NP D1V33 Assmebly Manual

Marking on board (next to SM5842):

BAL PCM63 DAC
2009-Apr DIY FUN
NP D1V33

Major differences from Pass D1 DAC:

1. No PLL, no uP, no remote.
2. Use CS8412, CS8414 (require 8414 to 8412 converter board) or DIR9001 receiver (require a separate DIR9001 to 8412 converter board).
3. Double series regulator for Digital section and analogy sections.
4. Use LM317/LM337 regulators instead of 78/79 series regulators. Thus LT1085/LT1033 regulators can also be used.
5. Change the Pass Mosfet IV to Jfet IV and add a buffer (source follower) at output stage to reduce the output impedance.
6. Jfet IV supply from a low noise series regulator.
7. Output path add a relay mute for power on/off pop noise and power on delay – NP design.
8. DAC Output signal level fine adjust at IV stage to ensure fully balance mode operation.

Major Features:

1. Two SPDIF digital inputs: - 1) RCA (75ohm) and 2) XLR (110 ohm) via separate coupling pulse transformer.
2. Required two transformers 18Vx2 30VA and 9Vx2 30VA to work.
3. Output is Single Ended or XLR balance output.
4. Digital inputs are selected by two relays with a 5V supply on a jumper. The jumper select can be extended to a front panel select switch for digital input select.
5. Input receiver IC CS8412/8414 can be set to 16 or 18 bit output mode (D1 original design is 18 bit output mode) by jumpers J28 & J29.
6. SM5842 can be set to 16 or 18 bit input signal mode by jumper J22.
7. Keep the functions Polarity, Jitter and Dither mode of the SM5842 by jumpers J5, J6 and J7 respectively.
8. J21 will set the De-emphasis function when different receiver chip is used.
9. SM5842 data output will be muted when the error LED is ON.
10. Add a Lock LED which is in reverse logic of the Error LED to indicate signal is locked.
11. In each Jfet IV module, there are 3 pots need to be adjusted:
    a. Input dc level to 0V point B1~4 on pcb: R2 for B1, R11 for B2, R22 for B3 and R32 for B4.
    b. Output dc level at half of +ve supply voltage at point A: R1 for A1, R10 for A2, R21 for A3 and R31 for A4. Since point A's are covered by the 2700p silver mica capacitors, use the points at the C4, C15, C25 & C35 (big 10uf) at the DAC side. Example if supply voltage is +18V, the point A should be at +9Vdc to provide max swing of output signal.

c. Output level of AC signal: require a Test CD of 1kHz or other freq and a AC voltmeter. All the AC output level need to be adjusted to same value at the output socket (+/-out points for left and right).

Major changes (from D1V3):

1. Change output mute circuit to short the output signal to ground using the relays when power off.
2. Use 5600uF Audio grade capacitor in analogy supply.
3. Enlarge rectifier diodes hole size.
4. Reroute supply voltage trace using star ground concept to improve background noise.
5. Improve ground plane near to rectifiers area. Add isolation to left and right ground plane.
6. Add ground plane at bottom output couple cap section to reduce cross coupling effect.
7. Increase pitch for R90 3W resistor. Enlarge hole size also.
8. Jfet IV: Replace K170 by K369 which has higher Yfs about 40mS (double of K170). This will also reduce the input impedance of Jfet IV so that the input point will be closer to virtual ground (measured below 20mV).
9. J74 is eliminated due to obsolete.
10. Use K246GR as the current source of LM336 voltage reference.
11. Reduce digital section trace width by 25%.
12. Eliminate 5 power supply jumpers to reduce soldering time and component count.
13. Add 4 jumpers for SM5842 for selection and thus SM5842 output bit can be set from 18 to 24bits. Thus 24-bit DAC chip can be used if the converter board fit PCM63 pin assignment.
14. Remove clock section. Remove SM5842 clock input selection jumper.
15. Add a pad for output couple capacitor – 5mm pitch for Muse BP E-cap or Black Gate E-cap.
16. Various change in resistor and capacitor value and size.

The above upgrades will reduce the background noise and sound stage will be more focus.

Stuffing and Adjustment Procedures:

The approach for successful assembly:

1. Main supply +/-23V is working
2. +/-18VL & +/-18VR Low noise regulators are working (P3, P4, P5 & P6)
3. +/-5V regulators for PCM63 are working
4. Main supply +/-12V is working
5. Digital section +8V regulator is working
6. All 5V regulators LT1117-5 are working in digital section.
7. Verify the input relay is functioning
8. Verify the output relay is functioning
9. Pre adjust Point As and Bs at target dc voltages

10. Plug in the IC one by one to see if the supply voltage is still at normal and no smoke come out in digital section.
11. Check for any oscillation on the Jfet IV.
12. Plug in PCM63 for final adjustment of point As and Bs.
13. Warm up for 1 hrs and do final adjustment and measurement.

Steps: (solder small parts and then bigger parts)

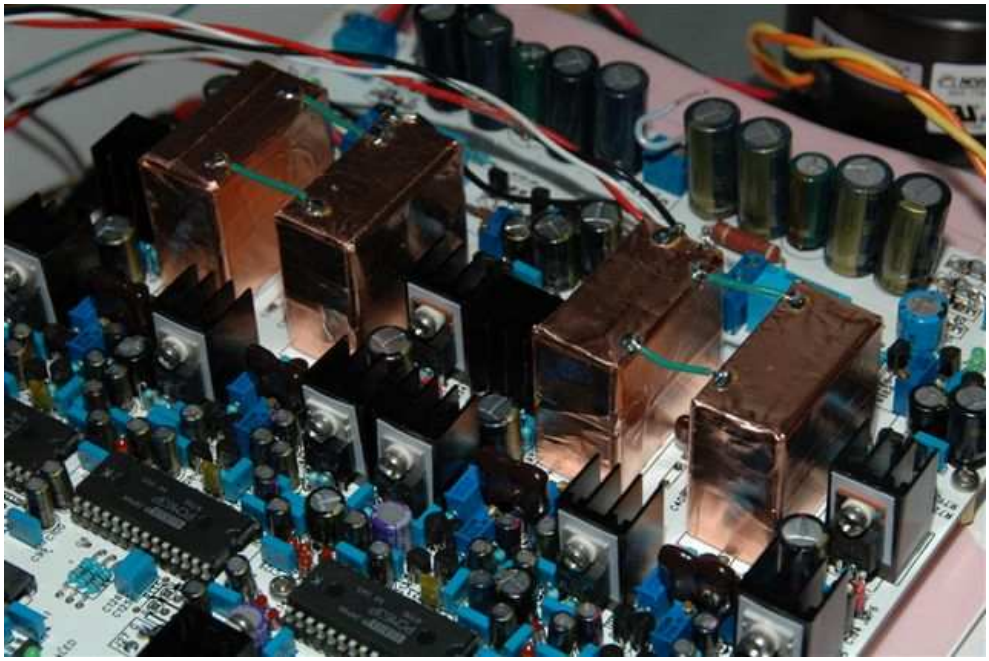
1. Solder LT1117 regulators on the digital section.
2. Solder resistors, LED and rectifiers/diodes, note the polarities.
3. Solder all jumper pins, do not short the pins.
4. Solder film capacitors, except Silver mica 2700pf .
5. Solder all IC sockets
6. Solder bead, inductors
7. Solder Pulse transformer
8. Solder input/output connectors if used
9. Solder all pots (VR) – For R2, R8, R9, R11, R17, R22, R18 and R32, you may want to reverse the position so as the 2700 mica cap will not block you from adjustment later.
10. Solder small E-caps (12uF to 220uF); note the polarity Square pad is +ve, Round is -ve – Note that C60 and C77 do not have enough space on the layout – need to twist a bit the body!
11. Solder the low noise Regulator +/-18V section Jfet / Transistors C2240 / A970 / LM336 etc.. (do not solder jfet IV fets)
12. Solder all relays.
13. Solder big E-caps 5600uf, 2200uf, and 560uF etc (note the polarity Square pad is +ve, Round is –ve).
14. With a transformer of 18Vx2, the P1 and P2 should be at +25 and -25Vdc, max +/-26Vdc, respectively. Check LEDs D9/D10 and let the voltage discharge first before going further.
15. Solder IRF610/9610 with heat sink and insulation sheet. Note that the heatsink is grounded and thus the mosfet must be insulated from it.
16. Power up again. Verify the +/- 18V regulators (at P3, P4, P5 and P6) are working and adjust the output voltage to +/-18V dc within 0.05V. If ok, then power off.
17. Then solder the Jfet IV FETs section. You may want to put a pin socket if you want to change jfets in future.
18. Power up again and adjust Pot R1 until Point A to 8.5Vdc (within 0.5V), Adjust Pot R2 until Point B is 0Vdc (within 5mV). Note that when the pcb is heat up after 15 mins, the voltage of point A and B will drifted a bit to the high size. Thus the initial adjustment should be at the low size of target voltages.
19. Repeat to solder other Jfet IV section and adjust voltages as above. You need to look for the other position or parts for measurement or adjustment!!
20. Then solder the heatsink and regulators as below:
21. Solder the LM317 and LM337 (U2/U3, U5/U6, U9/U10, U12/U13) with heat sink in pairs.
22. **Caution below!**
23. **The digital supply of PCM63 is powered from +/-12V raw digital supply This section involves solder of jumper wire (0.8 to 1mm diameter single core copper or silver**

wire) at the bottom of the pcb (no marking) and thus the wiring must be very careful!

24. **Connection:**
    a. **When J3 (+12V pin) is power with +12V (via a wire from J25), U2 is powered.**
    b. **When J4 (-12V pin) is power with -12V (via a wire from J1), U3 is powered.**
    c. **When J8 (+12V pin) is powered with +12V (via a wire from J25), U9 is powered.**
    d. **When J27 (-12V pin) is power with -12V (via a wire from J1), U10 is powered.**
    e. **Connect also 4 ground wires from J17/J26 to the "G" hole of J3/J4/J8/J27.**
    f. **So total there are 8 wires at the bottom of PCB.**
25. An optional ground wire can be connected from J24 to J26, ie the analogy and digital star ground points.
26. Verify all the 5V regulators output voltage at +/- 5V +/-0.05V at the PCM63 IC socket positions.
    a. Pin 2 = +5VA
    b. Pin 11 = -5VD
    c. Pin 13 = +5VD
    d. Pin 28 = -5VA
27. Verify the +18/-18V regulators are still within target voltage. This voltage should not change more than 0.05V or else short circuit may have occurred.
28. **Back to Digital section: When you power up digital section, you do not need to power up analogy section together!**
29. Solder the LM317 (U20) regulator with insulator & heatsink.
30. Check all LT1117 regulators are at +5V output at the heat sink (or middle pin).
31. Before plug in any IC, set the jumper as below (NP default mode with 8412 or 8414 receiver):
    a. J2 D input Sel, short RCA side two pins
    b. J28 open
    c. J29 short (select 16 bit mode)
    d. J30 short pin 1-2 and J31 short pin 2-3
    e. J9 and J20 to Low side, short pin 2-3
    f. J5 Pol Sel short pin1/2, NorPol side two pins
    g. J9 Clk Sel short 8412 side two pins
    h. J21 Dem Sel short 8412 side two pins
    i. J22 bit sel short 16bit side pins 1-2
    j. J6 jitter sel any side two pins short
    k. J7 Dither sel any side two pins short.
32. Check U15 pin 7 & 22 is at 5V, then Plug in the 8412 and check pin 7 and 22 still at +5V within +/-0.05V.
33. Check U16 pin 22 is at 5V, then Plug in SM5842 chip and check pin 22 still at +5V within +/-0.05V.
34. Plug in all 74HC86, check pin 14 at +5V. Note that polarity of IC and follow marking on pcb!
35. See below to verify the digital section is working:
36. Power up the digital section, the error LED should be ON and Lock LED should be off. Then inject a SPDIF signal to the RCA digital in socket, the Error LED should be OFF

now and Lock LED should be ON. The DemLED should be OFF if the signal do not carry any De-emphasis signal.

37. Use a scope to check if there is pulsed at CLK, LE, DOL and DOR (150 ohm resistor R85/86/87, R92/93/94, R99/100/101, & R106/107/108. If don't have scope, use a DC voltmeter and check voltage is about 1.4 to 2.5VDC.
38. **Power down and go back to DAC section.**
39. Plug in PCM63 first chip. Note the direction of pin 1.
40. **POWER up both Digital and Analogy supply.**
41. Verify the Iout is at 0V dc (point B), if not, fine tune the R2 (R11/R22/R32 for other DAC). Note that this voltage should not change much after the first Pre-adjustment. Check point A still at about 9V, if not, adjust R1 (R10/R21/R31 for other DAC). Due to the variation of the sinking and driving idle current from PCM63, you will need to fine adjust the point A and B voltages. Moreover, for the point A and B voltage is more or less independent to each other. Note that slow drifting of voltages due to heating up of circuit is normal. Thus these voltages need to be fine tune again after warm up 1 hour.
42. Repeat for other PCM63 one by one.
43. Check the points A and B to see if the voltages are stable for power on and off.
44. Power down and Solder the 4 BIG film caps 10uF. **Here some good capacitor with shielding is recommended. Eg E-cap like black gate or film cap wrap by copper foils grounded to J19. Muse BP capacitor is also recommended. If E-cap is used, good small film cap from 0.01 to 0.1uf 100v should be added in parallel.**
45. Check the points A and B dc voltage again and it should be very close to the readings. **If the voltages is not same and point A is changed more than 1V and point B is more than 0.15 to 0.3V dc, then the big capacitor may cause some oscillation and go to next step to trouble shoot. Else skip next step.**
46. **Check for Jfet IV for any oscillation (using a scope of >100MHz), the symptom is that Point As and Bs dc voltage is not stable. Moreover the output sound will be distorted and harsh! The cause of the oscillation is due to the bulky 10uf film capacitor cross couple to each other for +/- signal swing. The only cure is to shield the bulky capacitors by using copper foil to wrap around the body and then ground the shield to star ground point J19. Note that the ground body of the cap cannot touch any pad of the C4/C15/C25/C36 or else the signal is shorted to ground! Position the capacitors by 90 deg will also help reducing the cross couple. Any shielded E-cap or oil cap with metal can is also good as there will be no leakage of signal.**
47. Shielding with big film capacitors as below (D1V3 photo):

48. 
49. n/a
50. If everything is fine, plug in transport and you should hear music from the output.
51. Play a test CD at 1kHz.
52. Measure the voltage output at the 4 capacitors C4/C15/C25/C36 and the Vrms should be about 2Vrms. Adjust the pot R8, R9, R17 and R18 so that the voltages output at the +out and –out sockets are within 0.005Vrms.
53. Perform usual measurement for output voltage, distortion and noise etc…
    a. Balance output distortion should be about 0.05% and Single end distortion level is about 0.5%. The distortion is dominated by second harmonics and thus the sound is very smooth with valve like sound.
    b. Spectrum analysis shows that the 4th harmonic is almost 85db below fundamental frequency and thus this DAC has a quiet black ground feeling.
54. Warm up the set for 1 hrs and adjust the voltage at point A and B again when needed.
55. For the output mute and delay, the relay K3 and K4 should be on after about 2 seconds power on but should cut off the output signal immediately when power off without hearing any pop noise.

Sonic Signature:

- For sonic improvement, I suggest the IV resistor 1.5k and also the output resistor 22R should use RMA carbon type resistor.
- Even without re-clock, D1V33 is still an improvement to D1V3 in resolution, back ground noise and smoothness of sound.

Jumper Functions:

Digital Section Jumper Select: ***pin 1 is in Square pad, short either pin 1-2 or 2-3***

Designation	Function	Short Pin 1-2	Short Pin 2-3
J2	Input Digital source select	RCA – use J15	XLR – use J16
J5	Polarity Select - Phase	Normal	Reverse
J6	SM5842 Jitter Select	Free mode	Normal mode
J7	SM5842 Dither Select	Dither Off	Dither On
J21	De-Emphasis Select	8412/8412 receiver	9001 receiver
J22	SM5842 bit input select	16bit – 9001	18bit – 8412
J28/J29	8412/14 output bit select	Short J28 & Open J29, 18 bit mode	Short J29 & Open J28, 16 bit mode
J9	**Clock Select – Low = 256fs; high = 384fs**	**384fs**	**Must set to Low – 256fs**
J20	**Input function**	**Not use**	**Must set to Low**
J30	**Output bit select**	**Set to High**	
J31	**Output bit select**		**Set to Low**

Notes:

1. **J30 and J31 = low is 24 bit output format.**
2. **J30 = High and J31 = Low is 20 bit output format**
3. **J30 = Low and J31 = High is 22 bit output format**
4. **J30 and J31 = High is 18 bit output format**

Operation modes:

There are two operation modes when 8412 or 8414 receiver IC is used for U15.

1. 18 bit: This is the original design of NP D1. 8412/8414 is output at 18bit mode (J28 short, J29 open) and the input of SM5842 is selected at 18 bit input mode (J22 pin 2-3 short).
2. 16 bit: This is a new option. 8412/8414 is output at 16 bit mode (J28 open, J29 short) and the input of SM5842 is selected at 16 bit input mode (J22 Pin 1-2 short).

For DIR9001 converter board, there is only one mode to use at 16 bit.

On 9001 converter board: Set J3 short and J1, J2, J4 & J5 open.

On DAC main board:

Set J22 to Pin 1-2 short – 16 bit mode.

Set J21 to Pin 2-3 short – 9001 de-emphasis mode

Note that J28 and J29 will not affect the output mode of the 9001converter board.

Thus there are totally 3 possible way to run the D1V33 DAC and these modes can be combine with the Jitter free, Dither on/off and Polarity to see which way sound best.

Enjoy!

~ END ~