MOTOROLA

AM STEREO

THE ANSWER TO THE MARKETPLACE DECISION

PART I

THE MARKETPLACE DECISION FOR AM STEREO

MOTOROLA INC.

INTRODUCTION

On March 4, 1982, the Federal Communications Commission voted for a Report and Order on AM Stereo which decrees that the "Marketplace" is the best arena for evolving a National Standard for AM Stereo Broadcasting. The following pages describe the Motorola responses to a "Marketplace" competition regarding AM Stereo.

QUESTION: WHAT DOES MOTOROLA INTEND TO DO IN VIEW OF THE MARKETPLACE DECISION FOR AM STEREO?

DISCUSSION:

Motorola is taking all of the necessary steps to maximize the probability of an orderly marketplace determination of a National Standard for AM Stereo broadcasting. Specifically, the Broadcasting Industry and the Receiver Industry will be provided with hardware and support in order that AM Stereo may serve the public.

QUESTION: DOES THIS MEAN THAT MOTOROLA WILL PROVIDE THE NECESSARY BROADCASTING EQUIPMENT?

DISCUSSION:

Yes, Motorola will assure that both Exciters and Monitors for the transmission of the Compatible Quadrature AM Stereo System are available.

QUESTION: WHAT IS TO PREVENT THE SITUATION OF A BROADCASTER STARTING WITH ONE SYSTEM ONLY TO HAVE THE MARKETPLACE TURN IN A DIFFERENT DIRECTION?

DISCUSSION:

Absolutely nothing! That is why it is very important that the Broadcaster do the necessary homework to both identify the best system and minimize his financial risk.

QUESTION: HOW CAN A BROADCASTER MINIMIZE FINANCIAL RISK?

DISCUSSION:

This can be accomplished in two ways. First, be certain that the system under consideration truly does have high technical performance. Second, become convinced that the system is fully supported. The latter translates into the availability of Broadcasting Equipment, Integrated Circuit Decoders, and AM Stereo Receivers with reasonable cost and high performance factors.

QUESTION: WILL MOTOROLA MANUFACTURE INTEGRATED CIRCUIT DECODERS FOR RECEIVER MANUFACTURERS?

DISCUSSION:

Yes, Motorola is one of the largest manufacturers of Integrated Circuits and also manufactures original equipment automobile receivers.

QUESTION: WILL OTHER RECEIVER MANUFACTURERS ALSO SUPPORT THE MOTOROLA AM STEREO SYSTEM?

DISCUSSION:

Motorola has several reasons for its conviction that others will join us in this thrust to bring order to a "marketplace" resolution. First, Compatible Quadrature is the best system which anyone can verify by thorough examination. Second, Motorola is committed to full system support to both the Broadcast Industry and the Receiver Industry. Third, there simply are no other good alternatives except perpetual marketplace confusion.

QUESTION: DON'T YOU THINK THAT IT WOULD STILL BE A LARGE RISK FOR A BROADCASTER TO GO WITH THE MOTOROLA SYSTEM?

DISCUSSION:

Not at all — Motorola is further minimizing risk to the Broadcaster by offering to "lease" its equipment. This way, for only a fraction of the equipment cost, a Broadcaster can "switch horses in the middle of the stream" if necessary.

QUESTION: BUT ISN'T THIS APPROACH A LARGE RISK FOR MOTOROLA?

DISCUSSION:

Motorola doesn't believe so. The combination of the best system, the necessary hardware and support, and a minimization of Broadcaster financial risk should offer a clear path through the maze of "marketplace" confusion.

FOR FURTHER INFORMATION REGARDING BROADCAST EQUIPMENT AND THE BROADCAST EQUIPMENT LEASE PLAN, WRITE OR CALL:

Richard Harasek, Special Products Manager
Motorola, Inc.
1244½ Remington Road
Schaumburg, Illinois 60195
(312-576-3591)

PART II

TECHNICAL DESCRIPTION AND PERFORMANCE OF THE MOTOROLA COMPATIBLE QUADRATURE SYSTEM

I. MOTOROLA COMPATIBLE QUADRATURE AM STEREO SYSTEM DESCRIPTION

Introduction and Encoding Alternatives

The Motorola AM Stereo system is simple, but elegant, solution to a difficult signal transmission compatibility problem. Let us briefly examine the options to AM stereo encoding.

Stereophonic information may be encoded through FM or PM modulation, but the dynamic receiver noise performance becomes inversely proportional to the AM modulation present; that is, excellent noise characteristics occur with positive AM modulation but steadily deteriorated performance occurs with negative AM modulation. In fact, as the instantaneous carrier becomes small, the stereophonic noise performance of FM or PM based stereo systems becomes unacceptably large.

Stereophonic encoding may also be accomplished through the utilization of single sideband techniques (upper sideband for one channel and lower sideband for the other channel) but the result is an incompatible resultant envelope modulation. If the envelope modulation is forced to be compatible, two undesirable effects occur. First, the desired single-sideband characteristics are lost in the presence of uncorrelated stereophonic information. Second, an exact decoder algorithm becomes unrealizable under the same modulation conditions; hence, approximate decoders suffer excessively large intermodulation distortions.

The remaining stereo encoding option is the use of quadrature modulation provided a satisfactory solution to envelope detector compatibility may be found.

Quadrature Modulation

The existing AM modulation transmission may be defined as:

$$(1)\quad (1 + S)\cos\omega_c t$$

$$\text{where}\begin{cases} S = M_s S(t) \\ M_s = \text{Index of Monaural Signal Modulation} \\ S(t) = \text{AM modulation monaural signal} \\ \quad\;\; = L(t) + R(t) \end{cases}$$

Now, the stereophonic information may be inserted in quadrature with the carrier and becomes:

$$(2)\quad D\sin\omega_c t$$

$$\text{where}\begin{cases} D = M_d D(t) \\ D(t) = \text{Difference Signal Modulation} \\ \quad\;\; = L(t) - R(t) \\ M_d = \text{Index of Difference Signal Modulation} \end{cases}$$

The resultant stereophonic signal becomes:

$$(3)\ (1 + S)\cos\omega_c t + D\sin\omega_c t$$

which may be rewritten to be:

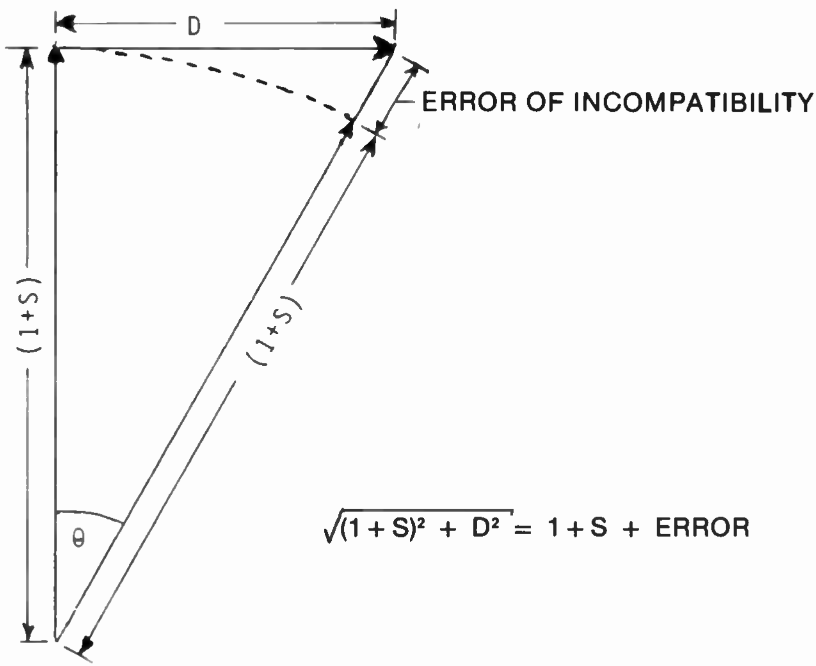
$$(4)\ \sqrt{(1 + S)^2 + D^2}\cos(\omega_c t + \theta) = QUAM$$

where $\theta = \tan^{-1}(D/(1 + S))$

But, this signal is incompatible. An envelope detector would detect:

$$\sqrt{(1 + S)^2 + D^2}$$

which contains serious distortion terms for the monaural listener. The figure below describes the problem.



QUADRATURE MODULATION COMPATIBILITY ERROR

The Motorola Compatible Quadrature AM Stereo System

Motorola engineers observed that, if Equation (4) is multiplied by cosineθ, the Error of Incompatibility vanishes. That is:

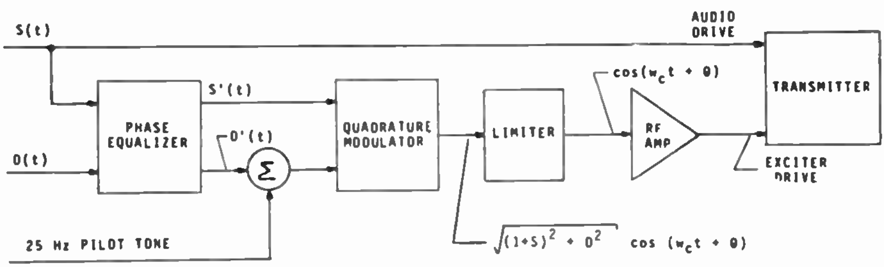
$$(5)\ \text{QUAM} \times \cos\theta = (1 + S) \cos(\omega_c t + \theta)$$

which is an envelope detector compatible signal. The angular modulation is unchanged from that of quadrature modulation.

Subsequent studies and measurements have shown that the Compatible Quadrature signal retains the stereophonic performance benefits of quadrature modulation over the entire range of expected stereophonic signals. In addition, the spectra characteristics are easily accommodated by existing AM broadcast standards.

II. ENCODING COMPATIBLE QUADRATURE MODULATION

Encoding of the Motorola stereo system is very simple. The existing RF oscillator of the transmitter is replaced by a substitute reference which has the angular modulation of a quadrature signal. The existing AM modulation technique is basically unchanged. Consider the following figure:



Note that the audio modulation sum information is unchanged and that a quadrature phase modulated RF drive is substituted for normal RF drive. The only other change is the presence of a Phase Equalizer to compensate for the differences in Amplitude/Phase relationships between the audio signal path and the RF path. This is necessary to maintain separation over a wide bandwidth.

Any suitable stereophonic audio processors and matrix may be used to generate the sum and difference information.

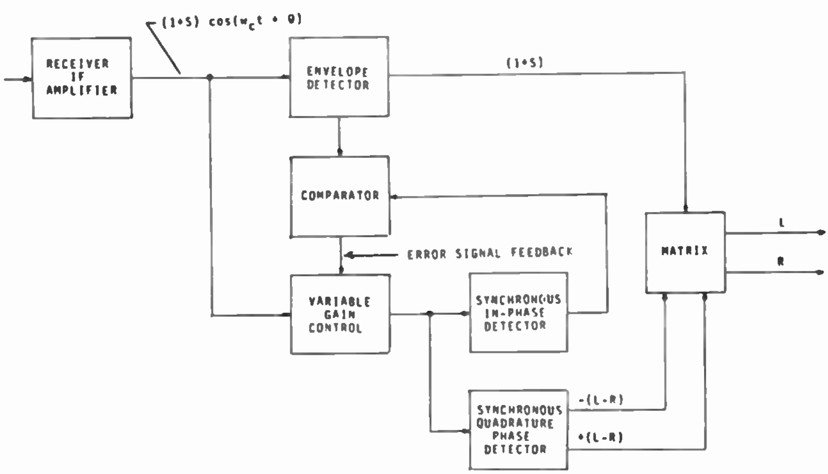
III. DECODING THE COMPATIBLE QUADRATURE SIGNAL

The received compatible quadrature signal is simply a quadrature signal which has been modulated by the cosine of its relative phase angle information. It is also a compatible envelope detector signal. Therefore, sum information may be decoded with either an envelope detector or a synchronous detector that is inversely modulated by the cosine of the phase modulation. Difference information may be decoded with a synchronous quadrature demodulator which is inversely modulated by the cosine of the phase modulation. In fact, there exists a multiplicity of decoding methods since:

$$L - R = D = S \tan\theta = S \times \sin\theta \div \cos\theta$$

Hence, any sequence of operations which results in L − R is a valid decoding algorithm. Even non-PLL decoders are allowed since a discriminator, integrator, tangent function sequence results in L − R.

Motorola has evolved a preferred decoder design which maximizes performance benefits at a minimum of cost and adjustments. The approach is shown in the following figure.



In the absence of the feedback loop, the In-Phase detector would produce $(1 + S) \cos\theta$. The feedback loop forces the In-Phase detector output to be identical to the envelope detector output - but, this action also forces the Variable Gain Control to be an inverse $\cos\theta$ modulator. Hence, the output of the Quadrature Phase Detector becomes the desired $L - R$ information.[1]

It thus becomes apparent why the Motorola system has a minimum of difficulty with noise performance in the troughs of amplitude modulation; when the output of the envelope detector is small, the ouputs of the synchronous detectors must be small. Hence, there is no "blow-up" on spurious signals as with the PM or FM type stereo systems.

[1]For maximum performance of PLL decoders, it is recommended that $L - R$ be utilized as the error signal for loop lock.

IV. ADVANTAGES OF THE COMPATIBLE QUADRATURE SYSTEM

Simplicity

Transmitter conversion is among the simplest of the proposed AM stereo systems. Receiver/decoders may be either PLL or non-PLL type.

Coverage

The noise characteristic of the Compatible Quadrature System stereophonic channel is approximately the same as the monophonic channel over all expected program material modulation probabilities. Therefore, the coverage is very similar to that of monaural. If there is no stereophonic information present, the S/N degrades 3 dB. At typical single channel modulations, the S/N is increased by 3 dB. On average, under typical stereophonic programming, there is only about 1.5 dB increase in measured noise which is more than offset by the directional and spatial effects of stereo.

Sensitivity to Aberrations

The Compatible Quadrature stereo system, in all first order effects, is still fundamentally a quadrature AM/AM system. Because of this, the system possesses nearly the same immunities to sideband asymmetry (caused by directional antenna arrays and/or receiver mis-tuning), interferences, incidental phase modulation, carrier phase shift relative to sidebands, and skywave effects.

Spectra Characteristics

Theoretically, because the Motorola system is compatible, there are higher order sidebands generated. However, experience and exhaustive tests have shown that these higher order compatibility sidebands are only significant at lower frequencies and are easily accommodated by AM broadcasting rules and typical receiver bandwidths. In fact, the spectra distribution and density of Compatible Quadrature, with stereophonic program material, is virtually indistinguishable from that of monaural program material. This is to be expected, since the amplitude of modulation of program material falls rapidly as frequency increases.

Summary

Compatible Quadrature AM Stereo is simple to generate and decode. In addition, its performance characteristics are unmatched because it is compatible, yet free of adverse effects which the amplitude modulation has on other proposed AM stereo systems.

The basic reason for the superiority of the Motorola AM stereo system lies in the nature of its phase modulation. The phase modulation is a function of the ratio of the difference signal information (D) to the sum signal information (1 + S). Hence, the angular phase modulation increases as the instantaneous carrier level decreases. This relationship maintains good stereophonic channel performance in the presence of heavy amplitude modulation. Other proposed FM or PM based systems suffer severe noise, interference, and other aberration penalties as instantaneous carrier level decreases.

V. TECHNICAL DETAILS AND PERFORMANCE DATA

The following group of Figures provides a small sampling of the characteristics of the Motorola Compatible Quadrature system as well as sources of additional information.

Figure A shows the closed loop performance of a high quality Decoder (Monitor) connected directly to an Encoder.

Figure B presents the closed loop performance of a 4.5 kHz bandwidth receiver.

Figure C provides the closed loop performance of a 2.7 kHz bandwidth receiver.

Figure D shows decoder noise degradation versus L = R modulation. The characteristic may also be interpreted as a system "sensitivity to stereophonic channel aberrations" chart. This comment also applies to Figure E and Figure F.

Figure E presents decoder noise degradation versus L = −R modulation.

Figure F presents decoder noise degradation versus single channel (L only or R only) modulation.

Figure G compares the spectral characteristics of the Motorola AM Stereo System to normal monaural modulation utilizing pink noise modulation.

Figures H present the measured coverage characteristics of the Motorola system on WTAQ of LaGrange, Illinois; WTAQ possesses a complex directional antenna array and is "protected" only to 4 millivolts per meter sensitivity. Yet, as can be observed, stereo performance is excellent well beyond its protected contours.

Figures I-1, I-2, and I-3 show AM stereo performance with receiver detuning. The results may also be interpreted to be reflective of the effect of sideband asymmetry caused by directional antennae.

Figures J-1 and J-2 present the dynamic noise performance characteristics of AM stereo.

Figure K presents calculated and measured Co-Channel interference characteristics of AM stereo.

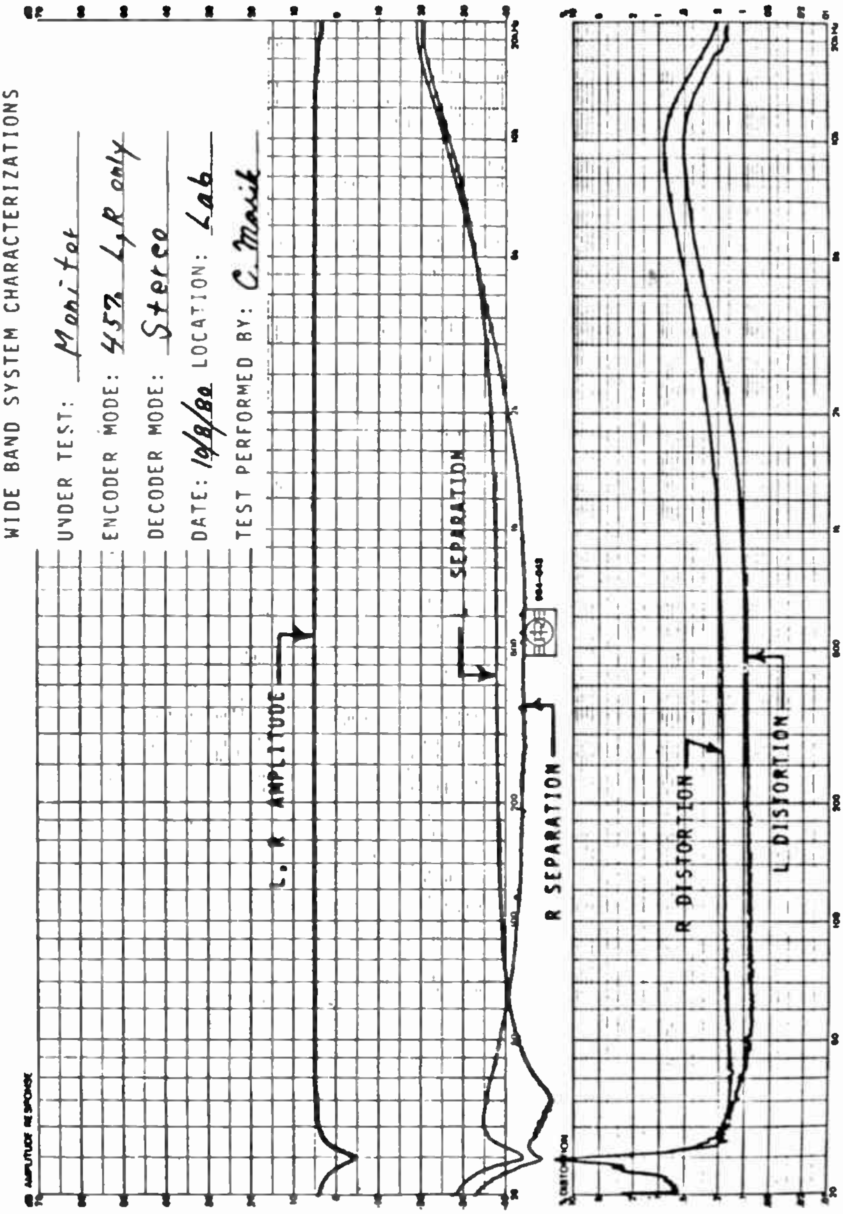
Figure L shows calculated and measured adjacent channel interference characteristics of AM stereo.

Figure M shows the qualitative effect of downward modulation on AM stereo and, therefore, is descriptive of the distinctive performance advantages of the Motorola system.

Figure N presents the complete signal equation of the Motorola system.

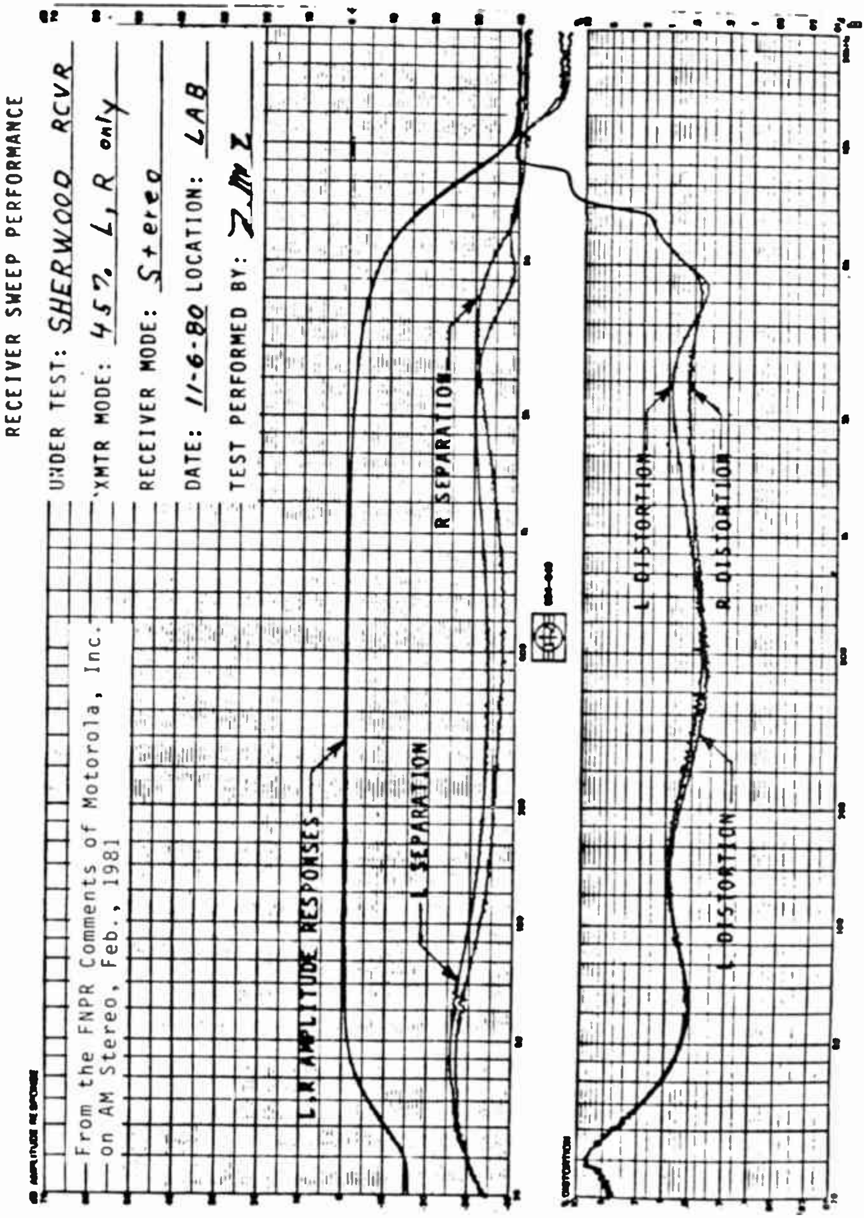
Figure O lists sources of additional information.

FIGURE A: MONITOR PERFORMANCE

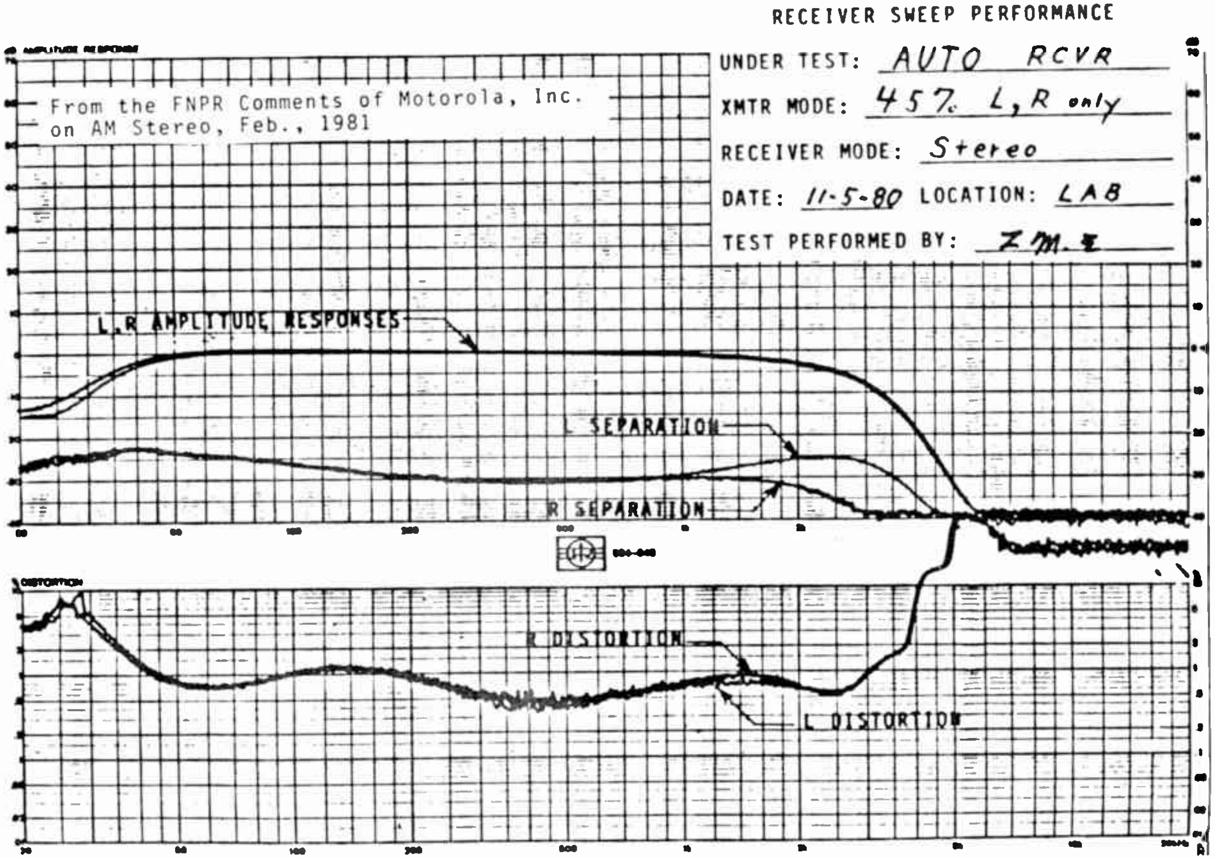


From the FNPR Comments of Motorola, Inc. on AM Stereo, Feb., 1981

FIGURE B: HOME RECEIVER PERFORMANCE



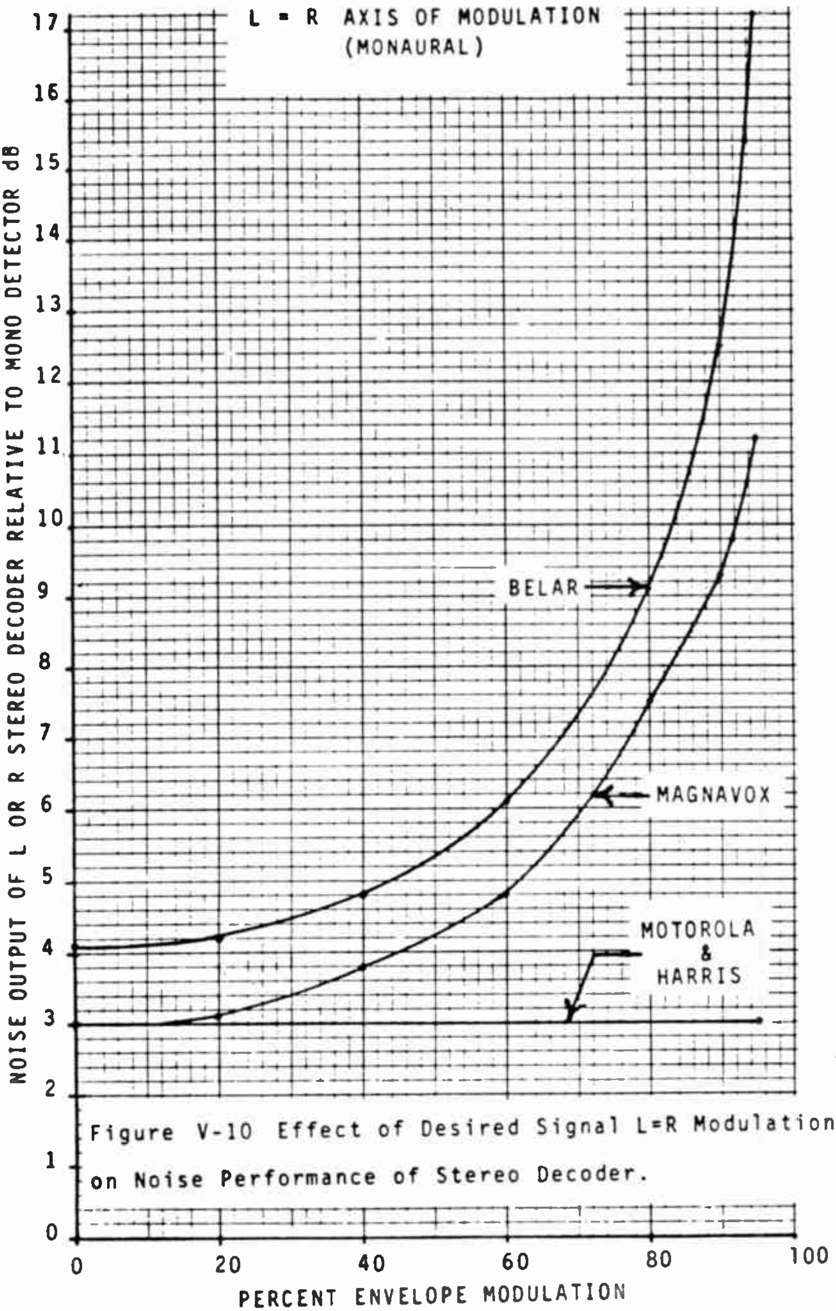
Receiver Tested: Motorola/Sherwood Experimental Home Receiver
Receiver Bandwidth: 4.5 kHz



Receiver Tested: Motorola Experimental Auto Receiver
Receiver Bandwidth: 2.7 kHz

FIGURE C: NARROW BAND RECEIVER PERFORMANCE

FIGURE D



From the FNPR Comments of Motorola, Inc.
on AM Stereo, Feb., 1981

FIGURE E

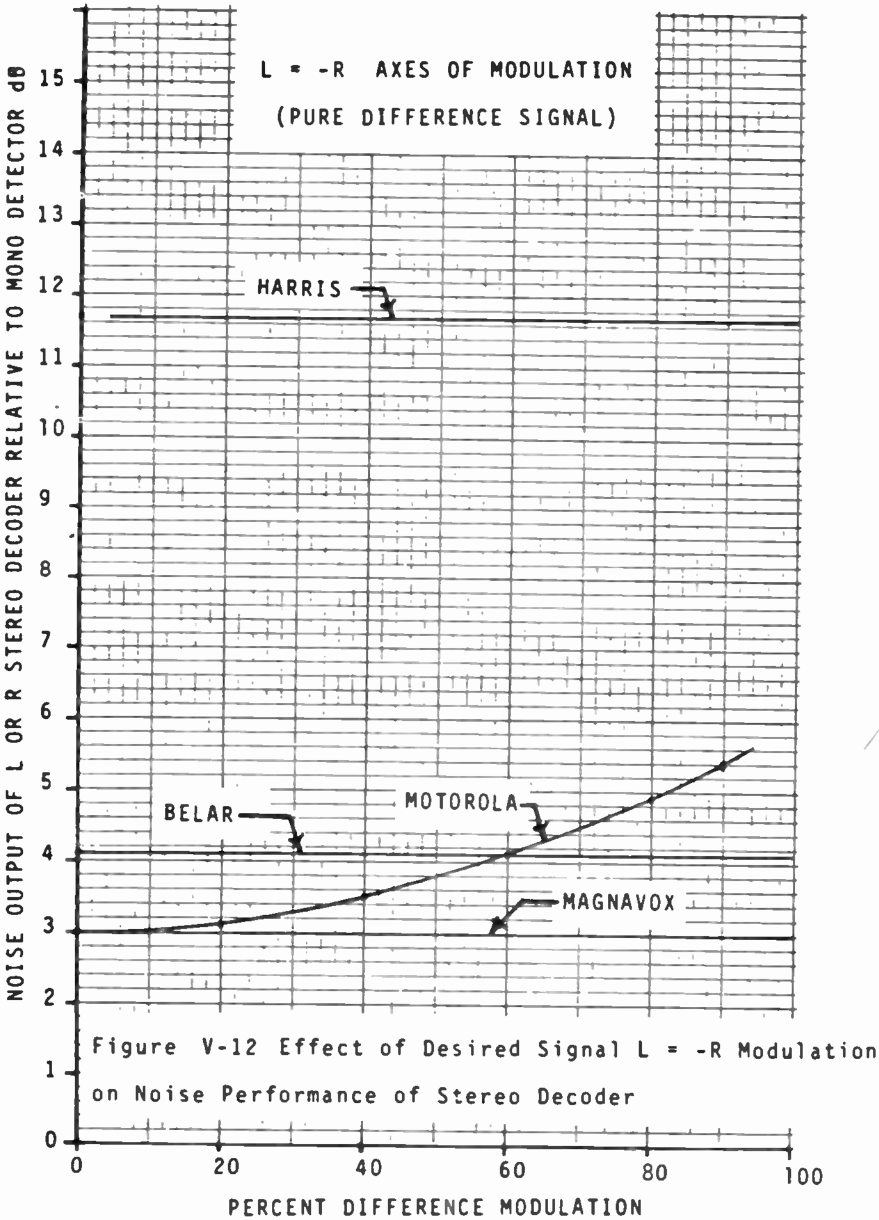


Figure V-12 Effect of Desired Signal L = -R Modulation on Noise Performance of Stereo Decoder

From the FNPR Comments of Motorola, Inc. on AM Stereo, Feb., 1981

FIGURE F

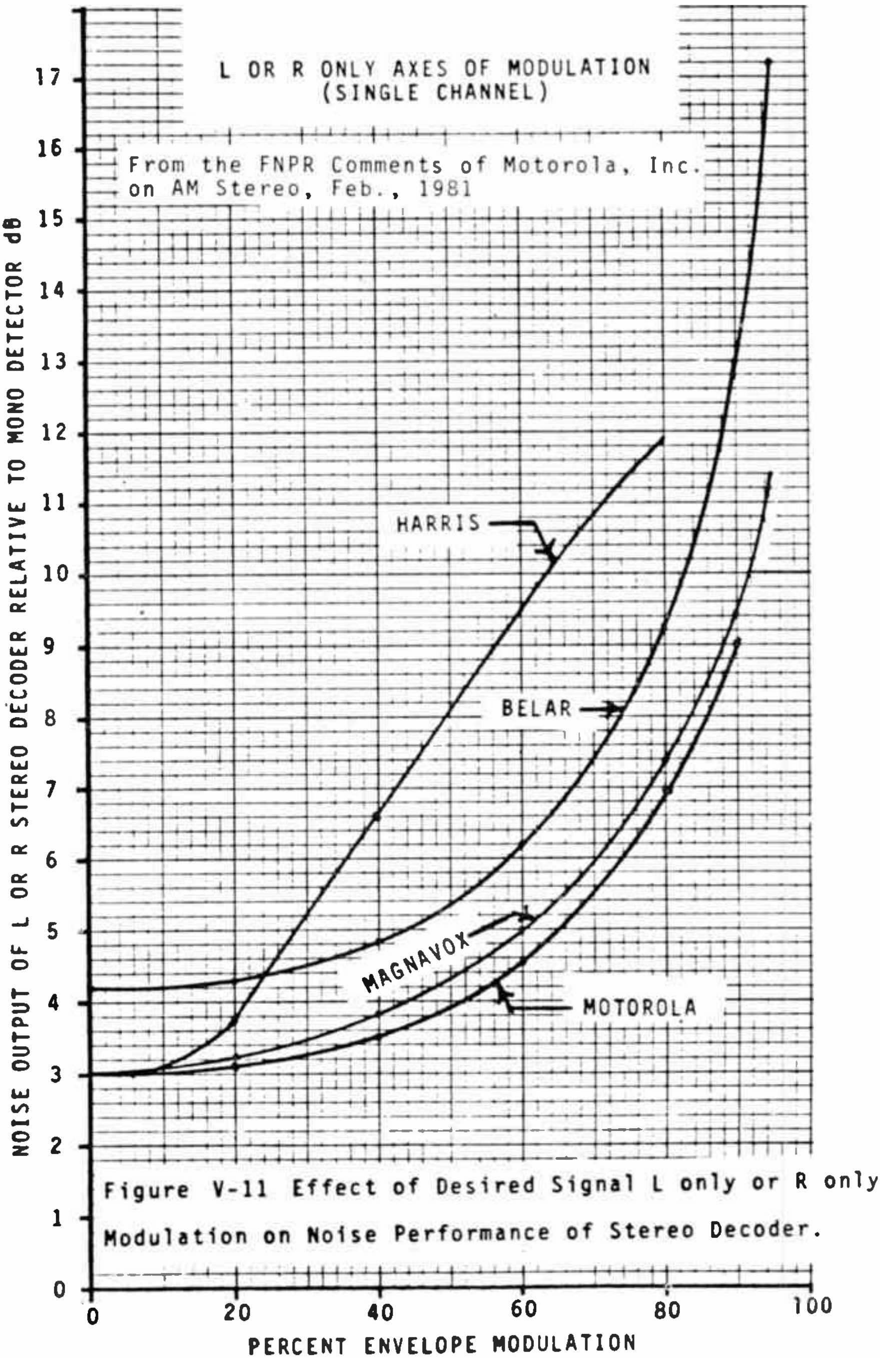
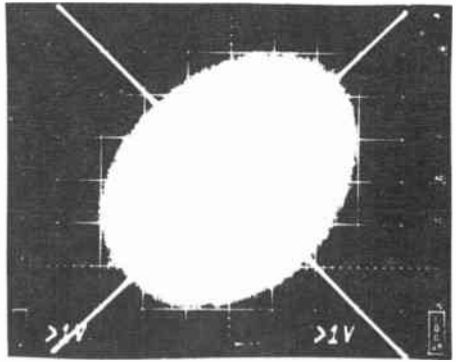


Figure V-11 Effect of Desired Signal L only or R only Modulation on Noise Performance of Stereo Decoder.

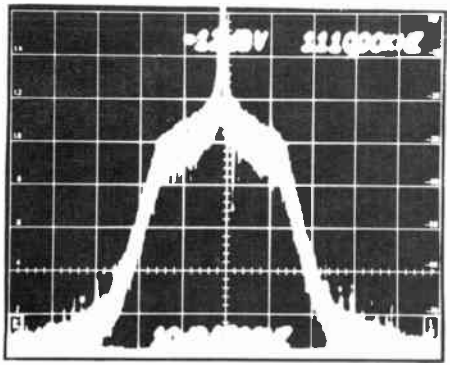
FIGURE G: COMPATIBLE QUADRATURE SPECTRA
FOR PINK NOISE MODULATION

1.4:1 SOUND FIELD WITH NOMINAL MODULATION LEVEL Odb

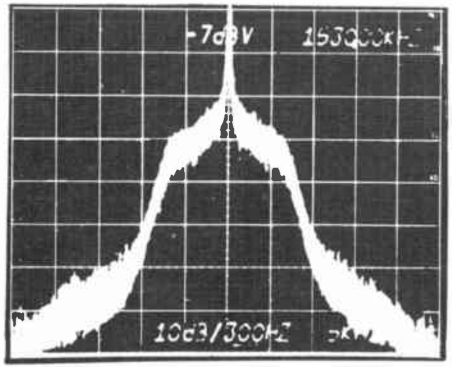
From the NPR Comments of Motorola, Inc.
on AM Stereo, May, 1979



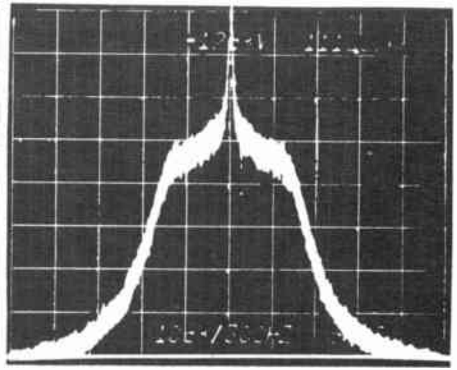
1.4:1 STEREO SOUND FIELD



MONOPHONIC SPECTRUM
C-QUAM LABORATORY GENERATOR
7.5 Khz BASEBAND



MONOPHONIC SPECTRUM
WKDC TRANSMITTER
7.5 Khz BASEBAND



1.4:1 STEREO SOUND FIELD
C-QUAM LABORATORY GENERATOR
7.5Khz BASEBAND

FIGURE H-1: WTAQ COVERAGE TESTS

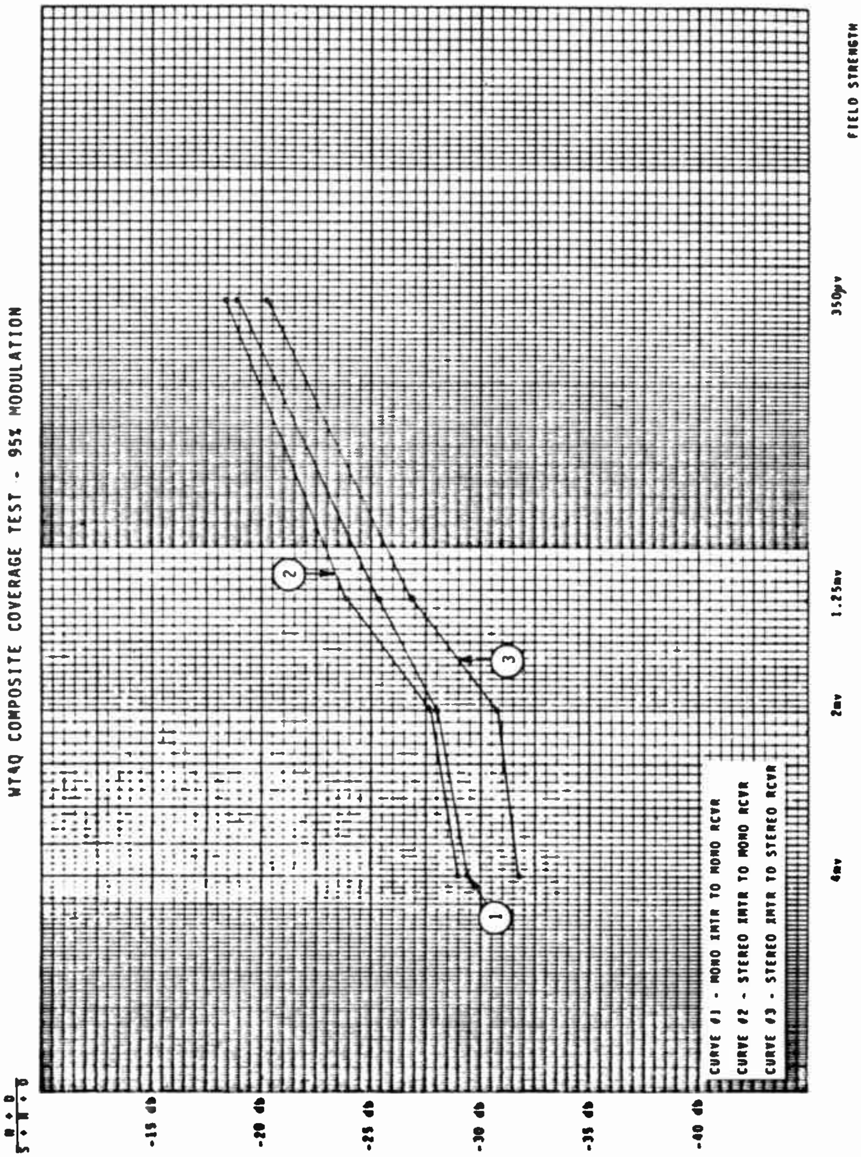
(N+D)/(S+N+D)

	2 Tone; 95% Modulation			400 Hz; 47.5% Modulation			700 Hz; 47.5% Modulation		
Signal Strenth	Mono XMT* Env RCV	Stereo XMT* Env RCV	Stereo XMT Stereo RCV	Mono XMT Env RCV	Stereo XMT Env RCV	Stereo XMT Stereo RCV	Mono XMT Env RCV	Stereo XMT Env RCV	Stereo XMT Stereo RCV
4 mv/m	-29.5db	-28.5db	-31.8db	-30 db	-31.8db	-35.3db	-33.3db	-33 db	-35.3db
2 mv/m	-28	-27.75	-30.8	-30.7	-31	-34	-31	-31.2	-33
1.25mv/m	-25.3	-23.9	-26.7	-26.4	-26.3	-29	-26.2	-25.9	-28.5
350 uv/m	-18.9	-18.5	-20.1	-21.4	-22.6	-25.5	-21.8	-21.8	-25.6

* The accuracy of the stereo performance data under each major column is = ± 1db; this is due to variation in interference floors during the course of the measurements. Mono data is slightly less accurate due to variance in noise floors between the stereo and monaural transmissions. At times, because several moments elapsed between stereo and mono transmissions of the same type, there would be up to a 2db relative change,stereo to mono, due to skywave interference changes in noise floors. Nevertheless, the aggregate of data provides excellent correlation and corroboration of Laboratory Coverage Tests, NAMSRC tests, and Coverage tests of previous filings. The Motorola system, with uncorrelated stereophonic information, has a 3db advantage over monophonic coverage. This is true even for high stereophonic modulation levels.

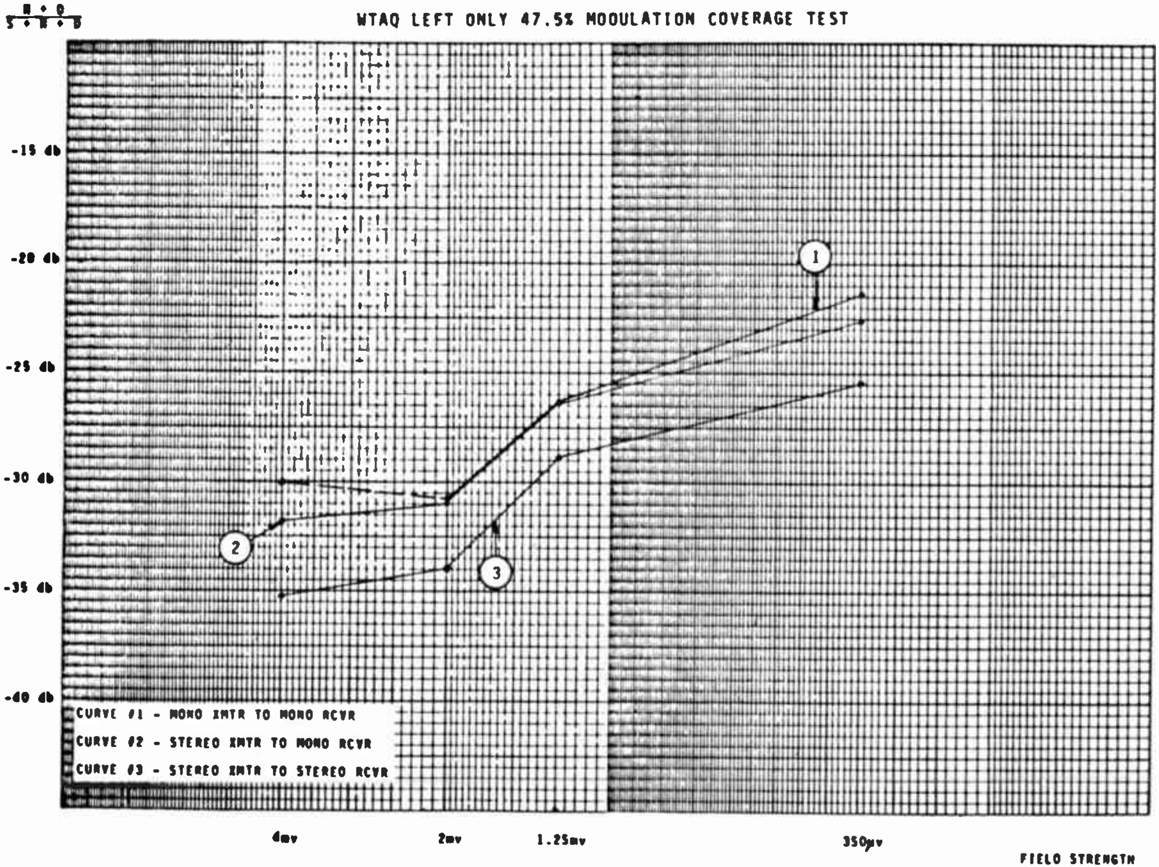
From the FNPR Comments of Motorola, Inc.
on AM Stereo, Feb., 1981

FIGURE H-2: WTAQ COVERAGE TESTS



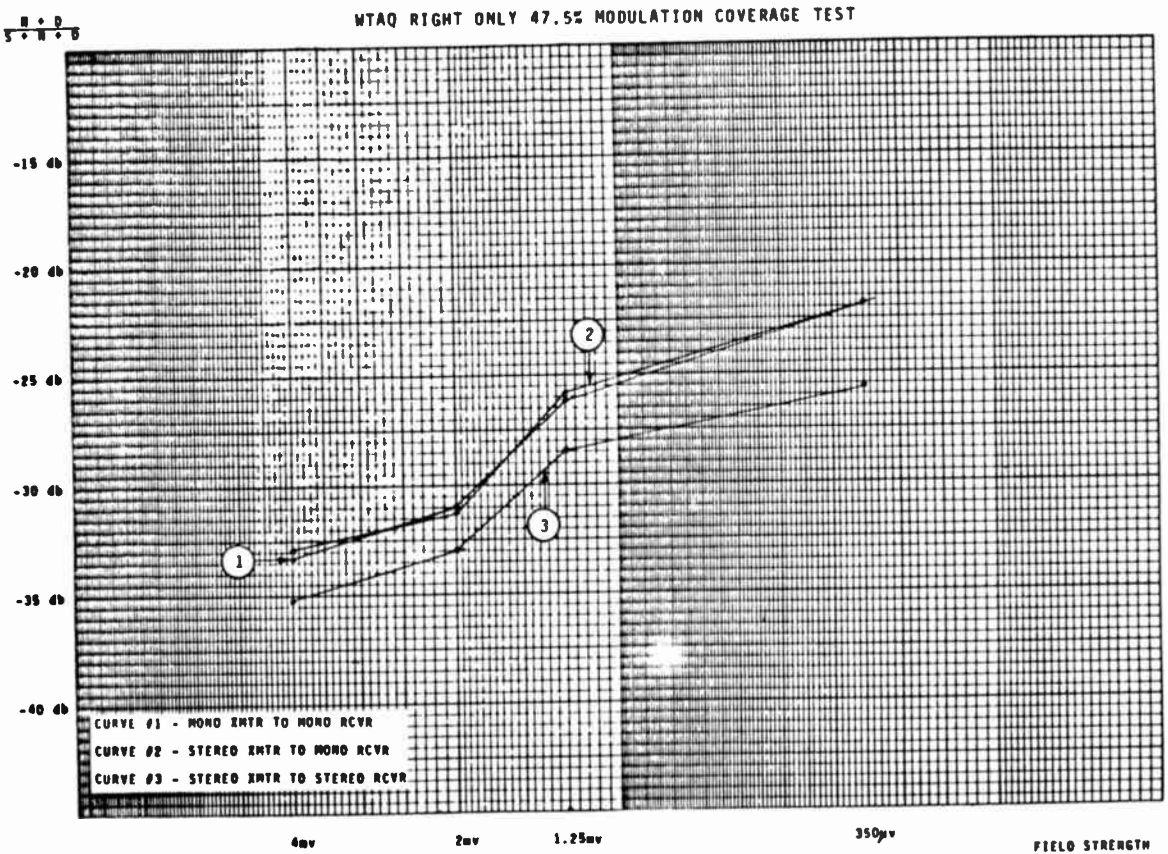
From the FNPR Comments of Motorola, Inc.
on AM Stereo, Feb., 1981

FIGURE H-3: WTAQ COVERAGE TESTS

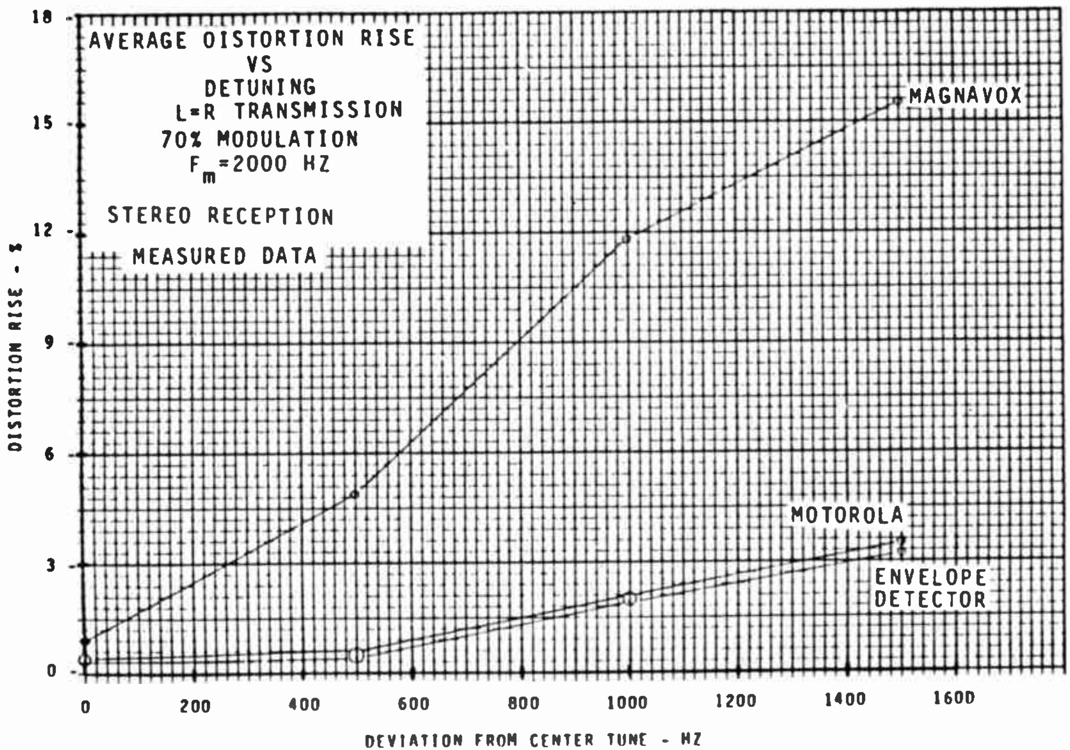


From the FNPR Comments of Motorola, Inc. on AM Stereo, Feb., 1981

FIGURE H-4: WTAQ COVERAGE TESTS

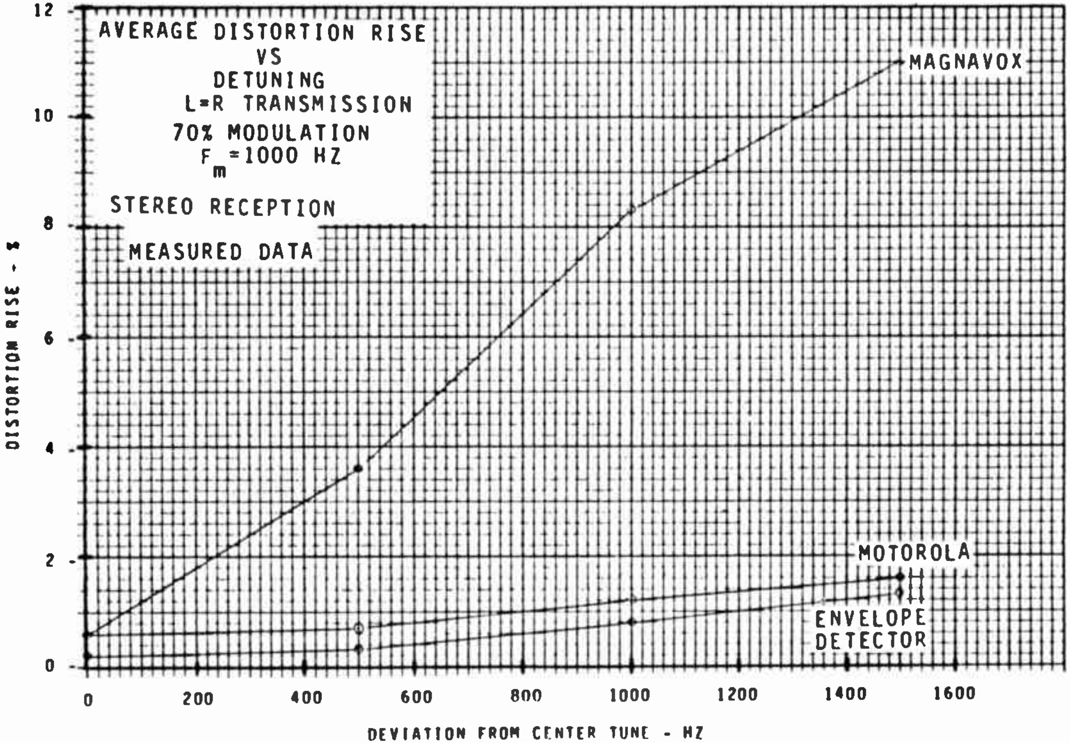


From the FNPR Comments of Motorola, Inc.
on AM Stereo, Feb., 1981



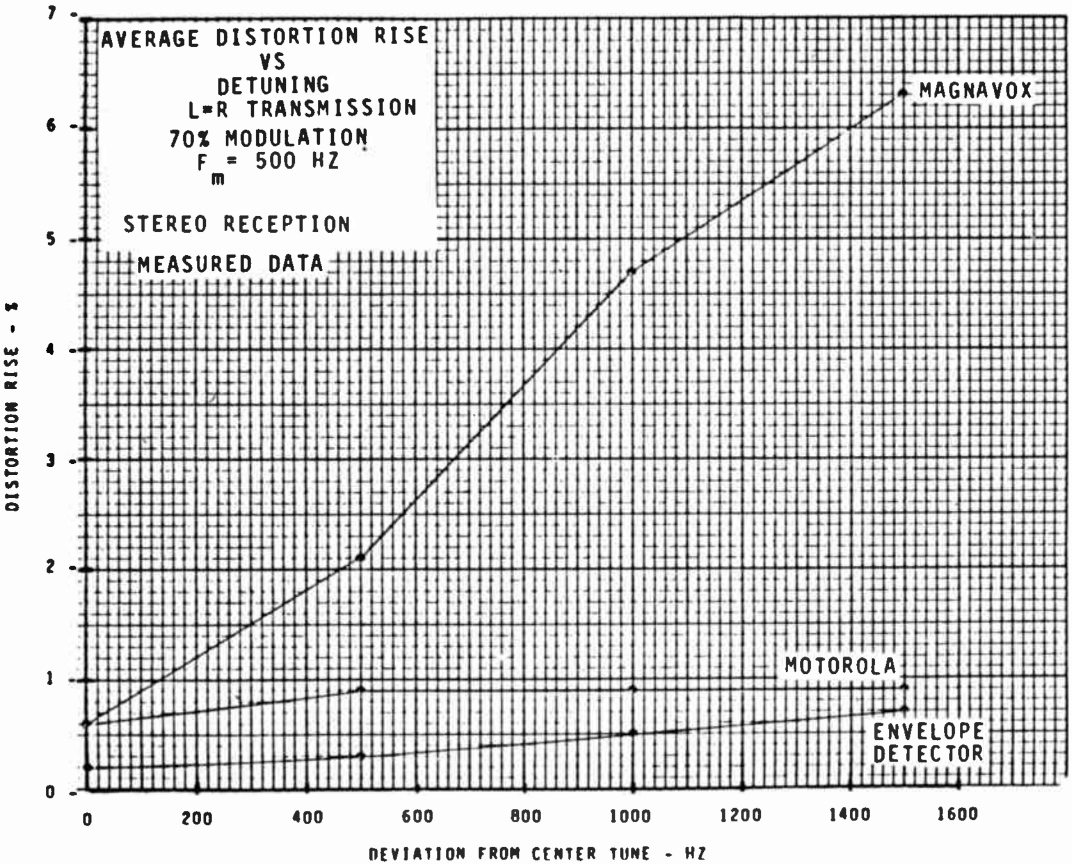
From the FNPR Reply Comments of Motorola, Inc.
on AM Stereo, Mar., 1981

FIGURE I-1



From the FNPR Reply Comments of Motorola, Inc.
on AM Stereo, Mar., 1981

FIGURE I-2

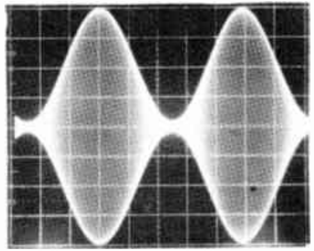


From the FNPR Reply Comments of Motorola, Inc.
on AM Stereo, Mar., 1981

FIGURE I-3

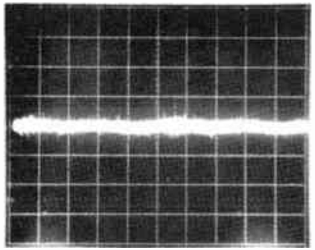
FIGURE J-1: EFFECTS OF NOISE ON DIFFERENCE CHANNEL (L-R) DECODER PERFORMANCE

From the FNPR Comments of Motorola, Inc. on AM Stereo, Feb., 1981

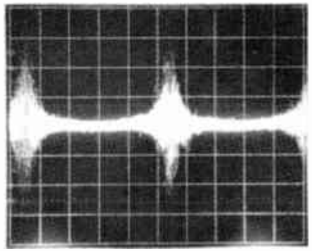


MONAURAL (L-R) SINE WAVE TRANSMISSION

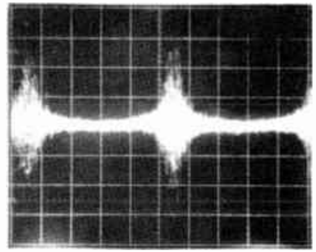
95% MODULATION



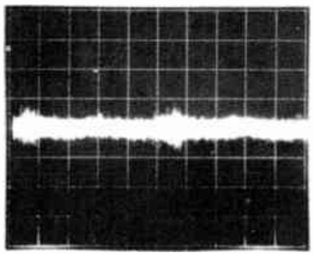
MOTOROLA (L-R) DETECTOR OUTPUT
MONAURAL REFERENCE NOISE LEVEL = -33 db
(100% MOD = FULL SCALE)



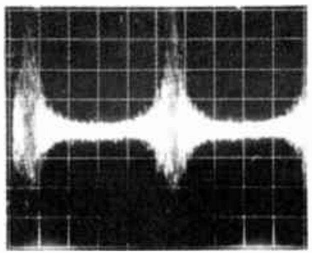
MAGNAVOX (L-R) DETECTOR OUTPUT NO BLANKER
MONAURAL REFERENCE NOISE LEVEL = -33 db
(100% MOD = FULL SCALE)



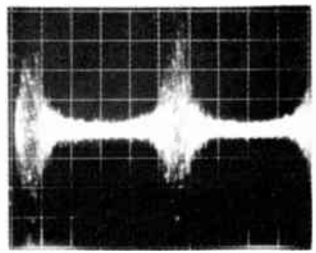
MAGNAVOX (L-R) DETECTOR OUTPUT WITH BLANKER
MONAURAL REFERENCE NOISE LEVEL = -33 db
(100% MOD = FULL SCALE)



MOTOROLA (L-R) DETECTOR OUTPUT
MONAURAL REFERENCE NOISE LEVEL = -27db
(100% MOD = FULL SCALE)



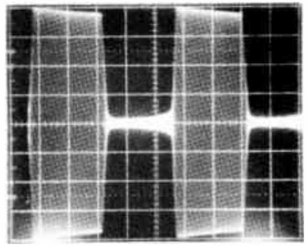
MAGNAVOX (L-R) DETECTOR OUTPUT NO BLANKER
MONAURAL REFERENCE NOISE LEVEL = -27db
(100% MOD = FULL SCALE)



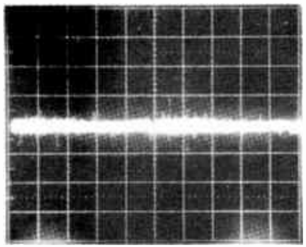
MAGNAVOX (L-R) DETECTOR OUTPUT WITH BLANKER
MONAURAL REFERENCE NOISE LEVEL = -27 db
(100% MOD = FULL SCALE)

FIGURE J-2: EFFECTS OF NOISE ON DIFFERENCE CHANNEL (L-R) DECODER PERFORMANCE

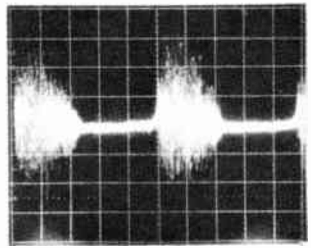
From the FNPR Comments of Motorola, Inc. on AM Stereo, Feb., 1981



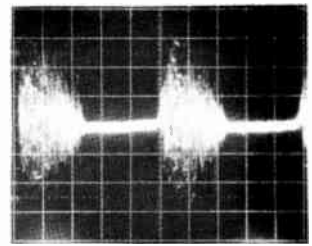
MONAURAL (L=R) SQUARE WAVE TRANSMISSION
95% MODULATION



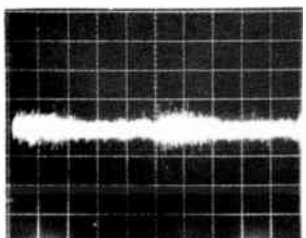
MOTOROLA (L-R) DETECTOR OUTPUT
MONAURAL REFERENCE NOISE LEVEL =-33db
(100% MOD = FULL SCALE)



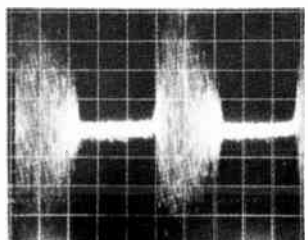
MAGNAVOX (L-R) DETECTOR OUTPUT NO BLANKER
MONAURAL REFERENCE NOISE LEVEL =-33db
(100% MOD = FULL SCALE)



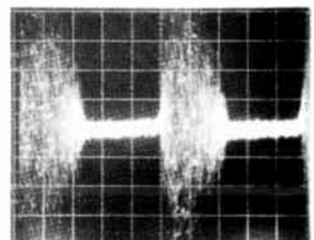
MAGNAVOX (L-R) DETECTOR OUTPUT WITH BLANKER
MONAURAL REFERENCE NOISE LEVEL =-33 db
(100% MOD = FULL SCALE)



MOTOROLA (L-R) DETECTOR OUTPUT
MONAURAL REFERENCE NOISE LEVEL =-27 db
(100% MOD = FULL SCALE)



MAGNAVOX (L-R) DETECTOR OUTPUT NO BLANKER
MONAURAL REFERENCE NOISE LEVEL =-27db
(100% MOD = FULL SCALE)



MAGNAVOX (L-R) DETECTOR OUTPUT WITH BLANKER
MONAURAL REFERENCE NOISE LEVEL =-27 db
(100% MOD = FULL SCALE)

FIGURE K: CO-CHANNEL INTERFERENCE CHARACTERISTICS

MEASUREMENTS VERIFICATION OF INTERFERENCE

INCREASE COMPARED TO MONO SYSTEM INTERFERENCE

Receiver Mode	Interfering Signal	Motorola System Calc.	Motorola System Meas.	Magnavox System Calc.	Magnavox System Meas.
Mono	A	0 db	0db	0db	0db
Stereo	A	2.83	2.5	13.32	14.0
Mono	B	2.47	1.0*	2.70	1.3*
Stereo	B	5.45	4.0	13.90	14.5

* Limited by noise floor.

Modulation is 90% L=R, 400Hz.

DESCRIPTION OF INTERFERING SIGNALS "A" AND "B"

TONES	SIGNAL A	SIGNAL B
#1 - 500 Hz - 35% mod. #2 - 2500 Hz - 25% #3 - 5500 Hz - 15% #4 - 9500 Hz - 10%	All four tones in L+R (monophonic) 85% envelope modulation.	Tones #1, #4 into Left channel; Tones #2, #3 into Right channel, (stereophonic) @ 85% envelope mod.

From the FNPR Reply Comments of Motorola, Inc.
on AM Stereo, Mar., 1981

FIGURE L: ADJACENT CHANNEL INTERFERENCE CHARACTERISTICS

SYSTEMS PERFORMANCE TO ADJACENT CHANNEL INTERFERENCE-
INTERFERENCE INCREASE IN dB OVER MONAURAL REFERENCE

Receiver Mode	Interfering Signal	Motorola		Magnavox	
		Calc.	Meas.	Calc.	Meas.
Mono	A	0 dB	0dB	0dB	0dB
Stereo	A	L=3.40 R=3.40	L=3.5 R=3.5	L=12.3 R=12.3	L=10.0 R=12.0
Mono	B	2.86	1.0*	2.47	1.0*
Stereo	B	L=5.97 R=5.97	L=5.5 R=5.3	L=12.3 R=13.9	L=11.0 R=12.5

Modulation is 95% L=R, 400 Hz.

* Limited by the noise floor.

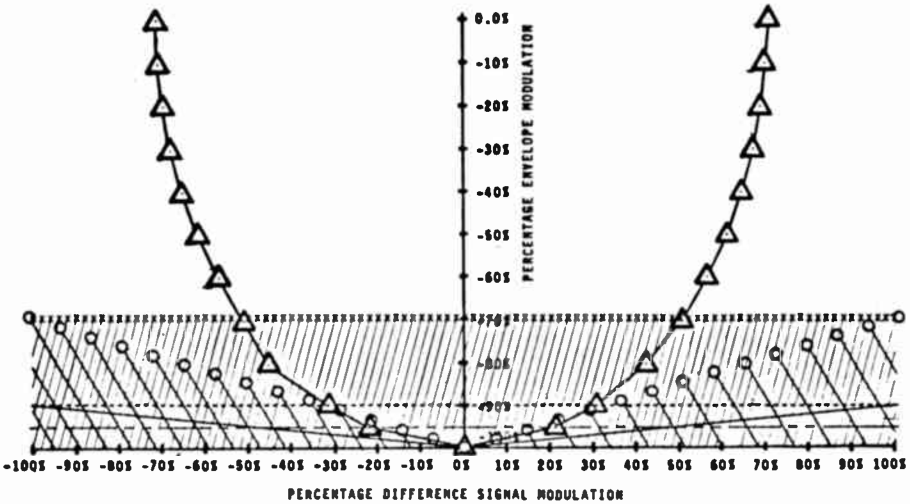
DESCRIPTION OF INTERFERING SIGNALS "A" AND "B"

TONES	SIGNAL A	SIGNAL B
#1 - 500 Hz - 35% mod. #2 - 2500 Hz - 25% #3 - 5500 Hz - 15% #4 - 9500 Hz - 10%	All four tones in L+R (monophonic) 85% envelope modulation.	Tones #1, #4 into Left channel; Tones #2, #3 into Right channel, (stereophonic) @ 85% envelope mod.

From the FNPR Reply Comments of Motorola, Inc.
on AM Stereo, Mar., 1981

FIGURE M

OVERVIEW - NEGATIVE MODULATION PERFORMANCE



LEGEND

- - ——— - - - ——— Magnavox System Modulation Limit

-------------------- Magnavox Blanker Limit

xxxxxxxxxxxxxxxxxxxx Locus of modulation whenever Magnavox deteriorations are significant; deteriorations further increase with negative modulation depth.

———————— Motorola System Modulation Limit

o o o o o o Locus of modulation whenever Motorola deteriorations begin to become significant; deteriorations increase with negative modulation depth.

Δ-Δ-Δ-Δ- Most probable extremes of modulation boundaries.

////////////////// Magnavox "distortion" area and/or sensitive to aberration area.

\ \ \ \ \ Motorola "distortion" area and/or sensitive to aberration area.

From the FNPR Reply Comments of Motorola, Inc. on AM Stereo, Mar., 1981

Figure N. SIGNAL EQUATION AND ADDITIONAL INFORMATION SOURCES.

SIGNAL EQUATION FOR MOTOROLA COMPATIBLE QUADRATURE SYSTEM

$$E_c = A_c(1 + M_s(L(t) + R(t)))\cos\left[\omega_c t + \tan^{-1}\left\{\frac{M_d(L(t) - R(t)) + .04\sin 50\pi t}{1 + M_s(L(t) + R(t))}\right\}\right]$$

where: M_s = index of modulation for sum information
M_d = index of modulation for difference information
$.04\sin 50\pi t$ = 25 Hz. pilot tone.

ADDITIONAL SOURCES OF INFORMATION

1. Petition of Motorola, Inc. for the Institution of Rulemaking Proceedings in the Matter of the Adoption of Technical Standards for Compatible Amplitude Modulation Stereophonic Broadcasting.

2. Comments of Motorola, Inc. on the Notice of Proposed Rulemaking in the Matter of AM Stereo.

3. Comments of Motorola, Inc. on the Further Notice of Proposed Rulemaking in the Matter of AM Stereo.

4. Reply Comments of Motorola, Inc. on the Further Notice of Proposed Rulemaking in the Matter of AM Stereo.

Figure O.

Motorola would be pleased to answer any detailed questions on Compatible Quadrature and provide all detailed information possible on request. Contact the following individuals:

Frank Hilbert (312-576-4889)
Motorola Center
1299 East Algonquin Road
Schaumburg, Illinois 60196

Norm Parker (312-576-5221)
Motorola Center
1303 East Algonquin Road
Schaumburg, Illinois 60196

Any questions on Exciters, Monitors, or the Lease Plan for the Compatible Quadrature AM Stereo System may be directed to:

Richard Harasek, Special Products Manager
Motorola, Inc.
1244½ Remington Road
Schaumburg, Illinois 60195
(312-576-3591)

MOTOROLA INC.