

AMSAT®



KEEPING AMATEUR RADIO IN SPACE

L BAND HELIX ANTENNA ARRAY

VE3NPC

A CONSTRUCTION PAPER

A BIT ABOUT VE3NPC

- Not an engineer – a technologist
- Not a craftsman
- But fairly successful at constructing things that work

HELIX ANTENNAS

- Ideal antenna for home construction
- Broad band - non critical dimensionally
- I favor a minimum of boom material

- Has high side lobes
- Deep notch between main and first side lobe

23cm AO-40 SSB ERP

- Nominal 1500 watts ERP
- Low gain antennas & high power
- High gain antenna & low power
- Array of 4 X 27 turn helix ants with 10 watts of drive and line loss of 1.25db provides very good operating on L1 uplink

HELIX ANTENNA MATCH

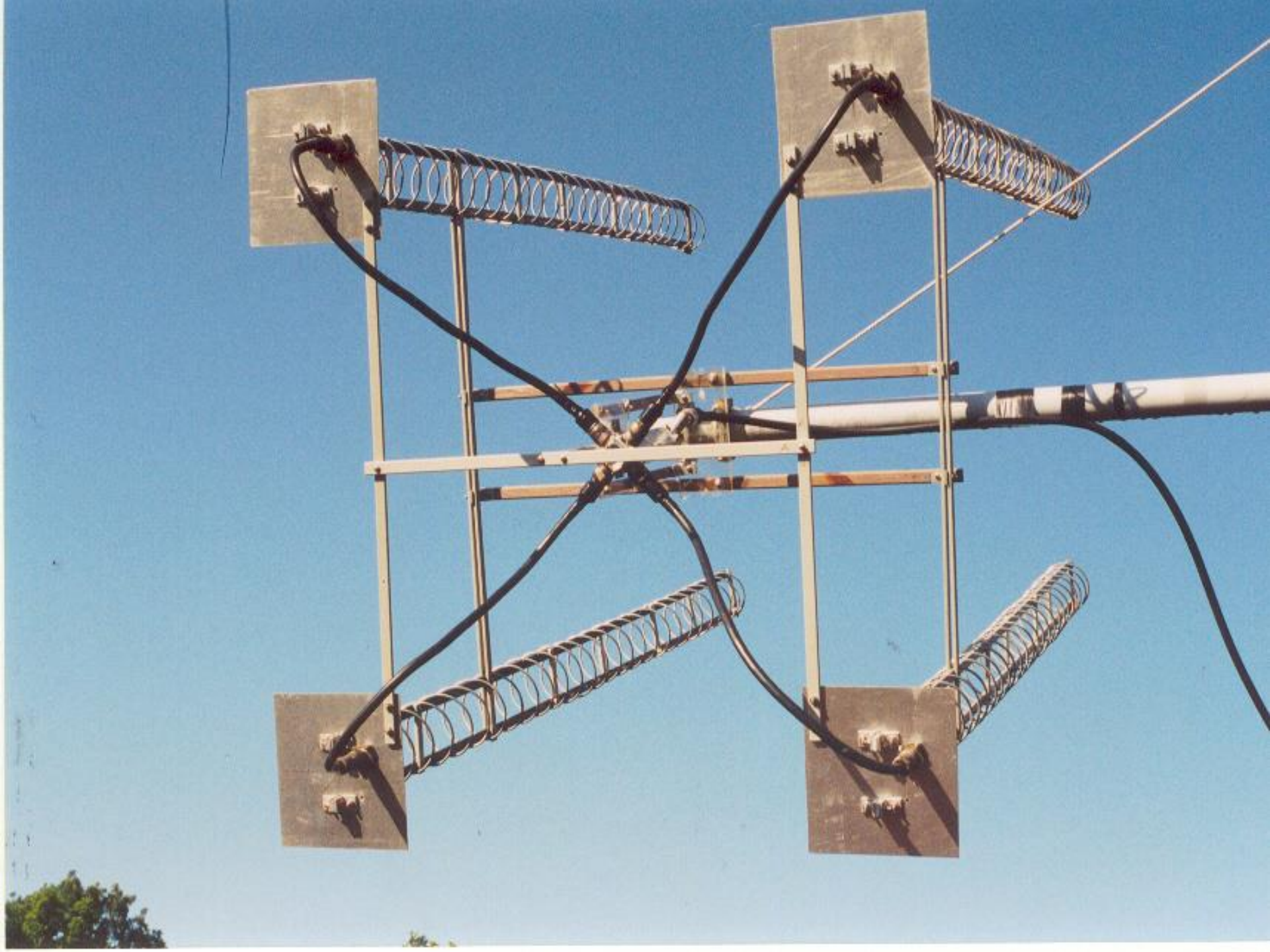
- Helix impedance = 140 ohms
- Conventional match – fin on conductor
- Use 84 ohm $\frac{1}{4}$ wave matching section to transform to 50 ohms
- Circular conductor above a ground plane
 $Z = 138 \log 4h/d$
- Place a ground plane under the 1st quarter turn

HELIX DIMENSION FORMULA

- I favor dimensions calculated using formula by Kraus in The Satellite Experimenters Handbook
- Circumference = 1 wavelength
- Pitch angle = 12.5 degrees

CONSTRUCTION MATERIALS

- Conductor – aluminum ground rod wire
- Boom and cross braces – fiberglass tension bars (chain link fence)
- Reflector – aluminum sheet
- Brackets – aluminum angle stock
- Machine screws and nuts – stainless steel
- Connectors – type N
- Match ground plane – hobby brass





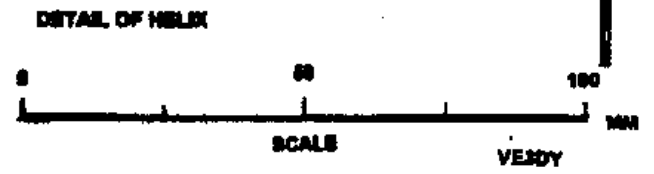
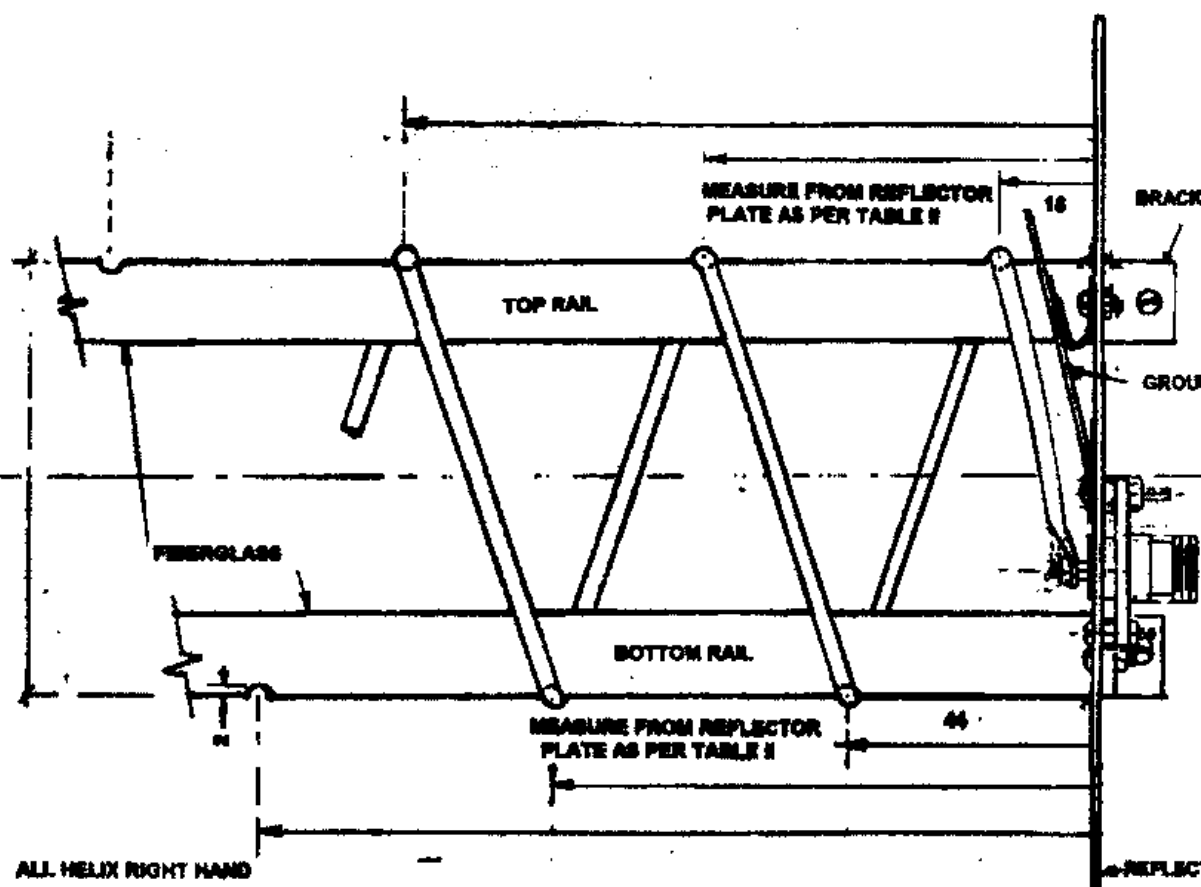
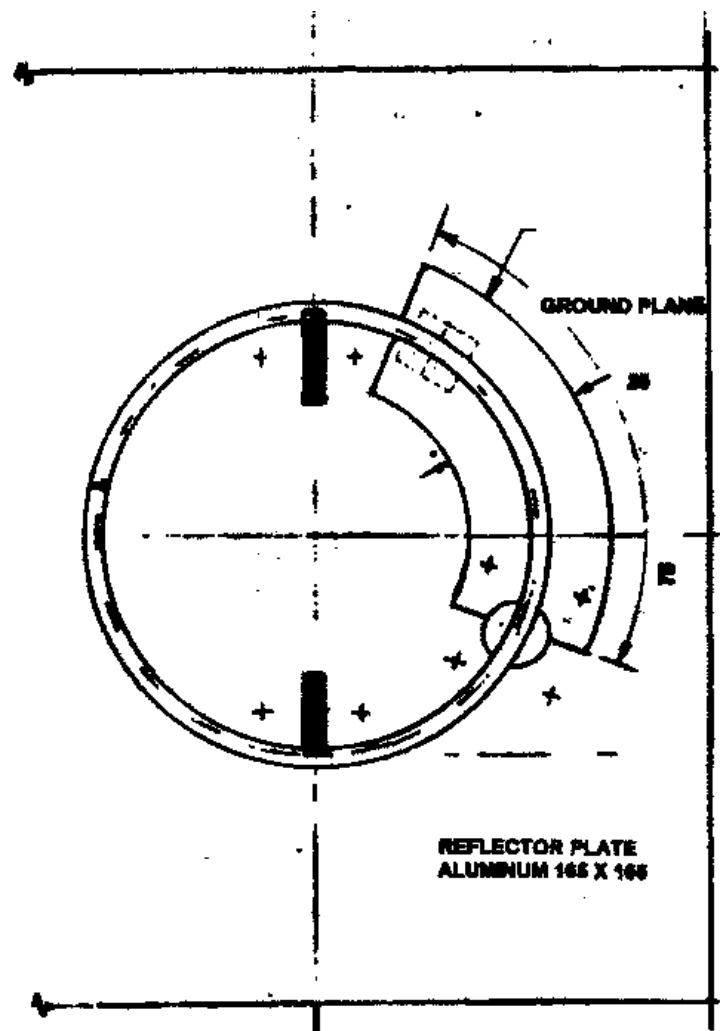
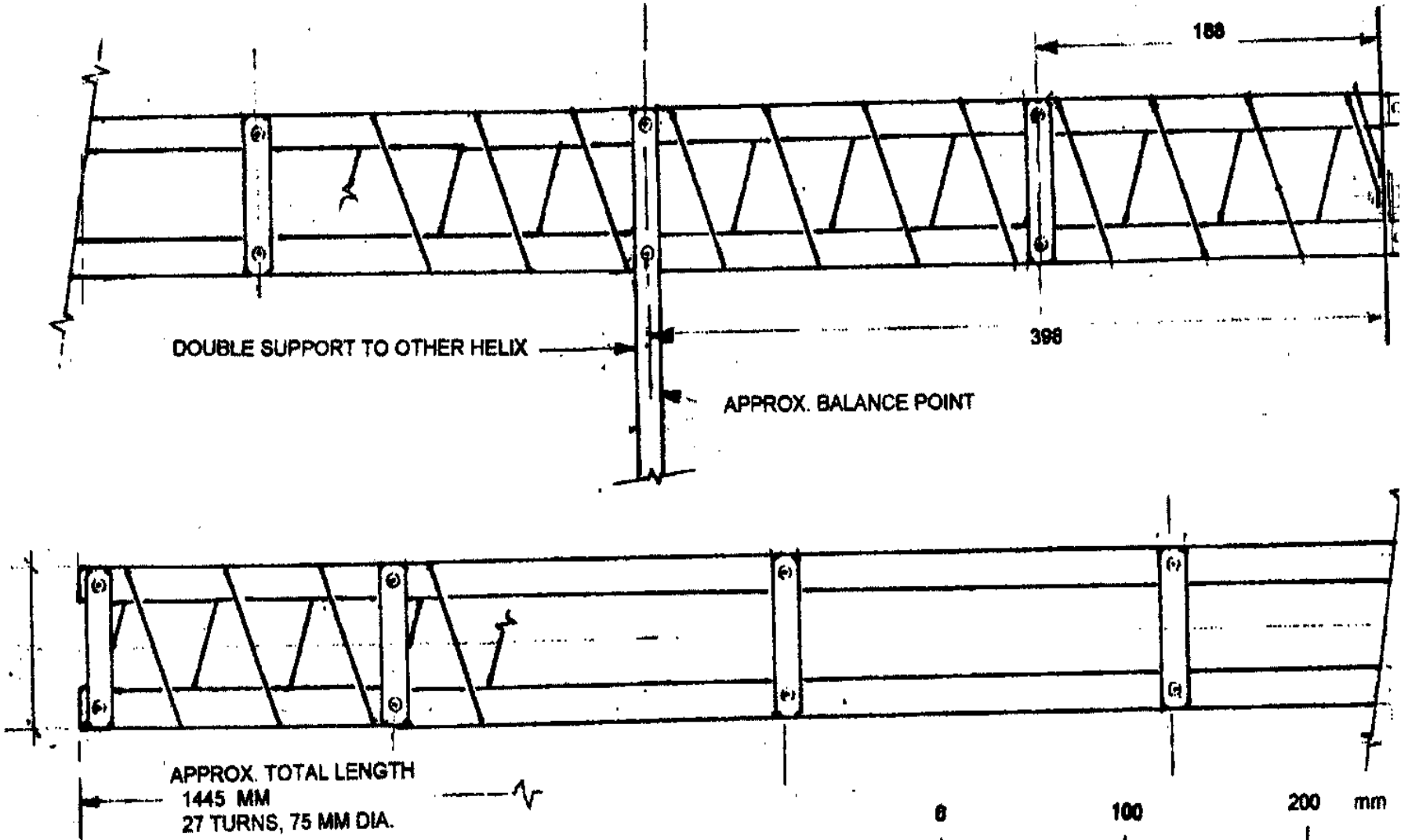


Fig. 1

SPACERS MEASURED FROM REFLECTOR PLATE
SEE TABLE I

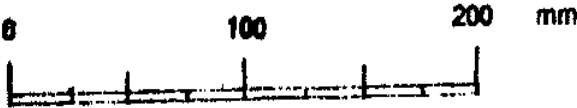


DOUBLE SUPPORT TO OTHER HELIX

APPROX. BALANCE POINT

APPROX. TOTAL LENGTH
1445 MM
27 TURNS, 75 MM DIA.

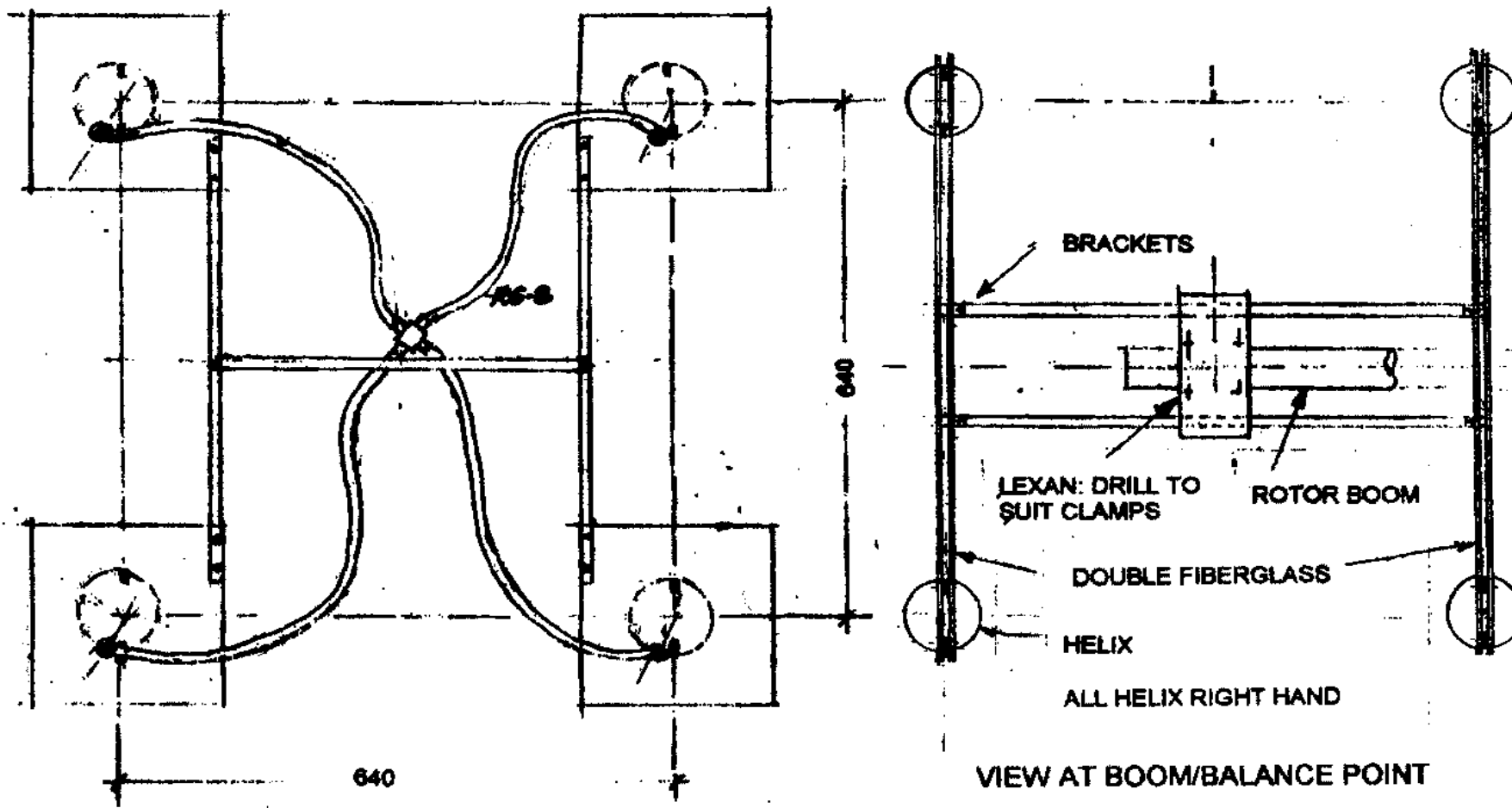
PLAN FOR ONE HELIX



SCALE MM

VE3DY

Fig. 2



COAX CABLES: BOTTOM VIEW OF ARRAY

DIM. IN MM



SCALE

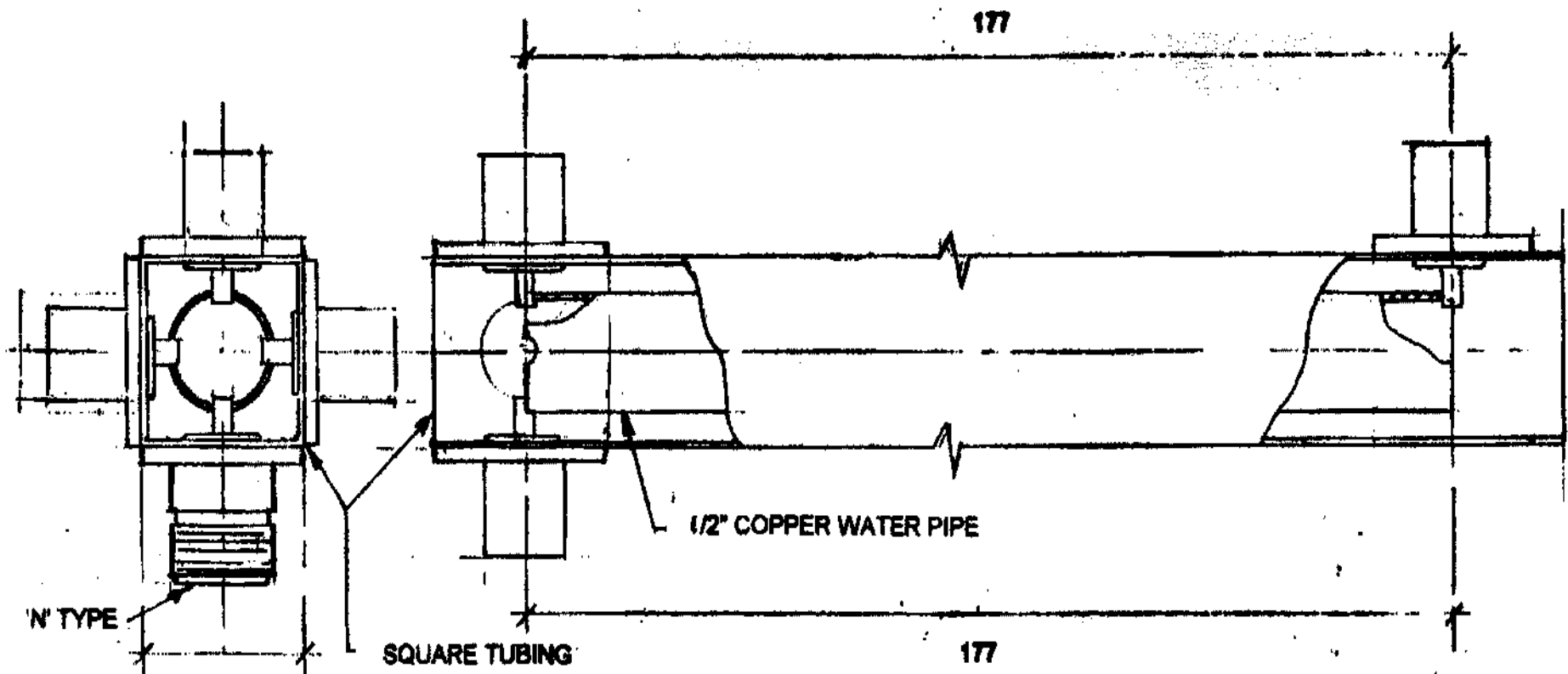
VE3DY

7/03

Fig. 4

4 WAY POWER DIVIDER

- Very easy to make
- 1 inch square aluminum tubing
- $\frac{1}{2}$ inch copper water pipe
- type N female chassis connectors
- Inside conductor length = odd multiple of a $\frac{1}{4}$ wavelength



'N' TYPE

SQUARE TUBING

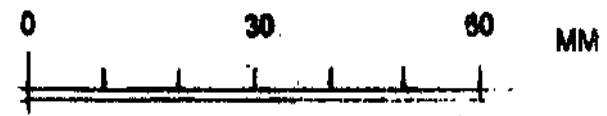
1/2" COPPER WATER PIPE

177

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ALL CONNECTORS ARE 'N' TYPE

POWER DIVIDER

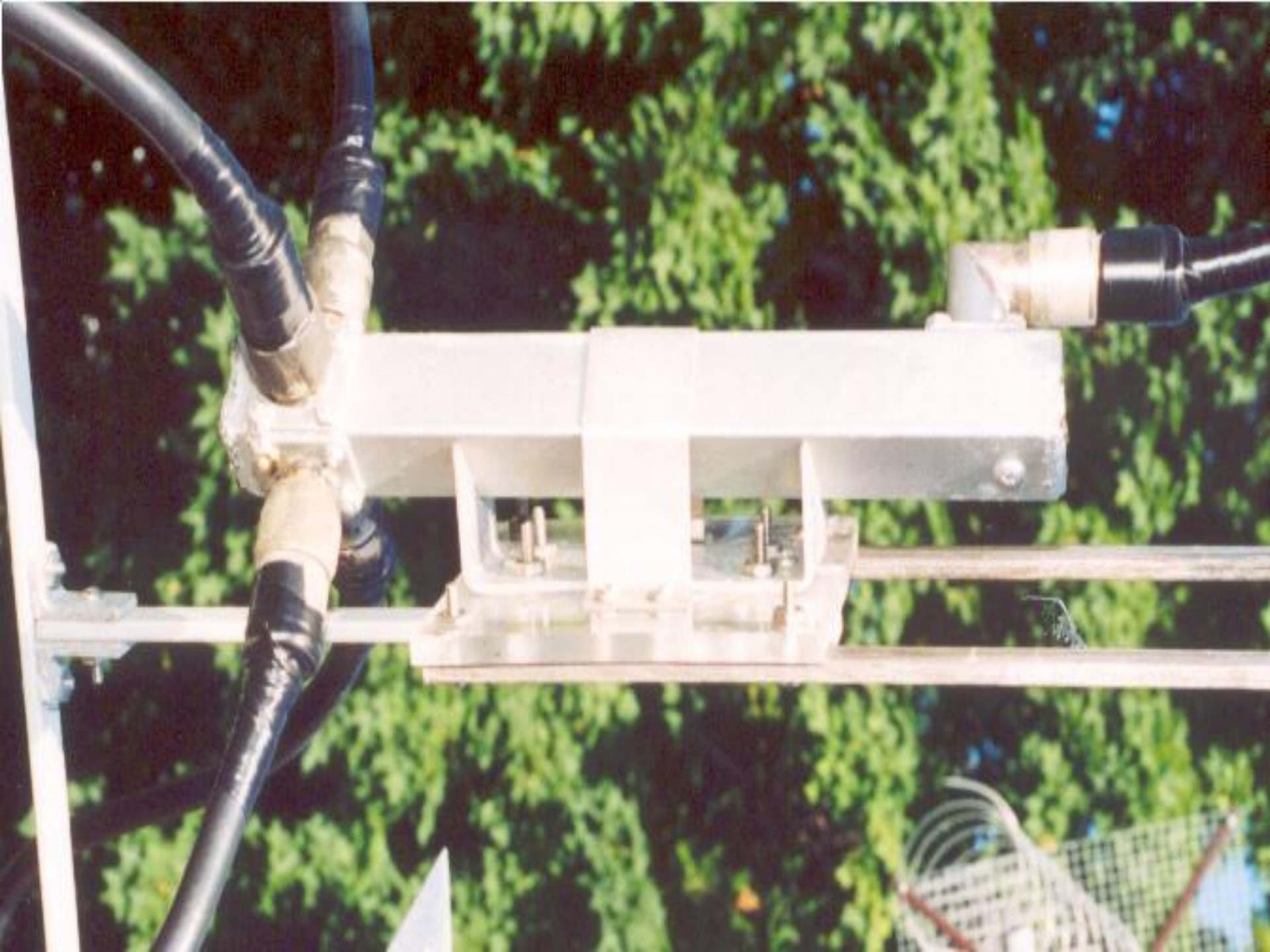


DIM. IN MM

SCALE

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Fig.3

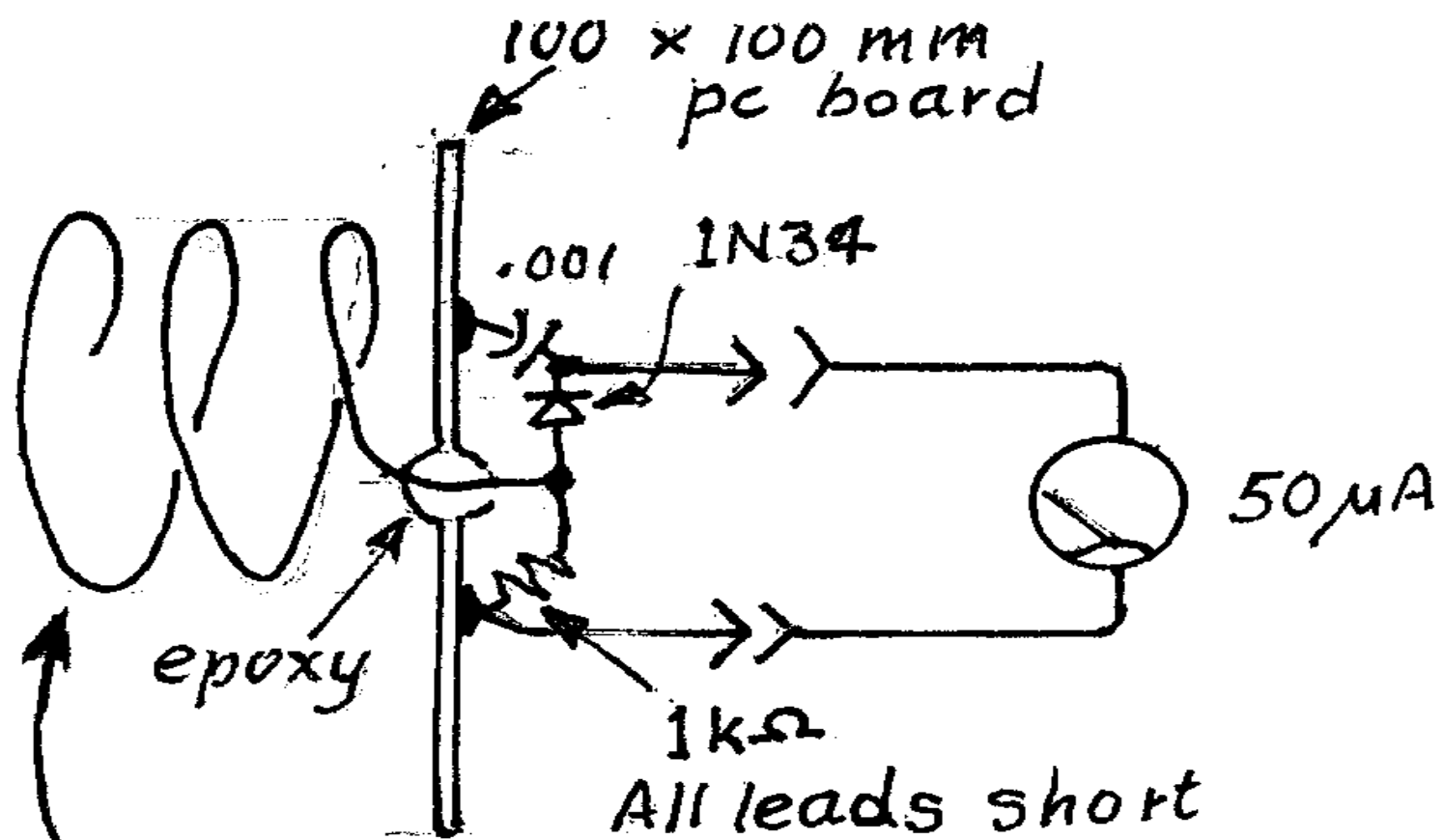


JOINING CABLES

- Equal length
- Multiple of electrical $\frac{1}{2}$ wavelength from feed point of helix to center conductor of power divider
- Minimizes effect of any impedance mismatch

SWR ADJUSTMENT

- Adjust match on each ant for min swr with swr meter connected directly to an antenna
- If no swr meter use a field strength meter



pickup 2-3 t. #14 wire

75 mm dia, 50 mm spacing

FIELD STRENGTH METER

Fig. 5

TABLE I

Cross Brace Spacing From Reflector

Both Rails

1	18.8 cm
2	39.8
3	60.7
4	81.7
5	102.7
6	123.6
7	144.6

TABLE II**Notch spacing from reflector.**

	Bottom Rail	Top Rail
1	4.4 cm	1.8 cm
2	9.7	7.0
3	14.9	12.3
4	20.1	17.5
5	25.4	22.8
6	30.6	28.0
7	35.9	33.2
8	41.1	38.5
9	46.3	43.7
10	51.6	49.0
11	56.8	54.2
12	62.1	59.4
13	67.3	64.7
14	72.5	69.9
15	77.8	75.2
16	83.0	80.4
17	88.3	85.6
18	93.5	90.9
19	98.7	96.1
20	104.0	101.4
21	109.2	107.0
22	114.5	111.8
23	119.7	117.1
24	124.9	122.3
25	130.2	127.6
26	135.4	132.8
27	140.7	143.3

SPECIFICATIONS

Frequency = 1269 MHz

Theoretical array gain = 25 dB

Circumference = 1 wavelength

Probable gain = 23 dB

Number of turns = 27

Theoretical beam width = 11deg

Pitch angle = 12.5 degrees

Ant Gain = 19 dB

Spacing between turns = 52.4 mm

Helix diameter = 75 mm

Beam width = 21 degrees

Reflector side = 200 mm

FIBERGLASS TENSION BAR SOURCES

- The Home Depot
- Love's
- ACE Hardware
- True Value

- Supplier – Master-Halco Inc.

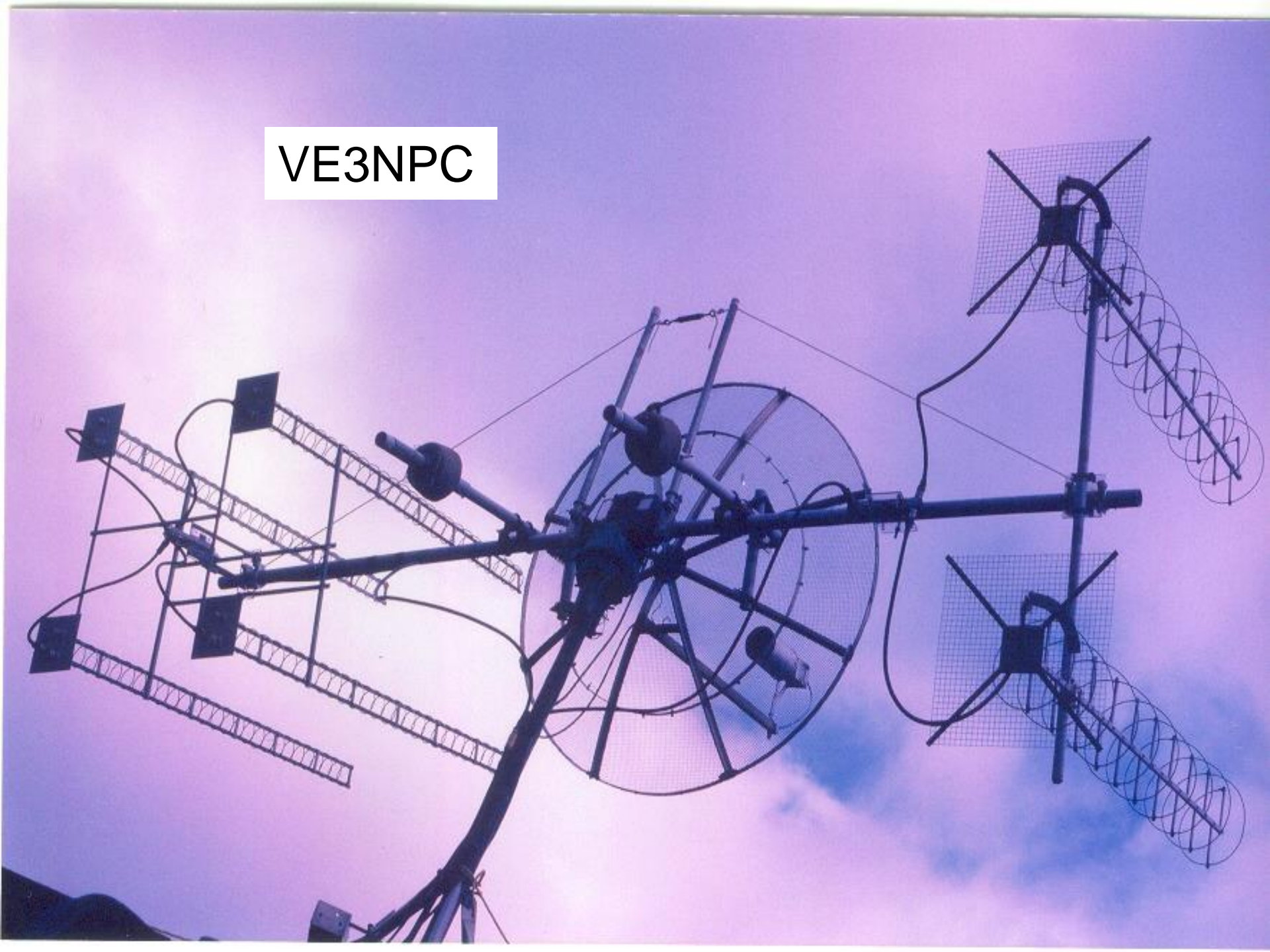
IN THE REAL WORLD

- In use at VE3NPC for about 3 years
- Make nearly all of contacts on L uplink
- In YB0KTQ QSO party used only mode L and made the most contacts of all entrants
- In last FD made 89 SSB and 13 CW using my Yaesu FT-736 with 10 watts and this antenna array

VARIATIONS

- Two helix antennas – 20 watts
- Two way power divider – center conductor 98 mm (13/32”) brass tube
- One helix antenna – 40 watts
- For every 3 db increase in feed line loss—need to double the power

VE3NPC





FD 2003