DXP-6-L MW Phaser

Prototype

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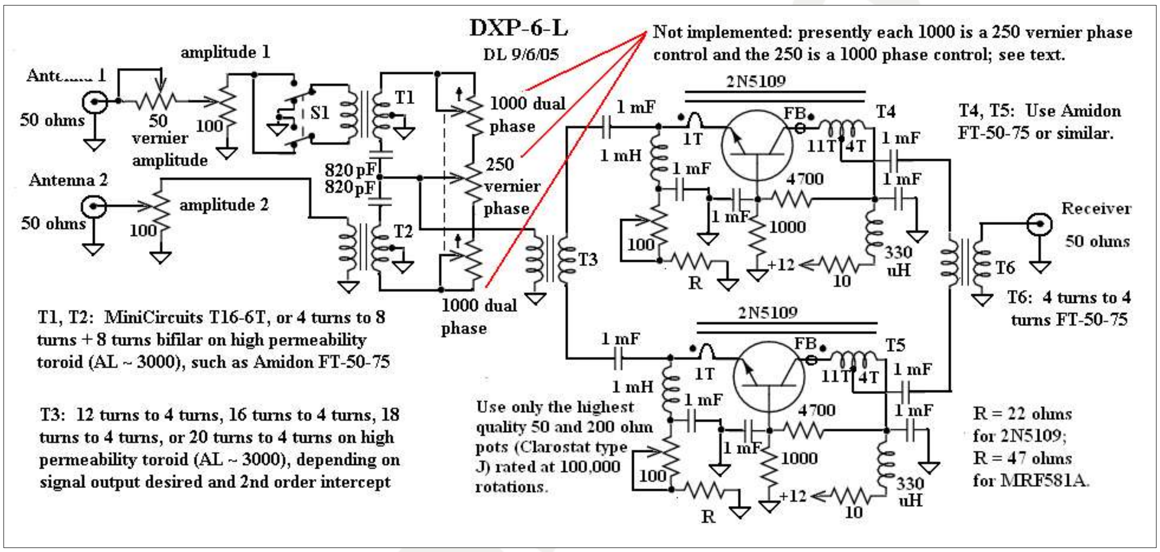
The DXP-6-L phaser, which is described here, is a MW only phaser based on the DXP-3, 4, 5, and 6 series of phasers, especially DXP-6, developed by Mark Connelly over the past several years; see http://www.qsl.net/wa1ion/index.html . The schematic of my modified DXP-6 phaser is given below. As the title states, this is a prototype, and I will make further modifications to Mark's phaser as deemed necessary or desirable.



I had not seen DXP-6 until a few days ago. It appears to be a recent addition to Mark's line of phasers (file dates for DXP-6 are April 2005). Earlier versions of this series, such as DXP-3, had considerable signal attenuation, about 10 dB more than Misek type phasers, which in my opinion made them unsuitable for weak signal DXing. Also, the relatively high impedance output of the phase shift circuit followed by a buffer amplifier or source follower (which Mark used in DXP-3 etc.) had terrible worst case 2nd and 3rd order input intercepts, about +5 dBm for both, which is less than desirable for moderately high or high level RF environments. When I saw the DXP-6 schematics I was quite interested in the changes Mark had made, namely (1) a 9:1 impedance step down transformer following the phase shift circuit, and (2) a fairly robust 2N5109 feedback amplifier. Mark's amplifier was not push-pull, so I expected the 2nd order performance would be poor. But I believed that could be corrected with a push-pull Norton amp or similar. As it has turned out, DXP-6-L is a quite good phaser.

All testing of DXP-6-L and all comparisons with modified Misek phasers were done with two 15 meter noise reducing verticals spaced 50 meters with lead in feed points 5 meters above ground. In the antenna 1 path I used a series connected 50 ohm pot as a vernier amplitude control. It appears that only one vernier amplitude control is needed; a second similar control seems not to be required for the antenna 2 path. Mark did not use a vernier amplitude control in his DXP-x phasers. S1 is a 180 degree phase shift DPDT toggle switch, which is needed (?) to obtain full phasing range. Mark used a second such switch in his DXP-x phasers, but I found that to be redundant. You can see from one of the photos below that I originally used a second such switch, because Mark did, but that I removed that second switch and added a 200 ohm vernier phase control in its place; see the brass washer I used as a hole diameter reducer. Without the vernier amplitude and vernier phase control pots I often found it virtually impossible to maximize null depth on daytime groundwaves, and sometimes difficult to maximize null depths on nighttime skywaves. A second 200 ohm vernier phase control was added later when it was found that the first one did not always vary the phase. Except for T3, the amplifier following the phaser is a conventional push-pull Norton amp with about 11 dB gain. Such amps have been discussed in detail in the article MW Phaser #2 (and other articles) at www.kongsfjord.no . T3 is a step down transformer used to match the high impedance phase shift circuit to a lower impedance amplifier. Mark used a 3:1 turns ratio (9:1 impedance) transformer. Initially I used the same ratio, but found the the 2nd order input intercept was a poor +64 dBm (worst case). So I changed T3 to a 4.5:1 turns ratio (about 20:1 impedance), which decreased output signal levels about 4 dB, but increased the 2nd order input intercept to +74 dBm. The worst case 3rd order intercept of DXP-6-L is +39 dBm with both the 9:1 and 20:1 impedance transformers. This suggests that the DXP-x phasers are intermod limited due to the high impedance phase shift circuit (because the push-pull Norton amp should give better intercepts). By contrast, my Misek phasers (MWP-2, et al.) typically have worst case 2nd order intercept of +84 dBm and worst case 3rd order intercept of greater than +50 dBm. Also, modified Misek phasers sometimes have better long term null stability than the DXP-6-L phaser, and modified Misek phasers null depths are sometimes greater than DXP-6-L nulls depths. Furthermore, modified Misek phasers are easier to use than DXP-6-L (2 basic controls vs. 3 basic controls), and it is easier to generate nulls with modified Misek phasers. On some nighttime channels with multiple signals DXP-6-L could not generate nulls. Based on these considerations, and because DXP-6-L is about as difficult to build and costs about as much as a modified Misek phaser, I would usually opt in favor of a modified Misek phaser. The exception might be where greater signal levels are desired, in which case a 9:1 T3 DXP-6-L might have an advantage for a few weak signals.

Above is a front panel view of DXP-6-L. The 3 larger knobs from left to right are amplitude 1, phase, and amplitude 2. Previously a 180 degree phase reverse toggle switch for signal path 2 was mounted in that position. The smaller black knob with brass hole reduction washer is one vernier phasing; the other smaller black knob is the other vernier phasing. The toggle switch is a

180 degree phase reverse toggle switch for signal path 1; it plays the role of an antenna swap switch. The smaller black knob on the right hand side is vernier amplitude for signal path 1.

Above is a bottom interior view of DXP-6-L. The push-pull Norton amp is the small PC board in the middle. It uses "dead bug" construction, and while not especially pretty, it is functionally as good as using a professional PC board. Otherwise, the wiring and construction is point to point, as can be seen. The pots a Clarostat / Honeywell type J. You are wasting your time if you use anything else. The transformers are home made, using high permeability ferrite toroids, either T-50-75 (Teflon wrapped) or white nylon coated of unknown type. The antenna inputs are on opposite sides of the rear panel, with the receiver output in the center. Separating the input signal paths by the full width of the metal box minimizes signal interaction.

Below is a view of the "dead bug" (also known as the "ugly weekender") construction used for the push-pull Norton amp. Throughout 4.7 meg ohm resistors are used as insulated standoff on an unetched copper PC board which was "tinned" with solder before construction began. The "bottom" ends of the 4.7 meg ohm resistors were trimmed to about 3/8 inch long, bent 90 degrees flush at the end of the resistor body, and soldered where necessary to the PC board. I took a few liberties with that approach, including epoxying two radial lead chokes to the PC board (5 minute Devcon clear epoxy, and fabricating (= cutting) two tiny PC boards for the 25 turn 100 ohm pot from Radio Shack proto PC board material. I used (Motorola) MRF581A's because of their small size and because they do not require heat sinks.