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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	HCS12
Core Size	16-Bit
Speed	32MHz
Connectivity	CANbus, EBI/EMI, I²C, IrDA, LINbus, SCI, SPI
Peripherals	LCD, Motor control PWM, POR, PWM, WDT
Number of I/O	50
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	4.5V ~ 5.5V
Data Converters	A/D 6x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LQFP
Supplier Device Package	64-LQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/s9s12hy64j0mlh

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Detailed Register Address Map

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
0x0244 PERT	R	PERT7	PERT6	PERT5	PERT4	PERT3	PERT2	PERT1	PERT0
	W								
0x0245 PPST	R	PPST7	PPST6	PPST5	PPST4	PPST3	PPST2	PPST1	PPST0
	W								
0x0246 Reserved	R	0	0	0	0	0	0	0	0
	W								
0x0247 PTTRR	R	0	0	PTTRR5	PTTRR4	0	0	PTTRR1	PTTRR0
	W								
0x0248 PTS	R	PTS7	PTS6	PTS5	PTS4	PTS3	PTS2	PTS1	PTS0
	W								
0x0249 PTIS	R	PTIS7	PTIS6	PTIS5	PTIS4	PTIS3	PTIS2	PTIS1	PTIS0
	W								
0x024A DDRS	R	DDRS7	DDRS6	DDRS5	DDRS4	DDRS3	DDRS2	DDRS1	DDRS0
	W								
0x024B RDRS	R	RDRS7	RDRS6	RDRS5	RDRS4	RDRS3	RDRS2	RDRS1	RDRS0
	W								
0x024C PERS	R	PERS7	PERS6	PERS5	PERS4	PERS3	PERS2	PERS1	PERS0
	W								
0x024D PPSS	R	PPSS7	PPSS6	PPSS5	PPSS4	PPSS3	PPSS2	PPSS1	PPSS0
	W								
0x024E WOMS	R	WOMS7	WOMS6	WOMS5	WOMS4	WOMS3	WOMS2	WOMS1	WOMS0
	W								
0x024F PTSRR	R	0	0	PTSRR5	PTSRR4	0	0	PTSRR1	PTSRR0
	W								
0x0250 -0x0257 Reserved	R	0	0	0	0	0	0	0	0
	W								
0x0258 PTP	R	PTP7	PTP6	PTP5	PTP4	PTP3	PTP2	PTP1	PTP0
	W								
0x0259 PTIP	R	PTIP7	PTIP6	PTIP5	PTIP4	PTIP3	PTIP2	PTIP1	PTIP0
	W								

(shaded) = Unimplemented or Reserved

1 Read: Anytime.
Write: Anytime.

Table 2-27. PTP Register Field Descriptions

Field	Description
7-0 PTP	**Port P general purpose input/output data**—Data Register, LCD segment driver output, PWM channel output Port P pins are associated with the PWM channel output and LCD segment driver output. When not used with the alternative functions, these pins can be used as general purpose I/O. If the associated data direction bits of these pins are set to 1, a read returns the value of the port register, otherwise the buffered pin input state is read. • The LCD segment takes precedence over the PWM function and the general purpose I/O function is LCD segment output is enabled • The PWM function takes precedence over the general purpose I/O function if the PWM channel is enabled.

2.3.32 Port P Input Register (PTIP)

Address 0x0259 Access: User read[1]

	7	6	5	4	3	2	1	0
R	PTIP7	PTIP6	PTIP5	PTIP4	PTIP3	PTIP2	PTIP1	PTIP0
W								
Reset	u	u	u	u	u	u	u	u

= Unimplemented or Reserved u = Unaffected by reset

Figure 2-30. Port P Input Register (PTIP)

1 Read: Anytime.
Write:Never, writes to this register have no effect.

Table 2-28. PTIP Register Field Descriptions

Field	Description
7-0 PTIP	**Port P input data**— This register always reads back the buffered state of the associated pins. This can also be used to detect overload or short circuit conditions on output pins.

2.3.33 Port P Data Direction Register (DDRP)

Address 0x025A Access: User read/write[1]

	7	6	5	4	3	2	1	0
R W	DDRP7	DDRP6	DDRP5	DDRP4	DDRP3	DDRP2	DDRP1	DDRP0
Reset	0	0	0	0	0	0	0	0

Figure 2-31. Port P Data Direction Register (DDRP)

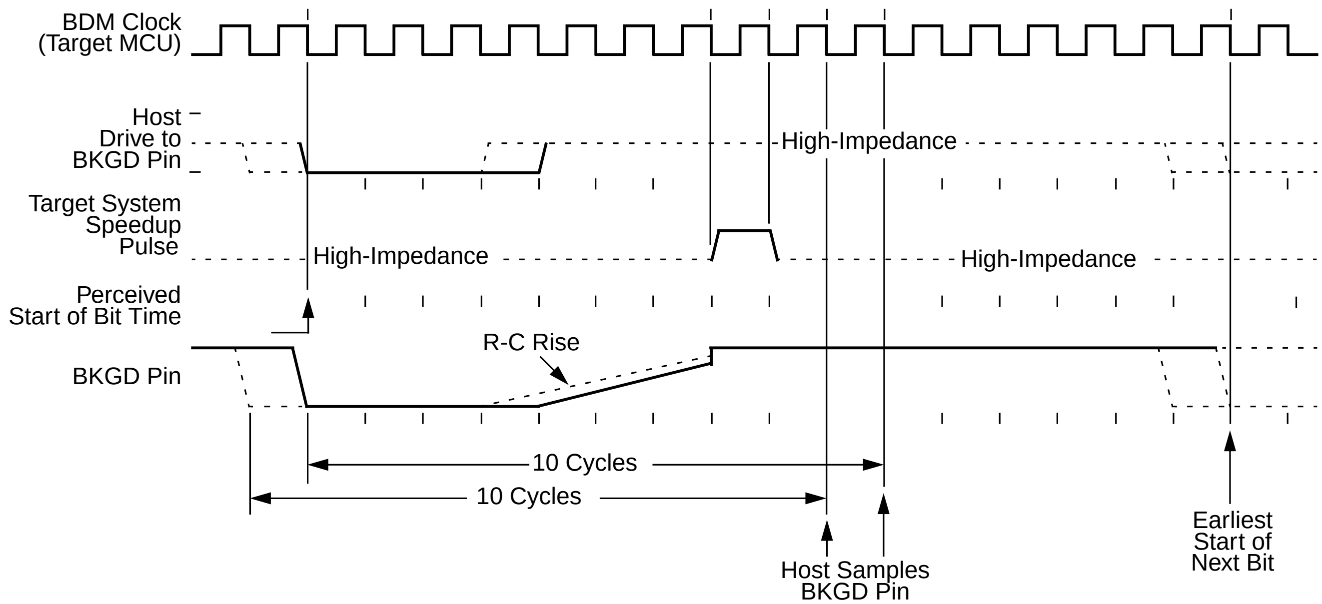


Figure 5-8. BDM Target-to-Host Serial Bit Timing (Logic 1)

Figure 5-9 shows the host receiving a logic 0 from the target. Since the host is asynchronous to the target, there is up to a one clock-cycle delay from the host-generated falling edge on BKGD to the start of the bit time as perceived by the target. The host initiates the bit time but the target finishes it. Since the target wants the host to receive a logic 0, it drives the BKGD pin low for 13 target clock cycles then briefly drives it high to speed up the rising edge. The host samples the bit level about 10 target clock cycles after starting the bit time.

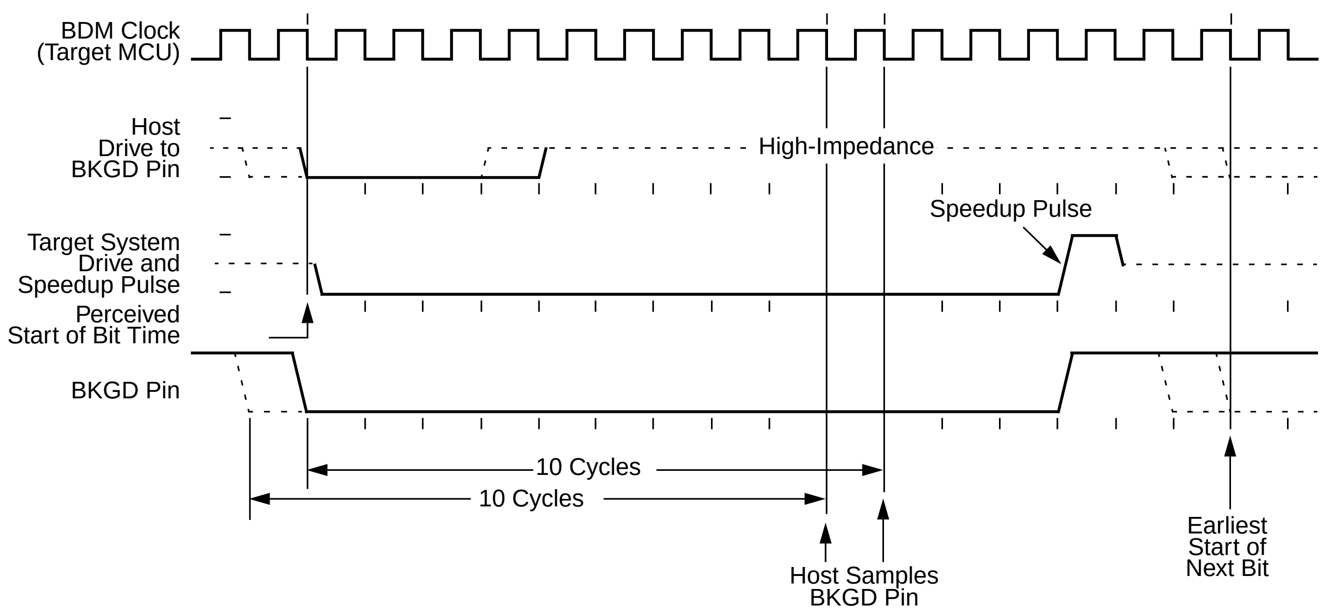


Figure 5-9. BDM Target-to-Host Serial Bit Timing (Logic 0)

NOTE:

When tracing is terminated using forced breakpoints, latency in breakpoint generation means that opcodes following the opcode causing the breakpoint can be stored to the trace buffer. The number of opcodes is dependent on program flow. This can be avoided by using tagged breakpoints.

6.4.5.3 Trace Buffer Organization (Normal, Loop1, Detail modes)

ADRH, ADRM, ADRL denote address high, middle and low byte respectively. The numerical suffix refers to the tracing count. The information format for Loop1 and Normal modes is identical. In Detail mode, the address and data for each entry are stored on consecutive lines, thus the maximum number of entries is 32. In this case DBGCNT bits are incremented twice, once for the address line and once for the data line, on each trace buffer entry. In Detail mode CINF comprises of R/W and size access information (CRW and CSZ respectively).

Single byte data accesses in Detail Mode are always stored to the low byte of the trace buffer (DATAL) and the high byte is cleared. When tracing word accesses, the byte at the lower address is always stored to trace buffer byte1 and the byte at the higher address is stored to byte0.

Table 6-37. Trace Buffer Organization (Normal,Loop1,Detail modes)

Mode	Entry Number	4-bits	8-bits	8-bits
		Field 2	**Field 1**	**Field 0**
Detail Mode	Entry 1	CINF1,ADRH1	ADRM1	ADRL1
		0	DATAH1	DATAL1
	Entry 2	CINF2,ADRH2	ADRM2	ADRL2
		0	DATAH2	DATAL2
Normal/Loop1 Modes	Entry 1	PCH1	PCM1	PCL1
	Entry 2	PCH2	PCM2	PCL2

6.4.5.3.1 Information Bit Organization

The format of the bits is dependent upon the active trace mode as described below.

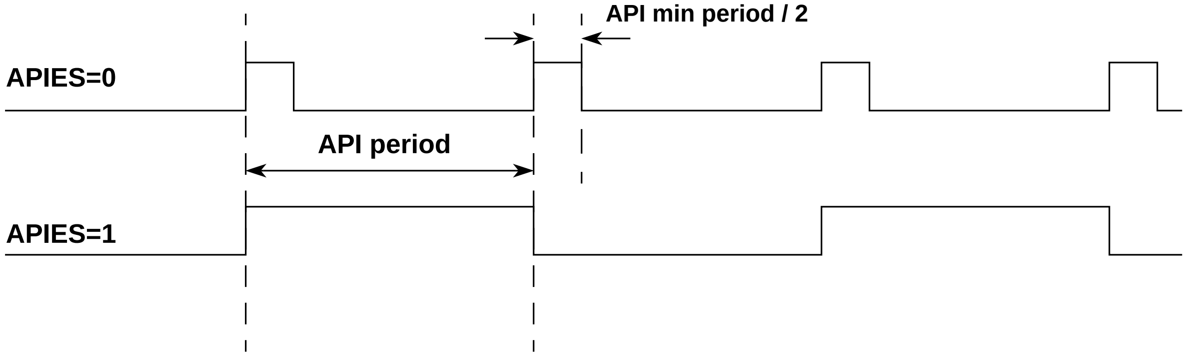
Field2 Bits in Detail Mode

Bit 3	Bit 2	Bit 1	Bit 0
CSZ	CRW	ADDR[17]	ADDR[16]

Figure 6-25. Field2 Bits in Detail Mode

In Detail Mode the CSZ and CRW bits indicate the type of access being made by the CPU.

Figure 7-19. Waveform selected on API_EXTCLK pin (APIEA=1, APIFE=1)



7.3.2.21 S12CPMU Oscillator Register (CPMUOSC)

This registers configures the external oscillator (OSCLCP).

0x02FA

	7	6	5	4	3	2	1	0
R	OSCE	OSCBW	0	OSCFILT[4:0]				
W								
Reset	0	0	0	0	0	0	0	0

Figure 7-28. S12CPMU Oscillator Register (CPMUOSC)

Read: Anytime

Write: Anytime if PROT=0 (CPMUPROT register) and PLLSEL=1 (CPMUCLKS register). Else write has no effect.

NOTE.

Write to this register clears the LOCK and UPOSC status bits.

NOTE.

If the chosen VCOCLK-to-OSCCLK ratio divided by two $((f_{VCO} / f_{OSC})/2)$ is not an integer number, then the filter can not be used and the OSCFILT[4:0] bits must be set to 0.

NOTE

The frequency modulation (FM1 and FM0) can not be used if the Adaptive Oscillator Filter is enabled.

Table 8-13. Sample Time Select

SMP2	SMP1	SMP0	Sample Time in Number of ATD Clock Cycles
1	1	1	24

8.3.2.6 ATD Control Register 5 (ATDCTL5)

Writes to this register will abort current conversion sequence and start a new conversion sequence. If external trigger is enabled (ETRIGE=1) an initial write to ATDCTL5 is required to allow starting of a conversion sequence which will then occur on each trigger event. Start of conversion means the beginning of the sampling phase.

Module Base + 0x0005

	7	6	5	4	3	2	1	0
R	0	SC	SCAN	MULT	CD	CC	CB	CA
W								
Reset	0	0	0	0	0	0	0	0

(shaded) = Unimplemented or Reserved

Figure 8-8. ATD Control Register 5 (ATDCTL5)

Read: Anytime

Write: Anytime

Table 8-14. ATDCTL5 Field Descriptions

Field	Description
6 SC	**Special Channel Conversion Bit** — If this bit is set, then special channel conversion can be selected using CD, CC, CB and CA of ATDCTL5. Table 8-15 lists the coding. 0 Special channel conversions disabled 1 Special channel conversions enabled
5 SCAN	**Continuous Conversion Sequence Mode** — This bit selects whether conversion sequences are performed continuously or only once. If external trigger is enabled (ETRIGE=1) setting this bit has no effect, that means external trigger always starts a single conversion sequence. 0 Single conversion sequence 1 Continuous conversion sequences (scan mode)

11.4.2 PWM Channel Timers

The main part of the PWM module are the actual timers. Each of the timer channels has a counter, a period register and a duty register (each are 8-bit). The waveform output period is controlled by a match between the period register and the value in the counter. The duty is controlled by a match between the duty register and the counter value and causes the state of the output to change during the period. The starting polarity of the output is also selectable on a per channel basis. Shown below in Figure 11-19 is the block diagram for the PWM timer.

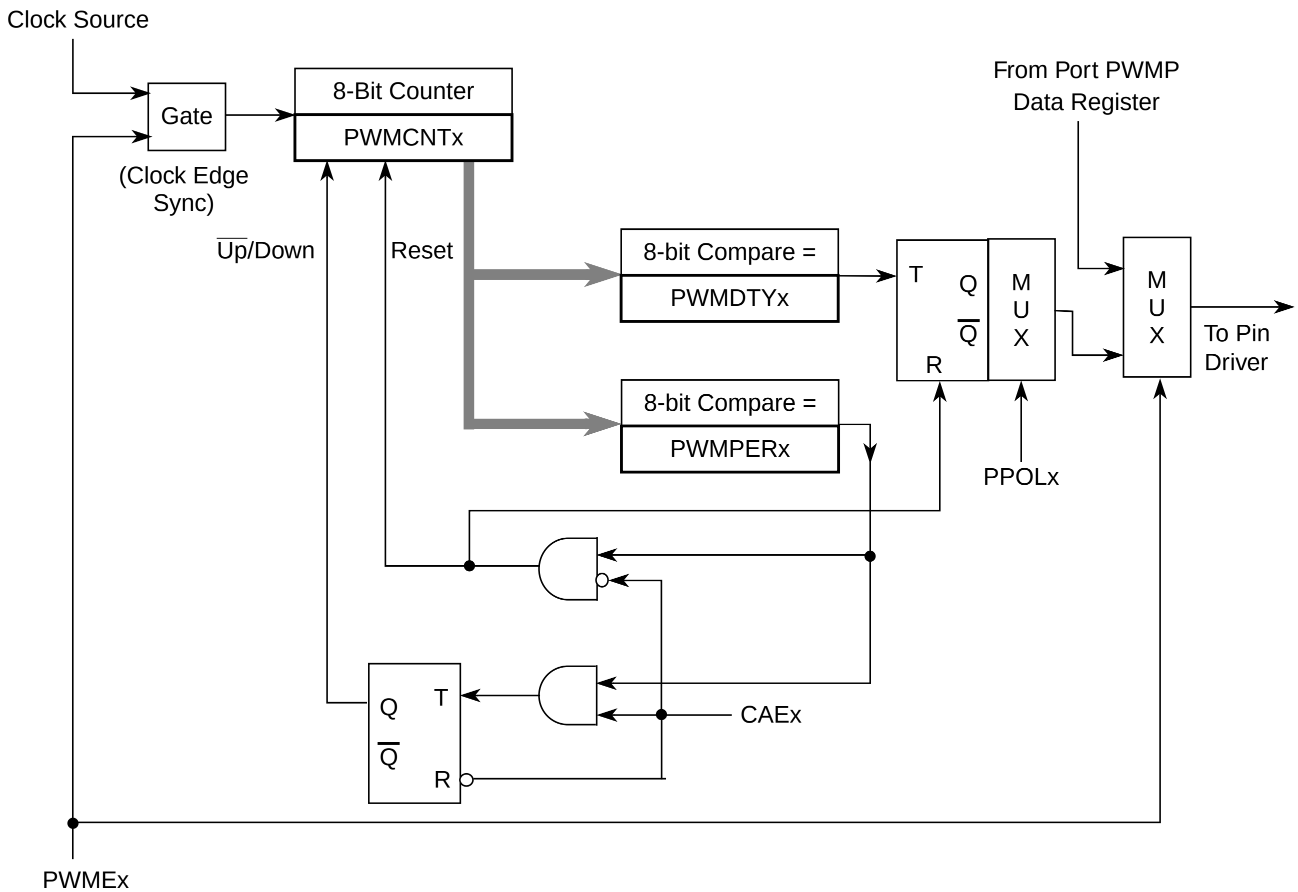


Figure 11-19. PWM Timer Channel Block Diagram

11.4.2.1 PWM Enable

Each PWM channel has an enable bit (PWMEx) to start its waveform output. When any of the PWMEx bits are set (PWMEx = 1), the associated PWM output signal is enabled immediately. However, the actual PWM waveform is not available on the associated PWM output until its clock source begins its next cycle due to the synchronization of PWMEx and the clock source. An exception to this is when channels are concatenated. Refer to Section 11.4.2.7, "PWM 16-Bit Functions" for more detail.

NOTE

The first PWM cycle after enabling the channel can be irregular.

13.3.2 Register Descriptions

This section consists of register descriptions in address order. Each description includes a standard register diagram with an associated figure number. Details of register bit and field function follow the register diagrams, in bit order.

13.3.2.1 SPI Control Register 1 (SPICR1)

Module Base +0x0000

	7	6	5	4	3	2	1	0
R W	SPIE	SPE	SPTIE	MSTR	CPOL	CPHA	SSOE	LSBFE
Reset	0	0	0	0	0	1	0	0

Figure 13-3. SPI Control Register 1 (SPICR1)

Read: Anytime

Write: Anytime

Table 13-2. SPICR1 Field Descriptions

Field	Description
7 SPIE	**SPI Interrupt Enable Bit** — This bit enables SPI interrupt requests, if SPIF or MODF status flag is set. 0 SPI interrupts disabled. 1 SPI interrupts enabled.
6 SPE	**SPI System Enable Bit** — This bit enables the SPI system and dedicates the SPI port pins to SPI system functions. If SPE is cleared, SPI is disabled and forced into idle state, status bits in SPISR register are reset. 0 SPI disabled (lower power consumption). 1 SPI enabled, port pins are dedicated to SPI functions.
5 SPTIE	**SPI Transmit Interrupt Enable** — This bit enables SPI interrupt requests, if SPTEF flag is set. 0 SPTEF interrupt disabled. 1 SPTEF interrupt enabled.
4 MSTR	**SPI Master/Slave Mode Select Bit** — This bit selects whether the SPI operates in master or slave mode. Switching the SPI from master to slave or vice versa forces the SPI system into idle state. 0 SPI is in slave mode. 1 SPI is in master mode.
3 CPOL	**SPI Clock Polarity Bit** — This bit selects an inverted or non-inverted SPI clock. To transmit data between SPI modules, the SPI modules must have identical CPOL values. In master mode, a change of this bit will abort a transmission in progress and force the SPI system into idle state. 0 Active-high clocks selected. In idle state SCK is low. 1 Active-low clocks selected. In idle state SCK is high.
2 CPHA	**SPI Clock Phase Bit** — This bit is used to select the SPI clock format. In master mode, a change of this bit will abort a transmission in progress and force the SPI system into idle state. 0 Sampling of data occurs at odd edges (1,3,5,...) of the SCK clock. 1 Sampling of data occurs at even edges (2,4,6,...) of the SCK clock.

14.3.2.4 Output Compare 7 Data Register (OC7D)

Module Base + 0x0003

	7	6	5	4	3	2	1	0
R W	OC7D7	OC7D6	OC7D5	OC7D4	OC7D3	OC7D2	OC7D1	OC7D0
Reset	0	0	0	0	0	0	0	0

Figure 14-9. Output Compare 7 Data Register (OC7D)

Read: Anytime

Write: Anytime

Table 14-5. OC7D Field Descriptions

Field	Description
7:0 OC7D[7:0]	**Output Compare 7 Data** — A channel 7 event, which can be a counter overflow when TTOV[7] is set or a successful output compare on channel 7, can cause bits in the output compare 7 data register to transfer to the timer port data register depending on the output compare 7 mask register.

14.3.2.5 Timer Count Register (TCNT)

Module Base + 0x0004

	15	14	13	12	11	10	9	9
R W	TCNT15	TCNT14	TCNT13	TCNT12	TCNT11	TCNT10	TCNT9	TCNT8
Reset	0	0	0	0	0	0	0	0

Figure 14-10. Timer Count Register High (TCNTH)

Module Base + 0x0005

	7	6	5	4	3	2	1	0
R W	TCNT7	TCNT6	TCNT5	TCNT4	TCNT3	TCNT2	TCNT1	TCNT0
Reset	0	0	0	0	0	0	0	0

Figure 14-11. Timer Count Register Low (TCNTL)

The 16-bit main timer is an up counter.

A full access for the counter register should take place in one clock cycle. A separate read/write for high byte and low byte will give a different result than accessing them as a word.

Read: Anytime

Table 16-23. FCCOB - NVM Command Mode (Typical Usage)

CCOBIX[2:0]	Byte	FCCOB Parameter Fields (NVM Command Mode)
011	HI	Data 1 [15:8]
	LO	Data 1 [7:0]
100	HI	Data 2 [15:8]
	LO	Data 2 [7:0]
101	HI	Data 3 [15:8]
	LO	Data 3 [7:0]

16.3.2.12 Flash Reserved1 Register (FRSV1)

This Flash register is reserved for factory testing.

Offset Module Base + 0x000C

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 16-18. Flash Reserved1 Register (FRSV1)

All bits in the FRSV1 register read 0 and are not writable.

16.3.2.13 Flash Reserved2 Register (FRSV2)

This Flash register is reserved for factory testing.

Offset Module Base + 0x000D

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 16-19. Flash Reserved2 Register (FRSV2)

All bits in the FRSV2 register read 0 and are not writable.

16.3.2.14 Flash Reserved3 Register (FRSV3)

This Flash register is reserved for factory testing.

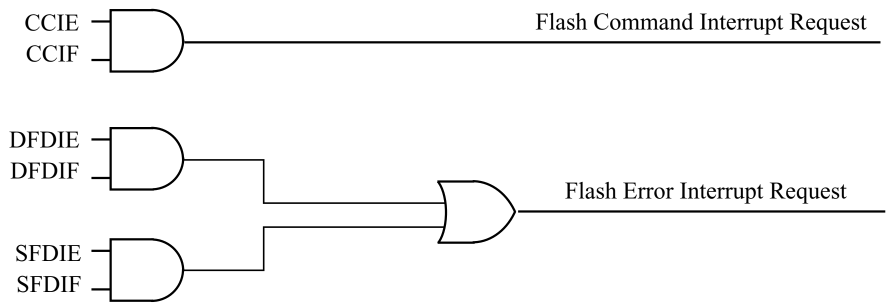


Figure 16-27. Flash Module Interrupts Implementation

16.4.7 Wait Mode

The Flash module is not affected if the MCU enters wait mode. The Flash module can recover the MCU from wait via the CCIF interrupt (see Section 16.4.6, “Interrupts”).

16.4.8 Stop Mode

If a Flash command is active (CCIF = 0) when the MCU requests stop mode, the current Flash operation will be completed before the CPU is allowed to enter stop mode.

16.5 Security

The Flash module provides security information to the MCU. The Flash security state is defined by the SEC bits of the FSEC register (see Table 16-10). During reset, the Flash module initializes the FSEC register using data read from the security byte of the Flash configuration field at global address 0x3_FF0F. The security state out of reset can be permanently changed by programming the security byte assuming that the MCU is starting from a mode where the necessary P-Flash erase and program commands are available and that the upper region of the P-Flash is unprotected. If the Flash security byte is successfully programmed, its new value will take affect after the next MCU reset.

The following subsections describe these security-related subjects:

- Unsecuring the MCU using Backdoor Key Access
- Unsecuring the MCU in Special Single Chip Mode using BDM
- Mode and Security Effects on Flash Command Availability

16.5.1 Unsecuring the MCU using Backdoor Key Access

The MCU may be unsecured by using the backdoor key access feature which requires knowledge of the contents of the backdoor keys (four 16-bit words programmed at addresses 0x3_FF00-0x3_FF07). If the KEYEN[1:0] bits are in the enabled state (see Section 16.3.2.2), the Verify Backdoor Access Key command (see Section 16.4.5.11) allows the user to present four prospective keys for comparison to the keys stored in the Flash memory via the Memory Controller. If the keys presented in the Verify Backdoor Access Key command match the backdoor keys stored in the Flash memory, the SEC bits in the FSEC

Table 17-59. Erase Verify D-Flash Section Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x10	Global address [17:16] to identify the D-Flash block
001	Global address [15:0] of the first word to be verified	
010	Number of words to be verified	

Upon clearing CCIF to launch the Erase Verify D-Flash Section command, the Memory Controller will verify the selected section of D-Flash memory is erased. The CCIF flag will set after the Erase Verify D-Flash Section operation has completed.

Table 17-60. Erase Verify D-Flash Section Command Error Handling

Register	Error Bit	Error Condition
FSTAT	ACCERR	Set if CCOBIX[2:0] != 010 at command launch
		Set if command not available in current mode (see Table 17-27)
		Set if an invalid global address [17:0] is supplied
		Set if a misaligned word address is supplied (global address [0] != 0)
		Set if the requested section breaches the end of the D-Flash block
	FPVIOL	None
	MGSTAT1	Set if any errors have been encountered during the read
	MGSTAT0	Set if any non-correctable errors have been encountered during the read

17.4.5.15 Program D-Flash Command

The Program D-Flash operation programs one to four previously erased words in the D-Flash block. The Program D-Flash operation will confirm that the targeted location(s) were successfully programmed upon completion.

A Flash word must be in the erased state before being programmed. Cumulative programming of bits within a Flash word is not allowed.

Table 17-61. Program D-Flash Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x11	Global address [17:16] to identify the D-Flash block
001	Global address [15:0] of word to be programmed	
010	Word 0 program value	
011	Word 1 program value, if desired	
100	Word 2 program value, if desired	

Figure 19-2. MC10B8C Memory Map (continued)

Offset	Register	Access
0x0016	Motor Controller Channel Control Register 6 (MCCC6)	RW
0x0017	Motor Controller Channel Control Register 7 (MCCC7)	RW
0x0018	Reserved	—
0x0019	Reserved	—
0x001A	Reserved	—
0x001B	Reserved	—
0x001C	Reserved	—
0x001D	Reserved	—
0x001E	Reserved	—
0x001F	Reserved	—
0x0020	Motor Controller Duty Cycle Register 0 (MCDC0) — High Byte	RW
0x0021	Motor Controller Duty Cycle Register 0 (MCDC0) — Low Byte	RW
0x0022	Motor Controller Duty Cycle Register 1 (MCDC1) — High Byte	RW
0x0023	Motor Controller Duty Cycle Register 1 (MCDC1) — Low Byte	RW
0x0024	Motor Controller Duty Cycle Register 2 (MCDC2) — High Byte	RW
0x0025	Motor Controller Duty Cycle Register 2 (MCDC2) — Low Byte	RW
0x0026	Motor Controller Duty Cycle Register 3 (MCDC3) — High Byte	RW
0x0027	Motor Controller Duty Cycle Register 3 (MCDC3) — Low Byte	RW
0x0028	Motor Controller Duty Cycle Register 4 (MCDC4) — High Byte	RW
0x0029	Motor Controller Duty Cycle Register 4 (MCDC4) — Low Byte	RW
0x002A	Motor Controller Duty Cycle Register 5 (MCDC5) — High Byte	RW
0x002B	Motor Controller Duty Cycle Register 5 (MCDC5) — Low Byte	RW
0x002C	Motor Controller Duty Cycle Register 6 (MCDC6) — High Byte	RW
0x002D	Motor Controller Duty Cycle Register 6 (MCDC6) — Low Byte	RW
0x002E	Motor Controller Duty Cycle Register 7 (MCDC7) — High Byte	RW
0x002F	Motor Controller Duty Cycle Register 7 (MCDC7) — Low Byte	RW
0x0030	Reserved	—
0x0031	Reserved	—
0x0032	Reserved	—
0x0033	Reserved	—
0x0034	Reserved	—
0x0035	Reserved	—
0x0036	Reserved	—
0x0037	Reserved	—
0x0038	Reserved	—
0x0039	Reserved	—
0x003A	Reserved	—
0x003B	Reserved	—
0x003C	Reserved	—
0x003D	Reserved	—

Address	Name		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00CD	SCISR2	R	AMAP	0	0	TXPOL	RXPOL	BRK13	TXDIR	RAF
		W								
0x00CE	SCIDRH	R	R8	T8	0	0	0	0	0	0
		W								
0x00CF	SCIDRL	R	R7	R6	R5	R4	R3	R2	R1	R0
		W	T7	T6	T5	T4	T3	T2	T1	T0

1. Those registers are accessible if the AMAP bit in the SCISR2 register is set to zero
2. Those registers are accessible if the AMAP bit in the SCISR2 register is set to one

0x00D0–0x00D7 Reserved

Address	Name		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00D0- 0x00D7	Reserved	R	0	0	0	0	0	0	0	0
		W								

x00D8–0x00DF Serial Peripheral Interface (SPI) Map

Address	Name		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00D8	SPICR1	R	SPIE	SPE	SPTIE	MSTR	CPOL	CPHA	SSOE	LSBFE
		W								
0x00D9	SPICR2	R	0	XFRW	0	MODFEN	BIDIROE	0	SPISWAI	SPC0
		W								
0x00DA	SPIBR	R	0	SPPR2	SPPR1	SPPR0	0	SPR2	SPR1	SPR0
		W								
0x00DB	SPISR	R	SPIF	0	SPTEF	MODF	0	0	0	0
		W								
0x00DC	SPIDRH	R	R15	R14	R13	R12	R11	R10	R9	R8
		W	T15	T14	T13	T12	T11	T10	T9	T8
0x00DD	SPIDRL	R	R7	R6	R5	R4	R3	R2	R1	R0
		W	T7	T6	T5	T4	T3	T2	T1	T0
0x00DE	Reserved	R	0	0	0	0	0	0	0	0
		W								
0x00DF	Reserved	R	0	0	0	0	0	0	0	0
		W								

0x00E0–0x00E7 Inter IC Bus (IIC) Map

Address	Name		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00E0	IBAD	R	ADR7	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	0
		W								
0x00E1	IBFD	R	IBC7	IBC6	IBC5	IBC4	IBC3	IBC2	IBC1	IBC0
		W								