FEEDBACK

The OFFICIAL Newsletter of the
Georgian Bay Amateur Radio Club Inc.

Sponsoring
VE3OSR FM REPEATER 146.940- OWEN SOUND
VE3IJD PACKET BBS 145.630 KEADY

April 1997

REGULAR EVENTS

GBARC MEETINGS: 4th Tuesday of each month at the Owen Sound Yatch Club 7:30 P.M.
BREAKFAST MEETINGS: 2nd and last Saturday of each month at the Rockford Esso , 9:30 A.M.
GBARC INFORMATION: Information regarding membership should be directed to VE3NEM Tom Merner RR#4 Owen Sound, N4K5N6 371-0655
FEEDBACK: Submissions or letters to the editor should be directed to VE3TSA Tom St.Amand, 1232 3rd Ave . East, Owen Sound N4K2L5

MINUTES OF THE GBARC MEETING MARCH 25,1997

The meeting was opened by Bob VE3XOX with the reading of the February minutes. A motion to accept the was moved by John VA3JRF and seconded by Jack VE3TWK and passed. Tom VE3NEM reported that Dave VE3DXO has audited the financial statements for the club. The current balance is approximately fifteen hundred dollars and a financial report will be posted in a future feedback. The club repeater licenses had been renewed for the three callsigns held by the club. Tom VE3NEM will be the license holder for the club. Carl VE3BY gave the membership a review of the recent a.p.r.s. packet reporting system meeting in Kincardine.

Bob VE3XOX informed the membership that the monthly meetings will now be held at the Georgian Yacht Club in Owen Sound. The meetings will be at the same time and dates. The cost for this meeting room is one hundred dollars per year. Jack VE3TWK introduced Joe VA3JNA to the membership. Joe recently passed the club course and received his callsign. Brad VE3RHJ reported to the group that fifteen of eighteen persons taking the course have passed with the other three yet to write. Brad will be donating a extra course manual to the Owen Sound library. Tom VE3TSA informed the membership that the hobbymarket will be June 14th at Notre Dame school in Owen Sound. Tom indicated that admission will be four dollars and tables will be ten dollars. Donations for the charity auction are requested.

Bob VE3XOX informed the group that it would be possible to link the osr repeater with Walkerton. A general discussion of the possible repeater set-ups was held and a motion to purchase a new antenna and feedline for the osr repeater was moved by Jim VA3CJM and seconded by Marv VA3ACI and passed. A nominating committee for the new executive was created. Gary VE3IOD and Tom VE3NEM will be contacting members. A plaque committee was created to review any suggestions or nominations for listing on the club plaque. The committee will be Jack VE3TWK and Joe VA3JNA and they should be contacted if you would care to see any members name added to this plaque. The 1997 field day will be held at John VA3JRF's place on June 28th and 29th. The meeting was moved for adjournment by Tom VE3NEM and seconded by John VA3JRF . The 50/50 draw was won by Jim VA3JVO .....minutes by Norm VE3NBJ

New Meeting Place - Owen sound Yatch Club

GBARC AMATEUR OF THE YEAR

VE3TXB

John Apsitis

Congratulations to John VE3TXB as the recipient of the coveted GBARC Amateur of the Year Award. Many thanks John for your many contributions to the club, not the least of which, is the many photographs you have taken of club activities over the years. Thanks again

Tom VE3TSA (left) shown presenting John with the GBARC Amateur of the Year Award

V.H.F. Antenna Facts and Fallacies

Part III — The How and Why of Matching Devices

BY EDWARD P. TILTON,* W1HDQ

As we have seen, there is a wide variety of antennas and transmission lines available. Feed lines most often used are of three impedance values, roughly 50, 72 and 300 ohms. Lines may be bought in 90-, 150- and 200-ohm types also, though these are not often used in amateur work. Lines classified as "300-ohm open-wire" are more often 400 to 450 ohms actual impedance. Homemade open-wire lines are usually 400 ohms or more, some being as much as 600. You can determine the impedance of your line from simple data in the *Antenna Book*.

It would be nice to know the impedance of the antenna, but this is subject to so many variations that it is seldom possible to put a very precise value on the impedance our line will have to work into. Some kind of adjustable matching device is, therefore, a very useful tool. Matching may take many forms, as any reader of antenna literature knows, but all perform the same basic functions. They are supposed to act as impedance transformation devices, so that the transmission lines will "see" impedances similar to their own regardless of what the actual antenna impedance may be.

Matching may be combined with other functions, such as conversion from an unbalanced line (coax) to a balanced load (center-fed antenna element). The balanced to unbalanced conversion, or vice versa, may be built into the matching system, or done with a separate component. In either case, the thing that does the job is usually called a *balun*. Details of the balun construction were given in Part II. (Incidentally, for such a simple word, this one is perhaps the most misspelled and manhandled in all radio talk.)

Matching also may be teamed up with phasing of the bays of large arrays, and the matching system may serve still another purpose: that of tuning the antenna or phasing system to resonance, as well as matching it to the transmission line. We'll get to examples of all these methods shortly, but first a little more about what we're going to do with them.

* V.H.F. Editor, *QST*.

About Antenna Impedance

This was discussed briefly in Part I, but to review, a half-wave dipole in free space has an impedance of about 72 ohms. When the dipole is close to ground, or objects that simulate ground, its impedance changes. In the first half wavelength from the ground up, the impedance swings from a few ohms near ground, through the free-space value near 0.25 wavelength to as much as 100 ohms at 0.3 wavelength, and then back to 72 ohms at the half-wave point. Beyond here it drops off to 60 ohms and rises through 72 ohms again to nearly 85 ohms, then drops back to 72 again at one wavelength. The effect of ground on impedance becomes relatively insignificant beyond two wavelengths, but it can be seen that in situations most hams encounter in putting up antennas the impedance of a dipole is anything but a sure thing.

Ground is only one factor. Adding parasitic elements drops the impedance, but how much is anyone's guess, especially in arrays with both reflector and director elements. Length, diameter and spacing of these elements can effect great changes in the impedance of the driven element, to the point where it is almost impossible to predict what the feed impedance of a Yagi array will be. The best course, then, is to make the antenna first, determine its impedance by experiment, and then make a matching device to fit the requirements. If we can make a reasonable guess at the impedance, we can make an adjustable matching device of small range that will do the job.

If our antenna is just a half-wave dipole, Fig. 1A and B, we can assume 72 ohms, knowing that it cannot vary much more than 30 ohms either way. Adding a reflector will bring the impedance down — to 40 or 50 ohms, on the average. Putting on directors will lower it further, to something around 20 ohms. All these are for the fed point of the split dipole, A. At the center of a dipole that is unbroken, Fig. 1B, the r.f. voltage between the element and ground is zero. This point can thus be grounded, as in all-metal arrays, and the impedance matched by tapping the line out on the element in various ways.

R.f. voltage and impedance at the ends of half-wave elements are very high. So is the feed impedance of two dipoles fed in phase at their inner element ends, Fig. 1C, the simplest collinear array. The feed impedance of an "H" array of four half-waves in phase is somewhere around 600 ohms. The popular v.h.f. collinear 16-element array (8 halfwaves in phase as in Fig. 5, but with reflectors) gets down to around 200 ohms — *maybe*! Remember that there are modifying factors, including that of coupling between elements, but 200 ohms is a good starting point for setting up a matching system for this type of array.

All these assumptions are valid approximations only for the frequency at which the system is resonant. If the array is out of tune all bets are off. We then must have some means of tuning the system before we can match it.

Common Matching Methods

We will not describe all kinds of matching systems, but will consider only those commonly used in v.h.f. work, or those that should get more attention. First there is the *delta* or *Y-match*, Fig. 2A. Here the transmission line is fanned out and tapped onto the driven element at points equidistant from the center. The taps can be adjusted until an impedance match is achieved, and then fastened permanently in place. One of the first impedance-matching devices ever employed, it still has its merits, not the least of which is simplicity. Chief fault is the likelihood of some radiation from the fanned-out portion of

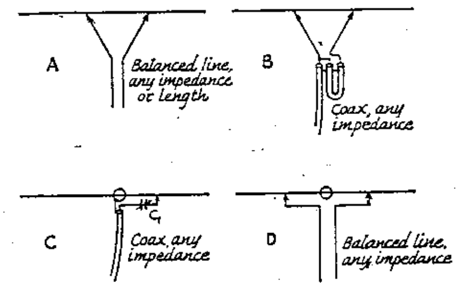


Fig. 2—The transmission line and antenna impedances may be matched by tapping the feedline out on the dipole in various ways. The delta or Y-match is shown at A. A variation for coaxial feed, using a balun, is given at B. The gamma match, C, is popular where coax feed is used. The T-match, D, may be fed with balanced line, or through a balun as in the case of B.

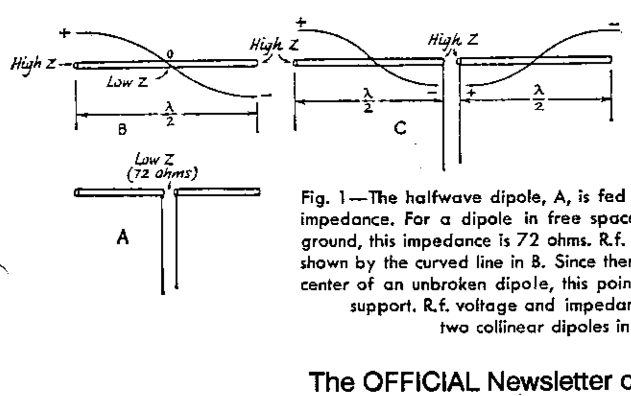


Fig. 1—The halfwave dipole, A, is fed at its center, the point of lowest impedance. For a dipole in free space, and at certain heights above ground, this impedance is 72 ohms. R.f. voltage on a halfwave dipole is shown by the curved line in B. Since there is no voltage to ground at the center of an unbroken dipole, this point can be grounded to the metal support. R.f. voltage and impedance are high at the ends of two collinear dipoles in phase, as at C.

the line. It is also quite frequency-sensitive.

The delta works well with a balun made of coax, or an antenna coupler of some kind. A coaxial balun connected at the base of the delta is shown at B. If this is made of 72-ohm coax there could be a 300-ohm line of any convenient length between the balun and the delta. Adjustment is very easy when the delta is combined with coax feed. You merely insert an s.w.r. bridge in the coaxial line near the balun and adjust the delta spread for zero reflected power. If the balun or balanced line is connected directly to the delta as shown in Fig. 2A and B, the lines can be of any impedances commonly available.

Variations of the tapping-out idea are seen in the *gamma* and *T-match*, *C* and *D* of Fig. 2. The gamma is fine for coaxial feed, while the T is most often used with balanced line. A balun and coaxial feed could be used with the T, of course, just as with the delta. The series capacitor, C_1, is used to tune out the inductive reactance of the gamma arm. Without it the gamma system cannot be made to work perfectly, as a slight unbalance is always present. The gamma arm is usually made of tubing of about the size of the driven element, and a sliding clip is used between the two, to facilitate adjustment. The capacitor can be at either end of the arm.

Once the proper value is found for C_1 it can be removed and a fixed capacitor substituted. An assumed value for your line can be taken, and only the point of connection of the arm made adjustable. Suitable fixed values for 50 ohms are as follows: 50 Mc. — 65 pf., 144 Mc. — 20 pf., 220 Mc. — 15 pf., 432 Mc. — 8 pf.

Strictly speaking, series capacitors should be used with the T system too, but since omitting them does not upset the balance of the dipole, as it would with the one-sided gamma, they are not always used.

One of the most commonly-used matching devices is the *folded dipole*, shown in various forms in Fig. 3. When a single conductor is bent around as shown at A, the impedance seen by the transmission line is quadrupled. Thus a folded dipole made from one size of conductor throughout has an impedance of 4 × 72, or 288 ohms, and it can be fed with 300-ohm line, or with a balun and 72-ohm coax, without appreciable mismatch. The dipole element can be made from a piece of Twin-Lead, with each outer end shorted and one conductor broken at the midpoint, for connecting the transmission line. This is a convenient arrangement for temporary or indoor use.

Additional impedance step-up can be obtained by making the unbroken portion of the dipole of larger cross-section than the fed portion, as at 3B. This is widely used in parasitic arrays, where the impedance of a split dipole would be less than 72 ohms. Impedance step-up depends on the ratio of conductor sizes, and the spacing between the conductors. Information on this is given in chart form in the *Antenna Book*. The practical limit of step-up is of the order of 15 to 1.

A problem with folded dipoles is that one must know the impedance to be matched in order to make the system work properly. Educated guesses suggested earlier may come close enough for most practical purposes. For example, if we assume the feed impedance of a Yagi array to be 20 ohms we can use a folded dipole with a 15-to-1 step-up as the driven element, and feed the array with 300-ohm line. The mismatch will be slight, even if the dipole impedance turns out to be 15 ohms, or 25 ohms, instead of 20. The s.w.r. will be only about 1.2 to 1 in either case. We could use a 10-to-1 dipole and 50-ohm coax with a balun equally well.

The folded dipole is easy to make, and it is somewhat more frequency tolerant than some other matching systems. It is very useful in stacked-Yagi arrays having open-wire phasing systems. Here a fairly high value of dipole impedance is desirable, but the exact value is not particularly important, as matching to the main transmission line will be taken care of where it connects to the phasing system.

A quarter wavelength of transmission line has the property of acting as a matching transformer between two different impedances. Such a transformer is called a "*Q*" section, and an example is shown in Fig. 3C. Here a 300-ohm folded dipole is matched to a 500-ohm line by using a "Q" section whose impedance is equal to the square root of the product of the two impedances to be matched. A 375-ohm section is required here, but the principle may be applied to many v.h.f. matching problems. The impedance obtainable with various conductor sizes and spacings is given in chart form in the *Handbook* and *Antenna Book*. Our 375-ohm transformer could be two No. 10 wires 1¼ inches apart, or two ¼-inch rods 2¾ inches apart, to show two typical examples.

An adjustable "Q" section is a convenient way of matching impedances that are known only approximately. Two ¼-inch rods can be made to provide impedances from 210 to 400 ohms, by varying their spacing from ¾ to 3 inches. The system can be used to step up or down, and it may be used with coaxial conductors as well. There will be examples of this later.

Probably the most useful device of all is the universal stub of Fig. 3D. Because the matching stub must be a half wavelength or more to start with, it is cumbersome at 50 Mc. and lower, but it is ideal for 144-Mc. and higher bands. No impedances need be known to utilize it, and within limits the system to be matched does not even have to be resonant. The short on th[illegible] section is adjusted to tune the system to be [illegible]d, and then the transmission line is tapped onto the stub at the matching point. The load can be any impedance, and the stub can be any convenient wire or tubing size, and any spacing. The feed line can be coaxial or balanced, any impedance. A balun is used with coax, as shown in the sketch. The shorting bar can be grounded, and the unused portion of the stub cut off, once adjustment is completed.

Two variables are involved, which complicates the adjustment procedure a bit, but with a standing-wave bridge in the line the job is quite simple. You merely move the position of the short and the point of connection of the transmission line until zero reflected power is indicated on the s.w.r. bridge. It will be recalled that this principle was used in the open-wire experiments detailed in Part II.

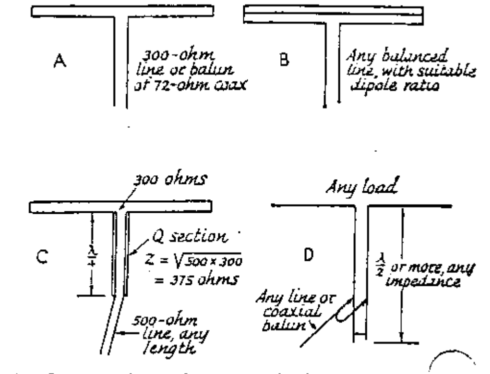


Fig. 3—A single conductor may be bent as at A to [illegible] a folded dipole, giving an impedance four times that of a simple split dipole. It may thus be fed with 300-ohm balanced line, or 72-ohm coax and a balun. Higher impedance step-up can be achieved by making the unbroken portion of the dipole of a larger conductor, as at B. A quarter-wavelength matching transformer, or Q section, is shown at C. A matching device that is useful for any balanced load is the universal stub, D. The transmission line can be coax or balanced line, any impedance.

Using the S.W.R. Bridge

Coaxial feed is recommended, if only for the reason that it permits easy monitoring of the matching process. You merely connect a standing-wave bridge in the coaxial line and adjust the matching device for lowest possible reflected power. This should be zero, or very close to it. All that is left then to make your antenna radiate effectively is to adjust the coupling at the transmitter for maximum forward power on the bridge meter. Note that you do *not* adjust the matching device for maximum forward power; you adjust for *zero* reflected. The forward-power indication is meaningless unless the reflected is zero.

Where the bridge is inserted in the line is important. Many hams are happy about their antenna systems because a bridge connected in the line at the transmitter output shows zero

...ected power, but they may be in a fool's paradise. If the transmission line is long in terms of wavelength, and lossy (all coaxial lines are lossy enough to throw us off) the line may, in effect, be self-terminating. That is to say you can have the world's worst mismatch at the end of a 100-foot run of RG-8 on 432 Mc. and you'll never know it if the bridge is connected at the transmitter. Try a direct short on the end of your line, or disconnect the antenna entirely, and see how little difference it makes on *your* line. The bridge must be connected at or near the antenna, when making matching adjustments.

There is no way to adjust an antenna properly without a bridge. Repeat — *no way*! Don't try to do without one, for it is probably the most important instrument you can own. It need not be fancy or "commercial." A very simple unit was described by the writer in September, 1961, *QST*.[1] It works well from 50 through 450 Mc., and it costs only a few dollars to make. Its meter is rigged up so that it is available for other transmitter test jobs as well.

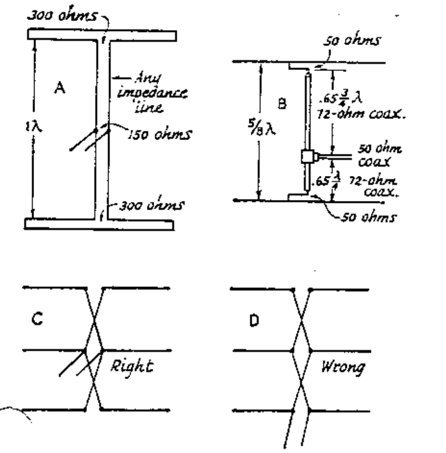


Fig. 4—In phasing bays of a stacked array, any impedance can be used for the connecting line, if it is a half wavelength or multiple thereof from the feed point to each of the driven elements. The feed impedance is half that of either bay, when two are connected as shown at A. A combination phasing and matching system for 50-ohm antennas is shown at B. Coaxial sections electrically ¼ and ¾ wavelength long, of 72-ohm coax, joined at a T fitting to a 50-ohm line. The bays are spaced ⅝ wavelength apart, though this is not particularly critical, so long as the lines are the correct length. In arrays with large numbers of driven elements it is important to feed at the center of the system, as at C, rather than at the top, or bottom, as at D.

Feeding Stacked and Phased Arrays

If individual bays of a stacked array are properly designed they will look like resistors to the matching system that connects them up. If a phasing line is a half wavelength or any multiple thereof, the impedance connected at one end is repeated at every half-wave point. Thus, in Fig. 4A our two 300-ohm dipoles are effectively in parallel at the feed point, and the impedance to be matched there is 150 ohms. (It will be slightly less than that, due to coupling between the dipoles, but we can ignore this for all practical purposes, at the 1-wavelength spacing shown.) The impedance will be near 150 ohms so long as there is a half wavelength or multiple thereof on both sides of the feed point.

So we see that if we have two Yagis that are designed for 300-ohm feed we can space them one wavelength apart, connect them with balanced line of any kind, and the impedance at the midpoint will always be near 150 ohms, regardless of the impedance of the line connecting them. This is important to remember in making up a phasing harness for a stacked array. Since open-wire phasing lines are short in terms of wavelength, we need not worry about their losses, so any convenient type of line may be used if the *electrical* length is right.

The velocity factor of the line has to be taken into account here, and it is wise to make a resonance check on any phasing line system, to be sure that it is resonant in the middle of the range the antenna is to work over. This can be done very readily with a dip-meter, as outlined in Part II, whether the line is Twin-Lead, open-wire or coax. A half wavelength of line is resonant with both ends open or shorted, though both-ends-shorted is usually more convenient for a dip test. A quarter wavelength is resonant with one end shorted and the other open. Resonances can be found for the various odd harmonics, also. That is, a quarter wavelength of line at 144 Mc. is very close to three-quarters of a wavelength at 432 Mc., and often may be used for either frequency. Matching sections requiring quarter-wave lines can be any *odd* multiple thereof. Half-wave lines can be *any* multiple of a half wavelength. Due to variations in velocity factor and the loading effects of terminations, lines cannot be measured off by theory only and be entirely accurate. Better make the dip check and be sure!

The impedance transformation property of quarter-wave lines can be employed in combined matching and phasing systems. An example is that of two 50-ohm loads matched to a 50-ohm line, as shown in Fig. 4B. The phasing system is, in effect, two "Q" sections, one a quarter wavelength and the other three quarters. Made from 72-ohm coax, such a phasing and matching system works out very nicely for bays that should be electrically one wavelength apart, but mechanically only ⅝ wavelength. Coaxial phasing lines may be wrapped around a metal support, or otherwise coiled up if too long mechanically for the job at hand. (You might want to put two halos or dipoles only a half wavelength apart, for example.)

In arrays having several bays, it is important to feed the system at its center, so that current distribution may be the same to all parts of the system. Fig. 4C is favored over 4D on this account, and the principle is even more important with larger numbers of driven elements. No more than 8 driven elements should be connected to one line terminal. A curtain of 12 driven elements should be broken up into two sets of 6 each. Even the familiar 8 half waves in phase, usually connected as shown in Fig. 5A, may be broken up advantageously as shown in 5B. Note that the latter enables the builder to make his entire driven system out of four pieces of wire or rod stock.

Lazy-Man Method

The thought of making matching adjustments at the top of a tower is often a bit staggering to the budding big-antenna enthusiast. Fortunately, such a high-wire act is not really necessary, but there are right and wrong ways to do the job on the ground. We've already mentioned the effect of ground on antenna impedance, so it is easy to see that matching adjustments made close to the ground could easily be quite a bit off when the array is boosted to 60 or 70 feet up. Furthermore, with a high-gain beam objects quite some distance out in front of the array may reflect enough energy back into the antenna so that an appreciable reflected-power indication results.

The solution to this problem is obvious, but not too many antenna workers seem to think of it: aim the beam straight up, with the reflectors close to ground. The writer has adjusted several stacked beams that way, including a 66-element, 220-Mc. stacked-Yagi system,[2] and it works every time.

How Important is Matching?

Due mainly to over-exposure to the term, a good many hams tend to worship perfect matching. To have a 1-to-1 s.w.r. is the ultimate achievement, for them. But is it so very important? Not necessarily! It depends on what you're going to do. An s.w.r. of 2:1 won't kill you with losses. In fact, a 100-foot line of RG-8 coax at 144 Mc. will have its loss increased by less than 0.5 decibel with a 2:1 s.w.r. compared to a perfectly-matched line. If the loading on the transmiter is adjusted properly and the line is trimmed for length, if necessary, a listener at a distant point would not be able to tell the difference. Note that this line trimming is to achieve a resonant condition and proper loading. *It does not affect the s.w.r.*!

Mismatch is important in some ways, and it can tell you things about your antenna system. Make a frequency run, measuring s.w.r. at 144, 144.5, 145, 145.5, 146 and so on. If your s.w.r. dips to near 1:1 at 147 Mc., and is 3:1 at 144, you need some work on your array. You're almost sure to be getting less than top performance at the low end, and if you're the typical 2-meter DXer that's not good. But if 2:1 is as

[1] "Two-Band Station for the V.H.F. Beginner," Part III, September, 1961, *QST*. This issue is sold out, but reprints of the entire series of four articles are available from ARRL Headquarters for 50 cents per set.

[2] "A 66-Element Stacked-Yagi 220-Mc. Array," January 1959 *QST*.

low as you can get, and it is around the frequency you work most often, you don't need to worry too much if the transmitter loads satisfactorily.

With high power a high s.w.r. runs you into the danger of flash-over of the line, but this doesn't happen very often in v.h.f. circles, at least with any coax worth using.

Exact matching *is* important in making measurements of antenna performance. If you would learn anything from attempted gain measurements you have to know *exactly* how much power you're putting into the antenna, or at least you have to know that you're using the same power every time. Forward-power readings with the usual s.w.r. bridge are useless for antenna evaluation purposes, unless the system is perfectly matched. This means adjusting for *zero* reflected power, every time a comparison or measurement is made.

The writer is convinced that much of the conflicting evidence reported in articles on antennas over the years has resulted from a lack of understanding of the importance of this precaution. Just putting up a field-strength meter and then pruning the elements or adjusting their spacing for maximum meter reading may result in your having a fairly good antenna, but it is a wholly unreliable way to make measurements. If you find the element lengths and spacings recommended in much of the literature on antennas confusing, failure to keep the radiated power constant, or inability to determine it accurately, may well be at the bottom of most of the inconsistencies.

So we come to the end of an involved discussion of v.h.f. antenna, transmission line and matching problems. The technically well-informed reader will have found little really new here, but we hope that the rest, who may be long on ambition but short on experience, will have been encouraged to try to improve the performance of their v.h.f. beams. There is more to the antenna game than going out and buying a Golden Super-Twelve, hooking it to a TV line, and then hoping for the best. The watts you save may be your own, and in ham radio at least, it's what's up *top* that counts! QST

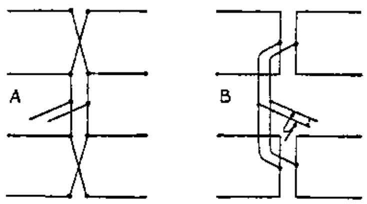
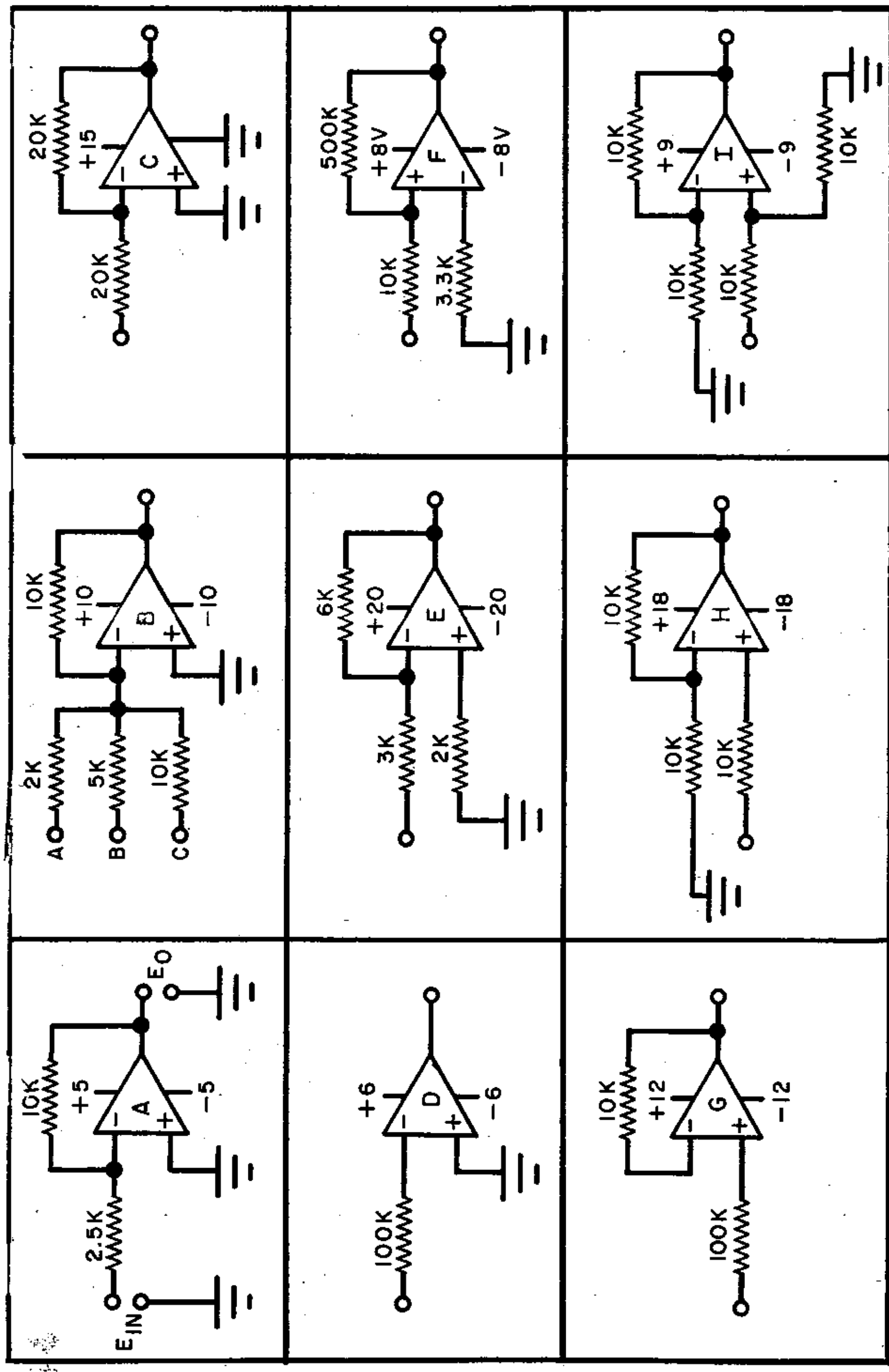


Fig. 5—In phasing large arrays no more than 8 elements should be connected to one line terminal, as at A. Even with 8 half waves in phase, it may be desirable to break the system up into two parts, as at B, joining their midpoints with a phasing line. The phasing harness so used should be a half wavelength or multiple thereof each side of the main feed point. The universal stub, Fig. 2D, is very usefull for feeding such a system.

OPERATIONAL AMPLIFIER QUIZ

BY WILLIAM E. PARKER

Assume each of these circuits is an ideal op amp and each input is +1.0 volt dc. Determine the output voltages.

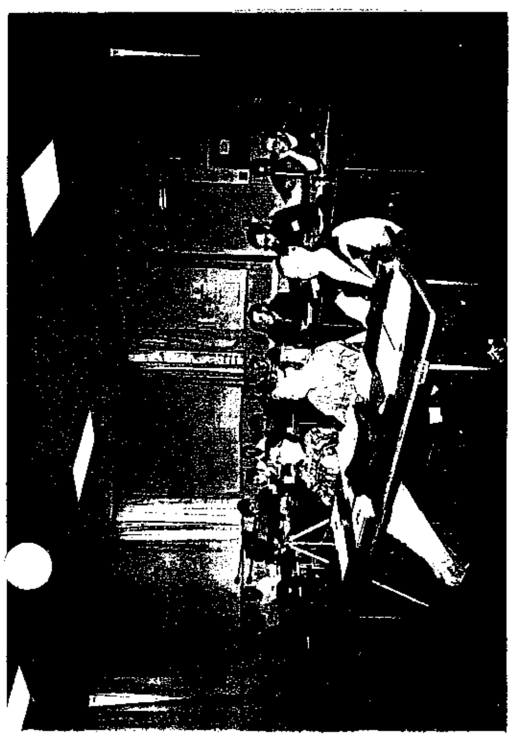


Answers A: –4; B: –8; C: 0; D: –6; E: –2; F: +8; G: +1; H: +2; I: +1;

Radio Course 1997

Here are a few photo's of the 1997 radio course held at the Kilsyth Community Centre.

Photo's by John TXB



Communications/Electronics

HobbyMarket

Sponsored by:

The Georgian Bay Amateur Radio Club - Owen Sound
The Bruce Amateur Radio Club - Kincardine
The Port Elgin Amateur Radio Club - Port Elgin

Dear Fellow Radio Amateur,

The Owen Sound, Kincardine and Port Elgin Amateur Radio Clubs are pleased to invite you to attend the 1997 Communications and Electronics Hobbymarket. We would ask that you consider supporting the market by signing up as a vendor. Last years market was a great success in large part due to the support of our local radio amateurs joining us as vendors.

This years market will be held on Saturday June 14th 1997 at the Notre Dame School in Owen Sound, Ontario. This is an ideal opportunity to display, sell and advertise items you have. It is also a great time to meet with fellow amateur radio operators in the Georgian Bay, Lake Huron district. Old friends and new.

The Market includes a Charity Auction with the proceeds donated to the Canadian National Institute for the Blind (Amateur radio program). Any items which you would like to donate to this worthwhile cause, would be greatly appreciated. For information about the Charity Auction please contact Jack Seaman at 519-371-4493.

We look forward to you attending this event as one of our vendors by filling out the attached vendor agreement form. ***Should you have any questions please contact VE3TSA Tom St.Amand at 519-371-9805 after 6:30 P.M.*** ***SEE YOU AT THE MARKET !!***

14th June 1997 Notre Dame School Gymnasium, 885 25th St East