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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, WDT
Number of I/O	38
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 12x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-TQFP
Supplier Device Package	48-TQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atsamc20g16a-aut

	Pin[1]		I/O Pin	Supply	A				B[2][3]				C	D	E	F	G	H	I
SAM C21E	SAM C21G	SAM C21J			EIC	REF	ADC0	ADC1	AC	PTC	DAC	SDADC	SERCOM[2][3][4]	SERCOM-ALT[4]	TC TCC	TCC	COM	AC/GCLK	CCL
																			IN[3]
12	14	18	PA09	VDDIO	EXTINT[9]		AIN[9]	AIN[11]		X[1]/Y[17]			SERCOM0/ PAD[1]	SERCOM2/ PAD[1]	TCC0/WO[1]	TCC1/ WO[3]			CCL1/ IN[4]
13	15	19	PA10	VDDIO	EXTINT[10]		AIN[10]			X[2]/Y[18]			SERCOM0/ PAD[2]	SERCOM2/ PAD[2]	TCC1/WO[0]	TCC0/ WO[2]		GCLK_IO[4]	CCL1/ IN[5]
14	16	20	PA11	VDDIO	EXTINT[11]		AIN[11]			X[3]/Y[19]			SERCOM0/ PAD[3]	SERCOM2/ PAD[3]	TCC1/WO[1]	TCC0/ WO[3]		GCLK_IO[5]	CCL1/ OUT[1]
	19	23	PB10	VDDIO	EXTINT[10]									SERCOM4/ PAD[2]	TC1/WO[0]	TCC0/ WO[4]	CAN1/TX	GCLK_IO[4]	CCL1/ IN[5]
	20	24	PB11	VDDIO	EXTINT[11]									SERCOM4/ PAD[3]	TC1/WO[1]	TCC0/ WO[5]	CAN1/RX	GCLK_IO[5]	CCL1/ OUT[1]
		25	PB12	VDDIO	EXTINT[12]					X[12]/Y[28]			SERCOM4/ PAD[0]		TC0/WO[0]	TCC0/ WO[6]		GCLK_IO[6]	
		26	PB13	VDDIO	EXTINT[13]					X[13]/Y[29]			SERCOM4/ PAD[1]		TC0/WO[1]	TCC0/ WO[7]		GCLK_IO[7]	
		27	PB14	VDDIO	EXTINT[14]					X[14]/Y[30]			SERCOM4/ PAD[2]		TC1/WO[0]		CAN1/TX	GCLK_IO[0]	CCL3/ IN[9]
		28	PB15	VDDIO	EXTINT[15]					X[15]/Y[31]			SERCOM4/ PAD[3]		TC1/WO[1]		CAN1/RX	GCLK_IO[1]	CCL3/ IN[10]
	21	29	PA12	VDDIO	EXTINT[12]								SERCOM2/ PAD[0]	SERCOM4/ PAD[0]	TCC2/WO[0]	TCC0/ WO[6]		AC/CMP[0]	
	22	30	PA13	VDDIO	EXTINT[13]								SERCOM2/ PAD[1]	SERCOM4/ PAD[1]	TCC2/WO[1]	TCC0/ WO[7]		AC/CMP[1]	
15	23	31	PA14	VDDIO	EXTINT[14]								SERCOM2/ PAD[2]	SERCOM4/ PAD[2]	TC4/WO[0]	TCC0/ WO[4]		GCLK_IO[0]	
16	24	32	PA15	VDDIO	EXTINT[15]								SERCOM2/ PAD[3]	SERCOM4/ PAD[3]	TC4/WO[1]	TCC0/ WO[5]		GCLK_IO[1]	
17	25	35	PA16	VDDIO	EXTINT[0]					X[4]/Y[20]			SERCOM1/ PAD[0]	SERCOM3/ PAD[0]	TCC2/WO[0]	TCC0/ WO[6]		GCLK_IO[2]	CCL0/ IN[0]
18	26	36	PA17	VDDIO	EXTINT[1]					X[5]/Y[21]			SERCOM1/ PAD[1]	SERCOM3/ PAD[1]	TCC2/WO[1]	TCC0/ WO[7]		GCLK_IO[3]	CCL0/ IN[1]
19	27	37	PA18	VDDIO	EXTINT[2]					X[6]/Y[22]			SERCOM1/ PAD[2]	SERCOM3/ PAD[2]	TC4/WO[0]	TCC0/ WO[2]		AC/CMP[0]	CCL0/ IN[2]
20	28	38	PA19	VDDIO	EXTINT[3]					X[7]/Y[23]			SERCOM1/ PAD[3]	SERCOM3/ PAD[3]	TC4/WO[1]	TCC0/ WO[3]		AC/CMP[1]	CCL0/ OUT[0]
		39	PB16	VDDIO	EXTINT[0]								SERCOM5/ PAD[0]		TC2/WO[0]	TCC0/ WO[4]		GCLK_IO[2]	CCL3/ IN[11]
		40	PB17	VDDIO	EXTINT[1]								SERCOM5/ PAD[1]		TC2/WO[1]	TCC0/ WO[5]		GCLK_IO[3]	CCL3/ OUT[3]
	29	41	PA20	VDDIO	EXTINT[4]					X[8]/Y[24]			SERCOM5/ PAD[2]	SERCOM3/ PAD[2]	TC3/WO[0]	TCC0/ WO[6]		GCLK_IO[4]	
	30	42	PA21	VDDIO	EXTINT[5]					X[9]/Y[25]			SERCOM5/ PAD[3]	SERCOM3/ PAD[3]	TC3/WO[1]	TCC0/ WO[7]		GCLK_IO[5]	
21	31	43	PA22	VDDIO	EXTINT[6]					X[10]/Y[26]			SERCOM3/ PAD[0]	SERCOM5/ PAD[0]	TC0/WO[0]	TCC0/ WO[4]		GCLK_IO[6]	CCL2/ IN[6]
22	32	44	PA23	VDDIO	EXTINT[7]					X[11]/Y[27]			SERCOM3/ PAD[1]	SERCOM5/ PAD[1]	TC0/WO[1]	TCC0/ WO[5]		GCLK_IO[7]	CCL2/ IN[7]
23	33	45	PA24	VDDIO	EXTINT[12]								SERCOM3/ PAD[2]	SERCOM5/ PAD[2]	TC1/WO[0]	TCC1/ WO[2]	CAN0/TX	AC/CMP[2]	CCL2/ IN[8]
24	34	46	PA25	VDDIO	EXTINT[13]								SERCOM3/ PAD[3]	SERCOM5/ PAD[3]	TC1/WO[1]	TCC1/ WO[3]	CAN0/RX	AC/CMP[3]	CCL2/ OUT[2]
	37	49	PB22	VDDIN	EXTINT[6]									SERCOM5/ PAD[2]	TC3/WO[0]		CAN0/TX	GCLK_IO[0]	CCL0/ IN[0]
	38	50	PB23	VDDIN	EXTINT[7]									SERCOM5/ PAD[3]	TC3/WO[1]		CAN0/RX	GCLK_IO[1]	CCL0/ OUT[0]
25	39	51	PA27	VDDIN	EXTINT[15]													GCLK_IO[0]	
27	41	53	PA28	VDDIN	EXTINT[8]													GCLK_IO[0]	
31	45	57	PA30	VDDIN	EXTINT[10]									SERCOM1/ PAD[2]	TCC1/WO[0]		CORTEX_M0P/ SWCLK	GCLK_IO[0]	CCL1/ IN[3]
32	46	58	PA31	VDDIN	EXTINT[11]									SERCOM1/ PAD[3]	TCC1/WO[1]		CORTEX_M0P/ SWDIO		CCL1/ OUT[1]
		59	PB30	VDDIN	EXTINT[14]									SERCOM5/ PAD[0]	TCC0/WO[0]	TCC1/ WO[2]		AC/CMP[2]	
		60	PB31	VDDIN	EXTINT[15]									SERCOM5/ PAD[1]	TCC0/WO[1]	TCC1/ WO[3]		AC/CMP[3]	
		61	PB00	VDDANA	EXTINT[0]			AIN[0]		Y[6]				SERCOM5/ PAD[2]	TC3/WO[0]				CCL0/ IN[1]
		62	PB01	VDDANA	EXTINT[1]			AIN[1]		Y[7]				SERCOM5/ PAD[3]	TC3/WO[1]				CCL0/ IN[2]
	47	63	PB02	VDDANA	EXTINT[2]			AIN[2]		Y[8]				SERCOM5/ PAD[0]	TC2/WO[0]				CCL0/ OUT[0]
	48	64	PB03	VDDANA	EXTINT[3]			AIN[3]		Y[9]				SERCOM5/ PAD[1]	TC2/WO[1]				

Peripheral Name	Base Address	IRQ Line	AHB Clock		APB Clock		Generic Clock	PAC		Events		DMA	
			Index	Enabled at Reset	Index	Enabled at Reset	Index	Index	Prot at Reset	User	Generator	Index	Sleep Walking
										45: STOP			
AHB-APB Bridge C	0x42000000		2	Y									N/A
EVSYS	0x42000000	8			0	N	6-17: one per CHANNEL	0	N				Y
SERCOM0	0x42000400	9			1	N	19: CORE 18: SLOW	1	N			2: RX 3: TX	Y
SERCOM1	0x42000800	10			2	N	20: CORE 18: SLOW	2	N			4: RX 5: TX	Y
SERCOM2	0x42000C00	11			3	N	21: CORE 18: SLOW	3	N			6: RX 7: TX	Y
SERCOM3	0x42001000	12			4	N	22: CORE 18: SLOW	4	N			8: RX 9: TX	Y
SERCOM4	0x42001400	13			5	N	23: CORE 18: SLOW	5	N			10: RX 11: TX	Y
SERCOM5	0x42001800	14			6	N	25: CORE 24: SLOW	6	N			12: RX 13: TX	Y
CAN0	0x42001C00	15	8	N			26					14: DEBUG	N/A
CAN1	0x42002000	16	9	N			27					15: DEBUG	N/A
TCC0	0x42002400	17			9	N	28	9	N	9-10: EV0-1 11-14: MC0-3	34: OVF 35: TRG 36: CNT 37-40: MC0-3	16: OVF 17-20: MC0-3	Y
TCC1	0x42002800	18			10	N	28	10	N	15-16: EV0-1 17-18: MC0-1	41: OVF 42: TRG 43: CNT 44-45: MC0-1	21: OVF 22-23: MC0-1	Y
TCC2	0x42002C00	19			11	N	29	11	N	19-20: EV0-1 21-22: MC0-1	46: OVF 47: TRG 48: CNT 49-50: MC0-1	24: OVF 25-26: MC0-1	Y
TC0	0x42003000	20			12	N	30	12	N	23: EVU	51: OVF 52-53: MC0-1	27: OVF 28-29: MC0-1	Y
TC1	0x42003400	21			13	N	30	13	N	24: EVU	54: OVF 55-56: MC0-1	30: OVF 21-32: MC0-1	Y
TC2	0x42003800	22			14	N	31	14	N	25: EVU	57: OVF 58-59: MC0-1	33: OVF 23-35: MC0-1	Y
TC3	0x42003C00	23			15	N	31	15	N	26: EVU	60: OVF 61-62: MC0-1	36: OVF 37-38: MC0-1	Y
TC4	0x42004000	24			16	N	32	16	N	27: EVU	63: OVF 64-65: MC0-1	39: OVF 40-41: MC0-1	Y
ADC0	0x42004400	25			17	N	33	17	N	28: START 29: SYNC	66: RESRDY 67: WINMON	42: RESRDY	Y
ADC1	0x42004800	26			18	N	34	18	N	30: START 31: SYNC	68: RESRDY 69: WINMON	43: RESRDY	Y
SDADC	0x42004C00	29			19	N	35	19	N	32: START 33: FLUSH	70: RESRDY 71: WINMON	44: RESRDY	Y
AC	0x42005000	27			20	N	34	20	N	34-37: SOC0-3	72-75: COMP0-3 76-77: WIN0-1		Y

Bit	31	30	29	28	27	26	25	24
	LENGTH[29:22]							
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
	LENGTH[21:14]							
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
	LENGTH[13:6]							
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
	LENGTH[5:0]							
Access	R/W	R/W	R/W	R/W	R/W	R/W		
Reset	0	0	0	0	0	0		

Bits 31:2 – LENGTH[29:0]: Length
Length in words needed for memory operations.

13.13.6 Data

Name: DATA
Offset: 0x000C
Reset: 0x00000000
Property: PAC Write-Protection

24.11 Register Summary - CLOCK

Offset	Name	Bit Pos.								
0x00	CTRLA	7:0	MATCHCLR	CLKREP			MODE[1:0]		ENABLE	SWRST
0x01		15:8	CLOCKSYNC				PRESCALER[3:0]			
0x02 ... 0x03	Reserved									
0x04	EVCTRL	7:0	PEREOn	PEREOn	PEREOn	PEREOn	PEREOn	PEREOn	PEREOn	PEREOn
0x05		15:8	OVFEO							ALARMO0
0x06		23:16								
0x07		31:24								
0x08	INTENCLR	7:0	PERn	PERn	PERn	PERn	PERn	PERn	PERn	PERn
0x09		15:8	OVF							ALARM0
0x0A	INTENSET	7:0	PERn	PERn	PERn	PERn	PERn	PERn	PERn	PERn
0x0B		15:8	OVF							ALARM0
0x0C	INTFLAG	7:0	PERn	PERn	PERn	PERn	PERn	PERn	PERn	PERn
0x0D		15:8	OVF							ALARM0
0x0E	DBGCTRL	7:0								DBGRUN
0x0F	Reserved									
0x10	SYNCBUSY	7:0			ALARM0		CLOCK	FREQCORR	ENABLE	SWRST
0x11		15:8	CLOCKSYNC				MASK0			
0x12		23:16								
0x13		31:24								
0x14	FREQCORR	7:0	SIGN	VALUE[6:0]						
0x15 ... 0x17	Reserved									
0x18	CLOCK	7:0	MINUTE[1:0]		SECOND[5:0]					
0x19		15:8	HOUR[3:0]				MINUTE[5:2]			
0x1A		23:16	MONTH[1:0]		DAY[4:0]					HOUR[4:4]
0x1B		31:24	YEAR[5:0]						MONTH[3:2]	
0x1C ... 0x1F	Reserved									
0x20	ALARM	7:0	MINUTE[1:0]		SECOND[5:0]					
0x21		15:8	HOUR[3:0]				MINUTE[5:2]			
0x22		23:16	MONTH[1:0]		DAY[4:0]					HOUR[4:4]
0x23		31:24	YEAR[5:0]						MONTH[3:2]	
0x24	MASK	7:0						SEL[2:0]		

24.12 Register Description - CLOCK

This Register Description section is valid if the RTC is in Clock/Calendar mode (CTRLA.MODE=2).

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.

24.12.10 Alarm Value in Clock/Calendar mode (CTRLA.MODE=2)

The 32-bit value of ALARM is continuously compared with the 32-bit CLOCK value, based on the masking set by MASK.SEL. When a match occurs, the Alarm n interrupt flag in the Interrupt Flag Status and Clear register (INTFLAG.ALARM) is set on the next counter cycle, and the counter is cleared if CTRLA.MATCHCLR is '1'.

Name: ALARM
Offset: 0x20
Reset: 0x00000000
Property: PAC Write-Protection, Write-Synchronized

Bit	31	30	29	28	27	26	25	24
	YEAR[5:0]						MONTH[3:2]	
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
	MONTH[1:0]		DAY[4:0]					HOUR[4:4]
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
	HOUR[3:0]				MINUTE[5:2]			
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
	MINUTE[1:0]		SECOND[5:0]					
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 31:26 – YEAR[5:0]: Year
The alarm year. Years are only matched if MASK.SEL is 6

Bits 25:22 – MONTH[3:0]: Month
The alarm month. Months are matched only if MASK.SEL is greater than 4.

Bits 21:17 – DAY[4:0]: Day
The alarm day. Days are matched only if MASK.SEL is greater than 3.

Bits 16:12 – HOUR[4:0]: Hour
The alarm hour. Hours are matched only if MASK.SEL is greater than 2.

Bits 11:6 – MINUTE[5:0]: Minute
The alarm minute. Minutes are matched only if MASK.SEL is greater than 1.

Bits 5:0 – SECOND[5:0]: Second
The alarm second. Seconds are matched only if MASK.SEL is greater than 0.

If CRC calculation is needed, the CRC engine must be configured before it is enabled, as outlined by the following steps:

- The CRC input source must selected by writing the CRC Input Source bit group in the CRC Control register (CRCCTRL.CRCSRC)
- The type of CRC calculation must be selected by writing the CRC Polynomial Type bit group in the CRC Control register (CRCCTRL.CRCPOLY)
- If I/O is selected as input source, the beat size must be selected by writing the CRC Beat Size bit group in the CRC Control register (CRCCTRL.CRCBEATSIZE)

Related Links

BASEADDR
CHCTRLA
CHCTRLB
CRCCHKSUM
CRCCTRL
CTRL
WRBADDR
BTCTRL
BTCNT
DSTADDR
SRCADDR

25.6.2.2 Enabling, Disabling, and Resetting

The DMAC is enabled by writing the DMA Enable bit in the Control register (CTRL.DMAENABLE) to '1'. The DMAC is disabled by writing a '0' to CTRL.DMAENABLE.

A DMA channel is enabled by writing the Enable bit in the Channel Control A register (CHCTRLA.ENABLE) to '1', after writing the corresponding channel id to the Channel ID bit group in the Channel ID register (CHID.ID). A DMA channel is disabled by writing a '0' to CHCTRLA.ENABLE.

The CRC is enabled by writing a '1' to the CRC Enable bit in the Control register (CTRL.CRCENABLE). The CRC is disabled by writing a '0' to CTRL.CRCENABLE.

The DMAC is reset by writing a '1' to the Software Reset bit in the Control register (CTRL.SWRST) while the DMAC and CRC are disabled. All registers in the DMAC except DBGCTRL will be reset to their initial state.

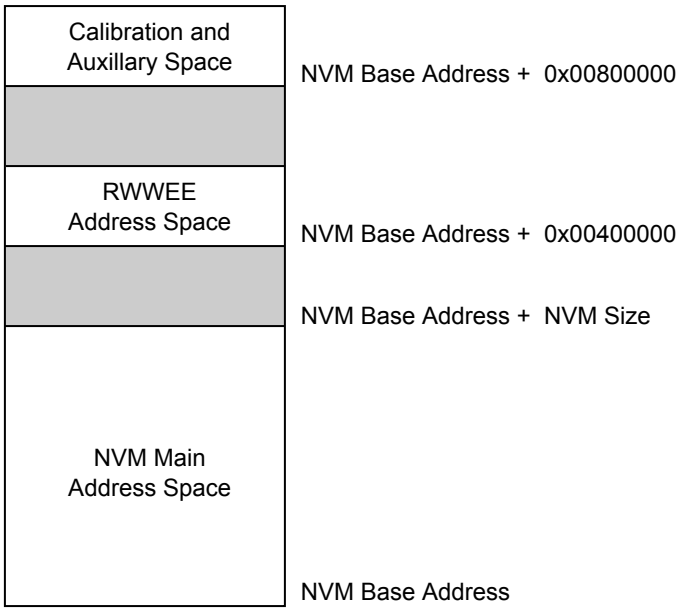
A DMA channel is reset by writing a '1' to the Software Reset bit in the Channel Control A register (CHCTRLA.SWRST), after writing the corresponding channel id to the Channel ID bit group in the Channel ID register (CHID.ID). The channel registers will be reset to their initial state. The corresponding DMA channel must be disabled in order for the reset to take effect.

25.6.2.3 Transfer Descriptors

Together with the channel configurations the transfer descriptors decides how a block transfer should be executed. Before a DMA channel is enabled (CHCTRLA.ENABLE is written to one), and receives a transfer trigger, its first transfer descriptor has to be initialized and valid (BTCTRL.VALID). The first transfer descriptor describes the first block transfer of a transaction.

All transfer descriptors must reside in SRAM. The addresses stored in the Descriptor Memory Section Base Address (BASEADDR) and Write-Back Memory Section Base Address (WRBADDR) registers tell the DMAC where to find the descriptor memory section and the write-back memory section.

Figure 27-3. NVM Memory Organization



The lower rows in the NVM main address space can be allocated as a boot loader section by using the BOOTPROT fuses, and the upper rows can be allocated to EEPROM, as shown in the figure below.

The boot loader section is protected by the lock bit(s) corresponding to this address space and by the BOOTPROT[2:0] fuse. The EEPROM rows can be written regardless of the region lock status.

The number of rows protected by BOOTPROT is given in Boot Loader Size, the number of rows allocated to the EEPROM are given in EEPROM Size.

Value	Description
0	The PMUXn registers of the selected pins will not be updated.
1	The PMUXn registers of the selected pins will be updated.

Bits 27:24 – PMUX[3:0]: Peripheral Multiplexing
These bits determine the new value written to the Peripheral Multiplexing register (PMUXn) for all pins selected by the WRCONFIG.PINMASK and WRCONFIG.HWSEL bits, when the WRCONFIG.WRPMUX bit is set.

These bits will always read as zero.

Bit 22 – DRVSTR: Output Driver Strength Selection
This bit determines the new value written to PINCFGy.DRVSTR for all pins selected by the WRCONFIG.PINMASK and WRCONFIG.HWSEL bits, when the WRCONFIG.WRPINCFG bit is set.

This bit will always read as zero.

Bit 18 – PULLEN: Pull Enable
This bit determines the new value written to PINCFGy.PULLEN for all pins selected by the WRCONFIG.PINMASK and WRCONFIG.HWSEL bits, when the WRCONFIG.WRPINCFG bit is set.

This bit will always read as zero.

Bit 17 – INEN: Input Enable
This bit determines the new value written to PINCFGy.INEN for all pins selected by the WRCONFIG.PINMASK and WRCONFIG.HWSEL bits, when the WRCONFIG.WRPINCFG bit is set.

This bit will always read as zero.

Bit 16 – PMUXEN: Peripheral Multiplexer Enable
This bit determines the new value written to PINCFGy.PMUXEN for all pins selected by the WRCONFIG.PINMASK and WRCONFIG.HWSEL bits, when the WRCONFIG.WRPINCFG bit is set.

This bit will always read as zero.

Bits 15:0 – PINMASK[15:0]: Pin Mask for Multiple Pin Configuration
These bits select the pins to be configured within the half-word group selected by the WRCONFIG.HWSEL bit.

These bits will always read as zero.

Value	Description
0	The configuration of the corresponding I/O pin in the half-word group will be left unchanged.
1	The configuration of the corresponding I/O pin in the half-word PORT group will be updated.

28.9.12 Event Input Control

Tip: The I/O pins are assembled in pin groups (”PORT groups”) with up to 32 pins. Group 0 consists of the PA pins, group 1 is for the PB pins, etc. Each pin group has its own PORT registers. For example, the register address offset for the Data Direction (DIR) register for group 0 (PA00 to PA31) is 0x00, and the register address offset for the DIR register for group 1 (PB00 to PB31) is 0x80.

29. EVSYS – Event System

29.1 Overview

The Event System (EVSYS) allows autonomous, low-latency and configurable communication between peripherals.

Several peripherals can be configured to generate and/or respond to signals known as events. The exact condition to generate an event, or the action taken upon receiving an event, is specific to each peripheral. Peripherals that respond to events are called event users. Peripherals that generate events are called event generators. A peripheral can have one or more event generators and can have one or more event users.

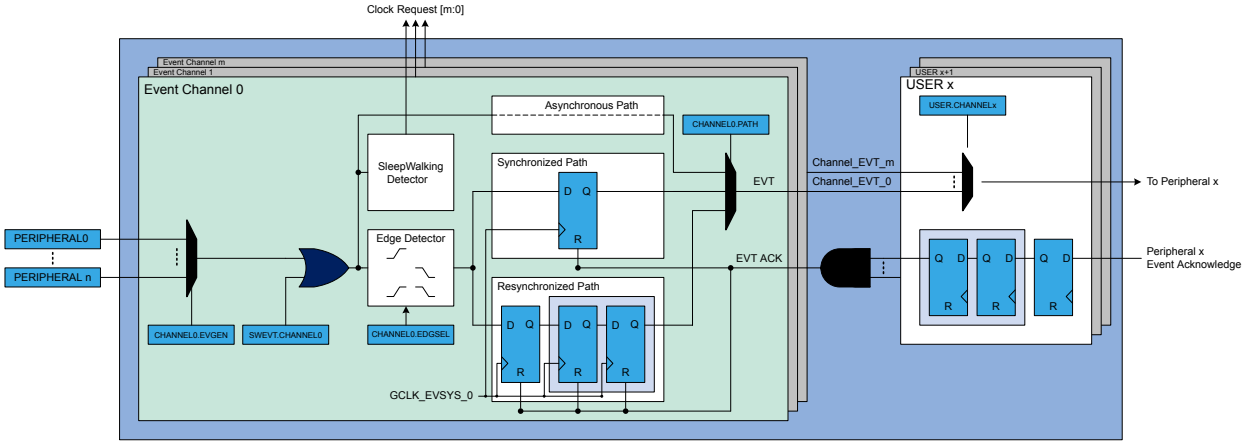
Communication is made without CPU intervention and without consuming system resources such as bus or RAM bandwidth. This reduces the load on the CPU and other system resources, compared to a traditional interrupt-based system.

29.2 Features

- 12 configurable event channels, where each channel can:
  - Be connected to any event generator.
  - Provide a pure asynchronous, resynchronized or synchronous path
- 87 event generators.
- 47 event users.
- Configurable edge detector.
- Peripherals can be event generators, event users, or both.
- SleepWalking and interrupt for operation in sleep modes.
- Software event generation.
- Each event user can choose which channel to respond to.

29.3 Block Diagram

Figure 29-1. Event System Block Diagram



Name: CTRLB
Offset: 0x04
Reset: 0x00000000
Property: PAC Write-Protection, Enable-Protected, Write-Synchronized

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

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

Bit	15	14	13	12	11	10	9	8
			PMODE			ENC	SFDE	COLDEN
Access			R/W			R/W	R/W	R/W
Reset			0			0	0	0

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

Bits 25:24 – LINCMD[1:0]: LIN Command
These bits define the LIN header transmission control. This field is only valid in LIN master mode (CTRLA.FORM= LIN Master).

These are strobe bits and will always read back as zero.

These bits are not enable-protected.

Value	Description
0x0	Normal USART transmission.
0x1	Break field is transmitted when DATA is written.
0x2	Break, sync and identifier are automatically transmitted when DATA is written with the identifier.
0x3	Reserved

Bit 17 – RXEN: Receiver Enable
Writing '0' to this bit will disable the USART receiver. Disabling the receiver will flush the receive buffer and clear the FERR, PERR and BUFOVF bits in the STATUS register.

Writing '1' to CTRLB.RXEN when the USART is disabled will set CTRLB.RXEN immediately. When the USART is enabled, CTRLB.RXEN will be cleared, and SYNCBUSY.CTRLB will be set and remain set until the receiver is enabled. When the receiver is enabled, CTRLB.RXEN will read back as '1'.

Writing '1' to CTRLB.RXEN when the USART is enabled will set SYNCBUSY.CTRLB, which will remain set until the receiver is enabled, and CTRLB.RXEN will read back as '1'.

This bit is not enable-protected.

For RS485 mode, the guard time is programmable from 0-7 bit times and defines the time that the transmit enable pin (TE) remains high after the last stop bit is transmitted and there is no remaining data to be transmitted.

31.8.4 Baud

Name: BAUD
Offset: 0x0C [ID-00000fa7]
Reset: 0x0000
Property: Enable-Protected, PAC Write-Protection

Bit	15	14	13	12	11	10	9	8
	BAUD[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
	BAUD[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 15:0 – BAUD[15:0]: Baud Value
Arithmetic Baud Rate Generation (`CTRLA.SAMPR[0]=0`):

These bits control the clock generation, as described in the SERCOM Baud Rate section.

If Fractional Baud Rate Generation (`CTRLA.SAMPR[0]=1`) bit positions 15 to 13 are replaced by FP[2:0] Fractional Part:

- **Bits 15:13 - FP[2:0]: Fractional Part**

  These bits control the clock generation, as described in the *SERCOM Clock Generation – Baud-Rate Generator* section.
- **Bits 12:0 - BAUD[21:0]: Baud Value**

  These bits control the clock generation, as described in the *SERCOM Clock Generation – Baud-Rate Generator* section.

Related Links
Clock Generation – Baud-Rate Generator
Asynchronous Arithmetic Mode BAUD Value Selection

31.8.5 Receive Pulse Length Register

Name: RXPL
Offset: 0x0E [ID-00000fa7]
Reset: 0x00
Property: PAC Write-Protection

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

Bit	23	22	21	20	19	18	17	16
				EFP[4:0]				
Access				R	R	R	R	R
Reset				0	0	0	0	0

Bit	15	14	13	12	11	10	9	8
				EFGI[4:0]				
Access				R	R	R	R	R
Reset				0	0	0	0	0

Bit	7	6	5	4	3	2	1	0
				EFFI[4:0]				
Access				R	R	R	R	R
Reset				0	0	0	0	0

Bit 25 – TEFL: Tx Event FIFO Element Lost
This bit is a copy of interrupt flag IR.TEFL. When IR.TEFL is reset, this bit is also reset.

Value	Description
0	No Tx Event FIFO element lost.
1	Tx Event FIFO element lost, also set after write attempt to Tx Event FIFO of size zero.

Bit 24 – EFF: Event FIFO Full

Value	Description
0	Tx Event FIFO not full.
1	Tx Event FIFO full.

Bits 20:16 – EFP[4:0]: Event FIFO Put Index
Tx Event FIFO write index pointer, range 0 to 31.

Bits 12:8 – EFGI[4:0]: Event FIFO Get Index
Tx Event FIFO read index pointer, range 0 to 31.

Bits 4:0 – EFFI[4:0]: Event FIFO Fill Level
Number of elements stored in Tx Event FIFO, range 0 to 32.

34.8.47 Tx Event FIFO Acknowledge

Name: TXEFA
Offset: 0xF8 [ID-0000a4bb]
Reset: 0x00000000
Property: -

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

Bit 11 – DFS: Non-Recoverable Debug Fault State Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after an Debug Fault State occurs.

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

Writing a '1' to this bit clears the Debug Fault State interrupt flag.

Bit 10 – UFS: Non-Recoverable Update Fault
This flag is set when the RAMP index changes and the Lock Update bit is set (CTRLBSET.LUPD).

Writing a zero to this bit has no effect.

Writing a one to this bit clears the Non-Recoverable Update Fault interrupt flag.

Bit 3 – ERR: Error Interrupt Flag
This flag is set if a new capture occurs on a channel when the corresponding Match or Capture Channel x interrupt flag is one. In which case there is nowhere to store the new capture.

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

Writing a '1' to this bit clears the error interrupt flag.

Bit 2 – CNT: Counter Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a counter event occurs.

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

Writing a '1' to this bit clears the CNT interrupt flag.

Bit 1 – TRG: Retrigger Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after a counter retrigger occurs.

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

Writing a '1' to this bit clears the re-trigger interrupt flag.

Bit 0 – OVF: Overflow Interrupt Flag
This flag is set on the next CLK_TCC_COUNT cycle after an overflow condition occurs.

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

Writing a '1' to this bit clears the Overflow interrupt flag.

36.8.13 Status

Name: STATUS
Offset: 0x30 [ID-00002e48]
Reset: 0x00000001
Property: -

Number of Accumulated Samples	AVGCTRL. SAMPLENUM	Intermediate Result Precision	Number of Automatic Right Shifts	Division Factor	AVGCTRL.ADJRES	Total Number of Right Shifts	Final Result Precision	Automatic Division Factor
64	0x6	18	2	16	0x4	6	12 bits	4
128	0x7	19	3	16	0x4	7	12 bits	8
256	0x8	20	4	16	0x4	8	12 bits	16
512	0x9	21	5	16	0x4	9	12 bits	32
1024	0xA	22	6	16	0x4	10	12 bits	64
Reserved	0xB –0xF				0x0		12 bits	0

38.6.2.11 Oversampling and Decimation

By using oversampling and decimation, the ADC resolution can be increased from 12 bits up to 16 bits, for the cost of reduced effective sampling rate.

To increase the resolution by n bits, 4^n samples must be accumulated. The result must then be right-shifted by n bits. This right-shift is a combination of the automatic right-shift and the value written to AVGCTRL.ADJRES. To obtain the correct resolution, the ADJRES must be configured as described in the table below. This method will result in n bit extra LSB resolution.

Table 38-3. Configuration Required for Oversampling and Decimation

Result Resolution	Number of Samples to Average	AVGCTRL.SAMPLENUM[3:0]	Number of Automatic Right Shifts	AVGCTRL.ADJRES[2:0]
13 bits	$4^1 = 4$	0x2	0	0x1
14 bits	$4^2 = 16$	0x4	0	0x2
15 bits	$4^3 = 64$	0x6	2	0x1
16 bits	$4^4 = 256$	0x8	4	0x0

38.6.2.12 Automatic Sequences

The ADC has the ability to automatically sequence a series of conversions. This means that each time the ADC receives a start-of-conversion request, it can perform multiple conversions automatically. All of the 32 positive inputs can be included in a sequence by writing to corresponding bits in the Sequence Control register (SEQCTRL). The order of the conversion in a sequence is the lower positive MUX selection to upper positive MUX (AIN0, AIN1, AIN2 ...). In differential mode, the negative inputs selected by MUXNEG field, will be used for the entire sequence.

When a sequence starts, the Sequence Busy status bit in Sequence Status register (SEQSTATUS.SEQBUSY) will be set. When the sequence is complete, the Sequence Busy status bit will be cleared.

Each time a conversion is completed, the Sequence State bit in Sequence Status register (SEQSTATUS.SEQSTATE) will store the input number from which the conversion is done. The result will be stored in the RESULT register, and the Result Ready Interrupt Flag (INTFLAG.RESRDY) is set.

If additional inputs must be scanned, the ADC will automatically start a new conversion on the next input present in the sequence list.

Note that if SEQCTRL register has no bits set to '1', the conversion is done with the selected MUXPOS input.

Value	Name	Description
0x18	GND	Internal ground
0x19 - 0x1F	-	Reserved

Bits 4:0 – MUXPOS[4:0]: Positive MUX Input Selection
These bits define the MUX selection for the positive ADC input. If the internal bandgap voltage input channel is selected, then the Sampling Time Length bit group in the Sampling Control register must be written with a corresponding value.

Value	Name	Description
0x00	AIN0	ADC AIN0 pin
0x01	AIN1	ADC AIN1 pin
0x02	AIN2	ADC AIN2 pin
0x03	AIN3	ADC AIN3 pin
0x04	AIN4	ADC AIN4 pin
0x05	AIN5	ADC AIN5 pin
0x06	AIN6	ADC AIN6 pin
0x07	AIN7	ADC AIN7 pin
0x08	AIN8	ADC AIN8 pin
0x09	AIN9	ADC AIN9 pin
0x0A	AIN10	ADC AIN10 pin
0x0B	AIN11	ADC AIN11 pin
0xC - 0x17	-	Reserved
0x18	-	Reserved
0x19	BANDGAP	Bandgap Voltage
0x1C	DAC	DAC Output
0x1E	-	Reserved
0x1F	-	Reserved

38.8.10 Control C

Name: CTRLC
Offset: 0x0A [ID-0000120e]
Reset: 0x0000
Property: PAC Write-Protection, Write-Synchronized

When executing an operation that requires synchronization, the corresponding synchronization bit is set in Synchronization Busy register (SYNCBUSY) and cleared when synchronization is complete.

If an operation that require synchronization is executed while its busy bit is on, the operation is discarded and a bus error is generated.

The following bits need synchronization when written:

- Software Reset bit in Control A register (CTRLA.SWRST)
- Enable bit in Control A register (CTRLA.ENABLE)

Write-synchronization is denoted by the Write-Synchronized property in the register description.

The following registers need synchronization when written:

- Input Control register (INPUTCTRL)
- Reference Control register (REFCTRL)
- Control C register (CTRLC)
- Window Monitor Lower Threshold register (WINLT)
- Window Monitor Upper Threshold register (WINUT)
- Offset correction register (OFFSETCORR)
- Gain correction register (GAINCORR)
- Shift correction register (SHIFTCORR)
- Software Trigger register (SWTRIG)
- Analog Control Register (ANACTRL)

Write-synchronization is denoted by the Write-Synchronized property in the register description.

40.7 Register Summary

Offset	Name	Bit Pos.								
0x00	CTRLA	7:0							ENABLE	SWRST
0x01	CTRLB	7:0					STARTx	STARTx	STARTx	STARTx
0x02	EVCTRL	7:0			WINEOx	WINEOx	COMPEOx	COMPEOx	COMPEOx	COMPEOx
0x03		15:8	INVEIx	INVEIx	INVEIx	INVEIx	COMPEIx	COMPEIx	COMPEIx	COMPEIx
0x04	INTENCLR	7:0			WINx	WINx	COMPx	COMPx	COMPx	COMPx
0x05	INTENSET	7:0			WINx	WINx	COMPx	COMPx	COMPx	COMPx
0x06	INTFLAG	7:0			WINx	WINx	COMPx	COMPx	COMPx	COMPx
0x07	STATUSA	7:0	WSTATE1[1:0]		WSTATE0[1:0]		STATEx	STATEx	STATEx	STATEx
0x08	STATUSB	7:0					READYx	READYx	READYx	READYx
0x09	DBGCTRL	7:0								DBGRUN
0x0A	WINCTRL	7:0		WINTSEL1[1:0]		WEN1		WINTSEL0[1:0]		WEN0
0x0B	Reserved									
0x0C	SCALERn0	7:0	VALUE[5:0]							
0x0D	SCALERn1	7:0	VALUE[5:0]							
0x0E	SCALERn2	7:0	VALUE[5:0]							
0x0F	SCALERn3	7:0	VALUE[5:0]							
0x10	COMPCTRL0	7:0		RUNSTDBY		INTSEL[1:0]		SINGLE	ENABLE	
0x11		15:8	SWAP	MUXPOS[2:0]				MUXNEG[2:0]		
0x12		23:16					HYSTEN		SPEED[1:0]	
0x13		31:24			OUT[1:0]			FLEN[2:0]		
0x14	COMPCTRL1	7:0		RUNSTDBY		INTSEL[1:0]		SINGLE	ENABLE	
0x15		15:8	SWAP	MUXPOS[2:0]				MUXNEG[2:0]		
0x16		23:16					HYSTEN		SPEED[1:0]	
0x17		31:24			OUT[1:0]			FLEN[2:0]		
0x18	COMPCTRL2	7:0		RUNSTDBY		INTSEL[1:0]		SINGLE	ENABLE	
0x19		15:8	SWAP	MUXPOS[2:0]				MUXNEG[2:0]		
0x1A		23:16					HYSTEN		SPEED[1:0]	
0x1B		31:24			OUT[1:0]			FLEN[2:0]		
0x1C	COMPCTRL3	7:0		RUNSTDBY		INTSEL[1:0]		SINGLE	ENABLE	
0x1D		15:8	SWAP	MUXPOS[2:0]				MUXNEG[2:0]		
0x1E		23:16					HYSTEN		SPEED[1:0]	
0x1F		31:24			OUT[1:0]			FLEN[2:0]		
0x20	SYNCBUSY	7:0		COMPCTRLx	COMPCTRLx	COMPCTRLx	COMPCTRLx	WINCTRL	ENABLE	SWRST
0x21		15:8								
0x22		23:16								
0x23		31:24								

40.8 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.

43.8.6 Interrupt Enable Set

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

Name: INTENSET
Offset: 0x05 [ID-00001f13]
Reset: 0x00
Property: PAC Write-Protection

Bit	7	6	5	4	3	2	1	0
					OVF	WINMON	OVERRUN	RESRDY
Access					R/W	R/W	R/W	R/W
Reset					0	0	0	0

Bit 3 – OVF: Overflow Interrupt Enable
Writing a zero to this bit has no effect.

Writing a one to this bit will set the Overflow Interrupt bit, which enables the Overflow interrupt.

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

Bit 2 – WINMON: Window Monitor Interrupt Enable
Writing a zero to this bit has no effect.

Writing a one to this bit will set the Window Monitor Interrupt bit, which enables the Window Monitor interrupt.

Value	Description
0	The Window Monitor interrupt is disabled.
1	The Window Monitor interrupt is enabled.

Bit 1 – OVERRUN: Overrun Interrupt Enable
Writing a zero to this bit has no effect.

Writing a one to this bit will set the Overrun Interrupt Enable bit, which enables the corresponding interrupt request.

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

Bit 0 – RESRDY: Result Ready Interrupt Enable
Writing a zero to this bit has no effect.

Writing a one to this bit will set the Result Ready Interrupt bit, which enables the Result Ready interrupt.

Value	Description
0	The Result Ready interrupt is disabled.
1	The Result Ready interrupt is enabled.

43.8.7 Interrupt Flag Status and Clear

Mode	Conditions	Ta	Vcc	Typ.	Max.	Units
		105°C	5.0V	6.3	7.1	
	CPU running a CoreMark algorithm	25°C	3.0V	5.2	5.7	mA
		105°C	3.0V	5.5	6.6	
	CPU running a CoreMark algorithm. with GCLKIN as reference	25°C	5.0V	115*Freq+167	126*Freq+167	µA (with freq in MHz)
		105°C	5.0V	118*Freq+383	110*Freq+1583	
IDLE		25°C	5.0V	1.2	1.7	mA
		105°C	5.0V	1.5	2.6	
STANDBY	XOSC32K running RTC running at 1kHz	25°C	5.0V	15.9	37.0	µA
		105°C	5.0V	187.0	602.0	
	XOSC32K and RTC stopped	25°C	5.0V	14.6	35.0	
		105°C	5.0V	185.0	600.0	

1. These are based on characterization.

47.4 Analog Characteristics

47.4.1 Power On Reset (POR) Characteristics

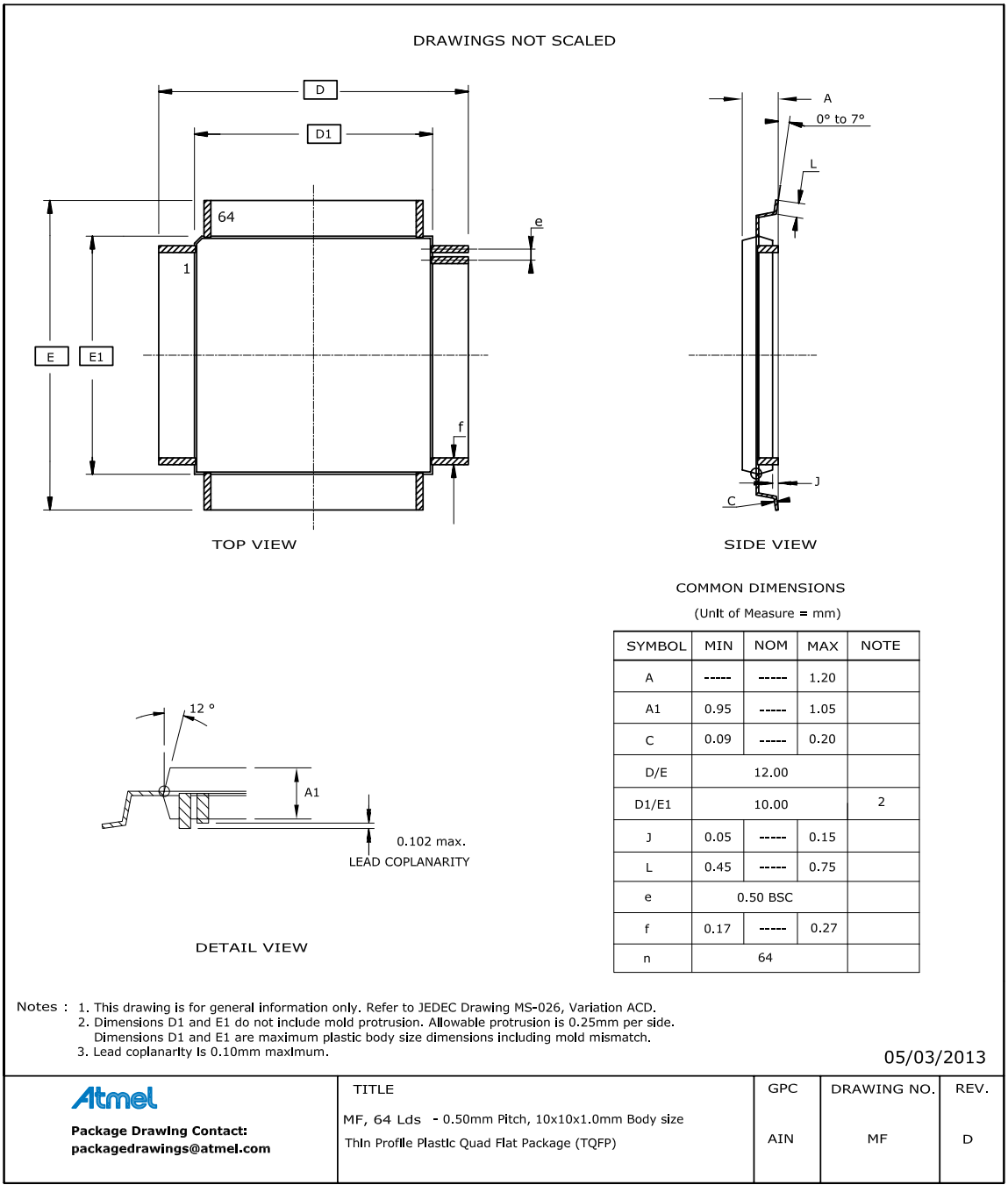
Table 47-3. POR Characteristics

Symbol	Parameters	Min	Typ	Max	Unit
V_{POT+}	Voltage threshold Level on VDDIN rising	-	2.55	-	V
V_{POT-}	Voltage threshold Level on VDDIN falling	1.77	1.92	2.04	

Table 48-4. Package Reference

JEDEC Drawing Reference	MS-026
JESD97 Classification	e3

48.2.2 64 pin TQFP



COMMON DIMENSIONS

(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	-----	-----	1.20	
A1	0.95	-----	1.05	
C	0.09	-----	0.20	
D/E		12.00		
D1/E1		10.00		2
J	0.05	-----	0.15	
L	0.45	-----	0.75	
e		0.50 BSC		
f	0.17	-----	0.27	
n		64		

Notes : 1. This drawing is for general information only. Refer to JEDEC Drawing MS-026, Variation ACD.
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
3. Lead coplanarity is 0.10mm maximum.

05/03/2013

Atmel	TITLE	GPC	DRAWING NO.	REV.
Package Drawing Contact: **packagedrawings@atmel.com**	MF, 64 Lds - 0.50mm Pitch, 10x10x1.0mm Body size Thin Profile Plastic Quad Flat Package (TQFP)	AIN	MF	D

Table 48-5. Device and Package Maximum Weight

300	mg