SERVING THE CREATIVE AUDIO AND MUSIC ELECTRONICS INDUSTRY

# SOUND ARTS

## MERCHANDISING JOURNAL

VOL.2 NO.4
MAY 1979

# HOW TO...

Build Repeating Equipment Sales
Build Repeating Equipment Sales
Build Repeating Equipment Sales
Build Repeating Equipment Sales
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Build Repeating Equipment Sales
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Build Repeating Equipment Sales
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Build Repeating Equipment Sales

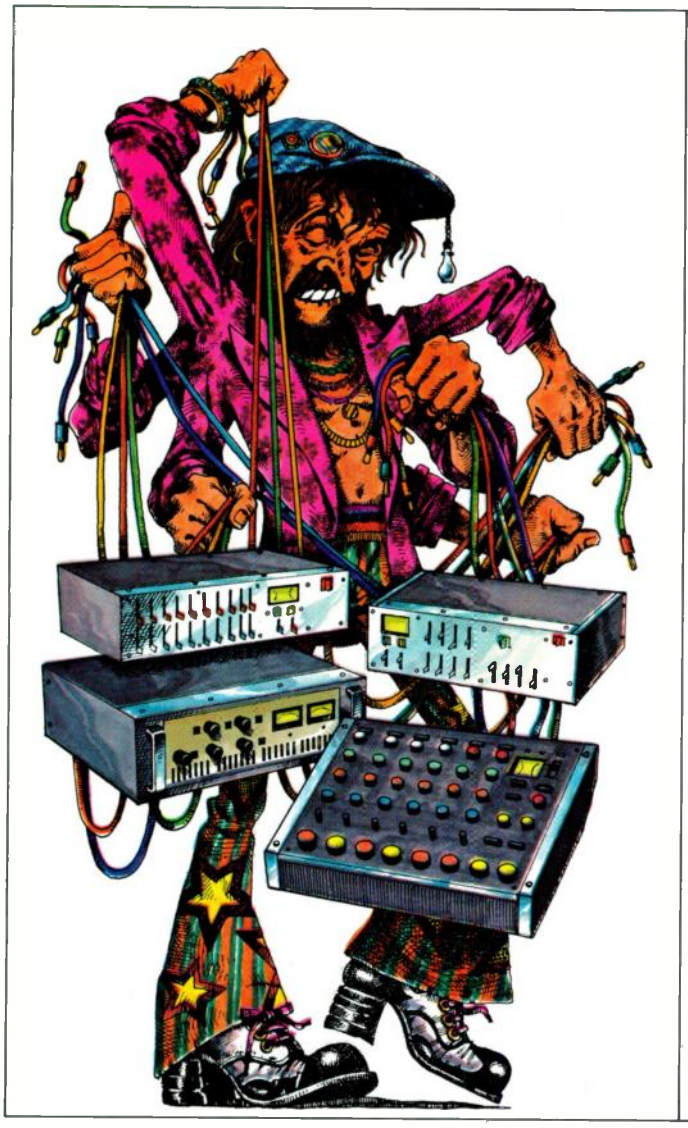
HOW TO...
Display
Hi Mark Up
Traffic Builders

HOW TO...
TALK
TAPE
...or "May
The Source
Be With You"



HOW TO...
Understand
Digital

# THE LONG AND THE SHORT OF SOUND REINFORCEMENT.



You know about the long part. Separate components can keep your hands full, what with the extra help and time needed to get your sound reinforcement act together.

Now for the short part. The Yamaha EM-200 and EM-300 stereo output integrated mixers. They leave you free to concentrate on the creativity of your job, not the mechanics of it.

You get the mixer, power amplifier, 9-band graphic equalizer, echo and reverb control **all in one unit**—great flexibility with options to expand and enlarge.

The EM-200 and EM-300 are ideal for small to medium size reinforcement applications, wherever you need a precisely placed, superbly clean and well-defined sound from a compact source that is easy to set up and operate.

The EM-200 has eight input channels and 120-watt speaker output. The EM-300 has 12 input channels and 200-watt speaker output. For increased flexibility, both the EM-200 and EM-300 have hi and lo impedance monitor output levels (+4dB into 10K ohms, and 0dB into 600 ohms). Additionally, eight patch points allow you to connect accessories directly to the mixer's power amp for dramatically lower noise levels.

The EM-200 and EM-300 give you the short-cut to reinforcement that won't short-change the quality of your sound. They're convenient to set up, operate and locate...at your Yamaha dealer now.

YAMAHA

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# New ATM31 *Fixed-Charge* Condenser

# For Vocalists Only

A great vocal microphone must do just two things:

1. Sound Fantastic. 2. Survive.

The New Audio-Technica ATM31 Vocal Microphone accomplishes both with considerable style. The sound is the direct result of new condenser technology from A-T. Our unique fixed-charge condenser element puts the electrical charge on the back plate rather than on the moving diaphragm. So the diaphragm can be made thinner, better able to react precisely to every vocal nuance.

The result is honest, very musical sound. Vocals with punch and clarity—a direct result of our frequency-aligned response. The ATM31 curve takes into account every element in the chain...voice, amps, and speakers. It's the same kind of sound you hear on the finest recordings, but delivered on the road, day after day, in concerts and club dates alike.

As for survival, take a close look at one example of ATM31 "Road Tough" construction: the windscreen. Not simply woven wire, but *three* layers of screen. A heavy outer wire mesh, a finer inner mesh, and finally a fine brass screen. All soldered firmly in place (others use cheaper epoxy, but it can get brittle and fail at absolutely the worst times).

Every other detail of the ATM31 is as carefully engineered for performance and long life. This is one vocal microphone which will stay new-looking and new-sounding long after others are showing their distress.

Great sound in the real world. It's not too much to ask of Audio-Technica.

**Sell the NEW "ROAD TOUGH" Artist Series Microphones from Audio-Technica.**



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# LOOK WHAT WE'RE GOING TO DO. FOR YOU.

Burns Audiotronics is the new and exclusive representative and distributor in the United States of Beyer Dynamic headphones, microphones and all accessories. And we handle Beyer products exclusively.

Hammond Industries is no longer an authorized Beyer distributor, and effective April 1, 1979, all orders and inquiries should go to Burns Audiotronics.

Because of our full-time concentration on Beyer, and the full support we receive from the Beyer factory, we will be very responsive to our dealers. And we're confident that Beyer will soon be as important in the American audio market as it is all over the world.

Here are our plans:

- The Beyer line will be made available to a limited number of highly qualified professional sound distributors and music stores who have demonstrated their ability to effectively serve the users of Beyer products.
- A substantial advertising and publicity campaign aimed at the professional audio and music markets will be launched June 1st.
- To back-up the ads, we will provide our dealers with a substantial in-store display and literature program.
- We will maintain a large and complete inventory for fast delivery of your orders.
- We are setting up a major service facility with factory-trained technicians and the latest test equipment to assure rapid turnaround of your repair orders.
- We're setting up a stringent quality control program so you'll rarely need the service department.

If there's anything else we can do for you, or if you need the name of your local representative, give us a call.

Beyer Dynamic

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SERVING THE CREATIVE AUDIO AND MUSIC ELECTRONICS INDUSTRY

VOL. 2 NO. 4

# SOUND ARTS

MERCHANDISING JOURNAL

MAY 1979

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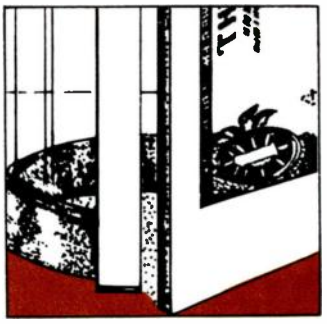

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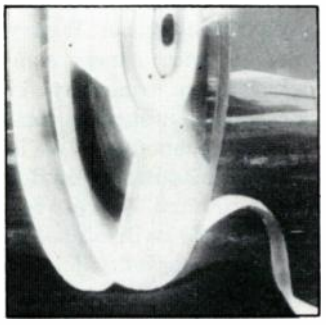

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Cover art by Liz Ryan

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# A LETTER FROM THE EDITOR

Kenny Rogers was on the Donahue show the other day. Amid the tidbits of trivia dispensed on that ersatz-candid program, Rogers said if he ever fell off his "plateau" in music, he wasn't worried, since he is very good at business. I'm in no position to judge his business acumen, but the statement itself seemed true to the hybrid nature of making it in the arts. There's more to getting the act together than getting the act together.

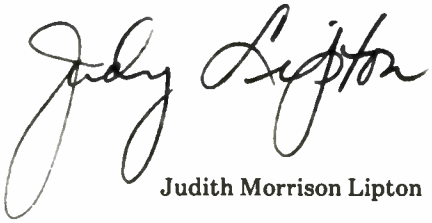
I was thinking about this when my desk had become Press Release Mountain, after I had been away from it awhile. A number of those releases were about personnel changes within the industry. Take a few weeks off and it seems as though the whole population has changed hats.

In a system of finite universes, some universes seem more finite than others. Energy and mass keep growing, but the quality may be strained. Four variations on the same discussion come to mind. Discussion 1: A sales manager is looking for some marketing people and says he is having trouble finding them because prerequisites include both technical and marketing experience. Discussion 2: A reader-rep writes that his firm puts great effort into an educational program, only to find the newly educated leaving for other endeavors. Discussion 3: A retailer, speaking of the paucity of good technicians, also says he doesn't train beginners, for fear they will leave once trained. Discussion 4: A job is open for a good sound reinforcement man. Of which we know many. He must be a good businessman.

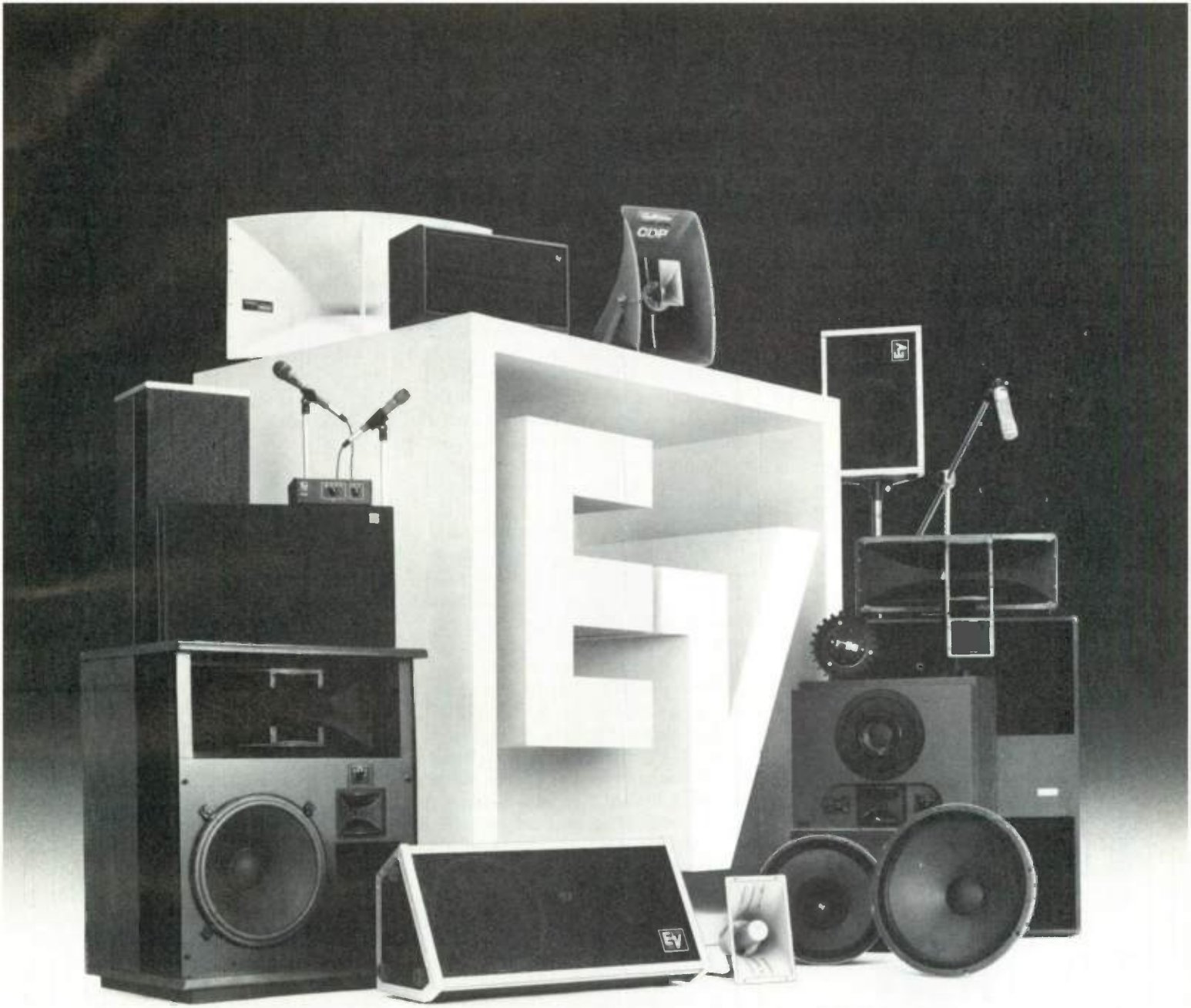
The point is not that there is a scarcity of talent, but there is a need for a cohesion of talents. The point of SOUND ARTS is to bring it all together. We try for a mix of merchandising and technology, with a basic commitment to music. Most of our readers feel the same way. The impetus for getting into this business in the first place comes from interests in music, sales, science and technology. Viva la combination.

My climbing down Press Release Mountain brought a related sub-issue to mind. A press release from Maxell speaks of marketing vp Gene LaBrie's belief that "the high quality open reel sector of the market will . . . show real growth . . . as the semi-pro recording market grows." LaBrie goes on to advise that, "Dealers should project the image of the recording professional . . . ." We are in no disagreement, and had in fact already scheduled for this issue a beginning article speaking of the basics of tape technology. The article is a non-esoteric rundown of must-know material basic to selling as a "recording professional." So, happy selling.

Regards,



Judith Morrison Lipton



# Listen to the Electro-Voice story. Your customers are.

As a music dealer, you should be interested in the Electro-Voice story, because when it comes to music microphones, loudspeakers and music speaker enclosures, Electro-Voice is the leader.

The music your customers listen to at home was probably recorded using Electro-Voice professional microphones and mixed using E-V Sentry® studio monitors. The same technology that goes into these products also goes into all E-V music systems. Is it any wonder that Electro-Voice is becoming *the* asked for name in music.

If music is your business, it's good to know that the famous EVM® loudspeakers are not only standard in many manufacturers' "premier" enclosures, but are the replacement speakers of choice by many concert sound men. These same speakers are standard in *every* Electro-Voice music speaker product. And E-V microphones are seen being used by more vocalists and instrumentalists on stage than ever before.

If your business is selling sound, Electro-Voice has a story to tell. A story your customers will want to hear. A story that will make a lot of profitable sales for you. To hear the Electro-Voice sales story in person, stop by our exhibit at NAMM and talk to Chuck Gring, Electro-Voice Music Products Sales Manager, or contact us at Electro-Voice, 600 Cecil Street, Buchanan, Michigan 49107. Phone 616/695-6831.

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**See us in Room 200, Second Level, Georgia World Congress Center, National Music & Sound Expo, June 9-12**

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REACHES THE PEOPLE WHO REACH THE PEOPLE

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# FORUM

Your March issue feature on "Adding Lighting to the Product Mix" was a unique insight into one of the most growing areas of interest and sales in the pro audio and music store markets. Unfortunately, the article on disco lighting only deals with half the story. The other area in which we are finding tremendous interest and increasing demand is packaged professional stage lighting systems for the professional entertainer. Just as the audio dealer finds a built-in demand to provide lighting with his sound equipment in disco installations, he and the music stores are receiving a constant demand for lighting from the live entertainer and live entertainment nightclubs. In the same way that Meteor is providing for the disco market, we are providing, in the ALICE Programmable Lighting Systems, a variety of complete lighting packages in different price ranges for the portable and installed live entertainment market. In addition to these packages, we are also offering a variety of control systems, lighting fixtures and rigging so that the dealer or entertainer who wants to design his own system will find no limit to his creativity. . . . We see the growing demand for professional stage lighting systems packaged for the live entertainer as the most exciting new market in the pro audio and music store markets. Since SOUND ARTS has taken the lead in covering lighting in these markets, I would certainly look forward to future articles on lighting for the live entertainer.

John M. Fly
Malatchi Electronic Systems

*[You've got it. We have several lighting articles in the works.—Ed.]*

After reading your article on the West Coast Expo, I wonder if you and I were at the same show. I would describe your view of the show as sugar-coated and totally out of the context and framework of any reality of 1979 economics. Unchecked growth? Check again.

Ellis F. Baxter
Dirty Don's P.A. Palace

Regarding your article on IRS refunds ["Selling in the Spring," March 1979], the Washington Post ran an article on the record refunds paid by the IRS this year—and the Post ran the story—the same day I received your magazine. Good timing! Keep up the good work.

Richard D. Karpe
Chevy Chase, Maryland

Hats off to a great magazine! There is a perfect mixture of technical and marketing info in every issue. I'm just sorry I missed out on prior issues. Are there any back copies prior to Feburary 1979 available? I'd be glad to have them for my files. Keep up the good work.

Oscar Webb, Jr.
Webb Sound Inc.
Toledo, Ohio

Hey, your magazine is just great! I've found it to be an invaluable tool in the art of retail sales. The more I know about P.A. gear, the better I can satisfy my customer's needs. The better I can do this, the bigger his smile as he walks out the door, his needs satisfied. Then he comes back to purchase more! To round out my collection of SOUND ARTS, my knowledge, and my customer's smile, could you please send me issues 1 through 8? I'd be most grateful.

Kevin Brown
Sound Stage
Fresno, California

I have been an avid reader of your magazine from its inception. Unfortunately, I have to borrow each copy from a friend. I am a member of Sound Technicians Union local 695, and am an employee of Walt Disney Studio. I would like a subscription, and if possible the first year of back issues.

Dennis Kirkpatrick
North Hollywood, California

*[SOUND ARTS is provided free to qualified readers. Requests for back issues by qualified readers are honored as long as supplies last.—Ed.]*

# TERMS:

## A CONTINUING INDUSTRY GLOSSARY

### RECORDING

**By Larry Blakely**

*Fixed-Type Filters:* Can be of the high-pass, low-pass, or band-pass types. Such fixed frequency high-pass or low-pass types of filters have a predetermined frequency at which the filter works that cannot be changed on the front panel. A band-pass filter will have two such predetermined frequencies that likewise cannot be changed on the front panel.

*Parametric-type Filters:* Can be of the high-pass, low-pass, or band-pass types. Such parametric-type filters will have a frequency range that can be adjusted or tuned (not switched). Like the parametric equalizer, a much wider range of frequencies are available to the operator.

*Notch Filter:* A special filter that has a very high "Q" (rate or slope). These filters are used to remove (attenuate) a very narrow frequency range. A notch filter is made up of a high-pass and low-pass in a band-pass configuration. A 60-Hz notch filter could be used to remove or reduce audible hum in an audio signal.

*Position Cut Button:* Often found on mixing consoles. On such consoles, a position cut button would be found on each input. Such a switch will allow levels to be set on certain input faders and provide a means of switching off those inputs until they were needed. For example: when doing a 16-track mixdown, all levels must be adjusted on the mixing console from the 16 tracks for the proper or desired mix. If two tracks are a background vocal that is only used in a small portion of the tune, those tracks could be switched off using the position cut buttons (removing any noise and leakage on those tracks) until they were needed in the mix and then could be switched off again when they were not needed. Inasmuch as noise is usually a problem in multi-track recording and mixdown, the switching out of unwanted tracks when there is no music on them will remove noise from the mix. The posi-

### ELECTRONIC MUSICAL INSTRUMENTS & ACCESSORIES

**By Wayne Howe**

*[Consistent with our concept of a rotating panel for this section, Wayne Howe becomes a contributor with this issue—Ed.]*

In the near future, the music scene will be hearing more and more about the different classes of amplifiers. We will therefore begin with a discussion of those classes.

*Amplifier:* A device which produces an enlarged replica of an input signal through the use of an external power source. There are many types, classes, and circuit configurations of amplifiers. There are also many ways of measuring the parameters or specifications of amplifiers.

*Gain:* The amount of amplification, usually represented as a constant A. It is the ratio of the output level over the input level and is usually expressed as a ratio (X1/X2) or as a decibel (dB) figure.

*Decibel (dB):* Because the human ear is capable of perceiving tremendous differences in sound levels, the decibel unit is used as a more mathematically workable means of handling large power level differences. For example, the human ear can easily hear differences in power levels of 1,000,000 to 1. Converting this power ratio of 1,000,000/1 to decibels results in a more mathematically workable figure of 60 dB. By the same process, a power ratio of one billion (1,000,000,000) to 1 can be more easily manipulated when expressed as a concise decibel figure of 90 dB. The formula for this conversion is as follows:

$$dB = 10 \log_{10} P_{out}/P_{in}$$

A decibel is a measure of power only! Nevertheless, with all other factors staying the same, a change in either current or voltage can be expressed in terms of the effective power change by the formula:

$$dB = 20 \log_{10} V_{out}/V_{in}$$

or

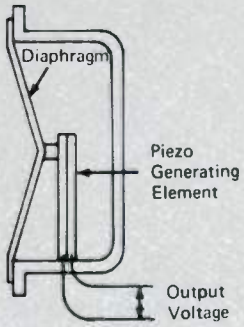
$$dB = 20 \log_{10} I_{out}/I_{in}$$

### SOUND REINFORCEMENT

**By Glen E. Meyer**

*Microphone Components:* All microphones have two basic components: the diaphragm and the generating element. The diaphragm is a membrane which vibrates in accordance with the pressure variations of sound. The generating element converts the diaphragm vibrations into electrical voltage. The kinds of generating elements vary greatly in expense, frequency response, complexity, ruggedness, and also in longevity.

*Ceramic and Crystal Generating Elements:* The diaphragm of a crystal or ceramic microphone is attached to a special material which produces an electrical output voltage when it is moved. Such materials are termed "piezoelectric." A typical ceramic microphone is shown below. Such microphones generally provide insufficient fidelity and ruggedness, even for the most modest requirement of the professional and serious amateur.




CERAMIC / CRYSTAL GENERATING ELEMENT

*Dynamic Microphone:* The diaphragm of a dynamic microphone is attached directly to a coil of wire (voice coil) located in a magnetic field; when the coil vibrates, a voltage is produced.

The dynamic microphone has proved preferable for the public address and instrumental miking requirements of the professional performer because it provides excellent fidelity, extremely stable performance characteristics, and a high degree of ruggedness—all at a reasonable price. (To demonstrate

# TERMS (CONTINUED)

## A CONTINUING INDUSTRY GLOSSARY

### RECORDING

tion cut button can also be used during live recording (laying down tracks). This will eliminate leakage of microphones that are only being used during a portion of the tune. Again, simply switch the microphone positions on and off (via the position cut button).

*Cue Button:* Usually found on broadcast or production-type mixing consoles. This button (switch) will allow you (when the input position fader is down) to hear what is on a particular input position without it going on tape. The signal from a particular input position would be routed directly to the monitor speakers when depressing the cue button. For example: if sound effects were to be used, they could be cued up to the proper starting point while you were recording the tape as you could hear the sound effect cueing by using the mixing console cue button. This gives the operator a great deal of additional flexibility for production-type work. This feature is commonly used in the production of radio advertising spots (commercials) or radio jingles.

*I.D. Strip:* A space (usually 1" to 2" wide) that is usually white, that is often found at the bottom of each console input. It is used to write the instrument appearing on that input position. This will give the operator quick visual access to what is on each input position of a mixing console. Often, consoles do not have an I.D. strip, and operators will place a strip of masking tape below the input position faders and mark on it with a grease pencil or a felt tip marker.

*Active Filter:* A filter that is made with active electronic components (i.e., transistors and integrated circuit amplifiers) as well as coils, condensers, and resistors for the filter function. An active filter will have no insertion loss and in some cases may be adjusted or wired to actually increase the signal level with an amplifier inside the filter. Such active filters do require an internal or external power supply.

### ELECTRONIC MUSICAL INSTRUMENTS & ACCESSORIES

One of the advantages of decibels is that dB levels can be added or subtracted, whereas ratio levels must be multipled or divided.

*Voltage Amp:* An amplifier that specifically increases the output voltage proportional to the input voltage. The voltage gain is written as:

$$A_v = V_{out}/V_{in}$$

*Current Amp:* An amplifier that specifically increases the output current in proportion to the input current. The current gain is written as:

$$A_i = I_{out}/I_{in}$$

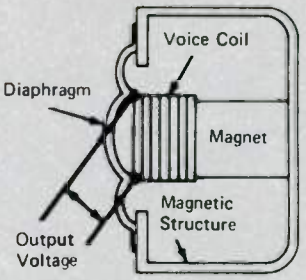
*Power Amp:* An amplifier that provides enough power to drive speakers. A power amp usually provides a large current to a low impedance load, thus resulting in high power output. Amplifier power is measured in watts and the power delivered to the speaker can be calculated by the formula: $P = I^2R$ where I=current delivered by the amplifier, and R=the resistance of the speaker. There are several classifications of amplifiers.

*Class A Amp:* An inefficient electronic circuit design usually used for low power amplification. On the average, a Class-A amplifier draws the same amount of current with an input signal as it draws with no input signal.

*Class B Amp:* A relatively efficient power amplifier that uses a positive and negative section. Each section operates on only half of the input cycle. When the input signal is positive, the correlative positive section of the Class B amp operates while the other section is turned off. When the input signal is negative, the correlative negative section of the amp operates while the first section is turned off. Class B amplifiers are relatively efficient because one section is off at all times. When no input signal is applied, very little current is drawn.

*Magamp:* A magnetic amplifier in which the gain of a coil around a magnetic core can be controlled by the amount of magnetic saturation of the core by a control coil.

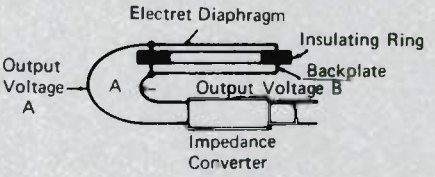
### SOUND REINFORCEMENT




DYNAMIC GENERATING ELEMENT

the ruggedness of a particular company's dynamic microphones, I know of a lecturer that literally pounds the lectern with the very microphone he is using for sound reinforcement with apparently no ill effects.) These same characteristics are ideal for conventional sound reinforcement and recording as well. In addition, and very important to the performer, the diaphragm of a well designed dynamic microphone is able to withstand the close miking and high sound pressure levels often employed by musicians; all without damaging the microphone or distorting its output.

*Condenser Microphone:* The diaphragm of a condenser microphone is a movable plate of a condenser (capacitor). When polarized by




CONDENSER GENERATING ELEMENT

applying a DC voltage, motion of the diaphragm in relation to a fixed back plate produces an output voltage. The extremely high impedance of the condenser generating element is matched to typical inputs by an impedance converter in the microphone. (More on condenser microphones next month.)

# FOR THE SMALL STUDIO OWNER WITH BIG IDEAS.

If you're a small studio owner, you may have a problem: your ideas are far beyond your present equipment.

Maybe you're an engineer, dreaming of an automated 24-track studio. Maybe you're a producer, searching for "the next big thing." Maybe you're an artist, trying to land a record contract. What you need is something that will get you from where you are to where you'd like to be.

Sound impossible? Not to us. At dbx, we're committed to make professional recording technology available to anyone with the determination to make use of it. We make a line of rack-mountable signal-processing devices designed and priced especially for the small studio.

Our tape noise reduction systems, the 155 (4-channel, switchable), the RM-155 (8-channel, switchable) and the 158 (8-channel, simultaneous), all offer the same 30 dB noise reduction and 10 dB headroom improvement as our state-of-the-art units and are fully compatible with them. They enable you to make master quality tapes, instead of demos, on your present equipment.

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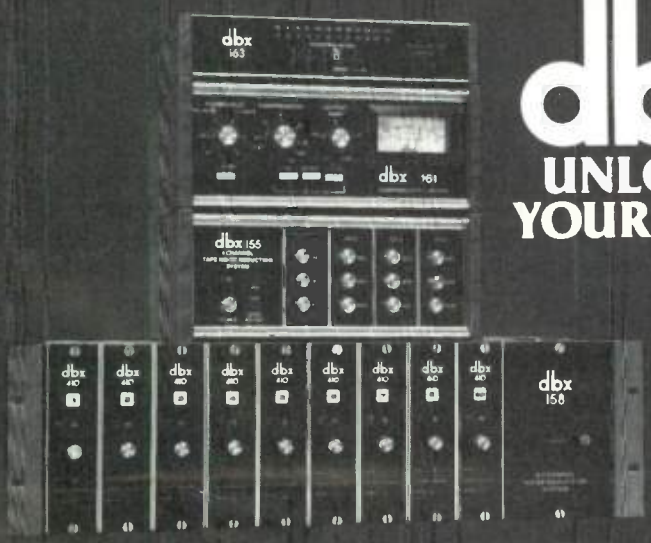



dbx

UNLOCK YOUR EARS

# TROUBLESHOOTERS' BULLETIN

(1)

Troubleshooters' Bulletin is designed as an aid to the dealer. Input is invited from both manufacturers and retailers. Share the wealth of your knowledge. Items refer to repair of equipment, preventive maintenance, and the correction of customer misconceptions. Send your contributions to SOUND ARTS MERCHANDISING JOURNAL, 14 Vanderventer Avenue, Port Washington, New York 11050.

(2)

## AMPLIFYING THE GRAND PIANO

In amplifying a Steinway grand piano, we had the following requirements: The piano had to sound like an acoustic grand, be loud, stand out enough to be heard through its monitors, and experience clean sound with no feedback.

Two sound systems were used in this instance - the first a monitor system and the second the main system. The key to successfully dealing with these

(3)

systems and the different environments of each lay in the necessity of a third octave graphic equalizer for each system. (There is no reason why a good parametric equalizer could not do the same thing as the graphic, but I think the graphic is faster.) If the piano were to be amplified in stereo, then two graphics should be used in the main system and one with the monitor system (presuming the monitor system is monophonic). As the Frap FS-200 is a dual transducer system and has an output for

each channel plus a mix of the two channels, this was an easy task.

The placement of the transducers was simple. Walter Rapaport of White Noise Sound, discovered this method of transducer placement on the grand piano. The transducers are placed on the large wooden struts that lie under the piano. (See figure 1.) The highs are rolled off or the midrange frequencies are boosted.



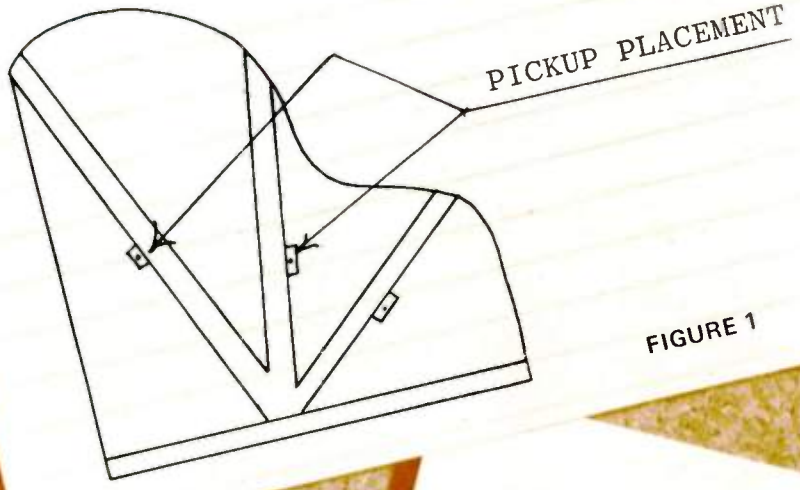



FIGURE 1



For tours or permanent installations, silicone rubber adhesive such as Dow Corning 3145 or G.E. Auto Seal can be used to affix the transducers.

Once set up, the lows should be rolled off on the FS-200 preamp, the phasing switch should be used to reduce or eliminate any feedback. When this is done, the graphics can be used. Each sound system should be set up separately.

(7)

A number of problems can be encountered due to the piano's huge surface acting as a giant sound collector:

The monitor's speaker will vibrate the piano - particularly the sounding board. This is also the case with the accompanying band or orchestra, and the primary sound system. These sources of sound and vibration will make the strings of the piano resonate whenever the pads are lifted from the strings. The solution is to modify the piano.

(8)

One way is to attach sound absorbing material such as shipping pads or furniture blankets to the piano just underneath the sound board. This will prevent sound from the monitors and reflected sound from the floor from getting to the sounding board. The floor underneath the piano should also be covered by a carpet.

The top of the piano also poses a problem. While it is a visual experience for the top to be open, it acts as a collector of sound. The solution? Keep the top open and build a sound insulated removable cover. A cover made of plywood with sound insulating material would suffice.

(9)

ARNIE LAZARUS
PRESIDENT
FRAP

(10)

TUNING RMI ELECTRA PIANOS

Tuning this piano requires no special skills. Simple touch-up tuning can be accomplished by "beating" the off-pitch note against the same note one octave apart. Example: C2 against C3. For a complete tuning, however, use of an external standard (strobe, etc.) is recommended.

(11)

These pianos employ an independent toroidal coil oscillator for each key. There is a well-labeled potentiometer control for each note. Earlier models used miniature metal type pots. Newer models have in-line wafer pots.

Turning the control clockwise raises the pitch, counterclockwise lowers the pitch. If the range of the

(12)

control is insufficient, capacitance must be added or lowered across the oscillator coil. If the note is too sharp - add; too flat - subtract.

On newer models, a negative bias circuit aids in the stability of pitch during the decay of the note.

There is one adjustment for the

(13)

entire keybord, and it is located near the power transformer. To adjust this control, strike one note at a time, in each octave. Adjust for best pitch stability during decay. This control has been factory adjusted and should not require adjustment unless tampered with. But it should be checked before tuning.

TOM EMERICK
NATIONAL SERVICE MGR.
RMI


**What is Ohm's law?**

Ohm's law is a basic formula that shows the relationship of voltage, current and resistance in any electric circuit. Basically, Ohm's law states that voltage equals the product of current multiplied by resistance; in simple formula:

$$E=IR$$

where "E" is voltage, "I" is current in amperes and "R" is resistance in ohms. Using algebra, it may also be expressed as:

$$I=\frac{E}{R}$$

$$\text{or } R=\frac{E}{I}$$

Thus, the formula can be used to find any one of these values using the other two. This is useful in repairing, testing, interfacing and designing electronic equipment.

A hypothetical application of Ohm's law: While building a turntable assembly we decide to install a fuse in the turntable motor circuit. To do this we need to know what current the circuit normally requires so we can choose a fuse that will not blow out at current levels too low to operate the motor. We also do not want to use a fuse that will pass currents large enough to damage the motor circuit.

Using an ohmmeter or the manufacturer's specifications, we determine that the motor's resistance is 480 ohms. The motor is to be operated directly from the 120 volt power lines. Using Ohm's law in the form of I=E/R we determine the operating current:

$$I=\frac{120}{480}$$

By dividing 120 by 480, the result is 0.25 ampere of current drawn by the motor. The proper fuse, in this example, is then easily chosen.

*Neil Lewbel*
*Consultant, Technical Writer*
*Kew Gardens, NY*

**What is a "computer designed speaker?"**

Recently, there has been a revolution in loudspeaker-system design. To understand it, let's backtrack a bit and see how loudspeakers used to be developed.

The typical cone-type loudspeaker really consists of a miniature motor connected to a (usually) paper cone. The "motor"—and that's what it's called by loudspeaker engineers—consists of a coil of wire wrapped around a cylindrical tube (the combo being the so-called "voice coil") immersed in a magnetic field. When audio current flows through the wire, it creates its own magnetic field that interacts with the fixed magnetic field causing the coil to move. That moves the cone, and the cone vibrates the air. Voila! Sound.

As the cone moves forward, it compresses the air in front of it. Simultaneously, it creates a partial vacuum (or "rarefaction") behind it. When the cone moves backwards, the situation is reversed—increased pressure behind, decreased pressure in front. If the air in back can slosh around the cone, it will fill in the hole in front, and the net result will be close to zilch. The speaker will move but produce no appreciable sound.

Now, it takes some time for the air to make the circuit, and the bigger the speaker, the longer it takes. Sound has a finite velocity in air—about 1000 feet per second. Any sound frequency has a wavelength given by the velocity of sound divided by the frequency. Thus a 100-Hz tone has a wavelength of about 10 feet. If the path from front to back is much shorter than a wavelength, the front and back radiations cancel. Obviously, then, if we're to get any bass from a practical-size speaker cone, we'd better do something about preventing the front and rear waves from colliding.

The simplest thing to do is put the speaker in a closed box and trap and absorb the rear radiation in a wad of matting. That's what an infinite-baffle or acoustic-suspension system is—a sealed box. The difference between them is basically one of size; an infinite-baffle enclosure should be large enough so that no appreciable back pressure is put on the speaker as it compresses the air inside. Essentially, an infinite-baffle box is the same as mounting the speaker on an infinitely large wall. The speaker cone moves freely, but the sound never makes it around the edge.

An acoustic-suspension box is smaller. The air pressure does build up inside as the speaker moves, and it does apply a force on the cone. That can have certain advantages. The air "spring" in the box is more linear than the mechanical springs (spider and surround) used to keep the cone in place, and so distortion is less.

Trouble with all sealed systems is that half the sound power is tossed away; you only get to hear what comes out the front. So for decades, speaker designers have tried to get some of that sound out but in a useful fashion. If you cut a hole in the box you have made a "Helmholtz resonator." Another Helmholtz resonator known to mankind is the Coke bottle—blow across the top and it'll whistle at its resonant frequency.

If you "tune" the box (by adjusting its volume and the size of the hole) appropriately, you can achieve several advantages—an extension in low-frequency response and an improvement in efficiency since some of the rear sound comes out in a useful fashion. (The resonant box creates a phase reversal at certain frequencies so the rear sound comes out in-phase with the front sound and this helps out.)

We've just described the principle of the bass-reflex or vented speaker system. Until recently, designing such a system was black magic. Do it wrong, and you'll get boomy one-note bass—the Coke bottle. A filter expert in Australia, A.N. Thiele by name, got

# THE ARP STORY: 10 YEARS, OVER 35,000 SYNTHESIZERS SOLD AND IT'S ONLY THE BEGINNING.

## An ARPography: 1969–1979

**1969:** Under the name Tonus, Inc., the ARP *2500* is introduced. It is the first synthesizer designed for live performance use, featuring slider-controlled matrix patching and rock-stable oscillators and filters.

**1970:** ARP introduces the world's first portable synthesizer, the *2600*, also known as "The Blue Meanie." The 2600 is discovered by Stevie Wonder and Pete Townshend, and becomes the most popular studio synthesizer of the 70's.

**1972:** The ARP *Odyssey* is introduced. Through many years and many design updates, it sets the standard for rugged, compact, versatile synthesizers, becoming "the most copied synthesizer in music" according to *Rolling Stone*.

**1974:** The ARP *String Ensemble* is introduced. The addition of "systems interface" jacks to the String Ensemble allows it to be used as a polyphonic synthesizer, more than two years before a self-contained polyphonic synthesizer is built.

**1975:** The *Axxe*, the first synthesizer under $1,000, is introduced. The Axxe opens up the amateur and educational market with its low price and high performance features.

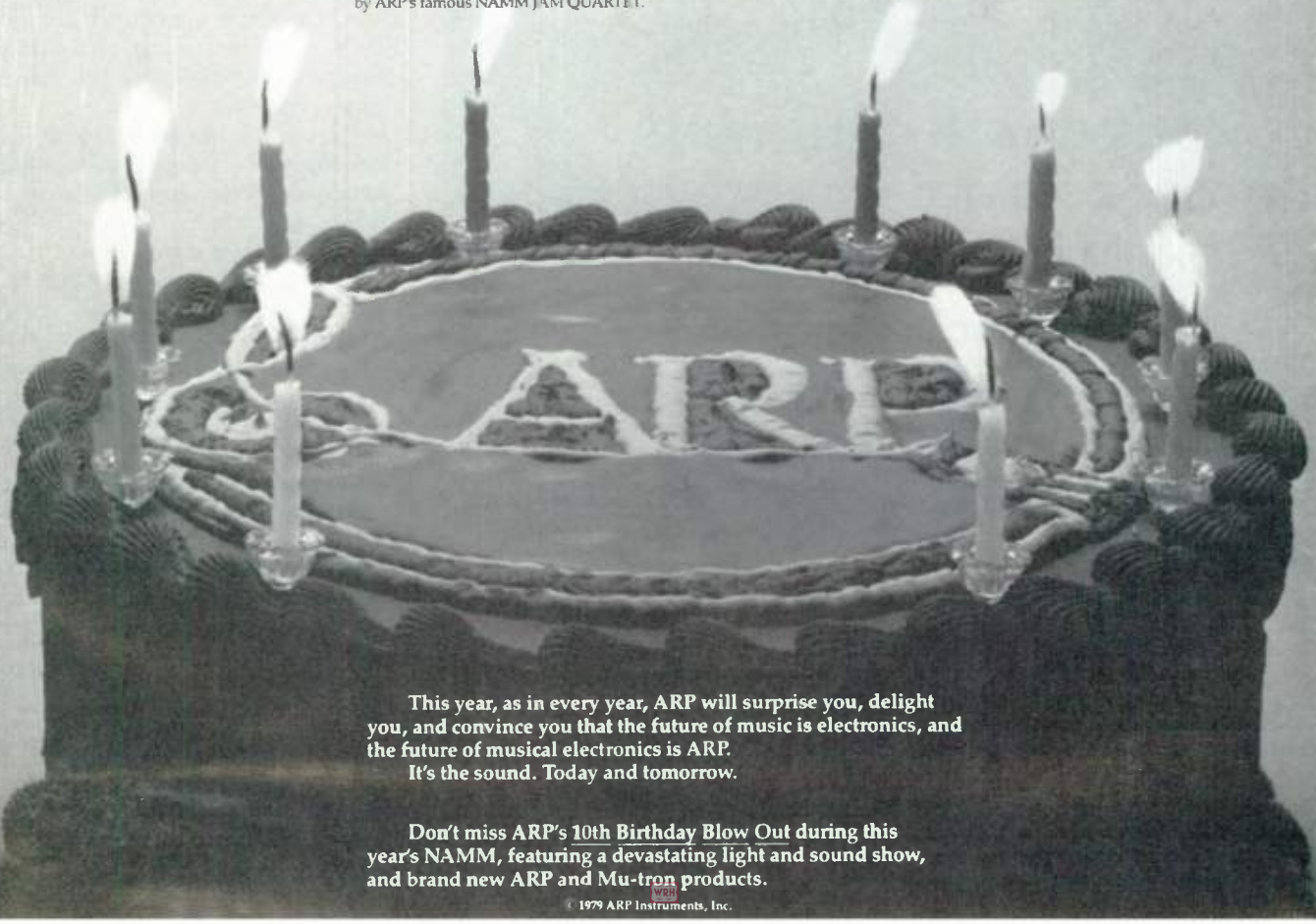
**1976:** The polyphonic wave begins with ARP's introduction of the *Omni*, a symphonic electronic instrument that produces strings, polyphonic keyboard effects, and bass synthesizer *simultaneously*. The Omni sets the music world on fire, outselling every other synthesizer on the market.

**1977:** In one revolutionary stroke, ARP opens up the incredible sound possibilities of synthesizers to electric guitarists. The ARP *Avatar* boggles the mind and creates a brand new market.

**1978:** Technology continues to change rapidly, and ARP takes the lead by introducing the ARP *Quadra*, a micro-processor controlled keyboard instrument with four synthesizers under one roof. Now musicians can write, edit, store, and recall programmed sounds in a fraction of a second.

ARP enters the sound modification and effects market with the purchase of the Mu-tron product line.

**1979:** Once again, ARP will unleash an incredible *new keyboard instrument*, featuring *new* sounds, *new* technology, and *new* opportunities for ARP dealers. Plus new Mu-tron effects products. NAMM '79 promises to be another remarkable trade show, with regular musical performances by ARP's famous NAMM JAM QUARTET.

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interested in loudspeakers and noticed a remarkable similarity between the equations that describe filters and those that describe a loudspeaker system. Once the light dawned, the magic disappeared. The vast mathematical lore that had already been developed to design filters could be applied directly to the design of a loudspeaker system.

The bass driver and its enclosure can be thought of as a high-pass filter. Plug in the proper parameters—volume of the enclosure, size of the port, motor strength, driver Q, etc.—and the equations predict the response, efficiency and other acoustic tidbits. Conversely, a designer can start off with the box size the sales department wants, the low-frequency cutoff point that is desired, the amount of bass-response irregularities that are tolerable, and the efficiency, and the equations will tell him what kind of driver he needs and the mass of air required in the port. (If the last is too great to realize even with a ducted port, he can use a passive radiator.)

All of the mathematics have now been programmed for computer—a calculator can even do it—so the bass performance of a loudspeaker system can be predicted before laying saw to wood—computer-designed speakers!

Does that mean you can get 20-Hz performance out of a palm-sized box at high efficiency? Try it! The computer will tell you you're nuts!

*Edward J. Foster*
*Diversified Science Laboratories*
*West Redding, Ct.*

**What is VU meter lag and what can be done to compensate for it?**

VU meter lag is a delayed response in which you see the needle move after you hear the corresponding change in sound. A sudden, short duration, small magnitude change may not be seen at all on the meter.

To understand this we must remember some basic laws of physics concerning motion: An object at rest (not in motion) tends to stay at rest, unless acted upon by a force sufficient to overcome its inertia. A body in motion tends to continue in that motion unless acted upon by a force strong enough to affect or change that motion.

In a VU meter the average sound is converted to electric signals that are fed to a small electromagnetic assembly. This assembly is mounted on springs and located between the poles of a permanent magnet. The needle of the VU meter is connected to this electromagnet assembly.

The signals energize the electromagnet causing it to repel or attract the poles of the permanent magnet. These attraction and repulsion forces cause the electromagnet assembly, which includes the needle, to move, thus moving the needle.

Although for our purposes, sound and electric signals are instantaneous, the magnetic forces must develop enough strength to overcome the inertia of the needle assembly. After the inertia is overcome, the needle starts moving. It then takes a certain amount of time for the needle to move up to the correct point on the scale.

When the needle reaches that point, it is in motion and will tend to stay in motion, and move past the correct point before it stops. This process causes the needle to reach the proper reading some time after the actual sound, resulting in VU meter lag.

In reality there is no way to completely compensate for VU meter lag when you are recording. There are, however, some tricks and devices that may be used to help. If your system has sufficient headroom over 0 VU, you have some margin for safety. Another built-in-to-the-system means of preventing peak level problems is to use limiters in the audio chain. The problems with using headroom or limiting are that the recording engineer has little control, if any, over these. Also exceeding the available headroom or overdriving a limiter may cause distortion.

There is, of course, no substitute for developing a good ear and using it to anticipate peaks and compensate by adjusting the faders or other controls. A sudden, sharp signal, like a cow bell, often does not show up accurately on the VU meter, so you must compensate by setting your faders so that it will not read over about 30 to 50 on the VU scale. In reality this type of signal will be much higher than the highest reading on the meter.

Newer meters using an all-electronic system have no moving parts, eliminating the major causes of VU meter lag. The most common of these uses a series of LEDs in a line on a VU meter scale. LEDs up to the volume level will light up.

*Neil Lewbel*
*Consultant, Technical Writer*
*Kew Gardens, N.Y.*

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# So... U want to know about Synthesizer Basics Part III

**By Craig Anderton**

In our first installment, we considered the synthesizer as a system. This system is sort of like an Erector set in that it contains a number of building blocks which, when connected in the proper order, create a complete musical instrument. In last month's installment, we took a closer look at one element of that system, the oscillator. This is the block that actually generates sound. We learned that the frequency of the oscillator depends upon a voltage injected into a certain input, called the *control voltage* input, and made an analogy to the automobile: As feeding more gas into the auto increases the speed, feeding more volts into the oscillator has the effect of increasing the frequency.

This month, it's time to take a look at the part of our synthesizer that generates the voltage that tells the oscillator what to do. On most synthesizers, this part is called the *controller*. Most often, a standard organ keyboard is the controller, although nowadays other instruments are more or less capable of controlling synthesizer oscillators (guitars, drums, woodwinds, etc.). Let's start by looking into the way a traditional synthesizer keyboard controller works.

Most voltage-controlled oscillators (called VCOs for short) are designed to accept a control voltage in the range of 0 to +10 volts; in other words, when you inject 0 volts into the oscillator, it's at its lowest frequency, and when you inject 10 volts into the VCO, it produces its highest frequency. In between these two extremes, the VCO responds in a very precise way: *Any change of exactly 1 volt causes an octave change in pitch.* For example, let's say that when you feed 5 V into the VCO, it produces an "A" 440. If you *raise* the voltage to 6 V, the pitch will go *up* an exact octave. If you *lower* the voltage to 4 V, the pitch will go *down* exactly one octave. Raising the voltage to 8 V boosts the pitch upwards by 3 octaves, and so on. Not surprisingly, this VCO is said to have a "1-volt-per-octave" response. As a result, since there are 12 notes per octave, a change of 1/12 of a volt changes the pitch upward or downward one semitone. Using our previous example (5 V="A" 440), then 5-1/12 V is "A#", 5-2/12 V is "B", 5-3/12 V is "C", and so on.

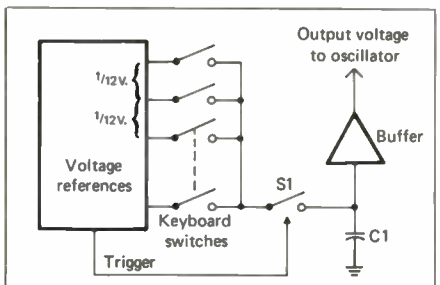


Figure 1. Conventional Analog Synthesizer Keyboard.

Now let's relate this back to the keyboard. *The keyboard is responsible for assigning a particular voltage to a particular white or black key, and sending that voltage to the oscillator.* Thus, again using our previous example, pressing the "A" 440 key will send 3 V to the VCO. Pressing the A# will send 3-1/12 V to the VCO, etc.

If you'd like a little insight into the actual electronic mechanism that makes up a "keyboard," here's how it works. (See figure 1.) A bunch of parts (a current source and many precision resistors, to be precise) form a series of reference voltages. Pressing one of the keyboard keys selects that particular voltage and passes it along to electronic switch S1. Now, remember how in Part 1 we said the keyboard produces a *trigger* output whenever a key is pressed? We use this trigger, among other things, to close switch S1 for a fraction of a second. The voltage selected by the keyboard then goes through this switch, and is stored in capacitor C1. When we stop pressing the key (in some designs, before we stop pressing the key), S1 opens up again—*but our voltage is still stored in capacitor C1, and C1 will continue to hold that voltage until another key is pressed.* The next logical question is, "What is that funny looking buffer box?" Well, if we used the voltage on the capacitor to directly drive the VCOs, it would have all its charge drained off very quickly, since the VCOs require a certain amount of power which the capacitor cannot provide by itself. The buffer isolates the capacitor from more power-hungry devices; it basically "reads" the voltage on the capacitor at its input, then converts this into a stronger, more powerful signal capable of driving multiple VCOs. A capacitor doesn't hold its charge forever, but if the buffer provides enough isolation, a synthesizer will be able to hold a pitch reasonably in tune for at least a minute or more.

This system is called a *sample-and-hold*, because when you press a key and select a specific voltage, S1 is triggered and "samples" whatever

voltage is present, while capacitor C1 "holds" it for an indefinite period of time. There . . . that wasn't too difficult, and now you have an understanding of what a sample-and-hold is, what a 1 v-per-octave-response is, and the fact that all a synthesizer keyboard really does is send out voltages (not sounds!) to other parts of the synthesizer system.

The system we've discussed so far is the traditional, "analog" way of building a synthesizer keyboard. But there are some limitations to this approach which we should really consider. First, the voltage references have to be perfectly accurate, or notes will sound out of tune. Next, switch S1 must have no resistance, or the voltage reaching C1 will not be accurate but will instead be a little bit lower. We've already mentioned that charge can leak off the capacitor, and this also produces an error; and there are other, more subtle problems. But, there are alternatives.

One such alternative is the *digital* keyboard. Actually, there are many ways to implement a digital keyboard, some of which are mind boggling in their complexity and usefulness (anybody who has played a Prophet can attest to that!). Let's consider a simple digital keyboard.

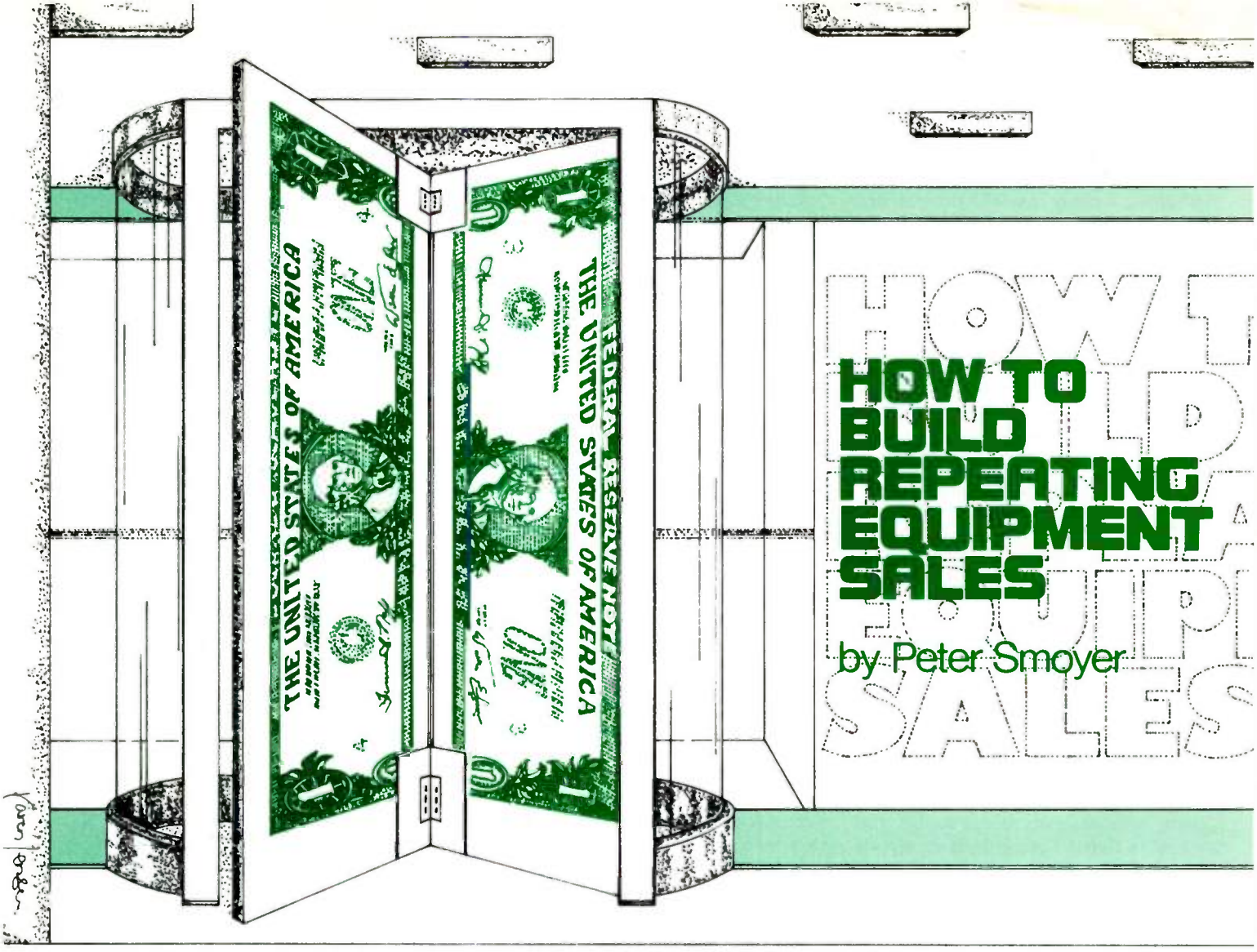
The general idea behind a digital keyboard is to have a circuit that constantly "scans" the keyboard, searching for a "key down" condition. When the circuit discovers such a condition, it sends out a trigger pulse to the rest of the system, thereby announcing its discovery to the other modules; simultaneously, it issues a coded digital number (in language machines can understand) that represents the key that is currently down. This code may not mean a lot to us, but it does mean a lot to the machine.

Now that we have this coded number, there are several things we can do with it. We can send it to another circuit that converts the number to a voltage output suitable for driving our oscillators. This other circuit is called a *digital-to-analog converter* (or simply, D/A converter), whose mission in life is to convert digital numbers to analog voltages that the VCOs can relate to. This resembles our sample-and-hold, but there is one important difference: We are dealing with coded numbers, not voltages, up to the point where the number is actually decoded into a voltage that the oscillator can understand. As a result, we don't have to treat the number with the same kid gloves with which we treat the voltage in an analog system (remember, any change in the voltage from ideal turns into a pitch problem). Another benefit is that we eliminate the holding capacitor (C1 in the diagram), since we can create a computer-like circuit that remembers the *number* instead of trying to have C1 remember a *voltage* using conventional techniques. This means we don't have to worry about the signal dropping as time goes on; since the number is constantly at the input of the D/A converter, then the voltage that comes out of the converter is going to stay constant also.

But, we don't have to stop there. The number could also be assigned into a computer, which can then remember that number while the scanner keeps searching for other notes. This is the basis of several polyphonic systems; the scanner finds a note and sends the code (which is translated into a voltage) to one oscillator; then it scans and finds the next note, and sends that code to another oscillator; and so on, for as many notes as the system can handle at one time. More and more companies are jumping on the digital bandwagon as digital techniques become less expensive and more reliable.

Let's sum up. A keyboard controls an oscillator by sending out a precisely calibrated voltage that causes the oscillator to generate a certain pitch. This can be done through either analog techniques, where a voltage picked off the keyboard is stored in a sample-and-hold unit, and then sent to an oscillator; or through digital techniques, where the keyboard is scanned for specific pieces of information, and this information is then decoded into a voltage for the benefit of the oscillators. Polyphonic techniques are much more easily realized with a digital system. I should again emphasize that there are many ways to skin a digital cat, and this is only one of them . . . but hopefully, it will give you a general feel for the entire process.

Now it's time to enter the mysterious world of the voltage controlled filter: thrill to uncontrolled resonances, variable slopes, and cutting off frequencies at the bandpass. This will all make sense after next month's installment in this series . . . see you then.




# HOW TO BUILD REPEATING EQUIPMENT SALES

by Peter Smoyer

There are many of us who have practically given our first born male child to the finance company just to get a studio off the ground. But, no matter what the investment, the main requirement for that studio customer is that he be able to make a recording that resembles the best aspects of a musical performance with a minimum of noise. Every sale—of whatever combination of equipment—should be geared to that best possible recording.

## SPEAKERS

First of all, without good-to-excellent monitors, your customer can never know how good or bad his recording may be. For instance, if the high end of a speaker starts to fall off at about 8,000 Hz, it would be difficult to hear any noise and hiss problems caused by the tape deck and other equipment. There is a similar problem with bass. A bad speaker to use for a monitor would be one that inaccurately represents the amount of bass being recorded. Even some well-known brand speakers have problems in the areas of resonance and in low frequency output relative to midrange and treble output.

Speaker specs are the longest standing joke in the audio business. They can tell you what's in the box, but not necessarily what's going to come out of it. For example—speakers "A" and "B" are two real, 12-inch, three-way speakers with similar price and power handling capability. Both are reputable American-made brands. Speaker "A" has a frequency response of 33-20 kHz ±4 dB. "B's" frequency response is 45-15 kHz ±3 dB. Which is the speaker with better high and low frequency response? Well, the specs won't tell you, and I won't either. But if you listen to them side by side, you should be able to tell immediately.

What do you tell the customer about speaker specs? Tell him what the manufacturer claims is in the box—power handling, speaker size and design, impedance, price and guarantee. Let his ears decide which speaker sounds better. Tell him also that the more he understands any speaker's shortcomings and strong points, the more he can make the speaker work well for him. It makes good sense for your customer to have a cheap, auxiliary pair of speakers hooked up along with the main playback speakers at all times, so that he can switch from one pair to the other. When I say cheap speakers, I mean less than $30 a pair, if not free! These cheap speakers give a good idea what the recording will sound like when played on a small home stereo. But mainly the cheap speakers will serve as a reminder of the weak and strong points of the main monitors. An engineer friend of mine claims that he changes his cheap speakers every chance he gets, because the more speakers he hears, the more he understands his main monitors.

---

*Peter Smoyer works at Soundroom Four, Eastern Light Company; and is a principal in Acme Sound Studio.*

## HEADPHONES

The selection of headphones is not as critical as speakers. Almost any good quality headphone will do. Some people even like to use open air designs, but they can cause problems in a small studio. For example, if the bass player is playing directly into the mixing console without using an amp, and the rest of the band is playing loudly through amps, it is advisable to block out room noise from the bass player's ears. The kind of headphone that seals out external sounds will do the best job. When the musicians want to talk to each other, the mics set up in the studio will pick up their voices and enable them to hear each other speak.

Headphones should be able to put out a good stiff volume level with no loss of clarity. A bright headphone will provide greater satisfaction than a bassy or boomy headphone, because each individual instrument will sound distinct at both high and low volume levels. You've probably noticed that most cheap headphones by most manufacturers have too few redeeming qualities in the high frequency range. Many more are bulky and uncomfortable. One of the most unfun things about recording can be that crunchy feeling you get in your ears after listening to bass drums through headphones that fit your head like a large piece of luggage.

## AMPLIFIERS

As for amplifiers, one percent distortion is not unacceptable for a good sized power amp. Fortunately, THD specs range between .5 and .005 percent. While THD specs like .005 percent are nice, one should not sacrifice power to get them. It is more desirable to have high power, say 100 watts, with reasonably low distortion, than only 60 watts, with .009 percent distortion. Remember, speakers are not guaranteed when a customer has pumped 65 watts of pure upper harmonic distortion through his tweeters. That risk is greater with a 65 watt amp than it is with a 100 watt amp, regardless of THD specs. With the multitude of mis-connectible connectors and unattenuated attenuators found in studios, it is very easy to dump a loud signal through the speakers. Any distortion added to that signal makes it even harder for the speakers to handle. Thus, the customer on a budget should buy as much power, within reason, as he can afford.

Since most speaker manufacturers recommend that the rated output in watts RMS of a power amp be as much as twice what the speaker system can handle, 100 watts per channel is usually not too much power for the retailer to recommend. This is for the safety of the speakers. Much of the peak information in music requires well over twice as much power as the average music level. This being the case, a small amp will be straining to get these peaks out if it is running at its full RMS output. Straining the amp can cause distortion, and distortion will shorten or end the life of the tweeters. A 100 watt power amp will rarely, if ever, have to strain when driving efficient speakers.

Although pre-amp is not necessary, it can come in very handy to facilitate playback from other sources such as a cassette deck, a reel-to-reel, or even a turntable. By the way, don't forget the turntable sale. It's very handy for the customer to compare his recordings to other well-known recordings. Records generally provide better quality than pre-recorded tapes.

## RECORDERS AND MIXERS

What kind of a multitrack machine does a customer need to buy? The more tracks the customer buys, the more sophisticated mixing console he will also have to buy. A quarter track/four-channel deck costs no more than a good half-track/two-channel deck. But while good results can be obtained on a two-channel deck using a small sound reinforcement type mixer like a common six input/two output unit, a much more complex mixer is needed for a four-track deck. These better mixers allow a customer to assign any microphone being used to any track on the tape deck without pulling and re-patching interconnecting cables.

Bigger mixers also allow you to use more microphones and more signal processing devices. The result is that once a customer buys this kind of recording gear, he can get hooked for life. My studio, Acme Sound Studio, started out with a small stereo, 7-inch reel-to-reel tape deck and two microphones sitting in a friend's basement. Acme now includes an eight-channel, multitrack deck, two cassette decks, two mixing consoles, half a dozen signal processing devices, three pairs of playback monitors, a grand piano, and much, much more.

Any person who owns or wants a multitrack deck requires a good mixdown deck and a good cassette deck. The mixdown from multitrack to stereo is usually done on a half-track/two-channel deck at 15 ips. Generally, the half-track deck with the best signal-to-noise ratio will be the best choice, as well as being the most expensive choice. Let me say again that one of the biggest problems of a small studio is noise. If Dolby noise reduction or dbx is available for the half-track deck, so much the better. Remember, however, that almost any half-track deck makes a better mixdown deck than any quarter-track, home stereo reel-to-reel deck.

Cassette requirements for studio purposes are almost the same as they are for home entertainment. For that reason, avoid selling your customer anything other than a cassette deck with noise reduction or one that runs at any speed other than the standard 1⅞ ips. The cassette deck is meant to be used as the universal format whereby your customer can make copies to be played on other people's home stereos.

The better the cassette deck, the better the copy your customer can make of his precious recordings. While the best cassette machines usually have three heads and two motors, that is not a necessity. The best assurance you can give him is that his cassette deck will copy accurately and without noise. You can recommend one of the new two head decks with variable bias or a bias fine adjust control.

## FURNISHINGS

After the customer buys his equipment, he has to furnish a room or two in which he can use it. Even if you don't sell building material, it's very helpful to have some background information in studio construction. What you want is a happy customer.

The design of the control room, or wherever your customer will be listening to the recording, is quite critical. The room is just as important as the speakers in it. If the room is too echoey or too sound absorbent, and the recording sounds good in that room, there's a good chance that the same recording will sound funny when played back elsewhere. The customer may blame this on the speakers that you sold him.

The proper listening room should have carpeted floors. The walls should be a combination of sound absorbing and reflective surfaces, with the wall

behind the listener completely sound absorbent. This rear wall treatment is commonly called a bass trap. A simple and inexpensive sound absorbing panel can be made by stretching burlap over a wood frame with fiberglas insulation stapled inside. Burlap is available in many colors at any fabric shop.

The customer may also be wondering where he can get information on how to design the walls of his studio so that sound does not leak either in or out. He may have discovered that covering the walls with egg crates and old carpet is cheap, but it does not do much except deaden the sound inside the studio and make instruments and voices sound very dull. The studio should be a semi-live room. An architect will be very expensive and, unless he design sound studios for a living, won't be very much help. Books on studios don't always show designs that will suit your customer's available space or pocketbook. Believe it or not, building supply and drywall companies are a good source for designs. They have fire code information for every type of wall, ceiling, and floor used in public dwellings. Along with the rated burn time given for each structure, there is an STC rating. STC means Sound Transfer Classification.

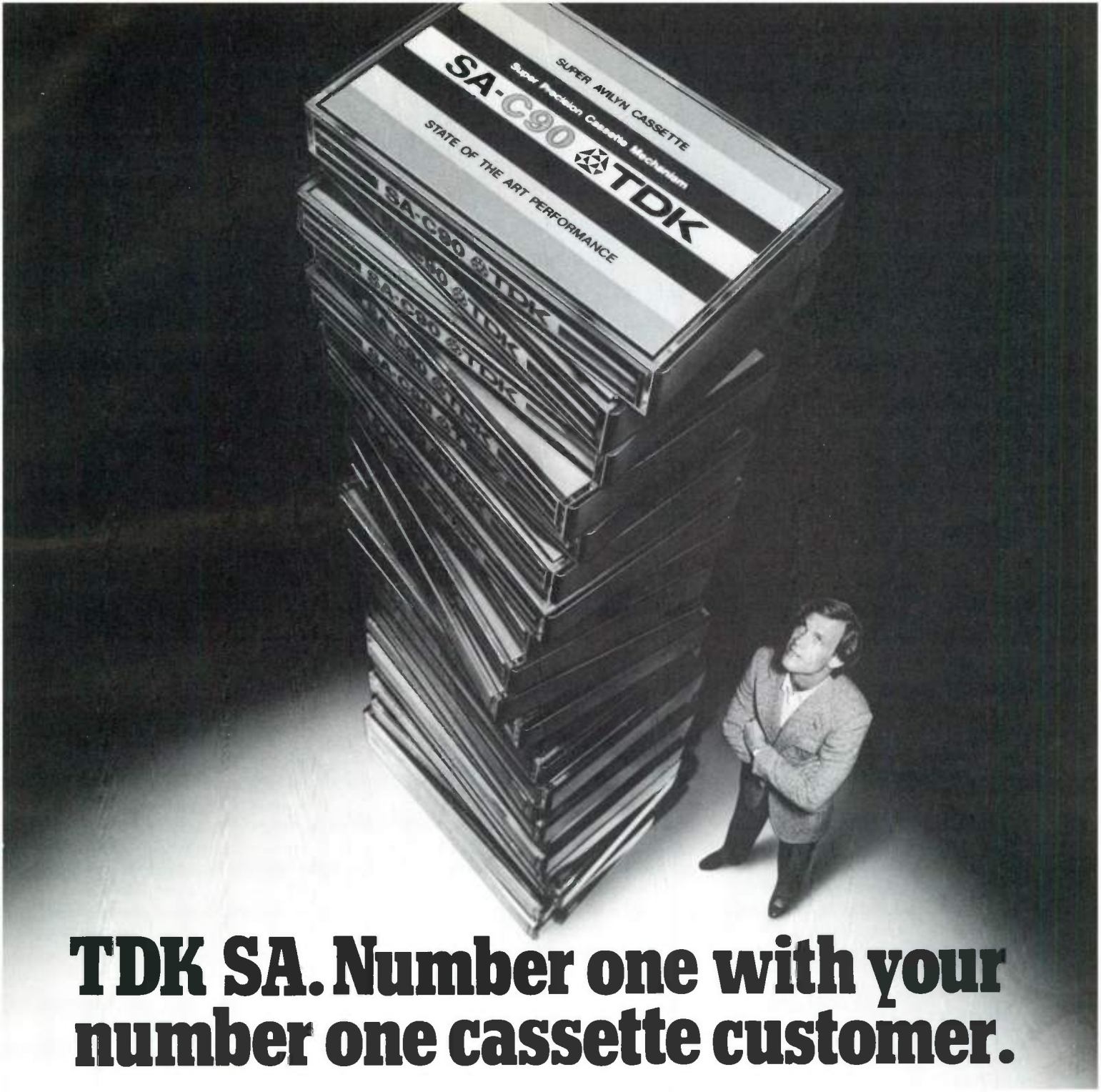
The math used in figuring out an STC rating is simple. If the studio wall STC rating is 50, and the inside volume level over 125 Hz is less than 90 dB, the music will be less than 40 dB on the other side of the studio wall. You can easily talk above 90 dB without screaming. Also, most good studio monitors require only one watt to deliver 80 dB at a distance of three feet. Thus, in a studio using a separate control room, the volume level of the control room monitors will easily mask any sound escaping from the studio.

What does all this mean? Well, if we have a band in the studio using 100 watt bass amps, and the drummer is just about standing on the bass drum and tom toms, our neighbors would find their fine china crashing on the floor due to excessive vibration. But the studio is not designed as a concert hall. A band wanting to record at such a volume would have to relocate.

Fortunately, the best recordings are made at lower volume levels anyway. Usually, the bass is played directly through the mixing console and monitored through the playback speakers and headphones. Guitars can also be recorded direct or through small amps at low volume. The drums are the only thing left that will cause any problems, and the drummer no longer has any competition. If the drummer is still too loud, you can turn up the volume level in his headphones only, until he gets the hint and starts to play softer, lest his ears bleed.

If the customer wants to use a typical home stereo for monitoring his multitrack recording, make him aware of the possible consequences. It won't be too long before he becomes painfully aware of the inadequacies of using a small home stereo, and he is back looking to buy what you've originally suggested to him. If his home stereo happens to be a good top-of-the-line system, he may not need a separate playback system except for convenience.

The least you can do is sell him some tape. He'll need the best you've got and lots of it. And give him a break on the price. The more money he can make on his studio, the more he'll spend in your store.




# TDK SA. Number one with your number one cassette customer.

In the world of audio, the perfectionists are a highly visible minority. In the premium cassette business, they account for 8% of the market in numbers, but over 18% in sales. Because of the influence they exert on their friends, their overall impact extends far beyond their purchases. Among audio perfectionists, the number one cassette, of any bias, is TDK SA.

The perfectionists want the best possible sound quality, and since most quality manufacturers set up their decks to sound their best with SA, SA is the logical choice for home use.

The perfectionists appreciate technological superiority. SA's advanced cobalt-adsorbed gamma-ferric oxide particle formulation made it the first non-chrome high bias cassette. And many parts of its super-precision mechanism, such as its double hub clamp and bubble liner sheet have yet to be equalled.

The perfectionists insist on reliability, and they know that TDK was first with a full lifetime warranty*–more than 10 years ago.

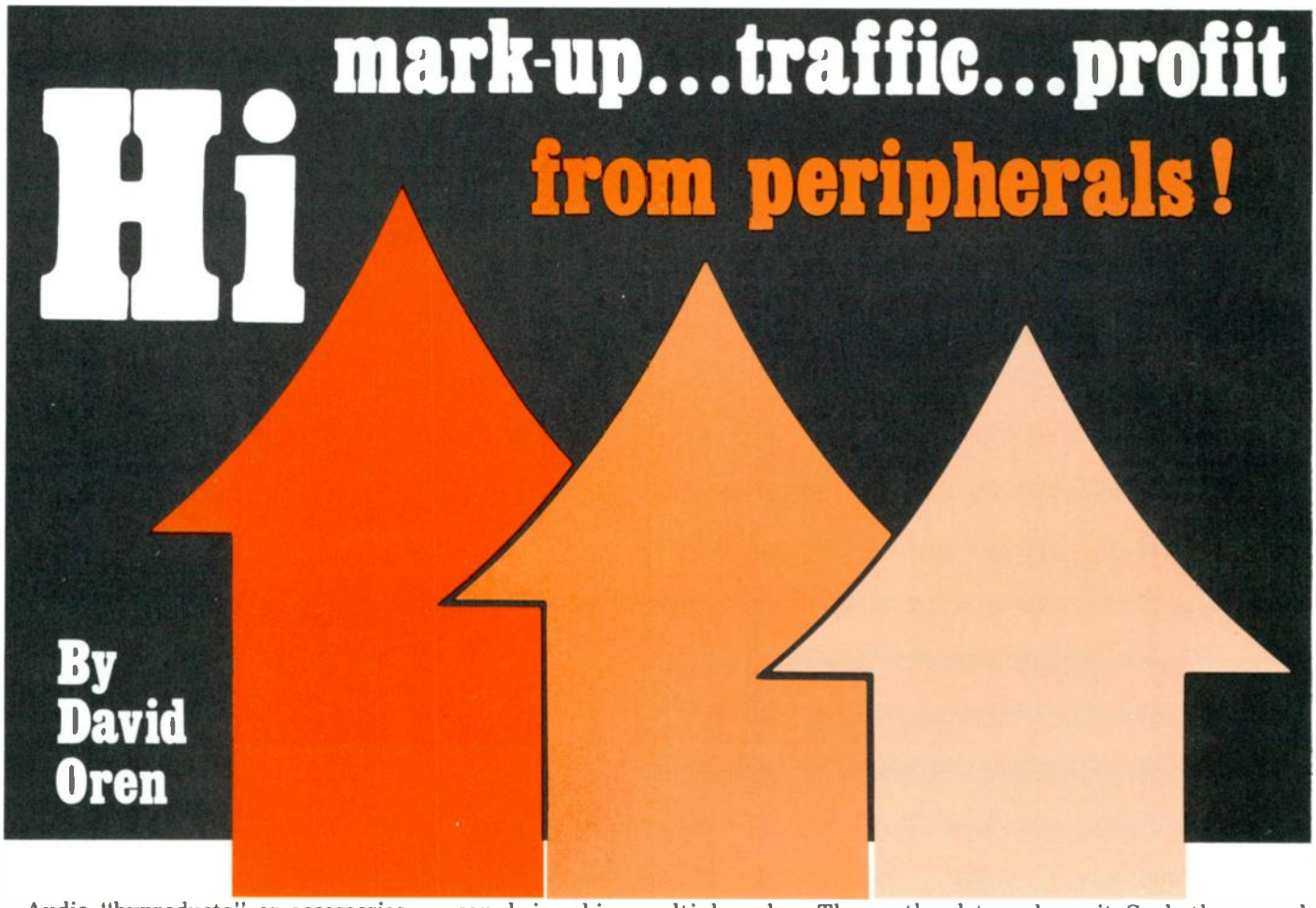
For the retailer, the opportunity is a lucrative one. Create an SA customer and you are also creating a better customer, one who buys more cassettes. Then he converts his friends and...you get the picture. It's all part of the ongoing process that has made TDK SA the number one selling high bias cassette in America. We'd like you to be part of that process. TDK Electronics Corp., Garden City, N.Y. 11530. In Canada, contact Superior Electronics Ind., Ltd.

*In the unlikely event that any TDK cassette ever fails to perform due to a defect in materials or workmanship, simply return it to your local dealer or to TDK for a free replacement.

TDK

The machine for your profit machine.

# Hi mark-up...traffic...profit from peripherals!



By David Oren

Audio "byproducts" or accessories can still be described as the audio industry's step-children, but they have come a long way. More and more dealers are beginning to see their intrinsic value, both as a profit center and a traffic builder. What's more, as audio gear has become more technologically advanced and complex, accessories have begun to advance. Catching up to fill the technological gap has resulted in improving the sound of current systems and in stretching the dollar.

Accessories, as a product category, began to appear about 10 years ago when the chains and large audio outlets emerged. Their advertising and merchandising techniques broadened consumer acceptance and, as high fidelity gear evolved, their selling methods changed and broadened with them. This evolution of electronic products has always produced a flow of "by-products." Today's sophisticated audio equipment requires additional products, and the aware dealer is the one who stocks full lines of good quality accessories, from tape to mics and mic cables, from demagnetizers to recorder maintenance kits. Using mass display techniques for greater impact, the smart dealer is finding accessories can bring him multiple sales. The return-on-investment and the amount of floor space these items take up in a store make it more than desirable for a dealer to carry them. Accessories are essential, if the dealer wants to serve his customer in a complete manner and if he wants to make sure that the customer will return to his store again and again for all his audio needs.

Many dealers haven't paid proper attention to "accessories" because they really haven't thought the thing through. Many retail salesmen don't know enough about accessories to be able to sell the customer the more expensive, quality accessory to make that system he has just sold sound its absolute best.

The first thing a dealer should do in thinking about how he should stock accessories is to visit his local supermarket or general merchandise chain store and study how products are displayed for impulse purchasing and multiple sales. If you're at the supermarket you'll never see just one brand of coffee or one row of cans for each brand of coffee. You'll more than likely see several shelves of different brands and several rows for each brand. Supermarkets are committed to selling coffee, soup and other categories, and they let you know it. So do the general merchandise chains. They have spent years refining the art of displays.

The next time you go shopping, make a point of looking at the displays at the ends of the islands and the products that are displayed in the aisle near the cash registers. Note which products are displayed at eye-level and which products are on the bottom shelf. These techniques work for the mass merchandisers and they can work for you.

Scotch brand tape years ago spent a lot of money to move its blank tape from underneath the counter to behind the counter, but in full view, and their sales doubled. Then, they moved their displays to the front of the counter and sales increased again. Recently, they have been putting tape in big bins, and dealer sales have jumped again. In spite of pilferage problems, the use of gondolas, bins and wall peg boards to display accessory products does increase sales tremendously and more than offsets the small percentage of money lost in pilferage.

Even if you consider generally accepted pilferage figures of three to four percent for small items (or the chain store/mass merchandiser-admitted figure of two to three percent

of total sales), it is evident that accessories can provide a dealer with substantial profit while using a comparatively small amount of floor space.

At Federated Electronics in Los Angeles, every store has no less than 50 linear feet of wall space devoted to peg board displays for accessories and at least 150 square feet devoted to tape in baskets and gondolas.

When a Federated customer needs tape, head cleaner, or batteries he goes to Federated, where he knows they will have it, not Radio Shack or the record store or the drug store.

Merchandise your stores. Show commitment to the accessory categories you carry. Stock in the back room doesn't make sales. Select the products you should carry and get behind them. Let's take cables as an example. You should have between three and five peg hooks for your faster moving numbers and then scale down to one or two peg hooks for your slower moving numbers. Take a few minutes every day to look at your display. If a hook is empty, move the product to fill the space. Even supermarkets don't stock shelves all the way to the back, but they always look full.

If you would use a more formalized approach to calculating return on investment you might be very surprised at the results. Most often the products you think are the most profitable may not be. (See Table 1).

With a little help from the sales force, accessory turns can be easily brought up to six or seven turns per year. If you plug six of seven turns into the above example you should start to see the profit potential in accessories.

The creative audio/pro dealer has the greatest potential to capitalize on technological change if he understands the problems it creates and presents the solutions.

One example is head cleaner and recorder maintenance. As the hardware manufacturers have continued to improve frequency response of all recorders—especially cassette recorders, and as blank tape manufacturers have continued to refine and improve coating and particle size, we have developed a very sophisticated system. So sophisticated that a change in tape to head contact of .000020 inches caused by oxide buildup in the head can cause a loss of 10 dB at 15 kHz in a cassette deck.

In the past, alcohol was the accepted head cleaner. Today, with new exotic oxides and binders, alcohol just doesn't cut it anymore. Nor do many of the less expensive chemicals. We may consider the best products available today to be fluorocarbons; trichlorotrifluorothane blended with 1,1,1 trichloroethane. Read the labels before you buy and sell your customer the best product.

Our environment is also changing, and we have to be aware of the changes it causes. There is more smog and more ozone in the air. Ozone causes the cracking and crazing on the sidewall of your car tires. It has the same effect on drive belts and causes hardening and loss of dimensional stability in rubber parts—pinch rollers. These effects are only magnified if you use the old standard "alcohol" head cleaner on the pinch roller.

Cable is another example. It is an accessory only because it doesn't come attached to the electronics or tape machines. But it does control the audible quality. When we began selling the 80-8 recorder/reproducer, we found a thoroughly disgruntled customer who kept saying the machine simply wouldn't operate the way it was supposed to. After many sessions with the dealer and after several telephone calls to the factory, it was determined that the cables being used to interface the unit were at fault. The cables were limiting the bandwidth. When our low capacitance coax interconnecting cables were substituted, the customer heard an entirely new sound.

| PRODUCT | CABLES | MIXER |
|---|---|---|
| Basic inventory at retail | $1,500 | $1,500 |
| Basic inventory at cost | 750 | 1,000 |
| Profit on sell | 50% | 33% |
| Annual inventory turns | 5 | 5 |
| Annual gross sales | $7,500 | $7,500 |
| Annual gross profit | 3,750 | 2,500 |
| Return on investment | 5.0 | 2.5 |
| Space required for display | 3.75 sq. ft | 4.0 sq. ft |
| Annual sales per square foot | $2,000 | $1,875 |
| Annual profit per square foot | $1,000 | $ 625 |

TABLE 1

The examples of recorded sound being produced using today's recorders demonstrate the professional approach necessary to the multi-channel art. The "minor detail" of cables is not minor at all, and neither is any aspect of the interrelated recording and mixdown process. Unfortunately, the old saw about the chain breaking at its weakest link is as true in the world of creative audio as it is elsewhere.

In creative audio we talk a lot about transient response. We want faster electronics, IC's with a faster slew rate, better rise time, better square wave response, broader power bandwidth in amplifiers (0-300,000 Hz), and for the most part we get what we ask for. Test reports done under laboratory conditions on a test bench produce volumes of graphs and charts that prove that the equipment meets its published specs.

Does *every* buyer really achieve this performance in practical application? The answer is, obviously, no. The 80-8 problem caused by poor quality cable is just one of hundreds happening every day. Some are gross and turn up quickly; many are more subtle and less easy to recognize. If that new mixer or amp doesn't sound as good as you thought it should, but it's close enough, you might not do anything about it. Yet you could be getting a lot more out of it by just upgrading to quality low capacitance coax cables.

All cables are not created equal. The accepted standards for cable of five years ago are no longer sufficient to guarantee optimum performance for today's creative audio products. We need much lower capacitance (nominally 15 pf/ft), more rugged multistranded cable for longer flex life, better connectors that do not deform or bend easily, multistranded cable for greater skin effect for broader frequency response, possibly to 1 megahertz or more, extremely low attenuation (4 db/100 ft at 1 MHz), and braided bare copper shielding for isolation from radio frequency interference.

"But," I hear, "It's only wire." No! It's an interactive component in a system chain. Wire has capacitance. The tendency of a capacitor to smooth out voltage variations is a disadvantage in

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*David Oren is National Sales Manager of TEAC Multitrack Series and of accessories. He is also Market Planning Manager.*

a cable. You can think of a cable as a capacitor because it has the inner conductor and the shield separated by an insulator. When an audio signal (AC) is fed into a cable, the capacitance of the cable must be charged to the signal voltage (which is constantly changing) before the load receives the full signal voltage. If a cable has high capacitance, the voltage may never reach full potential, because the cable is acting as a filter. It doesn't take much capacitance to have an effect. The difference between 15 picofarads per foot and 100 pf per foot may sound like a lot, but remember, a pico is $10^{-12}$ or 0.000,000,000,001.

Skin effect plays a big role in cable performance. Skin effect is the tendency of the audio signal (alternating current), as frequency increases, to travel only on the surface or skin of the conductor. We all learned that DC flows through the cross-sectional area of the conductor. In a stranded cable, each strand is considered a conductor. As frequency increases, the signal (current) flows more and more on the outside of each conductor on the skin.

Skin effect is part of Radio Frequency (RF) theory and has little effect on sine wave response in the audible range to 20,000 Hz. But, the fast rise time associated with transients in music corresponds to frequencies beyond the audible range and definitely in the RF region. Therefore multiple conductor bare copper cables will offer less resistance to current flow and more skin surface to conduct the signal. Insure that your customer gets all the performance he paid for. Since you stock the best and newest technology product, sell the cable that will insure its performance. Show your commitment. Be sure your customers see you display systems wired up with the best possible cable. Be sure to package cable with your system sales. It's an interactive in the system chain and deserves to be treated as such. Pay attention to the hardware manufacturer's recommendations on cable.

If you commit to merchandising and selling accessories, you can achieve high profit and high turnover. One of our Tascam dealers sold more than $20,000 last year in cable, patch bays and recorder maintenance products. It forms a substantial part of his comprehensive profit picture.

Manufacturers are helping by producing various kinds of blister packs and designing other new packaging to intrigue the customer. Discwasher, for example, has its excellent disc kit. At TEAC, we produced a glass-topped, commemorative gift box containing 3 ounce bottles of head and rubber cleaner, stainless polish, a demagnetizer and swabs and a wipe. The entire stock was sold out quickly.

Blank tape manufacturers, such as TDK and Maxell, have traditionally been responsive to and innovative in their accessory lines. The important point that you must recognize is that the optimum performance of quality creative audio products simply cannot be obtained without quality accessories. And with your customer learning how to upgrade the *sound* of his equipment with the careful selection of good accessories, you should encourage such sales by stocking quality product. When you also consider the return-on-investment and the little amount of floor space required for such products, the dealer is missing a real profit center when he ignores quality accessories.

Accessories can help tremendously in turning any dealership into a one-stop audio shop.

# If it doesn't have an ANVIL®... you don't have a case.

A lot of musical instrument and amp cases are going around these days trying to pass themselves off as ANVIL® cases. And a few dealers are adding to the confusion by using the word "anvil" to describe cases that may look like ours on the outside but don't even begin to measure up on the inside.

The fact of the matter is simple: If it doesn't have the ANVIL® on it – it doesn't have ANVIL®'s experience, reputation and quality construction in it.

Sturdy, dependable ANVIL® cases are the industry standard – always have been. They're designed around the delicate equipment they carry and are perfectly balanced for easy handling. They're dent-proof, scuff-proof, and slippery-fingered-roadie-proof. And they're available in just about any color you can name.

So if you want your guitar, synthesizer, cello, drums, amps and sound-reinforcement gear to get to the gig in one piece – depend on ANVIL®. We can make a strong case for just about anything.


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CIRCLE 83 ON READER SERVICE CARD

# MAY THE SOURCE BE WITH YOU

## TALKING ABOUT TAPE

**By Del Eilers**

You can serve your customers better when you help them choose the proper tapes for their needs. Unfortunately, even some very sophisticated customers and retailers believe that because all recording tapes look basically alike, they perform basically alike.

The truth is that there are significant differences among various types of recording tape—differences that can seriously alter the results a customer will get with his purchase.

It's not just a matter of better and worse, although there *are* qualitative differences in various prices and brands of tape. Frequently, it's simply a matter of matching the proper tape to the customer's specific need, just as you would do with any other critical component in a recording system. The professional system is designed to be less influenced by minor flaws because the system accepts wider tapes and plays them at faster speeds. However, on the other end of the scale, the pro is more concerned with what is heard. He is more critical.

As far as tape care, the same principles apply to the professional or semi-professional as apply to the amateur. These are to handle the tape with care, keep dust, dirt and grime from reaching the tape, and to store the tape in boxes.

### WHAT IS TAPE MADE OF?

*Backing:* The substrate, or base material, of magnetic recording tape is a film. Once it was a paper film. Next came cellulose acetate. It has many fine properties, but cellulose acetate can deteriorate in time.

A desire for permanence led to the development of polyester films, the base most commonly used today. Polyesters are not only more stable than cellulose acetate over time, they are also stronger.

*Binder:* The binder holds in place the magnetic particles on which recording actually takes place.

The chemistry and physics of binders are the most proprietary part of tape design and manufacture. Binders are responsible for differences among brands and among different qualities of tapes. Advances in binders have made significant contributions to the evolutionary improvements in recording tapes.

Binders must have a lubricative quality, for ease in sliding past the magnetic heads on recorders. The "integrity" of a binder compound determines, among other things, how well the tape will last, and avoidance of rub-off or flake-off, or abrasive damage to recorder heads. The evenness of the binder coating is important to frequency response and to the avoidance of drop-outs.

*Magnetic Particles:* The ultimate performance quality of any tape is dependent upon the magnetic particles upon which sound is actually recorded.

It has long been known that ferric oxide is a stable and reliable material that can be processed into small particles, each one of which will act as a discrete magnet. The particular oxide formula, standardized since the early days of tape, has been gamma-ferric oxide. By adjusting the particle size and shape, different tape properties were obtained from this one basic material.

Gamma-ferric oxide was unchallenged as the basic raw material of tape until about 1970, when magnetic tapes with chromium-dioxide particles were introduced.

Chromium-dioxide tape's potential for improved signal-to-noise ratios and extended frequency response is most useful with slow-speed tapes. At higher speeds, these advantages over gamma-ferric oxide tapes disappear. Thus, chromium-dioxide tapes have been used almost exclusively in tape cassettes, which move at 1-7/8 ips.

Whereas chrome-oxide tapes have better *high* frequency capabilities, iron-oxide (or *ferric oxide*) tapes have a better *low* frequency output. And because lower frequencies are recorded deeper in the tape, while higher frequencies are recorded on the surface, an ingenious development has offered users the best of both worlds. This development is known as "ferri-chrome" or "Fe-Cr" tape.

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*Del Eilers is Technical Services Supervisor for the Magnetic Audio/Video Products Division of the 3M Company.*

Ferri-chrome tapes feature a thin coating of chromium-dioxide on top of a thicker coating of gamma-ferric oxide, which rests on the the base. Thus, lower frequencies are recorded throughout, including the more-responsive gamma-ferric oxide particles, while higher frequencies are recorded near the surface on chrome oxide particles, which are more receptive to them.

The signal-to-noise ratio on ferri-chrome tapes is excellent across the entire spectrum.

The newest entry in recording tapes, of course, is one that employs fine metal particles in place of traditional metal-oxide particles.

The performance of this tape surpasses that of metal-oxide tapes by a considerable margin. While exact performances will depend upon the recording equipment used—as is the case with all tapes—fine metal particle tapes have demonstrated a maximum output double (or more than double) that of other tapes at some frequencies. It has also displayed significantly lower distortion, additional high-frequency response, and improved signal-to-noise ratios.

Indeed, the one catch with this new tape is that it represents such a significant improvement over existing tapes that it takes special equipment to record on it. For while the tape will play back satisfactorily in the "chrome" mode of existing decks, it requires increased bias, stronger erase currents, and often different record-head technology than any other existing tape. Several manufacturers have now begun production of recorders designed to handle fine metal particle audio cassette tape. Many more are on the way.

The user's choice of gamma-ferric oxide, chromium-dioxide, ferri-chrome, or metal particle tapes exists almost exclusively in cassettes. In open reel systems, the choice is basically between low-noise tapes and premium high-output low-noise tapes. The latter offer superior performance, when used on machines that are biased and equalized for them.

## SPECIAL PROPERTIES OF TAPE

When tape is used in a particular application, a special property may be needed.

One visible special property applied to some tapes is a black finish on the non-magnetic-coated side of the film. This backing has a slight texture, analogous to the tread in a tire, which results in smoother winding by allowing orderly dispersion of air between layers. The texture also gives a better surface for the recorder's drive capstan and pinch roller to grab. This means a slip-free tape motion past the recorder's heads.

In high quality, high performance, open-reel tapes, the magnetic coated side is often treated to make it smoother. This frequently takes the form of compression or polishing. Smoothing out the hills and valleys on a tape surface means that more magnetic particles come into contact with the recording heads, improving output levels and high-frequency response.

As a result of these two developments, the old rule, "shiny side away from the recording head" is no longer true with some tapes. There are those on the market with both sides equally shiny, and there are others with surface-treated magnetic sides shinier than the positive-traction backsides.

## TAPE FORMATS

Open reel tape was the springboard for other formats. This tape is, as you know, available in several widths. Home recordists generally use only ¼-inch widths. However, professionals use ¼-inch, ½-inch, 1-inch, and 2-inch widths. Tape comes on various size reels. The professional primarily uses reels of 10½ inches in diameter, while consumer machines accept 10½-inch, 7-inch, 5-inch, and even smaller reels. All commonly used tape speeds, from the professional's 30 inches-per-second on down, are used on open reel. Open reel speeds are fractions of 30: 15, 7½, 3¾, and 1⅞ ips.

The cassette format was developed as a home and portable system; high-fidelity sound was not a part of the original concept. The cassette contains a tape slit to a width of 0.150 inches, and runs at a speed of 1⅞ ips. In many ways, the cassette is a miniature open-reel system, with the tape traveling inside the cassette from one reel to another. Therefore, it has fast-forward and rewind capabilities.

## HOW TO READ SPECIFICATIONS

Specifications are where the hype stops. The manufacturer must tell you what his tape is made of and what it can do. Understanding the various specifications can help you to help

your customer select the right tape for his recording needs.

Data sheets generally contain three types of information: physical properties, intrinsic magnetic properties, and electromagnetic properties.

Physical properties detail the backing material, width, thicknesses, and strength. The information is generally compatible among data sheets of the various manufacturers, so it is easy to compare. One physical property for which no industry standard exists, however, is durability. This would be difficult to discern from reading specifications.

Intrinsic magnetic properties are the basic magnetic characteristics of the tape. Generally, you can compare tapes with confidence, because of the well-established industry standards for determining the magnetic properties of tape. These properties are:

*Coercivity:* The demagnetizing force or field intensity required to reduce the induction of a piece of tape from saturation to zero. It's the force required to erase a tape.

Expressed in *oersteds*, coercivity affects both bias and high-frequency distortion limitations. Tapes below 290 oersteds are characterized as non-low-noise tapes. The higher the coercivity, the more bias is required. Chrome tapes, for example, are 500 oersteds and require special bias beyond that of conventional ferric-oxide tapes, as mentioned previously.

*Retentivity:* The amount of magnetic retention in relation to the amount of binder applied to the tape's backing. In today's jargon, "high-density" is really high retentivity. Tape designs of recent years have generally used a retentivity level of from 1,000 to 1,500 "gauss" (the unit of measure for retentivity), as compared to 700-1,000 gauss for earlier tapes. The new Scotch "Metafine" tape, however, as an example, has a retentivity level of 3,000 gauss.

By itself, retentivity is not especially meaningful to the consumer. It is useful, however, as a component of remnance.

*Remnance:* The higher a remnance figure, the higher a tape's potential maximum output before distortion occurs at low frequencies. Remnance is not always shown on data sheets. If not specified, it can be determined by multiplying the retentivity (given in gauss) by the coating caliper (given in mils), and then dividing by 629.

For open reel tapes, remnance for the standard output tapes will be in the 0.5 to 0.7 range. High output tapes should have a range of remnance on the order of 0.8 to 1.2.

For cassettes, the spread among competitive tapes will be much less, because manufacturers are generally putting on the thickest coating with the highest retentivity possible. Most high-density-low-noise tapes will have a remnance range of 0.3 to 0.4; with high-output tape, the range should be 0.4 to 0.5. With such narrow ranges, remnance obviously becomes less of a factor in choosing among cassette tapes than among open reel tapes.

*Bias:* A high-frequency, inaudible signal intentionally added to the recording signal during recording as an electromagnetic property. It helps carry the signal from the recorder to the tape and makes it possible for tapes to record a range of high and low decibel sounds that would otherwise be beyond its capacity.

In some cases, the bias requirement of a tape may be stated quite simply. With a chrome-oxide cassette, for example, there may simply be a notation on the box: "For use in the chrome position." The customer then need only set his tape deck switch to "chrome," and the unit will adjust the bias to the greater level required for chrome-oxide tape.

On open-reel tape data sheets, however, there is generally a series of bias curves, depicting the response of the tape to the raising and lowering of bias. Using these curves, a customer who is especially concerned with such variables as sensitivity, output and distortion, and who has tested to determine the bias output of his recorder, can select a tape which will perform better in the desired area. Or, if the customer has already decided upon the tape, he can use the curves to adjust the bias output of his recorder to promote the desired results. On most machines, this work should be performed only by properly trained and equipped people.

Professional users would add three parameters to a checklist of tape. These are:

*Modulation noise:* Modulation noise will show up on a tape when a low frequency solo instrument (bass guitar or viol) is recorded and played back on one track of a multi-track system.

*Print-through:* Print-through is difficult to assess. All magnetic tapes have some degree of print-through. Most professionals concerned about print-through will use a 1½-mil tape so there is maximum insulation between one layer of tape and the next. High temperature will increase the probability of print-through, so tape should be kept in a cool, dry place.

*Uniformity:* When a lot of editing is required to be done, it is critical to have uniformity within one reel of tape and from reel to reel.

## A WARNING ABOUT ELECTROMAGNETIC PROPERTIES

Electromagnetic properties are probably the most familiar standards of tape comparison to users. But in reality, these properties are difficult to compare. There is no single standard technique that may be used to define electromagnetic properties. Each recorder used to test the tape is critical to all the measurements. The adjustment of bias, recorder levels, and equalization are critical to the tape numbers generated. Thus, two different machines can produce two different sets of numbers for the same tape.

Of electromagnetic properties, the following probably best characterize tape and minimize the influence of machine variables: peak bias, maximum modulated level, sensitivity, and uniformity. But, again, it is not always easy to compare different tapes, even by these standards. Each tape data sheet compares the tape's electromagnetic qualities with those of a reference tape. Few, if any, of the different manufacturers use the same reference tape for open reel tapes.

The situation is somewhat better in cassettes, in which a standard reference has been generally accepted (DIN Bezugsband, a German tape).

There are two performance characteristics frequently quoted on technical data sheets of which you should be wary: signal-to-noise ratio and frequency response. Both are extremely dependent on a tape recorder's design and adjustment.

In summary, if you've seen one tape, you haven't seen them all. Though they look essentially alike, tapes include a wide variety of components and deliver a wide variety of results.

As a concerned retailer, you can help increase customer satisfaction by learning the varied capabilities of tapes; learning the varied expectations and equipment of your customers; and seeing that each customer walks out with the right tape for the job.

# a chip off the old circuit block

## part II

## digitizing the signal

**by Mike Beigel**

Digital processing of audio and musical signals is perhaps the most interesting and challenging application of computer technology in the audio field. Surprisingly, "real-time" digital audio requires the most advanced techniques of both analog and digital processing in order to deliver the uncompromising performance it promises. In order to connect audio signals from analog to digital format, and to recover them, many factors which were either ignored or unknown in conventional audio processing have become directly critically important. New kinds of audio specifications and performance criteria are thus evolving along with the advent of this new technology.

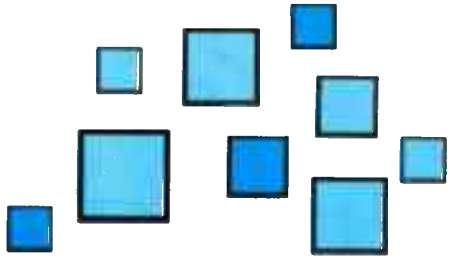
High quality digital audio systems are currently quite expensive and somewhat inaccessible to the general public, but we can expect the progress of technology to bring them into our industry within a couple of years. In presenting a brief overview of the process of "digitizing" audio signals, I have followed the general format of Dr. Barry Blesser's article, "Digitization of Audio: A Comprehensive Examination of Theory, Implementation, and Current Practice," which appeared in the October 1978 issue of the Journal of the Audio Engineering Society. I recommend Dr. Blesser's article, which included an excellent bibliography of other writings on digital audio, to readers who would like to further investigate the field.

### DISCRETE TIME AND QUANTIZED AMPLITUDE

The essential process of transforming an analog audio signal into a series of digital "numbers" can be understood as mapping a wavy line onto a piece of graph paper. The wavy line corresponds to the analog signal: a continuously varying voltage in time. The graph paper corresponds to the two dimensions of the digitization process: measuring the analog voltage at regular time intervals and "rounding off" the measurements to a digital number. (See figure 1)

The period of time between each measurement of the analog signal determines the *sampling rate*. It would seem that information from the signal is lost in this time sampling process; but if the sampling rate is at least twice as high as the highest frequency-component of the audio signal, there will be no information loss. The signal can be completely reconstructed from the information content of these samples (Nyquist's theorem). An audio signal with frequencies as high as 20 kHz could be sampled at 40 kHz with no information loss, though in practice a higher sampling rate is used.

The quantizing process, assigning a limited set of digital numbers to all possible analog voltages, *does* result in a loss of signal information. Since each digital number will represent a range of analog values, a *quantizing error* occurs. The size of the quantizing error will decrease as the number of possible digital numbers becomes larger, and thus by increasing the number of binary digits (bits) in the conversion process the resolution is enhanced. The signal-to-quantizing error ratio corresponds to the analog concept of signal-to-noise ratio, or dynamic range. In an analog system, the signal-to-noise ratio is equal to the maximum signal amplitude divided by the amplitude of the residual noise in the system. In a digital system, the signal-to-quantizing error ratio is directly proportional to the number of bits used to



represent the signal. Each bit contributes 6 dB to the performance of the system. (See table 1.)

**Table 1: Word length vs. Signal-to-Quantizing Error**

| Number of Bits | Signal-to-Quantizing Error |
|---|---|
| 4 | 24 dB |
| 8 | 48 dB |
| 10 | 60 dB |
| 12 | 72 dB |
| 14 | 84 dB |
| 16 | 96 dB |

## THE CONVERSION SYSTEM

The electronic system to convert signals between analog and digital format is comprised of six essential building blocks. (See figure 2.)

The *input low-pass filter*, with a sharp cutoff frequency set at less than one-half of the system sampling rate, insures that no frequency components in the analog signal will be present above that frequency. The prevents an extremely undesirable phenomenon known as "aliasing." Frequencies above one-half the system sampling rate, if allowed into the system, would produce "difference components" with the sampling frequency: the difference components would be heard as an objectionable noise signal.

The *input sample-hold* circuit detects the analog signal level at each sample interval, and holds that valve steady until the next sample is needed. It is necessary since the analog-to-digital converter in the following section requires a steady voltage for an accurate conversion.

The analog-to-digital converter produces at its output a digital number which corresponds to the analog voltage at its input. A "successive approximation" converter is most often used for audio. This is a system consisting of a digital-analog converter (described in last month's article), a comparing circuit, and a digital register for storage. (See figure 3.)

The successive approximation converter actually tries to "guess" the analog input voltage by comparing the output of a digital-analog converter with the input voltage. The successive-approximation register sets the first bit of the DAC, and the output voltage is tested. If it is higher than the input signal, a 1 is stored in the SAR, otherwise a 0. The next bit is set and the process is repeated until the system successively approximates the analog voltage. The digital number in the SAR is then output into the computer system or digital processor.

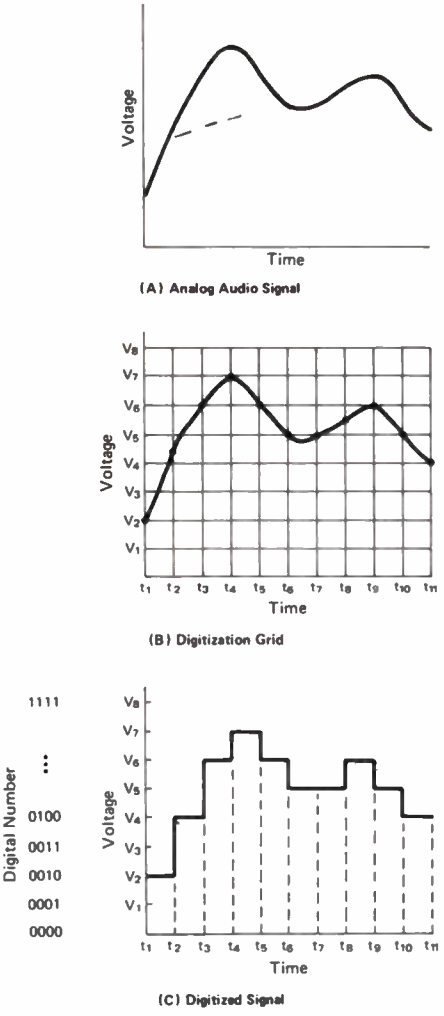



**Figure 1.**

Once the digital signal has been processed (stored, delayed, wordified, etc.), it is converted to an analog signal by *digital-analog converter*. (This process was explained last month.)

The signal from the digital-analog converter may contain erroneous outputs or "glitches" caused by transitions between legitimate digital codes. The *output sample-hold* acquires the DAC output voltage only when the DAC has "settled" to its intended output value.

The *output low-pass filter* (LPF) changes the stepped output of the sample-hold into a continuous analog signal by removing all high-frequency components associated with the sampling process. Since the output of the system can be connected to other devices which also use sampling processes (tape-recorder bias oscillator, other digital system clock, etc.), a sharp low-pass filter insures that frequency components from the system do not create audible interference by combining with the sampling frequencies of other systems.

## ERRORS AND SPECIFICATIONS

Though the system for digitization is not particularly simple, it at least seems straightforward. An analog audio signal converted to digital format would no longer be exposed to the forms of distortion and inaccuracy present in analog systems. That's what the innovators in the digital audio field thought, but the conversion process itself presented more subtle problems than they imagined it would. As Dr. Blesser has stated, "It is probably safe to say that the audio profession . . . [was] unaware of many of the central issues when the first commercial equipment was designed." A few cursory observations are worth noting:

Quantization Noise: The usual conception of "noise" breaks down when applied to digital systems. The quantizing process can generate "coherent" noise with an annoyance value far

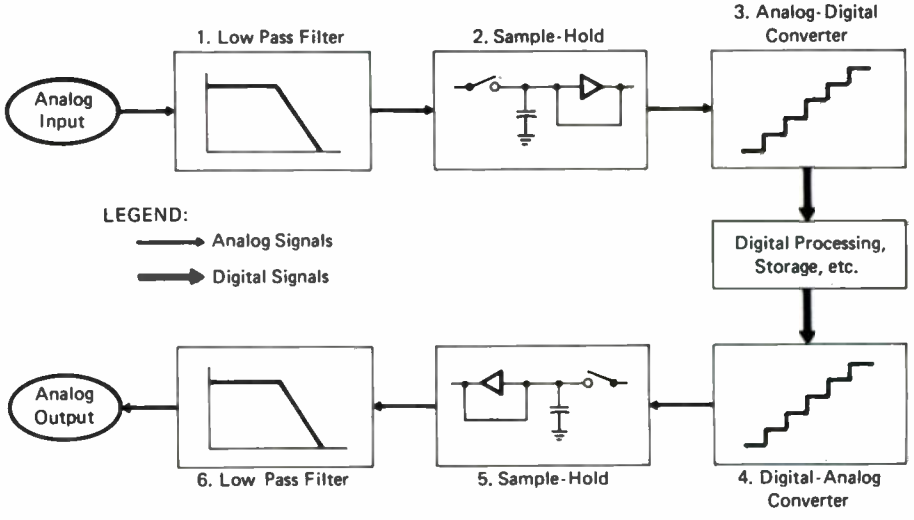



**Figure 2 - Digital Audio System Block Diagram.**

exceeding its numerical value: A low level sine wave can be transformed into a square wave, creating new frequency components which can cause "aliasing" with the digital system's sampling frequency. A paradoxical solution to problems of this kind is the addition of a small amount of analog "white noise" into the system, in order to mask the quantization noise.

Quantization Accuracy: We have spoken of digital-analog converters in ideal terms so far. Each digital code will correspond to an equal analog voltage step. But this doesn't happen in the real world, and the voltage steps may be unequal. This creates nonlinearities in the system, and produces modulation noise.

Peak Overload: In an analog system, peak overload creates limiting or clipping (the origin of "fuzz tone"), whereas in a digital system this "clipping" would create new harmonics which "alias" with the sample clock. Thus, precautions are needed to make sure any overload occurs before the input low-pass filter. And that means throwing away some of the dynamic range of the digital conversion system.

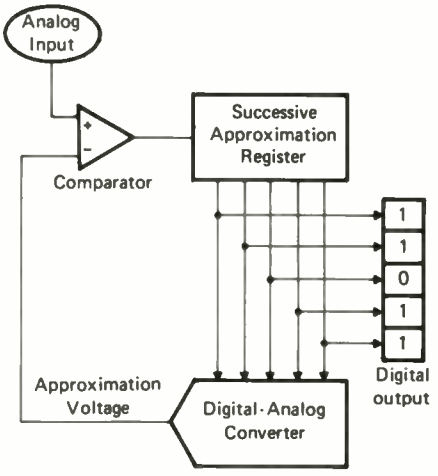
Input Low Pass Filter: The requirements for extremely steep rolloff and flat passband response amount to an analog designer's nightmare. These multi-stage filters require extremely careful design, and the optimum filter has not yet been established.

Sampler: Previously unimportant specifications such as "time base jitter," accuracy of "hold" mode, and slope of sample acquisition acquire a disproportionate perceptual importance. A new form of distortion was discovered, which required the use of "exponential slope" samplers for the output of digital systems.

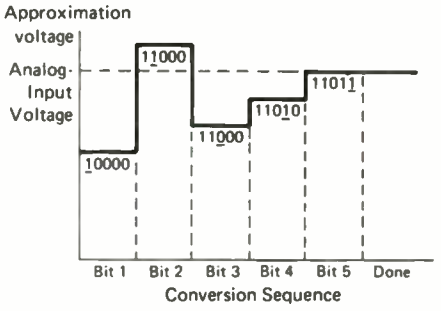
Other subtleties and specifications are still being discovered. For designers of digital equipment, these details are required knowledge. For music store owners, salespeople and consumers; awareness of the existence of these issues is necessary to prevent the possibility of technological fraud in the marketplace. The final judge of audio quality is the human ear and not the specification sheet.

## CONVERSION SYSTEMS

All the above descriptions have assumed the use of a system which converts analog signals to equal-sized increments represented by digital




(A) Successive Approximation A-D Converter




(B) Conversion Sequence Showing Successive Approximation Voltages and Corresponding Digital Numbers

**Figure 3 - Successive Approximation ADC and Output.**

codes. This method is referred to as "Linear PCM" (Pulse-Code Modulation). It is a logical, straightforward method and provides a digital output which is easy to work with. The "state of the art" performance for this type of system is embodied by a 16-bit conversion system, offering about 90 dB dynamic range, 20 kHz bandwidth and employing a 50 kHz sampling rate. This type of system is extremely expensive and is found in precious few pieces of audio equipment.

Other systems of encoding are employed in an effort to reduce the expense of the conversion system and also the storage requirements for the digital information. They all involve performance compromises, in terms of cost-performance. The current "art" of digital audio design is the economic-versus-perceptual tradeoff solutions to the high cost of conversion. The objective is to represent the same signal dynamic range with fewer bits or with less expensive hardware.

Alternatives to the linear PCM system are floating point converters, nonlinear converters, differential converters, and such arcane systems as delta modulators and adaptive systems. Descriptions of these systems are outside the scope of this article, but interested readers can refer to Blesser's article.

In shopping for a digital audio product, the interval system used is not really as important as the overall performance. However, in the future, when digital audio systems may become modularized, the method of conversion may become much more important. Each conversion method results in a different format for the digital numbers it produces. Some formats (linear PCM, for instance) are much easier to process with conventional computer technology, and this issue will increase in significance as digital audio methods continue in their development.

## WHAT'S IT FOR?

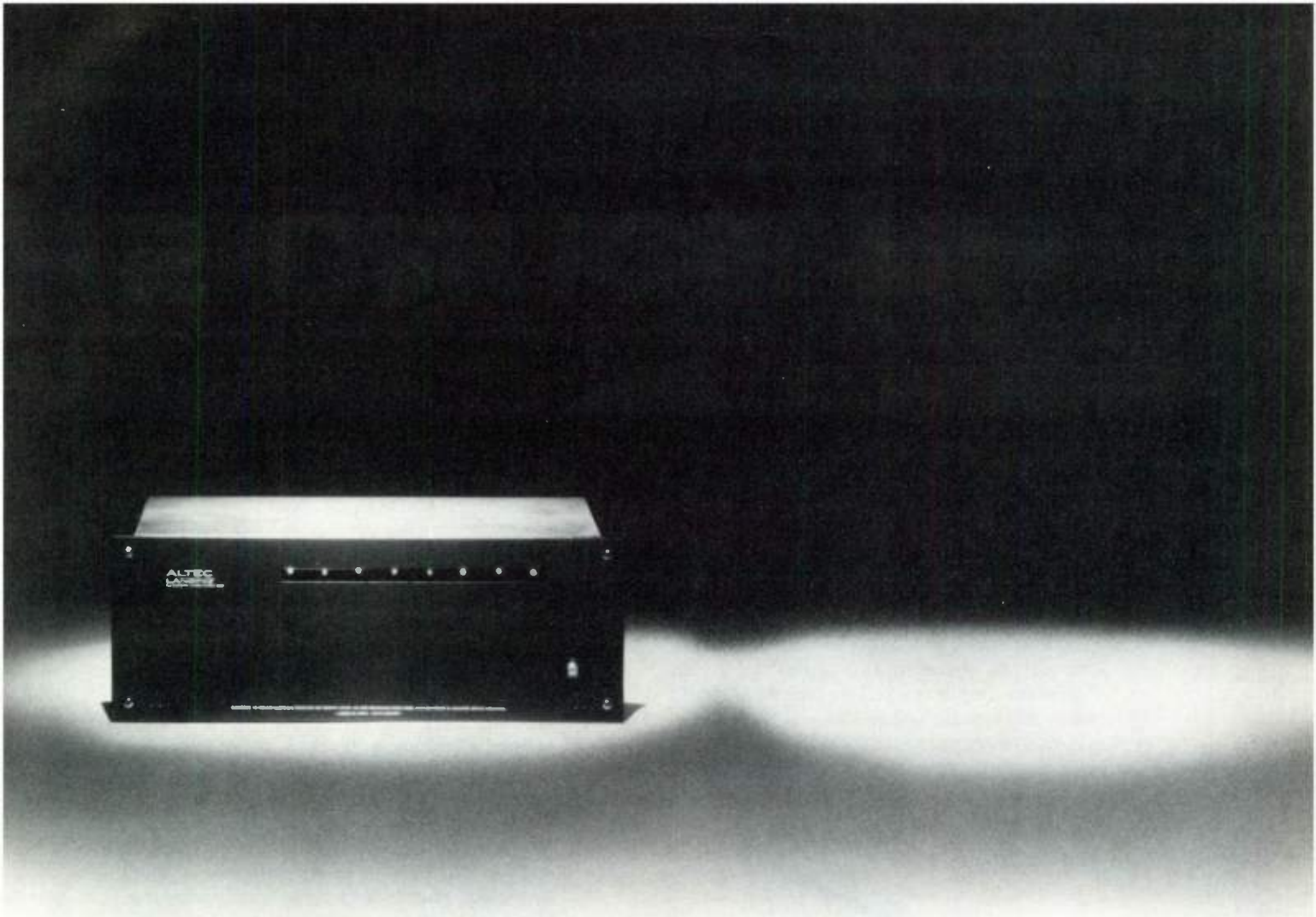
Why bother with all this complexity? It appears that digital audio is even more complicated than we thought it would be. Even with today's amazing technology (it really is amazing, you know) digital audio seems to be on the outer limits of our collective grasp. After all, analog technology is improving too. Why can't it be directed to the same problems that we are trying to solve with digital? There is no simple answer, but here are some reasons in favor of digital methods.

Once converted to digital format, signals are no longer subject to distortion or degradation. They can be stored indefinitely without deterioration. Hence the popularity of digital delay units and the emergence of digital tape recorders.

Computer processing of digital signals can provide functions and operations which are extremely difficult in the analog domain: speech analysis, resynthesis, harmonization, complex filtering, etc. The possibilities of computer processing have not really been tapped in the audio field; it is a technology very much in its infancy.

The overwhelming economic and technical advances in digital processing continue to outpace all other economic and technical progress in today's society. We can expect digital technology to continue to get "better-cheaper" for the foreseeable future.

In the next and final article of this series, I will describe some of the processes and functions performed with digital audio signals once they have been converted into digital form: What the "computer's" function is.



# Introducing Altec Lansing's Incremental Power System. And Its Closest Competitor.

Lately a lot of the big names in professional amplification have been making head-to-head comparisons with their competition. And, understandably, the brand being featured in each ad usually comes out on top. But one product that no one is comparing themselves with is Altec Lansing's new Incremental Power System.

That's not really surprising since Incremental Power is a lot more than just an amplifier. Each main frame actually contains a flexible array of power amps, electronic crossovers, line amps and input devices. So you get a complete amplification system that's prewired and ready to use. And since it is a system, Incremental Power offers a degree of flexibility that's unmatched by any single amplifier. In fact, to match the overall performance of one Incremental Power System you'd need a rack full of traditional components.

Skeptical? To prove the point we've devised a head-to-head comparison that you can make for yourself. Below you'll find the published specifications for an Incremental Power System set up for stereo, triamplified operation. Simply select the competitive components that you'd need to match Incremental Power's performance and then judge for yourself.

There's a lot more to Incremental Power than we have room to tell you here. So if this kind of performance and package size sounds good to you, drop by the Altec Lansing suite at the L.A. Hilton during the 63rd A.E.S. Convention (May 15-19). We'll make sure you get the complete Incremental Power story as well as information on our exciting new line of sound reinforcement and studio monitor products. And while you're at the convention, be sure and stop by the Mission Room and see our latest multimedia presentation starring Don Hahn, Lani Hall and Herb Alpert.

Altec Lansing Sound Products Division, 1515 South Manchester Avenue, Anaheim, California 92803.

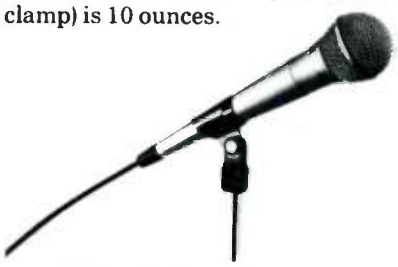
ALTEC LANSING
Altec Corporation

| | Power Available for L.F. @ Mfg. Rec. Load | Power Available for M.F. @ Mfg. Rec. Load | Power Available for H.F. @ Mfg. Rec. Load | Electronic X-over | Cooling | Weight | Height | Reliability |
|---|---|---|---|---|---|---|---|---|
| Incremental Power System | 300 Watt Total 150 Watt/Ch. @ 8 ohm | 150 Watt Total 75 Watt/Ch. @ 16 ohm | 150 Watt Total 75 Watt/Ch. @ 16 ohm | 2 or 3-way Selectable Freq. | Built-in fan blows side-to-side | 70 lbs. | 7" | Excellent each unit factory tested |

CIRCLE 76 ON READER SERVICE CARD

# The SOUND SH

**Audio-Technica's** new AT814 is a moving coil dynamic unidirectional (cardioid) microphone with a frequency response of 50 to 16,000 Hz and sensitivity of −56 dB. According to the company, rejection of off-axis sound is uniform throughout the useful range, useful for feedback control or sound isolation. Features include a windscreen, 600-ohm output balanced and phased to match solid-state amplifiers and mixers with 150 to 1,000-ohm inputs, and an integral XLR-3 connector. The output of the 2-conductor shielded cable is pre-wired with a standard ¼″ phone plug. Weight of the microphone (less cable and clamp) is 10 ounces.



CIRCLE 1 ON READER SERVICE CARD

Bi-Fet amplification, used in the new Model 1000B stereo graphic equalizer from **Spectra Sound Products, Inc.**, is credited with providing advantages not found in conventional EQ circuits, according to the manufacturer. These are: high slew rate (13 volts/microsecond); wide bandwidth (±0.5 dB, 20 Hz to 20 kHz); low distortion (0.008% for either THD or IM); and S/N of greater than 100 dBm. The unit's power supply has independent voltage regulation for each channel, and is completely shielded against ambient hum. EQ on each channel uses gyrator synthesized inductors, and covers ten bands starting at 31 Hz and ending at 16 kHz. Control range for each frequency band may be ±8 dB or ±16 dB. Each channel has a level control that runs from −15 through unity gain to +15 dB. The device may be standard rack-mounted. Prices are: balanced, $595; unbalanced, $545.

Cassette decks are the subject of much speculation these days. In light of the new metal tape technology, many manufacturers are gearing up to produce cassette units with record heads, playback heads, and bias circuitry that are compatible with the new tape. Some companies already have such units on the market.

CIRCLE 2 ON READER SERVICE CARD

**Road Electronics** has introduced a new line of sound reinforcement equipment and bass speaker enclosures. New products include mixing consoles, midrange horns, and high frequency arrays for sound reinforcement applications as well as a new series of front radiating, rear loaded bass horn enclosures. Road cabinets, according to the company, use solid core plywood with interlocking dado construction, heavy metal corners, industrial grade wheels and heat bonded naugahyde.

The RS-9953 high frequency array features three high frequency 2″ x 5″ piezo tweeters, high frequency level control and maximum power at 35 V RMS. The RS-9400 midrange features a radial horn and driver system, high frequency level control, passive crossover with biamp mode select, maximum power of

# OPPE

## By Charlie Lawing

50 watts continuous, nominal impedance of 16 ohms, and crossover at 1200 Hz. The RS-8550 bass enclosure is a "Road Special Design" 15" speaker with front radiating, rear loading bass horn, die cast speaker mounting rings and heavy wire mesh grills. Maximum power is 75 watts continuous; nominal impedance of the bass enclosure is 8 ohms.

CIRCLE 3 ON READER SERVICE CARD

You've seen this guy a hundred times. He plays the piano from 4 'til 7 in the motel lounge, running the gamut from Manilow to Merle Haggard while folks get happy at half price. The man behind the piano probably won't be up for a Grammy next year, but he is a musician, nonetheless, with a job to do and a crowd to please.

When he comes into your store, he'll be looking for something to add a little spice to his act. If this solo musician has electronic keyboards, he might want to look over your display of effects: echo units, envelope followers, phase shifters, and so forth. Probably, though, your customer will inquire about a "rhythm box," or an "electric drummer." Whaddaya got?

If you are a **Roland** dealer, there are two new units that you can offer the customer. These units are fairly sophisticated, but they offer the musician variations that he should find attractive. The new CR-78 by Roland is a computer rhythm unit that is capable of adding various accents to the basic beat. But even though any rhythm unit helps the musician keep a steadier beat and gives the listener something to tap his toe to, many musicians find some rhythm units annoying because they are so monotonous.

The CR-78 seeks to overcome this monotonous, mechanical feeling by accentuating and synchopating different percussive voices, thus adding a real feeling to the rhythm. These "fill" phrases don't just occur at preset intervals, either. They can be triggered by a


front panel button or a footswitch at the discretion of the musician. Or, if the song calls for a "fill" every 2, 4, 8, or 16 measures, the CR-78 will automatically trigger itself. That in itself should be enough to take the mechanical feel out, but there's more to it.

The CR-78 has a programmer. This is where the computer part comes in. The musician can pre-program four rhythm tracks, each containing up to eleven percussion voices, by selecting the memory and voice and then tapping out each part on a programming pad. In addition, the CR-78 contains a mixer capable of handling up to three add-on voices, and a fade in/fade out control.

The CR-78, and its less sophisticated counterpart, the CR-68, each have 20 different voices, including two different disco beats, and several variations on the rock theme. The CR-68 has all the features of the CR-78, with the exception of the programmer section. However, both units have programmable pulses for driving synthesizers in sync with rhythm voices.

Suggested list price of the CR-78 is $795.00. The CR-68 lists for $495.00.

CIRCLE 4 ON READER SERVICE CARD

In his heyday in the sixties, soul singer James Brown often punctuated his live performances by turning back to his band and shouting, "Give the drummer some!" at which time the drummer took the obligatory drum solo before retiring into his usual role as timekeeper in the rhythm section. In the years since then, drum manufacturers have taken Brown's words to heart; they have given the drummer plenty to work with. Today drummers have an arsenal of percussive instruments like never before, including some things that aren't just percussive, but melodic as well.

**Star Instruments**, maker of the Synare 3 electronic drum, has added a sequencer to its line of equipment which is capable of

memorizing from one to four 32-note sequences of up to 10 seconds duration each. Each sequence can be played directly into the sequencer, using hands, sticks, or mallets.

Operation of the sequencer is fairly simple: The drummer selects one of the memory banks, hits the "load" pad, and plays the sequence on the Synare drums. When he is through with one sequence, the drummer hits the "stop" pad, and the sequence is stored in the memory bank for recall at any time. To play back the sequence, the drummer hits the "play" pad and the sequence will repeat until the "stop" pad is hit again. There is a variable rate control which governs the speed of the sequence when it is played back, and there is a volume control for all sequences. It is simple enough for any drummer to understand, no matter how little he or she may know about electronic devices in general.

The days when drummers were thought of as little more than metronomes with appetites have long since passed. Drummers now have a chance to play melody, not just percussion, and many of them are taking advantage of this new freedom. Just listen to the radio and you'll hear those electronic drums on dozens of recordings.

However, electronic wizardry such as this doesn't come cheap, and some wary retailer may wonder if his investment in such esoteric equipment will pay off. I think it is important to remember that drums are always expensive, and so are cymbals; therefore drummers are familiar with high-priced items. Also it is worth remembering that drummers have been bound to the hi-hat and the snare for lo these many years, and the possibility of playing a tuned electronic drum is so tempting that drummers can't resist. At least, that has been our experience at Strings and Things.

Star has also introduced heavy duty road cases for Synare 1, 2 and 3, constructed of furniture grade plywood with exterior formica finish, heavy gauge aluminum interior and exterior edging, and steel corner angle plates. Suggested retail prices are $110 for Synare 3, and $125 for Synare 1 and 2.

CIRCLE 5 ON READER SERVICE CARD

Well, you are *not* going to believe this one. The burgeoning custom guitar components market (as typified by Schecter Guitar Research, DiMarzio, Mighty-Mite, Charvel Manufacturing and the like) has reached its most Orwellian limits thus far, with the introduction of the **FACT** guitar pickup. FACT (Frequency Analysis and Circuits Technology) is a new company based in Washington, D.C. that has come up with the most radical approach to pickup design that I ever heard of, bar none. Here's the deal:

The people at FACT have a SCARF (Servo/Computer-Assisted Reproduction of

# The SOUND SHOPPE
## REAR ENTRANCE

Frequencies) unit that you set up in your shop. When a customer comes in and says, "I wanna sound like Jimi Jett on the guitar," you take a recording of Jimi Jett, or whoever, supplied by the customer, and play it on a standard turntable which is interfaced with the SCARF. The guitar sound on record is then electronically analyzed and stored in the computer. Then the customer plays his guitar into the computer unit, and within 90 seconds the computer will prescribe, through a digital readout, a pickup design that will make the customer's guitar sound like the one on the record ("subject of course to the usual wide variety of modifications in tone through the normal controls on the guitar . . .," according to the company brochure). After the computer has prescribed the pickup, the customer pays a deposit, the digital readout is sent to the FACT laboratory, and within 14 days the pickup is delivered to the customer, who has a 30-day, full refund option on the pickup.

Since I've never heard one, I can't say 'yea' or 'nay' to this idea. I'm just wondering which of my salesmen is going to run the computer!

CIRCLE 6 ON READER SERVICE CARD

**BGW** amplifiers are just plain hard to beat. They are clean, rugged, have excellent specs, and can take the punishment of rock and roll.

The new model 410 stereo power amplifier is no exception. Conservatively rated at 200 watts RMS per channel, the Model 410 has some front panel features not found on other power amplifier models.

Two groups of ten-segment color-coded LED power indicators form two arcs across the front panel. These LED arcs simulate conventional meter scales, and each channel is calibrated to yield precise power measurement via the LED readout.

Also on the front panel is a sensitivity switch which allows the audiophile to select any of several power indication levels. In addition, the Model 410 has a four-position speaker selector switch, individual gain controls, a headphone jack and a power switch, all located on the front panel.

That's all well and good, but inside the BGW is where the real beauty lies. Each channel has a 330-square-inch heat-sink module for the twelve power transistors, thus providing a large "safe operation area." The Model 410 design is DC-coupled, fully complementary, and incorporates some sophisticated temperature sensing circuitry. Input amplifier stages on the Model 410 are very high-speed. high-slew-rate circuits.

Of all the many excellent features of these amps, the one that always works best for me as a selling tool is the protection circuitry. Any time you can reassure a customer that

his power amp virtually cannot be destroyed under normal operating conditions, it makes a sale go a lot smoother. I always make it a point to tell my customers about the speaker protection features of the BGW. In the event of a malfunction or a subsonic transient signal, the BGW simply disconnects itself from the speaker load before the spurious signal can reach the speakers and cause any damage. When a customer realizes what kind of quality the BGW possesses, price does not usually stand in his way.

The BGW 410 has a smaller relative, the Model 210, which is similar in every way except its power output, which is 100 watts per channel RMS. The 210 sells for $599. Suggested list price of the Model 410 is $799.

CIRCLE 7 ON READER SERVICE CARD

By Phil Missimore

# DEALER DOSSIER

## Suntronics
## Upland, California

It's a cliche of small businesses that a business reflects the owner's personality, but in the case of Suntronics, in Upland, California, it's true. Owner Ron Sundell runs a unique operation out of his 950-square-foot shop. Customers mingle, sit down and play with the equipment for hours on end, often with Ron back in the repair area unaware of who's in the shop. The atmosphere is friendly, congenial and low-key—very much like the owner.

Starting as a one-day-a-week business, Suntronics, through its attention to customer needs and willingness to avoid pressure selling, has grown to a point where $1 million in sales are expected for the coming year. And this is done in a location that's 45 miles from downtown Los Angeles, and in a building so inconspicuous that many customers literally drive right past it.

Ron Sundell is a man who has very definite opinions on how to best service the recording equipment market, and what *not* to do. Whether you agree with him or not, it's hard to argue with the success he has achieved with his philosophy of personalized service and attention to detail.

*Let's start with some information about Suntronics.*

**Sundell:** Well, we get a lot of our customers from the downtown Los Angeles area, simply because we do business differently. We really work with our customers. The main difference is attitude; other stores will tell you they'll talk to you, but we will have a customer come in and work the board for four hours. If he wants to do that, it's fine with me. That's the key. Everything we have here in the room is wired up and ready to go. Also, if someone buys some equipment from us and at a later date needs to come back to do a mix or add effects for a demo tape, that's fine too.

*Was this something that you consciously decided to promote when you opened the business?*

**Sundell:** Our market is the 2-, 4- and 8-track customer, and just now we're beginning to get into 16-track. We work with the home recordist, the man who has the equipment in his garage. He saves his nickels and dimes to buy the stuff one piece at a time, or maybe he can obtain $10,000 to buy a whole system at a whack. We don't put pressure on to buy big here. We'll sell one piece of equipment, and not see the customer for six months, until he's saved up enough money to come back for more equipment.


*Is most of your business repeat customers, then?*

**Sundell:** I'd like to think so, but that's not the case. In the last six months, we've seen a large turnover from Los Angeles and Orange counties, people who have heard about us from other customers; we've built a network of people who talk about us. It's like an exotic car dealer—once you own a Porsche or Ferrari, you tend to cling to other owners, and the dealer gets known without even advertising. And our market, generally, is not what most people think it is.

*In what way?*

**Sundell:** Our market is not the purist artists, the starving musicians. Many dealers perceive them to be the market, and I feel that's a mistake. We feel our market is the professional who's a musician on the side. That guy is very picky about what he can buy, or what his wife or group members will let him buy. He does a gig on the weekend, comes in and buys some equipment. The type of person who comes in and plunks down an incredible amount of money, he's not our customer. We don't have that kind of equipment here. But we're getting more and more people like that.

*Are your customers looking more to larger systems, say 16-track, or are they still buying piecemeal?*

**Sundell:** We're selling more 8-track, about one a week. That's a complete package, from recorder to mixing board to cables to the splicing box,

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- Phase with color and rate controls
- Master reverb
- Input preamp, send and return
- Preamp and line outputs
- Power amp input

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- Six-band graphic equalizer with in/out switches on each channel
- AUTOMIX function selects either or both channels with remote footswitch
- Bi-amping capability with variable crossover points
- "DDT" compression circuit with LED indicator and in/out switch
- PARAMID and mid shift equalization
- Channel LED indicators
- Preamp and line outputs
- Power amp input





### THE STANDARD

- 130 Watts RMS @ 1% THD, 4 Ohms
- Two channels with pre and post gain on each channel
- Low, mid and high equalization
- PARAMID and mid shift controls
- AUTOMIX function selects either or both channels with remote footswitch
- LED channel indicators
- Master reverb
- Preamp and line outputs
- Power amp input

### THE CENTURION

- 130 Watts RMS @ 1% THD, 4 Ohms
- Two channels with pre and post gain on each channel
- Individual channel equalization
- Parametric equalization
- AUTOMIX function selects either or both channels with remote footswitch
- LED channel indicators
- "DDT" compression circuit with LED indicator and in/out switch
- Preamp and line outputs
- Power amp input

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CIRCLE 91 ON READER SERVICE CARD

everything. He'll come in over a period of two weeks, check out the equipment, and come in one day with the money. It's all done. But one point needs to be emphasized: nothing goes out the door here without being checked. I do the sales and service myself. As an example, I just got a call from Arizona, where one of my customers had a problem, and I was able to walk him through it. We've put in a separate phone line just to handle calls from various parts of the country. We'll sit down with a schematic and walk them through the problem.

*How long has Suntronics actually been in operation?*

**Sundell:** Since 1973. I was working at Xerox at the time, doing repair work on recording equipment on the weekends. It got to the point where I was making more money doing the repair work than I was at Xerox, and I had to make a decision, and went with the repair business. I used to work in research and development at Ampex before I went to Xerox, and I've always had the philosophy that anybody who buys equipment from me knows that it's been thoroughly checked out. If it's in the box, they don't trust it. We got into retailing more or less by accident; we started out as a repair shop, primarily in Teac, but other brands as well. In my dealings with Teac, I got to know their sales force, and they suggested I sell as well as repair. By the end of 1974, I was selling Teac cassette and reel-to-reel. Although it seemed like there was a Teac dealer every 10 miles back then, we had service, and that was the difference. Tascam started the same way. Teac approached me in 1974, and asked me if I'd be willing to carry it. They told me it was $6,000 as a first order and $20,000 annually. At that time, the only place to get that type of gear was to go to Hollywood. I took the line on, and a friend of mine who was involved with church recording wanted Tascam, and he basically bought my initial order. We still wondered how I was going to make the rest of $14,000. That was in September; by December, we'd gone beyond the $45,000 mark. All of a sudden, we had a whole new breed of customer. We went two years without disturbing the L.A. market. But we let our customers come in and play with the equipment to their heart's content; six months later we'd see them with their money. And that's how we got started.

*A great deal of word-of-mouth.*

**Sundell:** We find that a lot of our customers are selling other customers.

*What kind of sales figures are you generating?*

**Sundell:** Back in 1975, we sold approximately $65,000 in Teac and Tascam combined, with no advertising. The next year we did about $120,000; last year we did $210,000, and we expect $300,000 this year, and this the first year we've done any advertising. Also, up until last August, we were only open on Saturdays, from noon to 6.

I feel there are about four levels to this market. The first level is the person who hangs around the fringes, who isn't really discriminating in what he buys. We get these customers, but they aren't our major interest. We call them "looky-lou's." The next level is the home enthusiast, who's also a professional musician. That's the market we're going after. On top of that you've got the professional musician who wants to open a 16-track or 24-track right from the top, and then you've got the professional businessmen who look on studios strictly as a business. That's way above our level. We don't aim at the lower level, but we don't aim at the top, like some dealers. They've gone vertical, while we've opted for horizontal penetration within the middle market range. I hate to separate the market like that, but that's the way it is. We're going after the grass roots—the 2-, 4- and 8-track progression.

*Do you think your stance will change as you grow?*

**Sundell:** No. We plan to dominate this market segment. It's important that you have the right equipment and are selling in the right area. I could take this operation to downtown Los Angeles and not do nearly as well. Yet we get nearly 30 percent of our customers from that area.

*Why?*

**Sundell:** Because other dealers aren't meeting their needs. They're geared differently. If you have a customer who wants to play with a $2,000 board, and you have a salesman on commission, he can't afford to spend time with that customer. It's not practical. That's why we're set up differently. We've had people who've bought from us before ask us, "Can I come in on Thursday to do a mix?" No problem—whatever it takes.

*What about servicing equipment?*

**Sundell:** All our service is guaranteed for one year parts and labor— better than the factory. The average turnaround time is about an hour and a half. That's for our studio customers. If a consumer walks in with Teac equipment, but he didn't buy it from us, it'll take longer—but whatever it takes, he's told right up front. We don't pull punches. Our first priorities have to be to our studio customers, since they can't have their equipment down for long. However, anybody who has his equipment serviced here gets the best service anywhere. We stock only factory parts, and we always have two of everything—two of every IC, modules, capacitors, anything that can possibly go out. The manufacturers fight me on this, but I require that I have the parts in stock. When that equipment goes down, I want to be able to have it right there.

*Do you feel that your target market audience is growing faster than the other market segments?*

**Sundell:** I'd say three or four to one.

The other dealers have kind of neglected this market. You got the chains who by their nature are price conscious, and they'll start grinding the prices. That's the problem in the market today.

*What about your price structure?*

**Sundell:** We know what the average prices are, and we have a certain point that's our rock bottom. But the big thing is service. There's no backup with the big chains. We pick up a lot of business that way. People buy the equipment, and it won't work. They take it to the factory, find out what it costs and how long it takes, and start to look for other places to take the gear. Eventually, they wind up out here. I originally sold everything at full list, and wasn't aware that some dealers in L.A. were grinding the prices. I couldn't figure out why some things weren't moving. Finally I went to L.A. and saw that you had to play games. So I learned to package deals, to keep the cash flow moving and be able to keep the customer with a good value on the purchase.

*Selling service basically?*

**Sundell:** Service, plus equipment. Maybe a patch bay thrown in with the equipment, so that it wasn't so blatant an attempt at price-cutting, of simply selling the stuff in the box. We're picking up a lot of the pieces, people who've been burned.

*Is that a long-term problem?*

**Sundell:** It really is. Too many dealers fail to service their customers. Most simply sell it out of the box. We sit down, we hold the customer's hand, we walk them through it.

*Do you think it's possible for a chain-type operation to take the approach you have?*

**Sundell:** I really don't think so. I've run into a situation often where we've worked with a customer over a period of time, helped him plan the system, and then he's disappeared. He's gone to the chain store that's giving the equipment away. But we don't hear about it until the equipment goes wrong, because he then finds he can't get the service he needs from the chains. It's the "we can beat any price in the world" syndrome. And I can't knock that marketing concept, except that this particularly market requires more than that. It's different from home audio. We get a lot of calls from people who simply want to talk to us first over the telephone. A lot of dealers don't do that, but if they did, I think their business would improve. It would help the industry in general.

*So you see even more people coming in over the next two years who were short-changed at the retail level?*

**Sundell:** We're seeing more every month. We're getting a lot of secondary business from other dealers. We're the alternative. It's our flexibility and expertise that makes the difference. For example, take P.A. boards vs. recording boards. If you take as a simple rule of thumb that you can use a recording board for P.A., but not a P.A. board for recording, you've eliminated a whole lot of music stores from this market. It's the dealer who can make the equipment work that separates the true recording retailer from the one who's selling P.A. It's like a used car dealer, who'll tell you the car looks great. Once you've driven it off the lot, you're on your own.

*Will that philosophy be communicated in your advertising?*

**Sundell:** It already is. Our advertising has generated calls from manufacturers asking if we're interested in carrying their lines—calls that I never got when we weren't advertising. It's kind of sad, though, that you can so easily manufacture an image with advertising. We already have our own image, but it would be easy to acquire a totally different one through advertising. It's the old question of once you buy your image, how can you maintain it? It's easy to spend more money on advertising than on your customers, but we won't do it.

*Do you feel that service will be even more important in the future?*

**Sundell:** We think you need to blend price and service. We keep our overhead low, in contrast to the chains. They're having some hard times when they really shouldn't be.

*What's your customer's average purchase for a total system?*

**Sundell:** In the $7,000 to $9,000 range. I'd rather put together five or six of those a month instead of one big one. You have too many financing questions with the larger deals. In fact, we're actually very negative when a customer first walks in. We sit him down and ask him some tough questions about what he wants, and what he intends to do. He needs to understand the true costs of doing this. It's too easy to hype somebody; I've actually talked some people right out of systems. It's something normally frowned upon, but I don't need dissatisfied customers.

*Are your present profit margins comfortable for you?*


*Does this mean that you plan to stay in this location?*

**Sundell:** We plan to. We've had people come in and laugh at our size. People have literally passed us by without noticing us. But we're far enough away from L.A. so that when people come out here, they come to see us specifically. They don't happen to drive by and stop on impulse.

*You mentioned earlier your $300,000 Tascam and Teac figure. What about total sales?*

**Sundell:** We're probably in the neighborhood of $1 million for this coming year. We sell a lot of tape and accessories; we sell a lot on Saturday, because that's when many of our customers are off work and can spend time here. It's like the camera buff who saves his pennies to get the newest gadget. We don't deal with the man who buys the $40 Kodak; we deal with the man who sits up at night trying to figure out how to buy his gear.

**Sundell:** At this point they're acceptable, but in terms of what we're doing, they could be better. We have a set point for us, we know what we need to survive, and I feel we're doing better than most in the industry in terms of profitability. I know by what comes in the door that our prices are average—not high, but not low. The problem has been that recording equipment has been identified too closely with hi-fi and music equipment. That's the biggest educational question facing the industry right now. We try to sit down with the customers and tell them, "This is not a guitar amplifier, and it's not a piece of home hi-fi. You have to baby this stuff, learn about it, and take care of it." That goes back to our philosophy again. We check everything out. We hand-check every cable, for example. It's a market that requires attention to detail, so that

customer knows that when he takes the equipment home, it will work.

Now if you're dealing with the large studios, it's a different matter; they'll simply pick up the phone and call the technician in. But for the man at home, it's disaster time if something doesn't work. We grow with the customer; most dealers have given up on the 2- and 4-track market, but we're selling more 4-tracks than ever. Most dealers went right for the 8-track, but we find a customer will trade up over a period of time. I think the market was geared too much to the initial 8-track purchase, and that market is becoming kind of saturated. If you neglect that market, you miss that growth cycle.

*What about your advertising?*

**Sundell:** We've just begun to advertise, and it seems to be giving us a little more visibility and credibility. We already have an excellent reputation, but this seems to boost it. It's one thing to hear the name, and another to see it in print. We do the ads ourselves, to keep in line with our overall company policy.

*What about the future?*

**Sundell:** It's very hard to say, because the market is so young. For example, 8-track could dry up tomorrow; we're trying to avoid a dependence upon it. So we have other markets, such as audio visual which is a very big market for us. A lot of people are doing slide shows with synch sound; they know how to operate the projector, but not the sound system. That's one market. Another market is churches and schools. Just about every college audio-visual department around us has bought equipment from us. Every church in the area that's into recording comes to us. We'll go to the site, work with them, build them patch bays or whatever they need. But we've avoided sound reinforcement and P.A. We're not into brute force.

*How much of your business would fall in the institutional category?*

**Sundell:** About 40 percent. It was even more than that before Proposition 13; but it's starting to pick up again, as old equipment breaks down.

People in general are becoming more sophisticated. We've done gospel shows where more people were knowledgeable about recording equipment than the factory reps who were with us could believe. We were at the recent L.A. consumer hi-fi show, where we had a hands-on 16-track setup there that people were welcome to play with. We put a limiter on the amplifier output, and turned it loose. They could mix tapes all day long. And we literally had to get people off the machine to allow others to play with it. We had wall-to-wall people for four days. If even 3 percent of all those people buy recording gear, even if it's not from me, the industry will still prosper.


I can't emphasize enough the need to work with the customer. It's one thing to deal with musical instruments, and have an out-of-tune guitar. But when the customer pushes the button and no sound comes out of the tape, that's a whole other ball game. As long as a dealer enters the market without realizing the extent of the service requirements and technical knowledge that's needed, he'll be in trouble. I think that manufacturers have to step in and require the dealers in recording equipment to be stronger in service and technical areas.

# INDUSTRY UPDATE

Quad-Eight has named **Ron Bennett** Director of Marketing. **Mark Pinske** has been named Technical Sales Director of the company.

**Jerome Ruzicka** has joined dbx as Vice President Marketing and Sales. Ruzicka was previously vice president and director of marketing and sales at Bose.

**Lawrence G. Jaffe** has joined dbx as Director of Marketing and Sales for the Professional Products Division. Jaffe was previously with Uni-Sync.

**F. Davis Merrey** has been named Vice President and General Manager of Technical Audio Products Company (Tapco), which recently became an operating unit of Electro-Voice. Merrey was previously General Manager of Electro-Voice's microphone manufacturing facility in Tennessee.

**Bernie Ullom** has been promoted to Vice President, Manufacturing of Electro-Voice. Ullom will oversee the manufacturing at all Electro-Voice facilities.

Shure Brothers has made some staff changes. **Allen R. Groh** has been promoted to Manager, High Fidelity Products Market Group. **Lottie Morgan** has been promoted to Sales Manager. **John A. Owens** has been named Manager, Product Management and OEM Sales.

**RolandCorp has appointed Ron Wilkerson** Vice President of Marketing, and **Jeff Cardozo** Sales Manager. Both men come to the company from MXR, Wilkerson from his position as sales and marketing manager, and Cardozo as western regional sales manager.

**Allan J. Evelyn** has joined dbx, Inc. as Director of Marketing and Sales for the Consumer Products Division. Evelyn was previously national marketing manager for U.S. operations at Bose.

**Kevin J. Byrne** has been appointed National Sales Manager of Tandberg of America, Inc. He was previously Assistant Sales Manager.

**Charlie Winkler** has been named to the new post of Marketing Manager—Music Products at Audio-Technica U.S. Winkler was previously Marketing Manager—Music Products at Electro-Voice.

**Michael J. Koss** has been promoted to the positions of Advertising Manager and New Products Manager. He has been with the company since 1977 as Marketing Services Coordinator for Koss-Europe.

**George Sheppard has been elected** Vice President, Manufacturing of Phase Linear. He was previously manufacturing manager for the firm.

BASF Systems has appointed **Ivan Sieben** Director of Marketing for Audio/Video Products. Sieben has been with the BASF Group since 1972.

The Sony Professional Audio Division has established a separate stereophone franchise to market its new line of headphones. The existing professional products rep network is responsible for selecting and servicing dealers in their territories.

UCLA Extension will provide a symposium entitled "The Revolution in Home Entertainment: New Technology's Impact on the Arts," May 11-13 at the Los Angeles Hilton Hotel.

**James O'Rourke** has been appointed Advertising Coordinator at MXR, and **Robert Wilson** has been named Coordinator of European Operations for the company.

**Steven Emspak** has been promoted to GLI's systems sales staff from his position on the company's technical team. Emspak has been in the disco design field for twelve years.

ProTech Audio Corporation, a newly incorporated audio products manufacturing company, has concluded an agreement with Robins Industries for the purchase of the Robins broadcast and sound product line.

TDK has named **Rex E. Dickinson** Territorial Marketing Manager, based in El Segundo, California. Additionally, TDK has appointed Centennial Marketing of Colorado to rep the entire TDK consumer product line, and has expanded the responsibilities of the Paul Seaman Co. of California to include videotape products.

Island Music of Staten Island, New York has been granted exclusive U.S. distribution rights to Londoner Strings, manufactured in Great Britain by British Music Strings Ltd.

The New England Conservatory of Music will hold a summer session from June 25-August 3, which will include an Electronic Music Workshop with Robert Ceely.

Farralane Enterprises Inc. has been formed in Farmingdale, New York to serve as manufacturers' representatives and distributors of lighting and audio products. **Gene Farrell** and **Peter Liberators**, principals, are also marketing their own line under the name Farralane.

**Robert Eshak** has been named Sales Administrator for Optonica High Fidelity Products, responsible for expediting all orders and working with the Optonica sales representative and dealer network.

LaTec International, the disco division of Musical Instrument Corporation of America, is planning a major expansion of both product and personnel, with a search on, according to the company, for acquirable disco companies and qualified sales reps and technicians.


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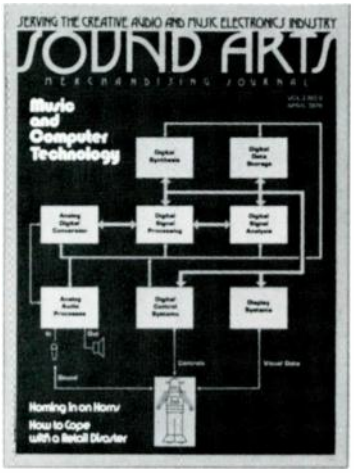


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