FINAL REPORT

A STUDY ON THE TECHNICAL AND ECONOMIC IMPACT OF A CHANGE FROM 10 KHz TO 9 KHz CHANNEL SEPARATION IN THE AM BROADCASTING BAND

DSS CONTRACT NO. OSV79 - 00016
FILE NO. 12SV.36100-9-0122

PREPARED FOR

THE DEPARTMENT OF COMMUNICATIONS

BY

P
91
C655
S894
1979

IMAGINEERING LIMITED
TORONTO ONTARIO
NOVEMBER 15, 1979

P
91
C655
S894
1979

Industry Canada
LIBRARY
JUIL JUL 2 0 1998
BIBLIOTHÈQUE
Industrie Canada

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Department of Communications of the Government of Canada.

COMMUNICATIONS CANADA
FEB 23 1992
LIBRARY – BIBLIOTHÈQUE

FINAL REPORT

A STUDY ON THE TECHNICAL AND ECONOMIC IMPACT OF A CHANGE FROM 10 KHz TO 9 KHz CHANNEL SEPARATION IN THE AM BROADCASTING BAND

DSS CONTRACT NO. OSV79 - 00016

FILE NO. 12SV.36100-9-0122

PREPARED FOR

THE DEPARTMENT OF COMMUNICATIONS

BY

IMAGINEERING LIMITED
TORONTO, ONTARIO
NOVEMBER 15, 1979

P
91
C655
S894
1979

TABLE OF CONTENTS

SECTION	PAGE
TABLE OF CONTENTS	i
LIST OF TABLES	iv
LIST OF FIGURES	v
SUMMARY	viii
1.0 INTRODUCTION	1
2.0 SOURCES OF STATION DATA	1
3.0 RESULTS OF STUDY	2
3.1 TASK 1	2
3.2 TASK 2	2
3.3 TASK 3	2
3.3.1 Change-over Methods	7
3.3.2 Technical Considerations	10
3.3.3 Economic Impact	22
3.3.4 Application of Costing Formulas	32
3.4 TASK 4	33
3.4.1 Existing Receiver Performance	33
3.4.2 Potential for Improved Receiver Performance	51
3.4.3 Conclusions	54
3.5 TASK 5	56
3.5.1 Modulation Capabilities of AM Transmitters	56
3.5.2 Occupied Bandwidth Measurements	57
3.6 TASK 6	85
3.6.1 Class I	85
3.6.2 Class II and Class III	87
3.6.3 Class IV	88
3.6.4 Class Designations for New Frequencies	89
3.6.5 Conclusions	91

... continued

TABLE OF CONTENTS

SECTION	PAGE
3.7 TASK 7	91
3.7.1 Information on Stereo Systems	91
3.7.2 Review of Proposed Systems	91
3.7.3 Occupied Bandwidth of AM Stereo Transmissions	92
3.7.4 Conclusions	94
APPENDICES	
I ANTENNA PATTERN PRINT-OUTS FOR REPRESENTATIVE STATIONS	97
CFUN Antenna Patterns, Day, 1410, 1406, 1414, 1314 KHz	98
CFUN Antenna Patterns, Night, 1410, 1406, 1414, 1314 KHz	100
CHLO Antenna Patterns, Day, 1570, 1574, 1566, 1458 KHz	105
CHLO Antenna Patterns, Night, 1570, 1574, 1566, 1458 KHz	108
CKJD Antenna Patterns, Day, 1110, 1106, 1114, 1044 KHz	117
CKJD, Antenna Patterns, Night, 1110, 1106, 1114, 1044 KHz	119
CJJD Antenna Patterns, Day, 1280, 1284, 1276, 1197 KHz	128
CJJD Antenna Patterns, Night, 1280, 1284, 1276, 1197 KHz	131
CFTR Antenna Patterns, Day, 680, 684, 676, 657 KHz	140
CFTR Antenna Patterns, Night, 680, 684, 676, 657 KHz	143
CJRS Antenna Patterns, Day, 1510, 1514, 1506, 1404 KHz	152
CJRS Antenna Patterns, Night, 1510, 1514, 1506, 1404 KHz	154

... continued

TABLE OF CONTENTS

SECTION		PAGE
APPENDICES (continued)		
I	(continued)	
	CJFX Antenna Patterns, Night, 580, 584, 576, 567 KHz	159
II	PRINT-OUT OF COSTING PROGRAM FOR THE FREQUENCY PLAN OF TABLE 1	164
III	PRINT-OUT OF COSTING PROGRAM FOR THE FREQUENCY PLAN OF TABLE 2	192
IV	COSTING PROGRAM LISTING AND FLOW-CHARTS	224

LIST OF TABLES

TABLE		PAGE
1	AM Station Frequency Allotments (From DOC Statement of Work)	3
2	AM Station Frequency Allotments (From DOC Statement of Work)	4
3	Frequency Change per Table 1 and Number of Stations Involved	5
4	Frequency Change per Table 2 and Number of Stations Involved	6-6(b)
5	Integration of Spectrum of Figure 5	45
6	Integration of Spectrum of Figure 6	46
7	Integration of Spectrum of Figure 7	47
8	List of Materials Received Pertaining to Stereophonic Broadcasting	96

LIST OF FIGURES

FIGURE		PAGE
1	Close-spaced and Wide-spaced Antenna Patterns	12
2	Antenna Efficiency vs. Ground Radial Length	17
3	Field Strength vs. Frequency	19
4	AM Receiver Passband Characteristics	38
5	Smoothed RF Spectrum of Station A for Recording by Gordon Lightfoot	42
6	Smoothed RF Spectrum of Station B for a Musical Selection, 1	43
7	Smoothed RF Spectrum of Station B for a Musical Selection, 2	44
8	RF Spectrum of Station A for Male Voice	58
9	RF Spectrum of Station A for Female Voice	59
10	RF Spectrum of Station A for a Musical Selection	60
11	RF Spectrum of Station A for a Light and Lively Musical Selection	61
12	RF Spectrum of Station A for a Musical Selection With Cymbals	62
13	RF Spectrum of Station A for a Soft Selection by a Female Vocalist	63
14	RF Spectrum of Station A for a Recording by Gordon Lightfoot	64

.... continued

LIST OF FIGURES

FIGURE		PAGE
15	RF Spectrum of Station A for "Riders in the Sky" by Johnny Cash, With Pre-amp	65
16	RF Spectrum of Station A for Last Half of "Riders in the Sky" Without Pre-amp	66
17	RF Spectrum of Station B for Male D.J.'s Voice	67
18	RF Spectrum of Station B for a Commercial - Male Voice Over Music, 3	68
19	RF Spectrum of Station B for a Commercial - Male Voice Over Music, 2	69
20	RF Spectrum of Station B for a Musical Selection	70
21	RF Spectrum of Station B for a Musical Selection, 1	71
22	RF Spectrum of Station B for a Musical Selection, 2	72
23	RF Spectrum of Station B for a Musical Selection, 3	73
24	Aural Spectrum of Station A for a Musical Selection Without Pre-amp	74
25	Aural Spectrum of Station A for a Musical Selection With Pre-amp	75
26	Baseband Spectrum of Station C from Off-air Monitor for a Musical Selection	76
27	Spectrum of a Violin at 294 Hz	77

.... continued

LIST OF FIGURES

FIGURE		PAGE
28	Spectrum of Orchestral Trumpet at 175 Hz	77
29	Spectrum of Cymbal at 175 Hz	77
30	RF Spectrum of Station D for a Musical Selection, 1	78
31	RF Spectrum of Station D for a Musical Selection, 2	79
32	RF Spectrum of Station D for a Musical Selection, 3	80

SUMMARY

This report summarizes the economic and technical considerations of changing from 10 KHz to 9 KHz separation in the AM broadcast band. Two re-allocation plans were provided for consideration in the referenced documents and both have been considered and costed. As well, receiver performance was evaluated and the limitations introduced by receiving apparatus discussed.

The effect of a change in operating parameters on proposed AM stereo systems, an evaluation of occupied bandwidth considerations, and the class of designation which would make best use of the new channels created have been considered.

A computer program was developed for costing analysis which is operable with any re-allocation plan. It calculates individual costs for all Canadian stations by comparing a particular station's operating parameters with models of degrees of complexity and difficulty, from whose detailed evaluation the costing formula and the appropriate weighing factors were derived. Certain of the parameters which will govern any implementation plan are discussed and recommendations made.

Essentially, 9 KHz spacing could be introduced in Canada in concert with all other Region 2 countries, at significant cost, with a somewhat increased level of mutual interference, with increased regulatory problems and with logistical difficulty.

REGISTERED PROFESSIONAL ENGINEER
E. BOGDANOWICZ
PROVINCE OF ONTARIO

Edward A. Bogdanowicz, P. Eng.
Vice President, Imagineering Limited

FINAL REPORT

A STUDY ON THE TECHNICAL AND ECONOMIC IMPACT OF A CHANGE FROM 10 KHz TO 9 KHz CHANNEL SEPARATION IN THE AM BROADCASTING BAND

1.0 INTRODUCTION

As a result of a Request for Proposal, DSS File 12SV.36100-9-0122, issued by Supply and Services Canada, Imagineering Limited entered into a contract with DSS to perform the work described in the Statement of Work contained in the above mentioned Request for Proposal.

During the course of the work three interim reports were submitted to describe the progress of work. Much of the material presented in these reports was in a state of evolution and consequently has been modified and refined. Therefore, this report is written to be self-contained and supersedes all material previously submitted in the interim reports.

2.0 SOURCES OF STATION DATA

The following sources of information were used in carrying out the various tasks of this study:

a) Official List of Assignments to Standard Broadcasting Stations in Canada as of December 1977,
b) List of Changes, Proposed Changes, and Corrections in Broadcast Station Assignments in Canada as of June 28, 1979 (the date of the contract),
c) Computer tape of station data for stations operating in Canada, supplied by the Department of Communications,
d) Engineering Briefs and Final Proof of Performance documents for the following stations: CFUN, CHLO, CKJD, CJJD, CFTR, CJRS, CJFX. These documents were supplied by the Department of Communications; and

..... 2/

2.0 SOURCES OF STATION DATA (continued)

e) Material supplied by AM stereo proponents as listed elsewhere in this report.

3.0 RESULTS OF STUDY

The following sections present the results of the work described in the Statement of Work as Tasks 1 through 7.

3.1 TASK 1 - Determine the number of Canadian stations requiring a change of channel, listing stations being moved by 1, 2, 3 or 4 KHz, as per Table 1 of the Statement of Work.

Using the data published by the DOC a count was made of the number of stations involved in the changes stipulated by the frequency plan of Table 1. The results are shown in Table 3.

3.2 TASK 2 - Determine the number of Canadian stations requiring a change of channel, listing stations being changed by 9 through 115 KHz as per Table 2 of the Statement of Work.

Using the data published by the DOC a count was made of the number of stations involved in the changes stipulated by the frequency plan of Table 2. The results are shown in Table 4.

3.3 TASK 3 - For each of the rearrangements described by Tables 1 and 2,

a) Determine methods by which each omnidirectional and directional station could change frequency to meet present coverage and protection requirements.

b) Estimate the cost involved for each station using such methods.

TABLE 1

AM STATION FREQUENCY ALLOTMENTS

PRESENT 10 kHz		PROPOSED 9 kHz
NEW		531
540	-	540
550		549
560		558
570		567
580		576
NEW		585
590		594
600		603
610		612
620		621
630	-	630
640		639
650		648
660		657
670		666
NEW		675
680		684
690		693
700		702
710		711
720	-	720
730		729
740		738
750		747
760		756
NEW		765
770		774
780		783
790		792
800		801
810	-	810
820		819
830		828
840		837
850		846
NEW		855
860		864
870		873
880		882
890		891
900	-	900
910		909
920		918
930		927
940		936

PRESENT 10 kHz		PROPOSED 9 kHz
NEW		945
950		954
960		963
970		972
980		981
990	-	990
1000		999
1010		1008
1020		1017
1030		1026
NEW		1035
1040		1044
1050		1053
1060		1062
1070		1071
1080	-	1080
1090		1089
1100		1098
1110		1107
1120		1116
NEW		1125
1130		1134
1140		1143
1150		1152
1160		1161
1170	-	1170
1180		1179
1190		1188
1200		1197
1210		1206
NEW		1215
1220		1224
1230		1233
1240		1242
1250		1251
1260	-	1260
1270		1269
1280		1278
1290		1287
1300		1296
NEW		1305
1310		1314
1320		1323
1330		1332
1340		1341
1350	-	1350

PRESENT 10 kHz		PROPOSED 9 kHz
1360		1359
1370		1368
1380		1377
1390		1386
NEW		1395
1400		1404
1410		1413
1420		1422
1430		1431
1440	-	1440
1450		1449
1460		1458
1470		1467
1480		1476
NEW		1485
1490		1494
1500		1503
1510		1512
1520		1521
1530	-	1530
1540		1539
1550		1548
1560		1557
1570		1566
NEW		1575
1580		1584
1590		1593
1600		1602

TABLE 2

AM STATION FREQUENCY ALLOTMENTS

PRESENT 10 kHz	PROPOSED 9 kHz	PRESENT 10 kHz	PROPOSED 9 kHz	PRESENT 10 kHz	PROPOSED 9 kHz
540	531	990	936	1440	1341
550	540	1000	945	1450	1350
560	549	1010	954	1460	1359
570	558	1020	963	1470	1368
580	567	1030	972	1480	1377
590	576	1040	981	1490	1386
600	585	1050	990	1500	1395
610	594	1060	999	1510	1404
620	603	1070	1008	1520	1413
630	612	1080	1017	1530	1422
640	621	1090	1026	1540	1431
650	630	1100	1035	1550	1440
660	639	1110	1044	1560	1449
670	648	1120	1053	1570	1458
680	657	1130	1062	1580	1467
690	666	1140	1071	1590	1476
700	675	1050 1150	1080	1600	1485
710	684	1160	1089	NEW	1494
720	693	1170	1098	NEW	1503
730	702	1180	1107	NEW	1512
740	711	1190	1116	NEW	1521
750	720	1200	1125	NEW	1530
760	729	1210	1134	NEW	1539
770	738	1220	1143	NEW	1548
780	747	1230	1152	NEW	1557
790	756	1240	1161	NEW	1566
800	765	1250	1170	NEW	1575
810	774	1260	1179	NEW	1584
820	783	1270	1188	NEW	1593
830	792	1280	1197	NEW	1602
840	801	1290	1206		
850	810	1300	1215		
860	819	1310	1224		
870	828	1320	1233		
880	837	1330	1242		
890	846	1340	1251		
900	855	1350	1260		
910	864	1360	1269		
920	873	1370	1278		
930	882	1380	1287		
940	891	1390	1296		
950	900	1400	1305		
960	909	1410	1314		
970	918	1420	1323		
980	927	1430	1332		

Assumed that 1050 should be 1150

TABLE 3

FREQUENCY CHANGE PER TABLE 1

AND NUMBER OF STATIONS INVOLVED

FREQ. SHIFT +1KHz/ NO. STNS.	FREQ. SHIFT +2KHz/ NO. STNS.	FREQ. SHIFT +3KHz/ NO. STNS.	FREQ. SHIFT +4KHz/ NO. STNS.	FREQ. SHIFT -4KHz/ NO. STNS.	FREQ. SHIFT -3KHz/ NO. STNS.	FREQ. SHIFT -2KHz/ NO. STNS.	FREQ. SHIFT -1KHz/ NO. STNS.	UNCHANGED FREQ. KHz/ NO. STNS.	NEW FREQUENCIES KHz
620 4 5	610 9	600 7	590 7	580 9	570 7	560 6	550 5	540 4	531
710 5	700 0	690 3	680 6	670 1	660 0	650 0	640 1	630 10	585
800 10	790 5 7	780 0	770 0	760 0	750 1	740 3	730 6 9	720 0	675
890 0	880 0	870 0	860 5	850 3 6	840 0	830 0	820 0	810 3	765
980 6	970 3	960 4 5	950 4	940 3 4	930 4	920 8	910 4	900 11	855
1070 3 4	1060 2	1050 6	1040 0	1030 0	1020 0	1010 2	1000 2	990 2	945
1160 0	1150 5 6	1140 3	1130 1	1120 0	1110 4 5	1100 0	1090 3	1080 1	1035
1250 5	1240 20 25	1230 16	1220 8 9	1210 1	1200 0	1190 3	1180 0	1170 2	1125
1340 19 20	1330 2	1320 4	1310 3	1300 2	1290 3 2	1280 6	1270 5	1260 3	1215
1430 1 3	1420 5	1410 3 4	1400 12 14	1390 2	1380 3	1370 3 5	1360 2 3	1350 7	1305
1520 0	1510 2	1500 1	1490 14 15	1480 1 2	1470 4 5	1460 2 3	1450 9 10	1440 3	1395
	1600 1	1590 0	1580 1	1570 6	1560 0	1550 1	1540 1	1530 1	1485
									1575
53 58	54 62	41 49	61 65	28 33	26 27	34 37	38 43	— 47	TOTAL STNS.

TOTAL NUMBER OF STATIONS REQUIRING FREQUENCY CHANGE: 421

388

TABLE 4

FREQUENCY CHANGE PER TABLE 2

and

NUMBER OF STATIONS INVOLVED

PRESENT 10 KHz	PROPOSED 9 KHz	FREQUENCY SHIFT KHz	NO. OF STATIONS
540	531	9	4
550	540	10	5
560	549	11	6
570	558	12	7
580	567	13	9
590	576	14	7
600	585	15	7
610	594	16	9
620	603	17	5
630	612	18	10
640	621	19	1
650	630	20	0
660	639	21	0
670	648	22	1
680	657	23	6
690	666	24	3
700	675	25	0
710	684	26	5
720	693	27	0
730	702	28	9
740	711	29	3
750	720	30	1
760	729	31	0
770	738	32	0
780	747	33	0
790	756	34	7
800	765	35	10
810	774	36	3
820	783	37	0
830	792	38	0
840	801	39	0
850	810	40	6
860	819	41	5
870	828	42	0
880	837	43	0
890	846	44	0
900	855	45	11

TABLE 4 (continued)

PRESENT 10 KHz	PROPOSED 9 KHz	FREQUENCY SHIFT KHz	NO. OF STATIONS
910	864	46	4
920	873	47	8
930	882	48	4
940	891	49	4
950	900	50	4
960	909	51	5
970	918	52	3
980	927	53	6
990	936	54	2
1000	945	55	2
1010	954	56	20
1020	963	57	0
1030	972	58	0
1040	981	59	0
1050	990	60	6
1060	999	61	2
1070	1008	62	4
1080	1017	63	1
1090	1026	64	3
1100	1035	65	0
1110	1044	66	5
1120	1053	67	0
1130	1062	68	1
1140	1071	69	3
1150	1080	70	6
1160	1089	71	0
1170	1098	72	2
1180	1107	73	0
1190	1116	74	3
1200	1125	75	0
1210	1134	76	1
1220	1143	77	9
1230	1152	78	16
1240	1161	79	25
1250	1170	80	5

TABLE 4 (continued)

PRESENT 10 KHz	PROPOSED 9 KHz	FREQUENCY SHIFT KHz	NO. OF STATIONS
1260	1179	81	3
1270	1188	82	5
1280	1197	83	6
1290	1206	84	2
1300	1215	85	2
1310	1224	86	3
1320	1233	87	4
1330	1242	88	8
1340	1251	89	20
1350	1260	90	7
1360	1269	91	3
1370	1278	92	5
1380	1287	93	3
1390	1296	94	2
1400	1305	95	14
1410	1314	96	4
1420	1323	97	5
1430	1332	98	3
1440	1341	99	3
1450	1350	100	10
1460	1359	101	3
1470	1368	102	5
1480	1377	103	2
1490	1386	104	15
1500	1395	105	1
1510	1404	106	2
1520	1413	107	0
1530	1422	108	1
1540	1431	109	1
1550	1440	110	1
1560	1449	111	0
1570	1458	112	6
1580	1467	113	1
1590	1476	114	0
1600	1485	115	1

3.3.1 Changeover Methods

The difficulties that will be encountered in changing over the standard broadcasting band to a new frequency plan are quite numerous. They can be subdivided into two general categories. The first is the technical and economic impact of the change from 10 KHz to 9 KHz spacing and will comprise the bulk of this task. The second is the question of organizing such a move and establishing the regulatory ground rules under which this move can be made.

A discussion of the regulatory aspects of the changeover is beyond the scope of this study, but it is necessary to address them since the approach taken by the regulatory bodies will affect the economics of the change to a large degree. It is also desired to address some of the practicalities of such an undertaking in order to focus attention on those areas which are not specifically included in the scope of this study, in order to bring about a general discussion and comment by interested parties.

There are a number of fairly obvious prerequisites for any such move. The first is co-ordination with other countries in Region 2. All the work would have to be done concurrently in each of the countries concerned in order to avoid interference between stations operating on both 9 KHz and 10 KHz separation plans. Well in advance of the implementation of the change, it would be necessary for the regulatory bodies involved to establish the philosophy used in judging the acceptability of designs for operation on the new frequency. There is also the question of controlling the workload involved, not only in carrying out the actual readjustment of all antenna systems in Region 2, but also in the workload of the regulatory bodies in processing the necessary documents. Before addressing the technical and economic considerations of this move, some of the above-mentioned factors should be discussed in more detail.

3.3.1 Changeover Methods (continued)

Depending on the particular frequency plan adopted, it would be necessary to set up a master timetable which would include every station's expected changeover date. All design, planning, acquisition of materials, erection of new towers, if required, and as much of the work as possible, would have to be completed before this date so that the change from the old frequency to the new could be accomplished expeditiously. There is no possibility that all the antenna systems could be adjusted to meet their protection requirements in every respect on a given night. Practically speaking, it would be necessary to accept a certain degree of interference for a period of time, until the stations have adjusted their antenna systems to operate within acceptable limits. This time limit would need to be uniform for all stations on a particular frequency, since the changeover would have to be continued in an orderly manner. This constraint would impose some difficulty on stations with extremely complex arrays which may require quite lengthy periods of time to meet their protection requirements. Whether such stations will have to shut down for a period of time while the antenna systems undergo adjustment, or be permitted to interfere to some degree for a short period of time, will depend largely on the philosophy adopted in the ground rules governing this changeover. The speed with which such a changeover can take place will, of necessity, be limited by the number of people available to work on the antenna systems, and also on the plan adopted.

It is apparent that with the plan of Table 1 there is the possibility that up to 24 frequencies can be moved at any particular time. However, if the maximum possible number of frequencies were to be moved each time, this procedure would be beyond the capability of the people available to do the work. Some lesser number of frequencies would have to be shifted at a single time depending, to some extent,

3.3.1 Changeover Methods (continued)

on the number of stations operating on the frequencies being changed. The period of time between moves of frequencies might also be variable, depending on the number of stations operating on those frequencies.

Though the scope of this study does not include working out the logistics of implementation, it is expected that planning and control will be an extremely complicated and difficult task, and one which will require great effort if the changeover is to be accomplished with minimum periods of interference and disruption of service. It is difficult to cost this activity, but rather than ignore this aspect, an allowance is made for this organizational effort in section 3.3.4 of this report.

The change from 10 KHz to 9 KHz spacing will potentially cause difficulty to some, and prolonged periods of interference to others. It is essential that the changeover be planned and paced in such a manner as to create the least amount of disruption and have the least impace on the operation of radio stations and their service to the public. The entire question of scheduling is an area which should be the subject of a detailed study co-ordinated with the other countries in Region 2.

The philosophy adopted by the regulatory bodies with regard to meeting protection requirements will have a great influence on the technical and economic implications of a move to 9 KHz spacing. [redacted] There are few advantages to the first approach other than minimum expenditure of funds. It pre-supposes the fact that antenna re-design would stop at the point where towers needed to be repositioned in order

3.3.1 Changeover Methods (continued)

to meet protections. It would mean that the plan of Table 1 would have to be adopted so that there would be a reasonably good chance of success in re-designing the arrays to prevent excessive interference in all cases. There would be the difficulty of judging whether a particular design was as good as it could be or whether it could be improved. The inability to meet previous protection requirements might result in a very difficult regulatory situation.

[redacted] It could be very much more expensive to implement depending on the frequency plan adopted. [redacted] Any shuffle of the existing frequency plan would produce a great many conflicts, requiring the formation of an arbitration body which would be empowered to pronounce on the adequacies of designs and attempt to settle other disputes arising out of the changes.

3.3.2 Technical Considerations

The primary technical consideration in the proposed frequency re-allocation is the antenna system which must be re-designed to operate on the new frequency with the objective of meeting all its previous protection requirements. For some stations all that may be required in the re-design is a confirmation that the existing array, even with the frequency change, will meet the protections and a simple, supporting supplementary proof. However, if the frequency shift is large or if the protections are very tight then the frequency change can be very costly. If one is determined to apply the principle that protections must be

3.3.2 Technical Considerations (continued)

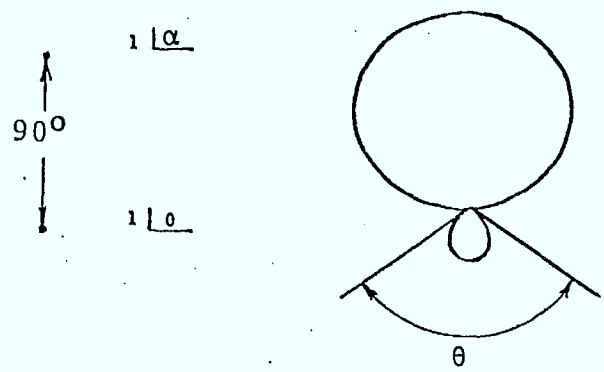
met, then situations might arise where it would appear that great sums of money would have to be spent to alleviate a theoretical interference condition that would have little practical effect. The cost/benefit relationship can become absurd if one is not careful to identify and review such situations as they occur. The arbitration committee's terms of reference should include this activity.

To assess the difficulty that a particular station would experience in making a frequency change, the antenna systems were segregated into two categories: those which are closely spaced producing only one pair of nulls or minima per tower pair, and those which are made up of widely spaced elements in order to achieve more than one pair of nulls or minima per tower pair.

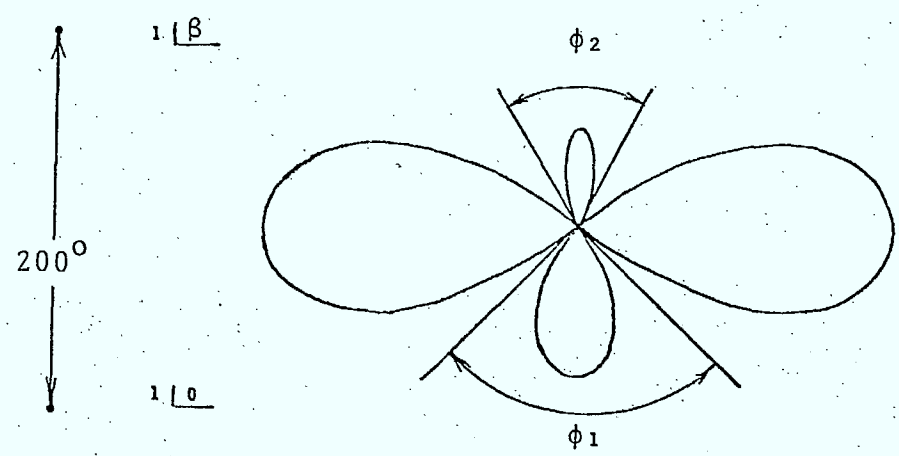
In the former type, it may be generalized that fairly large frequency changes can be tolerated by making appropriate changes to the tower phases and current ratios, to offset the effect of changed spacing which would result from a change in frequency. In the latter case, it is not possible to compensate for effective spacing changes by modifying array parameters. This situation may best be illustrated by an example. Figure 1 shows the radically different patterns which may be generated by two towers. The spacings are typically 90 degrees and 200 degrees in the two situations shown. In the first case it is seen that only one pair of nulls is generated by the two towers; however, in the second case two sets of nulls are generated. If the apparent spacing is changed by changing the frequency of operation, then the angle α in case one can be changed to keep the angle Θ constant. If the spacing changes are large, then the rate of change of field around the nulls might vary significantly and may cause difficulties in very tight situations. In case two, it is possible to maintain angle ϕ_1 or ϕ_2 constant,

FIGURE 1

CLOSE-SPACED AND WIDE-SPACED ANTENNA PATTERNS



CASE 1



CASE 2

3.3.2 Technical Considerations (continued)

but not both, by readjusting the angle β to compensate for spacing changes. Examining case two it can be seen that as the spacing decreases and ϕ_1 is kept constant by re-adjusting β, then ϕ_2 will vary. Conversely, ϕ_2 can be kept constant and ϕ_1 will vary. In any case, if there are protections in the null positions, and presumably the array is so designed that there are no unnecessary nulls, then the protections met by one set of nulls can be maintained at the expense of the protections met by the other. Though the example deals with the horizontal radiation patterns, the same problem would also be experienced at angles of elevation greater than zero.

A certain amount of compromise can be exercised if there is any margin between the allowable and the proposed radiation in the original operation. There are other techniques which can be employed, short of re-positioning towers, if protections are marginally exceeded at one or two points. However, since in most arrays the amount of latitude is fairly small by design, these various techniques might meet with limited success.

It is the above characteristic of wide-spaced systems which makes tower relocation inevitable if the frequency change becomes large enough, as would be the case with the plan of Table 2.

As the electrical height of the towers changes, so do the vertical radiation characteristics. If all the towers in a given system are equal in height, the change in the vertical radiation pattern should be small. Where unequal tower heights are used, the difference will be greater but still small since, in reality, the change in radiation results from the difference of the difference in vertical radiation characteristics at two tower heights.

3.3.2 Technical Considerations (continued)

For example, in the case of CKJD, the nighttime pattern consists of 9 towers at 1110 KHz; the centre tower is 115°, whereas the other 8 towers are 110° high. This arrangement was chosen to develop a null at 135° azimuth and 55° elevation. With equal tower heights the radiation would be in the order of 6 mV/m. It can be seen by comparing the appended pattern printouts for 1110 KHz and 1044 KHz, that the null is well maintained.

One concludes that vertical radiation patterns which depend on unequal tower heights would not be greatly compromised in a moderate frequency shift. A far greater influence on the vertical pattern will be exerted by the type of array, that is, whether it is close or wide-spaced.

It should be noted that there are several other technical factors which must be addressed besides the theoretical antenna pattern re-design. Foremost among these is the behaviour of the antenna phasing equipment. As the frequency changes, the delay through various networks and transmission lines will also change. The amount of change in transmission line delay will be proportional to frequency in the same manner that the electrical spacing between towers changes in proportion to frequency.

The ability of phasing networks to compensate for changes in transmission line lengths, as well as other design changes in the antenna system, is largely a factor of how long the lines are and the degree of change in the tower currents. In a wide-spaced situation, where spacings may be of the order of 400° to 600° or more, the actual length of transmission lines may also be equally long depending on where the transmitter building location is and where the power division takes place. It is conceivable that in a situation like this, the change in electrical length of

3.3.2 Technical Considerations (continued)

the line resulting from a change in frequency will be in excess of the networks' ability to compensate. In such wide-spaced situations involving a large frequency change, the towers would need to be repositioned. This would necessitate the construction of new phasing equipment so that the problem of network adjustment range would tend to solve itself. In other instances where the spacing is not as great or where the frequency shift is not as large, the adjustment range and voltage and current safety margins of networks should be capable of accomodating the changes.

Whereas the phase shift through a transmission line is linear with frequency, the delay through a network may not vary in such a linear fashion, because it is common practice to use a coil and capacitor in series to achieve the equivalent of a variable capacitor. If some previous adjustment of the array resulted in a near resonance condition, the change in value of such a combination may be quite dramatic with a small change in frequency. For this reason, it is impossible to predict what changes in the pattern will occur with a change of input frequency. [redacted]

There is also the question of variation in operating impedances with large frequency shifts. It is recognized that some antenna designs are more sensitive to changes in spacing and phasing, and it is conceivable that there would be cases where even small frequency variations could result in fairly large percentage changes in operating impedances. However, this kind of situation is very difficult to predict without a detailed study of each individual case. Since such difficulties are expected to arise in relatively few cases, no attempt was made in the costing program to recognize such situations and provide for them. However, this should not

3.3.2 Technical Considerations (continued)

lead to large errors in costing since, in most cases, the replacement of a coil or a capacitor would solve the problem.

The question of antenna efficiency, as it relates to apparent changes in ground system length, was investigated. A paper written by Brown, Lewis and Epstein, (Ground System as a Factor in Antenna Efficiency, Proc. IRE, June, 1937) presents the results of experimental work on short antenna efficiency as it relates to ground system configuration. Though this paper does not treat in detail the effects of different ground system lengths on antenna efficiency for a given frequency, there is some information in this regard. Figure 34 of the original paper contains a graph of field strength vs. antenna height and three curves relating these variables for ground system lengths of 135', 90' and 45', which corresponds to .412 λ, .274 λ, and .137 λ. In the case of a tower whose height was 75°, a plot of antenna efficiency vs. ground system length was made which is shown in Figure 2. It was assumed that the curve is a smooth one. From this graph one can derive the difference in antenna efficiency as the ground system length is changed. For a ground system whose length is .412 λ, it can be seen that if the length is reduced by about 7%, the efficiency will drop by about 1%.

Changes in operating frequency will also affect tower heights in a manner similar to the changes in ground system lengths. Where the new frequency is lower than the original operating frequency, the electrical length of the towers will decrease. This will result in a decrease in the horizontal RMS value of a particular pattern.

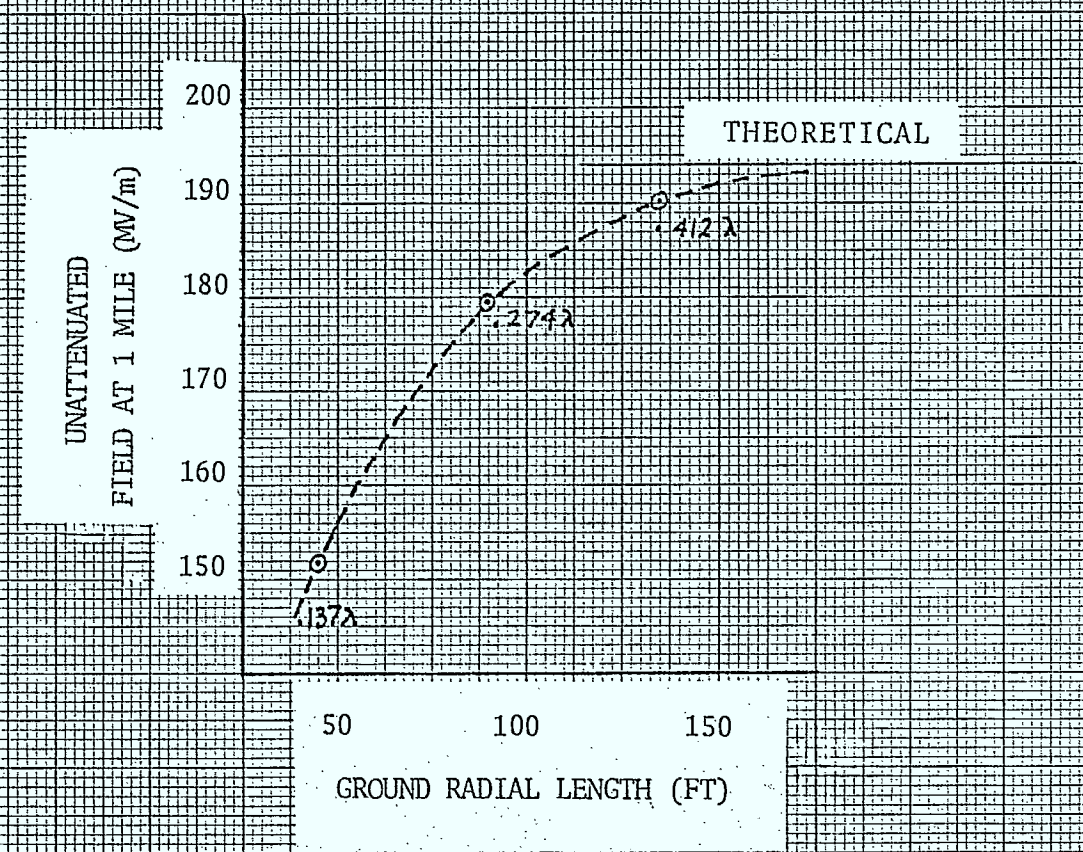
In the case of a 90° tower undergoing a worst case frequency shift of 7%, the RMS field would go from 188 millivolts to 190.5 millivolts per meter. This is a change of only 1.3 percent.

FIGURE 2

ANTENNA EFFICIENCY

VS

GROUND RADIAL LENGTH



46 1473
KEUFFEL & ESSER CO. MADE IN U.S.A.

3.3.2 Technical Considerations (continued)

On most antenna sites there would be the possibility of extending the ground system in certain areas to compensate for the effectively smaller ground system. There is also the possibility of installing ground rods at the ends of the radials to increase their efficiency, though the improvement may not warrant the costs. Thus, for apparent reductions in tower height and ground system lengths of 7%, the reductions in antenna efficiencies are 1.3% and 1%, respectively. The combined effect of reduced ground system and reduced antenna height will result in a 2.3% reduction in RMS field.

In summary, in those cases where the frequency shift is negative and there is no space around the antenna to extend the ground system, little would be lost by simply leaving the ground system exactly as it was before.

To assess the effect of a change in frequency on the propagation losses, a graph was drawn relating field strength vs. frequency at conductivity 8 mmho/m at a distance of 80 miles and 200 miles. This graph, shown in Figure 3, was constructed by taking the mid-frequency of the family of curves contained in NARBA relating field strength vs.distance and plotting it against the field strength which would result at a distance of 80 miles and again at 200 miles for a conductivity of 8 mmho/m. It can be seen by examining these curves that the effects on field strength at these distances with changes in frequency are far greater than the effects on antenna efficiencies resulting from changes in antenna height and ground system lengths. For example, inspecting the 80 mile curve, it will be found that the change around 1 MHz is a 2.5 to 1 ratio between percent change in frequency and percent change in received field strength. That is to say, if the frequency changes by 1% then the

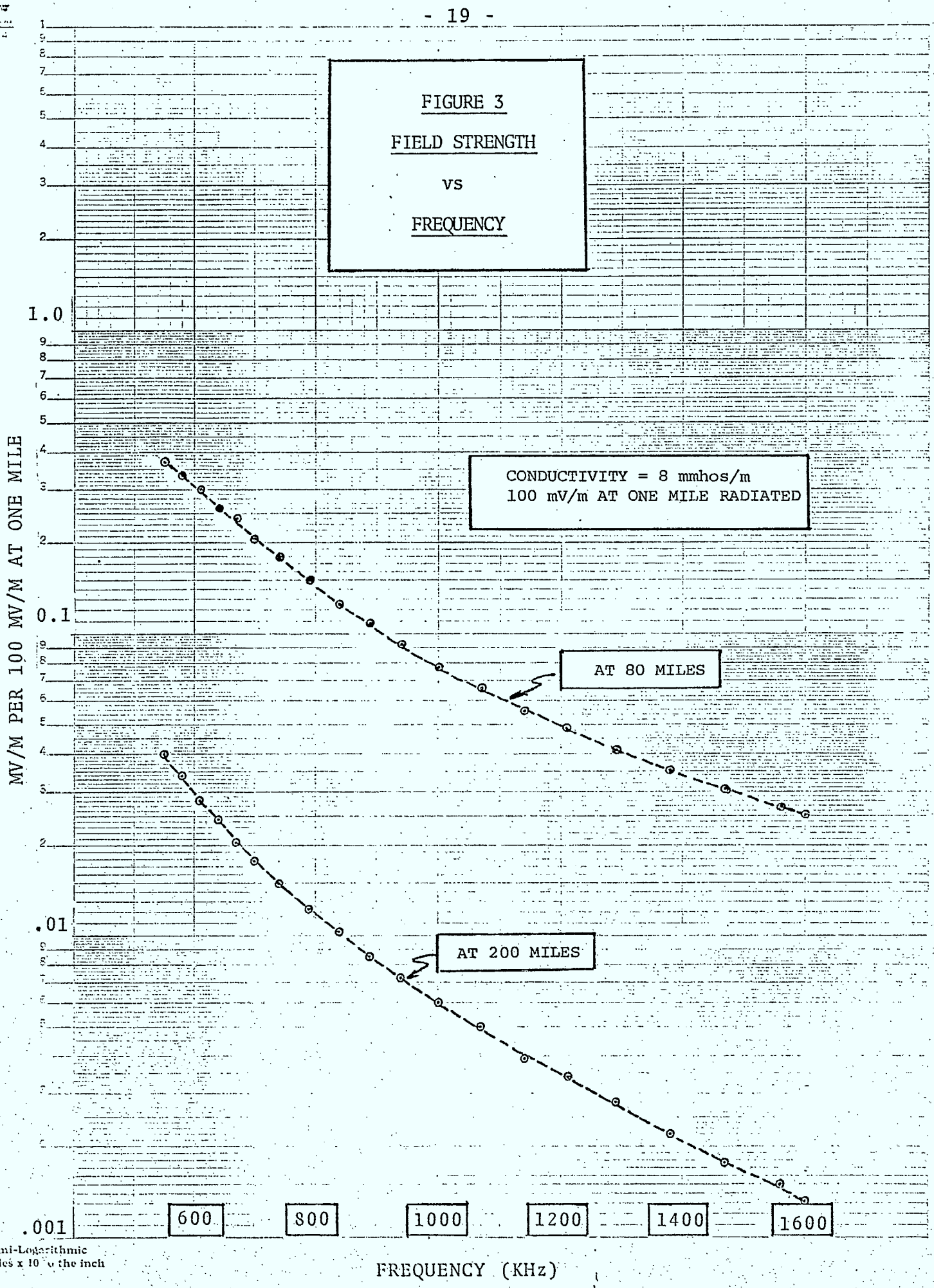


FIGURE 3
FIELD STRENGTH
VS
FREQUENCY
CONDUCTIVITY = 8 mmhos/m
100 mV/m AT ONE MILE RADIATED
AT 80 MILES
AT 200 MILES
MV/M PER 100 MV/M AT ONE MILE
1.0
0.1
.01
.001
600
800
1000
1200
1400
1600
FREQUENCY (KHz)
Semi-Logarithmic
4 Cycles x 10 to the inch

3.3.2 Technical Considerations (continued)

field strength will change by 2.5%. [redacted]

[redacted]

For example, assume that a station on 1000 KHz is operating such that its 0.5 mV/m contour extends 80 miles and that it is protected by another station which is 200 miles distant from th 0.5 mV/m contour of the first station and whose signal is 0.025 mV/m at the protected contour. Examination of the graph in Figure 3 will reveal that the ratio of percentage field change to percentage frequency change at 200 miles is 3.3. It was stated above that the slope at 80 miles is 2.5. It is clear that, even at the original 0.5 mV/m contour, as the frequency of the two stations goes down, the field strength of the interfering station will go up faster than that of the protected station. Thus, even if the patterns of both stations were to be identical at both frequencies, there would result an interference condition which would be a function of the percentage change in frequency.

[redacted]

One way around this difficulty might be to define the protections which have to be met on the new frequency as being identical to the protections defined in the station's engineering brief for its original frequency.

3.3.2 Technical Considerations (continued)

There is an aspect of the changeover which has not been discussed yet but which will play a significant role in determining the cost of the changeover. This is the question of possible interference for a limited period in order to effect the frequency change in a minimum of time and overall expense and maintain a certain degree of continuity of service.

An example of such a situation would be a station which had to replace several towers in its array. Because of the relatively small distance involved between the present and required positions of the towers, it may be necessary to dismantle them before erecting new ones. Such a situation would require some sort of interim operation for perhaps several weeks, while this work is carried out and the required pattern was implemented on the new frequency. This example is perhaps a bit extreme. A far more common occurrence would involve arrays requiring lengthy proving-in periods simply due to the tightness of the protections. The details of the kind of operation which would be acceptable during such an interim period would have to be worked out and approved in advance in order to prevent abuses. However, such temporary operation would go a long way to easing the transition for those stations which have very critical arrays or which require a great deal of civil works to accomplish the changeover.

[redacted]

3.3.2 Technical Considerations (continued)

[redacted]

[redacted]

3.3.3 Economic Impact

The economic impact is considered to consist of the following components:

a) Re-design cost to move to new frequency
b) Implementation costs - proof of performance
   - towers
   - transmitter retuning costs
c) Peripheral cost such as lost advertising revenue during implementation.

The approach taken was to select a number of stations representative of the stations operating in Canada and, based on the analysis of these stations, develop a number of formulas which could be used in a computer program to generate cost figures for all stations.

In order to develop a basis for the re-design cost formula the daytime and nighttime arrays of the following representative stations were analyzed:

CFUN, CKJD, CHLO, CJJD, CFTR, CJRS and CJFX.

3.3.3 Economic Impact (continued)

The re-design consisted basically of the breaking down of the array into its component parts, making corrections to allow for the changed tower spacing and re-synthesizing the antenna pattern. Admittedly, this approach yields a first-order correction. [redacted] The pattern printouts contained in this report show what correlation can be achieved even by this first-order correction process.

The patterns were corrected for three cases. The first two are for plus and minus 4 KHz from the original operating frequency. The actual shift called for by Table 1 for the stations involved is usually less than this, but since the study is to determine the feasibility of implementation rather than an actual re-design for each station, it was decided to evaluate the maximum possible shift. In the third case, the patterns were re-designed for the actual frequency shift involved in Table 2.

Computer printouts of the original, as well as the re-designed patterns, are tabulated side by side for ease of comparison. It appears that there would be little trouble in readjusting these stations to meet the original protections for the 4 KHz shifts; however, the plan of Table 2, which involves a much larger shift, would likely require repositioning of towers in order to meet protections. This is true in the situation where an array incorporates a wide-spaced tower pair exhibiting two pairs of nulls rather than one. This type of array, among others, is used by CJJD, CKJD and CFTR nighttime arrays. CJJD's daytime array, though an addition form, would also

3.3.3 Economic Impact (continued)

experience the inability to meet protections because of widely spaced elements, if the plan in Table 2 were used.

Before presenting the costing formulas, some of the general conditions which apply to the costing exercise should be discussed.

[redacted] For greater frequency shifts, towers will likely need to be repositioned in certain cases and the criteria regarding this are discussed in section 3.3.3 (c).

The costs generated in the computer program are based on the premise that each station will be made to operate within the limits established on its previous frequency and detailed in its original engineering brief.

In carrying out a supplementary proof of performance, it is customary for the station to provide manpower to assist in the work, arrange for transportation, lodging, and so on, in an effort to keep the billings to a minimum. It was assumed in the costing that such assistance would not, as a general rule, be forthcoming since there would be no advantage to the station to do so. In carrying out the costing, no effort was made to identify and treat separately, those isolated cases which might be much more difficult to change over than the formulas predict. It is hoped that this situation will be offset by others in which conversion is less costly than predicted by the formulas, and will thus average out.

3.3.3 Economic Impact (continued)

It is assumed that no real estate transactions will be involved, that is, all changes can be implemented on the existing sites. No allowances are made, specifically, for such things as re-radiation problems since we are dealing in each case with an existing station which is presumed to have successfully dealt with its environmental difficulties and which difficulties are not expected to change materially on the new frequency. However, some allowance is made for changeovers of greater than average difficulty by a 20% contingency which would cover items such as extra time involved in a supplementary proof to retune the traps on hydro towers.

a) Re-design Cost - The cost to re-design a particular antenna for operation on its new frequency is given by the following expression:

$$385 + 580N^{0.4} + (100N^{1.4})(DFP/7.2)^{0.5}$$

where N = number of towers in the array
DFP = frequency change in percent.

The re-design cost is primarily a function of the number of towers. This cost is considered to be independent of tower height, spacings, current ratios etc. since these are all considerations which will have very little influence on how difficult it is to re-design the antenna to meet the original protection requirements. The three parts of this formula are: the cost to assemble the necessary information to proceed with the design, the cost associated with the preparation of the documents, and finally the cost of development of a new pattern as modelled from representative samples. In generating this formula it was found that the number of towers in an array bears a very direct relationship to the severity of protections and consequently to the effort required to re-design it.

3.3.3 Economic Impact (continued)

b) Proof of Performance Cost - This cost is given by the following expression:

$$F_{1A} + (F_{1B})(F_2)(F_3)(F_4)(F_5)$$

where $F_{1A} = 600\ (1 + N/2)$

$$F_{1B} = 600\ N^{1.8} + 145\ (N/2 + N^{1.8})$$

$$F_2 = \frac{1+5000/SPM^2}{2} + 0.19$$

$$F_3 = \frac{1+HA^2/10000}{2} + 0.09$$

$$F4 = (DFP/7.2)^{0.33}$$

$$F_5 = \text{greatest value of} \left[\frac{\left(\frac{FRRnm}{SPnm/90}\right)}{2}\right]^{0.25}$$

and where N = number of towers in the array

HA = average tower height

SPM = minimum spacing between any two towers in an array

SPnm = spacing between towers n and m where n = 1 to (N-1) and m = 2 to N

FRRnm - ratio of field ratios of towers n and m where n = 1 to (N-1) and m = 2 to N

The factor F_{1A} covers those aspects of the job which are relatively independent of the array type, such as impedance measurements, selection of ratio points and network setup, etc. F_{1B} covers the actual adjustment of the array, which is very much affected by such factors as tower spacings, heights and field ratios. The formulas described by F_{1A} and F_{1B} were derived by fitting, as closely as possible, estimates of time to do a proof of performance on various representative antenna systems.

3.3.3 Economic Impact (continued)

b) Proof of Performance Cost (continued)

These times include preparation for the field work, the field work itself, radial measurements and preparation of the resulting documents. This is based on arrays of average difficulty, that is for tower heights and spacings of 90 degrees, and maximum current ratios between adjacent towers of 2 to 1. The other factors shown as F_2, F_3, F_4, and F_5 are all functions which modify the F_{1B} factor of the basic cost. If the tower spacing differs from 90 degrees the function will produce a value which is greater than or less than one, depending on whether the spacing becomes less or greater than 90 degrees. Similarly, the other functions produce values which are greater than or less than one, depending on the degree of departure from the normal values assumed in F_{1A} and F_{1B}.

c) New Tower Cost - The two formulas used to estimate the cost of new towers and the associated work were as follows:

- for towers less than or equal to 350 feet:

$$1.33(13550e^{.003HA}) + (11500 + 1000(Pkw/10)^{0.5})$$

- for towers greater than 350 feet but less than 500 feet:

$$1.33(3628e^{.006667HA}) + (11500 + 1000(Pkw/10)^{0.5})$$

where e = base of the natural logarithm
= 2.718
HA = average tower height in the antenna system
Pkw = average daytime and nighttime power level.

The configuration of array plays a large role in determining whether it will be necessary to shift the position of towers in accomplishing a particular change

3.3.3 Economic Impact (continued)

c) New Tower Cost (continued)

in frequency. Those designs which incorporate wide-spaced tower pairs are most likely to require moving towers. It was therefore undertaken to look at the layout of towers in every directional antenna system in Canada and to make a judgement as to what number would have to be re-positioned, if the frequency shift exceeded a certain value. The basis for determining whether a station was or was not a candidate for tower re-location was a spacing of 135 degrees between adjacent towers. It was assumed that if the spacing exceeded this value, the design was such that more than one pair of nulls were developed per tower pair or that one pair of nulls plus an additional minima was developed by a tower pair. This would apply in both the multiplicative as well as additive array forms. The list of stations which were judged to be of the wide-spaced variety are incorporated into the data base and are used to determine the cost of tower re-locations if the frequency shift for that particular station warrants it.

[redacted] The actual frequency shift which can be tolerated before towers need to be moved will be different in every case. For instance, the arrays of CFTR, CJJD and CKJD, all very wide-spaced systems, will exceed their protections with a frequency shift of less than 20 KHz. On the other hand, stations with close spacings will tolerate greater frequency increments. While refinement of the decision process as to whether to price in new towers or not would mean better accuracy in individual cases, this increased accuracy was not considered worthwhile as the only way to make a

3.3.3 Economic Impact (continued)

c) New Tower Cost (continued)

meaningful decision would be to analyse each individual antenna system with regard to its protection requirements, frequency shift, and the actual antenna design. This would be beyond the scope of this study. In addition, though this process would give much better accuracy in individual cases, it is not believed that it would change the final figure significantly. For this reason, the figure of 20 KHz was applied overall.

Estimates were obtained for average tower costs in southern Ontario. Towers in the coastal areas of the country would be more expensive; whereas, towers in the midwestern part of the country might be less expensive. The following costs were used to derive the tower cost formulas:

TOWER HEIGHT	COST
200'	$18,250
250'	22,100
300'	25,450
350'	28,750
450'	56,000

The cost involved in moving a tower is composed not only of cost of the tower itself but also the cost of dismantling the old tower, the cost to make changes in the ground system, and to provide new antenna tuning units. This represents the second part of the tower costing formula. The cost of supplying a new tower was increased by 33% in the program for dismantling the old tower.

d) Transmitter Retuning Costs

This component of the changeover costs was arrived at after consultation with representatives of two major transmitter manufacturers. It was decided that where

3.3.3 Economic Impact (continued)

d) Transmitter Retuning Costs (continued)

minor transmitter retuning was required it could be achieved for about $585 for a 10 KW transmitter. If the frequency shift were greater than 55 KHz an additional factor would be added for frequency determining component parts. Thus for a frequency shift less than 55 KHz the cost is $585.

For a frequency shift greater than 55 KHz the cost is given by the following expression:

$$585 + 250\ (Pmax/10000)^{0.5}$$

where Pmax is the maximum of the daytime or nighttime power level.

e) Lost Revenue - Since the intent of this exercise is to establish the overall economic impact, the cost of lost advertising revenue during the time that a proof of performance would be conducted at a particular station was included. This factor is composed partly of the formula which establishes the cost of the proof of performance which ties in the number of days likely to be spent doing the proof. This factor is as follows:

$$324(N/2 + N^{1.8})(F_2)(F_3)(F_4)(F_5)$$

It was found by examining the rate cards of several large market stations that their average advertising cost between the hours of midnight and 6 AM were $13.50 per minute. Assuming 4 minutes of advertising per hour this produces a cost of $324. per night. It is conceded that the figures used are approximations at best. There is the possibility that if commercials are not run at night, they can be run during daytime hours as long as the maximums allowed per week and per hour are not exceeded.

3.3.3 Economic Impact (continued)

e) Lost Revenue (continued)

Stations offer their advertisers package deals where the cost per minute is more difficult to determine so that the average per-minute figure used may be considered inappropriate. Lost revenue for large-market stations will tend to be much higher than for small-market stations. In fact, some stations cease broadcasting in the 1 AM to 5 AM period and therefore may not experience any loss of this nature at all.

There are also many other hidden costs such as the effect of nighttime audience loss during a lengthy supplementary proof of performance. This will affect newer stations in large markets the most since their antenna system will be more complicated than old stations which were established when protection requirements may have been less stringent. Thus, in that proof-times will vary, so will the effect on the nighttime and, to a lesser degree, the daytime audience.

The impact on a station of the loss of air time, even overnight, may mean much more than the loss of commercial time involved. However, this factor is not included.

The cost to re-educate the public as to the station's new location on the dial will vary for different stations. For instance, if the primary mode of advertising is billboards the cost to change them all may be considerably higher than if newspaper ads are used.

[redacted]

3.3.4 Application of Costing Formulas

The formulas presented in their essential form above, are used in a computer program which substitutes the appropriate values for each Standard Broadcasting Station in Canada and develops the costs based on the frequency plan contained in a DATA statement. The costing of the various cases, and cost accumulation, is done in subroutines while the main program contains the logic concerning selection of present and proposed frequencies, and appropriate subroutines to cost the various combinations of operating modes. A flow diagram as well as a listing of the program is included in this report. The program was executed for the frequency plans of Table 1 and Table 2 and the output is attached.

The costs for the frequency plan of Table 1 are estimated to be as follows:

Total cost given by program execution	$2,609,550
20% contingency	521,910
20% logistics and administration	626,292
Total	$3,757,752

The cost figures for the frequency plan of Table 2 are estimated to be as follows:

Total cost given by program execution	$11,193,114
20% contingency	2,238,623
20% logistics and administration	2,686,347
Total	$16,118,084

All costs are in 1979 dollars and are expected to increase over time.

3.4 TASK 4 - Study the effect of reduced channel separation on reception due to adjacent channel interference taking into account:

a) existing receiver performance
b) potential for improved receiver performance.

3.4.1 Existing Receiver Performance

a) Receiver Data

To obtain data on AM receivers that are being marketed at present, a questionnaire was compiled and sent out to 20 receiver manufacturers. A copy of the questionnaire is shown overleaf. The manufacturers include those making fixed, portable and automobile AM radios. The intent of the questionnaire was to gather technical data which is not normally published by the manufacturers. The process is complicated by the fact that very few AM radios are manufactured in Canada. Manufacturing of AM radios in Canada appears to be restricted to automobile radios which are assembled here from imported parts. Most other AM radios are imported in whole from Japan or other Far East countries.

The response from the receiver manufacturers to the questionnaire was disappointing. Only 30% of the companies polled responded. Many claimed that the questionnaire was not received while others refused to provide information on the grounds that it was proprietary. The responses from the manufacturers who did cooperate provided information that was helpful, although no questionnaire was completed in full. The poor response to the questionnaire is attributed to three salient factors:

i) Very few radio receivers sold in Canada are manufactured here. The sales organizations have minimal technical support and are often incapable of answering technical questions.

AM RADIO SPECIFICATION QUESTIONNAIRE

RESPONDENT - _____

QUESTION	RESPONSE
1. Type of Radio	_____
2. Primary power	_____ VAC _____ VDC
3. Antenna Input impedance or type	_____
4. Sensitivity	uV for _____dBS/N uV/metre for _____dB/SN MODULATION CONDITIONS _____% at_____HZ
5. Selectivity	_____KHz BW at -6dB _____KHz BW at -60dB _____KHz BW at -_____dB _____KHz BW at -_____dB
6. Number of IF tuned circuits	_____ coupled _____ single
7. Special filters to improve selectivity	Yes _____ No _____ If Yes - Type_____ Number _____ Response - ____KHz BW at____dB ____KHz BW at____dB

AM RADIO SPECIFICATION QUESTIONNAIRE (page 2)

8. Post detection Filter to suppress inter-carrier beats.

Yes _____

No _____

9. Image rejection

_____dB at_____ KHz

_____dB at_____ KHz

_____dB at_____ KHz

10. IF rejection

I.F. KHz

_____dB at_____ KHz

_____dB at_____ KHz

_____dB at_____ KHz

11. Cross modulation

_____

_____

_____

_____

_____

12. Radio frequency Amplification

Yes_____

No _____

13. Local Oscillator Radiation Either into antenna image termination or field strength at a specified distance

_____uV at _____KHz

_____uV at _____KHz

OR

_____uV/m at_____KHz at_____M

_____uV/m at_____KHz at_____M

_____uV/m at_____KHz at_____M

3.4.1 Existing Receiver Performance (continued)

a) Receiver Data (continued)

ii) Due mainly to economic constraints, the performance of most AM radios being marketed is not all that good and manufacturers are reluctant to publish performance data which would verify this.

iii) Again, due to economic constraints, quality control in the manufacture of the radio product is lax and consistency of performance is poor. [redacted] This is a further reason for not wanting to publish representative product specifications.

The data received from questionnaire replies, together with specification information extracted from some equipment instruction books and some test results contained in a US report on AM stereo, was sufficient to permit the characterization of a typical AM radio in use and being marketed at the present moment.

b) Receiver Characterization - Typical Receiver Design

The typical receiver design used for most domestic applications consists of a self-oscillating converter which is coupled to a ferrite rod antenna by a single tuned circuit. The converter is followed by a single intermediate frequency stage of amplification followed by a diode detector. The coupling between the converter and the IF stage and between the IF stage and the detector is by double-tuned LC-coupled circuits. These coupled circuits provide the principal selectivity of the radio. The RF tuning circuits provide very little additional attenuation to adjacent channel signals. Automatic gain control is applied to both the converter and the intermediate frequency stage, and an AGC range of 50 to 60 dB is typical.

3.4.1 Existing Receiver Performance (continued)

b) Receiver Characterization - Typical Receiver Design (con't)

Automobile radios have a similar circuit format but in all cases, except very low cost receivers, the radio is equipped with a stage of RF amplification preceeding the converter. This stage is necessary to provide improved image performance due to the low IF used (262.5 KHz) and to reduce local oscillator radiation.

The selectivity of the radio is largely determined by the passband of the 2 IF transformers and the shape factor (6-60 dB bandwidth) of the response curve that can be achieved with practical IF transformers having a working "Q" of between 50 and 100 and a coupling factor (QK) of unity is between 4 and 5. Thus, if the 6 dB bandwidth is 6 to 7 KHz, for reasonable AM fidelity, then the 60 dB bandwidth is betwen 25 and 30 KHz. The bandwidth curves drawn for a sample of receivers is shown in Figure 4. The curves are drawn to show the narrowest, widest and typical responses. The narrowest response appears to be encountered in small, low cost receivers and it is felt that the peaky response is due, in part, to a certain amount of regeneration which takes place because of the lack of shielding and the compactness of the radio circuit board. The widest response was encountered in a high-fidelity console radio and may have been an attempt by the manufacturer to improve the overall fidelity of the AM section of the radio. The bandwidth of a typical receiver is about 6.5 KHz at the 6 dB points and about 26 KHz at the 60 dB points. The response at the adjacent channel is typically between 30 and 40 dB down relative to the desired carrier.

The greatest selectivity for the typical AM radio is that which will be achieved at low signal levels. At high

KEUFFEL & ESSER CO. MADE IN U.S.A.
40 0782

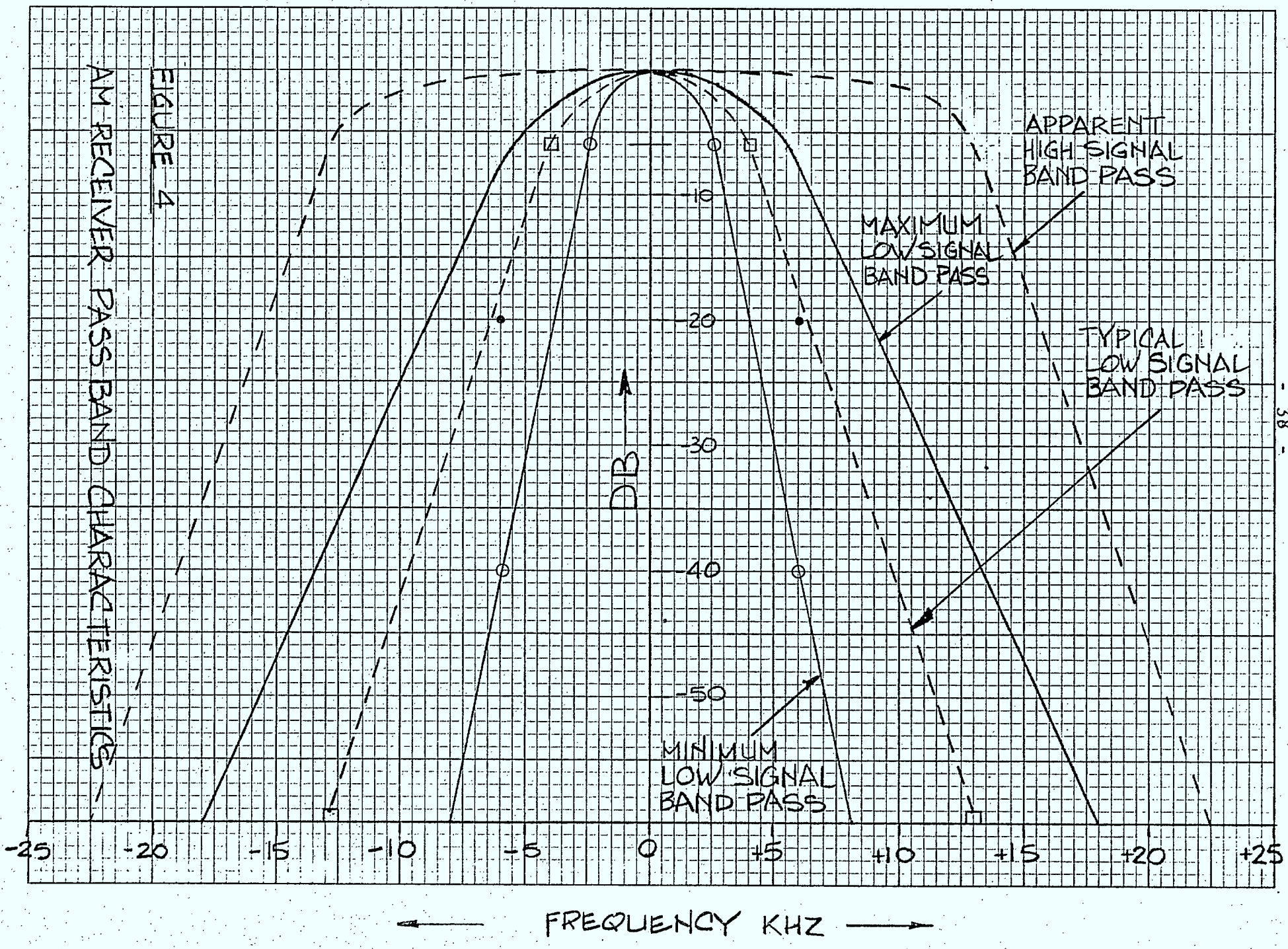


FIGURE 4

AM RECEIVER PASS BAND CHARACTERISTICS

3.4.1 Existing Receiver Performance (continued)

b) Receiver Characterization - Typical Receiver Design (con't)

signal levels the apparent bandwidth is considerably wider due to the AGC action in the radio. Typically, the AGC figure of merit is between 50 and 60 (figure of merit is defined as the change in input signal level giving a 1 dB change in audio output.) This means that the typical AM radio has between 50 and 60 dB of excess gain at high signal levels. This excess gain compensates for the selectivity attenuation such that a high input signal will produce an audio output even though the radio is de-tuned by an amount which can be 2 to 3 times the low signal selectivity bandwidth. This increase in apparent bandwidth at high signal levels tends to reduce the ability of the typical AM radio to receive low level signals when there is a high level signal present on an adjacent channel.

c) Effect of Channel Separation Change on Adjacent Channel Interference

[redacted]

At the 0.5 mV/m contour a typical AM radio will provide a signal-to-noise ratio of better than 20 dB, full rated power output and will be slightly (6-10 dB) into AGC. While, with a signal strength of 0.5 mV/m the typical radio is not being operated at maximum sensitivity, it is felt that 0.5 mV/m represents the maximum with regard to listener tolerance. At signal strengths below 0.5 mV/m the increased noise (atmospheric, precipitation and man-made) requires increased listener concentration which will only be forthcoming if the situation demands, ie. weather reports, regional emergencies etc. It is therefore

3.4.1 Existing Receiver Performance (continued)

c) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

intended to analyze the effect of channel separation with the typical receiver performance for two adjacent channel signals each having a field strength of 0.5 mV/m. [redacted] However, depending on the audio spectral content of the adjacent channel's modulation there may be components which would fall into the passband of the receiver and would be detected as noise in the desired channel by beating with the desired carrier. Although inverted, this noise has some semblance of coherence and can be objectionable.

As part of this study, measurements were made to determine the spectral distribution of types of AM transmitters in common use. This information, together with the defined passband of a typical AM receiver, was used to determine the effect of the change in carrier separation from 10 to 9 KHz on the interference from first adjacent stations. To arrive at a numerical value for the possible increase in interference, it was necessary to conduct a numerical integration of the received signal in terms of power for 10 KHz and 9 KHz spacing. Three cases were considered, each case representing different types of program material. The difference in ratios between the 10 and 9 KHz cases, in decibels, is the increase in interference that would be expected as a result of the spacing change.

It should be noted that the spectrum analyser output is the result of many successive sweeps during a program period. The spectrum analyser had the capability of digitally storing the sampled spectral information. Further, the instrument was used in the "MAX HOLD" mode. In this mode of operation, if in a particular sweep the level of the

3.4.1 Existing Receiver Performance (continued)

b) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

new sample of information exceeds the level stored from the previous sweep, then the new level would be stored and displayed. It is obvious that instantaneous spectral components will not be at the maximum value recorded by the spectrum analyser for all spectral components. Although this mode of operation gives a good representation of the envelope of the spectral content, it also gives the incorrect impression that the average power in the sidebands is greater than it actually is.

By integrating the received power "on-tune" and comparing it to the power received when detuned by 10 KHz and 9 KHz, one can obtain the ratio of desired-to-undesired signals which, in this case, works out to be in the neighbourhood of 16 dB. The integration process is detailed in Tables 5, 6 and 7. The method used was as follows:

i) The amplitude of the emitted spectrum for Figures 5, 6 and 7 was read at 1 KHz intervals and tabulated in column 2 of Tables 5, 6 and 7 respectively.

ii) The bandpass characteristic of the typical receiver (see Figure 4) was tabulated in column 3 for the "on-tune" condition.

iii) The level of the emitted spectrum in 1 KHz increments reaching the detector of the receiver was tabulated in column 4 of Tables 5, 6 and 7. This level is the sum of the levels in columns 2 and 3 and represents the transmitter emitted spectrum modified by the passband of the receiver.

iv) The levels in column 4 were converted to a power and normalized assuming a carrier

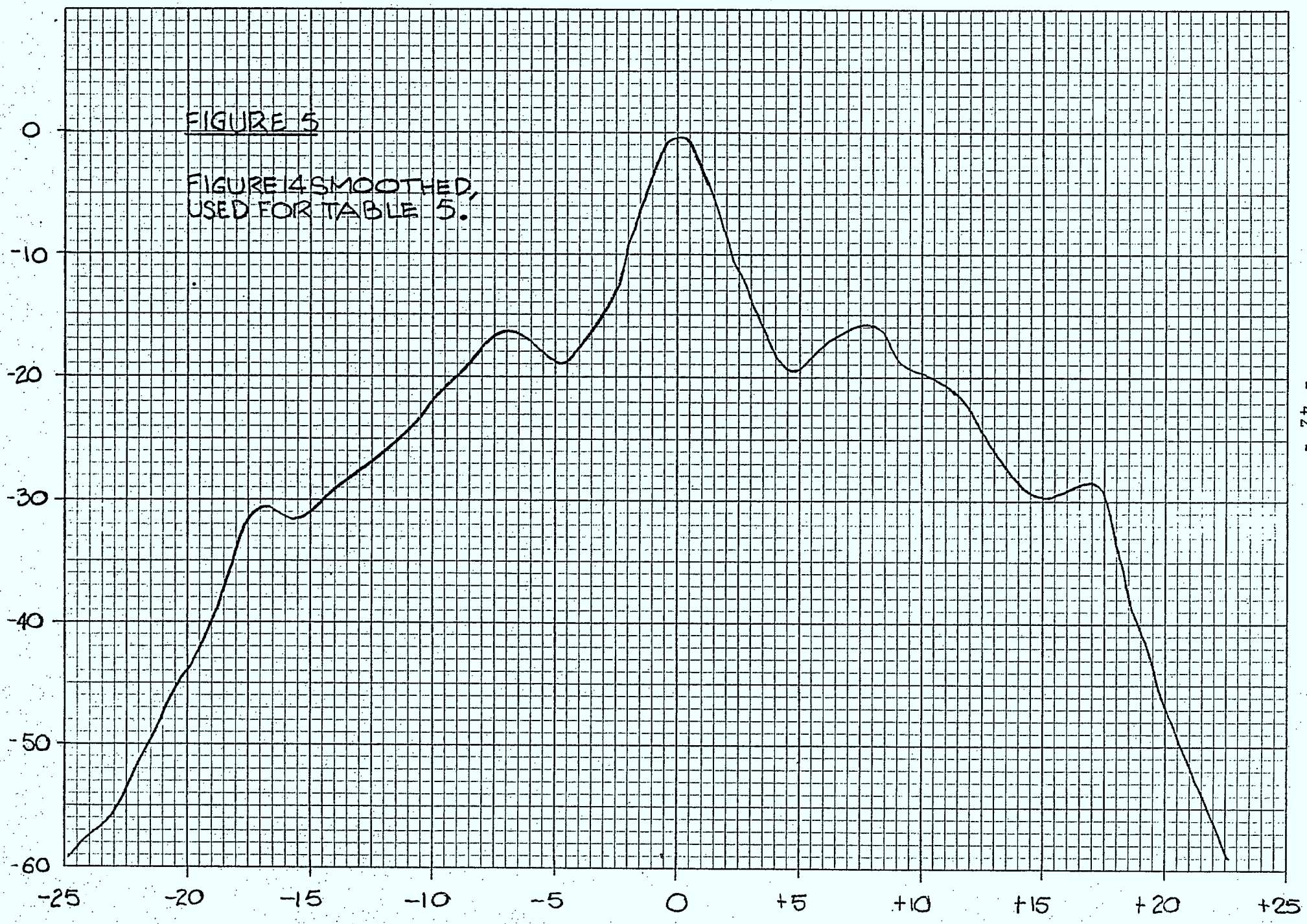


FIGURE 5
FIGURE 14 SMOOTHED, USED FOR TABLE 5.
0
-10
-20
-30
-40
-50
-60
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25

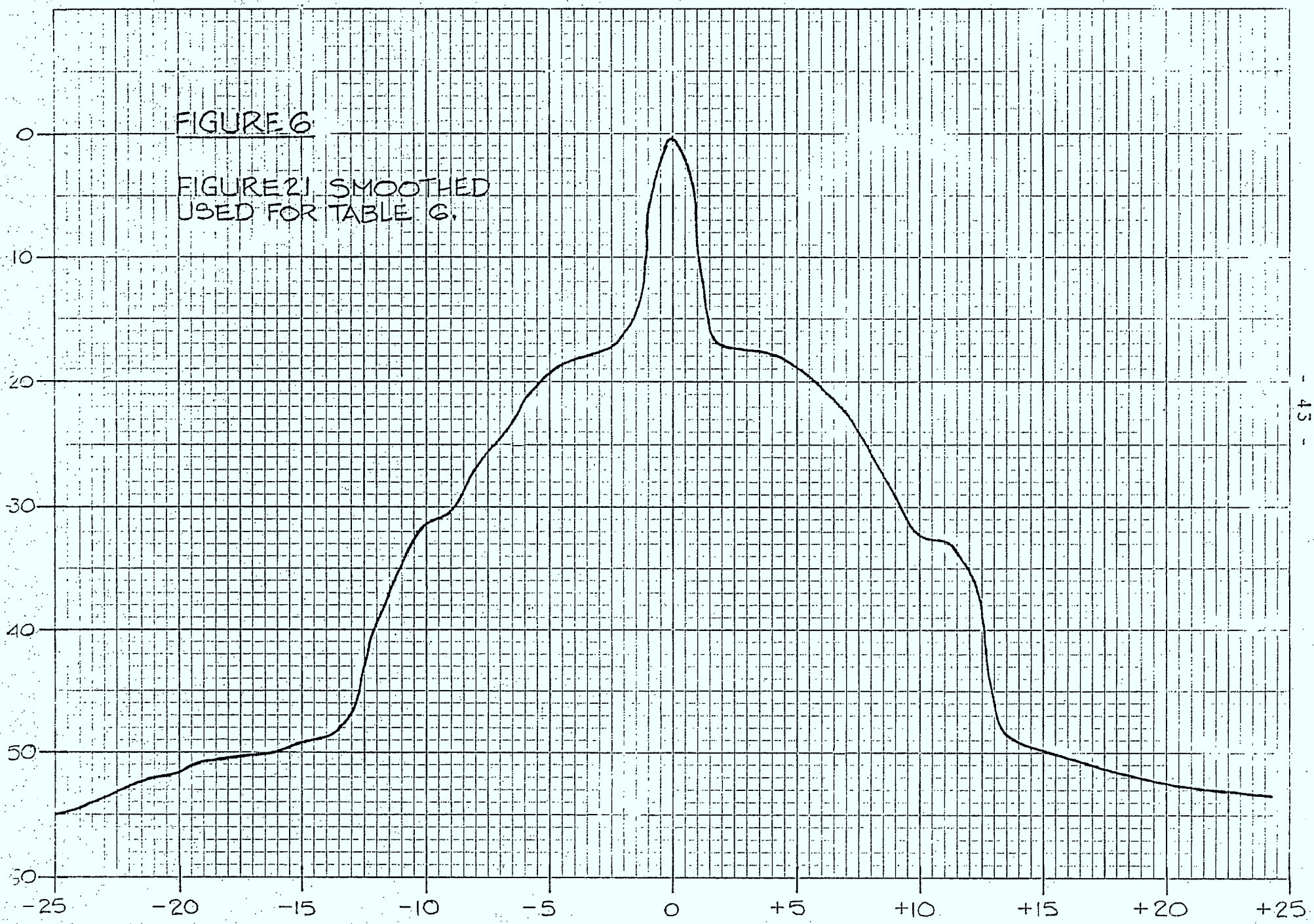


FIGURE 6
FIGURE 21 SMOOTHED
USED FOR TABLE 6.
0
10
20
30
40
50
60
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25

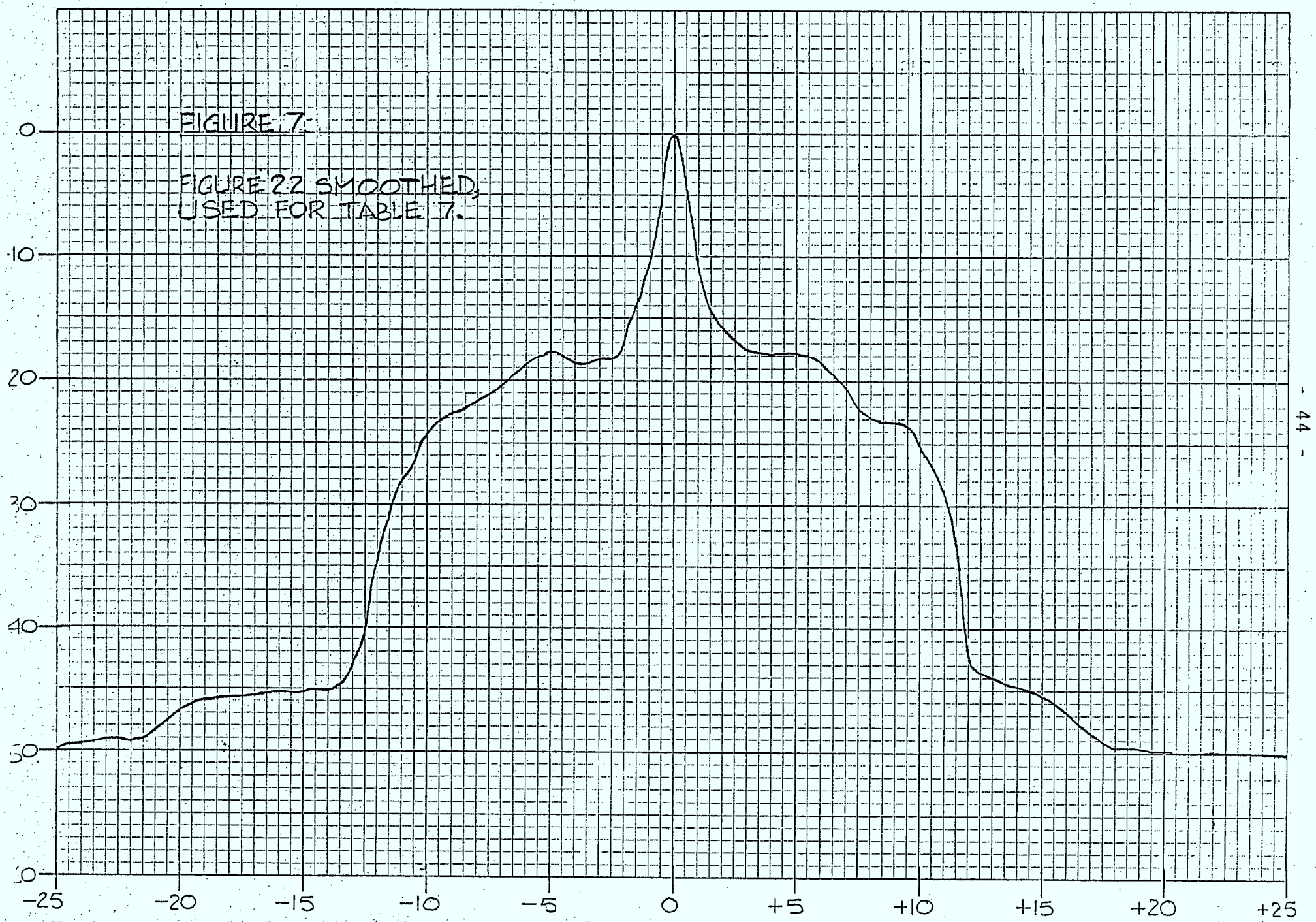


FIGURE 7.
FIGURE 22 SMOOTHED, USED FOR TABLE 7.
0
10
20
30
40
50
60
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25

Carrier Frequency ± KHz	Transmitted Spectrum Level dB Rel.	Receiver on Frequency: Receiver Pass-band level dB Rel.	Receiver on Frequency: Level at Receiver Detector dB Rel	Receiver on Frequency: Relative Power	Receiver Tuned 10KHz Off Frequency: Receiver Pass-band Level dB Rel.	Receiver Tuned 10KHz Off Frequency: Level at Receiver Detector dB Rel	Receiver Tuned 10KHz Off Frequency: Relative Power	Receiver Tuned 9KHz Off Frequency: Receiver Pass-band Level dB Rel.	Receiver Tuned 9KHz Off Frequency: Level at Receiver Detector dB Rel	Receiver Tuned 9KHz Off Frequency: Relative Power
15	31.1	71.8								
14	29.0	65.8								
13	27.4	59.8	87.2							
12	29.8	53.8	83.6							
11	23.9	47.8	71.7							
10	21.8	41.8	63.6							
9	19.8	35.8	55.6	.00001						
8	17.7	29.8	47.5	.00006						
7	16.5	23.8	40.3	.000212						
6	17.0	17.8	34.8	.00060				71.8	88.8	
5	18.8	11.8	30.6	.002774	71.8	90.6		65.8	84.6	
4	17.2	6.1	23.3	.01083	65.8	83.0		59.8	77.0	
3	14.5	3.2	17.7	.043889	59.8	74.3	2.3×10^{-7}	53.8	68.3	.000001
2	9.8	1.7	11.5	.25365	53.8	63.6	.000004	47.8	57.8	.000017
1	3.2	.4	3.6	.71826	47.8	51.0	.000037	41.8	45.0	.000147
0	0	0	0		41.8	41.8	.000102	35.8	35.8	.000406
1	2.8	.4	3.2	.73932	35.8	38.6	.000138	29.8	32.6	.000550
2	8.8	1.7	10.5	.28388	29.8	38.6	.000162	23.8	32.6	.000645
3	13.5	3.2	16.7	.05525	23.8	37.3	.000228	17.8	31.3	.000906
4	17.9	6.1	24.0	.01268	17.8	35.7	.000550	11.8	29.7	.002081
5	19.0	11.8	30.8	.00241	11.8	30.8	.002649	6.1	25.1	.00590
6	17.4	17.8	35.2	.00057	6.1	23.5	.007974	3.2	20.6	.012464
7	16.2	23.8	40.0	.00020	3.2	19.4	.014839	1.7	17.9	.020383
8	15.7	29.8	45.5	.00006	1.7	17.4	.016843	.4	16.1	.020765
9	17.7	35.8	53.5	.00002	.4	18.1	.013354	0	17.7	
10	19.5	41.8	61.3	2.6×10^{-6}	0	19.5		.4	19.9	.013607
11	20.3	47.8	68.1		.4	20.7	.009866	1.7	22.0	.008271
12	22.8	53.8	76.6		1.7	24.5	.00603	3.2	26.0	.004411
13	26.2	59.8	86.0		3.2	29.4	.00235	6.1	32.3	.001550
14	28.3	65.8	94.1		6.1	34.4	.000756	11.8	40.1	.000343
15	29.4	71.8	101.2		11.8	41.2	.000219	17.8	47.2	.000058
16	29.0				17.8	46.8	.000048	23.8	52.8	.000012
17	28.2				23.8	52.0	.000014	29.8	58.0	.000003
18	33.4				29.8	63.2	.000003	35.8	69.2	.000001
19	40.5				35.8	76.3	2.5×10^{-7}	41.8	82.3	6.3×10^{-8}
20	46.2				41.8	88.0		47.8	94.0	
		TOTAL -		2.124665	TOTAL -		.076165	TOTAL -		.092522

RATIO OF WANTED TO UNWANTED AT 10 KHz = 14.45 dB

RATIO OF WANTED TO UNWANTED AT 9 KHz = 13.61 dB

RATIO OF UNWANTED AT 10 KHz and 9 KHz = 0.84 dB

TABLE 5

INTEGRATION OF SPECTRUM OF FIGURE 5

Carrier Frequency ± KHz	Transmitted Spectrum Level dB Rel.	Receiver on Frequency: Receiver Pass-band level dB Rel.	Receiver on Frequency: Level at Receiver Detector dB Rel.	Receiver on Frequency: Relative Power	Receiver Tuned 10KHz Off Frequency: Receiver Pass-band Level dB Rel.	Receiver Tuned 10KHz Off Frequency: Level at Receiver Detector dB Rel.	Receiver Tuned 10KHz Off Frequency: Relative Power	Receiver Tuned 9KHz Off Frequency: Receiver Pass-band Level dB Rel.	Receiver Tuned 9KHz Off Frequency: Level at Receiver Detector dB Rel.	Receiver Tuned 9KHz Off Frequency: Relative Power
15	49.3	71.8								
14	48.5	65.8								
13	46.5	59.8								
12	39.0	53.8								
11	34.5	47.8	82.3							
10	31.3	41.8	73.1							
9	30.3	35.8	66.1	.000001						
8	26.8	29.8	56.6	.000008						
7	24.5	23.8	48.3	.000062						
6	21.8	17.8	39.6	.000471				71.8	93.6	
5	19.0	11.8	30.8	.002361	71.8	90.8		65.8	84.8	
4	18.0	6.1	24.1	.006104	65.8	83.8		59.8	77.8	
3	17.6	3.2	20.8	.012083	59.8	77.4		53.8	71.4	2.3×10^{-7}
2	16.3	1.7	18.0	.127866	53.8	70.1	.000002	47.8	64.1	.000009
1	5.8	.4	6.2	.619942	47.8	53.6	.000035	41.8	47.6	.000140
0	0	0	0		41.8	41.8	.000048	35.8	35.8	.000190
1	9.5	.4	9.9	.551165	35.8	45.3	.000025	29.8	39.3	.000098
2	17.2	1.7	18.9	.057605	29.8	47.0	.000046	23.8	41.0	.000184
3	17.6	3.2	20.8	.010600	23.8	41.4	.000171	17.8	35.4	.000680
4	17.9	6.1	24.0	.006149	17.8	35.7	.000560	11.8	29.7	.002117
5	18.9	11.8	30.7	.002416	11.8	30.7	.001545	6.1	25.0	.003764
6	20.4	17.8	38.2	.000501	6.1	26.5	.002529	3.2	23.6	.004173
7	22.3	23.8	46.1	.000088	3.2	25.5	.002363	1.7	24.0	.003276
8	25.5	29.8	55.3	.000014	1.7	27.2	.001527	.4	25.9	.001915
9	29.0	35.8	64.8	.000002	.4	29.4	.000875	0	29.0	
10	32.2	41.8	74.0	1.85×10^{-7}	0	32.2		.4	32.6	.000904
11	33.0	47.8	80.8		.4	22.4	.000530	1.7	34.7	.000444
12	35.0	53.8	88.8		1.7	36.7	.000335	3.2	38.2	.000245
13	46.0	59.8	105.8		3.2	49.2	.000113	6.1	52.1	.000079
14	49.0	65.8	114.8		6.1	55.1	.000008	11.8	60.8	.000003
15	50.0	71.8	121.8		11.8	61.8	.000002	17.8	67.8	4.98×10^{-7}
16	50.3				17.8	68.1	4.08×10^{-7}	23.8	74.1	
17	51.0				23.8	74.8		29.8	80.8	
18	51.6				29.8	81.4		35.8	87.4	
19	52.0				35.8	87.8		41.8	93.8	
20	52.3				41.8	94.1				
		TOTAL - 1.39744			TOTAL - .010713			TOTAL - .018222		

RATIO OF WANTED TO UNWANTED AT 10 KHz = 21.15 dB

RATIO OF WANTED TO UNWANTED AT 9 KHz = 18.85 dB

RATIO OF UNWANTED AT 10 KHz AND 9 KHz = 2.30 dB

TABLE 6

INTEGRATION OF SPECTRUM OF FIGURE 6

		Receiver on Frequency			Receiver Tuned 10KHz Off Frequency			Receiver Tuned 9KHz Off Frequency		
Carrier Frequency ± KHz	Transmitted Spectrum Level dB Rel.	Receiver Pass-band level dB Rel.	Level at Receiver Detector dB Rel.	Relative Power	Receiver Pass-band Level dB Rel.	Level at Receiver Detector dB Rel.	Relative Power	Receiver Pass-band Level dB Rel.	Level at Receiver Detector dB Rel.	Relative Power
15	45.2	71.8								
14	45.0	65.8								
13	43.0	59.8								
12	34.5	53.8	88.3							
11	28.3	47.8	76.1							
10	24.2	41.8	66.0	.000001						
9	22.5	35.8	58.3	.000004						
8	21.8	29.8	51.6	.000023						
7	20.3	23.8	44.1	.000131						
6	18.7	17.8	36.5	.000660				71.8	90.5	
5	17.8	11.8	29.6	.002282	71.8	89.6		65.8	83.6	
4	18.5	6.1	24.6	.005356	65.8	84.3		59.8	78.3	
3	18.2	3.2	21.4	.010367	59.8	78.0		53.8	72.0	1.9×10^{-7}
2	17.0	1.7	18.7	.050293	53.8	70.8	.000001	47.8	64.8	.000003
1	10.2	.4	10.6	.543548	47.8	58.0	.000034	41.8	52.0	.000135
0	0	0	0		41.8	41.8	.000044	35.8	35.8	.000177
1	10.6	.4	11.0	.539716	35.8	46.4	.000025	29.8	40.4	.000100
2	15.8	1.7	17.5	.048608	29.8	45.6	.000051	23.8	39.6	.000202
3	17.5	3.2	20.7	.013147	23.8	41.3	.000175	17.8	35.3	.000696
4	17.8	6.1	23.9	.006293	17.8	35.6	.000686	11.8	29.6	.002585
5	17.8	11.8	29.6	.002585	11.8	29.6	.002282	6.1	23.9	.005417
6	18.5	17.8	36.3	.000665	6.1	24.6	.003818	3.2	21.7	.006325
7	20.6	23.8	44.4	.000135	3.2	23.8	.003581	1.7	22.3	.005337
8	22.8	29.8	52.6	.000021	1.7	24.5	.003957	.4	23.2	.004786
9	23.2	35.8	59.0	.000003	.4	23.6	.003693	0	23.2	
10	25.2	41.8	67.0	.000001	0	25.2		.4	25.6	.003770
11	29.0	47.8	76.8		.4	29.4	.002084	1.7	30.7	.001803
12	41.8	53.8	95.6		1.7	43.5	.000596	3.2	45.0	.000441
13	44.0	59.8			3.2	47.2	.000032	6.1	50.1	.000021
14	44.8	65.8			6.1	50.9	.000014	11.8	56.6	.000006
15	45.3	71.8			11.8	57.1	.000005	17.8	63.1	.000001
16	46.8				17.8	64.6	.000001	23.8	70.6	
17	48.5				23.8	72.3		29.8	78.3	
18	49.4				29.8	79.2		35.8	85.2	
19	49.6				35.8	85.4		41.8		
20	49.8				41.8			47.8		
		TOTAL - 1.223840			TOTAL - .021356			TOTAL - .031807		

RATIO OF WANTED TO UNWANTED AT 10 KHz = 17.58 dB

RATIO OF WANTED TO UNWANTED AT 9 KHz = 15.85 dB

RATIO OF UNWANTED AT 10 KHz AND 9 KHz = 1.73 dB

TABLE 7

INTEGRATION OF SPECTRUM OF FIGURE 7

3.4.1 Existing Receiver Performance (continued)

b) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

iv) (continued)
level equal to unity. Then the relative power in each 1 KHz increment was computed using the trapezoidal rule. These values are tabulated in column 5. The total sideband energy is the summation of the individual values and this is shown at the bottom of column 5.

Steps (i) through (iv) were repeated with the receiver tuned to a frequency removed 10 KHz and 9 KHz. The resulting data were tabulated in columns 6 through 8 for the 10 KHz shift and 9 through 11 for the 9 KHz shift.

The ratios of sideband energies (wanted-to-unwanted) were calculated and converted to decibels. The calculated change is that expected in detected sideband energy in a typical AM radio for a change in carrier separation from 10 to 9 KHz. The assumption is that the radio is operative at a point where the field strengths from two adjacent channels is approximately equal and is of the order of 0.5 mV/m.

It should be possible to do a similar integration on the output of the transmitter, without modifying it by the receiver selectivity curve, to determine the occupied bandwidth. This would be possible if one obtained a true power representation of the spectrum on an instantaneous basis. However, since the presentation shows the peak values over a long period of time, an integration would lead to an occupied bandwidth calculation which would be greater than it is in fact. If this were done,

3.4.1 Existing Receiver Performance (continued)

b) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

the real occupied bandwidth should not be greater than the figure obtained. However, since it is very difficult to develop the relationship between real instantaneous power and the peak envelope as represented by the spectrum analyser, this was not attempted. Rather, in another part of this report, occupied bandwidth is established using FCC criteria which define it as the bandwidth outside of which components are 25 dB below carrier level.

Comparing the results of a single sweep through the spectrum to the levels recorded after many sweeps, as was done in the graphs accompanying this report, one could safely conclude that, on an instantaneous basis, the average sideband energy in the 4 to 15 KHz region is 10 to 15 dB lower than the maximum shown in the graphs. No photographs were taken of single sweep displays, since they bore little relationship to the program material because the instrument displays the amplitudes of spectral components which exist in a particular region at the time of the sample. For example, if a cymbal were struck when the low frequency area was being sampled, the single-sweep display would not show any high frequency components. Similarly, if a drum or base guitar sounded when the high frequency part of the spectrum was being sampled no low frequency components would be shown. Therefore, to get a reasonably continuous and symmetrical spectral distribution the analysis was performed on the maximum values of many sweeps.

Despite the fact that numerical integration of the peak value envelope yields higher than expected values for adjacent channel interference, and are probably wrong on an absolute basis when compared with the received power on-tune, the difference between the 10 KHz and 9 KHz cases

3.4.1 Existing Receiver Performance (continued)

b) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

should be fairly representative of the change in received interference in the three cases, regardless of the absolute accuracy of the received interference figures.

There is some variation in the calculated interfering signal level which results from the shape of the sideband spectrum of the interfering stations. Generally speaking, the broader the spectral response the smaller the percentage change in moving 1 KHz closer to the unwanted signal. For instance, Figure 5 shows the output of a transmitter modulated by a musical selection which produced a broad spectrum. This particular situation yielded the smallest (0.8 dB) change in the unwanted signal when the receiver was moved from 10 KHz to 9 KHz from the interfering signal. However, the ratio of wanted-to-unwanted signals in this case was the lowest. Conversely, Figure 6 shows the narrowest spectral distribution of the three cases studied. It has the highest ratio of wanted-to-unwanted signals but the percentage change in moving 1 KHz closer to the interfering signal is the highest. However, the change in the relative power received with 10 KHz and 9 KHz spacing in each case was relatively close considering the differences in the spectra being analyzed. The figures obtained in Tables 5, 6 and 7 are 0.84, 2.3 and 1.73 dB respectively, the average being 1.6 dB.

Second and third adjacent interference situations are not considered here since the mechanism of interference is not simply the reception of unwanted signals due to lack of selectivity, but also that of cross-modulation and intermodulation. There are few, if any, meaningful specifications available on these parameters for commonly used receivers.

3.4.1 Existing Receiver Performance (continued)

b) Effect of Channel Separation Change on Adjacent Channel Interference (continued)

However, it is expected that the change in cross-modulation or inter-modulation levels would be less than the change in first-adjacent situations since in the typical receiver there is relatively little selectivity before the first active device where cross-modulation and inter-modulation could take place. A change of 2 KHz in 20 KHz or 3 KHz in 30 KHz is not likely to produce a significant difference.

[redacted]

[redacted] change the wanted-to-unwanted ratio to 1:0.83. [redacted] accept the difference and maintain the present value of 1:1 in the interest of maximizing spectrum utilization. [redacted] ference are discussed in another section of this report.

3.4.2 Potential for Improved Receiver Performance

There appear to be three areas in the design of AM radio receivers where manufacturers could implement improvements. These are:

a) Improved Selectivity,
b) Improved tuning accuracy, and
c) Improved front-end performance.

3.4.2 Potential for Improved Receiver Performance (continued)

a) Improved Selectivity - There is a trend in AM receiver design away from conventional LC circuit filters towards filters employing piezo-electric and surface acoustic wave techniques to achieve the primary selectivity of the receiver. The principal advantage of this trend, besides improved performance, is that the filters are pre-tuned and require no adjustment thus reducing the time required to test and align a completed radio. The principal disadvantage, at the moment, is cost, however, with improved production techniques the cost differential is being reduced. The amount of selectivity improvement available through the use of the new filters appears to be substantial. Whereas shape factors (60/6 dB bandwidths) achieved with LC circuits varied between 4 and 5, these can be reduced to between 2 and 3 using the appropriate piezo-electric or surface wave filter. Such an improvement in selectivity shape factor is not required to compansate for the effect on receiver end performance of the change in carrier separation from 10 to 9 KHz. Only a 10% improvement is required to compensate for this change. However, other factors such as the implementation of an AM stereo system may cause manufacturers to use the more selective filters in their designs. If this is, in fact, the case the increased use of the filters will further assist in reducing the cost differential.

b) Improved Tuning Accuracy - Whereas, in prior receiver design the local oscillator was a free-running variable frequency oscillator; there is a trend towards the use of a synthesized master oscillator (SMO) which may be locked to a quartz crystal reference at discrete frequency increments. The fact that the local oscillator is locked to a referenced frequency means that the frequency error,

3.4.2 Potential for Improved Receiver Performance (continued)

b) Improved Tuning Accuracy (continued)

at worst, would amount to a few Hertz. The technology is available today and has been implemented in a large number of citizens' band transceivers that are now on the market. Further, the circuits used, both analog and digital, lend themselves to LSI techniques such that the whole local oscillator could be contained on a single chip. The quartz crystal watch, which, after only a short time in production, commands 40% of the watch market, typifies the technology which could be applied to AM and FM radio local oscillators in the immediate future.

The change in carrier separation from 10 to 9 KHz will present a minor problem to radio receiver manufacturers contemplating the use of SMO local oscillators for AM radios. This problem is that of the choice of intermediate frequency. At the present time the two frequencies that are used are 455 KHz and 262.5 KHz. To obtain the simplest frequency generation system the intermediate frequency must be an exact multiple of the frequency increment, i.e., 10 or 9 KHz or a sub-multiple thereof. The present intermediate frequencies are compatible with 10 KHz separation because multiples of these frequencies are exactly divisable by 10 KHz. To be compatible with the 9 KHz channel separation the high intermediate frequency 455 KHz will have to be reduced to 454.5 KHz and the low intermediate frequency 262.5 will have to be increased to 263.25 KHz. However, these values would not be compatible with the 10 KHz channel separation so there may be some consideration by the receiver manufacturers to use intermediate frequencies which are compatible with both the 10 and 9 KHz carrier separation. These frequencies would be 450 KHz and 270 KHz respectively for the high and low intermediate frequencies. The use of these IF frequencies would permit receiver manufacturers to make the transition from 10 to 9 KHz carrier

3.4.2 Potential for Improved Receiver Performance (continued)

b) Improved Tuning Accuracy (continued)

separation without a major design change and it would be possible with little added cost to have a receiver that would be switchable to operate on either 10 or 9 KHz carrier separation.

c) Improved Front-end Performance - Cross-modulation and inter-modulation products generated in the RF or input stages of AM radios tend to limit the ability of presently-used AM radios to operate under high-signal conditions. Receiver manufacturers have addressed this problem in FM radios with the use of field-effect transistors in place of bi-polar transistors in the front-end stages. While the use of such devices will have an economic impact on the receiver's end cost, there is no other reason why the technology cannot be applied to AM radios. If, as a result of other requirements, radio receiver manufacturers use more selective IF filters then the front-end performance may well become a performance limiting factor and manufacturers may move to improve this portion of the radio design. Improvements of 10 dB or more in inter-modulation and cross-modulation products may be expected by such a change.

3.4.3 Conclusions

The conclusions of the receiver study are as follows:

a) Other than changing from vacuum tubes to transistors and/or bipolar integrated circuits, there has not been much change in AM receiver designs over the last twenty-five years.

b) The performance of existing AM receivers is governed, to a large extent, by economic contraints but is sufficient to provide reasonable fidelity service to AM listeners.

3.4.3 Conclusions (continued)

c) [redacted]

d) The need for improvements in AM reception performance has been recognized by some receiver and component manufacturers, and some receivers incorporating some of the possible technological improvements are becoming available now. It has not been possible to obtain data on these new receivers to determine if the 10 to 9 KHz channel spacing was considered in the design, or if such receivers would be rendered obsolete by such a change.

e) If the radio manufacturers do implement in their receiver designs the improvements noted, there is no reason why AM receiver performance with the reduced channel separation of 9 KHz can be equal to or better than the present day performance with 10 KHz channel separation. These changes will have an economic effect in that the improved radios will cost more, and the extremely low-cost receiver may disappear from the market. The economic impact will lessen as the changes are implemented in more of the total radios produced, and integration techniques are developed to reduce the total number of components required to make up a complete radio. This process is expected to take about five years.

3.5 TASK 5 - Assess the occupied bandwidth situation of existing stations and the limitations that may need to be imposed with 9 KHz separation.

3.5.1 Modulation Capabilities of AM Transmitters

The occupied bandwidth of modern AM transmitters, type-approved in Canada, is not limited or controlled in any way by the type-approval specification RSS 150. The audio response of a type-accepted transmitter must extend out to 10 KHz with the response being not greater than 2.5 dB down relative to the 1000 KHz response. There are no limits defined beyond 10 KHz such that the transmitter audio bandwidth could be up to 20 KHz or more. Thus, the occupied bandwidth of a station using the type accepted transmitter could extend out to 40 KHz or beyond.

Most of the AM transmitters operated in Canada are manufactured in the USA. The transmitters are designed to comply with the FCC regulations which require that all emissions between 15 to 30 KHz from the carrier are down at least 25 dB relative to the unmodulated carrier (paragraph 73-40 (A-12)). To achieve this performance, most transmitters are equipped with a low pass filter in the early audio stages to provide an attentuation of 25 dB at 15 KHz with the actual roll-off commencing around 10 KHz. With high level plate modulation, a plate modulating transformer acts as a low pass filter which, depending on size, will attenuate the high frequency components up to 12 dB per octave. The low pass filter network, which is in a plate modulation circuit, is made up from the inherent capacitance and leakage inductance of the modulation transformer coupled with the capacitive loading caused by the RF by-pass circuits which must be provided to isolate the RF currents from the modulator circuit. The trend in modern transmitter design has been towards modulation systems which offer higher overall efficiencies and in most cases this has meant the elimination of the high level plate modulation

3.5.1 Modulation Capabilities of AM Transmitters (continued)

transformer. But some of the newer systems have similar inherent bandwidth limitations. There are other systems, however, in which the modulation transformer has been eliminated and the modulation bandwidth has been enhanced.

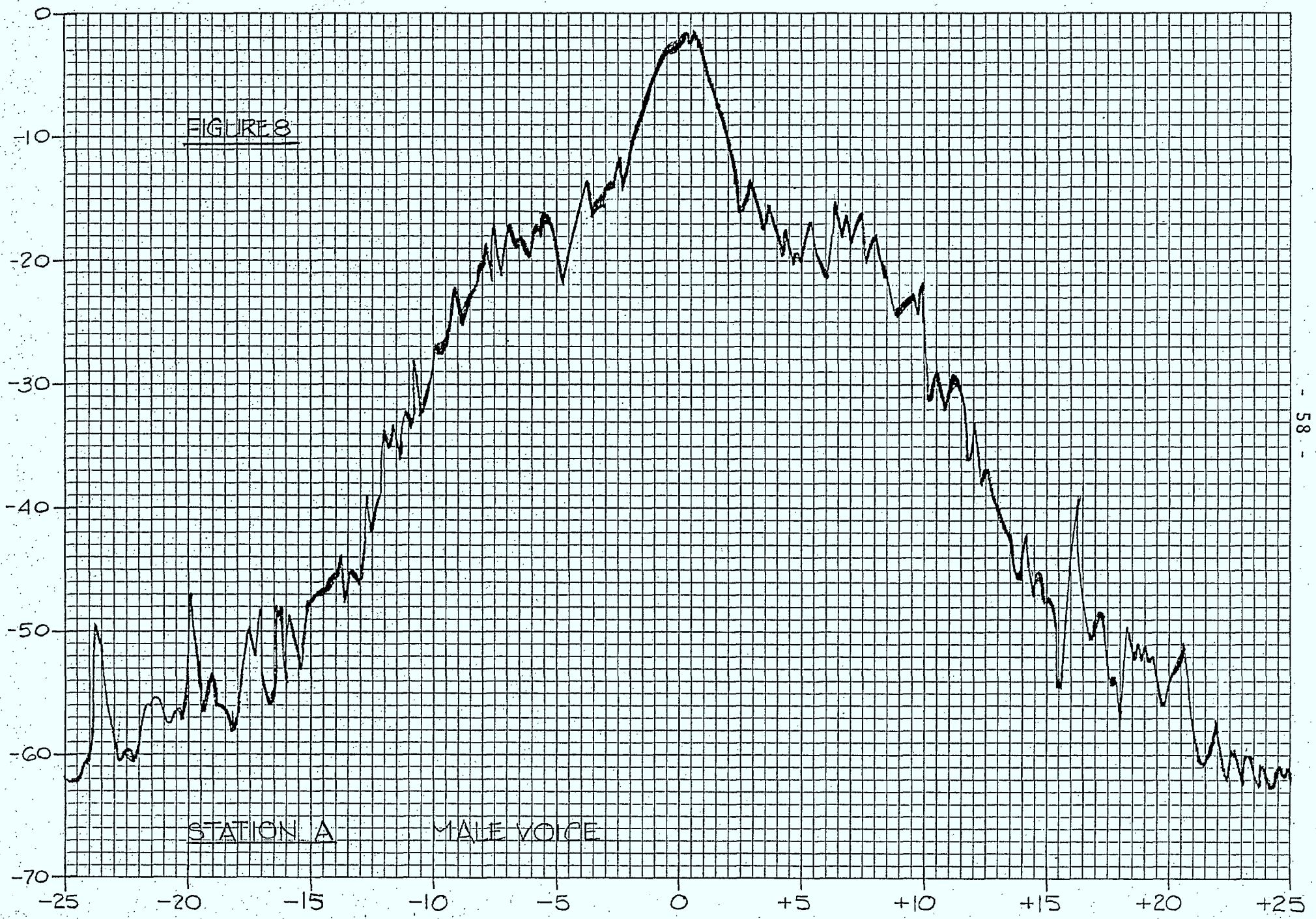
In summary, the various transmitters in operation today are not required by regulation to have a specified modulation bandwidth. They are required to modulate out to 10 KHz, such that the occupied bandwidth will be at least 20 KHz and in most cases somewhat more.

3.5.2 Occupied Bandwidth Measurements

[redacted] To try and define the actual occupied bandwidth, it is intended to examine typical program material for spectral content to determine if the occupied bandwidth of an AM transmission in the broadcast band is, in fact, limited and controlled by the spectral content of the program material rather than by the modulation capabilities of the transmitter.

The initial intent was to make a theoretical analysis of typical program material, however, due to a large number of variables in such an analysis it was decided to make measurements of the emitted spectra of local AM broadcast stations. Although three broadcasters were contacted, each having a transmitter with a different modulation system, due to equipment problems, it was only possible to make measurements on two transmitters. Some emitted spectrum data were obtained from a fourth broadcaster contacted.

K+E KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0705



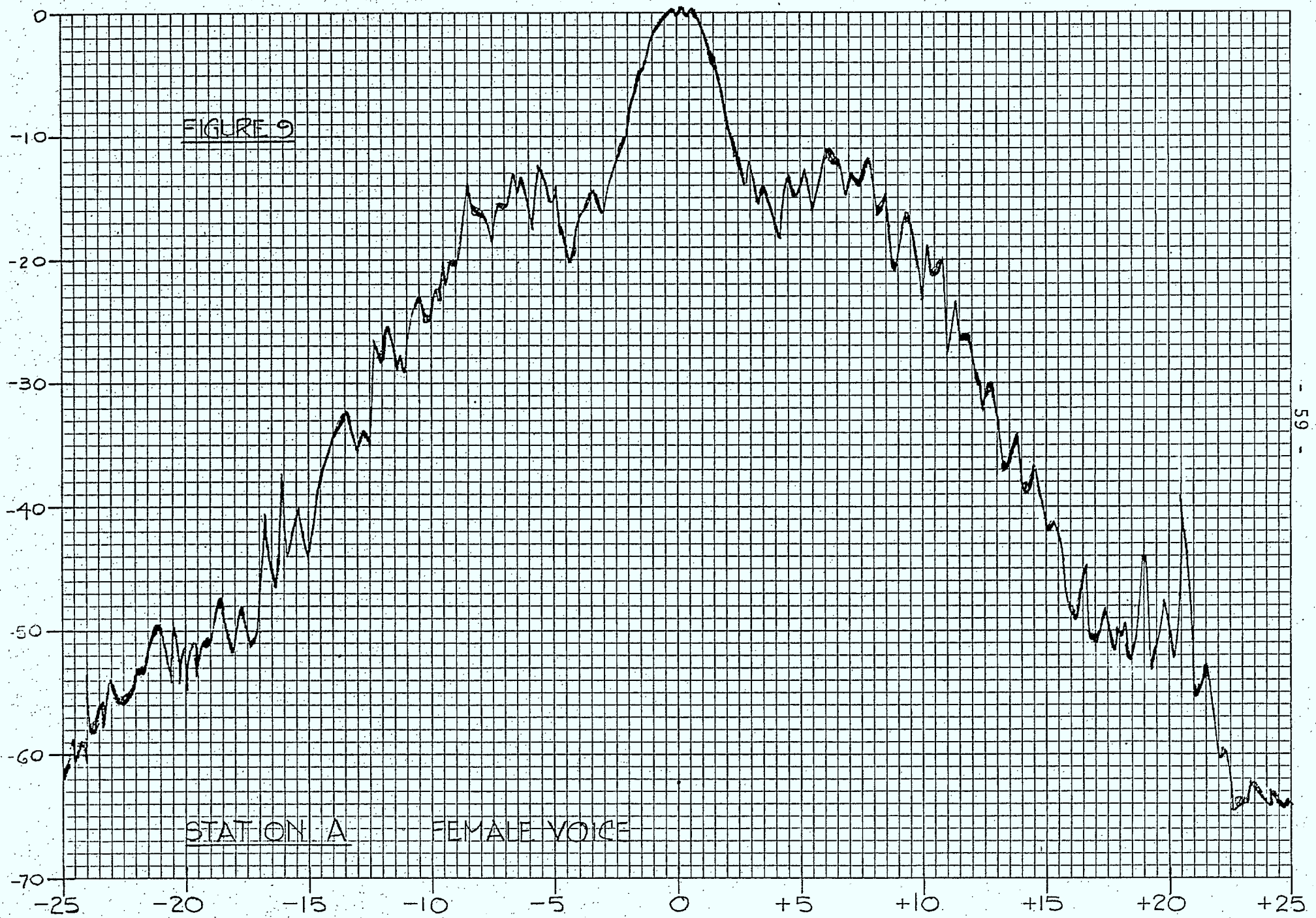
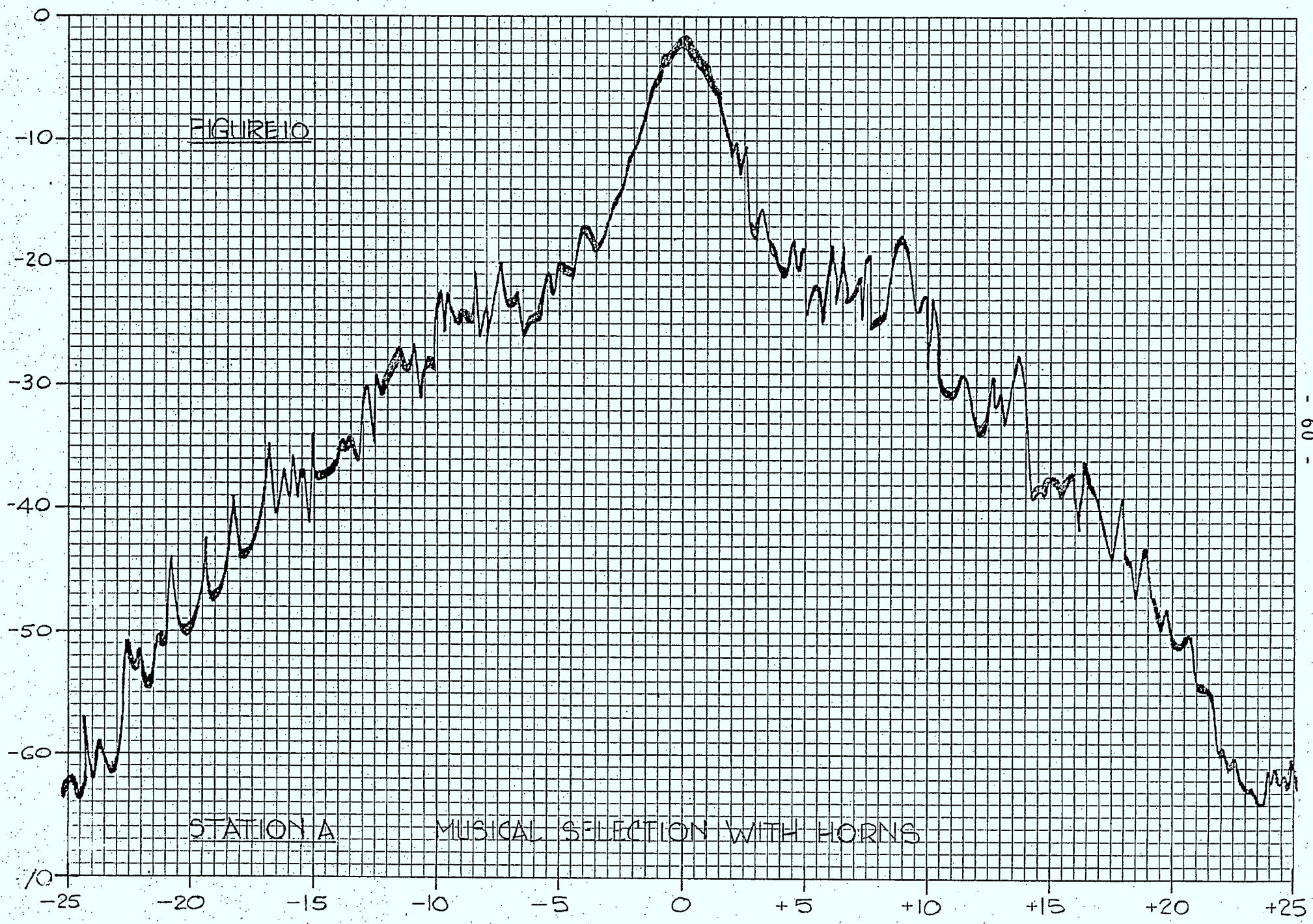


FIGURE 9
STATION A FEMALE VOICE
0
-10
-20
-30
-40
-50
-60
-70
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



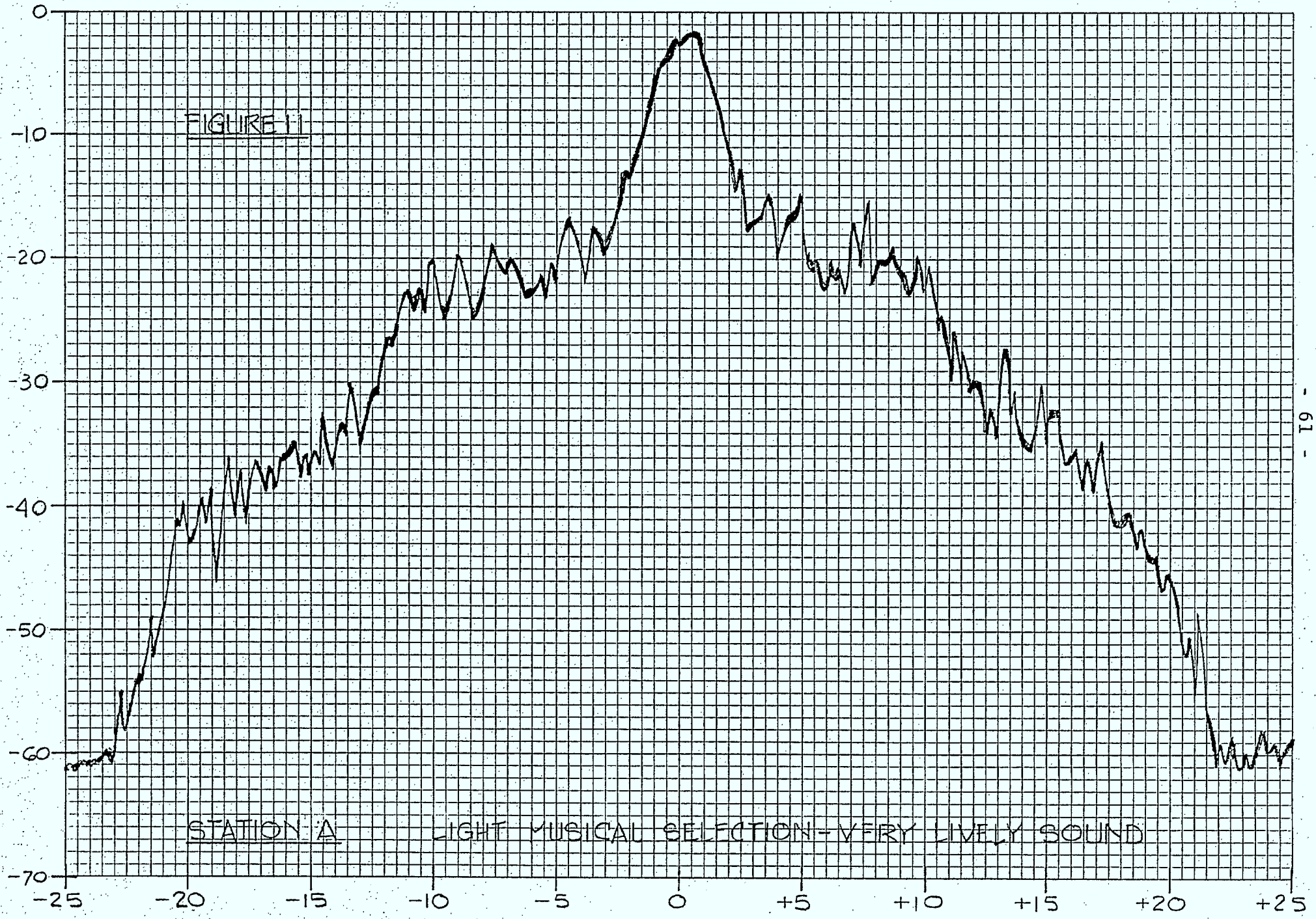


FIGURE 11
STATION A
LIGHT MUSICAL SELECTION - VERY LIVELY SOUND
0
-10
-20
-30
-40
-50
-60
-70
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25

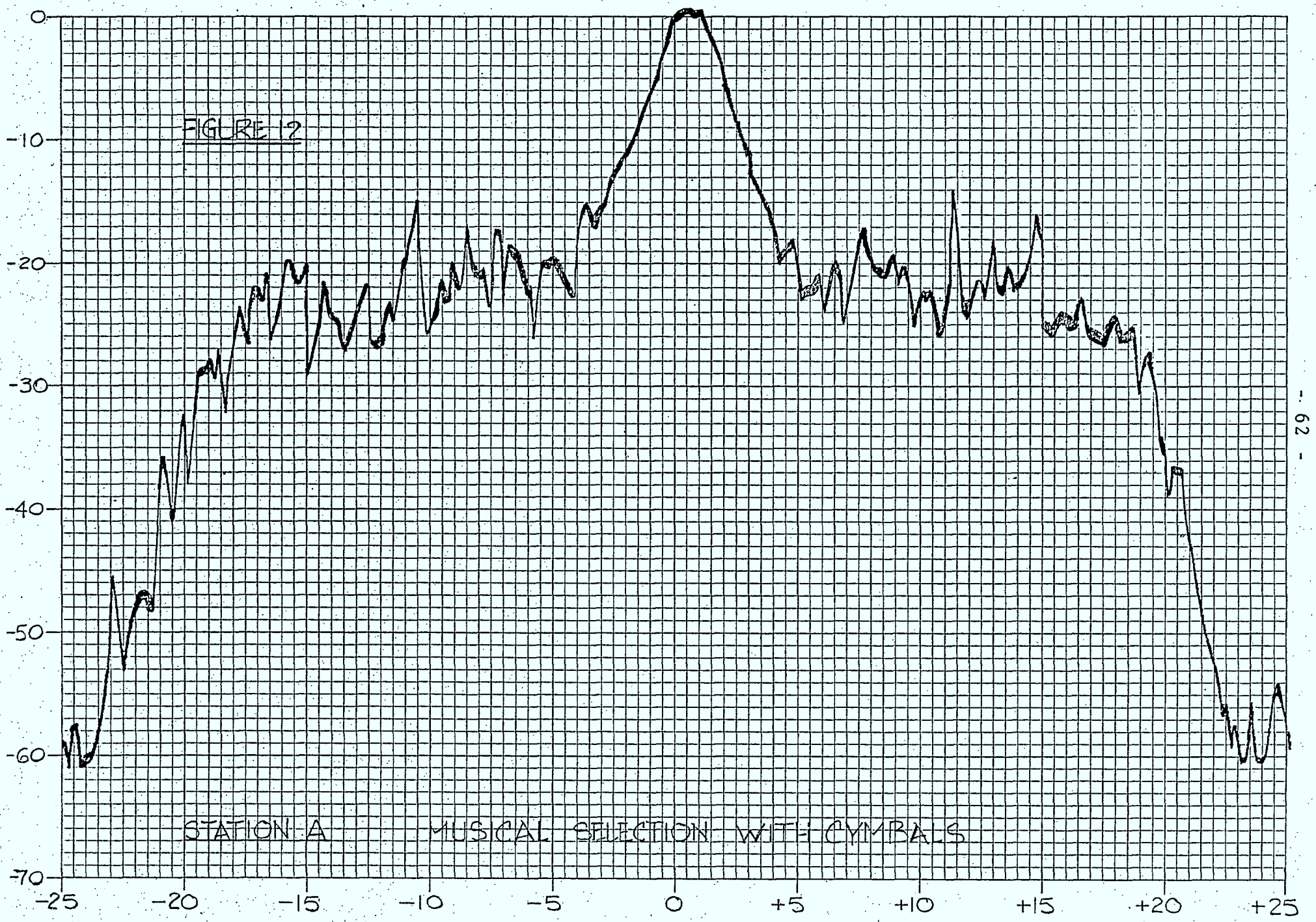
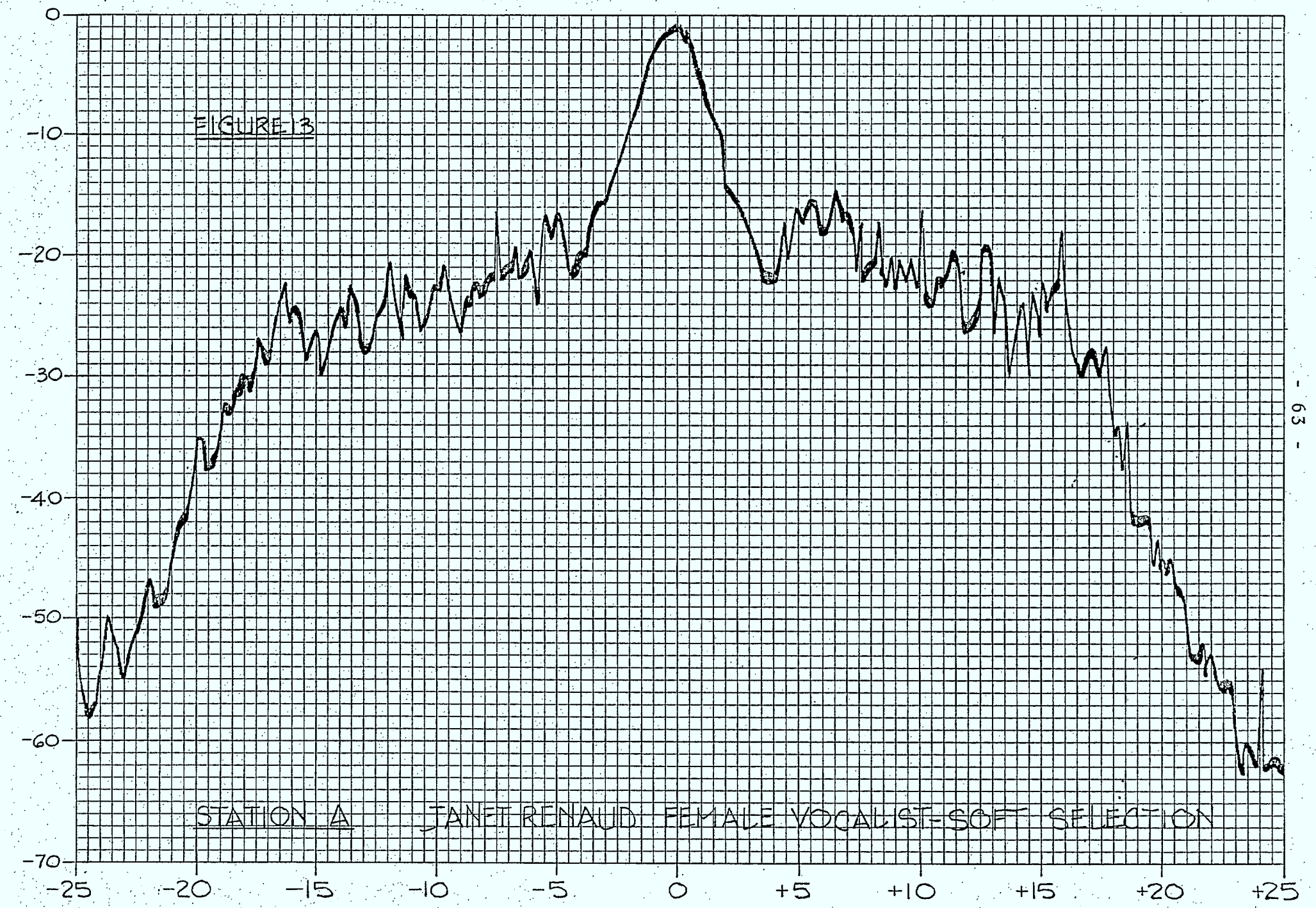
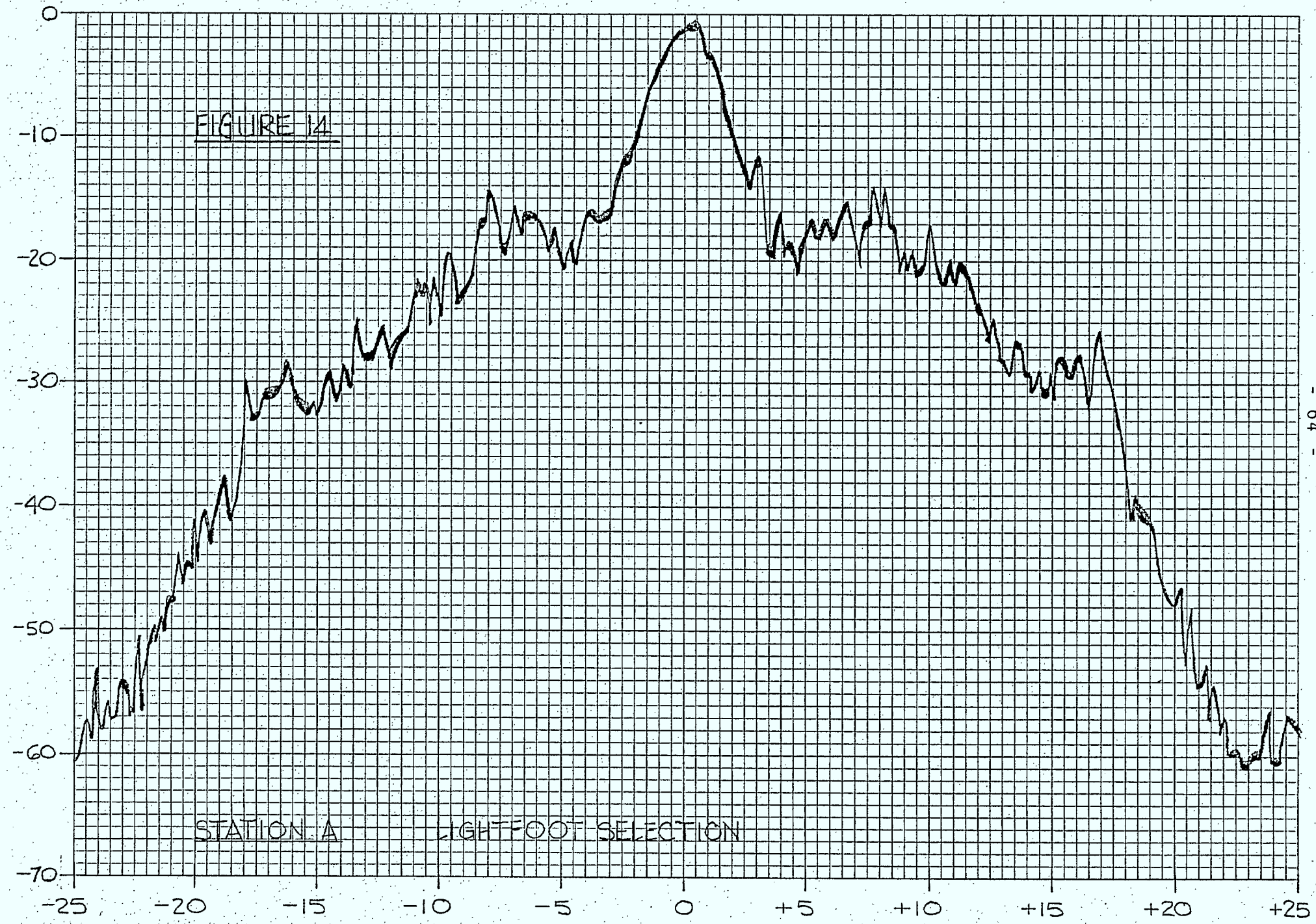


FIGURE 12
0
-10
-20
-30
-40
-50
-60
-70
-25
-20
-15
-10
-5
0
+5
+10
+15
+20
+25
STATION A MUSICAL SELECTION WITH CYMBALS

K+E 10 TC INCH .0 INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

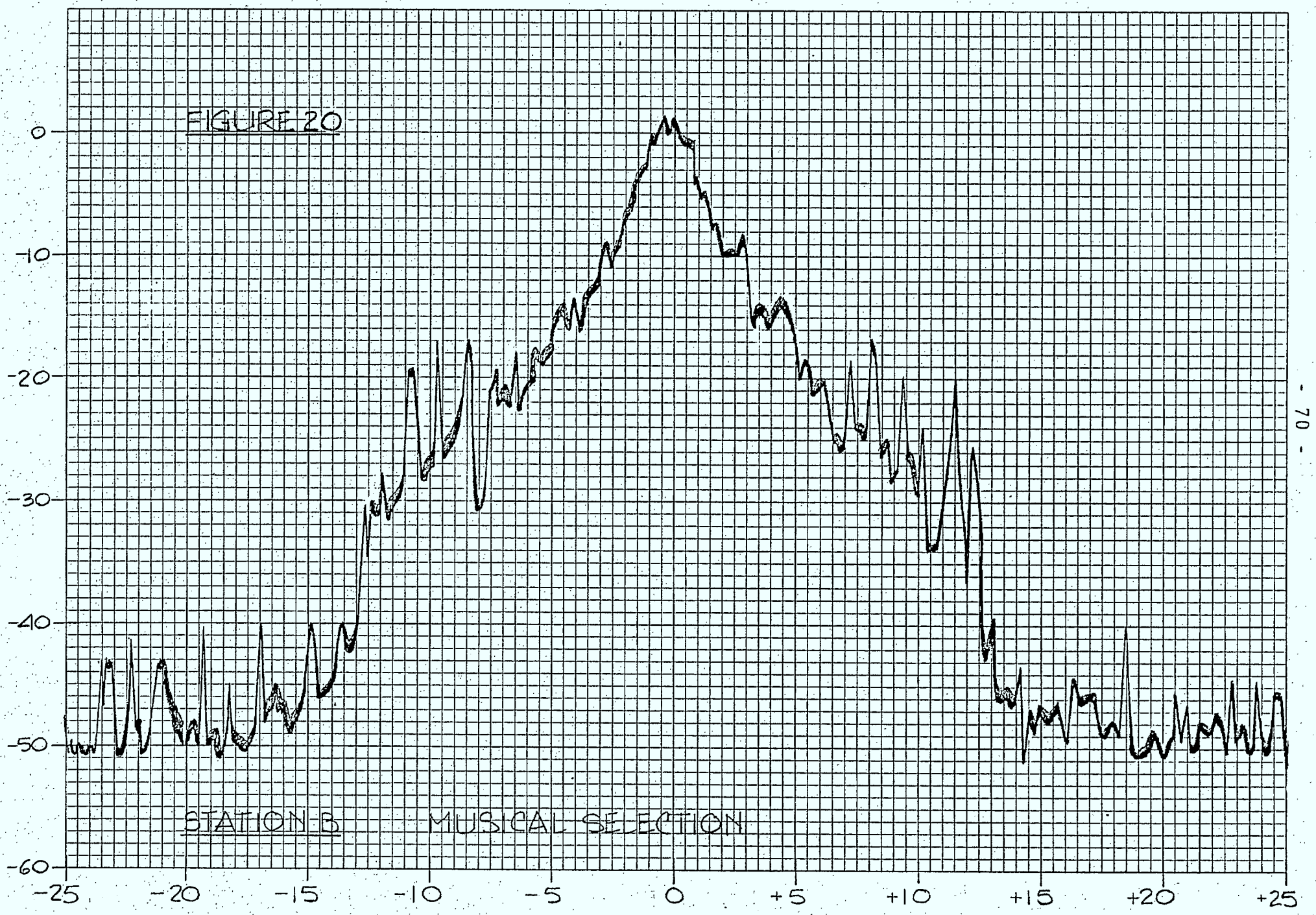
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

K+E 10 TO ... INCH ... 3 INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

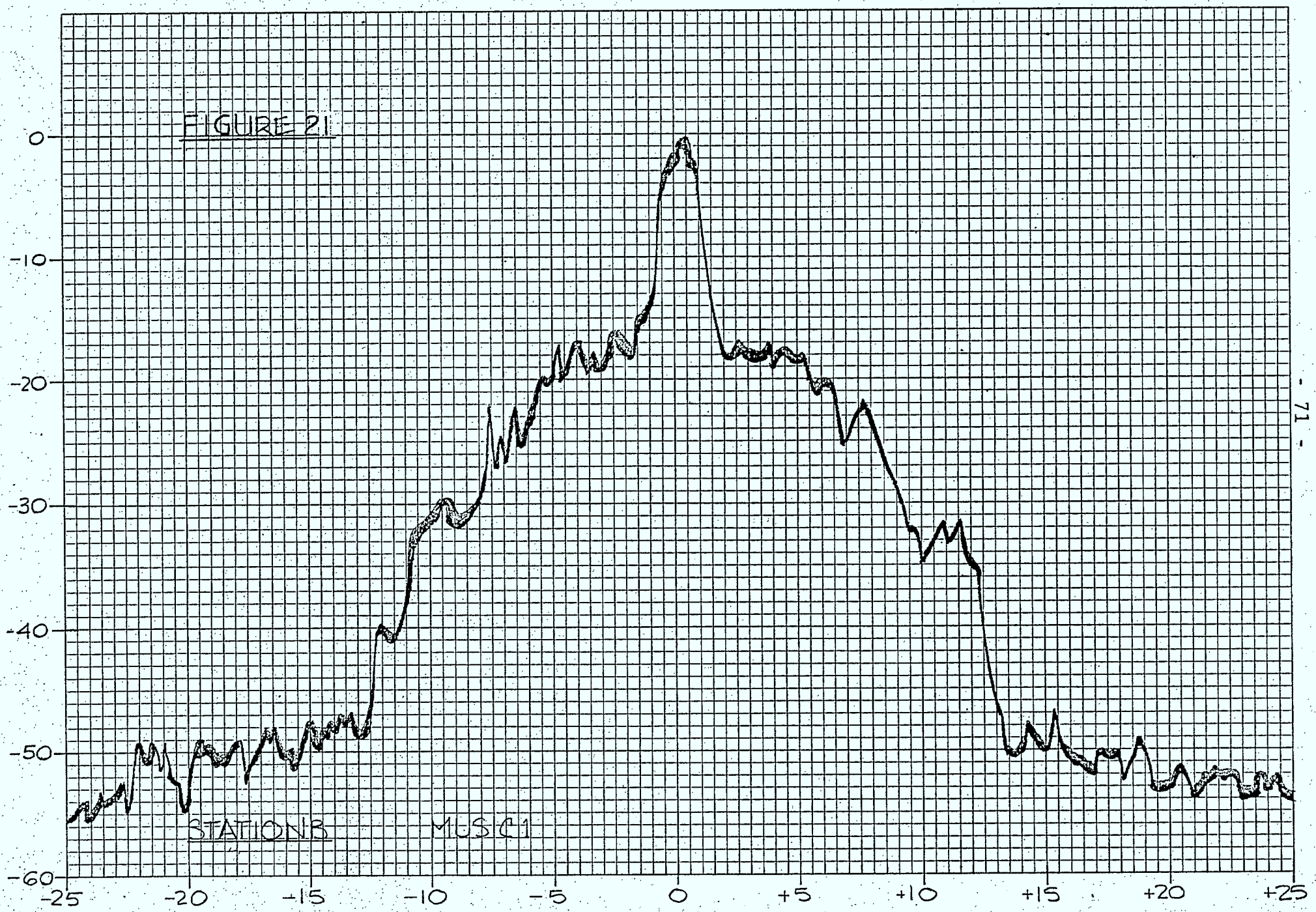
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

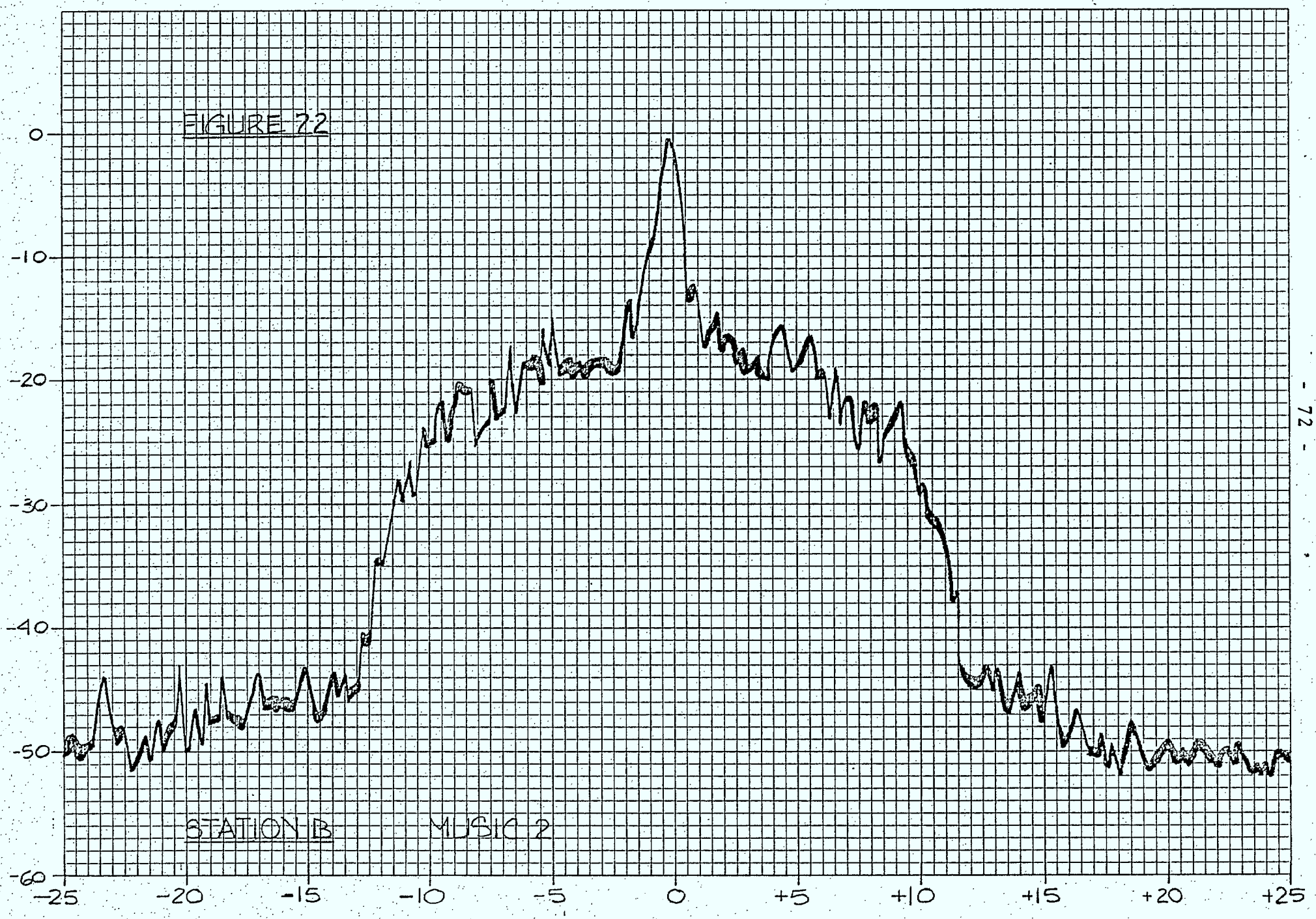
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



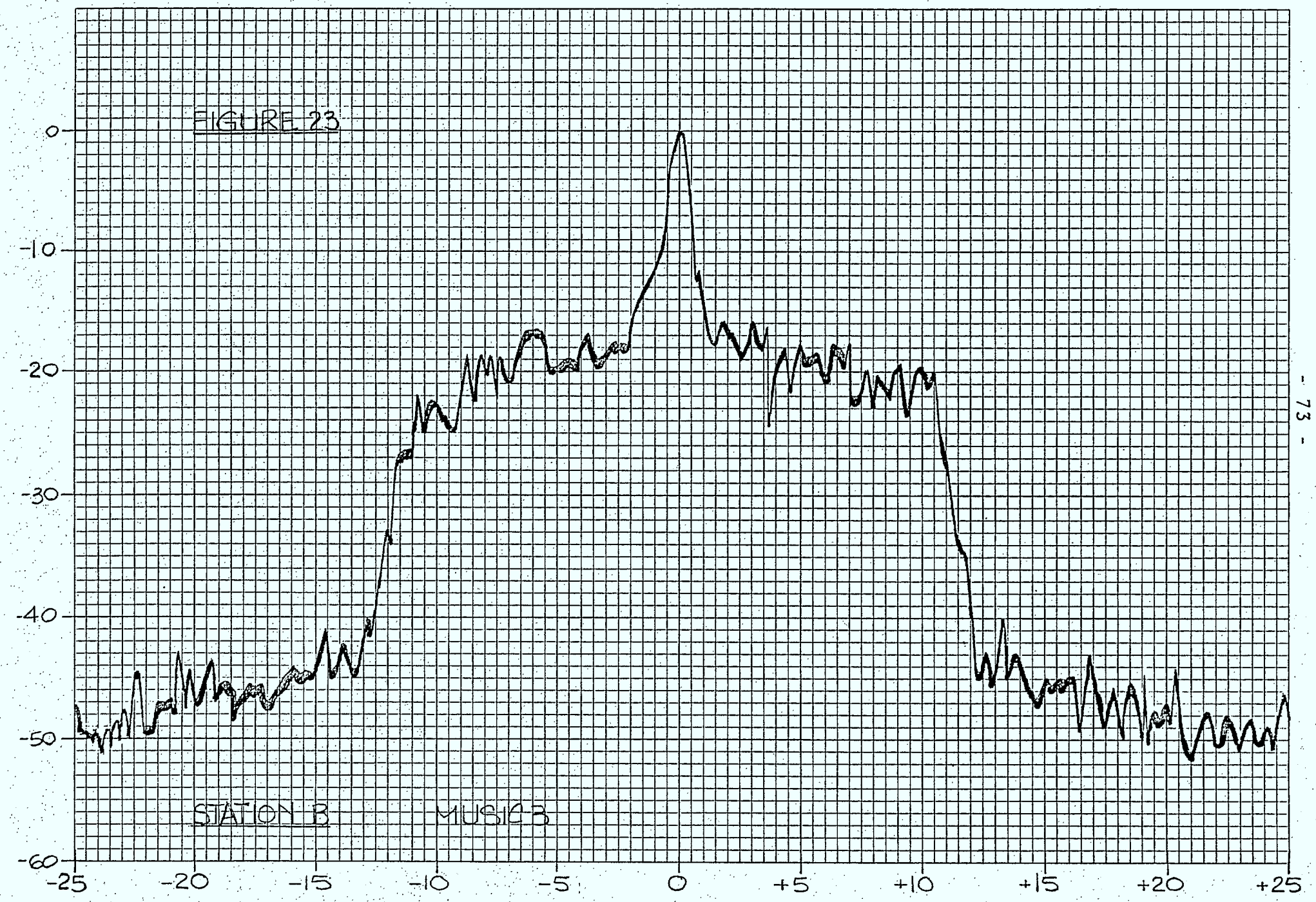
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

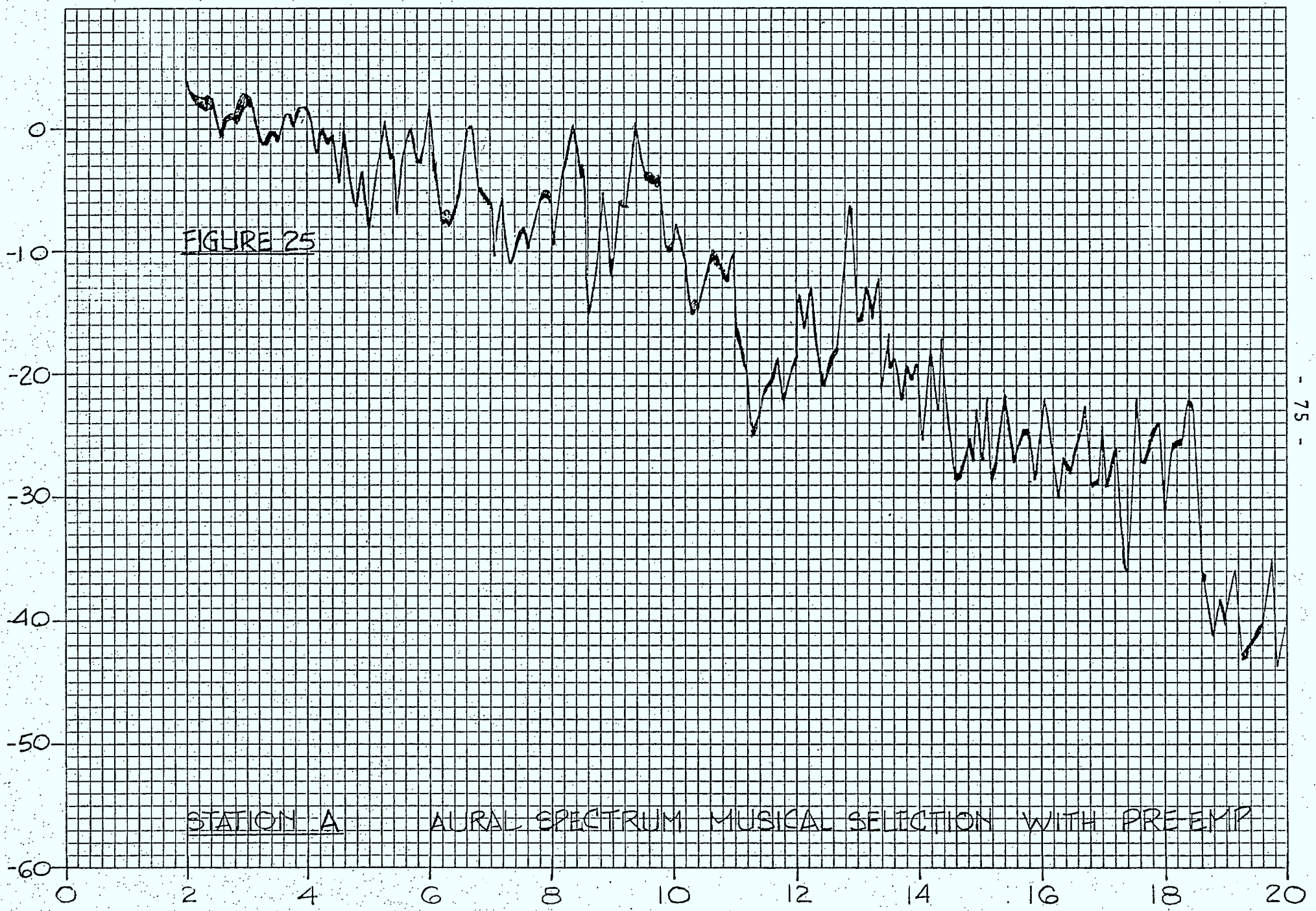


K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

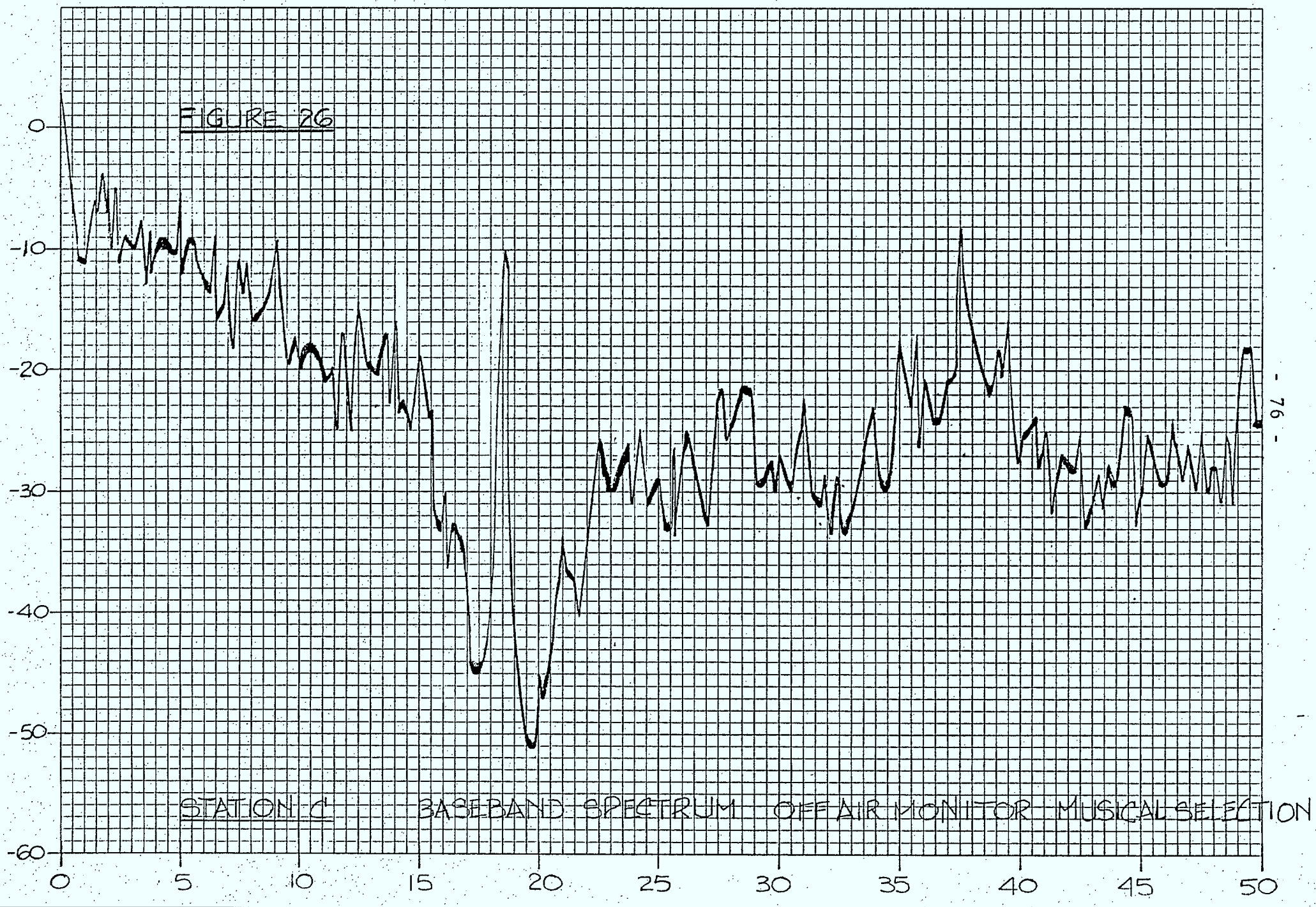


K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



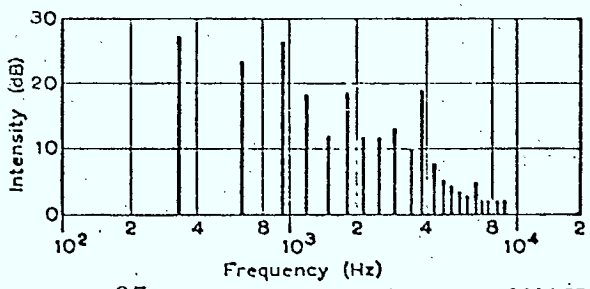


Fig 27 Spectrum of violin at frequency of 294 Hz

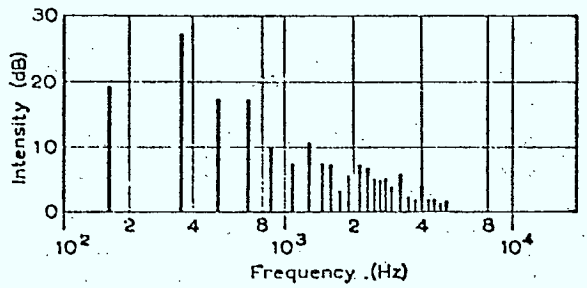


Fig 28 Spectrum of orchestral trumpet at frequency of 175 Hz

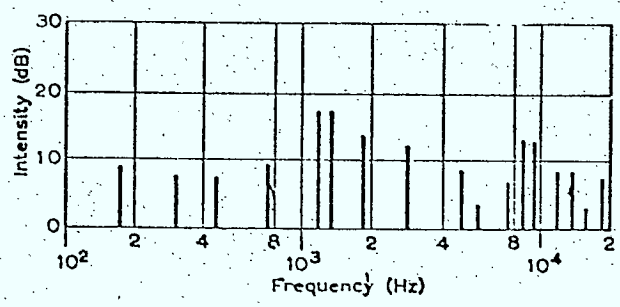
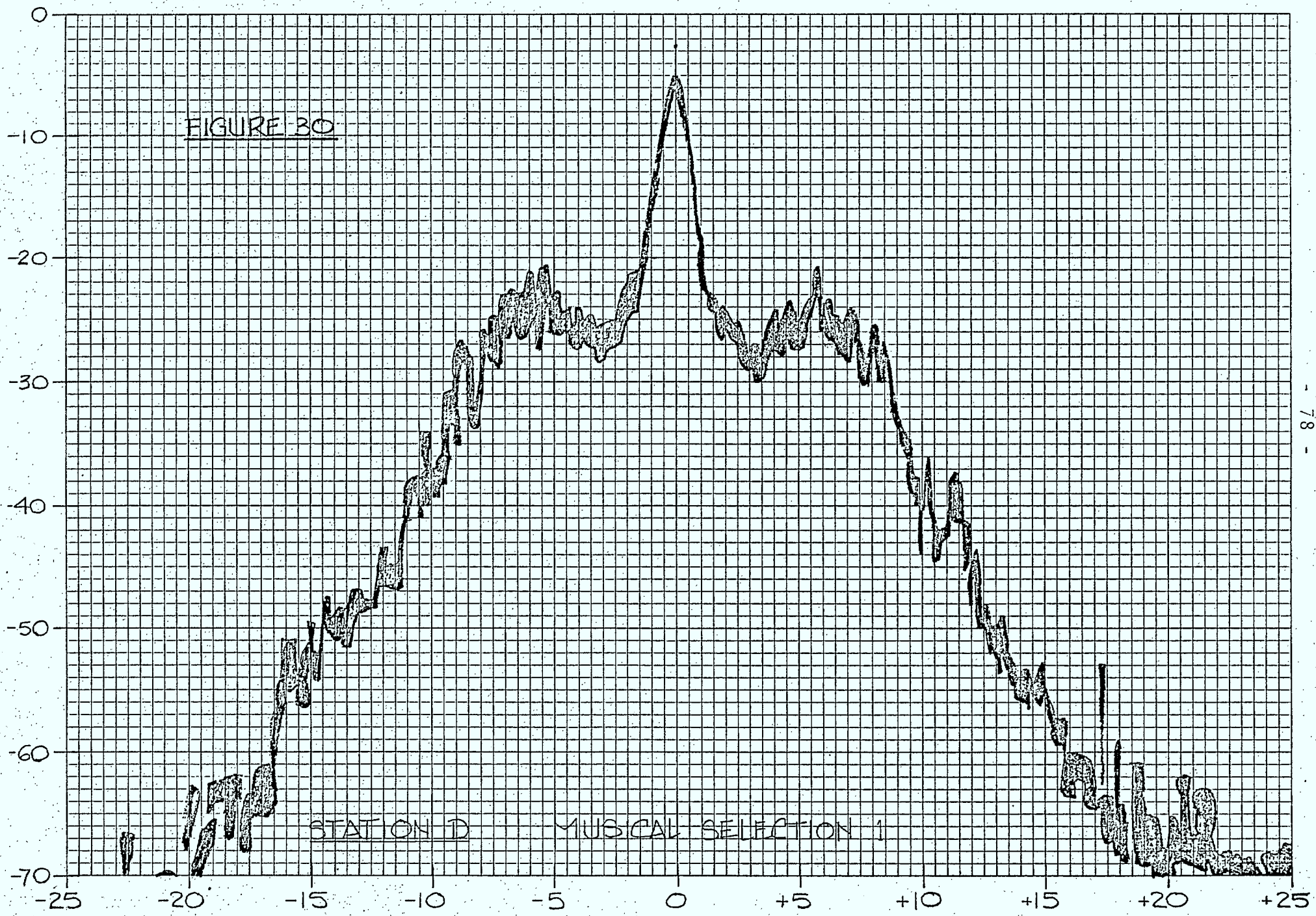
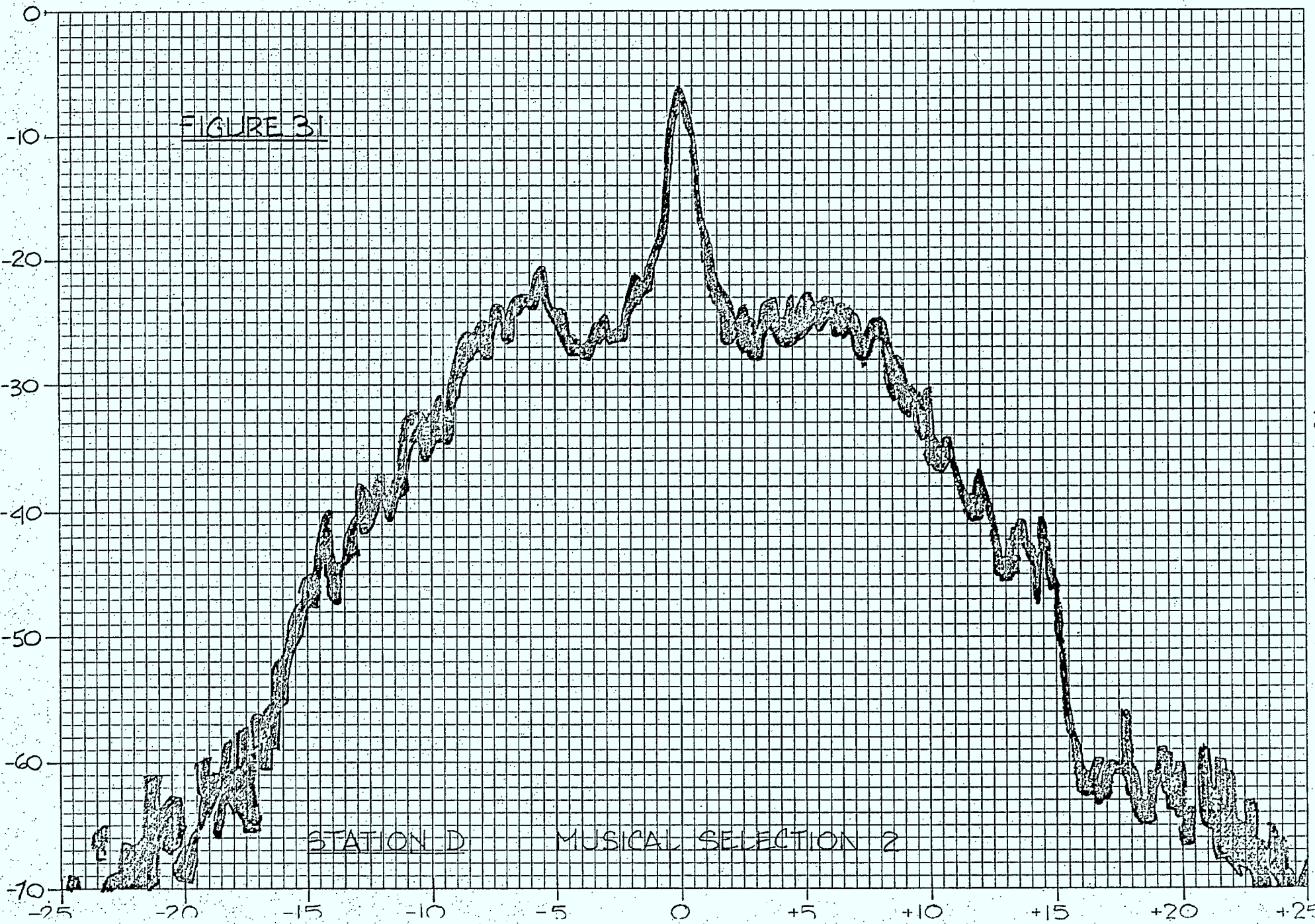


Fig 29 Spectrum of cymbal at frequency of 175 Hz

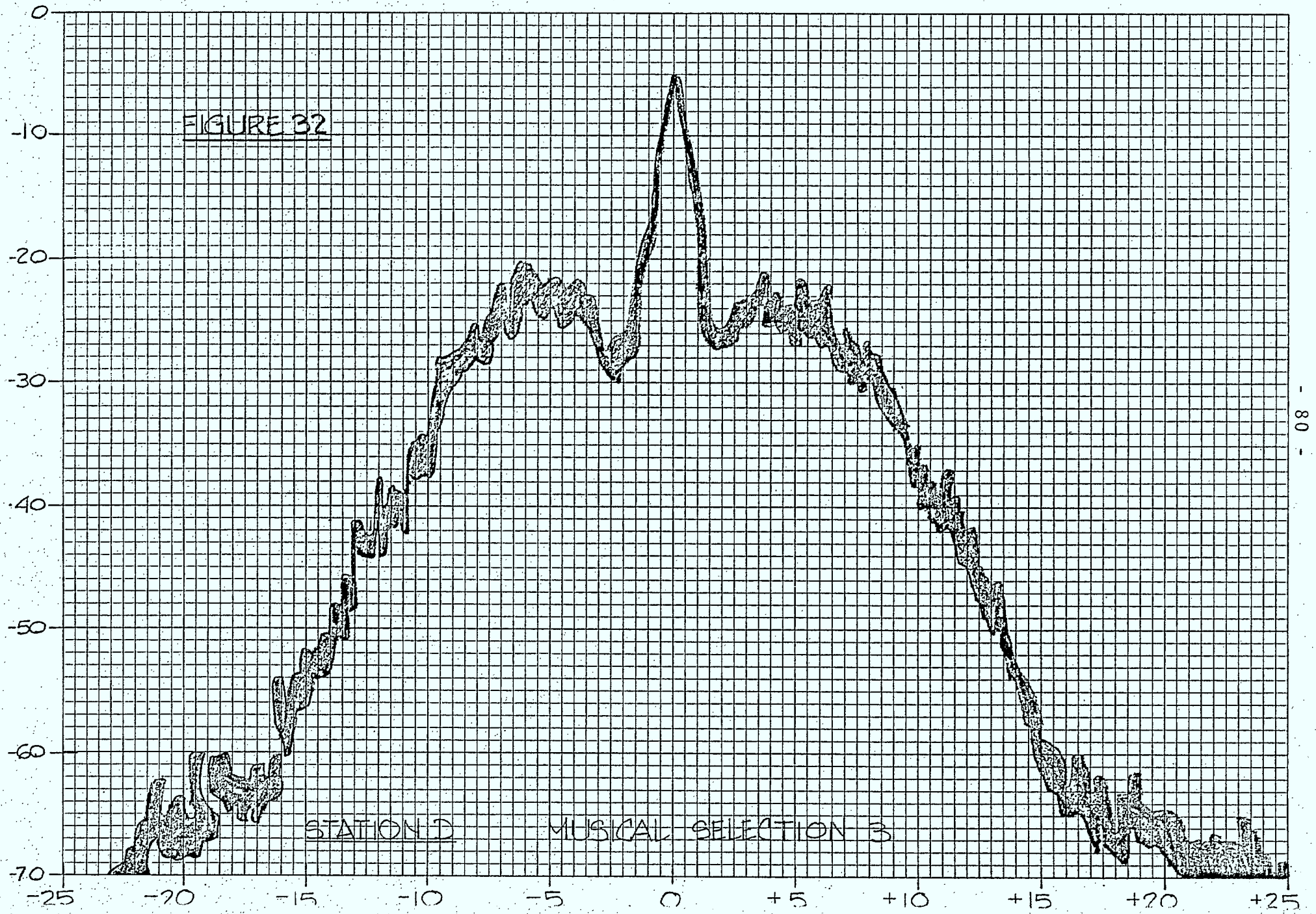
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0703



3.5.2 Occupied Bandwidth Measurements (continued)

Figures 8 through 23 show the spectra emitted by two broadcasting transmitters in the Toronto area. The transmitters differ in the modulation system used. Figures 30 through 32 show the emitted spectrum of another high power broadcast transmitter using a further method of modulation. All three broadcasters use audio processing to raise the average modulation level. Also, all three broadcasters use pre-emphasis at the higher audio frequencies to compensate for the very bassy responses which are typical of automobile radios.

Analysis of the emitted spectra shows that typical program materials exhibit, in most cases, a natural de-emphasis at the higher frequencies which is about 10 dB per octave above 5 KHz, (see Figure 24). With pre-emphasis applied to the audio circuits, the roll-off in the program drops to about 6 dB per octave, (see Figure 25). This is apparent in most of the sample program material, except for one musical selection in which cymbals were one of the predominant instruments. Cymbals are one of the few musical instruments that produce a large number of overtones which are reasonably constant in amplitude. In other instruments the overtones tend to taper down in amplitude with increasing order, i.e., 3rd > 5th > 7th. (Figures 27 through 29).

There is a difference in the audio processing used at station A compared with that of station B. At station A the high frequency roll-off occurs due to normal parameters in the transmitter, i.e., modulation transformer etc. At station B the transmitter audio input is rolled-off at frequencies above 11 KHz by a sharp low pass filter having an attenuation of 36 dB per octave in the transition band. The effect of the difference in audio processing can be seen in the emitted spectra. Station A's modulation response extends out to about 18 KHz. Above this frequency the modulation components attenuate rapidly. At station B the sharp cut-off at 11 KHz

3.5.2 Occupied Bandwidth Measurements (continued)

shows up as a narrower emitted spectrum. The conclusion is that occupied bandwidth can be controlled by pre-modulation shaping of the audio spectrum. It is felt, however, that station A is typical of the majority of AM stations and that emitted spectra will tend to extend out to 15 KHz, or more, on either side of the carrier.

There appear to be two accepted methods for the determination of occupied bandwidth. These are:

a) Determination of the bandwidth occupied by 99% of the power emitted by the transmitter.
b) Determination of the bandwidth of components exceeding a specified level below the carrier.

Of these two methods, the second is the simplest to implement. Using modern spectrum analysers, modulation product levels can be determined reasonably quickly over a fairly wide bandwidth. The method is fallible with some types of transmitter and modulation systems. Where there are a large number of modulation components it is possible for a transmitter to produce objectionable levels of spurious emissions, but still be compliant with occupied bandwidth requirements. An AM broadcast transmitter, however, has a highly linear modulation system and the occupied bandwidth appears to be largely determined by the modulation content. It is therefore intended to use the second method, with -25 dB relative to the carrier at the specified level, to determine the occupied bandwidth of the transmitters on which measurements were made. Individual components 25 dB below carrier represent .3% of the carrier power. Since the roll-off at frequencies where the -25 dB points occur is relatively high, the energy in the components beyond the -25 dB response points would be small. Then it is reasonable to assume that, for a broadcast transmitter, the 99% power method and the -25 dB response method would correlate reasonably closely.

3.5.2 Occupied Bandwidth Measurements (continued)

The calculated occupied bandwidth for stations A and B is shown in the table below for the typical program material samples.

Sample #	Station A Bandwidth (KHz)	Station B Bandwidth (KHz)
1	36.3	22.0
2	33.0	20.0
3	22.5	22.5
4	22.5	20.0
5	22.5	16.5
6	26.5	22.5
7	24.5	19.5
8	20.0	-
Total	207.8	143.0
Average	26.0	20.4
Minimum	20.0	16.5
Maximum	36.3	22.5

The effect of audio filtering at station B becomes evident in the reduction of the occupied bandwidth from the point of view of adjacent channel interference. Such reduced and controlled occupied bandwidths could result in the reduction of adjacent channel interference of up to 6 dB because of the reduced illumination of the desired channel by modulation products from the unwanted channel. [redacted] This phenomenon is related to the different audio processing used at the two transmitters. Station B, having the sharp cut-off filter, can use more pre-emphasis such that the spectral response tends to be more uniform out to the filter cut-off frequency. However, a change in carrier separation means that with station B as an interfering source, the desired channel would be exposed to a larger quantity of unwanted sideband energy than if station A

3.5.2 Occupied Bandwidth Measurements (continued)

were the interfering source.

3.5.3 Conclusions -

The conclusions from the occupied bandwidth study are as follows:

a) There are no specified requirements to control the bandwidth occupied by the emitted spectrum of an AM broadcast transmitter in Canada,

b) The use of pre-modulation audio processing circuits appears to have a considerable influence on the bandwidth of the occupied spectrum,

c) Depending on the criteria used to specify occupied bandwidth, the occupied bandwidth of an AM broadcast transmitter could approach ± 20 KHz either side of the carrier. A change in carrier separation from 10 KHz to 9 KHz will increase the level of radio frequency energy per unit bandwidth, particularly in areas where there are several high power stations, and

d) [redacted]

3.5.3 Conclusions (continued)

d) (continued)

[redacted]

3.6 TASK 6 - Determine the class of designation which would make the best use of the new channels created by the 9 KHz separation.

One way of determining the best use of the new frequencies is to consider the pros and cons of the four basis classifications which are presently in use.

3.6.1 Class I - This class of station is very effective if the type of programming that it carrier is of a national or broad interest category. Because of the widespread coverage that is possible by the combination of groundwave and skywave, it is very difficult to identify the station with any particular municipality or city and therefore the type of programming that it carries must, of necessity, be as general as possible. The only type of service that we have in Canada which would approach this requirement is that of the CBC. One would expect that CBC stations operating on Canadian clear channels would be operated in this manner. This, in fact, is not the case. For example CBL and CBM are stations operating in Toronto and Montreal and though they carry such national interest material, the thrust of the programming is aimed at the residents of these two cities, that is, they carry traffic reports, local weather, theatrical activities, entertainment and the like during the peak listening periods. When the CBC's ACP program started it was intended only to provide the national service on the various outlets that were planned in this program. As the project was implemented, it had to be modified to allow for greater local origination as a result of public demand for a community flavour to the

3.6.1 Class I (continued)

programs that these stations carried. The desire by the public for community oriented radio is one of the reasons why very few of the CBC's operations take advantage of the enormous coverage that is possible through skywave propagation. There are other reasons as well. One of these is the performance of the average AM receiver which does not have adequate tuning accuracy to consistently find a weak signal and has insufficient adjacent channel rejection to be useful for skywave reception. In addition, because of weak signal levels, the audio quality is generally far poorer than the listener is willing to accept. There is also the unreliability due to fading which detracts from the usefulness of the medium.

An additional factor which limits the usefulness of skywave coverage is that adjacent channel protection is afforded only to the groundwave signal. Skywave coverage can virtually be eliminated in large areas because of the presence of adjacent channel stations in those areas which are enclosed by the 0.5 mV/m skywave contour. Whereas United States Class I stations are generally grouped so that adjacent channel interference to skywave is minimized, most of Canada's Class I frequencies are bordered by frequencies whose designations allow either Class II or Class III operations on one or both sides of the Canadian Class I frequency. This has the effect of considerably diminishing the usefulness of skywave coverage in Canada.

The present approach to Class I usage in Canada seems quite wasteful of spectrum during daytime hours. Stations which might occupy these frequencies in other parts of the country are prevented from doing so because they are within an area that would be enclosed by the 0.5 mV/m skywave contour. This issue raises several technical and political factors which are beyond the scope of this study and which will be more properly dealt with in a public forum.

3.6.1 Class I (continued)

If the new channels are to be used to carry programming of a broad general nature then Class I designations may be the logical choice for these stations. [redacted]

With the frequency plan of Table 2 adjacent channel difficulty would be less prevalent since the density of Class I stations which could exist would be far lower than would be the case if these frequencies were used for stations operating in a Class II or Class III mode.

3.6.2 Class II and Class III - These two categories are essentially the same in Canada in that stations with these designations provide only groundwave coverage and are not limited in power. Since the coverage provided by these stations is by means of groundwave only, their primary coverage is limited to an area which identifies itself with the community in which the station is located. These stations by and large provide a service which is carefully tailored to match the interests of the residents of that community and consequently develop a loyal listening audience. If there are two stations carrying similar programming the listener will usually opt for the station which identifies itself with his community.

These stations will sometimes have listeners in their weak signal areas if there is no local station providing a similar service. Generally speaking, however, these stations' audiences are located within relatively high signal levels and as a result receiver performance is not a big factor in determining if the station will be listened to or not. The signals are usually strong enough that they are easy to find, tuning is not critical, there is no fading, and signal-to-noise values are quite acceptable even in high noise urban areas.

3.6.2 Class II and Class III - (continued)

Because of the protection rules which govern nighttime operations of Class II and Class III stations, their nighttime coverage is usually degraded due to skywave interference, but this is true primarily for new stations which have been squeezed into an already crowded situation. Certainly the stations which were originally established enjoy reasonably close daytime and nighttime audience correlation. Even for recently implemented stations when one looks at the percentage of audience within the NIF contour compared to the total audience, it is not much different due to the fact that the NIF contour must cover the community which the station is licenced to serve.

One concludes that this type of service has the potential for a high density of usage, does not tie up daytime spectrum because of nighttime skywave coverage, as is the case with Class I stations, and does have the capability to align itself with a particular community without being wasteful of spectrum. Nighttime levels of interference can be high but in most cases stations provide good nighttime service in the communities which they are located.

3.6.3 Class IV - This class of station cannot be anything other than a local service by definition and is generally used only when no other frequency can be utilized or when economy of transmitting and antenna systems is paramount. There is limited capability for future expansion and thus also little appeal from a business point of view. This is akin to the Class A FM channels which also seem to attract little interest on the part of broadcasters.

3.6.4 Class Designations for New Frequencies

From the foregoing it would seem that the class designation for the new frequencies should be at least similar to the existing Class II or Class III designations with a maximum allowable power of 50 KW. However, there remains the question of what is the useful area of coverage. [redacted] They are invariably able to find a local station which provides a signal far greater than 0.5 mV/m and which also enables them to listen to their own community station. In other parts of the country, where there are fewer population centres, there is probably a very significant portion of the population which does rely on weak signals as its only means of radio coverage. Thus, any change in the definition of protected contours may have to be confined to certain densely populated regions, such as is the case with television co-channel spacings, so that the coverage enjoyed by people of less densely populated regions will not be compromised.

In order to determine whether the 0.5 mV/m contour is a realistic limit of a station's coverage, it was necessary to establish if a significant percentage of listeners of a particular station resided outside of, say, the 5 mV/m field strength contour. This value was chosen since it is usually included in stations' proof of performance maps. It is also the level at which it is believed that receiver inadequacies begin to show up. Sources of man-made noise, when coupled with improper receiver orientation, i.e., loop antenna orientations, can result in reception degraded to the point where the listener becomes fatigued by the low signal-to-noise ratio, impulse noise, buzz from florescent lights, motors, poor power line insulators, and tunes away. It is not suggested that the 5 mV/m level is the point at which

3.6.4 Class Designations for New Frequencies (continued)

these problems become the dominant factor in people's tuning away, but only that they begin to become a factor at this point. This level, then, was chosen to gauge the relative number of people who would listen to stations with weak signal levels.

To this end, a copy of the Fall 1978 BBM ratings was obtained and the 5 mV/m daytime coverage contours of several stations were plotted on the maps showing the reporting areas used by BBM. The figures for populations contained within and beyond the 5 mV/m contours were quite scattered. One reason for this is that the area contained by the 5 mV/m contour was, in many cases, as large as the reporting areas used by BBM. Where the coverage of a station was very large and included several of the reporting areas it was possible to compile a fairly accurate picture of the distribution of listeners. However, in the majority of cases the 5 mV/m contour was too small in relation to these reporting areas to be reliable. BBM was approached to supply further breakdowns of the census data in order that the distribution of population could be more accurately determined, even for stations whose 5 mV/m contours were relatively small. However, it was not able to supply this data and consequently no firm conclusions could be drawn from the results obtained as described above. There was, however, a trend which did show up and that was that large market stations tended to have listenership which extended far beyond the 5 mV/m contour and in fact may have extended beyond the half millivolt contour in some cases. Small market stations tended to have listeners which were concentrated in the community which they were licenced to serve, with very few beyond those areas. It seems evident that the large market stations have larger budgets for programming and for on-air personalities and consequently can deliver a product which is considered desireable in spite of the reception problems that arise in weak signal areas. In other words, if the programming is right, people's

3.6.4 Class Designations for New Frequencies (continued)

tolerance to various forms of interference rises dramatically.

3.6.5 Conclusions

[redacted] While it seems possible, and desireable, in the interests of greater density of stations, to increase the signal strength level which defines the protected contour, the brief examination of the situation that was undertaken did not confirm this. The listenership in weak signal areas seems to be more a function of programming and on-air personalities than of the absolute level of signal strength. [redacted]

3.7 TASK 7 - Determine the limitations imposed on AM stereo by using 9 KHz separation.

3.7.1 Information on Stereo Systems

All of the U.S. companies who are proposing an AM broadcast stereo system were contacted. Information was forwarded by these companies on their particular systems.

Also, a copy of a report published by the Electronic Industries Association on AM stereo was obtained. A complete listing of all the published material received is given in Table 8.

3.7.2 Review of Proposed Systems

All of the material on the proposed systems was reviewed, and the following conclusions were drawn and are applicable to all systems.

a) In order to achieve compatability with existing AM receivers equipped only with an envelope detector, the combined left and right channels (L + R) are amplitude modulated on the carrier.

b) Nothwithstanding the claims of the various companies and individuals as to the merits of their particular system of modulation, in all of the systems the stereo, or difference channel L-R, is transmitted as an angular (phase or frequency) modulation of the carrier.

3.7.3 Occupied Bandwidth of AM Stereo Transmissions

The occupied bandwidth due to the amplitude modulated components will be defined by the spectral distribution of the program material and was dealt with in Task 5. The occupied bandwidth due to the angular modulation (PM or FM) components is governed not only by the spectral distribution of the program material, but also the modulation index of the angular modulation. All of the systems propose a modulation index (β) of one or less. The actual choice is a compromise between stereo effect (separation) and noise immunity on the one hand and occupied bandwidth and distortion on the other. With a modulation index of unity the first order sidebands, which are co-incident with the AM sidebands, have a magnitude of .44 (-7.13 dB) relative to the carrier. The second order sidebands, which occur at twice the modulating frequency, have a magnitude of 0.115 (-19 dB) relative to the carrier. The third order components, which occur at three times the modulating frequency, have a magnitude of 0.02 (-34 dB) relative to the carrier and can be neglected when considering occupied bandwidth.

3.7.3 Occupied Bandwidth of AM Stereo Transmissions (continued)

It would appear that with all AM stereo systems, as now proposed, the high-level, high-frequency modulation components in the angular modulation channel (L-R) will produce components which increase the occupied bandwidth compared to monaural operation. This shortcoming has been recognized, and there are recommendations to restrict the bandwidth of the stereo channel to 7.5 KHz such that the second order modulation components do not exceed 15 KHz, and thus the systems can comply with present FCC occupied bandwidth rules.

The occupied bandwidth of the stereo channel in actual operation will depend on the program material. Extreme unbalance between the right and left channels is believed to occur rarely. To verify this, measurements were made on the baseband spectrum of an FM stereo broadcast station and this is shown in Figure 26. The left-plus-right channel modulation shows the natural fall-off in the high frequency area mentioned in the occupied bandwidth study. The natural slope is about 6 to 7 dB per octave above 5 KHz. The 19 KHz pilot is used as a reference, being set at -20 dB relative to the peak carrier deviation. What is of interest in this figure, is the relative levels of the left-minus-right modulation compared with the left-plus-right modulation. The two sidebands of the left-minus-right modulation are well defined above and below 38 KHz. Comparing the modulation levels, it would appear that the left-minus-right modulation of the combined upper and lower sidebands is between 4 to 6 dB lower than the left-plus-right modulation. Also, the fall-off at the higher frequencies is less in the left-minus-right channel than in the left-plus-right channel. This can be attributed to the fact that because of the shorter wavelength at the higher audio frequencies there is much less chance of partial cancellation, such that the instantaneous levels of the left-minus-right channel will tend to increase with frequency. This increase is not enough to compensate

3.7.3 Occupied Bandwidth of AM Stereo Transmissions (continued)

for the natural fall-off previously mentioned. The slope in the left-minus-right channel is about 3 dB per octave compared with 6 to 7 dB per octave in the left-plus-right channel.

From the derived data it would appear that the average modulation in the left-minus-right channel will be 4 to 6 dB below that in the left-plus-right channel. As stated previously, the left-minus-right channel information in all of the proposed AM stereo systems is transmitted by angular modulation of the carrier. Also, the magnitude of this angular modulation is restricted to a β equal to or less than unity. With typical program material, the modulation index will be of the order of 0.5, such that the second-order modulation components will be in the neighbourhood of 0.03 or -25dB relative to the carrier. The second-order modulation products of the angular modulation should not, therefore, increase the occupied bandwidth of the emitted spectrum.

3.7.4 Conclusions - The following conclusions may be drawn with regard to the limitation imposed on AM stereo by using 9 KHz separation.

a) With the AM stereo systems proposed, and typical broadcasting program material, the occupied bandwidth of AM broadcast transmitter emissions will not be increased by stereo broadcasting. However, since more information is being transmitted, the total sideband energy will be increased such that there will be marginally increased adjacent channel interference with stereo transmission.

3.7.4 Conclusions (continued)

b) The use of pre-emphasis by broadcasters to improve the overall response of AM systems, by compensating at the transmitter for the passband characteristics of typical receivers, may not be practical with AM stereo systems. The reason for this is that pre-emphasis of the angular channel modulation is proposed to improve the noise performance of this channel. The use of additional program material pre-emphasis will require the very careful adjustment of levels in order to avoid overmodulating the stereo channel. Overmodulation will show up as increased distortion in the channel and increased occupied bandwidth.

c) The change to 9 KHz separation will require improvements in AM receiver design to maintain the present performance with 10 KHz separation. It is felt that if an AM stereo system is implemented, receiver manufacturers will attempt to improve receiver passband performance as an incentive to buyers of such radios. Further, since FM stereo is widely used in North America, there will probably be an effort by competing manufacturers to reduce the differences in subjective performance between the two types of stereo transmission. The change in channel separation from 10 KHz to 9 KHz will make the task of improving the receiver performance more difficult. However, component manufacturers have, to date, made considerable improvements in low-cost selective filters, and there is reason to believe that the implementation of an AM stereo system would add further impetus to develop even better devices.

TABLE 8

LIST OF MATERIALS RECEIVED PERTAINING TO STEREOPHONIC BROADCASTING

1. National AM stereophonic radio committee final report dated December 1977.

2. Supplement to final report dated March 8, 1978.

3. Belar Electronics Laboratory.
   Comments in response to FCC notice of proposed rule making re AM stereophonic broadcasting dated May 29, 1978.

4. Harris Corporation Broadcast Products Division Reply on comments of the Harris Corporation.

   a) Volume 1 dated May 15, 1979.
   b) Volume 2 dated May 15, 1979.
   c) Volume 1 dated August 3, 1979.
   d) Volume 2 dated August 3, 1979.
   e) C.P.M. AM stereo system description dated October 1977.

5. Kahn Communications Inc.

   a) Reply comments in response to FCC notice of inquiry regarding AM stereophonic broadcasting dated March 6, 1978.
   b) Reply comments in response to FCC notice of proposed notice of rule making regarding AM stereophonic broadcasting dated August 1, 1979.

6. Magnavox Consumer Electronics Company.

   a) Response to notice of inquiry on AM stereophonic broadcasting
   b) Response to notice of proposed rule making on AM stereophonic broadcasting dated May 3, 1979.
   c) Reply comments to proposed rule making dated May 15, 1979.

7. CKLW Broadcasting Ltd.

   Test results of the Harris Corporation V-C.P.M. AM stereophonic broadcasting system dated July 13, 1979.

8. Motorola Inc.

   a) Comments of Motorola Inc. on the notice of proposed rule making in the matter of the adoption of technical standards for compatible AM stereophonic broadcasting.
   b) AM stereophonic compatible quadrature modulation.

APPENDIX I

ANTENNA PATTERN PRINT-OUTS

FOR

REPRESENTATIVE STATIONS

CFUN DAY

CASE 1 1410.0 KHZ

N= 2 RMS=1640.0 UV=1098.9

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	180.50
2	1.0000	-48.00	120.00	0.	180.50

CASE 2 1406.0 KHZ

N= 2 RMS=1640.0 UV=1098.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	179.99
2	1.0000	-48.34	119.66	0.	179.99

CASE 3 1414.0 KHZ

N= 2 RMS=1640.0 UV=1099.7

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	181.02
2	1.0000	-47.66	120.34	0.	181.02

CASE 4 1314.0 KHZ

N= 2 RMS=1640.0 UV=1086.0

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	168.21
2	1.0000	-56.17	111.83	0.	168.21

ELEVATION ANGLE= Ø.

	CASE 1	CASE 2	CASE 3	CASE 4
AZIM	MV/M	MV/M	MV/M	MV/M
Ø	1778.1	1784.5	1771.6	192Ø.9
1Ø	1798.4	18Ø4.6	179Z.Z	1935.7
ZØ	1856.1	1861.6	185Ø.5	1977.Z
3Ø	1941.Z	1945.6	1936.8	ZØ36.7
4Ø	ZØ38.3	ZØ41.Z	ZØ35.4	Z1ØØ.5
5Ø	Z127.Z	Z128.4	Z125.9	Z151.7
6Ø	Z185.8	Z185.3	Z186.Z	Z17Z.1
7Ø	Z193.8	Z191.7	Z195.8	Z145.6
8Ø	Z136.4	Z133.1	Z139.6	ZØ61.3
9Ø	ZØØ7.8	ZØØ3.8	ZØ11.8	1916.3
1ØØ	1813.Ø	18Ø8.8	1817.3	1716.4
11Ø	1567.Ø	1563.Ø	1571.1	1475.5
1ZØ	1Z91.8	1Z88.3	1Z95.4	1Z13.3
13Ø	1Ø1Z.5	1ØØ9.8	1Ø15.3	951.3
14Ø	753.Ø	751.1	755.Ø	71Ø.1
15Ø	533.1	531.9	534.3	5Ø6.7
16Ø	367.Z	366.6	367.9	353.7
17Ø	Z64.5	Z64.Z	Z64.8	Z59.Ø
18Ø	ZZ9.7	ZZ9.6	ZZ9.9	ZZ7.Ø
19Ø	Z64.5	Z64.Z	Z64.8	Z59.Ø
ZØØ	367.Z	366.6	367.9	353.7
Z1Ø	533.1	531.9	534.3	5Ø6.7
Z2Ø	753.Ø	751.1	755.Ø	71Ø.1
Z3Ø	1Ø1Z.5	1ØØ9.8	1Ø15.3	951.3
Z4Ø	1Z91.8	1Z88.3	1Z95.4	1Z13.3
Z5Ø	1567.Ø	1563.Ø	1571.1	1475.5
Z6Ø	1813.Ø	18Ø8.8	1817.3	1716.4
Z7Ø	ZØØ7.8	ZØØ3.8	ZØ11.8	1916.3
Z8Ø	Z136.4	Z133.1	Z139.6	ZØ61.3
Z9Ø	Z193.8	Z191.7	Z195.8	Z145.6
3ØØ	Z185.8	Z185.3	Z186.Z	Z17Z.1
31Ø	Z1Z7.Z	Z1Z8.4	Z1Z5.9	Z151.7
3ZØ	ZØ38.3	ZØ41.Z	ZØ35.4	Z1ØØ.5
33Ø	1941.Z	1945.6	1936.8	ZØ36.7
34Ø	1856.1	1861.6	185Ø.5	1977.Z
35Ø	1798.4	18Ø4.6	179Z.Z	1935.7

CFUN NITE

CASE 1 1410.0 KHZ

N= 2 RMS=1670.0 UV=1272.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	180.50
2	0.8500	-90.00	105.00	317.00	180.50

CASE 2 1406.0 KHZ

N= 2 RMS=1670.0 UV=1273.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	179.99
2	0.8500	-90.25	104.71	317.00	179.99

CASE 3 1414.0 KHZ

N= 2 RMS=1670.0 UV=1271.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	181.02
2	0.8500	-89.73	105.31	317.00	181.02

CASE 4 1314.0 KHZ

N= 2 RMS=1670.0 UV=1299.6

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	168.21
2	0.8500	-96.12	97.86	317.00	168.21

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	2338.5	2339.0	2337.9	2349.7
10	2290.3	2289.9	2290.8	2279.4
20	2196.3	2195.0	2197.7	2165.5
30	2048.0	2046.0	2050.1	2001.9
40	1843.5	1841.2	1846.1	1788.8
50	1589.1	1586.7	1591.8	1532.8
60	1298.5	1296.3	1300.9	1247.2
70	991.0	989.2	993.0	949.7
80	689.6	688.4	691.0	661.4
90	420.7	420.1	421.5	406.8
100	228.6	228.5	228.6	228.8
110	204.3	204.4	204.2	206.9
120	285.9	285.7	286.1	281.2
130	347.5	347.1	347.9	338.3
140	358.4	358.0	358.8	348.5
150	315.8	315.4	316.0	308.8
160	234.4	234.4	234.5	234.1
170	195.0	195.1	194.9	198.6
180	330.5	330.1	331.0	322.5
190	576.4	575.4	577.6	553.8
200	868.4	866.8	870.1	832.0
210	1176.3	1174.2	1178.6	1128.5
220	1476.2	1473.9	1478.8	1421.2
230	1747.1	1744.7	1749.8	1690.9
240	1972.7	1970.6	1975.1	1922.4
250	2143.7	2142.2	2145.5	2106.1
260	2258.8	2258.0	2259.6	2239.5
270	2324.0	2324.1	2323.8	2326.2
280	2350.7	2351.7	2349.5	2375.0
290	2352.9	2354.8	2350.8	2397.1
300	2344.4	2347.0	2341.6	2403.7
310	2336.0	2339.0	2332.8	2404.2
320	2334.4	2337.4	2331.1	2404.1
330	2340.5	2343.3	2337.5	2404.2
340	2350.1	2352.3	2347.7	2401.0
350	2353.7	2355.1	2352.1	2386.4

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	2198.6	2200.0	2197.2	2228.0
10	2151.6	2152.1	2151.1	2160.1
20	2062.4	2062.0	2062.8	2051.7
30	1923.4	1922.3	1924.5	1897.4
40	1733.0	1731.6	1734.6	1697.3
50	1497.1	1495.4	1498.9	1457.6
60	1228.0	1226.5	1229.8	1190.6
70	943.6	942.3	945.1	912.8
80	664.6	663.7	665.7	643.2
90	414.6	414.1	415.1	404.2
100	229.5	229.5	229.6	230.6
110	184.3	184.5	184.1	189.4
120	248.1	248.1	248.1	247.7
130	302.2	302.0	302.4	298.1
140	312.0	311.8	312.2	307.3
150	274.1	274.0	274.2	271.8
160	205.6	205.7	205.4	208.6
170	190.4	190.6	190.3	194.9
180	329.6	329.3	330.0	323.8
190	559.6	558.9	560.5	542.5
200	830.1	829.0	831.4	802.8
210	1115.0	1113.5	1116.6	1079.8
220	1392.5	1390.9	1394.3	1353.3
230	1643.6	1642.0	1645.3	1605.6
240	1853.2	1852.0	1854.6	1822.6
250	2013.0	2012.3	2013.7	1995.6
260	2121.5	2121.6	2121.4	2122.0
270	2184.2	2185.2	2183.1	2205.2
280	2211.3	2213.2	2209.3	2252.9
290	2215.5	2218.2	2212.7	2275.4
300	2209.3	2212.5	2205.8	2283.2
310	2202.5	2206.1	2198.7	2284.5
320	2201.2	2204.8	2197.3	2284.5
330	2206.2	2209.6	2202.6	2284.1
340	2213.7	2216.6	2210.5	2279.8
350	2215.0	2217.2	2212.6	2264.3

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1823.5	1827.0	1819.9	1898.3
10	1780.6	1783.3	1777.8	1837.8
20	1704.9	1706.9	1702.9	1744.8
30	1590.9	1592.2	1589.6	1615.3
40	1437.7	1438.5	1437.0	1449.9
50	1249.9	1250.2	1249.6	1253.5
60	1036.9	1037.1	1036.9	1035.7
70	812.4	812.4	812.4	809.4
80	591.7	591.7	591.8	589.6
90	391.9	391.9	391.9	392.3
100	233.7	233.9	233.6	238.4
110	153.4	153.7	153.0	162.3
120	165.2	165.5	164.8	173.3
130	196.4	196.7	196.1	202.7
140	202.8	203.1	202.5	208.8
150	179.2	179.5	178.8	186.4
160	150.2	150.6	149.8	159.4
170	189.5	189.8	189.3	196.2
180	322.1	322.2	322.1	324.0
190	508.3	508.3	508.3	507.0
200	722.7	722.7	722.8	719.9
210	947.7	947.7	947.7	945.4
220	1167.0	1167.3	1166.9	1168.2
230	1366.3	1366.9	1365.8	1374.6
240	1534.2	1535.3	1533.1	1553.3
250	1664.0	1665.7	1662.3	1697.5
260	1754.7	1757.1	1752.2	1804.8
270	1809.8	1813.0	1806.5	1877.6
280	1836.9	1840.8	1832.9	1921.8
290	1845.4	1849.9	1840.7	1944.9
300	1844.4	1849.3	1839.2	1954.8
310	1841.3	1846.5	1835.8	1958.0
320	1840.6	1845.9	1835.1	1958.4
330	1843.0	1848.1	1837.7	1956.6
340	1845.6	1850.3	1840.7	1950.0
350	1842.0	1846.2	1837.7	1933.1

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1325.0	1330.8	1319.0	1451.0
10	1290.0	1295.2	1284.6	1402.1
20	1233.5	1238.1	1228.8	1330.8
30	1152.6	1156.6	1148.6	1234.8
40	1047.0	1050.4	1043.7	1114.8
50	919.8	922.5	917.1	974.3
60	777.0	779.1	774.8	819.8
70	626.9	628.6	625.2	659.9
80	479.2	480.5	478.0	504.2
90	344.1	345.0	343.1	362.8
100	231.4	232.1	230.7	246.0
110	152.3	152.8	151.7	165.3
120	115.4	116.0	114.8	128.6
130	109.8	110.3	109.2	123.1
140	110.1	110.7	109.5	123.4
150	110.9	111.5	110.4	124.2
160	132.4	132.9	131.8	145.4
170	195.1	195.7	194.5	208.7
180	295.7	296.5	294.9	312.5
190	423.1	424.2	422.0	445.3
200	567.0	568.5	565.5	596.5
210	717.3	719.2	715.3	756.0
220	864.1	866.6	861.6	913.8
230	998.5	1001.6	995.4	1060.8
240	1113.3	1117.0	1109.5	1189.5
250	1204.2	1208.5	1199.7	1295.4
260	1270.2	1275.2	1265.0	1376.4
270	1313.3	1318.9	1307.5	1433.9
280	1337.7	1343.8	1331.4	1471.2
290	1349.0	1355.6	1342.2	1493.1
300	1352.7	1359.5	1345.6	1504.4
310	1353.1	1360.2	1345.9	1509.1
320	1353.1	1360.2	1345.8	1509.8
330	1353.0	1360.0	1345.9	1506.9
340	1351.1	1357.8	1344.2	1498.6
350	1343.5	1349.8	1337.0	1481.6

CHLO DAY

CASE 1 1570.0 KHZ

N= 8 RMS= 595.0 UV= 122.8

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	120.90
2	3.0000	12.00	200.00	80.00	120.90
3	3.0000	12.00	400.00	80.00	120.90
4	1.0000	12.00	600.00	80.00	120.90
5	1.0000	94.00	90.00	170.00	120.90
6	3.0000	106.00	219.31	104.23	120.90
7	3.0000	106.00	410.00	92.68	120.90
8	1.0000	106.00	606.70	88.53	120.90

CASE 2 1574.0 KHZ

N= 8 RMS= 595.0 UV= 122.9

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	121.21
2	3.0000	11.49	200.51	80.00	121.21
3	3.0000	11.49	401.02	80.00	121.21
4	1.0000	11.49	601.53	80.00	121.21
5	1.0000	93.78	90.23	170.00	121.21
6	3.0000	105.22	219.87	104.23	121.21
7	3.0000	105.22	411.04	92.68	121.21
8	1.0000	105.22	608.25	88.53	121.21

CASE 3 1566.0 KHZ

N= 8 RMS= 595.0 UV= 122.6

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	120.59
2	3.0000	12.51	199.49	80.00	120.59
3	3.0000	12.51	398.98	80.00	120.59
4	1.0000	12.51	598.47	80.00	120.59
5	1.0000	94.22	89.77	170.00	120.59
6	3.0000	106.73	218.75	104.23	120.59
7	3.0000	106.73	408.96	92.68	120.59
8	1.0000	106.73	605.15	88.53	120.59

CASE 4 1458.0 KHZ

N= 8 RMS= 595.0 UV= 119.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	112.28
2	3.0000	26.27	185.73	80.00	112.28
3	3.0000	26.27	371.46	80.00	112.28
4	1.0000	26.27	557.19	80.00	112.28
5	1.0000	100.14	83.58	170.00	112.28
6	3.0000	126.41	203.66	104.23	112.28
7	3.0000	126.41	380.75	92.68	112.28
8	1.0000	126.41	563.42	88.53	112.28

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1662.6	1665.6	1659.7	1578.0
10	1059.1	1059.5	1058.9	1051.6
20	498.0	495.6	500.5	565.5
30	179.2	175.9	182.6	274.1
40	69.2	66.4	71.9	148.3
50	47.0	45.0	48.9	102.0
60	43.1	41.2	44.9	88.0
70	35.7	33.7	37.6	79.5
80	29.6	27.8	31.3	69.4
90	26.6	25.1	28.0	58.5
100	23.5	22.5	24.5	47.0
110	18.1	17.4	18.8	38.1
120	17.7	17.0	18.3	36.5
130	27.2	26.9	27.7	39.7
140	35.3	35.6	35.4	38.0
150	13.2	13.8	13.2	12.4
160	38.2	37.7	38.1	34.1
170	68.4	67.9	68.1	61.2
180	40.1	39.5	40.0	37.5
190	14.4	14.9	14.5	14.7
200	38.8	38.9	39.1	46.6
210	24.1	23.8	24.5	40.1
220	9.3	8.9	9.8	23.7
230	17.8	17.1	18.5	33.2
240	24.1	23.2	25.0	46.8
250	33.1	32.2	34.0	58.6
260	41.6	40.6	42.5	69.8
270	44.5	43.2	45.7	79.6
280	44.3	42.6	46.0	87.8
290	46.4	44.5	48.2	89.1
300	36.8	34.9	38.5	96.6
310	158.8	155.4	162.2	276.8
320	548.0	543.0	553.0	694.2
330	1158.4	1154.4	1162.3	1257.7
340	1743.3	1743.0	1743.5	1735.4
350	1958.5	1961.5	1955.5	1866.9

CHLO NITE

CASE 1 1570.0 KHZ

N= 8 RMS= 601.0 UV= 155.6

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	120.90
2	2.2740	49.60	200.00	80.00	120.90
3	2.2740	96.86	400.00	80.00	120.90
4	1.0000	146.50	600.00	80.00	120.90
5	1.0000	95.00	90.00	170.00	120.90
6	2.2740	144.60	219.31	104.23	120.90
7	2.2740	191.85	410.00	92.68	120.90
8	1.0000	241.50	606.70	88.53	120.90

CASE 2 1574.0 KHZ

N= 8 RMS= 601.0 UV= 156.0

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	121.21
2	2.2700	49.33	200.51	80.00	121.21
3	2.2700	96.11	401.02	80.00	121.21
4	1.0000	145.44	601.53	80.00	121.21
5	1.0000	94.74	90.23	170.00	121.21
6	2.2700	144.07	219.87	104.23	121.21
7	2.2700	190.85	411.04	92.68	121.21
8	1.0000	240.18	608.25	88.53	121.21

CASE 3 1566.0 KHZ

N= 8 RMS= 601.0 UV= 155.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	120.59
2	2.2766	50.00	199.49	80.00	120.59
3	2.2766	97.48	398.98	80.00	120.59
4	1.0000	147.47	598.47	80.00	120.59
5	1.0000	95.52	89.77	170.00	120.59
6	2.2766	145.51	218.75	104.23	120.59
7	2.2766	193.00	408.96	92.68	120.59
8	1.0000	242.99	605.15	88.53	120.59

CASE 4 1458.0 KHZ

N= 8 RMS= 601.0 UV= 145.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	112.28
2	2.3673	58.83	185.73	80.00	112.28
3	2.3673	115.70	371.46	80.00	112.28
4	1.0000	174.54	557.19	80.00	112.28
5	1.0000	101.20	83.58	170.00	112.28
6	2.3673	159.85	203.66	104.23	112.28
7	2.3673	216.73	380.75	92.68	112.28
8	1.0000	275.56	563.42	88.53	112.28

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	706.9	713.8	702.3	557.8
10	132.2	134.6	131.9	101.3
20	53.8	53.2	52.2	39.5
30	8.9	10.2	10.0	7.0
40	83.5	85.7	83.8	61.5
50	59.2	61.2	59.8	43.9
60	30.1	29.1	28.5	21.4
70	105.5	105.5	103.0	76.7
80	120.3	120.6	117.6	87.3
90	78.0	78.0	76.0	56.3
100	16.2	15.7	15.2	11.6
110	22.4	23.2	22.4	15.8
120	20.7	21.3	20.5	14.5
130	1.3	1.5	1.4	1.1
140	3.4	3.3	3.1	2.1
150	0.5	0.5	0.1	0.8
160	22.4	22.5	24.1	16.2
170	64.3	64.4	67.7	49.8
180	62.9	62.6	67.8	52.6
190	7.3	7.9	2.1	7.0
200	86.8	86.8	83.5	95.6
210	107.0	105.3	106.6	150.6
220	66.0	62.9	67.7	146.3
230	8.5	5.2	10.7	103.9
240	31.9	34.6	30.4	57.2
250	52.0	53.9	51.5	25.7
260	62.9	64.6	62.8	15.6
270	70.3	72.8	69.7	34.9
280	59.3	64.1	56.8	108.0
290	22.4	13.8	28.5	282.6
300	266.5	253.5	276.6	612.2
310	746.6	731.8	758.7	1098.1
320	1394.8	1383.7	1403.8	1614.8
330	1925.4	1923.2	1926.8	1912.4
340	1983.8	1990.6	1977.9	1773.7
350	1474.3	1484.2	1466.3	1224.2

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	696.8	703.5	692.2	550.8
10	140.1	142.5	139.7	107.5
20	50.9	50.2	49.3	37.4
30	1.5	2.7	2.6	1.5
40	77.1	79.2	77.5	56.9
50	66.0	68.0	66.5	48.8
60	8.0	6.8	6.7	5.3
70	74.6	74.3	72.6	54.1
80	89.9	89.9	87.7	65.2
90	55.4	55.2	53.8	40.0
100	4.3	3.7	3.6	3.1
110	25.4	26.2	25.4	18.0
120	19.8	20.4	19.6	13.9
130	0.2	0.4	0.4	0.6
140	3.7	3.7	3.5	2.3
150	2.1	2.2	1.7	2.0
160	13.9	13.8	15.6	9.9
170	45.4	45.3	48.8	35.1
180	38.4	37.9	43.2	32.0
190	28.2	28.9	23.2	26.6
200	100.7	100.6	97.4	109.9
210	116.9	115.2	116.5	161.3
220	75.2	72.1	77.0	156.6
230	16.9	13.5	19.2	115.5
240	25.8	28.7	24.0	69.6
250	48.3	50.5	47.3	38.5
260	59.9	62.1	59.4	29.7
270	65.0	68.0	63.9	52.2
280	47.4	52.6	44.3	130.1
290	44.0	35.0	50.3	308.1
300	293.8	280.9	303.8	633.5
310	764.5	750.2	776.1	1101.3
320	1382.9	1372.4	1391.4	1588.1
330	1877.3	1875.5	1878.5	1859.6
340	1920.9	1927.5	1915.2	1717.8
350	1430.5	1440.1	1422.8	1189.3

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	666.0	672.2	661.6	529.4
10	161.9	164.4	161.3	124.9
20	39.2	38.6	37.9	28.9
30	16.8	16.0	15.6	12.1
40	55.2	56.9	55.7	41.0
50	72.9	74.8	73.1	53.9
60	36.5	38.1	37.2	27.2
70	6.6	5.7	5.5	4.5
80	21.3	20.7	20.2	15.3
90	5.0	4.3	4.2	3.4
100	20.5	21.4	20.8	14.8
110	29.6	30.5	29.5	21.1
120	15.6	16.1	15.5	11.1
130	3.1	2.9	2.8	2.1
140	4.1	4.1	3.9	2.6
150	7.9	8.1	7.4	6.2
160	10.0	10.4	8.2	7.9
170	4.9	5.4	1.4	4.2
180	26.2	27.0	21.5	22.3
190	84.5	85.3	79.8	78.9
200	139.8	139.6	136.7	149.6
210	146.9	145.0	146.4	192.0
220	104.6	101.3	106.3	187.4
230	45.5	41.7	48.1	150.8
240	1.8	5.4	0.7	108.9
250	29.6	32.9	27.6	80.6
260	42.1	45.5	40.2	76.5
270	39.2	43.6	36.7	107.9
280	3.1	9.6	1.2	197.4
290	112.0	102.5	119.1	380.8
300	371.2	358.8	381.0	688.4
310	808.1	795.3	818.4	1101.2
320	1340.1	1331.4	1347.0	1504.6
330	1736.4	1735.3	1736.9	1706.6
340	1742.5	1748.6	1737.1	1557.3
350	1306.3	1314.9	1299.3	1090.0

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	613.6	619.1	609.7	492.2
10	191.9	194.5	191.0	149.4
20	13.2	12.4	12.3	9.5
30	33.6	33.1	32.5	24.8
40	18.0	19.1	18.7	13.7
50	55.7	57.2	56.0	41.4
60	58.1	59.7	58.3	43.1
70	43.8	45.1	44.1	32.5
80	33.9	35.1	34.2	25.0
90	33.7	34.8	33.9	24.7
100	34.3	35.2	34.3	24.9
110	24.7	25.4	24.7	17.8
120	5.9	6.2	6.0	4.3
130	7.7	7.6	7.4	5.4
140	2.1	2.0	1.9	1.2
150	20.0	20.4	19.4	15.2
160	44.7	45.4	42.7	34.4
170	69.8	70.8	66.3	55.8
180	107.6	108.7	103.1	91.4
190	157.9	158.7	153.6	146.1
200	195.7	195.4	192.8	203.3
210	194.9	193.1	194.3	237.0
220	155.7	152.4	157.2	235.5
230	100.6	96.5	103.4	208.8
240	52.6	48.2	55.8	176.8
250	22.5	17.9	25.7	157.0
260	12.8	7.9	16.3	162.2
270	29.2	23.2	33.4	205.3
280	89.4	81.7	95.0	304.9
290	227.3	217.6	234.8	483.0
300	479.8	468.8	488.6	749.4
310	848.1	838.0	856.2	1072.3
320	1249.2	1243.0	1253.9	1357.1
330	1513.5	1513.4	1513.0	1470.0
340	1477.1	1482.4	1472.4	1319.5
350	1120.9	1128.0	1114.9	940.8

ELEVATION ANGLE= 40.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	539.8	544.3	536.5	438.4
10	220.2	222.8	218.9	173.7
20	29.8	30.7	30.1	23.4
30	31.0	30.6	30.1	23.1
40	17.4	16.9	16.5	12.8
50	13.7	14.6	14.3	10.5
60	33.7	34.7	34.0	25.2
70	39.4	40.5	39.6	29.4
80	37.3	38.3	37.4	27.6
90	31.3	32.2	31.4	23.1
100	21.2	21.9	21.3	15.6
110	6.8	7.2	7.0	5.1
120	6.7	6.5	6.3	4.7
130	9.2	9.1	8.8	6.5
140	6.8	7.1	6.8	5.4
150	40.0	40.6	39.2	30.5
160	82.6	83.6	80.5	64.4
170	129.1	130.5	125.9	104.5
180	178.1	179.5	174.2	152.1
190	223.5	224.5	219.8	205.0
200	251.5	251.4	248.9	252.9
210	250.5	249.1	249.7	282.6
220	222.2	219.4	223.2	288.9
230	180.7	176.8	183.1	277.9
240	142.4	137.8	145.7	263.0
250	119.3	114.1	123.1	258.2
260	119.0	113.2	123.3	275.7
270	150.1	143.5	155.1	327.3
280	226.5	218.9	232.4	424.3
290	365.7	357.3	372.3	574.8
300	577.8	569.3	584.4	772.7
310	843.2	836.3	848.4	984.4
320	1094.8	1091.3	1097.1	1144.5
330	1229.7	1230.4	1228.4	1177.1
340	1164.4	1168.6	1160.4	1039.7
350	900.7	906.1	896.0	761.9

ELEVATION ANGLE= 50.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	446.9	450.3	444.2	368.3
10	234.0	236.3	232.5	187.8
20	81.7	82.9	81.4	64.5
30	2.1	2.6	2.5	2.0
40	22.3	22.0	21.6	16.8
50	18.5	18.2	17.9	13.8
60	7.5	7.1	6.9	5.4
70	0.6	1.0	1.0	0.6
80	3.0	3.4	3.3	2.4
90	0.5	0.8	0.8	0.6
100	5.1	4.8	4.7	3.6
110	10.4	10.2	10.0	7.6
120	10.3	10.2	10.0	7.5
130	0.8	1.0	1.0	0.9
140	26.5	27.0	26.2	20.4
150	65.9	66.7	64.9	51.3
160	114.5	115.7	112.5	91.1
170	166.6	168.0	163.9	137.0
180	216.7	218.0	213.5	186.3
190	258.2	259.2	255.1	234.7
200	284.4	284.6	282.0	276.6
210	291.3	290.5	290.2	306.5
220	281.2	279.2	281.4	323.0
230	262.0	259.0	263.4	329.8
240	244.0	240.2	246.4	334.4
250	237.0	232.5	240.1	345.9
260	249.0	243.9	252.6	372.7
270	287.3	281.8	291.4	421.9
280	358.8	352.9	363.1	497.8
290	467.2	461.4	471.5	599.1
300	607.4	602.3	611.1	714.6
310	757.3	753.8	759.6	820.1
320	876.4	875.1	876.7	880.5
330	916.3	917.6	914.7	863.0
340	845.8	848.9	842.7	754.5
350	672.8	676.6	669.4	574.2

ELEVATION ANGLE= 60.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	339.8	342.1	337.8	284.5
10	221.2	223.1	219.8	181.1
20	123.1	124.3	122.3	99.0
30	54.5	55.3	54.3	43.4
40	14.3	14.8	14.5	11.5
50	4.9	4.6	4.5	3.6
60	11.8	11.6	11.4	8.9
70	13.2	13.0	12.8	9.9
80	12.6	12.5	12.2	9.5
90	11.4	11.2	11.0	8.5
100	8.8	8.7	8.5	6.5
110	3.1	3.0	2.9	2.2
120	8.1	8.3	8.1	6.4
130	26.9	27.4	26.7	21.1
140	54.5	55.2	53.9	42.9
150	89.9	90.8	88.8	71.7
160	130.7	131.8	129.0	106.4
170	173.3	174.5	171.1	145.0
180	213.6	214.8	211.2	184.8
190	247.9	248.9	245.6	223.3
200	273.3	273.8	271.4	257.6
210	288.8	288.7	287.5	286.1
220	295.9	295.1	295.2	308.5
230	298.2	296.7	298.3	326.5
240	300.7	298.7	301.5	343.4
250	308.9	306.3	310.2	363.0
260	327.0	324.2	328.7	389.0
270	358.6	355.6	360.5	423.6
280	404.8	401.8	406.6	466.7
290	463.5	460.8	465.1	514.9
300	527.6	525.7	528.6	560.5
310	584.5	583.5	584.6	592.0
320	617.1	617.3	616.3	596.5
330	609.9	611.2	608.2	564.5
340	555.2	557.4	553.0	494.4
350	459.1	461.5	456.7	395.3

CKJD DAY

CASE 1 1110.0 KHZ

N= 4 RMS= 555.0 UV= 172.1

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	110.00
2	2.9732	-119.03	70.00	70.50	67.00
3	2.9732	121.93	140.00	70.50	67.00
4	1.0000	10.79	216.75	69.34	67.00

CASE 2 1106.0 KHZ

N= 4 RMS= 555.0 UV= 173.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	109.60
2	2.9734	-119.25	69.75	70.50	66.76
3	2.9734	121.49	139.50	70.50	66.76
4	1.0000	10.13	215.97	69.34	66.76

CASE 3 1114.0 KHZ

N= 4 RMS= 555.0 UV= 171.1

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	110.40
2	2.9730	-118.82	70.25	70.50	67.24
3	2.9730	122.37	140.50	70.50	67.24
4	1.0000	11.44	217.53	69.34	67.24

CASE 4 1044.0 KHZ

N= 4 RMS= 555.0 UV= 191.0

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	103.46
2	2.9790	-122.67	65.84	70.50	63.02
3	2.9790	115.62	131.68	70.50	63.02
4	1.0000	-0.12	203.86	69.34	63.02

ELEVATION ANGLE= 0.

	CASE 1	CASE 2	CASE 3	CASE 4
AZIM	MV/M	MV/M	MV/M	MV/M
0	440.9	439.8	442.0	427.4
10	590.4	589.4	591.5	576.3
20	732.3	731.5	733.1	720.9
30	854.7	854.3	855.0	848.8
40	950.5	950.7	950.3	951.8
50	1017.7	1018.3	1017.0	1025.6
60	1056.7	1057.6	1055.7	1069.3
70	1069.0	1070.1	1067.9	1083.2
80	1055.2	1056.2	1054.3	1067.7
90	1014.7	1015.4	1014.1	1022.3
100	946.1	946.2	945.9	947.0
110	848.8	848.5	849.2	842.9
120	725.7	724.9	726.5	714.7
130	584.2	583.2	585.2	570.9
140	436.5	435.5	437.6	424.4
150	297.6	296.7	298.6	289.2
160	181.0	180.3	181.7	177.6
170	95.0	94.6	95.6	96.4
180	40.8	40.5	41.1	45.7
190	12.7	12.6	13.0	19.7
200	2.0	1.9	2.2	9.9
210	0.1	0.2	0.1	8.0
220	0.2	0.1	0.5	8.3
230	0.0	0.1	0.2	7.9
240	1.4	1.5	1.1	6.5
250	3.4	3.6	3.2	4.4
260	5.9	6.0	5.7	2.0
270	8.9	9.0	8.6	1.5
280	12.7	12.9	12.5	5.3
290	16.8	17.0	16.6	9.7
300	18.8	19.0	18.5	12.7
310	17.7	17.8	17.5	15.6
320	35.0	34.8	35.2	36.7
330	89.1	88.6	89.6	88.3
340	178.2	177.5	179.0	173.0
350	298.7	297.8	299.8	288.7

CKJD NITE

CASE 1 1110.0 KHZ

N= 9 RMS= 195.0 UV= 45.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	110.00
2	1.9769	116.64	85.00	160.50	109.98
3	1.0000	-126.72	170.00	160.50	109.98
4	1.9253	4.64	207.50	101.50	109.58
5	3.8061	121.28	261.63	117.67	115.02
6	1.9253	-122.08	329.08	127.78	109.98
7	1.0000	9.28	415.00	101.50	110.00
8	1.9769	125.92	464.53	110.50	110.00
9	1.0000	-117.44	523.26	117.67	110.00

CASE 2 1106.0 KHZ

N= 9 RMS= 195.0 UV= 45.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	109.58
2	1.9770	116.87	84.69	160.50	109.58
3	1.0000	-126.26	169.39	160.50	109.58
4	1.9258	5.27	206.75	101.50	109.58
5	3.8073	122.15	260.69	117.67	114.61
6	1.9258	-120.98	327.89	127.78	109.58
7	1.0000	10.55	413.50	101.50	109.58
8	1.9770	127.42	462.86	110.50	109.58
9	1.0000	-115.71	521.37	117.67	109.58

CASE 3 1114.0 KHZ

N= 9 RMS= 195.0 UV= 45.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	110.38
2	1.9767	116.41	85.31	160.50	110.38
3	1.0000	-127.19	170.61	160.50	110.38
4	1.9247	4.00	208.25	101.50	110.38
5	3.8046	120.41	262.57	117.67	115.43
6	1.9247	-123.19	330.27	127.78	110.38
7	1.0000	8.00	416.50	101.50	110.38
8	1.9767	124.41	466.20	110.50	110.38
9	1.0000	-119.19	525.15	117.67	110.38

CASE 4 1044.0 KHZ

N= 9 RMS= 195.0 UV= 45.6

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	103.44
2	1.9795	120.41	79.95	160.50	103.44
3	1.0000	-119.19	159.89	160.50	103.44
4	1.9339	15.07	195.16	101.50	103.44
5	3.8282	135.47	246.07	117.67	108.18
6	1.9339	-104.13	309.51	127.78	103.44
7	1.0000	30.13	390.32	101.50	103.44
8	1.9795	150.54	436.91	110.50	103.44
9	1.0000	-89.06	492.15	117.67	103.44

ELEVATION ANGLE= Ø.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
Ø	572.1	573.3	57Ø.8	581.7
1Ø	612.Ø	61Ø.3	613.7	576.7
2Ø	52Ø.1	516.8	523.4	463.8
3Ø	343.7	34Ø.7	346.8	294.4
4Ø	167.Ø	165.2	168.8	138.9
5Ø	5Ø.8	5Ø.2	51.4	41.4
6Ø	3.2	3.1	3.2	2.6
7Ø	3.7	3.7	3.8	3.Ø
8Ø	Ø.7	Ø.6	Ø.7	Ø.6
9Ø	2.5	2.4	2.5	2.Ø
1ØØ	1.2	1.2	1.2	1.Ø
11Ø	Ø.Ø	Ø.Ø	Ø.Ø	Ø.Ø
12Ø	Ø.1	Ø.1	Ø.1	Ø.1
13Ø	Ø.1	Ø.1	Ø.1	Ø.1
14Ø	Ø.2	Ø.2	Ø.1	Ø.1
15Ø	1.7	1.7	1.7	1.4
16Ø	6.3	6.2	6.4	5.1
17Ø	1Ø.8	1Ø.6	1Ø.9	8.8
18Ø	9.5	9.4	9.6	8.Ø
19Ø	2.Ø	2.Ø	2.Ø	1.8
2ØØ	3.8	3.8	3.8	3.5
21Ø	Ø.6	Ø.7	Ø.6	Ø.6
22Ø	7.8	7.8	7.7	9.2
23Ø	1Ø.9	11.3	1Ø.6	17.Ø
24Ø	5.1	5.6	4.5	15.8
25Ø	2.7	2.4	3.Ø	7.7
26Ø	3.7	4.1	3.2	Ø.7
27Ø	2.9	1.6	4.3	5.2
28Ø	9.2	7.2	11.4	6.9
29Ø	6.9	4.8	9.2	7.9
3ØØ	4.4	5.6	2.9	4.9
31Ø	11.3	1Ø.9	11.7	14.8
32Ø	12.Ø	14.7	9.4	7Ø.2
33Ø	93.5	98.1	88.8	176.Ø
34Ø	241.3	246.6	236.Ø	325.9
35Ø	424.2	428.3	42Ø.1	481.4

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	554.9	556.0	553.7	563.6
10	591.1	589.4	592.7	557.2
20	503.3	500.2	506.5	449.3
30	335.8	332.8	338.8	288.0
40	166.7	164.9	168.5	138.9
50	53.4	52.8	54.1	43.7
60	4.9	4.8	5.0	4.0
70	3.9	3.8	3.9	3.1
80	0.5	0.5	0.5	0.4
90	1.5	1.5	1.5	1.2
100	0.8	0.8	0.8	0.6
110	0.2	0.2	0.2	0.1
120	0.3	0.3	0.3	0.2
130	0.3	0.3	0.2	0.2
140	0.2	0.3	0.2	0.2
150	1.4	1.4	1.4	1.1
160	5.3	5.3	5.4	4.3
170	8.9	8.8	9.0	7.3
180	7.3	7.2	7.4	6.2
190	0.6	0.6	0.6	0.6
200	4.1	4.1	4.1	3.7
210	0.3	0.3	0.3	0.2
220	8.2	8.3	8.1	9.8
230	11.5	11.9	11.2	17.6
240	5.9	6.5	5.4	16.9
250	2.2	1.8	2.6	9.1
260	4.6	4.8	4.3	0.7
270	0.3	1.3	0.9	4.4
280	4.4	2.7	6.1	6.6
290	2.0	0.3	3.8	7.1
300	7.1	8.0	6.1	2.3
310	10.2	9.5	10.9	19.6
320	16.8	19.6	14.0	76.0
330	98.9	103.5	94.3	179.7
340	242.3	247.4	237.1	323.4
350	416.2	420.0	412.3	470.4

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	505.6	506.5	504.6	511.8
10	532.1	530.6	533.5	502.0
20	455.7	452.9	458.4	408.2
30	312.3	309.6	314.9	269.1
40	164.7	162.9	166.4	138.0
50	60.7	59.9	61.4	49.8
60	10.6	10.4	10.7	8.6
70	3.1	3.0	3.1	2.5
80	2.6	2.6	2.6	2.1
90	0.8	0.8	0.8	0.7
100	0.6	0.5	0.5	0.5
110	0.8	0.8	0.8	0.7
120	0.8	0.8	0.8	0.6
130	0.8	0.7	0.7	0.6
140	0.7	0.7	0.7	0.6
150	0.3	0.4	0.4	0.3
160	2.6	2.6	2.7	2.1
170	4.2	4.1	4.3	3.5
180	2.1	2.1	2.2	1.8
190	2.6	2.6	2.6	2.2
200	4.3	4.3	4.3	3.9
210	1.1	1.1	1.1	1.3
220	9.7	9.8	9.6	11.5
230	13.4	13.8	13.1	19.6
240	8.8	9.5	8.2	20.2
250	0.4	1.0	0.3	13.8
260	5.2	5.0	5.4	5.6
270	5.8	6.1	5.4	0.3
280	4.9	5.7	4.2	2.9
290	6.9	7.6	6.2	1.6
300	10.2	10.1	10.2	7.5
310	3.6	2.2	5.0	34.4
320	31.7	34.8	28.6	92.2
330	113.5	117.9	109.1	188.6
340	243.0	247.5	238.3	314.3
350	391.7	395.0	388.3	437.4

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	430.6	431.2	429.9	433.6
10	445.0	443.8	446.1	420.5
20	384.7	382.5	386.9	346.5
30	274.8	272.6	277.0	238.7
40	158.3	156.7	159.9	133.8
50	70.0	69.2	70.7	57.9
60	20.6	20.3	20.9	16.8
70	1.3	1.3	1.3	1.0
80	3.0	2.9	3.0	2.4
90	2.7	2.6	2.6	2.2
100	2.0	2.0	2.0	1.7
110	1.7	1.6	1.7	1.4
120	1.5	1.5	1.5	1.3
130	1.6	1.5	1.5	1.3
140	1.6	1.6	1.6	1.3
150	1.4	1.4	1.3	1.2
160	0.9	0.8	0.8	0.7
170	1.1	1.1	1.1	0.9
180	2.9	2.8	2.9	2.4
190	4.7	4.6	4.7	4.1
200	3.0	2.9	2.9	2.6
210	3.9	4.0	3.9	4.2
220	12.5	12.7	12.5	14.5
230	16.9	17.3	16.6	23.0
240	14.1	14.8	13.5	25.4
250	6.7	7.5	5.9	21.9
260	0.6	0.2	1.3	15.8
270	5.1	4.5	5.5	10.8
280	7.0	6.6	7.4	9.3
290	7.2	6.6	7.8	13.6
300	2.9	1.7	4.1	27.7
310	14.3	16.4	12.1	58.8
320	56.2	59.4	53.0	114.1
330	132.0	135.9	128.1	195.9
340	237.8	241.4	234.0	294.0
350	350.1	352.5	347.5	383.8

ELEVATION ANGLE= 40.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	339.7	340.0	339.3	339.7
10	343.7	342.8	344.5	325.5
20	301.0	299.4	302.5	273.1
30	226.3	224.7	228.0	198.7
40	144.6	143.3	145.9	123.7
50	77.1	76.3	77.9	64.7
60	33.2	32.8	33.6	27.4
70	10.4	10.3	10.6	8.5
80	1.2	1.2	1.3	0.9
90	1.6	1.5	1.5	1.4
100	2.1	2.1	2.1	1.8
110	2.1	2.0	2.0	1.7
120	2.1	2.0	2.0	1.7
130	2.2	2.1	2.1	1.8
140	2.6	2.5	2.5	2.1
150	2.9	2.8	2.9	2.4
160	3.4	3.3	3.3	2.8
170	4.0	3.9	3.9	3.3
180	4.4	4.3	4.3	3.7
190	3.3	3.2	3.2	2.8
200	1.1	1.1	1.1	1.2
210	8.6	8.7	8.6	8.9
220	16.7	16.9	16.7	18.7
230	21.7	22.1	21.4	27.2
240	21.5	22.2	20.9	31.7
250	17.2	18.1	16.3	32.1
260	11.5	12.5	10.5	30.0
270	7.2	8.3	6.1	28.5
280	5.8	7.0	4.6	30.3
290	9.0	10.4	7.5	38.1
300	19.6	21.4	17.7	55.3
310	42.6	45.0	40.2	85.7
320	83.7	86.5	80.7	131.9
330	144.8	147.7	141.7	192.4
340	219.8	222.4	217.1	258.3
350	292.3	293.9	290.6	313.4

ELEVATION ANGLE= 50.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	242.5	244.6	244.3	242.5
10	242.4	241.8	242.9	230.0
20	215.7	214.7	216.7	197.5
30	171.7	170.6	172.8	152.7
40	122.0	121.0	122.9	106.0
50	77.3	76.6	78.0	66.0
60	43.8	43.3	44.2	36.8
70	22.2	22.0	22.5	18.5
80	10.2	10.1	10.4	8.4
90	4.1	4.1	4.2	3.3
100	1.3	1.3	1.4	1.0
110	0.1	0.0	0.0	0.1
120	0.8	0.7	0.7	0.7
130	1.3	1.2	1.2	1.1
140	1.8	1.7	1.7	1.5
150	2.2	2.1	2.1	1.8
160	2.4	2.3	2.3	2.0
170	2.1	2.0	2.0	1.8
180	0.8	0.7	0.7	0.6
190	2.3	2.4	2.4	2.2
200	7.5	7.6	7.6	7.3
210	14.5	14.5	14.5	14.6
220	21.5	21.7	21.5	23.1
230	26.8	27.1	26.6	31.0
240	29.1	29.7	28.7	37.0
250	28.9	29.7	28.2	40.8
260	27.5	28.4	26.5	43.3
270	26.8	27.9	25.6	46.3
280	28.7	30.0	27.3	51.7
290	35.0	36.5	33.4	61.6
300	47.9	49.6	46.1	77.8
310	69.4	71.4	67.4	101.9
320	100.9	103.0	98.8	133.6
330	141.1	143.0	139.1	170.4
340	184.8	186.3	183.2	206.3
350	222.8	223.6	221.8	233.1

ELEVATION ANGLE= 60.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	156.2	156.2	156.2	153.4
10	152.4	152.0	152.7	144.9
20	138.4	137.8	138.9	127.9
30	116.8	116.1	117.4	105.4
40	91.7	91.1	92.4	81.2
50	67.4	66.9	68.0	58.7
60	46.8	46.4	47.2	40.3
70	31.1	30.8	31.4	26.5
80	20.2	20.0	20.4	17.1
90	13.0	13.0	13.2	11.0
100	8.6	8.5	8.8	7.2
110	5.9	5.9	6.0	4.9
120	4.2	4.2	4.3	3.5
130	3.2	3.2	3.3	2.7
140	2.7	2.7	2.8	2.3
150	2.6	2.6	2.7	2.3
160	3.1	3.1	3.2	2.7
170	4.3	4.3	4.4	3.8
180	6.5	6.5	6.6	5.9
190	9.9	9.9	10.0	9.2
200	14.4	14.4	14.5	13.8
210	19.6	19.7	19.7	19.5
220	25.0	25.1	25.0	25.8
230	29.8	30.0	29.6	32.2
240	33.5	33.9	33.2	38.1
250	36.2	36.8	35.8	43.4
260	38.6	39.3	38.0	48.4
270	41.5	42.3	40.7	53.8
280	46.0	46.9	45.1	60.6
290	53.1	54.1	52.0	69.4
300	63.6	64.7	62.4	81.1
310	78.0	79.1	76.8	95.6
320	95.9	97.0	94.7	112.1
330	115.8	116.7	114.8	129.1
340	135.0	135.6	134.2	143.6
350	149.6	150.0	149.3	152.7

CJJD DAY

CASE 1 1230.0 KHZ

N= 6 RMS= 556.0 UV= 295.1

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	0.2800	35.00	0.	0.	81.00
2	1.1000	38.00	196.00	285.00	81.00
3	0.9000	-56.00	262.00	300.00	81.00
4	0.2800	-35.00	340.00	309.00	81.00
5	1.1000	-38.00	180.00	335.00	81.00
6	0.9000	56.00	90.00	335.00	81.00

CASE 2 1284.0 KHZ

N= 6 RMS= 556.0 UV= 295.9

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	0.2800	34.76	0.	0.	81.25
2	1.1000	37.79	196.61	285.00	81.25
3	0.9000	-55.90	262.82	300.00	81.25
4	0.2800	-34.76	341.06	309.00	81.25
5	1.1000	-37.79	180.56	335.00	81.25
6	0.9000	55.90	90.28	335.00	81.25

CASE 3 1276.0 KHZ

N= 6 RMS= 556.0 UV= 294.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	0.2800	35.10	0.	0.	80.75
2	1.1000	38.12	195.39	285.00	80.75
3	0.9000	-56.10	261.18	300.00	80.75
4	0.2800	-35.10	338.94	309.00	80.75
5	1.1000	-38.12	179.44	335.00	80.75
6	0.9000	56.10	89.72	335.00	80.75

CASE 4 1197.0 KHZ

N= 6 RMS= 556.0 UV= 280.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	0.2800	38.70	0.	0.	75.75
2	1.1000	41.30	183.29	285.00	75.75
3	0.9000	-58.10	245.01	300.00	75.75
4	0.2800	-38.70	317.95	309.00	75.75
5	1.1000	-41.30	168.33	335.00	75.75
6	0.9000	58.10	84.16	335.00	75.75

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1121.9	1122.9	1120.4	1094.1
10	1044.5	1045.0	1043.3	1024.2
20	916.0	915.9	915.5	907.3
30	743.9	743.0	744.2	751.3
40	545.2	543.3	546.6	572.3
50	346.8	344.0	349.3	393.4
60	178.6	175.1	181.9	239.2
70	62.6	58.9	66.1	127.2
80	4.9	2.5	7.7	61.9
90	8.6	10.9	6.7	34.3
100	5.6	4.9	6.4	27.0
110	15.4	15.0	15.7	21.2
120	9.5	9.8	9.3	5.6
130	23.5	22.8	23.8	31.8
140	71.4	70.8	71.5	76.9
150	121.8	121.5	121.5	120.1
160	153.6	153.5	152.7	144.6
170	147.3	147.4	146.2	134.9
180	92.1	91.9	91.0	82.5
190	9.5	10.2	10.2	10.1
200	137.8	139.1	137.9	127.0
210	263.6	265.2	263.2	244.6
220	355.7	357.2	355.4	337.8
230	396.5	397.2	396.7	391.0
240	389.5	389.0	390.8	405.0
250	358.1	356.3	360.4	396.2
260	333.7	331.1	336.9	388.7
270	343.3	340.5	346.8	404.7
280	400.6	398.1	403.8	456.9
290	504.0	502.3	506.4	546.1
300	640.3	639.6	641.7	663.3
310	789.7	789.9	790.0	792.9
320	930.9	931.9	930.3	917.2
330	1045.5	1046.8	1044.2	1020.1
340	1120.0	1121.5	1118.3	1088.9
350	1146.7	1148.0	1145.0	1115.1

CJJD NITE

CASE 1 1280.0 KHZ

N= 6 RMS= 556.0 UV= 263.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	81.00
2	1.0000	-18.00	196.00	285.00	81.00
3	1.8400	-156.00	262.00	300.00	81.00
4	1.0000	66.00	340.00	309.00	81.00
5	1.0000	84.00	180.00	335.00	81.00
6	1.8400	-138.00	90.00	335.00	81.00

CASE 2 1284.0 KHZ

N= 6 RMS= 556.0 UV= 263.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	81.25
2	1.0000	-17.59	196.61	285.00	81.25
3	1.8400	-155.46	262.82	300.00	81.25
4	1.0000	66.67	341.06	309.00	81.25
5	1.0000	84.26	180.56	335.00	81.25
6	1.8400	-137.87	90.28	335.00	81.25

CASE 3 1276.0 KHZ

N= 6 RMS= 556.0 UV= 263.1

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	80.74
2	1.0000	-18.59	195.39	285.00	80.74
3	1.8420	-156.68	261.18	300.00	80.74
4	1.0000	65.23	338.93	309.00	80.74
5	1.0000	83.82	179.43	335.00	80.74
6	1.8420	-138.09	89.72	335.00	80.74

CASE 4 1197.0 KHZ

N= 6 RMS= 556.0 UV= 262.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	75.74
2	1.0000	-28.51	183.29	285.00	75.74
3	1.8600	-169.19	245.01	300.00	75.74
4	1.0000	50.13	317.95	309.00	75.74
5	1.0000	78.64	168.32	335.00	75.74
6	1.8600	-140.68	84.16	335.00	75.74

ELEVATION ANGLE= Ø.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
Ø	149Z.6	1495.3	1489.4	141Z.Z
1Ø	1428.Ø	1433.Z	1421.7	1297.4
ZØ	1194.8	12ØØ.9	1187.6	1Ø51.5
3Ø	853.6	858.9	847.4	73Z.6
4Ø	499.Ø	5ØZ.4	494.8	419.9
5Ø	Z18.Z	Z19.8	Z16.3	18Ø.8
6Ø	54.7	55.Ø	54.1	44.4
7Ø	4.3	4.4	4.4	4.1
8Ø	1.4	1.4	1.4	1.Z
9Ø	17.8	17.9	17.5	14.4
1ØØ	ZØ.7	ZØ.8	ZØ.5	17.1
11Ø	6.Z	6.1	6.1	5.5
12Ø	11.8	12.Z	11.7	9.1
13Ø	14.1	14.5	14.Ø	1Ø.8
14Ø	11.7	11.6	11.5	1Ø.6
15Ø	6Z.1	6Z.5	61.4	52.1
16Ø	118.3	119.Z	117.Ø	98.6
17Ø	15Ø.9	15Z.Z	149.4	126.Z
18Ø	136.6	137.9	135.4	115.3
19Ø	74.5	75.4	74.Ø	64.Z
ZØØ	14.4	14.1	14.1	1Z.5
Z1Ø	7Ø.Ø	69.8	69.1	61.9
ZZØ	74.9	74.7	74.1	69.3
Z3Ø	Z6.9	Z6.5	Z6.3	Z5.7
Z4Ø	41.6	41.4	42.5	48.6
Z5Ø	88.5	87.Ø	9Ø.8	12Ø.Ø
Z6Ø	92.4	88.6	97.1	167.4
Z7Ø	6Z.3	55.8	7Ø.Ø	191.5
Z8Ø	31.Z	ZZ.3	41.6	Z13.Ø
Z9Ø	38.9	Z8.Ø	51.7	Z61.5
3ØØ	118.4	1Ø6.4	13Z.5	36Z.Ø
31Ø	Z85.8	Z73.8	Z99.7	525.9
32Ø	535.1	524.4	547.7	745.6
33Ø	837.8	829.5	847.5	993.1
34Ø	1142.9	1137.9	1148.5	1ZZZ.8
35Ø	1383.4	138Z.4	1384.5	1379.1

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1446.5	1449.2	1443.3	1366.8
10	1380.1	1385.2	1374.1	1253.5
20	1155.0	1160.8	1148.0	1016.6
30	828.2	833.3	822.2	711.1
40	488.6	491.9	484.6	411.5
50	218.3	219.9	216.4	181.0
60	58.4	58.8	57.8	47.5
70	3.1	3.1	3.1	2.9
80	1.4	1.4	1.4	1.4
90	15.3	15.4	15.1	12.4
100	19.1	19.2	18.9	15.8
110	7.3	7.2	7.3	6.4
120	7.8	8.1	7.7	5.8
130	8.9	9.2	8.8	6.5
140	15.3	15.2	15.1	13.5
150	61.2	61.6	60.5	51.4
160	111.3	112.1	110.1	92.8
170	138.7	139.9	137.3	116.1
180	122.6	123.8	121.5	103.6
190	63.1	63.9	62.7	54.5
200	18.7	18.4	18.3	15.9
210	70.7	70.6	69.9	62.6
220	73.0	72.8	72.3	67.5
230	25.0	24.7	24.5	23.8
240	43.0	42.9	43.9	49.5
250	91.9	90.4	94.0	121.2
260	101.2	97.6	105.7	171.4
270	79.0	72.8	86.2	200.2
280	55.6	47.1	65.6	226.7
290	68.6	58.2	80.7	278.2
300	148.7	137.4	162.0	378.0
310	310.9	299.6	324.1	536.5
320	549.4	539.4	561.2	746.3
330	836.7	828.9	845.7	980.5
340	1123.9	1119.4	1129.2	1195.9
350	1348.1	1347.3	1348.9	1340.1

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1313.6	1316.3	1310.4	1236.5
10	1243.9	1248.6	1238.5	1128.4
20	1041.6	1046.9	1035.4	917.3
30	755.0	759.6	749.7	649.4
40	457.5	460.6	453.8	386.2
50	216.7	218.3	214.9	180.3
60	67.9	68.4	67.3	55.6
70	6.4	6.4	6.3	4.9
80	2.5	2.5	2.5	2.3
90	8.6	8.7	8.5	6.9
100	13.9	13.9	13.7	11.5
110	8.4	8.4	8.3	7.2
120	1.2	1.2	1.2	1.3
130	2.6	2.5	2.6	2.7
140	21.4	21.5	21.2	18.4
150	55.5	55.9	54.9	46.6
160	90.1	90.8	89.2	75.4
170	104.8	105.8	103.9	88.1
180	85.1	86.0	84.4	72.3
190	33.5	34.1	33.5	29.5
200	31.9	31.6	31.4	27.2
210	71.6	71.4	70.7	63.3
220	67.1	66.8	66.3	61.7
230	19.6	19.3	19.1	18.4
240	46.8	46.7	47.6	52.0
250	100.0	98.9	101.9	123.7
260	123.1	120.2	126.9	180.3
270	121.3	116.2	127.4	220.7
280	118.2	111.1	126.6	259.5
290	144.4	135.8	154.7	318.0
300	225.2	215.7	236.4	414.8
310	372.4	363.0	383.4	557.8
320	580.4	572.1	590.1	739.8
330	824.7	818.5	832.1	937.5
340	1063.4	1060.0	1067.4	1114.1
350	1243.3	1243.1	1243.6	1226.2

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	1109.9	1112.5	1107.0	1038.6
10	1039.7	1043.8	1035.2	941.5
20	872.2	876.6	867.2	768.8
30	643.4	647.3	639.0	554.9
40	406.0	408.8	403.0	344.2
50	208.9	210.5	207.3	174.7
60	79.0	79.6	78.4	65.2
70	15.5	15.6	15.4	12.5
80	3.0	3.0	3.0	2.8
90	0.6	0.6	0.6	0.5
100	4.7	4.7	4.6	3.9
110	4.9	4.9	4.9	4.3
120	3.7	3.7	3.7	3.5
130	7.5	7.5	7.5	6.7
140	20.3	20.4	20.1	17.4
150	39.7	40.0	39.3	33.5
160	56.2	56.8	55.7	47.4
170	57.6	58.3	57.2	48.9
180	36.6	37.1	36.4	31.6
190	8.8	8.7	8.7	7.7
200	47.1	47.0	46.4	40.5
210	69.0	68.9	68.2	61.1
220	56.3	56.1	55.6	51.5
230	10.9	10.6	10.4	9.9
240	51.8	51.8	52.5	55.1
250	108.4	107.7	109.9	124.2
260	146.8	144.8	149.6	186.0
270	169.0	165.4	173.5	238.3
280	190.4	185.3	196.6	289.9
290	231.7	225.4	239.2	354.4
300	310.3	303.4	318.4	444.0
310	434.0	427.4	442.0	563.1
320	597.7	591.9	604.6	705.2
330	781.5	777.3	786.4	852.2
340	953.5	951.5	955.9	976.5
350	1074.8	1075.2	1074.3	1047.1

ELEVATION ANGLE= 40.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	861.4	863.8	858.9	800.0
10	797.5	800.8	794.0	720.4
20	671.8	675.2	668.0	592.8
30	507.4	510.5	504.2	439.3
40	337.0	339.2	334.6	287.2
50	190.5	191.9	189.2	160.4
60	86.2	86.9	85.7	71.8
70	26.1	26.4	26.1	21.5
80	1.5	1.5	1.5	1.4
90	6.7	6.7	6.5	5.6
100	6.1	6.1	5.9	4.9
110	4.6	4.6	4.4	3.6
120	3.1	3.1	3.0	2.3
130	1.6	1.6	1.6	1.6
140	6.9	7.1	6.9	6.2
150	13.8	14.0	13.8	12.0
160	16.8	17.1	16.8	14.6
170	10.9	11.2	11.0	9.8
180	9.7	9.5	9.4	8.0
190	33.5	33.3	32.9	28.3
200	54.5	54.5	53.8	47.1
210	59.5	59.4	58.8	52.7
220	40.6	40.4	39.9	36.7
230	3.4	3.5	3.7	4.0
240	56.1	56.3	56.7	57.2
250	111.4	111.1	112.4	119.0
260	158.9	157.9	160.7	179.8
270	198.7	196.7	201.5	237.2
280	238.3	235.3	242.1	294.5
290	288.6	285.0	293.2	358.4
300	359.4	355.4	364.3	434.7
310	454.0	450.2	458.7	524.6
320	567.9	564.7	571.8	622.7
330	687.3	685.3	689.9	716.8
340	791.4	790.9	792.3	789.3
350	856.2	857.3	855.3	821.7

ELEVATION ANGLE= 50.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	601.0	602.9	599.1	553.3
10	551.1	553.5	548.7	496.3
20	468.0	470.4	465.5	413.5
30	364.1	366.3	362.0	316.6
40	256.2	257.9	254.6	219.8
50	159.8	161.0	158.8	135.6
60	85.2	85.9	84.7	71.7
70	35.3	35.6	35.2	29.5
80	6.7	6.9	6.8	5.6
90	7.2	7.2	7.0	6.0
100	12.7	12.6	12.4	10.4
110	14.3	14.3	14.0	11.7
120	14.3	14.3	14.0	11.7
130	13.6	13.6	13.4	11.1
140	12.8	12.8	12.6	10.4
150	13.1	13.0	12.8	10.6
160	16.1	16.0	15.8	13.2
170	23.0	22.9	22.6	19.1
180	33.2	33.2	32.7	28.0
190	43.5	43.5	42.9	37.2
200	48.3	48.3	47.6	41.9
210	41.9	41.8	41.3	37.0
220	21.1	20.9	20.5	18.8
230	14.0	14.2	14.4	13.7
240	57.6	57.8	58.0	56.4
250	104.6	104.7	105.2	105.6
260	150.6	150.3	151.5	156.9
270	194.5	193.8	195.9	208.3
280	238.6	237.4	240.4	260.0
290	286.8	285.3	288.9	313.7
300	342.5	340.9	344.7	370.7
310	406.2	404.7	408.2	430.2
320	474.2	473.2	475.8	488.5
330	538.8	538.4	539.6	538.5
340	588.8	589.2	588.6	571.3
350	612.6	613.8	611.4	578.2

ELEVATION ANGLE= 60.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	363.0	364.4	361.8	331.1
10	331.6	333.1	330.2	297.6
20	285.6	287.1	284.2	252.7
30	230.5	231.9	229.3	201.4
40	172.9	174.0	171.9	149.4
50	119.2	120.0	118.5	102.1
60	74.0	74.6	73.7	63.0
70	39.6	39.9	39.5	33.5
80	15.5	15.7	15.6	13.1
90	0.5	0.5	0.5	0.5
100	9.5	9.5	9.3	7.9
110	15.1	15.1	14.8	12.5
120	18.4	18.4	18.1	15.3
130	20.7	20.7	20.3	17.2
140	22.6	22.6	22.2	18.8
150	24.8	24.8	24.4	20.7
160	27.5	27.5	27.0	23.1
170	30.6	30.6	30.1	25.8
180	33.1	33.1	32.6	28.2
190	33.4	33.4	32.9	28.7
200	29.3	29.2	28.8	25.4
210	18.9	18.8	18.5	16.5
220	2.2	2.1	2.0	2.0
230	23.7	24.0	24.0	22.3
240	53.7	53.9	53.9	50.9
250	86.8	87.0	87.0	83.8
260	121.1	121.3	121.5	118.9
270	155.7	155.7	156.1	155.0
280	190.4	190.3	190.9	191.3
290	225.5	225.3	226.1	227.1
300	261.3	261.1	261.8	262.0
310	296.8	296.8	297.3	294.7
320	330.0	330.2	330.2	323.0
330	357.3	357.8	357.2	343.8
340	374.4	375.2	373.9	353.8
350	377.2	378.4	376.3	350.1

CFTR DAY

CASE 1 680.0 KHZ

N= 6 RMS= 850.0 UV= 246.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	74.60
2	1.9890	-37.00	155.00	310.00	74.60
3	1.0000	-74.00	310.00	310.00	74.60
4	1.0000	-80.00	100.40	2.72	74.60
5	1.9890	-117.00	230.13	330.31	74.60
6	1.0000	-154.00	379.32	322.16	74.60

CASE 2 684.0 KHZ

N= 6 RMS= 850.0 UV= 248.1

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	75.04
2	1.9890	-36.16	155.91	310.00	75.04
3	1.0000	-72.31	311.82	310.00	75.04
4	1.0000	-79.41	100.99	2.72	75.04
5	1.9890	-115.57	231.48	330.31	75.04
6	1.0000	-151.72	381.55	322.16	75.04

CASE 3 676.0 KHZ

N= 6 RMS= 850.0 UV= 244.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	74.16
2	1.9890	-37.84	154.09	310.00	74.16
3	1.0000	-75.68	308.18	310.00	74.16
4	1.0000	-80.59	99.81	2.72	74.16
5	1.9890	-118.43	228.77	330.31	74.16
6	1.0000	-156.26	377.09	322.16	74.16

CASE 4 657.0 KHZ

N= 6 RMS= 850.0 UV= 236.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	72.08
2	1.9900	-41.83	149.76	310.00	72.08
3	1.0000	-83.67	299.51	310.00	72.08
4	1.0000	-83.38	97.01	2.72	72.08
5	1.9900	-125.21	222.34	330.31	72.08
6	1.0000	-167.05	366.49	322.16	72.08

ELEVATION ANGLE= Ø.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
Ø	141Ø.4	1396.4	142Ø.8	1179.4
1Ø	17Ø3.9	1698.8	17Ø8.4	172Ø.2
2Ø	19Ø8.6	1914.2	19Ø2.4	1866.2
3Ø	1943.7	1959.3	192Ø.9	1848.5
4Ø	1766.9	1788.6	1745.2	1641.7
5Ø	14Ø5.6	142Ø.8	1383.7	128Ø.3
6Ø	955.1	972.9	937.7	857.5
7Ø	534.7	545.9	523.9	474.6
8Ø	23Ø.6	235.9	225.6	2Ø3.Ø
9Ø	64.6	66.2	63.1	56.6
1ØØ	4.1	4.3	4.Ø	3.7
11Ø	2.6	2.6	2.6	2.1
12Ø	3.8	3.9	3.6	3.4
13Ø	5.3	5.5	5.2	4.7
14Ø	1.9	1.9	1.8	1.7
15Ø	Ø.6	Ø.6	Ø.6	Ø.4
16Ø	Ø.4	Ø.4	Ø.4	Ø.4
17Ø	1.5	1.5	1.5	1.4
18Ø	Ø.6	Ø.6	Ø.6	Ø.5
19Ø	2.1	2.2	2.1	1.9
2ØØ	35.4	36.2	34.6	31.1
21Ø	132.6	135.4	129.9	117.6
22Ø	3Ø8.5	314.2	3Ø3.Ø	277.5
23Ø	535.7	543.6	527.9	491.2
24Ø	748.8	756.3	741.2	7Ø4.2
25Ø	88Ø.6	884.2	876.7	855.Ø
26Ø	9ØØ.8	897.9	9Ø3.2	9Ø9.6
27Ø	828.5	818.7	837.8	876.5
28Ø	712.6	697.2	727.5	793.7
29Ø	6Ø2.1	583.2	62Ø.7	7Ø5.8
3ØØ	529.4	5Ø8.6	549.9	646.2
31Ø	51Ø.1	488.3	531.8	634.5
32Ø	552.7	53Ø.Ø	575.2	681.5
33Ø	664.3	641.1	687.2	794.Ø
34Ø	85Ø.6	828.1	872.8	974.Ø
35Ø	11Ø7.8	1Ø88.Ø	112Ø.Ø	1212.3

CFTR NITE

CASE 1 680.0 KHZ

N= 9 RMS= 960.0 UV= 466.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	74.60
2	1.9000	355.00	220.00	310.00	74.60
3	1.0000	351.00	440.00	310.00	74.60
4	1.2800	-163.00	80.00	43.00	74.60
5	2.4320	-168.00	230.10	330.30	74.60
6	1.2800	-172.00	443.10	320.40	74.60
7	1.0000	-313.00	160.00	43.00	74.60
8	1.9000	-318.00	265.20	347.10	74.60
9	1.0000	-322.00	460.30	330.30	74.60

CASE 2 684.0 KHZ

N= 9 RMS= 960.0 UV= 466.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	75.04
2	1.8870	354.97	221.29	310.00	75.04
3	1.0000	350.94	442.59	310.00	75.04
4	1.2720	-162.90	80.47	43.00	75.04
5	2.4000	-167.93	231.45	330.30	75.04
6	1.2720	-171.96	445.71	320.40	75.04
7	1.0000	-312.80	160.94	43.00	75.04
8	1.8870	-317.83	266.76	347.10	75.04
9	1.0000	-321.86	463.01	330.30	75.04

CASE 3 676.0 KHZ

N= 9 RMS= 960.0 UV= 467.8

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	74.16
2	1.9120	355.03	218.71	310.00	74.16
3	1.0000	351.06	437.41	310.00	74.16
4	1.2820	-163.10	79.53	43.00	74.16
5	2.4520	-168.07	228.75	330.30	74.16
6	1.2820	-172.40	440.49	320.40	74.16
7	1.0000	-313.11	159.00	43.00	74.16
8	1.9120	-318.08	263.64	347.10	74.16
9	1.0000	-322.05	457.59	330.30	74.16

CASE 4 657.0 KHZ

N= 9 RMS= 960.0 UV= 468.9

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	72.08
2	1.9600	355.17	212.56	310.00	72.08
3	1.0000	351.34	425.12	310.00	72.08
4	1.3250	-163.58	77.29	43.00	72.08
5	2.5970	-168.41	222.32	330.30	72.08
6	1.3250	-172.24	428.11	320.40	72.08
7	1.0000	-314.16	154.59	43.00	72.08
8	1.9600	-318.99	256.23	347.10	72.08
9	1.0000	-322.82	444.73	330.30	72.08

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	206.7	193.1	222.5	277.8
10	829.3	814.6	846.9	904.6
20	1824.4	1818.0	1833.8	1855.2
30	2785.8	2791.6	2782.4	2753.1
40	3163.9	3174.5	3153.9	3106.3
50	2713.2	2716.1	2708.5	2696.0
60	1714.3	1703.7	1721.3	1767.8
70	726.2	707.9	740.9	821.3
80	140.0	124.2	153.3	222.0
90	31.4	38.6	23.7	11.5
100	6.8	7.2	2.9	5.6
110	20.2	20.9	18.7	15.7
120	49.7	52.4	43.9	36.0
130	114.7	121.0	106.4	82.7
140	126.3	133.4	117.2	89.5
150	65.9	70.1	59.6	44.2
160	12.4	13.1	15.7	8.7
170	24.2	28.7	22.8	6.4
180	43.7	38.6	50.0	71.3
190	111.9	108.4	119.8	132.3
200	150.1	147.1	155.7	167.5
210	283.8	283.2	279.9	287.9
220	398.8	400.3	391.2	391.4
230	348.6	349.2	344.2	346.0
240	191.3	189.3	193.2	202.9
250	98.6	95.6	101.8	116.8
260	54.3	50.4	55.8	76.7
270	11.4	15.4	12.5	18.0
280	29.6	32.2	30.3	16.3
290	18.2	19.4	19.4	13.1
300	71.4	75.9	68.7	48.4
310	81.1	85.9	78.2	56.1
320	42.1	44.7	40.6	28.8
330	5.0	5.3	4.5	3.7
340	12.8	14.1	12.2	6.3
350	9.3	15.0	3.1	30.6

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	219.7	206.7	234.9	287.5
10	823.4	809.8	839.9	893.6
20	1768.6	1763.0	1777.3	1796.2
30	2673.2	2678.9	2669.7	2641.1
40	3028.1	3038.2	3018.3	2972.9
50	2607.0	2609.9	2602.0	2589.4
60	1667.7	1658.0	1673.8	1716.7
70	727.9	710.6	741.4	817.2
80	156.2	141.0	168.9	235.4
90	25.0	32.2	17.2	17.5
100	10.2	11.3	7.2	6.0
110	14.6	15.1	13.2	11.4
120	40.4	42.7	35.0	28.8
130	93.8	99.1	86.2	66.6
140	100.6	106.6	92.7	70.2
150	46.2	49.4	41.2	30.4
160	19.1	20.5	21.3	11.3
170	20.8	25.6	19.1	9.3
180	52.8	47.5	59.5	81.3
190	125.4	121.8	133.8	146.0
200	155.0	151.9	162.8	173.0
210	251.4	250.1	250.5	259.4
220	346.2	346.8	341.2	344.0
230	304.1	304.0	301.8	305.9
240	176.5	174.2	179.9	190.4
250	109.8	106.7	113.4	128.2
260	64.6	60.5	66.5	87.9
270	7.7	10.7	9.9	24.9
280	31.6	34.7	31.7	15.4
290	9.6	9.7	13.1	9.2
300	50.5	53.9	48.8	33.7
310	60.7	64.5	58.5	41.3
320	30.1	32.1	29.1	20.3
330	2.3	2.4	4.3	2.2
340	12.9	14.4	12.1	5.6
350	6.5	8.3	9.8	38.1

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	251.2	240.0	264.4	309.0
10	795.8	784.9	809.3	851.9
20	1601.4	1597.5	1607.8	1620.3
30	2351.6	2356.9	2347.8	2321.8
40	2644.2	2653.1	2635.2	2595.9
50	2302.3	2305.3	2297.0	2284.5
60	1525.3	1517.8	1529.0	1562.4
70	721.8	707.5	732.2	795.2
80	198.8	185.4	209.5	268.6
90	6.5	10.0	7.5	40.5
100	15.1	17.3	12.5	5.5
110	3.5	3.5	3.1	3.4
120	16.9	18.1	12.7	11.3
130	42.7	45.5	37.5	28.5
140	39.9	42.7	35.2	26.1
150	5.6	5.7	8.1	5.2
160	30.3	33.6	29.8	12.7
170	6.9	11.2	9.7	28.5
180	83.5	77.9	91.3	113.8
190	168.5	164.8	178.1	189.5
200	196.6	193.8	207.9	213.3
210	213.7	211.0	222.5	229.6
220	246.5	244.7	251.2	258.1
230	225.4	223.2	231.1	238.7
240	178.4	175.5	185.7	195.4
250	153.7	150.6	158.3	171.8
260	99.2	94.7	102.3	124.3
270	21.1	15.9	24.7	50.9
280	28.8	33.3	27.8	8.5
290	24.8	26.8	25.6	14.7
300	8.5	8.7	11.6	8.0
310	15.0	16.0	15.8	10.6
320	4.7	4.9	7.5	4.4
330	5.6	6.0	8.5	3.1
340	9.8	11.5	8.6	2.7
350	26.4	20.1	33.5	59.9

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	277.3	269.2	287.3	319.5
10	721.6	714.3	730.8	758.8
20	1327.5	1325.6	1331.0	1336.4
30	1869.3	1873.8	1865.3	1844.1
40	2079.3	2086.3	2071.5	2041.6
50	1841.9	1844.8	1836.4	1825.2
60	1284.9	1280.3	1285.6	1307.2
70	679.4	669.4	685.4	730.5
80	246.2	235.8	253.3	299.7
90	42.6	35.9	47.3	78.0
100	6.5	9.0	4.3	8.8
110	3.5	4.0	6.1	0.7
120	7.0	7.5	9.3	3.7
130	7.0	7.4	9.6	4.2
140	15.1	16.3	16.7	8.4
150	28.2	31.3	27.4	11.4
160	19.7	25.0	16.8	11.7
170	40.1	33.6	47.7	75.2
180	142.5	136.8	151.7	173.2
190	242.7	239.1	253.2	262.7
200	293.9	291.9	306.0	305.8
210	297.7	296.1	311.1	308.2
220	288.2	286.5	301.4	299.7
230	280.1	278.3	291.5	291.6
240	270.5	268.7	279.0	282.4
250	238.6	235.8	244.2	255.0
260	165.5	160.7	169.8	191.1
270	72.9	66.7	77.3	106.0
280	7.6	8.4	11.5	35.8
290	28.0	32.7	26.3	7.5
300	28.3	31.4	27.7	12.3
310	22.1	24.3	22.2	10.7
320	16.9	18.8	17.6	6.9
330	7.6	9.0	9.5	1.8
340	2.4	2.0	2.5	11.5
350	60.0	54.7	66.3	87.6

ELEVATION ANGLE= 40.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	263.5	258.7	269.5	288.5
10	578.2	574.4	583.1	597.7
20	969.4	968.9	970.4	971.1
30	1302.7	1305.9	1298.9	1284.8
40	1432.1	1436.6	1425.7	1407.2
50	1295.4	1297.7	1290.2	1282.4
60	959.0	957.0	957.3	968.8
70	569.9	564.3	571.5	598.4
80	260.1	253.7	263.1	293.4
90	82.7	77.9	84.7	107.7
100	14.8	12.5	14.6	26.9
110	1.1	1.6	1.0	7.2
120	8.9	11.1	8.4	3.2
130	15.7	18.8	14.3	2.2
140	16.6	20.8	14.2	7.1
150	5.0	9.4	7.1	26.9
160	39.7	33.2	47.1	74.1
170	120.2	113.7	129.1	154.3
180	229.1	224.1	238.9	255.9
190	336.0	333.2	346.3	351.5
200	410.1	409.2	420.9	415.4
210	442.5	442.8	453.7	442.2
220	446.2	446.8	457.0	444.4
230	434.3	434.7	443.7	433.7
240	405.3	404.9	412.7	408.8
250	348.3	346.3	354.1	359.7
260	261.5	257.4	266.7	283.4
270	163.0	157.2	168.1	193.8
280	79.2	72.6	84.2	113.9
290	26.0	19.9	30.7	59.0
300	5.7	7.5	8.8	30.3
310	6.6	10.4	7.1	20.1
320	3.3	4.3	5.5	20.2
330	10.0	7.7	9.9	22.4
340	17.0	15.3	17.0	26.4
350	81.8	78.3	86.1	100.2

ELEVATION ANGLE= 50.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	187.6	185.3	190.5	200.1
10	370.5	368.8	372.2	379.1
20	578.3	578.3	577.8	578.4
30	747.0	748.6	744.0	738.4
40	813.8	815.9	809.3	802.1
50	752.4	753.6	748.1	745.8
60	589.3	588.6	586.4	592.7
70	386.5	384.1	385.2	399.0
80	206.6	203.5	206.1	222.7
90	85.0	82.4	84.5	98.6
100	29.2	27.6	29.2	38.5
110	26.6	24.7	28.8	36.8
120	30.4	27.5	34.1	46.2
130	35.9	31.9	40.8	57.2
140	51.2	46.3	57.2	77.2
150	84.4	78.9	91.6	113.3
160	141.7	136.1	149.7	170.7
170	223.3	218.5	232.0	248.4
180	320.1	316.8	329.0	337.4
190	414.8	413.4	423.5	422.2
200	489.7	490.1	498.2	487.9
210	535.1	536.7	543.2	527.0
220	550.4	552.6	558.0	539.9
230	538.9	540.8	545.6	529.6
240	501.9	502.9	507.7	497.5
250	440.3	439.7	445.4	443.7
260	359.6	357.3	364.5	372.3
270	272.2	268.2	277.1	293.3
280	193.0	187.9	197.9	219.7
290	132.6	127.1	137.2	161.3
300	94.0	88.7	98.1	121.7
310	74.0	69.3	77.3	98.4
320	65.6	61.9	67.8	84.9
330	59.0	56.6	60.1	72.3
340	46.1	44.5	46.6	55.2
350	70.8	68.8	73.2	82.2

ELEVATION ANGLE= 60.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	88.6	87.1	90.8	97.3
10	154.3	153.1	155.3	161.1
20	235.0	234.4	234.8	238.7
30	299.9	299.8	298.5	300.6
40	327.2	327.3	325.0	326.8
50	308.3	308.1	305.9	309.2
60	250.6	249.9	248.5	254.4
70	173.4	172.1	171.9	180.2
80	100.7	99.1	100.2	109.3
90	58.9	57.5	60.5	67.2
100	64.1	62.9	67.3	70.8
110	83.7	82.2	87.7	92.2
120	102.2	100.0	106.9	113.9
130	122.2	119.4	127.5	136.9
140	149.1	145.9	155.0	165.7
150	187.0	188.8	193.4	203.8
160	237.6	234.7	244.3	252.6
170	299.2	297.1	306.0	310.3
180	366.3	365.3	373.0	371.7
190	430.8	431.0	437.0	429.7
200	484.0	485.4	489.8	477.0
210	519.8	522.0	525.1	508.4
220	534.7	537.3	539.5	521.4
230	528.4	530.9	532.7	515.8
240	502.2	504.0	506.1	492.7
250	459.1	460.0	462.8	454.6
260	404.3	404.0	407.9	405.7
270	344.8	343.4	348.4	351.9
280	287.7	285.5	291.3	299.3
290	238.7	236.0	242.2	252.9
300	200.4	197.5	203.6	215.3
310	172.1	169.4	174.9	185.9
320	150.1	148.0	152.4	161.5
330	129.0	127.5	130.8	137.2
340	103.3	102.3	104.9	109.1
350	77.1	76.0	79.2	83.7

CJPS DAY

CASE 1 1510.0 KHZ

N= 2 RMS=1343.0 UV=1364.5

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	90.00
2	0.5500	-130.00	90.00	42.00	90.00

CASE 2 1514.0 KHZ

N= 2 RMS=1343.0 UV=1362.7

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	90.26
2	0.5500	-129.87	90.24	42.00	90.26

CASE 3 1506.0 KHZ

N= 2 RMS=1343.0 UV=1366.3

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	89.78
2	0.5500	-130.13	89.77	42.00	89.78

CASE 4 1404.0 KHZ

N= 2 RMS=1343.0 UV=1417.0

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	83.70
2	0.5500	-133.51	83.68	42.00	83.70

ELEVATION ANGLE= Ø.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
Ø	183Ø.6	183Ø.8	183Ø.3	182Z.8
1Ø	19Ø7.4	19Ø7.4	19Ø7.4	19Ø6.Z
ZØ	1957.9	1957.6	1958.Z	196Z.9
3Ø	1986.9	1986.4	1987.3	1996.4
4Ø	1998.1	1997.6	1998.7	2ØØ9.6
5Ø	1993.4	1992.9	1993.9	2ØØ4.Ø
6Ø	1971.8	1971.5	1972.2	1978.9
7Ø	193Ø.5	193Ø.3	193Ø.6	1931.9
8Ø	1864.8	1864.9	1864.6	1859.6
9Ø	177Ø.Ø	177Ø.4	1769.6	1758.6
1ØØ	164Z.9	1643.5	164Z.3	1627.1
11Ø	1483.5	1484.Z	148Z.8	1466.3
1ZØ	1296.7	1297.3	1296.1	1281.9
13Ø	1Ø93.9	1Ø94.Z	1Ø93.5	1Ø85.5
14Ø	894.Z	894.Z	894.Z	895.9
15Ø	727.1	726.7	727.5	74Ø.4
16Ø	629.1	628.3	629.8	651.Z
17Ø	621.4	62Ø.6	62Z.Z	644.3
18Ø	682.1	681.6	68Z.7	699.3
19Ø	767.7	767.5	768.Ø	777.9
ZØØ	846.3	846.Z	846.4	85Ø.9
Z1Ø	9Ø1.1	9Ø1.1	9Ø1.1	9ØZ.3
ZZØ	924.6	924.7	924.6	924.4
Z3Ø	914.4	914.6	914.4	914.9
Z4Ø	871.6	871.6	871.7	874.6
Z5Ø	8Ø1.Z	8Ø1.Ø	8Ø1.4	8Ø8.9
Z6Ø	715.6	715.1	716.Ø	729.8
Z7Ø	639.9	639.Z	64Ø.7	661.Ø
Z8Ø	615.4	614.6	616.Z	638.9
Z9Ø	677.6	677.Ø	678.Z	695.Z
3ØØ	821.5	821.3	821.6	827.8
31Ø	1Ø12.Z	1Ø12.4	1Ø12.Ø	1ØØ7.5
32Ø	1Z16.6	1Z17.1	1Z16.1	1ZØ3.9
33Ø	1411.6	1412.Z	141Ø.9	1394.8
34Ø	158Z.9	1583.5	158Z.Z	1566.1
35Ø	1723.1	1723.6	172Z.6	17Ø9.7

CJRS NITE

CASE 1 1510.0 KHZ

N= 4 RMS= 585.0 UV= 166.9

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	-177.00	0.	0.	90.00
2	2.8460	61.00	90.00	42.00	90.00
3	2.8460	-61.00	180.00	42.00	90.00
4	1.0000	177.00	270.00	42.00	90.00

CASE 2 1514.0 KHZ

N= 4 RMS= 585.0 UV= 166.2

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	-177.23	0.	0.	90.26
2	2.8460	60.93	90.24	42.00	90.26
3	2.8460	-60.93	180.48	42.00	90.26
4	1.0000	177.23	270.72	42.00	90.26

CASE 3 1506.0 KHZ

N= 4 RMS= 585.0 UV= 167.7

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	-176.57	0.	0.	89.78
2	2.8460	61.08	89.77	42.00	89.78
3	2.8460	-61.08	179.54	42.00	89.78
4	1.0000	176.57	269.31	42.00	89.78

CASE 4 1404.0 KHZ

N= 4 RMS= 585.0 UV= 186.7

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	-170.89	0.	0.	83.70
2	2.8650	63.04	83.68	42.00	83.70
3	2.8650	-63.04	167.36	42.00	83.70
4	1.0000	170.89	251.04	42.00	83.70

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	884.6	885.2	883.9	870.1
10	997.6	997.6	997.6	996.4
20	1074.3	1073.8	1075.0	1086.6
30	1118.7	1117.8	1119.9	1141.3
40	1135.9	1134.8	1137.4	1163.2
50	1128.6	1127.6	1130.0	1153.8
60	1095.6	1094.9	1096.6	1112.6
70	1032.5	1032.3	1032.8	1036.8
80	934.3	934.6	933.8	924.8
90	799.6	800.4	798.4	778.7
100	634.9	636.0	633.4	608.0
110	456.4	457.5	454.9	430.1
120	287.1	288.0	286.0	266.6
130	149.5	150.0	149.0	137.1
140	57.2	57.4	57.4	51.8
150	10.2	10.2	10.9	9.0
160	3.6	3.7	2.6	3.4
170	1.1	1.3	0.0	1.1
180	3.4	3.2	4.5	3.0
190	2.8	2.7	3.8	2.6
200	2.9	3.1	2.0	2.6
210	9.9	10.1	9.0	8.9
220	13.7	13.9	12.8	12.3
230	12.0	12.2	11.2	10.8
240	5.9	6.0	5.0	5.2
250	0.9	0.8	1.9	0.9
260	3.9	3.8	4.9	3.5
270	1.0	0.9	2.1	0.8
280	3.6	3.7	2.6	3.4
290	1.6	1.6	2.4	1.3
300	33.4	33.5	33.8	30.1
310	106.8	107.2	106.6	97.5
320	227.2	227.9	226.3	209.9
330	386.2	387.2	384.8	361.7
340	564.0	565.1	562.4	536.5
350	736.6	737.6	735.3	712.5

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	852.6	853.1	851.8	838.1
10	962.6	962.7	962.5	960.5
20	1037.8	1037.4	1038.4	1048.4
30	1081.7	1080.9	1082.8	1101.9
40	1098.8	1097.8	1100.1	1123.4
50	1091.6	1090.6	1092.8	1114.2
60	1058.9	1058.2	1059.7	1073.8
70	996.7	996.6	996.9	999.9
80	900.8	901.2	900.3	891.1
90	770.3	771.1	769.1	749.9
100	611.6	612.6	610.1	585.7
110	440.2	441.3	438.8	415.0
120	277.9	278.7	276.8	258.3
130	145.8	146.3	145.3	133.8
140	56.8	57.0	56.9	51.5
150	10.7	10.7	11.4	9.5
160	3.4	3.5	2.4	3.2
170	1.5	1.6	0.4	1.4
180	3.0	2.9	4.1	2.7
190	3.2	3.0	4.2	2.9
200	1.5	1.6	0.5	1.3
210	7.4	7.6	6.6	6.6
220	10.7	10.9	9.9	9.6
230	9.2	9.4	8.4	8.3
240	3.9	4.1	3.0	3.5
250	1.7	1.6	2.7	1.6
260	3.8	3.6	4.8	3.4
270	0.6	0.5	1.7	0.5
280	3.7	3.8	2.6	3.4
290	2.1	2.1	2.9	1.7
300	33.6	33.7	34.0	30.3
310	104.7	105.1	104.5	95.7
320	220.5	221.2	219.6	203.8
330	372.9	373.9	371.6	349.5
340	543.4	544.5	541.9	517.1
350	709.5	710.4	708.2	686.2

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	762.0	762.6	761.2	748.0
10	863.0	863.1	862.7	858.8
20	933.5	933.2	933.8	939.5
30	975.4	974.8	976.2	989.4
40	992.0	991.3	992.9	1009.5
50	985.0	984.3	985.8	1000.9
60	953.5	953.1	954.0	963.1
70	894.8	894.7	894.8	894.8
80	806.0	806.4	805.4	795.8
90	687.7	688.4	686.6	669.0
100	546.1	547.0	544.7	523.2
110	394.8	395.7	393.5	372.7
120	252.1	252.8	251.1	234.8
130	135.4	135.8	135.0	124.6
140	55.4	55.6	55.5	50.4
150	12.3	12.4	12.9	11.0
160	2.6	2.6	1.7	2.5
170	2.3	2.4	1.3	2.1
180	1.9	1.8	2.9	1.7
190	3.5	3.4	4.5	3.2
200	1.5	1.4	2.4	1.4
210	1.9	2.1	1.1	1.7
220	4.0	4.1	3.1	3.5
230	3.0	3.2	2.2	2.7
240	0.2	0.0	1.0	0.2
250	3.1	3.0	4.0	2.8
260	3.0	2.9	4.0	2.7
270	0.6	0.7	0.4	0.6
280	3.5	3.6	2.6	3.3
290	3.7	3.7	4.4	3.2
300	34.1	34.2	34.4	30.9
310	98.7	99.1	98.5	90.5
320	201.5	202.1	200.7	186.7
330	335.6	336.4	334.4	315.1
340	485.8	486.7	484.4	462.6
350	633.2	634.0	632.0	612.3

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	628.4	628.9	627.6	615.4
10	714.3	714.5	713.8	708.0
20	776.0	775.9	776.0	776.7
30	813.8	813.5	814.0	819.9
40	829.0	828.6	829.3	837.6
50	822.5	822.1	822.8	830.0
60	793.9	793.7	794.0	797.1
70	741.9	742.0	741.6	738.5
80	665.5	665.9	664.9	655.1
90	566.4	567.0	565.4	550.4
100	450.5	451.3	449.4	431.9
110	328.5	329.2	327.5	310.9
120	214.0	214.5	213.2	200.0
130	119.5	119.9	119.2	110.5
140	53.0	53.1	53.0	48.5
150	14.8	14.8	15.3	13.4
160	0.8	0.9	0.1	0.9
170	2.9	3.0	2.1	2.8
180	0.0	0.1	0.9	0.1
190	2.6	2.5	3.5	2.3
200	3.1	3.0	4.0	2.9
210	2.3	2.2	3.1	2.1
220	1.6	1.5	2.4	1.5
230	1.9	1.8	2.8	1.8
240	2.9	2.8	3.7	2.6
250	3.0	2.9	3.9	2.8
260	1.2	1.1	2.1	1.1
270	2.0	2.1	1.1	1.9
280	2.8	2.8	2.0	2.6
290	6.3	6.3	6.9	5.6
300	34.5	34.6	34.7	31.4
310	89.4	89.6	89.2	82.3
320	173.2	173.7	172.6	161.2
330	281.0	281.7	280.1	264.6
340	401.7	402.5	400.6	383.1
350	521.6	522.3	520.5	504.1

CJFX NITE

CASE 1 580.0 KHZ

N= 2 RMS= 600.0 UV= 472.0

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	60.46
2	0.8800	-122.00	120.00	128.00	60.46

CASE 2 584.0 KHZ

N= 2 RMS= 600.0 UV= 470.6

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	60.88
2	0.8800	-121.61	120.82	128.00	60.88

CASE 3 576.0 KHZ

N= 2 RMS= 600.0 UV= 473.4

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	60.04
2	0.8800	-122.41	119.17	128.00	60.04

CASE 4 567.0 KHZ

N= 2 RMS= 600.0 UV= 476.7

TOWER	RATIO	PHASE	SPACING	ORIENT.	HEIGHT
1	1.0000	0.	0.	0.	59.11
2	0.8800	-123.31	117.31	128.00	59.11

ELEVATION ANGLE= 0.

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	134.8	135.2	134.5	133.7
10	58.1	57.9	58.2	58.6
20	170.4	170.9	169.8	168.7
30	317.4	318.4	316.2	313.8
40	460.8	462.2	459.3	456.1
50	589.2	590.7	587.6	584.1
60	695.1	696.4	693.7	690.6
70	775.0	775.9	774.1	772.1
80	829.5	829.6	829.2	828.8
90	862.1	861.5	862.7	864.0
100	878.7	877.3	880.0	883.0
110	885.2	883.3	887.2	891.5
120	887.0	884.7	889.3	894.4
130	887.2	884.8	889.6	894.9
140	886.6	884.4	888.8	893.7
150	883.4	881.7	885.2	889.0
160	873.6	872.5	874.6	876.9
170	851.3	851.0	851.6	852.2
180	810.6	811.0	810.0	808.9
190	746.2	747.3	745.1	742.6
200	655.7	657.2	654.2	650.9
210	540.2	541.7	538.6	535.1
220	404.7	406.0	403.3	400.3
230	258.2	259.0	257.2	255.2
240	115.5	115.7	115.1	114.6
250	71.2	71.2	71.3	71.4
260	180.3	181.0	179.8	178.6
270	283.5	284.5	282.6	280.4
280	364.3	365.6	363.1	360.4
290	420.4	421.9	419.1	416.1
300	451.9	453.4	450.5	447.3
310	459.1	460.6	457.7	454.5
320	442.2	443.7	440.9	437.7
330	400.9	402.3	399.7	396.7
340	334.9	336.1	333.8	331.3
350	244.6	245.5	243.8	242.0

ELEVATION ANGLE= 10.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	124.7	125.1	124.5	123.8
10	58.8	58.7	58.9	59.2
20	171.3	171.8	170.7	169.5
30	313.4	314.4	312.3	309.9
40	452.1	453.4	450.6	447.4
50	576.4	577.9	574.8	571.5
60	679.3	680.6	677.9	675.0
70	757.4	758.2	756.5	754.5
80	811.1	811.3	810.9	810.4
90	843.9	843.3	844.4	845.5
100	861.0	859.7	862.2	864.9
110	868.2	866.4	870.0	874.0
120	870.4	868.3	872.6	877.4
130	870.8	868.5	873.0	878.0
140	869.9	867.8	872.0	876.5
150	866.2	864.5	867.8	871.3
160	855.6	854.7	856.6	858.7
170	833.0	832.7	833.2	833.6
180	792.4	792.9	791.9	790.7
190	729.2	730.2	728.1	725.7
200	641.0	642.4	639.5	636.3
210	528.9	530.4	527.3	524.0
220	397.8	399.1	396.4	393.6
230	256.2	257.0	255.2	253.3
240	117.9	118.1	117.5	116.9
250	65.8	65.7	65.9	66.0
260	168.5	169.0	168.0	166.9
270	268.2	269.2	267.3	265.3
280	346.6	347.8	345.5	343.0
290	401.3	402.6	400.0	397.1
300	431.9	433.4	430.6	427.6
310	439.0	440.4	437.6	434.6
320	422.5	423.9	421.2	418.2
330	382.3	383.6	381.1	378.3
340	318.1	319.2	317.0	314.7
350	230.5	231.4	229.8	228.1

ELEVATION ANGLE= 20.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	97.3	97.5	97.2	96.8
10	63.9	63.9	64.0	64.1
20	173.3	173.8	172.7	171.5
30	301.5	302.4	300.4	298.2
40	426.5	427.8	425.2	422.3
50	539.2	540.6	537.8	534.8
60	633.4	634.6	632.2	629.5
70	706.2	707.0	705.3	703.5
80	757.5	757.7	757.2	756.6
90	790.2	789.8	790.5	791.3
100	808.6	807.6	809.6	811.7
110	817.5	816.0	819.0	822.2
120	820.9	819.2	822.7	826.6
130	821.6	819.7	823.4	827.5
140	820.0	818.3	821.7	825.4
150	814.8	813.5	816.1	818.9
160	802.6	801.9	803.4	805.0
170	779.1	779.0	779.2	779.4
180	739.4	739.9	738.9	737.7
190	679.7	680.7	678.7	676.4
200	598.2	599.5	596.9	594.0
210	496.1	497.4	494.7	491.7
220	377.5	378.7	376.3	373.7
230	249.9	250.7	249.0	247.2
240	124.4	124.7	124.1	123.4
250	54.1	54.0	54.3	54.6
260	135.4	135.9	135.1	134.3
270	225.1	225.9	224.4	222.8
280	296.6	297.6	295.7	293.5
290	346.7	347.9	345.7	343.2
300	375.0	376.2	373.9	371.3
310	381.5	382.8	380.4	377.8
320	366.3	367.5	365.2	362.7
330	329.3	330.4	328.3	325.9
340	270.5	271.4	269.6	267.7
350	191.0	191.7	190.5	189.2

ELEVATION ANGLE= 30.0

AZIM	CASE 1 MV/M	CASE 2 MV/M	CASE 3 MV/M	CASE 4 MV/M
0	61.8	61.8	61.8	61.9
10	76.8	76.9	76.7	76.6
20	174.3	174.8	173.7	172.6
30	281.6	282.4	280.7	278.7
40	386.3	387.3	385.1	382.7
50	481.4	482.5	480.2	477.6
60	562.1	563.1	561.1	558.8
70	626.0	626.7	625.3	623.6
80	672.9	673.2	672.5	671.8
90	704.5	704.3	704.6	704.9
100	723.9	723.3	724.5	725.9
110	734.6	733.6	735.5	737.7
120	739.4	738.2	740.6	743.3
130	740.4	739.1	741.7	744.5
140	738.0	736.9	739.2	741.7
150	731.1	730.3	732.0	733.9
160	717.4	716.9	717.8	718.8
170	693.5	693.5	693.4	693.3
180	656.1	656.6	655.6	654.4
190	602.6	603.4	601.6	599.7
200	531.8	532.8	530.6	528.2
210	444.8	445.9	443.6	441.1
220	345.2	346.2	344.1	341.9
230	238.5	239.2	237.7	236.1
240	132.9	133.2	132.5	131.7
250	51.5	51.4	51.6	51.9
260	89.1	89.3	89.1	88.8
270	162.1	162.6	161.7	160.7
280	222.5	223.2	221.8	220.3
290	265.4	266.2	264.6	262.8
300	289.8	290.7	288.9	287.0
310	295.4	296.4	294.6	292.6
320	282.3	283.2	281.5	279.5
330	250.4	251.2	249.7	248.0
340	200.3	200.9	199.7	198.4
350	133.8	134.2	133.5	132.8

APPENDIX II

PRINT-OUT OF COSTING PROGRAM

FOR THE

FREQUENCY PLAN OF TABLE 1

STATIONS ON 540KHZ ARE NOT MOVED

PRESENT FREQUENCY 550KHZ PROPOSED FREQUENCY 549KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFJC	KAMLOOPS	BC	1954	6889	0	585	2034	11462
CKPG	PRINCE GEORGE	BC	1192	2182	0	585	184	4143
CFNB	FREDERICTON	NB	1490	2996	0	585	537	5608
CHNO	SUDBURY	ON	1657	4184	0	585	971	7397
CHLN	TROIS RIVIERES	QU	1735	4619	0	585	1148	8087

TOTAL COST FOR 550KHZ IS $ 36697

PRESENT FREQUENCY 560KHZ PROPOSED FREQUENCY 558KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKNL	FORT ST JOHN	BC	1209	2606	0	585	409	4809
CHTK	PRINCE RUPERT	BC	0	1680	0	585	324	2589
CHCM	MARYSTOWN	NF	1209	2627	0	585	420	4841
CJKL	KIRKLAND LAKE	ON	1209	2299	0	585	246	4339
CFOS	OWEN SOUND	ON	1703	4640	0	585	1204	8132
CKCN	SEPT-ILES	QU	1703	4436	0	585	1105	7829

TOTAL COST FOR 560KHZ IS $ 32539

PRESENT FREQUENCY 570KHZ PROPOSED FREQUENCY 567KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKEK	CRANBROOK	BC	1221	2623	0	585	417	4846
CKWL	WILLIAMS LAKE	BC	1548	3617	0	585	867	6617
CJEM	EDMUNDSTON	NB	1221	2582	0	585	396	4784
CFCB	CORNER BROOK	NF	0	1505	0	585	324	2414
CHYM	KITCHENER	ON	1746	8768	0	585	2907	14006
CKSW	SWIFT CURRENT	SA	3158	25237	0	585	9681	38661
CFWH	WHITEHORSE	YT	0	1505	0	585	324	2414

TOTAL COST FOR 570KHZ IS $ 73742

PRESENT FREQUENCY 580KHZ PROPOSED FREQUENCY 576KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKUA	EDMONTON	AB	1766	4788	0	585	1284	8423
CKXR	SALMON ARM	BC	1231	2358	0	585	277	4451
CKY	WINNIPEG	MB	1947	7767	0	585	2584	12883
CJFX	ANTIGONISH	NS	1231	2513	0	585	359	4688
CKAP	KAPUSKASING	ON	1231	2654	0	585	434	4904
CFRA	OTTAWA	ON	2164	10164	0	585	3642	16555
CKPR	THUNDER BAY	ON	0	1680	0	585	324	2589
CKWW	WINDSOR	ON	1610	6268	0	585	1881	10344
CHLC	HAUTERIVE	QU	1766	4249	0	585	1009	7609

TOTAL COST FOR 580KHZ IS $ 72446

PRESENT FREQUENCY 590KHZ PROPOSED FREQUENCY 594KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFNL	FORT NELSON	BC	0	1505	0	585	324	2414
CFTK	TERRACE	BC	1231	3197	0	585	722	5735
CFAR	FLIN FLON	MB	1231	2486	0	585	345	4647
CJCW	SUSSEX	NB	1568	4653	0	585	1416	8222
VOCM	ST JOHN'S	NF	1231	2442	0	585	322	4580
CKEY	TORONTO	ON	1781	8594	0	585	2823	13783
CKRS	JONQUIERE	QU	1945	10626	0	585	3990	17146

TOTAL COST FOR 590KHZ IS $ 56527

PRESENT FREQUENCY 600KHZ PROPOSED FREQUENCY 603KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOR	VANCOUVER	BC	1407	3911	0	585	896	6799
CBNA	ST ANTHONY	NF	1544	3708	0	585	915	6752
CKCL	TRURO	NS	1219	3643	0	585	959	6406
CFCT	TUKTOYAKTUK	NT	0	1505	0	585	324	2414
CFCH	NORTH BAY	ON	1732	4871	0	585	1328	8516
CFCF	MONTREAL	QU	1578	5918	0	585	1710	9791
CFQC	SASKATOON	SA	1219	2402	0	585	300	4506

TOTAL COST FOR 600KHZ IS $ 45184

PRESENT FREQUENCY 610KHZ PROPOSED FREQUENCY 612KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKYL	PEACE RIVER	AB	1384	3709	0	585	794	6472
CHNL	KAMLOOPS	BC	1384	3604	0	585	741	6314
CJAT	TRAIL	BC	1206	2666	0	585	440	4897
CHTM	THOMPSON	MB	0	1505	0	585	324	2414
CKYQ	GRAND BANK	NF	1518	3481	0	585	794	6378
CKTB	ST CATHARINES	ON	1692	6590	0	585	1858	10725
CKML	MONT LAURIER	QU	1206	2524	0	585	365	4680
CHNC	NEW CARLISLE	QU	1206	2339	0	585	267	4397
CKRW	WHITEHORSE	YT	0	1505	0	585	324	2414

TOTAL COST FOR 610KHZ IS $ 48691

PRESENT FREQUENCY 620KHZ PROPOSED FREQUENCY 621KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJCI	PRINCE GEORGE	BC	1189	2416	0	585	308	4498
CKCM	GRAND FALLS	NF	1189	2291	0	585	242	4307
CFCL	TIMMINS	ON	1870	5010	0	585	1173	8638
CKCK	REGINA	SA	1189	2281	0	585	236	4291

TOTAL COST FOR 620KHZ IS $ 21734

STATIONS ON 630KHZ ARE NOT MOVED

PRESENT FREQUENCY 640KHZ PROPOSED FREQUENCY 639KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBN	ST JOHN'S	NF	0	1505	0	585	324	2414

TOTAL COST FOR 640KHZ IS $ 2414

THERE ARE NO CANADIAN STATIONS ON 650KHZ

THERE ARE NO CANADIAN STATIONS ON 660KHZ

PRESENT FREQUENCY 670KHZ PROPOSED FREQUENCY 666KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHYQ	MUSGRAVETOWN	NF	1558	3416	0	585	760	6319

TOTAL COST FOR 670KHZ IS $ 6319

PRESENT FREQUENCY 680KHZ PROPOSED FREQUENCY 684KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHFA	EDMONTON	AB	1418	4210	0	585	1047	7260
CJOB	WINNIPEG	MB	1418	4020	0	585	951	6974
CIYQ	GRAND FALLS	NF	1556	3337	0	585	718	6196
CFDR	DARTMOUTH	NS	1749	5634	0	585	1712	9680
CKGB	TIMMINS	ON	1749	4230	0	585	1003	7567
CFTR	TORONTO	ON	3150	25767	0	585	9945	39447

TOTAL COST FOR 680KHZ IS $ 77124

PRESENT FREQUENCY 690KHZ PROPOSED FREQUENCY 693KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBU	VANCOUVER	BC	1565	4285	0	585	908	7343
CBF	MONTREAL	QU	0	1505	0	585	324	2414
CBKF-1	GRAVELBOURG	SA	1565	8217	0	585	2838	13205

TOTAL COST FOR 690KHZ IS $ 22962

THERE ARE NO CANADIAN STATIONS ON 700KHZ

PRESENT FREQUENCY 710KHZ PROPOSED FREQUENCY 711KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKVO	CLARENVILLE	NF	1187	2256	0	585	223	4251
CHYR	LEAMINGTON	ON	1622	5395	0	585	1282	8884
CJRN	NIAGARA FALLS	ON	2763	25613	0	585	9679	38640
CIPC	PORT CARTIER	QU	1350	3841	0	585	861	6637
CKVM	VILLE MARIE	QU	1350	3287	0	585	581	5803

TOTAL COST FOR 710KHZ IS $ 64215

STATIONS ON 720KHZ ARE NOT MOVED

PRESENT FREQUENCY 730KHZ PROPOSED FREQUENCY 729KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKLG	VANCOUVER	BC	1856	6585	0	585	1955	10981
CKDM	DAUPHIN	MB	1186	2620	0	585	416	4807
CKGA	GANDER	NF	1186	2370	0	585	283	4424
CJNR	BLIND RIVER	ON	1186	2358	0	585	277	4406
CHYR-7	LEAMINGTON	ON	1186	2173	0	585	179	4123
CKAC	MONTREAL	QU	1186	2489	0	585	347	4607

TOTAL COST FOR 730KHZ IS $ 33348

PRESENT FREQUENCY 740KHZ PROPOSED FREQUENCY 738KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBX	EDMONTON	AB	1836	6104	0	585	1765	10290
CBNM	MARYSTOWN	NF	1201	2626	0	585	419	4831
CBL	TORONTO	ON	0	1505	0	585	324	2414

TOTAL COST FOR 740KHZ IS $ 17535

PRESENT FREQUENCY 750KHZ PROPOSED FREQUENCY 747KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBGY	BONAVISTA BAY	NF	1530	3408	0	585	757	6280

TOTAL COST FOR 750KHZ IS $ 6280

THERE ARE NO CANADIAN STATIONS ON 760KHZ

THERE ARE NO CANADIAN STATIONS ON 770KHZ

THERE ARE NO CANADIAN STATIONS ON 780KHZ

PRESENT FREQUENCY 790KHZ PROPOSED FREQUENCY 792KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFCW	CAMROSE	AB	2192	11965	0	585	4209	18951
CFAN	NEWCASTLE	NB	1504	2794	0	585	431	5314
CFNW	PORT AUX CHOIX	NF	1199	2307	0	585	250	4341
CHIC	BRAMPTON	ON	3271	30724	0	585	11669	46249
CKSO	SUDBURY	ON	2272	12061	0	585	4186	19104

TOTAL COST FOR 790KHZ IS $ 93959

PRESENT FREQUENCY 800KHZ PROPOSED FREQUENCY 801KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJJC	LANGLEY	BC	2294	11181	0	585	3601	17661
CKOK	PENTICTON	BC	0	1680	0	585	324	2589
VOWR	ST JOHN'S	NF	0	1505	0	585	324	2414
CJBQ	BELLEVILLE	ON	2294	11943	0	585	3964	18786
CFOB	FORT FRANCES	ON	0	1680	0	585	324	2589
CBQ	THUNDER BAY	ON	1346	3706	0	585	793	6430
CKLW	WINDSOR	ON	2110	10866	0	585	3709	17270
CJAD	MONTREAL	QU	1916	10166	0	585	3643	16310
CHRC	QUEBEC	QU	1734	6598	0	585	1695	10612
CHAB	MOOSE JAW	SA	1346	3205	0	585	540	5676

TOTAL COST FOR 800KHZ IS $ 100337

STATIONS ON 810KHZ ARE NOT MOVED

THERE ARE NO CANADIAN STATIONS ON 820KHZ

THERE ARE NO CANADIAN STATIONS ON 830KHZ

THERE ARE NO CANADIAN STATIONS ON 840KHZ

PRESENT FREQUENCY 850KHZ PROPOSED FREQUENCY 846KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKRD	RED DEER	AB	1404	3614	0	585	746	6349
CFVR	ABBOTSFORD	BC	2088	8649	0	585	2898	14220
CKVL	VERDUN	QU	1727	4954	0	585	1362	8628

TOTAL COST FOR 850KHZ IS $ 29197

PRESENT FREQUENCY 860KHZ PROPOSED FREQUENCY 864KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFPR	PRINCE RUPERT	BC	1217	3021	0	585	629	5452
CBH	HALIFAX	NS	1217	2761	0	585	491	5054
CHAK	INUVIK	NT	0	1505	0	585	324	2414
CJBC	TORONTO	ON	0	1505	0	585	324	2414
CBKF-2	SASKATOON	SA	1894	6611	0	585	2007	11097

TOTAL COST FOR 860KHZ IS $ 26431

THERE ARE NO CANADIAN STATIONS ON 870KHZ

THERE ARE NO CANADIAN STATIONS ON 880KHZ

THERE ARE NO CANADIAN STATIONS ON 890KHZ

STATIONS ON 900KHZ ARE NOT MOVED

PRESENT FREQUENCY 910KHZ PROPOSED FREQUENCY 909KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJDV	DRUMHELLER	AB	1701	4781	0	585	1229	8296
CFSX	STEPHENVILLE	NF	0	1505	0	585	324	2414
CKLY	LINDSAY	ON	1342	3644	0	585	762	6333
CHRL	ROBERVAL	QU	1182	2328	0	585	261	4356

TOTAL COST FOR 910KHZ IS $ 21399

PRESENT FREQUENCY 920KHZ PROPOSED FREQUENCY 918KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKCQ	QUESNEL	BC	1196	2460	0	585	331	4572
CFRY	PORTAGE LA PRAIR	MB	1747	4711	0	585	1194	8237
CJCJ	WOODSTOCK	NB	1498	3202	0	585	646	5931
CJCH	HALIFAX	NS	1365	3709	0	585	795	6454
CBO	OTTAWA	ON	2245	10536	0	585	3459	16825
CKCY	SAULT STE MARIE	ON	1897	8174	0	585	2744	13400
CKNX	WINGHAM	ON	1667	5306	0	585	1560	9118
CFLS	LEVIS	QU	1196	2717	0	585	467	4965

TOTAL COST FOR 920KHZ IS $ 69502

PRESENT FREQUENCY 930KHZ PROPOSED FREQUENCY 927KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJCA	EDMONTON	AB	1854	6514	0	585	1967	10920
CFBC	SAINT JOHN	NB	2028	14936	0	585	5984	23533
CJYQ	ST JOHN'S	NF	1695	3832	0	585	795	6907
CKNS	ESPANOLA	ON	1542	4801	0	585	1161	8089

TOTAL COST FOR 930KHZ IS $ 49449

PRESENT FREQUENCY 940KHZ PROPOSED FREQUENCY 936KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJIB	VERNON	BC	1214	3218	0	585	733	5750
CBM	MONTREAL	QU	0	1505	0	585	324	2414
CJGX	YORKTON	SA	1564	5874	0	585	1688	9711

TOTAL COST FOR 940KHZ IS $ 17875

PRESENT FREQUENCY 950KHZ PROPOSED FREQUENCY 954KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAM	ALTONA	MB	1977	8863	0	585	3083	14508
CKNB	CAMPBELLTON	NB	1534	3283	0	585	690	6092
CHER	SYDNEY	NS	1214	2687	0	585	451	4937
CKBB	BARRIE	ON	1811	8899	0	585	3308	14603

TOTAL COST FOR 950KHZ IS $ 40140

PRESENT FREQUENCY 960KHZ PROPOSED FREQUENCY 963KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAC	CALGARY	AB	1382	4192	0	585	1038	7197
CHNS	HALIFAX	NS	1205	2384	0	585	291	4465
CFTJ	CAMBRIDGE	ON	2022	9135	0	585	3136	14878
CKWS	KINGSTON	ON	1938	5662	0	585	1498	9683

TOTAL COST FOR 960KHZ IS $ 36223

PRESENT FREQUENCY 970KHZ PROPOSED FREQUENCY 972KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJYR	EDSON	AB	1194	2511	0	585	358	4648
CBZ	FREDERICTON	NB	1194	2679	0	585	447	4905
CKCH	HULL	QU	1363	4561	0	585	1224	7733

TOTAL COST FOR 970KHZ IS $ 17286

PRESENT FREQUENCY 980KHZ PROPOSED FREQUENCY 981KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKNW	NEW WESTMINSTER	BC	1477	4799	0	585	1160	8021
CFPL	LONDON	ON	1898	5812	0	585	1505	9800
CHEX	PETERBOROUGH	ON	1697	5072	0	585	1377	8731
CKGM	MONTREAL	QU	2262	12903	0	585	4420	20170
CBV	QUEBEC	QU	1181	2479	0	585	341	4586
CKRM	REGINA	SA	1468	3204	0	585	648	5905

TOTAL COST FOR 980KHZ IS $ 57213

STATIONS ON 990KHZ ARE NOT MOVED

PRESENT FREQUENCY 1000KHZ PROPOSED FREQUENCY 999KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBW	BRIDGEWATER	NS	1339	3179	0	585	527	5630
CFLP	RIMOUSKI	QU	1763	5659	0	585	1534	9541

TOTAL COST FOR 1000KHZ IS $ 15171

PRESENT FREQUENCY 1010KHZ PROPOSED FREQUENCY 1008KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBR	CALGARY	AB	1494	4723	0	585	1454	8256
CFRB	TORONTO	ON	1889	8279	0	585	2802	13555

TOTAL COST FOR 1010KHZ IS $ 21811

THERE ARE NO CANADIAN STATIONS ON 1020KHZ

THERE ARE NO CANADIAN STATIONS ON 1030KHZ

THERE ARE NO CANADIAN STATIONS ON 1040KHZ

PRESENT FREQUENCY 1050KHZ PROPOSED FREQUENCY 1053KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFGP	GRANDE PRAIRIE	AB	1202	2628	0	585	420	4835
CKAL	VERNON	BC	1202	2399	0	585	299	4485
CKSB	ST BONIFACE	MB	1202	2287	0	585	239	4313
CFYN	SAULT STE MARIE	ON	1202	2274	0	585	233	4294
CHUM	TORONTO	ON	2460	21294	0	585	8413	32752
CJNB	NORTH BATTLEFORD	SA	1533	4828	0	585	1174	8120

TOTAL COST FOR 1050KHZ IS $ 58799

PRESENT FREQUENCY 1060KHZ PROPOSED FREQUENCY 1062KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFCN	CALGARY	AB	1360	3694	0	585	787	6426
CJRP	QUEBEC	QU	1659	4928	0	585	1358	8530

TOTAL COST FOR 1060KHZ IS $ 14956

PRESENT FREQUENCY 1070KHZ PROPOSED FREQUENCY 1071KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAX	VICTORIA	BC	1474	5018	0	585	1268	8345
CBA	MONCTON	NB	0	1505	0	585	324	2414
CHOK	SARNIA	ON	2067	9171	0	585	2871	14694

TOTAL COST FOR 1070KHZ IS $ 25453

STATIONS ON 1080KHZ ARE NOT MOVED

PRESENT FREQUENCY 1090KHZ PROPOSED FREQUENCY 1089KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHEC	LETHBRIDGE	AB	1623	4506	0	585	1140	7854
CKKW	KITCHENER	ON	2443	41992	0	585	17711	62731
CHRS	ST JEAN	QU	0	1505	0	585	324	2414

TOTAL COST FOR 1090KHZ IS $ 72999

THERE ARE NO CANADIAN STATIONS ON 1100KHZ

PRESENT FREQUENCY 1110KHZ PROPOSED FREQUENCY 1107KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHQT	EDMONTON	AB	1375	4537	0	585	1212	7709
CBD	SAINT JOHN	NB	1682	4969	0	585	1379	8615
CHPR	HAWKESBURY	ON	0	1505	0	585	324	2414
CKJD	SARNIA	ON	2674	25025	0	585	9758	38042

TOTAL COST FOR 1110KHZ IS $ 56780

THERE ARE NO CANADIAN STATIONS ON 1120KHZ

PRESENT FREQUENCY 1130KHZ PROPOSED FREQUENCY 1134KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKWX	VANCOUVER	BC	1208	2857	0	585	542	5192

TOTAL COST FOR 1130KHZ IS $ 5192

PRESENT FREQUENCY 1140KHZ PROPOSED FREQUENCY 1143KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKXL	CALGARY	AB	1374	4133	0	585	1008	7100
CBI	SYDNEY	NS	1200	2599	0	585	405	4789
CJTR	TROIS RIVIERES	QU	2113	11225	0	585	3861	17784

TOTAL COST FOR 1140KHZ IS $ 29673

PRESENT FREQUENCY 1150KHZ PROPOSED FREQUENCY 1152KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKIQ	KELOWNA	BC	1191	3148	0	585	696	5620
CKX	BRANDON	MB	1654	6783	0	585	2285	11307
CHSJ	SAINT JOHN	NB	1488	7751	0	585	3059	12883
CKOC	HAMILTON	ON	2137	9416	0	585	2975	15113
CJRC	OTTAWA	ON	1950	8708	0	585	2926	14169

TOTAL COST FOR 1150KHZ IS $ 59092

THERE ARE NO CANADIAN STATIONS ON 116ØKHZ

STATIONS ON 117ØKHZ ARE NOT MOVED

THERE ARE NO CANADIAN STATIONS ON 118ØKHZ

PRESENT FREQUENCY 119ØKHZ PROPOSED FREQUENCY 1188KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJMR	MISSISSAUGA	ON	15Ø1	4436	Ø	585	982	75Ø4
CHTN	CHARLOTTETOWN	PE	1356	3277	Ø	585	576	5794
CFSL	WEYBURN	SA	15Ø1	5581	Ø	585	1544	9211

TOTAL COST FOR 119ØKHZ IS $ 22509

THERE ARE NO CANADIAN STATIONS ON 12ØØKHZ

PRESENT FREQUENCY 121ØKHZ PROPOSED FREQUENCY 12Ø6KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFFB	FROBISHER BAY	NT	Ø	15Ø5	Ø	585	324	2414

TOTAL COST FOR 121ØKHZ IS $ 2414

PRESENT FREQUENCY 1220KHZ PROPOSED FREQUENCY 1224KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOC	LETHBRIDGE	AB	1206	3230	0	585	740	5761
CKDA	VICTORIA	BC	1692	11340	0	585	4147	17764
CJRB	BOISSEVAIN	MB	2030	9908	0	585	3516	16039
CKCW	MONCTON	NB	1206	2345	0	585	270	4406
CJSS	CORNWALL	ON	1518	3746	0	585	936	6785
CJRL	KENORA	ON	0	1505	0	585	324	2414
CHSC	ST CATHARINES	ON	1834	12596	0	585	4548	19563
CKSM	SHAWINIGAN	QU	1785	8760	0	585	3238	14368

TOTAL COST FOR 1220KHZ IS $ 87100

PRESENT FREQUENCY 1230KHZ PROPOSED FREQUENCY 1233KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOK	FORT MCMURRAY	AB	0	1680	0	585	324	2589
CKQR	CASTLEGAR	BC	1198	3030	0	585	633	5446
CKTK	KITIMAT	BC	0	1680	0	585	324	2589
CJNL	MERRITT	BC	0	1680	0	585	324	2589
CFBV	SMITHERS	BC	0	1680	0	585	324	2589
CHFC	CHURCHILL	MB	0	1505	0	585	324	2414
CFLN	GOOSE BAY	NF	0	1680	0	585	324	2589
CFGN	PORT AUX BASQUES	NF	0	1505	0	585	324	2414
VOAR	ST JOHN'S	NF	0	1505	0	585	324	2414
CFLK	KAPUSKASING	ON	0	1505	0	585	324	2414
CKMP	MIDLAND	ON	0	1680	0	585	324	2589
CJTT	NEW LISKEARD	ON	0	1680	0	585	324	2589
CFPA	THUNDER BAY	ON	0	1680	0	585	324	2589
CJLP	DISRAELI	QU	0	1680	0	585	324	2589
CHVD	DOLBEAU	QU	0	1680	0	585	324	2589
CJSA	STE AGATHE MONTS	QU	0	1680	0	585	324	2589

TOTAL COST FOR 1230KHZ IS $ 43581

PRESENT FREQUENCY 1240KHZ PROPOSED FREQUENCY 1242KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFEK	FERNIE	BC	1189	2794	0	585	508	5076
CKGO	HOPE	BC	0	1680	0	585	324	2589
CKMK	MACKENZIE	BC	0	1680	0	585	324	2589
CKOO	OSOYOOS	BC	0	1680	0	585	324	2589
CJAV	PORT ALBERNI	BC	0	1680	0	585	324	2589
CKBX	100 MILE HOUSE	BC	0	1680	0	585	324	2589
CJAR	THE PAS	MB	0	1680	0	585	324	2589
CKIM	BAIE VERTE	NF	0	1680	0	585	324	2589
CBSI-4	LABRADOR CITY	NF	0	1680	0	585	324	2589
CJNH	BANCROFT	ON	0	1680	0	585	324	2589
CJCS	STRATFORD	ON	0	1680	0	585	324	2589
CJWA	WAWA	ON	0	1680	0	585	324	2589
CJRW	SUMMERSIDE	PE	0	1505	0	585	324	2414
CJAF	CABANO	QU	0	1680	0	585	324	2589
CJMD	CHIBOUGAMAU	QU	0	1680	0	585	324	2589
CKLS	LA SARRE	QU	0	1680	0	585	324	2589
CFLM	LA TUQUE	QU	0	1680	0	585	324	2589
CIRB	LAC ETCHEMIN	QU	0	1680	0	585	324	2589
CKBS	ST HYACINTHE	QU	0	1505	0	585	324	2414
CJNS	MEADOW LAKE	SA	0	1680	0	585	324	2589

TOTAL COST FOR 1240KHZ IS $ 53917

PRESENT FREQUENCY 1250KHZ PROPOSED FREQUENCY 1251KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHSM	STEINBACH	MB	1880	6660	0	585	1921	11046
CHWO	OAKVILLE	ON	2114	10202	0	585	3294	16195
CBOF	OTTAWA	ON	1986	10336	0	585	3443	16350
CBGA	MATANE	QU	1178	2388	0	585	293	4444
CKOM	SASKATOON	SA	1334	3315	0	585	596	5830

TOTAL COST FOR 1250KHZ IS $ 53865

STATIONS ON 1260KHZ ARE NOT MOVED

PRESENT FREQUENCY 1270KHZ PROPOSED FREQUENCY 1269KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHAT	MEDICINE HAT	AB	1333	3357	0	585	617	5892
CHWK	CHILLIWACK	BC	1177	2651	0	585	433	4846
CJCB	SYDNEY	NS	1177	2437	0	585	319	4518
CJTN	TRENTON	ON	1683	4938	0	585	1309	8515
CFGT	ALMA	QU	1333	4438	0	585	1162	7518

TOTAL COST FOR 1270KHZ IS $ 31289

PRESENT FREQUENCY 1280KHZ PROPOSED FREQUENCY 1278KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHRB	HIGH RIVER	AB	1867	6996	0	585	2156	11604
CHQB	POWELL RIVER	BC	1189	2154	0	585	169	4097
CJJD	HAMILTON	ON	2332	14186	0	585	5031	22134
CJMS	MONTREAL	QU	2194	12983	0	585	4625	20387
CKCV	QUEBEC	QU	1648	4354	0	585	1064	7651
CJSL	ESTEVAN	SA	1189	2527	0	585	367	4668

TOTAL COST FOR 1280KHZ IS $ 70541

PRESENT FREQUENCY 1290KHZ PROPOSED FREQUENCY 1287KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFRW	WINNIPEG	MB	1671	6812	0	585	2330	11398
CJBK	LONDON	ON	3029	35049	0	585	13960	52623
CHRM	MATANE	QU	1500	3226	0	585	659	5970

TOTAL COST FOR 1290KHZ IS $ 69991

PRESENT FREQUENCY 1300KHZ PROPOSED FREQUENCY 1296KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBAF	MONCTON	NB	1204	2767	0	585	494	5050
CJME	REGINA	SA	1204	2685	0	585	450	4924

TOTAL COST FOR 1300KHZ IS $ 9974

PRESENT FREQUENCY 1310KHZ PROPOSED FREQUENCY 1314KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CIOK	ST PAUL	AB	1204	2655	0	585	434	4878
CKOY	OTTAWA	ON	1995	7898	0	585	2453	12931
CHGB	LA POCATIERE	QU	1204	2735	0	585	477	5001

TOTAL COST FOR 1310KHZ IS $ 22810

PRESENT FREQUENCY 1320KHZ PROPOSED FREQUENCY 1323KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHQM	VANCOUVER	BC	1751	5728	0	585	1708	9772
CKEC	NEW GLASGOW	NS	1197	2529	0	585	368	4679
CFGM	RICHMOND HILL	ON	2628	27812	0	585	11090	42115
CJSO	SOREL	QU	1902	7131	0	585	2226	11844

TOTAL COST FOR 1320KHZ IS $ 68410

PRESENT FREQUENCY 1330KHZ PROPOSED FREQUENCY 1332KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKLD	THETFORD MINES	QU	1352	5935	0	585	1918	9790
CKKR	ROSETOWN	SA	1188	2613	0	585	412	4798

TOTAL COST FOR 1330KHZ IS $ 14588

PRESENT FREQUENCY 1340KHZ PROPOSED FREQUENCY 1341KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBR	BROOKS	AB	0	1680	0	585	324	2589
CFKC	CRESTON	BC	0	1505	0	585	324	2414
CKGF	GRAND FORKS	BC	0	1680	0	585	324	2589
CKCR	REVELSTOKE	BC	0	1680	0	585	324	2589
CIVH	VANDERHOOF	BC	0	1680	0	585	324	2589
CFGB	GOOSE BAY	NF	0	1505	0	585	324	2414
CFLW	WABUSH	NF	0	1505	0	585	324	2414
CJLS	YARMOUTH	NS	1615	4021	0	585	890	7111
CFYK	YELLOWKNIFE	NT	0	1505	0	585	324	2414
CKNR	ELLIOT LAKE	ON	0	1680	0	585	324	2589
CFLH	HEARST	ON	0	1680	0	585	324	2589
CFBQ	PARRY SOUND	ON	0	1505	0	585	324	2414
CKDK	WOODSTOCK	ON	1332	3062	0	585	468	5447
CHAD	AMOS	QU	0	1680	0	585	324	2589
CJAN	ASBESTOS	QU	1177	2407	0	585	303	4472
CFED	CHAPAIS	QU	0	1505	0	585	324	2414
CKMG	MANIWAKI	QU	0	1680	0	585	324	2589
CBGA-7	STE ANNE MONTS	QU	0	1680	0	585	324	2589
CKVT	TEMISCAMINGUE	QU	0	1680	0	585	324	2589

TOTAL COST FOR 1340KHZ IS $ 57404

STATIONS ON 1350KHZ ARE NOT MOVED

PRESENT FREQUENCY 1360KHZ PROPOSED FREQUENCY 1359KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBC	BATHURST	NB	1176	2351	0	585	273	4385
CJVL	STE MARIE BEAUCE	QU	1614	3464	0	585	607	6270

TOTAL COST FOR 1360KHZ IS $ 10655

PRESENT FREQUENCY 1370KHZ PROPOSED FREQUENCY 1368KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFOK	WESTLOCK	AB	1187	2485	0	585	345	4602
CHPQ	PARKSVILLE	BC	1187	2539	0	585	373	4684
CFLV	VALLEYFIELD	QU	1494	5519	0	585	1513	9111

TOTAL COST FOR 1370KHZ IS $ 18397

PRESENT FREQUENCY 1380KHZ PROPOSED FREQUENCY 1377KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKPC	BRANTFORD	ON	1974	9709	0	585	3419	15687
CKLC	KINGSTON	ON	1897	7579	0	585	2447	12508
CFDA	VICTORIAVILLE	QU	1667	5637	0	585	1719	9608

TOTAL COST FOR 1380KHZ IS $ 37803

PRESENT FREQUENCY 1390KHZ PROPOSED FREQUENCY 1386KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKKC	NELSON	BC	1203	3080	0	585	660	5528
CHOO	AJAX	ON	1679	8178	0	585	2623	13065

TOTAL COST FOR 1390KHZ IS $ 18593

PRESENT FREQUENCY 1400KHZ PROPOSED FREQUENCY 1404KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHOA	STETTLER	AB	0	1680	0	585	324	2589
CFLD	BURNS LAKE	BC	0	1680	0	585	324	2589
CHNL-1	CLEARWATER	BC	0	1680	0	585	324	2589
CKGR	GOLDEN	BC	0	1680	0	585	324	2589
CINL	PRINCETON	BC	0	1680	0	585	324	2589
CKCB	COLLINGWOOD	ON	0	1680	0	585	324	2589
CKOB	RENFREW	ON	0	1505	0	585	324	2414
CKRV	DRUMMONDVILLE	QU	1202	2737	0	585	478	5002
CKFL	LAC MEGANTIC	QU	0	1680	0	585	324	2589
CJFP	RIVIERE-DU-LOUP	QU	0	1680	0	585	324	2589
CKRN	ROUYN	QU	0	1680	0	585	324	2589
CKSJ	ST-JOVITE	QU	0	1680	0	585	324	2589

TOTAL COST FOR 1400KHZ IS $ 33306

PRESENT FREQUENCY 1410KHZ PROPOSED FREQUENCY 1413KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFUN	VANCOUVER	BC	1496	4734	0	585	1459	8274
CKSL	LONDON	ON	2110	11564	0	585	4135	18394
CFMB	MONTREAL	QU	1514	5838	0	585	1670	9607

TOTAL COST FOR 1410KHZ IS $ 36275

PRESENT FREQUENCY 1420KHZ PROPOSED FREQUENCY 1422KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKDY	DIGBY	NS	1187	2823	0	585	524	5119
CKPT	PETERBOROUGH	ON	1859	6930	0	585	2125	11499
CJMT	CHICOUTIMI	QU	1187	2833	0	585	529	5134
CKTL	PLESSISVILLE	QU	1187	2246	0	585	218	4236
CJVR	MELFORT	SA	1187	2994	0	585	614	5380

TOTAL COST FOR 1420KHZ IS $ 31368

PRESENT FREQUENCY 1430KHZ PROPOSED FREQUENCY 1431KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKFH	TORONTO	ON	2046	12858	0	585	4669	20158

TOTAL COST FOR 1430KHZ IS $ 20158

STATIONS ON 1440KHZ ARE NOT MOVED

PRESENT FREQUENCY 1450KHZ PROPOSED FREQUENCY 1449KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKYR	JASPER	AB	0	1505	0	585	324	2414
CKSP	SUMMERLAND	BC	0	1680	0	585	324	2589
CBG	GANDER	NF	0	1680	0	585	324	2589
CFAB	WINDSOR	NS	0	1505	0	585	324	2414
CFJR	BROCKVILLE	ON	1176	2591	0	585	400	4752
CHUC	COBOURG	ON	1612	4312	0	585	1035	7544
CBGA-4	CAUSAPSCAL	QU	0	1680	0	585	324	2589
CHEF	GRANBY	QU	1809	6139	0	585	1732	10265
CHRT	ST ELEUTHERE	QU	0	1505	0	585	324	2414

TOTAL COST FOR 1450KHZ IS $ 37570

PRESENT FREQUENCY 1460KHZ PROPOSED FREQUENCY 1458KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOY	GUELPH	ON	1715	4872	0	585	1275	8447
CKRB	ST GEORGE BEAUCE	QU	1349	3702	0	585	791	6427

TOTAL COST FOR 1460KHZ IS $ 14874

PRESENT FREQUENCY 1470KHZ PROPOSED FREQUENCY 1467KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJVB	VANCOUVER	BC	1663	4209	0	585	987	7444
CHOW	WELLAND	ON	1663	3940	0	585	847	7035
CKPB	BAGOTVILLE	QU	1194	2283	0	585	237	4299
CKO	POINTE CLAIRE	QU	1743	5905	0	585	1797	10030

TOTAL COST FOR 1470KHZ IS $ 28808

PRESENT FREQUENCY 1480KHZ PROPOSED FREQUENCY 1476KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHRD	DRUMMONDVILLE	QU	1767	6110	0	585	1900	10362

TOTAL COST FOR 1480KHZ IS $ 10362

PRESENT FREQUENCY 1490KHZ PROPOSED FREQUENCY 1494KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJPR	COLEMAN	AB	0	1680	0	585	324	2589
CFWB	CAMPBELL RIVER	BC	0	1680	0	585	324	2589
CHPG	PRINCE GEORGE	BC	0	1505	0	585	324	2414
CFNC	CROSS LAKE	MB	0	1505	0	585	324	2414
CKMV	GRAND SAULT	NB	0	1680	0	585	324	2589
CBDQ	WABUSH	NF	0	1680	0	585	324	2589
CKEN	KENTVILLE	NS	1201	2774	0	585	497	5057
CFMR	FORT SIMPSON	NT	0	1505	0	585	324	2414
CFRC	KINGSTON	ON	0	1505	0	585	324	2414
CFPS	PORT ELGIN	ON	0	1680	0	585	324	2589
CKLR	L'ANNONCIATION	QU	0	1680	0	585	324	2589
CKBM	MONTMAGNY	QU	0	1680	0	585	324	2589
CJMC	STE ANNE MONTS	QU	0	1680	0	585	324	2589
CJSN	SHAUNAVON	SA	0	1680	0	585	324	2589

TOTAL COST FOR 1490KHZ IS $ 38014

PRESENT FREQUENCY 1500KHZ PROPOSED FREQUENCY 1503KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKAY	DUNCAN	BC	1494	2997	0	585	538	5614

TOTAL COST FOR 1500KHZ IS $ 5614

PRESENT FREQUENCY 1510KHZ PROPOSED FREQUENCY 1512KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKOT	TILLSONBURG	ON	1348	5372	0	585	1634	8939
CJRS	SHERBROOKE	QU	1781	5998	0	585	1704	10068

TOTAL COST FOR 1510KHZ IS $ 19007

THERE ARE NO CANADIAN STATIONS ON 1520KHZ

STATIONS ON 1530KHZ ARE NOT MOVED

PRESENT FREQUENCY 1540KHZ PROPOSED FREQUENCY 1539KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHIN	TORONTO	ON	1175	2816	0	585	520	5096

TOTAL COST FOR 1540KHZ IS $ 5096

PRESENT FREQUENCY 1550KHZ PROPOSED FREQUENCY 1548KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBE	WINDSOR	ON	1185	3272	0	585	761	5803

TOTAL COST FOR 1550KHZ IS $ 5803

THERE ARE NO CANADIAN STATIONS ON 1560KHZ

PRESENT FREQUENCY 1570KHZ PROPOSED FREQUENCY 1566KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKTA	TABER	AB	1199	2660	0	585	437	4881
CHUB	NANAIMO	BC	1504	3486	0	585	797	6372
CKLQ	BRANDON	MB	1372	4162	0	585	1023	7142
CFOR	ORILLIA	ON	0	1680	0	585	324	2589
CHLO	ST THOMAS	ON	2856	29116	0	585	11495	44052
CKLM	MONTREAL	QU	1504	6573	0	585	2434	11096

TOTAL COST FOR 1570KHZ IS $ 76132

PRESENT FREQUENCY 1580KHZ PROPOSED FREQUENCY 1584KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBJ	CHICOUTIMI	QU	1199	3062	0	585	651	5497

TOTAL COST FOR 1580KHZ IS $ 5497

THERE ARE NO CANADIAN STATIONS ON 1590KHZ

PRESENT FREQUENCY 1600KHZ PROPOSED FREQUENCY 1602KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHNR	SIMCOE	ON	1849	6691	0	585	2006	11131

TOTAL COST FOR 1600KHZ IS $ 11131

SUB TOTALS OF COSTS FOR ALL STATIONS

DESIGN	$ 374900
PROOF	$ 1580738
TOWER REPLACEMENT	$ 0
TRANSMITTER RETUNING	$ 199485
LOST REVENUE	$ 454427

TOTAL FOR ALL STATIONS $ 2609550

APPENDIX III

PRINT-OUT OF COSTING PROGRAM

FOR THE

FREQUENCY PLAN OF TABLE 2

PRESENT FREQUENCY 540KHZ PROPOSED FREQUENCY 531KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBT	GRAND FALLS	NF	0	1505	0	585	324	2414
CBEF	WINDSOR	ON	1729	8882	0	585	3165	14361
CBGA-1	NEW CARLISLE	QU	2035	8461	0	585	3087	14168
CBK	WATROUS	SA	0	1505	0	585	324	2414

TOTAL COST FOR 540KHZ IS $ 33357

PRESENT FREQUENCY 550KHZ PROPOSED FREQUENCY 540KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFJC	KAMLOOPS	BC	2432	11606	0	585	4349	18972
CKPG	PRINCE GEORGE	BC	1282	2578	0	585	394	4839
CFNB	FREDERICTON	NB	1670	4151	0	585	1150	7556
CHNO	SUDBURY	ON	1907	6352	0	585	2076	10920
CHLN	TROIS RIVIERES	QU	2055	7209	0	585	2456	12305

TOTAL COST FOR 550KHZ IS $ 54592

PRESENT FREQUENCY 560KHZ PROPOSED FREQUENCY 549KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKNL	FORT ST JOHN	BC	1288	3189	0	585	718	5780
CHTK	PRINCE RUPERT	BC	0	1680	0	585	324	2589
CHCM	MARYSTOWN	NF	1288	3226	0	585	737	5836
CJKL	KIRKLAND LAKE	ON	1288	2649	0	585	431	4953
CFOS	OWEN SOUND	ON	1922	6423	0	585	2114	11044
CKCN	SEPT-ILES	QU	1922	6064	0	585	1940	10511

TOTAL COST FOR 560KHZ IS $ 40713

PRESENT FREQUENCY 570KHZ PROPOSED FREQUENCY 558KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKEK	CRANBROOK	BC	1293	3080	0	585	660	5618
CKWL	WILLIAMS LAKE	BC	1692	4566	0	585	1370	8213
CJEM	EDMUNDSTON	NB	1293	3015	0	585	625	5518
CFCB	CORNER BROOK	NF	0	1505	0	585	324	2414
CHYM	KITCHENER	ON	2003	12267	0	585	4594	19449
CKSW	SWIFT CURRENT	SA	4152	37251	0	585	15298	57286
CFWH	WHITEHORSE	YT	0	1505	0	585	324	2414

TOTAL COST FOR 570KHZ IS $ 100912

PRESENT FREQUENCY 580KHZ PROPOSED FREQUENCY 567KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKUA	EDMONTON	AB	1947	5979	0	585	1895	10406
CKXR	SALMON ARM	BC	1297	2607	0	585	409	4898
CKY	WINNIPEG	MB	2186	10231	0	585	3813	16815
CJFX	ANTIGONISH	NS	1297	2836	0	585	531	5249
CKAP	KAPUSKASING	ON	1297	3044	0	585	641	5567
CFRA	OTTAWA	ON	2510	13692	0	585	5373	22160
CKPR	THUNDER BAY	ON	0	1680	0	585	324	2589
CKWW	WINDSOR	ON	1783	8090	0	585	2776	13234
CHLC	HAUTERIVE	QU	1947	5187	0	585	1487	9206

TOTAL COST FOR 580KHZ IS $ 90124

PRESENT FREQUENCY 590KHZ PROPOSED FREQUENCY 576KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFNL	FORT NELSON	BC	0	1505	0	585	324	2414
CFTK	TERRACE	BC	1301	3894	0	585	1091	6871
CFAR	FLIN FLON	MB	1301	2820	0	585	522	5228
CJCW	SUSSEX	NB	1708	6021	0	585	2141	10455
VOCM	ST JOHN'S	NF	1301	2754	0	585	487	5127
CKEY	TORONTO	ON	2035	11593	0	585	4269	18482
CKRS	JONQUIERE	QU	2201	14747	0	585	6032	23565

TOTAL COST FOR 590KHZ IS $ 72142

PRESENT FREQUENCY 600KHZ PROPOSED FREQUENCY 585KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOR	VANCOUVER	BC	1559	5157	0	585	1525	8826
CBNA	ST ANTHONY	NF	1716	4919	0	585	1557	8777
CKCL	TRURO	NS	1305	4911	0	585	1631	8432
CFCT	TUKTOYAKTUK	NT	0	1505	0	585	324	2414
CFCH	NORTH BAY	ON	1970	6687	0	585	2260	11502
CFCF	MONTREAL	QU	1805	8360	0	585	2908	13658
CFQC	SASKATOON	SA	1305	2800	0	585	511	5201

TOTAL COST FOR 600KHZ IS $ 58810

PRESENT FREQUENCY 610KHZ PROPOSED FREQUENCY 594KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKYL	PEACE RIVER	AB	1566	5262	0	585	1578	8991
CHNL	KAMLOOPS	BC	1566	5053	0	585	1473	8677
CJAT	TRAIL	BC	1309	3486	0	585	875	6255
CHTM	THOMPSON	MB	0	1505	0	585	324	2414
CKYQ	GRAND BANK	NF	1724	4961	0	585	1580	8850
CKTB	ST CATHARINES	ON	2063	10393	0	585	3690	16731
CKML	MONT LAURIER	QU	1309	3204	0	585	726	5824
CHNC	NEW CARLISLE	QU	1309	2837	0	585	531	5262
CKRW	WHITEHORSE	YT	0	1505	0	585	324	2414

TOTAL COST FOR 610KHZ IS $ 65418

PRESENT FREQUENCY 620KHZ PROPOSED FREQUENCY 603KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJCI	PRINCE GEORGE	BC	1313	3315	0	585	784	5997
CKCM	GRAND FALLS	NF	1313	2998	0	585	617	5513
CFCL	TIMMINS	ON	2413	8672	0	585	2990	14660
CKCK	REGINA	SA	1313	2972	0	585	602	5472

TOTAL COST FOR 620KHZ IS $ 31642

PRESENT FREQUENCY 630KHZ PROPOSED FREQUENCY 612KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHED	EDMONTON	AB	2941	16139	0	585	6210	25875
CKOV	KELOWNA	BC	0	1680	0	585	324	2589
CKRC	WINNIPEG	MB	2173	9004	0	585	3361	15123
CFCO	CHATHAM	ON	2941	25442	0	585	10688	39656
CFBK	HUNTSVILLE	ON	1578	4349	0	585	1117	7629
CJET	SMITHS FALLS	ON	3518	33108	0	585	14032	51243
CFCY	CHARLOTTETOWN	PE	2173	6848	0	585	2274	11880
CHLT	SHERBROOKE	QU	2610	12282	0	585	4681	20158

TOTAL COST FOR 630KHZ IS $ 174153

PRESENT FREQUENCY 640KHZ PROPOSED FREQUENCY 621KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBN	ST JOHN'S	NF	0	1505	0	585	324	2414

TOTAL COST FOR 640KHZ IS $ 2414

THERE ARE NO CANADIAN STATIONS ON 650KHZ

THERE ARE NO CANADIAN STATIONS ON 660KHZ

PRESENT FREQUENCY 670KHZ PROPOSED FREQUENCY 648KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHYQ	MUSGRAVETOWN	NF	1762	4500	0	585	1335	8182

TOTAL COST FOR 670KHZ IS $ 8182

PRESENT FREQUENCY 680KHZ PROPOSED FREQUENCY 657KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHFA	EDMONTON	AB	1604	5831	0	585	1866	9886
CJOB	WINNIPEG	MB	1604	5493	0	585	1695	9377
CIYQ	GRAND FALLS	NF	1768	4397	0	585	1280	8030
CFDR	DARTMOUTH	NS	2041	8253	0	585	3050	13929
CKGB	TIMMINS	ON	2041	5754	54491	585	1788	64659
CFTR	TORONTO	ON	4507	42372	256076	585	17715	321255

TOTAL COST FOR 680KHZ IS $ 427136

PRESENT FREQUENCY 690KHZ PROPOSED FREQUENCY 666KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBU	VANCOUVER	BC	1878	6109	55456	585	1803	65831
CBF	MONTREAL	QU	0	1505	0	585	324	2414
CBKF-1	GRAVELBOURG	SA	1878	13919	0	585	5637	22019

TOTAL COST FOR 690KHZ IS $ 90264

THERE ARE NO CANADIAN STATIONS ON 700KHZ

PRESENT FREQUENCY 710KHZ PROPOSED FREQUENCY 684KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKVO	CLARENVILLE	NF	1338	3070	0	585	654	5647
CHYR	LEAMINGTON	ON	2167	10532	27969	585	3757	45010
CJRN	NIAGARA FALLS	ON	4907	65774	197526	585	28365	297157
CIPC	PORT CARTIER	QU	1617	7136	0	585	2524	11862
CKVM	VILLE MARIE	QU	1617	5513	0	585	1705	9420

TOTAL COST FOR 710KHZ IS $ 369096

THERE ARE NO CANADIAN STATIONS ON 720KHZ

PRESENT FREQUENCY 730KHZ PROPOSED FREQUENCY 702KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKLG	VANCOUVER	BC	2544	14481	57463	585	5876	80949
CKDM	DAUPHIN	MB	1342	4194	0	585	1251	7372
CKGA	GANDER	NF	1342	3443	0	585	852	6222
CJNR	BLIND RIVER	ON	1342	3408	0	585	833	6168
CHYR-7	LEAMINGTON	ON	1342	2851	0	585	538	5316
CKAC	MONTREAL	QU	1342	3800	0	585	1042	6769

TOTAL COST FOR 730KHZ IS $ 112796

PRESENT FREQUENCY 740KHZ PROPOSED FREQUENCY 711KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBX	EDMONTON	AB	2359	11098	0	585	4267	18309
CBNM	MARYSTOWN	NF	1345	3747	0	585	1013	6690
CBL	TORONTO	ON	0	1505	0	585	324	2414

TOTAL COST FOR 740KHZ IS $ 27413

PRESENT FREQUENCY 750KHZ PROPOSED FREQUENCY 720KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBGY	BONAVISTA BAY	NF	1800	5034	0	585	1618	9037

TOTAL COST FOR 750KHZ IS $ 9037

THERE ARE NO CANADIAN STATIONS ON 760KHZ

THERE ARE NO CANADIAN STATIONS ON 770KHZ

THERE ARE NO CANADIAN STATIONS ON 780KHZ

PRESENT FREQUENCY 790KHZ PROPOSED FREQUENCY 756KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFCW	CAMROSE	AB	3184	25457	86818	585	10722	126766
CFAN	NEWCASTLE	NB	1814	4054	27723	585	1099	35275
CFNW	PORT AUX CHOIX	NF	1354	3037	0	585	637	5613
CHIC	BRAMPTON	ON	6213	69783	232363	585	29723	338667
CKSO	SUDBURY	ON	3399	25548	0	585	10663	40195

TOTAL COST FOR 790KHZ IS $ 546516

PRESENT FREQUENCY 800KHZ PROPOSED FREQUENCY 765KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJJC	LANGLEY	BC	3886	28084	112876	585	11642	157073
CKOK	PENTICTON	BC	0	1680	0	585	324	2589
VOWR	ST JOHN'S	NF	0	1505	0	585	324	2414
CJBQ	BELLEVILLE	ON	3886	30550	116058	585	12815	163894
CFOB	FORT FRANCES	ON	0	1680	0	585	324	2589
CBQ	THUNDER BAY	ON	1647	7214	0	585	2564	12010
CKLW	WINDSOR	ON	3344	28053	87449	585	11993	131424
CJAD	MONTREAL	QU	2818	26738	143307	585	11777	185225
CHRC	QUEBEC	QU	2530	14554	0	585	5479	23148
CHAB	MOOSE JAW	SA	1647	5594	55450	585	1746	65022

TOTAL COST FOR 800KHZ IS $ 745388

PRESENT FREQUENCY 810KHZ PROPOSED FREQUENCY 774KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHQR	CALGARY	AB	2699	18682	0	585	7720	29686
CKJS	WINNIPEG	MB	1942	9148	0	585	3295	14970

TOTAL COST FOR 810KHZ IS $ 44656

THERE ARE NO CANADIAN STATIONS ON 820KHZ

THERE ARE NO CANADIAN STATIONS ON 830KHZ

THERE ARE NO CANADIAN STATIONS ON 840KHZ

PRESENT FREQUENCY 850KHZ PROPOSED FREQUENCY 810KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKRD	RED DEER	AB	1661	5298	0	585	1596	9140
CFVR	ABBOTSFORD	BC	2858	15369	28294	585	6197	53303
CKVL	VERDUN	QU	2130	7997	27727	585	2914	41353

TOTAL COST FOR 850KHZ IS $ 103796

PRESENT FREQUENCY 860KHZ PROPOSED FREQUENCY 819KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFPR	PRINCE RUPERT	BC	1365	4392	0	585	1355	7697
CBH	HALIFAX	NS	1365	3832	0	585	1059	6841
CHAK	INUVIK	NT	0	1505	0	585	324	2414
CJBC	TORONTO	ON	0	1505	0	585	324	2414
CBKF-2	SASKATOON	SA	2432	11267	58293	585	4326	76903

TOTAL COST FOR 860KHZ IS $ 96269

THERE ARE NO CANADIAN STATIONS ON 870KHZ

THERE ARE NO CANADIAN STATIONS ON 880KHZ

THERE ARE NO CANADIAN STATIONS ON 890KHZ

PRESENT FREQUENCY 900KHZ PROPOSED FREQUENCY 855KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJVI	VICTORIA	BC	1370	3942	0	585	1117	7014
CKDH	AMHERST	NS	1846	5753	0	585	1999	10183
CKDR	DRYDEN	ON	0	1680	0	585	324	2589
CHML	HAMILTON	ON	1370	2797	27724	585	510	32986
CFBR	SUDBURY	ON	1846	5540	0	585	1886	9857
CJBR	RIMOUSKI	QU	1370	7996	0	585	3266	13217
CKTS	SHERBROOKE	QU	2665	12684	55450	585	4980	76364
CJEN	ST JEROME	QU	1673	4367	55446	585	1127	63198
CKVD	VAL D'OR	QU	2282	12784	84027	585	4843	104521
CKBI	PRINCE ALBERT	SA	1370	4243	0	585	1276	7474

TOTAL COST FOR 900KHZ IS $ 327403

PRESENT FREQUENCY 910KHZ PROPOSED FREQUENCY 864KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJDV	DRUMHELLER	AB	2367	10967	55448	585	4353	73720
CFSX	STEPHENVILLE	NF	0	1505	0	585	324	2414
CKLY	LINDSAY	ON	1675	7476	0	585	2696	12432
CHRL	ROBERVAL	QU	1371	3582	0	585	926	6464

TOTAL COST FOR 910KHZ IS $ 95030

PRESENT FREQUENCY 920KHZ PROPOSED FREQUENCY 873KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKCQ	QUESNEL	BC	1372	3608	0	585	940	6505
CFRY	PORTAGE LA PRAIR	MB	2371	9053	0	585	3387	15396
CJCJ	WOODSTOCK	NB	1850	5442	0	585	1835	9712
CJCH	HALIFAX	NS	1677	6599	0	585	2253	11114
CBO	OTTAWA	ON	3532	23730	86194	585	9807	123848
CKCY	SAULT STE MARIE	ON	2675	18320	56841	585	7780	86201
CKNX	WINGHAM	ON	2155	10857	0	585	4424	18021
CFLS	LEVIS	QU	1372	4336	0	585	1326	7619

TOTAL COST FOR 920KHZ IS $ 278416

PRESENT FREQUENCY 930KHZ PROPOSED FREQUENCY 882KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJCA	EDMONTON	AB	2463	12403	57983	585	4913	78347
CFBC	SAINT JOHN	NB	2912	33182	87768	585	14941	139388
CJYQ	ST JOHN'S	NF	2158	6156	27726	585	1985	38610
CKNS	ESPANOLA	ON	1984	8342	0	585	2899	13810

TOTAL COST FOR 930KHZ IS $ 270155

PRESENT FREQUENCY 940KHZ PROPOSED FREQUENCY 891KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJIB	VERNON	BC	1374	4998	0	585	1677	8634
CBM	MONTREAL	QU	0	1505	0	585	324	2414
CJGX	YORKTON	SA	1987	10297	0	585	3859	16728

TOTAL COST FOR 940KHZ IS $ 27776

PRESENT FREQUENCY 950KHZ PROPOSED FREQUENCY 900KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAM	ALTONA	MB	2690	16958	0	585	7095	27328
CKNB	CAMPBELLTON	NB	1856	4980	0	585	1590	9011
CHER	SYDNEY	NS	1375	3797	0	585	1040	6797
CKBB	BARRIE	ON	2383	17429	0	585	7615	28012

TOTAL COST FOR 950KHZ IS $ 71148

PRESENT FREQUENCY 960KHZ PROPOSED FREQUENCY 909KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAC	CALGARY	AB	1684	7376	0	585	2646	12291
CHNS	HALIFAX	NS	1377	3235	28625	585	742	34564
CFTJ	CAMBRIDGE	ON	2930	19024	57973	585	7990	88502
CKWS	KINGSTON	ON	2694	10334	83384	585	3817	100814

TOTAL COST FOR 960KHZ IS $ 236171

PRESENT FREQUENCY 970KHZ PROPOSED FREQUENCY 918KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJYR	EDSON	AB	1378	3818	0	585	1051	6832
CBZ	FREDERICTON	NB	1378	4310	0	585	1312	7585
CKCH	HULL	QU	1686	9246	0	585	3589	15106

TOTAL COST FOR 970KHZ IS $ 29523

PRESENT FREQUENCY 980KHZ PROPOSED FREQUENCY 927KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKNW	NEW WESTMINSTER	BC	1998	11200	60146	585	4302	78231
CFPL	LONDON	ON	2940	14117	55197	585	5582	78421
CHEX	PETERBOROUGH	ON	2393	12458	0	585	5105	20541
CKGM	MONTREAL	QU	4100	38060	86339	585	16388	145472
CBV	QUEBEC	QU	1379	4224	0	585	1267	7455
CKRM	REGINA	SA	1864	6517	29252	585	2404	40622

TOTAL COST FOR 980KHZ IS $ 370742

PRESENT FREQUENCY 990KHZ PROPOSED FREQUENCY 936KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBW	WINNIPEG	MB	0	1505	0	585	324	2414
CBY	CORNER BROOK	NF	0	1505	0	585	324	2414

TOTAL COST FOR 990KHZ IS $ 4828

PRESENT FREQUENCY 1000KHZ PROPOSED FREQUENCY 945KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBW	BRIDGEWATER	NS	1691	6055	0	585	1978	10309
CFLP	RIMOUSKI	QU	2489	14133	0	585	5760	22967

TOTAL COST FOR 1000KHZ IS $ 33276

PRESENT FREQUENCY 1010KHZ PROPOSED FREQUENCY 954KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBR	CALGARY	AB	1868	10219	0	1144	4366	17597
CFRB	TORONTO	ON	2715	19569	65214	1144	8414	97056

TOTAL COST FOR 1010KHZ IS $ 114653

THERE ARE NO CANADIAN STATIONS ON 1020KHZ

THERE ARE NO CANADIAN STATIONS ON 1030KHZ

THERE ARE NO CANADIAN STATIONS ON 1040KHZ

PRESENT FREQUENCY 1050KHZ PROPOSED FREQUENCY 990KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFGP	GRANDE PRAIRIE	AB	1385	3968	0	835	1130	7318
CKAL	VERNON	BC	1385	3351	29252	835	804	35627
CKSB	ST BONIFACE	MB	1385	3050	29252	835	644	35166
CFYN	SAULT STE MARIE	ON	1385	3016	29093	835	626	34955
CHUM	TORONTO	ON	4160	51138	117494	1144	22610	196546
CJNB	NORTH BATTLEFORD	SA	2015	8866	57147	835	3157	72020

TOTAL COST FOR 1050KHZ IS $ 381632

PRESENT FREQUENCY 1060KHZ PROPOSED FREQUENCY 999KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFCN	CALGARY	AB	1701	6951	61623	1144	2431	73850
CJRP	QUEBEC	QU	2193	10460	0	1144	4197	17994

TOTAL COST FOR 1060KHZ IS $ 91844

PRESENT FREQUENCY 1070KHZ PROPOSED FREQUENCY 1008KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFAX	VICTORIA	BC	2019	12520	0	835	4950	20324
CBA	MONCTON	NB	0	1505	0	1144	324	2973
CHOK	SARNIA	ON	3393	26386	114172	835	11212	155998

TOTAL COST FOR 1070KHZ IS $ 179295

PRESENT FREQUENCY 1080KHZ PROPOSED FREQUENCY 1017KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKSA	LLOYDMINSTER	AB	1704	6752	28471	835	2331	40093

TOTAL COST FOR 1080KHZ IS $ 40093

PRESENT FREQUENCY 1090KHZ PROPOSED FREQUENCY 1026KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHEC	LETHBRIDGE	AB	2199	11065	0	761	4501	18526
CKKW	KITCHENER	ON	4706	153157	221597	835	69872	450167
CHRS	ST JEAN	QU	0	1505	0	835	324	2664

TOTAL COST FOR 1090KHZ IS $ 471357

THERE ARE NO CANADIAN STATIONS ON 1100KHZ

PRESENT FREQUENCY 1110KHZ PROPOSED FREQUENCY 1044KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHQT	EDMONTON	AB	1708	8796	0	835	3362	14701
CBD	SAINT JOHN	NB	2204	9738	0	835	3825	16602
CHPR	HAWKESBURY	ON	0	1505	0	624	324	2453
CKJD	SARNIA	ON	4722	61878	182256	835	27061	276752

TOTAL COST FOR 1110KHZ IS $ 310508

THERE ARE NO CANADIAN STATIONS ON 1120KHZ

PRESENT FREQUENCY 1130KHZ PROPOSED FREQUENCY 1062KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKWX	VANCOUVER	BC	1391	4440	0	1144	1381	8356

TOTAL COST FOR 1130KHZ IS $ 8356

PRESENT FREQUENCY 1140KHZ PROPOSED FREQUENCY 1071KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKXL	CALGARY	AB	1711	7758	0	835	2838	13142
CBI	SYDNEY	NS	1392	3986	0	835	1140	7353
CJTR	TROIS RIVIERES	QU	3197	25822	88046	835	10870	128770

TOTAL COST FOR 1140KHZ IS $ 149265

PRESENT FREQUENCY 1150KHZ PROPOSED FREQUENCY 1080KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKIQ	KELOWNA	BC	1392	6079	0	835	2250	10556
CKX	BRANDON	MB	2211	16836	0	1144	7388	27579
CHSJ	SAINT JOHN	NB	1890	20637	0	835	9890	33252
CKOC	HAMILTON	ON	3432	23198	144711	835	9620	181796
CJRC	OTTAWA	ON	3014	22021	0	1144	9461	35640

TOTAL COST FOR 1150KHZ IS $ 288823

THERE ARE NO CANADIAN STATIONS ON 1160KHZ

PRESENT FREQUENCY 1170KHZ PROPOSED FREQUENCY 1098KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKGY	RED DEER	AB	2215	8806	0	835	3351	15207
CFIX	CORNWALL	ON	1394	4915	0	835	1633	8777

TOTAL COST FOR 1170KHZ IS $ 23984

THERE ARE NO CANADIAN STATIONS ON 1180KHZ

PRESENT FREQUENCY 1190KHZ PROPOSED FREQUENCY 1116KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJMR	MISSISSAUGA	ON	2042	9025	56396	835	3234	71532
CHTN	CHARLOTTETOWN	PE	1717	5896	0	835	1898	10346
CFSL	WEYBURN	SA	2042	12793	0	835	5084	20754

TOTAL COST FOR 1190KHZ IS $ 102632

THERE ARE NO CANADIAN STATIONS ON 1200KHZ

PRESENT FREQUENCY 1210KHZ PROPOSED FREQUENCY 1134KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFFB	FROBISHER BAY	NT	0	1505	0	624	324	2453

TOTAL COST FOR 1210KHZ IS $ 2453

PRESENT FREQUENCY 1220KHZ PROPOSED FREQUENCY 1143KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOC	LETHBRIDGE	AB	1397	5539	0	835	1964	9735
CKDA	VICTORIA	BC	2380	25571	0	1144	11006	40101
CJRB	BOISSEVAIN	MB	3036	21756	0	835	9331	34958
CKCW	MONCTON	NB	1397	3189	0	835	718	6139
CJSS	CORNWALL	ON	1900	6667	0	664	2484	11715
CJRL	KENORA	ON	0	1505	0	664	324	2493
CHSC	ST CATHARINES	ON	2722	28408	267235	664	12070	311099
CKSM	SHAWINIGAN	QU	2457	19372	0	835	8595	31259

TOTAL COST FOR 1220KHZ IS $ 447499

PRESENT FREQUENCY 1230KHZ PROPOSED FREQUENCY 1152KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOK	FORT MCMURRAY	AB	0	1680	0	664	324	2668
CKQR	CASTLEGAR	BC	1397	5337	0	664	1857	9255
CKTK	KITIMAT	BC	0	1680	0	664	324	2668
CJNL	MERRITT	BC	0	1680	0	664	324	2668
CFBV	SMITHERS	BC	0	1680	0	664	324	2668
CHFC	CHURCHILL	MB	0	1505	0	624	324	2453
CFLN	GOOSE BAY	NF	0	1680	0	664	324	2668
CFGN	PORT AUX BASQUES	NF	0	1505	0	624	324	2453
VOAR	ST JOHN'S	NF	0	1505	0	610	324	2439
CFLK	KAPUSKASING	ON	0	1505	0	610	324	2439
CKMP	MIDLAND	ON	0	1680	0	664	324	2668
CJTT	NEW LISKEARD	ON	0	1680	0	664	324	2668
CFPA	THUNDER BAY	ON	0	1680	0	664	324	2668
CJLP	DISRAELI	QU	0	1680	0	664	324	2668
CHVD	DOLBEAU	QU	0	1680	0	835	324	2839
CJSA	STE AGATHE MONTS	QU	0	1680	0	664	324	2668

TOTAL COST FOR 1230KHZ IS $ 48558

PRESENT FREQUENCY 1240KHZ PROPOSED FREQUENCY 1161KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFEK	FERNIE	BC	1398	5063	0	664	1711	8836
CKGO	HOPE	BC	0	1680	0	664	324	2668
CKMK	MACKENZIE	BC	0	1680	0	664	324	2668
CKOO	OSOYOOS	BC	0	1680	0	664	324	2668
CJAV	PORT ALBERNI	BC	0	1680	0	664	324	2668
CKBX	100 MILE HOUSE	BC	0	1680	0	664	324	2668
CJAR	THE PAS	MB	0	1680	0	664	324	2668
CKIM	BAIE VERTE	NF	0	1680	0	664	324	2668
CBSI-4	LABRADOR CITY	NF	0	1680	0	664	324	2668
CJNH	BANCROFT	ON	0	1680	0	664	324	2668
CJCS	STRATFORD	ON	0	1680	0	640	324	2644
CJWA	WAWA	ON	0	1680	0	664	324	2668
CJRW	SUMMERSIDE	PE	0	1505	0	624	324	2453
CJAF	CABANO	QU	0	1680	0	664	324	2668
CJMD	CHIBOUGAMAU	QU	0	1680	0	664	324	2668
CKLS	LA SARRE	QU	0	1680	0	664	324	2668
CFLM	LA TUQUE	QU	0	1680	0	664	324	2668
CIRB	LAC ETCHEMIN	QU	0	1680	0	664	324	2668
CKBS	ST HYACINTHE	QU	0	1505	0	624	324	2453
CJNS	MEADOW LAKE	SA	0	1680	0	664	324	2668

TOTAL COST FOR 1240KHZ IS $ 59074

PRESENT FREQUENCY 1250KHZ PROPOSED FREQUENCY 1170KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHSM	STEINBACH	MB	3046	19371	0	835	8161	31413
CHWO	OAKVILLE	ON	3725	32467	113479	835	13992	164498
CBOF	OTTAWA	ON	3235	33567	90891	1144	14625	143462
CBGA	MATANE	QU	1399	4184	0	835	1245	7663
CKOM	SASKATOON	SA	1723	7149	0	835	2531	12238

TOTAL COST FOR 1250KHZ IS $ 359274

PRESENT FREQUENCY 1260KHZ PROPOSED FREQUENCY 1179KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFRN	EDMONTON	AB	1399	6976	0	1144	2725	12244
CIHI	FREDERICTON	NB	1724	5712	58505	835	1806	68582

TOTAL COST FOR 1260KHZ IS $ 80826

PRESENT FREQUENCY 1270KHZ PROPOSED FREQUENCY 1188KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHAT	MEDICINE HAT	AB	1725	7370	0	835	2642	12572
CHWK	CHILLIWACK	BC	1400	5332	0	835	1854	9421
CJCB	SYDNEY	NS	1400	4412	0	835	1366	8013
CJTN	TRENTON	ON	2467	13455	0	664	5608	22194
CFGT	ALMA	QU	1725	11997	0	835	4978	19535

TOTAL COST FOR 1270KHZ IS $ 71735

PRESENT FREQUENCY 1280KHZ PROPOSED FREQUENCY 1197KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHRB	HIGH RIVER	AB	2798	17528	0	835	7373	28534
CHQB	POWELL RIVER	BC	1400	2926	27723	664	578	33291
CJJD	HAMILTON	ON	4302	39776	86339	835	17204	148456
CJMS	MONTREAL	QU	3737	36306	29649	1144	15817	86653
CKCV	QUEBEC	QU	2232	9371	29119	835	3639	45196
CJSL	ESTEVAN	SA	1400	4202	0	664	1255	7521

TOTAL COST FOR 1280KHZ IS $ 349651

PRESENT FREQUENCY 1290KHZ PROPOSED FREQUENCY 1206KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFRW	WINNIPEG	MB	2234	15892	0	835	6997	25958
CJBK	LONDON	ON	6371	95239	175516	835	41925	319886
CHRM	MATANE	QU	1908	5724	0	835	1983	10450

TOTAL COST FOR 1290KHZ IS $ 356294

PRESENT FREQUENCY 1300KHZ PROPOSED FREQUENCY 1215KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBAF	MONCTON	NB	1401	4392	0	761	1355	7909
CJME	REGINA	SA	1401	4166	0	664	1235	7466

TOTAL COST FOR 1300KHZ IS $ 15375

PRESENT FREQUENCY 1310KHZ PROPOSED FREQUENCY 1224KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CIOK	ST PAUL	AB	1402	4092	0	835	1196	7525
CKOY	OTTAWA	ON	2905	16692	0	1144	6752	27493
CHGB	LA POCATIERE	QU	1402	4312	0	835	1313	7862

TOTAL COST FOR 1310KHZ IS $ 42880

PRESENT FREQUENCY 1320KHZ PROPOSED FREQUENCY 1233KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHQM	VANCOUVER	BC	2477	12627	0	1144	5191	21439
CKEC	NEW GLASGOW	NS	1402	3944	0	761	1118	7225
CFGM	RICHMOND HILL	ON	4860	75844	247795	1144	33695	363338
CJSO	SOREL	QU	2808	16277	59203	835	6764	85887

TOTAL COST FOR 1320KHZ IS $ 477889

PRESENT FREQUENCY 1330KHZ PROPOSED FREQUENCY 1242KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKLD	THETFORD MINES	QU	1731	15383	0	835	6687	24636
CKKR	ROSETOWN	SA	1403	4549	0	835	1438	8225

TOTAL COST FOR 1330KHZ IS $ 32861

PRESENT FREQUENCY 1340KHZ PROPOSED FREQUENCY 1251KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBR	BROOKS	AB	0	1680	0	664	324	2668
CFKC	CRESTON	BC	0	1505	0	624	324	2453
CKGF	GRAND FORKS	BC	0	1680	0	664	324	2668
CKCR	REVELSTOKE	BC	0	1680	0	664	324	2668
CIVH	VANDERHOOF	BC	0	1680	0	664	324	2668
CFGB	GOOSE BAY	NF	0	1505	0	664	324	2493
CFLW	WABUSH	NF	0	1505	0	624	324	2453
CJLS	YARMOUTH	NS	2241	9938	0	761	3921	16861
CFYK	YELLOWKNIFE	NT	0	1505	0	664	324	2493
CKNR	ELLIOT LAKE	ON	0	1680	0	664	324	2668
CFLH	HEARST	ON	0	1680	0	664	324	2668
CFBQ	PARRY SOUND	ON	0	1505	0	624	324	2453
CKDK	WOODSTOCK	ON	1732	6212	0	664	2058	10666
CHAD	AMOS	QU	0	1680	0	664	324	2668
CJAN	ASBESTOS	QU	1403	4353	0	664	1335	7755
CFED	CHAPAIS	QU	0	1505	0	624	324	2453
CKMG	MANIWAKI	QU	0	1680	0	664	324	2668
CBGA-7	STE ANNE MONTS	QU	0	1680	0	664	324	2668
CKVT	TEMISCAMINGUE	QU	0	1680	0	664	324	2668

TOTAL COST FOR 1340KHZ IS $ 76760

PRESENT FREQUENCY 1350KHZ PROPOSED FREQUENCY 1260KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJDC	DAWSON CREEK	BC	0	1505	0	664	324	2493
CFYQ	GANDER	NF	0	1505	0	664	324	2493
CKAD	MIDDLETON	NS	1733	6456	60696	664	2181	71730
CKAR	OSHAWA	ON	2814	15554	0	835	6393	25596
CHOV	PEMBROKE	ON	1914	4899	29243	664	1546	38266
CJLM	JOLIETTE	QU	2243	12190	0	835	5093	20361
CHAL	ST PAMPHILE	QU	1404	5407	0	664	1894	9369

TOTAL COST FOR 1350KHZ IS $ 170308

PRESENT FREQUENCY 1360KHZ PROPOSED FREQUENCY 1269KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKBC	BATHURST	NB	1404	4122	0	835	1212	7573
CJVL	STE MARIE BEAUCE	QU	2243	7529	58504	835	2693	71804

TOTAL COST FOR 1360KHZ IS $ 79377

PRESENT FREQUENCY 1370KHZ PROPOSED FREQUENCY 1278KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFOK	WESTLOCK	AB	1405	4137	0	835	1220	7597
CHPQ	PARKSVILLE	BC	1405	4327	0	664	1321	7717
CFLV	VALLEYFIELD	QU	2067	13345	0	835	5355	21602

TOTAL COST FOR 1370KHZ IS $ 36916

PRESENT FREQUENCY 1380KHZ PROPOSED FREQUENCY 1287KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKPC	BRANTFORD	ON	3080	24377	0	835	10617	38909
CKLC	KINGSTON	ON	2820	17975	0	835	7600	29230
CFDA	VICTORIAVILLE	QU	2246	12705	0	664	5343	20958

TOTAL COST FOR 1380KHZ IS $ 89097

PRESENT FREQUENCY 1390KHZ PROPOSED FREQUENCY 1296KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKKC	NELSON	BC	1406	5364	0	664	1871	9305
CHOO	AJAX	ON	2411	18164	0	835	7436	28846

TOTAL COST FOR 1390KHZ IS $ 38151

PRESENT FREQUENCY 1400KHZ PROPOSED FREQUENCY 1305KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHOA	STETTLER	AB	0	1680	0	664	324	2668
CFLD	BURNS LAKE	BC	0	1680	0	664	324	2668
CHNL-1	CLEARWATER	BC	0	1680	0	664	324	2668
CKGR	GOLDEN	BC	0	1680	0	664	324	2668
CINL	PRINCETON	BC	0	1680	0	664	324	2668
CKCB	COLLINGWOOD	ON	0	1680	0	664	324	2668
CKOB	RENFREW	ON	0	1505	0	624	324	2453
CKRV	DRUMMONDVILLE	QU	1406	4403	0	624	1361	7794
CKFL	LAC MEGANTIC	QU	0	1680	0	664	324	2668
CJFP	RIVIERE-DU-LOUP	QU	0	1680	0	835	324	2839
CKRN	ROUYN	QU	0	1680	0	664	324	2668
CKSJ	ST-JOVITE	QU	0	1680	0	664	324	2668

TOTAL COST FOR 1400KHZ IS $ 37098

PRESENT FREQUENCY 1410KHZ PROPOSED FREQUENCY 1314KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CFUN	VANCOUVER	BC	1918	10622	0	1144	4581	18265
CKSL	LONDON	ON	3430	29781	0	835	12980	47026
CFMB	MONTREAL	QU	2072	13115	0	835	5242	21264

TOTAL COST FOR 1410KHZ IS $ 86555

PRESENT FREQUENCY 1420KHZ PROPOSED FREQUENCY 1323KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKDY	DIGBY	NS	1407	5395	0	664	1887	9353
CKPT	PETERBOROUGH	ON	2828	18074	0	835	7652	29389
CJMT	CHICOUTIMI	QU	1407	5428	0	835	1905	9575
CKTL	PLESSISVILLE	QU	1407	3317	29448	664	786	35622
CJVR	MELFORT	SA	1407	6010	0	835	2213	10465

TOTAL COST FOR 1420KHZ IS $ 94404

PRESENT FREQUENCY 1430KHZ PROPOSED FREQUENCY 1332KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKFH	TORONTO	ON	3716	47168	0	1144	21205	73233

TOTAL COST FOR 1430KHZ IS $ 73233

PRESENT FREQUENCY 1440KHZ PROPOSED FREQUENCY 1341KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOI	WETASKIWIN	AB	1739	11255	0	835	4603	18432
CFCP	COURTENAY	BC	1408	4089	0	664	1195	7356
CFGO	OTTAWA	ON	2075	12664	0	1144	5021	20904

TOTAL COST FOR 1440KHZ IS $ 46692

PRESENT FREQUENCY 1450KHZ PROPOSED FREQUENCY 1350KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKYR	JASPER	AB	0	1505	0	610	324	2439
CKSP	SUMMERLAND	BC	0	1680	0	664	324	2668
CBG	GANDER	NF	0	1680	0	664	324	2668
CFAB	WINDSOR	NS	0	1505	0	624	324	2453
CFJR	BROCKVILLE	ON	1408	5291	0	664	1832	9195
CHUC	COBOURG	ON	2254	11570	0	664	4732	19220
CBGA-4	CAUSAPSCAL	QU	0	1680	0	664	324	2668
CHEF	GRANBY	QU	2833	18622	0	835	7921	30211
CHRT	ST ELEUTHERE	QU	0	1505	0	624	324	2453

TOTAL COST FOR 1450KHZ IS $ 73975

PRESENT FREQUENCY 1460KHZ PROPOSED FREQUENCY 1359KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJOY	GUELPH	ON	2499	11568	0	835	4656	19558
CKRB	ST GEORGE BEAUCE	QU	1741	7854	0	835	2886	13316

TOTAL COST FOR 1460KHZ IS $ 32874

PRESENT FREQUENCY 1470KHZ PROPOSED FREQUENCY 1368KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJVB	VANCOUVER	BC	2257	8455	0	835	3162	14709
CHOW	WELLAND	ON	2257	7593	27723	664	2713	40950
CKPB	BAGOTVILLE	QU	1409	3271	29250	664	761	35355
CKO	POINTE CLAIRE	QU	2501	13748	0	835	5757	22841

TOTAL COST FOR 1470KHZ IS $ 113855

PRESENT FREQUENCY 1480KHZ PROPOSED FREQUENCY 1377KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHRD	DRUMMONDVILLE	QU	2501	13348	0	835	5554	22238

TOTAL COST FOR 1480KHZ IS $ 22238

PRESENT FREQUENCY 1490KHZ PROPOSED FREQUENCY 1386KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CJPR	COLEMAN	AB	0	1680	0	664	324	2668
CFWB	CAMPBELL RIVER	BC	0	1680	0	664	324	2668
CHPG	PRINCE GEORGE	BC	0	1505	0	624	324	2453
CFNC	CROSS LAKE	MB	0	1505	0	597	324	2426
CKMV	GRAND SAULT	NB	0	1680	0	664	324	2668
CBDQ	WABUSH	NF	0	1680	0	664	324	2668
CKEN	KENTVILLE	NS	1410	4587	0	664	1459	-8120
CFMR	FORT SIMPSON	NT	0	1505	0	598	324	2427
CFRC	KINGSTON	ON	0	1505	0	610	324	2439
CFPS	PORT ELGIN	ON	0	1680	0	664	324	2668
CKLR	L'ANNONCIATION	QU	0	1680	0	664	324	2668
CKBM	MONTMAGNY	QU	0	1680	0	664	324	2668
CJMC	STE ANNE MONTS	QU	0	1680	0	664	324	2668
CJSN	SHAUNAVON	SA	0	1680	0	664	324	2668

TOTAL COST FOR 1490KHZ IS $ 41877

PRESENT FREQUENCY 1500KHZ PROPOSED FREQUENCY 1395KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKAY	DUNCAN	BC	1926	5268	0	761	1742	9697

TOTAL COST FOR 1500KHZ IS $ 9697

PRESENT FREQUENCY 1510KHZ PROPOSED FREQUENCY 1404KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKOT	TILLSONBURG	ON	1744	14135	0	835	6057	22771
CJRS	SHERBROOKE	QU	2598	15250	0	835	6322	25005

TOTAL COST FOR 1510KHZ IS $ 47776

THERE ARE NO CANADIAN STATIONS ON 1520KHZ

THERE ARE NO CANADIAN STATIONS ON 1530KHZ

PRESENT FREQUENCY 1540KHZ PROPOSED FREQUENCY 1431KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHIN	TORONTO	ON	1411	6449	0	1144	2446	11450

TOTAL COST FOR 1540KHZ IS $ 11450

PRESENT FREQUENCY 1550KHZ PROPOSED FREQUENCY 1440KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBE	WINDSOR	ON	1412	7227	Ø	835	2858	12332

TOTAL COST FOR 1550KHZ IS $ 12332

THERE ARE NO CANADIAN STATIONS ON 1560KHZ

PRESENT FREQUENCY 1570KHZ PROPOSED FREQUENCY 1458KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CKTA	TABER	AB	1412	4313	Ø	761	1313	7799
CHUB	NANAIMO	BC	1930	6500	Ø	835	2396	11661
CKLQ	BRANDON	MB	1748	8224	Ø	835	3073	13880
CFOR	ORILLIA	ON	Ø	1680	Ø	835	324	2839
CHLO	ST THOMAS	ON	5822	78371	185861	835	34520	305409
CKLM	MONTREAL	QU	1930	15773	Ø	1144	7311	26158

TOTAL COST FOR 1570KHZ IS $ 367746

PRESENT FREQUENCY 1580KHZ PROPOSED FREQUENCY 1467KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CBJ	CHICOUTIMI	QU	1413	5533	35462	835	1960	45203

TOTAL COST FOR 1580KHZ IS $ 45203

THERE ARE NO CANADIAN STATIONS ON 1590KHZ

PRESENT FREQUENCY 1600KHZ PROPOSED FREQUENCY 1485KHZ

CALL	CITY	PROV	DESIGN	PROOF	NEW TOWERS	TX TUNE	LOST RVNU	STATION TOTAL
CHNR	SIMCOE	ON	2857	18059	0	835	7644	29395

TOTAL COST FOR 1600KHZ IS $ 29395

SUB TOTALS OF COSTS FOR ALL STATIONS

DESIGN	$ 565164
PROOF	$ 3514605
TOWER REPLACEMENT	$ 5487227
TRANSMITTER RETUNING	$ 263824
LOST REVENUE	$ 1362294
TOTAL FOR ALL STATIONS	$11193114

APPENDIX IV

COSTING PROGRAM

LISTING AND FLOW-CHARTS

```
COST        10:09EST    11/12/79

110 FILELIST"BDSSF","TEMP"
120 ALPHA CTRY,PROV,CTY(4),CSG(3),OPMOD
121 DIMENSION CR(2),CP(2),CCTL(2),SEPR(11,11),SEPI(11,11)
122 INTEGER CHNL,F(107,2),FREQ,RN,PW,PDAY,PNT,DN
123 INTEGER CRS,CPS,FREQCOST,ALSTNTOT,CT,CTXT,CCTLS,CTOTS,CR,CP,CCTL
124 REAL FR(2,12),PH(2,12),SP(2,12),OT(2,12),TH(2,12),PD,PN
160 DATA (F(K,1),F(K,2),K=1,107,1)/540,540,550,549,560,558,570,567,580,576,
170&590,594,600,603,610,612,620,621,630,630,640,639,650,648,660,657,670,
180&666,680,684,690,693,700,702,710,711,720,720,730,729,740,738,750,747,
190&760,756,770,774,780,783,790,792,800,801,810,810,820,819,830,828,840,
200&837,850,846,860,864,870,873,880,882,890,891,900,900,910,909,920,918,
210&930,927,940,936,950,954,960,963,970,972,980,981,990,990,1000,999,1010,
220&1008,1020,1017,1030,1026,1040,1044,1050,1053,1060,1062,1070,1071,1080,
230&1080,1090,1089,1100,1098,1110,1107,1120,1116,1130,1134,1140,1143,1150,
240&1152,1160,1161,1170,1170,1180,1179,1190,1188,1200,1197,1210,1206,1220,
250&1224,1230,1233,1240,1242,1250,1251,1260,1260,1270,1269,1280,1278,1290,
260&1287,1300,1296,1310,1314,1320,1323,1330,1332,1340,1341,1350,1350,1360,
270&1359,1370,1368,1380,1377,1390,1386,1400,1404,1410,1413,1420,1422,1430,
280&1431,1440,1440,1450,1449,1460,1458,1470,1467,1480,1476,1490,1494,1500,
290&1503,1510,1512,1520,1521,1530,1530,1540,1539,1550,1548,1560,1557,1570,
300&1566,1580,1584,1590,1593,1600,1602/
310 DO 100 I=1,107,1
320 DF1=F(I,1)-F(I,2)
330 DF=ABS(DF1)
340 IF(DF)6,5,6
350 5 PRINT 7,F(I,1)
360 7 FORMAT(8X,"STATIONS ON",I5,"KHZ ARE NOT MOVED",///)
370 GOTO 100
380 6 DFP=(DF/F(I,1))*100.
390 FREQ=F(I,1)
400 FREQCOST=0.
410 SET("TEMP") TO 1
420 10 READ("TEMP",END=99) RN,CHNL,CSG(1),CSG(2),NTR
430 IF(FREQ.NE.CHNL) GO TO 10
440 SET("BDSSF")TO RN
450 READ("BDSSF")II,CTRY,PROV,CTY(1),CTY(2),CTY(3),CTY(4),CSG(1),
460&CSG(2),CSG(3),CHNL,CLAS,LAT,LONG,PDAY,PNT,RMSD,RMSN,NTD,NTN,OPMOD,
470&(FR(1,J),PH(1,J),SP(1,J),OT(1,J),TH(1,J),J=1,12),(FR(2,K),PH(2,K),
480&SP(2,K),OT(2,K),TH(2,K),K=1,12)
490 IHEADER=IHEADER+1
500 IF(IHEADER-1)9,8,9
510 8 PRINT 120,FREQ,F(I,2)
520 120 FORMAT(8X,"PRESENT FREQUENCY ",I4,"KHZ   PROPOSED FREQUENCY ",
530&I4,"KHZ")
540 PRINT 130
550 130 FORMAT(8X,"-----------------------------------------------------")
560 PRINT 132
570 132 FORMAT(/)
580 PRINT 133
590 133 FORMAT(53X,"NEW    TX   LOST  STATION")
```

```
600 PRINT 134
610 134 FORMAT(8X,"CALL",8X,"CITY",7X,"PROV   DESIGN  PROOF TOWERS TUNE
620&  RVNU   TOTAL")
630 PRINT 135
640 135 FORMAT(8X,"-----------------------------------------------------
650&----------",//)
660 9 PD=PDAY/1000.
670 PN=PNT/1000.
680 DO 11 K=1,2,1
690 CR(K)=0.
700 CP(K)=0.
710  11 CCTL(K)=0.
720 CT=0.
730 CTXT=0.
740 CRS=0.
750 CPS=0.
760 CTOTS=0.
770 CCTLS=0.
780 IF(NTD)30,30,36
790 30 CONTINUE
800  IF(NTN-1)31,31,33
810 31 DN=2
820 CALL   A1(DN,CR,CP,CT,CCTL)
830 CALL  D(DF,CTXT,DN,PDAY,PNT)
840 CP(DN)=CP(DN)+635.
850 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
860 GO TO 80
870 33 DN=2
880 NT=NTN
890 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
900 CALL  B(DFP,DN,NT,CR)
910 CALL  D(DF,CTXT,DN,PDAY,PNT)
920 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
930 CP(DN)=CP(DN)+635.
940 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
950 GO TO 80
960 36 IF(NTN)37,37,40
970 37 CONTINUE
980  IF(NTD-1)38,38,39
990 38 DN=1
1000 CALL  A1(DN,CR,CP,CT,CCTL)
1010 CALL  D(DF,CTXT,DN,PDAY,PNT)
1020 CP(DN)=CP(DN)+635.
1030 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1040 GO TO 80
1050 39 DN=1
1060 NT=NTD
1070 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1080 CALL  B(DFP,DN,NT,CR)
1090 CALL  D(DF,CTXT,DN,PDAY,PNT)
1100 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
1110 CP(DN)=CP(DN)+635.
1120 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
```

```
1130 GO TO 80
1140 40 IF((NTD+NTN).GT.2) GO TO 50
1150 PDIF=PDAY-PNT
1160 IF(PDIF) 42,41,42
1170 41 DN=1
1180 CALL  A1(DN,CR,CP,CT,CCTL)
1190 GO TO 43
1200 42 DN=1
1210 CALL  A1(DN,CR,CP,CT,CCTL)
1220 CP(DN)=CP(DN)+175.
1230 43 CALL  D(DF,CTXT,DN,PDAY,PNT)
1240 CP(DN)=CP(DN)+635.
1250 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1260 GO TO 80
1270 50 CONTINUE
1280  IF(NTN-1)52,51,52
1290 51 DN=1
1300 NT=NTD
1310 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1320 CALL  B(DFP,DN,NT,CR)
1330 CALL  D(DF,CTXT,DN,PDAY,PNT)
1340 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
1350 CP(DN)=CP(DN)+635.
1360 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1370 GO TO 80
1380 52 CONTINUE
1390  IF(NTD-1)56,55,56
1400 55 DN=2
1410 NT=NTN
1420 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1430 CALL  B(DFP,DN,NT,CR)
1440 CALL  D(DF,CTXT,DN,PDAY,PNT)
1450 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
1460 CP(DN)=CP(DN)+635.
1470 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1480 GO TO 80
1490 56 CONTINUE
1500 IF(OPMOD.EQ."DA-1")GOTO 70
1510 DN=1
1520 NT=NTD
1530 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1540 CALL  B(DFP,DN,NT,CR)
1550 CALL  D(DF,CTXT,DN,PDAY,PNT)
1560 DN=2
1570 NT=NTN
1580 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1590 CALL  B(DFP,DN,NT,CR)
1600 CALL  D(DF,CTXT,DN,PDAY,PNT)
1610 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
1620 IF(NTD.EQ.NTN)GO TO 64
1630 NT=AMIN0(NTD,NTN)
1640 64 CP(DN)=CP(DN)+635.-745.*SQRT(NT)
1650 CR(DN)=CR(DN)-385.-385.*(NT**.4)
```

```
1660 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1670 GO TO 80
1680 70 DN=1
1690 NT=NTD
1700 CALL  A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
1710 CALL  B(DFP,DN,NT,CR)
1720 CALL  D(DF,CTXT,DN,PDAY,PNT)
1730 CALL  E(CT,PDAY,PNT,NTR,HA,DF)
1740 CP(DN)=CP(DN)+635.
1750 CALL  C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
1760 80 CONTINUE
1770 CRS=CR(1)+CR(2)
1780 CPS=CP(1)+CP(2)
1790 CCTLS=CCTL(1)+CCTL(2)
1860 PRINT 82,CSG(1),CSG(2),CTY(1),CTY(2),CTY(3),CTY(4),PROV,
1870&CRS,CPS,CT,CTXT,CCTLS,CTOTS
1880 82 FORMAT(8X,2A4,4A4,A3,2X,I6,2I7,I6,1X,I5,I8)
1890 GO TO 10
1900 99 CONTINUE
1910 IF(FREQCOST)140,140,141
1920 140 PRINT 142,FREQ
1930 142 FORMAT(8X,"THERE ARE NO CANADIAN STATIONS ON",I5,"KHZ",////)
1940 GOTO 100
1950 141 CONTINUE
1960 PRINT 132
1970 PRINT 90,FREQ,FREQCOST
1980 90 FORMAT(8X,"TOTAL COST FOR",I6,"KHZ IS $",I8,)
1990 PRINT 137
2000 137 FORMAT(8X,"-----------------------------------")
2010 PRINT 138
2020 138 FORMAT(////)
2030 ALSTNTOT=ALSTNTOT+FREQCOST
2040 100 IHEADER=0
2050 PRINT 132
2060 PRINT 136
2070 136 FORMAT(8X,"SUB TOTALS OF COSTS FOR ALL STATIONS")
2080 PRINT 132
2090 PRINT 121,CRR
2100 121 FORMAT(20X,"DESIGN",18X,"$",I8,//)
2110 PRINT 122,CPR
2120 122 FORMAT(20X,"PROOF",19X,"$",I8,//)
2130 PRINT 123,CTR
2140 123 FORMAT(20X,"TOWER REPLACEMENT",7X,"$",I8,//)
2150 PRINT 124,CTXTR
2160 124 FORMAT(20X,"TRANSMITTER RETUNING",4X,"$",I8,//)
2170 PRINT 125,CCTLR
2180 125 FORMAT(20X,"LOST REVENUE",12X,"$",I8,)
2190 PRINT 126
2200 126 FORMAT(45X,"-----------",///)
2210
2220 PRINT 101,ALSTNTOT
2230 101 FORMAT(8X,"TOTAL FOR ALL STATIONS",14X,"$",I8,//////////)
2240 STOP
```

```
2250 END
2260 SUBROUTINE A(DN,FR,PH,SP,OT,TH,NT,DFP,CP,HA,CCTL)
2270 DIMENSION SEPR(11,11),SP(2,12),FR(2,12),CCTL(2),CP(2),SEPI(11,11),
2280&PH(2,12),OT(2,12),TH(2,12),AZ(12),AC(12),AS(12)
2290 INTEGER DN,CP,CCTL
2300 Z=57.29578
2310 FRR=0.
2320 SEP=10000.
2330 DO 20 J=1,NT,1
2340 AZ(J)=OT(DN,J)/Z
2350 AC(J)=SP(DN,J)*COS(AZ(J))
2360 AS(J)=SP(DN,J)*SIN(AZ(J))
2370 20 CONTINUE
2380 JJ=NT-1
2390 DO 75 J=1,JJ,1
2400 K=J+1
2410 DO 75 L=K,NT,1
2420 SEPR(J,L)=AC(J)-AC(L)
2430 SEPI(J,L)=AS(J)-AS(L)
2440 SEP1=SQRT(SEPR(J,L)**2+SEPI(J,L)**2)
2450 SEP=AMIN1(SEP,SEP1)
2460 FRR1=FR(DN,J)/FR(DN,L)
2470 IF(FRR1-1.)21,22,22
2480 21 FRR1=1./FRR1
2490 IF(SEP1)25,25,22
2500 25 PRINT,"DATA BASE ERROR"
2510 GOTO 75
2520 22 FRR2=(FRR1/(SEP1/90.))/2.
2530 FRR=AMAX1(FRR,FRR2)
2540 75 CONTINUE
2550 F2=((1.+(5000./SEP**2.))/2.)÷.19
2560 F5=FRR**.25
2570 H=0.
2580 DO 23 KK=1,NT,1
2590 23 H=H+TH(DN,KK)
2600 HA=H/NT
2610 F3=((1.+(HA**2.)/10000.)/2.)+.09
2620 F4=(DFP/7.2)**.33
2630 CCTL(DN)=324.*(NT/2.+NT**1.8)*F2*F3*F4*F5
2640 CP(DN)=600.*(1.+NT/2.)+((600.*NT**1.8)+145.*(NT/2.+NT**1.8))*F2*F3*F4*F5
2650 RETURN;END
2660 SUBROUTINE A1(DN,CR,CP,CT,CCTL)
2670 DIMENSION CCTL(2),CR(2),CP(2)
2680 INTEGER DN,CR,CP,CT,CCTL
2690  CR(DN)=0.
2700 CP(DN)=870.
2710 CT=0.
2720 CCTL(DN)=324.
2730 RETURN;END
2740 SUBROUTINE B(DFP,DN,NT,CR)
2750 DIMENSION CR(2)
2760 INTEGER DN,CR
2770 CR(DN)=385.+580.*(NT**.4)+(100.*(NT**1.4))*(DFP/7.2)**.5
```

```
2780 RETURN;END
2790 SUBROUTINE C(CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,FREQCOST,CTXTR,CTR)
2800 DIMENSION CR(2),CP(2),CCTL(2)
2805 INTEGER SUM,CR,CP,CT,CCTL,CTXT,CTOTS,CRR,CPR,CCTLR,CTXTR,CTR,FREQCOST
2810 SUM=0.
2820 DO 1 K=1,2
2830 SUM=SUM+CR(K)+CCTL(K)+CP(K)
2840 CRR=CRR+CR(K)
2850 CPR=CPR+CP(K)
2860 1 CCTLR=CCTLR+CCTL(K)
2870 CTR=CTR+CT
2880 CTXTR=CTXTR+CTXT
2890 CTOTS=SUM+CT+CTXT
2900 FREQCOST=FREQCOST+CTOTS
2910 RETURN;END
2920 SUBROUTINE D(DF,CTXT,DN,PDAY,PNT)
2930 INTEGER DN,PDAY,PNT,CTXT
2940 IF(DF-55.)1,1,2
2950 1 CTXT=585.
2960 GO TO 3
2970 2 PMAX=AMAX0(PDAY,PNT)
2980 CTXT=585.+250.*(SQRT(PMAX/10000.))
2990 3 RETURN;END
3000 SUBROUTINE E(CT,PDAY,PNT,NTR,HA,DF)
3005 INTEGER CT
3010 IF(DF.LT.20.)GO TO 3
3020 PA=(PDAY+PNT)/2.
3030 POW=.003*HA
3040 POW1=.006667*HA
3050 IF(HA-350.)1,1,2
3060 1 CT=(13550.*EXP(POW)+(11500.+1000.*((PA/10.)**.5)))*NTR
3070 GO TO 4
3080 2 CT=(3623.*EXP(POW1)+(11500.+1000.*((PA/10.)**.5)))*NTR
3090 GO TO 4
3100 3 CT=0.
3110 4 RETURN;END
```

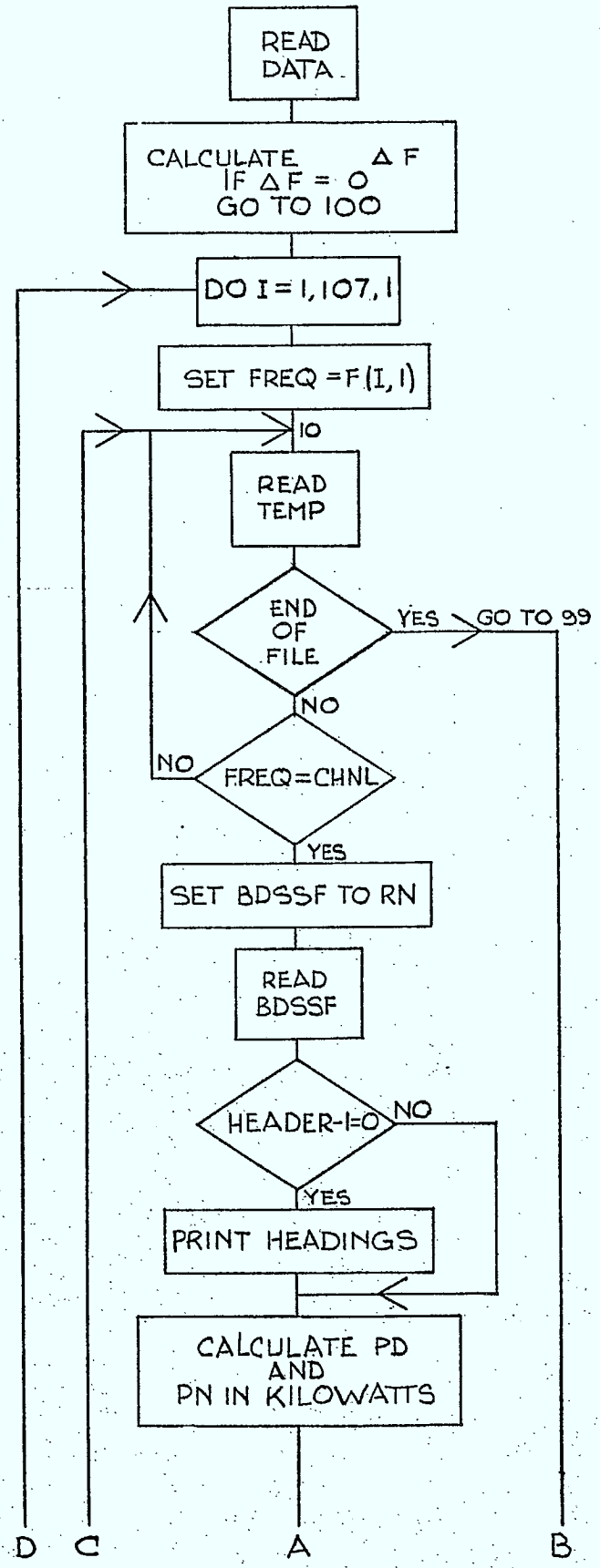
DATA FOR

FREQUENCY PLAN OF TABLE 2

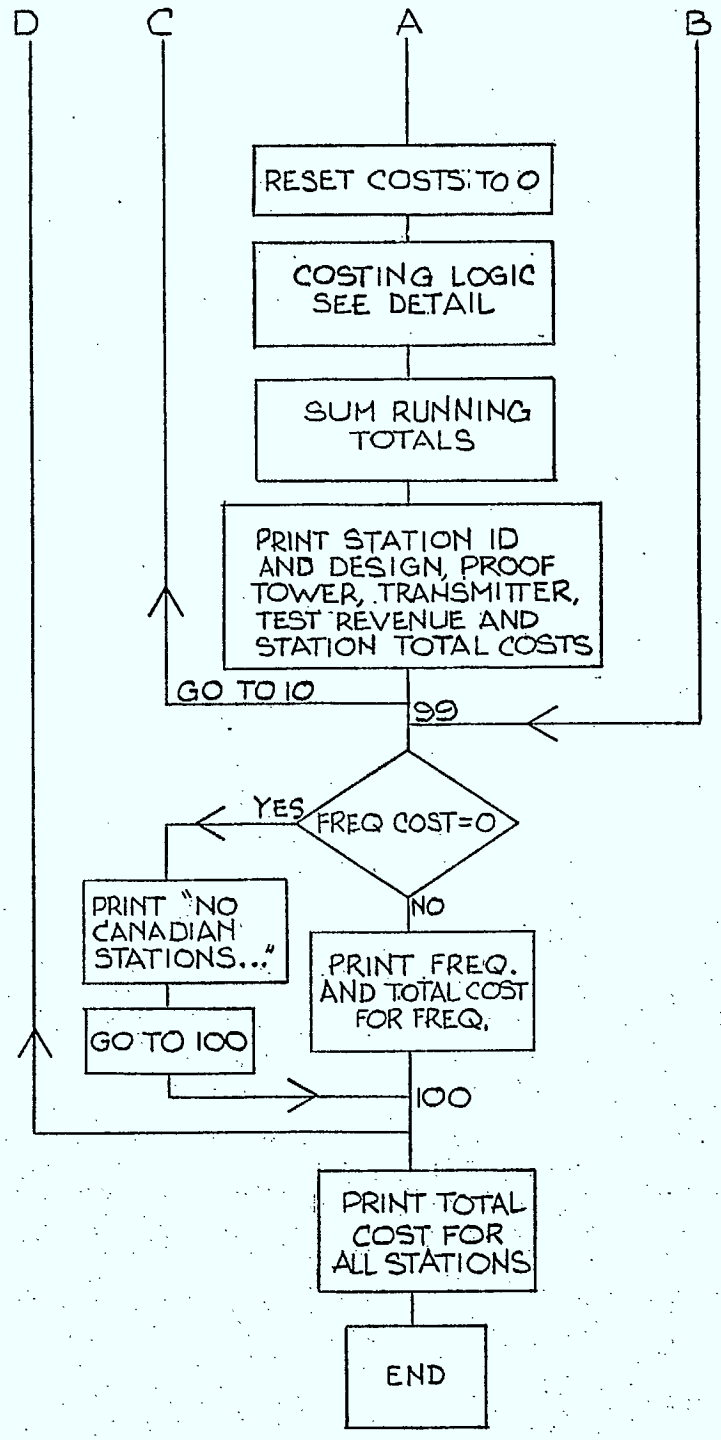
```
123 DATA (F(K,1),F(K,2),K=1,107,1)/540,531,550,540,560,549,570,558,580,
124%587,590,575,600,585,610,594,620,603,630,612,640,621,650,630,660,639,
127%670,648,680,657,690,666,700,675,710,684,720,693,730,702,740,711,750,
128%720,760,729,770,738,780,747,790,756,800,765,810,774,820,783,830,792,
129%840,801,850,810,860,819,870,828,880,837,890,846,900,855,910,864,920,
130%873,930,882,940,891,950,900,960,909,970,918,980,927,990,936,1000,945,
131%1010,954,1020,963,1030,972,1040,981,1050,990,1060,999,1070,1008,1080,
132%1017,1090,1026,1100,1035,1110,1044,1120,1053,1130,1062,1140,1071,1150,
133%1080,1160,1089,1170,1098,1180,1107,1190,1116,1200,1125,1210,1134,1220,
134%1143,1230,1152,1240,1161,1250,1170,1260,1179,1270,1188,1280,1197,1290,
135%1206,1300,1215,1310,1224,1320,1233,1330,1242,1340,1251,1350,1260,1360,
136%1269,1370,1278,1380,1287,1390,1296,1400,1305,1410,1314,1420,1323,1430,
137%1332,1440,1341,1450,1350,1460,1359,1470,1368,1480,1377,1490,1386,1500,
138%1395,1510,1404,1520,1413,1530,1422,1540,1431,1550,1440,1560,1449,1570,
139%1458,1580,1467,1590,1476,1600,1485/
```

Note. Data for frequency plan of Table 1 contained in printout of computer program.

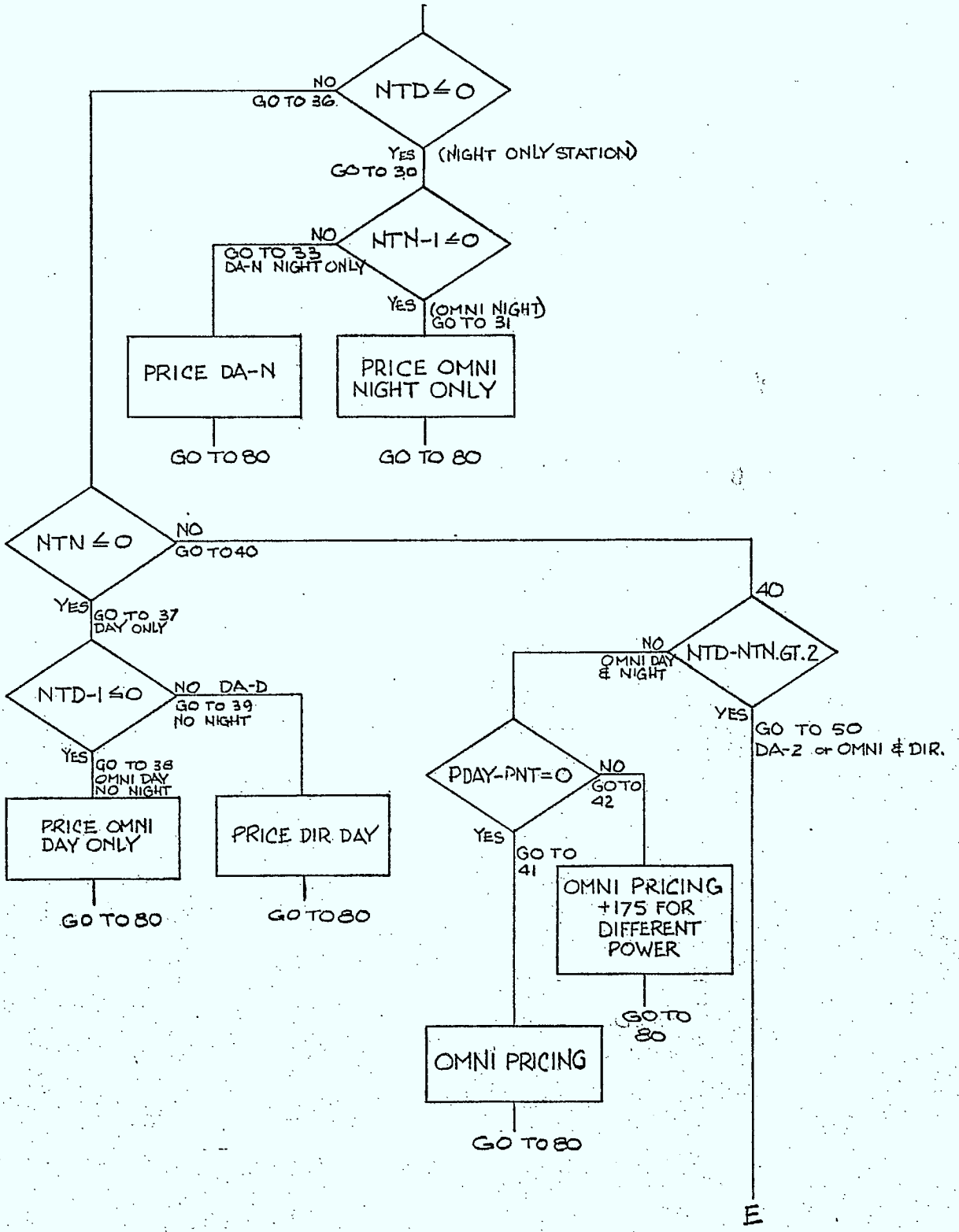
FLOW DIAGRAM FOR COSTING PROGRAM



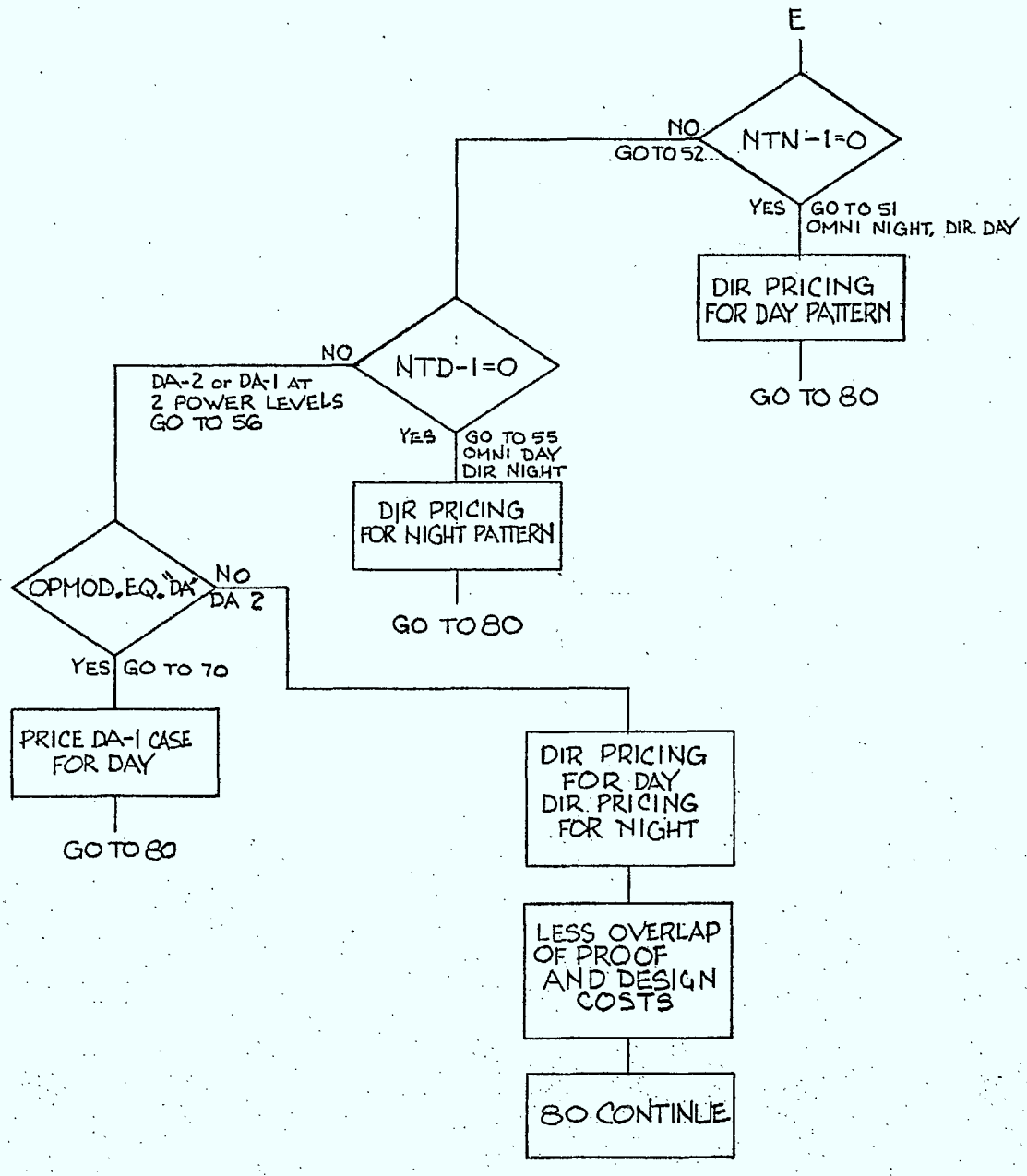
FLOW DIAGRAM FOR COSTING PROGRAM (CONT)



FLOW DIAGRAM FOR COSTING LOGIC

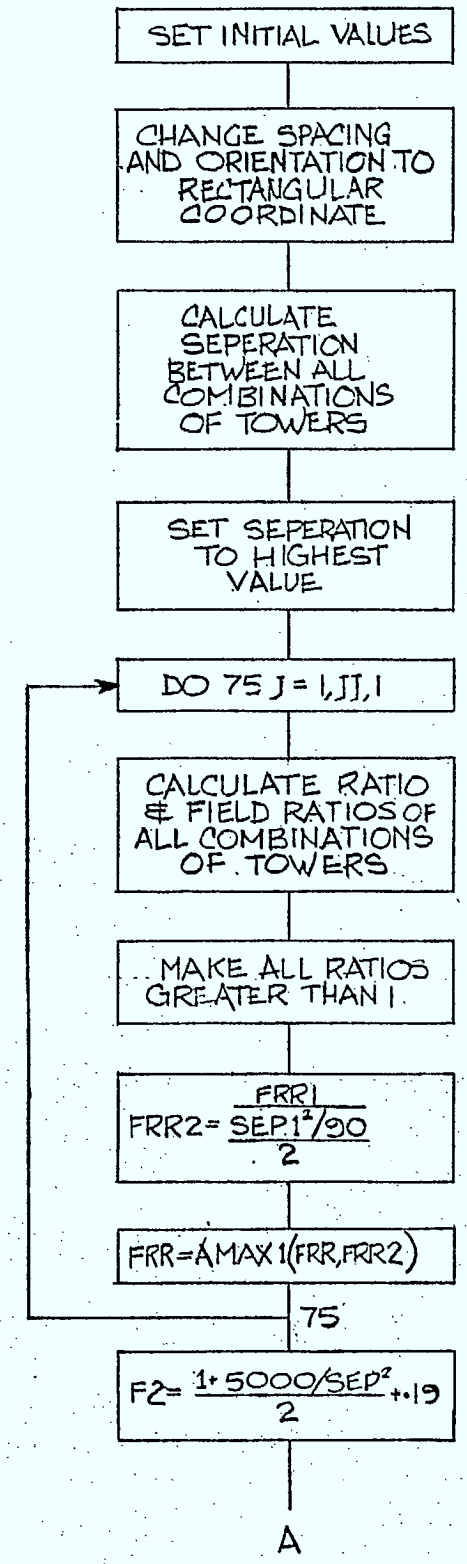


FLOW DIAGRAM
FOR COSTING LOGIC (CONT)

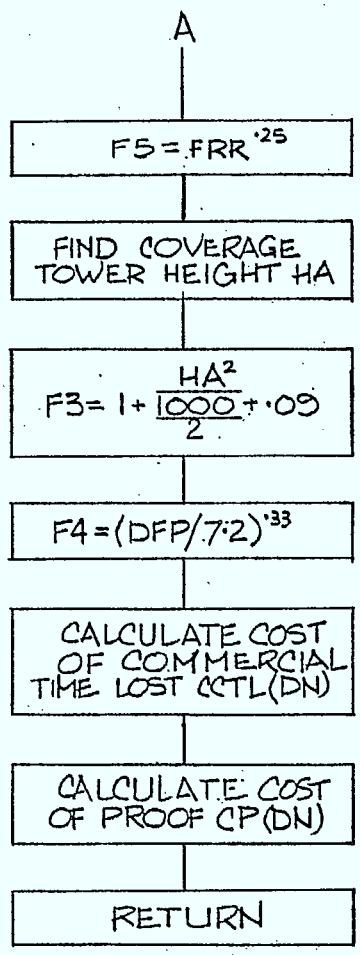


FLOW DIAGRAM OF SUBROUTINE A

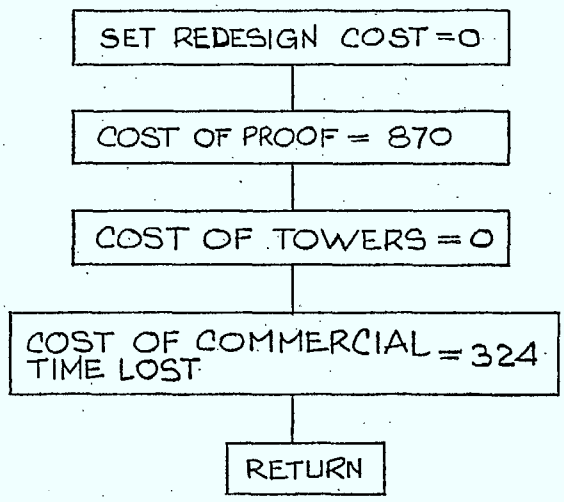
SUBROUTINE A CALCULATION OF PROOF OF PERFORMANCE COST & COST OF COMMERCIAL TIME LOST FOR DIRECTIONAL ANTENNA.



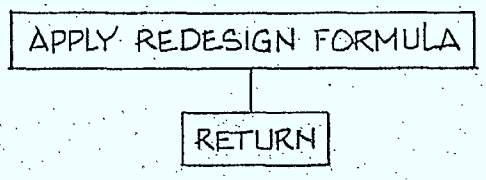
SUBROUTINE A (CONT.)



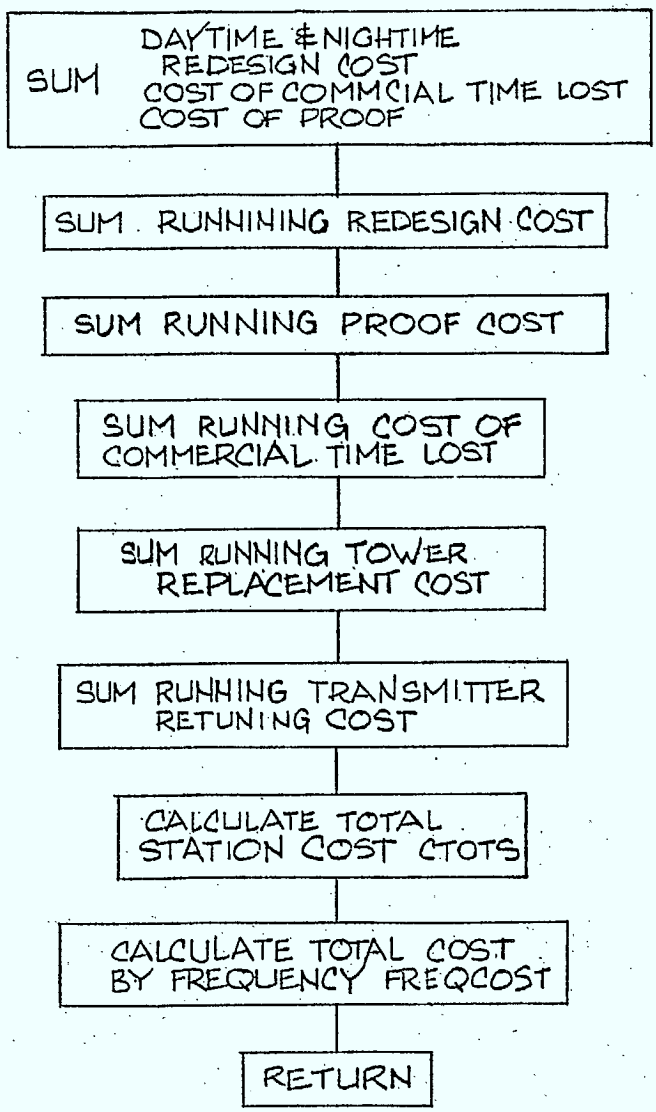
SUBROUTINE A1 - CALCULATION OF PROOF COST FOR OMNI DIRECTIONAL ANTENNA.



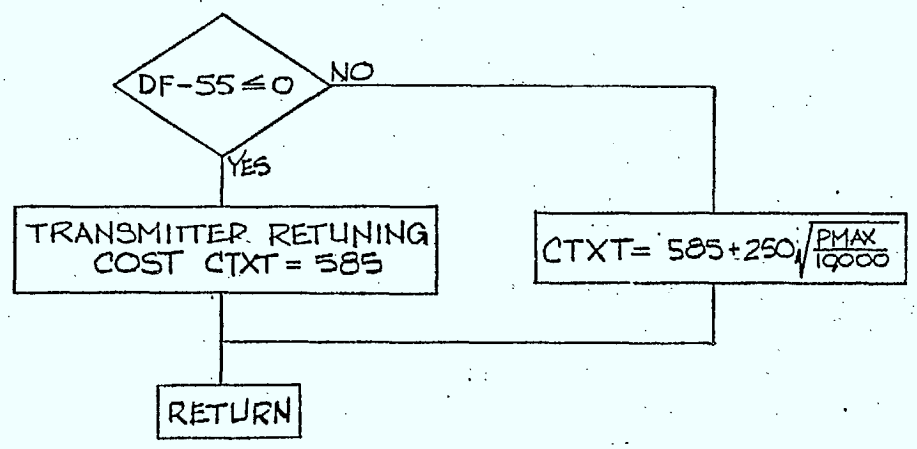
SUBROUTINE B - CALCULATES REDESIGN COST FOR DIRECTIONAL ARRAY.



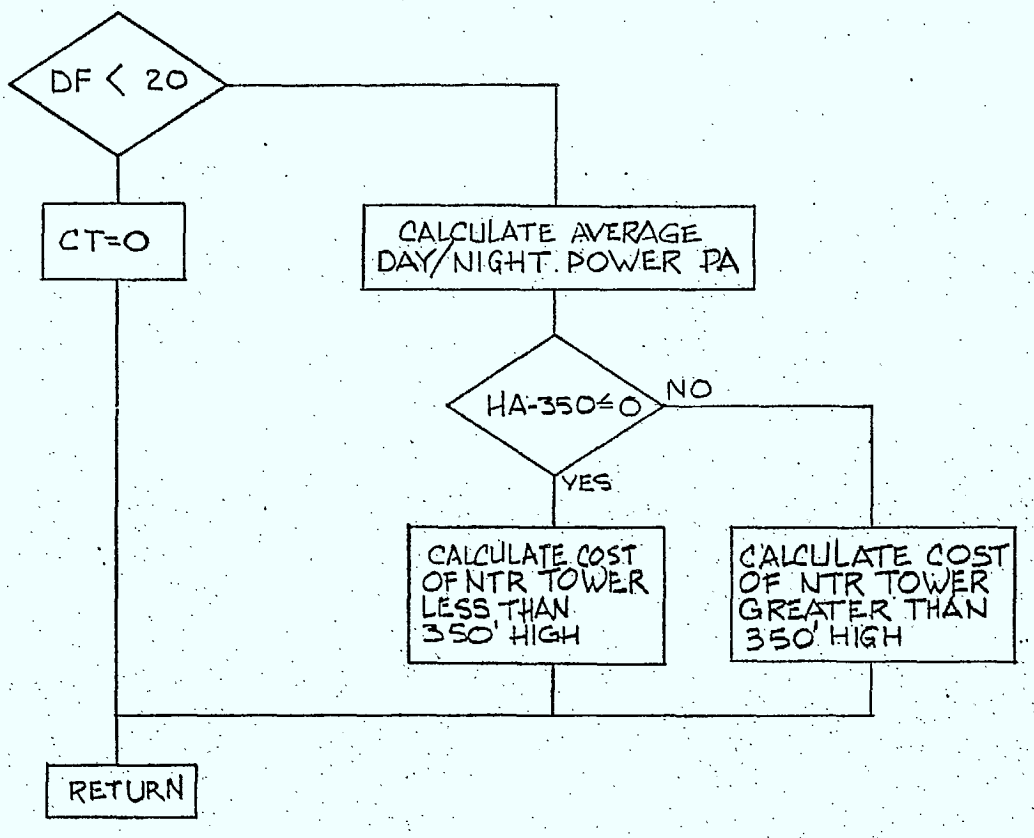
SUBROUTINE C - ACCUMULATES COSTS



SUBROUTINE D CALCULATES TRANSMITTER RETUNING COSTS



SUBROUTINE E CALCULATE TOWER REPLACEMENT COST.



A STUDY ON THE TECHNICAL AND ECONOMIC IMPACT OF A CHANGE FROM 10KHz TO 9 KHz CHANNEL SEPARATION IN THE...

P
91
C655
S894
1979

DATE DUE
DATE DE RETOUR

LOWE-MARTIN No. 1137

CACC / CCAC
87317