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BUF-A Buffer Amplifier Card: A Valuable Building Block for DX Projects

Mark Connelly - WA1ION - 15 JUN 1992

My previous article "One-Chip Active Whips" mentioned the use of commercially-available buffer amplifier IC's that could be used instead of discrete-FET circuits in active whips. I have purchased some of these devices and tested them in real-life DXing situations as well as in laboratory tests for such characteristics as gain, noise, and strong-signal handling.

All buffer chips are not created equal. Most have no trouble handling big signal inputs up to 5 volts p-p (Vpp) with low distortion. It is in the weak signal end of things that these devices vary considerably. Those in DIP packages, especially those listed as being "monolithic" rather than "hybrid" in design and those designed to operate at relatively low maximum power supply rails (e. g. +/- 7 VDC), tend to be rather noisy. The VA033PJ (made by VTC) and the AD9630AN (made by Analog Devices) fall into this category. These amplifiers, therefore, are not recommended for use with short whips (less than 1 m. / 3.3 ft.) or with small ferrite loops. They could be used with larger whips and larger loops. Experimentation here has shown that the 12-pin round metal can (TO-8) devices, listed as "hybrid" and having wide power supply rail limits, are very quiet - indeed as good as, or better than, numerous discrete-FET designs that have served DXers well in the past.

The National Semiconductor LH0033CG and the Elantec ELH0033G performed admirably in quiet-site daytime field tests. Signal-to-noise results were comparable to discrete-FET amplifiers of several designs including Lankford, Connelly, Thomas, Sanserino, Hagan, and MFJ. Both loop and whip tests were performed deep in a pitch-pine woodland near the Shawsheen River in Billerica, MA suitably far from buildings and noisy power lines. Such field tests are necessary because the line-noise level at the house is too high for such stringent sensitivity evaluations. It is likely that other "0033" chips - e. g. Teledyne TP0033 - would perform similarly. Of the two 0033's tested, the National device is the cheaper: still, it costs a relatively high $ 15 (approximately). I got my LH0033CG from Gerber Electronics. Address and telephone information is shown in the parts list to follow. They will take personal checks and COD, but they have no credit card operation.

The LH0033CG-based buffer card (which I've designated BUF-A) clearly outperforms the vast majority of discrete-FET front-ends I've built when it comes to strong-signal handling (immunity to harmonic and intermodulation distortion). Now I've finally reached the point at which varactors used in remotely-tuned applications are the weaker link than the front-end card. (The varactors can still take a lot of "heat" before yielding any spurs.) Very weak WRKO-680 X 2 can be heard with WLYN-1360 nulled on a remotely-tuned loop with the BUF-A. With the BUF-A in a conventional tuning-capacitor (non-remote) loop, there is no evidence of a WRKO harmonic with WLYN nulled - only WDRC-1360 (Hartford, CT) is noted. Some discrete-FET amplifiers could not pass this daytime test, whether tuned by variable capacitors or by varactors.

When operated at B+ = 12.6 VDC (typical car cigarette-lighter jack output), an clean output of 6 Vpp is achievable. Scope tests show that higher supply voltage (up to 40 VDC) can yield even greater low-distortion output levels. Heat-sinking is advisable at high supply voltages. For continuous high signal level operation (urban sites), the National LH0063CK (at about twice the price of the LH0033CG) may offer slightly improved IMD performance for the perfectionist. The LH0063CK package is different, so card layout would have to be altered if that IC is to be used.

Documentation

Figure 1 shows the schematic of the BUF-A. Figure 2 shows the BUF-A component layout. Table 1 is a parts list. I adjusted some of the component values from those in the generic design of the "One-Chip Active Whips" article. These changes made subtle improvements to the signal-to-noise performance. Drawings in the appendices show some of the many applications for the BUF-A card that are of value to the DXer. These drawings should be thought of as sketches; not all component values and details are given. Functions shown include active whip, loop (remote and non-remote), broadband amplifier, and longwire preselector (tuner). Subsequent articles may be issued to develop some of these applications in greater detail.

Table 1: BUF-A parts list

Vendor codes:

GER = Gerber Electronics / 128 Carnegie Row / Norwood, MA 02062 / Tel. 1-617-769-4852, 769-6000

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

Item	Designator	Description/Value	Vendor	Vendor Stock #	QTY
1	BD	perfboard(1.2"X2.0")	MOU	153-1105 (cut)	1
2	C1	capacitor, 0.01 uF	MOU	539-CK05103K	1
3	C2	capacitor, 10uF tant.	MOU	581-10K35	1
4	C3	capacitor, 0.001 uF	MOU	539-CK05102K	1
5	C4,C5	capacitor, 0.1 uF	MOU	539-CK05104K	2
6	H1,H2	screw, 4-40 X .25"	MOU	572-01880	2
7	H1,H2	spacer, 4-40 X .5"	MOU	534-1450C	2
8	H1,H2	solder lug, #4	MOU	534-7311	2
9	P1-P7	flea-clip for .042 hole	MOU	574-T42-1/C	7
10	R1,R2	resistor, 680K	MOU	271-680K	2
11	R3	resistor, 100 ohm	MOU	271-100	1
12	R4,R5	resistor, 4.7 ohm	MOU	295-4.7	2
13	T1	RF transformer 4:1	MCL	T4-6T-X65	1
14	U1	buffer amplifier IC	GER	(National) LH0033CG	1

(+ buss wire, solder as required)

Table 2 - A Partial List of Commercially-Available Buffer IC's

Note: Not all have been tested. Some may be unsuitable because of a high noise floor or other reasons. The "0033's" and "0063's" are industry standards and, generally, have predictable, good-quality performance.

Analog Devices	AD9630AN, AD9620, ADLH0033
Analog Devices / PMI	BUF-03AJ, BUF-03EJ, BUF-03FJ
Burr Brown	3553AM, HOS-100, 3533
Comlinear	CLC110AJP
CTS	CTS0033
Elantec	ELH0033G, EL2005CG, EL2004CG, EL2031CG, ELH0002
Harris	HA2-5033-5, HA3-5033-5, HA2520
Linear Technology	LT1010CH, LT1010CN8
Micra	MC0002, MC0063, MC0033
National Semiconductor	LH0033G, LH0033J, LH0033CG, LH0033CJ, LH0063K,
" "	LH0063CK, LH4010G, LH4010CG, LH4010CN,
" "	LH4011K, LH4011CK, LH4011CT, LH4012K,
" "	LH4012CK, LH4063CT, LH4033CN, LH4009K,
" "	LH4009CK, LH4009CT, LH4008K, LH4008CK,
" "	LH4008CT, LM6121H, LM6221H, LM6221N, LM6321N
Sipex	SP4010C
Teledyne Components	TP0033
VTC	VA033PJ

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FIGURE 1 : BUF-A BUFFER AMP. CARD (SCHEMATIC)

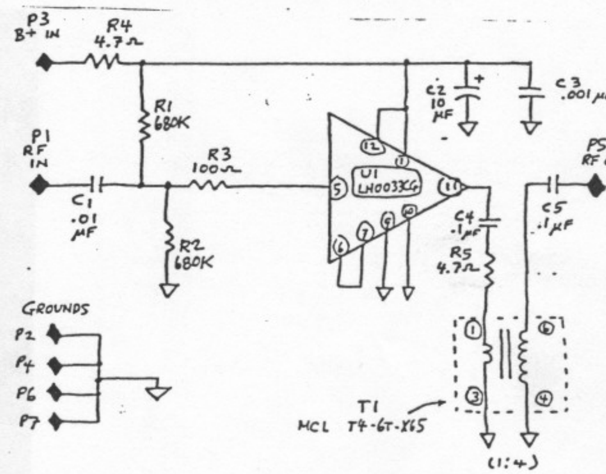
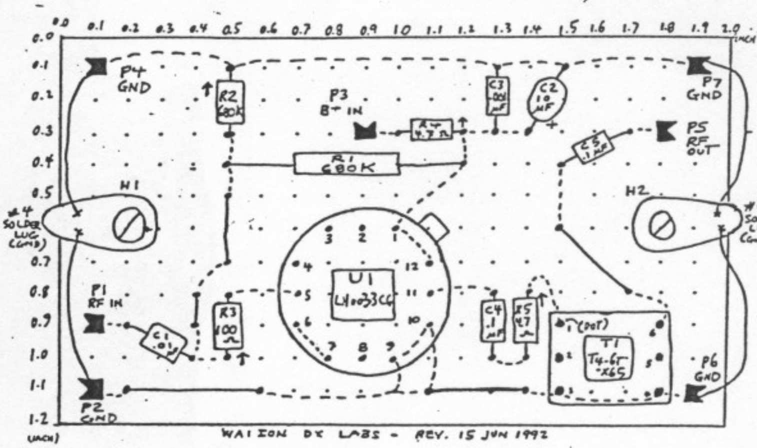


FIGURE 2 : BUF-A BUFFER AMP. CARD (ASSEMBLY)



NOTES:

FOR SCHEMATIC, SEE FIGURE 1.

FOR PARTS LIST, SEE TABLE 1.

↑ = LONG-LEAD SIDE OF VERTICALLY-MOUNTED COMPONENT

— = BUSS WIRE ON COMPONENT SIDE OF BOARD

--- = BUSS WIRE ON SOLDER SIDE OF BOARD

■ = "FLEA CLIP" TERMINAL PIN (OPEN SIDE)

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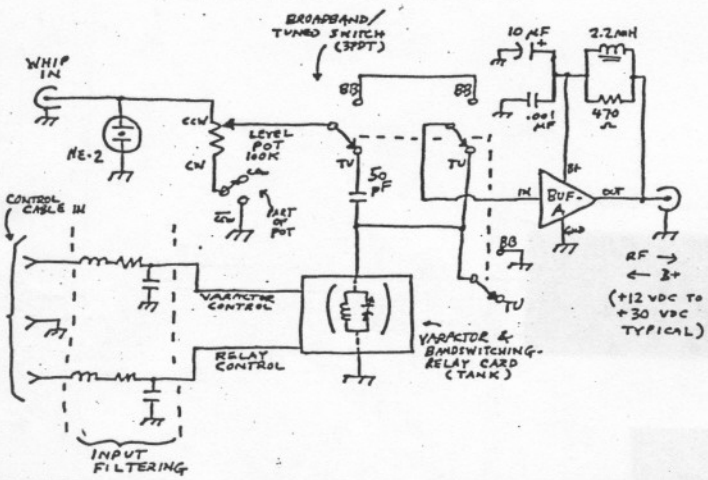
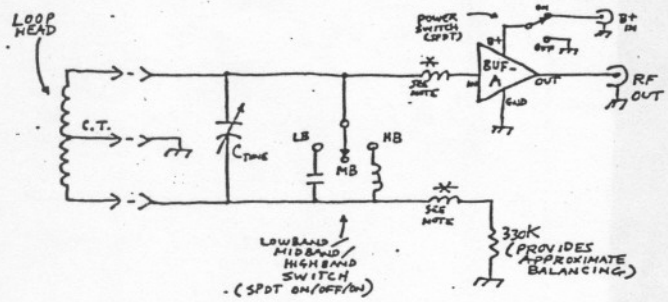
APPENDIX A : ACTIVE WHIP



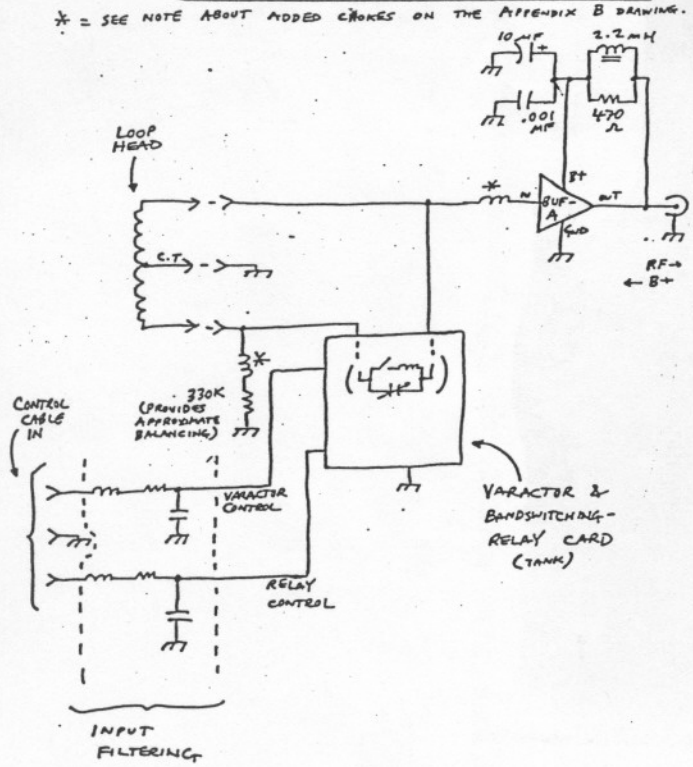
APPENDIX B : LOOP (NON-REMOTE)

* NOTE: CHOKES ADDED, IF NECESSARY, FOR SHORTWAVE IMD REJECTION - TYPICAL VALUE = 47 µH EACH. THESE ARE REPLACED BY DIRECT CONNECTION IF NOT USED.

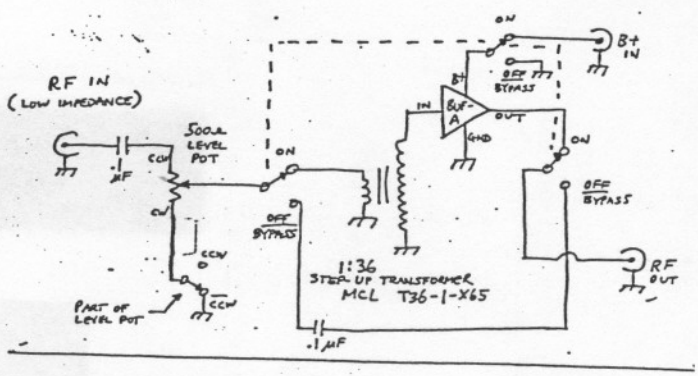


APPENDIX C : REMOTELY-TUNED LOOP

* = SEE NOTE ABOUT ADDED CHOKES ON THE APPENDIX B DRAWING.



APPENDIX D : BROADBAND AMPLIFIER



APPENDIX E : LONGWIRE PRESELECTOR (MEDIUM WAVE)