

# ANODE

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## New year brings new resolutions

### New equipment layout for the club station

There is a new station desk layout at the club. Please feel free to use these radios after the meetings.



### Boot Sale

There will be a Boot Sale on the 3rd of March.

### Morse Classes On Air

Morse classes are

### The new layout of the equipment

about to start. OM Henk will be doing them on Tuesdays. Re-broadcast of the bulletin also takes place on Tuesday. At the recent meeting

the question was asked; do we carry on with the re-broadcast and this was passed unanimously. Morse lessons should start around 19:00 and last until 20:00 hours with the bulletin afterwards. The first Morse lesson will be January 23rd.

### Web site

### developments

[www.zs6wr.org.za](http://www.zs6wr.org.za) is

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## Linear Voltage Controlled Oscillator

*A novel configuration which utilizes an i.c. transistor array and is capable of a linearity better than 1% per MHz*

The growing use of phase locked loop systems in applications such as very high quality fm. demodulators, in which a high degree of linearity between input frequency and output (control) voltage is sought, has focused attention on the characteristics of the available voltage controlled oscillators (v.c.os) - the linearity of the phase

locked loop is mainly determined by, and cannot be better than, that of the v.c.o. contained within it. However, although the availability of a very linear v.c.o. system would allow improvements to be made in phase locked loops built around it, the usefulness of a circuit arrangement having a linear voltage/frequency characteristic extends beyond this to such applications as r.f. telemetry, "wobblers", f.m. broadcast transmissions, and linear f.m.

signal generators

It is convenient in practice if the v.c.o. can be constructed using some form of multivibrator circuit in that this avoids the need for inductors, and, with a regard to the potential use of such a v.c.o. in an fm. tuner demodulator system with an i.f. of 10.7MHz, it is desirable that the controlled frequency range of the circuit should extend some way above this. In view of the small lead inductances and

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## Special points of interest:

- Contact details on back page

## Linear Voltage Controlled Oscillator

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stray capacitances which are demanded for satisfactory operation of any multivibrator circuit at these frequencies, it is helpful if the device can be constructed using some readily available high frequency linear integrated circuit, and the component arrangement has been chosen with this object in mind.

### Circuit development

A number of multivibrator arrangements can be adapted to operate in a voltage-controlled mode, but for optimum performance in high frequency applications, the non-saturating emitter-coupled systems are preferable. A suitable configuration for a free running square-wave generator is shown in Fig. 1

In this the operation of the circuit is to switch the current available from the constant current source backwards and for  $Tr_x$  and  $Tr_y$ . Resistor  $R_1$  is the collector load of  $Tr_2$ . When this transistor is conducting, the voltage drop across  $R$ , will always be constant and independent of the h.t. voltage supply, provided that this does not alter the output of the constant current source. This arrangement offers a high degree of intrinsic frequency stability and if  $C_T$  or  $R_2$  is made variable, the "base" frequency can be altered.

A practical system is shown in

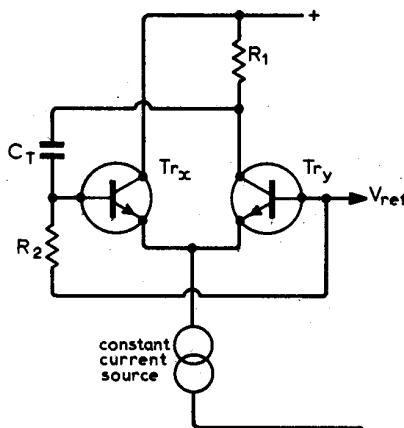


Fig. 1. Multivibrator configuration for a free running square-wave generator.

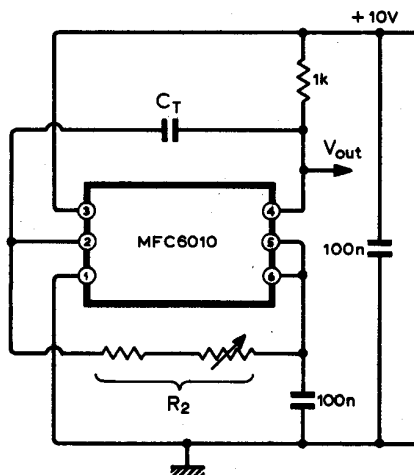


Fig. 2. Square-wave oscillator with a high long term stability. Operation is up to at least 20MHz.

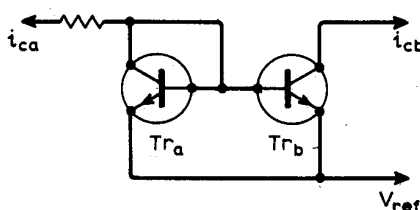


Fig. 3. "Current mimic" circuit which can be used to substitute the timing resistor,  $R_2$ , in Fig. 2.

Fig. 2, using a Motorola MFC6010 i.f. integrated circuit amplifier, which incorporates a long tailed pair, a constant current source and a reference

voltage point. With a stabilised h.t. supply, this circuit gives a high long term frequency stability, and will operate to at least 20MHz.

This circuit arrangement can be converted into a linear and stable voltage controlled oscillator by the substitution of a "current mimic" or "current mirror" circuit for the timing resistor  $R_2$  in Fig. 2.

### Current mimic operation

The circuit configuration shown in Fig. 3 is widely used in integrated circuit manufacture, as for example in the Motorola MC3401P to provide a non-inverting input on a Liniac type amplifier, or in the RCA CA3060/3080 micropower op-amps, to replace load resistors. Its attractiveness to the monolithic integrated circuit manufacturer arises from the ease with which identical pairs of transistors can be fabricated in this process.

If a given forward bias voltage is applied to the bases of an ideal identical pair of transistors, the same current will flow in the collector circuits of both. If, now, the bases of both of these transistors are joined to the collector of one of these  $Tr_a$ , and a certain current is drawn from this, this current will be the collector current of  $Tr_a$  plus the two base currents. Since the forward base potential of  $Tr_a$  has adjusted itself to the level required to produce the collec-

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# Linear Voltage Controlled Oscillator

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tor current of  $Tr_a$ , it will also have adjusted the base potential of  $Tr_b$  to produce the same collector current in  $Tr_b$ .

This will imply that the output "mirror" current of  $Tr_b$  will be the same as the current drawn from the input, less the two base current contributions. If the current gains of the transistors used are high enough, or if - as will be the case in integrated circuit manufacture - the areas of the transistor junctions are trimmed to suit, the two currents (the input current and the mirror current) will be very nearly identical, and this identity will hold good over a wide current and temperature range. Although this is an integrated arrangement, discrete transistors can be used if their characteristics are reasonably closely matched.

In several circuits of the type shown in Fig. 4, the transistors used in the mimic circuit were BC184s in which the base emitter forward voltage drop was matched by selection to about 10 mV at 50  $\mu$ A forward current (i.e., say 0.58V to 0.59V).

This is inconvenient, but not difficult if one has a voltmeter and six or eight similar transistors to choose from. Although BC184s were used, any other similar small signal silicon devices would serve

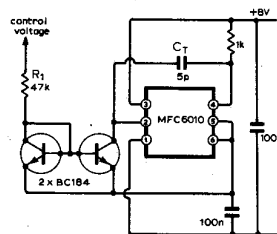


Fig. 4. Circuit of the v.c.o. using discrete transistors for the current mimic circuitry.

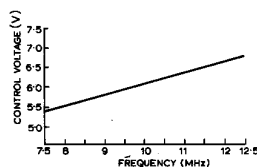


Fig. 5. Performance of the circuit shown in Fig. 4.

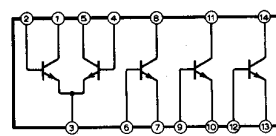


Fig. 6. Layout of transistors and pin connections for the i.c. transistor array contained in the RCA CA3046.

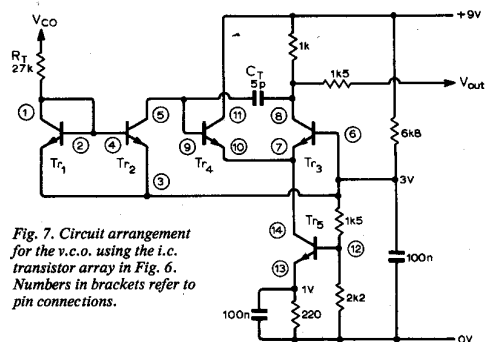


Fig. 7. Circuit arrangement for the v.c.o. using the i.c. transistor array in Fig. 6. Numbers in brackets refer to pin connections.

Fig. 8. Connections to the CA3046 which complete the circuit shown in Fig. 7. The view is from below.

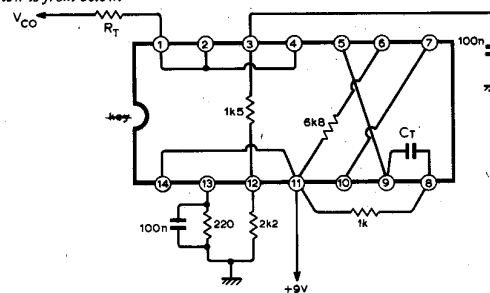
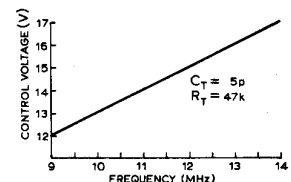


Fig. 9. Control characteristic of the v.c.o. in Fig. 7.



just as well.

The performance of the circuit shown in Fig. 4 is given in Fig. 5. The relationship between the control voltage and the frequency had a linearity better than 1% per MHz, and the frequency stability was as good as that of the author's signal generator during a six hour measurement period.

In view of this encouraging performance, a means was sought for avoiding the inconvenience of having to select a matched pair of "current mimic" transistors, without the expense involved

in the use of a matched-pair device. The solution was found in the use of an i.c. transistor array of the type contained in the RCA CA3046 (3086), of which the internal circuitry is shown in Fig. 6. In this particular case the array contains all the active components needed to make the v.c.o. circuit, including a matched pair of transistors. The circuit arrangement is in Fig. 7, for which the necessary interconnections across the base of the CA3046/86 are shown in Fig. 8.

The performance of this circuit  
(Continued on page 7)

## New year brings new resolutions

*(Continued from page 1)*

registered and now needs a home (a host server). I propose to place it temporarily on my web pages on Mweb. Please let me know what you would like to see on 'our' web site.

### Champagne breakfast with the 'Buffs'

We are invited to a Champagne Breakfast on Sunday the 18th of February. The time will be 9:30 for 10:00 18th Feb. It should only cost around R15 per head. Please let OM John (ZS6BZF) or OM Simon (ZR6SS)

to if you are interested in coming to the breakfast.

### Club projects

OM John (ZS6WL) is concerned that the club is not actually doing any electronic projects. He feels we are wasting our time as the committee if we don't organise a suitable project for the members to construct.

What do you think? Do you have any particular project in mind for your future spare time? Maybe the article on the

VCO in this Anode will trigger you off to designing that "wobbulator" for 20m antenna research.

*Editor at Large - John (ZS6BZF)*  
[john.brock@pixie.co.za](mailto:john.brock@pixie.co.za)



## Under the blue light - recent developments

*Blue L.E.D.s were rare but available at a price. Seeing this news recently reminded me of the 'April Issue' of a magazine some years ago which had the "Flame Emitting Diode" announcement. However blue light has some interesting properties.*

Recently announced blue lasers used inside of DVD drives are going to give about 22GB capacity (that's 22,000 Megabytes!) using the now standard 4.7GB writeable DVD media.

Hard disks are still growing in capacity. 20GB is fairly common in new pc's. 10GB is the smallest size available at the present. Capacities up to 75GB are available. It was predicted that we would see 100GB drives by the end of 2000. We may well see it by the end of this year.

Over the last few years, digital still cameras have improved in resolution. The current average camera can provide between 3 and 5 Megapixels. The charge coupled devices are slow and have to be read out in sequence to non-volatile memory. Announced late last year a new CMOS imaging sensor will provide 16.8 Million pixels. This will also mean a 'real-time' image display for view finding as the memory is the chip and transfer of the image takes milliseconds. Lower cost and about one eighth current drain will make this a winner for next years digital cameras.

## Are you 'computer literate' ?

This is a "true" story from the WordPerfect helpline. Needless to say the helpdesk employee was fired; however, he/she is currently suing the WordPerfect organization for "Unfair Dismissal".

Actual dialogue of a former WordPerfect Customer Support employee:

"Ridge Hall computer assistant; may I help you?"

"Yes, well, I'm having trouble with WordPerfect."

"What sort of trouble?"

"Well, I was just typing along, and all of a sudden the words went away."

## Another article

"Went away?"

"They disappeared."

"Hmm. So what does your screen look like now?"

"Nothing."

"Nothing?"

"It's blank; it won't accept anything when I type."

"Are you still in WordPerfect, or did you get out?"

"How do I tell?"

"Can you see the C: prompt on the screen?"

"What's a sea-prompt?"

"Never mind. Can you move the cursor around on the screen?"

"There isn't any cursor: I told you, it won't accept anything I type."

"Does your monitor have a power indicator?"

"What's a monitor?"

"It's the thing with the screen on it that looks like a TV. Does it have a little light that tells you when it's on?"

"I don't know."

"Well, then look on the back of the monitor and find where the power cord goes into it. Can you see that?"

"Yes, I think so."

"Great. Follow the cord to the plug, and tell me if it's plugged into the wall."

".....Yes, it is."

"When you were behind the monitor, did you notice that there were two cables plugged into the back of it, not just one?"

"No."

"Well, there are. I need you to look back there again and find the other cable."

"..... Okay, here it is."

"Follow it for me, and tell me if it's plugged securely into the back of your computer."

"I can't reach."

"Uh huh. Well, can you see if it is?"

"No."

"Even if you maybe put your knee on something and lean way over?"

"Oh, it's not because I don't have the right angle - it's because it's dark."

"Dark?"

"Yes -the office light is off, and the only light I have is coming in from the window."

"Well, turn on the office light then."

"I can't."

"No? Why not?"

"Because there's a power cut."

"A power... A power cut? Aha, Okay, we've got it licked now. Do you still have the boxes and manuals and packing stuff your computer came in?"

"Well, yes, I keep them in the closet."

"Good. Go get them, and unplug your system and pack it up just like it was when you got it. Then take it back to the store you bought it from."

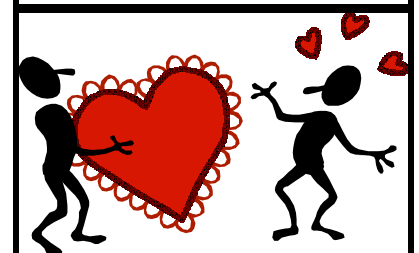
"Really? Is it that bad?"

"Yes, I'm afraid it is."

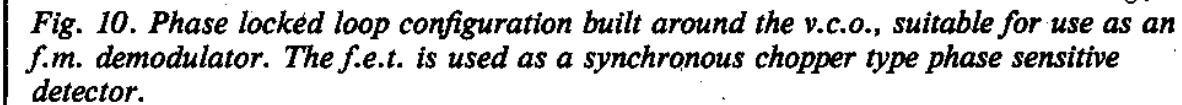
"Well, all right then, I suppose. What do I tell them?"

"Tell them you're too flaming stupid to own a computer."

Don't forget its  
Valentine's Day on  
the 14th



Age Group	Total	Male	Female	Male	Female
18-24	15%	12%	18%	10%	25%
25-34	25%	22%	28%	15%	35%
35-44	30%	28%	32%	20%	40%
45-54	20%	18%	22%	12%	30%
55-64	10%	8%	12%	5%	15%
65+	5%	3%	7%	2%	10%



## Farewell Stephen!

*Saturday before last we held a very quickly organised braai for OM Stephen and Charmaine and family, who had just got his immigration papers for the USA.*

*The braai was extremely well attended and the car park was full to capacity.*

*Whilst we are sorry to see him go, we wish them well in their new life in the US.*



**Stephen (on left) at the braai**

## Linear Voltage Controlled Oscillator

*(Continued from page 3)*  
cuit for a timing capacitor of 5pF, and with the other values as indicated, is shown in Fig. 9. The linearity of this arrangement is as good as that of the circuit in Fig. 4., but the long term stability of the Fig. 4 circuit is slightly better. Several CA3046 units were tried and gave identical free running operating frequencies.

### Typical applications

A simple phase locked loop configuration built around this v.c.o. and suitable for use as a high quality fm. demodulator, using a f.e.t. as a synchronous chopper type phase sensitive detector, is shown in Fig. 10. An amplitude limited input r.f. signal, of nominal 10.7MHz frequency, and of about 500mV

amplitude is desirable for correct operation of the system. The output a.f. signal will be about 20mV for 75kHz deviation, with a second harmonic distortion content of about 0.07%.

An arrangement usable as a low distortion frequency modulated signal generator if a suitable low distortion sine-wave modulation signal, is applied, or as a "wobbulator" if a sawtooth input signal is provided, is shown in Fig.11. Increasing the capacitance of the timing capacitor will provide a proportional reduction in operating frequency, allowing the system to be used, if required, down to audio frequencies, as a voltage controlled oscillator in electronic organ and similar applications.

As a final provocative thought, since it is possible to build voltage controlled oscillators (and phase locked loop demodulator systems containing these) whose linearity, over the 75kHz bandwidth normally used for fm. transmissions, is better than 0.1%, by some margin, is not the ball now in the court of the broadcasting authorities to take note of this, and improve their fm. transmission quality?

From Wireless World, November 1973 p567

By J. L. Linsley Hood

*These circuits could be used to form the basis of quite a few useful gadgets for the radio amateur. Please let the editor know if you use them in any application.*



## The West Rand Amateur Radio Club

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Email: [john.brock@pixie.co.za](mailto:john.brock@pixie.co.za)

## 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!



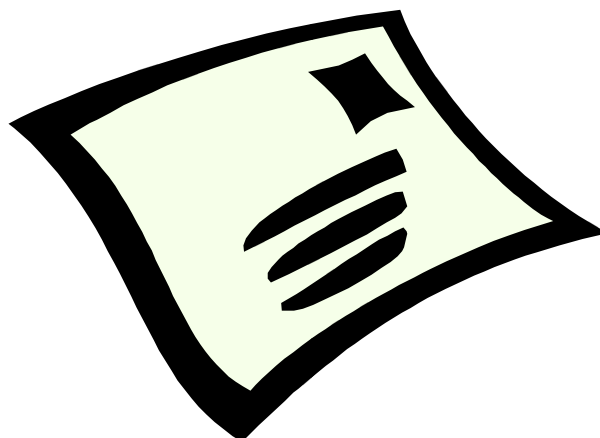
Please note this has been just been registered. Our site will be up in the new year.

Chairman	Bill	ZS6REV	726 6892	---
Vice-Chairman	John	ZS6BZF	768 1626 (A/H)	<a href="mailto:john.brock@pixie.co.za">john.brock@pixie.co.za</a>
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## 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.



**We need your input! Email us articles, comments and suggestions please.**  
[john.brock@pixie.co.za](mailto:john.brock@pixie.co.za)