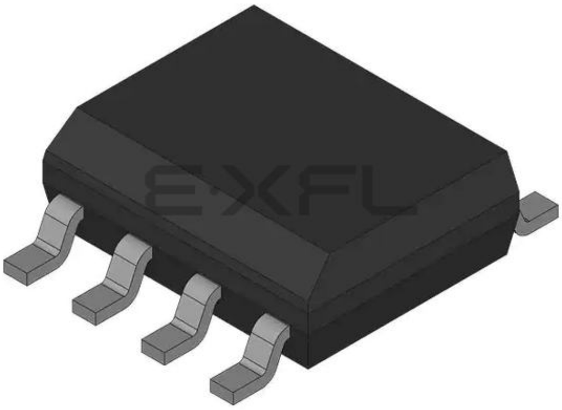
Freescale Semiconductor - S9S08SG4E2CSC Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	S08
Core Size	8-Bit
Speed	40MHz
Connectivity	I²C, LINbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	4
Program Memory Size	4KB (4K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256 x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 4x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	8-SOIC (0.154", 3.90mm Width)
Supplier Device Package	8-SOIC
Purchase URL	https://www.e-xfl.com/pro/item?MUrl=&PartUrl=s9s08sg4e2csc

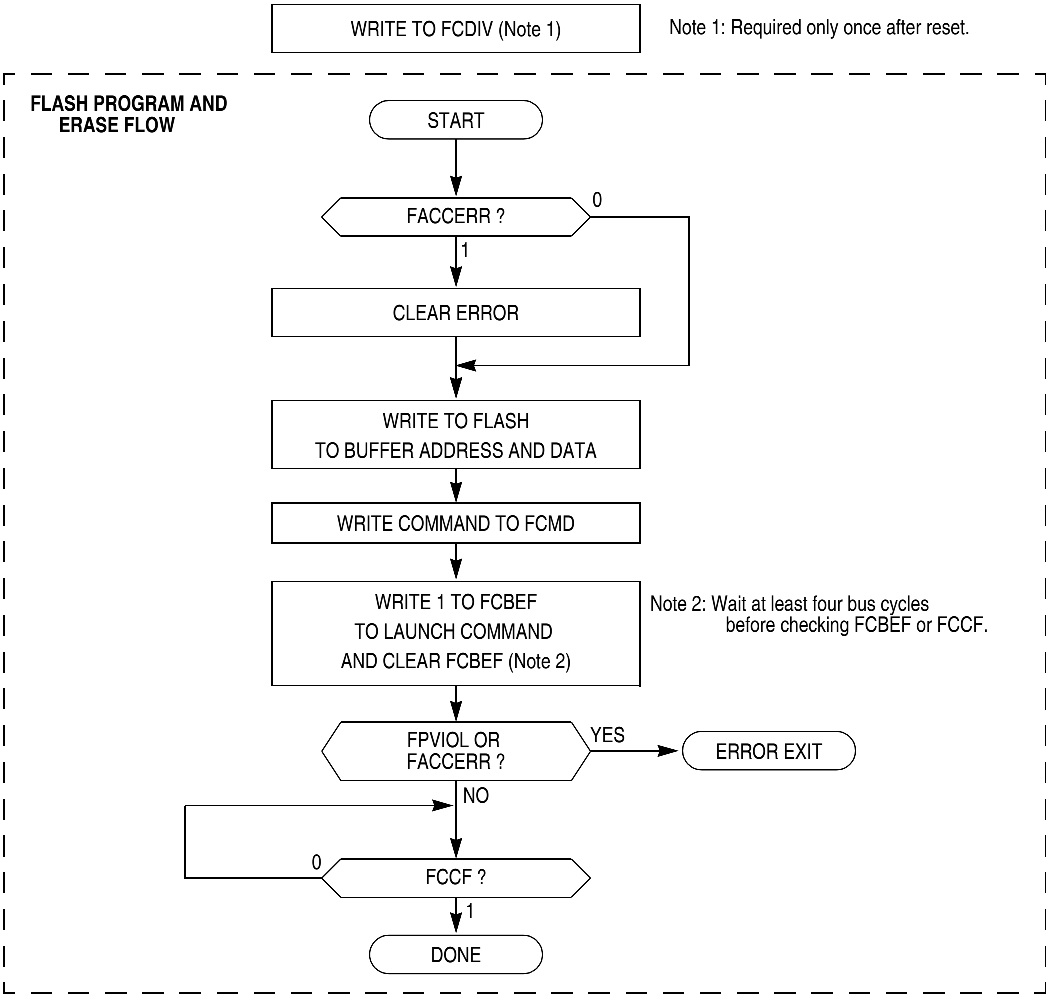


Figure 4-2. FLASH Program and Erase Flowchart

4.5.4 Burst Program Execution

The burst program command is used to program sequential bytes of data in less time than would be required using the standard program command. This is possible because the high voltage to the FLASH array does not need to be disabled between program operations. Ordinarily, when a program or erase command is issued, an internal charge pump associated with the FLASH memory must be enabled to supply high voltage to the array. Upon completion of the command, the charge pump is turned off. When a burst program command is issued, the charge pump is enabled and then remains enabled after completion of the burst program operation if these two conditions are met:

- The next burst program command has been queued before the current program operation has completed.
- The next sequential address selects a byte on the same physical row as the current byte being programmed. A row of FLASH memory consists of 64 bytes. A byte within a row is selected by addresses A5 through A0. A new row begins when addresses A5 through A0 are all zero.

It is a good programming practice to write to the port data register before changing the direction of a port pin to become an output. This ensures that the pin will not be driven momentarily with an old data value that happened to be in the port data register.

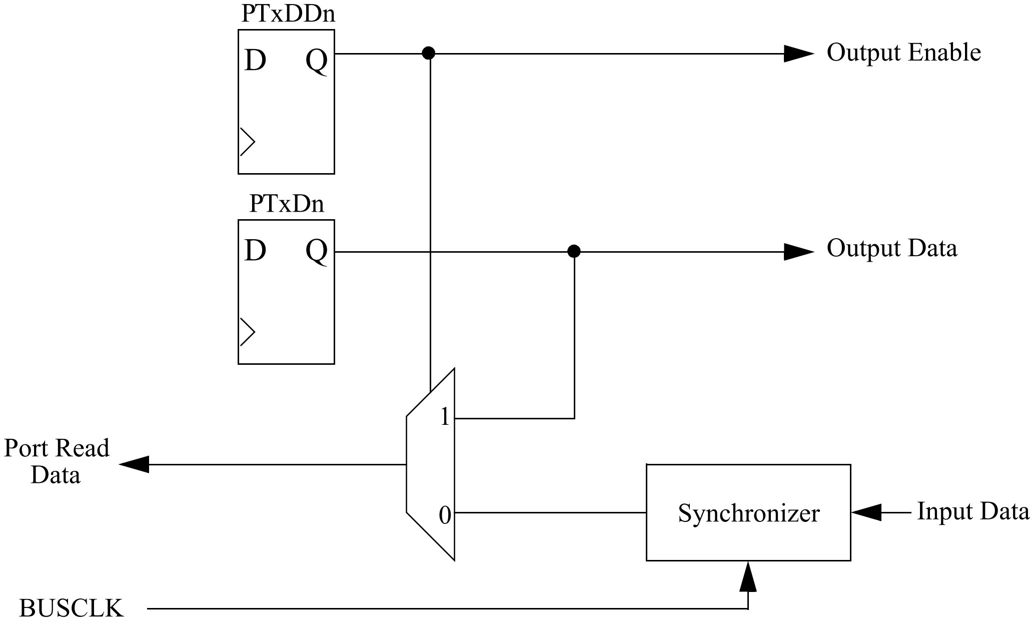


Figure 6-1. Parallel I/O Block Diagram

6.2 Pull-up, Slew Rate, and Drive Strength

Associated with the parallel I/O ports is a set of registers located in the high page register space that operate independently of the parallel I/O registers. These registers are used to control pull-ups, slew rate, and drive strength for the pins.

An internal pull-up device can be enabled for each port pin by setting the corresponding bit in the pull-up enable register (PTxPEn). The pull-up device is disabled if the pin is configured as an output by the parallel I/O control logic or any shared peripheral function regardless of the state of the corresponding pull-up enable register bit. The pull-up device is also disabled if the pin is controlled by an analog function.

Slew rate control can be enabled for each port pin by setting the corresponding bit in the slew rate control register (PTxSEn). When enabled, slew control limits the rate at which an output can transition in order to reduce EMC emissions. Slew rate control has no effect on pins that are configured as inputs.

An output pin can be selected to have high output drive strength by setting the corresponding bit in the drive strength select register (PTxDSn). When high drive is selected, a pin is capable of sourcing and sinking greater current. Even though every I/O pin can be selected as high drive, the user must ensure that the total current source and sink limits for the MCU are not exceeded. Drive strength selection is intended to affect the DC behavior of I/O pins. However, the AC behavior is also affected. High drive allows a pin to drive a greater load with the same switching speed as a low drive enabled pin into a smaller load. Because of this, the EMC emissions may be affected by enabling pins as high drive.

6.4.3 Pull-up/Pull-down Resistors

The pin interrupts can be configured to use an internal pull-up/pull-down resistor using the associated I/O port pull-up enable register. If an internal resistor is enabled, the PTxES register is used to select whether the resistor is a pull-up (PTxESn = 0) or a pull-down (PTxESn = 1).

6.4.4 Pin Interrupt Initialization

When a pin interrupt is first enabled, it is possible to get a false interrupt flag. To prevent a false interrupt request during pin interrupt initialization, the user should do the following:

1. Mask interrupts by clearing PTxIE in PTxSC.
2. Select the pin polarity by setting the appropriate PTxESn bits in PTxES.
3. If using internal pull-up/pull-down device, configure the associated pull enable bits in PTxPE.
4. Enable the interrupt pins by setting the appropriate PTxPEn bits in PTxPE.
5. Write to PTxACK in PTxSC to clear any false interrupts.
6. Set PTxIE in PTxSC to enable interrupts.

6.5 Pin Behavior in Stop Modes

Pin behavior following execution of a STOP instruction depends on the stop mode that is entered. An explanation of pin behavior for the various stop modes follows:

- Stop2 mode is a partial power-down mode, whereby I/O latches are maintained in their state as before the STOP instruction was executed. CPU register status and the state of I/O registers should be saved in RAM before the STOP instruction is executed to place the MCU in stop2 mode. Upon recovery from stop2 mode, before accessing any I/O, the user should examine the state of the PPDF bit in the SPMSC2 register. If the PPDF bit is 0, I/O must be initialized as if a power on reset had occurred. If the PPDF bit is 1, I/O data previously stored in RAM, before the STOP instruction was executed, peripherals may require being initialized and restored to their pre-stop condition. The user must then write a 1 to the PPDACK bit in the SPMSC2 register. Access to I/O is now permitted again in the user application program.
- In stop3 mode, all I/O is maintained because internal logic circuity stays powered up. Upon recovery, normal I/O function is available to the user.

6.6 Parallel I/O and Pin Control Registers

This section provides information about the registers associated with the parallel I/O ports. The data and data direction registers are located in page zero of the memory map. The pull up, slew rate, drive strength, and interrupt control registers are located in the high page section of the memory map.

Refer to tables in Chapter 4, “Memory,” for the absolute address assignments for all parallel I/O and their pin control registers. This section refers to registers and control bits only by their names. A Freescale Semiconductor-provided equate or header file normally is used to translate these names into the appropriate absolute addresses.

9.4.5 Automatic Compare Function

The compare function can be configured to check for either an upper limit or lower limit. After the input is sampled and converted, the result is added to the two's complement of the compare value (ADCCVH and ADCCVL). When comparing to an upper limit (ACFGT = 1), if the result is greater-than or equal-to the compare value, COCO is set. When comparing to a lower limit (ACFGT = 0), if the result is less than the compare value, COCO is set. The value generated by the addition of the conversion result and the two's complement of the compare value is transferred to ADCRH and ADCRL.

Upon completion of a conversion while the compare function is enabled, if the compare condition is not true, COCO is not set and no data is transferred to the result registers. An ADC interrupt is generated upon the setting of COCO if the ADC interrupt is enabled (AIEN = 1).

NOTE

The compare function can be used to monitor the voltage on a channel while the MCU is in either wait or stop3 mode. The ADC interrupt will wake the MCU when the compare condition is met.

9.4.6 MCU Wait Mode Operation

The WAIT instruction puts the MCU in a lower power-consumption standby mode from which recovery is very fast because the clock sources remain active. If a conversion is in progress when the MCU enters wait mode, it continues until completion. Conversions can be initiated while the MCU is in wait mode by means of the hardware trigger or if continuous conversions are enabled.

The bus clock, bus clock divided by two, and ADACK are available as conversion clock sources while in wait mode. The use of ALTCLK as the conversion clock source in wait is dependent on the definition of ALTCLK for this MCU. Consult the module introduction for information on ALTCLK specific to this MCU.

A conversion complete event sets the COCO and generates an ADC interrupt to wake the MCU from wait mode if the ADC interrupt is enabled (AIEN = 1).

9.4.7 MCU Stop3 Mode Operation

The STOP instruction is used to put the MCU in a low power-consumption standby mode during which most or all clock sources on the MCU are disabled.

9.4.7.1 Stop3 Mode With ADACK Disabled

If the asynchronous clock, ADACK, is not selected as the conversion clock, executing a STOP instruction aborts the current conversion and places the ADC in its idle state. The contents of ADCRH and ADCRL are unaffected by stop3 mode.After exiting from stop3 mode, a software or hardware trigger is required to resume conversions.

In cases where separate power supplies are used for analog and digital power, the ground connection between these supplies must be at the V_{SSAD} pin. This should be the only ground connection between these supplies if possible. The V_{SSAD} pin makes a good single point ground location.

9.6.1.2 Analog Reference Pins

In addition to the analog supplies, the ADC module has connections for two reference voltage inputs. The high reference is V_{REFH}, which may be shared on the same pin as V_{DDAD} on some devices. The low reference is V_{REFL}, which may be shared on the same pin as V_{SSAD} on some devices.

When available on a separate pin, V_{REFH} may be connected to the same potential as V_{DDAD}, or may be driven by an external source that is between the minimum V_{DDAD} spec and the V_{DDAD} potential (V_{REFH} must never exceed V_{DDAD}). When available on a separate pin, V_{REFL} must be connected to the same voltage potential as V_{SSAD}. Both V_{REFH} and V_{REFL} must be routed carefully for maximum noise immunity and bypass capacitors placed as near as possible to the package.

AC current in the form of current spikes required to supply charge to the capacitor array at each successive approximation step is drawn through the V_{REFH} and V_{REFL} loop. The best external component to meet this current demand is a 0.1 μF capacitor with good high frequency characteristics. This capacitor is connected between V_{REFH} and V_{REFL} and must be placed as near as possible to the package pins. Resistance in the path is not recommended because the current will cause a voltage drop which could result in conversion errors. Inductance in this path must be minimum (parasitic only).

9.6.1.3 Analog Input Pins

The external analog inputs are typically shared with digital I/O pins on MCU devices. The pin I/O control is disabled by setting the appropriate control bit in one of the pin control registers. Conversions can be performed on inputs without the associated pin control register bit set. It is recommended that the pin control register bit always be set when using a pin as an analog input. This avoids problems with contention because the output buffer will be in its high impedance state and the pullup is disabled. Also, the input buffer draws dc current when its input is not at either V_{DD} or V_{SS}. Setting the pin control register bits for all pins used as analog inputs should be done to achieve lowest operating current.

Empirical data shows that capacitors on the analog inputs improve performance in the presence of noise or when the source impedance is high. Use of 0.01 μF capacitors with good high-frequency characteristics is sufficient. These capacitors are not necessary in all cases, but when used they must be placed as near as possible to the package pins and be referenced to V_{SSA}.

For proper conversion, the input voltage must fall between V_{REFH} and V_{REFL}. If the input is equal to or exceeds V_{REFH}, the converter circuit converts the signal to $3FF (full scale 10-bit representation) or $FF (full scale 8-bit representation). If the input is equal to or less than V_{REFL}, the converter circuit converts it to $000. Input voltages between V_{REFH} and V_{REFL} are straight-line linear conversions. There will be a brief current associated with V_{REFL} when the sampling capacitor is charging. The input is sampled for 3.5 cycles of the ADCK source when ADLSMP is low, or 23.5 cycles when ADLSMP is high.

For minimal loss of accuracy due to current injection, pins adjacent to the analog input pins should not be transitioning during conversions.

10.3.3 ICS Trim Register (ICSTRM)

	7	6	5	4	3	2	1	0
R W	TRIM							
POR:	1	0	0	0	0	0	0	0
Reset:	U	U	U	U	U	U	U	U

Figure 10-5. ICS Trim Register (ICSTRM)

Table 10-4. ICS Trim Register Field Descriptions

Field	Description
7:0 TRIM	**ICS Trim Setting** — The TRIM bits control the internal reference clock frequency by controlling the internal reference clock period. The bits' effect are binary weighted (i.e., bit 1 will adjust twice as much as bit 0). Increasing the binary value in TRIM will increase the period, and decreasing the value will decrease the period. An additional fine trim bit is available in ICSSC as the FTRIM bit.

10.3.4 ICS Status and Control (ICSSC)

	7	6	5	4	3	2	1	0
R	0	0	0	IREFST	CLKST		OSCINIT	FTRIM
W								
POR:	0	0	0	1	0	0	0	0
Reset:	0	0	0	1	0	0	0	U

Figure 10-6. ICS Status and Control Register (ICSSC)

Table 10-5. ICS Status and Control Register Field Descriptions

Field	Description
7:5	Reserved, should be cleared.
4 IREFST	**Internal Reference Status** — The IREFST bit indicates the current source for the reference clock. The IREFST bit does not update immediately after a write to the IREFS bit due to internal synchronization between clock domains. 0 Source of reference clock is external clock. 1 Source of reference clock is internal clock.
3-2 CLKST	**Clock Mode Status** — The CLKST bits indicate the current clock mode. The CLKST bits don't update immediately after a write to the CLKS bits due to internal synchronization between clock domains. 00 Output of FLL is selected. 01 FLL Bypassed, Internal reference clock is selected. 10 FLL Bypassed, External reference clock is selected. 11 Reserved.

Table 11-8. IICD Field Descriptions

Field	Description
7–0 DATA	**Data** — In master transmit mode, when data is written to the IICD, a data transfer is initiated. The most significant bit is sent first. In master receive mode, reading this register initiates receiving of the next byte of data.

NOTE

> When transitioning out of master receive mode, the IIC mode should be switched before reading the IICD register to prevent an inadvertent initiation of a master receive data transfer.

In slave mode, the same functions are available after an address match has occurred.

The TX bit in IICC must correctly reflect the desired direction of transfer in master and slave modes for the transmission to begin. For instance, if the IIC is configured for master transmit but a master receive is desired, reading the IICD does not initiate the receive.

Reading the IICD returns the last byte received while the IIC is configured in master receive or slave receive modes. The IICD does not reflect every byte transmitted on the IIC bus, nor can software verify that a byte has been written to the IICD correctly by reading it back.

In master transmit mode, the first byte of data written to IICD following assertion of MST is used for the address transfer and should comprise of the calling address (in bit 7 to bit 1) concatenated with the required $R/\overline{W}$ bit (in position bit 0).

11.3.6 IIC Control Register 2 (IICC2)

	7	6	5	4	3	2	1	0
R	GCAEN	ADEXT	0	0	0	AD10	AD9	AD8
W			▨	▨	▨			
Reset	0	0	0	0	0	0	0	0

▨ = Unimplemented or Reserved

Figure 11-8. IIC Control Register (IICC2)

Table 11-9. IICC2 Field Descriptions

Field	Description
7 GCAEN	**General Call Address Enable.** The GCAEN bit enables or disables general call address. 0 General call address is disabled 1 General call address is enabled
6 ADEXT	**Address Extension.** The ADEXT bit controls the number of bits used for the slave address. 0 7-bit address scheme 1 10-bit address scheme
2–0 AD[10:8]	Slave Address. The AD[10:8] field contains the upper three bits of the slave address in the 10-bit address scheme. This field is only valid when the ADEXT bit is set.

12.1.2 Features

Timer system features include:

- 8-bit up-counter
  - Free-running or 8-bit modulo limit
  - Software controllable interrupt on overflow
  - Counter reset bit (TRST)
  - Counter stop bit (TSTP)
- Four software selectable clock sources for input to prescaler:
  - System bus clock — rising edge
  - Fixed frequency clock (XCLK) — rising edge
  - External clock source on the TCLK pin — rising edge
  - External clock source on the TCLK pin — falling edge
- Nine selectable clock prescale values:
  - Clock source divide by 1, 2, 4, 8, 16, 32, 64, 128, or 256

12.1.3 Modes of Operation

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

12.1.3.1 MTIM in Wait Mode

The MTIM continues to run in wait mode if enabled before executing the WAIT instruction. Therefore, the MTIM can be used to bring the MCU out of wait mode if the timer overflow interrupt is enabled. For lowest possible current consumption, the MTIM should be stopped by software if not needed as an interrupt source during wait mode.

12.1.3.2 MTIM in Stop Modes

The MTIM is disabled in all stop modes, regardless of the settings before executing the STOP instruction. Therefore, the MTIM cannot be used as a wake up source from stop modes.

Waking from stop1 and stop2 modes, the MTIM will be put into its reset state. If stop3 is exited with a reset, the MTIM will be put into its reset state. If stop3 is exited with an interrupt, the MTIM continues from the state it was in when stop3 was entered. If the counter was active upon entering stop3, the count will resume from the current value.

12.1.3.3 MTIM in Active Background Mode

The MTIM suspends all counting until the microcontroller returns to normal user operating mode. Counting resumes from the suspended value as long as an MTIM reset did not occur (TRST written to a 1 or MTIMMOD written).

12.3 Register Definition

Figure 12-3 is a summary of MTIM registers.

Name		7	6	5	4	3	2	1	0
MTIMSC	R	TOF	TOIE	0	TSTP	0	0	0	0
	W			TRST					
MTIMCLK	R	0	0	CLKS		PS			
	W								
MTIMCNT	R	COUNT							
	W								
MTIMMOD	R	MOD							
	W								

Figure 12-3. MTIM **Register Summary**

Each MTIM includes four registers:

- An 8-bit status and control register
- An 8-bit clock configuration register
- An 8-bit counter register
- An 8-bit modulo register

Refer to the direct-page register summary in the Memory chapter of this data sheet for the absolute address assignments for all MTIM registers.This section refers to registers and control bits only by their names and relative address offsets.

Some MCUs may have more than one MTIM, so register names include placeholder characters to identify which MTIM is being referenced.

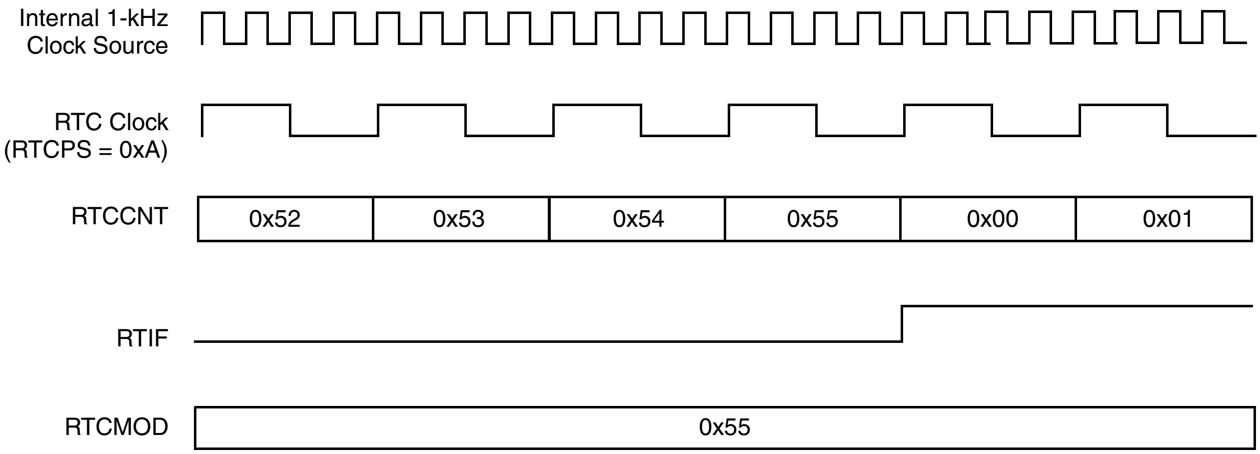


Figure 13-6. RTC Counter Overflow Example

In the example of Figure 13-6, the selected clock source is the 1-kHz internal oscillator clock source. The prescaler (RTCPS) is set to 0xA or divide-by-4. The modulo value in the RTCMOD register is set to 0x55. When the counter, RTCCNT, reaches the modulo value of 0x55, the counter overflows to 0x00 and continues counting. The real-time interrupt flag, RTIF, sets when the counter value changes from 0x55 to 0x00. A real-time interrupt is generated when RTIF is set, if RTIE is set.

13.5 Initialization/Application Information

This section provides example code to give some basic direction to a user on how to initialize and configure the RTC module. The example software is implemented in C language.

The example below shows how to implement time of day with the RTC using the 1-kHz clock source to achieve the lowest possible power consumption. Because the 1-kHz clock source is not as accurate as a crystal, software can be added for any adjustments. For accuracy without adjustments at the expense of additional power consumption, the external clock (ERCLK) or the internal clock (IRCLK) can be selected with appropriate prescaler and modulo values.

```
/* Initialize the elapsed time counters */
Seconds = 0;
Minutes = 0;
Hours = 0;
Days=0;

/* Configure RTC to interrupt every 1 second from 1-kHz clock source */
RTCMOD.byte = 0x00;
RTCSC.byte = 0x1F;

/**********************************************************************
Function Name : RTC_ISR
Notes : Interrupt service routine for RTC module.
**********************************************************************/
```

15.3 Modes of Operation

15.3.1 SPI in Stop Modes

The SPI is disabled in all stop modes, regardless of the settings before executing the STOP instruction. During either stop1 or stop2 mode, the SPI module will be fully powered down. Upon wake-up from stop1 or stop2 mode, the SPI module will be in the reset state. During stop3 mode, clocks to the SPI module are halted. No registers are affected. If stop3 is exited with a reset, the SPI will be put into its reset state. If stop3 is exited with an interrupt, the SPI continues from the state it was in when stop3 was entered.

15.4 Register Definition

The SPI has five 8-bit registers to select SPI options, control baud rate, report SPI status, and for transmit/receive data.

Refer to the direct-page register summary in the Memory chapter of this data sheet for the absolute address assignments for all SPI registers. This section refers to registers and control bits only by their names, and a Freescale-provided equate or header file is used to translate these names into the appropriate absolute addresses.

15.4.1 SPI Control Register 1 (SPIC1)

This read/write register includes the SPI enable control, interrupt enables, and configuration options.

	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 15-5. SPI Control Register 1 (SPIC1)

Table 15-1. SPIC1 Field Descriptions

Field	Description
7 SPIE	**SPI Interrupt Enable (for SPRF and MODF)** — This is the interrupt enable for SPI receive buffer full (SPRF) and mode fault (MODF) events. 0 Interrupts from SPRF and MODF inhibited (use polling) 1 When SPRF or MODF is 1, request a hardware interrupt
6 SPE	**SPI System Enable** — Disabling the SPI halts any transfer that is in progress, clears data buffers, and initializes internal state machines. SPRF is cleared and SPTEF is set to indicate the SPI transmit data buffer is empty. 0 SPI system inactive 1 SPI system enabled
5 SPTIE	**SPI Transmit Interrupt Enable** — This is the interrupt enable bit for SPI transmit buffer empty (SPTEF). 0 Interrupts from SPTEF inhibited (use polling) 1 When SPTEF is 1, hardware interrupt requested

Table 15-7. SPIS Register Field Descriptions

Field	Description
7 SPRF	**SPI Read Buffer Full Flag** — SPRF is set at the completion of an SPI transfer to indicate that received data may be read from the SPI data register (SPID). SPRF is cleared by reading SPRF while it is set, then reading the SPI data register. 0 No data available in the receive data buffer 1 Data available in the receive data buffer
5 SPTEF	**SPI Transmit Buffer Empty Flag** — This bit is set when there is room in the transmit data buffer. It is cleared by reading SPIS with SPTEF set, followed by writing a data value to the transmit buffer at SPID. SPIS must be read with SPTEF = 1 before writing data to SPID or the SPID write will be ignored. SPTEF generates an SPTEF CPU interrupt request if the SPTIE bit in the SPIC1 is also set. SPTEF is automatically set when a data byte transfers from the transmit buffer into the transmit shift register. For an idle SPI (no data in the transmit buffer or the shift register and no transfer in progress), data written to SPID is transferred to the shifter almost immediately so SPTEF is set within two bus cycles allowing a second 8-bit data value to be queued into the transmit buffer. After completion of the transfer of the value in the shift register, the queued value from the transmit buffer will automatically move to the shifter and SPTEF will be set to indicate there is room for new data in the transmit buffer. If no new data is waiting in the transmit buffer, SPTEF simply remains set and no data moves from the buffer to the shifter. 0 SPI transmit buffer not empty 1 SPI transmit buffer empty
4 MODF	**Master Mode Fault Flag** — MODF is set if the SPI is configured as a master and the slave select input goes low, indicating some other SPI device is also configured as a master. The $\overline{SS}$ pin acts as a mode fault error input only when MSTR = 1, MODFEN = 1, and SSOE = 0; otherwise, MODF will never be set. MODF is cleared by reading MODF while it is 1, then writing to SPI control register 1 (SPIC1). 0 No mode fault error 1 Mode fault error detected

15.4.5 SPI Data Register (SPID)

	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 15-9. SPI Data Register (SPID)

Reads of this register return the data read from the receive data buffer. Writes to this register write data to the transmit data buffer. When the SPI is configured as a master, writing data to the transmit data buffer initiates an SPI transfer.

Data should not be written to the transmit data buffer unless the SPI transmit buffer empty flag (SPTEF) is set, indicating there is room in the transmit buffer to queue a new transmit byte.

Data may be read from SPID any time after SPRF is set and before another transfer is finished. Failure to read the data out of the receive data buffer before a new transfer ends causes a receive overrun condition and the data from the new transfer is lost.

When a channel is configured for edge-aligned PWM (CPWMS=0, MSnB=1 and ELSnB:ELSnA not = 0:0), the data direction is overridden, the TPMxCHn pin is forced to be an output controlled by the TPM, and ELSnA controls the polarity of the PWM output signal on the pin. When ELSnB:ELSnA=1:0, the TPMxCHn pin is forced high at the start of each new period (TPMxCNT=0x0000), and the pin is forced low when the channel value register matches the timer counter. When ELSnA=1, the TPMxCHn pin is forced low at the start of each new period (TPMxCNT=0x0000), and the pin is forced high when the channel value register matches the timer counter.

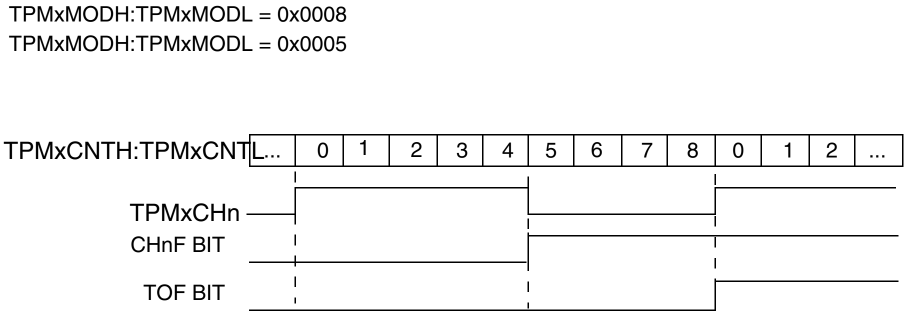


Figure 16-3. High-True Pulse of an Edge-Aligned PWM

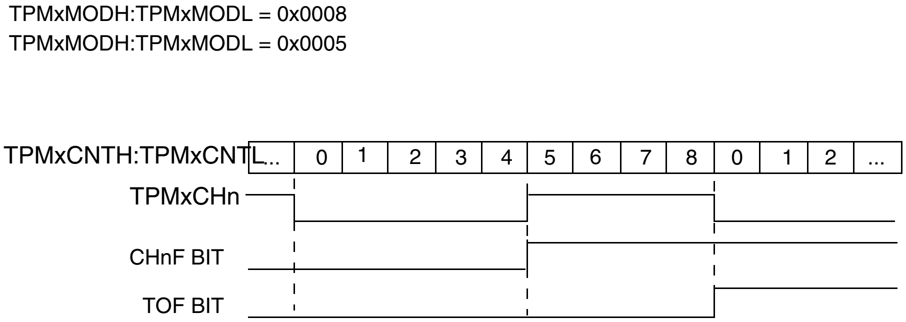


Figure 16-4. Low-True Pulse of an Edge-Aligned PWM

Input capture, output compare, and edge-aligned PWM functions do not make sense when the counter is operating in up/down counting mode so this implies that all active channels within a TPM must be used in CPWM mode when CPWMS=1.

The TPM may be used in an 8-bit MCU. The settings in the timer channel registers are buffered to ensure coherent 16-bit updates and to avoid unexpected PWM pulse widths. Writes to any of the registers TPMxMODH, TPMxMODL, TPMxCnVH, and TPMxCnVL, actually write to buffer registers.

In center-aligned PWM mode, the TPMxCnVH:L registers are updated with the value of their write buffer according to the value of CLKSB:CLKSA bits, so:

- If (CLKSB:CLKSA = 0:0), the registers are updated when the second byte is written
- If (CLKSB:CLKSA not = 0:0), the registers are updated after the both bytes were written, and the TPM counter changes from (TPMxMODH:TPMxMODL - 1) to (TPMxMODH:TPMxMODL). If the TPM counter is a free-running counter, the update is made when the TPM counter changes from 0xFFFE to 0xFFFF.

When TPMxCNTH:TPMxCNTL=TPMxMODH:TPMxMODL, the TPM can optionally generate a TOF interrupt (at the end of this count).

Writing to TPMxSC cancels any values written to TPMxMODH and/or TPMxMODL and resets the coherency mechanism for the modulo registers. Writing to TPMxCnSC cancels any values written to the channel value registers and resets the coherency mechanism for TPMxCnVH:TPMxCnVL.

16.5 Reset Overview

16.5.1 General

The TPM is reset whenever any MCU reset occurs.

16.5.2 Description of Reset Operation

Reset clears the TPMxSC register which disables clocks to the TPM and disables timer overflow interrupts (TOIE=0). CPWMS, MSnB, MSnA, ELSnB, and ELSnA are all cleared which configures all TPM channels for input-capture operation with the associated pins disconnected from I/O pin logic (so all MCU pins related to the TPM revert to general purpose I/O pins).

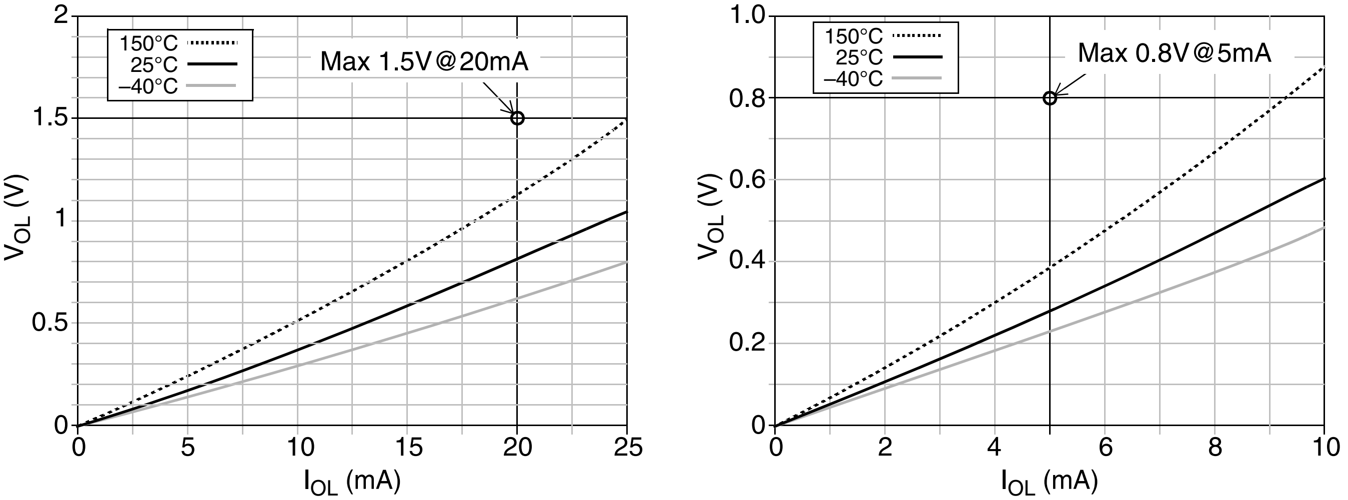
16.6 Interrupts

16.6.1 General

The TPM generates an optional interrupt for the main counter overflow and an interrupt for each channel. The meaning of channel interrupts depends on each channel’s mode of operation. If the channel is configured for input capture, the interrupt flag is set each time the selected input capture edge is recognized. If the channel is configured for output compare or PWM modes, the interrupt flag is set each time the main timer counter matches the value in the 16-bit channel value register.

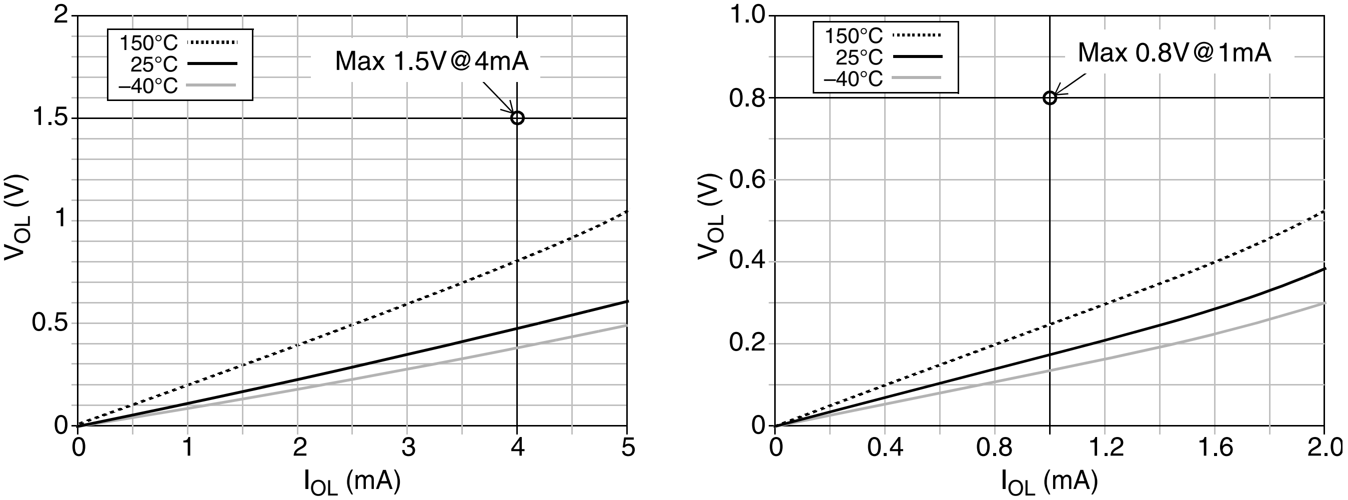
Table A-6. DC Characteristics (continued)

Num	C	Characteristic		Symbol	Condition	Min	Typ[1]	Max	Unit	Temp Rated[2]	
										Standard	AEC Grade 0
11	P	Pullup or Pulldown[3] resistors; when enabled	I/O pins	R_{PU},R_{PD}		17	37	52	kΩ	x	x
	C		$\overline{\text{RESET}}$[4]	R_{PU}		17	37	52	kΩ	x	x
12	D	DC injection current [5, 6, 7, 8]	Single pin limit	I_{IC}	$V_{IN} > V_{DD}$	0	—	2	mA	x	x
					$V_{IN} < V_{SS}$	0	—	–0.2	mA	x	x
			Total MCU limit, includes sum of all stressed pins		$V_{IN} > V_{DD}$	0	—	25	mA	x	x
					$V_{IN} < V_{SS}$	0	—	–5	mA	x	x
13	D	Input Capacitance, all pins		C_{In}		—	—	8	pF	x	x
14	D	RAM retention voltage		V_{RAM}		—	0.6	1.0	V	x	x
15	D	POR re-arm voltage[9]		V_{POR}		0.9	1.4	2.0	V	x	x
16	D	POR re-arm time[10]		t_{POR}		10	—	—	µs	x	x
17	P	Low-voltage detection threshold — high range	V_{DD} falling	V_{LVD1}		3.9 3.88	4.0 4.0	4.1 4.12	V	x	x
			V_{DD} rising			4.0 3.98	4.1 4.1	4.2 4.22		x	x
18	P	Low-voltage detection threshold — low range[11],[12]	V_{DD} falling V_{DD} rising	V_{LVD0}		2.48 2.54	2.56 2.62	2.64 2.70	V	x x	x x
19	P	Low-voltage warning threshold — high range 1	V_{DD} falling	V_{LVW3}	.	4.5 4.48	4.6 4.6	4.7 4.72	V	x	x
			V_{DD} rising			4.6 4.58	4.7 4.7	4.8 4.82		x	x
20	P	Low-voltage warning threshold — high range 0	V_{DD} falling	V_{LVW2}		4.2 4.18	4.3 4.3	4.4 4.42	V	x	x
			V_{DD} rising			4.3 4.28	4.4 4.4	4.5 4.52		x	x
21	P	Low-voltage warning threshold low range 1	V_{DD} falling V_{DD} rising	V_{LVW1}		2.84 2.90	2.92 2.98	3.00 3.06	V	x x	x x
22	P	Low-voltage warning threshold — low range 0	V_{DD} falling V_{DD} rising	V_{LVW0}		2.66 2.72	2.74 2.80	2.82 2.88	V	x x	x x



a) V_{DD} = 5V, High Drive **b) V_{DD} = 3V, High Drive**

Figure A-1. Typical V_{OL} vs I_{OL}, High Drive Strength



a) V_{DD} = 5V, Low Drive **b) V_{DD} = 3V, Low Drive**

Figure A-2. Typical V_{OL} vs I_{OL}, Low Drive Strength

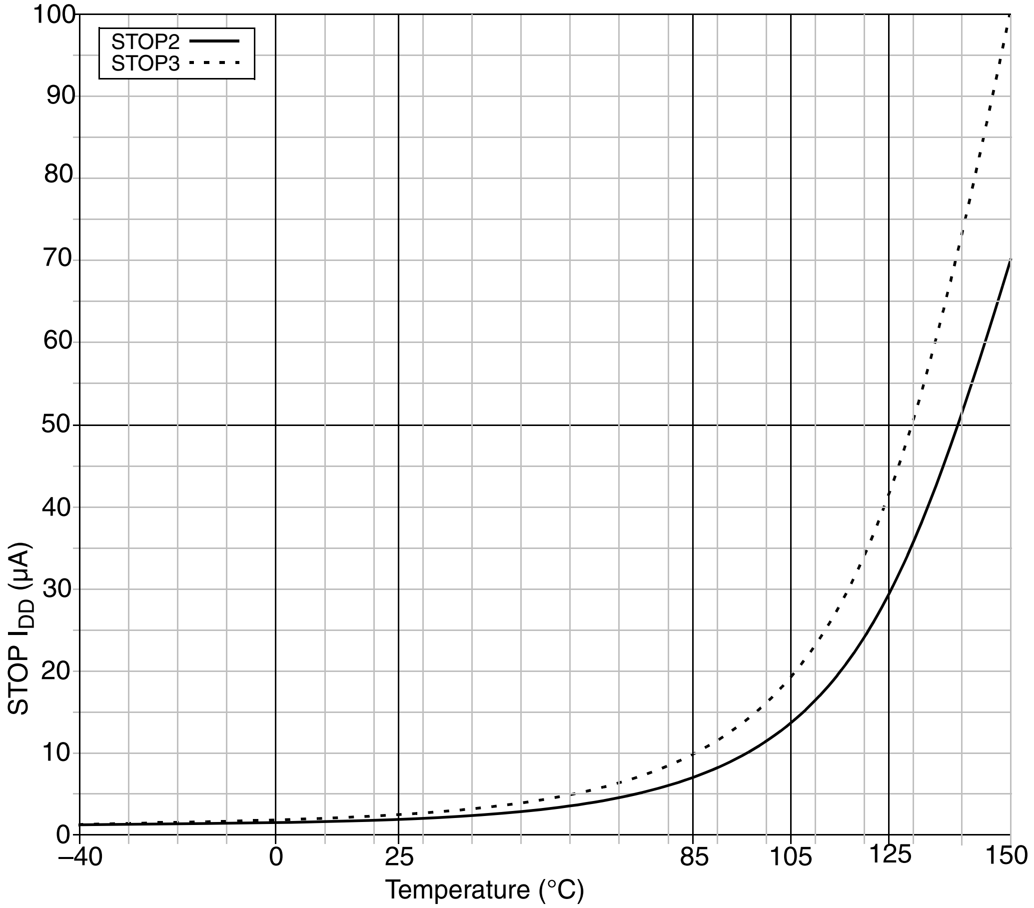


Figure A-7. Typical Stop I_{DD} vs. Temperature (V_{DD} = 5V)

B.2 Mechanical Drawings

The following pages are mechanical specifications for MC9S08SG8 package options. See Table B-2 for the document number for each package type.

Table B-2. Package Information

Pin Count	Type	Designator	Document No.
20	TSSOP	TJ	98ASH70169A
16	TSSOP	TG	98ASH70247A
8	NB SOIC	SC	98ASB42564B

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