

AM Directional Antenna Essentials

Referee: Jeff Littlejohn

Ron Rackley

Ben Dawson

A Practical Guide to System Operation and Maintenance

- DA System Hardware and What it Does
- Bandwidth Optimization Concepts
- How to Keep the System in Good Repair
- Tactical Troubleshooting
- Dealing with the FCC

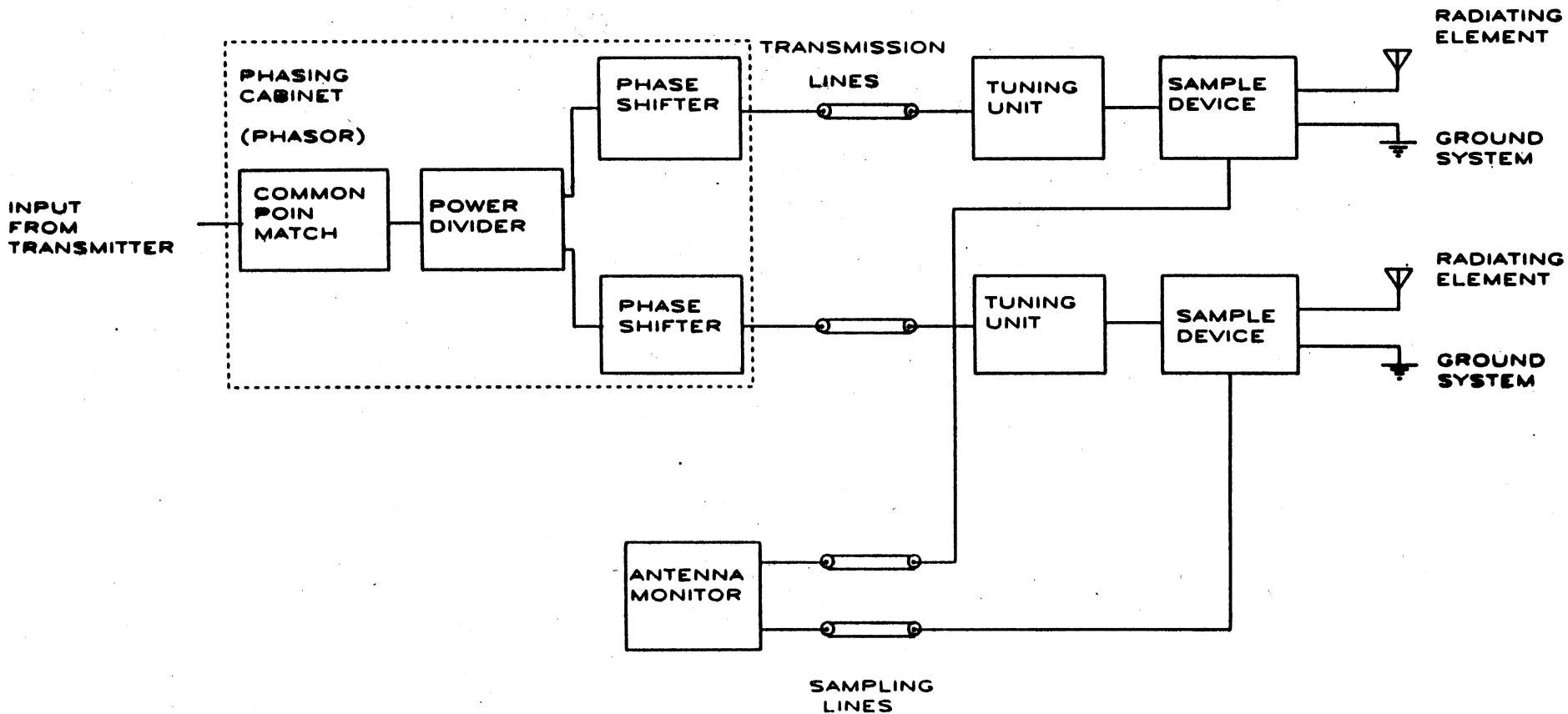
Directional Antenna Hardware

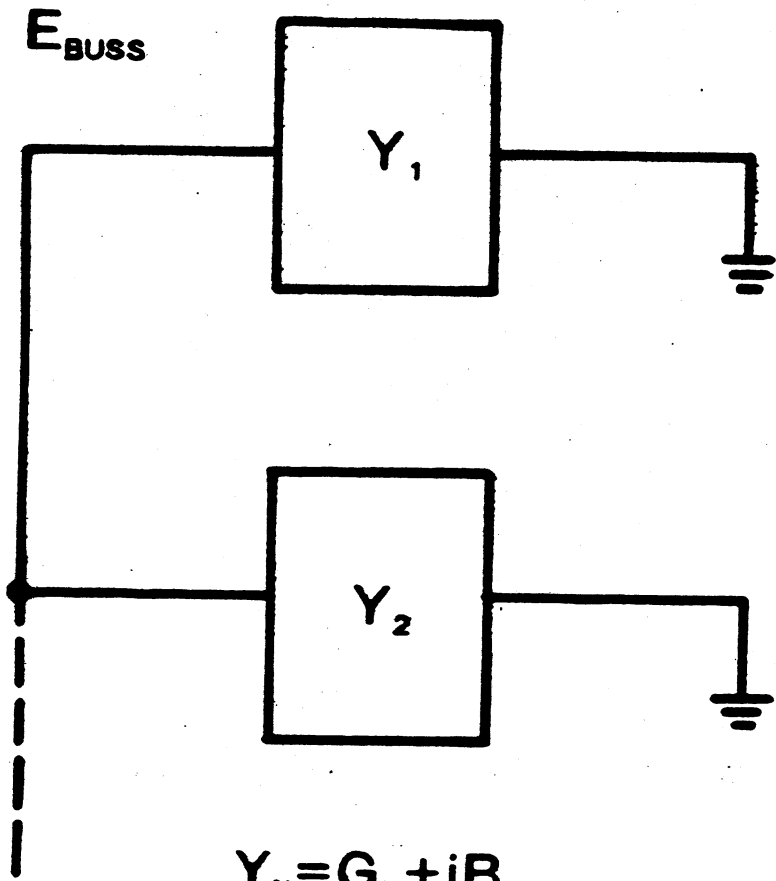
- The components and purpose

Network Building Blocks

- T Networks
- L Networks
- Shunt Reactance
- Series Reactance

System Block Diagram





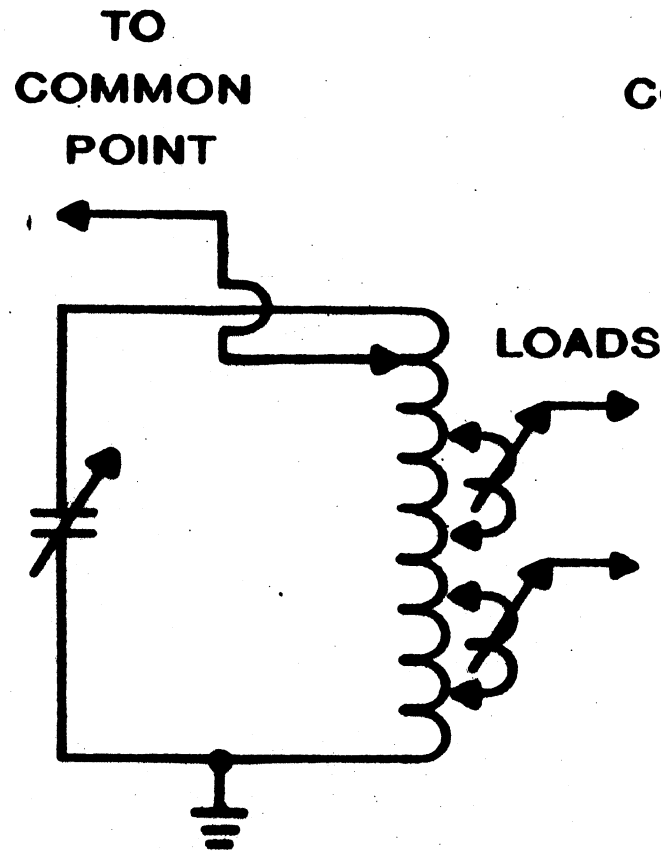
$$Y_N = G_N + jB_N$$

$$P_N = G_N (E_{BUSS})^2$$

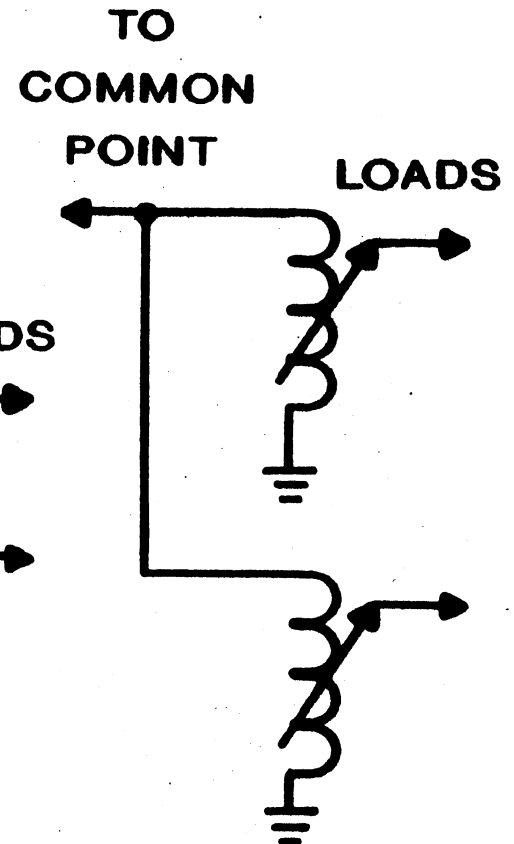
**General Power Divider
Principle**

Power Division

Divider Types



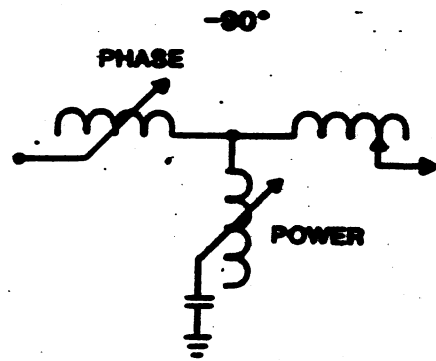
"TANK" OR
"JEEP COIL"



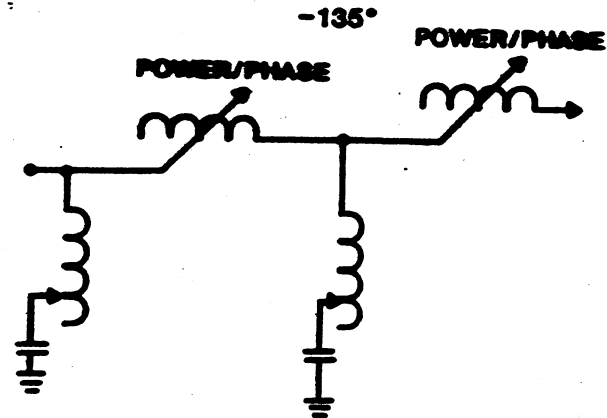
"PARALLEL" OR
"OHMS LAW"

**Traditional Power Divider
Types**

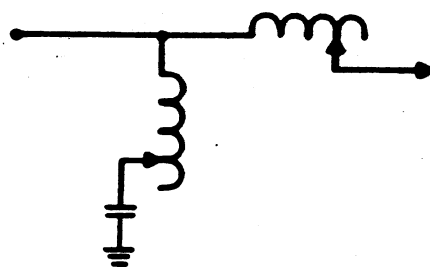
Divider Types



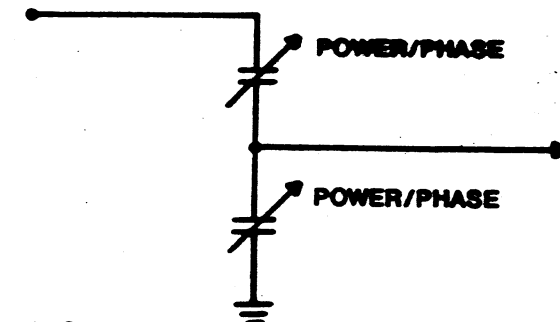
(a) T NETWORK



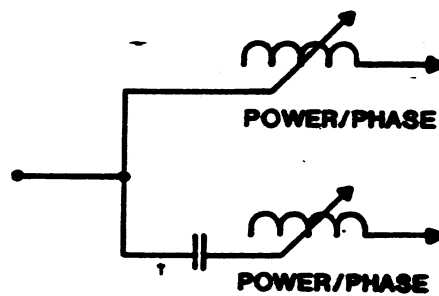
(b) 135 DEGREE



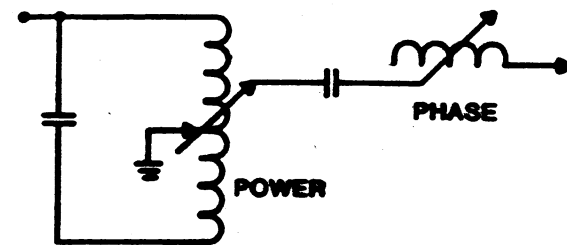
(c) FIXED L NETWORK



(d) CAPACITIVE

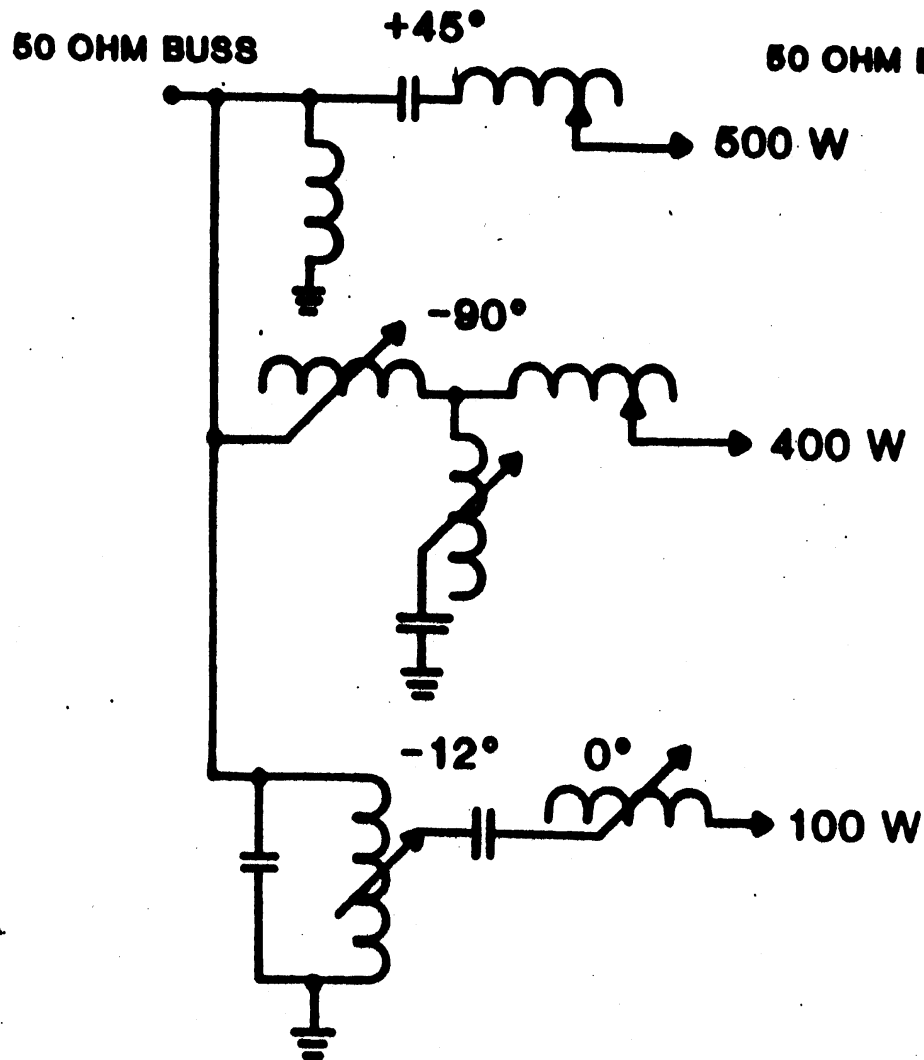


(e) QUADRATURE

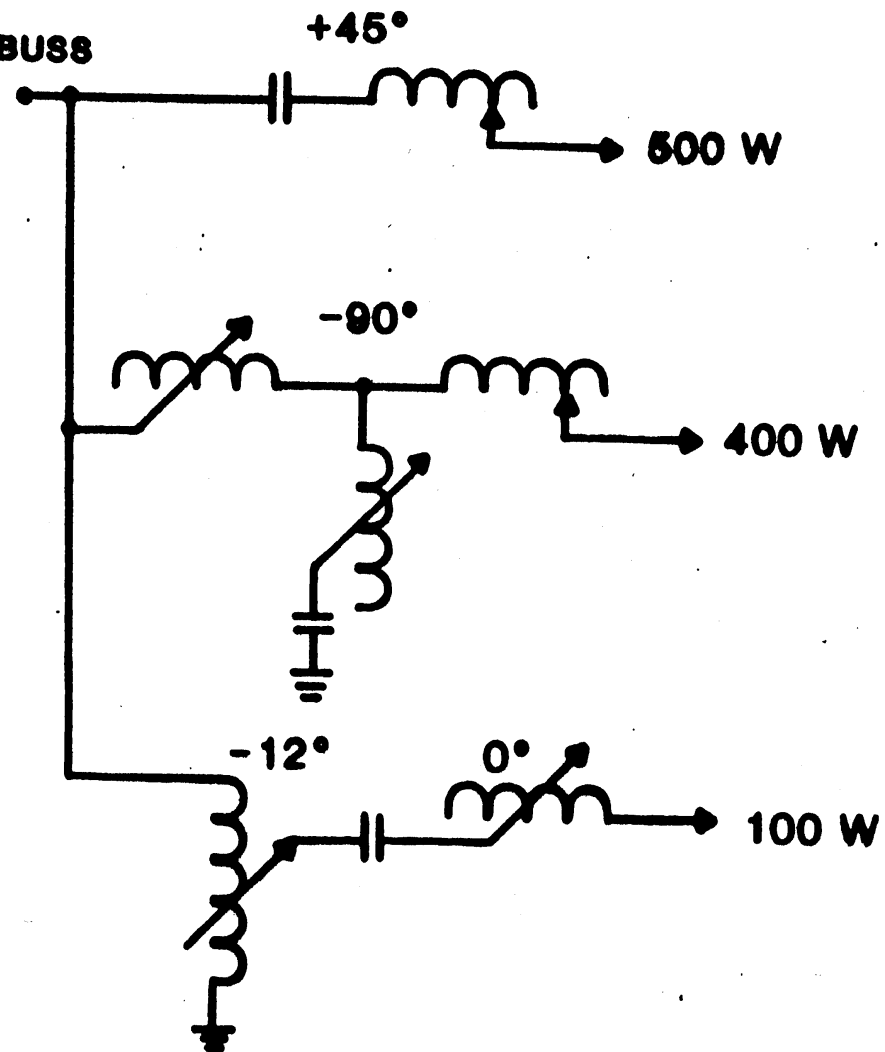


(f) FLEXIBLE POWER FLOW

Examples



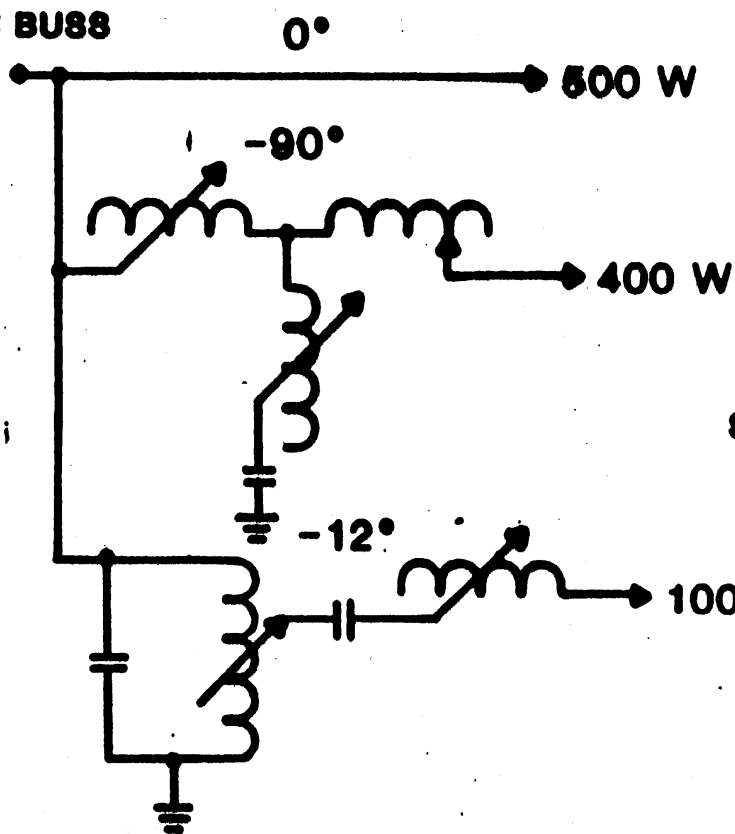
(a) MIXED USE OF POWER DIVIDER TYPES



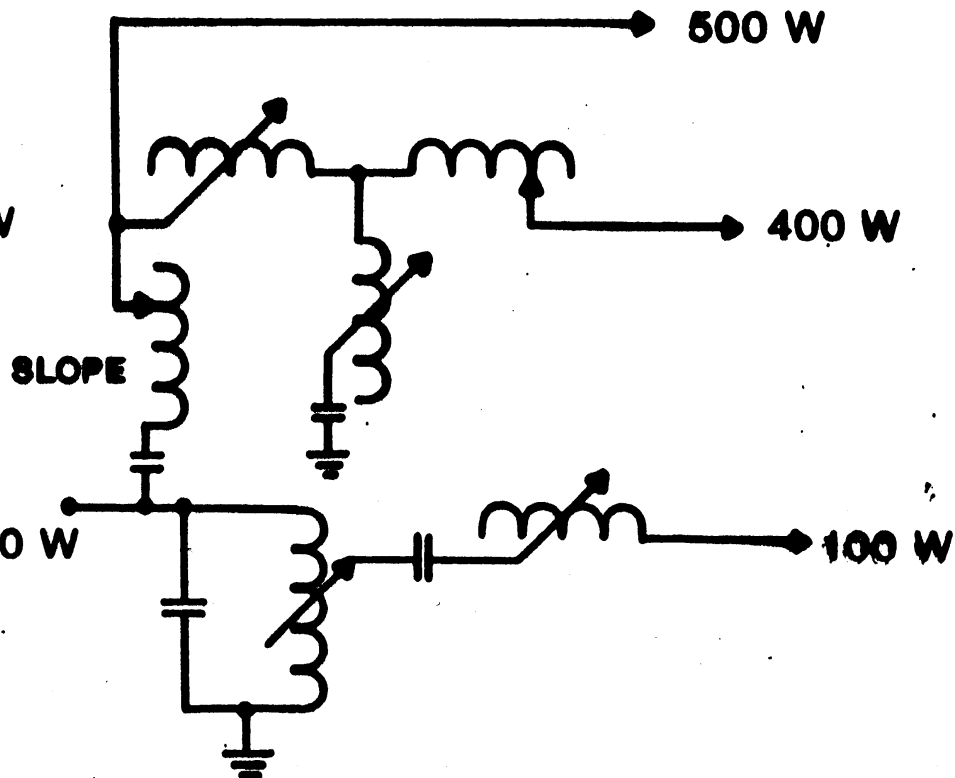
(b) SIMPLIFICATION BY ELIMINATION OF PARALLEL COMPONENTS

More Examples

25 OHM BUSS



(c) DIRECT FEED TO HIGHEST POWER TOWER



(d) SPLIT BUSS WITH PATTERN BANDWITH IMPROVEMENT

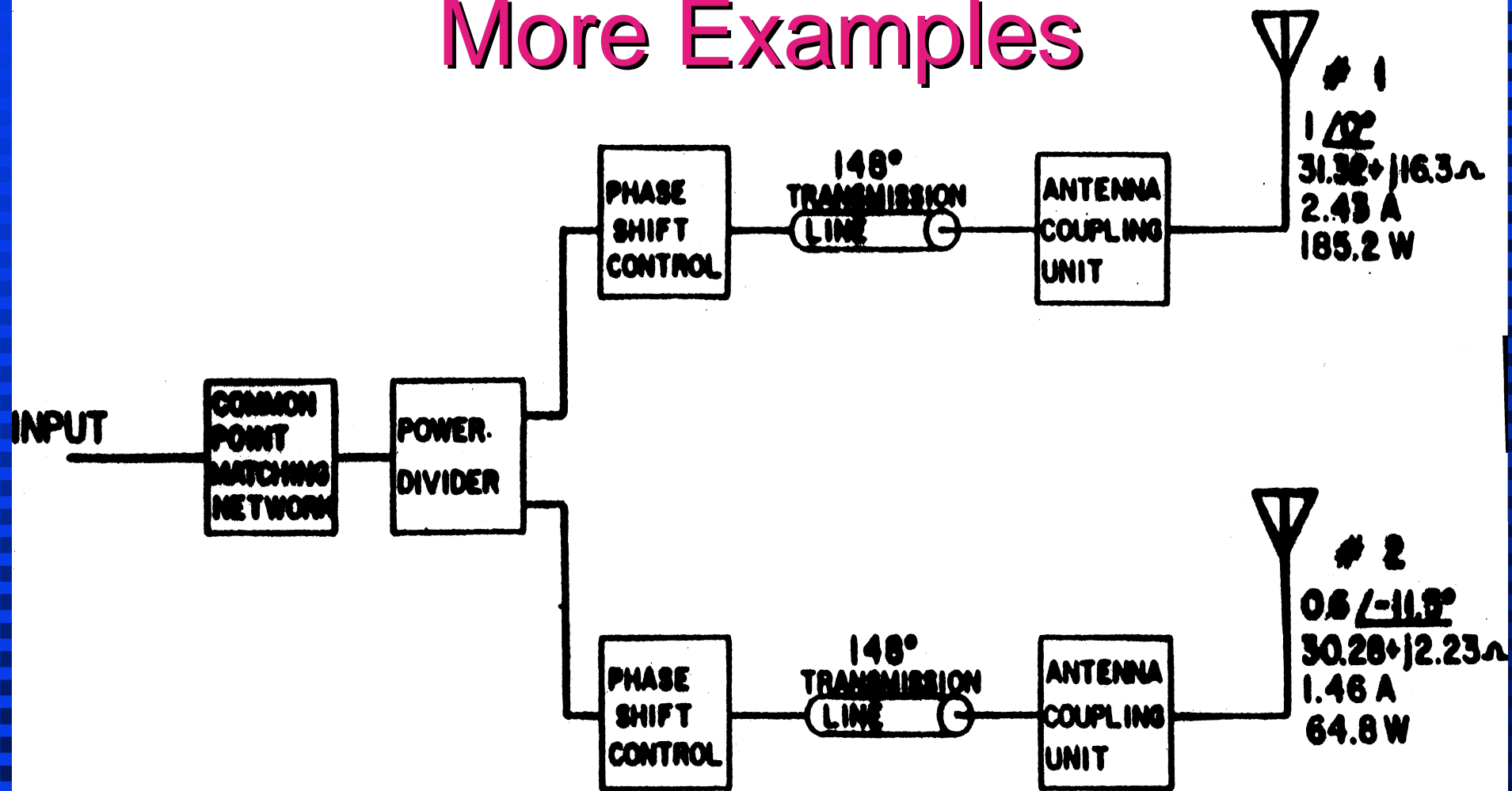
Two-Tower Phasing System Example

- Necessary Specifications
 - Parameters
 - Base Impedances
 - Base Currents
 - Power Distribution
 - Transmission Lines and Their Lengths

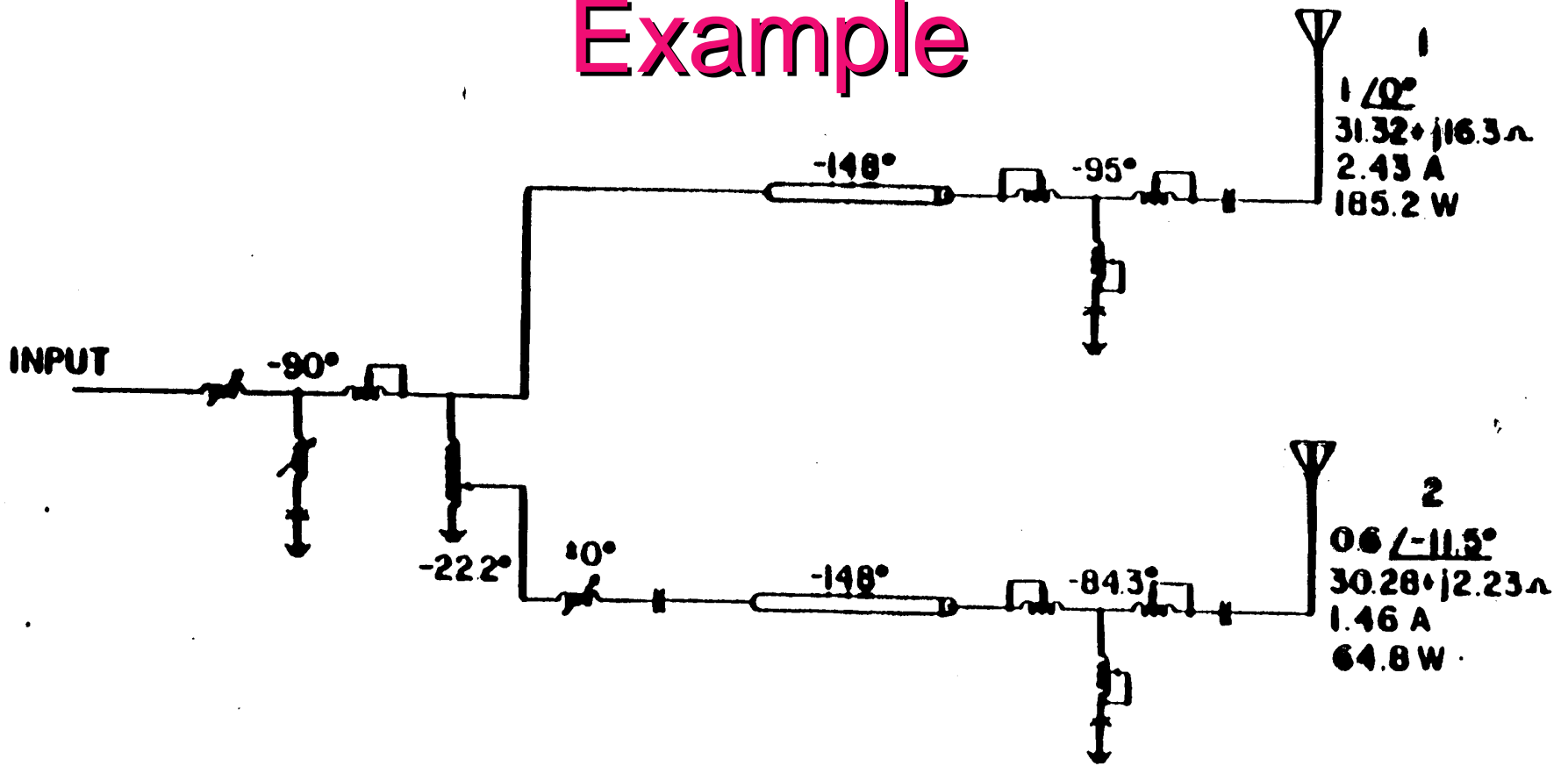
Two-Tower Phasing System Example

- Block Diagram
 - Power Division Controls
 - System Phase Shifts
 - Phase Controls
 - ATUs
 - Common Point Matching

More Examples



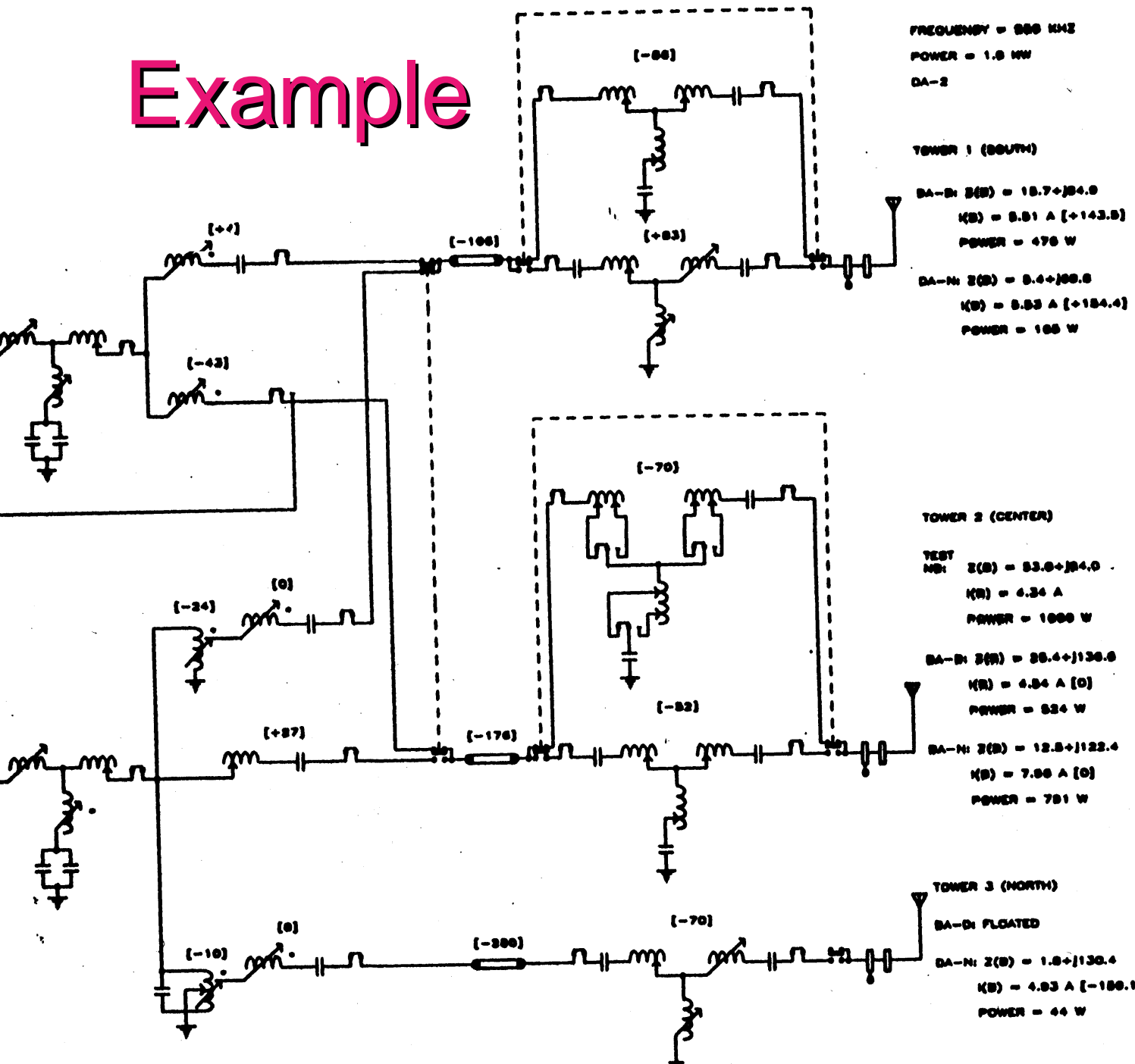
Example



Larger System Examples

- Pattern Switching
- ND Operation
- Test Jacks

Example



FREQUENCY = 900 KHZ
 POWER = 1.0 MW
 DA-2

TOWER 1 (SOUTH)

DA-DI Z(B) = 18.7 + j24.0
 I(B) = 8.51 A [+143.5]
 POWER = 476 W

DA-NI Z(B) = 8.4 + j28.8
 I(B) = 8.55 A [+154.4]
 POWER = 165 W

TOWER 2 (CENTER)

TEST
 NI: Z(B) = 53.8 + j24.0
 I(B) = 4.34 A
 POWER = 1000 W

DA-DI Z(B) = 28.4 + j138.8
 I(B) = 4.54 A [0]
 POWER = 824 W

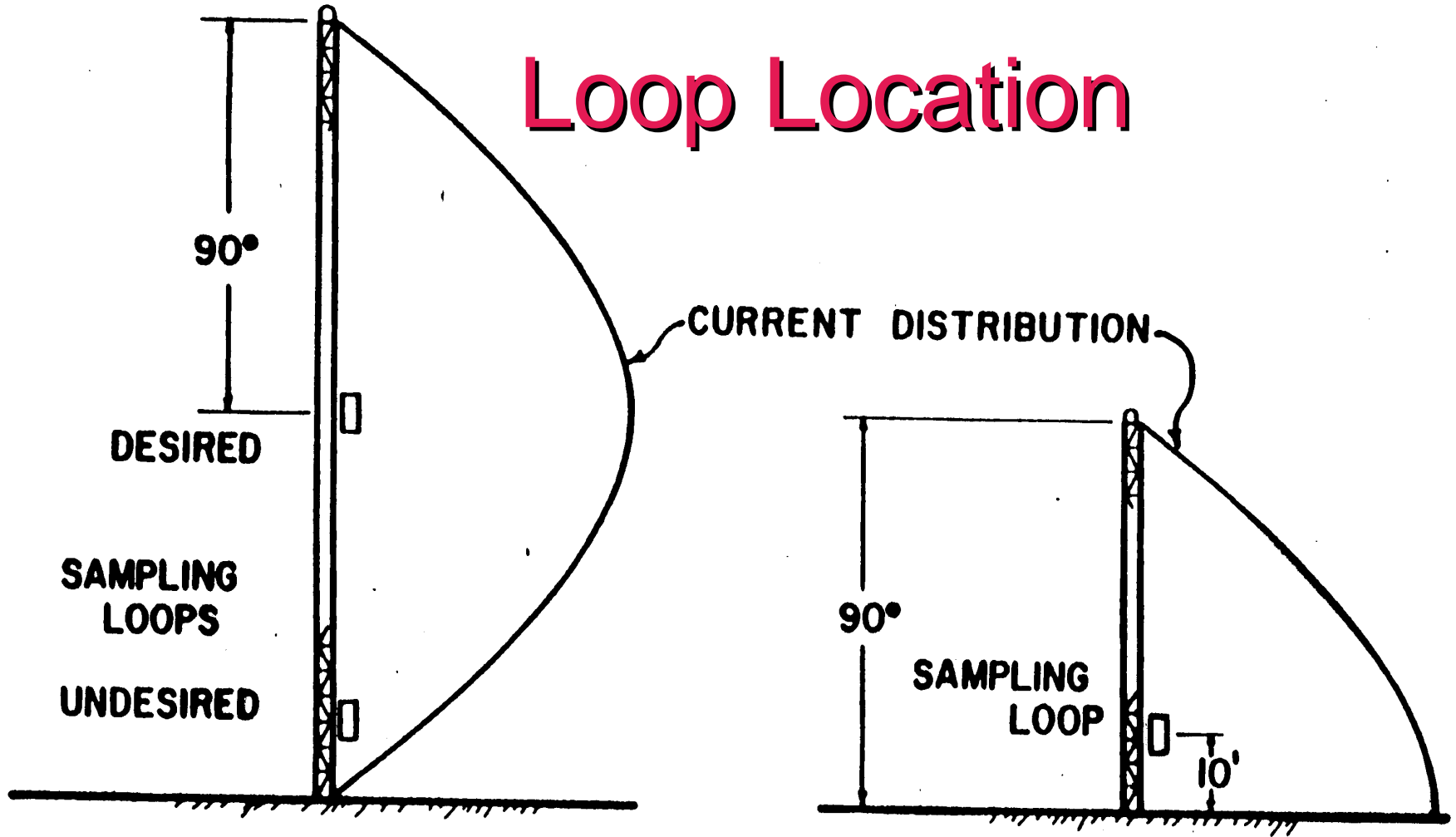
DA-NI Z(B) = 12.8 + j122.4
 I(B) = 7.88 A [0]
 POWER = 781 W

TOWER 3 (NORTH)

DA-DI FLOATED

DA-NI Z(B) = 1.8 + j130.4
 I(B) = 4.93 A [-159.1]
 POWER = 44 W

Loop Location



INSTALLATION OF SAMPLE LOOPS

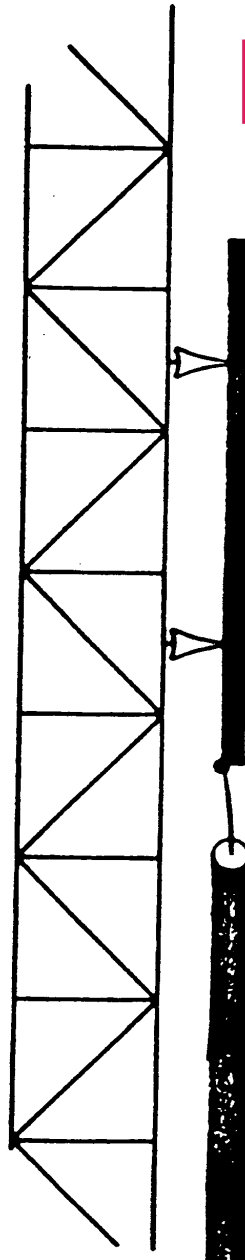
Loop Details

SAMPLE LOOP

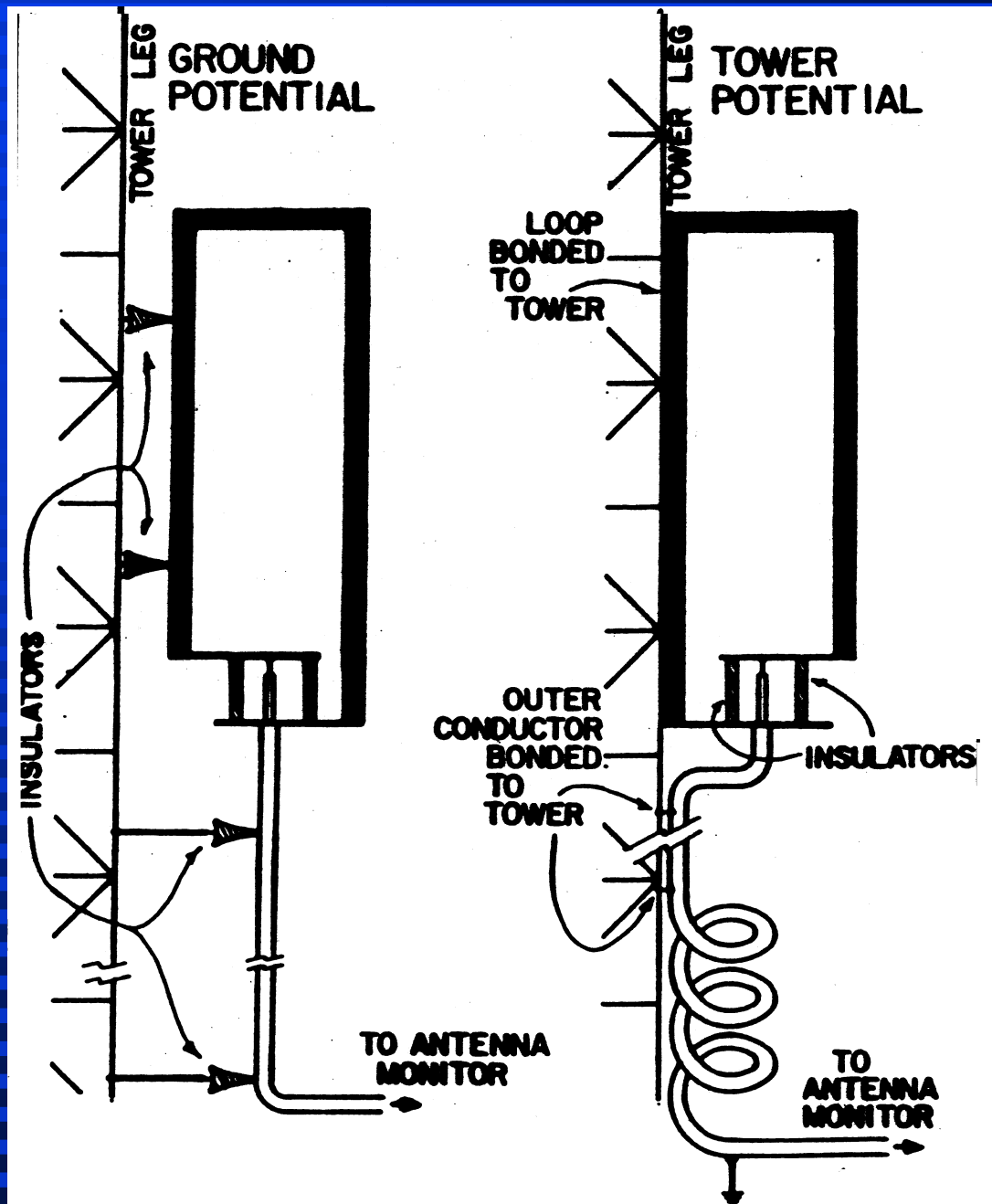
1. SINGLE TURN
2. UNTUNED
3. UNSHIELDED -
4. NON-ROTATABLE (RIGID)
5. NON-HYGROSCOPIC INSULATORS

SAMPLE LINE

1. SOLID OUTER CONDUCTOR
2. AIR or POLYETHYLENE DIELECTRIC
3. IDENTICAL ELECTRICAL CHARACTERISTICS
4. SAME ENVIRONMENTAL CONDITIONS

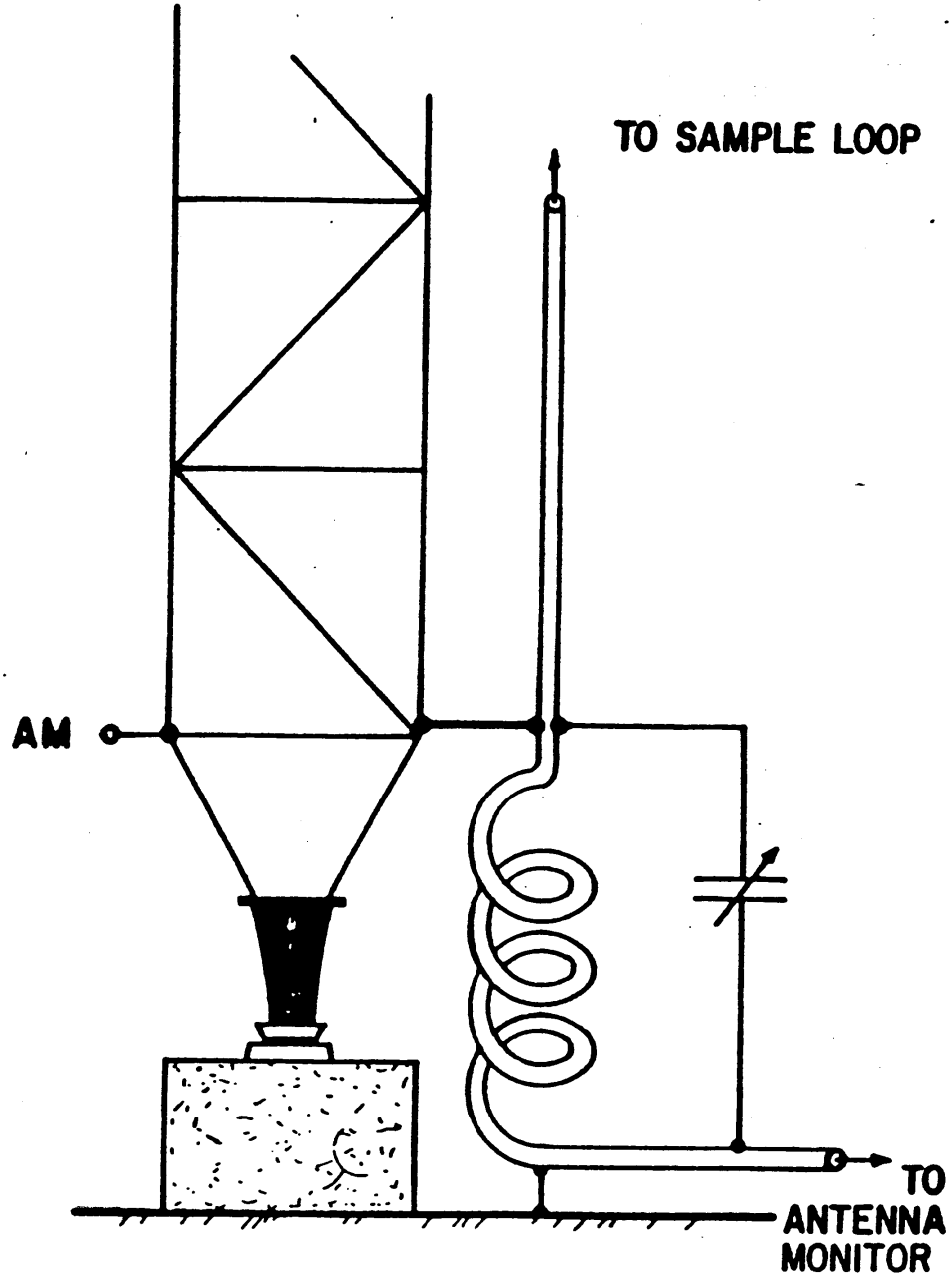


Loop Mounting



METHODS OF SAMPLING LOOP MOUNTING

Isolation Coil

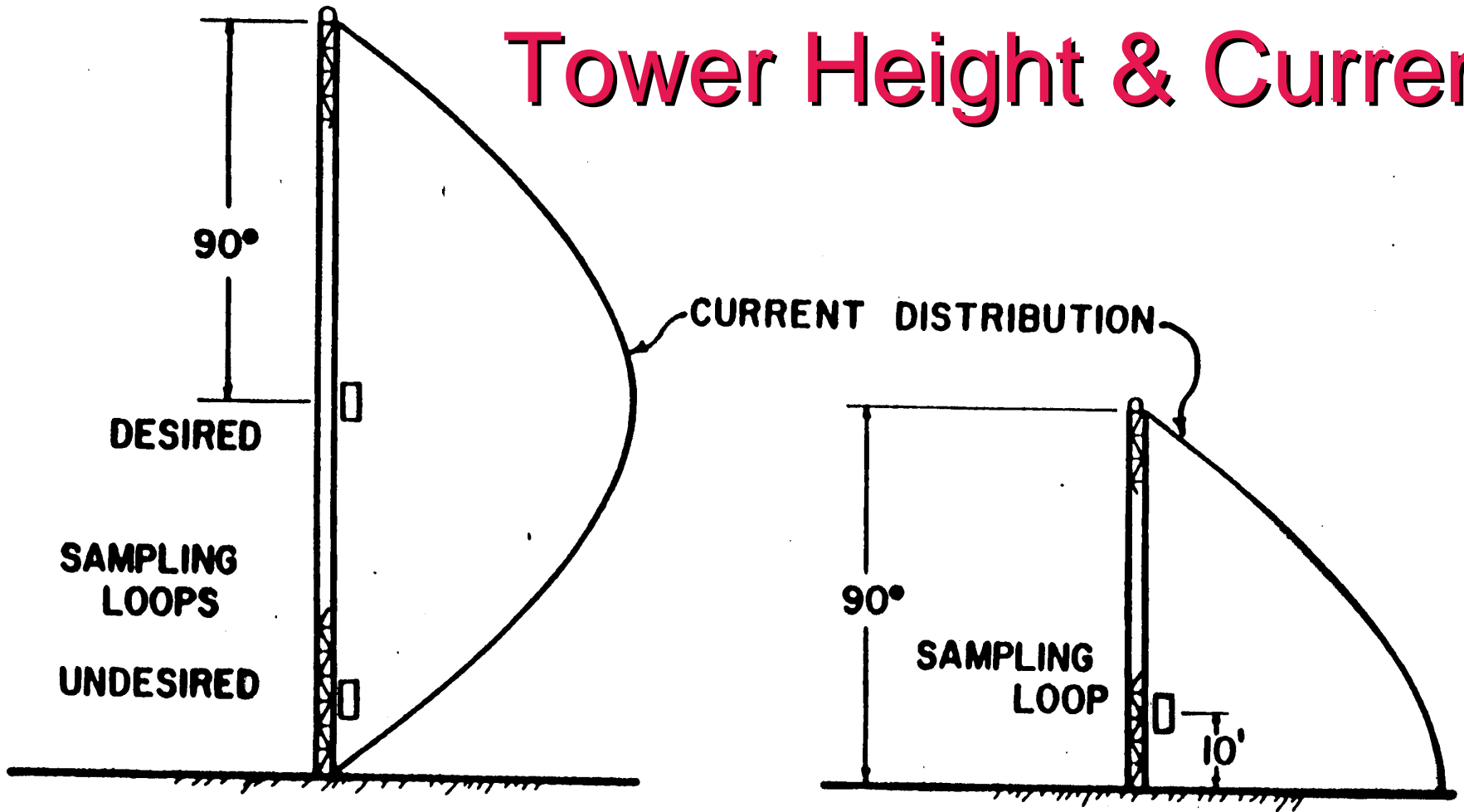


PARALLEL RESONANT ISOLATION COIL

Toroids

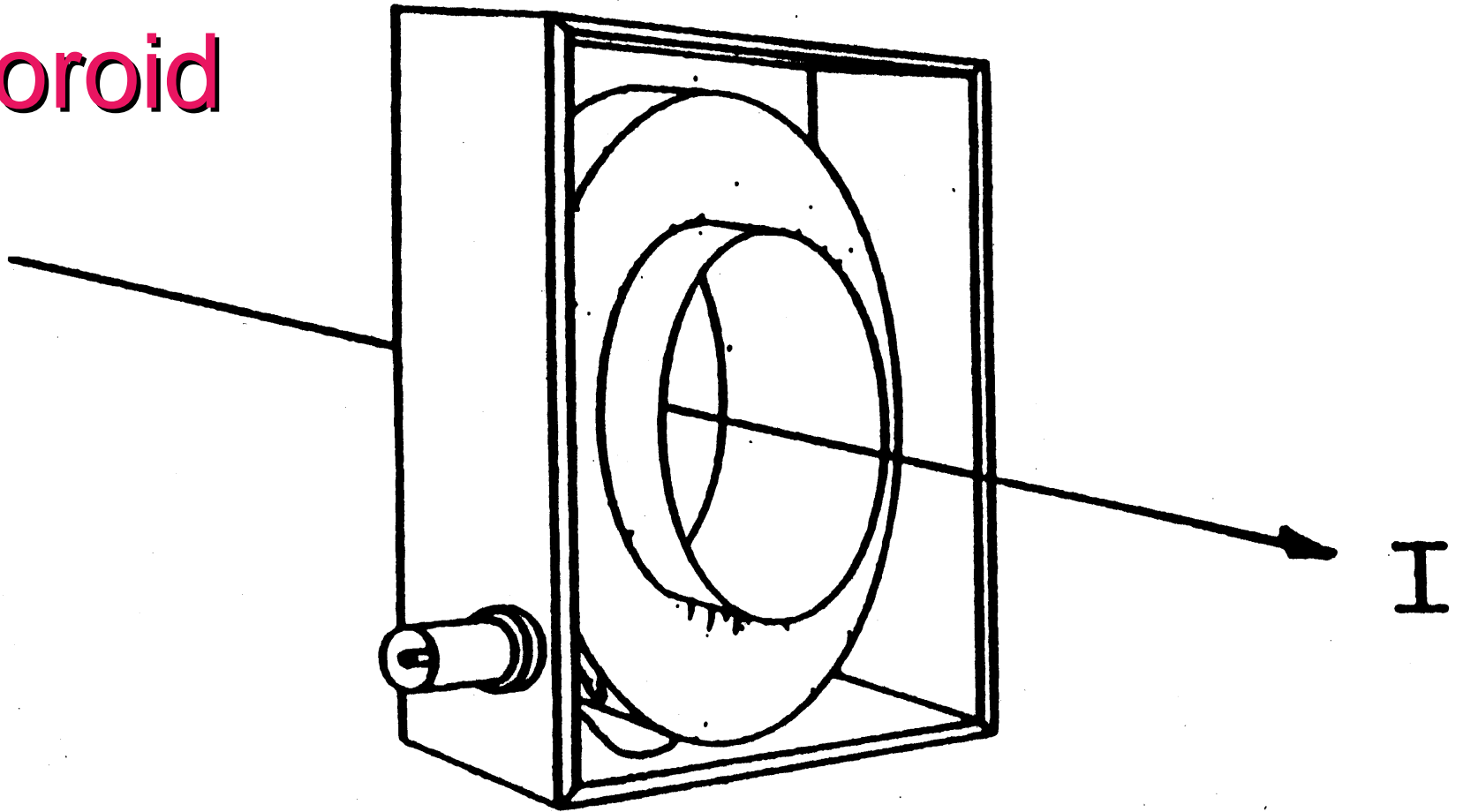
- Appropriate Tower Heights
- Subject to Shunt Effects

Tower Height & Current



INSTALLATION OF SAMPLE LOOPS

Toroid

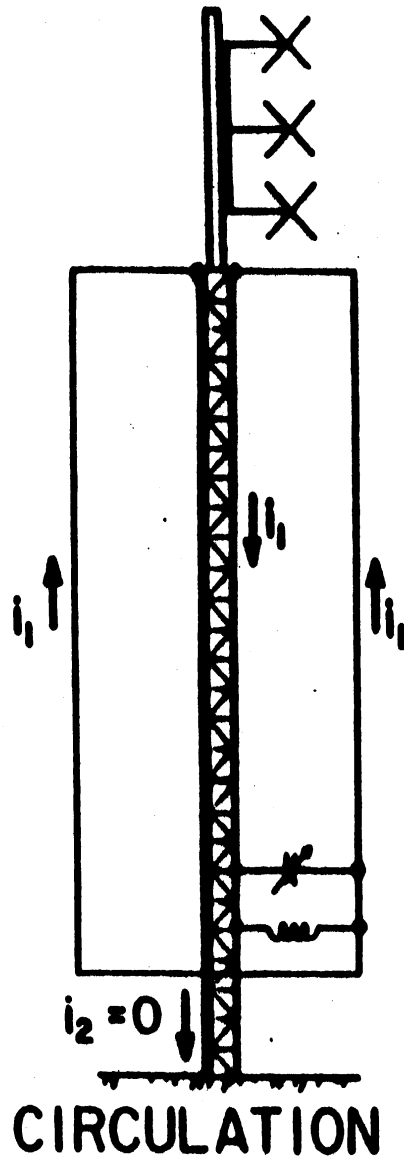
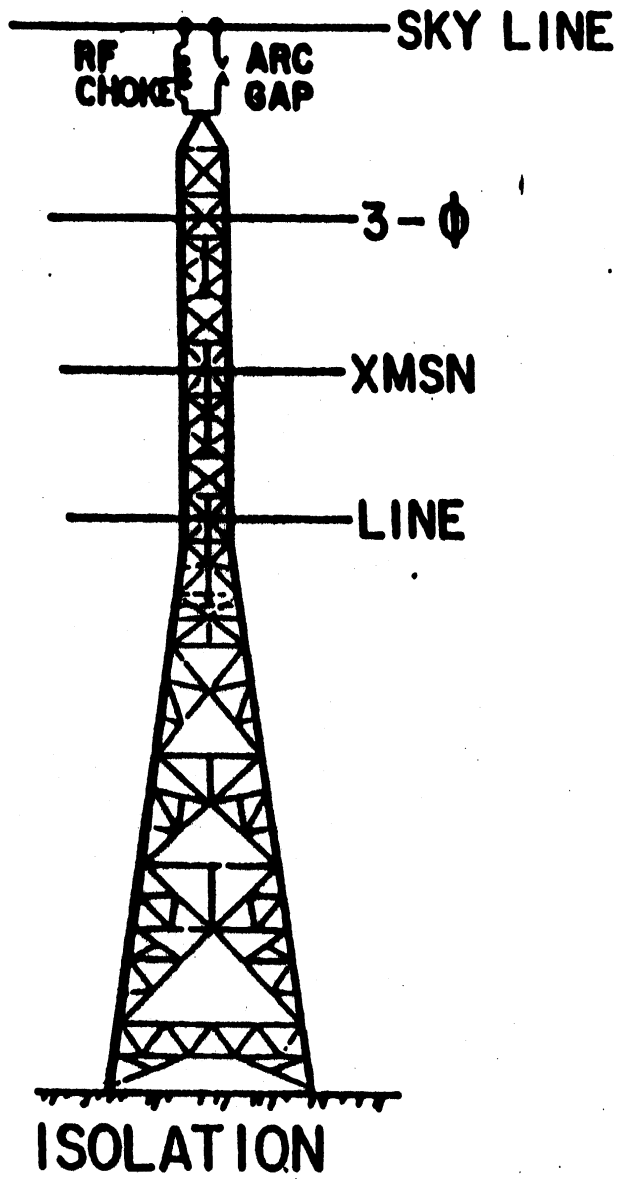


TOROIDIAL CURRENT TRANSFORMER

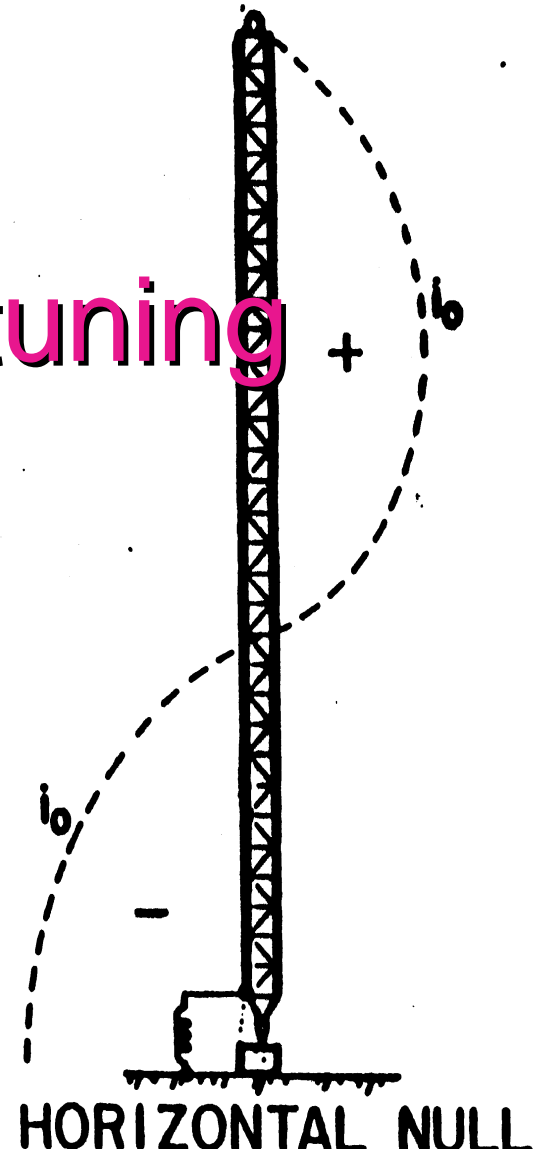
Detuning of Structures

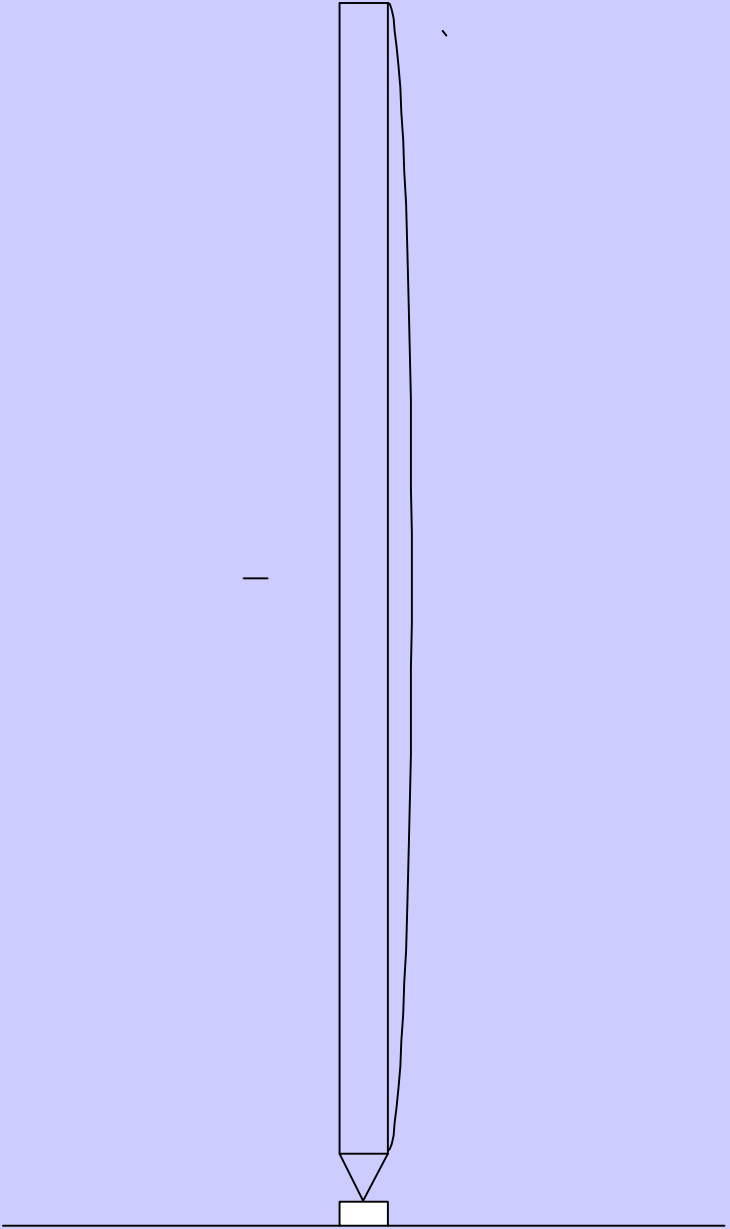
- Unused array towers
- Nearby Communications towers
- Power Line Towers

BASIC METHODS OF DETUNING

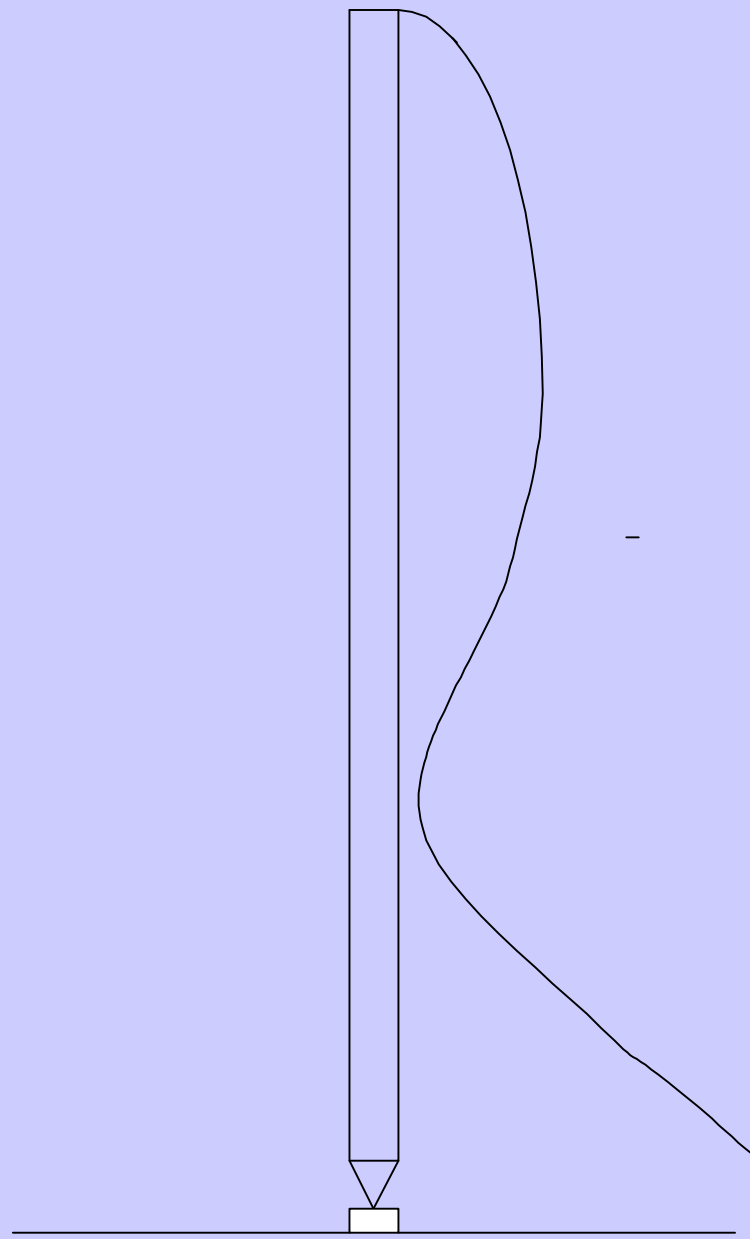


Detuning

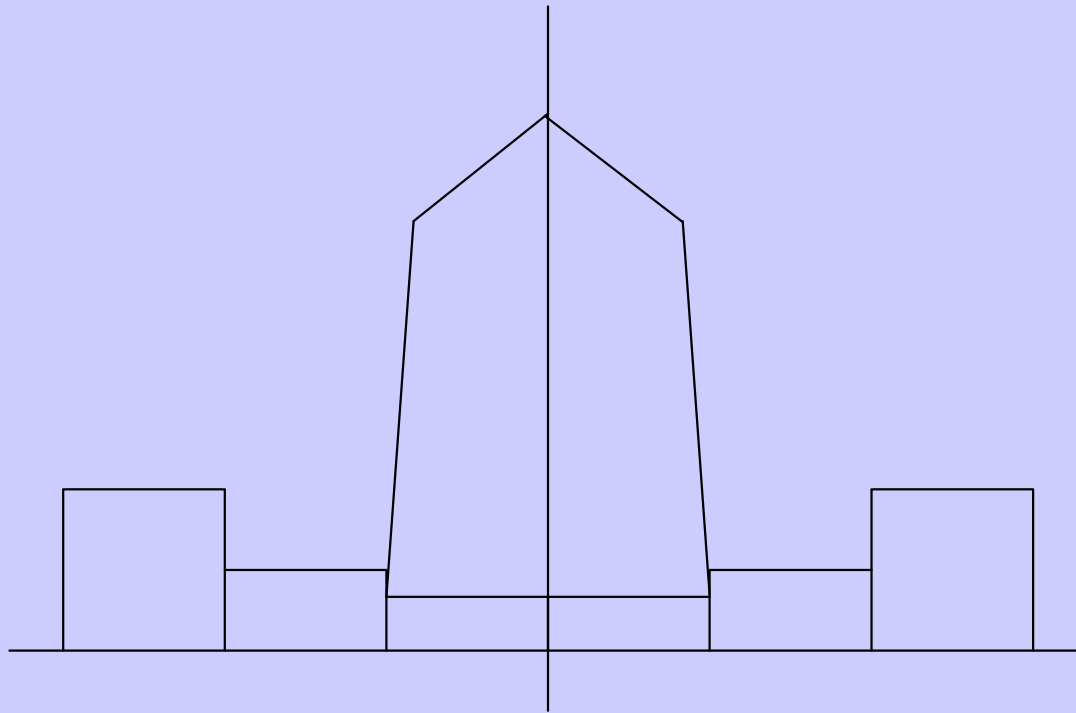




BASE FLOATING



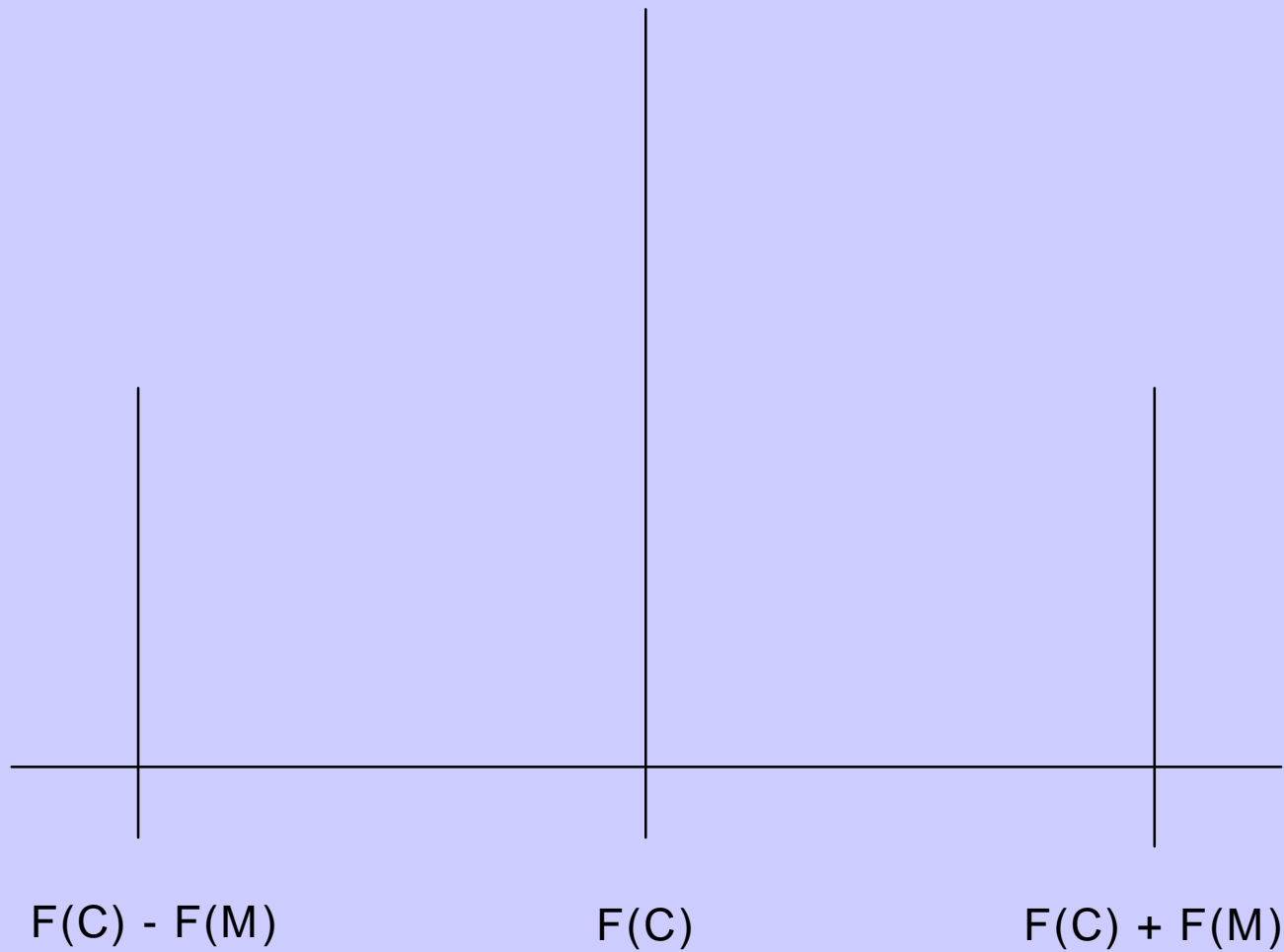
BASE REACTANCE DETUNING



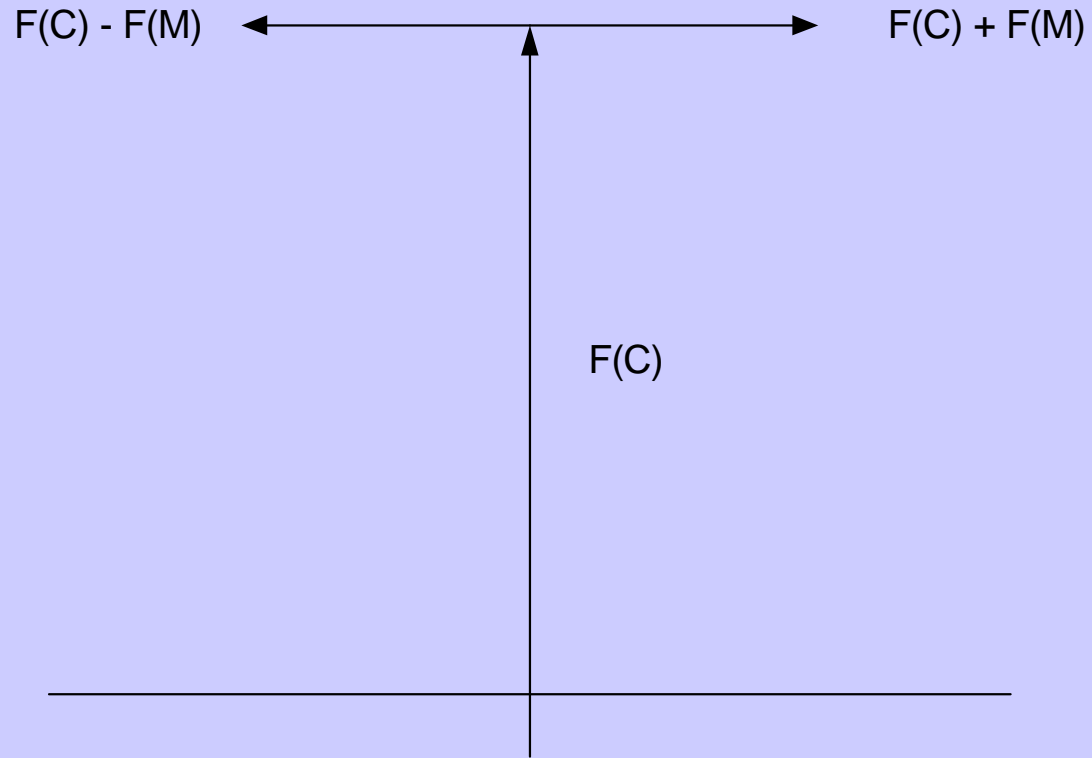
F(C)

AM IBOC MODULATION SPECTRUM
(FREQUENCY DOMAIN)

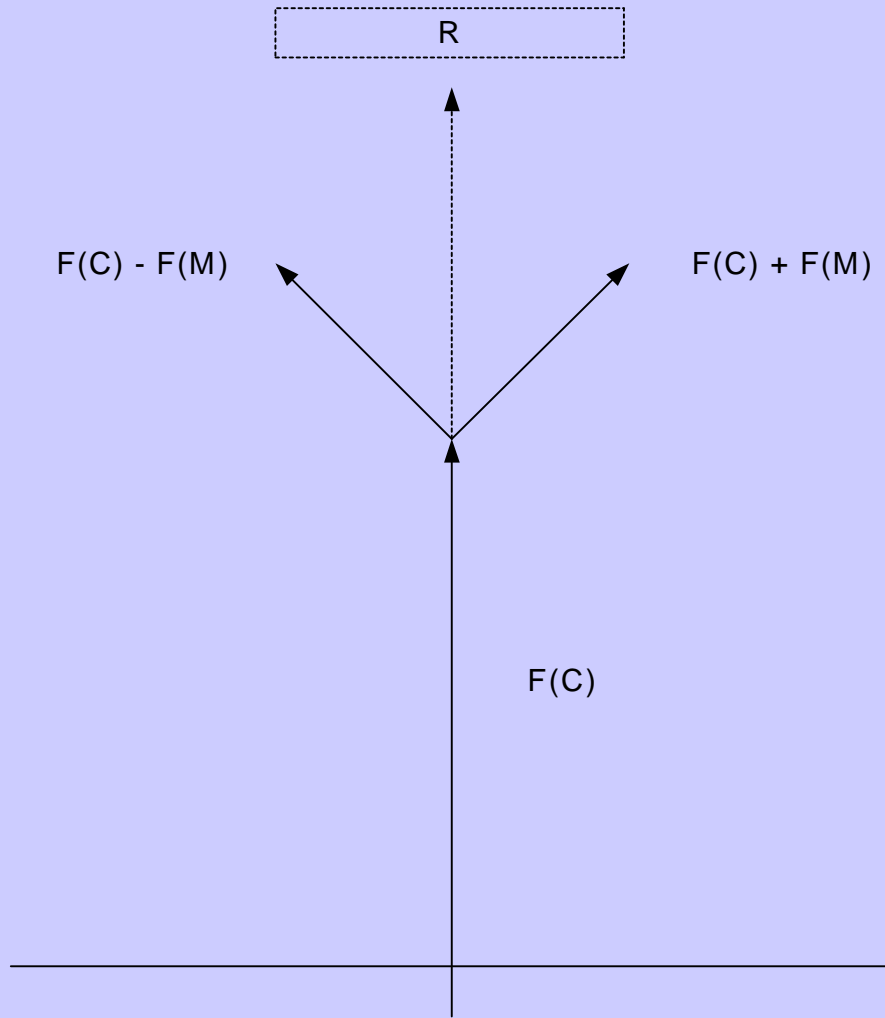
CONCEPTUAL - NOT TO SCALE



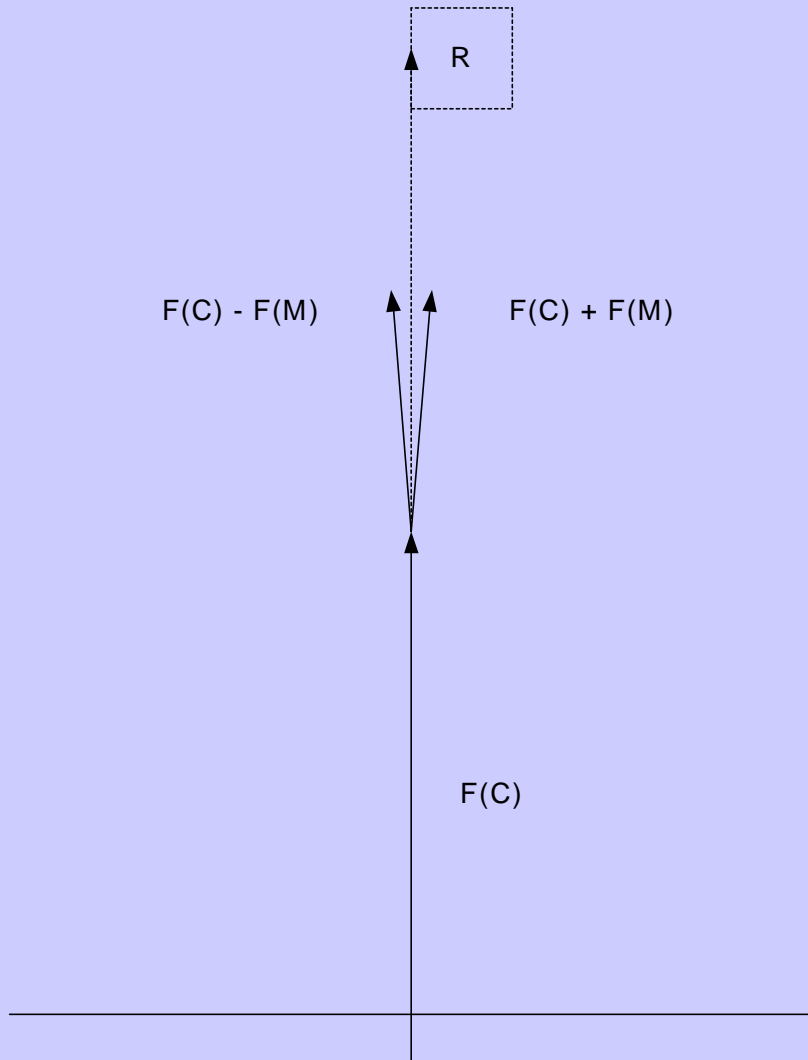
AM SINUSOIDAL MODULATION SPECTRUM
(FREQUENCY DOMAIN)



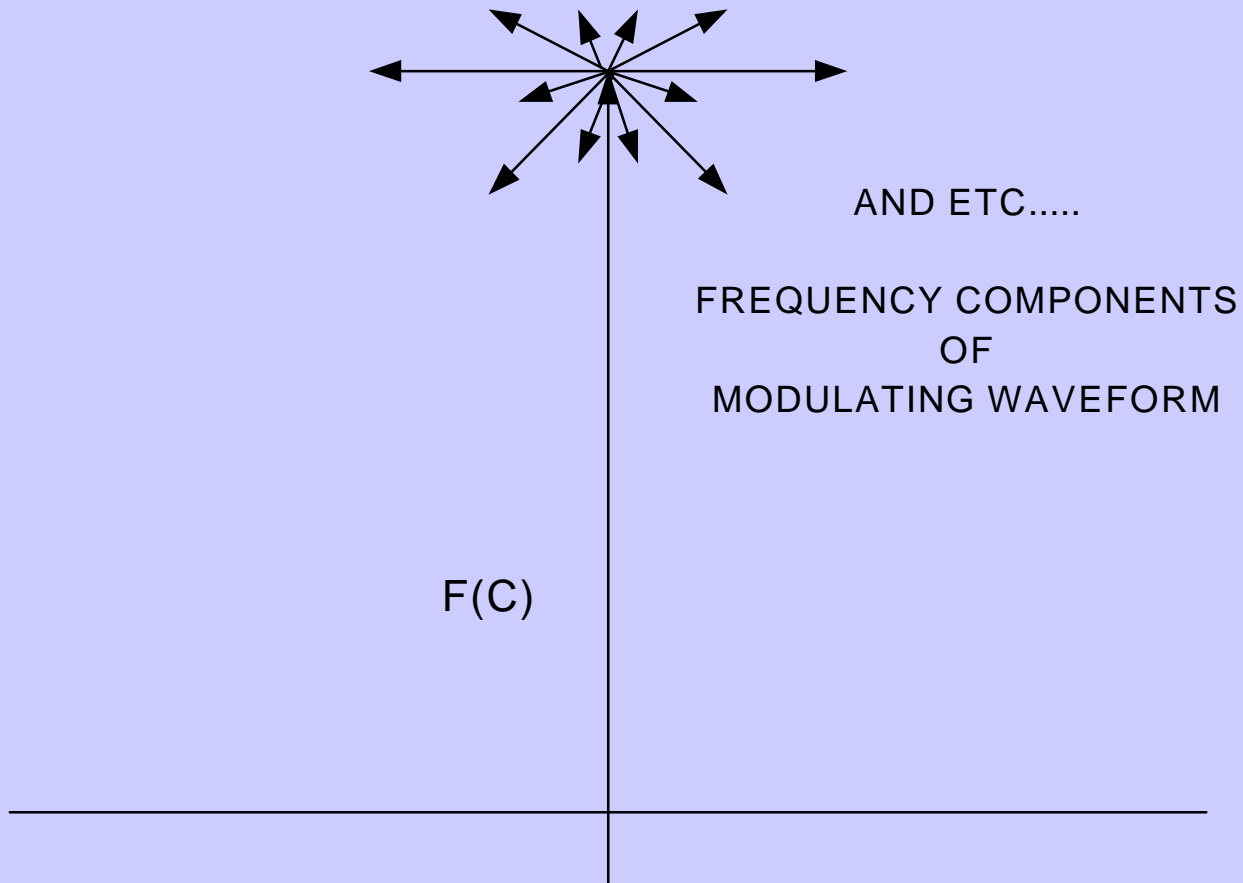
AM SINUSOIDAL MODULATION
(VECTOR REPRESENTATION)



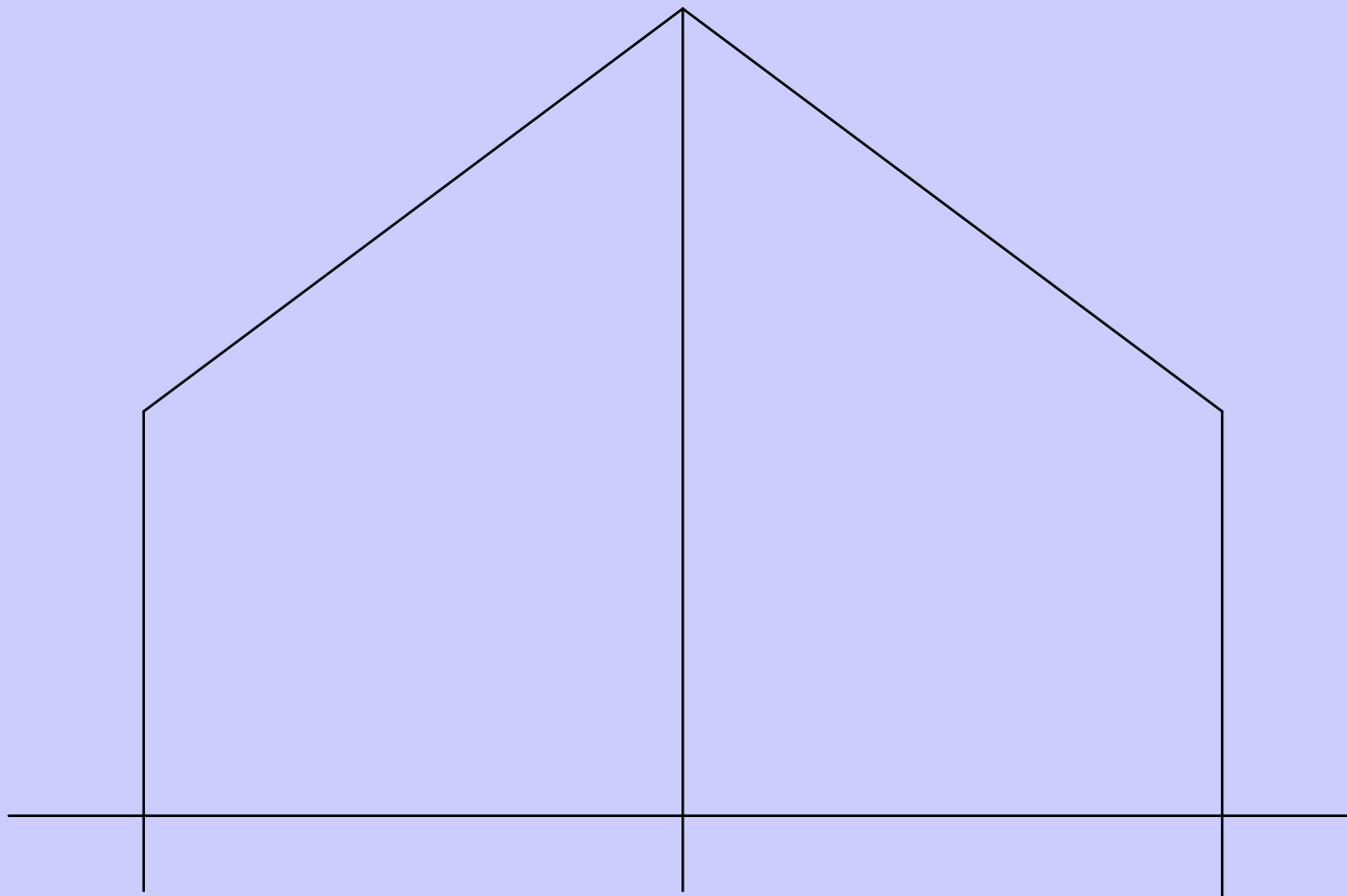
AM SINUSOIDAL MODULATION
(VECTOR REPRESENTATION)



AM SINUSOIDAL MODULATION
(VECTOR REPRESENTATION)

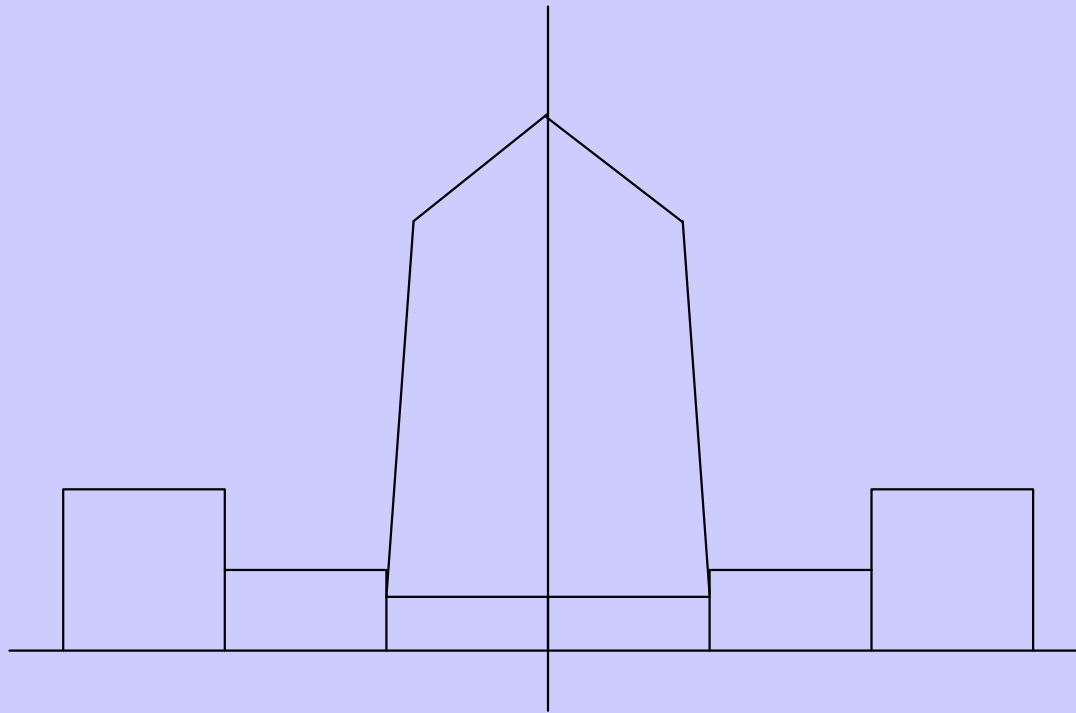


AM COMPLEX MODULATION
(VECTOR REPRESENTATION)



$F(C)$

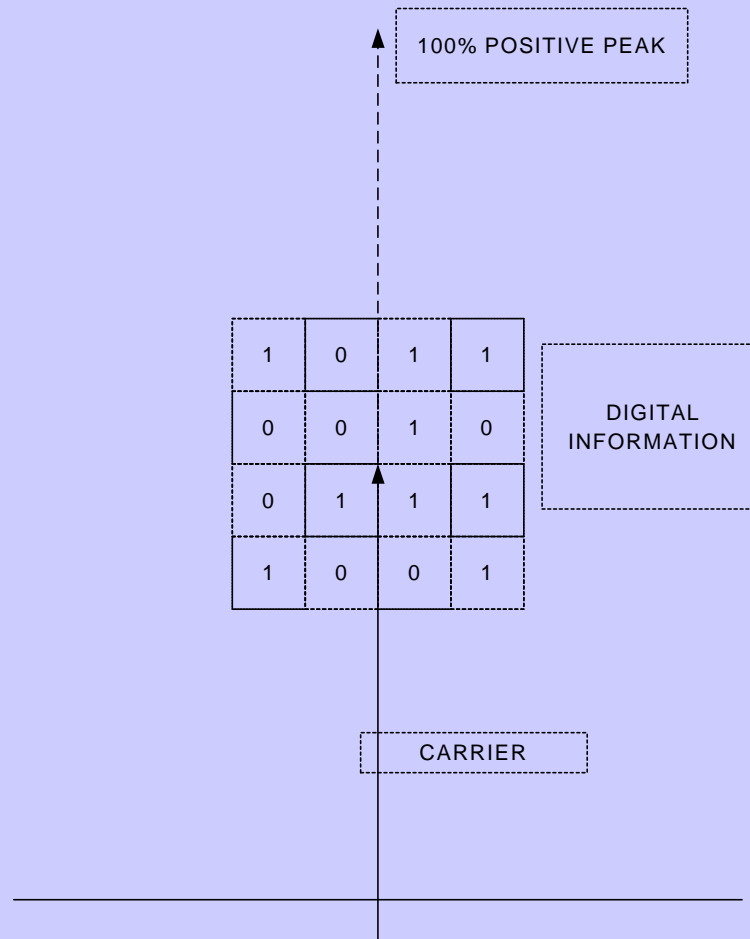
AM COMPLEX MODULATION SPECTRUM
(FREQUENCY DOMAIN)



F(C)

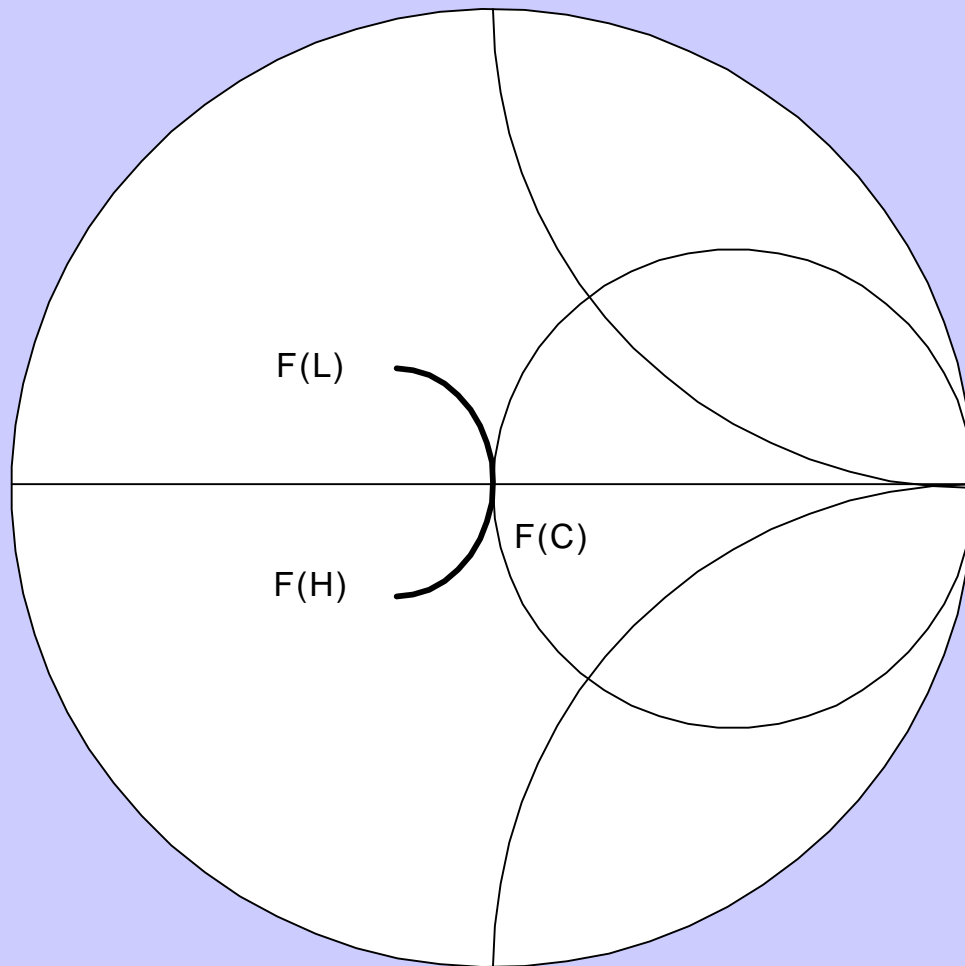
AM IBOC MODULATION SPECTRUM
(FREQUENCY DOMAIN)

CONCEPTUAL - NOT TO SCALE

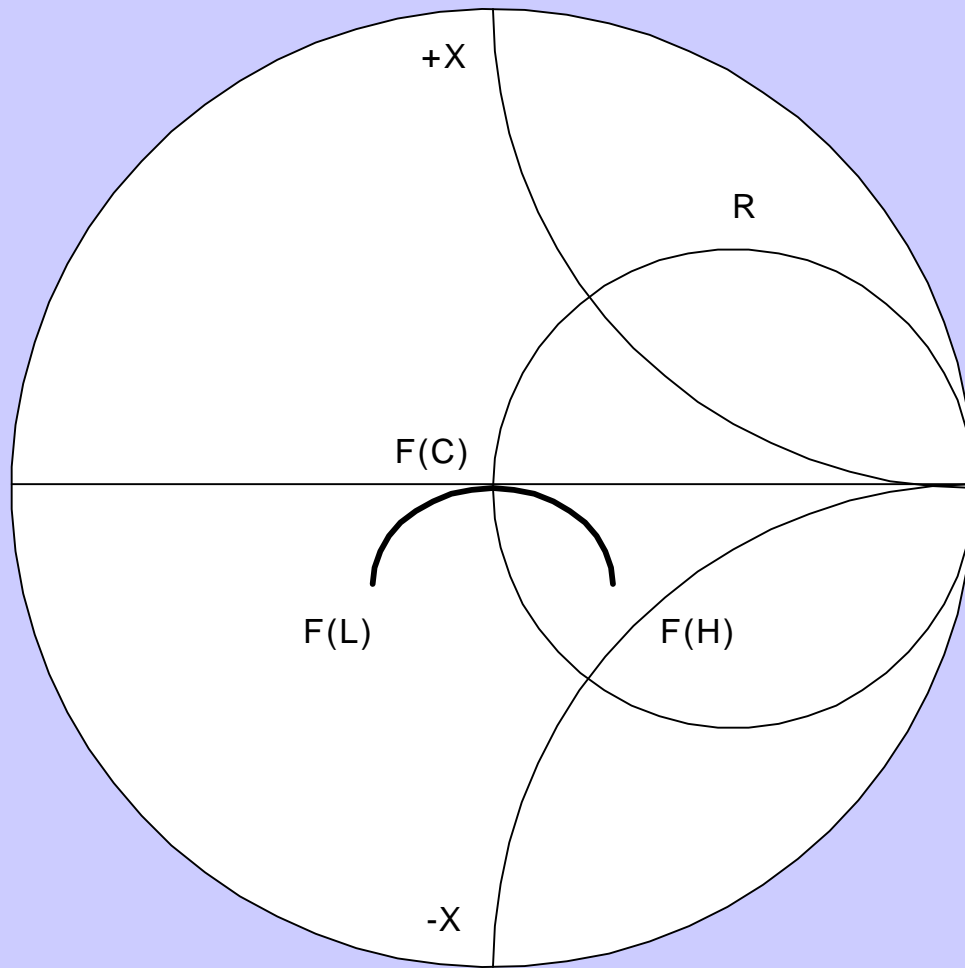


AM + DIGITAL IQ MODULATION

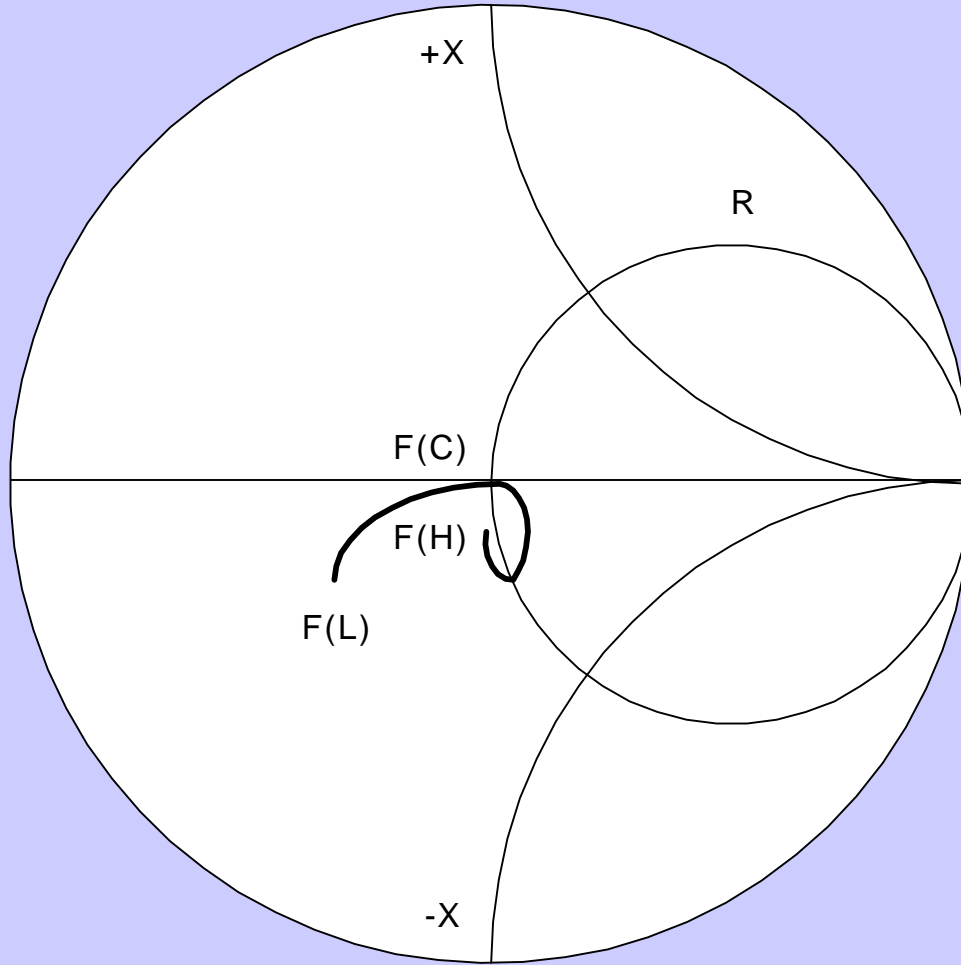
CONCEPTUAL ONLY - NOT TO SCALE



FINAL AMPLIFIER LOAD IMPEDANCE SYMMETRY



SYMMETRICAL ANTENNA IMPEDANCE



ANTENNA IMPEDANCE ASYMMETRY