October 2008
Volume 9, Issue 4

ANODE

Inside this issue:

Special points of interest:

- Contact details on back page (corrected & updated)
- Ham-Comp Latest on web site.

Editor's Comments

Volume 9 Issue 4
October 2008

"Ham radio is Alive!
Ham Radio is Homebrew Radio!"
http://www.qrpproject.de/UK/indexuk.html
Check the page out, it has all sorts of nice projects that you can build.

This Sunday is the Anode day, when I get to "do" the Anode. Its usually intensive as I get to read the correspondence and correct all the past mistakes I have made. It also is the day when I realise the Agendas are going to be needed for the committee meeting and the main club meeting.

These agendas should not be a long list of points. As the time is brief for discussion and decisions. Perhaps we should have the committee meeting before the 'Bring and Fix' meeting to give us more time for discussion. If we over-run into the social meeting, the input we get from members might be more relevant as well.

I am not sure about having the agendas and other club material on the web-site. Maybe we could discuss this at the main meeting.

I did manage to "listen" to the bulletin...

Ham-Comp Latest

As the last meeting was well attended and I did not have enough copies of circuit diagrams etc., I have put a complete new set of pages detailing the club projects onto the site. If you look on the main club's page, you will see a link to the Ham-Comp latest. Here's the link:-

http://www.jbcs.co.za/ham_radio/hc_and_ee.php

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Local "spam" gets members together

If a member wishes to email everyone who is a member, he can get the list from the web site. The subsequent email "transmission" might be a problem as no email client does one-off email sending. This might be called "Member Bulletins" and could be a useful addition to our club web activities.

This all started because Phillip wanted to send out an email to all the members. In the old days we would do a mail-merge and personalise the fax or snail-mailed letter.

The club's database

Our database of past and present members now contains the email addresses of the majority of the members. This information needs to update the distribution list of the Anode and member bulletins etc. on a regular basis. We also need to keep it

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"behind the curtain" [login access], as it could be "trawled" for email addresses and sold to unscrupulous others.

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Distributing the Anode and Member bulletins.

The distribution of emails is an ever present problem for any club or collective activity. Previously I used my Telkom account and immediately ran into problems. The hijacking of the Telkom servers in the past and recently, has meant that there are many restrictions on isp 'customers'. The maximum number of recipients is a maximum of only three (3). When this was made apparent to me, I used my Google mail account and managed to send out the Anode with no restrictions. I have done so ever since.

The email 'transmitter' is Outlook Express as this is my 'secondary' email client. I use Thunderbird as my primary email client as it provides excellent spam control and general facilities. Neither is suited to 'distribution list' operation as the 'Address Book' functions are not databases or easy to import and export recipients.

Not too many members have a 'spare' PC to do the distributing of emails. I don't usually but I think this is now something I must look at for the Club. Bear in mind that our club PC (Linux) can act as a full email server and can distribute emails and attachments via WiFi.

The facility of 'bulk' emailing for just the club members or 'chat' facility, can be put onto the web site. Would you (the members) use such a facility? In a similar manner, a 'blog' facility could be put onto the club's web site. But most of the members are still on dial-up type connections to the Internet. So the speed would be very erratic and probably very slow. ZS6GRL, OM Geoff and I have used the 'chat' facility on Google. With very pleasing results and high speed.

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Ubuntu Release 8.1

Its now a couple of years since I tried a Ubuntu installation. So I was very pleasantly surprised by the latest download. It installed easily from the ISO image I downloaded from the South African site. Remember that this is Mark Shuttleworth's company that puts this Linux distribution out onto the Internet. The update facility also automatically downloaded all the patches via my Internet connection. I was also able to download and install the Thunderbird email client as well. It also has a full installation of OpenOffice as well that works cross-platform as well as cross-office suites. It will even open MS Word 2 documents.

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Morse "Receive Software"

Searching for this on Google only gave 232 hits. Which is a puzzle because I thought the function was an easy one. So the original software program demonstrated at the club house is now also provided on the web site. [see Ham-Comp Latest above]

I think I will be putting the revised BASIC program up there later this week for download and trial. Also I intend putting some other programs of interest there. So keep an eye on the Ham-Comp pages.

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JB 2008-10

Variable frequency oscillator for the amateur

A phase lock loop design using discrete components.

[This novel approach provides stability by using a low-frequency control oscillator. In this design an 800 kHz v.f.o. is used to control a 72 MHz v.c.o., the resulting error in stability being only ten times that of the 800 kHz oscillator.]

The need for a flexible, stable and variable frequency source for use in a transmitter or receiver local oscillator in an amateur band station has never been more evident that at the present time. The approach of generating a 70 MHz carrier facilitates operation on 144 and 432 MHz by multiplication, and by using a v.h.f. local-oscillator receivers of high performance and single conversion are possible.

A useful way of generating stable high-frequency signals which are frequency agile is to arrange a lower-frequency oscillator to control a higher one such that the latter assumes the stability of the former. By phase comparison it is possible to derive a controlling element which when applied to the high-frequency oscillator, via a feedback loop, performs this function. It is relatively easy to achieve a high order of stability in a v.f.o. at a low frequency but it is not so straightforward when the frequency approaches the megahertz region. It is true that with due care the problem is not so awesome; nevertheless if the frequency is kept below the MHz region repeatability of results is assured, particularly when the constructor has limited time and equipment.

Oscillator

Reference to Fig. 1 will show how locking is achieved. A sample of the 72 MHz signal is mixed down to 9.29 MHz with a quartz crystal local oscillator. This signal is then amplified and squared through a digital comparator before being divided down in a decade counter. The resulting 929 kHz signal is then applied to one input of an exclusive OR gate employed as a comparator. The other input is supplied with the v.f.o. signal via the same type of digital comparator to bring it up to the logic levels. The output of the gate is proportional to the phase difference between the two signals and after filtering, to obtain only 'the d.c. component, this voltage is applied to the v.c.o. to maintain an in-phase signal with that of the v.f.o. Any drift in the crystal oscillator is also compensated for in the v.c.o. because it will always try to maintain a zero phase shift with the v.f.o.

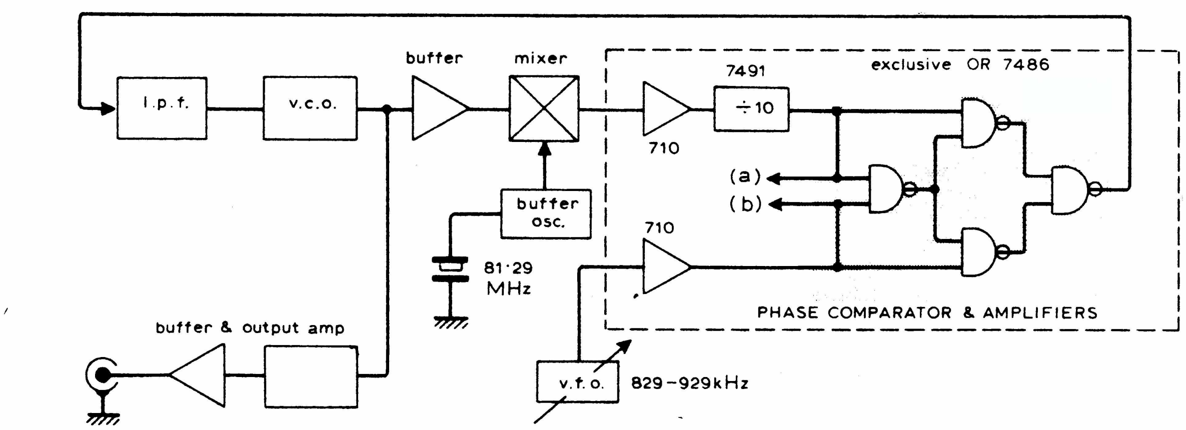

Fig. 1. Block diagram illustrating how phase locking is achieved.

The output at 72 MHz is first fed to a buffer and

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Variable frequency oscillator for the amateur

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then to a frequency doubler, because in this application it was desired to produce a signal in the 144 MHz band. Since the intermediate frequency is divided by ten in the decade counter, variation of the 800 kHz v.f.o. is effectively multiplied by ten. For a one megahertz covering at 72 MHz the 800 kHz v.f.o. needs to tune only over 100 kHz. Clearly drift of the v.f.o. will also be multiplied by ten at this output frequency, but it is relatively easy to construct a stable oscillator at 800 kHz and a suitable design is included. To avoid problems of modulating the 72 MHz signal with either the 63.71 MHz crystal oscillator or the 8.29 to 9.29 MHz i. f. being generated it is necessary to ensure high isolation between the mixer and the output stages. Therefore, one must be very careful with layout and avoid any urges to economise with the buffering. Whether the application be a transmitter v.f.o. or a receiver local oscillator cleanness in the output spectrum is essential. One could simplify the buffering circuit but it is not everyone who has a spectrum analyser necessary to set up the unit if the full circuit is not employed. All that is required in setting up the v.f.o. is a grid dip oscillator and a receiver.

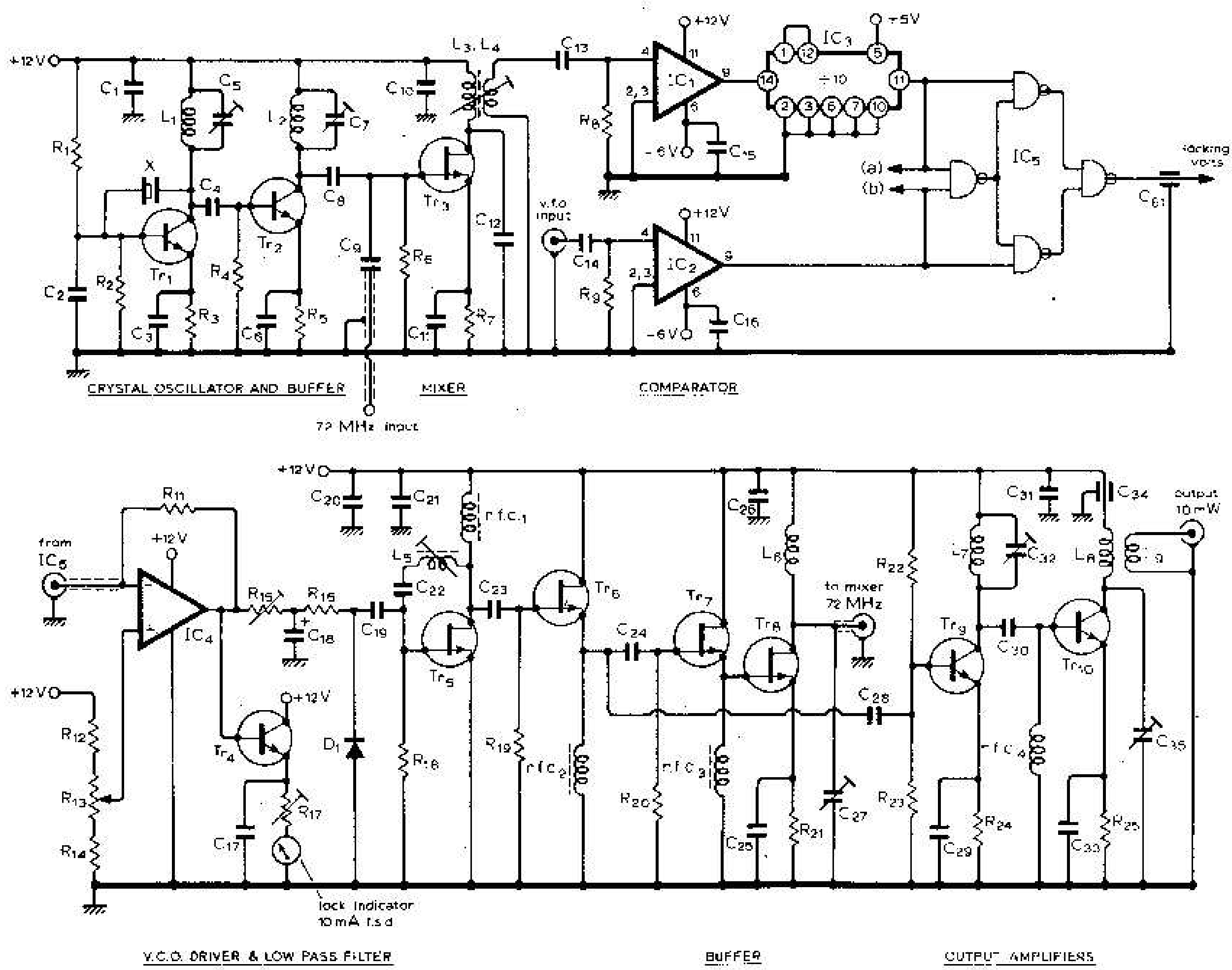

Fig. 2. V.f.o. circuit, divided into two parts for mounting on separate boards as shown in Fig. 4 and 5.

Circuit units

The crystal oscillator uses an available unit and

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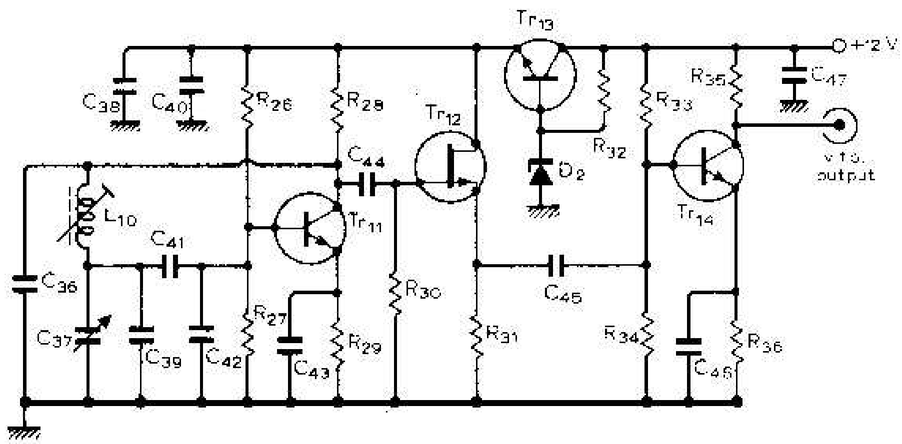
is intended for fundamental operation at 63.71 MHz. See Fig. 2. One could use a lower-frequency unit with the appropriate multiplier chain provided suitable filtering was employed before the mixer, but if one is starting from scratch then it is nearly as cheap to use a 60 MHz crystal rather than a lower-frequency one. The oscillator is straightforward - the tuned collector resonates at the fundamental frequency and the class B buffer stage provides the correct injection for the mixer with the additional filtering of its tuned-circuit.

The mixer consists of a gate injected f.e.t., the tuned circuit in the drain being broadly resonant over 8 to 9 MHz, providing a load for the i.f. signal. The transformer coupled output is then fed into the SN72710 comparator which squares and amplifies the signal prior to the decade counter which consists of a SN.7490.

The SN7486 gate performs the comparison of the i.f. signal and the v.f.o. The comparator circuit has proved very useful in practice because the SN72710 devices have a bandwidth up to 30 MHz and are insensitive to input level changes above a threshold of around 10 mV. One practical point to note however is that since the outputs of the gates are square waves, screening of the computer output before it reaches the amplifier and low-pass filter is essential otherwise there may be unwanted signals in the station receiver.

To obtain the required swing from the v.c.o. it is necessary to amplify the voltage from the 7400 output. This is conveniently achieved with an operational amplifier whose output is filtered with the network R15 - C18, which is the low-pass filter. The variable resistor on the non-inverting input of the 741 provides for initial setting of the output voltage, while R 16 provides a high impedance to the tuning diode and the v.c.o. but does not upset the d.c. bias to the tuning diode because there is very little current needed in this configuration. The diode (D,) suggested allows sufficient swing in capacitance at 70 MHz to provide a 1 MHz change in output frequency with the voltage applied. It is possible to use a 1N916 variety and achieve similar results but with reduced capacitance swing and hence frequency variation. This is because C19 has to be increased in value to allow the Vackar oscillator to oscillate with the lower Q factor of this type of diode. However, if a smaller swing in frequency can be tolerated this approach is possible.

Fig. 3. Stable Vackar type variable low-frequency oscillator tuning between 829 and 929kHz.



The output of the oscillator is split two ways: one path goes to a source follower whose output is fed to two more buffers before the mixer; the other path goes to the output amplifier chain.

Variations in the circuit of the output chain are unlimited and one design is shown in Fig.2. Transistor Tr9 is a buffer followed by a doubler

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arrangement providing about 10 dBm output power into 50 ohms which is sufficient to drive most class C stages.

Variable frequency oscillator

The oscillator shown in Fig. 3 has proved very stable and trouble free. The basic circuit is a Vackar type and by using the type of capacitors suggested no trouble should be experienced with drift and stability provided the oscillator is mounted in a good insulated box, preferably filled with polyurethane foam. The output is buffered with a source follower and amplified for injection into the comparator with Tr13. A series voltage regulator is used to supply the oscillator and buffer as this was found to be superior to just supplying the oscillator. With the components indicated a swing of around 100 kHz is produced over the frequency desired.

Construction

Suggested printed circuit layouts are shown in Fig. 4 and 5. It is convenient to make the v.f.o. unit on two boards each housed separately, one containing the phase lock circuitry and the other the v.c.o. and buffers. A separate box for the low-frequency controlling oscillator, tuning dial and drive is also required.

The use of double sided p.c.b is advisable (component side etched to form an earth plane as shown in Fig. 4 and 5) because this facilitates easy earthing of components and good screening. Components are non critical (if the p.c. layout is used components of the correct size must be employed). Do not forget to join both sides of the board with links in the several indicated place's to avoid instability caused by the earth plane floating up at an r.f. potential. Adequate decoupling of the control voltage is essential as any r.f. reaching the v.c.o. at this point will cause weird and wonderful effects. Because the logic requires five volts it is necessary to use a separate supply for this, not just a zener dropper. It is easy for the supply rail to be modulated with logic pulses, so this must be decoupled efficiently.

The original low-frequency v.f.o. was constructed in a die cast box, measuring two inches deep. This allowed the p.c.b. to be mounted in the centre of the box while the rest of the volume was filled with foam as suggested to produce a stable chamber.

Alignment and testing

First ensure that the crystal oscillator is working by resonating the coils with a grid dip oscillator or simply rotate the variable capacitor C5 until a signal is produced. Peak the output of Tr2 by monitoring the strength of the signal on a g.d.o.

Next with no input on the 741 from the NAND gate, adjust R13 until the voltage at the output is roughly 4V positive. Leave R15 at about 1k0 and adjust L5 until a signal is obtained* at roughly 72.5 MHz, the frequency does not have to be accurate. Next adjust the voltage on the opamp to + 4V if it has moved, and readjust L5. The signal should be reasonably stable and not microphonic. Disconnect C21 from the f.e.t. buffer. Connect the output of Tr8 to C9 in the mixer, setting C27 half way. After checking that the v. c.o. will swing over at least 1 MHz between 0 and 12V on adjusting R131 monitor the voltage at the output pin of IC 1.

Adjust L3 until the voltage registers 1.5 to 2.0V, indicating that it is squaring the i.f. signal. Swing the v.c.o. over the required range and ensure that it is still squaring by adjusting L3 as necessary. If there is difficulty with this, increase L4 with a few more turns. Slight adjustment of C27, which should be almost set, may improve mixing at the edges of the coverage.

Next check that the v.c.o. is tuning over the cor-

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rect frequency range 829-929 kHz and apply it to IC2 making sure that this is squaring. Setting this to 880 kHz (mid-band) and the control voltage on IC4 to about 6V tune L5 to produce an output at 72.5 MHz, this should be easily receivable using a small wire placed on the bench. Connecting IC5 output to the input of IC4, and adjusting R13 will produce a lock condition which can be recognized because the pot is being turned and the meter is not moving.

forward Tr9 being tuned to 72 MHz and Tr10 to 144 MHz.

Check that all is well by tuning plus and minus the carrier 8 to 9 MHz and adjust C77 and C27 for minimum signal if necessary.

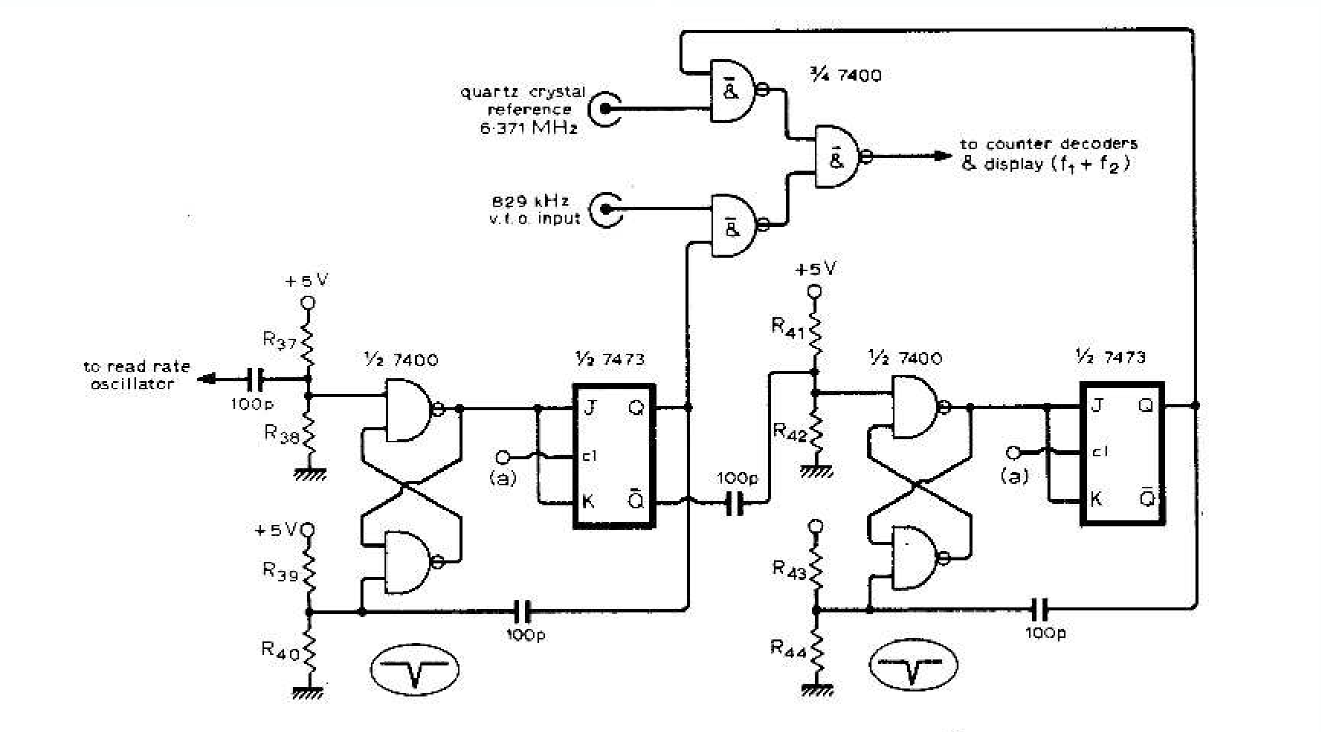

Fig. 7. Frequency-addition circuit to display output frequency – the read rate oscillator in the counter is routed into the cross coupled gates, the output is transferred to input gate only when the gating pulse is present. The output pulse of the 7473 sets a second pair of cross coupled gates which load a further 7473 flip-flop whose output is only present after the gating pulse at the clock input. Provided the counter is not reset in this period the display will show the sum of the two input frequencies.

Adjusting C37 in the v.f.o. will cause the meter needle to move up and down depending on which direction the frequency is being moved. The loop bandwidth is lowered with R15 until a clean signal is produced which has no amplitude modulation. Too much resistance will produce a long lock-in time and this should be set to around midway for best results, although there is no reason why it should not be set higher. Tuning of the output stages is straight

Using the v.f.o.

Lock should be obtained on switch-on or as soon as the low-frequency reference oscillator is present at the comparator input. The loop bandwidth of the filter is approximately 1 kHz and therefore the locking time is 1 mSec. The meter being driven from the operational amplifier output serves to indicate that the v.c.o. is tracking

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with the 800 kHz v.f.o. A more elegant way of doing this is shown in Fig. 6. Although this system is not foolproof it could be used to good effect.

If the v.f.o. is to be used in a transmitter then some means of measuring the output frequency will be needed. If one has a direct reading frequency counter at the output there is no problem. Nevertheless it is possible to use a lower-frequency counter indirectly. For example one method is to measure the 829 kHz v.f.o. frequency and add to this, in the counter, the difference between this and the output. frequency. An output frequency of 72 MHz corresponds to a frequency of 829 kHz in the v.f.o., if this is stored in a counter and a frequency of 6.37 MHz is injected, from a crystal oscillator, before the counter is reset. The true 72 MHz output frequency will result. A possible modification to some frequency counters is shown in Fig. 7.

Depending on the frequency at which it is desired to radiate, buffering and frequency selective stages must be incorporated at the output before it is used with an aerial system. The output stage as it stands produces a component at 144 MHz, approximately 18 dB stronger than the 72 MHz component, and was intended for the first in a chain of class C stages. Frequency modulation is easily applied to the v.c.o. by introducing a few milliVolts onto the tuning diode. Care should be taken with screening however if this is tried.

by I. J. Dilworth, B.Sc.,
Department of Electrical Engineering Science,
University of Essex

Taken from Wireless World, September 1975

Resistors all 1/4W unless marked

1	15k
2	6.8k
3	270
4	6.8k
5	220
6	100k
7	2.2k
8	10k
9	10k
11	270k
12	1.8k
13	1000 linear
14	820
15	50k linear miniature skeleton
16	270k
17	10k linear miniature skeleton
18	100k
19	1M
20	1M
21	1k
22	10k
23	2.7k
24	220
25	220
26	22k
27	10k
28	4.7k
29	3.3k
30	1M
31	2.2k
32	220
33	100k
34	33k
35	3.3k
36	1.5k
37	5.6k
45	470
46	330
47	3.3k
48	470
49	4.7k
50	680
51	1k
52	1k
53	1k linear miniature skeleton
54	5.6k
55	2.7k
56	1k linear miniature skeleton
57	10k
58	220 Ohms 1/2W

Capacitors

1	0.1 disc ceramic
2	10pF ceramic
3	0.01uF disc ceramic
4	10pF ceramic
5	4-2pF variable Mullard 808

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6 0.01uF disc ceramic
7 4 to 20pF variable Mullard 808
8 15pF silver mica
9 2pF ceramic
10 0.1uF disc ceramic
11 0.01uF disc ceramic
12 6.8pF tantalum
13 0.001uF disc
14 0.001uF disc
15 0.1uF disc ceramic
16 0.1uF disc ceramic
17 0.1uF disc ceramic
18 6.4uF 10V
19 1.8pF silver mica
20 0.1uF disc ceramic
21 0.001uF disc ceramic
22 10pF ceramic
23 10pF ceramic
24 10pF ceramic
25 0.01uF disc ceramic
26 0.1uF disc ceramic
27 4 to 20pF variable 808
28 10pF ceramic
29 0.01uF disc ceramic
30 18pF
31 0.1uF disc ceramic
32 4 to 20pF Mullard 808
33 0.47uF paper
34 0.001uF feed-through
35 4 to 20pF Mullard 808
36 1500pF polyester
37 100pF Air spaced
38 0.1uF disc ceramic
39 180pF silver mica
40 0.001uF disc
41 100pF silver mica
42 1500pF polyester
43 0.1uF disc ceramic
44 50pF silver mica
45 50pF silver mica
46 0.1uF disc ceramic
47 0.1uF disc ceramic
48 0.47uF paper
49 100uF 40V electrolytic
50 250uF 25V
51 0.47uF paper
52 100uF 15V
53 0.47uF paper
54 1000uF 5V
55 0.1uF disc ceramic
56 1000uF 40V electrolytic
57 250uF 25V
58 0.1uF disc ceramic
59 100uF 15V
60 0.1uF disc ceramic
61 0.001uF feed through

Coils and chokes L
All r.f.cs are Radiospares 1 amp types
1 10 turns 1/4in 0.d. 22 s.w.g. airspaced
2 9 turns 1/4in 0.d. 22 s.w.g. airspaced
3 30 turns on Aladdin pot cored former 28 s.w.g.
4 15 turns in centre of former
5 7 turns 22 s.w.g. on Aladdin F804 former slug tuned
6 6 turns 22 s.w.g. 1/4in airspaced
7 8 turns 22 s.w.g. airspaced 1/4in 0.d.
8 4 turns 22 s.w.g. airspaced 1/4in 0.d.
9 1 turn pushed into L8 insulated 22 s.w.g.
10 100 turns pile wound on slug tuned %in former

Crystal 63.71MHz overtone. HCHU

Transistors Tr
1, 2, 9, 10 ME3002
3, 5, 6, 7, 8, 12 2N3819
4, 11, 13, 14, 15, 16, 18 BC 109
17, 19 2N3055
20,21 ZTX500

Diodes D
1 MV1650 (Motorola)
2 5.6V 200mW zener
3 8.2V 20mW zener
4 5.6V 200mW zener
5 3.3V 200mW zener
6 to 9 diode bridge 1A 100V p.i.v.

Integrated circuits IC
1, 2 SN72710
3 SN7490
4 741
5 SN7486

The West Rand Amateur Radio Club
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KG33XU 26.14122 South - 27.91870 East

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Roodepoort
1725

Phone: **082 342 3280** (Chairman)
Email: **zs6wr.club@gmail.com**
Web page: www.jbcs.co.za/ham_radio

Bulletins (Sundays at …)
11h15 Start of call in of stations
11h30 Main bulletin start

Frequencies
439.000MHz 7.6MHz split
Input: 431.4MHz (West Rand Repeater)
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

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West Rand members - 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 July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June 2005. This included the new Adobe reader. It has been updated, check with the chairman for details.

We need your input! Email us articles, comments and suggestions please. zs6wr.club@gmail.com