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"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 "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	CANbus, I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, WDT
Number of I/O	52
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 20x12b, 3x16b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atsamc21j15a-aut

	SAM C20N	SAM C20J	SAM C20G	SAM C20E
Peripheral Touch Controller (PTC) Number of self-capacitance channels (Y-lines)	32	32	22	16
Peripheral Touch Controller (PTC) Number of mutual-capacitance channels (X x Y lines)	256 (16x16)	256 (16x16)	121 (11x11)	64 (8x8)
Frequency Meter (FREQM) reference clock divider	Yes	Yes	Yes	Yes
Maximum CPU frequency	48 MHz			
Packages	TQFP	QFN TQFP WLCSP	QFN TQFP	QFN TQFP
Oscillators	32.768 kHz crystal oscillator (XOSC32K) 0.4-32 MHz crystal oscillator (XOSC) 32.768 kHz internal oscillator (OSC32K) 32 kHz ultra low-power internal oscillator (OSCULP32K) 48 MHz high-accuracy internal oscillator (OSC48M) 96 MHz Fractional Digital Phased Locked Loop (FDPLL96M)			
Event System channels	6	6	6	6
SW Debug Interface	Yes	Yes	Yes	Yes
Watchdog Timer (WDT)	Yes	Yes	Yes	Yes

Related Links

I/O Multiplexing and Considerations

Name: DIVIDEND
Offset: 0x08
Reset: 0x0000
Property: -

Bit	31	30	29	28	27	26	25	24
	DIVIDEND[31:24]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	23	22	21	20	19	18	17	16
	DIVIDEND[23:16]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	15	14	13	12	11	10	9	8
	DIVIDEND[15:8]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
	DIVIDEND[7:0]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bits 31:0 – DIVIDEND[31:0]: Dividend Value
Holds the 32-bit dividend for the divide operation. If the Signed bit in Control A register (CTRLA.SIGNED) is zero, DIVIDEND is unsigned. If CTRLA.SIGNED = 1, DIVIDEND is signed two's complement. Refer to Performing Division, Operand Size and Signed Division.

14.8.4 Divisor

Name: DIVISOR
Offset: 0x0C
Reset: 0x0000
Property: -

Bit	31	30	29	28	27	26	25	24
Access								
Reset								

Bit	23	22	21	20	19	18	17	16
								TICKON
Access								RW
Reset								0

Bit	15	14	13	12	11	10	9	8
	STATESx	PRESCALERx[2:0]			STATESx	PRESCALERx[2:0]		
Access	RW	RW	RW	RW	RW	RW	RW	RW
Reset	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
	STATESx	PRESCALERx[2:0]			STATESx	PRESCALERx[2:0]		
Access	RW	RW	RW	RW	RW	RW	RW	RW
Reset	0	0	0	0	0	0	0	0

Bit 16 – TICKON: Pin Sampler frequency selection
This bit selects the clock used for the sampling of bounce during transition detection.

Value	Description
0	The bounce sampler is using GCLK_EIC.
1	The bounce sampler is using the low frequency clock.

Bits 3,7,11,15 – STATESx: Debouncer number of states x
This bit selects the number of samples by the debouncer low frequency clock needed to validate a transition from current pin state to next pin state in synchronous debouncing mode for pins EXTINT[7+(8x):8x].

Value	Description
0	The number of low frequency samples is 3.
1	The number of low frequency samples is 7.

Bits 2:0,6:4,10:8,14:12 – PRESCALERx: Debouncer Prescaler x
These bits select the debouncer low frequency clock for pins EXTINT[7+(8x):8x].

Value	Name	Description
0x0	F/2	EIC clock divided by 2
0x1	F/4	EIC clock divided by 4
0x2	F/8	EIC clock divided by 8
0x3	F/16	EIC clock divided by 16
0x4	F/32	EIC clock divided by 32
0x5	F/64	EIC clock divided by 64
0x6	F/128	EIC clock divided by 128
0x7	F/256	EIC clock divided by 256

26.8.13 Pin State

- Address register (ADDR)

Optional write-protection by the Peripheral Access Controller (PAC) is denoted by the "PAC Write-Protection" property in each individual register description.

PAC write-protection does not apply to accesses through an external debugger.

Related Links

PAC - Peripheral Access Controller

30.5.9 Analog Connections

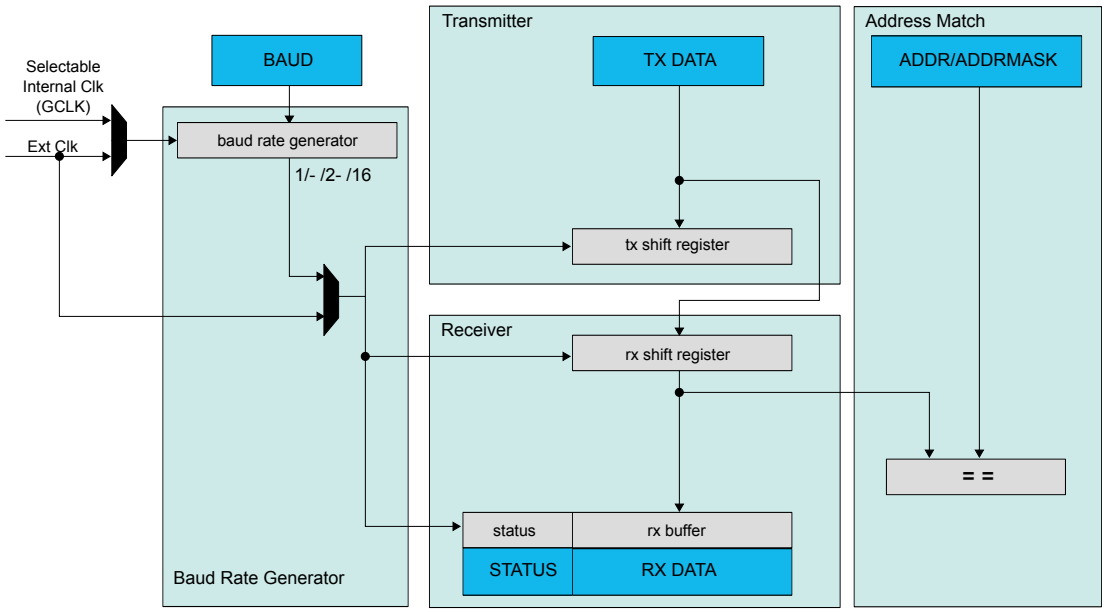
Not applicable.

30.6 Functional Description

30.6.1 Principle of Operation

The basic structure of the SERCOM serial engine is shown in Figure 30-2. Labels in capital letters are synchronous to the system clock and accessible by the CPU; labels in lowercase letters can be configured to run on the GCLK_SERCOMx_CORE clock or an external clock.

Figure 30-2. SERCOM Serial Engine



The transmitter consists of a single write buffer and a shift register.

The receiver consists of a two-level receive buffer and a shift register.

The baud-rate generator is capable of running on the GCLK_SERCOMx_CORE clock or an external clock.

Address matching logic is included for SPI and I^2C operation.

30.6.2 Basic Operation

30.6.2.1 Initialization

The SERCOM must be configured to the desired mode by writing the Operating Mode bits in the Control A register (CTRLA.MODE). Refer to table SERCOM Modes for details.

RUNSTDBY	External Clock	Internal Clock
0x0	External clock is disconnected when ongoing transfer is finished. All reception is dropped.	Generic clock is disabled when ongoing transfer is finished. The device can wake up on Receive Start or Transfer Complete interrupt.
0x1	Wake on Receive Start or Receive Complete interrupt.	Generic clock is enabled in all sleep modes. Any interrupt can wake up the device.

Bits 4:2 – MODE[2:0]: Operating Mode
These bits select the USART serial communication interface of the SERCOM.

These bits are not synchronized.

Value	Description
0x0	USART with external clock
0x1	USART with internal clock

Bit 1 – ENABLE: Enable
Due to synchronization, there is delay from writing CTRLA.ENABLE until the peripheral is enabled/disabled. The value written to CTRLA.ENABLE will read back immediately and the Enable Synchronization Busy bit in the Synchronization Busy register (SYNCBUSY.ENABLE) will be set. SYNCBUSY.ENABLE is cleared when the operation is complete.

This bit is not enable-protected.

Value	Description
0	The peripheral is disabled or being disabled.
1	The peripheral is enabled or being enabled.

Bit 0 – SWRST: Software Reset
Writing '0' to this bit has no effect.

Writing '1' to this bit resets all registers in the SERCOM, except DBGCTRL, to their initial state, and the SERCOM will be disabled.

Writing '1' to CTRLA.SWRST will always take precedence, meaning that all other writes in the same write-operation will be discarded. Any register write access during the ongoing reset will result in an APB error. Reading any register will return the reset value of the register.

Due to synchronization, there is a delay from writing CTRLA.SWRST until the reset is complete. CTRLA.SWRST and SYNCBUSY.SWRST will both be cleared when the reset is complete.

This bit is not enable-protected.

Value	Description
0	There is no reset operation ongoing.
1	The reset operation is ongoing.

31.8.2 Control B

Bit	31	30	29	28	27	26	25	24
Access								
Reset								

Bit	23	22	21	20	19	18	17	16
Access								
Reset								

Bit	15	14	13	12	11	10	9	8
					HDRDLY[1:0]		BRKLEN[1:0]	
Access					R/W	R/W	R/W	R/W
Reset					0	0	0	0

Bit	7	6	5	4	3	2	1	0
						GTIME[2:0]		
Access						R/W	R/W	R/W
Reset						0	0	0

Bits 11:10 – HDRDLY[1:0]: LIN Master Header Delay

These bits define the delay between break and sync transmission in addition to the delay between the sync and identifier (ID) fields when in LIN master mode (CTRLA.FORM=0x2).
This field is only valid when using the LIN header command (CTRLB.LINCMD=0x2).

Value	Description
0x0	Delay between break and sync transmission is 1 bit time. Delay between sync and ID transmission is 1 bit time.
0x1	Delay between break and sync transmission is 4 bit time. Delay between sync and ID transmission is 4 bit time.
0x2	Delay between break and sync transmission is 8 bit time. Delay between sync and ID transmission is 4 bit time.
0x3	Delay between break and sync transmission is 14 bit time. Delay between sync and ID transmission is 4 bit time.

Bits 9:8 – BRKLEN[1:0]: LIN Master Break Length

These bits define the length of the break field transmitted when in LIN master mode (CTRLA.FORM=0x2).

Value	Description
0x0	Break field transmission is 13 bit times
0x1	Break field transmission is 17 bit times
0x2	Break field transmission is 21 bit times
0x3	Break field transmission is 26 bit times

Bits 2:0 – GTIME[2:0]: Guard Time

These bits define the guard time when using RS485 mode (CTRLA.TXPO=0x3).

Value	Description
0	Interrupt disabled.
1	Interrupt enabled.

34.8.18 Interrupt Line Select

The Interrupt Line Select register assigns an interrupt generated by a specific interrupt flag from IR to one of the two module interrupt lines.

Name: ILS
Offset: 0x58 [ID-0000a4bb]
Reset: 0x00000000
Property: -

Bit	31	30	29	28	27	26	25	24
			ARAL	PEDL	PEAL	WDIL	BOL	EWL
Access			R/W	R/W	R/W	R/W	R/W	R/W
Reset			0	0	0	0	0	0

Bit	23	22	21	20	19	18	17	16
	EPL	ELOL	BEUL	BECL	DRXL	TOOL	MRAFL	TSWL
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	15	14	13	12	11	10	9	8
	TEFLL	TEFFL	TEFWL	TEFNL	TFEL	TCFL	TCL	HPML
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
	RF1LL	RF1FL	RF1WL	RF1NL	RF0LL	RF0FL	RF0WL	RF0NL
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit 29 – ARAL: Access to Reserved Address Interrupt Line

Value	Description
0	Interrupt assigned to CAN interrupt line 0.
1	Interrupt assigned to CAN interrupt line 1.

Bit 28 – PEDL: Protocol Error in Data Phase Interrupt Line

Value	Description
0	Interrupt assigned to CAN interrupt line 0.
1	Interrupt assigned to CAN interrupt line 1.

Bit 27 – PEAL: Protocol Error in Arbitration Phase Interrupt Line

Value	Description
0	Interrupt assigned to CAN interrupt line 0.
1	Interrupt assigned to CAN interrupt line 1.

Bit	31	30	29	28	27	26	25	24
	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn
Access	R	R	R	R	R	R	R	R
Reset	0	0	0	0	0	0	0	0

Bit	23	22	21	20	19	18	17	16
	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn
Access	R	R	R	R	R	R	R	R
Reset	0	0	0	0	0	0	0	0

Bit	15	14	13	12	11	10	9	8
	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn
Access	R	R	R	R	R	R	R	R
Reset	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn	TRPn
Access	R	R	R	R	R	R	R	R
Reset	0	0	0	0	0	0	0	0

Bits 31:0 – TRPn: Transmission Request Pending
Each Tx Buffer has its own Transmission Request Pending bit.

The bits are reset after a requested transmission has completed or has been cancelled via register TXBCR.

TXBRP bits are set only for those Tx Buffers configured via TXBC. After a TXBRP bit has been set, a Tx scan is started to check for the pending Tx request with the highest priority (Tx Buffer with lowest Message ID).

A cancellation request resets the corresponding transmission request pending bit of register TXBRP. In case a transmission has already been started when a cancellation is requested, this is done at the end of the transmission, regardless whether the transmission was successful or not. The cancellation request bits are reset directly after the corresponding TXBRP bit has been reset.

After a cancellation has been requested, a finished cancellation is signaled via TXBCF

- after successful transmission together with the corresponding TXBTO bit
- when the transmission has not yet been started at the point of cancellation
- when the transmission has been aborted due to lost arbitration
- when an error occurred during frame transmission

In DAR mode all transmissions are automatically canceled if they are not successful. The corresponding TXBCF bit is set for all unsuccessful transmissions.

Value	Description
0	No transmission request pending.
1	Transmission request pending.

34.8.39 Tx Buffer Add Request

Note: If an add request is applied for a Tx Buffer with pending transmission request (corresponding TXBRP bit is already set), this add request is ignored.

35.7.2 Register Summary - 16-bit Mode

Offset	Name	Bit Pos.								
0x00	CTRLA	7:0	ONDEMAND	RUNSTDBY	PRESCSYNC[1:0]		MODE[1:0]		ENABLE	SWRST
0x01		15:8					ALOCK	PRESCALER[2:0]		
0x02		23:16			COPEN1	COPEN0			CAPTEN1	CAPTEN0
0x03		31:24				CAPTMODE1[1:0]			CAPTMODE0[1:0]	
0x04	CTRLBCLR	7:0	CMD[2:0]					ONESHOT	LUPD	DIR
0x05	CTRLBSET	7:0	CMD[2:0]					ONESHOT	LUPD	DIR
0x06	EVCTRL	7:0			TCEI	TCINV		EVACT[2:0]		
0x07		15:8			MCEOx	MCEOx				OVFEO
0x08	INTENCLR	7:0				MCx			ERR	OVF
0x09	INTENSET	7:0				MCx			ERR	OVF
0x0A	INTFLAG	7:0				MCx			ERR	OVF
0x0B	STATUS	7:0				CCBUFVx	PERBUFV		SLAVE	STOP
0x0C	WAVE	7:0							WAVEGEN[1:0]	
0x0D	DRVCTRL	7:0								INVENx
0x0E	Reserved									
0x0F	DBGCTRL	7:0								DBGRUN
0x10	SYNCBUSY	7:0		CCx	PER	COUNT	STATUS	CTRLB	ENABLE	SWRST
0x11		15:8								
0x12		23:16								
0x13		31:24								
0x14	COUNT	7:0	COUNT[7:0]							
0x15		15:8	COUNT[15:8]							
0x16 ... 0x19	Reserved									
0x1A	PER	7:0	PER[7:0]							
0x1B		15:8	PER[15:8]							
0x1C	CC0	7:0	CC[7:0]							
0x1D		15:8	CC[15:8]							
0x1E	CC1	7:0	CC[7:0]							
0x1F		15:8	CC[15:8]							
0x20 ... 0x2D	Reserved									
0x2E	PERBUF	7:0	PERBUF[7:0]							
0x2F		15:8	PERBUF[15:8]							
0x30	CCBUF0	7:0	CCBUF[7:0]							
0x31		15:8	CCBUF[15:8]							
0x32	CCBUF1	7:0	CCBUF[7:0]							
0x33		15:8	CCBUF[15:8]							

35.7.2.1 Control A

Name: CTRLA
Offset: 0x00
Reset: 0x00000000
Property: PAC Write-Protection, Write-Synchronized, Enable-Protected

Bit	31	30	29	28	27	26	25	24
				CAPTMODE1[1:0]			CAPTMODE0[1:0]	
Access				R/W	R/W		R/W	R/W
Reset				0	0		0	0

Bit	23	22	21	20	19	18	17	16
			COPEN1	COPEN0			CAPTEN1	CAPTEN0
Access			R/W	R/W			R/W	R/W
Reset			0	0			0	0

Bit	15	14	13	12	11	10	9	8
					ALOCK	PRESCALER[2:0]		
Access					R/W	R/W	R/W	R/W
Reset					0	0	0	0

Bit	7	6	5	4	3	2	1	0
	ONDEMAND	RUNSTDBY	PRESCSYNC[1:0]		MODE[1:0]		ENABLE	SWRST
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	W
Reset	0	0	0	0	0	0	0	0

Bits 28:27 – CAPTMODE1[1:0]: Capture mode Channel 1
These bits select the channel 1 capture mode.

Value	Name	Description
0x0	DEFAULT	Default capture
0x1	CAPTMIN	Minimum capture
0x2	CAPTMAX	Maximum capture
0x3		Reserved

Bits 25:24 – CAPTMODE0[1:0]: Capture mode Channel 0
These bits select the channel 0 capture mode.

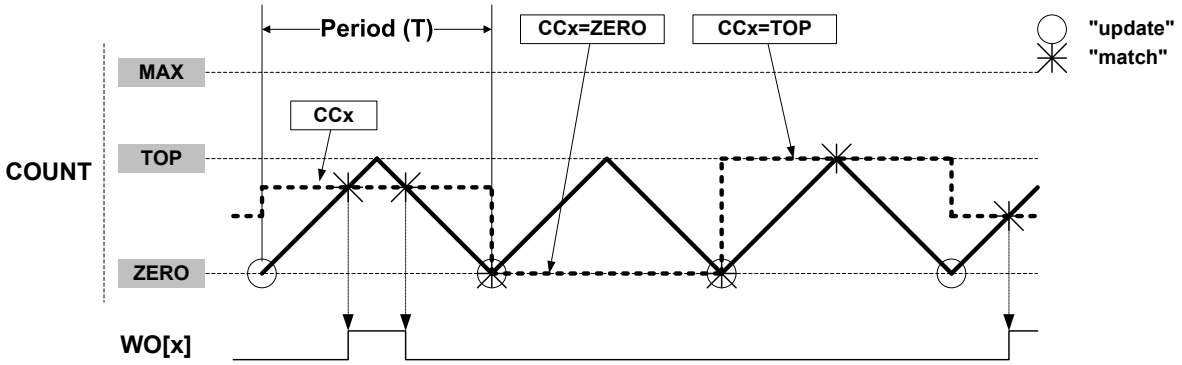
Value	Name	Description
0x0	DEFAULT	Default capture
0x1	CAPTMIN	Minimum capture
0x2	CAPTMAX	Maximum capture
0x3		Reserved

Bits 20, 21 – COPENx: Capture On Pin x Enable
Bit x of COPEN[1:0] selects the trigger source for capture operation, either events or I/O pin input.

Value	Description
0	Event from Event System is selected as trigger source for capture operation on channel x.
1	I/O pin is selected as trigger source for capture operation on channel x.

In DSBOTH operation, the circular buffer must be enabled to enable the update condition on TOP.

Figure 36-7. Dual-Slope Pulse Width Modulation



Using dual-slope PWM results in a lower maximum operation frequency compared to single-slope PWM generation. The period (TOP) defines the PWM resolution. The minimum resolution is 1 bit (TOP=0x00000001).

The following equation calculates the exact resolution for dual-slope PWM (R_{PWM_DS}):

$$R_{PWM\_DS} = \frac{\log(PER+1)}{\log(2)}.$$

The PWM frequency f_{PWM_DS} depends on the period setting (TOP) and the peripheral clock frequency f_{GCLK_TCC}, and can be calculated by the following equation:

$$f_{PWM\_DS} = \frac{f_{GCLK\_TCC}}{2N \cdot PER}$$

N represents the prescaler divider used. The waveform generated will have a maximum frequency of half of the TCC clock frequency (f_{GCLK_TCC}) when TOP is set to 0x00000001 and no prescaling is used.

The pulse width (P_{PWM_DS}) depends on the compare channel (CCx) register value and the peripheral clock frequency (f_{GCLK_TCC}), and can be calculated by the following equation:

$$P_{PWM\_DS} = \frac{2N \cdot (TOP - CCx)}{f_{GCLK\_TCC}}$$

N represents the prescaler divider used.

Note: In DSTOP, DSBOTTOM and DSBOTH operation, when TOP is lower than MAX/2, the CCx MSB bit defines the ramp on which the CCx Match interrupt or event is generated. (Rising if CCx[MSB] = 0, falling if CCx[MSB] = 1.)

Related Links

Circular Buffer

Dual-Slope Critical PWM Generation

Critical mode generation allows generation of non-aligned centered pulses. In this mode, the period time is controlled by PER while CCx control the generated waveform output edge during up-counting and CC(x+CC_NUM/2) control the generated waveform output edge during down-counting.

Offset	Name	Bit Pos.								
0x65		15:8	PGVB0[7:0]							
0x66 ... 0x67	Reserved									
0x68	WAVEBUF	7:0	CIPERENB		RAMPB[1:0]			WAVEGENB[2:0]		
0x69		15:8					CICCENB3	CICCENB2	CICCENB1	CICCENB0
0x6A		23:16					POLB3	POLB2	POLB1	POLB0
0x6B		31:24					SWAPB 3	SWAPB 2	SWAPB 1	SWAPB 0
0x6C	PERBUF	7:0	PERBUF[1:0]		DITHERBUF[5:0]					
0x6D		15:8	PERBUF[9:2]							
0x6E		23:16	PERBUF[17:10]							
0x6F		31:24								
0x70	CCBUF0	7:0	CCBUF[1:0]		DITHERBUF[5:0]					
0x71		15:8	CCBUF[9:2]							
0x72		23:16	CCBUF[17:10]							
0x73		31:24								
0x74	CCBUF1	7:0	CCBUF[1:0]		DITHERBUF[5:0]					
0x75		15:8	CCBUF[9:2]							
0x76		23:16	CCBUF[17:10]							
0x77		31:24								
0x78	CCBUF2	7:0	CCBUF[1:0]		DITHERBUF[5:0]					
0x79		15:8	CCBUF[9:2]							
0x7A		23:16	CCBUF[17:10]							
0x7B		31:24								
0x7C	CCBUF3	7:0	CCBUF[1:0]		DITHERBUF[5:0]					
0x7D		15:8	CCBUF[9:2]							
0x7E		23:16	CCBUF[17:10]							
0x7F		31:24								

36.8 Register Description

Registers can be 8, 16, or 32 bits wide. Atomic 8-, 16-, and 32-bit accesses are supported. In addition, the 8-bit quarters and 16-bit halves of a 32-bit register, and the 8-bit halves of a 16-bit register can be accessed directly.

Some registers require synchronization when read and/or written. Synchronization is denoted by the "Read-Synchronized" and/or "Write-Synchronized" property in each individual register description.

Optional write-protection by the Peripheral Access Controller (PAC) is denoted by the "PAC Write-Protection" property in each individual register description.

Some registers are enable-protected, meaning they can only be written when the module is disabled. Enable-protection is denoted by the "Enable-Protected" property in each individual register description.

36.8.1 Control A

Value	Description
0	The Overflow interrupt is disabled.
1	The Overflow interrupt is enabled.

36.8.12 Interrupt Flag Status and Clear

Name: INTFLAG
Offset: 0x2C [ID-00002e48]
Reset: 0x00000000
Property: -

Bit	23	22	21	20	19	18	17	16
					MCx	MCx	MCx	MCx
Access					R/W	R/W	R/W	R/W
Reset					0	0	0	0

Bit	15	14	13	12	11	10	9	8
	FAULTx	FAULTx	FAULTB	FAULTA	DFS	UFS		
Access	R/W	R/W	R/W	R/W	R/W	R/W		
Reset	0	0	0	0	0	0		

Bit	7	6	5	4	3	2	1	0
					ERR	CNT	TRG	OVF
Access					R/W	R/W	R/W	R/W
Reset					0	0	0	0

Bits 19,18,17,16 – MCx: Match or Capture Channel x Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a match with the compare condition or once CCx register contain a valid capture value.

Writing a '0' to one of these bits has no effect.

Writing a '1' to one of these bits will clear the corresponding Match or Capture Channel x interrupt flag

In Capture operation, this flag is automatically cleared when CCx register is read.

Bits 15,14 – FAULTx: Non-Recoverable Fault x Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a Non-Recoverable Fault x occurs.

Writing a '0' to this bit has no effect.

Writing a '1' to this bit clears the Non-Recoverable Fault x interrupt flag.

Bit 13 – FAULTB: Recoverable Fault B Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a Recoverable Fault B occurs.

Writing a '0' to this bit has no effect.

Writing a '1' to this bit clears the Recoverable Fault B interrupt flag.

Bit 12 – FAULTA: Recoverable Fault A Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a Recoverable Fault B occurs.

Writing a '0' to this bit has no effect.

Bit	7	6	5	4	3	2	1	0
							START	FLUSH
Access							W	W
Reset							0	0

Bit 1 – START: ADC Start Conversion
Writing a '1' to this bit will start a conversion or sequence. The bit is cleared by hardware when the conversion has started. Writing a '1' to this bit when it is already set has no effect.

Writing a '0' to this bit will have no effect.

Bit 0 – FLUSH: ADC Conversion Flush
Writing a '1' to this bit will flush the ADC pipeline. A flush will restart the ADC clock on the next peripheral clock edge, and all conversions in progress will be aborted and lost. This bit is cleared until the ADC has been flushed.

After the flush, the ADC will resume where it left off; i.e., if a conversion was pending, the ADC will start a new conversion.

Writing this bit to '0' will have no effect.

38.8.18 Debug Control

Name: DBGCTRL
Offset: 0x1C [ID-0000120e]
Reset: 0x00
Property: PAC Write-Protection

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

Bit 0 – DBGRUN: Debug Run
This bit is not reset by a software reset.

This bit controls the functionality when the CPU is halted by an external debugger.

This bit should be written only while a conversion is not ongoing.

Value	Description
0	The ADC is halted when the CPU is halted by an external debugger.
1	The ADC continues normal operation when the CPU is halted by an external debugger.

38.8.19 Synchronization Busy

Name: SYNCBUSY
Offset: 0x20 [ID-0000120e]
Reset: 0x0000
Property: -

Offset	Name	Bit Pos.								
0x2B										
0x2C	ANACTRL	7:0	BUFTEST	ONCHOP		CTLSDADC[4:0]				
0x2D	Reserved									
0x2E	DBGCTRL	7:0								DBGRUN

39.8 Register Description

Registers can be 8, 16, or 32 bits wide. Atomic 8-, 16-, and 32-bit accesses are supported. In addition, the 8-bit quarters and 16-bit halves of a 32-bit register, and the 8-bit halves of a 16-bit register can be accessed directly.

Some registers are optionally write-protected by the Peripheral Access Controller (PAC). Optional PAC write-protection is denoted by the "PAC Write-Protection" property in each individual register description. For details, refer to

Some registers are synchronized when read and/or written. Synchronization is denoted by the "Write-Synchronized" or the "Read-Synchronized" property in each individual register description. For details, refer to

Some registers are enable-protected, meaning they can only be written when the peripheral is disabled. Enable-protection is denoted by the "Enable-Protected" property in each individual register description.

39.8.1 Control A

Name: CTRLA
Offset: 0x00 [ID-0000243d]
Reset: 0x00
Property: PAC Write-Protection, Write-Synchronized (ENABLE, SWRST)

Bit	7	6	5	4	3	2	1	0
	ONDEMAND	RUNSTDBY					ENABLE	SWRST
Access	R/W	R/W					R/W	R/W
Reset	0	0					0	0

Bit 7 – ONDEMAND: On Demand Control
The On Demand operation modes allows the SDADC to be enabled or disabled, depending on other peripheral request.

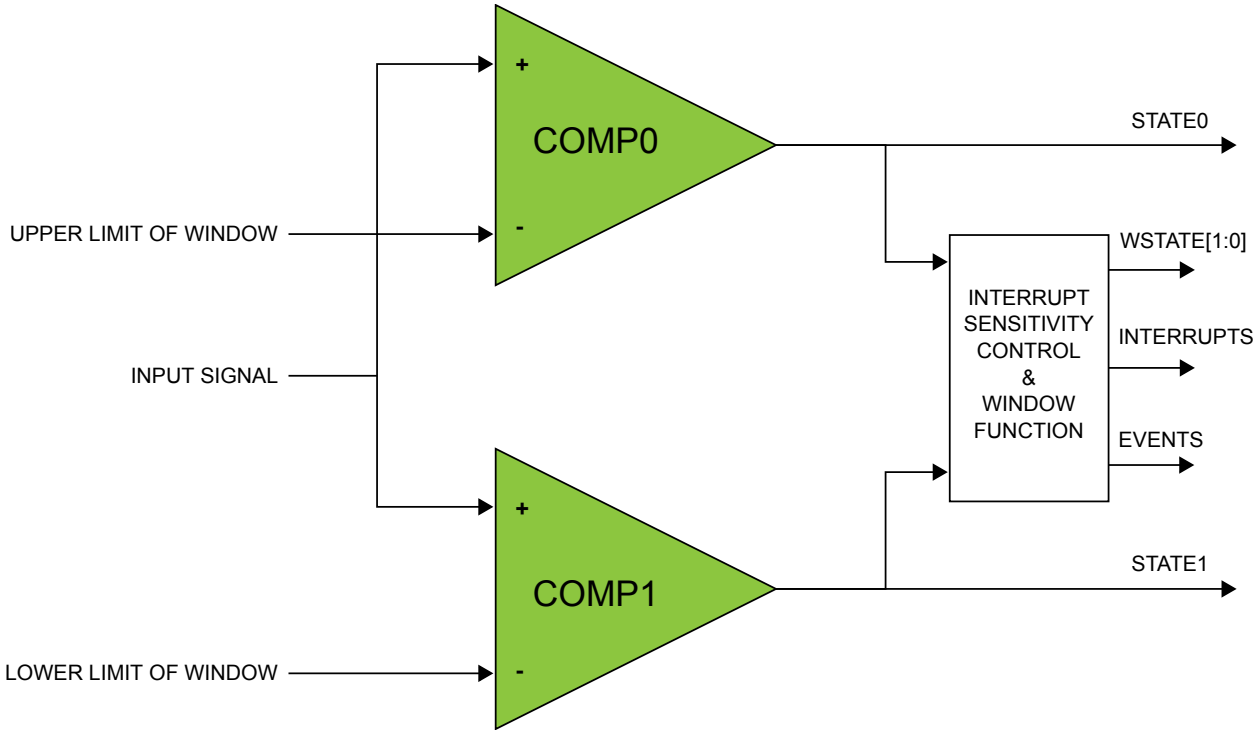
In On Demand operation mode, i.e., if the ONDEMAND bit has been previously written to one, the SDADC will only be running when requested by a peripheral. If there is no peripheral requesting the SDADC will be in a disable state.

If On Demand is disable the SDADC will always be running when enabled.

In standby sleep mode, the On Demand operation is still active if the CTRLA.RUNSTDBY bit is one. If CTRLA.RUNSTDBY is zero, the SDADC is disabled.

This bit is not synchronized.

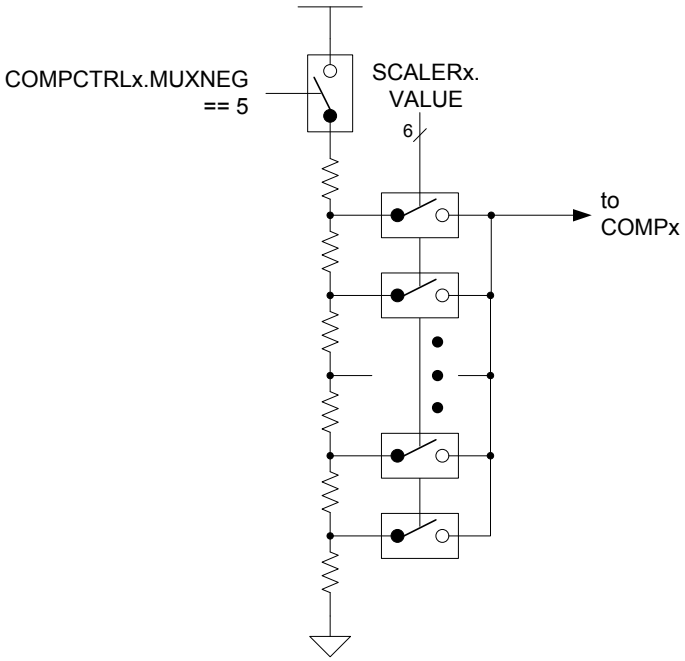
Figure 40-5. Comparators in Window Mode



40.6.5 VDD Scaler

The VDD scaler generates a reference voltage that is a fraction of the device's supply voltage, with 64 levels. One independent voltage channel is dedicated for each comparator. The scaler of a comparator is enabled when the Negative Input Mux bit field in the respective Comparator Control register (COMPCTRLx.MUXNEG) is set to 0x5 and the comparator is enabled. The voltage of each channel is selected by the Value bit field in the Scaler x registers (SCALERx.VALUE).

Figure 40-6. VDD Scaler



Value	Description
0	No ongoing synchronization.
1	Synchronization is ongoing.

Bit 0 – SWRST: Software Reset
This bit is set when CTRLA.SWRST bit is written.

This bit is cleared when CTRLA.SWRST synchronization is completed.

Value	Description
0	No ongoing synchronization.
1	Synchronization is ongoing.

41.8.11 Debug Control

Name: DBGCTRL
Offset: 0x18 [ID-00000bc7]
Reset: 0x00
Property: PAC Write-Protection

Bit	7	6	5	4	3	2	1	0
								DBGRUN
Access								
Reset								0

Bit 0 – DBGRUN: Debug Run
This bit is not reset by a software reset.

This bits controls the functionality when the CPU is halted by an external debugger.

Value	Description
0	The DAC is halted when the CPU is halted by an external debugger. Any ongoing conversion will complete.
1	The DAC continues normal operation when the CPU is halted by an external debugger.

Bit	31	30	29	28	27	26	25	24
Access								
Reset								

Bit	23	22	21	20	19	18	17	16
	OFFSETC[23:16]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	15	14	13	12	11	10	9	8
	OFFSETC[15:8]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
	OFFSETC[7:0]							
Access	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

Bits 23:0 – OFFSETC[23:0]: Offset Correction
This value from production test must be loaded from the NVM temperature calibration row into the register by software to achieve the specified accuracy.

The bitfield can also be written by CPU.

These bits define how the TSENS measurement result is compensated for offset error before being written to the VALUE register. This OFFSET value is in two's complement format.

43.8.15 Calibration

Name: CAL
Offset: 0x20 [ID-00001f13]
Reset: 0x00000000
Property: Enable-Protected, PAC Write-Protection, not reset by a software reset

Symbol	Parameter	Conditions	Min.	Typ.	Max	Units
		XOSC.GAIN=0				
		F = 4MHz CL=20pF XOSC.GAIN=1	-	-	218	
		F = 8MHz CL=20pF XOSC.GAIN=2	-	-	114	
		F = 16MHz CL=20pF XOSC.GAIN=3	-	-	58	
		F = 32MHz CL=12pF XOSC.GAIN=4	-	-	62	
Cxin	Parasitic load capacitor		-	6.7	-	pF
Cxout			-	4.1	-	
Tstart	Startup time	F = 2MHz CL=20pF XOSC.GAIN=0	-	12.3	48.7	KCycles
		F = 4MHz CL=20pF XOSC.GAIN=1	-	8.2	30.1	
		F = 8MHz CL=20pF XOSC.GAIN=2	-	6.2	19.9	
		F = 16MHz CL=20pF XOSC.GAIN=3	-	10.8	30.1	
		F = 32MHz CL=12pF XOSC.GAIN=4	-	8.7	23.6	

1. These are based on characterization.

47.6.2 External 32kHz Crystal Oscillator (XOSC32K) Characteristics

The following table describes the characteristics for the oscillator when a digital clock is applied on XIN32 pin.