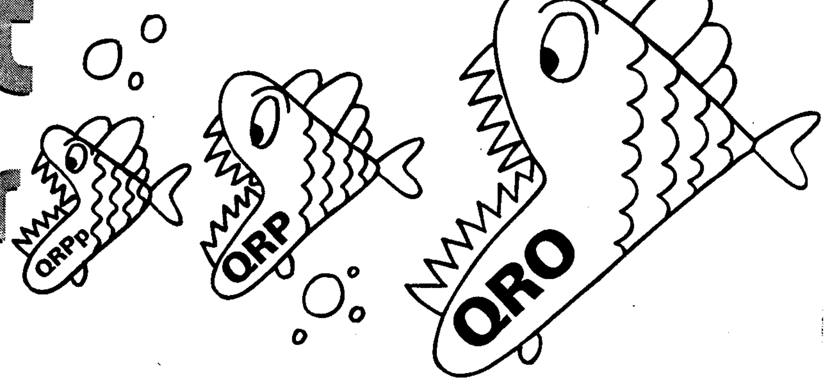
The Sprat Transceiver



By Rev. George Dobbs G3RJV

The Rev. George Dobbs G3RJV has come up with a compact QRP c.w. transceiver for the 3.5MHz band. We've called it the 'Sprat', to commemorate the G-QRP Club's own magazine, which of course is edited by G3RJV!

The 3.5MHz band offers good pickings for the QRP operator. Many QRP operators hang around the International QRP Calling Frequency on 3560KHz and QSOs with the whole of the UK and many continental countries are easily available with a few watts of r.f. power.

The Sprat project was designed to provide a viable QRP Superhetrodyne (superhet) c.w. station. It's ideal for low power operation on 3.5MHz although the Sprat receiver is so designed to be used alone.

This also means that the receiver, always the trickiest bit of a transceiver, can be built first. Once the receiver is working, the constructor can go on to complete the transmitter board.

The receiver would be a useful project in its own right for those who only wish to listen on the band or would like a stand-by receiver for 3.5MHz. It also makes a very compact stand-alone receiver.

Novice Operators

The 3.5MHz band is available to the Novice operator so the transmitter is designed to deliver the 3W output allowed to Class A Novice licensees. The power amplifier, a single m.o.s.f.e.t. device, is operated in Class AB.

My choice design may appear to be a waste of power. But for novice builders, the 'wing and a prayer' Class C amplifier, so common in simple QRP transmitter designs, can lead to all sorts of problems.

Why Sprat? Well - the Editor of *PW* suggested this little project to me, saying that he wanted it to be called the 'Sprat' in tribute to another (rather special) journal. *Sprat* is the name of the journal of the G-QRP Club, which I've edited for the last 21 years.

The name Sprat is quite appropriate because it stands for **S**mall **P**owered Amateur **RA**dio **T**ransmission following as a suggestion from **G3DNF** when the journal first appeared.

The Receiver

The receiver (**Fig. 1.1**) is a superhet circuit based on the Motorola MC3362 chip. The MC3362 was designed as a single chip narrow band v.h.f. f.m. receiver but has enough internal functions available at the pins to receive c.w. Several designs for h.f. receivers, configuring the MC3362 with a product detector, have appeared in recent years.

*"The little fishes of the sea,
They sent an answer back to me..."*

From *Through the Looking Glass*, by Lewis Carroll.

The first person to exploit the MC3362 for h.f. c.w. use was **Gary Breed K9AY**, in his 'Portable QRP c.w. Transceiver' in *QST*, December 1990. There was a simplified version of the circuit by **Peter Parker VK6BWI**, published in *Lo Key*, the journal of the VK c.w. Operators QRP Club in March 1993.

The MC3362 had not been featured in any UK designs and my first prototype suggested that it could produce a very useful little h.f. receiver. Although no sooner had I completed the first full version of the Sprat than a design from **Bernie Pallet G3VML**, appeared in the October and November issues of *RadCom* using the MC3362 in a receiver!

But after consultation with Rob G3XFD, I decided to proceed with my original project. After all, we were almost ready to go in any case!

The Circuit

Considering the circuit from the input: C1, L1, and D1-4 form an input protection circuit for the transceiver to operate in full break-in mode.

A two-pole band-pass filter, around L2 and L3 selects the 3.5MHz band signals which are coupled, via C5, to the first balanced mixer in the chip. The MC3362 performs all the receiver functions as far as the audio stages.

The internal varicap local oscillator (l.o.) is tuned from 7.933 to 8.033MHz by using L4/C9 as the tank circuit and R2, with R1 and R3, as the tuning control.

The MC3362 provides a buffered output from the l.o. on pin 20. This output is used to drive the transmitter.

The i.f. selectivity is provided by a three-pole 4.433MHz crystal filter, XL1, XL2 and XL3. The filter is of the ladder configuration, computer designed with Butterworth coefficients for a nominal 500Hz bandwidth.

Several filters have been built using standard 'off the shelf' TV colour burst crystals. All worked well without any need to find a matched set of crystals.

The second l.o. (using pins 3 and 4 and another colour burst crystal) is used for the beat frequency oscillator (b.f.o.). A trimmer capacitor 'pulls' the crystal to vary the beat note.

The recovered audio (at pin 5) passes to Tr1, the audio muting part of the change-over system. The receiver is on in both receive and transmit modes so during transmit,

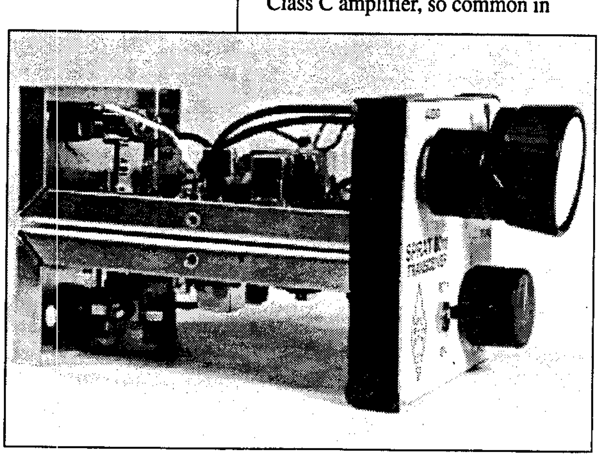


Fig 1.1

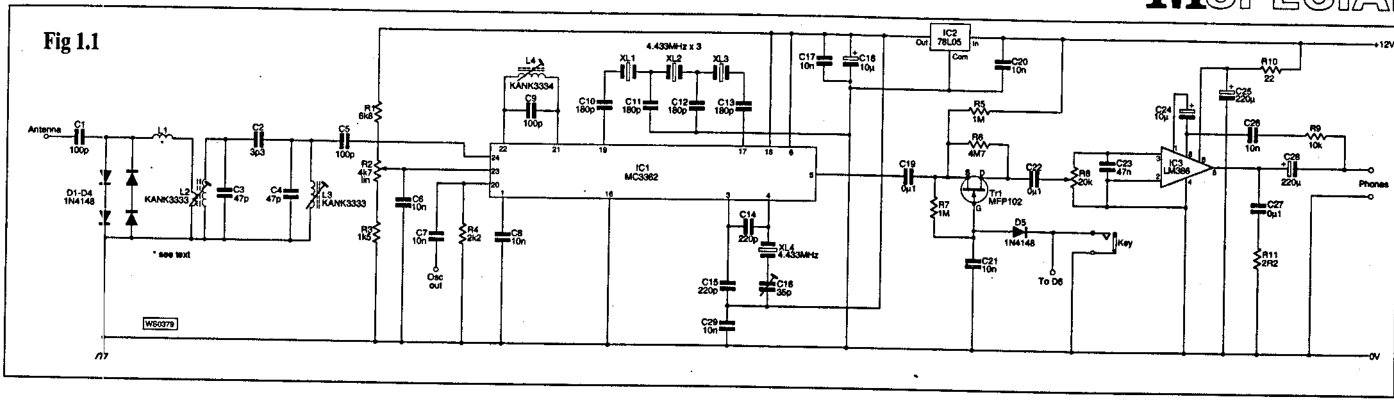
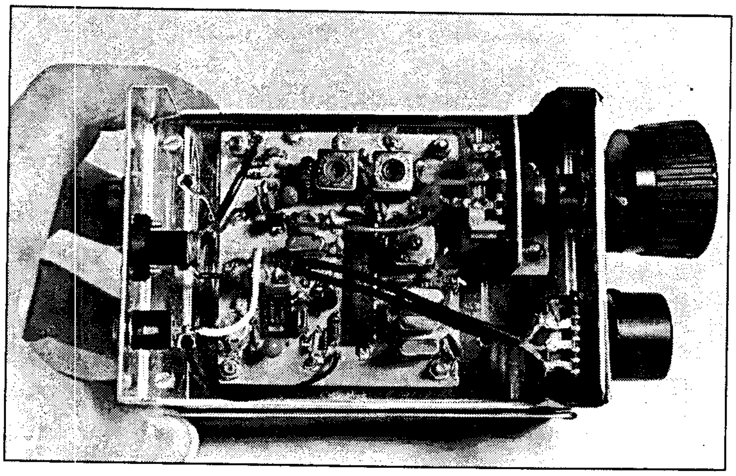


Fig. 1.1: The Sprat superhetrodyne receiver has a crystal filter in the i.f. for improved performance. It also provides an output signal to couple to the transmitter.



the key mutes the audio output via Tr1.

A conventional LM386 audio output circuit gives adequate loudspeaker output under quiet room conditions. The feedback filter provided by R9/C26, reduces the high frequency noise often associated with the LM386.

The Transmitter

The Sprat transmitter is designed to produce a comfortable 3W of r.f. power thus complying with the requirements of the novice and QRP operator. It's perhaps a somewhat 'over designed' but very simple transmitter circuits have an unpleasant tendency to misbehave. The transmitter circuit, **Fig. 1.2**, shows the complete transmit board.

The signal from the receiver board is fed to a BC183 buffer stage, which produces a clear signal which doesn't shift frequency between receive and transmit. A preset control, R14, adjusts the amount of drive available to the mixer.

The mixer stage is the commonly used NE602 (IC5). The internal oscillator of the NE602 generates a signal at the 4.433MHz i.f. The crystal may be 'pulled' by C37 to align the transmitted signal to the received signal.

Because the receiver remains on, but muted, during transmit, the transceiver monitors the actual transmitted note. This not only provides a 'live' side tone to monitor the Morse but ensures the transmitter and receiver are on the same frequency. Additionally, if the station being worked is at the same audio pitch as the monitored transmitter signal, the transceiver is netted with the other station.

The transmit mixer output is coupled to a 3.5MHz band-pass filter (L5/L6), followed by a two stage buffer-driver circuit to the power amplifier stage. In this project the power amplifier is an IRF510 m.o.s.f.e.t. device running well within its power handling capabilities. However, it does require a heatsink.

As an attempt has been made to keep the p.a. stage trouble-free and stable the power amplifier has a manually controlled biasing circuit, set by R24 across Zener diode D7. There is also some feedback via C53 and R22.

The output is through a trifiliar wound 4:1 balun transformer (T1) (5 turns 0.32mm wire on an FT37-43 toroid). Note the heavy decoupling at the top of this transformer (C49/52) which helps to minimise r.f. leakage to the 12V power source.

The output is taken through a seven element low-pass filter. This filter follows the W3NQN values for standard capacitor value low pass filters. Coils L9 and L11 are 25 turns of 0.32mm (32s.w.g.) enamelled copper wire on a T37-2 toroid. Coil L10 has 27 turns on a T37-2 toroid.

The input to the receiver is 'picked off' between C57 and the low-pass filter allowing the filter to remain in circuit on receive.

The transmitter mixer and buffer stages are keyed via Tr5, a *PNP* transistor acting as a switch. The power amplifier remains on all the time. This produces a nice keying characteristic (good reports have been obtained on the air).

I'm sorry that's all I have space for this time. Next time I'll show you how to build the Sprat Transceiver.

PW

Full size copies of the Sprat circuits + Pre-publication Shopping list are available from the Editorial Offices.

Fig. 1.2: Taking the l.o. signal from the receiver and mixing it with a reference at the i.f. allows the Sprat receiver to control the frequency of the transmitter.

Fig 1.2