A Preview of the AM Antenna Systems Course

About the Author
This course was written for SBE by Cris Alexander, CPBE, AMD, DRB.

Introduction
This course will take the student through every facet of AM antenna systems in all their forms, both dealing with each element or variation separately and pulling the elements together to show how they are used in concert.

Course Description
For many radio engineers, particularly those who have been more involved with FM facilities throughout their careers, AM antenna systems with their "singing" coils and big hardware are often mysterious and many times vexing. AM directional antennas can be intimidating to even the most experienced radio engineers, particularly when something goes wrong and the cause is not immediately apparent. This course is designed to provide the student with a good understanding of all facets of AM antenna systems, directional and non-directional. With the material provided, the student will gain skills that will allow him to construct, troubleshoot and maintain just about any AM antenna system with confidence.

There are several quiz questions prior to most of the chapters to help the student understand what the chapter covers and confirm to the student how much they already know.

Course Content

1. Introduction to AM Antenna Systems
2. AM Antenna Basics
3. Non-Directional Antennas
4. Current Distribution
5. Vertical Radiation Characteristics
6. Insulated and Grounded Towers
7. Base Impedance
8. Ground Systems
9. Directional Antenna Systems
10. Transmission Lines
11. RM Ammeters
12. Sampling Systems
13. Control Systems
14. Troubleshooting
15. Regulatory Requirements
16. Summary of AM Antenna Systems

SBE Recertification Credit
The completion of a course through SBE University qualifies for 1 credit, identified under Category I of the Recertification Schedule for SBE Certifications.

Enrollment Information

SBE Member Price:	$80
Non-Member Price:	$115

AM Antenna Basics

The purpose of any AM antenna is to radiate the power generated by the transmitter. Some antennas do this better than others, and there are many ways to get a signal into the air.

Non-directional antennas radiate equally in all directions, providing the simplest way to get a signal out in an efficient manner. Directional antennas are used to concentrate signal in some directions (toward population centers, for instance) while suppressing signal in others (toward other stations which must be protected from interference).

The antenna system is the last point in a broadcast system where the broadcaster has any control over the signal. After that point, environmental factors, receiver characteristics and other factors have sway over what the listener hears. The amount of signal received at a given point is dependent on the amount of radiation toward that point from the antenna, the distance to the receiver, the conductivity of the earth between the transmit and receive locations, the character of the terrain between antennas and, sometimes, the ionospheric conditions. Atmospheric noise, natural and manmade, affect the signal-to-noise ratio at the receiver, but it does not affect the level of signal arriving from the transmit antenna.

AM antenna systems are vertically polarized. This is done for a number of reasons, including superior groundwave propagation and simplicity of antenna systems. The downside of vertical polarization is that most atmospheric noise is also vertically polarized. Still, vertical polarization is a better choice for AM broadcast than horizontal and virtually all AM radiators are vertical. Not only are horizontal dipole antennas mechanically impractical, their radiation on the horizon is not nearly as good as that of a vertical radiator. Since it is necessary to erect two relatively tall towers to support a horizontal dipole, why not just drive one of the towers directly and forget about the other tower and dipole?

Earlier, we mentioned that several things influence the amount of signal received at a particular point from a given antenna system. The first of these was the amount of radiation toward the receiver. The amount of radiation toward a particular point is influenced by the transmitter power, system losses, antenna efficiency and antenna directivity. Transmitter power is self-explanatory. System losses come in several areas — resistive losses in conductors, ground system and tuning components, and transmission line losses. Antenna efficiency is really defined in two ways: One has to do with the vertical radiation characteristics of the antenna; the other has to do with the radiation resistance. We'll look at both of these in more detail later. The efficiency of a non-directional AM antenna is expressed in millivolts per meter at one kilometer (mV/m/km), and this figure is referred to as the inverse distance field or IDF.

Another factor that influences the amount of signal received at a particular point is attenuation. Over perfectly conducting earth, the amount of signal received at a distance would be inversely proportional to the distance from the transmit antenna. This relationship is known as the inverse distance rule. For example, if at a distance of 1 km a field strength of 100 mV/m is present, at 2 km the field strength would be 50 mV/m. At 4 km, the field strength would be 25 mV/m, and at 8 km it would be 12.5 mV/m. If you were to graph this relationship as field strength versus distance on log-log graph paper, it would plot as a straight diagonal line.

In the real world, the earth is not perfectly conductive. Ground conductivity varies from very good (seawater) to very poor (rock and certain soils). The more conductive the ground is, the less a signal from an AM antenna will be attenuated and the more the field strength versus distance plot will resemble the inverse distance line. Over ground that is less conductive, the more a signal from an AM antenna will be attenuated and the more the field strength versus distance plot will curve away from the inverse distance line.

A family of groundwave curves is published by the FCC for each group of frequencies, showing the effects of different ground conductivities. These curves are the basis for predicting distance to a field strength and thus the entire US allocation system. A slightly different set of curves is used internationally, the reason for this having to do with treaties that predate the adoption of the current set of US groundwave curves.

We previously mentioned the efficiency expressed as the inverse distance field of a non-directional antenna. You have probably already figured out that the conductivity of the ground in the region between the antenna itself and the receive point 1 km away will cause the field strength at that point to be attenuated below what it would be over perfectly conductive earth. How, then, can one accurately measure the efficiency of an antenna? The answer is with many measurements taken radially, beginning very close to the antenna (usually at the point where the first on-scale reading can be taken). The very close-in measurements establish the unattenuated IDF while measurements farther away from the antenna establish the conductivity of the ground between the antenna and the last point measured.

What is the main purpose of any antenna system?

- ☐ To satisfy FCC regulatory requirements with regard to minimum efficiency.
- ☐ To meet all FAA marking and lighting requirements.
- ☐ To protect the public and workers from high levels of nonionizing radiation.
- ☐ To radiate the power generated by the transmitter.

Directional antennas are used to:

- ☐ A. Minimize radiation in some directions.
- ☐ B. Maximize radiation in some directions.
- ☐ C. Provide a certain level of null-fill in populated areas.
- ☐ D. Both A and B.