A Modular, High-Performance 23-cm ATV Transceiver

Here's an easy-to-build design by GM4PLM using low-cost, readily built ATV modules.

By Simon Lewis,* GM4PLM

Amateur Fast Scan television has been a part of the hobby that has fascinated me since my early days in amateur radio. I can still remember the thrill of watching those early 70-cm black-and-white transmissions using a modified domestic TV set I acquired from a trunk sale. My first real introduction to Amateur Television (ATV) was as a young man through a local ham, Barry White, G8YGT. He proudly showed me his beautifully kept Pye Image Orthicon camera and home-brewed 70-cm transceiver in his small, home-built studio at the back of his house. Barry kept my imagination flowing with stories of his days as a cameraman for prestigious, and now historic, TV programs such as *Sunday Night at the London Palladium.*

Those stories and visits to his studio gave me an interest that has never left me, and over the years I have enjoyed numerous bouts of ATV activity on 70 cm and 23 cm using both home-brewed and commercial equipment. In recent years my ATV activities were curtailed because of antenna problems at my small QTH, but a recent move to a new QTH and access to wide-open space brought me back to ATV with a renewed enthusiasm to "get going again."

I was quite shocked, however, when I picked up a copy of the British Amateur Television Club (BATC) magazine, *CQ-TV.* Technology certainly had moved on during the few years I was away from it, and the pages were now packed with readily available equipment for 23 cm, 13 cm, and even 10 GHz. The impact of the SATTV (satellite TV) market was also readily visible, with some of the vendors offering a variety of modules and surplus equipment from the market for use on the amateur bands. The introduction of other technologies, such as Wireless PC networking, also seemed to be having an effect, with readily available equipment that was only dreamed of a few years before. Things certainly had moved on very quickly, but all to the ham's benefit, that's for certain!

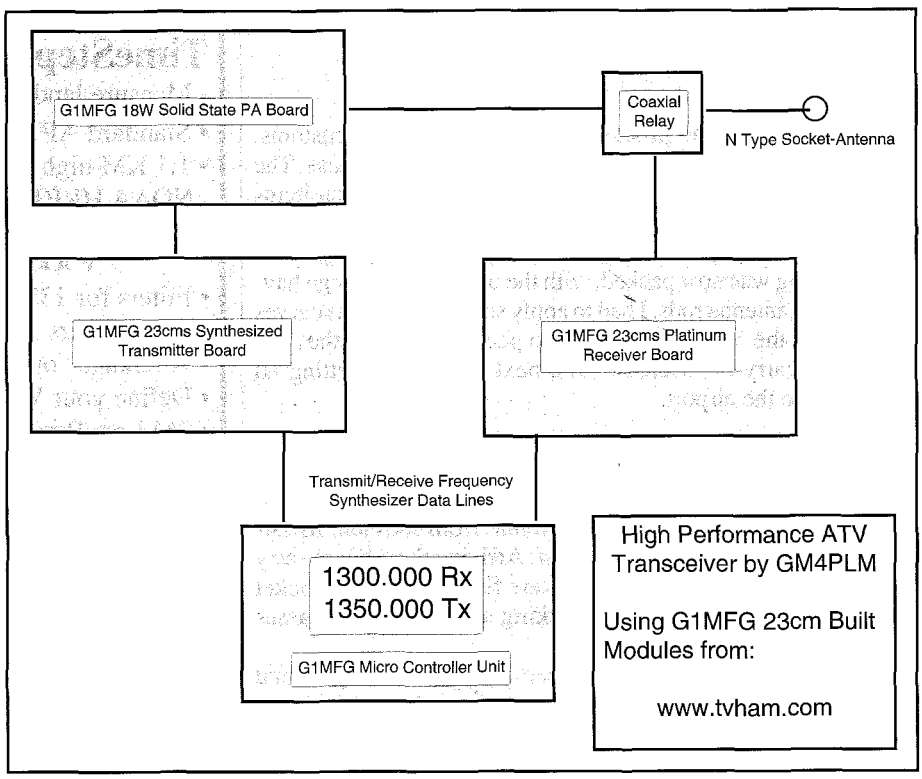

Figure 1. Block diagram of ATV station.

I decided that a good start would be to build a new station using some of the available modern components rather than try to resurrect some old equipment I had, which definitely was in need of some TLC to get it going again. Finally I decided I would build a new transceiver for the 23-cm ATV band using some of the ready-made modules available on the pages of *CQ-TV.* This course of action would allow me to construct a new transceiver that would perform well with the minimum amount of construction and alignment time. These modules certainly seemed to be able to offer quick access to the band with the minimum amount of fuss, a far cry from a few years ago.

After some deliberation I finally decided to buy some of the products from Giles Read, G1MFG. Giles runs a small, but busy internet and magazine mail-order business that specializes in ATV products (see <http://tvham.com>). He also has a great customer approach and a keen interest in home construction. I was pleased

**Creoch Farm, Ochiltree, Ayrshire, KA18 2QH, Scotland*
e-mail: <gm4plm@emn.org.uk>

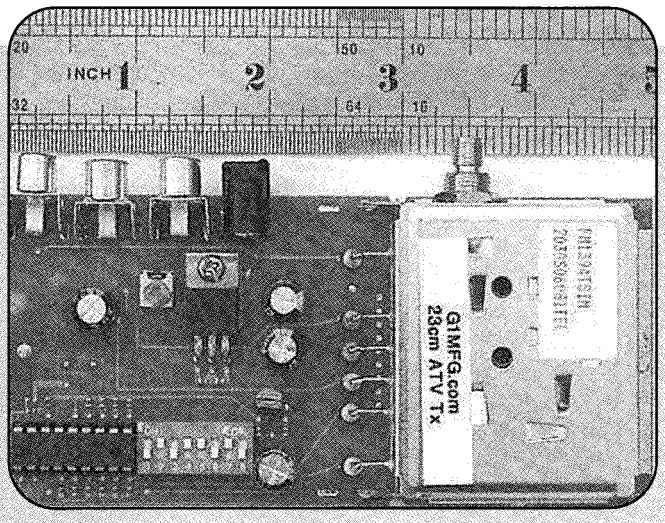

Photo A. Transmitter card.

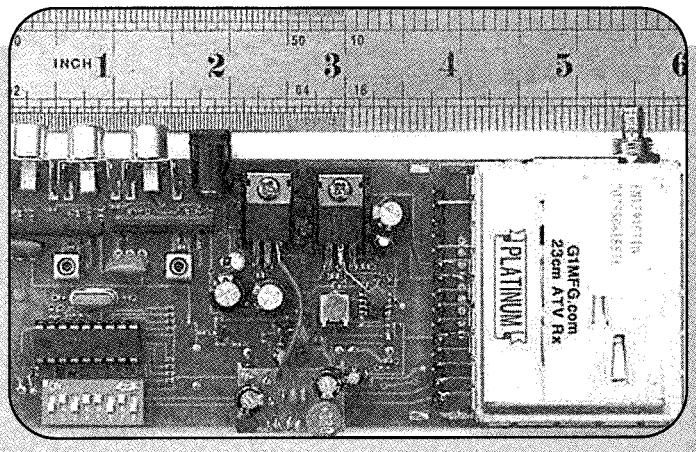

Photo B. Receiver card.

that he could answer all my queries quickly, and a set of modules was soon on its way to Scotland. Incidentally, Giles has a U.S.-based presence as well and has been featured in the American ATV magazine *ATVQ*. He has become quite well known on the other side of the pond for his ATV activities.

The modules were delivered quickly and came safely packaged, including detailed instructions for each of the modules in the form of a small booklet.

Figure 1 shows a block diagram of the transceiver that forms the basis of the transceiver I constructed. It is based on four modules from Giles—a receiver, a transmitter, a controller, and a solid-state power amplifier. The only module not supplied by Giles was the DC power supply, which is an external 13.8 VDC supply. I decided from the outset that the modules would be built into a small desktop case so that it could reside on one of the shelves where I house a lot of my equipment. Of course, you don't have to follow this construction pattern, and you can house the modules in any suitable enclosure that meets your needs. It really does not need to be anything spectacular, but I would advise using a metal enclosure, as it is an RF kit, which should be screened.

Before describing how the whole unit fits together, it's worth looking at some of the features of each of the modules, as they will work as standalone units if required.

Module 1: Synthesized Transmitter

This module comes built and working. Its Its size is just amazing! It's simply a case of mounting the unit into the chosen enclosure. As the transmitter only runs low power, at this point I decided not to enclose the unit in a smaller screened housing. I mounted it directly in the main chassis. The board measures 125 × 60 × 18 mm, and I was amazed at the very low component count. There really is hardly anything on this board!

The biggest component is a screened tinplate unit that houses all the RF components. Other than input sockets for audio/video and DC power, there is not a great deal else on the board to talk about! RF out is fed via a small microwave-type SMA socket, which is a good choice. They are easily available at low cost, perform well at these frequencies, and nicely fit miniature low-loss PTFE coax.

Frequency selection is made via an 8-way miniature PCB-mounting, DIL-style switch, which in a standalone unit selects the operating frequency from a PIC microprocessor. Frequency steps are selectable in 500-kHz steps and will cover the whole of the 23-cm amateur band. The board requires 12–18 VDC and produces between 50 and 100 mW RF output.

Module 2: Receiver

The receiver module looks similar in style to the transmitter module but is slightly larger, measuring 150 × 60 × 18 mm. Again, the board looks sparsely populated, although it has a few more components than the previously described transmitter. It is also dominated by the metal-screened RF module at one end of the PCB. RF input is again via a microwave-style SMA socket. Audio and video outputs are via phono-style sockets, with sockets for 6- and 6.5-MHz sound outputs. The DC connector is also a 2.1-mm DC-style item (tip positive).

As in the previously described transmitter, this unit requires 12–18 VDC. Frequency control is selectable in 500-kHz steps in exactly the same manner as the transmitter, using an 8-way DIL PCB switch and a PIC microprocessor. A small onboard LED shows the PLL is locked. This version of the receiver range is the Platinum model, which includes a video de-emphasis filter on the PCB.

Module 3: LCD Transceiver Controller

Although both transmitter and receiver units can act autonomously, in a transceiver it would be rather unwieldy to keep adjusting the internal DIL switches every time a frequency change is necessary. To overcome this problem, a companion controller PCB has been introduced. This module contains a PIC microprocessor, which provides the frequency control signals directly to the transmitter and receiver synthesizers instead of the onboard PICs (that are removed) and DIL switches.

There are a number of benefits, other than simply allowing easy control of both transmit and receiver modules, to be derived from using the controller module. Because frequency control is no longer restrained by the limits of an 8-digit binary number programmed by the DIL switches, the frequency-control step resolution can be increased to 125-kHz steps. This can also be used to extend the receiver range, although the

rear panel to be switched between transmit and receiver modules. This connector is switched using the transmit/receive control line. Make sure the relay you choose is capable of carrying the power you are running through it, and that it is also rated at 23 cm. Otherwise you will find that it becomes lossy and could turn out to be an unwitting dummy load!

RF interconnections between the modules were made using miniature PTFE coax and small SMA connectors. These connectors are an excellent choice at these frequencies. They allow good, reliable, and (more important at microwave frequencies) low-loss connections to be made between the modules. This is particularly important where (a) low-power connections are made and poor connections would lose that power, or (b) high-power microwave transmissions in the wrong type of connector can cause heating because of high losses and potential damage to RF modules and connectors alike. Choosing the right connector and cables at these frequencies is very important. SMAs are readily available these days and are quite cheap as well.

Connecting the units is a quite simply matter of wiring together the DC control lines and RF, audio, and video connectors.

Testing

Once the unit is wired, you can carry out the basic DC tests. Once the unit has passed the initial smoke test, you can test the frequency controller tests. The two-line display should follow the up/down keys on the controller. With a suitable dummy load and power meter connected to the transmitter, you can test the output of the unit, which should be approximately 15–18 watts.

The VFO buttons and autonet functions can be checked, and that just about completes the testing. As all the modules are simple to build and there is no alignment to carry out! Now I see why I chose these modules!

On The Air

I used the modules over a couple of weeks' holiday, and I was very pleased with their performance. They certainly do the trick! Combining them, using the controller module was a good plan, and it was easy to program in a simplex channel and the local ATV repeater channels, switching between both of them with the simple push of a button. The frequency display using the LCD was bright and easy to read, providing a simple "at a glance" view of the operating frequency.

Building the units into a transceiver was simple, and with a few nights' work even a beginner can produce a quality unit that will work the first time. This simplicity has to be good for encouraging newcomers to the hobby!

The transceiver was taken on a hilltop DXpedition and proved itself out in the wilds. With the addition of a small, modern digital video camera or CCD camera module, a very compact ATV transceiver could be built for grid-hopping contests.

Overall, I highly recommend the modules as a good start, and with a very good price. Giles, G1MFG, offers an excellent service and he certainly loves his ATV!

The modules are available at <http://TVham.com> and are priced as follows: ATV transmitter, £89.99; ATV platinum receiver, £129.99; micro controller, £89.99; and 18 watt PA, £199.99. All items include shipping and handling. Also available are miniature coax and SMA plugs. Soon to be offered are metal custom cases. Price conversion to U.S. dollars is at the time of purchase. ■

Transmitter

Operating frequency range 1.2400 GHz to 1.3675 GHz in 0.5-MHz steps. *Note:* The transmitter is capable of operating outside the 23cm amateur band (1.240 GHz to 1.325 GHz).
Output power +17 dBm (50 mW) typical (minimum +15 dBm, maximum +19 dBm)
Deviation variable, typically 6 MHz
Output impedance 75 ohms nominal (works fine into 50-ohm antennas and power amplifiers)
Output connector 50-ohm SMA or 75-ohm "F." We recommend you go for the SMA version (for better RF performance)
Video input standard 1-V peak-to-peak, phono connector
Audio sub-carrier frequencies 6.0 MHz and 6.5 MHz
Audio input line level (approx. 1 V max.), phono connectors
Audio deviation 45 kHz typical
Power requirements 12 to 18 VDC, 150 mA approx, tip positive. Best results are obtained with a supply of 15 V or more.

Receiver

Operating frequency range 1.2400 GHz to 1.3675 GHz in 0.5-MHz steps
Intermediate frequency 479.50 MHz
IF bandwidth 27 MHz
Local oscillator leakage –63 dBm typical
Input impedance 75 ohms nominal (works fine with 50-ohm systems)
Input connector 50 ohm SMA or 75 ohm "F." We recommend you go for the SMA version (for better RF performance)
DC power to masthead preamp user defined, up to 18 V, 250 mA max.
Power requirements 12 to 18 VDC, tip positive, 250 mA typical, excluding preamp power

Table 1. Technical specifications. Note: These transmitters and receivers will work fine with PAL, NTSC, or SECAM video signals.