ATCO NEWSLETTER

VOLUME 6 NUMBER 2 APRIL 1989

WHAT'S NEXT FOR ATCO?

We think the letter we received from Dave, KB2ARL, (see page 8) is worth bringing to your attention. During the past two years ATCO has had three well attended events. These were the September 1987 Antenna Measuring Party, the April 1988 Technical Symposium, and the Hidden Transmitter Hunt last fall.

(continued on next page)

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INSIDE OUR APRIL 1989 ISSUE

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The ATCO Newsletter is the official publication of a group of television amateurs known as "AMATEUR TELEVISION IN CENTRAL OHIO" and is published in January, April, July, and October.

Membership in ATCO is open to any FCC licensed radio amateur who has an interest in amateur television.

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HIGH-DEFINITION ATV (HDATV) - AN EDITORIAL

As radio and TV amateurs, we are always eager and ready to experiment with new developments and ideas concerning our hobby. So why not HDATV? The relocation of the TV industry to foreign countries from the United States has resulted in the loss of many jobs and much money. It is expected that high-definition television will revolutionize both the video and computer industries and will become a multibillion industry by the late 1990's.

Already industry is petitioning our government for research and development funding, and a company in Westerville (Ohio) is on the bandwagon, too. We can expect to see articles appearing soon in technical journals regarding just what the standards and requirements should be.

Digital television techniques offer many well-known advantages. The interface between VCR's, cameras, and computers is another whole area of engineering if any degree of compatibility is to occur.

And the BANDWIDTH required for high-definition television presents a great opportunity to 70 cm ATV operators! Experimenting with HDATV would extend sidebands into the 442-444 MHz portion of the spectrum with greater amplitude. Now, doesn't HDATV sound a little more like fun? Why not "expand" our operation to reserve a little guard band? Experience has proven that ATV operators are losing sound, color, and raster synchronization as well as the use of the 442-444 Mhz portion of the band. (Written by Bill, W8DMR)

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WHAT'S NEXT FOR ATCO?

(continued from page 1)

Thought was given to having another Technical Symposium this year, but the idea generated very little enthusiasm and so it was discarded.

Now we are thinking about getting together and displaying our recently acquired homebrewed or store bought equipment. Would you be interested in such a gathering? We hope so!

ATCO has no elected officers. What happens depends on volunteers! Several members, led by Bill, W8DMR, our technical editor, contribute regularly to the ATCO Newsletter. Bill, WB8URI, and Tom, KA8ZNY, plan and promote our technical and social events. And your editor publishes the newsletter and is Acting Treasurer.

Yes, Dave, we wonder, too!

ATV NEWS ITEMS OF INTEREST

By Bill, W8DMR

AMATEUR TELEVISION QUARTERLY MAGAZINE (ATVQ) - Most ATCO members received a complimentary copy of ATVQ Magazine late last year. The glossy cover and color photos were pleasing to see. The first issue had 60 pages including the front and back covers. Advertisements for PC Electronics appeared on eight pages. The two columns per page format is scheduled to change to a three column format in future issues.

MICROWAVE OVEN ATV TRANSMITTER FOLLOW-UP - On 14 January, ATCO members W8EHW, W8RVH, and WB8URI attended the Indiana UHF and ATV Club meeting in Indianapolis. Pictures of the transmitter were taken, and technical information was received regarding construction details.

CUSTOM VIDEO DISPLAY GENERATOR (VDG) EQUIPMENT REPORT - Bill, W8DMR, has purchased a prototype VDG for use in his ten watt ATV transmitter. It has been installed and now operational. His call letter test pattern has appeared in a few of WB8ELK's Elktronics ads. ATCO wishes Bill, WB8ELK, the VDG designer great success.

MORE 33 CM ACTIVITY REPORTS - Several Central Ohio ATVers are active on the 33 cm frequency. Guy, K8HVA, has swapped P-4 pictures with Lowell, K8PYQ, in Mt. Victory. The distance from Guy's QTH in Plymouth to Lowell's location is about 50 miles. Dick, W8RVH, has also exchanged video with K8PYQ. Dale, WA8KQQ, and Jack, W8VSY continue to test nearly every morning on 33 cm. They meet on 144.34 MHz and then QSY to 144.45 MHz at about 7:45 a.m. to check conditions. Mel, KA8LWR, and Dick, WB8VNC, have 33 cm receive capability.

K8HVA REPORTS ON 5 INCH TV SET - A black and white TV set now being sold by Sun TV will tune both 439 and 910 MHz without modification. Guy says the brand name is Gold Seal and can be purchased for the low price of $34. The model number is HY 5500.

DAYTON HAMVENTION ATVQ WORKSHOP AND SOCIAL - Henry, KB9FO, has announced that an ATV gathering is planned for Friday 28 April at the Travelodge Motel in Dayton from 7 p.m. to 1 a.m. An ATV Homebrew Contest with a first prize of $100 will be featured. Admission is free and refreshments will be provided.

ATV HAM LOSES ANTENNAS DURING RECENT HIGH WINDS - Dick, W8RVH, is currently rebuilding his multielement array for 70 cm. He plans to incorporate two additional antennas on the reverse side of his collinear antenna. Also, antennas for 910 and 1270 MHz will be added.

WANTED! - We need your articles for the July ATCO Newsletter. Deadline is 10 June.

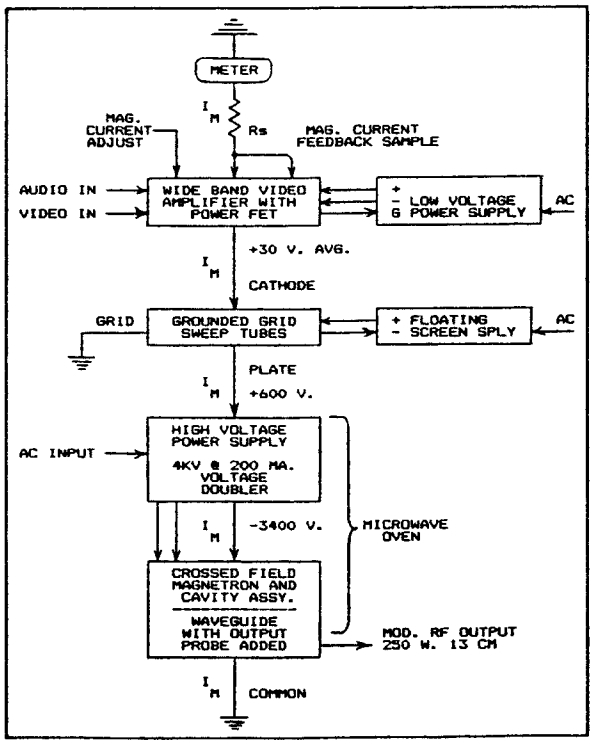
MICROWAVE OVEN ATV TRANSMITTER

GENERAL DESCRIPTION

New microwave ovens can be purchased for about $45 to $85. A typical 450 watt oven delivers about 250 watts of RF at a frequency of 2400 MHz. The addition of a video modulator and some power supply changes will cost less than $199; many of the parts are available at Radio Shack and at hamfests. To receive 13 cm, MDS (multipoint distribution system) downconverters can be utilized with good results and at a very reasonable cost of between $89 and $129. The MDS units include a 20 inch dish antenna with about 40 dB gain, a downconverter that tunes remotely from 1.9 to 2.7 GHz, and a power supply.

A microwave oven magnetron is a self-contained crossed field power oscillator. Built-in cavities primarily determine the oscillation frequency. However, the amount of plate voltage and strength of the magnetic field around the megatron does determine the quiescent operating frequency. The best type of operating mode would be wide band FM video transmission. Experimental tests made by Dave Pacholok[1] indicate that a maximum usable frequency swing is about 20 MHz. The coefficient of frequency change is approximately 0.1 MHz/mA of magnetron current.

As shown in the block diagram, the video modulator is a bit unusual. It functions as a high voltage current source of high open-loop gain that can set the magnetron current to a known value. This establishes the operating frequency and power output.



The unit of transconductance is the siemen (formerly mho). Transconductance is the reciprocal of resistance. For volts in, the modulator provides a current out. It is essentially ohm's law inverted or upside down, mhos = current/voltage. The video modulator has a transconductance of 0.2 siemens.

Enough bandwidth must be provided by the transconductance amplifier to amplify all the video modulation components. And if an audio subcarrier is used, the bandwidth required is 6.0 MHz. A capacitor and a resistor, C6 and R27 (see schematic), are used to extend the high frequency response from approximately 4.5 MHz to 6.0 MHz. A video

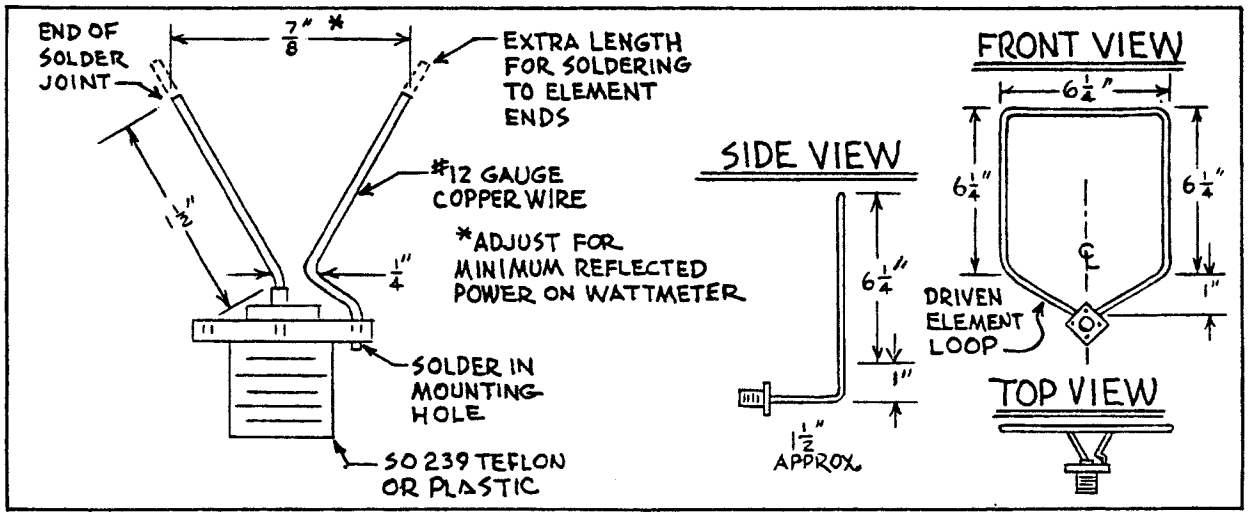
(continued on page 6)

MATCHING A QUAD DRIVEN ELEMENT

This article details the solving of the problem of matching the transmission line to the driven element in an eight element Quagi antenna.

A review of several amateur radio handbooks failed to show that anyone had developed a satisfactory method of matching the quad loop; the bottom line appeared to be "fix with the mismatch."

Many configurations of the matching section shown below were tried. One was found that tuned out all the reflected power as indicated on a Bird wattmeter at both the transmitter and the antenna. My transmitter now tunes and loads properly, and signal reports at 25 to 40 miles are consistently P-2.25 to P-4.5. Goodbye to "ho-hum P-0 and P-1" reports! (Submitted by John, WA8EOY.)



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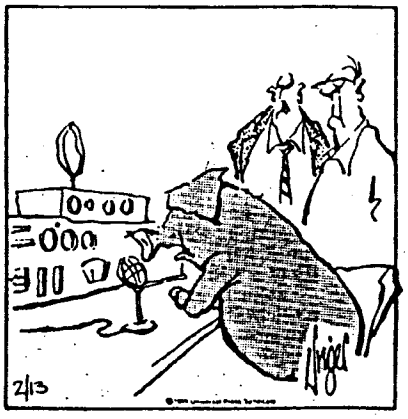
DO YOU. . . ?

P Pay your dues on time?
A Submit ARTICLES for the newsletter?
R RESPOND when asked to assist?
T TALK up ATV to your friends?
I INVITE others to join ATCO?
C COMMUNICATE with other members?
I Suggest new IDEAS?
P PURPOSELY ask questions?
A ATTEND ATCO events?
T TAKE a turn as ATV net control?
E ENCOURAGE membership in ATCO?
..But most of all... PARTICIPATE!



"You never seen a ham operator before?"

(Thanks to ASCI Newsletter, Rancho Cucamonga, CA.)

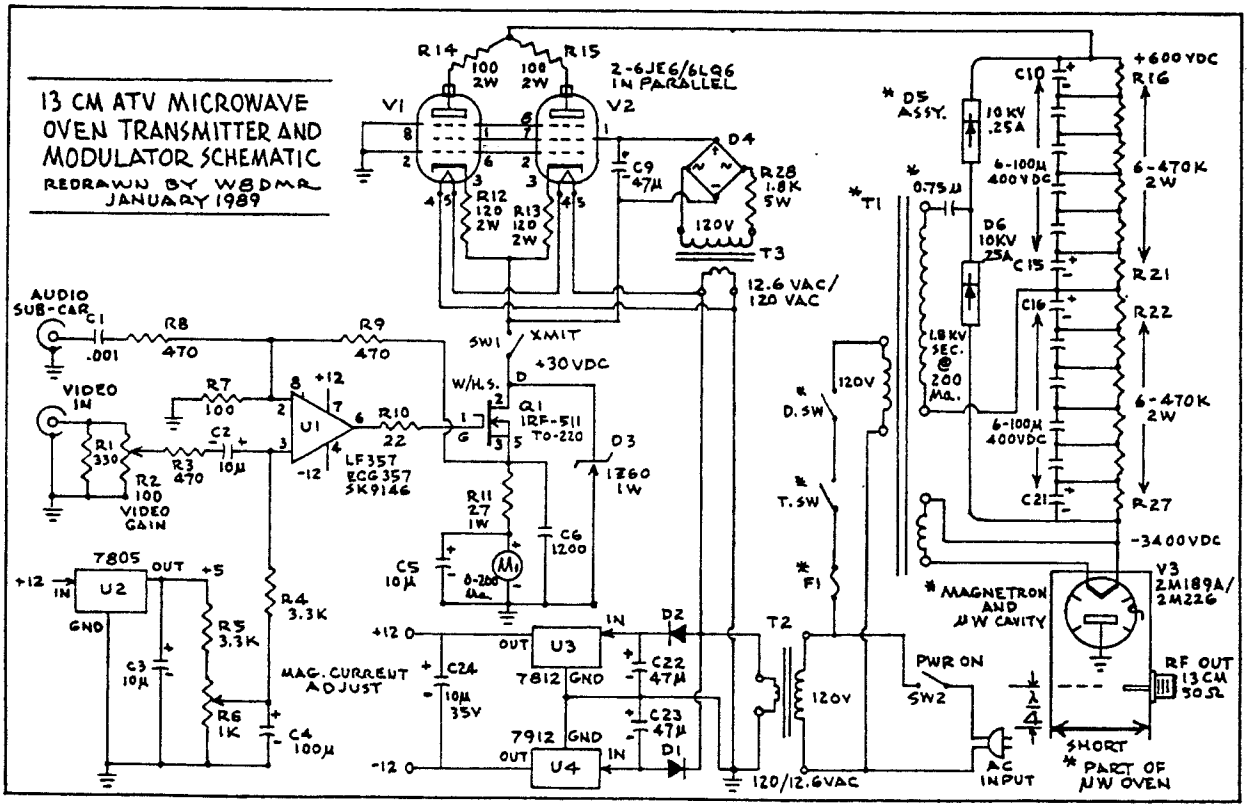
MICROWAVE OVEN ATV TRANSMITTER

(continued from page 4)

pre-emphasis circuit is still required for FM usage.

The screen supply for the two sweep tubes must float above ground. Only the magnetron plate current must be allowed to enter the current source control loop as the controlled variable. The screen current should not be included.

The waveguide circuit must be modified by adding a shorting partition or plate. This is analogous to a 1/2 wave coaxial stub or a 1/4 wave when a reflected path provides twice the distance.



In either case, wave fronts are phase shifted by 180 degrees. The shorting plate causes the reflected wave to be in phase with the incident wave from the magnetron. The E-field probe is inserted where the RF voltage maximum occurs.

Normally, the length of an output probe is 1/4 wave for maximum power output. Shortening the output probe introduces a reactive component to the output port of the magnetron. After an undetermined number of degrees of rotation within the magnetron feed structure, the magnetron cavities cause the operating frequency to be lowered by about 25 MHz. This helps to insure operation on the legal 13 cm band.

(continued on page 7)

MICROWAVE OVEN ATV TRANSMITTER

(continued from page 6)

CIRCUIT DESCRIPTION

The +5 volt regulator U2 provides a voltage reference. It is divided by R5 and R6 and is connected to the noninverting input of wideband op-amp U1 establishing a current reference. The output of U1 feeds the gate of Q1.

The output of source follower Q1 is sent to R9 and through R7 providing negative feedback to the inverting input of U1. The feedback ratio is calculated as follows:

$$\text{Feedback Ratio} = \frac{R9 + R7}{R7} = \frac{470 + 100}{100} = \frac{570}{100} = 5.7$$

At equilibrium, Q1's drain-to-source current produces a drop across R11 that is 5.7 times U1's noninverting input voltage. Pot R6 sets a drain current in Q1 that is proportional to the noninverting input of U1. The plate and cathode current of V1 and V2 in parallel are one and the same if screen current is not considered at this time.

The voltage on the drain of Q1 increases or decreases until the control grid of V1 and V2 changes the cathode bias until Ik = Id = Is. V1 and V2 are a grounded-grid voltage amplifier with unity current gain. V1 and V2 have sufficient current capacity to serve as a current source for the magnetron. Actually, a transconductance amplifier is formed with a high value of 220,000 microsiemens (0.2 siemens). The value can be calculated as follows:

$$S = I/V = \left(\frac{R9 + R7}{R7}\right) \times \left(\frac{1}{R11} + \frac{1}{R9 + R7}\right) = 0.22 \text{ siemen}$$

Transformer T3 provides a nongrounded +100 volt screen supply for V1 and V2. R28 limits the screen dissipation. The screen floats above ground because only the plate current (Ik = Im) should enter the control loop by way of the V1 and V2 cathodes and is the control parameter (less the screen current).

Components R14 and R15 help provide current sharing in V1 and V2. Zener diode D3 protects power FET Q1. Resistors R16 through R27 serve as voltage equalizing as well as bleeder resistors. Regulators U3 and U4 provide +12 and -12 volts for the op-amp. The magnetron current is monitored by meter M1.

(continued on page 9)

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THE ATCO TUESDAY NIGHT NET MEETS EVERY WEEK AT 8 EST AND 9 EDT

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NEW ATCO MEMBERS

We welcome the following:

Bob, KB8BIY; Tommy, KB8ESR; Lowell, K8PYQ; Phil, KA8WEX; and Johnny, KA8ZPF

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BUILD A POWER DIVIDER FOR 33 CM

When connecting two antennas to form an array, the need for sending equal power to each antenna occurs. The illustration at the right of a power divider (also called a power splitter) details how this may be done. The dimensions shown are for 910 MHz.

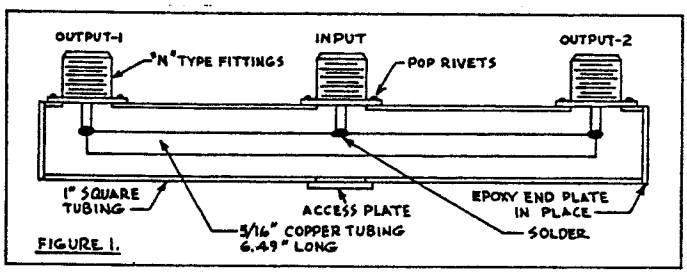

FIGURE 1.

If the need arises to connect two antennas to one receiver, the power divider is then referred to as a combiner. It must be remembered that a splitter/combiner operates properly in the band for which it is designed. (Submitted by Guy, K8HVA.)

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LETTERS TO THE EDITOR

Congratulations on the January 1989 ATCO Newsletter. It has to be the best issue so far.

Thinking ahead for 1989, I can't help but wonder what will be in store for all of us this year. What kind of social events will ATCO unfold? Will we get together and finally put up some kind of ATCO ATV on the air bulletin/test pattern system accessed by 2-meter touch tones on 147.45 MHz? Will we all take our XYL's microwave oven for amateur radio use? It will be interesting to see.

Dave, KB2ARL

- - - -

I have not been on the air lately because my workroom is being revamped. My transmitter has been redone to include a built-in video modulator. I listen a lot, but if I "rag chew" no work gets done. I'll be more active later.

Art, WA8RMC

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MICROWAVE OVEN ATV TRANSMITTER

(continued from page 7)

CONSTRUCTION DETAILS

PARTS LIST

ITEM	QTY.	DESCRIPTION	EST. COST
1.	1 ea.	Microwave Oven, 400-500 watt with 2M189A or 2M226A magnetron	$ 70.00
2.	2 ea.	TV sweep tube, 6JE6C/6LQ6C	24.00
3.	12 ea.	Capacitor, electrolytic, 100 uF/400V	36.00
4.	1 ea.	Diode, high V. rectifier, 10 kV, 250 mA	12.50
5.	12 ea.	Resistors, 470 k ohms, 1 or 2 watt	6.00
6.	1 ea.	Transformer, 12.6 VAC, 3.0 A	8.00
7.	1 ea.	Transformer, 12.6 VAC, 450 mA	4.00
8.	1 ea.	Meter, 0-200 mA, used or surplus	5.00
9.	1 ea.	Connector, N-type, female, chassis mnt	3.00
10.	2 ea.	Connector, F-type, female, chassis mnt	.50
11.	1 ea.	IC, LF357, wideband or op-amp	3.00
12.	1 ea.	IC, regulator, 7812	1.00
13.	1 ea.	IC, regulator, 7912	1.50
14.	1 ea.	IC, regulator, 7805	1.00
15.	1 ea.	Transistor, power FET, IRF-511	2.00
16.	2 ea.	Diode, low V. rectifier, 200 V, 1 A	1.00
17.	1 ea.	Diode, bridge assembly, 400 V, 1 A	2.00
18.	1 ea.	Diode, zener, 68 V, 1 W	2.00
19.	1 ea.	Capacitor, ceramic, 0.001 uF	.50
20.	1 ea.	Capacitor, electro., 10 uF, 25 V	.50
21.	2 ea.	Capacitor, electro., 100 uF, 10 V	1.00
22.	1 ea.	Capacitor, electro., 330 uF, 10 V	.50
23.	1 ea.	Capacitor, poly., 1200 pF, 100 V	.50
24.	1 ea.	Capacitor, ceramic, 0.1 uF, 50 V	.50
25.	2 ea.	Capacitor, electro., 47 uF, 160 V	1.50
26.	2 ea.	Capacitor, electro., 470 uF, 25 V	2.00
27.	1 ea.	Resistor, 390 ohms, 1/4 W	.10
28.	1 ea.	Resistor, 100 ohms, variablle, panel mount	2.00
29.	3 ea.	Resistor, 470 ohms, 1/4 W	.30
30.	2 ea.	Resistor, 3.3 k ohms, 1/4 W	.20
31.	1 ea.	Resistor, 1.0 k ohms, variable, PC board	1.00
32.	1 ea.	Resistor, 100 ohms, 1/4 W	.10
33.	1 ea.	Resistor, 22 ohms, 1/4 W, 5%	.10
34.	1 ea.	Resistor, 27 ohms, 1.0 W, 5%	.25
35.	2 ea.	Resistor, 120 ohms, 1.0 W, 5%	.50
36.	2 ea.	Resistor, 100 ohms, 1.0 W. 5%	.50
37.	2 ea.	Resistor, 470 ohms, 1.0 W. 5%	.50
38.	1 ea.	Switch, power, 125 VAC, 0.5 A	2.00
ESTIMATED TOTAL			$197.05

Inside the microwave oven cooking chamber, it is necessary to remove the radome (food splatter cover). Remove the dielectric RF energy dispersal unit (stirrer), also. Next, the feed guide to the multimode cavity Z-matching plate is removed. The matching plate is removed by cutting or sawing.

The magnetron cooling air is discharged into the oven chamber. If the video modulator tubes are mounted inside this chamber, they too are then cooled.

Retention of the oven door and interlock switches provides a safe way to disable the high voltage whenever the oven door is opened. The outer cabinet cover further increases safety and is drilled to accept and allow the output N-connector to exit when the cover is later reinstalled.

Depending on the brand and model of microwave oven that is to be modified, the following general information applies:

1. Inside the oven, cut off the wave guide that connects to the cooking cavity matching flange.

2. A wave guide shorting cover needs to be fabricated to cover the feed port to the oven chamber. The size of this port is typically about 1-1/2 by 3-1/2 inches. A piece of 18-22 gauge copper approximately 3 x 5 inches will do nicely. Drill 16 to 20 holes around the outer edge for mounting holes, and an equal number of matching holes will need to be drilled around the open

(continued on page 10)

MICROWAVE OVEN ATV TRANSMITTER

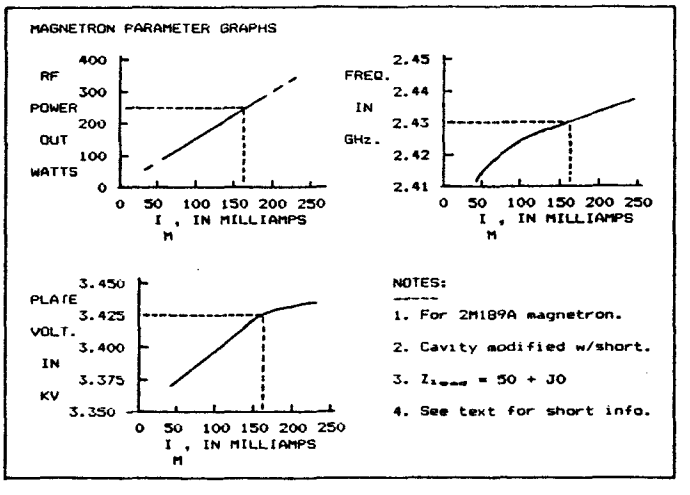
(continued from page 9)

wave guide port in the oven. Sheet metal screws or machine screws with nuts will provide a good shorting partition for the open wave guide end.

3. An E-field probe needs to be constructed. Using an N-connector, solder a piece of 5/8 inch long brass tubing with a 0.175 inch diameter to the N-connector. Next, solder a brass nut to the other end of the brass tubing and insert a 1/2 inch brass screw into the nut. This forms a tuning adjustment for the probe. Have the screw fully inserted and snug tight.

4. A hole must be made in the wave guide to accept the probe. The hole is placed in the top of the wave guide from outside the oven and mounts 1-5/16 inches from where the wave guide cavity shorting partition was added. Also, it should be centered in the wave guide.

5. The filament leads of the magnetron are by-passed by feedthru capacitors. The ground side of each feedthru capacitor must be opened. The capacitors are about 2000 pF and are white oval shaped ceramic. By drilling out four rivets, the ground is removed. Simply push the capacitors back into the tube housing 1/8 inch or so. Care must be taken not to damage the insulation on the filament wiring.



SAFETY CONSIDERATIONS

Radiant energy above a certain level can be harmful. Use an inexpensive microwave leakage detector to verify the safety of the finished ATV transmitter. Readings in the unsafe or red zone from any surface of the transmitter indicate a leak that must be corrected.

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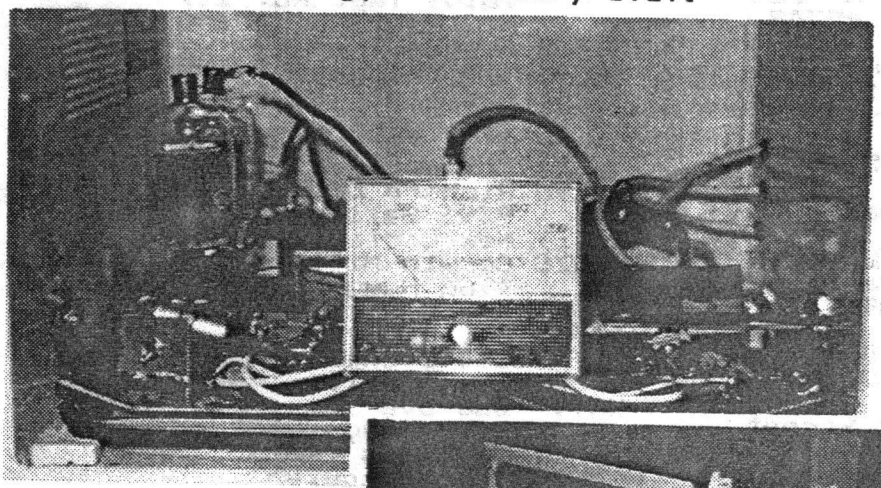
MICROWAVE OVEN ATV TRANSMITTER

(continued from page 10)

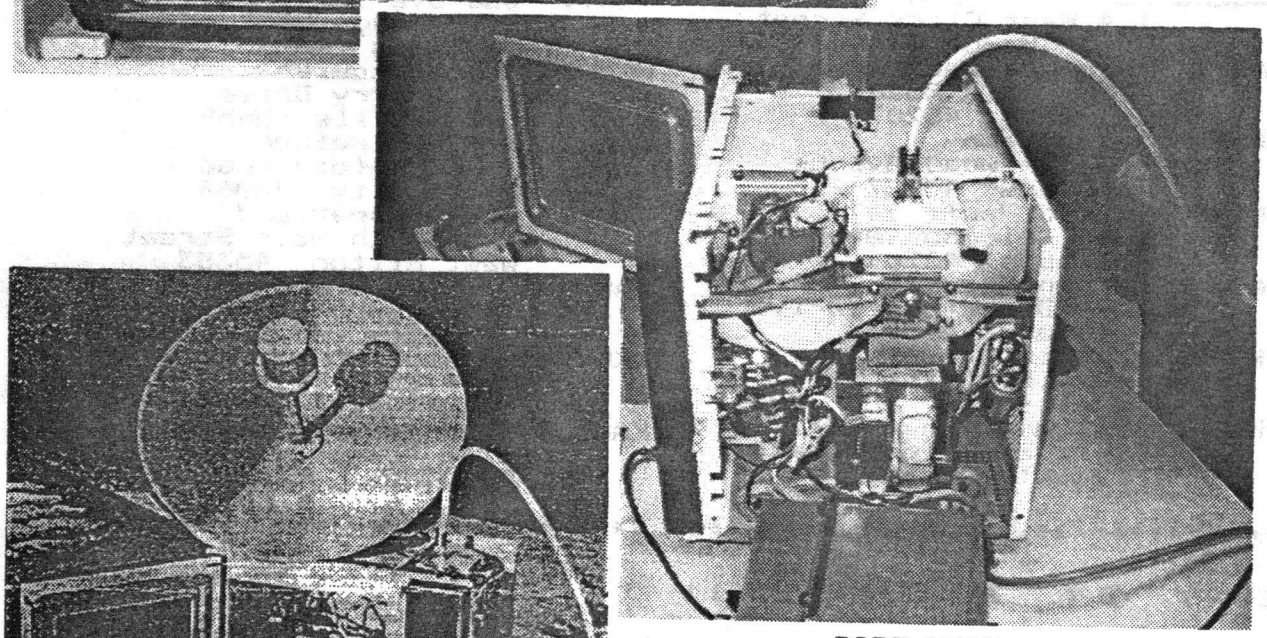
Do not point a microwave antenna emitting RF power levels in the class of this transmitter at people, pets, buildings, or residential areas. Use common sense! Currently, a level of more than five mW per square centimeter at 2400 MHz is considered hazardous. (Submitted by Bill, W8DMR.)

REFERENCES

1. RF Design Magazine, Design Award, Dave Pacholok, pp. 24-25, July 1988.
2. Microwave Oven ATV Transmitter by Dave Pacholok, Indiana UHF and ATV Meeting, 14 January 1989.



MODULATOR
(WB8URI photo)



SIDE VIEW
(WB8URI photo)

PACHOLOK'S MICROWAVE OVEN ATV XMTR²

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WB8URI William Heiden
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WA8WEX Phil Hardman
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K8YAH Ronald Vanke
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Westerville 43081

KA8ZPF Johnny Camm
1267 Arkwood Avenue
Columbus 43227

****

SAY IT ISN'T SO!

According to the New York Times, a television monitor capable of displaying the vivid movie-quality images associated with high-definition television still costs $60,000.

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INVITE A HAM FRIEND TO JOIN ATCO

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ATCO FINANCIAL STATEMENT

CASH BALANCE:
As of 31 December 1988.....$363.78

RECEIPTS:
Dues.....$190.00

EXPENDITURES:

Printing charges for January 1989 ATCO Newsletter....	$ 44.84
Postage for January 1989 ATCO Newsletter.....	19.80
Misc. costs incidental to publication of newsletter..	15.64
Total expenditures.....	$ 80.28

SUMMARY:

Cash Balance as of 31 December 1988.....	$363.78
Receipts.....	190.00
Expenditures.....	-80.28
Balance as of 31 March 1989.....	$473.50

The above financial report was prepared as of 31 March 1989 by Warren G. Duemmel, KA8GZQ, Acting ATCO Treasurer.

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OUR CONTRIBUTORS

Thanks to the following ATCO members for articles appearing in this issue of our newsletter!

John, WA8EOY - "Matching a Quad Driven Element." Guy, K8HVA - "Build a Power Divider for 33 cm." Bill, W8DMR - "Microwave Oven ATV Transmitter," "High Definition ATV," and "ATV News Items of Interest."

The cartoon on page 5 was sent to us by Art, WA8RMC.

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MORE ATV NEWS ITEMS OF INTEREST

ATCO NEWSLETTER TECHNICAL EDITOR SAYS NO THANK YOU! - Bill, W8DMR, has declined Spec-Com Magazine's invitation to present a program at their Dayton Hamvention Work Shop and a similar invitation from ATVQ Magazine to speak at an ATV Forum in York, Pennsylvania. He has also said no to an offer to be Spec-Com's Senior Technical Editor.

W8AER REPLACES COAX ON 23 cm CABLE - A factory made splice caused Dave's coax cable to pull apart at the top of his tower. New RG-59U and F-fittings solved the problem.

MICROWAVE OVEN ATV TRANSMITTER PROGRAM - Dave Pacholok is scheduled to show and demonstrate his microwave oven transmitter on Saturday 29 April during the Dayton Hamvention ATV Forum.

WB8URI 23 cm TRANSMITTER PROJECT - Bill is putting together a MOPA as outlined on page seven of the October 1988 ATCO Newsletter and will place it in his ham shack. Later he plans to add another mast-mounted power amplifier similar to what WA8EOY has.

****

Editor: Warren, KA8GZQ
Technical Editor: Bill, W8DMR

FIRST CLASS MAIL

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c/o Warren G. Duemmel
3488 Darbyshire Drive
Hilliard, Ohio 43026

ATCO NEWSLETTER

CONVERT AN
INEXPENSIVE
MICROWAVE OVEN
INTO AN ATV XMTR

ARTICLE BEGINS ON PAGE 4.