160m
Quick Study

Receiving Antenna Size
vs
Performance
v02

Jukka OH6LI

Design Target:
to receive better than a full size GP

- 160m Full Size GP as reference

- Task:
  Quick study to tell how a simple and affordable receiving antenna gives performance over the Full Size GP

Design Target:
to receive better than a full size GP

How to measure the performance

Design Target:
to receive better than a full size GP

- New receiving Antenna Performance Measure: Minimum Discernible Signal

Design Target:
to receive better than a full size GP

- New receiving Antenna Performance Measure: Minimum Discernible Signal

  - Excel tool: Dan AC6LA

  - Algorithm: Jukka OH6LI

  - Ideas, clarifications: Markku OH2RA

Design Target:
to receive better than a full size GP

- New receiving Antenna Performance Measure: Minimum Discernible Signal

- Noise Margin as secondary measurable

Design Target:
to receive better than a full size GP

- New receiving Antenna Performance Measure:
  Minimum Discernible Signal

- Calculation based on:
  Antenna peak gain
  Antenna average gain
  QTH noise level   - source ITU P.372-13, Figure 10
  Feed system losses
  RX noise figure

Reference: GP on 160m

- Feed at ground level, apex 39.75m

- Wire diameter 20mm copper

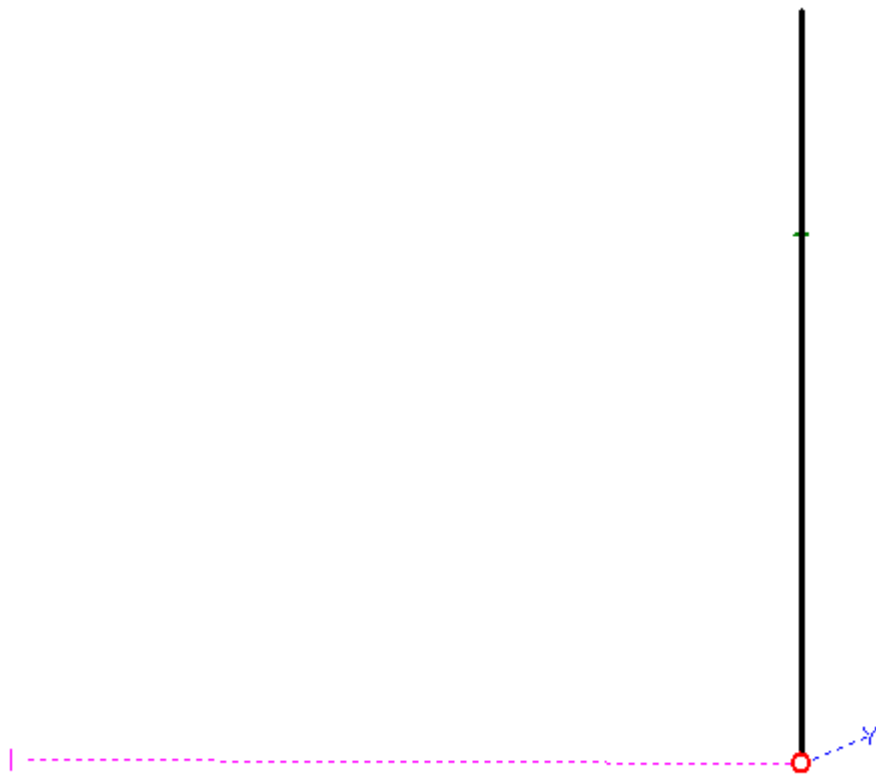- Real ground

Reference: GP on 160m
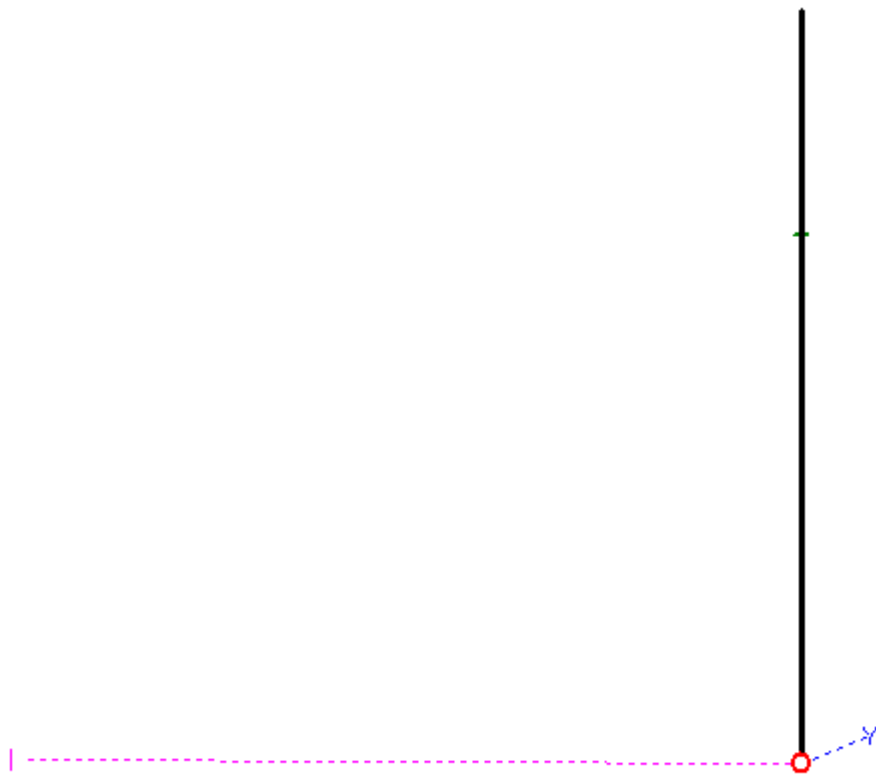
Wire No.1
X1 : 0.0 m
Y1 : 0.0 m
Z1 : 0.0 m
X2 : 0.0 m
Y2 : 0.0 m
Z2 : 39.75 m
R   : 10.0 mm
Length : 39.75 m
Azim. : 0.0 deg
Zenith : 90.0 deg

Reference: GP on 160m
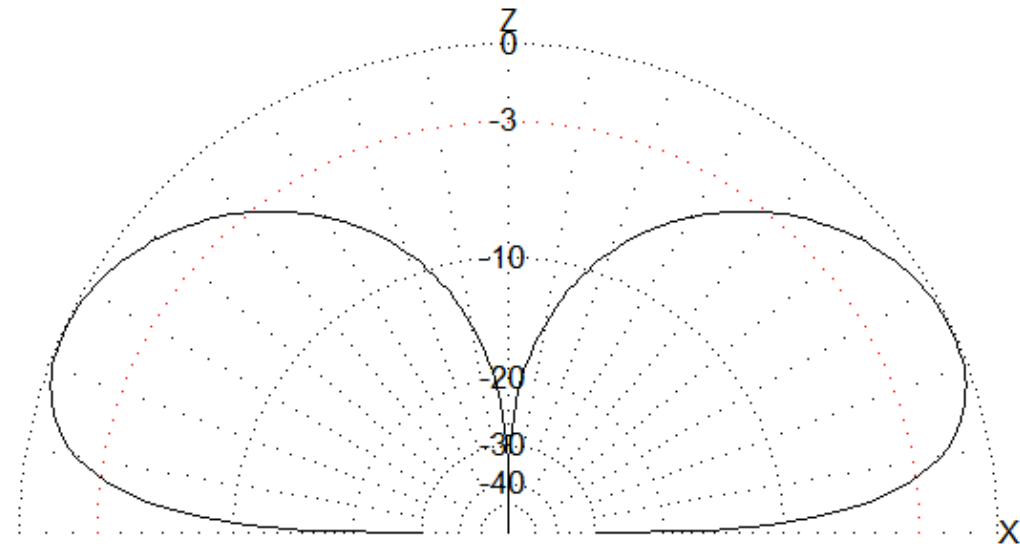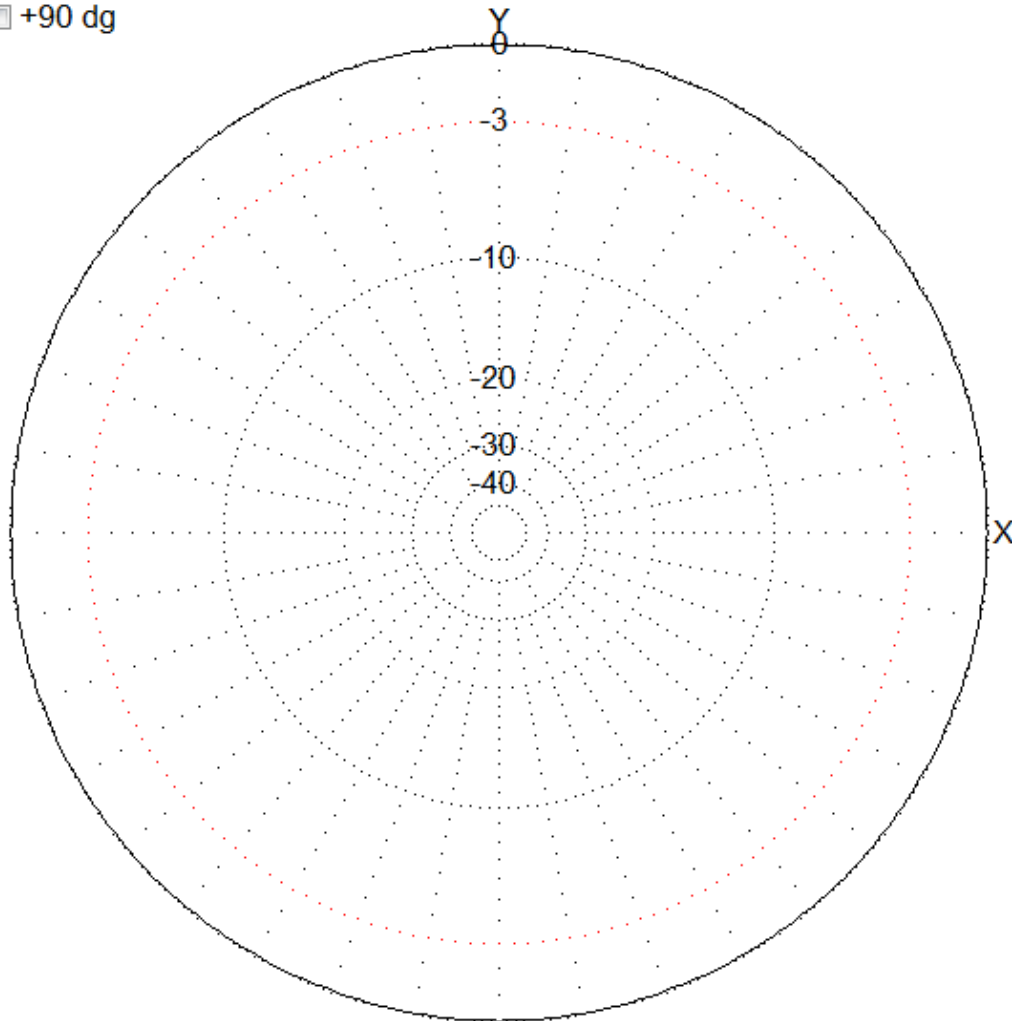
- Feed at ground level, apex 39.75m, W=20Cu

Wire No.1
X1 : 0.0 m
Y1 : 0.0 m
Z1 : 0.0 m
X2 : 0.0 m
Y2 : 0.0 m
Z2 : 39.75 m
R : 10.0 mm
Length : 39.75 m
Azim. : 0.0 deg
Zenith : 90.0 deg

Reference: GP on 160m

- Feed at ground level, apex 39.75m, W=20Cu

Ga : 0.83 dBi = 0 dB (Vertical polarization)
F/B: 0.00 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 1.830 MHz
Z: 36.204 + j0.024 Ohm
SWR: 1.4 (50.0 Ohm),
Elev: 24.1 deg (Real GND :0.00 m height)

Reference: GP on 160m

☐ +90 dg

Real ground setup

No.	Dielec.	Conduct(mS/m)	X (m)	Height(m)
1	13.0	3.0	0.0	0
next				

Type of the media in the complex (>1 line in up table) ground

☐ on- radial boundary (R), off-linear boundary (X)

Additional wire radials

Number 8   Radius of wire 0.8   mm

OK   Cancel

Other Parameters

- First amplifier Noise Figure 6dB

  - W7IUV preamp now measured, NF below 6dB

- Matching & Feed Losses 2dB

- QTH Noise specified above -204dBW

  - Fa defined in ITU P.372 document

  - 64dB for Residential QTH on 160m

  - 46dB for Quiet Rural QTH on 160m

Reference: GP on 160m

- Feed at ground level, apex 39.75m, W=20Cu

- Residential, QTH Noise 64dB

- MDS -142,1dBW

- Noise Margin 47,8dB

- Quiet Rural, QTH Noise 46dB

- MDS -160,1dBW

- Noise Margin 29,8dB

Reference: GP on 160m

- Feed at ground level, apex 39.75m, W=20Cu

- Residential, QTH Noise 64dB

- MDS -142,1dBW

- Noise Margin 47,8dB

- Quiet Rural, QTH Noise 46dB

- MDS -160,1dBW

- Noise Margin 29,8dB

Reference: GP on 160m

- Feed at ground level, apex 39.75m, W=20Cu

- Residential, QTH Noise 64dB

- MDS -142,1dBW

- Noise Margin 47,8dB

- Quiet Rural, QTH Noise 46dB

- MDS -160,1dBW – exactly 64-46dB=18dB better

- Noise Margin 29,8dB

Comparison antenna:
Modified K6SE / FO0AAA

- Triangle shape

- Length 8.0m

- Bottom wire at 2.2m, apex 8.5m

- Wire 4mm diameter copper

- Rear resistor 5% above the rear corner
  to optimize pattern, value 810-850 ohms

- Lobster antenna

Basic Lobster on 160m
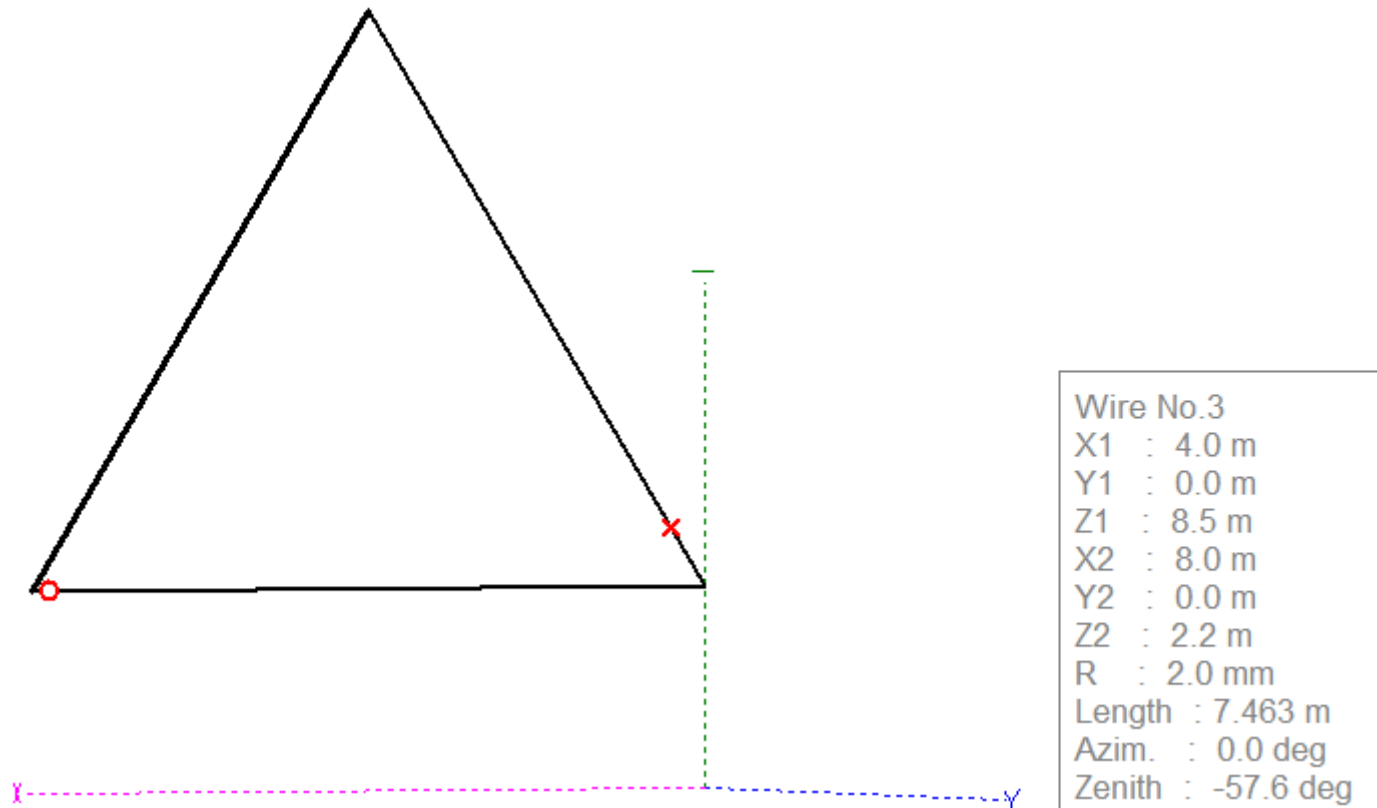
- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

Wire No.3
X1 : 4.0 m
Y1 : 0.0 m
Z1 : 8.5 m
X2 : 8.0 m
Y2 : 0.0 m
Z2 : 2.2 m
R   : 2.0 mm
Length : 7.463 m
Azim. : 0.0 deg
Zenith : -57.6 deg

Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

FEED

REAR
RESISTOR

Wire No.3
X1 : 4.0 m
Y1 : 0.0 m
Z1 : 8.5 m
X2 : 8.0 m
Y2 : 0.0 m
Z2 : 2.2 m
R : 2.0 mm
Length : 7.463 m
Azim. : 0.0 deg
Zenith : -57.6 deg

Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

REAR
RESISTOR
835 ohm

FEED
800 ohms

Wire No.3
X1 : 4.0 m
Y1 : 0.0 m
Z1 : 8.5 m
X2 : 8.0 m
Y2 : 0.0 m
Z2 : 2.2 m
R : 2.0 mm
Length : 7.463 m
Azim. : 0.0 deg
Zenith : -57.6 deg
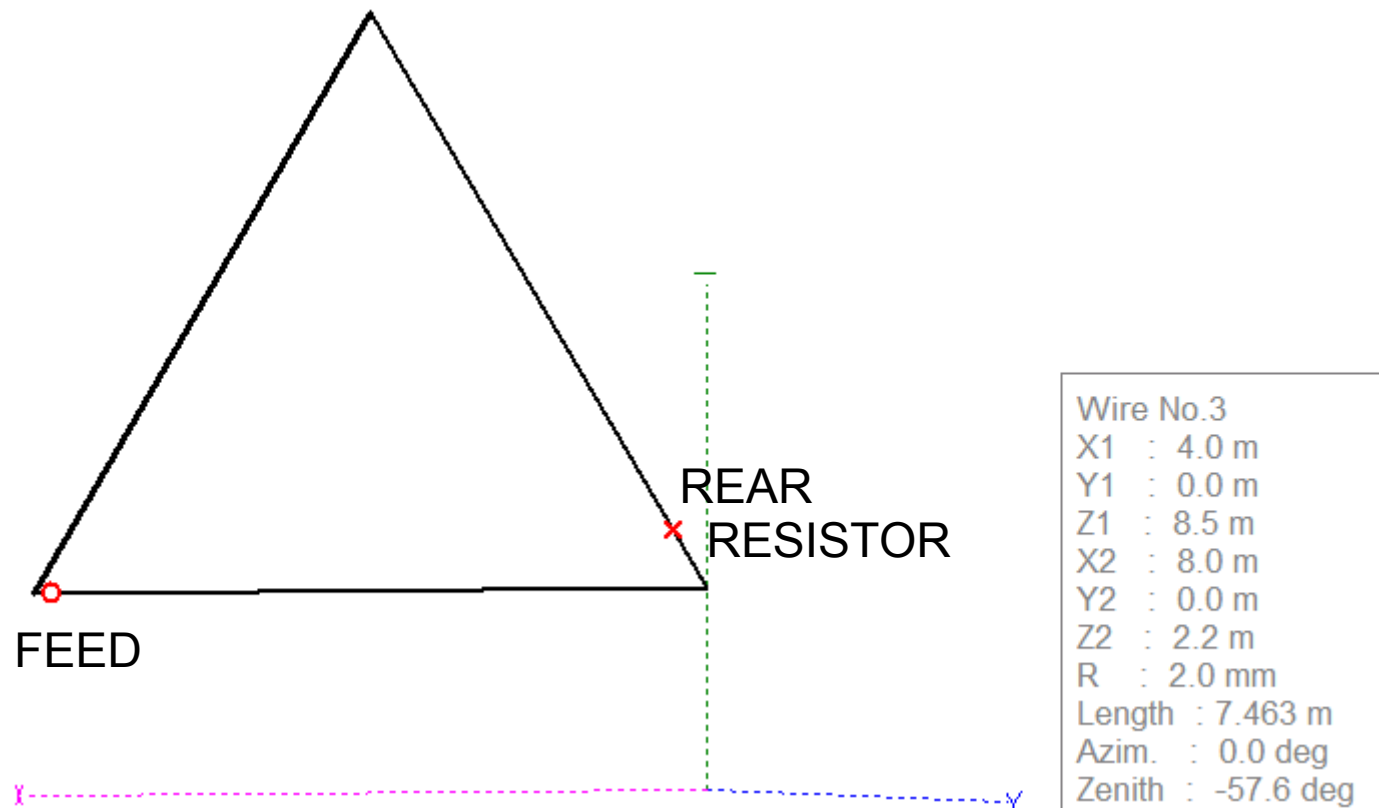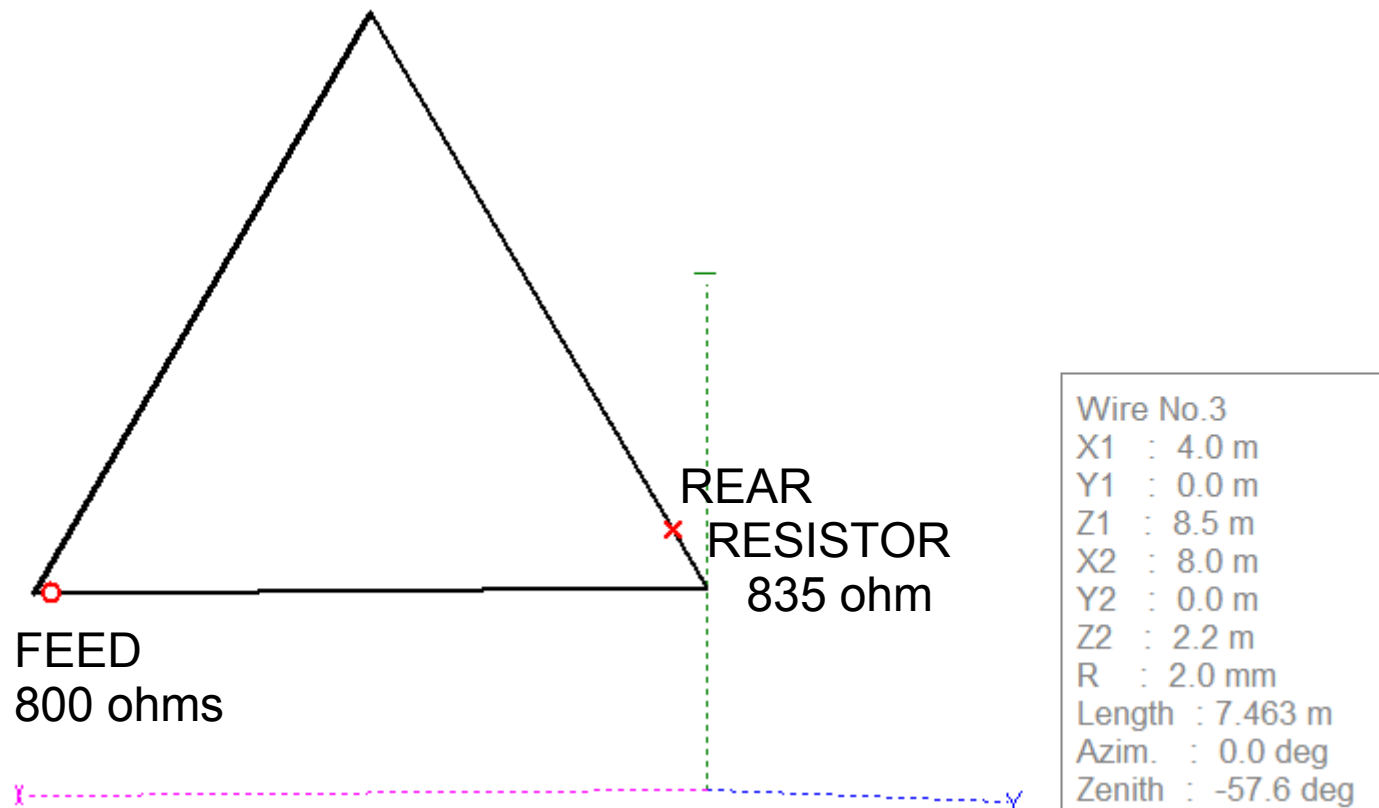
Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu
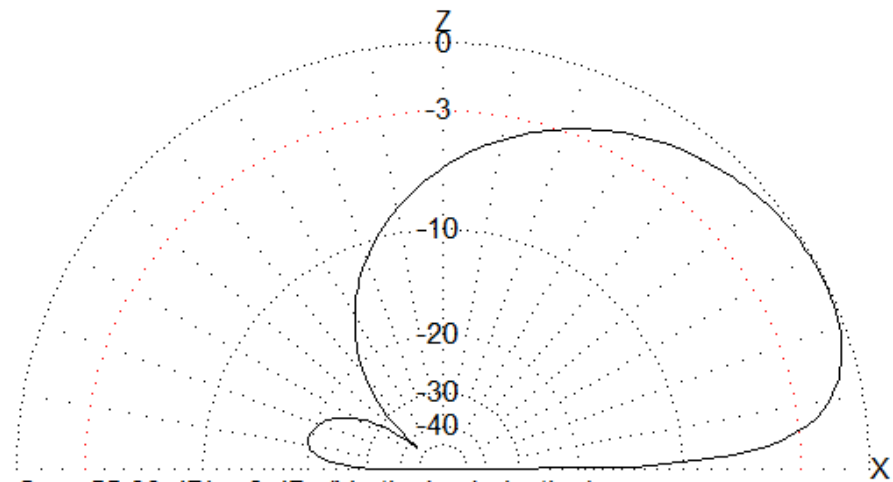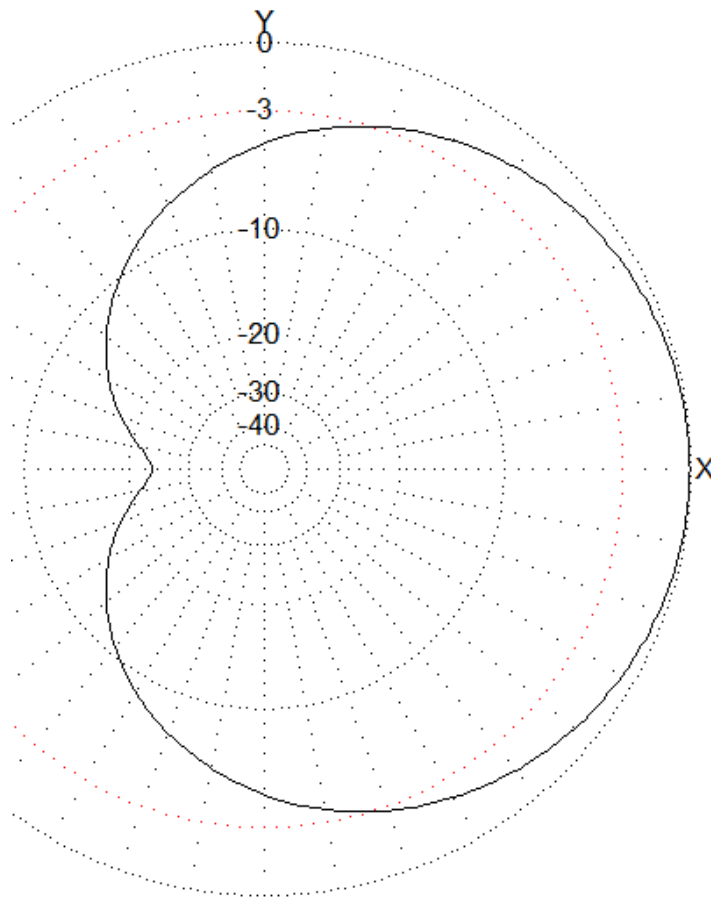
Ga : -55.39 dBi = 0 dB (Vertical polarization)
F/B: 19.48 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 834.233 - j12.117 Ohm
SWR: 1.0 (800.0 Ohm),
Elev: 27.4 deg (Real GND :0.00 m height)

Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

- Residential QTH Noise 64dB

- MDS -144,6dBW

- Noise Margin 11,0dB

- Rural, QTH Noise 46dB

- MDS -157,3dBW

- Noise Margin -7,0dB

Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

- Residential QTH Noise 64dB
- MDS -144,6dBW – GP MDS -142,1dBW
- Noise Margin 11,0dB – strong positive margin

- Rural, QTH Noise 60dB
- MDS -157,3dBW – GP MDS -160,1dBW
- Noise Margin -7,0dB – not perfect for quiet QTH
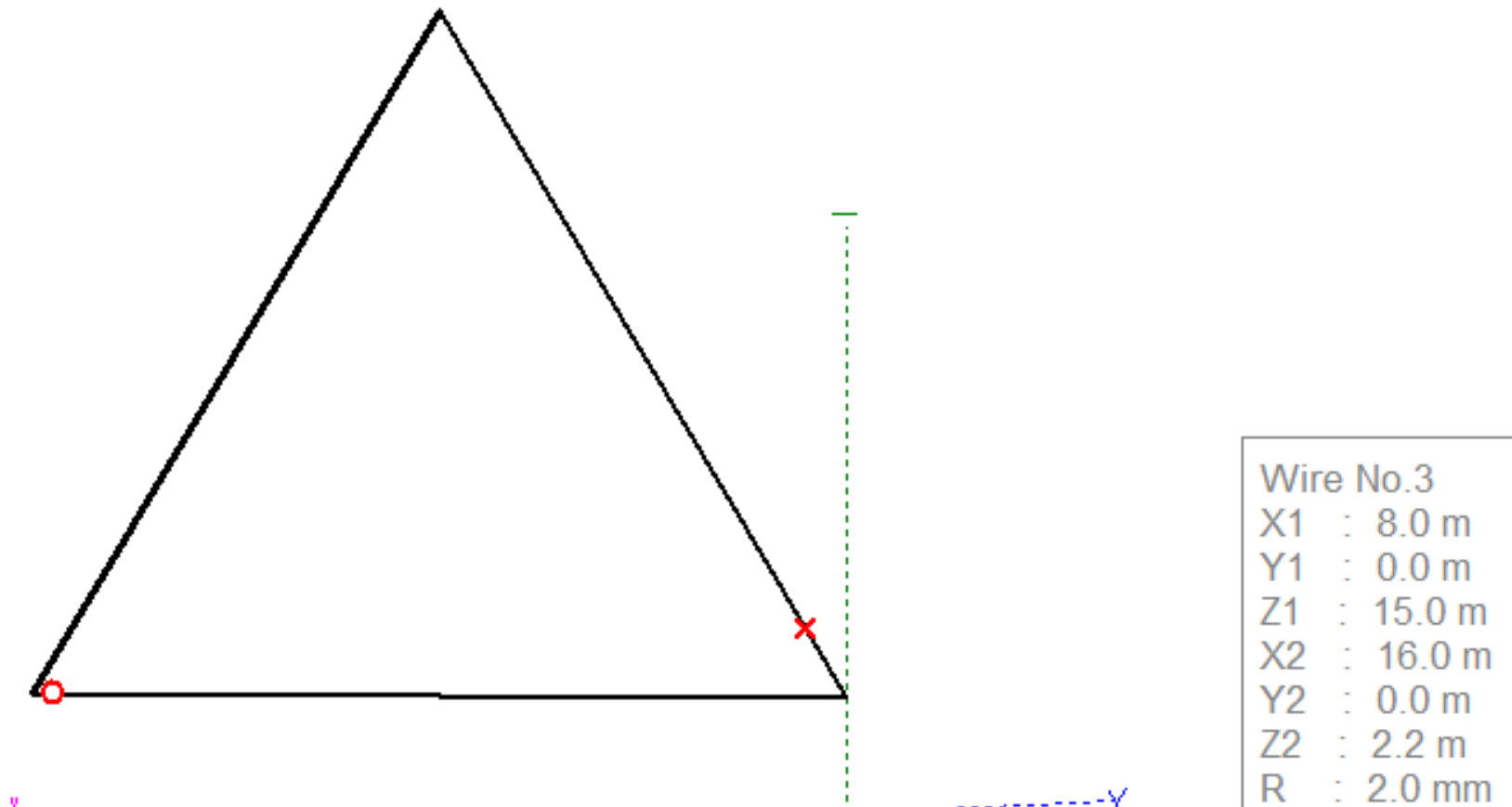
Basic Lobster on 160m

- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

- Residential QTH Noise 64dB

- MDS -144,6dBW – GP MDS -142,1dBW

- Noise Margin 11,0dB – strong positive margin

Excellent for suburban locations

- Rural, QTH Noise 60dB

- MDS -157,3dBW – GP MDS -160,1dBW

- Noise Margin -7,0dB – not perfect for quiet QTH

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

Wire No.3
X1 : 8.0 m
Y1 : 0.0 m
Z1 : 15.0 m
X2 : 16.0 m
Y2 : 0.0 m
Z2 : 2.2 m
R : 2.0 mm

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu
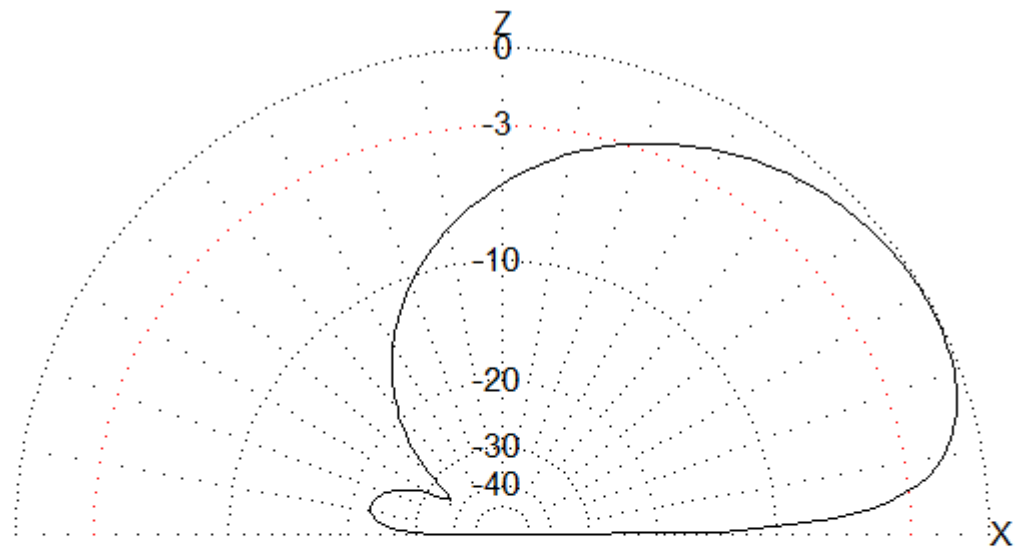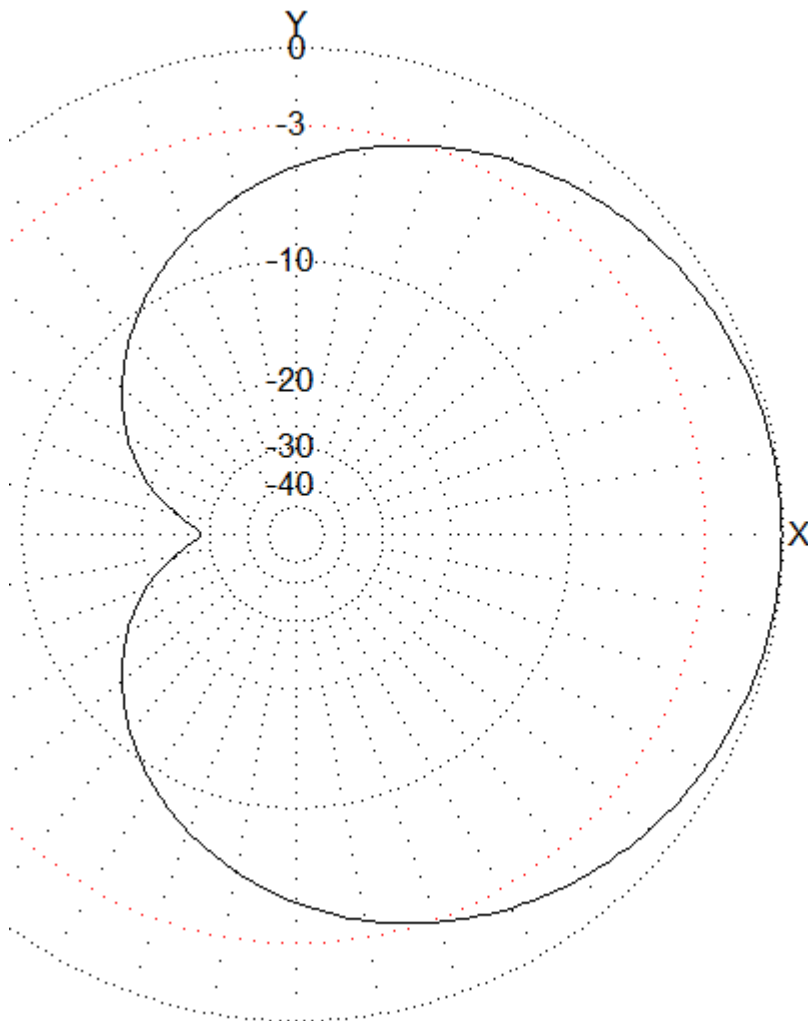
Ga : -43.52 dBi = 0 dB (Vertical polarization)
F/B: 22.23 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 842.119 + j28.007 Ohm
SWR: 1.1 (800.0 Ohm),
Elev: 27.7 deg (Real GND :0.00 m height)

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

- Residential, QTH Noise 64dB
- MDS -144,7dBW
- Noise Margin 22,9dB

- Rural, QTH Noise 46dB
- MDS -162,0dBW
- Noise Margin 4,9dB

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

- Residential, QTH Noise 64dB
- MDS -144,7dBW – 0,1dB above Basic Lobster
- Noise Margin 22,9dB

- Rural, QTH Noise 46dB
- MDS -162,0dBW – GP MDS -160,1dBW
- Noise Margin 4,9dB – basic Lobster was negative

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

- Residential, QTH Noise 64dB
- MDS -144,7dBW – 0,1dB above Basic Lobster
- Noise Margin 22,9dB – unnecessarily high

- Rural, QTH Noise 46dB
- MDS -162,0dBW – GP MDS -160,1dBW
- Noise Margin 4,9dB – basic Lobster was negative

Double Size Lobster on 160m

- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

- Residential, QTH Noise 64dB
- MDS -144,7dBW – 0,1dB above Basic Lobster
- Noise Margin 22,9dB – unnecessarily high

- Rural, QTH Noise 46dB
- MDS -162,0dBW – GP MDS -160,1dBW
- Noise Margin 4,9dB – basic Lobster was negative

Good for rural locations

Results summary

- GP MDS is   -133.0 / -125.0 dBW
- Lobster MDS ranges   -135.7 / -127.5 dBW

Results summary

- GP MDS is   -160,1 / -142,1 dBW
- Lobster MDS ranges   -157,3 / -144,6 dBW
- Double Size Lobster   -162,0 / -144,7 dBW

- Design Target achieved
  Lobster wins over GP at affordable size & cost
  For Quiet Rural QTH, Double Size Lobster

- Performance difference 1,9 – 2,6dB

Findings

- A receiving antenna length 16m is enough on 160m band to provide better reception than a Full Size GP – at most QTHs, most of the time

- Increasing the antenna size will not bring automatical improvement in MDS capability

- Common mode and signal leaking related issues may be improved by increasing the antenna size bigger than Double Size Lobster

- At locations with minimal ambient noise a Triple Size Lobster is not needed - 2,5x is enough

More Information

- A receiving antenna "LIRA" with 33m length wins Double Size Lobster

  - Beyond the scope of this Quick Study

- Antenna details and simulation models available from Jukka OH6LI

  - Also LIRA design details available for those wanting to pursue for the best reception capability

Excel Workbook

- Excel workbook to analyze MDS and Noise Margin available

- Also Leaking Index for directional antenna pattern comparisons

Antenna pattern file name	3D Max Gain (dBi)	At Azim	At Elev	Average Gain (ratio)	Average Gain (dB)	Direc-tivity (dB)	Rear Hemi Avg Gain	Rear Hemi MSL (dB)	Leaking Index (%)	Using LI Rear Azim Range	Plus LI Front Elev Range	QTH Noise Level (dB)	Noise Margin (dB)	MDS (dBW)	Length (m)	Width (m)	Height (m)	Antenna pattern file name
01 GP 160m.csv	0,83	0°	24°	0,37684	-4,24	5,07	-4,24	5,07	96,8	80°-280°	80°-90°	64	47,8	-142,1	40	40	39,75	01 GP 160m.csv
02 BasicLobster 160m.csv	-33,21	0°	34°	0,00008	-41,00	7,79	-45,97	12,76	77,6	80°-280°	80°-90°	64	11,0	-144,6	10	1	7,5	02 BasicLobster 160m.csv
03 DoubleSizeLobster 160m.csv	-21,45	0°	35°	0,00123	-29,12	7,67	-33,87	12,42	78,9	80°-280°	80°-90°	64	22,9	-144,7	18	1	11	03 DoubleSizeLobster 160m.csv
04 TripleSizeLobster 160m.csv	-14,09	0°	35°	0,00698	-21,56	7,47	-26,04	11,95	79,9	80°-280°	80°-90°	64	30,4	-144,5	26	1,5	22	04 TripleSizeLobster 160m.csv
05 LIRA L22 H7.2 160m.csv	-35,81	0°	27°	0,00003	-45,50	9,69	-55,06	19,25	46,3	80°-280°	80°-90°	64	6,5	-146,2	24	1	7	05 LIRA L22 H7.2 160m.csv
06 LIRA L33 H10.0 160m.csv	-25,20	0°	28°	0,00033	-34,84	9,64	-44,95	19,75	42,0	80°-280°	80°-90°	64	17,2	-146,6	33	1	10	06 LIRA L33 H10.0 160m.csv
01 GP 160m.csv	0,83	0°	24°	0,37684	-4,24	5,07	-4,24	5,07	96,8	80°-280°	80°-90°	46	29,8	-160,1	40	40	39,75	01 GP 160m.csv
02 BasicLobster 160m.csv	-33,21	0°	34°	0,00008	-41,00	7,79	-45,97	12,76	77,6	80°-280°	80°-90°	46	-7,0	-157,3	10	1	7,5	02 BasicLobster 160m.csv
03 DoubleSizeLobster 160m.csv	-21,45	0°	35°	0,00123	-29,12	7,67	-33,87	12,42	78,9	80°-280°	80°-90°	46	4,9	-162,0	18	1	11	03 DoubleSizeLobster 160m.csv
04 TripleSizeLobster 160m.csv	-14,09	0°	35°	0,00698	-21,56	7,47	-26,04	11,95	79,9	80°-280°	80°-90°	46	12,4	-162,3	26	1,5	22	04 TripleSizeLobster 160m.csv
05 LIRA L22 H7.2 160m.csv	-35,81	0°	27°	0,00003	-45,50	9,69	-55,06	19,25	46,3	80°-280°	80°-90°	46	-11,5	-155,6	24	1	7	05 LIRA L22 H7.2 160m.csv
06 LIRA L33 H10.0 160m.csv	-25,20	0°	28°	0,00033	-34,84	9,64	-44,95	19,75	42,0	80°-280°	80°-90°	46	-0,8	-162,6	33	1	10	06 LIRA L33 H10.0 160m.csv