

IN1

J1

REPEAT(AMP,1,1)
CM2.SchDoc

A Amp

OUT

D0
D1
D2
D3
D4
D5

REPEAT(CB,1,1)
CM3A.SchDoc;CM3B.SchDoc

Crossbar/
Boost

OUT1
OUT2

GND

OUT2

IN2

J2A

GND

J2B

REPEAT(AMP,2,2)
CM2.SchDoc

B Amp

OUT

D6
D7
D8
D9
D10
D11

REPEAT(EXC,2,2)
CM4.SchDoc

B Exc

MON1

MON2

OUT

ENABLE

OPTION

D47
D48

OUT 1

J3A

GND

J3B

REPEAT(SPLIT,1,1)
CM5A.SchDoc;CM5B.SchDoc;CM5C.SchDoc

Split

IN

OUT1

OUT2

POLARITY1

FILTER1

ENABLE

POLARITY2

SPLIT

COMP

BIAS

BOOST

FILTER2

BYPASS

OPTION

ENOF5

FIXED

OFFSET

SLOWFB

SLOW

D20
D21
D22
D23
D33
D37
D29
D30
D25
D24
D27
D26
D38
D39
D40

J11

B EXC

REPEAT(BP,1,1)
CM7A.SchDoc;CM7B.SchDoc

Backplane/Power

D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
D29
D30
D31
D32
D33
D34
D35
D36
D37
D38
D39
D40
D41
D42
D43
D44
D45
D46
D47
D48

GND

IN+

IN-

C Amp

OUT

G0
G1
G2
G3
G4
G5

D41
D42
D43
D44
D45
D46

DAQ 1

J6A

GND

J6B

SERVO

J5B

J5A

GND

J6B

DAQ 2

J6B

GND

REPEAT(FAST,1,1)
CM6A.SchDoc;CM6B.SchDoc

Fast

IN

OUT

MON

LIMITS

SLOW

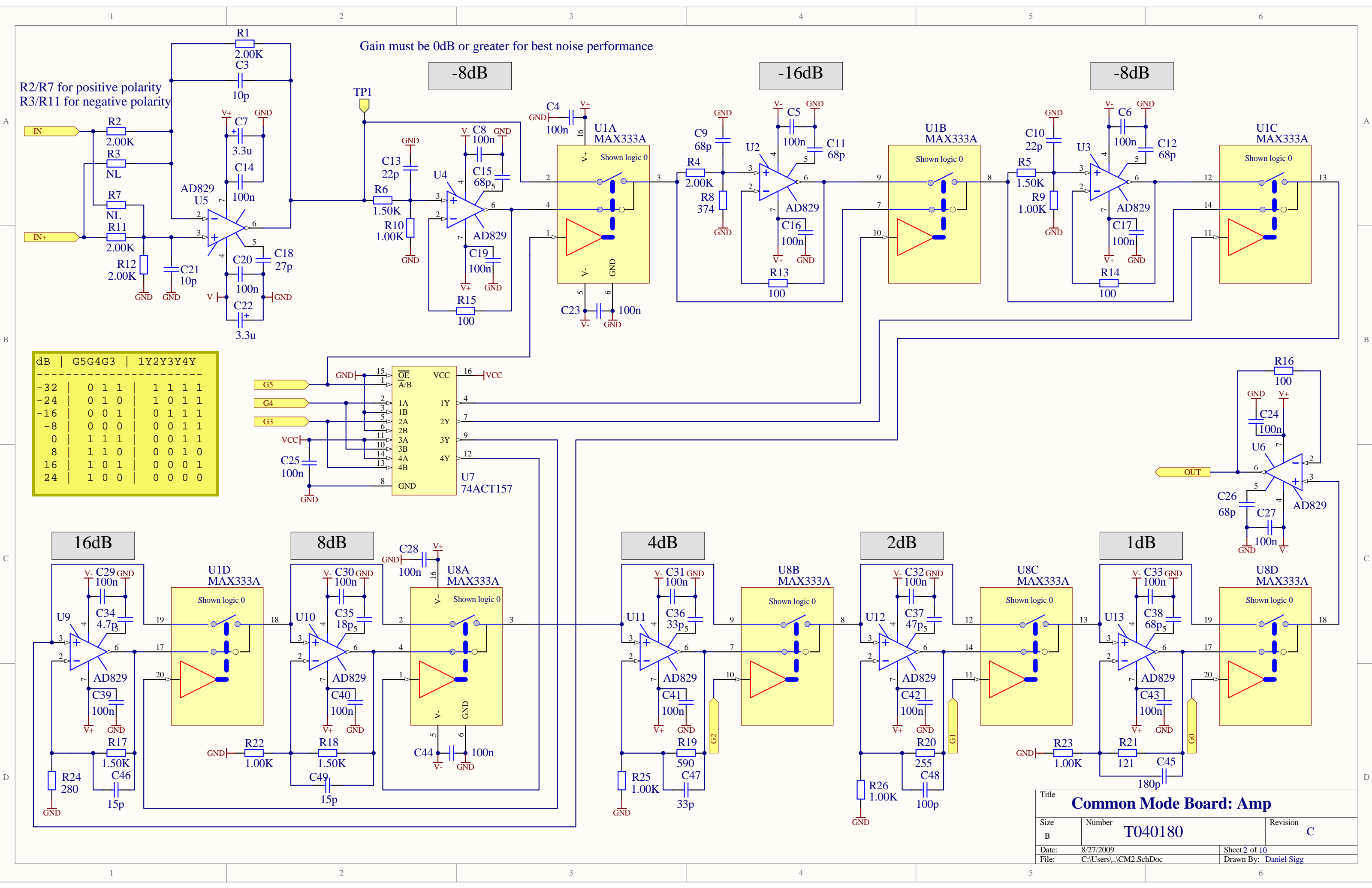
LIMIT

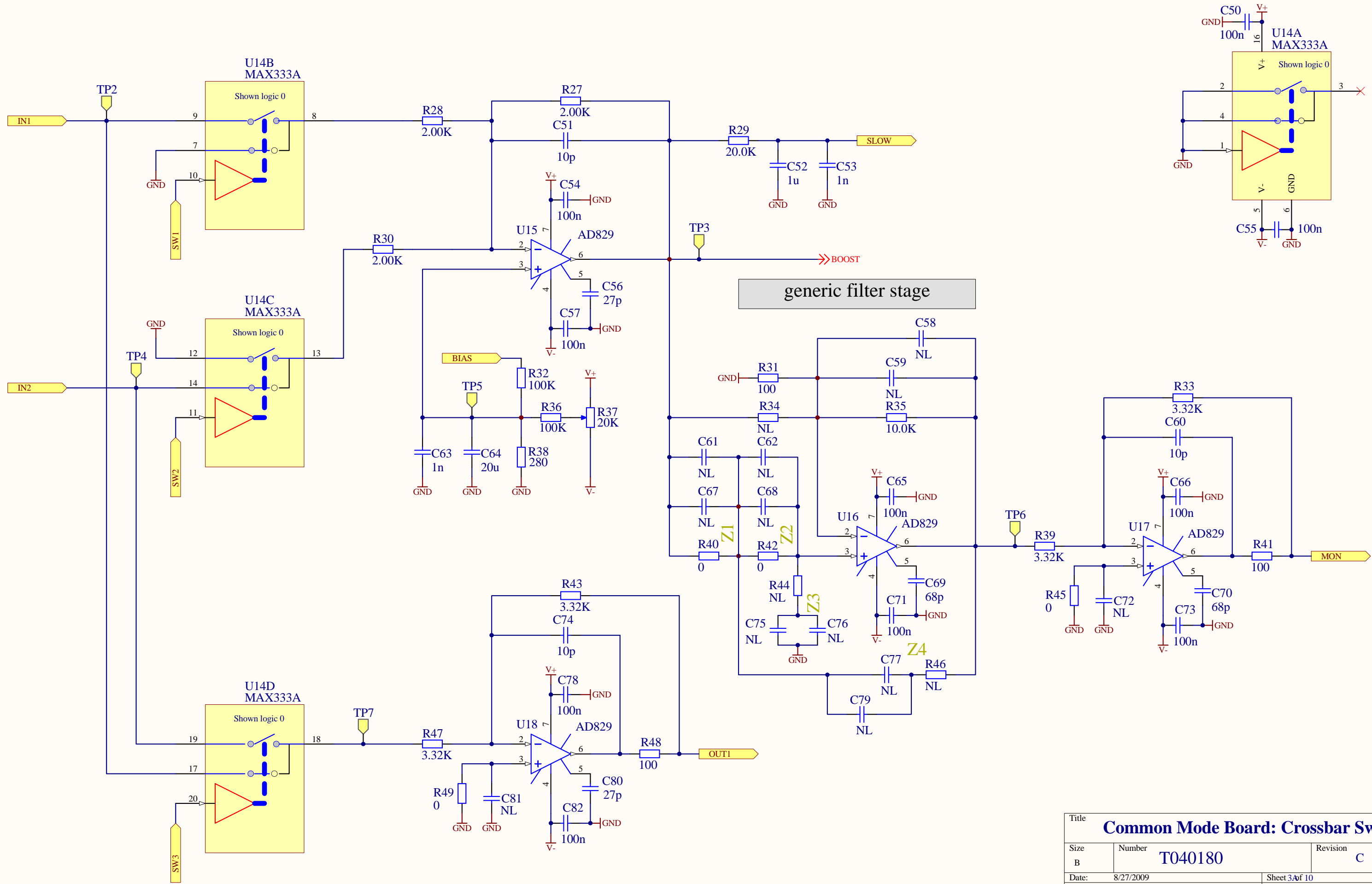
D31
D34
D35

T2
C1
T1
NL

T4
C2
T3
NL

Title Common Mode Board		
Size B	Number D040180	Revision C
Date: 8/27/2009	Sheet 1 of 10	
File: C:\Users\...\CM1.SchDoc	Drawn By: Daniel Sigg	





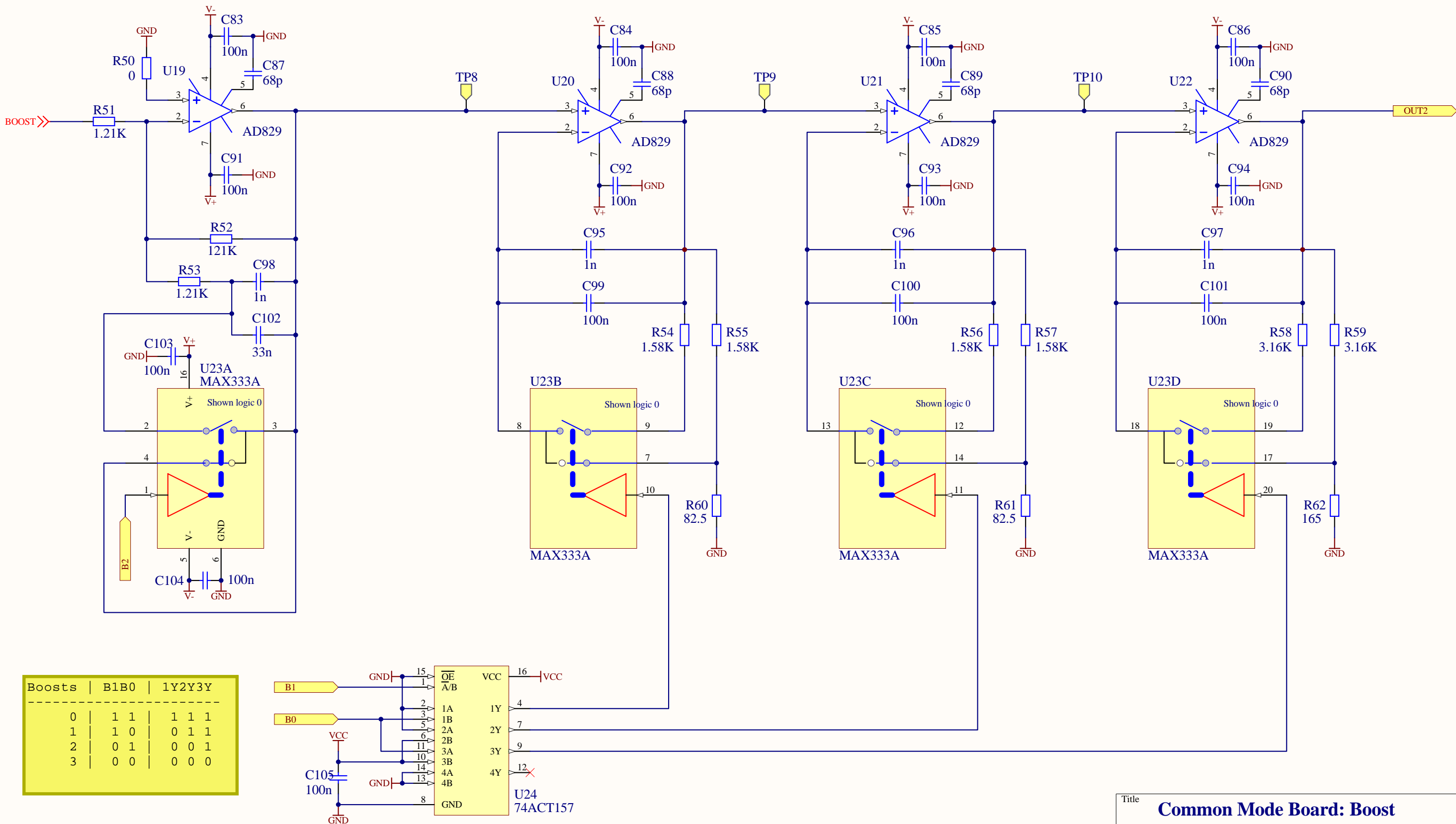
Title		Common Mode Board: Crossbar Switch	
Size B	Number T040180	Revision C	
Date:	8/27/2009	Sheet 3 of 10	
File:	C:\Users\...CM3A.SchDoc	Drawn By: Daniel Sigg	

40Hz/4kHz pole/zero pair

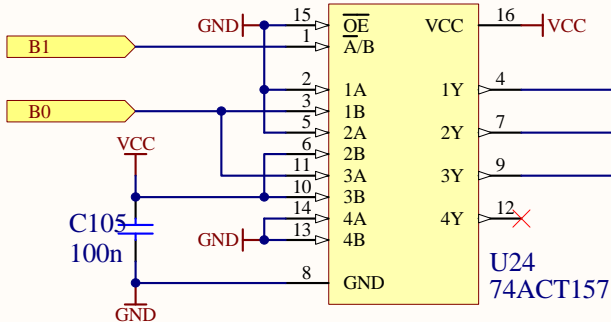
1kHz/20kHz pole/zero pair

1kHz/20kHz pole/zero pair

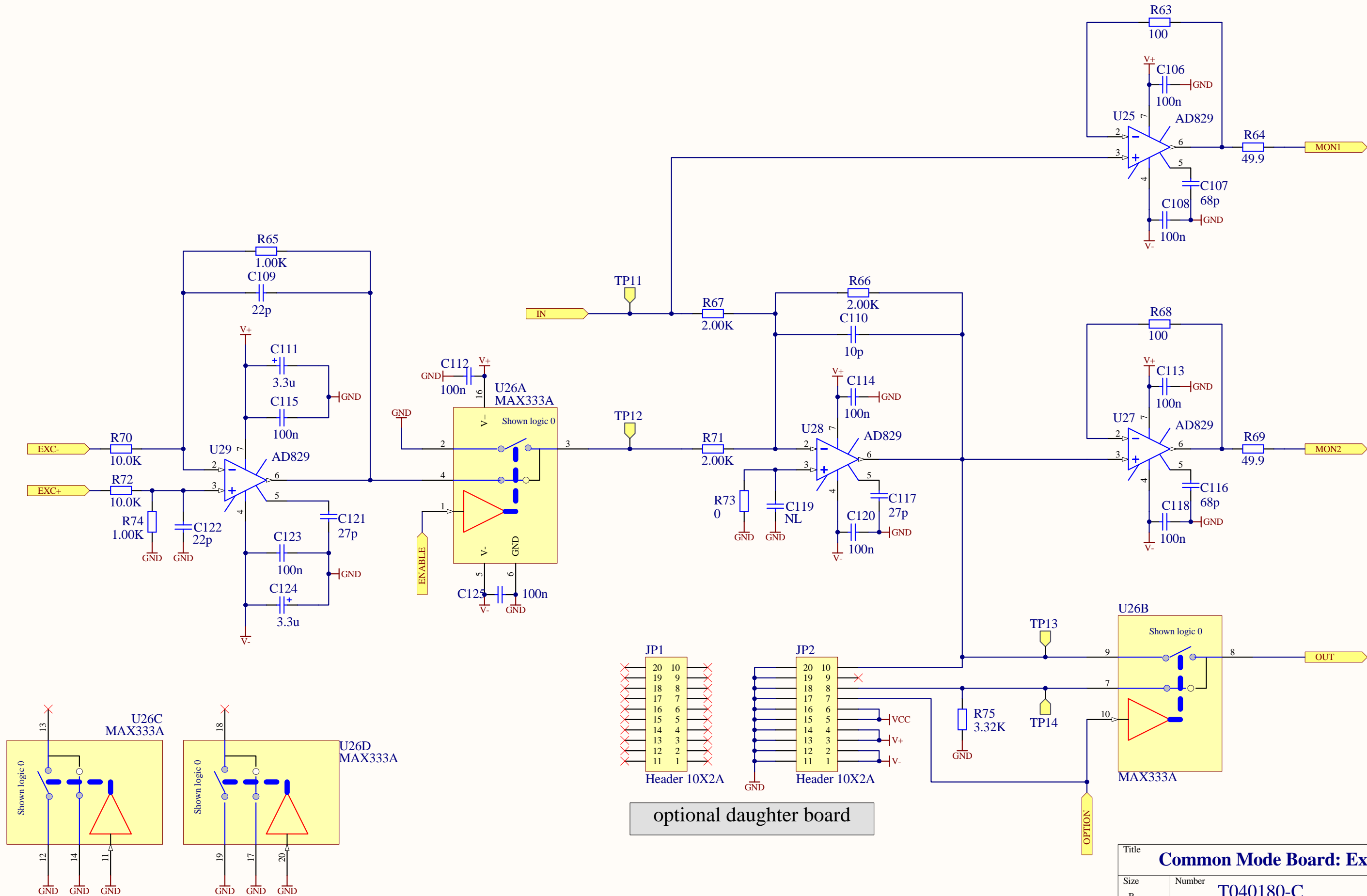
500Hz/10kHz pole/zero pair



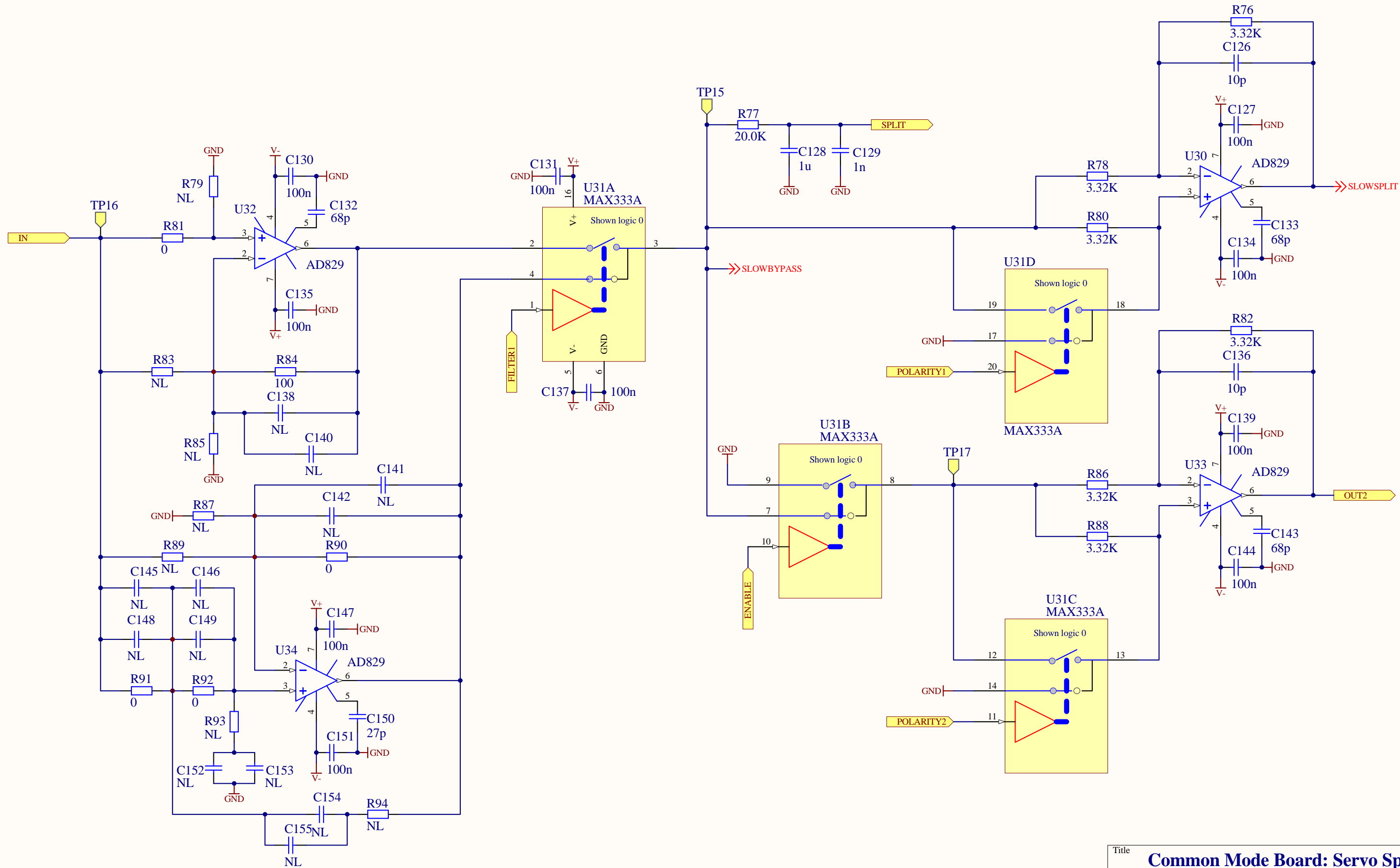
Boosts	B1B0	1Y2Y3Y
0	1 1	1 1 1
1	1 0	0 1 1
2	0 1	0 0 1
3	0 0	0 0 0



Title Common Mode Board: Boost		
Size B	Number T040180-C	Revision C
Date: 8/27/2009	Sheet 3B of 10	
File: C:\Users\...\CM3B.SchDoc	Drawn By: Daniel Sigg	

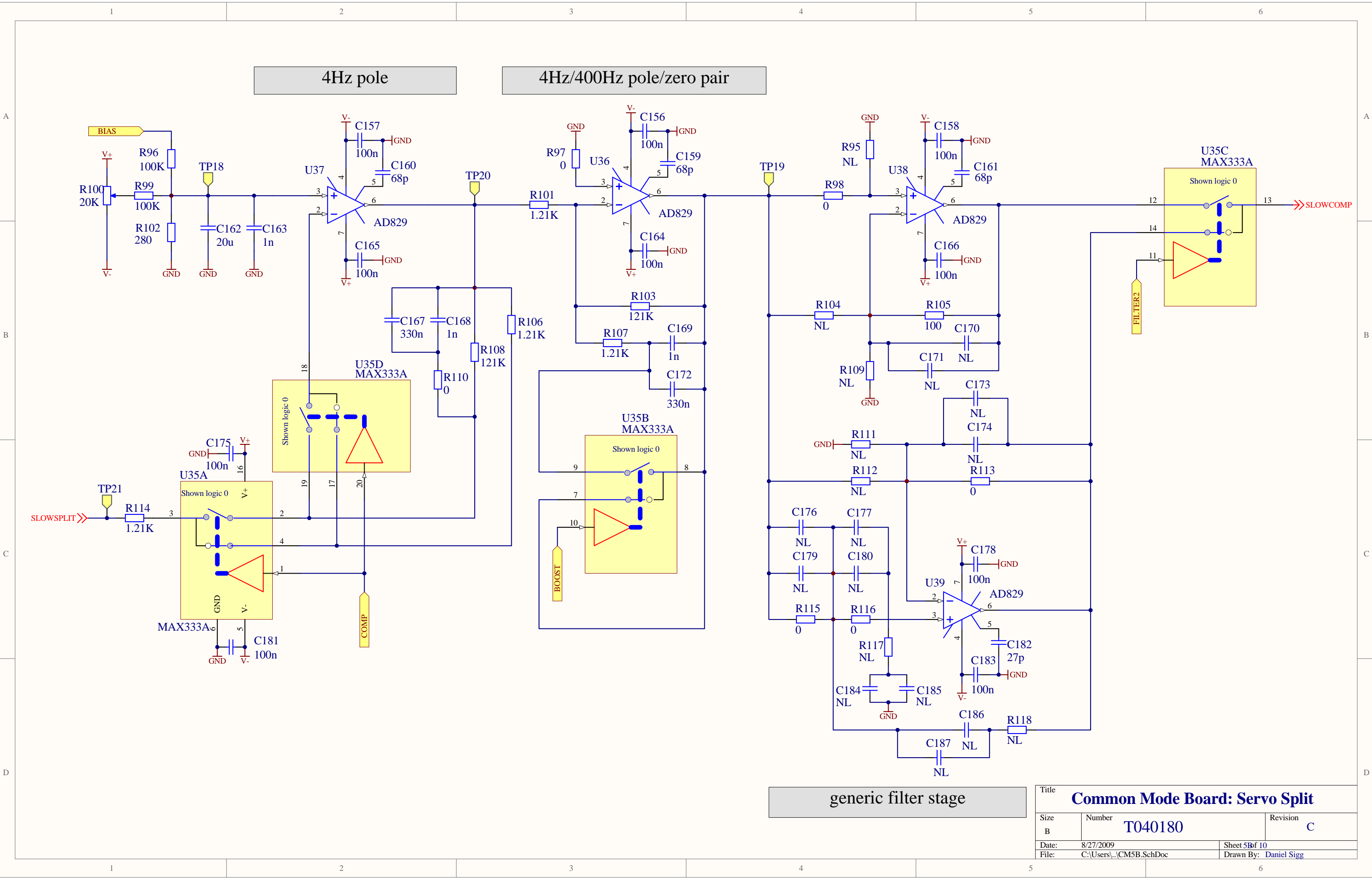


Title Common Mode Board: Excitation Point		
Size B	Number T040180-C	Revision C
Date: 8/27/2009	Sheet 4 of 10	
File: C:\Users\...\CM4.SchDoc	Drawn By: Daniel Sigg	



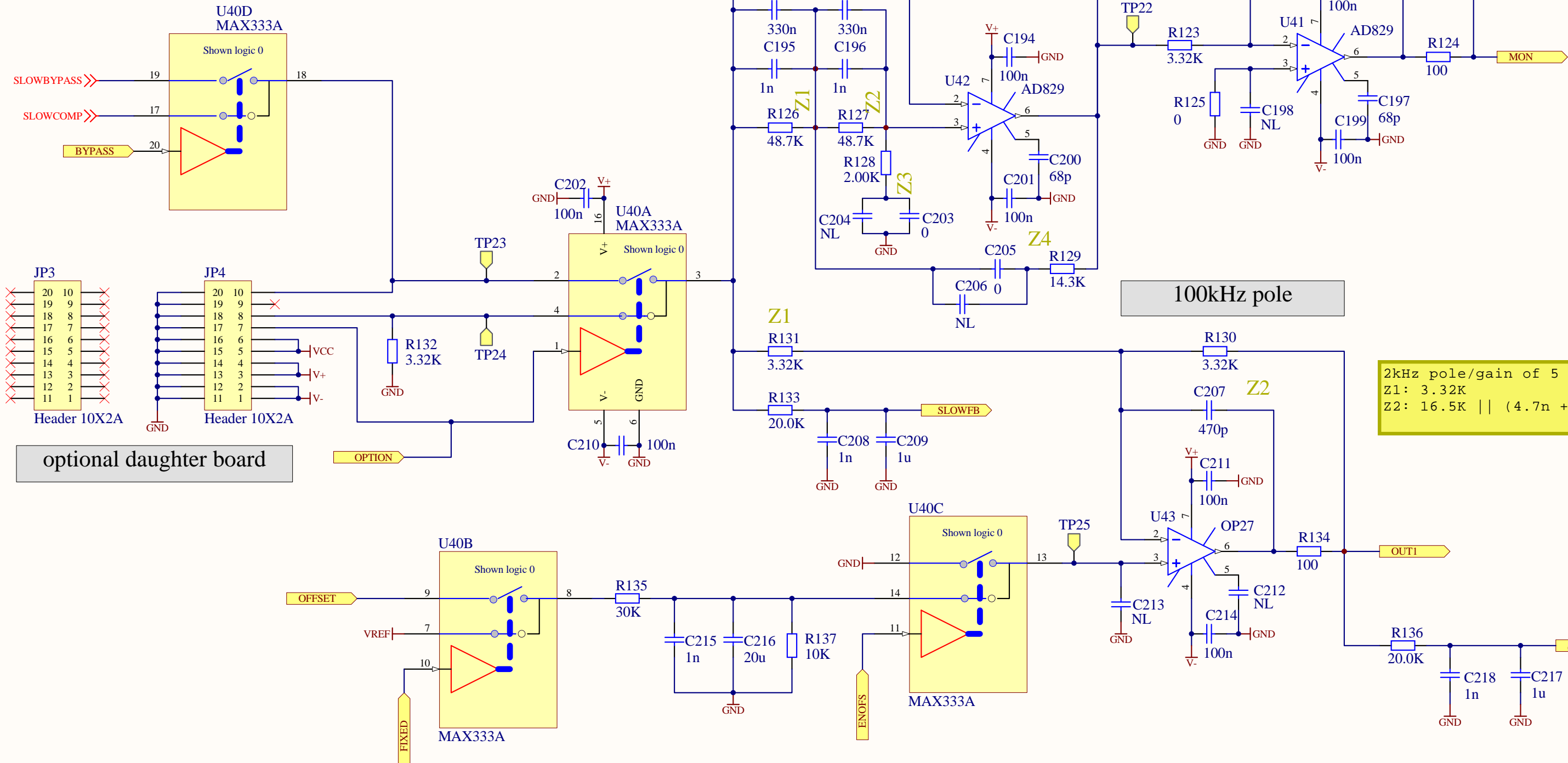
generic filter stage

Title		
Common Mode Board: Servo Split		
Size	Number	Revision
B	T040180	C
Date:	8/27/2009	Sheet 5 of 10
File:	C:\Users\...\CM5A.SchDoc	Drawn By: Daniel Sigg



Title Common Mode Board: Servo Split		
Size B	Number T040180	Revision C
Date: 8/27/2009	Sheet 5B of 10	
File: C:\Users\...\CM5B.SchDoc	Drawn By: Daniel Sigg	

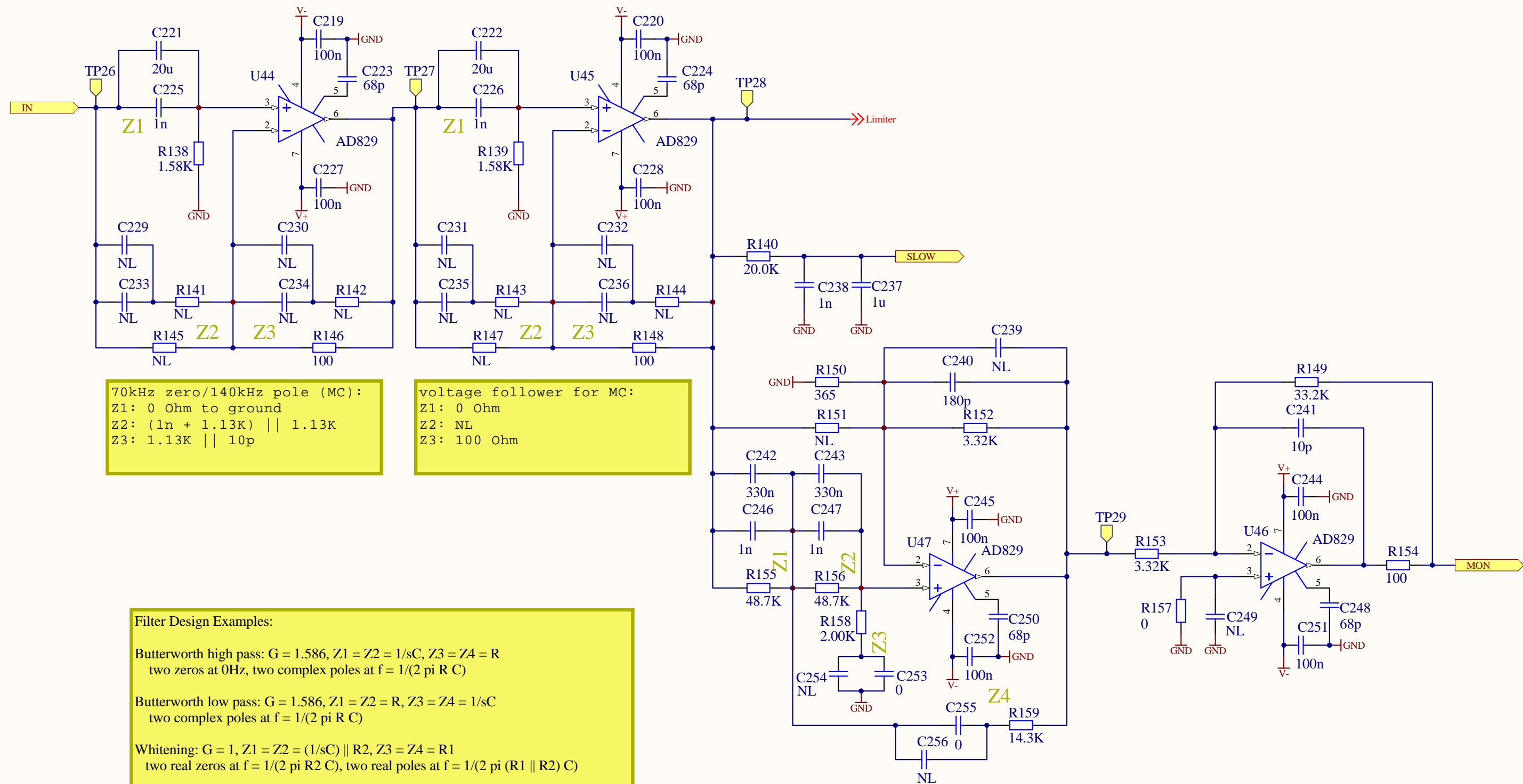
generic filter stage
2 real zeros at 10Hz
2 real poles at 100Hz
dc gain of 0.1



Title		
Common Mode Board: Servo Split		
Size	Number	Revision
B	T040180	C
Date:	8/27/2009	Sheet 5 of 10
File:	C:\Users\...\CM5C.SchDoc	Drawn By: Daniel Sigg

5Hz high pass

5Hz high pass



70kHz zero/140kHz pole (MC):
Z1: 0 Ohm to ground
Z2: (1n + 1.13K) || 1.13K
Z3: 1.13K || 10p

voltage follower for MC:
Z1: 0 Ohm
Z2: NL
Z3: 100 Ohm

Filter Design Examples:

Butterworth high pass: $G = 1.586$, $Z1 = Z2 = 1/sC$, $Z3 = Z4 = R$
two zeros at 0Hz, two complex poles at $f = 1/(2 \pi R C)$

Butterworth low pass: $G = 1.586$, $Z1 = Z2 = R$, $Z3 = Z4 = 1/sC$
two complex poles at $f = 1/(2 \pi R C)$

Whitening: $G = 1$, $Z1 = Z2 = (1/sC) || R2$, $Z3 = Z4 = R1$
two real zeros at $f = 1/(2 \pi R2 C)$, two real poles at $f = 1/(2 \pi (R1 || R2) C)$

Dewhiteninig: $G = 1$, $Z1 = Z2 = R1$, $Z3 = Z4 = 1/sC + R2$
two real poles at $f = 1/(2 \pi (R1 + R2) C)$, two real zeros at $f = 1/(2 \pi R2 C)$

generic filter stage
2 real zeros at 10Hz
2 real poles at 100Hz
dc gain of 0.1

Title		
Common Mode Board: Fast Path		
Size	Number	Revision
B	T040180	C
Date:	8/27/2009	Sheet 6 of 10
File:	C:\Users\...\CM6A.SchDoc	Drawn By: Daniel Sigg

Diodes only for
mode cleaner board

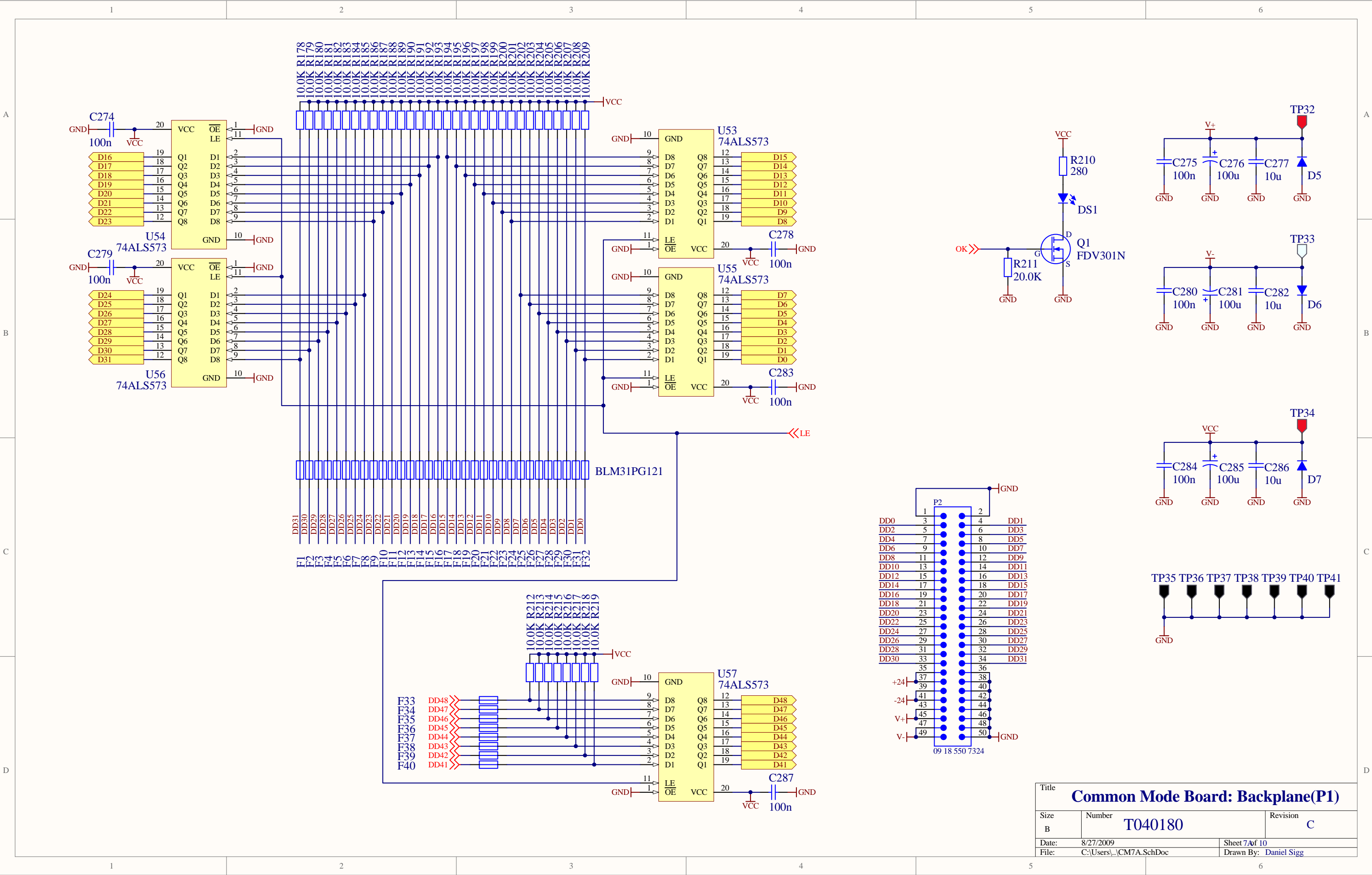
limiter

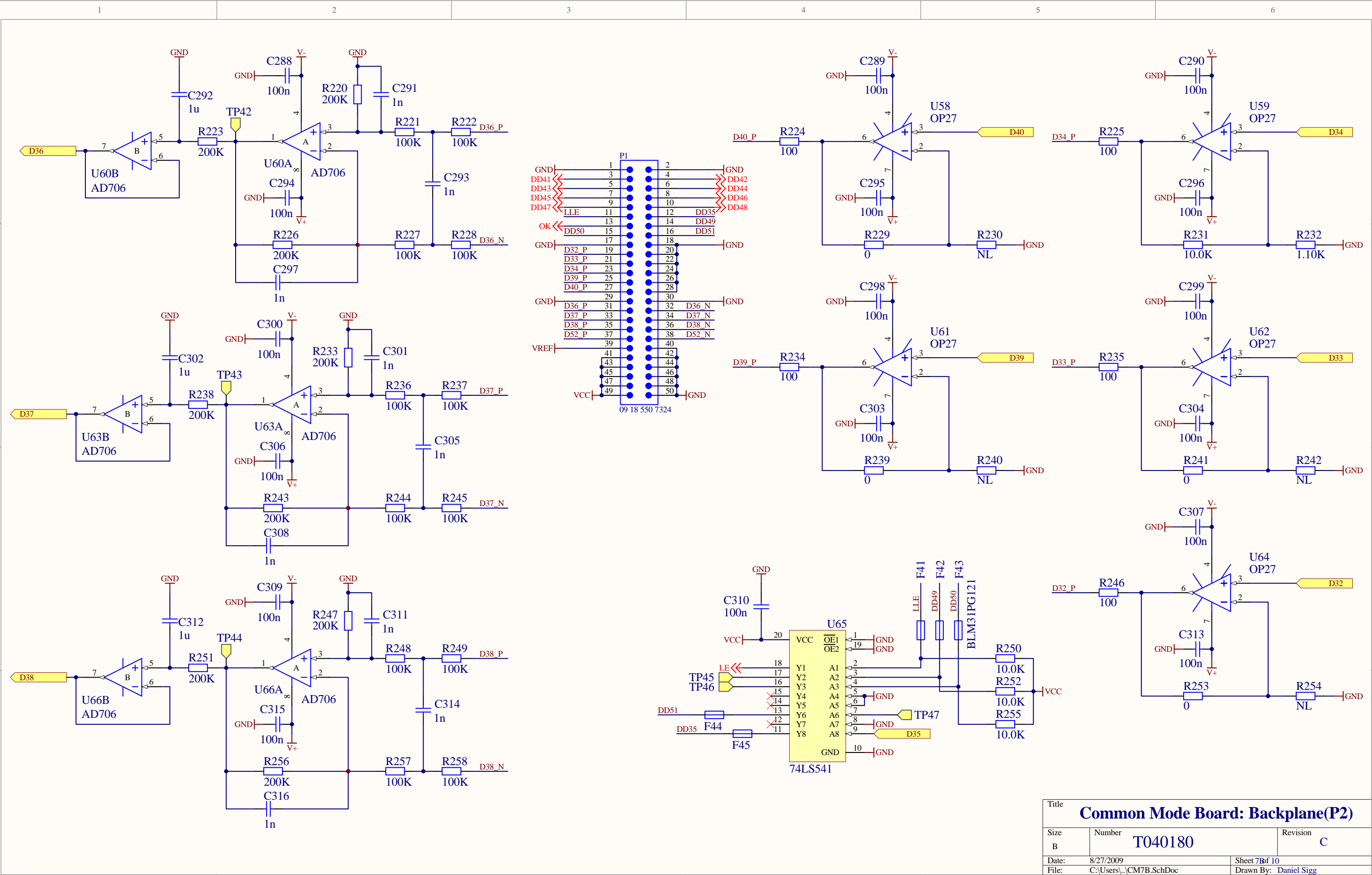
Gain of 1/2 (MC):
 $Z1 = 1.65K \parallel (18p + 49.9)$

window comparator & one-shot

Common Mode Board: Output Limiter

Size B	Number T040180	Revision C
Date: 8/27/2009	Sheet 6B of 10	
File: C:\Users\...\CM6B.SchDoc	Drawn By: Daniel Sigg	





Title			Common Mode Board: Backplane(P2)	
Size	Number	Revision		
B	T040180	C		
Date:	8/27/2009	Sheet 7Bf 10		
File:	C:\Users\...\CM7B.SchDoc	Drawn By: Daniel Sigg		