SLED-II and DLDS Pulse Compression

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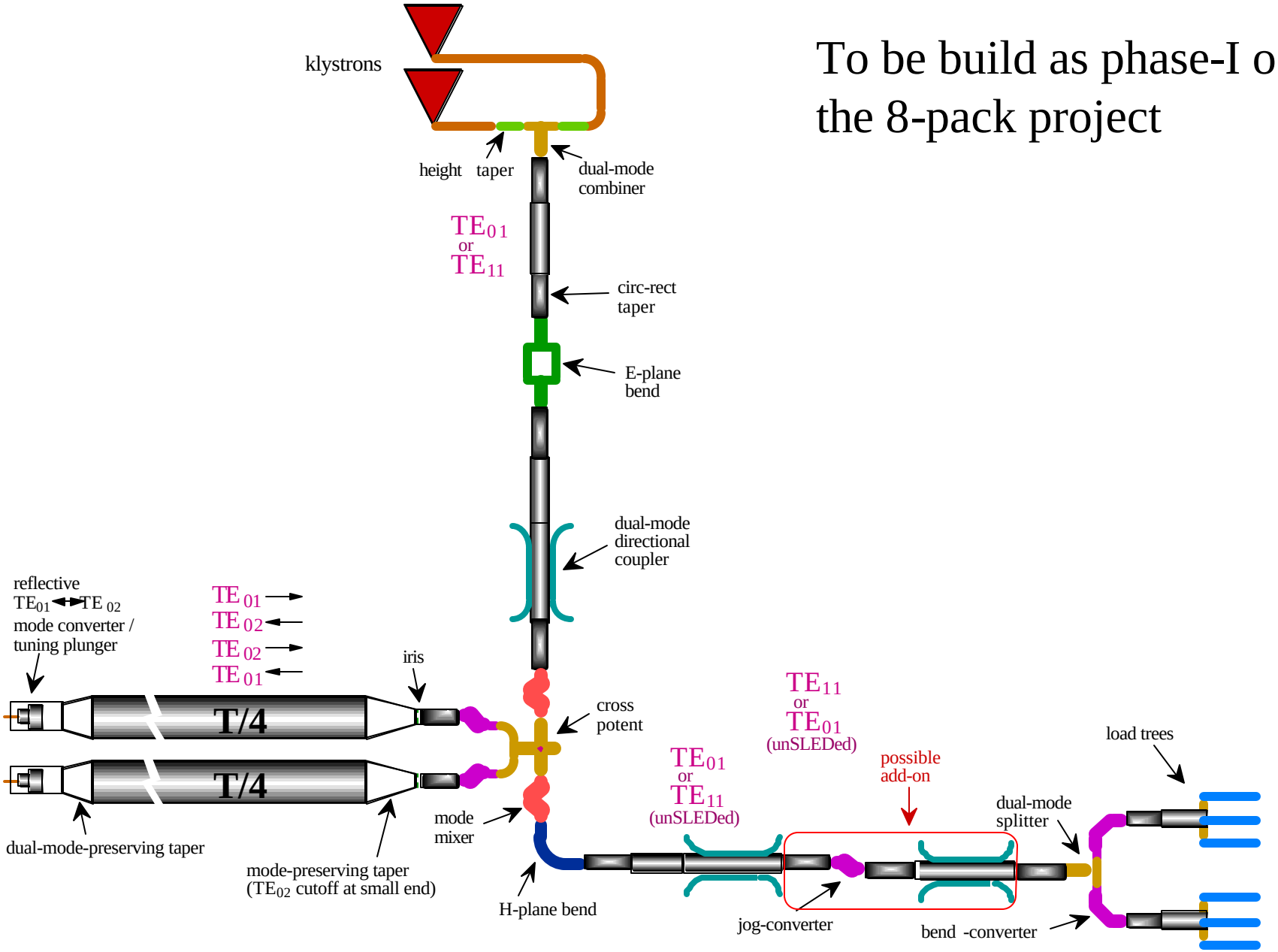
SLAC

Outline

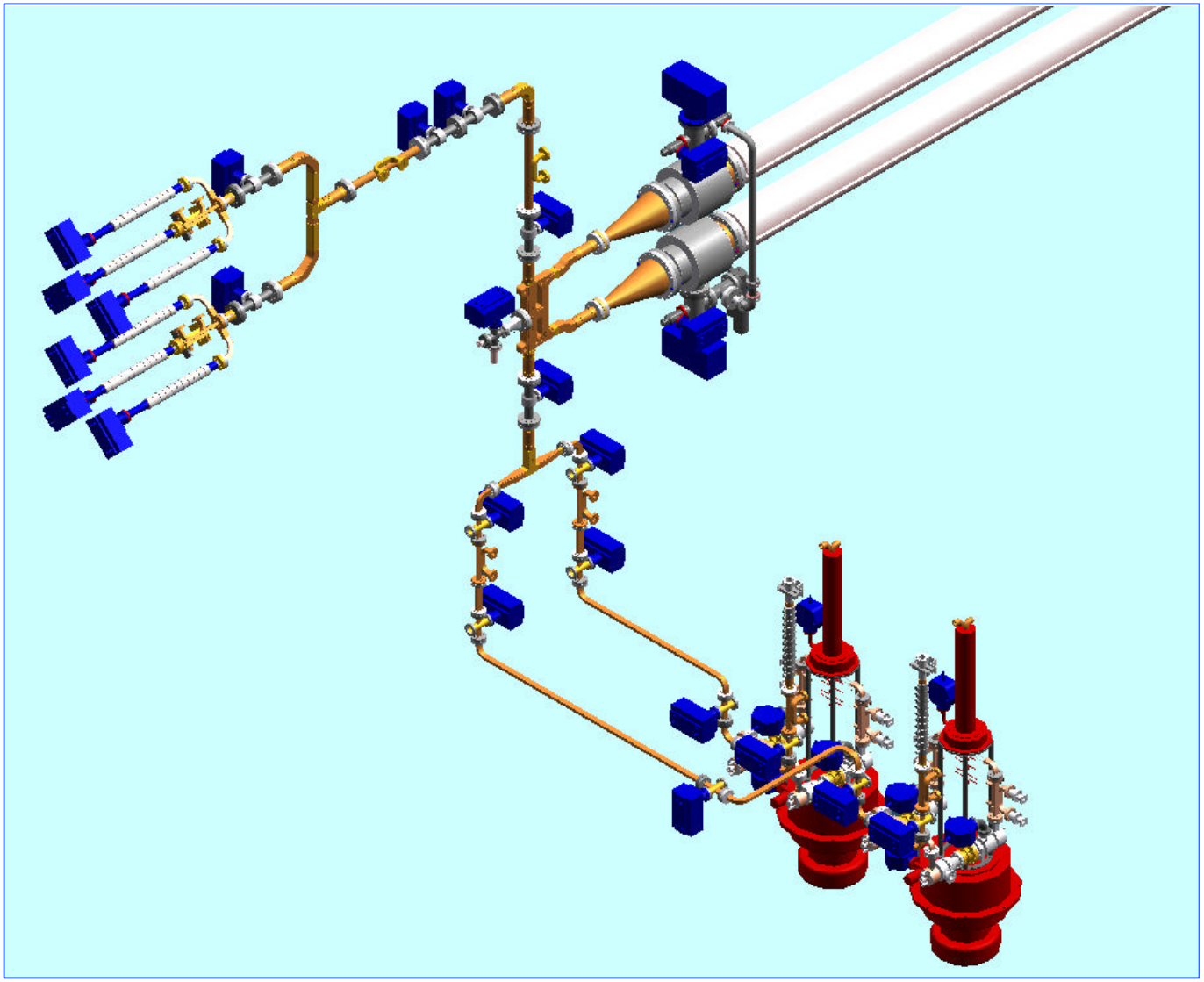
- Phase-I layout
- RF design of the SLED-II head
- RF design of the dual-moded delay lines
- Progress in active pulse compression systems

Dual-Moded Pulse Compression System

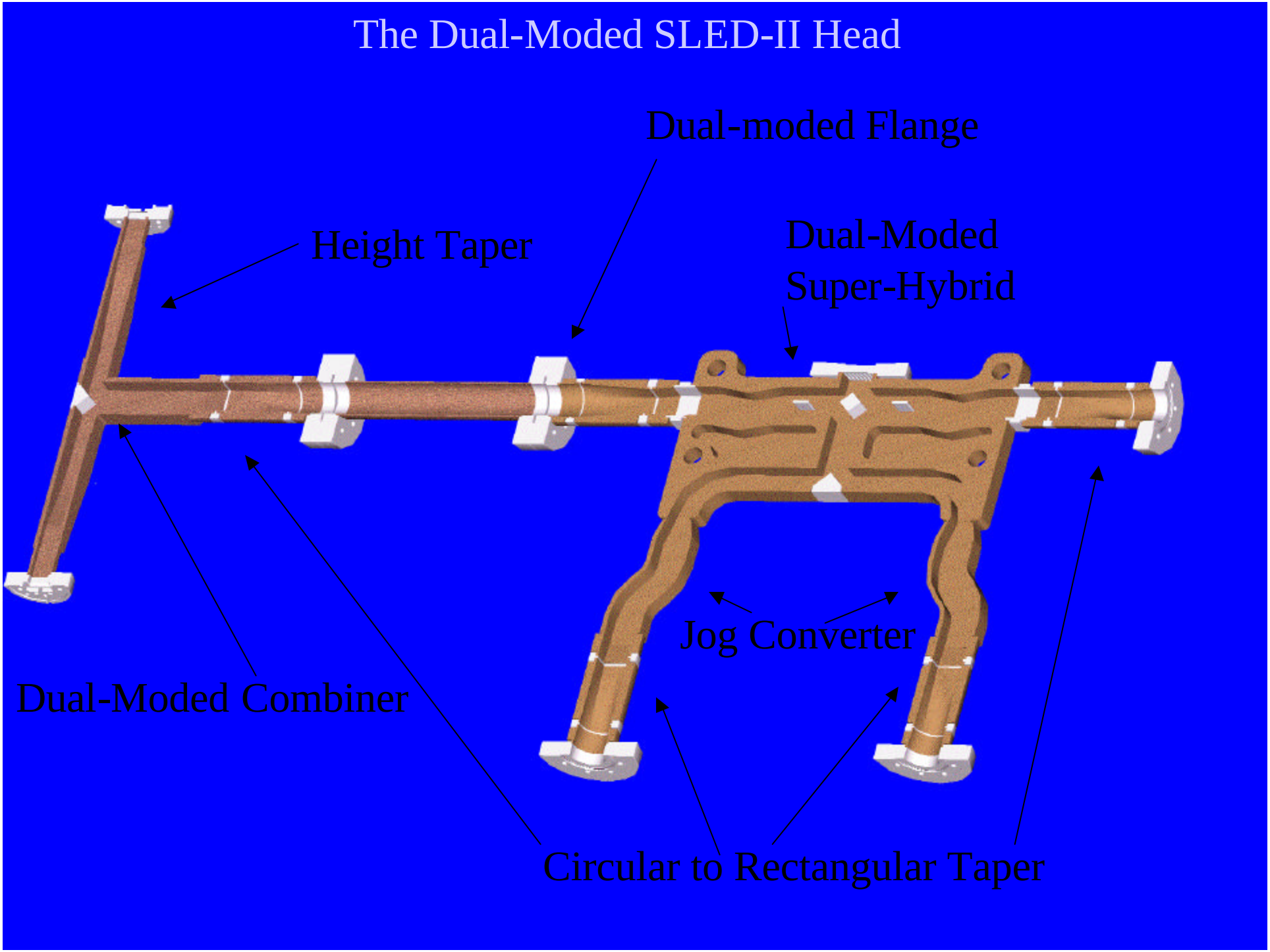


To be build as phase-I of the 8-pack project

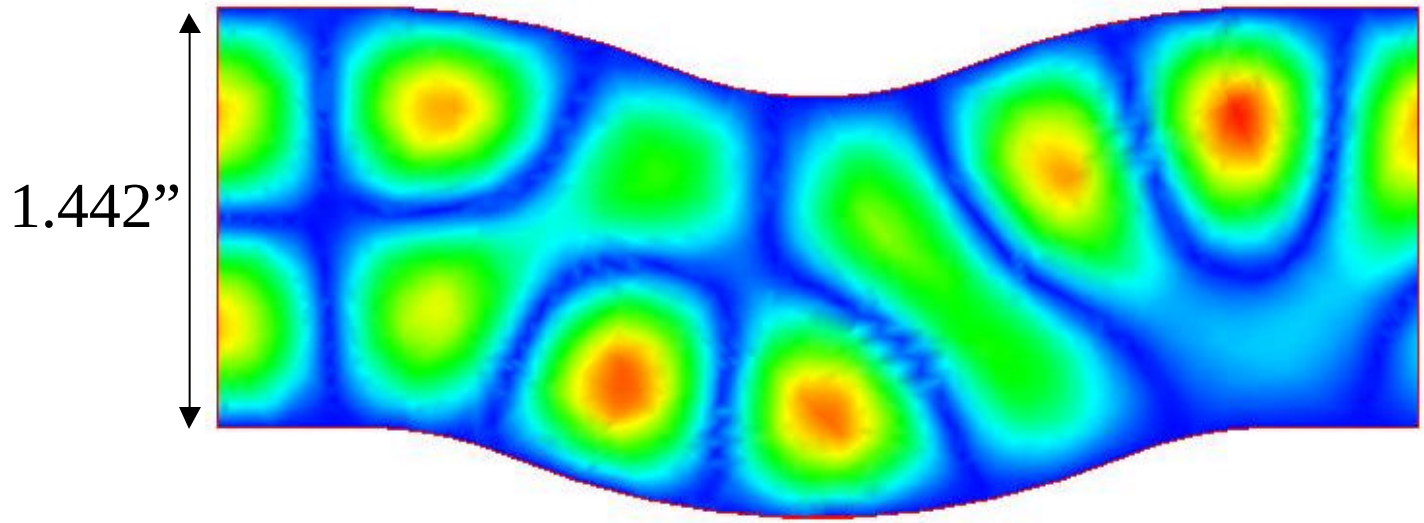
October layout for SLED commissioning



The Dual-Moded SLED-II Head

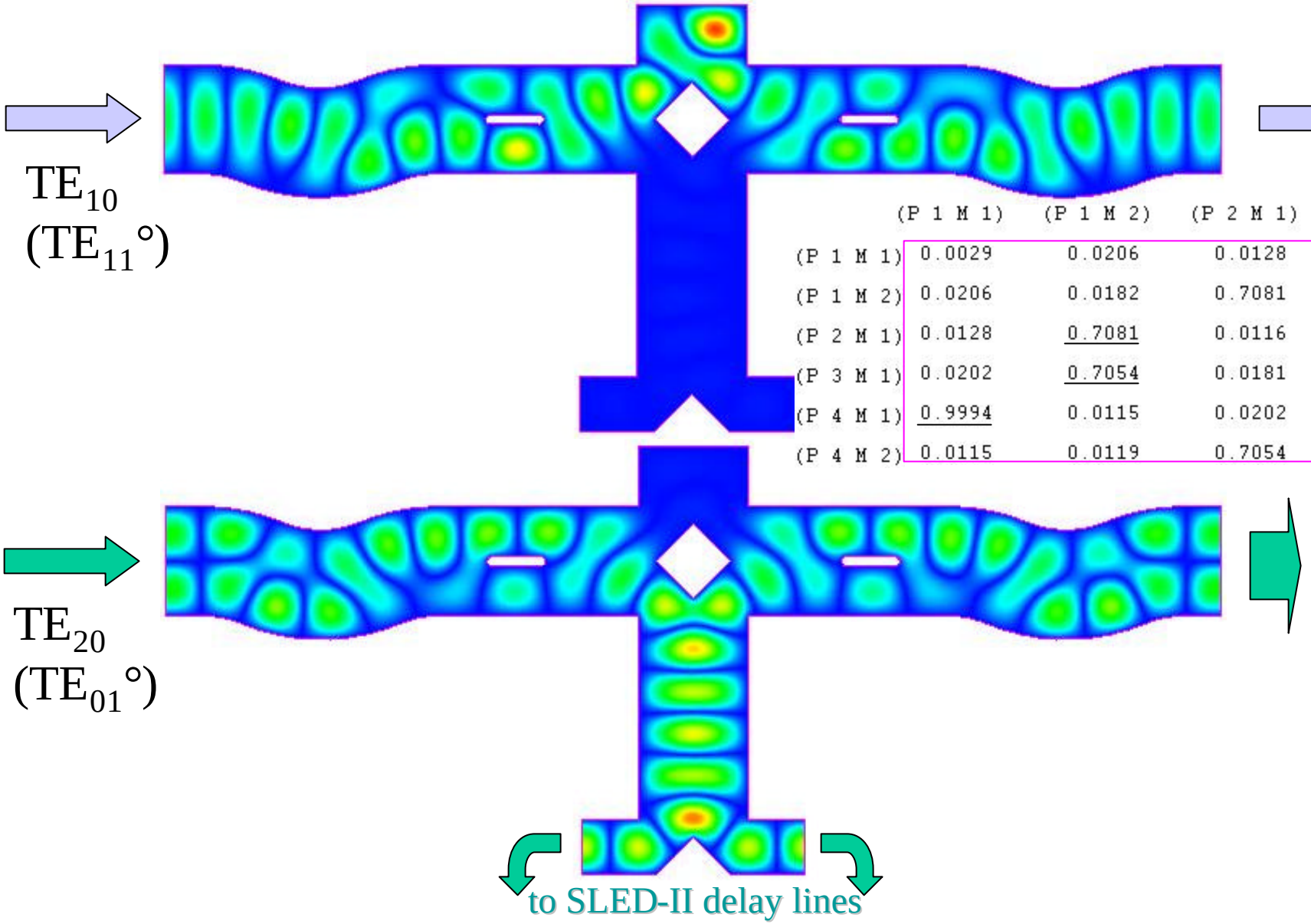


Mode Mixer



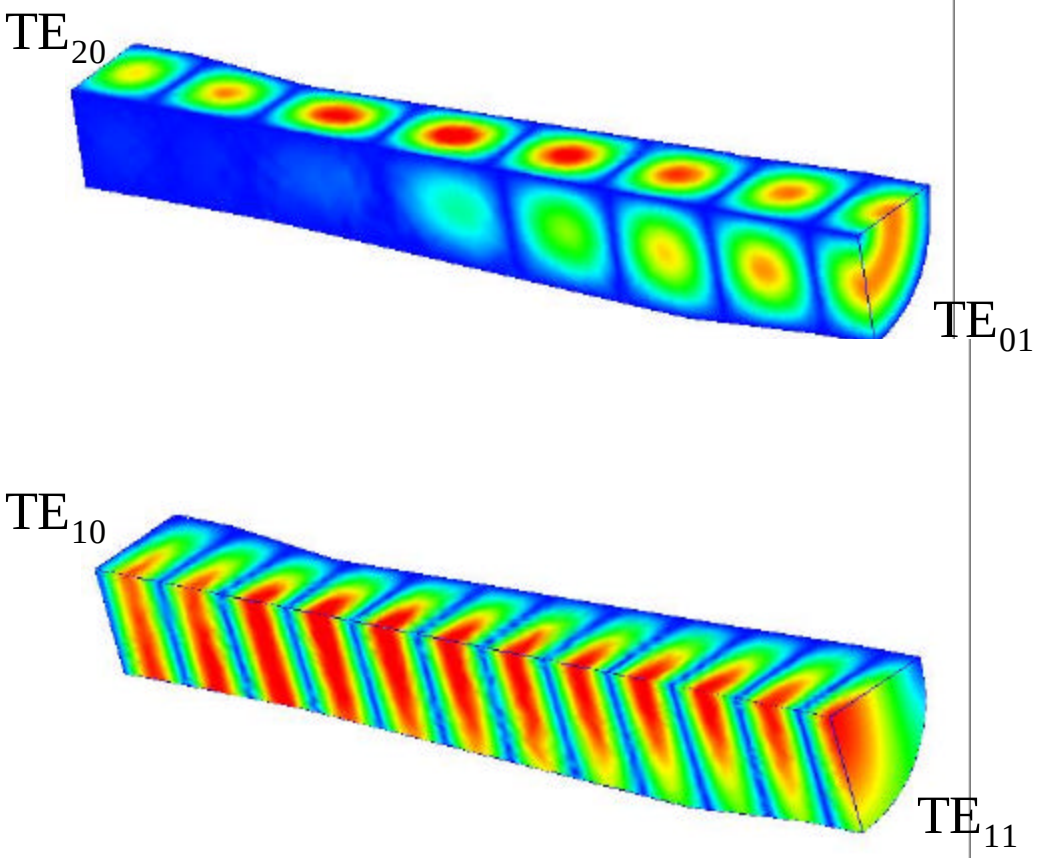
	(P 1 M 1)	(P 1 M 2)	(P 2 M 1)	(P 2 M 2)
(P 1 M 1)	0.0129	0.0118	0.7036	0.7103
(P 1 M 2)	0.0118	0.0114	0.7103	0.7037
(P 2 M 1)	0.7036	0.7103	0.0129	0.0118
(P 2 M 2)	0.7103	0.7037	0.0118	0.0114

8-Pack Phase-I Super Hybrid

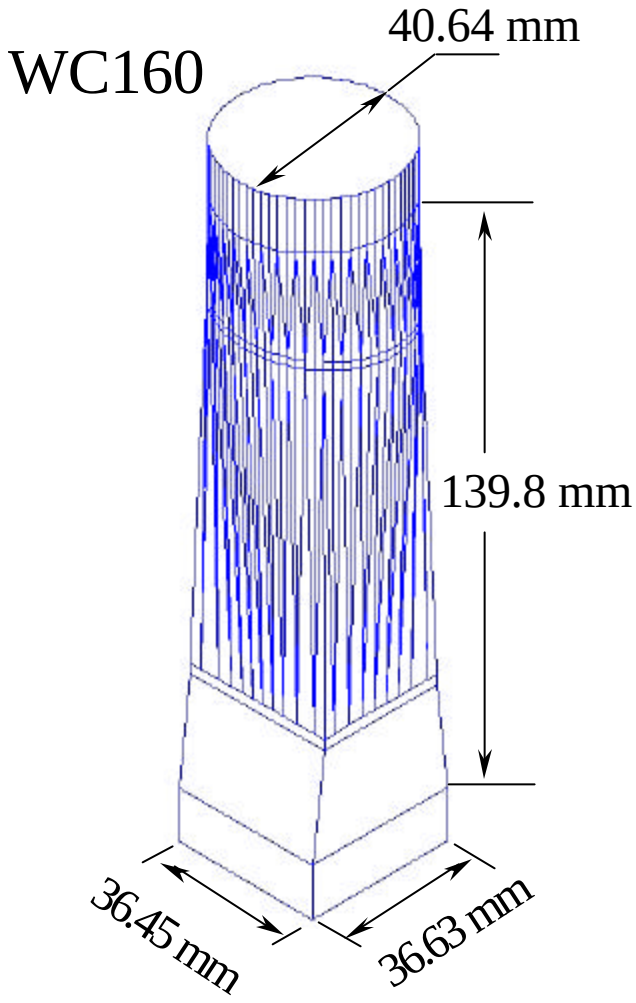


	(P 1 M 1)	(P 1 M 2)	(P 2 M 1)	(P 3 M 1)
(P 1 M 1)	0.0029	0.0206	0.0128	0.0202
(P 1 M 2)	0.0206	0.0182	0.7081	0.7054
(P 2 M 1)	0.0128	0.7081	0.0116	0.0181
(P 3 M 1)	0.0202	0.7054	0.0181	0.0116
(P 4 M 1)	0.9994	0.0115	0.0202	0.0128
(P 4 M 2)	0.0115	0.0119	0.7054	0.7081

Dual-Mode Rectangular-to-Circular Taper

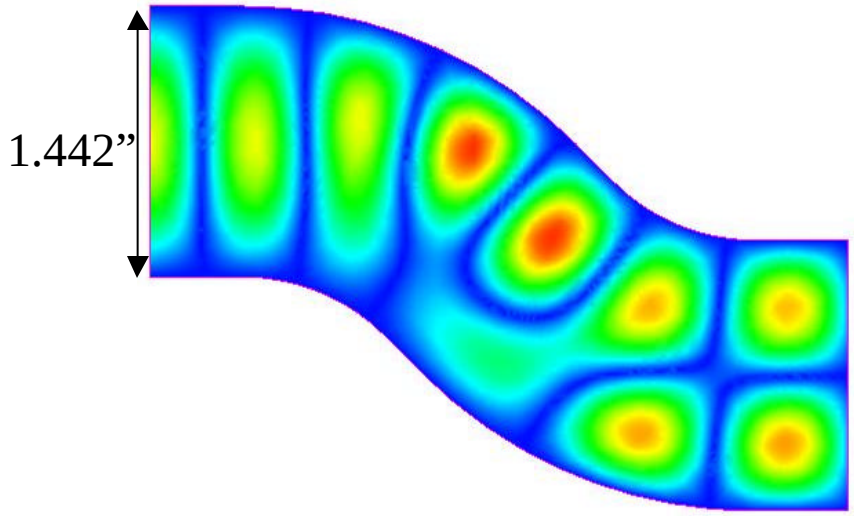


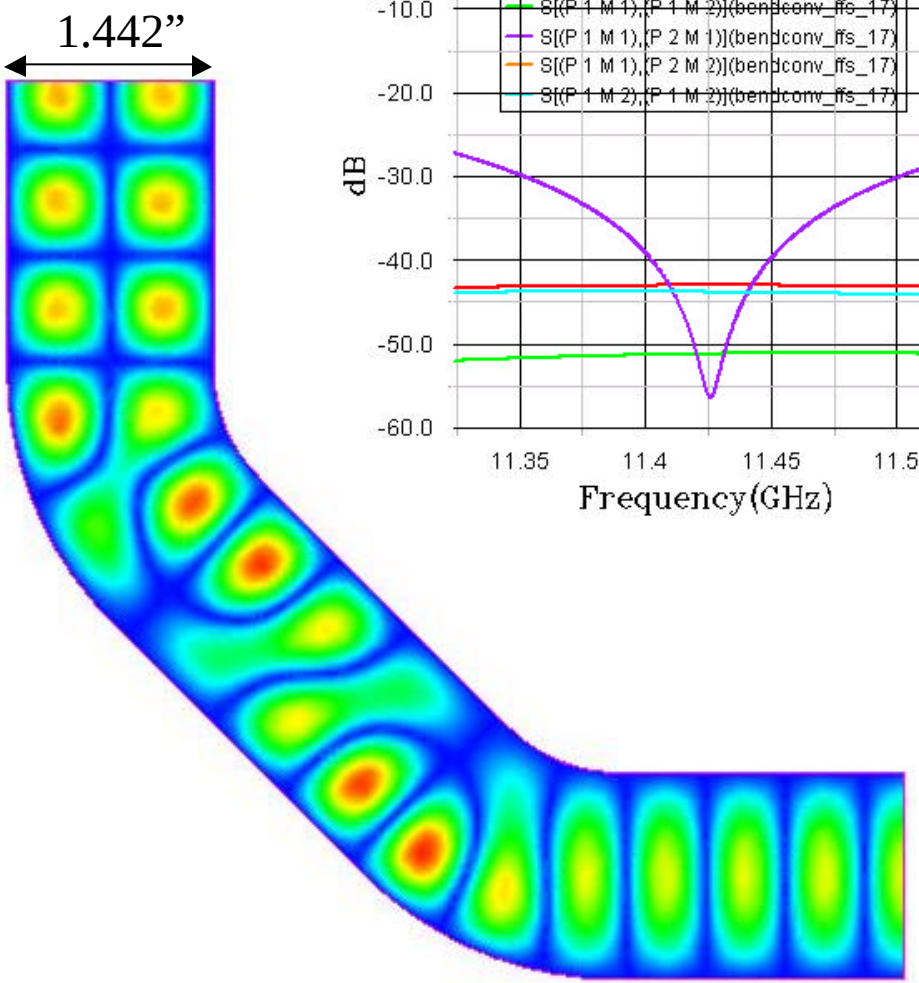
Simulated electric fields (HFSS)of the multi-moded circular to rectangular taper

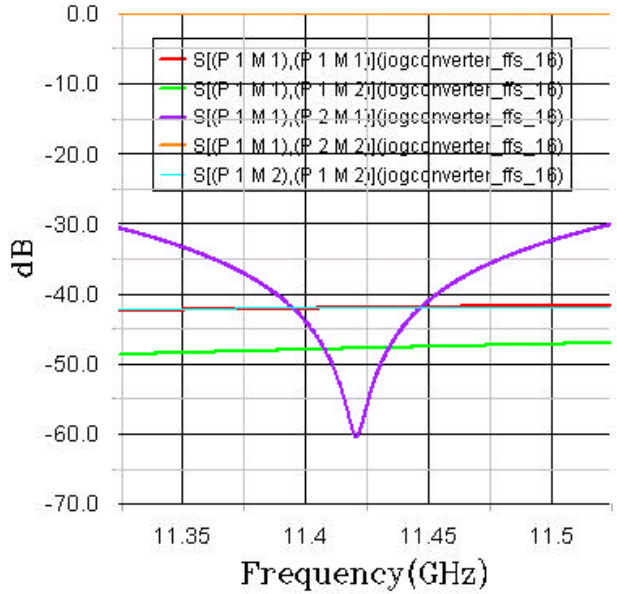


Taper Geometry

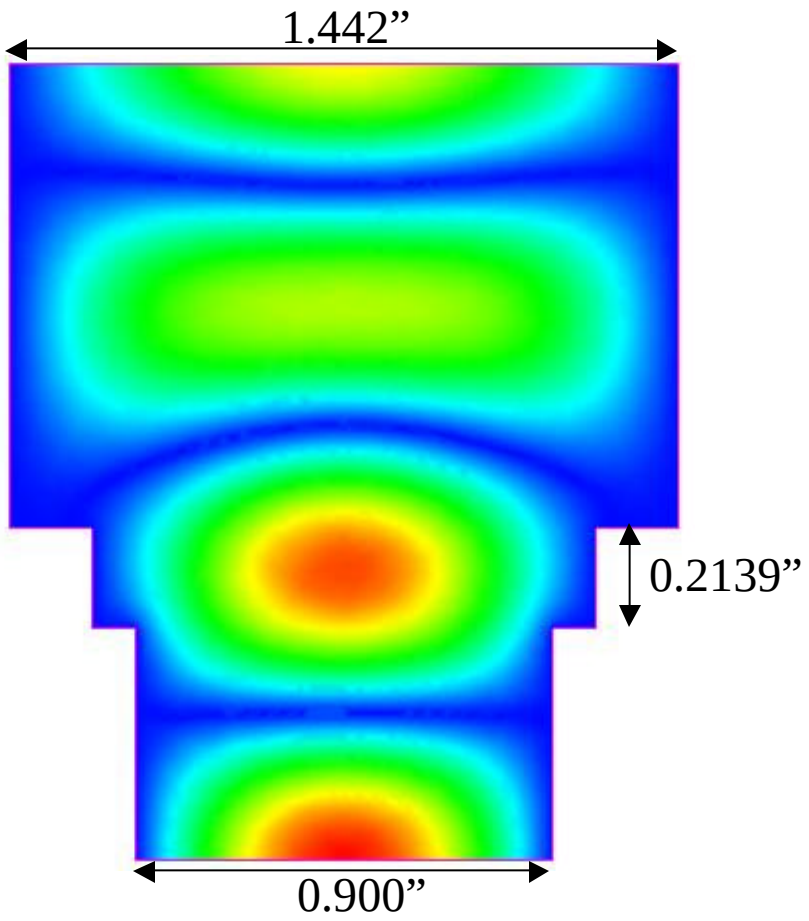
Jog Converter and Bend Converter





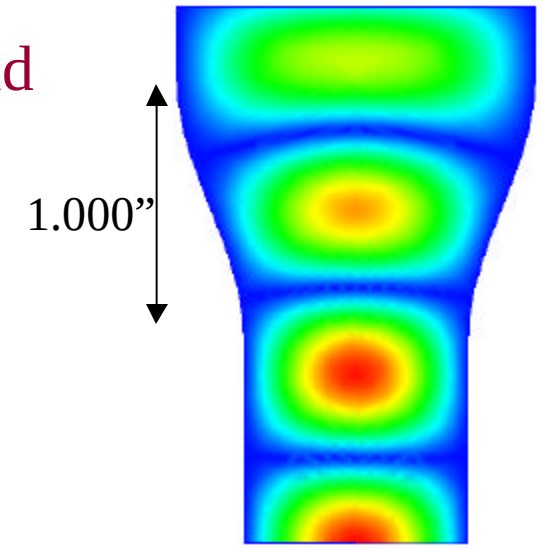


Width Taper (0.900”→1.442”)



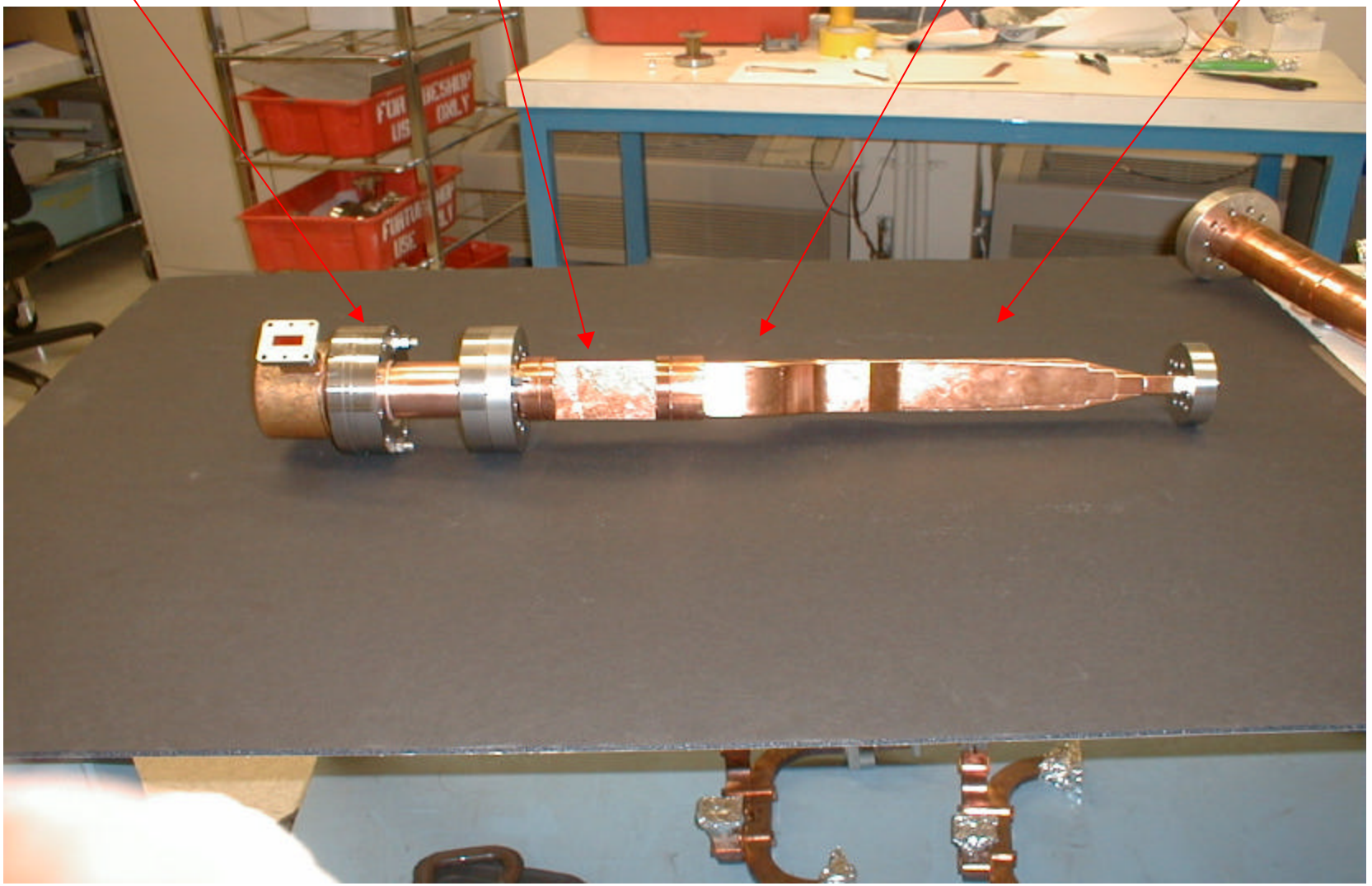
	(P 1 M 1)	(P 2 M 1)	(P 2 M 2)
(P 1 M 1)	0.0001	1	8.586e-006
(P 2 M 1)	1	0.0001	8.587e-006
(P 2 M 2)	8.586e-006	8.587e-006	1

old

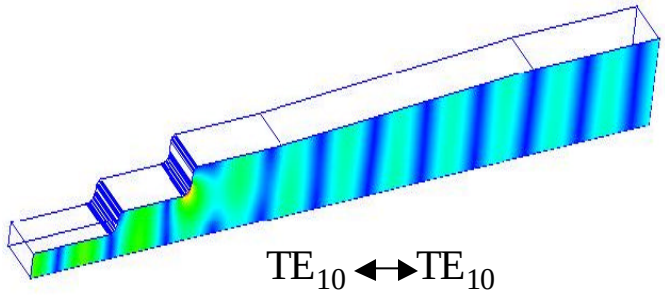


	(P 1 M 1)	(P 2 M 1)	(P 2 M 2)
(P 1 M 1)	0.0104	0.9999	0.0227
(P 2 M 1)	0.9999	0.0104	0.0225
(P 2 M 2)	0.0227	0.0225	0.0361

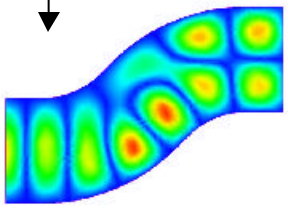
Wraparound mode converter, circular to rectangular taper, jog mode converter, height tapers,



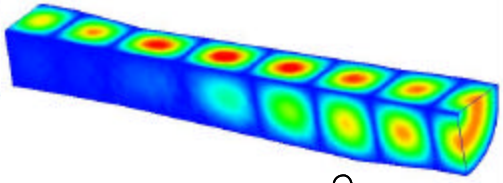
An Assembly to test new components and concepts: height tapers, jog mode converter, circular to rectangular tapers



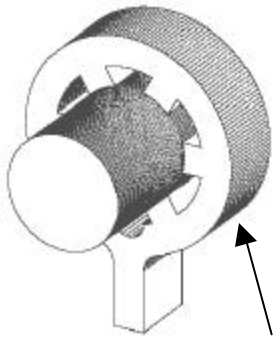
$TE_{10} \leftrightarrow TE_{10}$



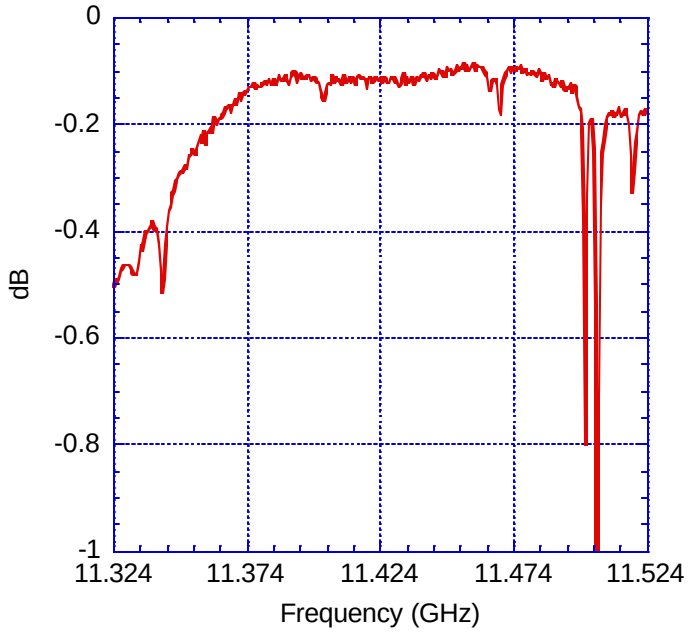
$TE_{10} \leftrightarrow TE_{20}$



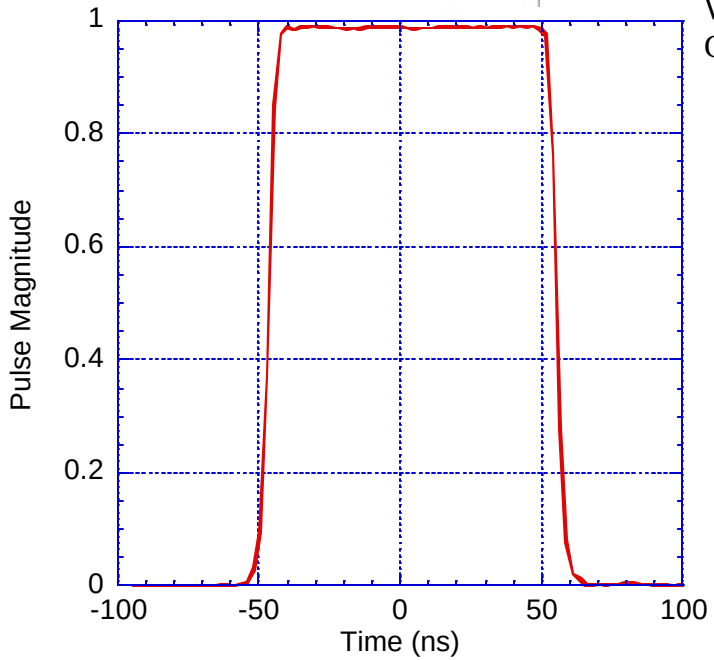
$TE_{20} \leftrightarrow TE_{01}^{\circ}$



Wrap-Around Converter

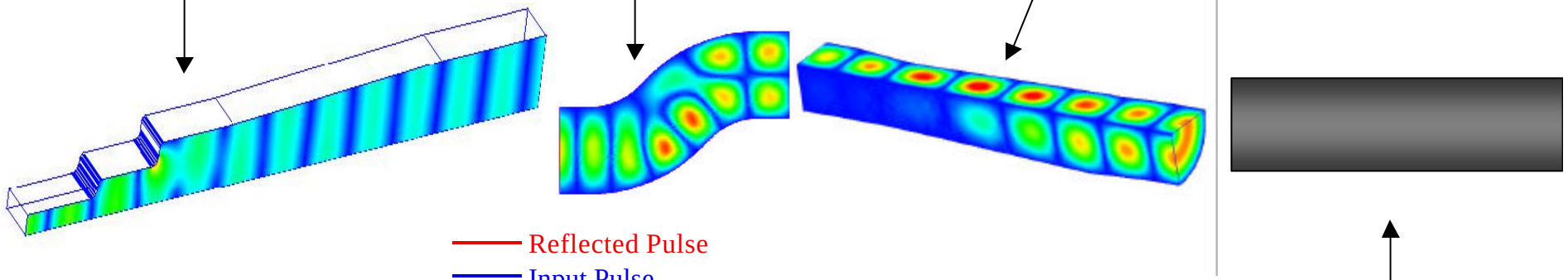


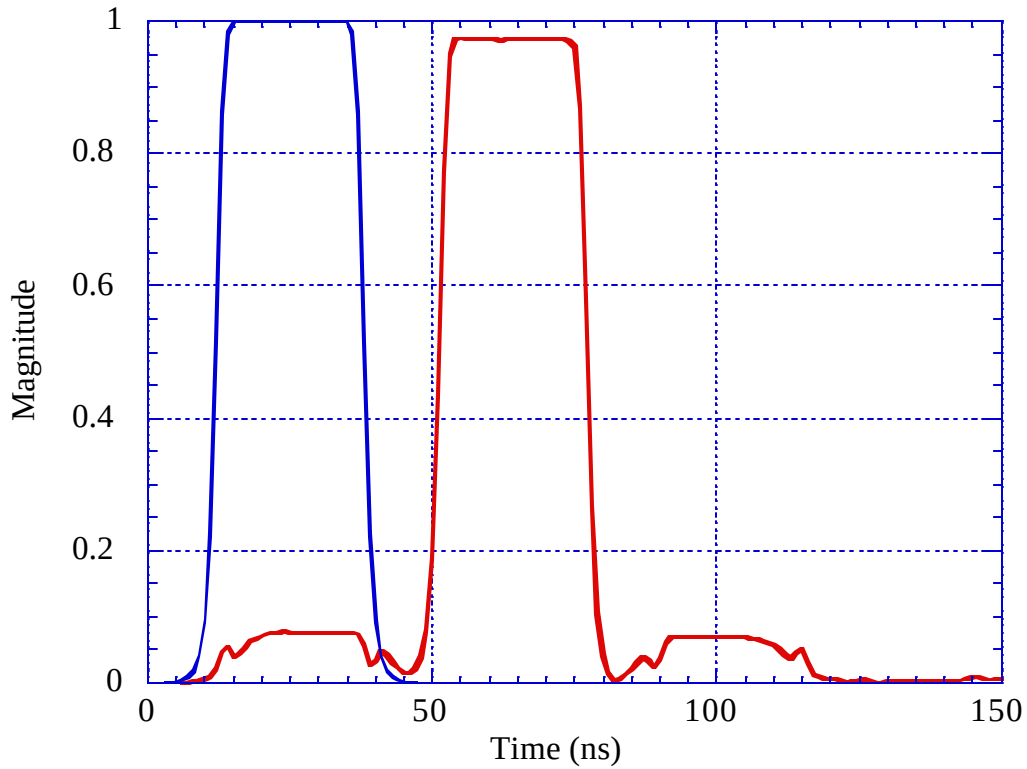
Frequency response of the assembly (S_{12})



Transmitted pulse through the assembly

height tapers, jog mode converter, circular to rectangular tapers



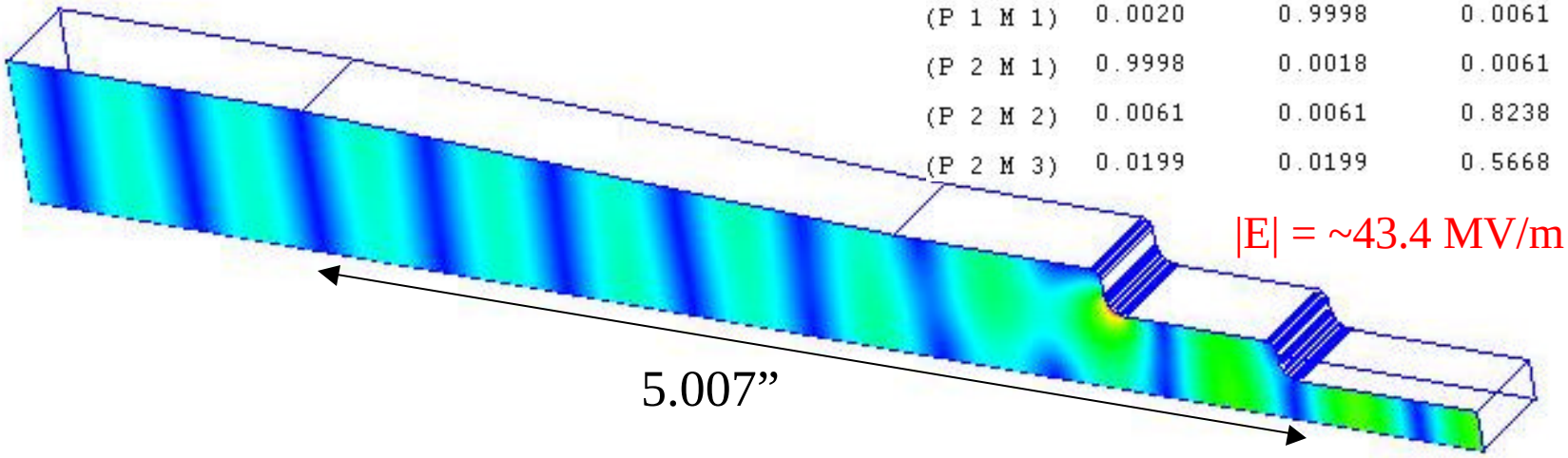


30 ns shorted transmission line

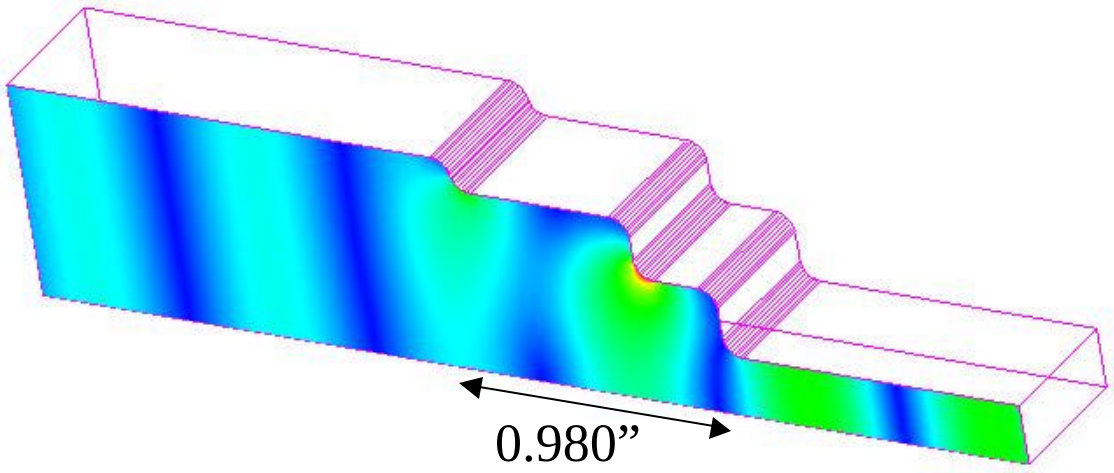
Reflection after an approximately 30 ns Transmission line

Height Taper (0.400”→1.435”)

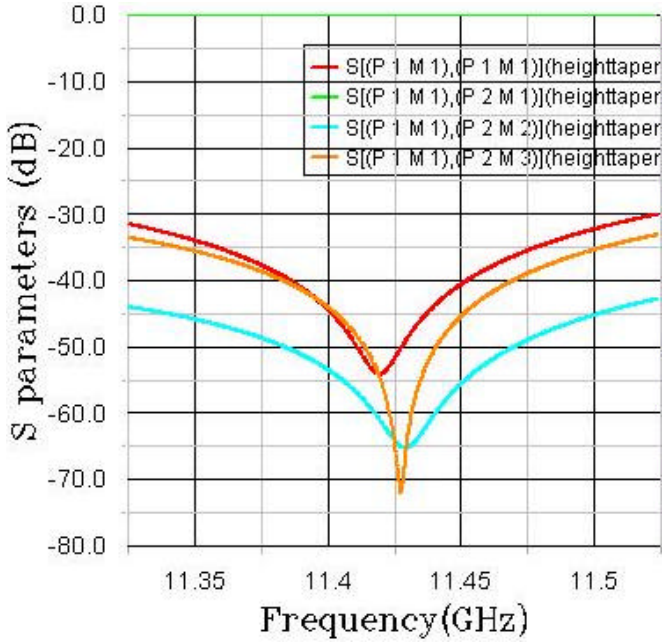
	(P 1 M 1)	(P 2 M 1)	(P 2 M 2)	(P 2 M 3)
(P 1 M 1)	0.0020	0.9998	0.0061	0.0199
(P 2 M 1)	0.9998	0.0018	0.0061	0.0199
(P 2 M 2)	0.0061	0.0061	0.8238	0.5668
(P 2 M 3)	0.0199	0.0199	0.5668	0.8234



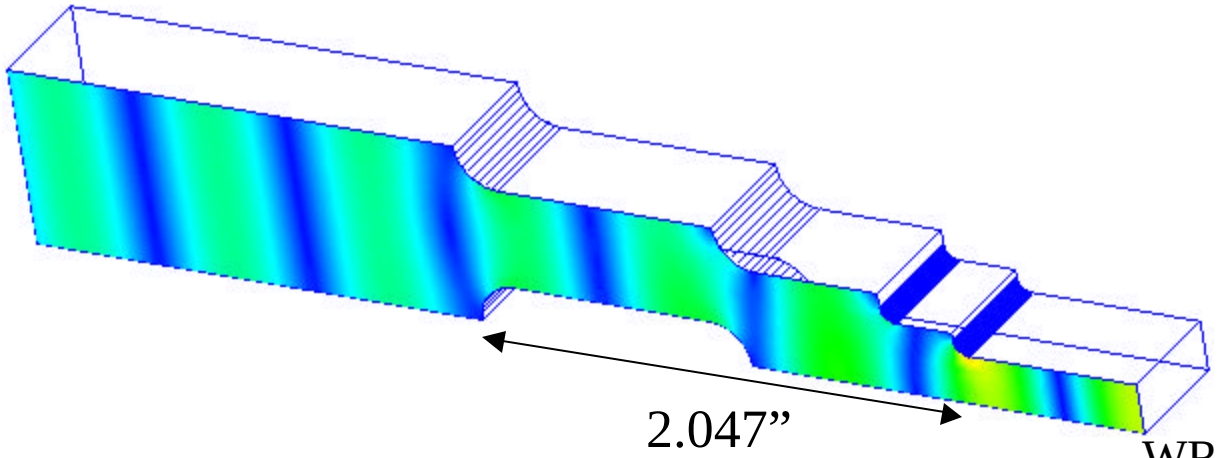
|E| = ~43.4 MV/m @ 75 MW



|E| = ~48.4 MV/m @ 75 MW

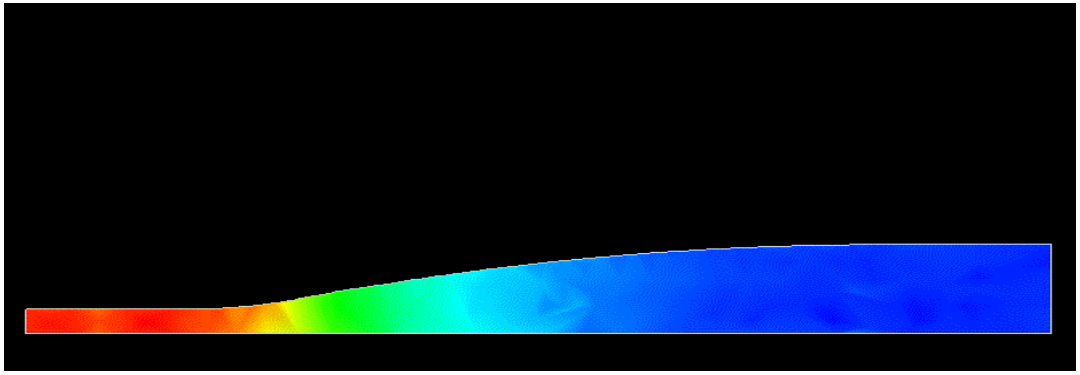


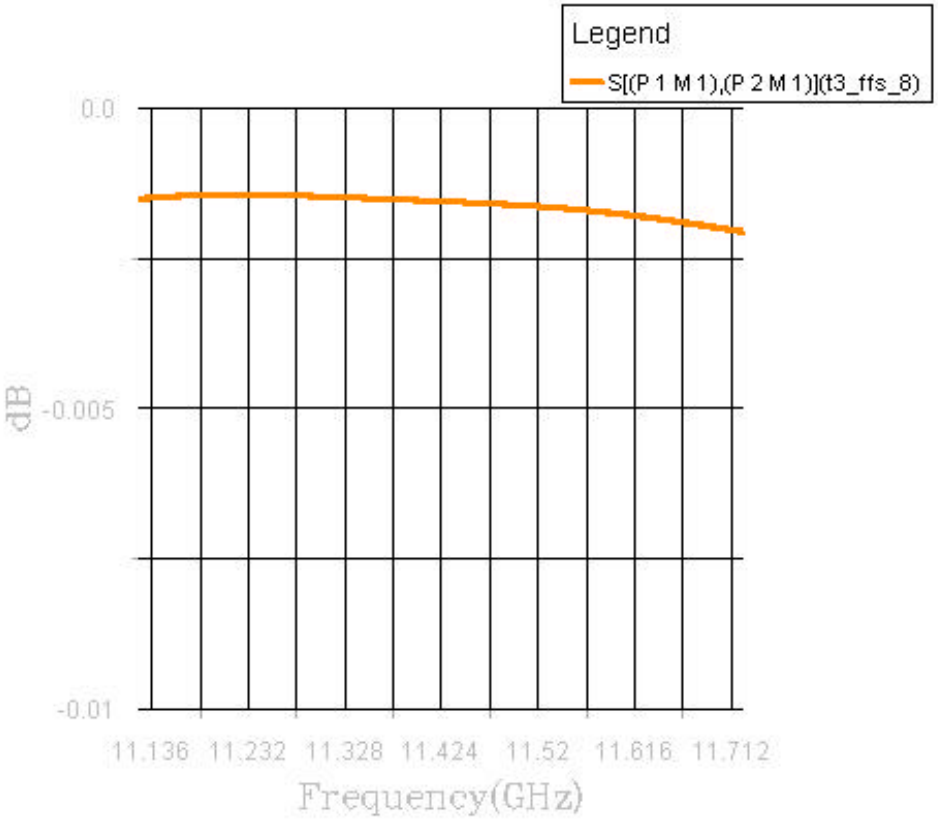
Height Taper



|E| = ~36.4 MV/m @ 75 MW

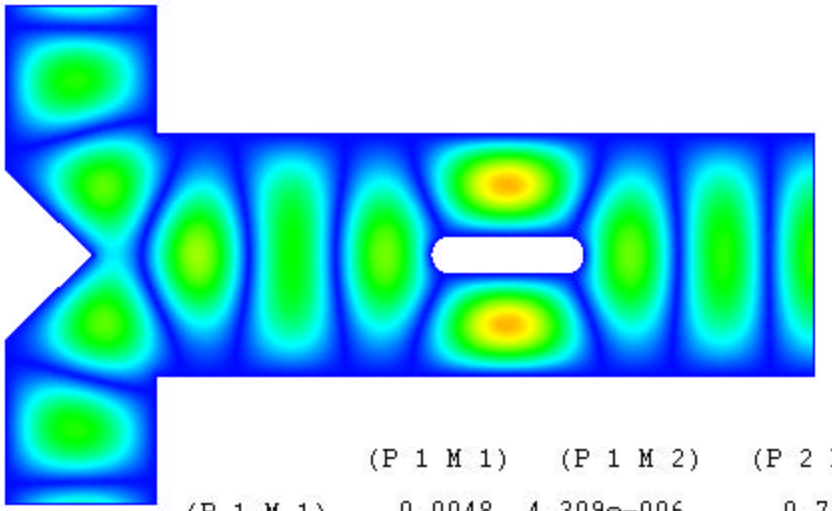
WR90: |E| = ~24.4 MV/m @ 75 MW



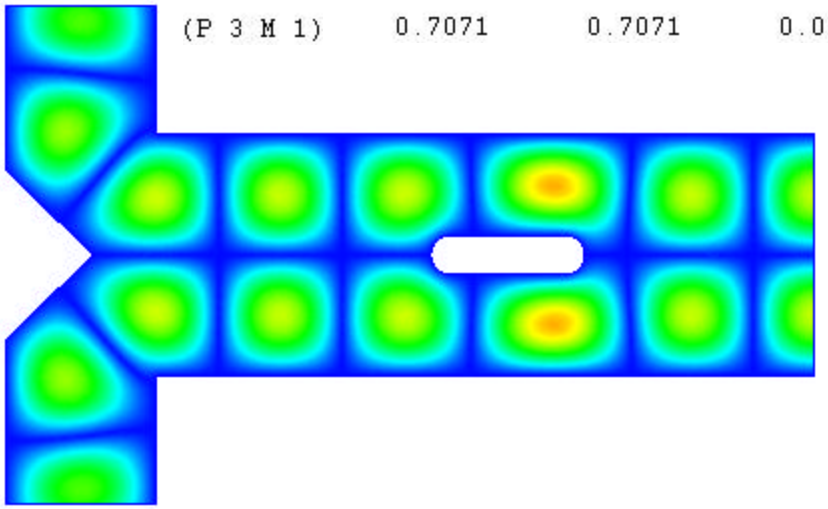


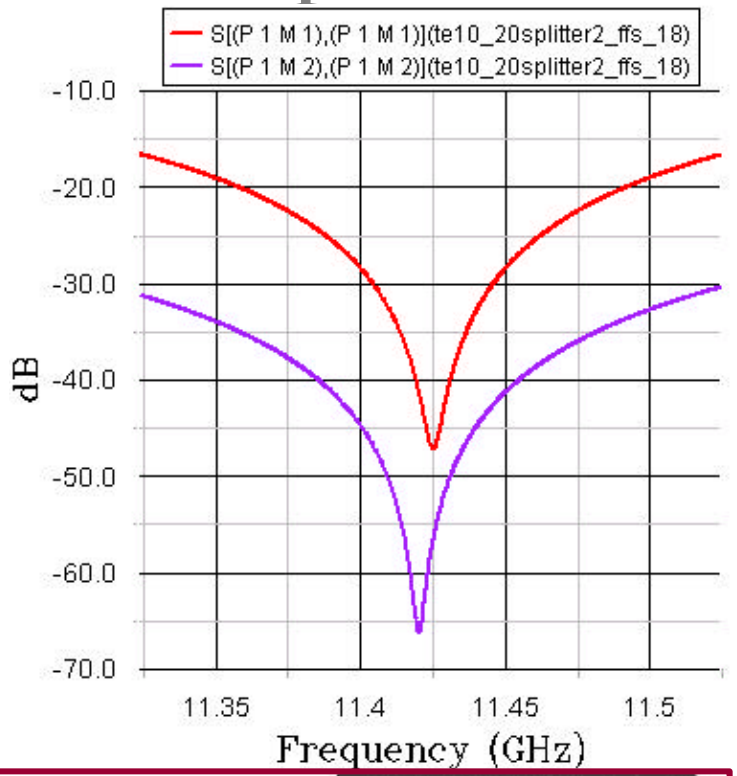
Height Taper
Peak Field~ 25 MV/m @ 75 MW
Total Length ~ 4 inches

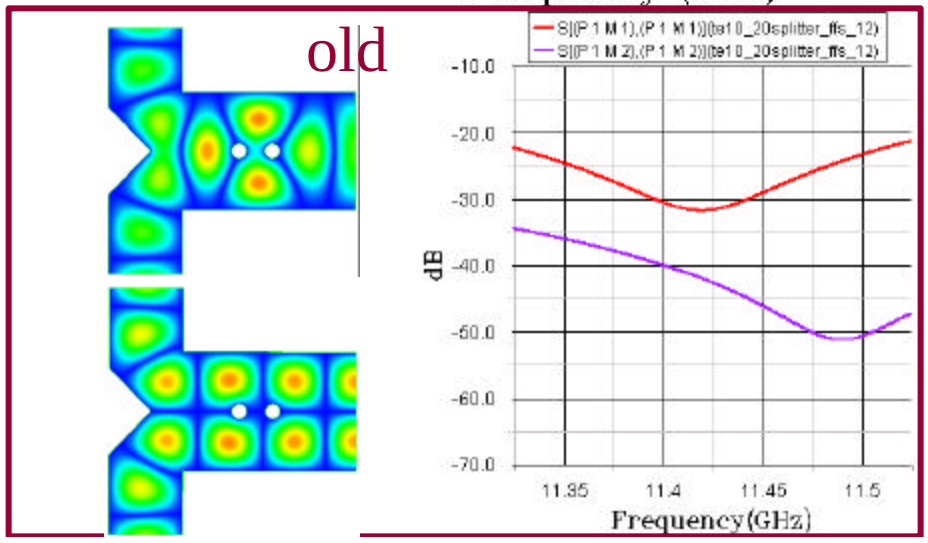
Dual-Mode Combiner/Splitter



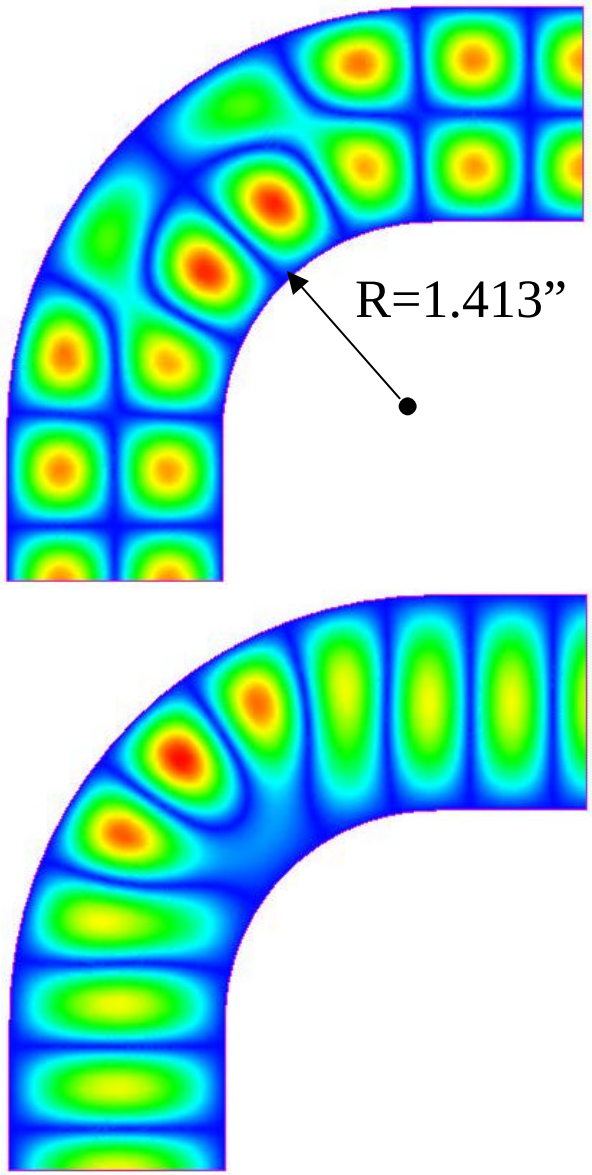
	(P 1 M 1)	(P 1 M 2)	(P 2 M 1)	(P 3 M 1)
(P 1 M 1)	0.0048	4.309e-006	0.7071	0.7071
(P 1 M 2)	4.309e-006	0.0011	0.7071	0.7071
(P 2 M 1)	0.7071	0.7071	0.0019	0.0029
(P 3 M 1)	0.7071	0.7071	0.0029	0.0019

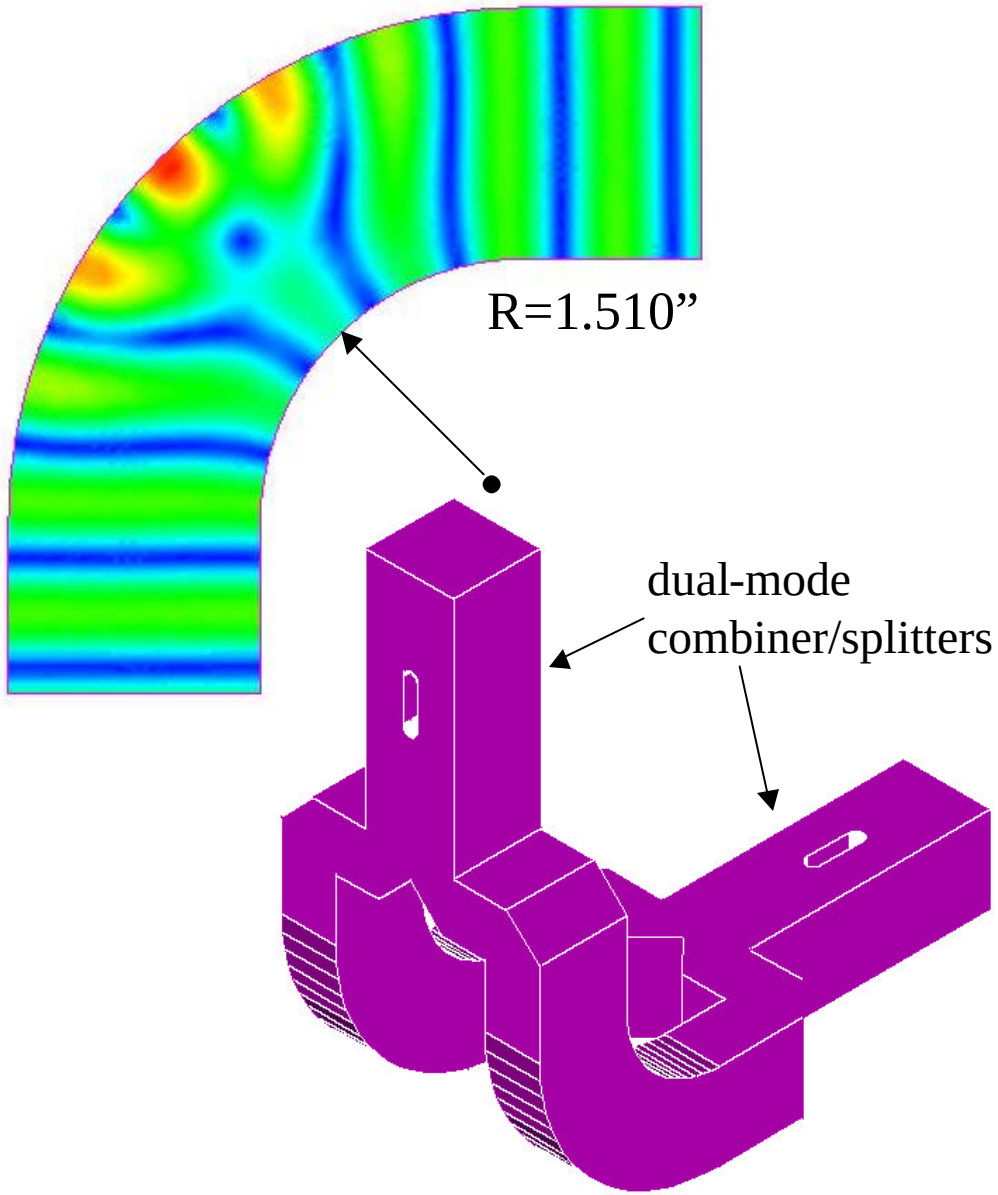




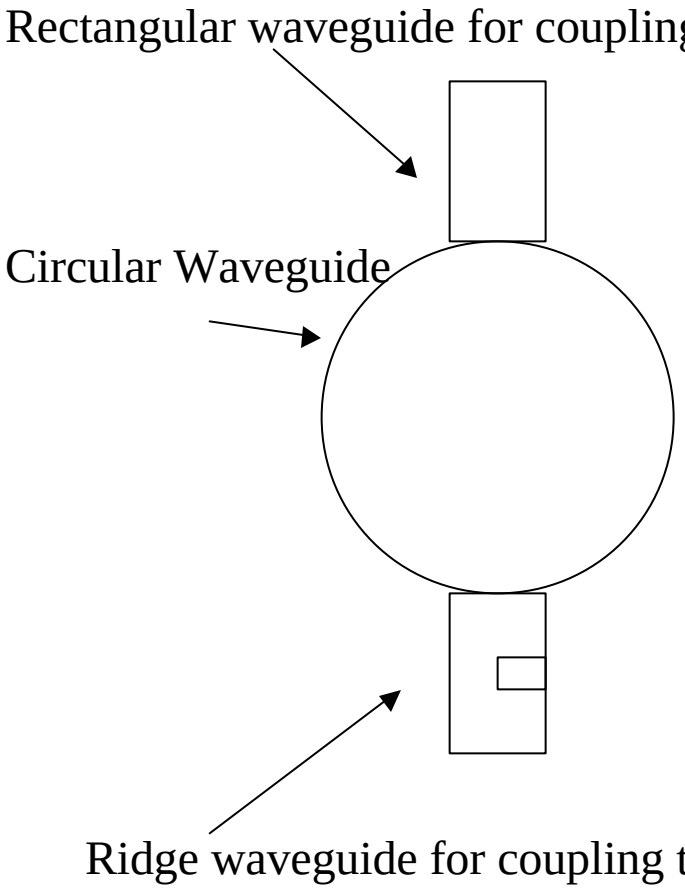


H-Plane Bend and E-Plane Bend



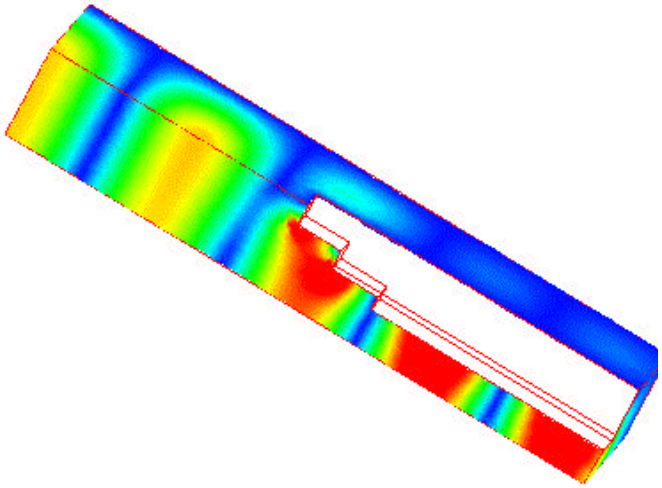


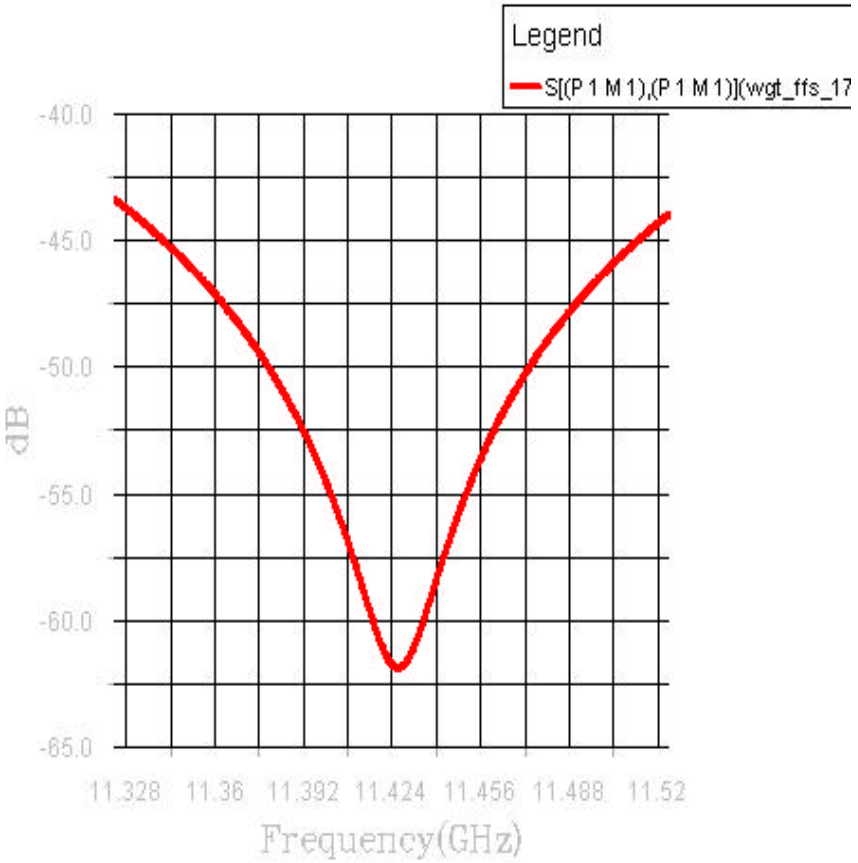
Dual-Moded Directional Coupler

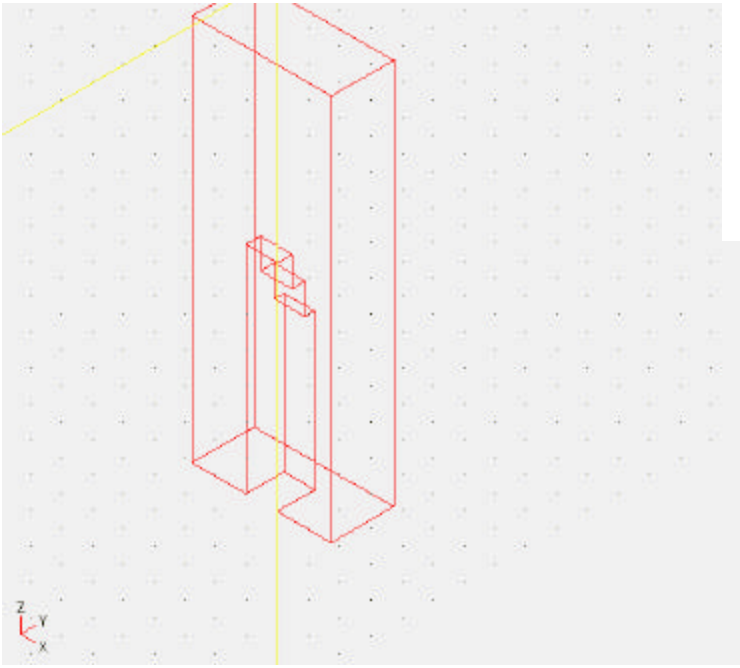


The waveguide sizes are chosen to match wavelengths between the circular waveguide modes and side waveguide fundamental mode

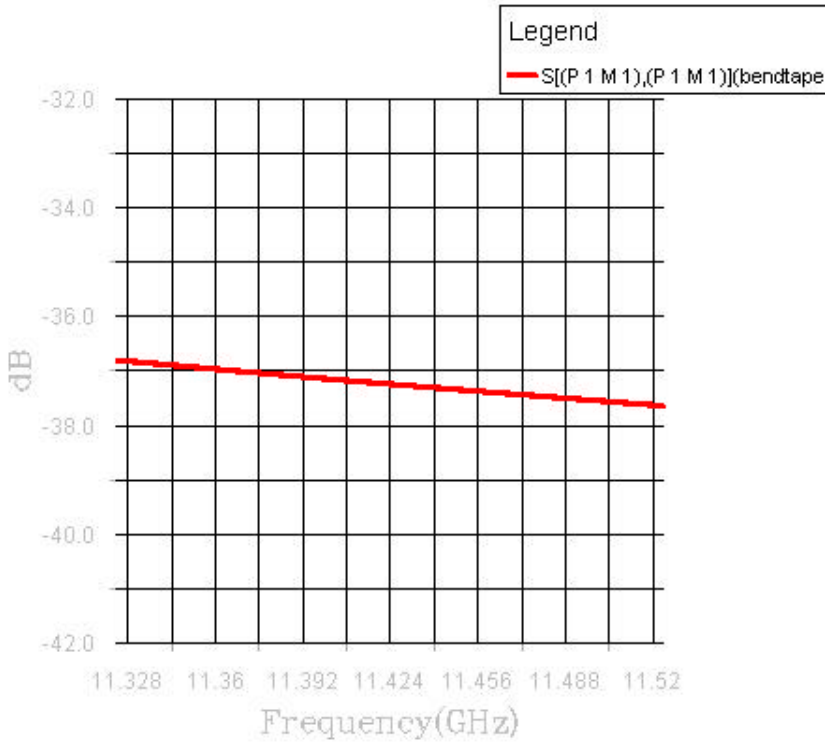
The coupling hole pattern represents a Hamming window







End taper for TE_{11} coupler

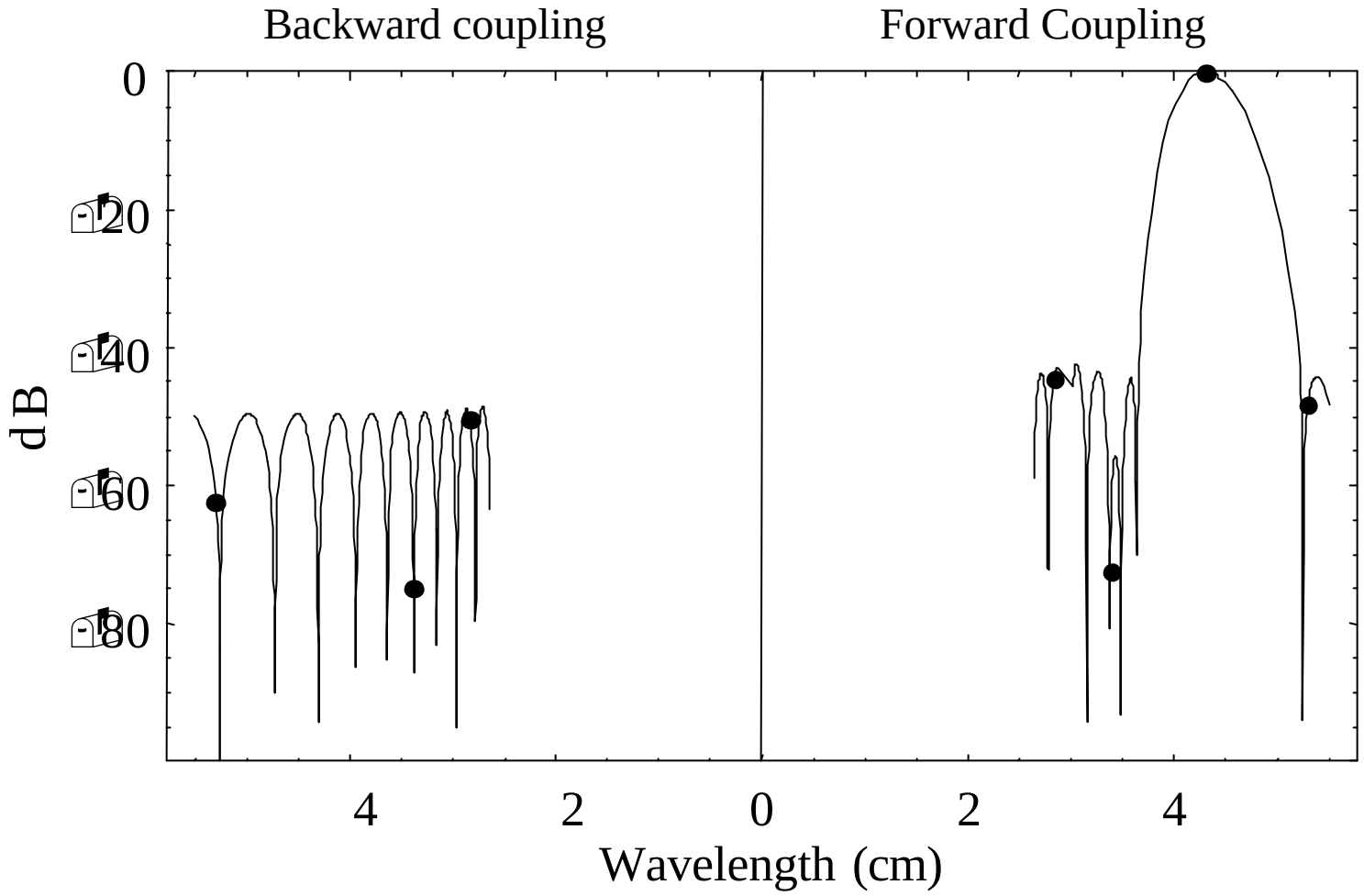


End taper for the TE_{01} coupler

TE_{01} directional coupler response (relative)

Coupler Length =50.6 cm

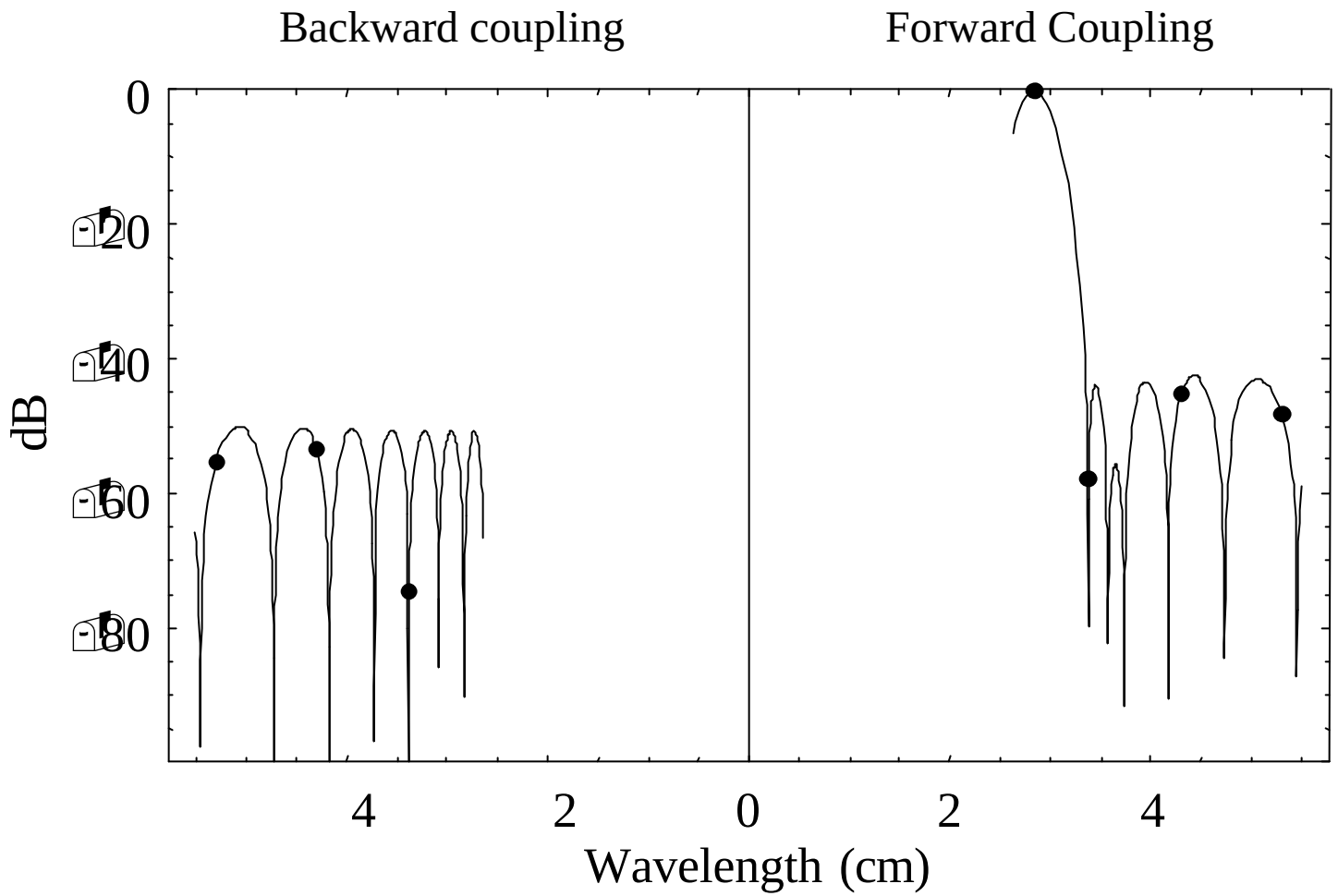
Number of coupling holes=44



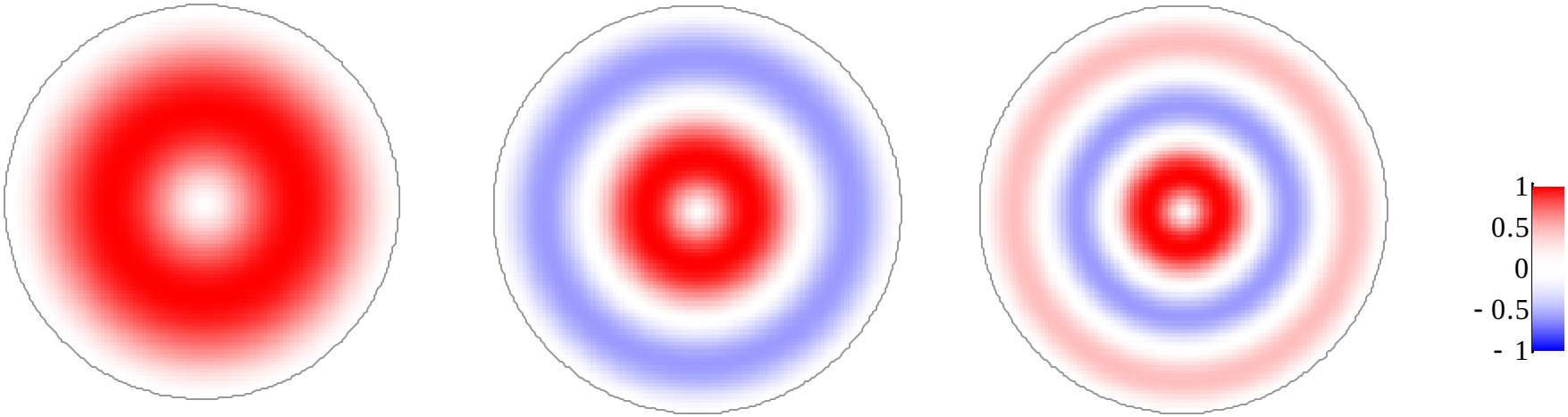
Points represent the following modes: TE_{11}, TE_{21}, TE_{01}, TE_{31}

TE_{11} directional coupler response (relative)

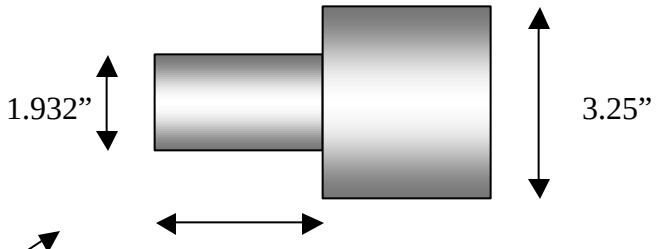
Coupler Length =38.3 cm
Number of coupling holes=51

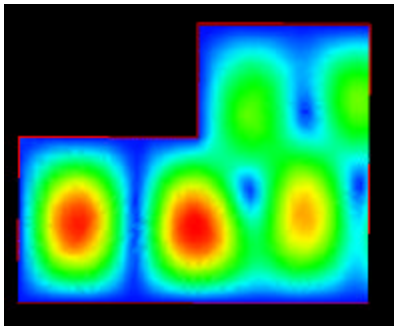


Points represent the following modes: TE_{11}, TE_{21}, TE_{01}, TE_{31}



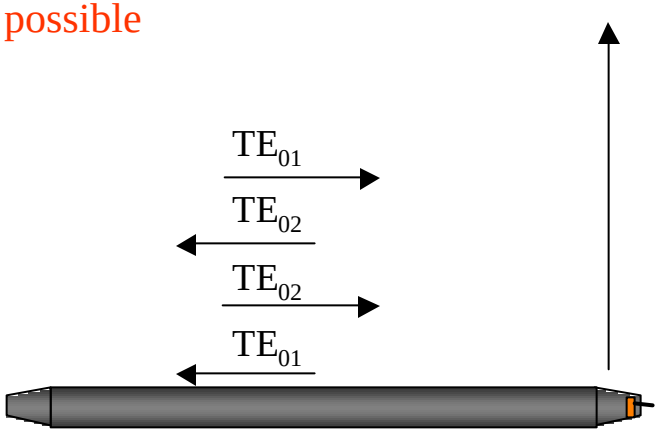
TE_{01} TE_{02} TE_{03}





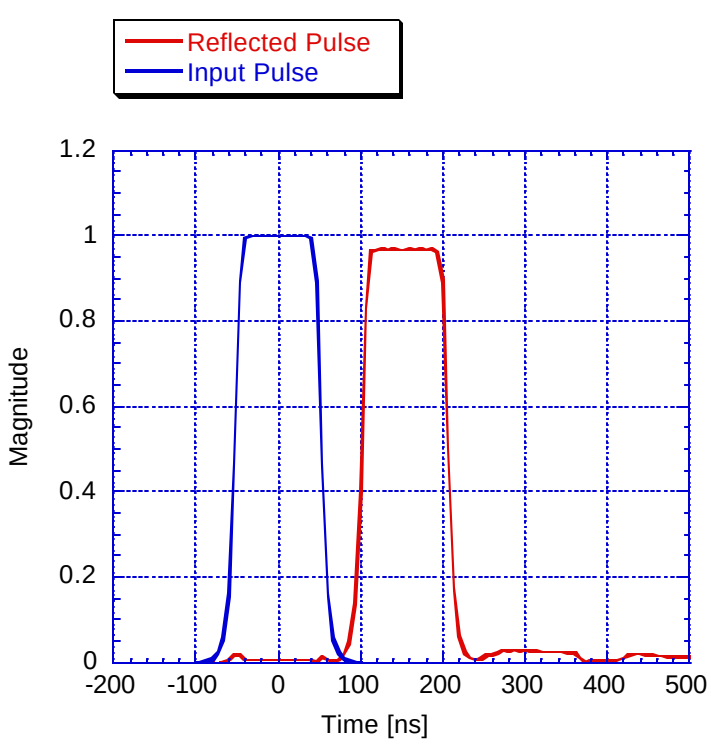
Movable TE10 to TE20 Mode converter

More sophisticated Mode converters for 4-mode and even 10 mode Delay lines are also possible

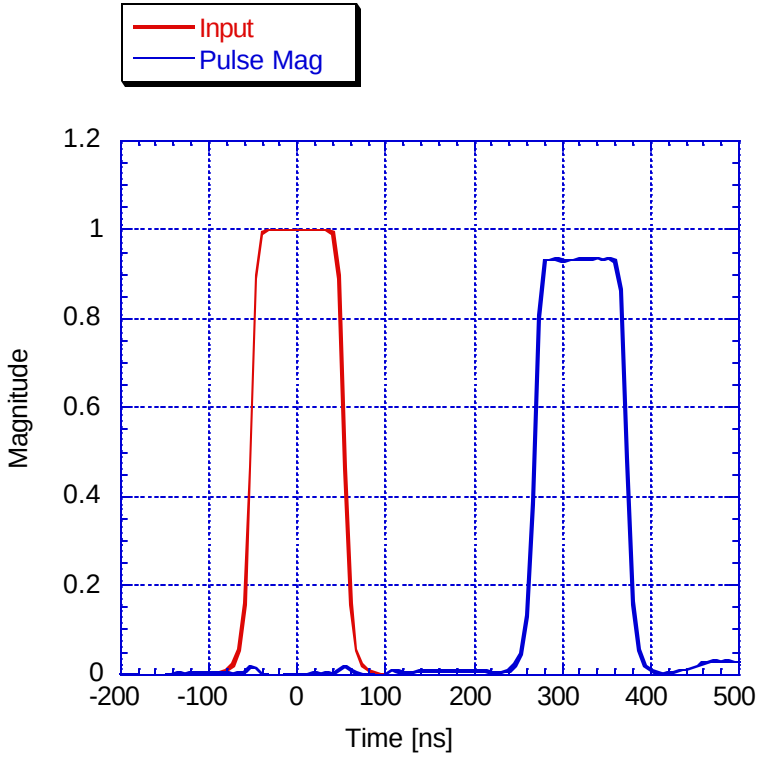


	TE_{01} (P 1 M 1)	TE_{02} (P 1 M 2)
(P 1 M 1)	0.0147	0.9999
(P 1 M 2)	0.9999	0.0147

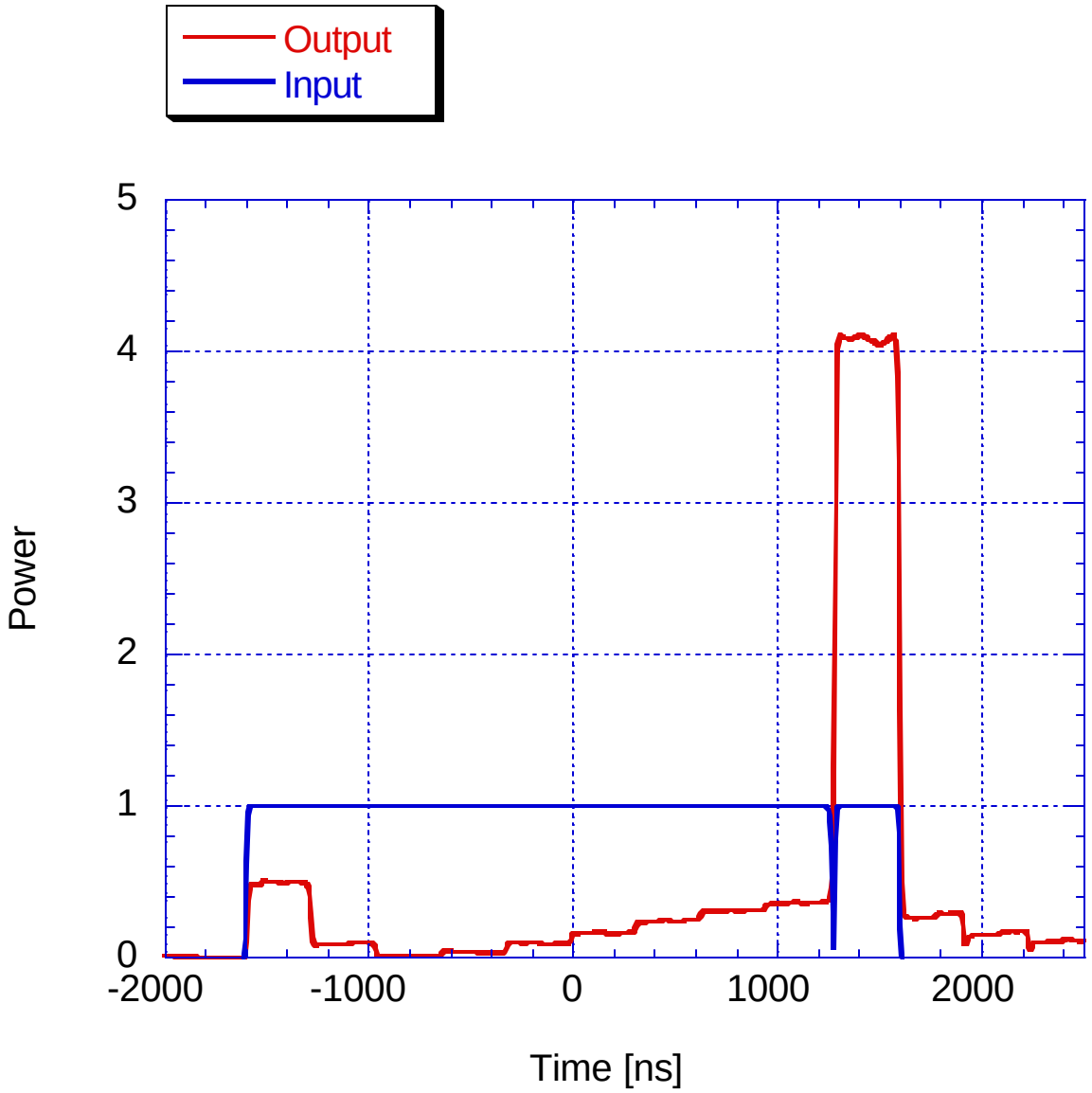
Field Pattern within the device. Peak field at 300 MW (one device per transmission line) is 26.6 MV/m. This field is in the middle of the small guide.



Measured Delay through 75 feet of WC475 waveguide terminated with a flat plate. The round trip delay time is 154 ns

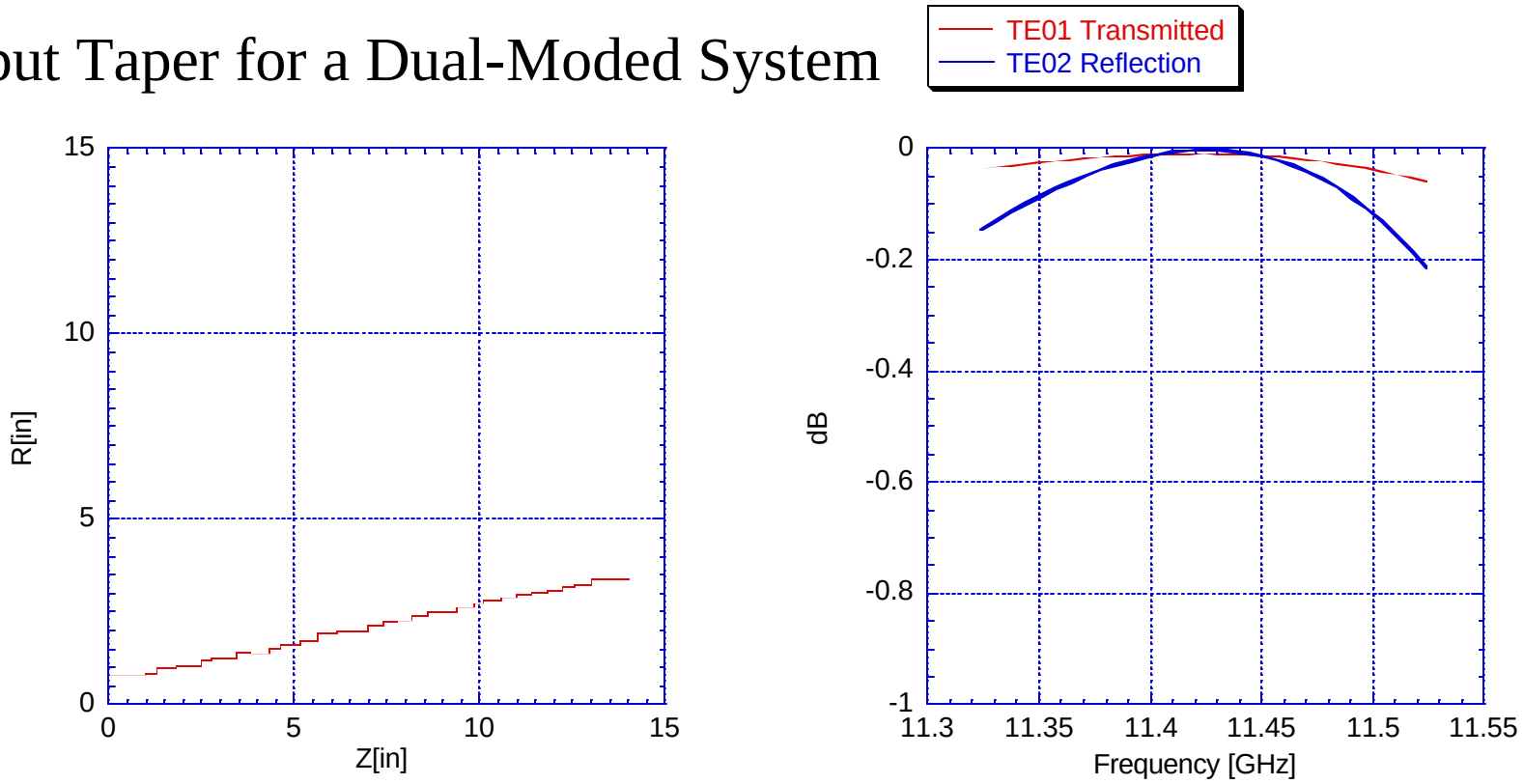


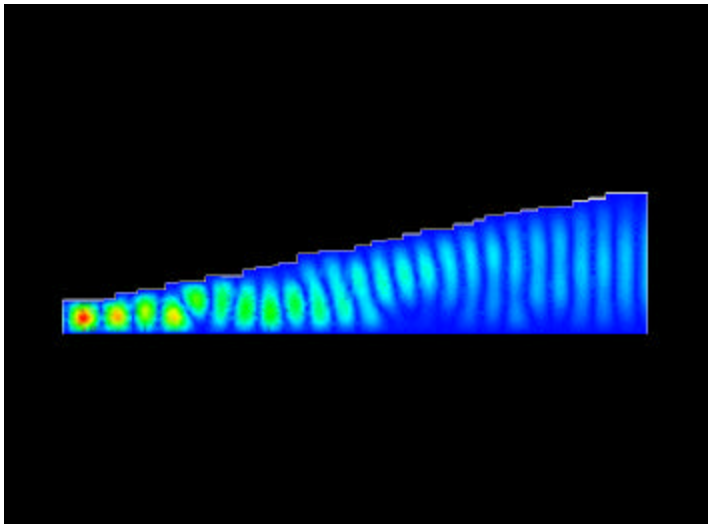
Measured delay through 75 feet of WC475 waveguide terminated with a TE01-TE02 Mode converter. The round trip delay time is 320 ns

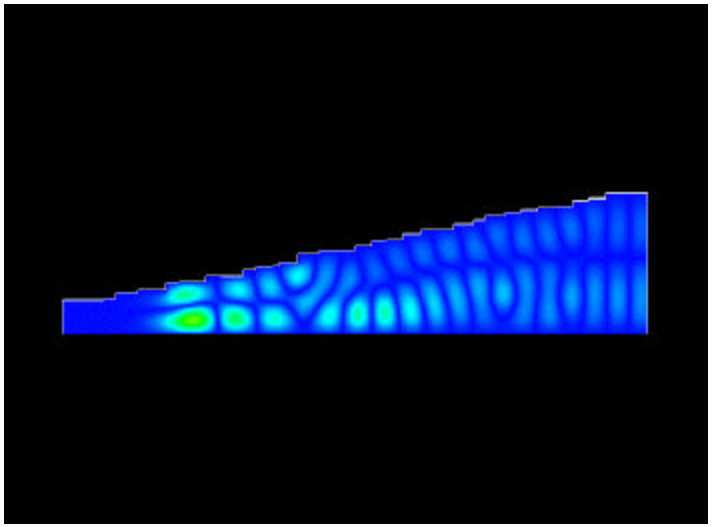


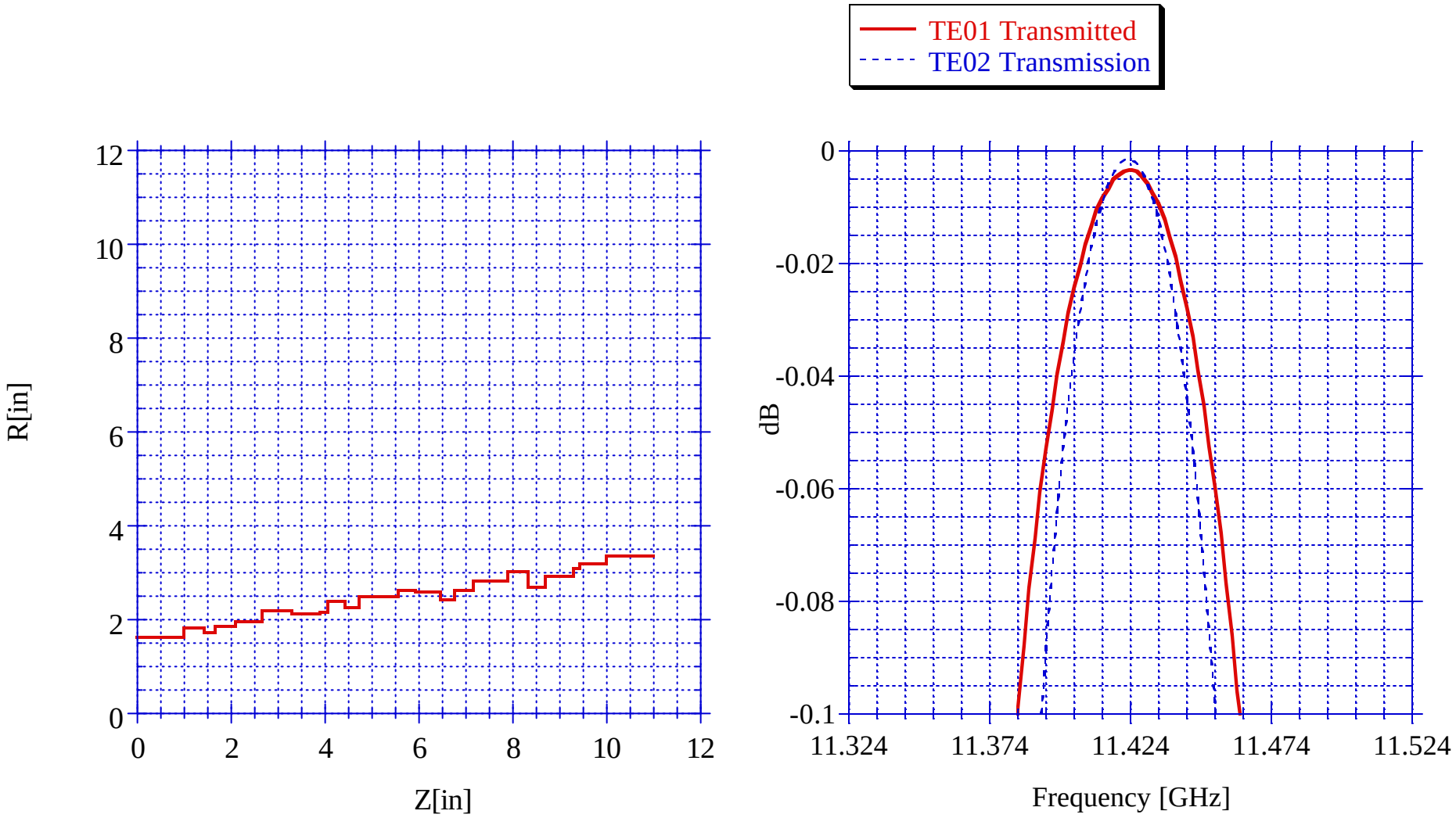
Measured Response of the dual-mode SLED-II Pulse compression system at a compression ratio of 10. Delay line length is 75 feet. Output pulse width is 320 ns.

Input Taper for a Dual-Moded System

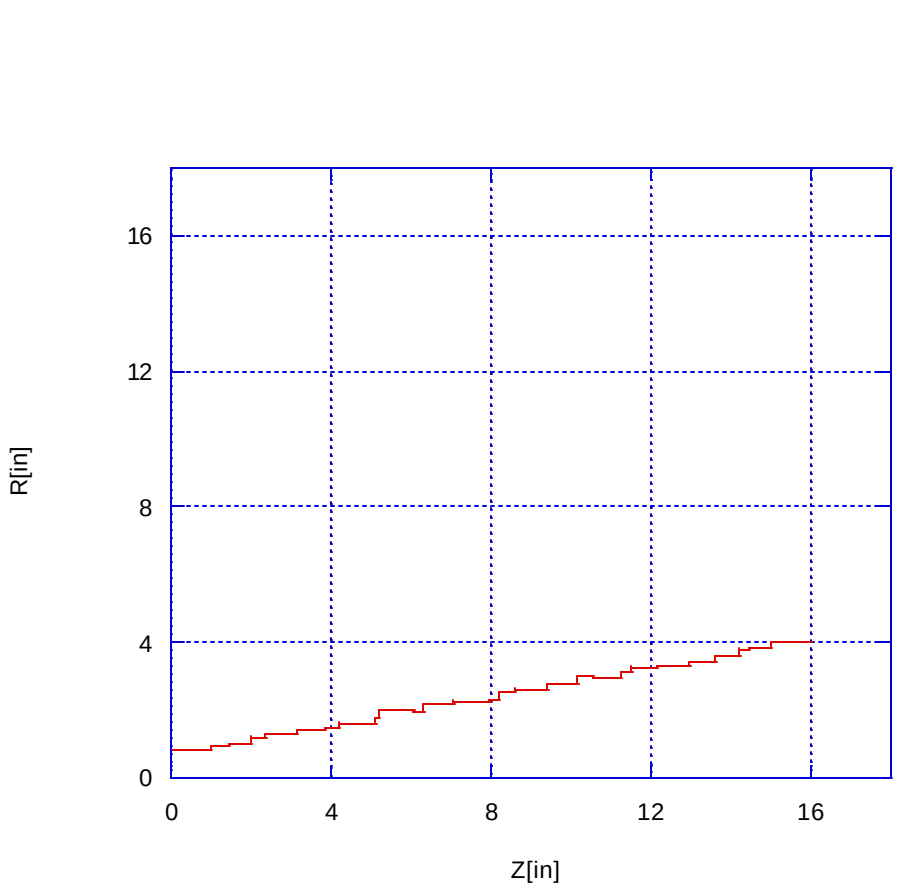


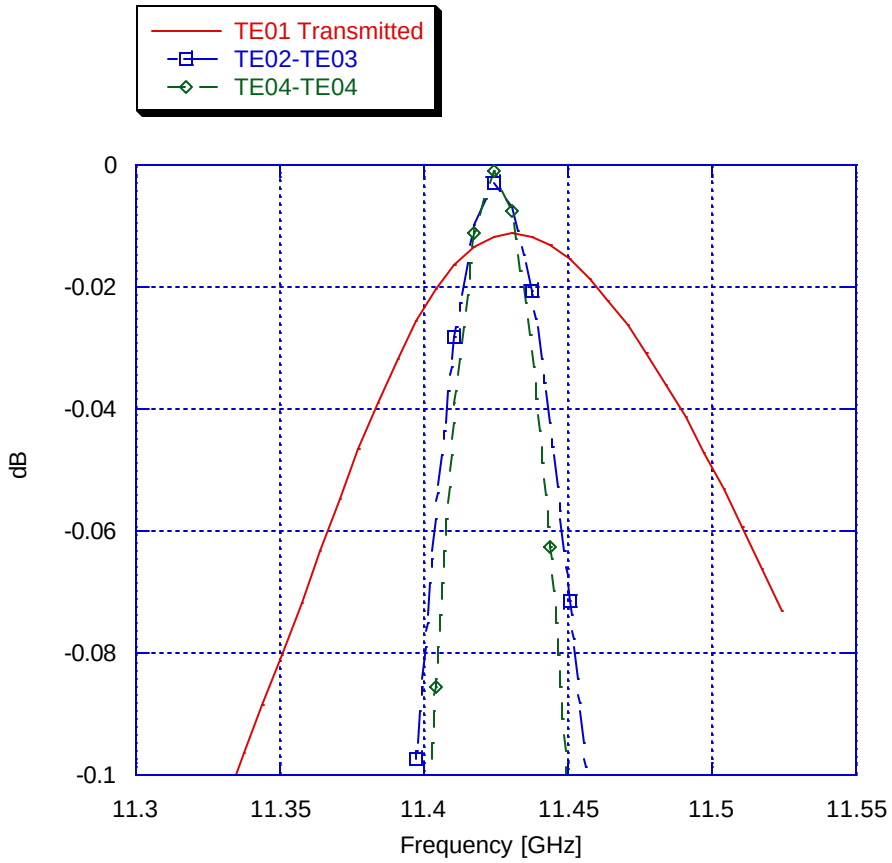




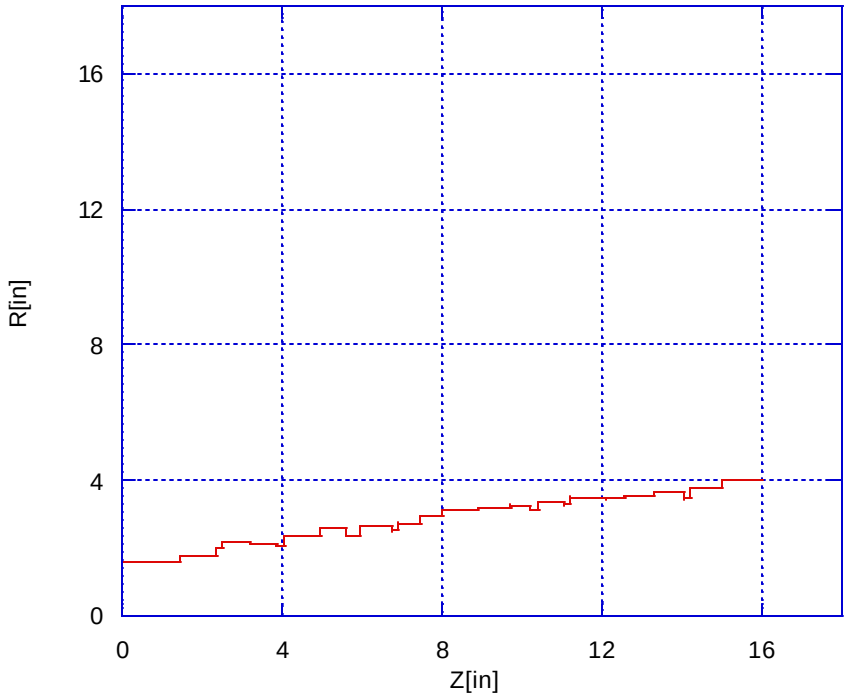


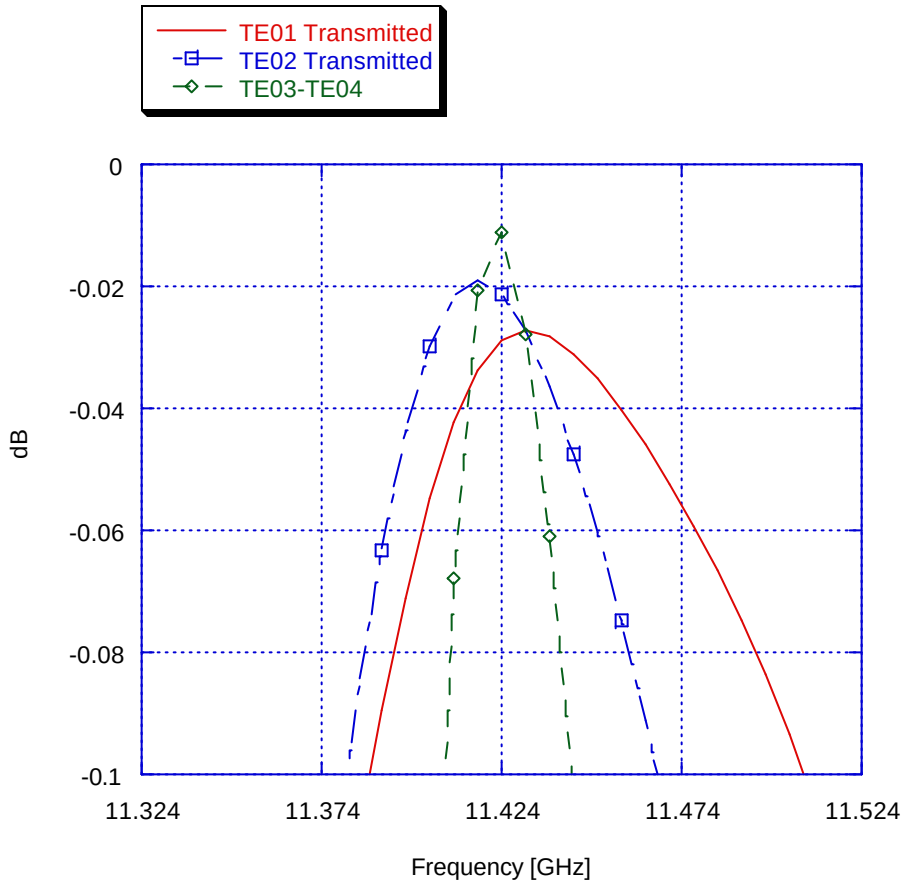
End Taper (before the TE_{01}-TE_{02} Mode converter)



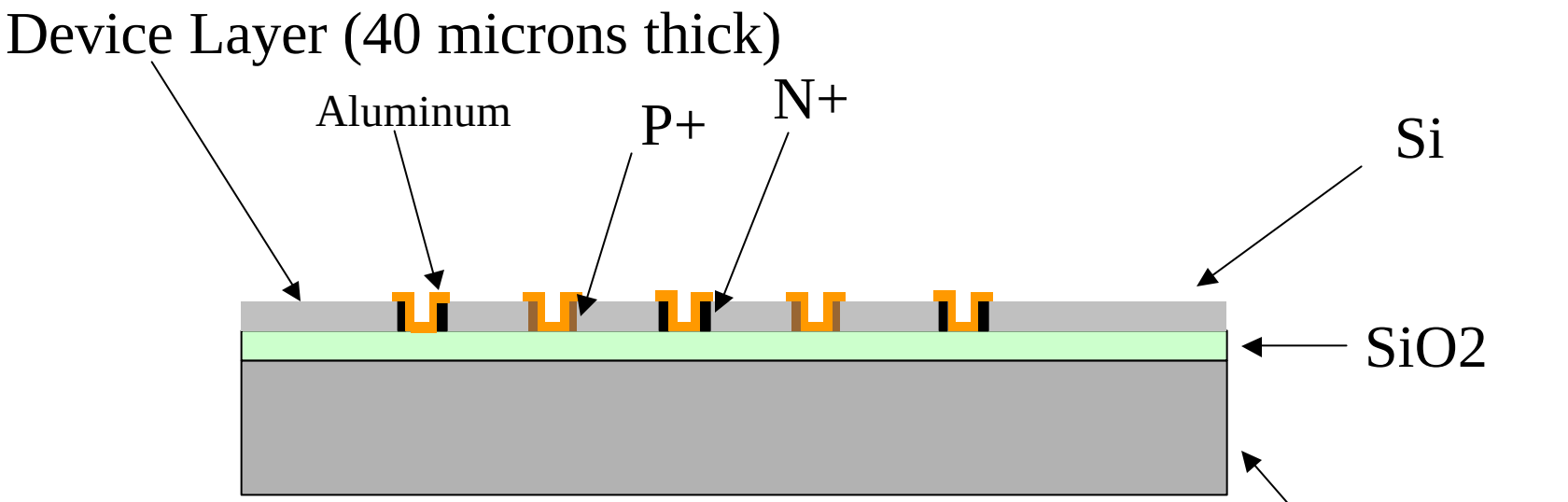


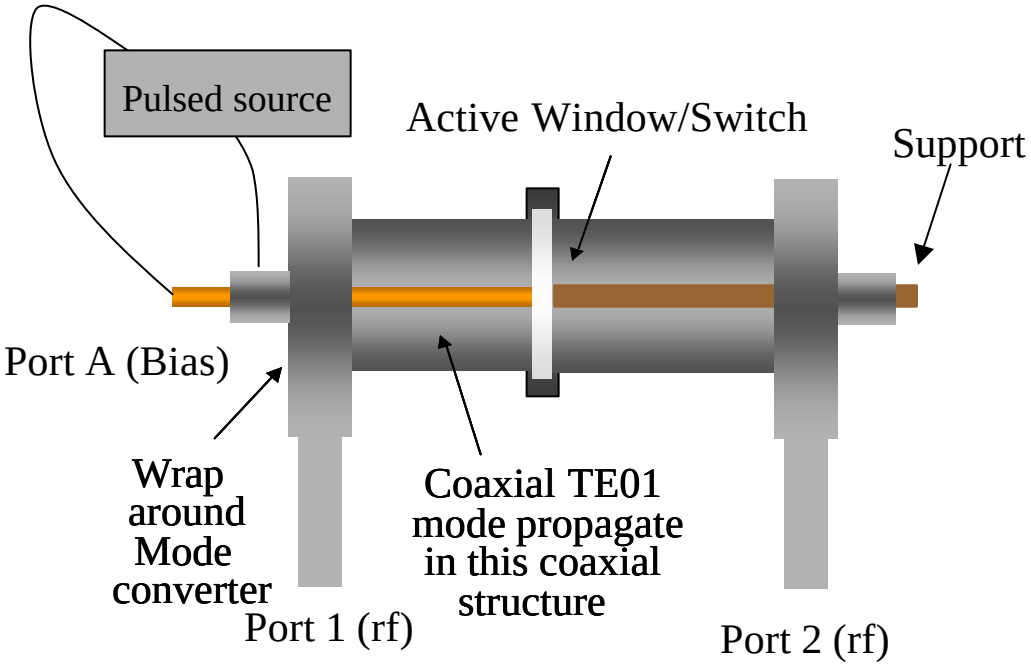
Input taper for a 4-mode system

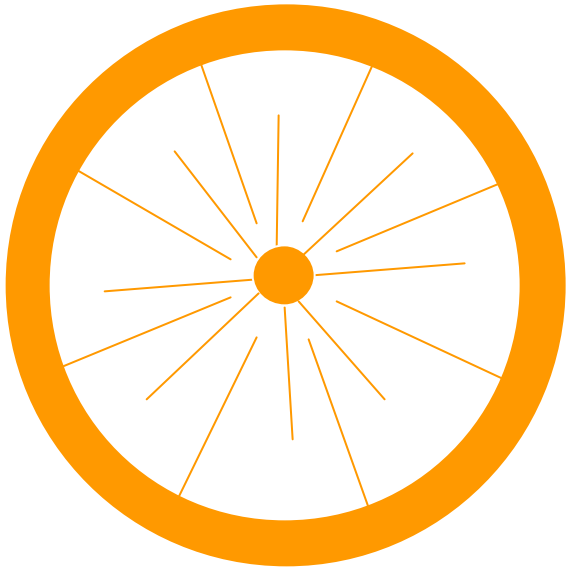




End taper for a 4-Mode System

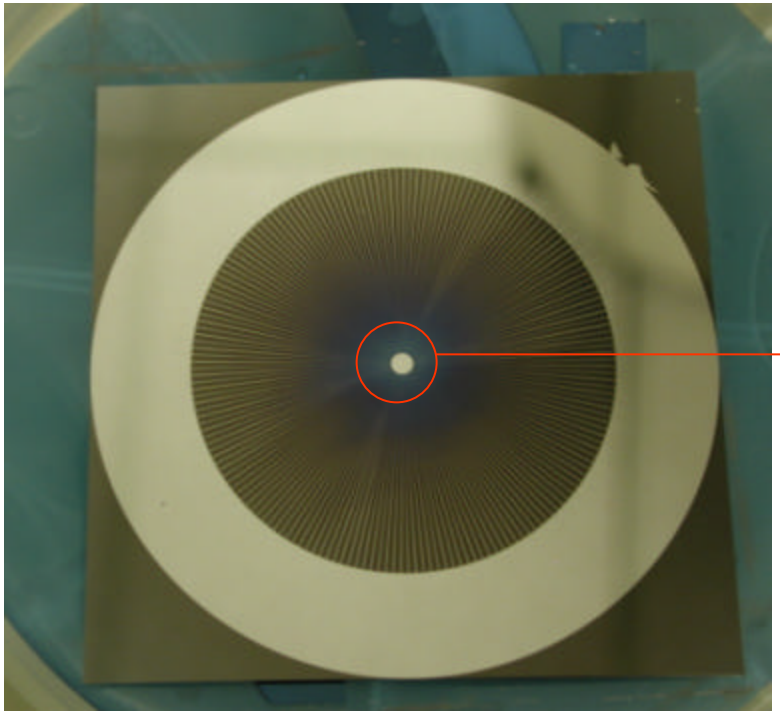


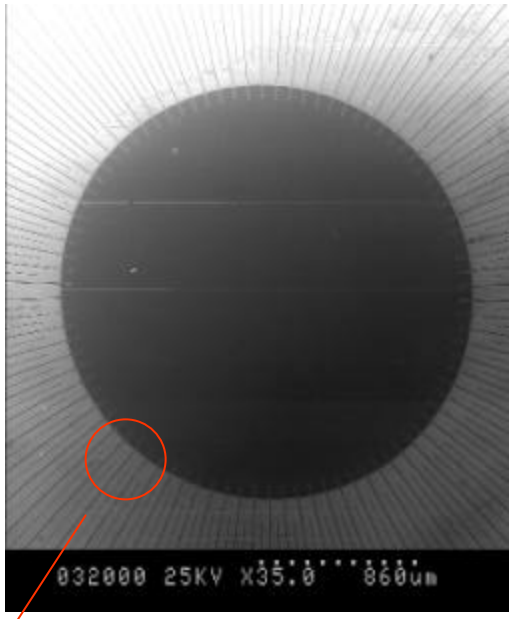




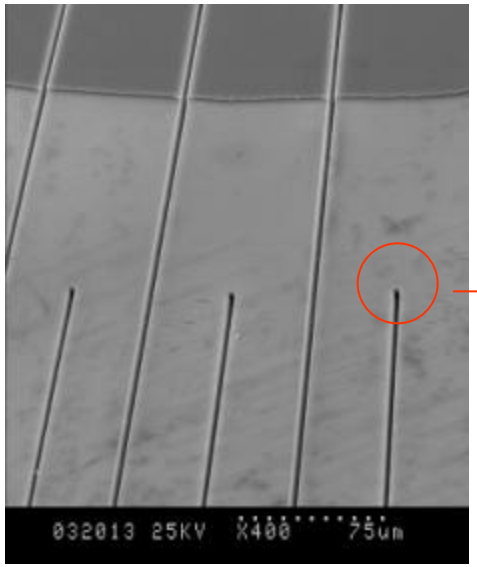
The real Device Contains 180 PIN Diodes

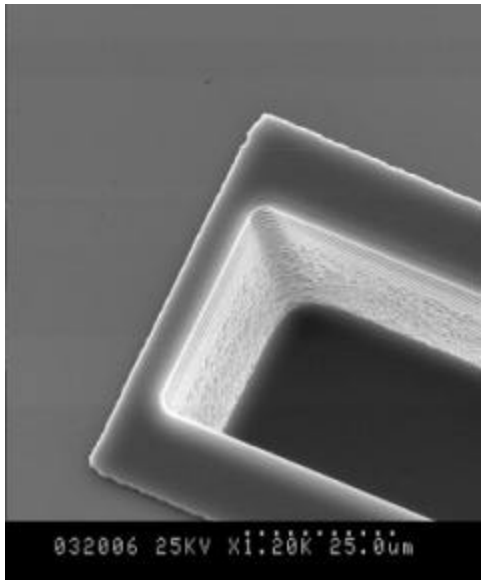
New Switch Configuration

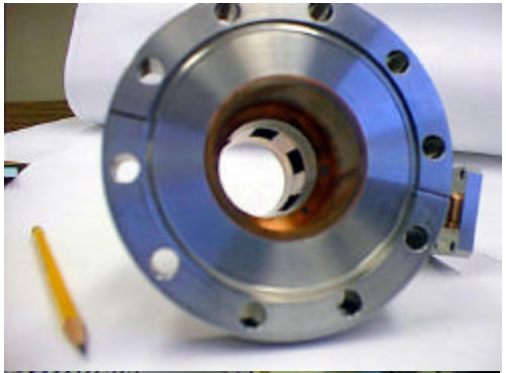


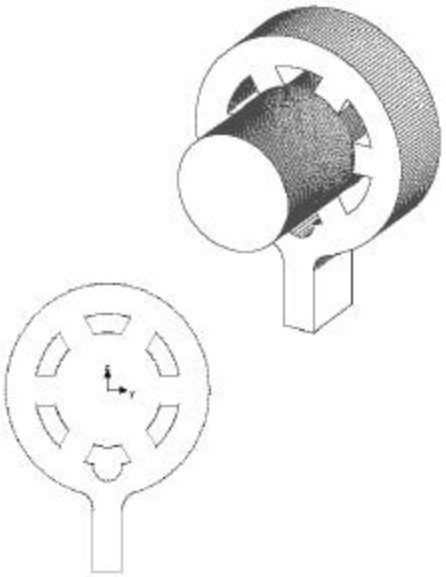


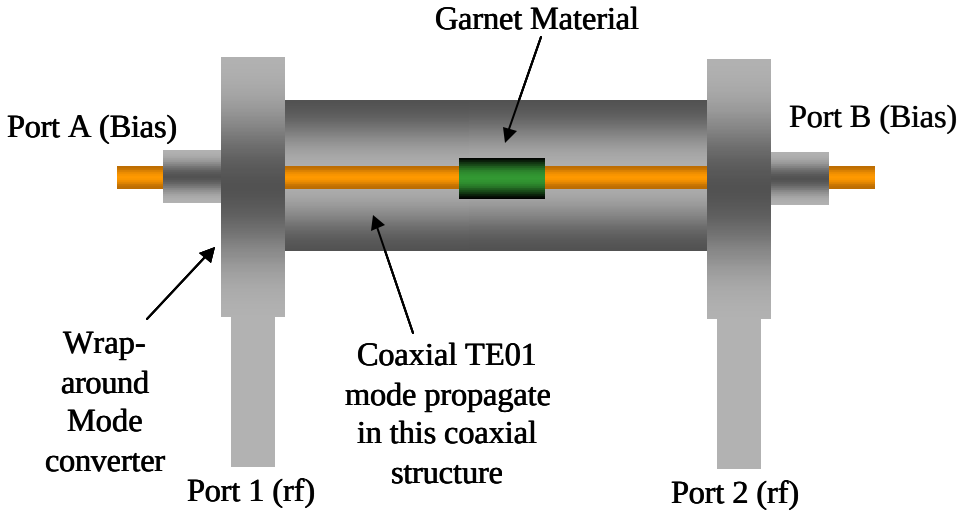
The structure of the new thin wafer RF Switch

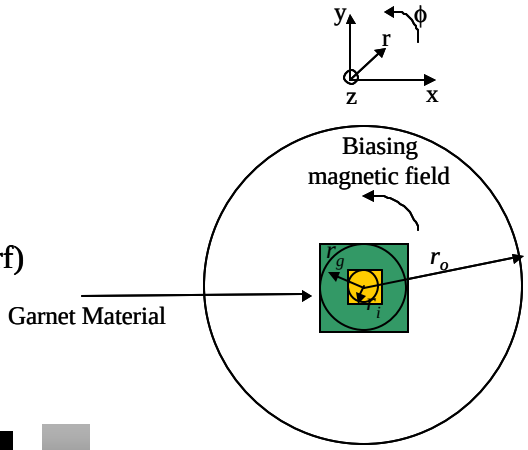


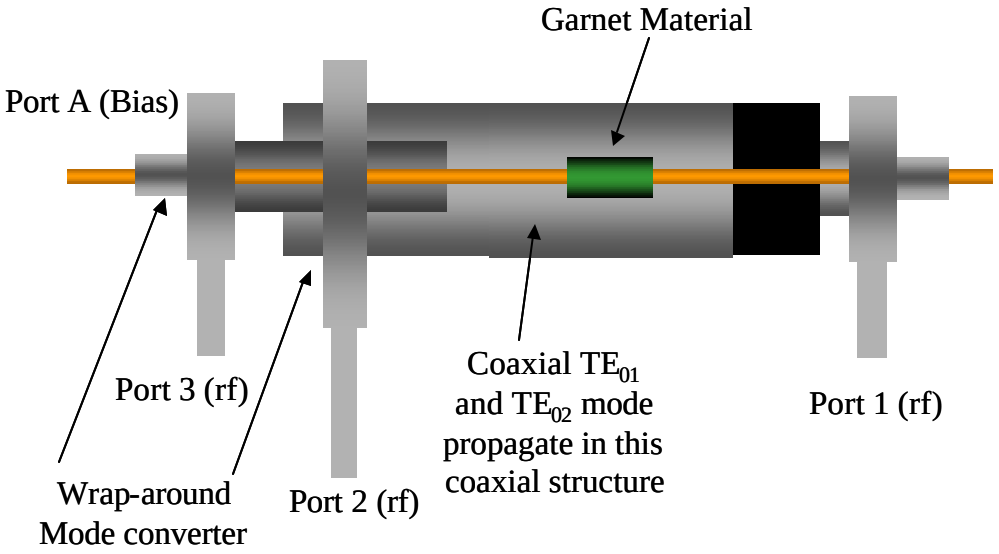




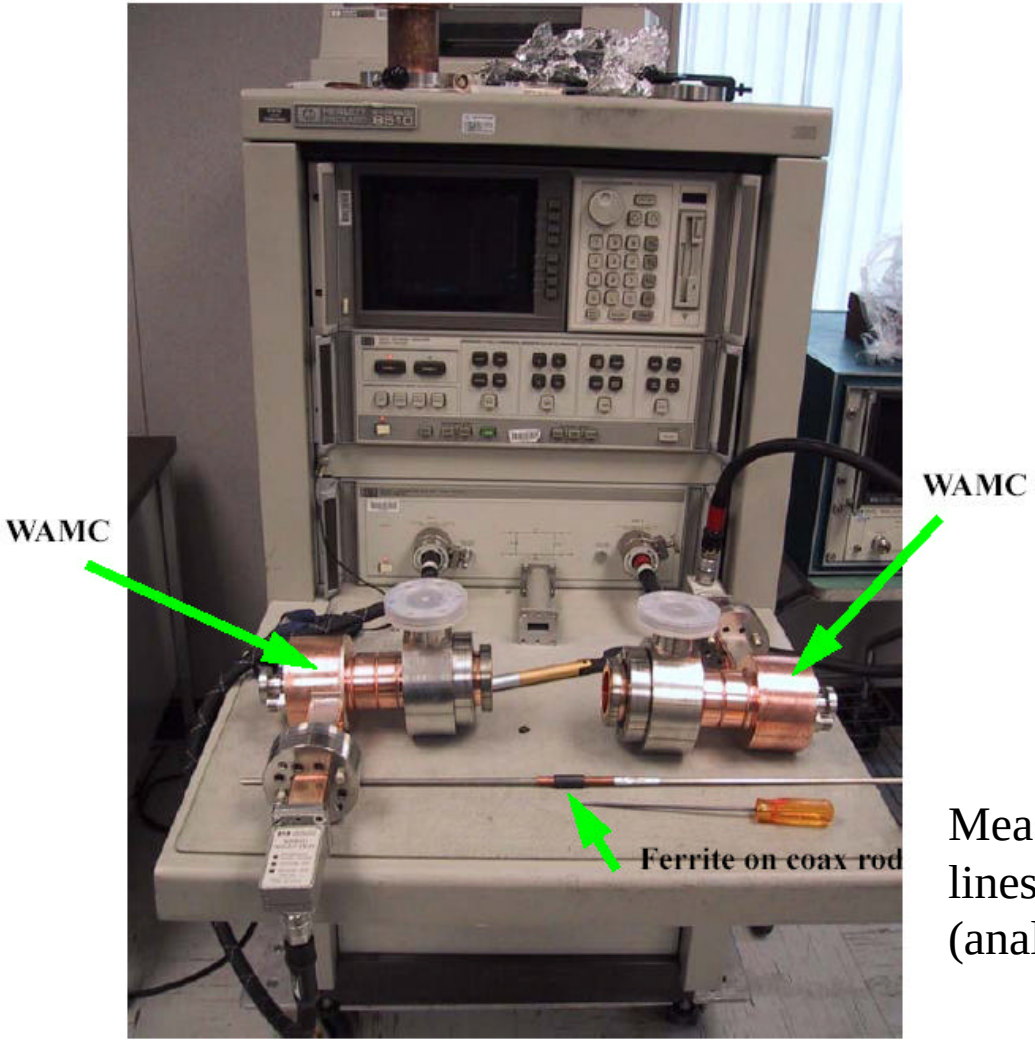


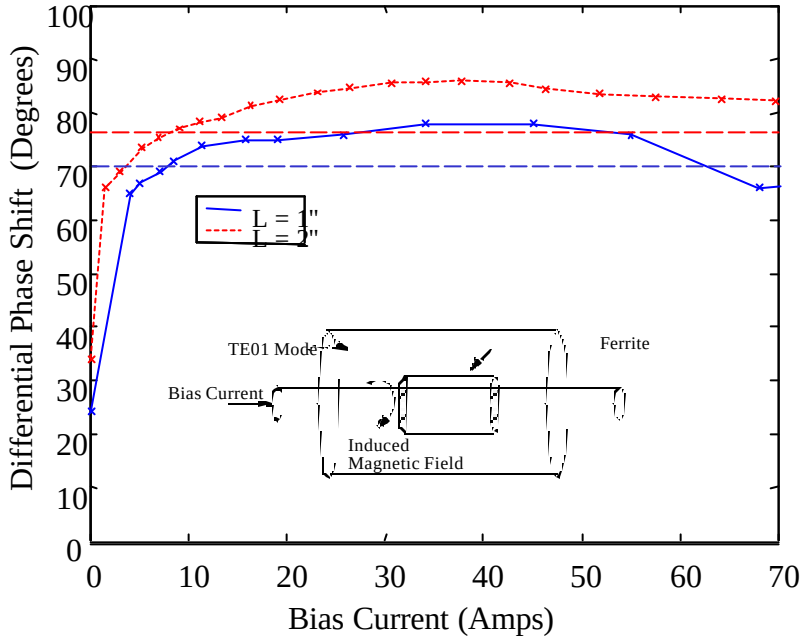






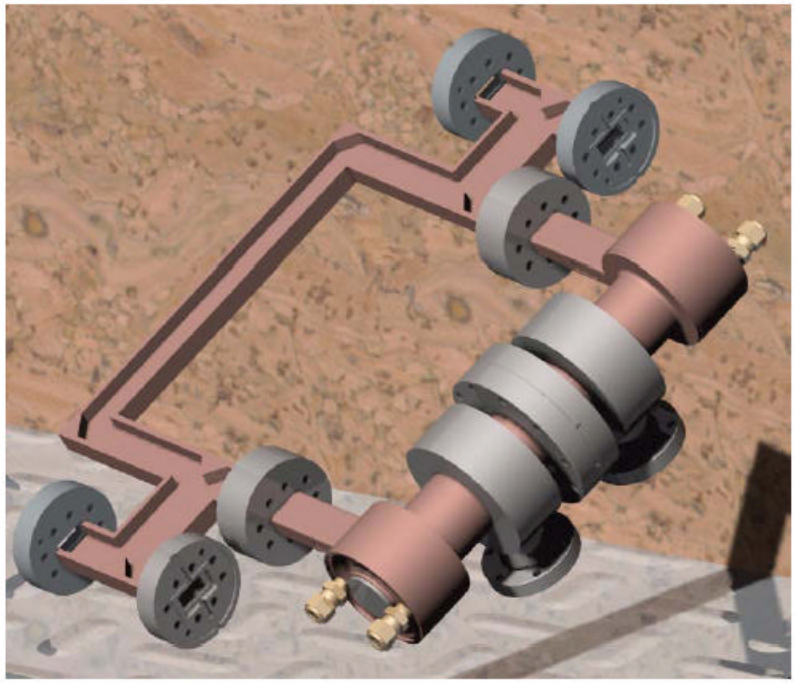
Wrap-Around Mode Converter for Tap-off, and extraction, tested to 470 MW



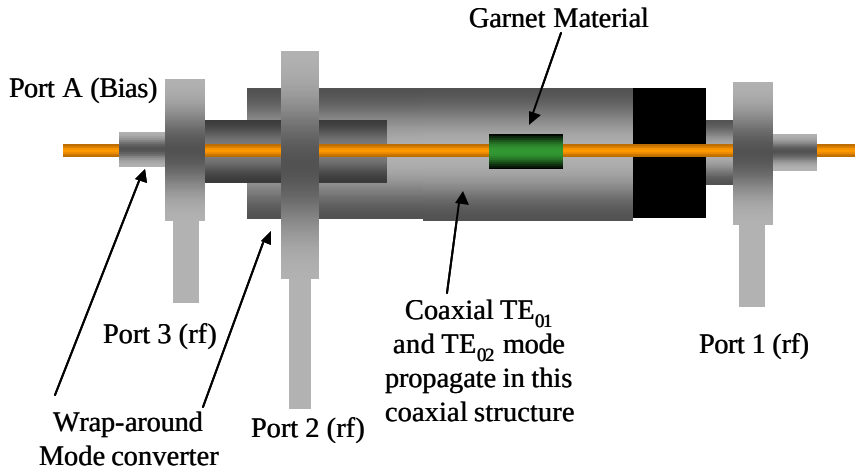


Measurement of 0.080” Thick Garnet. Dashed lines are HFSS calculation
(analytic calculation predicts 85 degrees)

Setup for measurement of differential phase shift in ferrite on inner coax rod.



Rendering of circulator composed of two “H” hybrids and nonreciprocal phase shift section. Cover of the hybrid section is removed.



An elegant way to synthesis the hybrid as an integrated part of the device.

High Power Circulator/Switch

Summary

•Although most of the rf designs have been completed, we are still perfecting some of the details. In particular the distance between components need to be adjusted.

•A set of cold tests are planned to verify and tune the performance of these devices.