Lampiran 1.

```
Uses crt;
Label
     1,2,3,5,7,10,15,20,25,30,35,40,45,50,79,80,90,100,
     Selesai,110,120,130,140,145,150,155,160,1000;

Var
     N,M,A,B,C,D,E,Tunda,KLA,Motor,Scan,H,I,J,F,AA,BB,KA,
     KB,XO,YO,X,Y,Z,ZZ,nn,mm,Koord_X,Koord_Y,XXX,YYY,AAA,
     DDD            : Integer;
     Lanjut,Pilih   : char;
     Cari,Titik     : Char;
     Yakin,Scaning  : Char;

{*.............. FUNGSI MEMUTAR MOTOR ..............*3

     Function MotorI(p:byte ; q:byte):integer;

        Begin
        Motor := 1;
        For I := 0 To q Do
            Motor  := Motor * p;
            MotorI := Motor;
        end;

     Function MotorO(r,s : byte):integer;

        Begin
             Motor := 0;
             For J := 0 To s Do
                 Motor  := Motor * r + 1;
                 MotorO := Motor;
        end;


{*.............. PROGRAM TAMPILAN AWAL ..............*3

Begin
Clrscr;
Delay(1000);
Gotoxy(30,1);Textcolor(9);Writeln('PROGRAM TUGAS AKHIR');
Gotoxy(34,3);Textcolor(9);Writeln('DENGAN JUDUL');
Delay(2000);
Gotoxy(16,8);Textcolor(10);
Writeln('OTOMATISASI PENGOPERASIAN DUA BUAH MOTOR LANGKAH');
Gotoxy(28,10);Textcolor(10);
Writeln('SEBAGAI PENGGERAK SENSOR');
Delay(1000);
Begin
For H := 1 To 48 Do
     Begin
     Begin
     Gotoxy(15+H,6);Textcolor(3);Write('1');
     Delay(50);
     end;
```

```
      Begin
      Gotoxy(15+H,12);Textcolor(3);Write('1');
      Delay(50);
      end;
      end;
end;
Gotoxy(37,16);Textcolor(9+128);Writeln('Oleh :');
Delay(2000);

      Begin
      Gotoxy(39,18);Textcolor(10);Sound(700);
      Write('T ');Delay(500);Nosound;end;
      Begin
      Gotoxy(37,18);Textcolor(10);Sound(700);Write('R ');
      Nosound;Gotoxy(41,18);Textcolor(10);Sound(700);
      Write('O ');Delay(500);Nosound;end;
      Begin
      Gotoxy(35,18);Textcolor(10);Sound(700);Write('A ');
      Nosound;Gotoxy(43,18);Textcolor(10);Sound(700);
      Write('N ');Delay(500);Nosound;end;
      Begin
      Gotoxy(33,18);Textcolor(10);Sound(700);Write('H ');
      Nosound;Gotoxy(45,18);Textcolor(10);Sound(700);
      Write('O');Nosound;end;

      Begin
      Gotoxy(33,20);Textcolor(10);Sound(700);Write('J');
      Nosound;Gotoxy(45,20);Textcolor(10);Sound(700);
      Write('0');Delay(500);Nosound;end;
      Begin
      Gotoxy(34,20);Textcolor(10);Sound(700);Write(' ');
      Nosound;Gotoxy(44,20);Textcolor(10);Sound(700);
      Write('8');Delay(500);Nosound;end;
      Begin
      Gotoxy(35,20);Textcolor(10);Sound(700);Write('4');
      Nosound;Gotoxy(43,20);Textcolor(10);Sound(700);
      Write('4');Delay(500);Nosound;end;
      Begin
      Gotoxy(36,20);Textcolor(10);Sound(700);Write('0');
      Nosound;Gotoxy(42,20);Textcolor(10);Sound(700);
      Write('0');Delay(500);Nosound;end;
      Begin
      Gotoxy(37,20);Textcolor(10);Sound(700);Write('1');
      Nosound;Gotoxy(41,20);Textcolor(10);Sound(700);
      Write(' ');Delay(500);Nosound;end;
      Begin
      Gotoxy(38,20);Textcolor(10);Sound(700);Write(' ');
      Nosound;Gotoxy(40,20);Textcolor(10);Sound(700);
      Write('0');Delay(500);Nosound;end;
      Begin
      Gotoxy(39,20);Textcolor(10);Sound(700);
      Write('9');Nosound;end;
```

```
Begin
Gotoxy(5,24);Textcolor(4);
Writeln('Untuk melanjutkan tekan    ');
Gotoxy(31,24);Textcolor(12);Write('"ENTER"');Readln;
end;


(*.............. PROGRAM PILIHAN OPERASI ..............*)

145:

Begin
Clrscr;
Gotoxy(28,7);Textcolor(9);
Writeln('OPERASI YANG DIKEHENDAKI');
Gotoxy(28,10);Textcolor(12);Writeln('[S]');
Gotoxy(31,10);Textcolor(10);Write('caning');
Gotoxy(28,12);Textcolor(12);Writeln('[M]');
Gotoxy(31,12);Textcolor(10);
Write('enuju Koordinat Tertentu');
Gotoxy(28,14);Textcolor(12);Writeln('[K]');
Gotoxy(31,14);Textcolor(10);Writeln('eluar');
Gotoxy(28,20);Textcolor(9);Writeln('Pilih ');
Gotoxy(34,20);Textcolor(12);Write('[S]');
Gotoxy(38,20);Textcolor(9);Write('atau ');
Gotoxy(43,20);Textcolor(12);Write('[M]');
Gotoxy(47,20);Textcolor(9);Write('atau ');
Gotoxy(52,20);Textcolor(12);Write('[K]    ');
Readln(Pilih);
Begin
IF (Pilih = 'S') or (Pilih = 's') Then
     Begin
     Goto 150;
    end;

IF (Pilih = 'M') or (Pilih = 'm') Then
     Begin
     Goto 155;
     end;

IF (Pilih = 'K') or (Pilih = 'k') Then
     Begin
     Goto 160;
     end

ELSE
     Begin
     Goto 145;
     end;
end;

end;
```

```
160:

Begin
Clrscr;
Gotoxy(13,13);Textcolor(15);Writeln('Anda yakin akan ');
Gotoxy(29,13);Textcolor(12);Write('keluar  ???    ');
Gotoxy(44,13);Textcolor(15);
Write('[ Y / T ]    ');Readln(Yakin);
IF (Yakin = 'Y') or (Yakin = 'y') Then
    Begin
    Goto 110;
    end
ELSE
    Begin
    Goto 145;
    end;
end;


{*.............. PROGRAM MELAKUKAN SCANING .............*}

150:

Begin
Clrscr;
Gotoxy(17,5);Textcolor(9);
Writeln('Akan melakukan Scaning sampai berapa "cm" ...?');
Gotoxy(17,7);Textcolor(9);Writeln('Pilih : ');
Gotoxy(25,7);Textcolor(12);
Writeln('[5]  [10]  [15]  [20]  [0] ');
Gotoxy(17,10);Textcolor(12);Writeln('[5]');
Gotoxy(25,10);Textcolor(10);
Writeln('Untuk Scaning sampai  5 cm.');
Gotoxy(17,12);Textcolor(12);Writeln('[10]');
Gotoxy(25,12);Textcolor(10);
Writeln('Untuk Scaning sampai 10 cm.');
Gotoxy(17,14);Textcolor(12);Writeln('[15]');
Gotoxy(25,14);Textcolor(10);
Writeln('Untuk Scaning sampai 15 cm.');
Gotoxy(17,16);Textcolor(12);Writeln('[20]');
Gotoxy(25,16);Textcolor(10);
Writeln('Untuk Scaning sampai 20 cm.');
Gotoxy(17,19);Textcolor(12);Writeln('[0]');
Gotoxy(25,19);Textcolor(14+128);
Writeln('Untuk Keluar dari Scaning.');
Gotoxy(25,22);Textcolor(15);Readln(Scan);


IF Scan = 5 Then
    Begin
    KLA := 50;
    Goto 1000;
    end;
```

```
IF Scan = 10 Then
    Begin
    KLA := 100;
    Goto 1000;
    end;
IF Scan = 15 Then
    Begin
    KLA := 150;
    Goto 1000;
    end;
IF Scan = 20 Then
    Begin
    KLA := 200;
    Goto 1000;
    end;
IF Scan = 0 Then
    Begin
    Goto 145;
    end;

end;

1000:
Begin
Clrscr;
Textcolor(15);Write('Waktu Tunda : '); Readln(Tunda);
clrscr;

For N:= 0 To 203 Do


(*.............. PEMUTARAN MOTOR I KE KANAN ..............*)

Begin
IF N = 203 Then

    Begin
    For A:= 1 To KLA  Do

        IF A = KLA  Then
            Begin
            Goto 30;
            end

        ELSE

            Begin
            IF keypressed Then
                Begin
                Writeln;
                Writeln;
                Writeln('Titik Pada Koordinat  ( ',',',',' )');
                Write('Akan melanjutkan, tekan (Y/T)   ');
                Readln(Lanjut);
                IF (Lanjut = 'y') or (Lanjut = 'Y') Then
```

```
                    Begin
                    Goto 10;
                    end

                ELSE

                    Begin
                    IF (Lanjut = 't') or (Lanjut = 'T') Then

                        Begin
                        Goto 30;
                        end

                    ELSE

                        Begin
                        Goto 10;
                        end;

                    end;
                end

                ELSE

10:
                Begin
                For B:= 0 To 2 Do

                    Begin
                    IF B = 0 Then

                    Begin
                    Delay(Tunda);
                    Writeln('MOTOR I PUTAR KANAN',
                    MotorO(2,0):4);
                    Port [$378] := MotorO(2,0);
                    end

                    ELSE

                    Begin
                    Goto 15;
                    end;

15:
                    Begin
                    Delay(Tunda);
                    Writeln('MOTOR I PUTAR KANAN',
                    MotorI(2,B):4);
                    Port [$378] := MotorI(2,B);
                    end;
                end;
            end;
        end;
    end
```

```
ELSE

    Begin
    Goto 1;
    end;



{*.................. PILIHAN PEMUTARAN MOTOR I .................*}
{*.................. UNTUK PEMUTARAN KE KANAN ..................*}

1:
    Begin
    IF N mod 2 = 0 Then

        Begin
        For A:= 1 To KLA - 1 Do

            Begin
            For AAA := 1 To 10 Do
5:
                Begin
                For B:= 0 To 2 Do

                  Begin
                  IF B = 0 Then

                  Begin
                  Delay(Tunda);
                  Writeln('MOTOR I PUTAR KANAN',
                  MotorO(2,0):4);
                  Port [$378] := MotorO(2,0);
                  end

                  ELSE

                  Begin
                  Goto 7;
                  end;

7:
                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KANAN',
                MotorI(2,B):4);
                Port [$378] := MotorI(2,B);
                end;

            end;
            end;

            Begin
            IF keypressed Then
```

```
Begin
clrscr;
Begin
xxx := A div 1;
yyy := N div 1;
gotoxy(20,10);
Writeln('Titik Berada Pada Koordinat (xxx,yyy);
End;
gotoxy(25,13);
Write('Akan melanjutkan tekan (Y/T)');
Readln(Lanjut);
    IF (Lanjut = 'y') or (Lanjut = 'Y') Then

        Begin
        clrscr;
        Goto 5;
        end

    ELSE

        Begin
        IF (Lanjut = 't') or (Lanjut = 'T') Then

            Begin
            Goto 30;
            end

        ELSE

            Begin
            Goto 5;
            end;

        end;
    end

    ELSE
```

```
(*.............. PROGRAM PEMUTARAN MOTOR II KE ATAS ..............
```

```
Begin
IF A div (KLA-1) = 1 Then

    Begin
    For F := 1 To 9+1 Do

    Begin
    For C := 3 To 6 Do
```

```
                    Begin
                    Delay(Tunda);
                    Writeln('PUTAR MOTOR II KE ATAS',
                    MotorI(2,C):5);
                    Port [$378] := MotorI(2,C);
                    end;

                    end;
                    end;

                end;
            end;

    end;

end;
ELSE


{*.............. PILIHAN PENUTARAN MOTOR I ..............*}
{*................. UNTUK PUTARAN KE KIRI  ..............*}

    Begin
    For A:= 1 To KLA - 1  Do

    Begin
    For AAA := 1 To 10 Do

20:
        Begin
        For B:= 2 DownTo 0 Do

            Begin
            Delay(Tunda);
            Writeln('MOTOR I PUTAR KIRI',MotorI(2,B):5);
            Port [$378] := MotorI(2,B);

            IF B = 0 Then

                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KIRI',Motor0(2,0):5);
                Port [$378] := Motor0(2,0);
                end;
            end;
        end;
    IF keypressed Then
        Begin
        Begin
        clrscr;
        xxx := A div 1;
        yyy := N div 1;
        gotoxy(20,10);
        Writeln('Titik Berada Pada Koordinat (xxx,yyy)');
        End;
```

```
        gotoxy(25,13);Write('Akan melanjutkan tekan (Y/T)');
        Readln(Lanjut);
        IF (Lanjut = 'y') or (Lanjut = 'Y') Then

            Begin
            clrscr;
            Goto 20;
            end

        ELSE

            Begin
            IF (Lanjut = 't') or (Lanjut = 'T') Then

                Begin
                Goto 30;
                end

            ELSE

                Begin
                Goto 20;
                end;

            end;
        end

        ELSE


{*.............. PROGRAM PEMUTARAN MOTOR II KE ATAS ..............



                Begin
                IF A div (KLA-1)  = 1 Then

                    Begin
                    For F := 1 To 9+1 Do

                    Begin
                    For C := 3 To 6 Do

                    Begin
                    Delay(Tunda);
                    Writeln('PUTAR MOTOR II KE ATAS',
                    MotorI(2,C):5);
                    Port [$378] := MotorI(2,C);
                    end;
                    end;
                    end;
                end;
            end;
        end;
    end;
end;
```

```
{*.............. PROGRAM PENGEMBALIAN TITIK ..............*}
{*.............. KE KOORDINAT SEMULA  (0,0) ..............*}

30:

Begin

     Begin
     IF N mod 2 = 0 Then
          Begin
          Goto 35;
          end
     ELSE
          Begin
          Goto 45;
          end;
     end;

     Begin
     IF N = 0 Then
          Begin
          Goto 40;
          end;
     end;

35:

Begin
clrscr;
For M:= 0 To N Do

  Begin

40:
        Begin
        For D:= 1 To 1835 Do

        Begin

             Begin
             IF D < A+1 Then

             Begin
             For DDD := 1 To 10 Do

             Begin
             For B := 2 DownTo 0 Do

                  Begin
                  Delay(Tunda);
                  Writeln('MOTOR I PUTAR KIRI',MotorI(2,B):5);
                  Port [$378] := MotorI(2,B);
                  end;
```

```
            IF B = 0 Then

                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KIRI',MotorO(2,0):5);
                Port [$378] := MotorO(2,0);
                end;

            end;
            end

        ELSE

            Begin
            Goto 50;
            end;

        end;

        end;

    end;

end;
end;


45:

Begin
clrscr;
For M:= 0 To N Do

    Begin

       Begin
       IF M mod 2 <> 0 Then

           Begin
           For D:= 1 To 1835 Do

                Begin
                IF A mod (KLA-1)  = 0 Then

                   Begin
                   For F := 1 To 9+1 Do
                   Begin
                   For C := 6 DownTo 3 Do

                   Begin
                   Delay(Tunda);
                   Writeln('PUTAR MOTOR II KE BAWAH',
                   MotorI(2,C):4);
                   Port [$378] := MotorI(2,C);
                   end;
```

```
                    end;
                    end;

                end;
            end;
        end;

            Begin
            For D:= 1 To 1835 Do

                Begin
                IF D < (KLA+1-A)+1 Then

                    Begin
                    For DDD := 1 To 10 Do

                    Begin
                    For B := 2 DownTo 0 Do

                        Begin
                        Delay(Tunda);
                        Writeln('MOTOR I PUTAR KIRI',
                        MotorI(2,B):5);
                        Port [$378] := MotorI(2,B);
                        end;

                    IF B = 0 Then

                        Begin
                        Delay(Tunda);
                        Writeln('MOTOR I PUTAR KIRI',
                        Motor0(2,0):5);
                        Port [$378] := Motor0(2,0);
                        end;

                    end;
                    end

                ELSE

                    Begin
                    Goto 50;
                    end;

                end;

            end;

     end;
end;

end;
```

```
50:

        Begin
        clrscr;
        For E := 0 To 210 Do

            Begin
            IF E < N Then

                Begin
                For F := 1 To 9+1 Do

                Begin
                For C := 6 DownTo 3 Do

                    Begin
                    Delay(Tunda);
                    Writeln('PUTAR MOTOR II KE BAWAH',
                    MotorI(2,C):4);
                    Port [$378] := MotorI(2,C);
                    end;

                end;
                end

            ELSE

                Begin
                Goto Selesai;
                end;

            end;

        end;

Selesai:


{*.............. PROGRAM MEMBAWA TITIK ..............*}
{*.............. KE KOORDINAT TERTENTU ..............*}

Begin
Clrscr;
Writeln;
Gotoxy(13,10);
Writeln('Anda akan menempatkan titik pada Koordinat tertentu ?');
Gotoxy(13,14);Write('Tekan  [ Y / T ]   ');Readln(Titik);
IF (Titik = 'Y') or (Titik = 'y') Then

    Begin
    Goto 79;
    end

ELSE
```

```
    Begin
    Goto 145;
    end;

end;

155:

Begin
Clrscr;
Textcolor(15);Write('Waktu Tunda :   ');Readln(Tunda);
end;

79:

Begin
nn := 0;
mm := 0;

X := nn + 0;
Y := mm + 0;


80:
Clrscr;
Gotoxy(10,5);
Writeln('Koordinat sekarang : ','(',' ',X,' ',',',' ',Y,' ',')');
Gotoxy(10,10);Write('Koordinat  X  yang dituju : '); Readln(nn);
Gotoxy(10,12);Write('Koordinat  Y  yang dituju : '); Readln(mm);
clrscr;

XO := 0;
YO := 0;


    Begin

    Begin

    Begin
    IF  nn > X Then

        Begin
        For AA := X+1 To nn Do

            Begin
            For KA := 1 To 9+1 Do

                Begin
                For B:= 0 To 2 Do

                    Begin

                    Begin
                    IF B = 0 Then
```

```
                    Begin
                    Delay(Tunda);
                    Writeln('MOTOR I PUTAR KANAN',
                    MotorO(2,0):4);
                    Port [$378] := MotorO(2,0);
                    end;

                end;

                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KANAN',
                MotorI(2,B):4);
                Port [$378] := MotorI(2,B);
                end;

                end;

            end;

        end;

    end;

end;

end;

Begin
IF nn < X Then

    Begin
    For AA := X-1 Downto nn Do

        Begin
        For KA := 1 To 9+1 Do

            Begin
            For B:= 2 DownTo 0 Do

                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KIRI',
                MotorI(2,B):5);
                Port [$378] := MotorI(2,B);

                IF B = 0 Then

                    Begin
                    Delay(Tunda);
                    Writeln('MOTOR I PUTAR KIRI',
                    MotorO(2,0):5);
                    Port [$378] := MotorO(2,0);
                    end;
```

```
                end;

            end;

        end;

    end;

X := XO + nn;

end;


Begin

Begin
IF  mm > Y Then

    Begin
    For BB := Y+1 To mm Do

        Begin
        For KB := 1 To 9+1 Do

            Begin
            For C:= 3 To 6 Do

                Begin
                Delay(Tunda);
                Writeln('PUTAR MOTOR II KE ATAS',
                MotorI(2,C):5);
                Port [$378] := MotorI(2,C);
                end;

            end;

        end;

    end;

end;

Begin
IF mm < Y Then

    Begin
    For BB := Y-1 Downto mm Do

        Begin
        For KB := 1 To 9+1 Do

            Begin
            For C:= 6 DownTo 3 Do

                Begin
```

```
                    Delay(Tunda);
                    Writeln('PUTAR MOTOR II KE BAWAH',
                    MotorI(2,C):4);
                    Port [$378] := MotorI(2,C);
                    end;

                end;

            end;

        end;

    end;

    Y := YO + mm;

    end;


    Begin
    clrscr;
    Gotoxy(28,12);Write('Akan Mencari Lagi  (Y/T)',' ');
    Readln(Cari);

        Begin
        IF (Cari = 'Y') or (Cari = 'y') Then

            Begin
            Goto 80;
            end

        ELSE

            Begin
            Goto 100;
            end;

        end;

    end;
    end;


(*.............. PROGRAM MENGEMBALIKAN TITIK ..............*)
(*.............. KE KOORDINAT ASAL  (0,0)  ..............*)

100:

    Begin
    Clrscr;
        Begin
        IF (X = 0) and (Y = 0) Then
            Begin
            Goto 145;
            end;
```

```
        end;
        Begin
        IF (X = 0) and (Y <> 0) Then
            Begin
            Goto 140;
            end;
        end;
        Begin
        IF (X <> 0) and (Y = 0) Then
            Begin
            Goto 130;
            end;
        end;
        Begin
        IF (X <> 0) and (Y <> 0) Then
            Begin
            Goto 120;
            end;
        end;

120:
    Begin

130:
    Begin
    For Z := 1 To X Do

        Begin
        For KA := 1 To 9+1 Do

            Begin
            For B:= 2 DownTo 0 Do

                Begin
                Delay(Tunda);
                Writeln('MOTOR I PUTAR KIRI',
                MotorI(2,B):5);
                Port [$378] := MotorI(2,B);

                    IF B = 0 Then

                    Begin
                    Delay(Tunda);
                    Writeln('MOTOR I PUTAR KIRI',
                    MotorO(2,0):5);
                    Port [$378] := MotorO(2,0);
                    end;

                end;

            end;

        end;

    end;
```

```
140:
    Begin
    For ZZ := 1 To Y Do

        Begin
        For KB := 1 To 9+1 Do

            Begin
            For C:= 6 DownTo 3 Do

                Begin
                Delay(Tunda);
                Writeln('PUTAR MOTOR II KE BAWAH',
                MotorI(2,C):4);
                Port [$3783] := MotorI(2,C);
                end;

            end;

        end;

    end;
    end;

    X := X - Z;
    Y := Y - ZZ;

    end;
    Begin
    Goto 145;
    end;
110:
end;
end;

END.
```

Lampiran II

Tabel 4.1a. Tabel nilai keluaran pada CPPA untuk B dari 0 sampai dengan 7.

B	Nilai Des	Nilai Biner B7..B0
0	1	0000 0001
1	2	0000 0010
2	4	0000 0100
3	8	0000 1000
4	16	0001 0000
5	32	0010 0000
6	64	0100 0000
7	128	1000 0000

Tabel 4.1b. Tabel nilai keluaran pada CPPA untuk B dari 7 sampai dengan 0.

B	Nilai Des	Nilai Biner B7..B0
7	128	1000 0000
6	64	0100 0000
5	32	0010 0000
4	16	0001 0000
3	8	0000 1000
2	4	0000 0100
1	2	0000 0010
0	1	0000 0001

Tabel 4.2. Tabel tegangan dan arus keluaran dari CPPA

No	Bit	Tegangan tanpa beban (V)	Tegangan dengan beban (V)	Arus (mA)
1	0	5	2.33	24.6
2	1	5	2.35	24.6
3	2	5.1	2.33	24.7
4	3	5.1	2.33	24.6
5	4	5	2.34	24.5
6	5	5.1	2.33	24.6
7	6	5	2.34	24.6
8	7	5	2.34	24.5

Tabel 4.3. Tabel Tegangan – arus masukan dan keluaran pada penguat darlington

Bit	Masukan		Keluaran	
	V (Volt)	I (mA)	V (Volt)	I (mA)
0	2.33	24.6	16.5	220.0
1	2.35	24.6	16.2	217.7
2	2.33	24.7	16.0	216.2
3	2.33	24.6	16.5	219.7
4	2.34	24.5	16.4	219.5
5	2.33	24.6	16.4	220.1
6	2.34	24.6	16.0	217.1
7	2.34	24.5	16.0	220.1

Tabel 4.4a. Tabel jumlah step dan besarnya sudut setiap 4 step untuk motor I.

No	Langkah ke-	Sudut (°)
1	0	0.0
2	4	7.2
3	8	14.6
4	12	21.8
5	16	29.0
6	20	36.2
7	24	43.4
8	28	50.8
9	32	58.0
10	36	65.2
11	40	72.4
12	44	77.8
13	48	85.0
14	52	92.0
15	56	99.2
16	60	106.4
17	64	113.6
18	68	121.0
19	72	128.2
20	76	135.4
21	80	142.6
22	84	149.8
23	88	157.0
24	92	164.2
25	96	171.4
26	100	178.6

No	Langkah ke-	Sudut (°)
27	104	185.8
28	108	193.0
29	112	200.2
30	116	207.4
31	120	212.6
32	124	221.8
33	128	229.0
34	132	236.2
35	136	243.4
36	140	250.4
37	144	257.6
38	148	264.8
39	152	272.0
40	156	279.2
41	160	286.4
42	164	293.6
43	168	300.8
44	172	308.0
45	176	315.2
46	180	322.4
47	184	329.8
48	188	337.0
49	192	344.2
50	196	351.4
51	200	360.0

Tabel 4.4b. Tabel jumlah step dan besarnya sudut setiap 4 step untuk motor II.

No	Langkah ke-	Sudut (°)
1	0	0.0
2	4	7.2
3	8	14.4
4	12	21.6
5	16	28.8
6	20	36.2
7	24	43.2
8	28	50.7
9	32	57.6
10	36	65.0
11	40	72.0
12	44	79.2
13	48	86.4
14	52	93.6
15	56	100.8
16	60	108.0
17	64	115.2
18	68	122.4
19	72	129.4
20	76	136.6
21	80	144.0
22	84	151.2
23	88	158.4
24	92	165.4
25	96	172.6
26	100	180.0

No	Langkah ke-	Sudut (°)
27	104	187.2
28	108	194.4
29	112	201.4
30	116	208.8
31	120	216.0
32	124	223.2
33	128	230.2
34	132	237.4
35	136	244.8
36	140	252.0
37	144	259.4
38	148	266.6
39	152	273.8
40	156	280.8
41	160	288.0
42	164	295.4
43	168	302.6
44	172	309.6
45	176	316.8
46	180	324.2
47	184	331.4
48	188	338.6
49	192	345.6
50	196	352.8
51	200	360.0

Tabel 4.5. Tabel Hambatan untuk setiap bit dari kedua motor langkah

Bit	Hambatan (ohm)	
	Motor I	Motor II
1	75,0	74,7
2	74,4	74,6
3	74,0	74,1
4	75,1	74,5

Tabel 4.6a. Tabel jarak translasi (mm) setiap 8 step dari motor I dalam arah sumbu X

No	Step	Jarak (mm)
1	8	0.20
2	16	0.45
3	24	0.65
4	32	0.85
5	40	1.10
6	48	1.30
7	56	1.50
8	64	1.75
9	72	1.95
10	80	2.15
11	88	2.40
12	96	2.60
13	104	2.80
14	112	3.00
15	120	3.25
16	128	3.45
17	136	3.65
18	144	3.90
19	152	4.10
20	160	4.30

No	Step	Jarak (mm)
21	168	4.55
22	176	4.75
23	184	4.95
24	192	5.20
25	200	5.40
26	208	5.60
27	216	5.85
28	224	6.05
29	232	6.25
30	240	6.50
31	248	6.70
32	256	6.90
33	264	7.15
34	272	7.35
35	280	7.55
36	288	7.80
37	296	8.00
38	304	8.20
39	312	8.40
40	320	8.65

Tabel 4.6b. Tabel jarak translasi (mm) setiap 8 step dari motor II dalam arah sumbu Y

No	Step	Jarak (mm)
1	8	0.20
2	16	0.45
3	24	0.65
4	32	0.85
5	40	1.10
6	48	1.30
7	56	1.50
8	64	1.75
9	72	1.90
10	80	2.20
11	88	2.40
12	96	2.60
13	104	2.85
14	112	3.05
15	120	3.25
16	128	3.50
17	136	3.70
18	144	3.90
19	152	4.15
20	160	4.35

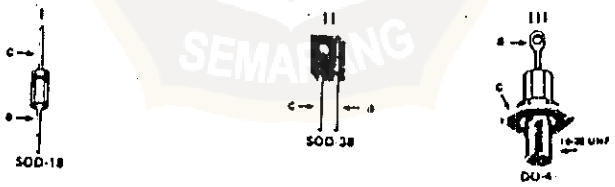
No	Step	Jarak (mm)
21	168	4.55
22	176	4.80
23	184	5.00
24	192	5.20
25	200	5.40
26	208	5.65
27	216	5.85
28	224	6.10
29	232	6.30
30	240	6.50
31	248	6.70
32	256	6.95
33	264	7.15
34	272	7.40
35	280	7.60
36	288	7.80
37	296	8.05
38	304	8.15
39	312	8.45
40	320	8.70

3. Dioda Daya Rendah

tipe	Ge-Si	tegangan terbalik dalam V:	Arus maju dalam mA:	Arus maju puncak dalam mA:	Borosan daya maks. dalam mW:	tegangan maju dalam mV dalam hal mA		arus terbalik dalam µA dalam hal V	
AA 112	Ge	15	30	200	–	0.22	0.1	22	15
AA 116	Ge	20	24	200	–	0.18	0.1	90	20
AA 117	Ge	90	50	500	–	0.18	0.1	40	75
AA 119	Ge	30	35	200	–	0.23	0.1	35	30
BA 127	Si	60	100	200	250	0.97	100	0.02	60
BA 147	Si	25	150	500	–	1	50	0.5	25
BAX 13	Si	50	48	250	500	1.53	75	0.2	50
1N914	Si	100	75	–	500	1	10	25 n	20
1N4148	Si	75	75	500	400	1	10	25 n	20
1N4150	Si	50	200	–	–	1	200	0.1	50
1N4151	Si	50	200	2000	500	0.88	50	14 n	50
1N4448	Si	75	150	–	500	1	100	25 n	20

Dioda Daya Silikon

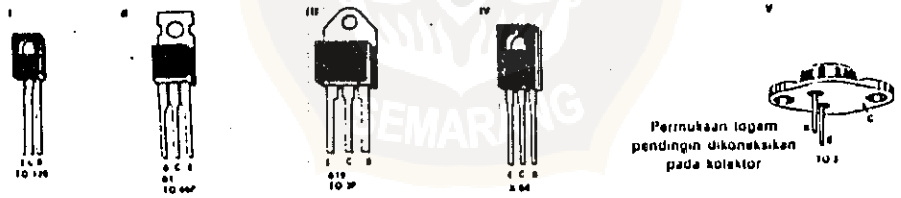
tipe	tegangan terbalik dalam V	arus maju dalam A	arus maju puncak dalam A	tegangan maju dalam V dalam hal A		arus terbalik dalam µA dalam hal V		kemasan
BY 126	650	1	40	1.2	1	–	–	I
BY 127	1250	1	40	1.2	1	–	–	I
BYX 71/350	300	7	80	1.35	5	–	–	II
BYX 71/600	500	7	80	1.35	5	–	–	II
1N3879	50	6	75	1.4	6	3	50	III
1N3881	200	6	75	1.4	6	15	200	III
1N3882	300	6	75	1.4	6	15	300	III
1N3883	400	6	75	1.4	6	15	400	III
1N3884	50	12	140	1.4	12	3	50	III
1N3885	100	12	140	1.4	12	3	100	III
1N3886	200	12	140	1.4	12	3	200	III
1N3887	300	12	140	1.4	12	3	300	III
1N3888	400	12	140	1.4	12	3	400	III
1N3889	50	12	140	1.4	12	25	50	III
1N4001	50	1	50	1.3	1	10	50	I
1N4002	100	1	50	1.3	1	10	100	I
1N4003	200	1	50	1.3	1	10	200	I
1N4004	400	1	50	1.3	1	10	400	I
1N4006	600	1	50	1.3	1	10	600	I
1N4006	800	1	50	1.3	1	10	800	I
1N4007	1000	1	50	1.3	1	10	1000	I
1N5400	50	3	100	1.1	3	20	50	III
1N5401	100	3	100	1.1	3	20	100	III
1N5402	200	3	100	1.1	3	20	200	III
1N5403	300	3	100	1.1	3	20	300	III
1N5404	400	3	100	1.1	3	20	400	III
1N5406	500	3	100	1.1	3	20	500	III
1N5406	600	3	100	1.1	3	20	600	III
1N5407	800	3	100	1.1	3	20	800	III
1N5408	1000	3	100	1.1	3	20	1000	III



13. Data Transistor Daya

tipe	P_{maks} dalam W	U_{maks} dalam V	I_{maks} dalam A	pengustan arus dengan I_C = ... mA		U_{jenuh} U_{CE} dengan I_C = V	mA	frekuensi transisi MHz	T dalam ndet	kemasan	jenis
BD135	7,5	45	1,5	40	250	< 0,5	500	50	-	-	NPN
BD135-6	7,5	45	1,5	40 ...	100	< 0,5	500	50	-	-	NPN
BD135-10	7,5	45	1,5	63 ...	160	< 0,5	500	50	-	-	NPN
BD135-16	7,5	45	1,5	100 ...	250	< 0,5	500	50	-	-	NPN
BD136	7,5	45	1,5	40	250	< 0,5	500	75	-	-	PNP
BD136-6	7,5	45	1,5	40 ...	100	< 0,5	500	75	-	-	PNP
BD136-10	7,5	45	1,5	63 ...	160	< 0,5	500	75	-	-	PNP
BD136-16	7,5	45	1,5	100 ...	250	< 0,5	500	75	-	-	PNP
BD137	7,5	60	1,5	40	250	< 0,5	500	50	-	-	NPN
BD137-6	7,5	60	1,5	40 ...	100	< 0,5	500	50	-	-	NPN
BD137-10	7,5	60	1,5	63 ...	160	< 0,5	500	50	-	-	NPN
BD138	7,5	60	1,5	40	250	< 0,5	500	75	-	-	PNP
BD138-6	7,5	60	1,5	40 ...	100	< 0,5	500	75	-	-	PNP
BD138-10	7,5	60	1,5	63 ...	160	< 0,5	500	75	-	-	PNP
BD139	7,5	80	1,5	40	250	< 0,5	500	50	-	-	NPN
BD139-6	7,5	80	1,5	40 ...	100	< 0,5	500	50	-	-	NPN
BD139-10	7,5	80	1,5	63 ...	160	< 0,5	500	50	-	-	NPN
BD139-16	7,5	80	1,5	100 ...	250	< 0,5	500	50	-	-	NPN
BD140	7,5	80	1,5	40	250	< 0,5	500	75	-	-	PNP
BD140-6	7,5	80	1,5	40 ...	100	< 0,5	500	75	-	-	PNP
BD140-10	7,5	80	1,5	63 ...	160	< 0,5	500	75	-	-	PNP
BD232	25	25	6	40	250	< 1	1 A	3	-	-	NPN
BD234	25	45	6	40	250	< 1	1 A	3	-	-	PNP
BD235	25	60	6	40	250	< 1	1 A	3	-	-	NPN
BD236	25	60	6	40	250	< 1	1 A	3	-	-	PNP
BD237	25	80	6	40	160	< 1	1 A	3	-	-	NPN
BD238	25	80	6	40	160	< 1	1 A	3	-	-	PNP
BD239	30	45	4	> 15	150	< 0,7	1 A	3	300	II	NPN
BD239A	30	60	4	> 15	150	< 0,7	1 A	3	300	II	NPN
BD239B	30	80	4	> 15	150	< 0,7	1 A	3	300	II	NPN
BD240	30	45	4	> 15	150	< 0,7	1 A	3	300	II	PNP
BD240A	30	60	4	> 15	150	< 0,7	1 A	3	300	II	PNP
BD240B	30	80	4	> 15	150	< 0,7	1 A	3	300	II	PNP

tipe	P_{maks} dalam W	U_{maks} dalam V	I_{maks} dalam A	pengustan arus dengan I_C = .. mA		U_{jenuh} U_{CE} dengan I_C = V	A	frekuensi transisi MHz	T dalam ndet	kemasan	jenis
BD241	40	45	6	> 25	1 A	< 1,3	3 A	3	300	II	NPN
BD241A	40	60	6	> 25	1 A	< 1,3	3 A	3	300	II	NPN
BD241B	40	80	6	> 25	1 A	< 1,3	3 A	3	300	II	NPN
BD241C	40	100	6	> 25	1 A	< 1,3	3 A	3	300	II	NPN
BD242	40	45	6	> 25	1 A	< 1,3	3 A	3	300	II	PNP
BD242A	40	60	6	> 25	1 A	< 1,3	3 A	3	300	II	PNP
BD242B	40	80	6	> 25	1 A	< 1,3	3 A	3	300	II	PNP
BD242C	40	100	6	> 25	1 A	< 1,3	3 A	3	300	II	PNP
BD243	65	45	10	> 15	3 A	< 1,5	6 A	3	300	III	NPN
BD243A	65	60	10	> 15	3 A	< 1,5	6 A	3	300	III	NPN
BD243B	65	80	10	> 15	3 A	< 1,5	6 A	3	300	III	NPN
BD243C	65	100	10	> 15	3 A	< 1,5	6 A	3	300	III	NPN
BD244	65	45	10	> 15	3 A	< 1,5	6 A	3	300	III	PNP
BD244A	65	60	10	> 15	3 A	< 1,5	6 A	3	300	III	PNP
BD244B	65	80	10	> 15	3 A	< 1,5	6 A	3	300	III	PNP
BD244C	65	100	10	> 15	3 A	< 1,5	6 A	3	300	III	PNP
BD245	90	45	15	> 20	3 A	< 4	10 A	3	300	III	NPN
BD245A	90	60	15	> 20	3 A	< 4	10 A	3	300	III	NPN
BD245B	90	80	15	> 20	3 A	< 4	10 A	3	300	III	NPN
BD245C	90	100	15	> 20	3 A	< 4	10 A	3	300	III	NPN
BD246	90	45	15	> 20	3 A	< 4	10 A	3	300	III	PNP
BD246A	90	60	15	> 20	3 A	< 4	10 A	3	300	III	PNP
BD246B	90	80	15	> 20	3 A	< 4	10 A	3	300	III	PNP
BD246C	90	100	15	> 20	3 A	< 4	10 A	3	300	III	PNP
BD247	125	45	25	> 10	15 A	< 4	25 A	3	300	III	NPN
BD247A	125	60	25	> 10	15 A	< 4	25 A	3	300	III	NPN
BD247B	125	80	25	> 10	15 A	< 4	25 A	3	300	III	NPN
BD247C	125	100	25	> 10	15 A	< 4	25 A	3	300	III	NPN
BD248	125	45	25	> 10	15 A	< 4	25 A	3	300	III	PNP
BD248A	125	60	25	> 10	15 A	< 4	25 A	3	300	III	PNP
BD248B	125	80	25	> 10	15 A	< 4	25 A	3	300	III	PNP
BD248C	125	100	25	> 10	15 A	< 4	25 A	3	300	III	PNP
BD249	25	25	1	40	250	< 1	1 A	60	-	V	NPN
BD250	25	25	1	40	250	< 1	1 A	60	-	V	PNP
BD433	36	22	10	20	4 A	< 1	10 A	3	-	V	NPN
BD434	36	22	10	20	4 A	< 1	10 A	3	-	V	PNP
BD435	36	32	10	20	4 A	< 1	10 A	3	-	V	NPN
BD436	36	32	10	20	4 A	< 1	10 A	3	-	V	PNP
BD437	36	45	10	20	4 A	< 1	10 A	3	-	V	NPN
BD438	36	45	10	20	4 A	< 1	10 A	3	-	V	PNP



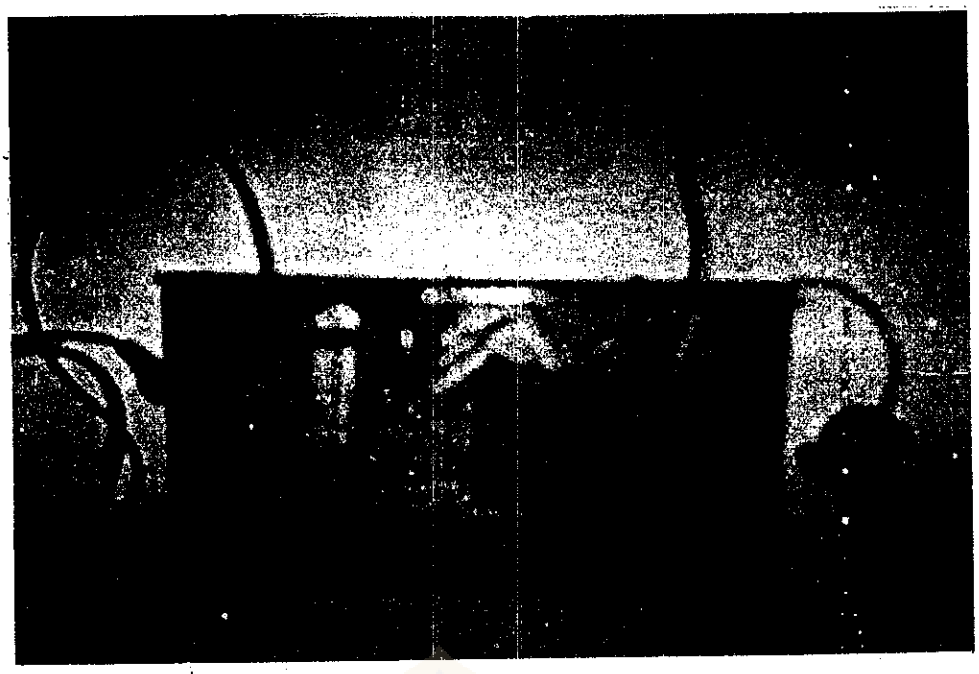


Foto Rangkaian Penguat Darlington

Foto Rangkaian Mekanik

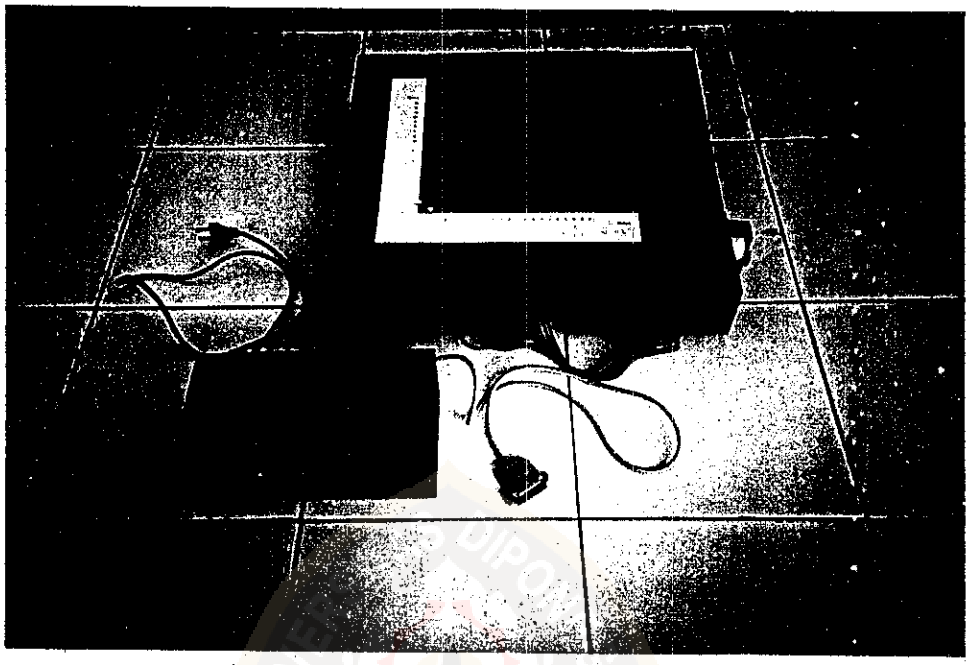


Foto Rangkaian Mekanik

yang telah dihubungkan dengan

Rangkaian Penguat Darlington