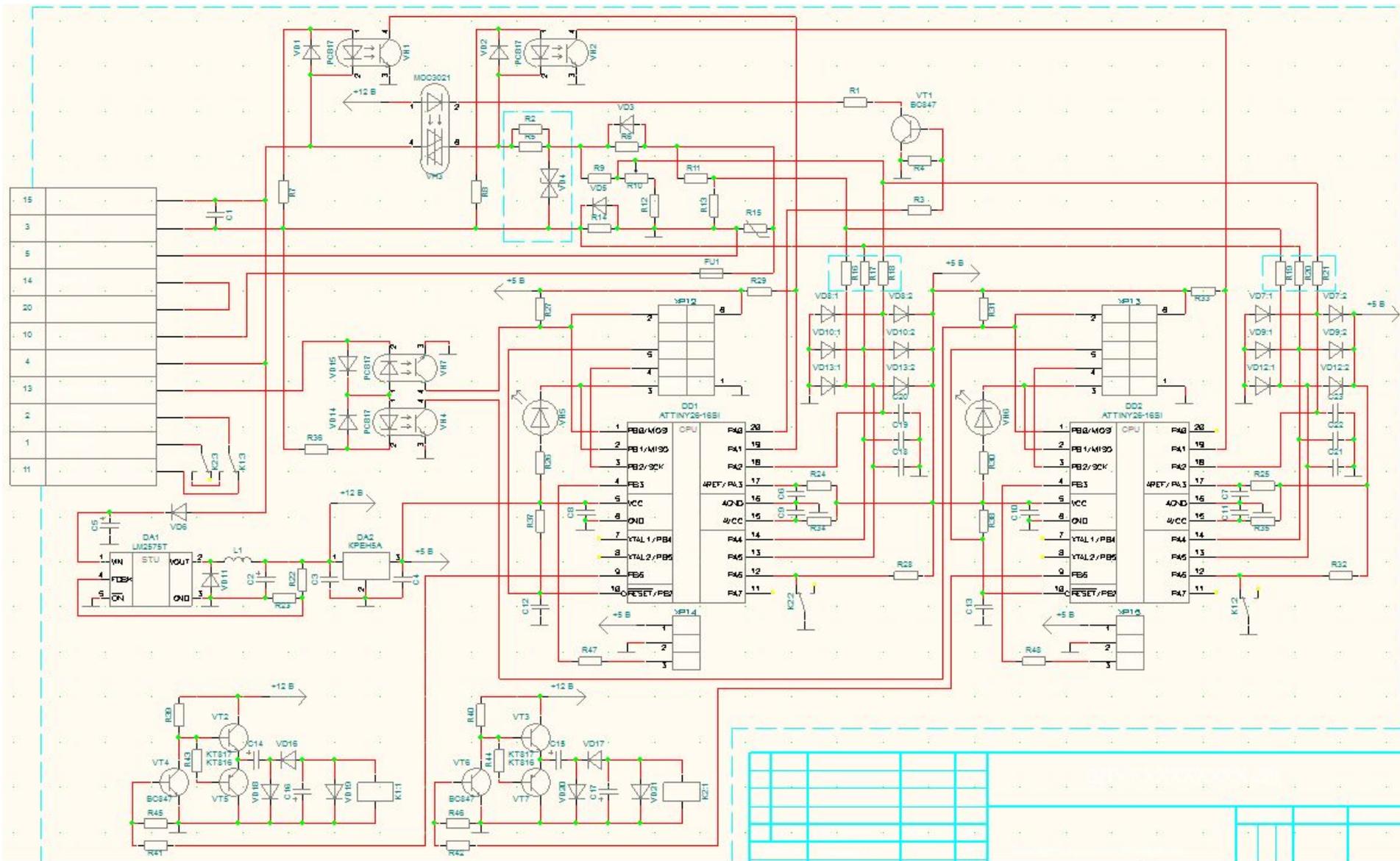


# **Микропроцессорные устройства**

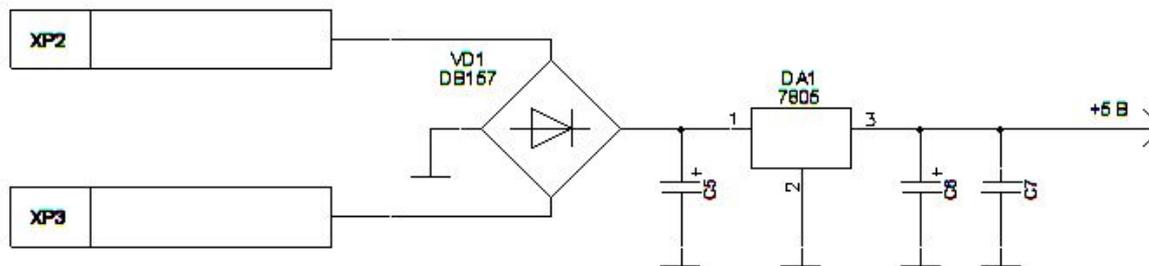
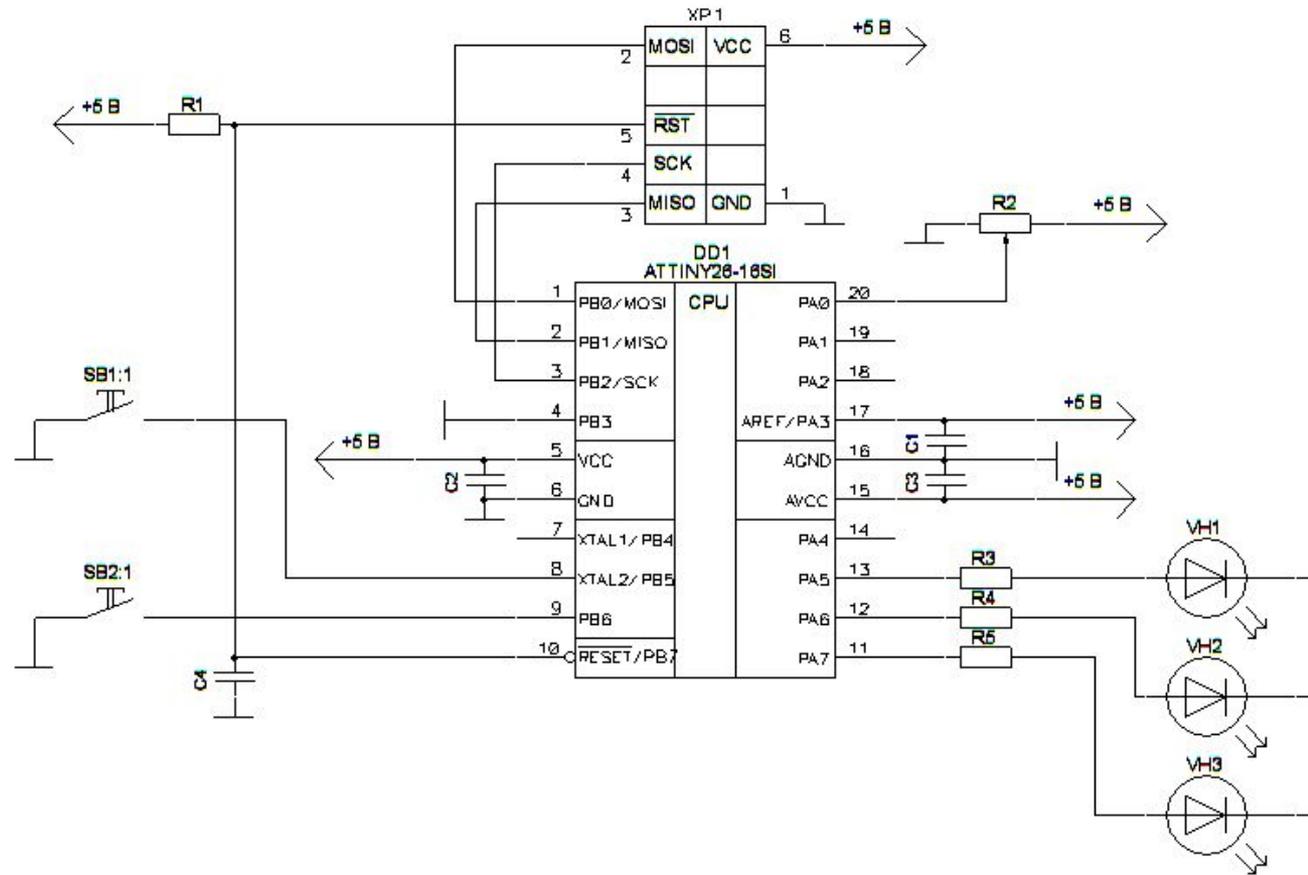
Лекция 4

**Микроконтроллеры серии AVR**

# Микроконтроллеры AVR (Схема устройства)



# Микроконтроллеры AVR (лабораторный стенд)



# Микроконтроллеры AVR (порты ввода/вывода)

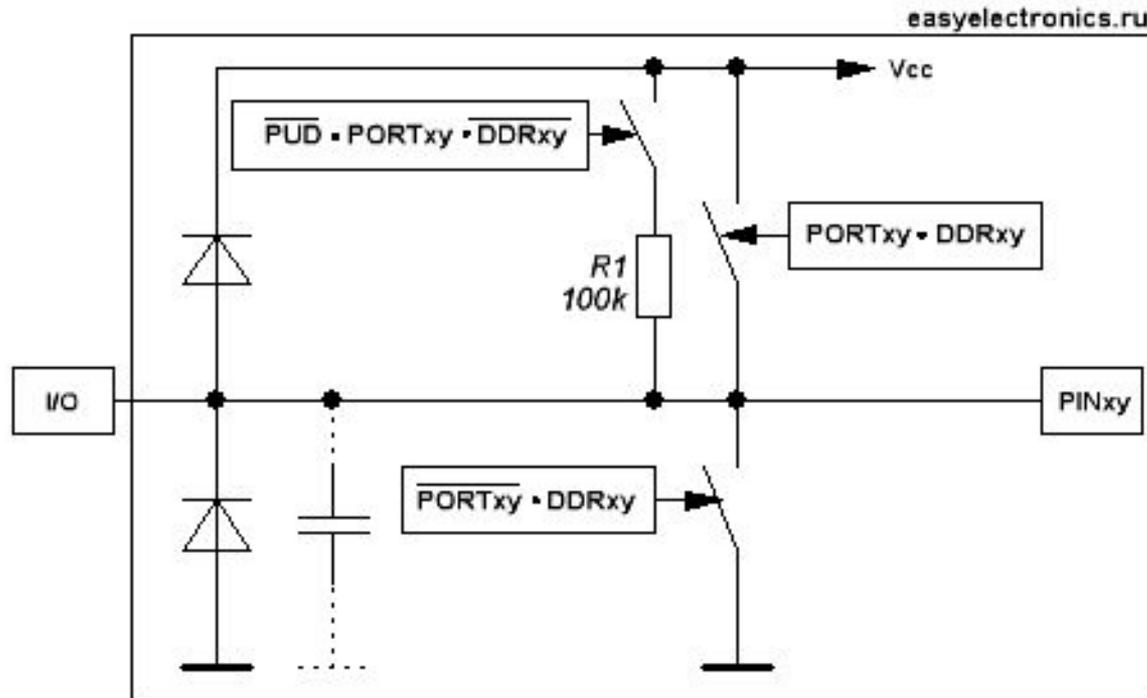


Схема одного вывода порта МК AVR без учета доп функций



# Микроконтроллеры AVR (порты ввода/вывода)

```
.include "tn26def.inc"

.org    $0000
rjmp   RESET    ; Reset handler
reti   ; IRQ0 handler
reti   ; Pin change handler
reti   ; Timer1 compare match 1A
reti   ; Timer1 compare match 1B
reti   ; Timer1 overflow handler
reti   ; Timer0 overflow handler
reti   ; USI Start handler
reti   ; USI Overflow handler
reti   ; EEPROM Ready handler
reti   ; Analog Comparator handler
reti   ; ADC Conversion Handler

RESET:
ldi    r16,0b00000000    ; Настроили Порт А
out    DDRA,r16         ;
ldi    r16,0b01001000    ;  -//-      Порт В
out    DDRB,r16         ;

ldi    r16,0b00001001    ; Установили начальное значение выходов портов
out    porta,r16        ;
ldi    r16,0b00100000    ;
out    portb,r16        ;

L1:
;
sbi    portb,6           ;
nop
cbi    portb,6           ;

in     r17,pina          ; проверка бита 0 порта А
andi  r17,0b00000001    ;
cpi   r17,1             ;
breq  S1                ;
rjmp  L1                ;

S1:
sbi    portb,7           ;
nop
;

rjmp  L1                ;
```

# Микроконтроллер ATtiny26 (Векторы прерываний)

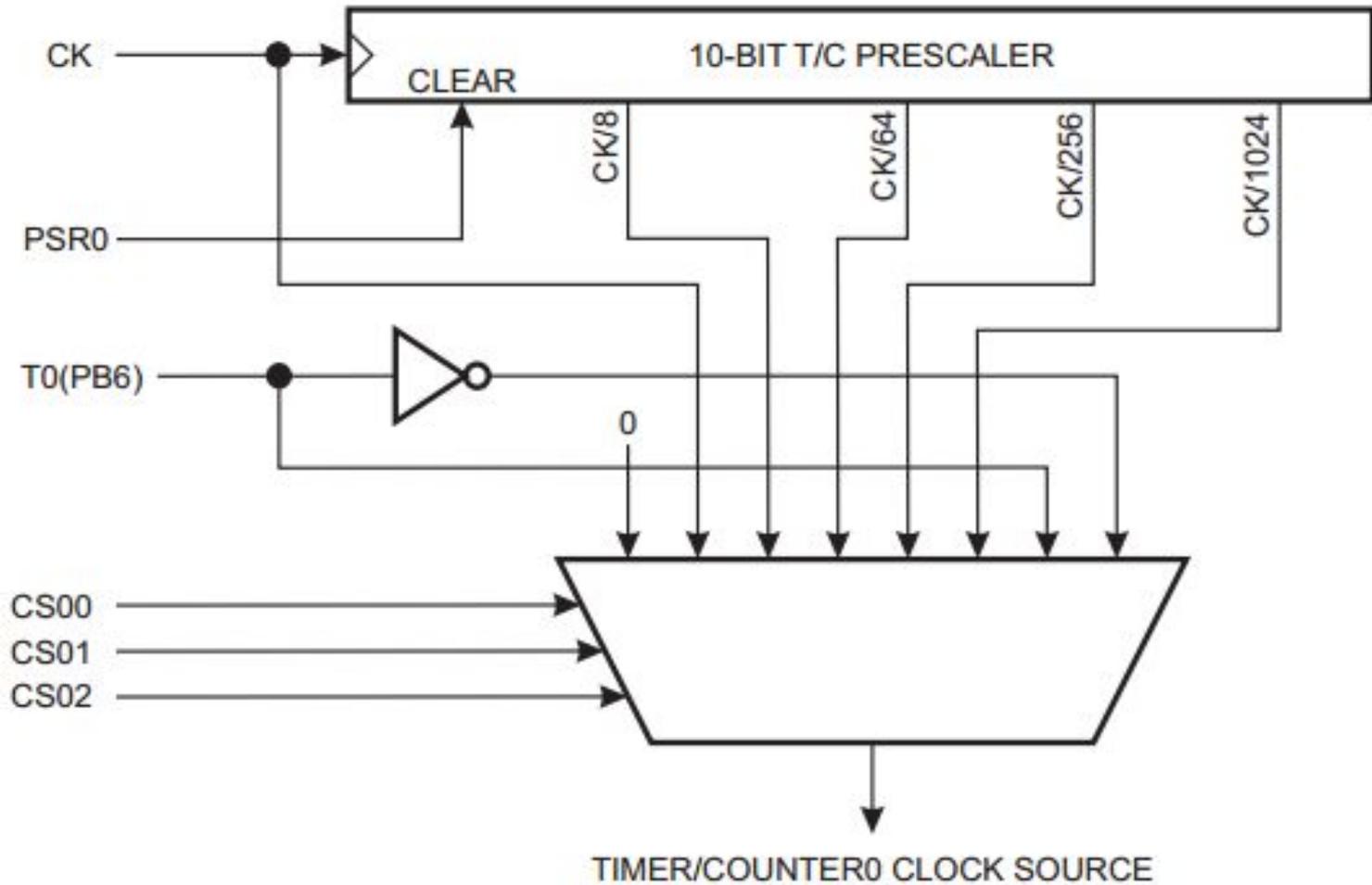
| Vector No | Program Address | Source       | Interrupt Definition            |
|-----------|-----------------|--------------|---------------------------------|
| 1         | \$000           | RESET        | Hardware Pin and Watchdog Reset |
| 2         | \$001           | INT0         | External Interrupt Request 0    |
| 3         | \$002           | I/O Pins     | Pin Change Interrupt            |
| 4         | \$003           | TIMER1, CMPA | Timer/Counter1 Compare Match 1A |
| 5         | \$004           | TIMER1, CMPB | Timer/Counter1 Compare Match 1B |
| 6         | \$005           | TIMER1, OVF1 | Timer/Counter1 Overflow         |
| 7         | \$006           | TIMER0, OVF0 | Timer/Counter0 Overflow         |
| 8         | \$007           | USI_STRT     | USI Start                       |
| 9         | \$008           | USI_OVF      | USI Overflow                    |
| A         | \$009           | EE_RDY       | EEPROM Ready                    |
| B         | \$00A           | ANA_COMP     | Analog Comparator               |
| C         | \$00B           | ADC          | ADC Conversion Complete         |

# Микроконтроллер ATtiny26 (Векторы прерываний)

```
$000      rjmp      RESET          ; Reset handler
$001      rjmp      EXT_INT0      ; IRQ0 handler
$002      rjmp      PIN_CHANGE    ; Pin change handler
$003      rjmp      TIM1_CMP1A    ; Timer1 compare match 1A
$004      rjmp      TIM1_CMP1B    ; Timer1 compare match 1B
$005      rjmp      TIM1_OVF      ; Timer1 overflow handler
$006      rjmp      TIM0_OVF      ; Timer0 overflow handler
$007      rjmp      USI_STRT      ; USI Start handler
$008      rjmp      USI_OVF       ; USI Overflow handler
$009      rjmp      EE_RDY        ; EEPROM Ready handler
$00A      rjmp      ANA_COMP      ; Analog Comparator handler
$00B      rjmp      ADC           ; ADC Conversion Handler
```



# Микроконтроллер ATtiny26 (Таймер 0)



# Микроконтроллер ATtiny26 (Таймер 0)

|               |   |   |   |   |      |      |      |      |       |
|---------------|---|---|---|---|------|------|------|------|-------|
| Bit           | 7 | 6 | 5 | 4 | 3    | 2    | 1    | 0    |       |
| \$33 (\$53)   | - | - | - | - | PSR0 | CS02 | CS01 | CS00 | TCCR0 |
| Read/Write    | R | R | R | R | R/W  | R/W  | R/W  | R/W  |       |
| Initial Value | 0 | 0 | 0 | 0 | 0    | 0    | 0    | 0    |       |

| CS02 | CS01 | CS00 | Description                         |
|------|------|------|-------------------------------------|
| 0    | 0    | 0    | Stop, the Timer/Counter0 is stopped |
| 0    | 0    | 1    | CK                                  |
| 0    | 1    | 0    | CK/8                                |
| 0    | 1    | 1    | CK/64                               |
| 1    | 0    | 0    | CK/256                              |
| 1    | 0    | 1    | CK/1024                             |
| 1    | 1    | 0    | External Pin T0, falling edge       |
| 1    | 1    | 1    | External Pin T0, rising edge        |

# Микроконтроллер ATtiny26 (Таймер 0)

```
.include "tn26def.inc"

.org    $0000
rjmp   RESET    ; Reset handler
reti   ; IRQ0 handler
reti   ; Pin change handler
reti   ; Timer1 compare match 1A
reti   ; Timer1 compare match 1B
reti   ; Timer1 overflow handler
rjmp   TIMO     ; Timer0 overflow handler
reti   ; USI Start handler
reti   ; USI Overflow handler
reti   ; EEPROM Ready handler
reti   ; Analog Comparator handler
reti   ; ADC Conversion Handler

RESET:
ldi    r16,RAMEND      ; устанавливаем стек
out    SP, r16        ;

ldi    r16,(256-25)    ; (8000000/64/50)=2500Гц 400мкс
out    TCNT0,r16      ; период = 400мкс
ldi    r16,0b00000011 ; Таймер 0 в режиме CK/64
out    TCCR0,r16      ;

ldi    r16,0b00000010 ;
out    TIMSK,r16      ;
sei    ; Разрешили прерывания

L1:    nop            ;
rjmp   L1            ;

TIMO:  ; Прерывание по переполнению таймера
ldi    r16,(256-25)    ; (8000000/64/50)=2500Гц 400мкс
out    TCNT0,r16      ; период = 400мкс

reti
```