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THE MWDX-2A PHASING UNIT
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The following article includes the schematic for the MWDX-2A phasing unit, an enhanced version of an earlier unit, the MWDX-2, which was described in February 1984 issues of DX News (National Radio Club) & DX Monitor (International Radio Club of America).

The earlier (MWDX-2) article contains worthwhile construction details pertinent to the MWDX-2A: notably with respect to chassis drilling and the T1, T2, C1, & C2 vectorboard-mounted subassemblies. Interested individuals may obtain a copy of the MWDX-2 article by sending a self-addressed stamped envelope to: MWDX-2 Plans c/o Mark Connelly - 30 William Road - Billerica, MA 01866.

The MWDX-2A eliminates a couple of MWDX-2 features not deemed, after evaluation, to be overly useful. Improvements have been made in the dual input tuners so that virtually any length wire pair may be tuned & then used to produce phasing nulls of dominant signal(s) (be they of a meaningful-communications nature or a noise-source origin), thereby permitting weaker 'sub-dominant' stations to be audible. The main stipulation in this scheme is that, since the S6 length switch controls both lines (in the interest of tuning simplicity), the two wires used should be of comparable (+/- 25%) lengths.

The length switch (S6) allows wire aerials whose reactance is either capacitive or inductive to be tuned successfully; it also permits the use of frequency range switches of only 4 positions to cover the band of interest. Note that, with proper inductor selection (see Table 1), one can build a longwave (LW) version of this unit, a medium-wave (MW) version, or a tropical-bands (TB) version.

MWDX-2 documentation can generally be used in conjunction with the notes & drawings of this article to guide the construction of the MWDX-2A. The hole list will be the same, with the following exceptions:

Right Side - delete J6 (holes 5, 6, 7)
Left Side - add S6 (DPDT on/off/on toggle)
hole 6 = S6 shaft (X=0, Y=1.5, DIA=0.25)
hole 7 = S6 tab (X=0.25, Y=1.5, DIA=0.113)

The revamped level-equalising/Q-spoiling pots (R1, R2) scheme permits smoother level/Q adjustment than the arrangement in several previous phasing unit designs.

Tuning and Nulling Procedure Abstract

NOTE: The receiver to be used should have a shielded input. Operation with portable radios using a coupling-coil input on a ferrite rod antenna may not always be successful because of stray pickup by the rod.

1.0 Two Wire Phasing

1.1 Setup

1.1.1 (Inputs)
Connect wire #1 to J1.
Connect earth-ground wire to J2.
(no connection to J3)
Connect wire #2 to J4.

1.1.2 (Output)
Connect the output cable from J5 to receiver or amp. input. Output cable must be of a coaxial type; amplification of MWDX-2A output by means of a tunable (e.g. APT-type) or broadband (e.g. BBA-type) RF amplifier is suggested if wires shorter than 1/10 wavelength (approx. 30 m./ 100 ft. at 1 MHz) are being used.

If an amplifier is put between the MWDX-2A output and the receiver input, switch the amplifier to its 'Off/Bypass' mode, thereby (initially) routing the MWDX-2A output directly to the receiver.

1.1.3 (Controls)
Set C1, C2, & C3 to midrange / half-meshed.
Set R1, R2, & R3 fully counterclockwise (CCW) = maximum Q.
S1 & S2 will be set in step 1.2.
Set S3 to '1' (= Line 1 tuner)
Set S4 to 'Wire'.
The position of S5 is irrelevant during this step.
Set S6 to 'short' if the wire is shorter than 1/10 of a wavelength; otherwise, set S6 to 'normal'.

1.2 Line 1 Tune

1.2.1 Run S1 through its 4 positions; leave it on the position yielding the strongest desired-frequency signal. (After the unit has been used for a while, a frequency-range-switches versus frequency 'look-up table' can be prepared for a particular pair of comparable-length wires.)

1.2.2 Tweak C1 for a peak. If maximum signal occurs with C1 fully meshed, then set S1 one position CCW (= higher tank L) and re-adjust C1 for a peak. If maximum signal occurs with C1 fully open, then set S1 one position CW (= lower tank L) and re-adjust C1 for a peak.

1.2.3 If, in step 1.2.2, a well-defined peak couldn't be obtained, try each of the other two possible positions of S6 (length switch); each time this is done, re-do steps 1.2.1 & 1.2.2. The S6 position which enables you to get the strongest, sharpest peak is the one which should be maintained throughout subsequent steps.

1.2.4 Once Line 1 has been peaked, set R3 to midrange.

1.3 Line 2 Tune

1.3.1 Set S3 to '2' (Line 2).

1.3.2 Set S2 to the position corresponding to that of S1, as set during section 1.2.

1.3.3 Tweak C2 for a peak. Apply the concepts of step 1.2.2 (with respect to S2 positions instead of those of S1) if proper C2 peaking doesn't occur.

1.4 Level Equalisation

1.4.1 Switch S3 back & forth from 1 to 2 (to 1, etc.): if the '1' position has the stronger signal from the station to be nulled, adjust R1 until the Line 1 & Line 2 levels are equal. If position '2' has the stronger 'pest station' signal, adjust R2 to equalise the Line 1 & Line 2 levels.

1.5 Null Initiation

1.5.1 Set S3 to 'N' (Null).

1.5.2 Flip S5 back & forth from 'a' to 'b' (to 'a', etc.). Leave S5 on the position with the lower 'pest-station' signal / greater evidence of subdominant stations.

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FIGURE 1 (of 2)

SCHEMATIC : MWDX-2A

PHASING UNIT

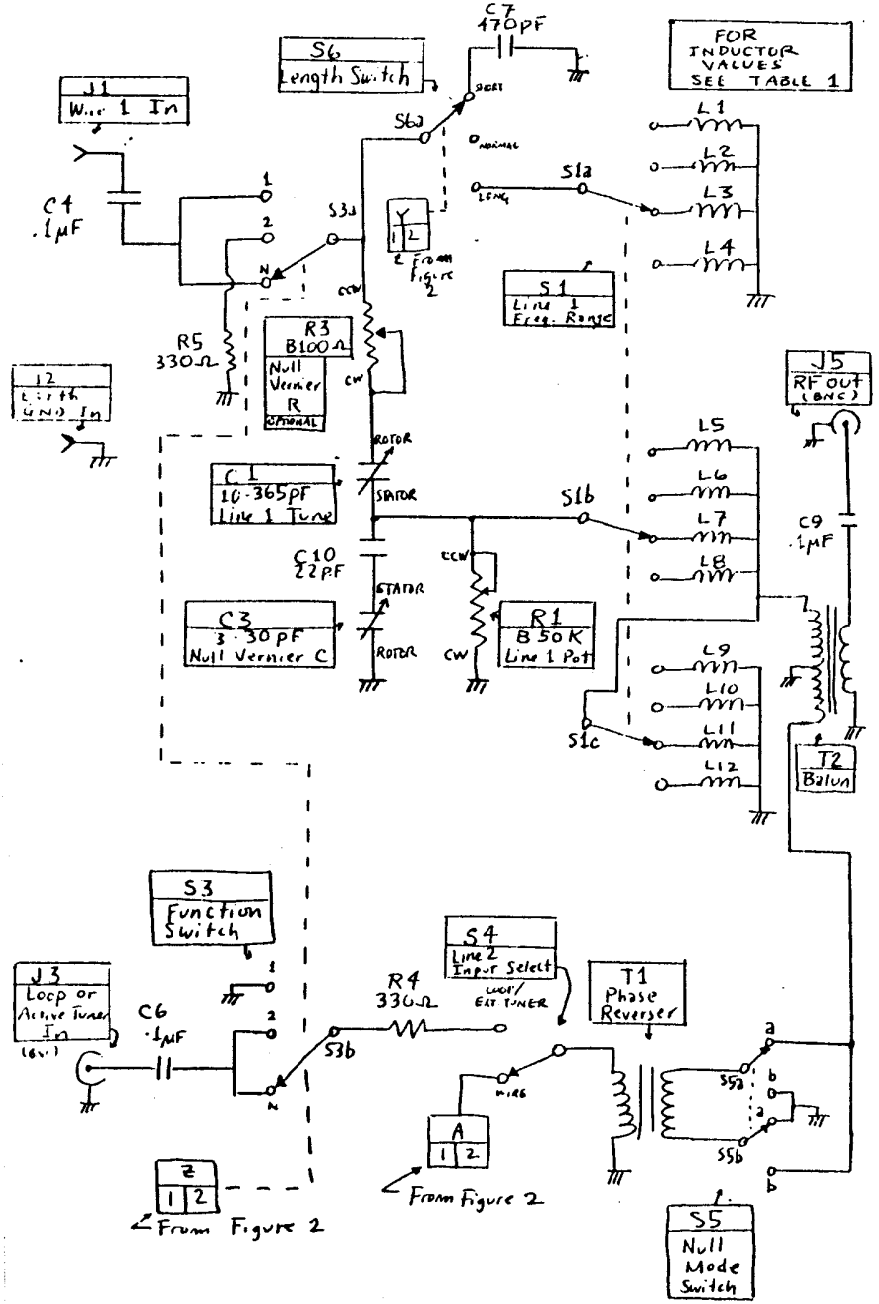

FIGURE 2 (of 2)

SCHEMATIC, MWDX-2A

PHASING UNIT

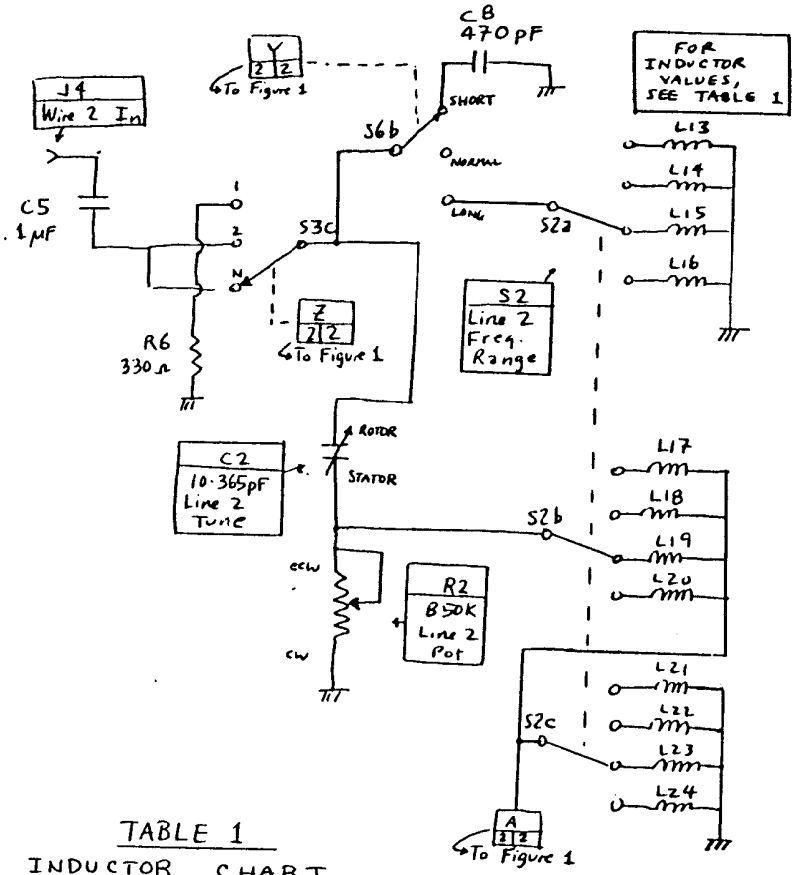

TABLE 1

INDUCTOR CHART

L #	LONGWAVE 150-600 KHz	MEDIUMWAVE 500 - 2000 KHz	TROPICAL-BANDS 1600 - 6400 KHz
1 , 13	1.5 mH	150 μH	10 μH
2 , 14	680 μH	68 "	4.7 "
3 , 15	330 "	33 "	2.2 "
4 , 16	150 "	15 "	1.0 "
5 , 17	4.7 mH	470 "	33 "
6 , 18	2.2 "	220 "	15 "
7 , 19	1.0 "	100 "	6.8 "
8 , 20	470 μH	47 "	3.3 "
9 , 21	1.0 mH	100 "	6.8 "
10 , 22	470 μH	47 "	3.3 "
11 , 23	220 "	22 "	1.5 "
12 , 24	100 "	10 "	0.68 "

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1.6 Nulling

1.6.1 Tweak C1 to get a 'dip' (= point at which adjusting the control either CW or CCW strengthens the station to be nulled). Re-adjust whichever pot had been tweaked in step 1.4.1 (try to get deeper 'dip'); if neither pot had previously been tweaked, try using R3 to enhance the dip. Tweak C2 for further dip (null) enhancement.

1.6.2 Repeat step 1.6.1 as long as continued improvements in the null are noted.

1.6.3 Finalise the null (when use of the main controls becomes too touchy; this may be accomplished by adjusting the vernier (fine-tune) controls C3 & R3.

1.7 Amplification

1.7.1 Set S5 to the opposite position from that yielding a null.

1.7.2 Treat the MWDX-2A phasing-unit output as a signal source and follow the normal steps for the external amplifier used (whether tunable or broadband) to get maximum level at the desired frequency, without creating objectionable spurious signals. (Such spurs usually result from the amp. being overdriven by strong local stations on frequencies not necessarily close to the operating frequency.)

1.7.3 Set S5 back to the null-producing position. If necessary, touch up the null by using C3 & R3 (this isn't usually needed). Increase amp. gain, if possible & if necessary, to bring weak desired station(s) (left after nulling the 'pest') up to readable level.

2.0 Loop versus Wire Phasing

NOTE: The loop to be used (whether active or passive) should be equipped with a 'Q-pot'. Such a pot (recommended value 50K or 100K, linear taper) should parallel the main loop L-C tank. A provision to switch the pot out of the circuit is advisable so that, when phasing is not being done, the loop can be used in its normal high-Q state. The Q pot shaft & case should be grounded to minimise hand capacitance effects.

2.1 Setup

Follow step 1.1 with the following changes: Loop output cable to J3. No connection to J4. The positions of R2 & C2 are irrelevant. Set S4 to 'Loop'.

2.2 Line 1 Tune

Perform step 1.2.

2.3 Line 2 Tune

2.3.1 Set S3 to '2'.

2.3.2 Turn loop power on, if an active loop is being used. Set loop's Q-pot to maximum Q position. If the loop has a frequency-range switch, set it to the proper position for the desired frequency. If the loop has regeneration capability, set the regeneration switch to 'Off'.

2.3.3 Tweak the loop's tuning capacitor for peak desired frequency signal. Aim the loop for (what you think) is the direction of the wanted subdominant station(s), regardless of the dominant's bearing.

2.3.4 Set the loop Q-pot to midrange if a 100K pot, or about '1 hour' (1/12 turn) from the maximum Q position if a 50K Q-pot is used.

2.4 Level Equalisation

2.4.1 Follow step 1.4.1 except substitute 'Loop Q-pot' for 'R2'.

2.5 Null Initiation

2.5.1 Perform step 1.5.1.

2.6 Nulling

2.6.1 Follow step 1.6.1 except substitute 'Loop Tuning Capacitor' for 'C2'.

2.6.2 Repeat step 2.6.1 as long as continued improvements in the null are noted.

2.6.3 Perform step 1.6.3.

2.6.4 'Absolute' null finalisation may be aided by slight re-positioning of the loop.

2.7 Amplification

2.7.1 If amplification of MWDX-2A output is required, perform all steps in section 1.7.

Construction

This unit is very similar to the MWDX-2. If you follow the MWDX-2A schematic (Figures 1 & 2) and the MWDX-2 hole list (taking note of the previously-mentioned modifications), construction should proceed in a relatively straightforward manner.

The MWDX-2 article details of the C1 & C2 'floating' variable capacitor card subassemblies and of the T1 & T2 RF transformer card subassemblies are still valid for the MWDX-2A.

The chassis box used is also the same, a 10 X 6 X 3.5-in. bare aluminium box (Mouser # 537-TF-784).

Conclusion

The MWDX-2A should prove to be a worthwhile DXing tool, for nulling both unwanted dominant stations and unwanted manmade noise (e.g. light dimmers, TV's). Use of an external output amplifier (broadband OK in country, tunable recommended in city) will enhance the MWDX-2A's operational capabilities, allowing use of much shorter wires than anyone ever thought about phasing back in the early '70s, when phasing units became popular with medium-wave Trans-Atlantic DXers in the Boston area.

It should be noted that the MWDX-2A is but one of many considerably different phasing unit designs generated here and in the 'labs' of other DXers. Medium-wave DXers have done the most research & development in this area; however, some designs have appeared in the longwave-DX and amateur radio press. Interestingly, most ham interest centres about the 160-m. band (1800-2000 kHz).

Phasing, like looping, provides the deepest nulls when signal vertical & horizontal arrival angles are not fluctuating greatly in short-term real time. It is on the frequencies below 5 MHz that these techniques have traditionally exhibited their greatest worth.