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The BBA-1 Broadband Amplifier

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A broadband amplifier is characterised by amplification at relatively constant gain over a wide band of frequencies.

This article provides documentation to assist the DXer in building and operating a broadband amplifier of proven ability, the BBA-1. This unit is in operation at the W. Yarmouth, MA foreign-DX monitoring station. A slightly different version is used at Neil Kazaross's QTH in Ogunquit, ME.

The BBA-1 provides approximately 15 dB of gain from 100 kHz to 30 MHz. Usable gain is influenced by source impedance, source noise, load impedance, battery voltage, and the spectral distribution of strong signals at frequencies other than that of operation.

A broadband amplifier can be used as a 'gain block'/gain 'black box' between a signal source and a receiver or other load. Aside from weak-station DX applications, the broadband amplifier can be used to boost small RF voltages to be observed on an oscilloscope or to boost baseband video signals.

In DXing applications, the broadband amplifier is of value in increasing the signal from passive wire tuners and from a loop antenna [whether the loop has its own built-in amplifier or not].

The author has found the Radio West & Palomar ferrite loops to have insufficient gain in some circumstances. Inclusion of the BBA-1 after these loops has allowed the 'dredging-up' of DX catches which would have otherwise been at the receiver noise floor.

In many situations, a wanted station (left after looping or phasing a pest) is too weak to give clear copy. There's much to be said for adding 2 or 3 S-units more gain to to the output of a passive loop or a small active loop. Addition of gain to passive phasing units is nearly mandatory, especially when wires considerably shorter than true Beverages are in use.

While it's true that substantial gain can be obtained from active tuners such as those of the APT series, it must be recalled that an active tuner has a fair number of controls to adjust. If you've just expended some DX time tweaking the controls on a loop or phaser for peaking & nulling, do you really want to tweak that many more things just to resurrect the weak wanted-station from the receiver noise?

DXing time for most of us is rather limited. The constraints of work & family life, the problem of RF interference, & the frequent lack of ionospheric cooperation in propagation viability greatly reduce the ability of DXers to log new stations efficiently.

When there is an opening, we want to extract as many stations as possible and, possibly, we still want to have some time to enjoy the programming content of the exotic signals coming in. Gathering details or taped audio for a reception report may be another way we wish to utilise the time. In short, time should be spent in direct listening-oriented activities, not in tweaking a confusing profusion of pots, switches, variable capacitors, & other assorted 'gizmotchies'. Using the broadband amplifier, with few controls to tweak, after a loop or phaser can speed up operating time considerably, when compared to using a tuned amplifier.

In certain instances, an untuned source (such as a short wire) may be inputted to the broadband amplifier: wideband amplification thereby provided can 'make the shortwire look like a longwire'. This can be of significant benefit to the DXer who is limited to use of an indoor antenna. Unlike the active-tuner approach to enabling shortwire usage, the BBA-1 scheme permits simultaneous boosting of all frequencies which may conceivably be used during a DX session.

There are limitations to how effective such a strategy can be, however. The principal limiting factor is the strong-signal-overloading consideration. Either the broadband amplifier or the receiver, or both, can be overloaded by strong signals on frequencies other than that of operation - with spurs, images, & cross-modulation as possible undesirable results.

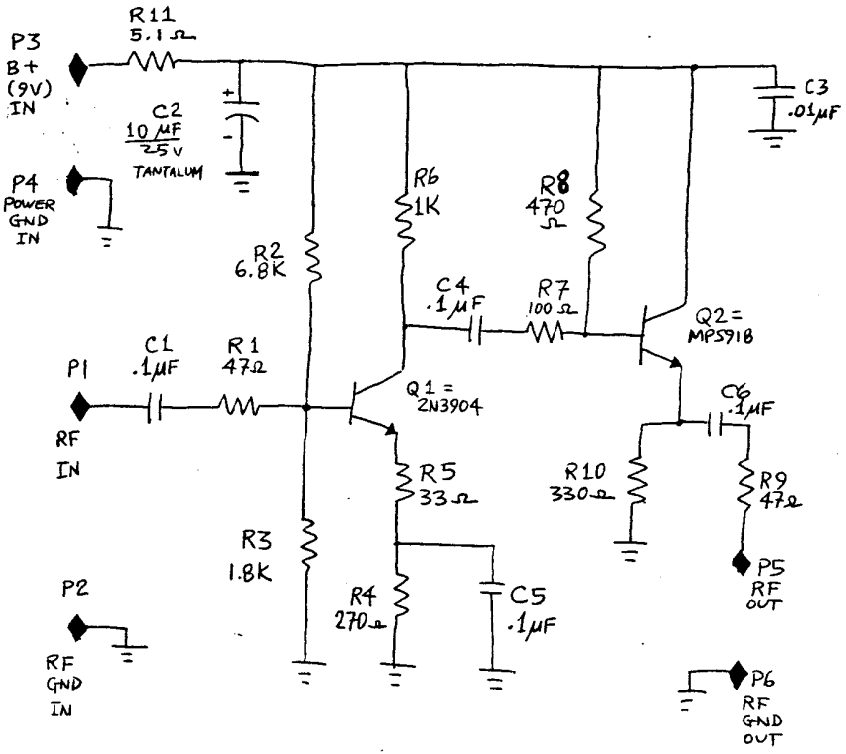
The broadband amplifier performs best when there is at least a modicum of pre-selection ahead of it. This may be in the form of an actual tank circuit (such as in a loop, tuner, or phaser) or it can be a wavetrap (useful for those with just one obnoxiously-loud local station) or it

FIGURE 2

BBA - A

SCHEMATIC: BROADBAND AMPLIFIER CARD SUBASSEMBLY

{A1 OF BBA-1}



NOTES

(1) FOR ROADMAP, SEE FIGURE 3

(2) FOR PARTS LIST, SEE TABLES 3 & 4

(3) COMPONENT DESIGNATIONS FOR THIS SUBASSEMBLY ARE A SEPARATE ENTITY FROM THE DESIGNATIONS OF MAIN-ASSEMBLY COMPONENTS.

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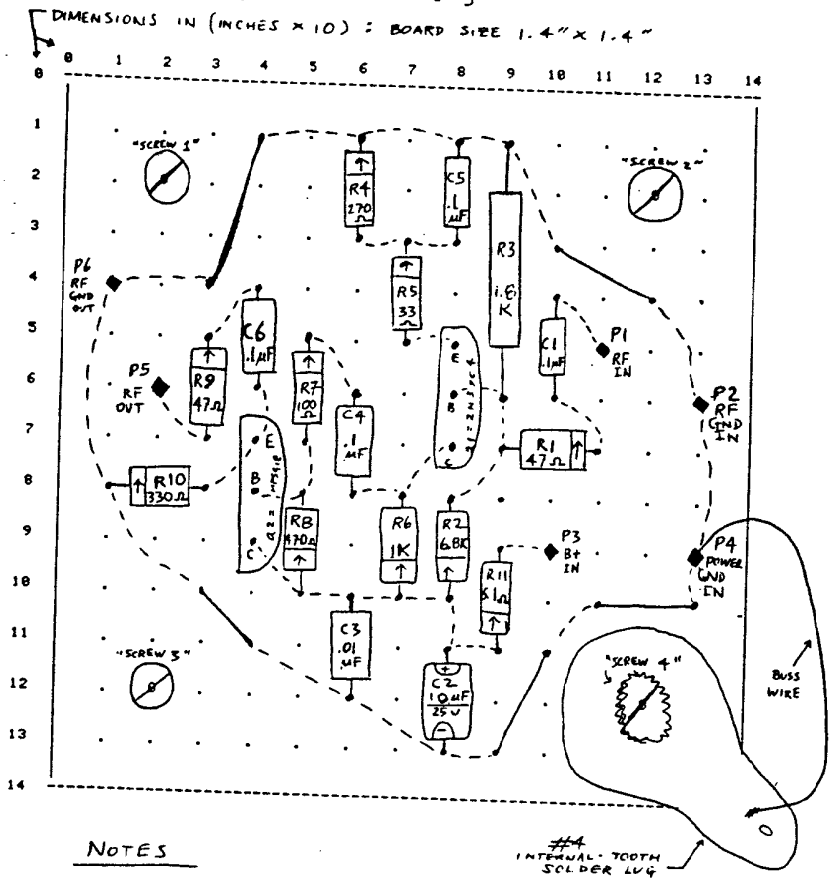
FIGURE 3

BBA - A

BROADBAND AMPLIFIER CARD ROADMAP

{ A1 OF BBA-1 }



NOTES

(1) FOR SCHEMATIC, SEE FIGURE 2

(2) FOR PARTS LIST, SEE TABLES 3 & 4

(3) END OF COMPONENT MARKED WITH ARROW (↑) INDICATES LONG-LEAD SIDE (→|) OF VERTICALLY-MOUNTED COMPONENT.

TABLE 1

BBA-1 Level 1 Parts List

A1	Broadband Amp. Card subass'y	[see Level 3,4 parts lists]
B1	9 volt battery	Duracell MN1604
C1	.1 uF ceramic	RS 272-135
C2	.1 uF ceramic	RS 272-135
C3	1000 pF feedthrough cap.	(Erie, Spectrum, or Tusonix)
J1	BNC jack	RS 278-105
J2	red binding-post banana jack	RS 274-662
J3	Motorola jack	RS 274-712
J4	black binding-post banana jack	RS 274-662
J5	BNC jack	RS 278-105
J6	Motorola jack	RS 274-712
J7	battery connector/holder	Acme Model Eng.[Ridgefield,NJ]
R1	A-10K pot	RS 271-215
R2	22 ohm	RS 271-005
S1	3PDT (on/off/on) toggle	Mouser 10TC285
-	hookup wire [as req'd]	RS 278-1296
-	busswire [as req'd]	RS 278-1341
-	RG174 coax.cable [as req'd]	Mouser 515-1156-12

TABLE 2

BBA-1 Level 2 Parts List

G1		4-40 X .25 screw	Mouser	529-Y4R4/100
G1		4-40 hex nut	Mouser	529-4CD/100
G1		#4 solder lug	Mouser	565-1416-4
G2		4-40 X .25 screw	Mouser	529-Y4R4/100
G2		4-40 hex nut	Mouser	529-4CD/100
G2		#4 solder lug	Mouser	565-1416-4
G3		4-40 X .25 screw	Mouser	529-Y4R4/100
G3		4-40 hex nut	Mouser	529-4CD/100
G3	[QTY=2]	#4 solder lugs	Mouser	565-1416-4
J3	[QTY=2]	6-32 X .375 screws	Mouser	529-Y6R6/100
J3	[QTY=2]	#6 lockwashers	Mouser	529-PLW6/100
J3	[QTY=2]	6-32 hex nuts	Mouser	529-6CDS/100
J6	[QTY=2]	6-32 X .375 screws	Mouser	529-Y6R6/100
J6	[QTY=2]	#6 lockwashers	Mouser	529-PLW6/100
J6	[QTY=2]	6-32 hex nuts	Mouser	529-6CDS/100
J7	[QTY=2]	4-40 X .375 screws	Mouser	529-Y4R6/100
J7	[QTY=2]	4-40 hex nuts	Mouser	529-4CD/100
J7	[QTY=2]	#4 lockwashers	Mouser	529-PLW4/100
R1		knob	RS	274-416
-		chassis box	RS	270-238

TABLE 3

BBA-1 Level 3 Parts List

A1 Broadband Amp. Card (BBA-A) Subassembly (electrical)

C1	.1 uF monolithic	Digi-Key P4525
C2	10uF/25v tantalum	Digi-Key P2049
C3	.01 uF ceramic	RS 272-131
C4	.1 uF monolithic	Digi-Key P4525
C5	.1 uF monolithic	Digi-Key P4525
C6	.1 uF monolithic	Digi-Key P4525
Q1	2N3904	RS 276-1603
Q2	MPS918	Mouser 597-MPS918
R1	47 ohm	RS 271-1307
R2	6.8K	RS 271-1333
R3	1.8K	RS 271-1324
R4	270 ohm	RS 271-1314
R5	33 ohm	RS 271-007
R6	1K	RS 271-1321
R7	100 ohm	RS 271-1311
R8	470 ohm	RS 271-1317
R9	47 ohm	RS 271-1307
R10	330 ohm	RS 271-017
R11	5.1 ohm	Digi-Key 5.1Q

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TABLE 4

BBA-1 Level 4 Parts List
A1 Broadband Amp. Card (BBA-A) Subassembly (mechanical)

P1	pushpin 'flea-clip' terminal	RS 270-1392
P2	pushpin 'flea-clip' terminal	RS 270-1392
P3	pushpin 'flea-clip' terminal	RS 270-1392
P4	pushpin 'flea-clip' terminal	RS 270-1392
P5	pushpin 'flea-clip' terminal	RS 270-1392
P6	pushpin 'flea-clip' terminal	RS 270-1392
-	perfboard[cut to 1.4X1.4 in.]	RS 276-1395
-	[QTY=4] 4-40 X .375 spacers	Digi-Key J170
-	[QTY=4] 4-40 X .75 screws	Digi-Key H150
-	#4 solder lug	Mouser 565-1416-4
-	[QTY=7] #4 lockwashers	Mouser 529-PLW4/100
-	[QTY=4] 4-40 hex nuts	Mouser 529-4CD/100

TABLE 5

Hole list for BBA-1 Broadband Amplifier
(X=horiz.distance from vert. centreline:- = left of CL,+ = right)
(Y=vertical distance from lower horizontal edge of side observed)

LEFT SIDE

Hole	Comp.	Description	X(in.)	Y(in.)	DIA(in.)
1	J4	GNDin-blk banana jack	-0.75	1.25	0.3125
2	J2	ShortwireIn-red b. jack	-0.75	0.5	0.3125
3	G1	GND screw/int.lug	0.0	1.125	0.113
4	J1	RF Source In (BNC)	0.0	0.5	0.375
5	J3	car ant.jack,screw 1	0.75	1.288	0.14
6	J3	car ant.jack, body	0.75	0.894	0.14
7	J3	car ant.jack,screw 2	0.75	0.5	0.14

TOP

Hole	Comp.	Description	X(in.)	Y(in.)	DIA(in.)
1	S1	Function Switch, shaft	-1.375	2.125	0.25
2	S1	Function Switch, tab	-1.375	1.875	0.113
3	G2	GND screw/int.lug	-0.8125	1.5	0.113
4	R1	Level Pot, shaft	-1.375	0.75	0.3125
5	R1	Level Pot, tab	-1.0625	0.75	0.14
6	A1	BBA-A Amp. Card, screw 2	-0.25	2.0	0.113
7	A1	BBA-A Amp. Card, screw 1	0.75	2.0	0.113
8	A1	BBA-A Amp. Card, screw 4	-0.25	1.0	0.113
9	A1	BBA-A Amp. Card, screw 3	0.75	1.0	0.113
10	J7	BatteryHolder, screw 1	1.25	2.0	0.14
11	J7	BatteryHolder, screw 2	2.2188	1.125	0.14

RIGHT SIDE

Hole	Comp.	Description	X(in.)	Y(in.)	DIA(in.)
1	C3	B+ In feedthrough cap.	-0.75	0.5	0.188
2	G3	GND screw/int.&ext.lugs	0.0	1.125	0.113
3	J5	RF out (BNC)	0.0	0.5	0.375
4	J6	RF out to car RX, screw 1	0.75	1.288	0.14
5	J6	RF out to car RX, body	0.75	0.894	0.5
6	J6	RF out to car RX, screw 2	0.75	0.5	0.14

NOTE: Diameters of RIGHT SIDE hole 1 may vary depending upon C3 used. In general, it is wise to verify hole locations & sizes, based upon the components available at the time of BBA-1 construction.

Table 6: Wiring List for BBA-1

Connections using insulated, stranded hookup wire

(Outside BBA-1 chassis)

FROM	TO	LENGTH (inches)
J7 + terminal tab	C3 external lead	4.0
J7 - terminal tab	G3 external lug	3.0

(Inside BBA-1 chassis)

FROM	TO	LENGTH (inches)
J1	J3	1.5
R1 switch arm	R1 pot-CW pin	1.0
R1 pot arm	S1a arm	2.0
S1a bypass-position pin	S1c bypass-position pin	1.0
S1a on-position pin	A1 pin P1	2.0
S1b on-position pin	C3, internal lead	6.0
S1b arm	A1 pin P3	3.0
J5	J6	1.5

* ALL LEADS LISTED HEREAFTER ARE INSIDE CHASSIS BOX *

Connections using solid bare buss-wire

FROM	TO	LENGTH (inches)
J1	J2	1.0
J4	G1 internal lug	1.0
lug at A1 card screw 4	A1 pin P4 [see Fig. 3]	1.0

Connections using RG174 coaxial cable

LEAD	FROM	TO	LENGTH (inches)
Centre Conductor	S1c arm	J5	6.0
Shield	G2 int. lug	G3 internal lug	6.0
Centre Conductor	S1c on-pin	A1 pin P5	4.0
Shield	G2 int. lug	A1 pin P6	4.0

'Air-Wired' components (for values see Fig. 1)

* USE SHORTEST POSSIBLE LEAD LENGTHS *
* USE 'SPAGHETTI' INSULATION ON BARE COMPONENT LEADS*

FROM	COMPONENT	TO
R1 switch, non-CCW pin	R2 + C2	G1 internal lug
J1	C1	R1 pot-CCW pin

BBA-1 Construction Strategy Abstract

The schematics, A1 roadmap, parts lists, hole list, and wire list should be enough information for an experienced builder. The APT-2 Active Tuner article is a useful reference for construction practices - indeed, allusions to that article will occasionally be made in order to keep BBA-1 construction details brief.

The BBA-1 is a good beginner's project. With that in mind, a short overview of construction steps is provided. The style is meant to be somewhat more cursory than the step-by-step hand-holding approach of the APT-2 assembly instructions. Nonetheless, the following steps should be sufficiently specific --

[1] Organise work area. Acquire necessary parts & tools.

[2] Ascertain that hole list (Table 5) is correct for the components on hand. If deviations from the parts list have been made, changes to the hole list may be necessary.

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[3] Mark hole locations on chassis box: Use an accurate ruler. Mark hole locations with a sharp scriber.

[4] Drill all holes. Holes of .25 in. diameter or greater should initially be drilled with a smaller bit.

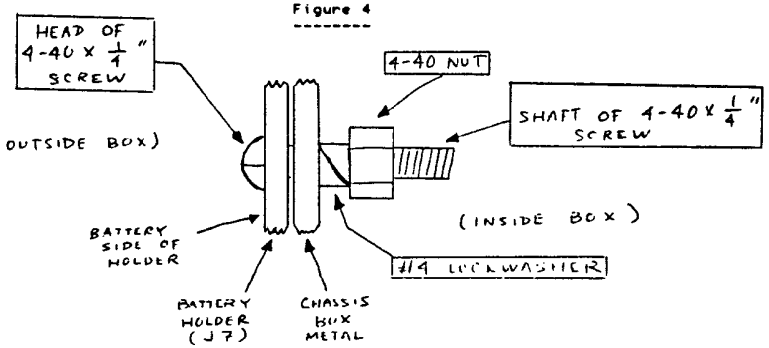
[5] Mount C3, J1, J2, J4, J5, R1, & S1 by using the hardware supplied with these components. Install knob on R1.

[6] Install grounding hardware assemblies G1, G2, & G3 at locations called out in Table 5. G1 & G2 should look like APT-2 article Figure 10; G3 should look like APT-2 article Figure 11.

[7] Install the two car jacks (J3 & J6). Mounting holes are Left Side holes 5 & 7 and Right Side holes 4 & 6. Use a 6-32 x .375 screw, #6 lockwasher, & 6-32 nut at each mounting hole. Refer to APT-2 article Figure 14.

[8] Install J7 Battery Holder: orient it so that the terminals are pointed towards the lower edge of the chassis Top Side. Mounting holes on the holder should line up with Top Side holes 10 & 11.
Hardware to be used at each hole should resemble Figure 4.

Figure 4

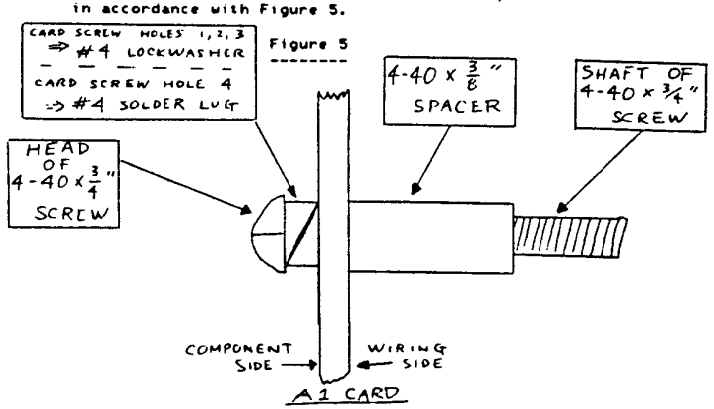


[9] Temporarily set the chassis box aside, until step 12.

[10] Assemble A1 Broadband Amplifier Card subassembly: see Figure 2 (schematic), Figure 3 (assembly layout 'roadmap'), and Tables 3 & 4 (parts lists).

[11] Mount hardware at four A1 card corner holes, in accordance with Figure 5.

Figure 5



[12] Place A1 assembly on inside of chassis box so that the shafts of the four screws (installed in step 11) protrude to the outside of the box through the holes *listed* by Table 5.

[13] On the shaft of each protruding A1 screw outside the box, install (first) a #4 lockwasher & (second) a 4-40 hexnut. Torque the nuts tight with a nutdriver.

[14] Mechanical assembly of components is completed at this point. Wire up the unit: use Table 6 as your reference. The APT-2 article contains possibly-useful information regarding the preparation of coaxial leads.

[15] At this juncture, BBA-1 is completed. Check workmanship carefully, then attach bottom chassis box cover with the sheet-metal screws provided.

Using the BBA-1 Broadband Amplifier

Operation of the BBA-1 is very simple: A source is connected to J1, J2, or J3; and a load (usually a receiver) is connected to J5 or J6. Loads must be connected via coaxial cable and steps must be taken to prevent coupling of the amplifier's output back to its input. Receivers used should preferably be of shielded, metal-case construction.

As mentioned earlier, an untuned SHORT wire aerial is a possible signal source. Even wires shorter than 10 m/ 33 ft may produce overloading at urban locations with R1 set for maximum level. R1 can be tweaked to bring the spurs under control, but in any event wires much longer than 10 m are not recommended at any location, urban or rural. The BBA-1 should be thought of as an untuned-shortwire booster primarily for stations from 3 to 30 MHz. Even in that range, use of a tuner for preselection helps, especially in removing possible FM & TV station mixing spurs.

On long-wave & medium-wave, the active-tuner (APT-2, APT-3) approach is still the best way to get good signals from short wires.

The BBA-1 is of the greatest benefit to DXers as a booster for the outputs of loops, passive tuners, and phasers.

The following procedure should illustrate the simplicity of the unit --

1.0 BBA-1 OPERATION
(Connect source, load as mentioned at beginning of 'Using the BBA-1' section.)

1.1 Initially set S1 to Bypass. This routes the input directly (through R1 level-pot & DC-blocking cap. C1) to the output. Set R1 to fully CCW (max. level).

1.2 If the source is tunable, perform normal peaking steps.

1.3 If the source is meant to produce a null (e. g. loop, phaser), perform normal nulling steps.

1.4 If the desired signal is not weak, there's no need for amplification: you may stop at this step. If the signal is weak, use of the BBA-1 is indicated - proceed forward from this step.

1.5 Turn R1 to fully CW (min. level).

1.6 Set S1 to On.

1.7 Adjust R1 progressively CCW: the wanted-station should be heard. R1 can then be set at the most-CCW position yielding maximum desired-frequency signal, consistent with freedom from unwanted 'gremlins' (spurious signals, cross-modulation, oscillations, etc.).

(END)