Lampiran 1 : Prosedur Program

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Program penguatanautomatik;
Uses dos, Crt, graph;
type da= array[0..10,0..640] of byte;
     pp= array[0..6] of byte;
     Aap= array[0..6] of real;
     VVp= array[0..3200] of integer;

Var
     z,tegref,V,Vmak,Vmin,Vm,Volt,TTrat,frat,fmak,fmin,fW,konfer,
     Tmak,Tmin,Trat,Vef,Vrat,sum,sumef,vma,vmi,Vdc  : real;
     N, m, k,  j, x,  a, b, c,i, grafdrv, grafmode,DP,DPP,IX,IOX,
     IOOX,IOOOX,perI,per20,per200,ke,TTmak,TTmin,cacah,fa,pe,kt
: integer;
     y, yt, yr, auto,auti,manual,pilih1,nol :byte;
     simpan :text;
     ys, yc : da;
     p  : pp;
     Ap,Vp  : Aap;
     Vi,Vj,Vpi,Vpj,TT   :VVp;


  procedure pilih_skala;
  Begin
  clrscr; tegref:=5.02; Vma:=-500; Vmi:=500;
  IX:=6; IOX:=4; IOOX:=2; IOOOX:=0;
  perI:=24; per20:=8; per200:=0;
  DP:=per200+IX;
  port[$378]:=DP;
  DPP:=DP+1;
  p[0]:=per200+IX;p[1]:=per20+IX;p[2]:=per20+IOX;p[3]:=perI+IX;
  p[4]:=perI+IOX;p[5]:=perI+IOOX;p[6]:=perI+IOOOX;

Ap[0]:=1/200;Ap[1]:=1/20;Ap[2]:=1/2;Ap[3]:=1;Ap[4]:=10;Ap[5]:=100;Ap[
6]:=1000;
  manual:=0;
  writeln('   Petunjuk skala pelemahan dan Penguatan');
  writeln('   Pilih (tekan tobol) angka sebagaiberikut');
  writeln('   Angka/Tombol     =    Skala');
  writeln('         0  = -500  Volt sampai +500 Volt');
  writeln('         1  = -50   Volt sampai +50  Volt');
  writeln('         2  = -5    Volt sampai +5   Volt');
  writeln('         3  = -2,5  Volt sampai +2,5 Volt');
  writeln('         4  = -250 mVolt sampai +250 mVolt');
  writeln('         5  = -25  mVolt sampai +25  mVolt');
  writeln('         6  = -2,5 mVolt sampai +2,5 mVolt');
  readln(manual);
  DP:=p[manual];
  port[$378]:=DP;
  DPP:=DP+1;
  delay(2000);
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    for i:=0 to 10 do
        begin
        port[$378]:=DP;
        for m:=0 to 1 do n:=m;
        m:=n;
        yt:=port[$379];
        ys[1,i]:=yt;
        yr:=port[$37A];
        yc[1,i]:=yr;
        port[$378]:=DPP;
        for m:=0 to 1700 do n:=m; {delay inijanganlebihkecil1700}
        end;
    for i:=0 to 10 do
        begin
        y:= ys[1,i] + yc[1,i] - 239;
        V:=((y-nol)/255)*tegref;
        Volt:=V/ap[manual];
        if Volt>Vma then Vma:=Volt;
        if volt<Vmi then Vmi:=Volt;
        end;
    if sqrt(sqr(Vmi))>Vma then Vma:=sqrt(sqr(Vmi));
    I:=1;
    while (V>2.5) and (I=1) do
       begin
       I:=2;
       DP:=p[0];
       port[$378]:=DP;
       writeln(' gagal  = tidak sesuai skala');
       readln;
       end;
    writeln('Vmaksimum=',Vma);
    writeln('Vminimum=',Vmi);
    delay(1000);
    auto:=manual;
 end;

Procedure port_ke_memory;
Begin
for j:=0 to 10 do
    begin
    for i:=0 to 640 do
        begin
        port[$378]:=DP;
        for m:=0 to 1 do n:=m;
        m:=n;
        yt:=port[$379];
        ys[j,i]:=yt;
        yr:=port[$37A];
        yc[j,i]:=yr;
        port[$378]:=DPP;
        for m:=0 to 1700 do n:=m; {delay jangan lebih kecil 1700}
        end;
    end;
End;

Procedure tampilan;
Begin
grafdrv :=detect;
InitGraph(grafdrv,grafmode,' ');
for j:=0 to 10 do
    begin
    cleardevice;
    line(0,nol,640,nol);
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```
    line(0,256,640,256);
    line(320,0,320,256);
    for i:=0 to 640 do
        begin
        y:= ys[j,i] + yc[j,i] - 239;
        delay (1);
        putpixel(i,y,3);
        end;
    end;
end;

Procedure puncak;
begin
Vmak:=-500;
Vmin:=500;
Vdc:=0;
ke:=0;
m:=1;n:=0;
for j:=0 to 10 do
    begin
     for i:=0 to 640 do
        begin
        n:=1;
        y:= ys[j,i] + yc[j,i] - 239;
        if j=10 then Vdc:=Vdc+y;
        while (y>=(Vmak-(Vmak/20))) and (n=1) do
              begin
              n:=2;
              Vi[m]:=i;
              Vj[m]:=j;
              if y>Vmak then Vmak:=y;
              m:=m+1;
              if m>=1500 then Vmak:=-500;
              if m>=3200 then m:=0;
              end;
        if y<Vmin then Vmin:=y;
        end;
     End;
     Vma:=-500;
     for i:=0 to m-1 do
         begin
         n:=2;
         y:= ys[Vj[i],Vi[i]] + yc[Vj[i],Vi[i]] - 239;
         if y>vma then vma:=y;
         while  ((Vi[i]-Vi[i-1])>5) and (n=2) do
                     begin
                     n:=3;
                     Vp[ke]:=vma;
                     Vpi[ke]:=Vi[i];
                     Vpj[ke]:=Vj[i];
                     ke:=ke+1;
                     Vma:=-500;
                     if ke>=320 then ke:=0;
                     end;
          end;
     Vmak:=(((nol-Vmak)/255)*tegref)/ap[auto];
     Vmin:=(((nol-Vmin)/255)*tegref)/ap[auto];
     Vdc:=((((nol-(Vdc/645))/255)*tegref)-0)/ap[auto];
End;

Procedure perioda;
Begin
TTmin:=6400;
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TTmak:=0;
TT[0]:=0;
TTrat:=0;
for m:=1 to ke-1 do
    begin
    if Vpj[m]=Vpj[m-1] then TT[m]:=(Vpi[m]-Vpi[m-1]) ;
    end;
J:=0;
for n:=4 to m do
    begin
    i:=0;
    while (TT[n]>0) and (i=0) do
          begin
          i:=1;
          if TT[n]>=TTmak then TTmak:=TT[n];
          if TT[n]<=TTmin then TTmin:=TT[n];
          ttrat:=ttrat+TT[n];
          end;
    if TT[n]>3 then j:=j+1;
    end;
if j=0 then j:=1;
TTrat:=ttrat/j;
End;

Procedure Konfersifrek;
Begin
Konfer:=6779.9;
frat:=((1/(TTrat+0.000001))*konfer)-0.5291;
fmak:=((1/(TTmak+0.000001))*konfer)-0.5291;
fmin:=((1/(TTmin+0.000001))*konfer)-0.5291;
Trat:=1/frat;Tmak:=1/fmak;Tmin:=1/fmin;
fW:=fmak-fmin;
end;

function fungsibode:string;
Begin
        case cacah of
          1: fa :=32;
          2: fa :=12;
          3: fa :=32;
          4: begin
               fa :=7;
               y:= ys[j,i] + yc[j,i] - 239;
               V:=((y-nol)/255)*tegref;
               sum := sum + (V*fa);
               sumef:= sumef + (sqr(V)*fa);
             end;
        end;
        y:= ys[j,i] + yc[j,i] - 239;
        V:=((y-nol)/255)*tegref;
        sum := sum + (V*fa);
        sumef:= sumef + (sqr(V)*fa);
        cacah:= cacah + 1;
        if(cacah=5) then cacah :=1;

End;

Procedure bode;
Begin
y:= ys[Vpj[ke-3],Vpi[ke-3]] + yc[Vpj[ke-3],Vpi[ke-3]] - 239;
V:=((y-nol)/255)*tegref;
sum:=(7.0*V);
sumef:=(7.0*sqr(V));
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```
Vrat:=0;
Vef:=0;
Cacah:=1;
n:=0;
while (Vpj[ke-2]-Vpj[ke-3]=0) and (n=0) do
      begin
      n:=1;
      j:=Vpj[ke-2];
      for i:=(Vpi[ke-3]+1) to Vpi[ke-2] do fungsibode;
      end;
while (Vpj[ke-2]-Vpj[ke-3]>0) and (n=0) do
      begin
      n:=2;
      for j:=Vpj[ke-3] to Vpj[ke-2] do
          begin
          n:=3;
          while (j<=Vpj[ke-3]) and (n=3) do
                begin
                n:=4;
                for i:=(Vpi[ke-3]+1) to 640 do fungsibode;
                end;
          while (j>Vpj[ke-3]) and (n=3) do
                begin
                n:=5;
                while (j<Vpj[ke-2]) and (n=5) do
                      begin
                      n:=6;
                      for i:=0 to 640 do fungsibode;
                      End;
                end;
          while (j>Vpj[ke-2]) and (n=3) do
                begin
                n:=7;
                for i:=0 to (Vpi[ke-2]-1) do fungsibode;
                end;
          end;
      End;
y:= ys[Vpj[ke-2],Vpi[ke-2]] + yc[Vpj[ke-2],Vpi[ke-2]] - 239;
V:=((y-nol)/255)*tegref;
sum := sum + (7.0*V);
sumef:= sumef + (sqr(V)*fa);
sum := ((2.0*1)/45.0)*sum;
sumef := ((2.0*1)/45.0)*sumef;
pe:=(Vpi[ke-2]+(((Vpj[ke-2]-Vpj[ke-3])*640)-Vpi[ke-3]));
if pe>0 then Vrat:=sum/pe;
Vrat:=-Vrat/ap[auto];
if pe>0 then Vef:=sqrt(sumef*1/(Pe));
Vef:=Vef/ap[auto];
end;

Procedure konfersiteg;
Begin
case auto of
     0: begin
              Vmak:= Vmak;
              Vmin:= Vmin;
              Vdc:=  Vdc;
              Vrat:= Vrat;
              Vef:=  Vef;
        End;
     1: begin
              Vmak:= (1.1292*Vmak) -0.1333;
              Vmin:= (1.1292*Vmin) -0.1333;
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                Vdc:=  (1.1292*Vdc) -0.1333;
                Vrat:= (1.1292*Vrat) -0.1333;
                Vef:=  (1.1292*Vef) -0.1333;
            End;
        2:begin
                Vmak:= (1.1209*Vmak) +0.0268;
                Vmin:= (1.1209*Vmin) +0.0268;
                Vdc:=  (1.1209*Vdc) +0.0268;
                Vrat:= (1.1209*Vrat) +0.0268;
                Vef:=  (1.1209*Vef) +0.0268;
            End;
        3: begin
                Vmak:= (0.0212*Vmak*Vmak*Vmak)-
(0.0039*Vmak*Vmak)+(0.9616*Vmak)+0.0128;
                Vmin:= (0.0212*Vmin*Vmin*Vmin)-
(0.0039*Vmin*Vmin)+(0.9616*Vmin)+0.0128;
                Vdc:=  (0.0212*Vdc*Vdc*Vdc)-
(0.0039*Vdc*Vdc)+(0.9616*Vdc)+0.0128;
                Vrat:= (0.0212*Vrat*Vrat*Vrat)-
(0.0039*Vrat*Vrat)+(0.9616*Vrat)+0.0128;
                Vef:=  (0.0212*Vef*Vef*Vef)-
(0.0039*Vef*Vef)+(0.9616*Vef)+0.0128;
            End;
        4: begin
                Vmak:= (1.0027*Vmak) -0.0001;
                Vmin:= (1.0027*Vmin) -0.0001;
                Vdc:=  (1.0027*Vdc) -0.0001;
                Vrat:= (1.0027*Vrat) -0.0001;
                Vef:=  (1.0027*Vef) -0.0001;
            End;
        5: begin
                Vmak:= (1.0323*Vmak) +0.0007;
                Vmin:= (1.0323*Vmin) +0.0007;
                Vdc:=  (1.0323*Vdc) +0.0007;
                Vrat:= (1.0323*Vrat) +0.0007;
                Vef:=  (1.0323*Vef) +0.0007;
            End;
    End;
    End;

  function intkestr(ii:integer):string;
  var s:string[8];
  begin
  str(i,s);
  intkestr:=s;
  end;

  function realkestr(rr:real):string;
  var s:string[18];
  begin
  str(rr,s);
  realkestr:=s;
  end;

    Procedure analisa;
    Begin
    outtextxy(5,280,'Tegangan Mak(Vdc)');
    outtextxy(180,280,realkestr(vmin));
    outtextxy(5,295,'Tegangan Min');
    outtextxy(180,295,realkestr(vmak));
    outtextxy(5,310,'Tegangan rata-rata(ac)');
    outtextxy(180,310,realkestr(Vrat));
    outtextxy(5,325,'TegDC rata-rata');
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outtextxy(180,325,realkestr(Vdc));
outtextxy(5,340,'Tegangan efektif');
outtextxy(180,340,realkestr(Vef));
outtextxy(340,280,'Frekuensi Mak');
outtextxy(500,280,realkestr(fmak));
outtextxy(340,295,'Frekuensi Min');
outtextxy(500,295,realkestr(fmin));
outtextxy(340,310,'Frekuensi rata-rata');
outtextxy(500,310,realkestr(frat));
outtextxy(340,325,'Perioda Mak');
outtextxy(500,325,realkestr(Tmak));
outtextxy(340,340,'Perioda Min');
outtextxy(500,340,realkestr(Tmin));
outtextxy(340,355,'Perioda rata-rata');
outtextxy(500,355,realkestr(Trat));
End;

Procedure Save_A;
Begin
assign(simpan,'a:dat1.dat');
rewrite(simpan);
for j:=0 to 10 do
    begin
    for i:=0 to 640 do
    begin
    y:= ys[j,i] + yc[j,i] - 239;
    writeln(simpan,y);
    flush(simpan);
    end;
    end;
writeln(simpan,vmak);
flush(simpan);
writeln(simpan,vmin);
flush(simpan);
writeln(simpan,Vrat);
flush(simpan);
writeln(simpan,Vef);
flush(simpan);
writeln(simpan,Vdc);
flush(simpan);
writeln(simpan,fmak);
flush(simpan);
writeln(simpan,fmin);
flush(simpan);
writeln(simpan,frat);
flush(simpan);
writeln(simpan,Tmak);
flush(simpan);
writeln(simpan,Tmin);
flush(simpan);
writeln(simpan,Trat);
flush(simpan);
close(simpan);
end;

Procedure Baca_disk;
Begin
assign(simpan, 'a:dat1.dat');
reset(simpan);
grafdrv :=detect;
InitGraph(grafdrv,grafmode,' ');
for j:=0 to 10 do
    begin
```

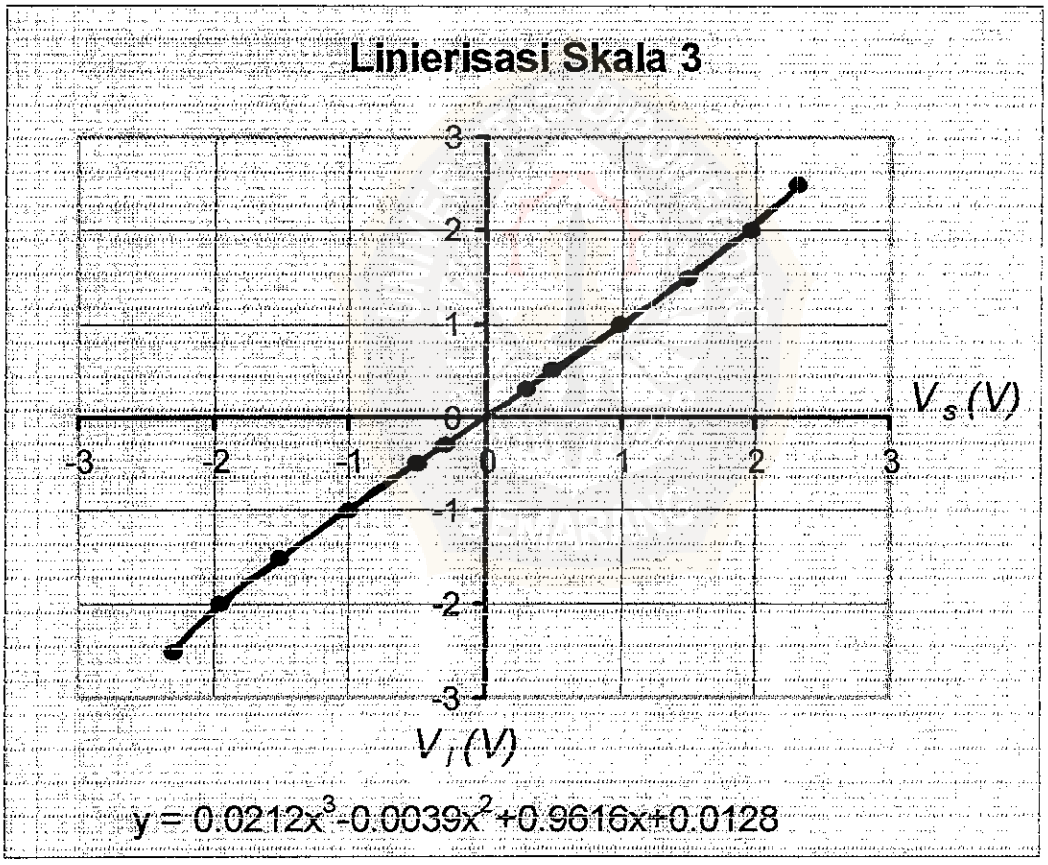
```
        cleardevice;
              cleardevice;
        line(0,nol,640,nol);
        line(0,256,640,256);
        line(320,0,320,256);
        for i:=0 to 640 do
        begin
        readln(simpan,y);
        delay(1);
        putpixel(i, y,3);
        end;
        end;
   readln(simpan,vmak);
   readln(simpan,vmin);
   readln(simpan,Vrat);
   readln(simpan,Vef);
   readln(simpan,Vdc);
   readln(simpan,fmak);
   readln(simpan,fmin);
   readln(simpan,frat);
   readln(simpan,Tmak);
   readln(simpan,Tmin);
   readln(simpan,Trat);
   close(simpan);
   end;


{Program Utama}
Begin
nol:=128;
clrscr;
writeln('       Selamat Menggunakan Program Penampil Sinyal');
writeln('       ');
writeln('       Pilih :');
writeln('       1 = Tampilan Data Disket');
writeln('       2 = Tampilan Sinyal Baru');
pilih1:=1;
write;
readln(pilih1);
while pilih1=1 do
      begin
      clrscr;
      writeln('         Masukkan disket ke drive A (lalu tekan
enter)');
      Readln;
      writeln('         Sedang Baca Data');
      Baca_disk;
      analisa;
      pilih1:=0;
      readln;
      end;
while pilih1=2 do
begin
pilih_skala;
delay(2000);
port_ke_memory;
DP:=per200+IX;
port[$378]:=DP;
puncak;
Bode;
perioda;
konfersifrek;
konfersiteg;
```

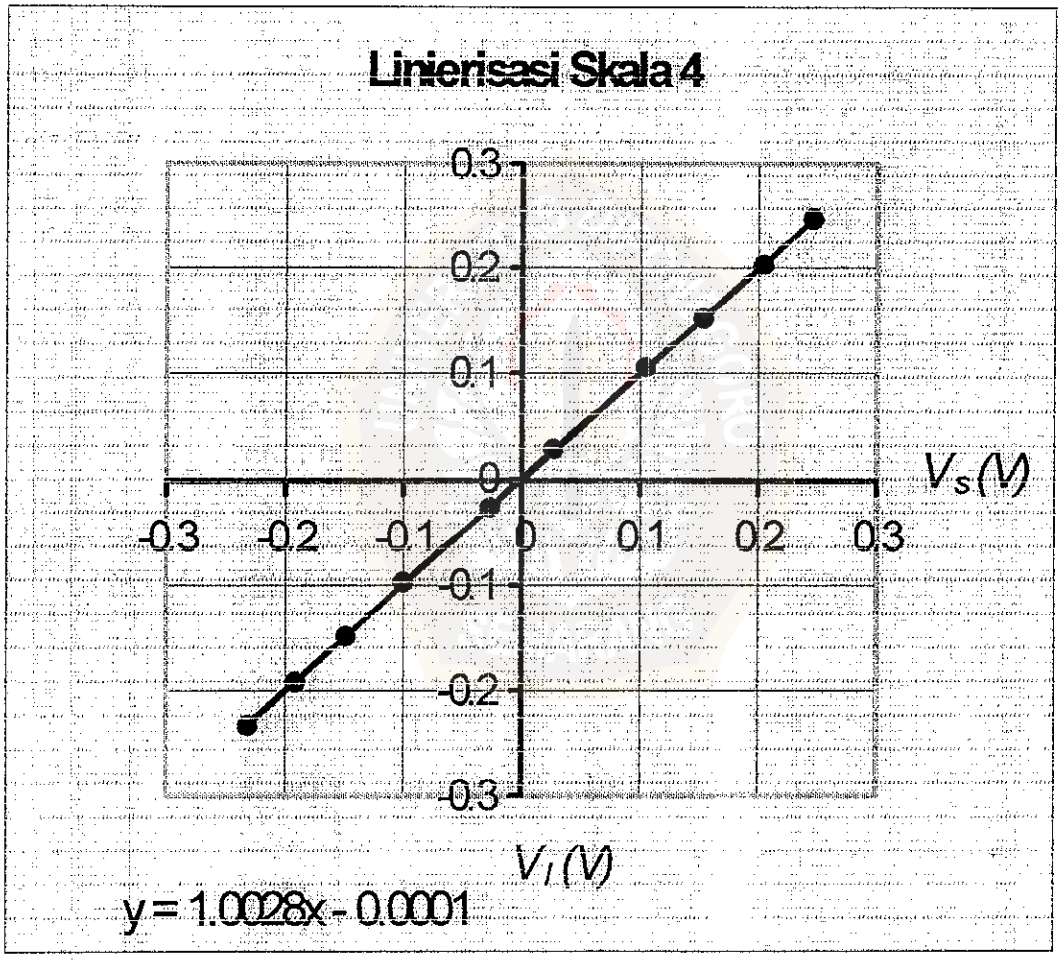
```
tampilan;
analisa;
readln;
closegraph;
clrscr;
write('     simpan data tekan 3 (bila tidak disimpan tekan 0)');
readln(pilih1);
if pilih1>2 then Save_A;
end;
end.
```

Lampiran 2 : Pengujian tegangan pada tiap skala untuk linierisasi

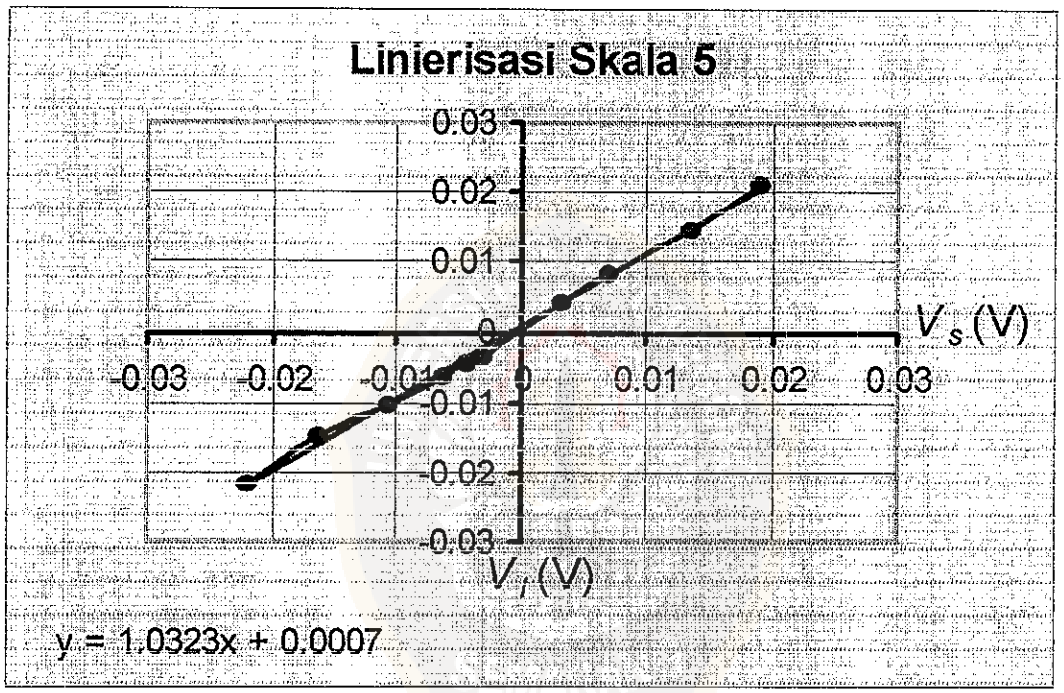
Skala	$V_r = V_t$ (V)	V_s (V)		
		min	mak	rata
3	-2.5	-2.30329	-2.2836	-2.293445
	-2	-1.968627	-1.948	-1.9583135
	-1.5	-1.51584	-1.49615	-1.505995
	-1	-1.023686	-9.84E-01	-1.0039996
	-0.493	-5.12E-01	-4.92E-01	-0.5019995
	-0.299	-3.15E-01	-2.95E-01	-0.305135
	0.311	2.95E-01	3.15E-01	0.304895
	0.501	4.72E-01	4.92E-01	0.48231
	1.008	9.84E-01	1.004	0.9941565
	1.5	1.47647	1.49615	1.48631
	2	1.948	1.96862	1.95831
	2.5	2.3032	2.32298	2.31309



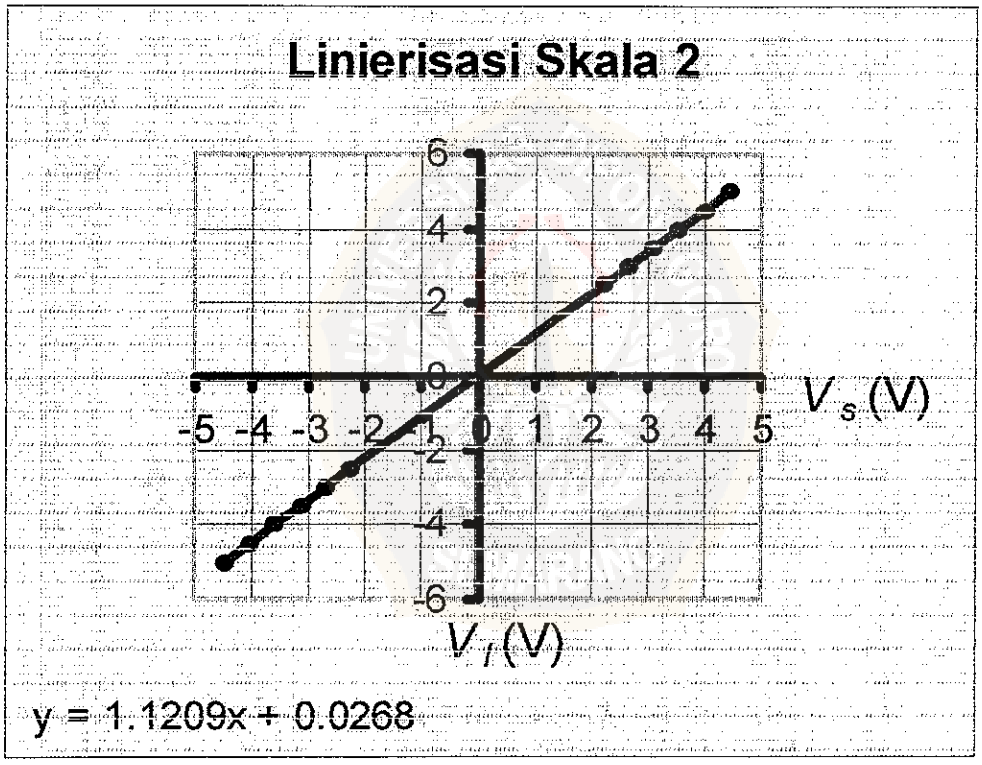
Skala	$V_r = V_l$	V_s (V)		
	(V)	min	mak	rata
4	-0.234	-0.23426	-0.230329	-0.230751
	-0.1915	-0.19686	-0.1909	-0.19117
	-0.14985	-0.1555	-1.4764	-0.1499
	-0.0986	-0.104337	-0.098431	-0.099201
	-0.0257	-0.029529411	-0.0255921	-0.02577833
	0.285	0.0255921	0.02952	0.02755605
	0.1061	0.1023686	0.106305	0.1043368
	0.153	0.149615	0.15521	0.1524125
	0.202	0.202768	0.206705	0.2047365
	0.247	0.244109	0.248047	0.246078



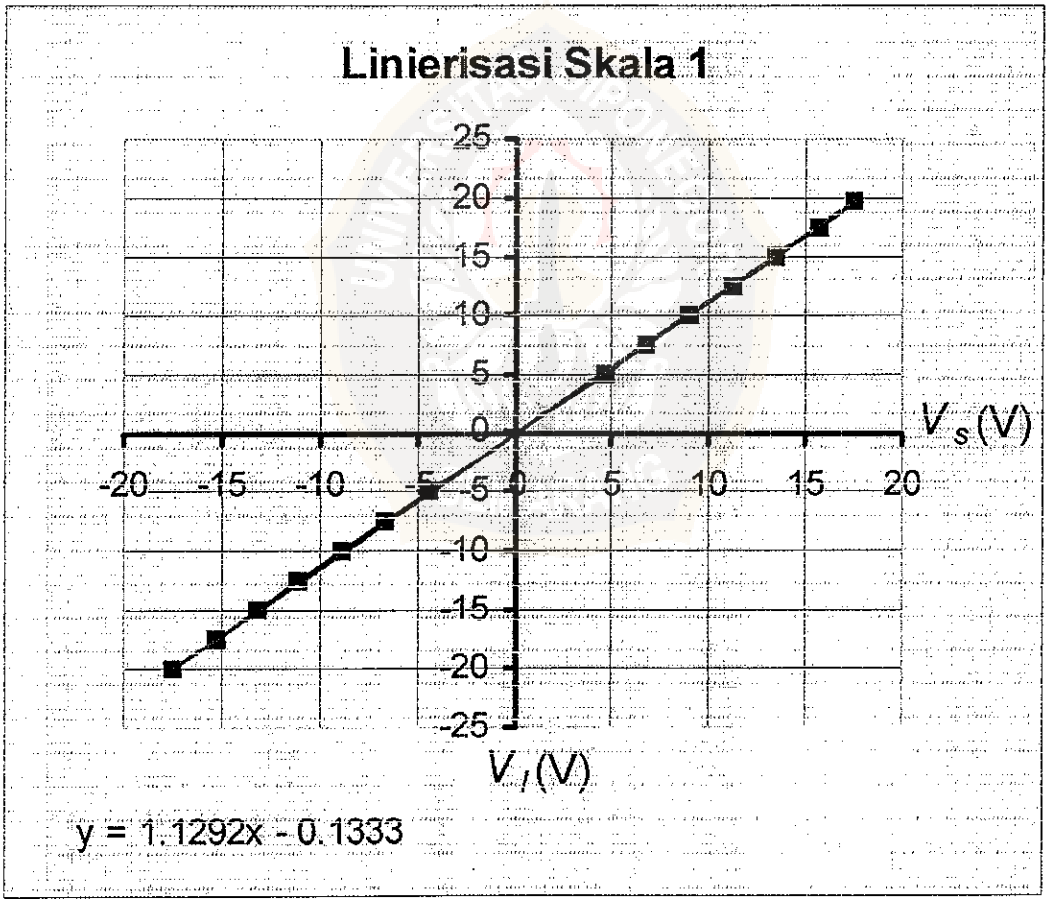
Skala	$V_r = V_l$ (V)	V_s (V)		
		min	mak	rata
5	-0.0217	-0.0222454	-0.02067	-0.0219372
	-0.0149	-0.01693	-0.01437	-0.01625
	-0.0103	-0.011024	-0.00925254	-0.010582
	-0.0063	-0.0066933	-0.0055121	-0.0061189
	-0.0044	-0.004724	-0.002952941	-0.0044115
	-0.0035	-0.0037	-0.0030378	-0.00309
	0.0042	0.002362	0.004921	0.0033259
	0.0082	0.0072244	0.0096462	0.00708705
	0.0144	0.012362	0.015945	0.013474
	0.0211	0.019095	0.022245	0.018977



Skala	$V_r = V_l$	V_s (V)		
	(V)	min	mak	rata
2	-5	-4.48291	-4.64596	-4.48291
	-4.5	-4.2128	-3.9766	-4.03797
	-4	-3.7797	-3.5435	-3.59889
	-3.5	-3.19888	-3.071	-3.1314
	-3	-2.8747	-2.26379	-2.707
	-2.51	-2.44109	-2.20486	-2.26828
	2.505	2.6473	2.36233	2.21676
	3	2.51984	2.7954	2.659142
	3.495	2.9529	3.22854	3.09858
	4	3.42541	3.66164	3.5117
	4.5	3.9372	4.09474	3.99646
	5	4.33098	4.56721	4.44836



Skala	$V_r = V_l$	V_s (V)		
	(V)	min	mak	rata
1	-19.915	-19.7259	-18.565	-17.5315
	-17.5	-16.5365	-14.5678	-15.2851
	-15.02	-14.567841	12.59921	-13.10281
	-12.495	-12.59921	-10.23686	-11.01088
	-10.04	-10.23686	-7.874509	-8.806
	-7.495	-7.8745	-5.9658	-6.59871
	-5.005	-5.9058	-3.5435	-4.39141
	5.02	3.14298031	5.11843	4.617881
	7.5	5.51215	7.48078	6.7645
	10	7.874509	9.84613	8.96045
	12.5	9.8431	12.2055	11.26055
	15	12.2055	14.17411	13.4294
	17.49	14.7259	16.5365	15.6196
	19.74	18.505	19.7259	17.5315

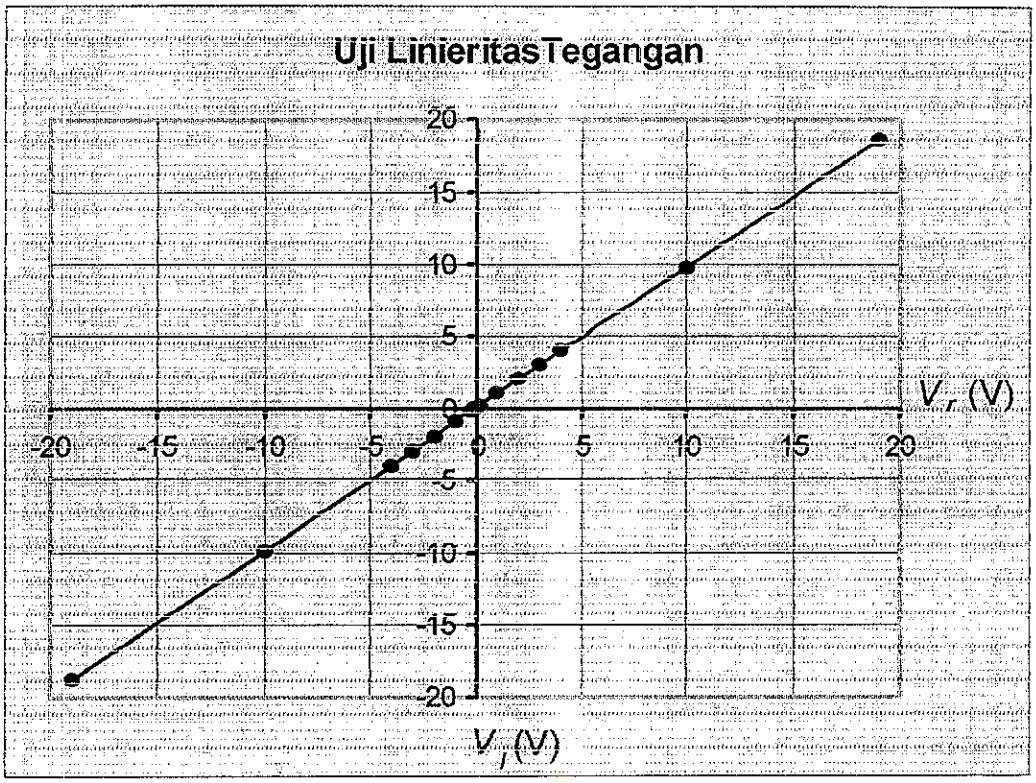


Lampiran 3 : Ralat pada tiap skala

Skala	Range tegangan (V)	Ralat (V)
0	1000	3.921568627
1	40	0.156862745
2	10	0.039215686
3	5	0.019607843
4	0.5	0.001960784
5	0.05	0.000196078
6	0.005	1.96078E-05

Lampiran 4 : Uji linieritas tegangan

Vr (V)	V_i (V)
-19	-18.77671
-9.97	-9.9205897
-4	-3.992832792
-3	-2.998307
-2	-2.00179092
-1.003	-0.96791
-0.203	-0.20298152
-0.1057	-0.106255
-0.0207	-0.02114929
-0.01	-0.010112324
0.0104	0.010701329
0.02	0.020072679
0.0994	0.098927446
0.199	0.199078473
1.005	0.9987224
2	2.04845
3	3.01133
4.01	4.009142
10	9.756
19	18.542887

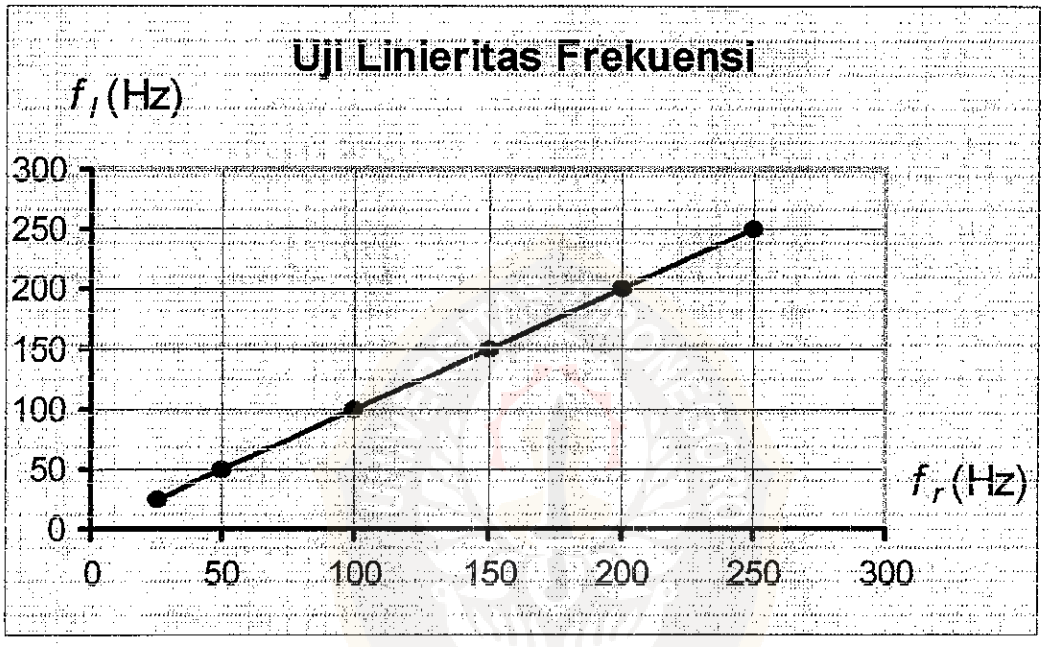


Lampiran 5 : Data frekuensi untuk dilinierisasi.

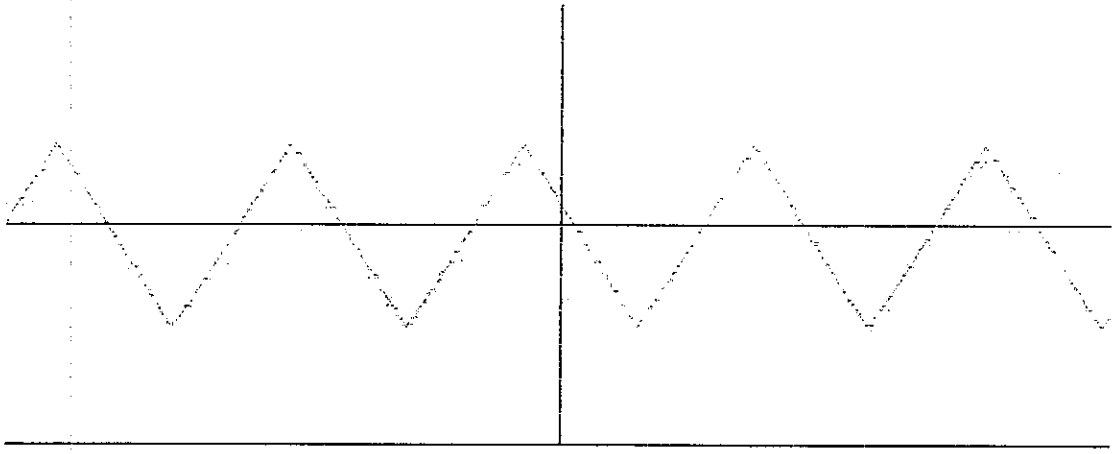
No.	$f_r = f_l$ (Hz)	f_s (Hz)		
		min	mak	rata-rata
1	25.0085	3.70E-03	3.72E-03	3.71E-03
2	30.0035	4.42E-03	4.57E-03	4.46E-03
3	40.009	5.81E-03	6.13E-03	5.98E-03
4	50	7.30E-03	7.52E-03	7.42E-03
5	60.004	8.77E-03	9.69E-03	8.91E-03
6	70.062	1.00E-02	1.08E-02	1.08E-02
7	80.095	1.16E-02	1.23E-02	1.19E-02
8	90.19	1.30E-02	1.39E-02	1.34E-02
9	100.01	1.41E-02	1.61E-02	1.49E-02
10	125.03	1.79E-02	1.96E-02	1.86E-02
11	150.002	2.08E-02	2.56E-02	2.23E-02
12	175.02	2.44E-02	2.86E-02	2.60E-02
13	200.04	1.47E-02	3.45E-02	2.96E-02
14	225.03	1.67E-02	3.31E-02	3.31E-02
15	250.03	1.82E-02	4.55E-02	3.69E-02

Lampiran 6 : Uji frekuensi linier

f_r (Hz)	f_l (Hz)
25	24.71252
50.3	49.91658
100.032	100.0325
150.01	150.7927
200	200.1762
250.07	250.4606

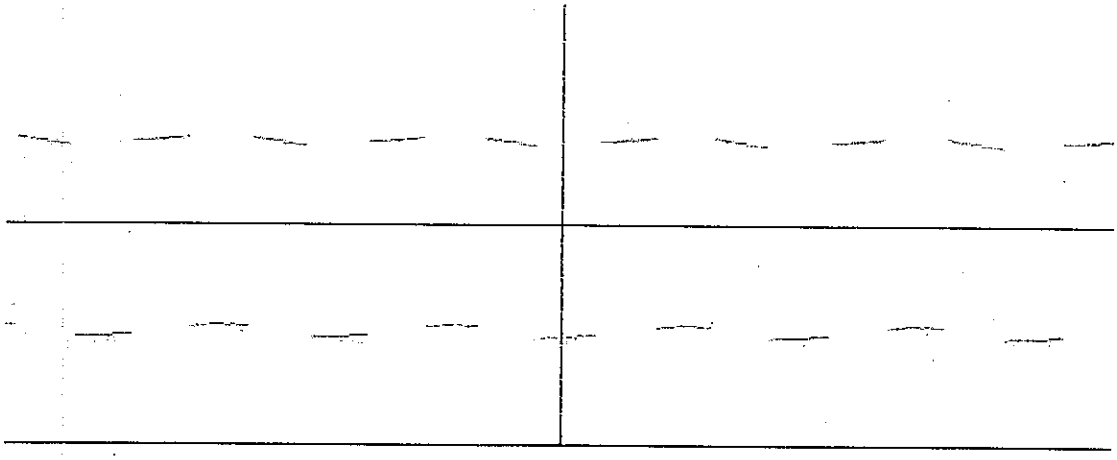


Lampiran 7 : Hasil tampilan gerigi



Tegangan Mak(Vdc)	9.3386039346E-01	Frekuensi Mak	4.8959220807E+01
Tegangan Min	-1.1633970543E+00	Frekuensi Min	5.1623976522E+01
Tegangan rata-rata(ac)	-1.1574487157E-01	Frekuensi rata-rata	4.9872617134E+01
TegDC rata-rata	-7.9646516293E-02	Perioda Mak	2.0425161666E-02
Tegangan efektif	6.2670313170E-01	Perioda Min	1.9370844080E-02
		Perioda rata-rata	2.0051083289E-02

Lampiran 8 : Hasil tampilan gelombang kotak



Tegangan Mak(Vdc)	1.0359412674E+00	Frekuensi Mak	9.7730318866E+01
Tegangan Min	-1.3109628306E+00	Frekuensi Min	1.0219665602E+02
Tegangan rata-rata(ac)	-1.3825131468E-01	Frekuensi rata-rata	1.0014331427E+02
TegDC rata-rata	-4.2276119651E-02	Periode Mak	1.0232392O3E-02
Tegangan efektif	1.1390928169E+00	Periode Min	9.7850559788E-03
		Periode rata-rata	9.9856090828E-03