Mini-MWDX-6 Phasing Unit

Mark Connelly - WA1ION - 22 MAR 1995

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Organization of article

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Table 1: Mini-MWDX-6 Controls and Input / Output Connectors

Controls location	designation	operational description
left side	S1	Line 1 ground swt. (FLOAT / COM)
left side	S2	Line 2 ground swt. (FLOAT / COM)
top	C1	Line 1 tuning capacitor
top	C2	Line 2 tuning capacitor
top	R1	Line 1 input level pot
top	R2	Line 2 input level pot
top	R3	Null vernier (Q-balance) pot
top	S3	Line 1 function switch
top	S4	Line 2 function switch
top	S5	Bandswitch
top	S6	Null (a/b) switch
right side	S7	Amplifier on/off switch
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Input / Output Connectors			
location	designation	operational description	connector type
left side	J1	Line 1 antenna input	red banana jack
left side	J2	Line 2 antenna input	red banana jack
left side	J3	earth ground input 1	blk banana jack
left side	J4	earth ground input 2	blk banana jack
right side	J5	RF output	BNC jack
right side	J6	B+ input	RCA phono jack
right side	BH1	battery holder	Keystone 1290
right side	P1	battery-to-B+ plug	RCA phono plug

Table 2: S5 Bandswitch Settings Chart

Ranges are usually a bit greater than those shown.
These ballpark values are for 50-m. / 164-ft. wires.
Wire length and coupling mode affect the ranges somewhat.

The Mini-MWDX-6 phasing unit has frequency coverage characteristics as noted in the following table:

S5 Pos. #	S5 Position	Min. Freq. kHz	Max. Freq. kHz	"Main" L Tank Inductor Values L#	uH	"Tap" L] Mouser Part#
==	==:==	=====	=====	=======	=====.=	==========
1	middle	440	720	L1,L7	390	43LR394
["	"	"	"	L4,L10	82	43LR825]
2	down	720	1270	L2,L8	220(//390)	43LR224
["	"	"	"	L5,L11	47(//82)	43LR475]
3	up	1270	2000	L3,L9	56(//390)	43LR565
["	"	"	"	L6,L12	12(//82)	43LR125]

Operating the Mini-MWDX-6

Figures 1, 2, and 3 are the schematic of the Mini-MWDX-6. Please refer to them and to Figures 4 and 5 (the chassis outside views) during the discussion of phasing procedure.

Best wire-antenna results will be with wires of at least 15m / 50 ft. For two-wire phasing, there should be some angular or distance separation between the wires for optimum results.

See Tables 2 and 6 for physical positioning of switches.

Nulling procedures may sound complicated at first, but are quickly executed once learned. The user should practice during non-skip daylight conditions on "graveyard" and regional channels having discernable subdominants to get familiar with operation of the controls before attempting night-time nulls of unsteady signals. As with a loop, solid nulls of skip stations above 1 MHz in the 50 to 500 mile range can be difficult at times because of the rapid changes in vertical (and sometimes horizontal) arrival angles inherent when dealing with high-angle and multiple-mode skip. Such nulls are better when using phased Beverages than when using a loop, loop versus loop, loop versus wire, or phased shorter wires.

The Mini-MWDX-6 contains a moderate-gain (approximately 15 dB) small-signal amplifier which is powerable from a 9 volt battery. This amplifier may be switched in when signals left over after the nulling process are too weak. When more gain is needed, or if the unit is being operated in a high-RF (e.g. urban) environment, better noise-figure capability and intermodulation-product rejection will be achievable by using a tuned external amplifier such as the MWT-3 regenerative preselector or one of Dallas Lankford's high-performance amplifiers with a link-coupled L-C tank ahead of it. For most situations, the built-in amplifier will be sufficient to regain signal lost in the loosely-coupled input coupling scheme used by the Mini-MWDX-6 to allow successful phasing of many different wire antenna lengths.

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1.0 Phasing Steps (2-wire)

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1.0      ***  Mini-MWDX-6 Two Wire Phasing Procedure  ***
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1.1 ** INITIALIZE CONNECTIONS AND CONTROLS **

< Left side of box >

J1: Connect Antenna #1 wire.

J2: Connect Antenna #2 wire.

J3: If a noise reducing ground for Antenna #1 is available, connect it; otherwise, no connection is needed.

J4: If a noise reducing ground for Antenna #2 is available, connect it; otherwise, no connection is needed.

G1: (lug) This may be connected to mains, earth, or vehicle ground if doing so improves signal-to-noise ratio. This would be done more often with portable receivers than with tabletop communications models having a metal case.

S1: Set to COMMON unless using a noise-reduced input pair at J1 and J3 for Antenna #1 (in that case, set S1 to FLOAT).

S2: Set to COMMON unless using a noise-reduced input pair at J2 and J4 for Antenna #2 (in that case, set S2 to FLOAT).
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< Top side of box >
S3: Set to (Line 1) Tuned.
S4: Set to (Line 2) Tuned.
S5: Set for the correct frequency range, according to Table 2.

R1: set to fully counterclockwise (minimum attenuation).
R2: set to fully counterclockwise (minimum attenuation).
R3: set to fully counterclockwise (maximum Q, Line 1).

< Right side of box >
J5: Connect, via coaxial cable, to the receiver input, or to the input of a tunable preselector between the phasing unit output and the receiver input.
J6: Connect this to a DC power source of +7.5 VDC minimum, +15 VDC maximum. If you don't intend to use the amplifier, DC power will not be necessary.
S7: Set to Amplifier Off.

1.2 ** PEAK LINE 1 **
With R3 fully counterclockwise, tune Line 1 by peaking desired-frequency signal strength with C1. At this time, leave C1 at its peaked-signal position. NOTE THE SIGNAL STRENGTH (observe S-meter, if available, or note audible level).

If objectionable spurious responses are noted, adjust R1 in a clockwise direction until the spurs are not noted with C1 peaked properly.

1.3 ** PEAK LINE 2 **
Set R3 fully clockwise. Tune Line 2 by peaking desired-frequency signal strength with C2. At this time, leave C2 at its peaked-signal position. NOTE THE SIGNAL STRENGTH (observe S-meter, if available, or note audible level).

If objectionable spurious responses are noted, adjust R2 in a clockwise direction until the spurs are not noted with C2 peaked properly.

1.4 ** EQUALIZE LINE 1, LINE 2 LEVELS **
If the dominant-station signal level noted when peaking Line 1 with C1 (Step 1.2) is comparable to (within 5 dB on meter, or not audibly different from) the strength noted when peaking Line 2 with C2 (Step 1.3), proceed to Step 1.5.
>>>
If the R3 CCW / Line 1 (C1 peaked) level is considerably greater than the R3 CW / Line 2 (C2 peaked) level, then adjust R1 until these levels are equal (within 5 dB) when R3 is adjusted alternately to fully CCW and fully CW. When done, re-peak C1 with R3 set fully CCW.
>>>
If the R3 CW / Line 2 (C2 peaked) level is considerably greater than the R3 CCW / Line 1 (C1 peaked) level, then adjust R2 until these levels are equal (within 5 dB) when R3 is adjusted alternately to fully CCW and fully CW. When done, re-peak C2 with R3 set fully CW.

1.5 ** INITIALIZE NULL **
Set R3 to center position (pointer at 12 o'clock). Observe the pointer positions of the R1 and R2 knobs. If the R2 knob pointer is farther from fully counterclockwise than R1's knob, start nulling with C2. Otherwise, start with C1.

Set S6 to Null-a and adjust the capacitor (C1 or C2) chosen above. Observe the depth and sharpness of any null found. Do the same with S6 set to Null-b. Leave S6 on the position that produced the deeper, sharper-tuning null; put the chosen tuning capacitor at the position yielding maximum null.

In some situations where R1 and/or R2 are not set fully counterclockwise, the null can be improved by making a few small alternate adjustments of the capacitor chosen above and of the pot on its respective line (e.g. tweak R1 if you're adjusting C1; R2 if you're using C2).

Adjust R3 (the Null Vernier pot) to improve the rejection of the dominant station or noise.

If nulling gets better with R3's knob aligned between center and fully clockwise, alternately adjust C2 and R3. Otherwise, use C1 and R3.

Subdominant signals, if present, should become audible.

1.6 ** FINALIZE NULL **

Make successive small interactive adjustments of R3, C1, and C2; and, if applicable, whichever level pot (R1 or R2) is set farther from fully counterclockwise.

If wanted-station signal level is too low, S7 may be set to Amplifier On, or an external preamplifier between the phasing unit output and receiver input may be enabled.

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2.0 *** Mini-MWDX-6 Loop v Wire Phasing Procedure ***

NOTES: The loop should be equipped with a Q-spoiling resistor of approximately 22K across its parallel-tuned LC tank. A 50K potentiometer (initially set to center) might be substituted; it can provide an added control over nulling if desired. The pot or fixed resistor should be easily removable (switch or clips) to facilitate stand-alone (high-Q) loop usage.

A loop used in a phasing application is usually oriented for best directivity toward desired DX signals, whether or not that position reduces the dominant. Sometimes orienting the loop for MAXIMUM dominant signal pick-up, or for dominant level equal to that from the wire, can actually help nulling.

2.1 ** INITIALIZE CONNECTIONS AND CONTROLS **

< Left side of box >
J1: Connect Antenna #1 wire.
J2: Connect center of coaxial cable from loop output.
J3: If a noise reducing ground for Antenna #1 is available, connect it; otherwise, no connection is needed.
J4: Connect shield of coaxial cable from loop output.
G1: (lug) This may be connected to mains, earth, or vehicle ground if doing so improves signal-to-noise ratio. This would be done more often with portable receivers than with tabletop communications models having a metal case.
S1: Set to COMMON unless using a noise-reduced input pair at J1 and J3 for Antenna #1 (in that case, set S1 to FLOAT).
S2: Set to COMMON, unless the loop's ground is to be isolated from receiver ground to improve noise rejection (in that case, set S2 to FLOAT).

< Top side of box >
S3: Set to (Line 1) Tuned.
S4: Set to (Line 2) Off.
S5: Set for the correct frequency range, according to Table 2.
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R1: set to fully counterclockwise (minimum attenuation).
R2: set to fully counterclockwise (minimum attenuation).
R3: set to mechanical center (12 o'clock).

< Right side of box >
J5: Connect, via coaxial cable, to the receiver input, or to the input of a tunable preselector between the phasing unit output and the receiver input.
J6: Connect this to a DC power source of +7.5 VDC minimum, +15 VDC maximum. If you don't intend to use the amplifier, DC power will not be necessary.
S7: Set to Amplifier Off.

2.2 ** PEAK LINE 1 **
Tune Line 1 by peaking desired-frequency signal strength with C1. At this time, leave C1 at its peaked-signal position. NOTE THE SIGNAL STRENGTH (observe S-meter, if available, or note audible level).

If objectionable spurious responses are noted, adjust R1 in a clockwise direction until the spurs are not noted with C1 peaked properly.

2.3 ** PEAK LINE 2 **
Set S3 to (Line 1) Off. Set S4 to (Line 2) Bypass. Tune Line 2 by peaking the loop's tuning capacitor. Leave the loop tuning capacitor at its peaked-signal position. NOTE THE SIGNAL STRENGTH (observe S-meter, if available, or note audible level).

2.4 ** EQUALIZE LINE 1, LINE 2 LEVELS **
If the dominant-station signal level noted when peaking Line 1 with C1 (Step 2.2) is comparable (within 5 dB on meter, or not audibly different) to the strength noted when peaking Line 2 with the loop tuning capacitor (Step 2.3), proceed to Step 2.5.
>>>
If the dominant-station signal level noted when peaking Line 1 with C1 (Step 2.2) is noticeably greater than the strength noted when peaking Line 2 with the loop tuning capacitor (Step 2.3), adjust R1 until the "pest station" level noted for Line 1 (S3 = Tuned / S4 = Off) is within 5 dB of (or not audibly different from) the level noted on Line 2 (S3 = Off / S4 = Bypass). Then, proceed to Step 2.5.
>>>
If the dominant-station signal level noted when peaking Line 2 with the loop tuning capacitor (Step 2.3) is noticeably greater than the strength noted when peaking Line 1 with C1 (Step 2.2), adjust R2 until the "pest station" level noted for Line 1 (S3 = Tuned / S4 = Off) is within 5 dB of (or not audibly different from) the level noted on Line 2 (S3 = Off / S4 = Bypass). Then, proceed to Step 2.5.

2.5 ** INITIALIZE NULL **
Set S3 to Tuned and set S4 to Bypass. Set S6 to Null-a and then to Null-b. If one of these positions shows noticeably-better reduction of the dominant signal, leave S6 at that setting and proceed to Step 2.6.
>>>
If R1 and R2 positions are approximately the same (e. g. both fully counterclockwise), or R2 is closer to its initial CCW setting, set S6 to Null-a and adjust C1 for a null of the dominant station. Do the same with S6 set to Null-b. Leave S6 at the position which gives the deeper, sharper null when you adjust C1. If there's little difference in null depth or sharpness between the two S6 null positions, select the S6 position that results in C1 being set closer to the center of its mechanical adjustment range when a null is produced. Make a few small re-adjustments of C1 and R1 to improve null depth. Then, proceed to Step 2.6.
>>>
If R1 is closer than R2 to its initial CCW setting, set S6 to Null-a and adjust the loop tuning capacitor for a null of the dominant station. Do the same with S6 set to Null-b. Leave S6 at the position which gives the deeper, sharper null when you adjust the loop cap. If there's little difference in null depth or sharpness between the two S6 null positions, select the S6 position that results in the loop cap. being set closer to the center of its mechanical adjustment range when a null is produced. Make a few small re-adjustments of R2 and the loop capacitor to improve null depth. Then, proceed to Step 2.6.

2.6 ** FINALIZE NULL **
Do the final null "touch-up" with an interactive adjustment of C1, the loop tuning capacitor, and R3. Slight physical re-positioning of the loop may also help to finalize the null. If a 50K pot (initially set to center, approximately 25K) had been installed across the loop coil (instead of the approximately-22K fixed resistor), it may also be touched up for null completion.

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3.0   ***  Mini-MWDX-6 Loop v Loop Phasing Procedure  ***
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NOTES: Each loop should be equipped with a Q-spoiling resistor of approximately 22K, or a 50K pot set to center (25K), across its parallel-tuned LC tank. Q-spoiling components should be removable for normal stand-alone loop usage.

Two-loop phasing works best when the loops are aimed at bearings that are angularly separated by more than 60 degrees and less than 120 degrees. Orthogonal (90 degree) positioning is customary, with the bisector of the angle between the loops pointing towards the direction of interest. Example: To produce a cardioid pattern nulling west and peaking east (or, for that matter, nulling east and peaking west), Loop #1 can be aligned northeast / southwest and Loop #2 set to southeast / northwest. Loops should have comparable gains for best nulling results.

3.1 ** INITIALIZE CONNECTIONS AND CONTROLS **

< Left side of box >
J1: Connect center of coaxial cable from Loop #1 output.
J2: Connect center of coaxial cable from Loop #2 output.
J3: Connect shield of coaxial cable from Loop #1 output.
J4: Connect shield of coaxial cable from Loop #2 output.
G1: (lug) This may be connected to mains, earth, or vehicle ground if doing so improves signal-to-noise ratio. This would be done more often with portable receivers than with tabletop communications models having a metal case.
S1: Set to COMMON, unless Loop #1's ground is to be isolated from receiver ground to improve noise rejection (in that case, set S1 to FLOAT).
S2: Set to COMMON, unless Loop #2's ground is to be isolated from receiver ground to improve noise rejection (in that case, set S2 to FLOAT).

< Top side of box >
S3: Set to (Line 1) Bypass.
S4: Set to (Line 2) Off.
S5: (position is irrelevant)

R1: set to fully counterclockwise (minimum attenuation).
R2: set to fully counterclockwise (minimum attenuation).
R3: (position is irrelevant)

< Right side of box >
J5: Connect, via coaxial cable, to the receiver input, or to
    the input of a tunable preselector between the phasing unit
    output and the receiver input.
J6: Connect this to a DC power source of +7.5 VDC minimum, +15 VDC
    maximum. If you don't intend to use the amplifier, DC power
    will not be necessary.
S7: Set to Amplifier Off.

3.2 ** PEAK LINE 1 **
Tune Line 1 by peaking desired-frequency signal strength with
Loop #1 Tune (the tuning capacitor on Loop #1). At this time,
leave Loop #1 Tune at its peaked-signal position. NOTE THE
SIGNAL STRENGTH (observe S-meter, if available, or note audible
level).

3.3 ** PEAK LINE 2 **
Set S3 to Off and set S4 to Bypass. Tune Line 2 by peaking
Loop #2 Tune (the tuning capacitor on Loop #2). Leave
Loop #2 Tune at its peaked-signal position. NOTE THE SIGNAL
STRENGTH (observe S-meter, if available, or note audible level).

3.4 ** EQUALIZE LINE 1, LINE 2 LEVELS **
If the dominant-station signal level noted when peaking Loop #1
(Step 3.2) is comparable to (within 5 dB on meter, or not audibly
different from) the strength noted when peaking Loop #2 (Step 3.3),
proceed to Step 3.5.
>>>
If the dominant-station signal level noted when peaking Loop #1
(Step 3.2) is noticeably greater than the strength noted when
peaking Loop #2 (Step 3.3), adjust R1 until the "pest station"
level noted for Line 1 (S3 = Bypass / S4 = Off) is within 5 dB
of (or not audibly different from) the level noted on Line 2
(S3 = Off / S4 = Bypass).   Then, proceed to Step 3.5.
>>>
If the dominant-station signal level noted when peaking Loop #2
(Step 3.3) is noticeably greater than the strength noted when
peaking Loop #1 (Step 3.2), adjust R2 until the "pest station"
level noted for Line 1 (S3 = Bypass / S4 = Off) is within 5 dB
of (or not audibly different from) the level noted on Line 2
(S3 = Off / S4 = Bypass).   Then, proceed to Step 3.5.

3.5 ** INITIALIZE NULL **
Set S3 to Bypass and S4 to Bypass. Set S6 to Null-a and then to Null-b. If one of these positions shows noticeably-better reduction of the dominant signal, leave S6 at that setting and proceed to Step 3.6.
>>>
If R1 and R2 positions are approximately the same (e. g. both fully counterclockwise), or R2 is closer to its initial CCW setting, set S6 to Null-a and adjust Loop #1 Tune for a null of the dominant station. Do the same with S6 set to Null-b. Leave S6 at the position which gives the deeper, sharper null when you adjust Loop #1 Tune. If there's little difference in null depth or sharpness between the two S6 null positions, select the S6 position that results in Loop #1 Tune being set closer to the center of its mechanical adjustment range when a null is produced. Make a few small re-adjustments of Loop #1 Tune and R1 to improve null depth. Then, proceed to Step 3.6.
>>>
If R1 is closer than R2 to its initial CCW setting, set S6 to Null-a and adjust Loop #2 Tune for a null of the dominant station. Do the same with S6 set to Null-b. Leave S6 at the position which gives the deeper, sharper null when you adjust Loop #2 Tune. If there's little difference in null depth or sharpness between the two S6 null positions, select the S6 position that results in Loop #2 Tune being set closer to the center of its mechanical adjustment range when a null is produced. Make a few small re-adjustments of Loop #2 Tune and R2 to improve null depth. Then, proceed to Step 3.6.

3.6 ** FINALIZE NULL **
Do the final null "touch-up" with an interactive adjustment of Loop #1 Tune, Loop #2 Tune, and whichever pot (R1 or R2), is not set to a fully counterclockwise position. Slight re-positioning of each loop may also help to finalize the null. If either, or both, loops have a 50K Q-pot (instead of a fixed resistor) across its coil, touch such pots up for null completion.

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Compatibility with noise-reducing antenna systems

Noise-reducing antenna considerations have been accommodated by the inclusion of two isolation transformers (T1, T2) on the inputs. When suitable "quiet" grounds or counterpoise wires are part of the antenna layout, reduction of local electrical noise is possible.
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If either Ground Mode switch (S1: Line 1; S2: Line 2) is set to the FLOAT position, the phasing unit may be interfaced correctly with coaxial inputs from low noise antenna systems consisting of a wire antenna and a "field site" earth ground fed to the primary of a (field site) step-down transformer in the 4:1 to 12:1 range; either a Mini-Circuits T9-1-X65 or Nick Hall-Patch's homebrew version consisting of an Amidon FT50-43 core with 35 turns primary / 11 turns secondary will work well. The lower impedance output of this field-site transformer is paralleled with 270 to 330 ohms; one secondary lead goes to the shield of the coaxial cable going to the operator's "shack" and the other secondary lead goes to the center conductor of this coaxial cable through a small series resistor in the 5 to 12 ohm range. The resistors form a low-loss matching pad to reduce the degree of mismatch. Excessive mismatch can compromise the shielding effectiveness of the coaxial cable. One such low-noise set-up can be phased against a loop or, even better, against a second low-noise antenna system with different directional properties. In any event, the "shack end" of a Line 1 low-noise coaxial feed is connected to J1 (center) and J3 (shield) of the phasing unit; similarly, if such a coaxial feedline is to be used for Line 2, it should be connected to J2 (center) and J4 (shield).

For further discussion of noise-reduction schemes, the reader is advised to consult my articles "Another Look at Noise-Reducing Antenna Systems" (6 JUL 1992), "Bevmatcher" (15 JAN 1991), the Nick Hall-Patch / John Bryant article "Impedance Matching a Beverage Antenna to a Receiver" in Proceedings 1988, and the 1991 noise-reducing inverted-L articles by Dallas Lankford and Denzil Wraight. The reader should be advised that the noise being reduced is LOCAL electrical noise of the type caused by TV sweep oscillator harmonics, light dimmer buzz, and the like. These antenna systems cannot, singly, reduce static from lightning bolts. Such noise CAN be nulled by phasing two antennas if it is coming from far enough away as to approximate a point source not having great incoming-angle variation over time (it is then treated as a "dominant signal" as if it were a broadcast station interfering with desired DX).

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Building the Mini-MWDX-6 Phasing Unit

The documentation (schematics, assembly drawings, parts lists, hole lists, etc.) serves as the starting point. The following procedure should serve as an outline for the builder. Some experience in electronic "homebrewing" is advisable.

1. Gather all necessary parts (see Tables 2, 4, 5). Prepare work area with appropriate tools.

2. Drill out chassis box, in accordance with Table 3.

3. Assemble the BBA-B Broadband Amplifier Card to be used for A1. Refer to Figures 7 and 8 and Table 5.

4. Pre-wire the bandswitch (S5) per Table 2.

5. Mount tuning capacitors (C1, C2) per Tables 3 and 4. At each mounting hole (two holes per capacitor), a 6-32 X .25" screw and two #6 split lockwashers are used. The lockwashers go between the inside chassis box surface and the front face of the tuning capacitor. The previously-released MWDX-6 article has additional information that may be useful. Regular knobs (rather than vernier types) are used on Mini-MWDX-6.

8. Mount the following components in the chassis box per pictorials (Figures 4, 5, 6) and parts list (Table 4):
   LEFT SIDE: J1, J2, J3, J4, S1, S2, G1
   TOP SIDE: R1, R2, R3, G2, S5, S3, S4, S6
   RIGHT SIDE: A1, BH1, G3, J6, J7

   Note that each grounding hardware assembly (G1, G2, G3) consists of a 4-40 X 0.375" screw, two #4 solder lugs, and a 4-40 hex nut. One lug and the nut are on the inside of the chassis box; the other lug and the head of the attached screw are outside the box.

   The BH1 battery holder is mounted with a 4-40 X 0.25" screw, a #4 split lockwasher, and a 4-40 hex nut at each of its two mounting holes. The lockwasher is placed between the battery holder back surface and the chassis box exterior; the nut is located against the interior surface of the chassis box.

9. Install remaining electrical components and wiring inside the chassis box in accordance with the parts list (Table 4), the assembly pictorial (Figure 6), and the schematics (Figures 1 through 3).

10. Install knobs on C1, C2, R1, R2, and R3 per Figure 6 and Table 4.

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Table 3: Mini-MWDX-6 hole-drilling list

X = Horizontal distance, in inches, from the vertical centerline (VCL) on the side observed. Negative values of X are left of VCL, positive values of X are right of VCL.

Y = Vertical distance, in inches, from the bottom horizontal edge of the side observed.

D = Hole diameter in inches.

Hole loci are first marked on the box with a scriber and are then drilled with a .125" bit. Subsequently, as required, the holes are enlarged to the proper size by using progressively larger bits up to that corresponding to the final desired diameter.

Chassis Box = Mouser 537-TF-779 (metal): 5" X 4" X 3"

L E F T S I D E

Hole #	Comp. Desig.	Description	X	Y	D
1	J1	Line 1 In - red banana jack	-1.375	0.5	0.3125
2	J3	GND1 In - black banana jack	-0.625	0.5	0.3125
3	S1	Line 1 Ground swt. - tab	-0.625	1.375	0.125
4	S1	Line 1 Ground swt. - shaft	-0.625	1.125	0.25
5	G1	grounding H/W - int&ext lugs	0.0	0.75	0.125
6	S2	Line 2 Ground swt. - tab	0.625	1.375	0.125
7	S2	Line 2 Ground swt. - shaft	0.625	1.125	0.25
8	J4	GND2 In - black banana jack	0.625	0.5	0.3125
9	J2	Line 2 In - red banana jack	1.375	0.5	0.3125

T O P S I D E

Mounting holes on C1 & C2 must be tapped to 6-32 thread.

Hole #	Comp. Desig.	Description	X	Y	D
1	R1	Line 1 Level pot - tab	-2.3125	3.0	0.144
2	R1	Line 1 Level pot - shaft	-2.0	3.0	0.3125
3	R2	Line 2 Level pot - tab	-2.3125	1.0	0.144
4	R2	Line 2 Level pot - shaft	-2.0	1.0	0.3125
5	C1	Line 1 Tuning Cap.-Mtg.H/W 1	-0.963	3.25	0.1875
6	C1	Line 1 Tuning Cap. - shaft	-0.5	3.0	0.5
7	C1	Line 1 Tuning Cap.-Mtg.H/W 2	-0.037	3.25	0.1875

Table 3 (continued)

8	C2	Line 2 Tuning Cap.-Mtg.H/W 1	-0.963	1.5	0.1875
9	C2	Line 2 Tuning Cap. - shaft	-0.5	1.25	0.5
10	C2	Line 2 Tuning Cap.-Mtg.H/W 2	-0.037	1.5	0.1875
11	S5	Bandswitch - tab	0.875	2.25	0.125
12	S5	Bandswitch - shaft	0.875	2.0	0.25
13	S3	Line 1 Function swt. - tab	0.875	3.625	0.125
14	S3	Line 1 Function swt. -shaft	0.875	3.375	0.25
15	S4	Line 2 Function swt. - tab	0.875	0.875	0.125
16	S4	Line 2 Function swt. -shaft	0.875	0.625	0.25
17	R3	Null vernier (Q) pot - tab	1.5625	2.0	0.144
18	R3	Null vernier (Q) pot - shaft	1.875	2.0	0.3125
19	S6	Null a/b switch - tab	2.0	0.875	0.125
20	S6	Null a/b switch - shaft	2.0	0.625	0.25
21	G2	grounding H/W - int&ext lugs	1.5	3.375	0.125

R I G H T S I D E

Hole #	Comp. Desig.	Description	X	Y	D
1	BH1	battery holder - Mtg. H/W 1	-1.625	2.75	0.125
2	BH1	battery holder - Mtg. H/W 2	-1.625	1.875	0.125
3	G3	grounding H/W - int&ext lugs	-1.125	1.5	0.125
4	S7	Amp. On/Off switch - shaft	-1.125	0.75	0.25
5	S7	Amp. On/Off switch - tab	-1.125	0.5	0.125
6	J6	B+ In - RCA phono jack	0.0	1.25	0.25
7	J5	RF out - BNC jack	0.0	0.5	0.375
8	A1	BBA-B Amp. Card - Mtg. H/W 4	0.625	1.5	0.125
9	A1	BBA-B Amp. Card - Mtg. H/W 3	0.625	0.5	0.125
10	A1	BBA-B Amp. Card - Mtg. H/W 2	1.625	1.5	0.125
11	A1	BBA-B Amp. Card - Mtg. H/W 1	1.625	0.5	0.125

Table 4: "upper level" parts list
NOTE: Inductors used on bandswitch S5 are itemized separately as shown by Table 2 and Figure 2.

*: Note follows parts list.

Vendor codes for this and subsequent parts lists:

AE = Antique Electronic Supply / 6221 S. Maple Ave. / Tempe, AZ 85283 /Tel. 1-602-820-5411

CS = Circuit Specialists / P. O. Box 3047 / Scottsdale, AZ 85271-3047 /Tel. 1-800-528-1417

MCL = Mini-Circuits Lab. / P. O. Box 350166 / Brooklyn, NY 11235-0003 /Tel. 1-718-934-4500

MOU = Mouser Electronics / 11433 Woodside Ave. / Santee, CA 92071 /Tel. 1-800-346-6873

RS = Radio Shack / Many locations worldwide

Item	Designator		Description/Value	Vendor	Vendor Stock #	QTY
1	-		chassis box 5X4X3"	MOU	537-TF-779	1
2	A1		BBA-B amp. card		(refer to text)	1
3	BH1	*	battery holder	MOU	534-1290	1
4		*	knob	RS	274-416	5
5	C1,2		var. cap.,10-365pF	AE	CV-231	2
6	C3,4,7		capacitor, 0.1 uF	MOU	539-CK05104K	3
7	C5,6		capacitor, 43 pF	MOU	21CB043	2
8	G1,2,3	*	solder lug, #4	MOU	534-7311	6
9	G1,2,3	*	screw, 4-40 X.375"	MOU	572-01881	3
10	G1,2,3,BH1	*	hex nut, 4-40	MOU	572-00484	5
11	(A1,BH1)	*	screw, 4-40 X .25"	MOU	572-01880	6
12	(A1,BH1)	*	split lockwasher,#4	MOU	572-00649	6
13	(C1,2)	*	screw, 6-32 X .25"	MOU	572-01888	4
14	(C1,2)	*	split lockwasher,#6	MOU	572-00650	8
15	J1,2		red banana jack	RS	274-662	2
16	J3,4		black banana jack	RS	274-662	2
17	J5		BNC jack	RS	278-105	1
18	J6		phono jack	RS	274-346	1
19	P1		phono plug	RS	274-339	1

Table 4 (continued)

20	R1,2	pot., 1K, linear	MOU	31CT301	2
21	R3	pot., 100K, linear	MOU	31CR501	1
22	R4,5	resistor, 330K	CS	RA330K	2
23	R6,7	resistor, 4.7 ohm	CS	RA4.7	2
24	S1,2	switch,SPDT,on-on	CS	8013	2
25	S3,4	switch,DPDT,onoffon	CS	8012	2
26	S5	switch,4PDT,onoffon	CS	8405	1
27	S6	switch,DPDT,on-on	CS	8011	1
28	S7	switch,3PDT,on-on	MOU	10TC280	1
29	T1,2	RF transformer,1:1	MCL	T1-6-X65	2

Misc. items: hook-up wire, buss wire, solder,labels "AS REQUIRED"
*Item 3 note: Keystone 1290
*Item 4 note: one each for C1, C2, R1, R2, R3
*Item 8 note: two each for G1, G2, G3
*Item 9 note: one each for G1, G2, G3
*Item 10 note: one each for G1, G2, G3; two each for BH1
*Item 11 note: four each for A1 mount; two each for BH1
*Item 12 note: four each for A1 mount; two each for BH1
*Item 13 note: two each for C1, C2
*Item 14 note: four each for C1, C2

Table 5: BBA-B Broadband Amplifier Card (A1) parts list
Vendor codes per Table 4.
Schematic = Figure 7 / Assembly = Figure 8.

Item	Designator	Description/Value	Vendor	Vendor Stock #	QTY
1	BD	perfboard:1.4"X1.4"	RS	276-1396 (cut)	1
2	C1,4,5,6	capacitor, 0.1 uF	MOU	539-CK05104K	4
3	C2	capacitor,10uF tant	MOU	581-10K35	1
4	C3	capacitor, 0.01 uF	MOU	539-CK05103K	1
5	H1,2,3,4	screw, 4-40 X .25"	MOU	572-01880	4
6	H1,2,3,4	spacer, 4-40 X .5"	MOU	534-1450C	4
7	H1,2,3	split lockwasher,#4	MOU	572-00649	3
8	H4	solder lug, #4	MOU	534-7311	1
9	P1-P6	flea clip,.042"hole	MOU	574-T42-1/100	6
10	Q1	NPN, 2N3904	MOU	570-2N3904	1
11	Q2	NPN, MPS918	MOU	526-NTE108	1
12	R1,5,9	resistor, 10 ohm	CS	RA10	3
13	R2	resistor, 6.8K	CS	RA6.8K	1
14	R3	resistor, 1.8K	CS	RA1.8K	1
15	R4	resistor, 270 ohm	CS	RA270	1
16	R6	resistor, 1K	CS	RA1.0K	1
17	R7	resistor, 470 ohm	CS	RA470	1
18	R8	resistor, 330 ohm	CS	RA330	1

+ buss wire, solder - as required

Table 6: control orientation conventions

Ensure that components are mounted and wired in accordance with this table; align knob pointers to clock positions indicated. Orientations are as viewed from outside the chassis box assembly.

Side	Control	Orientation Conventions
left	S1	COMMON = down; FLOAT = up
left	S2	COMMON = down; FLOAT = up
top	C1	CCW = minimum C = 9:00; CW = maximum C = 3:00
top	C2	CCW = minimum C = 9:00; CW = maximum C = 3:00
top	R1	CCW = Line 1 maximum level = 7:00 CW = Line 1 minimum level = 5:00
top	R2	CCW = Line 2 maximum level = 7:00 CW = Line 2 minimum level = 5:00
top	R3	CCW = maximum Q Line 1 (min. Line 2)= 7:00 CW = maximum Q Line 2 (min. Line 1)= 5:00
top	S3	Line 1: Tuned = up; Off = middle; Bypass = down
top	S4	Line 2: Tuned = up; Off = middle; Bypass = down
top	S5	[see Table 2]
top	S6	Null-a = up; Null-b = down
right	S7	Amplifier On = up; Amplifier Off = down

FIGURE 1: MINI-MWDX-6 PHASING UNIT
INPUT SECTION SCHEMATIC

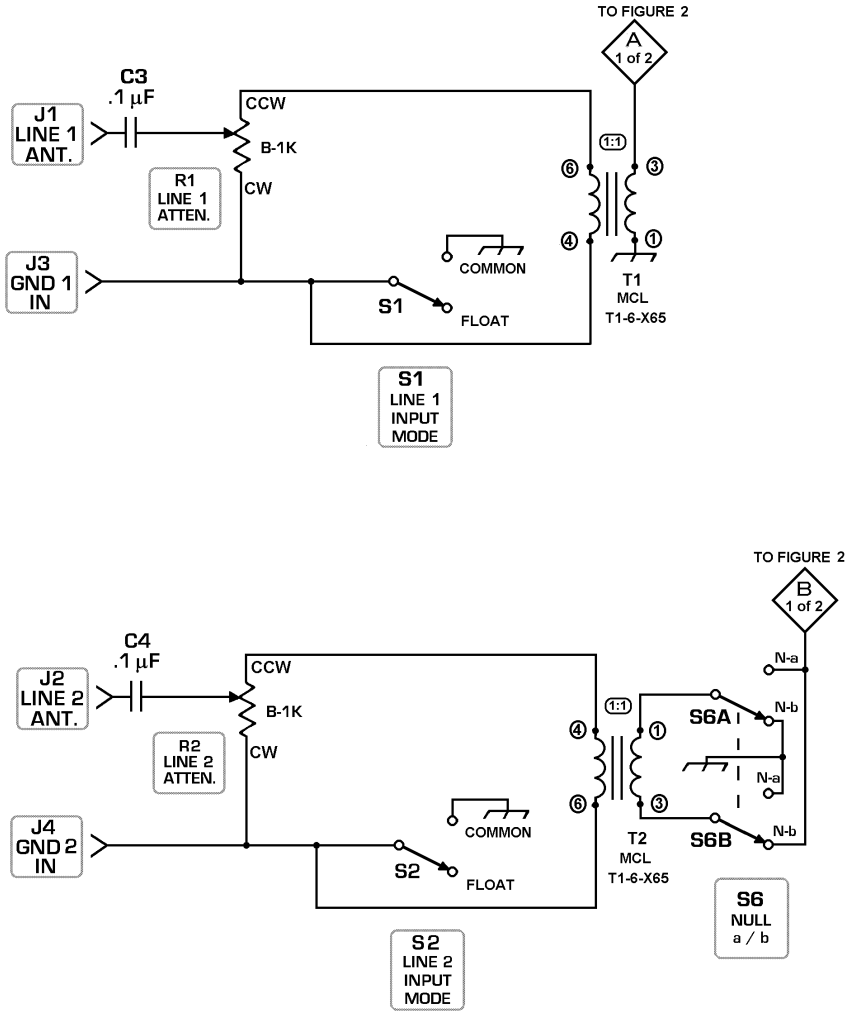

FIGURE 2: MINI-MWDX-6 PHASING UNIT
CENTRAL SECTION SCHEMATIC

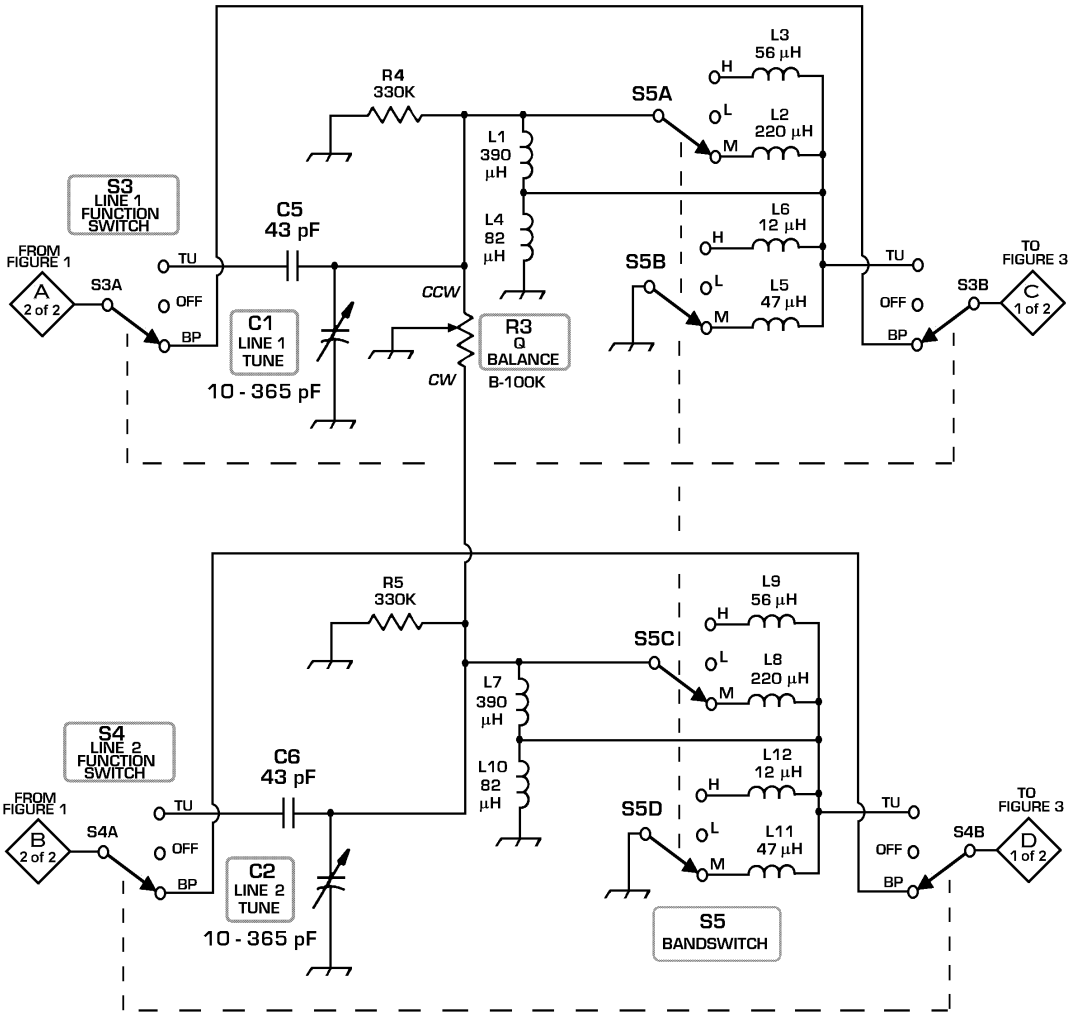

FIGURE 3: MINI-MWDX-6 PHASING UNIT OUTPUT SECTION SCHEMATIC

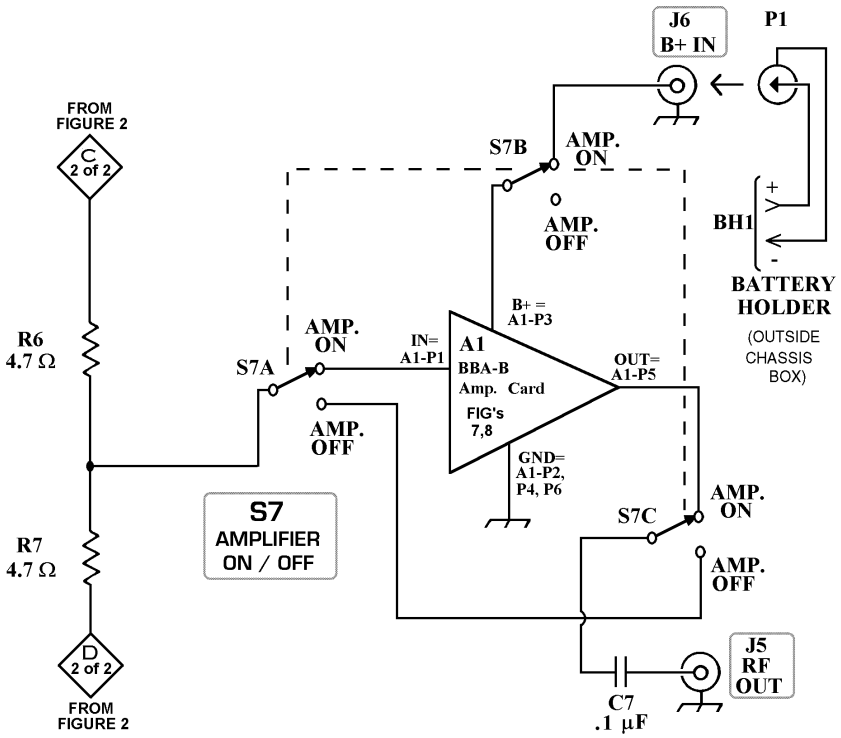

FIGURE 4: MINI-MWDX-6 CHASSIS PICTORIAL (TOP)

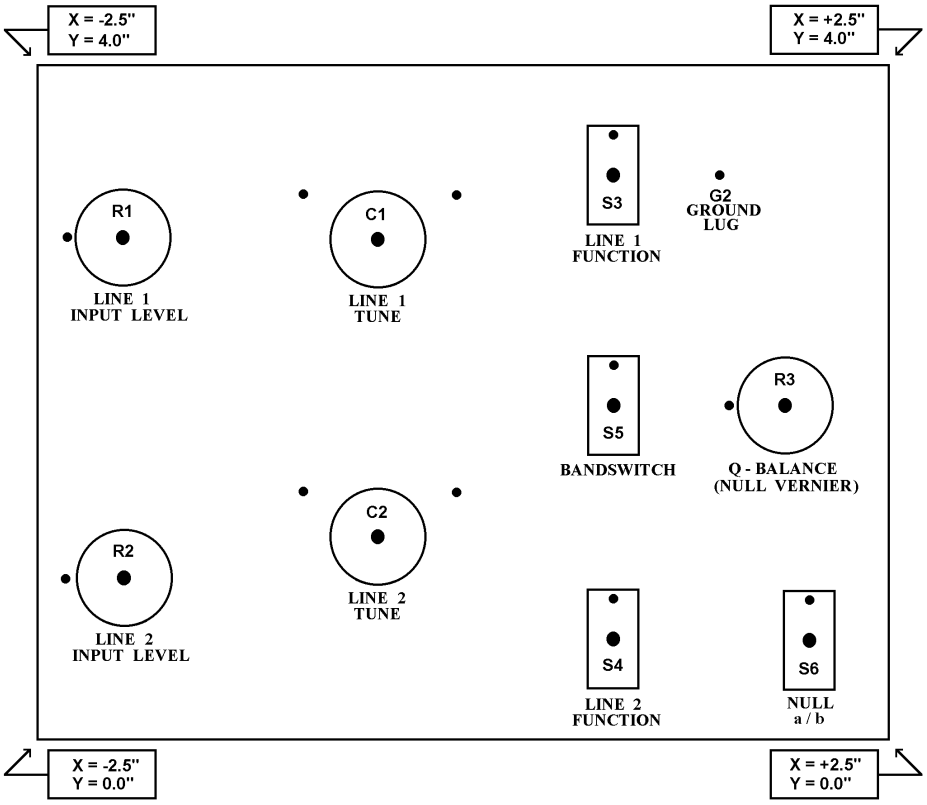

FIGURE 5: MINI-MWDX-6 CHASSIS PICTORIAL (LEFT, RIGHT SIDES)

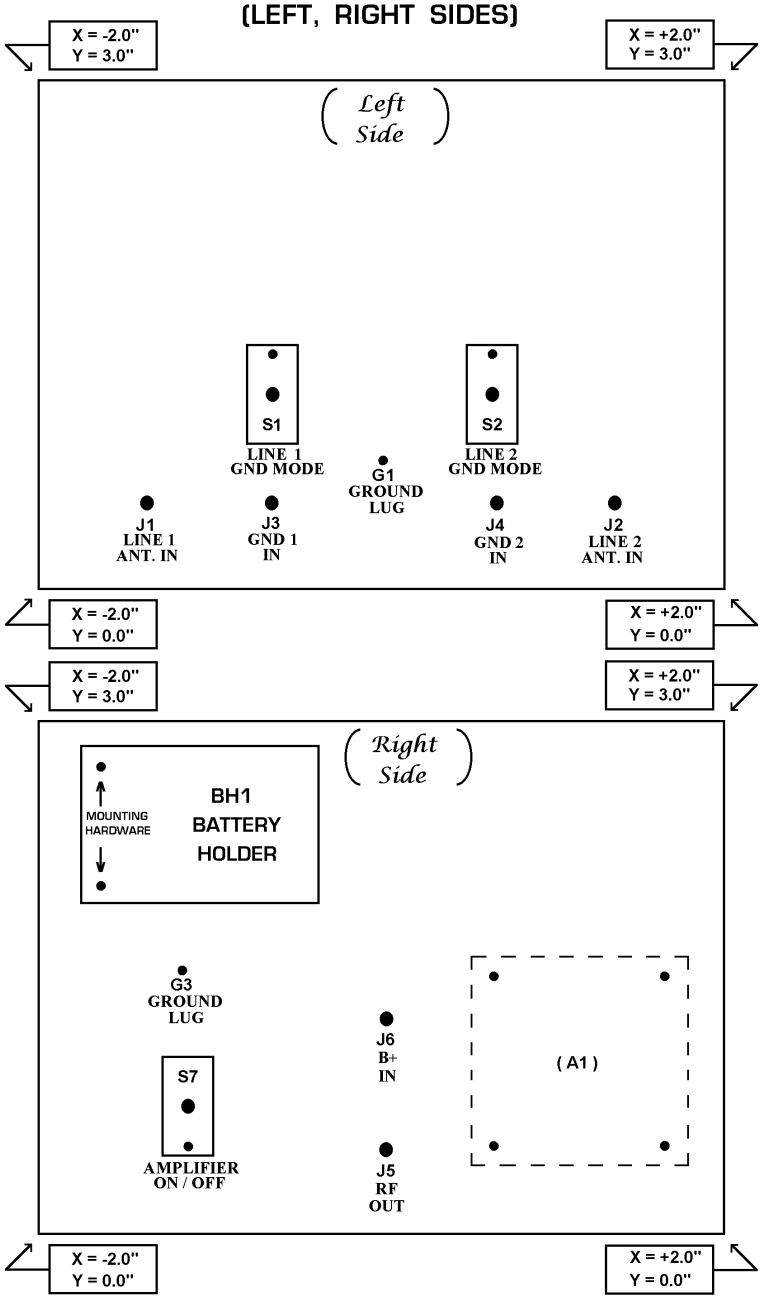

FIGURE 6: MINI-MWDX-6 ASSEMBLY PICTORIAL
(SCALE IS APPROXIMATE)

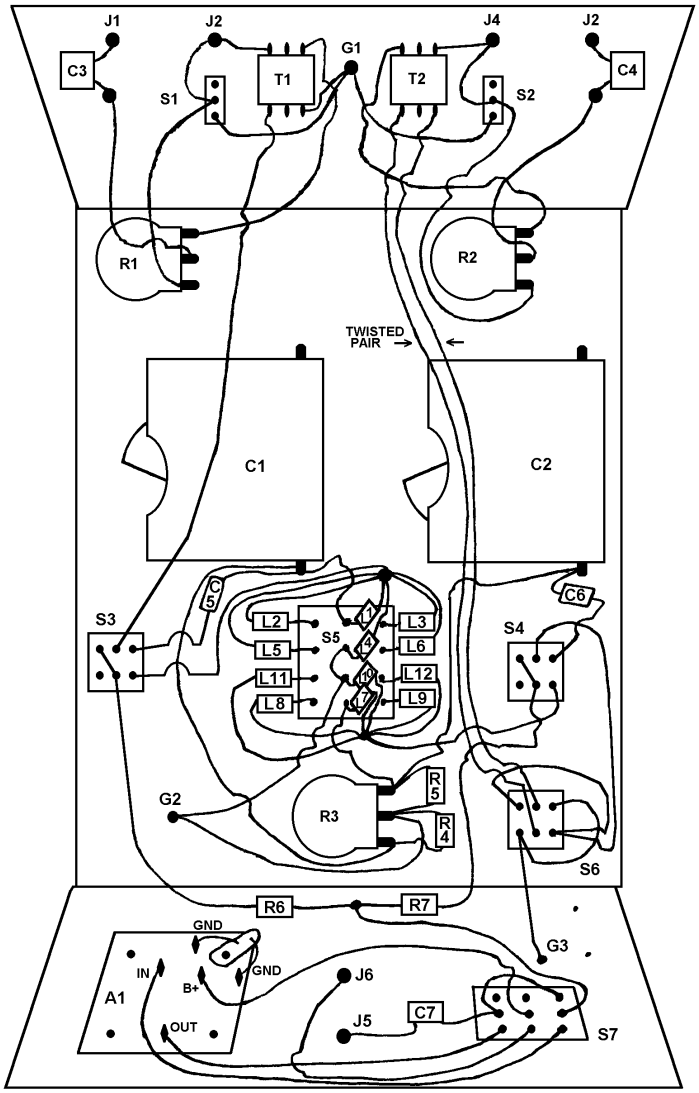

FIGURE 7 - MINI - MWDX- 6 PHASING UNIT - A1 SUBASSEMBLY

BBA-B BROADBAND AMPLIFIER CARD - SCHEMATIC DWG.

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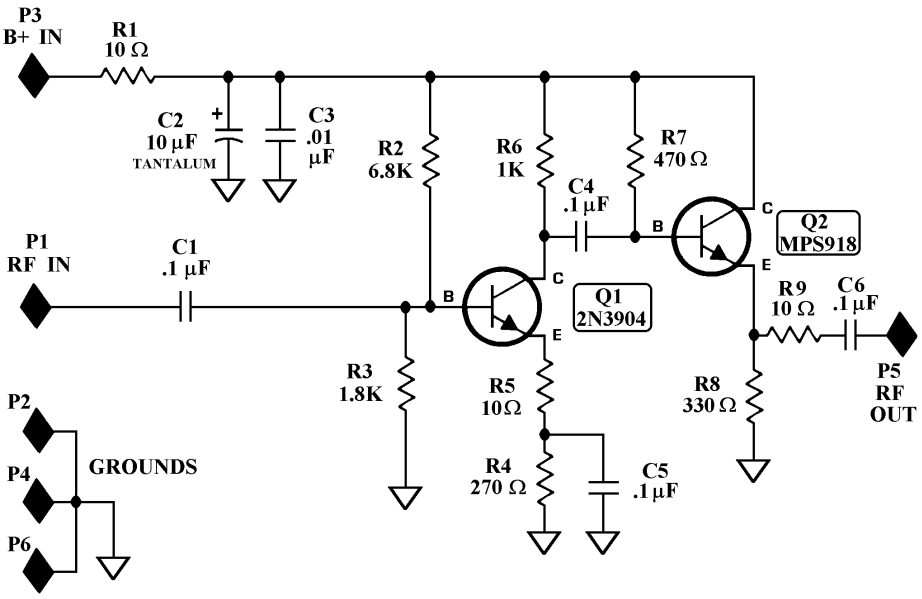

FIGURE 8 - MINI - MWDX- 6 PHASING UNIT - A1

BBA-B BROADBAND AMPLIFIER CARD: ASSEMBLY

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