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#### What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

### Applications of "<u>Embedded -</u> <u>Microcontrollers</u>"

### Details

Details	
Product Status	Obsolete
Core Processor	FR81S
Core Size	32-Bit Single-Core
Speed	80MHz
Connectivity	CANbus, CSIO, EBI/EMI, LINbus, UART/USART
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	156
Program Memory Size	1.0625MB (1.0625M x 8)
Program Memory Type	FLASH
EEPROM Size	64K x 8
RAM Size	872K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 32x8/10b
Oscillator Type	External
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	208-LQFP
Supplier Device Package	208-LQFP (28x28)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/mb91f594bspmc-gsk5e1

Address: Room A, 16/F, Full Win Commercial Centre, 573 Nathan Road, Mongkok, Hong Kong



# **MB91590 Series**

# FR Family FR81S 32-Bit Microcontroller

This series is Cypress 32-bit microcontroller designed for automotive and industrial control applications. It contains the FR81S CPU that is compatible with the FR family. The FR81S has a high level performance among the Cypress FR family by enhancing CPU instruction pipeline and load store processing, and improving internal bus transfer. It is best suited for application control for automotive.

# **Features**

### **FR81S CPU Core**

- 32-bit RISC, load/store architecture, pipeline 5-stage structure
- ■Maximum operating frequency:

128 MHz (Source oscillation = 4.0 MHz and 32 multiplied (PLL clock multiplication system))

It shows maximum CPU frequency of series. The specification of each part number can be referred in "Product Lineup" and "Electrical Characteristics."

- ■General-purpose register : 32 bits ×16 sets
- 16-bit fixed length instructions (basic instruction), 1 instruction per cycle
- Instructions appropriate to embedded applications
   Memory-to-memory transfer instruction
   Bit processing instruction
   Barrel shift instruction etc.
- High-level language support instructions
  - □ Function entry/exit instructions
- □ Register content multi-load and store instructions
- Bit search instructions
- □ Logical 1 detection, 0 detection, and change-point detection
- Branch instructions with delay slot
   Reduced overhead during branch process
- Register interlock function □ Easy assembler writing
- The support at the built-in / instruction level of the multiplier □ Signed 32-bit multiplication : 5 cycles □ Signed 16-bit multiplication : 3 cycles
- Interrupt (PC/PS saving) □ 6 cycles (16 priority levels)
- The Harvard architecture allows simultaneous execution of program and data access.
- ■Instruction compatibility with the FR Family
- ■Built-in memory protection function (MPU)
  - □ Eight protection areas can be specified commonly for instructions and the data.
  - Control access privilege in both privilege mode and user mode.

■Built-in FPU (floating point arithmetic) □ IEEE754 compliant

□ Floating-point register 32-bit × 16 sets

# **Peripheral Functions**

Clock generation (equipped with SSCG function)
 Main oscillation (4MHz)
 Sub oscillation (32kHz) or none sub oscillation
 PLL multiplication rate : 1 to 32 times

- Built-in Program flash memory capacity 2048 + 64KB (series maximum)
- Built-in Data flash memory capacity(WorkFlash) 64KB
- ■Built-in RAM capacity
  □ Main RAM 192KB (Series maximum)
  □ Sub RAM (on AHB) 64KB (Series maximum)
  □ Backup RAM 8KB
- ■General-purpose ports (5V Pin) : 63 (dual clock products : 61)
   □ Included I<sup>2</sup>C pseudo open drain support ports : 4
- ■General-purpose ports (3V Pin) : 93
   □ Included 48 combined external bus interface (For GDC external memory I/F)
- External bus interface
   GDC external memory for I/F use
   25-bit address, 16-bit data
   Power supply voltage fixed to 3.3V
- ■DMA Controller

□ Up to 16 channels can be started simultaneously. □ 2 transfer factors (Internal peripheral request and software)

- ■A/D converter (successive approximation type)
   □ 8/10-bit resolution : 32 channels
   □ Conversion time : 3µs
- External interrupt input: 16 channels Level ("H" / "L"), or edge detection (rising or falling) enabled

### LIN-UART

- □ 6 channels, ch.2 to ch.7
- □ UART, synchronous mode, LIN-UART mode is selectable.
- □ LIN protocol Revision 2.1 is supported
- SPI (Serial Peripheral Interface) supported (synchronous mode)
- □ Full-duplex double buffering system
- LIN synch break detection (linked to the input capture)
- Built-in dedicated baud rate generator
- DMA transfer support

Cypress Semiconductor Corporation Document Number: 002-04727 Rev. \*B 198 Champion Court •



Item	Product	MB91F592B /BS	MB91F592BH /BHS	MB91F594B /BS	MB91F594BH /BHS				
CPU core		FR81S							
Technology		90nm							
Package		LQFP208							
Sub clock		Yes (Non-S series) No (S series)							
Maximum CPU operative operative operative operation oper	ating	80MHz							
Maximum GDC oper frequency	ating	81MHz							
Built-in CR oscillator		100kHz							
System clock		On chip PLL							
	Main	576KB		1088KB					
Flash	Work	64KB							
	Main	40KB		64KB					
RAM	Backup	8KB							
VRAM	• • •	800KB							
		1ch Hardware							
Watchdog timer		1ch Software							
Clock supervisor		Initial value "ON"	Initial value "OFF"	Initial value "ON"	Initial value "OFF"				
Low-voltage detectio (External low-voltage		Yes							
Low-voltage detection reset (Internal low-voltage detection)		Yes							
NMI function		Yes							
DMA Controller		16ch							
CAN		1ch (64msg) 2ch (32msg)							
LIN-UART		6ch							
Multi-function Serial	Interface	2ch							
A/D converter (8bit/1		1unit/32ch							
Reload timer(16bit)	0.0.1	4ch							
Base timer(16bit)		2ch							
Free-run timer(32bit)		2ch							
Input capture(32bit)		6ch							
Output compare(32b	it)	4ch							
PPG timer(16bit)	/	24ch							
Sound generator		5ch							
Real-time clock		Yes							
External interrupt		16ch							
CR/SUB compensation function		Yes							
CRC generation		Yes							
Stepping motor control		6ch							
Stop mode (including power									
shut-off)		Supported							
Power supply voltage		MICOM:4.5V to 5.5V GDC:3.0V to 3.6V							
Operating temperatu	re	-40°C to +105°C							
Allowable power [mV		1250							
Others	-	Flash product							
On chip debugger		Yes							



Item	Product	MB91F59AC /F59ACS	MB91F59ACH /F59ACHS	MB91F59BC /F59BCS	MB91F59BCH /F59BCHS				
CPU core		FR81S							
Technology		90nm							
Package		BGA320/TEQFP-2	208* <sup>1</sup>						
Sub clock		Yes (Non-S series No (S series)	)						
Maximum CPU ope frequency	rating	128MHz							
Maximum GDC ope	erating	81MHz							
Built-in CR oscillato	r	100kHz							
System clock	1	On chip PLL							
	Main	1600KB		2112KB					
Flash	Work <sup>*2</sup>	64KB		ZHZRD					
	Main	192KB							
	Sub on								
RAM	AHB	64KB							
	Backup	8KB							
VRAM	h	1792KB							
Watchdog timer		1ch Hardware 1ch Software							
Clock supervisor		Initial value "ON"	Initial value "OFF"	Initial value "ON"	Initial value "OFF"				
Low-voltage detecti (External low-voltag		Yes							
Low-voltage detecti (Internal low-voltage	on reset	Yes							
NMI function		Yes							
DMA Controller		16ch							
CAN		1ch (64msg) 2ch (32msg)							
LIN-UART		6ch							
Multi-function Seria	I Interface	6ch <sup>3</sup>							
High Speed SPI (G		Yes							
A/D converter (8bit/		1unit/32ch							
Up/down counter(10		3ch							
Reload timer(16bit)	/	8ch							
Base timer(16bit)		2ch							
Free-run timer(32bi	t)	8ch							
Input capture(32bit)		12ch							
Output compare(32		4ch							
PPG timer(16bit)		24ch							
Sound generator		5ch							
Real-time clock		Yes							
External interrupt									
CR/SUB compensation function		Yes							
CRC generation		Yes							
Stepping motor control		6ch							
Stop mode (includir shut-off)	ng power	Supported							
Power supply voltage		MICOM:4.5V to 5.5V GDC:3.0V to 3.6V							
Operating temperat	ure	-40°C to +105°C							
Allowable power [m		2500							
Others	4	Flash product							
JTAG Boundary Sca	an Test	Yes (Only support BGA package products)							
On chip debugger		Yes							





Pin No.	Pin Name	Polarity	I/O Circuit Types <sup>*1</sup>	Function <sup>*2</sup>				
	P107	-		General-purpose I/O port				
	SGO4_1	-		Sound generator ch.4 SGO output pin				
121	AN7	-	с	ADC Analog 7 input pin				
121	PPG5_1	-		PPG ch.5 output pin (1)				
	TOT7_1	-		Reload timer ch.7 output pin (1) (MB91F59A/B only)				
	ICU11_1	-		Input capture ch.11 input pin (1) (MB91F59A/B only)				
	P110	-		General-purpose I/O port				
	TX1	-		CAN transmission data1 output pin				
101	PPG1_2	-	С	PPG ch.1 output pin (2)				
	FRCK5	-		Free-run timer 5 clock input pin(MB91F59A/B only)				
	TOT8_1	-		Reload timer ch.8 output pin (1) (MB91F59A/B only)				
	P111	_		General-purpose I/O port				
	RX1	_	-	CAN reception data 1 input pin				
	INT10	_		INT10 External interrupt input pin				
102	PPG2_2	_	С	PPG ch.2 output pin (2)				
	FRCK6	_		Free-run timer 6 clock input pin(MB91F59A/B only)				
	TOT9_1	-	-	Reload timer ch.9 output pin (1) (MB91F59A/B only)				
	P112	_		General-purpose I/O port				
	TX2	_		CAN transmission data 2 output pin				
158	PPG3_2	_	С	PPG ch.3 output pin (2)				
	TOT10_1	-	-	Reload timer ch.10 output pin (1) (MB91F59A/B only)				
	P113	<u> </u>		General-purpose I/O port				
		_		CAN reception data 2 input pin				
150	10.2		с	INT11 External interrupt input pin				
159 INT11 PPG4_2		-						
	TIN7	-	-	PPG ch.4 output pin (2) Reload timer ch.7 event input pin(MB91F59A/B only)				
		-						
	P114 SGA2	-	-	General-purpose I/O port				
	SCK3	-	-	Sound generator ch.2 SGA output pin				
160	TRG3	-		LIN-UART ch.3 clock I/O pin				
162		-	С	PPG trigger 3 input pin (ch.12 to ch.15)				
	TIN1	-	-	Reload timer ch.1 event input pin				
	ICU5_1	-	-	Input capture ch.5 input pin (1)				
	FRCK7	-		Free-run timer 7 clock input pin(MB91F59A/B only)				
	P115	-	_	General-purpose I/O port				
400	SGO2	-		Sound generator ch.2 SGO output pin				
163	SIN4	-	С	LIN-UART ch.4 serial data input pin				
	TIN2	-		Reload timer ch.2 event input pin				
	FRCK4	-		Free-run timer 4 clock input pin(MB91F59A/B only)				
	P116	-	_	General-purpose I/O port				
	SGA3	-	4_	Sound generator ch.3 SGA output pin				
164	SOT4	-	c	LIN-UART ch.4 serial data output pin				
	TIN3	-	4	Reload timer ch.3 event input pin				
	FRCK3	-		Free-run timer 3 clock input pin(MB91F59A/B only)				
	P117	-	-	General-purpose I/O port				
	SGO3	-	]	Sound generator ch.3 SGO output pin				
165	SCK4	-	с	LIN-UART ch.4 clock I/O pin				
100	TRG4	-		PPG trigger 4 input pin (ch.16 to ch.19)				
	TOT0	-	]	Reload timer ch.0 output pin				
	FRCK2	-		Free-run timer 2 clock input pin(MB91F59A/B only)				





SIN11         -         Multi-function serial ch.11 serial data input pin(MB91F59A/B only)           109         P124         -         General-purpose I/O port           109         P124         -         Output compare ch.2 output pin           109         PPG9_2         -         Output compare ch.3 output pin           109         PPG9_2         -         A           109         PPG9_2         -         A           109         PPG9_2         -         A           109         PU25         -         Output compare ch.3 output pin           110         P125         -         Output compare ch.3 output pin           110         PPG10_2         -         A           110         PP	Pin No.	Pin Name	Polarity	I/O Circuit Types <sup>*1</sup>	Function <sup>*2</sup>				
SIN5         -         C         LIN-UART ch.5 serial data input pin           166         INT6         -         INT6 External interrupt input pin           17011         -         PPG.2         -           1707         -         PPG.5.2         -           1707         -         PPG.6.5 output pin (2)         -           1707         -         FRCK0         -           1707         -         -         Free-run timer 0 clock input pin           1707         -         -         PPG.6.6 output pin (2)           1707         -         -         PPG.6.6 output pin           1707         -         -         PPG.6.6 output pin           1707         -         -         PPG.6.6 output pin           1707         -         -         PPG.6.7 output pin           168         SCK5         -         C         LIN-UART ch.5 serial data output pin           168         SCK5         -         C         Unput compare ch.2 output pin           168         SCK5         -         C         LIN-UART ch.5 serial data output pin           168         SCK5         -         C         Unput compare ch.2 output pin (2)           160		P120	—		General-purpose I/O port				
INT6         -         C         INT6 External interrupt input pin           TOT1         -         PPG5_2         -           PPG5_2         -         PPG ch.5 output pin         PPG ch.5 output pin           167         SOT5         -         FRCK0         -           167         SOT5         -         C         Free-run timer 0 clock input pin           167         SOT5         -         C         Free-run timer 0 clock input pin           168         SOT5         -         C         General-purpose I/O port           168         SOK5         -         C         General-purpose I/O port           168         SOK5         -         C         C         General-purpose I/O port           168         SOK5         -         C         C         General-purpose I/O port           0CU0         -         Output compare ch.0 output pin         P         P           108         PPG2_2         -         P         P         C         Output compare ch.1 output pin           108         PPG8_2         -         A         A         General-purpose I/O port         Output compare ch.2 output pin           109         P124         -         OCU         <		FRCK1	-		Free-run timer 1 clock input pin				
IN16         -           TOT1         -           PPG5_2         -           PPG7         -           FRCK0         -           INT7         -           TOT2         -           PPG6_2         -           PPG6_2         -           PPG6_2         -           OCU0         -           OCU1         -           PPG7_2         -           PPG ch.3 output pin         2)           OCU1         -           OCU1         -           PPG ch.3 output pin         2)           IN8         -           IN9         -           IN10         -	166	SIN5	-		LIN-UART ch.5 serial data input pin				
PPG5_2         -         PPG ch.5 output pin (2)           167         P121         -         -           167         FRCK0         -         -           1107         -         -         FRCK0         -           1107         -         -         Free-run timer 0 clock input pin         -           1107         -         -         PFGc.5 serial data output pin         -           1107         -         -         PFGc.6.5 output pin (2)         -           1108         P122         -         -         PFG ch.6 output pin (2)         -           1108         SCK5         -         C         UN-UART ch.5 clock I/O pin         -           1108         PFG.2         -         -         PFG ch.6 output pin (2)         -           1108         PFG.2         -         C         UN-UART ch.5 clock I/O pin         -           1108         PFG.2         -         C         UN-UART ch.5 clock I/O pin         -           1108         PFG.2         -         C         UN-UART ch.5 clock I/O pin         -           1108         PFG.2         -         C         Output compare ch.1 output pin         -           1108	100	INT6	-	C	INT6 External interrupt input pin				
P121         -         General-purpose I/O port           167         SOT5         -         INT7         -           107         TOT2         -         P         Free-run timer 0 clock input pin           1NT7         -         TOT2         -         P           108         P122         -         OCU0         -         PPG ch.6 output pin (2)           168         SCK5         -         C         C         UIN-UART ch.5 clock I/O pin           168         SCK5         -         C         C         UIN-UART ch.5 clock I/O pin           168         SCK5         -         C         C         UIN-UART ch.5 clock I/O pin           168         SCK5         -         C         C         IIN-UART ch.5 clock I/O pin           168         SCK5         -         C         C         IIN-UART ch.5 clock I/O pin           168         SCK5         -         C         C         IIN-UART ch.5 clock I/O pin           169         PPG7_2         -         P         PG ch.7 output pin (2)         P           108         P         -         A         General-purpose I/O port         Output compare ch.2 output pin           108         P		TOT1	-		Reload timer ch.1 output pin				
FRCK0         -           167         SOT5         -           1NT7         -         -           TOT2         -         PP66_2           PP66_2         -         PPG ch.6 output pin           168         SCK5         -           168         SCK5         -           TOT3         -         PPG ch.6 output pin           PP7_2         -         Output compare ch.0 output pin           108         PP7_2         -           PP67_2         -         PPG ch.7 output pin           108         PP68_2         -           PP68_2         -         PPG ch.8 output pin           108         PP68_2         -           108         PP68_2         -           108         PP69_2         -           108         PP69_2         -           109         P124         -           0CU2         -         Output compare ch.2 output pin           109         P124         -           0CU2         -         Input capture ch.5 input pin(MB91F59A/B only)           109         P125         -           100         PV6 ch.9 output pin (2)           P		PPG5_2	-	-	PPG ch.5 output pin (2)				
SOT5         -         C         LIN-UART ch.5 serial data output pin           167         INT7         -         INT7         -           TOT2         -         PP66_2         -         PPG ch.6 output pin           PP66_2         -         PPG ch.6 output pin         PPG ch.2 output pin           168         SCK5         -         C         LIN-UART ch.5 serial data output pin           168         SCK5         -         C         Output compare ch.0 output pin           168         SCK5         -         C         LIN-UART ch.5 clock I/O pin           168         SCK5         -         C         Unput compare ch.0 output pin           168         SCK5         -         C         Unput compare ch.0 output pin           168         SCK5         -         C         Unput compare ch.0 output pin           108         PP67_2         -         PPG ch.7 output pin (2)         Output compare ch.1 output pin           108         PP68_2         -         A         PPG ch.8 output pin (2)           109         P124         -         OcU2         Output compare ch.2 output pin           109         P124         -         OcU2         Output capture ch.9 input pin (2)      <		P121	-		General-purpose I/O port				
SOT5         -         C         LIN-UART ch.5 serial data output pin           167         INT7         -         INT7         -           TOT2         -         PP66_2         -         PPG ch.6 output pin           PP66_2         -         PPG ch.6 output pin         PPG ch.2 output pin           168         SCK5         -         C         LIN-UART ch.5 serial data output pin           168         SCK5         -         C         Output compare ch.0 output pin           168         SCK5         -         C         LIN-UART ch.5 clock I/O pin           168         SCK5         -         C         Unput compare ch.0 output pin           168         SCK5         -         C         Unput compare ch.0 output pin           168         SCK5         -         C         Unput compare ch.0 output pin           108         PP67_2         -         PPG ch.7 output pin (2)         Output compare ch.1 output pin           108         PP68_2         -         A         PPG ch.8 output pin (2)           109         P124         -         OcU2         Output compare ch.2 output pin           109         P124         -         OcU2         Output capture ch.9 input pin (2)      <		FRCK0	_		Free-run timer 0 clock input pin				
IN17         -         IN17 External interrupt input pin           TOT2         -         Reload timer ch.2 output pin           PPG6_2         -         PPG ch.6 output pin (2)           168         SCK5         -         C           TOT3         -         PPG ch.6 output pin (2)           PPG7_2         -         Output compare ch.0 output pin           PPG7_2         -         PPG ch.7 output pin (2)           PPG8_2         -         General-purpose I/O port           OCU1         -         PPG ch.8 output pin (2)           PPG8_2         -         Output compare ch.1 output pin           OCU1         -         PPG ch.8 output pin (2)           TIN8         -         Output compare ch.1 output pin           IN11         -         PPG ch.8 output pin (2)           Reload timer ch.8 event input pin(MB91F59A/B only         Multi-function serial ch.11 serial data input pin(MB91F59A/B only)           ID9         PPG9_2         -         A           109         PPG10_2         -           110         PP125         -           110         PP126         -           110         PP126         -           110         PP126         -	407	SOT5	-		LIN-UART ch.5 serial data output pin				
PPG6_2         -         PPG ch.6 output pin (2)           0CU0         -         General-purpose I/O port           0CU0         -         Output compare ch.0 output pin           168         SCK5         -         C           TOT3         -         PPG ch.6 output pin         Output compare ch.0 output pin           108         PPG7_2         -         PPG ch.7 output pin (2)           P123         -         Output compare ch.1 output pin           0CU1         -         PPG ch.7 output pin (2)           PPG ch.7 output pin (2)         PPG ch.8 output pin (2)           0CU1         -         Output compare ch.1 output pin           0CU1         -         PPG ch.8 output pin (2)           Reload timer ch.8 event input pin(MB91F59A/B only         Multi-function serial ch.11 serial data input pin(MB91F59A/B only)           109         P124         -         Output compare ch.2 output pin           109         P124         -         Output compare ch.2 output pin           109         P124         -         Output compare ch.2 output pin           109         P124         -         Output compare ch.3 output pin           109         P125         -         Output compare ch.3 output pin           1000 <td>167</td> <td>INT7</td> <td>-</td> <td>C</td> <td>INT7 External interrupt input pin</td>	167	INT7	-	C	INT7 External interrupt input pin				
P122         -         General-purpose I/O port           168         SCK5         -         C         Unput compare ch.0 output pin           168         SCK5         -         C         LIN-UART ch.5 clock I/O pin           108         PPG7_2         -         PPG ch.7 output pin (2)           108         PPG8_2         -         A           108         PPG9_2         -         A           109         PP24         -         OcU2           109         PP24         -         General-purpose I/O port           109         PP32         -         A           109         PP32         -         A           109         PP32         -         A           110         PP33         -         OcU2         -           110         F119         -         General-purpose I/O port         Output pin(MB91F59A/B only           110         P125         -         OcU3					Reload timer ch.2 output pin				
P122         -         General-purpose I/O port           0CU0         -         Output compare ch.0 output pin           168         SCK5         -         Output compare ch.0 output pin           108         PPG7_2         -         PPG ch.7 output pin           108         PPG8_2         -         PPG ch.7 output pin           108         PPG8_2         -         Output compare ch.1 output pin           108         PPG8_2         -         A           108         PPG8_2         -         A           108         PPG8_2         -         A           108         PPG8_2         -         A           109         PPG9_2         -         A           110         PPG1_1         -         Output compare ch.2 output pin           110         -         -         Output compare ch.3 output pin           110         PPG10_2         -         A           1100         -					PPG ch.6 output pin (2)				
OCU0         -           168         OCU0         -           108         SCK5         -           PPG7_2         -         PPG (h.7)           0CU1         -         PPG (h.7)           0CU1         -         PPG (h.7)           0CU1         -         PPG (h.7)           0CU1         -         PPG (h.8)           0CU1         -         PPG (h.8)           0CU1         -         PPG (h.8)           0CU1         -         Output compare ch.0 output pin           0CU1         -         PPG (h.8)           0CU1         -         Output compare ch.1 output pin           0CU1         -         Output compare ch.1 output pin           108         TIN8         -           SIN11         -         PPG (h.8)         Output compare ch.1 output pin           109         P124         -         OCU2         Output compare ch.2 output pin         Input capture ch.3 output pin           109         P124         -         OCU2         Output compare ch.2 output pin         Input capture ch.3 output pin           109         P124         -         OCU2         Output compare ch.3 output pin         Input capture ch.3 output pin		P122	_						
168         SCK5         -         C         LIN-UART ch.5 clock I/O pin           TOT3         -         PPG7_2         -         PPG ch.7 output pin (2)           P123         -         OCU1         PPG ch.7 output pin (2)           0CU1         -         Output compare ch.1 output pin           PP68_2         -         A         Reload timer ch.8 output pin (2)           108         PP68_2         -         A         Reload timer ch.8 event input pin(MB91F59A/B onl)           108         -         OCU2         -         PPG ch.8 output pin (2)           109         P124         -         OcU2         -           109         P124         -         OcU2         -           109         PP69_2         -         A         PPG ch.9 output pin (2)           109         PP69_2         -         A         PPG ch.9 output pin (2)           109         PP69_2         -         A         PPG ch.9 output pin (2)           109         P125         -         OcU3         -           110         P125         -         OcU3         -           110         PPG 10_2         -         A         PPG ch.10 output pin (2) <td< td=""><td></td><td>OCU0</td><td>_</td><td>-</td><td></td></td<>		OCU0	_	-					
TOT3         -         Reload timer ch.3 output pin           PPG7_2         -         PPG ch.7 output pin (2)           P123         -         OCU1         -           OCU1         -         PPG ch.7 output pin (2)         Output compare ch.1 output pin           108         PPG8_2         -         A         PPG ch.8 output pin (2)           108         PPG8_2         -         A         PPG ch.8 output pin (2)           108         PI124         -         OCU2         Reload timer ch.8 event input pin(MB91F59A/B only)           P124         -         OcU2         -         Output compare ch.2 output pin           109         PPG9_2         -         A         PPG ch.9 output pin (2)           109         PPG9_2         -         A         PPG ch.9 output pin (2)           110         PPG9_2         -         A         PPG ch.9 output pin (2)           110         SOT11         -         Output compare ch.3 output pin (2)           110         PPG12_2         -         A         General-purpose I/O port           110         OCU3         -         Input capture ch.0 input pin (MB91F59A/B only           110         PPG10_2         -         A         General-purpose I/O p	168	-	_	с					
PPG7_2         -         PPG ch.7 output pin (2)           108         P123         -         General-purpose I/O port           108         PPG8_2         -         A           108         PPG8_2         -         A           108         PPG8_2         -         A           108         PPG8_2         -         A           108         PI24         -         Output compare ch.1 output pin (MB91F59A/B only           109         P124         -         General-purpose I/O port           0CU2         -         Input compare ch.2 output pin           109         PPG9_2         -         A           109         PPG9_2         -         A           109         PPG0_2         -         A           109         PPG12         -         A           109         P125         -         Output compare ch.3 output pin (2)           110         PPG10_2         -         A           110         PPG10_2         -         A           110         PPG10_2         -         A           110         PPG10_2         -         A           110         PPG10_2         -		-	_	-					
P123         -         General-purpose I/O port           108         PPG8_2         -         A         General-purpose I/O port           108         PPG8_2         -         A         PPG ch.8 output pin (2)           108         TIN8         -         Nutli-function serial ch.11 serial data input pin(MB91F59A/B only)           109         P124         -         General-purpose I/O port           109         PFG9_2         -         A           109         PFG9_2         -         A           109         PFG9_2         -         A           109         PG9_2         -         A           110         SOT11         -         Reload timer ch.9 output pin (2)           110         P125         -         General-purpose I/O port           0CU3         -         Input capture ch.0 input pin           110         PPG ch.10 output pin         PPG ch.10 output pin			_	-					
OCU1         -           108         PPG8_2         -           1108         -         Output compare ch.1 output pin           1108         -         PPG8_2           1108         -         PPG ch.8 output pin (2)           1111         -         PPG ch.8 output pin (2)           1111         -         Multi-function serial ch.11 serial data input pin (MB91F59A/B only)           1109         P124         -           1109         P124         -           1109         PPG9_2         -           1109         PPG9_2         -           1109         -         PPG ch.9 output pin (2)           1109         -         PPG ch.9 output pin (2)           110         PPG10_2         -           110         -         A           1100         -         PPG ch.10 output			_						
108         PPG8_2         -         A         PPG ch.8 output pin (2)           118         -         Reload timer ch.8 event input pin(MB91F59A/B only)           119         P124         -           1109         P125         -           1109         P125         -           110         P125         -           110         P125         -           110         P125         -           110         PPG10_2         -           110         P126         -           110         P126         -           110         P126         -           110         - <td></td> <td></td> <td>_</td> <td></td> <td></td>			_						
TIN8         -         A         Reload timer ch.8 event input pin(MB91F59A/B only)           SIN11         -         Multi-function serial ch.11 serial data input pin(MB91F59A/B only)           109         P124         -         OCU2         -           109         P124         -         Output compare ch.2 output pin           109         P125         -         Output compare ch.3 output pin (2)           110         P125         -         Multi-function serial ch.11 serial data output pin (MB91F59A/B only)           110         P125         -         Output compare ch.3 output pin           110         P125         -         Output compare ch.3 output pin           110         PPG10_2         -         A           110 <td< td=""><td></td><td></td><td>_</td><td></td><td></td></td<>			_						
SIN11         -         Multi-function serial ch.11 serial data input pin(MB91F59A/B only)           P124         -         General-purpose I/O port           OCU2         -         Output compare ch.2 output pin           ICU5_2         -         Output compare ch.2 output pin           ICU5_2         -         PPG9_2           TIN9         -         Reload timer ch.9 event input pin(MB91F59A/B only)           SOT11         -         Multi-function serial ch.11 serial data output pin(MB91F59A/B only)           P125         -         Octu3         -           OCU3         -         Output compare ch.3 output pin           ICU0         -         PPG ch.10 output pin (2)           PPG10_2         -         Output compare ch.3 output pin           IN10         -         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B orl         Input capture ch.0 input pin           IN10         -         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B orl         Multi-function serial ch.11 clock I/O pin(MB91F59A/B orl           90         P126         -         PPG trigger 0 input pin (ch.0 to ch.3)           90         P126         -         -           INT1         -         A </td <td>108</td> <td></td> <td>-</td> <td>А</td> <td colspan="5">Reload timer ch.8 event input pin(MB91F59A/B only)</td>	108		-	А	Reload timer ch.8 event input pin(MB91F59A/B only)				
SINT         -         pin(MB91F59A/B only)           P124         -         General-purpose I/O port           OCU2         -         Itus           ICU5_2         -         PPG9_2           TIN9         -         Input capture ch.5 input pin (2)           SOT11         -         PPG ch.9 output pin (2)           SOT11         -         Reload timer ch.9 event input pin(MB91F59A/B only           Multi-function serial ch.11 serial data output pin(MB91F59A/B only)         Multi-function serial ch.11 serial data output pin(MB91F59A/B only)           P125         -         General-purpose I/O port           OCU3         -         Output compare ch.3 output pin           ICU0         -         PPG ch.10 output pin (2)           TIN10         -         PPG ch.10 output pin           PPG ch.10 output pin         PPG ch.10 output pin           Input capture ch.0 input pin         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B or         Multi-function serial ch.11 clock I/O pin(MB91F59A/B or           90         TRG0         -         PPG trigger 0 input pin (ch.0 to ch.3)           90         TRG0         -         PPG trigger 0 input pin (ch.0 to ch.3)           Multi-function serial ch.0 serial data input pin         INT1 External int	TIN8			-					
OCU2         -           109         PC9_2         -           109         PPG9_2         -           109         PPG9_2         -           109         PG9_2         -           109         PG9_2         -           109         PG9_2         -           109         PG9_2         -           109         -         PPG ch.9 output pin (2)           PPG ch.9 output pin (2)         PPG ch.9 output pin (2)           Reload timer ch.9 event input pin(MB91F59A/B only)         Multi-function serial ch.11 serial data output pin (MB91F59A/B only)           P125         -         Octuat         General-purpose I/O port           OCU3         -         Input capture ch.0 input pin           ICU0         -         PPG ch.10 output pin (2)           ITIN10         -         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B orly)         Nulti-function serial ch.11 clock I/O pin(MB91F59A/B orly)           90         P126         -           91         P126         -           92         P126         -           93         P126         -           94         P126         -           95		-	-		pin(MB91F59A/B only)				
ICU5_2         -           109         PPG9_2         -           1109         -         Input capture ch.5 input pin (2)           1109         -         Reload timer ch.9 event input pin(MB91F59A/B only)           110         SOT11         -           110         P125         -           0CU3         -         General-purpose I/O port           0CU3         -         Output compare ch.3 output pin           110         PPG10_2         -           110         -         A           110         -         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B only)         Nulti-funct			-	-					
109         PPG9_2         -         A         PPG ch.9 output pin (2)           TIN9         -         Reload timer ch.9 event input pin(MB91F59A/B only           SOT11         -         Multi-function serial ch.11 serial data output pin(MB91F59A/B only)           P125         -         OCU3         -           ICU0         -         OUtput compare ch.3 output pin         Output compare ch.3 output pin           ICU0         -         PPG ch.10 output pin (2)         Output compare ch.3 output pin           IN10         -         PPG ch.10 output pin (2)         Reload timer ch.10 event input pin(MB91F59A/B orly           IN10         -         PPG ch.10 output pin (2)         Reload timer ch.10 event input pin(MB91F59A/B orly           90         P126         -         Multi-function serial ch.11 clock I/O pin(MB91F59A/B orly)           90         P126         -         PPG trigger 0 input pin (ch.0 to ch.3)           90         SIN0         -         A           90         INT1         -         A			-	-					
TIN9-TIN9-SOT11-P125-OCU3-ICU0-ICU0-PPG10_2-TIN10-SCK11-P126-SCK11-P126-SCK11-P126-TRG0-NU10-P126-TRG0-NU10-P126-TRG0-NU10-IN10-IN10-IN10-IN10-IN10-IN10-IN10-IN10-IN11 </td <td></td> <td></td> <td>-</td> <td></td> <td colspan="5"></td>			-						
SOT11-Multi-function serial ch.11 serial data output pin(MB91F59A/B only)P125OCU3ICU0ICU0IR00TIN10SCK11P126TRG0SIN0INT1OCU3INT1<	109	PPG9_2	-	А					
SOTH         -         pin(MB91F59A/B only)           P125         -         General-purpose I/O port           OCU3         -         Output compare ch.3 output pin           ICU0         -         Output compare ch.3 output pin           ICU0         -         PPG10_2           TIN10         -         PPG ch.10 output pin (2)           Reload timer ch.10 event input pin(MB91F59A/B or         Multi-function serial ch.11 clock I/O pin(MB91F59A/B or           90         P126         -           TRG0         -           SIN0         -           INT1         -		TIN9	-	_					
OCU3-ICU0-ICU0-ICU0-PPG10_2-TIN10-SCK11-P126-TRG0-SIN0-INT1-INT1-		SOT11	-						
ICU0-110PPG10_2-PPG10_2-TIN10-SCK11-SCK11-P126-TRG0-SIN0-INT1-INT1-		P125	_		General-purpose I/O port				
110       PPG10_2       -       A       PPG ch.10 output pin (2)         TIN10       -       Reload timer ch.10 event input pin(MB91F59A/B or Multi-function serial ch.11 clock I/O pin(MB91F59A/only)         SCK11       -       Multi-function serial ch.11 clock I/O pin(MB91F59A/only)         90       P126       -         TRG0       -       A         SIN0       -         INT1       -         INT1       -		OCU3	_		Output compare ch.3 output pin				
TIN10       -       Reload timer ch.10 event input pin(MB91F59A/B or Multi-function serial ch.11 clock I/O pin(MB91F59A/ only)         90       P126       -         TRG0       -         SIN0       -         INT1       -		ICU0	_		Input capture ch.0 input pin				
TIN10       -       Reload timer ch.10 event input pin(MB91F59A/B or Multi-function serial ch.11 clock I/O pin(MB91F59A/only)         90       P126       -       General-purpose I/O port         90       TRG0       -       PPG trigger 0 input pin (ch.0 to ch.3)         NUlti-function serial ch.0 serial data input pin       INT1       -	110	PPG10_2	_	А	PPG ch.10 output pin (2)				
SCK11     -     Multi-function serial ch.11 clock I/O pin(MB91F59A/ only)       90     P126     -       TRG0     -       SIN0     -       INT1     -         Multi-function serial ch.11 clock I/O pin(MB91F59A/ only)		TIN10	_		Reload timer ch.10 event input pin(MB91F59A/B only)				
90     P126     -       TRG0     -       SIN0     -       INT1     -         General-purpose I/O port       PPG trigger 0 input pin (ch.0 to ch.3)       Multi-function serial ch.0 serial data input pin       INT1		SCK11	-		Multi-function serial ch.11 clock I/O pin(MB91F59A/B only)				
90 TRG0 – SIN0 – INT1 – A PPG trigger 0 input pin (ch.0 to ch.3) Multi-function serial ch.0 serial data input pin INT1 External interrupt input pin		P126	_						
90     SIN0     –     A       INT1     –     Multi-function serial ch.0 serial data input pin       INT1     External interrupt input pin			_						
INT1 – INT1 External interrupt input pin	90		-	A					
			_	-					
I REAL I I I I I I I I I I I I I I I I I I I		P127			General-purpose I/O port				
	Q1		-	ĸ	Multi-function serial ch.0 serial data output pin / $I^2C$ ch.0				
serial data I/O pin	51		-	IX.	serial data I/O pin				
P130 – General-purpose I/O port		P130	-						
		SCK0	-		Multi-function serial ch.0 clock I/O pin / I <sup>2</sup> C ch.0 clock I/C pin				
92 INTO – K INTO External interrupt input pin	92	INT0	-	к					
ICU1 – Input capture ch.1 input pin			_	1					
		TIOA0	-	1	Base timer TIOA0 output pin				





BGA Pin No.	Pin Name	Polarity	I/O Circuit Types <sup>11</sup>	Function <sup>*2</sup>
136	D0	-	0	External bus · Data bit0 I/O pin
	P000			General-purpose I/O port (3V pin)
136	SIN2_1		0	LIN-UART ch.2 serial data input pin (1)
130	PPG0	-	0	PPG ch.0 output pin
	TIN0_2			Reload timer ch.0 event input pin (2)
137	VSYNC	_	0	Display vertical sync signal output pin (for Internal sync)/ Display vertical sync signal input pin (for External sync)
	PG5			General-purpose I/O port (3V pin)
138	BOUT7		0	Display digital B7 output pin
150	PF7	-	0	General-purpose I/O port(3V pin)
139	BOUT5		0	Display digital B5 output pin
159	PF5	_	0	General-purpose I/O port (3V pin)
140	BOUT3		0	Display digital B3 output pin
140	PF3	-	0	General-purpose I/O port (3V pin)
141	GOUT6		0	Display digital G6 output pin
141	PE6	_	0	General-purpose I/O port (3V pin)
142	GOUT3		0	Display digital G3 output pin
142	PE3	_	0	General-purpose I/O port (3V pin)
4.40	ROUT6		0	Display digital R6 output pin
143	PD6	_	0	General-purpose I/O port (3V pin)
	ROUT3		0	Display digital R3 output pin
144	PD3	_	0	General-purpose I/O port (3V pin)
145	VSS	-	_	GND pin
	DCKIN			Display reference clock input pin (for External sync)
146	CMDTRG	<b> </b> _	0	GDC command trigger input pin
	PG0			General-purpose I/O port (3V pin)
147	CSOUT	_	0	Display composite sync signal output pin, Graphics / Video switch (for External sync) output pin
	PG3			General-purpose I/O port (3V pin)
148	HSIN	Ρ	0	Capture horizontal sync signal input pin
140	PG2	-	0	General-purpose I/O port (3V pin)
149	BIN7		0	Capture B7 input pin (RGB mode)
149	PC7	_	0	General-purpose I/O port (3V pin)
150	BIN4		0	Capture B4 input pin (RGB mode)
150	PC4	_	0	General-purpose I/O port (3V pin)
151	GIN7		0	Capture G7 input pin (RGB mode)
151	PB7	_	0	General-purpose I/O port (3V pin)
150	GIN4		0	Capture G4 input pin (RGB mode)
152	PB4	_	0	General-purpose I/O port (3V pin)
	RIN7			Capture R7 input pin (RGB mode)
153	VIN5	_	0	Capture VIN5 input pin (656 mode)
	PA7			General-purpose I/O port (3V pin)
	RIN4			Capture R4 input pin (RGB mode)
154			0	Capture VIN2 input pin (656 mode)
	PA4	1		General-purpose I/O port (3V pin)
	FRCK0			Free-run timer 0 clock input pin
155	P121	]_	С	General-purpose I/O port
	INT7	1		INT7 External interrupt input pin



### Static Electricity

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

- 1. Maintain relative humidity in the working environment between 40% and 70%. Use of an apparatus for ion generation may be needed to remove electricity.
- 2. Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.
- 3. Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 M $\Omega$ ).

Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.

- 4. Ground all fixtures and instruments, or protect with anti-static measures.
- 5. Avoid the use of styrofoam or other highly static-prone materials for storage of completed board assemblies.

### 5.3 Precautions for Use Environment

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

For reliable performance, do the following:

1. Humidity

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

2. Discharge of Static Electricity

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

3. Corrosive Gases, Dust, or Oil

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

4. Radiation, Including Cosmic Radiation

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

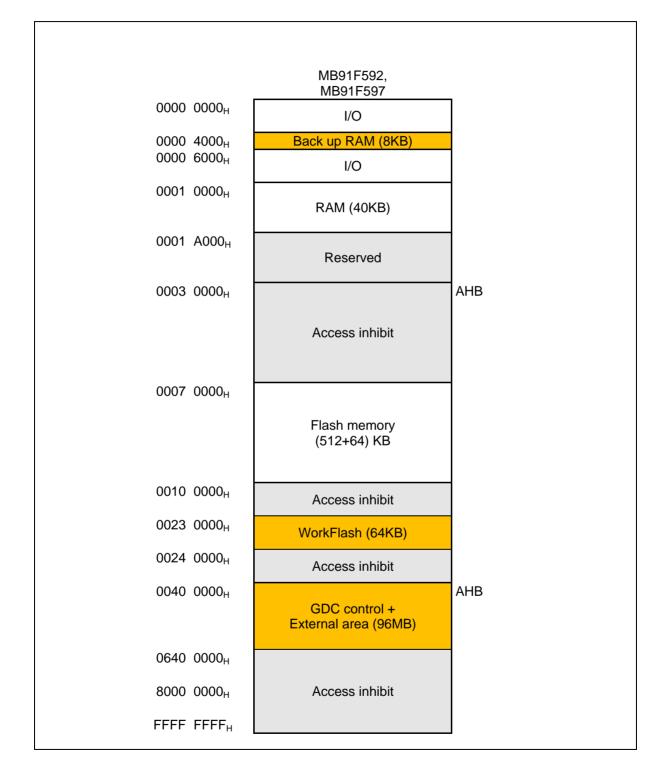
5. Smoke, Flame

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

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



#### Memory map





# 9. I/O Map

The following I/O map shows the relationship between memory space and registers for peripheral resources.

■Legend of I/O Map

Address			Address Offset Va	lue/ Register Name		Block		
Audiess	+0		+1	+1 +2 +3				
000090 <sub>H</sub>	BT1TMR[R] H 00000000 0000	0000		BT1TMCR[R/W]B,H,W 00000000 00000000	1			
000094 <sub>н</sub>	-		BT1STC[R/W] B 00000000	-	-	Base timer 1		
000098 <sub>н</sub>	BT1PCSR/BT11 00000000 0000		/W] H	BT1DTBF[R/W] H	base umer i			
00009C <sub>н</sub>	BTSEL[R/W] B 000 0		-	BTSSSR[W] B,H 11				
0000A0 <sub>н</sub>	ADERH [R/W]B 00000000 0000			ADERL [R/W]B, H, W 00000000 00000000				
0000A4 <sub>Н</sub>	ADCS1 [R/W] B 00000000	8, H,W	ADCS0 [R/W] B, H,W 00000000	ADCR1 [R] B, H,W XX	ADCR0 [R] B, H,W XXXXX XXX	A/D converter		
0000A8 <sub>н</sub>	ADCT1 [R/W] B 00010000	, H,W	ADCT0 [R/W] B, H,W 00101100	ADSCH [R/W] B, H,W 00000	ADECH [R/W] B, H,W 00000			
					Data access attributes B: Byte H: Half-word W: Word (Note) The access access attribute not disabled.	ess by the dat		
					Initial register valu	e after reset		

The initial register value after reset indicates as follows:

- "1": Initial value "1"
- "0": Initial value "0"
- "X": Initial value undefined
- "-": Reserved bit/Undefined bit
- "\*": Initial value "0" or "1" according to the setting

Note: The access by the data access attribute not described is disabled.





Address		Block			
Address	+0			BIOCK	
000E00 <sub>H</sub>	DDR00[R/W] B,H,W 00000000	DDR01[R/W] B,H,W 00000000	DDR02[R/W] B,H,W 00000000	DDR03[R/W] B,H,W 00000000	
000E04 <sub>H</sub>	DDR04[R/W] B,H,W 00000000	DDR05[R/W] B,H,W 00000000	DDR06[R/W] B,H,W 00000000	DDR07[R/W] B,H,W 00000000	
000E08 <sub>Н</sub>	DDR08[R/W] B,H,W 00000000	DDR09[R/W] B,H,W 00000000	DDR10[R/W] B,H,W 00000000	DDR11[R/W] B,H,W 00000000	Data direction
000E0C <sub>H</sub>	DDR12[R/W] B,H,W 00000000	DDR13[R/W] B,H,W 00-00000	_	_	register
000E10 <sub>H</sub>	DDRA[R/W] B,H,W 000000	DDRB[R/W] B,H,W 000000	DDRC[R/W] B,H,W 000000	DDRD[R/W] B,H,W 000000	
000E14 <sub>Н</sub>	DDRE[R/W] B,H,W 000000	DDRF[R/W] B,H,W 000000	DDRG[R/W] B,H,W 00000000	DDRH[R/W] B,H,W 0	
000E18 <sub>H</sub> to 000E1C <sub>H</sub>	_	_	_	_	Reserved
000Е20 <sub>Н</sub>	PFR00[R/W] B,H,W 00000000	PFR01[R/W] B,H,W 00000000	PFR02[R/W] B,H,W 00000000	PFR03[R/W] B,H,W 00000000	
000E24 <sub>H</sub>	PFR04[R/W] B,H,W 00000000	PFR05[R/W] B,H,W -0000000	PFR06[R/W] B,H,W 00000000	PFR07[R/W] B,H,W 00000000	
000E28 <sub>Н</sub>	PFR08[R/W] B,H,W 00000000	PFR09[R/W] B,H,W 0-000000	PFR10[R/W] B,H,W 00000000	PFR11[R/W] B,H,W 00000000	
000E2C <sub>Н</sub>	PFR12[R/W] B,H,W 0-000000	PFR13[R/W] B,H,W 00000	_	_	Port function register
000Е30 <sub>Н</sub>	PFRA[R/W] B,H,W 	PFRB[R/W] B,H,W 	PFRC[R/W] B,H,W 	PFRD[R/W] B,H,W 000000	
000E34 <sub>Н</sub>	PFRE[R/W] B,H,W 000000	PFRF[R/W] B,H,W 000000	PFRG[R/W] B,H,W 00000	PFRH[R/W] B,H,W 	
000E38 <sub>H</sub> to 000E3C <sub>H</sub>	_	_	_	_	Reserved



Address	A	Block			
Audress	+0	+1	+2	+3	BIOCK
002500 <sub>н</sub>	SEEARH[R] B,H,W 000000 0000000		DEEARH[R] B,H,W 000000 0000000		
002504 <sub>н</sub>	EECSRH[R/W] B,H,W 0000	_	EFEARH[R/W]B,H 000000 0000000		AHB RAM ECC control register MB91F59A/B only
002508 <sub>Н</sub>	—	EFECRH[R/W]B,H 0 00000000 0	,W 0000000		
00250C <sub>H</sub> to 002FFC <sub>H</sub>	_	_	—	—	Reserved
003000 <sub>Н</sub>	SEEARA[R] B,H,W 000 00000000	I	DEEARA[R] B,H,W 000 00000000	I	
003004 <sub>н</sub>	EECSRA [R/W] B,H,W 0000	_	EFEARA[R/W] B,⊢ 000 00000000	l,W	Backup RAM ECC control register
003008 <sub>Н</sub>	_	EFECRA[R/W] B,H 0 00000000 0			
00300С <sub>Н</sub> to 003FFC <sub>Н</sub>	_		_	_	Reserved
004000 <sub>н</sub> to 005FFC <sub>H</sub>	Backup RAM				Backup RAM area
006000 <sub>н</sub> to 00EFFC <sub>H</sub>		_		_	Reserved
00F000 <sub>H</sub> to 00FEFC <sub>H</sub>	_	_	_	_	Reserved [S]
00FF00 <sub>н</sub>	DSUCR [R/W] B,H 0	,W	_	_	OCDU [S]
00FF04 <sub>H</sub> to 00FF0C <sub>H</sub>	_	_	_	_	Reserved [S]
00FF10 <sub>H</sub>	PCSR [R/W] B,H,V XXXXXXXX XXXX	v XXXX XXXXXXXX	xxxxxxx		
00FF14 <sub>H</sub>	PSSR [R/W] B,H,W XXXXXXXX XXXX	V XXXX XXXXXXXX	xxxxxxx		
00FF18 <sub>H</sub> to 00FFF4 <sub>H</sub>	_	_	_	_	Reserved [S]
00FFF8 <sub>H</sub>	EDIR1 [R] B,H,W XXXXXXXX XXXX	xxxx xxxxxxxx	xxxxxxx		
00FFFC <sub>н</sub>	EDIR0 [R] B,H,W XXXXXXXX XXXX	xxxx xxxxxxxx	xxxxxxx		OCDU [S]

[S]:It is a system register. The illegal instruction exception (data access error) is generated in these registers in the user mode when reading and writing to it.



# **11. Electrical Characteristics**

# 11.1 Absolute Maximum Ratings

Deremeter	Symbol	Ra	ating	Unit	Remarks	
Parameter	Symbol	Min	Max	Unit	Remarks	
	V <sub>cc</sub> 5	Vss-0.3	Vss+6.0	V		
Power supply voltage <sup>*1,*2</sup>	V <sub>cc</sub> 3	Vss-0.3	Vss+4.0	V	Vcc3 ≤ Vcc5	
	DVcc	Vss-0.3	Vss+6.0	V	DVcc ≤ Vcc5	
Analog power supply voltage <sup>*1,*2</sup>	AV <sub>CC</sub> 5	Vss-0.3	Vss+6.0	V	AVRH5 ≤ AVcc5 ≤ Vcc5	
Analog power supply vollage	AV <sub>CC</sub> 3	Vss-0.3	Vss+4.0	V	$AVR3 \le AVcc3 \le Vcc3$	
Analog reference voltage <sup>*1</sup>	AVRH5	Vss-0.3	Vss+6.0	V	AVRH5 ≤ AVcc5	
Analog reference voltage	AVR3	Vss-0.3	Vss+4.0	V	AVR3 ≤ AVcc3	
Input voltage <sup>*1</sup>	VI1	Vss-0.3	Vcc5+0.3	V	5V pins other than SMC multiplied pins	
input voltage	V <sub>I2</sub>	Vss-0.3	Vcc3+0.3	V	3.3V dedicated pin	
	V <sub>I3</sub>	Vss-0.3	Vcc5+0.3	V	SMC shared pin	
Analog pin input voltage <sup>*1</sup>	V <sub>IA</sub> 5	Vss-0.3	Vcc5+0.3	V		
Analog pin input voltage	V <sub>IA</sub> 3	Vss-0.3	Vcc3+0.3	V		
Outrast set to re <sup>*1</sup>	V <sub>O1</sub>	Vss-0.3	Vcc5+0.3	V	5V pins other than SMC multiplied pins	
Output voltage <sup>*1</sup>	V <sub>O2</sub>	Vss-0.3	Vcc3+0.3	V	3.3V dedicated pin	
	V <sub>O3</sub>	Vss-0.3	Vcc5+0.3	V	SMC shared pin	
Maximum clamp current	ICLAMP	-4	4	mA	*9	
Total maximum clamp current	ΣIICLAMP	-	20	mA	*9	
	I <sub>OL1</sub>	-	7	mA	When setting to 2mA <sup>*6</sup>	
"L" level maximum output current *3	I <sub>OL2</sub>	-	40	mA	When setting to 30mA <sup>7</sup>	
	I <sub>OL3</sub>	-	30	mA	When setting to 20mA <sup>*8</sup>	
	I <sub>OLAV1</sub>	-	2	mA	When setting to 2mA <sup>*6</sup>	
"L" level average output current *4	I <sub>OLAV2</sub>	-	30	mA	When setting to 30mA <sup>*7</sup>	
-	I <sub>OLAV3</sub>	-	20	mA	When setting to 20mA <sup>*8</sup>	
	ΣI <sub>OL1</sub>	-	50	mA	*6	
"L" level total output current *5	ΣI <sub>OL2</sub>	-	250	mA	*7	
	ΣI <sub>OL3</sub>	-	50	mA	*8	
	I <sub>OH1</sub>	-	-7	mA	When setting to 2mA <sup>*6</sup>	
"H" level maximum output current *3	I <sub>OH2</sub>	-	-40	mA	When setting to 30mA <sup>*7</sup>	
	I <sub>OH3</sub>	-	-30	mA	When setting to 20mA <sup>*8</sup>	
	I <sub>OHAV1</sub>	-	-2	mA	When setting to 2mA <sup>*6</sup>	
"H" level average output current *4	I <sub>OHAV2</sub>	-	-30	mA	When setting to 30mA*7	
	I <sub>OHAV3</sub>	-	-20	mA	When setting to 20mA <sup>*8</sup>	
	ΣI <sub>OH1</sub>	-	-50	mA	*6	
"H" level total output current *5	ΣI <sub>OH2</sub>	-	-250	mA	*7	
	Σl <sub>OH3</sub>	-	-50	mA	*8	
		-	1250	mW	LQFP product	
Power consumption	P <sub>D</sub>	_	2500	mW	BGA product TEQFP product HQFP product	
Operating temperature	T <sub>A</sub>	-40	+105	°C	*10	
Storage temperature	Tstg	-55	+150	°C		

<sup>\*1</sup>: These parameters are based on the condition that  $V_{SS}=AV_{SS}=DV_{SS}=0.0V$ 

<sup>\*2</sup>: Caution must be taken that AV<sub>CC</sub>5 and DV<sub>CC</sub> do not exceed V<sub>CC</sub>5.Similarly,AV<sub>CC</sub>3 must not exceed V<sub>CC</sub>3.

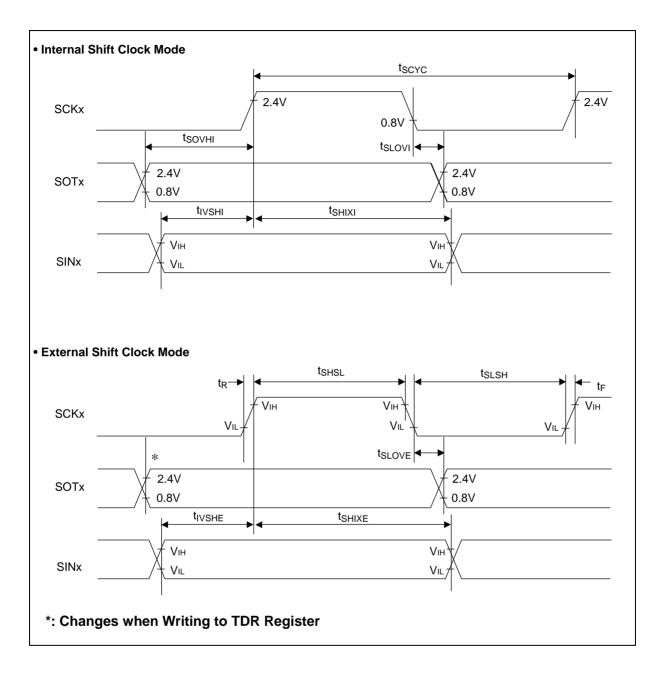
<sup>\*3</sup>: The maximum output current is defined as the value of the peak current flowing through any one of the corresponding pins.

\*4: The average output current is defined as the value of the average current flowing through any one of the corresponding pins for a 10 ms period. The average value is the operation current × the operation ratio.

<sup>\*5</sup>: The total output current is defined as the maximum current value flowing through all of corresponding pins.

<sup>\*6</sup>: Outputs other than P60-P87 and 3V pin.







## I<sup>2</sup>C Timing

Parameter	Symbol	Pin Name	Conditions	Standard Mode		I High-Speed Mode		Unit	Remarks
				Min	Max	Min	Max		
SCL clock frequency	f <sub>SCL</sub>	SCK0, SCK1		0	100	0	400	kHz	
Repeat "start" condition hold time SDA $\downarrow \rightarrow$ SCL $\downarrow$	t <sub>hdsta</sub>	SOT0, SOT1, (SDA) SCK0, SCK1, (SCL)		4.0	_	0.6	_	μs	
Period of "L" for SCL clock	t <sub>LOW</sub>	SCK0, SCK1, (SCL)		4.7	-	1.3	_	μs	
Period of "H" for SCL clock	t <sub>ніGH</sub>	SCK0, SCK1, (SCL)		4.0	_	0.6	-	μs	
Repeat "start" condition setup time SCL $\uparrow \rightarrow$ SDA $\downarrow$	t <sub>susta</sub>	(SCL)	C <sub>L</sub> =50pF (When drive capability is	4.7	-	0.6	_	μs	
Data hold time SCL $\downarrow \rightarrow$ SDA $\downarrow \uparrow$	t <sub>hddat</sub>	SOT0, SOT1, (SDA) SCK0, SCK1, (SCL)	2mA or more.) C <sub>L</sub> =20pF (When	0	3.45 <sup>*2</sup>	0	0.9	μs	
Data setup time SDA $\downarrow \uparrow \rightarrow$ SCL $\uparrow$	t <sub>sudat</sub>	SOT0, SOT1, (SDA) SCK0, SCK1, (SCL)		250 <sup>*3</sup>	_	100	_	ns	
"Stop" condition setup time SCL $\uparrow \rightarrow$ SDA $\uparrow$	t <sub>susto</sub>	SOT0, SOT1, (SDA) SCK0, SCK1, (SCL)		4.0	_	0.6	_	μs	
Bus-free time between "stop" condition and "start" condition	t <sub>BUF</sub>	_		4.7	-	1.3	_	μs	
Noise filter	t <sub>SP</sub>	_	_	2t <sub>CPP</sub> <sup>^4</sup>	_	2t <sub>CPP</sub> <sup>^4</sup>	_	ns	

(T<sub>A</sub>: Recommended operating conditions,  $V_{CC}5=5.0V \pm 10\%$ ,  $V_{SS}=AV_{SS}=0.0V$ )

<sup>\*1</sup>: R and C<sub>L</sub> represent the pull-up resistance and load capacitance of the SCL and SDA output lines, respectively. Vp shows that the power-supply voltage of the pull-up resistor and I<sub>OL</sub> shows the V<sub>OL</sub> guarantee current.

<sup>\*2</sup>: The maximum  $t_{HDDAT}$  only has to be met if the device does not extend the "L" width ( $t_{LOW}$ ) of the SCL signal.

\*3: A high-speed mode I<sup>2</sup>C bus device can be used on a standard mode I<sup>2</sup>C bus system as long as the device satisfies the requirement of "t<sub>SUDAT</sub> ≥ 250 ns".

<sup>\*4</sup>: t<sub>CPP</sub> is the peripheral clock cycle time. Adjust the peripheral clock frequency to 8MHz or more when use I<sup>2</sup>C.



11.4.1.10 Low voltage detection (Internal low-voltage detection)

(T<sub>A</sub>: Recommended operating conditions, V<sub>SS</sub>=AV<sub>SS</sub>=0.0V)

Parameter	Symbol	Pin	Pin Conditions Value		Value Unit Remarks		Bomarks	
Farameter	Symbol	Name	Conditions	Min	Тур	Max	Unit	Rellidiks
Power supply voltage range	$V_{RDP5}$		-	-	-	1.3	V	
Detection voltage	V <sub>RDL</sub>	VCC	*	0.8	0.9	1.0	V	When power-supply voltage falls
Hysteresis width	V <sub>RHYS</sub>		-	-	-	50	mV	When power-supply voltage rises
Low voltage detection time	Td	_	-	_	_	30	μs	

\*: If the fluctuation of the power supply is faster than the low voltage detection time(Td), there is a possibility to generate or release after the power supply voltage has exceeded the detection voltage range.



### 11.4.1.13 GDC display signal

### Clock

AC timing of video interface clock signal

(T<sub>A</sub>: Recommended operating conditions,  $V_{CC}3=3.3V \pm 10\%$ ,  $V_{SS}=AV_{SS}=0.0V$ )

Parameter	Symbol	Pin Name	Value		Unit	Remarks
		Fill Name	Min	Max	Unit	Remarks
DCLKI frequency	Fdclki0		_	54	MHz	
DCLKI "H"width	Thdclki0	DCLKI	18	-	ns	
DCLKI "L"width	Tldclki0		18	-	ns	
DCLK frequency	Tldclk0	DCLK (internal)	_	54	MHz	*1
DCLKO frequency	Fdclko0	DCLKO	-	54	MHz	*2

\*1: The internal display clock of PLL synchronous mode is generated with internal PLL of display clock prescaler.

\*2: DCLKI or PLL internal display clock is output.

Apply only DCLKI synchronous mode. (reference clock= DCLKI)

• AC timing of video interface input signal

(T<sub>A</sub>: Recommended operating conditions,  $V_{CC}3=3.3V \pm 10\%$ ,  $V_{SS}=AV_{SS}=0.0V$ )

Parameter	Symbol	Pin Name	Value			Unit	Remarks
Farameter	Symbol	Fill Name	Min	Тур	Max	Unit	Remarks
HSYNC input setup time	Tshsync0	HSYNC(i)	4	-	-	ns	
HSYNC input hold time	Thhsync0		1	-	-	ns	
VSYNC input pulse width	Twvsync0	VSYNC(i)	1	-	_	HSYNC	

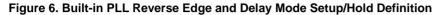
■ Display input signal timing

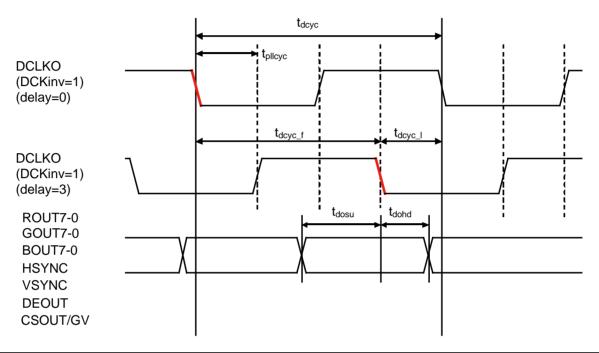
DCLK In ,	1/Fdclkin	Thdclkin Tldclkin	·	
HSYNCn (i)	Twhsync <i>n</i>	Thhsync <i>n</i> Twvsync <i>n</i>		
VSYNCn (i)	Tsvsyncn			Thvsync <i>n</i>



#### Built-in PLL reverse edge and delay mode (DCM3.DCKinv=1)

Figure 6 shows the setup/hold definition when the external display device receives the signal at the falling edge of DCLKO. (Example: When frequency division ratio = 4)

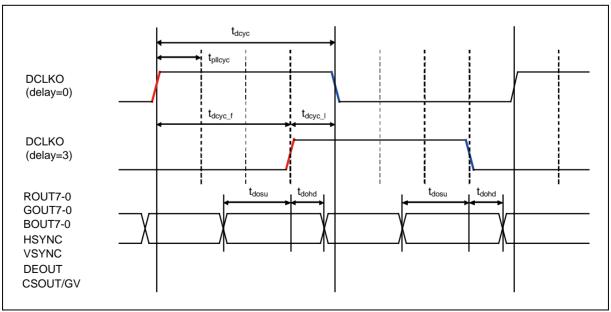




Built-in PLL both edge and delay mode (DCM3.DCKinv=0)

Figure 7 shows the setup/hold definition when the external display device (TFT) receives the signal both at the rising edge and the falling edge of DCLKO. (Example: When frequency division ratio = 4) Although there are two sampling locations in both edge mode; one at the rising edge and the other at the falling edge, the values of setup/hold definition are same.

Figure 7. Built-in PLL Both Edge and Delay Mode Setup/Hold Definition





### 11.5 A/D Converter

#### 11.5.1 Electrical Characteristics

(T<sub>A</sub>: Recommended operating conditions,  $V_{CC}5=AV_{CC}5=5.0V \pm 10\%$ ,  $V_{SS}=AV_{SS}=0.0V$ )

Parameter Symbol Pin Name		Din Nama	Value			Unit	Remarks	
Farameter	Symbol	Fin Name	Min	Тур	Max	Unit	Remarks	
Resolution	-	_	—	-	10	bit		
Total error	-	_	—	-	±3	LSB		
Non linearity error	-	_	—	-	±2.5	LSB		
Differential linearity error	_	_	_	-	±1.9	LSB		
Zero transition voltage	V <sub>OT</sub>	AN0 to AN31	AV <sub>SS</sub> - 1.5LSB	-	AV <sub>SS</sub> + 2.5LSB	V	1LSB = (AV <sub>CC</sub> - AV <sub>SS</sub> )	
Full-scale transition voltage	V <sub>FST</sub>	AN0 to AN31	AVRH5 - 3.5LSB	-	AVRH5 + 0.5LSB	V	/1024	
Sampling time	t <sub>SMP</sub>	-	1.2	-	-	μs	*1	
Compare time	t <sub>CMP</sub>	-	1.8	-	—	μs	*1	
A/D conversion time	t <sub>CNV</sub>	_	3.0	-	—	μs	*1	
Analog port input current	I <sub>AIN</sub>	AN0 to AN31	-5	-	+5	μA	$V_{AVSS} \le V_{AIN} \le V_{AVCC}$	
Analog input voltage	V <sub>AIN</sub>	AN0 to AN31	AV <sub>SS</sub>	-	AVRH5	V		
Deference veltere	A <sub>VRH</sub>	AVRH5	4.5	-	5.5	V	AVRH5 ≤ AV <sub>CC</sub> 5	
Reference voltage	A <sub>VRL</sub>	AVSS	-	0.0	-	V		
	I <sub>A</sub>	AVCC	-	-	4.0	mA		
Power supply current	I <sub>AH</sub>	AVCC	-	-	6.0	μA	*2	
	I <sub>R</sub>	AVRH5	-	600	900	μA		
	I <sub>RH</sub>	АУКПЭ	-	-	5	μA	*2	
Variation between channels	_	AN0 to AN31	_	_	4	LSB		

\*1: Time for each channel.

\*2: Power supply current (V<sub>CC</sub> = AV<sub>CC</sub> = 5.0 V) is specified if A/D converter is not operating and CPU is stopped.

#### Note:

Be sure to use the clock with a frequency between 8MHz and 17MHz for the ADC compare clock in order to ensure its accuracy.



# **12. Ordering Information**

Part Number	Package
MB91F591BPMC-GSE1	
MB91F591BSPMC-GSE1	
MB91F591BHPMC-GSE1	
MB91F591BHSPMC-GSE1	
MB91F592BPMC-GSE1	
MB91F592BSPMC-GSE1	208-pin plastic LQFP
MB91F592BHPMC-GSE1	(LQR208)
MB91F592BHSPMC-GSE1	
MB91F594BPMC-GSE1	
MB91F594BSPMC-GSE1	
MB91F594BHPMC-GSE1	
MB91F594BHSPMC-GSE1	
MB91F59BCEQ-GSE1	208-pin plastic TEQFP
MB91F59BCHSEQ-GSE1	(LET208)
MB91F59ACPB-GSE1	
MB91F59ACSPB-GSE1	
MB91F59ACHPB-GSE1	
MB91F59ACHSPB-GSE1	320-Ball Grid Array Package
MB91F59BCPB-GSE1	(BYA320)
MB91F59BCSPB-GSE1	
MB91F59BCHPB-GSE1	
MB91F59BCHSPB-GSE1	

<sup>\*1</sup>: For details of the package, see "Package Dimensions ".



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