The Pye Bantam HP1AM

Colin Guy G4DDI

This is another of those radios that was once sought after by the amateur radio fraternity, but has now become almost forgotten. The first time I came across one was when Mr. Rushton, the local GPO Radio inspector, turned up and informed me that there had been a complaint of TVI from a neighbour of mine. After giving my transmitter a clean bill of health (well, almost, it needed a few tweaks!) he plonked a large canvas bag with a Pye logo on the front of it on the bench, and produced a telescopic aerial and a small blue microphone from within. I was told to await a call via this mysterious bag, then to operate my transmitter until told to stop. Also, if a reply was required, I was to use the callsign “Fen Post 2”, and the GPO man was “Fen Post 1”.

After our man trundled off, naturally I had a sneaky look in this bag, inside was a pair of enormous Ever Ready dry batteries (PP1? – not sure), connected to a blue box half the size of the batteries via a Bulgin connector similar to the type used for mains supply on later Pye base stations. Eventually the call came through and the TVI problem was pronounced to be a defect in the neighbours set. Afterwards Mr. Rushton told me that his Bantam had caused interference on the TV set as well!! Happy days.

In the following years I saw the odd Bantam for sale at the more upmarket rallies but a prices well out of my reach. Eventually I came across one in the flesh whilst doing pmr repairs for a local vet, and got to know what they were made of. I also discovered that in fact there was room for an internal battery, various options were available: a tray to hold AA dry cells, a rechargeable Ni-Cad or external supply as in the Post Office version.

My interest in these was rekindled last year when I came across a very dilapidated, though complete except for battery and leather case specimen at the QRP convention. It hadn’t sold by the end of the event and I managed to persuade the owner to part with it for £1.00, complete with microphone and a manual.

This set turned out to be a highband AM model so I thought about setting it up on 145.8, to be compatible with the other vintage AM VHF gear I have on this frequency. It turned out that the crystal multiplication factor is the same as the Pye Cambridge, and I had some crystals of the right frequency though the wrong holder. I soon made a pair of HC6u to HC25u adapters. Application of 9 volts to the battery terminals, crystals in, a few tweaks with the correct trimming tool and the Bantam was soon producing about ½ a watt of RF, and the receiver was about as sensitive as the Cambridge (not very!) I had to make a sort of battery cassette, and attach a strap to the metal case and out I went /p.

Success with using the set to talk back to the Cambridge and also my SCR522 at various events led me to think about looking for a lowband one to use with 4m AM sets such as the B44, an ad in the Newsletter produced, thanks to member Alan Hobbs G8GOJ, a box of four complete sets with leather cases, eight batteries and a charger, which I then had to lug half way across London to get the train home. There turned out to be two lowband AM, one highband AM and a highband FM set, so I’ve got plenty to be going on with. The FM version is quite different to the AM one, and uses a different battery pack (18 volts as opposed the the AM set’s 9.6 volts) The rest of this article refers to the AM set only.

The Bantam is a portable transceiver which was first issued in the mid sixties, uses mostly germanium transistors and is built on a single pcb mounted in a steel chassis, which slides into a steel case 8½ “ high by 5 $^{5}/_{8}$” wide by 2$^{1}/_{16}$ deep in turn housed in a leather carrying case. The following description is derived from the manual for these sets.

Circuit Description - Receiver

The Bantam receiver employs fifteen transistors and six diodes in a double superheterodyne circuit. Two r.f. amplifiers feed a diode mixer which, with a crystal controlled first local oscillator produces a first i. f. of 10.7 Mc/s. The two first i.f. amplifier stages include a crystal bandpass filter. This is followed by a second mixer/oscillator to produce the second i.f. of 455 kc/ s. Two amplifier stages at this frequency drive the detector stage which is followed by a variable squelch circuit, and noise limiter and agc circuits. The audio voltage produced is fed to the a.f. section which has two amplifier stages driving a push pull output stage. The audio output can be fed either to the loudspeaker or the electromagnetic microphone which then acts as an earphone.

R.F. Section

Signal input is fed through the aerial changeover relay contact RLA4 to the tuned circuit L1 and C2, C3. The tuned circuit matches the aerial impedance of 50 ohms to the input impedance of the first r.f. amplifier transistor TR1. This transistor is connected in a common emitter circuit with the amplified signal output being taken from the transformer T1 in the collector circuit. The second r.f. amplifier stage TR2 has a similar circuit. The collector of TR2 has two tuned circuits, L2 and C7 which is capacitively coupled through C9 to the primary of T2 which is tuned by C11. This arrangement gives the necessary r.f. bandpass characteristic.

The first mixer is a diode D1. It is inductively coupled to T2 and is fed by the local oscillator TR3. The 10.7 Mc/s i.f. is developed across the tuned circuit formed by the primary of T51 and C53. TR3 is a crystal oscillator with the crystal selected by the channel selection switch section SA2. The exact frequencies of oscillation can be adjusted by the variable inductors L3, L4 and L5.

The output of the oscillator is fed through C19 to the mixer diode. To prevent the mixing voltage from being short circuited to the chassis through T51, the network L51 and R51 is placed between the mixer diode D1 and the first i.f. transformer T51. This network has a high impedance at r.f. and local oscillator frequencies but a low impedance at 10.7 Mc/s. R52 and C54 form a biasing network to set the mixing diode to its optimum working point.

First I. F. Amplifier

Two stages are used, TR51 and TR52. Both are operated as common emitter amplifiers. TR51 is inductively coupled to the mixer diode by T51, the earthy end of the secondary being taken to the a. g. c. line and decoupled by C56. This stage feeds TR52 through the 10. 7 Mc/ s crystal bandpass filter unit FL51.

Second I.F. Section

The output from TR52 is coupled through T52, the secondary winding of which feeds the 10.7 Mc/s signal to the base of

TR76. The earthy end of the winding is taken via RV76 to the chassis and decoupled by C77. RV76, with R76 forms a potential divider controlling the base bias of the stage thereby controlling the gain of the receiver.
TR79 is the second local oscillator and is connected in a crystal controlled circuit. Output is taken from the emitter through C94 to the base of the mixer TR76. The second intermediate frequency of 455 kc/s is taken from the collector of TR76 by T76 and is fed to the two 455 kc/s amplifier stages TR77 and TR78 which drive the detector D101 through T78.

A.G.C. System

As the detector diode D101 rectifies the incoming signal a voltage positive to earth is developed across C101. This voltage is fed through R89 and the secondary of T76, and opposes the bias on TR77. As the signal strength increases so the bias on TR77 becomes less negative, causing the stage gain to fall.
D76 is the delay diode which holds the agc line at a potential which prevents TR1 and TR2 drawing excessive current under no-signal conditions. This protects the r.f. transistors and allows the gain to remain constant until the signal is strong enough to cause the agc voltage to rise above this gating potential.
Automatic gain control is also applied to both r.f. stages and to the 10.7 Mc/s i.f. amplifier TR51. The bias for these stages (approximately - 1.2 volts under no-signal conditions) is obtained from the voltage dropped across R83, the emitter resistor of TR77. As the bias on TR77 goes less negative with an increase in signal strength so the current flowing through the emitter- collector circuit is reduced and the emitter potential falls towards earth, i.e. less negative and therefore the gain falls.
TR51 has a small amount of emitter bias applied to it through R58 to ensure that the gain of this stage falls more quickly than that of the r.f. stages to maintain a low noise figure.
A.F. signals produced by the detector are developed across R101and R102 and are passed through D102, to the volume control. D102 is the noise limiting diode. As was seen in the agc description the detector diode produces both a.f. signals and a d.c. potential to earth. As the cathode of D102 is connected to the junction of R101 and Rl02 a current flows from D101 through R103/R104 causing D102 to conduct. In this condition DlO2 can pass a.f. signals through to the volume control,
RV102.
A noise pulse causes a sudden increase in the positive d.c. produced by the detector. The potential on the cathode of D102 rises but its anode potential cannot rise so quickly since C104 must charge through R103. The diode D102 therefore has a higher positive voltage on its cathode than on its anode and is cut off. No a.f. signals pass through D102 until either C104 is charged or the noise pulse ends, reducing the positive potential on the cathode of D102.

Squelch Gate

As the receiver is very sensitive the amount of noise heard from the loudspeaker when there is no signal may become objectionable. The Squelch Gate circuit silences the set until a signal is received. When this occurs the Squelch Gate opens and the receiver works normally. As soon as the incoming signal ceases the receiver is again silenced. With no signal input TR102 conducts holding the cathode of D103 at a potential less negative than its anode. The diode is therefore non-conducting and all a.f. signals are blocked. An incoming signal to the aerial causes the agc. line to become less negative thereby reducing the bias on TR102 and consequently reducing the current flow through R115. The cathode of D103 is then more negative than its anode and the diode conducts permitting the a.f. signals to pass through. As the receiver cannot distinguish between bursts. of noise and normal signals a noise compensation circuit is provided. C113 and R110 form a high pass noise filter feeding the noise amplifier TR1O1. The amplified noise is fed through a second high pass filter C106, C 108, R113 to the noise rectifier D104. The purpose of the high pass filter is to prevent speech components reaching the noise rectifier. Thus only noise and not speech signals will operate this circuit. In the presence of noise the agc line potential will vary but this will not affect the squelch gate since the voltage developed by D104 maintains a constant base potential on TR102. RV101 controls the sensitivity of TR102 and enables the silencing threshold to be adjusted to suit particular conditions.

AF Section

From the squelch circuit the audio voltage is fed via RV102 and transmit/ receive relay contact RLA3 to the a.f. amplifier stages, TR1S2, TR153, TR154 and TR155. The first two amplifier stages are r.c. coupled common emitter amplifier circuits. TR1S3 drives the push pull output stage which can deliver up to 200 mW output. The audio output is fed from the secondary of the output transformer T152, through the transmit/receive relay contact RLA2, C168 to either the loudspeaker or the terminating resistor R171, across which the microphone is connected when used as an earphone. Loudspeaker or earphone operation is selected by the OFF, ON, LS switch, SB.

Transmitter

The transmitter is crystal controlled and employs six transistors in the band 25-68 Mc/s and seven in the band 68-174 Mc/s. High level amplitude modulation is employed, the a.f. section described above acting as a modulator in the “transmit” condition. Up to three adjacent working frequencies can be selected by the Channel switch.

RF Section

TR201 is the crystal oscillator and uses one of the crystals XL201, XL202, or XL203 as selected by the Channel switch SA1. The exact frequency of each crystal can be adjusted by shunt capacitors C20l, C202, C203. Output is taken from the emitter through C209 to the base of the first multiplier stage TR202. There follow two more multiplier stages TR203, TR204, a driver stage TR205 and the power amplifier using TR206 and TR207 in parallel. From TR203 onwards v.h.f. transistors of the n.p.n. type are employed in contrast with the p.n.p. types used throughout the rest of the Bantam. The n.p.n. transistors, denoted by the reversed arrowhead of the emitter element, require the collector to be at a positive potential with respect to the emitter. But as the chassis is at a potential positive to the supply line, the last four stages of the transmitter, which employ these transistors, are inverted to keep their polarity correct.
In the second multiplier stage TR203, the drive is obtained from the secondary of T201 and applied to the base and emitter of the transistor. The emitter is also connected to the tap of T202. Output is taken from T202 which is effectively connected in the collector circuit of TR203, through C214 and C213. This circuit arrangement is used in all of the succeeding stages including the power amplifier which has TR206 and TR207 connected in parallel. Note on the circuit diagram, that on 132-174 Mc/s, L207 L208 are substituted for T20l (See Note 4 on the diagram) whilst for 25-68 Mc/s the last multiplier stage TR204 is omitted. (See Note 1 on the diagram).
The p.a. tank circuit has two tuned circuits at the channel frequency C228, L205, L206 and C230, from which the output is taken, at 50 ohms impedance, to the aerial relay RLA4.

Modulator

Modulation is applied to both the driver and p. a. stages simultaneously. Speech voltage from the microphone is applied through pin D on SKA, Rl53 and relay contact RLA3 which is closed on ‘transmit’, to the A. F. Section. Output from the secondary of T152 is applied through RLA2 and r,f.

chokes L203, L204 to the emitters of TR205 and TR206, TR207.
Part of the output from T152 is also rectified by D151 and fed to the base of the Modulation Compressor TR151 as a negative potential. When modulation exceeds the pre-determined level set up during manufacture this negative potential controls the effective shunt impedance formed C154 TR151 and Cl51 and consequently prevents any further increase in modulation level.

Alignment and Use

Easy to troubleshoot, and alignment is straightforward following the charts below, and fig. 2. These sets are quite useable, you just need to choose a frequency in the all – mode section of the relevant band to avoid upsetting the 'bandplan police' – 70.26 is ideal for the lowband sets as it is officially the 'all-mode' calling frequency. Anyone any suggestions for a 2m AM frequency? We use 145.8 at the moment, but I gather it's a bit politically incorrect nowadays.

Receiver Alignment (refer to fig. 2)	
Ref	Adjustment
1 2 3	Apply signal generator to aerial socket. Adjust in sequence for maximum diode voltage.
TP2	Check 2nd local oscillator voltage on R93 with valve voltmeter or diode probe (0.15 volts minimum)
4 5	Adjust in turn for maximum diode voltage
TP1	Check 1st local oscillator at L51. Should be 0.3 volts minimum.
6	Adjust for maximum injection at D1 if necessary.
7 - 10	Apply signal generator to aerial socket. Adjust in turn for maximum diode voltage. Reduce signal generator level as necessary.
	Carry out performance checks.

Transmitter Alignment (Refer to fig. 2)	
Ref	Adjustment
11	Connect voltmeter between TP201 and earth. Tune for a dip in meter reading (25 – 136Mc/s). 132 – 174 Mc/s tune L208 for maximum at TP202
12	Connect voltmeter to TP203. Tune for maximum reading.
13	Connect voltmeter to TP204. Tune for maximum reading.
14	Connect voltmeter to TP205. Tune for maximum reading. Check that reading is the same on TP206 (± 20%)
15 16	Connect RF power meter to aerial socket. Tune for maximum output.
(17) (18)	Tune for maximum output at aerial.

RF Power Output			
Band	Output mW	Band	Output mW
A	400	F	650
B	300	G	700
Air	350	H	750
D	400	J	750
E	450	P	400

Carrier Freq Mc/s	Band	Receiver	Transmitter
148 - 174	A	(fc-10.7)/3	fc/18
132 - 156	B	(fc-10.7)/3	fc/18
118 - 136	Air	(fc-10.7)/3	fc/12
88 - 108	D	(fc-10.7)/3	fc/12
79 - 101	P	(fc-10.7)/2	fc/12
68 - 88	E	(fc-10.7)/2	fc/8
54 - 68	F	(fc+10.7)/2	fc/6
42 - 54	G	fc-10.7	fc/6
32.5 - 42	H	fc+10.7	fc/4
25 – 32.5	J	fc+10.7	fc/4

Table 1 – Crystal formulae (fc = carrier freq)

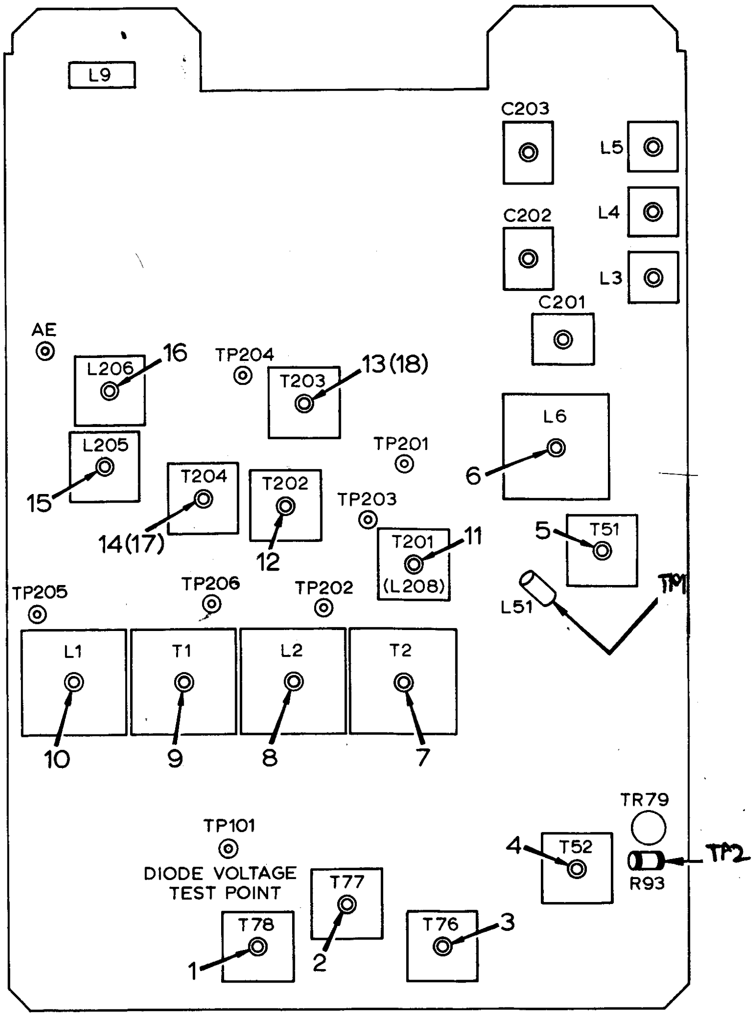
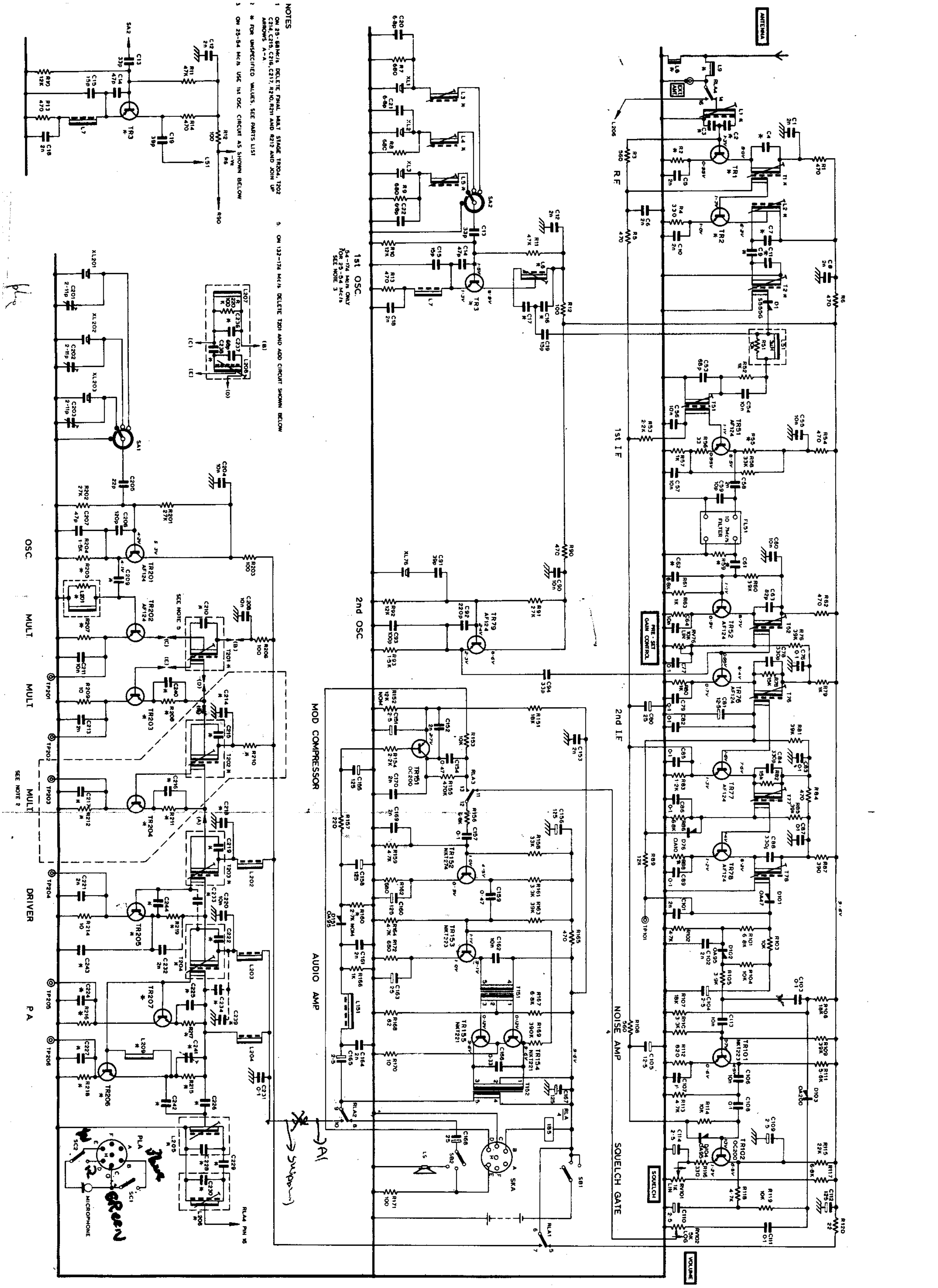


Fig.2 Test and alignment points.

Faults

Generally reliable, faults are mostly confined to such things as noisy relay contacts, dry joints and the odd electrolytic capacitor that goes open circuit. For poor sensitivity or low/zero transmitter drive, look inside the coils for dry joints. Only rarely do the transistors fail unless subjected to abuse. All in all an easy set to work on. Do use the correct trimming tool for alignment though!

Fig. 3 (next page) Pye AM Bantam circuit diagram.


ANTENNA
R.F
1st I.F
2nd I.F
NOISE AMP
SQUELCH GATE
PRE-SET GAIN CONTROL
SQUELCH
VOLUME
1st OSC
2nd OSC
MOD COMPRESSOR
AUDIO AMP
OSC.
MULT
MULT
MULT
DRIVER
P A
MICROPHONE
NOTES