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Details

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Product Status	Active
Core Processor	S08
Core Size	8-Bit
Speed	40MHz
Connectivity	CANbus, I ² C, LINbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	39
Program Memory Size	48KB (48K x 8)
Program Memory Type	FLASH
EEPROM Size	1.5K x 8
RAM Size	3K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 16x12b
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/pro/item?MUrl=&PartUrl=mc9s08dz48aclf

Email: info@E-XFL.COM

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



MC9S08DZ60 Data Sheet

Covers MC9S08DZ60 MC9S08DZ48 MC9S08DZ32 MC9S08DZ16

MC9S08DZ60 Rev. 4 6/2008

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Chapter 2 Pins and Connections

2.2 Recommended System Connections

Figure 2-4 shows pin connections that are common to MC9S08DZ60 Series application systems.



Figure 2-4. Basic System Connections (Shown in 64-Pin Package)

MC9S08DZ60 Series Data Sheet, Rev. 4



5.5 Interrupts

Interrupts provide a way to save the current CPU status and registers, execute an interrupt service routine (ISR), and then restore the CPU status so processing resumes where it left off before the interrupt. Other than the software interrupt (SWI), which is a program instruction, interrupts are caused by hardware events such as an edge on the IRQ pin or a timer-overflow event. The debug module can also generate an SWI under certain circumstances.

If an event occurs in an enabled interrupt source, an associated read-only status flag will become set. The CPU will not respond unless the local interrupt enable is a 1 to enable the interrupt and the I bit in the CCR is 0 to allow interrupts. The global interrupt mask (I bit) in the CCR is initially set after reset which prevents all maskable interrupt sources. The user program initializes the stack pointer and performs other system setup before clearing the I bit to allow the CPU to respond to interrupts.

When the CPU receives a qualified interrupt request, it completes the current instruction before responding to the interrupt. The interrupt sequence obeys the same cycle-by-cycle sequence as the SWI instruction and consists of:

- Saving the CPU registers on the stack
- Setting the I bit in the CCR to mask further interrupts
- Fetching the interrupt vector for the highest-priority interrupt that is currently pending
- Filling the instruction queue with the first three bytes of program information starting from the address fetched from the interrupt vector locations

While the CPU is responding to the interrupt, the I bit is automatically set to avoid the possibility of another interrupt interrupting the ISR itself (this is called nesting of interrupts). Normally, the I bit is restored to 0 when the CCR is restored from the value stacked on entry to the ISR. In rare cases, the I bit can be cleared inside an ISR (after clearing the status flag that generated the interrupt) so that other interrupts can be serviced without waiting for the first service routine to finish. This practice is not recommended for anyone other than the most experienced programmers because it can lead to subtle program errors that are difficult to debug.

The interrupt service routine ends with a return-from-interrupt (RTI) instruction which restores the CCR, A, X, and PC registers to their pre-interrupt values by reading the previously saved information from the stack.

NOTE

For compatibility with M68HC08 devices, the H register is not automatically saved and restored. It is good programming practice to push H onto the stack at the start of the interrupt service routine (ISR) and restore it immediately before the RTI that is used to return from the ISR.

If more than one interrupt is pending when the I bit is cleared, the highest priority source is serviced first (see Table 5-1).



The IRQ pin, when enabled, defaults to use an internal pull device (IRQPDD = 0), the device is a pull-up or pull-down depending on the polarity chosen. If the user desires to use an external pull-up or pull-down, the IRQPDD can be written to a 1 to turn off the internal device.

BIH and BIL instructions may be used to detect the level on the IRQ pin when the pin is configured to act as the IRQ input.

5.5.2.2 Edge and Level Sensitivity

The IRQMOD control bit reconfigures the detection logic so it detects edge events and pin levels. In the edge and level detection mode, the IRQF status flag becomes set when an edge is detected (when the IRQ pin changes from the deasserted to the asserted level), but the flag is continuously set (and cannot be cleared) as long as the IRQ pin remains at the asserted level.

5.5.3 Interrupt Vectors, Sources, and Local Masks

Table 5-1 provides a summary of all interrupt sources. Higher-priority sources are located toward the bottom of the table. The high-order byte of the address for the interrupt service routine is located at the first address in the vector address column, and the low-order byte of the address for the interrupt service routine is located at the next higher address.

When an interrupt condition occurs, an associated flag bit becomes set. If the associated local interrupt enable is 1, an interrupt request is sent to the CPU. Within the CPU, if the global interrupt mask (I bit in the CCR) is 0, the CPU will finish the current instruction; stack the PCL, PCH, X, A, and CCR CPU registers; set the I bit; and then fetch the interrupt vector for the highest priority pending interrupt. Processing then continues in the interrupt service routine.



Chapter 5 Resets, Interrupts, and General System Control

5.8.2 System Reset Status Register (SRS)

This high page register includes read-only status flags to indicate the source of the most recent reset. When a debug host forces reset by writing 1 to BDFR in the SBDFR register, none of the status bits in SRS will be set. Writing any value to this register address causes a COP reset when the COP is enabled except the values 0x55 and 0xAA. Writing a 0x55-0xAA sequence to this address clears the COP watchdog timer without affecting the contents of this register. The reset state of these bits depends on what caused the MCU to reset.

	7	6	5	4	3	2	1	0
R	POR	PIN	COP	ILOP	ILAD	LOC	LVD	0
W		Wr	iting 0x55, 0xA	A to SRS addr	ess clears CO	P watchdog tim	ier.	
POR:	1	0	0	0	0	0	1	0
LVD:	u	0	0	0	0	0	1	0
Any other reset:	0	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	0	0	0

¹ Any of these reset sources that are active at the time of reset entry will cause the corresponding bit(s) to be set; bits corresponding to sources that are not active at the time of reset entry will be cleared.

Figure 5-3. System Reset Status (SRS)

Table 5-3. SRS Register Field Descriptions

Field	Description
7 POR	 Power-On Reset — Reset was caused by the power-on detection logic. Because the internal supply voltage was ramping up at the time, the low-voltage reset (LVD) status bit is also set to indicate that the reset occurred while the internal supply was below the LVD threshold. 0 Reset not caused by POR. 1 POR caused reset.
6 PIN	 External Reset Pin — Reset was caused by an active-low level on the external reset pin. 0 Reset not caused by external reset pin. 1 Reset came from external reset pin.
5 COP	 Computer Operating Properly (COP) Watchdog — Reset was caused by the COP watchdog timer timing out. This reset source can be blocked by COPE = 0. 0 Reset not caused by COP timeout. 1 Reset caused by COP timeout.
4 ILOP	 Illegal Opcode — Reset was caused by an attempt to execute an unimplemented or illegal opcode. The STOP instruction is considered illegal if stop is disabled by STOPE = 0 in the SOPT register. The BGND instruction is considered illegal if active background mode is disabled by ENBDM = 0 in the BDCSC register. 0 Reset not caused by an illegal opcode. 1 Reset caused by an illegal opcode.
3 ILAD	 Illegal Address — Reset was caused by an attempt to access either data or an instruction at an unimplemented memory address. 0 Reset not caused by an illegal address. 1 Reset caused by an illegal address.



5.8.5 System Options Register 2 (SOPT2)

This high page register contains bits to configure MCU specific features on the MC9S08DZ60 Series devices.



Figure 5-6. System Options Register 2 (SOPT2)

¹ This bit can be written only one time after reset. Additional writes are ignored.

Field	Description
7 COPCLKS	 COP Watchdog Clock Select — This write-once bit selects the clock source of the COP watchdog. See Table 5-6 for details. Internal 1-kHz clock is source to COP. Bus clock is source to COP.
6 COPW	 COP Window — This write-once bit selects the COP operation mode. When set, the 0x55-0xAA write sequence to the SRS register must occur in the last 25% of the selected period. Any write to the SRS register during the first 75% of the selected period will reset the MCU. 0 Normal COP operation. 1 Window COP operation.
4 ADHTS	 ADC Hardware Trigger Select — This bit selects which hardware trigger initiates conversion for the analog to digital converter when the ADC hardware trigger is enabled (ADCTRG is set in ADCSC2 register). 0 Real Time Counter (RTC) overflow. 1 External Interrupt Request (IRQ) pin.
2:0 MCSEL	MCLK Divide Select— These bits enable the MCLK output on PTA0 pin and select the divide ratio for the MCLK output according to the formula below when the MCSEL bits are not equal to all zeroes. In case that the MCSEL bits are all zeroes, the MCLK output is disabled. MCLK frequency = Bus Clock frequency ÷ (2 * MCSEL)

Table 5-7. SOPT2 Register Field Descriptions



Chapter 6 Parallel Input/Output Control

This section explains software controls related to parallel input/output (I/O) and pin control. The MC9S08DZ60 Series has seven parallel I/O ports which include a total of up to 53 I/O pins and one input-only pin. See Chapter 2, "Pins and Connections," for more information about pin assignments and external hardware considerations of these pins.

Many of these pins are shared with on-chip peripherals such as timer systems, communication systems, or pin interrupts as shown in Table 2-1. The peripheral modules have priority over the general-purpose I/O functions so that when a peripheral is enabled, the I/O functions associated with the shared pins are disabled.

After reset, the shared peripheral functions are disabled and the pins are configured as inputs (PTxDDn = 0). The pin control functions for each pin are configured as follows: slew rate control enabled (PTxSEn = 1), low drive strength selected (PTxDSn = 0), and internal pull-ups disabled (PTxPEn = 0).

NOTE

- Not all general-purpose I/O pins are available on all packages. To avoid extra current drain from floating input pins, the user's reset initialization routine in the application program must either enable on-chip pull-up devices or change the direction of unconnected pins to outputs so the pins do not float.
- The PTE1 pin does not contain a clamp diode to V_{DD} and should not be driven above V_{DD} . The voltage measured on the internally pulled up PTE1 pin may be as low as $V_{DD} 0.7$ V. The internal gates connected to this pin are pulled all the way to V_{DD} .

6.1 Port Data and Data Direction

Reading and writing of parallel I/Os are performed through the port data registers. The direction, either input or output, is controlled through the port data direction registers. The parallel I/O port function for an individual pin is illustrated in the block diagram shown in Figure 6-1.

The data direction control bit (PTxDDn) determines whether the output buffer for the associated pin is enabled, and also controls the source for port data register reads. The input buffer for the associated pin is always enabled unless the pin is enabled as an analog function or is an output-only pin.

When a shared digital function is enabled for a pin, the output buffer is controlled by the shared function. However, the data direction register bit will continue to control the source for reads of the port data register.

When a shared analog function is enabled for a pin, both the input and output buffers are disabled. A value of 0 is read for any port data bit where the bit is an input (PTxDDn = 0) and the input buffer is disabled.

6.5.1.3 Port A Pull Enable Register (PTAPE)



Figure 6-5. Internal Pull Enable for Port A Register (PTAPE)

Table 6-3. PTAPE Register Field Descriptions

Field	Description
7:0	Internal Pull Enable for Port A Bits — Each of these control bits determines if the internal pull-up or pull-down
PTAPE[7:0]	device is enabled for the associated PTA pin. For port A pins that are configured as outputs, these bits have no
	effect and the internal pull devices are disabled.
	0 Internal pull-up/pull-down device disabled for port A bit n.
	1 Internal pull-up/pull-down device enabled for port A bit n.

NOTE

Pull-down devices only apply when using pin interrupt functions, when corresponding edge select and pin select functions are configured.

6.5.1.4 Port A Slew Rate Enable Register (PTASE)

	7	6	5	4	3	2	1	0
R W	PTASE7	PTASE6	PTASE5	PTASE4	PTASE3	PTASE2	PTASE1	PTASE0
Reset:	0	0	0	0	0	0	0	0

Figure 6-6. Slew Rate Enable for Port A Register (PTASE)

Table 6-4. PTASE Register Field Descriptions

Field	Description
7:0 PTASE[7:0]	 Output Slew Rate Enable for Port A Bits — Each of these control bits determines if the output slew rate control is enabled for the associated PTA pin. For port A pins that are configured as inputs, these bits have no effect. Output slew rate control disabled for port A bit n. Output slew rate control enabled for port A bit n.

Note: Slew rate reset default values may differ between engineering samples and final production parts. Always initialize slew rate control to the desired value to ensure correct operation.



Chapter 6 Parallel Input/Output Control

6.5.2.5 Port B Drive Strength Selection Register (PTBDS)



Figure 6-15. Drive Strength Selection for Port B Register (PTBDS)

Table 6-13. PTBDS Register Field Descriptions

Field	Description
7:0 PTBDS[7:0]	 Output Drive Strength Selection for Port B Bits — Each of these control bits selects between low and high output drive for the associated PTB pin. For port B pins that are configured as inputs, these bits have no effect. 0 Low output drive strength selected for port B bit n. 1 High output drive strength selected for port B bit n.

6.5.2.6 Port B Interrupt Status and Control Register (PTBSC)



Figure 6-16. Port B Interrupt Status and Control Register (PTBSC)

Table 6-14. PTBSC Register Field Descriptions

Field	Description
3 PTBIF	 Port B Interrupt Flag — PTBIF indicates when a Port B interrupt is detected. Writes have no effect on PTBIF. 0 No Port B interrupt detected. 1 Port B interrupt detected.
2 PTBACK	Port B Interrupt Acknowledge — Writing a 1 to PTBACK is part of the flag clearing mechanism. PTBACK always reads as 0.
1 PTBIE	 Port B Interrupt Enable — PTBIE determines whether a port B interrupt is requested. 0 Port B interrupt request not enabled. 1 Port B interrupt request enabled.
0 PTBMOD	 Port B Detection Mode — PTBMOD (along with the PTBES bits) controls the detection mode of the port B interrupt pins. 0 Port B pins detect edges only. 1 Port B pins detect both edges and levels.



6.5.5.5 Port E Drive Strength Selection Register (PTEDS)

_	7	6	5	4	3	2	1	0
R W	PTEDS7	PTEDS6	PTEDS5	PTEDS4	PTEDS3	PTEDS2	PTEDS1 ¹	PTEDS0
Reset:	0	0	0	0	0	0	0	0

Figure 6-36. Drive Strength Selection for Port E Register (PTEDS)

¹ PTEDS1 has no effect on the input-only PTE1 pin.

Field	Description
7:0 PTEDS[7:0]	 Output Drive Strength Selection for Port E Bits — Each of these control bits selects between low and high output drive for the associated PTE pin. For port E pins that are configured as inputs, these bits have no effect. 0 Low output drive strength selected for port E bit n. 1 High output drive strength selected for port E bit n.



Chapter 8 Multi-Purpose Clock Generator (S08MCGV1)

- c) MCGC1 = 0x98 (% 10011000)
 - RDIV (bits 5-3) set to %011, or divide-by-8 because 8 MHz / 8= 1 MHz which is in the 1 MHz to 2 MHz range required by the PLL. In BLPE mode, the configuration of the RDIV does not matter because both the FLL and PLL are disabled. Changing them only sets up the the dividers for PLL usage in PBE mode
- d) MCGC3 = 0x44 (%01000100)
 - PLLS (bit 6) set to 1, selects the PLL. In BLPE mode, changing this bit only prepares the MCG for PLL usage in PBE mode
 - VDIV (bits 3-0) set to %0100, or multiply-by-16 because 1 MHz reference * 16 = 16 MHz. In BLPE mode, the configuration of the VDIV bits does not matter because the PLL is disabled. Changing them only sets up the multiply value for PLL usage in PBE mode
- e) Loop until PLLST (bit 5) in MCGSC is set, indicating that the current source for the PLLS clock is the PLL
- 3. Then, BLPE mode transitions into PBE mode:
 - a) Clear LP (bit 3) in MCGC2 to 0 here to switch to PBE mode
 - b) Then loop until LOCK (bit 6) in MCGSC is set, indicating that the PLL has acquired lock
- 4. Last, PBE mode transitions into PEE mode:
 - a) MCGC1 = 0x18 (%00011000)
 - CLKS (bits7 and 6) in MCGSC1 set to %00 in order to select the output of the PLL as the system clock source
 - b) Loop until CLKST (bits 3 and 2) in MCGSC are %11, indicating that the PLL output is selected to feed MCGOUT in the current clock mode
 - Now, With an RDIV of divide-by-8, a BDIV of divide-by-1, and a VDIV of multiply-by-16, MCGOUT = [(8 MHz / 8) * 16] / 1 = 16 MHz, and the bus frequency is MCGOUT / 2, or 8 MHz



Chapter 10 Analog-to-Digital Converter (S08ADC12V1)

ADCSC1 = 0x41 (%01000001)

Bit 7	COCO	0	Read-only flag which is set when a conversion completes
Bit 6	AIEN	1	Conversion complete interrupt enabled
Bit 5	ADCO	0	One conversion only (continuous conversions disabled)
Bit 4:0	ADCH	00001	Input channel 1 selected as ADC input channel

ADCRH/L = 0xxx

Holds results of conversion. Read high byte (ADCRH) before low byte (ADCRL) so that conversion data cannot be overwritten with data from the next conversion.

ADCCVH/L = 0xxx

Holds compare value when compare function enabled

APCTL1=0x02

AD1 pin I/O control disabled. All other AD pins remain general purpose I/O pins

APCTL2=0x00

All other AD pins remain general purpose I/O pins



Figure 10-13. Initialization Flowchart for Example



Chapter 15 Real-Time Counter (S08RTCV1)

15.1 Introduction

The RTC module consists of one 8-bit counter, one 8-bit comparator, several binary-based and decimal-based prescaler dividers, three clock sources, and one programmable periodic interrupt. This module can be used for time-of-day, calendar or any task scheduling functions. It can also serve as a cyclic wake up from low power modes without the need of external components.

All devices in the MC9S08DZ60 Series feature the RTC.

15.1.1 RTC Clock Signal Names

References to ERCLK and IRCLK in this chapter correspond to signals MCGERCLK and MCGIRCLK, respectively.





15.1.2 Features

Features of the RTC module include:

- 8-bit up-counter
 - 8-bit modulo match limit
 - Software controllable periodic interrupt on match
- Three software selectable clock sources for input to prescaler with selectable binary-based and decimal-based divider values
 - 1-kHz internal low-power oscillator (LPO)
 - External clock (ERCLK)
 - 32-kHz internal clock (IRCLK)

15.1.3 Modes of Operation

This section defines the operation in stop, wait and background debug modes.

15.1.3.1 Wait Mode

The RTC continues to run in wait mode if enabled before executing the appropriate instruction. Therefore, the RTC can bring the MCU out of wait mode if the real-time interrupt is enabled. For lowest possible current consumption, the RTC should be stopped by software if not needed as an interrupt source during wait mode.

15.1.3.2 Stop Modes

The RTC continues to run in stop2 or stop3 mode if the RTC is enabled before executing the STOP instruction. Therefore, the RTC can bring the MCU out of stop modes with no external components, if the real-time interrupt is enabled.

The LPO clock can be used in stop2 and stop3 modes. ERCLK and IRCLK clocks are only available in stop3 mode.

Power consumption is lower when all clock sources are disabled, but in that case, the real-time interrupt cannot wake up the MCU from stop modes.

15.1.3.3 Active Background Mode

The RTC suspends all counting during active background mode until the microcontroller returns to normal user operating mode. Counting resumes from the suspended value as long as the RTCMOD register is not written and the RTCPS and RTCLKS bits are not altered.

Field	Description
7 CHnF	Channel n flag. When channel n is an input-capture channel, this read/write bit is set when an active edge occurs on the channel n pin. When channel n is an output compare or edge-aligned/center-aligned PWM channel, CHnF is set when the value in the TPM counter registers matches the value in the TPM channel n value registers. When channel n is an edge-aligned/center-aligned PWM channel and the duty cycle is set to 0% or 100%, CHnF will not be set even when the value in the TPM counter registers matches the value in the TPM channel n value registers.
	A corresponding interrupt is requested when CHnF is set and interrupts are enabled (CHnIE = 1). Clear CHnF by reading TPMxCnSC while CHnF is set and then writing a logic 0 to CHnF. If another interrupt request occurs before the clearing sequence is complete, the sequence is reset so CHnF remains set after the clear sequence completed for the earlier CHnF. This is done so a CHnF interrupt request cannot be lost due to clearing a previous CHnF.
	 Reset clears the CHnF bit. Writing a logic 1 to CHnF has no effect. 0 No input capture or output compare event occurred on channel n 1 Input capture or output compare event on channel n
6 CHnIE	 Channel n interrupt enable. This read/write bit enables interrupts from channel n. Reset clears CHnIE. 0 Channel n interrupt requests disabled (use for software polling) 1 Channel n interrupt requests enabled
5 MSnB	Mode select B for TPM channel n. When CPWMS=0, MSnB=1 configures TPM channel n for edge-aligned PWM mode. Refer to the summary of channel mode and setup controls in Table 16-6.
4 MSnA	 Mode select A for TPM channel n. When CPWMS=0 and MSnB=0, MSnA configures TPM channel n for input-capture mode or output compare mode. Refer to Table 16-6 for a summary of channel mode and setup controls. Note: If the associated port pin is not stable for at least two bus clock cycles before changing to input capture mode, it is possible to get an unexpected indication of an edge trigger.
3–2 ELSnB ELSnA	Edge/level select bits. Depending upon the operating mode for the timer channel as set by CPWMS:MSnB:MSnA and shown in Table 16-6, these bits select the polarity of the input edge that triggers an input capture event, select the level that will be driven in response to an output compare match, or select the polarity of the PWM output.
	Setting ELSnB:ELSnA to 0:0 configures the related timer pin as a general purpose I/O pin not related to any timer functions. This function is typically used to temporarily disable an input capture channel or to make the timer pin available as a general purpose I/O pin when the associated timer channel is set up as a software timer that does not require the use of a pin.

Table 16-5. TPMxCnSC Field Descriptions

Table 16-6.	Mode,	Edge,	and	Level	Selection
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CPWMS	MSnB:MSnA	ELSnB:ELSnA	Mode	Configuration
Х	XX	00	Pin not used for purpose I/O or	TPM - revert to general other peripheral control



CPWMS	MSnB:MSnA	ELSnB:ELSnA	Mode	Configuration
0	00	01	Input capture	Capture on rising edge only
		10		Capture on falling edge only
		11		Capture on rising or falling edge
	01	01	Output compare	Toggle output on compare
		10		Clear output on compare
		11		Set output on compare
	1X	10	Edge-aligned PWM	High-true pulses (clear output on compare)
		X1		Low-true pulses (set output on compare)
1	XX	10	Center-aligned PWM	High-true pulses (clear output on compare-up)
		X1		Low-true pulses (set output on compare-up)

Table 16-6. Mode, Edge, and Level Selection

16.3.5 TPM Channel Value Registers (TPMxCnVH:TPMxCnVL)

These read/write registers contain the captured TPM counter value of the input capture function or the output compare value for the output compare or PWM functions. The channel registers are cleared by reset.

	7	6	5	4	3	2	1	0
R W	Bit 15	14	13	12	11	10	9	Bit 8
Reset	0	0	0	0	0	0	0	0



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

Figure 16-14. TPM Channel Value Register Low (TPMxCnVL)

In input capture mode, reading either byte (TPMxCnVH or TPMxCnVL) latches the contents of both bytes into a buffer where they remain latched until the other half is read. This latching mechanism also resets

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Chapter 17 Development Support

Figure 17-3 shows the host receiving a logic 1 from the target HCS08 MCU. Because the host is asynchronous to the target MCU, there is a 0-to-1 cycle delay from the host-generated falling edge on BKGD to the perceived start of the bit time in the target MCU. The host holds the BKGD pin low long enough for the target to recognize it (at least two target BDC cycles). The host must release the low drive before the target MCU drives a brief active-high speedup pulse seven cycles after the perceived start of the bit time. The host should sample the bit level about 10 cycles after it started the bit time.



Figure 17-3. BDC Target-to-Host Serial Bit Timing (Logic 1)



Chapter 17 Development Support

17.4.1.1 BDC Status and Control Register (BDCSCR)

This register can be read or written by serial BDC commands (READ_STATUS and WRITE_CONTROL) but is not accessible to user programs because it is not located in the normal memory map of the MCU.



= Unimplemented or Reserved

Figure 17-5. BDC Status and Control Register (BDCSCR)

Table 17-2. BDCSCR Register Field Descriptions

Field	Description
7 ENBDM	 Enable BDM (Permit Active Background Mode) — Typically, this bit is written to 1 by the debug host shortly after the beginning of a debug session or whenever the debug host resets the target and remains 1 until a normal reset clears it. 0 BDM cannot be made active (non-intrusive commands still allowed) 1 BDM can be made active to allow active background mode commands
6 BDMACT	 Background Mode Active Status — This is a read-only status bit. 0 BDM not active (user application program running) 1 BDM active and waiting for serial commands
5 BKPTEN	 BDC Breakpoint Enable — If this bit is clear, the BDC breakpoint is disabled and the FTS (force tag select) control bit and BDCBKPT match register are ignored. 0 BDC breakpoint disabled 1 BDC breakpoint enabled
4 FTS	 Force/Tag Select — When FTS = 1, a breakpoint is requested whenever the CPU address bus matches the BDCBKPT match register. When FTS = 0, a match between the CPU address bus and the BDCBKPT register causes the fetched opcode to be tagged. If this tagged opcode ever reaches the end of the instruction queue, the CPU enters active background mode rather than executing the tagged opcode. 0 Tag opcode at breakpoint address and enter active background mode if CPU attempts to execute that instruction 1 Breakpoint match forces active background mode at next instruction boundary (address need not be an opcode)
3 CLKSW	Select Source for BDC Communications Clock — CLKSW defaults to 0, which selects the alternate BDC clock source. 0 Alternate BDC clock source 1 MCU bus clock



Appendix B Timer Pulse-Width Modulator (TPMV2)

Freescale-provided equate or header file is used to translate these names into the appropriate absolute addresses.

B.2.1 Timer Status and Control Register (TPMxSC)

TPMxSC contains the overflow status flag and control bits that are used to configure the interrupt enable, TPM configuration, clock source, and prescale divisor. These controls relate to all channels within this timer module.

	7	6	5	4	3	2	1	0
R	TOF	TOIE	CPWMS	CLKSB	CLKSA	PS2	PS1	PS0
vv								
Reset	0	0	0	0	0	0	0	0
		= Unimplemer	ted or Reserve	ed	•			

Figure B-2. Timer Status and Control Register (TPMxSC)

Field	Description
7 TOF	Timer Overflow Flag — This flag is set when the TPM counter changes to 0x0000 after reaching the modulo value programmed in the TPM counter modulo registers. When the TPM is configured for CPWM, TOF is set after the counter has reached the value in the modulo register, at the transition to the next lower count value. Clear TOF by reading the TPM status and control register when TOF is set and then writing a 0 to TOF. If another TPM overflow occurs before the clearing sequence is complete, the sequence is reset so TOF would remain set after the clear sequence was completed for the earlier TOF. Reset clears TOF. Writing a 1 to TOF has no effect. 0 TPM counter has not reached modulo value or overflow 1 TPM counter has overflowed
6 TOIE	 Timer Overflow Interrupt Enable — This read/write bit enables TPM overflow interrupts. If TOIE is set, an interrupt is generated when TOF equals 1. Reset clears TOIE. 0 TOF interrupts inhibited (use software polling) 1 TOF interrupts enabled
5 CPWMS	 Center-Aligned PWM Select — This read/write bit selects CPWM operating mode. Reset clears this bit so the TPM operates in up-counting mode for input capture, output compare, and edge-aligned PWM functions. Setting CPWMS reconfigures the TPM to operate in up-/down-counting mode for CPWM functions. Reset clears CPWMS. All TPMx channels operate as input capture, output compare, or edge-aligned PWM mode as selected by the MSnB:MSnA control bits in each channel's status and control register All TPMx channels operate in center-aligned PWM mode
4:3 CLKS[B:A]	Clock Source Select — As shown in Table B-2, this 2-bit field is used to disable the TPM system or select one of three clock sources to drive the counter prescaler. The external source and the XCLK are synchronized to the bus clock by an on-chip synchronization circuit.
2:0 PS[2:0]	Prescale Divisor Select — This 3-bit field selects one of eight divisors for the TPM clock input as shown in Table B-3. This prescaler is located after any clock source synchronization or clock source selection, so it affects whatever clock source is selected to drive the TPM system.



In input capture mode, reading either byte (TPMxCnVH or TPMxCnVL) latches the contents of both bytes into a buffer where they remain latched until the other byte is read. This latching mechanism also resets (becomes unlatched) when the TPMxCnSC register is written.

In output compare or PWM modes, writing to either byte (TPMxCnVH or TPMxCnVL) latches the value into a buffer. When both bytes have been written, they are transferred as a coherent 16-bit value into the timer channel value registers. This latching mechanism may be manually reset by writing to the TPMxCnSC register.

This latching mechanism allows coherent 16-bit writes in either order, which is friendly to various compiler implementations.

B.3 Functional Description

All TPM functions are associated with a main 16-bit counter that allows flexible selection of the clock source and prescale divisor. A 16-bit modulo register also is associated with the main 16-bit counter in the TPM. Each TPM channel is optionally associated with an MCU pin and a maskable interrupt function.

The TPM has center-aligned PWM capabilities controlled by the CPWMS control bit in TPMxSC. When CPWMS is set to 1, timer counter TPMxCNT changes to an up-/down-counter and all channels in the associated TPM act as center-aligned PWM channels. When CPWMS = 0, each channel can independently be configured to operate in input capture, output compare, or buffered edge-aligned PWM mode.

The following sections describe the main 16-bit counter and each of the timer operating modes (input capture, output compare, edge-aligned PWM, and center-aligned PWM). Because details of pin operation and interrupt activity depend on the operating mode, these topics are covered in the associated mode sections.

B.3.1 Counter

All timer functions are based on the main 16-bit counter (TPMxCNTH:TPMxCNTL). This section discusses selection of the clock source, up-counting vs. up-/down-counting, end-of-count overflow, and manual counter reset.

After any MCU reset, CLKSB:CLKSA = 0:0 so no clock source is selected and the TPM is inactive. Normally, CLKSB:CLKSA would be set to 0:1 so the bus clock drives the timer counter. The clock source for the TPM can be selected to be off, the bus clock (BUSCLK), the fixed system clock (XCLK), or an external input. The maximum frequency allowed for the external clock option is one-fourth the bus rate. Refer to Section B.2.1, "Timer Status and Control Register (TPMxSC)" and Table B-2 for more information about clock source selection.

When the microcontroller is in active background mode, the TPM temporarily suspends all counting until the microcontroller returns to normal user operating mode. During stop mode, all TPM clocks are stopped; therefore, the TPM is effectively disabled until clocks resume. During wait mode, the TPM continues to operate normally.

The main 16-bit counter has two counting modes. When center-aligned PWM is selected (CPWMS = 1), the counter operates in up-/down-counting mode. Otherwise, the counter operates as a simple up-counter.