DRIVE CONTROL

REVISIONS			
REV.	DESCRIPTION	CHANGE BY	DATE
1	Prototype	R.S.S.	06/06/11
A	RELEASE	S.D.	06/30/11
A1	BOM TWEAKS FOR INITIAL BUILD	R.S.S.	07/21/11
B	ADD LIMITER, CHANGE BBD BIAS, ETC	R.S.S.	09/08/11
.	.	.	xx/xx/xx

AUDIO IN

J1 (T, TN, R, RN, S, G) 2Vpp
C1 0.47uF 50V / 20%
R1 10.0K
D11 BAT54S
C2 47pF
R2 1.00M
U1-B TL074A
R211 2.21K
AUD_IN_BUFFERED [1]
C94 47pF
R3 1.00K
P1 50KA CCW
-6.9 – +27.25dB Gain
-2.00Vpp
U1-C TL074A
R210 2.21K
V_GND
AGND
+15V

C2 = 100Pf A TAD LARGE – 0.5dB @ 10KHz

1M DOES NOT QUITE GIVE 7.5v OFFSET

AC couple?

U1-E TL074A
C51 0.10uF

DIRECT MIX VCA

AUD_IN_BUFFERED [1]
AUD_IN_POST-GAIN [1,2,5]
C10 2.2uF 35V / 20%
R10 10.0K
U5-B LM13700
R128 33.2K
R88 267
R89 267
BIAS

CV_MIX-SUM [1,4]
R37 10.0K
R84 10.0K
R36 11.0K
U7-B LM13700
R85 8.66K
Q5 MMBT3906
R27 2.21K
LEVEL [1]
C144 0.01uF
CV_LEVEL-SUM [4]
R86 10.0K
R87 8.66K
R35 10.0K
U8-B LM13700

DELAY MIX VCA

AUD_LOOP_BUFFERED [1,2,5]
C21 2.2uF 35V / 20%
R92 10.0K
U6-B LM13700
R133 33.2K
R90 267
R91 267

U5-D LM13700
R93 10.0K
C6 330pF
R94 4.75K
C209 4.7UF BP
R137 100K

LEFT / MONO MIX OUT

U2-B CD4053
R71 267
D8 BAT54S
C85 10uF 25V / 20%
R213 100K
R4 100K
D7 7.5V
R212 221
AUD_MIX-OUT [1]

BYPASS_15V [1]
RN17-A 8 4.7K 1
RN17-D 5 4.7K 4
Q2 2N3904
4.7K RN12-A
RN12-B 2 4.7K 7
MPU_BYPASS [6]
BYPASS_3.3V [2]
U3-E

R85 || R87 || R214 || R215 MUST BE < R27 OR GAIN INVERTS AT END

P8
A2501WV12 / B12B-XH-A(LF)(SN)
AUD_MIX-OUT [1]
AUD_DELAY-OUT [1]
AUD_LOOP-SEND [2]
AUD_LOOP-RETURN [2]
CV_LFO-AMT_PREBUF [4]
5V_AMOUNT-CV [4]
+2.5V1 [4,5]
MIDI_IN+ [6]
MIDI_IN– [6]
DGND
AGND

POPULATE W/ CAS-02-000-0085

NORMAL (STEREO OUT) DIP SWITCH SETTINGS

SW 1 = ON
SW 2 = OFF
SW 3 = OFF
SW 4 = ON
SW 5 = ON
SW 6 = OFF

DRY PHASE/MIX

AUD_IN_BUFFERED [1]
AUD_IN_POST-GAIN [1,2,5]
C16 2.2uF 35V / 20%
SW3-A
SW3-B
R109 10.0K
R108 10.0K
R110 33.2K
U5-A LM13700
R116 267
R117 267

MIX ENABLE

CV_MIX-SUM [1,4]
SW3-E
SW3-F
R26 10.0K
R118 10.0K
R138 11.0K
R156 10.0K
U7-A LM13700
R214 8.66K
I_LEVEL [1]

DELAY MIX VCA

R158 10.0K
R119 10.0K
R215 8.66K
U8-A LM13700

AUD_LOOP_BUFFERED [1,2,5]
C127 2.2uF 35V / 20%
SW3-C
SW3-D
R82 10.0K
R97 10.0K
R134 33.2K
U6-A LM13700
R98 267
R99 267

WET PHASE/MIX

U5-C LM13700
R95 10.0K
C7 330pF
R96 4.75K
C213 4.7UF BP
R241 100K
BYPASS_15V [1]

RIGHT/ STEREO DELAY OUT

U2-A CD4053
R242 267
D10 BAT54S
C5 10uF 25V / 20%
R111 100K
R5 100K
D9 7.5V
R139 221
AUD_DELAY-OUT [1]

MIX CV IS 3.85V TO 11.15V WITH 7.5V BALANCED MIX
LEVEL CV IS 7.5V TO 14.30V WITH 10.0515V UNITY GAIN
LEVEL RANGE FOR 4.0V PP OUTPUT IS +4.1dB TO –31.7dB

changing 267 ohm to 221 is ~–0.92dB
Or increase R110 / R134

NOTES: (UNLESS OTHERWISE SPECIFIED):
1. RESISTORS 0805, 1%, 1/8W, VALUE IN OHMS
2. CAPACITORS 0805, X7R, 50V, VALUE IN uF

DRAFTER R. SHAICH	DATE 06/06/11	MOOG MUSIC INC. 2004-E Riverside Drive. Asheville, NC 28804 (828) 251-0090 Fax (828) 254-6233 http://www.moogmusic.com	
DESIGN ENG. R. SHAICH	DATE 06/06/11		
PROJECT MGR. R. SHAICH	DATE 06/06/11		
MANUFACTURING ERICH CHURCH	DATE 07/21/11		
PLANT MANAGER X	DATE xx/xx/11	TITLE MF-108M CLUSTER FLUX tm Chorus Flanger I/O and Mix Buss	
PURCHASING X	DATE xx/xx/11		
PRESIDENT X	DATE xx/xx/11	SIZE D	FILENAME MF108M.SCH
DOC. CONTROL X	DATE xx/xx/11	SCALE N/A	CAD DIRECTORY X
		DWG. NO. BRD-10-011-362	REV B
		PROJECT CODE X	SHEET NO. 1 OF 7

BRD-10-011-362

FEEDBACK SUMMING

INPUT FILTER

6.75k 6th order Chebyshev 0.01dB ripple

V_GND
U2-C
CD4053
AUD_IN_POST-GAIN [1,5]
+15V
RN17-B 4.7K
RN17-C 4.7K
RN12-C 4.7K
RN12-D 4.7K
MPU_SPILL [6]
Q6 2N3904
SPILL_15V
AGND
R38 12.1K
D23 2.4V
D24 2.4V
R62 2.21K
C97 220pF
R39 10.0K
50V 5%
PRE_FILTERS
C22 2.2uF 35V / 20%
U11-A OPA1644A
+1.65Vpp (-1.66dB)
R104 11.3K
C37 3300pF
R105 23.2K
C38 680pF
U11-D OPA1644A
6.5405k, Q=1.034
R106 14.3K
C39 6800pF
R107 34.8K
C40 120pF
U11-C OPA1644A
7.9062k, Q=3.416
C41 2200pF
R140 0.00 NOPOP
R132 0.00
R52 12.1K
R53 28.0K
C42 1500pF
U11-B OPA1644A
4.801k, Q=0.556
R43 221
5015 NOPOP TP5
+1.65Vpp
AA_FILTER_OUT [3]
OUT_TO_BBDS
C26 0.022uF
AGND

R100 47.5K
V_GND

CV_FEEDBACK-SUM [4]
VR1 100K
CCW
R24 4.75K
R221 10.0K
C43 0.01uF
R80 10.0K
TL074A U16-B
R42 6.81K
C36 0.01uF
R136 10.0K
R135 10.0K
U16-A TL074A
R55 6.81K
V_GND

U9-B LM13700
+15V
R219 22.1K
2.2u = (-0.6dB @ 20Hz)
C23/27 S/B .027 BUT USING .022 TO SAVE LINE ITEM.
R103 10.0K
C24 2.2uF 35V / 20%
DO WE NEED C24/C35?
R101 267
R102 267
C23 0.022uF
V_GND
D1 BAT54S
BYPASS_3.3V [1]
D20 BAT54S
MMBT3906 Q3
MMBT3906 Q4
R141 5.23K
R54 4.75K
AGND
+15V
R51 22.1K
R50 10.0K
C35 2.2uF 35V / 20%
R49 267
R48 267
C27 0.022uF
U9-A LM13700
V_GND

AUD_LOOP_BUFFERED [1,5]
C98 220pF
R13 47.5K
C15 2.2uF
AGND
R14 10.0K
+2.00Vpp
U1-D TL074A
R11 10.0K
C13 0.47uF
R218 475
+1.60Vpp
AUD_LOOP-RETURN [1]
C14 220pF 50V 5%
R12 1.00M
C28 6800pF
D22 7.5V
R217 1.00M
AGND
V_GND

SEND/RETURN FROM LOOP INSERT

FEEDBACK TRIM

VR1 GAIN ADJUSTS FROM +3.8dB (0k) TO -3.0dB (100k)
CV INPUT VOLTAGE 4.75V TO 10.25V
7.5V = NO FEEDBACK
4.75V = INVERTED PHASE

FEEDBACK VCA

OUTPUT_FILTER

7.36k 6th order Chebyshev 0.01dB ripple

OUTPUT BUFFER

BBDS_OUT [3]
+2.0Vpp
R112 9.09K
R113 21.0K
C59 0.01uF
U19-A OPA1644A
C60 180pF
8.6207k, Q=3.416
R114 23.7K
R232 23.7K
C61 820pF
R115 21.5K
U19-B OPA1644A
5.2348k, Q=0.556
-1.95Vpp
R46 12.1K
C34 220pF 50V 5%
C62 2200pF
AGND
C44 330pF 50V 5%
R47 10.0K
U1-A TL074A
+1.95Vpp
R127 221
C63 10uF 25V / 20%
C29 0.01uF 50V 5%
D21 7.5V
R69 221
+1.60Vpp
AUD_LOOP-SEND [1]
R70 100K
AGND

+15V
C88 0.10uF
U11-E OPA1644A
AGND
C91 0.10uF
U19-E OPA1644A
C84 0.10uF
U9-E LM13700
U9-D LM13700
U9-C LM13700

BRD-10-011-362

Moog Music Inc

TITLE: MF-108M	REV: B
FILTERS & FEEDBACK	
Date: 04/15/11	SHEET 2 OF 7

DELAY ELEMENTS

POP R216 FOR 1 BBD

Audio out from anti-alias filter

MN3009 256 BUCKETS

MN3006 128 BUCKETS NOPOP

Fo= 7.1316K, Q=1.034 av=1.155

R44 = 84.5k – ~10.5k (Rbbd) = 73.2k

BBD_BIAS Adjustment point

BBD GATE BIAS

SET BIAS W/ CLOCK ~50KHz

MN3007 1024 BUCKETS

MN3107 MEASURED Zout ~ 10.5K @ 200k clock.

Z goes up as clock goes down.

Fo= 7.1316K, Q=1.034

R40 = 54.9 k – ~10.k (Rbbd) = 44.2k

CHANGE TO COG?

Vgg S/B SLIGHTLY > 1.0V

CLOCK GENERATION

SET TO <500nS RISE @125KHz

~12KHz to 200KHz

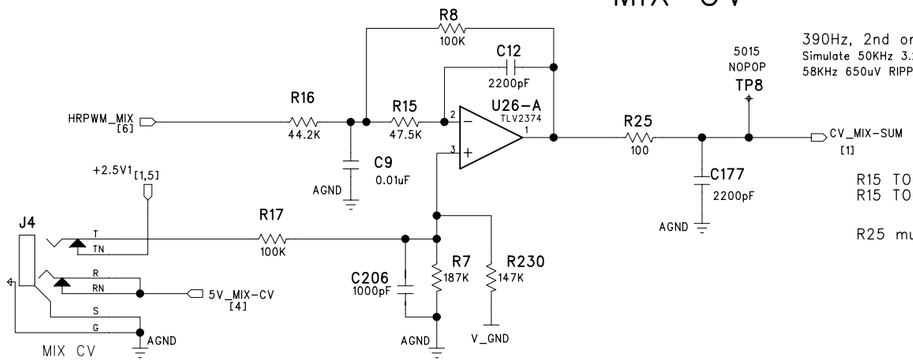
CLOCKS MUST BE ROUTED SERIALLY. NO STUBS

Moog Music Inc	
TITLE: MF-108M	REV: B
BBDS AND CLOCKS	
Date: 04/15/11	SHEET 3 OF 7

MIX CV = 7.5v +/- 3.65V
or 3.85v - 11.15v (7.3v total)
this gives some flat near the ends
linear is from ~4.08v to 10.92V

MIX CV

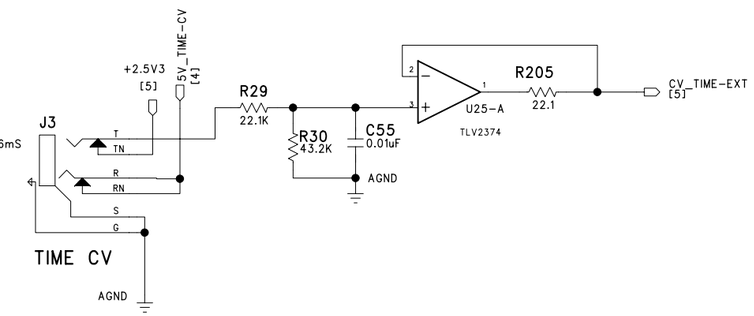
PWM @ CV = 2.5v: 0%=3.824v 100%=11.128v

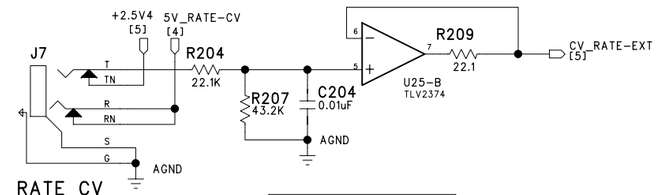


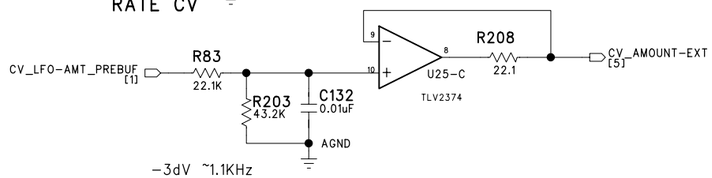
390Hz, 2nd order Bessel, AV=2.25
Simulate 50KHz 3.25V: Ripple = 900uV (13 bits); ring = ~ 33mV, Rise = 1.6mS
58KHz 650uV RIPPLE

R15 TO 47.5K, RIPPLE 650uV, RING 30mV
R15 TO 46.4K PER DESIGN

R25 must be under 150 ohms

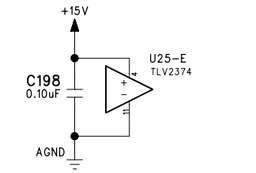




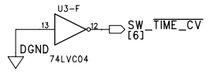


-3dV ~1.1KHz

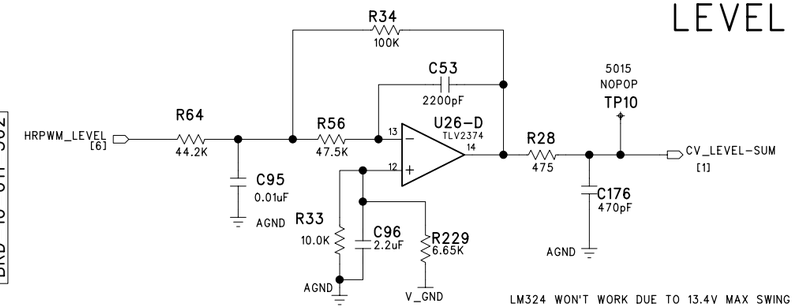
7% worst case non linearity @ middle travel w/ 20k pot (3.5% 10k pot)



extra gate used for +5V CV



LEVEL CV



LM324 WON'T WORK DUE TO 13.4V MAX SWING

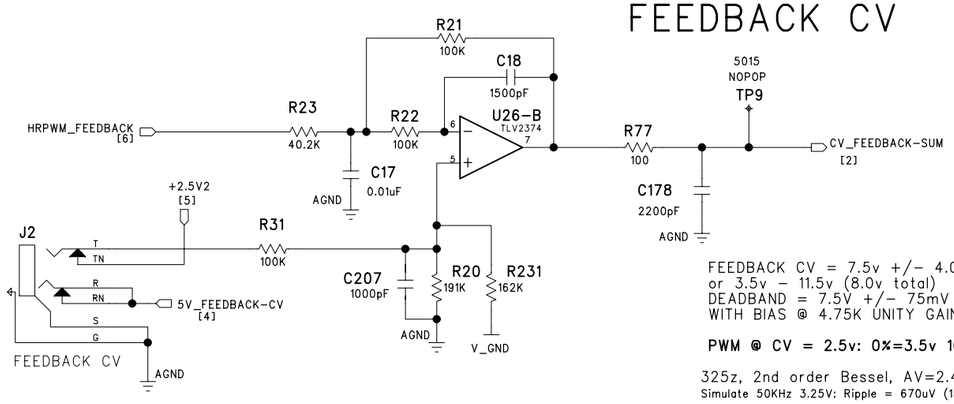
LEVEL CV = 7.5 - 14.3V (6.8V)
<7.5V = ~+4.9dB , 14.3V = -31.3dB
CAN GO TO ABOUT 14.5V BUT NOT LINEAR
UNITY GAIN ~ 10.550V

390Hz, 2nd order Bessel, AV=2.25
Simulate 50KHz 3.25V: Ripple = 900uV (13 bits); ring = ~ 33mV, Rise = 1.6mS
58KHz 650uV RIPPLE
Range 0% = 14.692V 100% = 7.344V 50% = 11.014V

R56 TO 47.5K, RIPPLE 650uV, RING 30mV
R56 TO 46.4K PER DESIGN

TO CHANGE TO BUTTERWORTH, C95=15nF, R56=47.5K
BW Ripple = 450uV, Ring >300mV

FEEDBACK CV



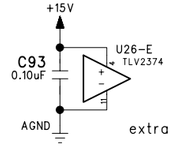
FEEDBACK CV = 7.5v +/- 4.0V
or 3.5v - 11.5v (8.0v total)
DEADBAND = 7.5V +/- 75mV
WITH BIAS @ 4.75K UNITY GAIN = 3.77/11.23V

PWM @ CV = 2.5v: 0%=3.5v 100%=11.5v

325z, 2nd order Bessel, AV=2.49
Simulate 50KHz 3.25V: Ripple = 670uV (13.5 bits); ring = ~ 33mV, Rise = 2.0mS

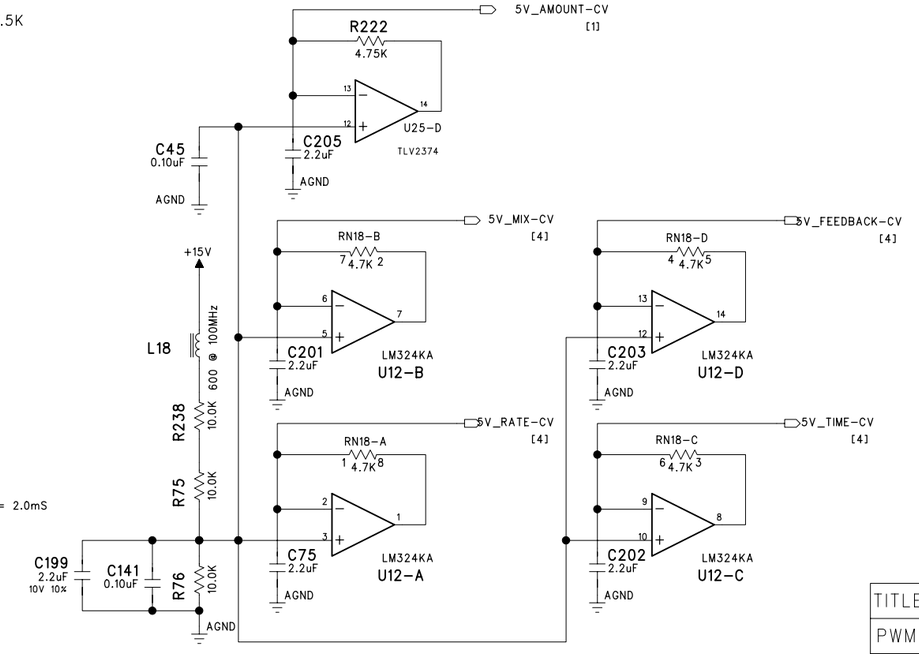
R77 must be under 150 ohms

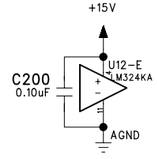
C18 TO 2.2nF RING =0, RISE = 4mS, RIPPLE = 450uV



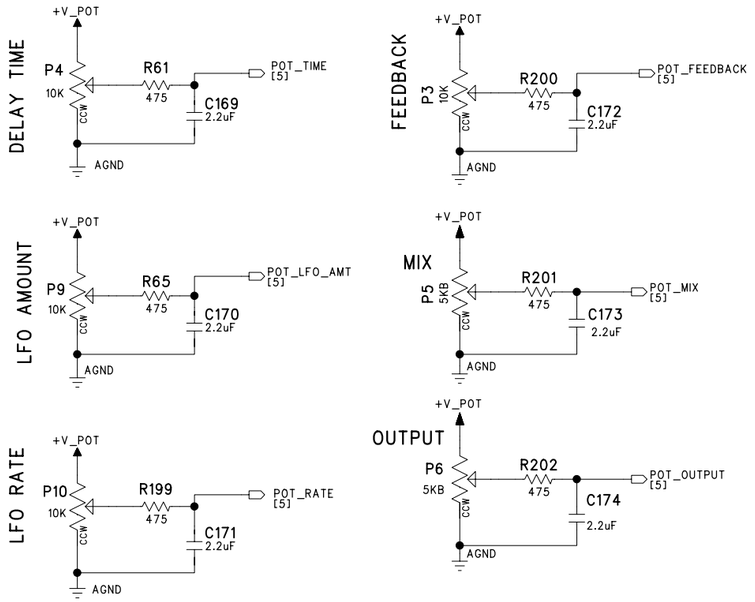
extra gate used for Vgg

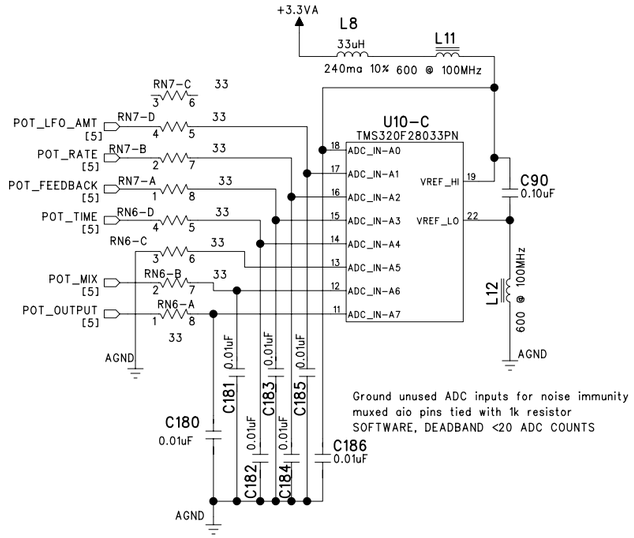
HRPWM: Output with 3.25V in
MFB, 2-Pole Bessel Filter, Fo = 390Hz
HRPWM Target Frequency 58.594KHz
SIMULATION: Effective Rise-Time: ~ 1.6mS, 50% ripple 900uV

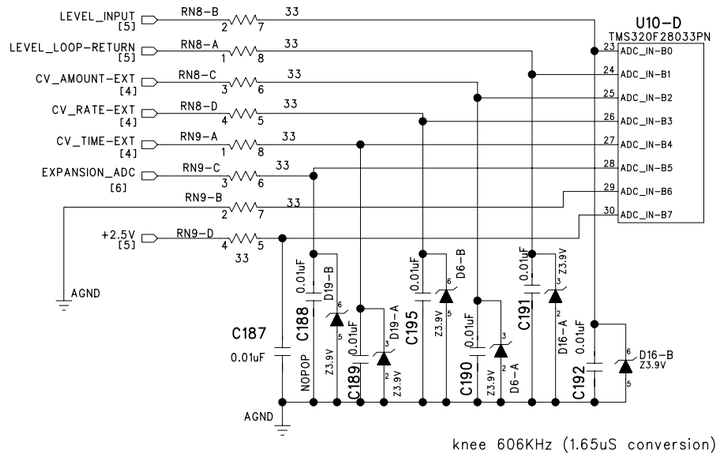




Moog Music Inc	
TITLE: MF-108M	REV: B
PWM FILTERS, CV IN, AND CV MIXERS	
Date: 04/14/11	SHEET 4 OF 7





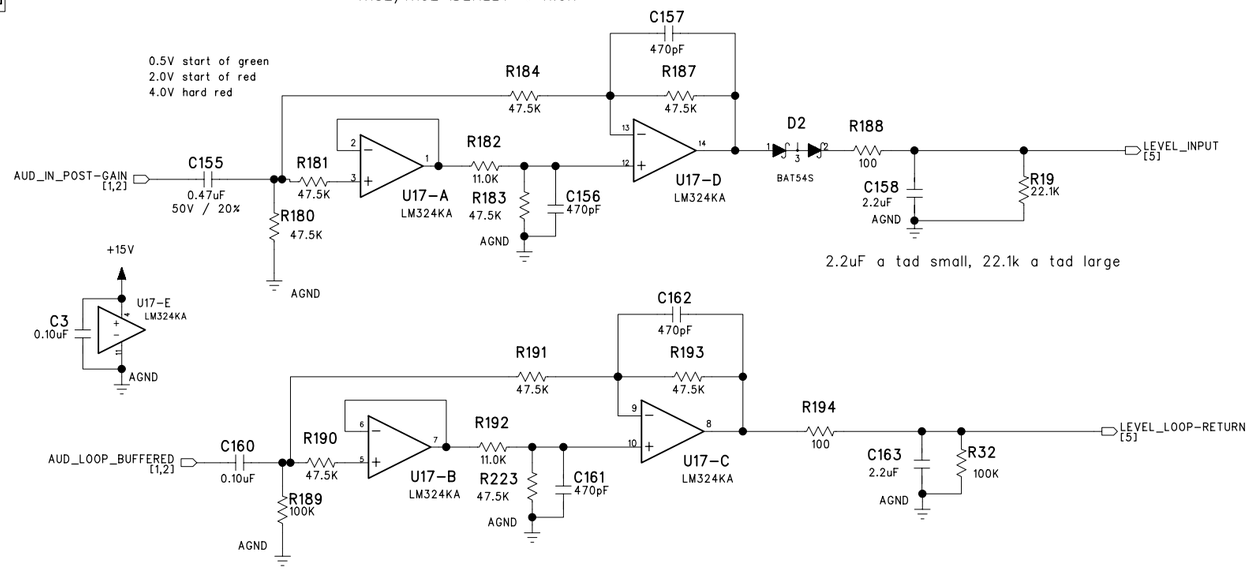


knee 606KHz (1.65uS conversion)

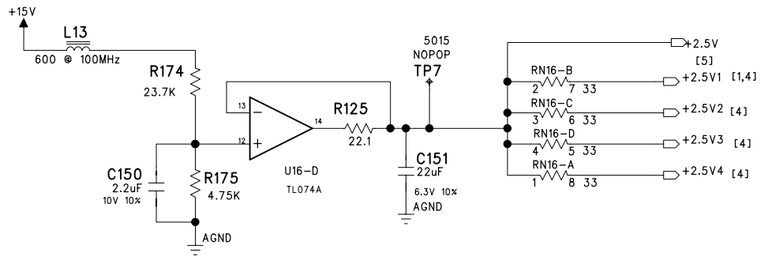
5K USED FOR CENTER SINCE WE ALREADY PURCHACE 5K 14MM ROUND

10k mid position pot gives rise of ~1uS so ACQPS s/b 63

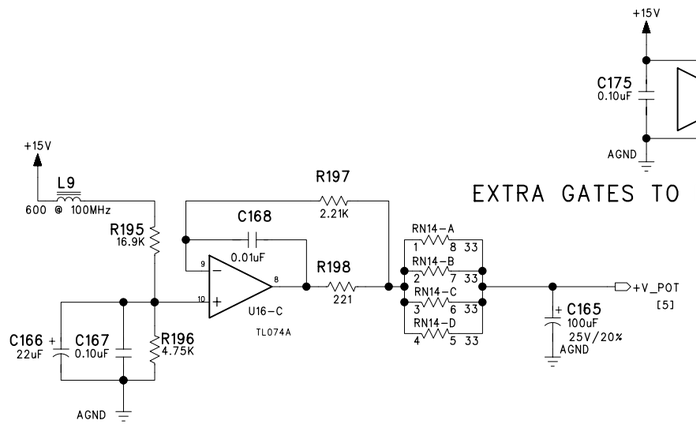
R182/R192 IDEALLY <=11.0K



2.2uF a tad small, 22.1k a tad large



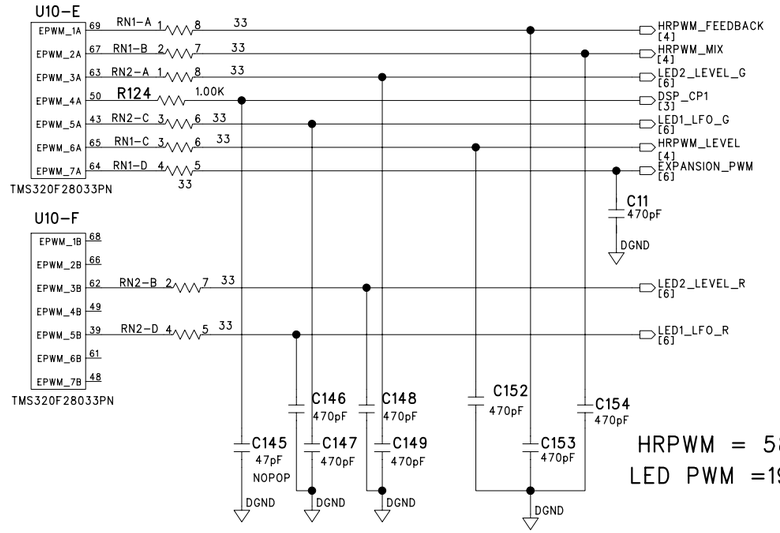
NO POP L13, R174, C150. R175 = 0 IF NOT USING MID POT

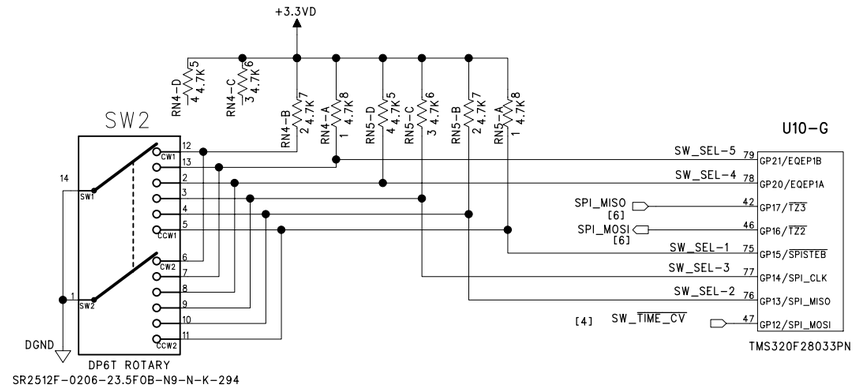


BRD-10-011-362

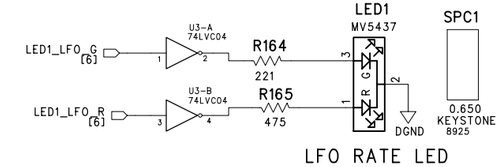
Moog Music Inc

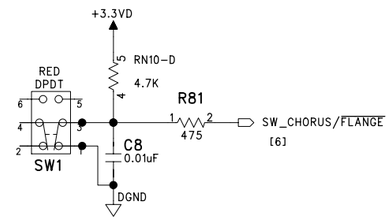
TITLE: MF-108M	REV: B
MPU ANALOG FUNCTIONS	
Date: 04/13/11	SHEET 5 OF 7

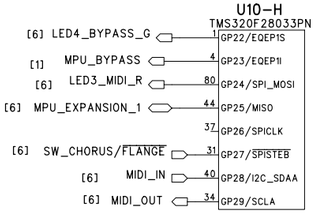


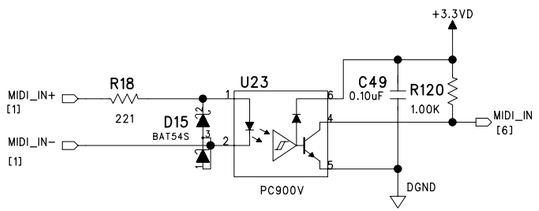


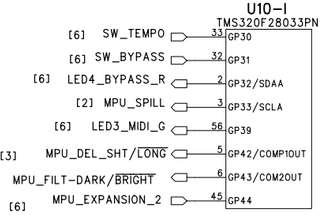
NEEDS SPACER, ID >8.8MM. od<21MM. H=7mm



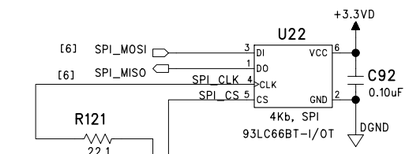


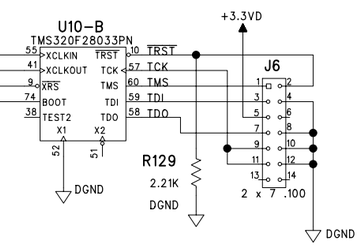


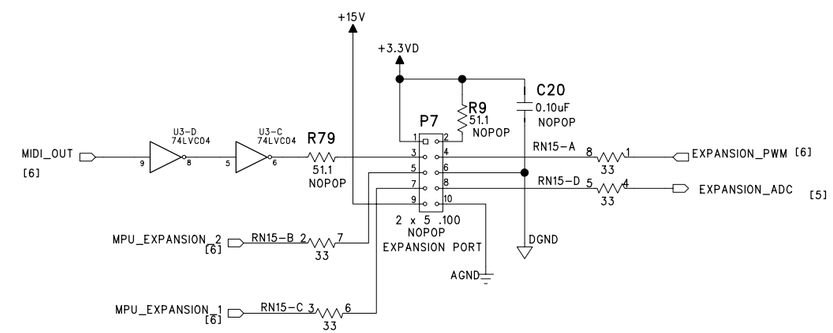




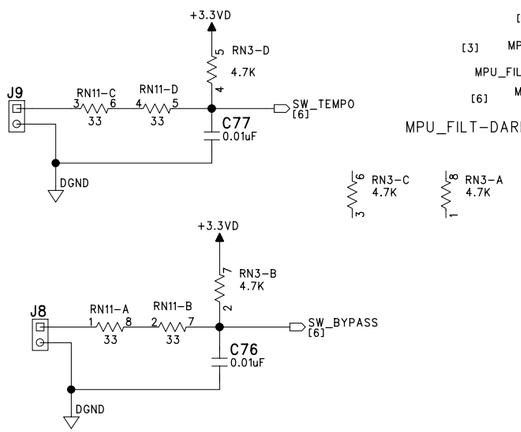
MPU_FILT-DARK/BRIGHT is a placeholder for delay product

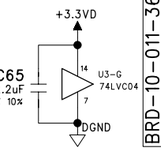






R9/R79 47.5 OHMS?





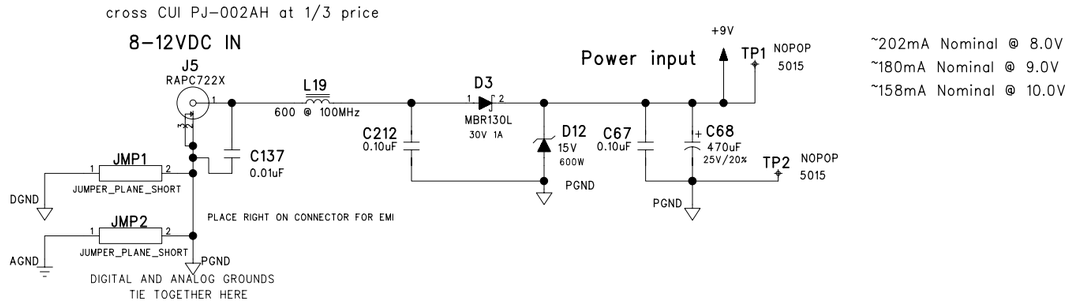
Moog Music Inc

TITLE: MF-108M	REV: B
MPU DIGITAL AND I/O FUNCTIONS	
Date: 04/13/11	SHEET 6 OF 7

BRD-10-011-362

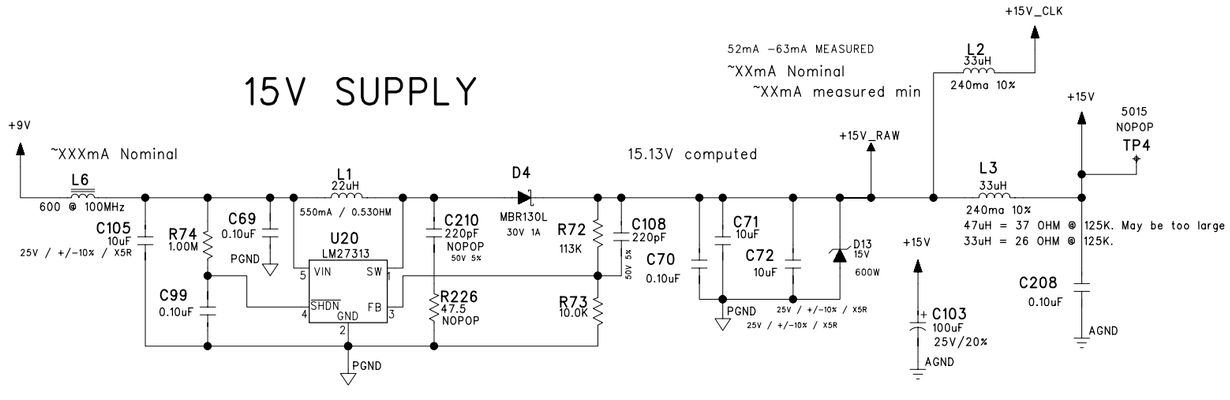
8–12VDC IN

cross CUI PJ-002AH at 1/3 price



~202mA Nominal @ 8.0V
~180mA Nominal @ 9.0V
~158mA Nominal @ 10.0V

15V SUPPLY

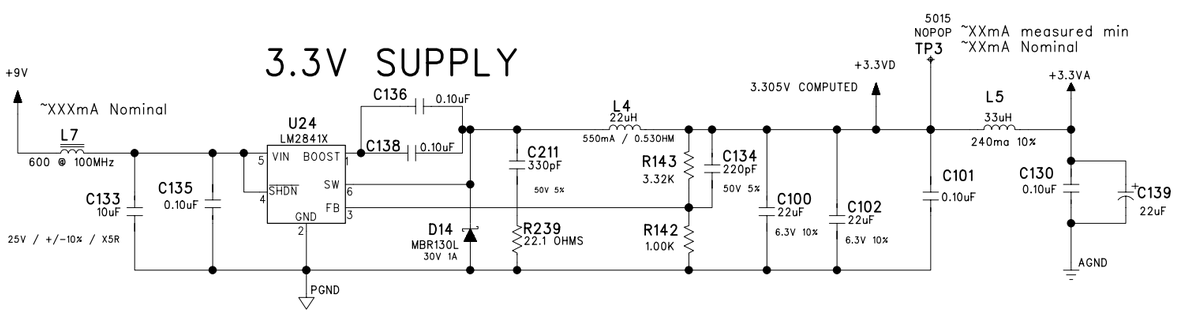


C99 SET TO ANALOG COMES UP 0.5S AFTER DIGITAL.

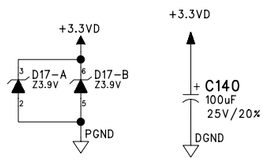
INDUCTOR BETWEEN 4.7uH AND 22uH
COMP CAP COMPUTED 180pF
ALT DIVIDOR 13.3K/147K/150pF

UCL1V101MCL6GS / NAZJ101M35V6.3X8NBF, 1/2 the Z. N/S yet

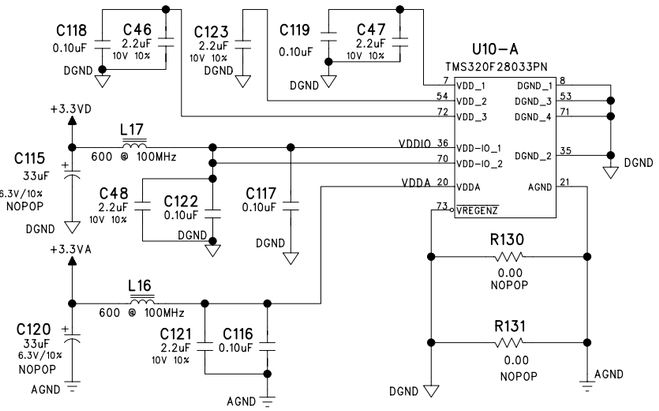
3.3V SUPPLY



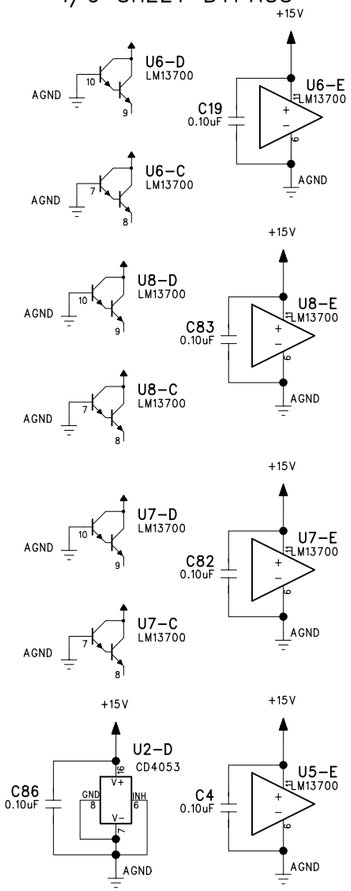
MBR130 CT=~50pF depending on Vr



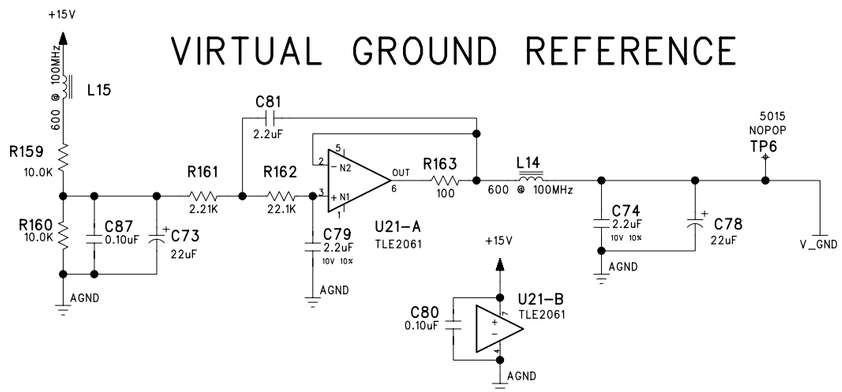
DSP BYPASS



I/O SHEET BYPASS



VIRTUAL GROUND REFERENCE



PCB1

PCB-01-011-362 Rev 1
RAW PCB, 4.300 x 6.700 .062 x 4 Layer

FID1 FID2 FID3
FID4 FID5 FID6

Moog Music Inc

TITLE: MF-108M	REV: B
POWER & BYPASS	
Date: 04/12/11	SHEET 7 OF 7

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REVISIONS			
REV.	DESCRIPTION	CHANGE BY	DATE
1	Prototype	R.S.S.	06/06/11
A	RELEASE	S.D.	06/30/11
A1	COMPONENT VALUE TWEAKS FOR PRODUCITON	R.S.S.	07/21/11
B	ADD LIMITER, CHANGE BBD BIAS, ETC	R.S.S.	09/08/11
.	.	.	xx/xx/xx

Rev A Changes from Rev 1

Page 1

1) R36 – change to 11.0K. Connect from U7–13/R37 to AGND
2) R138 – change to 11.0K. Connect from U7–4/R118 to AGND
3) Add AC coupling to output of U5C/U5D to eliminate bypass switching glitch . Add C209/C213: 4.7uF BP Electrolytic, Add R137/R241 100K, Add R71, R242 267 Ohm
4) R26 connected to +15V
5) U5–B/U6–B outputs referenced to VGND (R93/C6); U5–A/U6–A outputs referenced to VGND (R95/C7)
6) Increase Resistance to Q2 B/C by putting RN7–A/D and RN12–A/B in series.

Page 2

7) R54 connect to AGND
8) Remove R132/R140 and R148/R157. Connect C38/C40/C42/C26 and C60/C62 to AGND.
9) Add R132, R140 (NOPOP) to feedback of U11–B as 0.00 Ohm – new topology allows for configuration as Sallen Key w/ Gain for gain adjustment.
10) Increase Resistance to Q6 B/C by putting RN7–C/B and RN12–C/D in series.

Page 3

11) Populate C129 – note all 330 pF caps changed to COG 0805
12) C30 should be 180 pF
13) Remove C11/R236
14) Increase resistance to Q1 B/C by putting RN13–C/D and RN13–A/B in series.
15) R126/R78 Change value to 267 Ohms.

Page 4

16) Remove R62/R63, terminate U3–F Input to DGND

Page 5

17) R19/R32 Change to 22.1K; C158/C163 Change to 2.2uF; Remove C159/C164

Page 6

18) Add C11 470 pF on Expansion PWM line.

Rev A1 Changes from Rev A

1) C129 changed back to NOPOP
2) C1, C109, C179 changed from 0.47uF to 2.2uF Non Polarized
3) C52 changed from 0.47uF to 2.2uF NP NOPOP
4) C5, C63, C85 changed from 4.7uF to 10uF
5) C44 changed from 220pF to 330pF COG
6) C29 changed from 1000pf to 10000pf COG
7) C28 changed from .01uf PPS to 6800pF PPS
8) C98 changed from 47pf to 220pf
9) R163 changed from 47.5 to 100 ohms

Rev A2 Changes from Rev A1

1) C1 & C13 changed back to 0.47uF to improve start up time.

Rev B Changes from Rev A2

1) Add limiter circuit with D23/D24 R62
2) Correct Footprint of L1 & L24 to accept 2nd source inductor
3) Chang LED spacers to all be same height.
4) Misc component location, routing and plane short changes.
5) U20 Part number corrected to ROHS part #.
6) R59 to 681K, R60 to 113k to help bias adjustment.
7) RN15, Expansion header resistor, now populated
8) Add C211/R239 3.3V snubber to reduce switcher ringing.
9) Move traces that could short on jacks ground pin
10) Remove Diode D18, R32 from 22.1k to 100k, R189 from 47.5k to 100k to improve low level offset in loop audio detector.
11) C155 to 0.47uF to improve low frequency responce of level meter.
12) R182 R192 to 11.0k to improve symetry of level meter.

NOTES: (UNLESS OTHERWISE SPECIFIED):
1. RESISTORS 0805, 1%, 1/8W, VALUE IN OHMS
2. CAPACITORS 0805, X7R, 50V, VALUE IN uF

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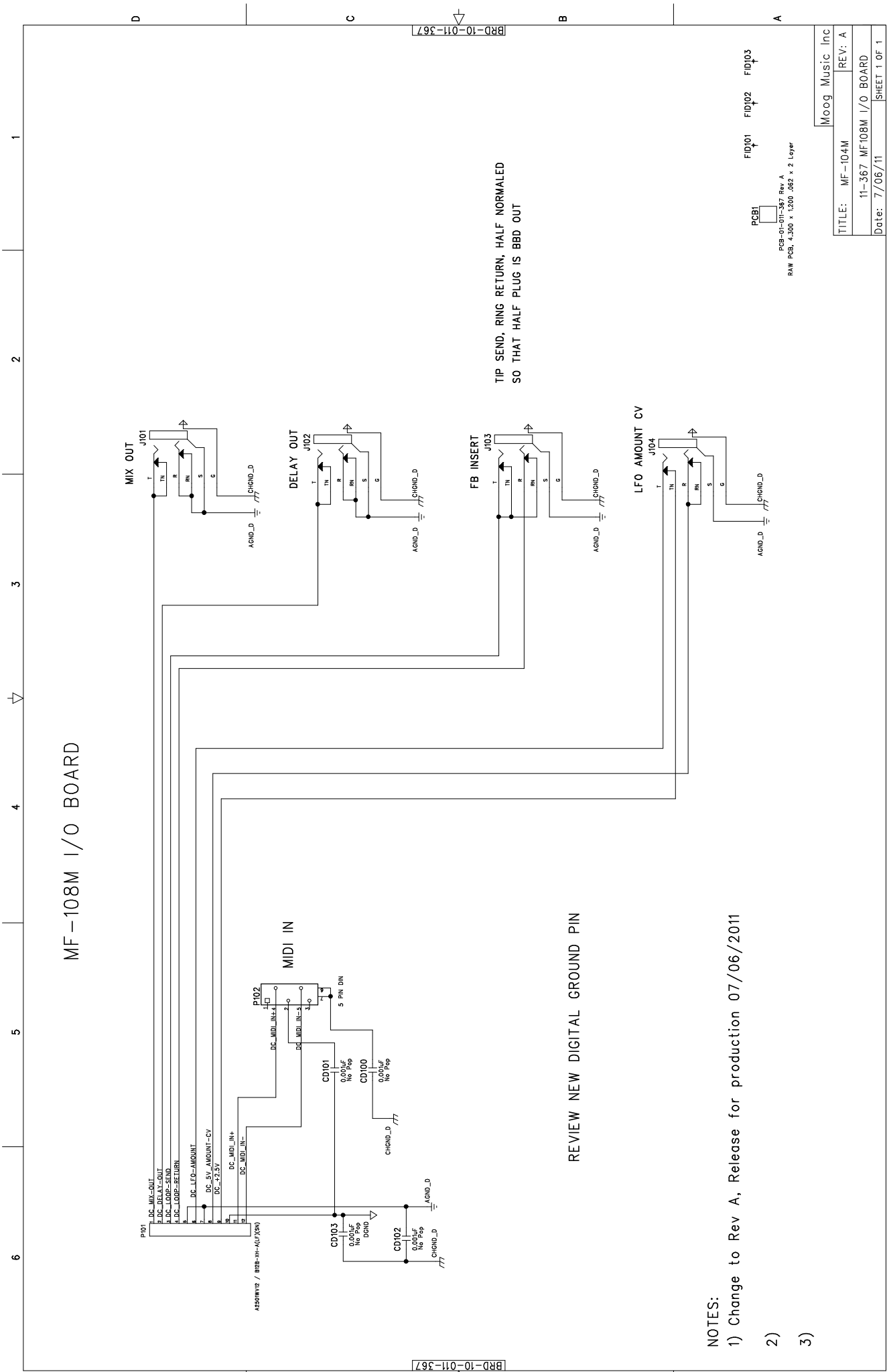
DESIGN ENG. R SHAICH	DATE 07/21/11	MOOG MUSIC INC. 2004–F Riverside Drive. Asheville, NC 28804 (828) 251-0090 Fax (828) 254-6233 http://www.moogmusic.com	
PROJECT MGR. R SHAICH	DATE 07/21/11		
MANUFACTURING X	DATE xx/xx/08	TITLE MF108M CHORUS FLANGER CLUSTER FLUX	
PLANT MANAGER X	DATE xx/xx/08		
PURCHASING X	DATE xx/xx/08		
PRESIDENT X	DATE xx/xx/08	SIZE D / FILENAME MF108M.SCH / DWG. NO. BRD–10–011–362 / REV B	
DOC. CONTROL X	DATE xx/xx/08	SCALE N/A / CAD DIRECTORY X / PROJECT CODE X / SHEET NO. 8 OF 7	

BRD–10–011–362


MF-108M I/O BOARD
MIX OUT
J101
DELAY OUT
J102
FB INSERT
J103
LFO AMOUNT CV
J104
TIP SEND, RING RETURN, HALF NORMALED
SO THAT HALF PLUG IS BBD OUT
MIDI IN
P102
5 PIN DIN
P101
A2503WV2 / B2B-XH-A(LF)(SN)
DC_MIX_OUT
DC_DELAY_OUT
DC_LOOP_SEND
DC_LOOP_RETURN
DC_LFO_AMOUNT
DC_5V_AMOUNT_CV
DC_+2.5V
DC_MIDI_IN+
DC_MIDI_IN-
CD101
CD100
CD103
CD102
0.001uF
No Pop
AGND_D
CHGND_D
DGND
PCB1
PCB-01-011-367 Rev A
RAW PCB, 4.300 x 1.200 .062 x 2 Layer
FID101
FID102
FID103
REVIEW NEW DIGITAL GROUND PIN
NOTES:
1) Change to Rev A, Release for production 07/06/2011
2)
3)
BRD-10-011-367
Moog Music Inc
REV: A
TITLE: MF-104M
11-367 MF108M I/O BOARD
Date: 7/06/11
SHEET 1 OF 1