472kHz
Quick Study

Receiving Antenna Size vs Performance

v03

Jukka OH6LI

Design Target:
to receive better than a full size GP

- Theoretical 472kHz Full Size GP as comparison

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

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How to measure the performance

Design Target:
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- New receiving Antenna Performance Measure: Minimum Discernible Signal

Design Target:
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- New receiving Antenna Performance Measure: Minimum Discernible Signal

  - Excel tool: Dan AC6LA
  - Algorithm: Jukka OH6LI
  - Ideas, clarifications: Markku OH2RA

Design Target:
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- New receiving Antenna Performance Measure: Minimum Discernible Signal

- Noise Margin as secondary measurable

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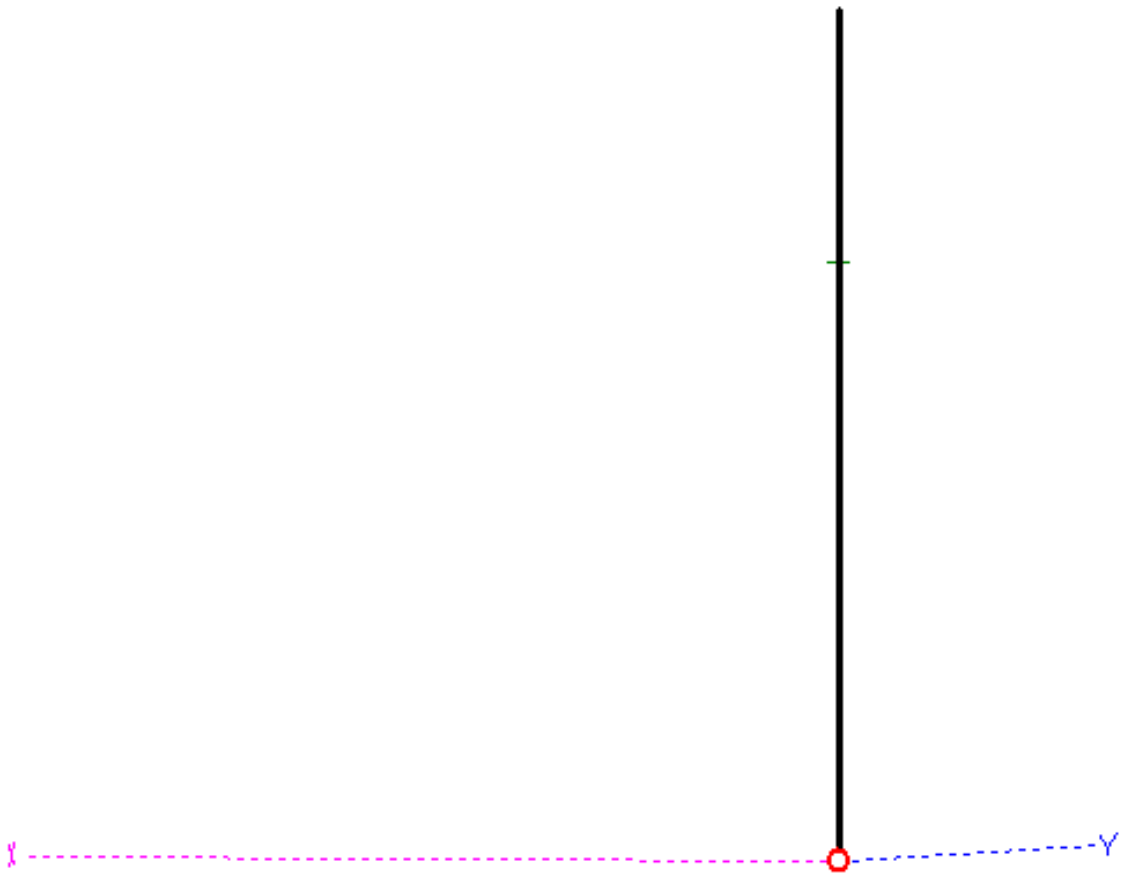
- New receiving Antenna Performance Measure:
  Minimum Discernible Signal

- 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 472kHz

- Feed at ground level, apex 154.84m
- Wire diameter 40mm copper
- Real ground

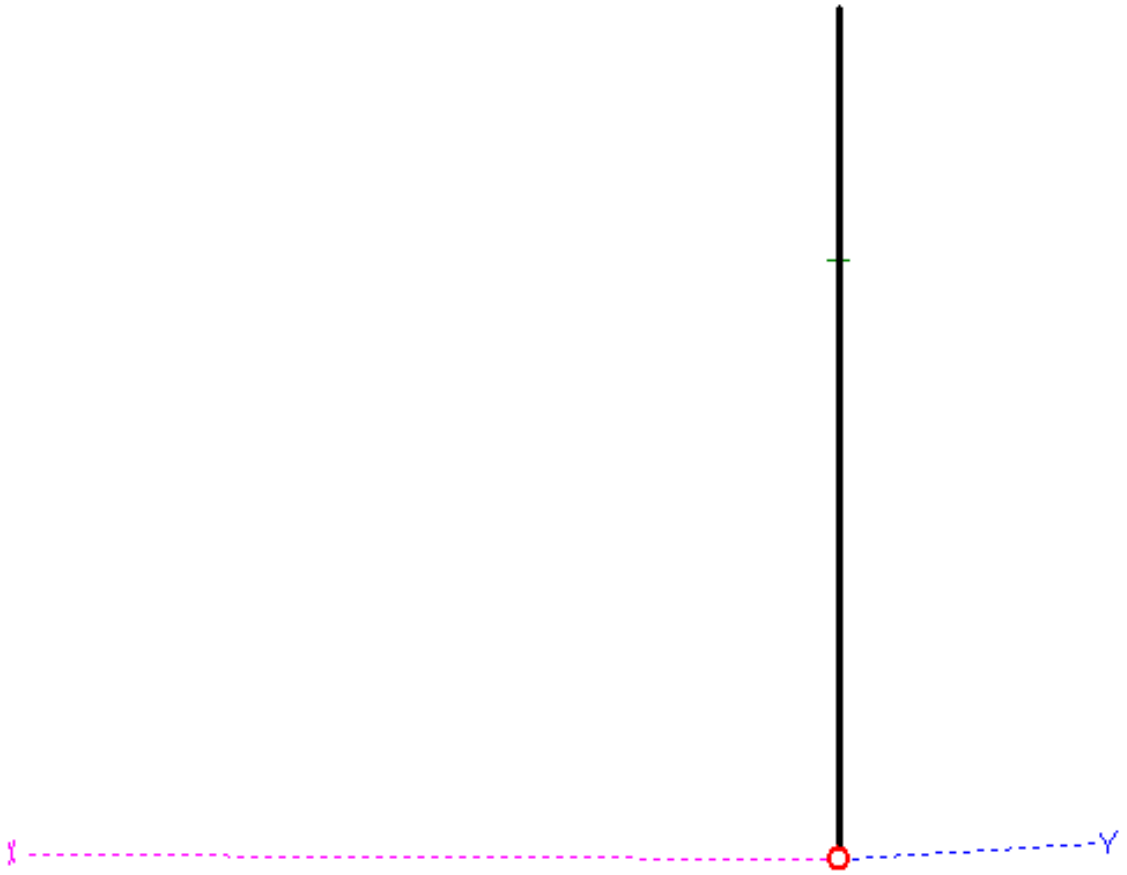
Reference: GP on 472kHz



Wire No.1
X1 : 0.0 m
Y1 : 0.0 m
Z1 : 0.0 m
X2 : 0.0 m
Y2 : 0.0 m
Z2 : 154.84 m
R : 10.0 mm

Reference: GP on 472kHz

- Feed at ground level, apex 154.84m, W=40Cu



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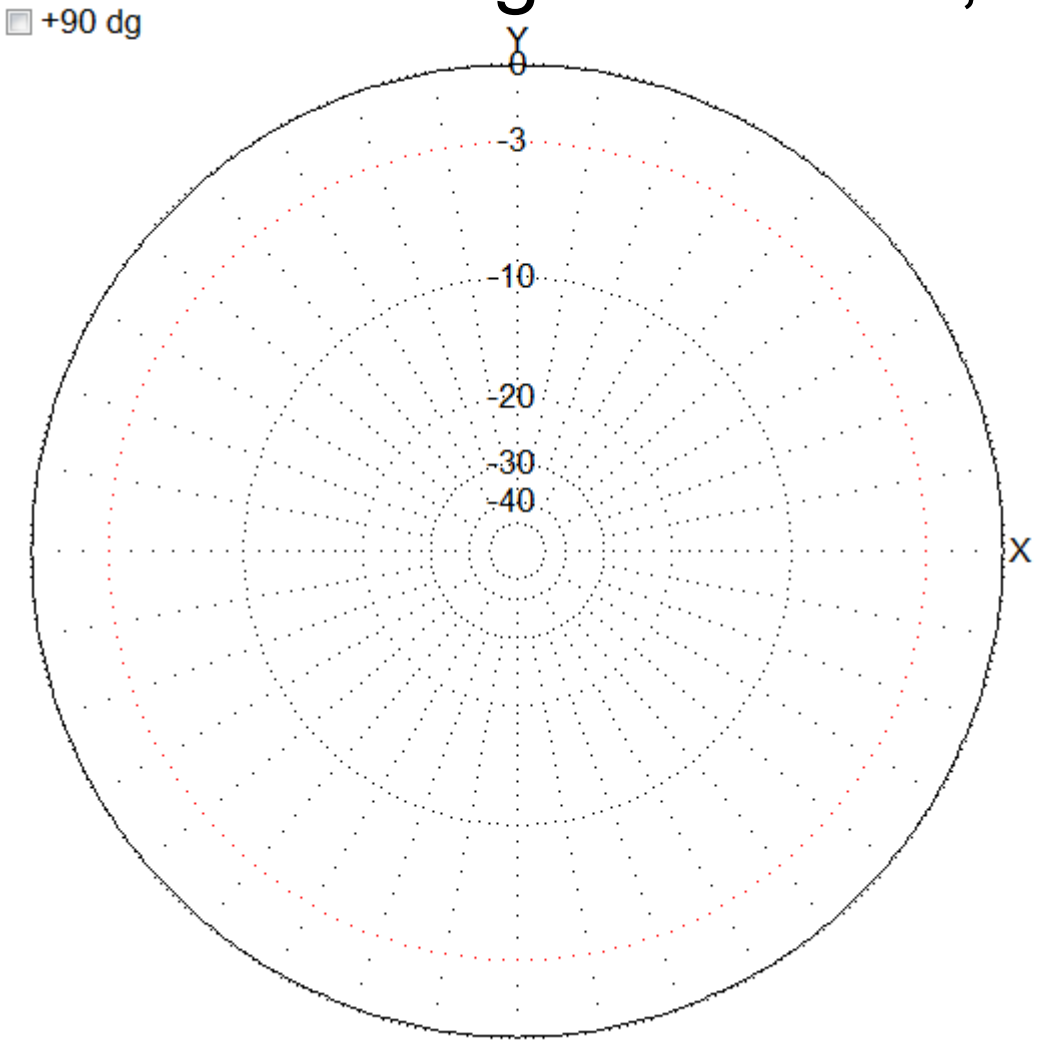
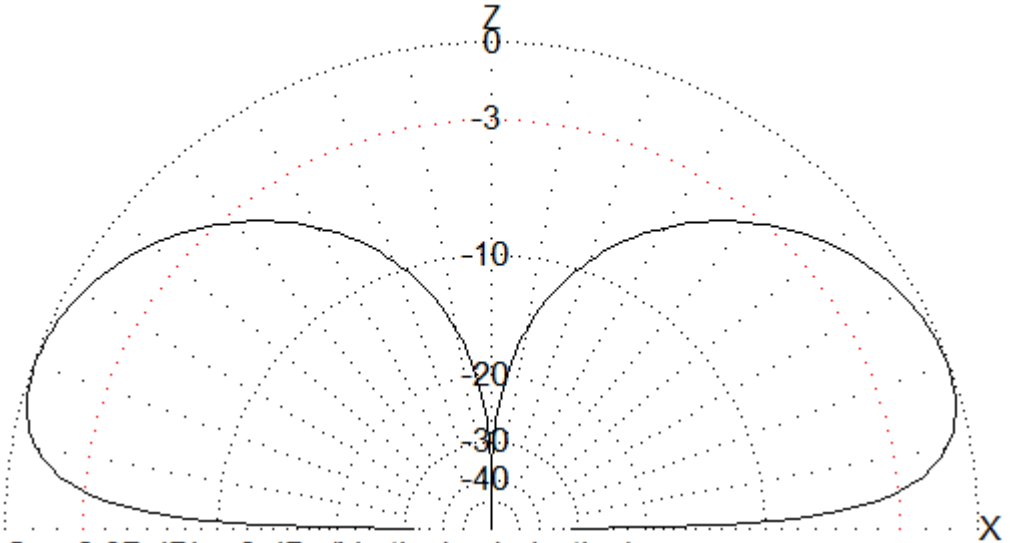
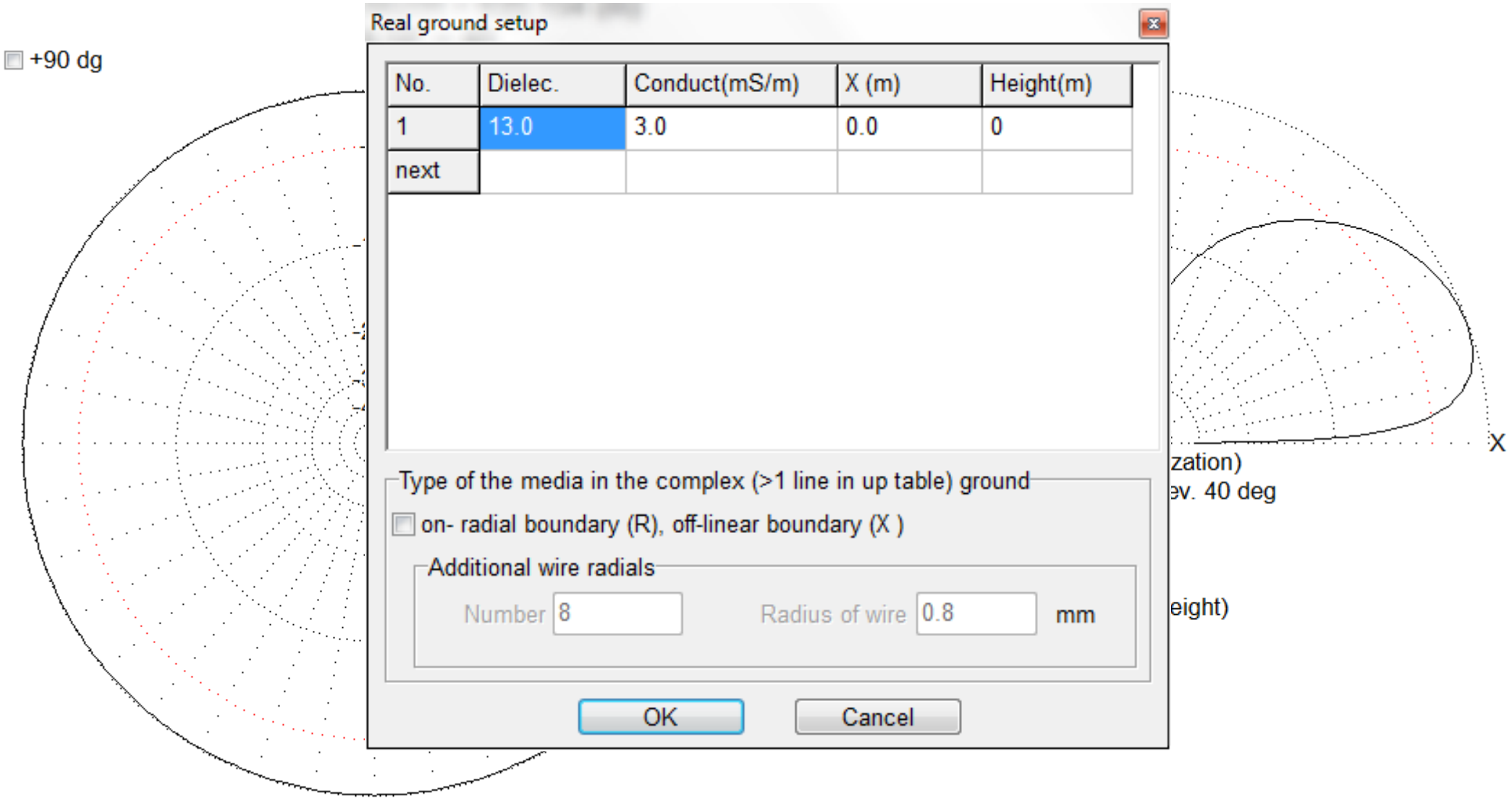




Ga : 2.37 dBi = 0 dB (Vertical polarization)
F/B: 0.00 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 36.363 - j0.008 Ohm
SWR: 22.0 (800.0 Ohm),
Elev: 19.9 deg (Real GND :0.00 m height)

Reference: GP on 472kHz



Other Parameters

- First amplifier Noise Figure 3dB
- Matching & Feed Losses 2dB

- QTH Noise specified above -204dBW
  - Fa in ITU P.372 document
  - 81dB for residential QTH on 472kHz
  - 73dB for rural QTH on 472kHz

Reference: GP on 472kHz

- Feed at ground level, apex 154.84m, W=40Cu

- Residential, QTH Noise 81dB
- MDS -125.0dBW
- Noise Margin 70.3dB

- Rural, QTH Noise 73dB
- MDS -133.0dBW
- Noise Margin 62.3dB

Reference: GP on 472kHz

- Feed at ground level, apex 154.84m, W=40Cu

- Residential, QTH Noise 81dB
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- Rural, QTH Noise 73dB
- MDS -133.0dBW - 8dB better due to QTH Noise
- Noise Margin 62.3dB

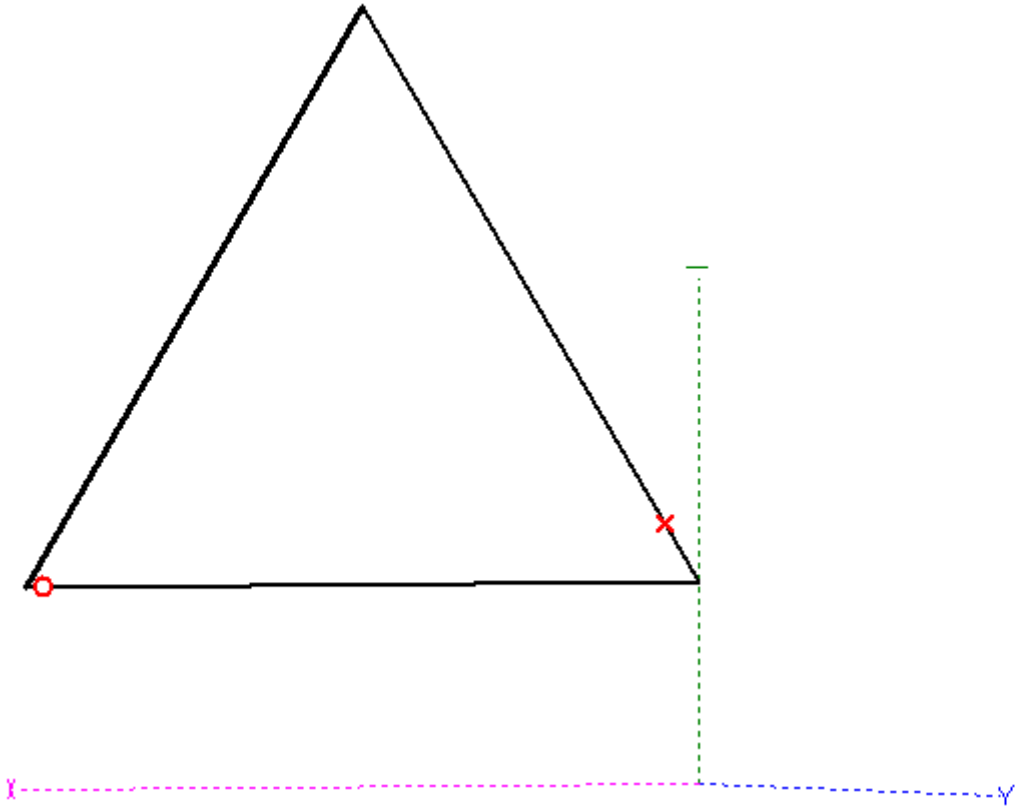
Comparison antenna: Modified K6SE / FO0AAA

- 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 472kHz

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



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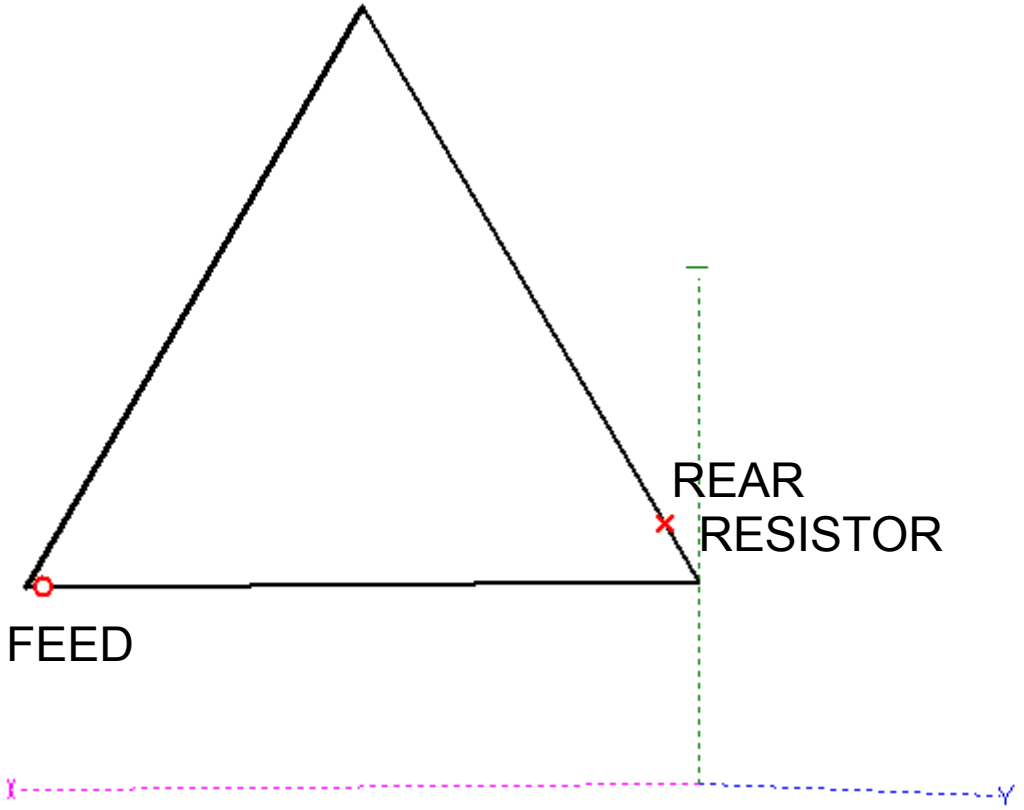

Wire No.3
X1 : 4.0 m
Y1 : 0.0 m
Z1 : 8.5 m
X2 : 8.0 m
Y2 : 0.0 m
Z2 : 2.2 m
R : 2.0 mm
Length : 7.463 m
Azim. : 0.0 deg
Zenith : -57.6 deg

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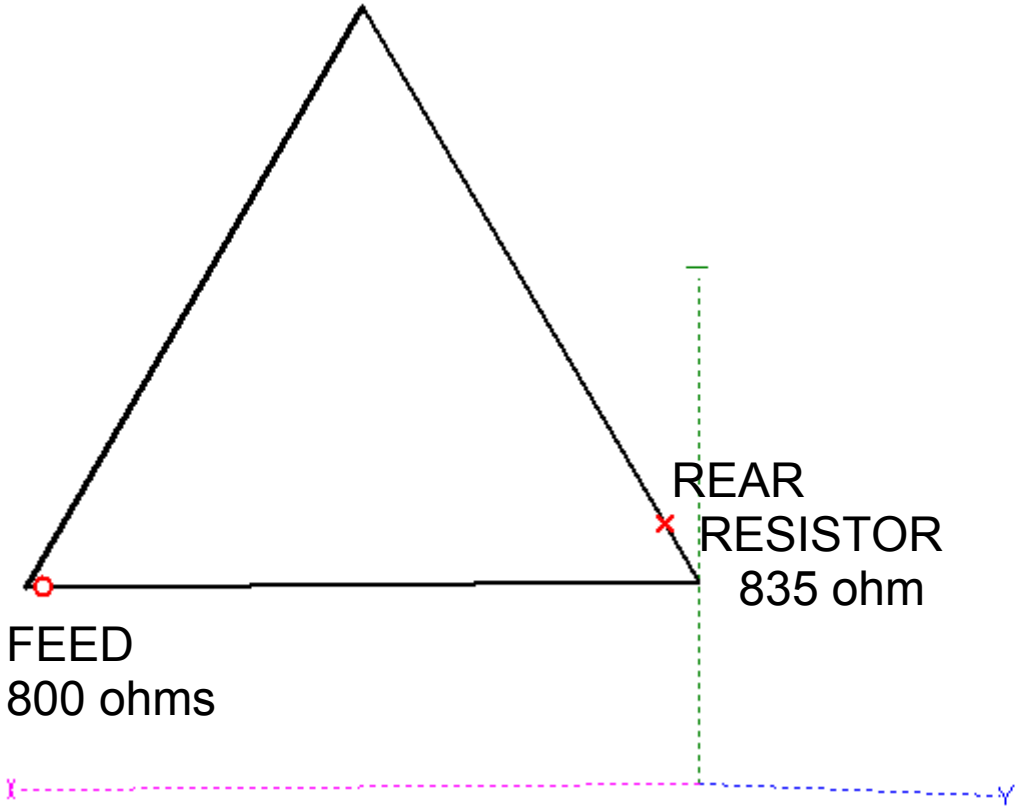

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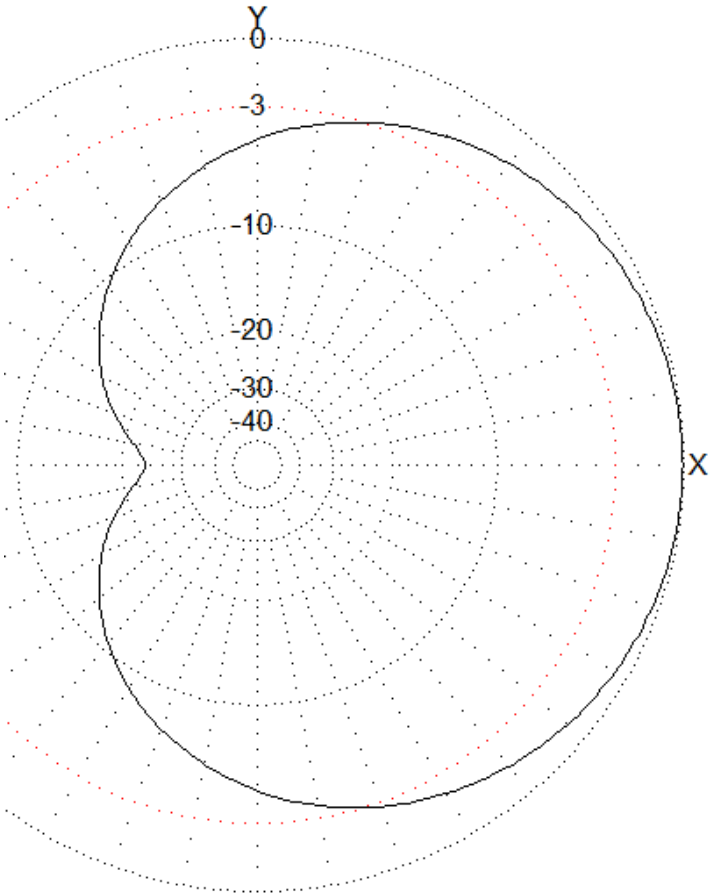
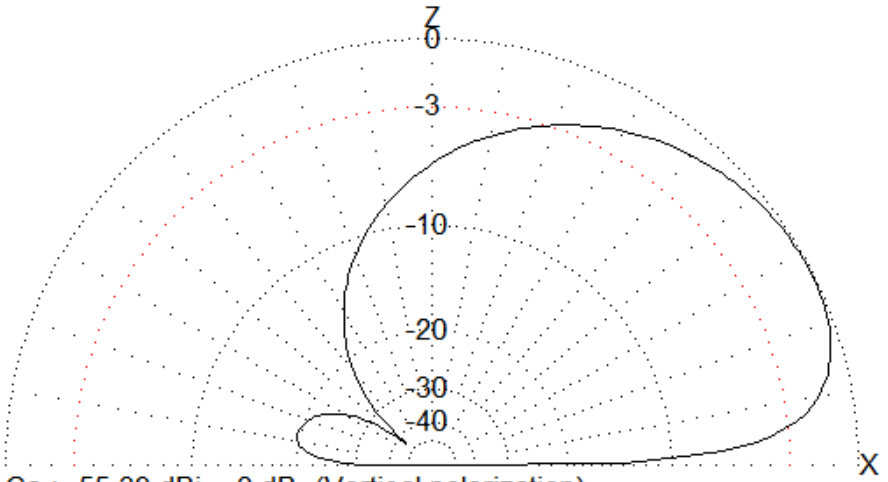




Ga : -55.39 dBi = 0 dB (Vertical polarization)
F/B: 19.48 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 834.233 - j12.117 Ohm
SWR: 1.0 (800.0 Ohm),
Elev: 27.4 deg (Real GND :0.00 m height)

Basic Lobster on 472kHz

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

- Residential QTH Noise 81dB
- MDS -127.5
- Noise Margin 9.9dB

- Rural, QTH Noise 73dB
- MDS -134.5dBW
- Noise Margin 1.9dB

Basic Lobster on 472kHz

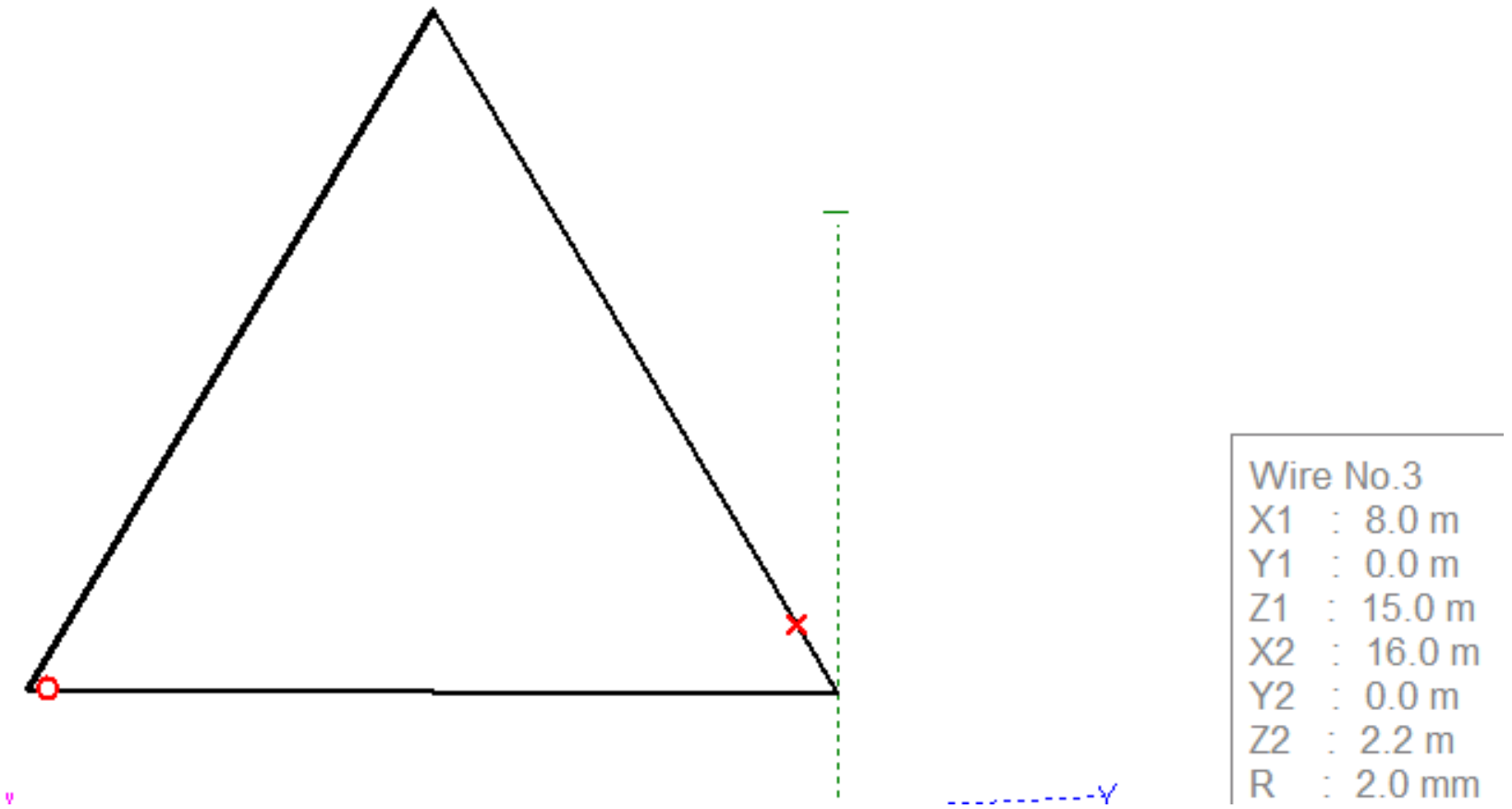
- L=8.0m, bottom wire at 2.2m, apex 8.5m, W=4Cu

- Residential QTH Noise 81dB
- MDS -127.5
- Noise Margin 9.9dB – acceptable number

- Rural, QTH Noise 73dB
- MDS -134.5dBW
- Noise Margin 1.9dB – Basic Lobster too small for low noise QTH

Double Size Lobster on 472kHz

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



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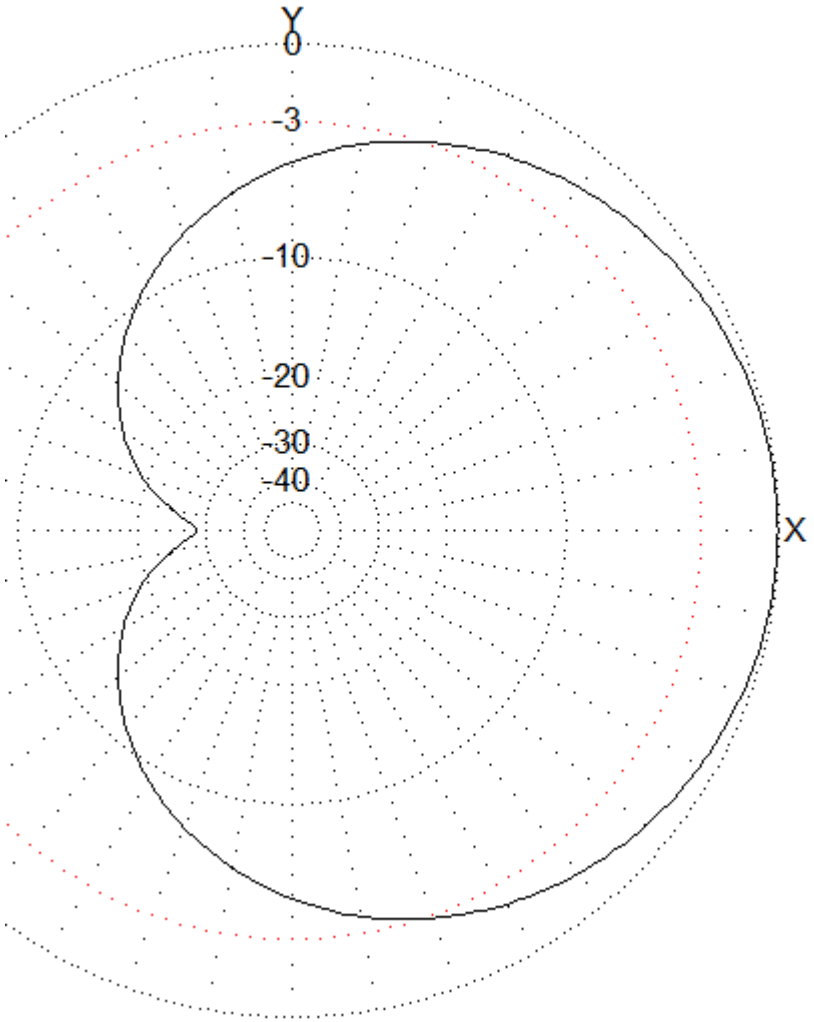
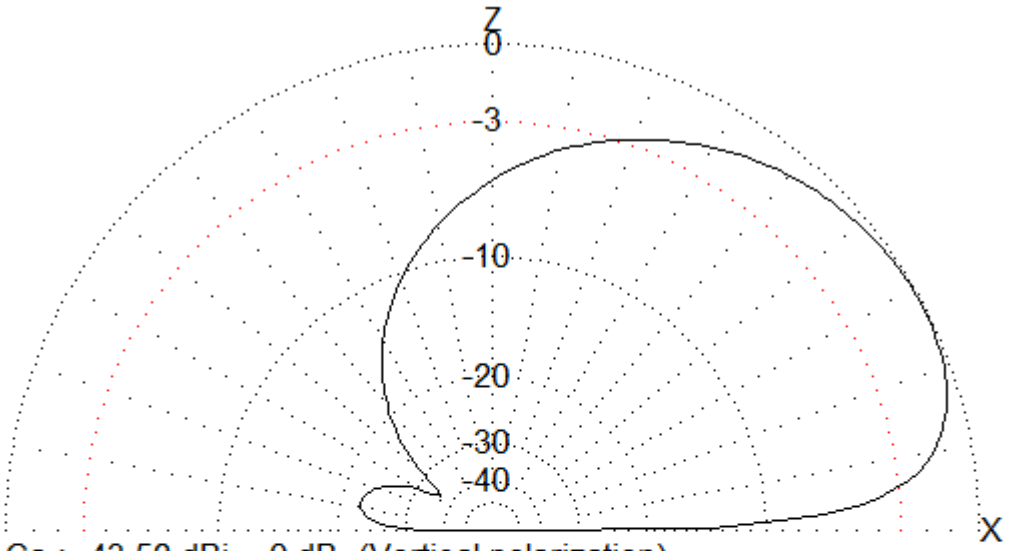




Ga : -43.52 dBi = 0 dB (Vertical polarization)
F/B: 22.23 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 842.119 + j28.007 Ohm
SWR: 1.1 (800.0 Ohm),
Elev: 27.7 deg (Real GND :0.00 m height)

Double Size Lobster on 472kHz

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

- Residential, QTH Noise 81dB
- MDS -127.8dBW
- Noise Margin 21.7dB

- Rural, QTH Noise 73dB
- MDS -136.7dBW
- Noise Margin 13.7dB

Double Size Lobster on 472kHz

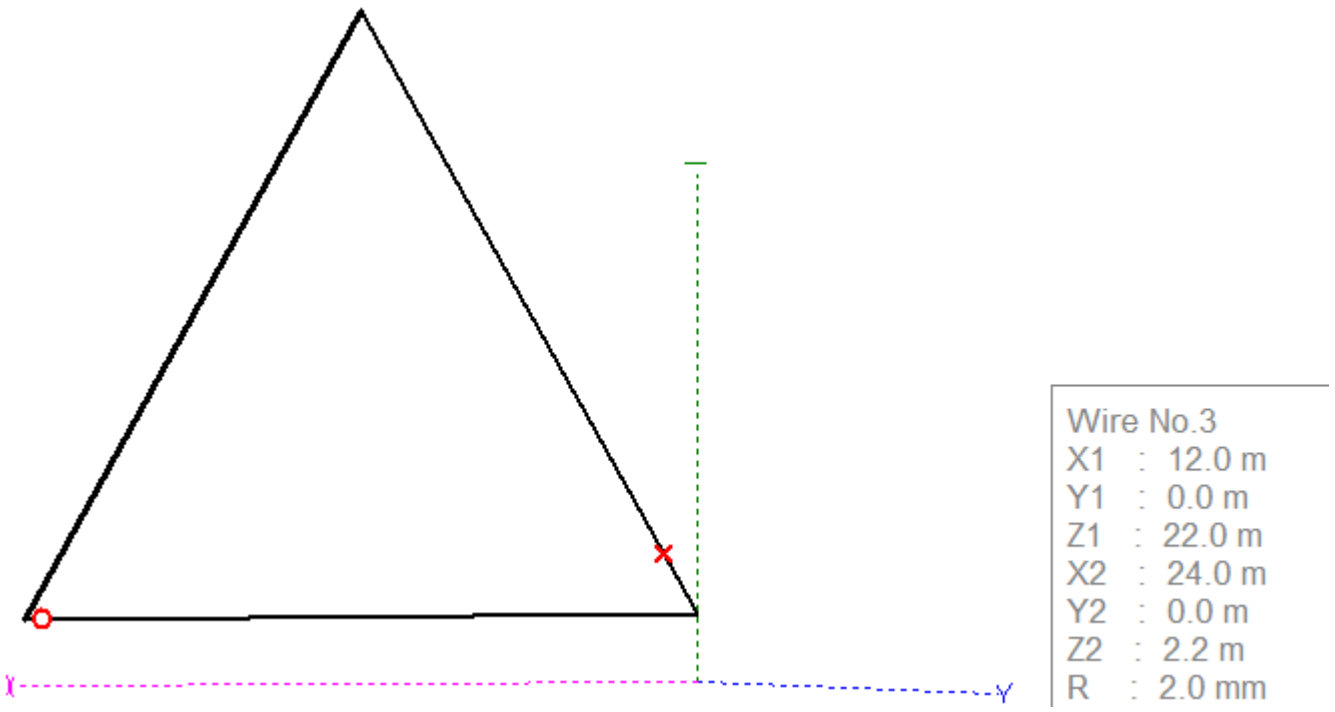
- L=16m, bottom wire at 2.2m, apex 15m, W=4Cu

- Residential, QTH Noise 81dB
- MDS -127.8dBW
- Noise Margin 21.7dB – unnecessarily large

- Rural, QTH Noise 73dB
- MDS -136.7dBW
- Noise Margin 13.7dB – good for rural QTH
  Too small for extreme rural

Triple Size Lobster on 472kHz

- L=24m, bottom wire at 2.2m, apex 22m, W=4Cu



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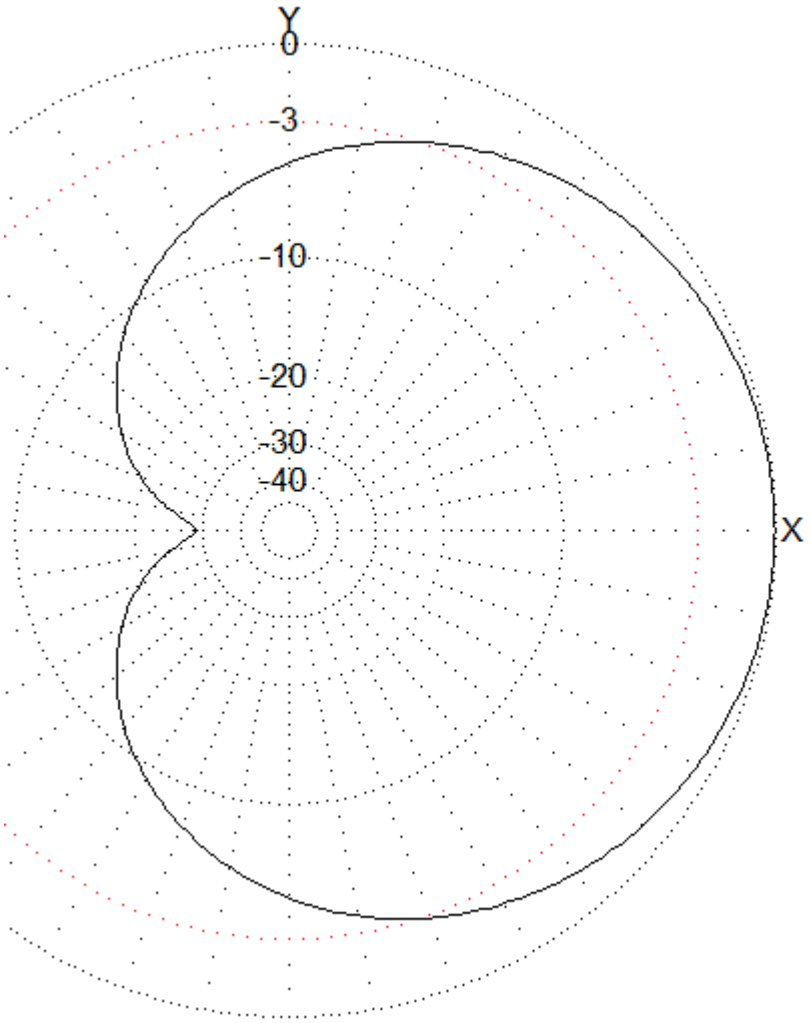
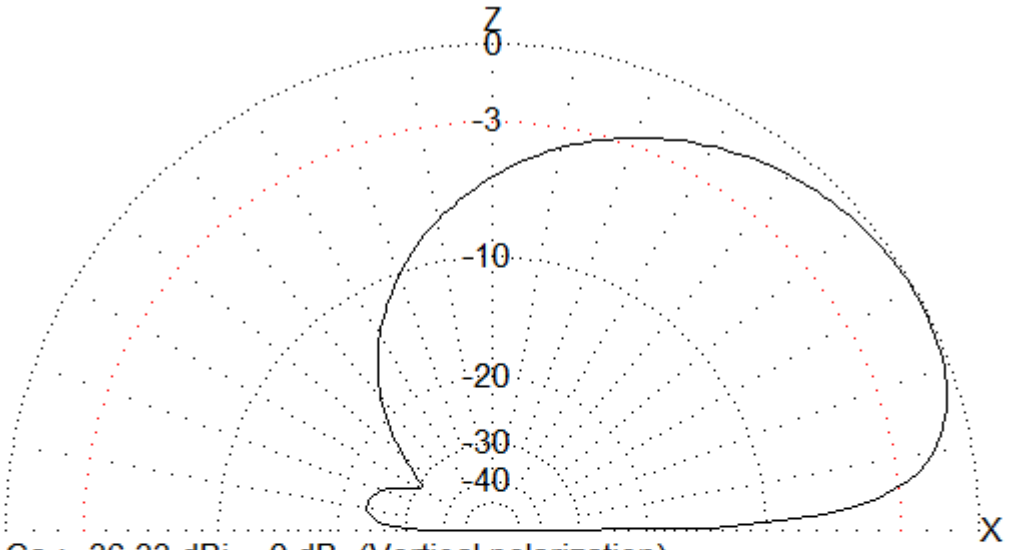
- L=24m, bottom wire at 2.2m, apex 22m, W=4Cu





Ga : -36.33 dBi = 0 dB (Vertical polarization)
F/B: 23.07 dB; Rear: Azim. 0 deg, Elev. 40 deg
Freq: 0.472 MHz
Z: 859.812 + j73.149 Ohm
SWR: 1.1 (800.0 Ohm),
Elev: 27.8 deg (Real GND :0.00 m height)

Triple Size Lobster on 472kHz

- L=24m, bottom wire at 2.2m, apex 22m, W=4Cu

- Residential, QTH Noise 81dB
- MDS -127.8dBW
- Noise Margin 28.9dB

- Rural, QTH Noise 73dB
- MDS -135.7dBW
- Noise Margin 20.9dB – good enough for quiet rural

Results summary

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

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- Design Target achieved

  Lobster wins over GP at affordable size & cost

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- Design Target achieved

  Lobster wins over GP at affordable size & cost

- Performance difference 2.5 – 2.8dB

Findings

- A receiving antenna length 16m is enough on 630m 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 to Double Size Lobster
- At locations with minimal ambient noise a Triple Size Lobster may bring benefit

More Information

- A receiving antenna "LIRA" with 50m 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 with more real estate

Excel Workbook

- Excel workbook to analyze MDS and Noise Margin available
- Also Leaking Index for antenna pattern comparisons

Antenna pattern file name	Gmax dBi	At Azim	At Elev	Gave dB	RDF dB	Back Gave dB	DMF dB	Leaking Index (LI) %	Using LI Rear Azim Range	Plus LI Front Elev Range	QTH Noise Level dB	Noise Margin dB	MDS dBW	RX Noise Figure dB	Feed System Losses dB	Note	Length m	Height m	Width m
DoubleSizeLobster 472kHz.csv	-43,5	0°	28°	-51,3	7,8	-56,7	13,1	76,4	80°-280°	80°-90°	73	13,7	-135,7	3,0	2,0	Rural	16,0	15,0	5,0
TripleSizeLobster 472kHz.csv	-36,3	0°	29°	-44,1	7,8	-49,4	13,1	76,3	80°-280°	80°-90°	73	20,9	-135,7	3,0	2,0	Rural	24	22,0	6,0
GP 472kHz.csv	2,4	0°	21°	-2,7	5,0	-2,7	5,0	96,5	80°-280°	80°-90°	81	70,3	-125,0	3,0	2,0	Residential	310	154,8	310,0
BasicLobster 472kHz.csv	-55,4	0°	28°	-63,1	7,8	-68,4	13,1	78,0	80°-280°	80°-90°	81	9,9	-127,5	3,0	2,0	Residential	8	8,5	4,0
DoubleSizeLobster 472kHz.csv	-43,5	0°	28°	-51,3	7,8	-56,7	13,1	76,4	80°-280°	80°-90°	81	21,7	-127,8	3,0	2,0	Residential	16,0	15,0	5,0
TripleSizeLobster 472kHz.csv	-36,3	0°	29°	-44,1	7,8	-49,4	13,1	76,3	80°-280°	80°-90°	81	28,9	-127,8	3,0	2,0	Residential	24	22,0	6,0
LIRA L30 v01.csv	-61,4	0°	22°	-71,2	9,9	-81,2	19,8	49,9	80°-280°	80°-90°	73	-6,2	-133,0	3,0	2,0	Rural	30	9,0	4,0
LIRA L50 v04 H13 W4Cu.csv	-48,3	0°	23°	-58,2	9,9	-69,6	21,2	36,3	80°-280°	80°-90°	73	6,8	-137,5	3,0	2,0	Rural	50	13,0	5,0
LIRA L50 v05 H17 W6Cu.csv	-44,9	0°	23°	-54,7	9,9	-65,7	20,8	38,7	80°-280°	80°-90°	73	10,3	-137,7	3,0	2,0	Rural	50	17,0	5,0
LIRA L50 v06 H22 W6Cu.csv	-41,5	0°	22°	-51,4	9,8	-62,1	20,5	40,1	80°-280°	80°-90°	73	13,6	-137,7	3,0	2,0	Rural	50	22,0	6,0