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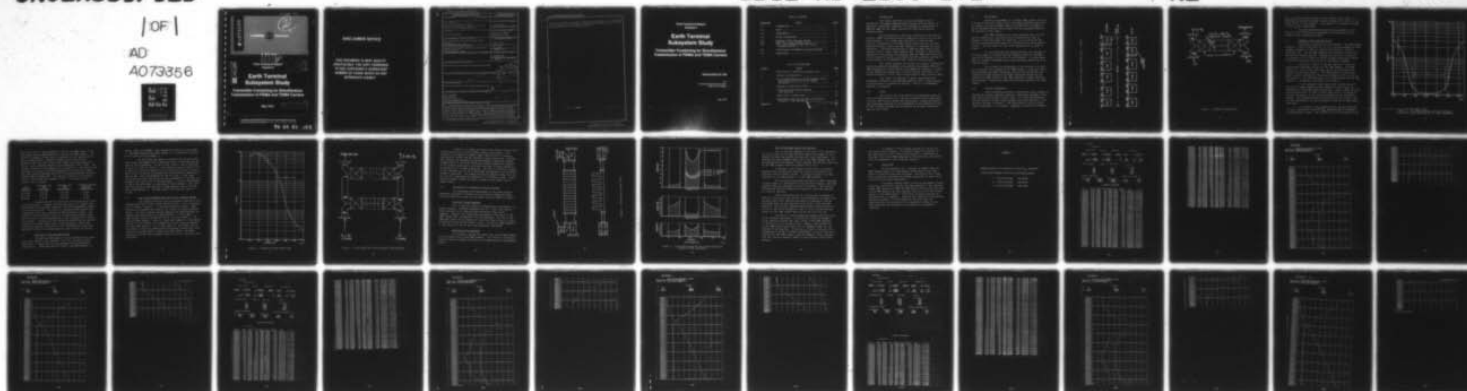
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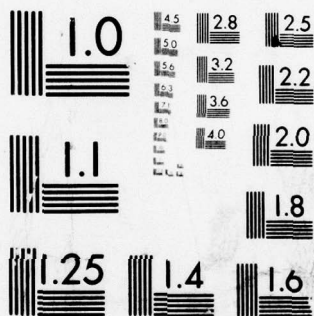


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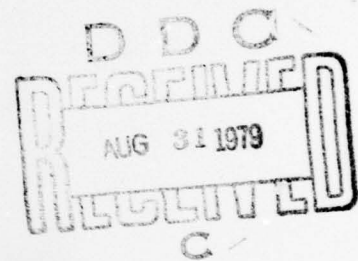
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LEVEL III

Final Technical Report
Volume 4



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Earth Terminal Subsystem Study

Transmitter Combining for Simultaneous
Transmission of FDMA and TDMA Carriers

May 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report addresses alternative methods of combining high-power TDMA and FDMA X-band carriers for simultaneous transmission from Defense Satellite Communi- cations System (DSCS) earth terminals. The TDMA signal is assumed to be in Channel 1 of the DSCS III frequency plan, with the FDMA carriers in Channels 2 and 6 (on both sides of the TDMA signal). Three alternative diplexer configu- rations are described: (1) a conventional bandpass filter; (2) a band-stop filter; and (3) a dual E-stub filter. The three configurations are evaluated		

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in terms of insertion loss, phase linearity, and complexity. It is concluded that the bandpass filter approach is the preferred approach, based on its low-loss characteristics and its design simplicity.

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**Final Technical Report
Volume 4**

Earth Terminal Subsystem Study

**Transmitter Combining for Simultaneous
Transmission of FDMA and TDMA Carriers**

Subcontract S-165

For
Computer Sciences Corporation
Falls Church, Virginia

May 1979

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1.0

INTRODUCTION

This report describes the work performed by Harris Corporation, Government Communications Systems Division (GCSD), on Subtask 4, Transmitter Combining for Simultaneous Transmission of FDMA and TDMA carriers under Subcontract S-165, Earth Terminal Subsystem Study.

The introduction of TDMA into the DSCS will mean that CW carriers (FDMA) and pulsed carriers (TDMA) must co-exist in the same earth terminal. If a common power amplifier is used for both carriers, degradation of the FDMA signals would occur due to cross-modulation effects unless the power amplifier is operated far below saturation. Efficient transmission of FDMA and TDMA signals simultaneously from a single earth terminal will, therefore, require the combining of the outputs from separate FDMA and TDMA power amplifiers. No such capability exists in the AN/FSC-78 (HT) terminals and none is being provided in the AN/MS-61 (MT) terminals being procured.

This report presents the results of a study of alternative diplexing/combining approaches for achieving simultaneous FDMA and TDMA transmissions in the AN/FSC-78 and AN/MS-61 terminals. Because of the commonality between the HT and MT terminal electronics, all efforts addressed in this study are applicable to both terminal types.

This report is organized to define requirements and assumptions relative to the diplexer/combiner; this is then followed by an evaluation of alternative designs. Finally, a recommended approach is presented.

2.0

SCOPE

The scope of the study effort to be performed under this task is limited primarily to a review of previous Harris experience in filter and diplexer design and construction. Design and fabrication experience obtained in the development of the diplexers for the MT and LT antenna systems will be used as the primary information base for this study.

3.0

REQUIREMENTS

The basic requirement is to diplex FDMA signals from the existing TWT HPA with signals from a new TDMA transmitter which will be located in the RF Equipment Room of the AN/FSC-78 or AN/MS-61. The RF Equipment Room of both terminals can be considered identical for purposes of this study.

The TDMA transmitter will have an output power of 5 kW and will operate at a 10% duty cycle at a 60 MHz burst rate in Channel 1 of the DSCS Phase III Satellite. The existing TWT HPA will be transmitting FDMA signals in a 40 MHz band in both Channels 2 and 6. The DSCS Phase III satellite frequency plan is shown in Figure 1.

It is assumed that the TDMA transmitter will operate at full peak power of 5 kW and that the composite power of the FDMA carriers in Channels 2 and 6 will be 2 kW maximum. It is desirable that all diplexer components have a power handling capability of at least 10 kW CW.

The criteria for performance of the diplexer is to minimize insertion loss, especially for FDMA signals. To prevent interaction between the TDMA transmitter and the existing TWT HPA, the rejection of TDMA signals at the FDMA transmitter output and the rejection of FDMA signals at the TDMA transmitter output should be 20 dB minimum. Group delay should be minimized especially for TDMA signals.

4.0

DESIGN ALTERNATIVES

Three alternative diplexer configurations were studied to perform the channel combining function; conventional bandpass filter, band stop filter and dual E-stub filter. All three configurations use two identical filters placed between short-slot hybrids of 3 dB couplers as shown in Figure 2. The functioning of such a filter/hybrid combination is as follows: frequency F_1 enters port number 2

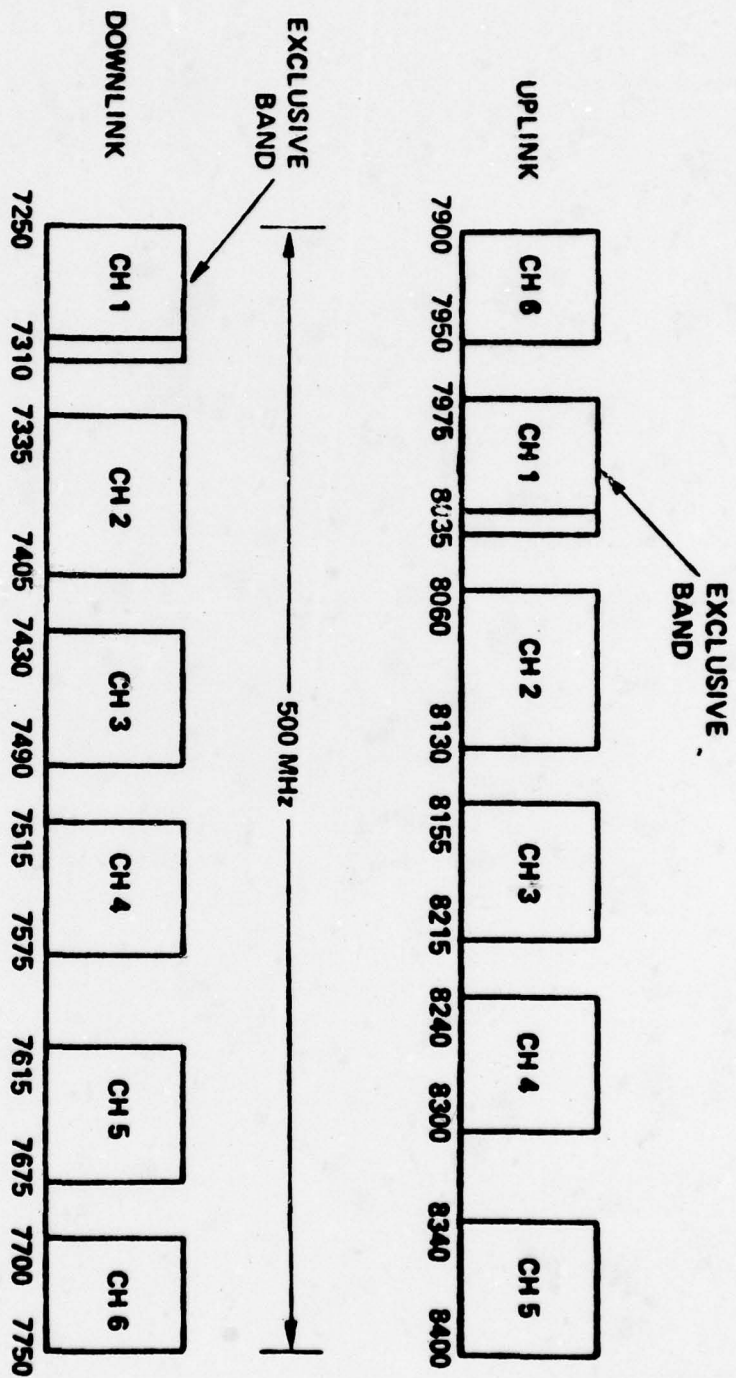


Figure 1. DSCS Phase III Satellite Frequency Plan

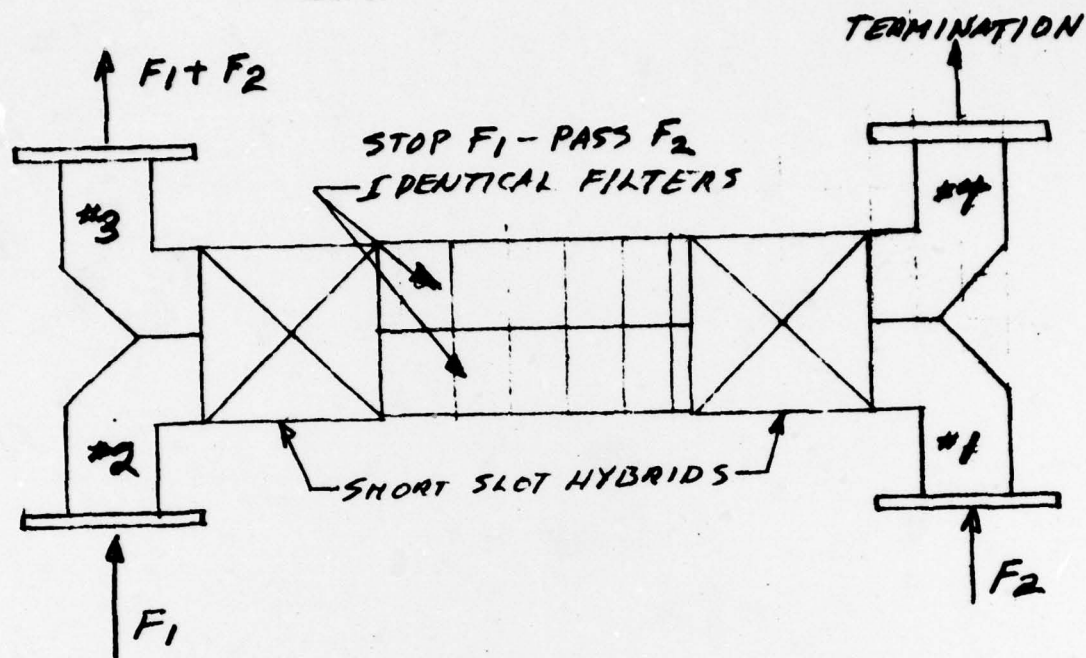


Figure 2. Diplexer Configuration

and is totally reflected by the filters and exits port number 3. Frequency F_2 enters port number 1 passes through the filters and combines with F_1 at port number 3. Port number 4 is isolated from both F_1 and F_2 and is terminated.

The three alternative diplexer configuration, all of which use the filter/hybrid arrangement described above, are discussed in the following paragraphs.

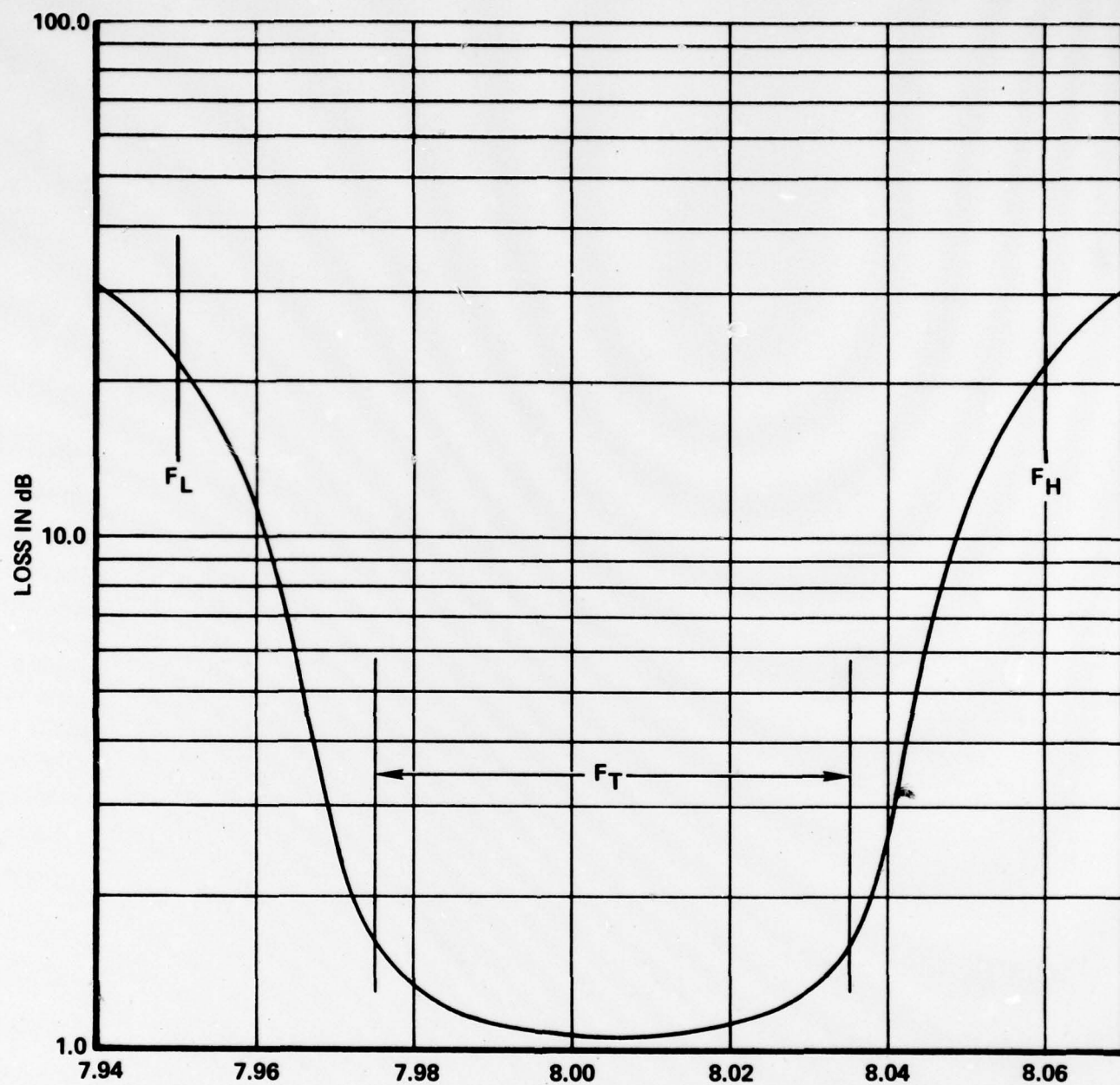
4.1 Bandpass Filter Diplexer Design

Three bands (channels) must be combined. The TDMA channel, Channel 1, 7.975 to 8.035 GHz (F_T) is to be inserted between two FDMA channels, Channel 6, 7.900 to 7.950 GHz and Channel 2, 8.060 to 8.130 GHz (F_H). The two FDMA channels are the output from the TWT HPA and are already combined. Although not given as a constraint for purposes of this study, the uplink frequency band above Channel 2 (8.130 to 8.400 GHz) should also be considered a bandpass.

Referring to Figure 2, the two identical filters are constructed as bandpass filters for the TDMA channel. The FDMA channels, F_L and F_H enter port number 2 and are reflected by the filters and exit port number 3. The TDMA channel F_T enters port number 1 passes through the filters and combines with F_L and F_H at port number 3. The combined output of the TDMA channel and the FDMA channels, is therefore, available at port number 3.

If the bandpass filters were direct coupled and built with WR 137 copper waveguide using symmetrical vane irises, an unloaded Q of about 8000 might be obtained. Figure 3 shows the bandpass characteristics of such a filter consisting of five poles to provide a minimum of 20 dB isolation between the two transmitter outputs. The complete combiner losses would be very low (0.1 dB) for the FDMA channels but would approach 2.0 dB at the TDMA channel band edges.

A variation of this bandpass filter design consisting of high Q cylindrical cavities TE_{011} mode provides an unloaded Q of approximately 18,000. The insertion loss of the diplexer using



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Figure 3. Loss Characteristics of 5-Pole Bandpass Filter when Constructed with WR 137 Copper Waveguide

this type filter is approximately 0.7 dB for the TDMA signal at the band edges and has approximately 0.1 dB loss for FDMA signals. The design of bandpass filters such as required for this application is very straightforward. Computer programs exist to accurately determine insertion loss, return loss (VSWR), and phase characteristics. Such a computer analysis was performed for this filter. The results are shown in the computer run in Appendix A. The analysis was performed using three different bandwidths to determine the lowest loss that could be obtained while still providing adequate isolation between FDMA and TDMA bands. The design is based on a five cavity 0.04 dB ripple Chebyshev bandpass filter. The results of the analysis are as follows:

<u>TDMA Bandwidth</u>	<u>Insertion Loss TDMA Band Edges</u>	<u>Insertion Loss TDMA Band Center</u>	<u>Isolation Between TDMA and FDMA Ports</u>
62.0 MHz	0.82 dB	0.55 dB	25 dB
64.0 MHz	0.77 dB	0.50 dB	23 dB
66.0 MHz	0.70 dB	0.46 dB	21 dB

The widest filter (66 MHz) also provides the least isolation between ports. However, the isolation was still greater than the minimum 20 dB required, therefore, the 66 MHz bandwidth appeared to be the best choice. The effect of reflecting FDMA signals from a nonperfect short was a concern for QPSK modulated signals. The nonperfect short manifests itself as an amplitude and phase characteristic which can cause degradation of the orthogonality of quadrature signals. Inspection of the reflection coefficient and angle of reflection has shown these values to be negligible. Hence, the 66 MHz wide bandpass filter used in this configuration should have negligible effect on the FDMA channels except for the 0.1 dB loss.

4.2 Band Stop Filter Diplexer Design

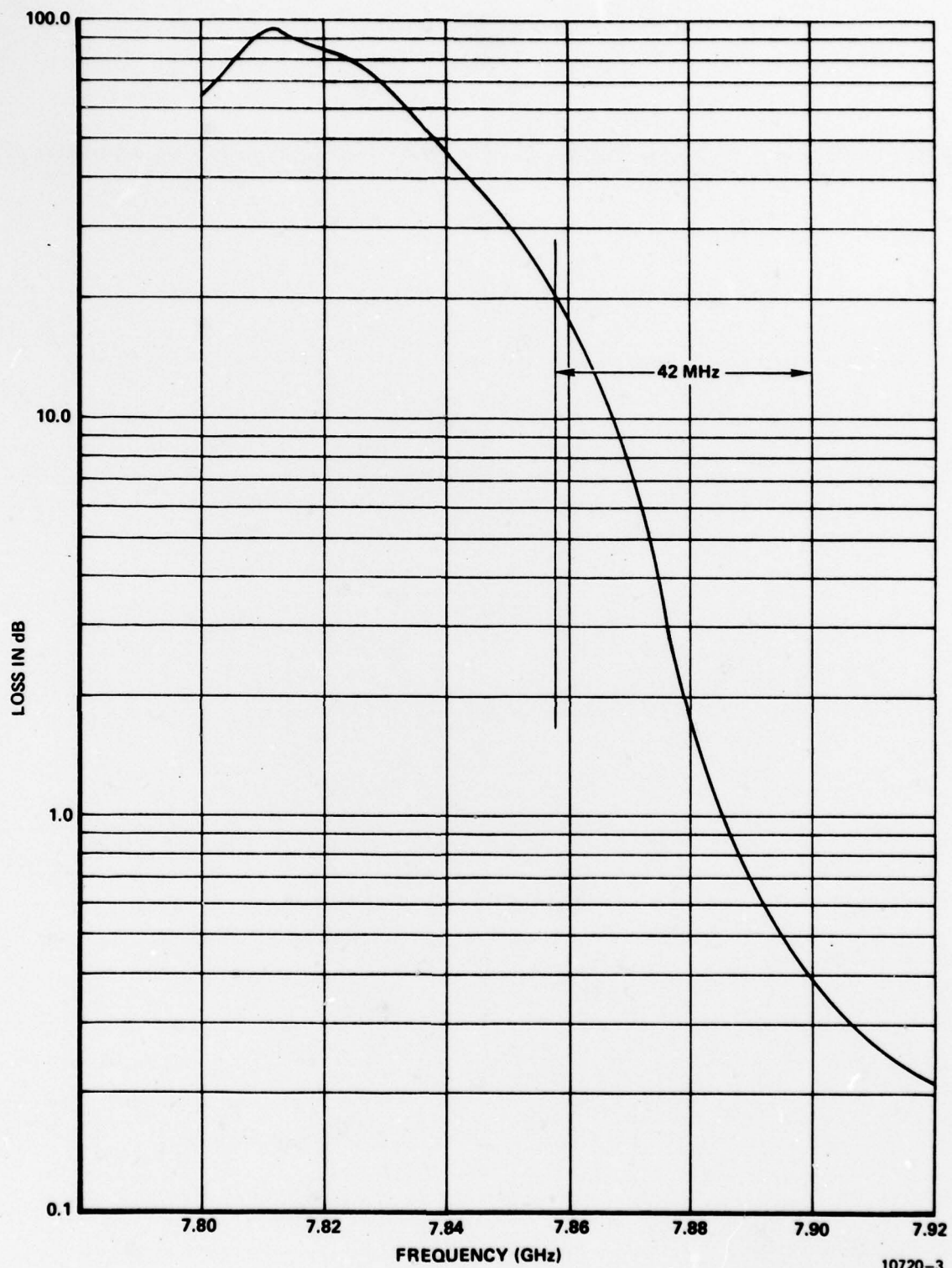
The FDMA and TDMA channels can be combined using a band stop filter design in the diplexer. For such a diplexer a band stop filter is substituted for the bandpass filter described in Paragraph 4.1. Referring again to Figure 2 the FDMA channels, F_L

and F_H , enter port number 1 pass through the filters to port number 3. The TDMA channel enters port number 2, is reflected by the band stop filters into port number 3.

No calculated loss data is available for the exact band-stop filter requirement, but a band-stop filter of the same type was used in the HT terminals. A plot of this filter's loss as measured at Harris is shown in Figure 4. The rejection slope of the HT filter is about half of that required for this application since the guard band is only 25 MHz and the passband to 20 dB stop-band separation is only 42 MHz. The stop bandwidth of the HT filter is also about twice that required. Narrowing the stop bandwidth will increase the passband loss, especially at the band edges. A loss of approximately 0.7 dB at the band edges is predicted for this approach. This band edge loss occurs at the high end of FDMA Channel 6 and at the low end of FDMA Channel 2. The TDMA channel loss would be close to 0.1 dB.

4.3 Dual E-Stub Wideband Band Stop Filter Diplexer Design

The combining function can be performed using dual E-stub wideband band stop filters in the diplexer design. Such a configuration is shown in Figure 5. It uses two diplexer sections. Each section uses broadband band stop E-stub filters to reduce passband losses. The first diplexer section separates the FDMA channels and combines the TDMA channel with FDMA Channel 6 in port number 3. FDMA Channel 2 passes through the filter into port number 4. The TDMA and FDMA Channels, F_T and F_L , enter port number 6 in the second section of the diplexer, pass through the filters and are combined with the FDMA Channel 2, F_H , in port number 8, the output port of the network. With this configuration the channel nearest the filter stop band (passband edge) is always the TDMA signal. The FDMA channels are either the reflected signals or are far from the filter band edges.



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Figure 4. Response of Band Stop Filter

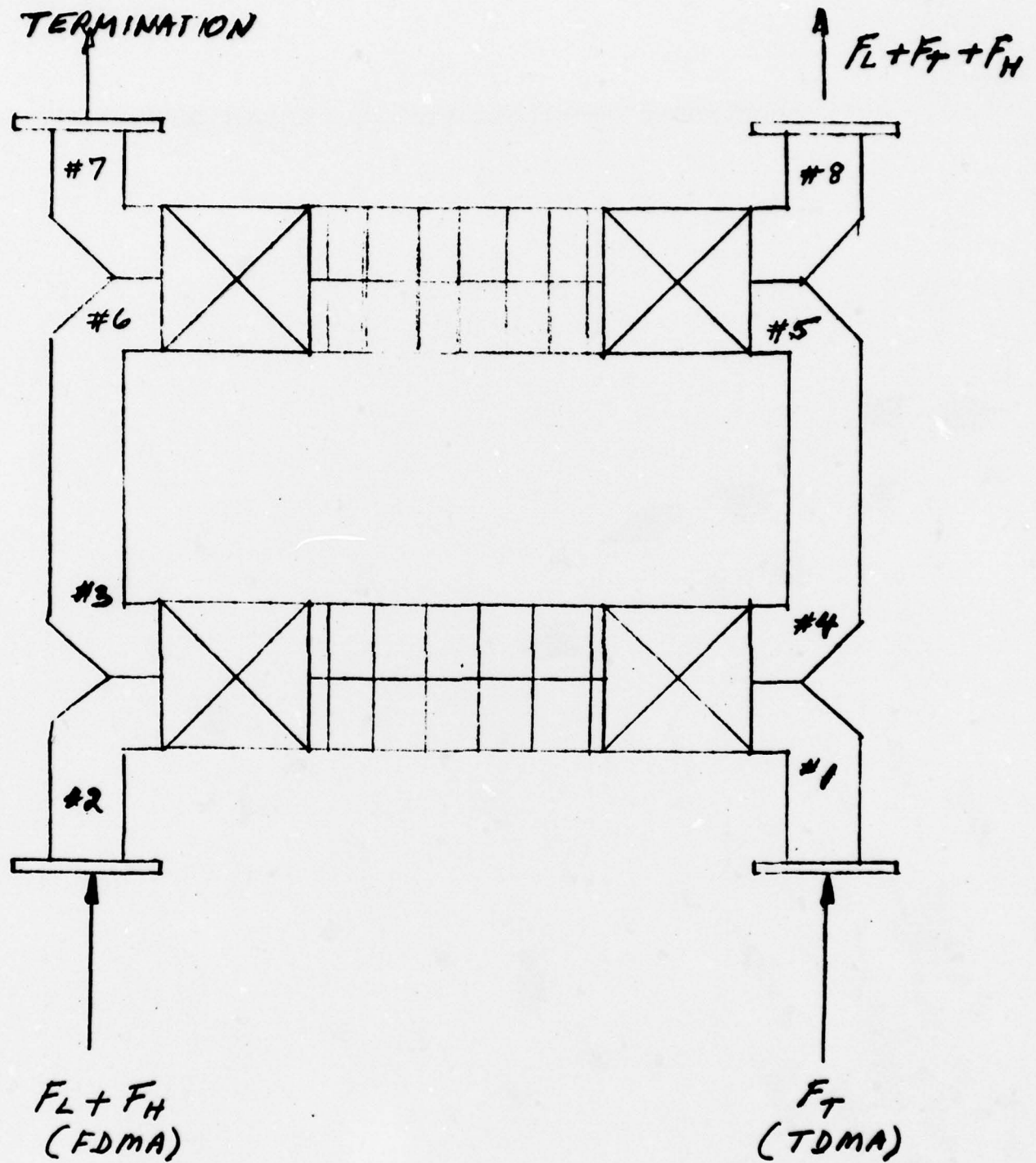


Figure 5. E-Stub Band Stop Filter Diplexer Configuration

Figure 6 is a sketch of a dual seven cavity, E-stub filter configuration used in an MT antenna diplexer application. This diplexer was designed to combine signal channels with a frequency separation of 50 MHz with an isolation greater than 60 dB. Although this diplexer was designed for 50 MHz frequency separation between channels which is twice the 25 MHz guard bands between the channels in the present application, test data indicated it would provide 25 dB isolation for a 25 MHz separation. The loss for reflected signals in this diplexer was 0.2 dB at band edge and dropped to 0.1 dB within 20 MHz of band edge. For signals passing through the filter the loss was 0.4 dB at band edge and dropped to 0.1 dB within 30 MHz. Losses could be reduced further by using a sharper cutoff (more stubs or longer stubs).

5.0 EVALUATION OF ALTERNATIVE DIPLEXER DESIGNS

The advantages and disadvantages of the three diplexer approaches discussed in Section 4.0 are briefly summarized below. The calculated loss curves for the three cases are shown in Figure 7.

Band Pass Filter Approach

This is the most simple, straightforward, and lowest risk design approach. Computer programs exist for almost exact design. Highly accurate loss, VSWR and phase characteristics can be computed. However, this design has unacceptably high losses in the TDMA channel when implemented in WR 137 waveguide. The loss at the TDMA band center can be reduced to 0.5 dB or slightly less if a TE_{011} cylindrical cavity design filter is used. The loss to FDMA channels is the lowest (0.1 dB) of the three approaches considered.

Band Stop Filter Approach

This approach provides the lowest loss to the TDMA channel but the highest loss to the FDMA channels. This filter is relatively simple in design although not quite as straightforward as the bandpass design.

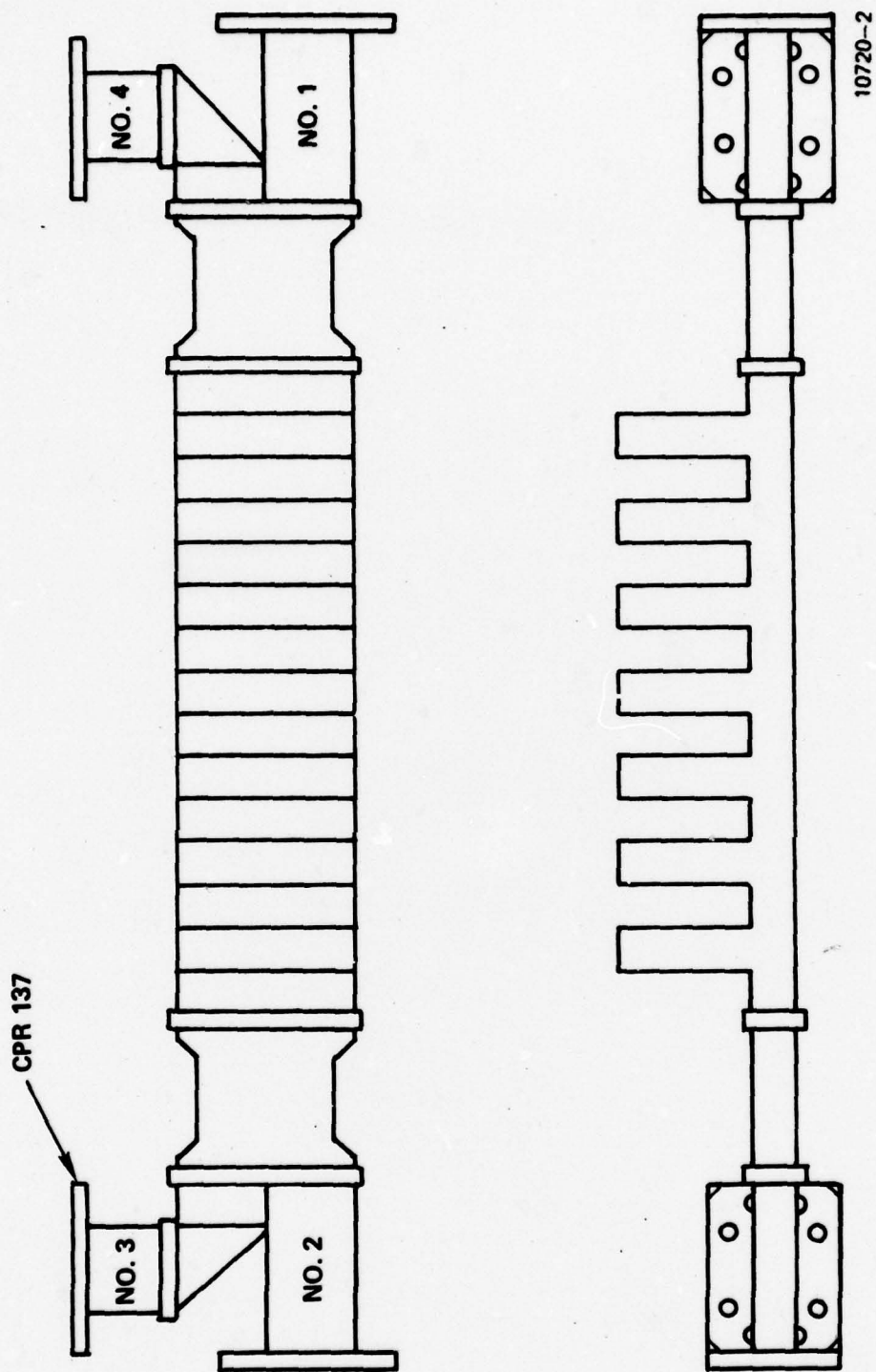
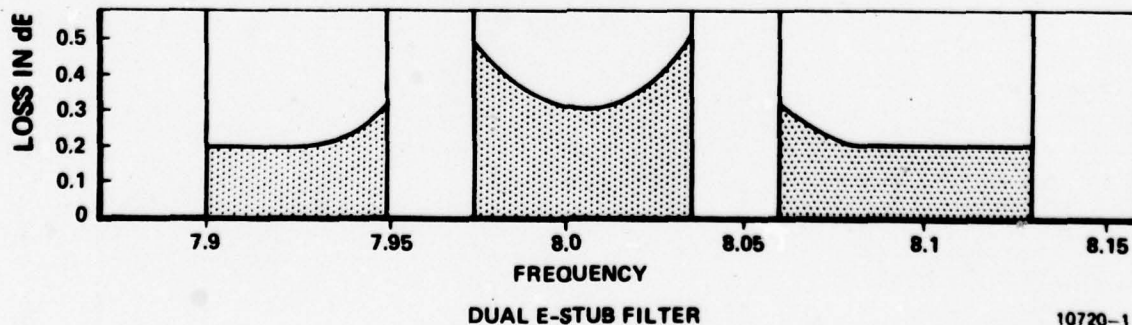
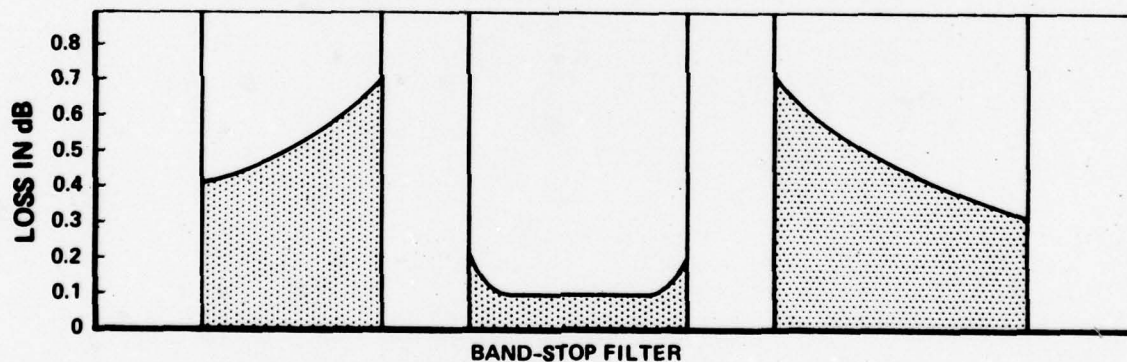
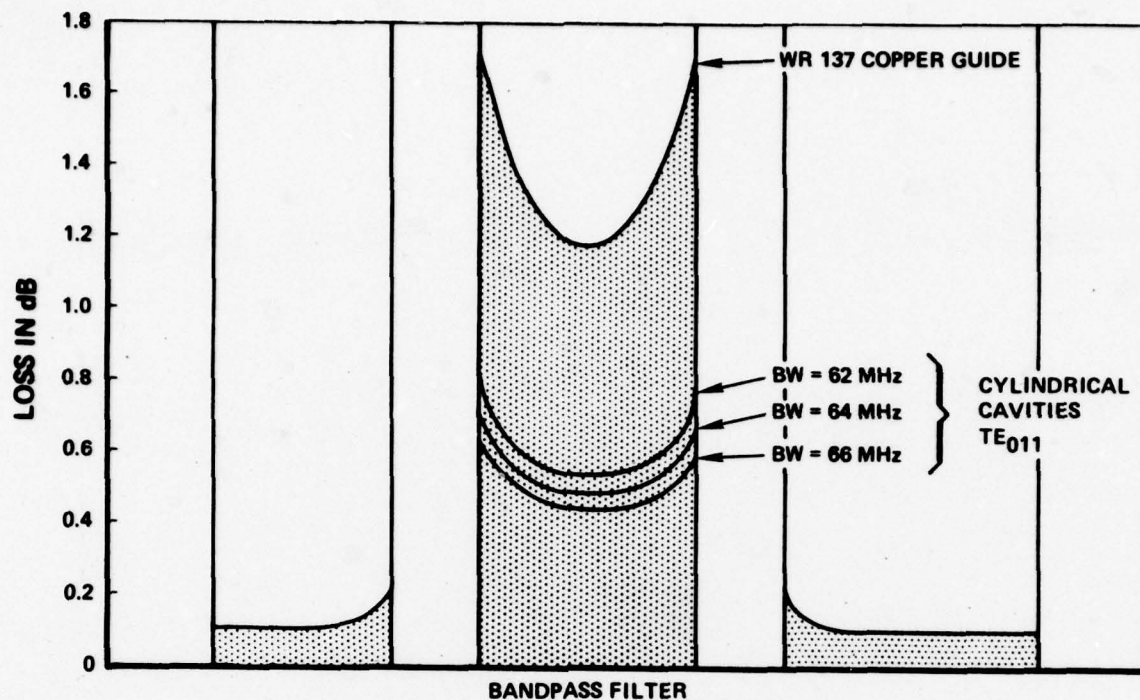


Figure 6. Seven Cavity E-Stub Filter



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Figure 7. Calculated Losses for the Three Alternative Diplexer Filter Approaches

Dual E-Stub Band Stop Filter Approach

This is the most complex of the three filter approaches. Two filter sections are required which doubles the number of components and more than doubles the diplexer space requirement. This approach provides somewhat lower loss to the TDMA channel than can be achieved with the bandpass filter approach and provides lower loss to the FDMA channels than the bandstop filter case.

In making a final tradeoff on the choice of diplexer approach some consideration should be given to the weight to be given the various channel losses. Is achieving lower losses more important in the TDMA channel or in the FDMA channels?

For the application being considered, a TDMA transmitter is being added as a modification to an existing terminal. Non-TDMA channels should be degraded as little as possible. Specifically, the terminal EIRP and therefore AJ capability should be impacted as little as possible.

After considering the loss calculations presented in Figure 6, along with other factors discussed above, it appears that the band stop filter approach discussed in Paragraph 4.2 can be eliminated based on the relatively high losses in the non-TDMA channels. This diplexer approach would present minimum losses of 0.3 to 0.4 dB for all portions of the 7.9 to 8.4 GHz uplink band except for the TDMA channel where losses would be very low.

The choice is then between the bandpass and the E-stub filter diplexer approaches. As previously stated the bandpass filter approach provides the least losses to non-TDMA channels, 0.1 dB versus 0.2 dB minimum losses. However, the minimum loss at the TDMA channel band center will be somewhat higher for the bandpass filter approach. Using TE_{011} cylindrical cavities with a bandwidth of 66 MHz a minimum loss between 0.4 and 0.5 dB can be achieved for the TDMA channel using the bandpass filter approach. This loss can be reduced to about 0.3 dB using the E-stub filter approach.

The bandpass filter diplexer approach is chosen over the E-stub filter approach. The slightly lower loss provided to the TDMA channel by the E-stub filter approach is outweighed by the lower loss in non-TDMA bands and by the simplicity, and smaller size of the bandpass filter diplexer approach.

6.0 CONCLUSIONS

Design approaches for a diplexer to combine FDMA and TDMA channel signals for simultaneous transmission in the DSCS Phase III Satellite have been evaluated. The scope of this study task limited the evaluation to diplexer approaches for which Harris has had previous design experience.

A diplexer approach based on the use of bandpass filters using TE_{011} cylindrical cavities has been presented. This approach allows the combining of FDMA and TDMA signals with low loss (0.1 dB) to non-TDMA channels and only moderate loss (0.4 to 0.5 dB at band center) to the TDMA channel. The effects on phase linearity are negligible for all channels. Based on the simplicity of the design approach presented it is concluded that the costs and risk associated with the diplexer will be negligible factors in any TDMA transmitter modifications to the AN/FSC-78 or AN/MSC-61 terminals.

APPENDIX A

Computer analysis for a cylindrical 5-cavity TE_{011} Tchebyscheff

0.04 dB ripple bandpass filter for the following passbands:

- | | |
|-----------------------|------------|
| 1. 7.973 to 8.037 GHz | BW= 64 MHz |
| 2. 7.972 to 8.038 GHz | BW= 66 MHz |
| 3. 7.974 to 8.036 GHz | BW= 62 MHz |

FILTER DESIGN

LOCK TONGUE FILTER

.0000 DB LOSS POINT		5 CAVITIES		.0000 DB RIPPLE		TCHUTSCHOFF FILTER	
ORIGINAL	F1 = 7975.00000	F2 = 8037.00000	BANDWIDTH =	64.00000	F0 = 8006.75000		
CORRECTED	F1 = 7975.00000	F2 = 8037.00000	BANDWIDTH =	64.00000	F0 = 8006.75000		
A = 1.37206		H = .62200000		I = .05000		L = 1.00000	
QJ = 10000.00000		R = 1.00000000		M = .00000		CLB = .00000	
OMEGA-PR = 1.00000		DTOL = .00500000		LV = 0.00000		RND = 0.00000	
DESIGN CHARACTERISTICS		LARGA-60/4 =		.447081 INCHES		= 1.110167 CM	
G		U		CAVITY LENGTH (CL)			
.0177		1.2207		.3272			
.9576		64.6640		.0674			
1.3704		60.6314		.1679			
1.7875		60.6314		.0674			
1.3704		64.6640		.3272			
.9576		1.2207		0.0000			
.0177		0.0000		0.0000			
PRACTICAL DESIGN DIMENSIONS		SUSCEPTANCE FOR THE SYMMETRIC VANE.					
CAVITY LENGTH (CL)		GAP WIDTH (G)		SUSCEPTANCE (B)		U	
.06319		.309246		7.27110		27.01207	
.90401		.1054153		68.17098		67.41165	
.90568		.1671902		86.34096		77.21903	

FILTER DESIGN - ANALYSIS OUTPUT

FREQUENCY	INSERTION LOSS	INSERTION PHASE	GAMMA(DB)	ANG OF GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP DELAY (NS)	DISPERSION
.7940000E+01	32.2019	352.8050	-.0066	.970004	100.00620	59.0000	.3761600E+01	-.1399400E+02
.7941000E+01	31.4166	354.1900	-.0713	.969545	96.60382	59.0000	.3594670E+01	-.1396470E+02
.7942000E+01	30.6190	355.6396	-.0765	.968992	97.29997	59.0000	.4110654E+01	-.1393574E+02
.7943000E+01	29.8044	357.1508	-.1023	.968256	95.04399	59.0000	.4002261E+01	-.1390641E+02
.7944000E+01	28.9715	358.7537	-.1067	.967545	94.32076	59.0000	.4541630E+01	-.1387705E+02
.7945000E+01	28.1204	360.4307	-.1150	.966752	92.72806	59.0000	.4770724E+01	-.1384771E+02
.7946000E+01	27.2502	362.1978	-.1239	.965876	91.04421	59.0000	.5050422E+01	-.1381836E+02
.7947000E+01	26.3599	364.0613	-.1331	.964927	89.26877	59.0000	.5362964E+01	-.1378900E+02
.7948000E+01	25.4486	366.0329	-.1435	.963916	87.38755	59.0000	.5690771E+01	-.1375964E+02
.7949000E+01	24.5151	368.1240	-.1555	.962835	85.39443	59.0000	.6035011E+01	-.1373028E+02
.7950000E+01	23.5584	370.3436	-.1680	.961687	83.24106	59.0000	.6395924E+01	-.1369092E+02
.7951000E+01	22.5773	372.7097	-.1810	.960463	81.02113	59.0000	.6774724E+01	-.1365156E+02
.7952000E+01	21.5706	375.2362	-.1952	.959165	78.72158	59.0000	.7171621E+01	-.1361220E+02
.7953000E+01	20.5369	377.9486	-.2103	.957796	76.34248	59.0000	.7586791E+01	-.1357284E+02
.7954000E+01	19.4752	380.8644	-.2263	.956357	73.88905	59.0000	.8020341E+01	-.1353348E+02
.7955000E+01	18.3893	384.0131	-.2430	.954847	71.37543	59.0000	.8472371E+01	-.1349412E+02
.7956000E+01	17.2832	387.4272	-.2603	.953266	68.80513	59.0000	.8942901E+01	-.1345476E+02
.7957000E+01	16.1612	391.1458	-.2780	.951615	66.18089	59.0000	.9431941E+01	-.1341540E+02
.7958000E+01	15.0285	395.2151	-.2960	.949894	63.50862	59.0000	.9939491E+01	-.1337604E+02
.7959000E+01	13.8790	399.6903	-.3143	.948103	60.79379	59.0000	.1.046554E+02	-.1333668E+02
.7960000E+01	12.7137	404.6372	-.3329	.946242	58.03160	59.0000	.1.101010E+02	-.1329732E+02
.7961000E+01	11.5366	410.1312	-.3517	.944311	55.22849	59.0000	.1.157316E+02	-.1325796E+02
.7962000E+01	9.2771	416.2503	-.3706	.942310	52.39049	59.0000	.1.215472E+02	-.1321860E+02
.7963000E+01	6.9412	423.1104	-.3896	.940249	49.52349	59.0000	.1.275488E+02	-.1317924E+02
.7964000E+01	7.7669	430.7763	-.4087	.938128	46.63349	59.0000	.1.337364E+02	-.1313988E+02
.7965000E+01	6.1359	439.3235	-.4278	.935947	43.72549	59.0000	.1.401100E+02	-.1310052E+02
.7966000E+01	4.9752	448.7711	-.4469	.933706	40.80449	59.0000	.1.466796E+02	-.1306116E+02
.7967000E+01	3.9247	459.0558	-.4659	.931405	37.87549	59.0000	.1.534452E+02	-.1302180E+02
.7968000E+01	3.0206	470.0072	-.4848	.929054	34.93449	59.0000	.1.604068E+02	-.1298244E+02
.7969000E+01	2.2806	481.3507	-.5036	.926653	31.97749	59.0000	.1.675644E+02	-.1294308E+02
.7970000E+01	1.7340	492.7579	-.5223	.924202	29.01049	59.0000	.1.749180E+02	-.1290372E+02
.7971000E+01	1.3429	505.9220	-.5409	.921701	26.03049	59.0000	.1.824676E+02	-.1286436E+02
.7972000E+01	1.0653	519.6214	-.5594	.919150	23.04249	59.0000	.1.902122E+02	-.1282500E+02
.7973000E+01	.8259	524.7436	-.5778	.916549	20.04249	59.0000	.1.981518E+02	-.1278564E+02
.7974000E+01	.6319	534.2707	-.5961	.913898	17.03549	59.0000	.2.062854E+02	-.1274628E+02
.7975000E+01	.4772	543.2459	-.6143	.911197	14.01849	59.0000	.2.146130E+02	-.1270692E+02
.7976000E+01	.3536	551.7425	-.6324	.908446	11.00049	59.0000	.2.231356E+02	-.1266756E+02
.7977000E+01	.2599	559.8411	-.6504	.905645	8.97849	59.0000	.2.318532E+02	-.1262820E+02
.7978000E+01	.1900	567.6160	-.6683	.902794	6.95049	59.0000	.2.407658E+02	-.1258884E+02
.7979000E+01	.1402	575.1337	-.6861	.900000	4.91549	59.0000	.2.498734E+02	-.1254948E+02
.7980000E+01	.1066	582.4424	-.7038	.897159	2.87249	59.0000	.2.591760E+02	-.1251012E+02
.7981000E+01	.0847	589.5816	-.7214	.894270	0.82149	59.0000	.2.686736E+02	-.1247076E+02
.7982000E+01	.0706	596.5784	-.7389	.891331	-1.23749	59.0000	.2.783662E+02	-.1243140E+02
.7983000E+01	.0633	603.4521	-.7563	.888342	-3.30049	59.0000	.2.882538E+02	-.1239204E+02
.7984000E+01	.0619	610.2142	-.7736	.885303	-5.35949	59.0000	.2.983364E+02	-.1235268E+02
.7985000E+01	.0629	616.8726	-.7908	.882214	-7.41349	59.0000	.3.086140E+02	-.1231332E+02
.7986000E+01	.0654	623.4319	-.8079	.879075	-9.46249	59.0000	.3.190866E+02	-.1227396E+02
.7987000E+01	.0694	629.8937	-.8249	.875886	-11.50649	59.0000	.3.297542E+02	-.1223460E+02
.7988000E+01	.0746	636.2673	-.8418	.872647	-13.54549	59.0000	.3.406168E+02	-.1219524E+02
.7989000E+01	.0809	642.5506	-.8586	.869358	-15.57949	59.0000	.3.516744E+02	-.1215588E+02
.7990000E+01	.0880	648.7507	-.8753	.866019	-17.60849	59.0000	.3.629270E+02	-.1211652E+02
.7991000E+01	.0957	654.8735	-.8919	.862630	-19.63249	59.0000	.3.743746E+02	-.1207716E+02
.7992000E+01	.1040	660.9263	-.9084	.859191	-21.65149	59.0000	.3.860172E+02	-.1203780E+02
.7993000E+01	.1127	666.9173	-.9248	.855702	-23.66549	59.0000	.3.978548E+02	-.1200000E+02
.7994000E+01	.1219	672.8447	-.9411	.852163	-25.67449	59.0000	.4.098874E+02	-.1196164E+02
.7995000E+01	.1314	678.7475	-.9573	.848574	-27.67849	59.0000	.4.221150E+02	-.1192328E+02
.7996000E+01	.1412	684.6300	-.9734	.844935	-29.67749	59.0000	.4.345376E+02	-.1188492E+02
.7997000E+01	.1513	690.4824	-.9894	.841246	-31.67149	59.0000	.4.471552E+02	-.1184656E+02
.7998000E+01	.1617	696.3139	-.1.0053	.837507	-33.66049	59.0000	.4.599678E+02	-.1180820E+02
.7999000E+01	.1724	702.0311	-.1.0211	.833718	-35.64449	59.0000	.4.729754E+02	-.1176984E+02
.8000000E+01	.1833	707.6325	-.1.0368	.829879	-37.62349	59.0000	.4.861780E+02	-.1173148E+02
.8001000E+01	.1944	713.2170	-.1.0524	.825990	-39.59749	59.0000	.4.995756E+02	-.1169312E+02
.8002000E+01	.2056	718.7842	-.1.0679	.822051	-41.56649	59.0000	.5.131682E+02	-.1165476E+02

A0010000E+01	4985	725.1245	-81.6151	082664	101.67254	1.0550	10010000E+02	-1.780000E+01
A0020000E+01	4986	730.8490	-87.2913	082669	112.79160	1.0477	10010000E+02	-1.780000E+01
A0030000E+01	4958	736.6510	-91.9005	082672	123.62801	1.0468	10010000E+02	-1.780000E+01
A0040000E+01	4966	742.9116	-36.0015	082675	223.18662	1.0379	10010000E+02	-1.780000E+01
A0050000E+01	4996	748.1646	-38.0505	082678	224.16170	1.0449	10010000E+02	-1.780000E+01
A0060000E+01	5042	753.9233	-27.1431	082681	225.07145	1.0519	10010000E+02	-1.780000E+01
A0070000E+01	5108	759.6765	-25.1149	082684	226.00229	1.1177	10010000E+02	-1.780000E+01
A0080000E+01	5164	765.4302	-23.6479	082687	219.47346	1.1407	10010000E+02	-1.780000E+01
A0090000E+01	5230	771.1874	-22.3693	082690	218.49509	1.1607	10010000E+02	-1.780000E+01
A0100000E+01	5295	776.9503	-21.0907	082693	200.00000	1.1768	10010000E+02	-1.780000E+01
A0110000E+01	5367	782.7100	-20.8100	082696	200.00000	1.1861	10010000E+02	-1.780000E+01
A0120000E+01	5396	788.5274	-21.0369	082699	199.99762	1.1957	10010000E+02	-1.780000E+01
A0130000E+01	5419	794.3512	-21.0667	082702	199.78005	1.1994	10010000E+02	-1.780000E+01
A0140000E+01	5433	800.2097	-21.2524	082705	189.55885	1.1994	10010000E+02	-1.780000E+01
A0150000E+01	5435	806.1118	-21.7276	082708	184.32074	1.1994	10010000E+02	-1.780000E+01
A0160000E+01	5427	812.0642	-22.5024	082711	179.10217	1.1994	10010000E+02	-1.780000E+01
A0170000E+01	5415	818.0792	-23.6412	082714	173.94514	1.1994	10010000E+02	-1.780000E+01
A0180000E+01	5405	824.1510	-25.3359	082717	169.04485	1.1994	10010000E+02	-1.780000E+01
A0190000E+01	5406	830.3000	-27.0153	082720	164.67303	1.1994	10010000E+02	-1.780000E+01
A0200000E+01	5423	836.5059	-31.0194	082723	162.03390	1.1994	10010000E+02	-1.780000E+01
A0210000E+01	5467	842.8330	-40.2216	082726	176.67590	1.1994	10010000E+02	-1.780000E+01
A0220000E+01	5500	849.2241	-40.9408	082729	297.41202	1.1994	10010000E+02	-1.780000E+01
A0230000E+01	5568	855.7022	-31.7752	082732	307.69022	1.1994	10010000E+02	-1.780000E+01
A0240000E+01	5570	862.2705	-27.6265	082735	305.11586	1.1994	10010000E+02	-1.780000E+01
A0250000E+01	5562	868.9381	-29.7115	082738	300.41401	1.1994	10010000E+02	-1.780000E+01
A0260000E+01	6159	875.7011	-27.0091	082741	295.52054	1.1994	10010000E+02	-1.780000E+01
A0270000E+01	6367	882.5894	-21.6903	082744	290.25254	1.1994	10010000E+02	-1.780000E+01
A0280000E+01	6577	889.6084	-21.0142	082747	285.06210	1.1994	10010000E+02	-1.780000E+01
A0290000E+01	6781	896.7876	-20.0540	082750	280.23214	1.1994	10010000E+02	-1.780000E+01
A0300000E+01	6975	904.1790	-21.2855	082753	276.28444	1.1994	10010000E+02	-1.780000E+01
A0310000E+01	7171	911.0133	-22.5145	082756	274.50275	1.1994	10010000E+02	-1.780000E+01
A0320000E+01	7403	917.7669	-24.9453	082759	279.01771	1.1994	10010000E+02	-1.780000E+01
A0330000E+01	7737	924.1036	-26.3762	082802	306.20945	1.1994	10010000E+02	-1.780000E+01
A0340000E+01	8291	936.9034	-25.7937	082805	357.99904	1.1994	10010000E+02	-1.780000E+01
A0350000E+01	9241	946.2247	-19.5355	082808	10.62986	1.1994	10010000E+02	-1.780000E+01
A0360000E+01	10835	956.1039	-15.3052	082811	13.36350	1.1994	10010000E+02	-1.780000E+01
A0370000E+01	13374	966.5177	-11.0450	082814	7.67415	1.1994	10010000E+02	-1.780000E+01
A0380000E+01	17113	977.3564	-9.1334	082817	359.67192	1.1994	10010000E+02	-1.780000E+01
A0390000E+01	22528	988.4150	-6.9456	082820	354.49762	1.1994	10010000E+02	-1.780000E+01
A0400000E+01	29542	999.4115	-5.3027	082823	344.49762	1.1994	10010000E+02	-1.780000E+01
A0410000E+01	38171	1010.0459	-4.0067	082826	331.22766	1.1994	10010000E+02	-1.780000E+01
A0420000E+01	48190	1020.0650	-3.0272	082829	322.46115	1.1994	10010000E+02	-1.780000E+01
A0430000E+01	54274	1029.3050	-2.2964	082832	313.40047	1.1994	10010000E+02	-1.780000E+01
A0440000E+01	71074	1037.6996	-1.7613	082835	305.55301	1.1994	10010000E+02	-1.780000E+01
A0450000E+01	83288	1045.2579	-1.3667	082838	298.41904	1.1994	10010000E+02	-1.780000E+01
A0460000E+01	95647	1052.0365	-1.0761	082841	292.06006	1.1994	10010000E+02	-1.780000E+01
A0470000E+01	108000	1058.1148	-0.8606	082844	284.27172	1.1994	10010000E+02	-1.780000E+01
A0480000E+01	126217	1063.5765	-0.6956	082847	281.09826	1.1994	10010000E+02	-1.780000E+01
A0490000E+01	152221	1068.3024	-0.5777	082850	276.42761	1.1994	10010000E+02	-1.780000E+01
A0500000E+01	183967	1072.9644	-0.4842	082853	272.15115	1.1994	10010000E+02	-1.780000E+01
A0510000E+01	253429	1077.0234	-0.4117	082856	264.33672	1.1994	10010000E+02	-1.780000E+01
A0520000E+01	365599	1080.7307	-0.3546	082859	264.00059	1.1994	10010000E+02	-1.780000E+01
A0530000E+01	477474	1084.1497	-0.3092	082902	261.56614	1.1994	10010000E+02	-1.780000E+01
A0540000E+01	600558	1087.2944	-0.2745	082905	258.57353	1.1994	10010000E+02	-1.780000E+01
A0550000E+01	746361	1090.2111	-0.2425	082908	255.00639	1.1994	10010000E+02	-1.780000E+01
A0560000E+01	906392	1092.9209	-0.2177	082911	253.22137	1.1994	10010000E+02	-1.780000E+01
A0570000E+01	118162	1095.4489	-0.1970	082914	250.01443	1.1994	10010000E+02	-1.780000E+01
A0580000E+01	147762	1097.8148	-0.1795	082917	246.56106	1.1994	10010000E+02	-1.780000E+01
A0590000E+01	183664	1100.0334	-0.1644	082920	244.44545	1.1994	10010000E+02	-1.780000E+01
A0600000E+01	246018	1102.1250	-0.1518	082923	242.57464	1.1994	10010000E+02	-1.780000E+01
A0610000E+01	324856	1104.0964	-0.1406	082926	240.79715	1.1994	10010000E+02	-1.780000E+01
A0620000E+01	426347	1105.9604	-0.1309	082929	239.11259	1.1994	10010000E+02	-1.780000E+01
A0630000E+01	551922	1107.7265	-0.1223	082932	237.51290	1.1994	10010000E+02	-1.780000E+01
A0640000E+01	701668	1109.4081	-0.1147	082935	235.99129	1.1994	10010000E+02	-1.780000E+01
A0650000E+01	882335	1110.9976	-0.1079	082938	234.54190	1.1994	10010000E+02	-1.780000E+01
A0660000E+01	1094131	1112.0165	-0.1018	082941	233.15706	1.1994	10010000E+02	-1.780000E+01
A0670000E+01	138862	1113.9636	-0.0963	082944		1.1994	10010000E+02	-1.780000E+01

LOCK YOUNG FILTER
FILTER DESIGN PLAIN

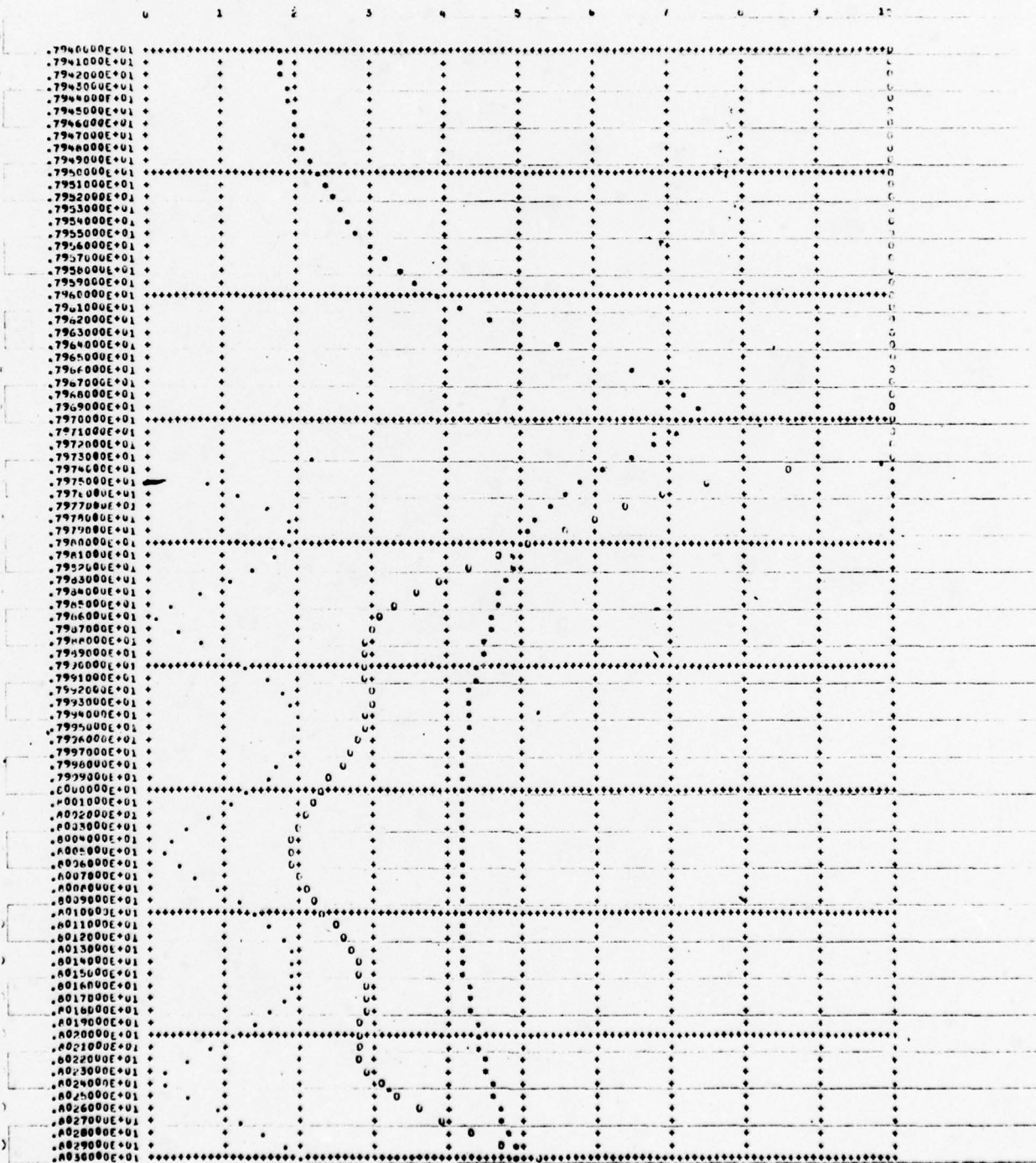
STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY

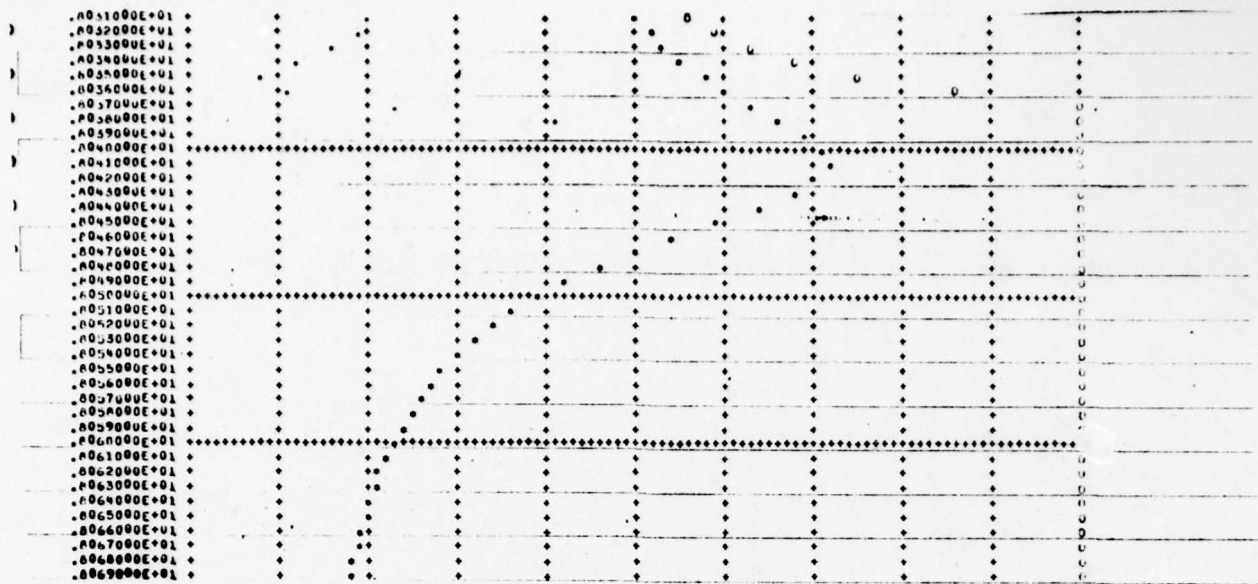
SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *

SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) = 0

SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE		JPLTH	
PLOT	LOWER	PENTH	JPLTH
1	.1000E+01	.1540E+01	.2160E+01
2	-.5000E+01	.7064E+02	.8500E+02
3	.4000E+00	.6500E+00	.9000E+00

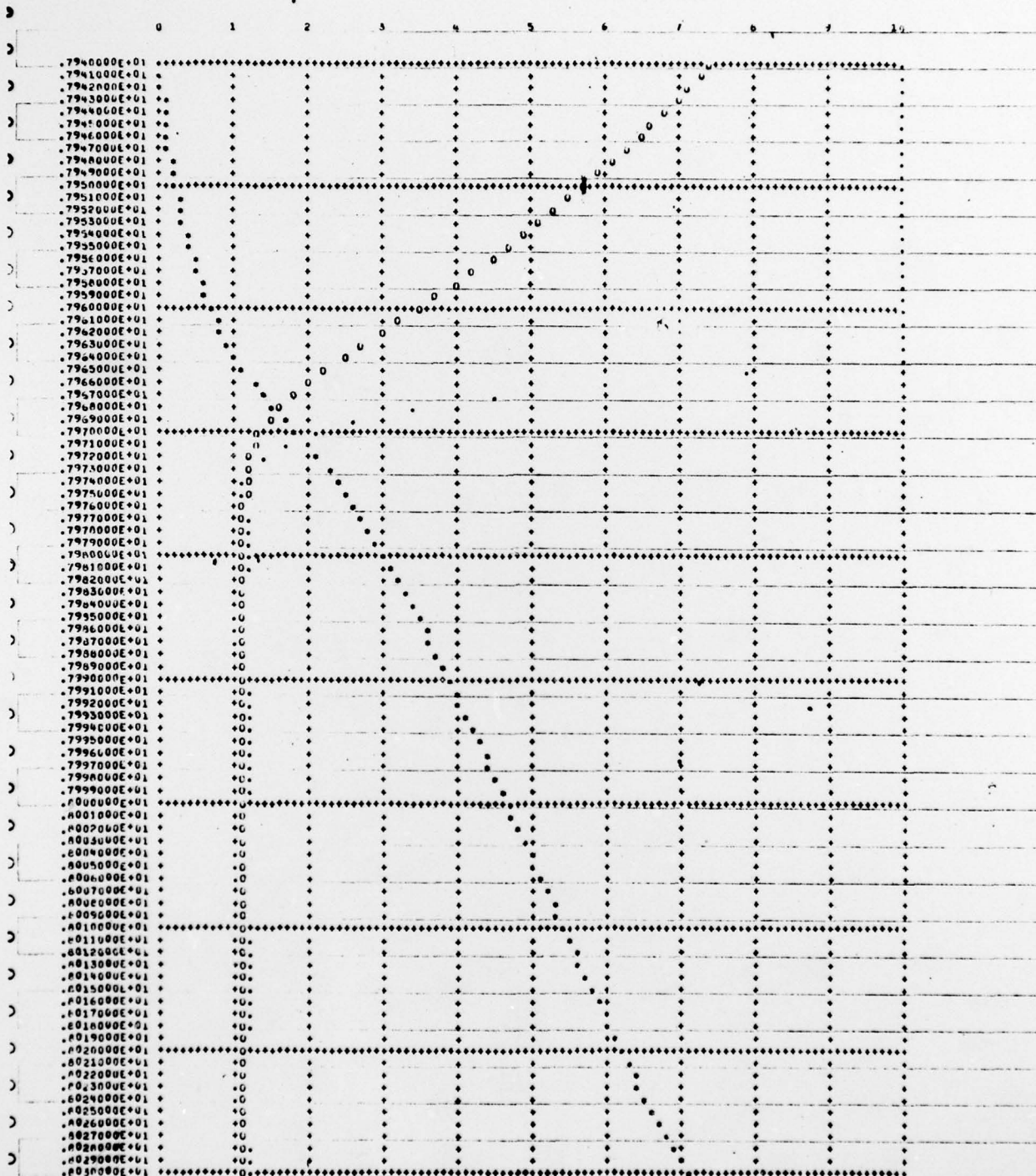


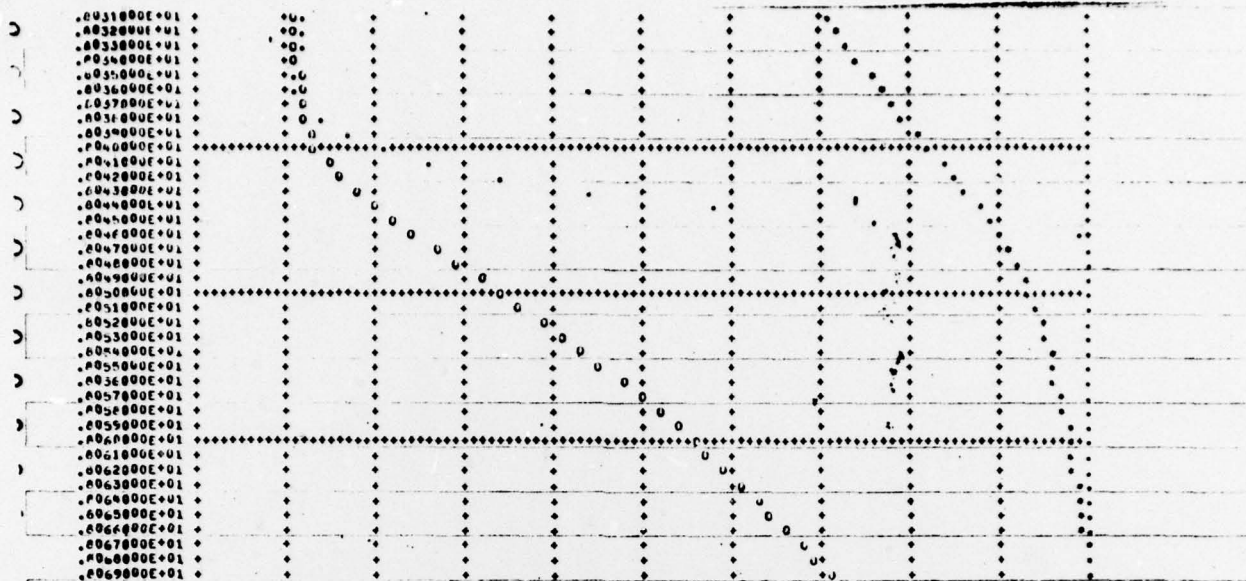


LOCK TUNING FILTER
FILTER DESIGN PLOTS

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (INSERTION PHASE VS FREQUENCY) = O
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = U

PILOT	LOWER	CENTER	UPPER
1	.0000E+01	.0000E+01	.1001E+02
2	.3520E+03	.7800E+03	.1114E+04
3	.5000E+01	.2000E+02	.4400E+02





LUCK YOUNG FILTER

1. KONTAKTSCHIFFER FÄHIG

FO # 0064,76112
PC # 4201,53163

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E = 1.00000
CL5 = .00500
RM = 4.00000

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2 1.110189 LM.

CAVATY LENGTH (CL)

.03161
.06651
.06769
.06651
.03161
0.00000
0.00000

SUBJECTANCE FOR THE STATEMENT NAME.

DELTA L
01000
0001P
00000

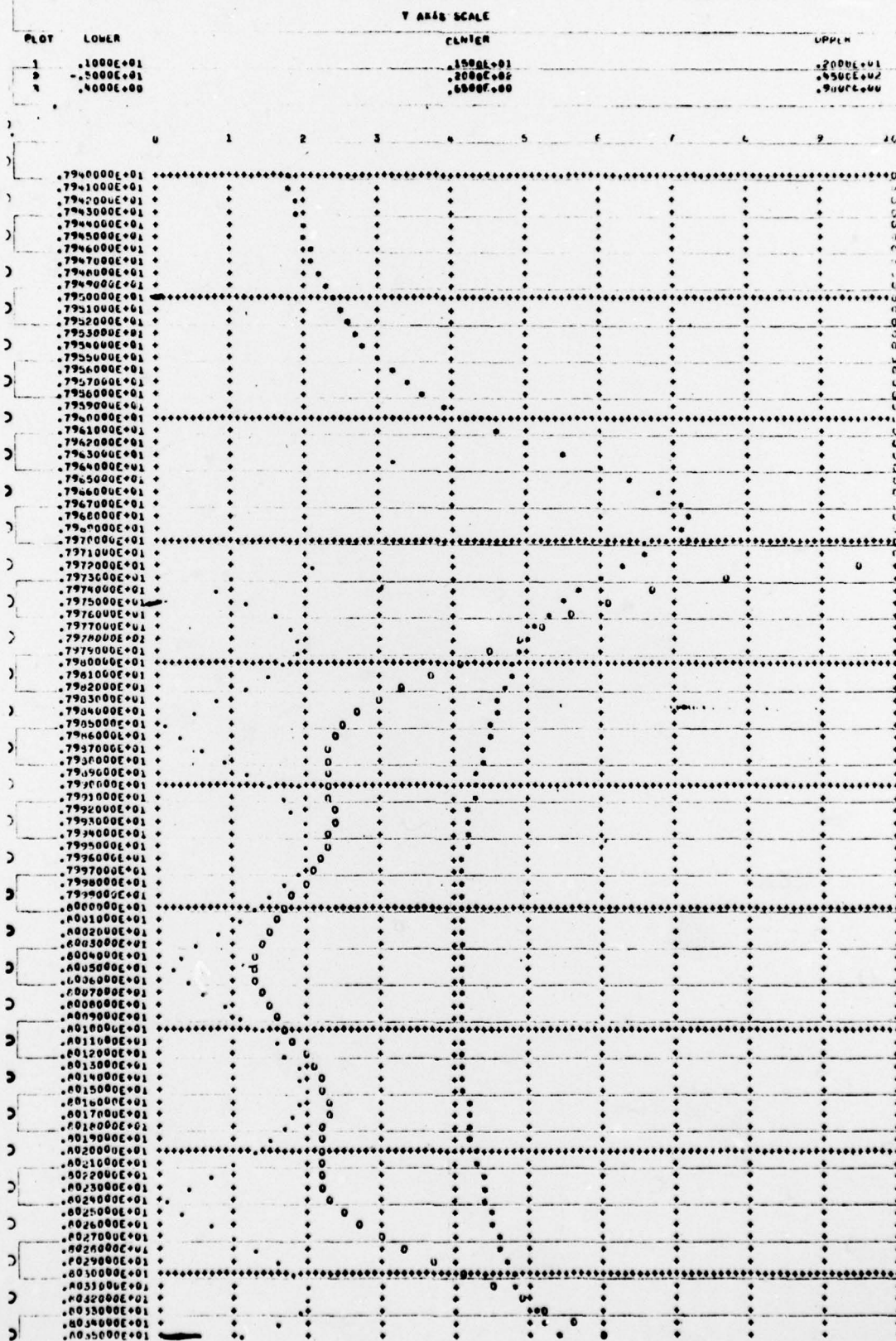
LOCK YOUNG FILTER

FREQUENCY	INSERTION LOSS	INSERTION	GAMMA DBI	ABS VALUE GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP	DISPENSIO.
799000000.01	30.6526	355.0790	-0.0907	989904	99.9904	99.0000	06117101.001	-1.3977372E+02
799100000.01	29.0619	357.0795	-0.0908	989903	99.7983	99.0000	06109994.001	-1.3261112E+02
799200000.01	29.0549	358.0163	-0.0910	989900	98.7821	99.0000	06072105.001	-1.3590595E+02
799300000.01	28.2368	360.0226	-0.1009	986799	97.7319	99.0000	06056400.001	-1.2900725E+02
799400000.01	27.3808	361.9260	-0.1157	987679	91.1051	99.0000	06026799.001	-1.2822285E+02
799500000.01	26.5260	363.7129	-0.1240	985620	89.0813	99.0000	06016900.001	-1.2630490E+02
799600000.01	25.6475	365.5908	-0.1334	984750	87.5959	99.0000	05994736.001	-1.2076102E+02
799700000.01	24.7464	367.5592	-0.1442	983530	85.6274	99.0000	05970116.001	-1.1775016E+02
799800000.01	23.8236	369.7073	-0.1566	982132	83.6732	99.0000	05940319.001	-1.1471359E+02
799900000.01	22.8761	371.9940	-0.1711	980493	81.5279	99.0000	05907116.001	-1.1163597E+02
799000000.01	21.9087	374.3479	-0.1861	978633	79.2821	99.0000	05869099.001	-1.0857479E+02
799100000.01	20.9191	376.7605	-0.2004	976597	76.9086	99.0000	05826706.001	-1.0550161E+02
799200000.01	19.9139	379.3398	-0.2137	974379	74.4170	99.0000	05779151.001	-1.0240467E+02
799300000.01	18.8842	382.0908	-0.2261	971982	71.7037	99.0000	05726020.001	-9.9282000E+01
799400000.01	17.7703	385.7088	-0.2373	969430	68.3350	99.0000	05668026.001	-9.6200182E+01
799500000.01	16.6655	389.2393	-0.2463	966743	65.0115	99.0000	05605944.001	-9.2927070E+01
799600000.01	15.5312	393.0014	-0.2600	963967	61.6579	99.0000	05539111.002	-8.9453380E+01
799700000.01	14.3760	397.1172	-0.2724	961062	57.3353	99.0000	05467300.002	-8.5783882E+01
799800000.01	13.2176	401.6016	-0.2860	958010	53.0574	99.0000	05391111.002	-8.1924707E+01
799900000.01	11.9590	406.6393	-0.3007	954760	48.8373	99.0000	05300905.002	-7.7877791E+01
799000000.01	10.7214	412.1835	-0.3515	950610	43.2163	99.0000	05198592.002	-7.2643505E+01
799100000.01	9.47113	418.5567	-0.4099	945519	37.3000	99.0000	05087905.002	-6.6347005E+01
799200000.01	8.2214	425.7990	-0.4657	939501	30.6881	99.0000	04969701.002	-5.8947000E+01
799300000.01	6.9564	432.9226	-0.5168	932753	23.5914	99.0000	04845905.002	-5.0543541E+01
799400000.01	5.6830	441.9543	-0.5319	925397	15.5777	99.0000	04718027.002	-4.1202603E+01
799500000.01	4.4054	450.8734	-0.5065	917035	6.8219	99.0000	04586567.002	-3.0760160E+01
799600000.01	3.1254	460.5958	-0.4594	907830	0.9300	99.0000	04451799.002	-1.9712395E+01
799700000.01	1.8413	471.7259	-0.4015	897945	-49.7699	99.0000	04314741.002	-8.0000000E+00
799800000.01	2.1529	482.7990	-0.3210	887620	-93.9219	99.0000	04176144.002	-3.5670797E+00
799900000.01	1.6331	493.0595	-0.1825	876192	-328.6642	99.0000	04036537.002	-1.0102620E+00
799000000.01	1.2664	504.7341	-12.0933	863447	-320.6267	1.0015	03895479.002	-0.0000000E+00
799100000.01	1.0243							

79940000E+01	5165	675,0224	-20,7757	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	5157	460,7949	-20,7699	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	5096	465,4657	-20,9769	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	5042	692,1110	-21,4007	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4979	497,7193	-22,0768	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4912	705,3537	-23,0119	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4844	768,9590	-24,2977	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4781	714,9565	-24,8245	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4724	720,1291	-25,1128	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4664	725,7469	-25,9254	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4604	731,3514	-27,7152	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4544	736,9257	-41,9046	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4470	762,3114	-34,4007	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4409	768,0955	-31,2418	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4342	753,6781	-27,3372	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4279	759,2340	-25,2963	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4215	764,8380	-23,6092	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4152	770,4147	-22,7119	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4089	776,0426	-21,9203	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	4026	781,6014	-21,3050	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3963	787,2170	-21,0019	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3900	792,8555	-20,9234	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3837	798,5243	-21,1361	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3774	804,2307	-21,3035	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3711	809,9021	-22,1419	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3648	815,7642	-23,1041	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3585	821,6493	-24,4666	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3522	827,5779	-24,4797	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3459	833,5765	-29,4933	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3396	839,5498	-34,7316	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3333	845,8084	-44,1466	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3270	852,0312	-34,1021	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3207	858,3847	-29,6071	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3144	864,7493	-24,3543	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3081	871,2354	-24,0410	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	3018	877,8244	-22,4778	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2955	884,3310	-21,4056	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2892	891,3470	-20,9171	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2829	898,3611	-20,8736	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2766	905,3640	-21,4114	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2703	912,0103	-22,7743	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2640	918,7592	-25,3029	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2577	924,8708	-24,9455	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2514	931,4376	-25,4024	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2451	938,4951	-14,6922	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2388	945,6253	-15,4129	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2325	952,1028	-11,9997	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2262	959,6975	-9,3106	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2199	967,4457	-7,1716	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2136	974,1666	-5,4024	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2073	981,0069	-4,1696	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	2010	987,9599	-3,1677	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1947	994,9271	-2,4150	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1884	1001,9001	-1,4053	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1821	1008,9523	-1,4411	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1758	1016,0476	-1,1493	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1695	1023,1651	-1,9060	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1632	1030,3459	-1,7346	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1569	1037,5959	-1,6047	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1506	1044,9050	-1,5050	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1443	1052,2750	-1,4277	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1380	1059,7050	-1,3670	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1317	1067,1950	-1,3166	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1254	1074,7450	-1,2757	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1191	1082,3550	-1,2440	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1128	1090,0250	-1,2219	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1065	1097,7550	-1,2001	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	1002	1105,5450	-1,1818	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	939	1113,3950	-1,1663	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	876	1121,3050	-1,1529	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	813	1129,2750	-1,1414	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	750	1137,3050	-1,1314	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	687	1145,3950	-1,1225	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	624	1153,5450	-1,1147	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	561	1161,7550	-1,1078	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	498	1170,0250	-1,1016	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	435	1178,3550	-1,0960	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	372	1186,7450	-1,0910	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	309	1195,1950	-1,0866	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	246	1203,7050	-1,0828	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	183	1212,2750	-1,0795	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	120	1220,9050	-1,0767	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	57	1229,5950	-1,0744	0914046	135,00697	1,2113	105491317E+02	105491317E+02
79940000E+01	0	1238,3450	-1,0725	0914046	135,00697	1,2113	105491317E+02	105491317E+02

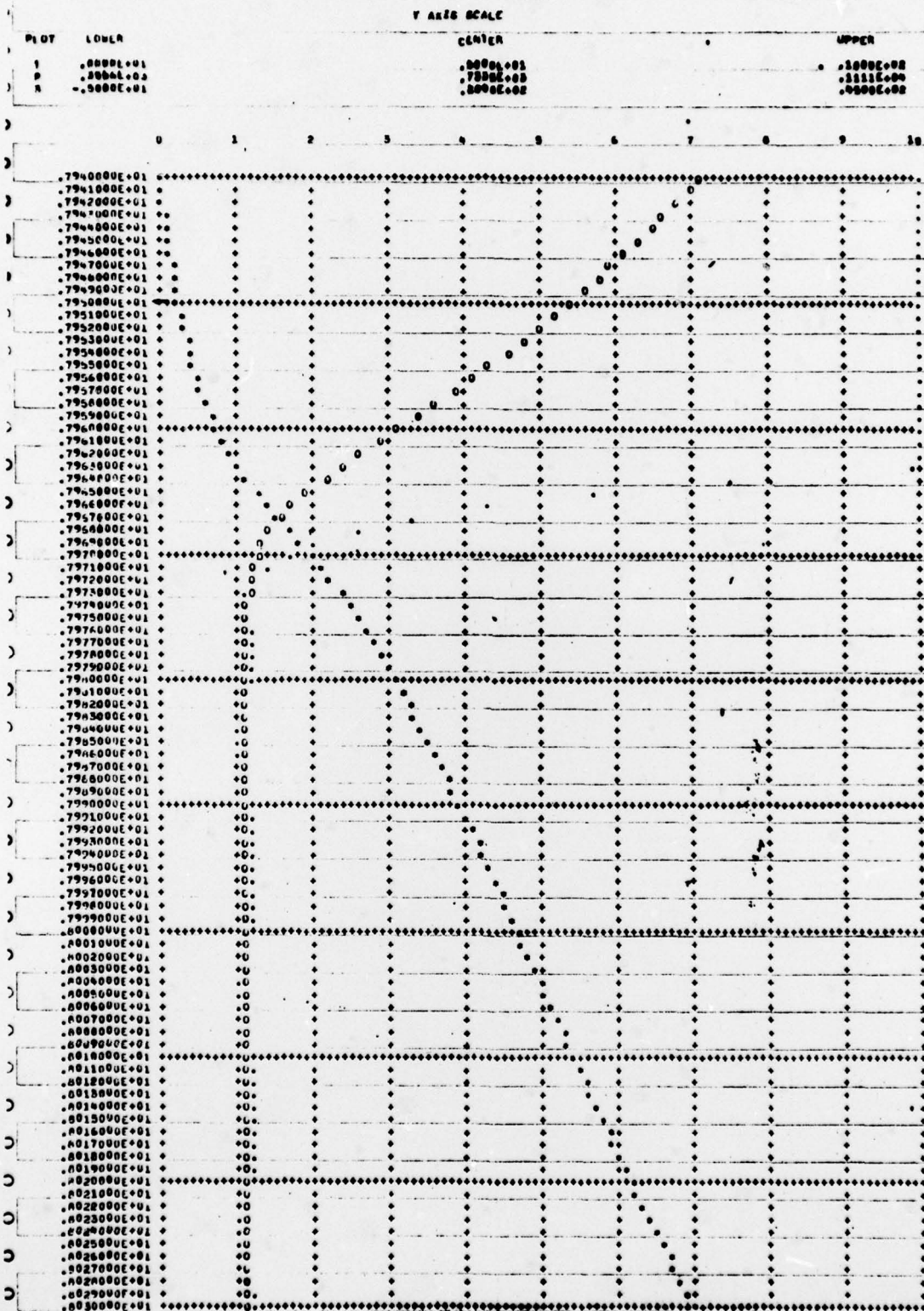
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY
SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) S
SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) O
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) U



LOCK TUNING FILTER
FILTER DESIGN PLOTS

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = S
SYMBOL FOR GRAPH 2 (INSERTION PHASE VS FREQUENCY) = P
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = L



DESIGN

LUCK YOUNG FILTER

.0000 D₀ LUMS POINT

5 CAVITIES

.0000 D₀ NIPPLE

TIME-TO-CHEFF FILTER

ORIGINAL F1 = 7974.00000 F2 = 8656.00000 BANDWIDTH = 42.00000 F0 = 8004.00000
 CORRECTED F1 = 7974.00000 F2 = 8656.00000 BANDWIDTH = 42.00000 F0 = 8004.00000

A = 1.37200 B = .62200000 I = .00000 C = 1.00000
 GJ = 10000.00000 H = 1.00000000 M = .62200 ELB = .07500
 DNEA-PH = 1.00000 DOL = .00000000 LO = 0.00000 RHM = 0.00000

DESIGN CHARACTERISTICS

LAMDA-00/4 =

.007000 INCHES

1.110100 CM.

G

.0171

.9576

1.3704

1.7075

1.3704

.9576

.0171

B

7.9406

66.9378

91.0217

91.0217

66.9378

7.9406

0.0000

CAVITY LENGTH (CL)

.03304

.16697

.06000

.06697

.03304

0.00000

0.00000

PRACTICAL DESIGN DIMENSIONS

SUBSTANCE FOR THE SYMMETRIC NAME.

CAVITY LENGTH (CL)

.06403

.00434

.00097

GAP WIDTH (G)

.387384

.1034605

.1034597

SUBSTANCE (S)

7.29032

65.81000

89.20224

B1

27.28296

60.00000

70.29004

DELTA L

.00994

.00407

.00395

FILTER DESIGN - ANALYSIS OUTPUT

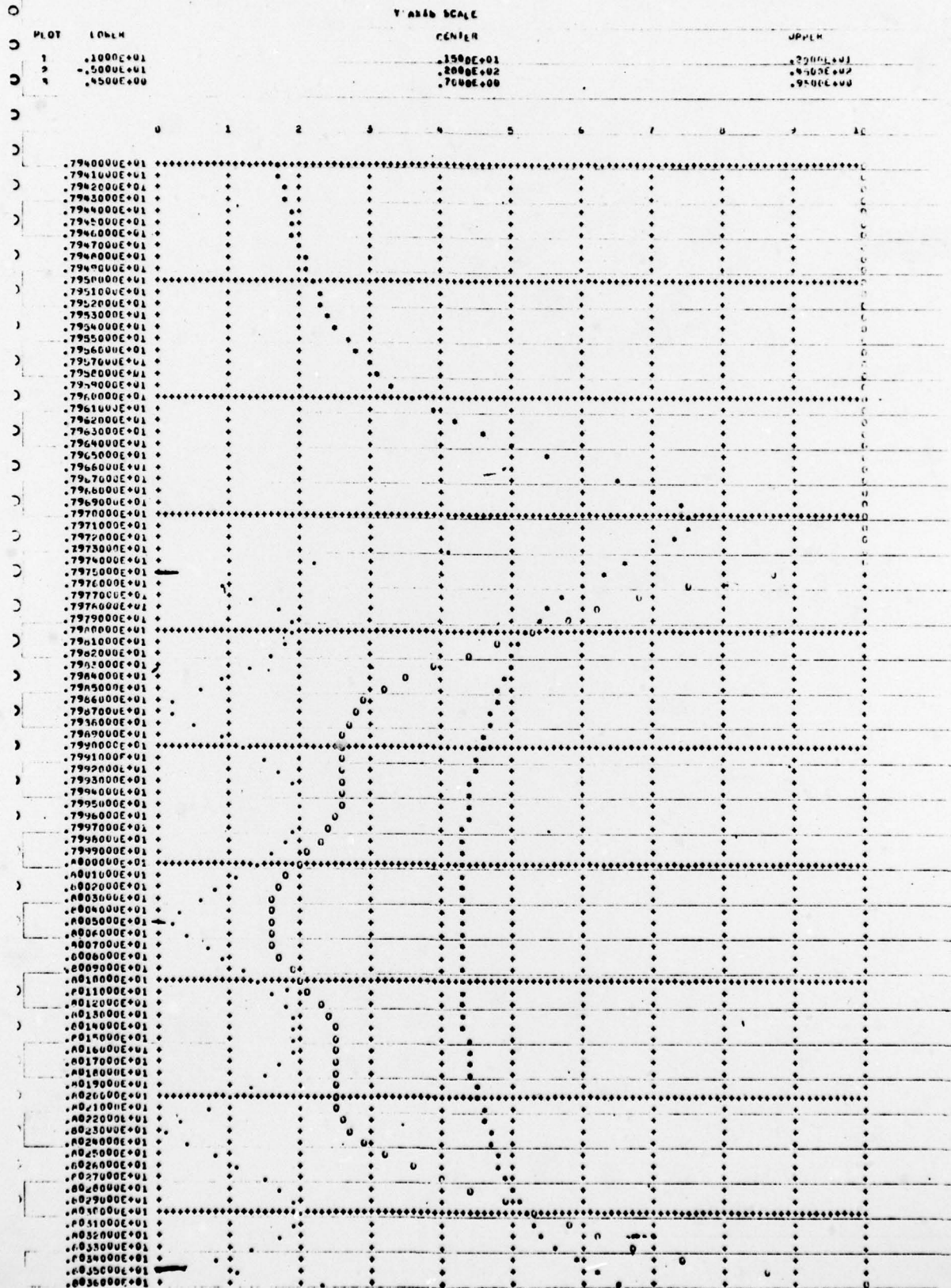
LUCK YOUNG FILTER

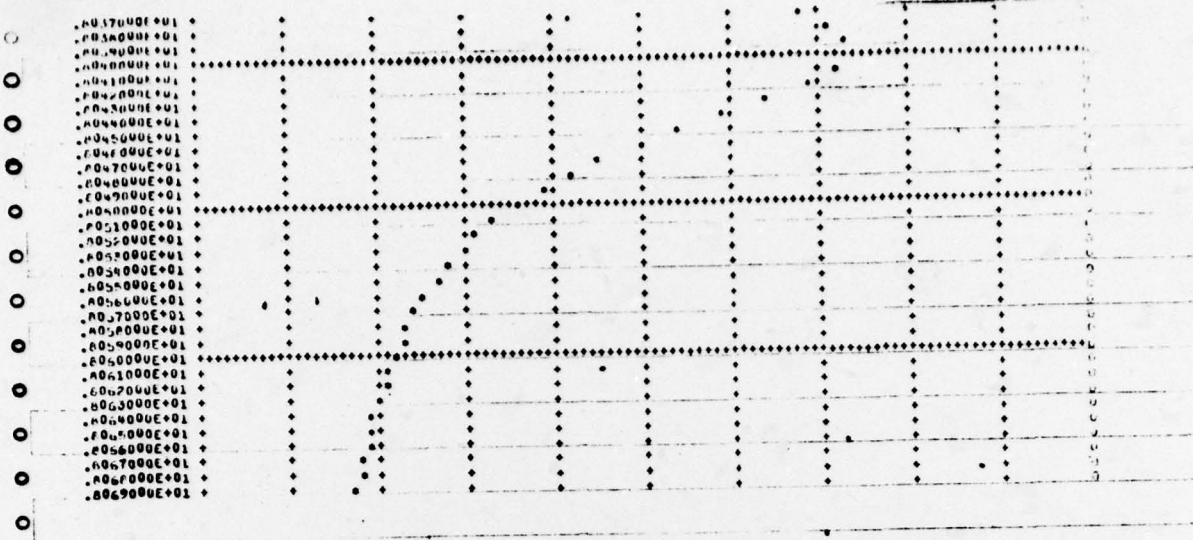
FREQUENCY	INSERTION LOSS	INSERTION PHASE	GAMMA (DB)	ABS VALUE OF GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP DELAY (NS)	DISPERSION
.7940000E+01	33.7637	350.0705	-.0030	.999955	102.79640	99.0000	.0557009E+01	-.1451200E+02
.7941000E+01	33.0063	351.3799	-.0073	.999009	101.54825	99.0000	.0727366E+01	-.1450000E+02
.7942000E+01	32.2173	352.7406	-.0920	.989449	100.24498	99.0000	.0864296E+01	-.1447750E+02
.7943000E+01	31.4101	354.1411	-.0971	.980862	98.98126	99.0000	.0972357E+01	-.1440000E+02
.7944000E+01	30.5860	355.6023	-.1024	.970249	97.65225	99.0000	.1071700E+01	-.1430000E+02
.7945000E+01	29.7442	357.2588	-.1091	.957513	95.25434	99.0000	.1163000E+01	-.1415000E+02
.7946000E+01	28.8836	359.0162	-.1112	.942711	92.77556	99.0000	.1255283E+01	-.1395000E+02
.7947000E+01	28.0039	360.8621	-.1141	.925814	90.21531	99.0000	.1349943E+01	-.1369000E+02
.7948000E+01	27.1035	362.8044	-.1130	.906739	87.56352	99.0000	.1447946E+01	-.1335000E+02
.7949000E+01	26.1817	364.8432	-.1132	.885649	84.81140	99.0000	.1549164E+01	-.1295000E+02
.7950000E+01	25.2375	366.9169	-.1154	.862326	81.94420	99.0000	.1653555E+01	-.1240000E+02
.7951000E+01	24.2651	369.0137	-.1184	.836862	78.96442	99.0000	.1761030E+01	-.1170000E+02
.7952000E+01	23.2759	371.1520	-.1241	.809630	75.84459	99.0000	.1871604E+01	-.1080000E+02
.7953000E+01	22.2564	373.3506	-.1266	.780743	72.57207	99.0000	.1985276E+01	-.9900000E+01
.7954000E+01	21.2098	375.6231	-.1247	.750459	69.13104	99.0000	.2102047E+01	-.8800000E+01
.7955000E+01	20.1336	377.9103	-.1213	.718770	65.51960	99.0000	.2221917E+01	-.7500000E+01
.7956000E+01	19.0270	380.2215	-.1150	.685813	61.64101	99.0000	.2344887E+01	-.6000000E+01
.7957000E+01	17.8894	382.5591	-.1040	.651813	57.49421	99.0000	.2470957E+01	-.4300000E+01
.7958000E+01	16.7199	384.9298	-.0884	.616813	53.07600	99.0000	.2600127E+01	-.2400000E+01
.7959000E+01	15.5167	387.3290	-.0584	.580813	48.37600	99.0000	.2732397E+01	-.3000000E+01
.7960000E+01	14.2817	389.7170	-.0210	.543813	43.39600	99.0000	.2867767E+01	-.1000000E+01
.7961000E+01	13.0159	392.0811	-.0292	.505813	38.12600	99.0000	.3006237E+01	.0000000E+00
.7962000E+01	11.7230	394.5519	-.0771	.466813	32.57600	99.0000	.3147807E+01	.1000000E+01
.7963000E+01	10.4090	397.0291	-.0970	.426813	26.74600	99.0000	.3292477E+01	.2000000E+01
.7964000E+01	9.0674	399.5040	-.12315	.385813	20.63600	99.0000	.3440247E+01	.3000000E+01
.7965000E+01	7.7732	401.9743	-.15956	.343813	14.24600	99.0000	.3591117E+01	.4000000E+01
.7966000E+01	6.5297	404.4422	-.20996	.301813	7.59600	99.0000	.3745087E+01	.5000000E+01
.7967000E+01	5.2794	406.9005	-.27963	.259813	0.68600	99.0000	.3902157E+01	.6000000E+01
.7968000E+01	4.0174	409.3529	-.37915	.217813	-2.11400	99.0000	.4062327E+01	.7000000E+01
.7969000E+01	2.7460	411.8044	-.50960	.175813	-5.09400	99.0000	.4225597E+01	.8000000E+01
.7970000E+01	1.4646	414.2599	-.67940	.133813	-7.97400	99.0000	.4391967E+01	.9000000E+01
.7971000E+01	0.1832	416.7144	-.88960	.091813	-10.85400	99.0000	.4560337E+01	.1000000E+02
.7972000E+01	0.0000	419.1744	-.1.00000	.049813	-13.73400	99.0000	.4730707E+01	.1100000E+02
.7973000E+01	0.0000	421.6344	-.1.00000	.007813	-16.61400	99.0000	.4903077E+01	.1200000E+02
.7974000E+01	0.0000	424.0944	-.1.00000	.000000	-19.49400	99.0000	.5077447E+01	.1300000E+02
.7975000E+01	0.0000	426.5544	-.1.00000	.000000	-22.37400	99.0000	.5253817E+01	.1400000E+02
.7976000E+01	0.0000	429.0144	-.1.00000	.000000	-25.25400	99.0000	.5432187E+01	.1500000E+02
.7977000E+01	0.0000	431.4744	-.1.00000	.000000	-28.13400	99.0000	.5612557E+01	.1600000E+02
.7978000E+01	0.0000	433.9344	-.1.00000	.000000	-31.01400	99.0000	.5794927E+01	.1700000E+02
.7979000E+01	0.0000	436.3944	-.1.00000	.000000	-33.89400	99.0000	.5979297E+01	.1800000E+02
.7980000E+01	0.0000	438.8544	-.1.00000	.000000	-36.77400	99.0000	.6165667E+01	.1900000E+02
.7981000E+01	0.0000	441.3144	-.1.00000	.000000	-39.65400	99.0000	.6354037E+01	.2000000E+02
.7982000E+01	0.0000	443.7744	-.1.00000	.000000	-42.53400	99.0000	.6544407E+01	.2100000E+02
.7983000E+01	0.0000	446.2344	-.1.00000	.000000	-45.41400	99.0000	.6736777E+01	.2200000E+02
.7984000E+01	0.0000	448.6944	-.1.00000	.000000	-48.29400	99.0000	.6931147E+01	.2300000E+02
.7985000E+01	0.0000	451.1544	-.1.00000	.000000	-51.17400	99.0000	.7127517E+01	.2400000E+02
.7986000E+01	0.0000	453.6144	-.1.00000	.000000	-54.05400	99.0000	.7325887E+01	.2500000E+02
.7987000E+01	0.0000	456.0744	-.1.00000	.000000	-56.93400	99.0000	.7526257E+01	.2600000E+02
.7988000E+01	0.0000	458.5344	-.1.00000	.000000	-59.81400	99.0000	.7728627E+01	.2700000E+02
.7989000E+01	0.0000	460.9944	-.1.00000	.000000	-62.69400	99.0000	.7932997E+01	.2800000E+02
.7990000E+01	0.0000	463.4544	-.1.00000	.000000	-65.57400	99.0000	.8139367E+01	.2900000E+02
.7991000E+01	0.0000	465.9144	-.1.00000	.000000	-68.45400	99.0000	.8346737E+01	.3000000E+02
.7992000E+01	0.0000	468.3744	-.1.00000	.000000	-71.33400	99.0000	.8555107E+01	.3100000E+02
.7993000E+01	0.0000	470.8344	-.1.00000	.000000	-74.21400	99.0000	.8764477E+01	.3200000E+02
.7994000E+01	0.0000	473.2944	-.1.00000	.000000	-77.09400	99.0000	.8975847E+01	.3300000E+02
.7995000E+01	0.0000	475.7544	-.1.00000	.000000	-79.97400	99.0000	.9189217E+01	.3400000E+02
.7996000E+01	0.0000	478.2144	-.1.00000	.000000	-82.85400	99.0000	.9404587E+01	.3500000E+02
.7997000E+01	0.0000	480.6744	-.1.00000	.000000	-85.73400	99.0000	.9621957E+01	.3600000E+02
.7998000E+01	0.0000	483.1344	-.1.00000	.000000	-88.61400	99.0000	.9841327E+01	.3700000E+02
.7999000E+01	0.0000	485.5944	-.1.00000	.000000	-91.49400	99.0000	.1.0062697E+02	.3800000E+02

79850000E+01	6102	612,3261	-81,2169	8879000	26,9729	1,4366	1910730E+02	1600790E+01
79860000E+01	5975	617,1578	-88,0891	8899000	28,6867	1,4361	1910730E+02	1600790E+01
79870000E+01	5806	625,0661	-90,1762	8909000	29,7128	1,4356	1910730E+02	1600790E+01
79880000E+01	5635	632,5178	-91,5678	8929000	30,7652	1,4344	1910730E+02	1600790E+01
79890000E+01	5468	639,8697	-92,8818	8949000	31,8422	1,4334	1910730E+02	1600790E+01
79900000E+01	5303	645,9518	-94,9808	8969000	32,9422	1,4324	1910730E+02	1600790E+01
79910000E+01	5140	651,8667	-96,8167	8989000	34,0642	1,4314	1910730E+02	1600790E+01
79920000E+01	4977	658,1447	-98,1749	8999000	35,2177	1,4304	1910730E+02	1600790E+01
79930000E+01	4817	664,8061	-99,8244	9009000	36,3981	1,4294	1910730E+02	1600790E+01
79940000E+01	4658	670,9611	-100,9632	9019000	37,6046	1,4284	1910730E+02	1600790E+01
79950000E+01	4500	676,5788	-102,6120	9029000	38,8372	1,4274	1910730E+02	1600790E+01
79960000E+01	4343	682,6408	-104,8892	9039000	40,0960	1,4264	1910730E+02	1600790E+01
79970000E+01	4187	688,6573	-106,7918	9049000	41,3812	1,4254	1910730E+02	1600790E+01
79980000E+01	4032	694,6559	-108,3190	9059000	42,6927	1,4244	1910730E+02	1600790E+01
79990000E+01	3878	700,6368	-109,8725	9069000	44,0305	1,4234	1910730E+02	1600790E+01
80000000E+01	3725	706,6057	-111,5524	9079000	45,3946	1,4224	1910730E+02	1600790E+01
80010000E+01	3572	712,5608	-113,3595	9089000	46,7850	1,4214	1910730E+02	1600790E+01
80020000E+01	3420	718,5029	-115,2940	9099000	48,2017	1,4204	1910730E+02	1600790E+01
80030000E+01	3268	724,4757	-117,3561	9109000	49,6448	1,4194	1910730E+02	1600790E+01
80040000E+01	3117	730,4261	-119,5464	9119000	51,1144	1,4184	1910730E+02	1600790E+01
80050000E+01	2966	736,3740	-121,8641	9129000	52,6105	1,4174	1910730E+02	1600790E+01
80060000E+01	2815	742,3191	-124,3091	9139000	54,1332	1,4164	1910730E+02	1600790E+01
80070000E+01	2664	748,2616	-126,8814	9149000	55,6825	1,4154	1910730E+02	1600790E+01
80080000E+01	2513	754,2014	-129,5824	9159000	57,2584	1,4144	1910730E+02	1600790E+01
80090000E+01	2362	760,1401	-132,4120	9169000	58,8607	1,4134	1910730E+02	1600790E+01
80100000E+01	2211	766,0797	-135,3703	9179000	60,4894	1,4124	1910730E+02	1600790E+01
80110000E+01	2060	772,0201	-138,4574	9189000	62,1445	1,4114	1910730E+02	1600790E+01
80120000E+01	1909	777,9776	-141,6732	9199000	63,8260	1,4104	1910730E+02	1600790E+01
80130000E+01	1758	783,9467	-145,0177	9209000	65,5339	1,4094	1910730E+02	1600790E+01
80140000E+01	1607	789,9383	-148,4910	9219000	67,2682	1,4084	1910730E+02	1600790E+01
80150000E+01	1456	795,9609	-152,0931	9229000	69,0289	1,4074	1910730E+02	1600790E+01
80160000E+01	1305	802,0232	-155,8250	9239000	70,8160	1,4064	1910730E+02	1600790E+01
80170000E+01	1154	808,1341	-159,6867	9249000	72,6295	1,4054	1910730E+02	1600790E+01
80180000E+01	1003	814,3026	-163,6782	9259000	74,4694	1,4044	1910730E+02	1600790E+01
80190000E+01	852	820,5370	-167,7995	9269000	76,3357	1,4034	1910730E+02	1600790E+01
80200000E+01	701	826,8446	-172,0506	9279000	78,2284	1,4024	1910730E+02	1600790E+01
80210000E+01	550	833,2316	-176,4315	9289000	80,1475	1,4014	1910730E+02	1600790E+01
80220000E+01	400	839,7032	-180,9422	9299000	82,0930	1,4004	1910730E+02	1600790E+01
80230000E+01	250	846,2630	-185,5827	9309000	84,0649	1,3994	1910730E+02	1600790E+01
80240000E+01	100	852,9143	-190,3530	9319000	86,0632	1,3984	1910730E+02	1600790E+01
80250000E+01	50	859,6606	-195,2531	9329000	88,0879	1,3974	1910730E+02	1600790E+01
80260000E+01	0	866,5069	-200,2839	9339000	90,1390	1,3964	1910730E+02	1600790E+01
80270000E+01	0	873,4593	-205,4444	9349000	92,2165	1,3954	1910730E+02	1600790E+01
80280000E+01	0	880,5232	-210,7357	9359000	94,3204	1,3944	1910730E+02	1600790E+01
80290000E+01	0	887,7442	-216,1578	9369000	96,4507	1,3934	1910730E+02	1600790E+01
80300000E+01	0	895,1286	-221,7115	9379000	98,6074	1,3924	1910730E+02	1600790E+01
80310000E+01	0	902,7699	-227,3967	9389000	100,7905	1,3914	1910730E+02	1600790E+01
80320000E+01	0	910,5856	-234,2130	9399000	103,0000	1,3904	1910730E+02	1600790E+01
80330000E+01	0	918,7257	-241,1603	9409000	105,2359	1,3894	1910730E+02	1600790E+01
80340000E+01	0	927,2957	-248,2386	9419000	107,5082	1,3884	1910730E+02	1600790E+01
80350000E+01	0	936,3461	-255,4479	9429000	109,8069	1,3874	1910730E+02	1600790E+01
80360000E+01	0	945,9465	-262,7882	9439000	112,1320	1,3864	1910730E+02	1600790E+01
80370000E+01	0	956,1539	-270,2595	9449000	114,4835	1,3854	1910730E+02	1600790E+01
80380000E+01	0	966,9800	-277,8618	9459000	116,8614	1,3844	1910730E+02	1600790E+01
80390000E+01	0	978,4605	-285,5951	9469000	119,2657	1,3834	1910730E+02	1600790E+01
80400000E+01	0	990,6230	-293,4694	9479000	121,6964	1,3824	1910730E+02	1600790E+01
80410000E+01	0	1011,5676	-301,4847	9489000	124,1535	1,3814	1910730E+02	1600790E+01
80420000E+01	0	1021,7266	-309,6410	9499000	126,6370	1,3804	1910730E+02	1600790E+01
80430000E+01	0	1031,0406	-317,9383	9509000	129,1469	1,3794	1910730E+02	1600790E+01
80440000E+01	0	1039,5803	-326,3766	9519000	131,6832	1,3784	1910730E+02	1600790E+01
80450000E+01	0	1047,3850	-334,9549	9529000	134,2459	1,3774	1910730E+02	1600790E+01
80460000E+01	0	1055,3951	-343,6732	9539000	136,8350	1,3764	1910730E+02	1600790E+01
80470000E+01	0	1063,6508	-352,5315	9549000	139,4505	1,3754	1910730E+02	1600790E+01
80480000E+01	0	1071,1829	-361,5298	9559000	142,0924	1,3744	1910730E+02	1600790E+01
80490000E+01	0	1078,9414	-370,6681	9569000	144,7607	1,3734	1910730E+02	1600790E+01
80500000E+01	0	1086,8663	-379,9464	9579000	147,4554	1,3724	1910730E+02	1600790E+01
80510000E+01	0	1094,9876	-389,3647	9589000	150,1865	1,3714	1910730E+02	1600790E+01
80520000E+01	0	1103,3451	-398,9230	9599000	152,9540	1,3704	1910730E+02	1600790E+01
80530000E+01	0	1111,9786	-408,6213	9609000	155,7579	1,3694	1910730E+02	1600790E+01
80540000E+01	0	1120,8289	-418,4606	9619000	158,5982	1,3684	1910730E+02	1600790E+01
80550000E+01	0	1129,9358	-428,4409	9629000	161,4749	1,3674	1910730E+02	1600790E+01
80560000E+01	0	1139,3391	-438,5622	9639000	164,3880	1,3664	1910730E+02	1600790E+01
80570000E+01	0	1149,0886	-448,8245	9649000	167,3375	1,3654	1910730E+02	1600790E+01
80580000E+01	0	1159,2341	-459,2278	9659000	170,3234	1,3644	1910730E+02	1600790E+01
80590000E+01	0	1169,8254	-469,7721	9669000	173,3457	1,3634	1910730E+02	1600790E+01
80600000E+01	0	1180,9125	-480,4574	9679000	176,4044	1,3624	1910730E+02	1600790E+01
80610000E+01	0	1192,5454	-491,2837	9689000	179,4995	1,3614	1910730E+02	1600790E+01
80620000E+01	0	1204,7749	-502,2510	9699000	182,6310	1,3604	1910730E+02	1600790E+01
80630000E+01	0	1217,6508	-513,3593	9709000	185,7985	1,3594	1910730E+02	1600790E+01
80640000E+01	0	1231,2231	-524,6086	9719000	189,0020	1,3584	1910730E+02	1600790E+01
80650000E+01	0	1245,5416	-535,9989	9729000	192,2415	1,3574	1910730E+02	1600790E+01
80660000E+01	0	1260,6561	-547,5302	9739000	195,5170	1,3564	1910730E+02	1600790E+01
80670000E+01	0	1276,5174	-559,2025	9749000	198,8285	1,3554	1910730E+02	1600790E+01
80680000E+01	0	1293,1754	-571,0158	9759000	202,1760	1,3544	1910730E+02	1600790E+01
80690000E+01	0	1310,6899	-582,9591	9769000	205,5595	1,3534	1910730E+02	1600790E+01
80700000E+01	0	1329,0198	-595,0324	9779000	208,9790	1,3524	1910730E+02	1600790E+01
80710000E+01	0	1348,2251	-607,2357	9789000	212,4345	1,3514	1910730E+02	1600790E+01
80720000E+01	0	1368,3656	-619,5690	9799000	215,9260	1,3504	1910730E+02	1600790E+01
80730000E+01	0	1389,4911	-632,0323	9809000	219,4535	1,3494	1910730E+02	1600790E+01
80740000E+01	0	1411,6616	-644,7256	9819000	223,0170	1,3484	1910730E+02	1600790E+01
80750000E+01	0	1434,9371	-657,5489	9829000	226,6165	1,3474	1910730E+02	1600790E+01
80760000E+01	0	1459,3676	-670,5022	9839000	230,2520	1,3464	1910730E+02	1600790E+01
80770000E+01	0	1484,9931	-683,6855	9849000	233,9235	1,3454	1910730E+02	1600790E+01
80780000E+01	0	1511,8636	-697,0988	9859000	237,6310	1,3444	1910730E+02	1600790E+01
80790000E+01	0	1539,9391	-710,7421	9869000	241,3745	1,3434	1910730E+02	1600790E+01
80800000E+01	0	1569,2796	-724,6154	9879000	245,1540	1,3424	1910730E+02	1600790E+01
80810000E+01	0	1600,0451	-738,7187	9889000	248,9695	1,3414	1910730E+02	1600790E+01
80820000E+01	0	1632,3056	-753,0520	9899000	252,8210	1,3404	1910730E+02	1600790E+01
80830000E+01	0	1666,0211	-767,6153	9909000	256,7085	1,3394	1910730E+02	1600790E+01
80840000E+01	0	1701,2526	-782,4086	9919000	260,6320	1,3384	1910730E+02	1600790E+01
80850000E+01	0	1738,0601	-797,					

LOCK YOUNG FILTER
FILTER DESIGN PLOTS

STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY
SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) = o
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = .





SYMBOL FOR GRAPH 1 (INSERTION LOSS AND INSERTION PHASE VS FREQUENCY)
SYMBOL FOR GRAPH 2 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 3 (INSERTION PHASE VS FREQUENCY) = o
SYMBOL FOR GRAPH 4 (INSERTION LOSS VS FREQUENCY) = o

POINT		Y AXIS SCALE		
LOWER		CENTER		
1	.0000E+01	.0000E+01	.0000E+01	.0000E+01
2	.3500E+03	.7300E+03	.7300E+03	.7300E+03
3	.5000E+01	.2000E+02	.2000E+02	.2000E+02

