FACTS ABOUT

FM AND FM STEREO RADIO PERFORMANCE

IN AUTOMOBILES

Published 1972 by MERCEDES-BENZ OF NORTH AMERICA, INC.

service

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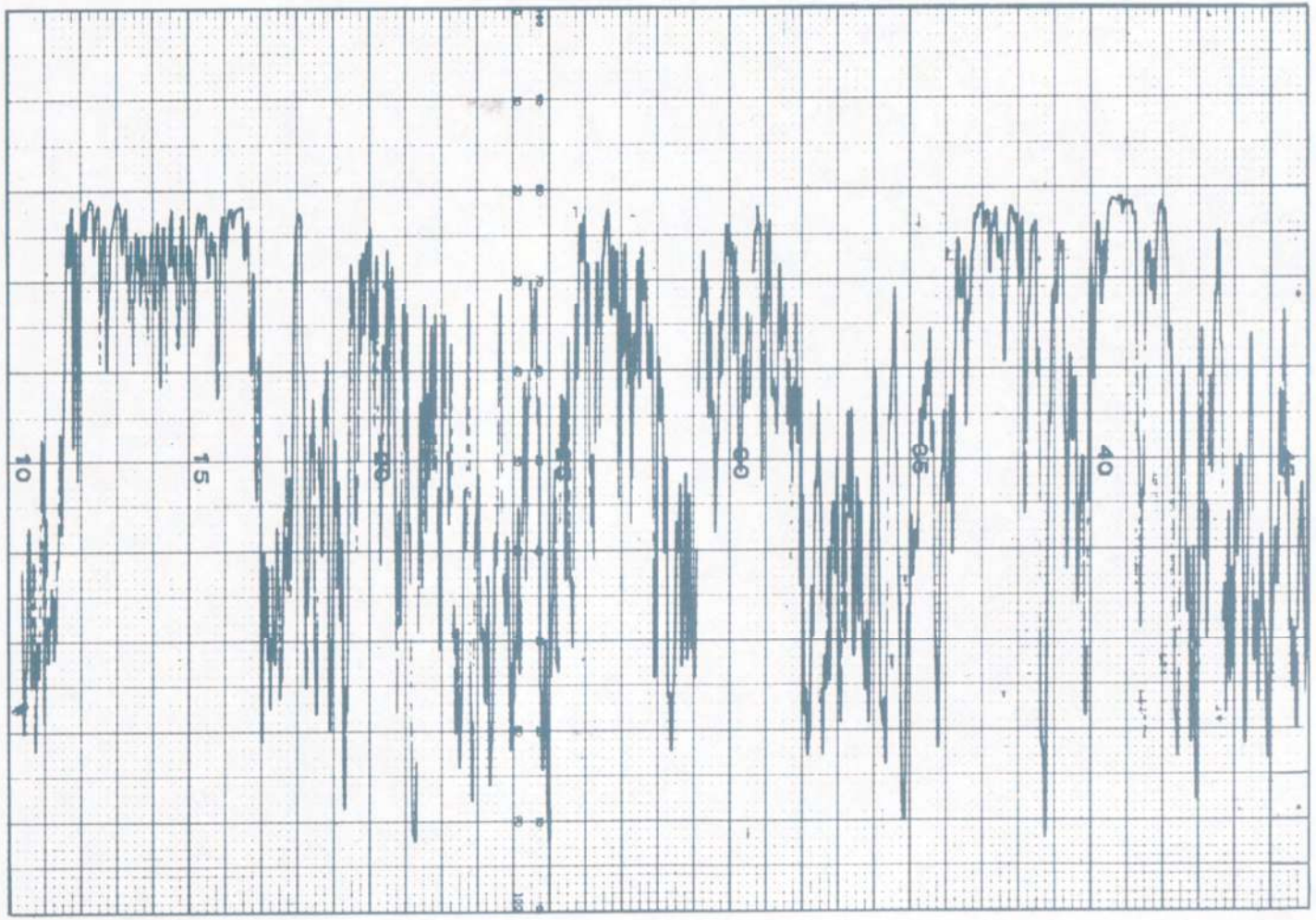
Introduction

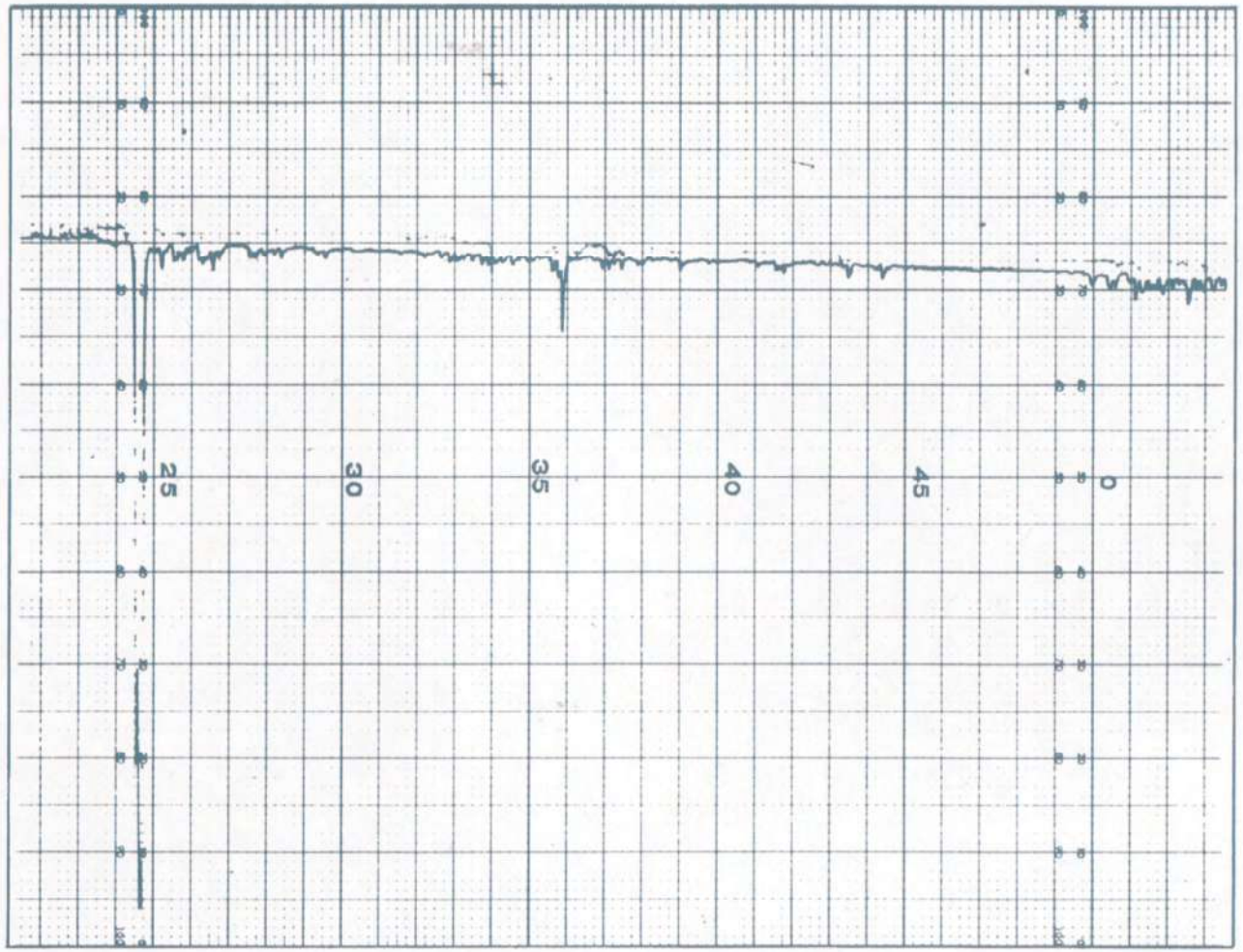
In April 1970, stereo radios were made available in Mercedes-Benz automobiles. Since that time, complaints have occasionally been made regarding the performance of these radios. In most cases, these complaints were actually based on a misunderstanding of stereo-radios and their performance capabilities, a misconception arising from a wide range of factors also significant in monaural reception. We have therefore published this pamphlet which summarizes the findings of numerous tests of stereo radio performance in automobiles.



Stereo Reception in a Moving Vehicle

Stereo reception in a moving vehicle is subject to operating conditions totally different from those of a stationary stereo set at home. The greatest difficulty stems from the constantly changing strength of the FM signal received when the car is in motion. In conducting tests on the radio's performance, it was found that extremely widespread signal strength variations are normal in cities. For instance, signal variations between 1 Microvolt (= 1/1000000 of a Volt) and 1 Volt (V) were found within a driving distance of only 2 yards. This means a drop or increase of signal strength of 1 Million times.

The illustration at left is a recording of signal strength over a driving distance of approximately 100 yards made in New York City, and shows the variations resulting chiefly from a constant change of geological conditions with signal reflections and signal "shadows" from buildings and other obstacles (such as windshield wipers). Whenever the signal strength falls below a certain limit, the radio will switch from the stereo to the mono mode which is usually accompanied by a "cracking" noise. Switching back to stereo will produce "cracking" too. Under city driving conditions, such switching can be very frequent.



The signal strength recording shown on the page opposite was made in a New Jersey suburb, and shows flawless, undisturbed signal reception from a strong, local station.

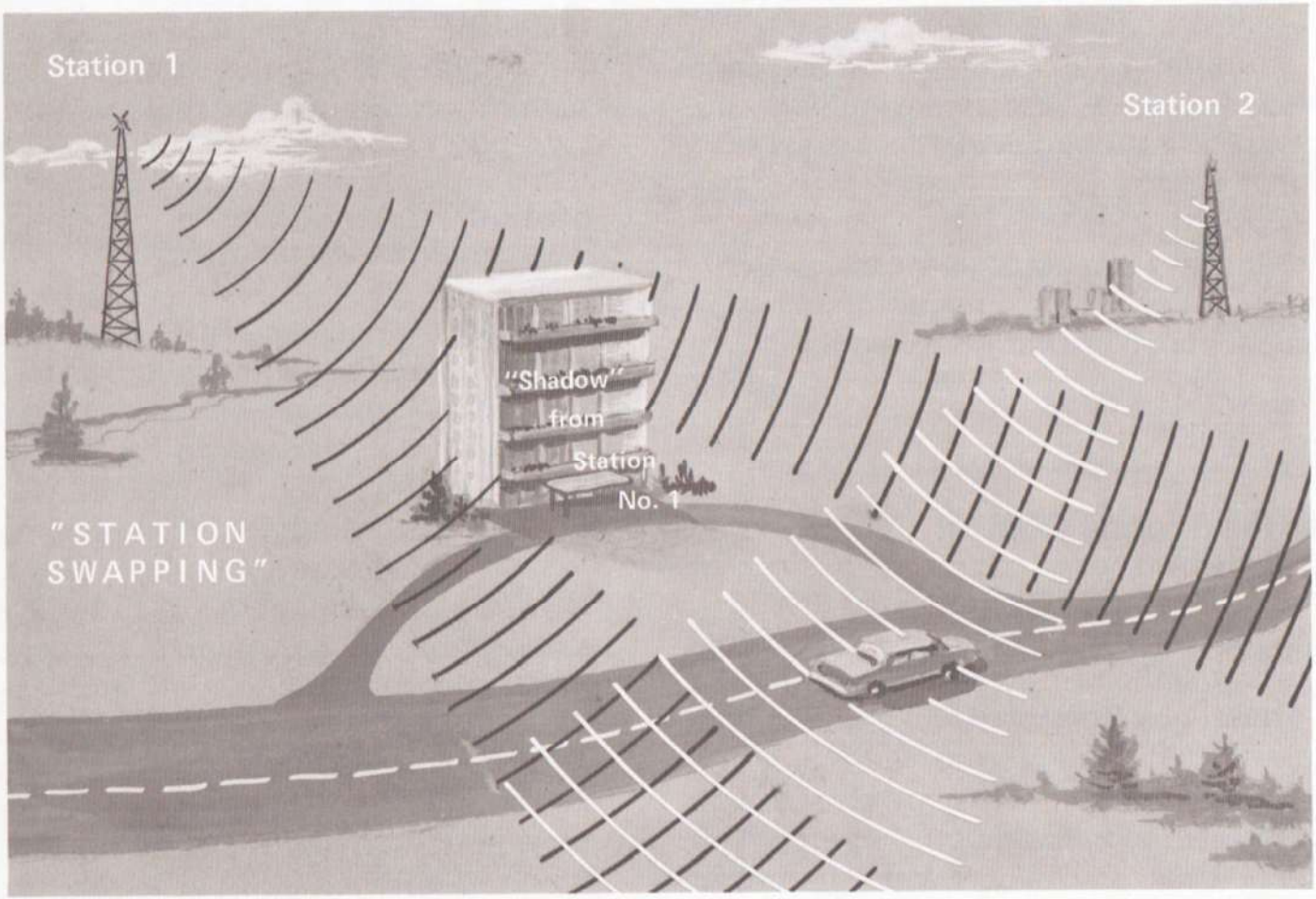
Aside from these basic design characteristics, there are other criteria having major influence on FM or stereo reception in a car which we would like to explain.

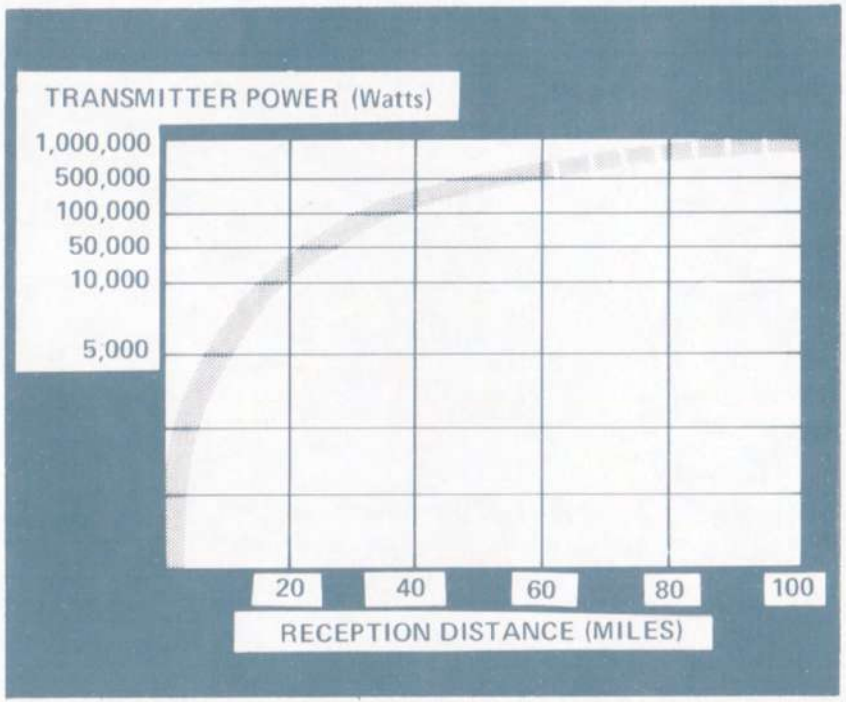
Automatic Frequency Control "Swapping Station"

It is possible that different signals overlap or that the radio "jumps stations". This is caused by the Automatic Frequency Control (AFC) and happens if the station the radio is tuned to, fades out and the AFC "senses" another, more powerful station nearby on the dial (see illustration, Page 6). This happens often when driving through a tunnel or under a bridge. On the other hand, AFC is needed to maintain a strong station in tune, i.e. to prevent the interference or overlapping of strong stations.

Station Transmitting Power-Signal Sensitivity

The range of satisfactory FM reception is greatly dependent upon the transmitting power of the station which, in most cases, is less than 50,000 watts (50 kW). Thus, the radio's level of sensitivity to signals is of primary importance. Generally, the more sensitive a car radio is, the better the reception will be at a greater distance from the station. This is advantageous in suburbs and outlying areas, however, the amount of reception disturbance apparent in cities will increase. FM has a range of approximately 20 to 30 miles from the station before reception noises become apparent; consequently, tuning to other stations is required more frequently than with AM. If the radio is operated in an area of level terrain, the reception distance will increase.





Directional Beam Stations / Radio Antenna

Many stations transmit through directional beam antennas in order to concentrate maximum power for good reception in heavily populated areas. Since stereo radios require a much stronger signal than FM mono radios (approximately 6 to 8 times stronger), they can only function disturbance-free where strong signals are available. For this reason, the antenna should be extended when receiving weak signals. Adjusting the antenna to a lower height, however, might help to filter out disturbing signals when a strong stereo signal is available (not possible with our electric antennas). A proper ground contact of the antenna (whip type) is also quite important. While this is normally provided on a newly installed antenna, it was found that corrosion at the foot of the antenna can destroy the efficiency of an antenna over 2-3 years.

FM Signal Path

Much similar to light waves, VHF signals (very high frequency) do not bend but travel only in a straight line which results in interrupted transmission whenever geographical conditions prevent either direct or indirect (through reflection) signal reception. AM signals, by comparison, are more flexible.

Multipath Signal

This is the most frequent type of reception distortion. Both a direct and reflected signal(s) from the same station may be received at the same time and momentarily cancel each other. This is called a multipath signal and will cause distortion or noise resulting in partial or complete loss of the station, or poor FM reception. This type of interference is usually of a moment's duration, however disturbing. Multipath noises are normally increased in city areas or roads surrounded by mountains.

Stereo/Mono Decoder

All present stereo car radios have a device incorporated which is designed to switch the radio from stereo to mono in the event signal strength falls below a specified value. The problem is to set the value so that the radio will play stereo as much as possible, but switch to mono when the signal gets disturbed. However, switching to mono will only partially improve reception by eliminating some disturbance.

In FM mono operation, however, a decoder noise will be apparent when the radio is trying to switch back and forth. "Cracking" noises received when traveling in outlying areas may result from this source.

Contrary to the instructions supplied with the radio by Becker, there is *no* switch provided to hold a radio in the mono mode. This switch is used on a different type of radio which is not available in the U.S.

Speaker Frequency Response

Most of the above mentioned disturbances are audible in the form of high-frequency noises, such as "hisses" or "clicks". In an attempt to reduce or eliminate such noises, some car manufacturers are using low frequency response speakers or they limit the adjustment range of the tone control accordingly. By this, however, they lose some of the treble so that the overall response of the radio is shifted to more bass response. This can be done manually on the Becker radio, if desired, by setting the tone control to a bass position. We suggest, however, to set it back to the center position whenever a strong station is received so that the full range of sound is played (for full utilization of the radio's capabilities).

Automatic Signal Strength Compensation

Some manufacturers are now developing devices designed to automatically adjust radio signal sensitivity to station signal strength. This would be a significant improvement as it would compensate for geographical condition influence, as well as that of station distance within the limits of physical/technical possibilities. However, there will always be a limit! At present, accurate fine-tuning is the only solution to these problems. If interference is experienced, the radio should be tuned to a stronger station. If no disturbance-free FM signal is available, station to receiver distance is too far, or a high interference area is present. Set the tone control to bass position (counterclockwise) or switch to AM until you have reached a strong FM signal area.

Tape Decks

For traveling in rural areas, the subsequent installation of a stereo tape deck is recommended. Factory installed Becker FM and FM stereo radios

have a pre-installed adapter which may be used by removing the blind plug on the back of the radio. A European Audio Plug must be used for installation. The blind plug provides an internal circuit which is connected by installation of the tape deck. A switch (radio to tape deck or vice versa) or a provision whereby the unit will switch automatically when inserting or removing a tape cartridge will be featured. Should the automatic switch be provided, the cartridge must be either partially or totally removed to play the radio. The tape deck to radio hook-up allows for tape playback volume control using the radio's volume control (and amplifier).

Finally, a few hints on tuning:

1. The fader control switch on the *dashboard* (round knob) controls the balance between the *front and rear* speakers.
2. The balance control switch (operated by a lever) next to the station selector knob on the radio controls the balance between the two channels, i.e., between left and right side. There is one channel on each side of the car (speakers are not hooked up crosswise as some domestic manufacturers are doing). We suggest to set this control to center position. This switch, however, will be omitted in the near future. A center position will be factory-adjusted.

We hope the above information will contribute to your understanding of the challenges associated with FM and, especially, FM-stereo radio transmission. You have seen that the conditions for undisturbed operation of your radio are not always ideal—but we still believe that when they are, beautiful stereo reception is worth some inconvenience at other times which, presently, cannot be completely eliminated.

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