THE PROPAGATOR

MONTHLY NEWSLETTER OF THE ILLAWARRA AMATEUR RADIO SOCIETY
PO BOX 1838 WOLLONGONG NSW 2500

APRIL 1982

MEETINGS ARE HELD ON THE SECOND MONDAY OF EACH MONTH (EXCEPT JANUARY) AT 7.30 P.M. IN THE CONGREGATIONAL HALL, CORNER OF COOMBE AND MARKET STREETS, WOLLONGONG. VISITORS ARE WELCOME TO ATTEND MEETINGS.

THE APRIL MEETING (Monday 19th April) ... speaker will be Ray O'Grady, (Police Communications) international chairman of Satcom ... another one not to be missed.

PLEASE NOTE that the previously published date of April 12th is Easter Monday and is incorrect. The meeting will be held on April 19th.

THE MARCH MEETING ... with Editorial Comment.

The Annual General Meeting of the Illawarra Amateur Radio Society, (which was well attended apart from the front two rows - wonder why?) took place on 8th March in the Congregational Hall, corner Coombe and Market Streets, Wollongong.

The following Officers were elected:

PRESIDENT - Keith Curle, VK2OB. VICE-PRESIDENT - Denis McKay, VK2DMR.
SECRETARY - Dave Meyers, VK2PBP. TREASURER - Geoff Cuthbert, VK2ZHU.
W.I.A. LIAISON - Geoff Cuthbert, VK2ZHU. BROADCAST OFFICER - Eric Fien, VK2YVF.
REPEATER CO-ORDINATOR - Graeme Dowse, VK2CAG. QSL INWARDS MANAGER - Mike Keech VK2VXS.
QSL OUTWARDS MANAGER - Ian Calcott, VK2EXN. PUBLICITY OFFICER - Dave Henderson, VK2VAV.

Additional Committee Members: Morry Van de Vorstenbosch, VK2EMV. Jock Taylor, VK2JT. Paul Ferguson, VK2DXJ (ex VK2VVS). Ray Ball, VK2PHD.

Positions remaining unfilled were: STOREMAN. NEWSLETTER EDITOR.

Paul, VK2DXJ, has agreed to take charge of small store items, and Keith, VK2OB will keep the larger items at his QTH. However, someone to run the Club Store is still required. Volunteers, forward!

The position of Propagator Editor is being taken on by two Co-Editors, Leo Kleeborn, VK2YJK and Ken Frost, VK2DOI, We take this opportunity to say that we realise only too well the difficulty of attempting to maintain the high standard of editorship set by Brian VK2AXI, and we thank Denis VK2DMR for his help in preparing this our first issue, as well as everyone else involved in its production and distribution.

Graeme, VK2CAG has undertaken to supply us with copy from the VK2TTY teleprinter broadcast each Sunday and we'll try to include some of this in each Propagator. Also, Brian, VK2AXI has advised that he aims to send something for each issue. Our grateful thanks to both of you. However, we appeal to ALL I.A.R.S. members to resolve to submit at least one article - if possible more - during the next twelve months. Production costs of the Propagator are increasing all the time. It's up to all of us to ensure that we get value for money by making our Newsletter as lively and interesting as possible.

From next month we plan to resume publication of the information sheet in the Propagator giving the details of office holders, nets etc, and, sadly, the increased annual subscription rate. Congratulations to Kevin, VK2PGP on his success in the last A.O.C.P. exam, and commiserations to those who dipped out. Kev is looking forward to receiving his new call soon.

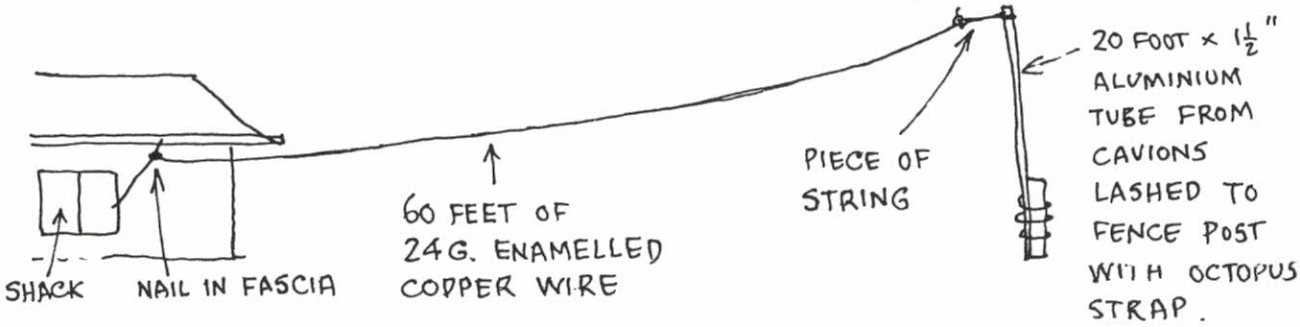
THE AXIOM COLUMN or A WORD FROM THE BUSH

Brian VK2AXI

Carole and I would like to thank our Illawarra friends for their hospitality over the years, and for the help which we had from so many quarters whilst in the throes of packing up to move.

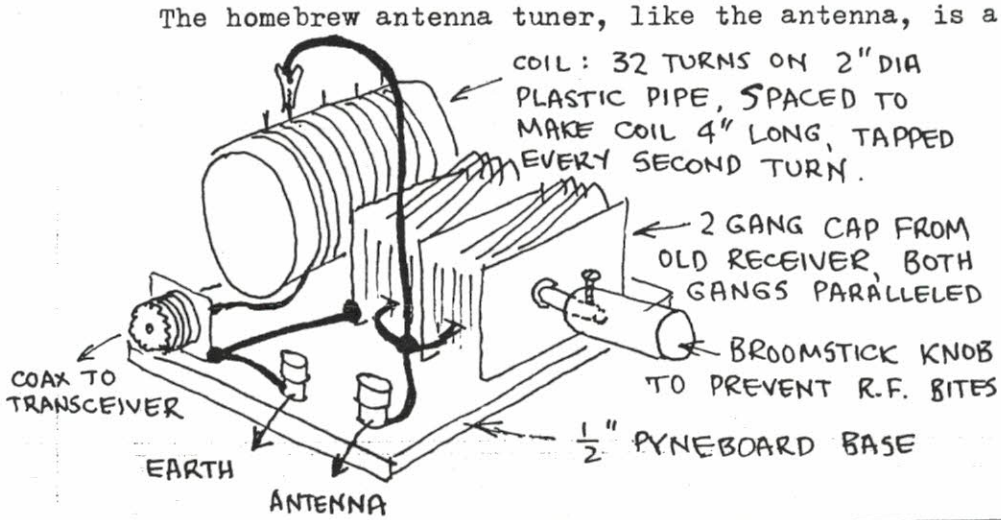
We arrived at Yanco, after a seven-hour drive, on the Sunday before school started - and the furniture van arrived at almost the same time (as Denis VK2DMR said, it must have been a supercharged Maserati Pantech). The family has now pretty well settled into our cottage on the school grounds, which overlooks the redgums along the bank of the Murrumbidgee River . Needless to say, amateur radio has had to take a bit of a back seat of late, although the trusty TS520 is back in action with a temporary (?) random wire antenna on 80 and 40 metres.

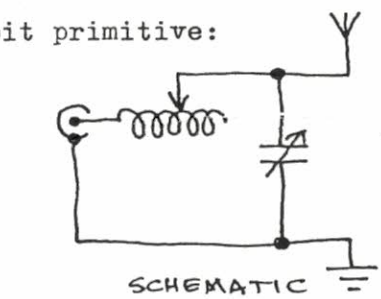
For those interested, here is a description of the antenna system, which took about 15 minutes to erect, and which works remarkably well.



The string insulator is not really recommended, but it has worked all right so far because there hasn't been any rain! Nylon bricklayer's line would be ideal, but I haven't been able to find my roll of it yet. After the wire had been up a few days, it stretched and sagged a bit; the problem was solved by rotating the aluminium tube which wound up the string and tightened the wire.

The homebrew antenna tuner, like the antenna, is a bit primitive:





TUNE TX INTO DUMMY LOAD. ADJUST ANTENNA TUNER FOR MINIMUM SWR.

WAGGA DAILY ADVERTISER, 1981

Tuned-in Cathy's no ham

A Year 10 girl from Mt. Austin High School has become the first girl in Wagga to gain her novice Amateur Radio operators licence.

Cathy Hughes, a member of the school's Radio Club, sat for her novice licence in Wagga last month.

The licenece means that Cathy can purchase or build her own radio sending and receiving set, and operate with a limited power outlet.

The novice test requires candidates to:

- Send and receive five words of morse code a minute;
- Pass a theory test; and
- Pass a test on regulations.

Cathy is the only female member of the Mt Austin High School's radio club and plans to pursue her interest in the field of "ham" radio.

"I hope to eventually get my full call licence," she said this week.

A full call licence allows operators to use a much wider range of frequencies and to use higher powered sets.

Two other members of the Club were also successful at the exams.

Simon Moglia also gained his novice licence, while Mark Austin passed his theory exam, the regulations exam and the morse code sending exam.

A pass rate of 70 percent is required in all exams.

The Mt Austin Radio Club, which has close affiliations with the Wagga Radio Club, has seven members and meets regularly.

At present the club is slowly dismantling a large number of old black and white television sets which were donated by members of the public.

"The parts are coming in very handy," teacher at the school and Wagga Radio Club president, Bruce Grimmond said this week.

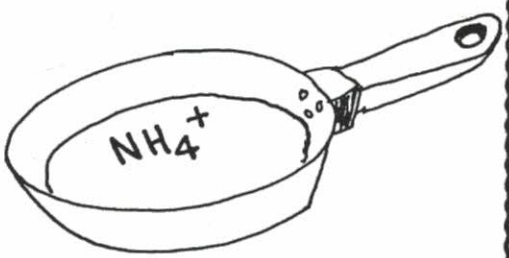
"The public were very generous."

Mr Grimmond was also successful himself at exams conducted last month.

He passed his full call licence which will be put to good use by the school's club.

• Wagga Radio Club president Bruce Grimmond, with Cathy Hughes.

TEST YOUR CHEMISTRY!



What is this? ...

(Answer at bottom of page).

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MORSE CODE TESTS IN U.S.A.

A new type of code test for amateur operator license examinations was approved and put into use late in September 1980. Designed to discourage the memorizers, the system requires a fill-in-the-blank answer rather than the former multiple-choice type.

After copying the the 5-minute tape of an amateur type of telegraphy transmission, the applicant is handed the questions by the examiner. An example question is: What is the name of the operator of the station transmitting? The passing requirement is 70 percent instead of the 80 percent required for former multiple-choice code exams. This was determined to be the comparable minimum during a two week trial run at two FCC Field Offices early this year. The trial revealed that those who made perfect or near-perfect copy of the tape would score 70 to 100 percent on filling in the blanks whereas those with marginal copy scored from 0 to 80 percent. Incidentally, those who failed the new type code test during the experiment were also given a shot at the routine multiple-choice test.

"Worldradio", November 1980.

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Pandemonium.

SIDEBAND Noise Problems in RECEIVER TESTING

by: Sol Abrams
Polarad Electronics, Electrical Equipment Australia

The signal generator which utilises a klystron-cavity tuned oscillator has long been a standard for measuring the performance of transmitting and receiving equipment in the microwave spectrum. It offers a very cost-effective method of generating a signal of precisely known frequency, power level, and modulation characteristics. In recent years, with the appearance of systems which are susceptible to off-carrier noise interference, the klystron-cavity tuned signal generator has proven itself to be particularly suitable for performance testing. Its off-carrier noise sidebands are extremely low because of the very high Qs obtainable with the klystron-cavity tuned device. These noise sidebands may be orders of magnitude below those of comparable solid state oscillators.

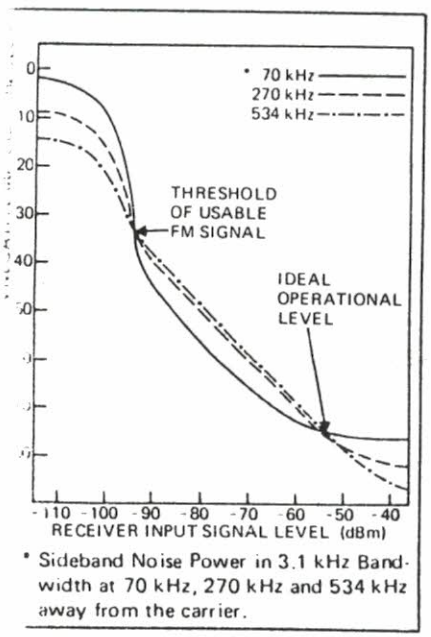


Fig. 1 FM receiver quieting curve

PERFORMANCE TEST LIMITATIONS DUE TO NOISE

The following examples will illustrate how sideband noise produced in the test generator may contribute to erroneous results during performance testing.

Wideband Communications System Quieting Curve Measurements

A standard test used to evaluate receiver performance in a wideband communications system is to plot its quieting curve (see Figure 1). It is a graphic representation of the receiver's dynamic range from the weakest detectable signal to the highest operational input level. Using receiver noise theory, the optimum curve for a particular receiver may be calculated. During test conditions, if the noise output exceeds the specified level, it indicates poor receiver operation. It is essential, however, that the noise sidebands of the test generator be below that of the receiver so that it does not contribute to the noise output level. Higher levels of generator noise falsely indicate receiver degeneration.

Doppler Radars

Doppler radars utilise a narrow bandwidth receiver to detect the shifted frequency return of a moving target relative to the return from the ground. The total power of the ground return, called ground clutter, far exceeds the power of the target return. This creates the need for a narrow bandwidth receiver tuned to the target return frequency.

Phase noise on either the transmitter oscillator or the receiver local oscillator could limit range resolution and sens-

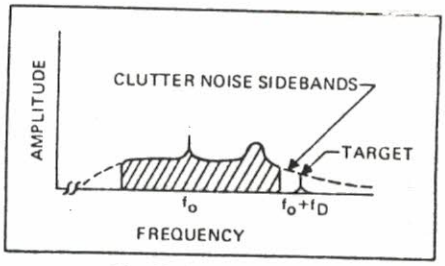


Fig. 2 Doppler radar

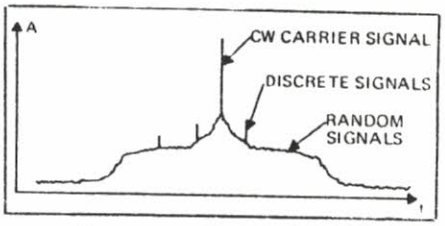


Fig. 3 RF sideband spectrum

itivity. The effect of excessive phase noise is to smear the clutter energy into the receiver reducing resolution and sensitivity. (See Figure 2). When using a test generator to check the receiver, the sideband noise contribution must be below that detectable by the receiver to preclude clutter interference.

Noise in Signal Generators

All signal sources exhibit some degree of random changes in their frequency and amplitude caused by effects such as random walk, flicker, white noise, temperature and other physical changes. In addition, noise may be generated at discrete frequencies, such as power line incidental FM. These effects can be considered as being equivalent to a combination of amplitude and frequency or phase modulations. The magnitude of AM components for most microwave signal generators is usually much smaller than the random FM or PM and need not be considered. A typical RF CW carrier and sideband spectrum is shown in Figure 3.

The discrete signals are signals related to the known phenomena such as vibration and power line frequency. The random noise appears as a broadband spectral distribution. This random noise can most easily be defined in terms of noise power in a given bandwidth relative in dB down from the RF carrier. It may also be referred to as an rms frequency deviation in a certain bandwidth at a particular frequency away from the carrier. References 1, 2 and 3 provide detailed relationships among the various noise elements and their measurement procedures.

TABLE I

NOISE POWER, dBc (1 Hz BW) at 7 GHz

Fc Separation From Carrier (kHz)	Polarad Model 1107 Series Klystron Generator	Cal (*) Microwave C-Band Phase-Lock	Solid State Sig. Gen. with Avantek YIG	H-P 86290B Sweeper	(*) H-P Synthesizer 8672A	(*) California Microwave Crystal Multiplier
30	117	97	98			92
40	121	101	102	91		95
50	122	104	104			98
60	124	107	106	98		100
70	125	109	108			101
80	126	110	110			102
100	128	114	112	101	103	105
200	130	120	118	106		110
500	141	128	126	112		120
1000	147	134	135	119	130	124
2000	149	139	144	124	134	
	Note 1	Note 2	Note 3	Note 4	Note 5	Note 6

(*) From P... ...ed Data

Note 1. Measured values. This characteristic not normally specified or guaranteed.
Note 2. Typical values from California Microwave Data Sheet T-6 10/73. Not guaranteed.
Note 3. Measurement values (2 units). No specification information.
Note 4. Measured values (1 unit). No specification information.
Note 5. Typical values from Hewlett Packard HP 1-B Technical Data Sheet 8/1/77. Guaranteed specification approximately 7 dB higher.
Note 6. Measured values. Specification guarantee is 1-10 dB higher (data sheet VT 573).

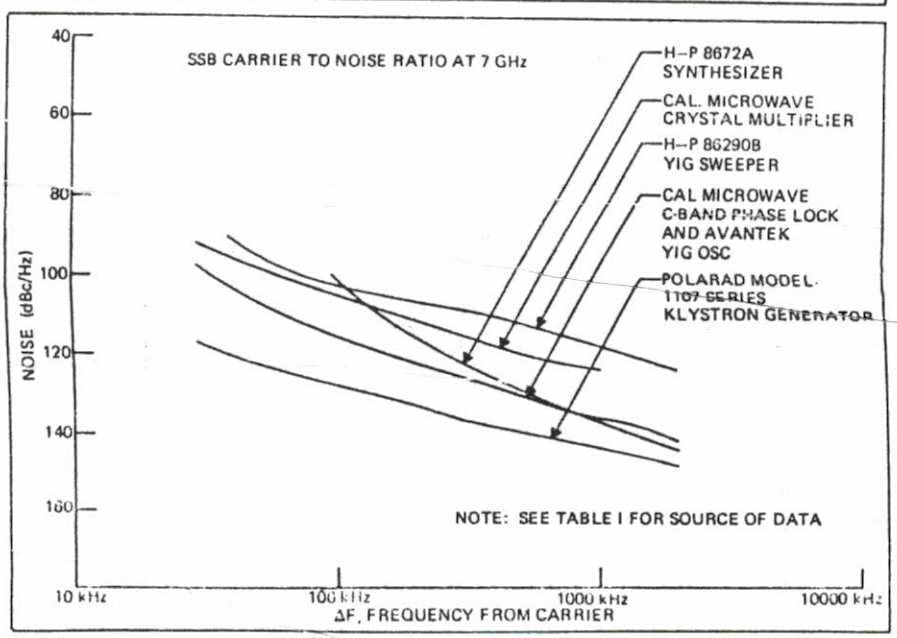


Fig. 4 Residual noise sideband levels of Polarad Model 1107E C-band signal generator and several Solid State C-band sources.

COMPARISON OF SIGNAL TO NOISE RATIOS OF MICROWAVE KLYSTRON-CAVITY TUNED SIGNAL GENERATORS AND SOLID STATE OSCILLATORS

The signal to noise ratio of a group of Klystron signal generators and solid state sources were measured. Where units were not available comparisons were made to published curves and data. Table 1 lists the data and Figure 4 is a graph representing the results of measurements on 'C' band sources at 7 GHz. The results point out the particular suitability of the klystron generator for testing noise-sensitive systems.

Measurements made in other microwave bands offer similar results. The measurement procedures used are described following the tabulated test results.

The solid state units listed contain YIG-transistor oscillators except for the California microwave oscillators. The C-Band Phase Lock Unit uses a transistor cavity plus multiplier and the crystal multiplier, a crystal oscillator.

NOISE MEASURING TECHNIQUES

The spectrum analyser is commonly used to make SSB noise measurements because of its simplicity to operate. The klystron-cavity tuned signal generator however, has such a large signal to noise ratio that the microwave spectrum analyser cannot be used directly. Its limited dynamic range, sensitivity, and bandwidth characteristics make it unsuitable. It is, therefore, necessary to translate the signal to a lower frequency to utilise a low frequency spectrum analyser with more suitable characteristics. This is accomplished by feeding two signal generators of the same type into a double balanced mixer and passing the output IF through a filter to a low frequency analyser. The test set up in Figure 5 was used to obtain some of the results shown.

Two signal generators of the same model number are fed at +10 dBm levels into an Anzac MD-112-1 double balanced mixer. The difference signal at 10.7 MHz is fed through the filter to the low frequency spectrum analyser. The filter serves two purposes. The first is to increase the dynamic range

Cont'd page 20

Sideband NOISE PROBLEMS in Receiver Testing (Continued.....)

of the system. The dynamic range of the analyser is only 70 dB. To measure the noise at ΔF (frequency from the carrier) the local oscillator generator is tuned outside the skirt of the filter and the noise measured in the centre of the band. The filter, however, decreases the level of the IF frequency fed into the analyser. In this way an IF level much beyond the overload level can be used without degrading performance. The second purpose of the filter is to sharpen the skirts of the analyser resolution so that noise close to the carrier may be measured. See Figure 5A.

A second noise measuring system employing an FM receiver and frequency selective voltmeter was used to verify the results obtained using the spectrum analyser. This system is shown in Figure 6.

Two identical model signal generators are fed at the same output level into the double balanced mixer. The output IF signal at 30 MHz is fed into the FM receiver where the limiting action removes any AM noise and is detected by the FM discriminator. The discriminator output is then fed into the frequency selective voltmeter. The voltmeter has three selectable bandwidths with very sharp skirts and a centre frequency control adjustable from 0 to 20 MHz. The noise measurement is made as follows:

A standard 200 kHz rms deviation is used to calibrate the amplitude reference of the system. One of the signal generators is frequency modulated by an FM test tone of 117.6 kHz. With a modulation index of 2.405 the deviation of the generator is set for a carrier null on the spectrum analyser. The deviation is thus set at exactly 200 kHz rms. The signal is then fed through the receiver to the voltmeter where the reference output level is measured. The signal generator is reset to CW operation and the measurements taken. This is done by scanning through the frequency off-set range and noting the amplitude level in dB below the reference and the bandwidth selected. Because of the sharp skirts of the voltmeter and the discrete modulating frequencies associated with incidental FM and vibration, noise levels very close to the carrier may be very accurately measured. The random noise level close to the carrier may also be measured due to the high sensitivity and narrow bandpass filters with sharp skirts.

The measuring systems described use two different amplitude references. The spectrum analyser methods use the CW carrier and the FM receiver method uses the FM signal reference level of 200 kHz rms deviation. These two approaches are mathematically related and transposition charts are available.[3]

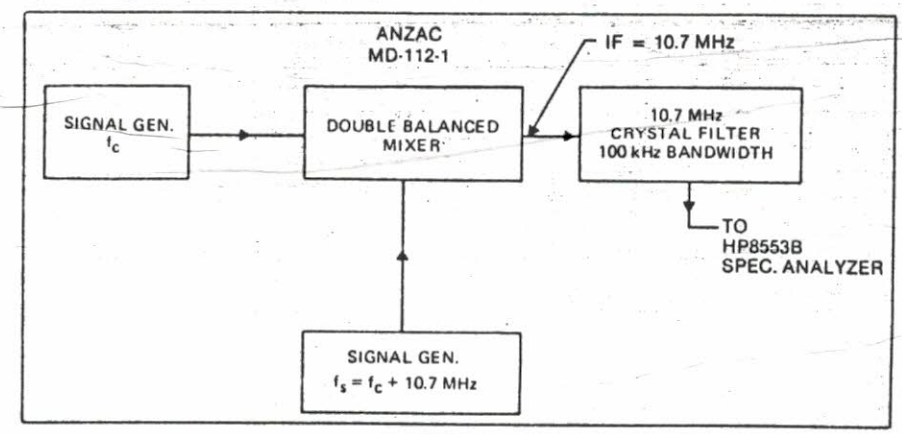


Figure 5

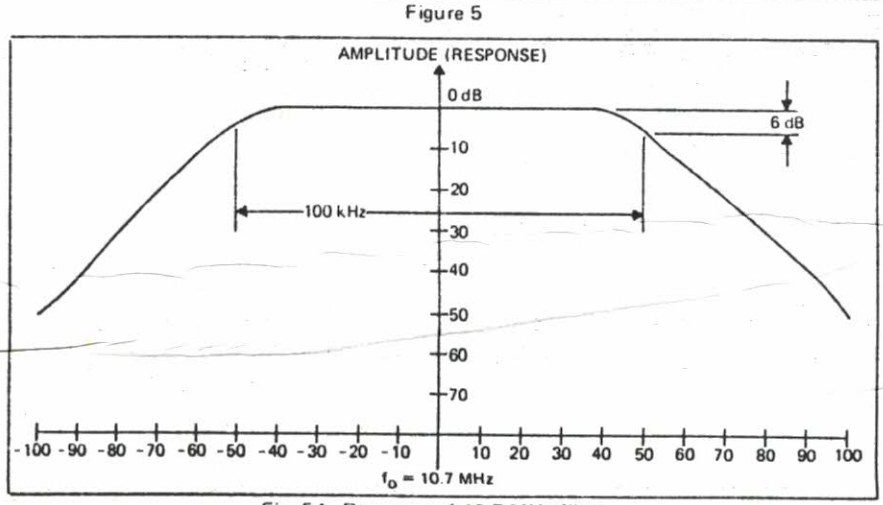


Fig. 5A Response of 10.7 MHz filter.

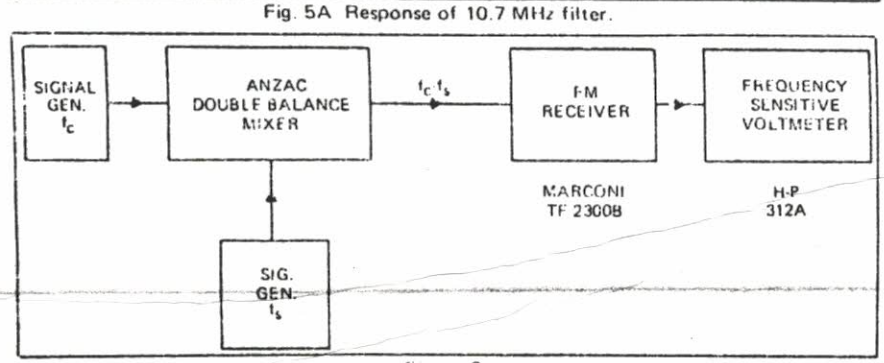


Figure 6

REFERENCES

1. "Understanding and Measuring Phase Noise in the Frequency Domain." Application Note 207, Hewlett-Packard Co. October, 1976.
2. Payne, J., III, "Measure and Interpret Short-Term Stability," Microwaves, July, 1976.
3. Hunt, D., "Chart Compares FM and Phase Noise," MSN, February, 1974.

Answers to last month's acrostic

THE THINGS PEOPLE SAY

"CQ, CQ, CQ, this is G8.... I have a Police Constable here with me, who urgently requires re-assuring that this is an Amateur Frequency, can anyone help please."

Reply: "Yes that's for sure, for sure good Buddy, put the Bear on the Air!!!"

Brighton and District RS Newsletter, quoted in Practical Wireless.

MAKING P.C. BOARDS.

The problem of obtaining a 'wettable' surface, mentioned in the February Propagator, is also encountered when Brasso is used to clean the board. You get a beautiful shiny circuit board, but it etches badly. You can easily and simply overcome the problem by cleaning instead with a 'ball pen eraser' which is less abrasive than an ordinary ink rubber. I have had no more trouble since I discovered this method.

My next step is to dot punch the positions of the holes (I use the spring-loaded type of automatic centre punch) and this can be done directly through the layout diagram. Circle and cover each punch mark with the etch resist, then join them up according to the layout. Next widen the etch resist tracks so that as much copper as possible is left - this economises on etching fluid and time as well as assisting in heat dissipation on the board. I don't drill the holes out until after etching to prevent them being 'undercut' by the fluid.

Larger areas of copper, such as one side of double-sided board, can be covered with Durex type tape. This is quick and economises on etch resist. To get the etch resist off, Brasso is best for the Dalo type of pen.

Ken, VK2DOI.

BOFFIN BOOKED

In Los Alamos, New Mexico, USA, a theoretical physicist at the town's Scientific Laboratory was hauled up for driving eight miles over the limit when he was doing only 25 miles/h.

After studying the state of the ecosphere at the time of his nabbing, he found that it occurred about 10 minutes before a thunder-storm, when the oncoming electricity created ionised particles in the air that could have played hell with the radar machine which accused him.

The proscecution case against him was accordingly dismissed. But before any home-grown scientists take this case as precedent for confidently belting away at 78 miles/h because they can detect a thunderstrom in the offing, they should note a particular requirment on any bench before which they may later be brought up.

The judge in the Los Alamos case was only a part-time magistrate and earned his principal living, also as a theoretical physicist at the local Scientific Laboratory. "Only in Los Alamos," he commented, "could a defendant use a principle of advanced physics in his defence and have a judge understand."

- New Scientist, November 1976.

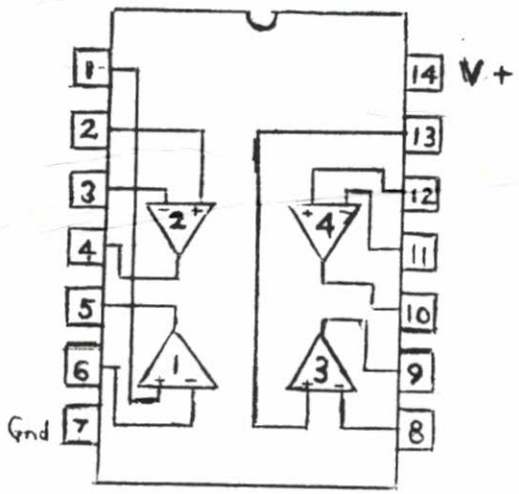
PHIL'S PHILTER.

Local Amateur Phil VK2BRP, of Dapto, is a CW enthusiast, and embarked on the construction of the 'Flexi-Filter' described in the December 1978 '73' Magazine. This is an active filter with tunable outputs - high pass, low pass, band pass and a very sharp rejection notch, using five op amps. Four of these are shown as being contained in the quad 3403 unit, the fifth being a single LM 318.

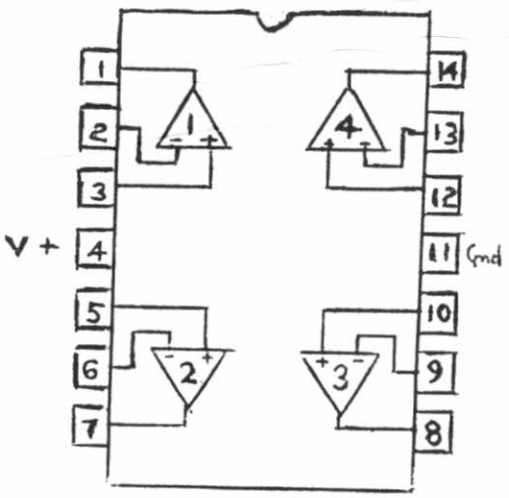
Having etched the p.c. board, mounted components and wired it all up, Phil plugged in the i.c.'s and put power on, only to find no output and the 3403 i.c. getting distinctly warm ! He thoroughly checked his board and connections to no avail so, suspecting a faulty i.c., he tried another one, with the same result. Now, the 'TTL i.c. Cookbook' says 'always suspect the i.c. last' and p.c. board and connections having been cleared, that left only the circuit. And so it proved.

Although a 3403 quad unit is specified in the article, the pin out connections given are for a 3900 i.c. For the benefit (probably too late) of anyone else, here are theconnections for these two i.c.'s. Oh for standardisation!

Ken VK2DOI.



3900



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