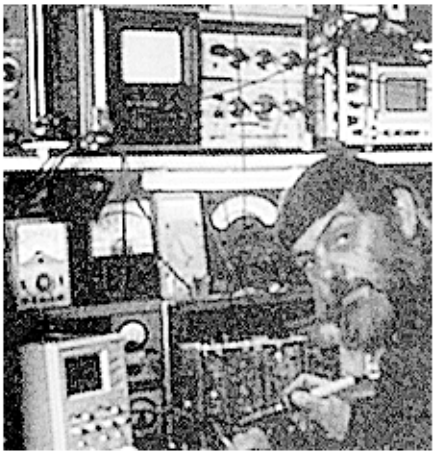

SPRAT
G-QRP CLUB
100

JOURNAL OF THE G QRP CLUB



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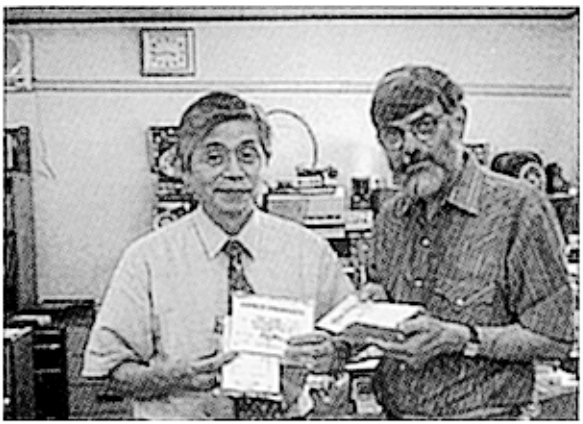
EDITORIAL

Dear Member,

Welcome to SPRAT 100. May I use this issue as a chance to thank everyone who has been in anyway involved in SPRAT for the 100 issues and especially those who have contributed articles towards making SPRAT the singular publication it is. This issue contains many simple circuits following the request for "Take Twenty" items : circuits with 20 parts or less. Although the "RJV" items break that rule - they are offered in the same spirit!

Please continue to send me the interesting and varied items for future issues of SPRAT.



The picture to the left shows me meeting Mr. Takada the Founder of Mizuho on my recent visit to Japan. I was the guest of a group of Japanese QRPers who treated me royally

My thanks are due to the members of the JA QRP Club and especially JR4CLN.

See you in the Winter Sports

72/3

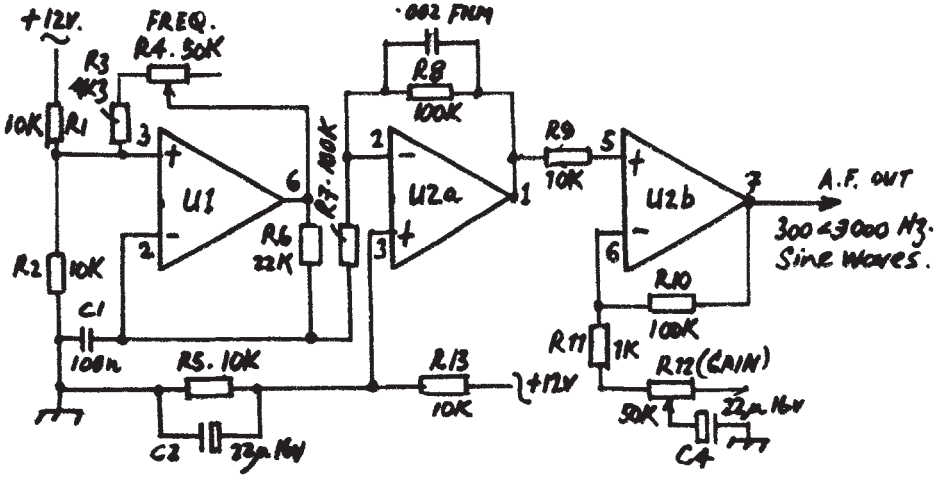
G3RJV

EDITED BY GEORGE DOBBS G3RJV ARTWORK BY A.W. (MAC) McNEILL G3FCK
PRINTED BY SHOREHAM COPY, 4 Hyde Square, Upper Beeding, Sussex BN44 3JE

Take 20

W4LJD Sine Wave Audio Generator

Frank Brumbaugh, W4LJD, P O Box 30 Defendini,
SALINAS, Puerto Rico. 00751-0030



Parts List

C1	**.1 uF ceramic or monolithic**
C2.C4	**22uF 16V electrolytic**
C3	**.002 uF mylar or polystyrene**
R1,2,5,9,13	**10K**
R3	**4K3**
R4,12	**50K pot**
R6	**22K**
R7,8,10	**1K**
R11	**1K**
U1	**TL081 single op amp**
U2	**TL082dual op amp**

There are 19 parts including the two chips, but I suggest you add the 20th part, a .1uF capacitor same as C1 in series with the audio output because there is a DC potential on U2 pin 7 of about half the power supply voltage. U1 is wired as an oscillator producing both square waves and triangular waves. Square waves are available at U1 pin 6 so you can read the frequency with a frequency counter. Triangular waves are taken from U1 pin 2 and injected into the inverting input of U2a, which integrates it and produces a clean sine wave at pin 1. This sine wave is injected into the non-inverting input of U2b, an amplifier.

The amplified sine wave at a level controlled by R12 (GAIN) is taken from U2b pin 7. (Add part No. 20, a .1 uF capacitor same as C1 to block the DC but pass the audio sine waves.)
Sine wave output is 99-44/100 percent pure. R4 (FREQUENCY) allows production of sine waves from 300 to 3000 Hertz at the output. Please note that sine wave amplitude is reduced as frequency is increased. Advancing GAIN pot too high causes the sine wave to distort as it runs into the positive and negative rails. Positive voltage connections to the chips are not shown in the interests of keeping the schematic clean and uncluttered, but they are assumed.

This circuit has a number of uses. As it stands it is a valuable piece of audio test equipment. It can be installed in any transceiver to provide ear-pleasing sine wave sidetone. It it is keyed in either the positive or negative lead it can be used as a code practice oscillator. If used as a code practice oscillator, "Part No.,20" should be an electrolytic capacitor of 47 to 220 uF to feed low impedance phones. The suggested .1uF is intended for the sidetone to be injected into your transceiver.

WEEKEND PROJECTS FOR QRPERS

George Dobbs G3RJV, 498 Manchester Rd, ROCHDALE. OL11 3HE

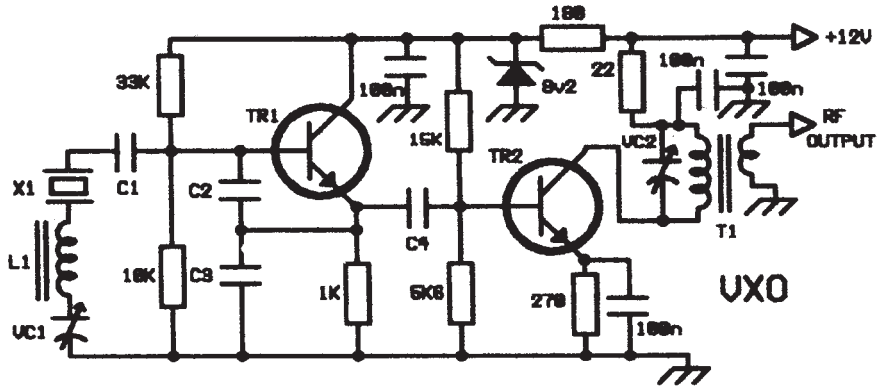
Introduction

Experience has taught me that relatively few radio amateurs build complex equipment. Rather more of them are inclined to build small projects, which can be completed in an evening or a weekend, cost very little in parts, and will probably work first time. It is satisfying to go to bed knowing that you have built something with your own hands and it worked. Few of us get the chance to do a lot of that these days.

Here are four simple projects, all of which could be built in a couple of hours or less. None of them is very original but all of them should work first time if built with care. Hopefully they all have practical applications for the QRPer.

A Universal VXO

I recall having a long conversation with the late Doug DeMaw, W1FB, who was an advocate for the use of the VXO in home built equipment. His contention was that the VXO is a very viable option for home built amateur radio equipment especially for miniature or portable stations. Some of the ideas below come from the scribblings I made at the time. What is offered here is a utility VXO circuit that can be used as a frequency source for a transmitter, or even a receiver, on a range of amateur bands.



The circuit for the VXO is a bipolar transistor oscillator followed by a bipolar tuned buffer stage. My prototype used 2N2222A transistors for both TR1 and TR2 but many similar types would work. I used 2N3904 devices in an earlier version. The oscillator has a stabilised supply derived from an 8.2 volt zener diode. I had intended to use a 9.1 volt zener but could find one. Other constructors might like to use a three-pin voltage regulator chip of similar voltage.

The oscillator is based on the popular Colpitts circuit. The capacitive feedback is via the capacitive divider provided by C2 and C3. These values vary according to band (see the band table). C1 is used to minimize the effects of the parallel capacitors, C2 and C3. Without C1, the upper frequency range of the oscillator would be restricted. By using an inductor, L1, and a variable capacitor, VC1, the crystal should pull slightly above its nominal frequency. The value of C1 will depend upon individual crystals. I found that around 100pF served very well for 40 m. Try 100pF as a starter value on other bands and experiment.

Suggested values for L1 and VC1 are also given in the band values table. The suggested inductors are standard commercial moulded inductors. These values can offer considerable frequency shift. I make no numeric promises

The oscillator stage is coupled to the buffer via C4, the value of which is ideally changed to suit the band. The table shows suitable values for C4. The buffer stage is tuned for the band in use using a tuned transformer, T1. These values for T1 and VC2 are chosen to resonate at the frequency of the crystal. The buffer amplifier operates in Class A to encourage a spectrally clean output.

UNIVERSAL VXO BAND COMPONENTS

Band	L1	VC1	C1	C2/C3	C4	T1	VC2
80	100uH	100pF	see	220pF	100pF	10.3uH	200
40	47uH	60pF	text	100pF	47pF	5.2uH	100
30	33uH	60pF		68pF	39pF	5.2uH	48
20	16uH	60pF		47pF	33pF	5.2uH	25

Notes:

T1 for 40/30/20 - 5.2uH = 36 turns on T50-6 core. Link winding 10 turns

T1 for 80 - 10.3uH = 45 turns on T50-2 core. Link winding 12 turns

VC2 is a trimmer capacitor Value given is theoretical capacitance to resonate T1 on the QRP Calling Frequency for the band in question.

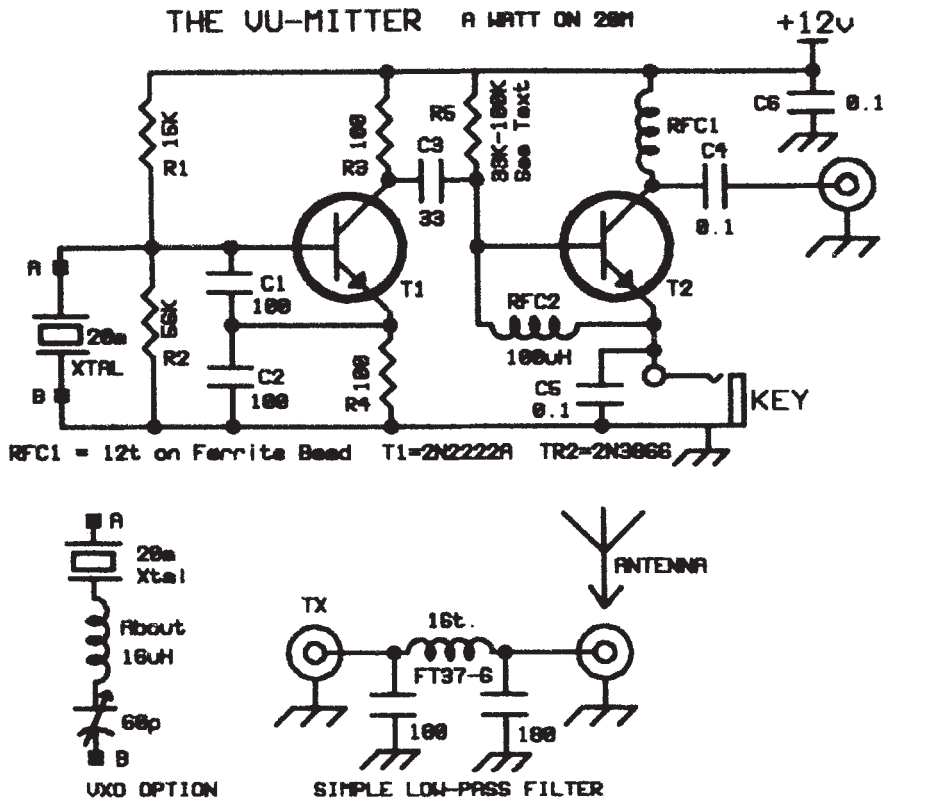
VC1 may be a mix of fixed and variable capacitance. The values for T1 and VC2 can be taken from the band table. To save additional calculations, I used the same value of inductance for all the bands from 40 to 20m. For 80m L1 is a larger inductance tuned with a larger capacitor. The figures in the table show the calculated values for VC2 to hit the International QRP Calling Frequencies on the 4 bands. These are 3.506MHz, 7.030MHz, 10.116MHz and 14.060MHz.

The higher frequency version of T1 (40, 30 and 20m) can be made using about 60cm of 26swg (about 25 awg) enamelled copper wire wound to occupy about three-quarters of the core. The version of T1 for 80m will need 32 swg (about 29 awg) enamelled copper wire.

T1 and VC2 should peak the output of the VXO at the desired frequency. This resonance ought to be fairly flat over the whole range of the VXO. If this is not so, the bandwidth of the tuned circuit can be increased by damping it with a resistor. Connect a resistor, try 4.7K or perhaps 10K, across the tuned winding of T1.

The VU-Transmitter for 20m

K.P.S. Kang, VU2OWF, of the recently formed VU QRP Club has designed several club projects based upon very small printed circuit boards. The first of these that I saw and built was a transmitter based on the W6BOY Pixie. My version is much bigger than the original - for ease of building.



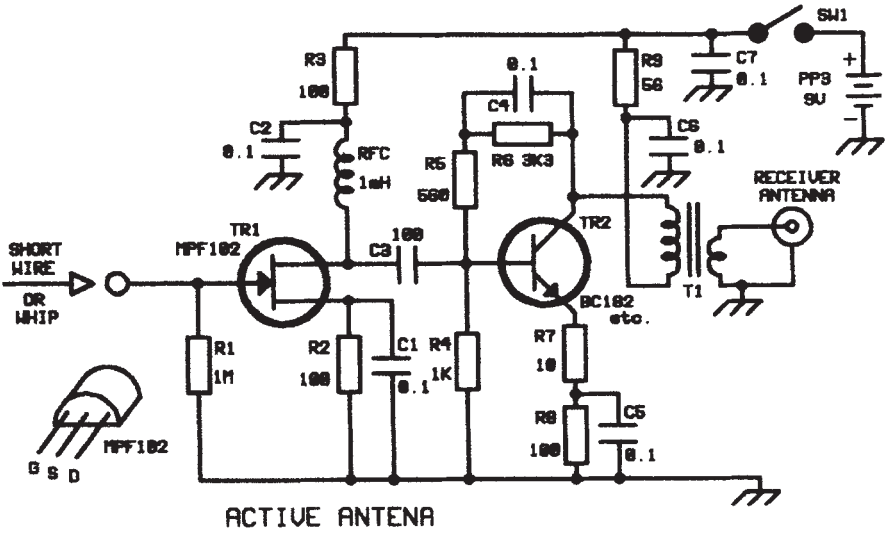
The drawing shows the circuit of the VU Transmitter. T1 is a Colpitts oscillator with C1 and C2 forming the capacitive feedback divider. The oscillator is crystal controlled but VC provides some useful frequency shift. VC can be a small variable capacitor or a trimmer. The maximum capacitance should be in the 50 to 75pF range. Larger values offer more shift but attempting to move the frequency too much will produce instability and eventually the oscillation will cease. The addition of an inductor of about 16uH will offer several kHz of frequency shift. [see VXO Option]

C3 couples the signal to the power amplifier, T2. The biasing resistor R5 controls the output of T2. Usually a value in the range 33K to 100K is suitable. The higher the value - the higher the output of T2. 47K is a useful starting value for experimentation. I suggest that T2 is not run higher than 1 watt of RF output power. It will get warm and a small star heatsink ought to be fitted.

The collector load for T2, RFC1, is a home made RF Choke. Carefully wind 12 turns of 38 swg (about 34 awg) enamelled copper wire (any small enough gauge will do) through a Ferrite Bead. RFC2 is a small 100uH axial choke which is essential when using T2 as the receiver mixer. It also provides a useful RF load on the input of T2 and increases the drive to T2. The transmitter output is coupled from the collector of T2 via C4 to a low pass filter.

An Active Antenna

It occurred to me that it might be useful to have a small general purpose active aerial for times when I might have a receiver and be without an aerial. The requirements seem to be for a small whip antenna, or similar, to feed a radio frequency amplifier capable of around 20 to 30 dB of gain. Too much gain and local noise or even internal amplifier noise becomes a problem and too little gain and it will serve little purpose. The short antenna will offer a high input impedance and the output will probably need to be low impedance to suit most receiver inputs.



ACTIVE ANTENA

The Active Antenna is a two-stage amplifier using a FET followed by a bipolar transistor. The FET stage offers a high impedance to the small antenna.

I chose not to use the usual telescopic whip but mounted a socket for a short wire antenna. Apart from saving the cost of a telescopic whip, this has several advantages. The length of wire can be varied according to the desired amount of signal pick up, the wire can be moved around for best reception and the unit is smaller.

TR1 is an MPF102 but the common 2N3819 would do the job. Be careful about the pin placement, they are not the same. TR1 is biased by choice of the source resistor and a 1mH RF Choke provides a RF load at the drain. Although no large signals are involved here, it is wise practice with these FET RF amplifiers to keep the input physically away from the output.

The Bipolar RF amplifier, TR2, uses shunt feedback between the base and collector and the un-bypassed emitter resistor also provides some degenerative feedback. Most common transistors will serve for TR1 although it should have a fairly high fT.

A small RF Transformer matches the output of TR2 to the typically low impedance found in receiver input circuits. I opted for a very simple choice, a transformer wound on a small "pig nose" ferrite former - they are common items in the surplus market.

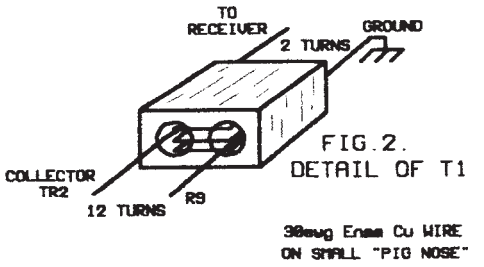


FIG.2.
DETAIL OF T1

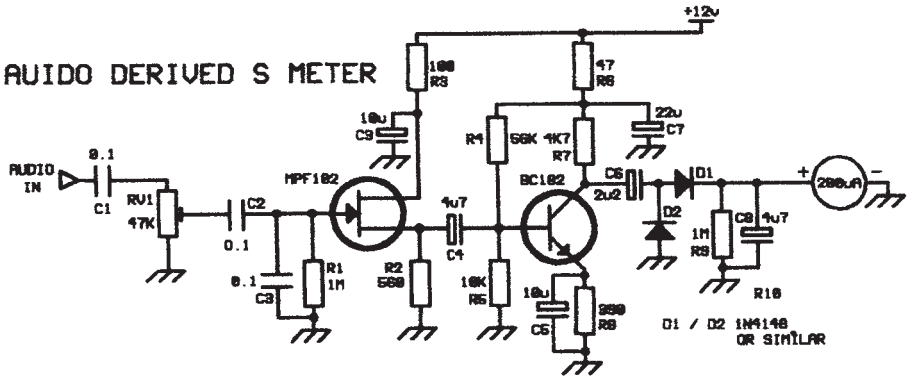
Fig.2. shows the winding of the transformer. The primary is 12 turns of 30 swg (about 28 awg) enamelled copper wire and the secondary is 2 turns wound from the opposite end. Fig.2. also shows how the connections are made to the transformer. More sophisticated constructors might like to make a trifilar wound 4:1 RF transformer but the simple arrangement I used appears to work well.

This simple little circuit appears to be at home with a variety of receivers and is a useful extra item to have for casual listening without resort to a larger antenna.

An Audio Derived S-Meter

When operating a receiver, there is something re-assuring about having a little meter needle dancing up and down in sympathy with the signal strength. The fact that it may not be doing much in the way of objective measurement seems to be of little importance. The more experience operator knows what an S7 signal sounds like on the receiver and also tends to doubt anyone who says "you are S7 on the meter". Many S-Meters only offer subjective readings but they do look nice on the front panel.

So I begin this little project with honesty. The meter described here has no objective accuracy at all, but it does indicate the relative audio output of the signal being tuned. Its chief advantage is cosmetic - it makes the front panel look better and gives the pleasing effect of seeing the signal as well as hearing it. It is based on a circuit by HE9VXB.



Since the circuit has to connect to the existing receiver audio stages, it is important that it does not offer a significant load to these circuits at the point of contact. Thus the input stage for the S-Meter offers a high impedance. A relatively high value pre-set potentiometer feeds the signal to a FET stage. This arrangement is unlikely to have much effect wherever it is connected, apart from sampling the audio signal. The stage really acts as an impedance transformer.

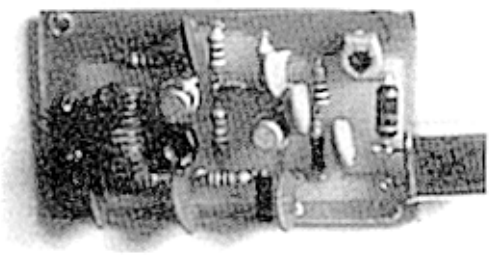
The capacitor, C4, couples the audio signal to a relatively high gain audio amplifier stage. This uses a bipolar device. Once again this could be almost any generic NPN transistor. I have stocks of the BC182 so that is what I used. If, in practice, the overall gain of the S-Meter seems a little low, try increasing R4 to around 100K ohms.

The capacitor, C6, feeds the audio signal to a detector circuit. which converts the audio signal into a relative DC signal. D1 and D2 act as a voltage doubler detector to drive the meter from the load. R9. The diode types are also uncritical. Mine are the popular 1N914. or they may have been the 1N4148 - who knows!

C8, a 4u7 capacitor, smoothes out the movement of the voltage. This may need a little experimentation. If you want the needle to give steady readings, increase the value of C8, if you like it to dance around a little, decrease C8. I found that 4u7 was a good compromise value.

The meter is one of those small edge-wise CB type S-Meters so often found at reasonable prices. They usually have a full-scale deflection of some 200uA. Any meter with a similar full-scale deflection would do the job.

The question remains - where to connect the S-Meter? I tried the circuit on several receivers, from simple direct conversion receivers to commercial superhets. The most appropriate place seems to be at the top end of the audio gain control. Not the slider of the control as this would obviously change the reading as the audio gain control was used. In most cases this will give enough audio signal to produce a useful range of readings. However it is possible to connect the input of the meter further down the audio amplification circuitry. There is no reason why it cannot be connected directly on to the output at the loudspeaker or headphone socket. The only answer is to try it and brighten up the front panel of that simple receiver.



The VU Transmitter
built on a printed circuit board as used in the Kit version of the Weekender projects

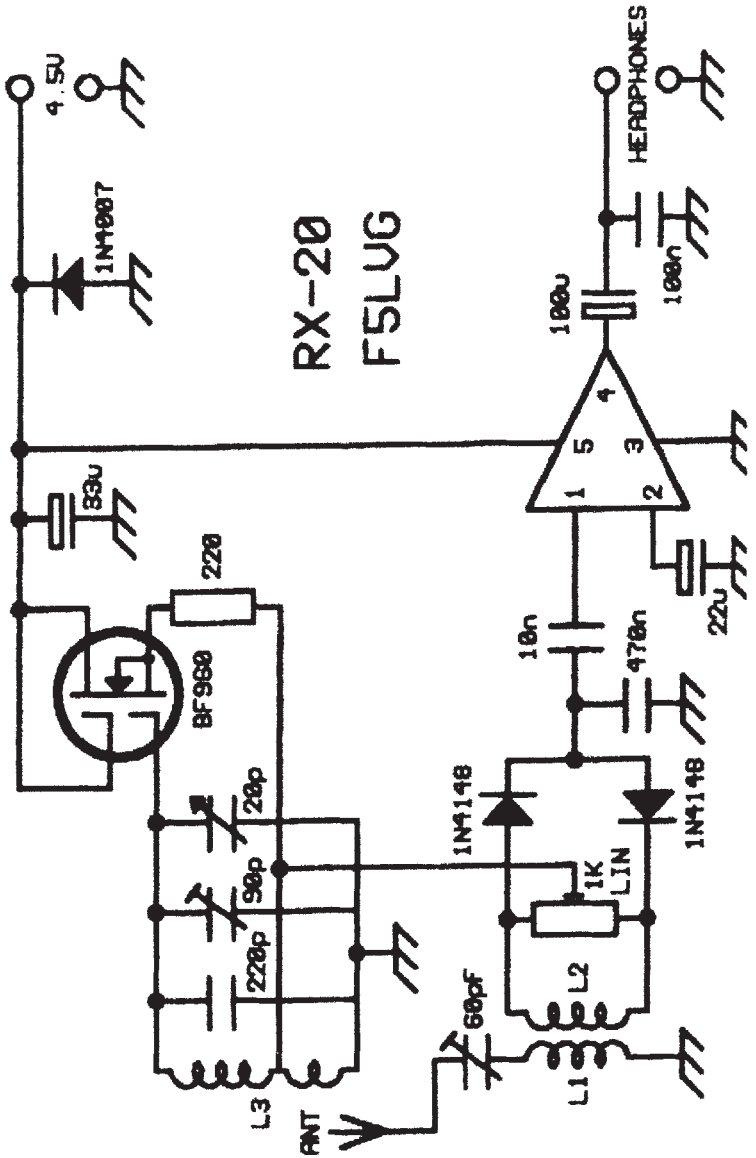
THE WEEKENDER KIT OFFER

The "Weekender" projects were first offered as part of the Four Days in May Symposium at the 1999 Dayton Hamvention. This included a full kit of parts for all four projects. The kit contains PCBs and all the parts [ex crystals] to build 4 projects described above.

The Weekender Kit is offered at:
£16 including UK postage and packing - £17 for EU postage and packing
Orders to:
Frank Lee G3YCC, 8 Westland Road. Kirkella. HULL. HU10 7PJ.
Please make out cheques to "G QRP Club"
Visa/MasterCard is available for overseas orders
Some Weekender kits are available at $25 from BILL KELSEY N8ET, 3521 SPRING LAKE DR. FINDLAY. OHIO 45840 U.S.A. [Kanga@bright.net]

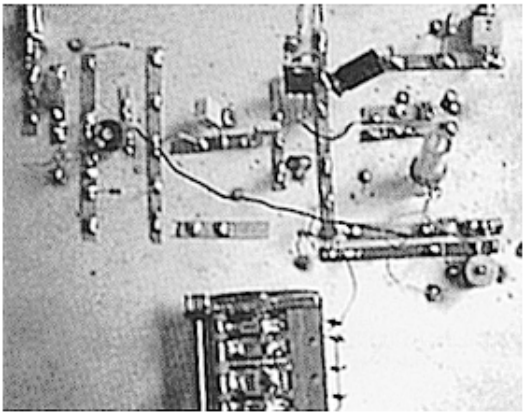
The RX-20 Receiver

Olivier Ernst F5LVG, 2 Rue de la Philanthropie
Marcq-en-Baroeul. 59700. France



In the 1970's I discovered regenerative receivers in old books. In the 1930's radio amateur were received world-wide on an 0-V-1 receiver. I built this kind of receiver with valves and then with transistors. It works fine but has shortcomings. A few years ago I discovered simple direct conversion receivers with a two diode-balanced mixer. With the same number of components, the results for SSB and CW are better than those obtained with a regenerative receiver.
This is a 20 component receiver built for the 40m band [SSB and CW]

The antenna trimmer is tuned for signal intensity, depending on the antenna. The 1K lin preset is adjusted to avoid AM detection and the tuned circuit trimmer is adjusted to receive the 40m band. L1 and L2 are moulded small chokes glued together for coupling. L1 = 22uH, L2 = 100uH. L3 is 15 turns, 8mm diameter, tapped 3 turns from ground - wound on a section of a "Bic-Type" ballpoint pen barrel. The Audio IC is a TDA2003 driving Walkman type headphones.



The oscillator achieves high stability by using a UHF MOSFET [BF960] an NPO 220pF capacitor and the 220 ohm resistor. The resistor increases the MOSFET impedance and decreases the phase differences between the input and output of the MOSFET. These characteristics significantly increase the frequency stability.

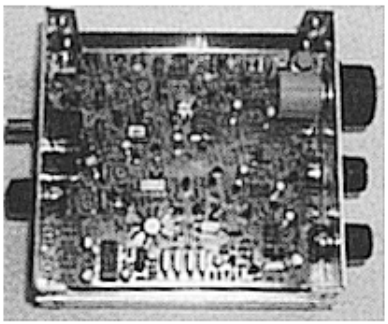
The power supply is a 4.5 volt battery [3-5 volts is suitable]
My prototype was built "ugly style" by gluing strips of PCB material on a PCB base plate.

Rochdale Mini-Convention 1999

Saturday 23rd October 1999.

St. Aidan's Hall, Sudden, Rochdale

For full details see SPRAT 99 or send an SAE to G3RJV

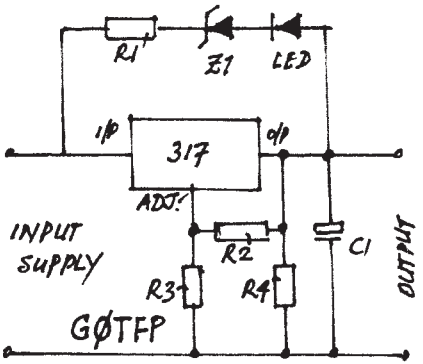


Rochdale Mini-Convention
Prize Draw
Win a NorCal-20
20m. CW Transceiver Kit
Presented by
Doug Henricks and Dave Fifield
Proceedings to St. Aidan's Church

Take 20

Regulator with Fail Safe Monitoring

Jim Brett G0TFP,11 Manor Rd. Tyldesley, MANCHESTER. M29 7PH



COMPONENT LIST

	3v. out	6v. out	9v. out
R1	470R	470R	470R
R2	220R	220R	220R
R3	300R	820R	1K3
R4	220R	470R	680R
C1	1uF	1uF	1uF
Z1	6v2	2v7	omitted

There is always a danger that a regulator circuit can fail and feed through the full voltage. "Crowbar" protection is all right but one never knows on switch on if the system is in a working state.

The provision of the LED indication in the circuit ensures that with it lit the output voltage is equal to or below the required.
The rule is thus " if the LED is not lit do not switch the following equipment on".
Any failure of the LED circuit means no light on hence this monitoring circuit is virtually fail safe, which is more than can be said for crowbar circuits and the like.

The circuit using a standard 317 regulator and values are given for output voltages of 9,6 and 3 with an input of 12-13.5 volts. Note the zener diode is only included in the 6 and 3 volt output application.

160M Cross Town Transmitter [SPRAT 99] George Fare, G3OGR, comments: Some people have pointed out that the varicap diode specified in the transmitter (BB212) is very hard to get. I have now changed this to a BB112 with the anode to ground and cathode connected to the ceramic resonator. BB112s are available from JAB Electronic Supplies.

Building with Valves?

Those constructors who build valve equipment and find suitable components difficult to obtain may like to contact **ISOPLETHICS**, 13 Greenway Close, North Walsham, Norfolk, NR28 0DE, who produce a range of difficult to obtain parts. A recent addition to their range is a 2.5mH [220mA] RF Chocke. Please send an SAE with enquiries about their products.

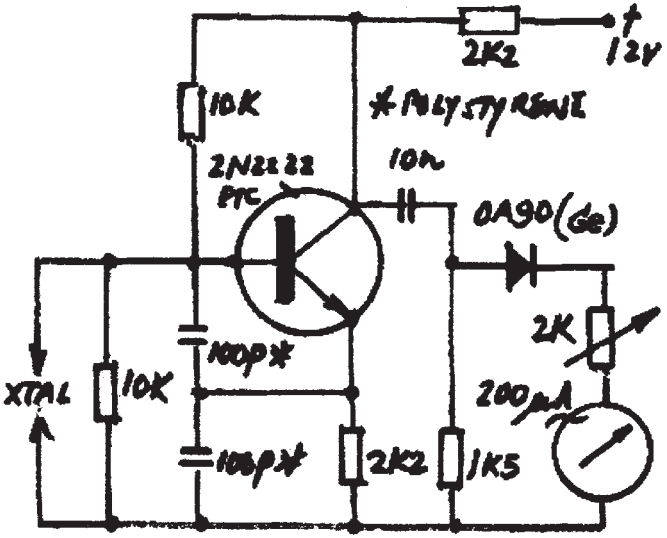
Two Way QRP QSL Labels and Blank G-QRP QSL Cards

QRP Labels: Black Lettering on Gold with Club Logo : 200 labels £2. Post inc.
Blank QSL Cards: You complete your address and call. Blue lettering on white card, 5.5" x 3.5". 100 cards £4. Post inc. Sample from : M.L. Prickett [Max] G3BSK, 260 Haslucks Green Road, Solihull, West Midlands. B90 2LR.
Cheques: "M.L. Prickett" [The G QRP Club benefits from each order]

Take 20

A Crystal Checker

Walter Farrar G3ESP 1 Barnsley Rd. Ackworth. WF7 7BS



A small defunct multi-meter provided the 200 uA meter and the 2 k-ohm "Ohms adjust" variable resistor. Everything else was stripped out of the case, including the matrix of test-lead sockets. The Crystal Checker circuit, on a 30 mm square pcb was fitted inside the case. Maybe I could have put inb a PP3 battery as well, but it is simpler to use the bench PSU.

Two wires are brought through the front of the meter case and small insulated crocodile clips attached. These are for connecting the crystal for test, as crystals come with various pin spacings, or even wires only.

In use, the crystal is clipped in and the meter should give a reading, deflection being adjusted by the variable 2 K-ohm. Two crystals of the same frequency may give different deflections: the one with the higher reading being the more active. If the crystal frequency is unknown, connect it up and start from the low-frequency end of a general-coverage receiver and tune upwards until you hear the signal loud and clear. Read off the dial to get the crystal frequency. (if you start tuning from the high-frequency end of the receiver you may pick up a harmonic of the crystal frequency, which could lead you astray).

FOR SALE: Ten-Tec Argosy II 50w/5w transceiver (Model 525 D), with original manual, power supply and (unused) desk microphone. Good CW rig with xtal/audio filters and full break-in. Price £440 plus carriage/packing at cost (but free personal delivery possible up to 75 miles). Tony Smith G4FAI, tel: 01263 821936 (Sheringham, Norfolk). E-mail: g4fai@connectfree.co.uk

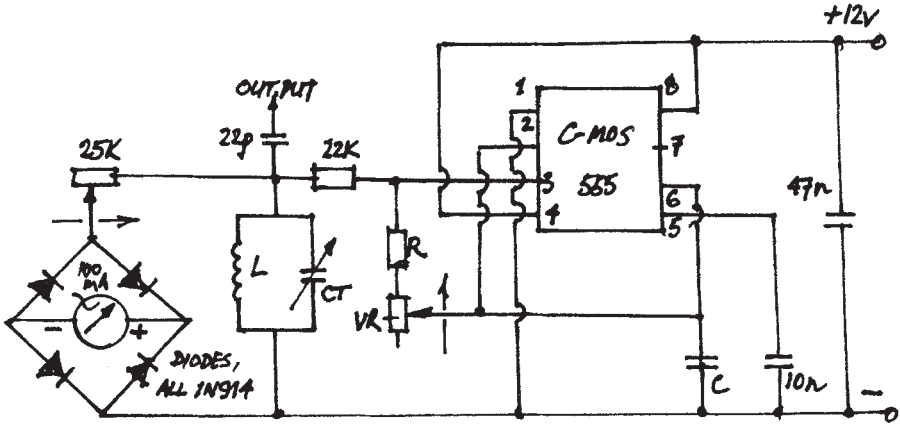
FOR SALE: KW2000B, ac psu + spkr. Manuals and cct diagram, mic and some spare valves (not pa) - £130. MFJ portable antenna, complete - cables, base box and whip, see http://www.mfjenterprises.com/antennas/mfj1621.html for full details. £30 Contact Ken, G4SGF (0114) 230 2352 or via ken@klat.freeserve.co.uk

FOR SALE: Tokyo HT-120 14MHz SSB/CW Mobile, fitted CW filter, ideal QRP £140. AR-1000 Scanner £99, Alinco DR-M06, fitted improved filters £140. All Mint, Boxed, No Offers Please. Mark, GØOIW, Reading. 0118 948 3593 or 070107 144 48.

Take 20

A Simple RF Source

Jim Brett G0TFP,11 Manor Rd. Tyldesley, MANCHESTER. M29 7PH



The circuit relies on picking out the fundamental or harmonic from a square wave generated by the 555.

It is essential to use a CMOS version of the 55 to obtain the higher frequencies and faster edges for selecting the harmonics.

The basic frequency is given by $f = \frac{10^3}{1.4CR}$

where f is in MHz, C in pF and R in KΩ

In choosing "C" and (R+VR) the following derivations may be useful :-

$CR = \frac{10^3}{1.4f}$ $C = \frac{10^3}{1.4f}$ $R = \frac{10^3}{1.4f}$

Fundamental setting of the 555 circuit is carried out using a receiver place close, preferably a PLL type

As a guide to cover top band make C = 100pF, R = 3K, VR = 1K

For 100kHz make C = 1000pF with total R = 7.1K and for 1MHz, C = 100pF with R = 7.1K
In general for fine control a 1K pot was used and thus calculations should consider "R" as the fixed resistor plus half the value of the pot.
Values below 2K2 total resistance should not be used, select a smaller capacitance instead.
For a wide range oscillator the fixed resistor could be made up from 2K2 fixed and a pot of 25 or even 50K with L and Cr to suit.

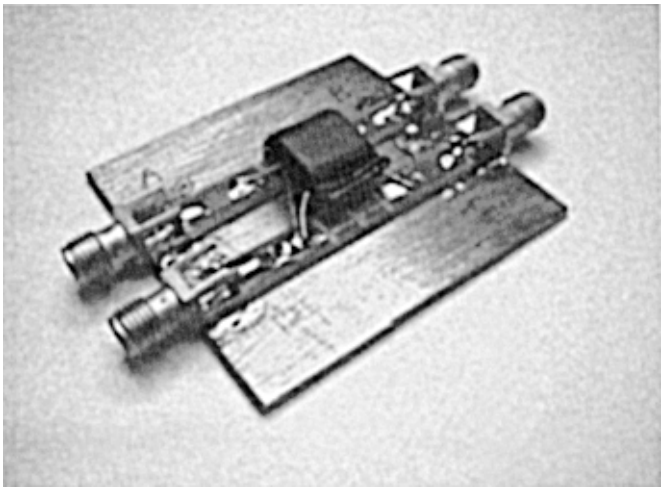
The circuit is remarkably stable if built in a metal box and run from a stabilised supply. It lends itself to a range of applications. e.g. making L and Cr tune to the IF of a receiver and using it as an external VFO for a direct conversion receiver as well as using it for a signal source for test purposes.

With a little imagination this circuit principle could form the basis of many ideas.

A Compact Directional Coupler for the Quiet Tuner

Tony Lymer GM0DHD 16 Gerson Park, Greendykes Rd, Broxburn, EH52 6PL

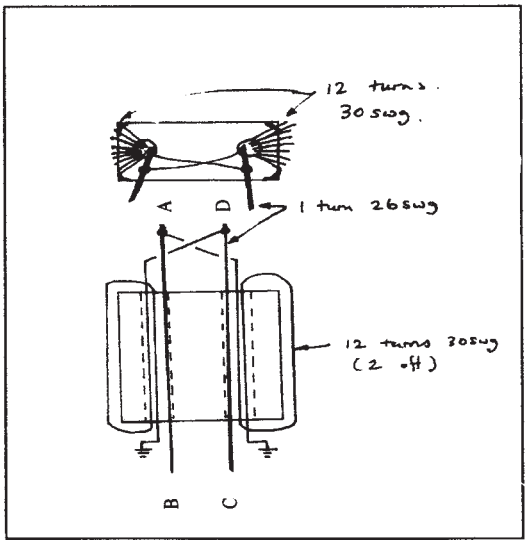
The directional coupler is the heart of the Quiet Tuner (SPRAT 97), several members have asked for details of how to build it. This simple, small, directional coupler only uses one magnetic core. It has a wide bandwidth and adequate power handling for QRP operation. It should be ideal to incorporate into your own transmitter design, or add to an existing rig.



The wire diameters are not critical. The core is a FAIRITE 2843000302 (Cirkit P/N 55-91175, currently costing less than 50p each). It works happily at 5 watts, but I haven't tested it above this level, because I don't have a high power transmitter.

Start with the two 12 turn windings of insulated wire. The number of turns is the same as the number of times the wire goes through the hole. The two single turn windings are added next, just slide a piece of wire through each hole.

The other "half" of the turn is completed by the circuitry you connect to the coupler.



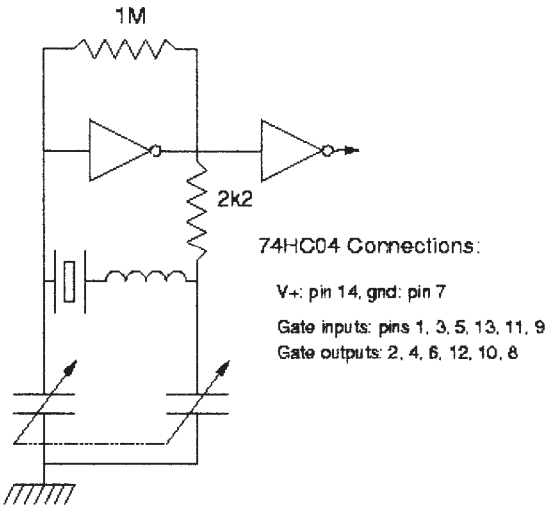
Construct the coupler as shown in the photograph or diagram. Connect into the Quiet Tuner using the letters ABC and D. These letters also appear on the schematic of the GM4ZNX power meter (SPRAT 61 p12), and this coupler could be used to reduce the overall size of David Stockton's design.

As built, the coupler covers 1.8 MHz to 50 MHz, but will work at reduced performance at 145 MHz.

Ceramic Resonators for Cheap and Cheerful VFOs

Jack Ponton GM0RWU, Legerwood, EARLSTON. TD4 6AS
Email : Jack@ecosse.ord

Ceramic resonator oscillators are as easy to construct as crystal oscillators, and nearly as stable and reliable. They can however be pulled over a much wider range, making them almost as good as VFOs for narrow bands or band CW segments. Resonators are now available for a number of frequencies useful for the amateur bands, not just the well known 3.57 MHz component. My basic resonator circuit uses a CMOS chip, and can be found in Sprat 92.



The Low Bands

For 80m a typical 3.57MHz resonator will cover from minimum capacity: 3.61MHz, to maximum capacity: 3.48 MHz, a total span of about 130kHz. A single resonator thus easily covers the whole of the CW section of 80m. It makes me wonder why anyone uses crystals for 80m CW/dc rigs! More recently introduced 3.695 MHz resonators cover much of the rest of 80m. Typically we can obtain 3.568 to 3.734 MHz (166kHz span). A single resonator can cover nearly all of the 'rest' of 80m. I have tried two switched resonators. Layout should try to minimise stray capacity as this will reduce the maximum frequency.

After seeing George, G3RJV's article in the January '98 Practical Wireless, I tried putting a 10 μ H axial inductor in series with a single and a pair of 3.69 MHz resonators, with the following results.

- Single resonator: 3.53MHz to 3.73MHz, span about 200kHz.
- Pair of resonators: 3.53MHz to 3.75MHz, span more than 220kHz.

In both cases stability seemed as good as with a single resonator without an inductor. Adding a second resonator has much less effect than with crystals, but does give a small increase in frequency. North Americans or those wanting to try the top end of the band there is a 4 MHz resonator which with a 22 μ H inductor will pull down to 3.78 MHz.

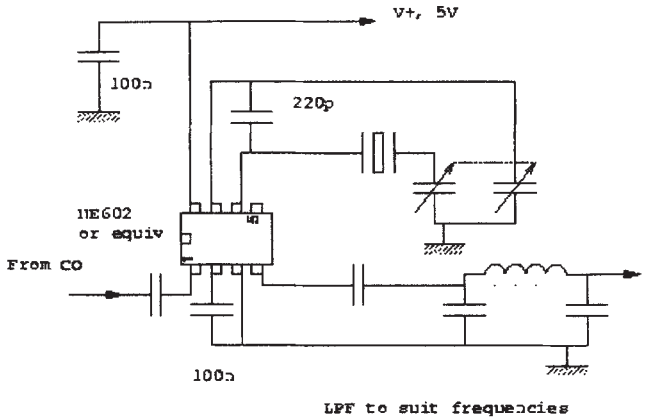
I originally used a 350pf dual gang air variable. High quality capacitors usually have lower minimum capacity, but this only matters if you want to squeeze the absolute maximum high frequency out of the circuit. Almost as good performance can be obtained with the cheaper and more compact plastic variables.

For **Top Band** 2MHz resonators will cover from about 1.92MHz to above 2.02 MHz. This covers a useful part of the band including all the novice section. There is clearly no point in using a second resonator as the top end coverage is more than adequate.
Adding series inductances of 10, 22 and 47 microhenries brings the bottom end down to 1.95. 1.89 and 1.875 MHz respectively, with the upper limit still reaching the top of the band. Higher inductance results in loss of stability.
Not all 10MHz resonators will stretch to the top of the **30m band.** However, by minimising the capacitance of the variable and stray capacitance I can get better than 10.170MHz consistently using the basic CMOS circuit and Maplin resonators (part number DJ38R). The cheapest variable capacitor available (Maplin FT78K, 142+59pF) is satisfactory with the trimmers set to minimum capacity. Tuning is significantly nonlinear, typically from 0 to 50% meshed positions cover the top two thirds of the frequency range.
The capacitance at the gate **output** (for a CMOS oscillator) seems to have a larger effect than that on the input, so when a twin gang capacitor is used put the smaller capacity gang, in this case the 49pF `oscillator' section, on the output (e.g. pin 2 on the 74HC04).

Resonator Stability and VFOs for the HF bands

Some resonators are more stable than others. I obtained two types of 3.69 MHz resonator from Farnell Components (they can now also be otained from JAB). The results given above are for Murata components. The much cheaper Newport resonators also supplied by Farnell showed a greater pulling range, right to the bottom of 80m with no inductance added, but seemed much more prone to drift.
From Murata's data sheets, the temperature stability of their type MG resonators, for frequencies up to 6.3MHz, is nearly twice as good as that for the type MT, used at higher frequencies. Since the stability is a percentage of operating frequency, it will be best to use as low a frequency resonator as possible. The 30m VFO using a 10 MHz resonator is thus a bit marginal. Similarly using higher harmonics of the MG resonators would be undesirable for a transmitter, although OK in receiving aplications.
However, better stability can be obtained by using resonators at less than 6Mz and mixing with a crystal oscillator. A `breadboard' was built up using an NE602 in the cicuit below.

This test version used a 10MHz resonator, which is not recommended, for reasons of stability, but a 24MHz crystal was to hand, This provided coverage of 20m from below 13.990MHz to 14.280 using a 350pF variable. A suitable output network is used in the `Gremlin' TX (Sprat 82). It would be better to use a 6MHz resonator and a 16MHz crystal, see table below.
In principle one can use either additive or subtractive mixing. The latter leads to an intrinsically cleaner design as most of the spurii will be above the output frequency. Also a lowpass, rather than a bandpass filter can be used to clean the signal up.
Looking for common computer frequency crystals, all obtainable new for less than about £ 2.0, and keeping to resonators of 6MHz or less, the following all look possible. Experiments suggest that 4MHz resonators can be pulled reliably down by 100kHz and 6MHz by about 150kHz, and both of these can be increased by using suitable inductors. It is easier to pull down than up, another advantage of subtractive mixing in this application.



Band, MHz	Resonator, MHz	Crystal
7	4	11 or 11.059
10.1	6	16
14.0	6	20
18.068	6	24
21.0	4	25
28.0	4	32

I haven't yet identified a suitable combination of a cheap crystal and stable resonator for 12m. As described by GM3RXU in Sprat 86, 40m can also be covered without a separate crystal oscillator by feeding the VFO from pin 7 of the NE602 through the capacitor to pin 1. A separate crystal oscillator will however give better stability.

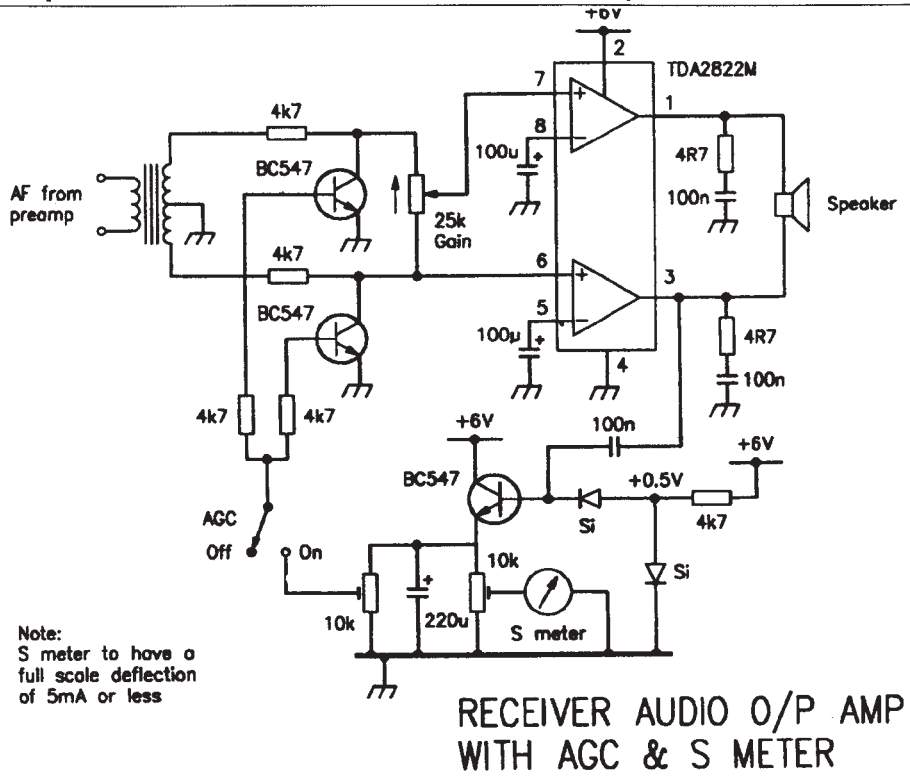
Other Applications

I have looked at only at generating frequencies in the amateur bands. There are too many possible IF combinations for me to consider all the possible mixer VFO superhet designs!
However, the original Epiphyte (Sprat 81) used a 4.19 MHz resonator which in my version with a 100pF capacitor pulls between 4.155 and 4.212 MHz. This lets my Epiphyte cover 3.70 to 3.76 MHz. Testing another resonator in a CMOS circuit with a twin gang capacitor doubled the span to about 120kHz down from 4.258 MHz. I now know also that 4MHz resonators can be pulled by more than 200kHz with an added 10µ H inductor, so coverage of the entire 80m SSB band is in principle possible with a 455kHz IF.
I have built a simple DSB exciter from a single NE602, feeding a standard electret mic into pin 1 through a 330nF capacitor and using the built in oscillator with a resonator. This is not advisable with a true VFO as the high level audio signal, typically several hundred mV, will pull the frequency causing a rather nasty FM-ing effect. The resonator seems to be sufficiently stable to avoid this problem, at least as far as my ears can detect. An output of a few milliwats of DSB (at 1k5 impedance) should be available, as the chip has 17dB of gain, and could be used to feed a simple linear.

Audio Output Stage for Receiver

Bill Currie VK3AWC P O Box 5197 Mordialloc Victoria 3195

Reproduced from LO KEY : Journal of the CW Operators' QRP Club Inc



This audio amplifier has AGC and "S" meter functions and works from 6 volts. It uses the TDA2822M stereo amp IC. The bottom half of the TDA2822M is "flat out" all the time thus giving independent AGC and "S" Meter operation. The top half can be varied from in phase [no sound] to out of phase [maximum sound] and does not affect the "S" Meter.

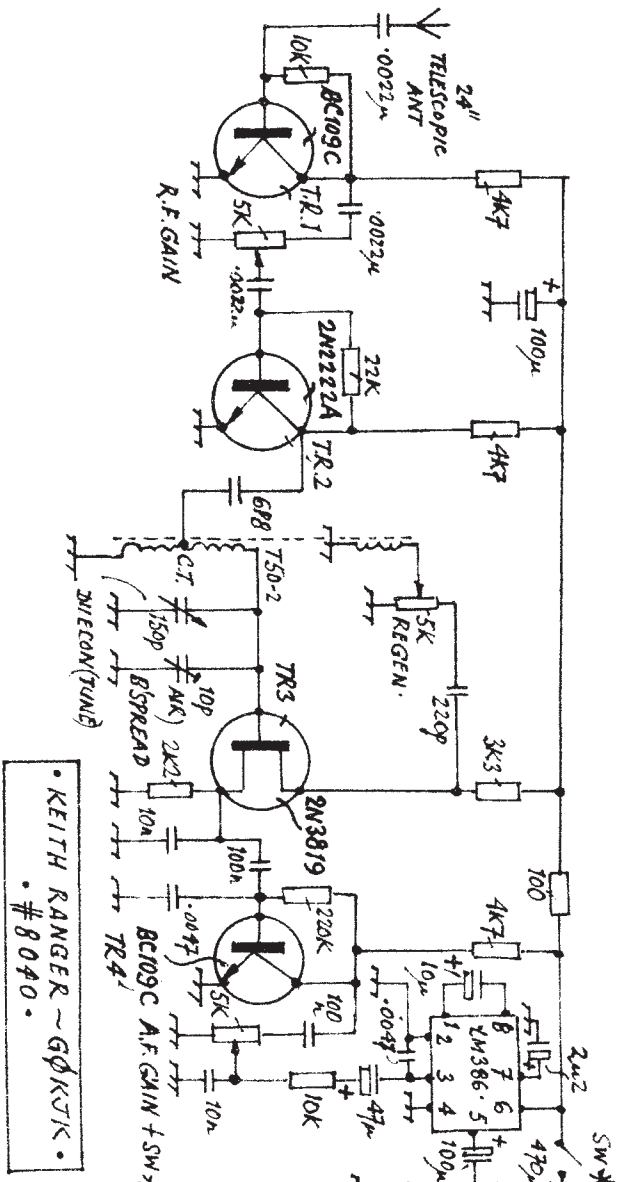
FOR SALE: FT-7B, Yaesu, with Mic and handbook. GWO £200 or swop solid state military gear, esp. PRC316/A-16. John G3GTJ, Somerset. 01963 - 240319

WANTED: Scrap HW7 or HW8, also cover for RAF D-Type Key. Adrian, G4GDR QTHR or 01793 - 762970.

WANTED: Crystals for 7.075, 7.050, 14.150, 18.120, 21.2MHz. freqs are aprox, prime aim it to be well within the phone part of relevant bands.
FOR SALE: Kanga LCK 20m, built, output power more than 1 watt £21, Mobile Whip for 6,2,&70cm £20. Open to offers, call David on 01322 381303, or write: D. Rowlands, 7 Broomfield Rd. Swanscombe, Kent. DA10 0LU.

A Telescopic Antenna DX Receiver

Rev. Keith Ranger G0KJK, 28 Charter Rd. ALTRINGHAM. WA15 9RL



The QRP movement is all about achieving more for less, for example working the world with 5 watts. Then about this for a challenge? The aim is to build a simple, non-Superhet short wave receiver to achieve HAC (Heard All Continents) with only a 14" telescopic antenna.

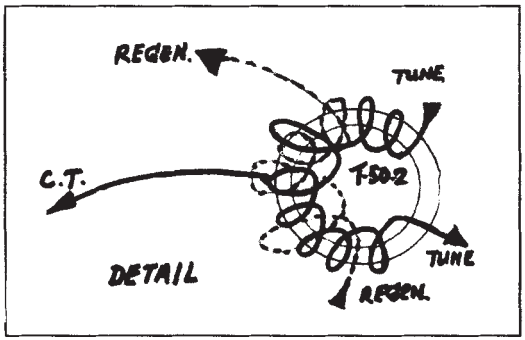
It was an expected, encouraging telephone call from a fellow club member that sparked off the idea. He said, "I built two MB4 receivers in one weekend for the design in SPRAT 97. What amazed me was hearing DL on 40 at S9 using only 6" of wire." The circuit here takes things much further. It has a more powerful front end than the MB4 and has received stations from thousands of miles away with the telescopic whip retracted to only 5 inches.

Many simple receivers, especially Direct Conversion ones, suffer from a relatively "deaf" front end for which AF amplification cannot compensate. This simple TRF design is different. This is how it works. The first RF stage, using a high gain BC109C, makes the receiver see its poor telescopic aerial as much longer. This is the active antenna principle. The greatly improved input signal is then fed via via a tri-functional 5K variable resistor (about which, more later) to a second RF stage, this time based on a 2N2222A transistor. By the time the amateur signals reach the 2N3819 Detector stage, they compare favourably with those delivered by a much more efficient antenna.

The operational heartland of this unusual but powerful little receiver is its three 5K variable resistor controls. The first separating the two RF stages can do three things. Once you gain some experience in using it, you will realise its versatility. It can attenuate the strongest signals, amplify the weak ones and act as a clarifier of SSB signals. If SSB signals are roughly tuned in using the receiver's 10pF bandspread control, a slight forward or reverse movement of this %k resistor konb will give clear speech resolution. The long suffering XYL does not deny this but took exception to an ear splitting S9++ SSB signal from an EU station. It was not worth pointing out that the whip was fully retracted to 5" at the time! Please note that because of the high RF gain needed to deliver the DX, the detector may complain of overload at certain frequencies. If so, simply back off the gain a little.

The second 5K variable at the detector stage controls the regeneration. Both CW and SSB signals are received with the Detector gently oscillating - AM signals just short of this point. The third 5K control is for AF gain and will often need to be held well back. The reason is that AF gain and room filling volume from the speaker is provided by another high gain BC109C and an LM386 chip. The receiver can be powered from a 12v PSU or for portability, a PP9 battery. The prototype uses a 12v PSU with almost no hum problems.

Few difficulties should be encountered with the construction and operation of this receiver. A wiring diagram is not provided, but observe keeping the RF and AF wiring well part to prevent unwanted feedback. Tuning and regeneration coils are wired over each other on the T50-2 core and in the opposite sense - the tuning coil centre tapped and approximately a third of the number of turns for the regenerative windings. "cut and try" methods must be used to secure exact frequency coverage. Three coils and a rotary switch can give all 9 HF bands. Mine cover: [1] 32/10MHz, [2] 10/3MHz, [3] 1.5MHz/MW (to follow the fortunes of Ipswich Town Football Club on Radio 5!). For starters, try 24 turns for the tuning coil, centre tapped at 12, with 6 - 8 turns for the regeneration, see what is covered and take it from there. A little experimentation will give you what you want. The 24 turns will probably get you the 14 and 10MHz amateur bands, although coverage could be



as high as 21MHz or as low as 7MHz, depending on stray capacitance and the tuning capacitor used. *If with the coils wound and inserted, the Detector FET will not oscillate when the 5K regeneration control is rotated clockwise, reverse the connections of the regenerative winding - this should solve the problem.*

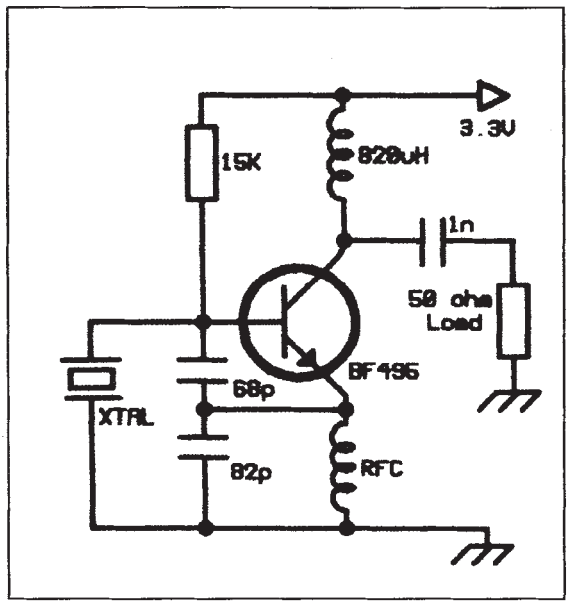
Your aim is HAC with a home-built simple receiver. Let me know how you get on !

Low-Voltage Oscillator features Increased Spectral Purity

Marco Eleuteri IK0VSV, Via Paolo Rolli 18, ODI (P). I-06059. ITALY

A common problem in crystal sinusoidal oscillator is the excitation of unwanted modes of the quartz crystal that degrade the spectral purity of the oscillator.
This problem is significant in overtone crystal oscillators , particularly for low voltage applications. In this case there is a compromise between oscillator voltage (power supply) and drive level of the crystal. If the low voltage (and current)of the transistor is very low, the crystal cant reach the minimum energy for correct vibrating startup.

The modification proposed is simple modification of Colpitts oscillator, in which the transistor's emitter is grounded through an inductor. The inductor increases the voltage gradient in the crystal plates during the transient response of the oscillator facilitating the crystal vibrations startup. Detailed analysis reveals that in overtone crystals the impedance is inductive at the crystal's fundamental frequency, whereas this impedance becomes capacitive at the desired overtone. Therefore, the desired overtone oscillation will be easily started and the undesired fundamental frequency perturbations are avoided.



In addition the overall transfer function has a low pass behaviour that eliminates higher harmonics in the oscillator output. This circuit has been used in the production of 27 MHz oscillators for industrial applications. Without the proposed modification about 23% are failed . With this mod practically ALL oscillators run correctly.
On other hand , the Total harmonic distortion (thd) with a classic Colpitts (with a resistor 47k ohm instead of inductor) is 28% and with inductor (Colpitts modified) is around 0.32%.

Ref: universitat politecnica de cataluna, Barcelona Espana
An article appeared on ELECTRONIC DESIGN 11/98 issue.

INFORMATION WANTED: Epiphyte-2 on 40 metres? Anyone with information please contact Chas Wilson 01775 - 766398

THE DRAINPIPE SPECIAL

AN IDEAL LOW PROFILE ANTENNA FOR THE QRPer

Leighton Smart GW0LBI 33 Nant Gwyn, Trelewis, Nr Treharris. CF46 6DB

I've used 'low profile' antennas ever since I got my amateur licence ten years ago. Most of them have been wire antennas, such as dipoles and long wires antennas which in the main do not attract too much attention from neighbours and passers-by.

However, apart from indoor antennas, the ultimate in low profile RF radiators must be the plain old rain guttering of the house.

About four years ago, in a fit of curiosity, I ran a length of wire from the station ATU through a hole in the window frame, and up the front wall of my house, fixing it to the aluminium guttering above.

I live in a semi-detached property, with the guttering 'shared' by both ourselves and next door. The down pipe is on my side, falling to a length of around 20 feet, while the guttering itself runs for around 50 feet or so along the front of the two houses.

My 'down lead' therefore fed the top of the 'antenna' roughly in the centre, while the downpipe acted as a second 'vertical element'. The guttering and downpipe are firmly bolted to masonry, which although are 'earthy' nevertheless separate the antenna from ground.

The impedance? No idea at all. All I knew was that the tuning 'dip' was very sharp indeed, but nevertheless I could load it up for 40m with an swr of 1:1.1 with a bit of careful effort.

As luck would have it, I did this on Sunday during one of the major contests, and gave the 'antenna' a whirl during the evening on the 40m band.

With just 5 watts available from my station I didn't expect miracles from this antenna; in fact if I contacted anybody at all I'd have considered it miraculous!

However, I hadn't reckoned for the amazing 'ears' of contest operators. (Is it that they really have good ears, or do they just **want** to work you because there's a contest?)

Within a matter of minutes I'd worked a string of US stations, receiving the inevitable (but highly suspect) 599 reports. Despite this I was astounded tht I'd actually crossed the Atlantic with QRP power radiated from a drainpipe!

Things were to prove even more exciting later, with Turkey being worked, as well as the Canary Islands, plus a few European countries, and even Uruguay! Thus, in a matter of an hour or so, I'd 'cracked' 5 of the 6 continents with nothing more than the rain guttering as an aerial and 5 watts output of CW.

As the evening wore on, I reduced power gradually, calling US stations in particular, and still making contacts with the USA with as little as 0.5W!

On more 'normal' days- ie: with no contests, the antenna proved a worthy tool for everyday contacts with stations closer to home, and was used mainly as as standby antenna for 40m, although it also tuned up for 30m and 20, but I didn't use these bands at all at that time.

Perhaps I should have experimented a bit more on those bands, but I've always been more of a LF operator than HF.

As more and more builders switch to plastic guttering, it may be that the end is nigh for these ready-made antennas, but fear not, all is not lost!

If you live in a house without one of these built-in antennas, simpy run a thin wire up your drainpipe and across your guttering - it'll have less capacitance than guttering I know, but why not give it a try?

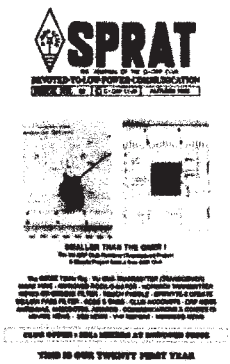
Enhanced Kenwood TS-520 QRP Operation

Dan Case KB0JUL, Ames/Beaman, Iowa
drcase@iastate.edu http://www1.iastate.edu/~drcase/radio.html

Use the switch on the back to switch the normal final screen voltage to the screen voltage used when the mode switch is in tune. I would have to have a manual to give more specific info. Then it will operate normally in all modes, except power is limited to what the tune level is. Reducing the screen voltage is how it is done in tune mode. Lowering the screen voltage will lower the maximum plate current you can draw.

I have used my 520 on QRP WITHOUT using this mod, and I have never had any finals get smoked (knock on wood) but the mod does work great!

SPRAT - The CD ROM



ISSUES 1 - 100 on CD ROM

The whole collection in PDF format to read or print
Prepared for the Club by Funk Amateur magazine
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Two Way QRP QSL Labels and Blank G-QRP QSL Cards

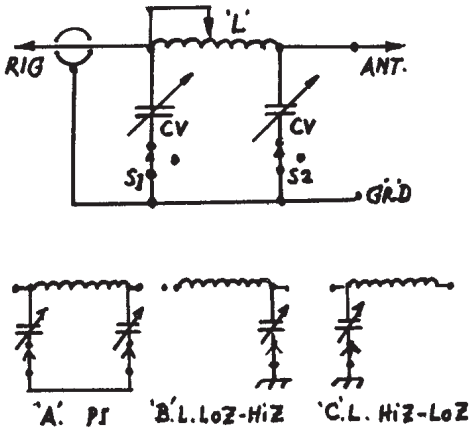
QRP Labels: Black Lettering on Gold with Club Logo : 200 labels £2. Post inc.

Blank QSL Cards: You complete your address and call. Blue lettering on white card, 5.5" x 3.5". 100 cards £4. Post inc. Sample from : M.L. Prickett [Max] G3BSK, 260 Haslucks Green Road, Solihull, West Midlands. B90 2LR.

Cheques: "M.L. Prickett" [The G QRP Club benefits from each order]

THE PILL - A VERSATILE ANTENNA COUPLER

AAA Technical Staff

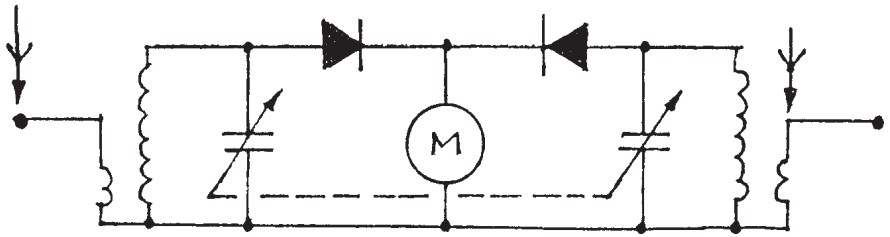


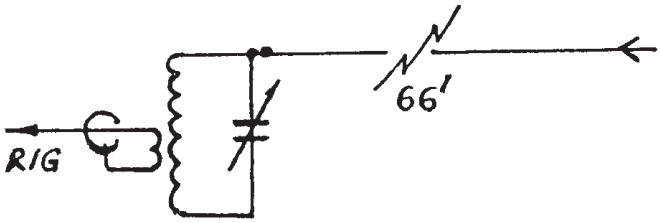
This is called the PILL becaue by operating two switches it can be configured as a pi coupler or as either of the two L-networks. The coil can be 40 turns on a 2.5 cm former for 7-28 MHz coverage, tapped at the first 4 turns and every fourth turn thereafter. the capacitors can be 250p or larger in capacity. It should provide a match to just about any length of end-fed antenna. It should also provide a good starter home brew project for the beginner.

THE G3GET NO-SWITCH ABSORPTION WAVEMETER / RADIATION METER

Peter Coppins, G3GET, 79, Westerham Road, Sittingbourne, ME10 1XF

This circuit allows two frequency bands to be covered with no mechanical switching. The original circuit used the two coils to cover an range of 14 to 63 MHz, but à suitable choice of coils and capacitors will allow 3.5 to 30 MHz to be covered. Constructin can be in a metal box, with the coils mounted outside, one on the left and the other on the right. It is recommended that the meter be a microammeter to give maximum sensitivity,and for the same reson the diodes should be Germanium types.





THE FUCHS VOLTAGE-FED ANTENNA RE-VISITED.

C.F. Rockey, W9SCH, PO Box 171, Albany,WI 53502, U.S.A.

Originally developed by J.Fuchs, EAAA and EAFZ (yes those were Austrian amateur callsigns at that time)the first description of this antenna appeared in QST for July 1928. My version, shown in the diagram above, covers 10 to 28 MHz. The tuning coil consists of 6 turns of 18 swg wire close wound on a 2.5cm diameter plastic former. I used an empty pill bottle. The link coil also uses 18 swg wire. Experiment with 1 to 3 turns, selecting the number of turns which give the lowest average swr on the bands covered. Wind this coil over the centre of the other coil. I used a 360p tuning capacitor, salvaged from an old BC set. The antenna wire can, if necessary, be bent to fit the space available. I really do guarantee it will work ! (if it does not, blame Rockey not us HI HI HI Ed.)

A NEW QRP CLUB IN PAKISTAN - AND AN INTERESTING ANTENNA.

Thanks to three Epiphyte transceivers for 3.5MHz, a Norcal 14 MHz transceiver, and a G3RJV 28 MHz transceiver, all donated via G QRP C, the Larkana Amateur and SW Listeners Club is now thriving and working loads of good DX , especially on 28 MHz QRP SSB. Their DXCC list is big, and they are also doing well on two-way QRP. Their Secretary is A.A. Quadri, AP2AHQ, and their address is ;- Quarter 81 (A.A.J.A,F.) ,Shaik Zaid Colony, Larkana-T1150 (SINDH) , Pakistan. Antenna space is rather limited at the Club. but they have been having a ball with a simple 28 MHz antenna. This consists of two inverted V dipoles, one running North/South and the other East/West. They are supported at the centre on a common 20ft high mast, and fed via a common 75 ohm co-ax feeder. Arshad, AP2AHQ, calls it the "DIV" (double inverted V) . sounds well worth a try.If you want Pakistan on two-way QRP SSB listen around 28480 to 28510 daily 1230-1630 UTC. Incidently, if anyone has a reasonably up-to-date copy of the Call Book to spare, this Club would love to have it! Next step has got to be getting them on CW as well so that they can push up their two-way QRP score !

OUR COMMUNICATIONS MANAGER LEADS FROM THE FRONT !

Peter, G3XJS, has become our first member to awarded a 100 country Endorsement to his Two-way QRP Countries Award. This is a really outstanding achievement, particularly as all contacts were made on CW. It can really be appreciated when one realises that his score is 30 countries above any other Endorsement so far issued. Well done indeed Peter ; we are proud of you !

THE KIVETON - A TRIANGULAR HORIZONTAL LOOP ANTENNA

Ian Roebuck, GoSVX, 3 Lodge Hill Drive, Kiveton Park, Sheffield S26 5RU

Needing an XYL-friendly antenna, I came up with the Kiveton. It is a horizontal triangular loop with a base 62 feet long and sides 42 feet long. It is fed via 300 ohm tuned line at the junction of the two sides. It is supported by a tree and two masts, and the average height is about 20 to 22 feet. It is intended for use on all bands 40-10 metres. It loads well on 10m, but has not been seriously tested on that band. On 40m all Europe has been worked, and on 20m , 17m, 15m and 12m VK and W have been worked on each band, plus a lot of other DX. The tuner I use is an S.E.M. Tranzmatch.
(Another happy horizontal loop user! This one should also work quite well on 80m with an Rr of about 5 ohms. Ed.)

AWAED NEWS

NEW QRP MASTER. We welcome G3JNB to the Worshipful Company.

QRP COUNTRIES. 75 G3JNB MoAVW; 50 2EoAOZ.

WORKED G QRP CLUB. 1300 GM3OXX (The Laird does it again !); 1100 G3XJS (chasing hard); 700 G3FYP; 400 G2HLU; 300 G3ZHE; 220 G3JNB; 140 GWoMYY; 100; GoUAP; 60 GWoVSW,
Correction. In last SPRAT G3LSW should have read 420 Members.

TWO-WAY QRP. 30 G2HLU; 20 2EoAOZ; 10 G4DGB.

SHARP EYED READERS will have noticed that with Endorsements for 100 Members, 50 countries and 20 countries on two-way QRP 2EoAOZ is well on the way to becoming the first Novice Master. This is great work indeed !

.....

THE SUNSPOT CYCLE

A few pundits are now suggesting that this cycle is unlike the cycles that we have experienced in the years since the hf bands began to be explored in the early 1920s, and that it may collapse entirely rather than reaching even a moderate peak . There have certainly been some ups and downs in the current cycle, but also some great patches of good conditions with lots of DX. As far as this writer is concerned it has overtones of the conditions in 1937/1938 when G8PG first became active as a teenager. That activity was halted by qualifying as a merchant navy radio officer and going to sea in January 1939, just in time for WW2. The next cycle in the late 40s/early 50s was a corker, but whether the present one will be good or bad we must wait to see. Our present sunspot activity data covers such a tiny part of the life of the sun that there may be many things about the short and long term sunspot cycles that we as yet know little about. The real answer is to do what amateurs have done from the beginning of hf radio - listen around and as soon as you realise that there is DX about get in there and go for it. Good hunting !

MANY THANKS to those who responded to the appeal for antenna and antenna related input to AAA. Some of the response is in this issue, and there is more to follow.

G-QRP CLUB ACCOUNTS

1998-9

INCOME	£	EXPENSES	£
Bank interest	376.73	Artwork & drawings	17.57
Donations	1.50	Awards and trophies	68.50
Sales at rallies etc.	2,700.50	Bank charges	326.13
Sales by post	1,754.24	Books	1,661.53
Subscriptions	19,543.26	Components for kits/sale	3,740.48
		Duplicating & copying	18.20
TOTAL INCOME	**24,376.23**	Miscellaneous expenses	136.90
		Officers expenses	832.71
		Postage	1,154.74
		Rally costs etc	791.89
		SPRAT mailing costs	6,638.15
Bank c/f	22815.00	SPRAT printing	10,284.00
Bank b/f	24878.65	Stationery etc	769.08
	-2,063.65	**TOTAL EXPENSES**	**26,439.88**

In addition to the figures above, our U.S. account holds $ 15097.44, the German account DM 2167.33 and the New Zealand account NZ$ 1368.13. When funds have been transferred from the US account then reserves will have increased slightly during the year and there will again be no need to alter the present subscription rates for next year.

The unified subscription arrangements made last year seem to have have worked well and have eliminated a lot of confusion. Those folks who did not increase their standing orders from £5 to £6 after five years and numerous reminders, no longer receive SPRAT. This year 30.9% of subscriptions were paid by standing order, 14.3% by VISA or MasterCard and the rest by cheque or cash at rallies. Card payments are fairly costly but are excellent when collecting subscriptions in unusual currencies. It would help us considerably, both financially and in terms of administration time, if UK members would consider paying by standing order. There has only been a need to change the amount paid once during the last 12 years. I am loathe to complicate the issue by having a scale of dues dependant upon the method of payment.

Our overseas representatives, DK4UH, N8ET, ZL1ABS, PE1MHO, F5OQO, OE6JAD and ON4KAR have again been very efficient. Indeed, since most of them are now using e-mail, subscriptions are updated much faster than if members were to write directly to the UK. It is hard to overstate the contribution they make to the administration of the club.

During the year the printer, the Shoreham Copy Centre has also mailed SPRAT, and the bulk posting arrangements have realised some very worthwhile savings. The additional cost of running the QSL bureau independently of SPRAT has been saved many times over. As an extra bonus, the number of failed deliveries has declined sharply as there are fewer opportunities for SPRAT to go astray in the system.

Yet again our thanks are due to Peter and Betty Jackson (G3KNU and GØNYL) who have been kind enough to audit the club accounts.

G3PDL, Hon. Treasurer. August 1999

Celticon 2000

The Millenium QRP Event
September 1 - 2 - 3, 2000
Marino Institute of Education - Dublin

QRP Programme by the G QRP Club - Hosted by the Marino Institute
A Full Programme over Saturday/Sunday 2nd, 3rd September
(Reception and Welcome on Friday Evening)
60 Residential Places available at the Marino Institute
Day Tickets are also available for local attendees

For information about booking please contact:
Sile Boylan, Marino Institute of Education, Griffith Avenue, Dublin 9
Tel: +353 [0] 1 8335111. Fax: +353 [0] 1 8369264
email: sboylan@mie.ie web: www.mie.ie

Why not combine a holiday in Ireland with a QRP Convention?

The Marino Institute of Education is set in its own grounds in the north of Dublin, close to the airport. It is the Dublin house of the Christian Brothers and a Teacher Training College with full conference facilities and single & twin accommodation.
There is a frequent bus service from the gates into the centre of Dublin - ideal for wives and family members to enjoy Dublin during the QRP events.

The G QRP CLUB is the largest QRP organisation in the world, drawing members from over 50 countries.
The club will be responsible for the QRP events at CELTICON 200.
This will include a full programme of lectures and workshop sessions. We hope to attract QRP traders to sell a range of kits and components. The resident amateur radio station at the Marino Institute will be available with a special callsign. Not least of all will be the chance to meet and talk with other QRP operators and enjoy good company in the attractive surroundings.

COMMUNICATIONS AND CONTESTS

Peter Barville G3XJS, 40 Watchet Lane, Holmer Green, High Wycombe, Bucks HP15 6UG.
E-mail: peter@barville.demon.co.uk Packet: g3xjs@gb7avm

Firstly, may I draw your attention to my new email address, as shown above. There are also new addresses for my QRP Contest, and QRP Dx Information Websites, and they can be found via: "http://www.barville.freeserve.co.uk". If you don't have Internet access, but would like up to date QRP Dx info, please let me have a small supply of ssaes.

Somerset Homebrew Contest

Because of the slightly early copy deadline for SPRAT 99, I was not able to include the results of the 1999 Contest. Tim Walford is very generous with the prizes he offers for this event each year, and it is a little surprising that we don't receive more entries. There were only 5 logs (plus one check log) submitted this year, and the results were as follows:

1. ON5UP	13 qso's	65 points Homebrew Malta 80	4W	dipole
2. G3ESP	10 qso's	42 points Homebrew Wedmore	4W	dipole
3. OK1FVD	8 qso's	32 points VXO/BU/Dr/PA	4W	130'
4. G4PCE	3 qso's	15 points Homebrew BD135	5W	doublet
5. G3XUO	2 qso's	10 points Homebrew Yeovil	5W	20m e/f
6. G3GC	6 qso's	check log	TR7	Dipole

Conditions for the Contest made it hard going but, as you can see, it is easy to put yourself in line for a very worthwhile prize if you put in an entry next year. Various suggestions have been made with a view to attracting more entries, but I suspect the Contest will be run under very similar rules as before, and I suggest you quickly pencil Sunday March 26th into your year 2000 diary.

International QRP Day

Even fewer entries for this event (only 2!), but I know that it can be difficult for many to be active when June 17th falls on a week day. New member Hans, SM4ATJ, joined the Club just in time to send an entry, but the winner was Thomas, DL4OBN, who used his SG-2020 with 3 watts into dipole and windom antennas. Our congratulations, and the QRP Day Plaque, go to Thomas. I'm sure many more of you **could** support events such as this, and help make our mark on the bands, so why not make another note now in your Y2K diary?

Yeovil FunRun, and Constructors Challenge

George, G3ICO, tells me that around 64 QRP stations in 11 countries took part in the 1999 FunRun. 16 entries were received (plus check logs from G3KZJ and G3MCK). The overall placings were: **1** G4EDG (1250) **2** G3GC (1224) **3** G3BPM (1038) **4** G3DDX (983) **5** G0KZO (858) **6** G3LHJ (728) **7** GM3XQJ (700) **8** G3CQR (681) **9** G4IYE (605) **10** G3XUO (571) **11** F6GGO (465) **12** G0WMJ (380) **13** DK5RY (365) **14** G4MRH (329) **15** GD0LQE (230) **16** DL2BQD (195) **17** G0MOU (163)

The 80m winner was G4EDG (2nd place G3GC), with G3GC winning the 40m section (G4EDG 2nd!). Full details are available from G3ICO, or G3XJS (ssae please).

G3KLT produced an excellent 5 Mhz vfo to win the Convention Constructors Challenge - it drifted a mere 100Hz during the 5 minute test period, but G3OFX was a close runner up with a measured drift of only 200Hz. Thanks also to M0AVN, G0HDJ, G0GFL and G2ARU for their entries.

O QRP Contest

I have seen comment recently asking why SPRAT does not include details of the O QRP Contest. held twice each year. The Contest dates are always included in the QRP Calendar (published in the Winter SPRAT each year), but with the limited space available I cannot undertake to publish full details of non G QRP Club events. I will do my best to provide 'pointers' during the year, but it is not possible to know exactly when SPRAT will be published and so getting the timing right may not be easy. In the meantime, I hope you know by now that I will be pleased to supply details of events included in the Calendar, or at least point you in the right direction. Despite what it says in the 1999 QRP Calendar, the next O QRP will be held during the weekend of 1st and 2nd January 2000 (the first day will coincide with the last day of G QRP's Winter Sports) and Hal, DJ7ST, is your point of contact, but an ssae to G3XJS will also do the trick.

SPECIAL ANNOUNCEMENT - G QRP CLUB Y2K CONTEST

To mark the new millennium, and the 100th edition of SPRAT, the Club has decided to run a special 'one-off' contest which, it is hoped, will encourage plenty of activity while providing the opportunity to win **Life Membership** of the G QRP Club. Just think, you need never pay your subs again - just enter **Y2K** and win! We live in an increasingly high-tech and commercialised world, but the Club has always championed the use of simple equipment which can be home constructed, but still yield excellent results. Therefore, the rules include an incentive for entrants to use homebrew equipment, but this is not essential.

The rules are as follows:

When: 1st January 0000z until 31st December 2359z

Where: All bands for which you are normally licensed

Modes: ssb, cw, fm (vhf/uhf) and data modes (data contacts not to take place within the normal cw section of the bands)

Power: not to exceed 5 watts output cw, fm (vhf/uhf) and digital modes, or 10 watts pep ssb.

All QSO's to be 2-way QRP

Points: 1 point per QRP/QRP qso
2 points per QRP/QRP qso with G QRP Club member
2 points multiplier per QRP/QRP DXCC country worked
1.2 multiplier if Homebrew Tx, or Rx or Tcvr is used throughout the event (it does not have to be the same equipment for the whole year)

For example, with commercial equipment:
24 QRP/QRP qso's + 38 member QRP/QRP qso's x 20 QRP/QRP countries = 2000
50 QRP/QRP qso's + 43 member QRP/QRP qso's x 15 QRP/QRP countries = 2040
38 QRP/QRP qso's + 11 member QRP/QRP qso's x 34 QRP/QRP countries = 2040

With Homebrew Equipment:
multiply the totals by 1.2 (ie 2000 x 1.2 = 2400, 2040 x 1.2 = 2448)

QSO's which are clearly not within the spirit of the Contest will not be allowed (eg please don't arrange contacts with your neighbour twice a day on each of ten bands!), and neither will contacts through repeaters or satellites.

As you can see, the magic figure "2000" in your points score is easily reached, and all entrants scoring 2000 (or more) will receive a special certificate. The station scoring the overall highest score throughout the year will win the **Life Membership** 1st prize, while those in 2nd and 3rd places will be awarded commemorative plaques.

Logs to be sent to G3XJS no later than 31st January, showing only the 2-way QRP contacts for which you are claiming points, marking those with G QRP members, and include a summary of each 2-way QRP DXCC country worked, and total points claimed. Enclose details of equipment used throughout the contest (including power, antennas etc), together with a statement that you have kept within the rules and spirit of the Contest.

There - that should keep you (and me) busy!

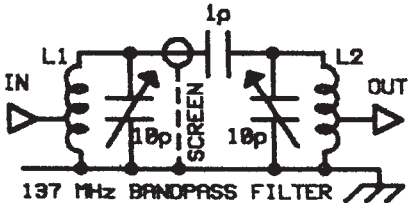
The HOT Party is due 21 Nov, and the 9A QRP Contest is scheduled 11 Dec1800z to 12 Dec 0559z. Don't forget (could you ever?) Winter Sports 26 Dec to 1 Jan, which takes you nicely into O QRP and, of course, **Y2K**. The deadline for SPRAT 101 is the beginning of November, and in the meantime have plenty of QRP FUN. See you on the bands?

ARRL Hosts QRP ARCI for a Black Cat Halloween Special Event

(August 6, 1999 -- Newington, CT) On October 30 and 31, 1999 the American Radio Relay League will host the QRP Amateur Radio Club International for a "Black Cat" QRP on-the-air party for all QRPers. For two days, W1AW/QRP will be on the air using the actual original Tuna Tin 2 transmitter designed and built by Doug DeMaw, W1FB! The "Black Cat" theme was chosen to tie the Tuna Tin 2 to Halloween, for a night of ghostly fun that QRPers can talk about for years.
The Tuna Tin 2, so called because it used a common tuna fish tin for a chassis and two 2N2222 transistors was introduced to the world in May, 1976 in a QST feature article by Doug DeMaw. For many hams, it served both as their first QRP experience, and their first building experience.
Even though it disappeared under mysterious circumstances from the ARRL Lab, it was later rediscovered at a hamfest over 100 miles away from ARRL HQ. Rescued from an ingominious end under that hamfest table by Ed Hare, W1RFI, a well-known QRPer who work in the ARRL Lab, it was restored to full operation in June of 1999 by Bruce Muscolino W6TOY/3. It is still in use today! Over this summer, it has had a short but exciting career, on the air from W1AW and W1RFI, travelling to various distant locations and hamfests to let others see the "real deal!" Now it comes home to rest up for this fall's operating event.
The original Tuna Tin 2 operation will be on 40 meters for the entire period. Late night operation will be directed toward working as many DX stations as can be heard! (QRP DX includes many parts of the United States an well as overseas hams.) You don't have to be using QRP to work the Tuna Tin 2, just listen around 7040 kHz for W1AW/QRP and give us a call! Additional Tuna Tin 2 replicas will be operating on 10.106 and 14.060 MHz, to give all the best chance to particpcate in this QRP extravaganza.
Certificates and special QSL cards will be issued to commemorate this ARRL/ARCI special event. Hams are welcome to stop by W1AW over the event weekend to see the original Tuna Tin 2. Operating time may be limited, but those who wish to operate the original Tuna Tin 2 should be able to make few contacts. Please set aside some time Halloween weekend to work W1AW/QRP, and each other for a weekend of informal QRP fun! Contact Bruce Muscolino, W6TOY (w6toy@erols.com) or Ed Hare, W1RFI (w1rfi@arrl.org) for more details.

NOVICE NEWS Steve Ortmayer G4RAW
14 The Crescent, Hipperholme, Halifax. HX3 8NQ. Tel: 01422-203062

Ron 2E0AIS has sent details of recent stations worked : TA4ED, 9A1CBA, SM3LUB, IK4HLQ, 5X1T, UA4CJJ, RW4WM, RW4WWA, EX8W, CQ9K, NX97. Great going Ron, It shows what can be done with a few watts and simple antennas.



Ron is having a problem receiving 137MHz weather satellites, because of QRM from pagers on a frequency close to 137MHz. Well Ron - you could try a bandpass filter or a T-Match to clean up the received signal. Has a member experienced a similar problem and found a good solution?

L1=L2 5 turns 20swg ½" [12mm] dia spaced ½" [12mm] long. Tap 2 turns

Wyn GW8AWT has written with details of how his XYL, Eileen, provided mobile radio cover for a walk organised by the local Historical Society. This is a very good way for Novice members to improve their skills and provide a useful service to a local society.

Wyn also sends a word of caution - the recent warm windy weather has on two occasions unscrewed the PL259 plugs to his aerial. So always check the SWR before transmitting.

There are now increased frequency allocations for Novice operators. What are your views on this? Does it go far enough? Please let me know. Also let me know if you have worked some good DX.

VHF MANAGER'S REPORT

John Beech, G8SEQ 124 Belgrave Road, Wyken Coventry CV2 5BH
Tel. or Fax 01203 617367. Packet Homebbs : GB7COV. Email: john8seq@discover.co.uk

Recently I was asked to give a talk at the Mid-Warks ARS in Warwick at which I demonstrated what must be the simplest two-metre direct conversion Rx ever! Previously at another talk to the same club I had built a simple xtal controlled Tx, using a 72 MHz xtal. I kept the circuit and used it as the LO for this Rx. It consists of the bipolar mixer shown below, using two BSX19 transistors. A feature of this mixer is that it can be used as a doubler and it has some gain, so consequently with just an antenna and a crystal earpiece it is possible to receive strong local signals. Obviously with a suitable audio amp. it would make quite a viable Rx, better still with an RF pre-amp in front of the mixer. There are plenty of published designs, but I hope to publish another next SPRAT.

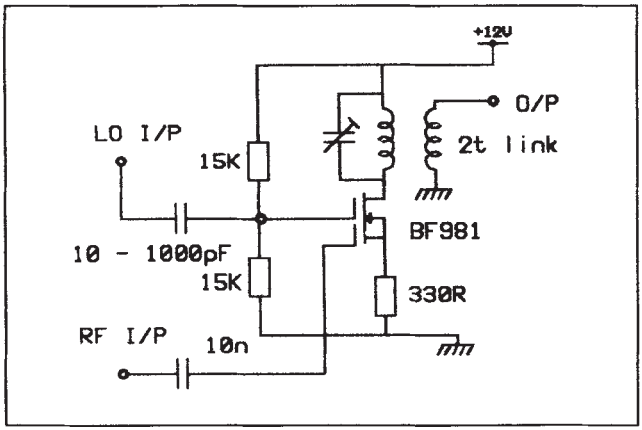
On the news front, I went to Reims to observe the eclipse and just about saw it! I did a radio experiment on 144 MHz and 50 MHz but haven't had time to analyse the results properly yet. I used the sound track on the video camera as the recording device and was hoping to show that radio noise comes from spots on the sun, but the sun seemed particularly quiet that day. I have a very interesting two minutes of video which shows an infra red image which may be re-radiated from one of the ionized layers.

Some news from Dave G0DJA. He says he has completed the log periodic for 4/6m and you may have seen it on display Telford. I've been experimenting with VHF and UHF omnidirectional antennas which will be published at a later date.

Dave has made a suggestion for VHF/UHF activity on QRP fun days, contest etc. He says operate on the VHF bands when the contests are advertised and send your VHF results to him, following the HF rules as published (except for band restrictions). You can send your HF entry to him and he'll forward it or you can send it direct yourself through the "official channels".

Dave's current address is: Dave Ackrill G0DJA, 104 Haigh Moor Road, West Ardsley WAKEFIELD WF3 1EF

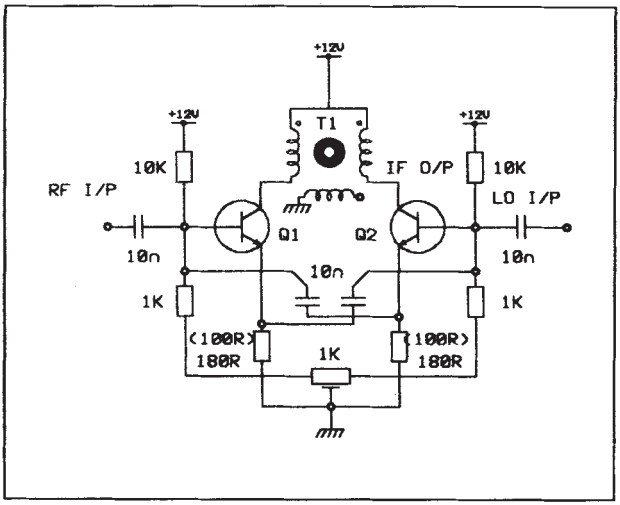
That's it for this quarter 73 de John G8SEQ.



ALTERNATIVE MIXERS

Mixers other than the diode ring such as the MC1496, SL6440 & NE602, However some other types may be of interest:

Dual gate MOSFET Mixer
Often used in receivers
About 10 - 14 dB gain.



This cross coupled mixer is doubly balanced and therefore should be bi -directional. As shown it is acting as an RX mixer and has about 12dB gain. The mixer will act as a doubler so care must be taken with RF filtering [lowpass or bandpass]. This also means that it could be useful at VHF/UHF, where it could be advantageous to have a local oscillator at half the usual frequency.

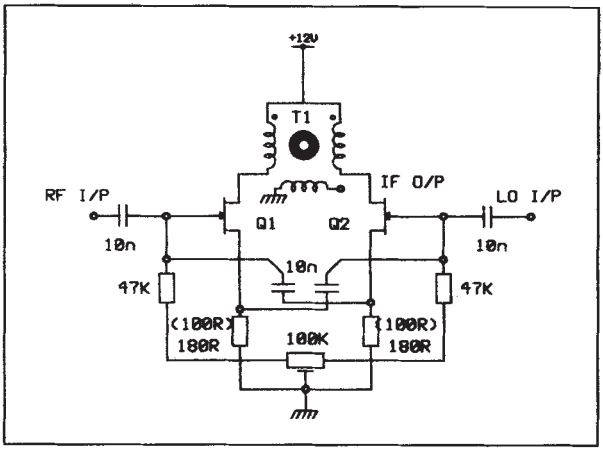
Q1,Q2 BSX19 or 20 [BFY90 & 6v supply]
T1 10t bifilar with 2t link on T20-12 core for VHF. At HF other cores may be used.

The balance pot could be connected in the emitter or source leads, in which case ir should be reduced to 100R in both designs.

The bipolar version is very similar to the mixer inside the NE602.

The FET version of the mixer IGFETs [MOSFET] could also be used. This has possibilities at UHF, perhaps up to 1.3GHz [reduce capacitor values].

Q1,Q2 J304, U310 etc.



N.B.T.V.A

The Narrow Bandwidth TV Association (founded in 1975) is dedicated to low definition and mechanical forms of ATV and introduces radio amateurs to TV at an inexpensive level based on home construction. NBTV should not be confused with SSTV which produces still pictures at a much higher definition. As TV base bandwidth is only about 7kHz recording of signals on mini cassette is easily achieved. A quarterly 12 page newsletter is produced and an annual exhibition is held in April/May in the East Midlands. If you would like to join, send a crossed cheque / postal order for £4 (or £3 plus a recent SPRAT wrapper) to Dave Gentle, G4RVI, 1 Sunny Hill, Milford, Derbys. DE56 0QR, payable to "NBTVA"

MEMBERS' NEWS

by Chris Page G4BUE

Highcroft Farmhouse, Gay Street,
Pulborough, West Sussex RH20 2HJ.
Tel: 01798 815711 Fax: 01798 813054
E-mail: g4bue@infinnet.co.uk
Packet: GB7DXS on UK DX PacketCluster

Is it coincidence that since mention was made in this column in SPRAT 99 of the encroachment of Feld-Hell down to 14060kHz, the situation seems to have improved a little? I monitored the situation for several weeks and passed details of offending stations (some transmitting as low as 14059kHz) to **G3PSM**, the RSGB HF Manager. Colin will report after the IARU Region 1 Conference in September when the band plan is to be discussed.

LY2PU came across a reference in Lithuania to the centre QRG for Feld-Hell being 14061kHz and another reference on the Internet to it being 14063kHz. Vytas correctly says this could cause problems for QRPers trying to use 14060kHz and I have passed this information to **G3PSM**. **G3GYV** is also concerned at the use of data modes down to 14060khz and has written to the RSGB about it. Michael suggests QRO Morse stations should start using 20m at 14070kHz (the top edge of the band plan) and reduce in frequency as you reduce in power until you reach the QRP QRG on 14005kHz. Ah, the ideal world, if only...?

G4DDX has heard data on 14060kHz, "a kind of pulse with rough note about 3-4kHz wide with sidebands even wider" and which he can see on his IC-756,. Ron suggests that "any new data mode this width should be in the SSB portion, say 14100-14125, not in the narrow band section."

G3LDI referred to the Band Plan in his August *RadCom* Data column and reported that "some creeping has been going on, venturing below 14070kHz in particular". Roger mentions the new modes, "the newest being PSK31" but does not mention Feld-Hell which was the biggest culprit, being used down to 14059kHz. Whilst Roger's reminder to data users of the Band Plan is to be welcomed, it will only be seen by those amateurs who are members of the RSGB.

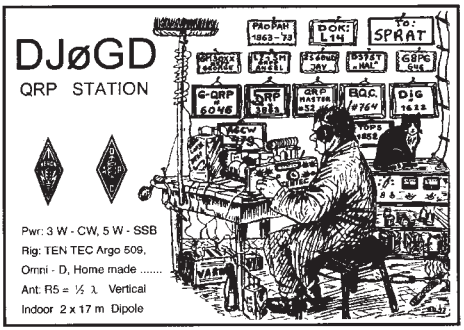
Whilst on the subject of new digital modes, at the beginning of June **G3LSL** was introduced to PSK31 and says "It's great, simple to get started on *and* lends itself very well to QRP operation". Dave continues "the need for a continuous duty cycle of your PA stage whilst transmitting, means that it's best to run low power and I'm convinced it would work well at QRP levels". Finally he adds "the popular frequencies for the mode are 14069-70kHz and 3580kHz" - please remember the band plan Dave! **GM3MXN** has been QRV as **2S3MXN** (special prefix for the Scottish Parliament) and says comments have ranged from "You're a pirate" to "is your QTH Monaco?" and "are you a Novice?". Tom has also been using PSK31 and says "it's a great mode for QRP,

Mike, DF2OK, in his shack with "most of my toys".

Stateside report 519 100% copy". Tom is also "having a go at QRP SSTV using JV Comm 32". Has anyone else tried QRP SSTV? I believe this is the first time I have reported it in this column.

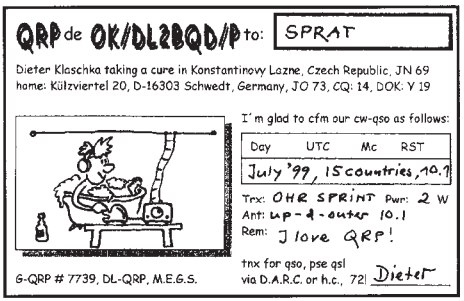
K2QJ was QRV from Farsund as **LA/K2QJ** for three weeks in May and June with his HW9, W3TS ATU and a W3EDP antenna (84 feet top and 17 feet counterpoise) "thrown over the roof of the house" on 40, 30 and 20m. Bob worked "many European stations and a few in Russia" but no DX, although he says a higher antenna would have helped. **EA3ADV** was planning to be QRV again in August from Valldemossa on the northwest coast of Mallorca Island (EA6) with his Maltas for 20 and 40m at 3W into dipoles. Vicens has been going there every year for his summer holiday.

G3CQR visited his daughter in May in Raleigh, NC, USA to attend their granddaughter's graduation from high school, and took a Hands GQ-20 with him. On arrival Peter "did a bit of plastic bottle throwing at suitable trees" to put up a dipole antenna and then went shopping for three 6v lantern batteries, one of which he opened up to use just one of its cells (in series with the other two batteries), to provide a 13.5v supply. His first call was immediately answered by **G3FGD** who lives a five minute walk from Peter's home QTH! Several QSOs ensued over the next few days back into his home area (with **G3ICO**, **MØBBO** and **G3GC**) and two-way QRP QSOs were made with **G3XJS**, **VE2KN**, **W5ZS** and **W9SUL**. Peter only decided to take the rig at the last minute, following the USA's entry into the CEPT agreement, and was delighted with the results. More information about his operation is on **G3XJS**'s Website at <www.barville.freeserve.co.uk>.



The rear of Peter's, DJØGD, QSL.

G3PDL was QRV from a boat on the Norfolk Broads in July (Canal Mobile?) with a fishing pole (usually as a 20 feet vertical wire and one 'earth' laid along the deck about a foot above the water line), QRP Plus and LDG auto-tuner. Peter's best DX was a two-way QRP QSO with **VK5FE/P** on 20m and he also worked two 9M2s, JA and Ws for five continents, but says "the weather was too good to spend much time on the bands and conditions were actually none too good). **G4ELZ** was planning to be QRV 4/18 September while holidaying at Puerto De La Cruz as **EA8/G4ELZ/P** on 20m only with his MFJ 9020. **DL2BQD** made QSOs with 15 DXCC on 40 and 30m in July whilst QRV as **OK/DL2BQD/P**. Here's his QSL.



GØWFH will be QRV 10/17 October from Jersey (near Sorel Point) on QRP SSB only on 1845kHz (daily 1930 to 0200z especially 14 October) and 3790, 3795 and 3799kHz nights of 13, 15 and 16 October, 7045kHz nights of 10-12 October, 14185kHz daily 1500-1700z and 14260kHz daily 2300-0100z, and 18135, 18150, 21285, 21295, 24930, 24960, 28360, 28460, and 28480kHz daily 0700-1500z. Chris will also be QRV 3685kHz 0930-1100z 10 October in the ISWL Net. G3YYF has been QRV on 6m with 4W from a homebrew valve transvertor and three element Yagi. Reg's best DX is **9J2BO**. Are there any other members using QRP on 6m?

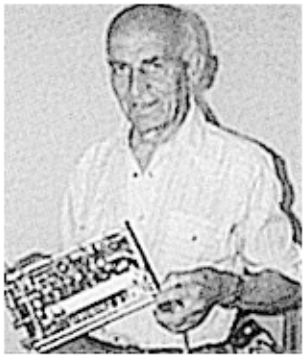
PA3HBB/GØBZF is now QRV with his K2 most evenings 80-20m and is looking for critical reports about it. Dave received

the kit on Monday and made his first QSO with it on the following Thursday evening (with **GM4CXP** on 40m). **G4DMH** received his kit 23 July (after ordering it at the end of February) and is "very impressed by the quality of the PCBs and the excellent instruction manual". Malcolm was charged £89.09 for import duty, VAT and handling by Parcel Force Worldwide.

DL4OBN was tuning around 15m recently "while rummaging through a stack of old QSLs". Thomas says "the QSL on top was from **KK3S** for a QSO on 20 June 1990. When I got to 21030kHz I caught the tail-end of a QSO 'es hpe cuagn = 73 es gd dx de **KK3S** ar sk'! I thought this just can't be true, but it was him. I listened closely to his next QSO and he gave name and QTH as Koos, Windsor, PA. I grabbed my Vibroplex and called but had to wait through two more QSOs before he heard my three watts, but then he came back with 539 for me. Wow, to meet someone again after so long a time. I told him of our first QSO almost exactly nine years ago and he was just as delighted as I was. We ragchewed for about half an hour before I had to QRT because of a thunderstorm that broke here. Coincidence?".

G3YYF (pictured above) has been trying homebrewing in a 'very big way'! Pictured above is Reg's Morse key which he made three years ago as a fun exhibit for one of his local club's special event stations. It is fully working, three feet long and the main arm is made of English oak. He says "I have had a QSO using it, though it takes up too much room on the operating table!". **PAØRBO** says the DL-QRP-PA in SPRAT 98 is "working very nicely". Robert feeds it with about 10mW from a pre-driver stage and has an adjustable 1 to 5W output.

The eight G-QRP Club members in Slovakia have formed a QRP Interest Group within the Slovak ARA (SARA) and a QRP column in *Radiozurnal SZR* and a regular QRP supplement *QRP Radio* are published. **G4FDC** says SARA sponsor an International Spring Sprint Low Power Contest every Easter Monday. Alex has translated some issues of SPRAT "line by line" into Slovak and he says "you would not believe how much information is packed into our little SPRAT until you have to translate it into another language". He also mentions the West Kent ARS Award for working WKARS members and which can be endorsed QRP - details from Alex.



Jaro, OM6TN, with his multi-band QRP TCVR at a Slovak QRP Convention.

The 9A QRP Championship is now part of the Croatian CW Contest as a QRP category with less than 5W held each year in the third full weekend of December (17/18 December 1999) on 160, 80, 40, 20, 15 and 10 metres, exchange RST and serial number. Score 10 points for each 9A QSO on 160-40m and 6 points for 9A QSOs on 20-10m, 6 points for non-EU QSOs on 160-40m and 3 points for non-EU QSOs 20-10m, and 2 points for EU QSOs (including your own country) on 160-40m and 1 point on 20-10m. Multiplier is DXCC and WAE list each band and final score is points x multipliers. Logs within 30 days to Hrvatski Radioamaterski Savez, Dalmatinska 12, 10000 Zagreb, Croatia.

Let me know how your autumn goes, by 20 November please.

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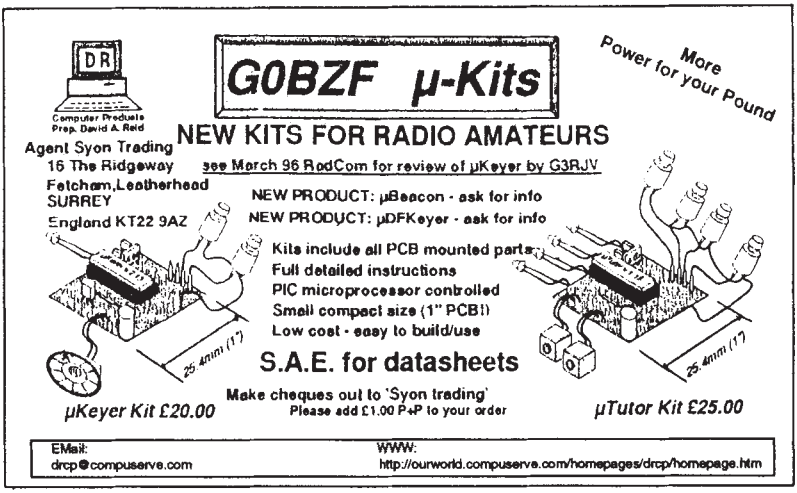

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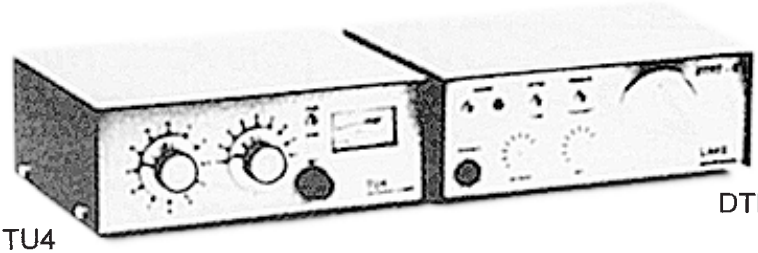

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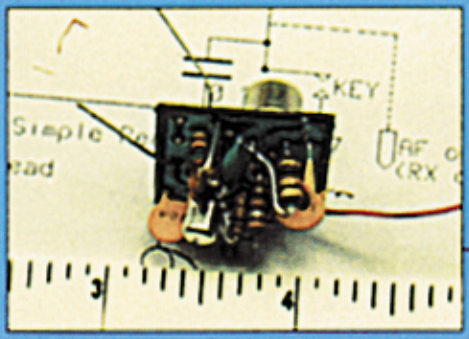
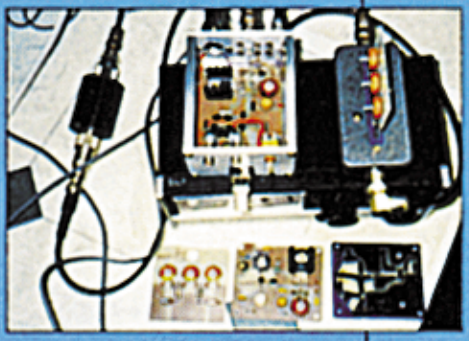

KEY

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