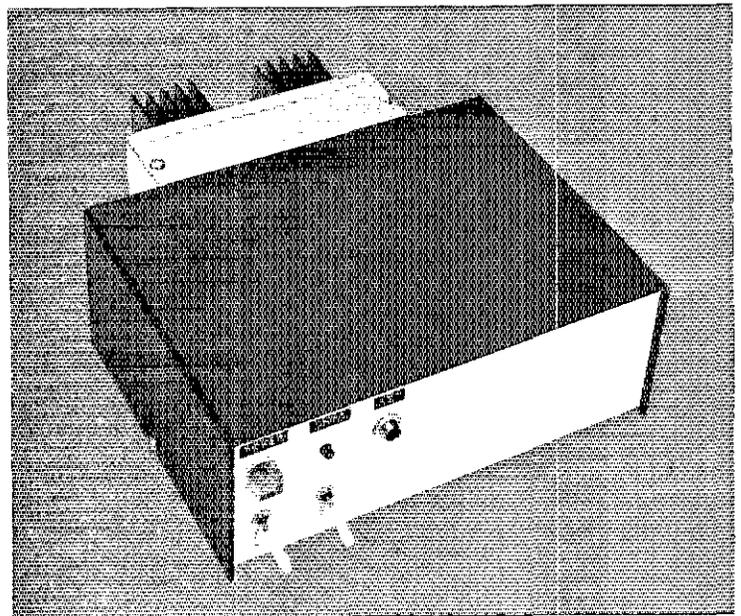


# A CW Transmitter for 902 MHz

This easy-to-build project is the perfect companion to the receiving converter and antenna described earlier in *QST*.

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The 902-MHz band, made available to the Amateur Service last September, can provide many stimulating challenges to the amateur who enjoys constructing equipment. Experimenters with some VHF and UHF building experience should have no trouble getting equipment for 902 MHz into operation. Many of the construction techniques used on 432 MHz still apply.

The project described here is a multiplier-type, crystal-controlled CW transmitter. Output power is 10 W. It is relatively simple to build and can be tuned up with readily available test equipment. Amateurs familiar with VHF and UHF techniques will see that stages of this transmitter design can be used along with the 902-to-144 MHz receiving converter I described in October 1985 *QST* to build a 902- to 144-MHz transverter, if tunable operation is desired.<sup>1</sup>

## Block Diagram

I designed the transmitter with many similarities to the 902- to 144-MHz receiving converter. Fig 1 shows a block diagram of the transmitter. The low-level exciter section uses four 2N5179 transistors. These devices are relatively inexpensive and are readily obtainable. The oscillator is tuned to approximately 112 MHz. The crystal frequency used depends on where in the 902-MHz band you want to operate. Three doubler circuits multiply the oscillator signal to the 902-MHz band. Output power is a few milliwatts. A simple band-pass filter cleans up the exciter output.

The power amplifier section consists of two prepackaged, class-C gain blocks from Toshiba. The driver requires about 1-mW of input power for 100-mW output, and the final amplifier requires about 100-mW drive for 10-W output. Another bandpass filter ensures a spectrally clean signal. A single power supply provides operating voltages for the various stages.

The transmitter is built in modules for maximum flexibility and ease of construction and troubleshooting. First, I will describe the design, construction and testing of the exciter. Then I will move on to a complete description of the RF power amplifier, followed by a discussion of filtering. Last, I will describe a suitable power supply and control circuitry.

## The Exciter Circuit

Fig 2 is a schematic diagram of the exciter. The oscillator (Q1) is a standard overtone circuit. A fifth-overtone crystal, 80.545 MHz, is operated on the seventh overtone, 112.763 MHz. Typically, fifth-overtone crystals work well up to the eleventh or thirteenth overtones. They are usually less expensive than higher-mode crystals and are more readily available.

C6 couples the output of the oscillator to Q2, which operates as a doubler to 225.5 MHz. A double-tuned circuit (C7, L2, L3, C10) is used in the collector of Q2 to reduce the level of the 112-MHz oscillator signal. This type of filtering is required if the spurious components at the output frequency are to be adequately suppressed. The output of Q2 is capacitively coupled (C11) to the base of Q3. This method of coupling may not be optimum, but it is simple and works adequately in this

circuit. The double-tuned circuit in the collector of Q3 (C12, L4, L5, C15) is tuned to 451 MHz.

A small capacitance, 2.7 pF, couples the 451-MHz signal to the base of another 2N5179, Q4, which doubles the signal to 902 MHz. Originally I tried an MRF911 in this circuit. However, the MRF911 was rather unstable and its output somewhat low. After spending a couple of hours trying to stabilize it, I tried a 2N5179. It proved to be stable and had considerably more output. Undoubtedly the MRF911 could have been made to function well, but the main purpose in designing the exciter was to provide a circuit that is stable, easily adjusted and inexpensive. Considering these goals, the 2N5179 is a better choice in this circuit.

The output of the 902-MHz doubler has a triple-tuned circuit (C17, L6, C19, L7, C20, L8) in its collector. Using only a double-tuned circuit, the signals 451 MHz on either side of the carrier were down only about 40 dB below the carrier (-40 dBc), and the second harmonic was down only about -40 dBc. The addition of another tuned circuit reduced the 451-MHz component to -44 dBc and the 1353-MHz component to -64 dBc. A 50-ohm pi attenuator (R7, R8, R9) at the exciter output reduces the power level to that required to drive the next amplifier stage.

## Building the Exciter

The enclosure that houses the exciter is made from unetched pieces of 0.062-inch, G-10 glass-epoxy circuit board. The base piece is 6 × 1¼ inches, and the sides and ends are ¾-inch high. This provides a strong, well-shielded box.

<sup>1</sup>Notes appear on page 39.

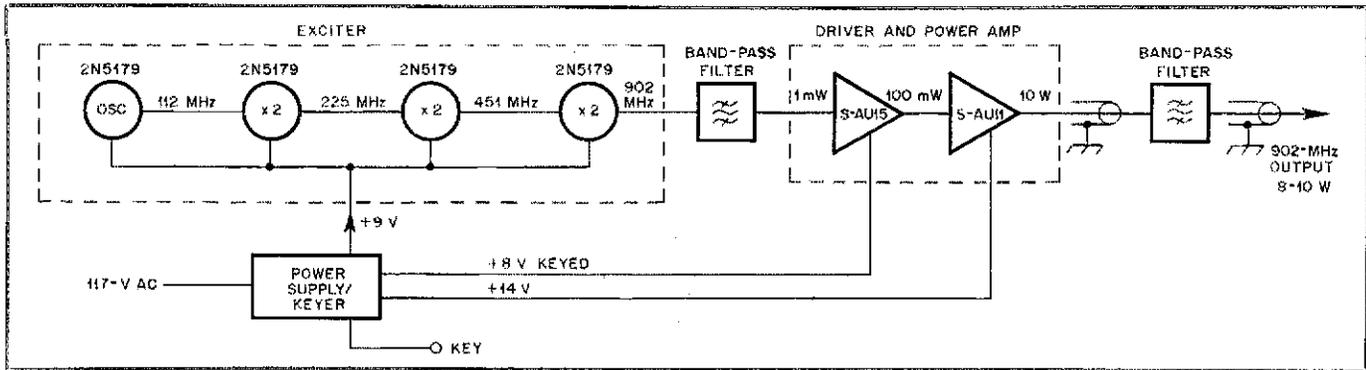


Fig 1—Block diagram of the 902-MHz CW transmitter.

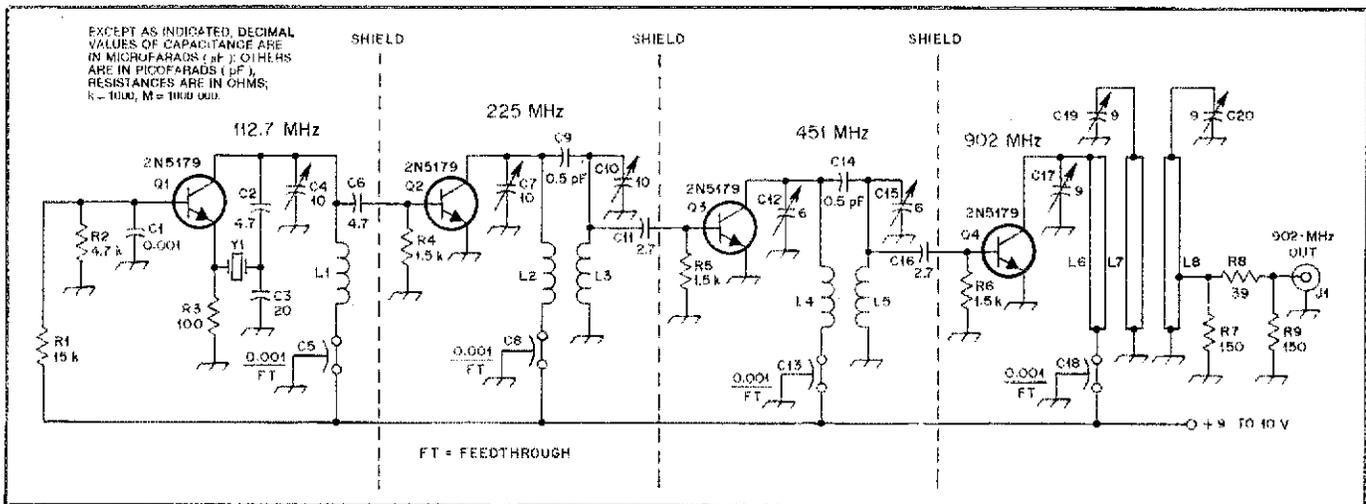


Fig 2—Schematic diagram of the exciter. Resistors are 1/4-W carbon composition. Capacitors are 50-V epoxy-coated ceramic types unless otherwise noted.

- C4, C7, C10—1.5-15 pF miniature air-variable capacitor (Trim-tronics 10-1120-25015-000 or equiv).
- C5, C8, C13, C18—470- to 1000-pF ceramic feedthrough capacitor, solder-in type preferred.
- C9, C14—0.5-pF "gimmick" capacitor (see text).
- C12, C15—1.6 pF miniature air-variable capacitor (Trim-tronics 10-1120-25006-000 or equiv).

- C17, C19, C20—0.6-9 pF ceramic piston trimmer capacitor (Voltronics EQT9 or equiv).
- J1—Chassis-mount female BNC connector (UG-1094 or equiv).
- L1—5t no. 22 tinned wire, 0.228-in ID (no. 1 drill), spaced 1 wire dia.
- L2, L3—4t no. 18 tinned wire, 1/4-in ID, spaced 1 wire dia.
- L4, L5—2t no. 18 tinned wire, 1/4-in ID,

- spaced 1 wire dia.
- L6, L7, L8—inductor made from copper strap, 1-in long x 1/8-in wide. See text and Fig 3 for details.
- Q1-Q4—2N5179 transistor.
- Y1—Fifth-overtone crystal, 80.545 MHz, or seventh-overtone crystal, 112.763 MHz, HC-25 holder, series resonant, 0.005% (avail from JAN Crystals, 2400 Crystal Dr, Ft Meyers, FL 33906 tel 800-237-3063).

Figs 3 and 4 show the general layout. Unless you have had experience laying out UHF circuits, I strongly recommend that you follow the described layout. Build the oscillator section first, then the first doubler, and so on. This allows you to test the circuits individually as you build.

All components except J1, the output BNC connector, are mounted on the foil side of the board. Ground connections are made directly to the copper ground plane. Using Fig 3 as a guide, first install the components that mount through holes in the circuit-board box. The four transistors mount in 0.190-inch-diameter holes. The feedthrough capacitors should be of the solder-in type and must have good UHF characteristics. The piston trimmers used in the 902-MHz output circuit mount in 1/4-inch holes. The output connector, J1,

mounts in a 3/8-inch hole.

Components such as resistors and capacitors that make up the circuit are soldered together and supported by their leads. Keep in mind throughout the construction phase that all leads should be kept to a minimum length. Stray capacitance and inductance can be troublesome in a circuit such as this. All resistors are 1/4-W carbon types. Do not use metal-film resistors.

The 0.5-pF coupling capacitors in the 225- and 451-MHz tuned circuits are of the "gimmick" type. They are made from short lengths of small, plastic-covered hookup wire twisted tightly together. The twisted length is 1/4 to 5/16 inch.

Refer to Fig 4 for layout specifics. L2 and L3 are mounted approximately 1/2 inch apart, center to center. L4 and L5 are mounted approximately 3/8 inch apart,

center to center. Details of L6, L7 and L8 are given in Fig 3.

After the oscillator circuit is finished, solder in place the shield that separates the oscillator and first doubler. In the unit shown in Fig 4, this shield is made from thin brass stock. This brass may be obtained from most hobby and hardware stores. If you wish, however, you could use circuit-board scraps instead of brass. There are similar shields between the other stages.

#### Exciter Adjustment

If you're experienced in tuning up UHF equipment and have a spectrum analyzer, you can probably tune up this exciter in two to three minutes. It is best to adjust one stage at a time, starting with the oscillator. First adjust C4 for maximum output at 112.7 MHz. A dip meter may be used to

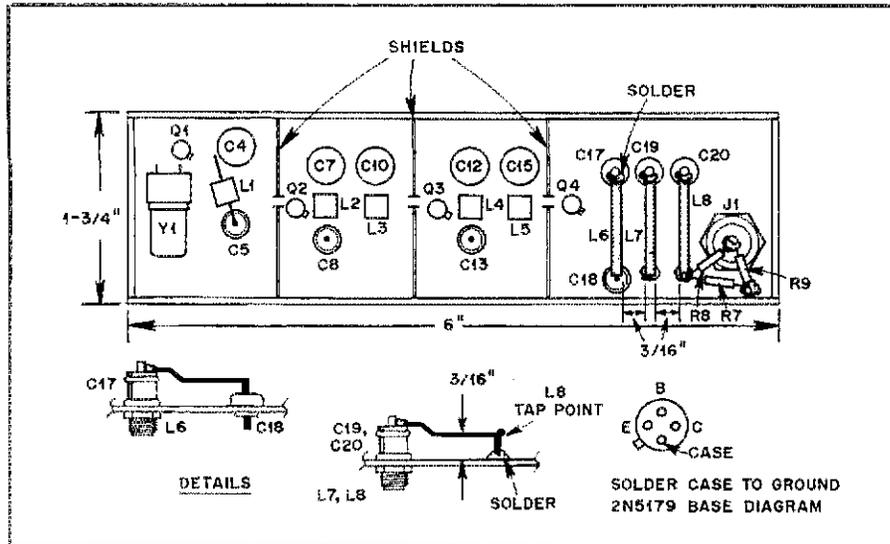


Fig 3—Suggested layout and construction details for the 902-MHz exciter.

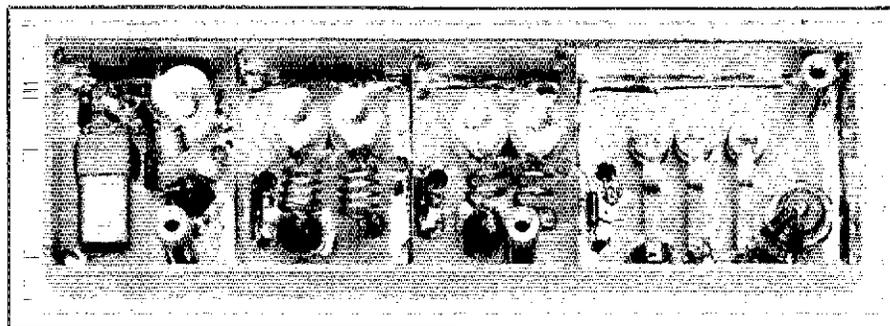


Fig 4—The exciter is built on a piece of copper-clad circuit-board material. Component leads are soldered together; lead lengths are as short as possible. Shields are used between each stage. Study this photo and Fig 3 for additional details.

determine this. Check to see that the oscillator starts readily by removing and reapplying the 9-V supply.

Once you're satisfied with the oscillator performance, apply supply voltage to C8 also. Again, using a dip meter or some other indicator, peak C7 and C10 for maximum output at 225 MHz. Similarly tune the next doubler by adjusting C12 and C15 for maximum output at 451 MHz.

Now adjust the 902-MHz doubler stage. Your dip meter probably does not cover this high a frequency, so you need another way of monitoring power. A simple diode detector such as an RF probe on your VTVM will work well. Touch the RF probe to the center pin on the output connector, J1, and tune C17, C19 and C20 for maximum output. This point will occur with all three capacitors near minimum capacitance if the circuits have been constructed properly. A power meter such as the Hewlett Packard 430, 431 or 432 series may also be used as an indicator.

Repeat all the tuning capacitors for maximum output at 902 MHz. Once this is done, the output should be approximately 4 to 6 mW. Fig 5 shows what the

output should look like on a spectrum analyzer.

This power level is still more than the 1 to 1.5 mW needed to drive the S-AU15 amplifier. The maximum drive power

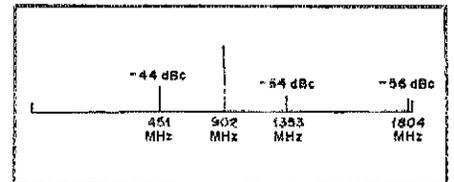


Fig 5—Spectral output of the 902-MHz exciter with no external filtering.

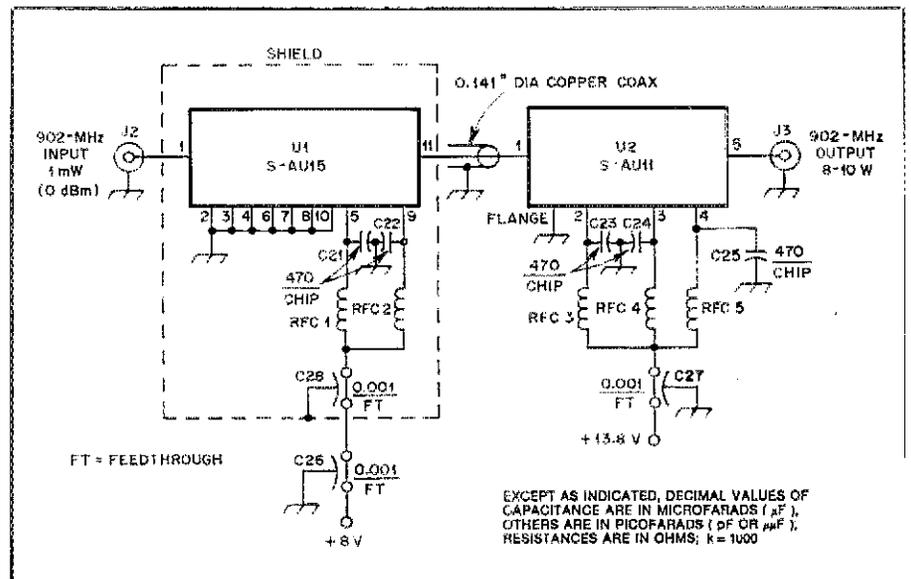
specified is 3 mW, so a pi attenuator is used to reduce the exciter output to the right level. The exact output power will vary from unit to unit, so the values of resistors R7, R8 and R9 that form the pi attenuator may have to be changed to obtain the desired output level. Resistor values may be obtained from Chapter 25 of *The 1986 ARRL Handbook*.<sup>2</sup> Keep in mind that a bandpass filter will be used between the exciter and driver stage, and the attenuation in this filter will also reduce the exciter output level.

### Driver and Power Amplifier Stages

During the development of this transmitter, I initially decided to use tuned amplifiers and a 20-W power block to amplify from the milliwatt level to a reasonable amount of power. The units were constructed and tested, and they worked well. The power block used as a

Fig 6—Schematic diagram of the driver and power-amplifier stages.

- C21-C25—470-pF, 50-V ceramic chip capacitor.
- C26, C27—470- to 1000-pF ceramic feedthrough capacitor, mounted with nut.
- C28—470- to 1000-pF ceramic feedthrough capacitor, solder-in type preferred.
- J2, J3—Chassis-mount female BNC connector (UG-1094 or equiv).
- RFC1-5—31 no 28 tinned wire, 0.10-in ID, spaced 1 wire dia.
- U1—Toshiba S-AU15 driver module (see text).
- U2—Toshiba S-AU11 power-amplifier module (see text).



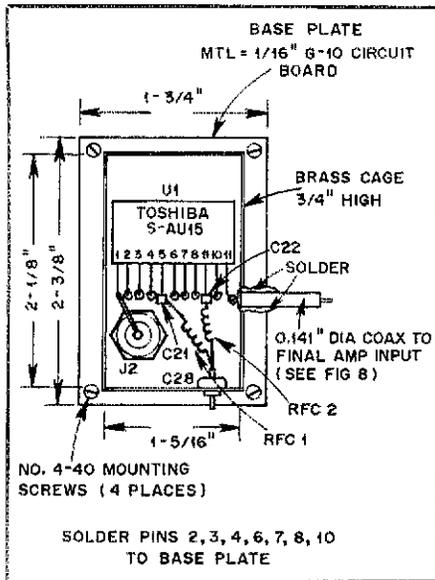


Fig 7—Construction details of the Toshiba S-AU15 driver subassembly.

final amplifier was rather expensive, however, so I looked for a better, less expensive way.

In mid-1984, Toshiba started producing power amplifiers for 900 MHz. The Toshiba S-AU15 driver stage and S-AU11 final stage appeared to be just what was needed. The S-AU15 is a small, multi-lead package that delivers up to 200-mW output with only 1.5-mW drive. It requires 8-V dc. The S-AU11 power module is rated at more than 9-W output with 100-mW drive. A check with the West Coast distributor for Toshiba yielded single-quantity price information of \$9.95 for the S-AU15 and \$31.50 for the S-AU11. Wow, I thought—10-W output and 40-dB of gain for just over \$40! The day after receiving them, I spent two hours building the amplifier unit described here.

Fig 6 is a schematic diagram of the driver and power amplifier stages. The Toshiba modules are encapsulated "black boxes" with leads. The only additional components are input, output and power connections, and some RF chokes and bypass capacitors on the power leads. No adjustments whatsoever are required. Just apply dc and RF drive. This is so much simpler and easier than building up discrete component amplifiers and struggling to get them working properly!

Initially, I had some reservations about building one box with 40 dB of gain in it. I decided to give it a try, however, and tried to use adequate decoupling. Maybe I could get away with it. I connected power supplies to the completed unit and apprehensively applied 1 mW (0 dBm) of 902-MHz power to the input. The wattmeter on the output registered 10 W. The unit appears to be unconditionally stable.

**Building the Driver and Power Amplifier**

Figs 7, 8 and 9 show construction details

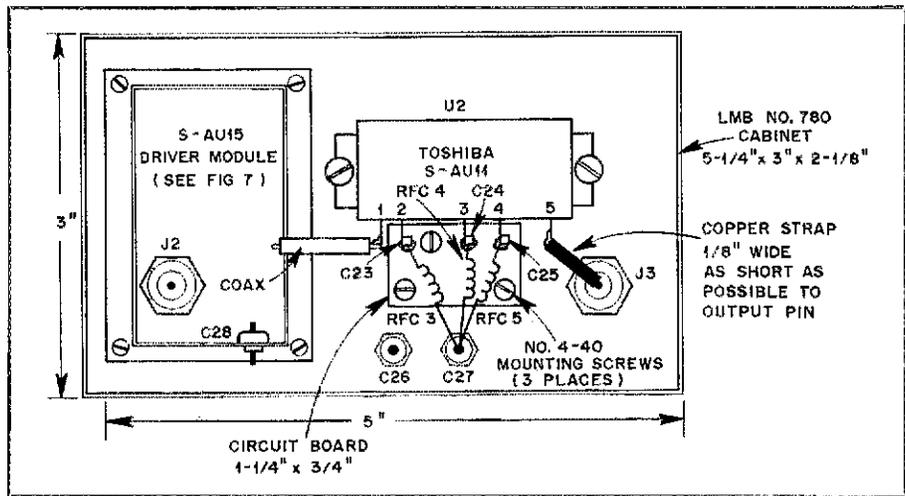


Fig 8—Construction details of the Toshiba S-AU11 final amplifier and the driver subassembly.

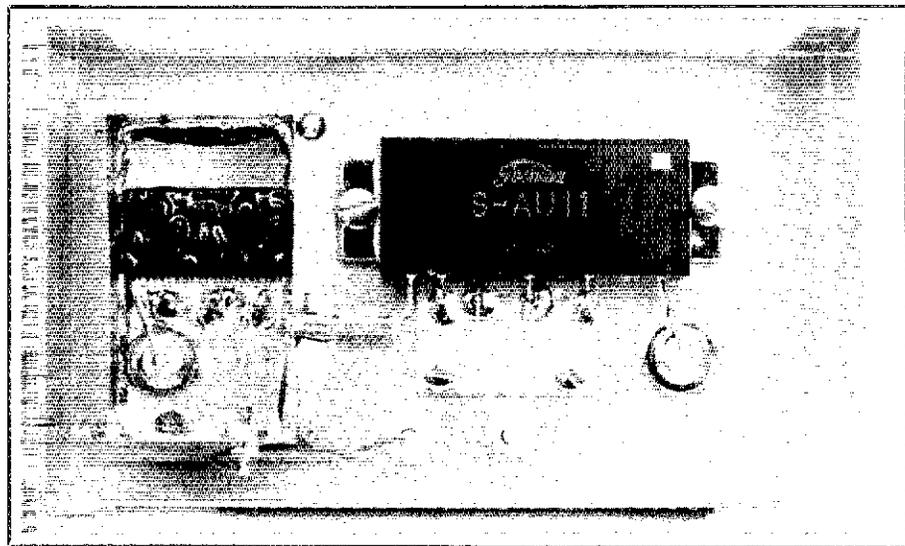


Fig 9—The driver and power amplifier mount in an LMB-780 Minibox. A heat sink is necessary for the final-amplifier module.

of the driver/power-amplifier module. The driver amplifier is built as a subassembly, as shown in Fig 7. A 2-3/8- x 1-3/4-inch piece of 0.062-inch-thick G-10, glass-epoxy circuit-board stock is used as a base plate. An enclosure 3/4 x 2-1/8 x 1-1/4 inches (HWD), constructed of "hobby-shop" brass sheet, is soldered to this base plate. This is the same brass material that I used for the shields in the exciter. It can be cut with regular scissors and bent into shape easily. It may be easier to cut or punch the holes for C28 and the output coaxial cable before this enclosure is soldered to the base. The completed driver subassembly is mounted in place by four no. 4-40 screws, one in each corner of the plate.

Fig 8 details the general component layout. A small piece of 0.062-inch-thick G-10 circuit-board material is mounted with three screws immediately under the leads of the S-AU11. This allows for easy soldering of chip capacitors C23, C24 and

C25 to the ground plane.

The S-AU11 device must be capable of dissipating a few watts, so the heat sink shown in Fig 9 is necessary. This heat sink is held in place by the two no. 6-32 screws used to mount the S-AU11 module. Holes are drilled and tapped in the heat sink to accommodate this type of mounting.

Again, there are no adjustments to make to the Toshiba power modules. Just apply power and RF drive, and you're on the air. Output power should be between 8 and 10 W, depending on the drive level from the exciter.

**RF Filtering**

Amateur-designed equipment often will not be spectrally clean. Although the FCC does not specify a minimum level for harmonics and spurious signal components at 902 MHz, good amateur practice dictates that they should not exceed -60 dBc. When class-C amplifier stages are added,

the spurious levels may increase significantly. Additional output filtering is required for this transmitter. I recommend that a filter be used at the output of the exciter and another at the power amplifier output.

I built and tested three different filters for possible use with this transmitter. They vary in performance and complexity. Two of the designs have relatively high loss and would make good choices for filtering the exciter output. The third filter, although a bit more difficult to build, has much lower loss than the other two (only 0.2 dB) and would make a good choice for an output filter. Using either of the first two filters between the exciter and power amplifiers and the third filter at the output, all spurious levels are greater than -60 dBc.

Fig 10 shows the construction details of a simple bandpass filter. It uses a box constructed from circuit-board material, much like the box the exciter is built in. The one drawback of this filter is that it uses two rather expensive (about \$3 each) piston trimmer capacitors for C1 and C2. Perhaps a redeeming feature is that it has a wide tuning range. Fig 11 shows what inserting this filter at the exciter output does. The 451- and 1353-MHz components are reduced significantly. The 3-dB bandwidth of the filter is approximately 7.6 MHz, and the insertion loss is approximately 1.7 dB with the coupling loops positioned as shown in Fig 12.

The second filter is similar to one described by Rick Campbell, KK7B, in a paper presented at the Estes Park, Colorado 1296/2304 Conference held September 19-22, 1985. It is based on a computer-aided design that recently appeared in *Ham Radio* magazine.<sup>4</sup> This interdigital filter has only 1-dB loss at 902 MHz. It does not require any tuning if built according to the description. Small errors in the dimensions, however, will degrade performance, and this usually means that losses will increase.

Fig 13 shows the construction details. The top and bottom plates of the enclosure are made from 0.062-inch-thick circuit-board material. The side and end plates are made from 0.032-inch-thick brass sheet. Inside dimensions of the enclosure are critical and must not be modified. Solder all contacting edges at final assembly.

This filter uses short lengths of 0.141-inch miniature Hardline for the resonators. The KK7B design used SMA connectors, but I opted for the BNC connector. Although inferior to the SMA series, the BNC series is adequate at this frequency if the connector has not been physically abused. The center conductor will be removed from the Hardline during final assembly, leaving the Teflon<sup>®</sup> dielectric in place in the copper tube. When assembling the filter, you may find it convenient to partially remove the inner conductor wire and use it to hold the resonator in place while making the soldered connections. Save the center con-

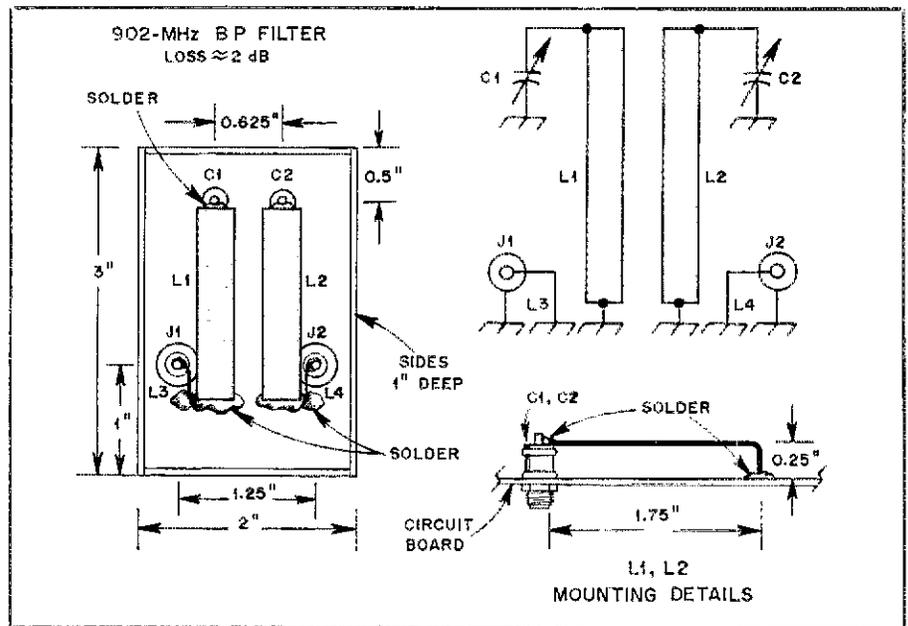


Fig 10—Schematic diagram and construction details of the simple 902-MHz band-pass filter. The base and sides are made from 0.062-in copper-clad circuit-board material.

C1, C2—0.6-9 pF ceramic piston trimmer capacitor (Voltronics EQT9 or equiv).  
J2, J3—Chassis-mount female BNC connector (UG-1094 or equiv).

L1, L2—Copper strap 2-in long × 11/32-in wide × 1/32-in thick.  
L3, L4—Coupling loop, no. 18 wire, spaced 1/16 inch from L1 and L2.

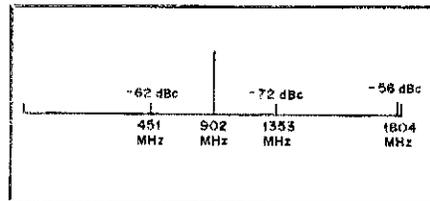


Fig 11—Spectral output of the 902-MHz exciter with the simple band-pass filter shown in Fig 10 on the output.

ductor. If you want to tweak the filter for optimum performance, make small tuning changes by inserting the inner conductor into the open end of the resonator.

This interdigital filter has an advantage over the simple tunable band-pass filter. Depending on the load impedance, the capacitors in the tunable version may arc if power levels of several watts are used. The interdigital filter does not use capacitors, so this limitation does not apply.

Fig 14 shows the effect that this filter has on the exciter output. The 451- and 1353-MHz components are reduced significantly, and the second-harmonic level at 1804 MHz remained about the same, -56 dBc. This filter has a 3-dB bandwidth of 26.5 MHz and an insertion loss of 1 dB. The finished, sealed filter is shown in Fig 15.

The third filter is shown in Figs 15 and 16. It is a variation of one described in *QST* some years ago.<sup>5</sup> Although somewhat larger than the previous two filters, it has

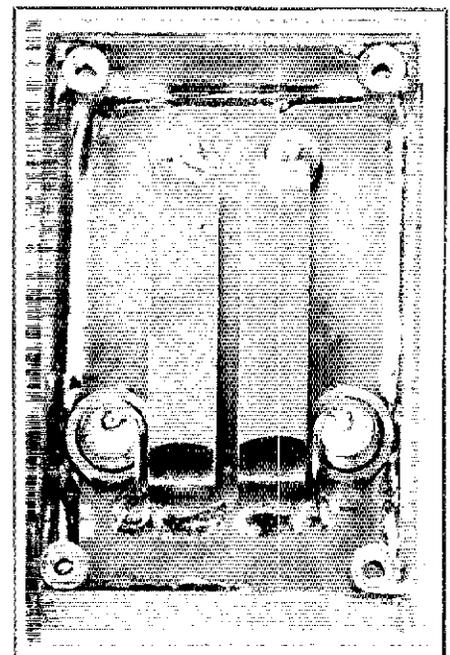


Fig 12—The simple bandpass filter is built in an enclosure made from circuit-board material.

relatively low loss and a considerably higher power-handling capability.

Again, it is important to follow the dimensions carefully if you expect the best performance. The resonator and coupling elements are made from brass rod, and the end plates are rectangular aluminum bar stock. The top and bottom plates are aluminum sheet. Good contact between the

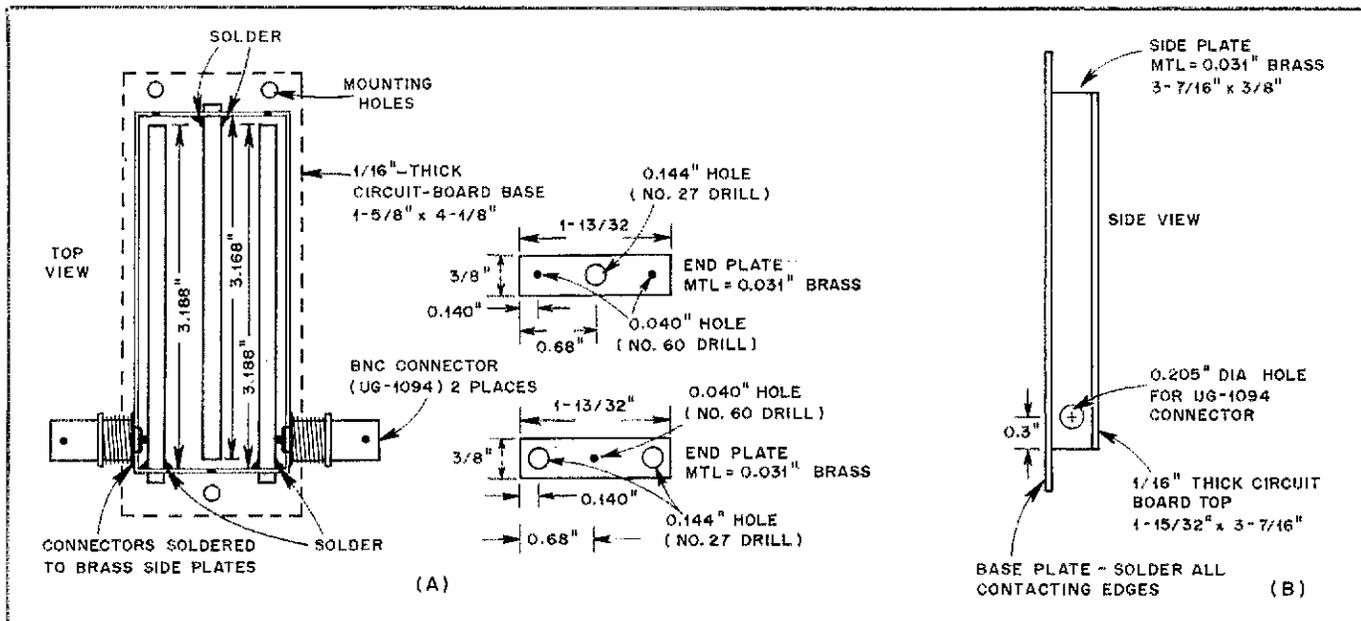


Fig 13—Construction details for the three-resonator interdigital filter. No tuning is required if you follow the dimensions given. The inside dimensions of the box are critical.

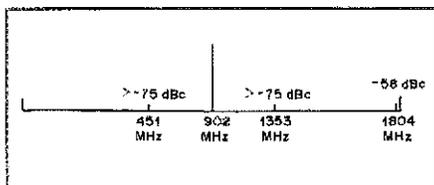


Fig 14—Spectral output of the 902-MHz exciter with the three-resonator interdigital filter shown in Fig 13 on the output.

resonator rods and the end plates is essential to reduce losses. Note the number and placement of machine screws. The top and bottom plate mounting screws are positioned so that there is a good connection at each of the filter element rods.

Long-term performance may suffer if the electrical connections between the filter parts deteriorate. I'm fortunate to live in a dry climate where corrosion is not a problem. If you live in an area where exposed metals tend to oxidize, you should probably make all of the metal parts from brass. Have them silver-plated before assembly. Another alternative is to make the parts from brass and solder the connections after assembly and testing. If you can't find them locally, brass and aluminum sheet, and rod and bar stock are available in small quantities from Small Parts, Inc.®

The resonant frequency of this filter may be lowered by turning the no. 10-32 screws at the ends of the resonator elements or raised by shortening each of the elements. The 3-dB bandwidth is 68.9 MHz, and the insertion loss was measured at 0.2 dB.

**Power Supply and Keyer**

The power-supply schematic diagram is

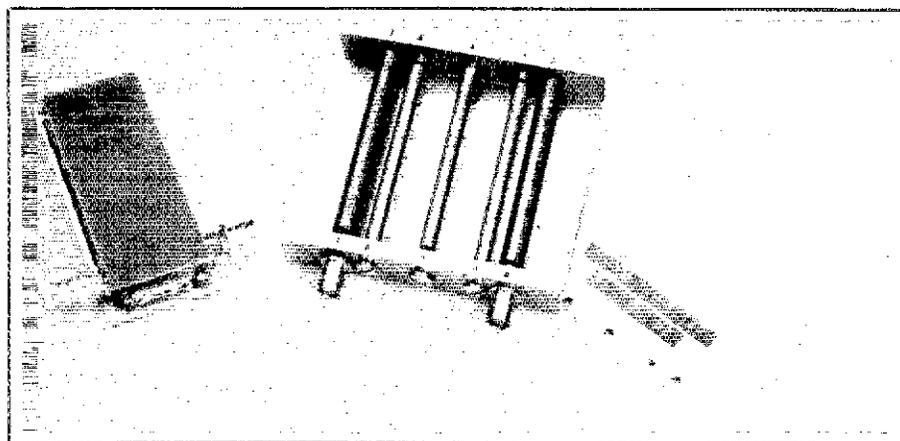


Fig 15—The three-resonator interdigital filter (Fig 13) with the cover soldered in place and the five-element filter (Fig 16) with the cover removed.

shown in Fig 17. The transformer/bridge, rectifier/capacitor combination delivers the unregulated dc voltage to three separate adjustable 3-terminal regulators and a fixed 12-V regulator. U1, a 7812 12-V regulator, is included to supply a matching receiving converter and preamplifier. U2, a 317-type of adjustable regulator, is set to supply a keyed voltage of approximately 8 V through Q1 to the Toshiba S-AU15 driver stage. U3, another 317-type regulator, is adjusted to supply 9 to 10 V to the exciter stages. You can vary the voltage of this supply to adjust the transmitter power output. U4, a higher-current 317K-type of regulator, supplies 13.5 V at approximately 1.5 A to the Toshiba S-AU11 final-amplifier package.

The keyer transistor, Q3, is a PNP power device. I used a Radio Shack 276-2027.

Almost any PNP transistor capable of handling a collector current of 100 to 125 mA can be used here.

The regulators require adequate heat sinking. The power transformer shown in the photographs has a 24-V secondary, resulting in an unregulated output of approximately 37 V. This means that the regulators must dissipate quite a bit of power. A much better choice would be a transformer with a 13- to 15-V secondary. This would reduce the voltage drop in the regulators and allow them to run cooler. The LM317K shown in the photographs runs rather warm, and more of a heat sink should have been used than just the corner of the cabinet.

The keyer circuit provides a clean-sounding CW note. If desired, an RC network could be used in the base of the

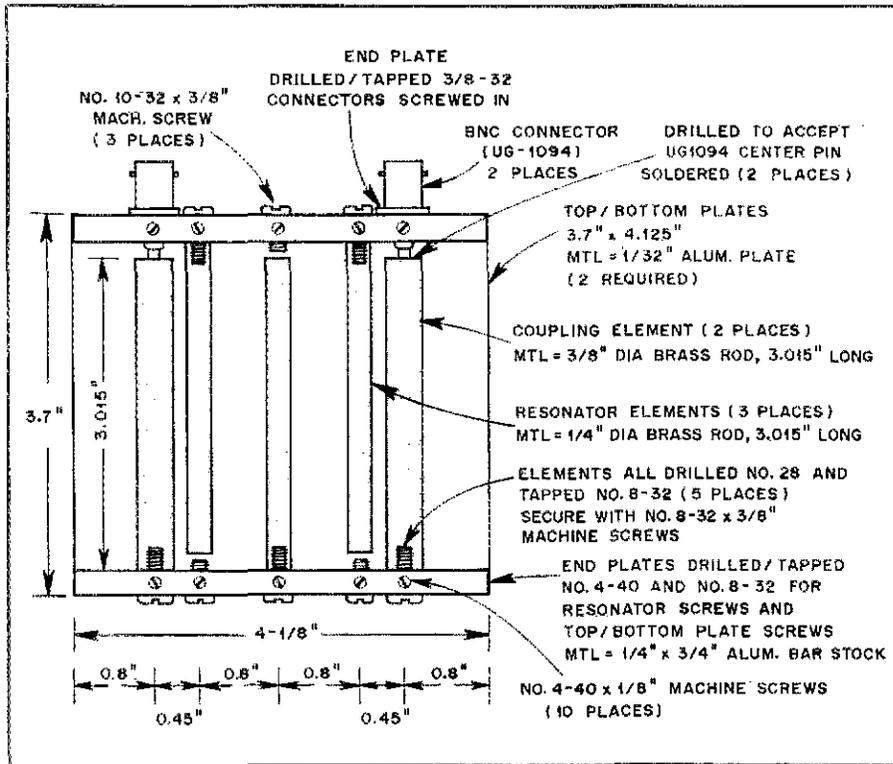


Fig 16—Construction details for the five-element interdigital filter.

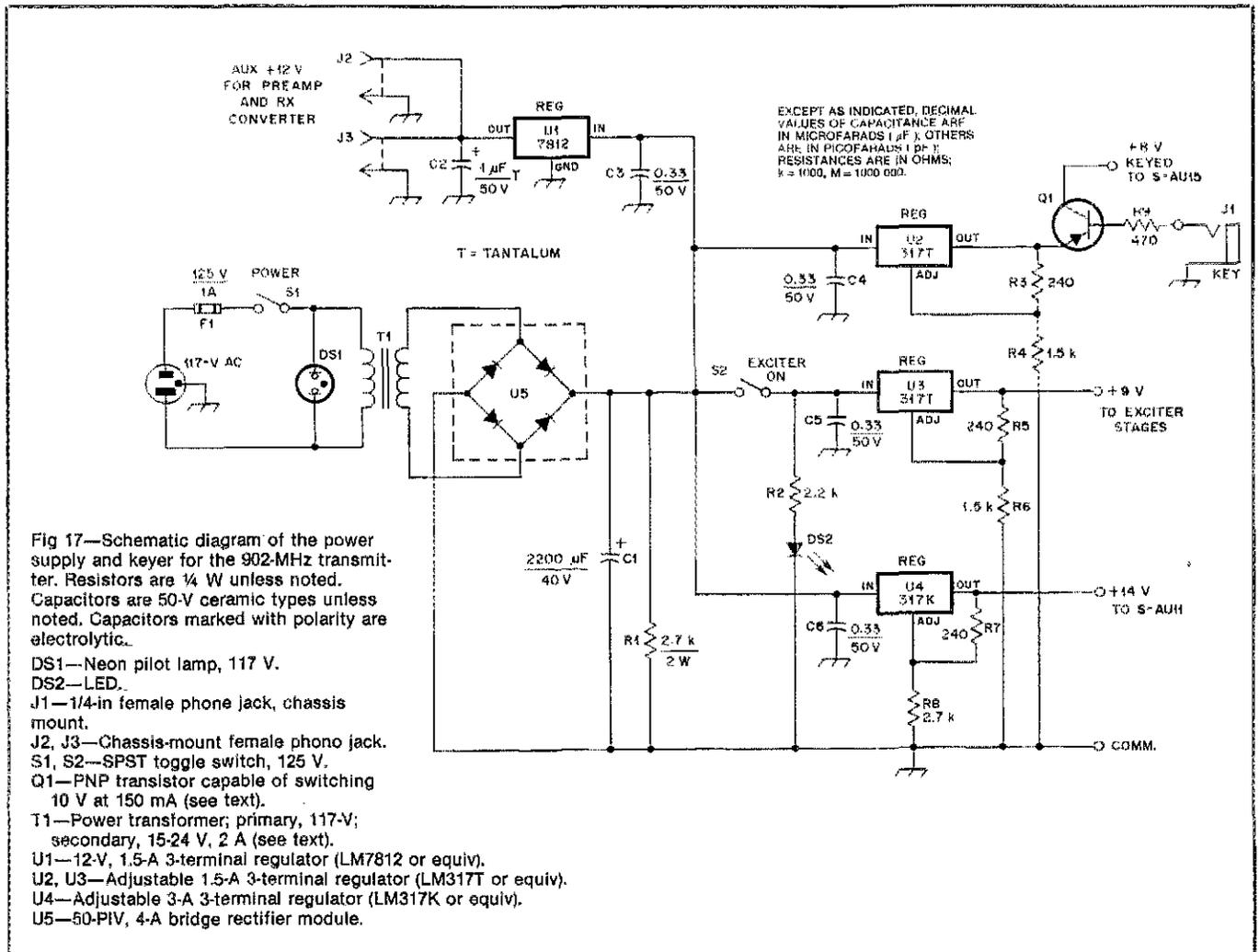
keying transistor to alter the attack and decay times of the keying wave form.

**Packaging**

I tend to build things without thinking much about how the end product will be packaged. This should be obvious from the pictures. There are X number of boxes to be combined into one unit, with power supply and so on. I packaged them as shown in Fig 18 because I happened to have the cabinet. It would be wise to estimate in advance what area you need and acquire an appropriate case. For convenience, you may want to package the receiving converter, preamp, transmitter and power supply in the same cabinet, along with antenna-changeover relay and other control circuitry. Consider these options as you decide on the final packaging.

**Conclusion**

Although 10 W is a rather modest amount



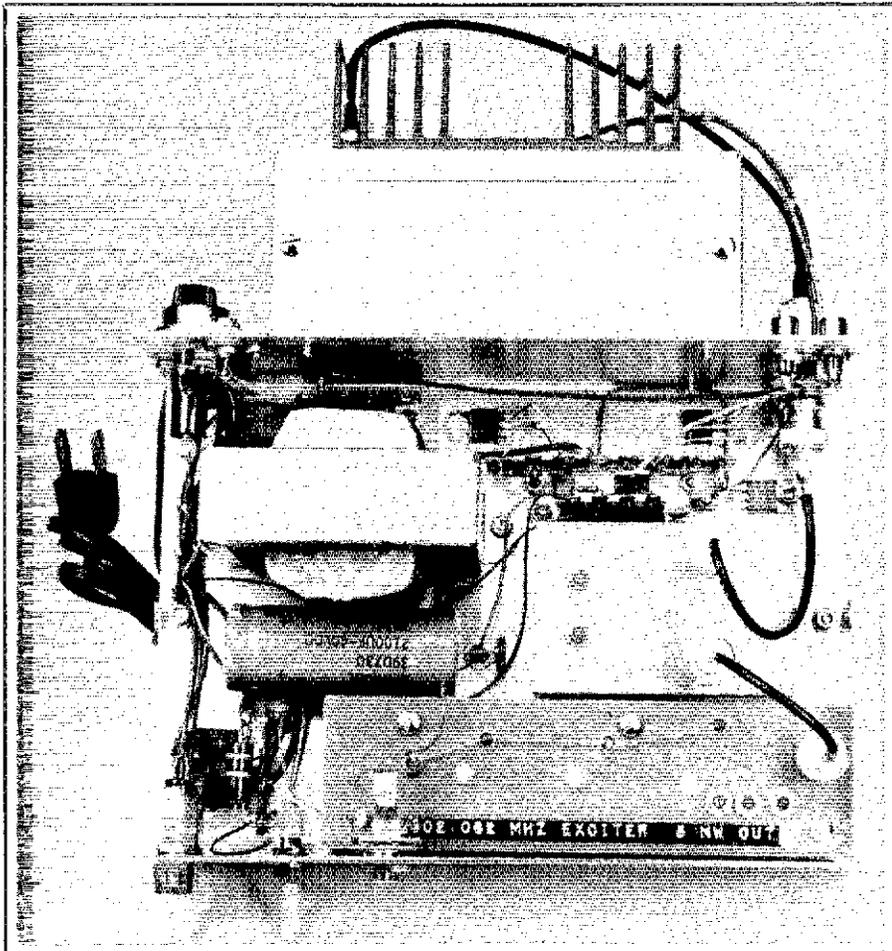


Fig 18—Interior view of the completed 902-MHz transmitter.

of power on 902 MHz, many interesting things can be done. When used with a good antenna system, contacts out to 200 to 300 miles should be easy with stations of similar or better capability. This assumes a good location with the antenna above surrounding objects and trees. During periods when tropospheric ducting is present, contacts at distances greater than 1000 miles might be made. Of course, this unit can be used to drive a higher power amplifier.

Give 902 MHz a try and be among the first to explore our new band!

**Notes**

- <sup>1</sup>D. Hilliard, "A 902- to 144-MHz Receive Converter," *QST*, Oct 1985, pp 21-26.
- <sup>2</sup>M. Wilson, ed, *The 1986 ARRL Handbook* (Newington: ARRL, 1985), p 25-44.
- <sup>3</sup>Toshiba modules are available in single-lot quantities from Matcom, Inc, 4505 San Antonio Rd, Palo Alto, CA 94306, tel 415-493-6127.
- <sup>4</sup>J. Hinshaw and S. Monemzadeh, "Computer-Aided Interdigital Bandpass Filter Design," *Ham Radio*, Jan 1985, pp 12-26.
- <sup>5</sup>R. Fisher, "Interdigital Bandpass Filters for Amateur VHF/UHF Applications," *QST*, Mar 1968, pp 32-33.
- <sup>6</sup>Small Parts, Inc, 6901 NE Third Ave, PO Box 381736, Miami, FL 33238, tel 305-751-0856.



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**Strays**



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Hamming is easy for most of us. We're blessed with our senses of sight and hearing and the abilities to move about and easily manipulate equipment controls. We tend to forget there are many amateurs who require assistance to do the things we take for granted. With computers having established their presence in the amateur's shack, perhaps some readers have developed human/computer/radio interfaces for the handicapped. We'd like to hear about them, and so would other *QST* readers. Jot down your ideas and send them to Paul K. Pagel, N1FB, Senior Assistant Technical Editor, ARRL, 225 Main St., Newington, CT 06111.

I would like to get in touch with...

- former personnel of the Ft Monmouth,

NJ Signal Corps Engineering Lab Development Det, 9400 Tech Service Unit, WW II. Dr John Bradley, K2BAY, Rte 60, Upper Montclair, NJ 07043-1605.

- any hams who attended Paul Smith's College. Ted Steinhorst, KA2BIG, 134 Berkshire Dr, Horseheads, NY 14845.
- any hams who served in the 7thAAF Radio Sq, Mobile, during WW II. Dave Seiler, N6ELM, 175 Alta Dr, Watsonville, CA 95076.
- any hams who attended SSB radio repair school at Ft Monmouth, NJ in 1950 or served in the 71st Signal Bn in Japan 1951-1952. Richard Pann, W1SUJ, 2447 Yates Dr, Augusta, GA 30906.
- any hams who served in the AF, 436th Troop Carrier Gp, 80th TC Sq, WW II. Leon Lustyk, W2PZU, 50 Cinnabar Rd, Rochester, NY 14617.
- any hams interested in starting a net for the Tandy 1000 or IBM PCs. Brad Bradford, WB9LFD, 906 Parkway Dr, E Peoria, IL 61611.