NRSC REPORT

NATIONAL RADIO SYSTEMS COMMITTEE

NRSC-R30
FM Subcommittee Task Force Report on FM Receiver Interference Rejection Capability
July 24, 1981

Part I - Report

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NOTICE

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Washington, DC 20036

FOREWORD

NRSC-R30, FM Subcommittee Task Force Report on FM Receiver Interference Rejection Capability, describes FM receiver tests conducted by the NRSC and submitted to the Federal Communications Commission (FCC) into Docket 80-90, in the matter of Modification of FM Broadcast Station Rules to Increase the Availability of Commercial FM Broadcast Assignments.

The RF protection ratios for seventeen (17) FM broadcast receivers were measured and documented in this report along with receiver sensitivity in mono and stereo modes of operation. The NRSC chairman at the time of original adoption of NRSC-R-30 was James D. Kearney.

The NRSC is jointly sponsored by the Consumer Electronics Association and the National Association of Broadcasters. It serves as an industry-wide standards-setting body for technical aspects of terrestrial over-the-air radio broadcasting systems in the United States.

National Radio Systems Committee
FM Subcommittee Task Force Report
on
FM Receiver Interference-Rejection Capability

July 24, 1981

General Electric Co.
Building 5, Room 200
Electronics Park
Syracuse, NY 13221

October 16, 1981

Mr. William J. Tricarico
Secretary
Federal Communications Commission
Room 222
1919 M Street, N.W.
Washington, D.C. 20554

Re: BC Docket No. 80-90

Dear Mr. Tricarico,

Enclosed are an original and eleven (11) copies of the Comments of the National Radio Systems Committee (NRSC). These Comments include results of receiver tests which were unavailable during the comment and reply comment periods of BC Docket No. 80-90. The undersigned, representatives of the NRSC, submit that addition of these test results to the record in this docketed proceeding would serve the public interest. Therefore, it is respectfully requested that these materials be included in the record of BC Docket No. 80-90.

If you have any questions on this matter, please communicate directly with one of the undersigned.

Respectfully submitted,

James D. Kearney / CHT

James D. Kearney
Chairman, NRSC
315-456-2423

Christopher Payne

Christopher P. Payne, NAB
202-293-3557

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E.M. Tingley, EIA
202-457-4975

/js
Enclosures

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Modification of FM Broadcast Station Rules to Increase the Availability of Commercial FM Broadcast Assignments	))))	BC Docket No. 80-90 RM-2587 RM-3226 RM-3367

COMMENTS OF THE NATIONAL RADIO SYSTEMS COMMITTEE

The National Radio Systems Committee (NRSC) is comprised of persons from the broadcasting and electronics manufacturing industries and others interested in improving the overall technical quality of radio broadcasting and reception. The NRSC is co-sponsored by the Electronic Industries Association (EIA) and the National Association of Broadcasters (NAB). The NRSC by its character does not assume a position of advocacy on any matter before the Federal Communications Commission or any other governmental body. One function, however, is to provide agencies with information on transmitting and receiving technology which may be used in rulemaking proceedings.

Attached is the NRSC FM Subcommittee Task Force report. It consists of RF protection ratio measurements on a group of 17 FM broadcast receivers. This material relates to the Commission's ongoing proceeding in Docket No. 80-90. However, this information was not available during the comment and reply comment periods. The undersigned believe the public interest would best be served by the Commission's consideration of these materials and, therefore, respectfully request that the attached be associated with the record in BC Docket No. 80-90.

Measurements were made using IEEE and CCIR (and IEC) procedures at audio protection ratios of 30 and 50 dB signal/noise, the latter with both rms and quasi-peak (with weighting) readings recorded. [It should be noted that 50 dB rms signal/noise is equivalent to 30 dB quasi-peak signal/noise]. Data were taken in this fashion to facilitate comparison with other receiver measurements.

If you have any questions on these matters, please communicate directly with one of the undersigned.

Respectfully submitted,

James D Kearney /EMT

James D. Kearney
Chairman, NRSC
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October 16, 1981

REPORT TO THE NATIONAL RADIO SYSTEMS COMMITTEE

FM Subcommittee Task Force
July 24, 1981

F. David Harris
Jon P. GrosJean
Howard L. Lester

Introduction

This report summarizes the work of the FM Subcommittee Task Force to date and includes the data gathered.

Measurements

Seventeen receiver models from ten different manufacturers were tested. Most receivers were supplied with an identical backup. No receiver was "prepped" by the manufacturers or by the task force.

All receivers were subjected to operational, listening, and spot sensitivity tests. Several receivers underwent full standard sensitivity tests, and that data is included. The "Distortion + Noise" graphs all run higher than would be expected due to the limitations of the test equipment used. All receivers were judged to be in good working order.

RF protection ratios to yield audio signal to interference ratios of eo dB and 50 dB were measured for desired carrier levels of 35 dBf and 65 dBf (31.6 and 1000 microvolts across 300 ohms). The undesired carrier was spaced at 0, +100, +150, +200, +300, and +400 kHz.

?

The modulation of the desired and undesired carriers was all four possible combinations of monophonic and stereophonic. The audio modulating signal for the desired carrier was a 500 Hz tone, 75 kHz deviation. The modulating signal for the undesired carrier was weighted noise, 32 kHz quasi-peak deviation as specified in publication 315-4 of the International Electrotechnical Commission, February, 1980. For all stereophonic carriers, the modulating signal was applied to the left channel only. All receiver outputs were left channel only.

A block diagram of the test setup and a description of how the interference modulation is set are included in this report.

The tests were conducted at three different locations within East Hall which houses the Ward Technical College of the University of Hartford. Several receivers were subjected to full or partial tests in at least two of these locations and elsewhere to check repeatability.

The noise signal used to modulate the interfering carrier in these tests is a standard developed to aproximate typical program material. The RF spectrum of an FM signal modulated by this noise (32 kHz quasi-peak deviation) is markedly "milder" than an FM signal modulated by a single tone (75 kHz deviation).

The measuring instrument, a quasi-peak reading psophometer, is a standard developed to accurately indicate the intensity of objectionable interference such as clicks that most listeners find highly disturbing.

The conclusion of the task force is that this combination of a test signal, more realistic than the IEEE standard yet less harsh in terms of RF spectrum and a measuring device sensitive to disturbing elements ignored by average reading instruments and which correlates closely to subjective annoyance factors is a better way of evaluating how receivers respond to interfering signals.

Results

I Sensitivity

Most sample receivers have monophonic sensitivities such that:

10 microvolts RF yields 55dB S+N/N

30 microvolts RF yields 60dB S+N/N

over 100 microvolts RF yields 65dB S+N/N

Most sample receivers have stereophonic sensitivities such that:

10 microvolts RF yields 40dB S+N/N

30 microvolts RF yields 55dB S+N/N

100 microvolts RF yields 60dB S+N/N

1000 microvolts RF yields 65dB S+N/N

Conclusion: Most current receivers are sensitive and quiet. For an audio S+N/N in the range of 40 to 50 dB, RF signal power for stereophonic broadcasts must be 10 dB higher than for monophonic broadcasts.

II Capture Ratio

RF protection ratios to yield given audio signal to interference levels when the interference is co-channel are much smaller when tones are used instead of noise for the modulation. The sample receivers generally have "good" capture ratios.

Conclusion: Capture ratio measurements cannot be used as an indication of desired co-channel RF protection ratio.

III RF Protection Ratios

For the desired signal to be stereophonic at a level of 65dBf, and the interfering signal to be stereophonic, the mean RF protection ratios required for 30dB and 50dB audio signal to interference ratios are as follows:

Frequency of Undesired Signal	RF protection ratio for 30 dB audio S/I
Co-channel	-20 dB
+100 kHz	-15 dB
+200 kHz	-5 dB
+300 kHz	+20 dB
+400 kHz	+50 dB

Frequency of Undesired Signal	RF protection ratio for 50 dB audio S/I
Co-channel	-40 dB
+100 kHz	-35 dB
+200 kHz	-25 dB
+300 kHz	+ 5 dB
+400 kHz	+20 dB

Conclusion: There is considerable loss of protection ratio as the interfering signal is moved closer in frequency to the desired signal.

The histograms which are part of this report show the loss in RF protection ratio for all test conditions when the interfering signal moves from 400 kHz to 300 kHz away from the desired signal.

For the receiver sample, the average of the mean loss in RF protection ratio going from 400 kHz to 300 kHz spacing is 23 dB.

General Observations

I. Although current receivers have improved specifications, the use of improved methods of measuring interference disturbing to a modern audience has shown that the better receiver performance cannot be used as a justification for reducing channel spacing.

II. Greater RF protection ratios than generally accepted are required for satisfactory listening, especially when the undesired signal is co-channel.

III. The reference for establishment of acceptable RF protection ratios should be an audio signal to interference ratio of 50 dB.

Respectfully submitted

F. D. Harris

F. David Harris

51.1. 51. Method of measurement using noise modulation.

The unwanted signal, instead of being modulated with 1 kHz, shall be modulated by a noise signal which is obtained from a gaussian white noise generator, passing the signal through a weighting filter as specified in Fig 11 followed by a low-pass filter having a cut-off frequency of 15 kHz and a slope of 60 dB/octave, and then through a pre emphasis network (50 µs or 75 µs).
The audio-frequency amplitude/frequency characteristic of the modulation stage of the signal generator should not vary by more than 2 dB up to the cut-off frequency of the low-pass filter.

The accuracy of the measurement depends very much on the precision with which frequency deviation of the signal generator can be set; this is especially true for the unwanted transmitter. The line-up procedure therefore should be carried out very carefully.
The deviation of the signal shall be measured by means of the arrangement shown in Fig.12. The meter V shall be a quasi-peak voltmeter. (See Appendix A). To obtain the required deviation conditions, the switches S1, S2 and S3 are placed in position 1 and the modulation at 500 Hz of the a.f. génerator adjusted to ± 32 kHz (± 21.3 kHz) deviation. The meter reading is noted. The switch S1 is then placed in position 2 and the noise modulation adjusted to give the same reading on the quasi-peak meter.

51.2.

For the determination of the reference level, the wanted signal is frequency modulated, using a sinusoidal tone of 500 Hz with the rated maximum system deviation.

Therefore the switches are set as follows: S1 in position 1, S2 in position 2 and S3 in position 3. The reading of the meter V indicates the reference level.

51.3 The noise voltmeter used to measure the wanted and interfering signals at the output of the receiver consists of the quasi-peak voltmeter with defined dynamic characteristics and an added filter which modifies the levels of the interfering frequencies according to their subjective interference effect as specified in Appendix A.

51.4 The audio-frequency signal-to-interference ratio should be measured at the low-level audio-frequency output of the receiver. If this is not possible, the tone-controls shall be in a position to ensure a flat audio frequency response (see clause 7.12 h).

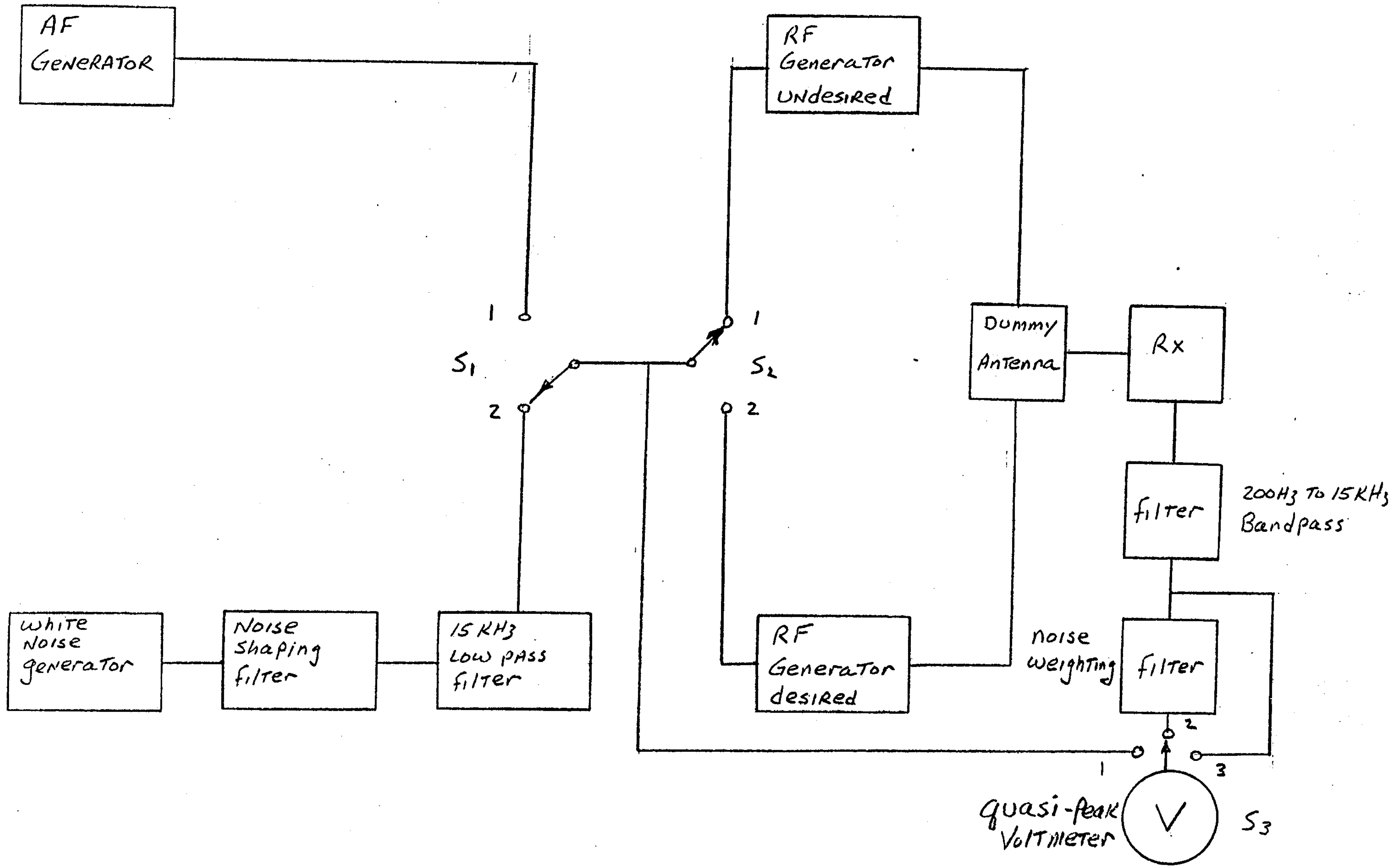
The level of the unwanted signal is adjusted to obtain an a.f. signal-to-interference ratio of 50dB at the a.f. output of the receiver, the value of 50dB being chosen in this case to correspond with CCIR Rec. 412-1. In this case, the weighting network at the quasi-peak voltmeter shall be switched in (switch 3 in position 2). The ratio between the r.f. levels of the wanted and unwanted signals is the required r.f. wanted-to-interfering signal ratio.

FOOTNOTE: These characteristics correspond with those given in CCIR Rec. 468-1.

52. Presentation of the results.

Curves are plotted with the audio-frequency signal-to-interference ratio and the wanted input signal level as parameters. The frequency difference between the wanted and unwanted signals is plotted linearly as abscissa and the radio-frequency signal-to-interference ratio expressed in decibels linearly as ordinate.

Excerpt from IEC Pub. 315-4



AF GENERATOR
RF Generator Undesired
1
S1
2
1
S2
2
Dummy Antenna
Rx
filter
200Hz To 15KHz Bandpass
white Noise generator
Noise shaping filter
15 KHz Low pass filter
RF Generator desired
noise weighting
filter
2
1
3
quasi-peak Voltmeter
V
S3

Differences between method used by the task force and the method outlined in IEC pub. 315-4.

1. The IEC method calls for the desired carrier RF level to be as low as possible, but sufficient to yield a 56 dB signal to interference ratio with the undesired carrier turned off.

   We used desired carrier levels of 35 and 65 dBf.

2. The IEC method calls for the desired carrier to be monophonic only.

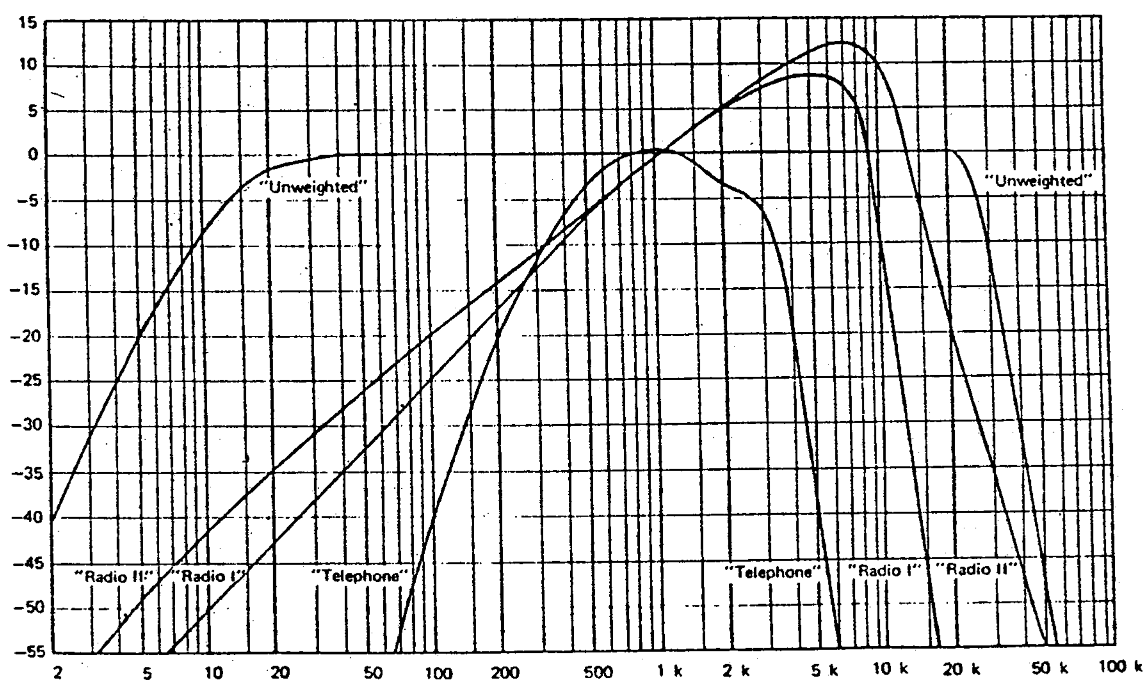
   We used monophonic and stereophonic.

3. The IEC method calls for setting the reference level with switch 3 in position 3.

   We set the reference level with switch 3 in position 2. Subsequent tests show that the protection ratios (RF) shown in our data are 6dB lower at co-channel than if we had set the reference level with switch 3 in position 3. All other protection ratios are the same, regardless of the method used.

4. The IEC method calls for finding the RF protection ratios that correspond to a 50 db signal to interference ratio.

   We found the RF protection ratios corresponding to 30 dB and 50 dB audio S/I.



Switch 3, position 1 & 3 correspond to "unweighted"

Switch 3, position 2 corresponds to "Radio II"

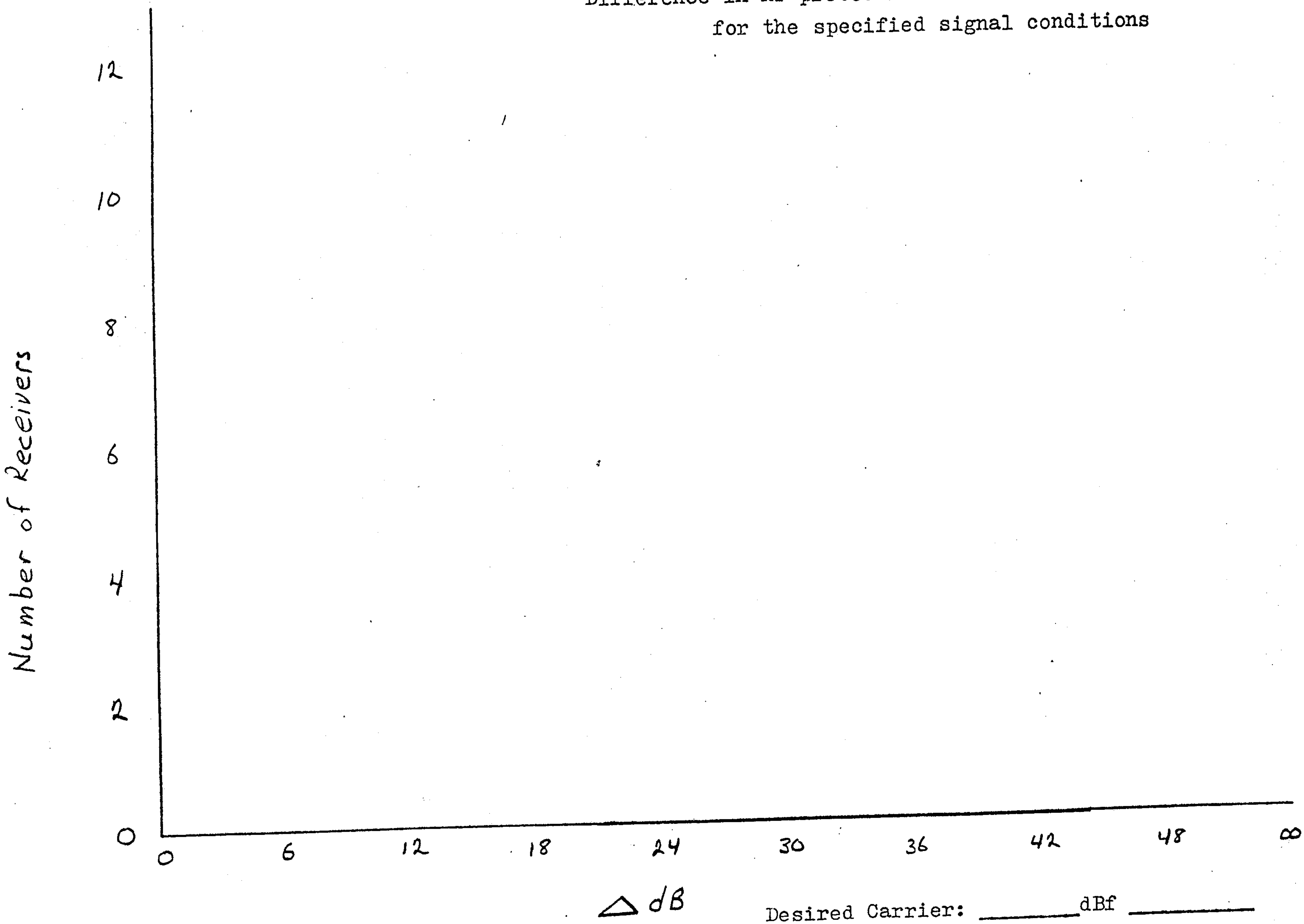
List of Receivers

Receiver	Type	Retail
A	Component	430
B	Portable	82
C	Auto	320
D	Table	109
E	Compact	430
F	Auto	200
G	Auto	99
H	Auto	320
I	Portable	210
J	Portable	130
K	Component	420
L	Compact	440
M	Component	330
N	Auto	178
O	Table	28
P	Portable	35
Q	Portable	43

Note: Prices within a category may not be comparable because the models tested did not have the same features and may or may not have included speakers, tape recorders, record players, clocks, etc.

Vs

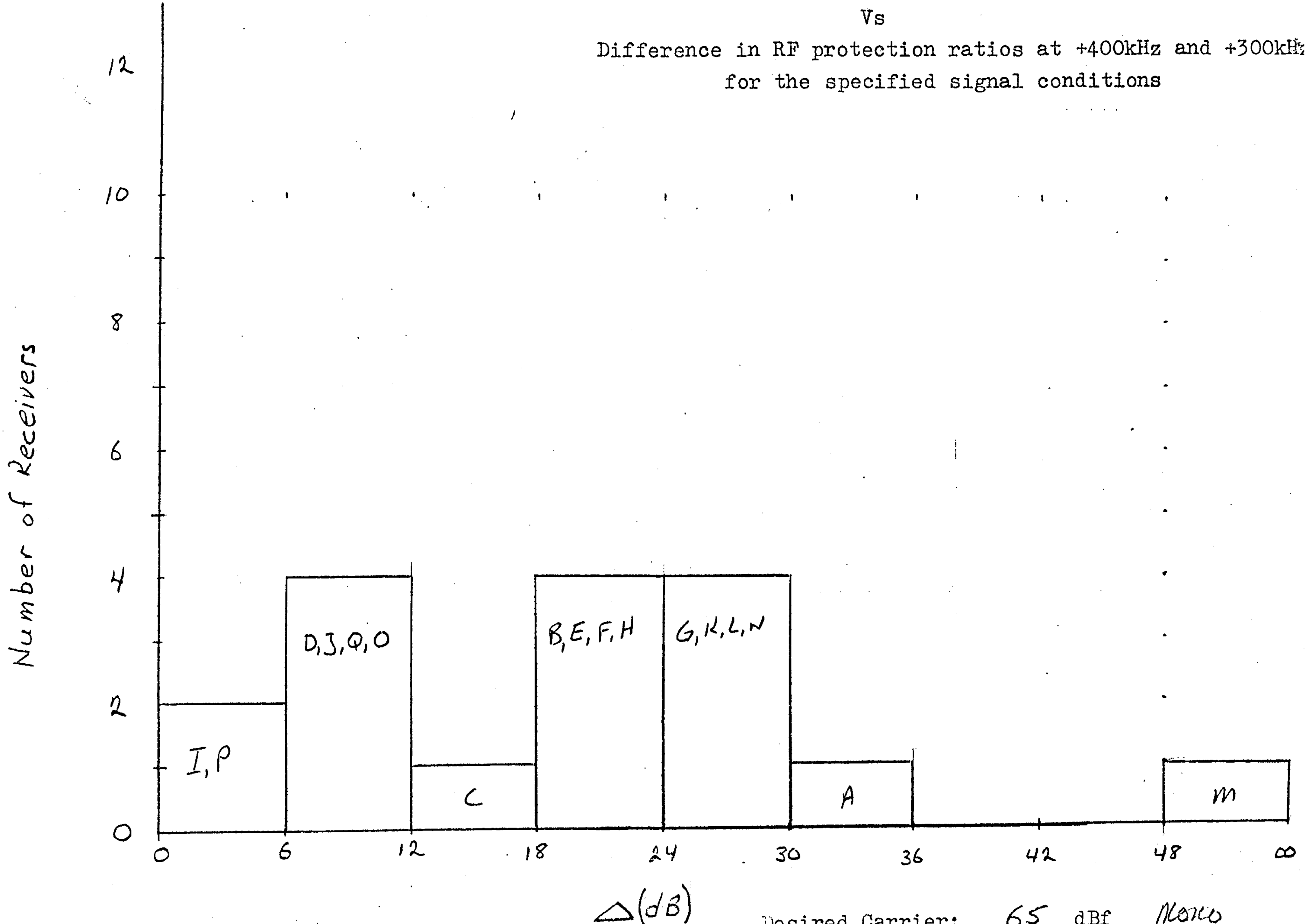
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________ dBf ________

Undesired Carrier: ________________

HISTOGRAM showing the number of receivers (of 17 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

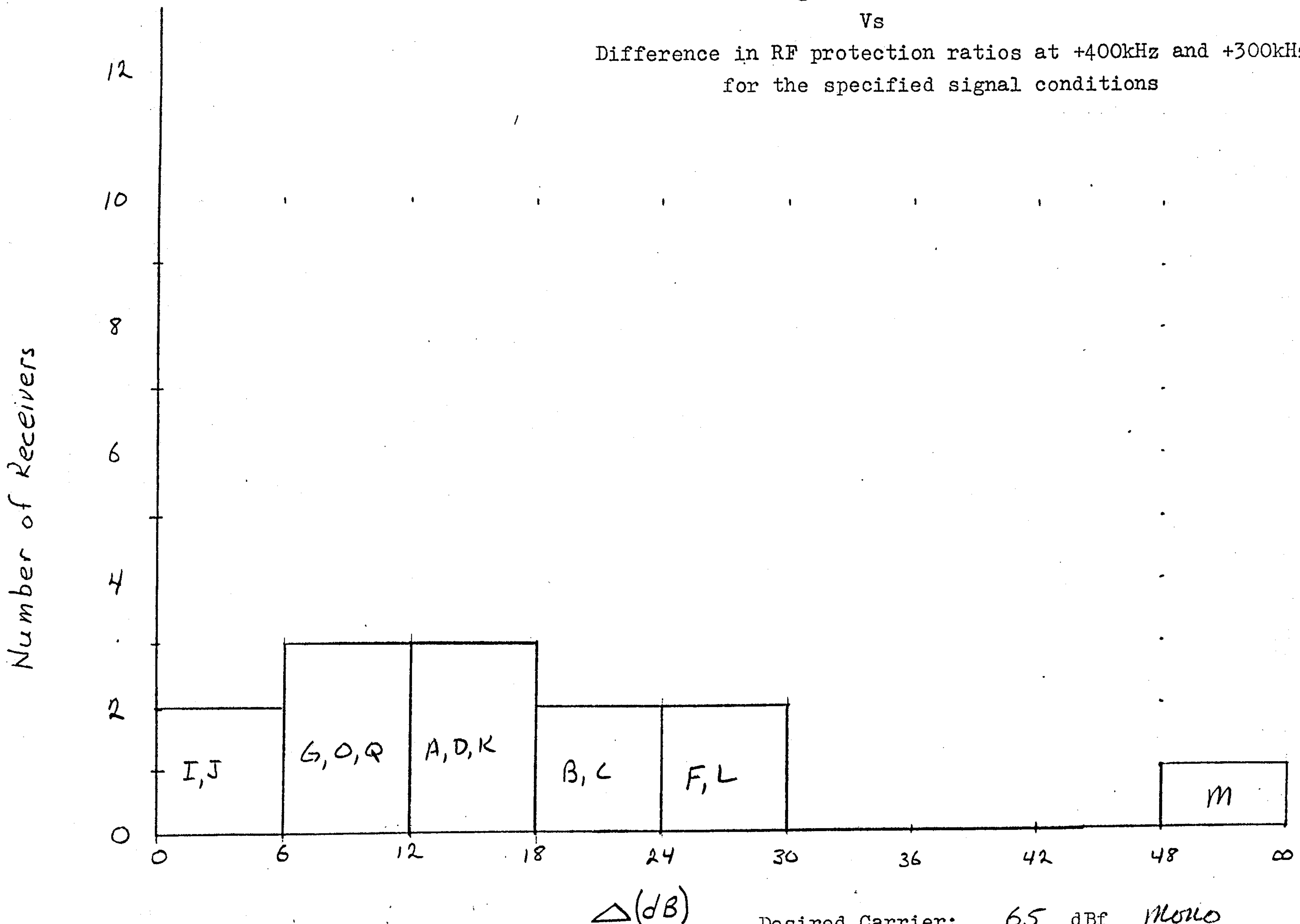


Desired Carrier: 65 dBf Mono

30 dB Audio S/I

Undesired Carrier: Mono

HISTOGRAM showing the number of receivers (of 13 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



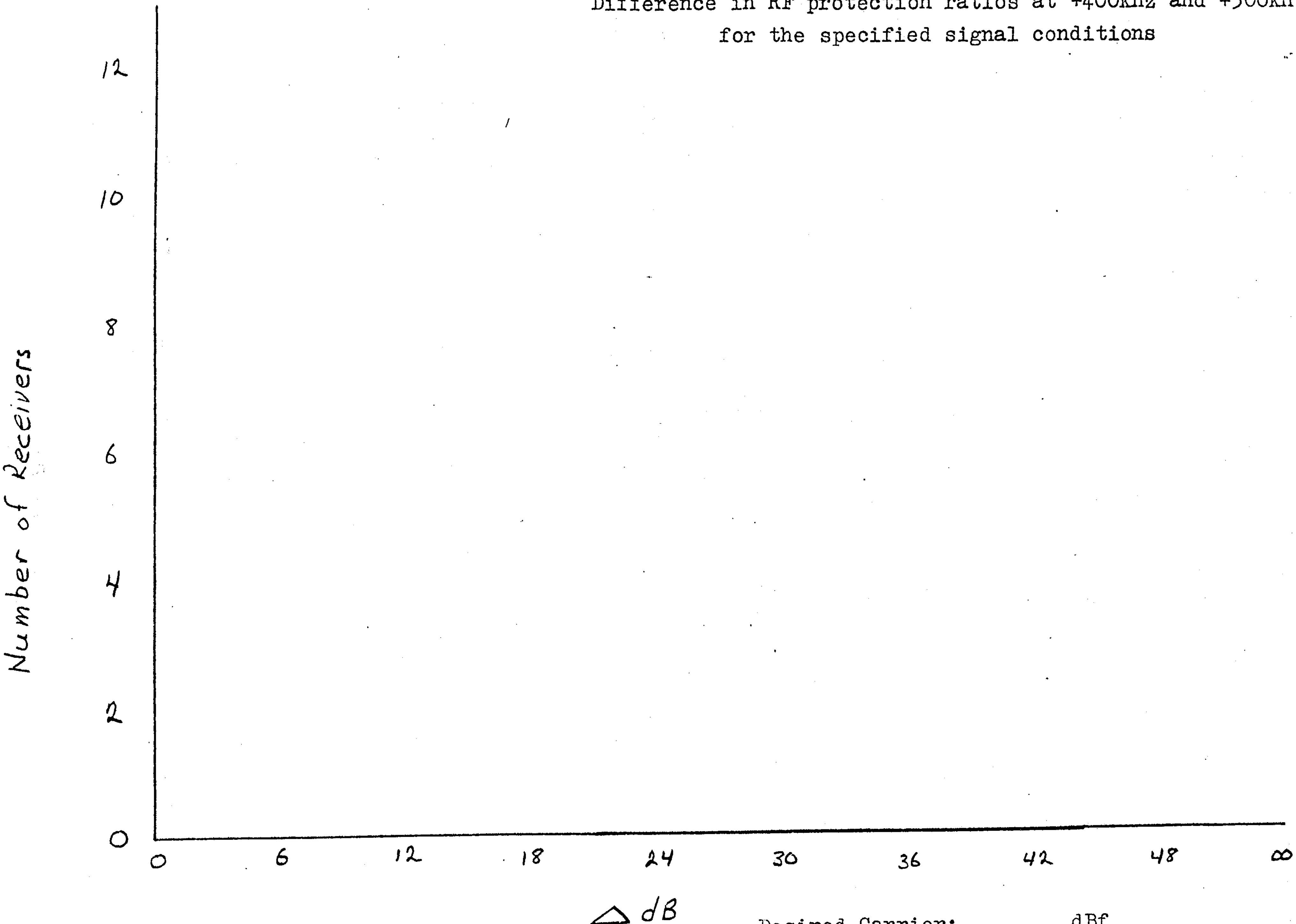
Desired Carrier: 65 dBf Mono
Undesired Carrier: Mono

50 dB Audio S/I

Vs

Difference in RF protection ratios at +400kHz and +300kH

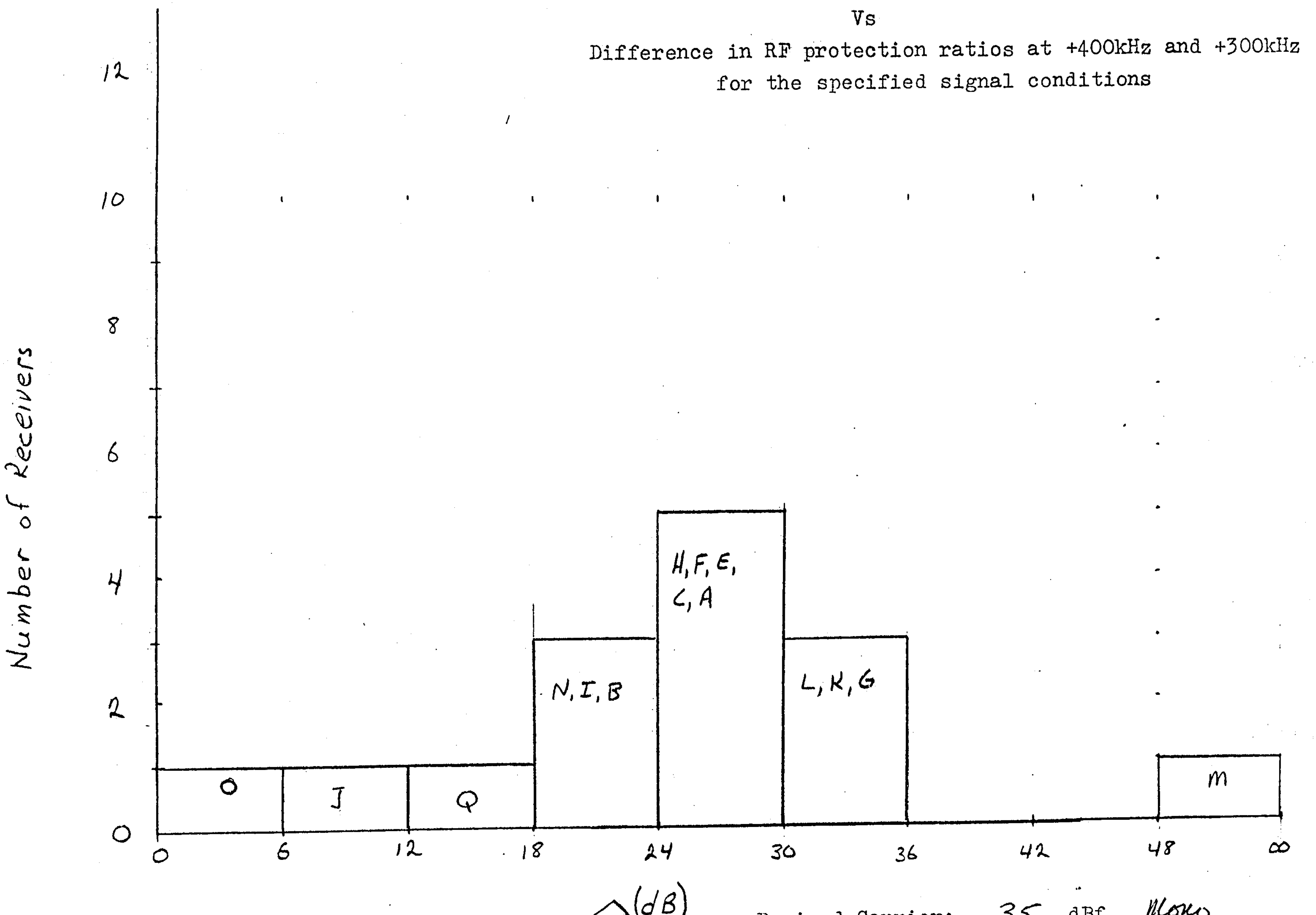
for the specified signal conditions



Desired Carrier: ________dBf __________

Undesired Carrier: ____________________

HISTOGRAM showing the number of receivers (of 15 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

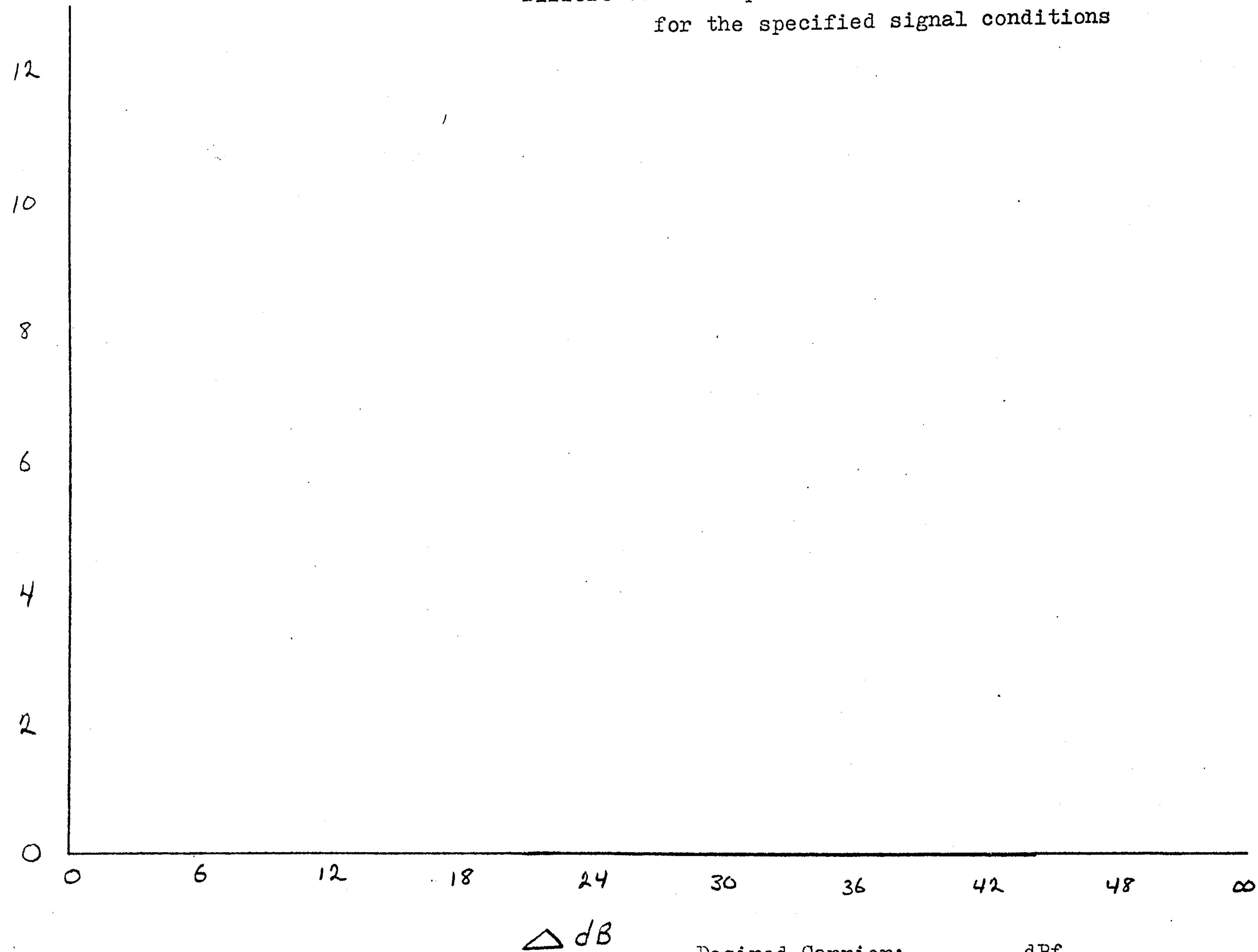


30 dB Audio S/I

Desired Carrier: 35 dBf Mono
Undesired Carrier: Mono

vs

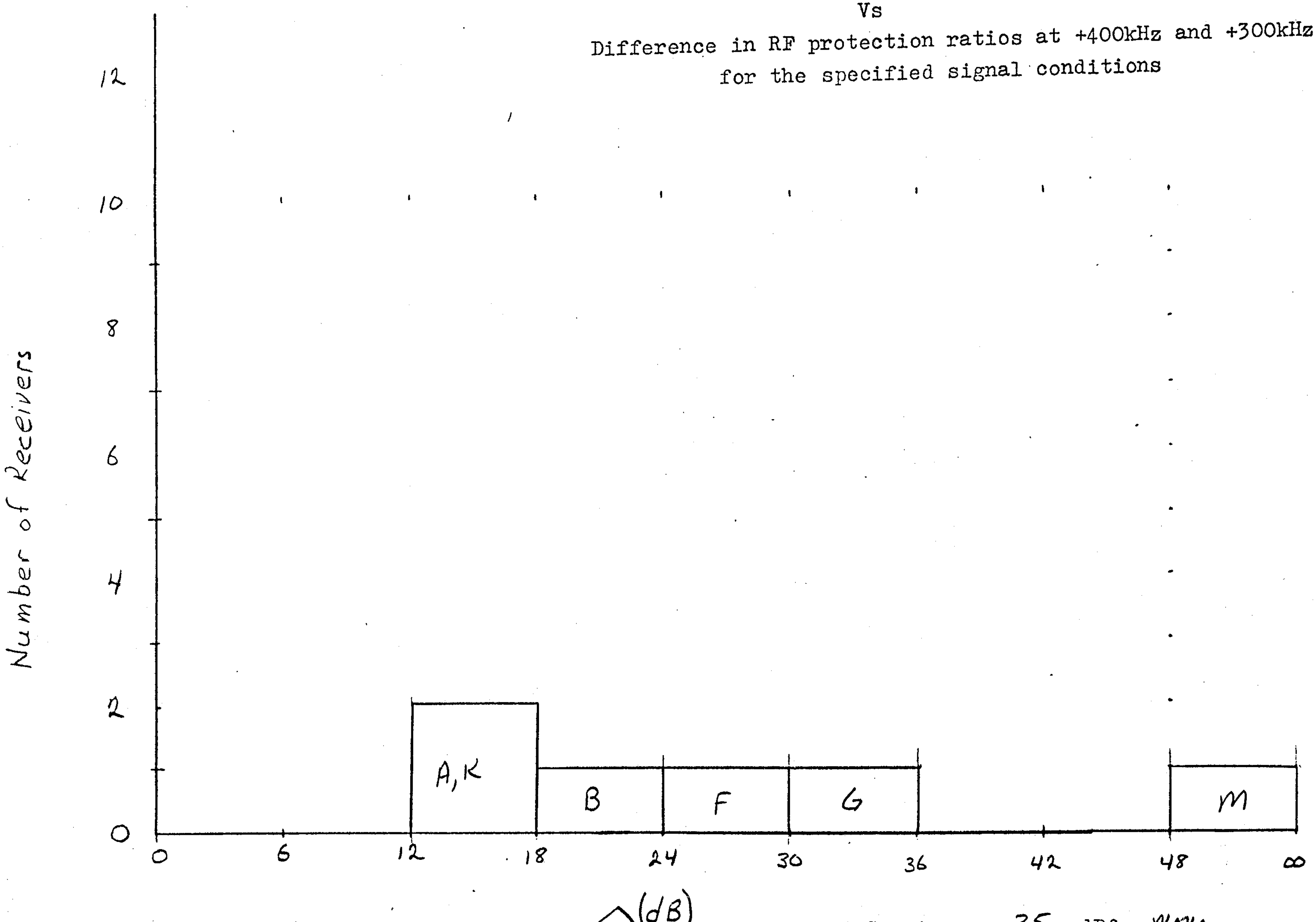
Difference in RF protection ratios at +400kHz and +300kHz for the specified signal conditions



Desired Carrier: ________dBf __________

Undesired Carrier: ____________________

HISTOGRAM showing the number of receivers (of 6 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



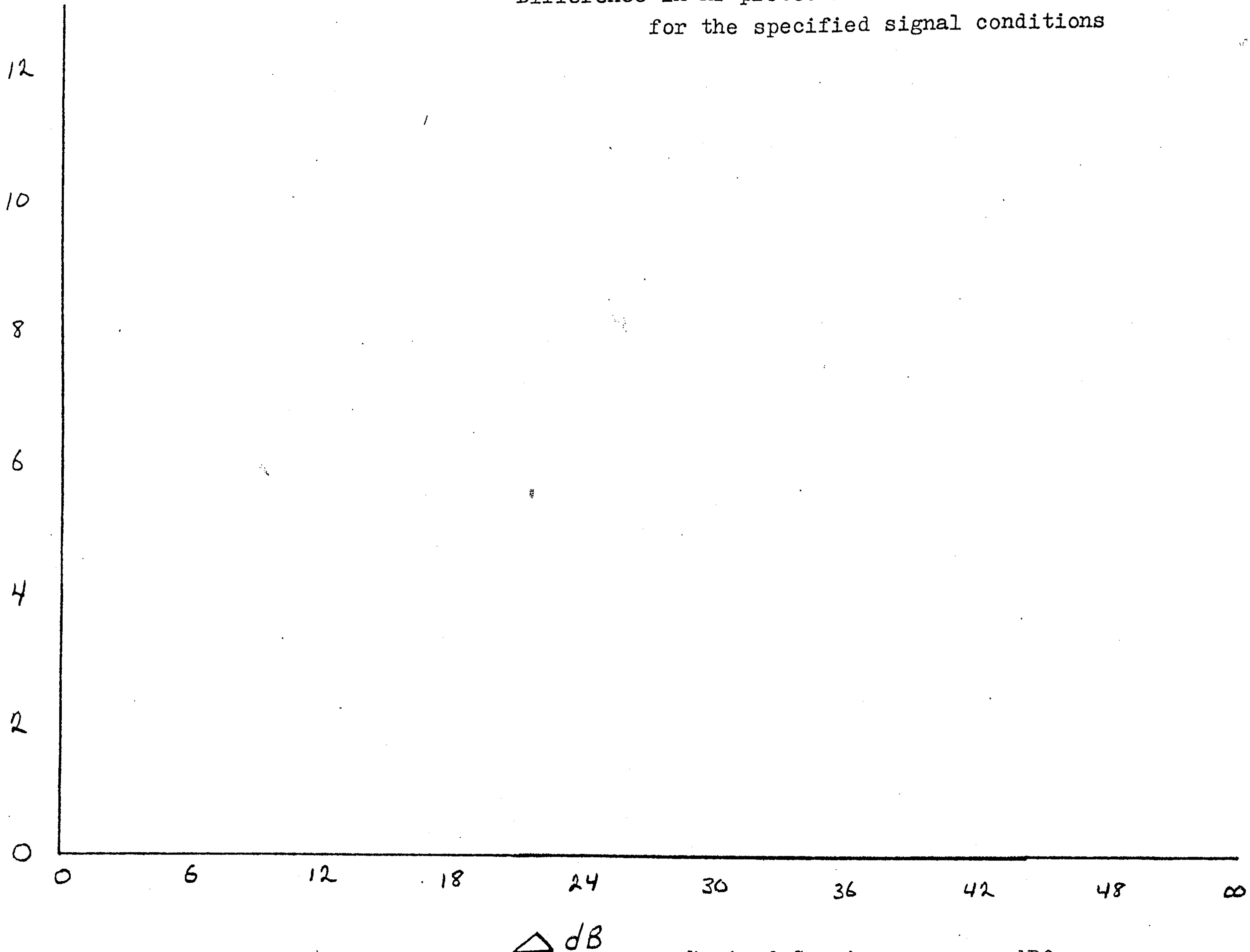
50 dB Audio S/I

Desired Carrier: 35 dBf mono
Undesired Carrier: mono

Vs

Difference in RF protection ratios at +400kHz and +300kHz

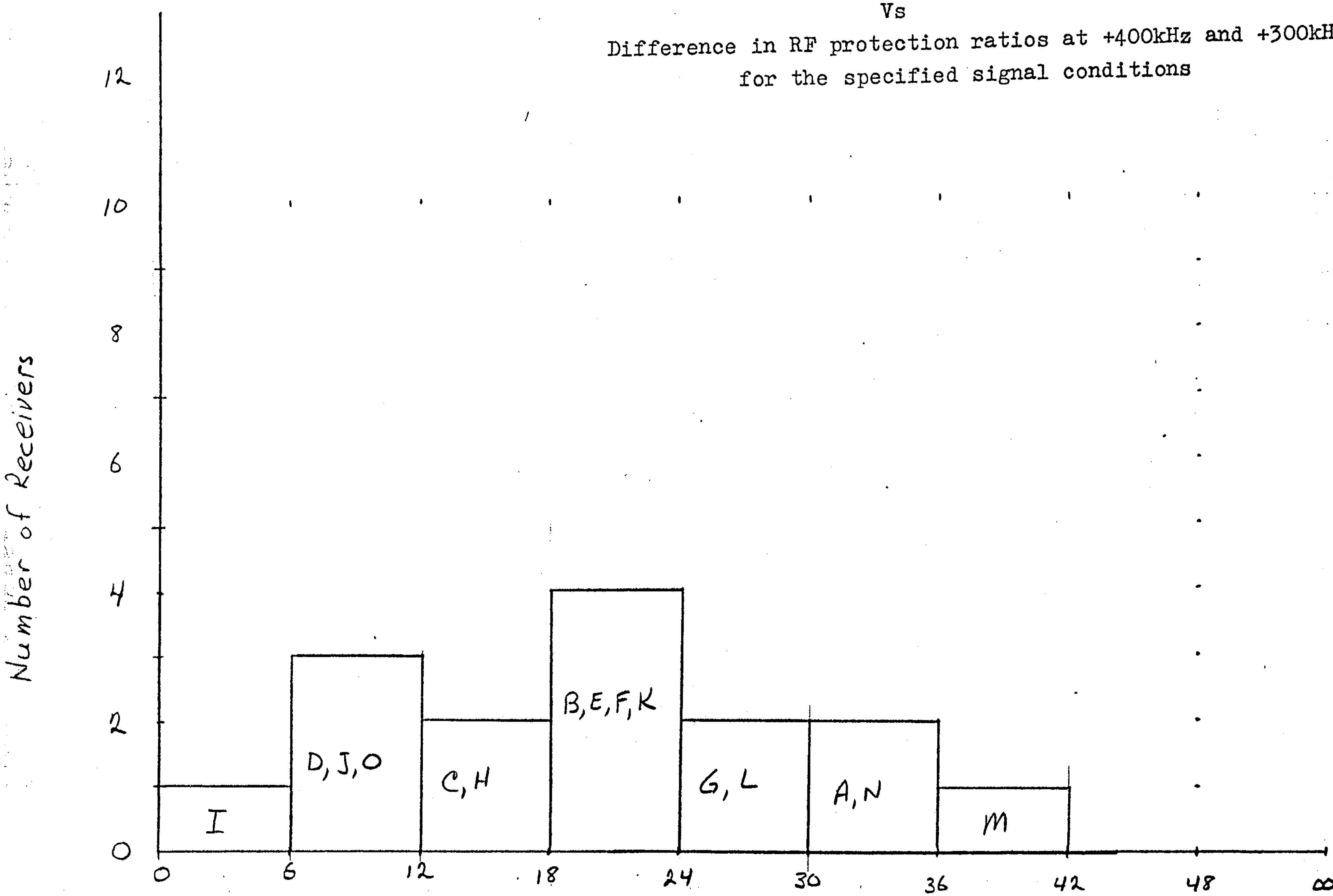
for the specified signal conditions



Desired Carrier: _______ dBf _________

Undesired Carrier:

HISTOGRAM showing the number of receivers (of 15 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



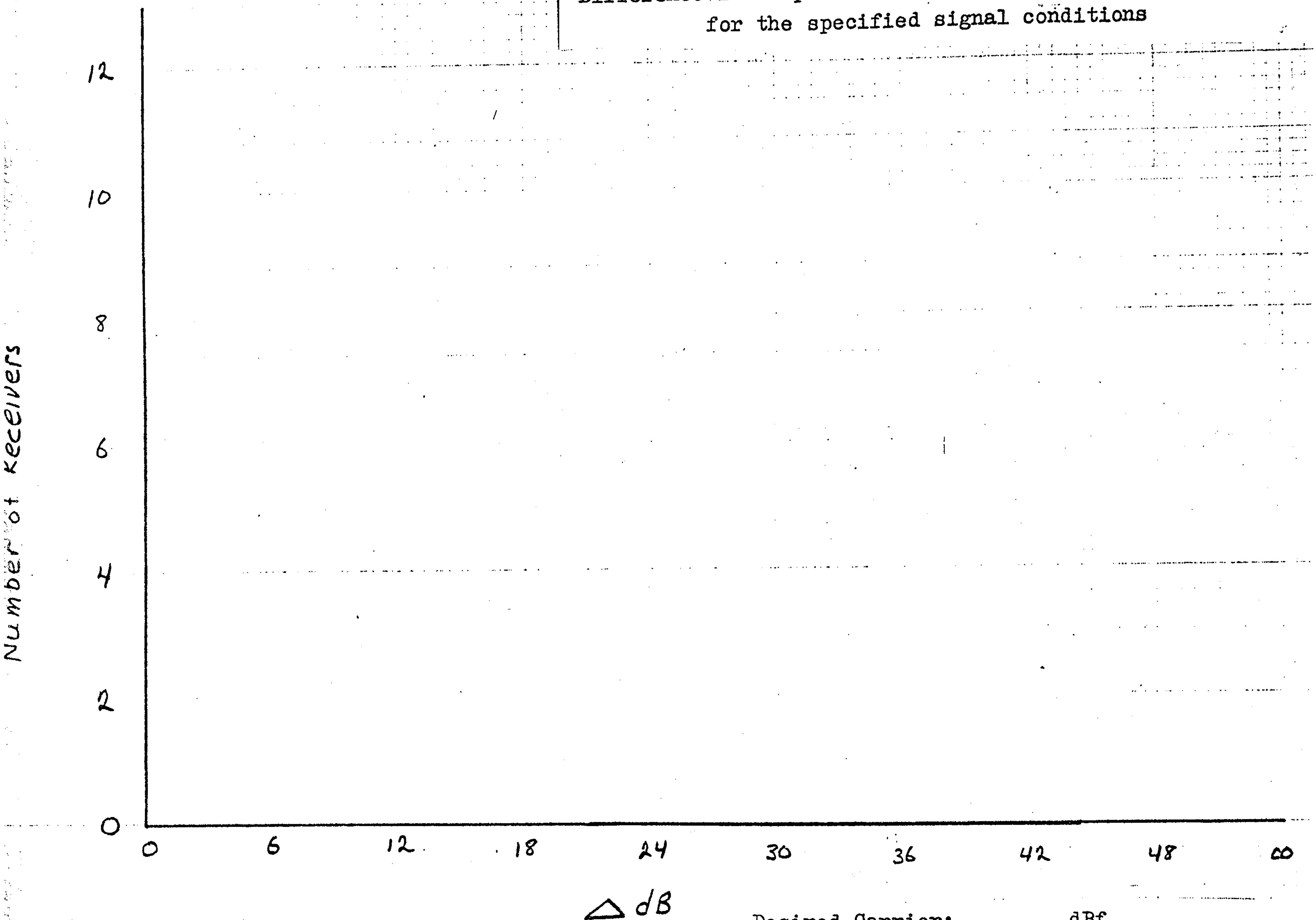
30 dB Audio S/I

Desired Carrier: 65 dBf Mono

Undesired Carrier: Stereo

Vs

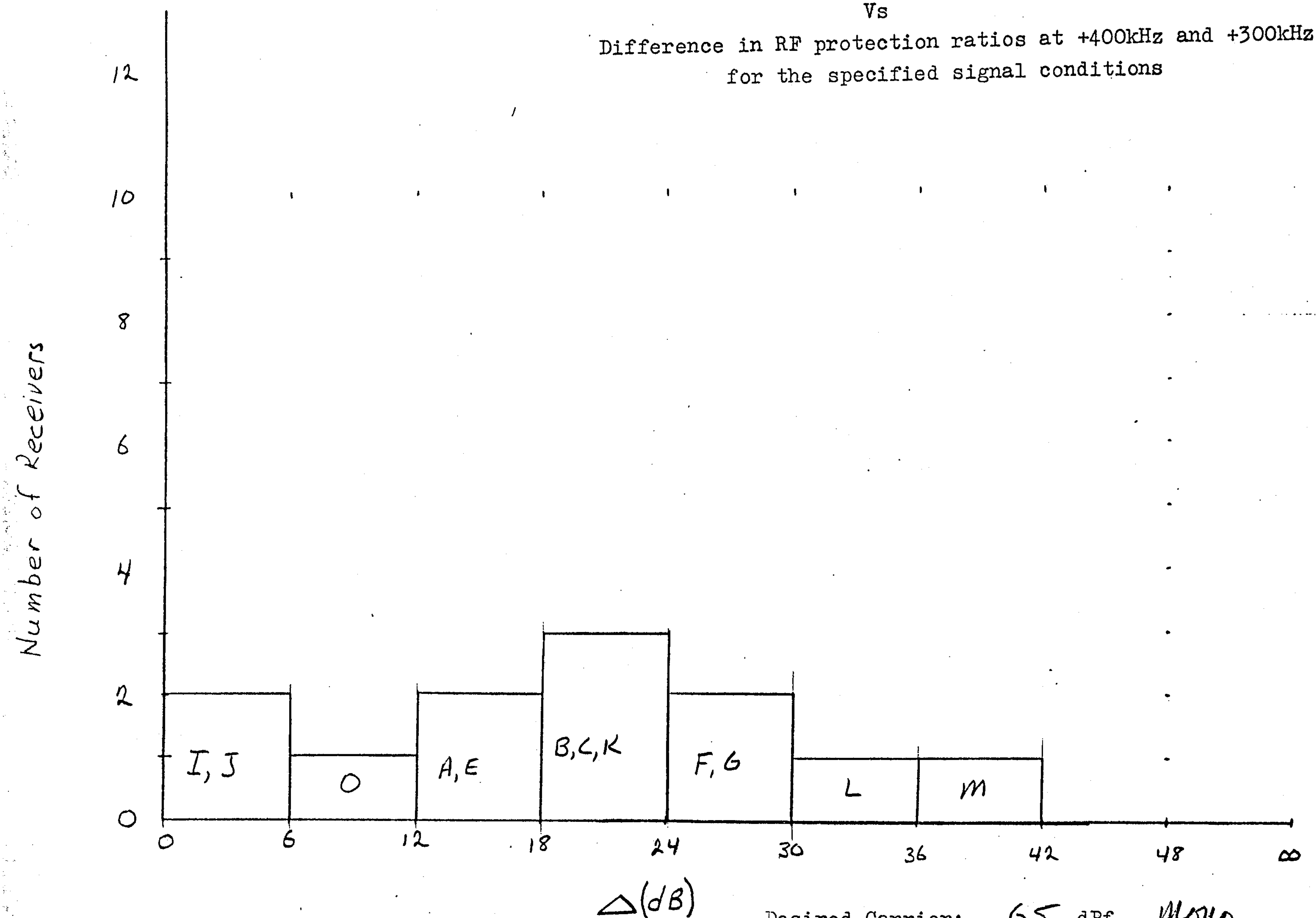
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________dBf __________

Undesired Carrier: __________

HISTOGRAM showing the number of receivers (of 12 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

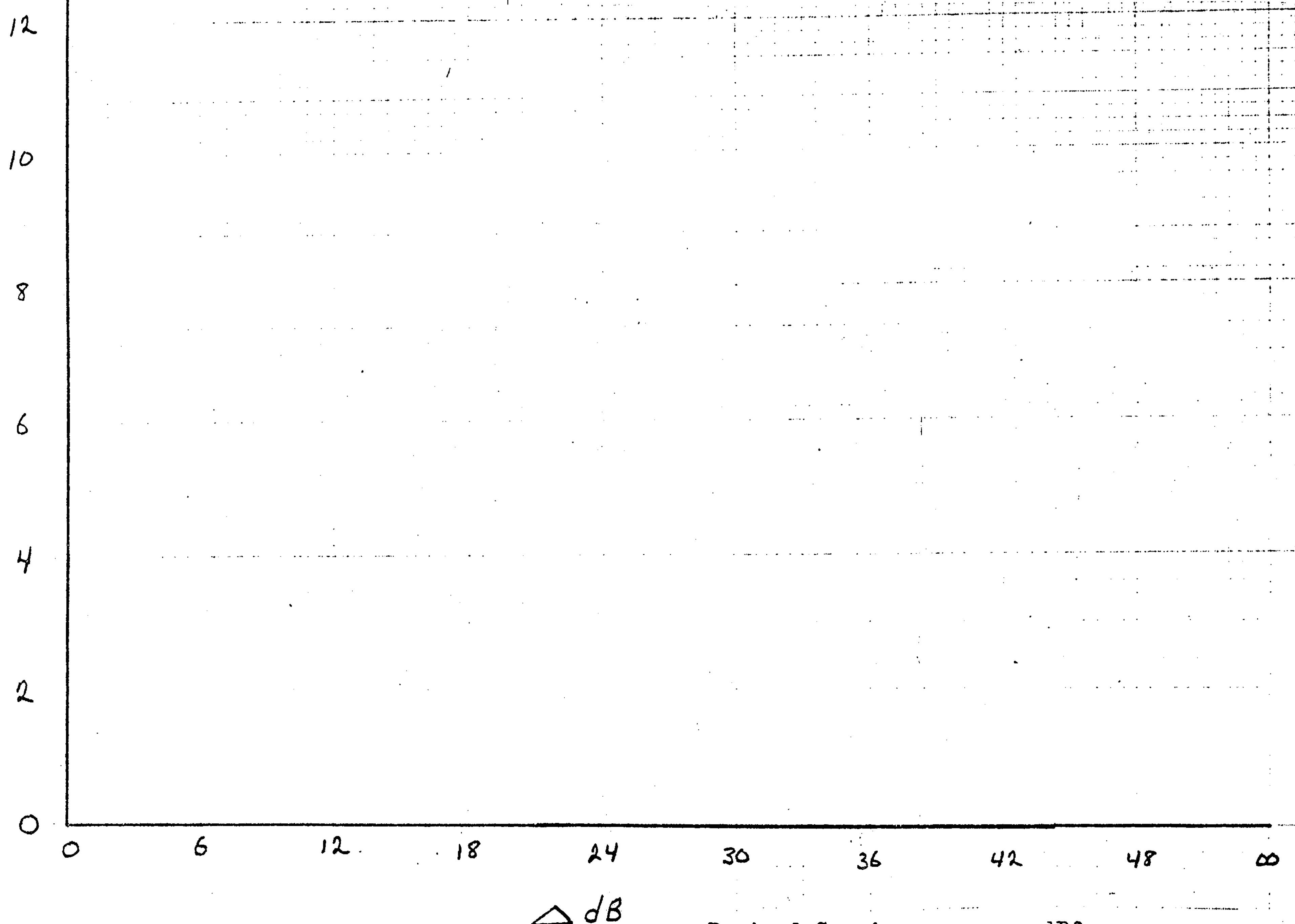


50 dB Audio S/I

Desired Carrier: 65 dBf Mono
Undesired Carrier: Stereo

Vs

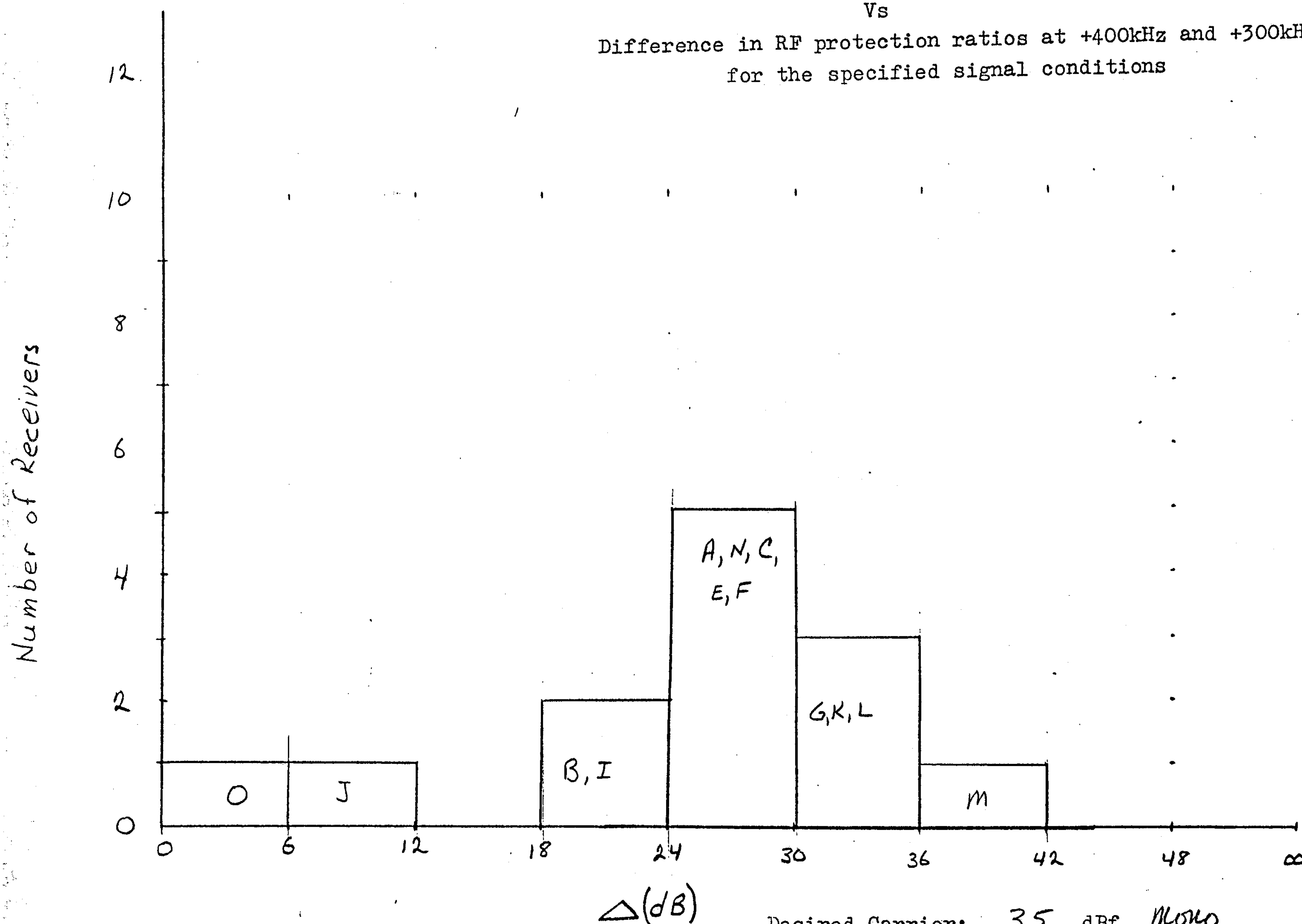
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________dBf __________

Undesired Carrier: __________

HISTOGRAM showing the number of receivers (of 13 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

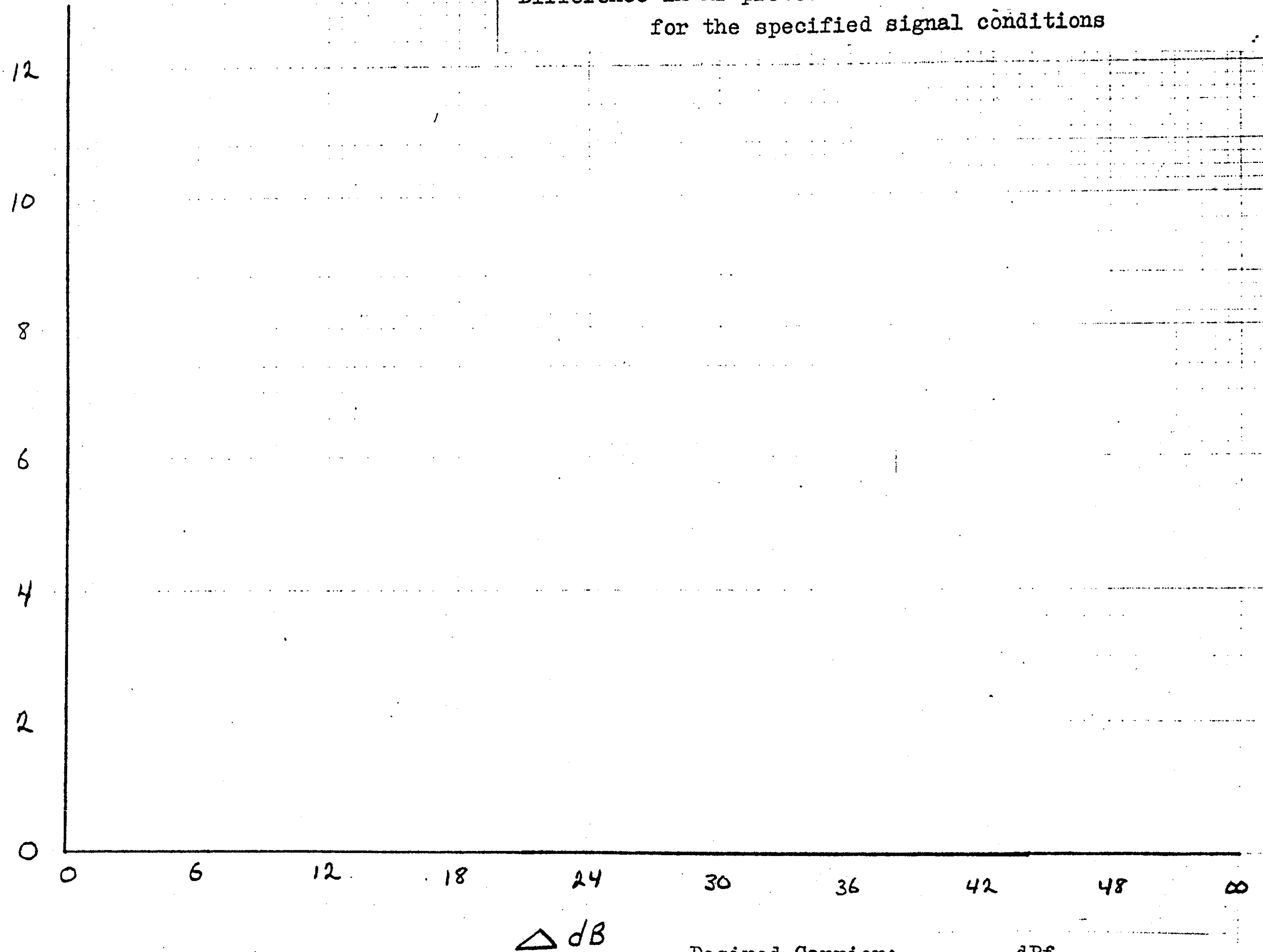


30 dB Audio S/I

Desired Carrier: 35 dBf Mono
Undesired Carrier: Stereo

Vs

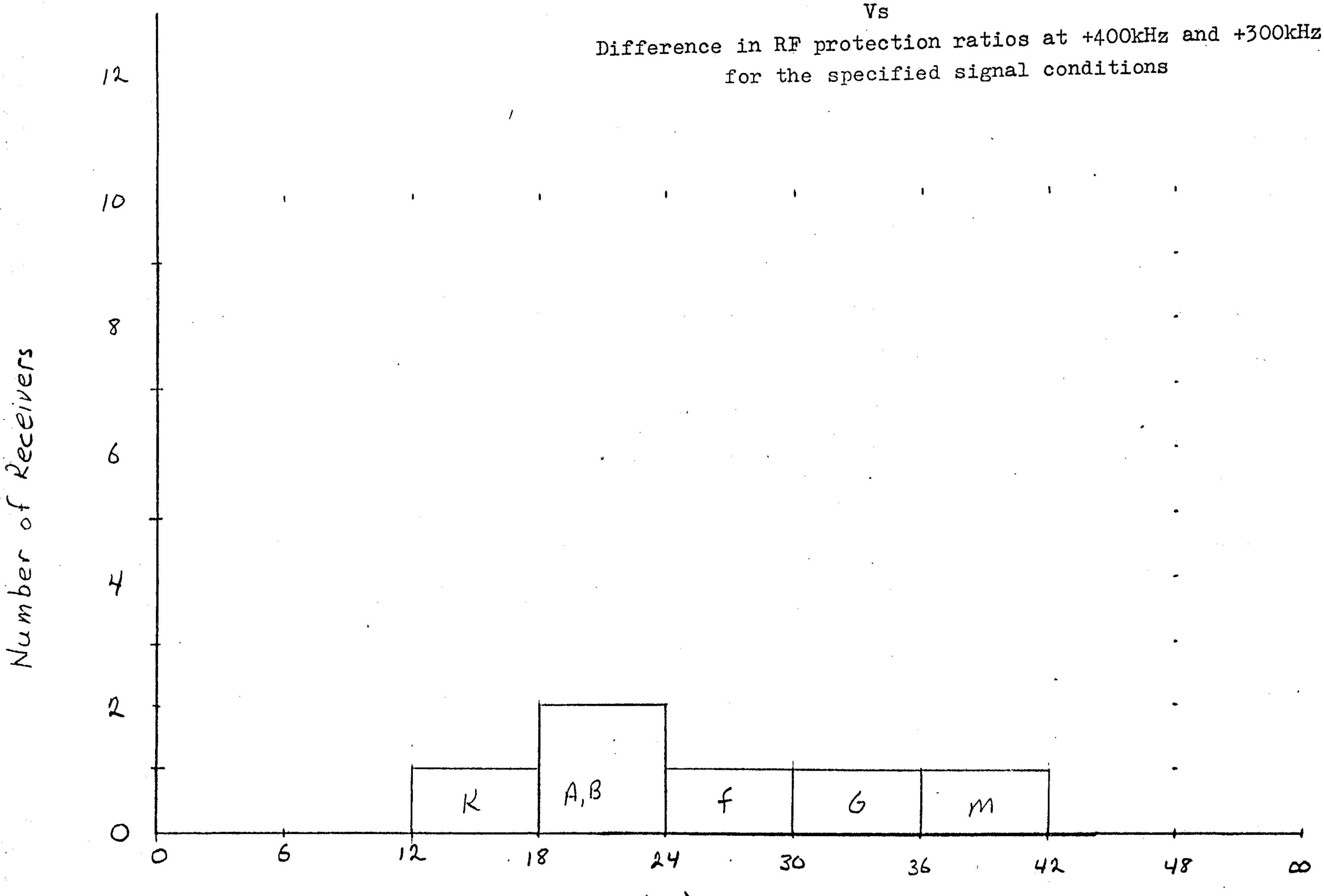
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________dBf __________

Undesired Carrier: ____________________

HISTOGRAM showing the number of receivers (of 6 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

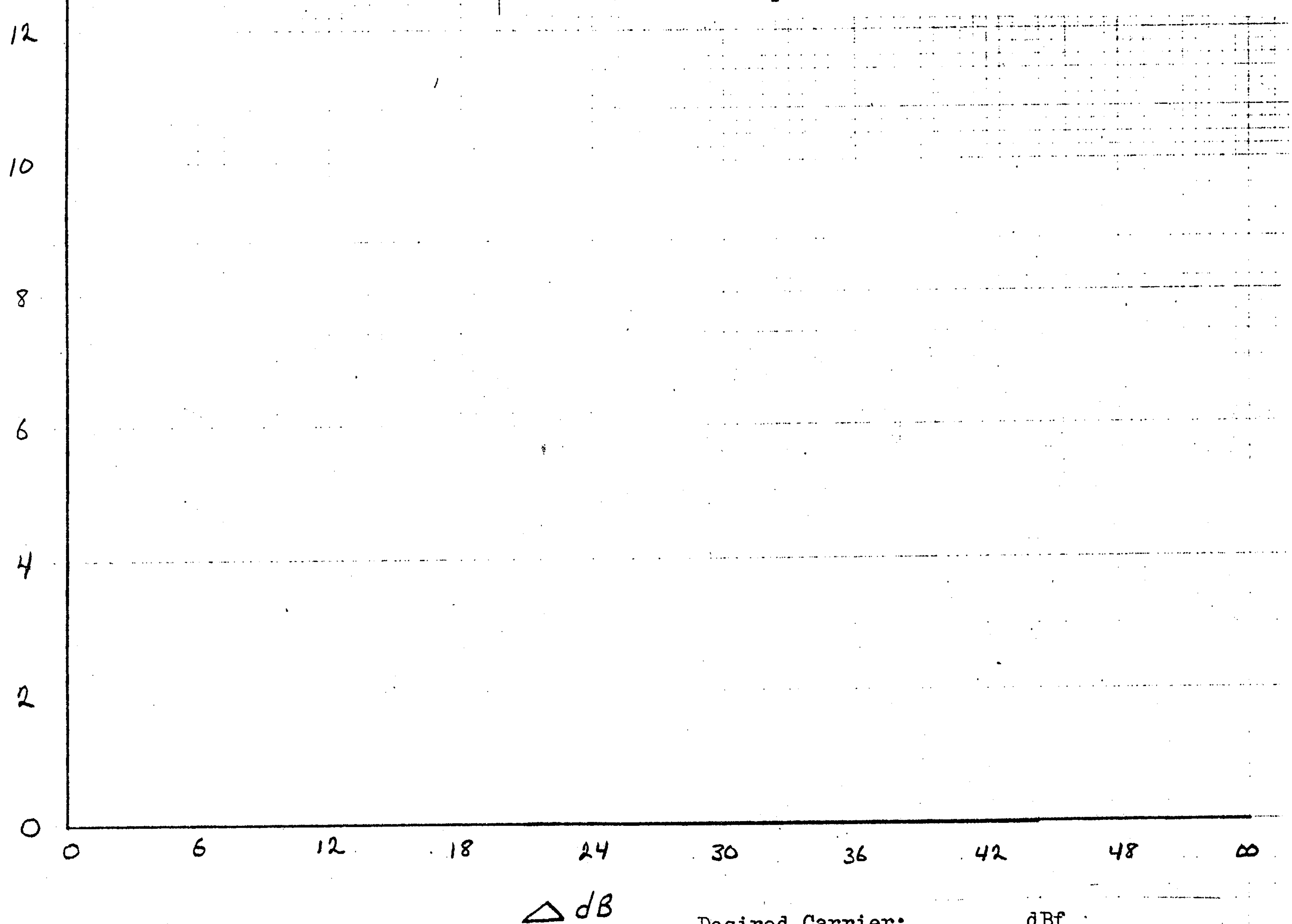


50 dB Audio S/I

Desired Carrier: 35 dBf Mono

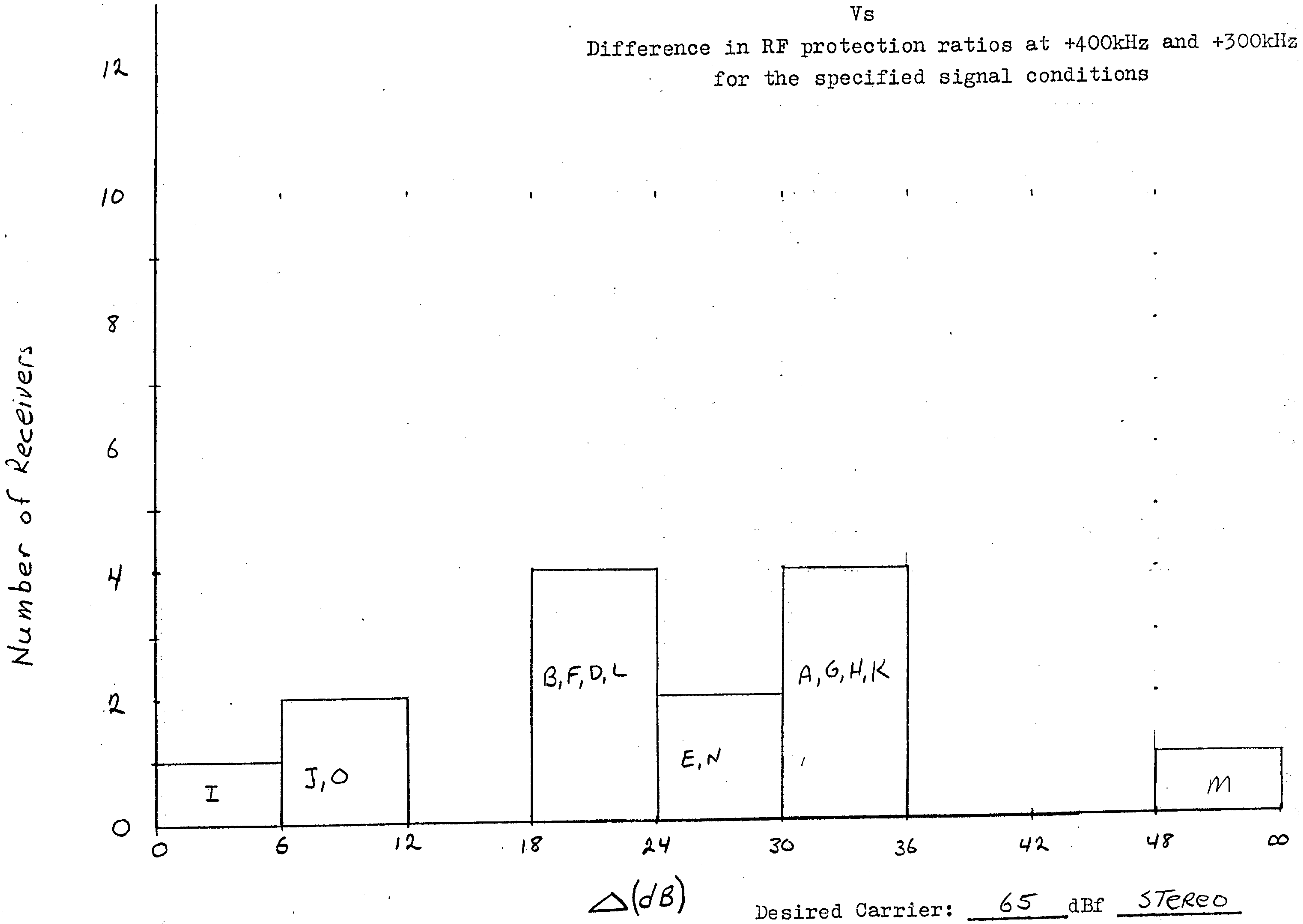
Undesired Carrier: Stereo

Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________dBf ____________
Undesired Carrier: ____________

HISTOGRAM showing the number of receivers (of 14 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

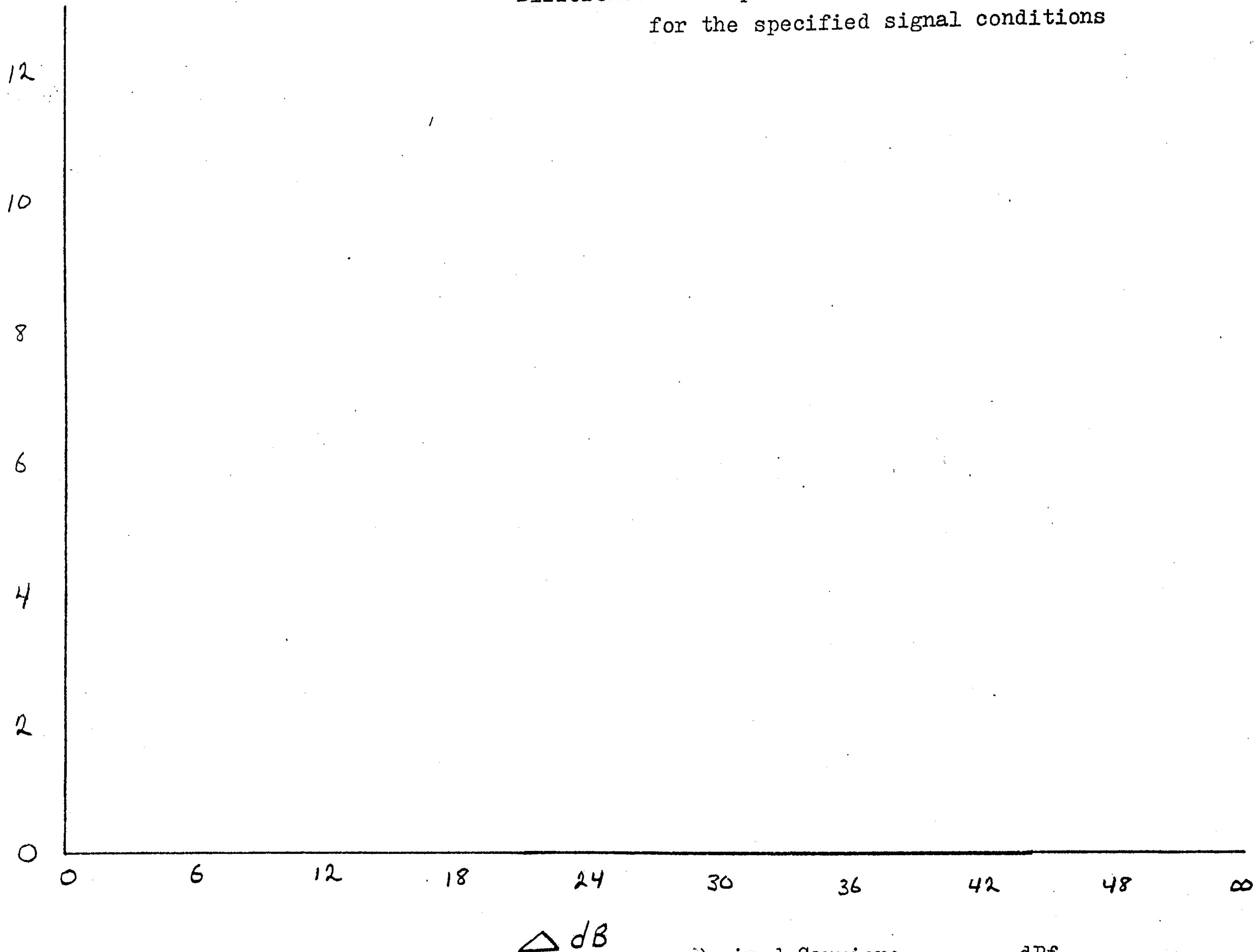


30 dB Audio S/I

Desired Carrier: 65 dBf STEREO
Undesired Carrier: MONO

vs

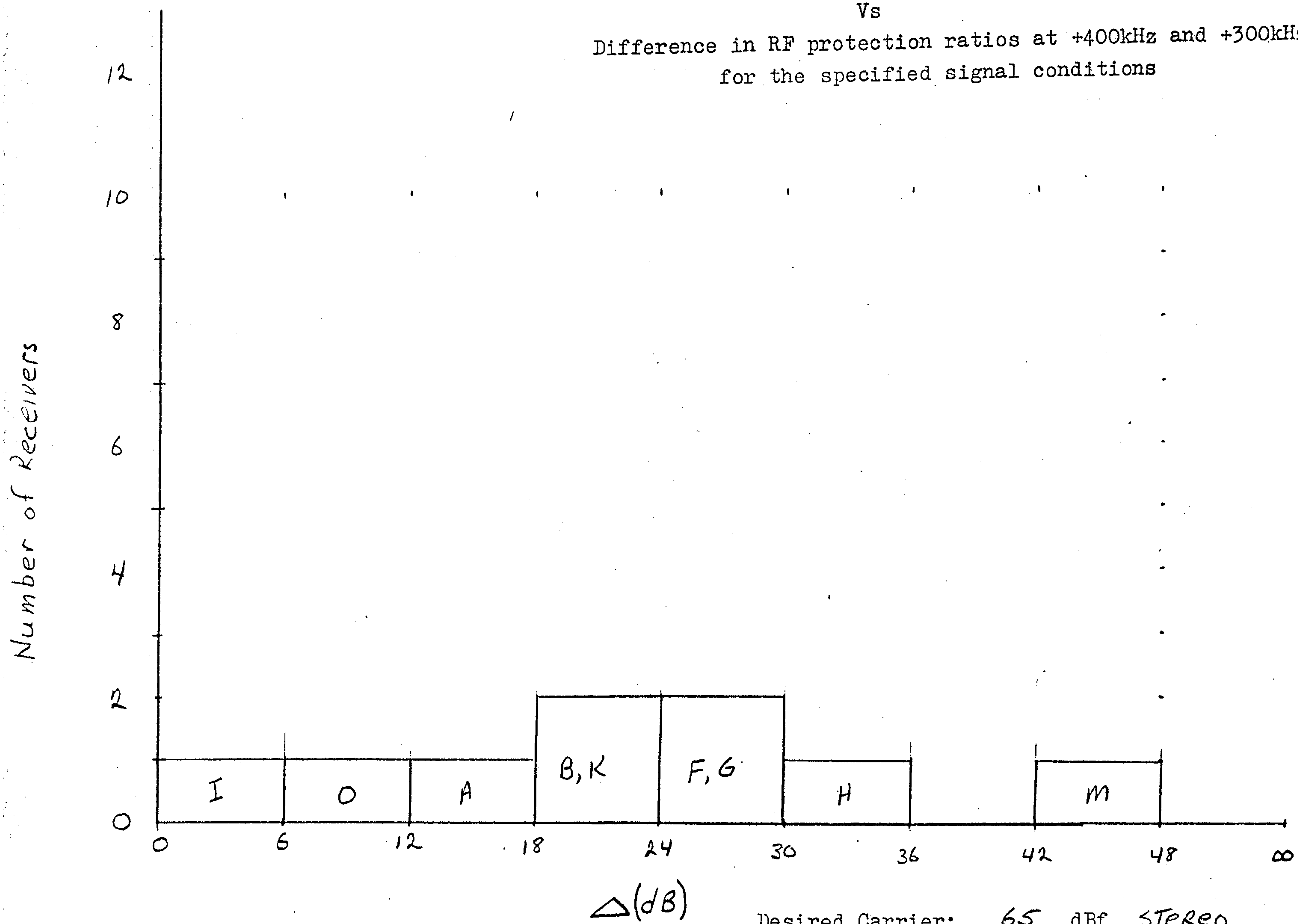
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________ dBf __________

Undesired Carrier: ____________________

HISTOGRAM showing the number of receivers (of 9 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



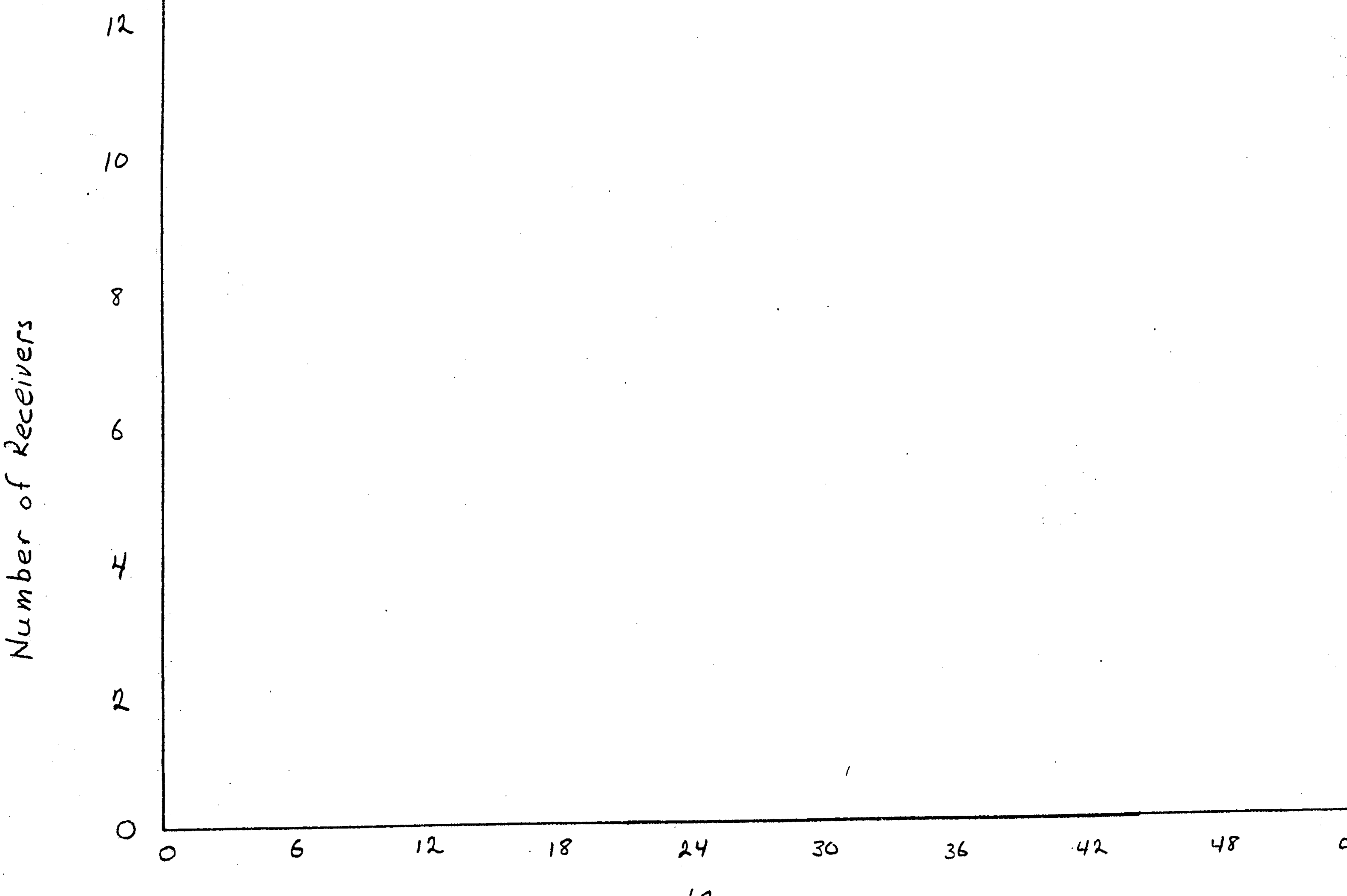
50 dB Audio S/I

Desired Carrier: 65 dBf STEREO
Undesired Carrier: MONO

Vs

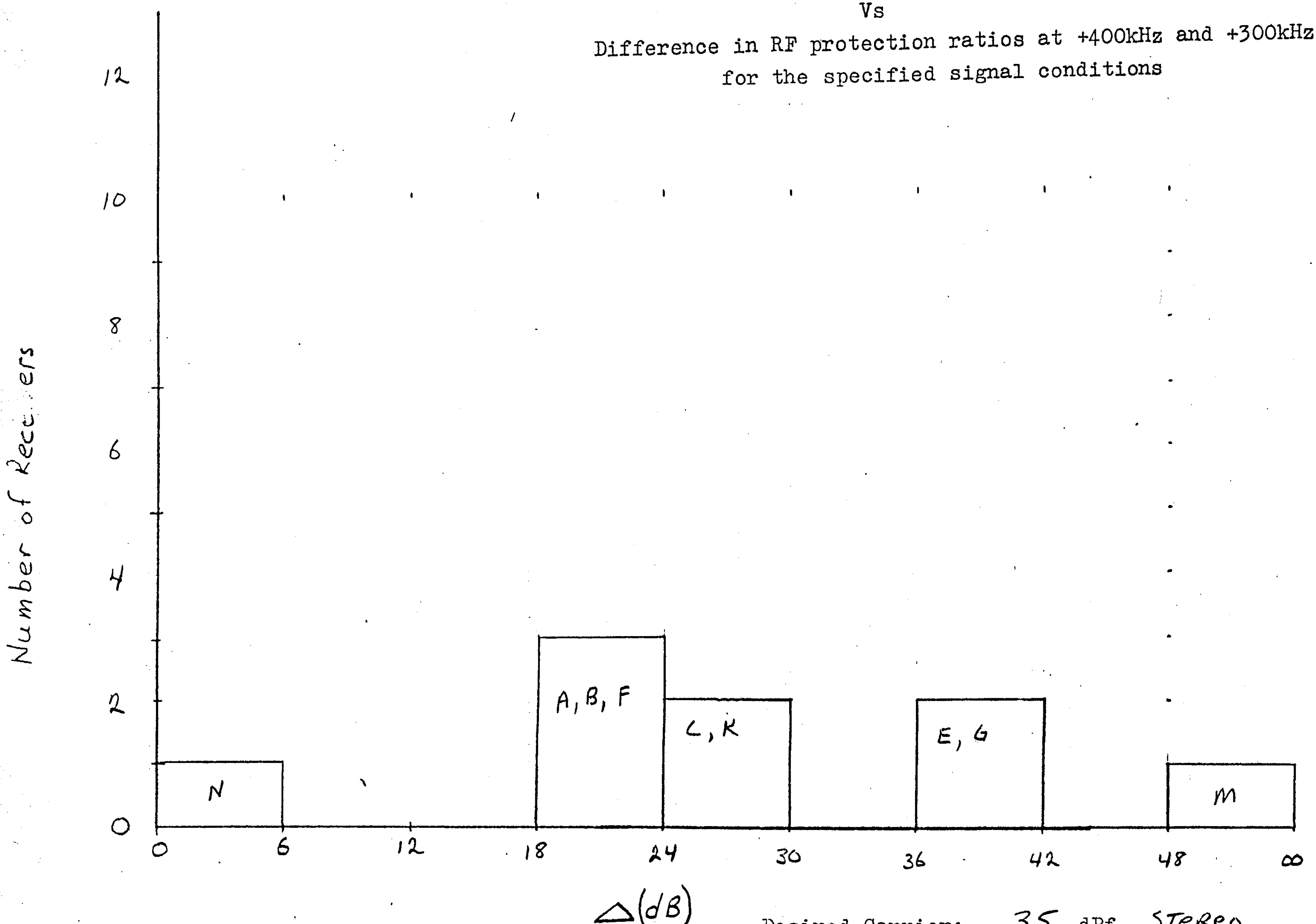
Difference in RF protection ratios at +400kHz and +300kH

for the specified signal conditions



Desired Carrier: ________dBf ________

HISTOGRAM showing the number of receivers (of 9 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

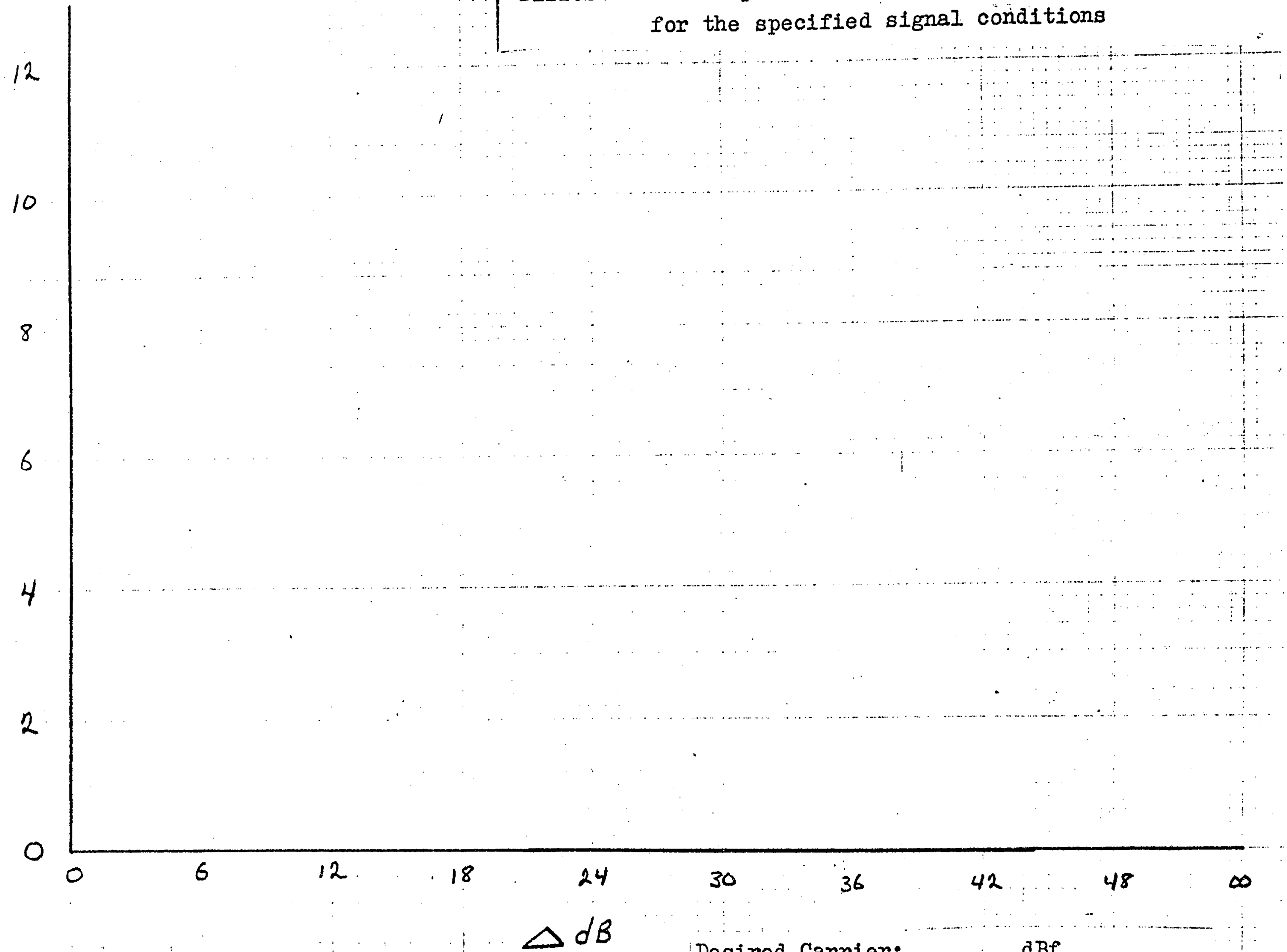


30 dB Audio S/I

Desired Carrier: 35 dBf STEREO
Undesired Carrier: MONO

Vs

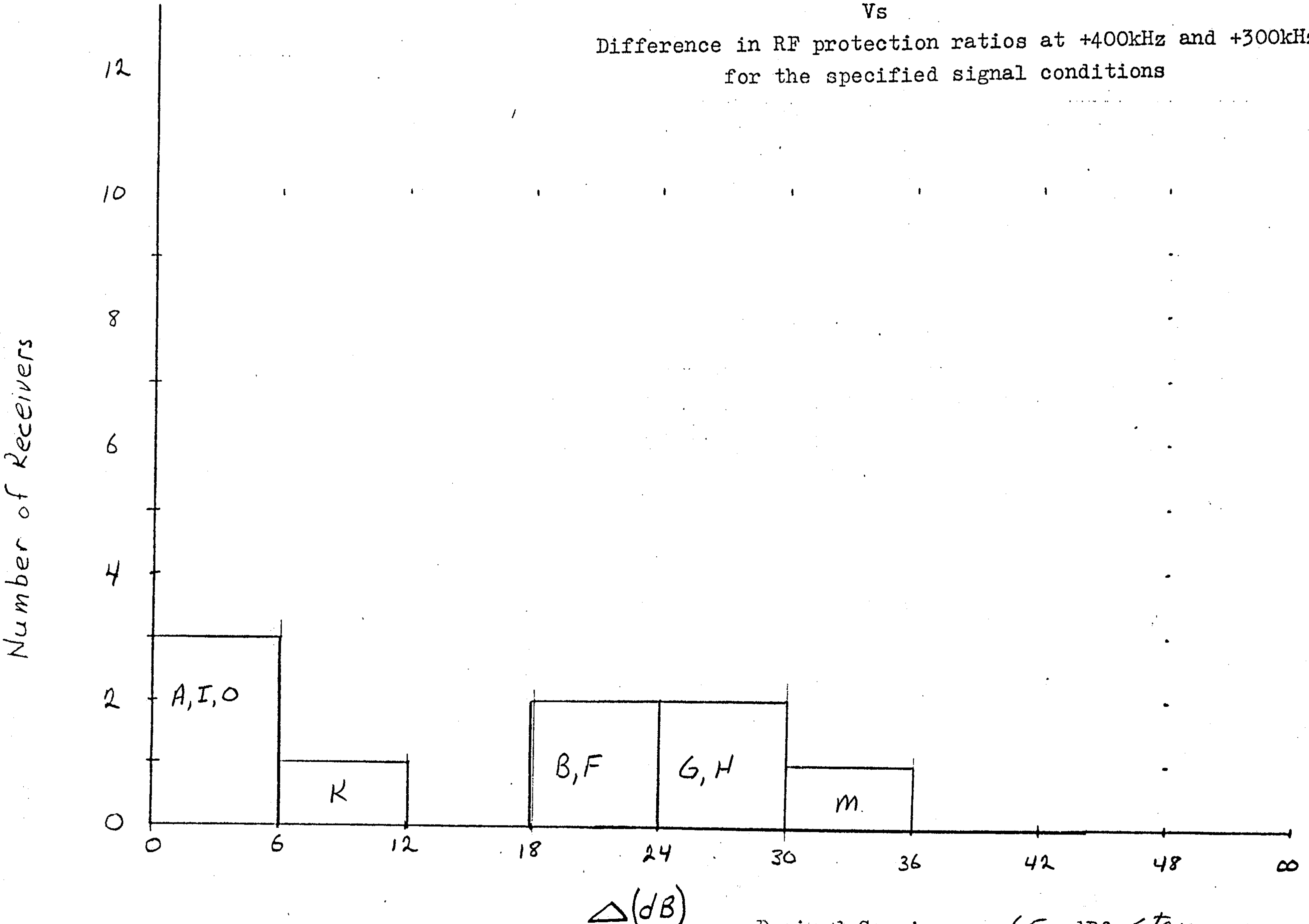
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________ dBf ________

Undesired Carrier: ________

HISTOGRAM showing the number of receivers (of 9 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

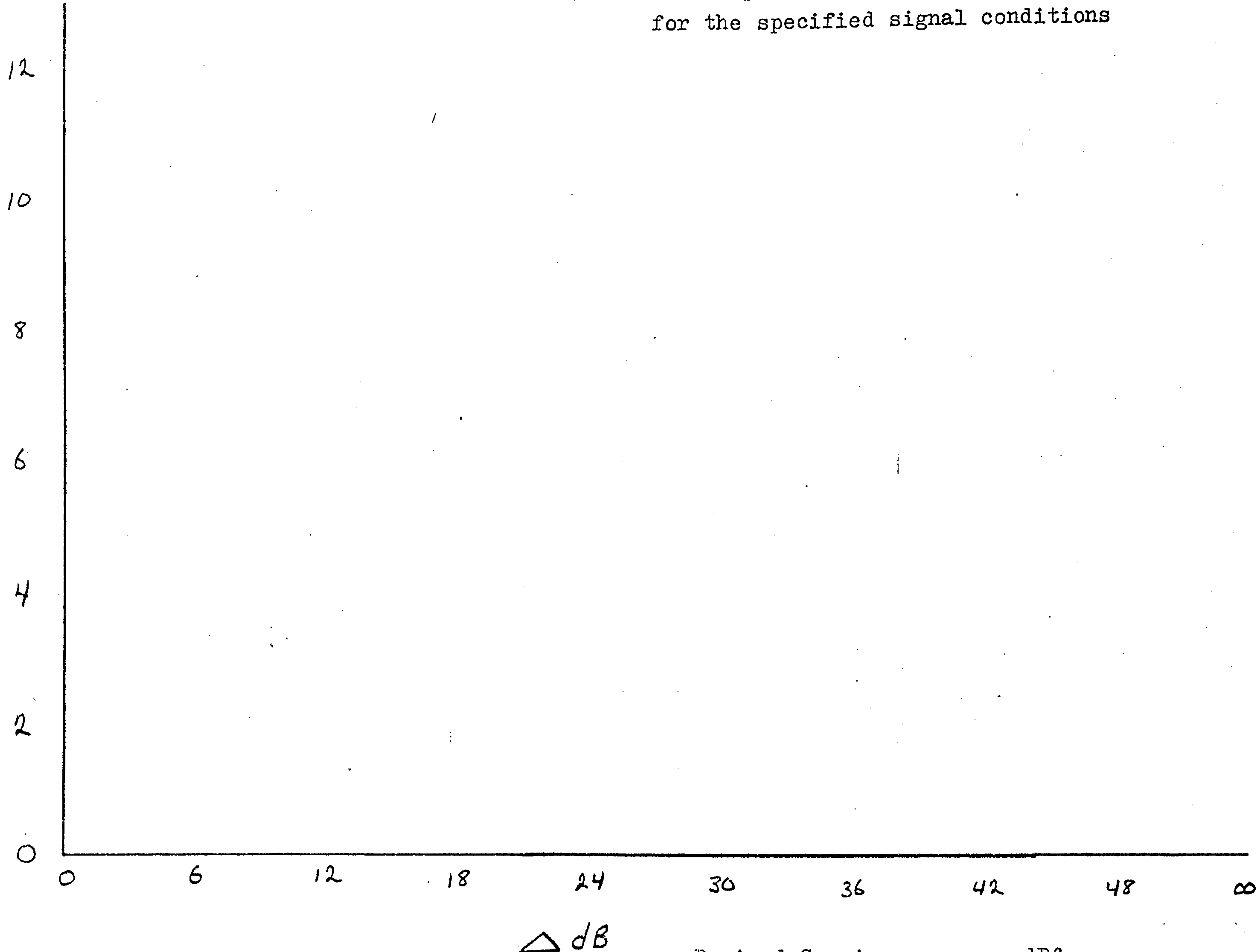


50 dB Audio S/I

Desired Carrier: 65 dBf Stereo
Undesired Carrier: Stereo

Vs

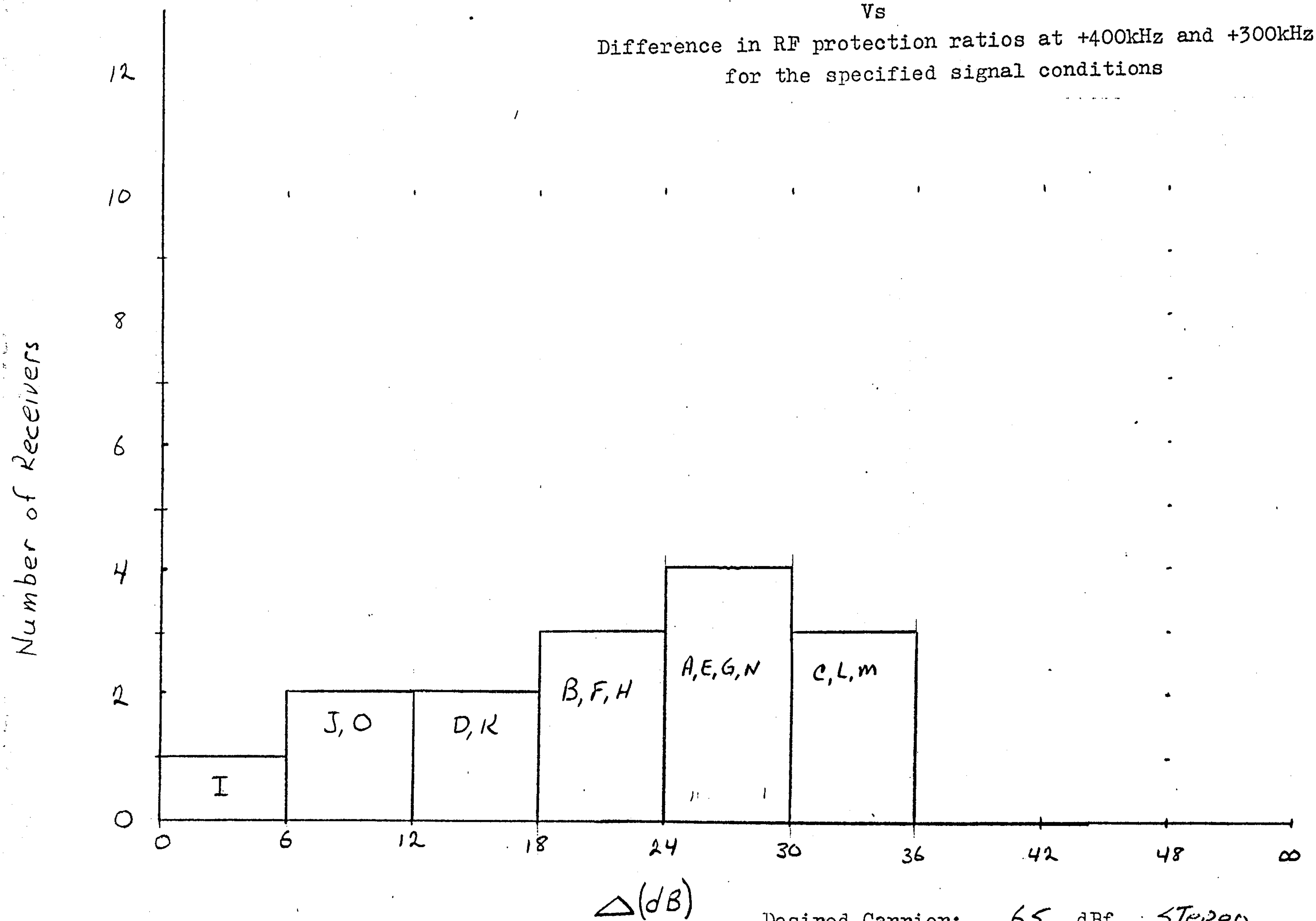
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________ dBf __________

Undesired Carrier: __________

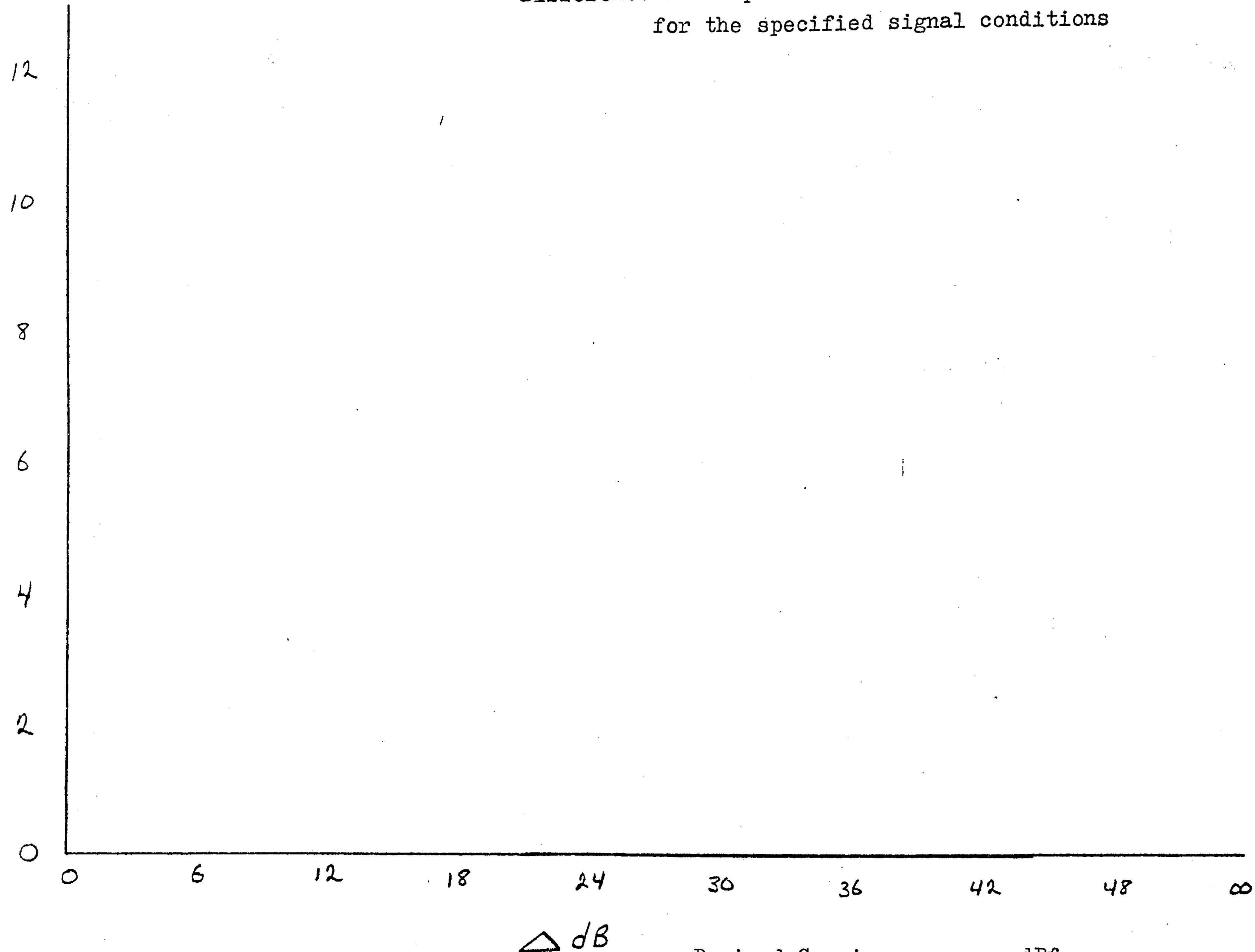
HISTOGRAM showing the number of receivers (of 15 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



30 dB Audio S/I

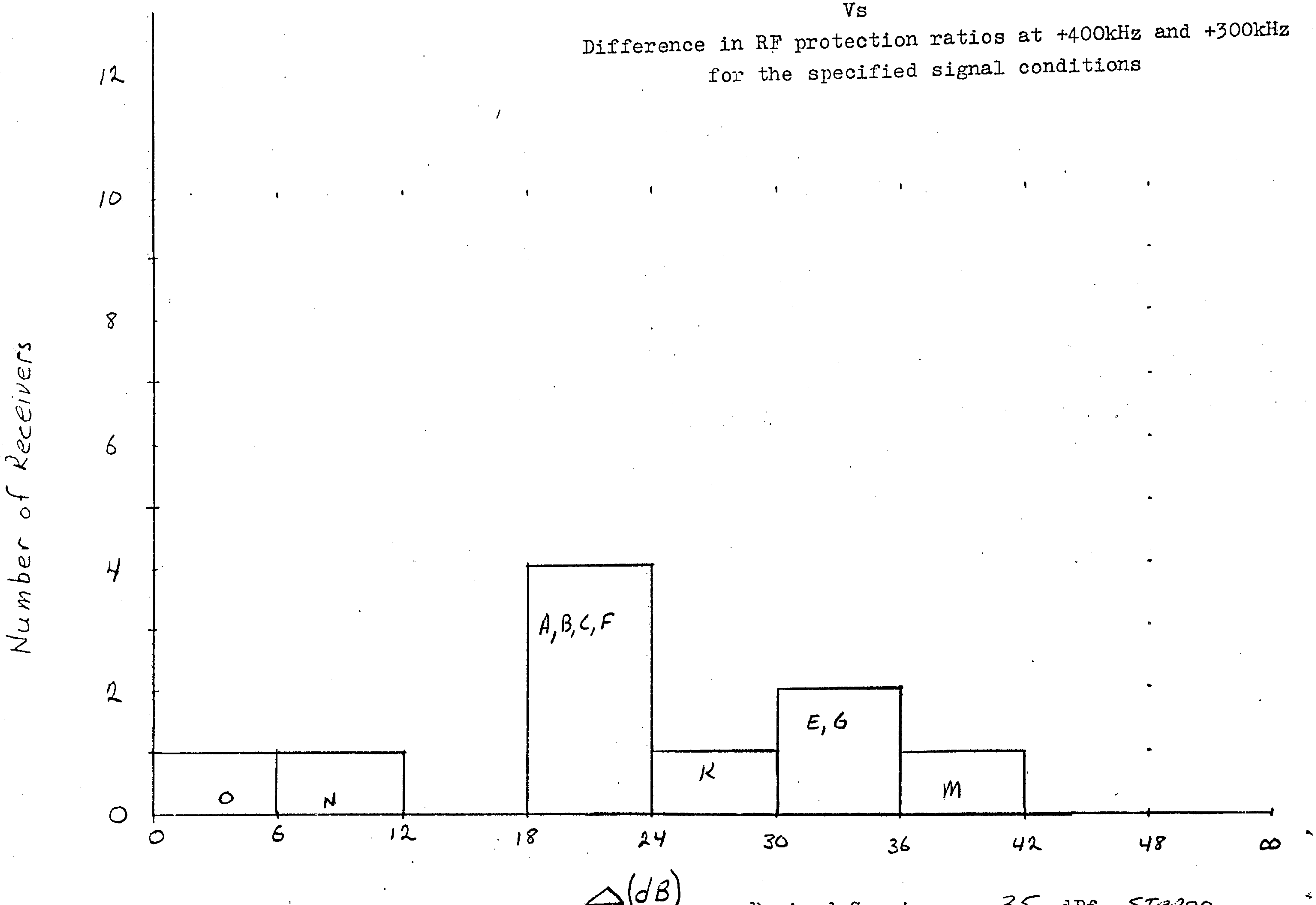
Desired Carrier: 65 dBf STEREO
Undesired Carrier: STEREO

Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



Desired Carrier: ________dBf __________
Undesired Carrier: ______________

HISTOGRAM showing the number of receivers (of 10 total)
Vs
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions

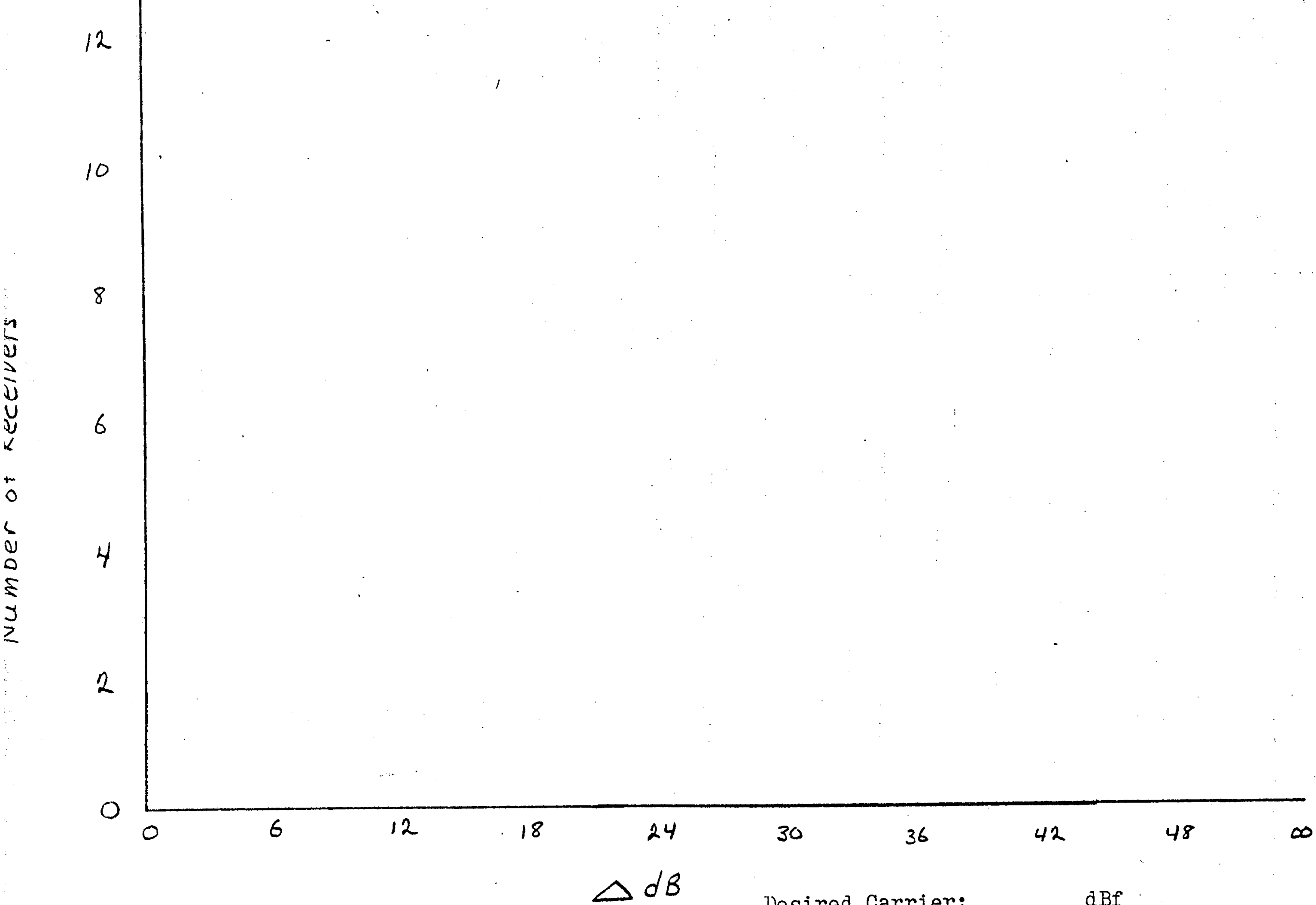


30 dB Audio S/I

Desired Carrier: 35 dBf STEREO
Undesired Carrier: STEREO

Vs

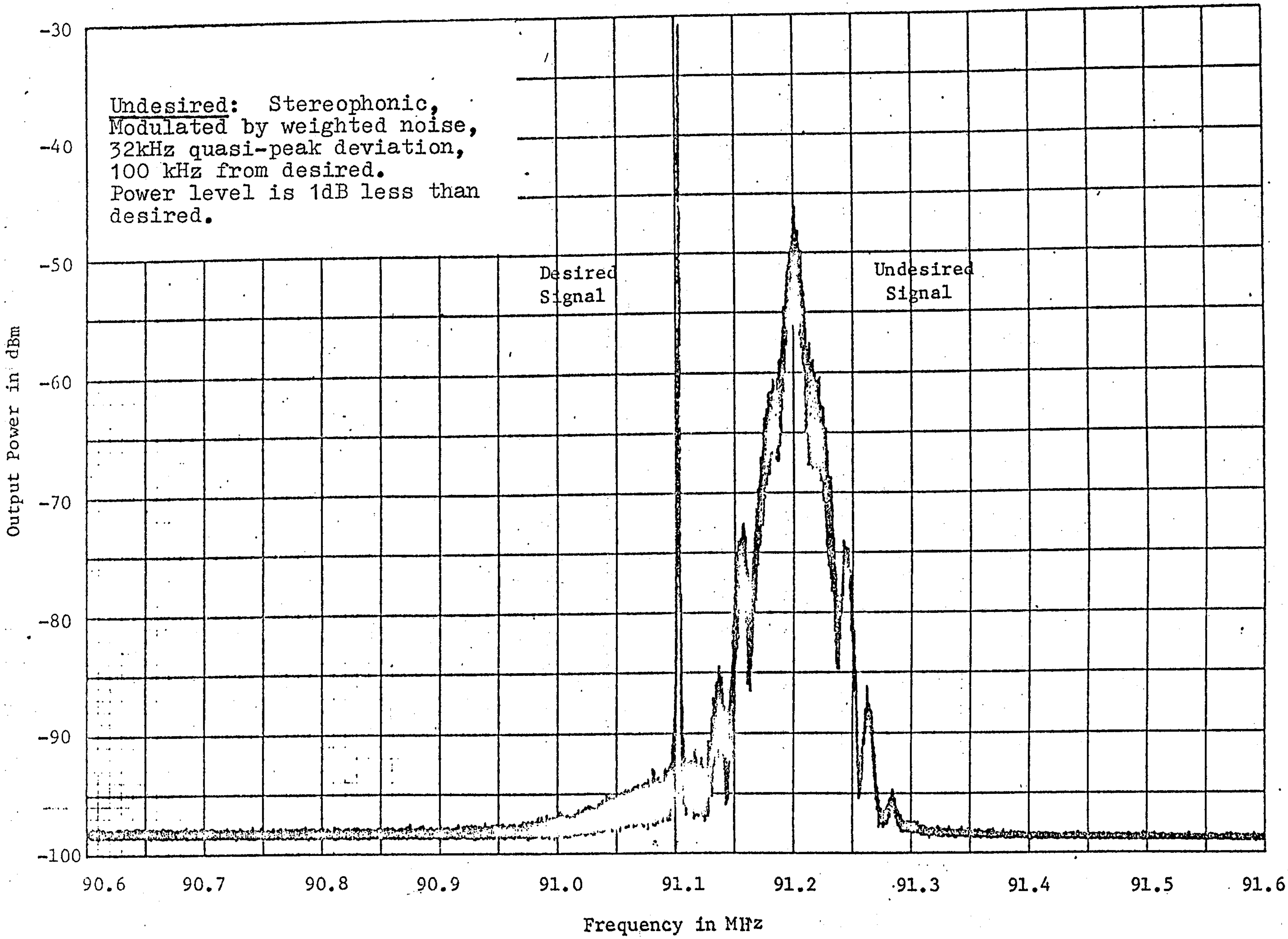
Difference in RF protection ratios at +400kHz and +300kHz
for the specified signal conditions



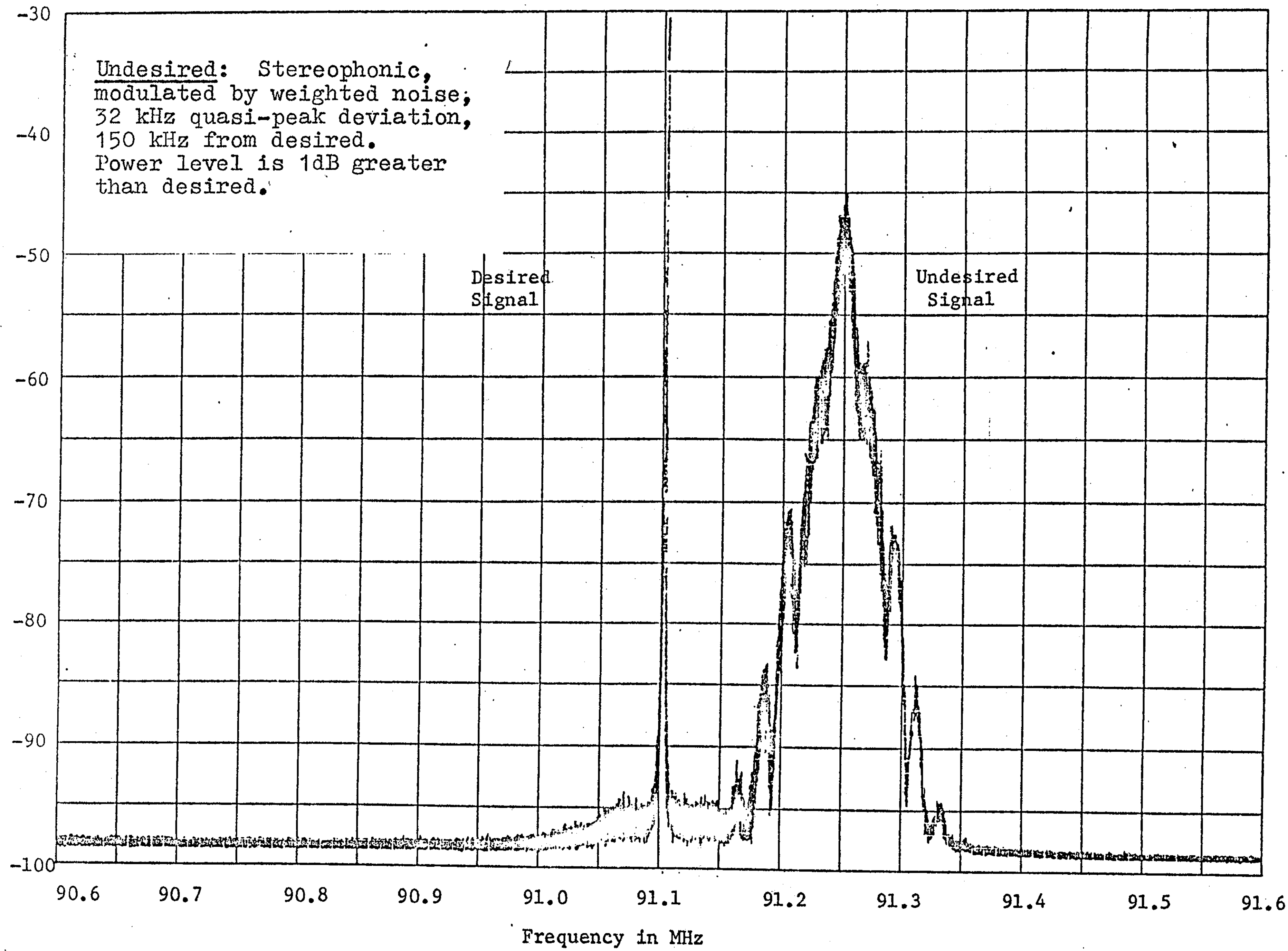
Desired Carrier: ________dBf __________

Undesired Carrier: ____________________

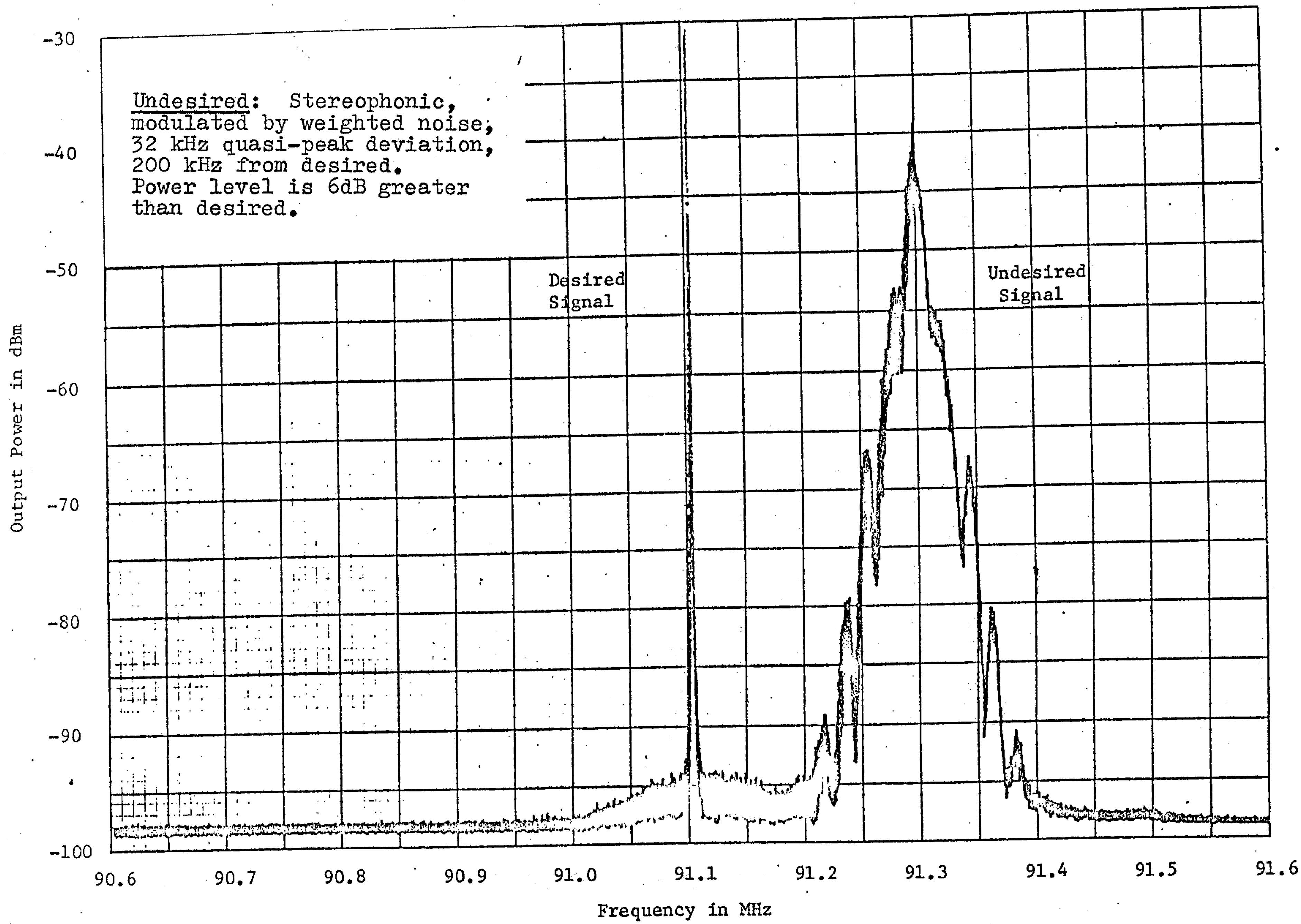
Signal Spectrums at Input to Receiver

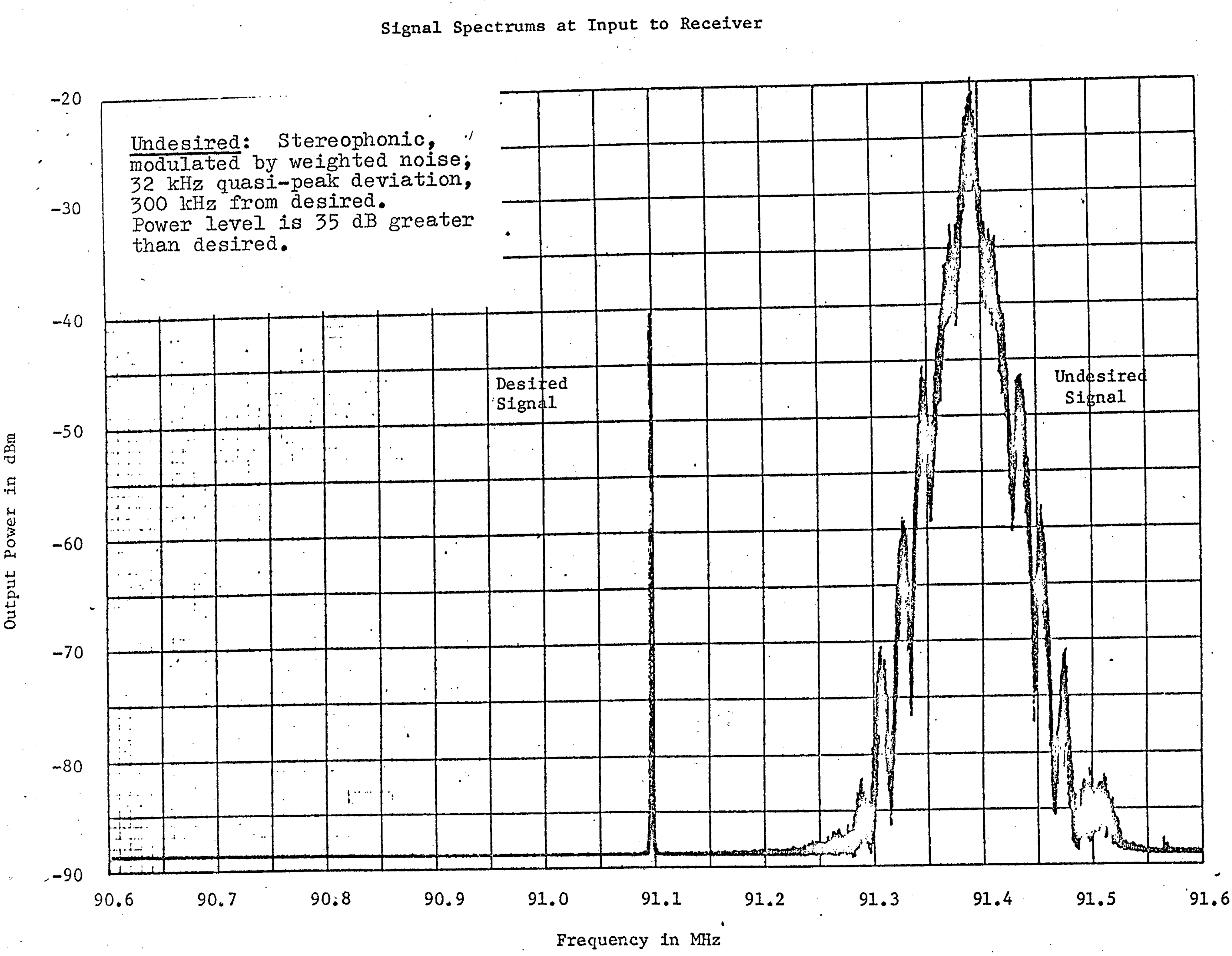


Signal Spectrums at Input to Receiver

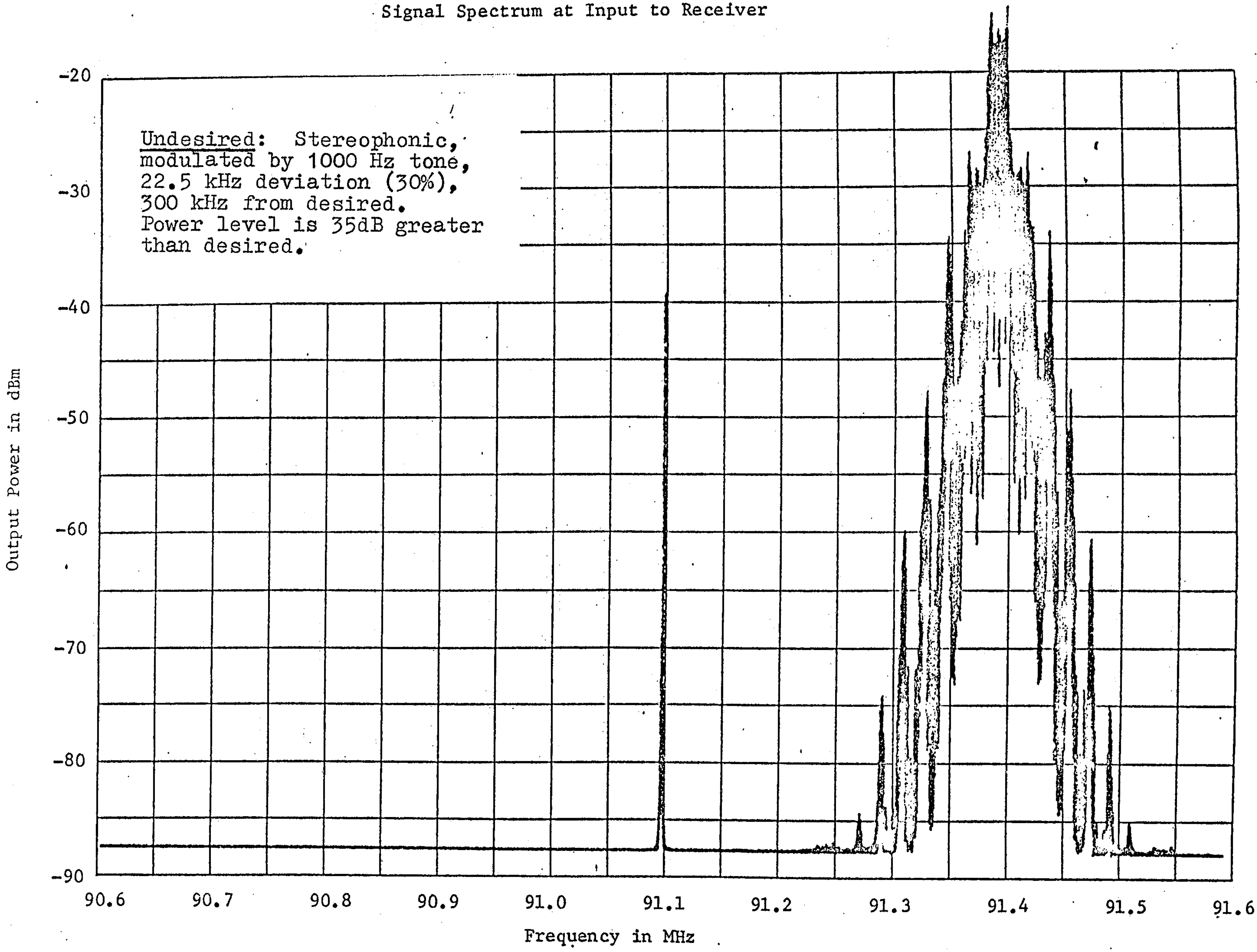


Signal Spectrums at Input to Receiver

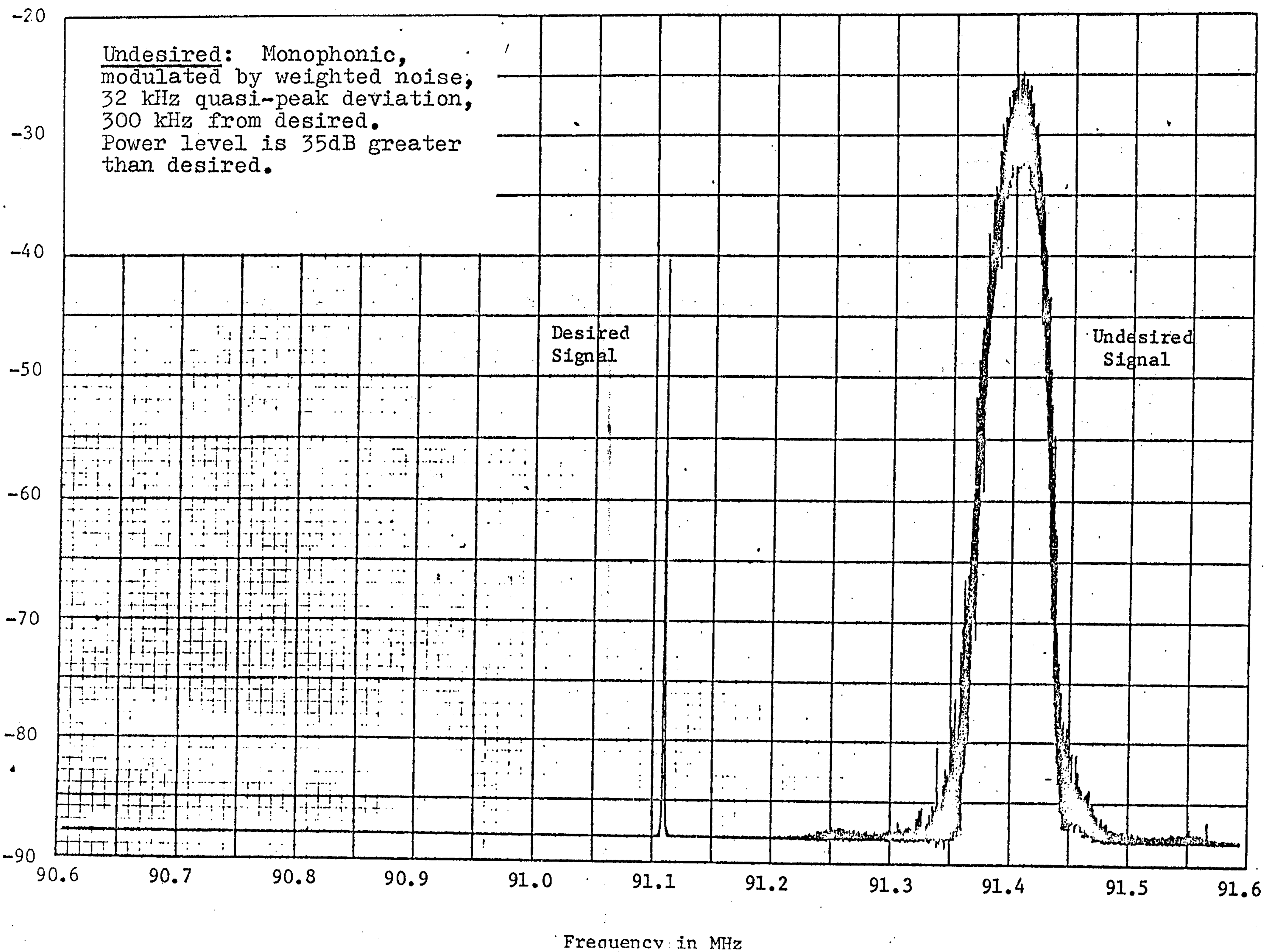



Signal Spectrums at Input to Receiver
Undesired: Stereophonic, modulated by weighted noise; 32 kHz quasi-peak deviation, 300 kHz from desired. Power level is 35 dB greater than desired.
Desired Signal
Undesired Signal
Output Power in dBm
-20
-30
-40
-50
-60
-70
-80
-90
90.6
90.7
90.8
90.9
91.0
91.1
91.2
91.3
91.4
91.5
91.6
Frequency in MHz

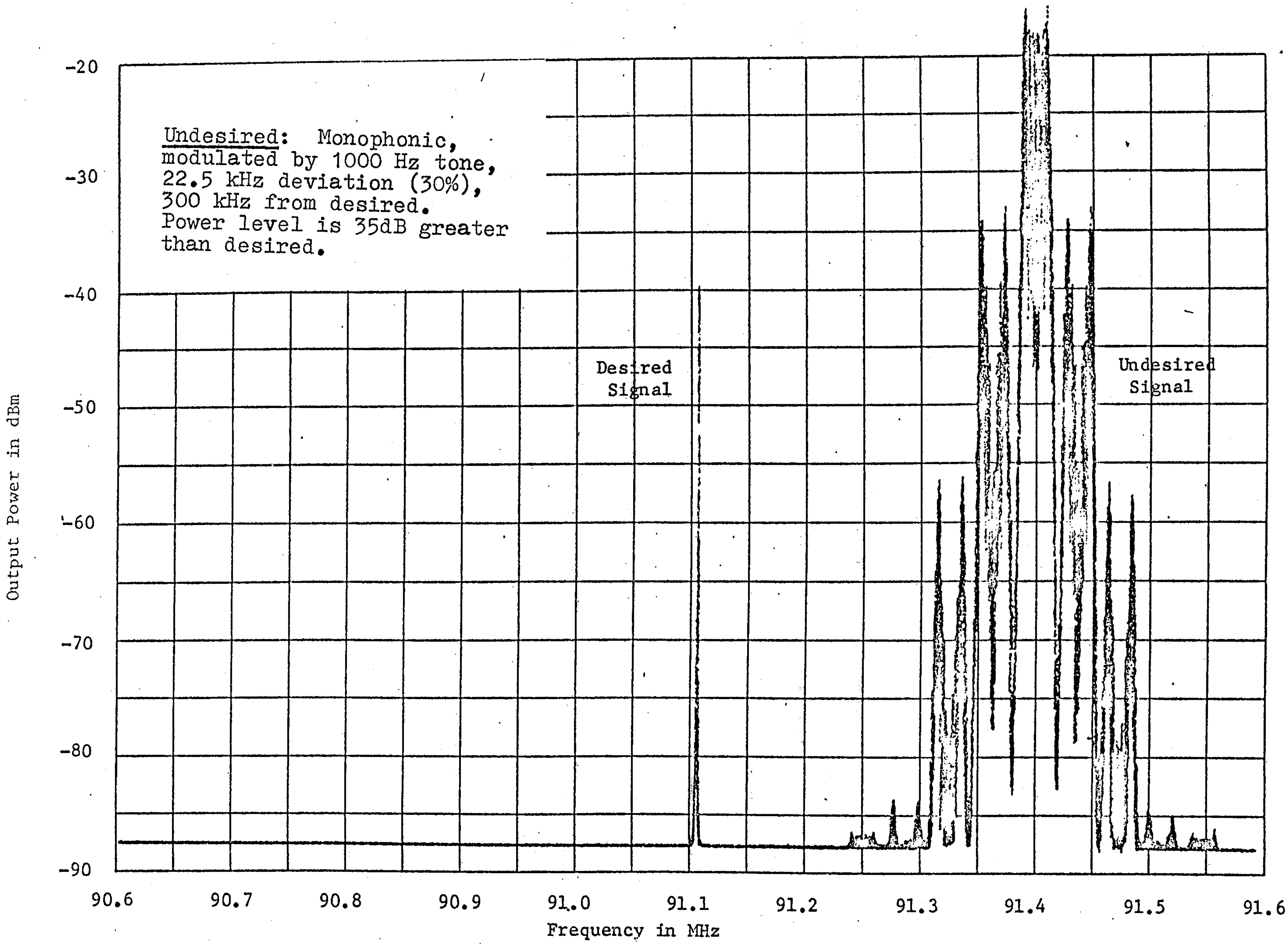
Signal Spectrum at Input to Receiver



Signal Spectrum at Input to Receiver



Signal Spectrum at Input to Receiver



SECTION 10B: FREQUENCY-MODULATION SOUND BROADCASTING IN BANDS 8 (VHF) AND 9 (UHF)

Recommendations and Reports

RECOMMENDATION 412-2 *

STANDARDS FOR FM SOUND BROADCASTING AT VHF

(1956 – 1959 – 1963 – 1974 – 1978)

The CCIR

UNANIMOUSLY RECOMMENDS

that for frequency-modulation sound broadcasting in band 8 (VHF):

1. the maximum frequency deviation should be either ± 75 kHz or ± 50 kHz;

2. the pre-emphasis characteristic should be defined as a curve rising with frequency in conformity with the admittance of a parallel combination of a capacitance and a resistance having a time constant of either 50 or 75 us;

3. in the absence of interference from industrial and domestic equipment:

3.1 a field strength (measured 10 m above ground level) of at least 50 μV/m can be considered to give an acceptable monophonic service;

3.2 a field strength of at least 250 μV/m (measured 10 m above ground level) can be considered to give an acceptable stereophonic (pilot-tone system, as defined in Recommendation 450) service if a directional antenna with appreciable gain is used;

4. in the presence of interference from industrial and domestic equipment **, a satisfactory service requires a median field strength (measured 10 m above ground level) of at least:

4.1 *for the monophonic service*

- 0.25 mV/m in rural areas,
- 1 mV/m in urban areas,
- 3 mV/m in large cities;

4.2 *for the stereophonic service*

- 0.5 mV/m in rural areas,
- 2 mV/m in urban areas,
- 5 mV/m in large cities;

5. the radio-frequency protection ratios required:

5.1 to give satisfactory *monophonic* reception for 99% of the time, in systems using a maximum frequency deviation of ± 75 kHz, are those given by the Curve M2 in Fig. 1. For steady interference, it is desirable to provide the higher degree of protection, shown by the Curve M1 in Fig. 1.

The corresponding values for systems using a maximum frequency deviation of ± 50 kHz are given in Fig. 2.

The protection ratios at important values of the frequency spacing are also given in Table I.

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* The Director, CCIR is requested to bring this Recommendation to the attention of the IEC, so that it may inform manufacturers of FM receivers accordingly. Serious difficulties have been encountered in introducing stereophonic FM services planned according to the standards given in this Recommendation. Special attention should be directed to § 5.3 which sets out the problems which will arise if the required design characteristics of such receivers are not met.

** For limits of radiation from such equipments refer to the relevant CISPR Recommendations.

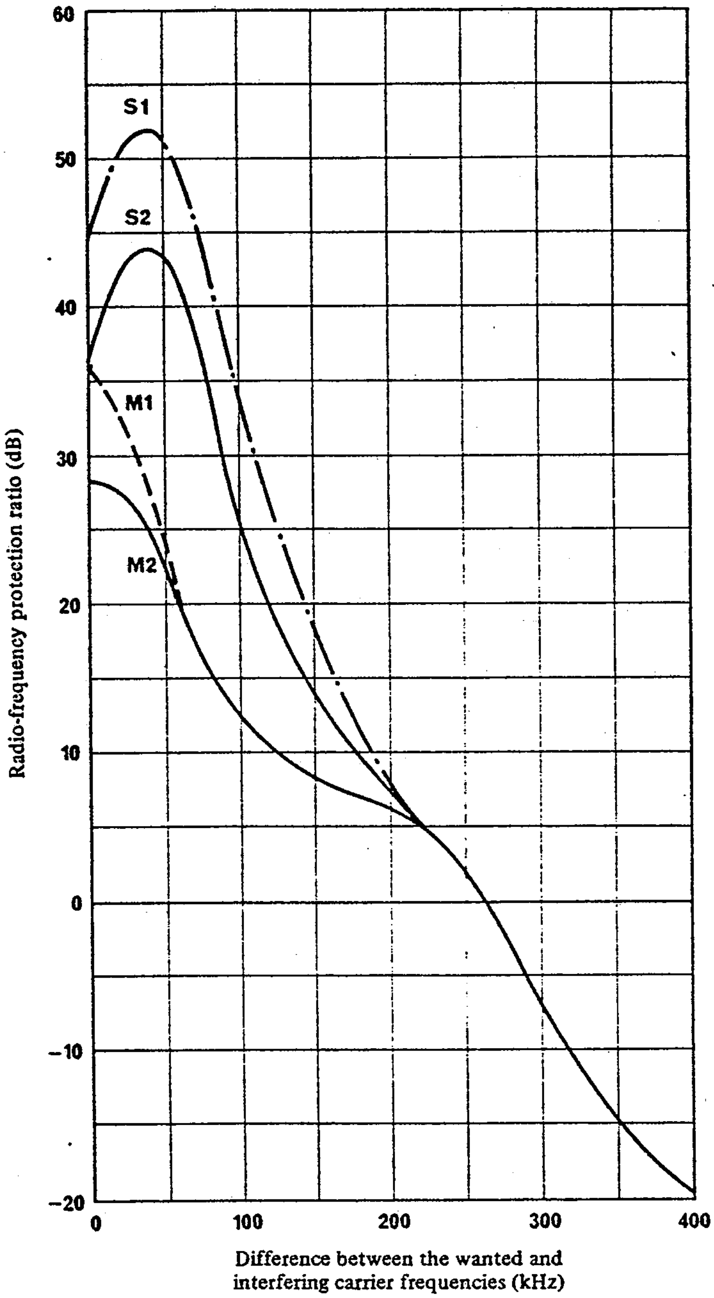

FIGURE 1 – *Radio-frequency protection ratio required by broadcasting services in band 8 (VHF) at frequencies between 87.5 MHz and 108 MHz using a maximum frequency deviation of ± 75 kHz*

Curve M1	: monophonic broadcasting; steady interference
Curve M2	: monophonic broadcasting; tropospheric interference (protection for 99% of the time)
Curve S1	: stereophonic broadcasting; steady interference
Curve S2	: stereophonic broadcasting; tropospheric interference (protection for 99% of the time)

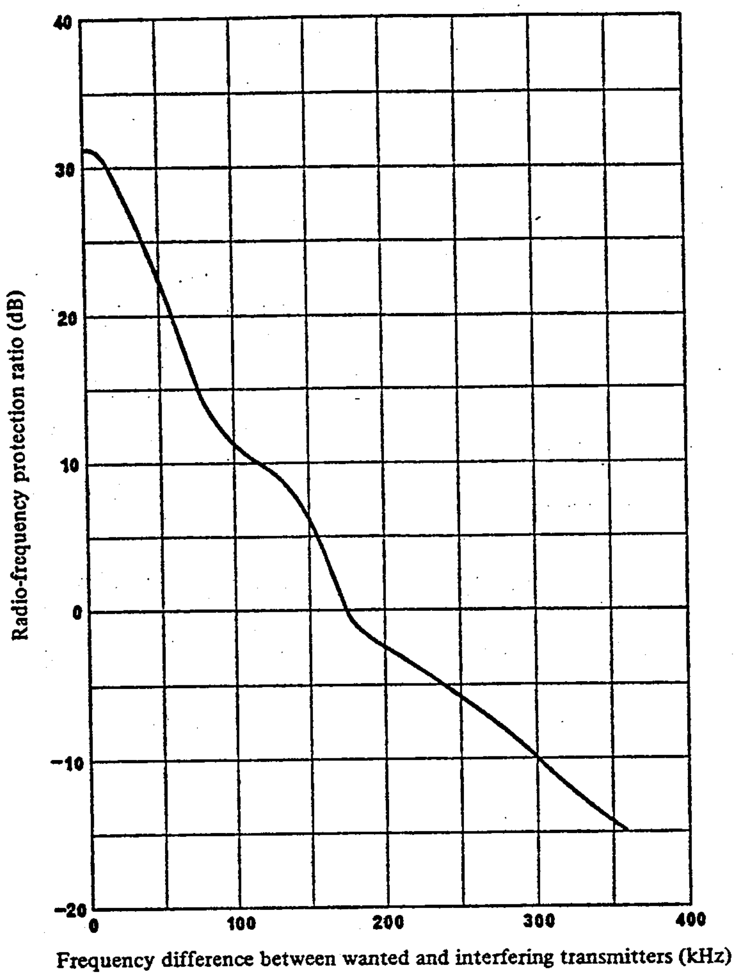

FIGURE 2 – *Radio-frequency protection ratios for monophonic sound broadcasting in band 8 (VHF) at frequencies below 87.5 MHz using a maximum frequency deviation of ± 50 kHz*

Tropospheric interference (protection for 99% of the time)

TABLE I

Frequency spacing, (kHz)	Radio-frequency protection ration (dB)			
	Monophonic		Stereophonic	
	Steady interference	Tropospheric interference	Steady interference	Tropospheric interference
0	36	28	45	37
25	31	27	51	43
50	24	22	51	43
75	16	16	45	37
100	12	12	33	25
150	8	8	18	14
200	6	6	7	7
250	2	2	2	2
300	− 7	− 7	− 7	− 7
350	−15	−15	−15	−15
400	−20	−20	−20	−20

5.2 to give satisfactory *stereophonic* reception for 99% of the time, for transmissions using the pilot-tone system and a maximum frequency deviation of ± 75 kHz, are given by Curve S2 in Fig. 1. For steady interference, it is desirable to provide a higher degree of protection, shown by Curve S1 in Fig. 1. The protection ratios at important values of the frequency spacing are also given in Table I.

5.3 The protection ratios for stereophonic broadcasting assume the use of a low-pass filter following the frequency-modulation demodulator designed to reduce interference and noise at frequencies greater than 53 kHz. Without such a filter or an equivalent arrangement in the receiver, the protection ratio curves for stereophonic broadcasting cannot be met, and significant interference from transmissions in adjacent or nearby channels is possible.

Note 1. – In determining the characteristics of the filters whose phase response is important in the preservation of channel separation at high audio frequencies, reference should be made to Report 293-4, particularly Table I and Figs. 2, 3 and 4.

Note 2. – The protection ratios for steady interference provide approximately 50 dB signal-to-noise ratio (r.m.s. weighted, reference signal at maximum frequency deviation).

Note 3. – It should be noted that a modulation compression of the interfering signal of, for example, 6 dB may require an increase in the protection ratio of about 6 dB, when the frequency spacing is of the order of 100 kHz. In consequence, the use of modulation compression would increase the effect of interference to other stations, especially at a separation of 100 kHz.

RECOMMENDATION 419

DIRECTIVITY OF ANTENNAE IN THE RECEPTION OF BROADCAST SOUND AND TELEVISION

(1963)

(The text of this Recommendation will be found in Section 11D of Volume XI.)

RECOMMENDATION 450

SYSTEMS FOR FREQUENCY-MODULATION STEREOPHONIC BROADCASTING IN BAND 8 (VHF)

(1966)

The CCIR,

CONSIDERING

(a) that it is technically possible to transmit stereophonic programmes by a single frequency-modulation transmitter;

(b) that, as far as possible, the introduction of these transmissions should not impair any aspects of existing monophonic reception;

(c) that such transmissions should be capable of rendering a high quality of stereophonic reproduction;

(d) that several systems exist that fulfil these requirements and are compatible within the definition contained in Question 15/10;

(e) that theoretical studies as well as experiments have been carried out with a number of these systems;

(f) that favourable operational results have been obtained with only two of the systems (see Report 300-4);

(g) that intercontinental standardization would enhance the development of stereophonic broadcasting,

UNANIMOUSLY RECOMMENDS

that stereophonic transmissions in band 8 (VHF) should be made, using one of the two systems defined by the following specifications which concern components of the signal used to frequency-modulate the transmitter;

1. Polar-modulation system

(maximum frequency deviation: ± 50 kHz or ± 75 kHz).

1.1 a compatible signal, M, equal to one half of the sum of the left-hand signal, A, and the right-hand signal, B, produces deviation of the main carrier by not more than 80% of the maximum frequency deviation for monophonic transmission;

NRSC Document Improvement Proposal

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