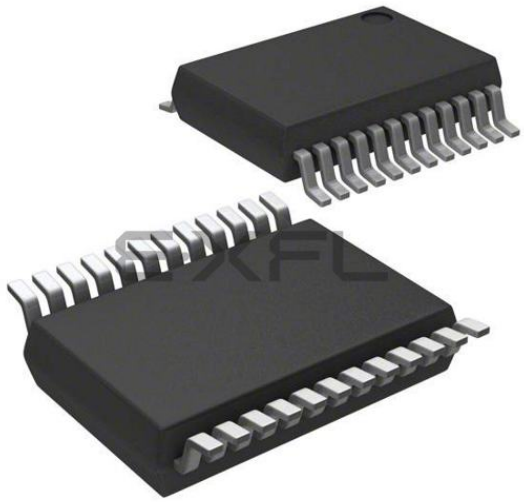

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M23
Core Size	32-Bit Single-Core
Speed	32MHz
Connectivity	I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	17
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	2K x 8
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.62V ~ 3.63V
Data Converters	A/D 5x12b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	24-SSOP (0.209", 5.30mm Width)
Supplier Device Package	24-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atsaml11d14a-yf

Table 4-7. Secure Pin Multiplexing on SERCOM Pins

Pin Name	Secure Pin Multiplexing Pad Name
PA16	SERCOM1/PAD[0]
PA17	SERCOM1/PAD[1]
PA18	SERCOM1/PAD[2]
PA19	SERCOM1/PAD[3]

4.5 General Purpose I/O (GPIO) Clusters

Table 4-8. GPIO Clusters

Package	Cluster	GPIO	Supply Pins Connected to the Cluster
32-pin	1	PA00 PA01 PA02 PA03 PA04 PA05 PA06 PA07	V_{DDANA}/GNDANA
	2	PA08 PA09 PA10 PA11 PA14 PA15 PA16 PA17 PA18 PA19 PA22 PA23 PA24 PA25 PA27 PA30 PA31	V_{DDIO}/GND
24-pin	1	PA00 PA01 PA02 PA03 PA04 PA05	V_{DDANA}/GND
	2	PA08 PA14 PA15 PA16 PA17 PA18 PA19 PA22 PA23 PA30 PA31	V_{DDIO}/GND

Module	Source	NVIC line
	LOCKE	
	NVME	
	KEYE	
	NSCHK(1)	
PORT - I/O Pin Controller	NSCHK(1)	10
DMAC - Direct Memory Access Controller	SUSP 0	11
	TERR 0	
	TCMPL 0	
	SUSP 1	12
	TERR 1	
	TCMPL 1	
	SUSP 2	13
	TERR 2	
	TCMPL 2	
	SUSP 3	14
	TERR 3	
	TCMPL 3	
	SUSP 4..7	15
	TERR 4..7	
	TCMPL 4..7	
EVSYS – Event System	EVD 0	16
	OVR 0	
	EVD 1	17
	OVR 1	
	EVD 2	18
	OVR 2	
	EVD 3	19
	OVR 3	
	NSCHK(1)	20
PAC - Peripheral Access Controller	ERR	21
SERCOM0 – Serial Communication Interface 0 (Interrupt Sources vary depending on SERCOM mode)	Interrupt Bit 0	22
	Interrupt Bit 1	23
	Interrupt Bit 2	24
	Interrupt Bits 3..6	25
SERCOM1 – Serial Communication Interface 1 (Interrupt Sources vary depending on SERCOM mode)	Interrupt Bit 0	26
	Interrupt Bit 1	27
	Interrupt Bit 2	28
	Interrupt Bit 3..6	29
SERCOM2 – Serial Communication Interface 2 (Interrupt Sources vary depending on SERCOM mode)	Interrupt Bit 0	30
	Interrupt Bit 1	31
	Interrupt Bit 2	32
	Interrupt Bits 3..6	33
TC0 – Timer Counter 0	ERR A	34
	MC 0	

Table 16-6. AMOD Bit Descriptions for MBIST

AMOD[1:0]	Description
0x0	Exit on Error
0x1	Pause on Error
0x2, 0x3	Reserved

Related Links

30. NVMCTRL – Nonvolatile Memory Controller

16.10.7 System Services Availability when Accessed Externally

External access: Access performed in the DSU address offset 0x100-0x1FFF range.

Internal access: Access performed in the DSU address offset 0x0-0xFF range.

Table 16-7. Available Features when Operated From The External Address Range and Device is Protected

Features	Availability From The External Address Range when DAL<2
CRC32	No
CoreSight Compliant Device identification	Yes
Debug communication channels	Yes
Boot communication channels	Yes
Testing of onboard memories (MBIST)	No

16.12.3 Status B

Name: STATUSB
Offset: 0x0002
Reset: 0xX
Property: PAC Write-Protection

Bit	7	6	5	4	3	2	1	0
	BCCDx	BCCDx	DCCDx	DCCDx	HPE	DBGPRES	DAL[1:0]	
Access	R	R	R	R	R	R	R	R
Reset	0	0	0	0	1	0	0	x

Bits 7,6 – BCCDx BOOT Communication Channel x Dirty [x=1..0]
Writing a '0' to this bit has no effect.

Writing a '1' to this bit has no effect.

This bit is set when BCCx is written.

This bit is cleared when BCCx is read.

Bits 5,4 – DCCDx Debug Communication Channel x Dirty [x=1..0]
Writing a '0' to this bit has no effect.

Writing a '1' to this bit has no effect.

This bit is set when DCCx is written.

This bit is cleared when DCCx is read.

Bit 3 – HPE Hot-Plugging Enable
Writing a '0' to this bit has no effect.

Writing a '1' to this bit has no effect.

This bit is set when Hot-Plugging is enabled.

This bit is cleared when Hot-Plugging is disabled. This is the case when the SWCLK function is changed. Only a power-reset or a external reset can set it again.

Bit 2 – DBGPRES Debugger Present
Writing a '0' to this bit has no effect.

Writing a '1' to this bit has no effect.

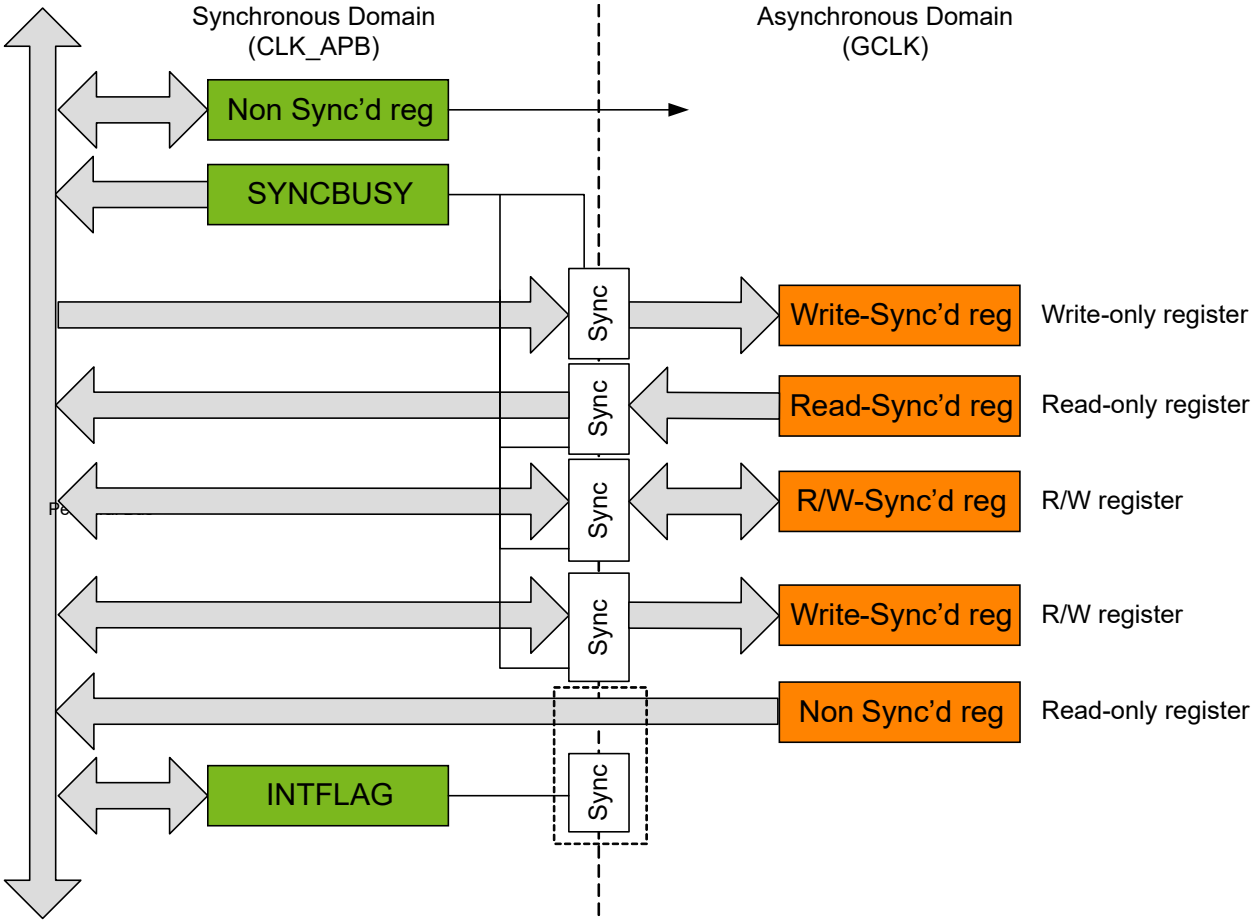
This bit is set when a debugger probe is detected.

This bit is never cleared.

Bits 1:0 – DAL[1:0] Debugger Access Level
Indicates the debugger access level:

- 0x0: Debugger can only access the DSU external address space.
- 0x1: Debugger can access only Non-Secure regions (SAM L11 only).
- 0x2: Debugger can access secure and Non-Secure regions.

Figure 17-3. Register Synchronization Overview



17.3.2 General Write Synchronization

Write-Synchronization is triggered by writing to a register in the peripheral clock domain (GCLK). The respective bit in the Synchronization Busy register (SYNCBUSY) will be set when the write-synchronization starts and cleared when the write-synchronization is complete. Refer also to17.3.7 Synchronization Delay.

When write-synchronization is ongoing for a register, any subsequent write attempts to this register will be discarded, and an error will be reported though the Peripheral Access Controller (PAC).

Example:

REGA, REGB are 8-bit core registers. REGC is a 16-bit core register.

Offset	Register
0x00	REGA
0x01	REGB
0x02	REGC
0x03	

Synchronization is per register, so multiple registers can be synchronized in parallel. Consequently, after REGA (8-bit access) was written, REGB (8-bit access) can be written immediately without error.

22.6.10 Sleep Mode Operation

The Power Manager is always active.

23.7 Register Summary

Offset	Name	Bit Pos.								
0x00	EVCTRL	7:0						TUNEINV	TUNEEI	CFDEO
0x01 ... 0x03	Reserved									
0x04	INTENCLR	7:0				OSC16MRDY			CLKFAIL	XOSCRDY
		15:8						DFLLULPNOLOCK	DFLLULPLOCK	DFLLULPRDY
		23:16					DPLLLDRTO	DPLLLTO	DPLLLCKF	DPLLLCKR
		31:24								
0x08	INTENSET	7:0				OSC16MRDY			CLKFAIL	XOSCRDY
		15:8						DFLLULPNOLOCK	DFLLULPLOCK	DFLLULPRDY
		23:16					DPLLLDRTO	DPLLLTO	DPLLLCKF	DPLLLCKR
		31:24								
0x0C	INTFLAG	7:0				OSC16MRDY			CLKFAIL	XOSCRDY
		15:8						DFLLULPNOLOCK	DFLLULPLOCK	DFLLULPRDY
		23:16					DPLLLDRTO	DPLLLTO	DPLLLCKF	DPLLLCKR
		31:24								
0x10	STATUS	7:0				OSC16MRDY		CLKSW	CLKFAIL	XOSCRDY
		15:8						DFLLULPNOLOCK	DFLLULPLOCK	DFLLULPRDY
		23:16					DPLLLDRTO	DPLLLTO	DPLLLCKF	DPLLLCKR
		31:24								
0x14	XOSCCTRL	7:0	ONDEMAND	RUNSTDBY		SWBACK	CFDEN	XTALEN	ENABLE	
		15:8	STARTUP[3:0]				AMPGC	GAIN[2:0]		
0x16	CFDPRESC	7:0						CFDPRESC[2:0]		
0x17	Reserved									
0x18	OSC16MCTRL	7:0	ONDEMAND	RUNSTDBY			FSEL[1:0]		ENABLE	
0x19 ... 0x1B	Reserved									
0x1C	DFLLULPCTRL	7:0	ONDEMAND	RUNSTDBY	DITHER	SAFE	BINSE		ENABLE	
		15:8						DIV[2:0]		
0x1E	DFLLULPDITHER	7:0		PER[2:0]				STEP[2:0]		
0x1F	DFLLULPRREQ	7:0	RREQ							
0x20	DFLLULPDLY	7:0	DELAY[7:0]							
		15:8								
		23:16								
		31:24								
0x24	DFLLULPRATIO	7:0	RATIO[7:0]							
		15:8						RATIO[10:8]		
		23:16								
		31:24								

25.8.8 Event Control

Name: EVCTRL
Offset: 0x2C
Reset: 0x0000000
Property: Enable-Protected, PAC Write-Protection

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
Access								
Reset								

Bit	7	6	5	4	3	2	1	0
							BOD33DETEO	
Access							R/W	
Reset							0	

Bit 1 – BOD33DETEO BOD33 Detection Event Output Enable

Value	Description
0	BOD33 detection event output is disabled and event will not be generated
1	BOD33 detection event output is enabled and event will be generated

15. PAC - Peripheral Access Controller

27.5.9 SAM L11 TrustZone Specific Register Access Protection

On **SAM L11** devices, this peripheral has different access permissions depending on PAC Security Attribution (Secure or Non-Secure):

- If the peripheral is configured as Non-Secure in the PAC:
  - Secure access and Non-Secure access are granted
- If the peripheral is configured as Secure in the PAC:
  - Secure access is granted
  - Non-Secure access is discarded (Write is ignored, read 0x0) and a PAC error is triggered

Refer to *Peripherals Security Attribution* for more information.

27.5.10 Analog Connections

A 32.768kHz crystal can be connected to the XIN32 and XOUT32 pins, along with any required load capacitors. See the Electrical Characteristics Chapters for details on recommended crystal characteristics and load capacitors.

27.6 Functional Description

27.6.1 Principle of Operation

The RTC keeps track of time in the system and enables periodic events, as well as interrupts and events at a specified time. The RTC consists of a 10-bit prescaler that feeds a 32-bit counter. The actual format of the 32-bit counter depends on the RTC operating mode.

The RTC can function in one of these modes:

- Mode 0 - COUNT32: RTC serves as 32-bit counter
- Mode 1 - COUNT16: RTC serves as 16-bit counter
- Mode 2 - CLOCK: RTC serves as clock/calendar with alarm functionality

27.6.2 Basic Operation

27.6.2.1 Initialization

The following bits are enable-protected, meaning that they can only be written when the RTC is disabled (CTRLA.ENABLE=0):

- Operating Mode bits in the Control A register (CTRLA.MODE)
- Prescaler bits in the Control A register (CTRLA.PRESCALER)
- Clear on Match bit in the Control A register (CTRLA.MATCHCLR)
- Clock Representation bit in the Control A register (CTRLA.CLKREP)

The following registers are enable-protected:

- Control B register (CTRLB)
- Event Control register (EVCTRL)
- Tamper Control register (TAMPCTRL)
- Tamper Control B register (TAMPCTRLB)

Enable-protected bits and registers can be changed only when the RTC is disabled (CTRLA.ENABLE=0). If the RTC is enabled (CTRLA.ENABLE=1), these operations are necessary: first write

Value	Description
0	Periodic Interval n interrupt is disabled.
1	Periodic Interval n interrupt is enabled.

27.10.14 Tamper Control

Name: TAMPCTRL
Offset: 0x60
Reset: 0x00000000
Property: PAC Write-Protection, Enable-Protected

Bit	31	30	29	28	27	26	25	24
					DEBNC3	DEBNC2	DEBNC1	DEBNC0
Access								
Reset					0	0	0	0

Bit	23	22	21	20	19	18	17	16
					TAMLVL3	TAMLVL2	TAMLVL1	TAMLVL0
Access								
Reset					0	0	0	0

Bit	15	14	13	12	11	10	9	8
Access								
Reset								

Bit	7	6	5	4	3	2	1	0
	IN3ACT[1:0]		IN2ACT[1:0]		IN1ACT[1:0]		IN0ACT[1:0]	
Access								
Reset	0	0	0	0	0	0	0	0

Bits 24, 25, 26, 27 – DEBNC Debounce Enable of Tamper Input INn

Value	Description
0	Debouncing is disabled for Tamper input INn
1	Debouncing is enabled for Tamper input INn

Bits 16, 17, 18, 19 – TAMLVL Tamper Level Select of Tamper Input INn

Value	Description
0	A falling edge condition will be detected on Tamper input INn.
1	A rising edge condition will be detected on Tamper input INn.

Bits 0:1, 2:3, 4:5, 6:7 – INACT Tamper Channel n Action
These bits determine the action taken by Tamper Channel n.

Value	Name	Description
0x0	OFF	Off (Disabled)
0x1	WAKE	Wake and set Tamper flag
0x2	CAPTURE	Capture timestamp and set Tamper flag
0x3	ACTL	Compare RTC signal routed between INn and OUT pins . When a mismatch occurs, capture timestamp and set Tamper flag

28.6.2.4 Arbitration

If a DMA channel is enabled and not suspended when it receives a transfer trigger, it will send a transfer request to the arbiter. When the arbiter receives the transfer request it will include the DMA channel in the queue of channels having pending transfers, and the corresponding Pending Channel x bit in the Pending Channels registers (PENDCH.PENDCHx) will be set. Depending on the arbitration scheme, the arbiter will choose which DMA channel will be the next active channel. The active channel is the DMA channel being granted access to perform its next transfer. When the arbiter has granted a DMA channel access to the DMAC, the corresponding bit PENDCH.PENDCHx will be cleared. See also the following figure.

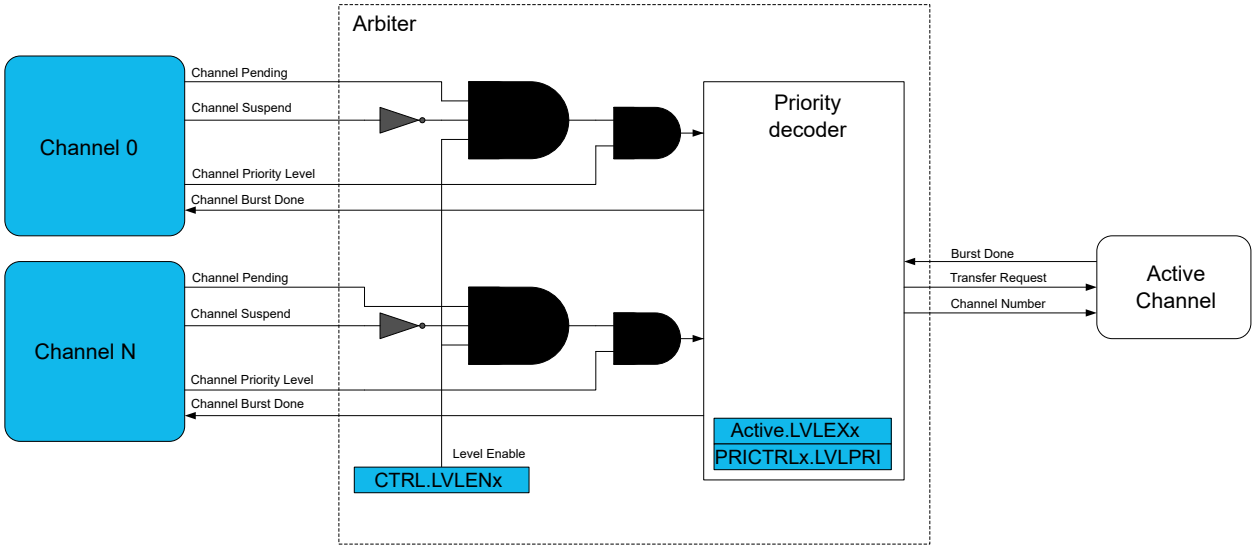
If the upcoming transfer is the first for the transfer request, the corresponding Busy Channel x bit in the Busy Channels register will be set (BUSYCH.BUSYCHx=1), and it will remain '1' for the subsequent granted transfers.

When the channel has performed its granted transfer(s) it will be either fed into the queue of channels with pending transfers, set to be waiting for a new transfer trigger, suspended, or disabled. This depends on the channel and block transfer configuration. If the DMA channel is fed into the queue of channels with pending transfers, the corresponding BUSYCH.BUSYCHx will remain '1'. If the DMA channel is set to wait for a new transfer trigger, suspended, or disabled, the corresponding BUSYCH.BUSYCHx will be cleared.

If a DMA channel is suspended while it has a pending transfer, it will be removed from the queue of pending channels, but the corresponding PENDCH.PENDCHx will remain set. When the same DMA channel is resumed, it will be added to the queue of pending channels again.

If a DMA channel gets disabled (CHCTRLA.ENABLE=0) while it has a pending transfer, it will be removed from the queue of pending channels, and the corresponding PENDCH.PENDCHx will be cleared.

Figure 28-4. Arbiter Overview



Priority Levels

When a channel level is pending or the channel is transferring data, the corresponding Level Executing bit is set in the Active Channel and Levels register (ACTIVE.LVLEXx).

Each DMA channel supports a 4-level priority scheme. The priority level for a channel is configured by writing to the Channel Arbitration Level bit group in the Channel Control B register (CHCTRLB.LVL). As long as all priority levels are enabled, a channel with a higher priority level number will have priority over a channel with a lower priority level number. Each priority level x is enabled by setting the corresponding Priority Level x Enable bit in the Control register (CTRL.LVLENx=1).

(ASYNCH.ASYNCH[x]). The EIC edge detection is operated synchronously when the Asynchronous Control Mode bit (ASYNCH.ASYNCH[x]) is '0' (default value). It is operated asynchronously when ASYNCH.ASYNCH[x] is written to '1'.

In *Synchronous Edge Detection Mode*, the external interrupt (EXTINT) or the non-maskable interrupt (NMI) pins are sampled using the EIC clock as defined by the Clock Selection bit in the Control A register (CTRLA.CKSEL). The External Interrupt flag (INTFLAG.EXTINT[x]) or Non-Maskable Interrupt flag (NMIFLAG.NMI) is set when the last sampled state of the pin differs from the previously sampled state. In this mode, the EIC clock is required.

The Synchronous Edge Detection Mode can be used in Idle and Standby sleep modes.

In *Asynchronous Edge Detection Mode*, the external interrupt (EXTINT) pins or the non-maskable interrupt (NMI) pins set the External Interrupt flag or Non-Maskable Interrupt flag (INTFLAG.EXTINT[x] or NMIFLAG) directly. In this mode, the EIC clock is not requested.

The asynchronous edge detection mode can be used in Idle and Standby sleep modes.

29.6.4.3 Interrupt Pin Debouncing

The external interrupt pin (EXTINT) edge detection can use a debouncer to improve input noise immunity. When selected, the debouncer can work in the synchronous mode or the asynchronous mode, depending on the configuration of the ASYNCH.ASYNCH[x] bit for the pin. The debouncer uses the EIC clock as defined by the bit CTRLA.CKSEL to clock the debouncing circuitry. The debouncing time frame is set with the debouncer prescaler DPRESCALER.DPRESCALERn, which provides the *low frequency clock* tick that is used to reject higher frequency signals.

The debouncing mode for pin EXTINT x can be selected only if the Sense bits in the Configuration y register (CONFIGy.SENSEx) are set to RISE, FALL or BOTH. If the debouncing mode for pin EXTINT x is selected, the filter mode for that pin (CONFIGy.FILTENx) can not be selected.

The debouncer manages an internal “valid pin state” that depends on the external interrupt (EXTINT) pin transitions, the debouncing mode and the debouncer prescaler frequency. The valid pin state reflects the pin value after debouncing. The external interrupt pin (EXTINT) is sampled continously on EIC clock. The sampled value is evaluated on each *low frequency clock* tick to detect a transitional edge when the sampled value is different of the current valid pin state. The sampled value is evaluated on each EIC clock when DPRESCALER.TICKON=0 or on each *low frequency clock* tick when DPRESCALER.TICKON=1, to detect a bounce when the sampled value is equal to the current valid pin state. Transitional edge detection increments the transition counter of the EXTINT pin, while bounce detection resets the transition counter. The transition counter must exceed the transition count threshold as defined by the DPRESCALER.STATESn bitfield. In the synchronous mode the threshold is 4 when DPRESCALER.STATESn=0 or 8 when DPRESCALER.STATESn=1. In the asynchronous mode the threshold is 4.

The valid pin state for the pins can be accessed by reading the register PINSTATE for both synchronous or asynchronous debouncing mode.

Synchronous edge detection In this mode the external interrupt (EXTINT) pin is sampled continously on EIC clock.

1. A pin edge transition will be validated when the sampled value is consistently different of the current valid pin state for 4 (or 8 depending on bit DPRESCALER.STATESn) consecutive ticks of the low frequency clock.
2. Any pin sample, at the *low frequency clock* tick rate, with a value opposite to the current valid pin state will increment the transition counter.

When the USART repetition number reaches the programmed value in CTRLC.MAXITER, the STATUS.ITER bit is set and the internal iteration counter is reset. If the repetition of the character is acknowledged by the receiver before the maximum iteration is reached, the repetitions are stopped and the iteration counter is cleared.

Disable Successive Receive NACK

The receiver can limit the number of successive NACKs sent back to the remote transmitter. This is programmed by setting the Disable Successive NACK bit (CTRLC.DSNACK). The maximum number of NACKs transmitted is programmed in the CTRLC.MAXITER field. As soon as the maximum is reached, the character is considered as correct, an acknowledge is sent on the line, the STATUS.ITER bit is set and the internal iteration counter is reset.

Protocol T=1

When operating in ISO7816 protocol T=1, the transmission is asynchronous (CTRL1.CMODE=0) with one or two stop bits. After the stop bits are sent, the transmitter does not drive the I/O line.

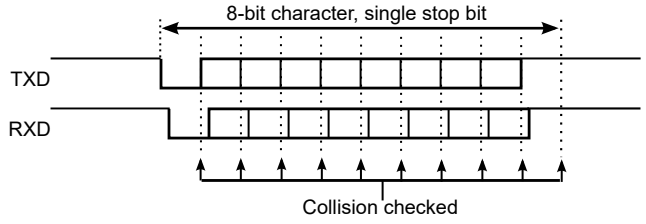
Parity is generated when transmitting and checked when receiving. Parity error detection sets the STATUS.PERR bit, and the erroneous character is written to the receive FIFO. When using T=1 protocol, the receiver does not signal errors on the I/O line and the transmitter does not retransmit.

35.6.3.7 Collision Detection

When the receiver and transmitter are connected either through pin configuration or externally, transmit collision can be detected after selecting the Collision Detection Enable bit in the CTRLB register (CTRLB.COLDEN=1). To detect collision, the receiver and transmitter must be enabled (CTRLB.RXEN=1 and CTRLB.TXEN=1).

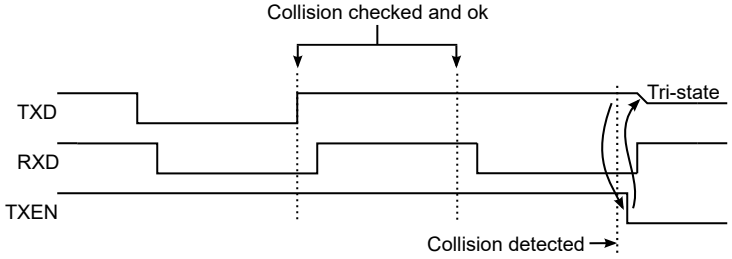
Collision detection is performed for each bit transmitted by comparing the received value with the transmit value, as shown in the figure below. While the transmitter is idle (no transmission in progress), characters can be received on RxD without triggering a collision.

Figure 35-18. Collision Checking



The next figure shows the conditions for a collision detection. In this case, the start bit and the first data bit are received with the same value as transmitted. The second received data bit is found to be different than the transmitted bit at the detection point, which indicates a collision.

Figure 35-19. Collision Detected



When a collision is detected, the USART follows this sequence:

35.8.7 Interrupt Enable Set

Name: INTENSET
Offset: 0x16
Reset: 0x00
Property: PAC Write-Protection

This register allows the user to disable an interrupt without doing a read-modify-write operation. Changes in this register will also be reflected in the Interrupt Enable Clear register (INTENCLR).

Bit	7	6	5	4	3	2	1	0
	ERROR		RXBRK	CTSIC	RXS	RXC	TXC	DRE
Access	R/W		R/W	R/W	R/W	R/W	R/W	R/W
Reset	0		0	0	0	0	0	0

Bit 7 – ERROR Error Interrupt Enable
Writing '0' to this bit has no effect.

Writing '1' to this bit will set the Error Interrupt Enable bit, which enables the Error interrupt.

Value	Description
0	Error interrupt is disabled.
1	Error interrupt is enabled.

Bit 5 – RXBRK Receive Break Interrupt Enable
Writing '0' to this bit has no effect.

Writing '1' to this bit will set the Receive Break Interrupt Enable bit, which enables the Receive Break interrupt.

Value	Description
0	Receive Break interrupt is disabled.
1	Receive Break interrupt is enabled.

Bit 4 – CTSIC Clear to Send Input Change Interrupt Enable
Writing '0' to this bit has no effect.

Writing '1' to this bit will set the Clear To Send Input Change Interrupt Enable bit, which enables the Clear To Send Input Change interrupt.

Value	Description
0	Clear To Send Input Change interrupt is disabled.
1	Clear To Send Input Change interrupt is enabled.

Bit 3 – RXS Receive Start Interrupt Enable
Writing '0' to this bit has no effect.

Writing '1' to this bit will set the Receive Start Interrupt Enable bit, which enables the Receive Start interrupt.

Value	Description
0	Receive Start interrupt is disabled.
1	Receive Start interrupt is enabled.

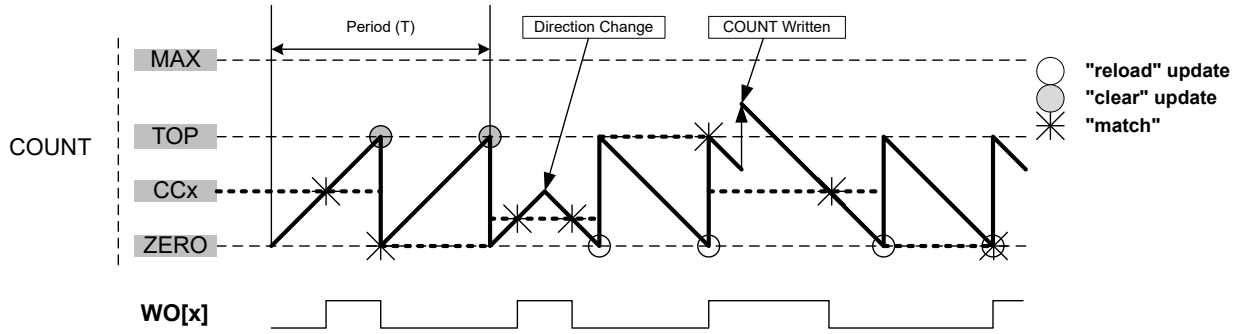
Bit 0 – DRE Data Register Empty
This flag is cleared by writing new data to DATA.

This flag is set when DATA is empty and ready for new data to transmit.

Writing '0' to this bit has no effect.

Writing '1' to this bit has no effect.

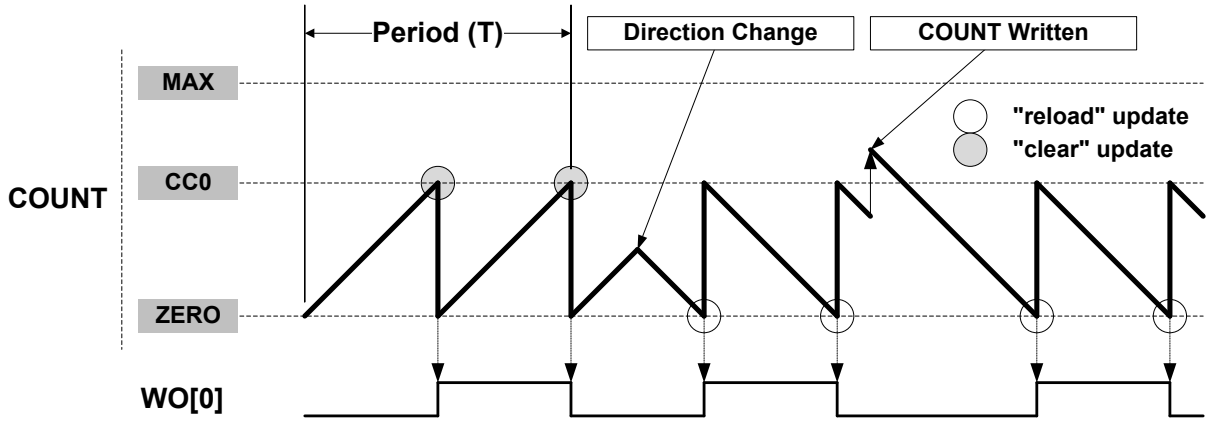
Figure 38-4. Normal Frequency Operation



Match Frequency Generation (MFRQ)

For Match Frequency Generation, the period time (T) is controlled by the CC0 register instead of PER or MAX. WO[0] toggles on each update condition.

Figure 38-5. Match Frequency Operation



Normal Pulse-Width Modulation Operation (NPWM)

NPWM uses single-slope PWM generation.

For single-slope PWM generation, the period time (T) is controlled by the TOP value, and CCx controls the duty cycle of the generated waveform output. When up-counting, the WO[x] is set at start or compare match between the COUNT and TOP values, and cleared on compare match between COUNT and CCx register values. When down-counting, the WO[x] is cleared at start or compare match between the COUNT and ZERO values, and set on compare match between COUNT and CCx register values.

The following equation calculates the exact resolution for a single-slope PWM (R_{PWM_SS}) waveform:

$$R_{PWM\_SS} = \frac{\log(TOP+1)}{\log(2)}$$

The PWM frequency (f_{PWM_SS}) depends on TOP value and the peripheral clock frequency (f_{GCLK_TC}), and can be calculated by the following equation:

$$f_{PWM\_SS} = \frac{f_{GCLK\_TC}}{N(TOP+1)}$$

Where N represents the prescaler divider used (1, 2, 4, 8, 16, 64, 256, 1024).

Match Pulse-Width Modulation Operation (MPWM)

In MPWM, the output of WO[1] is depending on CC1 as shown in the figure below. On every overflow/ underflow, a one-TC-clock-cycle negative pulse is put out on WO[0] (not shown in the figure).

38.7.1.16 Period Buffer Value, 8-bit Mode

Name: PERBUF
Offset: 0x2F
Reset: 0xFF
Property: Write-Synchronized

Bit	7	6	5	4	3	2	1	0
	PERBUF[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	1

Bits 7:0 – PERBUF[7:0] Period Buffer Value
These bits hold the value of the period buffer register. The value is copied to PER register on UPDATE condition.

Bit 0 – DIR Counter Direction
This bit is used to change the direction of the counter.

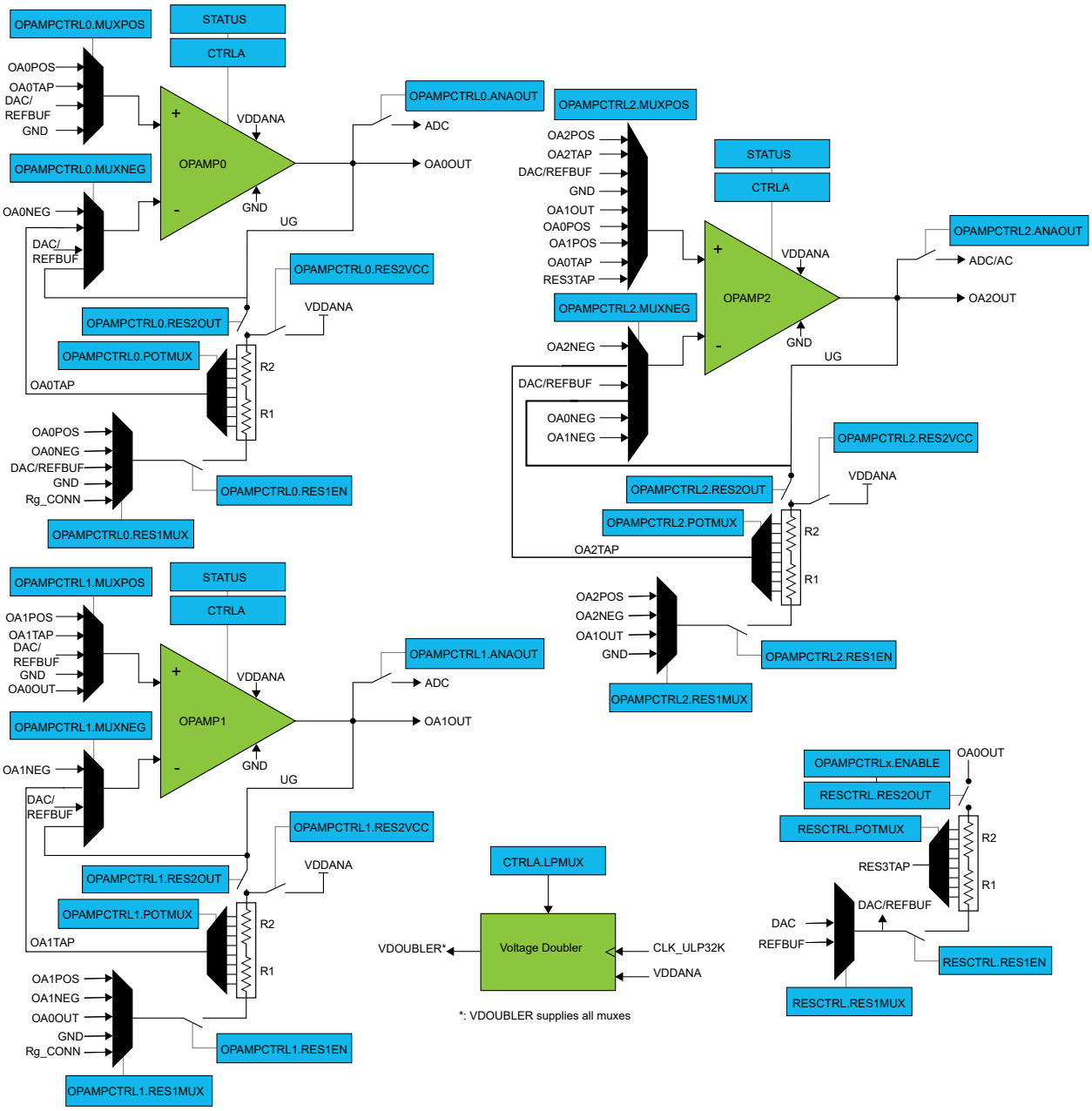
Writing a '0' to this bit has no effect.

Writing a '1' to this bit will clear the bit and make the counter count up.

Value	Description
0	The timer/counter is counting up (incrementing).
1	The timer/counter is counting down (decrementing).

44.3 Block Diagram

Figure 44-1. OPAMP Block Diagram



44.4 Signal Description

Signal	Description	Type
OA0POS	OPAMP0 positive input	Analog input
OA0NEG	OPAMP0 negative input	Analog input
OA1POS	OPAMP1 positive input	Analog input