DCFluX in:

Moon-Bouncer

Presented By:
Matt Krick, DCFluX – K3MK
Chief Engineer, New West Broadcasting Systems, Inc.

DEFCON 18; Las Vegas, NV
Track 4
Friday July 30, 2010; 17:00 – 17:50


FLUX
RESEARCH

In A.D. 2101
War Was Beginning

Hidden Agenda

0. About the Author
1. A Series of Tubes
2. Natural Satellites and Moon Bouncing
3. Artificial Satellites and cleaver ways to use them
4. Weather balloons as satellites
5. Other stuff you can blame me for

0. About the Author

- Matt Krick
- “DCFluX”
- Video Editor
- Broadcast Engineer
  - 1998 to Present
- K3MK
  - Licensed to Transmit, 1994 to Present

0. About the Author

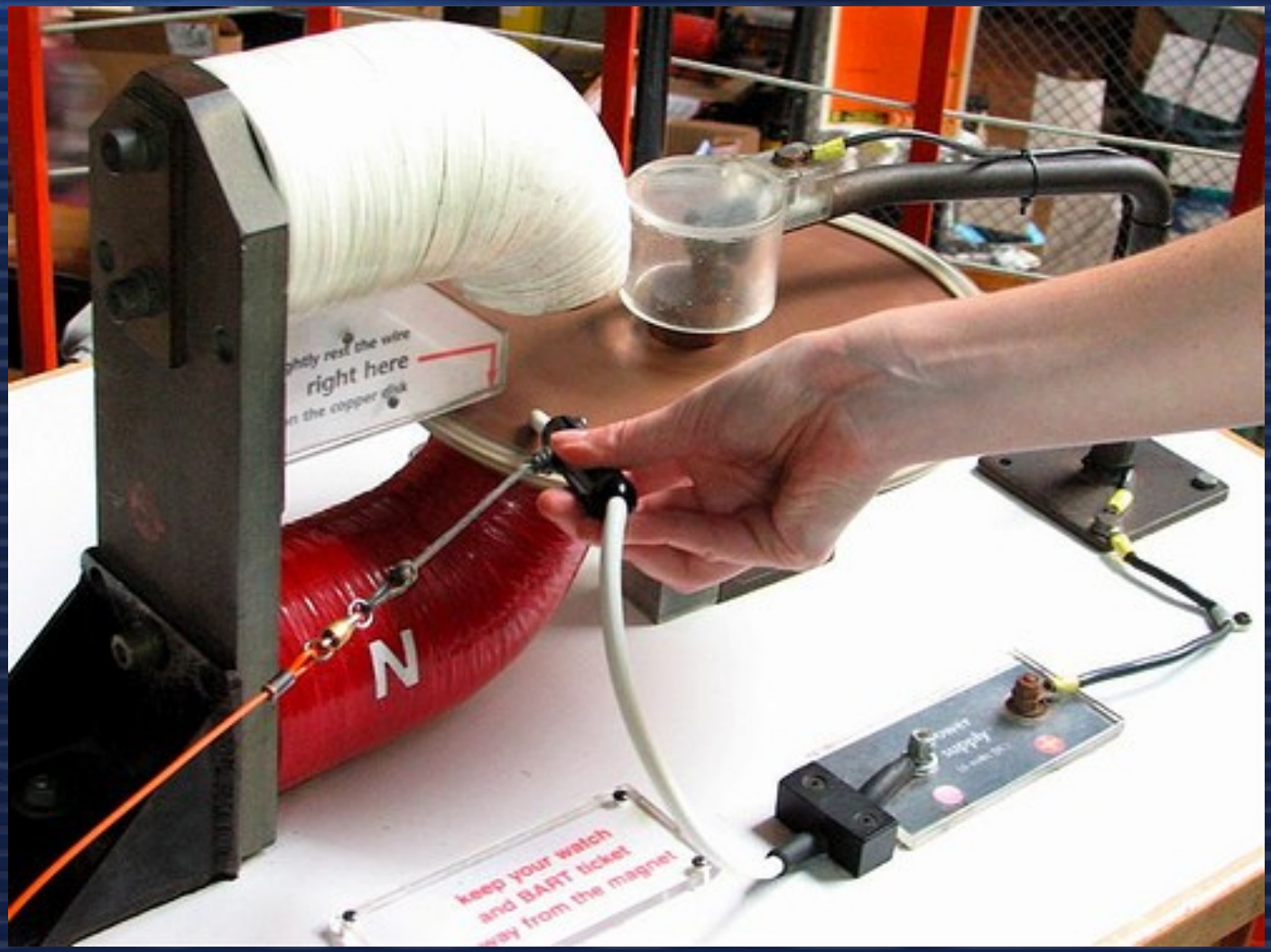
1. A Series of Tubes

Triodes and Tetrodes

Magnetron (Radar Type)

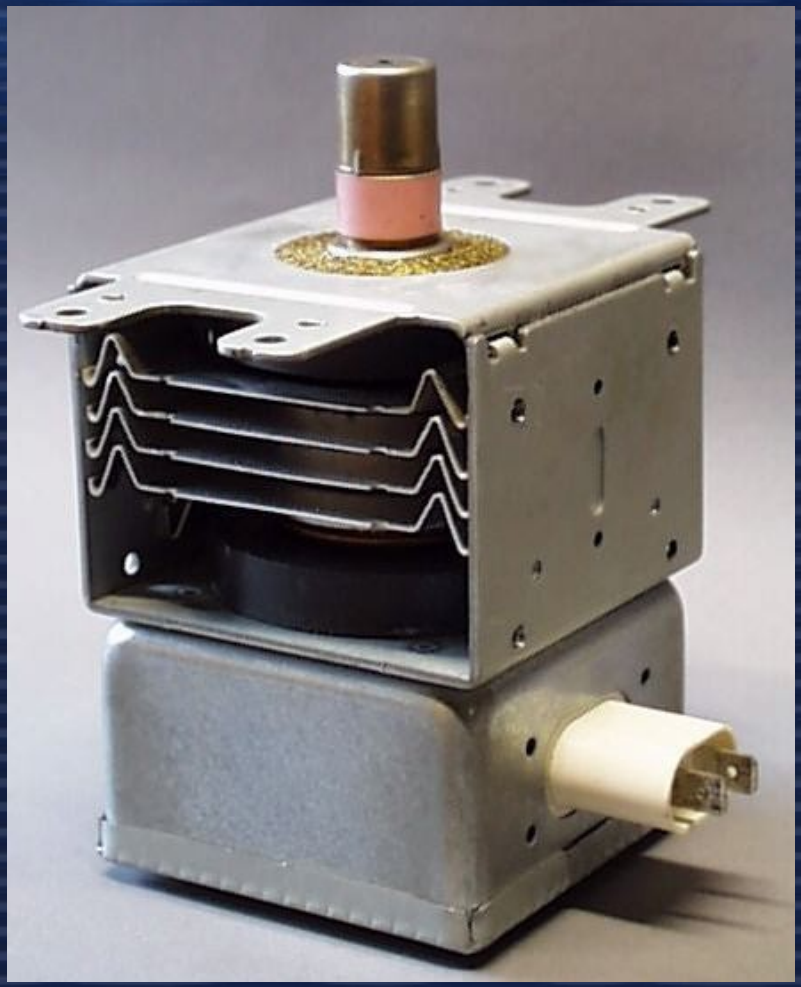
1. A Series of Tubes

Magnetron (Radar Type) Magnet



1. A Series of Tubes

Magnetron (Microwave Oven Type)



1. A Series of Tubes

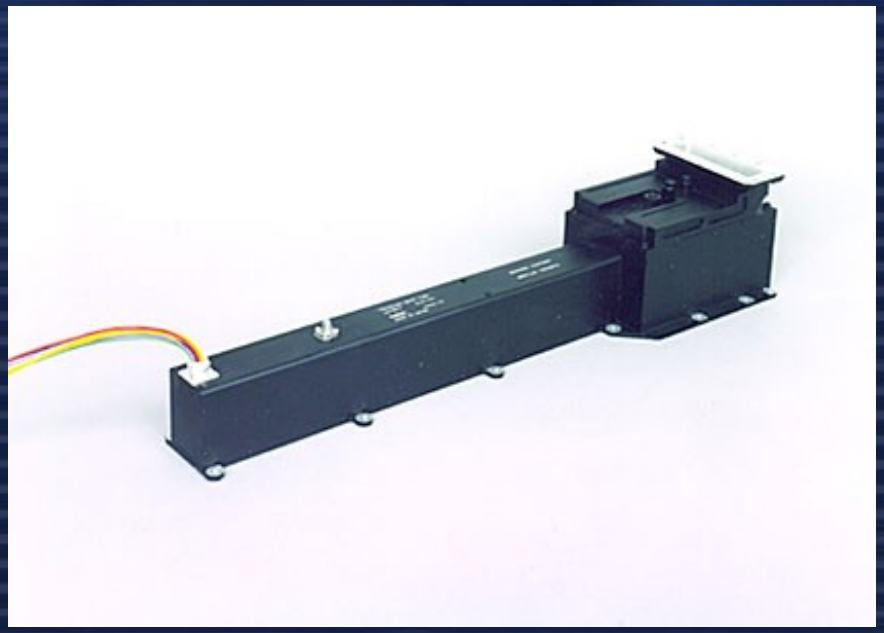
Klystron Tube

1. A Series of Tubes

Klystron Tube (Reflex)

1. A Series of Tubes

Traveling Wave Tube

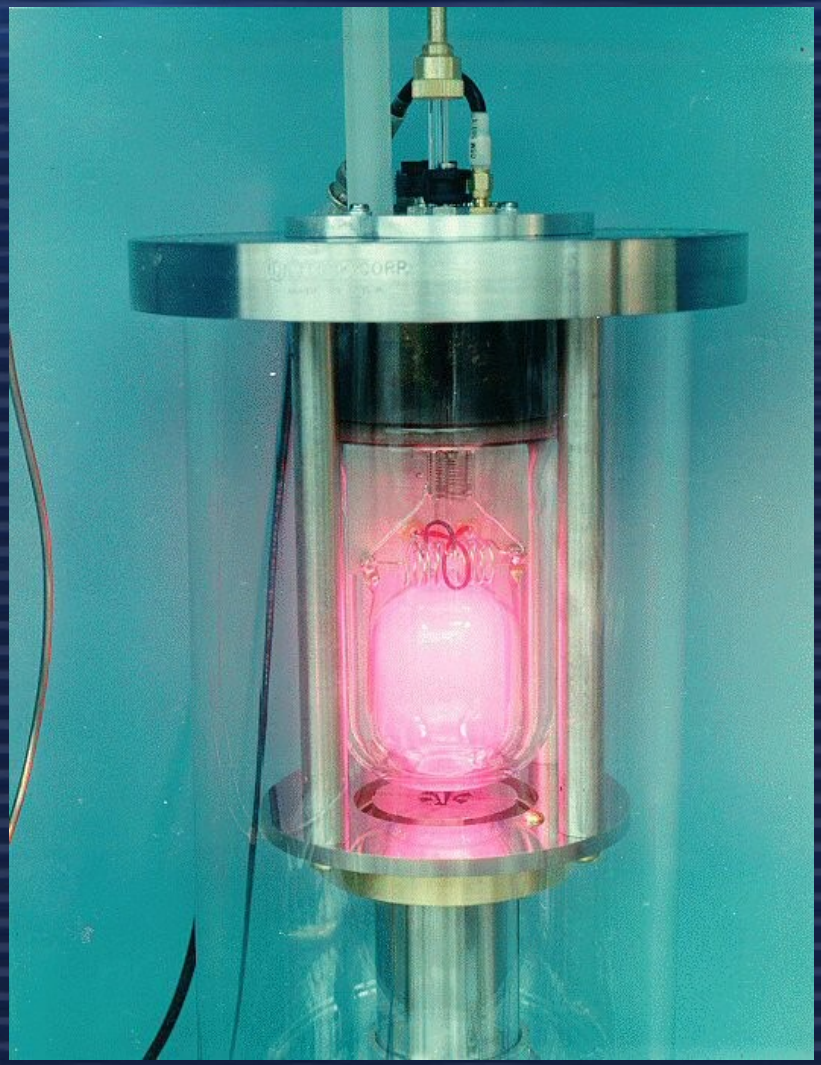


1. A Series of Tubes

Traveling Wave Tube Amplifier

1. A Series of Tubes

Hydrogen MASER



1. A Series of Tubes

Hydrogen MASER

2. Natural Satellites and Moon Bouncing

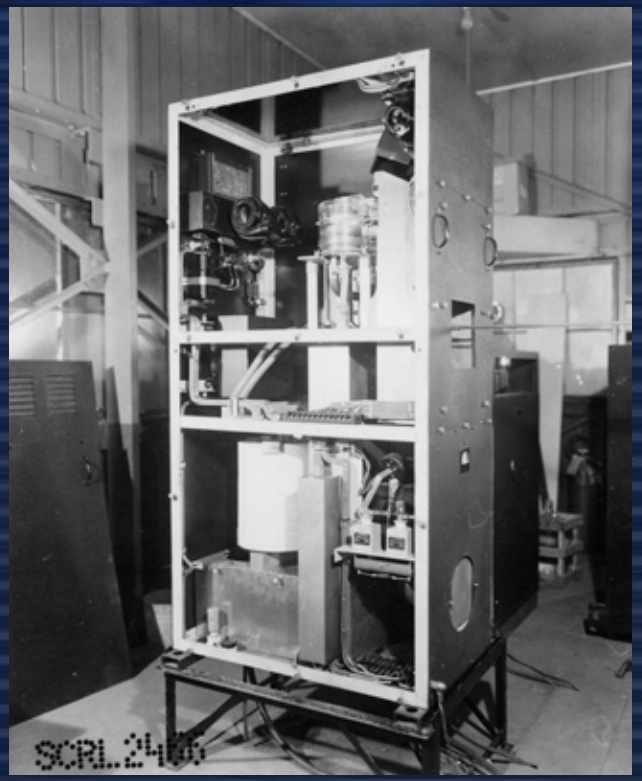
2. Natural Satellites and Moon Bouncing

Earth's Moon

- Diameter: 3,474.2 km

2. Natural Satellites and Moon Bouncing

Project Diana



- Frequency: 111.50 MHz

Moon Bounce Path Attenuation

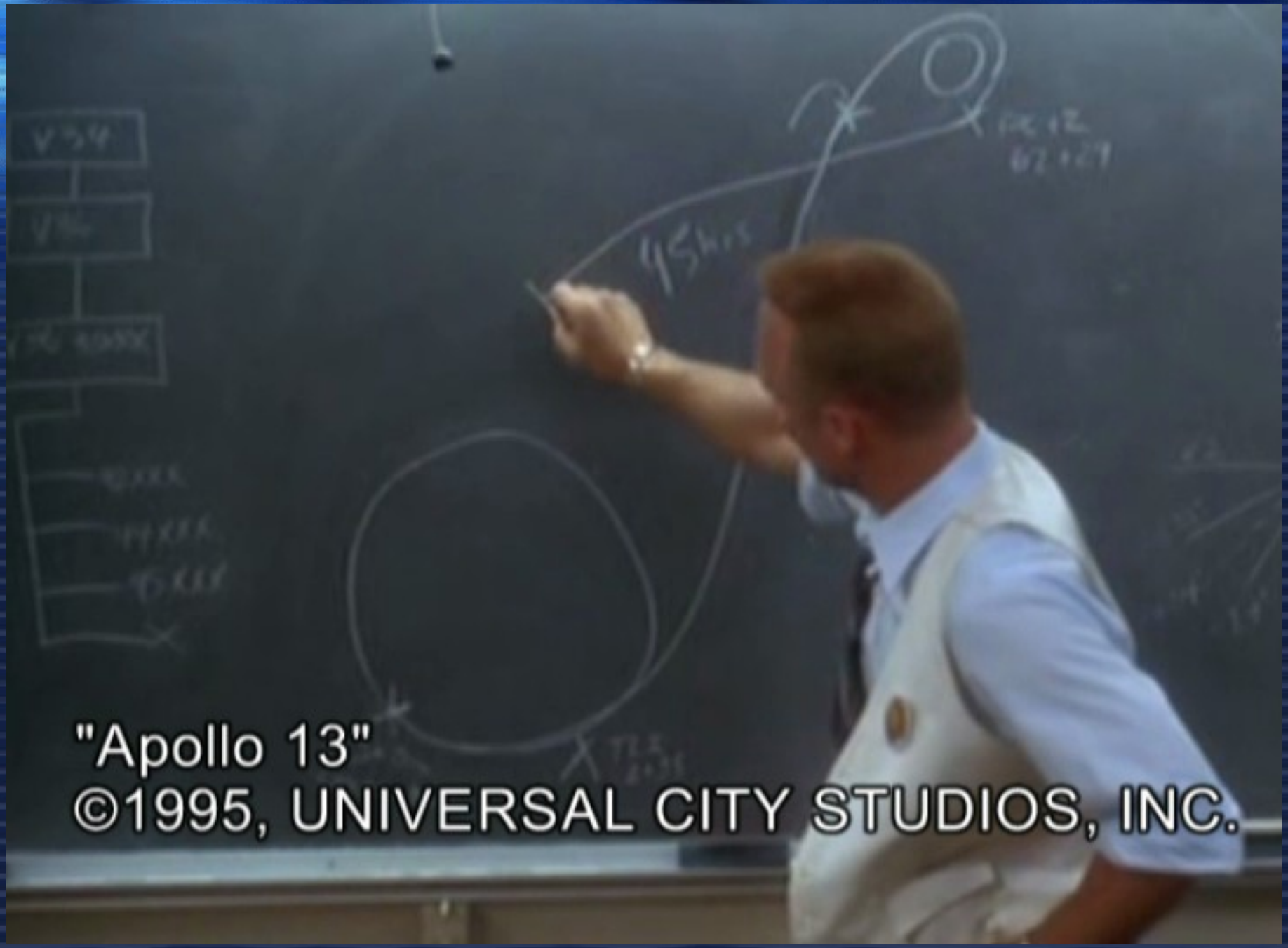
	Perigee	Apogee
40m (7 MHz)	**230.5 dB**	**232.7 dB**
10m (30 MHz)	**242.5 dB**	**244.8 dB**
6m (54 MHz)	**247.5 dB**	**249.8 dB**
2m (148 MHz)	**256.7 dB**	**259.0 dB**
70cm (450 MHz)	**266.0 dB**	**268.3 dB**
33cm (928 MHz)	**272.6 dB**	**274.9 dB**
23cm (1.3 GHz)	**275.4 dB**	**277.7 dB**
13cm (2.45 GHz)	**281.2 dB**	**283.4 dB**
3cm (10.5 GHz)	**294.0 dB**	**296.2 dB**

Project Diana Path Loss

- 8000 W Transmitter (+69 dBm)
- 111.5 MHz EME Path (-256.7 dB)
- 64 Dipole Array (+24 dB)
- Feed Line Loss (-4.2 dB)

69 + 24 - 4.2 - 256.7 + 24 – 4.2 =

-148.1 dBm

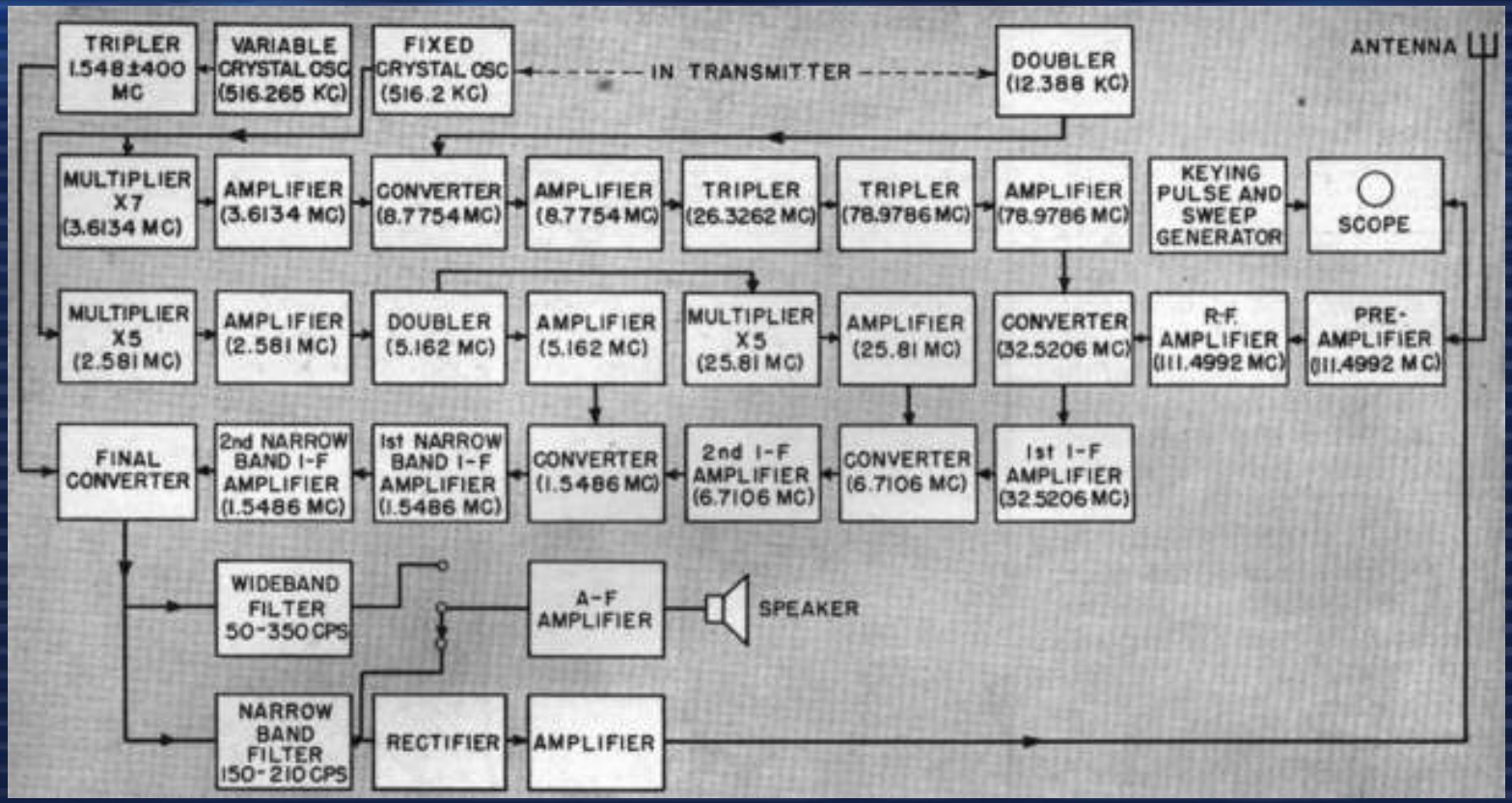

"Apollo 13"
©1995, UNIVERSAL CITY STUDIOS, INC.

Increasing Receiver Sensitivity

- Decrease Thermal Noise
- Decrease Bandwidth
- Decrease System Noise Figure

2. Natural Satellites and Moon Bouncing

Project Diana Receiver



- Receiver Bandwidth: 57 Hz

2. Natural Satellites and Moon Bouncing

Sensitivity vs. Bandwidth and Temperature

	70° F (294.3° K)	-321° F (77° K)	-457° F (1° K)
0.01 Hz	-194.0 dBm	-210.0 dBm	-218.0 dBm
0.1 Hz	-184.0 dBm	-200.0 dBm	-208.0 dBm
1 Hz	-174.0 dBm	-190.0 dBm	-198.0 dBm
10 Hz	-164.0 dBm	-180.0 dBm	-188.0 dBm
500 Hz	-147.0 dBm	-163.0 dBm	-171.0 dBm
3 kHz	-139.2 dBm	-155.2 dBm	-163.2 dBm
16 kHz	-132.0 dBm	-148.0 dBm	-156.0 dBm
1 MHz	-114.0 dBm	-130.0 dBm	-138.0 dBm
22 MHz	-100.0 dBm	-116.0 dBm	-124.0 dBm

Project Diana Receiver Sensitivity

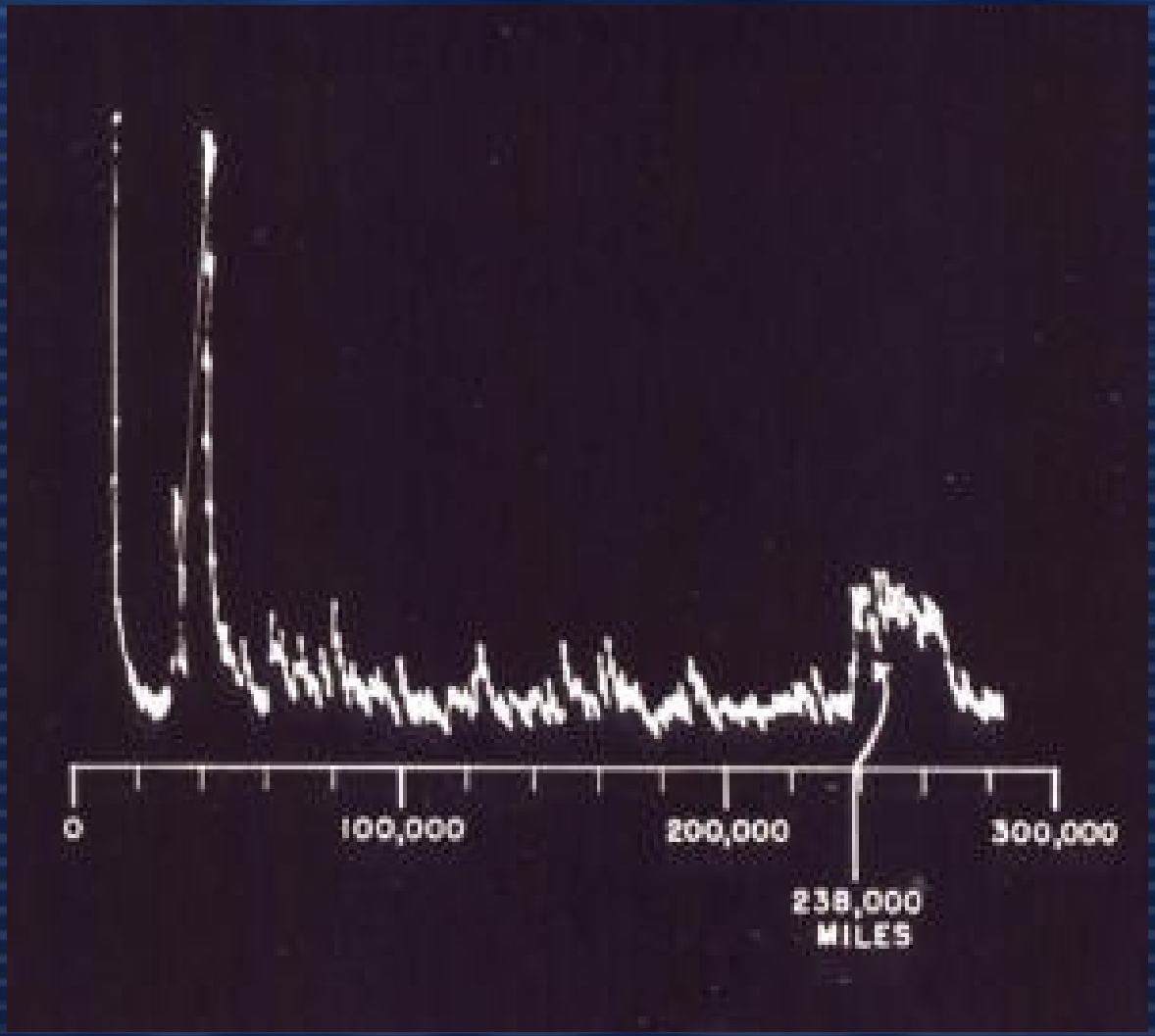
- -174 dBm per Hz at 70° F
- 10 $\log_{10}$ bandwidth (57 Hz = 17.6 dB)
- 7 dB Receiver Noise Figure

-174 + 17.6 + 7 =

-149.4 dBm

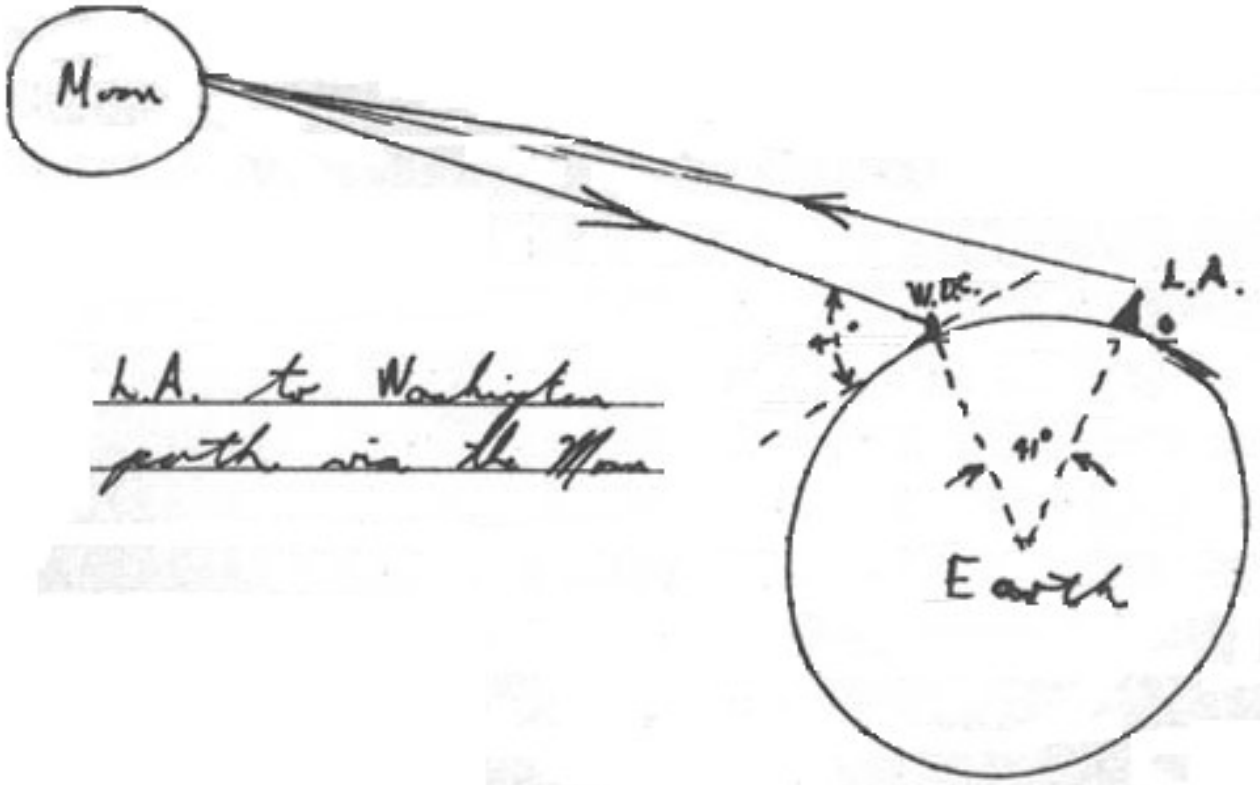
2. Natural Satellites and Moon Bouncing

Project Diana Returned Echo



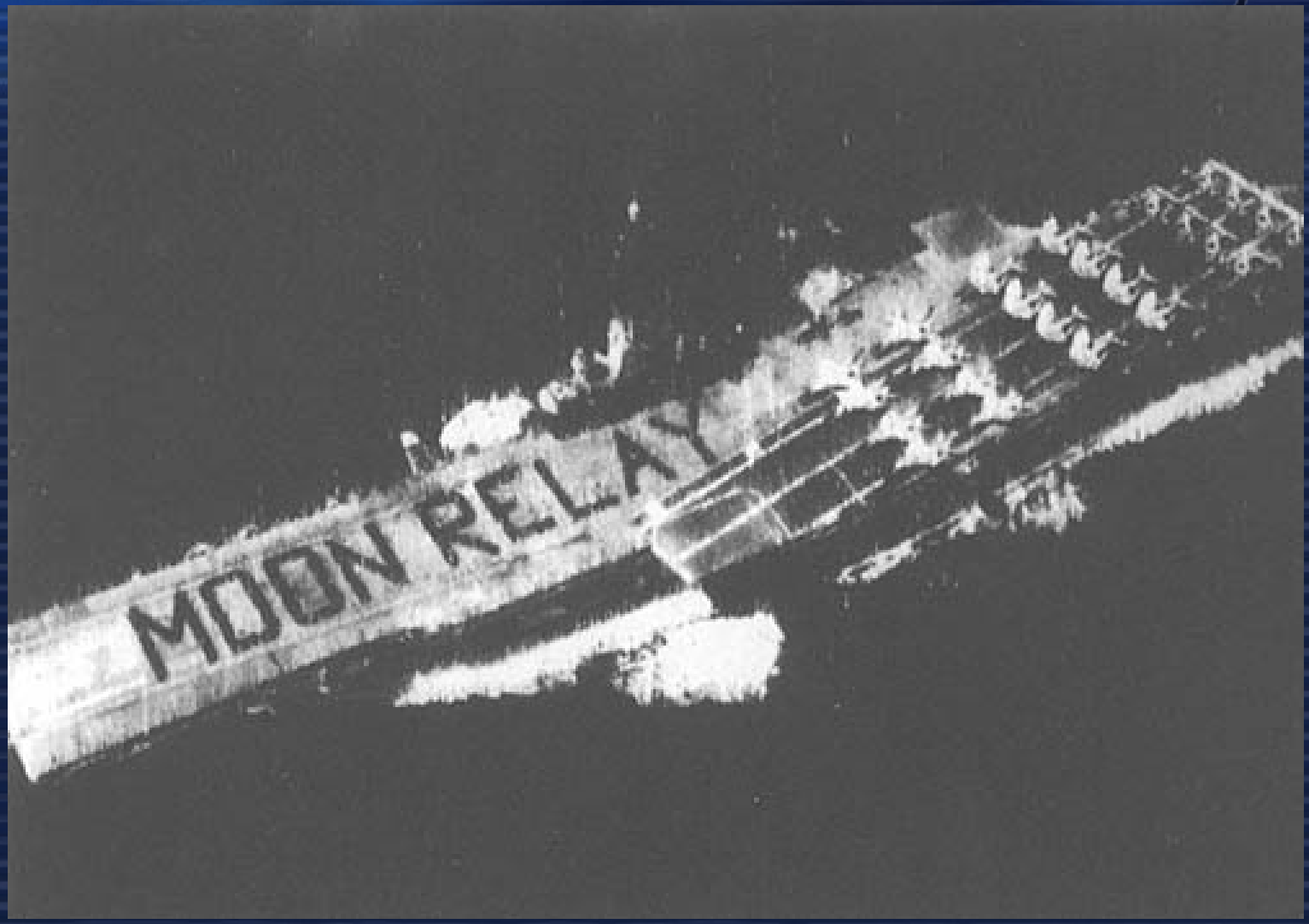
2. Natural Satellites and Moon Bouncing

Communication Moon Relay



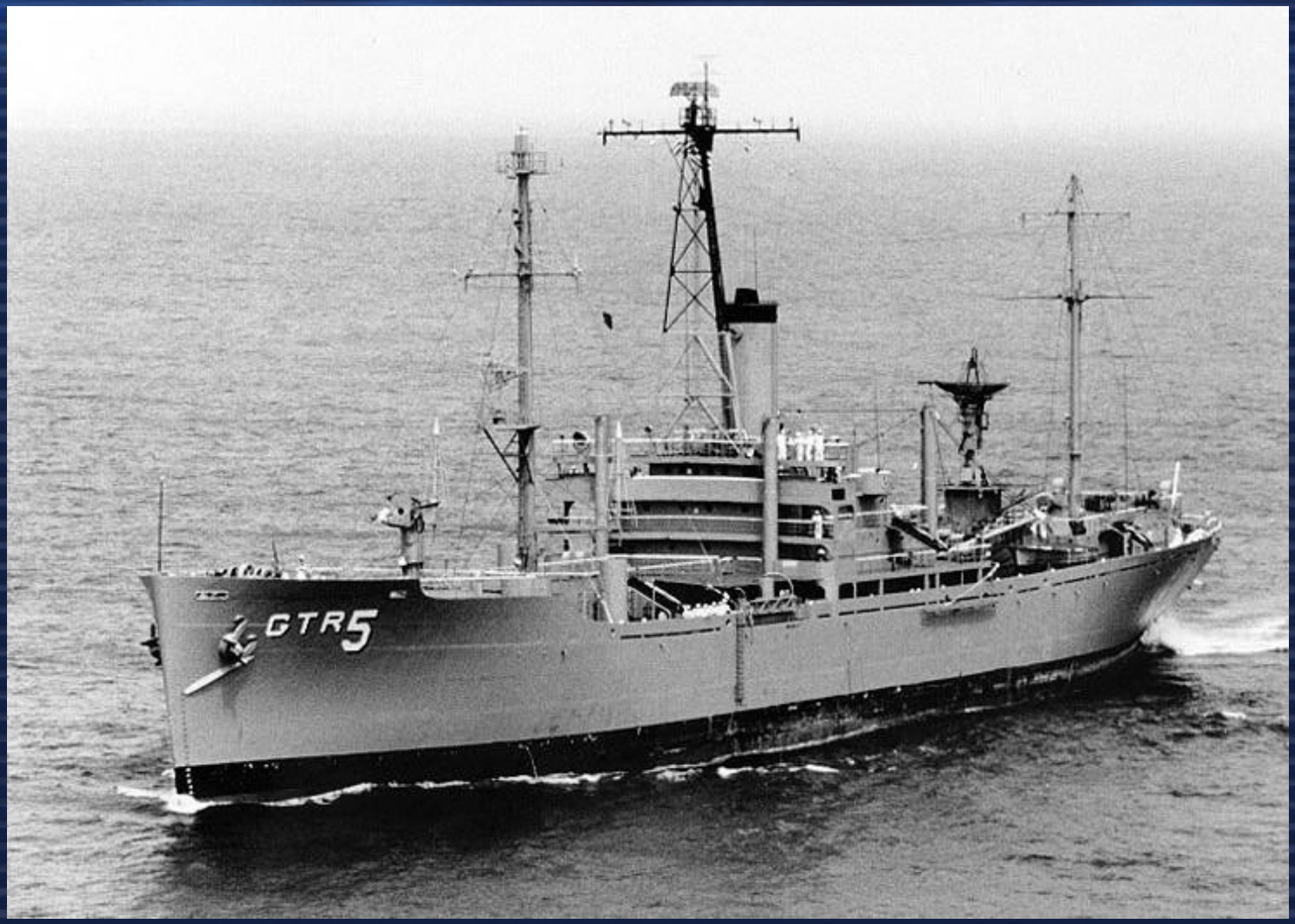
2. Natural Satellites and Moon Bouncing

Communication Moon Relay



2. Natural Satellites and Moon Bouncing

Communication Moon Relay



Bandwidth of Popular Modes

	Minimum	Maximum
SSCW (Morse Code)	0.1 Hz	20 Hz
CW (Morse Code)	20 Hz	150 Hz
RTTY	270 Hz	370 Hz
PSK31	-	37.5 Hz
JT65A	-	177.6 Hz
Side Band Phone	2.4 kHz	3 kHz
AM Phone	5 kHz	10 kHz
Narrower Band FM Phone	-	8 kHz
Narrow Band FM Phone	-	16 kHz

900 MHz WiFi Moon Bounce?

- 10W Transmitter (+40 dBm)
- Receiver Pre Amplifier (+12dB)
- 928 MHz EME Path (-274.9 dB)
- 15’ Parabolic Dish (+30 dB)
- Feed Line Loss (-0.5 dB)

40 + 30 - 0.5 – 274.9 + 30 - 0.5 + 12

-163.9 dBm

2. Natural Satellites and Moon Bouncing

900 MHz WiFi One Way?

- 10W Amplifier (+40 dBm)
- Receiver Pre Amplifier (+12dB)
- 928 MHz x 405,696 km (-204 dB)
- 15’ Parabolic Dish (+30 dB)
- Feed Line Loss (-0.5 dB)

40 + 30 - 0.5 - 204 + 30 + 12 - 0.5

-93 dBm

2. Natural Satellites and Moon Bouncing

900 MHz WiFi One Way?

2. Natural Satellites and Moon Bouncing

802.11b/g Moon Bounce

- 1W Amplifier (+30 dBm)
- Receiver Pre Amplifier (+12 dB)
- 2.45 GHz EME Path (-283.4 dB)
- Arecibo Dish (+75 dB)
- Feed Line Loss (-1 dB)

30 + 75 - 1 - 283.4 + 75 +12 - 1

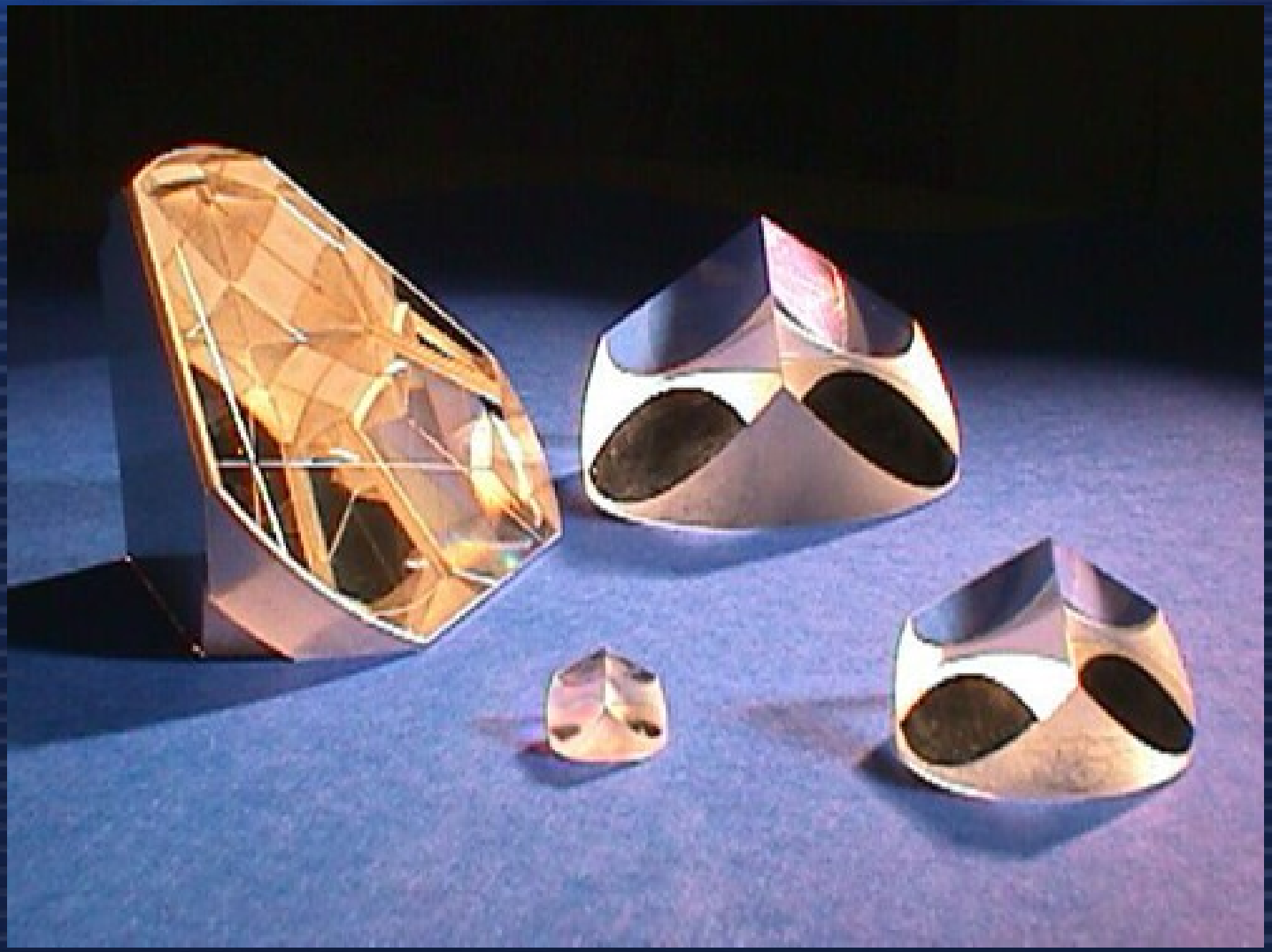
-93.4 dBm

2. Natural Satellites and Moon Bouncing

802.11b/g Moon Bounce

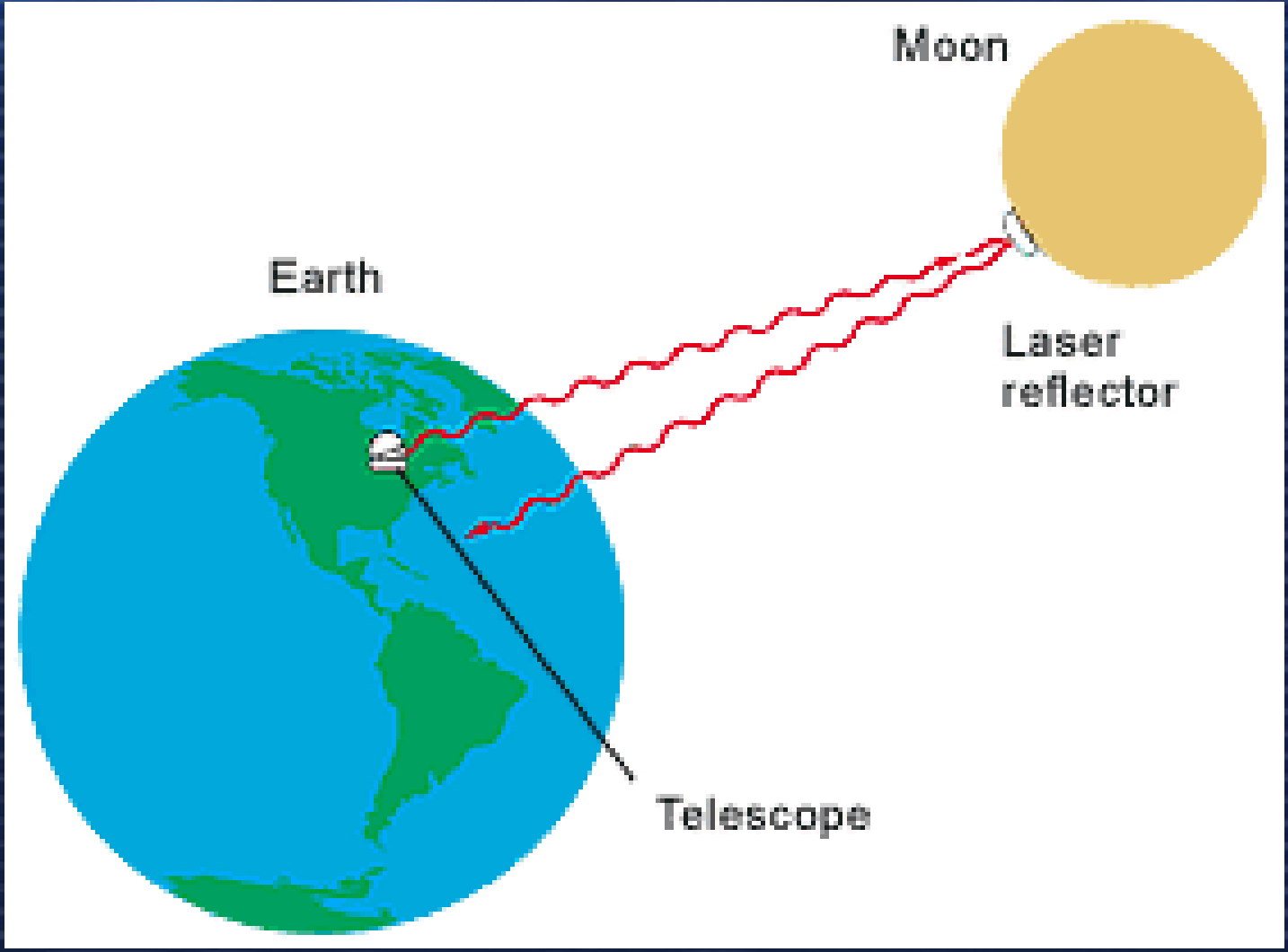
2. Natural Satellites and Moon Bouncing

Frickin' Laser Beams



2. Natural Satellites and Moon Bouncing

Frickin' Laser Beams

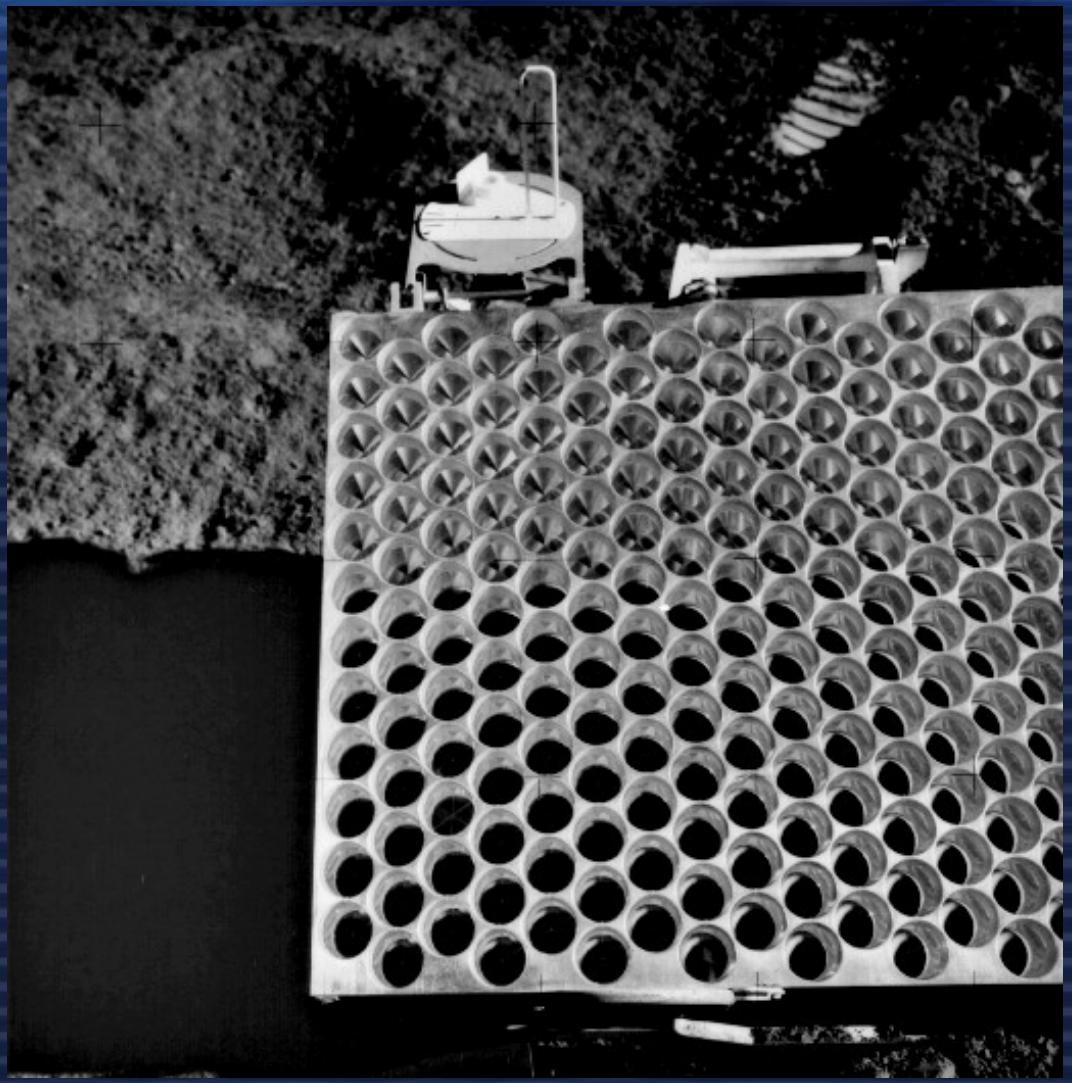


2. Natural Satellites and Moon Bouncing

Frickin' Laser Beams

2. Natural Satellites and Moon Bouncing

Frickin' Laser Beams



2m Moon Bounce

- 1500 W Transmitter (+61.8 dBm)
- Receiver Pre Amplifier (+24 dB)
- 144 MHz EME Path (-259 dB)
- 17 Element Yagi (+18 dB)
- Feed Line Loss (-0.5 dB)

61.8 + 18 - 0.5 - 259 + 18 + 24 - 0.5

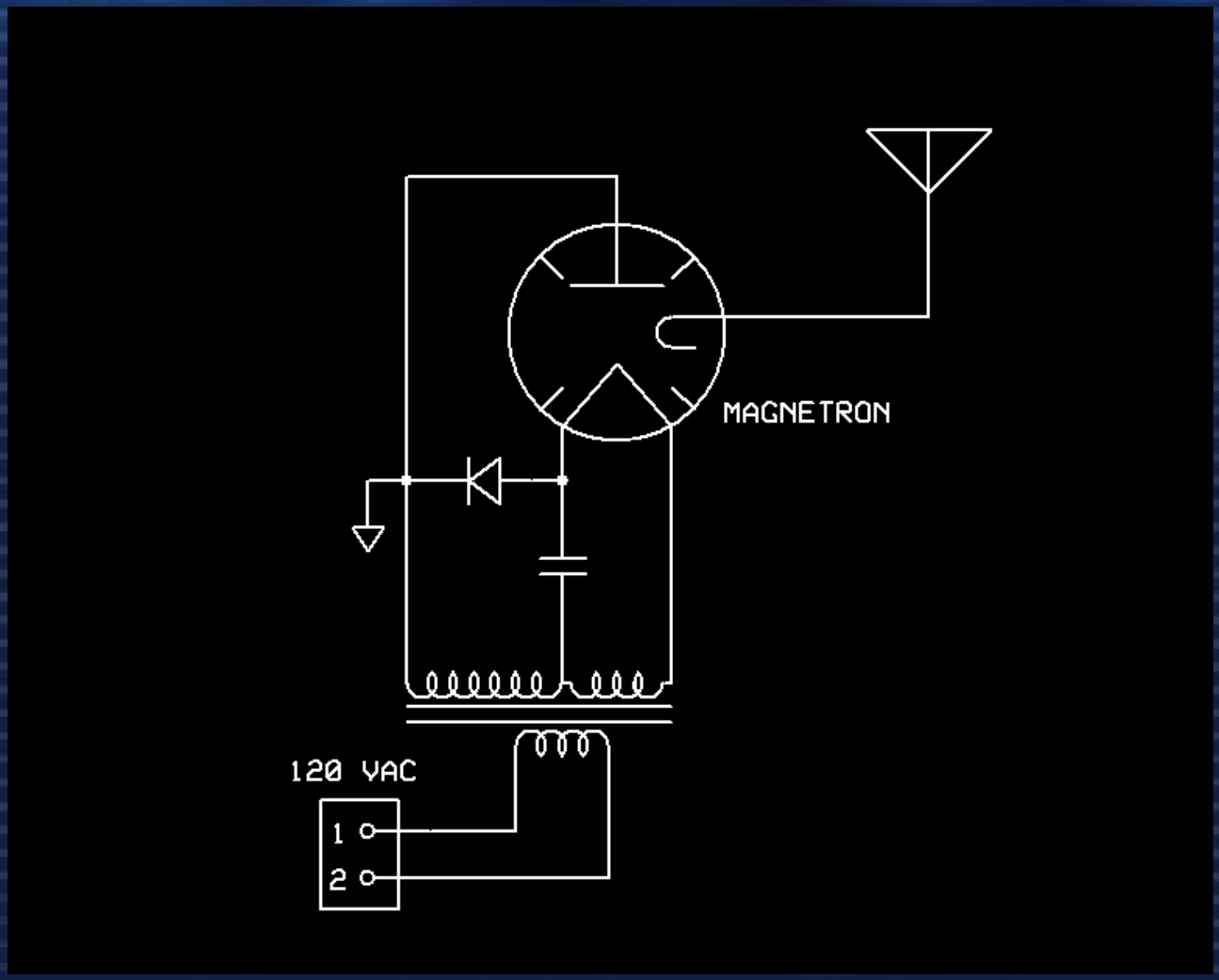
-138.2 dBm

2. Natural Satellites and Moon Bouncing

2m 48 Yagi Phased Array

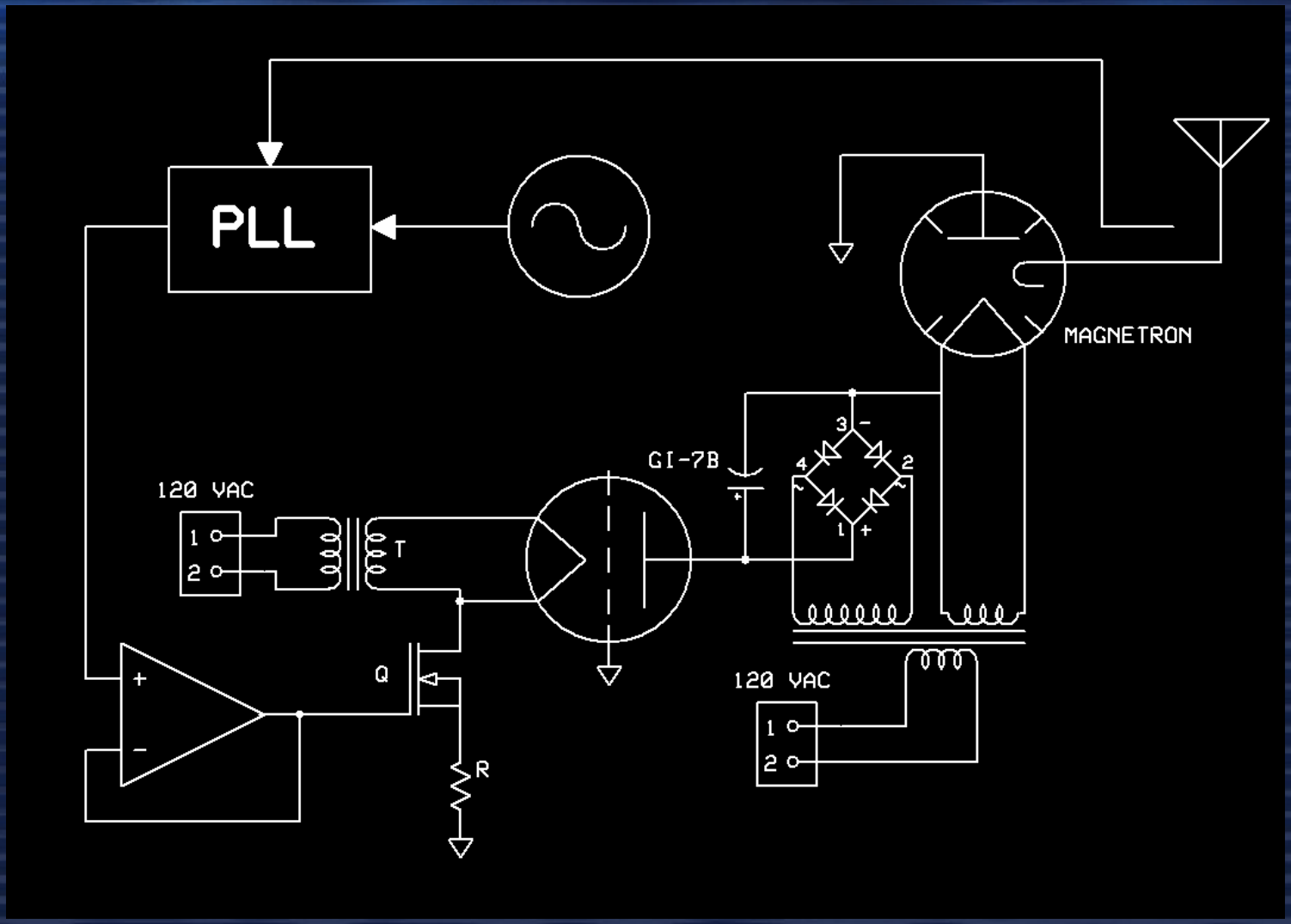
Typical Microwave Oven

Typical Microwave Oven



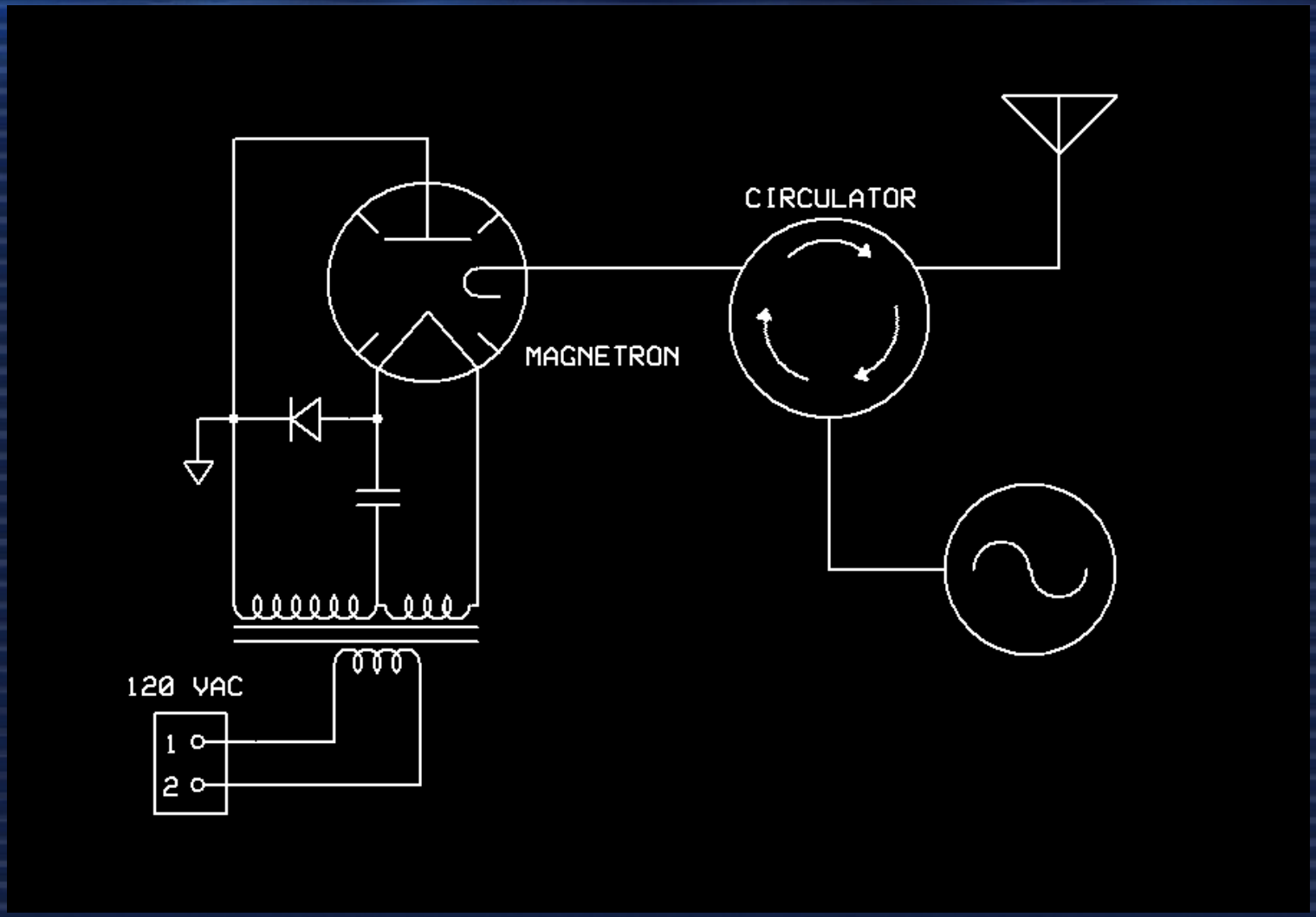
2. Natural Satellites and Moon Bouncing

Phase Locked Microwave Oven



2. Natural Satellites and Moon Bouncing

Injection Locked Microwave Oven



13cm Moon Bounce

- 750W Microwave Oven (+59 dBm)
- Receiver Pre Amplifier (+12 dB)
- 2.45 GHz EME Path (-283.4 dB)
- 12’ Parabolic Dish (+36.4 dB)
- Feed Line Loss (-0.5 dB)

59 + 36.4 - 0.5 - 283.4 + 36.4 + 12 - 0.5

-140.6 dBm

Surplus Parabolic Dishes

2. Natural Satellites and Moon Bouncing

Surplus Parabolic Dishes

Surplus Parabolic Dishes

Surplus Parabolic Dishes

2. Natural Satellites and Moon Bouncing

Surplus Parabolic Dishes

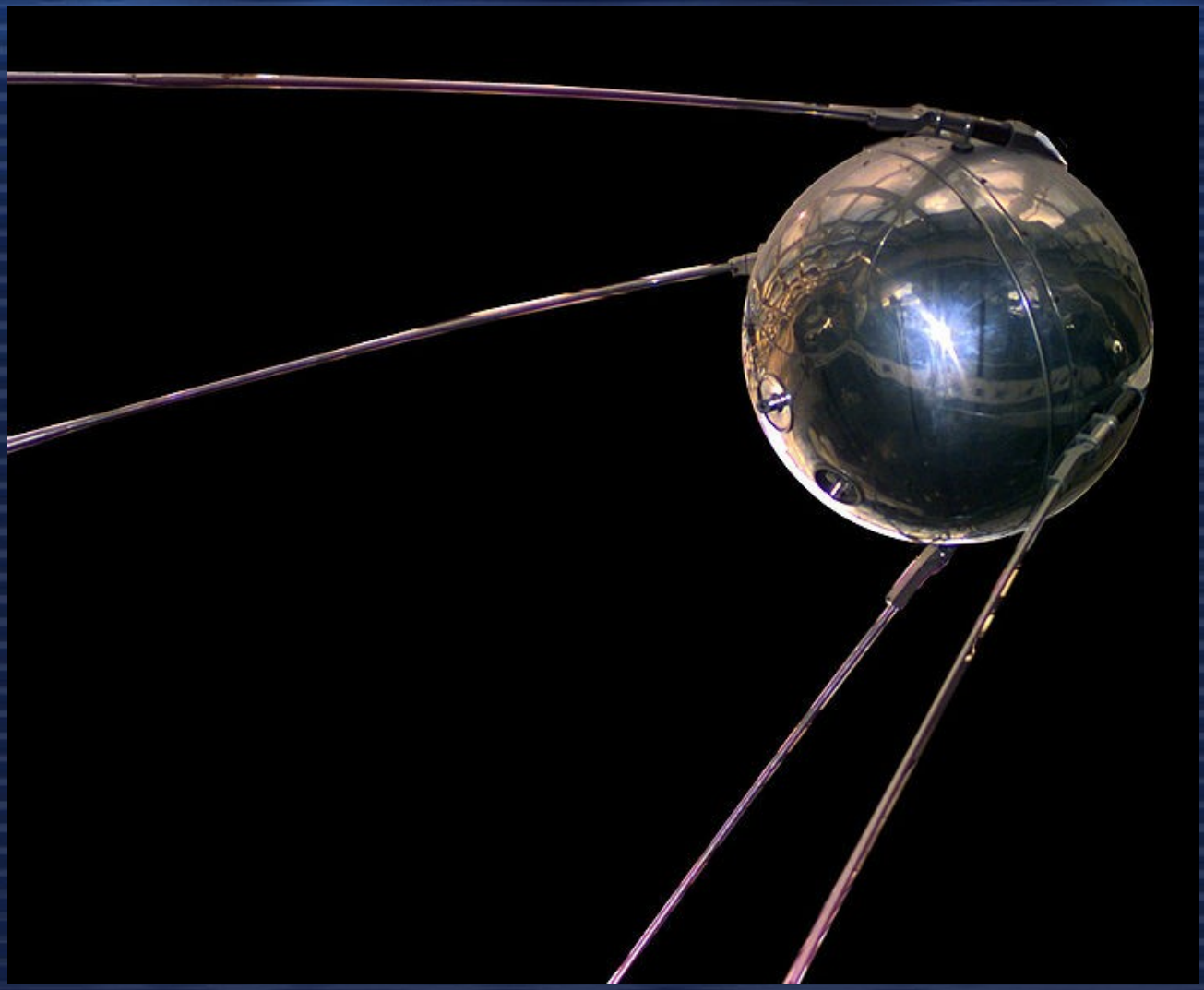
2. Natural Satellites and Moon Bouncing

My Dish Has Holes In It

	Highest Usable Frequency
2.00”	590 MHz
1.50”	790 MHz
1.00”	1.18 GHz
0.750”	1.57 GHz
0.500”	2.36 GHz
0.375”	3.15 GHz
0.250”	4.72 GHz
0.125”	9.45 GHz
0.0625”	18.9 GHz

3. Artificial Satellites and cleaver ways to use them

Sputnik 1

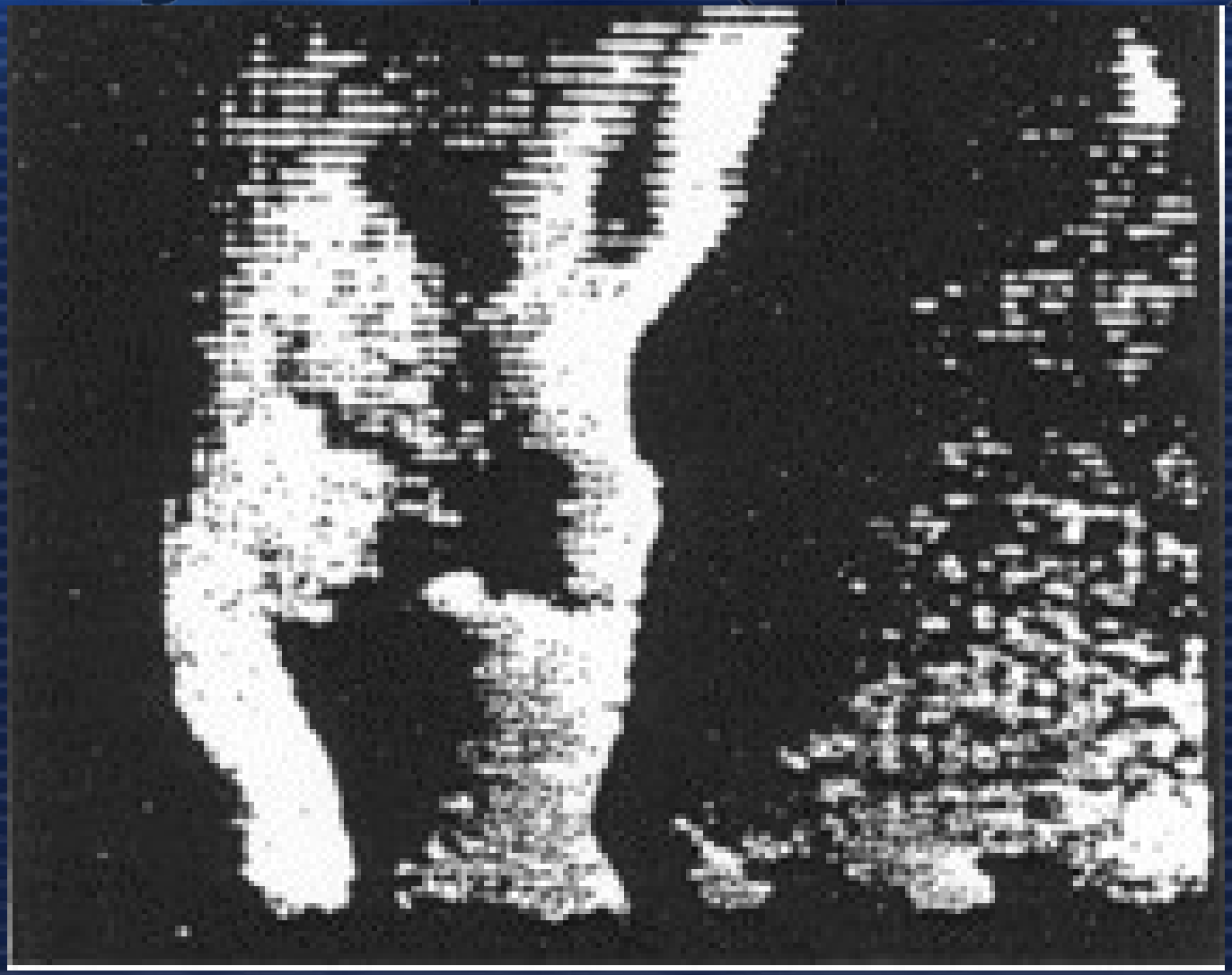


3. Artificial Satellites and cleaver ways to use them

Dogs in Space (Sputnik 2)

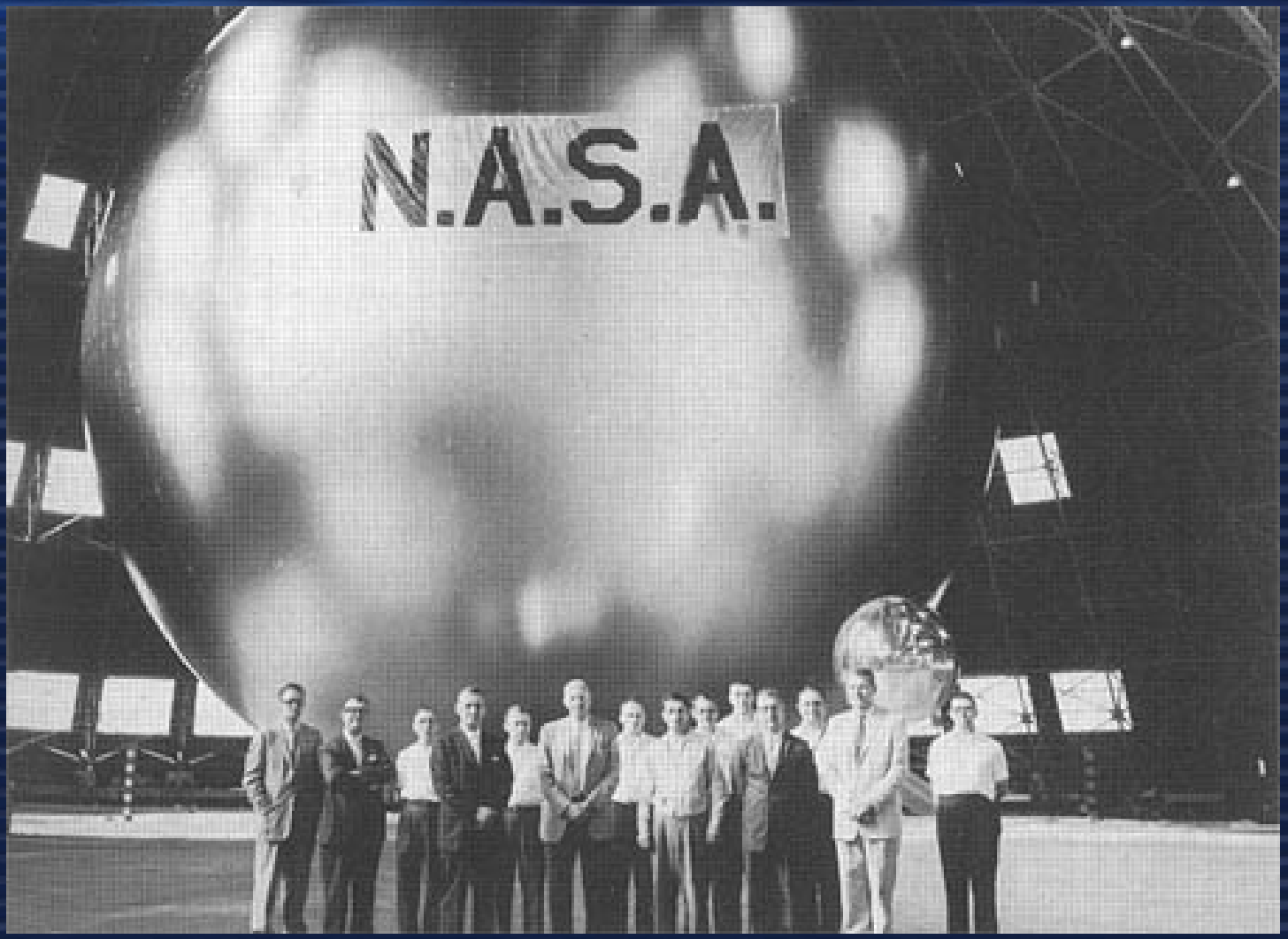
3. Artificial Satellites and cleaver ways to use them

Dogs in Space (Sputnik 6)



3. Artificial Satellites and cleaver ways to use them

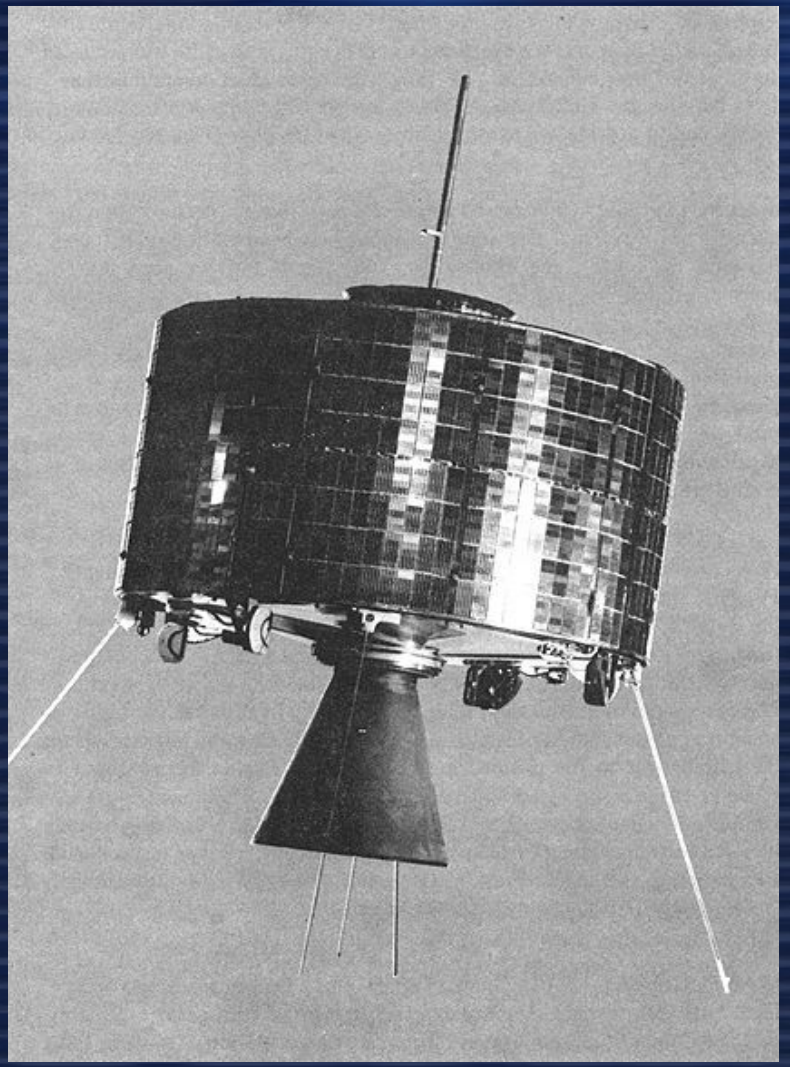
ECHO-1A



3. Artificial Satellites and cleaver ways to use them

Syncom 3

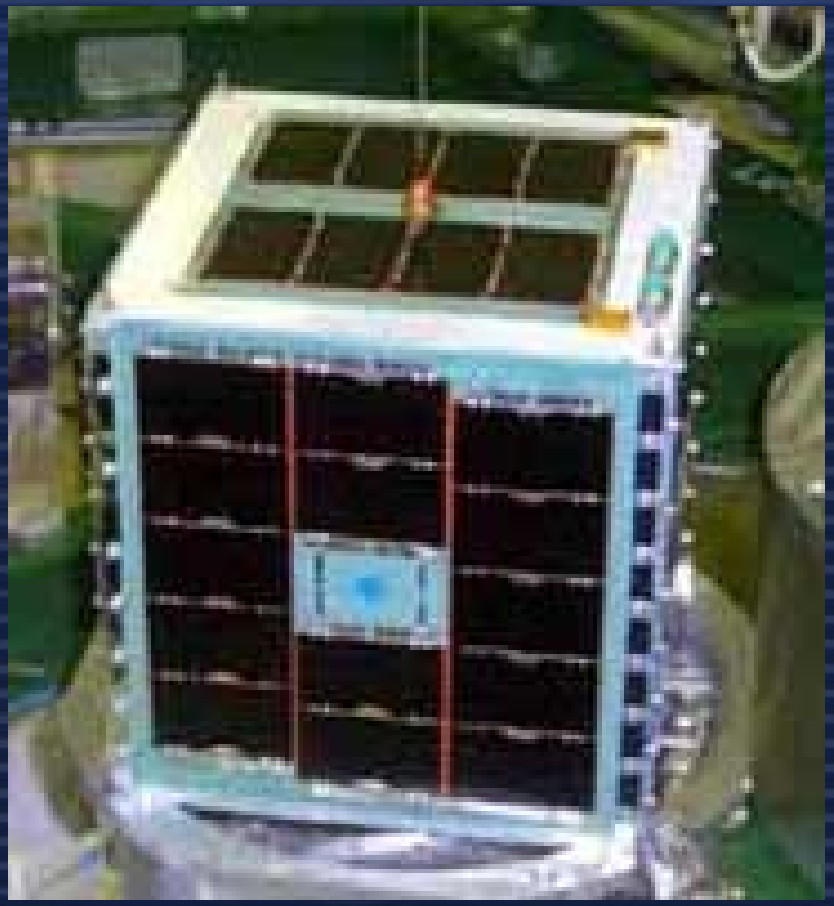
- 180° West
- 7360 MHz Uplink
- 1815 MHz Downlink
- 1- 5 MHz Channel
- 1 - 13 MHz Channel



3. Artificial Satellites and cleaver ways to use them

AMSAT-OSCAR 51 (Echo)

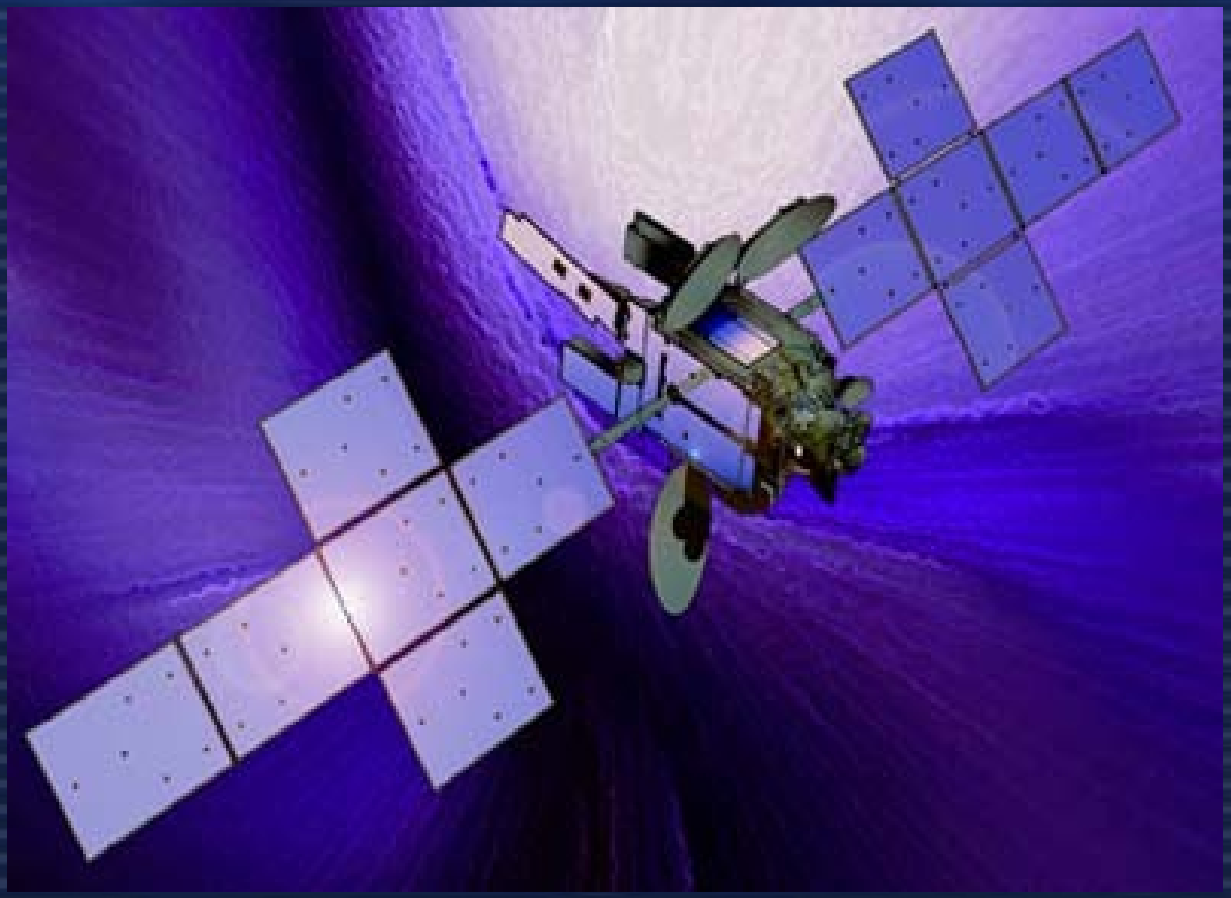
- Apogee: 818.00
- Perigee: 696.00
- Inclination: 99.97
- Period: 99.97
- Uplinks
  - 2 m & 23 cm
- Downlinks
  - 70 cm & 13 cm



3. Artificial Satellites and cleaver ways to use them

Telstar 28 (S2205)

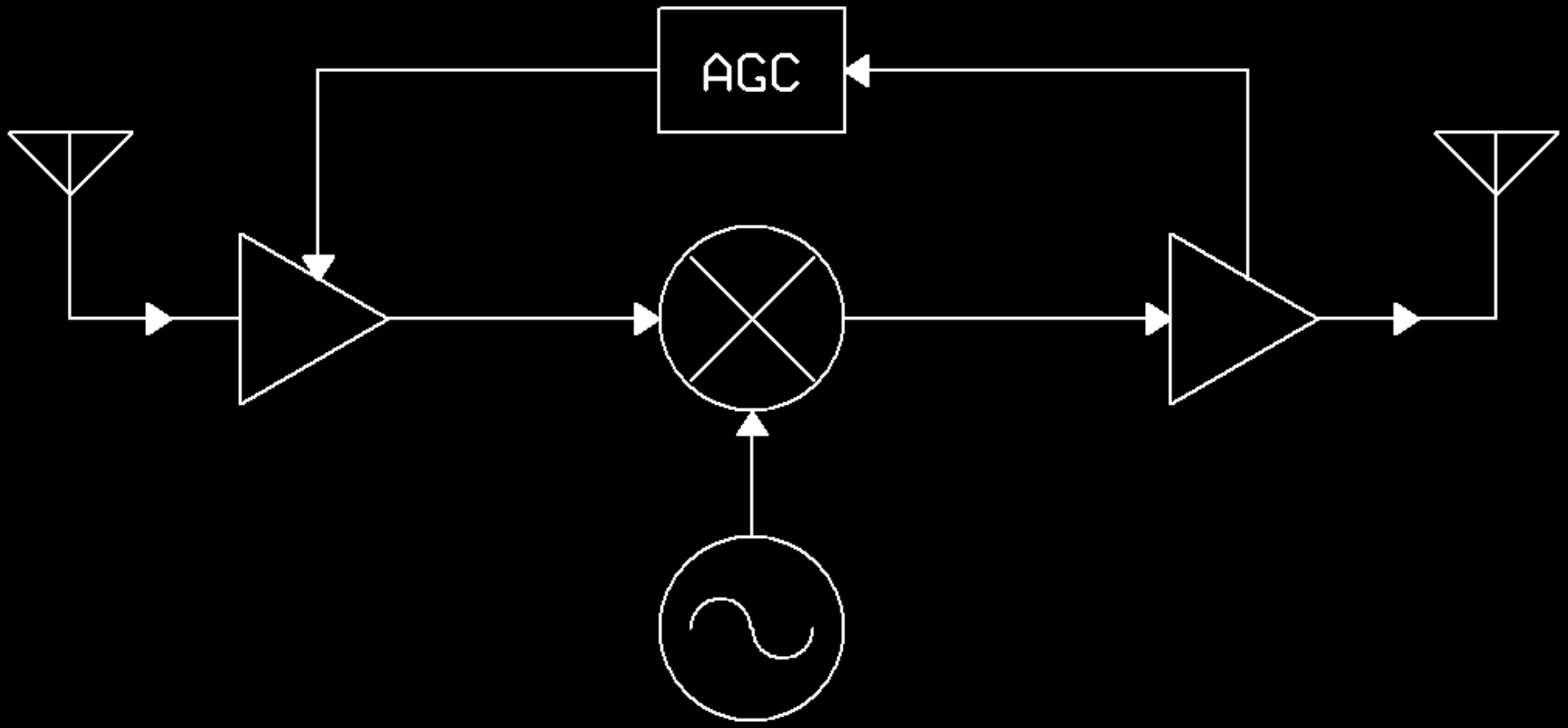
- 89° West
- 22 C Band
- 36 Ku Band
- 24 Ka Band



"Spaceballs"
©1987, METRO-GOLDWYN-MAYER

3. Artificial Satellites and cleaver ways to use them

Linear Transponder



3. Artificial Satellites and cleaver ways to use them

Ku Band Coverage (S2205)

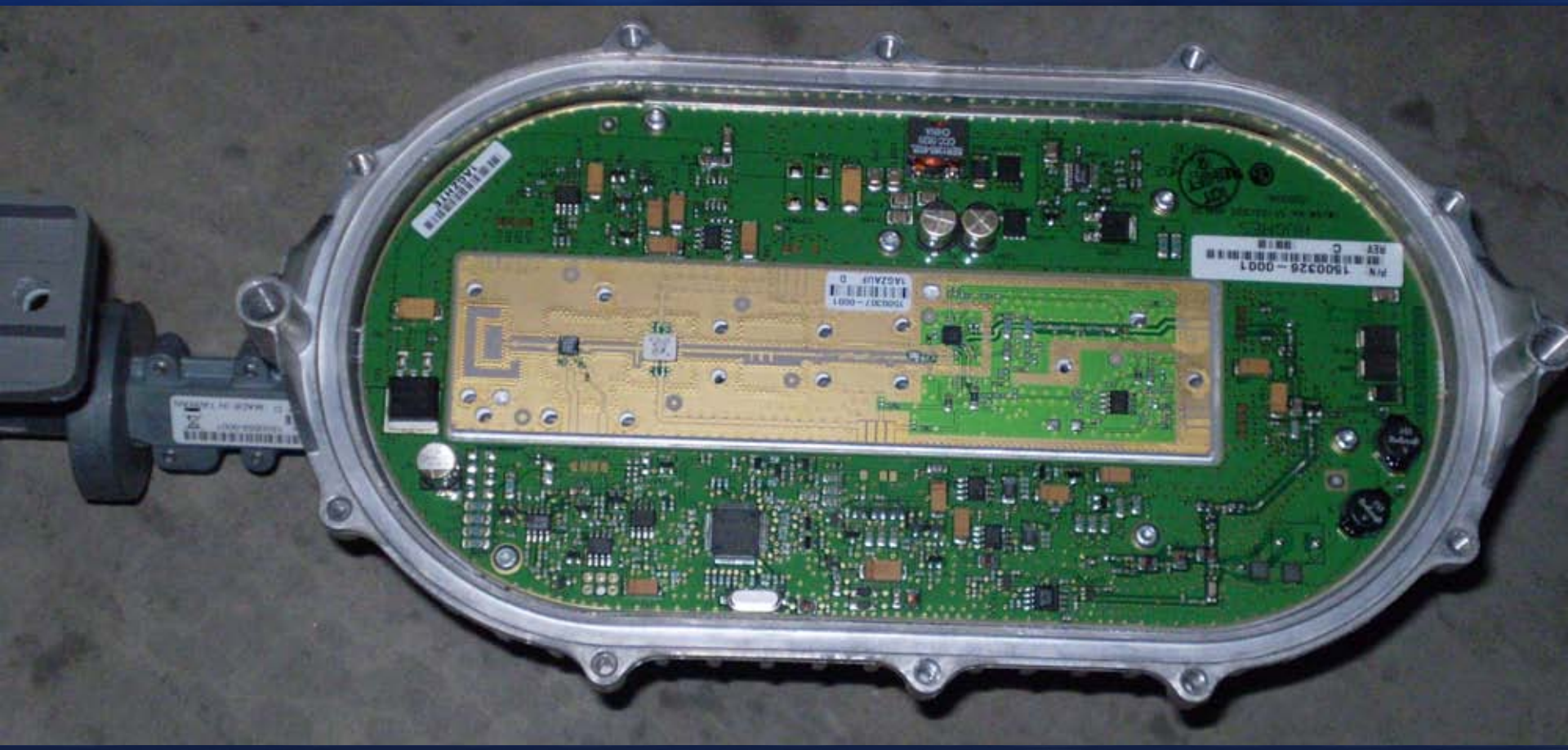
3. Artificial Satellites and cleaver ways to use them

Satellite Path Attenuation

	Average
C Band Downlink (4.2 GHz)	196.3 dB
C Band Uplink (6.4 GHz)	200.0 dB
Ku Band Downlink (12.2 GHz)	205.5 dB
Ku Band Uplink (14.5 GHz)	207.0 dB
Ka Band Downlink Gateway (18.8 GHz)	209.3 dB
Ka Band Downlink VSAT (20.2 GHz)	209.9 dB
Ka Band Uplink Gateway (28.6 GHz)	212.9 dB
Ka Band Uplink VSAT (30 GHz)	213.4 dB

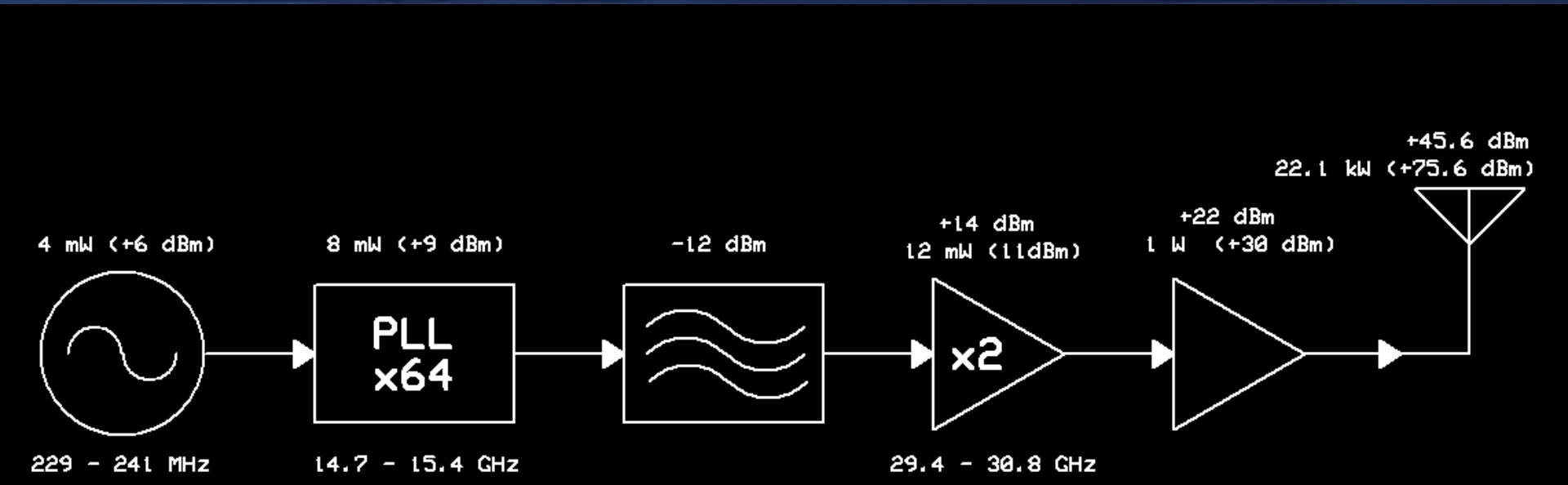
3. Artificial Satellites and cleaver ways to use them

Ka Band VSAT Transmitter



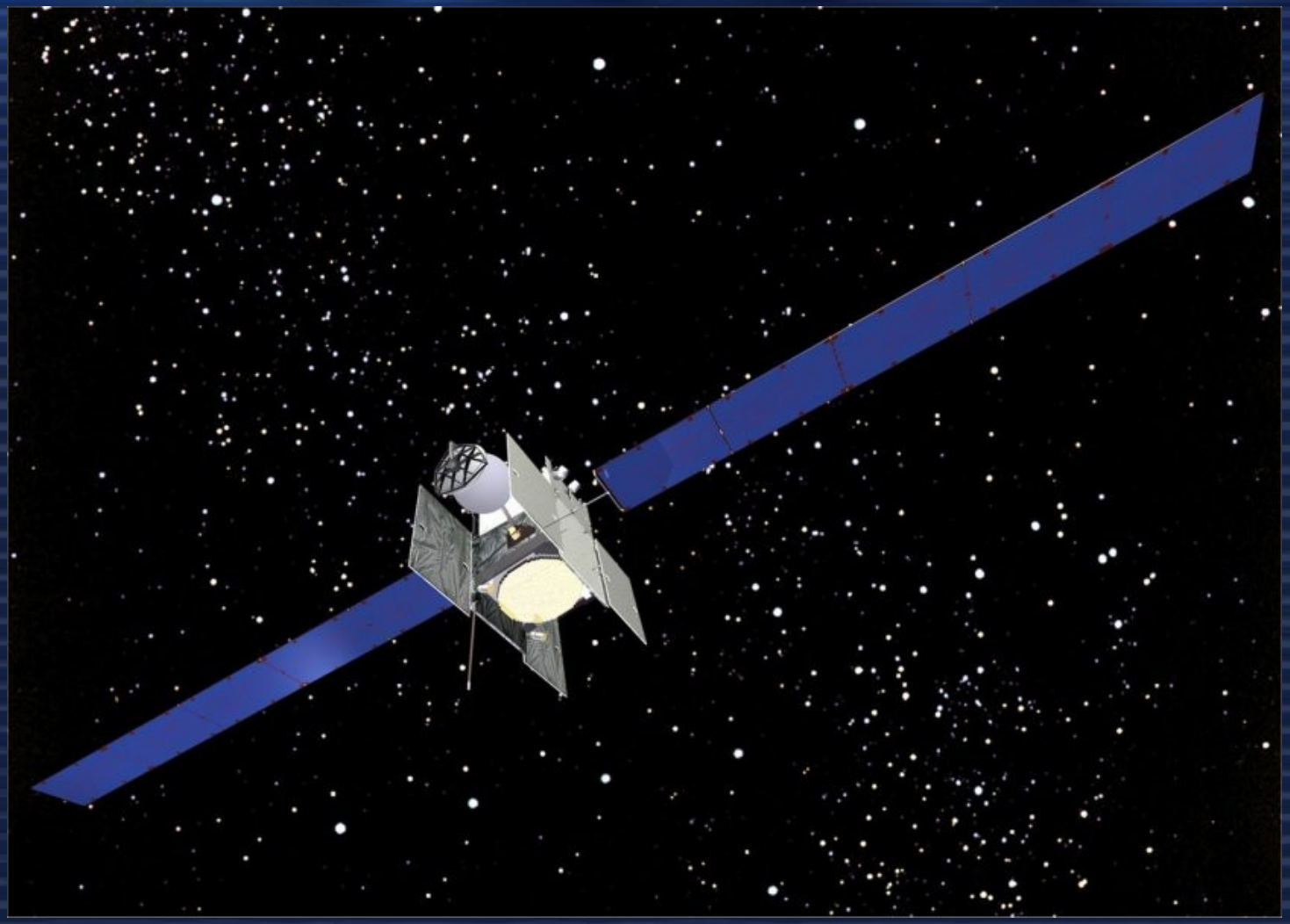
3. Artificial Satellites and cleaver ways to use them

Ka Band VSAT Transmitter



3. Artificial Satellites and cleaver ways to use them

Spaceway 3 (S2663)

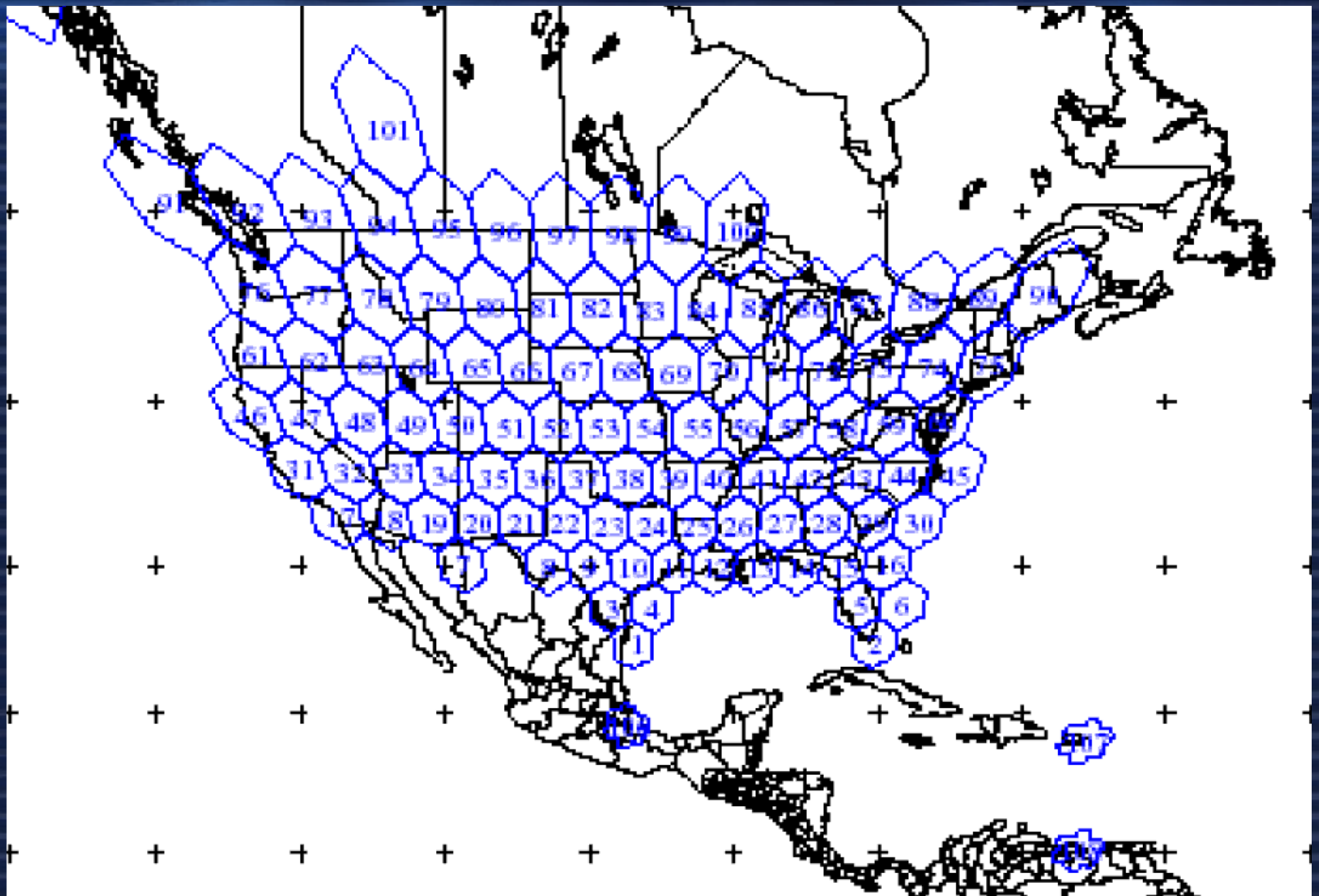


3. Artificial Satellites and cleaver ways to use them

Spot Beam Reflector

3. Artificial Satellites and cleaver ways to use them

Spot Beam Input Tubes



Taking Down Satellites (Natural Causes)

- Meteorites
- Solar Flares
- Leaking Capacitors
- Exploding Batteries
- Tin Whiskers

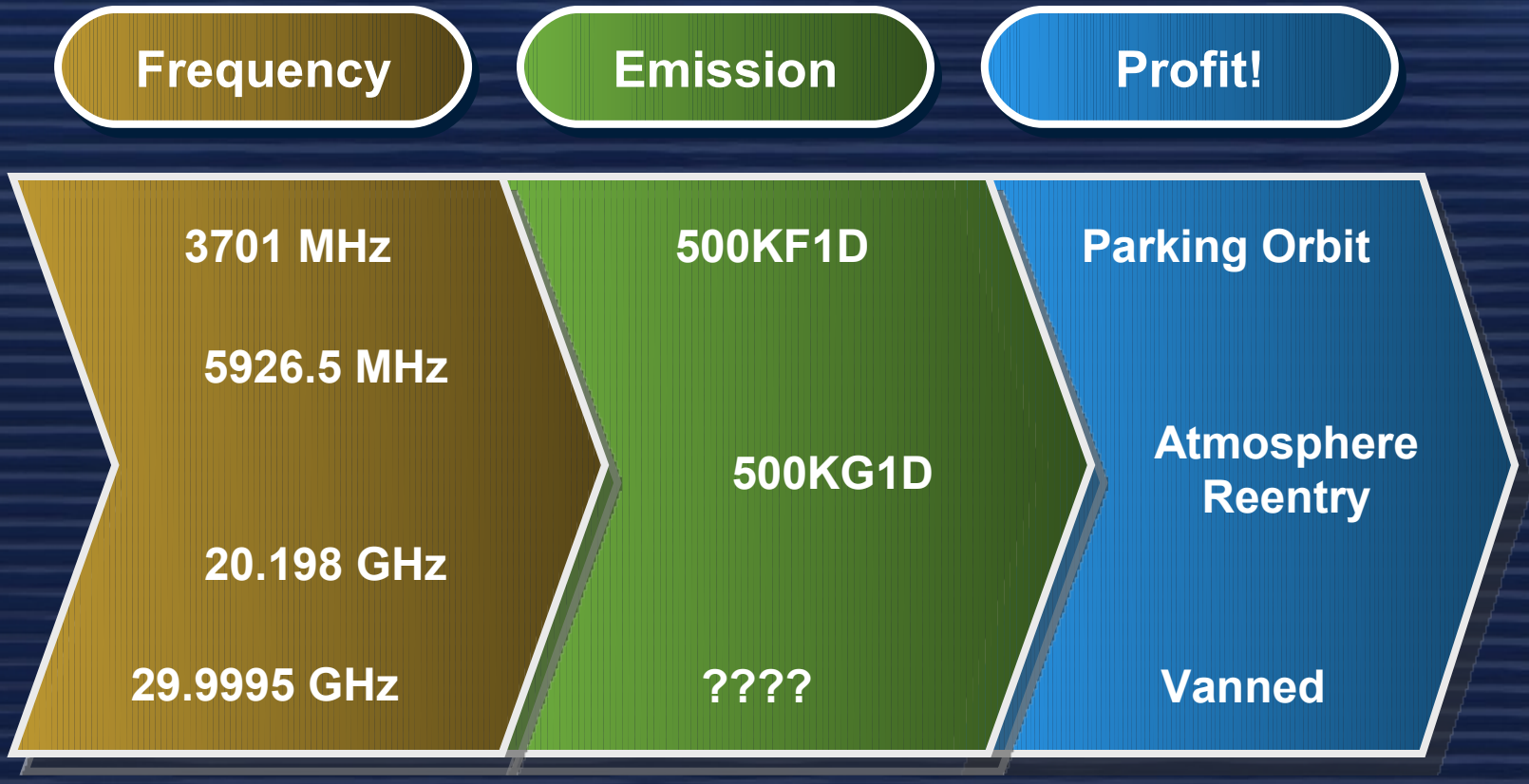

"Spies Like Us"
©1985, WARNER BROS., INC.

Taking Down Satellites (Government Intervention)

- China
  - Modified Ballistic Missiles
- United States
  - Modified Surface to Air Missiles
  - Frickin' Laser Beams
- Russia
  - 23 mm Cannon
  - Weather Satellites

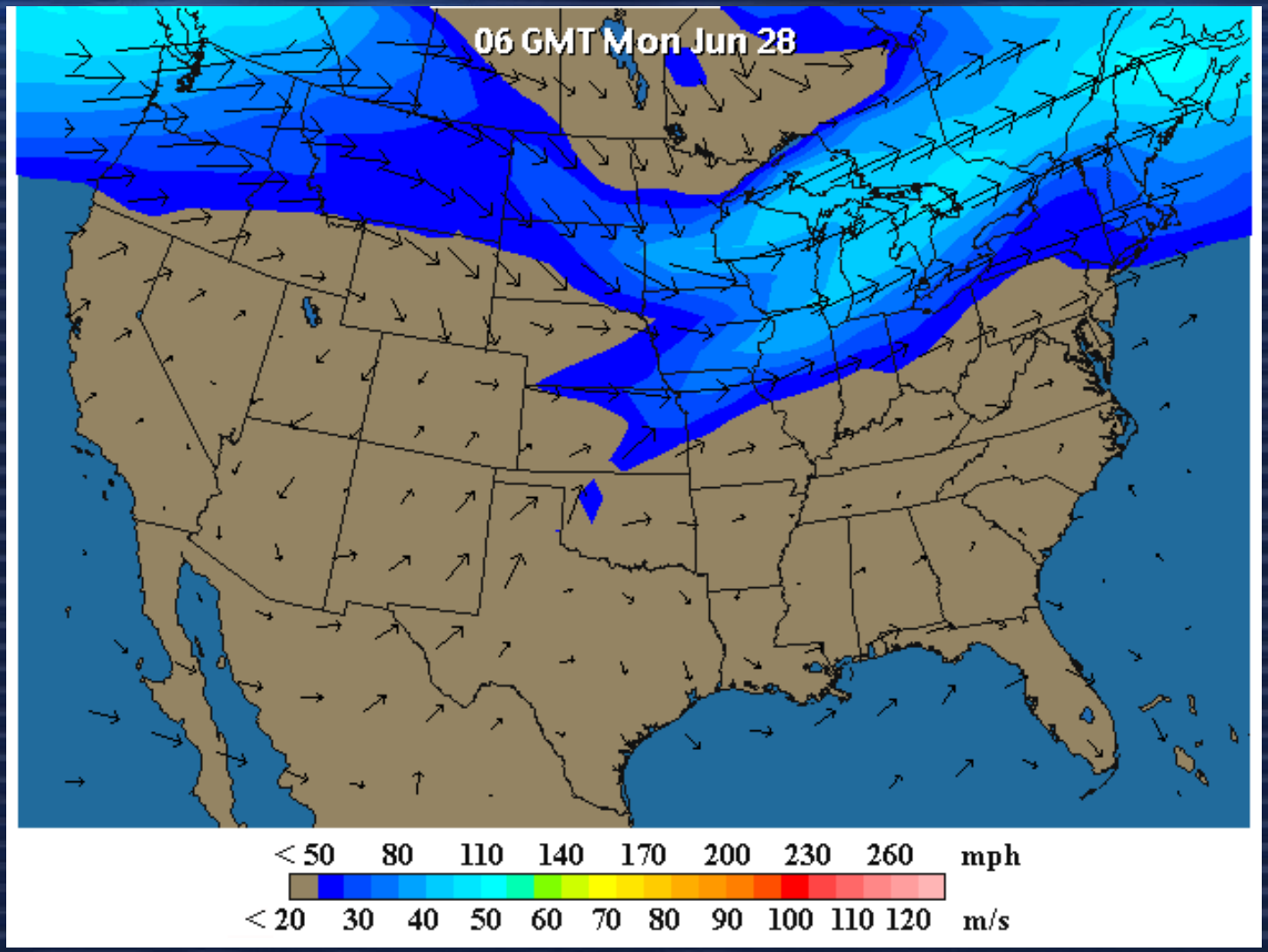
3. Artificial Satellites and cleaver ways to use them

Taking Down Satellites (Home Edition)



4. Weather balloons as satellites

Jet Stream



Example Payload

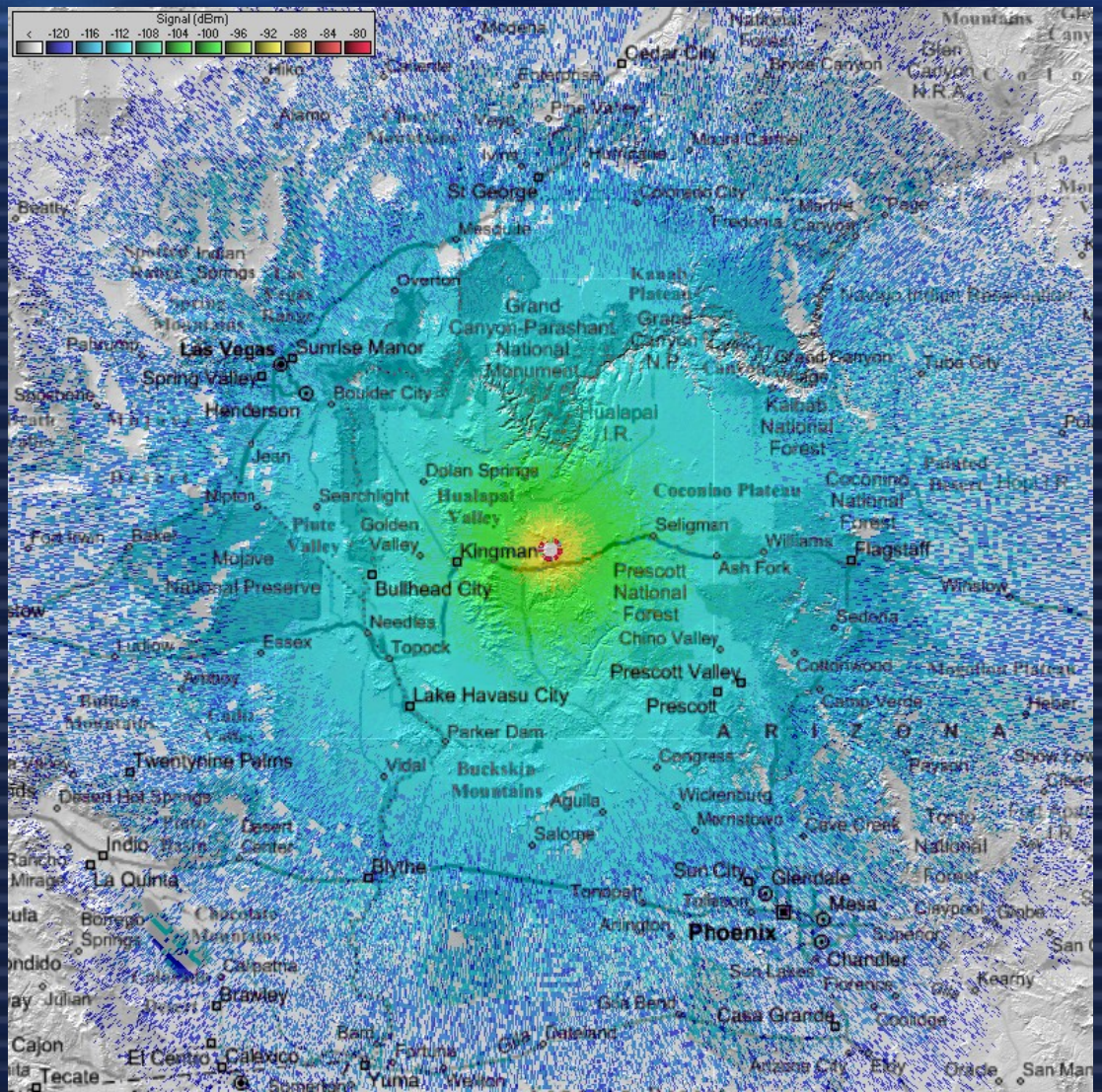
- WRT54GL
  - 200 mW (+23 dBm)
  - 9 dB Antenna
  - 8 GB Secure Digital Card
- 32’ Latex Balloon
  - Altitude Station Keeping System
- GPS & TinyTrak-4
  - 144.39 MHz APRS
  - Provides Altitude Information

4. Weather balloons as satellites

2.4 GHz at 2 m Altitude

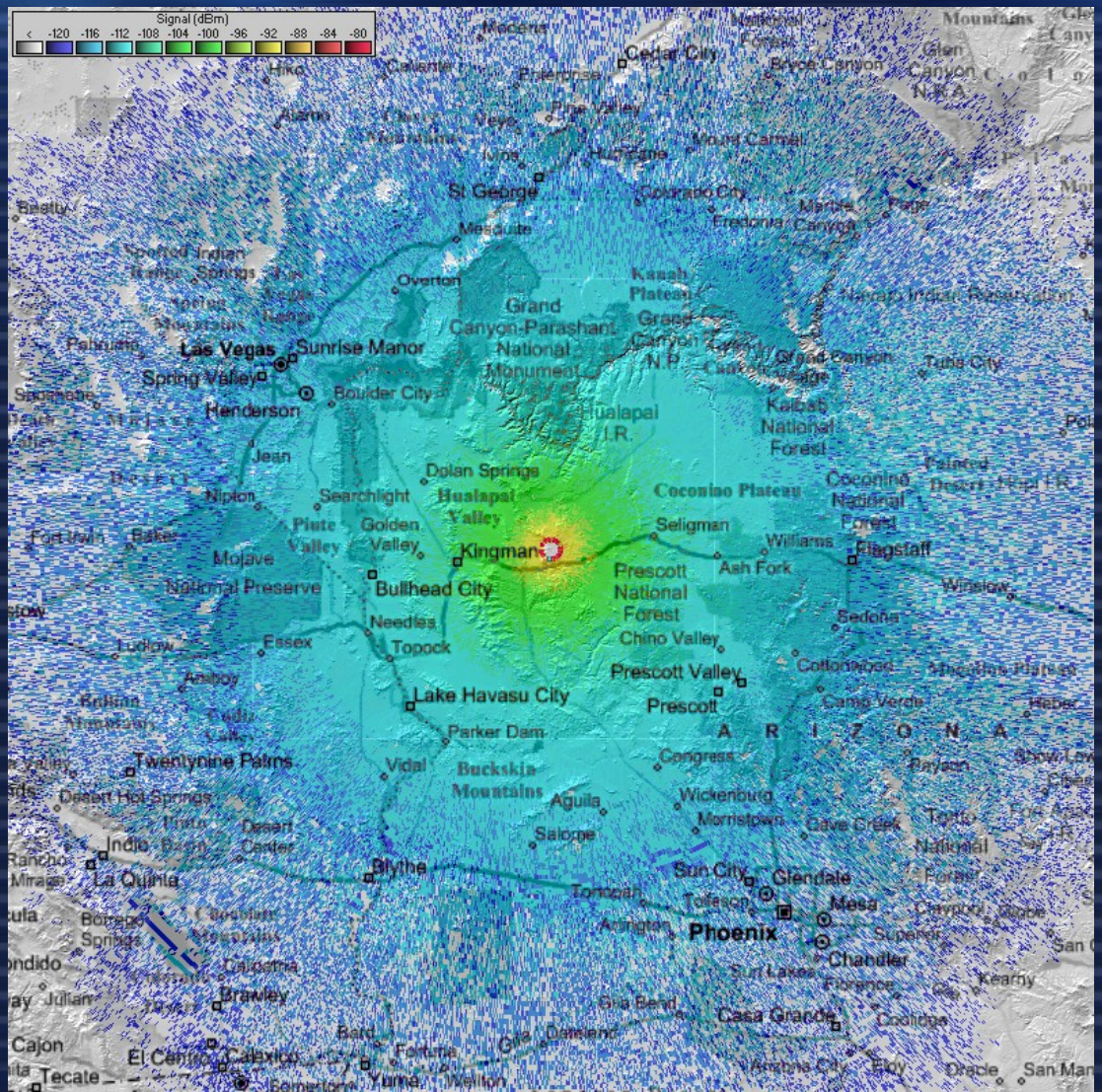
4. Weather balloons as satellites

2.4 GHz at 18000 m Altitude



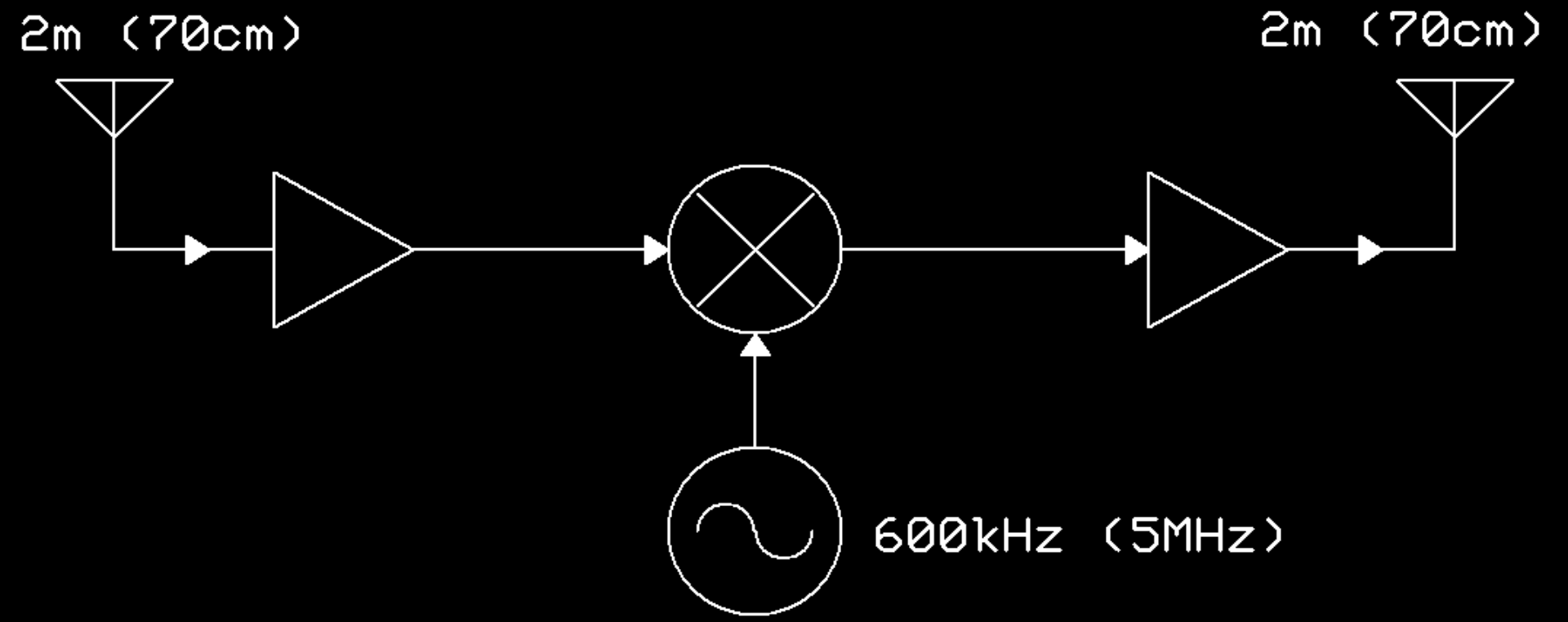
4. Weather balloons as satellites

2.4 GHz at 25000 m Altitude



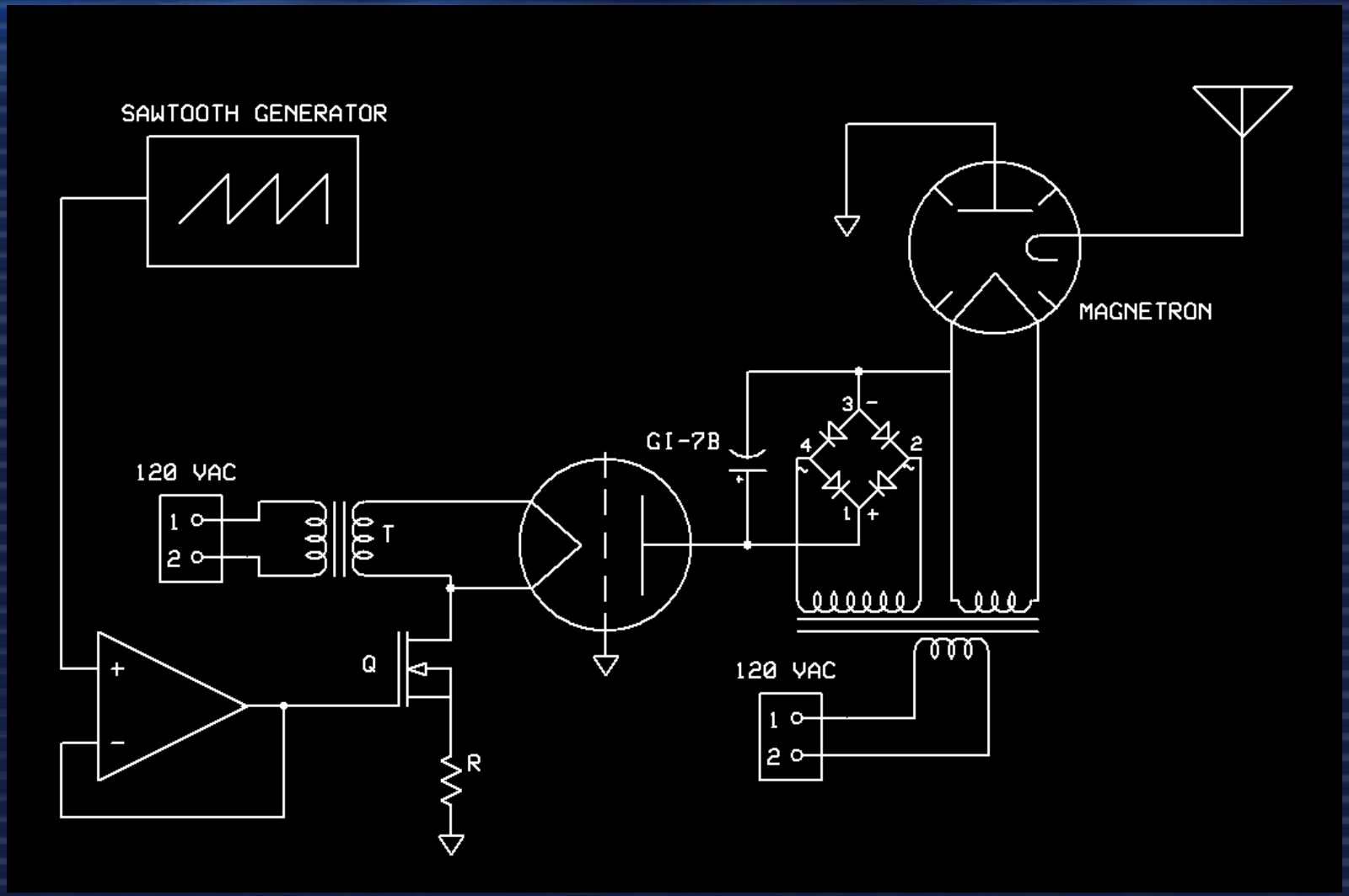
5. Other stuff you can blame me for

Repeater Desense Generator



5. Other stuff you can blame me for

Microwave Oven 802.11b/g Jammer



DCFluX in: Moon-Bouncer

Questions?

Track 4 Q&A Room

matt@kgmn.net

FLUX RESEARCH

DCFluX will return in:

License to Transmit