November 2011
Volume 12, Issue 5

ANODE

Inside this issue:

Special points of interest:

- **Contact details on back page UPDATED 2011-11-14**
- **Ham-Comp Latest on web site. Still under construction...**

Anode Editor's Comments

Volume 12, Issue 5
November 2011

A Special Thank you
To Johan for work on the Lawn Mower. Hope the mower will fight off the grass growth this season. A second thank you for the new hose and bull noise fitted to the braai.

An Apology to Nico
Nico ZS6NJV pointed out that his name and contact details are still not on the back of the Anode as a committee member. Please correct this. [I have done JB]

An invitation to non-members
Please be so kind as to invite the non member on your email list of the up-coming boot sale. Please mention that we expect a lot of vendors the like of Sam Ford and KevTronics to name a few.

Please note that the Year-end function is for Paid up members only and should not be promoted to the non members.

Another Special Thank you
To Rory for work on the fridge. Hope the fridge will fight off the summer heat. The fridge has been stocked on Friday for the Monday meeting as well as items for the field Day Contest.

If you hadn't already realised,

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Amateur Communications Receiver Pt2

Part 2 ; I.f. amplifier, b.f.o., product detector and a.f. amplifier.
By D.R. Bowman, A.M. Inst. E.., G3LUB

This month sees the of the description of the final design and construction of the receiver. Inevitably there will be quite a few loose ends that will be tidied-up later.

All the coil winding details are given although much of the circuitry does not appear in this issue.

Table one gives the complete frequncy coverage and it will be noticed that this does not include the last section of 10 metres, however this can be added by incorporating and extra crystal if required.

Component considerations
Throughout the various components lists given in this article the values are as used by the author and it is strongly recommended that new components only be employed. The resistors except where stated are 0.25 Watt carbon ± 5% types, but 10% types could equally well be used. In almost all cases where silver mica capacitors

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Amateur Communications Receiver Pt2

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are specified they must be used. In the case of the larger values of disc ceramics, Mullard C280 miniature foil capacitors could be substituted. Again wherever Philips concentric air dielectric trimming capacitors are specified other types of trimmers could be substituted.

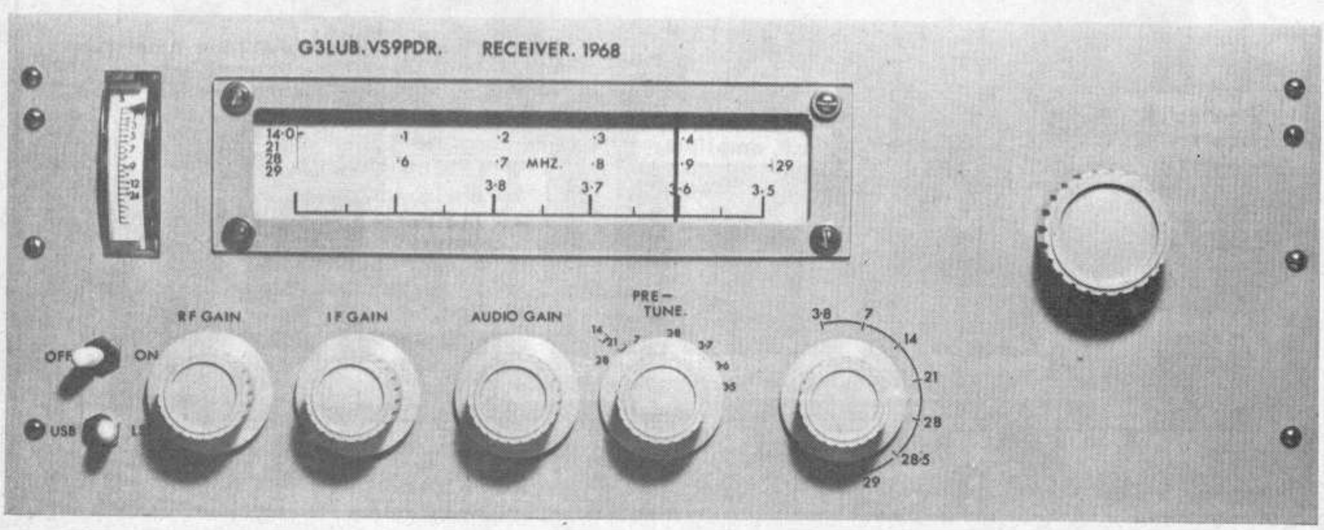
With two exceptions coils are wound on Radiospares core formers which can be obtained from Home Radio (Components) Ltd., Mitcham, Surrey, under catalogue number CR2. The iron dust cores can be obtained from the same address (catalgoue number CR5).

Whilst on the subject of coil winding the author found the simplest method of anchoring the wire to the former was to wrap a number of turns of seewing cotton over the wire end round the former. The only exceptions are L10 and L3 and L11. L10 should be wound on a CR12 former with a screening can No. CR13. These are small ¾ inch ¾ inch i.f. transformer cans. L3 and L11 are 1/3 inch diameter CR9 formers. The crystal filter used is the K.V.G. No. XF-9B which can be obtained from Lowe Electronics, 50/52 Wellington Street, Matlock, Derby. There are a number of alternative filters, but details are not included as this filter has by far the best performance and value for money. The various tuning capacitors can be supplied by Jackson Brothers (London) Ltd. C12 and C11 type are U102 6-75 pF, 2 gang (front end tuning) and C1 is type U101 6-75 pF, single gang (v.f.o. tuning).

The dual ratio ball-drive type 4511/DRF can also be supplied by Jackson Bros. The odd r.f. c. is a standard valve type 2.5 mH radio frequency choke.

Now we come to the transistor types. There are a number of devices which could be expected to perform equally well as an alternative to type 2N706. The following are a few 2N706A, 2N708, BSY38, BF115, C111, 2N2926. The BC107 can be replaced by any silicon n-p-n high-gain transistor with an hfe, in excess of 150. The h.f. crystal oscillator uses a 2N918 for which any of the following devices could be used as an alternative 2N4292, BFY90, TIS48. The audio output pair ACY17 and a BFY50 are very cheap and unless a matched complementary pair are available the author would advise no change.

Fig. 10. Front view of the prototype showing the marking of the various controls.



Since starting, a substitute for the 3N140 dual gate F.E.T. has come on the market which is strongly recommended since it incorporates built-in gate protection. The new device is

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Amateur Communications Receiver Pt2

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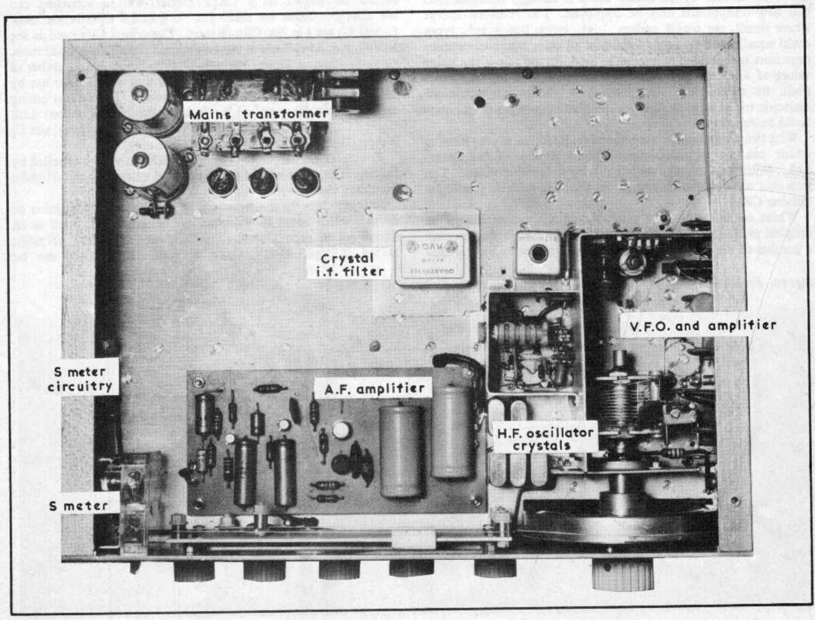
the MEM564C and is available from: S.D.S. (Portsmouth) Ltd, Gunstone Road, Hilsea Industrial Estate. Portsmouth, Hants.

Fig. 11. A view of the upper side of the chassis.



The i.f. amplifier and particularly the b.f.o. and product detector must be completely screened, as must the M. crystal oscillator and synthesizer mixer (the screening covers were removed for photography). It is also advantageous to screen the i.f. break-through filter from the r.f. amplifier.

With the exception of the r.f. stage the various circuits can be laid out on individual printed circuit boards. As can be seen from the photographs the author used boards only for the following circuits: i.f. amplifier, a.f. amplifier, product detector, b.f.o. and the S meter. The other stages were built using conventional wiring techniques for convenience during circuit development.

The diodes used in the power supply can be almost any types with at least a 50V p.i.v. rating. Zener diodes used can again be replaced by alternative types. (The 9 volt device has a power rating of 1 Watt and the 5.6V zener a rating Of 0.25 watt). All coils were wound using wire which can be obtained from Post Radio Supplies, 22 Bourne Gardens, London E.4. The h.f. oscillator crystals used were purehased from Cathodeon Ltd, who it should be noted have a minimum charge of 3 Pounds. These crystals are for series, fundamental or third overtone mode operation, as noted in the crystal list. The particular types used in this receiver were of HC/6 U construction.

Physical construction
Figs. 10, 11 and 12 show the layout of the original receiver built by the author. The dial drum used was home made, but an alternative would be Jackson Bros. Part No. 5035 3.5 inch drum.

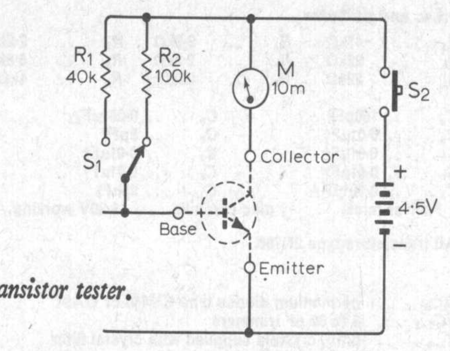


Fig. 15. A simple transistor tester.

The i.f. amplifier
The i.f. amplifier is constructed on a 5 1/8 inch. x 3 inch piece of copper clad printed circuit board. The layout drawing is shown in Fig. 13 and the circuit in Fig. 14. The holes should be drilled using a 0.03 in. drill. The components, with the exception of R3, R10, and the transistors can be mounted as shown in the diagram and soldered into place. The small aluminium screens should be attached and the

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mounting screws firmly soldered to the copper earth mat to complete the construction of the board.

The constructor is advised to purchase twenty-five 2N706 transistors which should be graded according to gain, say, 20, 40, 60 and over 60, using the simple transistor tester shown in Fig. 15. Any meter with a 10 mA range can be used in the circuit. With the range switch set to R1 the meter will give a full scale deflection when the gain is 100 and 250 when set to R2. The switch S2 has to be pressed to make these measurements. The two ranges may not quite agree, due to the transistor's gain dependency upon collector current, however, the discrepancy is unimportant. From the 25 transistors choose three pairs with similar gain figures. The author's devices were within the range 40 to 50. Solder these into the i.f. amplifier board, together with a transistor with a gain of 40 to 80 in the Tr7 position. Temporarily connect two 120k Ohm resistors into the board, at positions R3 and R10, connecting only the base ends at this stage. The other two ends are tied together and connected to the h.t. Supply.

After careful circuit checking connect the amplifier to a 9V supply and measure the potential at the collectors of Tr2 and Tr4 using either a valve voltmeter or a sensitive multimeter. This potential should be between 4 and 6V and can be varied by adjusting the value of the temporary h.t. to base resistors. Having found the appropriate resistance value the resistance of R3 and R10 can be found as follows:

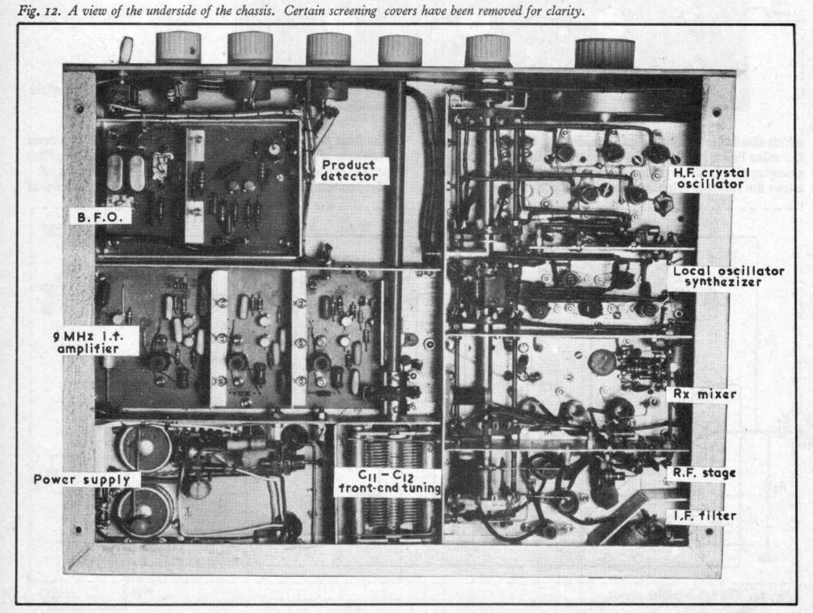
R3 and R10 = (R (h.t. to base)/2) - R23

if for example the resistor from the h.t. supply to the base of Tr1 was 120k Ohms, then:

R3 = [(120 * 10^3) / 2] - (33 * 10^3) = 27k Ohms

Resistors of the calculated value should be soldered into circuit in the R3 and R10 positions in place of the two temporary 120k Ohm resistors. The next step is to reconnect the 9V supply, and a high value potentiometer of about 100k Ohms between the point on the board marked X and the h.t. supply. Using a valve voltmeter the potential on terminal F should be monitored. It will be found that with potentiometer set to maximum resistance and no signal input, the potential should be between 5 - 6 Volts.

Fig. 12. A view of the underside of the chassis. Certain screening covers have been removed for clarity.



A source of 9MHz r.f. voltage is injected into terminal D (from a grid dip oscillator, a signal generator or simple test oscillator) and the i.f. transformer cores ot T1, T2 and T3 are adjusted until the potential at F dips to a minimum. It will be necessary to progressively reduce the 9MHz drive, as this process continues. It is strongly advised that the amplifier be well screened during these tests and that all signal leads to and from the amplifier be made as short as possible. If the amplifier should show signs of instability, increasing the values of R6, R9 and

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R19 should cure the trouble. R4, R11 and R17 also can be increased if necessary. It will be found that the amplifier has more gain than is required and it will be unconditionally stable when incorporated as part of the receiver. A photograph of the i.f. amplifier is given in Fig. 16.

acceptable communication quality. This entails setting the b.f.o. frequencies about 20dB down either side of the filter characteristic. The particular filter used in this receiver is supplied with the appropriate b.f.o. crystals.

The author would advise any prospective constructor to purchase new crystals and not attempt to use war surplus which are now at

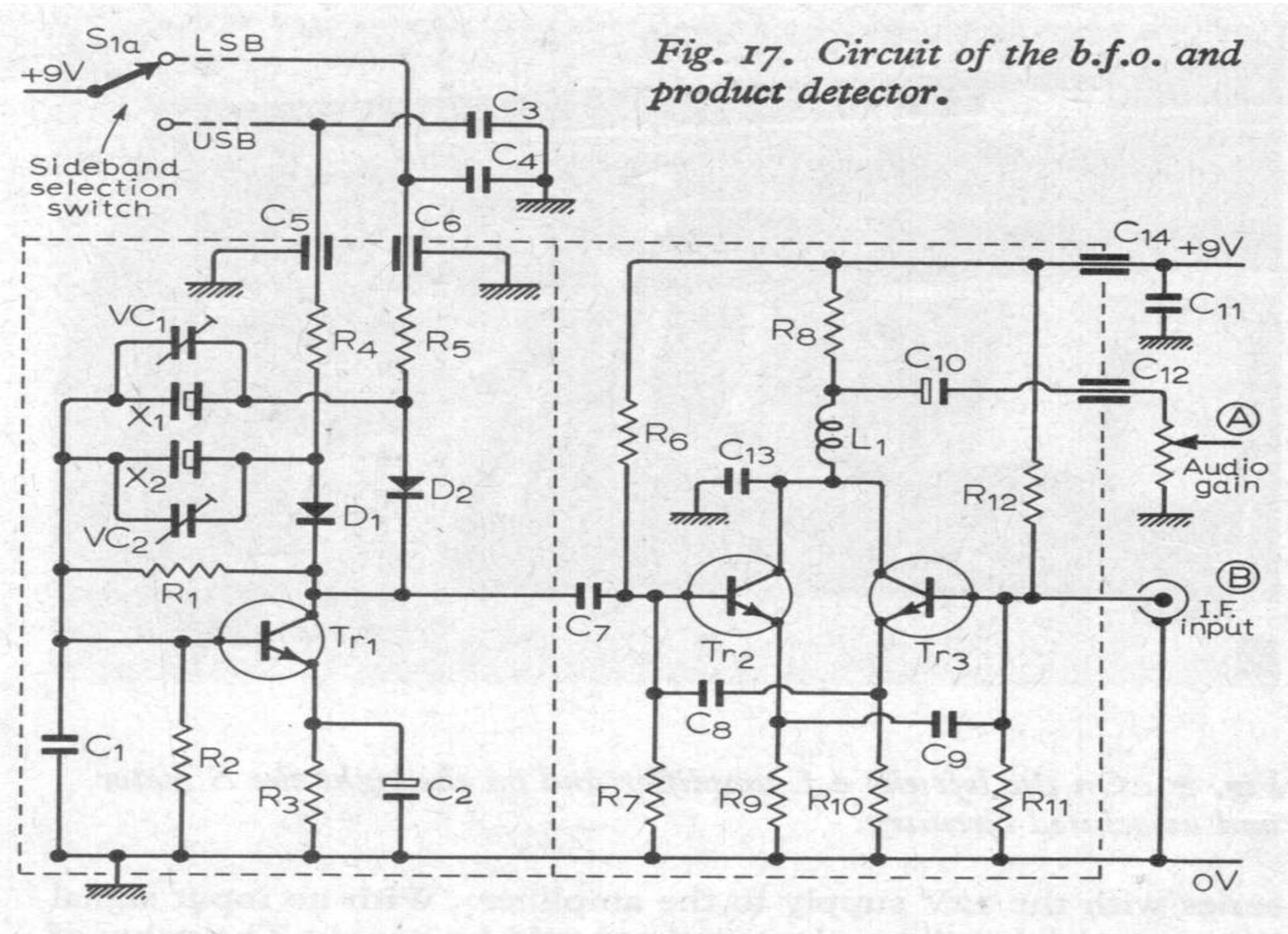

Fig. 17. Circuit of the b.f.o. and product detector.

The b.f.o. and product detector

It is essential that these sections be constructed in a well screened aluminium box. The b.f.o. (Fig. 17) is required to generate either one of two frequencies, positioned on either side of the i.f. filter characteristic (Fig. 2). It is generally accepted that an audio frequency response covering the range 300Hz to 2.6kHz is the minimum for least 25 years old. The b.f.o. uses a circuit configuration not more than 100mV which means a small value of coupling capacitance (5pF) between the oscillator and detector. The process of product detection is analogous to normal mixer action with the output being in the audio frequency spectrum. It is recommended that a pair of 2N706 transistors

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(Tr2 & 3 Fig. 17) with similar current gains should be used in the circuit. The signal requirement is modest at 10 mV, and the capacitive potential divider (C16 & 20 Fig.14) on the output of the i.f. amplifier serves the dual purpose of reducing the i.f. amplifier voltage to suit the detector and reducing the reverse transfer of stray b.f.o. voltage back into the i.f amplifier.

The presence of unwanted b.f.o. signals in the final receiver can be checked by removing one b.f.o. crystal from the circuit and adjusting the receiver to a clear channel. The S meter reading should be identical when the sideband switch is operated. In other words the application of b.f.o. voltage to the detector should not affect the S meter zero reading. The r.f. filter in the detector collector circuit makes use of a 10uH r.f.c. which is easily constructed by close winding 30 turns of 34 s.w.g. enamel covered copper wire on a Radiospares coil former which is fitted with an iron dust core and adjusted to produce maximum inductance. This filter is used to eliminate the 9 MHz component present in the audio signal at the output of the detector. The finished b.f.o. and product detector is shown in Fig. 18.

The a.f. amplifier

The audio amplifier is of conventional transformer-less design (Fig. 19) consisting of two common emitter-connected stages driving a complementary output pair which drive the 3 Ohm loudspeaker. Considerable negative feedback is applied over the last two stages which tends to stabilize the d.c. operating point as welj as reducing output non-linearity. It is essential that the following procedure is carried out to set-up bias levels otherwise the output stages transfer characteristic will include considerable cross-over distortion.

In the audio output circuit this bias voltage is determined by the values of the resistor chain R7 and R8. First connect the audio amplifier to a 12Volt supply and a 3 Ohm loudspeaker to the output terminals. Connect an audio signal generator with an output of about 30mV to the amplifier input. A general multimeter or milliammeter set to 50 mA full scale deflection should be connected in series with the 12V Supply to the amplifier. With no input signal the current taken from the supply should be noted. The value of resistor R8 should be progressively increased until the previously noted current begins to increase. The final value for R8 will be that value which produces an increase in current from 1 to 3mA.

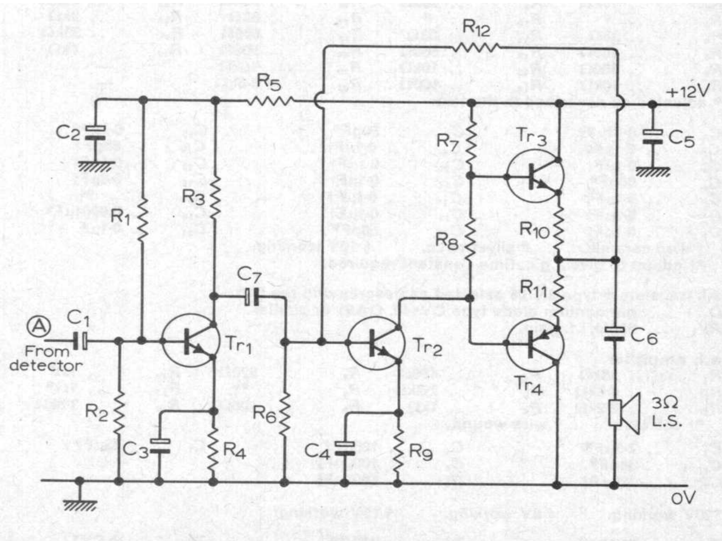

Fig. 19. The a.f. amplifier circuit.

It is most important not to make the value of this resistor too large as this may cause thermal runaway in the output transistors. The complementary pair consist of one silicon n-p-n BFY50 and a germanium p-n-p ACY17 transistor. It is generally bad practice to mix silicon and germanium devices in a complementary circuit, but the continued high price and supply difficulties forced the author to consider their use. In practice it will be found that the performance of this amplifier is far better than is required for a communications receiver. By careful adjustment the cross-over distortion can be reduced to a very low level. The finished a.f. amplifier is shown in

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Fig. 20. In the photograph the not yet discussed S meter and associated circuitry can also be seen.

This description ends this month with

COMPONENTS LIST

i.f. amplifier

R_1	.. 33kΩ	R_8	.. 150Ω	R_{15}	.. 22kΩ	R_{22}	.. 5·6kΩ
R_2	.. 10kΩ	R_9	.. 560Ω	R_{16}	.. 33kΩ	R_{23}	.. 33kΩ
R_3	.. *	R_{10}	.. *	R_{17}	.. 33Ω	R_{24}	.. 3kΩ
R_4	.. 33Ω	R_{11}	.. 33Ω	R_{18}	.. 560Ω	R_{25}	.. 33kΩ
R_5	.. 560Ω	R_{12}	.. 560Ω	R_{19}	.. 560Ω	R_{26}	.. 1kΩ
R_6	.. 560Ω	R_{13}	.. 10kΩ	R_{20}	.. 10kΩ		—
R_7	.. 10kΩ	R_{14}	.. 100Ω	R_{21}	.. 3·6kΩ		—

* adjusted as described in the text.

C_1	.. 0·01µF†	C_8	.. 50pF*	C_{15}	.. 0·1µF†
C_2	.. 0·1µF†	C_9	.. 0·1µF†	C_{16}	.. 68pF†
C_3	.. 0·1µF†	C_{10}	.. 0·1µF†	C_{17}	.. 0·1µF†
C_4	.. 50pF*	C_{11}	.. 0·1µF†	C_{18}	.. 6·8µF§
C_5	.. 0·1µF†	C_{12}	.. 0·1µF†	C_{19}	.. *†
C_6	.. 0·1µF†	C_{13}	.. 0·1µF†	C_{20}	.. 0·0001µF*
C_7	.. 0·1µF†	C_{14}	.. 50pF*	C_{21}	.. 0·1µF

† disc ceramic. * silver mica. § 10V working.
*† adjust to give a.g.c. time constant required.

All transistors type 2N706 selected as described in the text.
D_1 .. germanium diode type CV448, OA91 or similar.
RV_1 .. 25kΩ, i.f. gain.

a.f. amplifier

R_1	.. 33kΩ	R_4	.. 430Ω	R_7	.. 620Ω	R_{10}	.. 1Ω*
R_2	.. 6·8kΩ	R_5	.. 2·2kΩ	R_8	.. *†	R_{11}	.. 1Ω*
R_3	.. 2·2kΩ	R_6	.. 1kΩ	R_9	.. 100Ω	R_{12}	.. 3·3kΩ

*† see text. * wire wound.

C_1	.. 2·5µF*	C_4	.. 125µF†	C_7	.. 25µF*
C_2	.. 50µF*	C_5	.. 1000µF§		—
C_3	.. 125µF†	C_6	.. 1000µF§		—

*20V working. † 6V working. § 15V working.

Tr_{1-2} .. 2N2706 Tr_3 .. BFY50 Tr_4 .. ACY17
3Ω Loudspeaker.

b.f.o. and detector

R_1	.. 47kΩ	R_4	.. 2·2kΩ	R_7	.. 2·2kΩ	R_{10}	.. 1kΩ
R_2	.. 22kΩ	R_5	.. 2·2kΩ	R_8	.. 6·8kΩ	R_{11}	.. 2·2kΩ
R_3	.. 220Ω	R_6	.. 22kΩ	R_9	.. 1kΩ	R_{12}	.. 22kΩ

C_1	.. 150pF*	C_6	.. 0·001µF△	C_{11}	.. 0·01µF†
C_2	.. 0·01µF†	C_7	.. 5pF*	C_{12}	.. 0·001µF△
C_3	.. 0·01µF†	C_8	.. 0·01µF†	C_{13}	.. 0·001µF†
C_4	.. 0·01µF†	C_9	.. 0·01µF†	C_{14}	.. 0·001µF△
C_5	.. 0·001µF△	C_{10}	.. 25µF§		—

* silver mica. † disc ceramic. § 20V working. △ feed-through.

All transistors type 2N706.

D_{1-2} .. germanium diodes type CV448 or OA91
VC_{1-2} .. 3 to 30 pF trimmers
X_{1-2} .. b.f.o. crystals supplied with crystal filter
L_1 .. 10µH r.f. choke
VR_1 .. 5kΩ logarithmic, a.f. gain

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Amateur Communications Receiver Pt2

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components lists for the circuits described so far and all the data on coil winding for the complete receiver. Next month more design and constructional information will be given.

COIL WINDING DETAILS

function	frequency or band	winding details	coil no.
signal frequency gate 1	40m	Wound on 0·3in diameter former type CR9. 55 turns of 30 s.w.g. wire close wound. Primary winding four turns wound over the earthy end of the previous winding.	L_3
	20 m	33 turns of 34 s.w.g. wire close wound.	L_4
	15 m	20 turns of 30 s.w.g. wire close wound	L_5
	10 m	19 turns of 22 s.w.g. wire close wound	L_6
signal frequency drain	40 m	Wound on 0·3in diameter former type CR9. 55 turns of 30 s.w.g. wire tapped at 22 turns from the h.t. end	L_{11}
	20 m	33 turns of 34 s.w.g. wire close wound	L_7
	15 m	20 turns of 30 s.w.g. wire close wound	L_8
	10 m	19 turns of 22 s.w.g. wire close wound	L_9
9MHz i.f. transformer	9MHz	Wound on 0·25in screened former cat. No. CR12 can No. CR13. Primary 40 turns of 30 s.w.g. wire close wound. Secondary wound over earthy end of primary. 6 turns also of 30 s.w.g.	L_{10}
v.f.o. base coil	5 to 5·5MHz	30 turns of 30 s.w.g. wire close wound	L_1
v.f.o. amplifier	wideband coupler 5 to 5·5MHz	Two coils each wound with 50 turns of 34 s.w.g. wire close wound. In addition L_3 has a secondary consisting of 4 turns close wound over the primary	L_2 L_3
h.f. crystal oscillator	11MHz	30 turns of 34 s.w.g. wire close wound.	L_1
	25MHz	22 turns of 28 s.w.g. copper wire close wound	L_2
	32MHz, 32·5MHz, 33MHz	9 turns of 26 s.w.g. wire spread to a winding length of 0·5in.	L_3 L_4 L_5
oscillator mixer	5·25MHz	25 turns of 28 s.w.g. wire close wound and tuned by a parallel capacitor of 200pF	L_6
	16.25MHz	20 turns of 28 s.w.g. wire close wound and tuned with a parallel capacitance of 15pF	L_7
	30·25MHz	12 turns of 22 s.w.g. copper wire close wound and tuned with a parallel capacitance of 5pF	L_8
	37·25MHz, 37·75MHz, 38·25MHz	11 turns of 36 s.w.g. wire spread to a winding length of 0·5in tuned with a parallel capacitance of 5pF	L_9 L_{10} L_{11}
9MHz i.f. amplifier	9MHz	Primary winding 35 turns of 30 s.w.g. wire close wound with the secondary consisting of 8 turns wound over the h.t. end of primary	
product detector	r.f.c. 10μH	30 turns of 34 s.w.g. wire close wound with an iron dust core	L_1
i.f. trap	9MHz	12 turns of 34 s.w.g. close wound	L_1
	9MHz	46 turns of 34 s.w.g. wire close wound	L_2

With the exceptions noted above, all coils are wound on Radiospares coil formers obtainable from Home Radio, Cat. No. CR2. Iron dust cores are used in all coils with the exception of the signal frequency and i.f. trap coil L_2. See later for signal frequency coil tuning adjustment. Home Radio also supply iron dust cores under the catalogue number CR5. The author found that a satisfactory method of anchoring the wire ends to the former was to wind several turns of ordinary sewing cotton over the wire To complete the job a small quantity of shellac can be applied to the cotton. Enamelled copper wire is used in all cases.

With the exceptions noted above, all coils are wound on Radiospares coil formers obtainable from Home Radio, Cat. No. CR2. Iron dust cores are used in all coils with the exception of the signal frequency and i.f. trap coil L2. See later for signal frequency coil tuning adjustment. Home Radio also supply iron dust cores under the catalogue number CR5. The author found that a satisfactory method of anchoring the wire ends to the former was to wind several turns of ordinary sewing cotton over the wire To complete the job a small quantity of shellac can be applied to the cotton. Enamelled copper wire is used in all cases.

Taken from:
Wireless World, August 1969

[I am not suggesting that you try and build this project today in 2011. But I believe this can give you immense insight into the construction techniques used in the 1960's. Also the design can be used as a reference for your own projects. JB2011]

Editor's Comments & News

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there is a 'Boot Sale/Flea Market'

You are hereby informed of the West Rand Amateur ZS6WR radio club boot sale on the 3rd of December.

The normal rule remain in place being the Gates open for vendors at 11:45 to set up and trading commence at 12 o'clock sharp. The club house and grounds will be open for pedestrians and refreshments as well as food will be available from early onwards.

The club will holding its year end function at 15h30 same day following the boot sale.

RSVP to Phillip ZS6PVT or email to zs6wr.club@gmail.com asap.

Phillip van Tonder

Upcoming dates for 'Flea Markets/Boot Sales'

- 3rd December 2011 Members Year end function
- 28th April 2012
- 30th June 2012
- 29th September 2012
- 1st December 2012 Year end function

Birthdays this month:-

11 / 2		Shaun	Child of ZS6PGR Peter / Ansie Roos
11 / 10		Rowen McHarry	
11 / 11	ZS6PGR	Peter Roos	
11 / 13	ZS6GPM	Graham McNally	
11 / 14	ZS6JVV	Johan Van Vuuren	
11 / 16	ZS6WWJ	Willem Weideman	
11 / 16	ZS6RBJ	Rory Crouch	
11 / 16		Estelle	Spouse of ZS6BUU Francois Botha
11 / 17	ZS6JJS	Janos Sajer	
11 / 30		Dries	Child of Andre / Esme Truter

[Data taken straight from the web site. Zs6wr.co.za]

The West Rand Amateur Radio Club
Established in 1938
KG33XU 26.14122 South - 27.91870 East

P.O. Box 5344
Weltevreden Park
1715

Phone: 083 267 3835 (Chairman)
Email: zs6wr.club@gmail.com
Web page: www.zs6wr.co.za

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

Frequencies
Output: 439.000 MHz 7.6 MHz split
Input: 431.4 MHz (West Rand Repeater)
145,625 MHz (West Rand Repeater)
(HF Relay when possible)

Radio Amateurs do it with more frequency!

Chairman (technical)	**Phillip van Tonder**	**ZS6PVT**	**083 267 3835**	**zs6wr.club@gmail.com OR zs6pvt@gmail.com**
Vice Chairman	**Geoff Levey**	**ZS6GRL**	**082 546 5546**	**glevey@gmail.com**
Secretary	**Rory Crouch**	**ZS6RBJ**	**082 448 4445**	**rorycrouch@mweb.co.za**
Treasurer	**David Cloete**	**ZR6AOC**	**083 449 8991**	**zr6aoc@mweb.co.za**
Member	**Romeo Nardini**	**ZS6ARQ**	**082 552 4440**	**roshelec@global.co.za**
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Member	**Johan van Vuuren**	**ZS6JVV**	**082 558 5811**	**johanvv@absamail.co.za**
SARL Liaison (PIO)	**Willem Weideman**	**ZS6WWJ**	**082 890 6775**	**willem@zs6wwj.co.za**
Club Manager & Groundsman	**Nico Vorster**	**ZS6NJV**	**082 221 1266**	**zs6njv@gmail.com**

West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

See Club website at www.zs6wr.co.za for all ANODE back issues.

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