SPRING 2017 PROJECT1_ DAC

MICROCONTROLLER III

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CECS 447 Monday, Wednesday 10:00am – 12:15 pm

Due Date: February 26, 2018

Instructor: John Vu

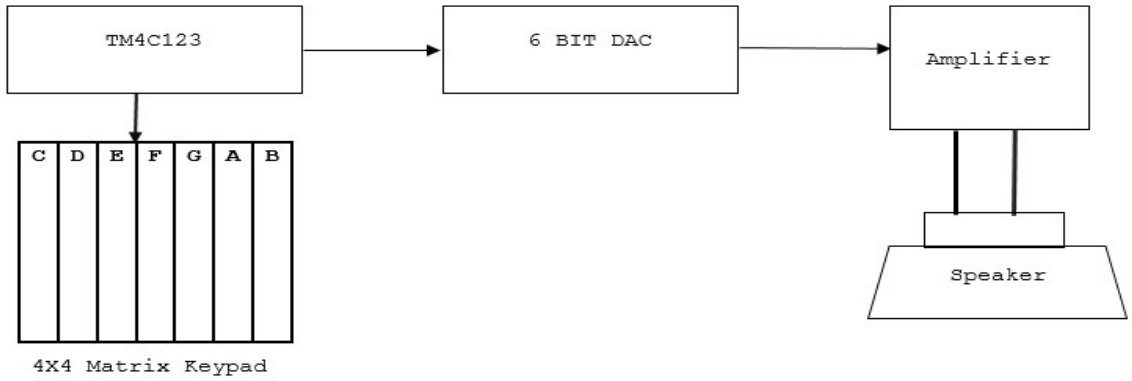
FEBRUARY 26, 2018

California State University Long Beach

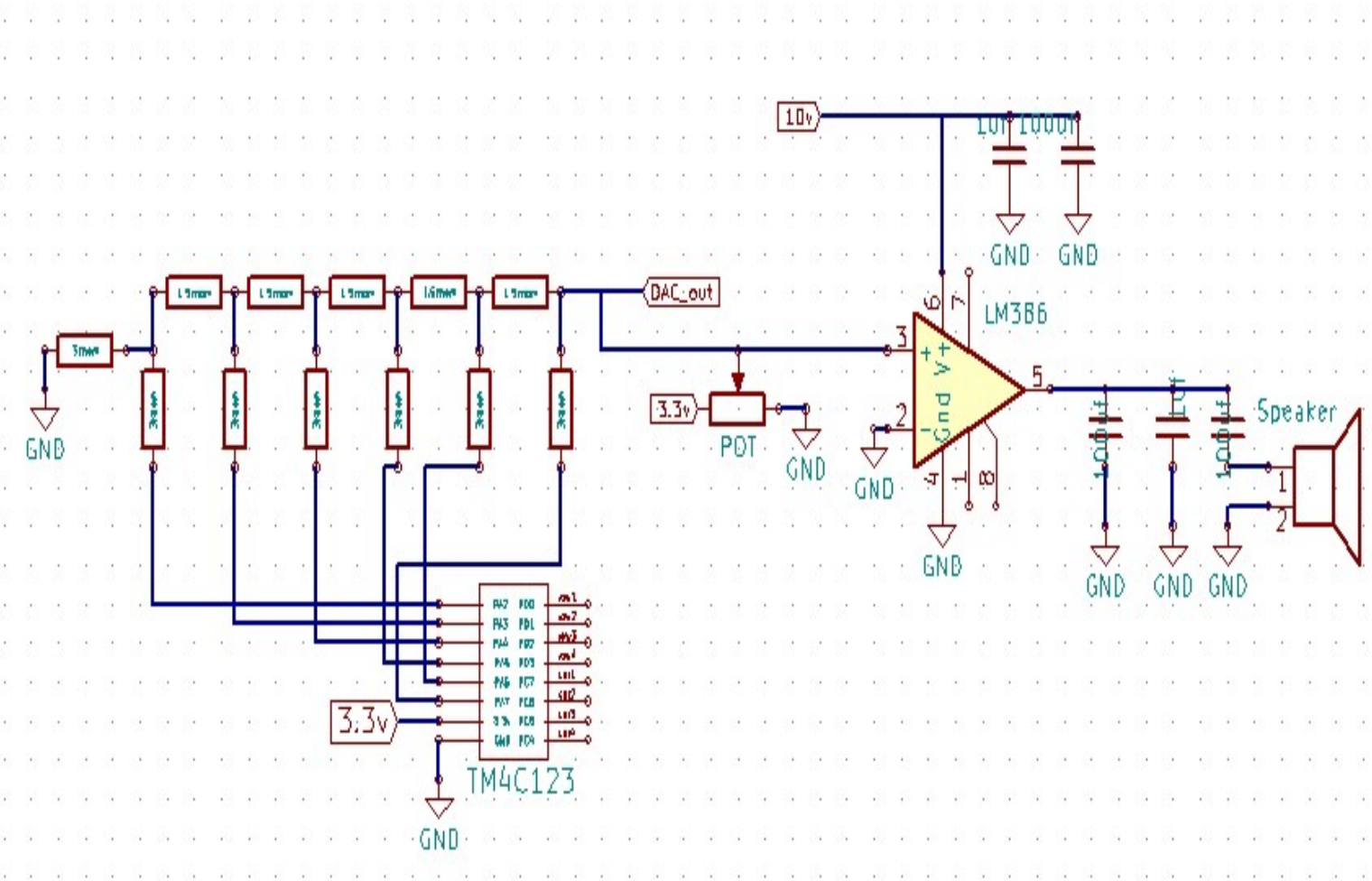
Hardware:

Hardware:

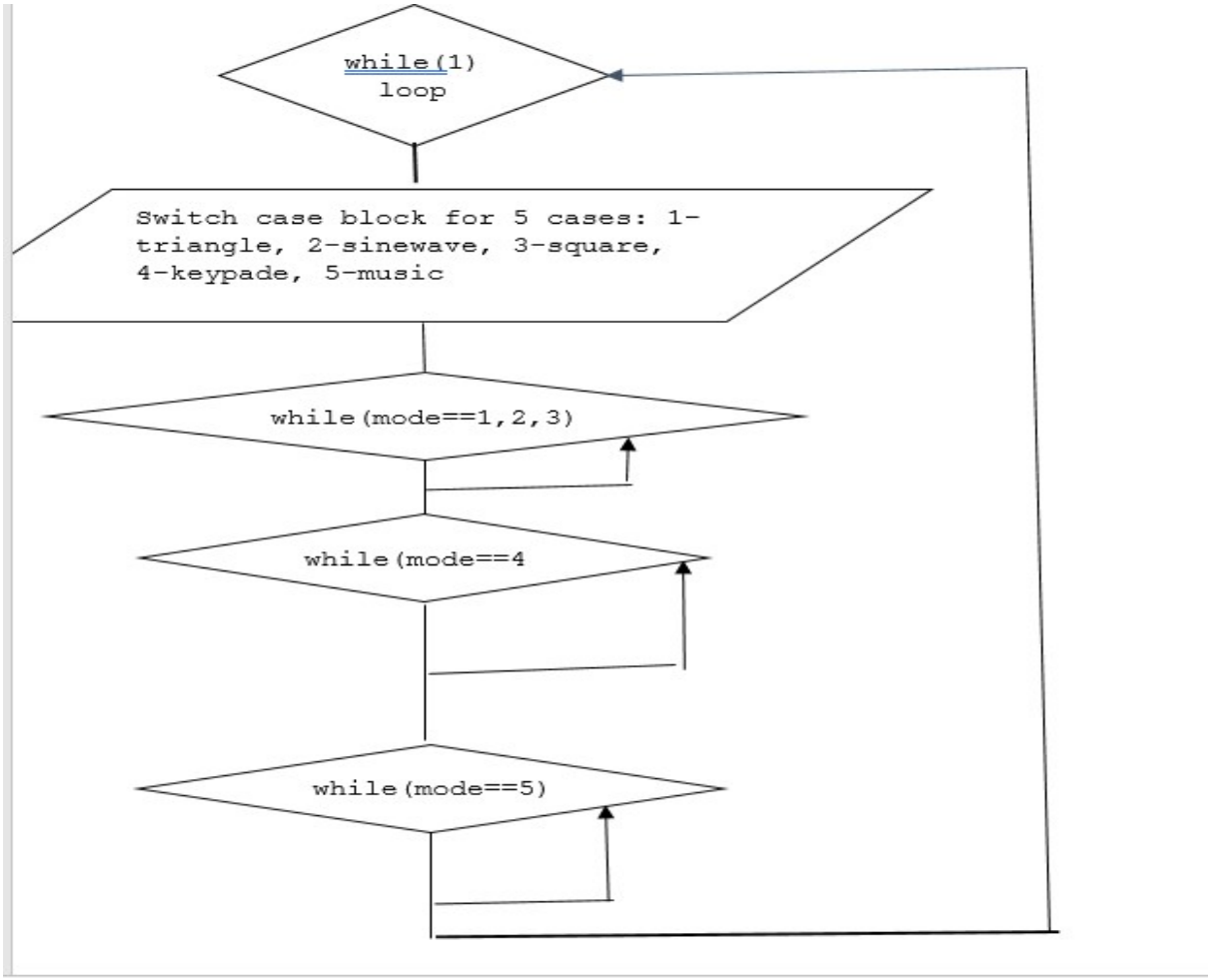
- **Hardware Block Diagrams**



- **Schematics**



❖ **Software Diagram**



Systick interrupt Handling of Sound Generation:

```
65  // Interrupt service routine
66  // Executed every 12.5ns*(period)
67  void SysTick_Handler(void){
68  //  GPIO_PORTF_DATA_R ^= 0x08;      // toggle PF3, debugging green
69  ////*******************Sinewave
70    if (mode == 2) {
71      if (Index == 100)
72        Index = 0;
73      else
74        Index = Index+1;
75      DAC_Out(SineWave[Index]);
76    }
77
78  //*****************Triangle wave
79     else if(mode == 1){
80      if ((up < 63) && (triangle < 63)) {
81        up = up + 1;
82        triangle = triangle + 1;
83      }
84      else if ((up == 63) && (triangle > 0)){
85        triangle = triangle -1;
86      }
87      else if ((up == 63) && (triangle == 0)) {
88        up = 0;
89      }
90      DAC_Out(triangle);
91    }
```

```
92  ////*****************Square wave
93    else if(mode == 3){
94      if ((count > 0)&&(count < 64)){
95        count = count + 1;
96        square = 63;
97        if (count == 64)
98          count = 65;
99      }
100     else if ((count > 64) && (count < 130)){
101       square = 0;
102       count = count + 1;
103       if (count == 130) {
104         count = 0;
105         high = 63;
106       }
107     }
108     else if ((high == 63) && (square == 0)&&(count == 0)){
109       square = high;
110       high = 0;
111       count = 1;
112     }
113     DAC_Out(square);
114   }
115   else if((mode == 4)||(mode == 5)){
116     if (Index == 100)
117       Index = 0;
118     else
119       Index = Index+1;
120     DAC_Out(SineWave[Index]);
121   }
122 }
```

Interfacing with 4x4 Matrix Keypad:

```
40 char ReadKey(void) {
41   GPIO_PORTC_DATA_R = ~0x80; //set col_PC7 == 0;
42   if       ((GPIO_PORTD_DATA_R&0x01) == 0)
43     return '1';
44   else if ((GPIO_PORTD_DATA_R&0x02) == 0)
45     return '4';
46   else if ((GPIO_PORTD_DATA_R&0x04) == 0)
47     return '7';
48   else if ((GPIO_PORTD_DATA_R&0x08) == 0)
49     return '*';
50
51   GPIO_PORTC_DATA_R = ~0x40; //set col_PC6 == 0;
52   if       ((GPIO_PORTD_DATA_R&0x01) == 0)
53     return '2';
54   else if ((GPIO_PORTD_DATA_R&0x02) == 0)
55     return '5';
56   else if ((GPIO_PORTD_DATA_R&0x04) == 0)
57     return '8';
58   else if ((GPIO_PORTD_DATA_R&0x08) == 0)
59     return '0';
60
61   GPIO_PORTC_DATA_R = ~0x20; //set col_PC5 == 0;
62   if       ((GPIO_PORTD_DATA_R&0x01) == 0)
63     return '3';
64   else if ((GPIO_PORTD_DATA_R&0x02) == 0)
65     return '6';
66   else if ((GPIO_PORTD_DATA_R&0x04) == 0)
67     return '9';
68   else if ((GPIO_PORTD_DATA_R&0x08) == 0)
69     return '#';
```

```
70
71    GPIO_PORTC_DATA_R = ~0x10; //set col_PC4 == 0;
72    if      ((GPIO_PORTD_DATA_R&0x01) == 0)
73      return 'A';
74    else if ((GPIO_PORTD_DATA_R&0x02) == 0)
75      return 'B';
76    else if ((GPIO_PORTD_DATA_R&0x04) == 0)
77      return 'C';
78    else if ((GPIO_PORTD_DATA_R&0x08) == 0)
79      return 'D';
80    return 0;
81  }
82
83  //---------------------Delay10ms---------------------
84  // wait 10ms for switches to stop bouncing
85  void Delay10ms(void){unsigned long volatile time;
86    time = 14545;  // 10msec
87    while(time){
88      time--;
89    }
90  }
```

Main Program:

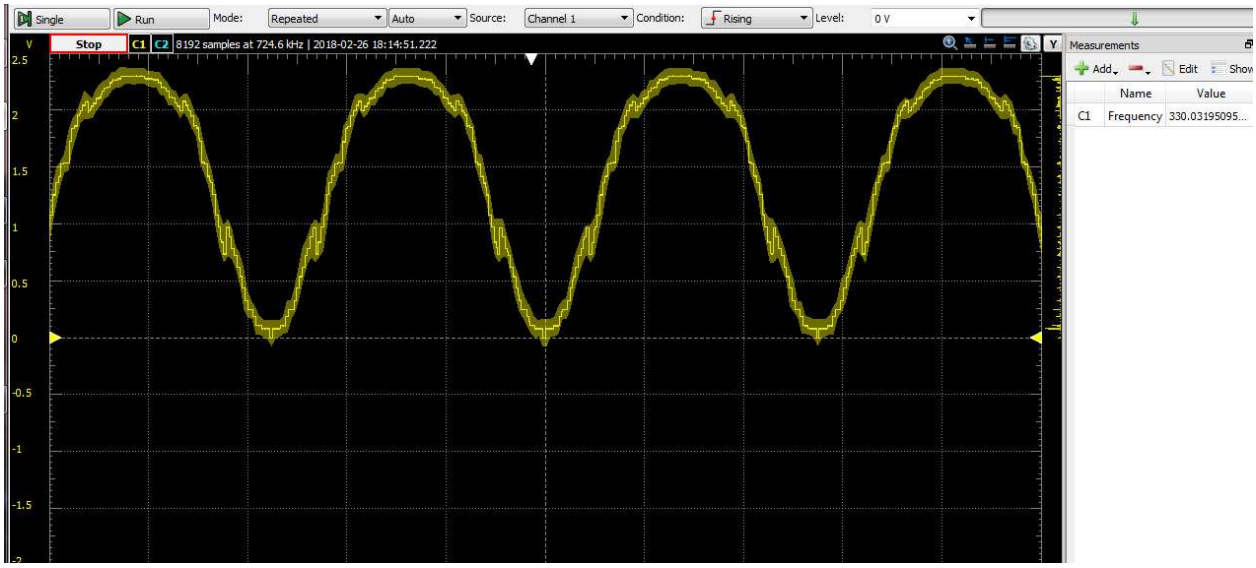
```
52  int main(void){
53    unsigned long input;
54    unsigned long period, delay;
55    DisableInterrupts();
56    PLL_Init();          // bus clock at 80 MHz
57    Switch_Init();       // Port F is onboard switches, LEDs, profiling
58    Keys_Init();
59    EnableInterrupts();
60    intr_mode = 0;
61    delay = 150;
62
63    while(1) {
64      unsigned long modee;
65      modee = intr_mode;
66      Interruupt_Mode(intr_mode);
67      switch(modee) {
68        case 1: {
69          Sound_Init(2385);  // triangel wave, 262 Hz
70        }
71        break;
72        case 2: {
73          Sound_Init(3023);  // sine wave, 262 Hz
74        }
75        break;
76        case 3: {
77          Sound_Init(2385);  // square wave, 262 Hz
78        }
79        break;
80        case 4: {
81          modee = 4;
82        }
83        break;
84        case 5: {
85          modee = 5;
86        }
```

```
      case 5: {
        modee = 5;
      }
      break;
      default: {
        modee = intr_mode;
      }
      break;
    }
    while (modee == intr_mode && modee != 4 && modee !=5) {
      GPIO_PORTF_DATA_R = 0x00;
      if (modee == 1)
        GPIO_PORTF_DATA_R = 0x0E;  //WHITE
      else if (modee ==2)
        GPIO_PORTF_DATA_R = 0x06;  //PINK
      else if (modee == 3)
        GPIO_PORTF_DATA_R = 0x0C;  //SKY-BLUE
    }
```

```
//Matrix Key Program:
    NVIC_ST_CTRL_R = 0;
    while(modee == 4 && intr_mode == 4){
      GPIO_PORTF_DATA_R = 0x00;
      input = ReadKey();   // key press == 0, negative logic
      if ((input == '1')&&(modee == 4) && (intr_mode == 4)) {
        EnableInterrupts();
        Sound_Init(3023);
        while((input == '1')&&(modee == 4 && intr_mode == 4)){
          GPIO_PORTF_DATA_R = 0x08;  //green
          input = ReadKey();
        }
        GPIO_PORTF_DATA_R = 0x00;
        NVIC_ST_CTRL_R = 0;
      }
      else if ((input == '2')&&(modee == 4) && (intr_mode == 4)){
        EnableInterrupts();
        Sound_Init(2694);             //Note 'D'
        while((input == '2')&&(modee == 4 && intr_mode == 4)){
          GPIO_PORTF_DATA_R = 0x02;  //RED
          input = ReadKey();
        }
        GPIO_PORTF_DATA_R = 0x00;
        NVIC_ST_CTRL_R = 0;
      }
      else if ((input == '3')&&(modee == 4) && (intr_mode == 4)){
        EnableInterrupts();
        Sound_Init(2400);             //Note 'E'
        while((input == '3')&&(modee == 4 && intr_mode == 4)){
          GPIO_PORTF_DATA_R = 0x04;  //BLUE
          input = ReadKey();
        }
```

```
133         }
134         GPIO_PORTF_DATA_R = 0x00;
135         NVIC_ST_CTRL_R = 0;
136       }
137       else if ((input == '4')&&(modee == 4) && (intr_mode == 4)) {
138         EnableInterrupts();
139         Sound_Init(2270);            //Note 'F'
140         while((input == '4')&&(modee == 4 && intr_mode == 4)){
141           GPIO_PORTF_DATA_R = 0x0E;  //WHITE
142           input = ReadKey();
143         }
144         GPIO_PORTF_DATA_R = 0x00;
145         NVIC_ST_CTRL_R = 0;
146       }
147       else if((input == '5')&&(modee == 4) && (intr_mode == 4)){
148         EnableInterrupts();
149         Sound_Init(2021);            //Note 'G'
150         while((input == '5')&&(modee == 4 && intr_mode == 4)){
151           GPIO_PORTF_DATA_R = 0x0A;  //YELLOW
152           input = ReadKey();
153         }
154         GPIO_PORTF_DATA_R = 0x00;
155         NVIC_ST_CTRL_R = 0;
156       }
157       else if((input == '6')&&(modee == 4) && (intr_mode == 4)){
158         EnableInterrupts();
159         Sound_Init(1800);            //Note 'A'
160         while((input == '6')&&(modee == 4 && intr_mode == 4)){
161           GPIO_PORTF_DATA_R = 0x0C;  //SKY_BLUE
162           input = ReadKey();
163         }
164         GPIO_PORTF_DATA_R = 0x00;
165         NVIC_ST_CTRL_R = 0;
166       }
166       }
167       else if ((input == '7')&&(modee == 4) && (intr_mode == 4)){
168         EnableInterrupts();
169         Sound_Init(1603);            //Note 'B'
170         while((input == '7')&&(modee == 4 && intr_mode == 4)){
171           GPIO_PORTF_DATA_R = 0x06;  //PINK
172           input = ReadKey();
173         }
174         GPIO_PORTF_DATA_R = 0x00;
175         NVIC_ST_CTRL_R = 0;
176       }
177     }
178     while(modee == 5 && intr_mode == 5){
179       GPIO_PORTF_DATA_R = 0x08; //GREEN
180         rainMusic(period, delay);
181     }
182   }
183 }
184
```


File Control View Window
Single Run Mode: Repeated Auto Source: Channel 1 Condition: Rising Level: 0 V
Stop C1 C2 8192 samples at 724.6 kHz | 2018-02-26 18:14:06.687
Measurements
Add Edit Show
Name Value
C1 Frequency 294.01063001...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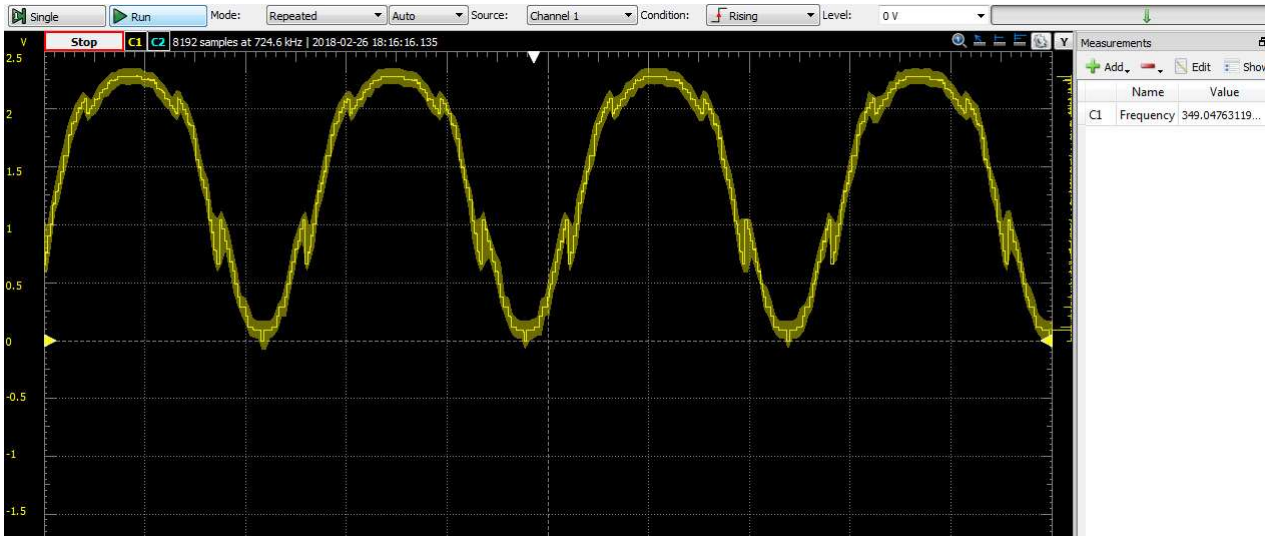
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Stop C1 C2 8192 samples at 724.6 kHz | 2018-02-26 18:16:16.135
Measurements
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Name Value
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Single
Run
Mode:
Repeated
Auto
Source:
Channel 1
Condition:
Rising
Level:
0 V
Stop
C1
C2
8192 samples at 724.6 kHz | 2018-02-26 18:16:59.712
Measurements
Add
Edit
Show
Name
Value
C1
Frequency
391.91333387...


Single
Run
Mode:
Repeated
Auto
Source:
Channel 1
Condition:
Rising
Level:
0 V
Stop
C1
C2
8192 samples at 724.6 kHz | 2018-02-26 18:17:35.633
Measurements
Add
Edit
Name
Value
C1
Frequency
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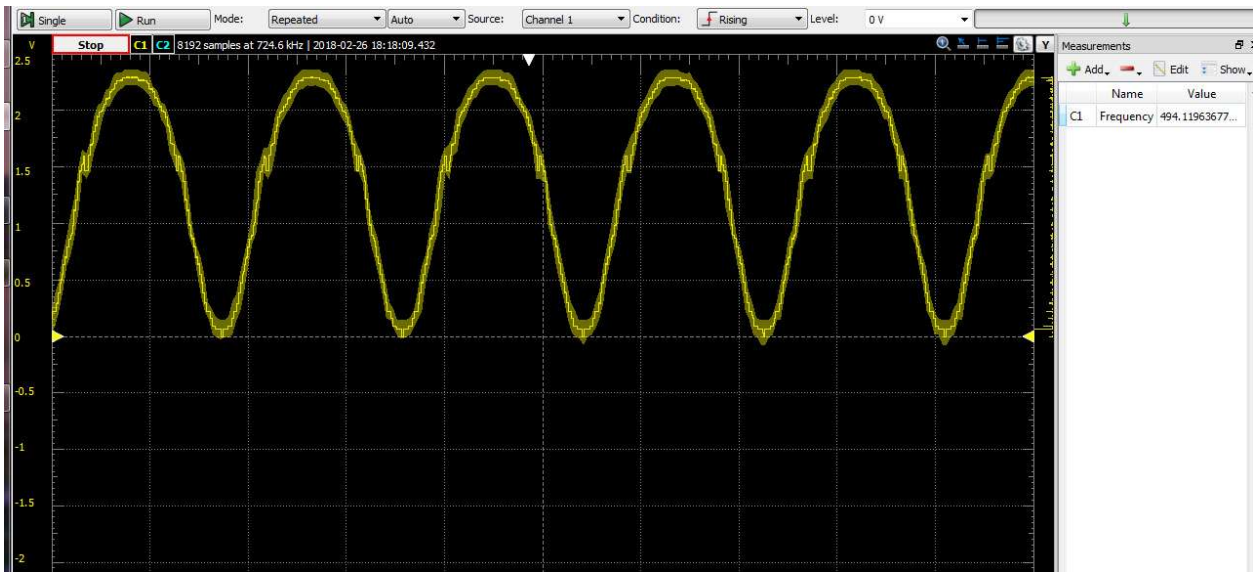
Single
Run
Mode:
Repeated
Auto
Source:
Channel 1
Condition:
Rising
Level:
0 V
Stop
C1
C2
8192 samples at 724.6 kHz | 2018-02-26 18:18:09.432
Measurements
Add
Edit
Name
Value
C1
Frequency
494.11963677...