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7.4 Optocouplers

Optocouplers were discovered right after photo-transistors (like any other transistor, except it is stimulated by light), by combining a LED and photo-transistor in the same case. The purpose of an optocoupler is to separate two parts of a circuit.

This is done for a number of reasons:

- Interference**.** Typical examples are industrial units with lots of interferences which affect signals in the wires. If these interferences affected the function of control section, errors would occur and the unit would stop working.
- Simultaneous separation and intensification of a signal**.** Typical examples are relays which require higher current than microcontroller pin can provide. Usually, optocoupler is used for separating microcontroller supply and relay supply.
- In case of a breakdown, optocoupled part of device stays safe in its casing, reducing the repair costs.

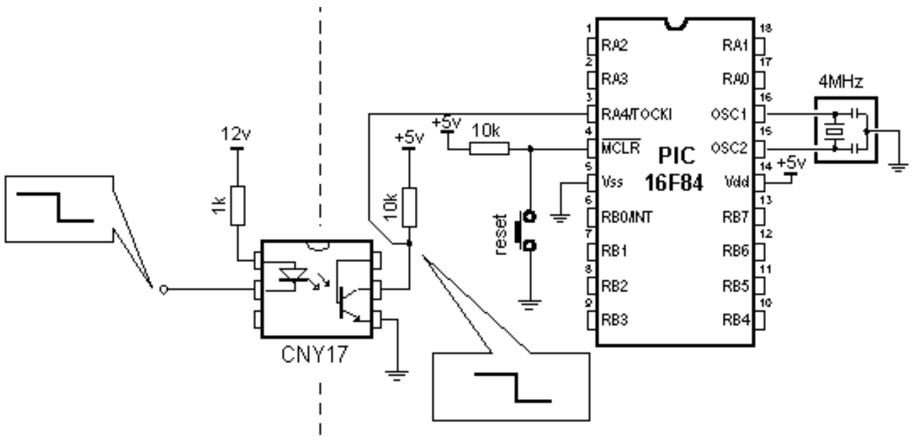
Optocouplers can be used as either input or output devices. They can have additional functions such as intensification of a signal or Schmitt triggering (the output of a Schmitt trigger is either 0 or 1 - it changes slow rising and falling waveforms into definite low or high values). Optocouplers come as a single unit or in groups of two or more in one casing.

Each optocoupler needs two supplies in order to function. They can be used with one supply, but the voltage isolation feature, which is their primary purpose, is lost.

7.4.1 Optocoupler on an input line

The way it works is simple: when a signal arrives, the LED within the optocoupler is turned on, and it illuminates the base of a photo-transistor within the same case. When the transistor is activated, the voltage between collector and emitter falls to 0.7V or less and the microcontroller sees this as a logic zero on its RA4 pin.

The example below is a simplified model of a counter, element commonly utilized in industry (it is used for counting products on a production line, determining motor speed, counting the number of revolutions of an axis, etc). We will have sensor set off the LED every time axis makes a full revolution. LED in turn will 'send' a signal by means of photo-transistor to a microcontroller input RA4 (TOCKI). As prescaler is set to 1:2 in this example, every second signal will increment TMR0. Current status of the counter is displayed on PORTB LEDs.



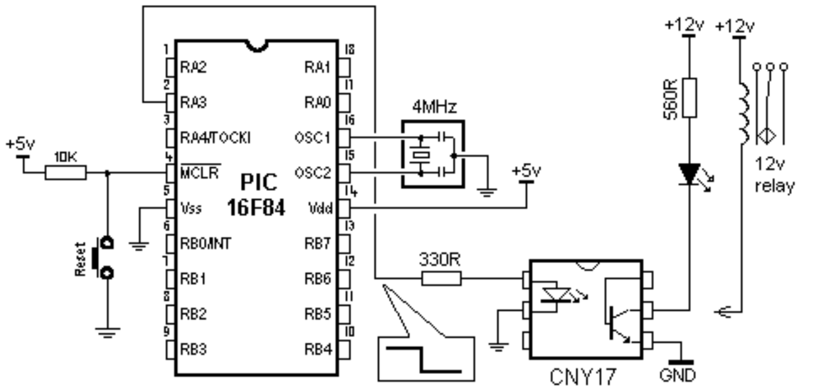
Example of optocoupler on an input line

Makro : OPTOIN.ASM

```
;***** Declaring and configuring a microcontroller *****

       PROCESSOR 16f84
       #include "p16f84.inc"

       __CONFIG _CP_OFF & _WDT_OFF & _PWRTE_ON & _XT_OSC

;***** Structure of program memory *****

       ORG    0x00            ;Reset vector
       goto   Main

       ORG    0x04            ;Interrupt vector
       goto   Main            ;no interrupt routine


Main                          ;Main program
       banksel TRISA
       movlw  0xef            ;Initialization of port A
       movwf  TRISA           ;TRISA <- 0xff
       movlw  0x00            ;Initialization of port B
       movwf  TRISB           ;TRISB <- 0x00
       movlw  b'00110000'     ;RA4 -> TMR0, PS=1:2
       banksel OPTION
       movwf  OPTION_REG      ;Increment TMR0 upon falling edge
       banksel PORTB

       clrf   PORTB           ;PORTB <- 0
       clrf   TMR0            ;TMR0 <- 0

Loop   movf   TMR0,w          ;Send value of the counter
       movwf  PORTB           ;to PORTB
       goto   Loop            ;Remain at this line

       End                    ;End of program
```

7.4.2 Optocoupler on an output line

An Optocoupler can be also used to separate the output signals. If optocoupler LED is connected to microcontroller pin, logical zero on pin will activate optocoupler LED, thus activating the transistor. This will consequently switch on LED in the part of device working on 12V. Layout of this connection is shown below.



Example of optocoupler on output line

The program for this example is simple. By delivering a logical one to the third pin of port A, the transistor will be activated in the optocoupler, switching on the LED in the part of device working on 12V.