RADIO ENGINEERING

MICROWAVE RADIO

INTERFERENCE

2-GHZ SYSTEMS

1. INTRODUCTION

A. General

1.01 This section contains the carrier-to-interference objectives for 2-GHz Microwave Radio Systems. The frequency separations used in computation of these objectives have been selected to be compatible with the recommended Bell System 5-channel frequency plan, which is briefly described in Part 2 of this section. Further information can be found in EL 6297 (RL-79-06-274) which describes the 2-GHz frequency plan for Bell System use.

1.02 Whenever this section is reissued, the reason for reissue will be given in this paragraph.

1.03 Section 940-330-104 (Determination and Use of C/I Objective) describes the use of carrier-to-interference tables and the application of baseband interference spectrum plots in determination of C/I values. Reference to this section can be made regarding interpretation of data herein contained.

2. RECOMMENDED FREQUENCY AND CHANNELIZATION PLAN

A. Frequency and Channelization

2.01 The 2-GHz frequency bands of interest (2110 to 2130 MHz and 2160 to 2180 MHz) do not have specific channel assignments as specified by the FCC, and are therefore open to optional channel assignments. In order to provide uniformity in the selection and application of 2-GHz channel frequencies throughout the Bell System, the following frequency and channelization plan has been established. The purpose of this plan (as shown below) is to obtain the highest capacity consistent with flexibility and high quality performance. As such, the plan uses the maximum authorized channel bandwidth of 3.5 MHz, permitting five channels each in the respective low and high bands with a 3.6-MHz center-to-center channel spacing.

CHAN NO.	FREQ (LOW)	CHAN NO.	FREQ (HIGH)
1A	2113.8	1B	2163.8
2A	2117.4	2B	2167.4
3A	2121.0	3B	2171.0
4A	2124.6	4B	2174.6
5A	2128.2	5B	2178.2

B. Implementation

2.02 The recommended diplexing arrangement is shown in Fig. 1. This arrangement allows the upper frequency to be transmitted (or received) on either of the two polarizations while the lower frequency band is received (or transmitted) on the opposite polarization. With this suggested utilization, three 2-way channels are available using a single antenna. It is then possible to add two additional channels to the route by equipping a second antenna.

3. INTERFERENCE OBJECTIVES

A. Rationale and Methodology

3.01 The C/I objectives as contained in Tables C through G were generated for use in the microwave interference computer program (MICPGM). The calculation considers the frequency tolerances of the wanted and unwanted systems to compute the maximum frequency drift of both systems combined. Computations are then made in 1.2-MHz increments, resulting in the C/I objectives selected for the frequency separations specified in Table A, and which comprise the separations of Tables C through G. The computer program is designed so as to yield the worst case objective for a given combination of radio systems.

3.02 While the selected frequency separations are designed to be compatible with the recommended Bell System frequency plan (note, for example, the adjacent channel separation at 3.6 MHz), the absence of specific FCC channel assignments permits almost any separations between 0 and 20 MHz as possibilities. Interferences at intermediate values say, for example, occurring at 2.8 MHz in the 2.4- to 3.6-MHz range, take the objective specified in the 2.4-MHz table. Although some error will result, the error will be conservative. The closer the difference comes to equaling the computed separation, the more accurate the designated objective. (There is one exception to this, as will be subsequently discussed in conjunction with carrier beat interference and the 0-MHz separation objectives.)

3.03 The objectives were computed on the basis of the short-haul noise allocation of 14 dBrnc0 per exposure, and an average talker power level of −19.6 dBm was assumed. Carrier beat interference (see Section 940-330-105 for an explanation of carrier beat phenomena) has been taken into account in computation of the objectives and, therefore, is not itemized as distinct from continuous or sideband objectives. The only exception to this is the cochannel or 0-MHz separation case for FM systems only. FM channels that are exactly cochannel take a smaller objective number than other separations between 0 and 1.2 MHz. This special case is handled by providing the "exactly 0 separation objective" along with the worst case objective on the attached matrix for 0-MHz separation. Two conditions must be met to use this objective. First, the wanted and unwanted systems must operate at exactly the same frequency, and second, the combined frequency drift must be no greater than the bottom baseband frequency of the wanted system. (Normally, carrier beat objectives are larger than continuous objectives. However, if the drift does not exceed the bottom baseband frequency, the condition will approximate zero beat.)

B. 2-GHz FM Radio System Characteristics

3.04 The characteristics of 2-GHz FM systems appear in Table B. The remaining systems are digital.

C. C/I Objectives

3.05 The C/I objectives are presented in Tables C, D, E, F, and G as follows:

Table C—0.0-MHz separation

Table D—1.2-MHz separation

Table E—2.4-MHz separation

Table F—3.6-MHz separation

Table G—4.8-MHz separation.

RECEIVE

RF CHAN | 1B | 3B | 5B

TRANSMIT

RF CHAN | 1A | 3A | 5A

H
HIGH
V
LOW

TRANSMIT

1B | 3B | 5B | RF CHAN

RECEIVE

1A | 3A | 5A | RF CHAN

H
HIGH
V
LOW

TRANSMIT

RF CHAN | 2A | 4A

RECEIVE

RF CHAN | 2B | 4B

H
LOW
V
HIGH

RECEIVE

2A | 4A | RF CHAN

TRANSMIT

2B | 4B | RF CHAN

H
LOW
V
HIGH
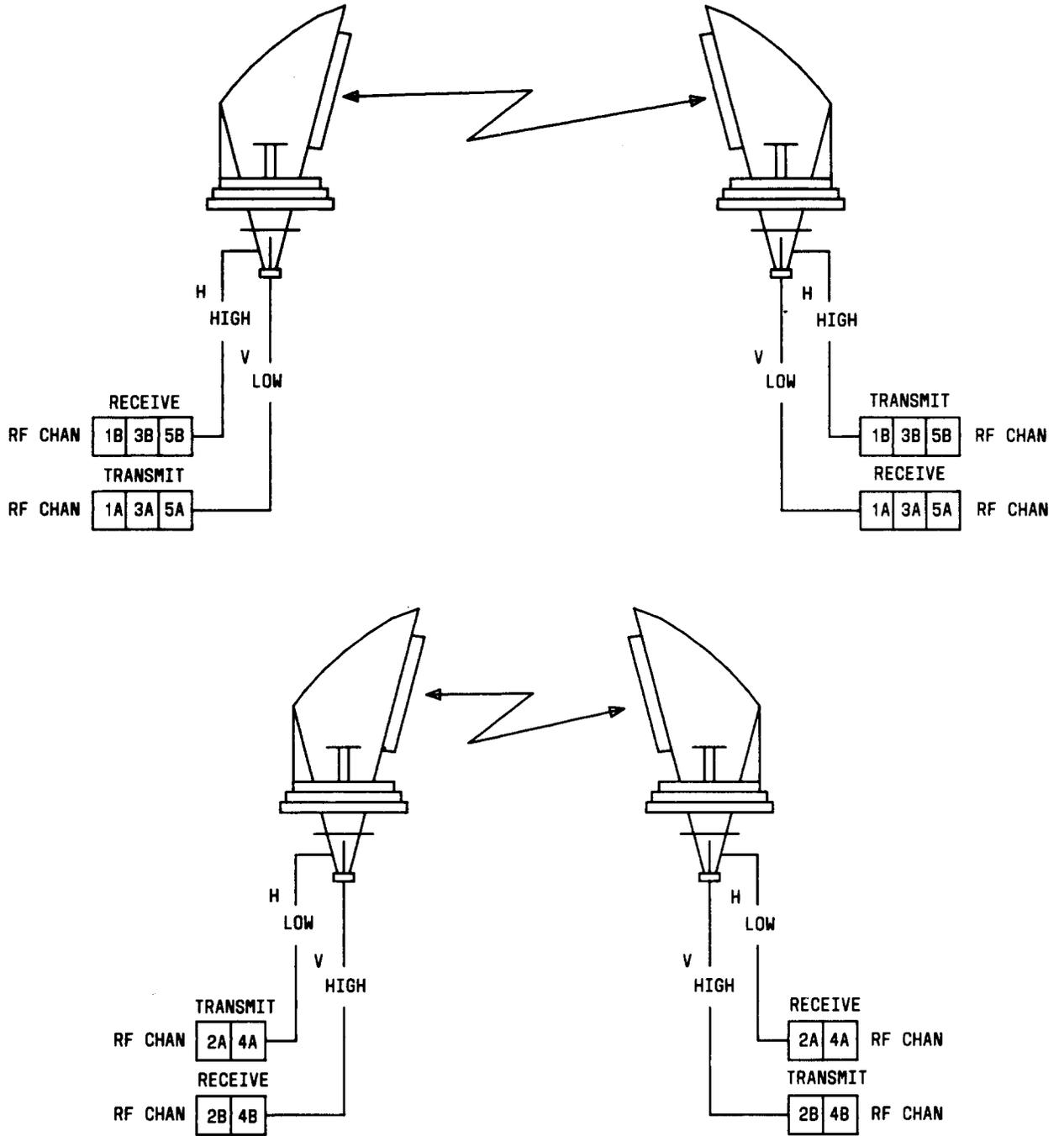
Fig. 1 — 2-GHz Channelization Implementation

TABLE A

SELECTED C/I OBJECTIVES

RESULT OF COMPUTATION	C/I OBJECTIVE SELECTED
0 MHz to 1.2 MHz	0-MHz Matrix
1.2 MHz to 2.4 MHz	1.2-MHz Matrix
2.4 MHz to 3.6 MHz	2.4-MHz Matrix
3.6 MHz to 4.8 MHz	3.6-MHz Matrix
4.8 MHz to 6.0 MHz	4.8-MHz Matrix
6.0 MHz to 20 MHz	Default to 20 dB

TABLE B

2-GHz FM RADIO SYSTEM CHARACTERISTICS

SYSTEM	CHANNEL CAPACITY	TOP BASEBAND FREQUENCY (MHz)	BOTTOM BASEBAND FREQUENCY (MHz)	TOTAL RMS FREQUENCY DEVIATION (kHz)	PRE-EMPHASIS
FM-72	72	.300	.023	238	CCIR
FM-132	132	.552	.012	188	CCIR
FM-252	252	1.052	.012	116	CCIR

TABLE C

**2-GHz INTERFERENCE OBJECTIVES
0.0-MHz SEPARATION**

INTERFERED-WITH SYSTEMS

	SYSTEM	72	132	252	NEC-STD	NEC-HI	DR2C	DR2D	FARINON DM1/2	VIDAR DRM2-6	LENKURT 79F1-D
INTERFERING SYSTEMS	72	46/45	55(54)	69(63)	65	65	65	65	65	65	65
	132	45	59(52)	74(61)	65	65	65	65	65	65	65
	252	46	62(54)	75(62)	65	65	65	65	65	65	65
	NEC-STD	46/42	52	65	65	65	65	65	65	65	65
	NEC-HI	46/42	52	65	65	65	65	65	65	65	65
	DR2C	46/42	52	64	65	65	65	65	65	65	65
	DR2D	46/40	51	65	65	65	65	65	65	65	65
	FARINON DM1/2	46/42	52	65	65	65	65	65	65	65	65
	VIDAR DRM2-6	46/43	53	64	65	65	65	65	65	65	65
	LENKURT 79F1-D	46/43	53	65	65	65	65	65	65	65	65

Note 1: AA(BB)   BB—Exactly 0.0-MHz separation and high stability
                             AA—Anywhere else

Note 2: XX/YY—XX is a threshold degradation number based on a 40-dB typical fade margin for nominal system IF filtering in the analog group. The objective may be relaxed dB for dB up to YY for lesser fade margins.

TABLE D

2-GHz INTERFERENCE OBJECTIVES
1.2-MHz SEPARATION

INTERFERED-WITH SYSTEMS

	SYSTEM	72	132	252	NEC-STD	NEC-HI	DR2C	DR2D	FARINON DM1/2	VIDAR DRM2-6	LENKURT 79F1-D
	72	46/30	46/45	67	64	64	59	62	65	65	64
	132	45/30	45/43	65	64	63	58	61	48	64	64
	252	45/27	45/41	59	64	63	58	62	44	64	65
I N T E R F E R I N G S Y S T E M S	NEC-STD	46/38	49	62	64	63	60	62	59	64	63
	NEC-HI	46/38	49	62	64	63	60	62	59	64	63
	DR2C	46/38	49	62	64	63	60	62	59	64	63
	DR2D	46/38	49	63	65	64	61	63	59	64	63
	FARINON DM1/2	46/40	50	61	64	63	61	62	61	63	62
	VIDAR DRM2-6	46/38	49	62	64	63	60	63	59	64	63
	LENKURT 79F1-D	46/37	48	64	65	63	60	62	58	62	63

Note: XX/YY—XX is a threshold degradation number based on a 40-dB typical fade margin for nominal system IF filtering in the analog group. The objective may be relaxed dB for dB up to YY for lesser fade margins.

TABLE E

2-GHZ INTERFERENCE OBJECTIVES
2.4-MHz SEPARATION

INTERFERED-WITH SYSTEMS

	SYSTEM	72	132	252	NEC-STD	NEC-HI	DR2C	DR2D	FARINON DM1/2	VIDAR DRM2-6	LENKURT 79F1-D
	72	45/20	45/20	45/40	60	52	27	46	20	60	38
	132	44/20	44/20	44/37	59	50	27	45	20	60	37
	252	44/20	44/20	44/31	59	49	29	43	20	61	40
INTERFERING SYSTEMS	NEC-STD	45/20	45/30	54	61	57	48	55	34	51	56
	NEC-HI	45/20	45/30	54	61	57	48	55	34	51	56
	DR2C	45/20	45/30	54	61	57	48	55	27	51	55
	DR2D	45/20	45/29	53	62	57	47	54	28	52	55
	FARINON DM1/2	45/24	45/38	60	61	59	53	57	43	46	58
	VIDAR DRM2-6	45/20	45/31	53	61	57	48	55	28	52	55
	LENKURT 79F1-D	45/20	45/31	51	61	56	46	53	38	51	53

Note 1: All underlined objectives are floor numbers.

Note 2: XX/YY—XX is a threshold degradation number based on a 40-dB typical fade margin for nominal system IF filtering in the analog group. The objective may be relaxed dB for dB up to YY for lesser fade margins.

TABLE F

2-GHz INTERFERENCE OBJECTIVES
3.6-MHz SEPARATION

INTERFERED-WITH SYSTEMS

	SYSTEM	72	132	252	NEC-STD	NEC-HI	DR2C	DR2D	FARINON DM1/2	VIDAR DRM2-6	LENKURT 79F1-D
INTERFERING SYSTEMS	72	41/20	41/20	41/20	42	20	20	20	21	41	25
	132	41/20	41/20	41/20	40	20	20	20	21	42	25
	252	41/20	41/20	41/20	38	20	20	20	20	43	26
	NEC-STD	41/20	41/20	41/30	52	44	20	32	21	31	28
	NEC-HI	41/20	41/20	41/30	52	44	20	32	21	31	28
	DR2C	41/20	41/20	41/22	52	39	20	32	21	31	25
	DR2D	41/20	41/20	41/25	52	37	20	30	22	32	26
	FARINON DM1/2	41/20	41/20	41/35	55	47	22	41	22	26	29
	VIDAR DRM2-6	41/20	41/20	41/23	52	38	20	30	21	32	24
	LENKURT 79F1-D	41/20	41/20	41/30	50	38	20	33	22	32	32

Note 1: All underlined objectives are floor numbers.

Note 2: XX/YY—XX is a threshold degradation number based on a 40 dB typical fade margin for nominal system IF filtering in the analog group. The objective may be relaxed dB for dB up to YY for lesser margins.

TABLE G

2-GHz INTERFERENCE OBJECTIVES
4.8-MHz SEPARATION

INTERFERED-WITH SYSTEMS

	SYSTEM	72	132	252	NEC-STD	NEC-HI	DR2C	DR2D	FARINON DM1/2	VIDAR DRM2-6	LENKURT 79F1-D
INTERFERING SYSTEMS	72	24/20	24/20	24/20	27	20	20	20	23	21	20
	132	23/20	23/20	23/20	26	20	20	20	22	22	20
	252	22/20	22/20	22/20	26	20	20	20	22	22	20
	NEC-STD	32/20	32/20	32/20	31	20	20	20	23	20	20
	NEC-HI	32/20	32/20	32/20	31	20	20	20	23	20	20
	DR2C	32/20	32/20	32/20	30	20	20	20	23	20	20
	DR2D	31/20	31/20	31/20	30	20	20	20	23	20	20
	FARINON DM1/2	40/20	40/20	40/20	36	20	20	20	23	20	20
	VIDAR DRM2-6	32/20	32/20	32/20	30	20	20	20	23	20	20
	LENKURT 79F1-D	40/20	40/20	40/20	32	20	20	20	23	20	20

Note 1: All underlined objectives are floor numbers.

Note 2: XX/YY—XX is a threshold degradation number based on a 40-dB typical fade margin for nominal system IF filtering in the analog group. The objective may be relaxed dB for dB up to YY for lesser fade margins.