THE WEST RAND AMATEUR RADIO CLUB

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ANODE

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Editor's Comments

The Direct Conversion Receiver is possibly one of the simplest receivers to build and yet provides superior performance over conventional designs. Designers of military equipment have used it with great success. See the article on page 2 for more details.

There is going to be a boot sale...

The other articles include an A to D that is pure 'vapourware' not much different from some articles in electronic construction magazines.

There is going to be a boot sale...

We also have a fun article about accountants on page 6. If you know of an accountant that would like to read the article, you may have help him count up to six....

There is going to be a boot sale...

And lastly we have Om Dirk's article called Gifts from the Sun.

There is going to be a boot sale...

There is going to be a boot sale on Saturday the 20th at the Club house. It will start at 12:00 hours and parking outside will be available. Parking for

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An A to D that hasn't been built in an afternoon

[In the best tradition of vapourware, we present here a project that's all in the mind.]

Special points of interest:

- Contact details on back page

Well, you remember the D to A that was so simple that it could be built in an afternoon? I said that I would take some time and build a simple Analogue to Digital interface based on the D to A. In the month since that article, a suitable afternoon has just not happened. Still I thought I would share with you the plan for putting it together. So you could do it!

The principle of the D to A is fairly simple to understand. It relies on the bits each having a 'weight' or value of voltage according to their position in the byte. That's eight bits if you didn't know it. By combining the bit values we could generate a sine wave and all sorts of other waveforms.

So if we can generate known voltages, we could compare them with an unknown voltage and get a 'true' or 'false' or above / below indication. By varying the known voltage we could get to the point at which the indication changes and say that the voltage is above x and below y. This last step would not be very accurate as the smallest step of our D to A is quite large. But it would at least give us the means of measuring and that's what this article is all about. Improvements and en-

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A Direct Conversion Receiver

Differential Direct Conversion
By Paul E. Gili, WA1WQH

In single-ended transmission systems, the signal voltage is taken with respect to a reference (usually "ground") which is assumed common to all stages of the receiver. Unfortunately this assumption cannot be realized in practice. In the differential mode, by which I mean that connections from one stage to the next are made with two wires and the signal information is contained in their voltage difference, with proper device selection and circuit design, push-pull type circuits naturally evolve which reduce second order intermodulation products and untuned signal detection. Induced hum and power supply ripple can similarly be reduced by using the high common-mode rejection ratios available in modern op amps. The beneficial side-effects are at least these three

- a balanced receiving antenna such as a small directional loop can be directly interfaced to the receiver without the phase and gain inaccuracies attendant with baluns - r.f. circuit layout problems are drastically reduced because in a differential mode we don't worry about maintaining a constant impedance to ground (there is no "ground") - if we ever cared about transmitting with a balanced antenna we would need both + and - drive signals -- these are automatically available with a differential layout.

I have built the receiver whose block diagram appears in Fig. 1, and found that it does indeed achieve all of the advantages outlined above. I wouldn't waste your time describing something that doesn't work, so at this point you can either go ahead and duplicate my circuit, shown in Fig. 2, or read on and find out why it works.

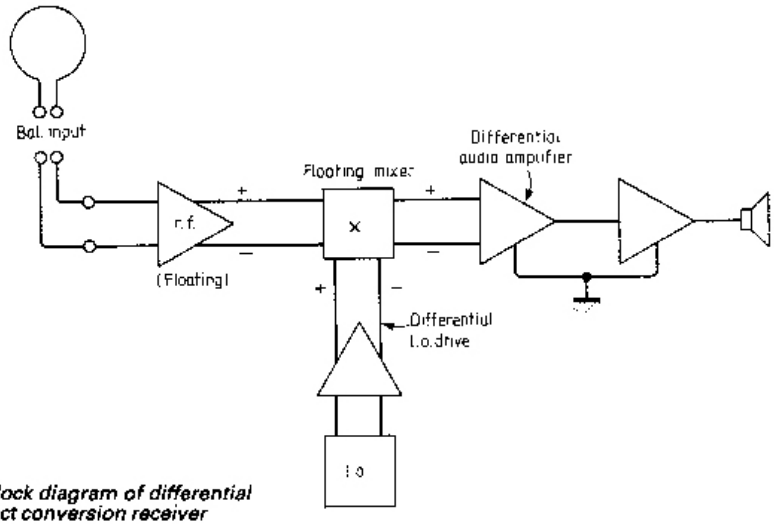

Fig. 1. Block diagram of differential direct conversion receiver

I used a tuned-loop antenna to differentially drive the balanced inputs to IC1, an MC 1590 untuned video amplifier with a voltage gain of about 10 and a 1OW differential input impedance. A collection of small loop-antenna design equations is given in the appendix, which also explains why you should be using a loop antenna on the h.f. bands. The receiver's first stage performs two functions: it provides constant input and output impedances and acts as a buffer between antenna and mixer, and it provides about 20dB gain for the inefficient loop antenna. Due to atmospheric noise in the h.f. bands for which this receiver was designed, noise figure and antenna efficiency or G/T are unimportant factors. The important consideration is dynamic range, and for the direct conversion receiver, second-order intermodulation products. They must be low to reduce untuned signal detection. In the circuit, the MC1590 operates in a push-pull mode which suppresses this type of non-linearity by generating two equal and opposing non-linearities (when the device is driven non-linear) and cancels even order harmonics.

After the antenna is amplified, it is differentially converted to the audio frequency range by a doubly balanced mixer circuit incorporating a CA3049. In fact, this circuit could be considered "triply balanced" as there are no unbalanced ports at all (don't fall over on that one). The CA3049, to be described later, operates as a differential ampli-

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Editors Comments

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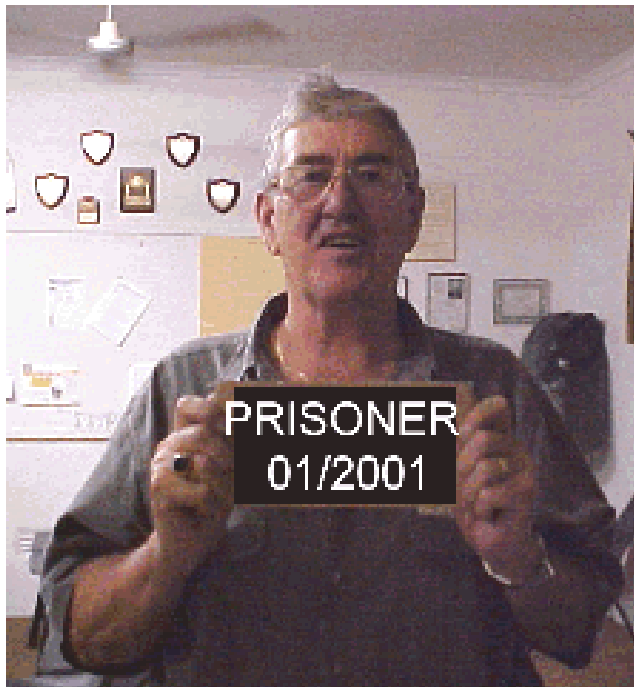
Vendors only will be inside at a charge of R20. On the previous evening we are having a 'bring and braai' and all are welcome.

Om Dirk is still looking for a tuning capacitor of around 100 to 350pF rated at 1.5kV or higher. If you have one spare and are not using it, could you please bring it to the next club meeting and give it to him.

Om Henk suggested that we have a small sales section in the Anode. I have no problem with that but nobody has ever asked to advertise their small sales. If you want to swap or sell for small amounts anything related to amateur radio please let me know.

See you at the Club. JB



This is OM Dirk
(taken at recent Bring & Fix meeting)
Author of the food articles.

A Direct Conversion Receiver

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fier with its outputs switched in polarity at the local oscillator rate. The fact that gain is available in the upper switching transistors whose bases are at pins 1, 4, 7 and 10 and also the fact that the L.o. signal is a square wave ensures fast switching transitions from positive gain to exactly the same but negative gain. Lack of symmetry during the short switching transition time is known to cause intermodulation products. At h.f. relatively faster switching can be achieved with active devices using squared-up drive waveforms than can be achieved with diode ring-type balanced mixers. Up to 30 MHz, therefore, I think that the integrated bipolar transistor type of balanced mixer driven by a square wave is superior to other types of mixers.

It will, however, respond to signals at odd harmonics of the L.o. almost as well as it does to the fundamental; these can be easily filtered out as they are widely separated in frequency.

At points C and D of Fig. 2, then, there is a differential audio signal which is amplified differentially by IC2. These are the two op-amps connected in the classical differential instrumentation amplifier configuration with a differential gain of 40dB. This is where power line hum gets rejected and the amount of rejection depends on how closely you can match the gains to maximize common-mode rejection. You might want to make the gain Of IC2(b) slightly variable (±10%) by using a 910 Ohm feedback resistor in series with a 200 Ohm potentiometer instead of the fixed lk Ohm resistor shown. Residual power supply ripple from the 6.2-volt zener diode is in-phase at the inputs to IC2 but the desired signals are 180 degrees out of phase with each other at these points. With the circuit shown, differ-

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A Direct Conversion Receiver

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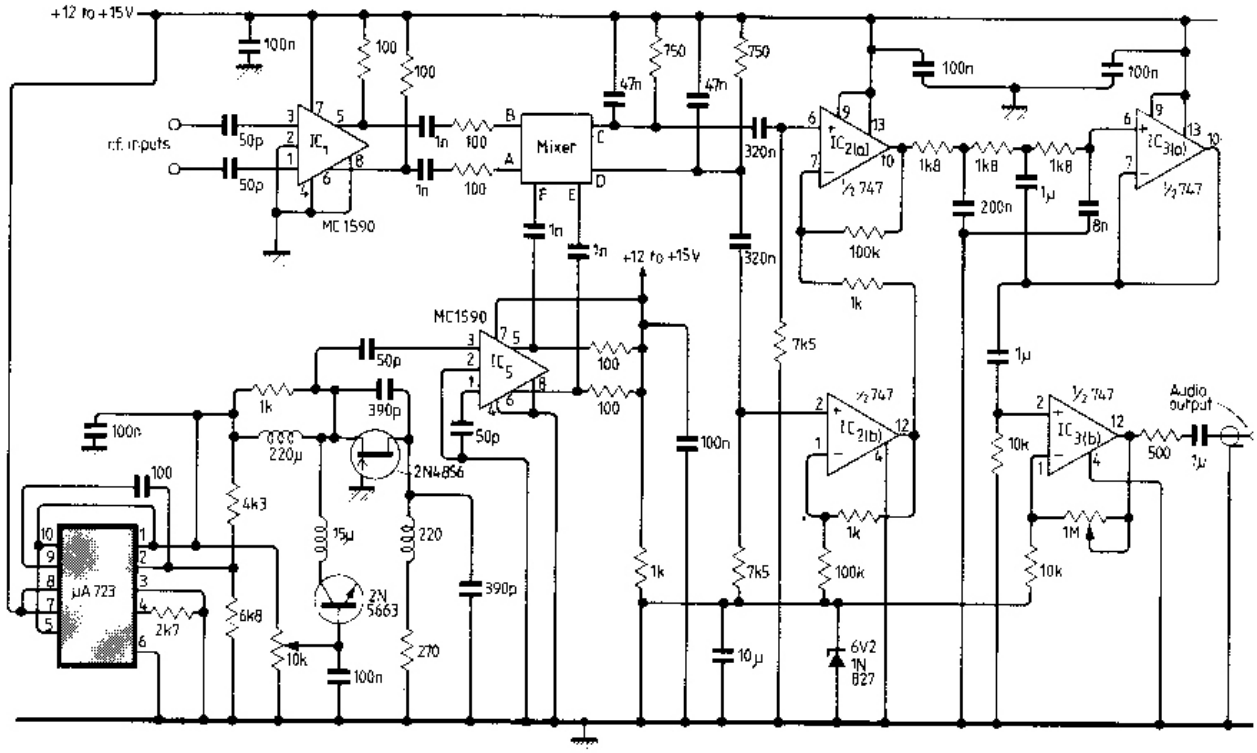
ential signals get amplified by 40dB, whereas changes in the zener diode reference voltage w. copy than a high-Q, narrow-band-single, section active filter because of less ringing.

future article.

With the differential signals available, we can take a very



come through unchanged. A 40dB improvement in signal to-ripple ratio over a single-ended design is therefore effected.

At the Output of IC2 the signal has been amplified and filtered to a level where it is relatively impervious to the interference effects important to a direct-conversion receiver. From here on, we can use standard single-ended operational amplifier circuitry with one input, one output, and ground as a reference. I used a three-section Tchebychev 0.1 dB ripple low-pass active filter with cut off at 500Hz for c.w. operation to drive the output stage. The low-pass filtering results in better c.

The local oscillator has to be stable, yet simple. In this circuit, oscillator transistor and integrated circuit provide an adequately stable differential local oscillator signal over about a 30% bandwidth centred at 3.6MHz. As the circuit shown is electrically tuneable, frequency stability depends on how stable a tuning voltage you can generate. After building and using the receiver, I came to the conclusion that unless some type of closed-loop frequency synthesis technique is used to stabilize a free-running wide-band v.c.o. mechanical tuning is preferable. I am, therefore, presently looking at electronically switched LC networks which may be the subject of a

different perspective on circuit layout. By maintaining relatively high common-mode impedances compared with differential-mode impedances, we can do without a ground plane.

Actually, the presence of a ground plane may negate some of the advantages achieved by the differential concept. If you intend to build a circuit of this type, feel perfectly confident that you can do it on perforated board with no decrease in the performance attributes outlined here. In fact. the further away you can get the balanced r.f. circuitry from a ground plane,

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A Direct Conversion Receiver

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the better off you will be.

Integrated circuits should still be bypassed at their supply voltage terminals. All differential signal leads should be tightly twisted pairs, as short as possible, and as far away from chassis or circuit ground as possible. This applies particularly to the following four transmission paths:

- connections from the balanced antenna outputs to pins 1 and 3 of IC1
- connections from pins 5 and 6 of IC1, to the A and B inputs of the mixer
- connections from points C and D of the mixer to pins 6 and 2 Of IC2
- L.o. connection from pins 5 and 6 Of IC5 to points E and F of the mixer.

fig. 2 Differential direct conversion receiver shown uses only five Ic's and three discrete transistors.

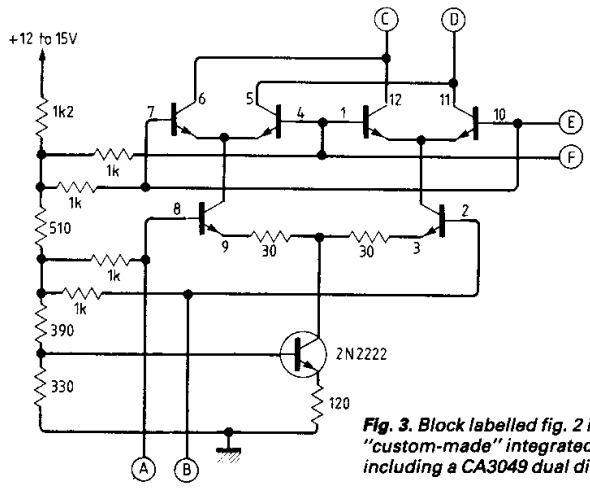
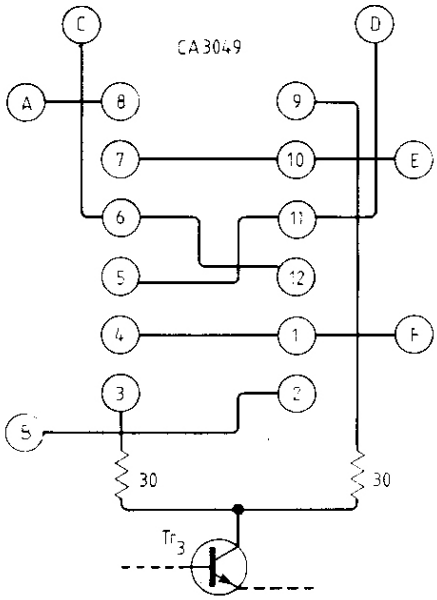


***Fig. 3.** Block labelled fig. 2 is really a "custom-made" integrated circuit including a CA3049 dual diff-pair.*



The CA3049 should be laid out and wired as shown in Figs 3 & 4 which relate to the terminal connections of Fig. 2. This device is a high-frequency, layout sensitive component and we are using its high frequency capabilities to reduce intermodulation distortion, as described earlier. (The nomenclature of points A, B, C, etc, on the mixer of Fig. 2 has been generated mainly to reduce the clutter which would appear on a detailed circuit schematic, but which is much more simple in an actual physical realization, as Fig. 4 shows.

Appendix

Small loop antennas are useful for receiving systems in the h.f. band because their dipole-like directional characteristics are preserved even though their size is orders of magnitude smaller than an actual dipole at these frequencies. Their efficiency is extremely low, but at h.f. where most of the receiver noise is due to random atmospheric disturbances, it doesn't matter if you have a lossy, noisy receiver front end. A small loop's main attribute is its ability to easily null out a coherent man made interfering signal by simple physical reorientation of the loop. A 3.5MHz receiving loop antenna can be as small as two feet in diameter and have the same directional properties as a rotateable 80-metre dipole which would be about 130 feet long. Null depths of around 20dB can be achieved if phase and gain of the balanced antenna output are preserved. Naturally, you'll need a differential direct conversion receiver to do a good job at this.

For convenience in building small loop antennas, I've put together a number of design equations from various sources, shown on the right. Included is one relationship assembled by me which allows you to calculate the approximate r.f. voltage received from a transmitter as a function of the transmitter's range, power, frequency, and your receive loop antenna parameters. Of course the range depends on how the signal got

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A Direct Conversion Receiver

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to you, i.e. how many ionospheric bounces it took and how high the reflecting ionospheric layer was at the time. Polarization of the received wave also plays a part, as does the angle of arrival from the sky with respect to the loop's orientation (elevation as opposed to azimuth). One can easily get carried away trying to account for more variables than can be measured or even defined; however, the equation does give an answer which probably is within an order of magnitude of the actual number.

The small loop antenna has an equivalent circuit which may be derived from its physical parameters.

RI = 31,200 (nA/λ^2)^2 Ohms

Rw = 2.61 x 10^–7 SQR(f(2nR/d) ohms for copper

L=n^2 μo R($\log_e$(8R/a)-2) nano Henries

Vr=(λ/4ΠD) SQR(8 Pt Rr) Volts

Definitions

R mean radius of loop
A area of loop
d wire diameter
n number of turns in loop
a radius of bundle of wires in loop or d/2 if n= 1
Vr peak amplitude of received signal
Rr radiation resistance
Rw conductor loss resistance with skin effect
L inductance of loop (nH)
f frequency (M)
λ free space wavelength
μo 12.56 nH/cm
Pt transmitted power (watts)
D range (same units as λ)

From Wireless World September 1982

Accountants and their daffynitions

What's the definition of an accountant?

Someone who solves a problem you didn't know you had in a way you don't understand.

What's the definition of a good tax accountant?

Someone who has a loophole named after him.

When does a person decide to become an accountant?

When he (she) realizes he doesn't have the charisma to succeed as an undertaker.

What does an accountant use for birth control?

His personality.

What's an auditor?

Someone who arrives after the battle and bayonets all the wounded.

Why did the auditor cross the road?

Because he looked in the file and that's what they did last year.

There are three kinds of accountants in the world. Those who can count and those who can't.

How do you drive an accountant completely insane?

Tie him to a chair, stand in front of him and fold up a roadmap the wrong way.
(ed. Absolutely ! Just ask the wife ! Ahhhh)

What do accountants suffer from that ordinary people don't?

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Gifts From The Sun

FRUIT FUDGE COOKIES

Serves around 24

25ml milk
800gr sugar
100gr (110ml) butter
100gr mixed dried fruit
10ml Van Der Hum
10gr castor sugar (15 ml)
10 ml water
10gr coconut (15 ml)
12 glacè cherries

Conventional method

1.. Cover a baking sheet with grease-proof paper
2.. Bring the milk to a boil. Add sugar, remove from the heat and stir to dissolve.
3.. Add the butter to the mixture and return to the heat. Cook until mixture reaches soft ball stage (120 C on sugar thermometer)

Microwave method

1.. Into a bowl, place the milk, sugar and butter
2.. Using a wooden spoon, remove all the lumps
3.. Microwave on 100% until it reaches soft ball stage, about 5 minutes.

To assemble

1.. Add the fruit and Van Der Hum and mix
2.. Using a wooden spoon, beat the until it begins to thicken
3.. Using a teaspoon, drop the mixture onto grease-proof paper, makes about 24 cookies. Allow them to harden completely.
4.. Sprinkle the cookies with coconut and cherries.
5.. Make a syrup with the castor sugar and water. Coat the cookies with the syrup. Store in an airtight container.

DRIED FRUIT WHEELS

Serves 8

Dough
230 gr Butter (250 ml)
225 cream cheese(225ml)
2 egg yolks
360 gr cake flour (750ml)
15 ml sugar
5 ml salt

Filling

240 gr dried fruit (600 ml)
100 gr pecans, chopped (250 ml)
100 gr brown sugar (125 ml)
5 ml ground cinnamon
5 ml vanilla essence
1 egg white
25 gr butter (30 ml)

1.. Cream together the butter, cream cheese and egg yolk
2.. Work the cream mixture into the flour, sugar and salt
3.. Mix to form a smooth dough
4.. Chill until very firm
5.. Divide dough into 16 portions, On a lightly floured board, roll 8 of the portions into circles 13 cm in diameter
6.. Line a 10 cm tart pan with the circles , pressing the dough firmly into the pan. Prick bottom and chill for at least 30 minutes.
7.. Bake in a preheated oven at 200 C for about 7 minutes. Allow to cool

Filling

1.. Combine the dried fruit and pecan nuts
2.. Mix the sugar, cinnamon and vanilla. Toss half the sugar mixture together with fruit and nuts. Set the remaining sugar aside.
3.. Roll the remaining dough portions into rectangles 1 cm thick. Cut rectangle strips 2.5 cm wide. Brush the strips with egg white and sprinkle with the remaining sugar.
4.. Top some of the strips with some of the fruit mixture and roll into spirals.
5.. Place spirals onto the partially baked tart shells. Dot with butter
6.. Bake in a preheated oven at 200 C for about 10 minutes

FLAKY APRICOT BALLS

Makes about 20

125 ml condensed milk
80 gr coconut (250ml)
200 gr dried apricot, roughly chopped (500ml)
100 gr castor sugar

1.. Mix all ingredients except castor sugar and form balls.
2.. Roll the balls in castor sugar

(Continued on page 8)

Gifts From The Sun

(Continued from page 7)

CHOCOLATE FRUIT BRANDIES

Serves 12-18
(If they can take it)

50 gr dates (75 ml)
50 gr prunes 75 ml)
25 ml Brandy (only)
2 ml lemon juice
15 ml chocolate vermicelli

1.. Grind dates and prunes
2.. Mix all the ingredients together except the vermicelli
3.. Form balls and roll in vermicelli
4.. Decorate with some cherries and chocolate leaves
5.. Store in an airtight container

RUM AND RAISIN ICE-CREAM

Serves 6

1x410 evaporated milk
250 ml cream
100 gr sugar (130 ml)
75 gr raisins (125 ml)
25 ml Rum (essence !!!)

1ml chocolate brown food colouring

1.. Whip the evaporated milk and cream separately until stiff. Combine.
2.. Add the sugar and beat until very stiff.
3.. Combine the raisins, rum essence and food colouring.
4.. Place in the freezer for one hour
5.. Remove and beat the mixture to break down the ice crystals. Freeze until firm

From: Dirk Beukman ZS6AU

Accountants and their daffynitions

(Continued from page 6)

Depreciation.
An accountant is having a hard time sleeping and goes to see his doctor.

"Doctor, I just can't get to sleep at night."

"Have you tried counting sheep?"

"That's the problem - I make a mistake and then spend three hours trying to find it"

Comprehending Accountants - Take One

Two accountancy students were walking across campus when one said,"Where did you get such a great bike?" The second accountant replied, "Well, I was walking along yesterday minding my own business when a beautiful woman rode up on this bike. She threw the bike to the ground, took off all her clothes and said, take what you want."

The second accountant nodded approvingly, "Good choice; the clothes probably wouldn't have fit."

Comprehending Accountants - Take Two

An architect, an artist and an accountant were discussing whether it was better to spend time with the wife or a mistress. The architect said he enjoyed time with his wife, building a solid foundation for an enduring relationship. The artist said he enjoyed time with his mistress, because of the passion and mystery he found there. The accountant said, "I like both." "Both?" The accountant replied "Yeah. If you have a wife and a mistress, they will each assume you are spending time with the other woman, and you can go to the office and get some work done."

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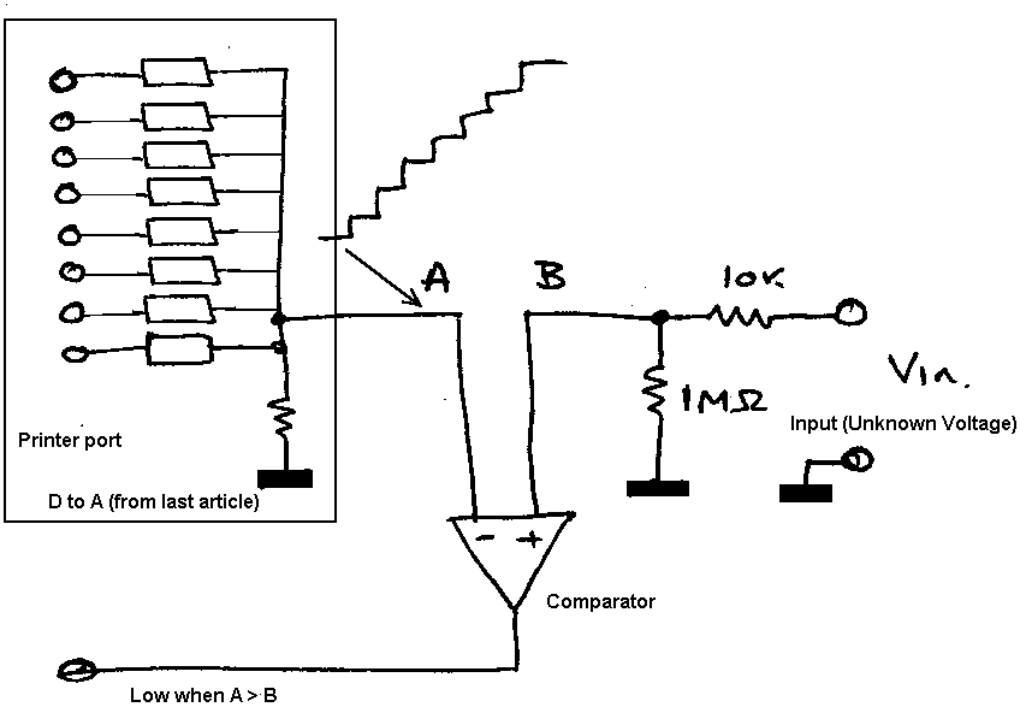
An A to D that hasn't been built in an afternoon

(Continued from page 1)

hancements are something that can come later.

To do this we need a comparator. This is similar to an Op Amp but is not designed for linear operation. Suitable types are the LM311 (single comparator) or the LM339 (quad comparator). If you haven't got either in your junk box you could use an Op Amp and hope that the output can switch low enough to be a '0' input on the printer port.



The idea here is to output a staircase waveform from the D to A and when the comparator switches from high to low, stop the count. This small piece of program code will then provide a count that represents the measured voltage.

This measured voltage could be stored and another count started to measure the unknown voltage. This would allow measurement of a varying voltage and with successive readings an average could be easily calculated in the program.

For example you could read a dc voltage obtained from a battery that was loaded and store the voltages that the battery gave over time. You could then see the discharge curve on screen and have the computer switch off the load at preset level.

More next month....

Accountants and their daffynitions

(Continued from page 8)

Comprehending Accountants - Take Three

To the optimist, the glass is half full.

To the pessimist, the glass is half empty.

To the accountant, the glass is twice as big as it needs to be.

The West Rand Amateur Radio Club
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Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

Frequencies
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

We are going on the Web
www.zs6wr.org.za

Please note this has been just been registered. Our site will be up in the new year.

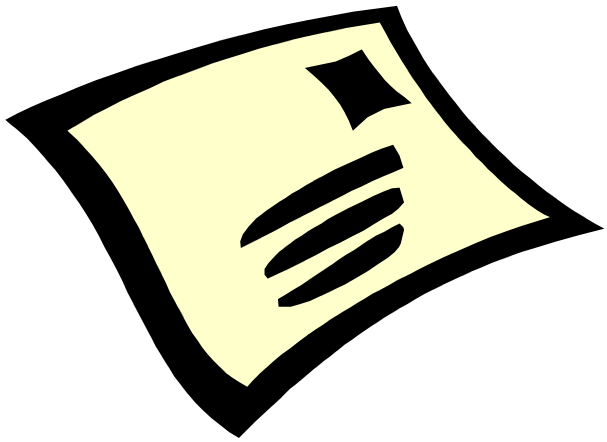
Chairman	Bill	ZS6REV	726 6807	---
Vice-Chairman	John		768 1626 (A/H)	john.brock@pixie.co.za
Treasurer	Dave	ZR6AOC	475 0566	david.cloete@za.unisys.com
Webmaster				
	Cobus	ZR6COB		support@feedemgrp.co.za
	John	ZS6FJ	672 4359 (A/H)	
	Keith	ZS6AGF	672 6745 (A/H)	mwbronie@iafrica.com
	Phillip	ZS6PVT		

West Rand members input - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In November, we published an Anode Compendium on CD. It has the issues from July 2000 until November this year. This included IE5.5 and the new Adobe reader.



We need your input! Email us articles, comments and suggestions please.
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