It came to pass while designing a pair of subwoofers that what was needed was an audio amp and test oscillator for the work bench. In the past I had always used a synth from the studio for this and ran a cable to the main system for monitoring. Since the studio upgrades, this is far less practical. So it was decided to quickly cobble together an audio test set. And as usual, a five minute job turned into a two month drama.

FEATURES

Oscillator

- Isolated sine/triangle outputs 600Ω impedance.
- Isolated Square output 600Ω impedance
- TTL/CMOS sync outputs (non-isolated 5V)
- Tri/sine out can be left or right leaning sawtooth.
- Amplitude Modulation input
- Frequency Modulation input
- Six selectable ranges from "real high™" to "Is this thing even working?™"
- Pulse LED on square ouput so you can see if it is actually working.
- Vernier frequency control for fine adjustment with a single knob.
- Sine/Triangle is level adjusted so that the triangle is the same amplitude as the sine. (A common problem with the XR2206)
- Master output level control. (though this only controls Tri/Sine)

Amplifier

- Switchable isolated inputs with reasonably high input impedance.
- Stereo balance, volume and simple tone control.
- Analog mechanical average metering with 3 LED peak meter. (Peak meter is summed from both channels)
- Meter can measure the input to the monitor amp or an external input.
- Headphone outputs

Additional

- Provides all these features on a small remote box connected to the main unit by a standard CAT5 cable.
- Remote box has a ± 12V regulator supply for quick prototyping.

Amplifiers aren't hard to find. In this case it came in the form of an old, stereo, radio cassette player. I have no idea where it came from but it's been in the junk pile for years and showing various signs of decay. At first the notion was to build it into the box it was already in. This would have had several advantages. A portable cassette player has everything, including the speakers, self contained. However, after building the basic oscillator board, it became apparent that this was not going to be entirely ideal. So back to the junk pile and I found a nice but dead stereo cassette deck.

The advantage of this box is that everything was already there on the front panel just about. Meters, knobs, switches etc. It was a fairly good looking unit though being a Sanyo it was understandably deader than Elvis. I'll get to the logistics of recycling later but for now I'll get straight to the circuit.

THE OSCILLATOR

The oscillator is based round an XR2206. For some reason I found this extraordinarily difficult to get working. Probably my state of mind. (*definitely* my state of mind.) These things are normally a doddle though. I played round with all kinds of current sink arrangements for the VCO (which is really a current controlled oscillator) but in the end settled for a more or less "Stick and rudder" approach.

The problem with the frequency control pot was that I wanted to use a vernier dial. The kind used on EMS VCS3 synths, etc. What I hadn't realized was that they only do a 180° rotation. Instead of the 270° (or so) rotation of a normal pot. So my first thought was that I would need some kind of level translation in order to afford trim pots at either end to adjust the range. I had figured this would be better than the somewhat mechanical solution which would be hit and miss.

This was just plain trouble. I spent most of my time redesigning this stuff until I finally gave up and went for the dumb pot approach. This does not yield a full range of the VCO but with the range switch, it's possible to get overlap. Since this wasn't really designed as a sweep oscillator, I could live with that. Although it does have a VC input if some kind of external sweep modulation is required. Both AM and FM are possible.

A switch sits across the symmetry adjustment pins on the XR2206. This allows the addition of a sawtooth or ramp output. The switch can select a left leading or right leading sawtooth as required. It works best when used with Triangle wave selected. It Does work with sinewave selected but offers no additional advantage.

The XR2206 has a problem that the triangle waveform output is something around twice the amplitude of the sine. So I used a trimpot to squash the level when switched to Tri. You need to adjust this till they are at the same level. The volume control follows this and is then buffered by an op-amp. This restores some of the level and helps drive the 600Ω isolating transformer.

Both Sine/tri and square outputs are isolated by the transformer. This does two things. Allows the oscillator to be electrically isolated from the test subject and provides a low impedance output of 600Ω. It means that the system can't introduce humloops. (Though I did this internally by accident in the prototype.) It helps reduce the possibility of any strange effects on the circuit under test that might arise due to unforeseen circumstances. One less thing to worry about when you've got you're head in something.

These transformers are designed for high quality audio but the frequency response tapers off after 20kHz. So even though the oscillator is capable of 100kHz or so, it's unlikely to pass through the transformer with any usable amplitude.

There is also a TTL/CMOS ouput in case you need to trigger a pulse into some logic. The oscillator can go down to about 0.05 Hz or so. So if required, this could be use for throwing at some logic design at a pinch.

An additional LED is provided which flashes with every square pulse. Normally it just looks like it's hard on but if the oscillator is slow enough you can see it pulsing. This is handy if you've got it down to a very slow rate and it's no longer audible. The TTL/CMOS output should have been 75Ω but due to a stuff up with the PSUs in the wiring I had to quickly add a 200Ω resistor otherwise there was a risk of shorting out the PSU if connected back into the amplifier. For whatever reason you'd want to do that.

THE AMPLIFIER

The Amplifier is obviously pre-built but required some modifications. This can be seen in sheet 2. No circuit is given however since I don't actually have one. Just a block diagram and the additional components/switching/wiring required.

The input to the amp has yet more 600Ω isolating transformers. Once again the objective here is to be able to listen in on a circuit but interact with it as little as possible. However 600Ω is way too low for input impedance so the extra resistors are there to prevent input loading.

There is a switch to switch out the isolation transformers so that ground referencing is possible. It's probably not all that useful but the switch was already there so it's been included.

Not much else can be said of the AMP. It's entirely up to whatever the constructor has on hand and the configuration she may wish to use.

THE METER

The meter circuit is adapted from an original idea by Rod Elliott of ESP (Elliott Sound Products) from his web site. I was looking for a reference for driving mechanical meters and while I could have done something much simpler, I kinda liked the look of this and decided to try it out.

The Meter did not have anywhere near enough gain to drive the meters in the cassette deck but the response was good. So I changed a number of things around and took a feed off to drive a mono peak meter.

The peak meter is a pretty much standard comparator ladder. There were 3 LEDs on the front of the cassette deck which I initially thought I'd use for status. But since these were not needed, I built up this peak meter quickly. If you wished, you could use the redundant op-amp from the quad package to provide a fourth LED. Just add another 1k resistor.

I used LM348s for this part of the project. They're pretty crappy but I had lots of them hanging round with nothing to do. Normally you'd probably use something like an LM324 but why waste them when you could use up some of your crappy ones. The LM348 is really just four 741 type op-amps in a quad package. So you can tell they're not exactly going to be great for anything if "Quality" is in the name. But for something like this they are suitably adequate. Just don't expect them to ever drive rail to rail like a 324 can.

POWER SUPPLY

The circuit shows a transformer with two secondaries. There are in fact three secondaries and two transformers in the whole thing. One transformer was the original from the amplifier cassette player. The other is the original Cassette DECK transformer with two secondaries. Your PSU requirements will vary entirely with what you've got on hand.

But a word of caution. Originally I thought it was going to be pretty cool to have three PSUs however somewhere in the mess I've created a small hum-loop it would seem. Despite the fact that I've tried to keep it all in something of a star earth topology. That is. All grounds are tied at a single point. This became not possible due to the configuration of the original cassette DECK's PSU So now I have to go back and try and hunt down where this problem exists. Still it's not a major problem. It just pisses me off but most people probably wouldn't hear it.

If you're available PSU is significantly different to that shown, don't worry, you can run the whole thing from one secondary and one rectifier/regulator circuit. The 7805/7905 regulators will stand about 35V DC each if memory serves. So you have quite a bit of room to move. I've taken the "Don't give a rat's rectum" approach but you might want to adapt the circuit to whatever you have to work with.

CONSTRUCTION

There are few, if any, part numbers on the circuit. There is no printed circuit layout. I prototyped it in my usual manner and all I need is a circuit. I suspect others won't even be interested in this but if they are, will be only interested in building a one-off anyway. But if a PCB is required I might consider designing one. It's not economically viable for me to make this into a full project so don't ask unless you can make it worth my while.

Since it's doubtful you'd have the same junk in your collection that I do, it's equally doubtful you'd build this with the same configuration anyway. So one should consider this as a guide to applying what junk you might have laying around. And speaking of which…

RECYCLING

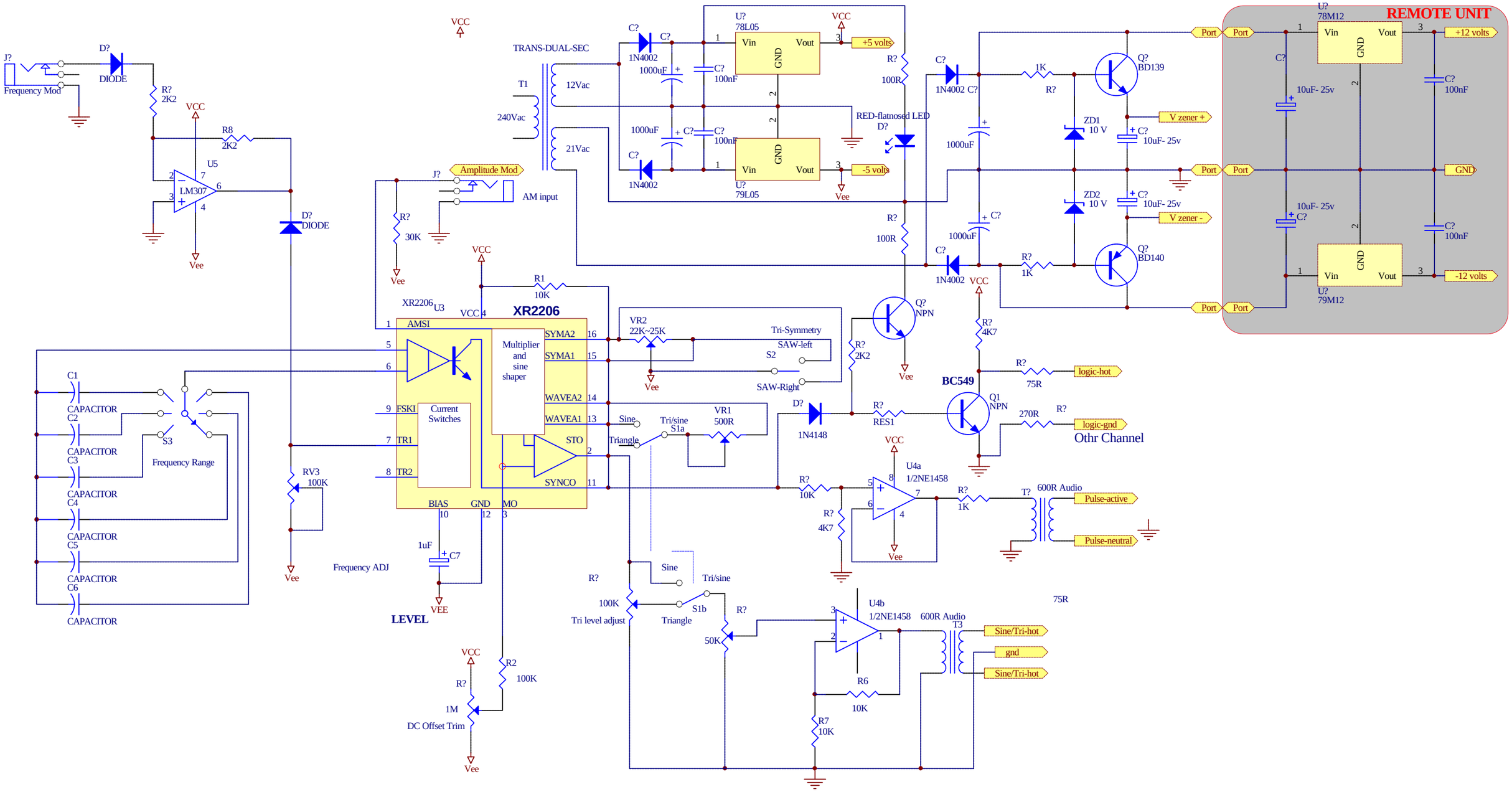
As mentioned, this project is build mainly out of recycled junk that was intercepted on the way to land fill. You could use almost any old junk as your amplifier as long as you can figure out how to put a signal into it. One source might be old, amplified computer speakers for example. I used an old radio cassette player. It seemed like a good idea at the time and it worked out easy to find the business end.

The oscillator however had to be built from scratch since there wasn't anything in the junk box already set up to do this. But I did have half a dozen 2206s in stock so I used one of them. I could have used an ICL8038 but these are trouble for experienced people let alone novices. I just didn't feel like the hassle.

Using an old cassette deck as the housing saved about a g'zillion hours of mechanical engineering. The hardest part was deciding what to do with all the bits on the front panel. In the end I'm left with one op-amp, one momentary press button and one LED redundant. I simply can't think of an additional use for them and of course, they're spread all over the device. They couldn't all be near each other physically now could they?

The result is that I now have a half decent looking box that sits above my bench and makes it easier to test audio crap.

Be absolutely Icebox.



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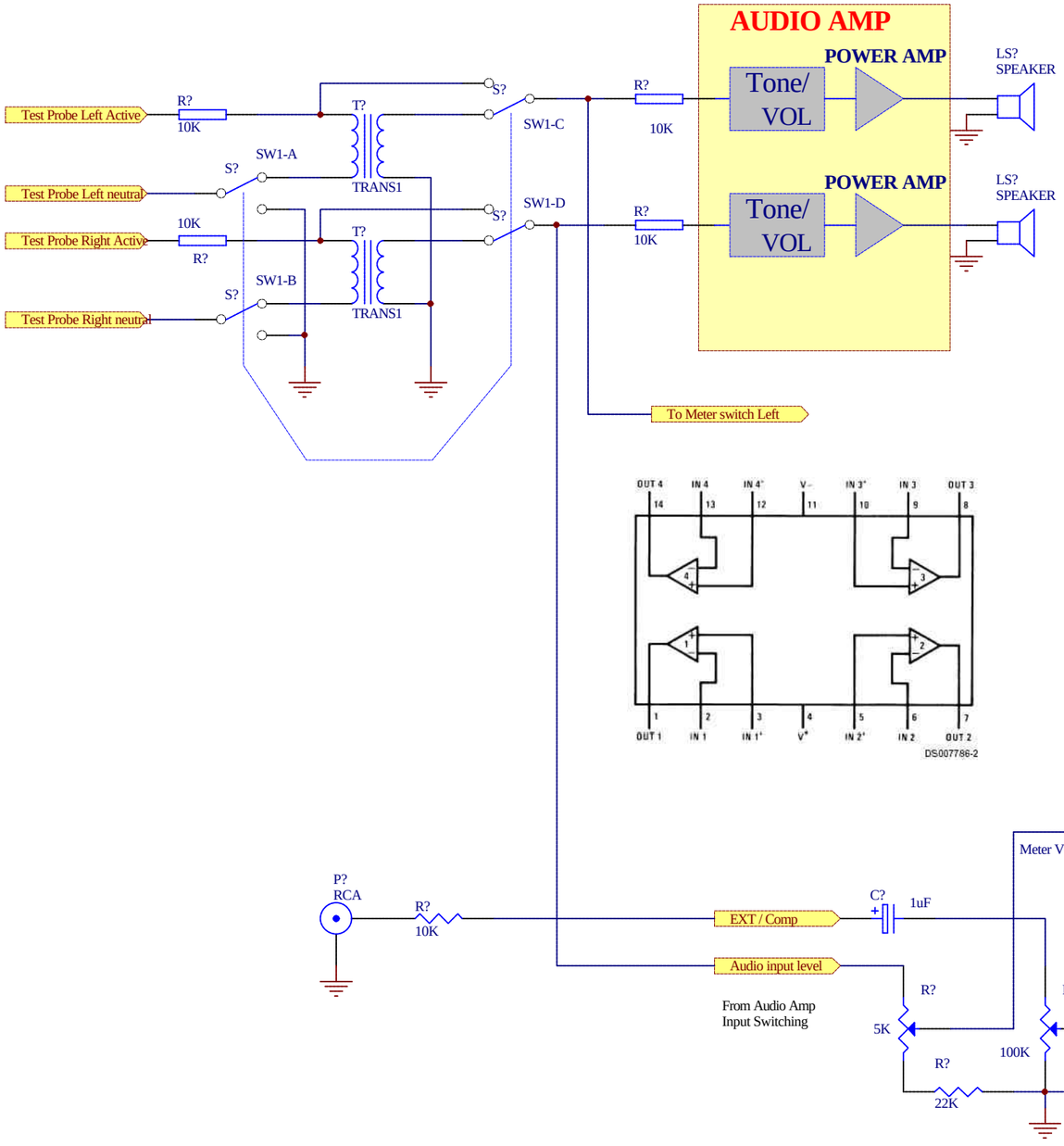
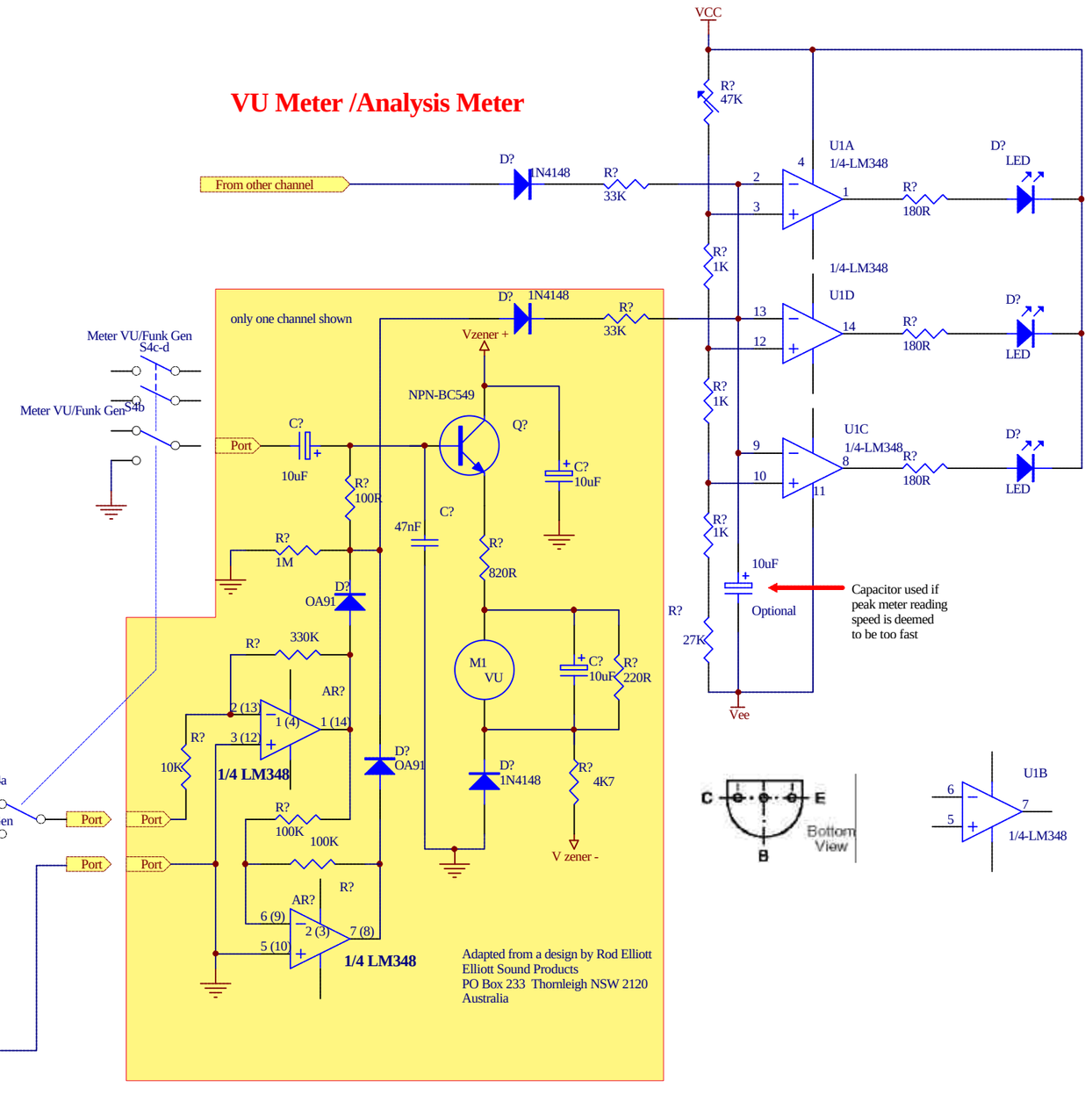
AUDIO TEST SET oscillator / Amp

REV-01-Take-05





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Sheet 2 of 2

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