

# Antenna Briefs #8 -- Antenna Design (plus EMC)

Slides downloaded from: <https://ecefiles.org/rf-design/>

Companion videos at: [https://www.youtube.com/watch?v=Gj\\_hiMrdok](https://www.youtube.com/watch?v=Gj_hiMrdok) (Part 1)  
and [https://www.youtube.com/watch?v=MfF\\_jCdBgS8](https://www.youtube.com/watch?v=MfF_jCdBgS8) (Part 2)

This material is [provided by ecefiles.org](https://ecefiles.org) for educational use only.

This final episode in the series focuses on antenna design, with underlying theory covered in the Part 1 video. Practical issues are also covered. In addition, the related subjects of radio frequency interference (RFI) from electronic products is touched on, and some electromagnetic compatibility (EMC) mitigation strategies are offered. Part 2 goes into additional detail on the vast set of antenna configurations possible and offers suggestions for designing your own antennas by showing and talking through a large set of examples. Given the size of the subject(s) details on design equations are not covered, but references are offered at the end for further study.

## Essential Theory (Dipoles)

Transmission Line

Sorta Dipole

Short Dipole

Transmission Line and Antenna Circuit Models

$R_{phy} + R_{rad}$

$\neq jX$

ECEFILES.ORG

Resonant Dipole

## 2-Page Class Handout

Antenna	Impedance	Features
1) Half-wave Dipole	$73-j0$ Ohms	Relatively isotropic, simple construction
2) Folded (half-wave) Dipole	$300-j0$ Ohms	Similar to dipole, higher impedance. Sometimes used in simple vertical arrays.
3) Quarter-wave Monopole	$37-j0$ Ohms	Similar to dipole. Groundplane often abbreviated (e.g. size of sub-wavelength in ground plane)
4) Short Monopole	$R < jX$ $R < jX$ , X large	Physically shorter than quarter-wave monopole, but requires mounting and not in standard antenna.
5) Loaded monopole	$R = jX$	Similar to short monopole, but resistive input impedance. Can be engineered to be essentially 50 Ohms.
6) Simple loop antenna	Varies Widely	Simple useful design at low freq (e.g. $> 30$ MHz). Often used for absorbance research.
7) Single large loop or smaller resonant loop	Varies Widely	Simple, broadband. Popular for indoor "TV" antennas or "cell phone" antennas. Resonant loop used in high-freq. bridge.
8) Small helical-resonant loop	$R = jX$	Physically small with large effective aperture. Used in portable. All bandwidth research and other LF to HF products.
9) Miniature patch	50 Ohms	Simple, low-cost. Useful mostly at high frequencies (e.g. point-to-point).
10) Other	Invented & used loaded patches, etc.	Simple, broadband designs for PCB boards. May use high-X dielectrics to make antenna (much) smaller than a wavelength.

### Directional Designs

- Yagi-Uda
- Log-Periodic
- Cornet Reflector
- Horn
- Helix
- Linear, vertical array (broadband dipole)
- Parabolic dish
- 2-D Planar array

Moderate gain (10 dB). Good front-to-back ratio. Relatively simple construction.

Similar to Yagi-Uda, but broadband. Lower gain and less directivity.

Good "factor-on-edge" (i.e. transparency) of the 120 degrees wide mechanical structure. Often used in cell-arrays.

Gain to about 12 dB. Good illumination pattern for dish antennas.

Circular polarization. Moderate gain, and good illumination for dish antenna.

Concentric geometry used for some designs. Used in portable (space efficiency). Used in cell-arrays when array enabled in corner reflector.

High gain, narrow-beamwidth. Simple, low-cost construction.

High gain, narrow-beamwidth, rapid-steering. Relatively high cost.

ECEFILES.ORG

## Microwave, PCB Log Periodics

From: "Broadband Antenna Probe for Microwave EMC Measurements", 2018 IEEE 27th Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS).

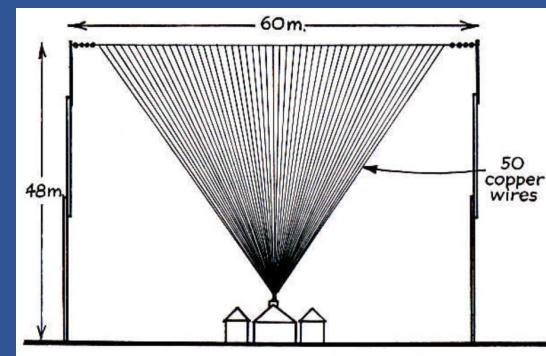
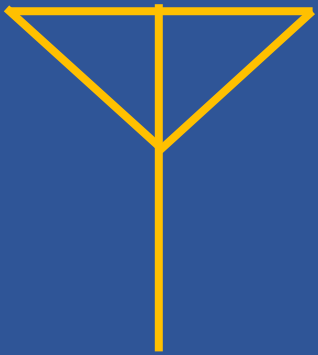
Fig. 1. 2-11 GHz commercial PC board log-periodic [3].

[3] WASVJB, "Printed Circuit Board Antennas - Log Periodic," Kent Electronics, <http://www.wasvj.com/products1.html>

Fig. 2. 3D EM simulator model and PCB prototype of 8-20 GHz LPDA antenna.

Fig. 3. Measuring antennas from 10 MHz to 40 GHz with VNA (Left). Simulated gain cross-section at 14GHz (Right).

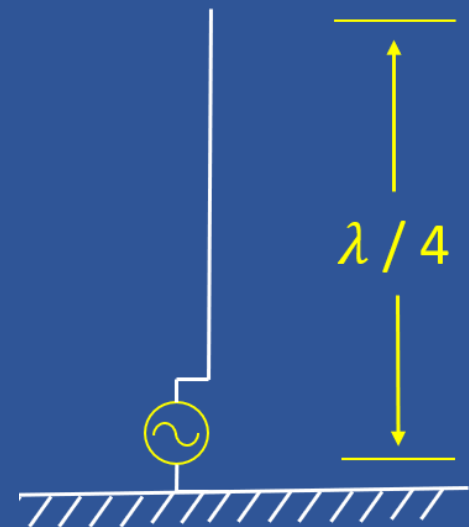
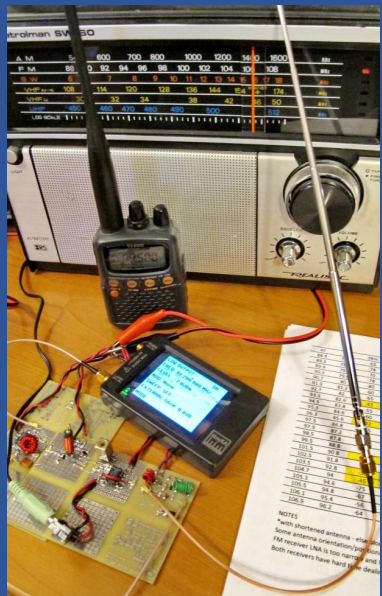
ECEFILES.ORG



<http://www.newscotland1398.net/nfld1901/marconi-nfld.html>

# Antenna Briefs #8

## Designing Antennas Part 1 – Essentials



# 2-Page Class Handout


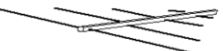






## Antenna Examples

Antennas come in a nearly infinite number of shapes and sizes. Here are a few of the more common ones. Note that many commercial designs are variations or combinations of these.

### "Non-directional" Types

Antenna	Impedance	Features
1) Halfwave Dipole	$73 + j0$ Ohms	Relatively isotropic, simple construction
2) Folded (halfwave) Dipole	$300 + j0$ Ohms	Similar to dipole. Higher impedance. Sometimes used in simple vertical arrays.
3) Quarterwave Monopole	$36 + j0$ Ohms	Similar to dipole. Ground-plane often abbreviated (e.g. case of cell-phone is ground plane)
4) Short Monopole	$R - jX$ $R \ll 36, X$ large	Physically shorter than quarterwave monopole, but requires resonating coil and/or matching network.
5) Loaded monopole	$R + j0$	Similar to short monopole, but resistive input impedance. Can be engineered to be nominally 50 Ohms.
6) Simple longwire	Varies Widely	Simple useful design at low freq (e.g. < 30 MHz). Often used for shortwave receivers.
7) Simple large loop or smaller resonant loop	Varies Widely	Simple, low-cost. Popular for indoor UHF TV antennas in "the old days".. Resonant loop used in KeyFobs today.
8) Small ferrite-core loop	$R + jX$	Physically small with large effective aperture. Used in portable AM broadcast receivers and other LF to HF products.
9) Microstrip patch	50 Ohms	Simple, low-cost. Useful mainly at high frequency (e.g. good for GPS).
10) Other	Inverted F, small loaded patches, etc.	50 Ohms Simple, low-cost designs for PC boards. May use high-K dielectrics to make antenna much smaller than a wavelength.

## Directional Designs

1) Yagi-Uda		Moderate gain (10 dB) Good front-to-back ratio. Relatively simple construction.
2) Log-Periodic		Similar to Yagi-Uda, but broadband. Lower gain and less directivity.
3) Corner Reflector		Good "sector-coverage" (i.e. beamwidth of 90 to 120 degrees with excellent front/back ratio). Often used in cell-towers.
4) Horn		Gains to about 12 dB. Good illumination pattern for dish antennas.
5) Helix		Circular polarization. Moderate gain, and good illumination for dish antenna.
6) Linear, vertical array (tower-mounted dipoles)		Concentrates power toward horizon for max range. Used in public-safety (police/fire/etc.). Used in cell-towers when array embedded in corner reflector.
7) Parabolic dish		High-gain, narrow-beamwidth. Simple, low-cost construction.
8) 2-D Phased-array		High-gain, narrow-beamwidth, rapid-steering. Relatively high cost.

# Episode 8 Topics

## Topics

- • Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- Surveying Common Antenna Designs
- Custom Design Examples

# Design Requirements

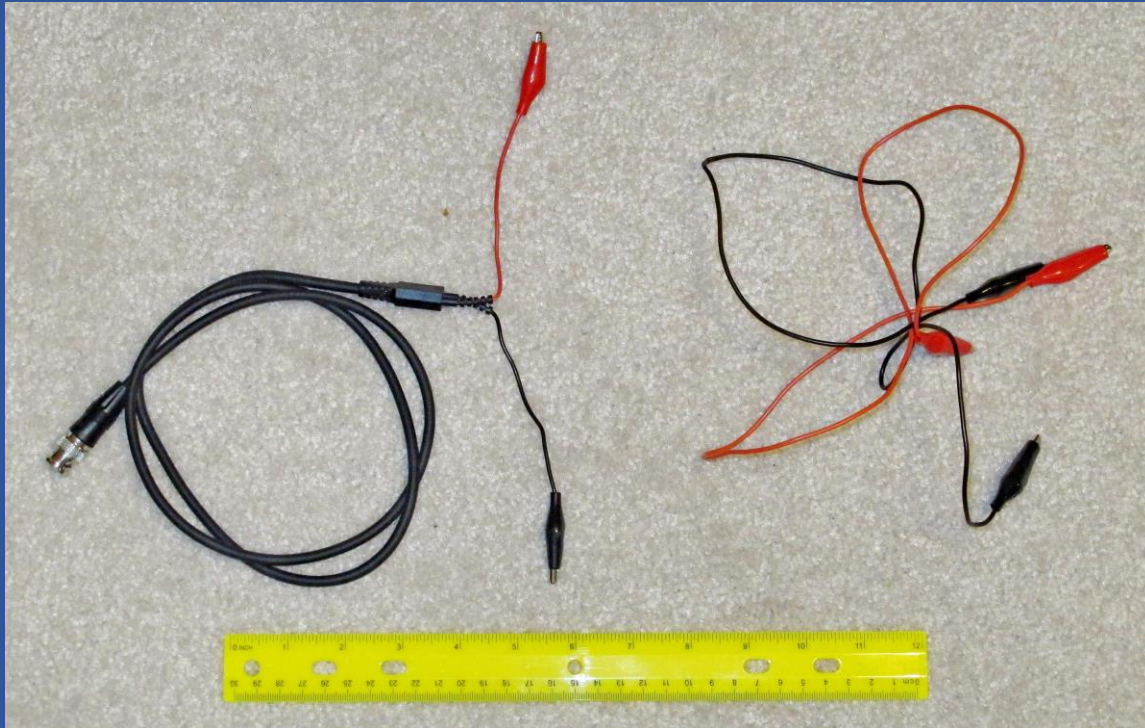
- Frequency, bandwidth, and size
- Main use – Transmit, receive, or transceive
- Impedance
- Directivity and Gain (pattern)
- Polarization
- Installation (feedline, siting, structure, environment)

# Episode 8 Topics

## Topics

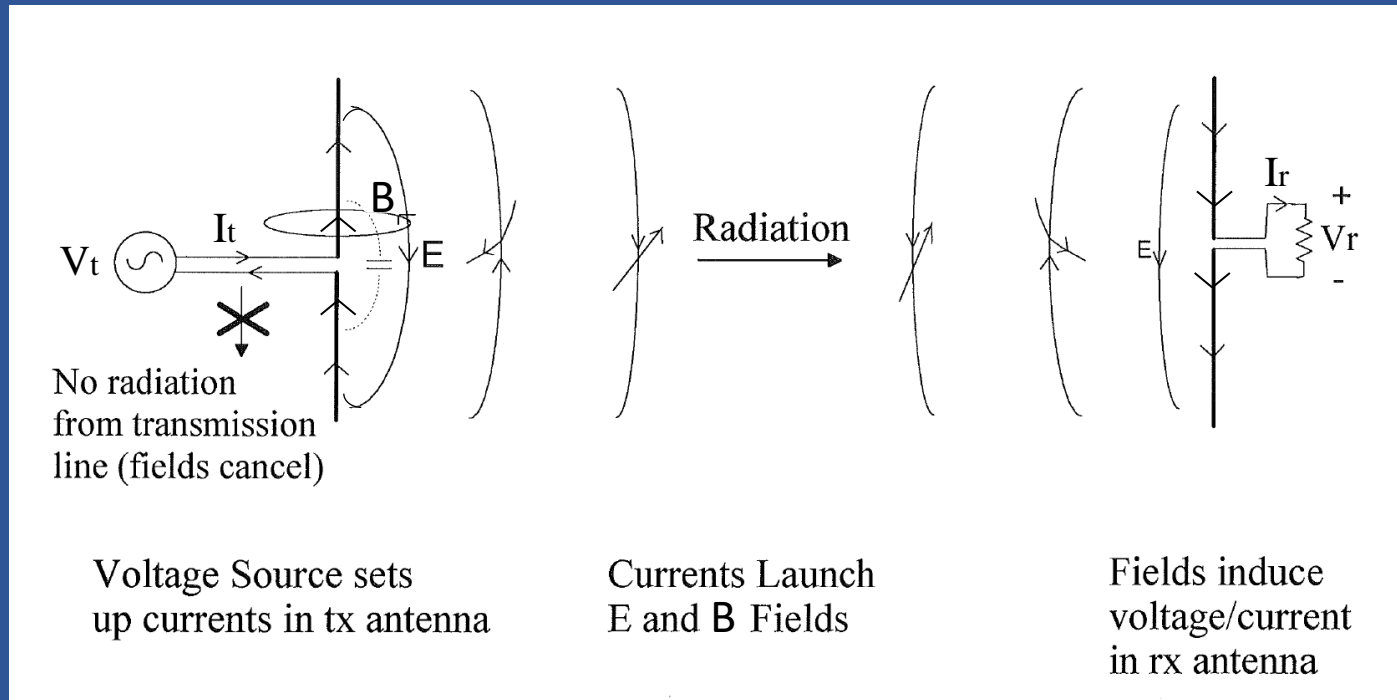
- Design Requirements
- • How to Make a (decent) Antenna
- How to NOT make an Antenna
- Surveying Common Antenna Designs
- Custom Design Examples

# How to Make a (decent) Antenna

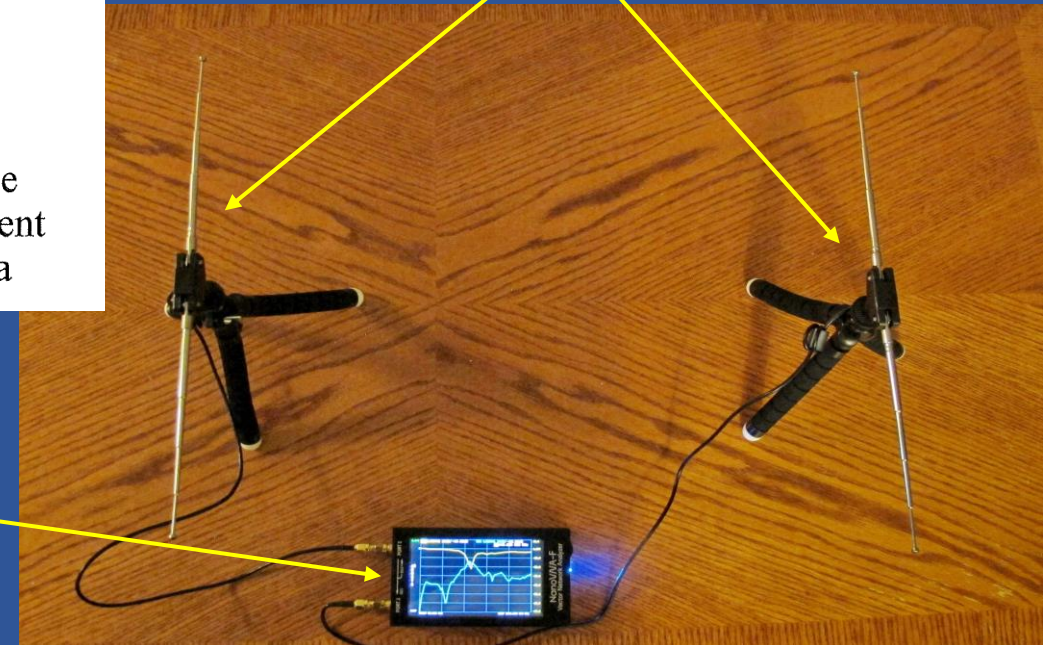


- Frequency, bandwidth, and size **440 MHz, 5%, 30 cm (1 ft)**
- Main use – Tx, Rx, or transceiver **Yes ☺**
- Impedance **About 50 Ohms**
- Directivity and Gain (pattern) **Not very much (2 dBi)**
- Polarization **Linear** (horizontal or vertical?)
- Installation (feedline, siting, structure, environment) **RG58 coax**  
**On my (upstairs) floor**  
**Not much ☹**  
**Carpet/wood underneath**

# Essential Theory (From Episode 5)



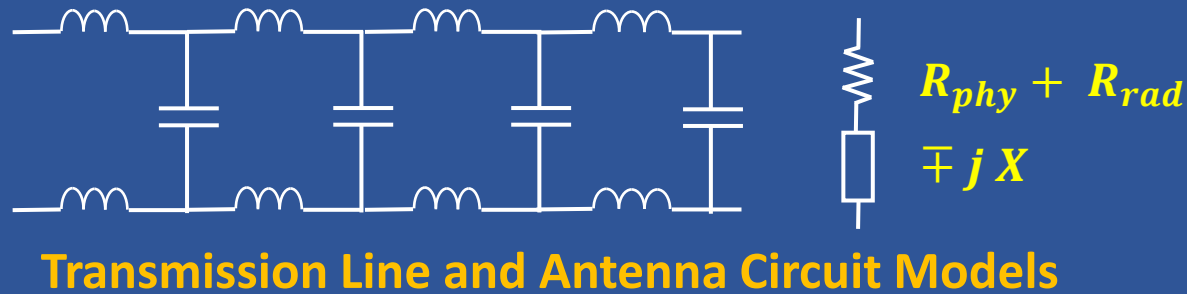
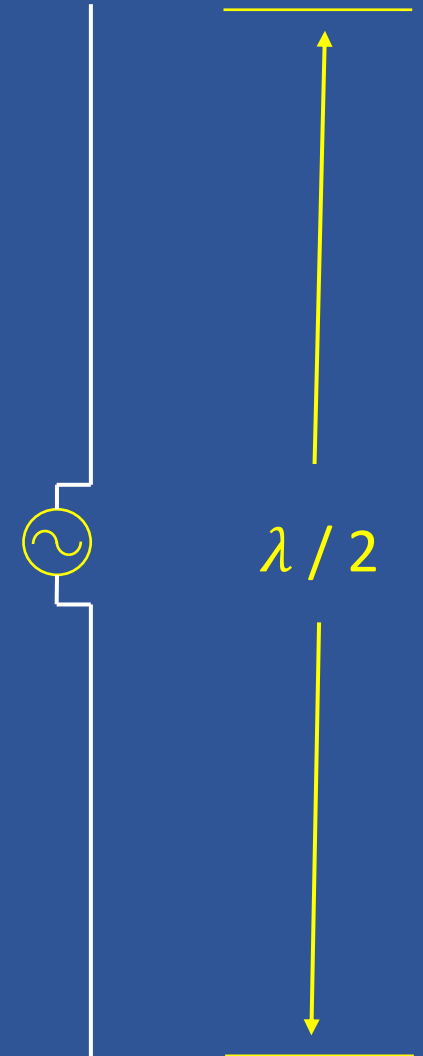
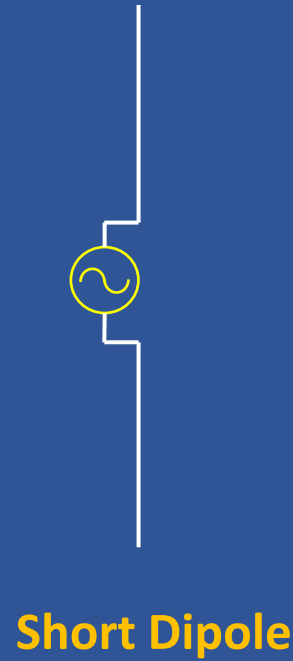
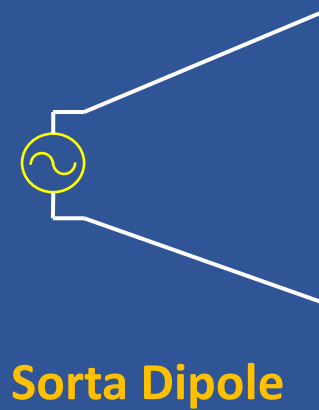
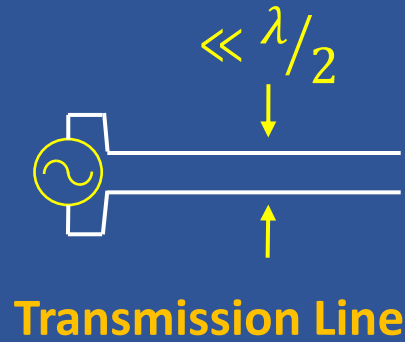
## RTL-SDR Antennas



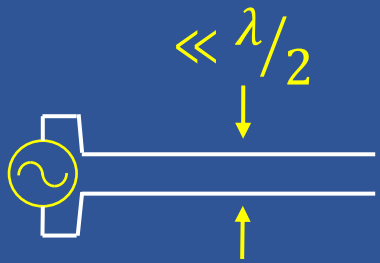
**NanoVNA**  
(Transmitter, receiver, display)



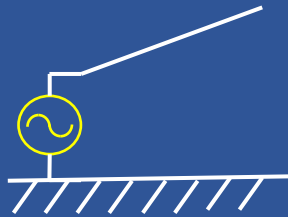
# Essential Theory (Dipoles)



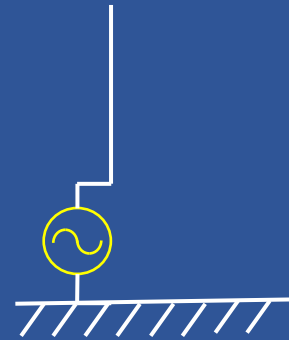
# Essential Theory (Monopoles)



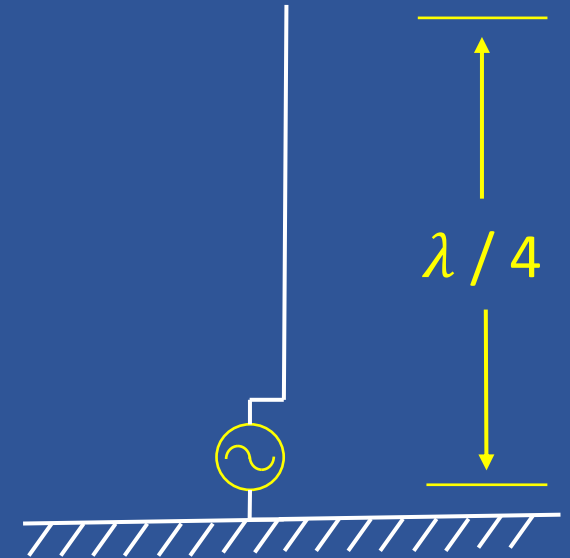
Transmission Line



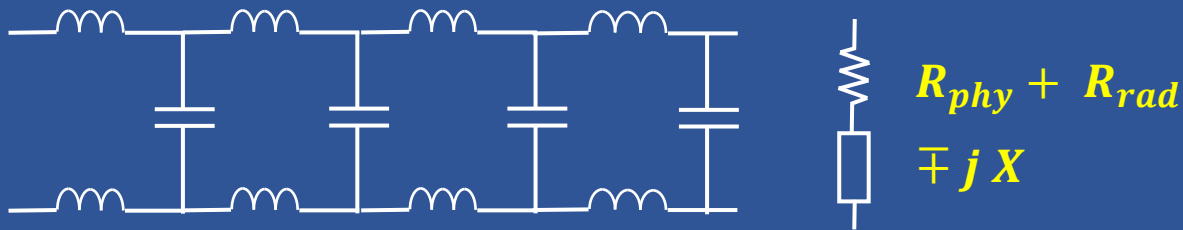
Sorta Monopole



Short Monopole



Resonant Monopole

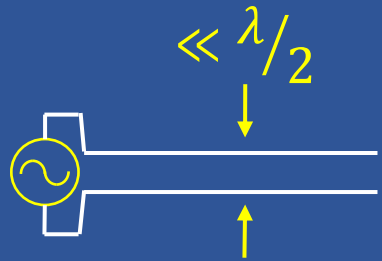


$$R_{phy} + R_{rad}$$

$$\mp jX$$

Transmission Line and Antenna Circuit Models

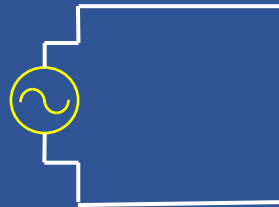
# Essential Theory (Loops)



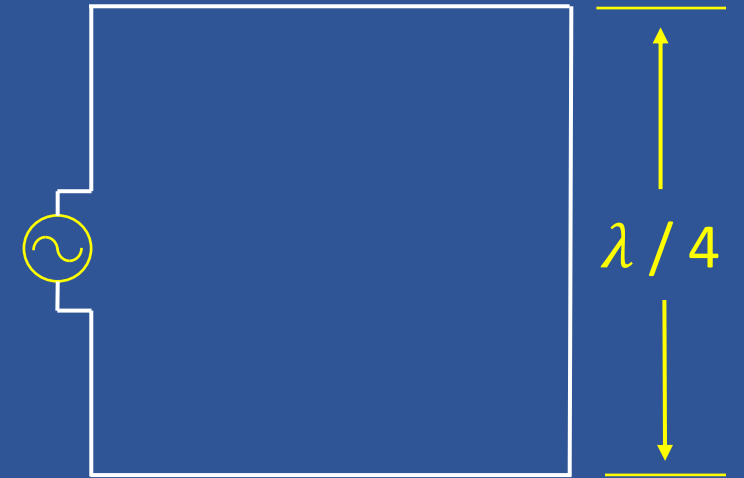
Transmission Line



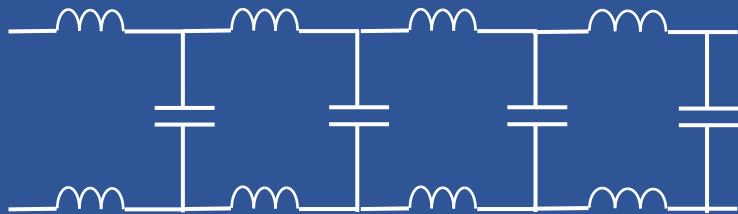
Sorta Loop



Small Loop



Resonant Loop

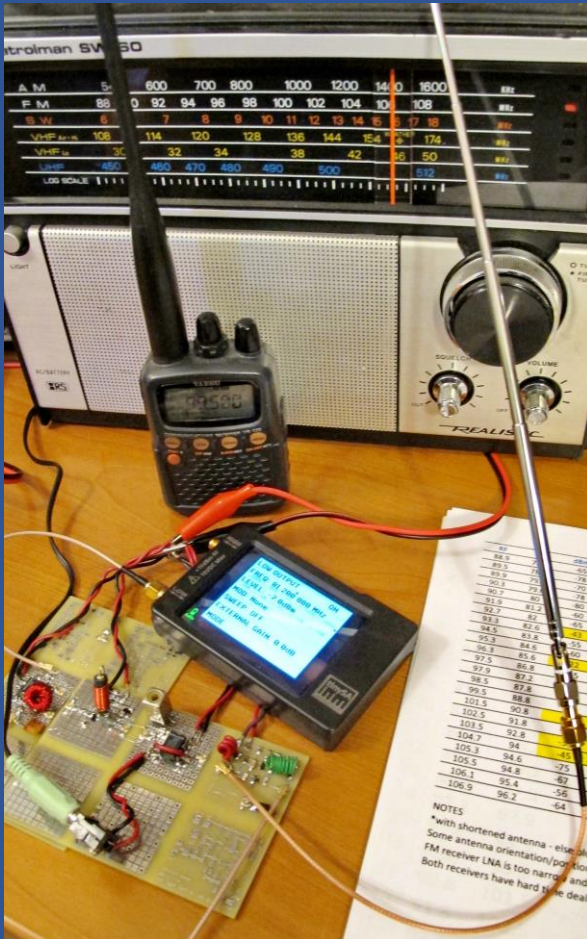


$$R_{phy} + R_{rad}$$

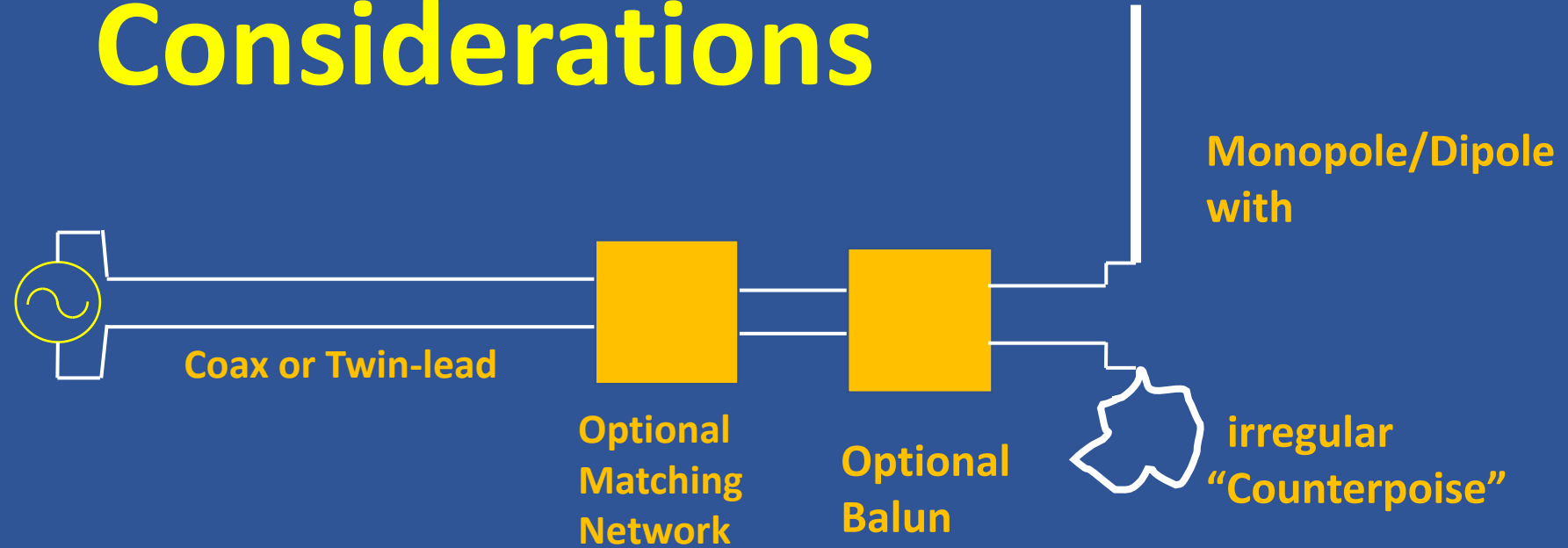
$$\pm jX$$

Transmission Line and Antenna Circuit Models

# Real-World Examples and Considerations



From this channel:  
Radio Design 101, Epilogue 1



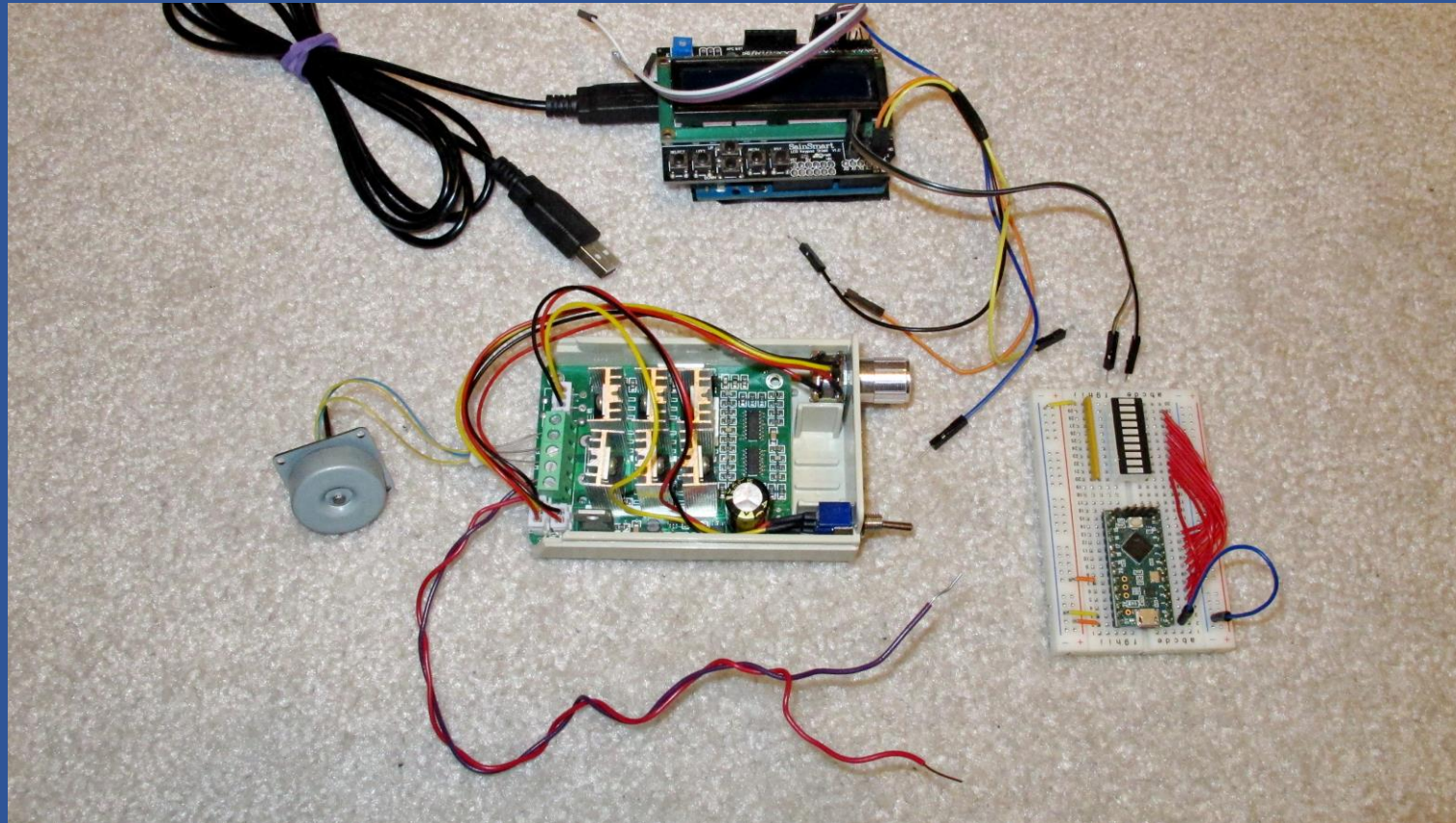
- Radiation resistance decreases with the square of length for "short" dipoles (length  $< \lambda/2$ ).
- Efficient antennas generally need to be  $> \lambda/10$  in size.
- But there is no magic number, especially for receive operation.
- Nearby objects (closer than  $\lambda/2$ ) can have strong effects.

# Episode 8 Topics

## Topics

- Design Requirements
- How to Make a (decent) Antenna
- • How to NOT make an Antenna
- Surveying Common Antenna Designs
- Custom Design Examples

# Unintentional Transmitters and Antennas

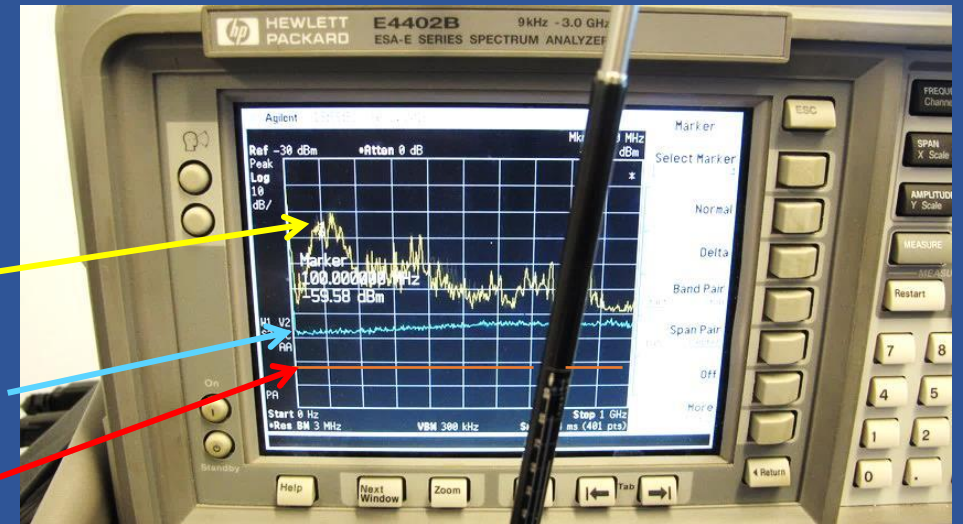
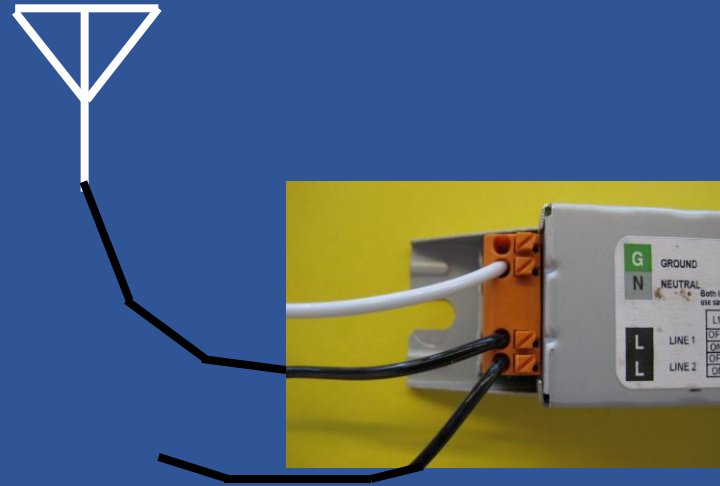


# RFI From High Efficiency Lighting



See: "Wireless Communication Problems in Energy-Efficient Building Construction",

2016 IEEE International Symposium on Electromagnetic Compatibility (EMC)



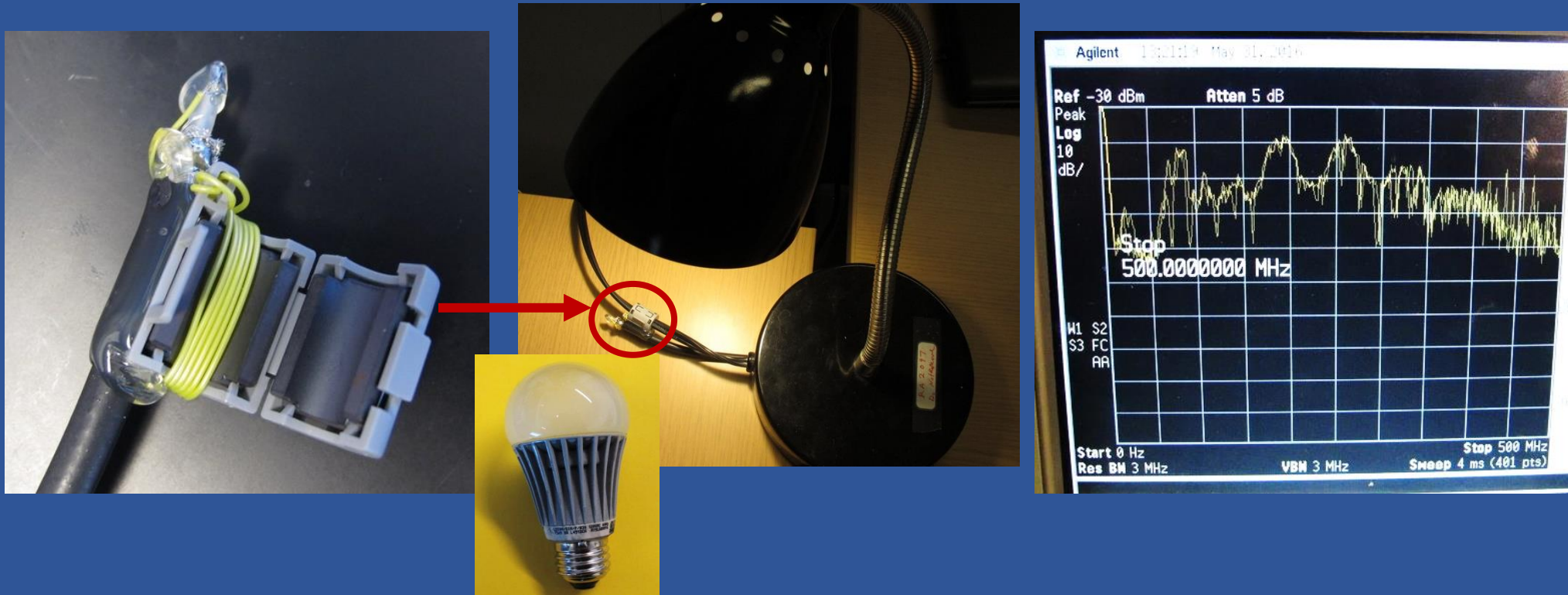
*In-building RFI*

*Analyzer noise floor*

*Thermal noise floor*

# Household LED Bulbs and SMPS

Some A19-base LED bulbs can be similar or worse, **turning household wiring into a large distributed antenna** transmitting broadband noise from 50 to 500 MHz and beyond...

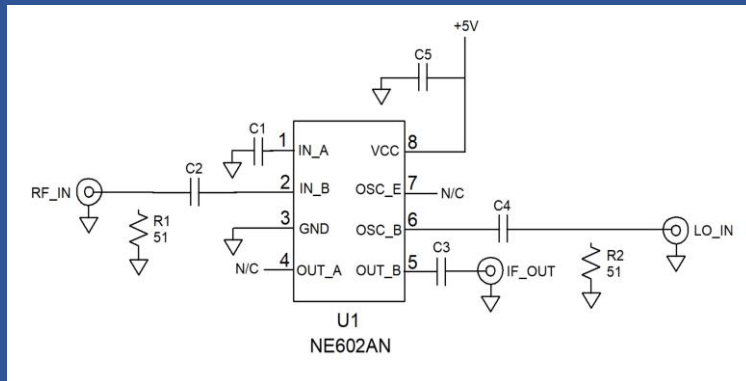


**Lots of other sources also exist – Anything with fast rise-time waveforms and inadequate bypass/filtering and/or shielding !**

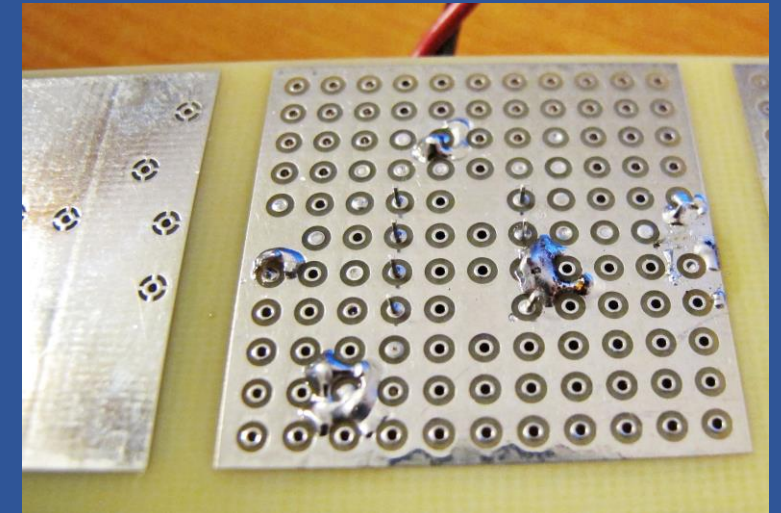
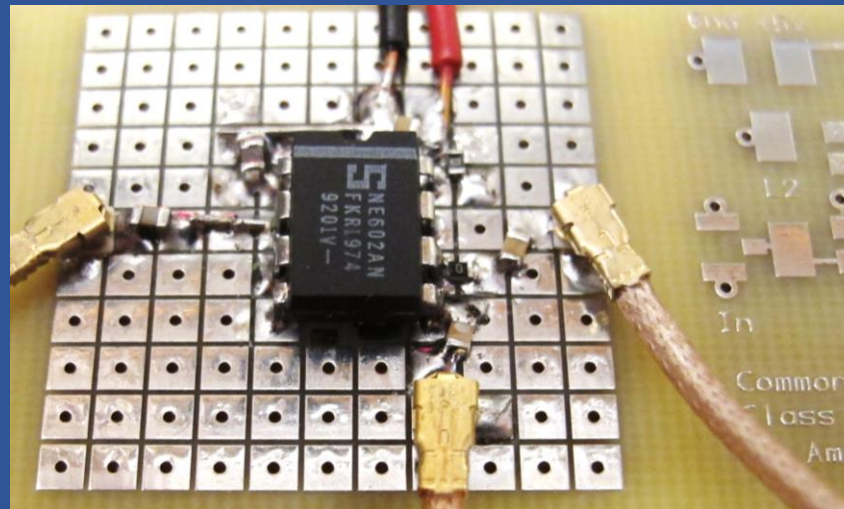


# How to NOT make Transmitters / Antennas

- Provide good supply bypass/filtering
- Use PC boards with ground-planes and SMT components
- Use twisted-pair, ground-paired, or shielded wiring
- Test product/system for Electro-Magnetic Compatibility (EMC) compliance !
- Encase product in shielded enclosure if necessary



Simple circuit & RF PCB  
example from Radio Design 101  
video series



# Episode 8 Topics

## Topics

- Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- • Surveying Common (intentional) Antenna Designs
- Custom Design Examples

# Common Antenna Designs








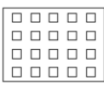
## Antenna Examples

Antennas come in a nearly infinite number of shapes and sizes. Here are a few of the more common ones. Note that many commercial designs are variations or combinations of these.

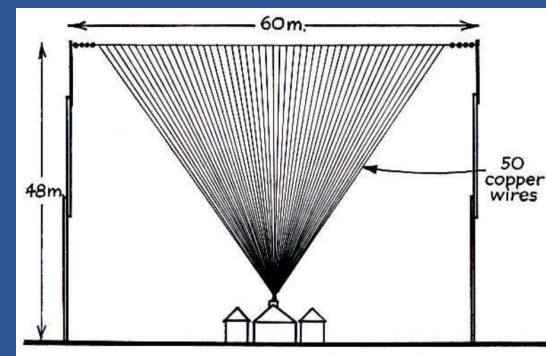
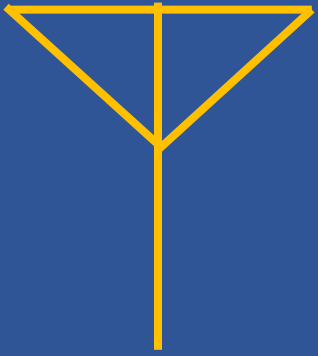
### "Non-directional" Types

Antenna	Impedance	Features
1) Halfwave Dipole	$73 + j0$ Ohms	Relatively isotropic, simple construction
2) Folded (halfwave) Dipole	$300 + j0$ Ohms	Similar to dipole. Higher impedance. Sometimes used in simple vertical arrays.
3) Quarterwave Monopole	$36 + j0$ Ohms	Similar to dipole. Ground-plane often abbreviated (e.g. case of cell-phone is ground plane)
4) Short Monopole	$R - jX$ $R \ll 36, X$ large	Physically shorter than quarterwave monopole, but requires resonating coil and/or matching network.
5) Loaded monopole	$R + j0$	Similar to short monopole, but resistive input impedance. Can be engineered to be nominally 50 Ohms.
6) Simple longwire	Varies Widely	Simple useful design at low freq (e.g. < 30 MHz). Often used for shortwave receivers.
7) Simple large loop or smaller resonant loop	Varies Widely	Simple, low-cost. Popular for indoor UHF TV antennas in "the old days".. Resonant loop used in KeyFobs today.
8) Small ferrite-core loop	$R + jX$	Physically small with large effective aperture. Used in portable AM broadcast receivers and other LF to HF products.
9) Microstrip patch	50 Ohms	Simple, low-cost. Useful mainly at high frequency (e.g. good for GPS).
10) Other	Inverted F, small loaded patches, etc.	Simple, low-cost designs for PC boards. May use high-K dielectrics to make antenna much smaller than a wavelength.

### Directional Designs

1) Yagi-Uda		Moderate gain (10 dB) Good front-to-back ratio. Relatively simple construction.
2) Log-Periodic		Similar to Yagi-Uda, but broadband. Lower gain and less directivity.
3) Corner Reflector		Good "sector-coverage" (i.e. beamwidth of 90 to 120 degrees with excellent front/back ratio). Often used in cell-towers.
4) Horn		Gains to about 12 dB. Good illumination pattern for dish antennas.
5) Helix		Circular polarization. Moderate gain, and good illumination for dish antenna.
6) Linear, vertical array (tower-mounted dipoles)		Concentrates power toward horizon for max range. Used in public-safety (police/fire/etc.) Used in cell-towers when array embedded in corner reflector.
7) Parabolic dish		High-gain, narrow-beamwidth. Simple, low-cost construction.
8) 2-D Phased-array		High-gain, narrow-beamwidth, rapid-steering. Relatively high cost.

# Thanks for Watching



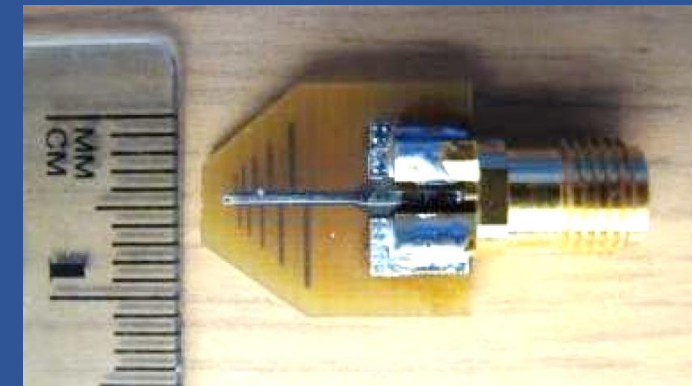
<http://www.newscotland1398.net/nfld1901/marconi-nfld.html>

# Antenna Briefs #8

---

## Designing Antennas

### Part 2 - Examples



# Common Antenna Designs









## Antenna Examples

Antennas come in a nearly infinite number of shapes and sizes. Here are a few of the more common ones. Note that many commercial designs are variations or combinations of these.

### "Non-directional" Types

Antenna	Impedance	Features
1) Halfwave Dipole	$73 + j0$ Ohms	Relatively isotropic, simple construction
2) Folded (halfwave) Dipole	$300 + j0$ Ohms	Similar to dipole. Higher impedance. Sometimes used in simple vertical arrays.
3) Quarterwave Monopole	$36 + j0$ Ohms	Similar to dipole. Ground-plane often abbreviated (e.g. case of cell-phone is ground plane)
4) Short Monopole	$R - jX$ $R \ll 36, X$ large	Physically shorter than quarterwave monopole, but requires resonating coil and/or matching network.
5) Loaded monopole	$R + j0$	Similar to short monopole, but resistive input impedance. Can be engineered to be nominally 50 Ohms.
6) Simple longwire	Varies Widely	Simple useful design at low freq (e.g. < 30 MHz). Often used for shortwave receivers.
7) Simple large loop or smaller resonant loop	Varies Widely	Simple, low-cost. Popular for indoor UHF TV antennas in "the old days".. Resonant loop used in KeyFobs today.
8) Small ferrite-core loop	$R + jX$	Physically small with large effective aperture. Used in portable AM broadcast receivers and other LF to HF products.
9) Microstrip patch	50 Ohms	Simple, low-cost. Useful mainly at high frequency (e.g. good for GPS).
10) Other	Inverted F, small loaded patches, etc.	50 Ohms Simple, low-cost designs for PC boards. May use high-K dielectrics to make antenna much smaller than a wavelength.

### Directional Designs

1) Yagi-Uda		Moderate gain (10 dB) Good front-to-back ratio. Relatively simple construction.
2) Log-Periodic		Similar to Yagi-Uda, but broadband. Lower gain and less directivity.
3) Corner Reflector		Good "sector-coverage" (i.e. beamwidth of 90 to 120 degrees with excellent front/back ratio). Often used in cell-towers.
4) Horn		Gains to about 12 dB. Good illumination pattern for dish antennas.
5) Helix		Circular polarization. Moderate gain, and good illumination for dish antenna.
6) Linear, vertical array (tower-mounted dipoles)		Concentrates power toward horizon for max range. Used in public-safety (police/fire/etc.) Used in cell-towers when array embedded in corner reflector.
7) Parabolic dish		High-gain, narrow-beamwidth. Simple, low-cost construction.
8) 2-D Phased-array		High-gain, narrow-beamwidth, rapid-steering. Relatively high cost.

# Episode 8 Topics

## Topics

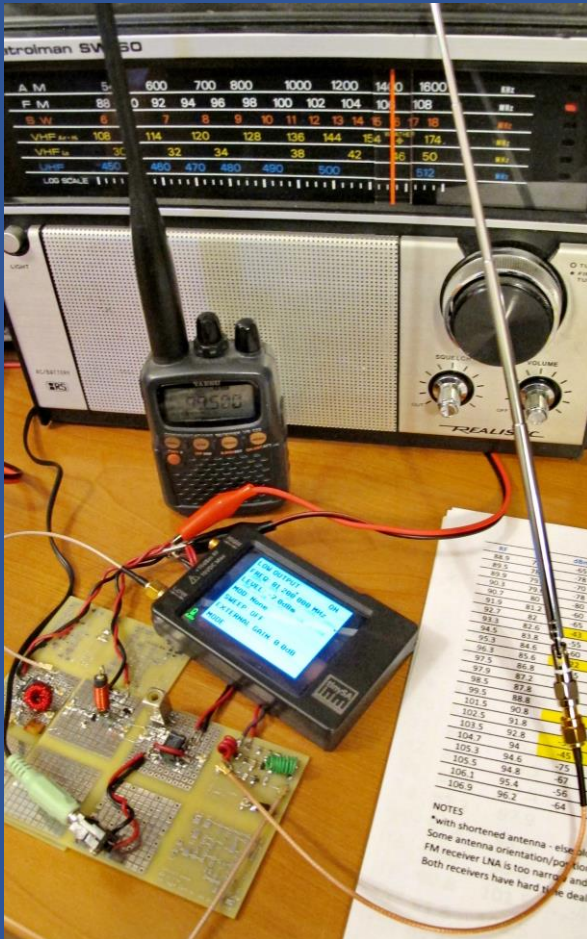
- Design Requirements
- How to Make an Antenna
- How to NOT make an Antenna
- Surveying Common (intentional) Antenna Designs
- Custom Design Examples

# Design Requirements

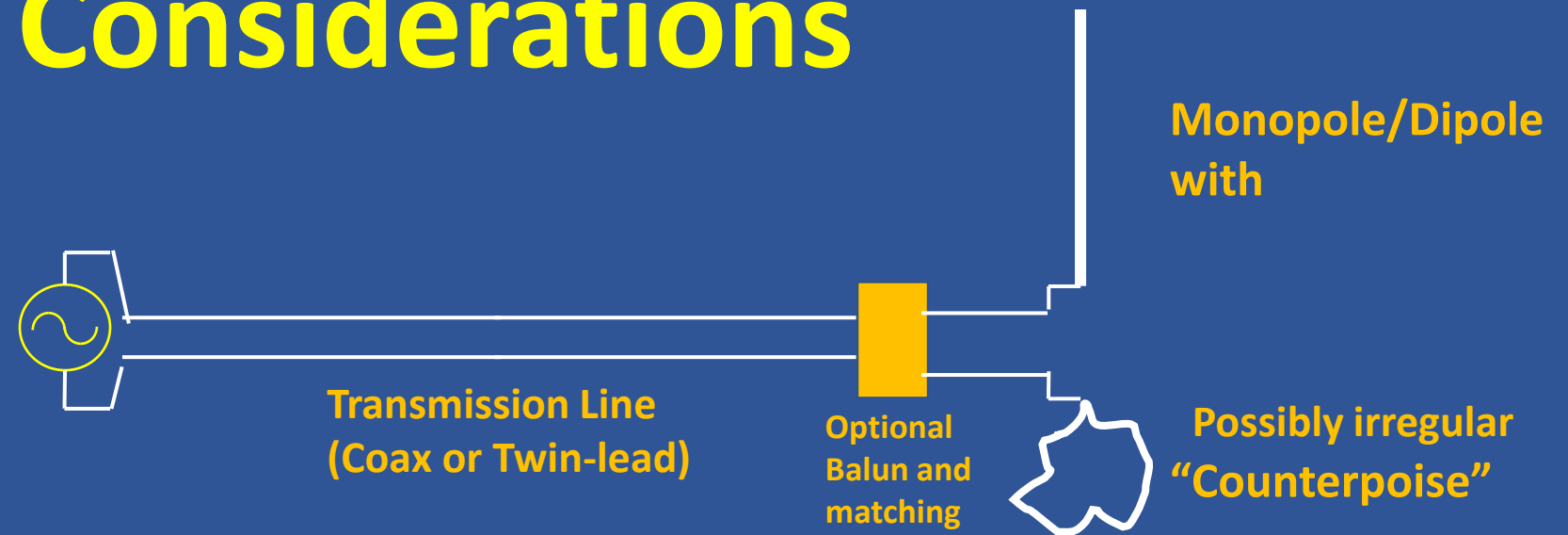
- Frequency, bandwidth, and size
- Main use – Transmit, receive, or transceive
- Impedance
- Directivity and Gain (pattern)
- Polarization
- Installation (feedline, siting, structure, environment)



# Real-World Examples and Considerations



From this channel:  
Radio Design 101, Epilogue 1



- Radiation resistance decreases with the square of length for "short" dipoles (length  $< \lambda/2$ ).
- Efficient antennas generally need to be  $> \lambda/10$  in size.
- But there is no magic number, especially for receive operation.
- Nearby objects (closer than  $\lambda/2$ ) can have strong effects.

# A Couple Key Points

Antenna size is proportional to wavelength  $\lambda$

$$\lambda = \frac{c}{f}$$

$$f = 1 \text{ MHz} \quad \lambda = 300 \text{ m}$$

$$f = 100 \text{ MHz} \quad \lambda = 3 \text{ m}$$

$$f = 10 \text{ GHz} \quad \lambda = 30 \text{ mm}$$

Designs can be scaled ! 😊

But watch out for near-field coupling, especially below 100 MHz ...

# Episode 8 Topics

## Topics

- Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- • Surveying Common Antenna Designs
- Custom Design Examples

# Hertz Loaded Dipole and Loop

Capacitively loaded 2.6-meter dipole

⇒  $\lambda$  is about 6 m

⇒  $f$  is about 50 MHz

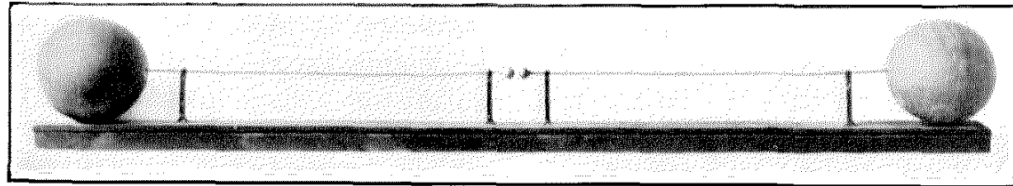


Figure 3—The First Oscillator of Hertz. Two copper wires, each 1 metre in length, supported on rods of sealing wax. The large spheres are of sheet zinc, and are 30 centimetres in diameter. Base 260 x 7.5 centimetres

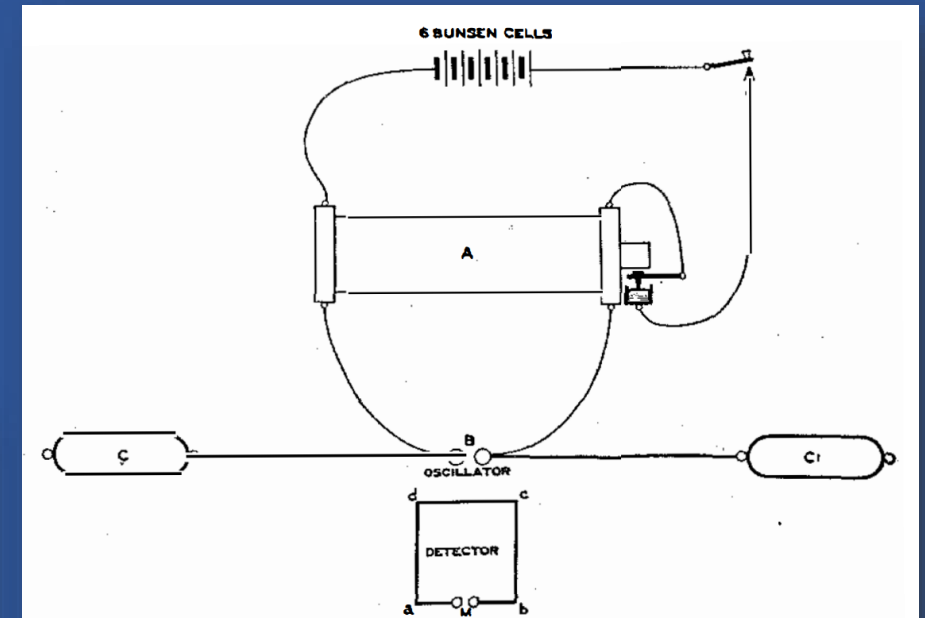


Figure 8—General Arrangement of Hertz Oscillator and Resonator

<https://worldradiohistory.com/Archive-ITT/20s/ITT-Vol-06-1927-02.pdf>

# Modern Dipoles



**Traditional Biconical Antennas**

SAS-542	SAS-543

<https://www.ahsystems.com/>



MFJ-1796  
40, 20, 15, 10 m (+6 and 2m) bands

# Monopoles (and Discone)



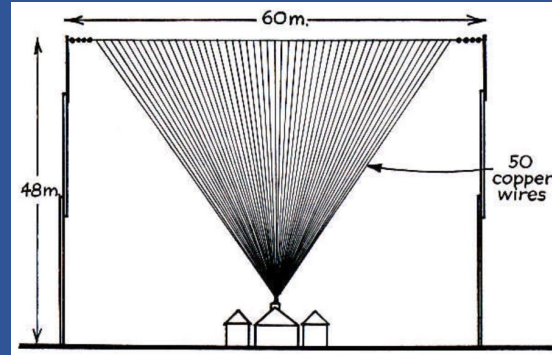
A typical mast radiator and antenna tuning hut of an AM radio station in ...

More details

Ildar Sagdejev (Specious) - Own work

CC BY-SA

[https://en.wikipedia.org/wiki/Mast\\_radiator#/media/File:2008-07-28\\_Mast\\_radiator.jpg](https://en.wikipedia.org/wiki/Mast_radiator#/media/File:2008-07-28_Mast_radiator.jpg)



<http://www.newscotland1398.net/nfld1901/marconi-nfld.html>



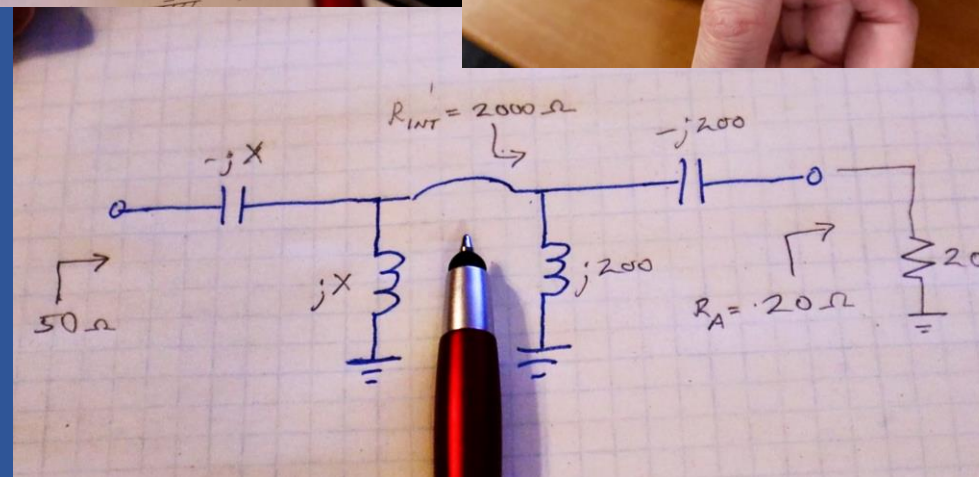
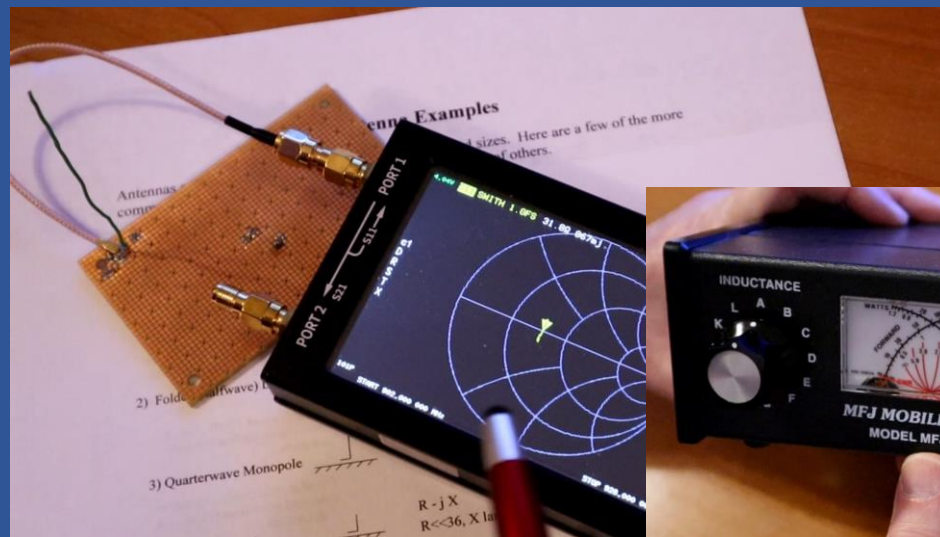
DX Engineering 5-BTV with ground-radial plate



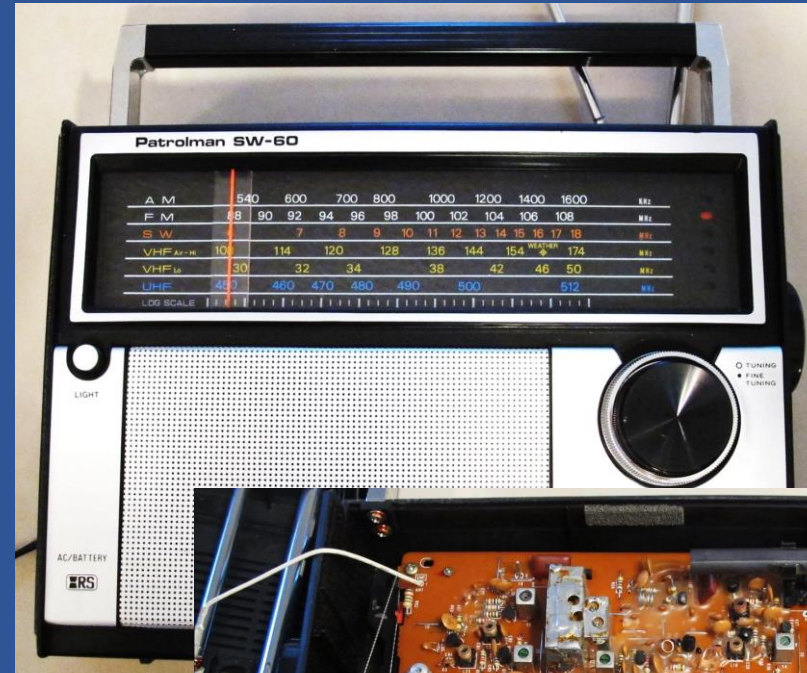
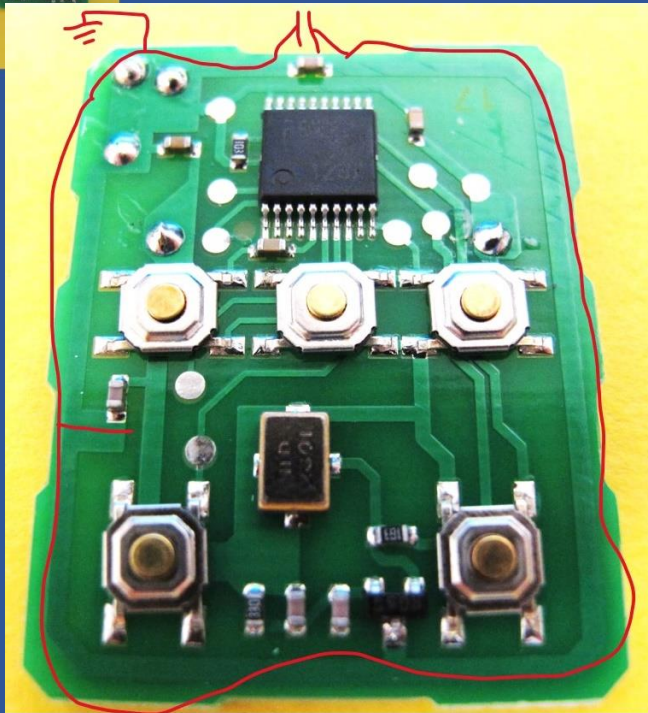
# Antenna Tuners

The screenshot shows the YouTube Studio interface for the channel 'MegawattKS'. The left sidebar contains navigation options: Dashboard, Content, Playlists, Analytics, Comments, Subtitles, Copyright, Monetization, Customization, Settings, and Send feedback. The main content area displays a list of videos. The video titled 'NanoVNA - Antennas and Tuners' is circled in purple. The video list includes:

- Radio Design 101 - Episode 2 - Impedance Matching networks. This is the second half of episode 2 in the Radi...
- Radio Design 101 - Episode 2 - Impedance Matching networks. This is episode 2 in the Radio Design 101 series...
- Radio Design 101 - Episode 1 - Transmission Line Theory. This video covers the design of bandpass filters, including the concept of quality...
- Radio Design 101 - Episode 1 - Transmitters and Receivers. This video overviews radio / wireless transmitters and receivers, circuit...
- NanoVNA - Antennas and Tuners** (circled in purple). Using the NanoVNA to illustrate the operation of antennas and antenna...
- NanoVNA and TinySA for Radio Design. Using the NanoVNA and TinySA to illustrate how radio / wireless devices...
- NanoVNA - Measuring RLC Components. Using a Vector Network Analyzer (VNA) to measure and understand RLC parasitics ...

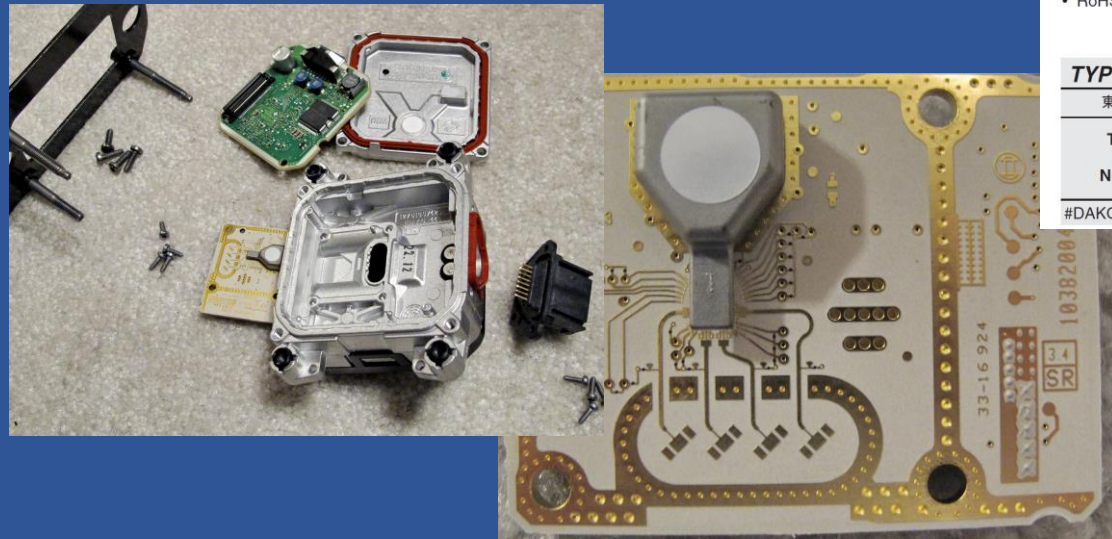
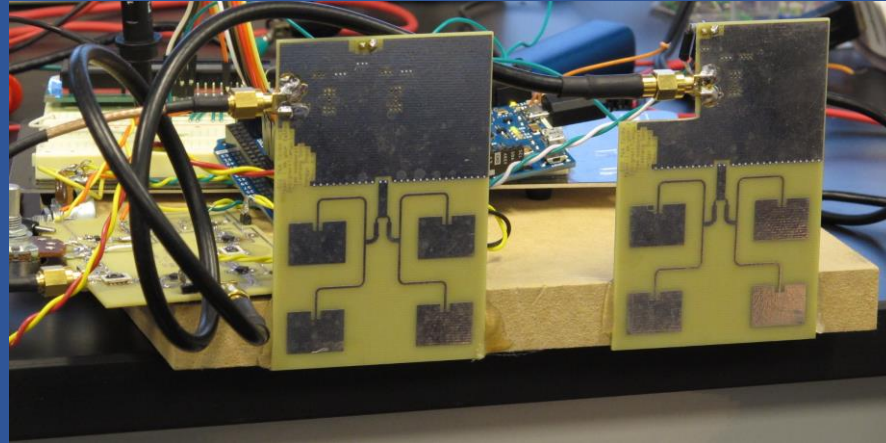
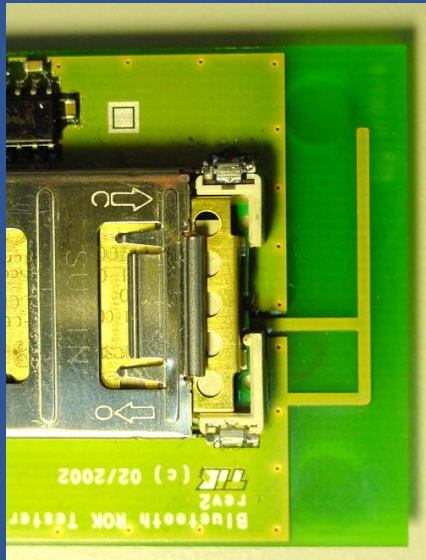


# Loops





# Planar/PCB Antennas



**TOKO** Dielectric Antenna  
GPS用誘電体アンテナ素子

**TYPE DAKC, DAG  
DAKC**




Unit : mm

**Features**

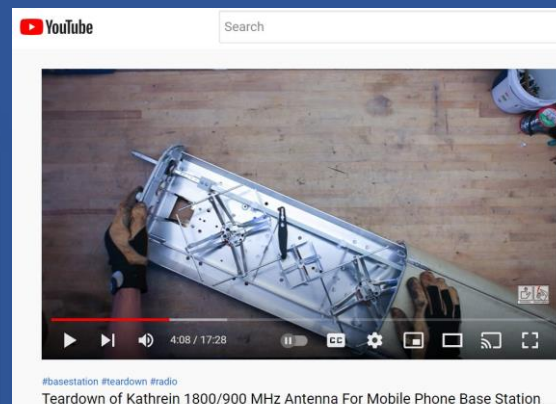
- Compact, Low-profile
- Rectangular microstrip structure, offset single feed through ground plane and substrate.
- Use of low temperature coefficient ceramics gives stability under changing temperature conditions.
- RoHS compliant

**SELECTION GUIDE FOR STA**

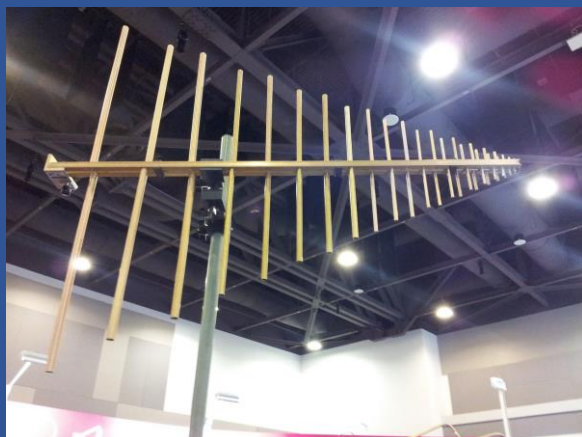
TYPE DAKC			
東光品番	受信周波数範囲	中心周波数	帯域幅
TOKO Part Number	Range of Receiving Frequency (MHz)	Center Frequency (MHz)	Bandwidth (MHz) Min.
#DAKC1575MS74	1575.42±1.023	1580.5*	9.0



# Directional Antennas



#basestation #teardown #radio  
Teardown of Kathrein 1800/900 MHz Antenna For Mobile Phone Base Station



**KATHREIN**  
Antennen · Electronic

**Dual-band Panel**  
**Dual Polarization**  
**Half-power Beam Width**  
**Adjust. Electr. Downtilt**  
**Integrated Combiner**

	<b>824-960</b>	<b>1710-1880</b>
	<b>X</b>	<b>X</b>
	<b>65°</b>	<b>63°</b>
	<b>0°-10°</b>	<b>2°</b>
	<b>C</b>	

**XXPol Panel 824-960/1710-1880 C 65°/63° 14.5/16.5dBi 0°-10°T/2°T**

Type No.	<b>742 151</b>		
Frequency range	<b>824-960</b>	<b>880-960 MHz</b>	<b>1710-1880 MHz</b>
Polarization	+45°, -45°	+45°, -45°	+45°, -45°
Gain	2 x 14 dBi	2 x 14.5 dBi	2 x 16.5 dBi
<b>Horizontal Pattern:</b>			
Half-power beam width	69°	65°	63°
Elect. to horiz. pattern	~ 20 dB	~ 20 dB	~ 27 dB

Horizontal Pattern      Vertical Pattern  
2° electrical downtilt

Internet: <http://www.kathrein.de>  
KATHREIN, Marke KG · Antenn., Kathrein, Straße 1 · 9 · D · D · 910 04 44 ·

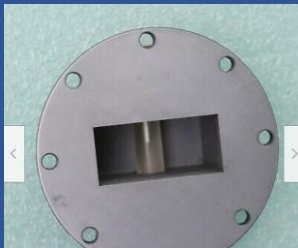
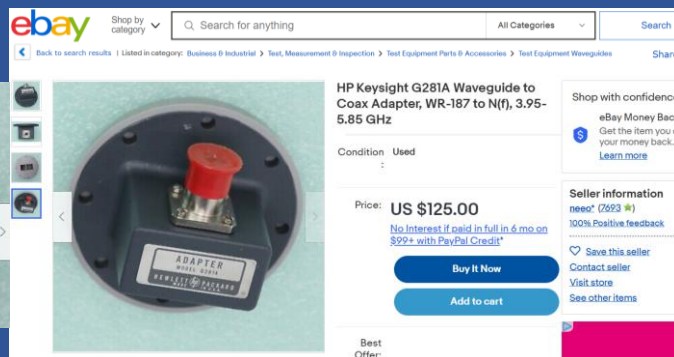


# Directional Antennas



Engineer Joel Steinkraus uses sunlight to test the solar arrays on one of the Mars Cube One (MarCO) spacecraft.

<https://solarsystem.nasa.gov/missions/mars-cube-one/in-depth/>



# Episode 8 Topics

## Topics

- Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- • Surveying Common Antenna Designs
- Custom Design Examples

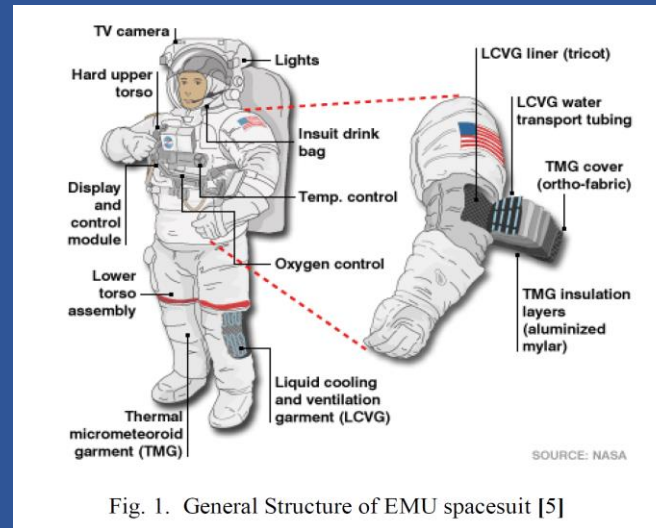
# Episode 8 Topics

## Topics

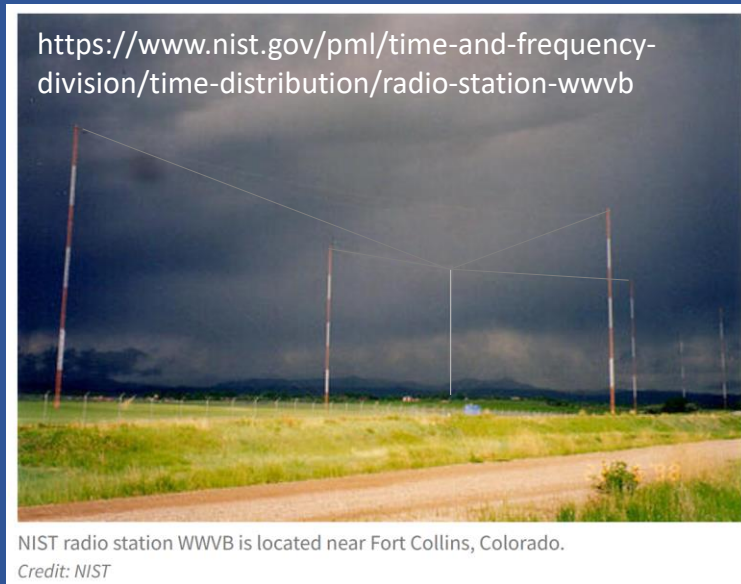
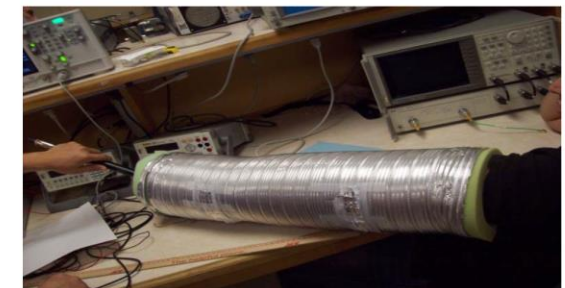
- Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- Surveying Common Antenna Designs
- • Custom Design Examples

# Body Area Network for Bio-Sensors in Space-suits

From: "Wireless Propagation Measurements for Astronaut Body Area Network", 2013 WiSEE conference.



has electrical properties similar to that of a real space suit (Fig. 9). The tube is 0.70 m long and has radius of 0.095 m. The air gap between the skin and the inner surface of tube is around 0.045 m, which is comparable to the space-suit.



# Microwave, PCB Log Periodics

From: "Broadband Antenna Probe for Microwave EMC Measurements", 2018 IEEE 27th Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS).

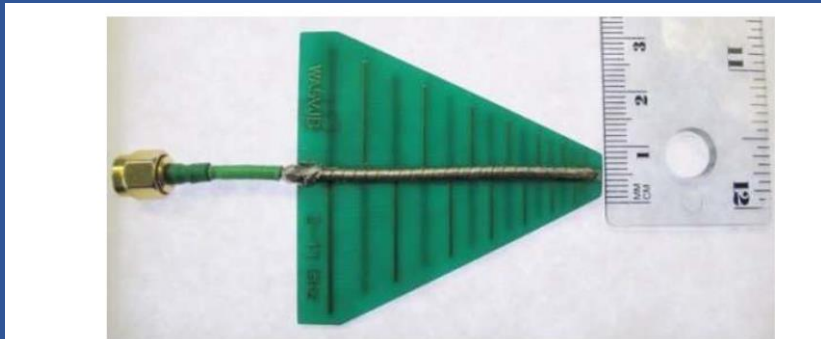


Fig. 1. 2-11 GHz commercial PC board log-periodic [3].

[3] WA5VJB, "Printed Circuit Board Antennas - Log Periodic," Kent Electronics, <http://www.wa5vjb.com/products1.html>

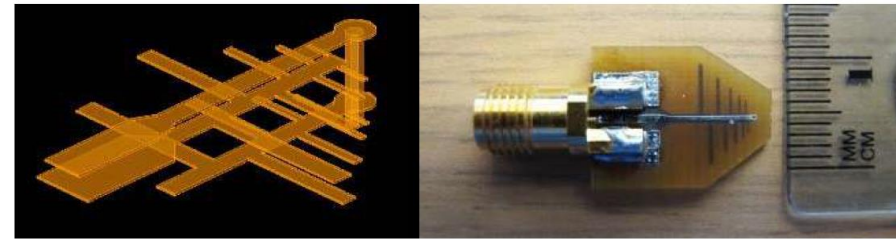


Fig. 2. 3D EM simulator model and PCB prototype of 8-20 GHz LPDA antenna.

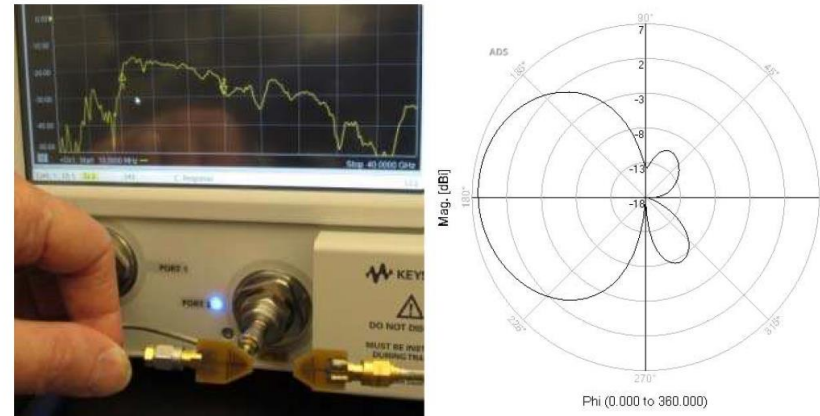


Fig. 3. Measuring antennas from 10 MHz to 40 GHz with VNA (Left). Simulated gain cross-section at 14GHz (Right).

# Episode 8 Topics

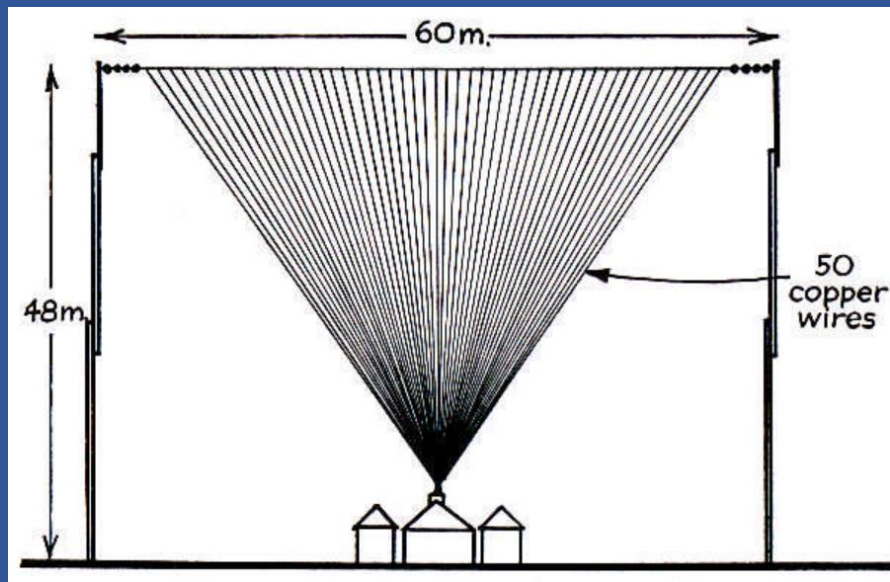
## Topics

- Design Requirements
- How to Make a (decent) Antenna
- How to NOT make an Antenna
- Surveying Common Antenna Designs
- Custom Design Examples



# Thanks for Watching

# Some Good References



<http://www.newscotland1398.net/nfld1901/marconi-nfld.html>

**ARRL**  
The National Association for  
Amateur Radio®

Login  
Register Account  
Login Help

Website Search  
Keyword  
Call Sign / Name  
Search License

Home On The Air Licensing, Education & Training Membership Regulatory & Advocacy Public Service Technology Get Involved ARRL Store

### ARRL Antenna Book

- ARRL Antenna Book
- Antenna Modeling for Beginners
- HF Digital
- Circuit Simulation
- History Of QST
- Arduino
- Arduino2
- ARRL Handbook 2020
- Arduino3
- End-Fed Half-Wave Antenna Kit
- Introduction to Radio Receiver Kit

### The Antenna Book

The ARRL Antenna Book for Radio Communications  
24th Edition

Limited Edition  
Four Volume Boxed Set

[Order Now >](#)

### Showcasing 80 Years of Antenna Know-How

*The ARRL Antenna Book for Radio Communications* is a single resource covering antenna theory, design and construction, and practical treatments and projects. This book contains everything you need to understand how radio signals propagate, how antennas work, and how to construct your own antenna system. Use *The ARRL Antenna Book* to build hundreds of antenna designs: dipoles, verticals, loops, beams, and more.

Presented in this 24th edition of *The Antenna Book* is persistent pioneering development by radio amateurs, for radio amateurs. You'll find new and time-tested

# Some Good EMC References

The screenshot shows the IEEE EMC Society website. At the top, there are navigation links for IEEE.org, IEEE Xplore Digital Library, IEEE Standards, IEEE Spectrum, and More Sites. The main header features the EMC Society logo, social media icons for LinkedIn, Facebook, Instagram, and Twitter, and a search bar with the IEEE logo. Below the header is a navigation menu with links for HOME, ABOUT, MEMBERSHIP, CHAPTERS, PUBLICATIONS, EVENTS, TRAINING/EDUCATION, STANDARDS, and COMMITTEES. The main content area is divided into four columns: EVENTS CALENDAR, BECOME A MEMBER, SCHOLARSHIPS, and DISTINGUISHED LECTURERS. Below this is a section titled "WHO IS EMC SOCIETY?" with a paragraph describing the society as the world's largest organization dedicated to the development and distribution of information, tools and techniques for reducing electromagnetic interference. A second paragraph describes the society's field of interest, including standards, measurement techniques, test procedures, instrumentation, equipment and systems characteristics, interference control techniques and components, education, computational analysis, and spectrum management.

<https://www.emcs.org/>

The screenshot shows the EMCFASTPASS website. The top navigation bar includes links for FASTPASS, ONLINE COURSES, TEST EQUIPMENT, RF CHAMBERS, GUIDES, CONTACT, and LOG IN. A dropdown menu is open, listing several topics: EMC Technician Training, EMC Design For Compliance: Emissions, EMC Design For Compliance: Immunity, Intrinsically Safe Hardware Design, and FCC Wireless Pre-Compliance. The main content area features a promotional offer for the eBook "Getting EMC Design Right First Time". The text states that the regular retail price is \$24.99, but it is currently offered for free. It mentions that the eBook has been downloaded over 10,000 times. A form is provided for users to enter their name and email address to receive the download. To the right of the text is an image of the eBook cover. Below the form is a "Next >" button. At the bottom right, there is a section titled "As Featured In:" with logos for EDN NETWORK and INTERFERENCE TECHNOLOGY.

<https://emcfastpass.com/rightfirsttime/>