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MB9B310T Series

32-bit ARM[®] Cortex[®]-M3 FM3 Microcontroller

The MB9B310T Series are highly integrated 32-bit microcontrollers dedicated for embedded controllers with high-performance and competitive cost.

These series are based on the ARM[®] Cortex[®]-M3 Processor with on-chip Flash memory and SRAM, and has peripheral functions such as Motor Control Timers, ADCs and Communication Interfaces (USB, UART, CSIO, I²C, LIN).

The products which are described in this data sheet are placed into TYPE2 product categories in "FM3 Family Peripheral Manual".

Features

32-bit ARM[®] Cortex[®]-M3 Core

- Processor version: r2p1
- Up to 144 MHz Frequency Operation
- Memory Protection Unit (MPU): improves the reliability of an embedded system
- Integrated Nested Vectored Interrupt Controller (NVIC): 1 NMI (non-maskable interrupt) and 48 peripheral interrupts and 16 priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management

On-chip Memories

[Flash memory]

- Up to 1 Mbyte
 - Built-in Flash Accelerator System with 16 Kbyte trace buffer memory
- The read access to Flash memory can be achieved without wait cycle up to operation frequency of 72MHz. Even at the operation frequency more than 72MHz, an equivalent access to Flash memory can be obtained by Flash Accelerator System.
- Security function for code protection

[SRAM]

This Series contain a total of up to 128Kbyte on-chip SRAM memories. This is composed of two independent SRAM (SRAM0, SRAM1). SRAM0 is connected to I-code bus and D-code bus of Cortex-M3 core. SRAM1 is connected to System bus.

- SRAM0: Up to 64 Kbyte.
- SRAM1: Up to 64 Kbyte.

External Bus Interface

- Supports SRAM, NOR and NAND Flash device
- Up to 8 chip selects
- 8-/16-bit Data width
- Up to 25-bit Address bit
- Maximum area size: Up to 256 Mbytes
- Supports Address/Data multiplex
- Supports external RDY input

USB Interface (Max 2 channels)

USB interface is composed of Function and Host.

[USB function]

- USB2.0 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 be selected Bulk-transfer or Interrupt-transfer
 - EndPoint 1 to 5 is comprised Double Buffer
 - EndPoint 0, 2 to 5: 64 bytes
 - EndPoint 1: 256 bytes

[USB host]

- USB2.0 Full/Low speed supported
- Bulk-transfer, interrupt-transfer and Isochronous-transfer support
- USB Device connected/dis-connected automatically detect
- IN/OUT token handshake packet automatically
- Max 256-byte packet-length supported
- Wake-up function supported

Multi-function Serial Interface (Max 8 channels)

- 4 channels with 16steps×9-bit FIFO (ch.4 to ch.7), 4 channels without FIFO (ch.0 to ch.3)
- Operation mode is selectable from the followings for each channel.
 - UART
 - CSIO
 - LIN
 - I²C

[UART]

- Full-duplex double buffer
- Selection with or without parity supported
- 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)
- Various error detect functions available (parity errors, framing errors, and overrun errors)

[CSIO]

- Full-duplex double buffer
- Built-in dedicated baud rate generator
- Overrun error detect function available

[LIN]

- LIN protocol Rev.2.1 supported
- Full-duplex double buffer
- Master/Slave mode supported
- LIN break field generate (can be changed 13 to 16-bit length)
- LIN break delimiter generate (can be changed 1 to 4-bit length)
- Various error detect functions available (parity errors, framing errors, and overrun errors)

[I²C]

- Standard-mode (Max 100 kbps) / Fast-mode (Max 400 kbps) supported

DMA Controller (8channels)

DMA Controller has an independent bus for CPU, so CPU and DMA Controller can process simultaneously.

- 8 independently configured and operated channels
- Transfer can be started by software or request from the built-in peripherals
- Transfer address area: 32-bit (4 Gbyte)
- Transfer mode: Block transfer/Burst transfer/Demand transfer
- Transfer data type: byte/half-word/word
- Transfer block count: 1 to 16
- Number of transfers: 1 to 65536

A/D Converter (Max 32 channels)

[12-bit A/D Converter]

- Successive Approximation Register type
- Built-in 3units
- Conversion time: 1.0 μs@ 5 V
- Priority conversion available (priority at 2 levels)
- Scanning conversion mode
- Built-in FIFO for conversion data storage (for SCAN conversion: 16 steps, for Priority conversion: 4 steps)

Base Timer (Max 16 channels)

Operation mode is selectable from the followings for each channel.

- 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 pins as I/O ports when they are not used for external bus or peripherals. Moreover, the port relocate function is built in. It can set which I/O port the peripheral function can be allocated.

- Capable of pull-up control per pin
- Capable of reading pin level directly
- Built-in the port relocate function
- Up 154 fast I/O Ports@ 176 pin Package
- Some pin is 5V tolerant I/O.
See "Pin Description" to confirm the corresponding pins.

Multi-function Timer (Max 3 units)

The Multi-function timer is composed of the following blocks.

- 16-bit free-run timer × 3ch./unit
- Input capture × 4ch./unit
- Output compare × 6ch./unit
- A/D activation compare × 3ch./unit
- Waveform generator × 3ch./unit
- 16-bit PPG timer × 3ch./unit

The following function can be used to achieve the motor control.

- PWM signal output function
- DC chopper waveform output function
- Dead time function
- Input capture function
- A/D convertor activate function
- DTIF (Motor emergency stop) interrupt function

Quadrature Position/Revolution Counter (QPRC) (Max 3 channels)

The Quadrature Position/Revolution Counter (QPRC) is used to measure the position of the position encoder. Moreover, it is possible to use up/down counter.

- The detection edge of the three external event input pins AIN, BIN and ZIN is configurable.
- 16-bit position counter
- 16-bit revolution counter
- Two 16-bit compare registers

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

The Dual Timer consists of two programmable 32-/16-bit down counters.

Operation mode is selectable from the followings for each channel.

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

Watch Counter

The Watch counter is used for wake up from power saving mode.

Interval timer: up to 64s (Max) @ Sub Clock: 32.768 kHz

External Interrupt Controller Unit

- Up to 32 external interrupt input pin
- Include one non-maskable interrupt(NMI)

Watch dog Timer (2 channels)

A watchdog timer can generate interrupts or a reset when a time-out value is reached.

This series consists of two different watchdogs, a "Hardware" watchdog and a "Software" watchdog.

"Hardware" watchdog timer is clocked by low speed internal CR oscillator. Therefore, "Hardware" watchdog is active in any power saving mode except STOP mode.

CRC (Cyclic Redundancy Check) Accelerator

The CRC accelerator helps a verify data transmission or storage integrity.

CCITT CRC16 and IEEE-802.3 CRC32 are supported.

- CCITT CRC16 Generator Polynomial: 0x1021
- IEEE-802.3 CRC32 Generator Polynomial: 0x04C11DB7

Clock and Reset

[Clocks]

Five clock sources (2 external oscillators, 2 internal CR oscillator, and Main PLL) that are dynamically selectable.

- Main Clock : 4 MHz to 48 MHz
- Sub Clock: 32.768 kHz
- High-speed internal CR Clock: 4 MHz
- Low-speed internal CR Clock: 100 kHz
- Main PLL Clock

[Resets]

- Reset requests from INITX pin
- Power on reset
- Software reset
- Watchdog timers reset
- Low-voltage detector reset
- Clock supervisor reset

Clock Super Visor (CSV)

Clocks generated by internal CR oscillators are used to supervise abnormality of the external clocks.

- External OSC clock failure (clock stop) is detected, reset is asserted.
- External OSC frequency anomaly is detected, interrupt or reset is asserted.

Low-Voltage Detector (LVD)

This Series include 2-stage monitoring of voltage on the VCC pins. When the voltage falls below the voltage has been set, Low-Voltage Detector generates an interrupt or reset.

- LVD1: error reporting via interrupt
- LVD2: auto-reset operation

Low Power Mode

Three power saving modes supported.

- SLEEP
- TIMER
- STOP

Debug

- Serial Wire JTAG Debug Port (SWJ-DP)
- Embedded Trace Macrocells (ETM) provide comprehensive debug and trace facilities.

Power Supply

Three Power Supplies

- Wide range voltage VCC
= 2.7 V to 5.5 V
- USBVCC0
= 3.0 V to 3.6 V: for USB ch.0 I/O voltage, when USB ch.0 is used.
= 2.7 V to 5.5 V: when GPIO is used.
- USBVCC1
= 3.0 V to 3.6 V: for USB ch.1 I/O voltage, when USB ch.1 is used.
= 2.7 V to 5.5 V: when GPIO is used.

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1. Product Lineup

Memory Size

Product name	MB9BF316S/T	MB9BF317S/T	MB9BF318S/T
On-chip Flash memory	512 Kbyte	768 Kbyte	1 Mbyte
On-chip RAM	64 Kbyte	96 Kbyte	128 Kbyte

Function

Product name		MB9BF316S MB9BF317S MB9BF318S	MB9BF316T MB9BF317T MB9BF318T
Pin count		144	176/192
CPU		Cortex-M3	
Freq.		144 MHz	
Power supply voltage range		VCC:2.7 V to 5.5 V (USBVCC0:3.0 V to 3.6 V) (USBVCC1:3.0 V to 3.6 V)	
USB2.0 (Function/Host)		2ch. (Max)	
DMAC		8ch.	
External Bus Interface		Addr:19-bit (Max) R/Wdata:8-/16-bit (Max) CS: 8 (Max) Support: SRAM, NOR & NAND Flash	Addr:25-bit (Max) R/Wdata:8-/16-bit (Max) CS:8 (Max) Support: SRAM, NOR & NAND Flash
MF Serial Interface (UART/CSIO/LIN/I ² C)		8ch. (Max) ch.4 to ch.7: FIFO (16steps × 9-bit) ch.0 to ch.3: No FIFO	
Base Timer (PWC/ Reload timer/PWM/PPG)		16ch. (Max)	
MF-Timer	A/D activation compare	3ch.	3 units (Max)
	Input capture	4ch.	
	Free-run timer	3ch.	
	Output compare	6ch.	
	Waveform generator	3ch.	
PPG	3ch.		
QPRC		3ch. (Max)	
Dual Timer		1 unit	
Watch Counter		1 unit	
CRC Accelerator		Yes	
Watchdog timer		1ch. (SW) + 1ch. (HW)	
External Interrupts		32 pins (Max) + NMI × 1	
I/O ports		122 pins (Max)	154 pins (Max)
12-bit A/D converter		24ch. (3 units)	32ch. (3 units)
CSV (Clock Super Visor)		Yes	
LVD (Low-Voltage Detector)		2ch.	
Built-in CR	High-speed	4 MHz	
	Low-speed	100 kHz	
Debug Function		SWJ-DP/ETM	

Note:All signals of the peripheral function in each product cannot be allocated by limiting the pins of package. It is necessary to use the port relocate function of the General I/O port according to your function use.

See "12. Electrical Characteristics 12.4. AC Characteristics 12.4.3. Built-in CR Oscillation Characteristics" for accuracy of built-in CR.

2. Packages

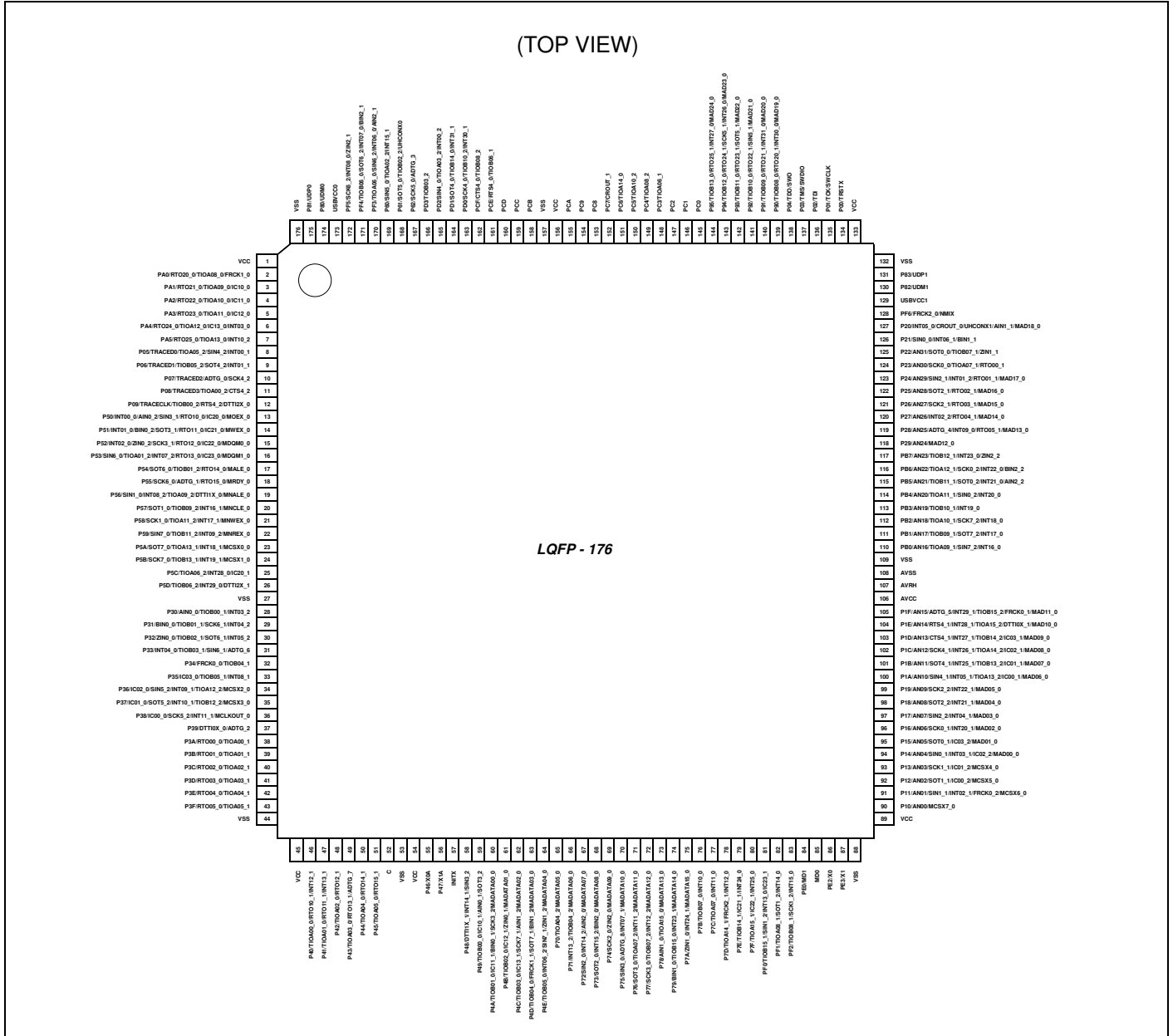
Package	Product name	MB9BF316S MB9BF317S MB9BF318S	MB9BF316T MB9BF317T MB9BF318T
LQFP:	FPT-144P-M08 (0.5 mm pitch)	○	-
LQFP:	FPT-176P-M07 (0.5 mm pitch)	-	○
BGA:	BGA-192P-M06 (0.8 mm pitch)	-	○

○: Supported

Note: See "14. Package Dimensions" for detailed information on each package.

3. Pin Assignment

FPT-176P-M07

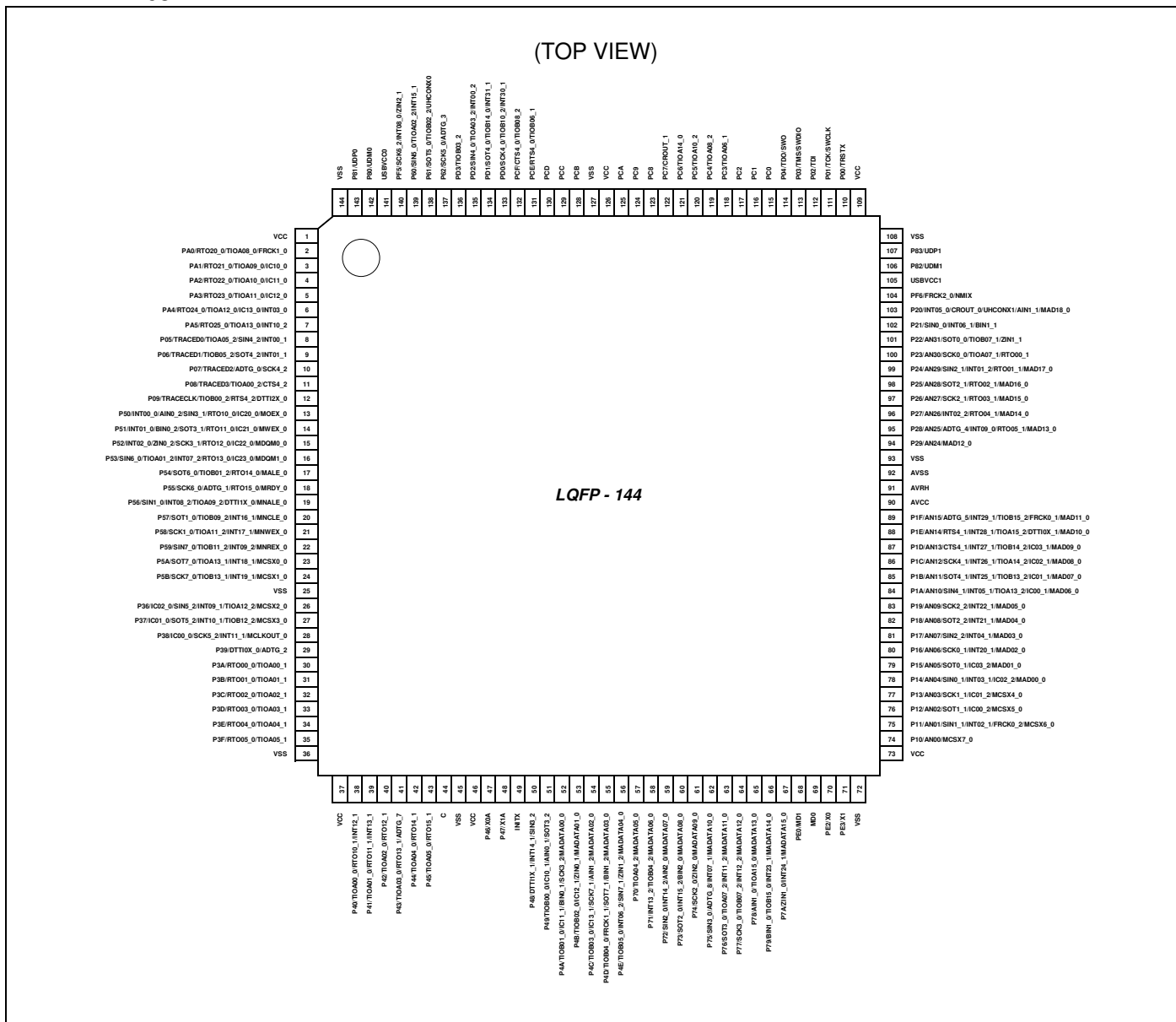


Note:

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

TIOA09_0, TIOA09_1, and TIOA09_2 cannot be used as the external startup trigger input (TGIN signal) at I/O mode 1 (timer full mode) of the Base Timer. See "Base Timer" in "7. Handling Devices" for details.

FPT-144P-M08

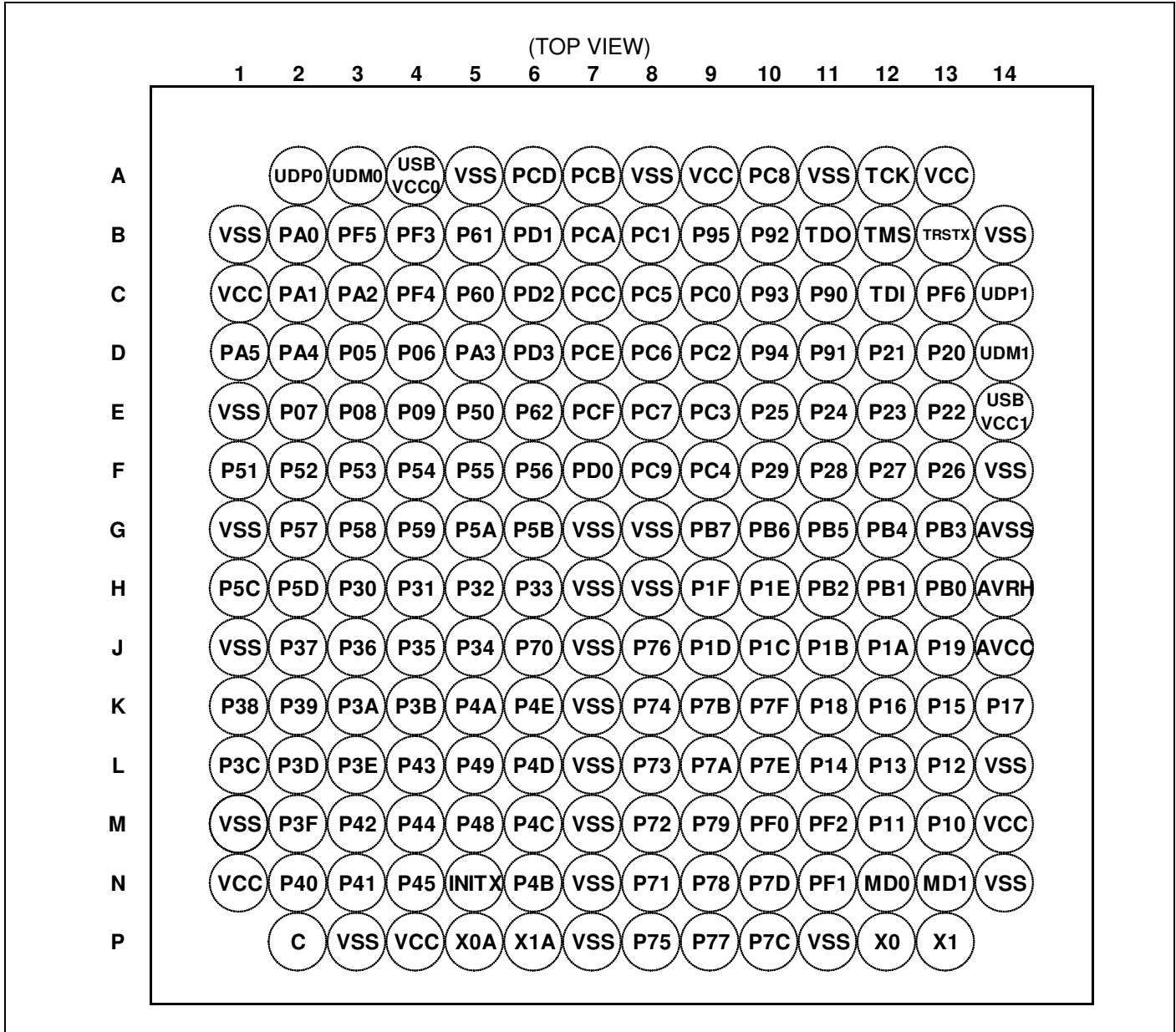


Note:

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

TIOA09_0 and TIOA09_2 cannot be used as the external startup trigger input (TGIN signal) at I/O mode 1 (timer full mode) of the Base Timer. See "Base Timer" in "7. Handling Devices" for details.

BGA-192P-M06



Note:

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

TIOA09_0, TIOA09_1, and TIOA09_2 cannot be used as the external startup trigger input (TGIN signal) at I/O mode 1 (timer full mode) of the Base Timer. See "Base Timer" in "7. Handling Devices" for details.

4. List of Pin Functions

List of pin numbers

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

Pin No			Pin Name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
1	1	C1	VCC	-	
2	2	B2	PA0	G	I
			RTO20_0		
			TIOA08_0		
			FRCK1_0		
3	3	C2	PA1	G	I
			RTO21_0		
			TIOA09_0		
			IC10_0		
4	4	C3	PA2	G	I
			RTO22_0		
			TIOA10_0		
			IC11_0		
5	5	D5	PA3	G	I
			RTO23_0		
			TIOA11_0		
			IC12_0		
6	6	D2	PA4	G	H
			RTO24_0		
			TIOA12_0		
			IC13_0		
			INT03_0		
7	7	D1	PA5	G	H
			RTO25_0		
			TIOA13_0		
			INT10_2		
8	8	D3	P05	E	F
			TRACED0		
			TIOA05_2		
			SIN4_2		
			INT00_1		
9	9	D4	P06	E	F
			TRACED1		
			TIOB05_2		
			SOT4_2		
			INT01_1		

Pin No			Pin Name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
10	10	E2	P07	E	G
			TRACED2		
			ADTG_0		
			SCK4_2		
11	11	E3	P08	E	G
			TRACED3		
			TIOA00_2		
			CTS4_2		
12	12	E4	P09	E	G
			TRACECLK		
			TIOB00_2		
			RTS4_2		
			DTTI2X_0		
13	13	E5	P50	E	H
			INT00_0		
			AIN0_2		
			SIN3_1		
			RTO10_0		
			IC20_0		
			MOEX_0		
14	14	F1	P51	E	H
			INT01_0		
			BIN0_2		
			SOT3_1		
			RTO11_0		
			IC21_0		
			MWEX_0		
15	15	F2	P52	E	H
			INT02_0		
			ZIN0_2		
			SCK3_1		
			RTO12_0		
			IC22_0		
			MDQM0_0		

Pin No			Pin Name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
16	16	F3	P53	E	H
			SIN6_0		
			TIOA01_2		
			INT07_2		
			RTO13_0		
			IC23_0		
17	17	F4	P54	E	I
			SOT6_0		
			TIOB01_2		
			RTO14_0		
			MALE_0		
18	18	F5	P55	E	I
			SCK6_0		
			ADTG_1		
			RTO15_0		
19	19	F6	MRDY_0	E	H
			P56		
			SIN1_0		
			INT08_2		
			TIOA09_2		
			DTT11X_0		
20	20	G2	MNALE_0	E	H
			P57		
			SOT1_0		
			TIOB09_2		
			INT16_1		
21	21	G3	MNCLE_0	E	H
			P58		
			SCK1_0		
			TIOA11_2		
			INT17_1		
22	22	G4	MNWEX_0	E	H
			P59		
			SIN7_0		
			TIOB11_2		
			INT09_2		
			MNREX_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
23	23	G5	P5A	E	H
			SOT7_0		
			TIOA13_1		
			INT18_1		
			MCSX0_0		
24	24	G6	P5B	E	H
			SCK7_0		
			TIOB13_1		
			INT19_1		
			MCSX1_0		
25	-	H1	P5C	E	H
			TIOA06_2		
			INT28_0		
			IC20_1		
26	-	H2	P5D	E	H
			TIOB06_2		
			INT29_0		
			DTTI2X_1		
27	25	J1	VSS	-	-
28	-	H3	P30	E	H
			AIN0_0		
			TIOB00_1		
			INT03_2		
29	-	H4	P31	E	H
			BIN0_0		
			TIOB01_1		
			SCK6_1		
			INT04_2		
30	-	H5	P32	E	H
			ZIN0_0		
			TIOB02_1		
			SOT6_1		
			INT05_2		
31	-	H6	P33	E	H
			INT04_0		
			TIOB03_1		
			SIN6_1		
			ADTG_6		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
32	-	J5	P34	E	I
			FRCK0_0		
			TIOB04_1		
33	-	J4	P35	E	H
			IC03_0		
			TIOB05_1		
34	26	J3	INT08_1	E	H
			P36		
			IC02_0		
			SIN5_2		
			INT09_1		
			TIOA12_2		
MCSX2_0					
35	27	J2	P37	E	H
			IC01_0		
			SOT5_2		
			INT10_1		
			TIOB12_2		
			MCSX3_0		
36	28	K1	P38	E	H
			IC00_0		
			SCK5_2		
			INT11_1		
			MCLKOUT_0		
37	29	K2	P39	E	I
			DTTI0X_0		
			ADTG_2		
38	30	K3	P3A	G	I
			RTO00_0		
			TIOA00_1		
39	31	K4	P3B	G	I
			RTO01_0		
			TIOA01_1		
40	32	L1	P3C	G	I
			RTO02_0		
			TIOA02_1		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
41	33	L2	P3D	G	I
			RTO03_0		
			TIOA03_1		
42	34	L3	P3E	G	I
			RTO04_0		
			TIOA04_1		
43	35	M2	P3F	G	I
			RTO05_0		
			TIOA05_1		
44	36	M1	VSS	-	
45	37	N1	VCC	-	
46	38	N2	P40	G	H
			TIOA00_0		
			RTO10_1		
47	39	N3	INT12_1	G	H
			P41		
			TIOA01_0		
48	40	M3	RTO11_1	G	I
			P42		
			TIOA02_0		
49	41	L4	RTO12_1	G	I
			P43		
			TIOA03_0		
50	42	M4	RTO13_1	G	I
			P44		
			TIOA04_0		
51	43	N4	RTO14_1	G	I
			P45		
			TIOA05_0		
52	44	P2	RTO15_1	-	
			C		
53	45	P3	VSS	-	
54	46	P4	VCC	-	
55	47	P5	P46	D	M
			X0A		
56	48	P6	P47	D	N
			X1A		
57	49	N5	INITX	B	C
58	50	M5	P48	E	H
			DTT11X_1		
			INT14_1		
			SIN3_2		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
59	51	L5	P49	E	I
			TIOB00_0		
			IC10_1		
			AIN0_1		
			SOT3_2		
60	52	K5	P4A	E	I
			TIOB01_0		
			IC11_1		
			BIN0_1		
			SCK3_2		
			MADATA00_0		
61	53	N6	P4B	E	I
			TIOB02_0		
			IC12_1		
			ZIN0_1		
			MADATA01_0		
62	54	M6	P4C	E	I
			TIOB03_0		
			IC13_1		
			SCK7_1		
			AIN1_2		
			MADATA02_0		
63	55	L6	P4D	E	I
			TIOB04_0		
			FRCK1_1		
			SOT7_1		
			BIN1_2		
			MADATA03_0		
64	56	K6	P4E	E	H
			TIOB05_0		
			INT06_2		
			SIN7_1		
			ZIN1_2		
			MADATA04_0		
65	57	J6	P70	E	I
			TIOA04_2		
			MADATA05_0		
66	58	N8	P71	E	H
			INT13_2		
			TIOB04_2		
			MADATA06_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
67	59	M8	P72	E	H
			SIN2_0		
			INT14_2		
			AIN2_0		
			MADATA07_0		
68	60	L8	P73	E	H
			SOT2_0		
			INT15_2		
			BIN2_0		
			MADATA08_0		
69	61	K8	P74	E	I
			SCK2_0		
			ZIN2_0		
			MADATA09_0		
70	62	P8	P75	E	H
			SIN3_0		
			ADTG_8		
			INT07_1		
			MADATA10_0		
71	63	J8	P76	E	H
			SOT3_0		
			TIOA07_2		
			INT11_2		
			MADATA11_0		
72	64	P9	P77	E	H
			SCK3_0		
			TIOB07_2		
			INT12_2		
			MADATA12_0		
73	65	N9	P78	E	I
			AIN1_0		
			TIOA15_0		
			MADATA13_0		
74	66	M9	P79	E	H
			BIN1_0		
			TIOB15_0		
			INT23_1		
			MADATA14_0		
-	-	E1	VSS	-	-
-	-	G1	VSS	-	-

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
75	67	L9	P7A	E	H
			ZIN1_0		
			INT24_1		
			MADATA15_0		
76	-	K9	P7B	E	H
			TIOB07_0		
			INT10_0		
77	-	P10	P7C	E	H
			TIOA07_0		
			INT11_0		
78	-	N10	P7D	E	H
			TIOA14_1		
			FRCK2_1		
			INT12_0		
79	-	L10	P7E	E	H
			TIOB14_1		
			IC21_1		
			INT24_0		
80	-	K10	P7F	E	H
			TIOA15_1		
			IC22_1		
			INT25_0		
81	-	M10	PF0	I*	H
			TIOB15_1		
			SIN1_2		
			INT13_0		
			IC23_1		
82	-	N11	PF1	I*	H
			TIOA08_1		
			SOT1_2		
			INT14_0		
83	-	M11	PF2	I*	H
			TIOB08_1		
			SCK1_2		
			INT15_0		
84	68	N13	PE0	C	P
85	69	N12	MD1	J	D
86	70	P12	PE2	A	A
			X0		
87	71	P13	PE3	A	B
			X1		
88	72	N14	VSS		-

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
89	73	M14	VCC	-	
-	-	L7	VSS	-	
-	-	K7	VSS	-	
90	74	M13	P10	F	K
			AN00		
			MCSX7_0		
91	75	M12	P11	F	L
			AN01		
			SIN1_1		
			INT02_1		
			FRCK0_2		
			MCSX6_0		
92	76	L13	P12	F	K
			AN02		
			SOT1_1		
			IC00_2		
93	77	L12	P13	F	K
			AN03		
			SCK1_1		
			IC01_2		
94	78	L11	P14	F	L
			AN04		
			SIN0_1		
			INT03_1		
			IC02_2		
MAD00_0					
95	79	K13	P15	F	K
			AN05		
			SOT0_1		
			IC03_2		
96	80	K12	MAD01_0	F	L
			P16		
			AN06		
			SCK0_1		
			INT20_1		
MAD02_0					
97	81	K14	P17	F	L
			AN07		
			SIN2_2		
			INT04_1		
			MAD03_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
-	-	P7	VSS	-	-
-	-	P11	VSS	-	-
-	-	L14	VSS	-	-
98	82	K11	P18	F	L
			AN08		
			SOT2_2		
			INT21_1		
			MAD04_0		
99	83	J13	P19	F	L
			AN09		
			SCK2_2		
			INT22_1		
			MAD05_0		
100	84	J12	P1A	F	L
			AN10		
			SIN4_1		
			INT05_1		
			TIOA13_2		
			IC00_1		
			MAD06_0		
101	85	J11	P1B	F	L
			AN11		
			SOT4_1		
			INT25_1		
			TIOB13_2		
			IC01_1		
			MAD07_0		
102	86	J10	P1C	F	L
			AN12		
			SCK4_1		
			INT26_1		
			TIOA14_2		
			IC02_1		
			MAD08_0		
103	87	J9	P1D	F	L
			AN13		
			CTS4_1		
			INT27_1		
			TIOB14_2		
			IC03_1		
			MAD09_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
104	88	H10	P1E	F	L
			AN14		
			RTS4_1		
			INT28_1		
			TIOA15_2		
			DTTI0X_1		
			MAD10_0		
105	89	H9	P1F	F	L
			AN15		
			ADTG_5		
			INT29_1		
			TIOB15_2		
			FRCK0_1		
			MAD11_0		
106	90	J14	AVCC	-	
107	91	H14	AVRH	-	
108	92	G14	AVSS	-	
109	93	F14	VSS	-	
110	-	H13	PB0	F	L
			AN16		
			TIOA09_1		
			SIN7_2		
			INT16_0		
111	-	H12	PB1	F	L
			AN17		
			TIOB09_1		
			SOT7_2		
			INT17_0		
112	-	H11	PB2	F	L
			AN18		
			TIOA10_1		
			SCK7_2		
			INT18_0		
113	-	G13	PB3	F	L
			AN19		
			TIOB10_1		
			INT19_0		
114	-	G12	PB4	F	L
			AN20		
			TIOA11_1		
			SIN0_2		
			INT20_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
115	-	G11	PB5	F	L
			AN21		
			TIOB11_1		
			SOT0_2		
			INT21_0		
			AIN2_2		
-	-	G7	VSS	-	-
-	-	J7	VSS	-	-
116	-	G10	PB6	F	L
			AN22		
			TIOA12_1		
			SCK0_2		
			INT22_0		
			BIN2_2		
117	-	G9	PB7	F	L
			AN23		
			TIOB12_1		
			INT23_0		
			ZIN2_2		
118	94	F10	P29	F	K
			AN24		
			MAD12_0		
119	95	F11	P28	F	L
			AN25		
			ADTG_4		
			INT09_0		
			RTO05_1		
			MAD13_0		
120	96	F12	P27	F	L
			AN26		
			INT02_2		
			RTO04_1		
			MAD14_0		
121	97	F13	P26	F	K
			AN27		
			SCK2_1		
			RTO03_1		
			MAD15_0		
122	98	E10	P25	F	K
			AN28		
			SOT2_1		
			RTO02_1		
			MAD16_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
123	99	E11	P24	F	L
			AN29		
			SIN2_1		
			INT01_2		
			RTO01_1		
			MAD17_0		
124	100	E12	P23	F	K
			AN30		
			SCK0_0		
			TIOA07_1		
			RTO00_1		
125	101	E13	P22	F	K
			AN31		
			SOT0_0		
			TIOB07_1		
			ZIN1_1		
126	102	D12	P21	E	H
			SIN0_0		
			INT06_1		
			BIN1_1		
127	103	D13	P20	E	H
			INT05_0		
			CROUT_0		
			UHCONX1		
			AIN1_1		
			MAD18_0		
128	104	C13	PF6	I*	J
			FRCK2_0		
			NMIX		
129	105	E14	USBVCC1	-	-
130	106	D14	P82	H	O
			UDM1		
131	107	C14	P83	H	O
			UDP1		
132	108	B14	VSS	-	-
133	109	A13	VCC	-	-
134	110	B13	P00	E	E
			TRSTX		
135	111	A12	P01	E	E
			TCK		
			SWCLK		
136	112	C12	P02	E	E
			TDI		