

LAMPIRAN

A. Hasil Perhitungan Frekuensi mode Continous

1. Frekuensi 35 Hz

$$\bar{X} = \frac{35,01+35,01+34,98+34,82+35,00+35,01+35,01+34,79+34,97+35,18}{10} = 34,978$$

$$\text{Koreksi} = 35 - 34,978 = 0,022$$

2. Frekuensi 40 Hz

$$\bar{X} = \frac{40,00+39,97+39,70+40,00+40,00+40,30+39,99+39,97+40,00+39,79}{10} = 39,972$$

$$\text{Koreksi} = 40 - 39,972 = 0,028$$

3. Frekuensi 45 Hz

$$\bar{X} = \frac{45,05+44,97+45,04+44,97+45,02+44,98+44,99+45,01+45,00+44,97}{10} = 45,00$$

$$\text{Koreksi} = 45 - 45,00 = 0$$

4. Frekuensi 50 Hz

$$\bar{X} = \frac{50,00+49,99+50,00+50,00+50,47+49,99+49,5+50,51+50,00+49,98}{10} = 50,044$$

$$\text{Koreksi} = 50 - 50,044 = - 0,044$$

5. Frekuensi 55 Hz

$$\bar{X} = \frac{54,98+54,97+55,06+55,07+55,04+54,95+55,01+55,06+54,5+54,95}{10} = 54,959$$

$$\text{Koreksi} = 55 - 54,959 = 0,041$$

6. Frekuensi 60 Hz

$$\bar{X} = \frac{59,96+59,97+59,96+60,09+59,99+59,96+59,99+59,97+59,98+60,08}{10} = 59,995$$

$$\text{Koreksi} = 60 - 59,995 = 0,005$$

7. Frekuensi 65 Hz

$$\bar{X} = \frac{64,94+64,24+64,96+65,06+65,06+64,95+64,94+65,07+64,94+65,05}{10} = 64,921$$

$$\text{Koreksi} = 65 - 64,921 = 0,079$$

8. Frekuensi 70 Hz

$$\bar{X} = \frac{70,03+70,02+69,98+70,02+70,01+70,02+69,99+70,91+70,03+70,02}{10} = 70,103$$

$$\text{Koreksi} = 70 - 70,103 = - 0,103$$

9. Frekuensi 75 Hz

$$\bar{X} = \frac{75,06+75,03+74,88+74,89+74,91+74,94+74,88+74,99+75,07+75,05}{10} = 74,97$$

$$\text{Koreksi} = 75 - 74,97 = 0,03$$

10. Frekuensi 80 Hz

$$\bar{X} = \frac{79,96+79,90+79,93+80,10+79,69+80,09+79,88+79,99+80,10+80,08}{10} = 79,972$$

$$\text{Koreksi} = 80 - 79,972 = 0,028$$

11. Frekuensi 85 Hz

$$\bar{X} = \frac{85,01+84,98+85,03+85,02+85,01+85,03+85,00+85,02+85,03+85,02}{10} = 85,015$$

$$\text{Koreksi} = 85 - 85,015 = - 0,015$$

12. Frekuensi 90 Hz

$$\bar{X} = \frac{90,02+90,05+89,99+89,88+89,95+90,04+90,01+89,96+90,05+89,95}{10} = 89,99$$

$$\text{Koreksi} = 90 - 89,99 = 0,01$$

13. Frekuensi 95 Hz

$$\bar{X} = \frac{94,92+95,03+95,03+94,92+94,94+94,96+94,93+95,03+95,04+95,00}{10} = 94,98$$

$$\text{Koreksi} = 95 - 94,98 = 0,02$$

14. Frekuensi 100 Hz

$$\bar{X} = \frac{100,00+99,99+100,00+99,93+100,00+100,00+100,00+99,98+100,00+99,97}{10} = 99,987$$

$$\text{Koreksi} = 100 - 99,987 = 0,013$$

15. Frekuensi 105 Hz

$$\bar{X} = \frac{105,00+104,90+105,00+105,00+105,00+105,00+104,90+105,00+105,10+105,00}{10} = 104,99$$

$$\text{Koreksi} = 105 - 104,99 = 0,01$$

16. Frekuensi 110 Hz

$$\bar{X} = \frac{110,0+110,0+110,0+110,0+110,0+110,0+110,0+110,0+110,0+110,0}{10} = 110,00$$

$$\text{Koreksi} = 110 - 110,00 = 0$$

17. Frekuensi 115 Hz

$$\bar{X} = \frac{115,0+115,0+115,0+115,0+115,1+115,0+115,0+115,0+114,9+115,0}{10} = 115,0$$

$$\text{Koreksi} = 115 - 115,0 = 0$$

18. Frekuensi 120 Hz

$$\bar{X} = \frac{120,0+120,0+120,0+120,0+120,0+120,0+120,0+120,0+120,0+120,0}{10} = 120,00$$

$$\text{Koreksi} = 120 - 120,00 = 0$$

19. Frekuensi 125 Hz

$$\bar{X} = \frac{125,0+125,0+125,0+125,0+125,0+125,0+125,0+125,0+125,0+125,0}{10} = 125,0$$

$$\text{Koreksi} = 125 - 125,0 = 0$$

20. Frekuensi 130 Hz

$$\bar{X} = \frac{130,0+129,9+130,0+130,0+130,0+129,9+130,0+130,0+130,0+130,0}{10} = 129,98$$

$$\text{Koreksi} = 130 - 129,98 = 0,02$$

21. Frekuensi 135 Hz

$$\bar{X} = \frac{135,0+135,0+135,0+135,0+135,0+135,1+135,0+134,9+135,0+135,0}{10} = 135,0$$

$$\text{Koreksi} = 135 - 135,0 = 0$$

22. Frekuensi 140 Hz

$$\bar{X} = \frac{140,0+140,0+139,9+140,0+139,9+140,0+140,0+140,0+139,9+140,0}{10} = 139,97$$

$$\text{Koreksi} = 140 - 139,97 = 0,03$$

23. Frekuensi 145 Hz

$$\bar{X} = \frac{145,0+145,0+144,9+145,0+145,0+145,0+145,1+145,0+145,0+145,0}{10} = 145,00$$

$$\text{Koreksi} = 145 - 145,00 = 0$$

24. Frekuensi 155 Hz

$$\bar{X} = \frac{150,0+150,0+150,0+150,0+150,0+149,9+150,0+150,0+149,9+150,0}{10} = 149,98$$

$$\text{Koreksi} = 155 - 149,98 = 0,02$$

25. Frekuensi 160 Hz

$$\bar{X} = \frac{155,0+155,0+154,9+155,1+154,9+154,9+155,0+155,0+154,9+155,0}{10} = 154,97$$

$$\text{Koreksi} = 160 - 154,97 = 0,03$$

26. Frekuensi 165 Hz

$$\bar{X} = \frac{160,0+160,0+160,0+160,0+160,0+160,0+160,0+160,0+160,0+160,0}{10} = 160,00$$

$$\text{Koreksi} = 160 - 160,00 = 0$$

27. Frekuensi 170 Hz

$$\bar{X} = \frac{165,0+165,0+165,0+165,0+165,0+165,0+165,0+165,0+165,0+165,0}{10} = 165,0$$

$$\text{Koreksi} = 165 - 165,0 = 0$$

28. Frekuensi 175 Hz

$$\bar{X} = \frac{170,0+170,0+169,9+169,7+170,0+170,3+169,9+170,0+170,0+170,0}{10} = 169,98$$

$$\text{Koreksi} = 175 - 169,98 = 0,02$$

29. Frekuensi 180 Hz

$$\bar{X} = \frac{180,0+180,0+179,9+180,0+180,1+180,0+179,9+180,0+180,0+180,1}{10} = 180,0$$

$$\text{Koreksi} = 180 - 180,0 = 0$$

B. Hasil Perhitungan Frekuensi mode Burst

$$\bar{X} = \frac{100,00+100,00+99,97+100,01+100,03+100,00+100,00+99,99+100,00+100,00}{10} = 100,0$$

$$\text{Koreksi} = 100 - 100,0 = 0$$

C. Hasil Perhitungan Timer

1. Timer 15 menit

$$\bar{X} = \frac{898+898+898+898+898+898+898+898+898+898}{10} = 898$$

$$\text{Koreksi} = 900 - 898 = 2$$

2. Timer 20 menit

$$\bar{X} = \frac{1197+1197+1197+1197+1197+1197+1197+1197+1197+1197}{10} = 1197$$

$$\text{Koreksi} = 1200 - 1197 = 3$$

3. Timer 30 menit

$$\bar{X} = \frac{1794+1794+1794+1794+1794+1794+1794+1794+1794+1794}{10} = 1794$$

$$\text{Koreksi} = 1800 - 1794 = 6$$

D. Hasil Perhitungan Tegangan Maksimal

$$\bar{X} = \frac{28,4+28,5+28,5+28,4+28,4+28,5+28,6+28,5+28,6+28,5}{10} = 28,49$$

E. Hasil Perhitungan Kapasitas Baterai

$$\bar{X} = \frac{302+305+303+307+304+308+310+306+304+309}{10} = 306$$

$$\begin{aligned}\text{Waktu pemakaian} &= (4,04-3,32) \times 100 \times 306 \\ &= 22.032 \text{ detik} \\ &= \pm 6 \text{ jam}\end{aligned}$$

F. Pembuatan Program Keseluruhan

```
#include<LiquidCrystal_I2C.h>
#include<Wire.h>
#include<PWM.h>
LiquidCrystal_I2C lcd(0x27,20,4 );
int led = 9; // the pin out PWM
int duty = 10;
int btup = 2;
int btdown = 1;
int btok = 4;
int btreset = 5;
int A=0;
int B=0;
const int ne=6; // pin MODE
int ledstate=LOW;
unsigned long mill=0;
const long interval=500;
unsigned long sebelum=0; // buat counter Timer
const long timer=993;
int a=1;
int b=0;
int t=0;
int waktu;
int btupx, btdownx, btsetx, btokx, btresetx;
int frek = 35, mode, pilih;
int detik;
```

```

void setup()
{
  lcd.init(); // initialize the lcd
  lcd.init();
  lcd.backlight();
  //initialize all timers except for 0, to save time
keeping functions
  InitTimersSafe();
  Serial.begin(9600);
  pinMode(btup, INPUT_PULLUP);
  pinMode(btdown, INPUT_PULLUP);
  pinMode(btok, INPUT_PULLUP);
  pinMode(btreset, INPUT_PULLUP);
  pinMode(ne, OUTPUT);
  pwmWrite(led, duty);
}
void loop()
{
  btupx = digitalRead(btup);
  btdownx = digitalRead(btdown);
  btokx = digitalRead(btok);
  btresetx = digitalRead(btreset);
  if(pilih == 0)
  {
    lcd.setCursor(6, 0);
    lcd.print("TENS");
    lcd.setCursor(3, 1);
    lcd.print("ATMEGA328P");
    pwmWrite(led, 0);
    detik=0;
    A=0;
    B=0;
  }
}

```



```
if(btresetx==LOW||B==1)
{
    pwmWrite(led, 0);
    pilih = 0;
    lcd.clear();
    delay(200);
}
if(btokx == LOW)
{
    pilih++;
    if (pilih > 4) pilih = 4;
    lcd.clear();
    delay(200);
}
if (pilih == 1)
{
    setmode();
}
else if (pilih == 2)setfrek();
else if (pilih == 3)settime();
else if (pilih == 4)mulai();
}
}
```

```
void setmode ()
{
  lcd.setCursor(0,0);
  lcd.print("PILIH MODE :");
  if(a==1)
  {
    lcd.setCursor(0,1);
    lcd.print("burst");
    lcd.print("  ");
  }
  if(a==2)
  {
    lcd.setCursor(0,1);
    lcd.print("continous");
    lcd.print("  ");
  }
  if(btupx == LOW)
  {
    delay(200);
    a++;
    if(a > 2) a = 2;
  }
  if(btdownx == LOW)
  {
    delay(200);
    a--;
    if(a < 1) a = 1;
  }
}
} //batas akhir set mode
```

```
void setfrek()
{
    if(a==1) frek=100;//burst
    lcd.setCursor(0,0);
    lcd.print("PILIH FREK :");
    lcd.setCursor(0,1);
    lcd.print(frek);
    lcd.print("  ");
    lcd.setCursor(4,1);
    lcd.print("Hz");
    if(btupx == LOW)
    {
        delay(200);
        if(a == 2)
        {
            frek = frek+5;
            if(frek < 35) frek = 35;
            if(frek > 180) frek = 180;
        }
    }
    if(btdownx == LOW)
    {
        delay(200);
        if(a == 2)
        {
            frek = frek-5;
            if (frek < 35) frek = 35;
            if(frek > 180) frek = 180;
        }
    }
}
} //batas akhir fungsi set frek
```

```
void settime ()
{
    lcd.setCursor(0,0);
    lcd.print("PILIH WAKTU : ");
    lcd.setCursor(0,1);
    lcd.print(waktu);
    lcd.print("  ");
    lcd.setCursor(3,1);
    lcd.print("Menit");
    if(t < 1)t = 1;
    if(t > 3)t = 3;
    if(t==1)waktu = 15;
    if(t==2)waktu = 20;
    if(t==3)waktu = 30;
    if(btupx == LOW)
    {
        delay(200);
        t++;
    }

    if(btdownx == LOW)
    {
        delay(200);
        t--;
    }
} //batas akhir settime
```

```
void mulai()
{
  if(a==1)
  {
    lcd.setCursor(5,0);
    lcd.print("Burst");
    unsigned long currentmillis=millis();
    if (currentmillis-mill>=interval)
    {
      mill=currentmillis;
      if(ledstate==LOW)
      {
        ledstate=HIGH;
      }
      else
      {
        ledstate=LOW;
      }
      digitalWrite(ne,ledstate);
    }
  }
  if(a==2)
  {
    lcd.setCursor(3,0);
    lcd.print("Continous");
    digitalWrite(ne,HIGH);
  }
}
```

```
if(A==1)
{
  unsigned long currenttimer=millis();
  if (currenttimer-sebelum>=timer)
  {
    sebelum = currenttimer;
    detik--;
  }
}
else{}
if(waktu < 0)
{
  B = 1;
}
if(detik < 0)
{
  waktu--;
  detik = 59;
}
A=1;
SetPinFrequencySafe(led, frek);
//Timer1_SetFrequency(nilaifrek);
pwmWrite(led, duty);
lcd.setCursor(0,1);
lcd.print(frek);
lcd.setCursor(4,1);
lcd.print("Hz");
lcd.setCursor(9,1);
lcd.print(waktu);
lcd.print(" : ");
lcd.print(detik);
lcd.print(" ");
} //batas akhir mulai
```