

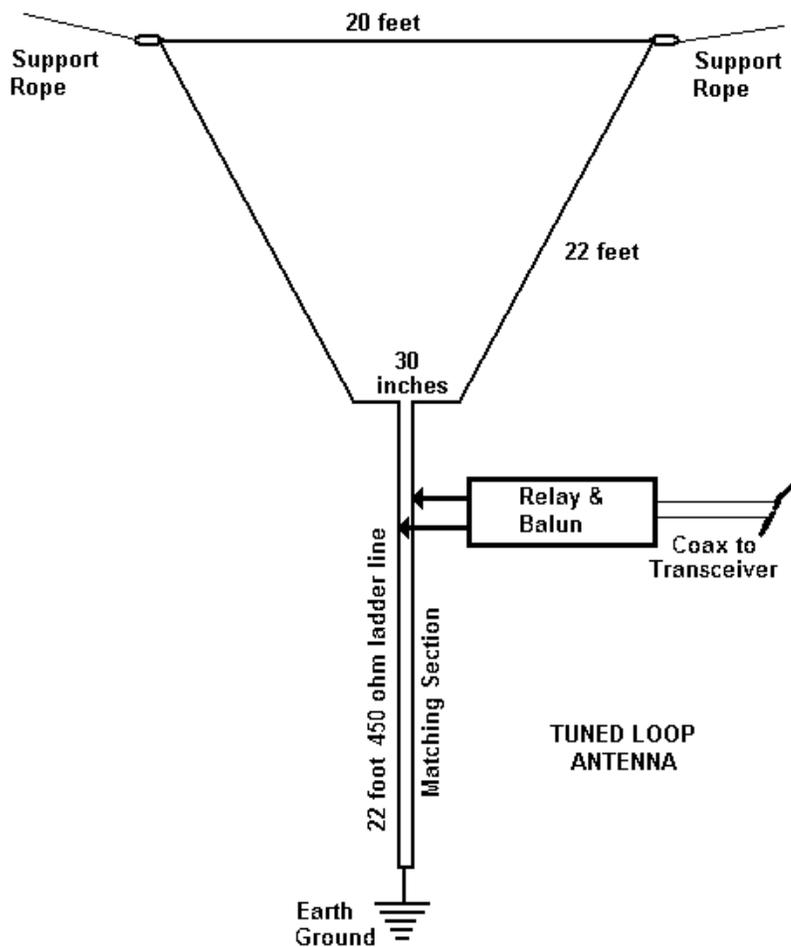
Tuned Loop Antenna – 20 through 10 meters - Revised:

2015-11-06

At K0MPH, a tuned loop antenna is used on the 20, 15 and 10 meter bands. I was inspired by George Badger, February 2008 QST - "The W6TC DX Loop", and Les Moxon, "HF Antennas for all locations", to create the loop in a space between two trees in my yard. I chose a loop because the feed line does not have to be supported by the antenna thus reducing the stress on the trees and enabling the antenna to be a few feet higher. The tuned loop aids in rejections of signals from a second transmitter (and antenna) operating on an different band. Yet it can cover several bands. Also it is fairly stealthy, except for the white support ropes. Because a tuned loop antenna is not a popular ham antenna, I thought others may be interesting in seeing its implementation reported on a web page

General Description

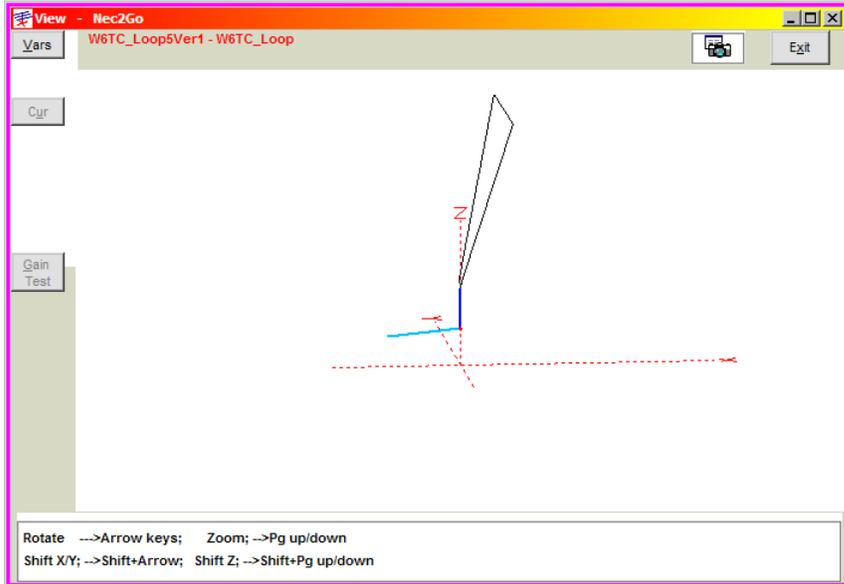
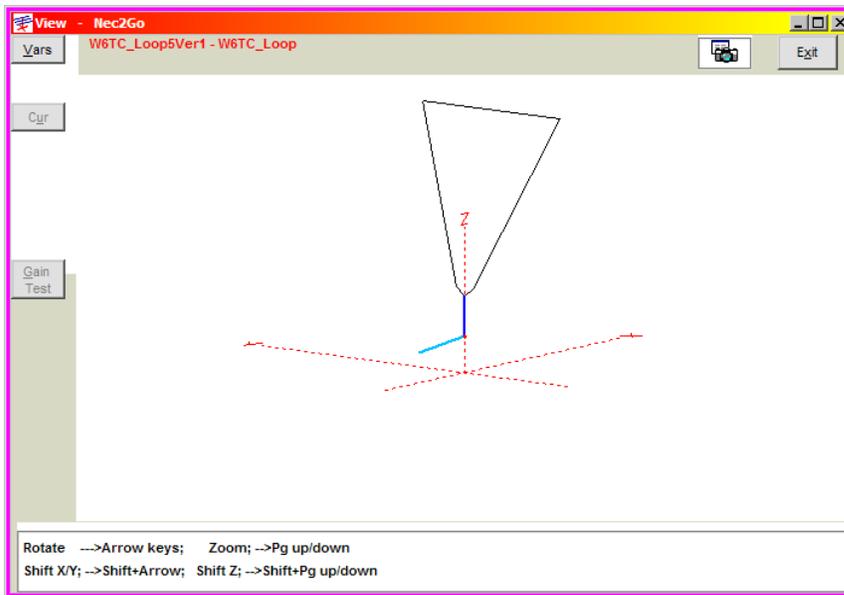
The figure below shows the general construction. At the top is a 20 foot wire supported by ropes hung between two trees. Two 22 foot wires connect the top wire to a 22 foot length of 450 ohm ladder line. The bottom end of the ladder line is shorted and connected to a ground rod. The matching section is "tapped" for connection to the transceiver. There is one "tap" for each band. For three bands there are three "taps" (only one is shown in the figure below). At each "tap" there is a balun and a relay. The relay connects the balun to the matching line when the band is selected and the balun transforms the balanced line to unbalanced coaxial cable and may also transform impedances if necessary. A 1:1 current balun is used on 20 and 15, meters. A 4:1 voltage balun is used on 10 meters. In addition a remote relay antenna switch connects the appropriate balun to the transceiver.



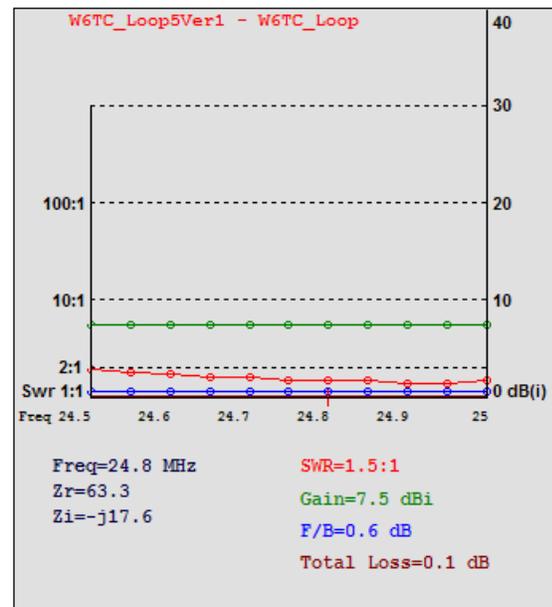
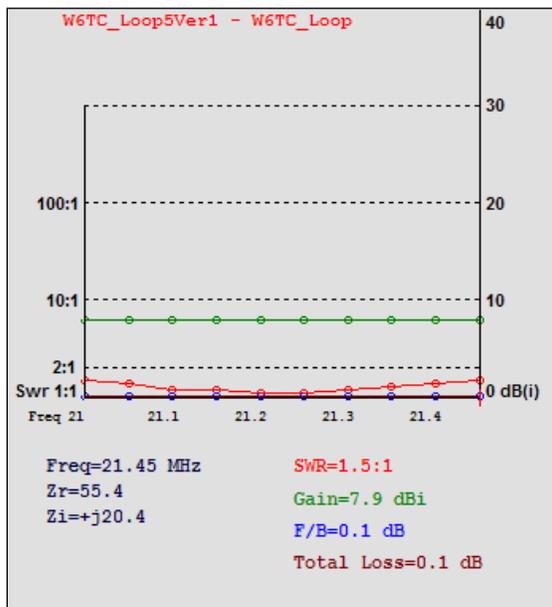
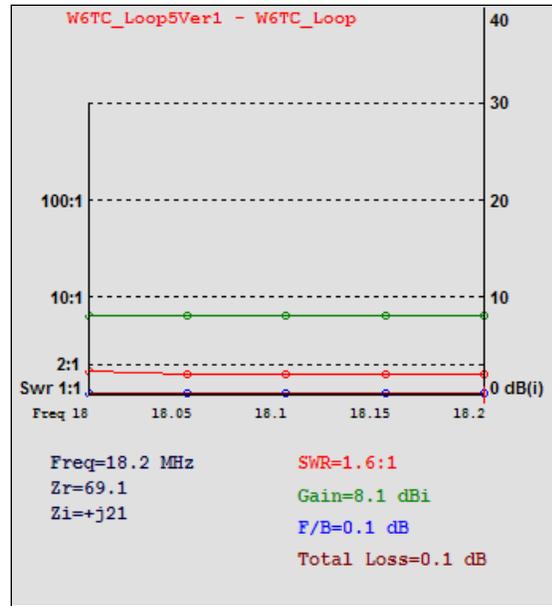
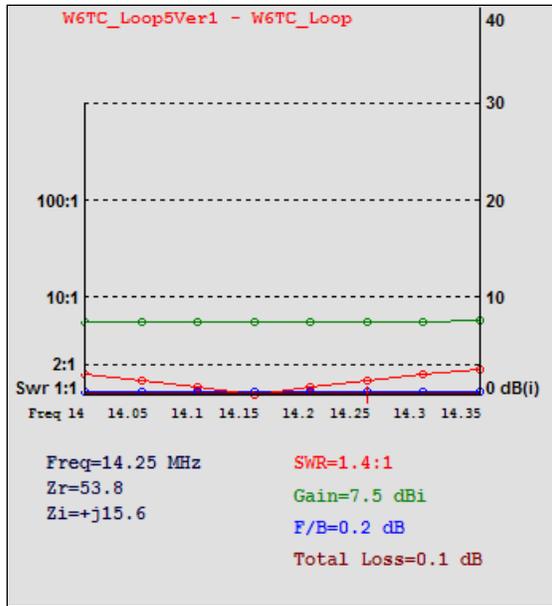
Computer Model

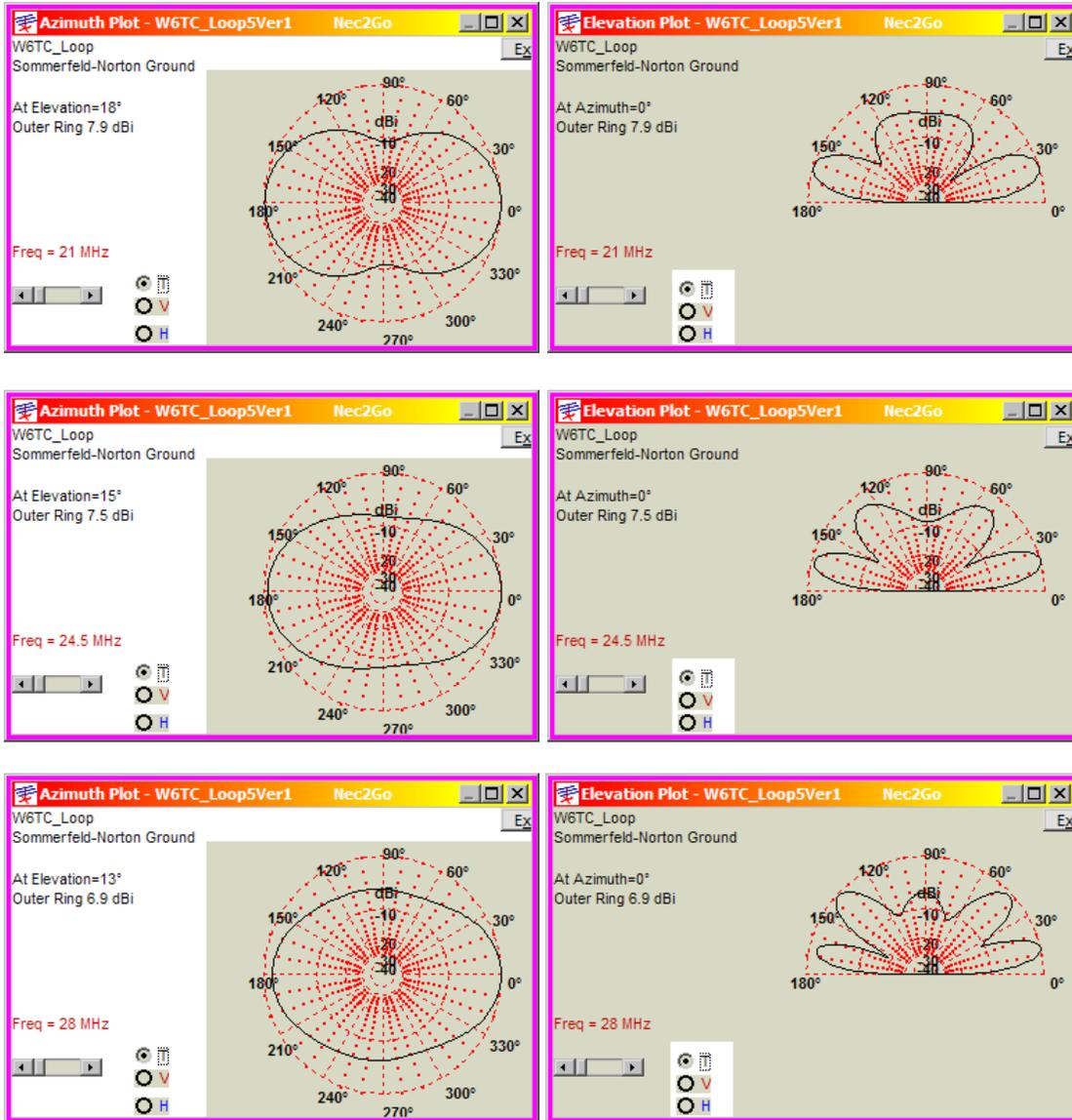
Using Nec2Go, I modeled the antenna. Nec2Go, based on NEC-2, allows the user to model antennas using a script language that can easily be changed or scaled. It also has an optimizer function that makes it possible to calculate an antenna dimensions for optimum SWR, gain or front to back ratio. A sweep function makes it possible to plot SWR, gain, and front to back ratio versus frequency or an antenna dimension. See www.Nec2Go.com for this fine and affordable program. The results of the computer model are reported below:

Basic antenna configuration viewed from two different angles. The matching section is not directly under the horizontal wire.



Predicted SWR, gain and front to back ratios for five bands based on the tap positions specified in the tuned loop script file. The 14, 18, 21, and 24 MHz bands are based on a 50 ohm match. The 28 MHz band is based on a 200 ohm match.





Construction – September 2008

A key component is the ladder line matching section and band taps. Twenty feet of 2 inch schedule 40 PVC electrical conduit supports the ladder line and band taps. Another smaller horizontal PVC electrical conduit supports the ends of the loop for connection to the ladder line. The picture below shows the upper 20 meter band tap and the lower 15 meter band tap. Above the 20 meter band tap, the ladder line is routed down the PVC electrical conduit. Below the 20 meter band tap, the coax and control cable are routed down the PVC conduit and the ladder line is supported by the band taps. The PVC conduit is tied with rope to the deck railing.



Connection of the loops to the matching support structure A 144/440 MHz vertical and 6 meter beam with its radials is in the back ground.



The ten meter band tap with the ladder line going below the deck for earth ground connection.



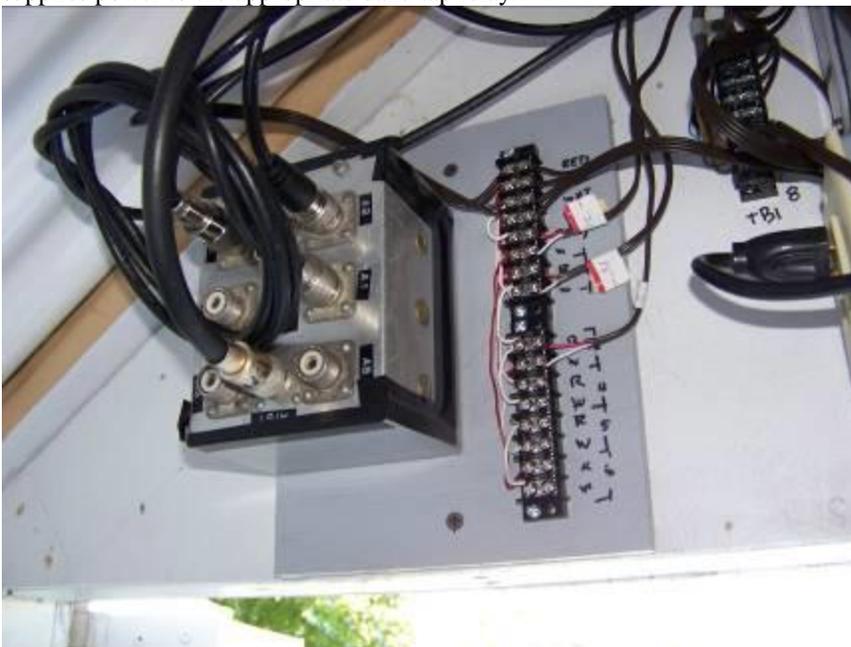
One of the band taps with the cover removed. The relay used is adequate for 100 watts. There is no QRO at KOMPH.



Puncturing the ladder line insulation at a band tap connection (later covered to protect the connection from the weather)



Using an old home made antenna switch box to select the active band tap. The terminal strip to the right supplies power to the appropriate band tap relay.



See if you can find the loop in this picture. All the wires in the foreground belong to the utilities. Note the new white vertical rope starting at the left end of the garage. It turns horizontal at a pulley in the tree and goes off toward the right. The loop is connected to the end of the rope. I can't see the loop in this picture either. I have watched walkers passing by staring at the rope.



Results

After raising the antenna and connecting the ladder line, the band taps were installed at the predicated locations. On 14 MHZ, the antenna initially was resonant below 14 MHZ. Changing the location of the 20 meter band tap 2.5 inches closer to the loop caused the antenna to tune the entire band with an SWR between 1.2 and 1.6. On 28 MHZ no changes were needed. The SWR ranged from 1.1 to 1.8 over the 28 to 29 MHZ range. Computer modeling may work after all.

On 21 MHZ, the antenna resonated at 19 MHZ. The 15 meter tap was moved 2.2 feet closer to the loop for resonance (no reactance) and a resistance of 27 ohms. The SWR is about 2 over the entire band. Something is amiss on 15 meters. Using the computer model to vary the various antenna dimensions, the antenna dimensions aren't critical. Only the tap position changes with modest antenna dimension changes. It is always possible to get a 50 ohm match. It was decided that something in the environment is causing the loop to be detuned. Maybe it is the 23 foot (21 MHZ half wave length) gutters on the garage. Maybe it is the guy wires for the 6 meter beam. If something in the environment is causing that much impedance change, the pattern will not be as predicted. For now I plan on living with the higher SWR and will eventually solve the problem.

I haven't yet spend much time using the antenna so I don't know how it performs. I have compared 20 meter received signals using this antenna, beaming east and west, with a dipole at the same height, beaming north and south. Sometimes there is one or two S-Unit difference depending on the location of the station, which is what I hoped to accomplish.

Computer Model File

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Tuned Loop
;By Roger Roth (K0MPH) - January 24, 2008 - Revised Aug 21, 2008
; Sloping top element - un equal height for supports
; Uninsulated wire
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Auto Seg Taper, Sommerfeld
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Freq: 21.2 MHz, Type=copper wires, Units=feet
;Insulation: Permittivity=2.5, Thickness=1mm
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; Element parameters =====
TotHt      = 40    ; Height of horizontal element
DSlope     = 0    ; Slope from one end to the other of top wire
ElLen      = 20    ; Length of horizontal element
BotHt      = 20    ; Height at feed point
BotLen     = 30/12 ; Feed wire length
Y1         = 5     ; Y distance between bottom and top

; Feed wires, and transmission lines =====
FWLen      = 0.1   ; Feed wire length
MatchLen   = 22    ; Length of Matching Transmission Line
PctPhasing = 0.505 ; Portion of MatchLen that is phasing xmission
line

;=====
; Freq      PctPhasing  Source Z  Bandwidth(Less than SWR = 2)
;-----
; 14.15    0.231     5.08ft   50    Whole Band
; 24.93    0.323     7.11ft   50    Whole Band
; 21.20    0.505    11.11ft   50    Whole Band
; 18.10    0.773    17.00ft   50    Whole Band
; 28.40    0.806    17.73ft  200    28 to 29 Mhz
; 10.15    can't match on 30 meters - Top hat is too short?
;PctPhasing - distance in chart above is from top of phasing line
;MatchLen = length of shorted 450 ohm Ladder line
;=====

; Calculations =====
TotHt1 = TotHt+DSlope/2
TotHt2 = TotHt-DSlope/2
PhaseLen = MatchLen*PctPhasing
StubLen  = MatchLen-PhaseLen
FWHt1 = BotHt - PhaseLen

; Feed wire =====
Source: Center
1 0  (-FWLen/2)    FWHt1    0  (FWLen /2)  FWHt1    #14

; Bottom wire =====
2 0  (-BotLen/2)   BotHt    0  (BotLen/2) BotHt    #14

; Top slanted element =====
3 Y1 (-ElLen/2)    TotHt1   Y1  (ElLen/2)  TotHt2   #14
; Connecting top and bottom wires =====
4 0  (-BotLen/2)   BotHt    Y1  (-ElLen/2) TotHt1   #14
5 0  (BotLen/2)    BotHt    Y1  (ElLen/2)  TotHt2   #14

; Matching and shorted stub transmission lines =====
TL: Wire 1 Center to Wire 2 Center, Type=LL450, Len=PhaseLen, Untwist ;
Phasing
TL: Wire 1 Center, Type=LL450, Len=StubLen, Untwist, Shorted ;
Parallel Stub
Comments:

;===== INFO =====
;Modelling notes:
; - Run with 200 segments

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; - Ground type: Sn