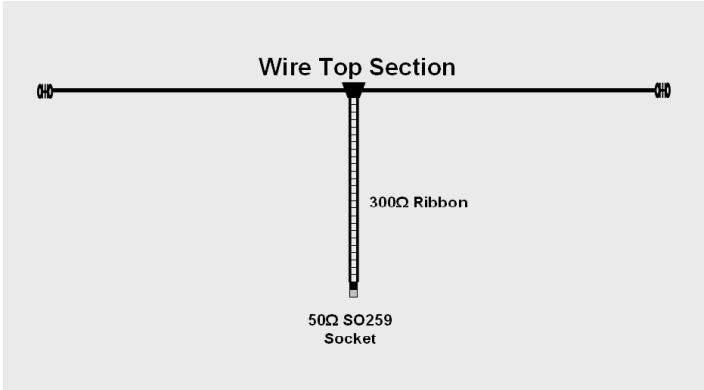
An Overview of the G5RV Antenna:

Understanding its Design and Operation.

Presented by:

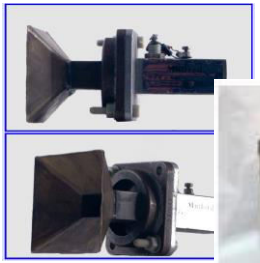
Mike Parkin

GØJMI



Concept of G5RV Antenna

Introduction



Mike Parkin:

- First licensed as G8NDJ in 1977.
- Became GØJMI in 1988.
- Interests in Radio have included:
  - Microwave Bands (Built from 23cm to 6mm)
  - 6m, 10m and 12m operating SSB/CW
  - 60m and 80m CW QRP
  - 472KHz (just got on band)
  - Building equipment (Tx, Rx, PSU)
  - Antennas (Designing, Building and Using)
  - Operating as /P
- QTH: Alton, Hampshire.
- BSC(Hons) MIET CEng MCGI (Electrical, Telecoms & Radio Engineer)

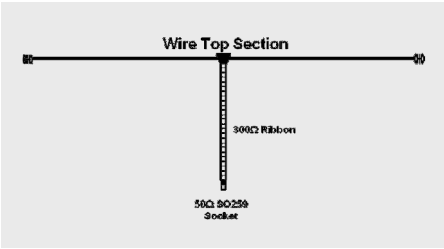
Presentation Content

1. Background.
2. Design Objectives.
3. Back to Basics.
4. Design of the Full Size G5RV.
5. Full Size G5RV Operation.
6. Half Size G5RV.
7. Designing a G5RV Derivative.
8. Useful Tips.
9. Summary.
10. Q&A Session.

Background:

The G5RV Antenna, an Overview:

- Basic antenna was devised by Louis Varney G5RV and design dates from 1946.
- The antenna is resonant on one band (20m for the 'Full Size' G5RV), but is able operate on several HF Amateur bands.
- Antenna was described in the November 1966 issue of the *RSGB's Bulletin.*
- Louis' concept was as a limited space antenna that will work on the HF bands from 80m to 10m. Had to fit in his home's 100ft long garden in Stony Stratford.



Background:

Louis Varney MIEE C.Eng, G5RV. A Short Summary:

- Born in 1911, London.
- Attended Hendon Secondary School.
- Granted an Artificial Aerial licence 2ARV in 1927.
- Granted Full Licence G5RV in C.1930 following a submission to the GPO's PMG on oscillator development.
- Held about 60 call-signs internationally!
- He was one of the founder Members of the Chelmsford Amateur Radio Society in 1936. He was a member of the Mid-Sussex Amateur Radio Society in his retirement. Was an RSGB member for 74 years.
- Worked for the Marconi Company as an instructor and on overseas radio maintenance/testing engineer/manager.
- Rose to Captain in Royal Corps of Signals during WW2.
- Died in 2000, Burgess Hill, Sussex.

Design Objectives

G5RV:

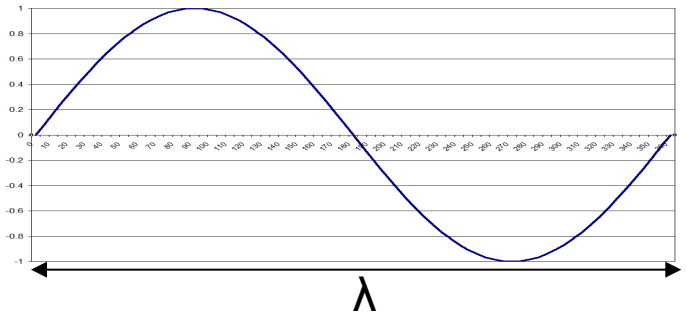
- Multiband antenna that does not use tuning (e.g. no traps or ferrite beads used).
- Straightforward to make.
- Lightweight.
- Ease of installation.
- Reliable.
- Still work even when ends have to be bent over.
- Able to handle 400w.

Back To Basics:

Wavelength (λ):

One Wavelength (λ): 360º or 2π Radians

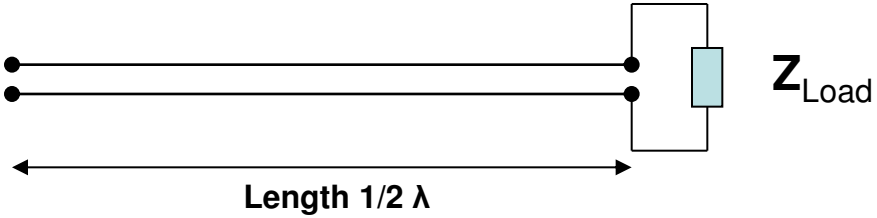
$$\lambda = \frac{300}{\text{Frequency in MHz}}$$



Transmission Line as a Transformer:

$Z_{in} = Z_{Load}$

But only at frequency corresponding to λ.



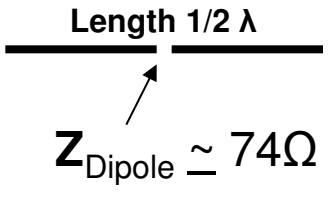
Z_{Load}

Velocity Factor (V_f)

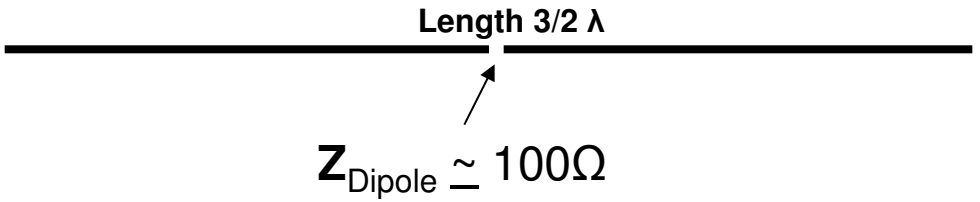
A Radio Wave travels slower in a medium (e.g. copper) than in air, this Velocity Factor ($\mathbf{V_f}$) is usually quoted as a decimal fraction (e.g. 0.98). $\mathbf{V_f}$ depends upon the material making up cable, e.g. plastic, copper, air. Can be as low as 0.8 for some Ladder Cable types.

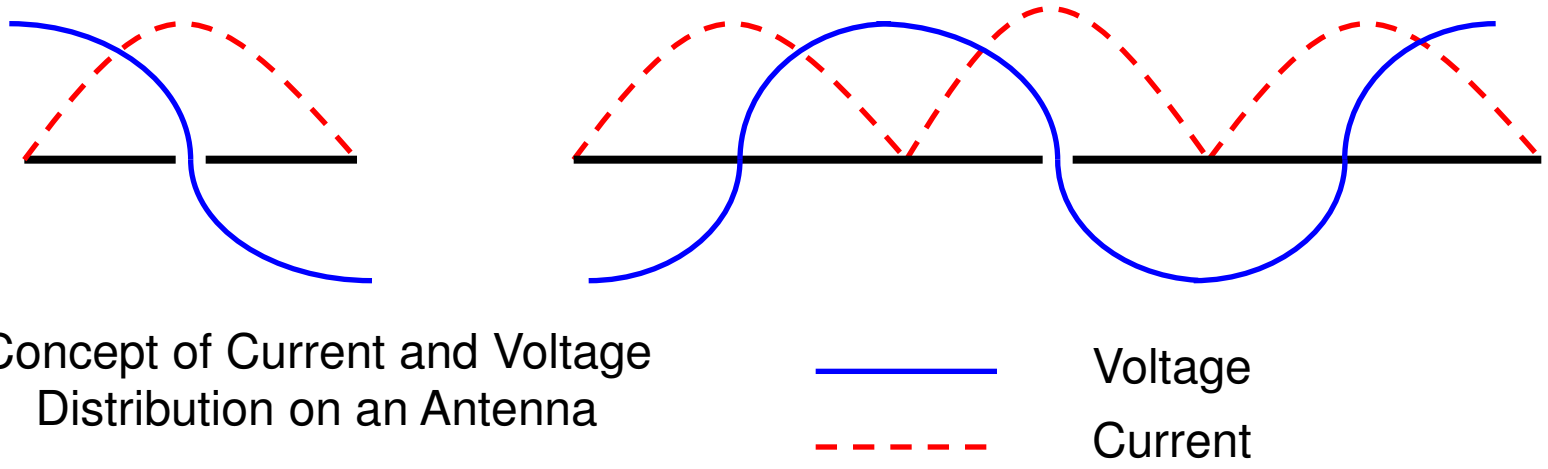
Back To Basics:

The 1/2 Wavelength Dipole:



The 3/2 Wavelength Dipole:

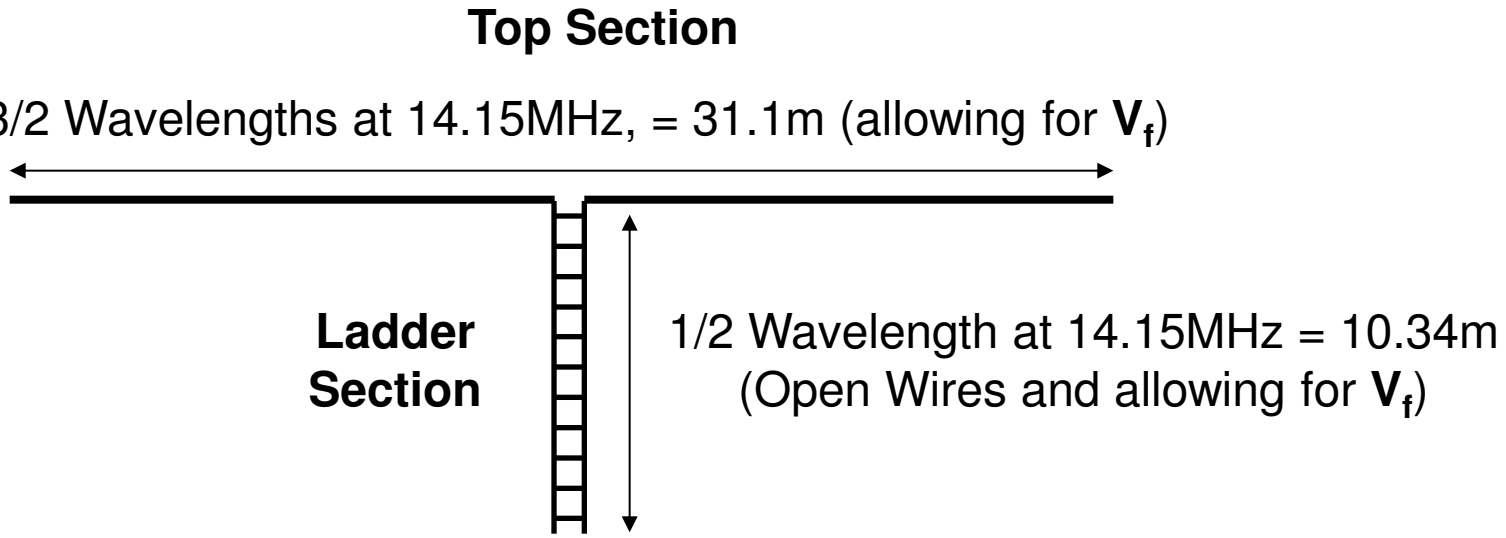




Concept of Current and Voltage Distribution on an Antenna

Design of the Full Size G5RV:

Designed for use between 80m and 10m, Resonant Band is 20m.



Top Section Length = **492(n-0.05)/14.15MHz**, where n = 3 1/2 Wavelengths, n-0.05 allows for V_f

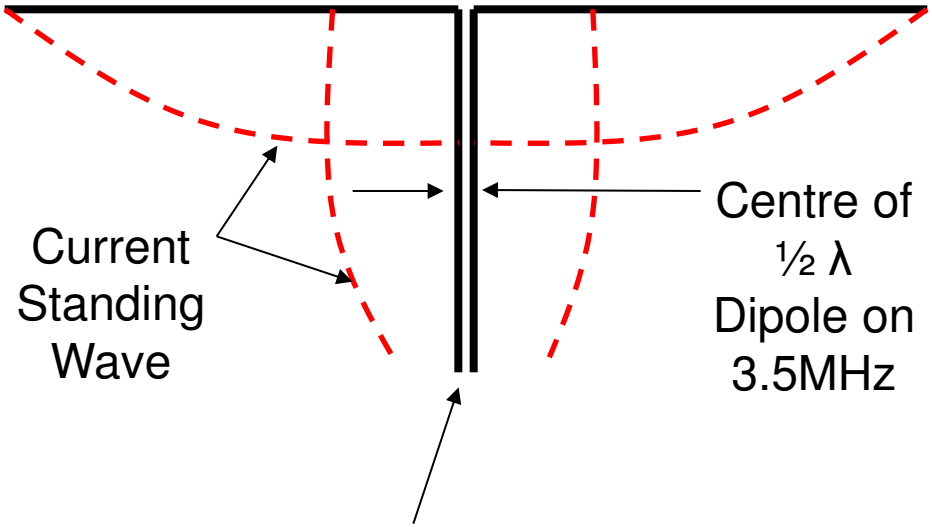
Ladder Section:

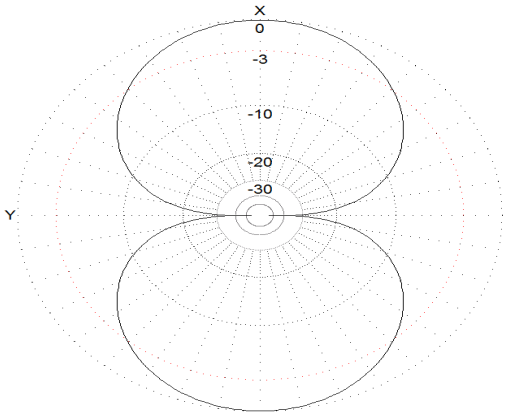
Always carries a standing-wave of current (and voltage), so its actual impedance is not important (often open wires, 300Ω or 450Ω Ladder Line used).

1/2 Wavelength Ladder Line is shorter due to V_f.

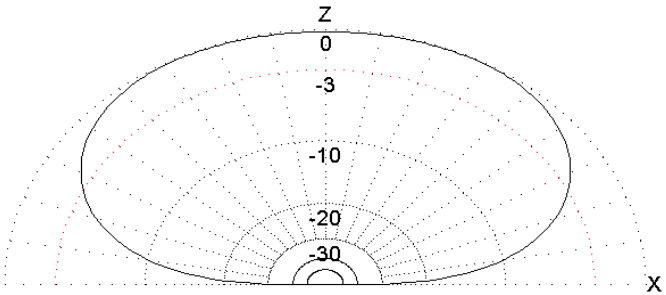
Full Size G5RV Operation

3.5MHz, 80m Band





Predicted Horizontal Polar Plot of Field Strength, free space.

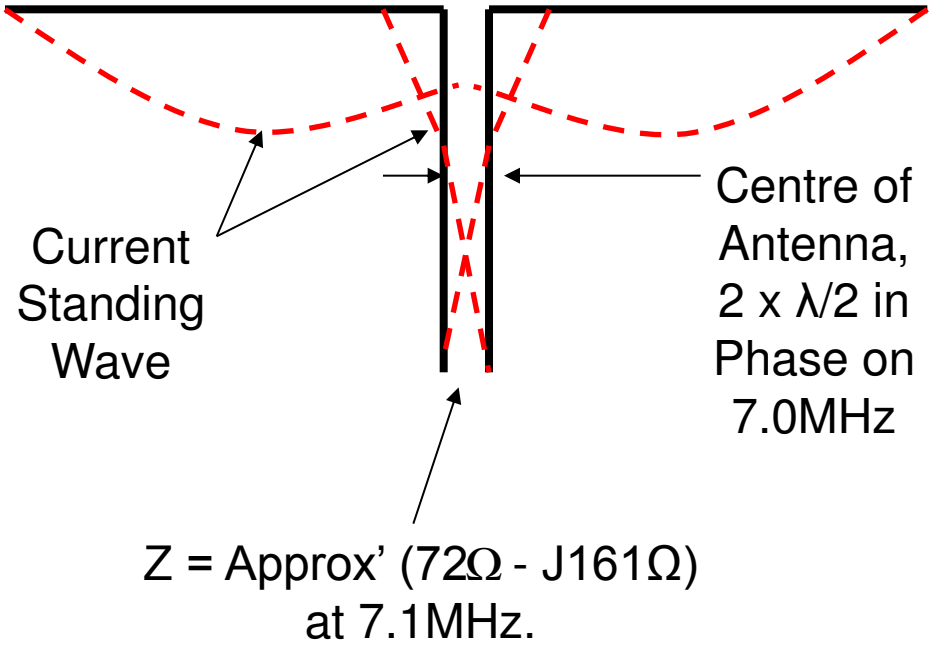


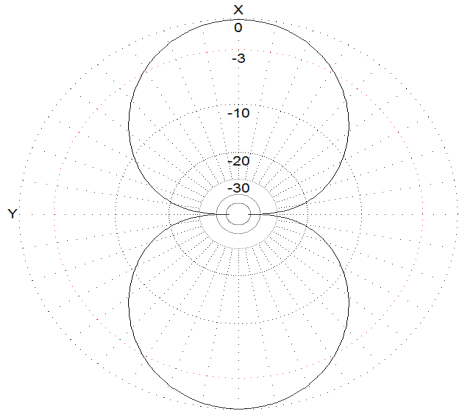
Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

Antenna is like a 1/2λ Dipole folded at its centre. Length approx' 70% of 80m Dipole.

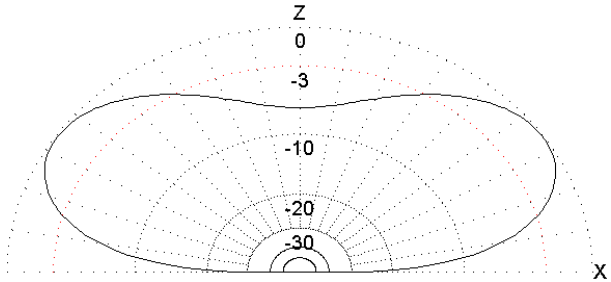
Full Size G5RV Operation

7.0MHz, 40m Band





Predicted Horizontal Polar Plot of Field Strength, Free Space.

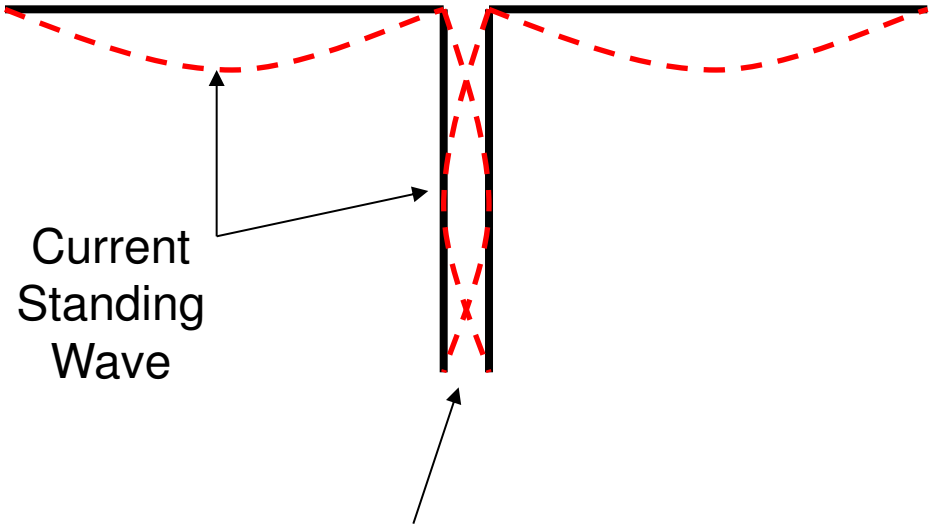


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

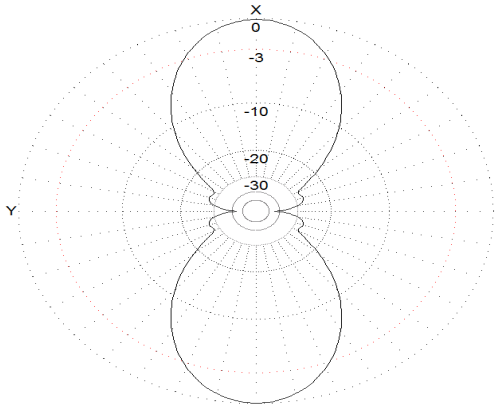
Antenna acts as a colinear with two 1/2λ fed in phase.

Full Size G5RV Operation

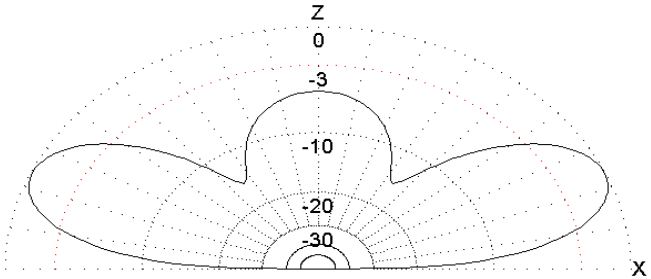
10MHz, 30m Band



Z = Approx' (39Ω + J334Ω) at 10.12MHz.



Predicted Horizontal Polar Plot of Field Strength, Free Space.

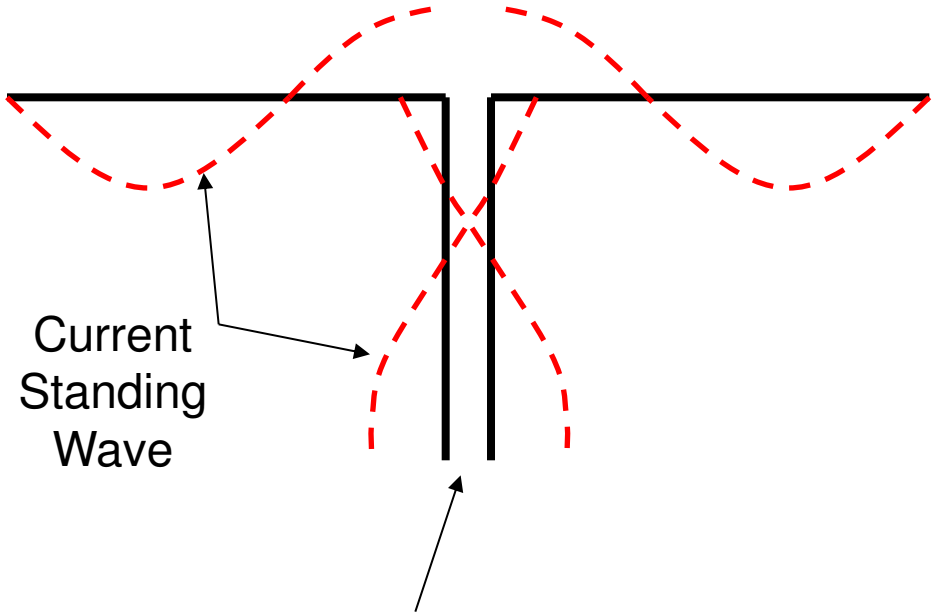


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

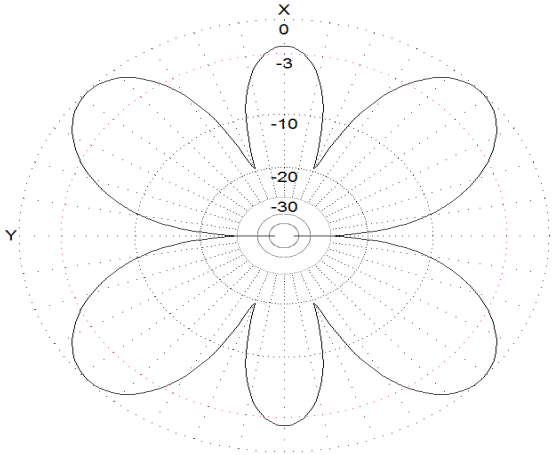
Antenna acts as a colinear with two 1/2λ fed in phase.

Full Size G5RV Operation

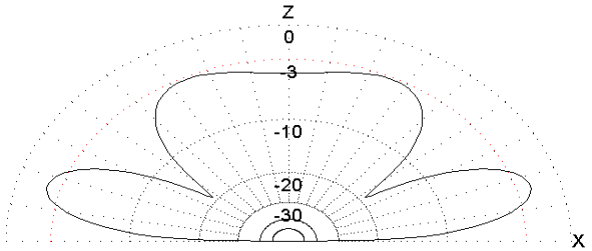
14.0MHz, 20m Band



Z = Approx' (106Ω - J102Ω) at 14.15MHz.



Predicted Horizontal Polar Plot of Field Strength, Free Space.

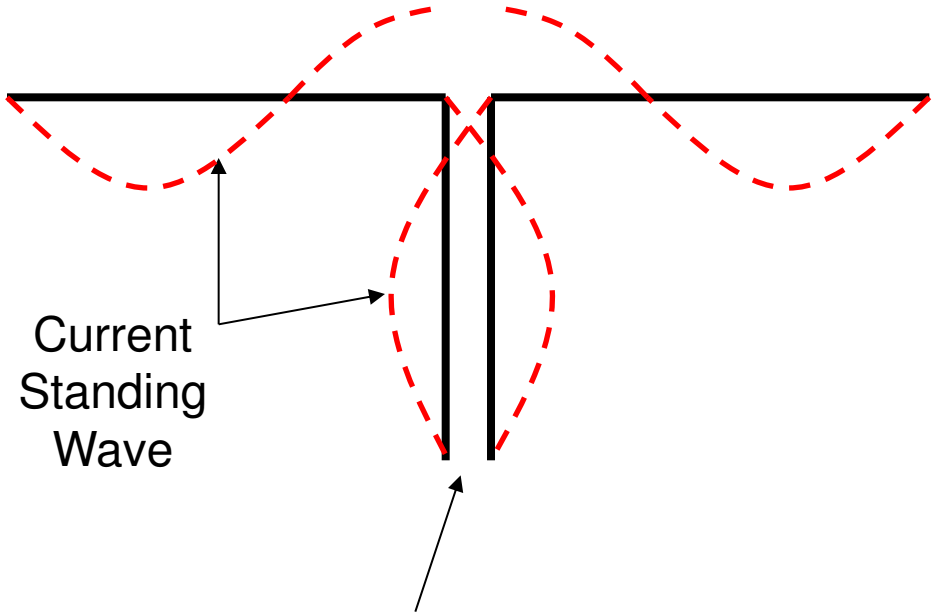


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

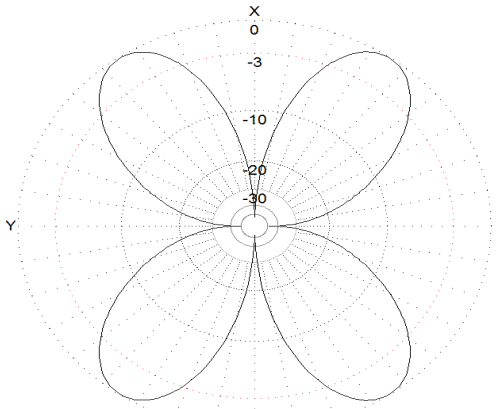
20m is the Full Size G5RV's Resonant Band. Fairly low angle of radiation.

Full Size G5RV Operation

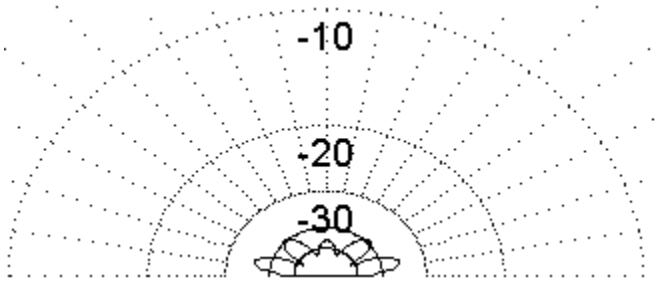
18.0MHz, 17m Band



Z = Approx' (151Ω - j500Ω) at 18.12MHz.



Predicted Horizontal Polar Plot of Field Strength, Free Space.

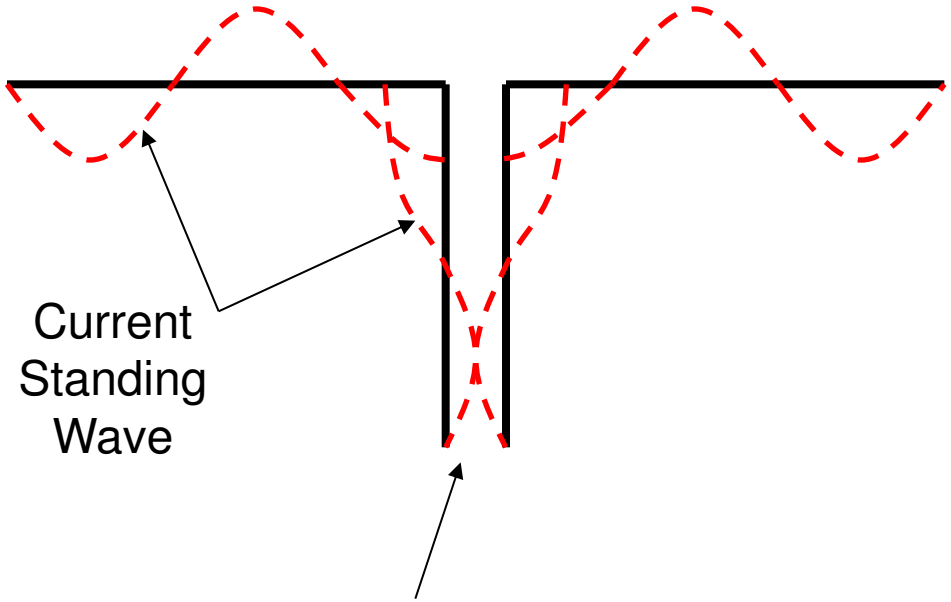


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

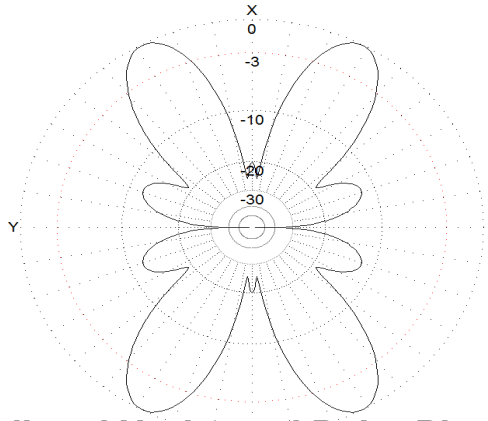
Antenna acts as a two λ wires, folded up centre, fed in phase. Low radiation angle.

Full Size G5RV Operation

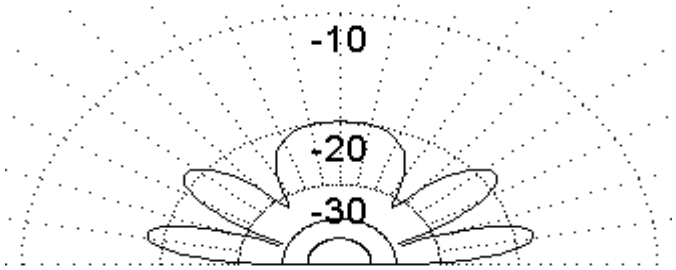
21.0MHz, 15m Band



Z = Approx' (37Ω + j66Ω) at 21.2MHz.



Predicted Horizontal Polar Plot of Field Strength, Free Space.

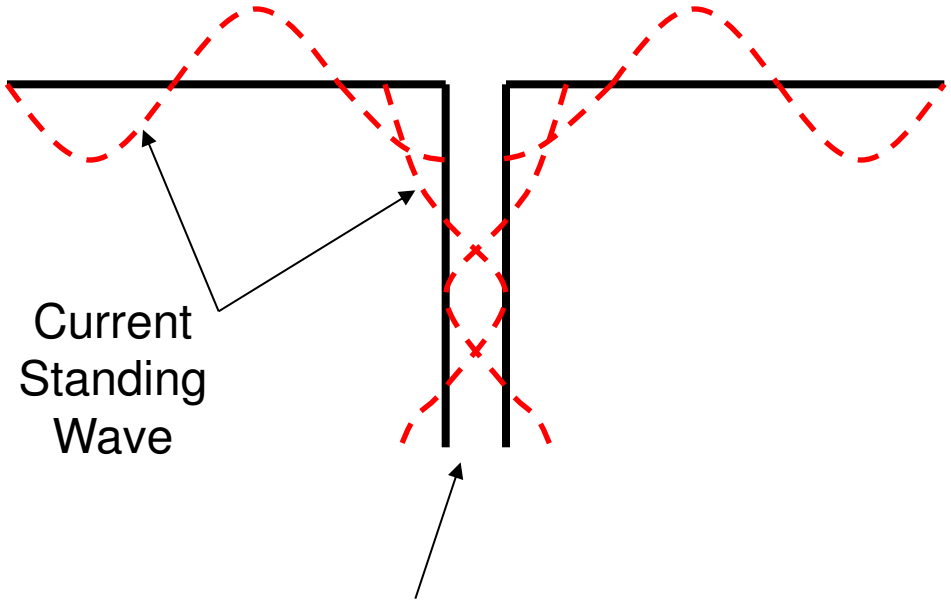


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

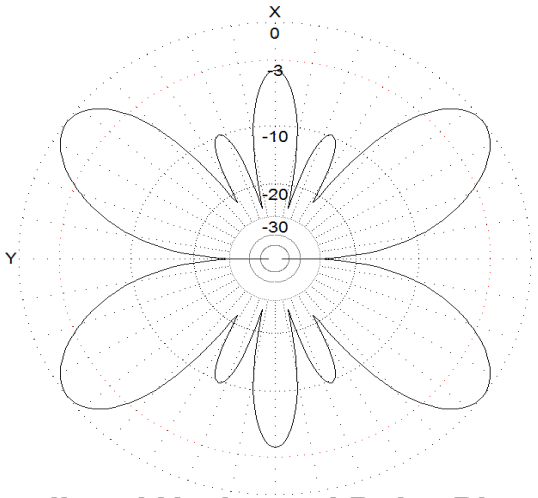
Antenna is a 5λ/2 wire presenting a high Z to transmitter. Higher radiation angle.

Full Size G5RV Operation

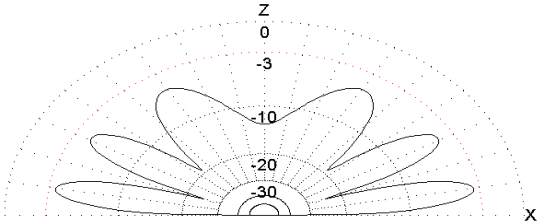
24.9MHz, 12m Band



Z = Approx' (137Ω - j91Ω) at 24.94MHz.



Predicted Horizontal Polar Plot of Field Strength, Free Space.

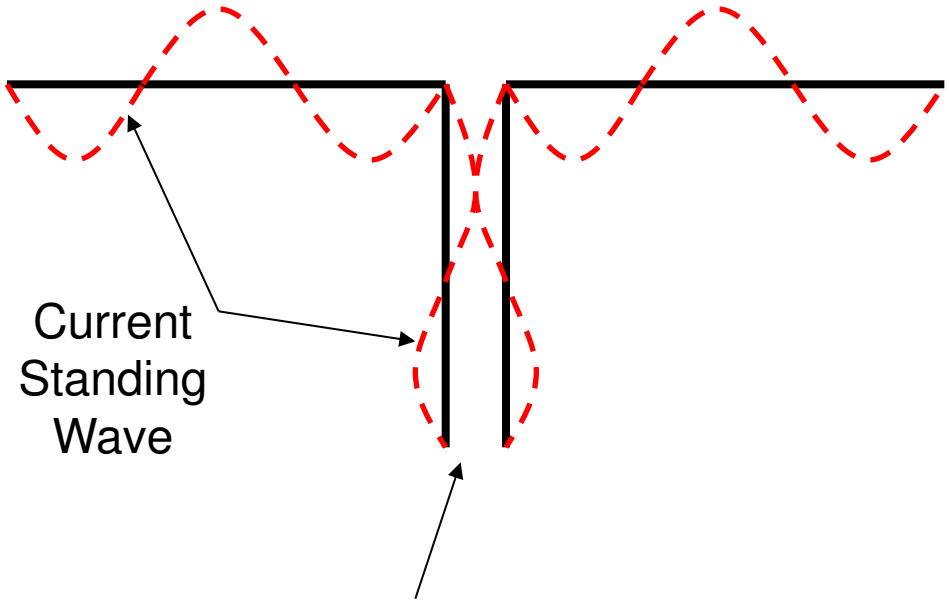


Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

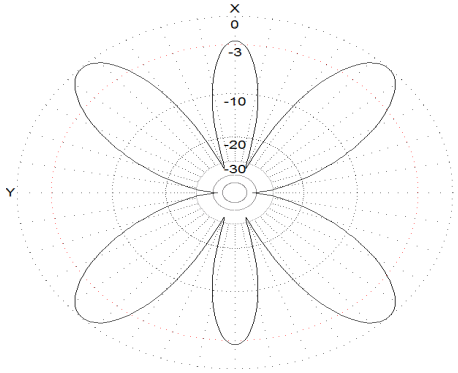
Antenna is 5λ/2 wire with a high Resistive Z seen by transmitter. Higher radiation angle.

Full Size G5RV Operation

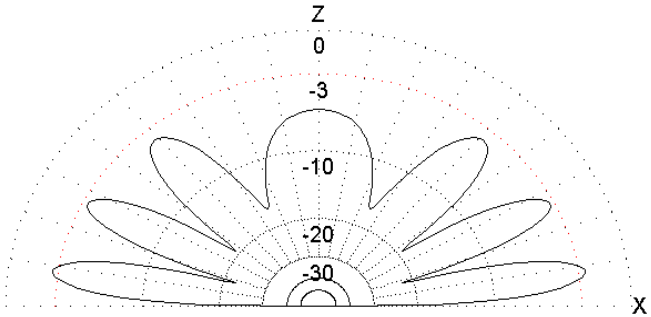
28.0MHz, 10m Band



Z = Approx' (37Ω + J2Ω) at 28.5MHz.



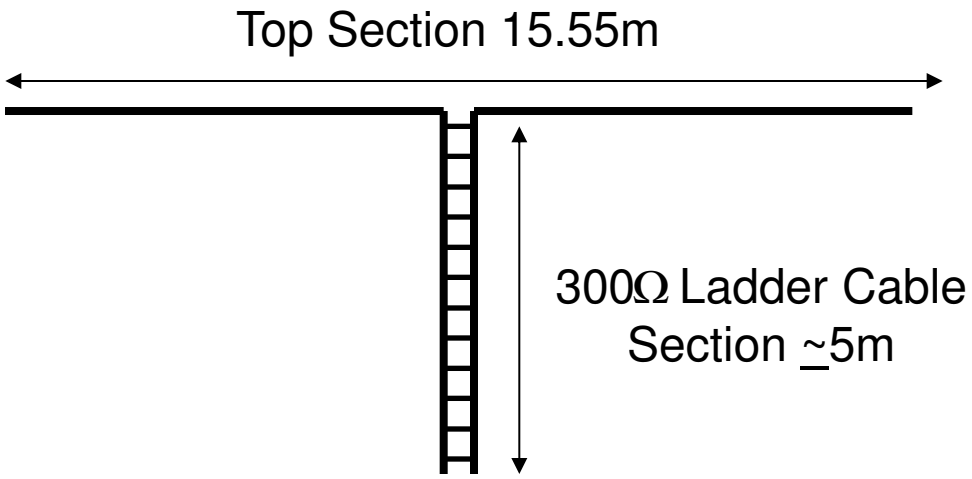
Predicted Horizontal Polar Plot of Field Strength, Free Space.



Predicted Vertical Polar Plot of Field Strength, Antenna at 7m agl.

Antenna acts as two 3λ/2 wires fed in phase with low angle of radiation.

Half Size G5RV



Resonant Band: 10m (i.e. Three λ/2 long)

Ladder Line is λ/2 long at 10m, 4.7m (allowing for V_f).

Bands: 40m, 30m, 20m, 17m, 15m, 12m and 10m.

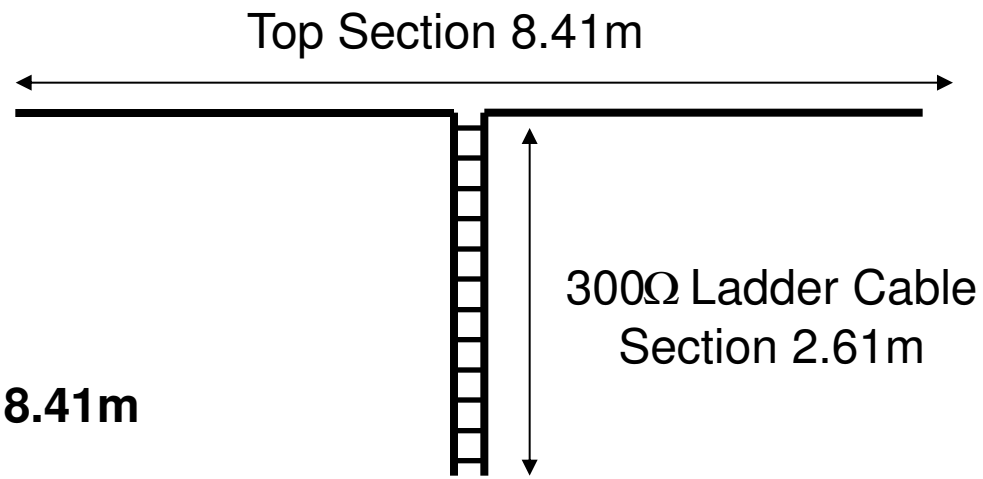
Basis for 4010RV

Designing a G5RV Derivative

Resonant Frequency: 50.2MHz.

λ = 300/50.2 or 5.98m

λ/2 = 2.99m



Top Section is 3λ/2, or 8.97m long.

Allowing $\mathbf{V_f}$ = 0.935, Top Section = **8.41m**

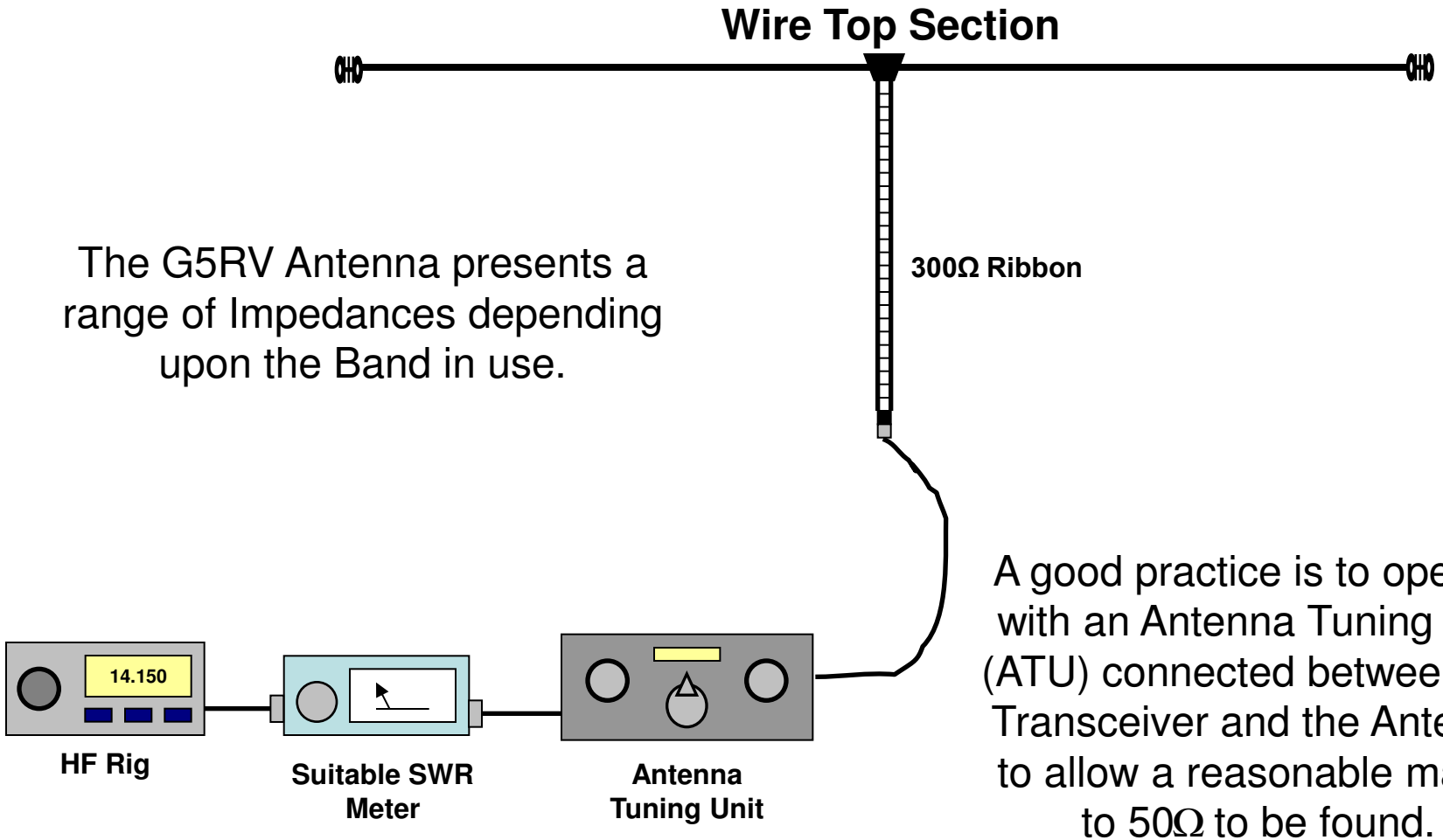
Ladder Section is λ/2 or 2.99m.

Allowing $\mathbf{V_f}$ = 0.88 for 300Ω Ladder Cable gives **2.61m**

Bands: 20m, 17m, 15m, 12m, 10m and 6m

Basis for 206RV

Useful Tips

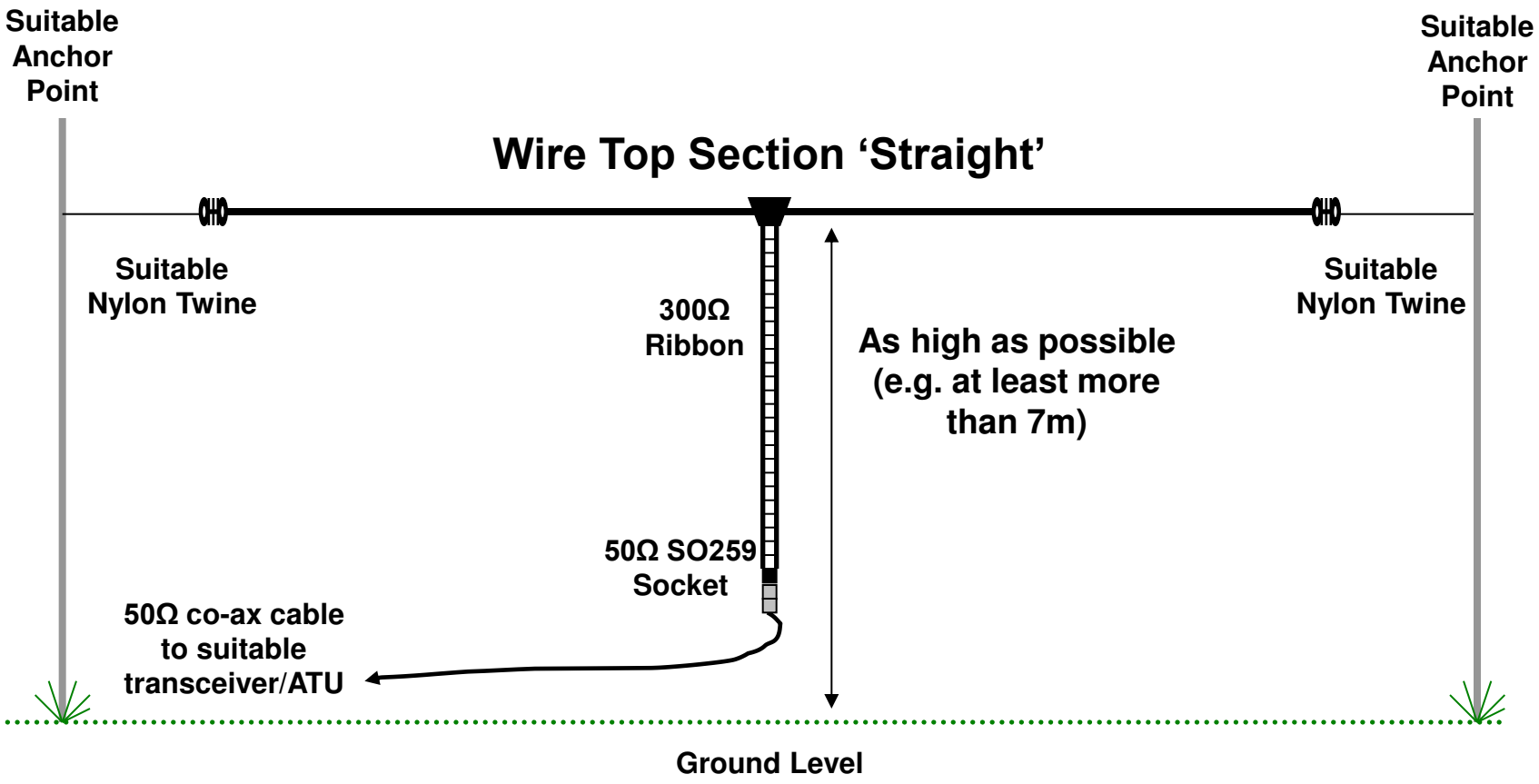


The G5RV Antenna presents a range of Impedances depending upon the Band in use.

A good practice is to operate with an Antenna Tuning Unit (ATU) connected between the Transceiver and the Antenna to allow a reasonable match to 50Ω to be found.

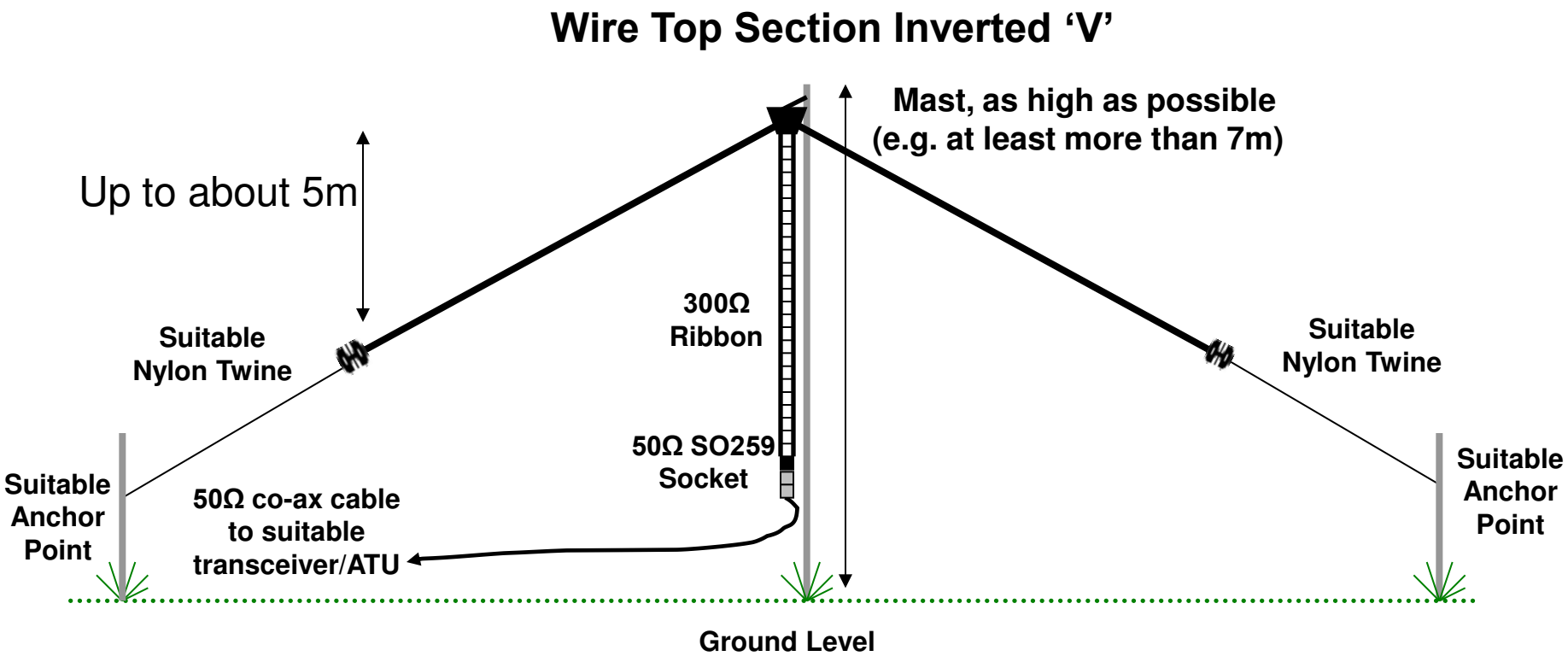
Useful Tips

A typical arrangement, ‘Straight’:



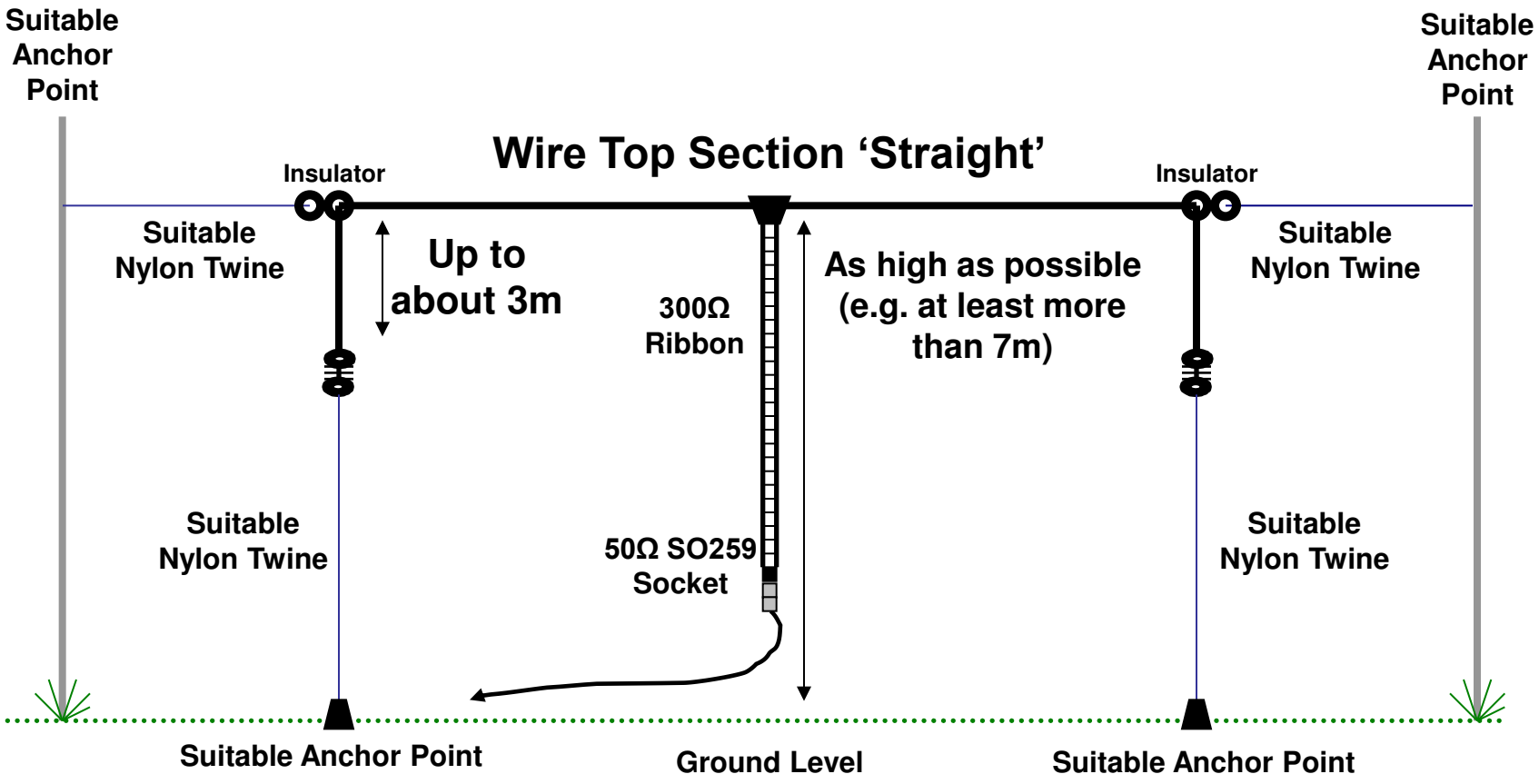
Useful Tips

A typical arrangement, Full Size G5RV as an ‘Inverted V’:



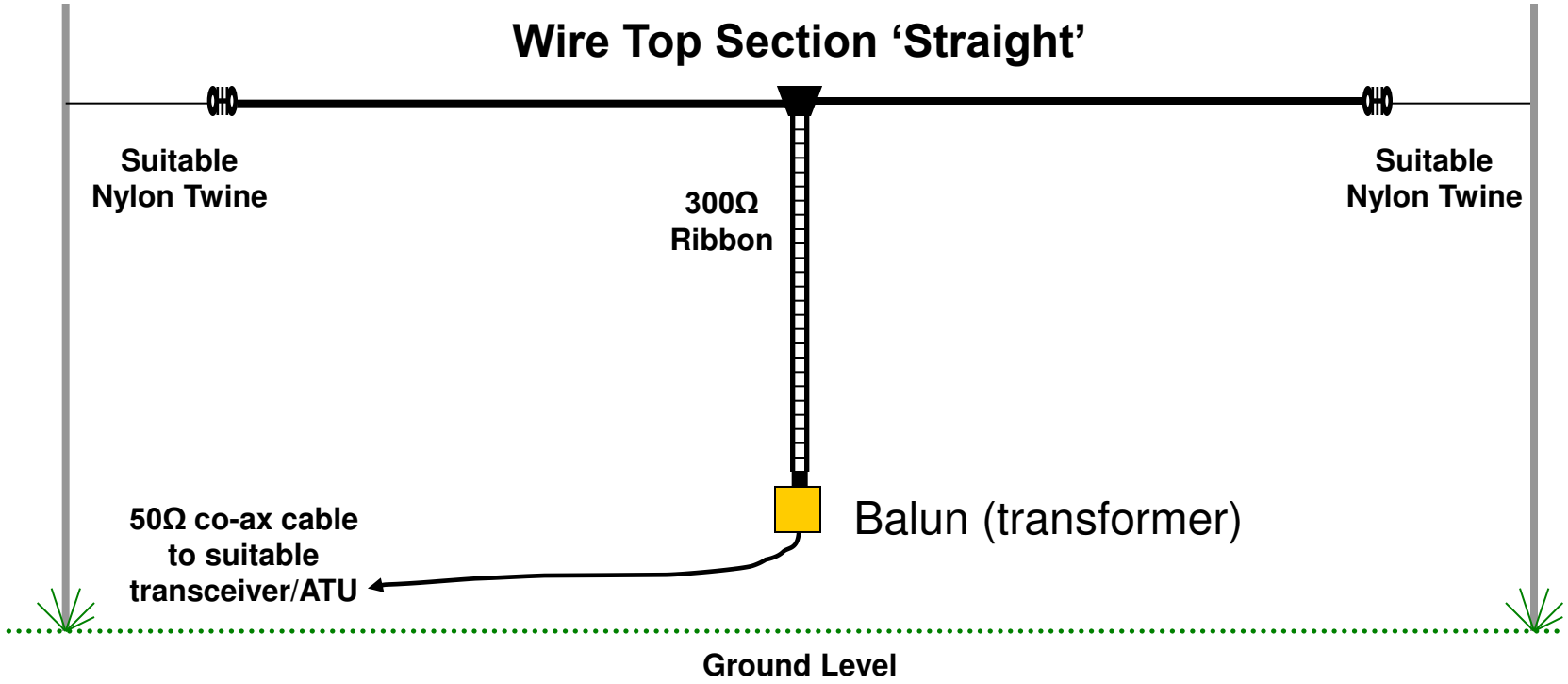
Useful Tips

A typical arrangement, Full Size G5RV installed ‘to Fit Space Available’:



Useful Tips

A typical arrangement, Using a Balun:



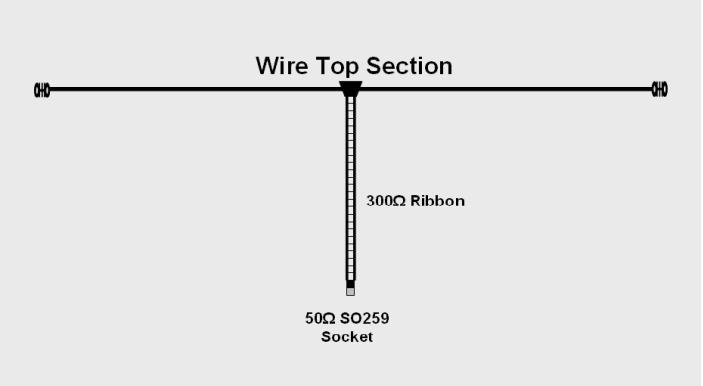
Sometimes the ATU can not find a 50Ω match, unless a 1:1 or a 4:1 Balun is used between the balanced Ladder Line and unbalanced Co-Ax Cable.

Summary

- Background.
- Design Objectives.
- Back to Basics.
- Design of the Full Size G5RV.
- Full Size G5RV Operation.
- Half Size G5RV.
- Designing a G5RV Derivative.
- Useful Tips.
- Summary.
- Q&A Session.

Thank you for listening

Question Session



Concept of G5RV Antenna