Our usual reminder here that the Resource Bin is now a two-way column. You can get tech help, consultant referrals and off-the-wall networking on nearly any electronic, tinaja questing, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

Be certain to frequently check out my new Guru’s Lair web site you’ll find at (where else?) www.tinaja.com This is the place you’ll go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the Resource Bin and other columns. Plus a brand new Research InfoPack Service.

You will get the best results if you have both Netscape Communicator and Acrobat Reader 3.0 installed.

Some Antenna Resources
An antenna is any method of getting electromagnetic energy to go between guided and free space propagation. The guided end can be a waveguide, a transmission line, fiber optics, or any other type of “wire”. The object of the game is to get as efficient a coupling between the media as possible.

There are many important ways to measure antenna performance. Your gain is how strong the intended signal appears compared against a standard antenna pattern such as a dipole or an isotropic radiator. The bandwidth is the range of operating frequencies over which the antenna is useful. Antennas usually have to get carefully tuned or matched to frequencies of interest.

The pattern of an antenna is a plot of its sensitivity in various directions. A tv satellite receiver demands a very narrow and a carefully aimed pattern, while a GPS nav antenna has to cover the entire sky. Television transmitters send most power horizontally, giving an effective radiated power typically five times higher than actual rf input.

An antenna pattern is intentionally created by the number and position of its elements. Patterns are also affected by the proximity to ground, to nearby reflectors, and to other conductors.

The SWR, or Standing Wave Ratio is a measure of how well the antenna does its job. On a transmitter, SWR is a comparison of your transmitted to reflected power. A SWR of one is ideal and has no reflections.

The field strength is the measure of how strong a received signal is. Often expressed as microvolts on the wire or microvolts per meter in free space. The signal to noise ratio is the measure of how strong the received signal will be compared to noise levels in the same effective bandwidth.

A minimum of 20 decibels of S/N is needed for quality FM reception. Data comm should need something around eleven decibels for decent error rates. By going to special spread spectrum or phaselock techniques, the signals may sometimes be extracted that are much weaker than the noise that happens to be present. Our GPS nav or planetary comm are two important examples.

Typical noise is either terrestrial or atmospheric at lower frequencies and inherent “kib” resistive noise at the higher ones. Your noise figure of an input stage is a measure of how much noise will get unavoidably added to an antenna’s received signal. Noise figures do become quite important at VHF and microwave frequencies. But they’re often of little concern at lower frequencies where interference from power lines, storms, and automotive ignition dominate.

That characteristic impedance of an antenna is a measure of its equivalent electrical resistance at frequencies of interest. Most antennas are matched to an impedance of 50 or 72 Ohms.

Television twinlead is 300 Ohms, while the usual free space impedance is equal to 377 Ohms.

Usually, the much smaller radiation resistance has to be transformed to the desired impedance. Such matching can get done using tuning inductors and capacitors; with transmission line stubs; or else by a balun or other high frequency transformer.

The directivity of an antenna is the ratio of your gain in its front and rear directions. Most antennas have one or more deep nulls where little signal is sent or received. These can sometimes be chosen to reduce interference from other stations on the same frequency.

The effective height of an antenna is a comparison against any quarter wave vertical radiator. The actual height of any antenna is simply how far it sits above the ground. At VHF, a line of sight is always needed for your best comm, so the higher the better.

Let’s look at a few more important antenna resources…

ARRL
Otherwise known as the American Radio Relay League, their superb Radio Amateur’s Handbook is your essential starting point to pick up most antenna fundamentals.

Their website is www.arrl.org.

The ARRL also offers a number of antenna specific publications. Their most important of which is the ARRL Antenna Book and its companion CD.

Other pubs include...

ARRL Antenna Book & CD
Antenna Compendiums (5 vols)
Antenna Experimenters Guide
Antenna Impedance Matching
Electronic Smith Chart Applications
HF Antenna Collection
IEEE Publications
The most important scholarly pubs on antennas usually arrive from the IEEE. Especially their Antennas and Propagation special interest group who publishes both their highly technical transactions and a informal magazine.
Their website is www.ieee.org More IEEE resources which might touch on antenna topics include Broadcasting, Microwave Theory & Techniques, and Consumer Electronics.
Many of these publications can be found in larger technical libraries. Or gotten through the Dialog or INSPEC commercial services.

More Mags
A lot of antenna info gets buried in non-antenna specific magazines. Such as these ham and popular titles...
73 Amateur Radio
Car Audio and Electronics
CB Radio
CQ
DX Listening Digest
DX Monitor
Electronics Now
Mobile Comp & Comm
Nuts & Volts
Popular Communications
Popular Electronics
QST
Radio & Communications
Wavelength
World Radio
WSYI Report

There are also these rf and microwave trade journals...
Applied Microwave and wireless Electrotechnology
GPS world
ITS world
Microwave Journal
Microwave Product Digest
Microwaves and Optical Tech Ltrs
Microwaves & rf
Mobile Electronics Monitor
Mobile Electronics Retailer
Mobile Radio Technology
Mobile & Wireless Internet
Personal Technologies
Portable Design
Radio Science
RF Design
Telecomm & Radio Engineering
TWICE

Wireless Data News
Wireless Design & Development
Wireless Technology International
Wireless Week

Other Antenna Books
Here’s my choice of useful antenna books from major publishers...
AM Broadcast Station Antennas
Antenna Design: Practical Guide
Antenna Engineering Handbook
Antenna Theory, Analysis & Design
Antenna Theory and Design
Antenna Toolkit
Antennas
Antennas for Nonsinusoidal Waves
Arrl Antenna Book
Integrated Active Antennas
Limited Space Shortwave Antennas
Microstrip Antenna Design
Mobile Antenna Systems Handbook
Modern Antennas
Phased Array Antenna Handbook
Practical Antenna Handbook
Practical Wireless Comm Antennas
Radio Amateur Antenna Handbook
The Right Antenna
Treatise on Electricity & Magnetism
Yagi Antenna Design

Additional details on these titles at www.tinaja.com/amlink01.html

Antennax and Friends
This is a fee based web ezine found at www.antennax.com Cost for a year is $24, while $38 also gives you access to a 450 article backlist. They also have dozens of freebie sample files on their website. I am not a subscriber. You can form your own opinion as to the quality of their offerings.
Other web antenna resources are:
rec.radio.amateur.antennas
sci.electronics.design
sci.physics.electromag
uk.radio.amateur
### SOME USEFUL ANTENNA RESOURCES

<table>
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<th>Company</th>
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<tr>
<td>Antennex</td>
<td>PO Box 72022</td>
<td>Corpus Christi TX 78472</td>
<td>(361) 855-0250</td>
</tr>
<tr>
<td>Applied Microwave &amp; Wireless</td>
<td>2245 Dillard Street</td>
<td>Tucker GA 30084</td>
<td>(770) 908-2320</td>
</tr>
<tr>
<td>ARRL</td>
<td>225 Main St</td>
<td>Newington CT 06111</td>
<td>(203) 666-1541</td>
</tr>
<tr>
<td>Artech House</td>
<td>685 Canton St</td>
<td>Norwood MA 02062</td>
<td>(901) 225-9777</td>
</tr>
<tr>
<td>Broadcast Engineering</td>
<td>9800 Metcalf Ave</td>
<td>Overland Park KS 66212</td>
<td>(913) 341-1300</td>
</tr>
<tr>
<td>CB Radio</td>
<td>76 N Broadway</td>
<td>H Hicksville NY 11801</td>
<td>(516) 681-2922</td>
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<tr>
<td>CO VHF</td>
<td>76 N Broadway</td>
<td>H Hicksville NY 11801</td>
<td>(516) 681-2922</td>
</tr>
<tr>
<td>Denon</td>
<td>222 New Road</td>
<td>Parsippany NY 07054</td>
<td>(201) 882-7449</td>
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<tr>
<td>Electronics Now</td>
<td>500-B Bi-County Blvd</td>
<td>Farmingdale NY 11735</td>
<td>(516) 293-3000</td>
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<tr>
<td>Global Communications</td>
<td>6500 S Syracuse Way #650</td>
<td>Englewood CO 80111</td>
<td>(303) 220-0600</td>
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<tr>
<td>GPS World</td>
<td>859 Willamette St</td>
<td>Eugene OR 97440</td>
<td>(503) 343-1200</td>
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<tr>
<td>ITS World</td>
<td>859 Willamette St</td>
<td>Eugene OR 97401</td>
<td>(541) 343-1200</td>
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<tr>
<td>Microwave Journal</td>
<td>685 Canton St</td>
<td>Norwood MA 02062</td>
<td>(781) 769-9750</td>
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<tr>
<td>Microwave/Optical Ltrs</td>
<td>605 Third Ave</td>
<td>New York NY 10185</td>
<td>(212) 850-6088</td>
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<tr>
<td>Microwave Product Digest</td>
<td>34 Evergreen Pl</td>
<td>Tenafly NJ 07670</td>
<td>(201) 568-1101</td>
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<tr>
<td>Microwaves &amp; RF</td>
<td>611 Rt #4 West</td>
<td>Hasbrouck Heights NJ 07604</td>
<td>(201) 393-6060</td>
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<tr>
<td>Mobile &amp; Wireless Internet</td>
<td>52 Foundling Ct</td>
<td>London WC1N 1AN UK</td>
<td>44 (0) 717 837 0815</td>
</tr>
<tr>
<td>Mobile Computing &amp; Comm</td>
<td>6420 Wilshire Blvd</td>
<td>Los Angeles CA 90048</td>
<td>(310) 589-3100</td>
</tr>
<tr>
<td>Mobile Electronics Monitor</td>
<td>2500 Wilson Blvd</td>
<td>Arlington VA 22201</td>
<td>(703) 907-7646</td>
</tr>
<tr>
<td>Mobile Electronics Retailer</td>
<td>21061 S Western Ave</td>
<td>Torrance CA 90201</td>
<td>(310) 533-2400</td>
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<tr>
<td>Mobile Radio Technology</td>
<td>PO Box 12901</td>
<td>New York NY 14150</td>
<td>(913) 343-1300</td>
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<tr>
<td>Personal Technologies</td>
<td>175 Fifth Ave</td>
<td>New York NY 10010</td>
<td>(800) 777-4643</td>
</tr>
<tr>
<td>Popular Communications</td>
<td>76 N Broadway</td>
<td>Hicksville NY 11801</td>
<td>(516) 618-2922</td>
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<td>500-B Bi-County Blvd</td>
<td>Farmingdale NY 11735</td>
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<td>QST</td>
<td>225 Main St</td>
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<td>(203) 688-1541</td>
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<td>34 Evergreen Pl</td>
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<td>(201) 568-1101</td>
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<tr>
<td>Radio Science</td>
<td>2000 Florida Ave NW</td>
<td>Washington DC 20009</td>
<td>(800) 966-2481</td>
</tr>
<tr>
<td>Radio World</td>
<td>5827 Columbia Pk #310</td>
<td>Falls Church VA 22041</td>
<td>(703) 998-7600</td>
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Or these broadcast magazines…

- Broadcast Engineering
- Broadcasting and Cable
- College Broadcaster
- Global Communications
- Radio World
- Radio and Comm Technology
- TV Technology
- Television Broadcast
- Wireless satellite & Broadcasting

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**"Miracle" Antennas**

Maxwell’s laws of electromagnetic behavior are well known and have been extensively explored. They get tested and retested in countless ways day in and day out. You can read all about them in any field theory book. My favorite remains the ancient *Fields and Waves in Modern Radio* by Ramo and Whinnery. Or you can actually read Maxwell himself in his readily available old *Treatise on Electricity and Magnetism* replica volumes. But be forewarned that (A) all the partial diff math is hairy, and (B) his primitive notation makes it much worse.

These laws lead us to conclude that efficient antennas have to be around a quarter wavelength or so in size and that highly directional ones should be much larger. One crucial paper here
is Wheeler’s *Fundamental Limitations upon Small Antennas* in the *Proceedings of the IRE* #35, pages 1497-1484.

As any conventional antenna gets smaller, the efficiency and radiation resistance both drop dramatically, the matching gets horrendously difficult, and the differences between your free space theory and the real world all get real ugly. Real quick like.

Yeah, the time is certainly ripe for antenna breakthroughs. By all of our newly discovered methods to analyze complex electromagnetics. By being newly able to more tightly integrate antennas with active electronics. By the expanded use of interferometer, holographic, and other large element array concepts.

By new spread spectrum comm that gives you much lower signal to noise ratios. And by those incredible new pulse radio schemes that we looked at in www.tinaja.com/glib/muse137.pdf

One new antenna approach I have been wanting to explore are ultra low frequency broadband arrays for cave finding and surface mapping. Pulse radio plus interferometry might make this newly possible.

The "miracle" antenna claims seem to be coming out of the woodwork. Everything from trucker’s foil wound fluorescent lamps for defeating police radar down to way overpriced small capacitors which "convert your house wiring into a giant antenna".

The latter of which fails to pick up on the fact that the line borne noise nearly always goes up much faster than the signal does.

At least in any uncontrolled design.

Let’s briefly look at three ongoing "miracle antennas" that may not end up being all they seem...

**CFA Crossed Field Antenna**– This is supposedly a rather small antenna particularly suited for hams and am broadcast transmitters. It purportedly applies a quadrature drive near field math trick to get far field results. In its decade long history, it seems to us to have been thoroughly discredited. But remains controversial to this day. The NAB even seems to have gotten sucked in on this fiasco.

**CTHA Contrawound Torodial Helical Antenna**– This one is another quite small antenna that is kinda hula-hoop shaped. Having two windings that go around in opposite directions. While their theory looks fairly good, there seems to be big time pattern and real world matching problems.

**Fractal Antennas**– These can be any self-similar or repeating element sets, but tend to apply *Serpinski* triangles, *Koch* curves, and other fancy 2-D or 3-D fractal math patterns. Modest size and pattern improvements over more traditional designs do actually appear possible. But hype abounds.

I’ve sure gotten a lot of email from highly vocal ham CFA proponents. They genuinely believe they are on to something. But if I replace the words "CFA antenna" and "field strength" with "carburetor" and "more miles per gallon", I always seem to end up with classic "looks like a duck - quacks like a duck" urban lore pseudoscience. I’d give more believability to one decent math paper and any one professional antenna range pattern measurement than I would to hundreds of stories about a QSL in Lower Tobonga.

Even a rusty bedspring will radiate.

What discourages me the most is the utter lack of any commercial CFA interest in an old concept. Other than its few early proponents

There is one "miracle" antenna that sure works well, though. And it has been around for years and years. And that is to hang a big old resonant loop near an AM receiver for long distance night reception.

It turns out the properties of any antenna can be greatly improved by carefully placing a resonator near it. At higher frequencies, these are called directors when they’ll go in front and reflectors if they go behind your main antenna. At any rate, just get a three foot vertical wooden or plastic form and wind several dozen turns of wire around it. Then resonate it with a stock 365 pf variable capacitor. Put it within a foot or two of your radio and tune it for its maximum pickup. There will be an axis null, so you may have to rotate it as well.


And lots more on pseudoscience in www.tinaja.com/pseud01.html

**FM DX**

I live fairly deep in a valley in a rather remote area, so it is a challenge to pick up decent FM stations. After a lot of experimenting, I ended up with a boosted and high roof mounted 10 element *Yagi* array combined with a better grade Dinon receiver that you can reduce the IF bandwidth on.

Favorite 120 mile distant stations such as KDKB in Phoenix or KXCI in Nogales Junction come in just fine.

Note that a "booster" cannot boost what is not there. Yes, they can make signals stronger, but they’ll only make the signal to noise ratio worse.

Boosters also create fake signals by aliasing strong local stations. And do have an annoying habit of blowing up during lightning season.

More details on FM DX in www.tinaja.com/glib/hack86.pdf A great list of FM stations is up on the web at wmb.mit.edu/stations/locate.html You use this fine service for trip planning or DX logging. You might even make a glove compartment book out of the places you are likely to travel often.

**For More Info**

Additional antenna info is found in www.tinaja.com/glib/muse138.pdf You can find details on most any antenna (or other) mag by using the OXBRDG button on my www.tinaja.com website or else by using www.mediaindicator.com Similarly, antenna sites are quickly found by using my HOTBOT, ALTA, or INFER buttons.

Use the THOMAS button for names and addresses of manufacturers, or that new QUEST button for most any semiconductor data sheet or ap note. Or try that DEJA button to see who is posting what to the newsgroups.

Great prices on standing wave ratio meters and other electronic bargains at www.tinaja.com/harg01.html Some ongoing research services are found at www.tinaja.com/info01.html and also at www.tinaja.com/consul01.html

Other products and services appear in my nearby Synergetics ad.

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Microcomputer pioneer and guru Don Lancaster is the author of 35 books and countless tech articles. Don maintains his no-charge US tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and consulting services. Don also offers free catalogs of his unique products and electronic bargains. The best calling times are 8-5 weekdays, MST.

Don is the webmaster of his Guru’s Lair found at http://www.tinaja.com

Full reprints and preprints of all Don’s columns and ongoing tech support appear here. You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to don@tinaja.com

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