SMDs

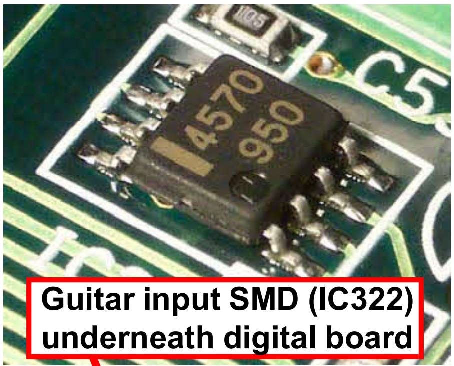
(Surface mount device)

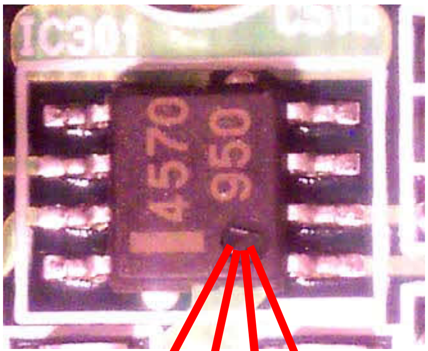
PART 2

MOVIN' OUT MUN

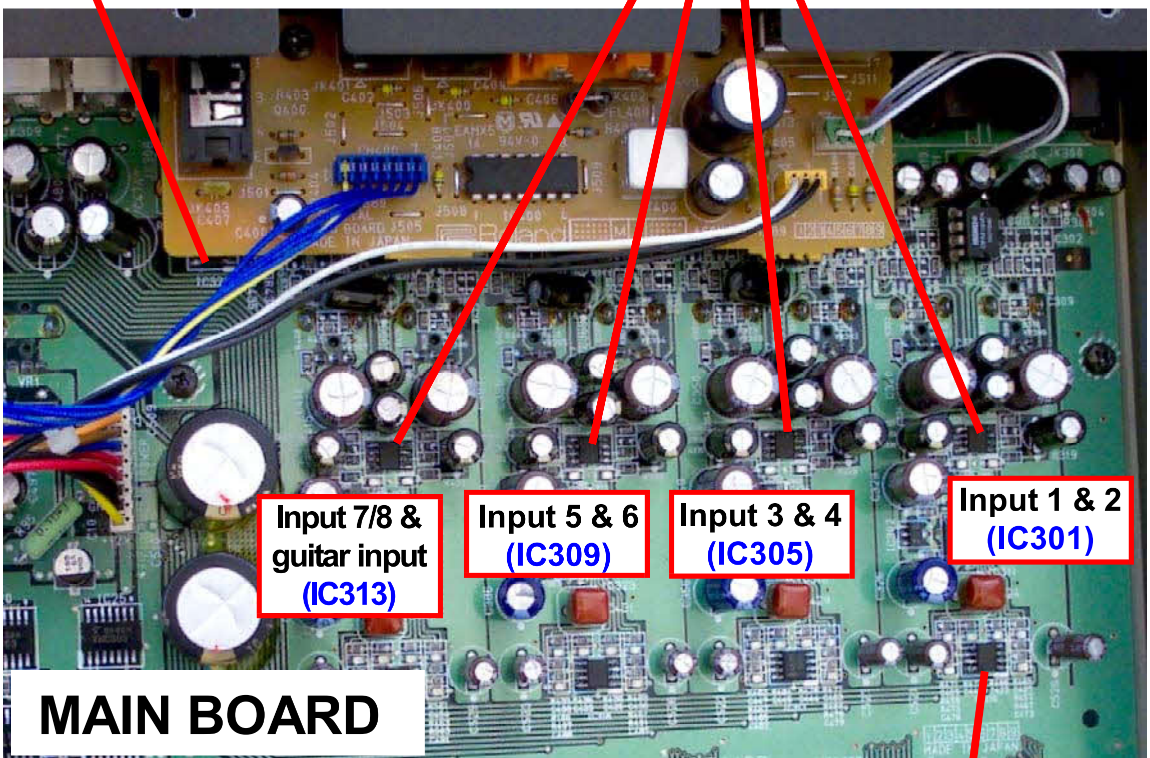
(Your best Jamaican accent please)

Thankfully, extracting the SMDs doesn't require removing the main board again, unlike NE5532, which is a through-board installation.

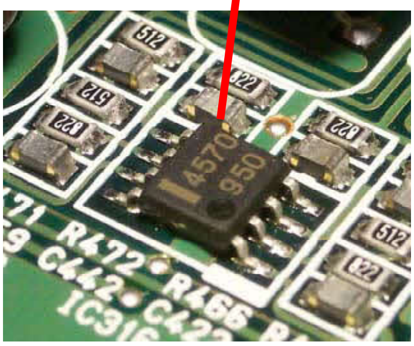




Input 1 & 2 (IC301)
Input 3 & 4 (IC305)
Input 5 & 6 (IC309)
Input 7/8 & guitar input (IC313)

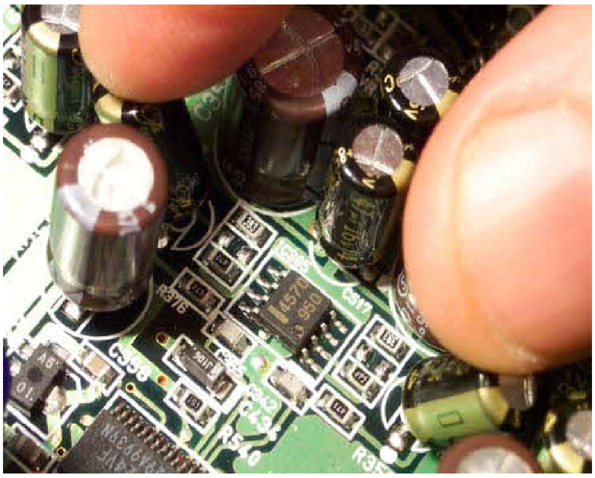


To fully appreciate the modifications, you'll have to change IC316 (Master L/R output UPC4570). Otherwise you'll only be listening to 50% of your efforts!

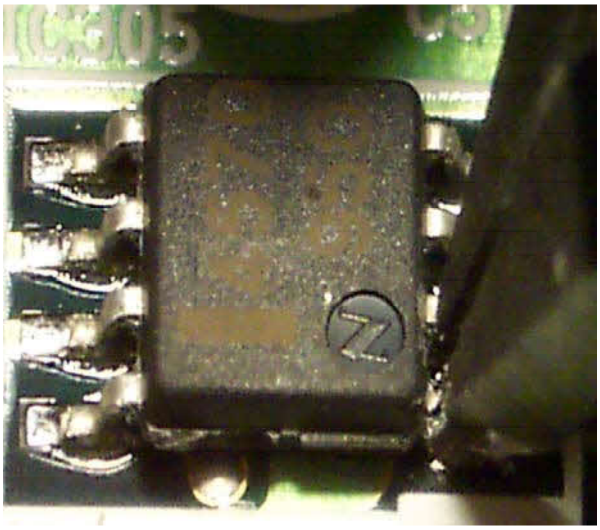


How to remove an SMD
Time taken: 20 minutes per IC

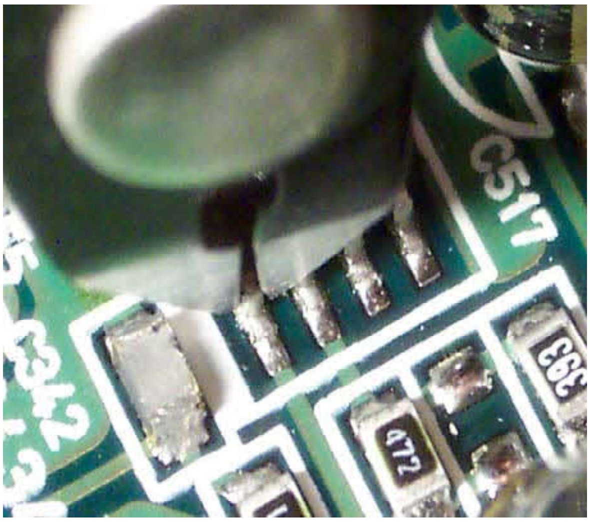
Creating space by gently bending back nearby capacitors.



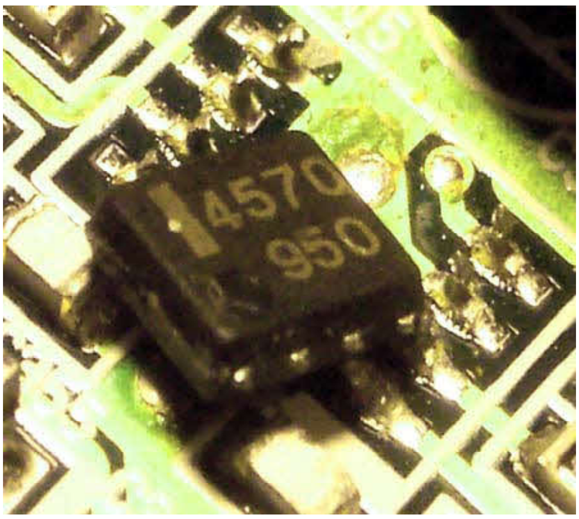
Working with micro nippers proves a tight fit. Don't try cutting through more than one leg at a time (*Sweet Jesus*), as you will risk serious damage to the delicate tracks. This operation should only take about 5 minutes



Another angle with the micro nippers

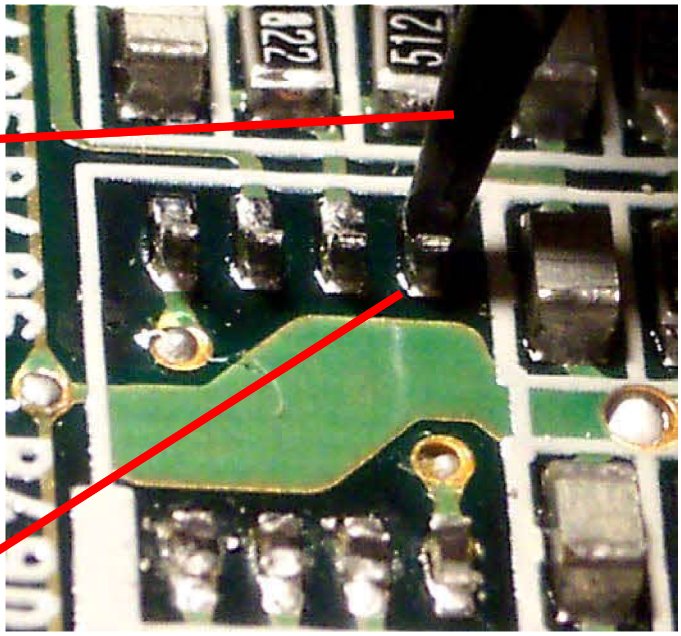


For sale. One 4570. 18 years old.
Will swap for six-pack. Bargain!



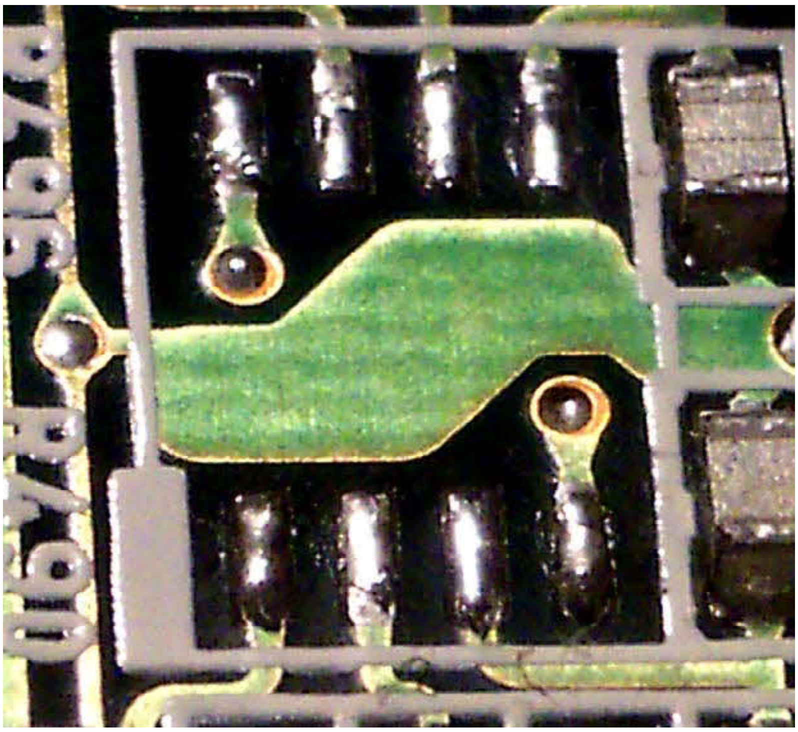
Cleaning up
Time taken: 15 minutes

Set temperature with a 2.5mm iron tip to about 420 Fahrenheit



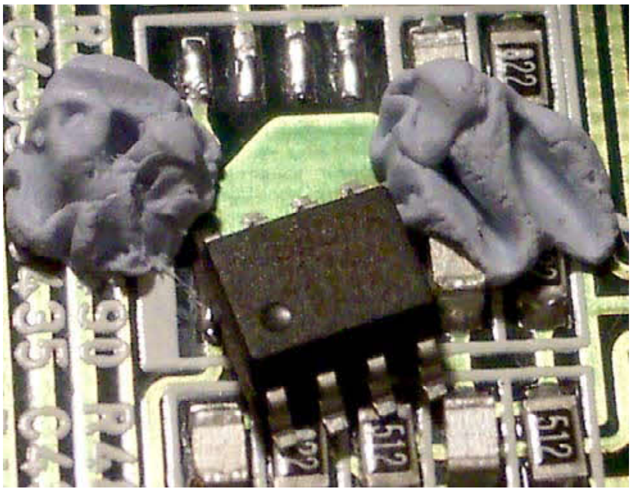
Nearly ready. All that's needing now is to remove the leg stumps, and glide the iron quickly over the tracks to level-off the surface. Watch out for heat damage to the tracks. A good idea is to only allow yourself a maximum of 3 seconds per track, and limit contact with the iron to just three attempts. After 3-4 goes with the iron, you risk serious heat damage, which will result in a track lifting. Watch those temperatures!

Ready to receive an SMD

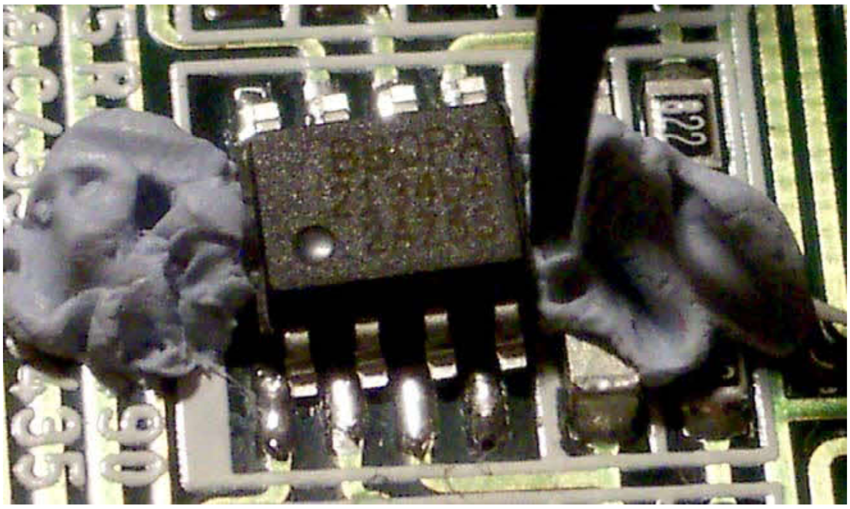


Soldering an SMD
Time taken: 15 minutes

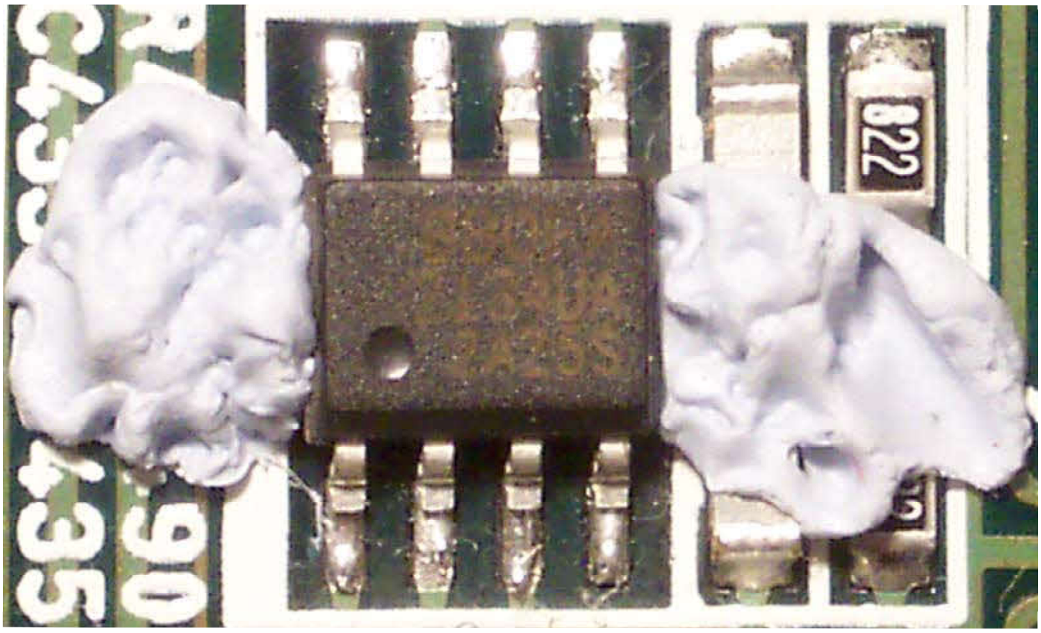
Blu-Tack positioned either side, and one new OPA2134



Packing it into position

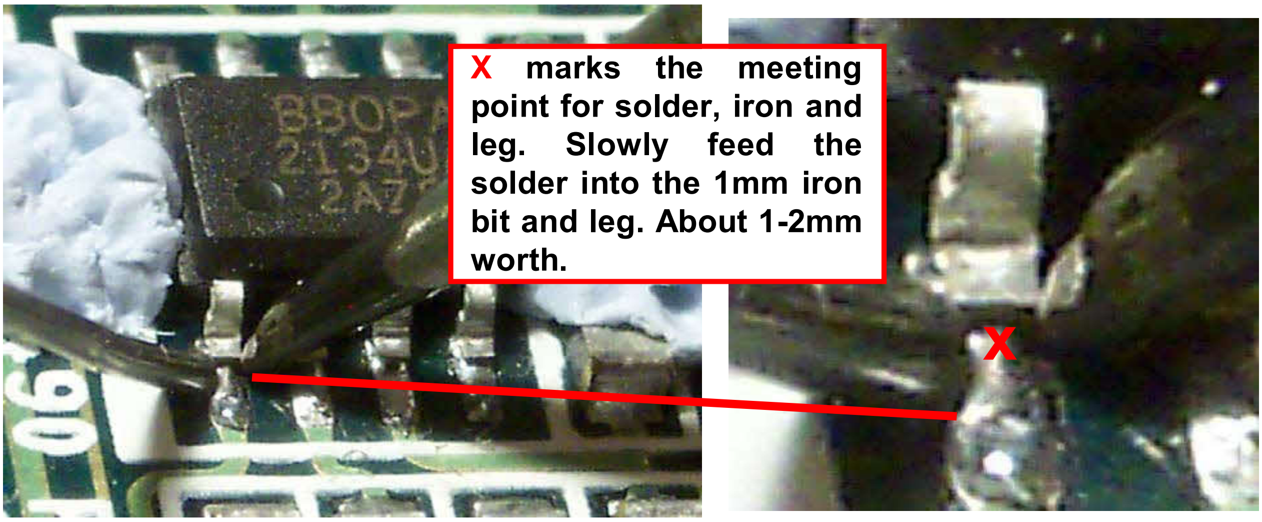


A fraction of a millimetre perfect. Blu-Tack enables precise positioning



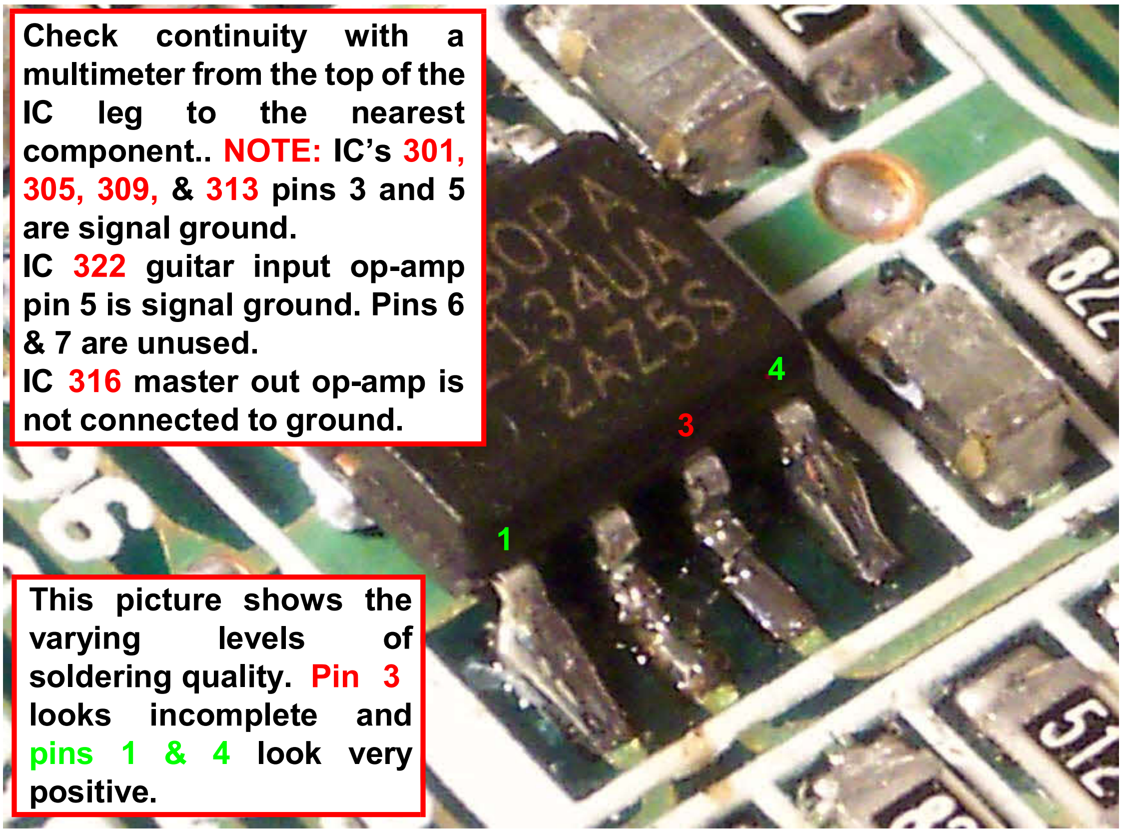
Soldering an SMD cont'd

Change iron tip to 1mm size and check temperature. 400 Fahrenheit should be about right for this job. Feel free to experiment. Although it's probably not a good idea to go much above 420 Fahrenheit, as you risk serious heat damage to the SMD and the tracks. A good 'rule of thumb', is to allow yourself a maximum of 3 seconds per leg. Allow the chip 10 seconds or so to cool down after each leg is completed.



X marks the meeting point for solder, iron and leg. Slowly feed the solder into the 1mm iron bit and leg. About 1-2mm worth.

SMD COMPLETE



Check continuity with a multimeter from the top of the IC leg to the nearest component.. NOTE: IC's 301, 305, 309, & 313 pins 3 and 5 are signal ground.
IC 322 guitar input op-amp pin 5 is signal ground. Pins 6 & 7 are unused.
IC 316 master out op-amp is not connected to ground.

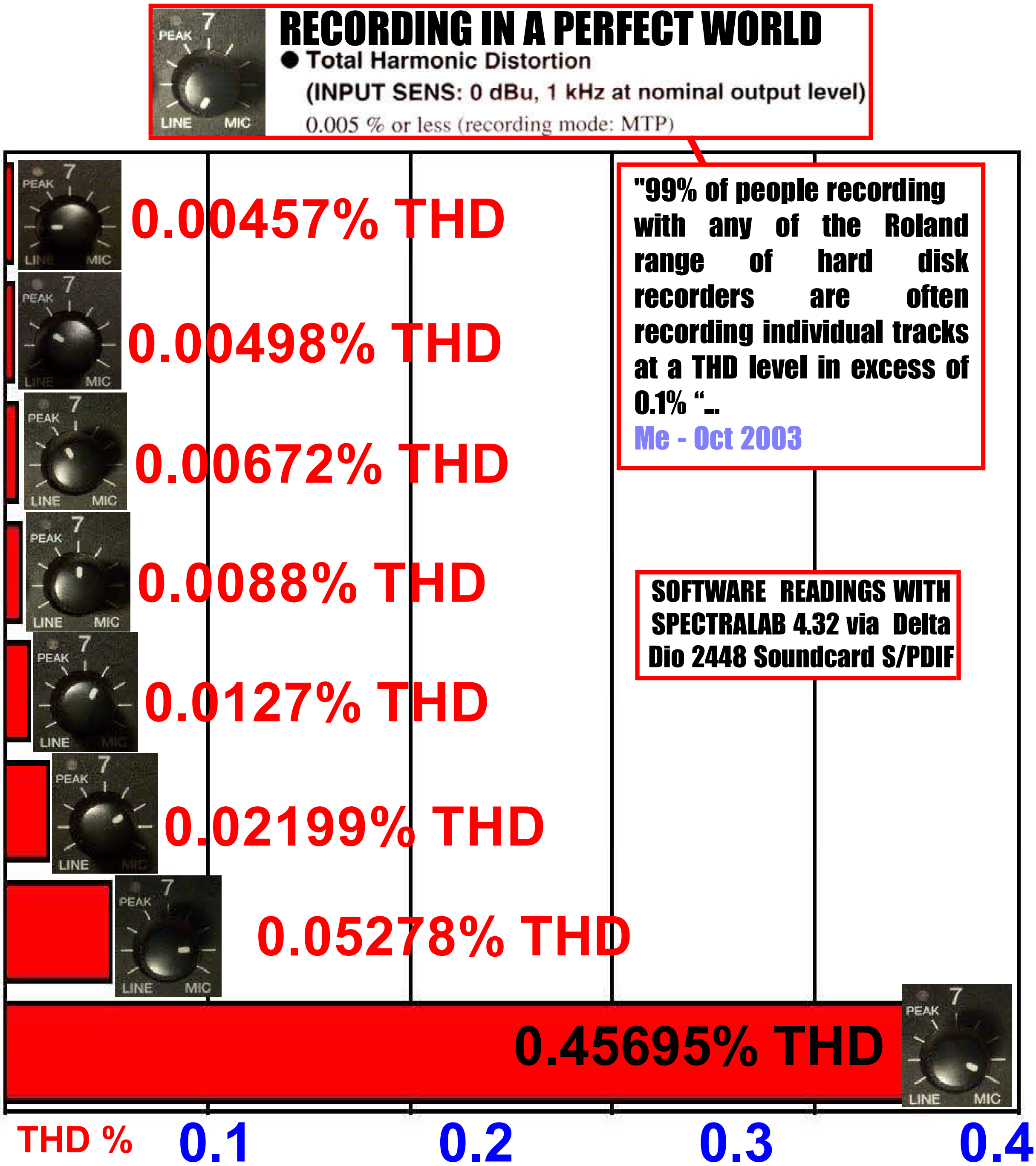
This picture shows the varying levels of soldering quality. Pin 3 looks incomplete and pins 1 & 4 look very positive.

Roland VS-1880
op-amp swap

PART 3

The input trim control considerations

Before mulling over op-amp replacement options. I feel it is important to mention an often overlooked factor in manufacturers' equipment performance specifications. Roland, like many music equipment developers have led us to believe, that as users, we can expect to be recording at a specified THD (Total harmonic distortion) levels quoted in their owners manuals. The sad fact is, that there aren't many people who are recording at a THD level of 0.005%! It is not clear how many Roland VS users, are aware of the alarming amount of harmonic distortion contributed by the input trim control settings. The chart below shows disturbing evidence to how serious a matter this is. If you're one of those people (like me) who have recorded with microphones and guitars with the trim set anywhere between 2, 3 & 4 o'clock, then you may have been recording at anything up to 0.1% THD. The following tests were undertaken with input 7, and the op-amp used is OPA2134 throughout (includingthe SMD IC313). A very low distortion sine wave (0.00356% THD) was input. Last word...I couldn't possibly have included a maximum input trim figure in the chart. You would probably need a 60-inch monitor to view the chart, and the THD was approximately 2.5%!



OP-AMP COMPARISON TABLE

Op-amp	THD Distortion @ 3 o'clock LED just illuminated	THD Distortion +3dB past LED illumination	THD Distortion @ -10dB below LED illumination	Minimum THD distortion	Input trim @ minimum NOISE LEVEL	Input trim @ maximum NOISE LEVEL
DBX386 4580 stock Op-amps	1ST Yellow LED 0.15394 %	+5dB above 1st Yellow LED 0.84174 %	0.06033 %	20dB below 1st Yellow LED 0.03002 %	-85.50 dB	-70.77 dB
DBX386 With OPA2134 throughout	1ST Yellow LED 0.15383 %	+5dB above 1st Yellow LED 0.94732 %	0.06534 %	20dB below 1st Yellow LED 0.02995 %	-91.35 dB	-72.51 dB
NE5532 Roland stock op-amp	0.05278 %	4.00036 %	0.00715 %	0.00457 %	-103.56 dB	-96.64 dB
OP270	0.05411 %	0.11952 %	0.00728 %	0.00382 %	-104.83 dB	-99.76 dB
OP275	0.05366 %	1.37398 %	0.00803 %	0.00494 %	-104.07 dB	-99.71 dB
OPA2604	0.05734 %	1.12721 %	0.00821 %	0.00614 %	-102.94 dB	-98.61 dB
AD825	0.05263 %	0.33490 %	0.00955 %	0.00428 %	-103.73 dB	-97.70 dB
OPA2134	0.04779 %	0.18875 %	0.00792 %	0.00391 %	-100.50 dB	-96.95 dB

Tried & Tested:
The Op-amp & Front-End shoot-out

DBX 386
Dual tube preamp with Digital out via S/PDIF
UK Price: £420

Features:

- **Two channel tube microphone pre-amplifier**
- **Insert Jack**
- **60dB of microphone gain and +/-**
- **15dB of output gain**
- **Selectable mic/line switch. 48 volts phantom power**
- **20dB pad**
- **75 Hz low cut filter**
- **Phase reverse**
- **Type IV conversion system**
- **Selectable 96 kHz, 88.2 kHz, 48 kHz, & 44.1 kHz sampling rate**
- **24, 20, & 16 bit wordlengths**
- **Selectable dither and noise shaping**
- **AES/EBU and S/PDIF digital outputs**
- **Word clock sync input and output**
- **Separate analog and digital output control**

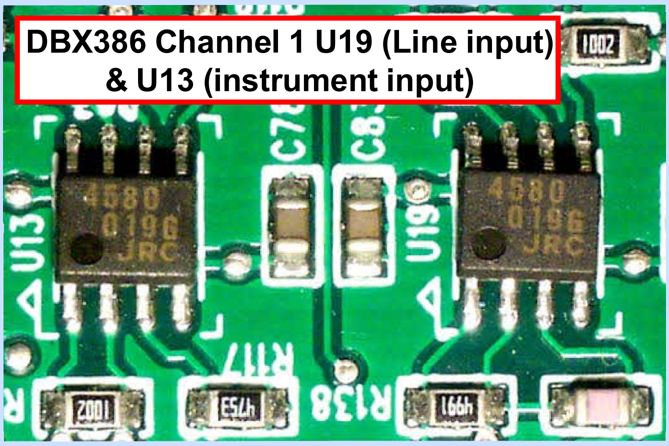
I have to admit it, I was seduced by the DBX386 when it first appeared on the market. It didn't even cross my mind what op-amps were in use. Only after examining the schematic diagram, and tracing the instrument input through to the output, did I begin to have misgivings about my purchase. To my distress I had found out that the DBX386 uses JRC4580 in a SMD package throughout. That's 9 op-amps, 2 carbon track pots, 4 switches, 1 vacuum tube, 1 insert point. And finally, 2 internal power supplies located next to analog channel 2. Yes all of this, before it even gets to the digital stage! At this point, I had to ask myself a few questions;

1. How can all of those op-amps, carbon pots, switches, and a poorly situated internal power supplies constitute a high quality front-end mic preamplifier?

2. How did I become seduced by the 'valve vampire' with S/PDIF out?

4. How would a modified DBX channel and unmodified channel, compare to various op-amp configurations in the VS-1880?...It's a can of worms....I need a breather!

Beautiful PCB. Excellent flood-filled ground plane design... Shame about the Op-amps!



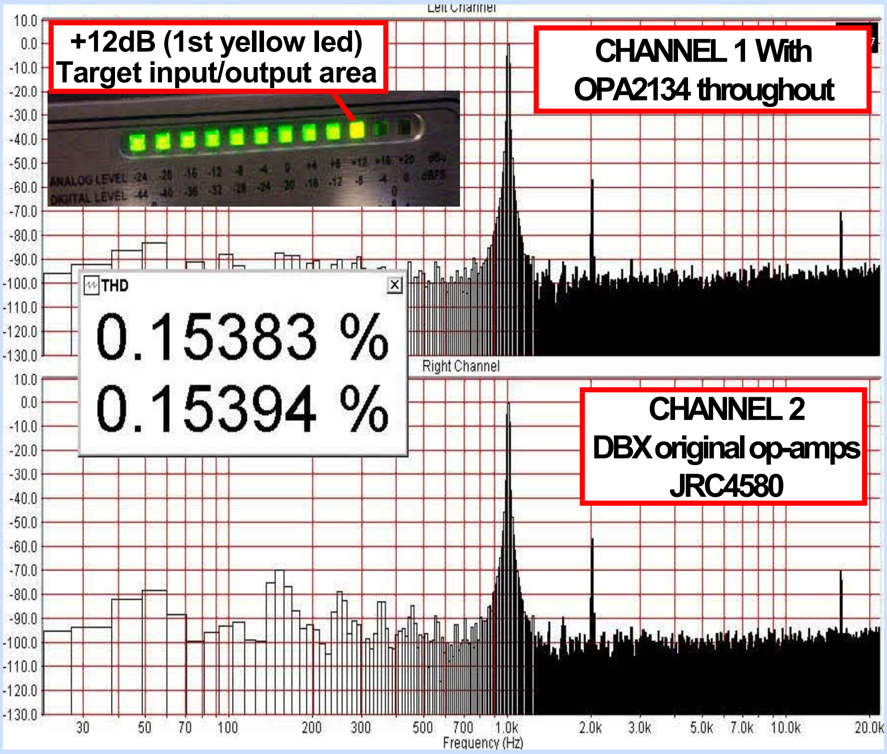
The DBX schematic is available for download @ http://uk.groups.yahoo.com/group/Roland VS-Upgraders/

The DBX386 Channel 1 upgrade

After seeing all those JRC4580's in the signal chain, I thought the least I could do is upgrade channel one, with something a little more modern like OPA2134. This way I will be able to do a direct comparison with channel two (unmodified). Changing 9 SMDs I must admit, was a bit of a long job. Also the components, unlike the VS-1880, aren't as accessible. Some 15 hours later I managed to change all 9 op-amps in the signal path.

Channels 1 & 2 comparison with Spectra Lab Pro audio test software Ref 1K sine tone @ 0.00356% THD

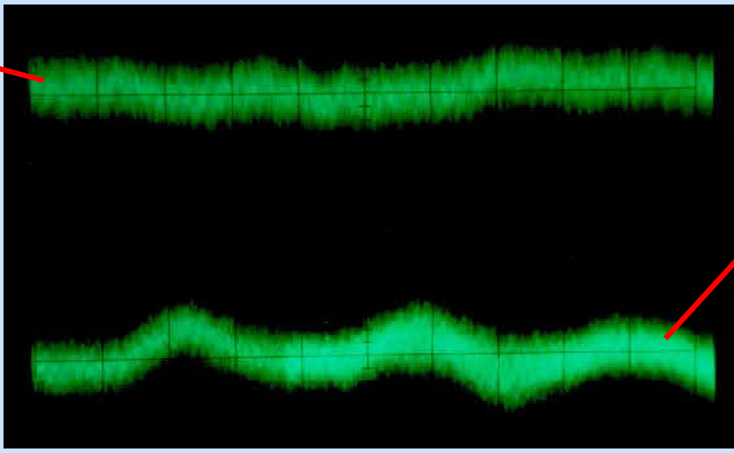
Total Harmonic Distortion Test



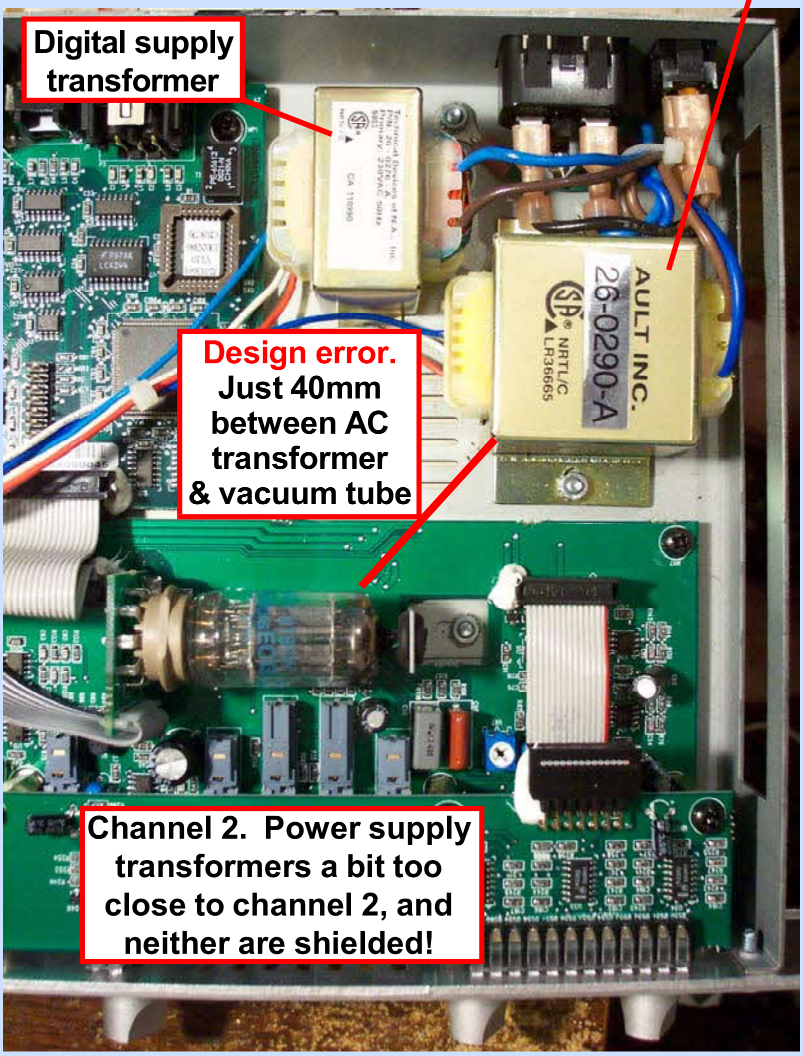
The perils of an internal power supply

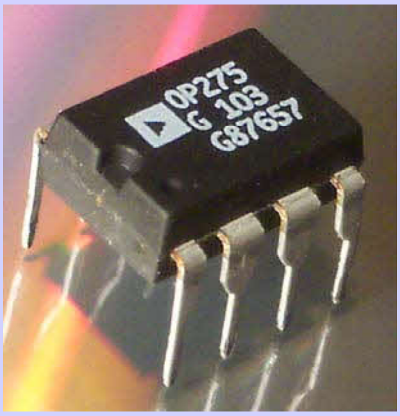
No input. Input/output controls set to maximum.
Oscilloscope traces

Channel 1. OPA2134 throughout. Peak Amplitude -72.51dB



Channel 2. All op-amps JRC4580. Peak Amplitude -70.77dB. The Lochness monster effect (150Hz hum), is caused by location of the AC transformer



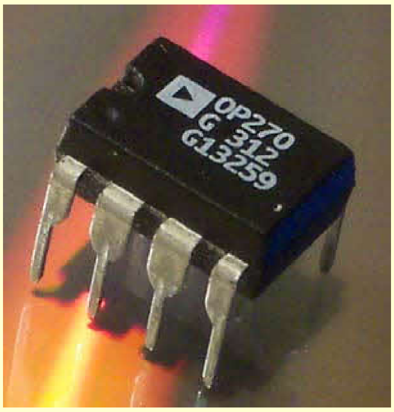


OP275 Dual op-amp. Price: £3.60 each. Supplier: Viewcom Electronics. www.viewcom.f9.co.uk

FEATURES

- Unity Gain Bandwidth: 9MHz
- Slew Rate: 22 V/uS
- Settling Time: 200 nS
- THD @ 1kHz: 0.0006%
- Noise: 6nV

Another popular option with VS modders. Decent noise figure of 6nV, although at the +3dB LED indication there was a noticeable increase in THD, typically 1.37398%. Nothing spectacular about this chip, and to put my head on the block, I'd say it would be an average replacement for the NE5532.



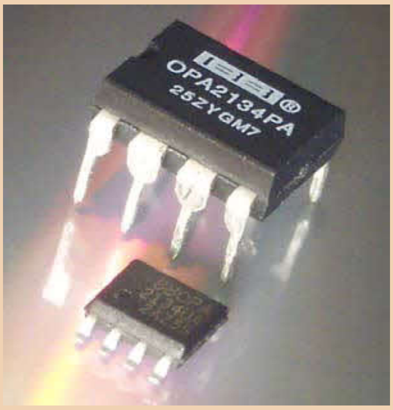
OP270 Dual op-amp. Price: £12.53 each
Supplier: Viewcom

FEATURES

- Unity Gain Bandwidth: 5MHz
- Slew Rate: 2.4 V/uS
- Settling Time: 5 uS
- THD @ 1kHz: Not Published

  (See test results)
- Noise: 3.6nV (Best Pub Figure)

A little bit expensive at £12.53, but gave an impressive lowest THD reading from the VS-1880, coming in at 0.00382%, not to mention an apparent best signal-to-noise of -104.83dB (Input trim set minimum), and -99.76dB with trim set to maximum. To my ears it sounded very clean when driven hard, which is shown in the 0.11952% THD at the +3dB (Led clipping indication) . A cautious recommendation, on account of the not-so-spectacular published features.

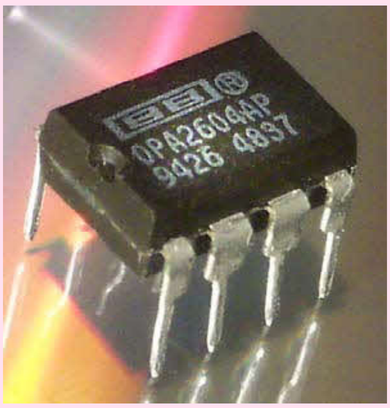


OPA2134 Dual op-amp. Price: Standard DIL £2.10. SMD £3.10.
Supplier: Viewcom

FEATURES

- Unity Gain Bandwidth: 8 MHz
- Slew Rate: 20 V/uS
- Settling Time: 700 nS
- THD @ 1kHz: 0.00008%
- Noise: 8nV

OPA2134 THD spec has more zeros than a Japanese aircraft carrier! Burr-Brown (Manufacturer) have given the op-amp a trademark of SOUNDPLUS. Looks like they're pushing the op-amp as a modern contender to the dated NE5532. Nevertheless, the sound quality is excellent. You can hear evidence at the Yahoo group files (AVI 1 & 2). Even at high-gain (guitar input) this op-amp is very forgiving. I'm tempted to recommended this IC as a total and easy replacement throughout the VS, including the SMDs.



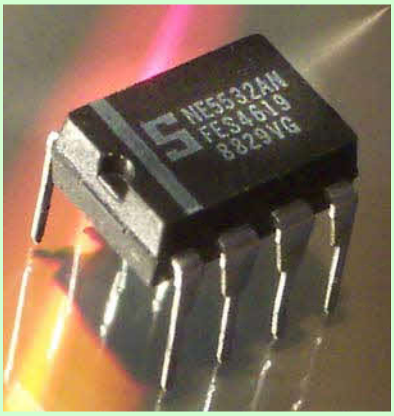
OPA2604 Dual op-amp. Price: £3.80 each.
Supplier: Viewcom

FEATURES

- Uninty Gain Bandwidth: 20MHz
- Slew Rate: 25 V/uS
- Settling Time: 1000 nS
- THD @ 1kHz: 0.0003%
- Noise: 10nV

Another one from Burr-Brown. I suppose a cut-down version of the OPA2134. A definite improvement on the NE5532 in sound quality. Another pleasant quality noticed, is an apparent small harmonic sparkle added to the sound. Almost like changing to a brand new set of guitar strings. The specifications are nothing to write home about, and this is also reflected in my VS spec table. A cautious recommendation.

NE5532 Dual op-amp. Price: £0.59 each.
Supplier: Widely available

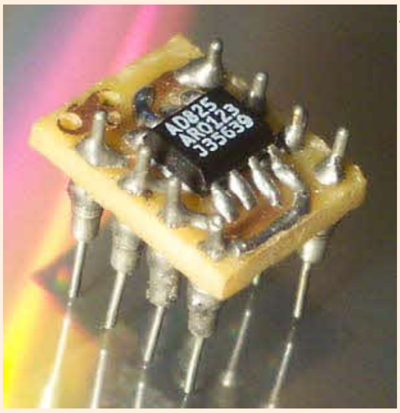


FEATURES

- Unity Gain Bandwidth: 10 MHz
- Slew Rate: 9 V/uS
- Settling Time: Not Published
- THD @ 1kHz: Not Published
- Noise: 5nV

NE5532 has been around since 1979. At the time it was considered to be among the best in op-amp designs. Today many music equipment manufacturers', and that includes some of the hi-end designers too, still continue to use it, almost out of blind habit you might say. What perplexes the well-informed equipment user is, why audio designers are continuing to use NE5532 as standard, instead of a hi-end component? During my VS tests a horrendous clipping of 4.00036% was noticed at the +3dB point in the VS. Obviously the chip doesn't like being driven hard. Also observed was a mid-frequency filtered 'rushing' noise when the input trim was set to maximum. NE5532 cannot be recommended for serious recording.

AD825 SMD Single op-amp. Price: £4.81 each. 2 pieces required to per module. Supplier: Viewcom & Sound Odyssey

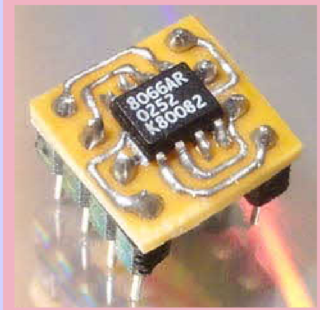


FEATURES

- Unity Gain Bandwidth: 41MHz
- Slew Rate: 125 V/uS
- Settling Time: 80 nS
- THD @ 1kHz: 0.00012%
- Noise: 12nV

The AD825 has picked up many recommendations from VS users. It boasts a range of impressive specs and is only let down by its noise figure of 12nV. Which means, when driven hard, recordings may sound a few dB noisier than other chips listed here. Priced at £4.81, you'll need two to make a module. To be honest, it will take the best part of a day to complete one module. Also the objectionable noise figure is a deterrent from using this chip.

AD8066 Dual op-amp. Price: $19.00 Supplier: Sound Odyssey

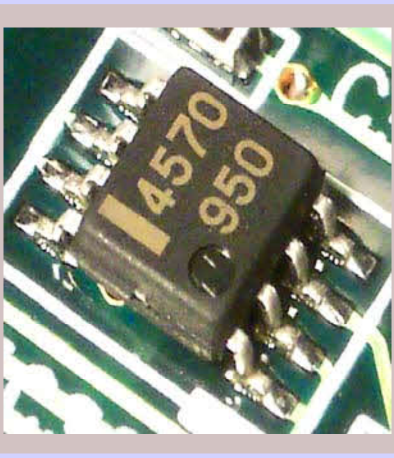


FEATURES

- Unity Gain Bandwidth: 145MHz
- Slew Rate: 180V/uS
- Settling Time: 55nS
- THD @ 1kHz: -88dB
  % figure not published
- Noise: 7nV

The specs are very impressive. Analog Devices have managed to cure the input noise problem down to a respectable 7nV, although I'm not sure about the LC Audio asking price of £28.75 per module. Also judging by their promo picture, I can't see the LC Audio's module fitting in any of the Roland VS range. It gets much worse... With the VS-1880 op-amp supply voltage of +-15 volts, and the AD8066 maximum 13.2 voltage limit, the prospect of using this 'superchip' is a remote one to the average modding enthusiast.

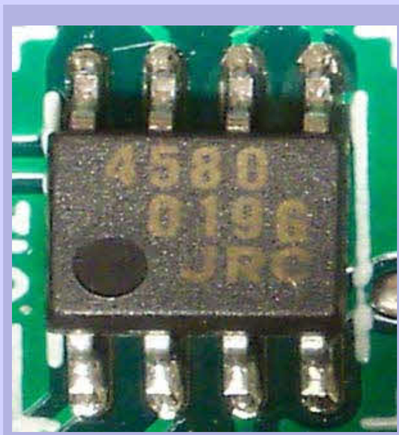
UPC4570 Dual op-amp SMD (Surface Mount Device)
Supplier: Viewcom



FEATURES

- Unity Gain Bandwidth: 15 MHz
- Slew Rate: 7 V/uS
- Settling Time: Not Published
- THD @ 1kHz: 0.002%
- Noise: 4.5nV

Another old model that dates back to the mid 80's. It's used as standard by Roland throughout in the VS range of hard disk recorders as a summing or input buffer amplifier. It provides an excellent noise figure of 4.5nV. Otherwise the device is totally average in its performance. A good standard cheap op-amp that is seldom seen as a gain element.



JRC4580 Dual op-amp SMD (Surface Mount Device)

Supplier: Viewcom

FEATURES

- Unity Gain Bandwidth: 15 MHz
- Slew Rate: 5 V/uS
- Settling Time: Not Published
- THD @ 1kHz: 0.0005%
- Noise: 8nV

DBX include JRC4580 throughout in their 386 Vacuum Tube mic preamplifier. With a price tag of £420 in the UK, we could have expected a better op-amp. Armed with this fact, I decided to change channel 1 throughout with OPA2134, and only discovered a marginal improvement in listening quality. Like the UPC4570, JRC4580 to the manufacturer, represents a cost-cutting off-the-peg solution.

And the winner is...

The DBX paints a sorry picture for a guitarist looking for the ultimate VS input...Even with A silver-plated cable.

AD825. Full of promise... But a bit too noisy

Well, actually there are no winners, but there are definitely some losers! 1st in line for the wooden-spoon, has got to be the **DBX386** preamp with S/PDIF out. My initial thoughts when recording with this unit, were, *"Yeah, it sounds grungy and dirty...it's got to be good...justlike back n the 70's recording through some old desk"*. Setting my rock 'n roll talk aside for a moment, I can't understand why anyone would want to record with an average THD level of 0.153%, not to mention an horrendous -72.51dB single-to-noise ratio from the guitar/instrument input. That's nearly 30dB worse than the best noise figure taken from the VS op-amp results in my tests. Admittedly, the mic input section sounded a lot fuller. But wait for it...Which opamp did DBX choose for the mic input circuit - Our little friend NE5532 in a SMD package. The DBX386 looks full of promise in glossy adverts...But with all those opamps, switches, pots and a poorly situated power supply - Forget it! If you're looking for a bit of audio fog and grunge, then the DBX386 at £420 is for you.

Next for the chopping block...**AD825**. LC Audio are the chief promoters for using this opamp. They come in at nearly £30 for each module when last checked. That's four opamps needed in the VS-1880, and a grand total of £120. There also appears to be a few further problems with the AD825 solution; **1.** Uncertain PCB fitting dimensions. An area of 10mm x13mm maximum seems to be about right in the VS. It's possible to gain 1-2mm safely by bending back those electrolytic capacitors surrounding the PCB. But even after this, the LC Audio PCB still looks too big for the VS job.

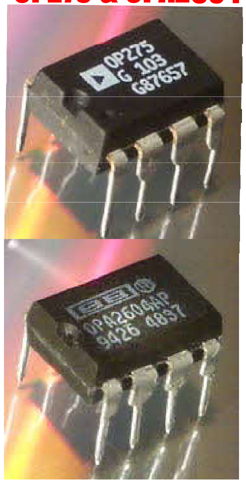
2. AD825 requires power supply decoupling capacitors close to pins 4 & 7, diverting any stray power supply noise to ground. This means the user, ideally, should hook-up a grounding wire to the module. How many VS users are prepared, or even want to do this?

3. AD825 boasts some very impressive specs, but it's let down by the disappointing input noise figure of 12nV.

4. If you decided to make your own, you'll probably spend the best part of a week furnishing 4 modules. Admittedly, you will be saving £100, ofcourse, assuming you have all the right PCB tools and materials.

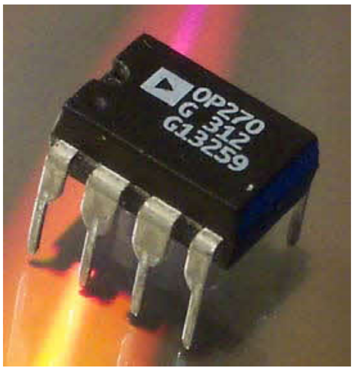
Popular VS upgrade choices

Nearly ran...
OP275 & OPA2604



Moving further into the pack, we come across two popular and widely available op-amps; **OP275** & **OPA2604.** Both amps represent a 50% solution to a satisfactory replacement of NE5532. I say this, partly because OP275 and OPA2604 are known in audio circles as fairly average performing op-amps, and also they are not a no-compromise solution to the VS upgrade. The part that often seems most confusing, is browsing over various specifications across several op-amps - The problem is, just when you think you've found the right op-amp with all the right figures, to your disappointment you find out that it is badly let down by just one crucial parameter. It can be very very confusing! Back to the op-amps. On the plus side with OPA2604, I thought I noticed a pleasant sparkle at about 13kHz. I couldn't hear this on my studio monitors, but through my Sennheiser HD280 headphones, and a bit of ear-squinting (near-field) the '*sparkle*' was apparent. OP275 to my ears sounded very neutral and quieter than OPA2604, and this is reflected in my VS tests (1.89dB difference with VS trim set to maximum). *Gentlemen, choose your weapons.*

A drop of the hard stuff



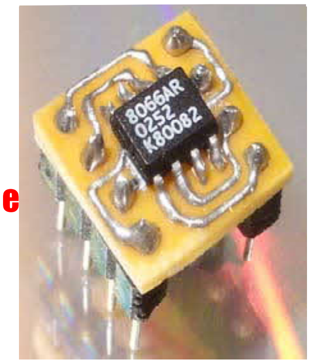
Further research into a replacement to NE5532, I came across **OP270** from Analog Devices. With a published input noise figure of 3.6nV (typically), I thought it best to check it out in the VS. During the tests, I found it gave the quietest performance (Typically -99.76dB) trim set to maximum and -104.07dB with trim set to minimum. It also boasted a THD of 0.00382%, the lowest THD level out of all op-amps tested in the VS, and that's not far off the reference input THD of 0.00356%! Unfortunately, the op-amp is let down by a few crucial perameters (See op-amp specs) and couple this with its rather hefty price tag (£12.53 from Viewcom). I have to give OP270 a reserved recommendation. If you want to use this op-amp, try OP271, as it has a slightly higher slew rate.

OPA2134 was first introduced in the mid 90's. It is arguably the best possible modern DIL and SMD replacement for NE5532/UPC4570. The forgiving THD at the +3dB point (LED clip) in the VS is excellent @ 0.18875%. Only bettered by OPA2604 (1.12721% THD) and the impressive +3dB point with the OP270 (0.11952% THD). Listening to OPA2134 and comparing it to the rest (minus AD8066), was for me a fairly simple deduction. Quite frankly, it sounded the best out of the pack. Check out OP-AMP REVIEW 2 at http://uk.groups.Yahoo.com/group/RolandVS-Upgraders/files/
The intimacy and increased detail in the review at OPA2134 section seems obvious. Headphones recommended.

OPA2134
Represents an
up-to-date & simple
solution to replacing
NE5532 & UPC4570

No compromise...Good & bad news...

AD8066... The very latest, but not compatible with the VS +-15V supply voltage.



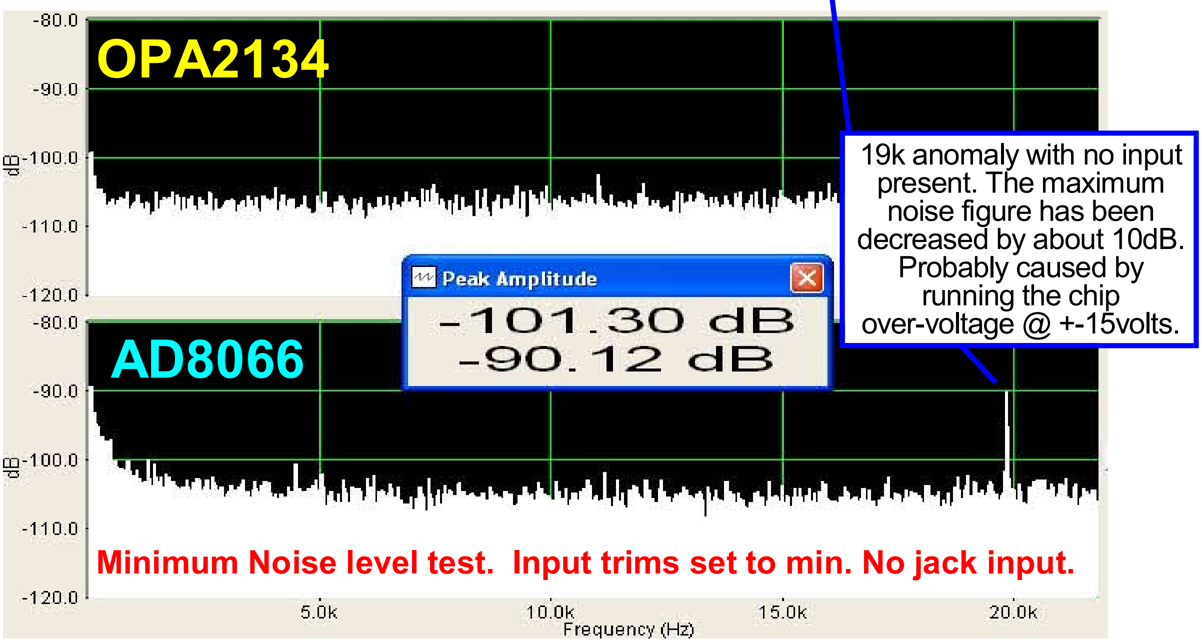
There is a no-compromise solutions for the VS. The new AD8066 has all the specs to satisfy nearly all but the most stubborn of cynics. On the downside, it's only available as an SMD. Also the chip has a supply voltage input limit of 13.2 volts per supply rail. That makes a maximum total of 26.4 volts. The VS-1880 opamp supply comes in at +-15 volts per supply rail, with a grand total of 30 volts. So comfortably using AD8066 is very tricky. If you're determined to use this chip as a replacement to NE5532, you'll need to design a compact custom PCB with a diode voltage-dropping network, in order to reduce the voltage down to something like 13.2volts.

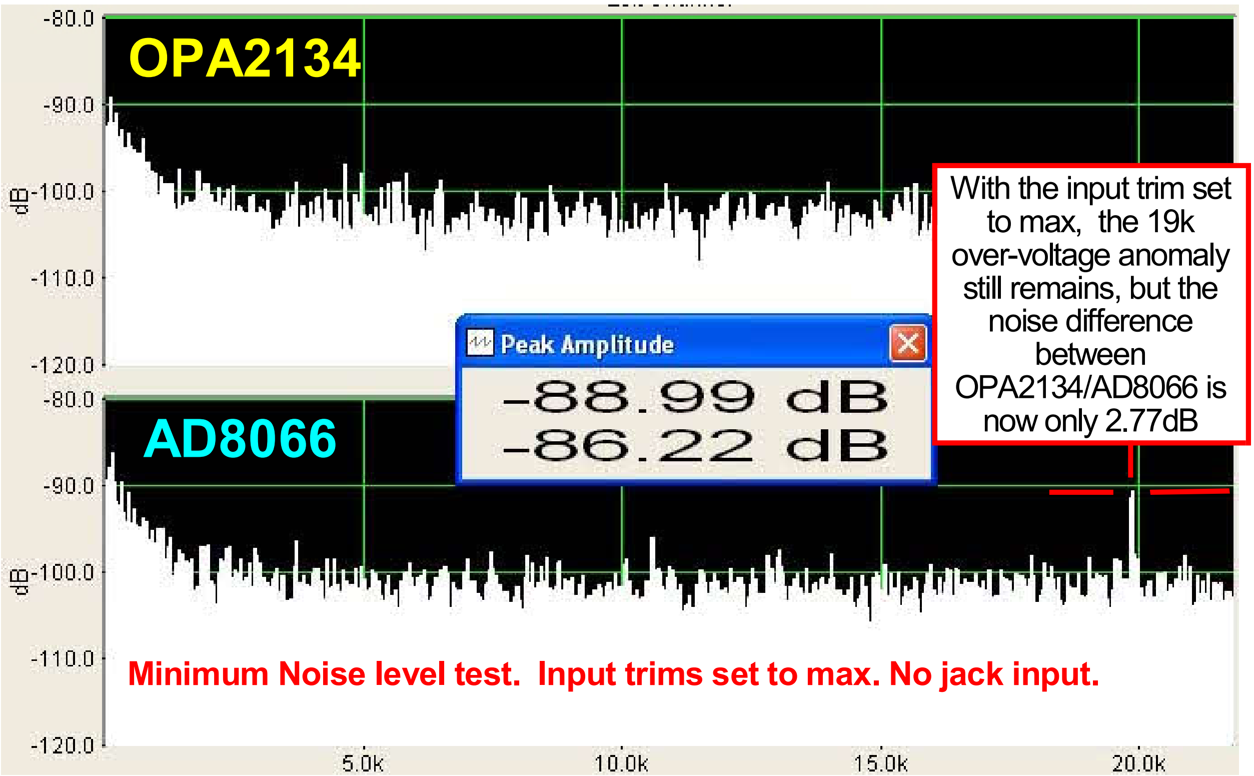
Going head to head with OPA2134 versus AD8066

I suppose the best of the pack before the arrival of AD8066 has got to be OPA2134. To my ears the listening and test results spoke for themselves, but then the AD8066 had to turn up looking mean and nasty. Yep, just like in the wild west, there has to be a shoot-out. The OPA2134 versus AD8066 Avi file is available from the Yahoo Upgraders group.

TEST RESULTS with SPECTRALAB

Opamp	THD Distortion @ 3 o'clock LED just illuminated	THD Distortion +3dB past LED illumination	THD Distortion @ -10dB below LED illumination	Minimum THD distortion	Input trim @ minimum NOISE LEVEL	Input trim @ maximum NOISE LEVEL
OPA2134	0.04830%	0.26842 %	0.00424%	0.00387%	-100.50dB	-88.99dB
AD8066	0.04231%	0.26329 %	0.00432%	0.00388%	-90.12dB	-86.22dB





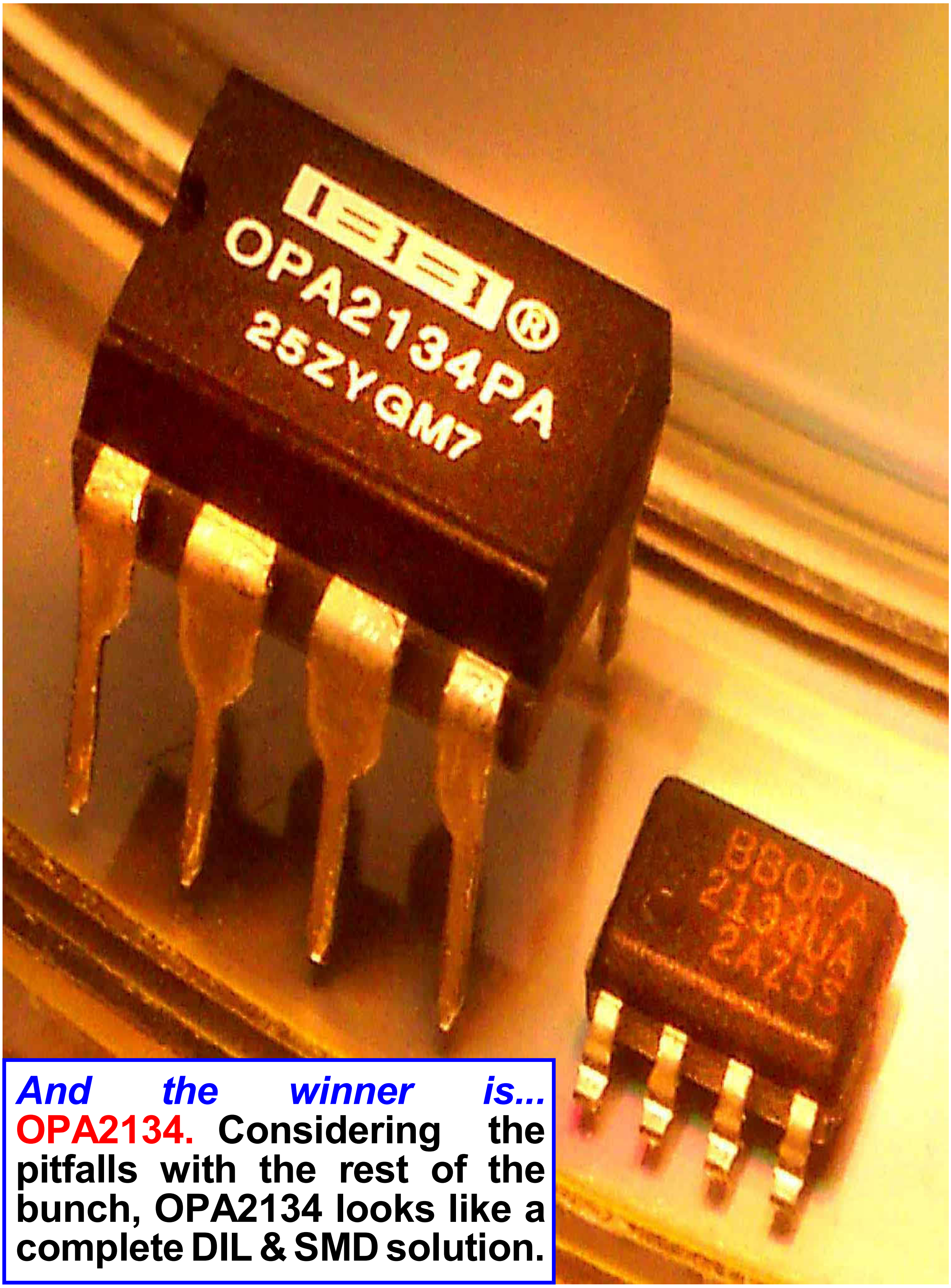
Conclusions

I could look at my VS op-amps test results all day, and yet still come no closer to a final judgement on which op-amp to use. Listening to the OPA2134 vs AD8066 avi file, I'd say AD8066 sounded slightly better, with a tiny increase in guitar string detail. On the negative side, I am a little alarmed at the over-voltage 19k anomaly down in the -90dB region (pictured above). Another possible discouragement from using AD8066 (*I'm stickin' the boot in now*), is its availability. Here in the UK, it appears to be under 'commercial lockout'. This probably means, companies like LC Audio and Sound Odyssey have bought in enough pieces to exploit the demand of the new 'superchip', and the private individual will be excluded from obtaining a supply.

The price of AD8066 *(My final deathblow)*, not to mention the necessity of a custom PCB with a voltage dropping diode network, is another negative aspect. Sound Odyssey will supply both the module and AD8066 separately. Module price is around £30. AD8066 without PCB; POA.

Part 4 of this document, shows my first attempt at an AD8066 module (minus the diode network) and the AD825 PCB artwork. Both artwork examples are a good starting point to making your own custom PCB. On the positive side, at least they are

Coming down off the fence...



And the winner is... **OPA2134. Considering the pitfalls with the rest of the bunch, OPA2134 looks like a complete DIL & SMD solution.**