Revision History:

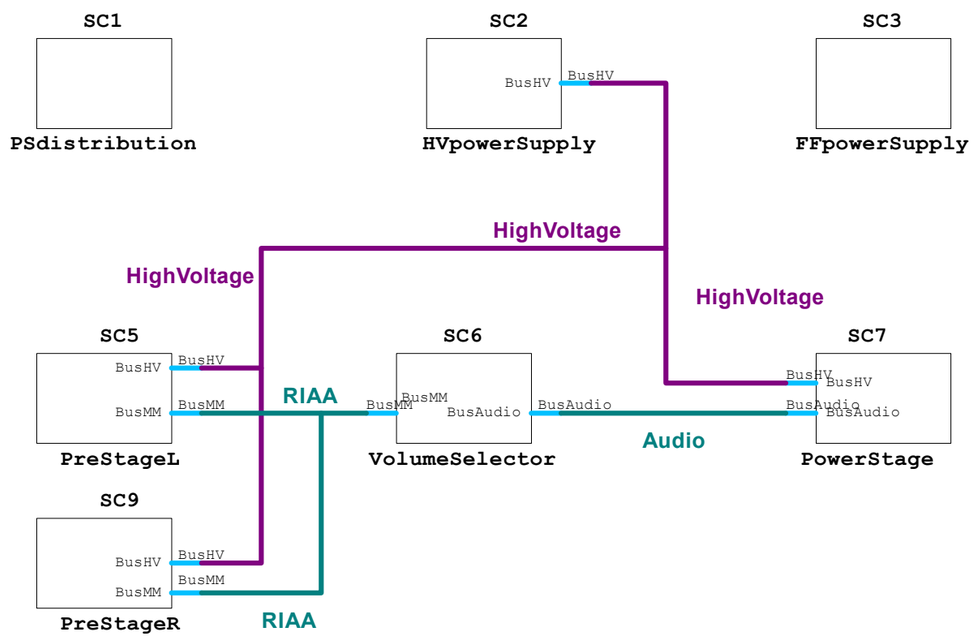
A Initial design, never prototyped

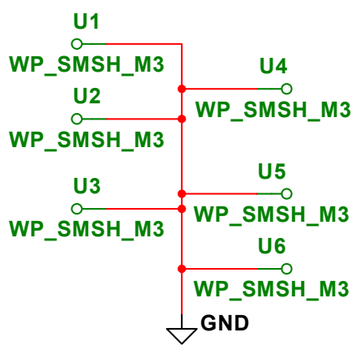
B Corrected filament connection ECC83
Changed Common Source topology MM stage into SRPP
New HV design
Filaments floating DC/DC supply
Made in total 6 inputs
For MC stage the isolated DC/DC converters changed from 15V in to 24V
Never prototyped

C Added gain stage after MM amplifier
Removed all experimental MC stage related electronics

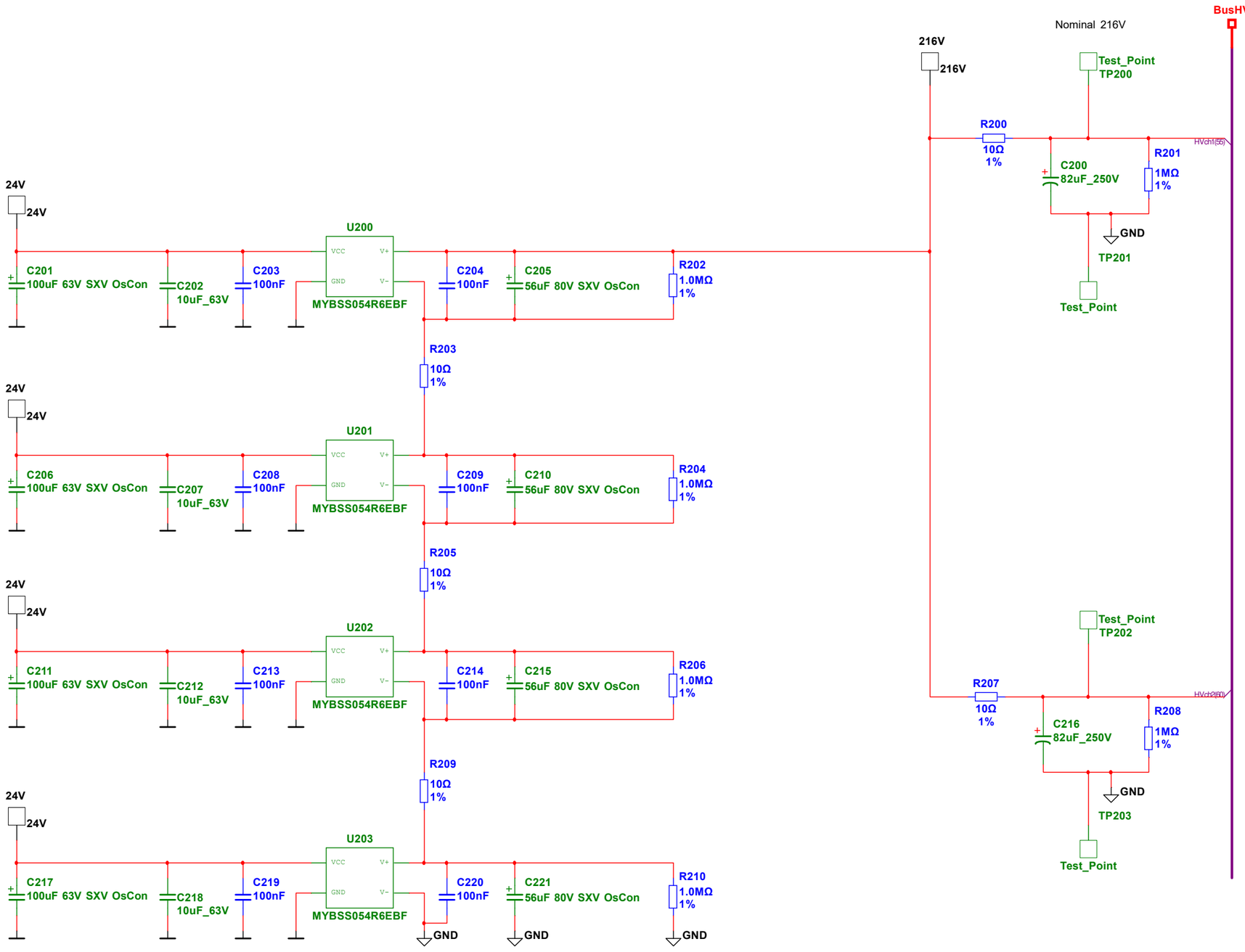
To be done:







德克斯 JCAD jcad.design The Netherlands		*Project* 0033/RO3	*Schematic* RO3_C
Title: Functional Diagram	Desc.: Overview and Revision History		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: A3	
Approved by:	Sheet 1 of 8	1st.date: Nov 4, 2017	

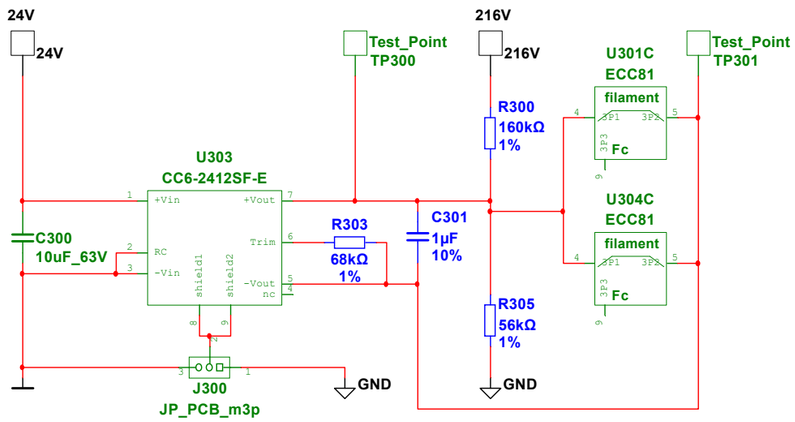


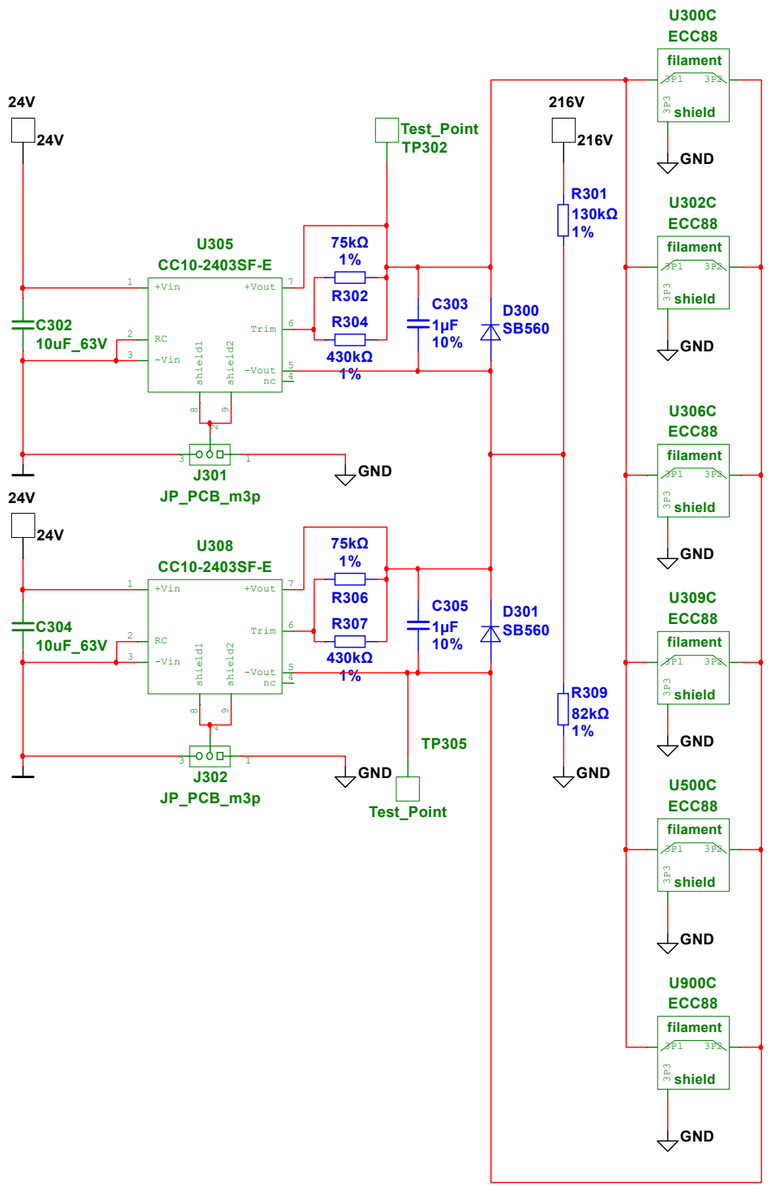
Required power capability per channel:

For output voltage: 4Vrms in 600 ohm => 9.4 mApeak
Line stage: 22 mA
RIAA stage: 3 mA
Total: 34.4 mA

(power supply should be able to deliver max 560 mA)

德克斯 JCAD jcad.design The Netherlands		*Project* **0033/RO3**	*Schematic* RO3_C
Title: High Voltage PS	Desc.: DC/DC converter for High Voltage (Isolated)		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: A2	
Approved by:	Sheet 2 of 8	1st.date: Dec 26, 2017	





Required power capability:
Filament: 6.3V at (600 + 600 + 2190) mA = 3.39 A

德克斯 JCAD jcad.design The Netherlands	*Project* 0033/RO3	*Schematic* RO3_C
Title: Filament PS	Desc.: DC/DC power supply for filaments	
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C
Checked by: A Ego	PCB No: 0033 RO3_C	Size: A2
Approved by:	Sheet 3 of 8	1st.date: Dec 24, 2017

Two tubes used:
* ECC83 with max 180V between the potential of the filament wrt one of the cathodes
* ECC81 with max 90V between the potential of the filament wrt one of the cathodes

To equal the differences in max delta's, the following can be used:
Delta for ECC83 = 0.5*(VlowerCathode - VupperCathode + VmaxPos + VmaxNeg) = 0.5*(0.5 - 99.6 + 180 + 180) = 130 volt
=> potential of filament should equal (VupperCathode - VmaxNeg) + Delta = (99.6-180) + 130 = 50 volt.
In this case a filament wrt to ground potential is also permitted.

Delta for ECC81 = 0.5*(VlowerCathode - VupperCathode + VmaxPos + VmaxNeg) = 0.5*(1.5 - 110 + 90 + 90) = 36 volt
=> potential of filament should equal (VupperCathode - VmaxNeg) + Delta = (110-90) + 36 = 56 volt.

Parallel capacitance
at the input:
47pF - 617pF
For typical MM elements.

Parallel capacitance
at the input:
100nF - 2.47uF
For high output MC elements.

C500 220pF_630V_PS
C502 150pF_630V_PS
C505 100pF_630V_PS
C507 100pF_630V_PS
C511 47pF_160V_PS
C501 1uF_PP
C503 680nF_PP
C506 470nF_PP
C508 220nF_PP
C512 100nF_c
GND

J500 TP-klein
J501 TP-klein
J502 1-534206-0
L500 6.4µH

Set jumper at desired input resistance.

J503 1-534206-0
R521 18.2kΩ 0.1%
R522 21.5kΩ 0.1%
R523 34kΩ 0.1%
R524 47.5kΩ 0.1%
R525 56.2kΩ 0.1%
R526 66.5kΩ 0.1%
R527 78.7kΩ 0.1%
R528 90.9kΩ 0.1%
R529 100kΩ 0.1%
R530 110kΩ 0.1%

Neohm/TE R series 0.1% 15ppm/K

R500 22kΩ 1%
R501 560Ω 1%
C504 82uF_250V

Zout: 16032 ohm according to simulator. With +/-15% tube tolerances Zout = 13k6 ... 18k4.
Rseries = 28k354 - (13k6 ... 18k4) = 10k ... 14k8

R503 100Ω 1%
U307A ECC83
C509 MKP4_1u5
C513 MKP4_1u5
C520 220nF_PP
J504 JP_PCB_m3p
R507 560Ω 1%
3uF (200nF for RIAA-IEC)
R505 16kΩ 1%
R506 2.55kΩ 1%
R508 50kΩ 20 % Key=A

R = 3212.12... ohm

R509 330Ω 0.1%
R510 91kΩ 0.1%
R511 91kΩ 0.1%
R514 3kΩ 0.1%

R515 100Ω 1%
R517 1MΩ 1%
U307B ECC83
R518 560Ω 1%
C514 470µF 63V
C515 33nF_63V_PS
C516 33nF_63V_PS
C517 33nF_63V_PS
C518 33nF_63V_PS
R519 100kΩ 0.1%

C = 34nF, so select proper value

Total Gain = 51 dB

R502 820Ω 1%
R504 100Ω 1%
U301A ECC81
C510 MKP4_1u5
R512 820Ω 1%
R516 100Ω 1%
U301B ECC81
R536 130Ω 1%
R520 680Ω 1%
C519 470µF 63V

R534 220Ω 1%
R533 100Ω 1%
U500A ECC88
C523 MKP4_1u5
R535 220Ω 1%
R531 100Ω 1%
R532 100kΩ 1%
U500B ECC88
C521 470µF 63V
R537 220Ω 1%

C522 82uF_250V
C524 4.7µF 2%
C525 4.7µF 2%
R513 1MΩ 1%
R538 10kΩ 1%

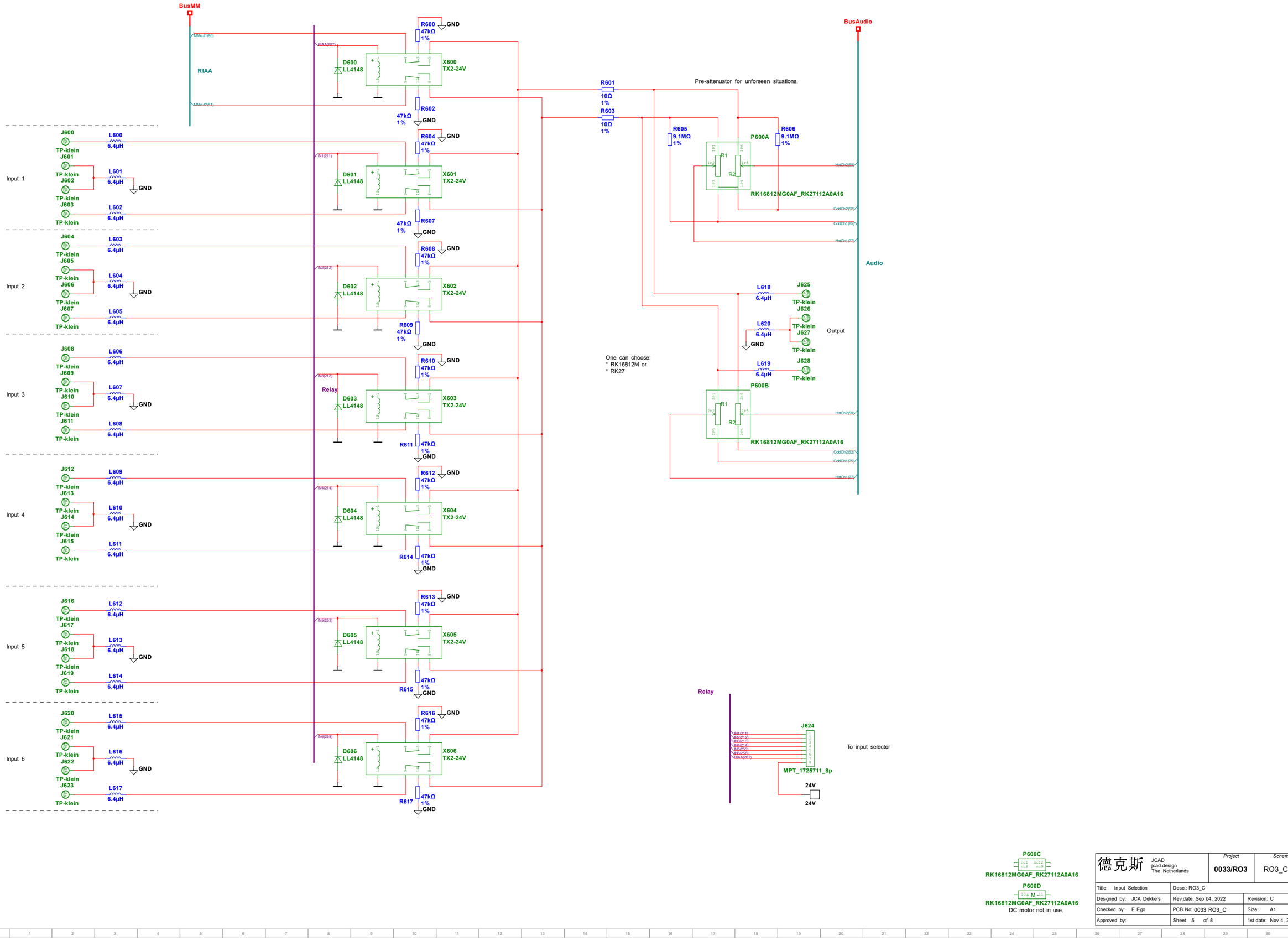
BusHV
HighVoltage
HVch1(55)
RIAA
MMout1(80)
BusMM

Expected power consumption:
High Voltage: 14 mA
Filament: 2 x 300 mA + 365 mA = 965 mA nominal

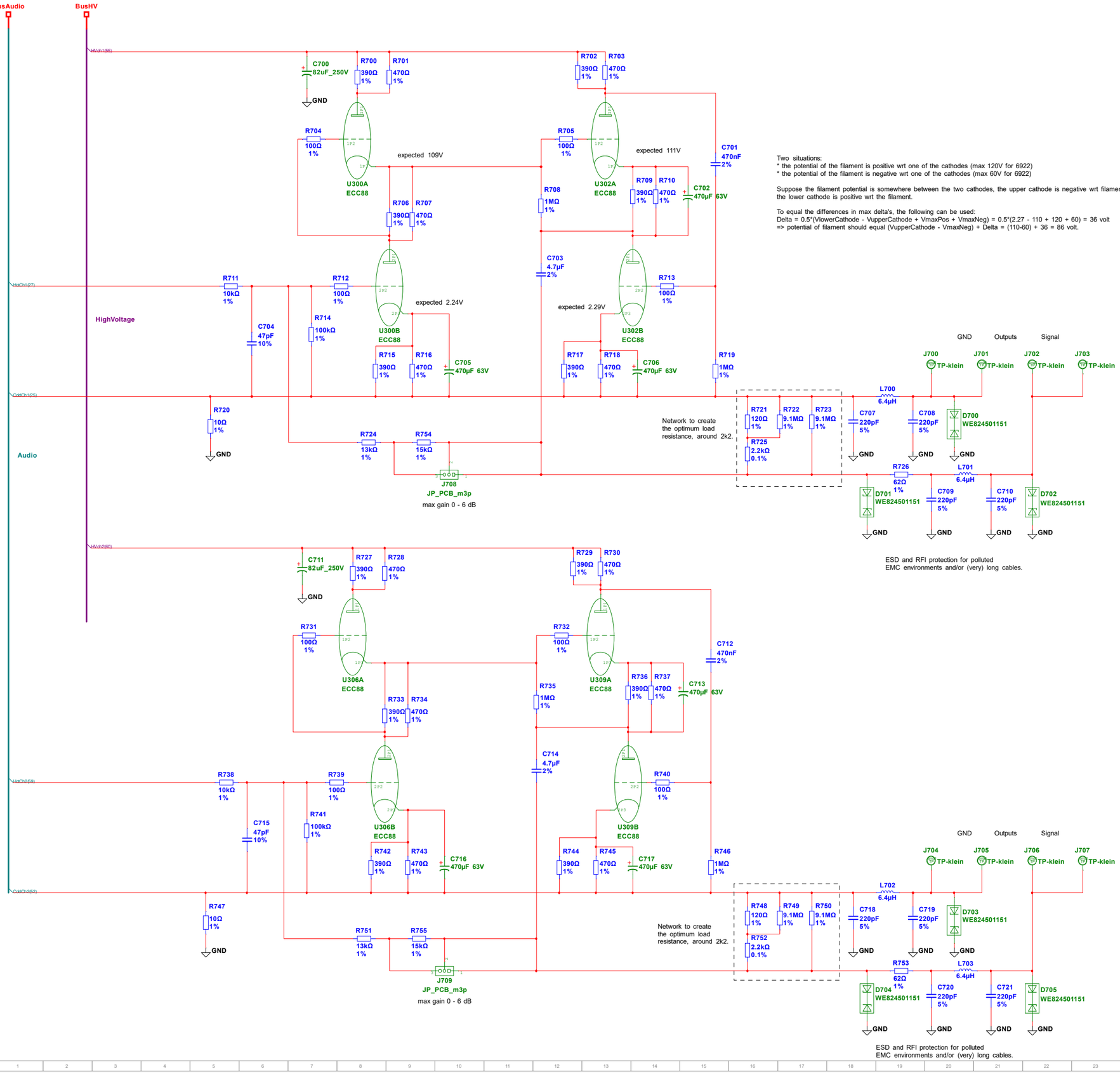
Capacitors: LCR Components FSC(/EX) series
Resistors: TE Connectivity/Neohm H8 (Holco), R series
Welwyn RC, RC55, PR (low cost) series
Vishay Dale PTF series
http://nl.farnell.com/webapp/wcs/stores/servlet/Search?catalogId=15001&langId=31&storeId=10168&categoryId=700000005447&pageSize=25&showResults=true&sf=432,502,721&pf=110003727,110075262,110101775,110124724,112067013

Passive RIAA calculator: http://amorgignitamorem.nl/WebPaginas/passieve_RIAA/passieve_RIAA.html

德克斯 JCAD jcad.design The Netherlands		Project: 0033/RO3	Schematic: RO3_C
Title: MM RIAA stage (left)	Desc.: Passive RIAA and Input Impedance Selection		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: Custom	
Approved by:	Sheet 4 of 8	1st.date: Nov 4, 2017	



德克斯 JCAD jcad.design The Netherlands		Project 0033/RO3	Schematic RO3_C
Title: Input Selection	Desc.: RO3_C		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: E Ego	PCB No: 0033 RO3_C	Size: A1	
Approved by:	Sheet 5 of 8	1st.date: Nov 4, 2017	



Bandwidth 7 MHz

f = 1 kHz, B = 20 Hz - 30 kHz:

Vin,rms	Vout,rms	THD+N [%]	SNR [dB]
0.0707	0.0645	0.008	82.0
0.707	0.645	0.0023	98.6
2.0	1.82	0.0021	105.1
4.0	3.64	0.0038	101.2

With 50 ohm source and 2.2 kohm load (optimum load).

Vin,dc = 0 mV
Vout,dc = 0 mV

f = 1kHz at -0.92 dB, 20 Hz at -0.96 dB, 20 kHz at -0.92 dB, 100 kHz at -0.94 dB
Without feedback (Rx desoldered): Av = 25.56 dB at 1 kHz.

Rin = 10k4 (1 kHz), Rout = 36 ohm (20 Hz), 12 ohm (1 kHz and 10 kHz).

Feedback resistor set to 13k to have 1:1 gain.

Two situations:
* the potential of the filament is positive wrt one of the cathodes (max 120V for 6922)
* the potential of the filament is negative wrt one of the cathodes (max 60V for 6922)

Suppose the filament potential is somewhere between the two cathodes, the upper cathode is negative wrt filament and the lower cathode is positive wrt the filament.

To equal the differences in max delta's, the following can be used:
Delta = 0.5*(VlowerCathode - VupperCathode + VmaxPos + VmaxNeg) = 0.5*(2.27 - 110 + 120 + 60) = 36 volt
=> potential of filament should equal (VupperCathode - VmaxNeg) + Delta = (110-60) + 36 = 86 volt.

4u7:
Audyn Cap Plus, 1341762
D = 36mm, L = 63mm, d2 = 1.5mm

Audyn Cap Plus, 1341758
D = 25mm, L = 43mm, d2 = 1mm

Audyn Cap Plus, 1341755
D = 25mm, L = 43mm, d2 = 1mm

Expected power consumption:
High Voltage: 4 x 11 mA = 44 mA
Filament: 4 x 365 mA = 1.46 A nominal

德克斯 JCAD jcad.design The Netherlands		Project 0033/RO3	Schematic RO3_C
Title: Line Driver	Desc.: 2 Channel SRPP/White with feedback		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: A1	
Approved by:	Sheet 6 of 8	1st.date: Nov 4, 2017	

Two tubes used:
* ECC83 with max 180V between the potential of the filament wrt one of the cathodes
* ECC81 with max 90V between the potential of the filament wrt one of the cathodes

To equal the differences in max delta's, the following can be used:
Delta for ECC83 = 0.5*(VlowerCathode - VupperCathode + VmaxPos + VmaxNeg) = 0.5*(0.5 - 99.6 + 180 + 180) = 130 volt
=> potential of filament should equal (VupperCathode - VmaxNeg) + Delta = (99.6-180) + 130 = 50 volt.
In this case a filament wrt to ground potential is also permitted.

Delta for ECC81 = 0.5*(VlowerCathode - VupperCathode + VmaxPos + VmaxNeg) = 0.5*(1.5 - 110 + 90 + 90) = 36 volt
=> potential of filament should equal (VupperCathode - VmaxNeg) + Delta = (110-90) + 36 = 56 volt.

Parallel capacitance
at the input:
47pF - 617pF
For typical MM elements.

Parallel capacitance
at the input:
100nF - 2.47uF
For high output MC elements.

C900 220pF_630V_PS
C902 150pF_630V_PS
C905 100pF_630V_PS
C907 100pF_630V_PS
C909 47pF_160V_PS
C901 1uF_PP
C903 680nF_PP
C906 470nF_PP
C908 220nF_PP
C910 100nF_c
GND

J900 TP-klein
J901 TP-klein
J902 1-534206-0
L900 6.4µH
GND

Set jumper at desired input resistance.
J903 1-534206-0

R921 18.2kΩ 0.1%
R922 21.5kΩ 0.1%
R923 34kΩ 0.1%
R924 47.5kΩ 0.1%
R925 56.2kΩ 0.1%
R926 66.5kΩ 0.1%
R927 78.7kΩ 0.1%
R928 90.9kΩ 0.1%
R929 100kΩ 0.1%
R930 110kΩ 0.1%
GND

Neohm/TE R series 0.1% 15ppm/K

R900 22kΩ 1%
R901 560Ω 1%
C904 82uF_250V
GND

Zout: 16032 ohm according to simulator. With +/-15% tube tolerances Zout = 13k6 ... 18k4.
Rseries = 28k354 - (13k6 ... 18k4) = 10k ... 14k8

R903 100Ω 1%
U311A ECC83
C920 220nF_PP
C911 MKP4_1u5
C913 MKP4_1u5
R907 560Ω 1%
J904 JP_PCB_m3p
3uF (200nF for RIAA-IEC)
R905 16kΩ 1%
R906 2.55kΩ 1%
R910 50kΩ Key=A 50 %

R = 3212.12... ohm

R911 330Ω 0.1%
R912 91kΩ 0.1%
R913 91kΩ 0.1%
R915 3kΩ 0.1%

R914 100Ω 1%
U311B ECC83
R917 1MΩ 1%
GND
R918 560Ω 1%
C914 470µF 63V
GND
C915 33nF_63V_PS
C916 33nF_63V_PS
C917 33nF_63V_PS
C918 33nF_63V_PS
GND
R919 100kΩ 0.1%
GND

C = 34nF, so select proper value

Total Gain = 51 dB

R902 820Ω 1%
U304A ECC81
R904 100Ω 1%
C912 MKP4_1u5
R908 820Ω 1%
R916 100Ω 1%
U304B ECC81
R938 130Ω 1%
R920 680Ω 1%
C919 470µF 63V
GND

R934 220Ω 1%
U900A ECC88
R933 100Ω 1%
C923 MKP4_1u5
R935 220Ω 1%
R931 100Ω 1%
R932 100kΩ 1%
U900B ECC88
C921 470µF 63V
R936 220Ω 1%
GND

C922 82uF_250V
GND
BusHV
HighVoltage
HVch2(60)

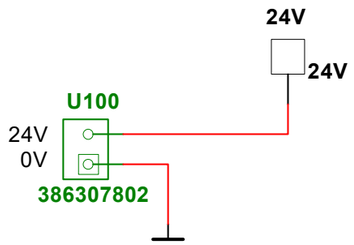
C924 4.7µF 2%
C925 4.7µF 2%
RIAA
MMout2(81)
R909 1.0MΩ 1%
GND
BusMM
R937 10kΩ 1%

Expected power consumption:
High Voltage: 14 mA
Filament: 2 x 300 mA + 365 mA = 965 mA nominal

Capacitors: LCR Components FSC(/EX) series
Resistors: TE Connectivity/Neohm H8 (Holco), R series
Welwyn RC, RC55, PR (low cost) series
Vishay Dale PTF series
http://nl.farnell.com/webapp/wcs/stores/servlet/Search?catalogId=15001&langId=31&storeId=10168&categoryId=700000005447&pageSize=25&showResults=true&sf=432,502,721&pf=110003727,110075262,110101775,110124724,112067013

Passive RIAA calculator: http://amorgignitamorem.nl/WebPaginas/passieve_RIAA/passieve_RIAA.html

德克斯 JCAD jcad.design The Netherlands		*Project* **0033/RO3**	*Schematic* RO3_C
Title: MM RIAA stage (right)	Desc.: Passive RIAA and Input Impedance Selection		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: Custom	
Approved by:	Sheet 7 of 8	1st.date: Nov 4, 2017	



德克斯 JCAD jcad.design The Netherlands		*Project* **0033/RO3**	*Schematic* RO3_C
Title: PS distribution	Desc.: Distribution Power Supply		
Designed by: JCA Dekkers	Rev.date: Sep 04, 2022	Revision: C	
Checked by: A Ego	PCB No: 0033 RO3_C	Size: A3	
Approved by:	Sheet 8 of 8	1st.date: Nov 4, 2017	