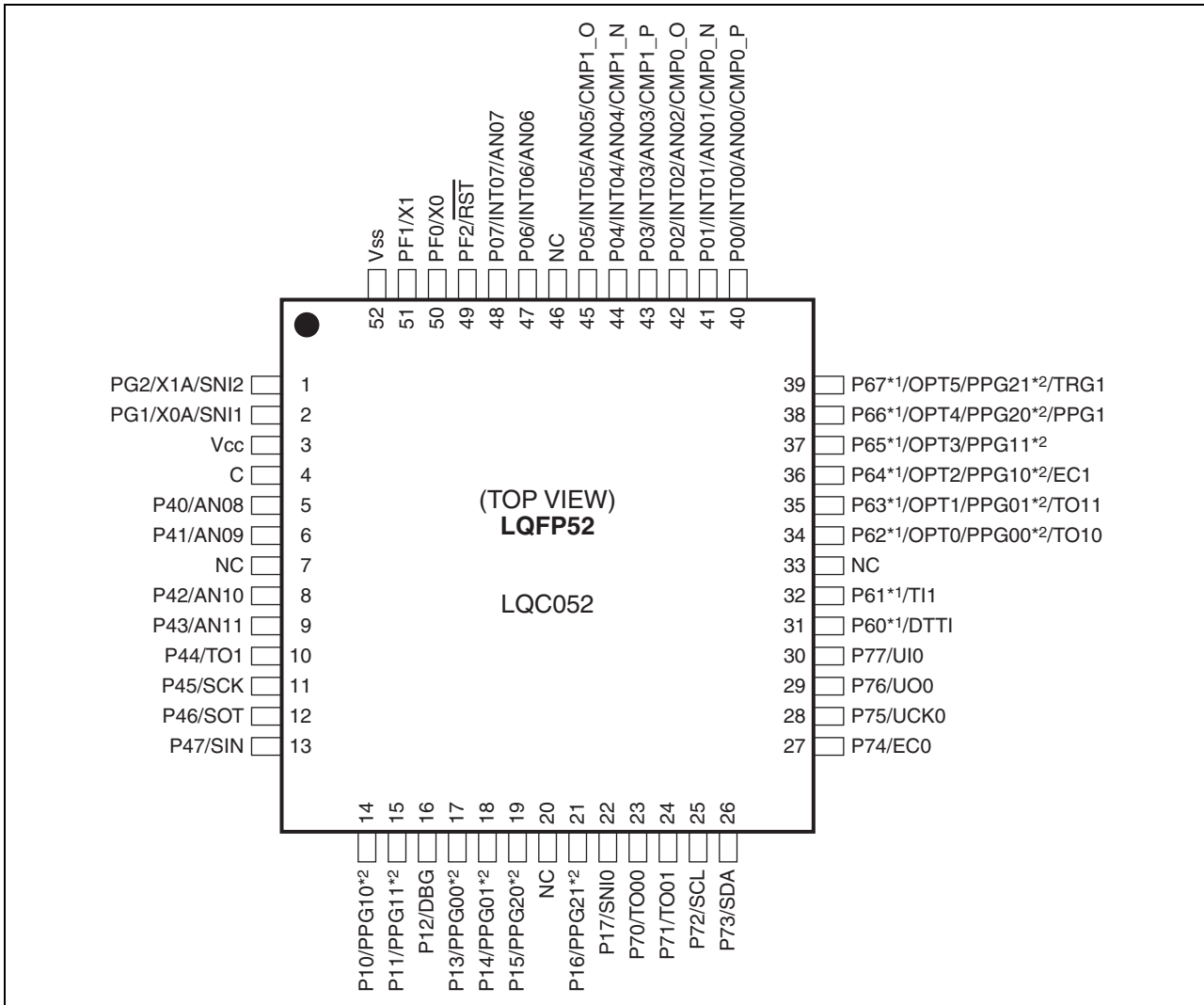
\*1: High-current pin (8 mA/12 mA)

\*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.



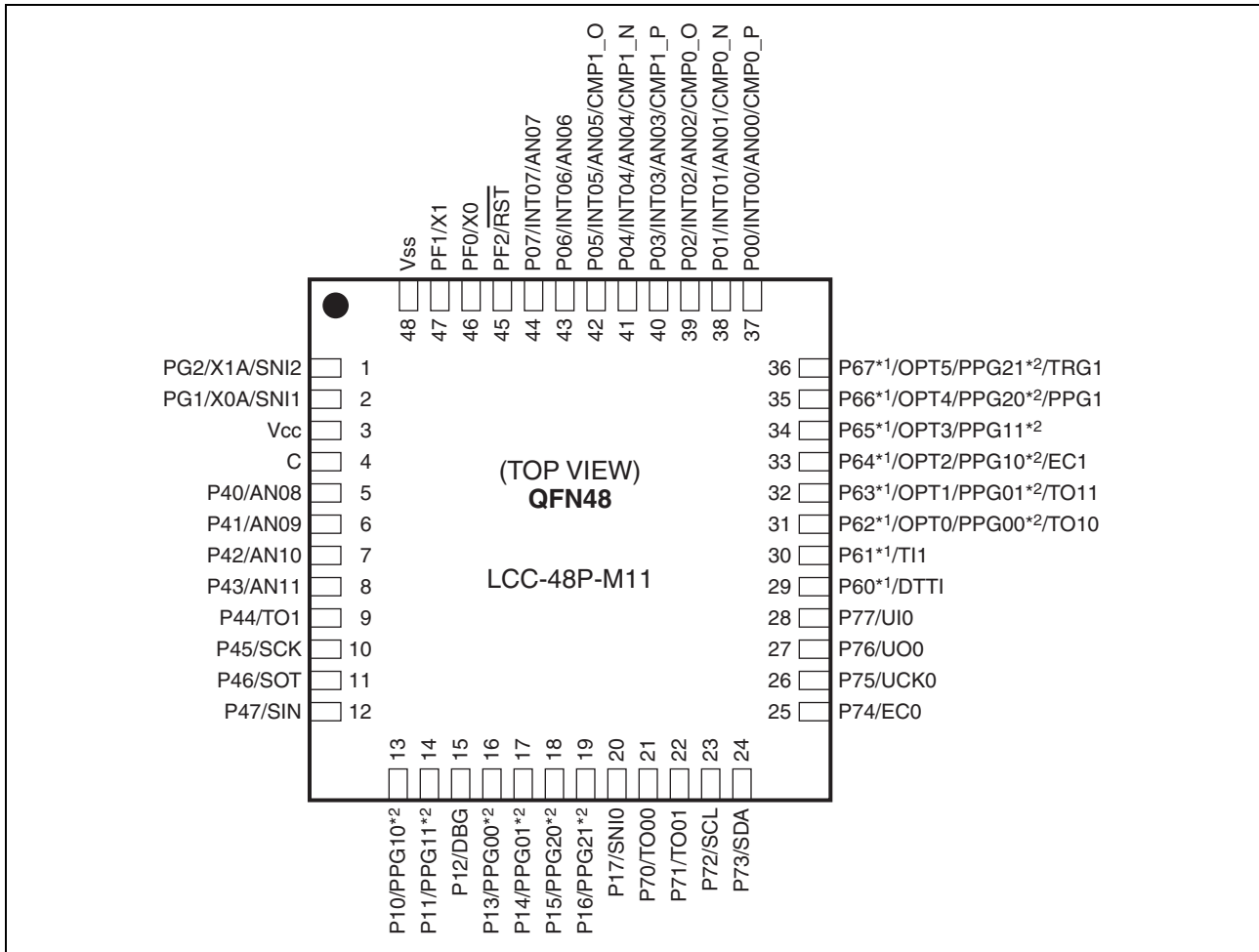
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**5. Pin Functions (LQF044)**

Pin no.	Pin name	I/O circuit type*1	Function	I/O type			
				Input	Output	OD*2	PU*3
1	Vss	—	Power supply pin (GND)	—	—	—	—
2	PG2	C	General-purpose I/O port	Hysteresis	CMOS	—	O
	X1A		Subclock I/O oscillation pin				
	SNI2		Trigger input pin for the position detection function of the MPG waveform sequencer				
3	PG1	C	General-purpose I/O port	Hysteresis	CMOS	—	O
	X0A		Subclock input oscillation pin				
	SNI1		Trigger input pin for the position detection function of the MPG waveform sequencer				
4	Vcc	—	Power supply pin	—	—	—	—
5	C	—	Decoupling capacitor connection pin	—	—	—	—
6	P40	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
	AN08		8/10-bit A/D converter analog input pin				
7	P44	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	TO1		16-bit reload timer ch. 1 output pin				
8	P45	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	SCK		LIN-UART clock I/O pin				
9	P46	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	SOT		LIN-UART data output pin				
10	P47	I	General-purpose I/O port	CMOS	CMOS	—	O
	SIN		LIN-UART data input pin				
11	P10	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG10		8/16-bit PPG ch. 1 output pin				
12	P11	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG11		8/16-bit PPG ch. 1 output pin				
13	P12	G	General-purpose I/O port	Hysteresis	CMOS	O	—
	DBG		DBG input pin				
14	P13	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG00		8/16-bit PPG ch. 0 output pin				
15	P14	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG01		8/16-bit PPG ch. 0 output pin				
16	P15	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG20		8/16-bit PPG ch. 2 output pin				
17	P16	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	PPG21		8/16-bit PPG ch. 2 output pin				

Pin no.	Pin name	I/O circuit type*1	Function	I/O type			
				Input	Output	OD*2	PU*3
18	P17	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	SNIO		Trigger input pin for the position detection function of the MPG waveform sequencer				
19	P70	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	TO00		8/16-bit composite timer ch. 0 output pin				
20	P71	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	TO01		8/16-bit composite timer ch. 0 output pin				
21	P72	H	General-purpose I/O port	CMOS	CMOS	O	—
	SCL		I <sup>2</sup> C bus interface ch. 0 clock I/O pin				
22	P73	H	General-purpose I/O port	CMOS	CMOS	O	—
	SDA		I <sup>2</sup> C bus interface ch. 0 data I/O pin				
23	P74	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	EC0		8/16-bit composite timer ch. 0 clock input pin				
24	P75	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	UCK0		UART/SIO ch. 0 clock I/O pin				
25	P76	F	General-purpose I/O port	Hysteresis	CMOS	—	O
	UO0		UART/SIO ch. 0 data output pin				
26	P77	I	General-purpose I/O port	Hysteresis	CMOS	—	O
	UI0		UART/SIO ch. 0 data input pin				
27	P60	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	DTTI		MPG waveform sequencer input pin				
28	P61	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	TI1		16-bit reload timer ch. 1 input pin				
29	P62	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT0		MPG waveform sequencer output pin				
	PPG00		8/16-bit PPG ch. 0 output pin				
	TO10		8/16-bit composite timer ch. 1 output pin				
30	P63	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT1		MPG waveform sequencer output pin				
	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 circuit type*1	Function	I/O type			
				Input	Output	OD*2	PU*3
31	P64	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT2		MPG waveform sequencer output pin				
	PPG10		8/16-bit PPG ch. 1 output pin				
	EC1		8/16-bit composite timer ch. 1 clock input pin				
32	P65	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT3		MPG waveform sequencer output pin				
	PPG11		8/16-bit PPG ch. 1 output pin				
33	P66	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT4		MPG waveform sequencer output pin				
	PPG20		8/16-bit PPG ch. 2 output pin				
	PPG1		16-bit PPG timer ch. 1 output pin				
34	P67	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
	OPT5		MPG waveform sequencer output pin				
	PPG21		8/16-bit PPG ch. 2 output pin				
	TRG1		16-bit PPG timer ch. 1 trigger input pin				
35	P00	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
	INT00		External interrupt input pin				
	AN00		8/10-bit A/D converter analog input pin				
	CMP0_P		Comparator ch. 0 non-inverting analog input (positive input) pin				
36	P01	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
	INT01		External interrupt input pin				
	AN01		8/10-bit A/D converter analog input pin				
	CMP0_N		Comparator ch. 0 inverting analog input (negative input) pin				
37	P02	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
	INT02		External interrupt input pin				
	AN02		8/10-bit A/D converter analog input pin				
	CMP0_O		Comparator ch. 0 digital output pin				
38	P03	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
	INT03		External interrupt input pin				
	AN03		8/10-bit A/D converter analog input pin				
	CMP1_P		Comparator ch. 1 non-inverting analog input (positive input) pin				



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

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.		Pin name	I/O circuit type*4	Function	I/O type			
LQFP48*1, QFN48*2	LQFP52*3				Input	Output	OD*5	PU*6
1	1	PG2	C	General-purpose I/O port	Hysteresis	CMOS	—	O
		X1A		Subclock I/O oscillation pin				
		SNI2		Trigger input pin for the position detection function of the MPG waveform sequencer				
2	2	PG1	C	General-purpose I/O port	Hysteresis	CMOS	—	O
		X0A		Subclock input oscillation pin				
		SNI1		Trigger input pin for the position detection function of the MPG waveform sequencer				
3	3	Vcc	—	Power supply pin	—	—	—	—
4	4	C	—	Decoupling capacitor connection pin	—	—	—	—
5	5	P40	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		AN08		8/10-bit A/D converter analog input pin				
6	6	P41	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		AN09		8/10-bit A/D converter analog input pin				
—	7	NC	—	It is an internally connected pin. Always leave it unconnected.	—	—	—	—
7	8	P42	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		AN10		8/10-bit A/D converter analog input pin				
8	9	P43	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		AN11		8/10-bit A/D converter analog input pin				
9	10	P44	F	General-purpose I/O port	Hysteresis	CMOS	—	O
		TO1		16-bit reload timer ch. 1 output pin				
10	11	P45	F	General-purpose I/O port	Hysteresis	CMOS	—	O
		SCK		LIN-UART clock I/O pin				
11	12	P46	F	General-purpose I/O port	Hysteresis	CMOS	—	O
		SOT		LIN-UART data output pin				
12	13	P47	I	General-purpose I/O port	CMOS	CMOS	—	O
		SIN		LIN-UART data input pin				
13	14	P10	F	General-purpose I/O port	Hysteresis	CMOS	—	O
		PPG10		8/16-bit PPG ch. 1 output pin				

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

Pin no.		Pin name	I/O circuit type*4	Function	I/O type			
LQFP48*1, QFN48*2	LQFP52*3				Input	Output	OD*5	PU*6
28	30	P77	I	General-purpose I/O port	Hysteresis	CMOS	—	O
		UI0		UART/SIO ch. 0 data input pin				
29	31	P60	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		DTTI		MPG waveform sequencer input pin				
30	32	P61	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		TI1		16-bit reload timer ch. 1 input pin				
—	33	NC	—	It is an internally connected pin. Always leave it unconnected.	—	—	—	—
31	34	P62	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT0		MPG waveform sequencer output pin				
		PPG00		8/16-bit PPG ch. 0 output pin				
		TO10		8/16-bit composite timer ch. 1 output pin				
32	35	P63	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT1		MPG waveform sequencer output pin				
		PPG01		8/16-bit PPG ch. 0 output pin				
		TO11		8/16-bit composite timer ch. 1 output pin				
33	36	P64	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT2		MPG waveform sequencer output pin				
		PPG10		8/16-bit PPG ch. 1 output pin				
		EC1		8/16-bit composite timer ch. 1 clock input pin				
34	37	P65	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT3		MPG waveform sequencer output pin				
		PPG11		8/16-bit PPG ch. 1 output pin				

Pin no.		Pin name	I/O circuit type*4	Function	I/O type			
LQFP48*1, QFN48*2	LQFP52*3				Input	Output	OD*5	PU*6
35	38	P66	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT4		MPG waveform sequencer output pin				
		PPG20		8/16-bit PPG ch. 2 output pin				
		PPG1		16-bit PPG timer ch. 1 output pin				
36	39	P67	D	General-purpose I/O port High-current pin	Hysteresis	CMOS	—	O
		OPT5		MPG waveform sequencer output pin				
		PPG21		8/16-bit PPG ch. 2 output pin				
		TRG1		16-bit PPG timer ch. 1 trigger input pin				
37	40	P00	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		INT00		External interrupt input pin				
		AN00		8/10-bit A/D converter analog input pin				
		CMP0_P		Comparator ch. 0 non-inverting analog input (positive input) pin				
38	41	P01	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		INT01		External interrupt input pin				
		AN01		8/10-bit A/D converter analog input pin				
		CMP0_N		Comparator ch. 0 inverting analog input (negative input) pin				
39	42	P02	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		INT02		External interrupt input pin				
		AN02		8/10-bit A/D converter analog input pin				
		CMP0_O		Comparator ch. 0 digital output pin				
40	43	P03	E	General-purpose I/O port	Hysteresis/ analog	CMOS	—	O
		INT03		External interrupt input pin				
		AN03		8/10-bit A/D converter analog input pin				
		CMP1_P		Comparator ch. 1 non-inverting analog input (positive input) pin				

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

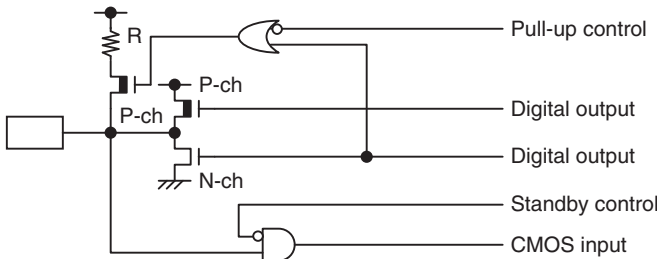
\*6: Pull-up

7. I/O Circuit Type

Type	Circuit	Remarks
A		<ul style="list-style-type: none"> <li>• N-ch open drain output</li> <li>• Hysteresis input</li> <li>• Reset output</li> </ul>
B		<ul style="list-style-type: none"> <li>• Oscillation circuit</li> <li>• High-speed side</li> <li>Feedback resistance: approx. 1 MΩ</li> <li>• CMOS output</li> <li>• Hysteresis input</li> </ul>
C		<ul style="list-style-type: none"> <li>• Oscillation circuit</li> <li>• Low-speed side</li> <li>Feedback resistance: approx. 5 MΩ</li> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Pull-up control</li> </ul>

Type	Circuit	Remarks
D		<ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Pull-up control</li> <li>• High current output</li> </ul>
E		<ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Pull-up control</li> <li>• Analog input</li> </ul>
F		<ul style="list-style-type: none"> <li>• CMOS output</li> <li>• Hysteresis input</li> <li>• Pull-up control</li> </ul>
G		<ul style="list-style-type: none"> <li>• N-ch open drain output</li> <li>• Hysteresis input</li> </ul>
H		<ul style="list-style-type: none"> <li>• N-ch open drain output</li> <li>• CMOS input</li> </ul>



Type	Circuit	Remarks
I		<ul style="list-style-type: none"> <li>• CMOS output</li> <li>• CMOS input</li> <li>• Pull-up control</li> </ul>

## 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.