Three-Element Circular Quad for 10m

For under $65!

Carl Markle K8IHQ
11570 Taylor Wells Road
Claridon OH 44024-8910

Now that ten meters is coming back again after a seven year rest, renewed interest by DX stations is again making the band exciting. Although a typical trapped 10-15-20 yagi beam is OK, an inexpensive ten-meter-only antenna is much less expensive and a real weekend do-it-yourself project.

What is being shown here is the ability of the novice, with limited technical expertise, to put together a world-class 9 dB (over a dipole) gain antenna for under $65. In today's expensive world, this is a real eye opener.

All of the components are readily available from the local hardware or home improvement store. Tools amount to the kind of tools that every home owner must have to maintain his investment—the ranch! These tools are a hack saw, screwdriver, adjustable wrench (or equivalent), and, of course, a drill with a couple of bits. If you want to make things look pretty, then maybe a crosscut file would help. Now, this project is not for the critics to bash or go into a Ph.D. thesis on—it's just common sense construction and tested results. Please, no experts need to criticize: Just go on purchasing those expensive commercial yagis.

This quad has been constructed and sized for 144 MHz and 440 MHz, and has been used for several years at this QTH. It has been modeled and plotted using several two meter repeaters in the area, a couple of which are of the 250 feet above ground and better variety. Signal strength readings were made on a Kenwood TS-780 (144 + 440 MHz) transceiver S-meter. The ten meter version was likewise plotted using a Kenwood TS-430-S transceiver S-meter using both ten meter Caribbean repeaters and European and African DX station signals. On the ten meter quad, these signal strengths (forward/back/side) were compared with an 80 meter dipole broadside in the same direction as reference. Signal strength at times was less than S-1 and unreadable; immediate switch to the ten meter quad resulted in an S-9 strength.

As for the use of circles instead of the classic square or diamond or delta shapes, there are many Ph.D.-type mathematical- and computer-derived reports of comparison with all of these shapes as well as yagi designs. The circle will always outperform these other types on weak DX conditions. That controversy will probably always go on, but my 36 years of military service as a communicator, plus the 43 years of being licensed as K8IHQ (with a huge number of operating hours on the bands), tend to give me common knowledge beyond the phony smoke and mirrors or political agenda folks. I endorse the circular quad.

If contemplation of extending the number of elements beyond four is rolling around in your mind, experience has taught me that real gain is just not there unless yagi elements are used beyond the four circular elements. One of the side effects of this will be higher noise levels, corona discharge (wind effects), and lowering the usable bandwidth, which is especially important on ten meters (also 2m–70cm). For those who wish to construct one of

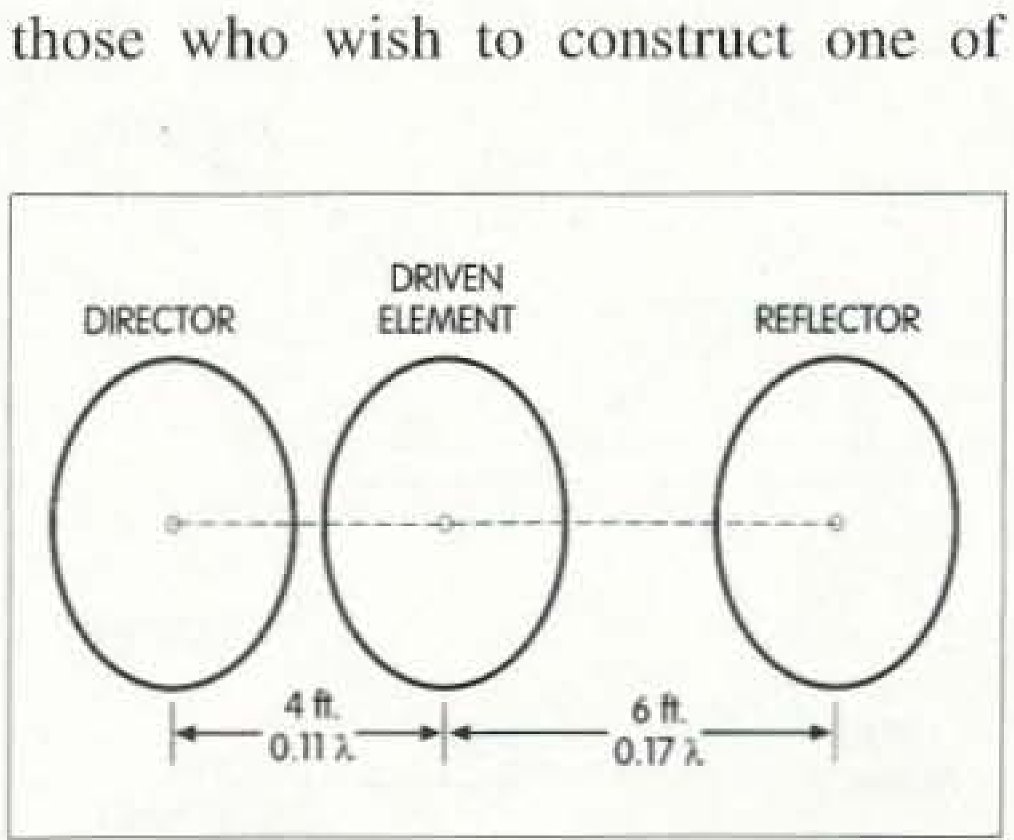


Fig. 1. Spacing diagram for the circular quad.

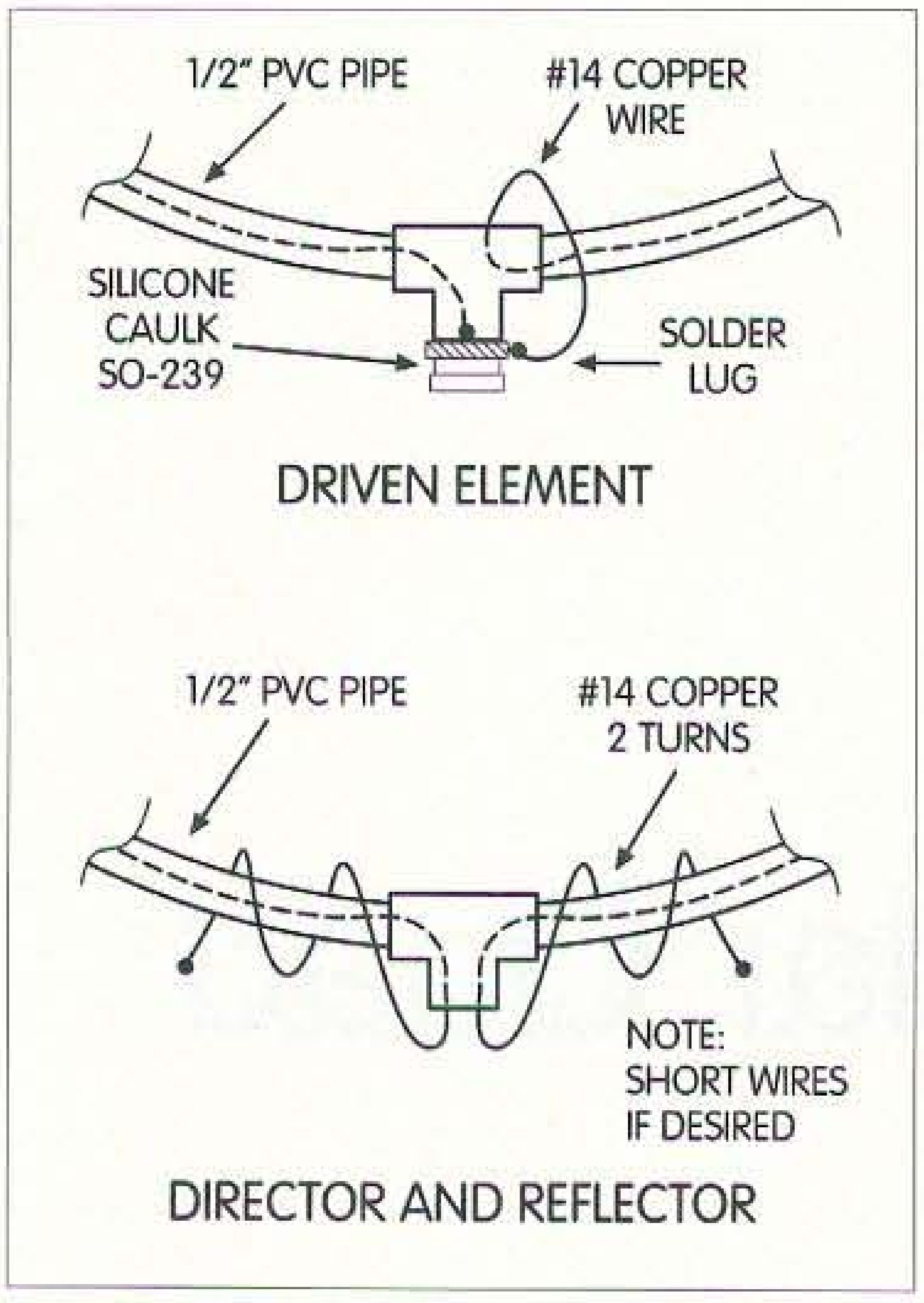


Fig. 2. Tee connections for the driven and parasitic elements.

these for two meters, it might be noted that it will be three wavelengths on 70cm—therefore you get additional gain on 70cm along with the large bandwidth gains.

The objective of this article is to provide detailed instruction on how to purchase components locally, cash-and-carry style, and put together an inexpensive high gain antenna system that does not require tuning, expensive meters, and gadgets to make it work.

Your coax length should be an odd multiple of one-half wavelengths at the lowest frequency you expect to operate. Make sure you include the VF (velocity factor) when figuring this length. Approximately 18 feet is one-half wavelength on 28.4 MHz. Now multiply the VF with this length to get the electrical (not physical) half wavelength at this frequency. Cables such as RG-213, RG-8, RG-58, etc., which have a solid poly internal covering (i.e., between the center conductor and shielded braid), have a VF of about 67%. The other types that have a foam insulation generally have a VF of about 79%. Whether you use 52 ohm or 75 ohm impedance types makes very little difference. In fact, a 75 ohm characteristic impedance more closely matches the circular loop impedance. This is not a critical item. For those few diehard old-timers who insist on minimum loss at 28 MHz and insist on using 300 or 450 ohm twinlead with a 4:1 balun or antenna tuner, you have been around long enough to know how to deal with that type of transmission line.

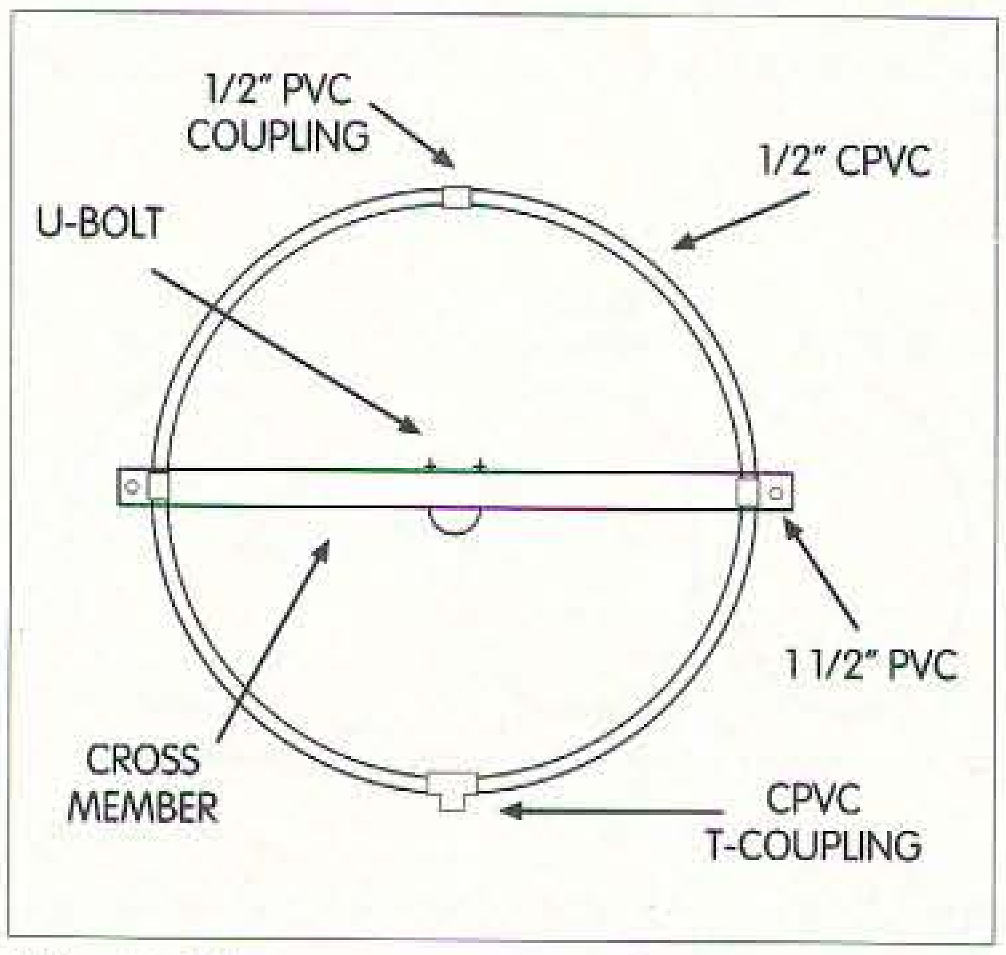


Fig. 3. Element mounting details.

Once you have determined that the tower is 22 feet tall or higher, then you can determine the physical length of the coax for proper operation (i.e., odd multiple of one-half wavelengths x VF at the lowest frequency that the cable is going to be used on—even at 1.8 MHz if you are remotely switching it to a 160 meter system). Also make sure, for propagation and safety reasons, that the shield of the coax is grounded at the base of the tower.

Now we can begin with the construction of the antenna system. The bill of materials shown in **Table 1** will be needed to make a good healthy antenna that has been proven to go through ice, snow, and 80 mph winds safely. The main reason is that it is extremely light in weight and very flexible. The rotor system will also benefit with this type of antenna system. One warning given is that the plastic should not be painted with anything. For an example, should black primer be used, summer sunshine will raise the temperature above the 200° F level and disaster will set in!

The source of a 10-foot boom is any place that sells chain link fence. This is a top rail made to telescope into another, so 20 feet or so of boom is possible. The optional 5-foot mast is in case your present mast does not extend 5 feet above the tower. If you need a mechanical system to connect the mast to the boom, the use of aluminum plates and stainless U-bolts is recommended. The additional couple of stainless bolts and nuts to secure the boom and mast to the plate for guaranteed non-slip is well worth the two dollars. Climbing towers is not my idea of fun.

Now that we have spent time and money purchasing and bringing home the plumbing and construction components, let's put together a nice looking quad antenna system. It must be noted that the general practice is to install a gamma match system to match the antenna array and coax impedances and to establish a balanced loading condition. I found that on the circular element

Parts List	
Qty.	**Description**
4	1.5" PVC-DWV drain pipe 10 ft.
3	1.5" PVC-DWV couplings
12	0.5" CPVC water pipe 10 ft.
9	0.5" CPVC water pipe couplings
3	0.5" CPVC water pipe T-couplings
1	1-5/8" galv. steel tubing 10 ft. (fence rail)
110 ft.	#14 or #12 AWG bare copper wire
3	4" x 8" galv. steel perforated plate (decks)
12	#6-1/2 stainless steel sheet metal screws
3	1.5" steel U-bolts, long (PVC-to-boom)
6	#1/4 x 3" galv. steel bolts (end cross member)
12	#1/4 nuts (use on item above, double nut)
1 can ea.	PVC cleaner, PVC/CPVC glue
Optional	
1	10" x 10" aluminum plate (0.25" thick)
2	1.5" galv. steel U-bolts (short)
2	2" galv. steel U-bolts (short)
2	#1/4 x 2" galv. steel bolts/nuts
1	1-7/8" x 5 ft. galv. steel mast (fence pole)

Table 1. Parts list.

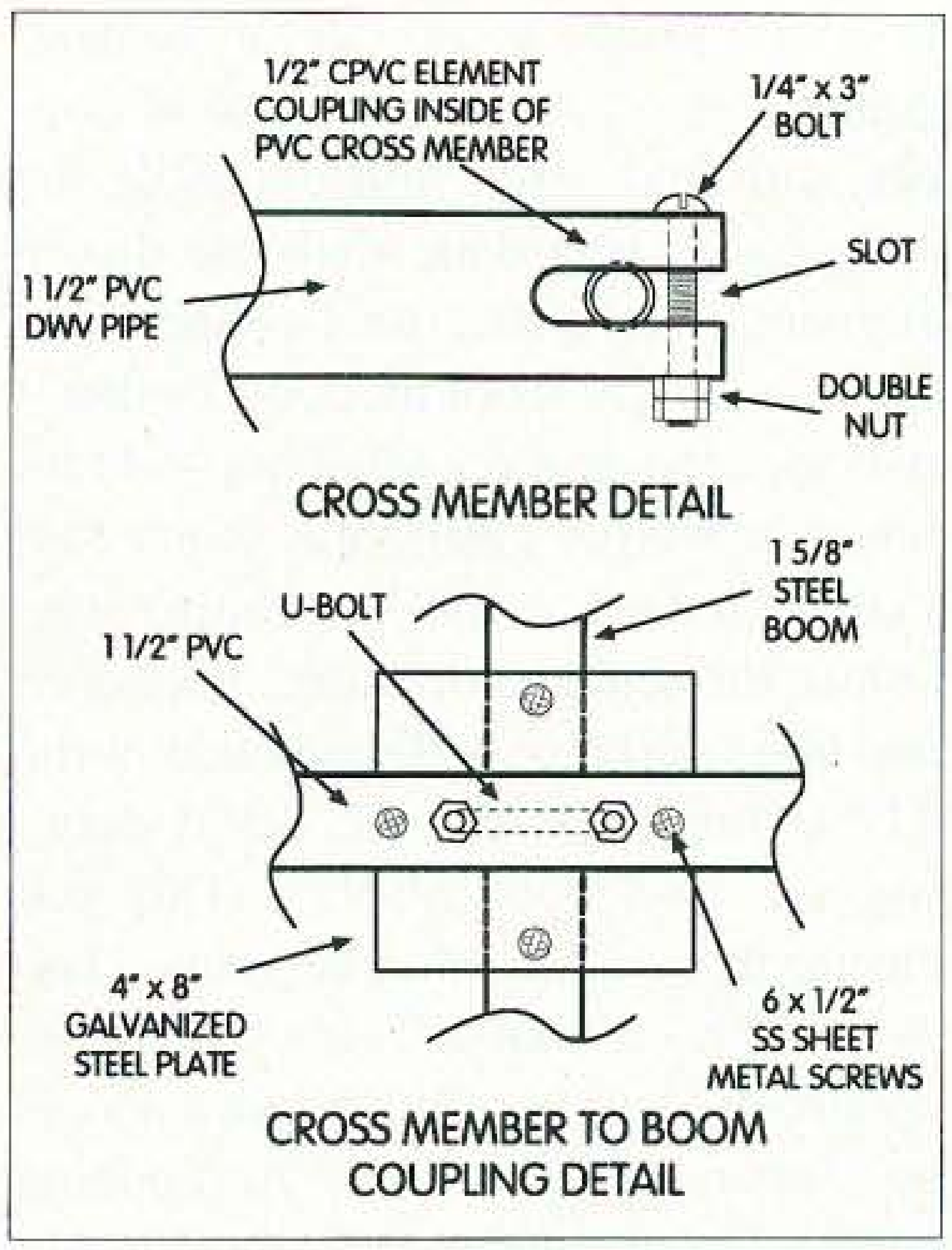


Fig. 4. Cross member and boom mounting details.

quads in particular, the driven element must be broken at the feedpoint to get it to comply with standard gamma match systems. After putting on the gamma match, a good match was accomplished. However, for unknown reasons the received signal was diminished considerably with the use of AC coupling vs. DC coupling (no gamma). So for simplicity and performance sake, a direct coupling unbalanced termination was made that resulted in excellent performance. Do what works!

First, make the driven element. It is being cut for approximately 28.4 MHz center. This results in about 35 feet of total length. Take four of the CPVC pipes and cut off the ends to achieve a length of 8 feet 9 inches, which equals a circumference of 35 feet. Cut a 36-foot length of copper wire and begin inserting into the end of the first section of pipe. When it reaches the end, clean the surface of the CPVC pipe and a coupling. Then apply glue and couple. Ensure that these pipes are lying on a relatively flat surface. Continue to insert the copper wire one section at a time. When all four sections are put together, use a T-coupling CPVC to complete the loop, ensuring that the ends of the copper wire are drawn through the holes in the T-coupling. See the drawing. Now insert an SO-239 or N coax receptacle. This is done with one copper wire to a solder

The NiCd Lady Company

Individual Cells - Replacement Packs - Lead Acids
Rebuilding Service - O.E.M. Assembly
for
*Handheld Radios *Laptops *Cellular Phones *Camcorders
*Portable Scanners *Test Equipment *Power Tools

Check into our rebuilding service - Substantial Savings over NEW!
Convert your pack to NiMH! Same size pack - HIGHER capacity!
Call for a price list or visit our website: www.nicdlady.com
17052 Alameda Dr., Perris, CA 92570-8846
(909) 789-0830 email:nicdlady@deltanet.com FAX: (909)789-4895

CIRCLE 141 ON READER SERVICE CARD

Amplifiers, ATV Down Converters & Hard to Find Parts

LINEAR AMPLIFIERS
HF Amplifiers
PC board and complete parts list for HF amplifiers described in the Motorola Application Notes and Engineering Bulletins:
AN779H (20W) AN 758 (300W)
AN779L (20W) AR313 (300W)
AN 762 (140W) EB27A (300W)
EB63 (140W) EB104 (600W)
AR305 (300W) AR347 (1000W)

2 Meter Amplifiers
(144-148 MHz)
(Kit or Wired and Tested)
35W - Model 335A, $79.95/$109.95
75W - Model 875A, $119.95/$159.95

HARD TO FIND PARTS
• RF Power Transistors
• Broadband HF Transformers
• Chip Caps - Kemet/ATC
• Metalclad Mica Caps - Unelco/Semco
• ARCO/SPRAGUE Trimmer Capacitors
We can get you virtually any RF transistor! Call us for "strange" hard to find parts!
DIGITAL FREQUENCY READOUT
For older analog transceivers
TK-1 (Wired and Tested) $149.95

ATV Down Converters
(Kit or Wired and Tested)
Model ATV-3 (420-450)
(Ga AS - FET) $49.95/$69.95
Model ATV-4 (902-926)
(GaAS - FET) $59.95/$79.95

For detailed information and prices, call or write for our free catalog!

ADDITIONAL ITEMS
Heat Sink Material
Model 99 Heat Sink (6.5" x 12" x 1.6"), $24
CHS-8 Copper Spreader (8 "x 6" x 3/8"), $24
Low Pass Filters (up to 300W) for harmonics $12.95
Specify 10M, 15M, 20M, 40M, 80M or 160M
HF Splitters and Combiners up to 2KW

Phone (937) 426-8600
FAX (937) 429-3811

CCI Communication Concepts Inc.
508 Millstone Drive • Beavercreek, Ohio 45434-5840
e-mail: cci.dayton@pobox.com
www.communication-concepts.com

CIRCLE 99 ON READER SERVICE CARD

THE ORIGINAL WD4BUM
HAM STICK™ ANTENNAS
for HF MOBILE OPERATION
$19⁹⁵ each
The only lightweight HF mobile antenna recommended by noted author Gordon West WB6NOA
• Monobanders for 75 to 6 meters.
• Very rugged fiberglass & stainless steel.
• Telescopes for easy adjustment.
• 3/8 x 24 TPI base fits most mounts.
• Low profile & low wind load.
• Needs no springs or guys.
• Complete tuning & matching instructions included.
• Approximately 7 ft. tall.
• 600 watts.

Cat.#	Band	Cat.#	Band
9175	75 meters	9115	15 meters
9140	40 meters	9112	12 meters
9130	30 meters	9110	10 meters
9120	20 meters	9106	6 meters
9117	17 meters		

NEW !! AT LAST!! NEW
2 METER ANTENNA
NO GROUND REQUIRED
• Boats • 3 Db Gain
• R.V.s • Power rated at 100 watts
• Fiberglass roof vans • NMO base mount
• Plastic cars • Only 40" tall
• Bicycles • 17-7 ph stainless steel whip
• Motorcycles • Adapter and fully adjustable marine mount available.
• Can be used with ground plane • Patent Pending
CAT. # HW-1
$44⁹⁵

NEW LICENSE PLATE MOUNT NEW
• Mounts behind license plate
• Mount is constructed of type 304 Stainless Steel
• Complete with S/S hardware
• For Antenna's with 3/8" x 24 Thread
• Accepts PL-259 Direct
• Ground strap included
• Complete mounting instructions included
100 % MADE IN USA
$44⁹⁵ CAT. #TM-1

Tri-Magnetic Mount
MODEL 375
Only $39⁹⁵
Now with no-rust all stainless steel hardware
• Holds all Hamstick Antennas and many others.
• Over 400# of holding power.
• 12" x 14" foot print.
• 3/8 x 24 thread mounting.
• 15' RG 58 coax w/PL-259.
• No rust aluminum construction.

Lakeview Company, Inc.
3620-9A Whitehall Rd., Anderson, SC 29626 • 864-226-6990
FAX: 864-225-4565 • E Mail: hamstick@hamstick.com • www.hamstick.com
ALL 100% MADE IN USA Add $7 per order for S/H

CIRCLE 275 ON READER SERVICE CARD

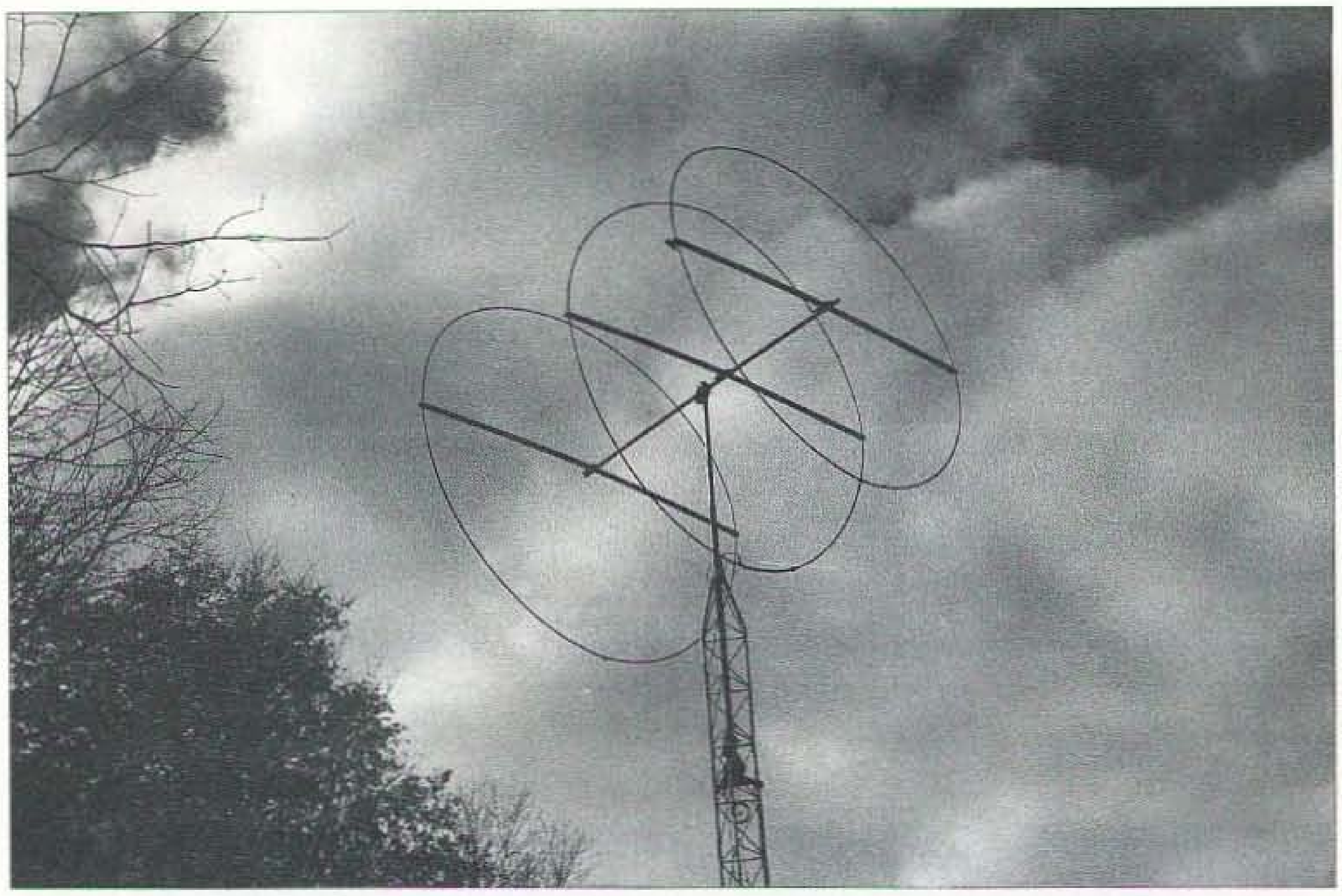


Photo A. K8IHQ's circular quad is an impressive sight.

lug attached to a screw on the flange of the receptacle and the other wire soldered to the center terminal. Now push into the T-coupling opening after applying some clear silicone caulk. Let it set overnight to ensure setup of the caulk. The next day, connect the coax to the element and test it with low power for SWR and frequency centering. Usable bandwidth should be in excess of 400 kHz, with a 1.3:1 or less SWR rising up to 1.7:1 for approximately 800 kHz. Most modern transceivers require the use of an antenna tuner; therefore the antenna will give a 1:1 SWR after tuning over the entire 10 meter band (28.1 through 29.7 MHz). Quads are low Q resonators and therefore have wide bandwidth.

While the driven element is stabilizing, work on the director and reflector elements can be done. Starting with the reflector element, the next four CPVC pipes can be cut to 9 feet 2 inches, which relates to approximately 36.5 feet in circumference or approximately 4% larger than the driven element. Note that the spacing on the boom will be 6 feet, resulting in a 0.17 lambda. This space has been shown to give best results as a reflector element. Again, cut off a 38-foot piece of copper wire and insert and assemble the reflector as was done with the driven element. Ensure that the T-connector is facing outward from the loop so that it will face the ground when hoisted into position. Before gluing this connector, make sure each end of the copper wire comes through the opening. Take each end and wind around the outside of the CPVC tubing as per the detail drawing, i.e., two loops, and cut. This will ensure that nothing bad happens when everything is hoisted into position. Again, the length of the copper wire is not super critical. Allow the opening on the T-connector to remain open (do not close with caulk)—condensation must be able to vent from the tubing.

Next is the director element. Construct it as the reflector element. Cut four CPVC pipes to a length of 8 feet 4 inches each. This will result in a 33.5-foot circumference, again 4% shorter then the driven element. This will be mounted about 4 feet in front of the driven element, which relates to a 0.11 lambda spacing. Terminate the copper wire as was done on the reflector element.

Now that we have the elements made, we must insert the horizontal cross members for boom mounting. These cross members are made of PVC-DWV 1.5" plastic pipe. Take one of the pipes and cut the following pieces: reflector, 18 inches (11 feet 6

Continued on page 25

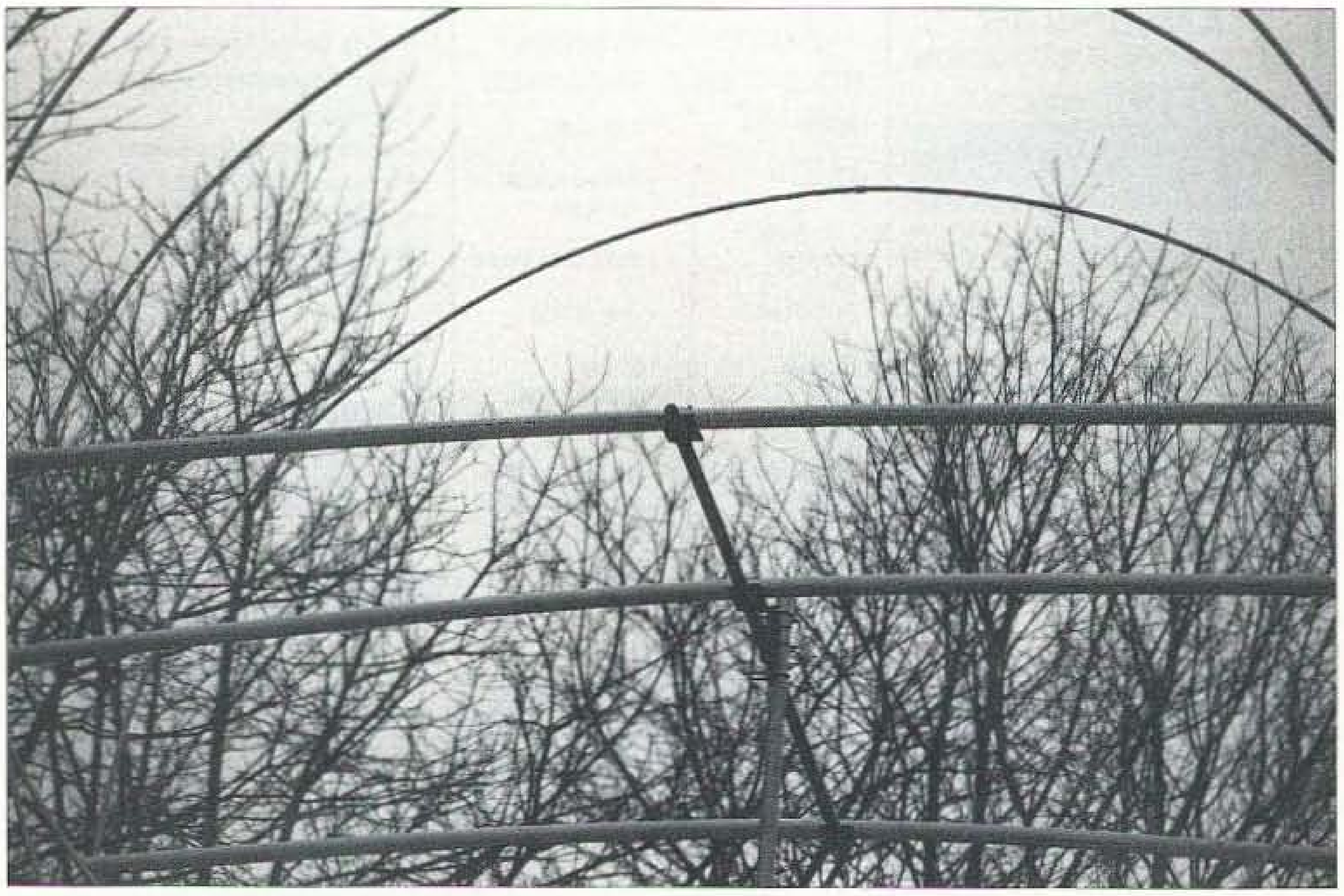


Photo B. Closer view of beam and elements.

Elements	
Reflector	4 x 9 ft. 2 in. pipes (36.5 ft.) — +4%
Driven	4 x 8 ft. 9 in. pipes (35.0 ft.) — 0%
Director	4 x 8 ft. 4 in. pipes (33.5 ft.) — -4%
Cross Members	
Reflector	11 ft. 6 in.
Driven	11 ft. 0 in.
Director	10 ft. 6 in.

Table 2. Lengths.

provided the possibility of good results in the contest.

The details of the contest itself are not really important. However, our most significant objective was to contact someone from the northerly direction—someone in Russia.

Most of the accessible Field Day contesters were from the southeastern Ukraine, because this area contained highly developed industry and larger concentrations of radio amateurs. No one had ever worked our northern neighbor country previously on 2 meters, but we knew that Russian amateurs were also pointing their antennas toward us. Our task was to face one another pattern-to-pattern at just the right time. After several attempts, I found weak CW signals from Russia. As I recall, it was UA3KYB. We had a nice QSO, and after one hour repeated again. It gave us some very good points for the contest. But, most of all, I'm still proud that it was a truly historical moment: the first QSO between Ukraine and Russia on 2 meters had became a reality. It was in June 1970 …

Note: The names of all fellows mentioned here are real, but some callsigns were changed later several times. The club station for our students became UK5LAP and this new callsign took its place in thousands of amateur logs all over the world.

I would like to express my gratitude to my friend David Evison W7DE, for reading and preliminarily editing (in a language sense) this article. 73

Three-Element Circular Quad

continued from page 20

inches) total; driven, 12 inches (11 feet 0 inches) total; and director, six inches (10 feet 6 inches) total.

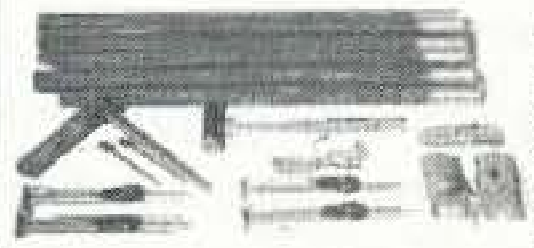
Take these pieces and glue to each additional 10-foot pipe to make the required lengths. Now take a hack saw and cut 0.5"-wide, 2"-deep cuts in the pipe as per the drawing. Pliers can be used to remove the excess to clear the slots. Now place the cross member into each loop. Drill holes into the cross members to accommodate the 1/4" x 3" bolts as per the detail drawing. These slots and bolts will keep the coupling of the element locked into place.

Now drill holes to accommodate the U-bolts per the detail drawing, ensuring that the U- bolt is centered. Next, drill holes into the center of the galvanized plates and insert pipe, bolt, and plate together. Now drill very small holes through the plate and PVC pipe so as to allow a stainless steel sheet metal screw to anchor the plate to the pipe.

Now the element is ready for mounting onto the boom. When all the elements are done, mounting on the boom may take place. I recommend that this be done at ground level. Once the elements are mounted to the boom, again drill small holes at the end of the plates as before and attach two stainless steel screws through the plate and into the galvanized steel boom. Once assembly is completed, connect the coax and test with low power RF. SWR will be 2:1 or a little more while on the ground. The 1.1:1 or better will be seen once the antenna is aloft.

This antenna system did not require very many hours of construction time nor a lot of bucks to obtain 9 dB gain over a dipole system. The DX will hear you very respectfully with just 100 watts. Good DX! 73

30 FT MAST KIT



AB-1244/GRC MAST KIT, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit in-cludes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus 2.5 pound sledge hammer. Part of OE-254/ GRC antenna set; 30 lbs sh. NEW, $139.50

ELECTRON TUBES, JAN-BOXED unused:

4CX300A Eimac,	$35.	1625 Nat. Union,	$4.50
4CX5000J Eimac,	$650.	5998A Sylvania,	$9.95
4D32 Raytheon,	~~$35~~ $28	6146W GE,	$19.95
83 Sylvania,	$9.00	6336B Cetron,	~~$40~~ $30
811A Cetron,	$25.00	7360 ECG,	$15.00

VISA, MASTERCARD or DISCOVER accepted.
Prices F.O.B. Lima, Ohio. Allow for shipping $.
Write for latest Catalog. Address Dept. 73
Phone 419/227-6573 + FAX 419/227-1313
E-mail: fairadio@wcoil.com
Home Page: http://www2.wcoil.com/~fairadio/

FAIR RADIO SALES
1016 E. Eureka P.O. Box 1105 Lima, OH 45802

CIRCLE 75 ON READER SERVICE CARD

MORSE Express
A Division of Milestone Technologies, Inc.

Keys, Bugs and Paddles from around the world!

USA: *Nye Speed-X*
Japan: *Hi-Mound, GHD*
Russia: *Key-8*
Spain: *Llaves TA*
England: *G4ZPY*
Germany: *Schurr*

Also Kits, Books, Tools and Software!

Morse Express
3140 S. Peoria St. K-156
Aurora, CO 80014
(303) 752-3382

FAX: (303) 745-6792
Orders: (800) 752-3382
E-mail: hq@MorseX.com
Web: www.MorseX.com

CIRCLE 136 ON READER SERVICE CARD

208-852-0830 rdc@rossdist.com
http://www.rossdist.com

SPECIAL! Under $1400.00
ICOM HF/6M/2M/440
IC-706MKIIG
RDC
Check Out Our Specials! We're On The Web.
Over 9010 HAM Items in Stock. All Prices Cash FOB Preston
ROSS DISTRIBUTING COMPANY, 78 S. State Street, Preston, ID 83263
Hours Tue.-Fri. 9-6 • 9-2 Mondays. Closed Saturday & Sunday

CIRCLE 254 ON READER SERVICE CARD

DRAKE SW-2

OPTION

The **Drake SW-2** provide continuous coverage from 100 to 30000 kHz in AM, LSB and USB modes. Tuning is easy via manual knob, up-down buttons or 100 memories. The sideband selectable synchronous tuning stabilizes fading signals. Other refinements include: RF gain, tuning bar graphs, huge 100 Hz LED readout, keypad and dimmer. The optional remote (shown) lets you operate this radio from across the room (*Order #1589* $48.95). All Drake receivers are proudly made in Ohio, U.S.A. and feature a one year limited warranty.
Regular Price ~~$489.95~~ **Sale $399.99** (+$7 UPS)

The **Drake SW-1** broadcast receiver also covers 100 to 30000 kHz, but in AM mode only. Features include: 1 kHz LED readout, keypad, RF Gain and 32 memories. Both models operate from 12 VDC or via the supplied AC adapter. A great starter radio!
Regular Price ~~$249.95~~ **Sale $199.99** (+$7 UPS)

universal radio inc.

Universal Radio
6830 Americana Pkwy.
Reynoldsburg, OH 43068
◆ Orders: 800 431-3939
◆ Info: 614 866-4267
◆ FAX: 614 866-2339
www.universal-radio.com

Quality Communications Equipment Since 1942