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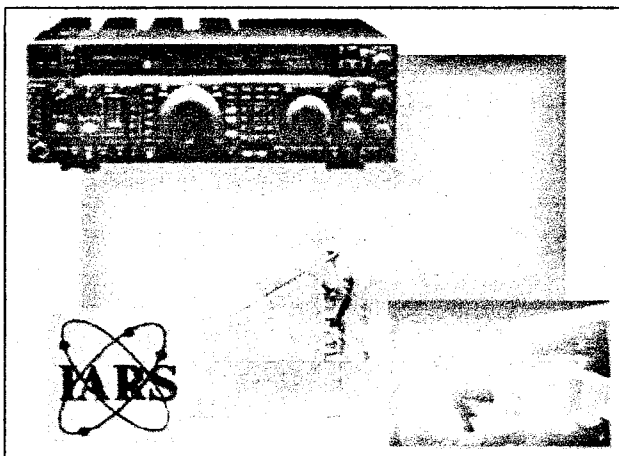
The Propagator



Official Newsletter of the Illawarra Amateur Radio Society
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IARS meets at 19:30 Hrs. on the second Tuesday of each month (except January) in the SES LHQ Montague St. North Wollongong.

VK2AMW Since 1948

IARS PO Box 1838 Wollongong 2500.

Direct Digital Synthesis

I had noticed the subject of these notes in the advertising blurbs for Yaesu equipment in the Dick Smith catalogue.

Curiosity got me interested in exactly what this was and the opportunity to be teaching a technical class on oscillators gave good reason to chase the matter up. I will say I was somewhat disappointed with results of Internet searches with one "basic tutorial" on the subject being unnecessarily complex and demoralizing to read.

The technique is in fact some thirty or so years old and with the advent of faster semiconductor memories and other devices has more recently (last ten or so years) become an economic proposition.

Direct Digital Synthesis (DDS) provides the opportunity for very fine tuning increments (eg 1 Hz) over large bandwidths (eg 500 MHz). Such would be astronomically expensive to attempt with crystals alone, and phase lock loops with comparable specifications would also be quite costly. DDS finds ready application in many finely tuned, wide bandwidth areas such as multiband amateur work and wideband RF testsets. DDS is very fast at changing frequency and so it finds another application in "frequency agile" systems (ie the frequency rapidly changes) as used in military frequency hopping radio systems, and now more commonly with the mobile phone CDMA (code division multiple access) systems.

So then, what is DDS. The principle, of which I wish to outline, is in fact very simple. DDS consists of four main sections which are
1. Clock
2. Phase Accumulator
3. Waveform Map
4. Digital to analogue converter and low pass filter.

In fact, I find these names a little "over the top" as it already seems to be overly complex, which, in principle, it is not. Let us approach each section in turn, to see what each does, and then attempt to knit the whole lot together.

First, the clock. This is a digital signal source where digital signals, high and low, are produced at a regular rate. A 555 timer can be configured as a clock, as one of its two main circuits (the clock is the 555 in "astable" mode).

Second, the phase accumulator. This is a fancy name (given its application in DDS) for a counter circuit. A counter circuit is able to measure how many high-low or low-high transitions a digital signal source makes. In this application, the phase accumulator will increment say by one, or perhaps two, three etc each time there is a transition in the clock, a little different to normal counting, though nothing startling.

Third, the waveform map. This is a bank of semiconductor memory. Each memory address stores bits of data that correspond to values of amplitude in a desired waveform (often a sine wave).

Fourth, the digital to analogue converter and filter. This takes the digital values from the waveform map and converts these to an analog signal. Digital to analog conversion results in analog waveforms that have digitized steps in them. A filter will remove those digitizing steps and leave a smooth desired waveform.

To knit these four elements together, let us assume we have a "three bit" phase accumulator. Hence the phase accumulator will have a count of 0,1,2,3,4,5,6,7 (for three bits). This will enable the principle of DDS to be more readily digested.

Now the clock outputs a digital signal at a constant rate. The phase accumulator monitors this clock signal and will increment by a rate determined by whoever set the system up. Let us increment by 1. The phase accumulator progressively moves through a count of 0,1 etc to 7 and then repeats. As each count occurs, the value held by the phase accumulator is passed as a memory address to the waveform map. So the phase accumulator holds a count of 1, therefore memory location 1 is "opened". As the phase accumulator increments, the next count is 2, therefore memory location 2 is "opened".

And so the process continues in a repetitive cycle.

Now the contents of each memory address is, say, a digital representation of the value of a part of a sine wave. So memory address 0 might contain a value of 0 corresponding to the sine of 0 degrees. In dividing a sine wave up into 8 parts, we might recognize that the value of every 45 degrees is held. So memory location 1 might contain a value of 0.707 equivalent to the sine of 45 degrees. Memory location 2, holds a value of 1 for sin 90, and memory location 3 holds a value of 0.707 again since sin 135 = 0.707.

The memory address and the value held therein for a 3 bit system would be as follows:-

memory address	address contents	comment
0	0	sin 0°
1	0.707	sin 45°
2	1	sin 90°
3	0.707	sin 135°
4	0	sin 180°
5	-0.707	sin 225°
6	-1	sin 270°
7	-0.707	sin 315°

Recycling after address 7 of course brings us to 360° or 0° (same thing isn't it!).

Don't forget that the memory contains *digital equivalents* to the values given in the address contents column above. The memory address contents are passed to a digital to analog converter which does the job of synthesizing a signal.

What appears at the digital to analog converter output if we increment the phase accumulator by 1? We commence to synthesize a sine wave. The waveform will have steps in it because of the digital to analog conversion process. A filter will remove the step edges resulting in a smooth sine waveform. The converter output before filtering is shown below.

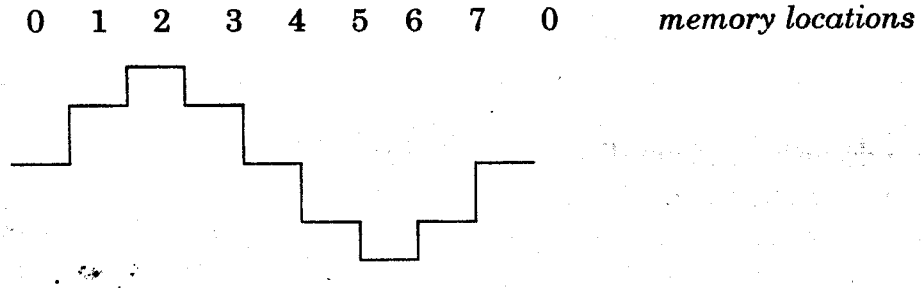


Figure 1. Digital to Analog output with a phase increment of 1

The memory locations on the diagram above show the locations that store the values that appearing.

If we now increment the phase accumulator by 2, we will *double* the frequency at the converter output. The following diagram illustrates how only every second memory address is accessed.

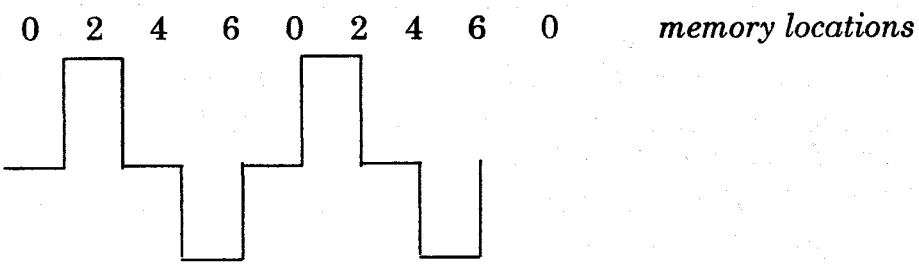


Figure 2. Digital to Analog output with a phase increment of 2

If we now increment the phase accumulator by 3, we will now have a signal as in the following diagram.

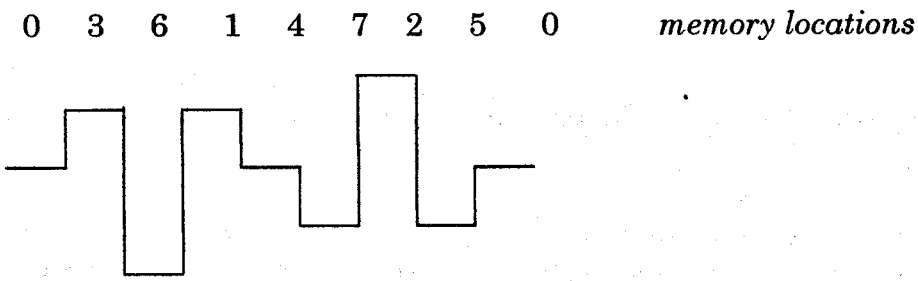


Figure 3. Digital to Analog output with a phase increment of 3

Not immediately obvious in the above is the fundamental frequency which is desired. It is in there and it is somewhat higher than for a phase increment of 2.

We cannot increment any faster than a count of 3 in our three bit example because a count of 4 would, if you refer to our table of the waveform map, simply cycle between sin 0 and sin 180 which are both 0!

So there you have it or "there we be" as some say.
What then do the "professional" systems have that our example doesn't?

Large bandwidths and small increments are achieved with sufficient clock speeds and very particularly, large count phase accumulators. A single cycle sine wave might be described by thousands of points. Each point is defined in the thousands of memory locations required to store it which are addressed in turn by the aforementioned large count accumulators.

The count sequence can be far more complex. In our simple example, other count sequences are possible such as counting 0 to 6 and skipping 7. This gives a higher fundamental frequency. With the typically far more voluminous memory map, many different count sequences yielding many frequecies of signal are possible.

DDS only became economically possible with the advent of vast amounts of fast semiconductor memory.
73's
Vaughan Williamson VK2KBI

IRLP

I will attempt to give a brief introduction to the IRLP system, as I understand it. In no way am I an authority on the subject, but I share what knowledge I have. In preparing this article I hope to increase my understanding and stimulate a desire in others to find out more on this interesting, and highly innovative development in the world of amateur radio.

IRLP stands for Internet Radio Linking Project. Briefly the aim of this project is to link radio systems separated by long distance. The system uses its own custom interface board and software suit, which allows the interfacing of our radio system (repeater network repeater) to the world. The IRLP runs a network of dedicated services and nodes giving excellent voice communications.
The heart of the IRLP system is its Amateur Radio network which reaches hundreds of towns and cities across Canada, the USA, Australia, New Zealand, UK and one in the Antarctica, linking them all with a full dynamic range, telephone quality sound reception. The system of radio net works mainly operates on VHF or UHF, depending on the local situation.

The aim of the Internet Radio Linking Project is to provide a simple and easy to link radio system using the Internet as the communication backbone.
Similar linking options exist, for example the New South Wales GRN (Government Radio Network) which is used by agencies such as the SES (State Emergency Service). These networks rely on dedicated land lines from various node sites which link into a central point, the Nock, which for the GRN is located at Police Headquarters in Sydney.
As one would expect this and other systems like it are expensive to set up, maintain and run. There are on going costs like the leasing of phone lines and or satellite equipment. It's not the goal of this project, as developed by David Cameron VE7LTD to compete, but to work along with other networks to improve the technology and improve radio linking for all involved parties. The people who benefit most from the IRLP are its users.

The IRLP software and the hardware requirements are minimal, and the cost to set up a Node is low. This brings the opportunity for smaller more remote locations operated by an individual, or small clubs, to experience national, indeed international linking without the need for large dollar outlay. David Cameron's design gives the ability to cover several applications in the commercial world of communications, replacing leased lines from phone companies, replacing older technology paging equipment etc.

I feel therefore there is plenty of room for experimentation in the world of amateur radio. The old adage truly does apply; we are only restricted by our imaginations.

Practically all that is needed is a repeater linked into a computer, which is in turn connected to the Internet where it runs 24 hours a day (not a necessity). The numerically coded signal comes into the repeater, say from your hand held. This signal is identified by the software. The systems Node computer, via the software, then selects the appropriate 'MP3' File which feeds back voice information to you, the sender, that you have activated a Node or sometimes that you have not activated any thing at all. The MP3 File 'lives' on the local Node computer. It is not the desired Node we actually hear responding.
At the same time the other aspects of the software runs making the link via the internet system and connects you to the desired distant Node. It is then you can call CQ or one of the DX stations in their area. I am sure that you have heard the words *"You are now connected to ....."* at some time when you have been listening to the Maddens Plains Repeater on 146.850 MHz.

Obviously if a problem has arisen, such as in puting an *incorrect code* for the desired Node or the Node is in *operation*, an *error or busy signal* is sent back to the local computer and you will be informed from a series of voice MP3 files of the situation.
The software often used in the system is LINUX.
I will attempt to bring you some background on this amazing 'platform' and its development in a future issue of the Propagator.

Until then I trust this has given you a desire to delve further into this wonderful innovation developed by a Cananadian amateur David Cameron VE7LTD.
If you haven't given it a go as yet then 'have a go' and enjoy yet another aspect of this great hobby.

Rob Heyer VK2XIC

The Propagator

From Your President.

FELLOW MEMBERS.

Well the year is coming to an end, again. It just seemed like last week that the New Year was just starting. I hope every member had a great year and worked all the DX that came their way!

It would be great if our club get two more sponsors. 5 times $60 equals $300. Which is the same as the site fees for VK2RMP Madderns Plains. This means that our club only has to find the other $600 needed for the other site fees. We are saving money by sending the propagator out via E-Mail.I think the postage has come down from around 85 posted to around 35 posted. This will save our club around $135 per year. So if you know of anybody interested contact me and I will take it from there.

I hope to make some changes early in 2002. Maybe the executive we have now will NOT come up for election until 2003. This will be a 2-year term. At this AGM in August, only the COMMITTEE we have now will need to be elected. This will mean that in 2003 the executive our club now has will be up for election. The rules of our club will need to be changed to do this. This will also mean that at each change over there will be some members on the committee / executive will have some idea of what goes on. I also hope to make it that NOBODY can hold ANY position for more that two terms.

So how about some input from you members out there. I sent out a request via the E-Mail list sometime back and got NO replies.
I hope we do not have to INCREASE the membership fees. I think a SMALL increase NOW of say $2 - $5 will be a LOT better that say a $10 increase in the near future. Maybe to offset the increases we could charge a SMALL $5 Administration fee on Application. (The rules of the club say we can). This may also apply if the payment is late.

The Rules of our club state that the year is 1st JULY to 30th June each year and the fees MUST be paid within 2 months of falling due. To me, this means that the fees MUST be paid by the end of AUGUST. In the PAST some members have NOT paid until the beging of the NEXT year and got upset when the Propagator was STOPPED. If we were a registered club and you are NOT financial at the DUE date you were NOT to avail yourself of the club facilities.

I hope to have the web page up and running in the not too distant future. I have telephoned these people about five times and sent about three E-Mails and I FINALLY got a telephone call the other evening. As this is costing our club NOTHING, I kept at it. I will advise when its up and running via the E-Mail list.

Well that is about all from me. I hope all members have a happy and safe Christmas period and we will see many members at this coming meeting.

I was going to have a Christmas Party at the Dam site but I will be VERY busy on the day I had picked out. December 8th.
Until next time best 73's De Brian VK2UBF President.

The Propagator

Modifications For FRG-100

Here are a few modifications for those who own a FRG-100. Once again the following mods have been gleaned off the 'net.' I trust that they will be of interest and they prove to be worth a look.

FRG-100 Tuning from 30 KHz to 30 MHz It's Possible.
For reception to cover 30 KHz to 30 MHz is relatively simple, you don't even have to open the 'Black Box.'
Press and hold the SSB and FM keys then turn the power ON.
Hay presto the job is done, reception 30KHz through to 30MHz.

I have carried out the mod for tuning down to 30KHz, it only works on older ones. Two of them, made in the last year, will only go to 50KHz.
Dave MW1DUJ

FRG-100 AGC Increased Speed
The original AGC is too slow for SWL DX and this mod will fix the AGC speed by about three times its normal speed.
There are only two simple steps to achieve the desired result as follows.
Open the 'Black Box' and locate resistor R 1091. The manufacturer used a 1.5 M, replace this with a 750K, then look for the capacitor C 1225 which is 1uF. Just replace it with 0.33uF.
It's that easy and works well!

"The Frog"

Note: It goes without saying that ***modification might void the manufacturers warranty.*** The decision to make any mods to any of your stations' gear is yours and yours alone, and if there are any difficulties arising from such mods the responsibility is also yours and yours alone!
Rob Heyer VK2XIC

The Propagator

"M" Theory

Questions for those working towards an amateur exam.

Or just test yourself. Answers on page 13

1. A power line filter for rejecting radio frequency (RF) interference has:

a) RF coupling capacitors in series with the power line.
b) RF chokes .in shunt across the power line.
c) 50 Hz chokes in series with the power line.
d) RF bypass capacitors in shunt across the power line.

2. Which of the following statements is **false**:

a) A lead-acid cell can be recharged.
b) A primary cell has a reversible chemical reaction.
c) A storage cell has a reversible chemical reaction.
d) A carbon-zinc cell has a limited shelf life.

3. The time constant of a 250 microhenry and a 50 ohm resistance is:

a) 0.2 microseconds.
b) 5 microseconds.
c) 25 microseconds.
d) 125 microseconds.

4.The velocity factor of a transmission line is:

a) The relationship between electrical length and physical length.
b) The speed of electron flow within the line.
c) A measure of the efficiency of the line.
d) A measure of its usefulness as a matching stub.

I dug up some questions which appeared on a typical AOCP Theory Exam Paper in the early seventies, 1973 in fact.

Here is the first of a number of such questions.
Hope you will find them as interesting and thought provoking as I do. It would be good to hear from anyone who would like to answer any of the questions that might be published.

Here is the first,
Caculate:- *The power dissipated in a resistor of 180 Ohms when a potential of 3 Volts exists across the resistor.*

The Propagator

Photo From The Past

As promised in the last Propagator here is some information on the photo.
The structure was the antenna, which was located at West Dapto.
The date was about May 1971.

The two bands the antenna was set up to work was 432 and 1296 MHz.

The antenna was 30ft (10 m) in diameter with a parabolic reflector and a polar mount with a circularly polarised crossed dipole system.

This was early days of the moonbounce project, when Lyle Patison VK2ALU and others from the Club and the then Wollongong University College worked at the leading edge of this facet of radio communications.

The project was aimed at establishing two-way communications on the 432 MHz amateur bands, using the moon as a passive reflector. The aim was to establish contact with amateur operators in the United States, United Kingdom and Europe. Truly exciting at the time.

The first objective upon completion of the project was to hear their own signals reflected from the moon. Once this was accomplished it would then open the way for contacts further afield.

The installation and commissioning of the project at West Dapto was carried out by the group of amateur operators who became known as the "Illawarra Branch WIA Moonbounce Group."
It was these people who constructed sections, such as the CW Transmitter, which was designed to run 1KW into the final amplifier stage. One kilowatt, yes, a special power permit was obtained from the Postmasters General Department (PMG) the organisation with similar authority as the now Australian Communications Authority (ACA).
The final amplifier utilised a pair of 4CX240 valves.

For the preamp of the receiver Standard Telephone and Cables Pty Ltd (STC) donated a receiver converter, input of 432 MHz to 28 MHz output this was used in conjunction with a commercial SSB as the IF stage. This was all high quality gear.

The audio was fed through a highly selective low-pass filter unit of about 200Hz bandpass at 3dB, and then into a chart recorder amplifier. The two units were constructed by one of the amateur operators making up the team.
The audio signal was then fed to a commercial chart recorder where the results could be seen.

The month of December marks a century since Marconi made his long distance transmittion from England to America. With the emergence of the IRLP in recent times, we as amateurs still hold a vision. May we never loose this, that we may look back in time and see projects such as the Moonbounce Project to cause us to experiment and to expand the bounds of our understanding and share the joy that comes from the experience.
Rob Heyer VK2XIC

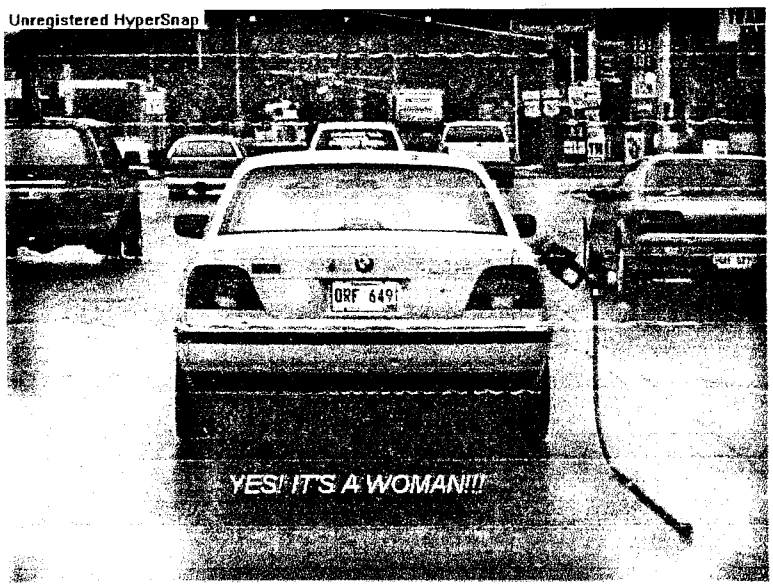
"M" Theory

Answers: -
1. (d)
2. (b)
3. (b)
4. (a)

Some Humour

IRISH BAR CHAT

Two men were sitting next to each other at a bar. After a while, one guy looks at the other and says, "I can't help but think, from listening to you, that you're from Ireland."
The other guy responds proudly, "Yes, that I am!"
The first guy says, "So am I! And where about from Ireland might you be?"
The other guy answers, "I'm from Dublin, I am."
The first guy responds, "Sure and begorah, and so am I! And what street did you live on in Dublin?"
The other guy says, "A lovely little area it was, I lived on McCleary Street in the old central part of town."
The first guy says, "Faith & it's a small world, so did I! And to what school would you have been going?"
The other guy answers, "Well now, I went to St. Mary's of course."
The first guy gets really excited, and says, "And so did I. "Tell me, what year did you graduate?"
The other guy answers, "Well, now, I graduated in 1964."
The first guy exclaims, "The Good Lord must be smiling down upon us! I can hardly believe our good luck at winding up in the same bar tonight. Can you believe it, I graduated from St. Mary's in 1964 my own self."
About this time, another guy walks into the bar, sits down, and orders a beer. The bartender walks over shaking his head & mutters, "It's going to be a long night tonight, the O'Malley twins are drunk again."



The Propagator

The IARS Repeaters

The Illawarra Amateur Radio Society
operates several repeaters on the Illawarra South Coast.
Below is the listing of frequencies in use.

Access tons are not required.
Their status is also displayed along with the type of repeater.
The listing below also includes the Satellite Gateway and BBS run by John Simon VK2XGJ.

Call sign	Freq In/Out	Type	Location	Linked To
VK2RUM	29.520/29.620	Voice	Knights Hill	Off Air
VK2RBT	146.075/146.675	Voice	Mt Boyne	RMP & RIS
VK2RMP	146.250/146.850	Voice	Maddens Plains	RIS & RBT
VK2RIS	146.375/146.975	Voice	Saddleback Mt	RBT & RMP
VK2RUW	433.225/438.225	Voice	Knights Hill	Off Air
VK2RMP	433.725/438.725	Voice	Maddens Plains	RGN, RHR RGI & RTW
VK2AMW-3	144.700/144.700	NODE DIGI	Maddens Plains	VK2AMW-4
VK2AMW-4	144.925/144.925	NODE DIGI	Maddens Plains	VK2AMW-3
VK2AMW-5	147.575/147.575	NODE DIGI	Mt Boyne	
VK2AMW-7	147.575/147.575	NODE DIGI	Mt Murray	
VK2XGJ	53.100/53.100	BBS / SATGATE	Dapto	
VK2XGJ	144.700/144.700	BBS / SATGATE	Dapto	
VK2XGJ	147.575/147.575	BBS / SATGATE	Dapto	
VK2XGJ	440.050/440.050	BBS / SATGATE	Dapto