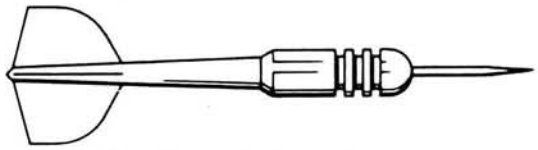

PW DART QRP TOP BAND TRANSMITTER

by Rev G.C. Dobbs G3RJV & Colin Turner G3VTT PART 1

I remember well my first venture into phone on Top Band. It was in the days that a.m. ruled. I had built the obligatory valve transmitter for Top Band: EF50 v.f.o., EF50 buffer and 807 p.a. with cathode of the 807 keyed for c.w. operation. Then following the advice of an old timer I put a carbon microphone in the key socket and shouted into it. Lo and behold—amplitude modulation . . . and a sore throat. It all seems so complex in these days when single side band holds sway. What we offer here is a simple means of being able to put a voice transmission onto an amateur band.

Each year my family and I leave the safety of Birmingham and make a sojourn in Kent to the G3VTT household. During these visits we usually make time from wife pacifying and child amusing to work on some project in the shack. On one such visit I found Colin towards the end of making a little double sideband suppressed carrier (d.s.b.s.c.) transmitter for Top Band and we completed the project together. I liked it. Practically nothing in the box and it put a useful signal onto the 1·8MHz (160m) band. The circuit appeared shortly afterwards in *SPRAT*, the journal of the G-QRP Club[1] and was named BREN after Colin's long suffering wife. Several G-QRP Club members built the transmitter with success. Bristol even produced a small 1·8MHz band net of people using the design. I have added a little to the circuit, standardised the components for ease of purchase, presented a p.c.b. layout and we now offer it to wider audience as the *PW* Dart.

The circuit offered has several advantages. It uses cheap bipolar devices plus a couple of common f.e.t.s. together with standard inexpensive components. The circuitry is simple enough for most amateurs to tackle. It has been built without problems by a number of people. But best of all, it puts a useful couple of watts onto the 1·8MHz band on c.w. and the d.s.b.s.c. signal is of good quality and taken by most people for an s.s.b. transmitter. Many modern multiband transceivers do not offer a 1·8MHz band option and this is a simple way to get on that band.

What are we talking about when referring to d.s.b.s.c.? Well, it is an amplitude modulated signal in which the two sidebands are transmitted but the carrier is removed.

BUYING GUIDE

The Jackson air-spaced capacitors used in this unit are available from Bi-Pak Semiconductors. The SBL-1 double balanced mixer is obtainable from Ambit International. Neosid Small Orders have a kit, PW80, for inductors L1 and L7 priced £1.50 including post and packing. The author's prototype was housed in a box obtainable from Minffords of Sun Street, Ffestiniog, Gwynedd LL41 4NE. All other components are readily available from advertisers in this magazine.

Approximate Cost £55

Construction Rating INTERMEDIATE

The Circuit

The complete circuit of the transmitter is shown in Fig. 1. The key item in the circuit is the mixer, it is the splendid SBL-1 Double Balanced Mixer module. The v.f.o. signal on 1·8 to 2MHz is fed into one port and, in theory, no signal will emerge at the output port (pin 1) unless the mixer is unbalanced with a signal on the third port. If this port is supplied with an audio signal, a double sideband r.f. signal will emerge—suppressed carrier because it only appears in response to the audio input. If a d.c. voltage is keyed onto the third port a keyed c.w. signal will emerge. In practice a little of the v.f.o. signal will leak through the double balanced mixer (d.b.m.) but with careful construction and layout this leakage is minimal.

The v.f.o. is a simple common drain Colpitts Oscillator, Tr1, with a single buffer stage, Tr2. The output from the source of Tr2 gives a reasonable match into the d.b.m. The Power Amplifier Board may lack sophistication but uses inexpensive devices in a linear arrangement to produce some 2 watts of output. It consists of a pre-driver BC108, a driver 2N3053 and a pair of 2N3053 transistors

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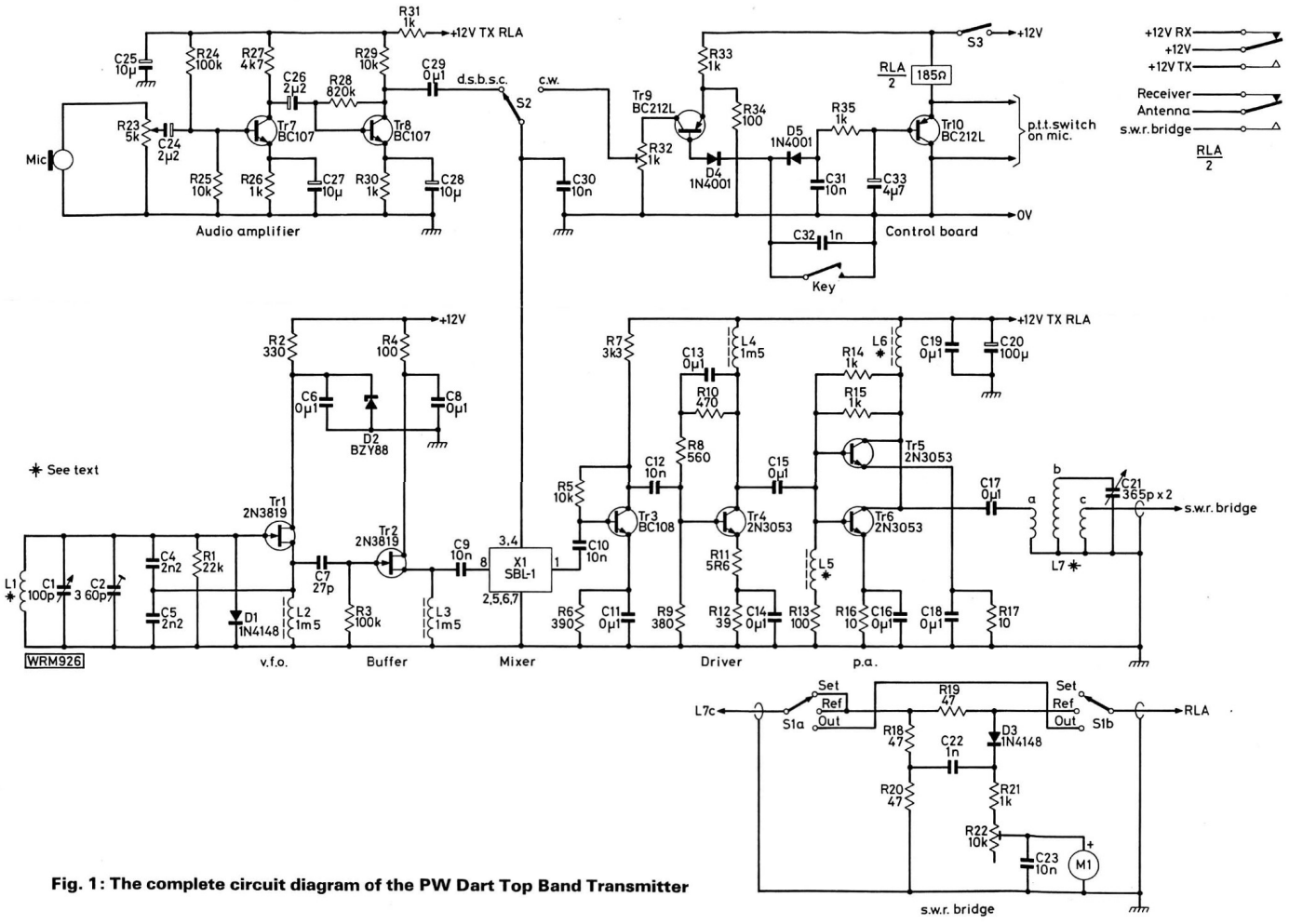

Fig. 1: The complete circuit diagram of the PW Dart Top Band Transmitter

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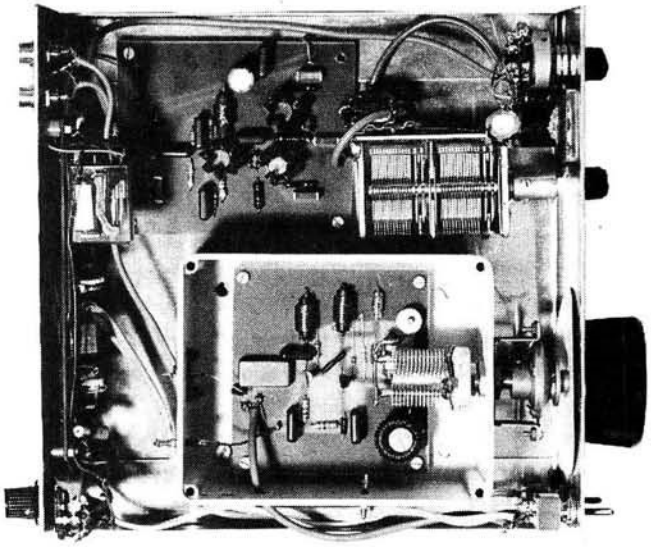
in the final. Other similar bipolars will probably give much the same results. The audio signal comes via a very scant two-stage amplifier, Tr7 and Tr8, which has more than adequate gain for full output from a cheap medium impedance CB type microphone. I hate microphone hugging and found even without full gain I could hold the microphone almost a metre from the mouth. The transmitter may even be capable of the "marble hall" effect that Italian s.s.b. operators seem to love.The key operates two d.c. switches Tr9 and Tr10. Keying produces a voltage through Tr9 onto a preset R32 which provides the d.c. voltage for the c.w. signal. Keying Tr10 operates a relay, RLA1, with a degree of hold on provided by C33 to give a semi-break in effect. On d.s.b.s.c. operation the "press-to-talk" switch shorts out Tr10 to put the circuits onto transmit. The two-pole changeover relay contacts switches the antenna between the transmitter and receiver and also provides 12VTX on transmit and 12VRX on receive from the 12 volt power line.

The output from the transmitter is tuned by a single tuned circuit, L7/C21, which has two small input and output link windings. This gives a low impedance output but most operators on Top Band cannot provide a 50Ω antenna . . . oh for the space of the dipole! So an integral s.w.r. bridge circuit is provided on the output. The circuit chosen has several advantages in that not only is it simple but also it offers impedance protection to the p.a. transistors and allows tuning-up to be a simple three switch action. The bridge is a resistive s.w.r. bridge based upon the Wheatstone Bridge beloved of physics masters. Resistors R18-20 provide three arms of the bridge, the fourth being the impedance of the antenna. When the output "sees" 50Ω the sensing circuitry, D3/C22, are at a null and the



★ components

Resistors

Carbon Film ¼W 5%

5·6Ω	1	R11
10Ω	2	R16, 17
39Ω	1	R12
47Ω	3	R18-20
100Ω	3	R4, 13, 34
330Ω	2	R2, 9
390Ω	1	R6
470Ω	1	R10
560Ω	1	R8
1kΩ	8	R14, 15, 21, 26, 30, 31, 33, 35
3·3kΩ	1	R7
4·7kΩ	1	R27
10kΩ	3	R5, 25, 29
22kΩ	1	R1
100kΩ	2	R3, 24
820kΩ	1	R28

Midget Potentiometer

5kΩ	1	R23

Vertical pre-set

1kΩ	1	R32

Horizontal pre-set

10kΩ	1	R22

Capacitors

Monolithic Ceramics

1nF	2	C22, 32
10nF	6	C9, 10, 12, 23, 30, 31
0·1µF	7	C6, 8, 13-15, 19, 29

Polystyrene

27pF	1	C7
1nF	1	C3
2·2nF	2	C4, 5

Electrolytic (axial)

4·7µF 16V	1	C33
10µF 25V	3	C25, 27, 28

Electrolytic (p.c.b. mounting)

2·2µF 16V	2	C24, 26
100µF 25V	1	C20

Miniature Layer Polyester

0·1µF	4	C11, 16-18

Miniature Trimmer

3-30pF	1	C2

Air-spaced Variable

100pF	1	C1
2 gang		
365pF	1	C21

Semiconductors

Diodes

BZY88	1	D2
IN4001	2	D4, 5
IN4148	2	D1, 3

Transistors

BC107	2	Tr7, 8
BC108	1	Tr3
BC212L	2	Tr9, 10
ZN3053	3	Tr4-6
ZN3819	2	Tr1, 2

Miscellaneous

p.c.bs; s.p.d.t. miniature toggle switch (2); 4p·3w wafer switch; 12V 2 pole changeover relay 185Ω coil; 1·5mH r.f. choke (3); ferrite beads (2); T68-2 torroids (2); SBL-1 double balanced mixer; 200µA moving coil meter (see text); 6:1 slow motion tuning control; 32 s.w.g. & 28 s.w.g. enamelled copper wire; case (see text).

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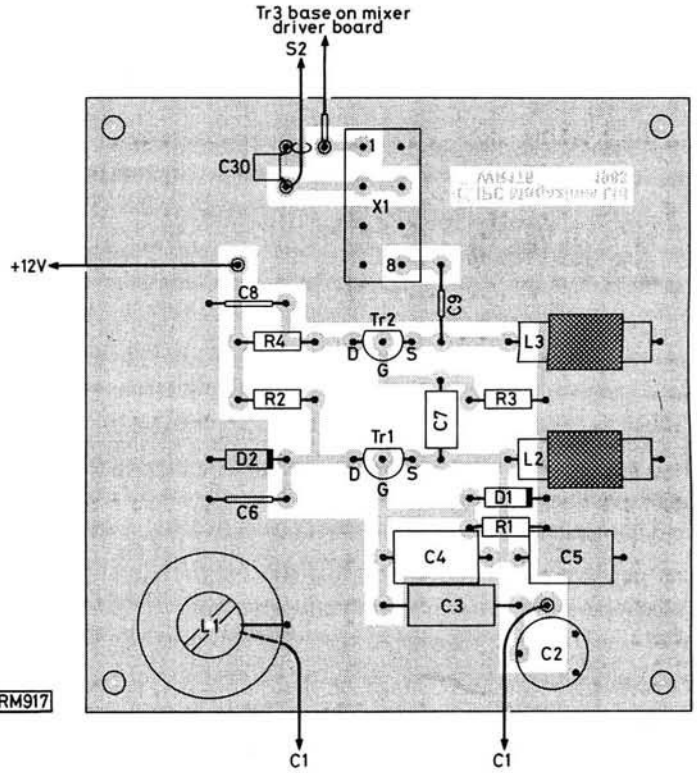
Fig. 2: Full size p.c.b. track pattern and component placement of the v.f.o./mixer board



WRM917

meter should read zero. So an external a.t.u. can be adjusted to obtain this match. This form of bridge is especially useful since even with a severe mismatch the transmitter output is always loaded by R18 and R20 which should be enough to stop the output transistors curling up their toes.

The tuning-up procedure is simplicity itself. The switch, S1, is placed in the SET position where it acts as an r.f. indicator. Capacitor C21 can then be adjusted for peak reading. The switch is then turned to the REF position where it acts as the resistive bridge. The external a.t.u. can then be adjusted for the minimum reading on the meter. The transmitter should now be matched and S1 can be moved to the OUT position which cuts out the resistive bridge and allows all the r.f. into the antenna. It is possible to tune up very quickly using this three step procedure without risk to the p.a. stages and only radiating a very low signal.

Construction

Most of the transmitter is built on three small boards; a v.f.o. Mixer Board, a Power Amplifier Board and an Audio/Changeover Board.

The v.f.o./Mixer Board is mounted in a small screened box within the body of the transmitter. The prototype used a diecast aluminium box 114 × 89 × 51mm in size, although any sturdy box would serve the purpose. Some constructors seem to have problems with stability in the v.f.o.s. In practice I have found that if a v.f.o. is built to be dropped from 9000m, it will probably be stable! The tuned circuit uses a toroid former which although not favoured by some for v.f.o. tuned circuits, seems to be very stable at this sort of frequency. Capacitor C1 should be a good airspaced capacitor of some 100pF, these can be very expensive though can be found on the surplus market, (but can't everything). In fact a value slightly over 100pF would be useful as with this value the v.f.o. barely covers the whole of the band. Capacitor C2, a semi-airspaced variable trimmer, sets the band edges. The critical fixed components are the capacitors C3, 4 and 5, these should be high quality temperature stable components. The prototype used polystyrene types but good quality silvered mica capacitors would also be suitable.

One of the problems of a simple d.s.b.s.c. transmitter is v.f.o. leakage through the mixer giving an unacceptable carrier level before the audio signal is applied. Short leads around the SBL-1 mixer, with good screening, are required. The SBL-1 is mounted on the v.f.o. printed circuit board within the v.f.o. case and the circuit board has a large copper ground mat around the mixer module as shown in Fig. 2. The filter capacitor, C30, although shown as part of the Audio Amplifier board in Fig. 1, is mounted as close as possible to the audio input port, pins 4 and 5, of the SBL-1. The mixer output capacitor, C10, is not board mounted but forms the connection between the output port of the SBL-1 on the printed board and a lead-through to take the signal out of the v.f.o. enclosure. The input and output leads to the mixer are all screened cables.

The tuning coil in the v.f.o., L1, is wound on a T68-2 toroidal core, and this core should be physically secure. The coil is 45 turns of 28 s.w.g. enamelled copper wire. The prototype was mounted onto the p.c.b. with a plastics 0BA bolt and held above the board with a large plastics pillar. The tuning requires some form of slow motion drive; the inexpensive little 6:1 epicyclic drives seem suitable for this application. They are easy to use, reasonably smooth, and a circular scale made of metal or stiff card can be mounted onto the portion of the reduction shaft in front of the main gearing. It is wise to build the v.f.o. first and test it in its own right, if only by listening for it on a receiver.

Part 2 of this article will deal with the audio amplifier/changeover board and p.a. board.

Readers who intend to operate the *PW* Dart should be in possession of the appropriate licence issued by the Department of Trade and Industry to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Department of Trade & Industry, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

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