

Designing a parasitic array

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via John Johnson

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Engineers recognize that two vertical radiators, spaced 90° apart and properly driven with one tower leading the other by 90°, result in a cardioid pattern. This design produced what was probably one of the earliest intentionally created directional patterns. The technique may have been applied by an amateur in search of DX, or it may have been developed by one of the pioneer engineers. If an amateur was responsible for the technique, it was almost certainly achieved through use of a parasitic element. If a broadcast radio engineer came up with it, the design probably used a driven element.

Directional antenna use has become almost universal. The United States is undoubtedly the largest user of the DA. Without directional antennas, more than half of U.S. AM radio stations would not be on the air.

As far as I know, no directional antennas in use today employ parasitic radiators. It is doubtful that any were intentionally built with parasitic elements. However, I have recollections of a station at which the DA started out as a conventional array with a driven element and ended up as an unintentional parasitic array.

Franklin antenna

The station was WWWE-AM, Cleveland, operating at 1,100kHz, DA-1 with 50kW of power. It was bought from NBC, and I was director of engineering for the new owner. As originally built, the transmitter used the tall tower of its sister TV station as a radiator. Because the tower height was approximately one wavelength of the AM frequency, the tower was built as a Franklin antenna. One vertical section of the tower was built above the other, as shown in Figure 1.

Because of a slight problem with excessive radiation toward Canada, the commission deemed it necessary to reduce radiation in the direction of Toronto. To achieve this reduction, a wire was dropped from a guy on the side toward Toronto, and a phaser was designed to drive this wire, which was close to the Franklin radiator.

The original plan was to drive the directional element. A transmission line was installed out to the tower base. As it turned out, driving the vertical wire did not accomplish the desired reduction in radiation toward Canada. The tower was then made parasitic by disconnecting the transmission line and substituting a resistor to ground to dissipate the undesired radiation. I do not recall whether the original base network was left in the circuit, but I think approximately 5kW was dissipated in the grounded resistor.

This vertical DA was monitored in much the same way as it would be today, with

the antenna monitor reading phase and current in each of the vertical elements of the Franklin and in the base of the wire element. Continual problems were encountered because of the high voltages in the center of the Franklin antenna. Slight changes in weather conditions resulted in

widely varying antenna-monitor readings. Stability was not one of the system's strong points.

Even so, the commission was finally persuaded that the transmitter was "within limits" as long as radiation toward Canada did not exceed a certain level. A monitor point was established in the appropriate direction, and this became the official checkpoint.

Sooner or later, the commission will accept parasitic antenna arrays in some specialized cases. However, I do not see this happening in situations in which a critical, or even mildly tight, tolerance exists. As far as I can tell, the rules do not prohibit parasitic arrays, but they do not specify how the desired radiation control is to be accomplished.

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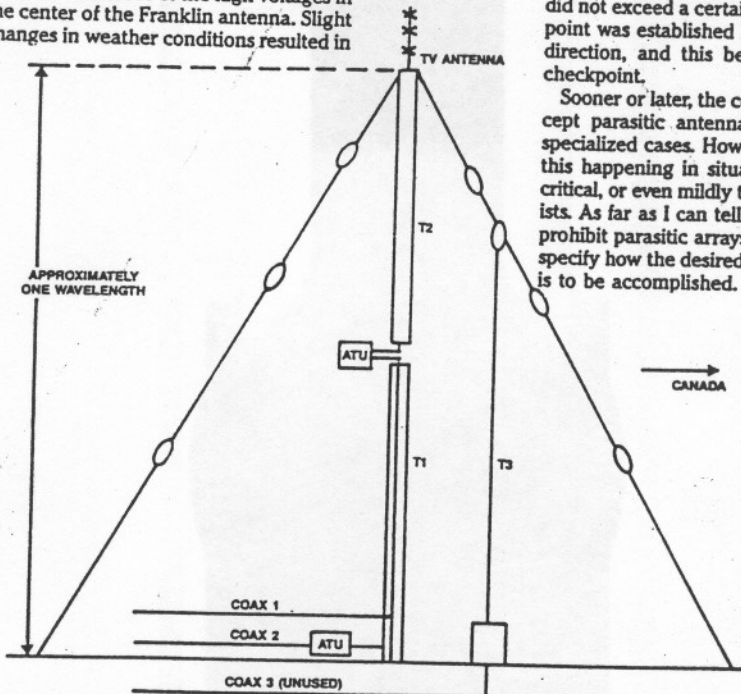


Figure 1. The original WWWE-AM Franklin antenna used a sectionalized, tall TV tower. Directional operation was first attempted by dropping a vertical wire from a guy and using it as a driven element.