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PHASING UNIT DESIGN MODIFICATIONS

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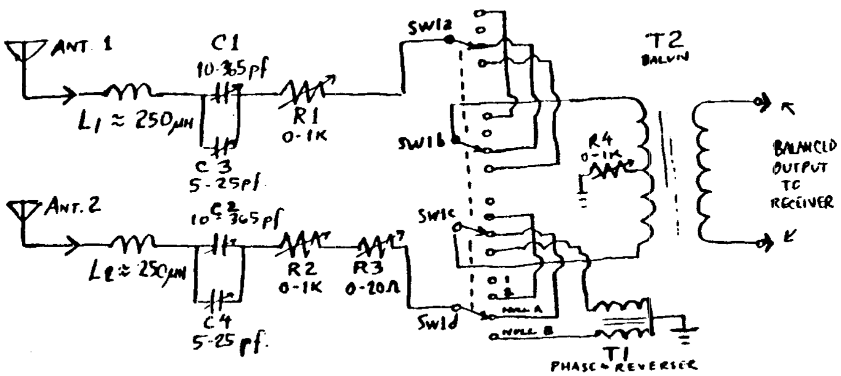
This article is presented for two purposes: (1) to improve upon existing designs of phasing units presently in use by several active international DXers. (2) to serve as a prelude to an upcoming phasing-unit construction article. The construction article to be released soon will also deal with a new concept, Amplified Phased Shortwires.

DXers who have used phasing units in recent years include Chuck Hutton, Nick Hall-Patch, Bill Bailey, Neil Kazaross, Gordon Nelson, and Mark Connelly. Most of the units in use have a schematic similar to that of Figure 1.

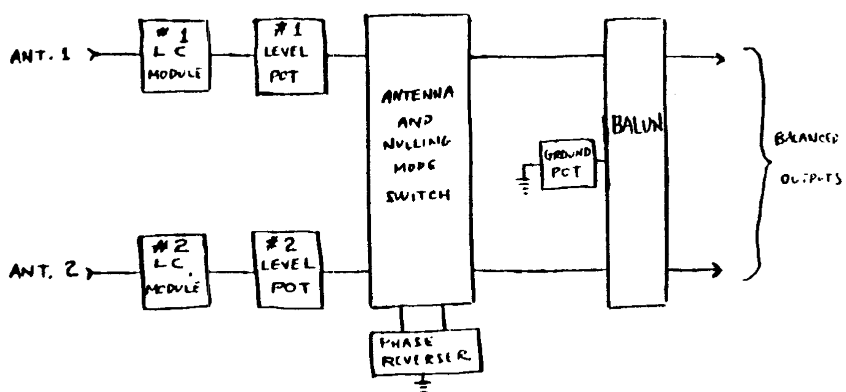
<u>Figure 1</u> a conventional phasing unit



The phase-reversing transformer and the balun are wound on toroidal cores such as J. W. Miller #F-125-1, F-87-1, or T-106-2.

Coil winding details will be supplied in a subsequent construction article.

<u>Figure 2</u> block diagram of conventional phasing unit



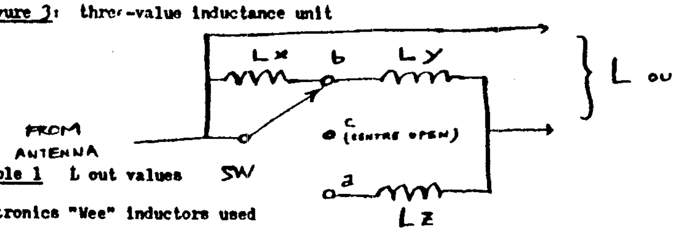
Nulling (using the unit of Figures 1 & 2) is accomplished by the following procedure: (1) initialise by setting all pots to zero ohms. (2) with antenna 1 switched in, peak the antenna 1 main tuning capacitor, C1, for maximum composite signal on the frequency of interest (3) with antenna 2 switched in, peak the antenna 2 main tuning capacitor, C2, for maximum composite (i. e. interfering signal to be nulled mixed with desired station signal) signal (4) switch between antenna 1 & antenna 2; note which switch position produces the strongest level of the <u>undesired</u> (interfering) station (5) switch to "null a" mode. (6) adjust the series potentiometer on the line which had produced the stronger "pest station" signal. (7) if a dip, or point on the pot where a distinct drop in signal occurs with a rise in level on either side of that point, is attainable, set the pot at that dip point and finely tune the main & vernier capacitors (C1,C2, C3, C4) and the ground resistor R4 for further dipping until the best null is achieved (8) if satisfactory nulling could not be obtained in steps 6 & 7, re-iterate steps 1 through 4 and then switch to "null b" (9) re-do steps 6 & 7 (in the "null b" mode).

<u>Some shortcomings of conventional phasing unit design</u>

(a) The series L-C "modules" each consisting of a 250 uH inductor in series with the parallel main (10-365 pf.) and trim (5-25 pf.) capacitors seem inadequate to peak-tune wires with lengths less than 30 metres. This problem is most acute on the lower frequencies, 520 - 900 kHz.

A two-pronged approach to this problem turned out to be most advantageous. The first step is to make a switchable 3-value inductance unit for each antenna line. Three inductors and a SPDT (centre-open position) switch are used in each of the two L-units.

<u>Figure 3</u>: three-value inductance unit



<u>Table 1</u> L out values

Nytronics "Wee" inductors used

L values, uH			L out , uH		
Lx	Ly	Lz	switch pos.: a Lz//(Lx+Ly)	b Ly	c Lx+Ly
390	220	100	86	220	610
470	270	120	103	270	740
560	270	120	105	270	830

J.W. Miller video-peaking type inductors used

L values, uH			L out , uH		
Lx	Ly	Lz	switch pos.: a Lz//(Lx+Ly)	b Ly	c Lx+Ly
420	200	100	86	200	620
470	250	120	103	250	720
550	275	120	105	275	825

J. W. Miller part #'s

L, uH	#
100	6112
120	6153
200	6154
250	6173
275	6130
420	6136
470	6138
550	6144

The Q of the coils listed in Table 1 is somewhat below that of the shielded can-type antenna coils used by Gordon Nelson and Chuck Hutton, but only a very slight decrease in tuning sharpness & signal transfer occurs. The small size of the coils used makes them ideal to be connected in a switched multiple L-value arrangement. The phasing unit's tuning range is extended considerably by this scheme.

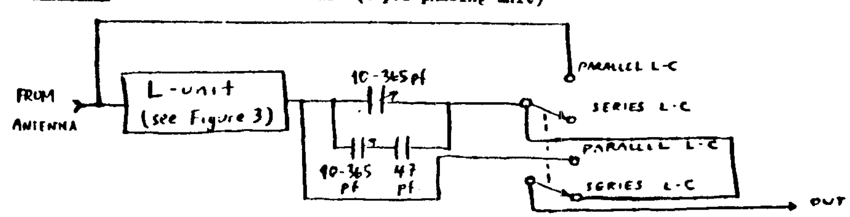
The author recommends that two separate SPDT switches for each antenna line L-unit should be utilised. If a DPDT switch were used to switch the inductance in the Antenna 1 leg & that in the Antenna 2 leg simultaneously, stray coupling from the Antenna 1 coils to those for Antenna 2 (and vice versa) could occur. The Antenna 1 L-unit should be located at least 10 cm./4" from the Antenna 2 L-unit.

The switchable inductance scheme has indeed extended the usefulness of the phasing unit in working with wires shorter than those commonly phased.

The second concept applied to extend the tuning capabilities further is the ability to switch between series L-C (as in the conventional phasing unit of Figure 1) and parallel L-C. Parallel L-C tuning seems to work well with shortwires, especially in the lower half of the band.

We shall incorporate the inductance-unit and switchable series/parallel L-C concepts in a subsection of the phasing unit to be referred to hereafter as the "LC module". Each antenna line has an LC module: the Antenna 1 LC module should be isolated from the Antenna 2 LC module by at least 10 cm. to prevent stray coupling or 'crosstalk'.

<u>Figure 4</u> schematic of LC module (2 per phasing unit)



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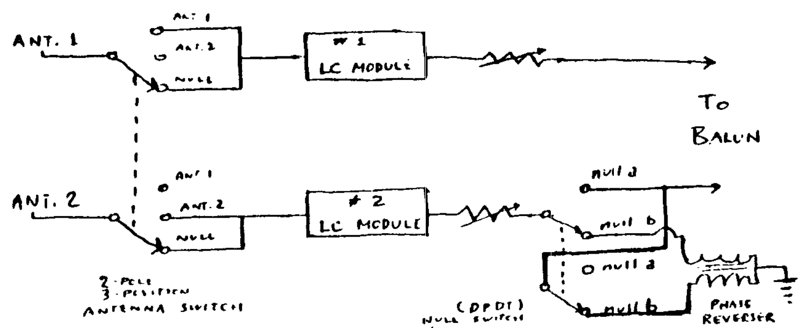
The 10-365 pf. capacitors used are the cheap miniature variety (e. g. Calectro/GC Electronics # A1-232, priced at about $ 2.70 each). The trim capacitor section, 10-365 pf. in series with 47 pf., is effectively a 8-42 pf. trimmer. The expensive air variable capacitors used in previous phasing units can be dispensed with.

(b) Even before switching to null, it is noticed that tweaking the controls for Antenna 2 effect the Antenna 1 control settings (and vice versa).

This indicates inadequate isolation within the phasing unit. Stray capacitance between the LC modules, between wires on the mode switch, and directly from the antennae to the output of the phasing unit may be the contributing factor.

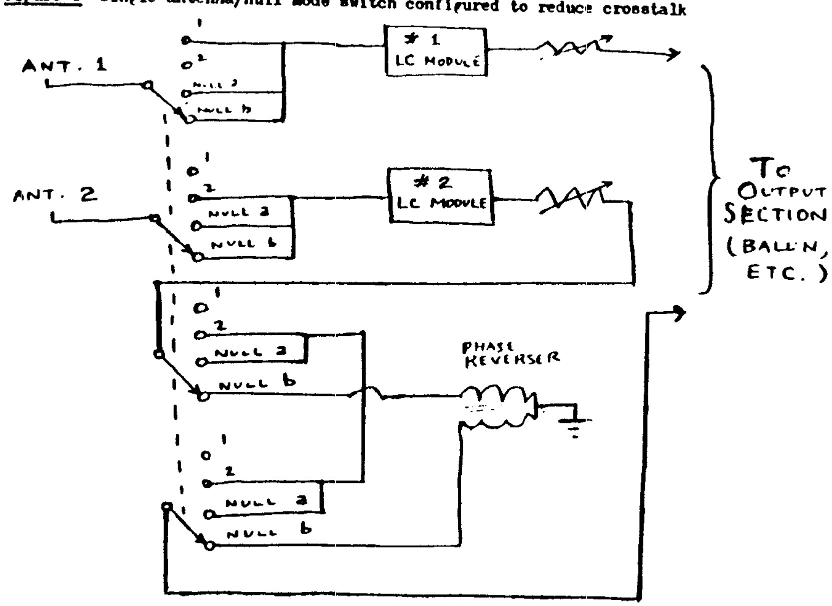
Re-configuring the antenna-line (mode) switch such that antennae are connected or disconnected directly at their inputs is the logical way to attack this problem. As a side benefit, this eliminates the need for the clumsy, expensive 4-pole 4-position switch used in previous phasers. That "kluge" is replaced by a 2-pole 3-position switch and a DPDT toggle switch (see Figure 5). The Antenna 2 line can be peaked with the phase-reverser in line if desired (null mode b): any peak-skewing effects of the phase-reverser can thereby be compensated out prior to the initiation of the actual nulling sequence.

Figure 5 antenna mode/null mode switching to improve isolation/reduce crosstalk



If you wanted to keep to one-switch operation while improving isolation, the 4-pole 4-position switch could be wired-in as in Figure 6.

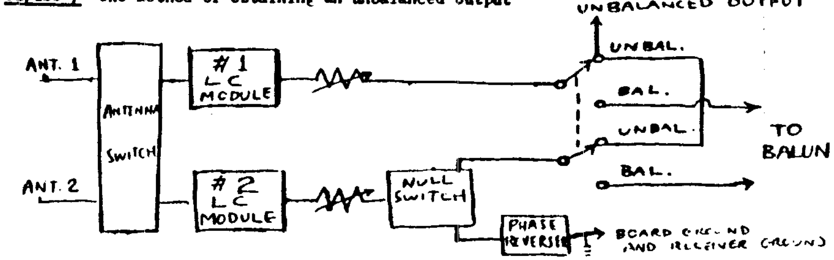
Figure 6 single antenna/null mode switch configured to reduce crosstalk



(c) Conventional phasing unit has no provision for unbalanced output.

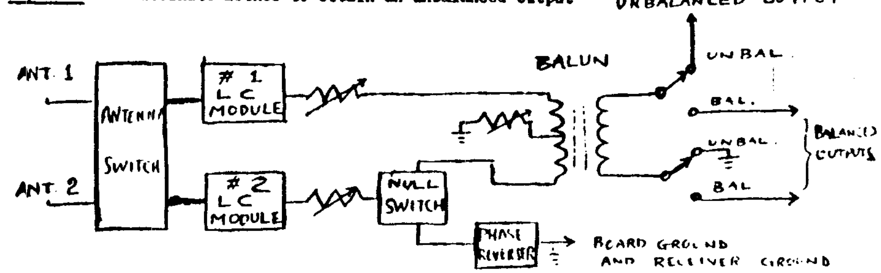
There are two philosophies regarding the provision of an unbalanced output. One is to disconnect the two tuned lines from the balun primary, short these together, and feed them out to an unbalanced output jack, as in Figure 7.

Figure 7 one method of obtaining an unbalanced output



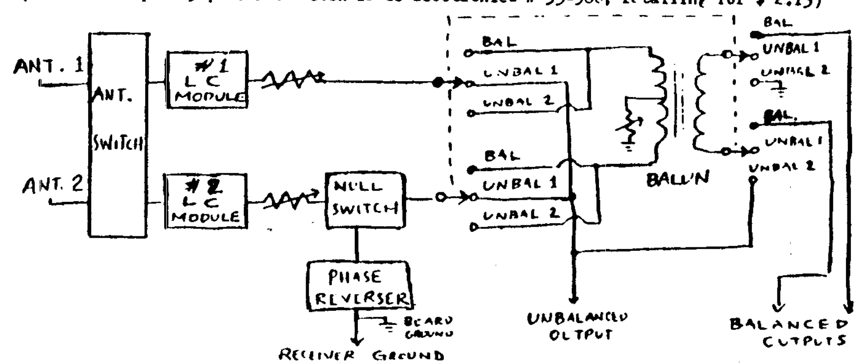
An alternate method is to leave the balun in the operating system and to connect one side of the balun output to ground/the other balun output to the unbalanced output jack, as in Figure 8.

Figure 8 an alternate method to obtain an unbalanced output



Perhaps the best solution to obtain unbalanced output is to build both approaches into the output section of the phasing unit, as in Figure 9.

Figure 9 versatile approach to unbalanced output
(Note: the 4-pole 3-position switch is GC Electronics # 35-380, retailing for $ 2.15)



(d) Metal case is expensive; isolating the tuning capacitors and other components from case ground requires much mechanical layout work.

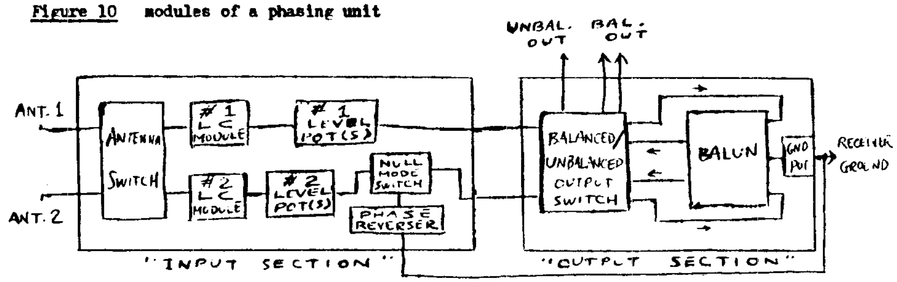
Worry not .... you can build the phasing unit on a standard epoxy-glass vectorboard: this will be discussed in a soon-to-be-released construction article.

(e) The 1K series pots don't always effect the signal levels on their respective antenna lines. Two reasons are postulated for this: (1) in some cases 1K may be too low a maximum resistance value to have any meaningful attenuating effect. One remedy may be the use of higher resistance pots in series with the 1K pots. The 1K pots would then become fine-tune pots. (2) leakage capacitance across pots negates the effect of their resistances. Several schemes may be initiated to remedy this: (a) pots could be placed right at the antenna inputs (between input jacks and antenna switch, ahead of LC modules) (b) try a different brand of pot (c) keep all leads short to minimise stray pickup.

Summary - The modular approach to phasing unit design

In this article several operator conveniences and tuning aids were discussed. A phasing unit need not have all of these "bells & whistles". The block diagram below (Figure 10) points out the modular concept of phasing unit development; actual contents of modules will be determined by the user's particular needs.

Figure 10 modules of a phasing unit



If only true longwires or Beverages are to be used, the LC modules can be reduced to the simple single-L-value (e. g. 250 uH) in series with 10-365 pf. The balun might be omittable if only an unbalanced output is desired, although this might decrease some null capability. Others may retain the balun, but they'll eliminate the phase-reversing toroid - again, nulling flexibility may be decreased slightly. In my experience, you have to have either the phase-reverser or the balun to have even minimal nulling power: having both, obviously, is the optimal situation.

The author believes that as phasing units come into more general use, they will take their place alongside loops as worthy weapons in the DXer's arsenal to combat both interference from "pest stations" and that from non-broadcast sources such as light-dimmers, TV sync. oscillators, power lines and the like.

The serious DXer should evenly blend the use of a good amplified loop with the use of a phased-wire system. Each setup may offer unique DX possibilities: the experienced DXer will soon learn which setup to use to "milk" a specific type of opening or to hunt for specific target stations. The ability of the phased-wire system to produce unidirectional nulls may open up new DX possibilities for many. Similarly, a loop might catch some DX not possible with a particular phased-wire setup. With ever-increasing levels of interference plaguing the DX efforts of us all, it seems wise to have as much antenna (and receiver) diversity as possible at our disposal.