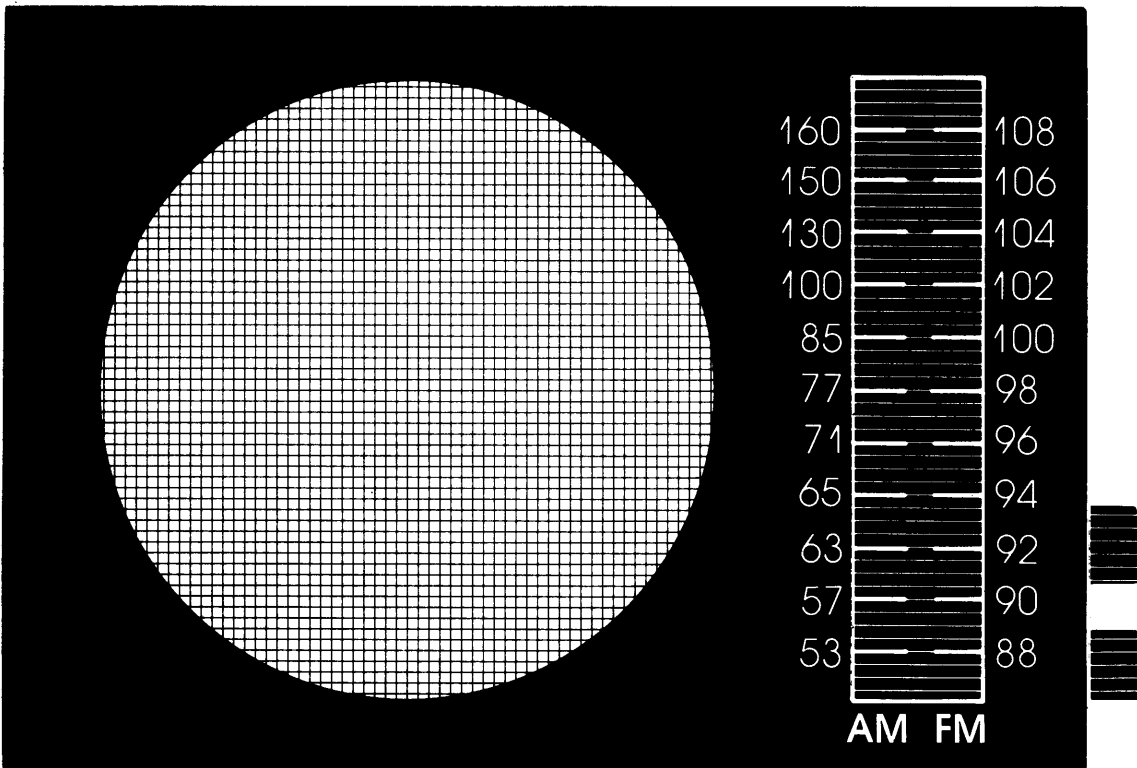


# NRBA AM Stereo Forum



**Belar, Harris, Kahn/Hazeltine,  
Magnavox and Motorola Tell You  
Why They're The One.**

**MAY, 1982**

**NRBA**

**National Radio Broadcasters Association**

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# FOREWORD

The AM Stereo proceeding was one of the longest in the FCC's history and the record one of the most extensive. The final decision to let the marketplace determine which of the five systems should be the AM Stereo standard has renewed the AM Stereo debate and presents AM radio broadcasters with a new set of decisions.

As a service to our members and to the radio broadcasting industry, the National Radio Broadcasters Association has invited all five manufacturers or system proponents to submit statements on the merits of their system for publication in this AM Stereo Forum. Their statements are published here unedited and without opinion. The NRBA expressly takes no position on the relative merits of any system or on the contents of any representation made by any system proponent concerning its own system or that of a competitor. Any comments or follow-up questions should be directed to the individuals listed below.

Our thanks to the system proponents for participating in this forum. We hope that their accompanying statements are educational to those who have been following the public debate concerning AM Stereo.

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# BELAR

## BELAR HAS A NEUTRAL POSITION

Belar's position in the AM Stereo proceedings has been relatively neutral from the very beginning of our involvement. Belar felt AM Stereo was a receiver manufacturer's decision. Belar entered an AM/FM Stereo development program at the unofficial request of RCA three years before the National AM Stereophonic Radio Committee (NAMSRC) was formed. RCA demonstrated this system at three NAB Conventions. Belar also demonstrated this system. These demonstrations sparked a new interest in AM Stereo.

NAMSRC was formed to call for proposed systems, to study these systems, to devise tests, to implement tests, and to submit a record and test data to the FCC. Everyone thought the Commission, armed with this report, could and would select a single system to be adopted.

Proponents came and went. RCA was one that withdrew, for reasons of their own. Two proponents were left--Motorola and Magnavox. Harold Kassens, the chairman of the NAMSRC, gave Belar a call to ask if we would support the AM/FM system in the committee. Harold said the committee could not continue if there were not enough system representation. With full realization that there were no royalties or license fees available as possible rewards, we agreed to represent the AM/FM system. We felt it was a good system and should receive a fair examination.

We cooperated with the committee, provided equipment, participated in the tests, and assisted NAMSRC in every way we could. We even submitted additional data as requested by the Commission in the Notice of Proposed Rulemaking. As history reveals, the Commission did not do what the Congress originally established as the FCC's duty, or what the AM Stereo committee thought it would do. Instead, we have this so-called "marketplace" decision.

## BELAR WANTS TO SEE AM STEREO SUCCEED

We are still neutral--we still feel AM Stereo is a receiver manufacturer's decision. We are building a monitor and measuring device for the Magnavox system. We will build a stereo exciter for this system if need be. We will build the AM/FM system if called upon. We are licensed to build all portions of the Motorola system. Whatever system or systems we build, we will do so to the best of our ability and the system capability. We want to see AM Stereo

succeed and we will do our absolute best to help, no matter which system ultimately survives.

### A RECEIVER OPPORTUNITY

This is a "marketplace" decision. There are currently five systems. There could be more. For example, since this is a receiver ballgame, a receiver manufacturer may not like the AM/FM system because of the corner frequency at 312 Hertz. He may not like the AM/PM system because there is no corner frequency. The receiver manufacturers may feel, by setting the system definition of the corner frequency to 50 Hertz, it may solve some receiver problems, particularly with non synchronous decoders. They may feel setting the deviation to 1 radian may be better. The marketplace decision permits these changes in systems as well as new systems. This is a potentially important option open to receiver manufacturers, or others wishing to support a system.

### YOU--THE BROADCASTER

Belar is neutral. Belar will do everything in its power to help AM Stereo succeed. Belar will listen to the industry. You, the broadcaster, must also do your part, and proceed with thought and care, with your assistance in the selection of the best system.

# HARRIS

## HARRIS' FIVE POINT PLAN FOR AM STEREO

After a long gestation period, AM broadcasters can now start transmitting in stereo just like their FM counterparts. The "marketplace" decision handed down by the FCC, however, has confused some broadcasters and receiver manufacturers as to which AM stereo system to select. Recognizing the dilemma the "marketplace" decision has created, Harris has placed into effect a comprehensive five point plan for system adoption that maximizes benefits while minimizing risks to both broadcasters and receiver manufacturers. It is the only proponent to address the full range of concerns of the "marketplace".

### WHY AM STEREO?

Now that two channel sound is available to AM broadcasters, stations are asking themselves why should we go stereo? Five years ago when the AM stereo approval cycle started, AM broadcasters recognized that FM stations would soon surpass them in listening ratings. The underlying reasons attributed to FM's gain in listener popularity were its high fidelity and stereo sound. Surrounded by other high fidelity, stereo mediums such as records and tapes, today's quality-conscious radio listeners have increasingly switched to FM if offered the same format.

AM broadcasters continue to lose listeners and advertising revenue due to FM. Consequently, the profitability and market value of many AM stations have declined. Thus, AM broadcasters urged the FCC five years ago to approve a high quality AM stereo broadcasting system to enable them to compete more effectively with the FM stereo counterparts.

In response to AM broadcasters' needs, the FCC started the AM stereo approval cycle. Four proponents each submitted different AM stereo systems for approval. At that time Harris Corporation, the leading AM transmitter manufacturer, worked closely with the various AM stereo evaluation groups and committees. During this period, Harris recognized that the four "non-linear" systems then proposed all had severe technical limitations that prohibited the achievement of the original goal of a high quality AM stereo broadcast system.

Harris, with sixty years of dedication to broadcast technical excellence, pooled its engineering resources and developed the Harris Linear AM Stereo System that meets the original goals of a high quality AM stereo broadcast system. Broadcasters, receiver manufacturers and the FCC (in Appendix E of its final Report and Order on AM Stereo) in-

creasingly recognized that the Harris Linear AM Stereo System is the only system that meets the high quality AM stereo goal.

Briefly, only the Harris Linear AM Stereo System offers these superior technical advantages to both broadcasters and receiver manufacturers.

#### OCCUPIED BANDWIDTH

The Harris Linear AM Stereo System is the only system that occupies the same bandwidth as current mono signals, minimizing station antenna problems, with no compromises in audio response or modulation level.

#### BEST COVERAGE

The Harris Linear AM Stereo System provides the best stereo coverage while not affecting mono coverage. The non-linear systems compromise coverage as supported by a thorough analysis during the AM Stereo proceedings at the FCC.

#### MAINTAIN PRE-EMPHASIZED AUDIO

Because the Harris Linear AM Stereo System has the same bandwidth as mono there is no degradation of signal when pre-emphasized audio is used. Non-linear systems transmit pre-distorted sidebands that cause compatibility problems, especially when pre-emphasis is used.

#### COMPATIBLE WITH SYNCHRONOUS DETECTORS

Since the Harris AM Stereo system is truly a linear system, it is the only system that is ideally suited to synchronous detector receivers. Synchronous detector receivers dramatically improve local and skywave reception and are the real key to high quality AM stereo reception in the future.

These technical features alone make the Harris Linear AM Stereo System the clear system choice. In fact, the FCC shares this opinion in Appendix E of the Commission's Final Report and Order on AM Stereo.

#### HARRIS' FIVE POINT PLAN FOR AM STEREO

The Harris Five Point Plan was developed to address the full range of needs of the broadcaster, the receiver manufacturers and, ultimately, the consumer.

## HARRIS' PLAN

1. Quickly deliver type-accepted Harris Linear AM Stereo Systems to the broadcaster beginning July, 1982
2. Provide installation, antenna system check-out and proof of performance test on Harris Linear AM Stereo Systems at a nominal fee.
3. Assist broadcasters in obtaining Harris AM stereo equipment by offering the following purchase plans:
  - a) Direct purchase.
  - b) Long term low monthly (60 month) lease plan.
  - c) Conditional sale plan featuring \$4500 fee for first twelve (12) months of operation, followed by \$416 monthly payments for next eighteen (18) months. You can cancel with no penalty after twelve (12) months or own equipment after thirty (30) months.
4. Harris Semiconductor to complete development of a single synchronous detector integrated circuit chip at a competitive price.
5. Make available to all radio receiver manufacturers the circuit design for a Harris Linear AM Stereo adaptor and instructions on how to modify current AM Mono, FM Stereo receivers to receive AM Stereo.

Clearly, only Harris has the leading AM stereo system, and the comprehensive five point system adoption plan that offers maximum benefit with minimum risk to broadcasters and receiver manufacturers. This is why Harris currently has more AM stereo orders than any other system proponent.

Follow the lead of major AM broadcasters in New York, Chicago, Los Angeles and 15 other cities in the top 25 markets that have chosen the Harris Linear AM Stereo System. Join with broadcasters such as Cox, Westinghouse, Jefferson Pilot, Taft, Metromedia, WGN Radio and many other progressive groups and stations who have decided to go on-the-air with the Harris Linear AM Stereo System.

Harris has the best AM stereo system and the comprehensive five point system adoption plan that will make high quality AM stereo a reality and enable the AM broadcasters' goals to be achieved.

# KAHN / HAZELTINE

Many AM broadcasters view the recent "marketplace" decision by the FCC with mixed emotions. They are uneasy with the responsibility for selecting an AM Stereo system, even though their attorneys agree with Chairman Fowler's conclusion that if the FCC imposed an AM Stereo standard, the matter would end up in a lengthy court review, and if the court found one reversible error in the huge record, the FCC would have to start all over again. By that time AM radio would be so weak that there would be little interest in refurbishing the system. This left the Commission with only one method for saving AM Stereo, the "marketplace".

Among the proponents, only those supporting our system favored the "marketplace". We were convinced that the court route would have dealt a death sentence to AM Stereo. We also believed that in view of the years of analysis and actual on-the-air tests (20,000 hours in the U.S., Mexico, and Canada, on 15 major stations) that the "marketplace" would quickly select a single system, our system. Apparently, all of our competitors recognized that they could not win in such a competition because they violently opposed allowing normal free enterprise to function.

Now, rather than spending your time telling why we believe our system is best, and why so many of the leading broadcasters and engineers favor the system, (a poll of the IEEE selected the Kahn/Hazeltine system and even Harris's own poll showed us leading by 2/1), we wish to quote from the official engineering reports of broadcasters and receiver manufacturers who actually tested the Kahn/Hazeltine system.

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## ADJACENT CHANNEL SENSITIVITY AND SKY WAVE PERFORMANCE

RKO-----"...a stereo reception during adjacent channel interference conditions were superior to monaural reception."

MEREDITH-"It is apparent the only AM stereo system capable of long-distance sky wave reception...is the Kahn/Hazeltine system."

## COVERAGE RELATION TO MONAURAL

RKO-----"...no decrease was noted in monaural coverage area."

ABC-----"The WABC Report did not find any evidence of coverage losses..."

MEREDITH-"During stereo broadcasting at KCMD and WOW, the Kahn/Hazeltine system was capable of the same full modulation level as was utilized during their normal mono mode of operation. A duplication of the existing audio processing equipment was all that was necessary for the conversion to the stereo mode of broadcasting. No special processing equipment was required to maintain the 'sound' of the station, whether listening in mono or stereo."



## STEREO TO STEREO PERFORMANCE

WESTINGHOUSE--"Full stereo reception with good separation was observed with signal levels down to 0.23 mv/m. which was as far away from the station as time permitted us to go. ...we observed a complete lack of the 'picket fence' effect frequently noted with FM automotive reception."

RKO-----"Skywave Reception. A test location...315 miles from the KFRC transmitter...night time skywave signal between .3 M/V to 1.0 M/V...It was evident that by conducting these A-B tests, that the stereo separation was still being maintained while listening in a remote skywave signal area...In our opinion, stereo coverage using the Kahn/Hazeltine system is 100% of the monaural coverage."

## TRANSMITTER PERFORMANCE

MEREDITH----"Separation figures reach 34 Db and distortion figures exceeded the original mono figures by less than one percent."

(RCA Ampliphase Transmitter).

## RECEIVER OPERATION

ABC-----"One of our skilled auditors reported that the reception of the AM stereo transmissions was of excellent quality and that the Kahn system produced audible results very nearly equal to that of some FM systems. In addition, the system used at WABC and the AM stereo receiver in use was 'transparent' enough that quality differences between older and newer cartridges was very evident."

SONY-----"When the effect of filters, antennas, and off tuning exists, the separation is degraded the least amount in the Kahn system..."

MOFFAT----"These results indicate that no change in monaural reception is apparent from the tests taken on CHED and CKY. Similarly no significant difference in frequency response, harmonic distortion or signal to noise was found when switching between the mono & stereo mode on the stereo exciter. Channel separation over the audio frequency band of interest was good and met the equipment specifications provided by Kahn Communications, Inc."

## SYNCHRONOUS DEMODULATION

SANSUI----"Sansui believes that only three (Harris, Kahn/Hazeltine, Motorola) of the five proposed systems can take maximum advantage of synchronous detection."

## TWO RECEIVER CAPABILITY

LIN-----"Public response to AM stereo was gratifying. Nearly 100% of the respondents indicated that the two receiver method was satisfactory for receiving stereo and that quality of the signal had not been compromised."

WATERMAN--"A unique and valuable feature of the Kahn/Hazeltine system is that it allows stereo reception utilizing 2 conventional mono receivers."

WESTINGHOUSE--"We found the two receiver approach to work quite well. In fact, Mr. Win Fanning in his column 'On The Air', which appears daily in THE PITTSBURGH POST GAZETTE, wrote on the subject of receiving the KDKA test programming, 'two transistor portables or two table top sets about the same size will work. The transistor setup I used worked splendidly."

RKO-----"...experienced good results utilizing the two receiver method for AM Stereo...good separation was observed utilizing the two receiver method."

#### MONO COMPATIBILITY

WFBR-----"When switching between stereo and mono there was absolutely no detectable difference in the air product which was off air monitored on a conventional AM receiver, amplifier and hi fidelity speaker combination."

WESTINGHOUSE---"...No monophonic receivers experienced any tuning or reception difficulties when the station was transmitting stereo programming. The system was capable of being modulated to the full legal limit with no apparent degradation of performance."

RKO-----"Modulation peaks up to 100% negative and up to 125% positive were easily obtained and caused no degradation of the stereo or mono signals...no decrease was noted in monaural coverage area."

ABC-----"...Operations & Engineering found no evidence of mistuning effects... WABC (on the air for about 2,000 hours) did not receive any public complaints...Accordingly, the system would certainly warrant the maximum of five points..."

SONY-----"Tested all systems. "Under the off-tuning condition, Kahn system exhibits the least deterioration of distortion, and most closely resembles the performance of monophonic reception during mono transmission."

#### INTERFERENCE CHARACTERISTICS

ABC-----"...the Kahn/Hazeltine system involves the smallest trade-off losses between occupied bandwidth and stereo performance and should be rated higher than the other four systems."

MOFFAT-----"...no increase in interference...was noticeable when CKY switched between mono and stereo transmission."

WFBR-----"The Kahn AM Stereo System, as delivered and tested by WFBR, meets all the technical requirements of Section 73.40 of the Commission's rules. It does not produce any detectable spurious emissions. The equipment operated in a stable and predictable manner during the test period. Stereo separation was excellent as transmitted."

PROTECTION RATIO

	<u>System</u>	<u>Average Protec- tion Ratio (db)</u>	<u>FCC's Score in Revised Matrix</u>	<u>Correct Score</u>
MAGNAVOX--2/9/81	Magnavox	32.6	7	7
FCC Comments	Motorola	32.6	10	7
Pg. 111-10	Harris	34.1	8	8
	Belar	25.1	Unknown	1
	Kahn	35.5	10	10

In view of the above comments, we believe that the AM broadcasting industry will, in the next few months, select a single system.

On the receiver front, license negotiations are being conducted with a number of car, home and personal receiver manufacturers; including, Radio Shack, McKay Dymek, and the Mura Corporation.

Many of these receiver manufacturers (especially car receiver manufacturers) are considering licensing, in addition to AM Stereo patents, newly issued patents covering means for providing adaptable asymmetrical sideband selectivity. This new form of inexpensive selectivity automatically (and even asymmetrically) adjusts its characteristics to best attenuate higher or lower frequency adjacent channel interference. When the signal is relatively free of interference it provides wideband performance.

Thus, AM broadcasters can, with the introduction of new technology, look forward confidently to the widespread use of not only stereo receivers, but also high fidelity AM receivers.

Finally, I would like to address those broadcasters who intend to take a leadership role in the selection of their industry's new AM Stereo system.

You not only have a serious obligation to your own station but to your industry, the public, and indeed, your own careers. Please, pick your system on the basis of solid engineering and avoid all attempts to make AM Stereo a short term gimmick to "hype" your ratings.

But, indeed, allow stereo to breathe new life into AM radio and convince your listeners and receiver manufacturers that AM does not mean "ancient modulation", but that it is actually the best form of modulation for automobile reception and is a worthy competitor of FM in the home. Not only is the ISB system best for your immediate requirements, but given the opportunity, in the next two decades AM will evolve into the theoretically optimum form of AM modulation--as ABC has pointed out, reduced carrier SSB for monophonic signals--and ISB for stereo.

The Commission has given you control of the future of your industry. It is now up to you.

# MAGNAVOX

## THE "MARKETPLACE" DECISION

Magnavox is ready to cooperate and compete in the "marketplace" selection of an AM Stereophonic Broadcast System. Throughout its participation in the National AM Stereo Radio Committee and the FCC's AM Stereo Broadcasting Docket, Magnavox has cooperated and competed. We will continue to do just that. Magnavox pledges an honest and fair contest as it has in the past, with the intention of bringing all pertinent information about its system to the attention of the marketplace.

Now, one might ask, who or what is the "marketplace"? As we see it, the "marketplace" that must decide on AM Stereo is made up of broadcasters, broadcast equipment manufacturers, receiver manufacturers, and integrated circuit manufacturers. The general public will not be included. There is no mechanism to do so. On the other hand, receiver manufacturers have unanimously taken the position that they will not build multi-system receivers. On the other hand, it is unlikely that listeners will buy multiple receivers so that they can compare two or more different AM Stereo systems. Therefore, the general public will have no means of participating in the "marketplace" decision.

The marketplace decision activity must take place in the broadcast industry and the consumer electronics industry. Except for occasional criticisms, these two industries have ignored each other for a long time. Now they must cooperate if AM stereo is to become a reality.

Generally speaking, broadcast hardware for all of the proposed AM stereo systems is about the same in purchase cost and installation difficulty. The limitations in system performance will depend primarily on receiver design and technology. For all of the proposed systems, it is the stereo receiver that is the hard part of AM stereo; not the broadcasting equipment. The "marketplace", therefore, must evaluate receiver performance in choosing an AM stereo system and not concentrate solely on the performance of the stereo exciter and the broadcast transmitter.

The performance of the broadcast equipment alone does not attract listeners or sell air time. The transmitter and stereo exciter are merely a portion of the overall broadcast system necessary to make programming available to the ears of listeners. Good receiver performance priced to allow broad public listening is indispensable to the success of AM stereo. For this reason, we suggest that broadcasters be very cautious in their evaluation of AM stereo systems when using one-of-a-kind laboratory-tweaked receivers provided by system proponents.

## MAGNAVOX SYSTEM DESCRIPTION

The left (L) and right (R) stereo signals are matrixed to provide an (L - R) signal, also called the stereo channel signal, and an (L + R) signal, which may be called the monaural signal. The low frequency pilot tone frequency modulates the r.f. carrier slowly about the assigned center frequency with a deviation somewhat less than 20 Hertz. To this signal the stereo or (L - R) program content is added by a technique of angular modulation called linear phase modulation with a peak deviation of one radian. The signal is then varied in amplitude with the (L + R) or monaural program content to produce the signal that is transmitted from the station antenna.

The reverse process occurs in a consumer AM stereo receiver where the amplitude variations are detected to produce the L+R or monaural program content and a phase detector recovers the L-R or stereophonic program content. These two signals are matrixed together to reproduce the original left (L) and right (R) audio channels. The pilot tone is also detected and used to control the mono/stereo mode of the AM stereo receiver. In a monaural AM receiver only the amplitude variations will be detected to produce the L+R or monaural program content of a stereo broadcast in the same manner that a monaural broadcast is received.

Pilot tone is very important to AM Stereo, not merely because it controls a little red light, but because it controls the switching of the receiver mono/stereo mode. The pilot tone detection circuit in the receiver must insure that the receiver does not switch into the stereo mode when the receiver is tuned to a monaural station. Some monaural stations have an undesirable sound if received in the stereo mode because of transmitter incidental phase modulation (IPM). The transmitters of AM stations that broadcast in stereo will be corrected to eliminate IPM, but in all probability stations that remain monaural will not be similarly upgraded. Therefore, if the pilot tone detection circuit fails to do its job properly and false trips, placing the receiver in the stereophonic mode while tuned to a monaural station, the listener could be exposed to a relatively unpleasant sound. This phenomenon is not unique to the Magnavox system. All of the proposed AM stereo systems utilize some form of angular modulation, and therefore are adversely affected by IPM. It is also undesirable for the stereo receiver to switch back to the monaural mode when receiving a stereophonic program. This would annoy the listener and probably cause him to tune to a different station. Therefore, a strong pilot tone, reliably detectable by circuitry immune to false tripping, is absolutely essential to consumer acceptance of any AM stereo system. Of all the proposed systems, the Magnavox system has the strongest and most reliably detectable pilot tone.

## MAGNAVOX SYSTEM PERFORMANCE

Modulation Capability. No AM stereo system compatible with existing monaural receivers can transmit stereo program material that is left only or right only and simultaneously achieve -100% envelope modulation.

Indeed, other proposed systems have significantly reduced modulation limits for left only or right only signals. Harris has set a limit of  $\pm 80\%$ . Motorola has set a limit of  $-90\%$ . Magnavox has set a limit of  $-95\%$ , as has Belar. Kahn has not specifically stated a modulation limit for left only or right only, but the proposed rules published by the FCC for the Kahn system suggests a  $-50\%$  limitation. To minimize the significance of these limitations, some proponents claim that high level left only and right only signals will not occur in program material. To the contrary, Magnavox submits that there are a good many stereo program sources available now, such as the various easy listening formats, that exhibit very high stereophonic content. The system selected should be capable of handling such material with full modulation. We believe that it will be difficult to selectively limit the peak modulations differently for left only, right only, and center channel program content in many AM stereo transmitters. Although other proponents are suggesting that this control will be possible and achievable for their systems, it remains to be seen whether broadcast stations will be able to transmit with  $-100\%$  peaks during center channel material, successfully support monaural loudness, and also control the negative peak modulations to lower levels during highly stereophonic program material. The Magnavox system provides the simplest and most convenient control of this parameter.

Coverage. The monaural coverage of a station broadcasting a Magnavox AM stereo signal will be substantially the same as for present day monaural broadcasts. The  $-95\%$  envelope modulation limitation suggested by Magnavox is such a small reduction from  $-100\%$  that a test tone metering circuit will indicate less than  $0.1$  dB drop compared to  $-100\%$  modulation. The positive limit of  $+125\%$  remains unchanged. Such a drop is almost too small to read on a meter and is totally undiscernible to a listener. As noted above, the receiver is the hard part of AM stereo. Any modulation restrictions will depend on the design and performance of AM stereo receivers; and any of the compared systems could end up being restricted in some way by receiver design and performance. Magnavox and other receiver manufacturers have designed and built receivers that operate satisfactorily with  $-100\%$  envelope modulation peaks. However, until such time as it may be determined that all receivers will be so designed, we believe that the  $-95\%$  limit should be retained to permit greater flexibility in receiver design.

Loudness. We think that broadcast stations should give attention to supporting monaural loudness during stereo broadcasting. This, of course, will have an effect on the type of audio processing used. For example, if a station were to utilize FM stereo audio processing techniques for an AM stereo broadcast, then a highly stereophonic program selection would envelope modulate the transmitter at only  $50\%$ . This represents one-quarter of the available monaural broadcast power. Although this situation must occur for FM stereo broadcasting, it need not occur for AM stereo broadcasting. The Magnavox AM stereo system is capable of transmitting full recommended envelope modulation for any program material whether it be left only, right only, or center channel. This capability permits the broadcaster, using proper audio processing, to maintain the same monaural loudness for his monaural listeners during stereo broadcasting that they enjoy during monaural broadcasting. Monaural loudness support will also enhance the audio level of material in a stereophonic receiver. For high left or right program material this enhancement can reach as much as  $3$  dB above the center channel value, an effective doubling of transmitted power.

## EQUIPMENT MANUFACTURERS

Many sources of equipment must be available to meet the needs of AM Stereo. One source for stereo exciters, one source for receivers, or even one source for IC decoders could not possibly provide an adequate range of features, quality, performance or price, to say nothing of the sheer quality of equipment that will be required. Magnavox, accordingly, has consistently shared information regarding its AM Stereo system with other receiver manufacturers, IC manufacturers and broadcast equipment manufacturers.

Broadcast Equipment. Magnavox has arranged for Continental Electronic Manufacturing Co. to produce an exciter for the Magnavox AM Stereo system. Type approval for this exciter is expected soon. Continental has forecast exciter availability in four to six months with a price of about \$6050. Broadcasters are invited to contact their normal supply sources for this exciter. Similarly, Belar Electronics Lab Inc. has a monitor available for the Magnavox AM Stereo system. The monitor availability is also expected to be four to six months, and Belar has indicated a price level of about \$3000. This monitor will also be available through the normal broadcast supply sources.

Magnavox has chosen not to enter the broadcast equipment field but rather to support the normal broadcast supply channels that stations currently use. We anticipate that other sources of exciters and monitors will be available in the near future. Magnavox has and will continue to work with all interested parties with regard to exciters and monitors for its AM stereo systems. We have published detailed schematics of monitors and exciters as part of our FCC filings. That information is readily available in the public record and may be used royalty-free by broadcasters and broadcast equipment manufacturers.

Receivers. Many receiver manufacturers are ready for the Magnavox AM stereo system. Perhaps the best demonstration of this was at the recent NAB in Dallas, Texas. The Magnavox presentation at that show featured several receivers made by other companies. Pioneer showed an automobile receiver that utilized the National Semiconductor LM1981 AM stereo decoder. This receiver also featured a switch to permit the listener to select between normal and high fidelity AM bandwidth. Ford Motor Co. made available a receiver which utilized standard off-the-shelf components to detect the Magnavox AM stereo signal. Chrysler Corp. demonstrated a receiver that incorporated the National Semiconductor LM1981 AM stereo decoder. Panasonic made available an automotive receiver and a portable receiver. The auto receiver utilized a custom integrated circuit designed and built by Panasonic for detecting the Magnavox system signal. A receiver was also available that demonstrated existing circuit detection technology from Signetics and Valvo. This circuitry was installed in a Delco automotive receiver.

In every case, the receivers were built and converted to the Magnavox AM stereo system by third parties independently of Magnavox. The demo of the above receivers is particularly significant in that it shows that the Magnavox system is well understood by receiver manufacturers and that they are capable of making it work.

To the best of our knowledge, no other AM stereo proponent has demonstrated receivers converted by other parties who are currently involved in the manufacture and marketing of consumer radio products. We value very highly the efforts of these manufacturers because they are uniquely knowledgeable of the consumer's perception of feature value and willingness to pay for it. We cannot over-emphasize the fact that the success of AM stereo is dependent upon the existence of commercially acceptable AM stereo broadcast signals and the availability of a wide range of "mass market" priced receivers for these signals.

Integrated Circuits. IC manufacturers are also ready for the Magnavox AM Stereo system. Many IC manufacturers have actual hardware available for detecting the Magnavox AM Stereo system and not just promises of some future integrated circuit development that may occur. The integrated circuit manufacturers who have detectors available for the Magnavox system are major suppliers of consumer electronic integrated circuits and are geared to understand and produce high volume electronics. They are familiar with receiver manufacturers' needs and business methods and will be able to rapidly supply the necessary circuitry for integration of the Magnavox AM Stereo system into consumer electronics. Magnavox had the cooperation of many of the IC manufacturers during the NAB Convention, where we had the pleasure of showing circuitry and chips from National Semiconductor, Panasonic, Toshiba, Sanyo and Signetics/Valvo.

#### MAGNAVOX SYSTEM EVALUATION

The Magnavox system has been rated number one in the matrices published by the FCC. This includes both the initial decision matrix for the first FCC decision on AM stereo in 1980, and the final matrix published in the FCC Report & Order in 1982. These U.S. government evaluations support our claim on the superior performance of the Magnavox AM stereo system. This performance is the result of the total system which provides system ease of signal generation at the transmitter and implementation of detection mechanisms at the receiver. Overall performance is critical because from the outset AM stereo must compete with a mature 20 year old FM stereo service.

In summary, as demonstrated in actual over-the-air tests, as evidenced by the FCC matrix evaluations, and as confirmed by the performance by products designed and built by several receiver manufacturers and IC manufacturers, the Magnavox AM stereo system has competed successfully, and will compete successfully--in the marketplace against the other proposed systems--and on the air for a share of the FM stereo listening audience.



# MOTOROLA

## MOTOROLA'S COMPATIBLE AM STEREO BROADCASTING SYSTEM

The Motorola compatible quadrature AM stereo system is based on the transmission of two independent signals whose effective carrier signals are arranged in quadrature. The method of quadrature transmission is the only one which provides complete independence of two AM signals using double sideband transmission.

This is the same technique used for the transmission of the two color difference signals in color television.

The problem with quadrature modulation in AM stereo transmission is that the envelope of the resulting signal contains a significant amount of distortion when received by an envelope detector or, stated another way, the envelope of a quadrature modulated stereo transmission is not compatible with existing monophonic receivers.

A solution to this problem proved elusive for nearly 20 years, resulting in the development of several compromise stereo systems designed to be compatible but lacking some or all of the desirable characteristics of quadrature modulation. In 1975, Motorola discovered a way to solve the problem of providing a compatible quadrature method of stereo-ponic transmission.

The Motorola system was tested extensively in the NAMSRC tests and on numerous transmitters since that time. The results have been extraordinarily successful, resulting in superior stereo performance, with relatively simple transmitters and receivers. These tests were supported by the computer simulation of the system as well.

The following review of the characteristics of the Motorola system provides an indication of why its performance has been superior.

### FULL MODULATION CAPABILITY

Motorola's system has the proven capability for modulation from -100% to +125%. Therefore, no change in modulation limits is required, and transmitter radiated power is most efficiently used.

### FULL MONOPHONIC COVERAGE

Extensive field measurements and computer calculations have shown the coverage of the Motorola C-QUAM system to be essentially the same as for a monophonic transmitter of equal power, fully modulated.

Many of the field tests were conducted using the WTAQ transmitter, and intended to fulfill the requirements of the Further Notice of Proposed Rulemaking.

Motorola was the only proponent to respond to the Commission's request for coverage measurements and calculations in the Further Notice of Proposed Rulemaking. Motorola measured signal-to-noise ratios on the WTAQ transmitter at signal levels from 350 uv to 4 mv. The protection contour limits of WTAQ are 4 mv in the nighttime pattern and thus the measurements made were more than 20 db below the signal levels within the protected contour of the station. These measurements indicated that the signal-to-noise ratios obtained when left or right signals were transmitted were better than the signal-to-noise ratios obtained at the same point with monophonic transmission.

The large body of measurements on the Motorola system provides ample evidence that essentially no coverage loss is to be expected when operating in stereo.

#### FULL FREQUENCY RESPONSE

The Motorola system added no limitations to the frequency response of any transmitter, thus there is no degradation of quality in the broadcast signal. When the stereophonic dimension is added, the result is a significant benefit to the listener of "quality" broadcasting. The Motorola system is one of only two systems that do not require in their signal specifications a filter for the left or right signals or for the stereophonic signal content which limits the frequency response of the transmitted signal.

#### NO UNDESIRABLE SIDE EFFECTS IN STEREO

The Motorola quadrature system of modulation provides independence of the L + R and L - R information. This characteristic prevents loss of signal-to-noise ratio in the L - R channel when modulation of the L + R channel occurs. Systems where independence between the two signals does not exist are often subject to what has been characterized as "clicks and pops" on heavy negative modulation swings. This effect causes some systems to require a minimum level of carrier to be always present at the receiver by limiting the allowable negative modulation to less than 100% at the transmitter.

#### OPTIMUM PILOT TONE

The frequency (25 Hz) of the Motorola pilot tone is the optimum frequency to use for a pilot tone since it is above the frequencies of possible co-channel interference and sidebands produced by modulation induced carrier shifts, yet below the audio modulation frequencies. This pilot tone can easily be detected, providing the "stereo station" indication and stereophonic switching desired by receiver manufacturers and users.

## SIMPLICITY OF TRANSMITTER DESIGN

Encoding of the Motorola AM Stereo signal is quite simple since it is a straightforward quadrature signal modulated by the cosine of its relative phase angle information. The amplitude of envelope modulation is, therefore,  $1 + L + R$  the monophonic signal. The existing RF oscillator of the transmitter is replaced by a reference signal having the angular modulation of a quadrature signal. Any suitable method of producing sum ( $L + R$ ) and difference ( $L - R$ ) signals may be used.

## SIMPLICITY AND FLEXIBILITY IN RECEIVER DESIGN

In view of Motorola's straightforward solution to the problem of combining a compatible monophonic signal with a high quality stereophonic signal, receiver designs have a minimum of complexity. This means two things for the receiver manufacturer, low cost (probably the lowest added cost of any system) and flexibility of design. For example, the  $L + R$  information may be obtained by simple envelope detection or by a synchronous detector using a cosine correction factor. Receivers may also include a phase locked loop or may use other non-synchronous decoders.

## MOTOROLA'S OFFER TO BROADCASTERS

Motorola was the first AM Stereo proponent to recognize the financial risk for broadcasters in the "marketplace" situation. In order to minimize that risk, Motorola proposed its "leasing" plan which other companies have been quick to copy. Under the Motorola plan, a broadcaster can lease the necessary equipment for a year at a modest cost, then can either return it or arrange to purchase it by reasonable monthly payments.

## SUMMARY

In view of the above remarks, and the extensive and exacting measurements supplied by Motorola to the FCC, it is apparent that the Motorola AM Stereo system will provide maximum advantages for broadcasters, receiver manufacturers and the general public.