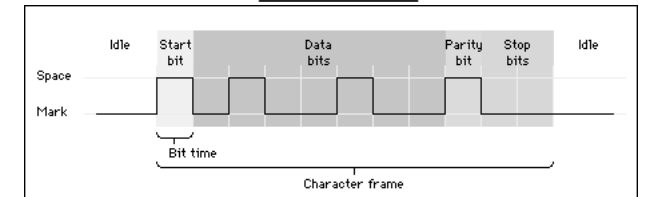


## Cheatsheet ATmega324a 2020 rev1

$$f_{CPU} = 16MHz, V_{CC} = 5V$$

(PCINT8/XCK0/T0) PB0	1	40	PA0 (ADC0/PCINT0)
(PCINT9/CLKO/T1) PB1	2	39	PA1 (ADC1/PCINT1)
(PCINT10/INT2/AINO) PB2	3	38	PA2 (ADC2/PCINT2)
(PCINT11/OC0A/AIN1) PB3	4	37	PA3 (ADC3/PCINT3)
(PCINT12/OC0B/SS) PB4	5	36	PA4 (ADC4/PCINT4)
(PCINT13/ICP3/MOSI) PB5	6	35	PA5 (ADC5/PCINT5)
(PCINT14/OC3A/MISO) PB6	7	34	PA6 (ADC6/PCINT6)
(PCINT15/OC3B/SCK) PB7	8	33	PA7 (ADC7/PCINT7)
RESET	9	32	AREF
VCC	10	31	GND
GND	11	30	AVCC
XTAL2	12	29	PC7 (TOSC2/PCINT23)
XTAL1	13	28	PC6 (TOSC1/PCINT22)
(PCINT24/RXD0/T3) PD0	14	27	PC5 (TDI/PCINT21)
(PCINT25/TXD0) PD1	15	26	PC4 (TDO/PCINT20)
(PCINT26/RXD1/INT0) PD2	16	25	PC3 (TMS/PCINT19)
(PCINT27/TXD1/INT1) PD3	17	24	PC2 (TCK/PCINT18)
(PCINT28/XCK1/OC1B) PD4	18	23	PC1 (SDA/PCINT17)
(PCINT29/OC1A) PD5	19	22	PC0 (SCL/PCINT16)
(PCINT30/OC2B/ICP) PD6	20	21	PD7 (OC2A/PCINT31)



USART frame

## Extras

```
cli(); // dezactiveaza intreruperi la nivel global
sei(); // activeaza intreruperi la nivel global
```

<b>TWBR</b>	TWBR7	TWBR6	TWBR5	TWBR4	TWBR3	TWBR2	TWBR1	TWBR0
<b>TWCR</b>	TWINT	TWEA	TWSTA	TWSTO	TWWC	TWEN	-	TWIE
<b>TWSR</b>	TWS7	TWS6	TWS5	TWS4	TWS3	-	TWPS1	TWPS0
<b>TWDR</b>	TWD7	TWD6	TWD5	TWD4	TWD3	TWD2	TWD1	TWD0

Câmp	Descriere	I2C API
TWINT	1 când s-a terminat jobul curent	<b>void I2C_init(void);</b>
TWEA	Generează bitul ACK	<b>uint8_t I2C_start(void);</b>
TWSTA	Setează secvența de START	<b>uint8_t I2C_write(uint8_t data);</b>
TWSTO	Setează secvența de STOP	<b>uint8_t I2C_read_ack(void);</b>
TWEN	Activează I2C/TWI	<b>uint8_t I2C_read_nack(void);</b>
TWIE	Activează întreruperea de I2C	<b>void I2C_stop(void);</b>
TWS7..3	Conține codul de status curent, diferă pentru Master/Slave	<b>uint8_t I2C_status(void);</b>
		<b>void I2C_stop(void);</b>
		<b>uint8_t I2C_read(void);</b>
		<b>void I2C_write(void);</b>

<b>EICRA</b>	-	-	ISC21	ISC20	ISC11	ISC10	ISC10	ISC00
<b>EIMSK</b>	-	-	-	-	-	INT2	INT1	INT0

Întreruperi externe	ISCn1	ISCn0	Acțiunea care generează întrerupere INTn
<b>INT0_vect</b>	0	0	Starea LOW
<b>INT1_vect</b>	0	1	Orice schimbare (any edge)
<b>INT2_vect</b>	1	0	Schimbarea HIGH -> LOW (falling edge)
<b>INT3_vect</b>	1	1	Schimbarea LOW -> HIGH (rising edge)

Mod	Frecvență	Duty
normal	$f_{ovf} = \frac{f_{cpu}}{PS \cdot (1 + MAX)}$	$D_{ocxy} = 50\%$
CTC/FPWM	$f_{ocr} = \frac{f_{cpu}}{PS \cdot (1 + TOP)}$	$D_{ocxy} = \frac{1 + OCRxy}{1 + TOP}$ (non-inverting)
PWM/PC PWM/PFC	$f_{ocr} = \frac{f_{cpu}}{2 \cdot PS \cdot (1 + TOP)}$	$D_{ocxy} = \frac{1 + OCRxy}{1 + TOP}$ (non-inverting)

Întreruperi Timere	<b>TIMERN_OVF_vect</b>
	<b>TIMERN_COMP_A_vect</b>
	<b>TIMERN_COMP_B_vect</b>

<b>TCCR1A</b>	COM1A1	COM1A0	COM1B1	COM1B0			WGM11	WGM10
<b>TCCR1B</b>				WGM13	WGM12	CS12	CS11	CS10
<b>TIMSK1</b>						OCIE1B	OCIE1A	TOIE1

CS12..0	PS	WGM13..10	type	TOP	OVF
000	stop	0000	normal	0xFFFF	MAX
001	1	0001	PWM PC	0x00FF	BOTTOM
010	8	0010	PWM PC	0x01FF	BOTTOM
011	64	0011	PWM PC	0x03FF	BOTTOM
100	256	0100	CTC	OCR1A	MAX
101	1024	0101	FPWM	0x00FF	TOP
		0110	FPWM	0x01FF	TOP
		0111	FPWM	0x03FF	TOP
		1000	PWM PFC	ICR1	BOTTOM
		1001	PWM PFC	OCR1A	BOTTOM
		1010	PWM PC	ICR1	BOTTOM
		1011	PWM PC	OCR1A	BOTTOM
		1100	CTC	ICR1	MAX
		1101	-	-	-
		1110	FPWM	ICR1	TOP
		1111	FPWM	OCR1A	TOP

COM1A1..0	Normal mode	FastPWM	PWM/PC
00	-	-	-
01	Toggle OC1x	Mod 14/15 – toggle OC1A	Mod 9/11 – toggle OC1A
10	Clear on comp	Clear on comp Set on bottom	Clear when ↑ Set when ↓
11	Set on comp	Set on comp Clear on bottom	Clear when ↓ Set when ↑

<b>TCCR0A</b>	COM0A1	COM0A0	COM0B1	COM0B0			WGM01	WGM00
<b>TCCR0B</b>					WGM02	CS02	CS01	CS00
<b>TIMSK0</b>						OCIE0B	OCIE0A	TOIE0

### CS02..0 la fel ca CS12..0

COM0A1..0	Normal mode	FastPWM	PWM/PC	WGM02..0	type	TOP	OVF
000	-	-	-	000	normal	0xFF	MAX
001	-	-	-	001	PWM PC	0xFF	BOTTOM
010	Toggle OC0x	Mod 7 – toggle OC0A	Mod 5 – toggle OC0A	010	CTC	OCR0A	MAX
011	Toggle OC0x	Mod 7 – toggle OC0A	Mod 5 – toggle OC0A	011	FPWM	0xFF	MAX
100	Clear on comp	Clear on comp Set on bottom	Clear when ↑ Set when ↓	100	-	-	-
101	Set on comp	Set on comp Clear on bottom	Clear when ↓ Set when ↑	101	PWM/PC	OCR0A	BOTTOM
110	Clear on comp	Clear on comp Set on bottom	Clear when ↑ Set when ↓	110	-	-	-
111	Set on comp	Set on comp Clear on bottom	Clear when ↓ Set when ↑	111	FPWM	OCR0A	TOP

<b>TCCR2A</b>	COM2A1	COM2A0	COM2B1	COM2B0			WGM21	WGM20
<b>TCCR2B</b>					WGM22	CS22	CS21	CS20
<b>TIMSK2</b>						OCIE2B	OCIE2A	TOIE2

### CS22..0 la fel ca CS12..0

CS22..0	PS	WGM22..0	type	TOP	OVF
000	stop	000	normal	0xFFFF	MAX
001	1	0001	PWM PC	0x00FF	BOTTOM
010	8	0010	PWM PC	0x01FF	BOTTOM
011	32	0011	PWM PC	0x03FF	BOTTOM
100	64	0100	CTC	OCR1A	MAX
101	128	0101	FPWM	0x00FF	TOP
110	256	0110	FPWM	0x01FF	TOP
111	1024	0111	FPWM	0x03FF	TOP

WGM22..0 la fel ca WGM02..0  
 COM2A1..0 la fel ca COM0A1..0  
 COM2B1..0 la fel ca COM0B1..0

PWM – pulse width modulation  
 FPWM – Fast PWM  
 PWM/PC – PWM phase correct  
 PWM/PFC – PWM phase and frequency correct  
 TOP – până la cât numără un timer  
 MAX – maximul până la cât poate număra un timer

Câmp	Descriere
COM	Controlează outputul pe canalul PWM
WGM	Modul de lucru al timerului
CS	Prescalerul timerului
OCIEA	Întrerupere de match pe OCRxA
OCIEB	Întrerupere de match pe OCRxB
TOIE	Întrerupere de overflow
TCNTx	Registru contor (16 biți pentru timer 1)
OCRxA	Registru prag (16 biți pentru timer 1)
OCRxB	
ICRx	

<b>TCCR1A</b>	COM1A1	COM1A0	COM1B1	COM1B0			WGM11	WGM10
<b>TCCR1B</b>				WGM13	WGM12	CS12	CS11	CS10
<b>TIMSK1</b>						OCIE1B	OCIE1A	TOIE1

CS12..0	PS	WGM13..10	type	TOP	OVF
000	stop	0000	normal	0xFFFF	MAX
001	1	0001	PWM PC	0x00FF	BOTTOM
010	8	0010	PWM PC	0x01FF	BOTTOM
011	64	0011	PWM PC	0x03FF	BOTTOM
100	256	0100	CTC	OCR1A	MAX
101	1024	0101	FPWM	0x00FF	TOP
		0110	FPWM	0x01FF	TOP
		0111	FPWM	0x03FF	TOP
		1000	PWM PFC	ICR1	BOTTOM
		1001	PWM PFC	OCR1A	BOTTOM
		1010	PWM PC	ICR1	BOTTOM
		1011	PWM PC	OCR1A	BOTTOM
		1100	CTC	ICR1	MAX
		1101	-	-	-
		1110	FPWM	ICR1	TOP
		1111	FPWM	OCR1A	TOP

<b>TCCR0A</b>	COM0A1	COM0A0	COM0B1	COM0B0			WGM01	WGM00
<b>TCCR0B</b>					WGM02	CS02	CS01	CS00
<b>TIMSK0</b>						OCIE0B	OCIE0A	TOIE0

COM0A1..0	Normal mode	FastPWM	PWM/PC	WGM02..0	type	TOP	OVF
000	-	-	-	000	normal	0xFF	MAX
001	-	-	-	001	PWM PC	0xFF	BOTTOM
010	Toggle OC0x	Mod 7 – toggle OC0A	Mod 5 – toggle OC0A	010	CTC	OCR0A	MAX
011	Toggle OC0x	Mod 7 – toggle OC0A	Mod 5 – toggle OC0A	011	FPWM	0xFF	MAX
100	Clear on comp	Clear on comp Set on bottom	Clear when ↑ Set when ↓	100	-	-	-
101	Set on comp	Set on comp Clear on bottom	Clear when ↓ Set when ↑	101	PWM/PC	OCR0A	BOTTOM
110	Clear on comp	Clear on comp Set on bottom	Clear when ↑ Set when ↓	110	-	-	-
111	Set on comp	Set on comp Clear on bottom	Clear when ↓ Set when ↑	111	FPWM	OCR0A	TOP

<b>TCCR2A</b>	COM2A1	COM2A0	COM2B1	COM2B0			WGM21	WGM20
<b>TCCR2B</b>					WGM22	CS22	CS21	CS20
<b>TIMSK2</b>						OCIE2B	OCIE2A	TOIE2

CS22..0	PS	WGM22..0	type	TOP	OVF
000	stop	000	normal	0xFFFF	MAX
001	1	0001	PWM PC	0x00FF	BOTTOM
010	8	0010	PWM PC	0x01FF	BOTTOM
011	32	0011	PWM PC	0x03FF	BOTTOM
100	64	0100	CTC	OCR1A	MAX
101	128	0101	FPWM	0x00FF	TOP
110	256	0110	FPWM	0x01FF	TOP
111	1024	0111	FPWM	0x03FF	TOP

## Comune Timere

## Timer 1

## Timer 0

## Timer 2

ADMUX	REFS1	REFS0	ADLAR			MUX2	MUX1	MUX0	
<b>ADCSRA</b>	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	
<b>ADCSRB</b>						ADTS2	ADTS1	ADTS0	
<b>ADC</b>	Registru pe 16 biți (10 biți aliniați după ADLAR, default dreapta)						<b>ADTS</b>	<b>PS</b>	
<b>Câmp</b>	<b>Descriere</b>						<b>Întreruperi</b>		
						<b>ADPS</b>	<b>PS</b>		
REFS	Referință tensiune						000	2	
ADLAR	Rezultat ajustat stânga						001	2	
MUX	Indexul canalului						010	4	
ADEN	Enable ADC						011	8	
ADSC	Start conversie						100	16	
ADATE	Enable auto-triggering						101	32	
ADIF	1 în timpul conversiei						110	64	
ADIE	Întrerupere ADC complete						111	128	
ADPS	Prescaler pentru conversie								
ADTS	Selectie eveniment auto-trigger								

UCSROA	RXC0		UDRE0				U2X0	
<b>UCSROB</b>	RXCIE0		UDRIE0	RXEN0	TXEN0	UCSZ02		
<b>UCSROC</b>			UPM01	UPM00	USBS0	UCSZ01	UCSZ00	
<b>UDR0</b>	Registru de transmisie/recepție, citirea se face din alt buffer față de scriere						<b>UCSZ02..0</b>	<b>size</b>
<b>UBRR0</b>	Registru pe 16 biți pentru configurarea baud rate						000	5-bit
						001	6-bit	
						010	7-bit	
						011	8-bit	
						<b>UPM01..0</b>	<b>parity</b>	
						00	disabled	
						01	-	
						10	even	
						11	odd	

Câmp	Descriere	Întreruperi USART
RXC0	1 când a fost primit un caracter	<b>USART0_RX_vect</b>
UDRE0	1 când bufferul de TX e gol	<b>USART0_TX_vect</b>
U2X0	Dublare baud rate	
RXCIE0	Întrerupere receive	
UDRIE0	Întrerupere buffer TX gol	
RXEN0	Enable recepție	
TXEN0	Enable transmisie	
UCSZ	Dimensiune Pachete	
UPM	Selectie paritate	
USBS	Selectie biți de stop	

$$U2X0==0 \quad BAUD = \frac{f_{cpu}}{16 \cdot (1 + UBRR)}$$

$$U2X0==1 \quad BAUD = \frac{f_{cpu}}{8 \cdot (1 + UBRR)}$$

SPCR	SPIE	SPE	DORD	MSTRL			SPR1	SPR0
<b>SPSR</b>	SPIF							SPI2X
<b>SPDR</b>	Registru buffer							
							<b>SPR1..0</b>	<b>prescaler</b>
							00	4
							01	16
							10	64
							11	128

## SPI

## PCINT

## GPIO