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FM0+ S6E1C Series Microcontroller Datasheet

40 MHz ARM Cortex-M0+ MCU with 35 µA/CoreMark Score

The FM0+ family of Flexible Microcontrollers is the industry's most energy-efficient 32-bit ARM® Cortex®-M0+ based MCUs. This family of MCUs is designed for ultra-low-power and cost-sensitive applications such as white goods, sensors, meters, HMI systems, power tools and Internet of Things (IoT) battery-powered or wearable devices.

This family of ultra-low-power MCUs features an industry-leading 35 µA/CoreMark® score and 40µA/MHz Active Power consumption.

The S6E1C Series is a series of highly integrated 32-bit microcontrollers designed for embedded controllers aiming at low power consumption and low cost. This series has the ARM Cortex-M0+ Processor with on-chip Flash memory and SRAM, and consists of peripheral functions such as various timers, ADC and communication interfaces (UART, CSIO (SPI), I^2C, I^2S, Smart Card, and USB). The products which are described in this data sheet are placed into TYPE3-M0+ product categories in "FM0+ Family Peripheral Manual".

Features

Ultra Low Power MCU Subsystem

- 40 MHz ARM Cortex-M0+ CPU with 1.65 V to 3.6 V operating voltage
- Maximum operating frequency: 40.8 MHz
- Nested Vectored Interrupt Controller (NVIC): 1 non-maskable interrupt (NMI) and 24 peripheral interrupt with 4 selectable interrupt priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management
- Up to 128 KB Flash, 16 KB SRAM
- Descriptor System Transfer Controller (DSTC)
- Industry's most efficient 35 µA/CoreMark Score
- Ultra-low-power consumption: Active – 40 µA/MHz and Standby – 0.6 µA
- Fast wake-up from standby mode (execute from Flash): 20 µs (Typ)

Digital Subsystem

- Up to 8x Base Timers
- 1x Dual Timer, 1x Watch Counter
- Up to 6x Multi-Function Serial (MFS) interfaces configurable as SPI, UART, I^2C
- 1x USB, 1x I^2S, up to 2x HDMI-CEC, up to 1x Smart Card interfaces

Analog Subsystem

- 1x 12-bit, 1-Msps ADCs with an 8-channel multiplexer input
- 1% high precision internal oscillator

Package Options

- 32-/48-/64-pin LQFP
- 32-/48-/64-pin QFN

Low-Power Consumption Modes

- This series has six low-power consumption modes:
  - Sleep
  - Timer
  - RTC
  - Stop
  - Deep standby RTC (selectable between keeping the value of RAM and not)
  - Deep standby Stop (selectable between keeping the value of RAM and not)

Ecosystem for Cypress FM0+ MCUs

Cypress provides a wealth of data at www.cypress.com to help you to select the right MCU for your design, and to help you to quickly and effectively integrate the device into your design. Following is an abbreviated list for FM0+ MCUs:

- Overview: Product Portfolio, Product Roadmap
- Product Selectors: FM0+ MCUs
- Application notes: Cypress offers a large number of FM0+ application notes covering a broad range of topics, from basic to advanced level. Recommended application notes for getting started with FM0+ family of MCUs are:
  - AN210985 – FM0+ Getting Started with FM0+ Development: AN210985 introduces you to the FM0+ family of 32-bit general-purpose microcontrollers. The FM0+ family is based on the ARM® Cortex®-M0+ processor core, ideal for ultra-low-power designs. This note provides an overview of hardware features and capabilities, firmware development, and the multitude of technical resources available to you. This application note uses the FM0+ S6E1B8-Series Starter Kit as an example.
  - AN203277 - FM 32-Bit Microcontroller Family Hardware Design Considerations: This application note reviews several topics for designing a hardware system around FM0+, FM3, and FM4 family MCUs. Subjects include power system, reset, crystal, and other pin connections, and programming and debugging interfaces.
  - AN205535 - FM0+ S6E100X Power Meter Demo Board : This document covers the S6E100X power meter demo board solution and configuration. At the same time, the AN also provides source code for secondary development.
  - AN205411 – FM0+ IEC60730 Class B Self-Test Library : This document covers how to use and implement the library functions provided. It will first show the requirement of IEC60730 Class B, and then explain how it can be implemented. At last an example is given to show how to integrate test functions into a real system.
  - AN202487 - Differences Among FM0+, FM3, and FM4 32-Bit Microcontrollers: Highlights the peripheral differences in Cypress's FM family MCUs. It provides dedicated sections for each peripheral and contains lists, tables, and descriptions of peripheral feature and register differences.
  - AN204438 - How to Setup Flash Security for FM0+, FM3 and FM4 Families: This application note describes how to setup the Flash Security for FM0+, FM**3**, and FM4 devices
- Development kits:
  - FM0-V48-S6E1A1 ARM® Cortex®-M0+ FM0+ MCU Evaluation Board
  - FM0-100L-S6E1B8 - ARM® Cortex®-M0+ MCU Starter Kit with USB and SD Card Interface
  - FM0-64L-S6E1C3 - ARM® Cortex®-M0+ MCU Starter Kit with USB and Digital Audio Interface
- Peripheral Manuals

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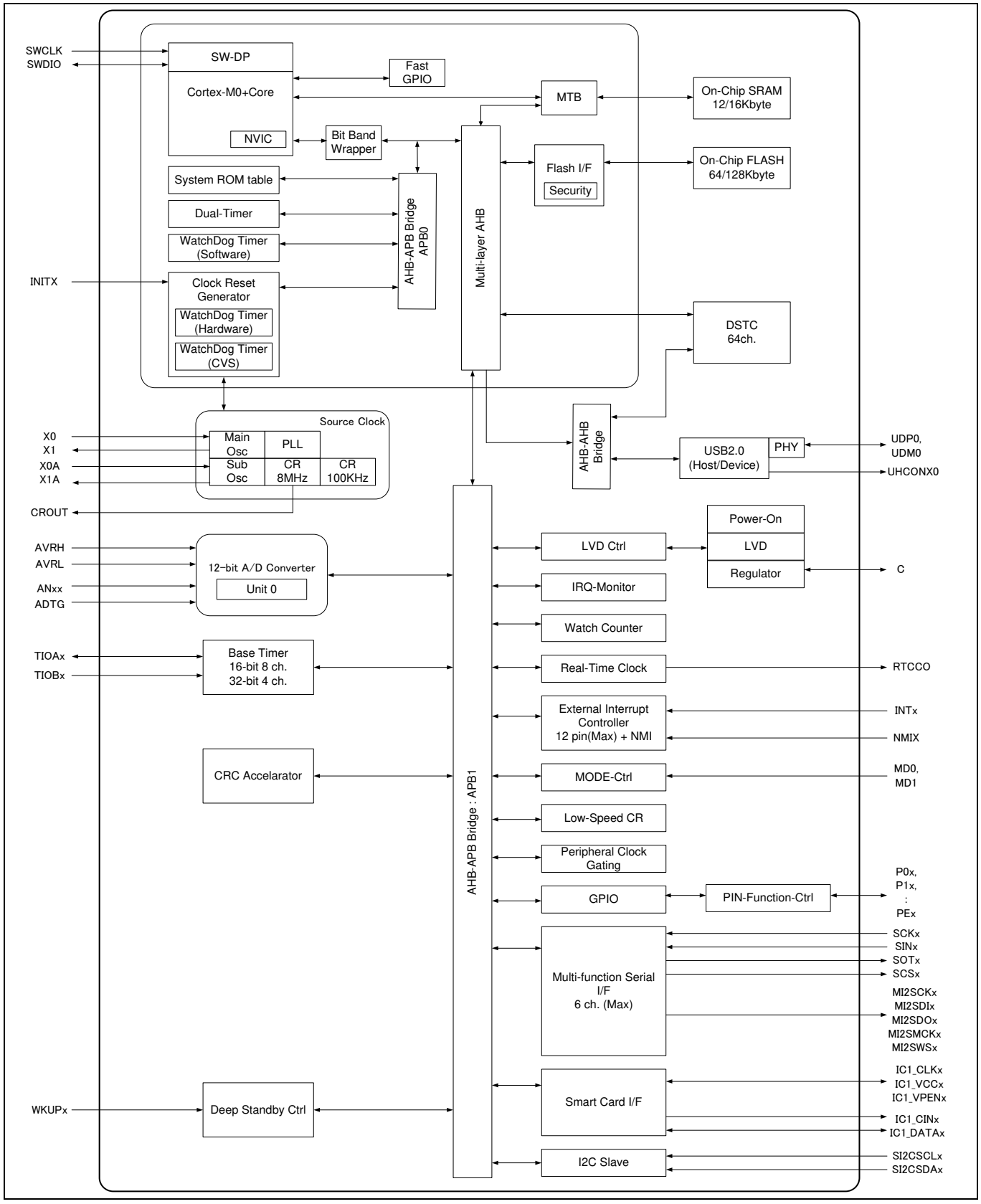
1. Block Diagram



2. Product Lineup

Memory Size

Product name	S6E1C11 S6E1C31	S6E1C12 S6E1C32
On-chip Flash memory	64 Kbytes	128 Kbytes
On-chip SRAM	12 Kbytes	16 Kbytes

Function

Function Name		S6E1C1	S6E1C3
CPU		Cortex-M0+	
	Frequency	40.8 MHz	
Power supply voltage range		1.65 V to 3.6 V	
USB2.0 (Device/Host)			1 unit
DSTC		64 ch.	
Base Timer (PWC/Reload timer/PWM/PPG)		8 ch. (Max)	
Dual Timer		1 unit	
Real-time Clock		1 unit	
Watch Counter		1 unit	
CRC Accelerator		Yes	
Watchdog timer		1 ch. (SW) + 1 ch. (HW)	
CSV (Clock Supervisor)		Yes	
LVD (Low-voltage Detection)		2 ch.	
Built-in CR	High-speed	8 MHz (Typ)	
	Low-speed	100 kHz (Typ)	
Debug Function		SW-DP	
Unique ID		Yes	

Note:

- *Because of package pin limitations, not all functions within the device can be brought out to external pins. You must carefully work out the pin allocation needed for your design.*
  You must use the port relocate function of the I/O port according to your function use.
- *See "11. Electrical Characteristics 11.4 AC Characteristics 11.4.3 Built-in CR Oscillation Characteristics" for accuracy of built-in CR.*

2.1 Package Dependent Features

Feature	Package		
	32 LQFP 32 QFN	**48 LQFP 48 QFN**	**64 LQFP 64 QFN**
Pin count	32	48	64
Multi-function Serial Interface (UART/CSIO/I^2C/I^2S)	4 ch. (Max) Ch.0/1/3 without FIFO Ch. 6 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO
	I^2S: No	I^2S: 1 ch (Max) Ch. 6 with FIFO	I^2S: 2 ch (Max) Ch. 4/6 with FIFO
External Interrupt	7 pins (Max), NMI x 1	9 pins (Max), NMI x 1	12 pins (Max), NMI x 1
I/O port	24 pins (Max)	38 pins (Max)	54 pins (Max)
12-bit A/D converter	6 ch. (1 unit)	8 ch. (1 unit)	8 ch. (1 unit)
I^2C Slave	No		1 ch (Max)
Smart Card Interface	No		1 ch (Max)
HDMI-CEC/ Remote Control Receiver	1 ch.(Max) Ch.1	2 ch (Max) Ch.0/1	

2.2 Packages

Package \ Package Suffix	B0A	C0A	D0A
LQFP: LQB032 (0.80 mm pitch)	❍	-	-
QFN: WNU032 (0.50 mm pitch)	❍	-	-
LQFP: LQA048-02 (0.50 mm pitch)	-	❍	-
QFN: WNY048 (0.50 mm pitch)	-	❍	-
LQFP: LQD064-02 (0.50 mm pitch)	-	-	❍
QFN: WNS064 (0.50 mm pitch)	-	-	❍

❍: Available

Note:

- *See "14. Package Dimensions" for detailed information on each package.*

3. Product Features in Detail

32-bit ARM Cortex-M0+ Core

- Maximum operating frequency: 40.8 MHz
- Nested Vectored Interrupt Controller (NVIC): 1 NMI (non-maskable interrupt) and 24 peripheral interrupt with 4 selectable interrupt priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management

Bit Band Operation

Compatible with Cortex-M3 bit band operation.

On-Chip Memory

- Flash memory
  - Up to 128 Kbytes
  - Read cycle: 0 wait-cycle
  - Security function for code protection
- SRAM

The on-chip SRAM of this series has one independent SRAM.

  - Up to 16 Kbytes
  - 4Kbytes: can retain value in Deep standby Mode

USB Interface

USB interface is composed of Device and Host
With Main PLL, USB clock can be generated by multiplication of Main clock.

- USB Device
  - USB 2.0 Full-Speed supported
  - Max 6 EndPoint supported
    - EndPoint 0 is control transfer
    - EndPoint 1, 2 can be selected Bulk-transfer, Interrupt-transfer or Isochronous-transfer
    - EndPoint 3 to 5 can select Bulk-transfer or Interrupt-transfer
    - EndPoint 1 to 5 comprise Double Buffer
    - The size of each EndPoint is according to the follows
    - EndPoint 0, 2 to 5 : 64 bytes
    - EndPoint 1 : 256 bytes
- USB host
  - USB 2.0 Full/Low-Speed supported
  - Bulk-transfer, Interrupt-transfer and Isochronous-transfer support
  - USB Device connected/disconnected automatically detect
  - IN/OUT token handshake packet automatically
  - Max 256-byte packet-length supported
  - Wake-up function supported

Multi-Function Serial Interface (Max 6channels)

- 3 channels with 64Byte FIFO (Ch.4, 6 and 7), 3 channels without FIFO (Ch.0, 1 and 3)
- The operation mode of each channel can be selected from one of the following.
  - UART
  - CSIO (CSIO is known to many customers as SPI)
  - I^2C
- UART
  - Full duplex double buffer
  - Parity can be enabled or disabled.
  - Built-in dedicated baud rate generator
  - External clock available as a serial clock
  - Hardware Flow control* : Automatically control the transmission by CTS/RTS (only ch.4)
    * : S6E1C32B0A/S6E1C31B0A and S6E1C32C0A/S6E1C31C0A do not support Hardware Flow control.
  - Various error detection functions (parity errors, framing errors, and overrun errors)
- CSIO (also known as SPI)
  - Full duplex double buffer
  - Built-in dedicated baud rate generator
  - Overrun error detection function
  - Serial chip select function (ch1 and ch6 only)
  - Data length: 5 to 16 bits
- I^2C
  - Standard-mode (Max: 100 kbps) supported / Fast-mode (Max 400 kbps) supported.
- I^2S (MFS-I2S)
  - Using CSIO (Max 2 ch: ch.4, ch.6) and I^2S clock generator
  - Supports two transfer protocol
    - I^2S
    - MSB-justified
  - Master mode only

I^2C Slave

- I^2C Slave supports the slave function of I2C and wake-up function from Standby mode.

Descriptor System Data Transfer Controller (DSTC) (64 Channels)

- The DSTC can transfer data at high-speed without going via the CPU. The DSTC adopts the Descriptor system and, following the specified contents of the Descriptor that has already been constructed on the memory, can access directly the memory / peripheral device and performs the data transfer operation.
- It supports the software activation, the hardware activation, and the chain activation functions

A/D Converter (Max: 8 Channels)

- 12-bit A/D Converter
  - Successive approximation type
  - Conversion time: 2.0 µs @ 2.7 V to 3.6 V
  - Priority conversion available (2 levels of priority)
  - Scan conversion mode
  - Built-in FIFO for conversion data storage (for scan conversion: 16 steps, for priority conversion: 4 steps)

Base Timer (Max: 8 Channels)

The operation mode of each channel can be selected from one of the following.

- 16-bit PWM timer
- 16-bit PPG timer
- 16/32-bit reload timer
- 16/32-bit PWC timer

General-Purpose I/O Port

This series can use its pin as a general-purpose I/O port when it is not used for an external bus or a peripheral function. All ports can be set to fast general-purpose I/O ports or slow general-purpose I/O ports. In addition, this series has a port relocate function that can set to which I/O port a peripheral function can be allocated.

- All ports are Fast GPIO which can be accessed by 1cycle
- Capable of controlling the pull-up of each pin
- Capable of reading pin level directly
- Port relocate function
- Up to 54 fast general-purpose I/O ports @64-pin package
- Certain ports are 5 V tolerant.
  See 5.List of Pin Functions and 6.I/O Circuit Typefor the corresponding pins.

Dual Timer (32-/16-bit Down Counter)

The Dual Timer consists of two programmable 32-/16-bit down counters. The operation mode of each timer channel can be selected from one of the following.

- Free-running mode
- Periodic mode (= Reload mode)
- One-shot mode

Real-Time Clock

The Real-time Clock counts year/month/day/hour/minute/second/day of the week from year 00 to year 99.

- The RTC can generate an interrupt at a specific time (year/month/day/hour/minute/second/day of the week) and can also generate an interrupt in a specific year, in a specific month, on a specific day, at a specific hour or at a specific minute.
- It has a timer interrupt function generating an interrupt upon a specific time or at specific intervals.
- It can keep counting while rewriting the time.
- It can count leap years automatically.

Watch Counter

The Watch Counter wakes up the microcontroller from the low power consumption mode. The clock source can be selected from the main clock, the sub clock, the built-in high-speed CR clock or the built-in low-speed CR clock.

Interval timer: up to 64 s (sub clock: 32.768 kHz)

External Interrupt Controller Unit

- Up to 12 external interrupt input pins
- Non-maskable interrupt (NMI) input pin: 1

Watchdog Timer (2 Channels)

The watchdog timer generates an interrupt or a reset when the counter reaches a time-out value.

This series consists of two different watchdogs, hardware watchdog and software watchdog.

The hardware watchdog timer is clocked by the built-in low-speed CR oscillator. Therefore, the hardware watchdog is active in any low-power consumption modes except RTC, Stop, Deep standby RTC and Deep standby Stop mode.

CRC (Cyclic Redundancy Check) Accelerator

The CRC accelerator calculates the CRC which has a heavy software processing load, and achieves a reduction of the integrity check processing load for reception data and storage.

- CCITT CRC16 and IEEE-802.3 CRC32 are supported.
  - CCITT CRC16 Generator Polynomial: 0x1021
  - IEEE-802.3 CRC32 Generator Polynomial: 0x04C11DB7

HDMI-CEC/Remote Control Receiver (Up to 2 Channels)

- HDMI-CEC transmitter
  - Header block automatic transmission by judging Signal free
  - Generating status interrupt by detecting Arbitration lost
  - Generating START, EOM, ACK automatically to output CEC transmission by setting 1 byte data
  - Generating transmission status interrupt when transmitting 1 block (1 byte data and EOM/ACK)
- HDMI-CEC receiver
  - Automatic ACK reply function available
  - Line error detection function available
- Remote control receiver
  - 4 bytes reception buffer
  - Repeat code detection function available

Smart Card Interface (Max 1 Channel)

- Compliant with ISO7816-3 specification
- Card Reader only/B class card only
- Available protocols
  - Transmitter: 8E2, 8O2, 8N2
  - Receiver: 8E1, 8O1, 8N2, 8N1, 9N1
  - Inverse mode
- TX/RX FIFO integrated (RX: 16-bytes, TX:16-bytes)

Clock and Reset

■Clocks
A clock can be selected from five clock sources (two external oscillators, two built-in CR oscillator, and main PLL).

- Main clock: 8 MHz to 48 MHz
- Sub clock: 32.768 kHz
- Built-in high-speed CR clock: 8 MHz
- Built-in low-speed CR clock: 100 kHz
- Main PLL clock 8MHz to 16MHz (Input), 75MHz to 150MHz (Output)

■Resets

- Reset request from the INITX pin
- Power on reset
- Software reset
- Watchdog timer reset
- Low-voltage detection reset
- Clock supervisor reset

Clock Supervisor (CSV)

The Clock Supervisor monitors the failure of external clocks with a clock generated by a built-in CR oscillator.

■If an external clock failure (clock stop) is detected, a reset is asserted.

■If an external frequency anomaly is detected, an interrupt or a reset is asserted.

Low-Voltage Detector (LVD)

This series monitors the voltage on the VCC pin with a 2-stage mechanism. When the voltage falls below a designated voltage, the Low-voltage Detector generates an interrupt or a reset.

■LVD1: monitor V_{CC} and error reporting via an interrupt

■LVD2: auto-reset operation

Low Power Consumption Mode

This series has six low power consumption modes.

■Sleep

■Timer

■RTC

■Stop

■Deep standby RTC (selectable between keeping the value of RAM and not)

■Deep standby Stop (selectable between keeping the value of RAM and not)

Peripheral Clock Gating

The system can reduce the current consumption of the total system with gating the operation clocks of peripheral functions not used.

Debug

■Serial Wire Debug Port (SW-DP)

■Micro Trace Buffer (MTB)

Unique ID

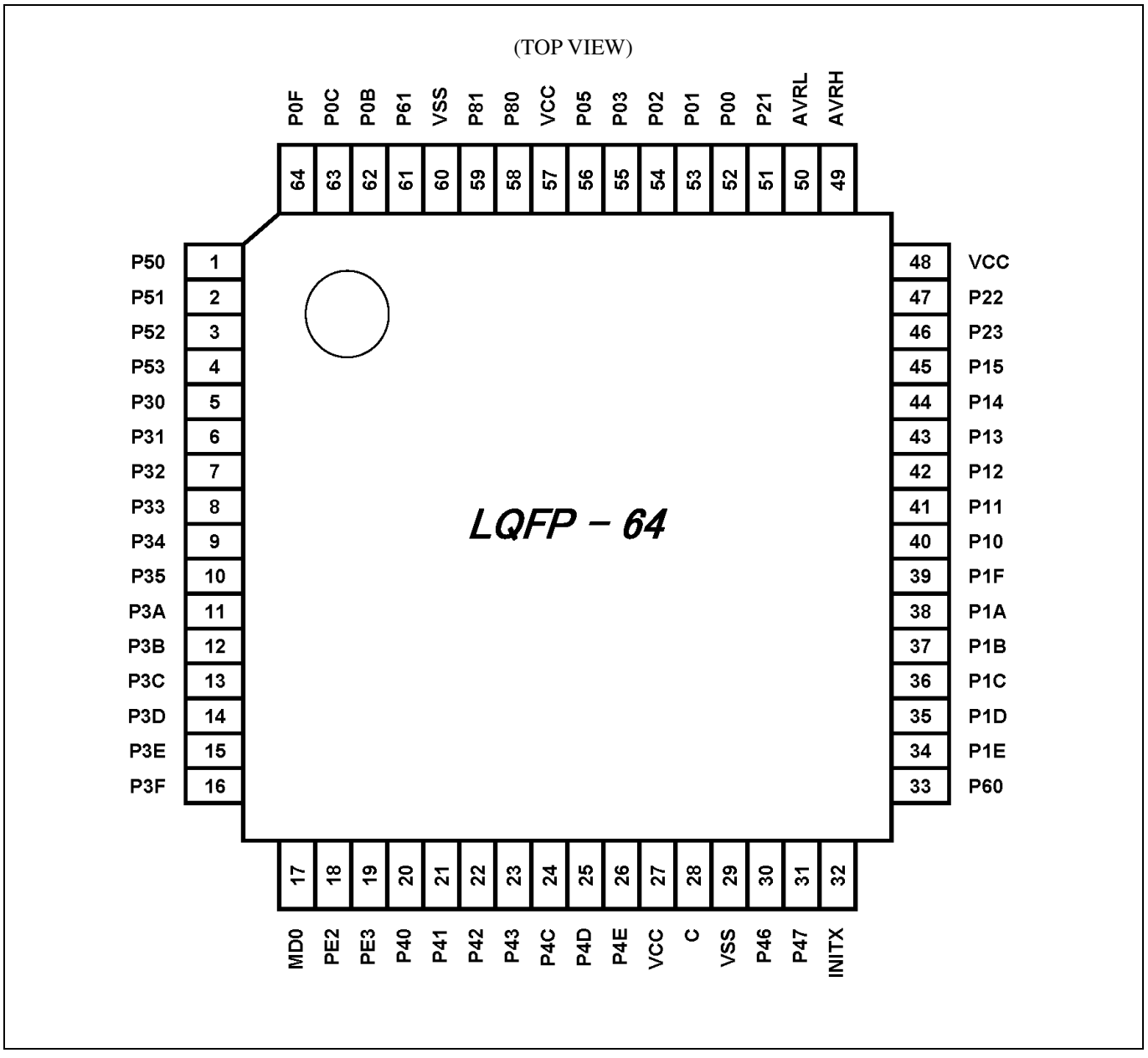
A 41-bit unique value of the device has been set.

Power Supply

■Wide voltage range:
VCC = 1.65V to 3.6 V
VCC = 3.0V to 3.6V (when USB is used)

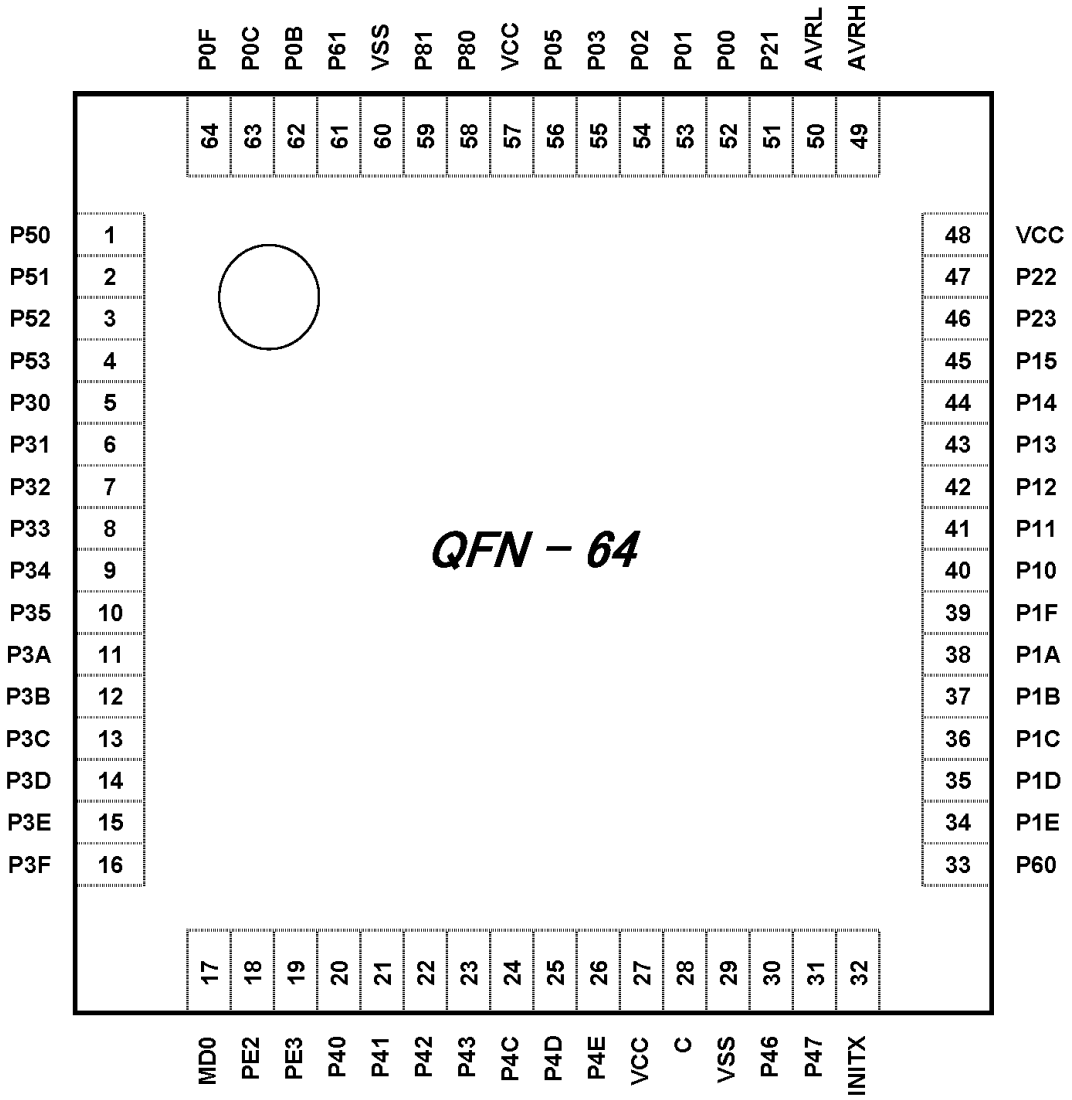
4. Pin Assignment

LQD064-02



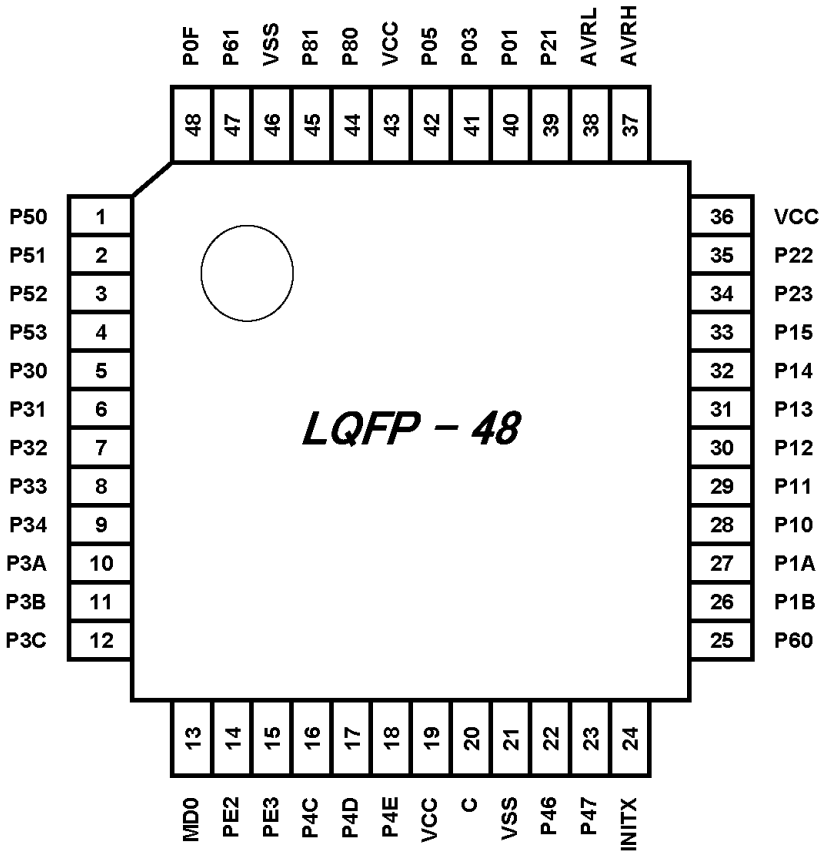
WNS064

(TOP VIEW)



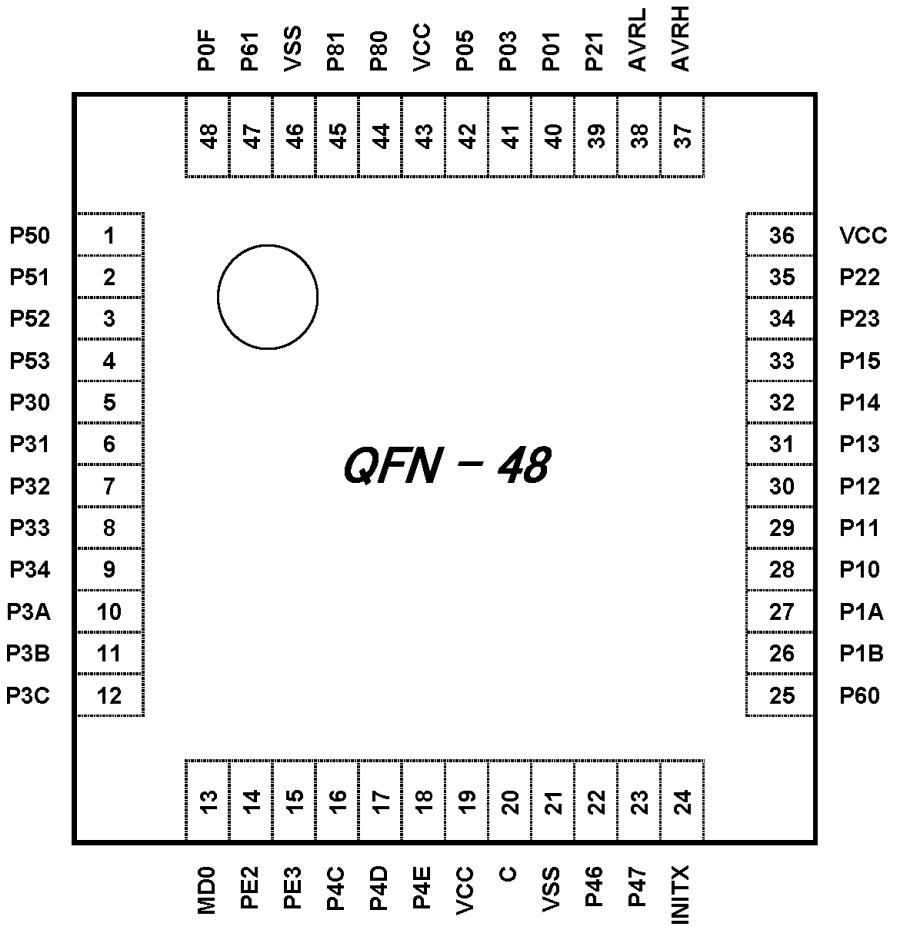
LQA048-02

(TOP VIEW)



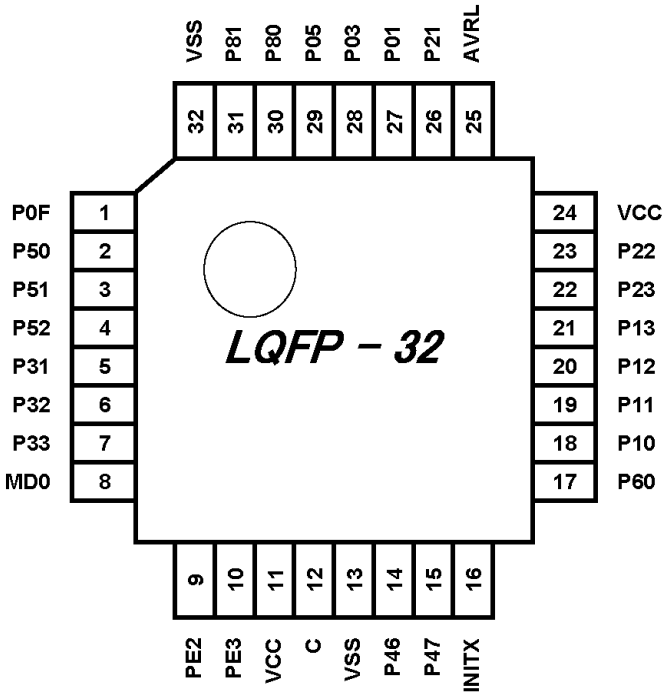
WNY048

(TOP VIEW)



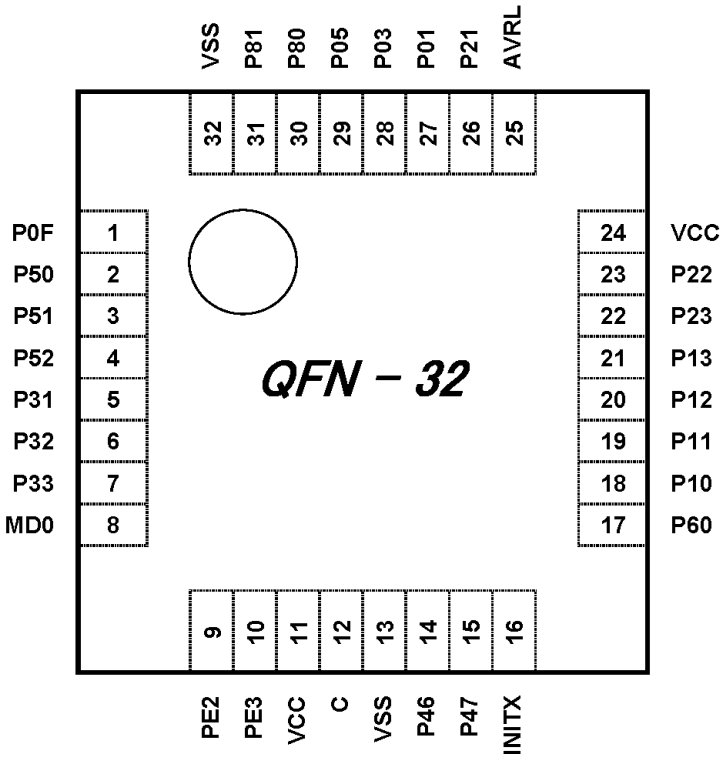
LQB032

(TOP VIEW)



WNU032

(TOP VIEW)



5. List of Pin Functions

List of Pin Numbers

The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.

Pin No.			Pin Name	Alternate Functions					I/O Circuit Type	Pin State Type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32								
1	1	2	P50	SIN3_1	INT00_0				D	K
2	2	3	P51	SOT3_1	INT01_0				D	K
3	3	4	P52	SCK3_1	INT02_0				D	K
4	4	-	P53	TIOA1_2	INT07_2				D	K
5	5	-	P30	SCS60_1	TIOB0_1	INT03_2	MI2SWS6_1		D	K
6	6	-	P31	SCK6_1	SI2CSCL6_1	INT04_2	MI2SCK6_1		H	K
-	-	5	P31	SCK6_1	SI2CSCL6_1	INT04_2			H	K
7	7	-	P32	SOT6_1	SI2CSDA6_1	TIOB2_1	INT05_2	MI2SDO6_1	H	K
-	-	6	P32	SOT6_1	SI2CSDA6_1	TIOB2_1	INT05_2		H	K
8	8	-	P33	ADTG_6	SIN6_1	INT04_0	MI2SDI6_1		H	K
-	-	7	P33	ADTG_6	SIN6_1	INT04_0			H	K
9	-	-	P34	SCS61_1	TIOB4_1	MI2SMCK6_1			D	K
-	9	-	P34	SCS61_1	MI2SMCK6_1				D	K
10	-	-	P35	SCS62_1	TIOB5_1	INT08_1			D	K
11	-	-	P3A	TIOA0_1	INT03_0	RTCCO_2	SUBOUT_2	IC1_CIN_0	D	K
-	10	-	P3A	TIOA0_1	INT03_0	RTCCO_2	SUBOUT_2		D	K
12	-	-	P3B	TIOA1_1	IC1_DATA_0				D	K
-	11	-	P3B	TIOA1_1					D	K
13	-	-	P3C	TIOA2_1	IC1_RST_0				D	K
-	12	-	P3C	TIOA2_1					D	K
14	-	-	P3D	TIOA3_1	IC1_VPEN_0				D	K
15	-	-	P3E	TIOA4_1	IC1_VCC_0				D	K
16	-	-	P3F	TIOA5_1	IC1_CLK_0				D	K
17	13	8	MD0						I	F
18	14	9	PE2	X0					A	A
19	15	10	PE3	X1					A	B
20	-	-	P40	TIOA0_0	INT12_1				D	K
21	-	-	P41	TIOA1_0	INT13_1				D	K
22	-	-	P42	TIOA2_0					D	K
23	-	-	P43	ADTG_7	TIOA3_0				D	K
24	-	-	P4C	SCK7_1	TIOB3_0				D	K
-	16	-	P4C	SCK7_1					D	K
25	17	-	P4D	SOT7_1					D	K
26	18	-	P4E	SIN7_1	INT06_2				D	K
27	19	11	VCC						-	-
28	20	12	C						-	-
29	21	13	VSS						-	-
30	22	14	P46	X0A					C	C
31	23	15	P47	X1A					C	D

Pin No.			Pin Name	Alternate Functions					I/O Circuit Type	Pin State Type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32								
32	24	16	INITX						B	E
33	25	17	P60	TIOA2_2	INT15_1	CEC1_0			H	K
34	-	-	P1E	RTS4_1	MI2SMCK4_1				D	K
35	-	-	P1D	CTS4_1	MI2SWS4_1				D	K
36	-	-	P1C	SCK4_1	MI2SCK4_1				D	K
37	-	-	P1B	SOT4_1	MI2SDO4_1				D	K
-	26	-	P1B	SOT4_1					D	K
38	-	-	P1A	SIN4_1	INT05_1	CEC0_0	MI2SDI4_1		H	K
-	27	-	P1A	SIN4_1	INT05_1	CEC0_0			H	K
39	-	-	P1F	ADTG_5					D	K
40	28	18	P10	AN00					F	J
41	29	19	P11	AN01	SIN1_1	INT02_1	WKUP1		G	J
42	30	20	P12	AN02	SOT1_1				F	J
43	31	21	P13	AN03	SCK1_1	RTCCO_1	SUBOUT_1		F	J
44	32	-	P14	AN04	SIN0_1	SCS10_1	INT03_1		F	J
45	33	-	P15	AN05	SOT0_1	SCS11_1			F	J
46	34	22	P23	AN06	SCK0_0	TIOA7_1			F	J
47	35	23	P22	AN07	TIOB7_1				F	J
48	36	24	VCC						-	-
49	37	-	AVRH[1]						-	-
50	38	25	AVRL						-	-
51	39	26	P21	INT06_1	WKUP2				E	K
52	-	-	P00	WKUP4					E	K
53	40	27	P01	SWCLK	SOT0_0				D	K
54	-	-	P02	WKUP5					E	K
55	41	28	P03	SWDIO	SIN0_0	TIOB7_0			D	K
56	42	29	P05	MD1	TIOA5_2	INT00_1	WKUP3		E	K
57	43	-	VCC						-	-
58	44	30	P80	UDM0					J	G
59	45	31	P81	UDP0					J	G
60	46	32	VSS						-	-
61	47	-	P61	UHCONX0	TIOB2_2				H	K
62	-	-	P0B	TIOB6_1	WKUP6				E	K
63	-	-	P0C	TIOA6_1	WKUP7				E	K
64	48	1	P0F	NMIX	WKUP0	RTCCO_0	SUBOUT_0	CROUT_1	E	I

[1] In a 32-pin package, the AVRH pin is internally connected to the V_{CC} pin.

List of Pin Functions

The number after the underscore ("_") in a function name such as XXX_1 and XXX_2 indicates one of the relocate options to route that function to a different pin. Use the Extended Port Function Register (EPFR) to disable or select the desired relocate option.

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
ADC	ADTG_5	A/D converter external trigger input pin	39	-	-
	ADTG_6		8	8	7
	ADTG_7		23	-	-
ADC	AN00	A/D converter analog input pin. ANxx describes ADC ch.xx.	40	28	18
	AN01		41	29	19
	AN02		42	30	20
	AN03		43	31	21
	AN04		44	32	-
	AN05		45	33	-
	AN06		46	34	22
	AN07		47	35	23
Base Timer 0	TIOA0_0	Base timer ch.0 TIOA pin	20	-	-
	TIOA0_1		11	10	-
	TIOB0_1	Base timer ch.0 TIOB pin	5	5	-
Base Timer 1	TIOA1_0	Base timer ch.1 TIOA pin	21	-	-
	TIOA1_1		12	11	-
	TIOA1_2		4	4	-
Base Timer 2	TIOA2_0	Base timer ch.2 TIOA pin	22	-	-
	TIOA2_1		13	12	-
	TIOA2_2		33	25	17
	TIOB2_1	Base timer ch.2 TIOB pin	7	7	6
	TIOB2_2		61	47	-
Base Timer 3	TIOA3_0	Base timer ch.3 TIOA pin	23	-	-
	TIOA3_1		14	-	-
	TIOB3_0	Base timer ch.3 TIOB pin	24	-	-
Base Timer 4	TIOA4_1	Base timer ch.4 TIOA pin	15	-	-
	TIOB4_1	Base timer ch.4 TIOB pin	9	-	-
Base Timer 5	TIOA5_1	Base timer ch.5 TIOA pin	16	-	-
	TIOA5_2		56	42	29
	TIOB5_1	Base timer ch.5 TIOB pin	10	-	-
Base Timer 6	TIOA6_1	Base timer ch.6 TIOA pin	63	-	-
	TIOB6_1	Base timer ch.6 TIOB pin	62	-	-
Base Timer 7	TIOA7_1	Base timer ch.7 TIOA pin	46	34	22
	TIOB7_0	Base timer ch.7 TIOB pin	55	41	28
	TIOB7_1		47	35	23
Debugger	SWCLK	Serial wire debug interface clock input pin	53	40	27
	SWDIO	Serial wire debug interface data input / output pin	55	41	28

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
External Interrupt	INT00_0	External interrupt request 00 input pin	1	1	2
	INT00_1		56	42	29
	INT01_0	External interrupt request 01 input pin	2	2	3
	INT02_0	External interrupt request 02 input pin	3	3	4
	INT02_1		41	29	19
	INT03_0	External interrupt request 03 input pin	11	10	-
	INT03_1		44	32	-
	INT03_2		5	5	-
	INT04_0	External interrupt request 04 input pin	8	8	7
	INT04_2		6	6	5
	INT05_1	External interrupt request 05 input pin	38	27	-
	INT05_2		7	7	6
	INT06_1	External interrupt request 06 input pin	51	39	26
	INT06_2		26	18	-
	INT07_2	External interrupt request 07 input pin	4	4	-
	INT08_1	External interrupt request 08 input pin	10	-	-
	INT12_1	External interrupt request 12 input pin	20	-	-
	INT13_1	External interrupt request 13 input pin	21	-	-
	INT15_1	External interrupt request 15 input pin	33	25	17
	NMIX	Non-Maskable Interrupt input pin	64	48	1
GPIO	P00	General-purpose I/O port 0	52	-	-
	P01		53	40	27
	P02		54	-	-
	P03		55	41	28
	P05		56	42	29
	P0B		62	-	-
	P0C		63	-	-
	P0F		64	48	1
GPIO	P10	General-purpose I/O port 1	40	28	18
	P11		41	29	19
	P12		42	30	20
	P13		43	31	21
	P14		44	32	-
	P15		45	33	-
	P1A		38	27	-
	P1B		37	26	-
	P1C		36	-	-
	P1D		35	-	-
	P1E		34	-	-
	P1F		39	-	-
GPIO	P21	General-purpose I/O port 2	51	39	26
	P22		47	35	23
	P23		46	34	22

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
GPIO	P30	General-purpose I/O port 3	5	5	-
	P31		6	6	5
	P32		7	7	6
	P33		8	8	7
	P34		9	9	-
	P35		10	-	-
	P3A		11	10	-
	P3B		12	11	-
	P3C		13	12	-
	P3D		14	-	-
	P3E		15	-	-
	P3F		16	-	-
GPIO	P40	General-purpose I/O port 4	20	-	-
	P41		21	-	-
	P42		22	-	-
	P43		23	-	-
	P46		30	22	14
	P47		31	23	15
	P4C		24	16	-
	P4D		25	17	-
	P4E		26	18	-
GPIO	P50	General-purpose I/O port 5	1	1	2
	P51		2	2	3
	P52		3	3	4
	P53		4	4	-
GPIO	P60	General-purpose I/O port 6	33	25	17
	P61		61	47	-
GPIO	P80	General-purpose I/O port 8	58	44	30
	P81		59	45	31
GPIO	PE2	General-purpose I/O port E	18	14	9
	PE3		19	15	10
Multi-function Serial 0	SIN0_0	Multi-function serial interface ch.0 input pin	55	41	28
	SIN0_1		44	32	-
	SOT0_0 (SDA0_0)	Multi-function serial interface ch.0 output pin. This pin operates as SOT0 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA0 when used as an I^2C pin (operation mode 4).	53	40	27
	SOT0_1 (SDA0_1)		45	33	-
	SCK0_0 (SCL0_0)	Multi-function serial interface ch.0 clock I/O pin. This pin operates as SCK0 when used as a CSIO pin (operation mode 2) and as SCL0 when used as an I^2C pin (operation mode 4).	46	34	22

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
Multi-function Serial 1	SIN1_1	Multi-function serial interface ch.1 input pin	41	29	19
	SOT1_1 (SDA1_1)	Multi-function serial interface ch.1 output pin. This pin operates as SOT1 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA1 when used as an I^2C pin (operation mode 4).	42	30	20
	SCK1_1 (SCL1_1)	Multi-function serial interface ch.1 clock I/O pin. This pin operates as SCK1 when used as a CSIO pin (operation mode 2) and as SCL1 when used as an I^2C pin (operation mode 4).	43	31	21
	SCS10_1	Multi-function serial interface ch.1 serial chip select 0 input/output pin.	44	32	-
	SCS11_1	Multi-function serial interface ch.1 serial chip select 1 output pin.	45	33	-
Multi-function Serial 3	SIN3_1	Multi-function serial interface ch.3 input pin	1	1	2
	SOT3_1 (SDA3_1)	Multi-function serial interface ch.3 output pin. This pin operates as SOT3 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA3 when used as an I^2C pin (operation mode 4).	2	2	3
	SCK3_1 (SCL3_1)	Multi-function serial interface ch.3 clock I/O pin. This pin operates as SCK3 when used as a CSIO (operation mode 2) and as SCL3 when used as an I^2C pin (operation mode 4).	3	3	4
Multi-function Serial 4	SIN4_1	Multi-function serial interface ch.4 input pin	38	27	-
	SOT4_1 (SDA4_1)	Multi-function serial interface ch.4 output pin. This pin operates as SOT4 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA4 when used as an I^2C pin (operation mode 4).	37	26	-
	SCK4_1 (SCL4_1)	Multi-function serial interface ch.4 clock I/O pin. This pin operates as SCK4 when used as a CSIO (operation mode 2) and as SCL4 when used as an I^2C pin (operation mode 4).	36	-	-
	CTS4_1	Multi-function serial interface ch4 CTS input pin	35	-	-
	RTS4_1	Multi-function serial interface ch4 RTS output pin	34	-	-

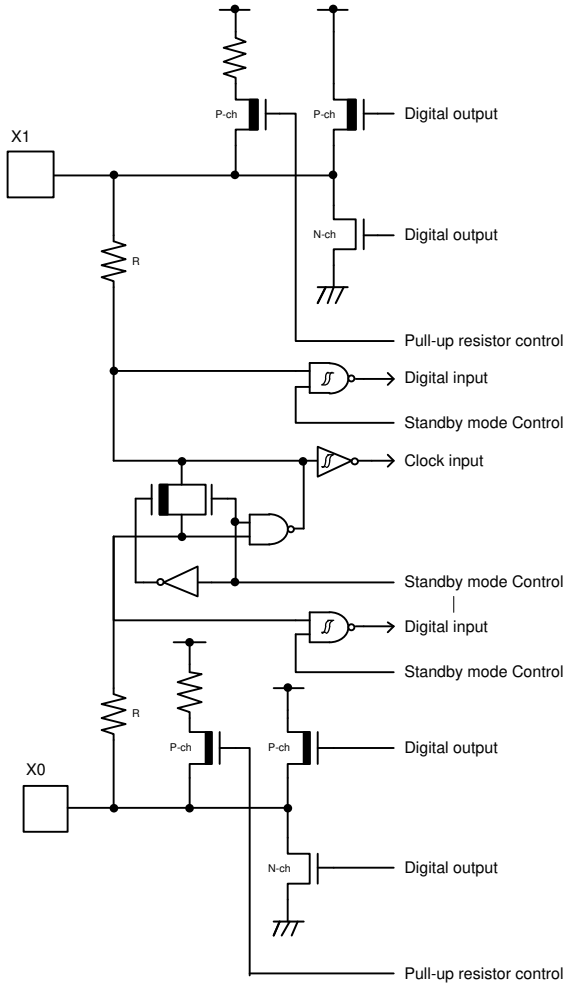
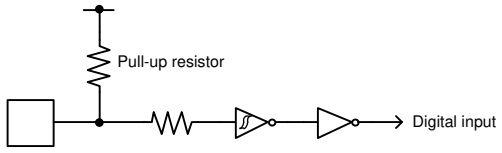
Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
Multi-function Serial 6	SIN6_1	Multi-function serial interface ch.6 input pin	8	8	7
	SOT6_1 (SDA6_1)	Multi-function serial interface ch.6 output pin. This pin operates as SOT6 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA6 when used as an I^2C pin (operation mode 4).	7	7	6
	SCK6_1 (SCL6_1)	Multi-function serial interface ch.6 clock I/O pin. This pin operates as SCK6 when used as a CSIO (operation mode 2) and as SCL6 when used as an I^2C pin (operation mode 4).	6	6	5
	SCS60_1	Multi-function serial interface ch.6 serial chip select 0 input/output pin.	5	5	-
	SCS61_1	Multi-function serial interface ch.6 serial chip select 1 output pin.	9	9	-
	SCS62_1	Multi-function serial interface ch.6 serial chip select 2 output pin.	10	-	-
Multi-function Serial 7	SIN7_1	Multi-function serial interface ch.7 input pin	26	18	-
	SOT7_1 (SDA7_1)	Multi-function serial interface ch.7 output pin. This pin operates as SOT7 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA7 when used as an I^2C pin (operation mode 4).	25	17	-
	SCK7_1 (SCL7_1)	Multi-function serial interface ch.7 clock I/O pin. This pin operates as SCK7 when used as a CSIO (operation mode 2) and as SCL7 when used as an I^2C pin (operation mode 4).	24	16	-

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
I2S(MFS)	MI2SDI4_1	I^2S Serial Data Input pin (operation mode 2).	38	-	-
	MI2SDO4_1	I^2S Serial Data Output pin (operation mode 2).	37	-	-
	MI2SCK4_1	I^2S Serial Clock Output pin (operation mode 2).	36	-	-
	MI2SWS4_1	I^2S Word Select Output pin (operation mode 2).	35	-	-
	MI2SMCK4_1	I^2S Master Clock Input/output pin (operation mode 2).	34	-	-
	MI2SDI6_1	I^2S Serial Data Input pin (operation mode 2).	8	8	-
	MI2SDO6_1	I^2S Serial Data Output pin (operation mode 2).	7	7	-
	MI2SCK6_1	I^2S Serial Clock Output pin (operation mode 2).	6	6	-
	MI2SWS6_1	I^2S Word Select Output pin (operation mode 2).	5	5	-
	MI2SMCK6_1	I^2S Master Clock Input/output pin (operation mode 2).	9	9	-
Smart Card Interface	IC1_CIN_0	Smart Card insert detection output pin	11	-	-
	IC1_CLK_0	Smart Card serial interface clock output pin	16	-	-
	IC1_DATA_0	Smart Card serial interface data input pin	12	-	-
	IC1_RST_0	Smart Card reset output pin	13	-	-
	IC1_VCC_0	Smart Card power enable output pin	15	-	-
	IC1_VPEN_0	Smart Card programming output pin	14	-	-
USB	UDM0	USB function/host D – pin	58	44	30
	UDP0	USB function/host D + pin	59	45	31
	UHCONX0	USB external pull-up control pin	61	47	-
Real-time Clock	RTCCO_0	0.5 seconds pulse output pin of real-time clock	64	48	1
	RTCCO_1		43	31	21
	RTCCO_2		11	10	-
	SUBOUT_0	Sub clock output pin	64	48	1
	SUBOUT_1		43	31	21
	SUBOUT_2		11	10	-
HDMI-CEC/Remote Control Reception	CEC0_0	HDMI-CEC/Remote Control Reception ch.0 input/output pin	38	27	-
	CEC1_0	HDMI-CEC/Remote Control Reception ch.1 input/output pin	33	25	17

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32
Low Power Consumption Mode	WKUP0	Deep Standby mode return signal input pin 0	64	48	1
	WKUP1	Deep Standby mode return signal input pin 1	41	29	19
	WKUP2	Deep Standby mode return signal input pin 2	51	39	26
	WKUP3	Deep Standby mode return signal input pin 3	56	42	29
	WKUP4	Deep Standby mode return signal input pin 4	52	-	-
	WKUP5	Deep Standby mode return signal input pin 5	54	-	-
	WKUP6	Deep Standby mode return signal input pin 6	62	-	-
	WKUP7	Deep Standby mode return signal input pin 7	63	-	-
I2C Slave	SI2CSCL6_1	I^2C Clock Pin	6	6	5
	SI2CSDA6_1	I^2C Data Pin	7	7	6
RESET	INITX	External Reset Input pin. A reset is valid when INITX="L".	32	24	16
MODE	MD0	Mode 0 pin. During normal operation, input MD0="L". During serial programming to Flash memory, input MD0="H".	17	13	8
	MD1	Mode 1 pin. During normal operation, input is not needed. During serial programming to Flash memory, MD1 = "L" must be input.	56	42	29
CLOCK	X0	Main clock (oscillation) input pin	18	14	9
	X0A	Sub clock (oscillation) input pin	30	22	14
	X1	Main clock (oscillation) I/O pin	19	15	10
	X1A	Sub clock (oscillation) I/O pin	31	23	15
	CROUT_1	Built-in high-speed CR oscillation clock output port	64	48	1
POWER	VCC	Power supply pin	27	19	11
	VCC		48	36	24
	VCC		57	43	-
GND	VSS	GND pin	29	21	13
	VSS		60	46	32
Analog Reference	AVRH[2]	A/D converter analog reference voltage input pin	49	37	-
	AVRL	A/D converter analog reference voltage input pin	50	38	25
C pin	C	Power supply stabilization capacitance pin	28	20	12

[2] In case of 32-pin package, AVRH pin is internally connected to the V_{CC} pin.

6. I/O Circuit Type

Type	Circuit	Remarks
A		It is possible to select the main oscillation / GPIO function When the main oscillation is selected. ・Oscillation feedback resistor Approximately 1 MΩ ・With standby mode control When the GPIO is selected. ・CMOS level output. ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA
B		CMOS level hysteresis input Pull-up resistor Approximately 33 kΩ