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Optimizing the Remote Pickup Audio

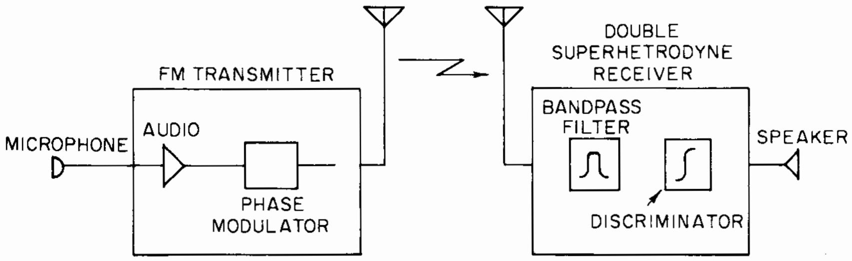

Figure 1. The basic system.

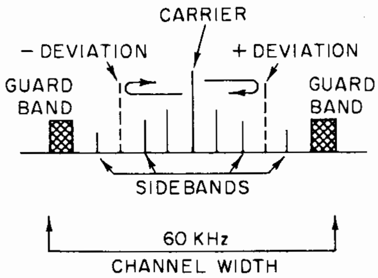

Figure 2. A typical remote pickup channel.

● Many broadcast stations use small portable radio transmitters for on-the-spot news reports and similar broadcasts. The type of unit used in most cases, is the small two-way radio system designed for voice communications. The audio specifications for these small systems may seem rather limited as compared to our large broadcast facilities, but they do provide a good voice channel, and this is quite adequate for the purpose. There are many natural as well as regulatory limitations which can either directly or indirectly affect the audio whieh can be recovered from these systems. In this column, we will discuss a few of the important areas which can directly effect the system's audio.

BASIC SYSTEM

The portable transmitter does not broadcast directly to the public, but instead, to a receiver back at the studios, where the audio is demodulated, and then coupled to the station's regular facilities. The system then, is made up of both a transmitter and a receiver. At the remote site, there is a transmitter and an antenna. Audio is picked up by the system's microphone and used to modulate the transmitter. The modulation process is usually achieved by phase modulation so that direct crystal control of the carrier may be maintained. The signal is an f.m. signal.

Transmitters may be licensed in many bands, from short wave to UHF. Very few channels (let alone bands) are allocated specifically for remote pickup use. Generally, the remote pickup shares the band with industrial or safety services. The particular band in use will have its own characteristics that will limit the distance the signal will travel and contribute noise and other factors to the recovered audio.

The transmitting antenna is usually at a low height, so to make up for this, the receiving antenna will be mounted high above the ground and connected to the receiver with a coaxial transmission line. The receiver is usually a double superheterodyne type (2 i.f. frequencies) and will contain a bandpass filter. This filter is intended for rejection of adjacent channel interference, but it will also automatically limit the maximum bandpass of the system. Limiters are used for noise suppression and detection is effected by a discriminator. The recovered audio passes through a de-emphasis network and on to the receiver's local speaker.

There are several areas in the system where the audio can be directly affected. The main ones are the microphone, the modulation process and bandwidth, receiver bandpass filter, demodulation process and then the interface of the audio to the station's facilities.

The system bandwidth is determined by the equipment capabilities and by FCC rules. The permitted bandwidth varies with different bands, and in some cases, with specific channels within a band.

BANDWIDTH

The bandwidth is based on a mathematical formula: $B_w = 2D + 2M \times K$. D = the deviation on one side of the carrier; M = the highest audio modulating frequency; K = a constant that, for this service, is usually 1. Narrowband telephony, for example, is permitted a deviation of 5 kHz, and the highest audio frequency is 3 kHz. Thus: 2 (5 kHz) + 2 (3 kHz) = 16 kHz. Adding the FCC emission designator F3, this becomes 16F3. This means: the bandwidth is 16 kHz, the modulation is f.m., and the operation is telephony (voice). A wideband communications channel is permitted a deviation of 15 kHz. Using this in the formula: 2 (15) + 2 (3) = 36 kHz, or 36F3.

Since the bandwidth is the product of the deviation and the audio modulating frequency, the actual bandwidth may be higher or lower in operation than the licensed value. All the emissions (including all the sidebands created during modulation) must fit within the channel. So, if you are attemptwidth tape. EIA-J standards, to which the previous ½-in system conformed, runs the tape at 7½ in/sec. Betamax uses a speed of 4.0 cm/sec., equivalent to about 1.6 in/sec. At present, the maximum recording time in a Betamax cassette is 60 minutes. (Incidentally, the model number for the Betamax is LV-1901.)

The complete Betamax console was first put on the market in New York at the end of last year, then was distributed elsewhere. At that time, since the system was being touted as a two-program device (view one, record the other), there was no mention of a free-standing unit or already-recorded cassettes. Things have changed since then. Early this year, there emerged a possibility of a separate player machine, and there was talk of a pre-recorded tape. By the time you read this, the player unit may be on the market and plans may be far along on getting movies and other programs into production. By working out deals with other manufacturers, Sony may get the Betamax to be the "standard" for the home as it did for the U-system for industry and education. The unit will also, no doubt, get attention from those users of video as well, for applications where the double-program idea can be beneficial.

As a semi-final note (there will be more detail in the near future), a camera is also being offered as an accessory to the Betamax system—model AVC 1420. It is a black-and-white unit, made to go with the Betamax. There is also the possibility that in the very near future there will be a cassette available which will be longer than the present 60 minutes in length—perhaps up to 2 hours.

T.V. GAMES

In the past year, the public was given an opportunity, or two, or three, to use the t.v. set for something other than to watch programming that was not to their liking. A device could be purchased that could be hooked into the antenna terminals that would provide the owner with a game he (or she) might enjoy better. Similar to the stand-alone type found in game areas of amusement parks, these devices offered several choices, each usually requiring the competition between two players, or at least two hands.

Among the games were ping-pong, tennis, and auto racing. Then there were others with planes or sharks. Prices for the devices ranged around $100. At the end of the year, color games were introduced. Most major department stores offer one type or another, and the number of manufacturers is growing in leaps and bounds, or is it pings-and-pongs?

This year, there will be several new game developments. It is expected that the simple games will remain but will fade in novelty and importance. The next generation will introduce computer action. This offers opportunities for more sophisticated games like chess, word games, number or math games, and the ultimate situation, for the present, anyway, an opportunity to program the computer to play games of the owner's own choosing and even with changing rules. Possibilities of this diversion seem limitless. There's even the chance that the consumer will be able to communicate with a large computer by phone line to get desired information, perhaps for projects the customer can do himself from instructions on a readout screen.

MICROPROCESSOR

The new word in the home game field is *microprocessor*. Through the use of the multi-function chip, the more usual games of hockey, football, handball, and squash will be joined by the solitaire feature, as it is called—a provision built in for the user to play against the machine itself. The device will analyze moves, counter against all steps taken by the just-human player, and in full color, too, and the player can even set the level of expertise at which the machine will play. In games where a certain amount of speed is required, like handball, the device will include a variable speed control. (Well, the human has to be able to win somehow, doesn't he?) Depending on the sophistication of the game and the device, the pricing will be from somewhere above $100 upwards to close to $1,000. (Some of the devices will also include the sound of the ball being hit, on-screen score keeping, and even a remote control unit.)

Pricing will go down on the less complex games as a result of improved manufacturing practice, development of less expensive material, and the entry into the field of toy manufacturers, who always seem to know how to introduce new "toys" for less than they cost when they were called games.

So, this year, you have a number of choices, for home amusement—you can watch two programs that are on at the same time (watch one now, one later) play a pre-recorded tape or make your own programs, or use your old t.v. set for the amusement of your own selection and programming. Think of all the fun you've just been introduced to. With several t.v. sets, several different games, a few of the Betamax units—drive you crazy, couldn't it? No fooling! ■

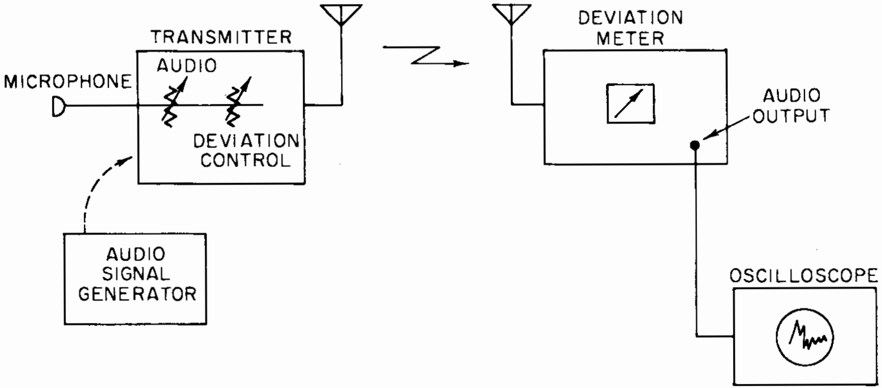

Figure 3. The setup to measure and adjust a transmitter deviation.

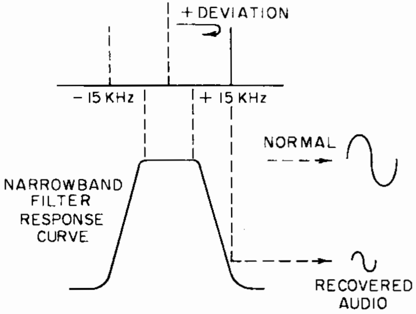

Figure 4. The narrowband filter in the receiver can reduce the output of a wideband system.

ing to extend the audio bandpass to 5 kHz instead of 3 kHz, the actual bandwidth can exceed the licensed channel width. For example, the audio is now 5 kHz and the deviation is adjusted for 15 kHz. Thus, $2\ (15) + (2\ (5) = 40$ kHz. If the licensed bandwidth is 60 kHz, you are okay, but if it is 25 kHz, then the signal is out of channel. It would be necessary to reduce the deviation to 7.5 kHz to accommodate 5 kHz in your channel. Thus: $2\ (7.5) + 2\ (5) = 25$ kHz.

AUDIO INPUT

The microphone has a direct bearing upon the quality of the audio. The usual microphone supplied with these units is designed to produce audio on a speaker which can cut through noise at the receiver location. This type of mic does not provide the best quality for broadcast purposes; select one of the better grade microphones that are available for these systems. This will be either a variable reluctance or dynamic-type microphone and may have its own transistorized preamp inside its case.

Internally, there will be one or two audio stages (in the transmitter) for amplification, and then a speech clipper. This clipper is required to provide a "brute force" limit on transmitter deviation by clipping off any excess audio peaks. This clipper needs proper adjustment, and of course, the audio should be kept below the point where clipping will occur or there will be distortion.

DEVIATION

The deviation of the carrier has a direct effect on the recovered audio and its quality. If the deviation is too low, then the recovered audio will be low and the system signal-to-noise ratio will suffer. Should the deviation be set too high, the system bandwidth can be exceeded and there can be emissions outside the channel. Emissions out of the channel can cause adjacent channel interference to other stations.

The system bandwidth can be exceeded in two ways. In the first case, the entire system has been tuned too narrowly and the bandpass filter in the receiver is for narrowband. This narrow bandpass of the system will have a filtering effect on the signal, so that the reproduced audio can be low, have a poor response curve, or be distorted. It all depends upon the actual conditions at the time. In the second case, the modulator and the modulated stage may be called upon to deviate for more than it has the capability. This can cause non-linearity of the audio signal or outright clipping. Both will produce distortion. The deviation is a very important factor in audio quality, so it should be adjusted carefully and properly.

ADJUSTING DEVIATION

The actual amount of deviation should be measured; using a deviation meter is the best method. This is a test instrument that serves in the same capacity as the station's modulation

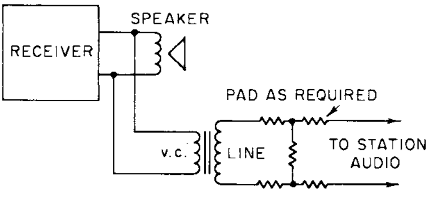

Figure 5. A line-to-voice coil transformer can be used in reverse to isolate and match the receiver to the station's audio system.

monitor. Deviation can also be measured by a communications receiver or a heterodyne frequency meter and the tone modulation of the carrier, although this is a more cumbersome method. Tone modulation is applied to the carrier and the deviation adjusted while listening for the carrier nulls. When the correct null occurs, then deviation is correct. The deviation meter is the better arrangement; an oscilloscope attached to its audio output can be useful.

Make the preliminary adjustment, using 1 kHz tone modulation of the carrier. This will allow getting all the adjustments within the ballpark and the oscilloscope, at the same time, can observe if there is non-linearity or clipping by the modulator. The speech clipper should be adjusted out of the way at this time so that it does not enter the considerations.

Once the preliminary adjustments have been made, connect up the regular microphone that will be used with this transmitter. The signal peaks for voice are 8 to 10 dB higher than sine wave peaks, so the final adjustments should always be made with voice transmissions. If the adjustments are made only with tone, these voice peaks can be driving the unit into severe distortion. Speak into the microphone at normal announcer delivery levels. Adjust the audio gain control and the deviation for the correct amount. It is best also to pull back the audio control because these peaks may be high enough to cause distortion in the audio stages.

When the correct deviation is observed on peaks, then observe the oscilloscope that is viewing the audio after the deviation meter. If any of the peaks are clipped, then back off the deviation or the audio control until the peaks are clean. Those clipped peaks mean that either the audio or the modulator is being overloaded and causing clipping. When the deviation has been set to the maximum undistorted amount, adjust the speech clipper to begin to clip at that deviation level. Leave the settings in these positions.

Another important aspect is microphone technique. Since there are no operating audio gain controls, announcers should practice their mic technique until they can determine the correct distance to hold the mic from their mouths for their normal delivery levels. They should develop a technique that will provide strong, full deviation, that is just below the clipping point.

RECEIVER

The bandpass filter is intended to reject adjacent channel interference, but it will also effect the system bandpass. If the filter is for a narrowband systems and you are trying to operate wideband, then the filter will remove most of the wideband deviation you so painstakingly coaxed into the transmitter. If you plan to operate wideband, then order the receiver with a wideband filter.

The discriminator response curve should be centered exactly on carrier (which should be right down the center of the entire system bandpass). During receiver alignment, these adjustments will have been made with a signal generator. But the final adjustment of the discriminator should be made with the carrier itself and modulating with voice. Tweak up the adjustments so the reproduced voice sounds good. This is only a touchup adjustment, so don't overdo it.

The industrial unit is designed only to supply audio to its own speaker. For remote pickup use, this audio must be coupled to the regular system audio. Unless this interfacing is done properly, the audio can be deteriorated and hum can be introduced. The best method is through a line-to-voice-coil transformer. The transformer will provide both a match and isolation. Attach the voice coil side to the speaker output of the unit and the 600 ohm side to the system. So the regular speaker can operate at normal volume, add a pad on the line side of the transformer to reduce the signal level to system requirements.

SUMMARY

The small, industrial-type communications transmitter systems can be used for remote pickup use, and the results will be satisfactory for voice broadcasts. But there are many possibilities where the audio can be deteriorated, so the units must be tuned and adjusted properly, especially the deviation, and the interfacing to the station's audio system done with care. ■