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Kiwi TV — Pt. 1

ATV 23cm FM Receiver

New Zealand–style.

Even though this system may not be too practical for USA hams, sometimes it's interesting to follow a project along in somebody else's shoes. Here's one such case.

All I ever wanted to do in amateur television was to watch the ATV repeater, on channel 39 at 615.25 MHz. This 10 W repeater has an amateur allocation in the middle of our UHF commercial TV band.

But now I have started a TV construction project, all because of this guy Grant Taylor ZL1WTT.

He wanted to use frequency modulation for its noise immunity and its capture effect—the strongest signal always completely swamps a weaker signal. He wanted to provide stereo sound, yet the whole project needed to be assembled from affordable parts, so that the cost of any single item would not act as a deterrent. Surplus parts should be used where possible.

The drawback with this approach is that such a project cannot be engineered for mass distribution overseas. Also, many of the overseas designs use components that are too hard to get in New Zealand. We have to design with components that are locally available. Even so, some parts for the FM transmitter are disappearing.

So, I will give details of the Auckland VHF Group ATV 23cm FM receiver, as an inspiration for any project you might come up with yourself. I should also note that although we are using the European PAL system for receiving color TV, this receiver is perfectly suitable for the American NTSC system. What comes out of it as composite video is simply what goes

Photo A. *Grant Taylor ZL1WTT designed and built the first FM amateur television system in New Zealand.*

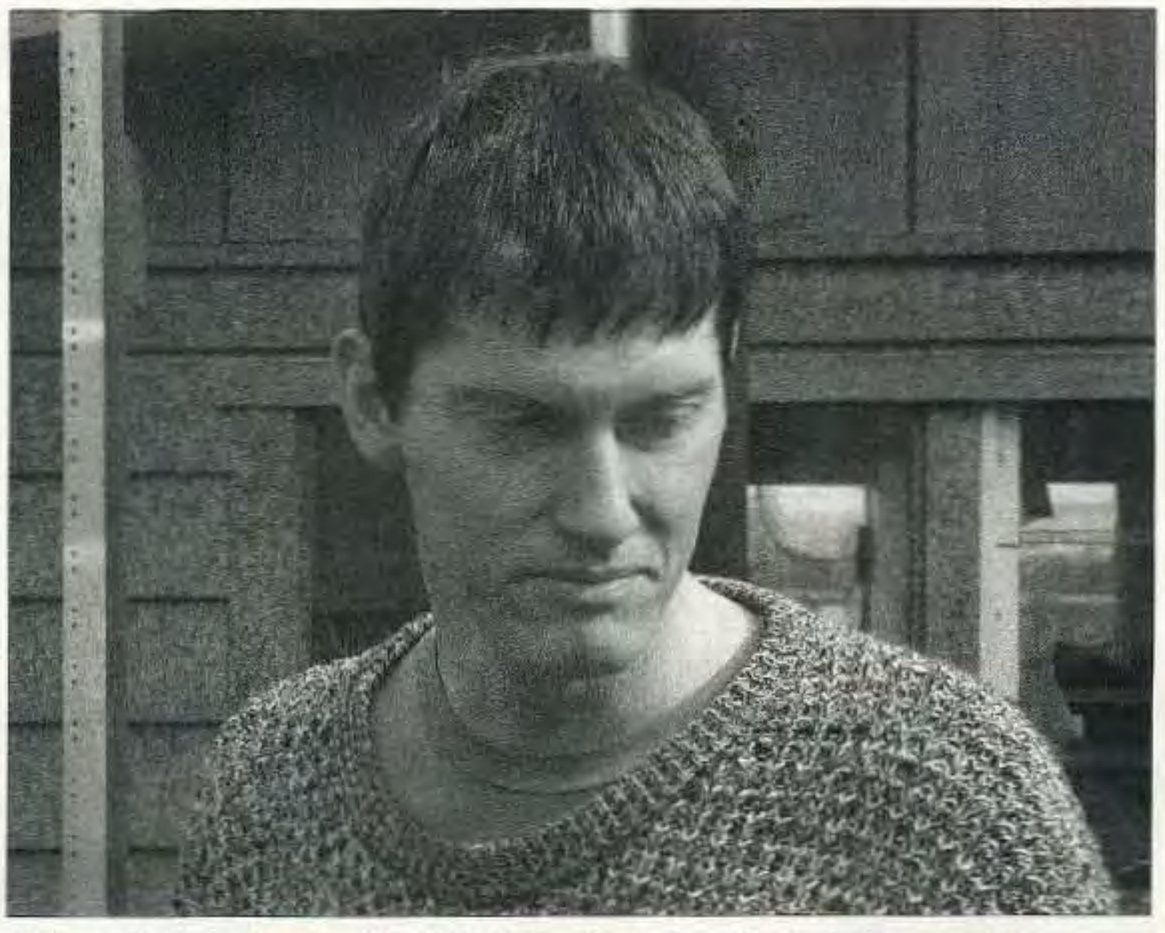

Photo B. *Ian Pople ZL1VFO further developed the receiver.*

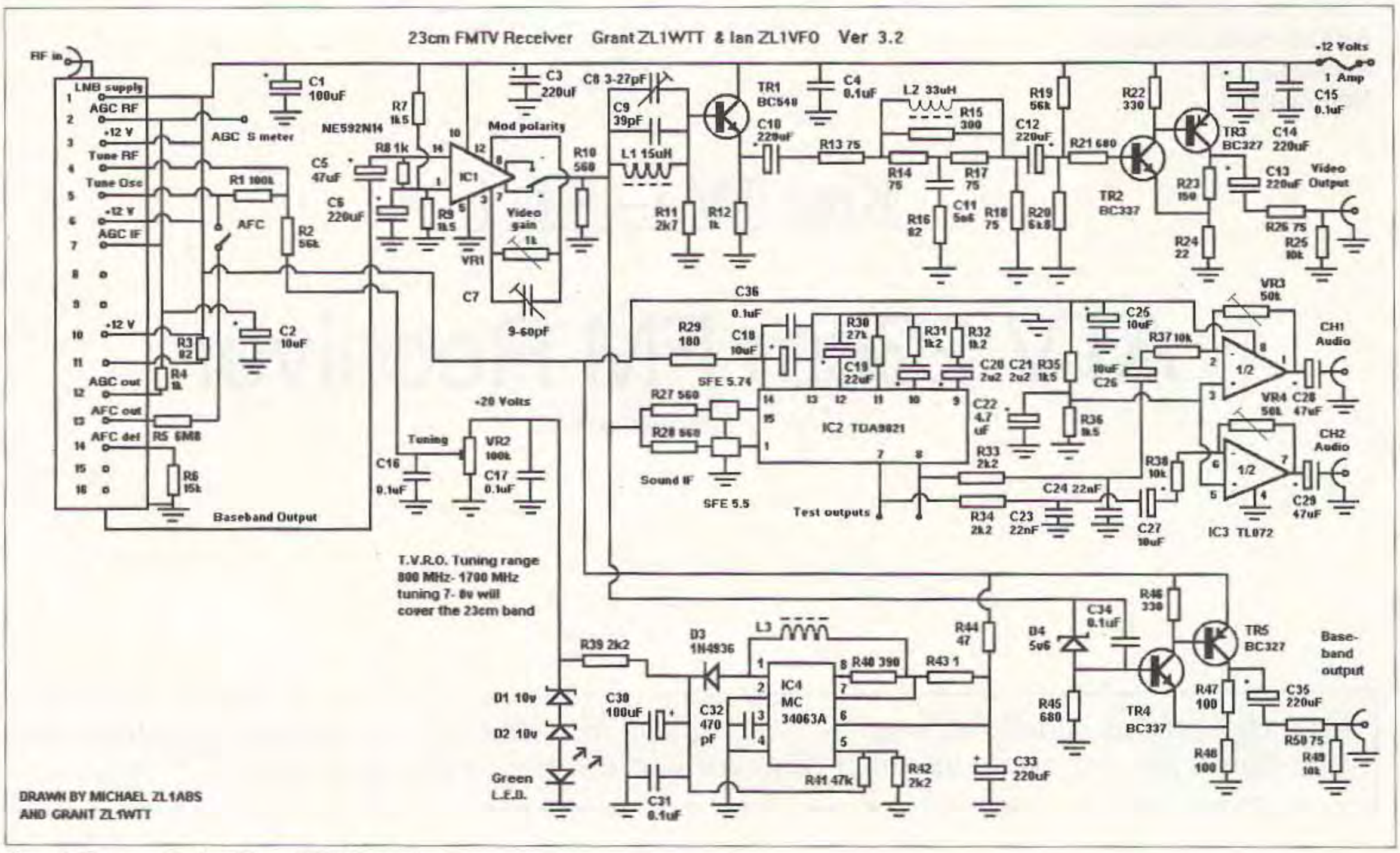

Fig. 1. Schematic for 23cm FMTV receiver.

into it as frequency-modulated ultra high frequencies at 1.28 GHz.

Grant made prototypes of the receiver and the transmitter, and did extensive tests, particularly with Wayne Griffin ZL1UKJ. Ian Pople ZL1VFO further developed the receiver, and this is the version I will describe.

The most complex part of the receiver is the analog satellite tuner, obtained surplus from Britain for less than $15 US. It has a separate RF and demodulator section. In the demodulator section, Grant increases the Phase Locked Loop time constant with an RC filter. This rolls off the high frequencies, and so reduces the bandwidth of the resulting video band, which is called the baseband from here on.

Grant demonstrated a 30 W transmission by Ralph Sanson ZL1TBG

***Photo C.** A filter added to this analog satellite receiver IF module reduces picture noise.*

Photo D. *A masthead amplifier sold for the satellite TV market is used.*

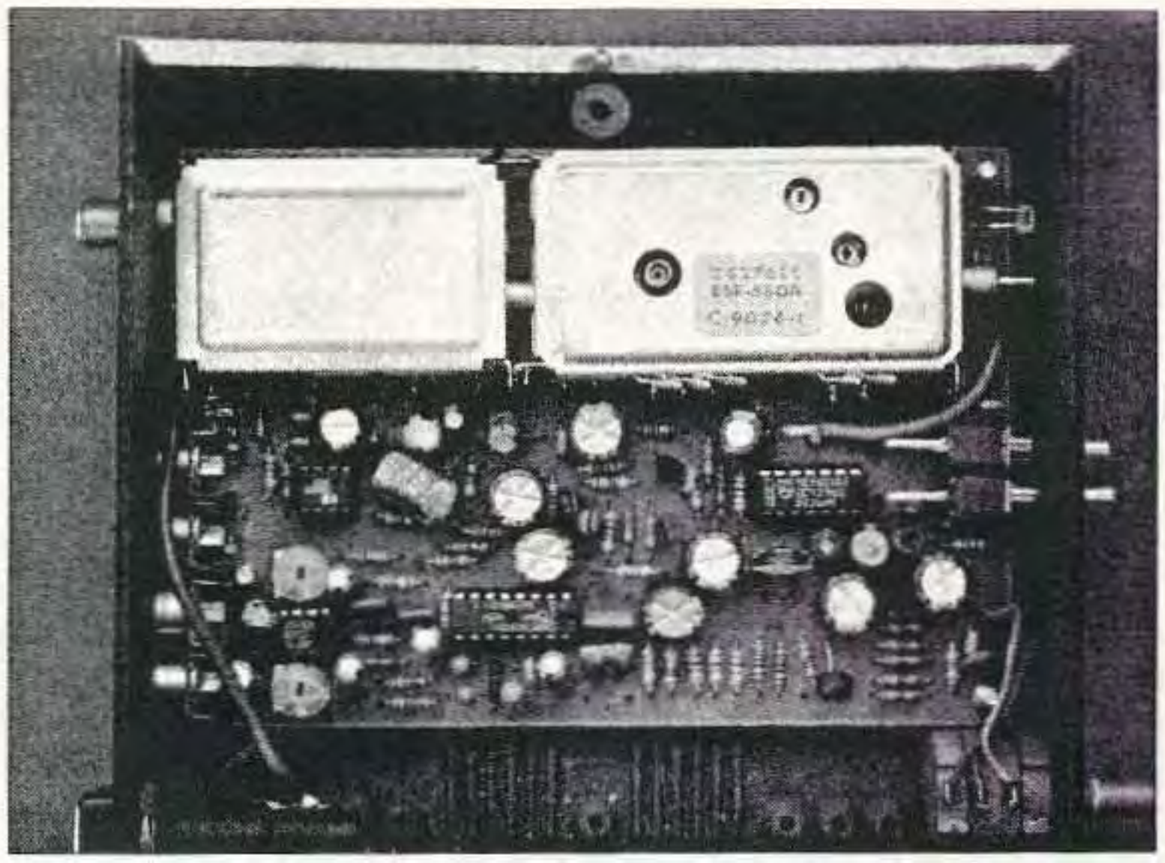

Photo E. *The author's version.*

from 68 km away. The modification improved the receive quality from quite noisy to nearly full quieting.

The board uses a single layer of foil, without coating. Solder bridges are possible, but the builders are generally technicians who can rectify their own mistakes.

Since the output from the satellite tuner covers a frequency range of from 50 Hz to 10 MHz, wire lead components can be used for the rest of the receiver. The tuner output is amplified in an NE592 video amplifier chip, and provision is made to change the modulation polarity externally. The signal is filtered and further amplified to produce composite video suitable for the AV input of a standard PAL television receiver.

The two sound carriers, at 5.742 and 5.5 MHz, are extracted with ceramic filters from the baseband and demodulated in a TDA9821 chip. This is a German A2 sound demodulator. Since the sound is transmitted in two separate subcarriers, no stereo decoding is necessary. A dual op amp (TLO72) provides line-out volume for the two sound channels.

There is a separate unfiltered baseband output provided, allowing for retransmission of the received signal complete with sound.

The whole receiver needs a regulated supply of 13.8 volts at 1 amp. The satellite tuner is very susceptible to induced hum. I use a locally made switch-mode power supply, rated at 3 amps continuous, which gives me no interference pattern on the TV.

Tuning this receiver, however, calls for 20 volts. It is provided by another switch-mode power supply on the receiver board. It employs an MC34063 chip, a 1N4936 diode, and a custom-made coil. These three components came from wrecked cell phones. A multi-gang potentiometer allows uncritical manual tuning.

This receiver does need a masthead amplifier. Shown here is a # SA20 high-gain in-line amplifier covering 900 to 2050 MHz. Grant says, "This can be obtained from your local satellite supplier. It also helps to use a GaAsfet preamp on the front of the line amp."

Michael Sheffield ZL1ABS can supply photos and drawings of the whole project on e-mail, via [zl1abs@xtra.co.nz].

He also says that loop yagi kit sets for the 23cm band can be obtained from Directive Systems, RR #1, Box 282, Dixon Road, Lebanon ME 04027 USA; tel. (207) 658-7758; fax (207) 658-4337; e-mail: [sales@directive-systems.com]. Their Web page is at: [http://www.directivesystems.com/antenna.html].

My receiver will be my first test instrument for the transmitter yet to be started. Grant tuned it up for me. "You can congratulate yourself," he said. "This is the first built-up kit that worked first time I switched it on."

Thanks very much to Grant Taylor ZL1WTT for his assistance with this article. 73

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Kiwi TV — Pt. 2

ATV Exciter

Latest addition to the Kiwi 23cm project.

The successfully completed 23cm receiver became a test instrument for a 23cm transmitter. Several transmitter PC boards are distributed by Wayne Griffin ZL1UJK, P.O. Box 28-300, Remuera, Auckland 1136, New Zealand. The essential one is the exciter board.

Grant Taylor ZL1WTT (Photo A, Pt. 1) had started with a free-running oscillator design from the British Amateur Television Club. He added a modulator, dual varicap tuning, and a prescaler for phase-locked-loop control. Wayne Griffin ZL1UJK did much of the circuit board layout.

The exciter, shown on the right half of the circuit diagram, is capable of producing a microwave signal typically between 1200 and 1300 MHz video directly from a camera, and two sound carriers for stereo transmission, derived from the German stereo broadcast concept.

***Photo A.** Wayne Griffin ZL1UJK.*

The modulator

A video camera can be directly connected to the filtered input of the NE592N-14 modulator chip by Philips. The filter shown provides PAL pre-emphasis. Sound has to be modulated first. For stereo, we use 5.5 MHz and 5.74 MHz subcarriers in New Zealand. The two preset potentiometers connected to pins 3-4 and 11-12 of the NE592N-14 chip provide video gain, and high frequency boost if needed. The preset on pin 7 or 8 controls modulation linearity. This part of the circuit handles frequencies below 10 MHz.

The exciter

Surface mount devices are used when available. The 23cm oscillator uses a bipolar BFR91 transistor in common base configuration, two coils, three biasing resistors, and a microstrip.

Varicap diode VC2 tunes the oscillator via the microstrip, manually by means of the preset VR4, or with an external phase-locked-loop board (PLL). The oscillator supply voltage is one of the parameters controlling the tuning range. The 78L08 regulator with the yellow LED provides 9.6 volts. Coil L3 is a choke, stopping microwave frequencies at that point.

Diode VC1 varies the tuned frequency within a range less than 10 MHz, which is the frequency modulation we require. Again, choke L2 stops microwaves from appearing at the modulator chip.

The two varicap diodes, DC-isolated by a 4.7 pF capacitor, keep the deviation reasonably constant over the tuning range of the microwave oscillator. The deviation is the amount by which the modulating frequency varies.

A second microstrip is loosely coupled to a buffer transistor, which is another BFR91, but this time in common-emitter configuration. It feeds a predriver stage. In the diagram, the predriver is an ERA5 IC.

Manual tuning is provided. But phase-locked-loop tuning is desirable for precision. It also permits transmitter switching, and adding a numerical frequency display. Both the PLL board and the frequency display are on separate boards. In fact, I have yet to construct them.

Grant Taylor ZL1WTT has included a divide-by-256 prescaler on the exciter board. The SAB6456 chip, from Philips, is being discontinued. RADIO SPARES lists, in Britain and here, an alternative prescaler suitable for microwave frequencies.

The prescaler output is buffered by a BC549, which has high gain. At the transistor collector, tracking of the tuning can be observed on a frequency meter and an oscilloscope, within a range that these instruments can handle. The prescaler output frequency varies typically between 4.5 to 5.3 MHz, which is easy to shunt to an external PLL board. For microwaves, any length of coaxial cable is more of an attenuator than a conductor.

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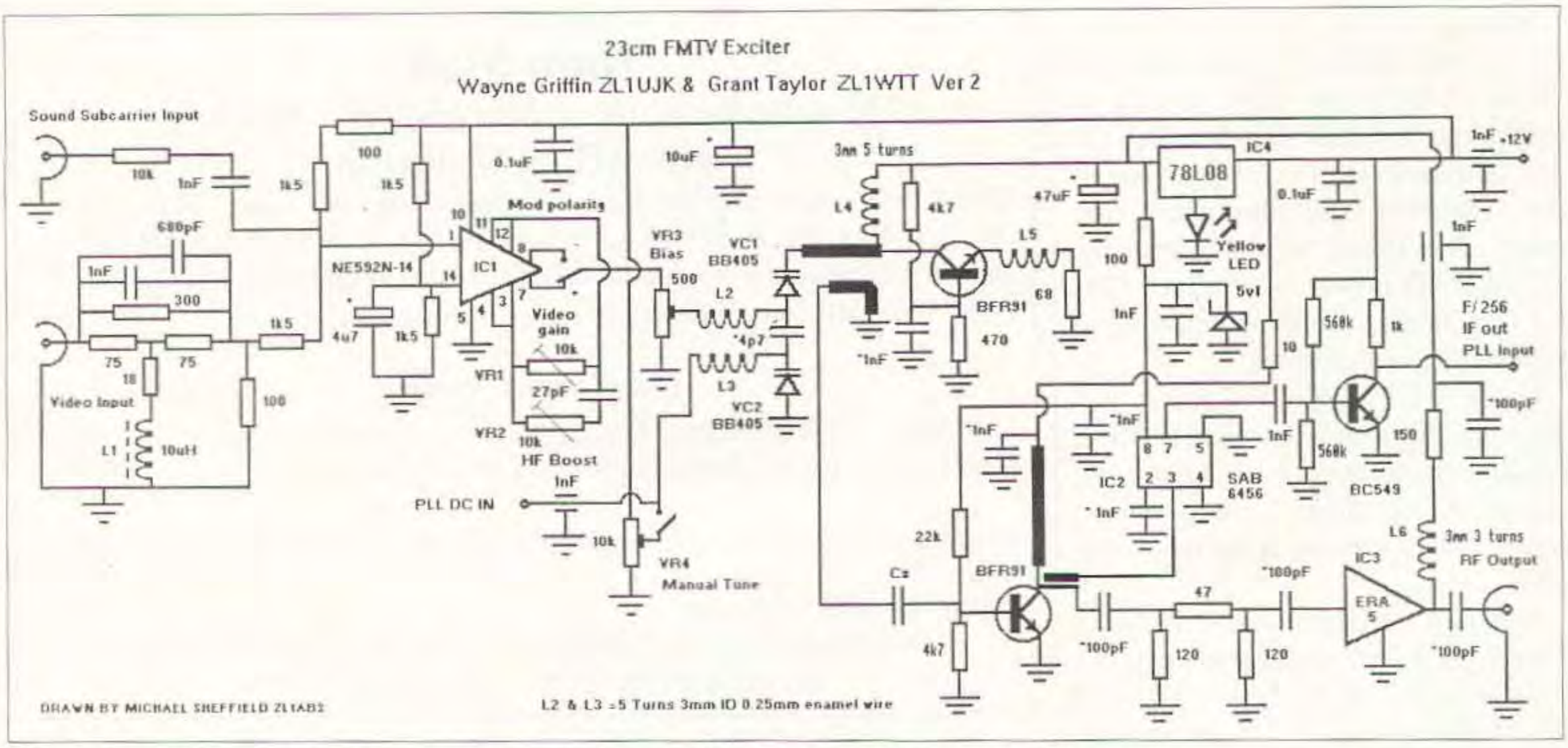

Fig. 1. *Exciter board with video and sound modulator, a buffered 23cm oscillator, and x256 prescaler.*

ATV Exciter

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Construction

Again, Grant Taylor ZL1WTT, tells me, I am the first one to get the exciter board going without him having to troubleshoot it. He says that the problems he sees are mistakes in the choice and placements of components, and construction technique.

Faults I had to rectify during testing were the wrong polarity of the electrolytic capacitor at pin 14, and not linking pins 3-4 and 11-12, at the NE592 chip.

The 75 and 300 ohm resistors in the PAL pre-emphasis (to the left), I could only obtain at a surplus store.

I used a 78L06 regulator, a blue LED, and a 100 ohm resistor to get a 9.6 volt supply for the oscillator. I used a BB833 varicap tuning diode for VC2.

This gives a tuning range of 1180 to 1360 MHz, with constant deviation and good linearity. Position of varicap diode VC1, a BB405 as specified, shifts the tuning range up or down (center of schematic).

The coils are not critical. Oscillator coil L5 is 1.5 turns of the tail of the 68 ohm emitter resistor, 3mm (1/8 inch) in diameter. The board layout requires that one of the biasing resistors has leads. Short tails are essential to minimize unwanted stray capacitance and instability.

The SAB6456 prescaler chip is designed for up to 1000 MHz (1 GHz). It is persuaded to work beyond 1.3 GHz by trimming its pins and mounting it prone on the board. I also put in pins to link the topside groundtrack and the bottom, plain side of the double-sided board.

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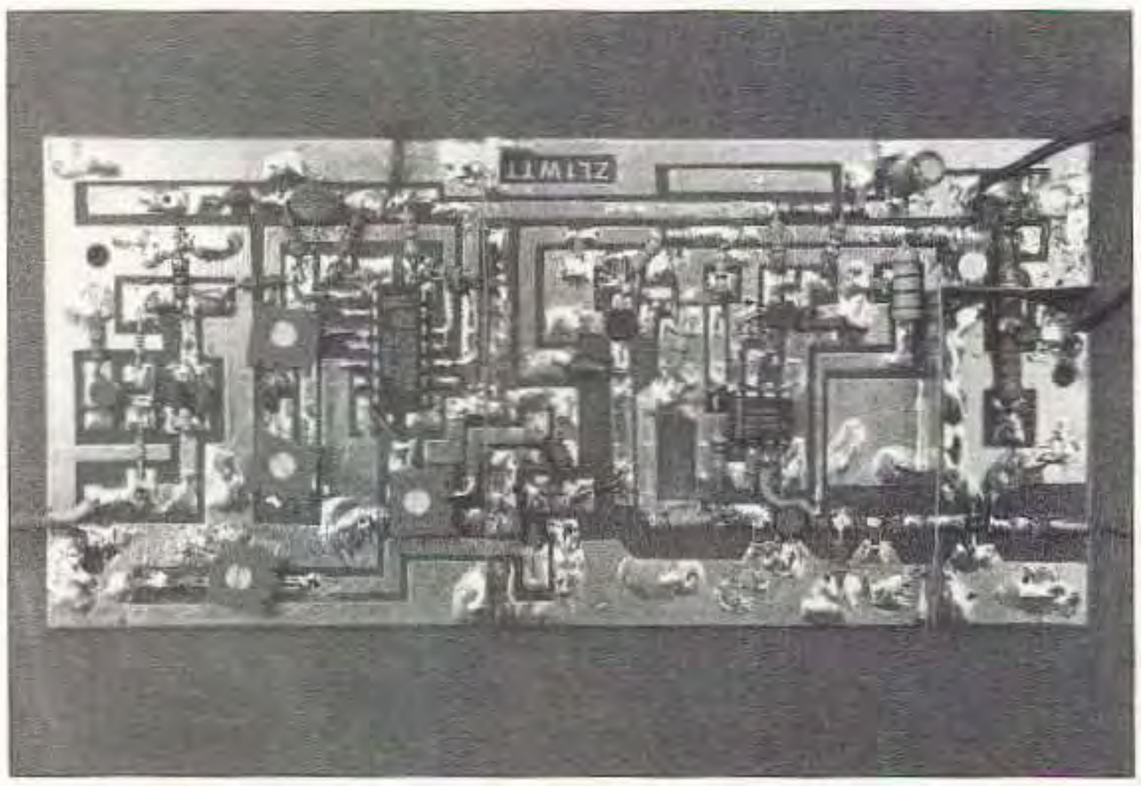

Photo B. *This photo shows two metal screens between modulator, oscillator/buffer, and predriver. I made them 1 inch (2.5cm) high. The presets are sealed types. Open types will work, but they may become intermittent.*

Photo C. *Trombone player Jane Hart from the folk band "Bantam at the Opera," at the Auckland Folk Festival.*

ATV Exciter

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As capacitors for the microwave buffer transistor, we use pieces of wire (yellow insulation) to provide loose coupling in and out. This prevents parasitic oscillation at 1.8 GHz, and makes the prescaler output look cleaner on the oscilloscope. I chose to use the 9.6 V supply for this BFR91, not the 12 V supply as shown in the diagram. Grant confirms that both supplies work. I found surface mount resistors, in quantities

of 50, for the attenuator ahead of the ERA4 pre- driver chip. It has less gain, but was easier to obtain than the ERA5.

Having established that this exciter tunes, without jumping, over the desired frequency range, I connected my 23cm receiver to the AV input of the TV, and stuck 6cm-long bits of wire to the exciter output and the receiver antenna socket. (The 6cm wire is a 1/4 wave antenna.) Then I connected my video camera to the video input of the board. I switched on everything, and tuned the receiver. The image would not lock. Bother. Hang on, what do the

switches do again on the receiver? Ah, the LEFT switch inverts the video polarity. Yippee! Now it works every time I try.

On several days, I spent up to an hour playing tapes from my camera through the 23cm setup, from the last Morris Tour and the last Auckland Folk Festival. **Photo D** was taken from the TV screen.

Thanks to Grant Taylor ZL1WTT and Wayne Griffin ZL1UJK for their documentation and assistance with this article.