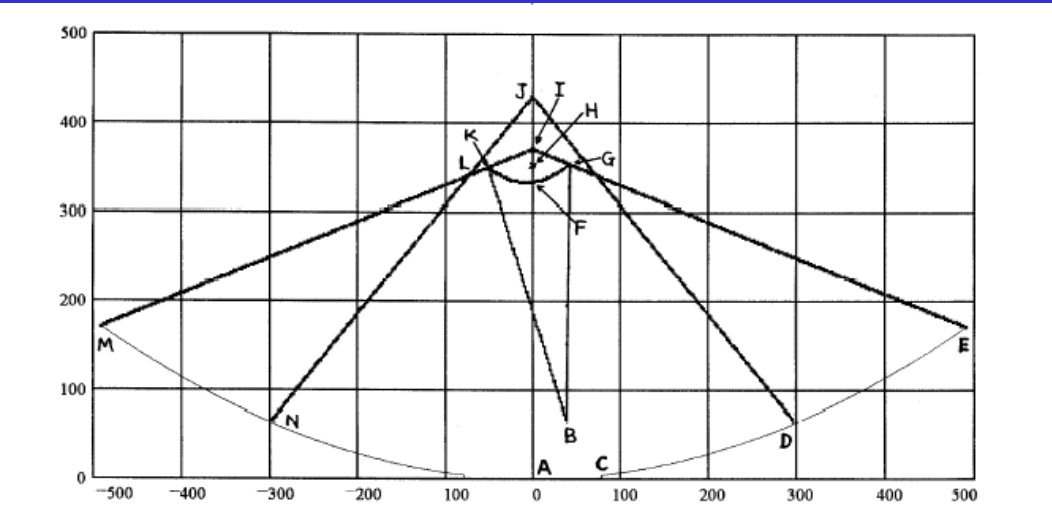
Antennas and Feeds

Scope

- Overview
- Feed Cone Mechanics
- Feed Manufacturing
- Electromagnetic Issues
- Feed Testing Plan

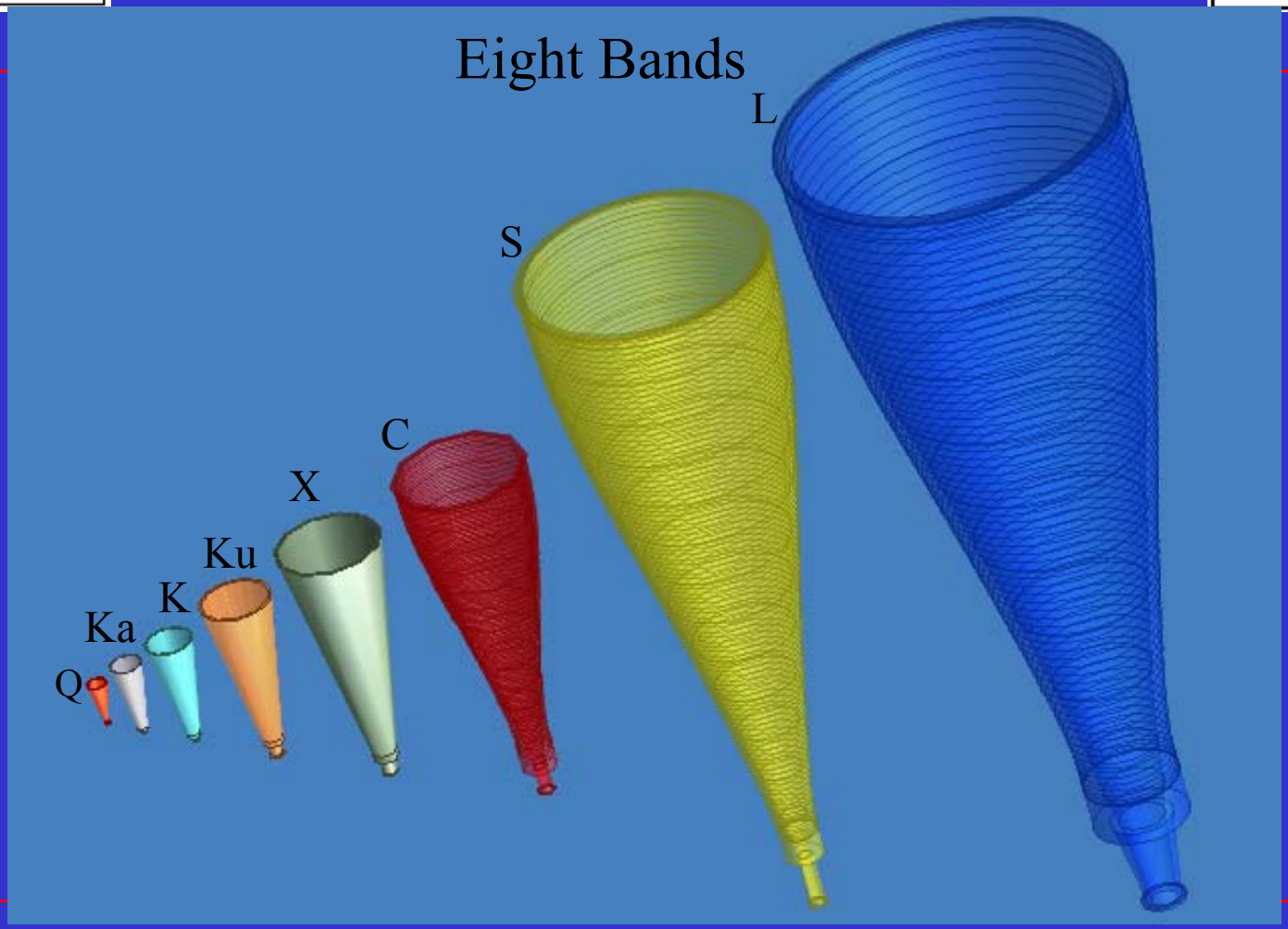
Overview
Antennas

- 28 Antennas
- Shaped Cassegrain Geometry
- Existing Optics
- 1 to 50 GHz Continuous



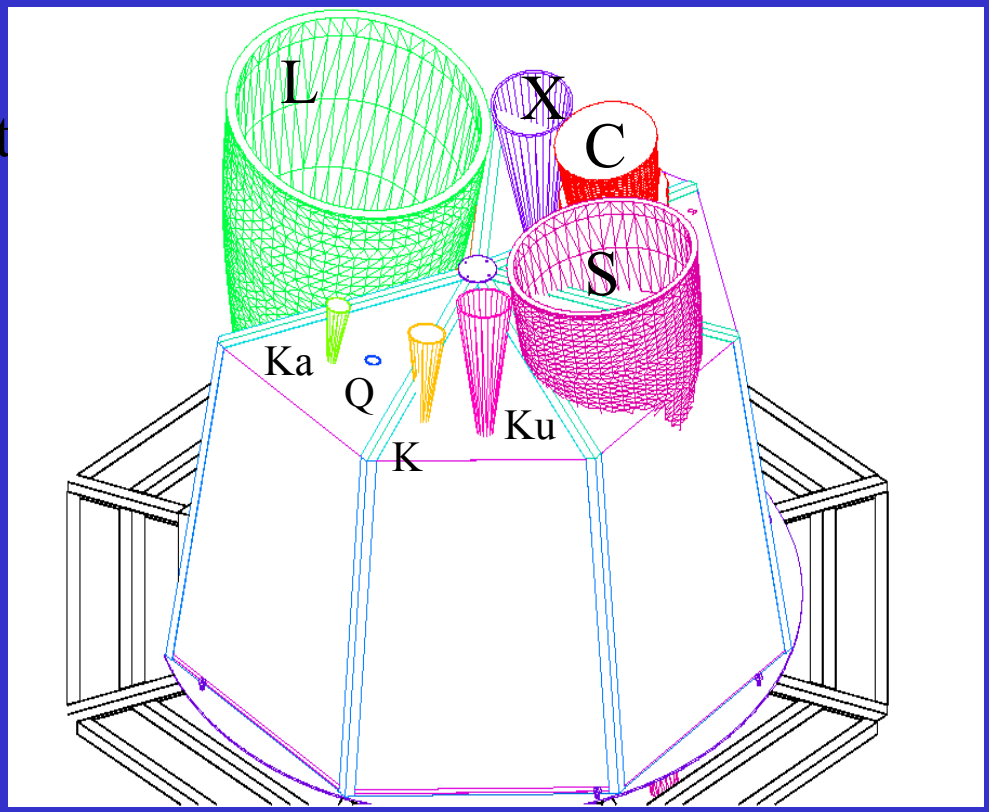
Overview

Feeds



Overview
Feed Cone

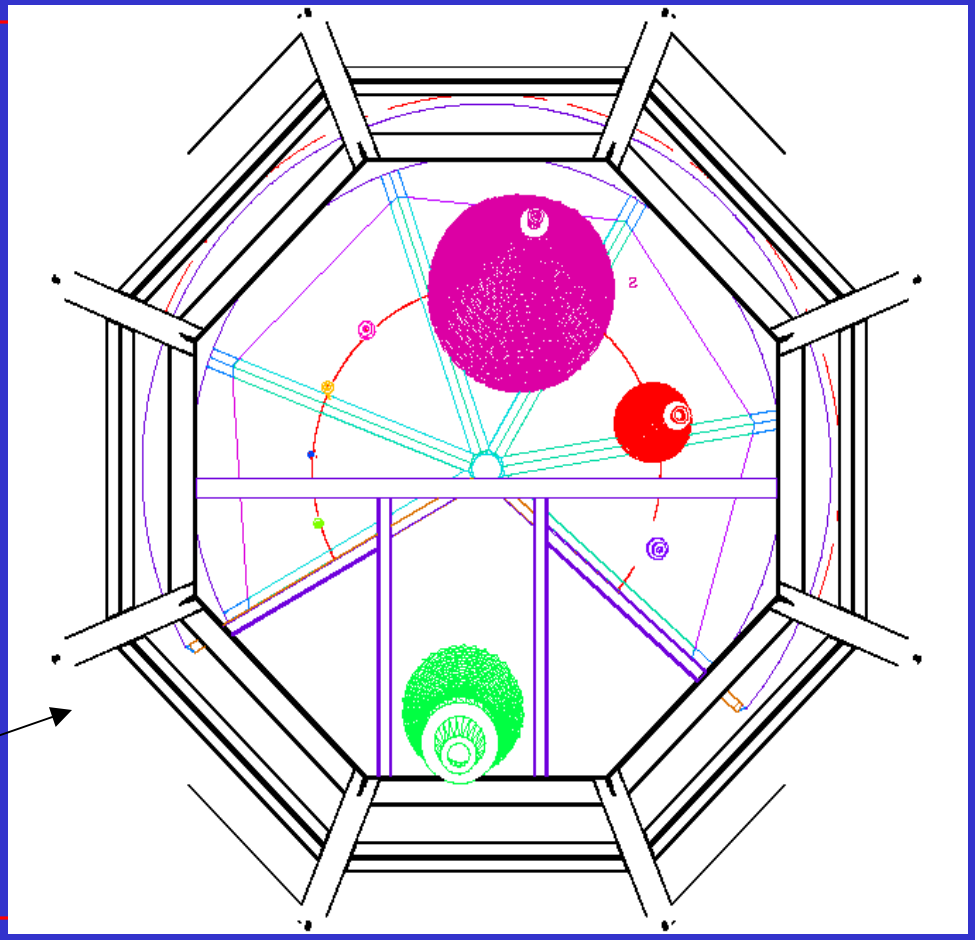
- Optimize G/Tsys
- No shadowing by adjacent feeds
- Minimize effects of reflections from adjacent feeds
- Minimize effects of gravitational sag
- Effective use of WVR at short wavelengths



Feed Cone Mechanics

Mounting L-Band

- No shadowing
- No structural changes outside designated feed cone
- Additional support

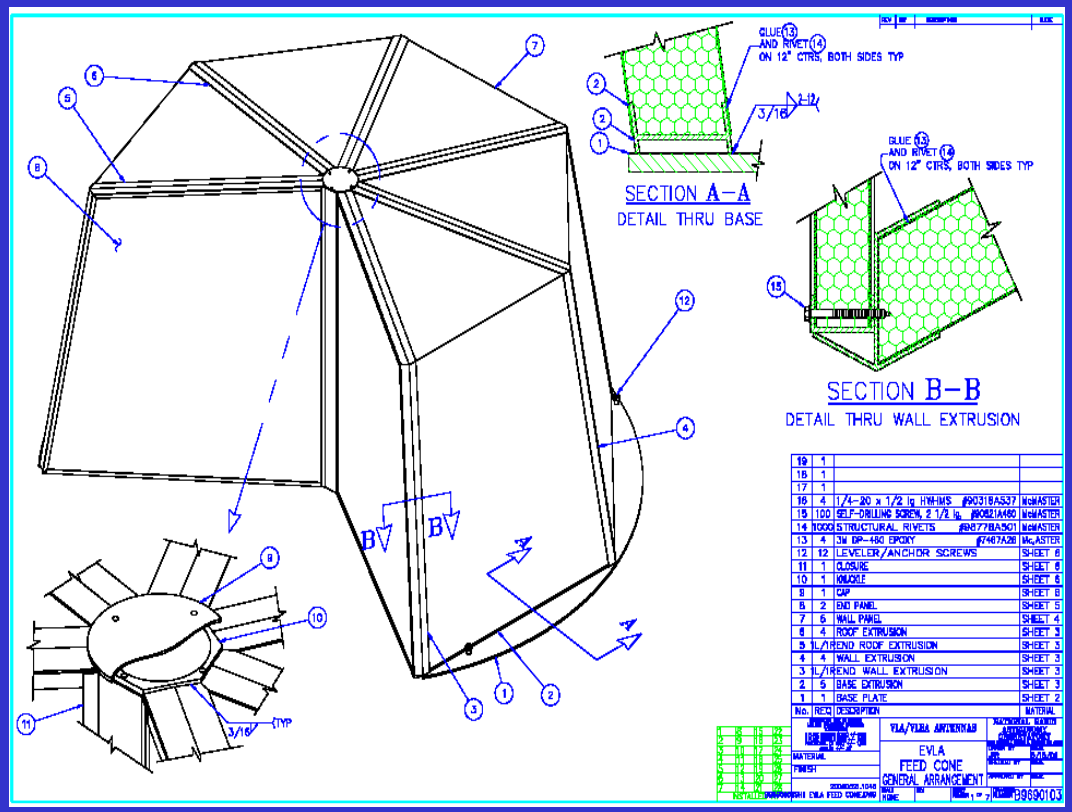


View: Looking up from Vertex Room

Feed Cone Mechanics

Feed Cone Structure

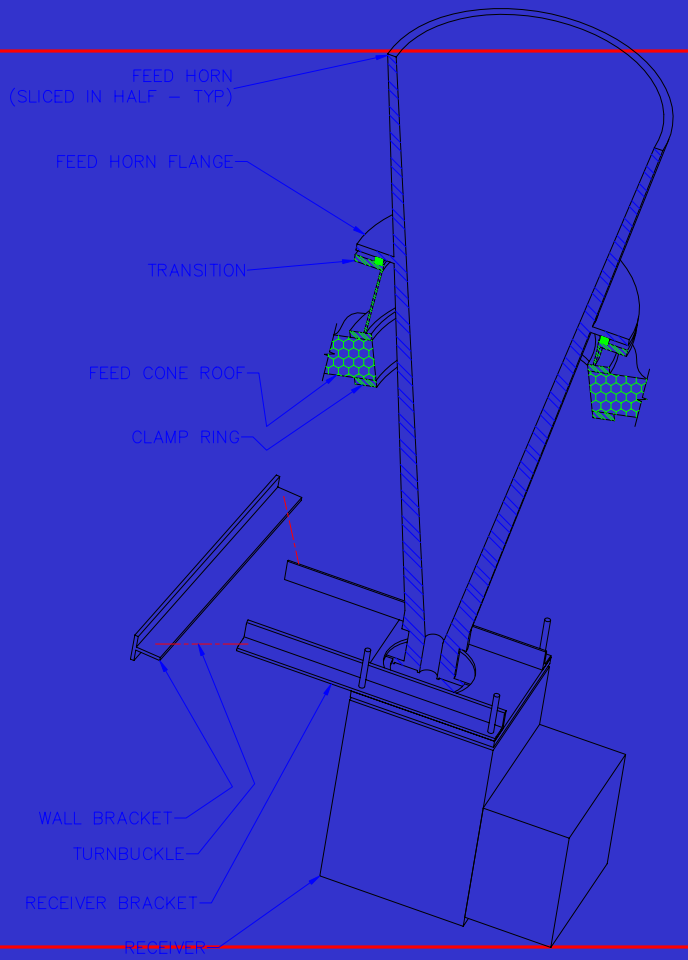
- Continuous conductive skin to reduce RFI/EMI
- Monolithic construction uses honeycomb panels with polycarbonate (thermal advantage)
- FE analysis complete



Feed Cone Mechanics

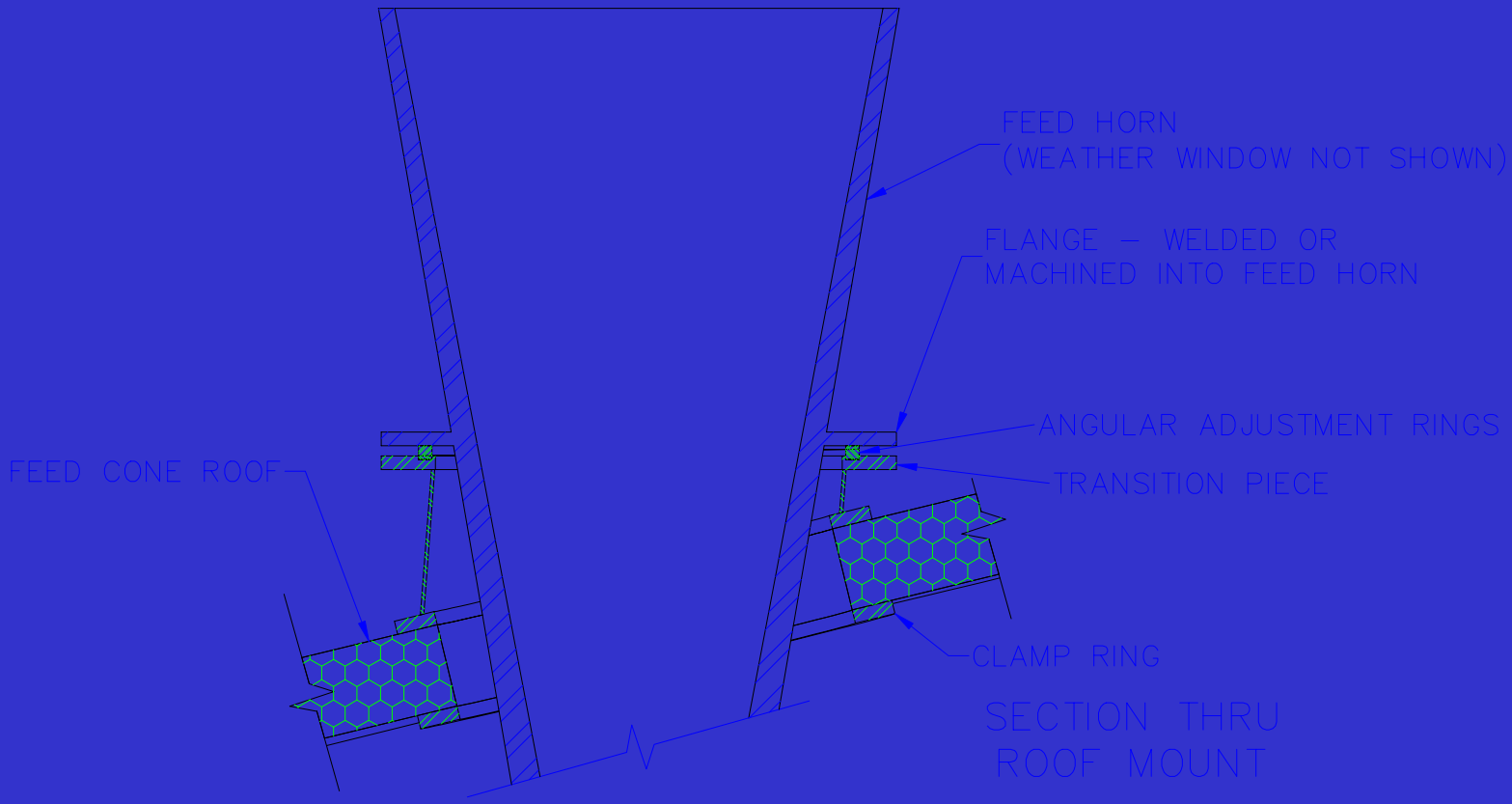
Feed Mounting/Pointing

- Provides accurate pointing
- Improved access and simplified receiver installation and removal



Feed Cone Mechanics

Feed Mounting/Pointing

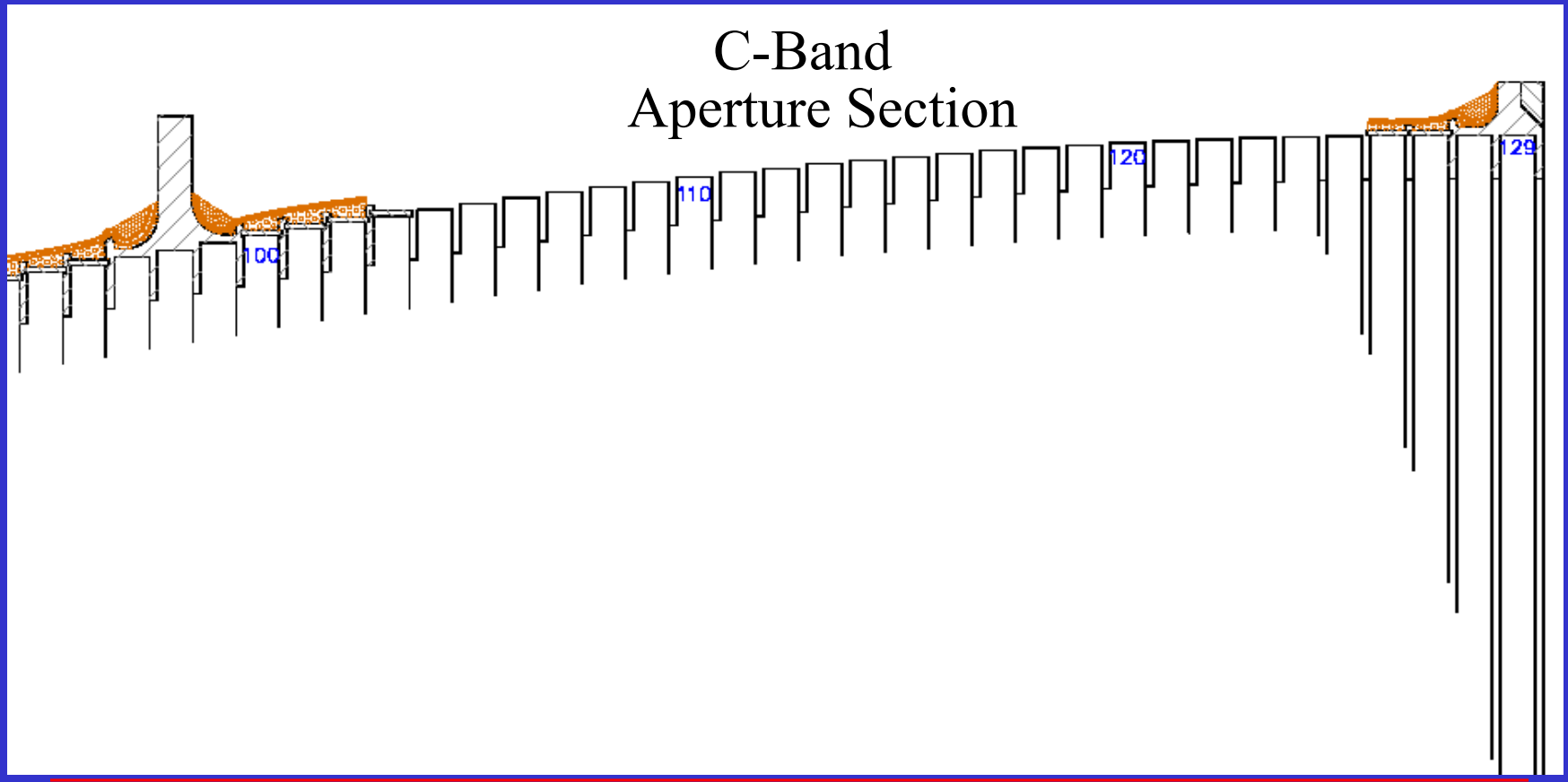


Feed Manufacturing

- L, S, and C Band feeds use Laminated technique for weight to strength advantages
- X thru Q Band feeds turned from solid aluminum

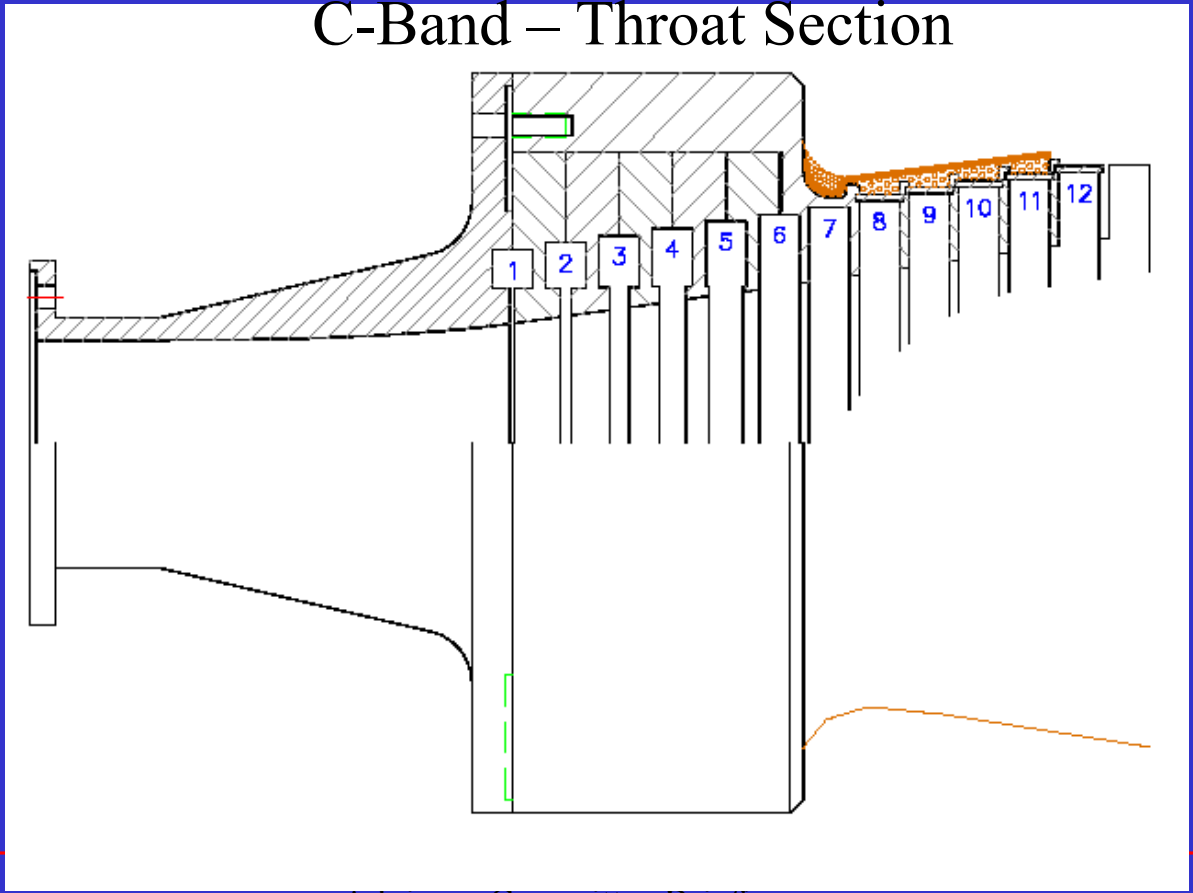
Feed Manufacturing

Laminated Horns



Feed Manufacturing

Laminated Horns



Feed Manufacturing

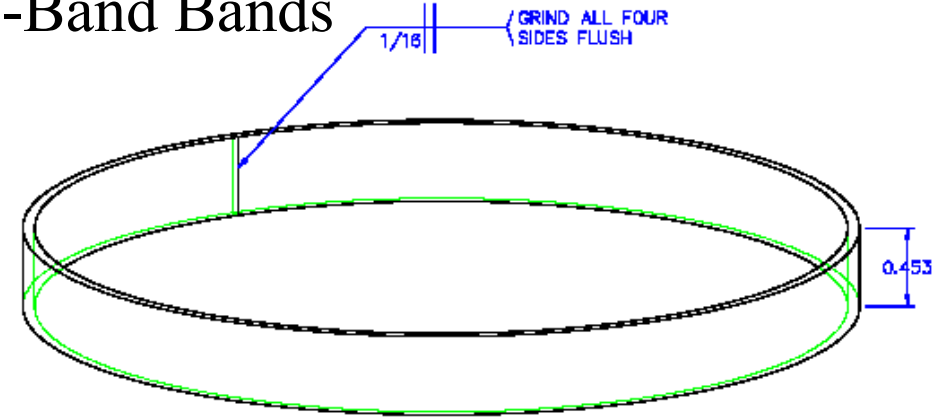
Laminated Horns

n	ID	L
6	4.326	13.726
7	4.452	14.122
8	4.580	14.524
9	4.711	14.935
10	4.842	15.347
11	4.978	15.774
12	5.114	16.202
13	5.252	16.635
14	5.392	17.075
15	5.535	17.524
16	5.679	17.977
17	5.825	18.435
18	5.972	18.897
19	6.121	19.365
20	6.272	19.839
21	6.424	20.317
22	6.578	20.801
23	6.734	21.291
24	6.891	21.784
25	7.049	22.281
26	7.210	22.786
27	7.371	23.292
28	7.534	23.804
29	7.698	24.319
30	7.864	24.841
31	8.031	25.366
32	8.199	25.893
33	8.370	26.431
34	8.540	26.965
35	8.712	27.505
36	8.886	28.052
37	9.060	28.598
38	9.236	29.151
39	9.413	29.707
40	9.590	30.263
41	9.769	30.828
42	9.949	31.391
43	10.130	31.960
44	10.312	32.532
45	10.495	33.106
46	10.678	33.681
47	10.863	34.263

n	ID	L
48	11.048	34.844
49	11.234	35.428
50	11.421	36.016
51	11.609	36.606
52	11.798	37.200
53	11.988	37.797
54	12.178	38.394
55	12.368	38.991
56	12.559	39.591
57	12.752	40.197
58	12.944	40.800
59	13.137	41.407
60	13.331	42.018
61	13.525	42.625
62	13.720	43.236
63	13.915	43.851
64	14.111	44.466
65	14.308	45.079
66	14.503	45.698
67	14.699	46.314
68	14.897	46.936
69	15.093	47.551
70	15.291	48.174
71	15.488	48.792
72	15.687	49.418
73	15.884	50.036
74	16.083	50.662
75	16.281	51.284
76	16.479	51.908
77	16.678	52.531
78	16.876	53.153
79	17.074	53.775
80	17.273	54.400
81	17.470	55.019
82	17.667	55.638
83	17.863	56.254
84	18.059	56.869
85	18.252	57.476
86	18.444	58.079
87	18.635	58.679
88	18.824	59.273
89	19.011	59.860

n	ID	L
90	19.195	60.441
91	19.378	61.013
92	19.558	61.579
93	19.734	62.132
94	19.908	62.678
95	20.079	63.215
96	20.247	63.743
97	20.411	64.258
98	20.572	64.764
99	20.728	65.254
100	20.881	65.735
101	21.030	66.203
102	21.175	66.659
103	21.315	67.098
104	21.451	67.526
105	21.582	67.937
106	21.708	68.333
107	21.829	68.713
108	21.945	69.078
109	22.056	69.426
110	22.162	69.759
111	22.263	70.077
112	22.358	70.375
113	22.447	70.655
114	22.531	70.919
115	22.609	71.164
116	22.681	71.390
117	22.748	71.600
118	22.808	71.789
119	22.862	71.959
120	22.911	72.112
121	22.953	72.244
122	22.989	72.357
123	23.018	72.449
124	23.042	72.524
125	23.059	72.577
126	23.070	72.612
127	23.074	72.625
128	23.073	72.621
129	23.07	72.612

C-Band Bands

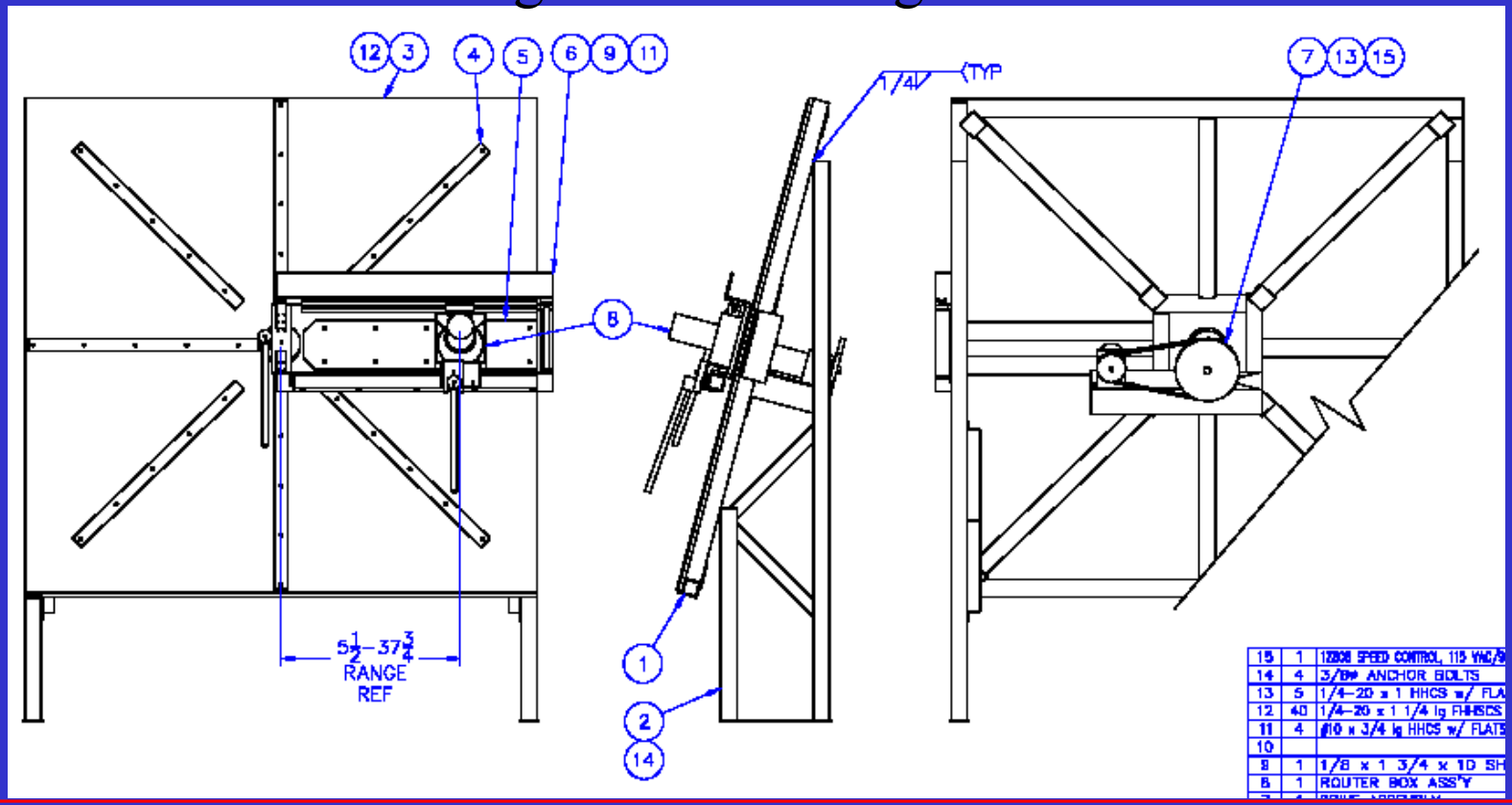


NOTES:
- NO BANDS REQUIRED IN GRAYED-OUT SIZES.
- ROLL STRIP TO APPROXIMATE DIAMETER, THEN MEASURE WITH A PI TAPE AND CUT TO LENGTH.
- 'L' IS THE THEORETICAL CENTER CIRCUMFERENCE LESS 1/16" WELD GAP.

Feed Manufacturing

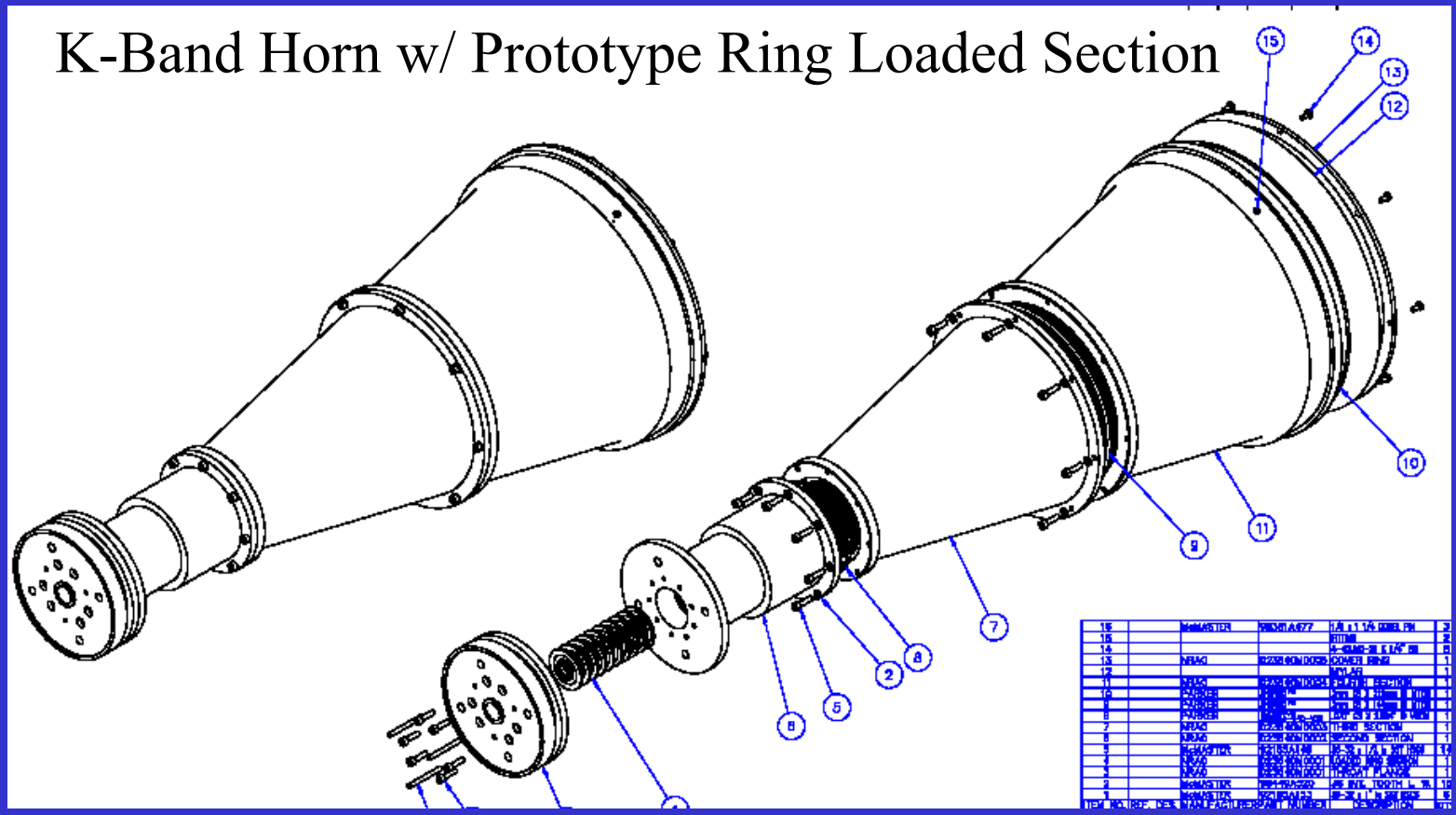
Laminated Horns

Ring Manufacturing Machine



Feed Manufacturing

Ring Loaded Section



Electromagnetic Issues

- Laminated Feed Bands
  - Welded Solid band
    - Welded and ground
  - Spiral Band
    - 10-15 thousandths thick w/ conductive bound
  - Concern
    - Leakage, discontinuities for circumferential currents
  - Build Prototype?

Electromagnetic Issues

- Adjacent Feed Interaction
  - Tasked at PDR (German Cortes, Bruce Veidt)
  - Near-field evaluation using Gaussian Beam propagation technique (Tuovinen, & Olver)
  - Evaluated using worst-case parameters and assumptions
  - Loss in illumination taper efficiency ~0.02% for C→S band case where 2% energy impinges on S-band cylinder

Feed Testing Plan

- Prototype
  - Green Bank Facilities
  - SWR
  - Beam Patterns (co/cross)
  - Phase Center [f(ν)]
  - RF Leakage
  - Adjacent feed interaction
- Production
  - Primary Test
    - SWR (Socorro)
    - Additional Testing as required
  - Sampling and Archive
    - Patterns for every 6th feed
    - Full test matrix as required
  - Monitor process variation and personnel turnover

Prototype Schedule

Band	Component	2002	2003	2004	2005
C-Band					
	Receiver	>------ ------->			
	Feed	>------ ------->			
	OMT	>--------->			
Ku-Band					
	Receiver	>------ ------->			
	Feed	>------ ------->			
	OMT	>--------->			
	Polarizer	>--------->			
	Transitions	>--------->			
L-Band					
	Receiver		>------ ------->		
	Feed	>----------> -->			
	OMT		>--------->		
X-Band					
	Receiver		>------ ------->		
	Feed		>------ ------->		
	OMT		>--------->		
	Polarizer		>--------->		
	Transitions		>--------->		
S-Band					
	Receiver			>------ ------->	
	Feed			>------ ------->	
	OMT			>--------->	
Ka-Band					
	Receiver			>------ ------->	
	Feed			>------ ------->	
	OMT			>--------->	
	Polarizer			>--------->	
	Transitions			>--------->	

Production Schedule

Band	Component	2003	2004	2005	2006	2007	2008	2009	2010
C-Band									
	Receiver	>-2->	-------7----->	-------7----->	-------7----->	-------7----->			
	Feed	>-3->	-------7----->	-------7----->	-------7----->	-------4----->	-------2----->		
	OMT	>----10---->	------10---->	-------4----->					
Ku-Band									
	Receiver	>--2-->	-------7----->	-------7----->	-------7----->	-------7----->			
	Feed	>----10---->	-------12--->	-------6----->	-------2----->				
	OMT	>----10---->	-------12--->	-------6----->	-------2----->				
	Polarizer	>----10---->	-------12--->	-------6----->	-------2----->				
	Transitions	>----10---->	-------12--->	-------6----->	-------2----->				
L-Band									
	Receiver			>-1->	-------3----->	-------3----->	-------8----->	-------8----->	-------7----->
	Feed	>----6--->	-------7----->	-------7----->	-------4----->	-------4----->	-------2----->		
	OMT			>-----4----->	-------6----->	-------6----->	-------6----->	-------6----->	--2-->
X-Band									
	Receiver			>-1->	-------3----->	-------3----->	-------8----->	-------8----->	-------7----->
	Feed			>-----4---->	-------5----->	-------6----->	-------6----->	-------6----->	---3--->
	OMT			>-----4---->	-------5----->	-------6----->	-------6----->	-------6----->	---3--->
	Polarizer			>-----4---->	-------5----->	-------6----->	-------6----->	-------6----->	---3--->
	Transitions			>-----4---->	-------5----->	-------6----->	-------6----->	-------6----->	---3--->
S-Band									
	Receiver				>-----3----->	-------3----->	-------7----->	-------9----->	-------8----->
	Feed				>-----3----->	-------6----->	-------10--->	-------11--->	
	OMT			>-----4----->	-------6----->	-------6----->	-------6----->	-------6----->	--2-->
Ka-Band									
	Receiver				>-----3----->	-------3----->	-------7----->	-------9----->	-------8----->
	Feed			>-2->	-------5----->	-------6----->	-------6----->	-------6----->	---5--->
	OMT			>-2->	-------5----->	-------6----->	-------6----->	-------6----->	---5--->
	Polarizer			>-2->	-------5----->	-------6----->	-------6----->	-------6----->	---5--->
	Transitions			>-2->	-------5----->	-------6----->	-------6----->	-------6----->	---5--->

Projected Costs
(unit cost per band)