DXP-1 DXpedition Phasing Unit

Mark Connelly, WA1ION - 12 JAN 1999

Phasing units of various types have been in use by medium wave DXers for at least 35 years, since the era of Gordon Nelson and Bill Bailey (and possibly before that). The devices have proved to be very valuable tools in the serious DXer's interference-fighting arsenal. Reprints of many designs may be obtained from the National Radio Club [***reference 1***]. The object of phasing units, as different as the individual designs may be, has always been to combine the contributions of two antennas at a 180 degree phase relation in order to null out a dominant signal (or noise) and let otherwise-inaudible weaker co-channel and adjacent channel signals come through.

The DXP-1 is intended to "pick up where the MFJ-1026 left off", namely coverage of the 100 to 2000 kHz frequency range.

DXP-1 provides features, such as tuning, that are not even available on a modified MFJ-1026 [***reference 2***].

At present (JAN 1999), "homebrewing" a unit such as the DXP-1, or modifying an MFJ-1026 (/ 1025), are the only phasing unit options open to LF and MF DX enthusiasts in the USA and Canada.

Al Merriman [***reference 3***] has been modifying MFJ phasers; contact him if you're interested in going this route. He might even be able to build homebrew design units for DXers as well. The JPS ANC-4 is another option, but it has been noted in some cases to have overload problems and hit-or-miss nulling below 2 MHz. In many countries there is another option: the Wellbrook APU 100, built in the UK (but presently not exported to the USA or Canada). Andy Ikin of Wellbrook [***reference 4***] can supply additional information.

It is sincerely hoped that MFJ, JPS, Kiwa, or some other competent DX-accessory manufacturer will soon produce a good longwave / medium wave phasing unit for US and Canadian DXers.

DXP-1 grew out of a need to simplify a larger unit, the Superphaser-1, for easier assembly and uncomplicated operation on DXpeditions where DXing is often done in a vehicle with less-than-optimum lighting, space, and temperature conditions.

Keeping the size of the unit compact (chassis: 5 x 4 x 3 in. / 12.7 x 10.16 x 7.62 cm) makes it a good candidate for DXpeditions involving air travel.

Phase shifting is wideband in nature: this is similar to the MFJ models, the Sherwood QRM Eliminator, and delay-line d-i-y models like the DL-2 and the (Gerry Thomas) Phase One.

Unlike R-L-C tank-circuit shifted models (the Nelson and early Connelly units), a null set up in a given direction is often effective plus or minus 100 kHz or more from the set-up frequency.

After the summation point, amplification can be broadband for rapid operation, quick checking of parallel frequencies, etc. Alternately, tuned operation may be used for improved sensitivity and signal-to-noise ratio, Tuned operation is especially beneficial with low to moderate priced receivers, particularly portables from Sony, Sangean, Grundig, et al.

There are two tuned modes. Mode TM1 places the varactor tuning capacitance in a series configuration for maximum signal transfer. Mode TM2, shunt (i.e. parallel) variable capacitance, provides a bit less signal coupling, but offers somewhat better freedom from spurious responses in high-signal areas such as cities. The TM2 mode also provides sharper tuning (higher "Q").

Frequency ranges are as noted in Table FR-DXP1.

Table FR-DXP-1

S4 to TM1; S3 to position noted

S3 = 1	145 to 300 kHz
S3 = 2	300 to 570 kHz
S3 = 3	570 to 1070 kHz
S3 = 4	1070 to 1900 kHz
S3 = 5	1900 to 3650 kHz
S3 = 6	3650 to 6300 kHz

S4 to TM2; S3 to position noted

S3 = 1	95 to 150 kHz
S3 = 2	150 to 290 kHz
S3 = 3	290 to 475 kHz
S3 = 4	475 to 950 kHz
S3 = 5	950 to 1550 kHz
S3 = 6	1550 to 3000 kHz

OPERATING THE DXP-1

Initial set-up:

Connect a passive (unpowered) antenna to J1, or connect an active antenna (such as an MFJ-1024 whip) to J3.

Connect the second antenna to J2 (if passive) or J4 (if active).

Connect a DC power source of +12 volts (min.) to +18 volts (max.) to J5.

Connect the receiver, via coaxial cable, to J6.

Set R1 and R2 fully clockwise and set R3 to center. Set S1 to 1.

Set S3, initially, to the position for the operating frequency as indicated in the TM1 section of Table 1.

If untuned (broadband) operation is desired, set S2 to BB (broadband) and skip over the "Tuning" part of this

procedure.

Tuning:

Set S2 to TUN (tuned). In most areas S4 can be set to TM1 for maximum system sensitivity. In strong signal areas, the TM2 setting of S4 may be preferable.

Ensure that S3 is set for the desired frequency range, in accordance with Table 1. Adjust R4 for maximum signal level (peak).

Amplitude Balancing:

With S1 on 1, observe the level of the dominant signal (or noise) to be nulled. Also do this with S1 on 2.

If the signal level had been greater in the S1 = 1 position, adjust R1 so that the signal level measured with S1 on 1 is equal to that obtained with S1 on 2.

Conversely, if the signal level had been greater in the S1 = 2 position, adjust R2 so that the signal level measured with S1 on 2 is equal to that obtained with S1 on 1.

Nulling:

NOTE: To get used to nulling, initially attempt it on steady daytime medium wave signals before trying it at night.

Set S1 to Null-a and adjust R3 for the best reduction of the dominant signal to be removed. Also do this R3 adjustment with S1 set to Null-b. Leave S1 on the null position which gave the deeper, better-defined null.

Finish up the null by small interactive adjustments of R3, R1, and R2. Occasionally it may help to go back to the "Amplitude Balancing" section and proceed forward from there.

References cited:

[1] National Radio Club

web = http://nrcdxas.org

[2] MFJ modification article

web = http://www.nordicdx.com/antenna/special/mfj1026.html

[3] Al Merriman, K4GLU

e-mail #1 = merriman@shore.intercom.net

e-mail #2 = k4glu@yahoo.com

[4] Andrew Ikin - Wellbrook Communications, UK

e-mail #1 = aikin@globalnet.co.uk

e-mail #2 = andrew.ikin@baedsl.co.uk

DXP-1 CONSTRUCTION DATA

Table HL-DXP-1: DXP-1 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: 5" X 4" X 3"

LEFT SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	J1	Line 1 Passive Ant.In (BNC-f)	-1.25	1.0625	0.375
2	J3	Line 1 Active Ant.In (BNC-f)	-0.75	0.4375	0.375
3	G1	grounding H/W - int.&ext.lug	0.0	0.4375	0.125
4	J4	Line 2 Active Ant.In (BNC-f)	0.75	0.4375	0.375
5	J2	Line 2 Passive Ant.In (BNC-f)	1.25	1.0625	0.375

TOP SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	S3	Bandswitch - tab	-1.6875	3.5	0.125
2	S3	Bandswitch - shaft	-1.6875	3	0.375
3	S1	Input Select switch - tab	-1.6875	1.5	0.125
4	S1	Input Select switch - shaft	-1.6875	1	0.375
5	R1	Line 1 Level pot - tab	-0.75	3.25	0.125
6	R1	Line 1 Level pot - shaft	-0.4375	3.25	0.3125
7	R3	Phase Null pot - shaft	-0.625	2	0.3125
8	R3	Phase Null pot - tab	-0.625	1.6875	0.125
9	R2	Line 2 Level pot - shaft	-0.4375	0.625	0.3125
10	R2	Line 2 Level pot - tab	-0.125	0.625	0.125
11	M1	Line 1 phase-shift card H/W	0.375	3.125	0.125
12	S2	Function switch - tab	0.375	2	0.125
13	S2	Function switch - shaft	0.625	2	0.25
14	M2	Line 2 phase-shift card H/W	0.375	0.875	0.125
15	S4	Tuning Mode switch - tab	1.75	3.5	0.125
16	S4	Tuning Mode switch - shaft	1.75	3.25	0.25
17	R4	Tuning pot - shaft	1.75	2.125	0.3125
18	R4	Tuning pot - tab	2.0625	2.125	0.125

RIGHT SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	A1	BUF-B amplifier card - H/W 1	-1.0625	2.4	0.125
2	A1	BUF-B amplifier card - H/W 2	-1.0625	0.4	0.125
3	J6	RF Out (BNC-f)	0.0	0.5	0.375
4	J5	B+ In (RCA-f)	0.75	0.875	0.25
5	G2	grounding H/W - int.&ext.lug	1.3125	0.875	0.125

Vendor Codes for Parts Lists

CS = Circuit Specialists = http://www.cir.com/

MCL = Mini-Circuits = http://www.minicircuits.com/

MOU = Mouser = http://www.mouser.com/

RS = Radio Shack = http://www.radioshack.com/

TA = Tech America = http://www.techam.com/

Table PL-DXP-1

DXP-1 DXpedition Phaser upper level parts list

* = A note relating to this item follows the parts list.

Item	Designator	Description / Value	Vendor	Vendor Stock #	QTY
1	A 1	BUF-B amp. card	>>>	see Table PL-BUF-B	1
2	C 1-8	capacitor, 0.1 uF	MOU	539-CK05104K	8
3	C 9,10,11	capacitor, 200 pF	CS	DM10-201J	3
4	C 12	capacitor, 150 pF	CS	DM10-151J	1
5	C 13,14	capacitor, 0.001 uF	MOU	581-EXCD102J	2
6	C 15,16	capacitor, 390 pF	CS	DM10-391J	2
7	D 1 *	varactor, MVAM108	TA	900-5704	1
8	G 1,2	screw, 4-40 X.375"	MOU	572-01881	2
9	G 1,2	hex nut, 4-40	MOU	572-00484	2
10	G 1,2	solder lug, #4	MOU	534-7311	2
11	H misc. *	screw, 4-40 X .25"	MOU	572-01880	4
12	H misc. *	split lockwasher,#4	MOU	572-00649	4
13	J 1-4,6	BNC jack	RS	278-105	5
14	J 5	RCA phono jack	RS	274-346	1
15	L 1	inductor, 4.7 mH	MOU	434-1120-473K	1
16	L 2	inductor, 1.5 mH	MOU	434-1120-153K	1
17	L 3	inductor, 470 uH	MOU	43LR474	1
18	L 4	inductor, 150 uH	MOU	43LR154	1

19	L 5	inductor, 47 uH	MOU	43LR475	1
20	L 6	inductor, 15 uH	MOU	43LR155	1
21	M 1,2	PH-A phase card	>>>	see Table PL-3	2
22	R 1,2,3	pot., 1K, linear	MOU	31CN301	3
23	R 4	pot., 50K, linear	MOU	31CN405	1
24	R 5,6,7	resistor, 15 ohm	CS	RA15	3
25	R 8	resistor, 33K	CS	RA33K	1
26	RFC 1,2	RF choke, 2.2 mH	TA	900-4895	2
27	RFC 3	RF choke, 10 mH	MOU	434-1120-104K	1
28	S 1	switch/3pole/4pos.r	MOU	10YX034	1
29	S 2	switch,3PDT,on-off-on	CS	8305	1
30	S 3	switch/4pole/6pos.r	MOU	10WR046	1
31	S 4	switch,DPDT,on-on	CS	8011	1
32	T 1	RF transformer,1:1	MCL	T1-6-X65	1
33	U 1	voltage reg., 10 V	MOU	511-L78M10CV	1
34	- *	knob (0.94" dia.)	MOU	45KN013	6
35	-	chassis box 5X4X3"	MOU	537-TF-779	1

Misc. items: hook-up wire, buss wire, solder, labels "AS REQUIRED"

notes -

*Item 7: Motorola MVAM109 or Siemens BB112 may be substituted directly. NTE618 may be substituted if the maximum control voltage is raised from +10 VDC to approximately +11 VDC.

*Item 11: one each for M1, M2 mount; two for A1 mount

*Item 12: one each for M1, M2 mount; two for A1 mount

*Item 34: one each for R1, R2, R3, R4, S1, S3

Table PL-PH-A

PH-A Phase Shift card parts list

Item	Designator	Description / Value	Vendor	Vendor Stock #	QTY
1	BD	perfboard:1.0"X0.8"	RS	276-1396 (cut)	1
2	C1	capacitor, 200 pF	CS	DM10-201J	1
3	H1	screw, 4-40 X .25"	MOU	572-01880	1
4	H1	spacer, 4-40 X .5"	MOU	534-1450C	1
5	H1	solder lug, #4	MOU	534-7311	1
6	P1-5	flea-clip/.042 hole	MOU	574-T42-1/100	5
7	R1,4	resistor, 33 ohm	CS	RA33	2
8	R2,3	resistor, 330 ohm	CS	RA330	2
9	T1	1:1 RF transformer	MCL	T1-6-X65	1

plus buss wire, solder "as required"

Table PL-BUF-B

BUF-B Buffer Amplifier card parts list

Item	Designator	Description / Value	Vendor	Vendor Stock #	QTY
1	BD	perfboard:1.4"X2.4"	RS	276-1396 (cut)	1
2	C1,5,9	capacitor, 0.01 uF	MOU	539-CK05103K	3
3	C2,3,4,7,8	capacitor, 0.1 uF	MOU	539-	5

				CK05104K	
4	C6,10	capacitor,10uF tant	MOU	581-10K35	2
5	H1,2	screw, 4-40 X .25"	MOU	572-01880	2
6	H1,2	spacer, 4-40 X .5"	MOU	534-1450C	2
7	H1,2	solder lug, #4	MOU	534-7311	2
8	P1-9	flea-clip/.042"hole	MOU	574-T42-1/100	9
9*	Q1	MOSFET, NTE222	MOU	526-NTE222	1
10	Q2	NPN, 2N5109	MOU	511-2N5109	1
11	R1	resistor, 330K	MOU	29SJ250-330K	1
12	R2	resistor, 51 ohm	MOU	29SJ500-51	1
13	R3,8	resistor, 270 ohm	MOU	29SJ250-270	2
14	R4	resistor, 100K	RS	271-1347	1
15	R5	resistor, 47K	RS	271-1342	1
16	R6	resistor, 680 ohm	RS	271-021	1
17	R7	resistor, 1K	RS	271-1321	1
18	R9,11,12	resistor, 4.7 ohm	MOU	295-4.7	3
19	R10	resistor, 39 ohm	MOU	29SJ500-39	1
20	RFC1	inductor, 2.2 mH	MOU	434-05-222J	1
21	T1	RF transformer, 4:1	MCL	T4-6T-X65	1

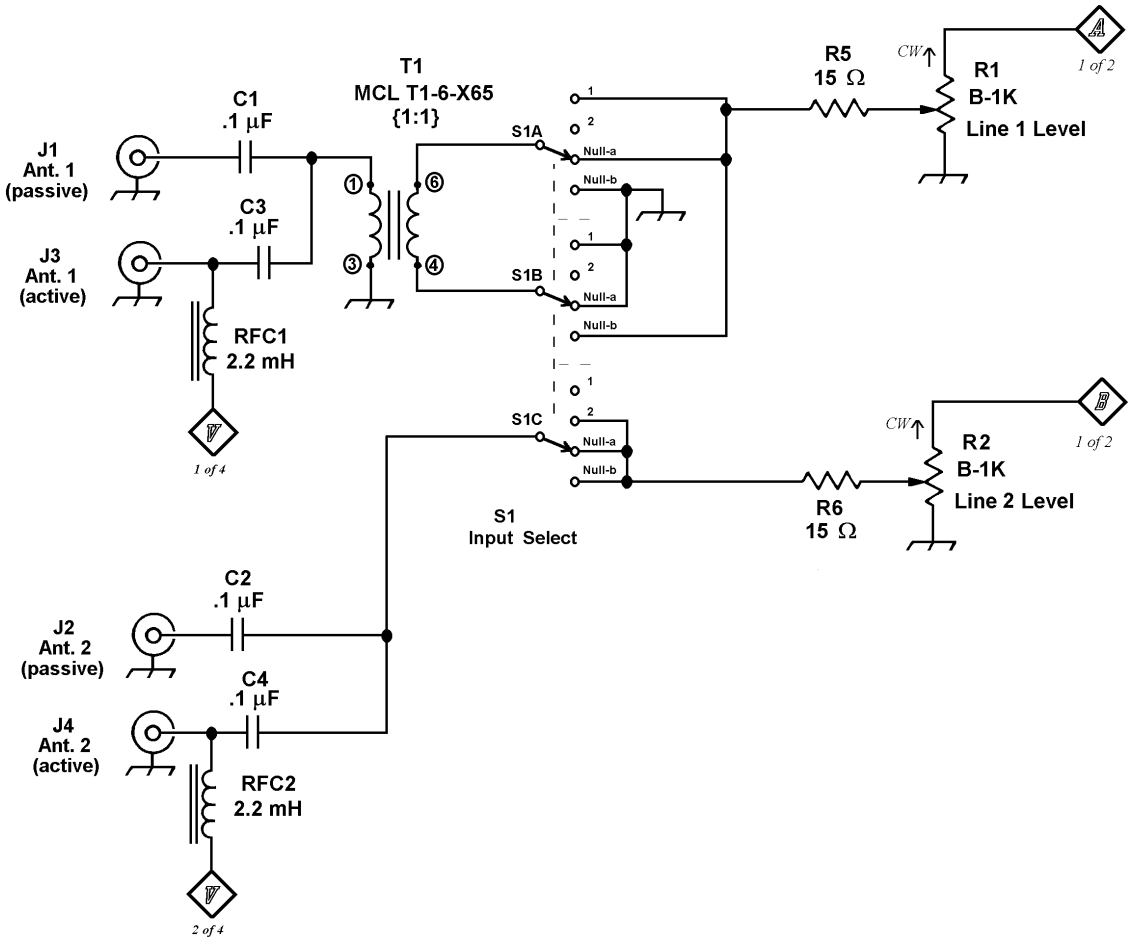
+ buss wire, solder - as required

* Item 9 - 3N201, 40673, or NTE454 may be substituted (Q1).

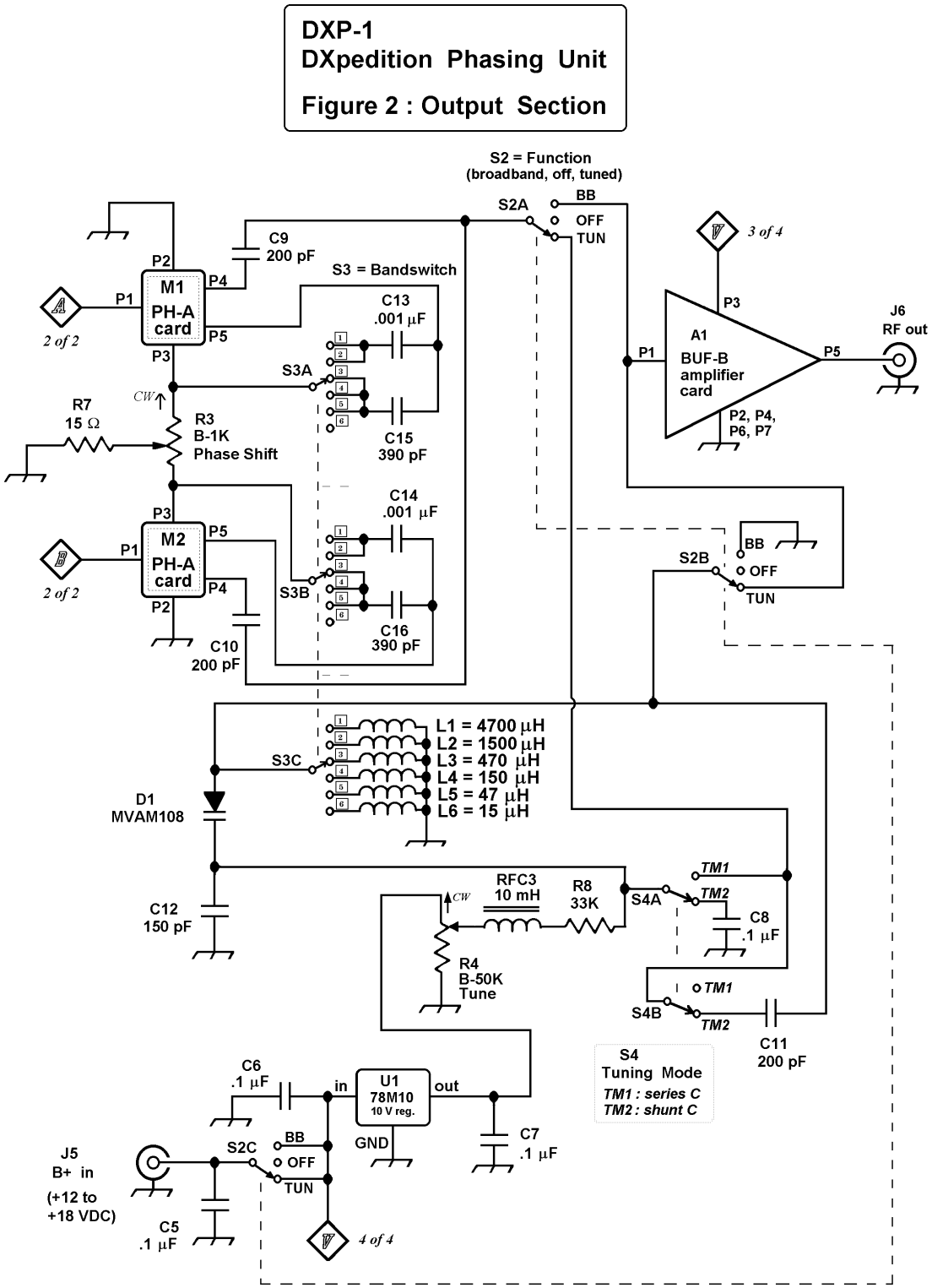
/* end of text; drawings follow */

DXP-1
DXpedition Phasing Unit

Figure 1 : Input Section



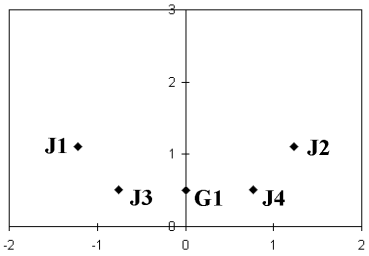
DXP-1 figure 1 above



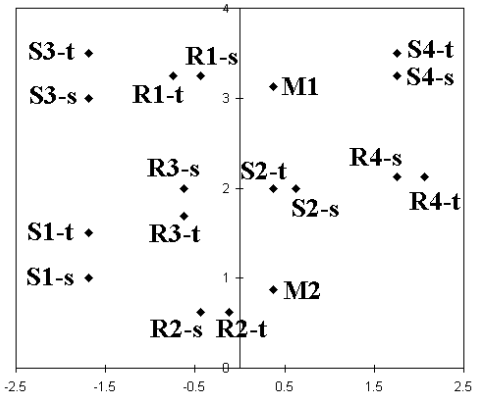
DXP-1 figure 2 above

DXP-1
DXpedition Phasing Unit
Figure 3 : Chassis Pictorials

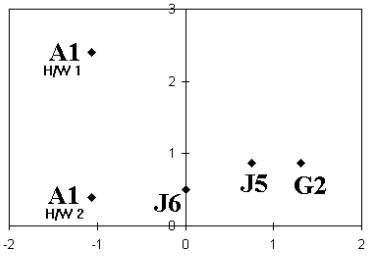
LEFT SIDE



TOP SIDE

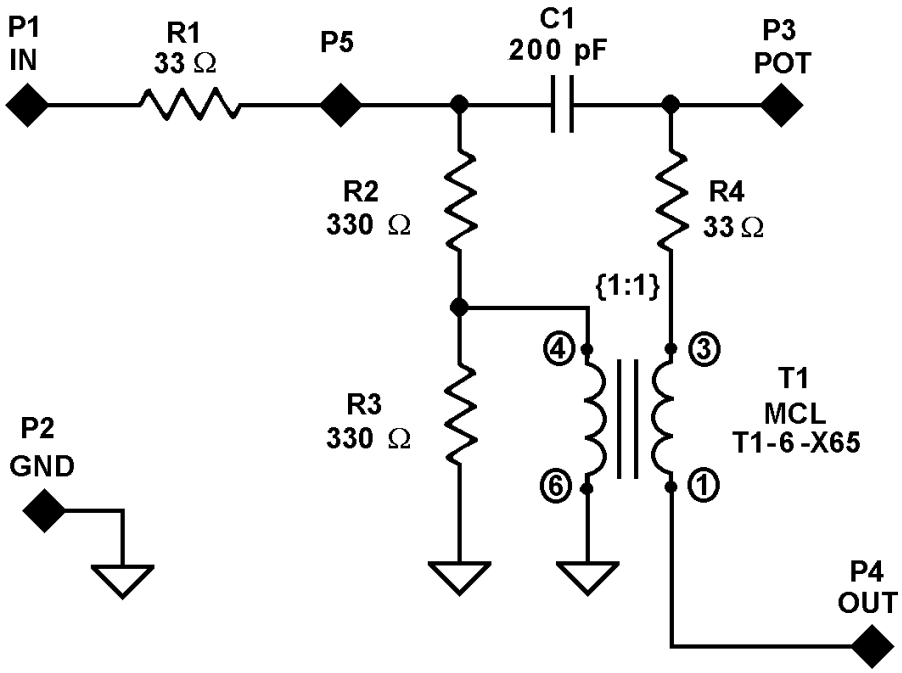


RIGHT SIDE



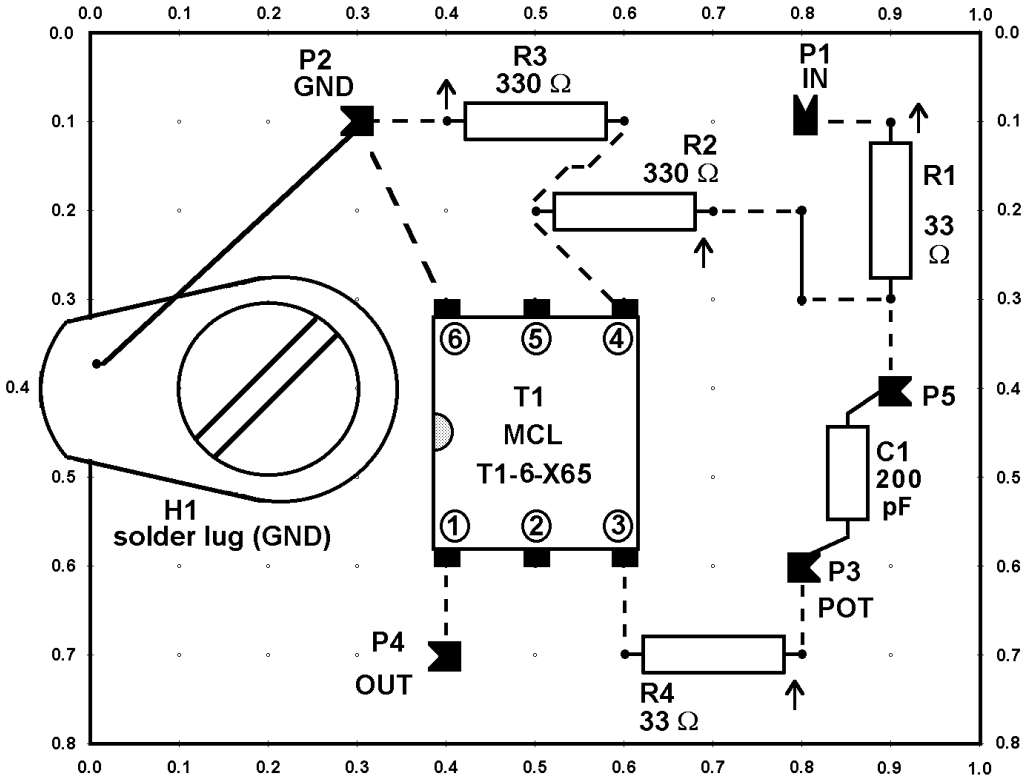
DXP-1 figure 3 above

PH-A PHASE SHIFT CARD
FIGURE 1: SCHEMATIC



PH-A figure 1 above

PH-A PHASE SHIFT CARD
FIGURE 2: ASSEMBLY



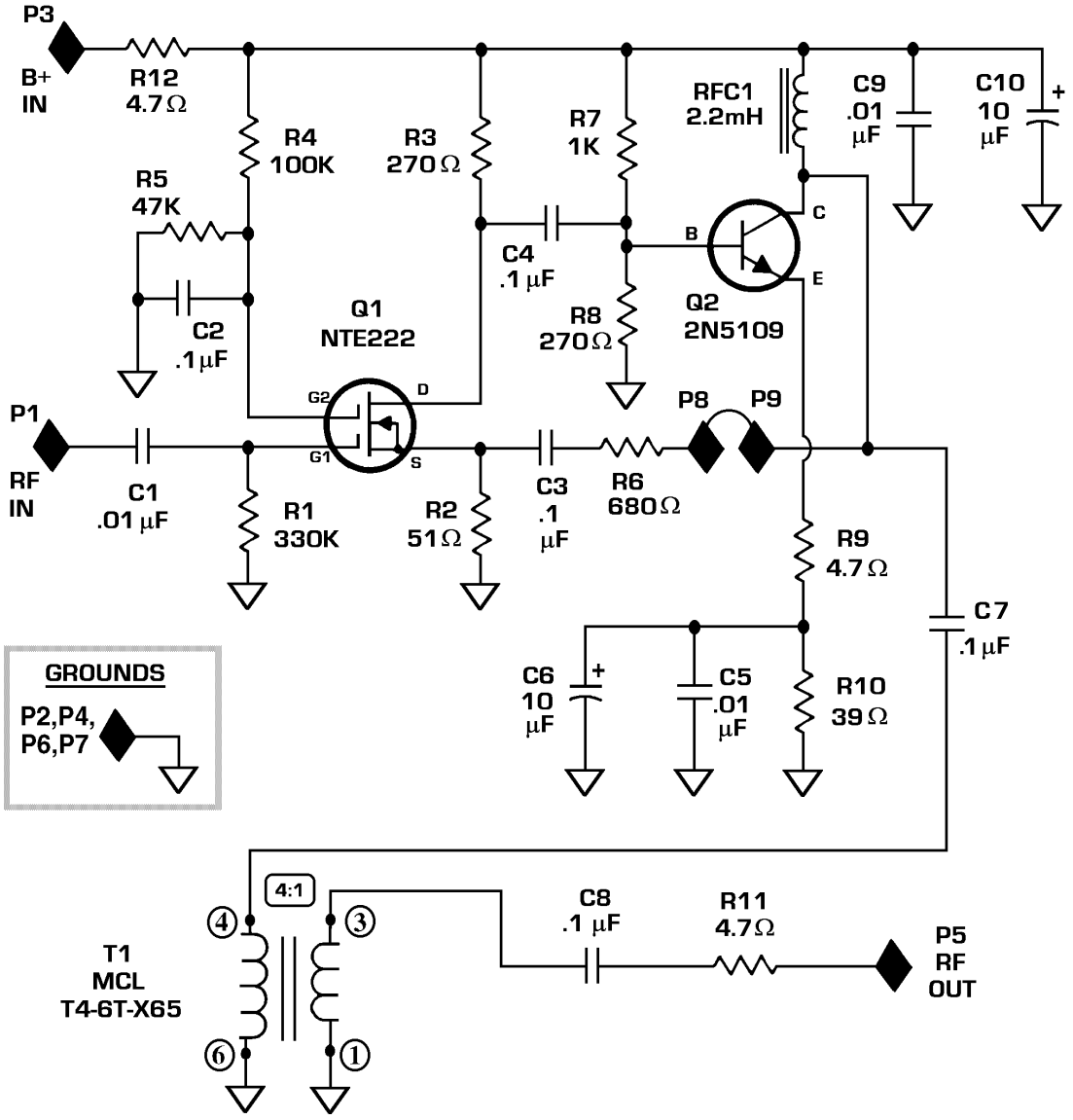
NOTES

↑ = long-lead side of vertically-mounted component

For schematic, see Figure 1.

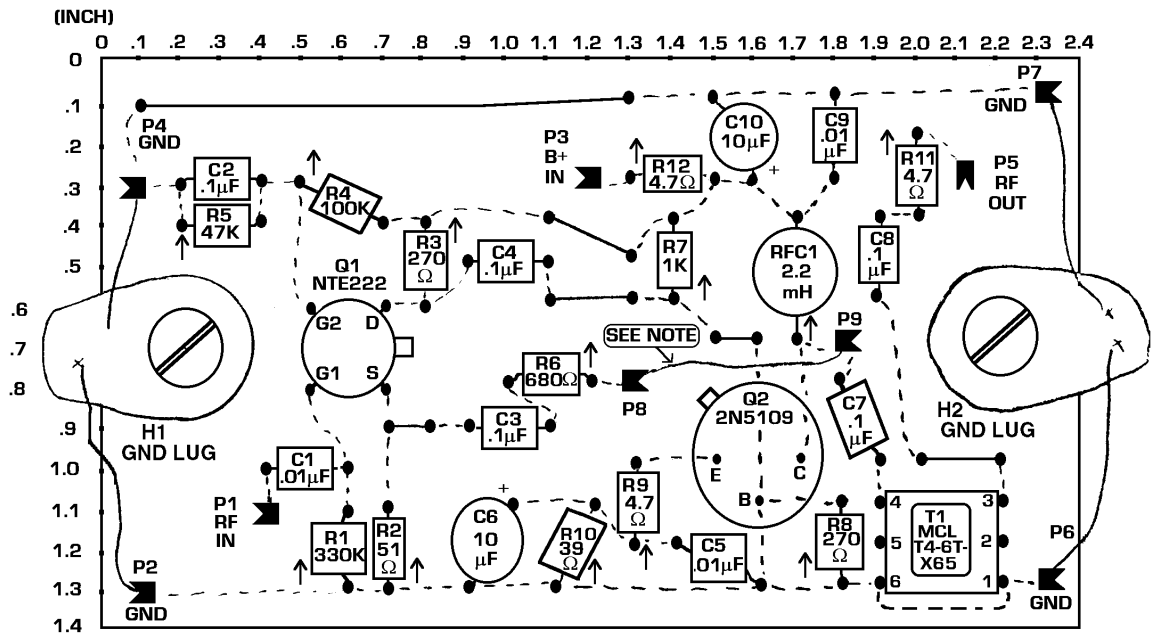
PH-A figure 2 above

SCHEMATIC: BUF-B BUFFER AMPLIFIER CARD



BUF-B figure 1 above

ASSEMBLY: BUF-B BUFFER AMPLIFIER CARD



Notes

↑ = Long lead side of vertically-mounted component
- - - = Buss wire on solder side of board
—— = Buss wire on component side of board
Wire from P8 to P9 should be insulated.

= "Flea clip" terminal pin
OPEN SIDE

BUF-B figure 2 above

/* end */