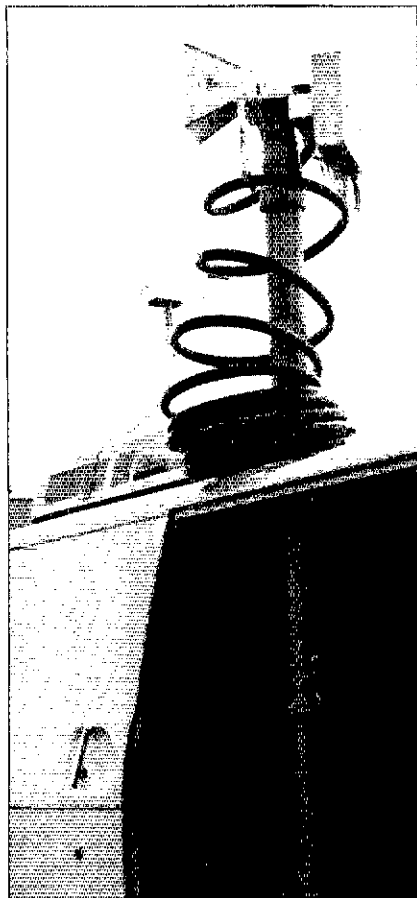


Annie Get Your Gunnplexer!

Are you looking for a band where you can do virtually *anything*? The 10-GHz microwave band is ripe with possibilities! Here's an inexpensive way to get started.

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Kent Britain, WA5VJB, takes his Gunnplexer on the road for the 1992 ARRL 10-GHz Cumulative Contest. Notice that he's using a horn as the antenna.

If you've read this far, I assume the use of the word *microwave* or the abbreviation *GHz* hasn't scared you too badly. To be sure, microwave operating departs from the well-worn paths that most amateurs take. The microwave bands are for curious, adventure-some hams.

Am I saying that microwave hamming is difficult? It's certainly more challenging than your usual plug-and-play scenario, but it's a specialty anyone can master. I think the most difficult part is wading through all the microwave jargon you'll find in most books. (There are few microwave books for beginners.) In addition, there are some components and operating techniques that may be unfamiliar to you.

Is microwave hamming expensive? Believe it or not, you can get up and running on the 10-GHz band for less than half the cost of a typical HF transceiver. By using some of the cost-saving ideas we're about to discuss, it can be even cheaper than getting on 2-meter FM.

If this surprises you, your reaction is understandable. Like so many areas of Amateur Radio that are off the beaten path, microwave operation has taken on an exotic air. Hams tend to equate "exotic" with "expensive."

What Can You Really Do on 10 GHz?

Ask most hams about microwave operating and I bet you'll hear, "You'll be lucky just to talk across town—if you can find anyone to talk to!"

Guess what? They're right! If you're looking for long-distance communications, the microwave bands are *not* for you. Except for some propagation enhancements caused by atmospheric conditions, low-power microwave operating is a line-of-sight mode. Some impressive distance records have been set on 10-GHz (several hundred miles or more), but those were under ideal circumstances with good equipment. If you're talking about an antenna on the roof of your house or apartment, a few miles is more likely—depending on how many build-

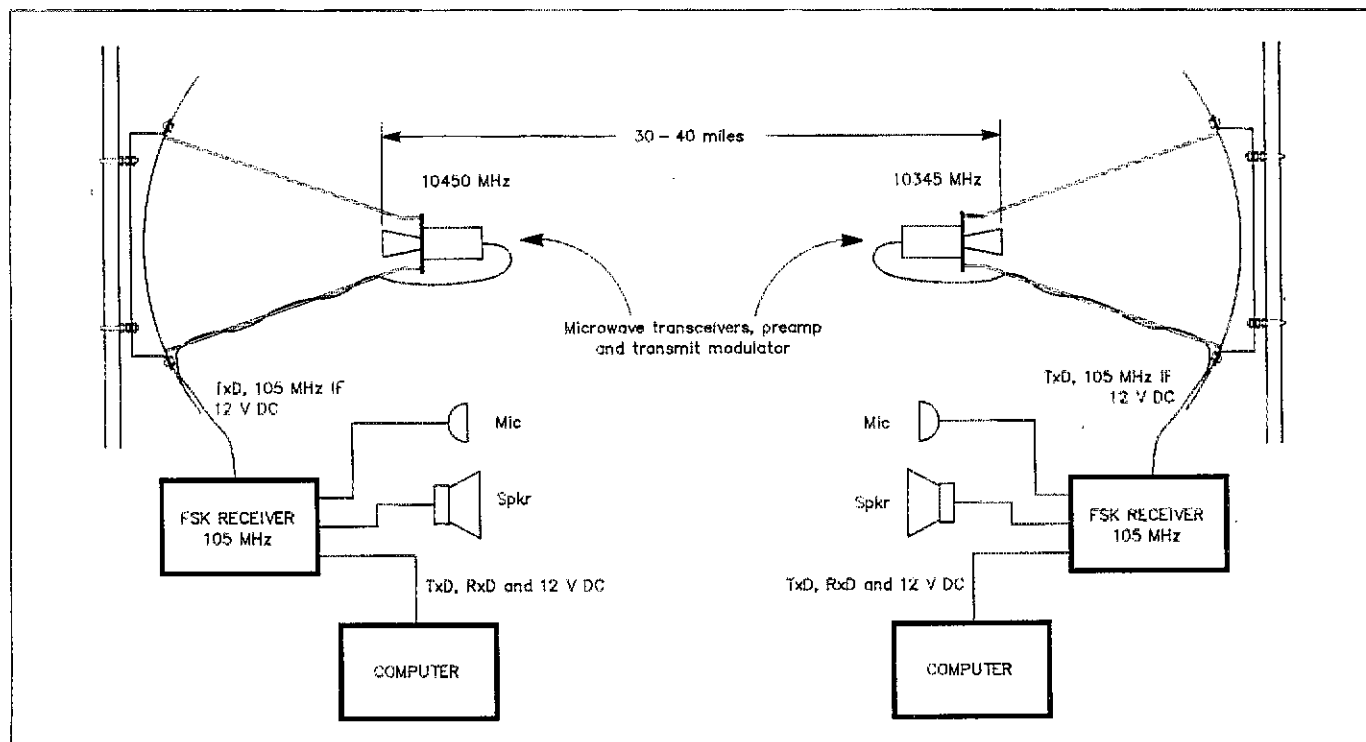


Fig 1—A system diagram of a 2-Mbit/s, 10-GHz computer link using Gunnplexers and parabolic dish antennas. This project is described in detail beginning on page 32-49 of the 1993 ARRL Handbook.

ings, hills and trees are in the way.

And it's true that the microwave-active population is small at the moment. Don't expect to haul your equipment to the top of a nearby hill and get an instant response to your first CQ. Unless you're participating in a contest, or unless you've arranged a schedule with another ham, you probably won't be able to contact anyone. Random contacts on the microwave bands are rare events.

Now that I've completely taken the wind out of your sails, I'll list just a few of the many activities that are *ideal* for the 10-GHz band:

□ **High-speed Data Transmissions:** With the proper equipment, you can swap information at a rate of *millions* of bits per second! (see Fig 1) Why not set up a 10-GHz local network and unleash the power of your computer? For example, I'm sure you've heard of those sophisticated air-combat computer programs that put you in command of a modern fighter jet. Many of these software packages allow you and a friend to "fly" together—as comrades or enemies. Imagine going head-to-head with your buddy using a 10-GHz link to transfer data between your computers at lightning speed. Only the microwave bands give you the room to do this kind of full-throttle networking.

□ **Repeater Linking:** How about using the 10-GHz band to integrate separate repeaters into one system? You can link several 2-meter repeaters together to cover an area much larger than any single repeater could cover by itself. All it takes are a few interference-free 10-GHz links to transfer signals from one machine to another.

□ **Remote Control:** You'd like to get on the HF bands, but you don't have room for antennas. Your friend a few miles away has plenty of room for your antennas, but you don't want to run over to his place every time you get the itch to operate. 10 GHz to the rescue! You could establish a 10-GHz link between your homes and operate your HF rigs by remote control. Most modern rigs feature computer control and you already know that you can transfer data on 10 GHz at very high speeds. The 10-GHz band handles voice and CW signals equally well. With a tiny 2-foot dish antenna on your roof, you could control your distant radios and work HF easily.

□ **Video:** You haven't seen amateur television until you've seen it on 10-GHz! You can send and receive wideband video with crisp, clear images. Talking to a friend on 10-GHz duplex ATV is the next best thing to having him or her in the room with you.

□ **Contests:** Yes, there are 10-GHz contests. These contests tend to bring all the 10-GHz buffs out of the woodwork. Just take your gear to a high place (a hill, mountain or even a building) and you may be surprised to hear a number of contest contacts taking place. The pace of a 10-GHz contest is very relaxed. It's not uncommon to engage in long conversations with other microwave enthusiasts you happen to find.

With more than 500 MHz of spectrum

from 10 to 10.5 GHz, this band is a wide-open frontier. You can let your imagination and inventiveness soar—without someone complaining that you're "hogging the repeater" or "tying up *their* frequency." If I've aroused your curiosity, the next step is to get on the air without breaking your budget.

Those Clever Gunnplexers

The cheapest way to get on 10 GHz is with *Gunnplexer* transceivers. The Gunnplexer shown in Fig 2 will fit easily in the palm of your hand and requires only 12 volts dc to operate. The portion of the transceiver that looks like a funnel is actually the *feed horn* (or just *horn*, for short). It captures and radiates microwave energy.

The heart of the Gunnplexer is the Gunn diode oscillator, named after its inventor, John Gunn of IBM. The Gunn diode is installed in a specially designed *resonant cavity*. The diode oscillates and radiates energy at microwave frequencies whenever a dc voltage is applied. (The oscillator frequency is determined by a varactor tuning diode and two mechanical tuning screws.) The energy radiated by the Gunn diode escapes from the cavity and out through the horn.

In addition to creating our transmitted signal, the Gunn diode also acts as the *local oscillator* for the receiver. If you remember your radio theory, you'll recall that the local-oscillator signal is combined with the received signal to create the *Intermediate Frequency*, or *IF*. A Gunnplexer transceiver uses the same technique, but in a very clever way.

When the Gunnplexer is transmitting, a



tiny portion of the signal is rerouted to a mixing diode. The incoming signal from the other station is mixed with this signal to create an IF. Think about this for a moment. Can you guess what's actually happening? The Gunnplexer is transmitting and receiving *simultaneously!*

The only catch is that both stations must be on separate frequencies to create a usable IF. For example, to create a 30-MHz IF using the technique we've just discussed, the frequencies of the transmitting and receiving stations must be separated by 30 MHz. Here's how it works:

1. KH6CP is transmitting and receiving on 10.280 GHz. WB81MY is doing the same on 10.250 GHz.

2. WB81MY's 10.250-GHz signal arrives at KH6CP and is mixed with the 10.280-GHz signal from his Gunn diode.

3. In the mixing process, the two frequencies are combined and the *difference* becomes our IF. So what's the difference between 10.280 and 10.250 GHz? It's 30 MHz—our intermediate frequency!

A Gunnplexer transceiver is only one component of your 10-GHz station. Once you convert the 10-GHz energy to an IF, you need an IF receiver to hear the received

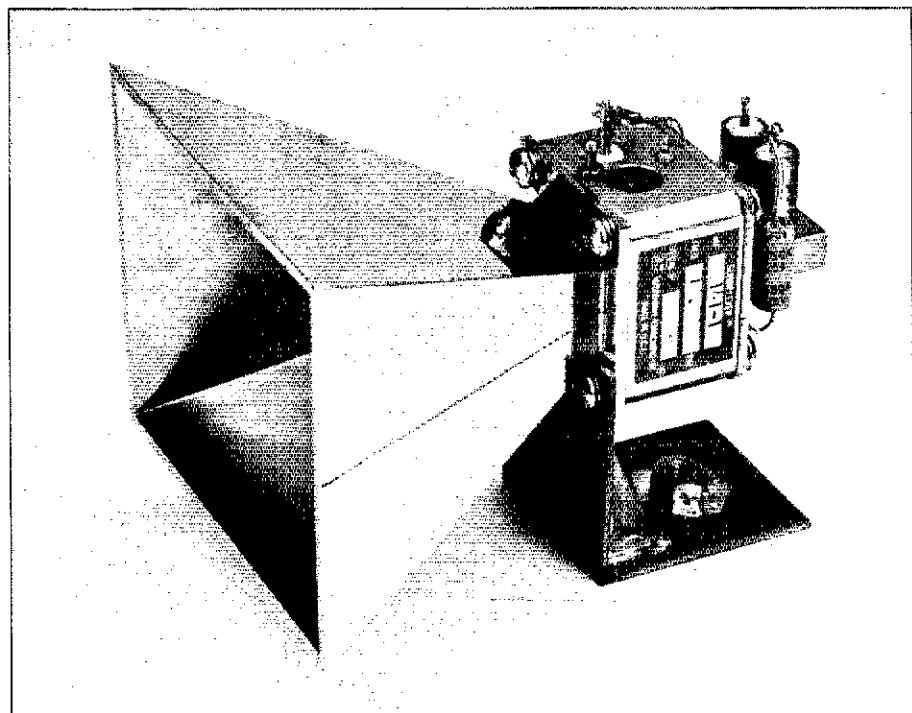


Fig 2—Don't let its tiny size fool you. You're looking at a 10-GHz Gunnplexer transceiver. Notice the funnel-shaped horn. It transmits and receives the microwave energy. Connect an inexpensive IF receiver (even an FM radio!) and a microphone and you're on the air!

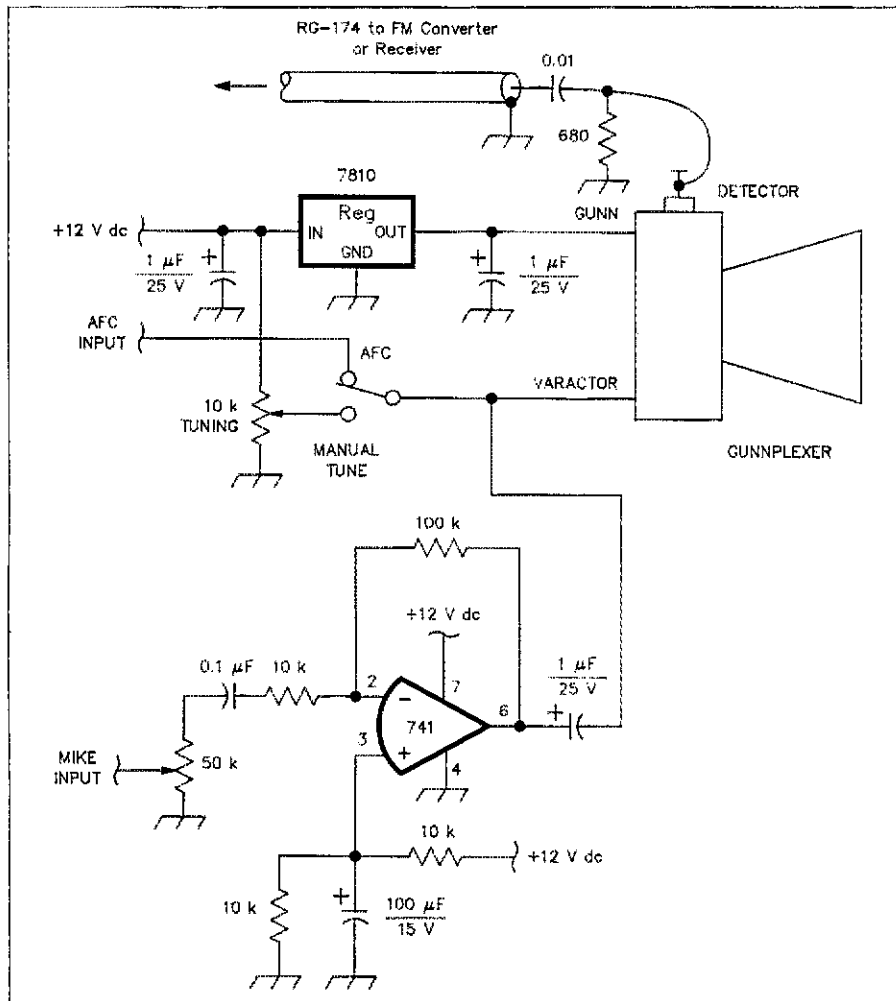


Fig 3—Here is a schematic diagram of a simple Gunnplexer communications system. You can use a standard FM broadcast radio as the IF receiver. The 741 IC is the microphone amplifier. The 7810 is a voltage regulator for the Gunnplexer. This bare-minimum system is described on page 32-44 of the 1993 ARRL Handbook.

signal. To send voice, data or other information, you also need a modulator.

If you're strapped for cash, you can use a common FM broadcast radio as your IF receiver. On page 32-44 of the 1993 ARRL Handbook you'll find an easy way to do this (see Fig 3). It only requires a handful of parts and includes a simple modulator circuit. To use FM radios as IF receivers, you'll need to separate your 10-GHz transmit and receive frequencies by a frequency between 88-108 MHz. For example...

1. Station #1 transmits on 10.250 GHz.
2. Station #2 transmits on 10.350 GHz.
3. The difference between these two frequencies is 100 MHz, creating an IF that can be received by using an FM radio tuned to 100 MHz.

The disadvantage of this system is that most 10-GHz enthusiasts insist on using a 30- or 33-MHz IF, neither of which is compatible with each other or an FM radio (30 MHz is the most common IF). Many 10-GHz experimenters use modified FM radios or distance-measuring devices known as Telurometers for their IF receivers. The latter was made by Pye Ltd of Cambridge in the UK and appar-

ently has been available inexpensively in Canadian and Australian surplus stores.

Gunnplexer transceivers, modulators and IF receivers can be purchased from a number of sources, including:

SHF Microwave Parts Company
7102 West 500 St
La Porte, IN 46350
(does not do business by telephone)

Advanced Receiver Research
Box 1242
Burlington, CT 06013
tel: 203-582-9409

Antennas

For reliable communications under a mile or so, you can simply use the Gunnplexer's feed horn as your antenna. No kidding! The horn will radiate in a reasonably focused pattern and is quite directive for receiving. You can install the transceiver and horn on a roof-mounted mast (with adequate weatherproofing, of course), and keep the IF receiver and modulator in your shack. Use low-loss coaxial cable between the transceiver and the IF receiver.

You'll get much better performance if

Recommended Reading

Books

The following books are available from your favorite dealer, or directly from the ARRL. See the publications catalog elsewhere in this issue.

The ARRL UHF/Microwave Experimenter's Manual.

The RSGB Microwave Handbook. (Volumes 1, 2 and 3)

Articles

Petersen, "The Care and Feeding of Gunnplexers," *QST*, April 1983, p 14.

Cooper, "\$30 Video Microwave System," *QST*, April 1980, p 71.

Steers, "A Simple 10-GHz Dish Antenna," *QST*, June 1986, p 62.

you use a parabolic dish to focus the energy going to and from your feed horn. A two- or three-foot aluminum dish is perfectly adequate. You can shop for dishes at hamfests and surplus stores. The suppliers noted above often sell dishes, too. Any reflector that's even close to parabolic will do the job. I've seen hams use snow sleds and trash can lids among other things.

Have Gunnplexer, Will Travel

10-GHz buffs like to take their rigs on the road. The challenge is to see just how far you can communicate. In many areas of the country you'll find groups of 10-GHz devotees who periodically gather on buildings, mountains and hilltops to test their mettle. (If such a group doesn't exist in your area, start your own!) They often coordinate contacts using 2-meter FM or SSB. It's easier to make frequency and antenna adjustments when you have direct feedback from the other station.

As I've already mentioned, contests are fun on 10-GHz. Most contesters take their portable Gunnplexers to the highest locations they can find. Contest operating can be a real challenge since you must sweep the band looking for new contacts. In addition to changing frequency, you may have to change your antenna orientation as well.

Conclusion

For more information, I suggest that you check the sidebar, "Recommended Reading." It also doesn't hurt to have some experienced help to get you started. Ask around at your next club meeting and see if you have any microwave-active members. If you're a packeteer, put a message on your local PBBS asking for advice from microwave veterans.

Microwave operating isn't as easy as 2-meter FM, but the best things in this world are rarely easy. When you explore the 10-GHz band, you'll be traveling back in time to the earlier days of ham radio when every mode was a challenge. Gather some friends and try it together!

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