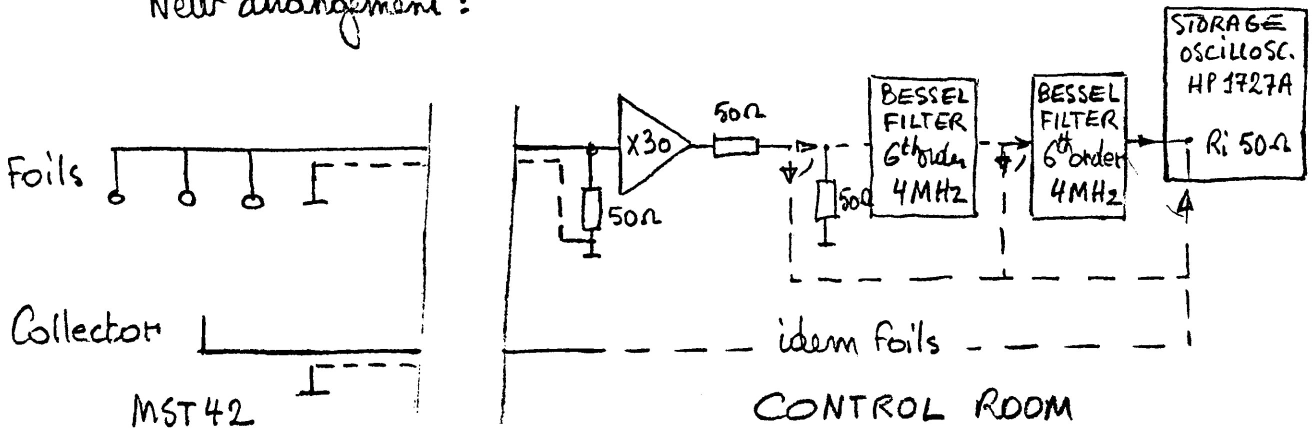
10.01.85

Improved circuits for observation of MST42 fast and slow electrons – Meas^t of remaining noise induced by DFH41/42.

New arrangement:



Shields of coaxial cables have been provisionally grounded to MST42 tank – Amplifier of effective gain 15 (See Annexe AI) is now in rack F032 of Lear Control room and can be followed by one or two Bessel filters (6th order, cut-off freq. 3dB : 4MHz. See Annexe A II)

The induced noise at the F032 end of the foils cable is ≈ ± 10mV (mainly 5MHz ringing), equivalent to ± 200 μA detector current in 50 Ω – This represents a reduction of about 6 since november (cable shields were not connected to MST42) –

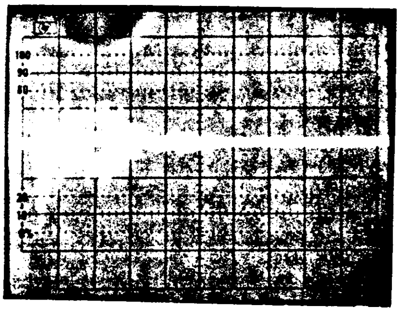
This signal, important only in the rising part of DFH 41/42 pulse, is shown on next page together with amplifier output through 0, 1 or 2 Bessel filters with noise reductions respectively 6, 18, 40 –

In the last case of 2 filters in series, the residual noise is equivalent to ± 30 μA input current – This is about 5 times too much for the measuring conditions of november 84, without pulsing DFH41/42 and with a small beam.

Measurements in normal conditions appears now possible with more careful shielding of MST 42 signals, H^- beam close to nominal value and a Bessel filter of lower cut-off frequency, but still exceeding rotation frequency - See Annexe III -

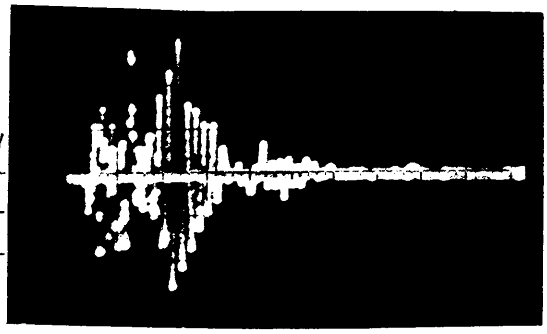
<u>Reference</u> : Test Foil-diagnostics E. Steffens 19-11-84

10mV/div



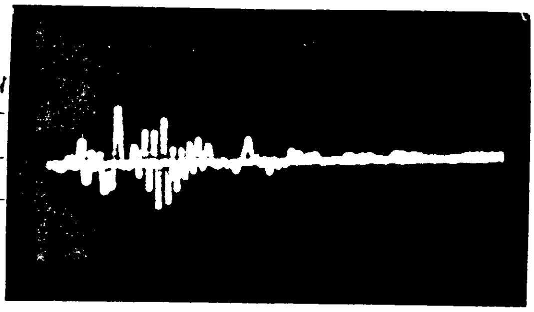
Noise on Foils cable (Collector cable : ≃ twice)

50mV/div



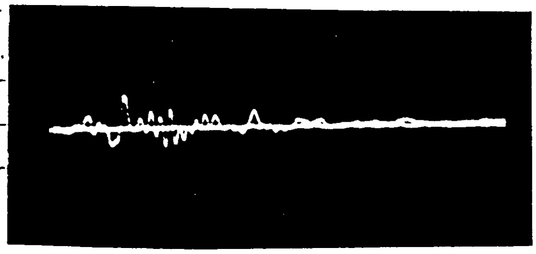
Foils signal out of amplifier without filter -

50mV/div



Foils signal out of amplifier followed by one filter

50mV /div.



Foils signals out of amplifier followed by two filters in series

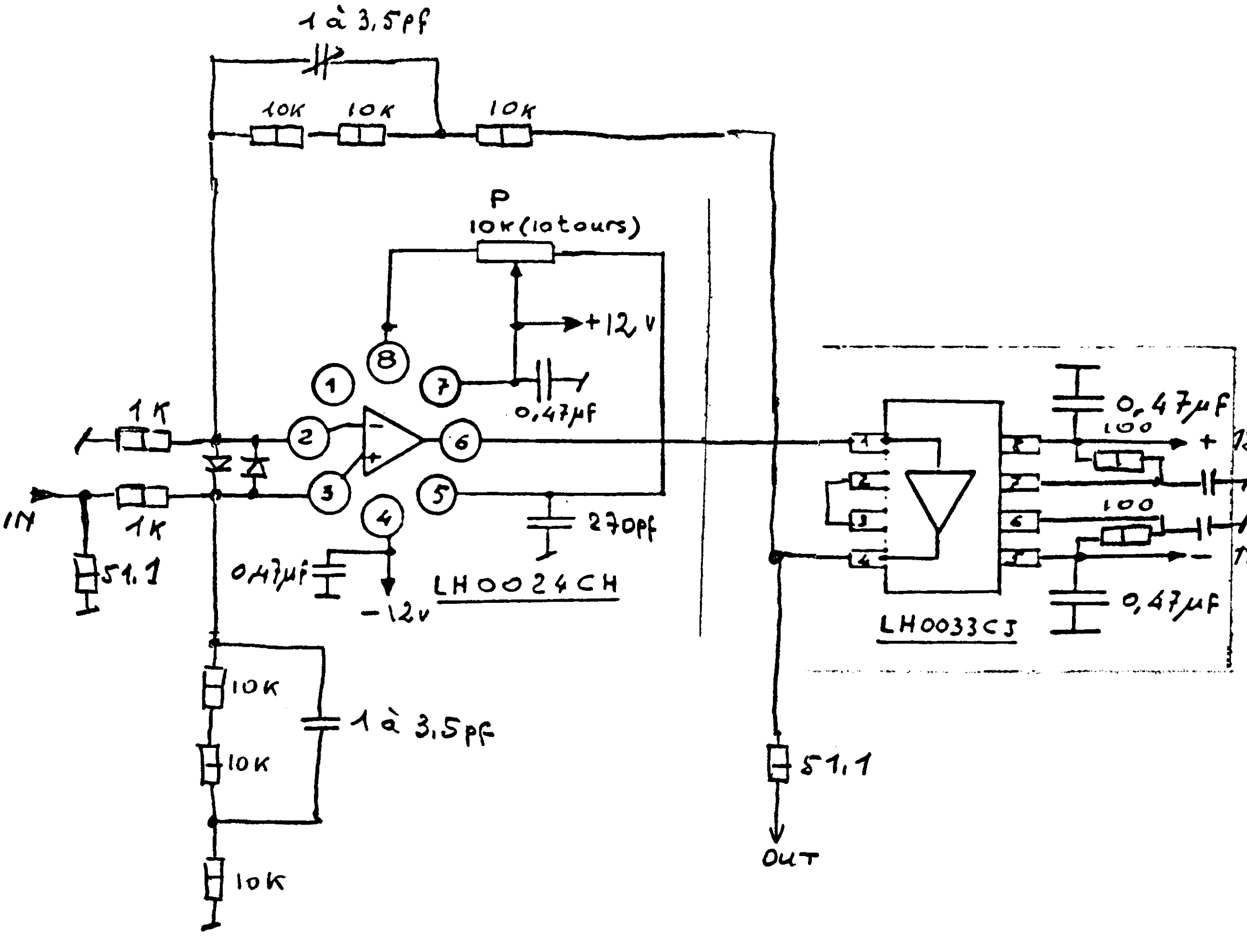
horiz. sweep: 1μs/div. (flat top length 12-13 μs) -

E. Asseo , C. Mazeline

Annexe AI

Ampli

On peut considérer le signal comme étant produit par une source de courant (grande impédance interne). La transmission entre l'anneau Lear et la salle de contrôle étant faite par coaxial 50Ω, on recevra le signaux sur une adaptation 50Ω



Annexe II

Elimination du bruit par filtrage

- Les fréquences de bruit sont approximativement :

$$f_b \geqslant 5\,MHz.$$

- On veut donc couper les fréquences de bruit (sans déformer le signal utile donc réponse de Bessel = retard pur) le plus vite possible tout en laissant le maximum de bande passante pour le signal utile. Il faut donc réaliser un filtre donnant le maximum d'atténuation pour les fréquences supérieures et proches de f_{3dB}. Sur la figure ci-après on voit que pour les fréquences comprises entre f_{3dB} et $2\,f_{3dB}$, on ne gagne que très peu en atténuation pour les filtres d'ordre $n \geq 6$. On prendra donc un filtre d'ordre $n = 6$.

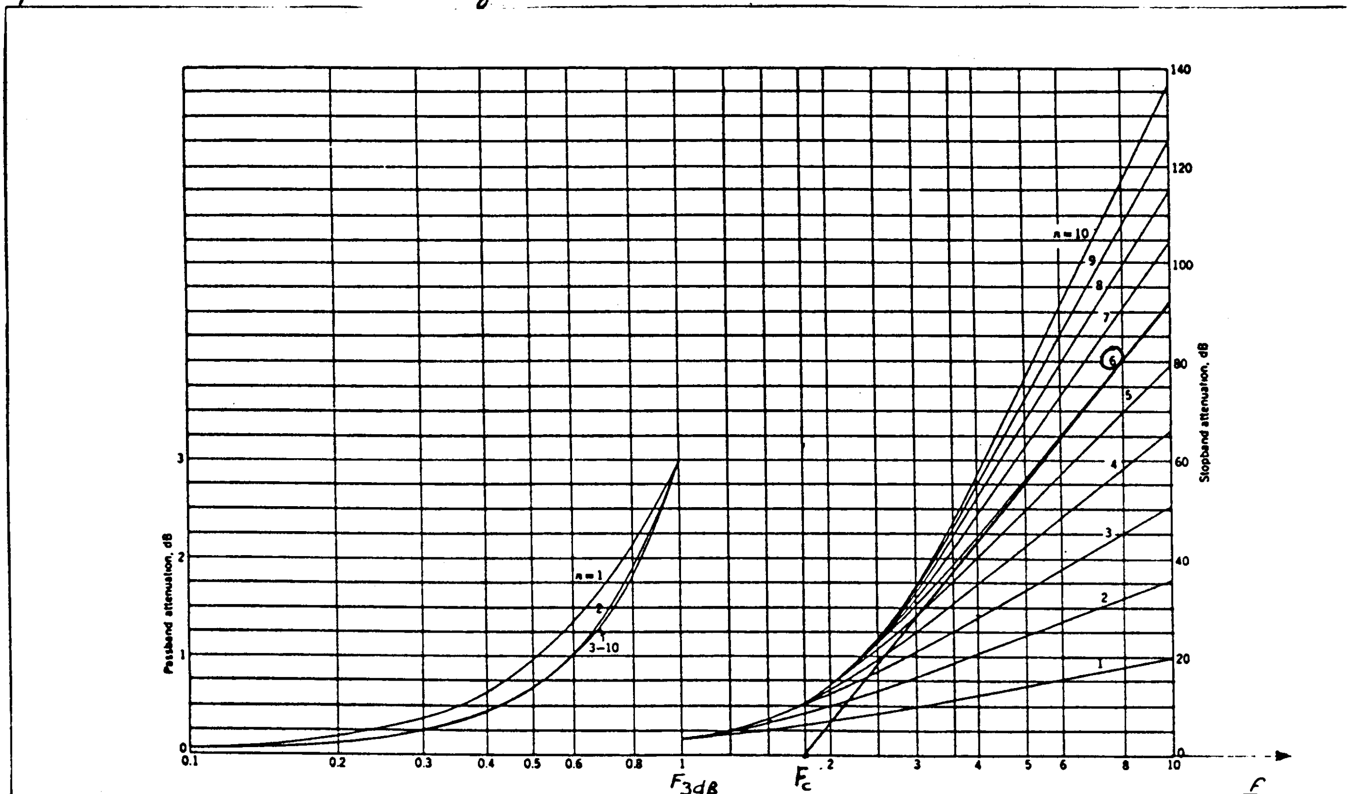


Figure Attenuation characteristics for maximally flat delay (Bessel) filters.

- Pour les signaux rapide on veut un temps de réponse indiciel $T_i \simeq 200$ à 220 nsec.
- Pour les filtres $n \geq 6$, le délais de propagation de groupe est pratiquement $T_g = \frac{T_i}{2}$ d'où

$$T_g = 100 \text{ à } 110 \text{ nsec.}$$

- Par ailleurs on voit sur la figure précédante que

$$f_c = f_{3dB} \times 1,75$$

f_c étant la fréquence de coupure qui donne un déphasage $\phi_c = n \times \frac{\pi}{4}$

- Par ailleurs :

$$T_g = \frac{\phi_c}{2\pi f_c} = \frac{T_i}{2}$$

d'où pour $n = 6$

$$f_c = \frac{n\frac{\pi}{4} \times 2}{2\pi T_i} = \frac{n}{4 \times T_i} = \frac{6}{4 \times T_i} = \frac{3}{2 T_i}$$

et $$f_{3dB} = \frac{3}{2 T_i} \times \frac{1}{1,75}$$

pour $T_i = 200 \; 10^{-9}$ sec on obtient

$$f_{3dB} = 4,28 \text{ MHz}$$

pour $T_i = 220 \; 10^{-9}$ sec on obtient

$$f_{3dB} = 3,89 \text{ MHz}$$

On prendra donc $f_{3dB} = 4$ MHz.

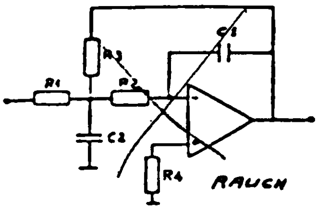
- On trouvera les calculs (réalisés par calculateur Hp 41C) =

pages AII-4 à AII-6 = calcul des composants réalisant la synthèse du filtre

AII-7 = calcul de la réponse indicielle

AII-8 et AII-9 = calcul de la réponse harmonique.

AII-10 = Schéma du filtre



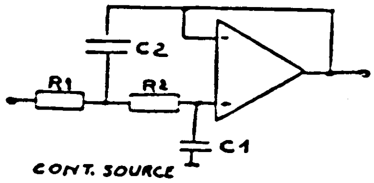
AII-4

FILTRES

FEUILLE DE CALCUL 1

Bessel 6ème ordre

f_{3dB} = 4 MHz



POLYNOMIAL FILTER
section 1

NORMALIZED ROOTS:
-RE=1,5735
+-IM=0,3213

NORMALIZED CARACT.:
Fc*=0,2556
1/Q=1,9596
1+1,2202.S+6,3877.S↑2

FILTER CARACT.
F3dB=4000000,000

Fc=6423875,392
1/Q=1,9596
1+4,85E-8.S+6,14E-16.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=6423875,392
1/Q=1,9596
G0=1

SCALING:
H%=12,00
RMIN=100,00
RMAX=1000,00

<C>MAXMAX?:88,99E-12
<C>MINMIN?:52,74E-12
OK->J

SIZING:
C1>52,74E-12
C1<67,12E-12
C1*=56,00E-12

C2>58,33E-12
C2<74,24E-12
C2*=68,00E-12

R1:270,053

RP?=270,053
RP1*=287,E0
RP2*=4,64E3
Re*=270,282
ERR=0,0849%

R2:596,898

RP?=596,898
RP1*=619,E0
RP2*=16,2E3
Re*=596,219
ERR=-0,1139%

RESULTS:
G0*=1,0000

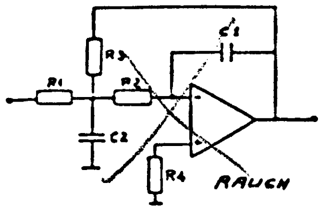
Fc*=6424809,542
ERR=0,0145%

1/Q*=1,9588
ERR=-0,0374%

1+A1.S+A2.S↑2
A1=4,8524E-8
A2=6,1365E-16

ROOTS:
RE=-39537316,78
+-IM=8148479,429

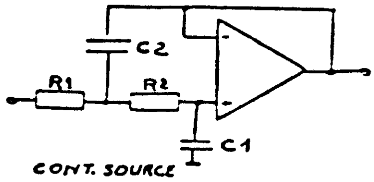
FILTRES



FEUILLE DE CALCUL 2

Bessel 6ème ordre

$F_{3dB} = 4\ MHz$



POLYNOMIAL FILTER
section 2

NORMALIZED ROOTS:
-RE=1,3836
+-IM=0,9727

NORMALIZED CARACT.
Fc*=0,2692
1/Q=1,6361
1+0,9674.S+0,3496.S↑2

FILTER CARACT.
F3dB=4000000,000

Fc=6765198,296
1/Q=1,6361
1+3,85E-8.S+5,53E-16.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=6765198,296
1/Q=1,6361
G0=1

SCALING:
H%=12,00
RMIN=100,00
RMAX=1000,00

<C>MAXMAX?:101,2E-12
<C>MINMIN?:41,81E-12
OK->J

SIZING:
C1>41,81E-12
C1<53,22E-12
C1*=47,00E-12

C2>70,23E-12
C2<89,38E-12
C2*=82,00E-12

R1:254,338

RP?=254,338
RP1*=261,E0
RP2*=10,0E3
Re*=254,361
ERR=0,0092%

R2:564,620

RP?=564,620
RP1*=619,E0
RP2*=6,19E3
Re*=562,727
ERR=-0,3353%

RS?=564,620
RS1*=562,E0
RS2*=2,61E0
Re*=564,610
ERR=-0,0018%

RESULTS:
G0*=1,0000

Fc*=6764949,884
ERR=-0,0037%

1/Q*=1,6361
ERR=-0,0021%

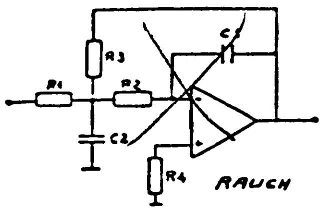
1+A1.S+A2.S↑2
A1=3,8492E-8
A2=5,5349E-16

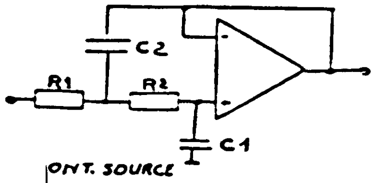
ROOTS:
RE=-34771656,60
+-IM=24446754,24

AII-6

FILTRES

FEUILLE DE CALCUL 3
Bessel 6ème ordre
$f_{3dB} = 4\ MHz$





POLYNOMIAL FILTER
section 3

NORMALIZED ROOTS:
-RE=0,9318
+-IM=1,6640

NORMALIZED CARACT.:
Fc*=0,3035
1/Q=0,9772
1+0,5124.S+0,2749.S↑2

FILTER CARACT.
F3dB=4000000,000

Fc=7628522,520
1/Q=0,9772
1+2,04E-8.S+4,35E-16.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=7628522,520
1/Q=0,9772
G0=1

SCALING:
H%=12,00
RMIN=100,00
RMAX=1000,00

(C)MAXMAX?:150,3E-12
(C)MINMIN?:22,15E-12
TOO LOW->J

(C)MAXMAX?:198,4E-12
(C)MINMIN?:29,24E-12
TOO LOW->J

(C)MAXMAX?:236,2E-12
(C)MINMIN?:34,81E-12
OK->J

SIZING:
C1>34,81E-12
C1<44,31E-12
C1*=39,00E-12

C2>163,4E-12
C2<207,9E-12
C2*=180,0E-12

R1:181,933

RP?=181,933
RP1*=196,E0
RP2*=2,61E3
Re*=182,309
ERR=0,2069%

RS?=181,933
RS1*=178,E0
RS2*=3,83E0
Re*=181,830
ERR=-0,0565%

R2:340,809

RP?=340,809
RP1*=348,E0
RP2*=16,2E3
Re*=340,682
ERR=-0,0374%

RESULTS:
G0*=1,0000

Fc*=7632106,693
ERR=0,0470%

1/Q*=0,9772
ERR=0,0029%

1+A1.S+A2.S↑2
A1=2,0378E-8
A2=4,3486E-16

ROOTS:
RE=-23430372,59
+-IM=41840148,94

Réponse indicielle
$f_{3dB} = 4\ MHz$

INV. LAPLACE TRANSFORM

TRANSFER FUNCTION:

numerator:
nbr. of poly.=1

POLYNOME N1=
order=0

A0 =1,0000E0

denominator:
nbr. of poly.=3

POLYNOME D1=
order=2

A0 =1,0000E0
A1 =48,520E-9
A2 =613,65E-18

POLYNOME D2,=
order=2,

A0 =1,0000E0
A1 =38,492E-9
A2 =553,49E-18

POLYNOME D3,=
order=2,

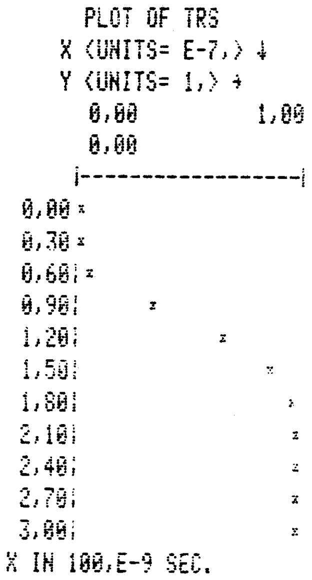
A0 =1,0000E0
A1 =20,378E-9
A2 =434,86E-18

INPUT FUNCTION
step=
v=1,00e0

TIME DOMAIN: (T IN SEC.)

T MIN.=0,000E0
T MAX.=300,0E-9
T INC.=30,00E-9

T=0,00E0 H(T)=1,22E-15
T=30,0E-9 H(T)=4,41E-3
T=60,0E-9 H(T)=64,5E-3
T=90,0E-9 H(T)=340,E-3
T=120,E-9 H(T)=654,E-3
T=150,E-9 H(T)=857,E-3
T=180,E-9 H(T)=957,E-3
T=210,E-9 H(T)=1,00E0
T=240,E-9 H(T)=1,01E0
T=270,E-9 H(T)=1,02E0
T=300,E-9 H(T)=1,01E0



FREQUENCY ANALYSIS

filtre Bessel 6ème ordre

f_{3dB} = 4 MHz

Réponse harmonique

FREQUENCY RESPONSE:

F MIN.=0,0000E0
F MAX.=10,000E6
F INC.=500,00E3

F=0,0000E0
G(F)=1,0000E0
=0,000 dB
∠=0,000 DEG.
=0,000*PI RAD.

F=500,00E3
G(F)=994,84E-3
=-0,045 dB
∠=-19,330 DEG.
=-0,107*PI RAD.

F=1,0000E6
G(F)=979,49E-3
=-0,180 dB
∠=-38,661 DEG.
=-0,215*PI RAD.

F=1,5000E6
G(F)=954,32E-3
=-0,406 dB
∠=-57,992 DEG.
=-0,322*PI RAD.

F=2,0000E6
G(F)=919,90E-3
=-0,725 dB
∠=-77,324 DEG.
=-0,430*PI RAD.

F=2,5000E6
G(F)=877,04E-3
=-1,140 dB
∠=-96,657 DEG.
=-0,537*PI RAD.

F=3,0000E6
G(F)=826,70E-3
=-1,653 dB
∠=-115,990 DEG.
=-0,644*PI RAD.

F=3,5000E6
G(F)=769,97E-3
=-2,271 dB
∠=-135,322 DEG.
=-0,752*PI RAD.

F=4,0000E6
G(F)=708,02E-3
=-2,999 dB
∠=-154,648 DEG.
=-0,859*PI RAD.

F=4,5000E6
G(F)=642,05E-3
=-3,849 dB
∠=-173,955 DEG.
=-0,966*PI RAD.

F=5,0000E6
G(F)=573,32E-3
=-4,832 dB
∠=166,792 DEG.
=0,927*PI RAD.

F=5,5000E6
G(F)=503,22E-3
=-5,965 dB
∠=147,668 DEG.
=0,820*PI RAD.

F=6,0000E6
G(F)=433,39E-3
=-7,262 dB
∠=128,800 DEG.
=0,716*PI RAD.

F=6,5000E6
G(F)=365,82E-3
=-8,735 dB
∠=110,381 DEG.
=0,613*PI RAD.

F=7,0000E6
G(F)=302,66E-3
=-10,381 dB
∠=92,646 DEG.
=0,515*PI RAD.

F=7,5000E6
G(F)=245,87E-3
=-12,186 dB
∠=75,834 DEG.
=0,421*PI RAD.

F=8,0000E6
G(F)=196,75E-3
=-14,122 dB
∠=60,139 DEG.
=0,334*PI RAD.

F=8,5000E6
G(F)=155,73E-3
=-16,153 dB
∠=45,675 DEG.
=0,254*PI RAD.

F=9,0000E6
G(F)=122,43E-3
=-18,242 dB
∠=32,470 DEG.
=0,180*PI RAD.

F=9,5000E6
G(F)=95,959E-3
=-20,358 dB
∠=20,486 DEG.
=0,114*PI RAD.

F=10,000E6
G(F)=75,215E-3
=-22,474 dB
∠=9,639 DEG.
=0,054*PI RAD.

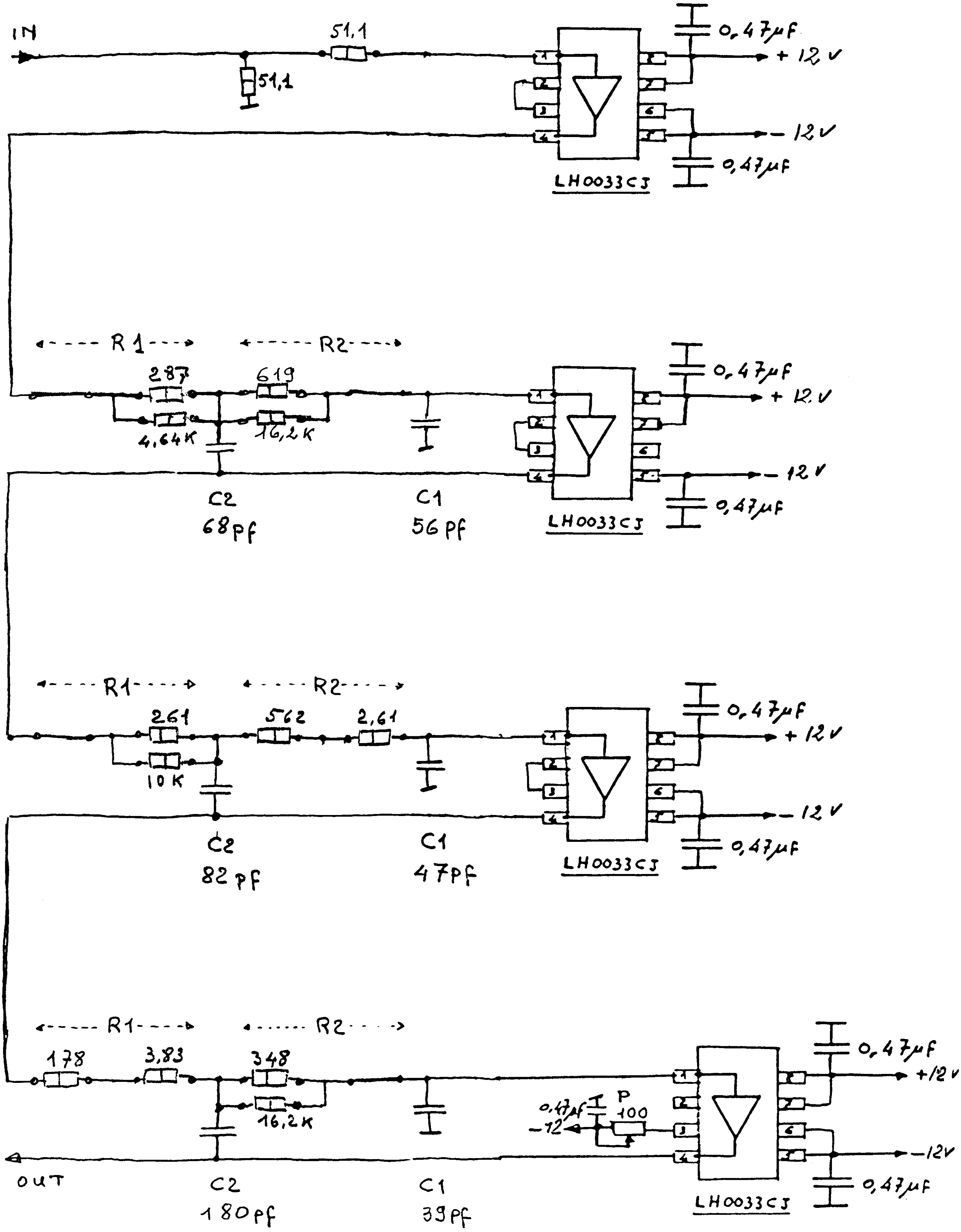
Bode plot

```
      PLOT OF GdB
    X (UNITS= E 7,) ↓
    Y (UNITS= 1,) →
     -25,0            0,0
                      0,0
    |------------------|
  0,00                x
  0,05                x
  0,10                x
  0,15                x
  0,20                x|
  0,25                x|
  0,30               x |
  0,35               x |
F3dB - 0,40          x |
  0,45              x  |
  0,50             x   |
  0,55             x   |
  0,60            x    |
  0,65           x     |
  0,70          x      |
  0,75         x       |
  0,80        x        |
  0,85      x          |
  0,90     x           |
  0,95   x             |
  1,00  x              |
 X IN 10,0E6 HERTZ
```

```
      PLOT OF PHA
    X (UNITS= E 7,) ↓
    Y (UNITS= 1,) →
     -1,00           1,00
             0,00
    |---------|---------|
  0,00        x
  0,05       x|
  0,10      x |
  0,15     x  |
  0,20    x   |
  0,25   x    |
  0,30  x     |
  0,35 x      |
  0,40 x      |
  0,45x       |
  0,50        |        x
  0,55        |       x
  0,60        |      x
  0,65        |     x
  0,70        |    x
  0,75        |   x
  0,80        |  x
  0,85        | x
  0,90        |x
  0,95        |x
  1,00        x
 X IN 10,0E6 HERTZ

 Y=1  :180 DEG.
      : PI RAD.
 Y=-1 :-180 DEG.
      : -PI RAD.
```

Filtre de Bessel 6ème ordre, $F_{3dB} = 4 MHz$



Annexe III

CALCUL DU NOUVEAU FILTRE

- période de révolution $= \frac{1}{1{,}2\,10^6} = 833$ nsec.

- On veut une réponse indicielle $\simeq \frac{1}{2}$ période de révolution $\cong 416$ nsec. $= T_i$

- Pour un filtre d'ordre $n \geq 6$, le délai de propagation de groupe T_g est pratiquement égal à $\frac{T_i}{2}$.

$$T_g = \frac{416}{2} = 208 \text{ nsec.}$$

- La fréquence de coupure f_c est celle qui fait correspondre un déphasage $\phi_c = n\frac{\pi}{4}$ (n étant l'ordre du filtre). On obtient

$$\phi_c = 6 \times \frac{\pi}{4} = \frac{3}{2}\pi$$

- Pour un filtre de Bessel du 6ème ordre (voir figure ci-après) :

$$f_{3dB} = \frac{f_c}{1{,}75}$$

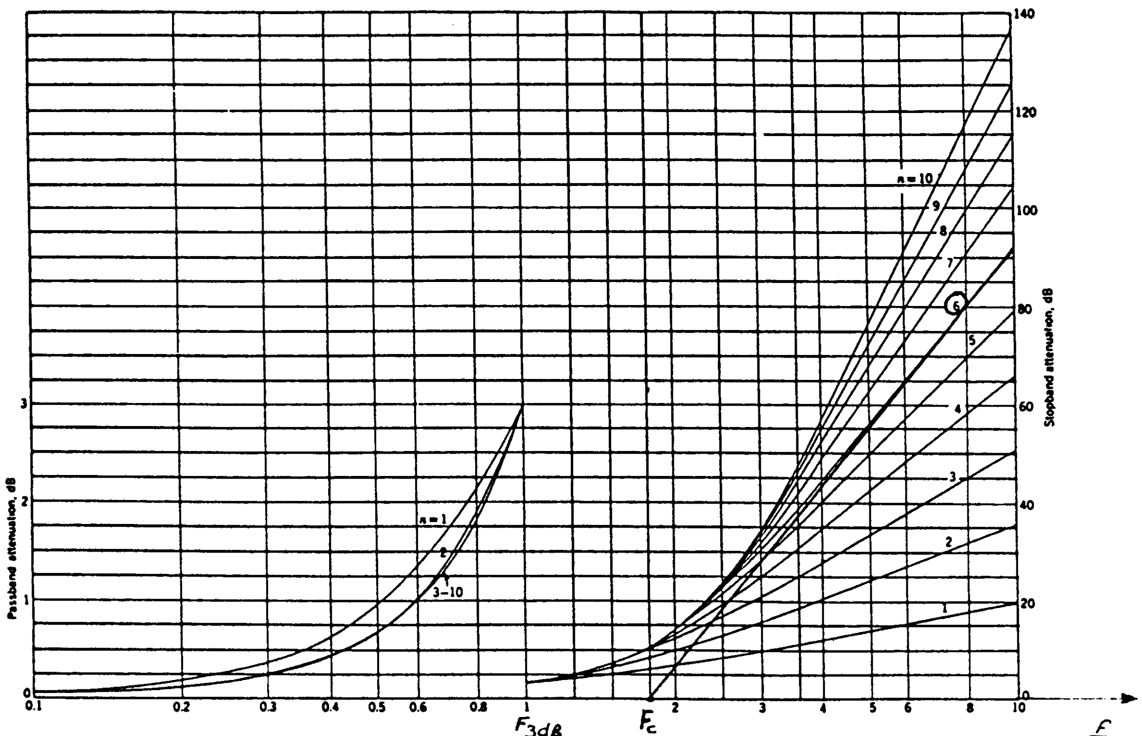


Figure Attenuation characteristics for maximally flat delay (Bessel) filters.

- On a par ailleurs :

$$T_g = \frac{\Phi_c}{2\pi f_c} = \frac{n\frac{\pi}{4}}{2\pi f_c}$$

d'où

$$T_g = \frac{n}{8\,f_c} \quad \text{et} \quad f_c = \frac{n}{8\,T_g}$$

soit $f_c = \dfrac{6}{8 \times 208\,10^{-9}} = 3,606$ MHz

d'où $f_{3dB} = \dfrac{3,606\,10^{6}}{1.75} = 2,06$ MHz.

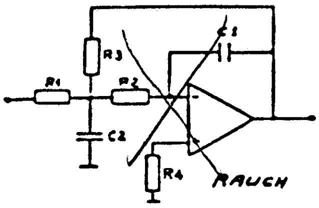
On trouvera ci après (réalisé par calculateur Hp 41 C) :

pages AIII-3 à AIII-5 : Calcul des composants réalisant la synthèse du filtre

page AIII-6 = Calcul de la réponse indicielle

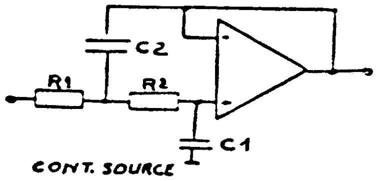
pages AIII-7 à AIII-8 : Calcul de la réponse harmonique.

page : AIII-9 = schéma du filtre.



FILTRES

FEUILLE DE CALCUL 1
Bessel 6ème ordre
f_{3dB} - 2,06 MHz



POLYNOMIAL FILTER
section 1

NORMALIZED ROOTS:
-RE=1,5735
+-IM=0,3213

NORMALIZED CARACT.:
Fc*=0,2556
1/Q=1,9596
1+1,2202.S+0,3877.S↑2

FILTER CARACT.
F3dB=2060000,000

Fc=3308295,827
1/Q=1,9596
1+9,43E-8.S+2,31E-15.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=3308295,827
1/Q=1,9596
G0=1

SCALING:
H%=12,00
RMIN=200,00
RMAX=2000,00

<C>MAXMAX?:86,40E-12
<C>MINMIN?:51,20E-12
OK->J

SIZING:
C1>51,20E-12
C1<65,17E-12
C1*=56,00E-12

C2>58,33E-12
C2<74,24E-12
C2*=68,00E-12

R1:524,374

RS?=524,374
RS1*=511,E0
RS2*=13,3E0
Re*=524,300
ERR=-0,0142%

R2:1159,026

RP?=1159,026
RP1*=1,21E3
RP2*=28,7E3
Re*=1161,050
ERR=0,1746%

RESULTS:
G0*=1,0000

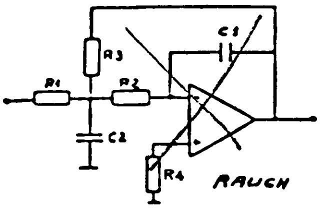
Fc*=3305645,717
ERR=-0,0801%

1/Q*=1,9603
ERR=0,0356%

1+A1.S+A2.S↑2
A1=9,4386E-8
A2=2,3181E-15

ROOTS:
RE=-20357312,24
+-IM=4119720,646

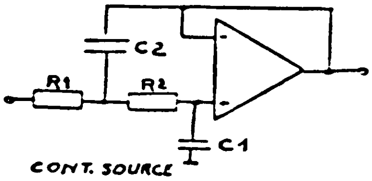
FILTRES



FEUILLE DE CALCUL 2

Bessel 6ème ordre

f_{3dB} = 2,06 MHz



POLYNOMIAL FILTER
section 2

NORMALIZED ROOTS:
-RE=1,3836
+-IM=0,9727

NORMALIZED CARACT.:
Fc*=0,2692
1/Q=1,6361
1+0,9674.S+0,3496.S↑2

FILTER CARACT.
F3dB=2060000,000

Fc=3484077,122
1/Q=1,6361
1+7,47E-8.S+2,09E-15.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=3484077,122
1/Q=1,6361
G0=1

SCALING:
H%=12,00
RMIN=200,00
RMAX=2000,00

<C>MAXMAX?:98,26E-12
<C>MINMIN?:40,60E-12
OK->J

SIZING:
C1>40,60E-12
C1<51,67E-12
C1*=47,00E-12

C2>70,23E-12
C2<89,38E-12
C2*=82,00E-12

R1:493,860

RP?=493,860
RP1*=511,E0
RP2*=14,7E3
Re*=493,833
ERR=-0,0053%

R2:1096,350

RP?=1096,350
RP1*=1,10E3
RP2*=316,E3
Re*=1096,184
ERR=-0,0152%

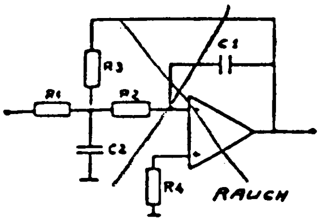
RESULTS.
G0*=1,0000

Fc*=3484434,294
ERR=0,0103%

1/Q*=1,6361
ERR=-0,0019%

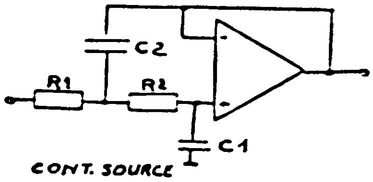
1+A1.S+A2.S↑2
A1=7,4731E-8
A2=2,0863E-15

ROOTS:
RE=-17909938,05
+-IM=12591772,46



FILTRES

FEUILLE DE CALCUL 3
Bessel 6ème ordre
f_{3dB} = 2,06 MHz



POLYNOMIAL FILTER
section 3

NORMALIZED ROOTS:
-RE=0,9318
+-IM=1,6640

NORMALIZED CARACT.
Fc*=0,3035
1/Q=0,9772
1+0,5124.S+0,2749.S↑2

FILTER CARACT.
F3dB=2060000,000

Fc=3928689,098
1/Q=0,9772
1+3,96E-8.S+1,64E-15.S↑2

LP FILTER
CONT.SOURCE?->J

SYNTH.?->J

Fc=3928689,098
1/Q=0,9772
G0=1

SCALING:
H%=12,00
RMIN=200,00
RMAX=1000,00

<C>MAXMAX?:232,1E-12
<C>MINMIN?:34,20E-12
OK->J

SIZING:
C1>34,20E-12
C1<43,53E-12
C1*=39,00E-12

C2>163,4E-12
C2<207,9E-12
C2*=180,0E-12

R1:353,268

RS?=353,268
RS1*=348,E0
RS2*=5,11E0
Re*=353,110
ERR=-0,0446%

R2:661,765

RP?=661,765
RP1*=681,E0
RP2*=23,7E3
Re*=661,979
ERR=0,0322%

RESULTS:
G0*=1,0000

Fc*=3928932,751
ERR=0,0062%

1/Q*=0,9773
ERR=0,0117%

1+A1.S+A2.S↑2
A1=3,9588E-8
A2=1,6409E-15

ROOTS:
RE=-12062782,17
+-IM=21538300,21

AIII-6

Réponse indicielle

filtre de Bessel 6ème ordre

$f_{3dB} = 2,06\ MHz$

INV. LAPLACE TRANSFORM

TRANSFER FUNCTION:

numerator:
nbr. of poly.=1

POLYNOME N1=
order=0

A0 =1,0000E0

denominator:
nbr. of poly.=3

POLYNOME D1=
order=2

A0 =1,0000E0
A1 =94,380E-9
A2 =2,3181E-15

POLYNOME D2,=
order=2,

A0 =1,0000E0
A1 =74,731E-9
A2 =2,0863E-15

POLYNOME D3,=
order=2,

A0 =1,0000E0
A1 =39,588E-9
A2 =1,6409E-15

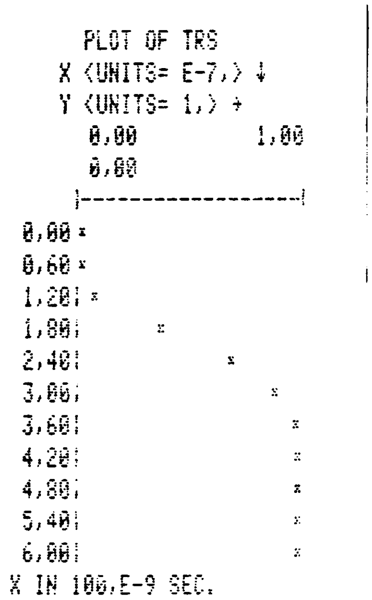
$$T(s) = \frac{1}{\underbrace{(A_0 + A1.S + A2.S^2)}_{D1}\underbrace{(A_0 + A1.S + A2.S^2)}_{D2}\underbrace{(A_0 + A1.S + A2.S^2)}_{D3}}$$

INPUT FUNCTION
step=
v=1,00e0

TIME DOMAIN: (T IN SEC.)

T MIN.=0,000E0
T MAX.=600,0E-9
T INC.=60,00E-9

T=0,00E0 H(T)=23,3E-18
T=60,0E-9 H(T)=4,78E-3
T=120,E-9 H(T)=74,7E-3
T=180,E-9 H(T)=370,E-3
T=240,E-9 H(T)=684,E-3
T=300,E-9 H(T)=877,E-3
T=360,E-9 H(T)=968,E-3
T=420,E-9 H(T)=1,00E0
T=480,E-9 H(T)=1,01E0
T=540,E-9 H(T)=1,01E0
T=600,E-9 H(T)=1,01E0



AIII-7

Réponse harmonique

filtre de Bessel 6ème ordre

$f_{3dB} = 2,06$ MHz

FREQUENCY ANALYSIS

FREQUENCY RESPONSE:

F MIN.=0,0000E0
F MAX.=5,0000E6
F INC.=250,00E3

F=0,0000E0
G(F)=1,0000E0
=0,000 dB
∡=0,000 DEG.
=0,000*PI RAD.

F=250,00E3
G(F)=995,11E-3
=-0,043 dB
∡=-18,763 DEG.
=-0,104*PI RAD.

F=500,00E3
G(F)=980,56E-3
=-0,170 dB
∡=-37,565 DEG.
=-0,209*PI RAD.

F=750,00E3
G(F)=956,69E-3
=-0,385 dB
∡=-56,347 DEG.
=-0,313*PI RAD.

F=1,0000E6
G(F)=924,03E-3
=-0,686 dB
∡=-75,127 DEG.
=-0,417*PI RAD.

F=1,2500E6
G(F)=883,31E-3
=-1,078 dB
∡=-93,906 DEG.
=-0,522*PI RAD.

F=1,5000E6
G(F)=835,40E-3
=-1,562 dB
∡=-112,683 DEG.
=-0,626*PI RAD.

F=1,7500E6
G(F)=781,32E-3
=-2,143 dB
∡=-131,458 DEG.
=-0,730*PI RAD.

F=2,0000E6
G(F)=722,11E-3
=-2,828 dB
∡=-150,227 DEG.
=-0,835*PI RAD.

F=2,2500E6
G(F)=658,87E-3
=-3,624 dB
∡=-168,981 DEG.
=-0,939*PI RAD.

F=2,5000E6
G(F)=592,75E-3
=-4,543 dB
∡=172,305 DEG.
=0,957*PI RAD.

F=2,7500E6
G(F)=524,95E-3
=-5,598 dB
∡=153,686 DEG.
=0,854*PI RAD.

F=3,0000E6
G(F)=456,89E-3
=-6,804 dB
∡=135,265 DEG.
=0,751*PI RAD.

F=3,2500E6
G(F)=390,30E-3
=-8,172 dB
∡=117,198 DEG.
=0,651*PI RAD.

F=3,5000E6
G(F)=327,11E-3
=-9,706 dB
∡=99,690 DEG.
=0,554*PI RAD.

F=3,7500E6
G(F)=269,23E-3
=-11,398 dB
∡=82,965 DEG.
=0,461*PI RAD.

F=4,0000E6
G(F)=218,15E-3
=-13,225 dB
∡=67,222 DEG.
=0,373*PI RAD.

F=4,2500E6
G(F)=174,62E-3
=-15,158 dB
∡=52,601 DEG.
=0,292*PI RAD.

F=4,5000E6
G(F)=138,62E-3
=-17,163 dB
∡=39,164 DEG.
=0,218*PI RAD.

F=4,7500E6
G(F)=109,55E-3
=-19,208 dB
∡=26,904 DEG.
=0,149*PI RAD.

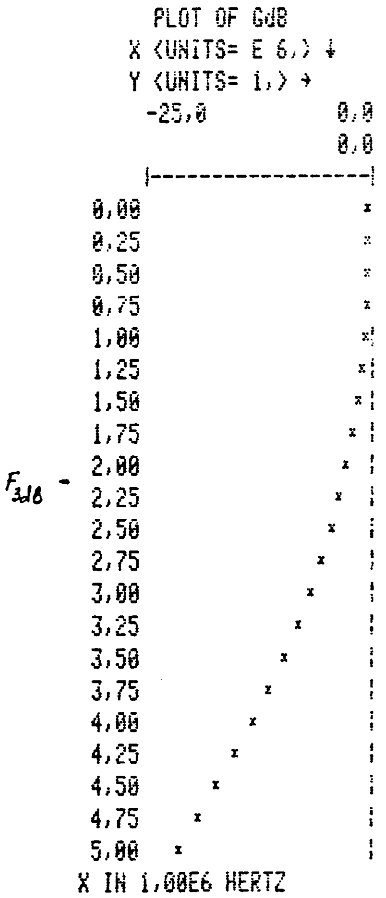
F=5,0000E6
G(F)=86,442E-3
=-21,265 dB
∡=15,763 DEG.
=0,088*PI RAD.

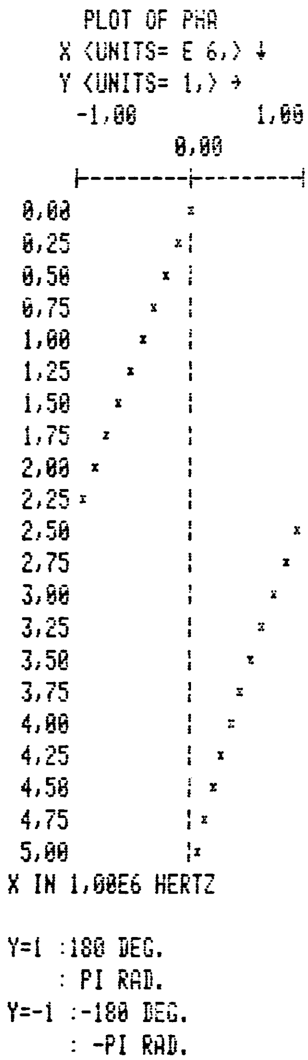
AIII-8

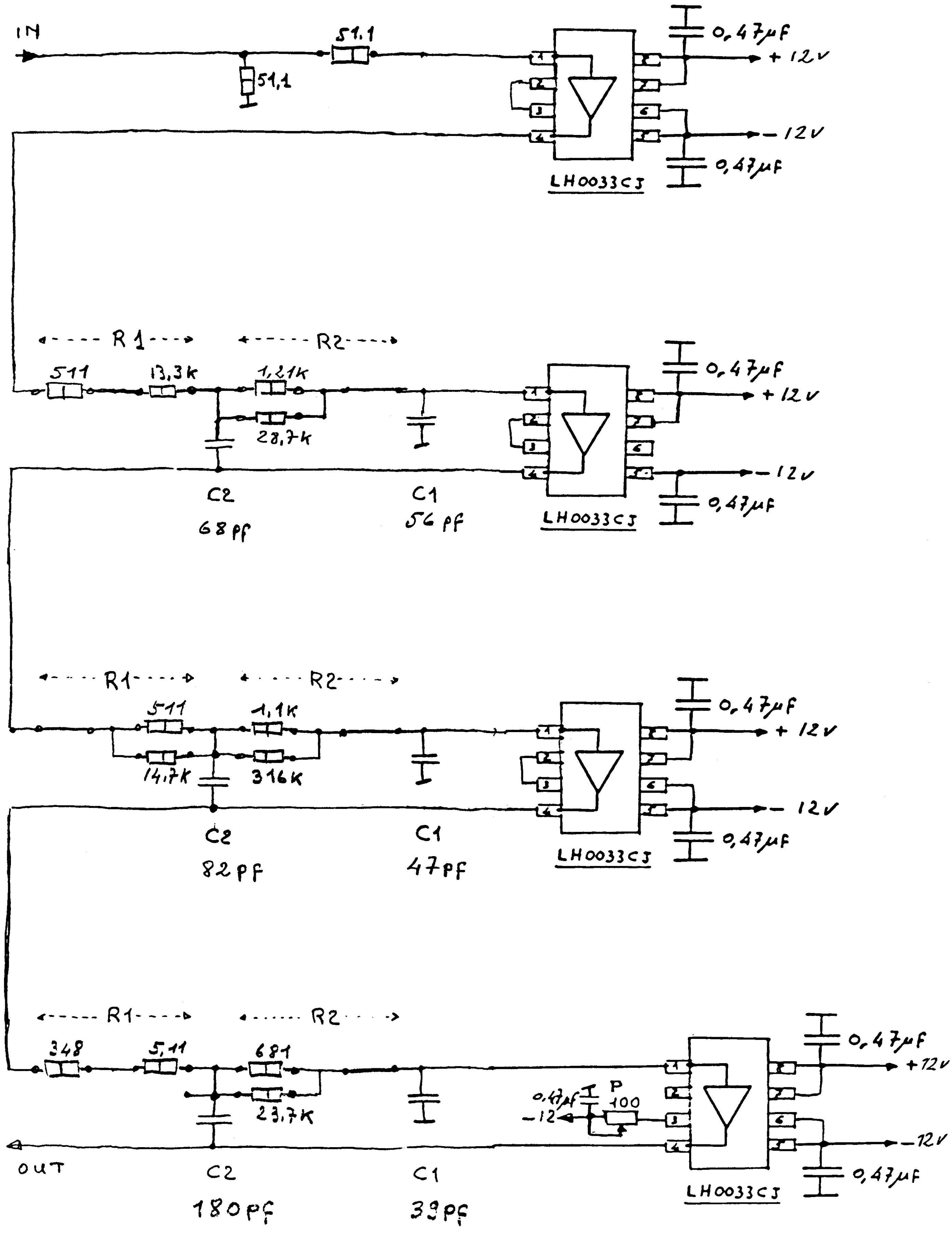
Bode plot :

filtre de Bessel 6ème ordre

$F_{3dB} = 2,06$ MHz.






IN
51,1
51,1
0,47μF
+12V
-12V
0,47μF
LH0033CJ
R1
R2
511
13,3k
1,21k
28,7k
C2
68pF
C1
56pF
0,47μF
+12V
-12V
0,47μF
LH0033CJ
R1
R2
511
1,1k
14,7k
316k
C2
82pF
C1
47pF
0,47μF
+12V
-12V
0,47μF
LH0033CJ
R1
R2
348
5,11
681
23,7k
OUT
C2
180pF
C1
39pF
0,47μF
P
100
-12
0,47μF
+12V
-12V
0,47μF
LH0033CJ

Distribution

M. Chanel
P. Lefèvre
D. Möhl
G. Molinari
E. Steffens
M. van Rooij

/ed