RADIO TODAY

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Enjoy the benefits of a world class microphone without the needless markup. EQUITEK II delivers that "condenser sound" for less than $600. EQUITEK II...made in the U.S. by CTI Audio.
See page 8 inside.

INSIDE: THE HARRIS CONNECTION

A HARRIS ALLIED PUBLICATION

ATHLETIC EQUIPMENT

Throughout this issue we feature the gear you need to bring football, basketball, soccer, baseball, wrestling and all your favorite sports back alive!

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Ronald R. Glasen, WGCI-AM/FM, Chicago, IL, wins a free 17"x24" Broadcast Cockpit poster (our 1990 Catalog cover) suitable for framing. Simply call 800-622-0022 for details.

ATHLETIC EQUIPMENT

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SKIM YOUR STATION

. . . or theirs! Squeeze-Play records the AM or FM station its tuned to for 2 to 30 seconds. Pause time between recordings can be varied from 30 seconds to 3.5 minutes. Telescope an entire day. Determine trends! **$159.95**

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All 3 as shown for $329.95

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COMREX MULTILINE

50 Hz to 8 kHz STUDIO QUALITY SOUND using only three standard dial-up telephone lines! It's easy when you use the COMREX PORTABLE MULTILINE FREQUENCY EXTENDER. The unit is simple and automatic. Use it with one line for a 50 Hz - 3 kHz response, two lines for 50 Hz - 5 kHz or three lines for a full 50 Hz to 8 kHz studio quality link. Talk to us at Harris Allied. We have complete information including a descriptive brochure on the extender and the decoder.

COMREX

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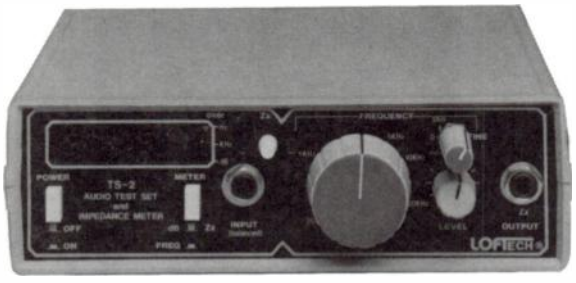
COMREX PLXmicro
Cellular telephone not included

Michael Allen Goldhart, WRUS/WBVR, Russellville, KY, wins a free set of Allied screwdrivers. Simply call 800-622-0022 for details.



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THIS PROFESSIONAL amateur is now professional all the way! The Loftech TS-2 provides all the features you've become accustomed to PLUS balanced broadcast levels and impedances in and out via ¼" jacks. Also available in a rack mount version (TS-1RMX) with cannon connectors.

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Radio World®

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KODJ On Fast Trac

by Jim Garrett, CE
KODJ-FM

Los Angeles CA A few months ago, KODJ, an all-oldies FM station in LA, made the decision to re-cart most of its music library. Existing titles would be redubbed from the best sources we could find and many new titles would be added.

USER REPORT

The existing production studios couldn't be used; they were busy enough and this project would take several months. The solution was a dedicated dubbing studio using the Fast Trac dubbing system from Henry Engineering.

The Fast Trac has inputs for three sources and I use all three: one for a Technics turntable, one for an Otari reel-to-reel deck and the third for a Studer CD player. There are internal gain adjustments for each scource, so a -10 dBv output from a turntable preamp can be made to match the level of a +4 dBm CD player.

KODJ re-carted its music library with the Fast Trac from Henry Engineering.

The unit's record output is connected to an ITC 99B cart recorder, and the monitoring outputs feed a Crown amplifier, which drives a pair of Tannoy near-field monitor speakers. The Fast Trac's "scope" output is connected to an X-Y audio monitor scope to check for phase error.

A snap to use

The most unique feature of the Fast Trac is its automatic machine control system, which is what makes dubbing carts a snap.

I first select one of the three source machines with a pushbutton. While auditioning the tune, I set the recording level by adjusting the "Line Gain" knob. I then cue the source, put a cart in the recorder and hit the "Start" button on the Fast Trac.

If I'm dubbing a record the turntable starts first—with the audio muted. A bit later the cart recorder starts. Just as modulation reaches the stylus, the audio is smoothly un-muted and recording begins.

If I am dubbing a CD, the cart machine will start just slightly before the CD player. This prevents the intro from being "clipped," since most CD players will start more quickly than a cart machine.

I especially liked the ability to select different recording modes on the Fast Trac. I can record in stereo but I can also take just the left or right channel and feed it to both L and R outputs. This is useful when the source is "re-channeled stereo" and only one channel is usable. The L and R inputs can also be summed to mono.

Being able to switch among these recording modes is an absolute necessity when dealing with "oldies" material from numerous sources. A "Balance" control lets me fix those "off center" vocals and there's a "Process In/Out" button that inserts external devices (like an equalizer or filter) into the recording chain for quick A/B comparison.

Monitoring playback

I always monitor the actual cart playback when dubbing. The PB output of the cart recorder is connected to the tape monitor input of the Fast Trac. A button allows me to switch between "Line" and "Tape" to instantly check recording quality.

A "Mono" button puts the monitor system in mono to check for phase error, without affecting the actual stereo recording. The X-Y scope displays the monitor signal and provides a visual indication of cart phase performance.

I've used the Fast Trac for about six months now, and it's done a fine job. The automatic start-timing makes the dubbing process a one-button operation and the carts are consistently tight. Having to re-dub a cart because the cue isn't quite right is a thing of the past. And it's great to be able to dub music carts without tying up a production studio.

What would I change about the unit? I'd put some kind of numerical scale around the "Line Gain" knob so I could easily return to a certain gain setting.

When you add up the quality, convenience and utility of this little unit, the Fast Trac dubbing system is hard to beat.

Complete dub center also available

Harris Allied can supply the FAST TRAC or a completely wired, assembled and tested package. CALL US!

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LEASE AKG'S DSE 7000 DIGITAL SOUND EDITOR FROM ALLIED.

Clifford W. Koch, Derby, KS, wins a free 17"x24" Broadcast Cockpit poster (our 1990 Catalog cover) suitable for framing. Simply call 800-622-0022 for details.

First the good news. The DSE 7000 is revolutionizing production at stations from Boston to San Diego. Production directors already know how to use the Digital Sound Editor's tape transport-style controls, real faders and on-screen "grease pencil." They sit right down and start turning out the tightest, cleanest, punchiest spots, promos, and news actualities they've ever done—three times as fast as they could with analog tape.

Now the even better news. With Allied's leasing program, the DSE 7000 can triple your production output for less than $30 a day. You can arm your sales staff with "killer" spec spots. Change copy every day, if the client wants to. And still have time left over for outside production that can generate extra income.

The future of radio production is here now. And at less than $30 a day, you can't afford not to be part of it. For more information on the DSE 7000 and details on our leasing plan, call your Allied representative toll free at 800-622-0022. It's the new speed of sound!

*60 month lease with one payment in advance, 10% purchase option, sales tax not included. Prior credit approval required.

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WRH

TWO COMPANIES, ONE GOAL

Allied Broadcast Equipment and the National Supervisory Network.

Our goal: to provide the most sophisticated broadcast operations possible. You've trusted Allied for years, because you know that the finest broadcast equipment is here for you. But equipment alone doesn't make a great broadcast station. You need a qualified, trained staff on duty to assure peak performance. Now, with your call to Allied, your station can add the most advanced off-premise control service in the world: the National Supervisory Network.

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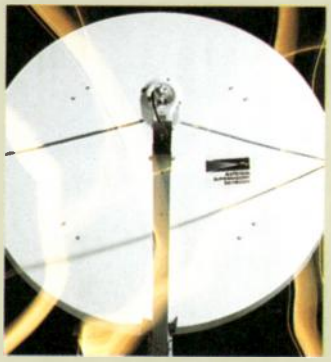
Through a dedicated, Ku-Band satellite link, the National Supervisory Network provides your facility with FCC legal off-premise control ***continuously***—24 hours a day, seven days a week. The National Supervisory Network monitors and commands your transmitter and EBS equipment. Logs readings on all technical parameters every 30 minutes. Furnishes trend analysis & equipment performance reports. Monitors security and fire alarm systems. And, the National Supervisory Network responds immediately and intelligently to all alarms.

Your staff has the freedom to concentrate on programming without the worry of technical logs and operations. Or, you can lock the doors and go out into the community to gather news, participate in events, and sell advertising. You'll know that experienced, trained operators are on duty to monitor, control, log, anticipate trouble, and keep your station running at its optimum—regardless of format or scheduling.

To minimize up-front costs, NSN supplies the computer and satellite hardware needed for the data link as part of your low, monthly service fee.



Satellite Sub-Networking

In addition, NSN now offers private Sub-Networking for station groups. These high-speed computer interconnections between stations help centralize business operations with easy transfers of files and data including: electronic mail, commercial copy, program logs, spreadsheets, promotion ideas, sales proposals, even CD quality audio spots and NTSC color video frames.

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NATIONAL OFF-PREMISE CONTROL

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Avon, Colorado

Save Class B1, B or C2 FM Transmission Line Cost with Andrew 2¼" HELIAX® Coaxial Cable

By Bob Leonard
Product Manager, Heliax Products, Andrew Corp.
Orland Park, IL

Class B1, Class B and Class C2 FM stations have customarily been designed using 3⅛ rigid line or 3" coaxial cable for transmission line. Certainly 3" line or cable has resulted in good service over the years. But, depending on the specific application, continued specification of 3" cable may be real design overkill, potentially wasting several thousand dollars which could be put to better use in the control room.

The introduction of 2¼" HELIAX® coaxial cable in 1987, now available with 3⅛" flanges, makes these savings possible. At 100 MHz it is rated for 20.6 kW average power, compared to 37.0 kW for 3" HELIAX cable. This is ideal for Class B1 applications, and sufficient for all Class B and C2 configurations with 7 or more antenna bays. Yet 2¼" cable costs over 20% less than 3" cable.

Let's take a look at the details. Table 1 shows the HELIAX coaxial cable sizes usable for Class B1, B or C2 FM stations per FCC 80-90 docket. For Class B1 stations, maximum effective radiated power is 25 kW. With a typical manufacturer's most commonly requested antenna-transmitter combinations, the required transmitter power output for 88.0% transmission line efficiency — the worst case for 2¼" HELIAX cable — does not exceed 13.3 kW regardless of the number of antenna bays. This is well within the rating for 2¼" cable.

The average power rating for 2¼" HELIAX cable at 100 MHz is 20.6 kW (21.9 kW at 88 MHz and 19.7 kW at 108 MHz). Of course, this needs to be derated for the VSWR of the FM antenna, which can range from 1.1 to as high as 1.5. These derating factors and derated average powers are shown in Table 2. Even with a 1.5 VSWR FM antenna, the average power rating at 100 MHz is 17.5 kW — a comfortable margin.

(continued on page 19)

Table 1

Alternative HELIAX® Coaxial Cable Sizes For Class B1, B or C2 FM Stations Per FCC 80-90 Docket

Required Transmitter Power Out — 2¼" Size Coax**	Required Transmitter Power Out — 3" Size Coax**	Antenna Bays	Effective Radiated Power**	Tower Height**	Coax Cable Length	HJ8-50B 3" Size Coax Cable Efficiency +	HJ12-50 2¼" Size Coax Cable Efficiency +
			Class B1 FM — 328 Feet				
13.3 kW	13.0 kW	4	25 kW	343'	332'	90.0	88.0
10.4 kW	10.2 kW*	5	25 kW	348'	327'	90.1	88.2
8.5 kW	8.4 kW*	6	25 kW	353'	322'	90.3	88.4
7.2 kW	7.1 kW	7	25 kW	358'	317'	90.4	88.5
6.3 kW	6.1 kW*	8	25 kW	363'	313'	90.5	88.7
			Class B or C2 FM — 492 Feet				
N.A.	21.5 kW	5	50 kW	512'	491'	85.6	N.A.
18.3 kW	17.7 kW*	6	50 kW	517'	486'	85.7	83.0
15.4 kW	15.0 kW	7	50 kW	522'	481'	85.8	83.1
13.4 kW	12.9 kW*	8	50 kW	527'	477'	85.9	83.2
11.8 kW	11.5 kW	9	50 kW	532'	511'	85.0	82.2
10.5 kW	10.3 kW*	10	50 kW	537'	511'	85.0	82.2

* Typical manufacturer's most commonly requested antenna-transmitter combinations (even number of bays required for beam tilt and null fill).
** Shown with maximum effective radiated power (e.r.p.) and maximum height allowed, at 98.1 MHz, VSWR = 1.00.
\+ At 98.1 MHz
Note: Average power at 100 MHz = 37.0 kW for 3" coaxial cable (HJ8-50B) and 20.6 kW for 2¼" coaxial cable (HJ12-50).

Table 2

VSWR Derating Factors and Derated Average Power Ratings for 3" and 2¼" Coaxial Cable at FM Frequencies

VSWR Derating Factors At 100 MHz						
	HJ8-50B 3" Coaxial Cable			HJ12-50 2¼" Coaxial Cable		
	1.1 VSWR	1.2 VSWR	1.5 VSWR	1.1 VSWR	1.2 VSWR	1.5 VSWR
	1.034	1.068	1.172	1.035	1.070	1.176
Average Power Ratings						
Frequency	**HJ8-50B 3" Coaxial Cable**			**HJ12-50 2¼" Coaxial Cable**		
88 MHz*	38.4 kW	37.2 kW	33.9 kW	21.2 kW	20.5 kW	18.6 kW
100 MHz	35.8 kW	34.6 kW	31.6 kW	19.9 kW	19.3 kW	17.5 kW
108 MHz*	34.2 kW	33.1 kW	30.2 kW	19.0 kW	18.4 kW	16.8 kW

* Approximate

ONE source for total

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With the Fairchild Dart 384 digital audio receiver, you receive program material broadcast via satellite that captures the heart. The Dart 384 is fully compatible with the high quality digital satellite system currently in use by ALL digital networks.

Target the heart ...with a Dart 384!

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THE HARRIS CONNECTION

IN THE NEWS

'Everything You Always Wanted To Know About RF,' Harris Allied Workshop, Slated Oct. 3

Dana Myers

If you've ever wanted some easy-to-understand, formal training on RF equipment and are planning to attend the October SBE National Convention in St. Louis, now is your perfect opportunity!

Harris Allied Broadcast Equipment will present "Everything You Always Wanted To Know About RF," from 9 a.m. to 5 p.m. Wednesday, Oct. 3, at the St. Louis Convention Center. The Harris Allied workshop will cover amplifier classes, impedance matching, transmission line technology, system measurement, and high power, overcoupled TV cavities.

Presenter will be Dana Myers, instructor for the Harris Allied Broadcast Technology Training Center, Quincy, Illinois.

This workshop is scheduled in conjunction with the SBE National Convention Oct. 4 through 7 and the **Broadcast Engineering** Conference under the auspices of the Ennes Foundation. Participation is limited to 25 paid registrants for the **Broadcast Engineering** Conference. There is no additional fee for the workshop.

The Harris Allied program is one of many special manufacturer workshops which will be offered. Ennes Engineering Workshops are intensive hands-on programs conducted by factory instructors. Participants may register to receive CEU credit from John Wood Community College, Quincy. One CEU credit will be awarded for a full-day or two half-day workshops.

Also In This Section . . .

Harris Allied's Single Source Solution

KJBR-FM Asserts Itself as Jonesboro, Arkansas 'Power 102'

When KJBR-FM Jonesboro, Arkansas switched to its virtually new facility in January 1990—a facility complete with a new tower, antenna, 30 kW transmitter, transmitter building, STL and two new control rooms—the station did much more than protect its full coverage area and Class C status under Docket 80-90.

With a super signal booming out to 39 different counties in four states, KJBR-FM asserted itself as the top broadcast facility in Northeast Arkansas.

"We had done what many people believed hometown radio station owners would not do—retooled and asserted ourselves," says General Manager Guy Patteson III.

Yet transforming KJBR into Power 102 was a lengthy and complex process. It began March 2, 1987—the last day for applications under FCC Docket 80-90—when Guy's father and uncle, Alan and Carter Patteson, owners of KJBR-FM and KBTM-AM since 1958, filed for a new, taller tower.

"From that day I've eaten, drunk and slept this project," Guy admits. "Technically and competitively, there would have been no point staying in the business without taking full advantage of the opportunities offered Class C's."

'Fighting Like Never Before'

While even Jonesboro residents and advertisers have been surprised by the extent of the project, for the Patteson family and the station staff, it has been a matter of commitment. Beyond protecting KJBR's coverage area, the Pattesons intended to maximize signal quality to become the competitive force in the healthy and growing Jonesboro market.

Indeed, Jonesboro—an hour northwest of Memphis—is now the fifth largest city in Arkansas with 45,000-plus people and, Guy predicts, will reach 50,000 after the 1990 census. One of the brightest economic spots in the state, Jonesboro has a strong and growing base in agriculture and industry, a university with 10,000 students, and two major regional medical centers.

"With this kind of promise, we would have been crazy not to upgrade," Guy says. "We have another AM and two more FMs right here in Jonesboro; many scattered Class A's in northeast Arkansas, and the Memphis stations to contend with. We realized we'd have to fight like never before for market share."

With so many options for listeners, Guy adds that signal quality is a key weapon in the local ratings war: "Our listeners are quite sound-conscious. Today, you can pick up a $30 jam box at Wal-Mart that sound as good as the most expensive gear 25 years ago."

Achieving top signal quality and coverage was destined to be complex: Despite numerous transmitter power upgrades from 1946 to the mid-1970s, KJBR's 195-foot angular steel freestanding tower was limiting. Even with a 10-bay Phelps-Dodge antenna, the low tower height restricted coveragd.

A Single Source Solution

After much discussion, the Pattesons decided to replace their Phelps-Dodge antenna and 20 kW Collins 831-G-2B transmitter. Consultants had unanimously predicted spotty local coverage with the 15-year-old 10-bay antenna on a new, taller tower. They recommended a maximum of 8 bays, which in turn, would require a 30 kW transmitter to produce 100,000 watts ERP.

As the complexity of the upgrade became apparent, the Pattesons decided on a turnkey, package-price approach. "We knew it would cost more," Guy says, "but peace of mind is worth

(continued on page 12)

Did You Know???

Many "firsts" in FM transmission equipment technology have been Harris Allied innovations. Some notable examples include:

- **Solid-State FM exciters**
- **Phase-Locked FM Exciters**
- **300 Watt Solid-State FM Transmitter**
- **Cavity-Backed Radiator FM Antenna.**

HARRIS ALLIED

INTRODUCTION

RF is a vast topic encompassing virtually every aspect of electronics as we know it today. Unfortunately, many work in RF electronics for years without really understanding large segments!

This is why the Harris Allied Broadcast Technology Training Center has developed two special programs—RF Circuits I and RF Circuits II. The courses, offered at the Quincy, Illinois Center many times each year, are open to any broadcaster. During the RF classes, important areas of RF technology are broken down into digestible chunks which give participants practical insight while removing the aura of mystery.

Materials are presented without using advanced, complex mathematics as the medium. Following are two sample articles from the courses which have been condensed for Radio Today. The first is a summary of amplifier classes—the foundation for how high power RF amplifiers work. The second, "Carson's Rule," answers one of the most frequently asked questions we receive—"Why is the FM bandwidth required to be so wide for final power amplifiers?"

We hope these articles are helpful, and would be happy to provide you with complete information about RF Circuits I and II and other courses offered at the Broadcast Technology Training Center. To learn more, please complete the RF Action Card at the back of Radio Today.

Formula I-1: Calculating Efficiency and Cost of Electricity

Efficiency:

$$\frac{P_{out}}{\text{Efficiency}} \times \text{Hours per day} \times \text{Days per month} = \text{Energy per month (kWh)}$$

Cost of Electricity:

$$\text{Energy per month (kWh)} \times \text{Electricity per kWh} = \text{Electricity cost per month}$$

Consider this example: A 50 kW FM radio transmitter has 62% overall efficiency and operates 24 hours per day, 30 days per month. If the electric power costs 15-cents per kilowatt hour, the monthly electricity cost is:

Efficiency:

$$\frac{50}{0.62} \times 24 \text{ Hours} \times 30 \text{ Days} = 58065 \text{ kWh}$$

Cost of Electricity:

$$58065 \times 0.15 = \$8{,}710.00 \text{ per month}$$

Formula I-2: Calculating Dissipation

A. Dissipation for a 62% efficient 50 kW (P_{out}) transmitter:

1. $\frac{Pout}{\text{Efficiency}} = P_{in}$ or $\frac{50 \text{ kW}}{0.62} = 80.6$ kW
2. $Pin - P_{out} = P_{diss}$ or $80.6 - 50 = 30.6$ kW

B. Dissipation for a 78% efficient 50 kW transmitter:

$$P_{diss} = \frac{50 \text{ kW}}{0.78} - 50 = 14.1 \text{ kW}$$

ARTICLE I:

CLASS OF AMPLIFICATION

Most electronics students are exposed to low power amplifiers, typically below 50 watts, studying such parameters as DC supply voltage and current; the quiescent operating point for the active devices; load impedance; linearity; distortion, and maybe even dissipation within the device. However, concepts important to the generation of high power usually are not discussed.

There are several parameters applying to high power amplifiers (100 watts or greater, and typically several thousand watts) that should be considered while studying the process of converting DC energy into high power levels of Radio Frequency (RF), audio, or other AC signals.

Before we review classes of amplification, we will examine efficiency and dissipation:

Efficiency: Efficiency is a ratio of usable power output to the required input power. This parameter is useful in determining the cost of generating output power.

Efficiency and the cost of electricity are calculated by using the Formula I-1.

Dissipation: Dissipation of an amplifier yields two important bits of information—first, how much power the active device must dissipate (how hot it will get), and second, how much heat must be removed from the general area where the transmitter is housed. Formula I-2 calculates dissipation for a 62% efficient 50 kW transmitter and also for a 78% efficient 50 kW transmitter.

The higher efficiency transmitter produces a substantially lower heat load to be removed, resulting in large savings on the cost and operation of the amplifier's cooling equipment. Please note: As efficiency drops, dissipation increases, requiring larger, more expensive active devices for the amplifier.

Introduction into Classes of Amplifiers

Class A

Class A amplification has the lowest distortion and the best linearity of any class of operation. It has a conduction angle of 360°, meaning that output current flows for 360° of the input cycle. While Class A amplifiers can be used to amplify any type of signal with faithful reproduction of the input signal, maximum Class A efficiency is 50% and typical efficiency is less than 25%. For high power operation, it is an expensive class of amplifier to operate in terms of cost of the amplifier; cost of the power needed to operate it, and cost of cooling.

Two interesting points concerning Class A: First, unlike other classes of operation, its DC plate or drain current is constant from zero signal to maximum signal output, and second, its power dissipation is maximum for zero signal and minimum for full signal.

Class B

Class B still offers reasonable linearity for one-half of the input AC cycle. It has a conduction angle of 180°. If two active devices are operating in push-pull, each amplifying one-half of the input cycle, Class B can be used to amplify audio or video signals.

Single-ended Class B amplifiers are linear for any type of modulated or unmodulated RF signal.

Class B is more efficient than Class A, with a maximum efficiency of 78.5% and typical efficiencies ranging from about 35% to 65%. In Class B amplifiers, the DC supply current and power dissipation are zero with no signal output and maximum for full signal output.

For high power audio and amplitude modulated RF, Class B offers lower power and cooling costs. The active Class B devices generally are smaller and cheaper than comparable devices used for Class A.

A disadvantage of Class B is that it has poor linearity when its AC output signal approaches the zero crossing points of its waveform. This is called "crossover distortion" in audio work and "poor linearity" for amplitude modulated signals.

Class AB

A Class AB amplifier is similar in all respects to Class B except that its conduction

angle is greater than 180° but less than 360°. This gives Class AB the dual advantage of Class A linearity with almost Class B efficiency.

The efficiency of Class AB is somewhat less than Class B because it is biased slightly above cutoff and some idle current (zero signal plate current) flows. This results in low efficiency at low signal levels. At large signal levels, dissipation and efficiency are the same as for Class B operation.

Class AB must be used in push-pull for audio and video and can be single-ended for any type of RF signal.

Class C

Class C is linear only for unmodulated RF carriers, FM (Frequency Modulated), or PM (Phase Modulated) signals. Due to its conduction angle of less than 180°, it has a higher efficiency—typically 65% to 80%—than Classes A, AB, and B, and therefore is economical for generating high power level signals.

The output of Class C is rich in harmonics which usually must be filtered out if they are not specifically desired. They can be removed by a resonant impedance matching network, or a low pass filter in the output circuit. A Class C amplifier can be used as an efficient frequency multiplier if the output circuit is tuned to a harmonic of the input frequency.

Class C amplifiers draw no idle current and produce no output power until the input signal level is large enough to drive the active device out of cutoff and into conduction. The DC supply (plate, collector, or drain) current also increases with input drive level. Any information contained in the lower signal levels of the input signal is lost because these levels are below the active device cutoff level.

Class C is effective in reproducing constant output signal levels while preserving the frequency information of the input signal. This is why Class C can be used to amplify unmodulated RF Continuous Wave (CW), FM, or PM signals. A Class C stage can be amplitude modulated by several methods, but it cannot be used to amplify previously modulated AM signals.

ARTICLE II:

CARSON'S RULE FOR REQUIRED FLAT BANDWIDTH

FM transmitters usually have a single tuned PA input and output resonant circuits, and the bandwidth is measured at the -3 dB points (See Figure II-1). Looking at the PA output resonant circuits, the following formulas apply:

$$Q = \frac{Z_P}{X_L}$$

Where: Z_P is the amplifier's plate load impedance, Z_L is the inductive reactance of the amplifier's output resonant circuits, and Q is the "Quality" of the resonant circuit.

$$BW = \frac{F_R}{Q}$$

Where: BW is the -3 dB bandwidth of the output resonant circuit and F_R is the transmitter carrier frequency.

The -3 dB bandwidth is not flat enough to satisfy the requirements for FM transmission, so the flatter part of the bandwidth (that is the portion that is closest to F_R) is used. This is called the flat bandwidth (BW Flat).

Insufficient flat bandwidth will cause two problems: 1) distortion of the main carrier's modulated signal, and 2) crosstalk between the main carrier and sub-carriers.

A convenient method to determine the required flat bandwidth for an AM signal is:

$$BW_{flat} = 2(F_{mod\ max} + \triangle F)$$

Where: BW_{flat} = Required flat bandwidth; $F_{mod\ max}$ = Highest modulating frequency, either main carrier monaural audio or sub-carrier's highest frequency; $\triangle F$ = Highest carrier frequency deviation.

Carson's Rule does not give absolute values of distortion or amounts of crosstalk, but it does give an approximate idea of the required flat bandwidth. Table II-1 gives some typical examples for applying Carson's Rule. Column 1 shows the use of the signal; column 2, the highest modulating signal; column 3, the greatest carrier deviation, and column 4, the required flat bandwidth:

Conclusion

As more sub-carriers are addd, additional flat bandwidth is required to minimize distortion and crosstalk between main carrier and sub-carriers. To achieve more flat bandwidth, the transmitter must be loaded harder—but this will lower the efficiency of the final amplifiers.

Figure II-1: The response of a typical single tuned resonant circuit showing the -3 dB bandwidth.

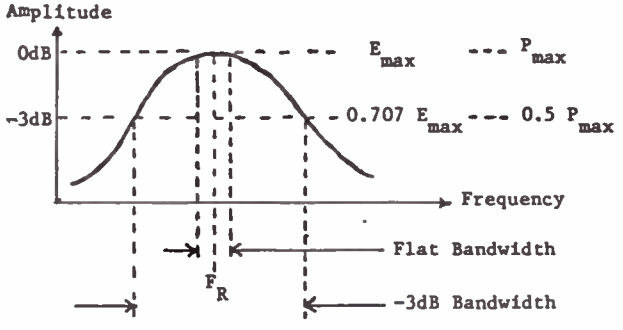


Table II-1: Carson's Rule Applied To FM Broadcasting

Use	Fmod max	△F	B.W. Flat
Monaural FM	15 KHz	75 KHz	180 KHz
FM Stereo	53 KHz	75 KHz	256 KHz
FM Stereo Plus ISCA	71 KHz	75 KHz	292 KHz
FM Stereo Plus Two SCA's	96 KHz	82.5 KHz	375 KHz

Harris Allied Slates 11 Radio Training Programs Through December

Harris Allied Broadcast Equipment will offer 11 technical training programs for radio broadcasters from September through December 1990 at its Quincy, Illinois Broadcast Technology Training Center.

Courses ranging from three to five days, combine theory with practical, hands-on training. Because of their interactive nature, enrollment is limited and on a first come-first served basis.

In addition to programs on specific Harris transmitters, five general RF training courses open to any broadcaster regardless of equipment manufacturer are slated. Classes, dates and program fees follow:

Harris Transmitter Training

- **HT 250/500/1FM Series:** Sept. 5-7, $395.
- **HT 3.5/5/7/10M and FM-3.5/5K1:** Sept. 24-27, $595.
- **HT 30/35FM and FM-30/35K:** Oct. 8-12, $695.
- **SX Series:** Oct. 22-26, $695.
- **DX 10/25/50:** Dec. 3-7, $695.
- **Gates 1/2/5:** Dec. 18-20, $395.

General Training Programs

- **FM Transmitter Workshop:** Oct. 2-5, $495.
- **Digital Control Logic:** Oct. 15-19, $649.
- **RF Circuits I:** Oct. 29-Nov. 2, $649.
- **RF Circuits II:** Nov. 5-9, $649.
- **AM Transmitter Workshop:** Nov. 27-30, $449.

To Learn More

For an outline and registration information for any of the programs listed above or a complete course schedule, please return the Action Card at the back of this publication or phone 217/222-8200, Extension 3508 from 8 a.m. to 5 p.m. (CDT) weekdays.

HARRIS ALLIED

(continued from page 9)

something too. We quickly figured out that coordinating the tower, construction of a new transmitter building, installation of a new transmitter and a new STL would be a real challenge—although exciting and fun."

In fact, even before Harris and Allied combined forces, the Pattesons already knew representatives of both companies.

Still in the throes of planning the new facilities, KJBR-FM had worked extensively with Allied to prepare for a switch from satellite format to live broadcasting in April 1988.

"We had intended to stay automated until the upgrade was finished," Guy says, "but growing competition in our market necessitated the move. We needed some studio equipment in a hurry, so I called eight suppliers to get bids on identical items and terms. Not only was Harris Allied's price the lowest on most items, but our sales representative demonstrated tremendous product knowledge unmatched by any of the other reps.

"At our station, we don't buy it until I understand what it is and what it does, and, while our Allied representative can talk technical to engineers, he can talk in English to managers like me," Guy adds.

From the RF side, Harris representative Curt Lutz had been in contact with the Pattesons as soon as they received their CP. "He must have revised the total bid eight or nine times," Guy recalls. "And when Harris bought Allied, we felt even better about getting a total bid price. Coincidentally, one of the tower companies we had already been talking to—Central Tower of Newburgh, Indiana—was the subcontractor selected by Harris Allied. So, when we signed a deal for the tower, a new Harris Signal/Star FMXH-8AC antenna, a new HT 30FM transmitter, a new Marti STL and other studio equipment on June 30, 1989, we felt very comfortable."

The Next Hurdles

The first problem? Finding a site to accommodate the proposed new tower's 1,100-foot height. With FAA restrictions around the Jonesboro, Paragould and Walnut Ridge airports as well as FCC regulations protecting other stations on KJBR's 101.9 frequency, the station had very few choices but quietly acquired a site that was accepted without delay.

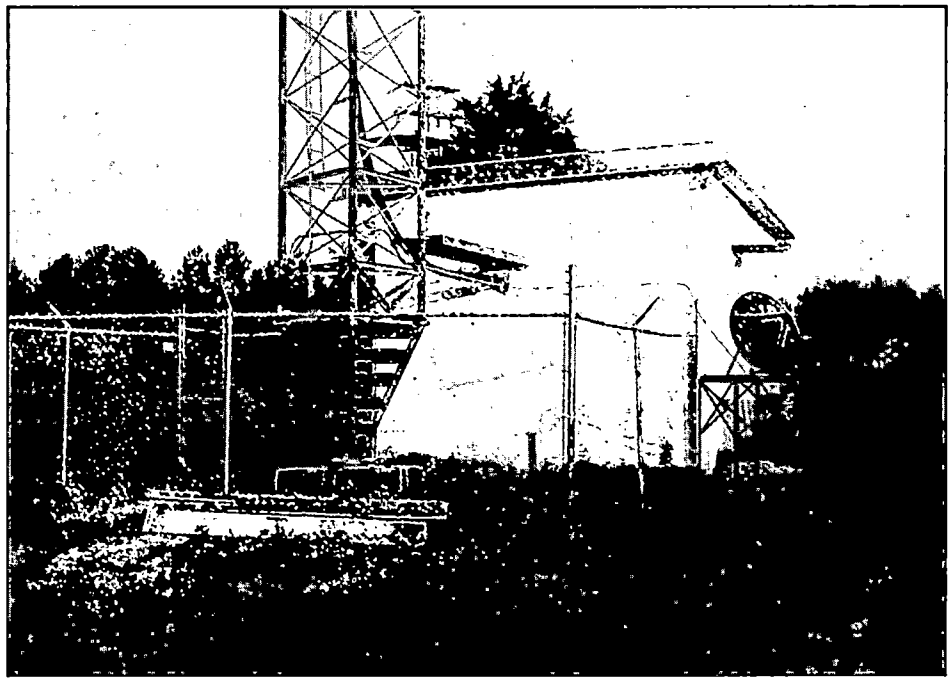
The second consideration? Finding a project engineer to tie all elements together and ensure a proper installation. "Our day-to-day engineering situation wasn't structured for a project of this magnitude," Guy says. "After exploring backgrounds of several qualified RF/studio engineers and several meetings, the station selected Ray Loewy from Greenbriar, Arkansas. Then the 'fun part' began."

Bricks, Mortar and More

With site preparation complete, transmitter building construction began. Because the site is fairly remote, no expense was spared.

"It's a fortress," Guy says proudly, "complete with double-thick steel doors; pre-stressed double-thick concrete roof sections to withstand ice falls from 1,100 feet; separate rooms for our equipment and that of any tenants (KJBR has one SCA tenant already); plenty of comfortable work space and plug mould, and a security system designed to notify us and the building's neighbors of any intruders. Curt Lutz made many helpful suggestions about proper air handling and working conditions. It's a Cadillac building designed to protect the Cadillac of FM transmitters—our Harris HT 30FM."

Smooth coordination between Harris Allied, contract engineer Ray Loewy and the construction crew helped speed the transmitter installation. Once the transmitter building was finished and the transmitter installed the tower project picked up steam.



Guy Patteson describes KJRB's new transmitter building as a fortress

Like the transmitter building, the 1,100-foot tower was built to accommodate additional tenants and their antennas. Its 10 anchor point and tower base holes are 17-feet deep and filled with 160 square yards of concrete. With cooperation from the weather, Central Tower rapidly completed Northeast Arkansas' tallest radio tower, topping out at 1,449 feet above sea level.

An Unplanned Emergency

If the upgrade weren't keeping the Pattesons busy enough, in the middle of the project a fire of undetermined origin broke out at KBTM-AM, causing smoke damage to the 28-year-old Gates BC-1T transmitter. The BC-1T stood next to a vintage Gates 250-A which had been installed by Parker Gates himself.

Guy Patteson's response was immediate. He had the BC-1T cleaned and designated as KBTM's backup; dispatched willing duo from the station and a family farm truck to the Harris factory in Quincy, Illinois, and had a new SX-1A transmitter on the air within a week.

On To The Studio

As the project progressed, the Pattesons realized they would need to upgrade their entire studio facility as well. "Our studio equipment was ancient," Guy says. "We were still transmitting via land lines, and we weren't completely pleased with our processing scheme."

Again Harris Allied provided answers, and, Guy says, the right price: "I still go through the bid process on occasion, but Harris Allied regularly comes in at or below everyone else's price."

New studio equipment—including Autogram Pacemaker 10 consoles, Otari 50-50 reel-to-reel tape decks; Denon DN-950F CD Cart Players, an Eventide H3000B Ultra-Harmonizer, several ITC Delta Record/Playback Cart Machines, Audiolab Desktop Tape Erasers, and Symetrix A 220 Amplifiers—was ordered. In addition, KJBR installed "all-new killer processing," using several mainstream components as well as some unconventional items.

"The assertive sound of the 'all new Power 102' is now a high quality, punchy, ear-grabbing sound with plenty of room for adjustment," Guy reports, "and it's produced without a composite clipper. Although we've had little contact with composite clipping, we've done enough homework to know it's not the way we want to go."

The Right Tools

In early January 1990, the all-new Power 102 went on the air. The HT 30FM 30 kW transmitter fired up without incident. "When we fired up this new beast," Guy recalls, "heads were spinning all over the area. In fact, we got calls from all four directions asking us how we had come out of nowhere. It sounds wonderful." The station also launched an aggressive marketing campaign to reestablish its commitment to the Jonesboro area.

Now that all the tasks of installing three phase power, shooting STL paths and coordinating delivery and installation of studio and RF equipment are complete, Guy Patteson is extremely happy with the revitalized KJBR. So are the station's 18 staff members, advertisers and listeners.

"We are thrilled with our new Harris antenna and transmitter and have nothing but high regard for those who sold and installed them," Guy says. "There is no doubt about it. This HT 30FM is a quality box all the way.

"It has been rewarding to see this project come together," Guy says. "Since the Docket 80-90 issue surfaced several years ago, there was never any doubt that KJBR could reassert itself as a market leader. I knew it; the market knew it, and our staff knew it.

"I'm reminded of the many times our staff would say, 'Just give us the tools and we'll get the job done.' We have those tools now—thanks to our owners who have made the investment in this growing market. Thanks to Harris Allied, we're getting the job done."

TASCAM

A TOTALLY PRO DIGITAL AUDIO TAPE UNIT, the DA-30 is the best sounding professional DAT recorder for digital mastering in recording studios and production facilities. Its specially designed digital converters use massive oversampling and ZD processing to achieve S/N better than 94 dB and great sound.

AES/EBU digital I/O allow the DA-30 to interact with other pro digital equipment. Standard consumer-type coaxial digital, and XLR and RCA connections are provided. The DA-30 records at 48 kHz, 44.1 kHz, and 32 kHz sampling frequencies. The deck is rack-mountable, and comes with a programmable full-function remote control.

A 15 pin parallel connector provides remote transport capability from an external device. Other features include 3 X cue and review and 9 X search functions, start ID positioning, and headroom margin display.

Special Introductory Price . . . $1429.00

TASCAM DA-30

HURRY-UP

THE 25-FOOT HURRY-UP TELESCOPING MAST is designed for fast and easy deployment of lightweight antennas and instruments. This portable 20 lb. telescoping mast is ideal for elevating equipment such as small ENG microwave antennas, Marti antennas and meterological instruments.

The HURRY-UP consists of 6 graduated aluminum tubes which nest one inside another. The mast is extended manually by pushing up the sections and fixing them in position using quick lock/release collars. It can be extended to its 25 foot height in one minute or less even when wearing thick gloves. The HURRY-UP mast design allows for quick direction adjustment with rigid azimuth locking. When supporting a 2 square foot topload, this mast has a survival wind speed capacity of 54 mph when fully extended and deflects less than 2 feet in 35 mph winds.

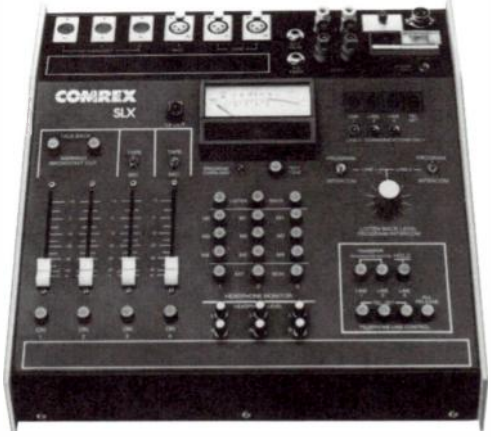
HURRY-UP is free standing (without guylines) in its universal vehicle mounting stand. This vehicle stand is a "drive-on" aluminum plate with an attached reinforced holding tube into which the telescoping mast is lowered and locked in position. The vehicle mounting stand can also be used with an optional 2 level guy kit if the mast is to be field mounted away from the vehicle. For permanent vehicle mountings, external support brackets are available.

ATHLETIC EQUIPMENT

COMREX SLX

Would you believe a complete sports mixer *with* frequency extension, all in one attractive package? Get your sports remote out of the barrel! Excellent voice quality with a matching, optional studio end decoder. You get 4 mixing channels (2 switchable to mic or line) and all inputs have defeatable AGC. P&G slide faders. Four headset jacks provide monitoring and intercom facility.

Sports Special . . . $4049.00



Lawrence H. Taylor, Baltimore, MD, wins a free 17"x24" Broadcast Cockpit poster (our 1990 Catalog cover) suitable for framing. Simply call 800-622-0022 for details

NRSC DEMODULATION (TUNER, EVEN!)

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This is the world's first NRSC compatible tuner. The Denon TU-660. Harris Allied is the world's first broadcast distributor to introduce it to you.

Now, precisely demodulate your NRSC signal with a tuner that also features 30-station memory presets that permit random intermixing of AM and FM. FM stereo, AM mono/NRSC compatible. 500 ohm unbalanced outputs. **TU-660 . . . $330.00**

Rack shelf by others available

ST-3 TIMER

Where have all the good times gone? Right here! The ST-3 will upcount to 23 hrs., 59 mins., 59 secs., has a crystal time base and bright ⅝" display numerals. ST-3 features 8 machine resets (pull to ground, push positive, latching or momentary), and complete rear terminal remote control for stop, start, reset. 2.25 lbs. in a 2½"H x 6⅜"W x 4½"D package. You can't buy a better one for . . . **$179.95**

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GENTNER CRM

The Gentner Combination Remote Mixer is winning the battle to reduce the number of pieces a remote usually requires AND to increase simplicity. A 4-mic mixer and 4-channel headset amp are built in. More features, great price. **Sports Special . . . $1313.00**

Dick F. Engh, Federal Way, WA, wins a free set of Allied screwdrivers. Simply call 800-622-0022 for details.

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Probably the most popular field mixer ever made. Four inputs with a master control. The front panel headphone output and control combined with 110V or battery ability make the M-267 an easy choice.

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SECURE STORAGE

The Rakvault takes only 4 RUs of space and securely stores equipment, tools, mics, CDs and personal stuff. Rakvault is fitted with a flush-mount latch and keyed lock. Four different locks available. Inside dimensions: 7"H x 17"W x 9"D. Black textured baked enamel finish. **Only $89.95 ea.**

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THE WORRY-FREE SYSTEM DESIGNED WITH THE BUSY BROADCAST PROFESSIONAL IN MIND!

Makes telephone polling quick, easy, and best of all, AUTOMATIC!

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The Tele-Vote basic unit includes one channel, desk top 115VAC, 1.5 minutes storage time, 600 ohm audio output, telephone line answer, and DTMF decoder.

FEATURES:
- Solid-state memory (no tape or moving parts)
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OTHER DIGITAL ANNOUNCERS AVAILABLE:
- Feed-back eliminator
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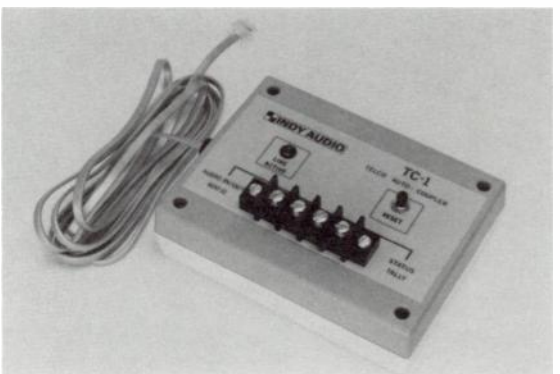
TC-1 TELCO AUTO-COUPLER

The Indy Audio TC-1 TELCO AUTO-COUPLER answers an incoming call on the first ring, maintains the connection until the calling party hangs up, then releases the line and resets itself. It can feed audio down the line to the caller, take audio off the line for broadcast, or can be connected to a hybrid for bi-directional communications.

The TC-1 is powered by the phone line, and requires no connection to AC power. A front panel LED indicates when the unit is in use, and a dry relay closure is provided to start a cart deck, alert the control room operator, etc.

The TC-1 is ideal for listen lines, concert lines, weather lines, dial-in remotes, remote control systems, or any other application which requires an auto-answering phone coupler.



TC-1 $159.95

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FREE SAMPLE

Discover the path of least installation resistance. We'll send a free sample piece of GEPCO multi-pair audio cable to your station upon request. It strips easier, has overall drain wire for star grounding and comes in the precise length you order. GEPCO . . . wiring up broadcasting.

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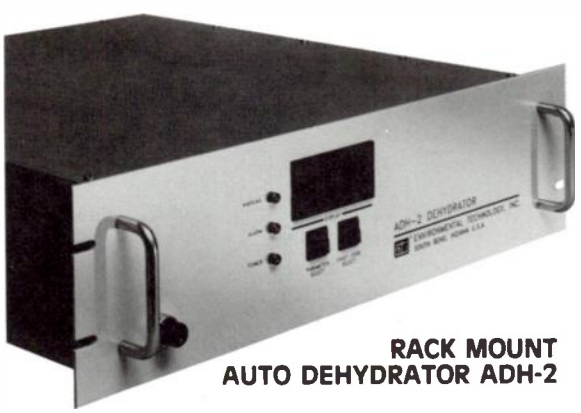
Leasing! It can be so easy. Easy to do & easy on your cash flow. Harris Allied salespeople are just waiting to tell you all about it!



RACK MOUNT AUTO DEHYDRATOR ADH-2

MODEL ADH-2

Auto Operation...Malfunction Alarm...Simple Installation
5¼" Rack Space...Easily Pressurize 1100 ft. of 3" Coax

The ADH-2 Automatic Air Dehydrator provides 0.5 psi dry air for pressuring coaxial cables, waveguides, feed horns and similar applications. User friendly features include digital display for operating information, fault diagnosis capability and a malfunction alarm with a relay contact for remote indication. Quiet operation, low vibration level, low heat output, rack mounting, light weight and bright light emitting diode display ideally suit the ADH-2 to the electronic environment.

The ADH-2 regenerates automatically at a frequency depending upon operating conditions. An evaporator eliminates the need for a water drain line. The ADH-2 employs a microcontroller for simplicity and reliability. Under normal conditions, the ADH-2 requires no operator attention.

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The BR-20 is Tascam's newest generation of professional 2-track recorders. The BR-20 ¼" half track broadcast 2-track features:

- 15/7.5 ips tape speed
- +4 dBm XLR balanced, or -10 dBV unbalanced in and out
- Full servo transport
- NAB/IEC equalization
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- Independent L/R reel size select
- Gapless/seamless punch in/out
- Spot erase function
- Built-in speaker monitor.

Introductory Price . . . $1800.00

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Mark Oldham, Sacramento, CA, wins a free set of Allied screwdrivers. Simply call 800-622-0022 for details.

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COMPACT AND PORTABLE, the FP-31 is as small as you can go! Carry the least to the press box to bring the games back live and professional. Three inputs and switchable cue and slate tones provide lots of features in little space. Sports Special . . . $724.00

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Equitek engineers dedicated themselves to solving both.

The Equitek condenser microphone system achieves the silky transients previously available only in very expensive units. Equitek is less than $600.

Use with any 48 volt power supply. Internal circuitry and enhanced power overcomes current limiting problems.

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Requires suitable shock mount & 48 volt P.S.

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TEN 32

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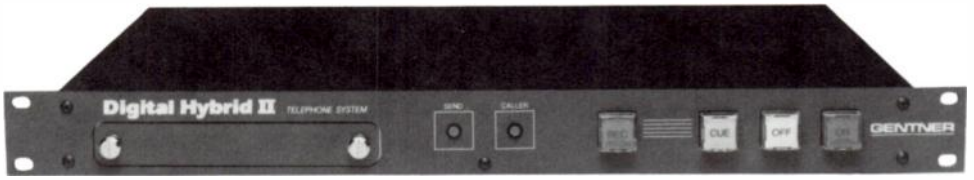

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Your current Gentner DH or DH ANA is worth up to $650 in trade toward a new Digital Hybrid II. Talk to us for complete details. Offer good thru 1990.

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Combine clock stopwatch/timer, rechargeable batteries (and charger), dial touch pad, cue channel, loss-of-line alarm and almost-any-level inputs and it can only be MAX-Z from Zercom.

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Listing 12,500 radio stations in the US and Canada, the M Street Radio Directory is 632 pages big this year.

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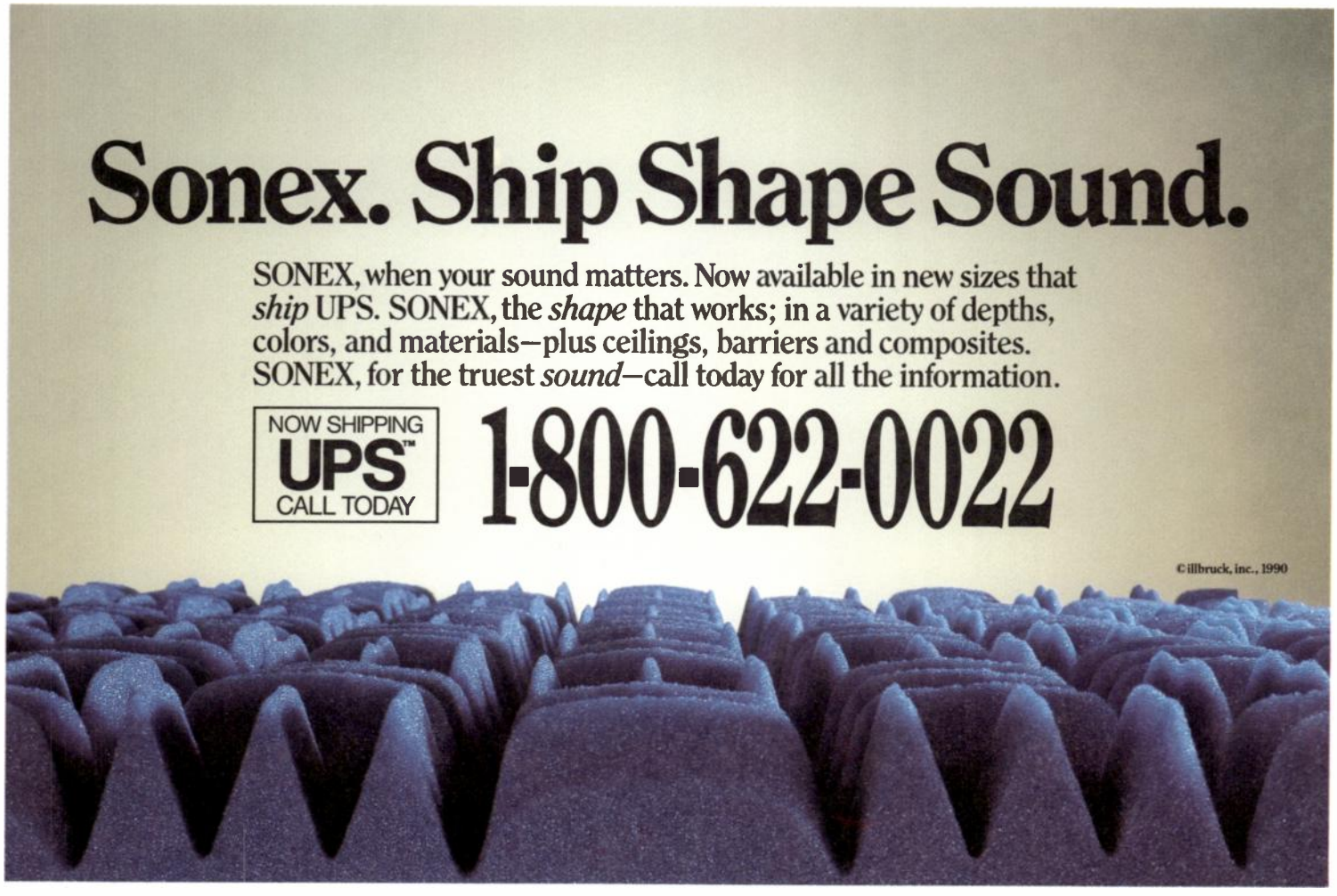

Save Class with Andrew *(continued from page 7)*

For Class B or C2 stations, however, selection of cable for transmission line is less clear cut and depends on the number of antenna bays used. Referring again to Table 1, we see that a station using 5 antenna bays at 85.6% transmission line efficiency requires transmitter output power of 21.5 kW — too much for 2¼" cable. With 6 antenna bays, 17.7 kW is required at 85.7% efficiency and 18.3 kW at 83.0% efficiency. If the VSWR of the antenna is 1.1, 2¼" cable is acceptable (Table 2), but for higher VSWRs, it is marginal at best. Stations with 7 or more antenna bays should experience satisfactory performance at any frequency or antenna VSWR condition likely to be encountered.

These average power ratings are specified for an ambient temperature of 104°F (40°C). For higher ambient temperatures they need to be derated using the data of Figure 4 in Andrew Catalog 34 (pp. 344-345) or the HELIAX coaxial cable catalog (pp. 84-85). Higher ambient temperatures also have a slight effect on attenuation. Normally this increase is insignificant and can be disregarded.

One Harris/Allied customer who saved money by selecting 2¼" HELIAX cable is Ron Turner, Chief Engineer at WTMX 102 FM Skokie, Illinois. Ron needed a 150 ft. run of transmission line to power

Tabl

ECALC™ Efficiency Calculator Program S
Note: System Cost is an Ap

ECALC . . . the HELIAX I
FM CHANNEL: 270 is 101.90 MHz

DESCRIPTION	TYPE No.	EFFICIENCY %
½ foam	LDF4-50A	78.8
⅞ foam	LDF5-50A	87.9
1¼ foam	LDF6-50	90.8
1⅝ foam	LDF7-50A	92.5
½ air	HJ4-50	74.9
⅞ air	HJ5-50	87.9
1⅝ air	HJ7-50A	93.0
2¼ air	HJ12-50	94.3
3 air	HJ8-50B	95.2
4 air	HJ11-50	96.1
5 air	HJ9-50	97.3
3⅛ EIA	MACX350	96.5
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( ) AM phasing systems
( ) FM transmitters: Power level _____
( ) FM antennas
( ) Shortwave transmitters
( ) Other _____

( ) Please have a Harris Allied sales representative call: Best time to phone _____

( ) Please send me information about the following Broadcast Technology Training Center Technical Education Programs:

( ) AM Transmission Workshop
( ) FM Transmission Workshop
( ) RF Circuits I
( ) RF Circuits II
( ) Digital Control Logic
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( ) SX Series
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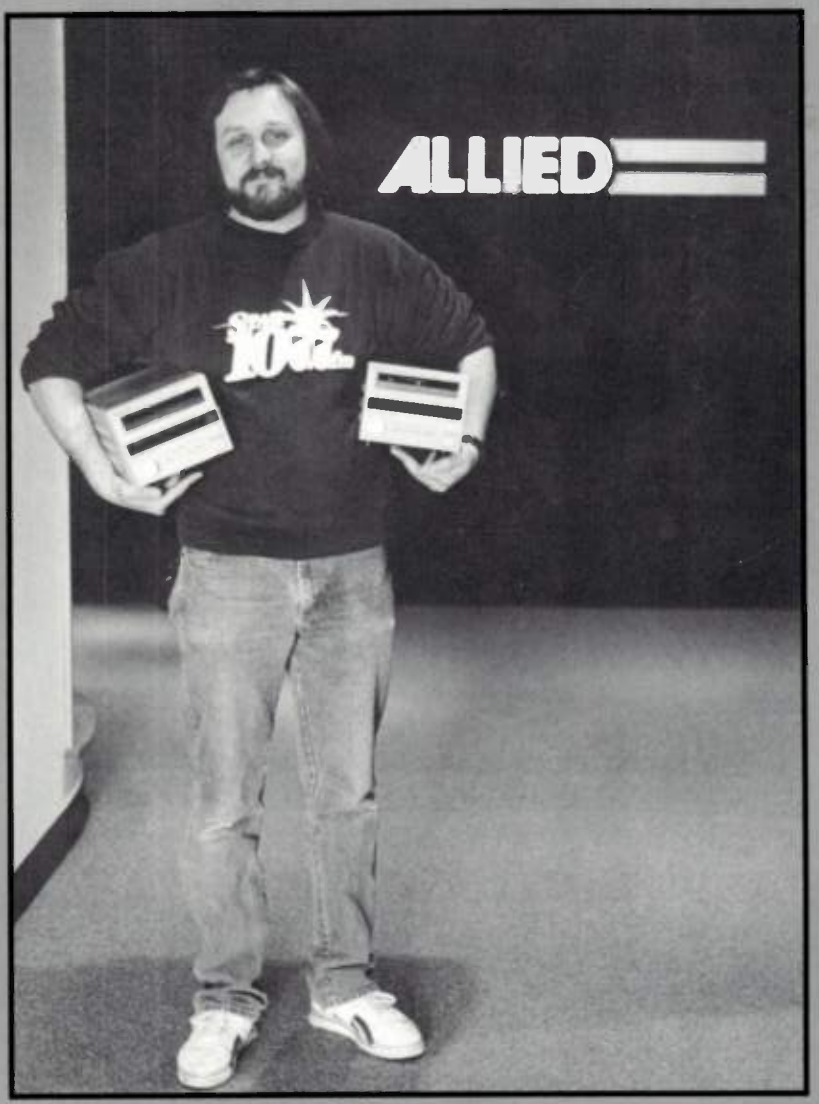

This happy man is Doug Walker. Doug's station, WWSN in Dayton, Ohio, was the winning entrant in the Denon CD Cart Player random drawing.

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