

# SMALL STATION EME *(EME ON A BUDGET)*

BY AL, K2UYH



INTRODUCTION

HISTORY

WHY EME?

TECH CHALLENGE

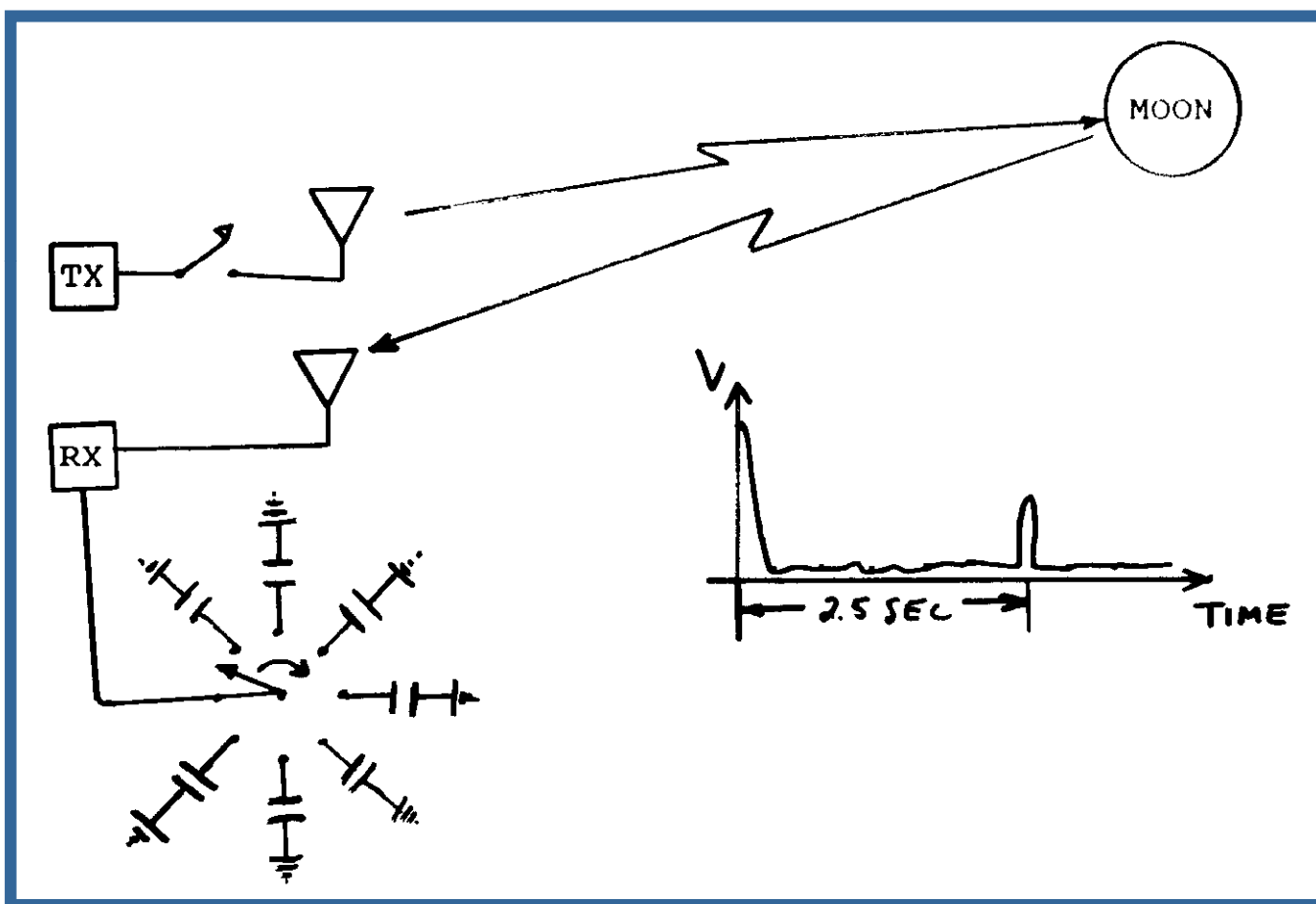
HOW DONE

WHAT YOU NEED

CONCLUSION

## FIRST APPLIED IN RADAR

DIANA RADAR (115 MHz)  
8 KW TO COLLINEAR ARRAY W4ERI IN CHARGE



**ANALYZED REPEATED TRANSMISSION OF A PULSE**

## AMATEURS WERE AMONG 1ST TO EXPERIMENT WITH EME COMMUNICATIONS

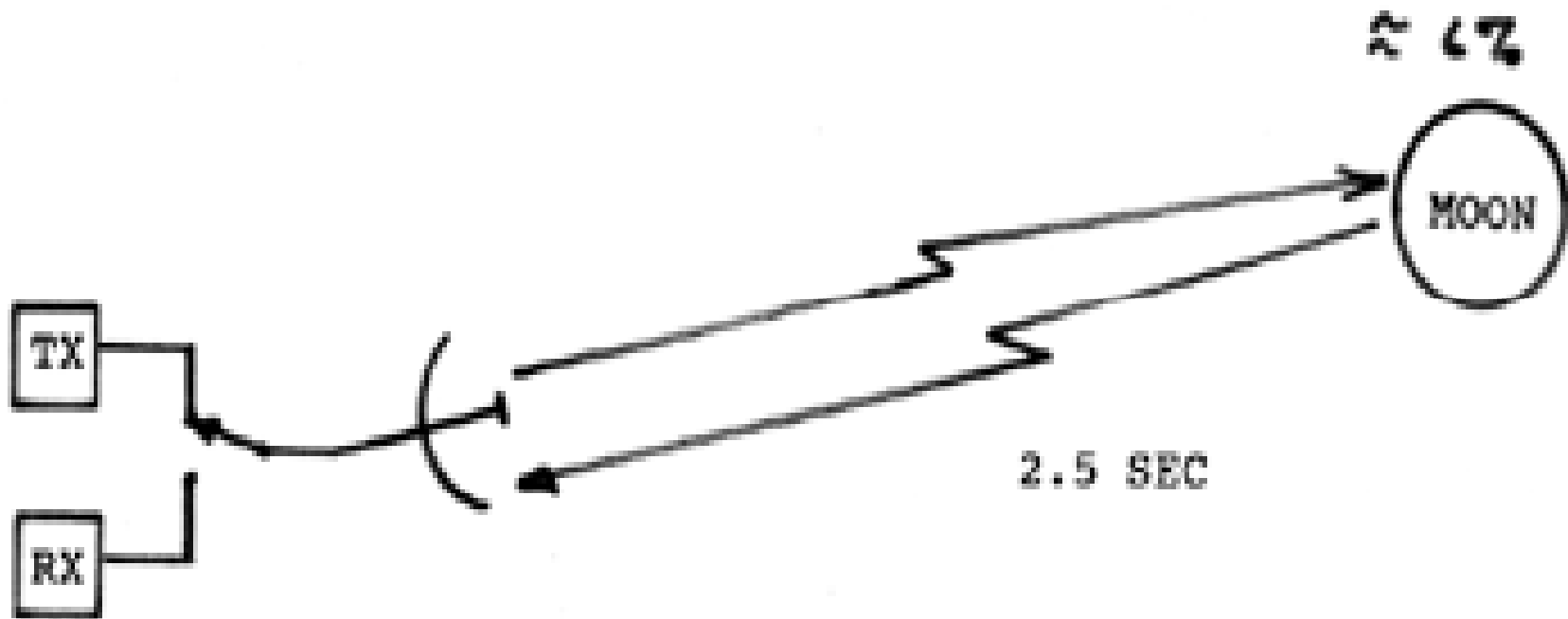
- ECHOES REPORTED ON 144 MHz IN 1953
- AMATEUR 2-WAY COMMUNICATION IN 1960
- ALL CONTINENTS WORKED IN 1976
- 10 GHz EME IN 1989
- 47 GHz EME IN 2002

# WHY WORK MOONBOUNCE?

- IT IS EXCITING!
- MOST FUN IN HAM RADIO IS MAKING RARE, UNUSUAL, OR DIFFICULT CONTACTS.
- EME ALLOWS YOU TO WORK WORLDWIDE DX ON ANY BAND - 6 M UP.
- WAY TO INCREASE YOUR GRID SQUARE, STATE & DXCC COUNT.



## EME CHALLENGE



$$P_L = 10 \text{ LOG } (D_M^2 W L \sigma / 16 \pi^2 R^4)$$

$$= 261 \text{ dB} \quad (\text{AT } 432 \text{ MHz})$$

# TECHNICAL CHALLENGE

**ANTENNA - LARGEST SIZE DESIRED?**

**TRANSMITTER - HIGHEST POWER WANTED?**

**RECEIVER - LOWEST NF ESSENTIAL?**

- YES – IF YOU WANT TO BE A ***BIG GUN!***
- SSB (VOICE) COMMON TODAY
- USING JT65 AND EVEN CW CAN GET BY WITH ***MUCH LESS.***

**BIGGER IS BETTER!**



HB9Q 15 M DISH



AD6IW JAMESBURG 30 M DISH

# **EME BY SMALL STATION**



- **MY 1<sup>ST</sup> DIGITAL CONTACT WAS ON 23 CM WITH OH3MCK.**
- **OH3MCK WAS USING 2 X 22 dBi YAGIES (LINEAR POL.) AND 40 W.**



# **DP1POL – Felix & 67 EL YAGI**

## **WINTER AT SOUTH POLE!**





**QSO'D DF3RU, DJ9YW, ES5PC, ES6RQ, G4CBW,  
G4CCH, K2UYH, LZ1DX, OE9ERC, OK1DFC,  
OK1KIR, PA3CSG, RD3DA & W5LUA.**

# **RA0ACM's SINGLE 49 EL YAGI & 75 W FROM APT WINDOW**



OY3JE - COPIED K2UYH WITH A  
PREAMP IN HIS SHACK



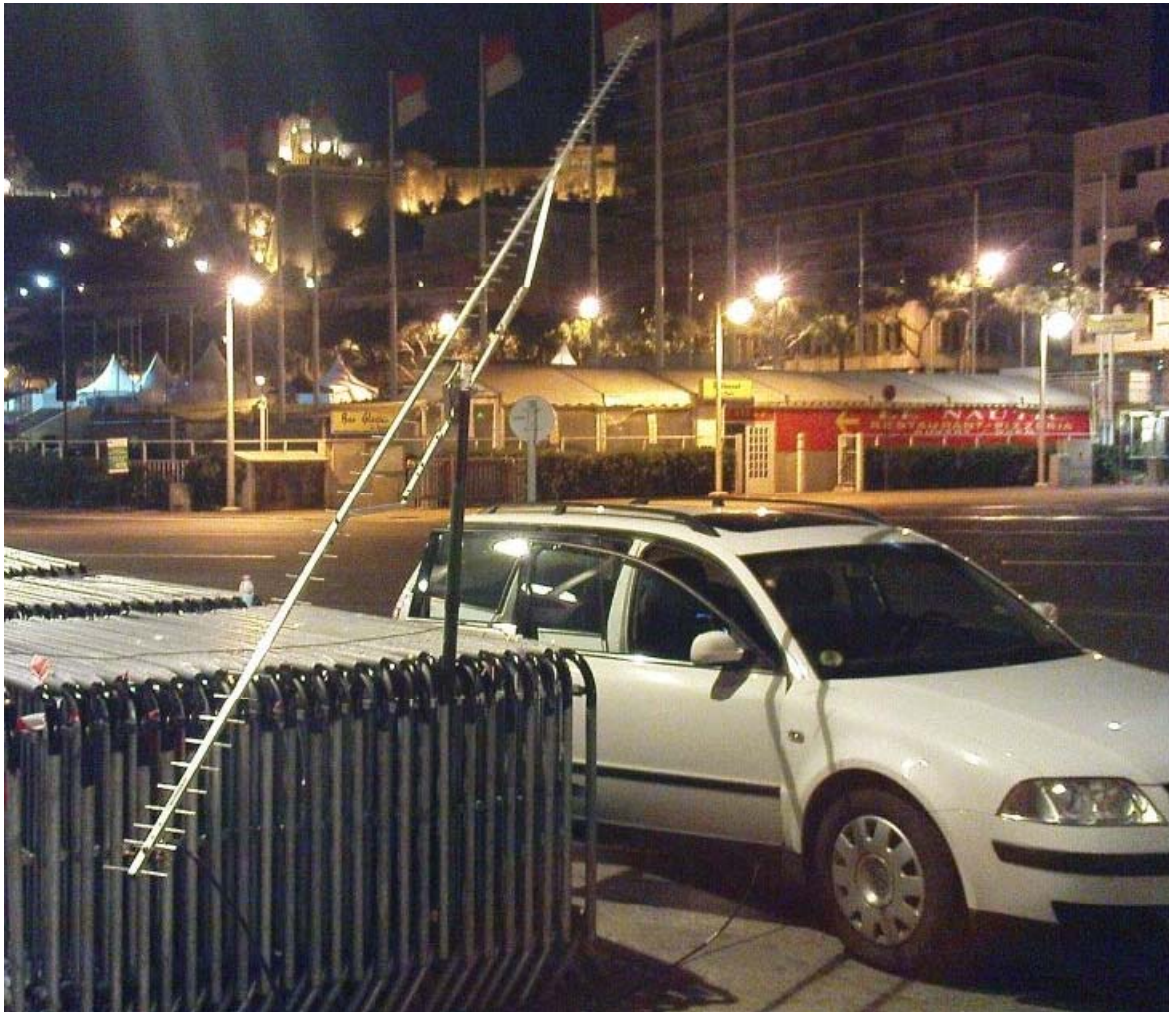
# PORTABLE EME – DL3OCH STYLE



- BODO USES IC-706, TRANSVERTER WITH 80 W AND A 59 EL YAGI (5 M LONG & 18.7 dBd) FROM HIS CAR.
- BESIDES DL, HE HAS OPERATED FROM 3A, HB0, EA8...



# 3A/DL30CH ON 23 CM FROM MONACO ON OF MOST SUCCESSFUL EME DXPEDITION OP USES SINGLE YAGI, NO PREAMP & 80 W!



**T7/HB9EHJ**

**San Marino**

## **5N0EME 70 CM YAGI POINTED TO MOON**



**BODO (DL3OCH) WAS  
ACTIVE FROM NIGERIA  
ON 432**

**RUNNING A 6 M YAGI  
WITH 100 W PA AND NO  
PREAMP INTO IC706**

**HB9Q (21DB/26DB),  
DL7APV (20DB/27DB),  
PA3CSG (24DB/27DB),  
K2UYH + MORE ON  
JT65B AND  
DL9KR ON CW!**



# **OK1TEH RUNS QRP EME ON 70 & 23 CM**



**432: 400 W & 5.7  
M YAGI**

**QSO'd K2UYH,  
G4CCH,  
HB9HAL,  
OE9ERC, HB9Q,  
F2TU & PI9CAM  
on CW.**

**1296: 1 M DISH &  
100 W**

**QSO'd K2UYH +  
OTHERS**



# VP9/K2UYH IN BERMUDA



**IF FLYING NEED  
PORTABLE ANTENNA  
THAT FITS IN A  
SMALL PACKAGE!**

# DIGITAL BASICS

- **CHALLENGE TO DEVISE THE MOST EFFECTIVE SYSTEM.**
- **JT65 BY JOE TAYLOR, K1JT MOST POPULAR**
- **EACH TRANSMISSION IS 60 SECONDS LONG AND CONSISTS OF MESSAGE AND SYNC INFORMATION.**
- **THE SYNC IS INTERSPERSED WITH THE MESSAGE AND SENT ABOUT HALF THE TIME.**
- **USES ERROR CORRECTING CODE – 6 BITS/ SYMBOLE (64 TONE FSK) + SYNC = 65!**

# OK1DFC'S JT65C SIGNAL

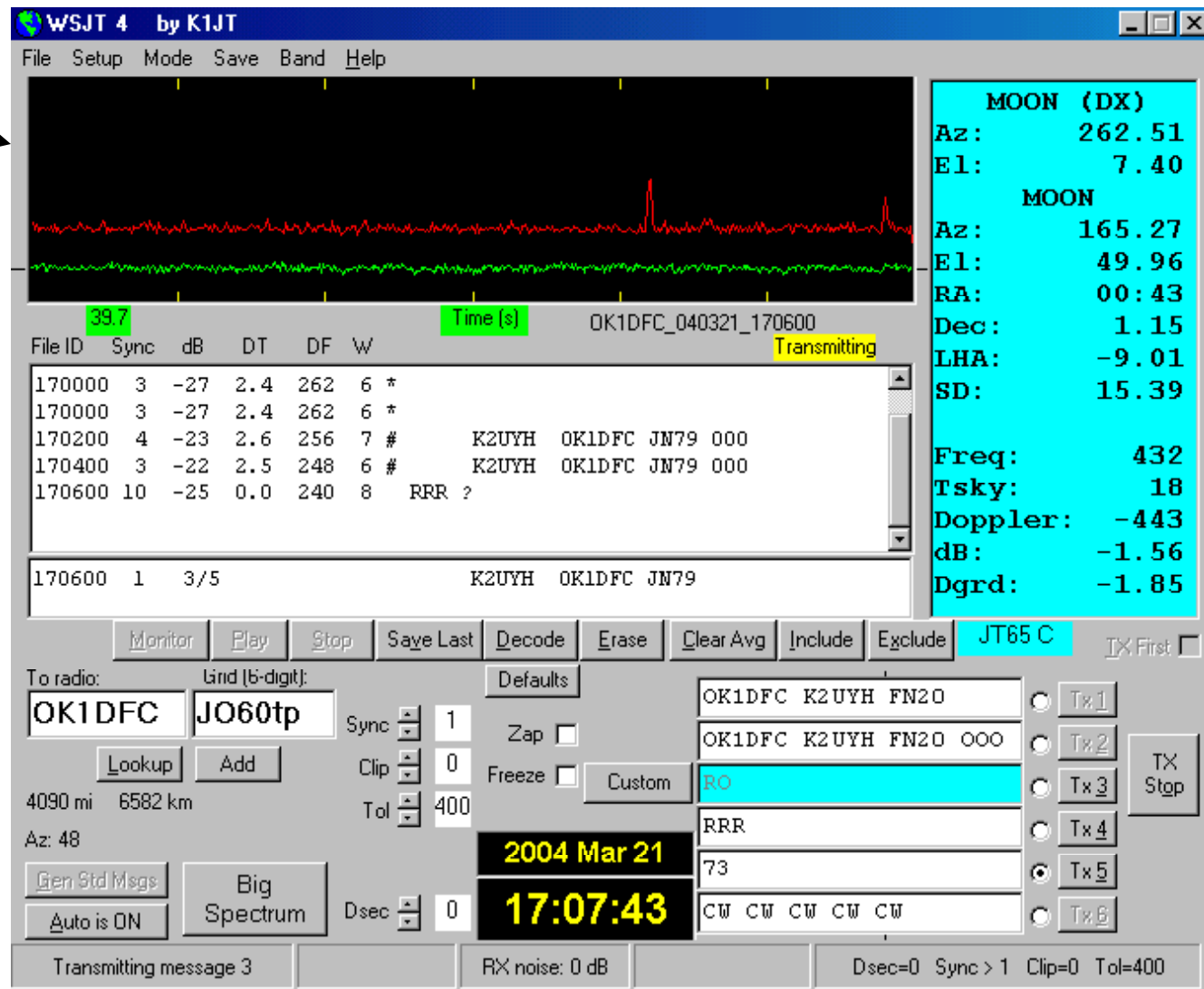
## ZDENEK RUNS A SINGLE YAGI ON HORIZ

TIME SYNC

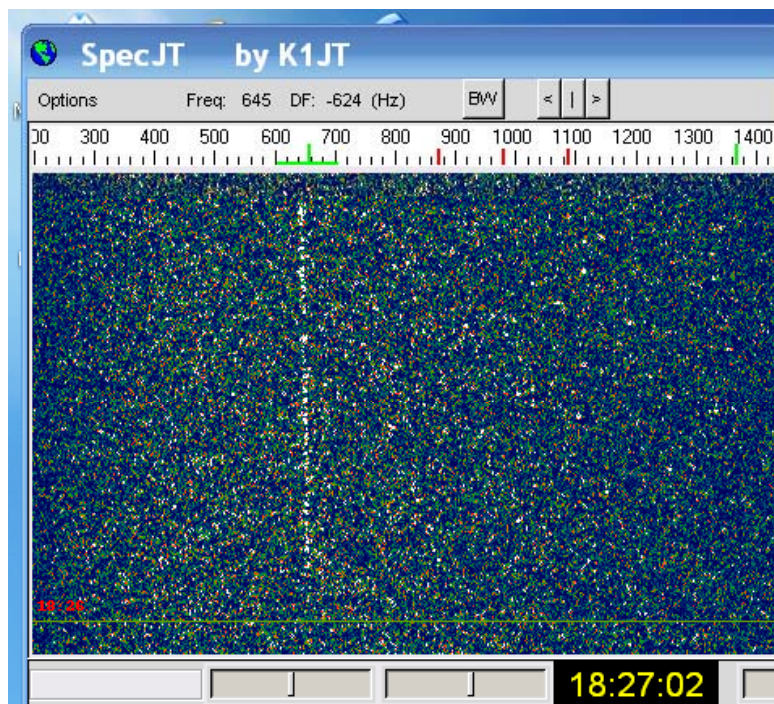
FREQ --

TIME AMP

HE'S  
WORKED  
2 YAGI  
STN







Moon:    Az: 157.44    El: 35.26  
 Moon/DX: 97.35    8.43  
 Sun:    219.15    55.28  
 Source: 351.24    -49.40

Doppler    df/dt  
 DX:    282    -11.80  
 Self:    282    -11.80

RA    DEC  
 Moon: 12:51    -11.67  
 Source: 00:00    0.00

Freq: 1296    Tsky: 3  
 MNR: 0.0    Dgrd: -1.0  
 DPOL: -32    SD: 15.99

### WSJT 6 by K1JT

File    Setup    View    Mode    Decode    Save    Band    Help

26.8    1.0000 1.0000    Time (s)    Mon\_090823\_182600

| FileID | Sync | dB    | DT   | DF   | VV   |                   |   |    |
|--------|------|-------|------|------|------|-------------------|---|----|
| 182100 | 0    | -33   | 6.6  | -116 | 3    |                   |   |    |
| 182200 | 0    | -33   | 6.3  | 116  | 12   |                   |   |    |
| 182300 | 0    | -33   | 2.1  | 175  | 28   |                   |   |    |
| 182400 | 1    | -22   | 2.6  | -579 | 12 * | CQ DP1POL IB59    | 1 | 10 |
| 182500 | 0    | -33   | -1.7 | -560 | 47   |                   |   |    |
| 182600 | 4    | -21   | 2.5  | -619 | 11 * | CQ DP1POL IB59    | 1 | 10 |
| 182600 | 1    | 10/63 |      |      |      | K2UYH DP1POL IB59 | 1 | 10 |
| 182600 | 2    | 2/25  |      |      |      | CQ W7UPF DM42     | 1 | 10 |

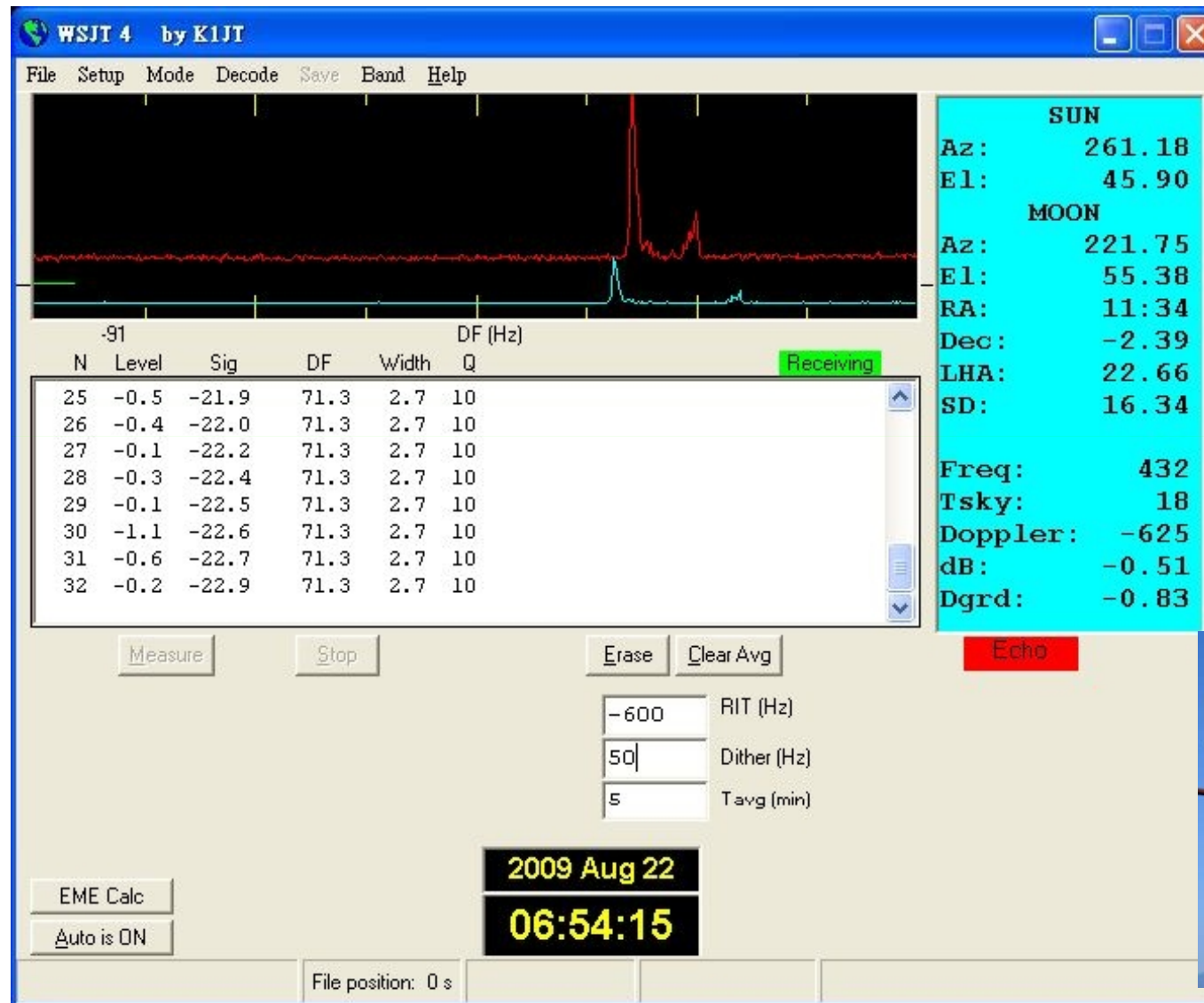
Log QSO    Stop    Monitor    Save    Decode    Erase    Clear Avg    Include    Exclude    TxStop

To radio: WD1V    Lookup    Sync 1    ☐ Zap    ☐ Tx First    WD1V K2UYH FN20    Tx1  
 Grid:    Add    Clip 0    ☐ NB    26 Rpt    WD1V K2UYH FN20 OOO    Tx2  
                          Tol 50    ☒ Freeze    ☐ Sh Msg    RO    Tx3  
                          Defaults    ☒ AFC    TxDF = 0    RRR    Tx4  
                          Dsec 0.0    Shift 0.0    GenStdMsgs    73    Tx5  
                                   Auto is OFF    CQ K2UYH FN20    Tx6

1.0000 1.0068    JT65C    Freeze DF: -614    Rx noise: 0 dB    TR Period: 60 s    Receiving



# ECHO MODE – WANT TO TRY EVEN IF DON'T USE EME



**BX1AD  
2 YAGIS  
100 W  
70 CM  
EME**



- LET'S YOU EVALUATE EME SYSTEM CAPABILITY.
- NOT GOOD FOR COMMUNICATIONS.

# OTHER REQUIREMENTS

- MUST KNOW TIME TO ~ 1 SECOND. S  
\*\*\* SOFTWARE IS AVAILABLE TO  
AUTOMATICALLY TO UPDATE YOUR  
CLOCK VIA THE INTERNET  
<<http://www.thinkman.com/dimension4/>>.
- MUST BE ABLE  
TO TRACK THE MOON  
\* HAS BUILT IN TRACKING.

|          |         |            |
|----------|---------|------------|
|          | AZ      | EL         |
| Moon:    | 157.44  | 35.26      |
| Moon/DX: | 97.35   | 8.43       |
| Sun:     | 219.15  | 55.28      |
| Source:  | 351.24  | -49.40     |
|          | Doppler | df/dt      |
| DX:      | 282     | -11.80     |
| Self:    | 282     | -11.80     |
|          | RA      | DEC        |
| Moon:    | 12:51   | -11.67     |
| Source:  | 00:00   | 0.00       |
| Freq:    | 1296    | Tsky: 3    |
| MNR:     | 0.0     | Dgrd: -1.0 |
| DPol:    | -32     | SD: 15.99  |

# FASCINATING PROPAGATION

- DISTANCE TO MOON VARIES (2 dB)
- SKY NOISE CHANGES WITH MOON LOCATION
- DOPPLER SHIFT MOVES FREQUENCY
- FARADAY ROTATES POLARIZATION
- MOON LIBRATION EFFECTS SIGNAL QUALITY

# CONCLUSION

- EME IS CHALLENGING.
- BUT ALL YOU NEED IS A YAGI, ~50 W, A COMPUTER AND JT65!
- IT IS PRETTY EASY WITH A BIG STATION, BUT THERE IS STILL A LOT TO IT: ACCURATE FREQ AND TIME, MOON TRACKING, DOPPLAR, POLARIZATION (ON 432).
- WITH A WEAK STATION, ALL THE ABOVE PLUS MUST UNDERSTANDING HOW TO USE JT65
- ACTIVITY ~ .070
- NL <<http://www.nitehawk.com/rasmit/em70cm.html>>



# **OFFSET DISHES SOME IDEAS FOR SMALL & LARGER DISHES**

## **OFFSET DISH ADVANTAGE:**

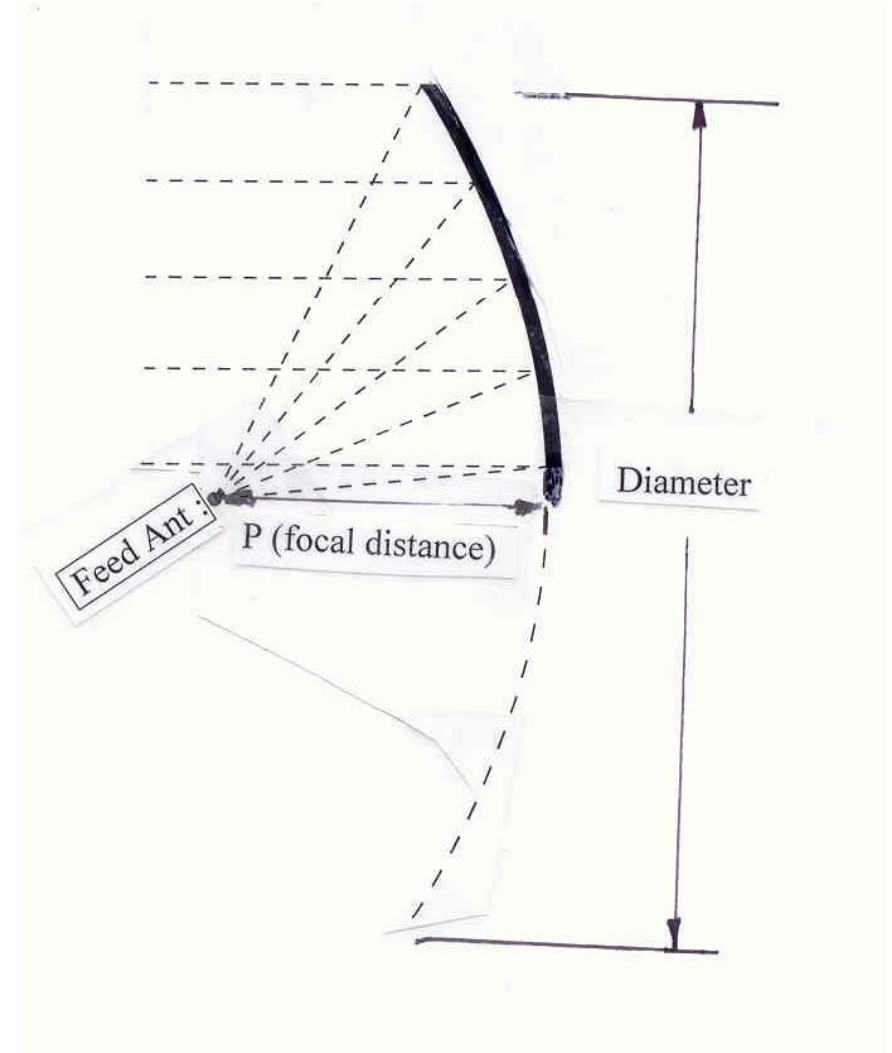
**SMALL DISH'S EFFICIENCY REDUCED  
BY APERTURE BLOCKAGE**

- **AN OFFSET DISH SOLVES THIS  
PROBLEM**

**BUT ALSO USEFUL FOR LARGER DISHES**

# OFFSET DISH USES PART OF SURFACE

- **USES  $\sim \frac{1}{4}$  DISH SURFACE**
- **FEED POINT DOES NOT CHANGE**
- **MOVES FEED HORN OUT OF MAIN BEAM**
- **FEED POINTS TO SURFACE**
- **NEEDS DEEPER DISH *EQUIVALENT* F/D OR HIGHER GAIN FEED**



- **Surface Reflector**

- **$f/d$        $f/d$**

- **0.90      0.46**

- **0.85      0.44**

- **0.80      0.43**

- **0.75      0.41**

- **0.70      0.40**

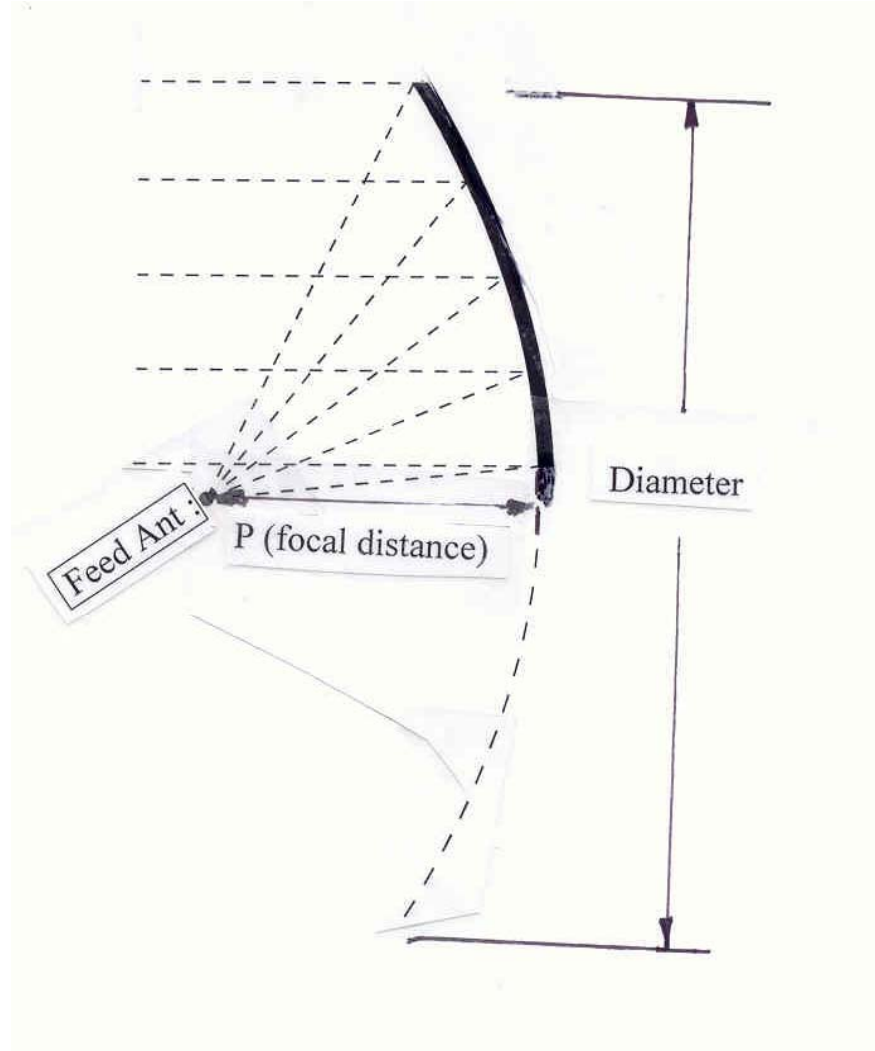
- **0.60      0.36**

- **0.55      0.34**

- **0.50      0.32**

- **0.45      0.30**

- **0.40      0.28**



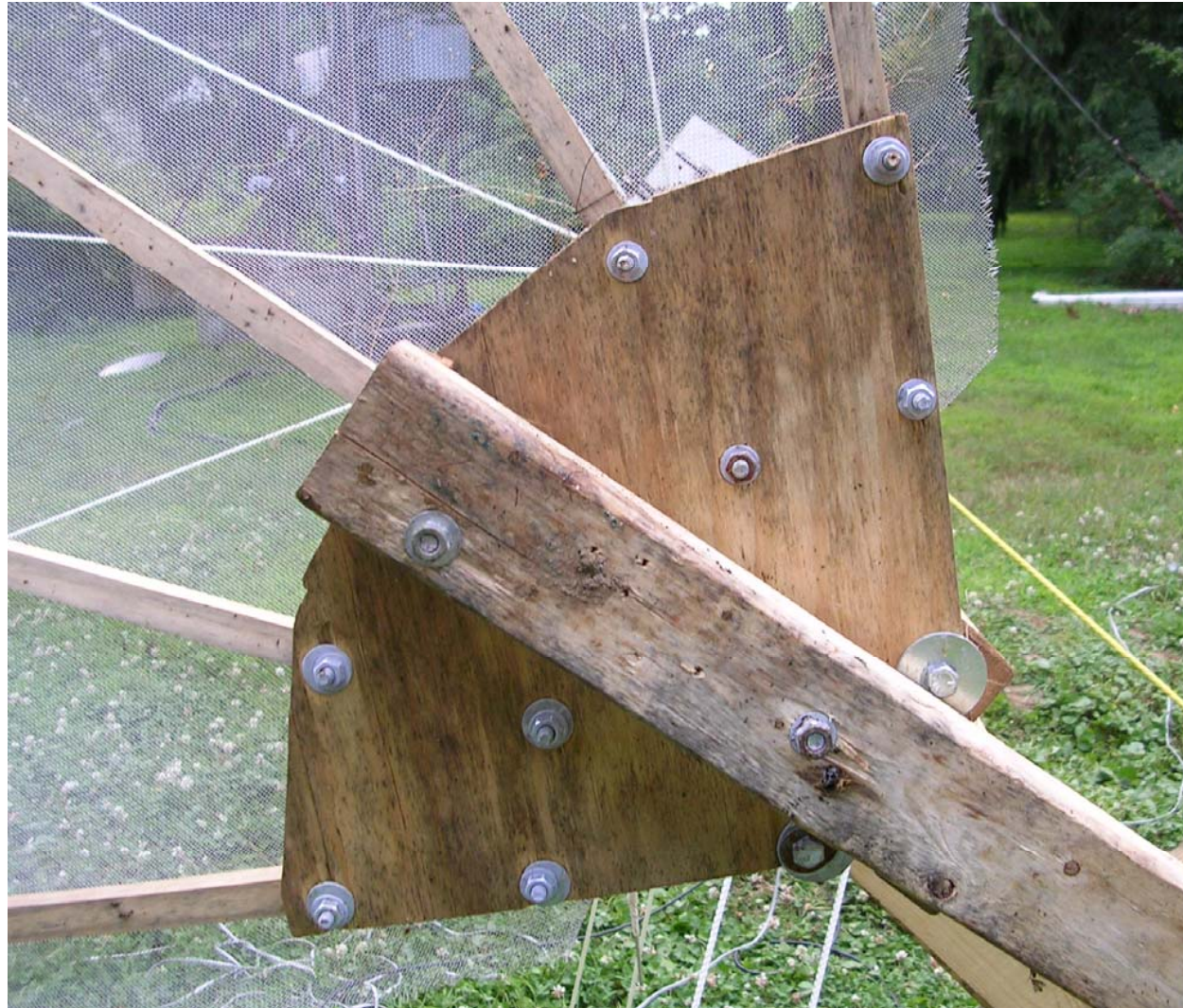
# OFFSET DISH CONSTRUCTION



- **7.5' OFFSET DISH**
- **5 LENGTHS OF  
7' x 1/2" x 3/4" WOOD  
MOLDING STOCK**
- **f/d ~ 0.3**
- **FEED HORN BW  
~ 90°**
- **POLAR MOUNT**



# SPOKES ATTACHED TO QUARTER ROUND PLYWOOD CENTER





# **OUTSIDE RIM FORMED FROM 3.5' LENGTH MODELING STRIPS**





# **COVERED BY ALUMINUM SCREENING TIED TO THE SPOKES USING WIRE**



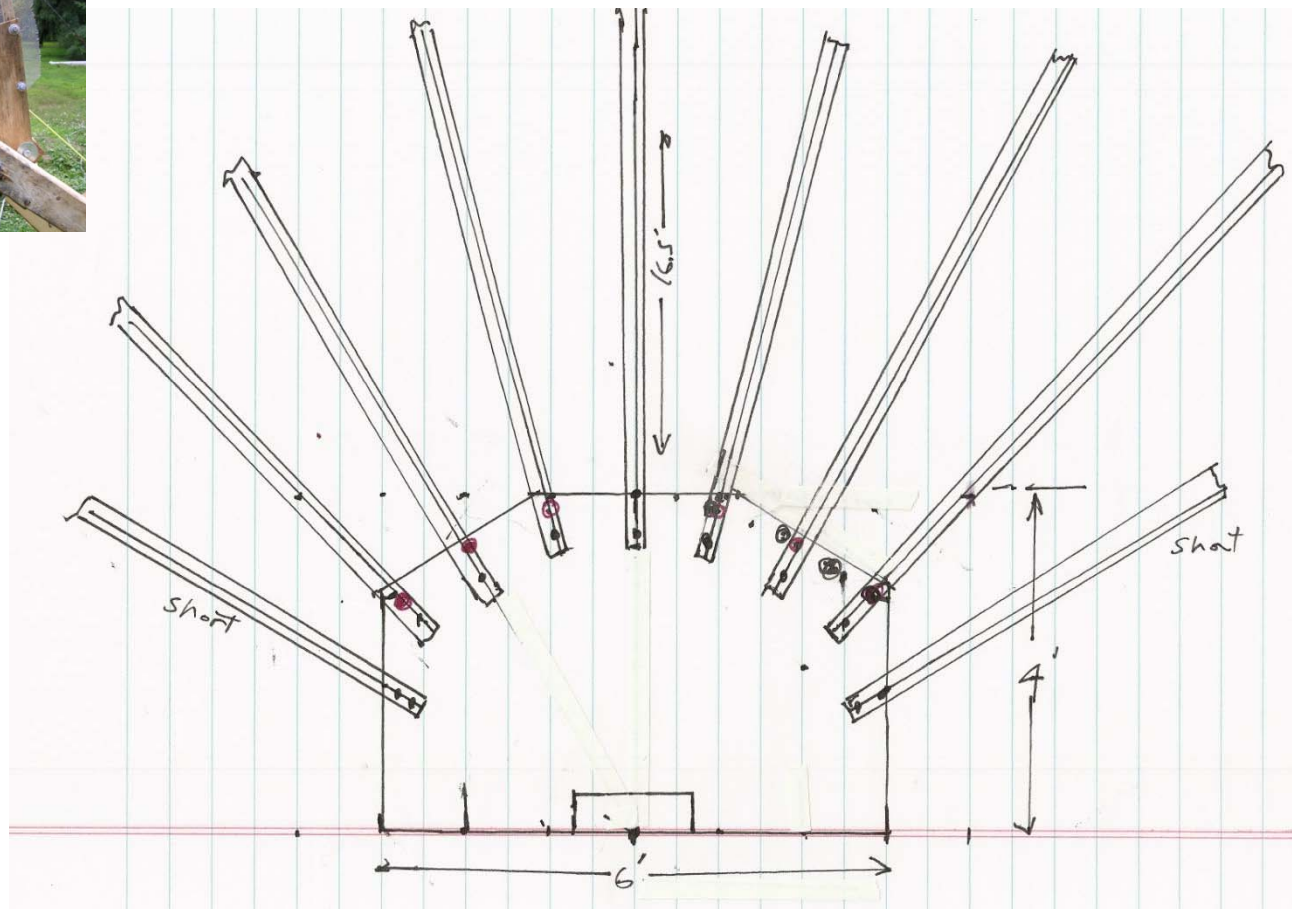
# BREAKS INTO A FEW SMALL & LIGHT WEIGHT PIECES





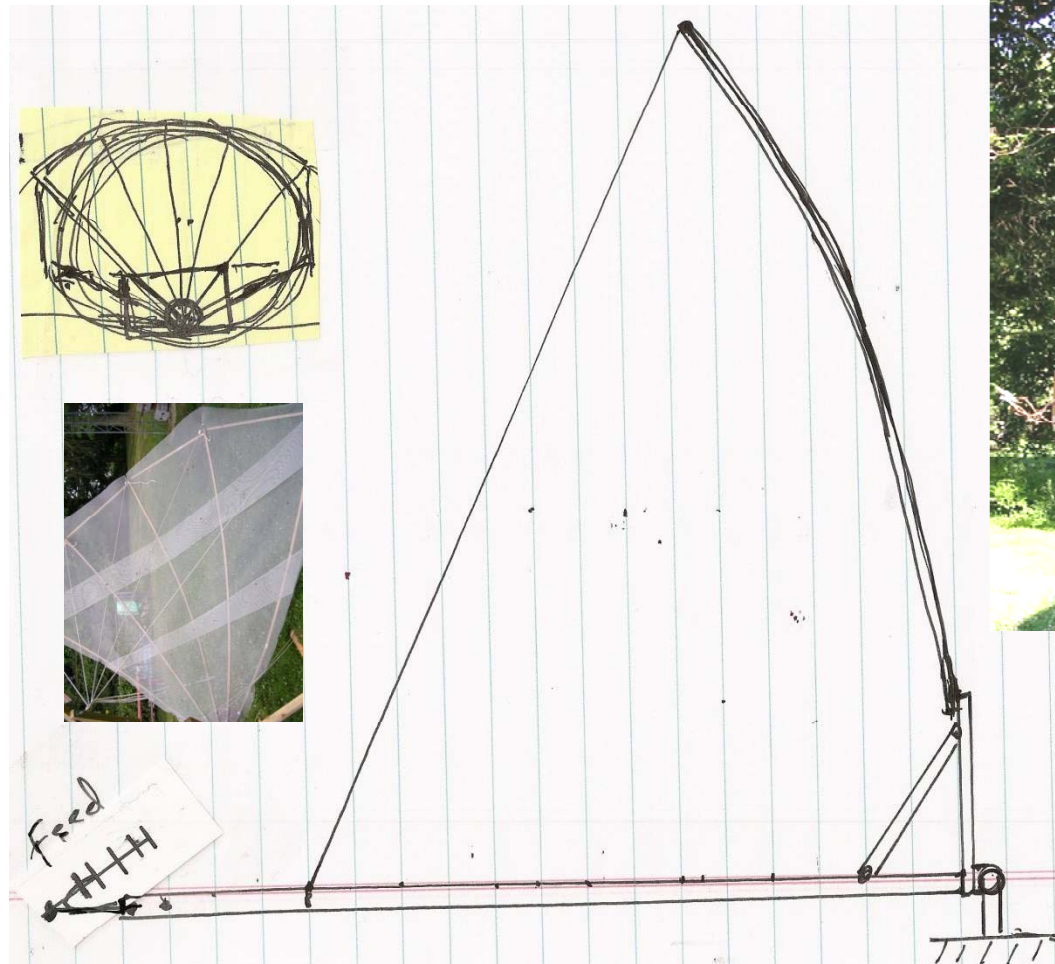
# BIG OFF-SET STRESS DISH (20')

## CENTER 6'x4', SPOKES (7 OR 9) 16.5'x1"x2"



# SIDE VIEW – OFFSET STRESS DISH

$f/d \sim 0.9$  – CAN USE YAGI TO FEED



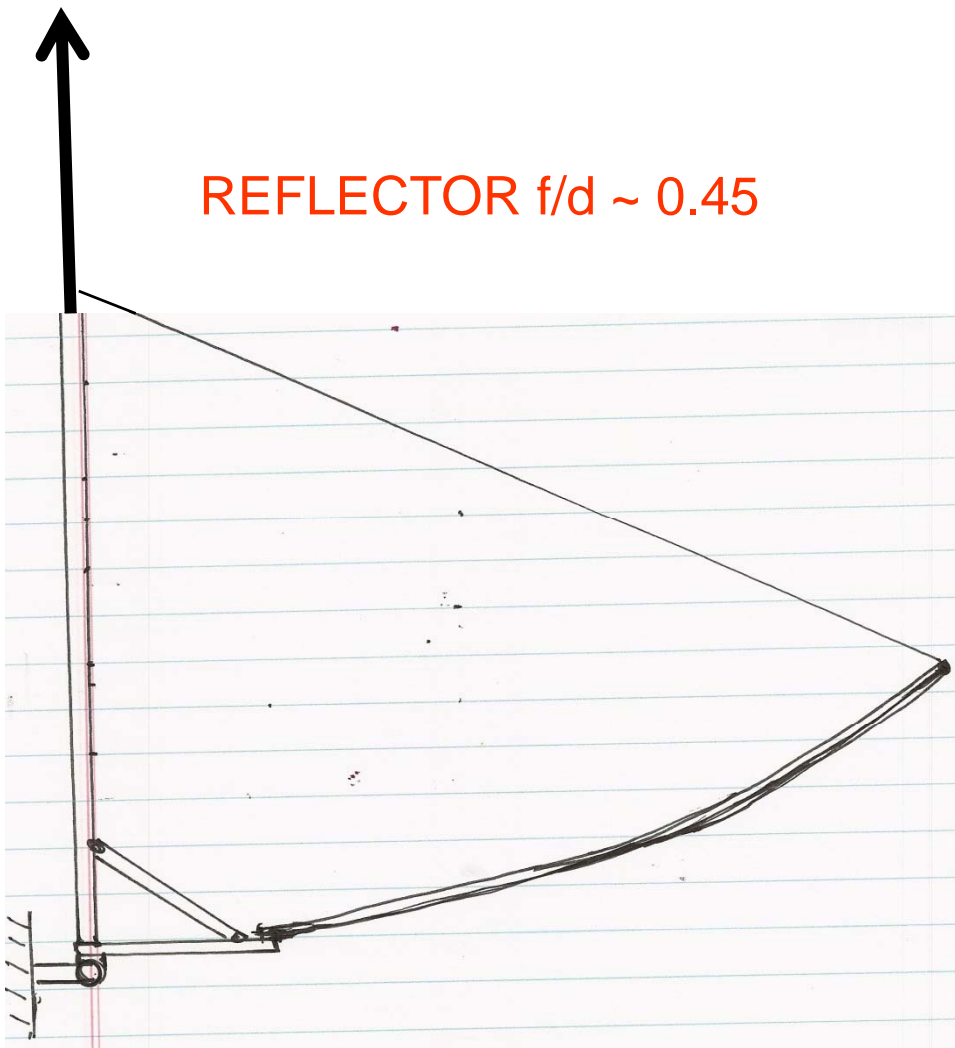
FEED POINT ~ 18' (2"x4")



CROSS BRACE ~5.5"

# SIDE VIEW – OFFSET STRESS DISH

WHEN NOT IN USE ROTATE SO FLAT ON GROUND



REFLECTOR  $f/d \sim 0.45$

## PARTS:

1 – 4'x6' (3/4" PLYWOOD) CENTER PLATE

7 (OR 9) - 16.5"x1"x2" REDWOOD SPOKES

6 (OR 8) – 5.5' x 3/4"x1/2" CROSS BRASES

1 – 18'x2"x4" FEED SUPPORT

~ 400 SQ FEET MESH OR WIRE COVERING

FEED MOUNTING HARDWARE

MOUNT HARDWARE



# CONCLUSION

## SMALL/LARGE STRESS DISHES:

- **INEXPENSIVE AND SIMPLE WAY OF OBTAINING ANTENNA FOR 70 OR 23 CM**
- **OFFSET MORE EFFICIENT  $> 8$  dB OF SUN NOISE**
- **VERY SIMPLE MOUNT**
- **CAN MOUNT VERY CLOSE TO THE GROUND**
- **STORE WITH DISH FLAT ON GROUND**