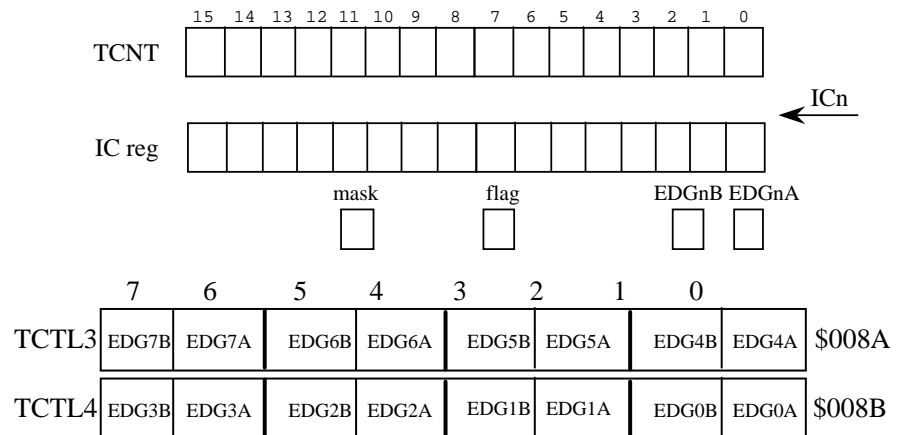


Lecture 19 objectives

- Input capture (edge trigger interrupt)
- Keyboard scanning
- Period Measurement

Input capture**When does it occur?****What happens?**

EDGnB	EDGnA	active edge
0	0	none
0	1	capture on rising
1	0	capture on falling
1	1	capture on both rising and falling

Table 6.6. Two control bits define the active edge used for input capture.

Things to do in an Input capture ritual**Initialize data structures****TSCR1 Turn on TCNT****TSCR2 set TCNT rate****DDRT clear bits to specify input****TIOS clear bits for input capture****TIE set bits to arm input capture****TCTL3 TCTL4 specify edge****TFLG1 make bits become low****Enable interrupts (cli)****Things to do in an Input capture ISR****Read TCn register to know exactly when the edge occurred****Acknowledge interrupt (make flag bit become low)****Do stuff**

Design a system to count switch pushes

Switch to PT7 (falling edge when touch)

```
unsigned short Count; // number of presses
```

```
void Switch_Init(void){
    asm sei // make atomic
    Count = 0;
    TIOS &= ~0x80; // PT7 input capture
    DDRT &= ~0x80; // PT7 is input
    TSCR1 = 0x80; // enable TCNT
    TSCR2 = 0x02; // divide by 4 clock
    TCTL3 = (TCTL3&0x3F)|0x80; // falling PT7
    TFLG1 = 0x80; // Clear C7F
    TIE |= 0x80; // Arm IC7
    asm cli
}
interrupt 15 void TC7handler(void){
    TFLG1 = 0x80; // ack by clearing C1F
    Count++;
}
```

```
void main(void) {
    Switch_Init(); // start IC thread
    for(;;) {
    }
}
```

Open IC_DP512 example in Metrowerks

Show three ISRs

Open **IC.uc** **IC.io** files in TExaS

Show hardware

Basic idea about scanning

Drive one row low, making other rows hiZ

Read columns, any 0's mean a key touched in that row,column

Repeat for all rows

Idle condition,

all rows output,

all rows 0

Input capture interrupt on falling edge of columns

When does IC2 interrupt happen?

When does IC3 interrupt happen?

Show what the IC2 ISR does

Disarm ICs, arm OC4

When does OC4 interrupt happen?

Show what the OC4 ISR does

Scan keyboard, save in global

Disarm OC4, arm IC2 IC3

Mention this is a very bad way to scan (prone for bugs)

Encourage students to read scan example in the book

Run in TExaS

Action->OpenS19 and import Metrowerks object code

Put a breakpoint at \$C112 (OC4 ISR saves key in global)

```
C112 ↔ 7a0000 [ 3 ] STAA LastKey
```

Run, and type a key

Show bounce

How long from key touch to **LastKey=myKey;** ??

16 bit Period Measurement with a 1us resolution

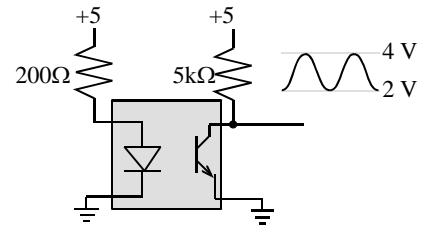
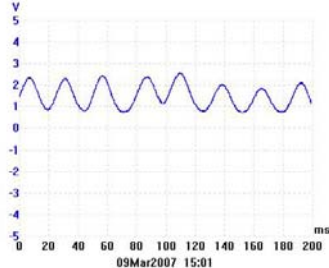


Figure 9.7. Tachometer data collected with a 15-slot disk powered at +9V. IR sensor interface on left

Design the analog interface between sensor and PT1

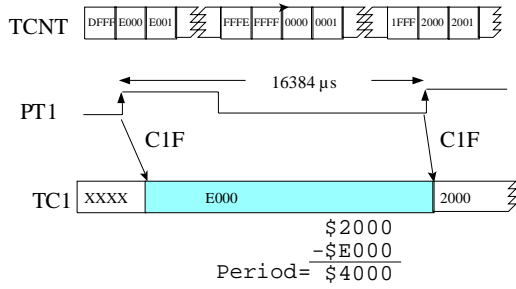


Figure 6.8. Timing example showing counter rollover during 16 bit period measurement.

```
// PT1/IC1 input = external signal
// rising edge to rising edge
// resolution = 1us
// Range = 36 μs to 65 ms,
// no overflow checking
// IC1 interrupt each period,
void Period_Init(void){
    asm sei // make atomic
    TIOS &= ~0x02; // PT1 input capture
    DDRT &= ~0x02; // PT1 is input
    TSCR1 = 0x80; // enable TCNT
    TSCR2 = 0x02; // 1us clock
    TCTL4 = (TCTL4&0xF3)|0x04; // rising
    TFLG1 = 0x02; // Clear C1F
    TIE |= 0x02; // Arm IC1
    asm cli
}
unsigned short Period; // units of 1us
interrupt 9 void TC1handler(void){
    unsigned short static First;
    Period = TC1-First;
    First = TC1; // Setup for next
    TFLG1 = 0x02; // ack by clearing C1F
}
```

Program 6.6. C language period measurement.

Design a capacitance meter

Conversions

- digital to analog,
- analog to digital
- capacitance to time

