The PHASE DNE --A Delay Line Phasins Unit

Serry Thomas

In the past few years, I've built and used over a half dozen different phasing units (from Mon Schatz's LSCA to some of dark Connelly's designs) and have come to appreciate what phasing can and cannot do in the pursuit of DX. If you have never used a phasing unit, I suggest you give one a try — I can almost guarantee that you'll hear stations you've never heard before. But, this being the imperfect world that it is, phasing has its limitations, there will be times when you want to null an offending station, but you won't be able to. Monetheless, In my painton, every serious DX'er should have a phasing unit in his

As I stated, I've built several phasers including some designs of my own (e.g., electronic FEI schemes, etc.) and have almost always been satisfied but never totally happy. Phasing units based on a tuned L-C circuit have several potential advantages, foremost of which are inexpensive components and potentially improved signal-to-noise ratios. (. however, have usually been driven a little nutso by the array of control knobs to manipulate and by problems like hand capacitance causing phase shifts, etc. Also, to null the splattery sidebands (in addition to the carrier) of an undesired station, you have to spoil the D of the tuned system, which reduces the signal-to-noise ratio. For the past year or so, I've been tinkering around with a somewhat different approach to phasing and would like to pass along a circuit that I'm not only satisfied with but also almost completely happy with.

Phasing Theory (in brief)

Phasing, in theory, is really very simple -- combine two equal amplitude, antiphasic signals and you get...nothing, a null. With a loop and longwire set-up, because the two receiving (figure 8) lobes are 188 degrees out of phase, all you have to do is combine an appropriate signal from the second antenna so that it's antiphasic with one of the loop's lobes and you have a cardioid receiving pattern. The tricky part of phasing comes in when you deal with the fact that the two antennas are displaced in space, resulting in a liven wavefront arriving at the two antennas at different times. This time difference must be corrected to effect a null. Juned L-C phasing units attack this problem by slightly de-tuning one of the antennas, causing it to lag befind the other. Because the phase relationship of the two antennas is so critical in obtaining optimal null depth (one degree of antiphasic difference reduces null depth yearings like hand capacitance in a less than optimally designed or constructed unit can make phasing somewhat touchy. But, on the whole, the tuned L-C approach works well.

A Different Approach

(deally, we could deal with the time of arrival differences between the two antennas by using a continuously variable delay line. Continuously variable delay line. Continuously variable delay lines are available and are used in commercial and military applications but they cost big bucks. The circuit described in this article uses a series of fixed delays (to make a band of frequencies "appear" to arrive at two different antennas at the same time), a phase shifter (to continuously vary one if the signals through 368 degrees), a level control (to set the optimal amplification), and two broadband amplifiers to offset the attenuation of the delay line/haser. Several circuits/discussions of the use of delay lines to achieve RF phasing have appeared in the radio engineering/amateur radio literature over the years, but the circuit which follows is a modified version of one described by John Webb in the October, 1982 issue of 051 (pp. 28-32) that was used to null military jamming signals on the RF frequencies.

Delay Lines

Several companies manufacture encapsulated "lumped constant" delay lines that are used in military and industrial settings and which are suitable for CM/SW phasing. These lines range in price from about \$30 to \$85 on the low end. I purchased an LC3892959A from Allen Avionics (224 Sat Second St., dineola, MY 11581) for around \$35. The LC3892959A is a 14 DIP packaged line with a maximum delay of 300 nSecs and an input/output impedance of 50 Dhms. A nice thing about this delay line is that it provides the 300-nSec delay required for optimal DW phasing as well as nine other taps (in 10% increments) to extend the usefulness of the circuit to around 12 MHz for use on the 50 bands. Mouser Electronics (11433 Woodside Ave, Santee, LG 52871) recently al-

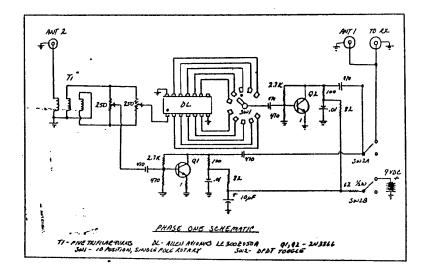
so began carrying delay lines at very attractive prices (about \$9) but the longest delay they offer is 200 nSecs and other specifications (e.g., input/output impedances, attenuation, etc.) are unknown (to me; a spec sheet has been ordered). Perhaps two of the 200-nSec Douser lines could be cascaded in the described circuit (with suitable component value changes).

Phasing/Amplitude Controls

This portion of the circuit samples relative amounts of in-phase and out-of-phase signals to provide a resultant signal whose phase can be set anywhere between zero and 360 degrees. Relative amplitude is also controlled at this stage. To create this control, the signal from one of the antennas is passed through a broadband transformer with two secondaries — one in phase, one 180 degrees out of phase. The broadband transformer is wound on an FT-37-61 toroid (Amidon Associates, 12033 Otswego St., Go. Hollywood, CA 15697) with 280 wire in a five-turn, trifilar configuration. The outputs of both secondaries are paralleled to two, 259-0hm linear taper, carbon composition potentiometers whose wipers serve as outputs to the next stage. Finding the required pots can be a problem (and expensive —— mine were \$5 each) but 250 Ohms allows fairly easy fine phasing adjustments. Easier to find 500 Ohm pots can be substituted but adjustment becomes a little touchier. Do not use wirewound pots.

Broadband Amplifiers

To offset the attenuation of the delay/phasing circuitry, two bipolar broadband amps are used. Special bipolar transistors were chosen (instead of FEI's) for a couple of reasons. First, the low input impedance (lass than 158 Ohms) of the bipolar transistors reduces the probability of amplifying stray RF and, secondly, the chosen transistors are used in CR1V amps and have good dynamic range, linearity, and excellent noise figures (better than many FEI's). The output of each amp at DW frequencies is 15-20 dB and they are very quiet. (originally used the LT1017 made by TMV but the circuit values listed here are for the assign-to-find 203865 (Hadio Shack 276-2038). The 189-Ohm output impedances of the two amps are combined to produce an approximate SB-Ohm impedance to the receiver input.



Construction

The circuitry is assembled on a PC board and housed in a metal, shielded cabinet. Signals are inputted and outputted to the Phase One using UKF con-

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nectors and RG-58U coax (leads are as short as possible). Power is supplied with 5 VDC wall transformer and a DPDT toggle switches the Phase One in and out of the signal line.

Step-by-step construction details are being foregone in this article for several reasons: a) apparent displeasure on the part of some readers for lengthy technical articles; (b) experienced tinkerers should have no trouble working directly from the schematic; and (c) the Phase One in kit (with detailed instructions) and assembled form should be available from Radio Plus-Electronics in 60-98 days,

Operation

The Phase One has only three principal controls -- delay range, amplitude, and phase. A single setting of the delay range control covers a large range of frequencies (about) CHz at CO frequencies), so it is not routinely adjusted while DX'ing the BCB. The amplitude and phase controls interact so alternately adjusting each is required for the deepest null. I've found that simultaneously rotating each locates the general null settings quickly then alternately adjusting each for deepest null works best for me. With practice, optimal nulls rarely take more than 10 - 15 seconds to attain. Once a null has been established, it can be "steered" throughout 369 degrees using the phase control and with only minor adjustments to the amplitude pot. Because the bandwidth of the null in this broadband design is also quite large (depending on the spacing of the antennas, etc.), it is often possible to change receiver frequencies several tens of kHz and retain the same nutling effect. As an example, using the Phase One with a dipole and a longwire, I was trying to receive \$VDG-698 (a regular receiver sensitivity/selectivity test station of mine). \$400-600 is located about 150 miles to the west of me and radiates 1 kW. Reception of WVOG is usually bothered by both WHYD-618, a local spiesher, and WDLP-538, a massy rocker. Luckity, because both WHYD and WDLP lay roughly in a straight line to the east of me, a single setting of the Phase One was able to simultaneously null both the 550 and 610 pests, and, at the same time, double the signal from WVOB to the wast (due to the summing of the in-phase signals on the opposite side of the null). This was my best ever reception of WVQB. This example represents phasing in general, and broadband phasing in particular, at its best. Phasing has its limitations though. In fact, phasing is definitely not guaranteed to null all undesired stations. It can do very well with single mode, one hop signals but if an offending station is "beating" or fading, this usually indicates either a combination groundways/skywaye arrival or a multi-hop skip. In these cases, a single null will remove one signal but the other will remain. (On the drawing board, incidentally, is a two-scape phaser (the Phase Two) to attempt to deal with this situation.... wa'll see how it works.)

So far i've used the Phase One with two longwires, a loop and longwire, a loop and dipole, and a longwire and dipole and have had no trouble nulling all of my locals (the strongest is 5 kW WCOR-1370 at six miles) to the noise level. From what I've read, two verticals are the best to phase but I haven't given those a try. Maither have I spent a great deal of time testing the Phase One at frequencies above 1.6 GHz other than to confirm that at least partial nulls (due to the multi-skip nature of SW signals) can be obtained up to about 12 DHz. Duch more testing needs to be done at AF frequencies and perhaps some

Dell, that about sums up the Phase One. If you have any questions (or can provide any answers, hi) or if you would like to be notified of the availability of the Phase One in kit or assembled form, drop me a line at 88010 PLUS+ Electronics, 3635 Chastain Way, Pensacola, FL 32583. 73's....61

Radio station gimmick is foul play

GEORGETOWN, Del. — Radio station WSEA-FM may have the USA's only Dead Chicken Report. Sussex County is in the heart of Delaware's poultry industry, so chickens are a big item here. Anyone can get one of the 10,000 Dead Chicken Cards that have been printed and become a member of the Dead Chicken Patrol, which reports to WSEA about dead chickens on roads. It's all in fun, morning disc jockey James McHush says, and it fills a void. "Big radio stations in the cities, they do traffic reports and pothole reports. But since we don't have too much of a traffic problem and the roads are in pretty good shape, the next problem is dead chickens, and we're here to tell people where they are." The reports allow motorists to "avoid (the dead chickens) or run them over, depending upon their disposition," McHugh said. Dead Chicken Card holders are eligible for prize drawings - conducted while a tape plays the sound of screeching tires and the cackle of an expiring chicken.



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DX ROUNDUP ************** ## Karl J. Zuk, Editor 154 Old Post Road N. Croton, NY 10520

REPORTERS IN THIS WEEK'S ISSUE:
[RB-NY] Raymond Bauernhuber, 141-12 243rd Street, Rosedale,
NY 11422...Panasonic RF-2800 with shotgun loop. (MB-ON) Mike Brooker, 245 Old Forest Hill Road, Toronto, UN M6C 2H5...Panasonic RF-2200 (JHD-PA) John H. Demmitt, KO848, Box A, Bellefonte, PA 15823 Sony ICF-S5W (MH-NJ) Mike Harla, 1337 Norris Drive, /ineland, NJ 08360 (RCR-PA) Robert C. Ritchey, RD#1, Box 738, East Freedom, PA 10037...Realistic DX-160 with 150 foot longwire (GS-DC) Gardner Smith, 1000 Perry Street, Washington, DC 20017...Sony 2010, %9ALZ, Ed:LMCA, graphic artist. (WPT-DC) William P. "Bill" Townshend, 4500 Connecticut Azenue Nw. #901, washington, DC 20008... Realistic 12-660 Portavision. (WPT-MD) William P. Townshend DXing outside his office. (KJZ-NY) Karl J. Zuk, 154 Old Post Road North, Croton, NY 10520...on the road in St.Louis and Lincoln, NE... No time to DX this week! Play ball, not radio! 540 CBGA1 PQ. New Carlisle. 10-18 0045 Fair with woman speaking in French introducing song. In null of CJSB, Ottawa, ON. (JHD-PA) 580 WLES VA, Lawrenceville. 10-22 0502 Sign on by man, weak, into news. (RCR-PA) 620 WTMJ WI, Milwaukee. 10-22 0715 weather by man, ID "WTMJ" mention of station contest, fair. (RCR-PA) 040 KF1 CA, Los Angeles. 10-5 Oc41 Fair to poor, man said "Let's go back to Here Comes The Sun by The Beatles on KFI." weather and invite to write in for T/ game show tickets. (JHD-PA) 660 WESC SC. Greenville. 10-21 0815 Talkshow, ad for Disneyworld. ID "WESC" severeal times, very good, over WNBC. New York, NY. (RCR-PA) c90 w.OK AL, Birmingham. 10-1 0638 Good with ID "All New W.OK." Record "Country Road west Virginia" and "Fooled Around And Fell Ir. Love." weather and CBS news followed by local news, sports and weather. (JHD-PA) 740 mPAQ NC. Nount Airy. 9-28 0303-0317 Equipment test with C&w music, periods of open carrier in between songs, 0317 ID by man with thick Gomer Pyle type drawl: "wPAQ, Mount Airy, NC completing equipment tests" then off. Fair to good with no CBL, Toronto, ON carrier. (MB-ON) 740 CBL ON, Toronto. 10-18 0530 with ID, News of Canadian events. Good. (JHD-PA) 750 wBmu MD, Baltimore. 10-18 0036 Good to fair with preacher talking about faith and Jesus walking on water. (JHD-PA) 800 WIMR NJ, Camden. 10-12 1425 First time heard mid-day. Slogan: "Your inspirational radio station in The Delaware Valley." Religious music, on top of three or four others. (GS-DC)(But do they play Madonna?-kz) 830 CFJR ON. Brockville. 10-21 1730 Music by Carly Simon, ID "830 CFJR," into local news, ex 1450 kHz, very good, station #800. (RCR-PA)(Congrats!-kz) 900 CHML ON, Hamilton. 10-7 0712 Song title contest answer: "Who's holding Donna Now?" and a bakery ad. (JHD-PA) (This is the right song title, John. When you wrote "Who's Holding Madonna Now?" it made me laugh-kz) 920 WMMN WV, Fairmont. 10-7 0703 with net news, weather, ID. In with wK/A, Lewistown, PA. Fair. (JHD-PA) 930 WFMD MD. Frederick. 10-7 0715 with traffic report with many references to the Capitol Beltway. In with wCNR, Bloomsburg, PA. Fair. (JHD-PA) 950 WPEN PA, Philadelphia. 10-19 1900 ID slogan "The Station Of The Stars" with Music of Your Life type music, news and weather. (RB-NY) 970 WWDJ NJ, Hackensack. 10-19 1830-1900 with The Pat Boone Show, religious pgm. with Christian songs. (RB-NY) 1000 WRAR VA. Tappahannock. 10-21 1745 with local ads, mention of Tappahannock, ID "WRAR", good at first but field into the fray. (RCR-PA) 1080 WTIC PA, Hartford. 10-19 1800 with pop music, news and weather. Cood. (RB-NY) 1090 CKKW ON, Kitchener. 10-9 0545 with ID. Eagle's "Take It Easy", time check at 0557, then discussion about The Kansas City Royals. Poor. (JHD-PA)
1100 WWWE OH, Cleveland. 9-20 0020 with "Exotic Moments In Sports." Fair. (RB-NY)
1110 WBT NC. Charlotte. 9-28 2330 with "Solid Gold Saturday Night". Very Good. (RB 1140 WCJW NY, Warsaw. 10-18 0804-0810 UPI network news. local news by woman, mention of Warsaw, sports by man, mention of upcoming game on "WCJW", poor to nil under WRVA, Richmond, VA. (RCR-PA) 1170 WOBM NJ. Lakewood. 10-19 1745 Sung ID, spots for Ton's River, and Freehold, NJ. Autorized for 1160 kHz, but hasn't moved yet. (GS-DC) 1170 WBRW NJ, Bridgewater. Listed as Somerville, but gave location as Bridgewater. 10-19 1730. (GS-DC)(I heard the same thing, last week-kz) 1190 WKDJ PA, Hugesville. 10-12 0715 with sign on moments before WANN, Armapolis, MD. Gave power as 1kW. Slogan "K-1190." A brand new station. (GS-DC) 1200 WKOX MA, Framingham. 10-19 1710 with light rock, heavy on sports. Sunset skip over local WAGE, Leesburg, VA. (GS-DC)+10-12 0800 with special news annoncement asking radio operators to report to town hall to join a rescue party. Regular news followed. Fair to good. (JHD-PA) There's more where this came from...so keep reading Eastern DX Roundup!.....