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The MB9B510T 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, CAN, UART, CSIO, I²C, LIN).

The products which are described in this datasheet 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 72 MHz. Even at the operation frequency more than 72 MHz, 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 128 Kbyte on-chip SRAM memories. This is composed of two independent SRAM memories (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 – 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

CAN Interface (Max. 2 channels)

- Compatible with CAN Specification 2.0A/B
- Maximum transfer rate: 1 Mbps
- Built-in 32 message buffer

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 13-16bit length)
- LIN break delimiter generate (can be changed 1-4bit 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 (8 channels)

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 3unit
- 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 @ 176pin Package
- Some pin is 5 V 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 64 s (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.

Contents

1. Product Lineup	7
2. Packages	8
3. Pin Assignment	9
4. List of Pin Functions	12
5. I/O Circuit Type	48
6. Handling Precautions	54
6.1 Precautions for Product Design	54
6.2 Precautions for Package Mounting.....	55
6.3 Precautions for Use Environment	56
7. Handling Devices	57
8. Block Diagram	60
9. Memory Size	61
10. Memory Map	61
11. Pin Status in Each CPU State	64
12. Electrical Characteristics	68
12.1 Absolute Maximum Ratings.....	68
12.2 Recommended Operating Conditions.....	70
12.3 DC Characteristics.....	71
12.3.1 Current Rating.....	71
12.3.2 Pin Characteristics	73
12.4 AC Characteristics.....	75
12.4.1 Main Clock Input Characteristics.....	75
12.4.2 Sub Clock Input Characteristics	76
12.4.3 Internal CR Oscillation Characteristics.....	76
12.4.4 Operating Conditions of Main PLL and USB PLL (In the case of using main clock for input of PLL)	77
12.4.5 Operating Conditions of Main PLL (In the case of using high-speed internal CR).....	77
12.4.6 Reset Input Characteristics	78
12.4.7 Power-on Reset Timing.....	79
12.4.8 External Bus Timing.....	80
12.4.9 Base Timer Input Timing	90
12.4.10 CSIO/UART Timing	91
12.4.11 External Input Timing.....	99
12.4.12 Quadrature Position/Revolution Counter timing.....	100
12.4.13 I ² C Timing.....	102
12.4.14 ETM Timing	103
12.4.15 JTAG Timing.....	104
12.5 12-bit A/D Converter.....	105
12.6 USB characteristics	108
12.7 Low-Voltage Detection Characteristics.....	112
12.7.1 Low-Voltage Detection Reset.....	112
12.7.2 Interrupt of Low-Voltage Detection.....	112
12.8 Flash Memory Write/Erase Characteristics	113
12.8.1 Write / Erase time.....	113
12.8.2 Write cycles and data hold time	113
12.9 Return Time from Low-Power Consumption Mode.....	114
12.9.1 Return Factor: Interrupt.....	114
12.9.2 Return Factor: Reset.....	116



13. Ordering Information 118
14. Package Dimensions 119
15. Major Changes 122
Document History..... 124

1. Product Lineup

Memory Size

Product name	MB9BF516S/T	MB9BF517S/T	MB9BF518S/T
On-chip Flash memory	512 Kbyte	768 Kbyte	1 Mbyte
On-chip RAM	64 Kbyte	96 Kbyte	128 Kbyte

Function

Product name	MB9BF516S MB9BF517S MB9BF518S		MB9BF516T MB9BF517T MB9BF518T	
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)			
CAN Interface	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	
Multi-function 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. Internal CR Oscillation Characteristics" for accuracy of built-in CR.

2. Packages

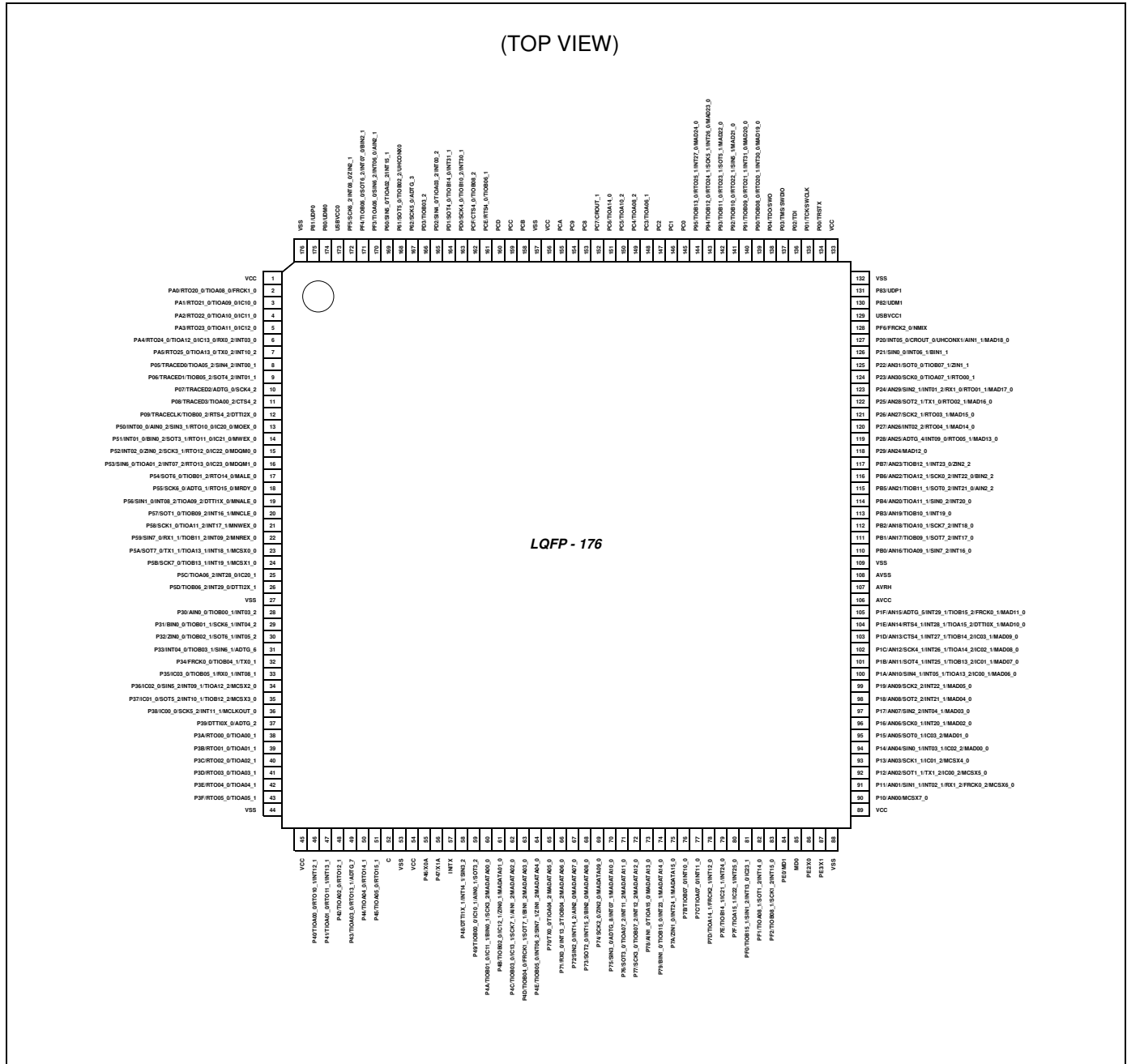
Package	Product name	MB9BF516S MB9BF517S MB9BF518S	MB9BF516T MB9BF517T MB9BF518T
LQFP: FPT-144P-M08 (0.5 mm pitch)		○	-
LQFP: FPT-176P-M07 (0.5 mm pitch)		-	○
BGA: BGA-192P-M06 (0.8 mm pitch)		-	○

○: Supported

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

3. Pin Assignment

FPT-176P-M07

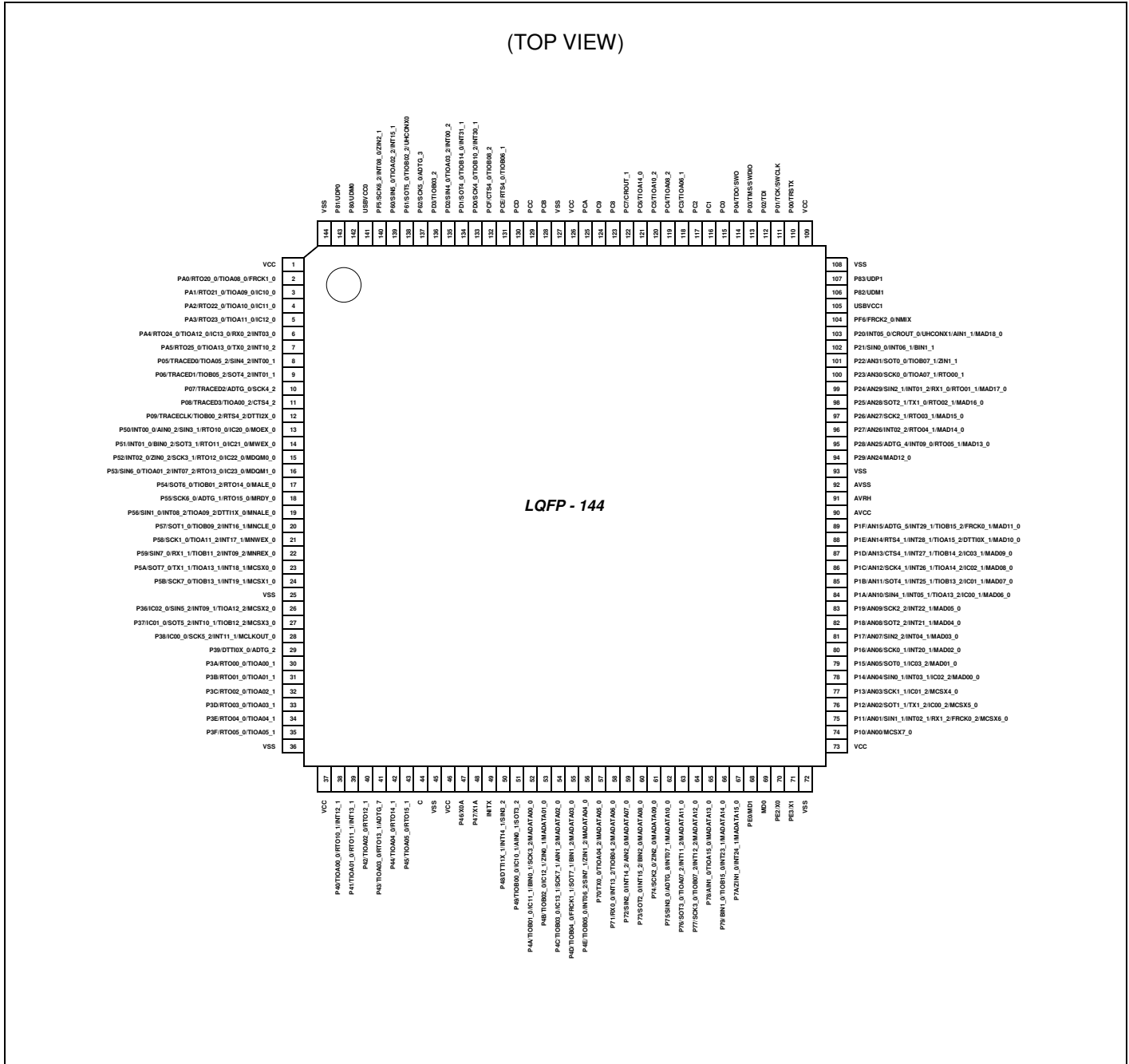


Note:

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



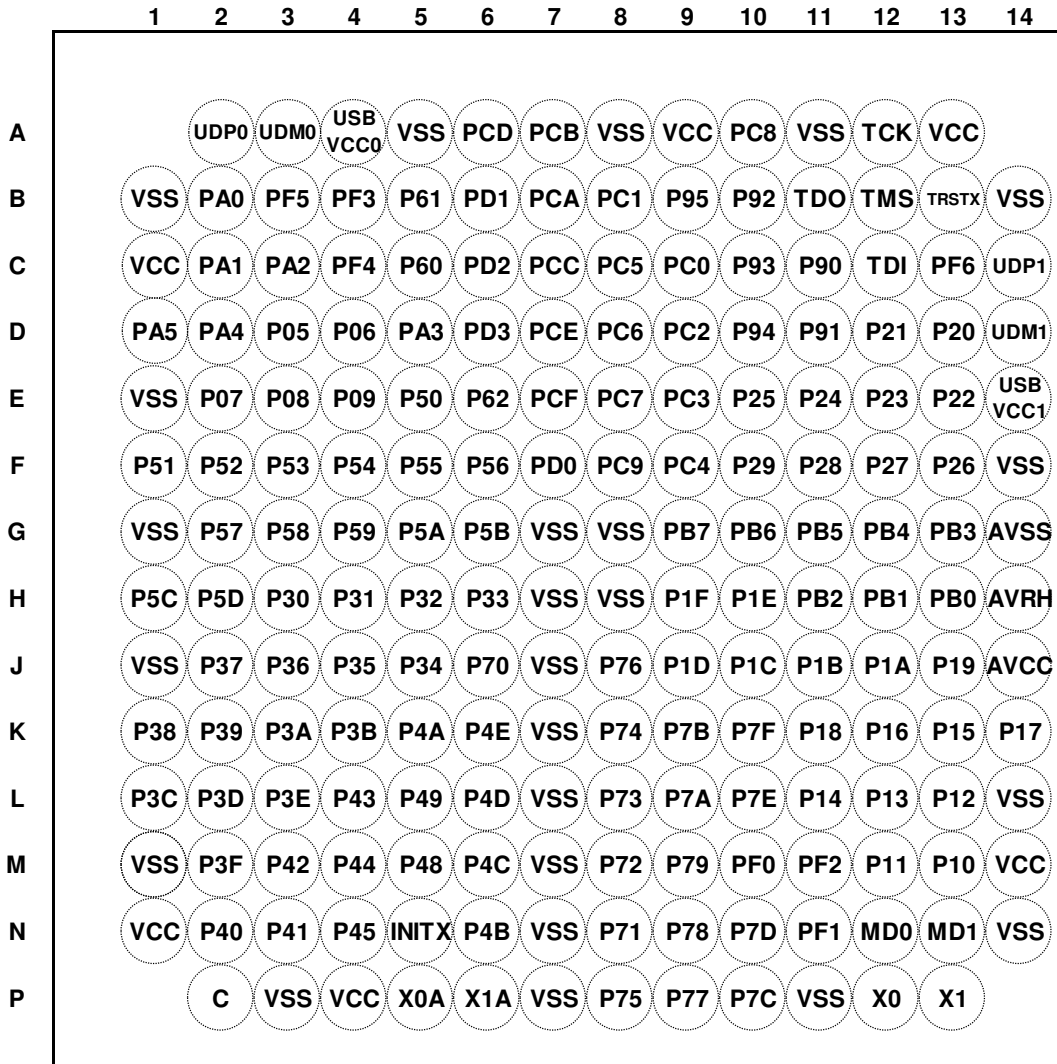
Note:

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

(TOP VIEW)



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		
			RX0_2		
			IC13_0		
INT03_0					
7	7	D1	PA5	G	H
			RTO25_0		
			TX0_2		
			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					
10	10	E2	P07	E	G
			TRACED2		
			ADTG_0		
			SCK4_2		

Pin No			Pin Name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
11	11	E3	P08	E	G
			TRACED3		
			TIOA00_2		
			CTS4_2		
12	12	E4	P09	E	G
			TRACECLK		
			TIOB00_2		
			RTS4_2		
13	13	E5	DTT12X_0	E	H
			P50		
			INT00_0		
			AIN0_2		
			SIN3_1		
			RTO10_0		
14	14	F1	IC20_0	E	H
			MOEX_0		
			P51		
			INT01_0		
			BIN0_2		
			SOT3_1		
15	15	F2	RTO11_0	E	H
			IC21_0		
			MWEX_0		
			P52		
			INT02_0		
			ZIN0_2		
16	16	F3	SCK3_1	E	H
			RTO12_0		
			IC22_0		
			MDQM0_0		
			P53		
			SIN6_0		
17	17	F4	TIOA01_2	E	I
			INT07_2		
			RTO13_0		
			IC23_0		
			MDQM1_0		
			P54		
18	18	F5	SOT6_0	E	I
			TIOB01_2		
			RTO14_0		
			MALE_0		
19	19	F6	P55	E	H
			SCK6_0		
			ADTG_1		
			RTO15_0		
19	19	F6	MRDY_0	E	H
			P56		
			SIN1_0		
			INT08_2		
			TIOA09_2		
19	19	F6	DTT11X_0	E	H
			MNALE_0		

Pin No			Pin Name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
20	20	G2	P57	E	H
			SOT1_0		
			TIOB09_2		
			INT16_1		
			MNCLE_0		
21	21	G3	P58	E	H
			SCK1_0		
			TIOA11_2		
			INT17_1		
			MNWEX_0		
22	22	G4	P59	E	H
			SIN7_0		
			RX1_1		
			TIOB11_2		
			INT09_2		
23	23	G5	P5A	E	H
			SOT7_0		
			TX1_1		
			TIOA13_1		
			INT18_1		
24	24	G6	MCSX0_0	E	H
			P5B		
			SCK7_0		
			TIOB13_1		
			INT19_1		
25	-	H1	MCSX1_0	E	H
			P5C		
			TIOA06_2		
			INT28_0		
26	-	H2	IC20_1	E	H
			P5D		
			TIOB06_2		
			INT29_0		
27	25	J1	DTT12X_1	-	
			VSS		
			P30		
			AIN0_0		
28	-	H3	TIOB00_1	E	H
			INT03_2		
			P31		
			BIN0_0		
29	-	H4	TIOB01_1	E	H
			SCK6_1		
			INT04_2		
			P32		
30	-	H5	ZIN0_0	E	H
			TIOB02_1		
			SOT6_1		
			INT05_2		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
31	-	H6	P33	E	H
			INT04_0		
			TIOB03_1		
			SIN6_1		
			ADTG_6		
32	-	J4	P34	E	I
			FRCK0_0		
			TX0_1		
			TIOB04_1		
33	-	J4	P35	E	H
			IC03_0		
			RX0_1		
			TIOB05_1		
34	26	J3	INT08_1	E	H
			P36		
			IC02_0		
			SIN5_2		
			INT09_1		
35	27	J2	TIOA12_2	E	H
			MCSX2_0		
			P37		
			IC01_0		
			SOT5_2		
			INT10_1		
36	28	K1	TIOB12_2	E	H
			MCSX3_0		
			P38		
			IC00_0		
			SCK5_2		
37	29	K2	INT11_1	E	I
			MCLKOUT_0		
			P39		
38	30	K3	DTTIOX_0	G	I
			ADTG_2		
			P3A		
39	31	K4	RTO00_0	G	I
			TIOA00_1		
			P3B		
40	32	L1	RTO01_0	G	I
			TIOA01_1		
			P3C		
41	33	L2	RTO02_0	G	I
			TIOA02_1		
			P3D		
42	34	L3	RTO03_0	G	I
			TIOA03_1		
			P3E		
			RTO04_0	G	I
			TIOA04_1		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
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		
			INT12_1		
47	39	N3	P41	G	H
			TIOA01_0		
			RTO11_1		
			INT13_1		
48	40	M3	P42	G	I
			TIOA02_0		
			RTO12_1		
49	41	L4	P43	G	I
			TIOA03_0		
			RTO13_1		
			ADTG_7		
50	42	M4	P44	G	I
			TIOA04_0		
			RTO14_1		
51	43	N4	P45	G	I
			TIOA05_0		
			RTO15_1		
52	44	P2	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		
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		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
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		
			TX0_0		
			MADATA05_0		
66	58	N8	P71	E	H
			INT13_2		
			TIOB04_2		
			RX0_0		
MADATA06_0					
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					

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
71	63	J8	P76	E	H
			SOT3_0		
			TIOA07_2		
			INT11_2		
72	64	P9	MADATA11_0	E	H
			P77		
			SCK3_0		
			TIOB07_2		
73	65	N9	INT12_2	E	I
			MADATA12_0		
			P78		
			AIN1_0		
74	66	M9	TIOA15_0	E	H
			MADATA13_0		
			P79		
			BIN1_0		
-	-	E1	VSS	-	-
-	-	G1	VSS	-	-
75	67	L9	TIOB15_0	E	H
			INT23_1		
			MADATA14_0		
			P7A		
76	-	K9	ZIN1_0	E	H
			INT24_1		
			MADATA15_0		
77	-	P10	P7B	E	H
			TIOB07_0		
			INT10_0		
78	-	N10	P7C	E	H
			TIOA07_0		
			INT11_0		
79	-	L10	P7D	E	H
			TIOA14_1		
			FRCK2_1		
			INT12_0		
80	-	K10	P7E	E	H
			TIOB14_1		
			IC21_1		
			INT24_0		
81	-	M10	P7F	E	H
			TIOA15_1		
			IC22_1		
			INT25_0		
82	-	N11	PF0	I*	H
			TIOB15_1		
			SIN1_2		
			INT13_0		
82	-	N11	IC23_1	I*	H
			PF1		
			TIOA08_1		
			SOT1_2		
			INT14_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
83	-	M11	PF2	I*	H
			TIOB08_1		
			SCK1_2		
			INT15_0		
84	68	N13	PE0	C	P
			MD1		
85	69	N12	MD0	J	D
86	70	P12	PE2	A	A
			X0		
87	71	P13	PE3	A	B
			X1		
88	72	N14	VSS	-	
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		
			RX1_2		
			INT02_1		
			FRCK0_2		
			MCSX6_0		
92	76	L13	P12	F	K
			AN02		
			SOT1_1		
			TX1_2		
			IC00_2		
			MCSX5_0		
93	77	L12	P13	F	K
			AN03		
			SCK1_1		
			IC01_2		
			MCSX4_0		
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		
			MAD01_0		
96	80	K12	P16	F	L
			AN06		
			SCK0_1		
			INT20_1		
			MAD02_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
97	81	K14	P17	F	L
			AN07		
			SIN2_2		
			INT04_1		
			MAD03_0		
-	-	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		
104	88	H10	P1E	F	L
			AN14		
			RTS4_1		
			INT28_1		
			TIOA15_2		
			DTTIOX_1		
MAD10_0					

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
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		
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		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
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		
120	96	F12	MAD13_0	F	L
			P27		
			AN26		
			INT02_2		
			RTO04_1		
121	97	F13	MAD14_0	F	K
			P26		
			AN27		
			SCK2_1		
			RTO03_1		
122	98	E10	MAD15_0	F	K
			P25		
			AN28		
			SOT2_1		
			TX1_0		
123	99	E11	RTO02_1	F	L
			MAD16_0		
			P24		
			AN29		
			SIN2_1		
124	100	E12	RX1_0	F	K
			INT01_2		
			RTO01_1		
			MAD17_0		
			P23		
125	101	E13	AN30	F	K
			SCK0_0		
			TIOA07_1		
			RTO00_1		
			P22		
126	102	D12	AN31	E	H
			SOT0_0		
			TIOB07_1		
			ZIN1_1		
126	102	D12	P21	E	H
			SIN0_0		
			INT06_1		
			BIN1_1		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
127	103	D13	P20	E	H
			INT05_0		
			CROUT_0		
			UHCONX1		
			AIN1_1		
128	104	C13	MAD18_0	I*	J
			PF6		
			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		
137	113	B12	P03	E	E
			TMS		
			SWDIO		
138	114	B11	P04	E	E
			TDO		
			SWO		
139	-	C11	P90	E	H
			TIOB08_0		
			RTO20_1		
			INT30_0		
			MAD19_0		
-	-	A8	VSS	-	
140	-	D11	P91	E	H
			TIOB09_0		
			RTO21_1		
			INT31_0		
141	-	B10	MAD20_0	E	I
			P92		
			TIOB10_0		
			RTO22_1		
			SIN5_1		
142	-	C10	MAD21_0	E	I
			P93		
			TIOB11_0		
			RTO23_1		
			SOT5_1		
			MAD22_0		

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
143	-	D10	P94	E	H
			TIOB12_0		
			RTO24_1		
			SCK5_1		
			INT26_0		
MAD23_0					
144	-	B9	P95	E	H
			TIOB13_0		
			RTO25_1		
			INT27_0		
MAD24_0					
145	115	C9	PC0	K	Q
146	116	B8	PC1	K	Q
147	117	D9	PC2	K	Q
148	118	E9	PC3	K	Q
			TIOA06_1		
149	119	F9	PC4	K	Q
			TIOA08_2		
150	120	C8	PC5	K	Q
			TIOA10_2		
-	-	A5	VSS	-	
151	121	D8	PC6	K	Q
			TIOA14_0		
152	122	E8	PC7	L	Q
			CROUT_1		
153	123	A10	PC8	K	Q
154	124	F8	PC9	K	Q
155	125	B7	PCA	K	Q
156	126	A9	VCC	-	
157	127	A11	VSS	-	
158	128	A7	PCB	L	Q
159	129	C7	PCC	K	Q
160	130	A6	PCD	K	Q
161	131	D7	PCE	L	Q
			RTS4_0		
			TIOB06_1		
162	132	E7	PCF	L	Q
			CTS4_0		
			TIOB08_2		
163	133	F7	PD0	L	R
			SCK4_0		
			TIOB10_2		
			INT30_1		
164	134	B6	PD1	L	R
			SOT4_0		
			TIOB14_0		
			INT31_1		
-	-	N7	VSS	-	
-	-	G8	VSS	-	
-	-	H7	VSS	-	
-	-	H8	VSS	-	

Pin No			Pin name	I/O circuit type	Pin state type
LQFP-176	LQFP-144	BGA-192			
165	135	C6	PD2	L	R
			SIN4_0		
			TIOA03_2		
			INT00_2		
166	136	D6	PD3	L	Q
			TIOB03_2		
167	137	E6	P62	E	Q
			SCK5_0		
			ADTG_3		
168	138	B5	P61	E	I
			SOT5_0		
			TIOB02_2		
			UHCONX0		
169	139	C5	P60	E	H
			SIN5_0		
			TIOA02_2		
			INT15_1		
170	-	B4	PF3	I*	H
			TIOA06_0		
			SIN6_2		
			INT06_0		
			AIN2_1		
171	-	C4	PF4	I*	H
			TIOB06_0		
			SOT6_2		
			INT07_0		
			BIN2_1		
172	140	B3	PF5	I*	H
			SCK6_2		
			INT08_0		
			ZIN2_1		
173	141	A4	USBVCC0	-	
174	142	A3	P80	H	O
			UDM0		
175	143	A2	P81	H	O
			UDP0		
176	144	B1	VSS	-	
-	-	M7	VSS	-	

*: 5 V tolerant I/O