LAMPIRAN

1) Rangkaian keseluruhan

2) Modul Rangkaian Buzer

LS1
BUZZER

+5V

VCC

PA0

R2

1K

Q1
PNP ECB

GND
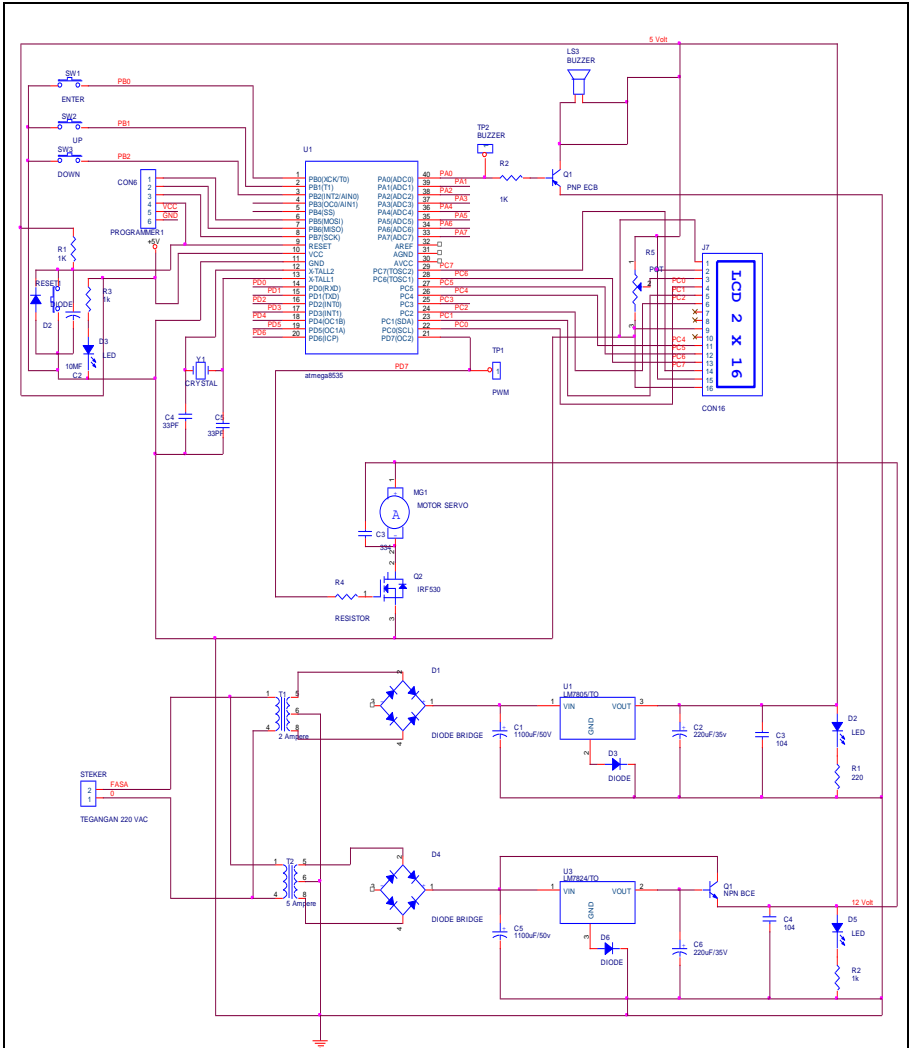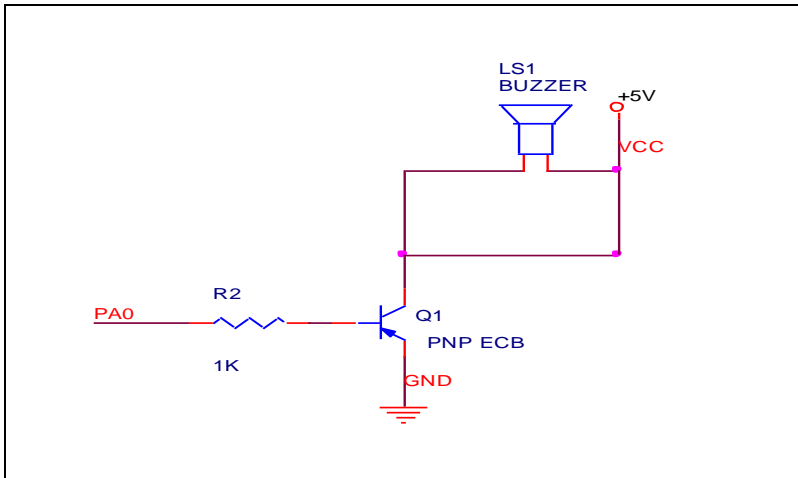
3) Modul Rangkaian Driver Motor

+24

J5
1
2
3
4
CONNECTOR BESAR

MG1
MOTOR SERVO

A

SUPPLY BESAR

C3

334

J8
4
3
2
1
ENABLE PWM

PD7

R4
RESISTOR

Q2
IRF530
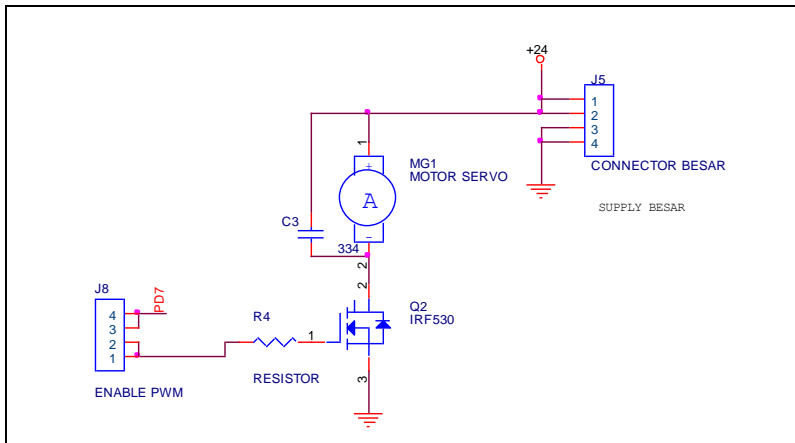
4) Listing Program Keseluruhan

```
/*********************************************
********
This program was produced by the
CodeWizardAVR V2.05.0 Professional
Automatic Program Generator
© Copyright 1998-2010 Pavel Haiduc, HP InfoTech s.r.l.
http://www.hpinfotech.com
Project :
Version :
Date   : 5/5/2014
Author  :
Company :
Comments:
Chip type           : ATmega8535
Program type         : Application
AVR Core Clock frequency: 1.000000 MHz
Memory model         : Small
External RAM size     : 0
Data Stack size       : 128
*********************************************
********/
#include <mega8535.h>
#include <delay.h>
#include <stdlib.h>
#define buzzer PORTA.0=1;
// Alphanumeric LCD Module functions
#include <alcd.h>
```

```c
// Timer 0 overflow interrupt service routine
unsigned char i=1, a;
unsigned char temp1[6]; //pemilihan waktu
unsigned char temp[6];
unsigned char mikrodetik;

int detik;
int menit;


// Timer 0 overflow interrupt service routine
interrupt [TIM0_OVF] void timer0_ovf_isr(void)
{
TCNT0=0x9E;
mikrodetik++;
if (mikrodetik==10)
{
detik-- ;    //untuk timer up
mikrodetik=0;
}
}

void tampil_waktu()
{

itoa(detik,temp);
lcd_gotoxy(10,1);
lcd_puts(temp);

lcd_gotoxy(9,1);
lcd_putsf(":");

itoa(menit,temp);
```

```
        lcd_gotoxy(7,1);
        lcd_puts(temp);


        }



        void jamdigi()
             {
                if(detik==-1)
                   {
                   lcd_clear();
                   detik=59;
                   menit--;
                   }
               if(detik<=10)
                   {
                   lcd_gotoxy(11,1);
                   lcd_putsf(" ");
                   }
               if (menit==-1)
                   {
                   lcd_clear();
                   menit=60;
                   }
               if (menit<=10)
                   {
                   lcd_gotoxy(8,1);
                   lcd_putsf(" ");

                   }
             }

        void selesai()
        {
```

```c
stop:
lcd_gotoxy(0,0);
lcd_putsf("Proses Selesai");
goto stop;
}

// Declare your global variables here

void main(void)
{
// Declare your local variables here

// Input/Output Ports initialization
// Port A initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=Out
// State7=T State6=T State5=T State4=T State3=T
State2=T State1=T State0=1
PORTA=0x01;
DDRA=0x01;

// Port B initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T
State2=P State1=P State0=P
PORTB=0x07;
DDRB=0x00;

// Port C initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T
State2=T State1=T State0=T
```

```
PORTC=0x00;
DDRC=0x00;

// Port D initialization
// Func7=Out Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=0 State6=T State5=T State4=T State3=T
State2=T State1=T State0=T
PORTD=0x00;
DDRD=0xFF;

// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: 0.977 kHz
// Mode: Normal top=0xFF
// OC0 output: Disconnected
TCCR0=0x00;
TCNT0=0x00;
OCR0=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: Timer1 Stopped
// Mode: Normal top=0xFFFF
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer1 Overflow Interrupt: Off
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x00;
```

```c
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer2 Stopped
// Mode: Fast PWM top=0xFF
// OC2 output: Non-Inverted PWM
ASSR=0x00;
TCCR2=0;
TCNT2=0x00;
OCR2=0x00;

// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
// INT2: Off
MCUCR=0x00;
MCUCSR=0x00;

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x01;

// USART initialization
// USART disabled
UCSRB=0x00;

// Analog Comparator initialization
```

```c
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1:
Off
ACSR=0x80;
SFIOR=0x00;

// ADC initialization
// ADC disabled
ADCSRA=0x00;

// SPI initialization
// SPI disabled
SPCR=0x00;

// TWI initialization
// TWI disabled
TWCR=0x00;

// Alphanumeric LCD initialization
// Connections specified in the
// Project|Configure|C Compiler|Libraries|Alphanumeric
LCD menu:
// RS - PORTC Bit 0
// RD - PORTC Bit 1
// EN - PORTC Bit 2
// D4 - PORTC Bit 4
// D5 - PORTC Bit 5
// D6 - PORTC Bit 6
// D7 - PORTC Bit 7
// Characters/line: 16

// Global enable interrupts
#asm("sei")
```

```c
lcd_init(16);
lcd_clear();
lcd_gotoxy(0,0);
lcd_putsf("mini");
lcd_gotoxy(0,1);
lcd_putsf("sieve shaker");
delay_ms(500);
lcd_clear();

    lcd_gotoxy(0,0);
    lcd_putsf("Sanchia Janita K");
    lcd_gotoxy(0,1);
    lcd_putsf("P27838011034");
    delay_ms(1000);
    lcd_clear();

while (1)
{
   while(PINB.0==1)//enter
   {
    lcd_gotoxy(0,0);
    lcd_putsf("Pilih waktu");
    lcd_gotoxy(3,1);
    lcd_putsf("menit");
    itoa(i,temp1);
    lcd_gotoxy(0,1);
    lcd_puts(temp1);

   if(PINB.1==0)//UP
    {
     i=i+1;
     delay_ms(500);

     if(i>30)
```

```
            {
            i=1;
            delay_ms(500);
            lcd_clear();
            }
          }

      else if(PINB.2==0)  //DOWN
        {
        i=i-1;
        delay_ms(500);

      if(i<1)
          {
          i=30;
          delay_ms(500);
          lcd_clear();
          }
        }
      }
    delay_ms(500) ;
    lcd_clear();
    lcd_gotoxy(0,0);
    lcd_putsf("pilih mode");
    delay_ms(500);


    while(PINB.0==1)//enter
      {
      lcd_gotoxy(0,0);
      lcd_putsf("pilih mode");
      if(PINB.1==0)//up
      {
        delay_ms(500);
```

```c
      a=0;
      lcd_clear();
      }

     else if(PINB.2==0)//down
     {
      delay_ms(500);
      a=1;
      lcd_clear();
      }
     if (a==0)
     {
     lcd_gotoxy(0,1);
     lcd_putsf("mode : low");
     }
     else if (a==1)
     {
     lcd_gotoxy(0,1);
     lcd_putsf("mode : high");
     }
    }

   lcd_clear();
   goto proses;

 proses:
   if(a==0)
   {
     lcd_clear();
     lcd_gotoxy(2,0);
     lcd_putsf("mode : low");
       PORTA.0=1;  //buzzer ON
       TCCR2=0x6D;
       OCR2=40;   //motor on misal mode low
```

```
    menit=i;      // setting timer
  satu:
   lcd_gotoxy(2,0);
   lcd_putsf("mode : low");
   TCCR0=0x05;      // aktifin timer
   jamdigi();        // void pemanggilan jamdigital
   tampil_waktu();     // void pemanggilan tampil timer
pada lcd
   if(menit==0&&detik==0)
     {
     TCCR0=0x00;     //non aktifkan timer
     PORTA.0=0;  //buzzer off
     TCCR2=0x00;      //matikan motor
     selesai();  //panggil void
     }
  goto satu;
  }

 if(a==1)
 {
   lcd_clear();
   lcd_gotoxy(2,0) ;
   lcd_putsf("mode : high");
     PORTA.0=1; //BUZZER MATI
     TCCR2=0x6D;
     OCR2=90;  // misal setting mode high
     menit=i;
   satuu:
    lcd_gotoxy(2,0);
    lcd_putsf("mode : high");
    TCCR0=0x05;
    jamdigi();
    tampil_waktu();
    if(menit==0&&detik==0)
```

```
           {
           TCCR0=0x00;
           PORTA.0=0;   //buzzer ON
           TCCR2=0x00;      // PWM MATI
           selesai();
           }
       goto satuu;

    }
  }
  }
```

A. Analisis Data

1. Perhitungan data pengukuran tanpa beban
1.1 Analisa Rpm

1.1.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{2460,3+2461,2+2462,3+2462,8+2460,5}{5}$

$= \dfrac{12306,5}{5} = \mathbf{2461,3}$

b. **Error** $= \text{X1} - \overline{X}$

$= 2460,3 - 2461,3$

$= \mathbf{1}$

c. **% Error** $= \dfrac{\text{X1} - \overline{X}}{x1} \times \mathbf{100\%}$

$= \dfrac{2460,3 - 2461,3}{2460,3} \times 100\%$

$= \mathbf{0,04\ \%}$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{\begin{array}{c}(2461,3-2460,3)\mathbf{2}+(2461,3-2461,2)\mathbf{2}+\\ (2461,3-2462,3)\mathbf{2}+ (2461,3-2462,8)\mathbf{2}+\\ (2461,3-2460,5)\mathbf{2}\end{array}}{5-1}}$

$= \mathbf{1,10}$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$$= \frac{1,106}{\sqrt{5}} = 0,49$$

1.1.2 Mode High

a. $\overline{X}$ $= \frac{x1+x2+x3+x4+x5}{n}$

$= \frac{2650,5+2652,7+2653,3+2652,1+2653,4}{5}$

$= \frac{13251,7}{5} = 2652,3$

b. **Error** $= X1 - \overline{X}$

$= 2650,5 - 2652,3$

$= 1,84$

c. **% Error** $= \frac{X1 - \overline{X}}{x1}$ x **100%**

$= \frac{2650,5 - 2652,3}{2650,5}$ x 100%

$= 0,07\ \%$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\ \right)2}{n-1}}$

$=$

$$\sqrt{\frac{(2652,3-2650,5\ )2+(2652,3-2652,7\ )2+(2652,3-2653,3)2 + (2652,3-2652,1)2+(2652,3-2653,1)2}{5-1}}$$

$= 1,126$

e. **Ua** $= \frac{SD}{\sqrt{n}}$

$$= \frac{1,126}{\sqrt{5}} = 0,50$$

1.2 Analisa Waktu

1.2.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$\quad\quad = \dfrac{59++59+60+60+60}{5}$

$\quad\quad = \dfrac{298}{5} = \mathbf{59{,}6}$

b. **Error** $= $ **Setting Waktu** $- \overline{X}$

$\quad\quad = 60 - 59{,}6$

$\quad\quad = \mathbf{0{,}4}$

c. **% Error** $= \dfrac{\text{Setting Waktu} - \overline{X}}{setting\ waktu} \times 100\%$

$\quad\quad = \dfrac{60 - 59{,}6}{60} \times 100\%$

$\quad\quad = \mathbf{0{,}6\ \%}$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{(59{,}6-59)2+(59{,}6-59)2+(59{,}6-60)2 +(59{,}6-60)2+(59{,}6-60)2}{5-1}}$

$= \mathbf{0{,}54}$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$$= \frac{0,54}{\sqrt{5}} = 0,24$$

1.2.2 Mode High

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{59++59+60+60+60}{5}$

$= \dfrac{298}{5} = 59,6$

b. Error $= $ Setting Waktu $- \overline{X}$

$= 60 - 59,6$

$= 0,4$

c. % Error $= \dfrac{\text{Setting Waktu} - \overline{X}}{setting\ waktu} \times 100\%$

$= \dfrac{60 - 59,6}{60} \times 100\%$

$= 0,6\ \%$

d. SD $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{\begin{array}{c}(59,6-59)2+(59,6-59)2+(59,6-60)2\\ +(59,6-60)2+(59,6-60)2\end{array}}{5-1}}$

$= 0,54$

e. Ua $= \dfrac{SD}{\sqrt{n}}$

$$= \frac{0,54}{\sqrt{5}} = 0,24$$

2. **Perhitungan data pengukuran dengan beban**

Dengan waktu 10 menit

2.1 Analisa Rpm

2.1.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{2460,3+2462,5+2460,4+2461,8+2462,5}{5}$

$= \dfrac{12307,5}{5} = 2461,5$

b. **Error** $= X1 - \overline{X}$
$= 2460,3 - 2461,5$
$= 1,2$

c. **% Error** $= \dfrac{X1 - \overline{X}}{x1} \times 100\%$

$= \dfrac{2460,3 - 2461,5}{2460,3} \times 100\%$

$= 0,048\ \%$

d. $\text{SD} = \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$$= \sqrt{\frac{\begin{array}{c}(2460,3 - 2461,5\,)2+(2460,3 - 2462,5\,)2+(2460,3 - 2460,4)2 \\ +(2460,3 - 2461,8\,)2+(2460,3 - 2462,5\,)2\end{array}}{5-1}}$$

$$= 1,74$$

e. Ua $= \dfrac{SD}{\sqrt{n}}$

$$= \dfrac{1,74}{\sqrt{5}} = 0,78$$

2.1.2   Mode High

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{2656,6+2655,1+2656,5+2655,2+2660,8}{5}$

$= \dfrac{13284,2}{5} = 2656,84$

b. Error $= X1 - \overline{X}$

$= 2656,6 - 2656,84$

$= 0,24$

c. % Error $= \dfrac{X1 - \overline{X}}{x1}$ x **100%**

$= \dfrac{2636,6 - 2647,84}{2636,6}$ x 100%

$= 0,009\ \%$

d. $SD = \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{\begin{array}{c}(2656,6 - 2656,84\,)2 + (2655,1 - 2656,84\,)2 + (2656,5 - 2656,84\,)2 \\ + (2655,2 - 2656,84)2 + (2660,8 - 2656,84)2\end{array}}{5-1}}$

$= 2,32$

e. Ua $= \dfrac{SD}{\sqrt{n}}$

$= \dfrac{2,32}{\sqrt{5}} = 1,04$

2.2 Analisa Waktu

2.2.1 Mode Low

a. $\overline{X} = \dfrac{x1 + x2 + x3 + x4 + x5}{n}$
$= \dfrac{590 + 590 + 600 + 600 + 590}{5}$
$= \dfrac{2970}{5} = 594$

b. Error $= $ Setting Waktu $- \overline{X}$
$= 600 - 594$
$= 6$

c. % Error $= \dfrac{\text{Setting Waktu} - \overline{X}}{setting\ waktu}$ x 100%

$$=\frac{600-594}{600} \text{ x } 100\%$$

$$= \textbf{1\%}$$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)^2}{n-1}}$

$$=\sqrt{\dfrac{\begin{array}{c}(590-594)^2+(590-594)^2+(600-594)^2\\+(600-594)^2+(590-594)^2\end{array}}{5-1}}$$

$$= \textbf{6,63}$$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$$= \dfrac{6,63}{\sqrt{5}} = \textbf{2,97}$$

2.2.2 Mode High

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$$= \dfrac{590+590+600+600+590}{5}$$

$$= \dfrac{2970}{5} = \textbf{594}$$

b. **Error** $=$ **Setting Waktu** $- \overline{X}$

$$= 600 - 594$$

$$= \textbf{6}$$

c. **% Error** $= \dfrac{\textbf{Setting Waktu} - \overline{X}}{\textbf{setting waktu}} \textbf{ x 100\%}$

$$=\dfrac{600-594}{600} \text{ x } 100\%$$

$$= 1\%$$

d. $\mathbf{SD} = \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$$= \sqrt{\dfrac{\substack{(590-594)2+(590-594)2+(600-594)2 \\ +(600-594)2+(590-594)2}}{5-1}}$$

$$= 6,63$$

e. $\mathbf{Ua} = \dfrac{SD}{\sqrt{n}}$

$$= \dfrac{6,63}{\sqrt{5}} = 2,97$$

Dengan waktu 20 menit

2.3 Analisa Rpm

2.3.1 Mode Low

a. $\overline{X} = \dfrac{x1+x2+x3+x4+x5}{n}$

$$= \dfrac{2459,5+2460,2+2461,5+2460,7+2461,1}{5}$$

$$= \dfrac{12303}{5} = 2460,6$$

b. **Error** $= \mathbf{X1} - \overline{X}$

$$= 2459,5 - 2460,6$$

$$= 1,1$$

c. **% Error** $= \dfrac{X1 - \overline{X}}{x1}$ **x 100%**

$\quad\quad\quad\quad\quad = \dfrac{2459,5 - 2460,6}{2459,5}$ x 100%

$\quad\quad\quad\quad\quad$ **= 0,044 %**

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\,\right)\mathbf{2}}{n-1}}$

$\quad\quad =$

$$\sqrt{\dfrac{(2459,5 - 2460,6\,)\mathbf{2} + (2460,2 - 2460,6\,)\mathbf{2} + (2461,5 - 2460,6\,)\mathbf{2} + (2460,7 - 2460,6\,)\mathbf{2} + (2461,1 - 2460,6\,)\mathbf{2}}{5-1}}$$

$\quad\quad$ **= 3,12**

e. **Ua** $\quad = \dfrac{SD}{\sqrt{n}}$

$\quad\quad\quad\quad = \dfrac{3,12}{\sqrt{5}} = $ **1,40**

2.3.2 Mode High

a. $\overline{X} \quad = \dfrac{x1 + x2 + x3 + x4 + x5}{n}$

$\quad\quad\quad = \dfrac{2654,8 + 2655,5 + 2656,3 + 2655,1 + 2654,6}{5}$

$\quad\quad\quad = \dfrac{13276,3}{5} = $ **2655,26**

b. **Error** $= X1 - \overline{X}$

$$= 2654,8 - 2655,26$$
$$= \mathbf{0,46}$$

c. **% Error** $= \dfrac{\mathbf{X1} - \overline{X}}{x1} \textbf{ x 100\%}$

$\quad = \dfrac{2654,8 - 2655,26}{2654,8}$ x 100%

$\quad = \mathbf{0,017\%}$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)\mathbf{2}}{n-1}}$

$=$

$$\sqrt{\dfrac{\begin{array}{c}(2654,8 - 2655,26\,)\mathbf{2} + (2655,5 - 2655,26)\mathbf{2} + (2656,3 - 2655,26\,)\mathbf{2} \\ + (2655,8 - 2655,26)\mathbf{2} + (2654,6 - 2655,26)\mathbf{2}\end{array}}{5-1}}$$

$= \mathbf{0,73}$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$\quad = \dfrac{0,73}{\sqrt{5}} = \mathbf{0,33}$

2.4 Analisa Waktu

2.4.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$\quad = \dfrac{1159+1200+1159+1158+1200}{5}$

$\quad = \dfrac{5876}{5} = \mathbf{1175,2}$

b. Error $= X1 - \overline{X}$

$= 1200 - 1175,2$

$= \mathbf{24,8}$

c. % Error $= \dfrac{X1 - \overline{X}}{x1} \times \mathbf{100\%}$

$= \dfrac{1200 - 1175,2}{1200} \times 100\%$

$= \mathbf{2\ \%}$

d. SD $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{\begin{array}{c}(1175,2-1159)2+(1175,2-1200)2+(1175,2-1159)2 \\ +(1175,2-1158)2+(1175,2-1200)2\end{array}}{5-1}}$

$= \mathbf{22,64}$

e. Ua $= \dfrac{SD}{\sqrt{n}}$

$= \dfrac{\mathbf{22,64}}{\sqrt{5}} = \mathbf{1,01}$

2.4.2 Mode High

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{1159+1200+1159+1158+1200}{5}$

$= \dfrac{5876}{5} = \mathbf{1175,2}$

b. Error $= \mathbf{X1} - \overline{X}$

$= 1200 - 1175,2$

$= \mathbf{24,8}$

c. % Error $= \dfrac{X1 - \overline{X}}{x1} \times \mathbf{100\%}$

$= \dfrac{1200 - 1175,2}{1200} \times 100\%$

$= \mathbf{2\ \%}$

d. SD $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{\begin{array}{c}(1175,2-1159\ )2+(1175,2-1200\ )2+(1175,2-1159\ )2\\ +(1175,2-1158\ )2+(1175,2-1200\ )2\end{array}}{5-1}}$

$= \mathbf{22,64}$

e. Ua $= \dfrac{SD}{\sqrt{n}}$

$= \dfrac{22,64}{\sqrt{5}} = \mathbf{1,01}$

Dengan waktu 30 menit

2.5 Analisa Rpm

2.5.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{2456,5+2455,1+2456,4+2458,6+2456,5}{5}$

$= \dfrac{12283,1}{5} = \mathbf{2456,62}$

b. **Error** $= \mathbf{X1} - \overline{X}$

$= 2456,5 - 2456,62$

$= \mathbf{0,12}$

c. **% Error** $= \dfrac{\mathbf{X1} - \overline{X}}{\mathbf{x1}}$ **x 100%**

$= \dfrac{2456,5 - 2456,62}{2456,5}$ x 100%

$= \mathbf{0,0048\ \%}$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\ \right)2}{n-1}}$

$=$

$\sqrt{\dfrac{(2456,5-2456,6\ )2+(2455,1-2456,6\ )2+(2456,4-2456,6\ )2 +(2458,6-2456,6\ )2+(2456,5-2456,6)2}{5-1}}$

$= \mathbf{1,226}$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$$= \frac{1,226}{\sqrt{5}} = 0,550$$

2.5.2 Mode High

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{2655,6+2554,6+2656,6+2655,8+2654,1}{5}$

$= \dfrac{13276,7}{5} = 2655,3$

b. **Error** $= X1 - \overline{X}$
$= 2655,6 - 2655,3$
$= 0,3$

c. **% Error** $= \dfrac{X1 - \overline{X}}{x1} \text{ x } 100\%$

$= \dfrac{2655,6 - 2655,3}{2655,6} \text{ x } 100\%$

$= 0,01\%$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{(2654,8 - 2655,3)2 + (2655,5 - 2655,3)2 + (2656,3 - 2655,3)2 + (2655,1 - 2655,3)2 + (2654,6 - 2655,3)2}{5-1}}$

$= 0,45$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$= \dfrac{0,45}{\sqrt{5}} = 0,20$

2.6 Analisa Waktu

2.6.1 Mode Low

a. $\overline{X}$ $= \dfrac{x1+x2+x3+x4+x5}{n}$

$= \dfrac{1759+1759+1800+1759+1800}{5}$

$= \dfrac{8877}{5} = 1775,4$

b. **Error** $= X1 - \overline{X}$

$= 1800 - 1775,4$

$= 24,6$

c. **% Error** $= \dfrac{X1 - \overline{X}}{x1} \text{ x } 100\%$

$= \dfrac{1800 - 1775,4}{1800} \text{ x } 100\%$

$= 1,36 \%$

d. **SD** $= \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$= \sqrt{\dfrac{(1775,4-1759\ )2+(1775,4-1759\ )2+(1775,4-1800\ )2 +(1775,4-1759\ )2+(1775,4-1800)2}{5-1}}$

$$= 20{,}71$$

e. $Ua \quad = \dfrac{SD}{\sqrt{n}}$

$\qquad\qquad = \dfrac{20{,}71}{\sqrt{5}} = 9{,}2$

2.6.2 Mode High

a. $\overline{X} \quad = \dfrac{x1+x2+x3+x4+x5}{n}$

$\qquad\qquad = \dfrac{1759+1759+1800+1759+1800}{5}$

$\qquad\qquad = \dfrac{8877}{5} = 1775{,}4$

b. **Error** $= X1 - \overline{X}$

$\qquad\qquad = 1800 - 1775{,}4$

$\qquad\qquad = 24{,}6$

c. **% Error** $\quad = \dfrac{X1 - \overline{X}}{x1} \times 100\%$

$\qquad\qquad = \dfrac{1800 - 1775{,}4}{1800} \times 100\%$

$\qquad\qquad = 1{,}36\ \%$

d. $SD = \sqrt{\dfrac{\left(\sum x - \overline{X}\right)2}{n-1}}$

$$= \sqrt{\frac{(1775,4-1759)2+(1775,4-1759)2+(1775,4-1800)2 + (1775,4-1759)2+(1775,4-1800)2}{5-1}}$$

$$= 20{,}71$$

e. **Ua** $= \dfrac{SD}{\sqrt{n}}$

$$= \dfrac{20{,}71}{\sqrt{5}} = 9{,}2$$