

Radio

HOMEBREW and EXPERIMENTER'S Group

An official function of the
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The Radio Homebrew and Experimenter's Group workshop meetings are free to Amateur Radio NSW (WIA NSW) members. A \$5 cover charge **may** apply to non-members. Meetings are currently held at Amateur Radio House in Parramatta on the first Tuesday night of each month around 6:30pm to 9pm (doors locked by 9:30pm) **and** on the last Sunday of each ODD numbered month around 12:30pm to 4:30pm (that is after the Trash-n-Treasure). The Technical Book Shop and Technical Library are also usually open at these times for those who can't get in during the week. Cold drinks (leave your money in the fridge) and tea/coffee making facilities (FREE) are also available. Plenty of shops just up the road if you would like to grab something to eat in the hour or so break between the T&T and the Homebrew Meeting. Only a short walk from either Harris Park or Parramatta Stations and usually plenty of on-street parking for these meetings. The Sunday afternoon meeting is usually first a show-n-tell for any works-in-progress or completed projects members are working on and followed by a Technical discussion or demonstration. The Tuesday nights are an informal Technical meeting where people bring in works-in-progress to get help or ideas from the rest of those attending. These workshop meetings are informal get-togethers of amateurs interested in building, or repairing their own radio equipment. Some people bring their latest piece of equipment along to work on or to receive advice, while others offer their experience and advice in helping others.

The group had some pieces of test equipment at Parramatta, while others are brought in for the occasion. If you think that you may need some equipment, then **please contact Peter O'Connell VK2EMU by email or leave a message for him at the Parramatta office** and he will endeavor to have the appropriate piece of equipment available.

This Month

- **Radio Homebrew and Experimenter's Group News**
- **!! STOP PRESS – We are on the Amateur Radio NSW Web page**
- **News from other Clubs or Groups which may be of interest**
- **Editors Comments – Bi-Monthly issue and Technical Articles**
- **Technical – Noise Bridge for measuring HF Impedance (1)**
- **Where do I get Parts for Homebrew Projects ??**
- **Need Circuits and ideas for “Project Circuit Folder”**

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Radio Homebrew and Experimenter's Group News

Tuesday (March 1, 2005)

This meeting as usual was a follow up to the Sunday meeting and more informal. We actually get a chance to sit down and chat about our projects and their progress.

Audio Filter and Amp Board (Peter VK2EMU). This project which he and Mark VK2XOF are working on is working well and has been incorporated in a number of communications projects by themselves and John VK2ASU.

Audio Pre-Amp Board (Peter VK2EMU) He has developed a postage stamp sized PCB using a 741 as a general audio or mic pre-amp and is currently modifying the PCB to include a additional dropping resistor so that an "electret" type mic insert can be utilized.

PIC Programmer extension Board (Peter VK2EMU) This addition to the latest Silicon Chip PIC Serial programmer board is working well with 28 pin PICs and is yet to be tested with 40 pin PIC chips. The latest Ver 1.05 of ICProg is needed to access these newer chips.

80M RX Board (John VK2ASU). He continues to experiment with VFOs based on ceramic resonators and is testing methods to get the best "swing" out of 80M and 40M resonators. He had some feedback problems on his "lashup" but has sorted them by re-routing and bypassing the power supply feeds.

Conversion of PC SMPS to 13.8V @ 10A (Keon VK2ZHA) This very interesting approach to conversion of old but functional PC power supplies scavenged from a PC or purchased at quite reasonable prices at markets etc. Instead of extensive modifications as per most articles, it basically involves re-wiring the +12VDC supply to a set of front panel terminals, re-configuring the input of the TL494 regulator chip to monitor the +12VDC instead of the +5VDC. Fit load resistors to the remaining supplies and mods to the fan control.

Looking forward to catching up with Keon at this coming meeting to get some further details as I have a couple of SMPSs stripped down and ready for conversion.

Morse code Beacon (Peter VK2EMU) is developing a new PIC/Micro based Morse code generator for the Dural Morse Beacon. His current project is PIC based but he is working with Les (VK2YJ) on an ATMEL based controller for more versatility.

Sunday 20th March 2005, 12:30pm at Amateur Radio House (after the Trash and Treasure meeting)

Because of Easter we have moved this meeting to the 20th March and Peter has re-scheduled the planned presentation to a future date. We are unsure just how many people will attend so will keep this meeting a bit informal. It will be mainly a show-n-tell session for your current projects or interests and bring along or fill us in on the gear you acquired at Wyong.

Next Meetings :

Tuesday 5th April 2005 (6:30pm at Wigram St)

Tuesday 3rd May 2005 (6:30pm at Wigram St)

Sunday 29th May 2005 (1pm after the Trash-n-Treasure meeting at Wigram St)

!! STOP PRESS – We are on the Amateur Radio NSW Web page

The Radio Homebrew and Experimenters Group is on the net, just go to www.wiansw.org.au and look for "Homebrew News" for latest news on the group and a "pdf" copy of this newsletter. Let your friends know too. We will shortly have our own email address, meantime just send any email to Parramatta office.

News from other Clubs or Groups which may be of interest

Sorry not much news on this front as most clubs are only just getting going again after the Xmas and New Year breaks. Over the next few months I hope to get to a number of other clubs to bring you news.

Wyong Field Day (February 2005) Did you get there, if not you missed a great show. I traveled up on the Sunday morning and stayed up there overnight and returned home on the Monday morning. This was most relaxing way to attend this meeting as you really need a full day to do it justice.

Initially the weather was very overcast and this may have put a dampener on the open-air sale in the car park. It was well attended but some familiar faces were missing and all the vendors seemed ready with tarps etc in case it rained. The rain did not come till late afternoon so it was a great day if a little humid. Many of us picked up some great bargains in bits and pieces and equipment.

I got a box (10) of 60-70MHz handhelds for \$10 !!, a beaut aluminum case (which in a previous life was a rather expensive transistor tester) to mount my 240V Variac into. Various components and a couple of pieces of test gear for spares will keep my junk box going for a while.

Jaycar, Oatley and Emona were there amongst the larger dealers all with great specials. I picked up a couple of 12v – 240Vac inverters (need repairs at \$10 ea), 3.5 Digit Voltmeter modules (\$5 ea). One of the dealers had a bunch of 13.8V @ 20A SMPS for about \$90, unfortunately I already have such a beast but I did splurge on some RG213 coax at about half its normal price from another dealer.

As usual there were plenty of stands with lots of Ham gear and our mate with his pre-owned test gear. Unfortunately my budget would not cover the R&S digitized RF Sig Generator on display (maybe next year !!)

Amateur Radio NSW was there (as usual) with its large display of books and Deceased Estate / T&T gear for sale and very busy too. Alongside were the WICEN, QSL Bureau and Historical Radio Society tables. The equipment Disposal in the downstairs area of the pavilion was well attended, you had to be quick as the good "stuff" disappeared quite rapidly.

Upstairs in the pavilion was the usual and very welcome tea/coffee and biscuits along with WIA (National) stand which was displaying some quite snazzy new display banners relating to Ham Radio activities.

Illawarra Amateur Radio Club: This is the only other club I have been to recently. I was invited down there by Max VK2AFE who was giving a talk on the G5RV antennae and its applications. Considering Max has problems with his eyesight, this was an excellent presentation accompanied with lots of practical suggestions on the application and installation of this versatile antenna.

Editors Comments – Bi-Monthly Newsletter and current Technical Articles

Bi-Monthly issue of the Newsletter : Our Tuesday night meeting tends to be a fairly informal affair with a 10 to 15 people attending, however the Sunday afternoon meeting after the T&T is by far our largest. We usually have a speaker or demonstration along with up to 30 people attending. We also seem to have most activity at the Sunday meeting as it is followed very closely by the Tuesday meeting only a couple of days later.

So, at least for the next few issues I will generate and issue the newsletter to co-inside with the Sunday meetings. This will ensure that the large number of attendees on a Sunday will get a new Newsletter and those that do not come to the Sunday meeting can pick up a copy at the Tuesday night meeting which closely follows it.

Current Technical Articles : Until just recently I generated and produced an additional newsletter for a Ham club I belonged to. In this newsletter I had an on-going series of technical and construction articles which I would like to continue and also present to you as well. This of course will necessitate starting at the beginning of each series, for those few of you who may have already seen these articles in the other newsletter, my apologies and please be patient whilst we catch up in these pages.

Starting in this issue is a series on "HF Noise Bridges" which will span three or four issues. The series started in last issue on "Making your own PCBs" will continue in the next issue.

The above items are presented in a series, simply as there is so much material to cover. However normally a technical article will appear and be completed in a particular issue, especially because of what will now be a two month space between issues. In fact it is my aim to have one or two "one pagers" in each edition.

Comment: All of you who actually build things will know how long it takes to select and source parts, then tidy up the design and build it, THEN get it working !!. In all the articles I generate the projects are actually built up and work, then have to be written up and circuits generated.

This is another reason why I need a bit more time between issues. The current monthly cycle is just too short along with the fact that I am thrashing around generating a newsletter for the smallest meeting.

Technical – Noise Bridge for Measuring HF Impedance (1)

(The text is written and compiled by your editor Brian VK2TOX from personal experience and items in various publications including ARRL Handbooks. The illustrations and pictures in this part of the article are from a page on the net by DJ4BR, Ing. Peter Weber, Hohegrabenweg 3b, D-40667 Meerbusch, Germany. This article in its original form and authored by VK2TOX appeared in "Dagnet" the newsletter of the St George Amateur Radio Society, but has been updated and slightly modified to appear in these pages)

We all at some time need to check out a piece of coax or an antenna. Usually the station Transmitter set to a low power and our SWR meter are pressed into service. A useful indication of resonance or lack of can be obtained with this basic equipment. In the field I have set up multi-band vertical antennas in this way quite quickly.

However when constructing RF related gear such as antennas, antenna tuning units and dummy loads, a more accurate indication of the devices parameters is usually required. For instance we have just built up a nice QRP 50ohm dummy load using discrete metal film resistors. If the resistors provided us with 50ohms for an infinite frequency range life would be so easy, but we know that anything we put together will have capacitance and inductance in the leads and between the components such that it will not provide us a constant 50ohms. We need some way of determining not only the resistive component but also the reactive component of our new device so that we can either allow for it or compensate for it with an appropriate capacitance or inductance in the construction.

If you do lots of design work and have plenty of money you can go along to one of the dealers, throw some money at him/her and get yourself one of the beaut RF Analyzers. It will show you SWR, Resistance and Reactive components values of your new dummy load along with a lot of other parameters. In fact most of them will actually allow you to do this over quite a wide frequency range.

For us ordinary hams with XYL and multiple harmonics to feed and clothe there is an easier and much less expensive way to go, an **RF Bridge**.

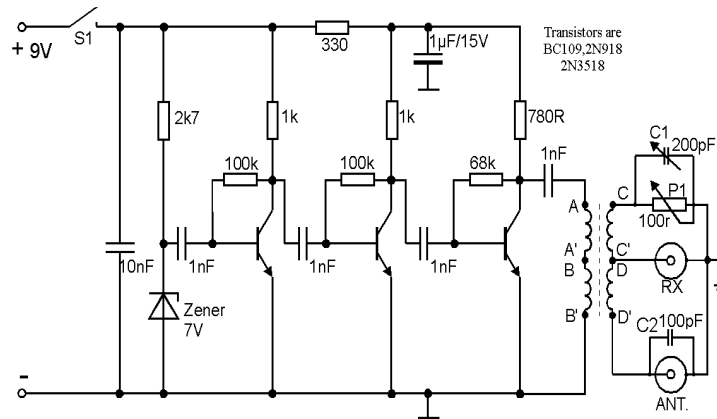
An RF Bridge is basically a Wheatstone bridge optimized for use at RF. Usually fed by a variable frequency source such as a Signal Generator or low power Transmitter and utilizing an audible or meter based system to detect balance of the bridge. There are usually both resistive and reactive elements in the bridge so both of these parameters can be determined. Greatly simplified versions of this bridge form the basis of more simply RF Bridges which have appeared in most issues of the ARRL Handbook. In fact this is usually the easiest way to implement an RF Bridge for use at 2m and above because it eliminates a lot of the distributed capacitance and inductance associated with the construction of equipment at these frequencies. Again see earlier versions of ARRL Handbook.

However if we take our RF Bridge and feed it with an Wide Band RF noise source and use a HF Receiver as the detector we can achieve similar results without risking radiation of unwanted RF. Thus we would have a **HF Noise Bridge**.

TenTec, Palomar and MFJ produce versions/kits of this noise bridge and most recent editions of the ARRL Handbook also contain a noise bridge project.

Drew VK3XU also has featured a number of instruments for measuring RF Impedance in components and antennas in his excellent series of circuit books (check with VK2 Bookshop at Parramatta)

The most basic of the noise bridges utilizes a zener diode or transistor junction to generate the RF "noise" which is then amplified by a wide band amplifier (discrete transistor or HF band op-amp) and then coupled to the bridge with a wide band transformer.

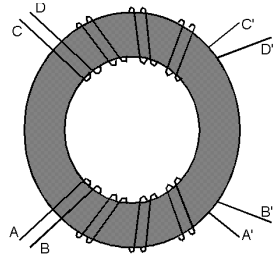


On the left is a circuit for such an instrument. The circuit is powered by a 9v battery via an on/off switch (or leave the switch out and simply disconnect the battery when not in use). The 10nF capacitor keeps the supply impedance low as the battery discharges. The 2K7 resistor biases the zener diode (6v8 is possibly more readily available) which produces the RF noise. The noise is then coupled to a three transistor amplifier to drive the bridge. The 330R and 1uF decouple the power supply for the final two stages of the amplifier. The transistors

are obviously NPN and should ideally be a HF Switching transistor, but in practice as most modern NPN have a high Ft almost anything in your junk box can be tried out. I have used BC109, 2N918, 2N3518, BC548 and 2SC1815 for various configurations. Resistors are ¼" watt metal film, small caps are ceramic, zener is 400mW

The amplified noise is coupled to the bridge by a toroid transformer as follows:

As there is no appreciable RF energy in the transformer a quite small core can be used. It only needs to be big enough so that you can actually wind the coils on it. Somewhere between 12 and 25mm diameter is suitable. More important is the frequency response of the core, it should certainly be within the range of frequencies you wish to test your antenna etc at. I have seen versions of this bridge built using a two hole balun core (as used in TV Baluns), a short piece of ferrite rod and even a whole bunch of ferrite beads with the wire fed through them. The ARRL Handbook recommends a FT-37-43 ferrite ring and I have used a T-68-2 powder ring. Small winding wire such as #26 or #28 is suitable while not being too small and fiddly for old fingers to manage. A recent article of Drew VK3XU in AR suggests the use of Jaycar's LO-1230 toroids for use at HF, these are readily available and good price too.



Some versions of this bridge use a three winding transformer, this one utilizes a four winding transformer which I guess would provide a more balanced distribution of the winding capacitance and inductance. See above for the windings and their connection.

Now we come to the actual bridge components. As mentioned this is a basic Wheatstone bridge reconfigured to that we can ground the Rx and Ant connectors. Examination of most circuits for this kind of Noise Bridge the capacitors are actually series components i.e. C1 is in series with P1 and the 100pF is in series with the Ant terminal (see ARRL Handbook). This makes construction of the circuit a bit more difficult as either C1 or P1 has to be insulated from earth, requiring either an insulated panel or insulated mounting and shaft extension. Apart from the actual construction issues this also makes the instrument more susceptible to hand-capacitance effects when making adjustments.

This circuit above has however been reconfigured with the capacitors as parallel components allowing both C1 and P1 to be mounted on a metal front panel, greatly simplifying construction and use of the instrument.

The values of both C1 and P1 are not critical in fact they should be adjusted to suit your expected range of measurement.

Value of P1: As you can see it is not a ratio potentiometer as in a standard Wheatstone bridge but wired as a variable resistor. Its total value relates to the highest resistive value you expect to measure with your new noise bridge. So if your range of measurement is based around 50 ohms then the 100R pot

is fine, but if you want to measure devices at 300 or 600ohms you will need to go to a 1K pot instead. In fact no single pot value will accurately cover a wide range of measurement. I think it is the MFJ bridge which gets around this by switching an extra resistor into the bridge to expand the use of the resistance pot. In fact unless you have a bottomless junk box or play around with a trimmer and an extension shaft you are going to find it difficult to get a pot with 100R resistance. Most suppliers don't stock anything below 500R for a linear pot these days so this is possibly a more practical value for this device. Unfortunately this will make measurement of 50ohms a bit difficult. My suggestion is to get say a 1K or 500R pot and experiment with various resistors in parallel with the track and also in series with the wiper to get a useful (to you) range of measurement points within the rotation of the pot. Suggest you use a good quality digital multimeter (on appropriate ohms range) to get accurate results. However allow for a bit of flexibility in the physical position of say 50ohms on the pot as you are measuring at DC, later you will need to calibrate this position at HF. Suggest you use a new part for this pot as an old "noisy" one will make measurements difficult.

Value of C1: Again the value of this component is not critical but should also reflect the range of values expected to be measured. You can add parallel or series values of fixed capacitance to vary the dial reading. The panel will actually be calibrated in relation to plus and minus half the value of C2 in this case +/- 100pF, so a component with a value of between 200 and 250pF would be good. If you have a component with the more usual value of 365pF then either use a good quality capacitor in series with it to reduce its effective capacitance or simply adjust the value of C2 as follows. Most tuning capacitors are "straight line frequency" so their half capacitance position will obviously not be in the center of the capacitors travel. Again you can fiddle this with the value of C2.

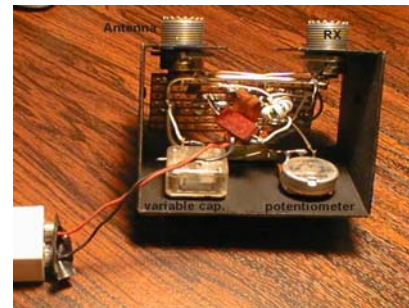
Value of C2: This should be half the value of the C1 capacitor as it actually sets the electrical mid scale of C1, see later comments re calibration. In the following illustrations a small "transistor radio" type of tuning capacitor is utilized. It is nice and compact and cheap but a bit fiddly to mount and an adapter needs to be made up so that a conventional knob can be fitted to the small shaft. They usually have two or three separate capacitor sections allowing a range of values to be selected for your particular circuit.

Following are a few pictures of one method of building the bridge.



Front Panel with bridge mounted in a simple aluminum chassis

View inside the chassis showing location of major components



Construction

Suggest you use a smallish steel or aluminum box to shield the bridge. Go to Woolies or Franklins a buy a can of "No-Name" ham, the one in a square metal can (not aluminum). These make great containers for small RF projects and the ham is good on your sandwiches.

Even a scrap of aluminum or tin could be bent up in a vice to a chassis similar to the illustrations above (if you do it this way you might consider making the holes for the controls and terminals BEFORE you bend the metal)

1. Mount the variable capacitor, pot, Ant and Rx terminals. Mount the on/off switch if used.
2. Wind the transformer, secure the windings with hot glue or electrical tape. For the time being allow say 50mm tails on the windings.
3. Build up the noise source and wide band amp on a piece of VeroBoard or dead bug style on a piece of single sided PCB. Mount in box.
4. Using short and direct wiring connect up the board, transformer, Ant, Rx, C1 and P1. Careful not all winding wire is directly solderable. Scrape off the ends and tin with solder prior to

connection. Suggest a common solid wire between the tops of C1 and P1 and connect "C" of transformer to the center of it. The wires C', D and D' should go straight to the center terminals of Ant and Rx with the 100pF wired directly across Ant terminal.

Careful wiring and a symmetrical approach to routing of interconnecting wiring will make operation of the bridge more reliable and any future mods or fault finding a lot easier. Next part of this article will cover Testing, Calibration and use of this instrument.

(To be continued).

Where do I get Parts for Homebrew Projects ??.

New Bits. When you want / need to build "something" the problem is usually where do you get the parts from !!. If you have your eye on building a recent project from Silicon Chip or even Electronics Australia then obviously the Jaycar or Altronics companies are good place to start and they both have excellent catalogs. I understand they both have quite good mail order facilities too. Unfortunately when it comes to electronic components the Dick Smith stores seem to be shedding this product line at least here in Sydney. Some of the ordinary DS stores (rather than the Power House stores) still have a dwindling range of components.

Two other places I use are Rockby in Melbourne and Dans Small Parts in the US, both have good internet sites.

Rockby has a wide range of equipment and components, they usually have specials every month at very good prices. They are not your local parts store as most of the stuff they offer is disposal stocks or manufacturer's over-runs, best to get a few mates together as best prices are in bulk buys. Easy to deal with and order by phone, Fax or online. Good source for commercial / industrial quality components at reasonable prices. They have a good range of semiconductors, ferrite cores and passive components.

Dans Small Parts is an excellent source for components many of which are not readily available in Australia. Again much like Rockby they are a bulk buy site with new, disposal and "pulls" items. "Pulls" are components removed from boards in good condition with usable lead lengths. They have most of the components for ARRL or 73 magazine circuits for the past twenty years or so. Unlike Rockby they are strictly a CASH only site, with payment required by International Money Order and orders placed by mail. Add cost of money order to US\$12 for overseas postage and you need to order at least US\$50 to make it worthwhile. Delivery is good, my last couple of orders turned up in my post box only 10 to 12 days after posting the order to them. Even with this "overhead" the parts are still good value.

Old Bits. Well !! where do I start? Obviously events like Wyong each February and the regular Wigram St Trash-n-Treasure are good sources of parts and equipment for the homebrewer. At both sites you can pick up what was quite expensive gear for a fraction of its original cost, to be "ratted" for your next project.

Westlakes have a sale around October – November of each year, Liverpool club have an auction earlier in the year and Chifley have a sale around December if I remember correctly. All are good sources of parts and equipment for the homebrewer.

Don't forget your mates, let it be known that you need a certain part. Someone will usually have something you can use and in most cases happy to swap it for something they are after. See if someone is about to send an order overseas, maybe they can tack your requirements on to their order, thus spreading out their costs and minimizing yours. But do the right thing, share the costs of placing the order.

Rubbish pickups by local Councils are heaven for the avid "builder", that old TV, radio, stereo or computer on the side of the road is chock full of useful components and hardware. Maintain good relations with relatives and friends not "in the trade" so that all the unwanted VHS, CD and DVD players come your way. I recently scraped a DVD player to come up with very useful switchmode PSU, a board full of op-amp and photocouplers, along with micro switches and hardware.

Talking of hardware the current mass upgrade of computers means lots of pre-loved PC cases on the streets, a little creative sheetmetal work will lower or shorten these case into quite useful and robust equipment enclosures.

Above all be flexible and creative in your collection of parts, you will always have something to build your project with. However what you collect is no use to you if you can't find when it is needed. Invest in some parts drawers from your local \$2 shop and some sealing plastic bags to sort and store

your growing "junk box" in. A hand written list or simple spreadsheet will keep track of what you have and also component parameters.

Search on the net or in spec sheets for component parameters. Most of the ARRL and RSGB handbooks have circuits for semiconductor and component testers. The Jaycar web site and Altronics catalogs are good sources of component specs as are the component sections of most ARRL Handbooks. While you are at it, start building up a folder of spec sheets. Very little of what we build is so critical that quite liberal substitution can't be applied. The old BC108 will work quite happily from audio out to HF. Except for tuned circuits and filters most capacitors function as either coupling or bypass, so one or two values up or down from that on the circuit will usually work quite well.

Need Circuits and ideas for "Project Circuit Folder"

For the benefit of our members I would like to build up a file of "building-blocks", that is self contained circuits we can use to construct or modify a complete piece of equipment. It is usually easier to build up a piece of gear, be it a piece of test equipment or a RX/TX by breaking it up into a number of modules. It is also easier on the pocket book too. That way you can be assured of functionality before moving onto the next module and also get quite quick results, rather than quite a long time on a one piece of gear.

Also of interest are circuits of small pieces of test equipment that members could "knock-up" to assist them in testing or aligning the gear they have homebrewed.

Thanks again to Max VK2AFE who brought in another selection of circuits from his own "must-do" file. I have scanned these in and they will be most useful.

So scribble a circuit down on a piece of toilet paper, photocopy an idea or email ideas/circuits to Brian VK2TOX (as per Call-Book or email address on front page). You can even hand it to him as he is there at most meetings.

This compendium of circuits will be available at meetings and eventually in booklet form to members. I am currently putting together some circuits to get it started, but I need your support too.

At the Homebrew we have a growing collection of passive parts, xtal osc modules and other useful parts, also an interesting quantity of various IC's. Most of these are older types but still quite useful to build projects around. These bits are NOT currently for general sale as they are primarily to help in developing projects.

A series of one page projects will appear shortly in this newsletter, we are hoping to put together kits of parts (incl PCB) to help those interested who don't have ready access to electronic parts.

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