

Periscope (Flyswatter) Antenna

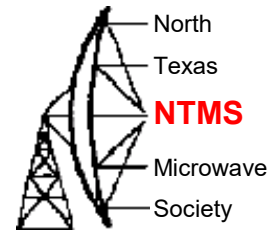
W5LUA

Al Ward

Southeast VHF Conference

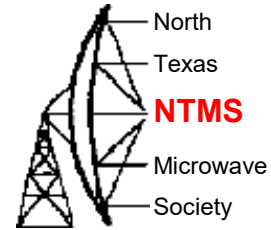
April 17, 2026

Why use a Periscope Antenna?

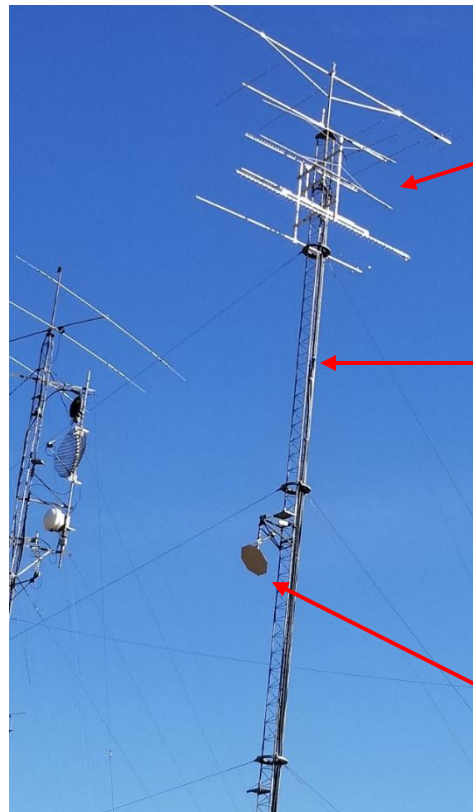


- Transmission Line losses are eliminated or minimized
- Sensitive electronics are at the base of the tower.
- Minimize climbing the tower!

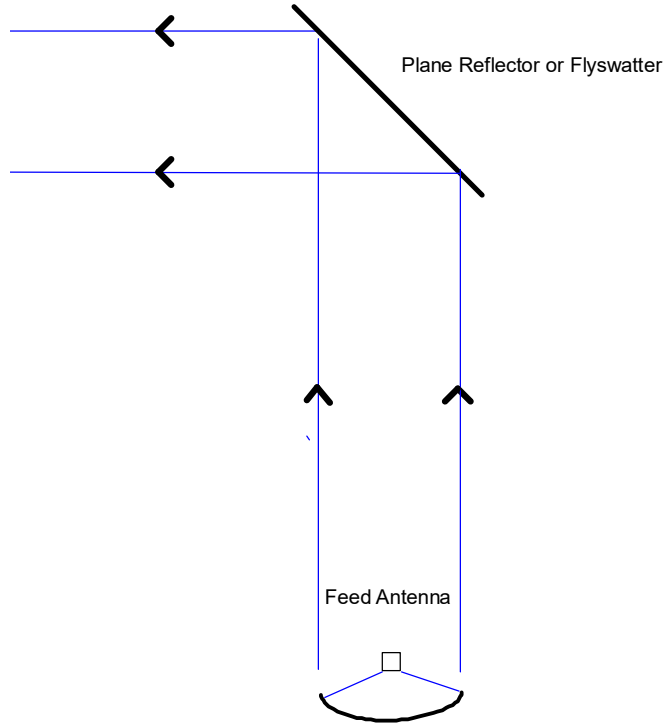
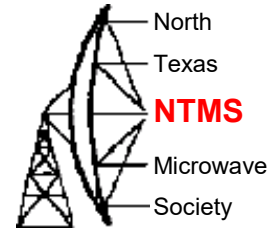
Introduction



- My son and I installed my Rohn 45 rotating tower back in 2015.
- With W5ZN's help, the VHF antennas were installed at 80 ft.
- My original plan was to install the microwave dishes between the second and third guy ring – still to be done.
- The microwave dishes are still functional on a second tower
- The plan was to install the flyswatter just under the 2nd guy ring at about 50 ft. My son Erik installed the reflector

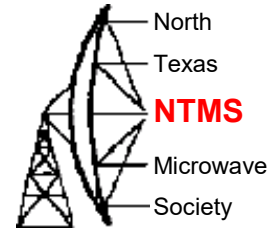


Periscope or Flyswatter Antenna



2 six foot ¼" thickness 6061-T6 Aluminum angle with turnbuckles

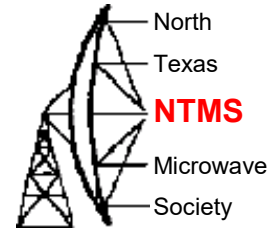
Stop Sign Flyswatter Reflector



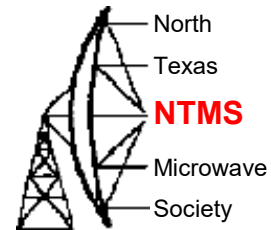
Built and originally used by KA5BOU

Small actuator used to optimize tilt from nominal 45 degree. Craig rotated the reflector since he used the reflector on a non-rotating tower. This also meant that he had to rotate the polarity of his source antenna to maintain horizontal polarity with respect to the horizon

Commercial Periscope Installation near Dublin, TX



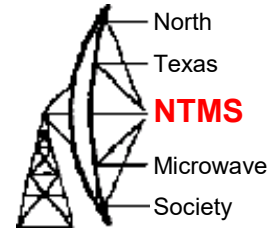
Paul Wade's Periscope Calculator



PERISCOPE ANTENNA GAIN CALCULATOR				
<i>W1GHZ 2000</i>				
ENTER INPUT PARAMETERS HERE:				
Frequency	47	GHz	my system	
Dish diameter	0.3	meters	0.3	Note: 1 meter = 3.28 feet
Flyswatter Aperture	0.76	meters	0.76	30 inches
Height (reflect. Spacing)	13.7	meters	13.7	45 ft
Suggested flyswatter =	0.4	meters - for this height and frequency		
READ FINAL RESULTS HERE:				
System Gain	28.0	dBi		
Dish Gain	40.8	dBi		
"FEEDLINE" equivalent	-12.8	dB (effective gain of periscope over dish)		
Intermediate terms -- don't mess with these				
Note: Analysis ToolPak must be installed. See "BESSELJ" in HELP				
Wavelength	0.006	meters		
Dish Rayleigh distance	28.2	meters		
Dish Directivity	21802.0			
Flyswatter Rayleigh distance	181.0			
Flyswatter Directivity	178151.8			
APPROXIMATIONS:				
G1	12496.5	41.0 dBi	spherical Bessel	
q	1.817		LAMB(1,z)	-0.04964
fc_term	0.115		LAMB(2,z)	0.161917
fs_term	0.190		LAMB(3/2,z)	0.056139
G2	1512.2	31.8 dBi	Fresnel sine & cosine	
delta_arg	4.096		x	5.187679
delta	0.056		f	0.172998
G3	24489.2	43.9 dBi	g	0.016369
Space Attenuation	0.000	-88.6 dB	fres_cos(q)	0.338687
Edge Effect	0.992	0.0 dB	fres_sin(q)	0.435391
System Gain	630.8			

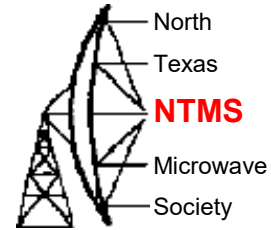
<https://www.w1ghz.org/antbook/contents.htm>

Closeup of the important numbers!



<u>PERISCOPE ANTENNA GAIN CALCULATOR</u>					
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<u>ENTER INPUT PARAMETERS HERE:</u>					
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Flyswatter Aperture	0.76	meters	0.76	30 inches	0.4 meter
Height (reflect. Spacing)	13.7	meters	13.7	45 ft	
<i>Suggested flyswatter = 0.4 meters - for this height and frequency</i>					
<u>READ FINAL RESULTS HERE:</u>					
System Gain	28.0	dBi			41.8 dBi
Dish Gain	40.8	dBi			40.8 dBi
"FEEDLINE" equivalent	-12.8	dB (effective gain of periscope over dish)			1.0 dB

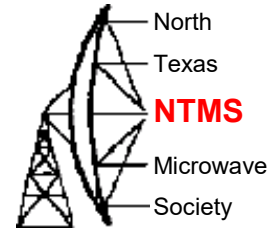
Comparison by Band



Frequency	5.76 GHz	10.3 GHz	24 GHz	47 GHz	47 GHz	76 GHz
Dish Diameter	.76m (30")	.76m (30")	.3m (12")	.3m (12")	.18m (7")	.3m (12")
Flyswatter Aperture	.76m (30")	.76m (30")	.76m (30")	.76m (30")	.76m (30")	.76m (30")
Reflector Spacing	13.7m (45ft)	13.7m (45ft)	13.7m (45ft)	13.7m (45ft)	13.7m (45ft)	13.7m (45ft)
Final Results						
Dish Gain	30.6 dBi	35.7 dBi	35.0 dBi	40.8 dBi	36.4 dBi	45.0 dBi
System Gain	27.5 dBi	34.6 dBi	37.5 dBi	28.0 dBi	28.8 dBi	37.4 dBi
Effective Gain of Periscope over Source Antenna	-3.2 dB	-1.0 dB	2.6 dB	-12.8 dB	-7.5 dB	-7.6 dB
	Table 1 Reflector Spacing 13.7m					

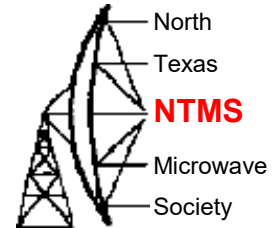
Best performance on 24 GHz, followed by 10 GHz – have not tried these bands yet
47 GHz performance could be improved with a smaller 7" source antenna

How does it work?

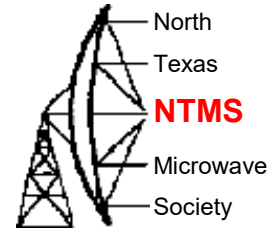


- 78 GHz – EM13 best DX 24 km
- Kuhne MKU LO 8-13 PLL-2, MKU 76 G2 xvtr 10 mW, WA1MBA LNA, 12 inch dish (45 dBi?)
- 47 GHz – Worked EM12, EM13, EM22, and EM23 at a best DX of 121 km thanks to KM5PO. These 4 plus RW3BP in KO85 via the moon provided me VUCC #22
- Kuhne MKU LO 8-13 PLL-2, MKU 47 G2 xvtr, PA .5 watt, JA8CMY LNA, 12 inch dish

47 GHz VUCC



W1GHZ Periscope Antenna Gain Calculator



Microsoft Excel interface showing the W1GHZ Periscope Antenna Gain Calculator spreadsheet. The spreadsheet includes input fields for Frequency (5.7 GHz), Dish diameter (0.77 meters), Flyswatter Aperture (0.8 meters), and Height (13.7 meters). It also displays calculated results for System Gain (28.1 dBi), Dish Gain (30.7 dBi), and "FEEDLINE" equivalent (-2.5 dB).

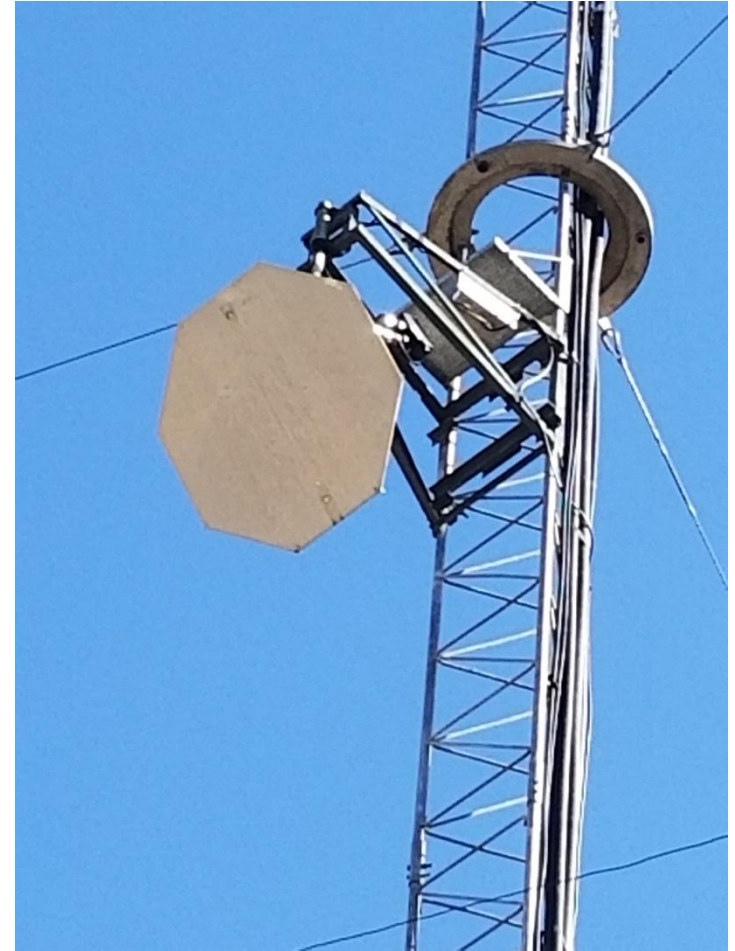
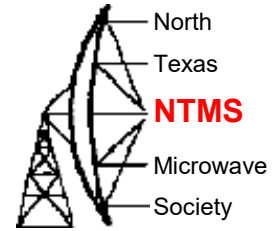
Dish diameter = 30 inches
 Reflector spacing ~ 45 ft
 Reflector above ground ~ 50 ft
 Flyswatter Aperture ~ 32 inches

Dish Dia.	Dish Gain	System Gain	Gain (periscope/dish)
35"	32 dBi	29 dBi	-3.0 dBi
30"	30.7 dBi	28.1 dBi	-2.5 dBi
24"	28.6 dBi	26.6 dBi	-2 dBi
18"	26.2 dBi	24.5 dBi	-1.7 dBi



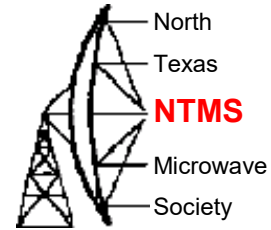
Most Important

30 inch Dish for 5760 MHz



Feed is WB5LUA Dual Band 5/10 GHz Feed

Radome



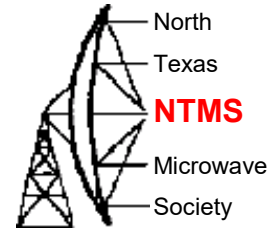
Radome purchased at Tractor Supply in Celina..

TSC 25 gal heavy duty round stock tank
SKU 222987099
\$34.99

Loss at 5760 MHz
measured at 2 to 3
dB

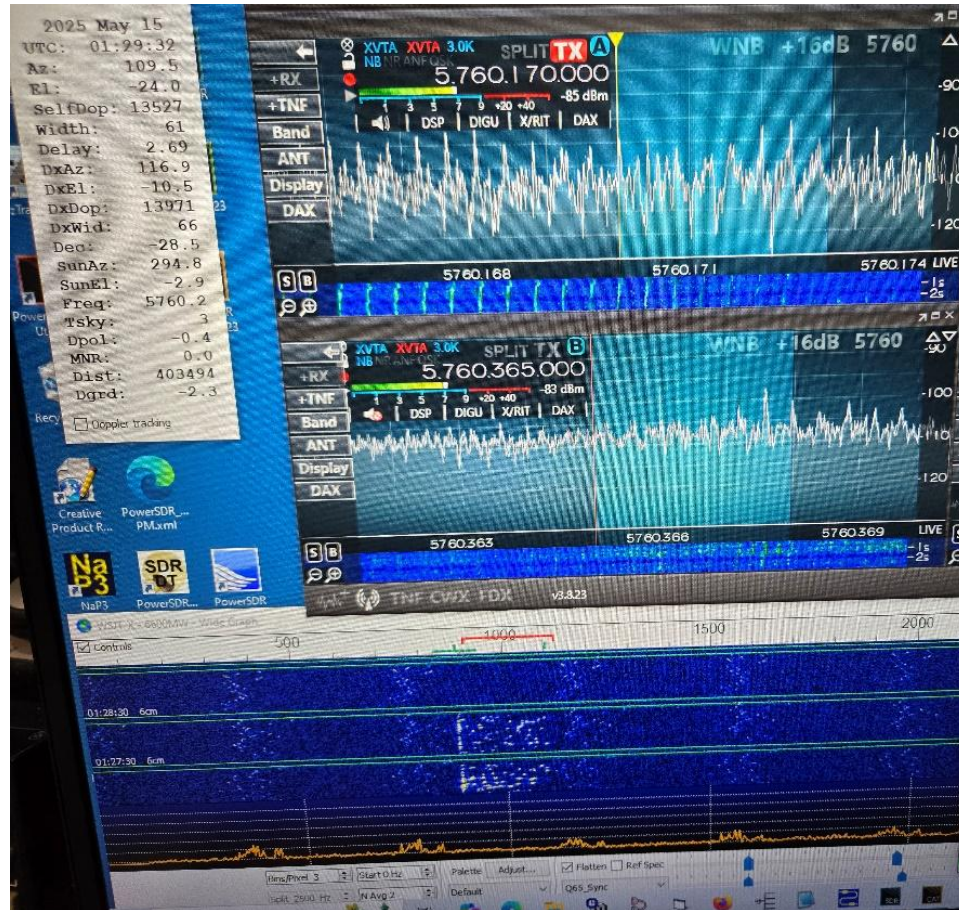
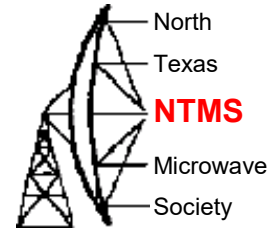
Has already proven to protect dish from hail on Jan 24th 2021

Pressurized WR-137 Rigid and Flex



31ft Rigid w/g 1 dB loss + 12ft Flex w/g .6 dB loss + 2 X 1/2" SF jumpers .9 dB loss for a total loss of 2.5 dB – Run with 1/2 in LDF and Superflex would be 3.5 dB loss....still not bad for 5760 MHz

Aiming at 107 degrees from EM13qc to Buddy WB4OMG



Buddy's station

100 watt Kuhne SSPA
 Laird GD 58-22 BBQ Grill Dish
 95 ft 5/8" Heliax

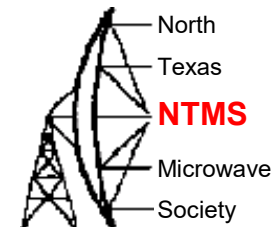
My station

150 watt SSPA in shack
 ~ 35 ft WR-137 rigid and flex waveguide
 30 inch dish at 6 ft aimed straight up
 to a stop sign flyswatter at 60 ft on side
 of a rotating Rohn 45 tower

I chose Q65-30A to fit his signal in
 between my spurs on 5760

DX 1509 km (936 miles)

5760 MHz QSO with WB4OMG



The screenshot displays a radio software interface. At the top, a waterfall plot shows a signal at 5760.170 MHz. Below the plot, a decode window is open, showing two columns of decoded messages: 'Single-Period Decodes' and 'Average Decodes'. The 'Single-Period Decodes' column contains the following entries:

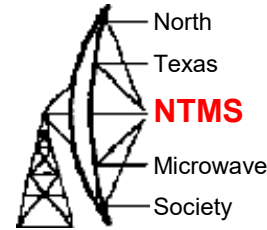
UTC	dB	DT	Freq	Message
012600	-6	0.2	917	WB4OMG W5LUA EM13 q3
012700	1	0.2	917	WB4OMG W5LUA R+00 q3
012800	2	0.2	920	WB4OMG W5LUA 73 q3
012900	1	0.2	924	TNX BUDDY q0

The 'Average Decodes' column contains the following entries:

UTC	dB	DT	Freq	Message
012515	Tx		900	CQ WB4OMG EL98
012545	Tx		900	CQ WB4OMG EL98
012600	-6	0.2	917	WB4OMG W5LUA EM13 q3
012630	Tx		900	W5LUA WB4OMG -06
012700	1	0.2	917	WB4OMG W5LUA R+00 q3
012730	Tx		900	W5LUA WB4OMG RR73
012800	2	0.2	920	WB4OMG W5LUA 73 q3

Below the decode window, the software interface shows the current frequency as 5,760.170 000 MHz. The DX Call is W5LUA and the DX Grid is EM13. The date and time are 2025 May 15 01:30:03. The interface also includes various control buttons like 'Log QSO', 'Monitor', 'Erase', 'Clear Avg', 'Decode', 'Enable Tx', 'Halt Tx', and 'Tune'. A list of messages to be transmitted is visible on the right side of the interface.

K4VJ Q65-15A



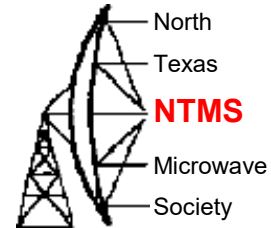
The screenshot shows the WSJT-X software interface. At the top, a wide graph displays a signal at 5760.170 MHz. Below the graph, the 'Single-Period Decodes' and 'Average Decodes' windows are visible, both showing the following decoded messages:

UTC	dB	DT	Freq	Message
124215	-23	0.5	493	W5LUA K4VJ +02 q2
124245	-24	0.5	494	W5LUA K4VJ RR73 q3

The main interface shows the frequency 5,760.170 000 MHz, a DX call of K4VJ, and a DX grid of EL98. The distance is 1581 km (931 miles). The date and time are 2025 May 28 16:34:32. The DT (Duty Cycle) is 0.49. The interface also includes various control buttons like 'Log QSO', 'Stop', 'Monitor', 'Erase', 'Clear Avg', 'Decode', 'Enable Tx', 'Halt Tx', and 'Tune'.

I was able to decode Mike's signal despite my local QRM on 5760
DX 1501 km (931 miles)

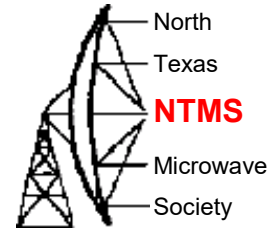
K4VJ IC-905 Setup in EL98cp



Picture courtesy of K4VJ

IC-905 RF unit is in shack
 18" of RG142 jumper from the RF unit to a Radiall 6 port latching relay
 3 feet of 1/2" hardline from Radiall switch to disconnect panel on the outside wall
 70' of Imr600 to
 80' of 7/8 hardline to
 2' pieces 1/2" connecting to the 2nd Radiall relay at the base or the tower
 1' Imr400 from relay to
 55' of 7/8 hardline to top of tower to
 15' of Imr600 up to antenna on the pipe.
 Measured loss at 5760 MHz is 17 dB dropping his 2 watts down to 40 mW at antenna!

What's next?

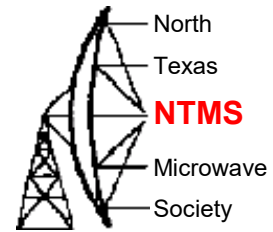


- Move flyswatter up another 20 ft.
- Consider adding a second flyswatter 120 degrees out so can cover multiple bands more easily.
- The Green Heron rotor control box can be programmed for a 120 degree offset.
- Here is what I expect....

Predicted Performance with Flyswatter Under the Third Guy Ring

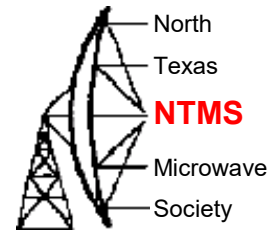
Frequency	5.76 GHz	10.3 GHz	24 GHz	47 GHz	76 GHz
Dish Diameter	.76m (30")	.76m (30")	.3m (12")	.3m (12")	.3m (12")
Flyswatter Aperture	.76m (30")	.76m (30")	.76m (30")	.76m (30")	.76m (30")
Reflector Spacing	19.8m (65ft)	19.8m (65ft)	19.8m (65ft)	19.8m (65ft)	19.8m (65ft)
Final Results					
Dish Gain	30.6 dBi	35.7 dBi	35.0 dBi	40.8 dBi	45.0 dBi
System Gain	25.0 dBi	33.8 dBi	38.7 dBi	39.0 dBi	30.7 dBi
Effective Gain of Periscope over Source Antenna	-5.6 dB	-1.9 dB	3.7 dB	-1.8 dB	-14.3 dB
Table 2 Reflector Spacing 19.8m					

Additional antenna height should help all bands, especially 47 and 76 GHz
 Increasing the reflector size will help 5 and 10 GHz but hinder the higher bands



- For further consideration to help others get a 10 GHz antenna up 20 ft.....

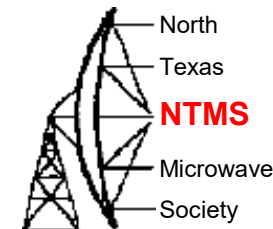
10 GHz Flyswatter at 20 ft.



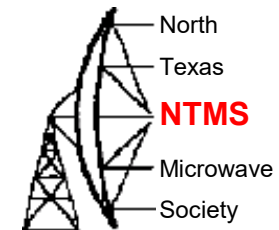
	A	B	C	D	E	F	G	H	I	J	K	L	
2	<u>PERISCOPE ANTENNA GAIN CALCULATOR</u>												
3	W1GHZ 2000												
4													
5	<u>ENTER INPUT PARAMETERS HERE:</u>												
6	Frequency	10.3	GHz										
7	Dish diameter	0.46	meters	Note: 1 meter = 3.28 feet									
8	Flyswatter Aperture	0.6	meters					Dish Dia.	Dish Gain	System G; Gain (periscope/dish)			
9	Height (reflect. Spacing)	6.1	meters					24"	33.8 dBi	31.3 dBi	-2.5 dB		
10								18"	31.3 dBi	31.9 dBi	0.5 dB		
11	<i>Suggested flyswatter =</i>	<i>0.6</i>	<i>meters - for this height and frequency</i>				12"	27.6 dBi	30.3 dBi	2.7 dB			
12													
13	<u>READ FINAL RESULTS HERE:</u>												
14	System Gain	31.9	dBi										
15	Dish Gain	31.3	dBi										
16	"FEEDLINE" equivalent	0.5	dB (effective gain of periscope over dish)										
17													

Dish diameter = 18 inches
 Reflector spacing ~ 20 ft
 Flyswatter Aperture ~ 24 inches

Pointing Accuracy and Alignment



- Rotating tower keeps reflector and source antenna in alignment as azimuth is rotated.
- Biggest challenge is keeping the source antenna aimed at the center of the reflector.
- I use a digital level and washers as spacers to keep antenna aimed straight up.
- I tried a LASER pointer in the past but hard to see during the day – I plan to revisit
- Pointing not critical on 10 GHz but 47 and 76 GHz requires precise pointing



- Any Questions?
- W5lua at sbcglobal.net