Repeater List

MAY 1978

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ARRL

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1978

PAARA GRAPHS

palo alto
AMATEUR
RADIO ASSN.

MENLO PARK C.D. RADIO CLUB, K6YQT

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PAARAgraphs is the official organ of the PALO ALTO AMATEUR RADIO ASSOCIATION and the MENLO PARK CIVIL DEFENSE RADIO CLUB

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Contributions to: WA6OFN 875 Sunset DRive San Carlos CA 94070

The MAY MEETING OF PAARA is on Friday, May 5, 7:30 PM at the Menlo Park Recreation Center. Refreshments are free! Prizes, you bet! Come one, come all!

Bob Miller WA6MTY of the Bay Area Amateur TV Society will talk about the ATV repeater in the 70-cm band now in operation. A video tape demonstration will be given. This should be an interesting talk.

* * * * * * * * *

PAARA'S BOARD OF DIRECTORS will meet the usual following Wednesday, May 10, in the repairable thing at SRI.

PAARA will continue to meet on the first Friday of the month, i.e., June 2, July 7, August 4, etc.

Check into one of PAARA'S NETS: 2 meter AM 145.24 at 8:15 PM, followed by FM 147.45 at 8:30 PM, every Monday night; 15 or 20 meter net SSB is at 9 AM on alternate Saturdays at 21.393 or 14.245 (contact W6NIR for more info).

FIELD DAY REPORT (Chairman, Fred K6YT). We will have a 10 meter phone station in addition to others. We have 10, 15, and 20 meter beams, but we need towers!

FOR SALE: NCX-5, Mark II, RCVR, $300 (excellent condn.) by Ed Clark W6KJI. New ICOM xtals for ICOM 22A, 21, etc., 147.45/.45, $10 by Gerry W6NIR.

WANTED: to borrow or buy Manual for Hallicrafters SX28 RCVR, David Lin N6WN, Lenkurt Radio Amateur Club, call 595-3000x769.

STARQUEST: Search for extraterrestial intelligence by amateur radio operators, 1900 GMT, 14.280 mc SSB, 1st. Sunday of the month.

HAM AUCTION: Foothill, May 6.

ROSTER ADDITIONS: John Arnold WA6YSY, 550 Morse Ave., SV 94086, 737-0123. Ralph B. Ryan WB6NNL, 1021 Stanley Way, PA 94303, no phone. Ken A. Thomas K6GDH, 628 Greer Lane, PA 94303, 326-7701.

ROSTER CORRECTIONS: Laxson W6OPA. Cruts WB6JST. Walther K6PKT. Callander WA6SZX. Ice K6CMT. Shabatura WB6NDS.

FAA TRIP: A visit to the FAA Flight Control Center in Fremont is in the offing. Details at the meeting.

CONSTRUCTION

Chuck Clark, K4ZN

Antenna tuners

#5 in a series

You have probably noticed the subscription blank that appears in each issue of Worldradio. (It's on page 11 of this issue.) Subscribers often take advantage of the space provided to say what they like and don't like, and what they want to see. Of course it's impossible for the staff to answer every note with a personal letter and still have time to publish, and the cost would be too great. But the notes are all read and used to try to give you what you want.

Mike Parsons, W7ICX ("retired, long on time, short on dough"), wrote: "Am interested in an antenna tuner from old BC and TV parts." And so this month we'll address the problem of antenna tuners.

Old-timers like Mike and I can't see what's so terribly wrong about calling the things antenna tuners. That's what everybody used to call them back when we got our first tickets. But these days there are purists who object that the things don't really tune the antenna at all, and usually aren't even directly connected to the antenna but to the transmission line, and merely match the line to the transmitter. Still, the term antenna tuner is short and simple, and does convey the idea that if you twiddle the dials properly you can adjust the antenna circuit to resonance and make it take power.

Is a matching network needed?

So, to pacify the purists, let's call it a matching network. Do we need one? If the transmission line is matched to the antenna, and the feed impedance is on the order of 50 to 75 ohms, as when a coaxial line is used to feed a dipole or inverted vee, or to feed a properly matched Yagi or quad, you can connect the line directly to the output of your transmitter and should have no problems.

But there's one hitch here. The line will usually be matched to the antenna at only one frequency, and so the SWR (VSWR for those who prefer the expression) will rise as you tune away from that frequency. A matching network will be needed if the voltage standing wave ratio rises above what the transmitter can handle.

In most cases you'll need one if you want to cover the whole 80-meter band with most any antenna, or the 20-meter band with a beam, unless your transmitter is designed to work with widely varying loads. Otherwise it's unnecessary, and actually reduces the efficiency of the antenna system because the matching network absorbs power that otherwise would have gone to the antenna and have been radiated.

There is much misinformation going around the amateur bands about SWR. There are good reasons for keeping it low, but some reasons offered are not so good. And at times there can be good reasons for keeping it high.

It is true that transmission-line losses are least when the standing wave ratio is 1:1. But with reasonably short and well-constructed lines on high frequencies, the losses are usually so low that the increase due to SWR is negligible. If 490 of the 500 watts your transmitter puts out actually reach the antenna with a perfect match, and only 475 when you have a mismatch, is the 15 watts worth worrying about?

TV stations have had to be concerned about SWR because reflections on the transmission line can cause ghosts in the picture. On VHF most any line is long enough that the losses are significant, and so get worse as the SWR rises. But for amateurs on the HF bands the usual reason why a low SWR is important is that many modern transmitters won't accept anything else.

Some rigs will load anything from a wet string to a full-sized rhombic, but most manufacturers these days economize by specifying a standard load and designing the transmitter to match that, usually 50 ohms resistive, leaving it to the user to install any additional network needed to match anything else. Some rigs, to make things worse, use transistors in the output stage which are not adequately protected against mismatched loads. The excessive voltages or currents caused by mismatched loads can ruin the transistors, and occasionally a high-power amplifier designed too economically can have coils burn up or capacitors break down when the circuits are not loaded heavily enough.

Is SWR important?

The misinformation mentioned above is the myth that SWR means lost power, that the energy reflected from a mismatch is wasted, is used up in heating the output coil and transmission line, or comes back and damages the rig. The reflected energy is not wasted any more than is the energy going out to the antenna, for the resistance of the line is the same in both directions.

And yet, despite many articles in *QST* and elsewhere, amateurs continue to want low SWR for the wrong reason. Not only on the air, but in print too. Denver Tolle, W9EBT, on page 56 of December 1977 WR, gives some examples. WR does not claim to be a technical publication, but you will find examples in technical manuals too.

The following statement is excerpted from a training manual used by the U.S. military: "This power, which is not being coupled to the antenna, is dissipated in the final amplifier tank circuit in the transmission line, resulting in heat and inefficient operation."

The paragraph is a bit confused, and the author might have gotten away with being reproached for vagueness, except that he adds an example:

"Let us assume that the input impedance of an antenna is 300 ohms and that it is fed by a transmission line whose characteristic impedance is 75 ohms. This line is perfectly matched to a transmitter's output impedance of 75 ohms, and the power output is 100 watts. . . Neglecting transmission line losses, 36 watts will return to the transmitter output terminals and subtract from the original 100 watts, leaving only 64 watts as the actual amount of useful power available from the transmitter."

Stupid! First of all, the line will not present a resistive 75-ohm load to the transmitter. The load could be anywhere from 18.75 ohms to 300 ohms depending on the length of the line, and if it's anywhere in between these values it will be a reactive load. So there will necessarily be a mismatch between the transmitter and the line.

Secondly, as a result of the mismatch, the energy reflected from the antenna mismatch will return to the transmitter end and be reflected once again and go back to the antenna. So, neglecting transmission-line losses, the full 100 watts from the transmitter will reach the antenna and be radiated.

It was a bit of a shock to find an inaccurate statement like that in a book intended to train electronic technicians in our military services.

Properly speaking, one shouldn't use the term reflected *power* at all. We tend to be careless in our use of the words power and energy.

Power is the rate at which energy is delivered. Energy being passed back and forth on a transmission line is not being delivered, and so should not be called power.

Our domestic electric bills are for energy, not for power. Some large users pay an additional charge for power, called the *demand* charge, based on the highest power used during the month, but for most of us the bill is the same whether we burn a 100-watt bulb for one hour or a 10-watt bulb for 10 hours. We use 100 watt-hours of energy, even though the power in one case is 10 times that in the other.

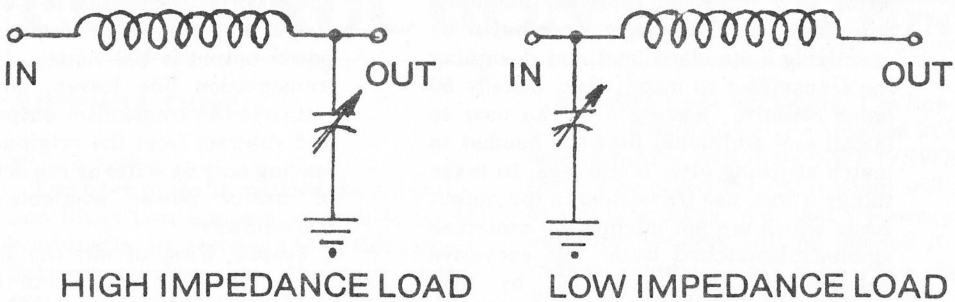


Figure 1

For a state-of-the-art tune-up procedure, you wouldn't need to put a signal on the air at all. Instead, use a noise bridge, like the one made by Palomar Engineers, or like the one described in February 1977 *Ham Radio*, page 10.

You measure the resistance and reactance of the load at the transmitter end of the line, design a suitable network to convert it to what the transmitter wants to see, and insert it into the line. The formulas for calculating the network's values are not complicated, but they rarely appear in amateur publications. There's not enough space to give them here, but I'll send a copy to anyone who sends an SASE to me at Route 3, Box 800, Moncks Corner, SC 29461.

L network

Any load of any impedance can be matched to the output of a transmitter by one of the two networks shown in Figure 1. The network to use depends on whether the load has a higher or lower impedance than the transmitter output. The general rule is that the capacitor goes on the high-impedance side.

Harry R. Hyder, W7IV, described a simple unit in May 1974 *Ham Radio* page 54. He used an E.F. Johnson 229-202 rotary inductor and a five-gang variable capacitor used in World War II direction-finding receivers, 420 pF per section.

One could use most any variable inductor capable of taking the power. The Johnson unit has a maximum inductance of 18 microhenries. With the capacitor, it is capable of matching a line operating with a 5:1 SWR to a 50-ohm output of a transmitter on 80 meters, and can handle most any mismatch on higher frequencies.

Harry added two switches to the circuit of Figure 1, one to shift the capacitor to either side of the coil and one to make it possible to use either one section of the capacitor with 420 pF maximum, or all five with 2100 pF maximum. A similar circuit is shown in Figure 2. You might try substituting a taped coil with a switch for the variable inductor, and you need not have that large a capacitor if you arrange to switch in mica capacitors (large ones if you're running high power) to increase the maximum capacitance.

The pi network

Variable inductors are rather expensive in the larger sizes, and the L network also must be reversed when going from a high to a low impedance load. For some loads, either the coil or capacitor may be a size that is not mechanically feasible, and so for **greater flexibility one can use the pi network.**

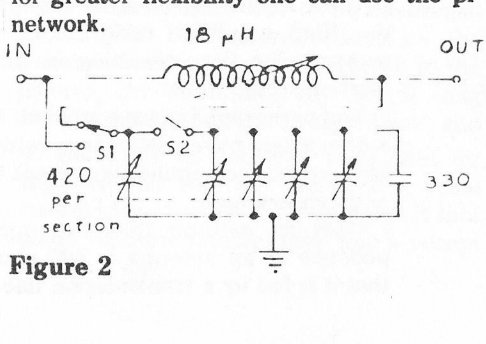


Figure 2

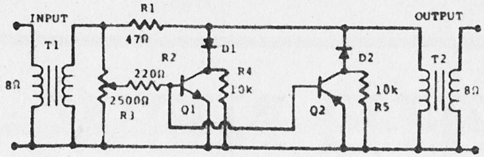
Dummies (*Ed. note* — You rang?)

Every amateur station has a dummy. There are two kinds. One is a resistance that can be used to dissipate the output power of the transmitter, making it possible to tune up without putting a signal on the air. The other is the operator who treats other amateurs to squawks and whistles as he tunes up with full power into the antenna, makes no effort to pick an unused frequency, and takes his own sweet time trying to squeeze every last milliwatt out of his rig.

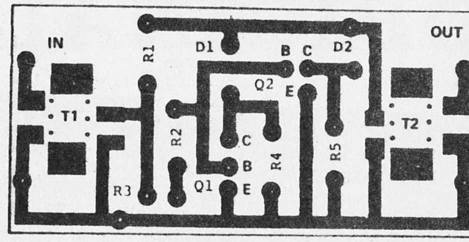
Even with a dummy antenna you can put out a signal, though, as this writer learned about 40 years ago. While still waiting for his license to arrive, he was listening on 80 meters one day, when just for fun, he answered the CQ of Abe Marantz, W8SWE, using his transmitter, running 10 watts to a type 45 tube, without any antenna. Surprise! Abe came back, so I had to go on with the QSO. I got a 579 report, and Abe lived a mile away too.

Even if you have a dummy antenna, though, you have to apply power to the antenna system to tune it up, at least most of us do. But you don't need the transmitter's full output for that. One should always use the least possible amount of power out of consideration for others. And try to spot your carrier where it will cause the least trouble, ordinarily on the same frequency as someone else's when using SSB. Nobody will hear it there.

— Worldradio, April 1978



Circuit diagram



PC board etching

Audio-powered noise clipper

(for AM and CW signals)

Harry Raykes, WB4AYO

Parts list

T1, T2	Archer (Radio Shack) 723-1379, 600-8 ohm
Q1	2N2222, HEP55, Archer RS-2009, NPN
Q2	2N22907, HEP52, Archer RS-2023, PNP
D1, D2	1N270

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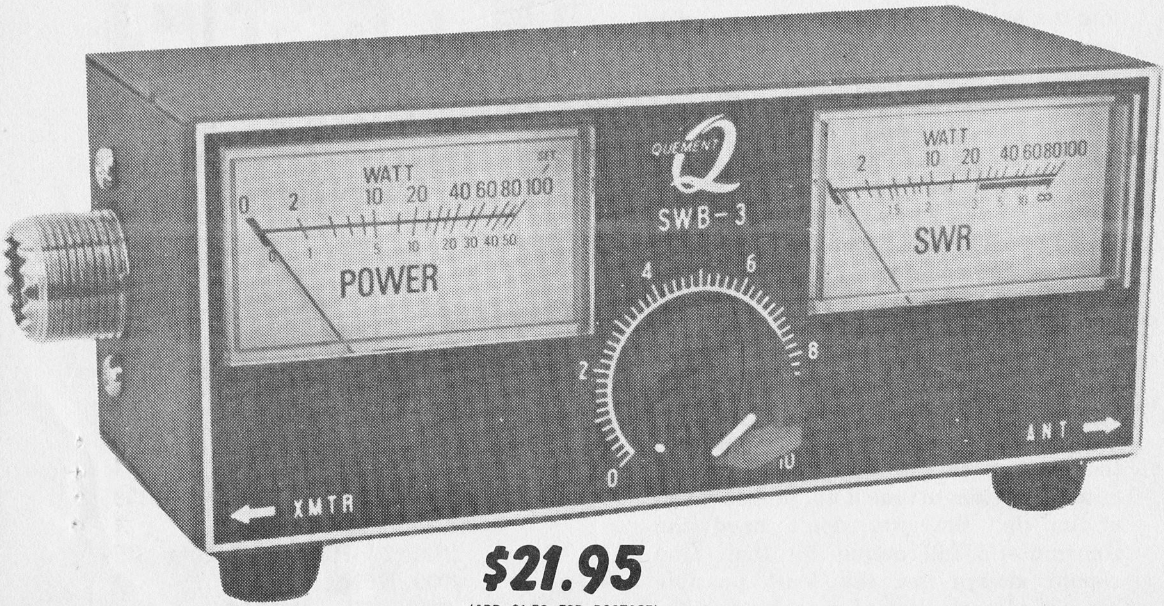

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