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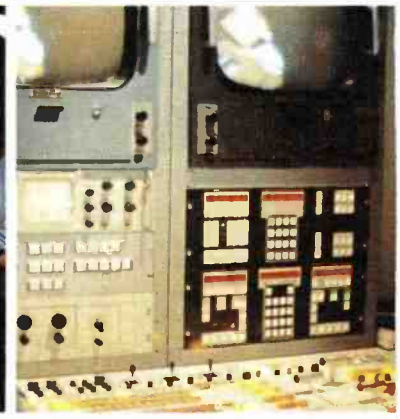
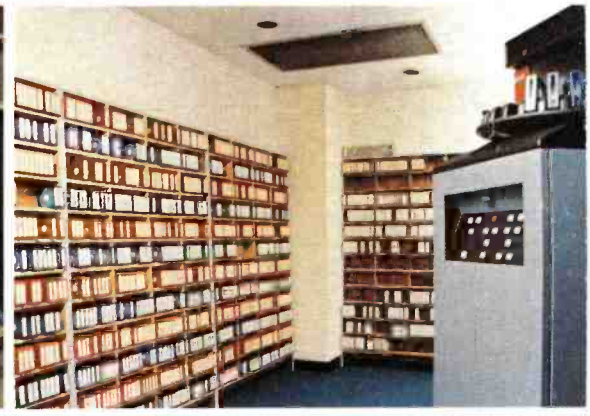
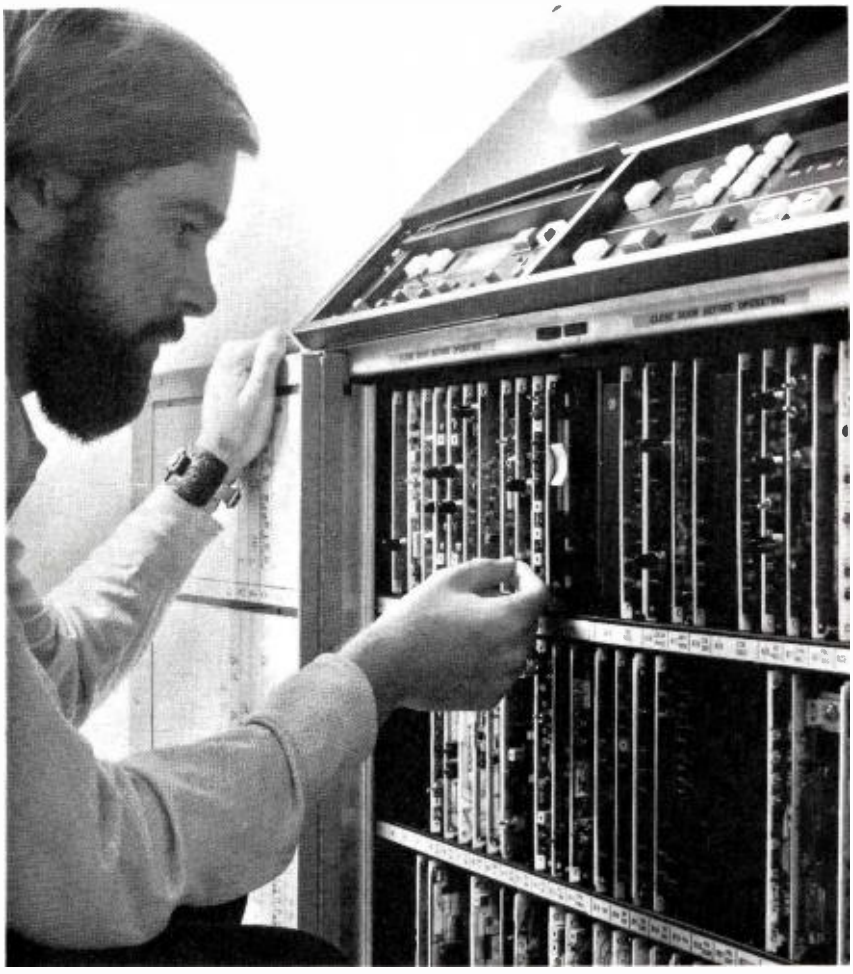
RCA Broadcast News

Volume No. 162, October 1977



KDNL-TV, St. Louis
Upgrades and Automates to Keep Pace





TR-600A: the quad VTR with $20,000 worth of cheering extras included.

Our new quad includes these desired features that would cost up to $20,000 to add to other machines: Chrominance Amplitude Corrector, Color Dropout Compensator, Automatic Color Framing, Automatic Control Track Phasing, LED diagnostic systems, vacuum guide and reel servos, a presettable tape timer with LED timer display. And more.

Great options, too.

Among them: Super Highband/Pilot Tone for better master recordings, thanks to improved signal-to-noise ratio and reduced moiré. And AE-600, the first and only on-line Time Code Editing System built into a VTR. It can operate one record and up to 8 playback TR-600As.

TR-600A is truly the complete quad. At a most attractive price. As your RCA Representative will gladly point out.

RCA

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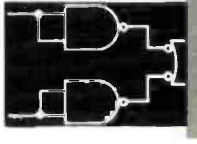


ViewFinder

BROADCAST EQUIPMENT BUY — Harry L. Francis, Vice President of Operations, and James Conley (center), President, of Meredith Corporation's Broadcasting Group, discuss the group's recent $7 million purchase of RCA broadcast equipment with J. E. Hill, Division Vice President and General Manager, RCA Broadcast Systems. Eleven TK-46 color TV cameras are included in the four-station, multi-year purchase, one of the largest orders of RCA equipment by any single broadcaster.

Meredith Corp. Places $7 Million Equipment Order

Meredith Corp.'s Broadcasting Group, headquartered in New York City, has ordered RCA TV broadcast equipment valued at approximately $7 million for its four television stations.

The order, one of the largest purchases of RCA equipment by any single broadcaster, represents multi-year equipment requirements of the group stations, according to James Conley, President of Meredith Broadcasting. Included are TV transmitting systems, TV cameras, and video tape and film studio equipment.

The purchase calls for a 50-kilowatt transmitter for each of the Meredith stations: KCMO-TV, Kansas City, Mo.; WTVH, Syracuse, N. Y.; KPHO-TV, Phoenix, Ariz.; and WNEM-TV, Saginaw, Mich.

The equipment order also includes sixteen TR-600 video tape recorders and seven complete TK-28 telecine islands. Camera systems on order include eleven TK-46 studio cameras, six TKP-45 portable production cameras, and eleven TK-76 electronic news-gathering cameras. The new ENG cameras will bring to twenty-four the total number of TK-76 units in use by the Meredith group.

Harry L. Francis, Vice President of Operations for the Meredith Broadcasting Group, said the equipment order is the result of a planned capitalization program aimed at systematically enhancing all the technical facilities of the Meredith stations.

"The RCA equipment purchased under the agreement is a final step in fully converting our stations to electronic news gathering. The additional production equipment included will enable Meredith stations to provide clients, advertisers and producers some of the most modern production facilities in the industry," Mr. Francis said.

Deliveries of the new broadcast equipment already have begun, and will continue through 1979.

New Transmitter For XHL-TV, Leon, Mexico

XHL-TV, Leon, Guanajuato, an affiliate of Telesistema Mexicano, is upgrading its transmitting plant with the addition of a new RCA 25 kW unit, TT-25FH.

The Channel 10 station's new transmitter replaces an RCA unit which has been in operation for more than 15 years. The transmitter, combined with the station's existing six-gain Superturnstile antenna, produces an effective radiated power of nearly 150 kilowatts.

Francisco Galindo, the station's President and General Manager, said the new transmiter provides improved color reception for XHL-TV viewers and achieves operational advantages and economies of new-design transmitters. The station serves more than three million people in Guanajuato State, and sections of Michoacan State and Jalisco State.

Ch. 6, Managua, Installs New RCA Transmitting System

The Television de Nicaragua, S. A., Channel 6, Managua, has replaced its transmitting plant with a new 25-kilowatt RCA transmitter and antenna valued at more than $250,000.

An RCA Type TT-25FL transmitter and a six-bay Superturnstile antenna have been installed. The new transmitter will replace a low-power RCA unit which has been in operation for more than 10 years.

The new antenna, which radiates an omnidirectional pattern, is installed on a new tall tower located in Las Nubes, on the outskirts of the capital city of Managua.

Rafael O. Cano, Managing Director of the station, said the new transmitter and antenna combination will approximately double Channel 6's viewing area, extending coverage to new viewers and improving the signal quality for current viewers.

Mini-Mobile Units Airlifted To Gabon

Quick, far-flung deployment of RCA's compact TV van was handily demonstrated recently when the first of three such units was air shipped from the Isle of Jersey to Libreville in the West African country of Gabon.

Designed and manufactured at RCA Jersey Limited, each van has three TKP-45 portable cameras, one TR-600 VTR, plus audio, production control and monitoring facilities. They were further customized with sirens and flashing emergency lights.

Mounted on the famous Range Rover chassis, the vans feature RCA-designed body work, a solid fiberglass wrapping of double-wall construction with foam insulation. They also have air conditioning systems to cope with Gabon's steamy equatorial heat, and in-board motor generators affording self-supporting power, even when in motion.

Radio-Television Gabonese purchased the highly maneuverable units, all on the SECAM standard, to inaugurate color service. First use was for full TV coverage of the Organization of African Unity (OAU) conference—an assembly of the Council of Ministers in late June, and a summit meeting of the Heads of State in early July.

All three vans generated on-the-spot recordings and distribution of events as they were happening. There were TV interviews with Heads of State at the airport and the Presidential Palace, as well as coverage of associated activities such as folk dances, soccer games and parades.

After the OAU conference, one of the vans was pressed into service for recorded coverage of independence day celebrations on August 18, which is considered one of the biggest events in the Gabonese calendar.

Normally, use of the three vans is divided between Gabonese TV's two channels. One van operates exclusively with a studio at the Presidential Palace for telecasts of press conferences, state dinners and the like. This comprises Channel 1. The other two vans complement a studio plant with a permanently installed TR-600. This arrangement forms Channel 2, which concerns itself with the production and airing of programs on Gabonese life.

To facilitate establishment of the new color service, RCA Jersey Limited also trained Gabonese engineers and technicians at the Jersey plant before shipment of the vans, and provided technical assistance for the first broadcast operations.

WFSA-TV Improves Service With New Tower And Transmitting System

WFSA-TV, Montgomery, has erected Alabama's tallest man-made structure —a 1935 foot "Tall Tower"—to increase its coverage area. The tower, 481 feet taller than Chicago's Sears Tower, is topped by a new TW-12 Traveling Wave Antenna.

The Cosmos Broadcasting Corp. station also replaced its 22-year old RCA transmitter with a new TT-50FH, 50 kW parallel transmitting system.

Thomas J. Josephsen, Vice President and General Manager of WFSA-TV, said, "This tower will expand WSFA-TV's service area (Grade B signal) 58%, from 12,700 square miles to over 20,050 square miles. In addition we are installing a new transmitter and antenna system which will improve WFSA-TV's picture and sound quality."

Coordination of the entire construction project was handled by Richard C. Payne, Chief Engineer for WFSA-TV. Mr. Payne also supervised the construction of the station's current tower when TV-12 went on air, December 25, 1954.

When the new transmitting system is operational, TV-12 will be broadcasting at 316 kW effective radiated power.

$1.2 Million Purchase By Gilmore Broadcasting

Gilmore Broadcasting Corporation has ordered RCA television broadcast equipment valued at approximately $1.2 million for three of its group TV stations.

Major equipment ordered includes a complete TV transmitting system: six TK-46 studio cameras, and a TK-76 portable camera.

WREX-TV, Channel 13, Rockford, Ill., will install a TT-35FH, 35-kilowatt VHF transmitter and a Superturnstile broadcast antenna.

The TV cameras on order will be placed into service by WREX-TV, KODE-TV, Joplin, Mo., and by WEHT-TV, Evansville, Ind.

Metromedia Television Orders $1.6 Million In RCA Broadcast Equipment

In a major upgrading of its technical facilities, Metromedia Television has ordered RCA TV broadcast equipment, valued at approximately $1.6 million, for four of its group stations.

The order includes TV transmitting equipment, nine studio cameras, film originating equipment and a video tape cartridge recorder.

KMBC-TV, Kansas City, will install a new TT-25FH 25-kilowatt transmitter. It will be combined with the station's existing 25-kW system (also a TT-25FH) to produce a 50-kilowatt parallel transmitting system.

Nine RCA TK-46 studio cameras, slated for WNEW-TV, New York, and for KMBC-TV, are included in the equipment order. WNEW-TV also will install two complete TK-28B TV film systems, and KTTV, Los Angeles, will receive a third TK-28B.

WXIX-TV, Metromedia's Cincinnati station, will install a TCR-100 video tape cartridge system.

RCA Equips New UHF TV Station In Ft. Wayne

A new UHF television station in Ft. Wayne, Ind., will install RCA transmitting and studio equipment valued at approximately $700,000 to begin broadcasting on Channel 55.

The Ontario Corp. of Muncie, Ind., licensee of the new outlet, has placed an order with RCA Broadcast Systems for a TTU-30C, 30-kilowatt transmitter, and a TFU-30J UHF pylon antenna.

The equipment order also includes two TR-600 quadruplex video tape recorders and a complete TK-28 telecine island.

Bob Faull, the station's General Manager, said Channel 55 is scheduled to go on the air the first of next year.

Up And Away!

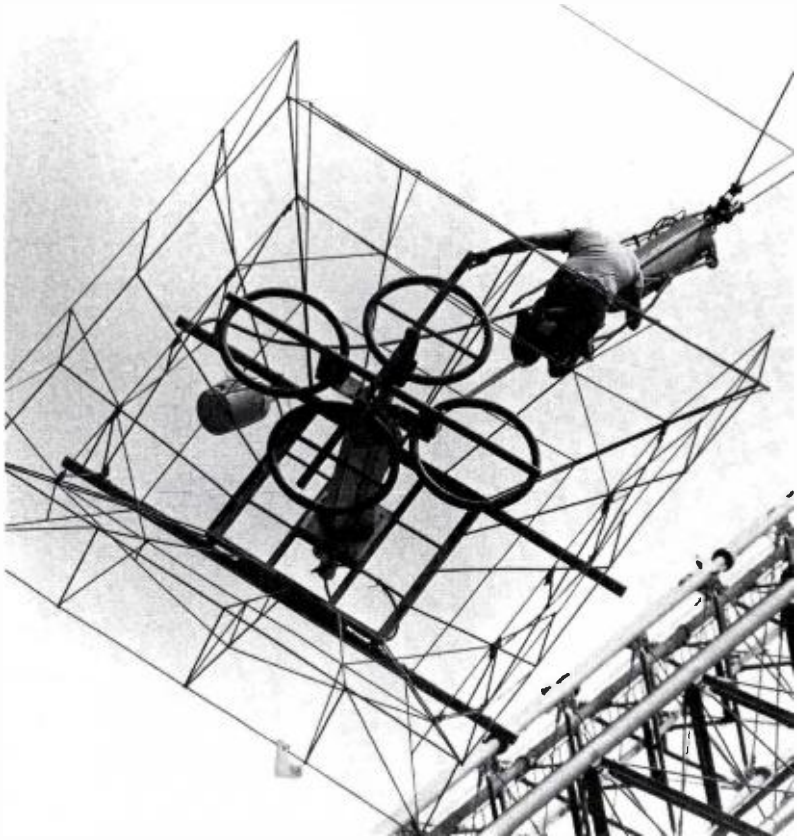
One layer of a new circularly polarized antenna for Ch. 2, Miami, lifts off for the trip to the top of the tower, with an intrepid rigger going along for the ride.

WPBT-TV, a non-commercial educational station operated by the Community TV Foundation of South Florida, Inc., is the first broadcast operation on-air with this RCA-designed panel type CP antenna.

The Quatrefoil lowband VHF antenna, Type TBK-6A2(S) is convertible between horizontally and polarized circularly polarized transmission signals by a simple electrical field adjustment of the antenna input, without any modifications to the antenna itself. The Ch. 2 antenna is side-mounted on a multiple-station tower which is topped by two UHF antennas.

The new six-layer CP antenna is a part of an extensive upgrading of facilities which also includes a new TT-25FL, 25 kW Transmitter and a new transmitter building. With the new transmitting system, the station expects to increase its ERP by about 40 percent in the horizontal plane, to 100 kW.

Bob Ware, WPBT's new Director of Engineering notes that initial tests of the CP transmission indicate a significant improvement in picture, particularly with indoor antennas—which are used by about half of the viewers in the Ch. 2 coverage area.



First TV Station In The Bahamas Goes On Air With RCA Color Equipment

The Broadcasting Corporation of The Bahamas, known as RADIO BAHAMAS, has established the first national television broadcast system in the Bahamas with RCA television equipment valued at approximately $2.5 million. The new Channel 13 outlet is bringing the first local programming to Nassau, the Bahamas capital, and to New Providence Island and several Family Islands.

The new studio facilities in Nassau includes three TK-46 cameras, two complete TK-28 telecine systems, two TR-600 quadruplex video tape recorders and two HR-1060 videocassette editing recording/reproducers.

A compact RCA-equipped television van is used for on-the-scene program and commercial production. The van, which was on display at the 1977 NAB exhibit, is equipped with two TKP-45 portable cameras; a TR-600A video tape recorder, a video switcher and audio and intercom equipment.

RADIO BAHAMAS also operates a complete electronic newsgathering department, using three TK-76 lightweight portable cameras and four HR-1020 portable videocassette recorders to provide for fast-response, on-site recording of events. Two additional HR-1060 recorders are used for editing and airing of the news material.

The transmitting system will use two 2.5-kilowat units, operating in parallel to produce 5-kW visual power output. Combined with the antenna, the transmitting system produces approximately 40-kilowatts effective radiated power.

Five Field Communications Stations Install TCR-100's

Installation of RCA TCR-100 video tape cartridge recorders is being completed by Field Communications, Inc. at the five television stations recently acquired from Kaiser Broadcasting Company.

The equipment purchase, valued at approximately $1 million, will provide cartridge tape capabilities for WKBD-TV, Detroit; WKBS-TV, Philadelphia; WLVI-TV, Cambridge-Boston; WFLD-TV, Chicago; and KBHK-TV, San Francisco.

The TCR-100 systems for the group stations include Signal Processing Units which make the cartridge machine a completely independent facility for on-line service or as an off-line recorder.

Warner Cable TV Orders Nine RCA TKP-45 Cameras

Warner Cable Corp., a subsidiary of Warner Communications, Inc., has ordered nine TKP-45 portable production cameras for use in its studios in Columbus, Ohio. The equipment order also includes audio and video switching, monitoring and control equipment.

Later this year, Warner will offer a new cable television service to 100,000 Columbus area homes. It will involve 30-channel programming and two-way communications between subscriber homes and computer-equipped studio facilities.

The nine TKP-45 cameras will be used in the production of special interest and local programs for the new cable service, according to James L. Fischer, Vice President, Operation, for Warner.

The cameras also will be used for on-location production of informational, educational and entertainment programs. The cameras are equipped with minipack battery and camera control unit, enabling them to be transported anywhere as a self-contained system, free of external power source and cable length restrictions.

The new cable service in Columbus is a computerized, interactive communication system that will include a small home terminal device to be connected to the subscriber's television set. By pressing buttons on the console, subscribers will be able to receive up to 30 channels of voice and other information, select programs, take tests, instantly register opinions, and participate at home in television programs and events. The TKP-45 camera also will be used for live programming for the interactive portions of the cable service.

IREECON, Another Debut for TK-760

Australia's IREE Convention, held in Melbourne in August, marked the latest stopover in the international launch schedule for RCA's newest color camera, the TK-760. It was first shown at the NAB Convention in Washington this year, followed by its European premiere at the International Television Symposium in Montreaux, Switzerland, in June.

The camera, easily adaptable to both inside and outside work, was an item of considerable interest to IREECON visitors, including Australia's Governor-General, and IREE Patron, Sir John Kerr. He is shown "checking out" the new studio/field camera which was demonstrated alongside the highly successful TK-76 portable camera.

RCA's working display at IREE also included live presentations of remote-control editing provided by TR-600A recorders with the built-in AE-600 Time Code Editing System.

Photo: Courtesy of "The Age" newspaper, Melbourne.

Christian Broadcasting Network Equips New Boston TV Station

The Christian Broadcasting Network, Inc. has ordered RCA color broadcast systems valued at approximately $1 million to equip its new TV station, WXNE-TV, in Boston.

The purchase covers a complete transmitting facility and associated studio equipment. The new station, due to begin broadcasts on Channel 25 this fall, will employ RCA's TTU-110B UHF television transmitter which produces 110 kilowatts of power. A TFU-25B pylon omni-directional antenna also is included in the order.

James A. Gimbel Appointed Director, Marketing

Appointment of James A. Gimbel as Director, Marketing, for RCA Broadcast Systems was announced by J. E. Hill, Division Vice President and General Manager.

Mr. Gimbel will have executive responsibility for marketing RCA's complete line of radio and television studio and transmitting systems throughout the U. S. For the past year he has been Manager, Sales, for the broadcast equipment activity in Europe, Africa and the Middle East.

Mr. Gimbel joined RCA in 1957 as a broadcast equipment sales representative covering several middle Atlantic states, and in 1969 became Manager, Northern Area Sales.

He came to RCA after a career as a studio engineer at Philadelphia, Pa., and Flint, Mich., radio and TV stations. During his Philadelphia assignments, he also instructed classes at Temple University in broadcast practices and techniques.

Action center at KDNL is Production Control. Efficiency has been enhanced with the addition of new TR-600 tape machines and AE-600 Editing System.

TV 30

A Lonesome "U" Automates And Upgrades For Extra Efficiency . . .

ST. LOUIS

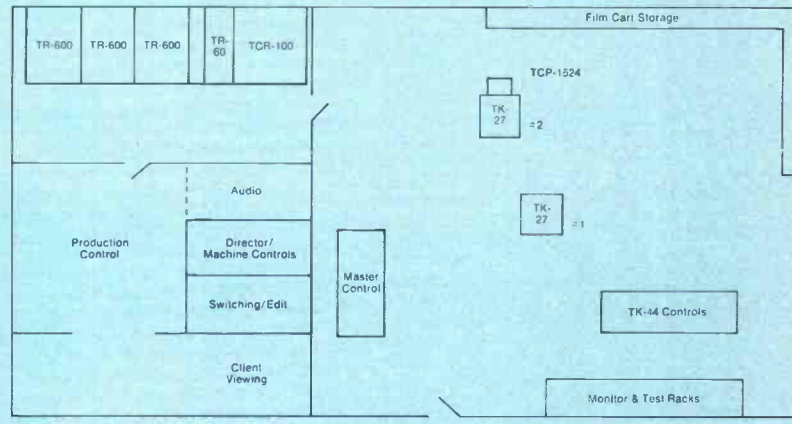
WHEN KDNL-TV, St. Louis, went on-air as the only commercial UHF station in the market, its survival chances were slim. However, TV-30 beat the odds, and is still alive and well. After eight years, it has wedged out a share of market and audience that augurs well for the future.

Investment in a fully-equipped facility —from studio to transmitter and antenna—got the new operation off to a good start. Making full use of the equipment as a production resource to augment the on-air operation has been an added strength.

Find A Need—And Meet It

How does a commercial UHF station make it in a market already covered by four V's? Responses to this question are many and varied, but Jack Petrik, President and General Manager of TV-30 offers this uncomplicated answer: find a need, then fill it.

For example, he says, while KDNL was in the planning stage, it was determined that there was a need for a quality TV production facility in St. Louis. Consequently, the TV-30 production center was equipped and staffed to handle this business.



Technical Area, KDNL-TV, St. Louis

TV-30's tape line-up includes TR-600's; TR-60 and TCR-100.

In programming, TV-30 established itself by offering a combination of popular entertainment programs for broad audience appeal, and specialty programming such as religion, sports and financial news for selective audiences.

The production resource brought in some clients who had never used television before, which resulted in spot sales for the station as well as production income. The new facility also attracted many clients who wanted to upgrade the quality of their TV commercials. TV-30's capability for quality production has been extended with the recent addition of three TR-600A quad VTR's and an AE-600 time code editing system. A TCR-100A Cartridge Tape System and TCP-1624 Cartridge Film System have automated station breaks and made tape and film equipment more available for production use.

Upgrading A "Showcase"

In 1969, the brand new KDNL-TV facility was the showcase studio/production operation in St. Louis; its impressive equipment complement including three TK-44 color cameras; three TR-60 quadruplex tape machines and two TK-27 film systems.

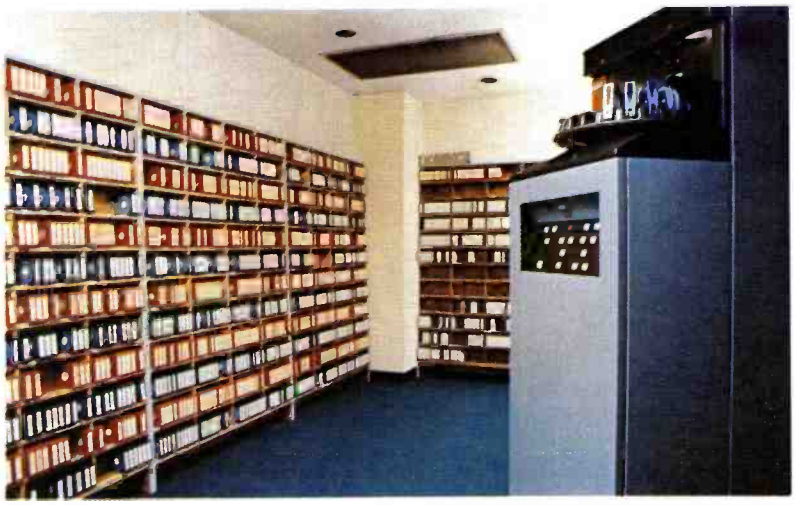
Since then, there has been no inclination to stand pat. The other stations in the market upgraded their technical facilities—and so did TV-30. Over the past two years, the Tape Room has been totally changed, with the replacement of two TR-60's with the TR-600A/AE-600 systems. A TCR-100A has been installed, with the third TR-60 as the "master". The telecine operation has been improved with the addition of a TCP-1624 film cartridge system to one of the film islands. Production Control has been refurbished, and its capability extended by a new Grass Valley 1600-3G video switcher. And in the Administration/Operations area, a new "in-house" computer system handles all business functions as well as the usual log print-out, avails listing, etc.

Busy Technical Staff

Chief Engineer Wayne Anderson started with TV-30 before it went on-air, and has been responsible for the initial planning of the station's technical facilities, as well as for the continuing upgrading program.

His staff of ten full-time engineers is responsible for air operations, maintenance, production support and related technical functions. Production support includes manning the video, audio and TD positions; and video tape machines. Two men handle the on-air operation. With this diversity of functions performed by a small staff, there is little wonder why TV-30 looks for new equipment to increase efficiency by automating routine functions.

Chief Engineer Wayne Anderson and Engineering Supervisor Jim Marlow with one of TV-30's new TR-600 tape machines.



TCP-1624 Cartridge Film System airs more than 100 film "carts" per day. Active carts are stored on wall shelves for easy access.

Addition of the cartridge film system freed up one of TV-30's two telecine systems for full-time production use.

Loading, unloading or changing film "carts" is a simple operation.

Film "Cart" System Eases Telecine Burden

The TCP-1624 film system airs more than 100 film carts per day, and has established an excellent performance record. It operates smoothly, resulting in fewer errors and a better on-air presentation. The system has been quite reliable and routine maintenance and regular cleaning have kept it operating efficiently.

End of the "Spot Reel"

Before the film "cart" system was installed, a spot reel was made up daily. It was a full-time job for one film operator making up and breaking down the spot, Mr. Anderson notes. Even this posed a problem when a saturation schedule required playing the same spot several times a day. One of the TP-66's had to be delegated for the single spot, which limited the availability of either film island for production use during the day.

Once installed, the TCP-1624 immediately saved making up the spot reel—and provided an additional resource for production. It did not take the TV-30 technical staff long to make use of the "cart's" stop-on-frame and instant stop/start capability as production effects. During the daytime, one of the film systems is used for programming, and the second is available for production.

Tape "Cart" Relieves A Giant Headache

In upgrading the technical area, tape equipment was given major emphasis, with the purchase of a TCR-100A Cartridge Tape system and the tape/editing combination of three TR-600 VTR's with AE-600 Time Code Editing Systems.

The "cart" machine was delivered first and was on-stream in September 1976, while the TR-600/AE-600 system became operational in late January 1977. The new tape machines replaced two of the original three TR-60's. The other TR-60 is the "master" for the TCR-100, and is used for program playback and for making dubs. Although primarily used for production, the three TR-600's are also used for programming when required—as is the case for the "700" Club, a 90-minute program which comes in two reels.

Jim Marlow, Engineering Supervisor, was delighted with the changeover to the film and tape "cart" machines. "Before the TCR-100 was on-stream, station breaks were a giant headache—with as many as twelve separate tape

reels having to be loaded and unloaded from the tape machines within 3-4 minutes. To get away from this impossible situation, a tape spot reel was made up, but this limited flexibility and tied up an engineer for making up the reel. The problem was compounded by the increasing number of 10-second commercials to be aired."

Engineer Dean Kuene says that the TCR-100 has worked out well. It has performed reliably and has substantially reduced the workload in the tape room. And, he adds, the TCR-100 and the TCP-1624 have resulted in improved air performance for both film and tape, with consistent color, fewer errors and less "make goods". The built-in pre-rolls on these machines are programmed to fade to black between spots.

Tape commercials are dubbed on the TCR-100 between 10 A.M. and 1 P.M. daily, and the "cart" machine is averaging 150 plays per day. Commercials produced by TV-30 and aired by them are dubbed to video cart. Some local commercials produced by TV-30 are also dubbed to cart for distribution to KPLR-TV and KSD-TV, other St. Louis stations equipped with TCR-100's.

Faster, More Economical Editing

The TR-600's are installed side-by-side in the tape room, set up for three-machine editing. "We needed a new tape /post-production facility with a time code editing system," Mr. Anderson notes, "and the TR-600/AE-600 combination provided state-of-the-art tape and editing systems. In addition, the AE-600 was the only editing system available that was integral to the tape machines, and this was important to us.

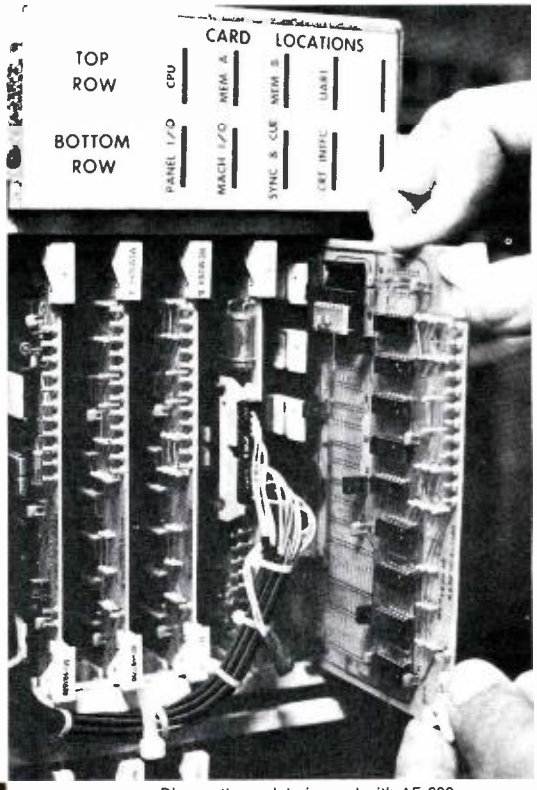
"Our clients are interested in quality results, but are cost-conscious. The new TR-600/AE-600 system permits us to edit faster and more economically to keep pace with market needs."

The installation went extremely smoothly, requiring only a day to complete the switchover from the TR-60's to the three TR-600 tape machines. The easy installation was possible because the AE-600 is built into the TR-600, requiring only three twisted pair wires in a single cable to tie the editing machines together. The local control access to the editing system—with controls mounted in the tape machines as well as in the remote Production Control room—is another feature of the AE-600 system which TV-30 finds useful.

One of the TR-600's is equipped with a video keyer for inserting time codes for monitor display. This is particularly useful when unedited quad production tape footage is transferred to cassette for rough editing. The time code display makes it easier for clients or agency personnel to select in-out times on the tape, saving editing time and expense.

A timing delay system was added by the technical staff so that the VTR's operate on house sync at all times, while the other sources—live cameras and film—are delayed. This system simplifies editing operations, particularly when one of the tape machines is used as another program source.

A videotape storage space is located behind the tape room, for easy access. Masters of current program and commercial tapes and 1,000 TCR-100 carts are stored here. Identifying numbers for both film and tape carts are assigned by traffic and programmed into the "house" computer.



Diagnostic module is used with AE-600 Editing system to confirm proper operation by testing all operating functions.

TR-600's are set up for three-machine editing. Both local and remote editing control panels are installed for added flexibility.

In Production Control at TV-30, the AE-600 remote editings control panels are rack-mounted above the video switcher.

Production Control—Action Center

Production control at TV-30 is located directly behind Master Control, and adjoins the tape area. Equipment complement here includes:

- RT-22 cue-operated reel-to-reel audio recorder
- RT-7 and 27 cartridge audio tape systems
- BC-7, 2-channel audio console
- Grass Valley switcher, type 1600-3G, with 16 composite/non-composite inputs, and three mix/effects buses.

Rack-mounted to the left of the switcher are machine controls for the four VTR's and the multiplexers. Directly above the switcher at fingertip reach, are the remote controls for the AE-600 system.

Since the editing system became operational in January, the difference in the production operation has been remarkable. Production goes faster, Jim Marlow notes. "Program material is easier to assemble, and, with the new switcher a wide range of effects can be inserted during the editing session. With this added versatility, more creativity can be applied in post-production, and more sophisticated commercials can be produced with available in-house resources."

With the AE-600 system, Mr. Marlow says he can strip off the audio and add effects and sweetening on the same pass, speeding the operation and saving a tape generation.

Jim Marlow looks ahead to the expansion of the system and extending its operational capabilities—such as using the editing system to trigger the switcher to make pre-selected dissolves and effects.

Production Manager Jack Fansher is enthusiastic about the added capabilities of the new TV-30 production facility, especially the TR-600/AE-600 system. One reason is that the remote controls for the AE-600 system moves the editing operation out of the tape room. "Clients love it," he notes. "Editing can be accomplished faster, with less disruption, and the edited material can be checked immediately for OK."

A client viewing room adjoins Production Control, so the edited tapes are viewed on a TV set in a living room environment, instead of having a group of people cluster around a monitor at the tape machines.

AE-600 Simplifies "Tagging"

Putting "tags" on order-by-mail merchandise spots is one assignment that the AE-600 system has simplified, Mr. Fansher continues. Since spots for mail order clients frequently require up to forty different tags to cover different markets, improvements in efficiency and speed reflect significant economies in production.

Production dubbing is done by an engineer at the end of the shift, or by the night projectionist/operator. TV-30 handles the distribution of completed spots as well as making the dubs.

The new film and tape cartridge machines have helped Production by opening up all of the new VTR's for production use during the day and freeing one film island. The TCP-1624 has been useful for production because its instant stop and start feature makes it easy to freeze frame and "super" an effect or graphic.

The normal production hours are from 9 A.M. to 5 P.M. However, the tape machines are operated on a much more extended schedule—usually from 6:30 A.M. to 1 A.M.

Four Separate Studios

KDNL-TV production facilities include four separate studios:

Main Studio
Kitchen Set
News Set
Bowling Alley

A complete working kitchen set-up is maintained in one of the studios for producing commercials for a major regional food chain.

A second permanent set is used for the "Financial Observer" program which features business news and a running display of stock market returns. This program is aired three times each weekday, and has a select, but avid audience. The program is on from 9:30 to 10:30 A.M., and from noon to 1:00 P.M., with a ten minute re-cap at

KDNL-TV Production Manager Jack Fansher (right) reviews shooting script with cameraman.

Client viewing room adjoins Production Control.

TV-44 cameras operate from four studios for programming and production.

2:50 P.M. following the afternoon movie. The stock market returns displayed on the screen are delayed for fifteen minutes.

Three TK-44 cameras are used for studio production, with cable runs set up so that the cameras are easily shifted from one studio to another. The cameras have been excellent, Mr. Fansher affirms producing consistenly high quality color commercials.

On-Air Switching; Control, and Monitoring Equipment

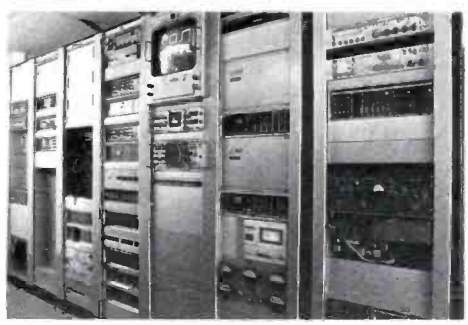
At KDNL, Master Control is not in an isolation booth. It is located in a large room which also houses the two telecine islands, the camera control units for the three TK-44 cameras, plus the rack equipment for the audio and video distribution and switching systems, and the microwave and transmitter studio monitoring and test facilities.

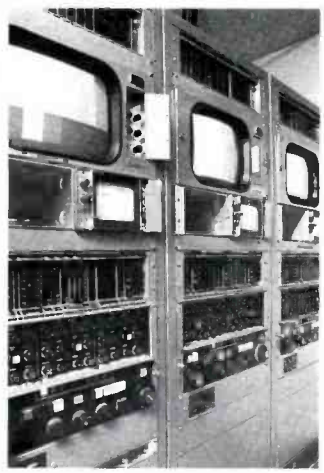
The on-air switching console includes a full complement of machine controls: VTR's; TCR-100A; film projectors, and a sequencer panel for the TCP-1624 cartridge film system. Also at the master control position are remote controls for the three studio cameras and the CCU's for the TK-27 film cameras. The remote control unit for the TTU-60 transmitter is located on the right side of the console.

The on-air operation is handled by two engineers—one manning the master control switcher, and the other loading all of the sources. This operator also handles any TCR-100 "cart" dubs required during the broadcast day.

"Turnkey" Studio and Transmitting System

TV-30 started broadcasting with a totally new broadcast system supplied and installed by RCA, including studio and transmitting facilities. The 60 kW TTU-60 Transmitter and TFU-25G Pylon Antenna deliver the authorized 1,190 kW ERP. The system is remote-controlled from the studio and has performed extremely well. Klystron life has been outstanding, Mr. Anderson says, with tubes going for 35 to 40,000 hours before being replaced.





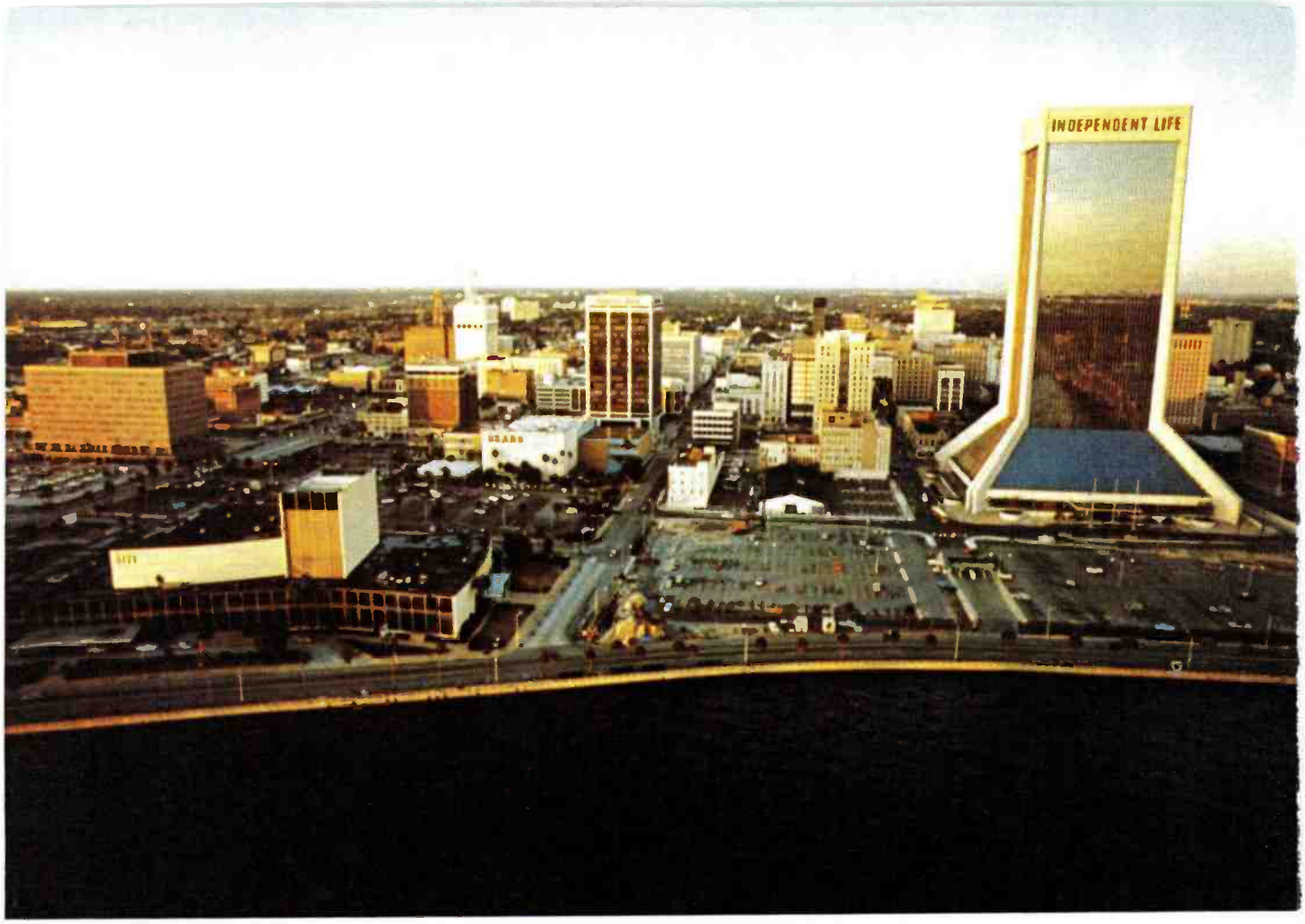
Master control console includes film camera shading controls; remote controls for film and tape "cart" machines, and multiplexers. Near Master Control are a bank of racks housing the TK-44 camera control units. Another row of racks mounts equipment for distribution, switching, monitoring and testing.

The KDNL-TV studio building was designed as a broadcast facility, but not for television. It was constructed in the late 1940's as a grand scale FM station operation, including numerous audio booths and four separate sound studios. Subsequently, the building was vacated by the radio station and converted by KMOX for their broadcast operation. When Channel 4 moved to their new location near the "Arch" in 1968, the building became available to Evans Broadcasting Company, who refurbished and re-equipped the facility.

Unchanged Commitment to Quality

KDNL-TV went on-air as the lone "U" in the St. Louis market, starting with a top quality broadcast and production operation. Since then, the station's philosophy has not changed: A commitment to quality and efficiency in maintaining an excellent on-air look, and in operating a first-rate television production facility.

New equipment acquisitions bear out this philosophy. The TCR-100A and TCP-1624 tape and film "cart" systems contribute to improved on-air appearance and improved operating efficiency. The TR-600A/AE-600 tape machines and time code editing systems enhance production capability and performance. □



Skyline view of expanding Jacksonville.

New Teleproduction Center Flourishes in Florida

JACKSONVILLE, FLA.

"Film Capital of the World!"

Once upon a time—before Hollywood—Jacksonville, Florida answered that description. The first full length motion picture was produced there, as was the first Technicolor feature.

Those palmy, glory days may never return to Jacksonville. But there is a definite upswing in the film and television production business in the area. Sparking this resurgence are Ted Johnson Productions and Communications 21. Ted Johnson Productions, a complete teleproduction center with remote unit, has been in operation since March 1976. Communications 21, a full service film, tape and audio-visual production house, has been in business just six years.

Ted Johnson, President of both companies had no idea of getting into either film or teleproduction. An active member of the Jacksonville Chamber of Commerce, he took on the task of bringing more film production into the area. During his study of available local resources for film production, Mr. Johnson was astounded to find them ex-

tremely limited. There was a need, he found, for a high quality full service film capability to meet local needs, particularly for business and industry.

Recognizing the potential, Mr. Johnson purchased a small film company and built it quickly into a complete film/audio-visual facility. Corporate communications assignments came first, then other production work, including film commercials for television. The company prospered and profits were re-invested to extend its resources.

From TV Spots to Teleproduction

With the growing volume of production work for television, the tight deadlines and multiple print requirements, expansion into teleproduction was a logical move for the company.

Handling the television commercials for the Winn-Dixie retail food chain accelerated the move into teleproduction. Producing these commercials on film was often a nightmare because of the variations, the multiplicity of commercials, the price and copy changes and short deadlines. The versatility, immediacy and fast turn-around time possible with video made it a practical necessity for servicing the Winn-Dixie account.

The teleproduction center for Ted Johnson Productions is designed to handle a high volume of tape spot commercials with numerous variations and dubbing requirements. The system is equipped with five TR-600 quad tape machines; TK-45A Studio and TKP-45 Portable Cameras; TK-27 telecine system; Grass Valley switcher, and Datatron computer editing system.

Three of the TR-600's are used for editing and dubbing; one handles master recording from the studio, and the fifth is mounted in a new mobile unit for location shoots.

Film and Video Expertise

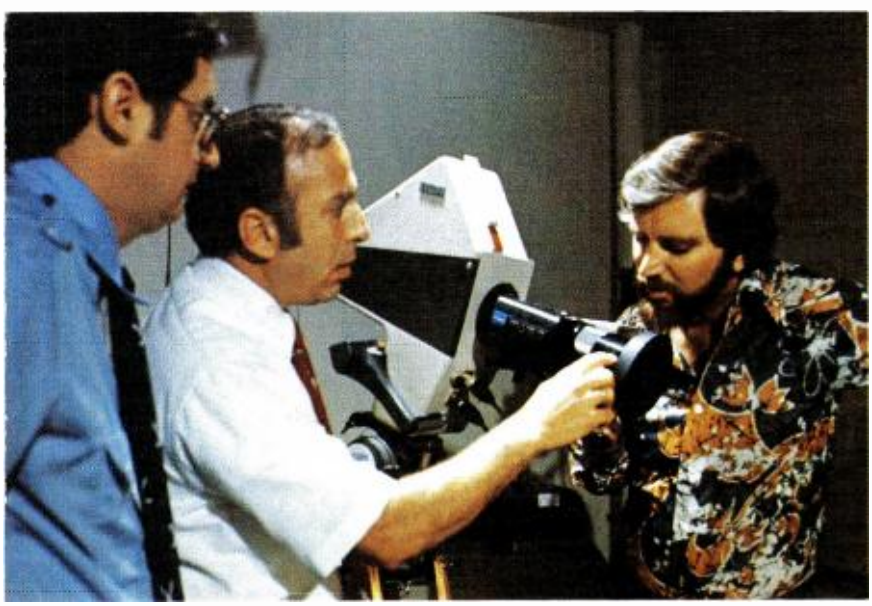
At Ted Johnson Productions, the video operators and technical staff come from broadcasting, while at Communications 21 the creative expertise is film-based. "This is a 'people' business," states Mr. Johnson, "—a blending of technical and creative. To succeed you need the best of both."

Communications 21 Vice President Lou DiGiusto III, who brought to the company a rich background in film production, emphasizes the point that film people are able to adapt easily to television.

"In shooting for television," he says, "we use the cinema technique with a single camera. This is not uncommon in teleproduction, but here the cinematographers and the television cameramen are the same individuals, just handling different equipment. One difference with teleproduction is that whether the shoot is on film or on tape, the release is almost always on tape, since this produces better results for television."

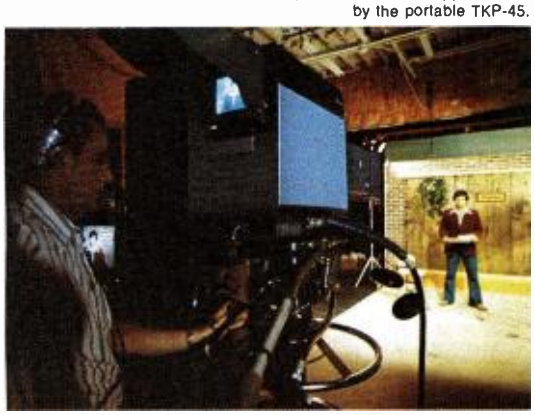
Tony Kennedy, Vice President of Ted Johnson Productions, has the ideal background for teleproduction—starting in broadcasting as a TV cameraman, then moving into cinematography, and operating his own film production firm.

Mr. Kennedy refers to TJP as being a "production oriented" facility—and this is most certainly the case. The



Lou DiGiusto, Vice President; Ted Johnson, President, and Tony Kennedy, Vice President, with TKP-45 camera.

TK-45 camera is primarily used for studio production work, supplemented by the portable TKP-45.



Master Record facility next to the studio area is equipped with a TR-600 tape machine; camera control units, and a basic video switcher.

facility is designed for flexibility and production. With efficient utilization of equipment, a limited staff is able to handle an unusually high volume of production for outside producers as well as for Communications 21.

The Production Game

In handling the tape spot commercials for a major retail food account, production is indeed the name of the game, and the pace is frenetic at times.

As many as forty commercials are produced in one day for Winn-Dixie through its Jacksonville agency, William Cook Advertising. This client has eleven divisions or regions, and each is treated as a separate account. Product and price promotions not only vary from region to region, but also within a given region there are different prices or products to be featured.

Fast turn-around is critical. For example, Tuesdays and Thursdays are reserved for studio shooting of retail food commercials. The tape spots are edited that night, and an "answer" tape for each is dubbed from the quad master to ¾-inch videocassettes. These are supplied to the agency the following morning for review and client approval. OK'd spots are then dubbed that night and distributed to TV stations in the designated regions. As many as 17 dubs are made of individual spots.

Studio Designed for Production

Some broadcasters, accustomed to huge studio facilities, would find the TJP studio confining. The area is tight, but since most of the shoots involve small sets and closeups, the space is well utilized. In fact, within the confines of a 30 x 50 foot studio area, three sets can be pre-set to expedite production.

A single TK-45A is used for the studio camera. Occasionally it is supplemented by the TKP-45 camera for special production requirements.

One unusual aspect of the TJP studio is the use of a front screen projection system instead of the customary Chromakey background. In this situation, the talent stands in front of the screen. The picture is projected from a slide projector, with a 45° angle mirror. The TK-45 shoots through the mirror, picking up both the talent and the image on the screen behind. Front projection provides an excellent background, and has the advantage over Chromakey in that the camera can zoom in or out on the talent, and the background will also enlarge or reduce in the same ratio. This technique provides more realistic backgrounds, and is particularly useful in producing Winn-Dixie commercials, showing various store interiors in the background.

Master Record

Next to one corner of the studio is the Master Record area, which reflects the production-oriented set up of Ted Johnson Productions. Master Record is a one-person production control operation. The video operator handles recording functions for the TR-600; shades camera for the studio TK-45A; has remote controls for the film camera projectors, and zoom controls for two monochrome titling cameras which are positioned next to the control console. Also at the control console is a basic switcher for adding dissolves, keys and shadows as needed during taping. This conserves editing time and speeds production.

Editing and Dubbing

Behind the Master Record area is Editing and Dubbing, a busy facility which operates around the clock during the week at Ted Johnson Productions. The equipment complement here includes three TR-600 tape machines; a Datatron computer editing system; production switcher; a monochrome titling camera; videocassette recorder, and monitoring facilities.

Controls for the Master Record TR-600 are also remoted to Editing, permitting this machine to be used for dubbing and editing when the studio is not in use.

In the editing operation, two machines are used for playback (A-B rolls), and the third is for master record.

The A-B rolls are cued by the Datatron editing system, using pre-recorded time codes. The production switcher, a Grass Valley Model 1600 3G, 16-input with three mix/effects, downstream keyer and quad split capability, is used primarily in the editing operations.

For efficiency, sometimes the same tapes are loaded on the two TR-600 playback machines. This permits inserting different audio and different video "supers" to the same basic commercial. Many Winn-Dixie commercials are produced as "doughnuts", with standard "masters" and various music "beds". Video Operator Barbara Bowen says that there are more than thirty different video masters used for producing Winn-Dixie tape spots at any given time.

The frequency of change and variation in the commercials requires constant playback shuttling of the tape machines, and the TR-600's ability to lock-up fast has been a production asset. In handling the changes, the trick, Tony Kennedy notes, is to find the common scenes and make thc audio track changes. The audio tracks are recorded separately and added to video during editing.

TR-600 Delivers Outstanding Service

During the week, from 7:30 A.M. Monday, until 9 A.M. Saturday, the TR-600's are operating continuously, editing and dubbing. The machines have given outstanding service: downtime has been minimal; reliability tops. Technically and operationally, the TR-600's are excellent, Chief Engineer Joe Atkins reports.

"Operationally, the machines are truly human-engineered. The slanted transports, straight-line threading, and drop-on reels all contribute to operator efficiency.

"The stability of the TR-600's, and their superb performance are also operational advantages. Top-quality multiple generation tapes are produced consistently, with no moire problems. The reel servo system provides better tape handling, which is important, considering the around-the-clock usage the machines get.

"The fast lock-up speeds editing timc and helps the operators by making editing and dubbing operations smoother and less frustrating. The TR-600's make clean, precise edits.

"With our dubbing and editing demands, reliability is a critical factor, and our tape machines have been super-reliable. For the first four or five months they ran with practically zero problems, other than normal maintenance. Failures are probably at a fraction of 1%. For teleproduction operations, downtime is a killer and a real dollar drain. Headwheel life has been good. After more than 800 hours of use, we have not had to replace any heads yet."

Contributing to this performance is a humidity control system in the tape areas. Two separate compressors are installed for redundancy, and are operated on an alternate-use base. Excess capability is built-in, since the compressors can handle up to ten tape machines plus the film system.

Versatile Routing Switcher

System flexibility is a key factor in maintaining a high volume production capability. The heart of the video system at TJP is a versatile routing switcher, a 12 x 9 vertical interval audio-follow-video system which provides complete flexibility.

The routing switcher has available all house sources including the outputs of the audio board and of the production switcher.

In addition to the usual video and audio sources, the switcher also permits monitoring other system devices such as the keyer, and the time code character generator. This keys the time code over thc video on the Master Record VTR and displays it on the monitor. (The time code is pre-recorded on all quad tapes by TJP.)

Sources can be keyed in at any location, and can be patched as needed. Each source outputs through a video distribution amplifier.

The house pulse system includes two

Editing and dubbing area includes three TR-600's, video switcher and computer editing system. Facility operates around the clock during the week to handle dubbing requirements.

Fully equipped recreational vehicle is used for location shoots. Unit is equipped with a TKP-45 camera; TR-600 VTR; video switching and audio facilities, and a 6 kW generator.

sync generators to provide redundancy in maintaining system timing. Each pulse goes through pulse DA's for distribution to all sources in the system.

Mobile Unit Expands Capability

The immediate success of the teleproduction operation and the full utilization of in-house facilities triggered TJP's expansion. In line with Ted Johnson's policy of re-investing to develop the business, the company added a new mobile unit to accommodate increased demands for on-location production.

The new mobile unit, a 27-foot Winnebago recreation vehicle, was activated in November, 1976, just eight months after the teleproduction center went on-stream. It operates with a three-man crew: an engineer; a cameraman, and a grip. The unit is equipped with a TKP-45 camera; TR-600 quad VTR; a basic production switcher; 2-input audio mixer, and a reel-to-reel audio recorder. A built-in 6 kW power generator, permits the system to be operated from its own power when necessary. The air compressor for the TR-600 is mounted in the bottom of the vehicle. For range and mobility, 750 foot of camera cable is carried for the TKP-45, with a power cable rewind.

The TKP-45 camera control unit is identical to that used for the TK-45A studio camera, and is mounted in a short rack in the van. This permits using the TKP-45 in the studio, and facilitates matching camera outputs when material shot on location with the TKP-45 is intermixed with studio-originated material.

The Winnebago has ample room for adding equipment. Present plans call for adding a titling camera and a second TKP-45, to make the mobile unit more self-sufficient. With the TR-600, single-frame edits can be made manually, and the switcher in the mobile unit can handle basic dissolves and wipes. The additional cameras will enable TJP to produce low budget, edited spots on site, without involving studio editing time.

If they choose, budget-limited clients can provide a pre-recorded audio tape with background music or effects which is matched to the shooting script. With careful planning, the spot could be completed on-location.

Another time and money-saving technique employed by TJP is to record tape spots on the quad VTR's, with time code, then dub to videocassette for client review. Time codes enable the client to make most of the edit decisions, thus reducing studio editing time.

Thomas Peery, Director of Photography for Communications 21, notes that the TKP-45 has the look and feel of a film camera, so a cinematographer has less problem in adjusting to the electronic medium with this camera. It does not hamper his style or creativity. The camera is mostly used on a tripod, dolly or crane mount, and is seldom carried on the shoulder.

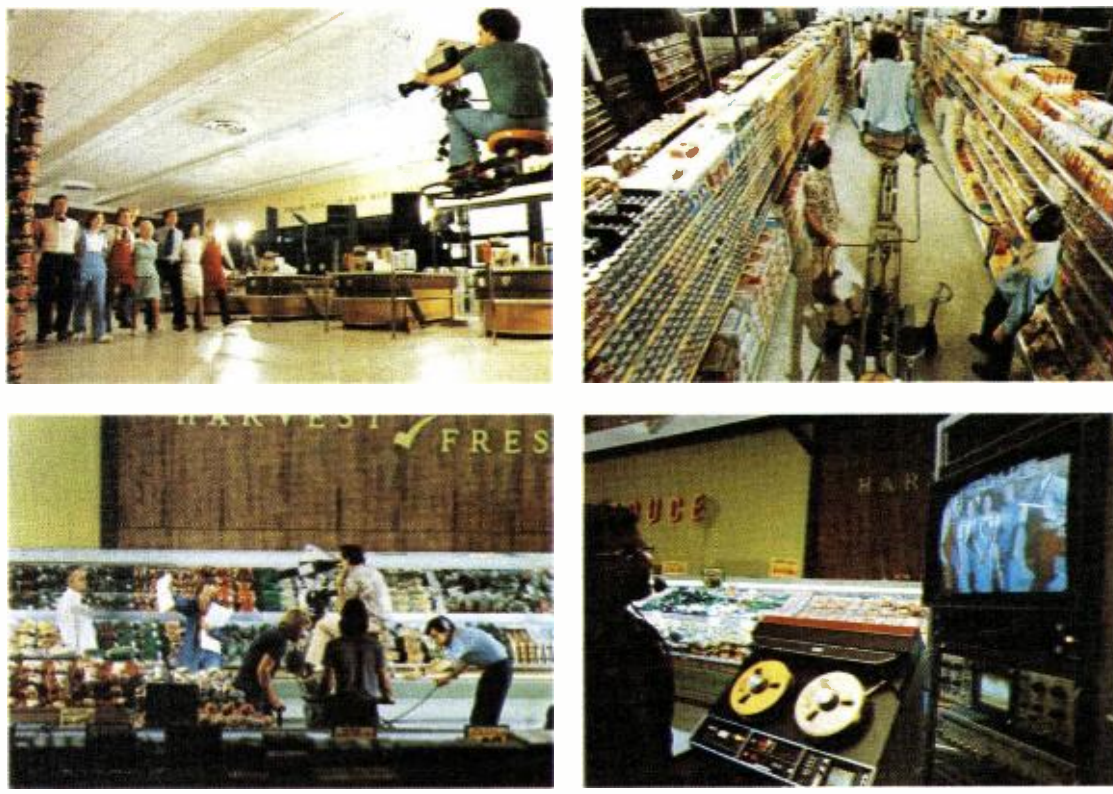
"The TKP-45 operates like a film camera and is a joy to use," remarks Mr. Peery. "And it can produce the 'film' look on tape which some clients prefer."

"Responsive"—a Productive Policy

Ted Johnson's operating philosophy is to be responsive—which is one reason why his company provides a full range of services, and is staffed to handle all aspects of TV production, technical and creative. While most of the assignments come through advertising agencies, facilities, equipment and personnel are also available to outside producers, including production services such as film-to-tape transfers and tape dubbing.

In addition to television commercials, the company is heavily involved in corporate communications, especially training. At present, much of this activity is on film, but it is moving toward television, and Mr. Johnson sees the business market as the growth area for the future.

From a standing start, Ted Johnson Productions has emerged as a major teleproduction facility, and Communications 21 has expanded into a full service film, tape and audio visual production house. □



One of the "extravaganza" type commercials handled by Communications 21 was a Winn-Dixie "Jamboree" theme spot which was produced on location at one of the chain's retail stores, after hours. This was one of the first shoots with the TKP-45 camera, and provided an effective demonstration of the camera's ability to produce studio quality results under less than optimum conditions.

TK-76
GLOBAL PERFORMER

The number count on TK-76 portable cameras in use is now up to 650, as the camera continues to build a world-wide reputation for quality performance.

More TK-76 cameras in action are depicted in this issue of BROADCAST NEWS.

ON LOCATION IN HAWAII

Hawaii Public Television, KHET Honolulu, was able to capture some of Hawaii's most picturesque but often inaccessible scenery with the help of the RCA TK-76 handheld camera. The scenes were shot for opening and closing segments of "Damien", a 90-minute teleplay on Father Damien, the remarkable and heroic Sacred Hearts priest who lived among the lepers of Hawaii as their priest and who died a leper and a martyr in 1889. The play is being produced and directed by KHET's Nino J. Martin for presentation on PBS (Public Broadcasting Service) in the late fall.

The scenes shot by the TK-76 were on the isolated Kalaupapa Peninsula of Molokai island where Damien lived for 16 years in a quarantined leper colony. KHET videographer Wade Couvillon shot from sunrise to sunset in a variety of outdoor locations and in differing light situations, including rocky seashores, lava beds, volcanic tubes, rainforests, high windswept cliffs, and even sea caves where the lepers once lived.

"A GOOD SOURCE OF REVENUE"

That's how Ralph Smith, Chief Engineer for KATV, Little Rock, describes his TK-76 camera. He adds, "It has been a good piece of equipment and delivers exceptional quality pictures. At KATV, the TK-76 is part of a complete field production system for commercial production as well as news.

MAURITIUS SCORES TWO TK-76 "FIRSTS

Mauritius Broadcasting Company has the distinction of owning the first TK-76 in Africa, and the first SECAM camera delivered. Pictures show the TK-76 in action recording the Independence Day happenings of the new nation. Mauritius is a sun-and-sea bathed group of islands planted in the Indian Ocean east of Malagasy Republic (Madagascar).

TV-12, PHOENIX, KEEPS TWO BUSY

KTAR-TV, Phoenix, uses its two TK-76 cameras for both live and video tape field production. The camera operates from a station-designed "Actioncam" mobile unit.

ROYAL PERFORMANCE

Channel 10, Sydney, Australia, gives colorful coverage of the news with its new TK-76 camera. For Queen Elizabeth's visit, the camera traveled to Canberra to record the festivities surrounding the royal tour.

SNOW DANCE IN QUEBEC

This cameraman operating a TK-76 camera with the Steadicam stabilizing system prances gracefully in the snow while taping footage for a colorful winter television special. The TK-76 handles with ease, goes anywhere, performs superbly.

TK-76 JOINS FIRST CRUISE TO CUBA

A TK-76 camera went along when some 380 Americans, the first U. S. tourist group in 16 years, visited Cuba earlier this year. The TK-76, operated here by an NBC-TV cameraman, is on a walking tour of a Havana street.

TK-76 SHOOTS "CALIFORNIA IMAGES"

Unlimited Productions' "California Images" is one of many award-winning productions handled by Ruxton Ltd.'s busy TK-76 cameras. The Burbank-based company, operated by Bill Hogan and Ron Stutzman, keeps its cameras on the go, logging an impressive list of credits. Among them: "Super Bowl '77"; "John Denver Special"; "Dorothy Hamill at the Quebec Winter Carnival"; 1977 Academy Awards; 1977 Emmy Awards; "Neil Diamond Special"; "Super Stunt Special", and the "Captain and Tennille" series.

The "California Images" production was absolutely amazing. It covered fifty-five different locations throughout the state, and was completed in just nine days using a TK-76 camera with the "Steadicam" mount, and an HR-200 portable 1-inch VTR. The result was a widely-acclaimed 27-minute video tape produced by Unlimited Productions.

The shoot covered 3400 miles, providing a rigorous endurance test for both crew and equipment. The scenes shown here are from the San Francisco segment of the production, demonstrating the mobility and maneuverability of the TK-76 with the "Steadicam" stabilizing system.

A NATURAL HABITAT

One might expect a TK-76 camera owned by Swedish Radio, Stockholm to be at home on the ski slope. And the TK-76 doesn't need a fur coat to do its job of making superb pictures —on the slope or in the city.

NEWS, COMMERCIALS AND PROMOTIONAL SPOTS

WOTV, Grand Rapids, keeps its TK-76 camera on the move handling a variety of assignments. According to Chief Engineer R. C. Smith, "The camera gives us the ability to shoot in all light levels and get good quality video which we have not been able to achieve with portable equipment prior to using the TK-76."

TK-76 SYSTEM NETS COMMERCIAL BUSINESS

WJKS-TV, Jacksonville, Florida, is one of the Rust Craft Broadcasting stations equipped with a complete TK-76 ENG system. While this system is most commonly used for ENG, at TV-17 it handles on-location production of TV commercials—Electronic Field Production—and is working out beautifully in this application, according to Chief Engineer Bill Vanscyoc. The mobility of the TK-76/HR-1020 combination makes a flexible, fast-moving production which saves time and keeps costs down. Clients are pleased with the results.

Nick Elkins, Production Manager, is delighted with the TK-76. "The video is crisp, colors true, and there is no lag. The automatic features of the camera make it easy to use indoors or outside."

Two features of the camera have been particularly valuable in handling production assignments, Mr. Elkins says. The white balance button has been especially helpful in setting up. By focussing on a white card at each shoot location or change in lighting, white balance is automatically set. The color bar generator in the camera has also been a convenient time-saver in providing a reference for editing the tape.

A special "crash" cart adapted by TV-17 mounts the camera case, the HR-1020 and a battery pack. The cart also carries an AC convenience outlet and a long extension cord for utilizing power when available.

KITV's new Superturnstile Antenna atop the Ala Moana Hotel.

Hawaiian Hoist

kitv

Airlifts New Antenna

HONOLULU

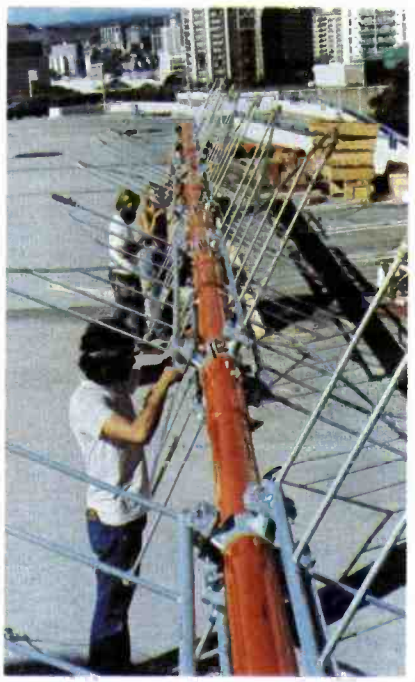
WITH the burgeoning growth of the Honolulu-Waikiki Beach area, and the accompanying proliferation of high rise buildings, KITV, Ch. 4, decided to make a big move to extend primary coverage and to deliver a better signal.

Both of these objectives are achieved with the new antenna/transmitter system located atop the Ala Moana Hotel, the tallest of the new high rise buildings on Waikiki Beach. The new system went on-air as scheduled on February 1, 1977.

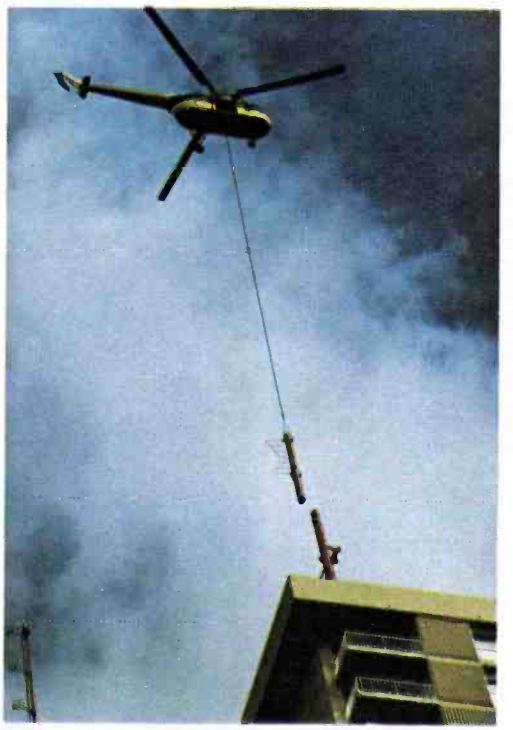
Planning for the new TV-4 antenna started in February 1976 with the application for a CP to make the proposed move. The move itself was made in two stages: first, dismantling and moving the TT-25EL Transmitter, and second, mounting the new antenna on the hotel rooftop.

The new antenna, an omnidirectional 5-bay Superturnstile, is the first sectionalized antenna to be welded in place in the air. This feat was possible because the Superturnstile is a fully developed antenna, with standardized parts.

In planning for the helicopter hoist, Director of Engineering Chuck Hartman specified that no pole section could weigh more than 1500 pounds. The antenna, a TF-5CM Special, was built at the RCA Antenna facility in Gibbsboro, N. J., and shipped in nine sections. It was ordered with an extended pole length—120 feet rather than the normal 85.2 feet for a 5-bay system.

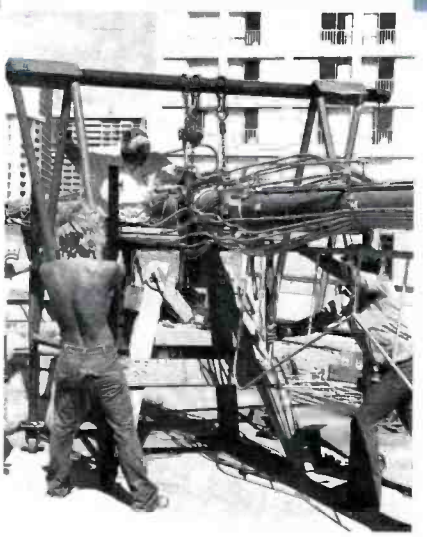


Shipped to Hawaii in sections, the antenna is assembled on the hotel parking lot.



The first batwing section is helicoptered into position.

Bat wings were installed and feed lines dressed and checked on site.



Transportation proved to be a worrisome factor in making the air date, Mr. Hartman notes. The antennas crossed the country in the middle of some severe winter snow storms. Delivered by ship to Honolulu, the antenna sections were assembled on site on a parking lot at the Ala Moana Hotel. Bat wings were installed, feed lines dressed and checked, and pole sections joined and re-checked for fit. Then the sections were disassembled piece by piece from the bottom up for the helicopter airlift to the top of the hotel.

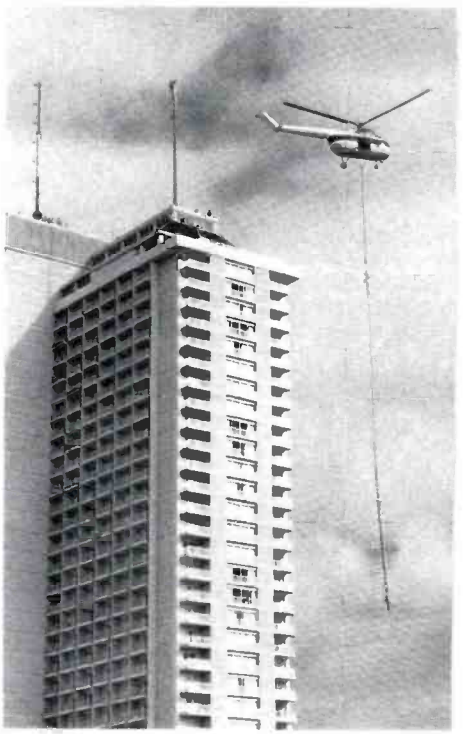
A "mainland" contractor, P & R Tower Company, handled rigging for the antenna, using a father and son team of Pete and Ron Smith. The senior Mr. Smith also doubles as President of P & R.

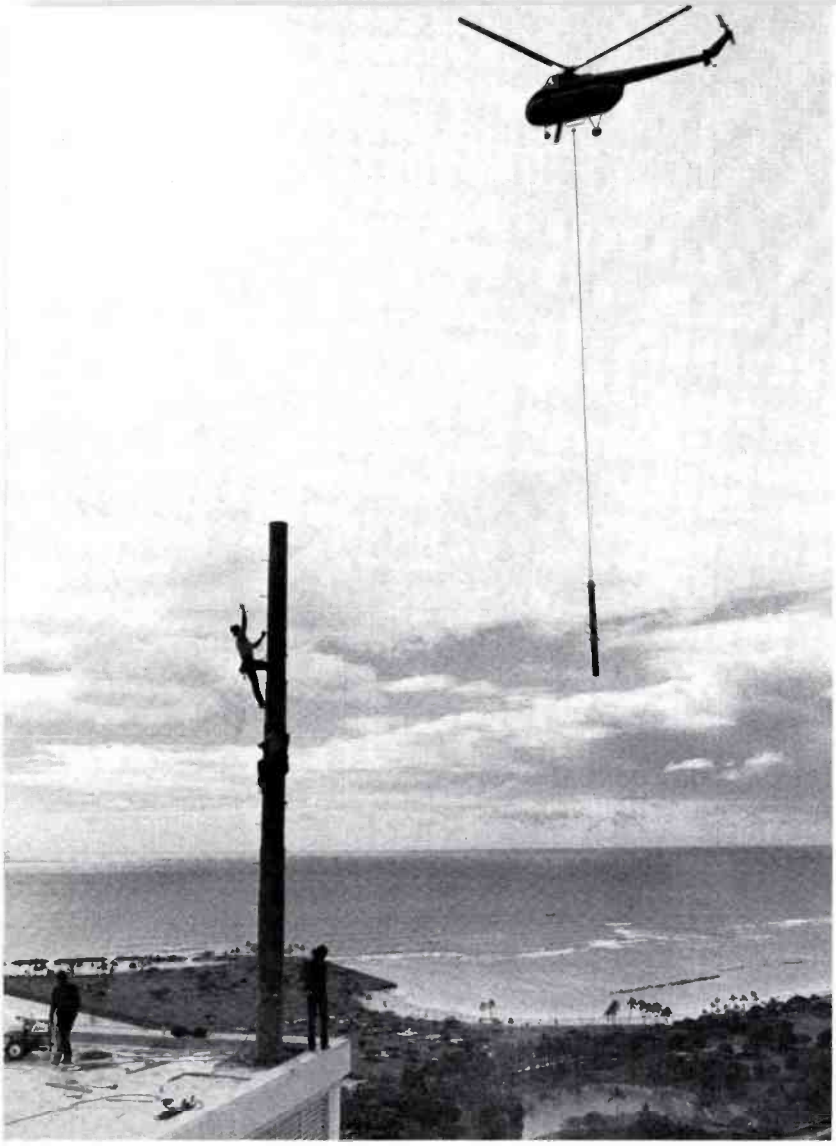
Expert helicopter piloting made it relatively easy for the riggers to complete the installation. The nine pole sections of the antenna were welded together in the air after the helicopter maneuvered the pieces into position. The lower end of the pole is buried 13 feet into the top of the building. One of the hazards of the aerial hook-up was that the antenna pieces became charged with static electricity, giving off quite a jolt unless first touched by a ground wire.

What was Chuck Hartman thinking about as the helicopter was lifting the antenna sections? "Well, I felt like I was flying with him on every load."

Adding the new antenna was the most visible and spectacular part of the shift to the Ala Moana Hotel. Even more difficult was the task of taking apart and re-locating the transmitter, a 25 kW TT-25EL. The system, weighing more than four tons, was dismantled and hauled to the new location. The parts were shoe-horned into a building elevator and lifted 36 floors. Then they were wheeled through a restaurant, hoisted into place, and re-assembled in a the new transmitter room.

With the lower sections in place, a 3-bay section is air-lifted.





View at the top. Few words are needed to explain this picture sequence showing the riggers at work, directing the helicopter; securing and dressing antenna feed lines, and "hanging tight" while welding in the sky. The KITV antenna is the first sectionalized antenna to be welded in place in the air.

The transmitter is remote-controlled from the studio. While the switch was in progress, the station operated on its old 5 kW standby transmitter.

Less than two weeks were required for re-locating the TT-25EL Transmitter and installing the new antenna. To facilitate making the change, RCA Service Company personnel were used to supervise installation and check out the new system. John Thayer, Manager, Central Area Broadcast Service, handled the antenna installation, and Jerry Servatius worked with the KITV technical staff in making the transmitter changeover.

The new antenna atop the Ala Moana Hotel is 490 feet above ground, about 125 feet higher than before. The combination of the increased height and the superior performance of the new Superturnstile antenna has extended KITV's coverage area and signal strength. Close-in and fringe viewers are now enjoying sharp, crisp color from TV-4—and loving it. □

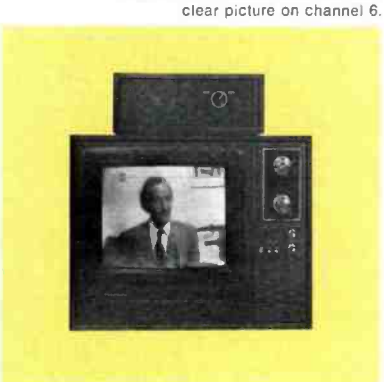
KBSC-TV

LOS ANGELES

This Glendale facility is shared by KBSC-TV and National Subscription Television.

Commercial Daytime Operation; Subscription TV At Night

During the subscription television broadcasts, Ch. 52 viewers get a "scrambled" video signal, while subscribers receive a clear picture on channel 6.



KBSC-TV, Ch. 52, the most powerful station in the Los Angeles market, is unique in that it provides a two-fold service:

First, as a commercial broadcast operation, with youth oriented, syndicated programming from sign-on until 8 P.M.

Second, as a subscription television system after 8 P.M., with service limited to paid subscribers.

The station is owned and operated by Oak Broadcasting, Inc., a joint venture of Oak Industries (NYSE), Crystal Lake, Illinois, and Jerry Perenchio of Los Angeles. The Subscription Television license is operated by another partnership of Oak and Mr. Perenchio.

Oak Broadcasting purchased Ch. 52 in 1976, and proceeded to re-vitalize the station. Technical facilities were upgraded with an extensive investment in a new RCA transmitting plant, including a TTU-110B, 110 kW transmitter, a new tower and a TFU-25G Pylon antenna. This system located atop Mt. Wilson was installed and checked out by the RCA Project Implementation group under a turnkey contract.

The studio equipment complement was expanded with the addition of two TR-600A quad tape machines, a TK-27 film system, and a Grass Valley switcher.

Soon after purchasing Ch. 52, the studio facilities, which were leased, had to be relocated, and were moved to the present site in Glendale.

The facility in Glendale is shared by both KBSC-TV and National Subscription Television, although the two operate as separate entities. Channel 52 provides the broadcast channel for program transmission, while National Subscription Television provides subscribers with decoders for viewing their programs. During the evening subscription program period, NST purchases time from Ch. 52 and supplies the program material which the station broadcasts.

In the subscription operating mode the signal is passed to an encoder which scrambles the video. This introduces a "tear" down the center of the TV picture.

Along with the scrambled video, viewers who tune to Ch. 52 in the evening receive a "barker" audio message periodically that the subscription programming is being broadcast, and that the service is available.

Commercial Programming

Since Oak Broadcasting has been operating Ch. 52, ratings have shown a marked improvement, according to Operations Manager Tony Burke. Even before the Pay TV operation was activated, the continuity of commercial programming was maintained with a regular schedule from 3 P.M. until 8

P.M. sign-off. Sponsorship of the commercial broadcasts is largely by local advertisers, Mr. Burke affirms.

Most of the daytime schedule consists of alternative programming directed to the younger audience, featuring such syndicated favorites as "F-Troop"; "McHale's Navy"; "Little Rascals"; "Banana Splits" and "Leave It To Beaver". In addition, local programming for Corona, the city of license for Ch. 52, is originated as a public service and aired daily.

Subscription TV Programming

A mix of sports, movies, cultural and special events comprises the Subscription TV programming. The sports schedule includes selected coverage of the area's major professional teams—

Colorful program booklets provide National Subscription Television customers with listings of monthly programs and synopses of movies and other scheduled events

Dodgers, Angels, Kings, Lakers, and Aztecs. Outside remote facilities are used when needed for live pickups. Each week a cultural event night is programmed, with concerts, ballet and symphony or special productions. Over twenty new events are presented monthly. First run movies and sports are the heart of the subscription TV schedule, and are effectively promoted by means of colorful program booklets which include synopses of the various programs being shown during the month. Movies are received already dubbed on quad tape and are usually played five or six times during a cycle. Every two months or so audience favorites are replayed.

Favorites are selected by subscribers who "vote" via questionnaire reply cards tipped in the monthly program booklets. Subscribers are invited to vote for "Winners" and "Turkeys".

Studio Relocation

The re-location of the studio provided an ideal opportunity for installing additional equipment in advance of the move date, which was timed to coincide with the inauguration of the subscription service.

Video tape and telecine systems are located in a separate humidity-controlled room. TR-600A tape machines handle most of the subscription television programming.

The changeover was made between sign-off March 31 and sign-on April 1, 1977. According to Chief Engineer Joe Hannigan—an active participant—the overnight shift was accomplished by a pre-planning and taping a day's programming ahead. And, he adds, it also involved a super effort on the part of his technical crew. At sign-on April 1, Ch. 52 was delivering the most powerful signal in the market, with an ERP of 2.6 megawatts.

The pre-planning involved installing two new TR-600-A video tape recorders at the Glendale studios, and a switcher for the new Master Control. A TK-27 telecine camera and multiplexer were also hooked up in advance for operation when the two TP-66 projectors and TP-7 projector were shifted from the downtown studio. Two durable TR-4 tape machines were also moved from the old facility.

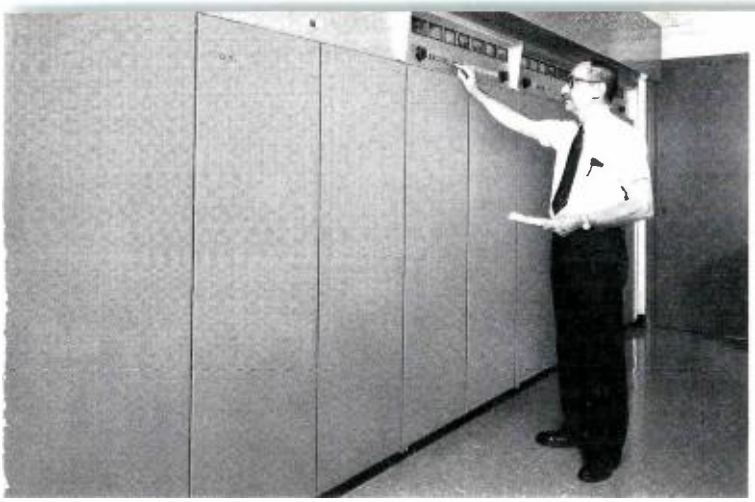
The tape machines and TK-27 telecine system are located in a separate glassed-in room, with temperature and humidity controlled. Commercial spots, film and tape, are run individually, and it has not been necessary to make up spot reels, Mr. Hannigan notes. The two TR-4 VTR's are used primarily for playing tape spots, while the TR-600's are reserved for airing the Subscription TV programs. Usually a back-up tape is run simultaneously for protection. The TR-600's have been reliable, operating from 7 A.M. until sign-off, screening tapes, making dubs and editing, averaging about 16 hours a day.

Master Control includes the switcher; a machine control panel designed by the Ch. 52 technical staff, and control units for the TK-27 and for two TK-42 cameras which are used in the studio.

In master control, two large monitors display the Ch. 52 output and the Ch. 6 picture. (The unscrambled Subscription TV picture is converted to Ch. 6 on the customer TV sets.)

The transmitter site is manned during broadcast hours, although the system is remote controlled from the studio via a DSC-2 digital remote control system. This dual system provides meter/monitor controls for up to sixty functions. (As a sidelight, although the sign-on for Ch. 52 is at 3 P.M., the transmitter is in operation during the day in the "scramble" mode, broadcasting a test signal for the subscription television installation and service crews.)

Master Control includes monitor displays of scrambled and unscrambled pictures.



TV-52's 110 kW transmitter, TTU-110, is checked by Transmitter Supervisor Max Thomas.

Two microwave systems are utilized for STL, one on-air and one on hot standby. The microwave hop to the Mt. Wilson transmitters is 13.5 miles. Computer data for the subscription television operation is inputted to the subcarrier of the microwave and is transmitted with the picture and sound. There are four subcarrier modulators for each microwave system—two for audio, and two for carrying computer data.

Antenna/Transmitter System

KBSC-TV's TTU-110B Transmitter is housed in the KTTV transmitter building on Mt. Wilson, in an area which was formerly occupied by a radio transmitter. The available space was extremely limited, but the 110 kW system was squeezed in as a straight-line installation.

For space conservation, the voltage regulators and related plumbing are located under the heat exchanger, which is suspended from the ceiling in an earthquake mounting. The heat exchanger and the steam pipes are wrapped for insulation and noise reduction. The front cabinets have been enclosed for further sound isolation. Heating and air conditioning for the facility are handled by a combined system which employs an energy-conserving heat-coil for heating.

A custom-designed motor-driven high voltage switching system permits any of the transmitter's three high efficiency vapor-cooled klystrons to be switched to dummy load. This arrangement provides added flexibility, since one of the visual stages can replace a failed aural klystron, while the other visual amplifier serves the visual channel at reduced power. When the transmitter is not manned, the coax switching can be remote-controlled from the studio. Also installed at the transmitter site is the encoding system for the subscription television operation.

Ch. 52's TFU-25G Pylon Antenna is mounted atop a new 195 foot tower. The antenna is omni-directional, with a vertical electrical beam tilt of 1¼° and a mechanical tilt for optimum coverage. It provides smoother null fill for the close-in areas, and improves the signal throughout the Los Angeles market. The antenna system also includes new 8-inch transmission line.

The replaced transmitter, a 55 kW system installed in 1966, is maintained as a standby unit, with a separate tower, antenna and transmission line.

Three Computer Systems

The subscription television operation is sophisticated, highly technical and tightly organized for efficient utilization of resources. Three separate computer systems are involved:

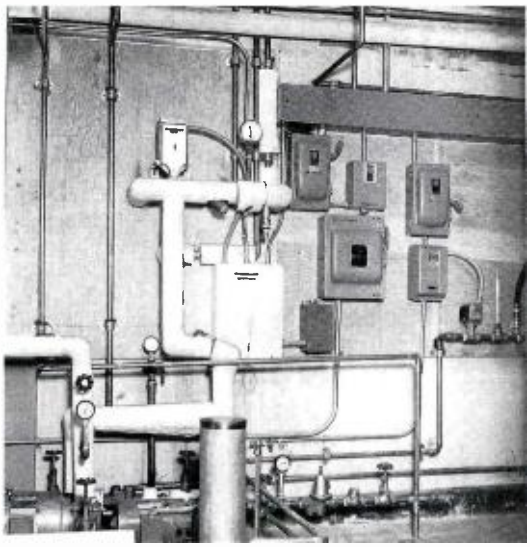
- A Process Control system which handles technical data for "Datastream" transmission
- A business computer for handling receivables, billings, accounting functions
- A back-up system interfaced with both other computers.

The computers can "talk" to each other.

An address code is assigned to each subscriber. This designates the level of service authorized and provides a means for continuously monitoring the status of each account. Each subscriber's "box" can be addressed by the computer to determine the status. Each program transmitted carries a special code which selects the boxes authorized to receive the signal. The code is aired every 10 seconds during transmission and the coding must match up with the subscriber's receiving unit, or the signal will not be unscrambled.

This "Datastream" information from the computer system is sent to the

Mr. Thomas reviews transmitter operation with Chief Engineer Joe Hannigan.



Heat exchanger, dummy load, voltage regulators and related plumbing are isolated behind the enclosed front cabinets of the TTU-110 Transmitter.

Sales and customer service personnel use a wall-wide visual status display to schedule new subscription hook-ups and service calls.

transmitter via the microwave subcarrier. The system encoder issues a composite signal with scrambled audio and video, on which the computerized control system overlays the "Datastream".

Sales and Customer Service

These key functions of National Subscription Television are handled from a large open room equipped with tables, files and batteries of phones and operators. A separate phone system is installed for this operation. One wall of the room is a status display which gives operators an accurate projection of the availability of service for a two-week period. Red, amber and green lights show the condition of the installation and service capability for A.M. and P.M. time divisions for a 14-day period. Red indicates that the installers are booked up for that time frame. Amber is close to full booking, and green indicates available time for hook-up or service.

The operators take phone information and prepare a pencilled work order form (for sales or repair). These forms go to the Computer Room where the work order is keypunched for the computer.

Once entered, the data goes to the Process Computer, so the customer will get service as soon as possible. Later the data is transferred via disc to the business and Back-up computers.

The computer print-out of the work order is given to the Dispatch Room which schedules installation and service operations. Currently, 34 service vehicles are on the road, with installers averaging 6 to 7 calls per day.

Phased Roll-Out

The Los Angeles system is the only pay TV operation that National Subscription Television has on-stream at present. However, applications and action are pending in a dozen other major markets. Populous Southern California is serving as a test market—and the system is meeting target goals for enrolling subscribers, Mr. Perenchio notes. Substantial interest has been generated, and the local media—both print and television—have given the Ch. 52 subscription operation good coverage. Since the market area is so large in geography as well as in population, the plan is to "roll-out" in phases, starting with the San Fernando Valley and San Gabriel areas, then moving on to Orange County. Since its start on April 1, the subscriber buildup has been sustained at suitable levels without mounting an extensive advertising effort.

The powerful new transmitting system on Mt. Wilson is helping KBSC-TV to carry out its unique dual mission as a commercial broadcast operation and as a subscription television service. The Ch. 52 signal super-saturates the metropolitan market, thrusting a clear signal as far as San Diego, some 90 miles south. □

New subscriber data is computerized for expedited service.

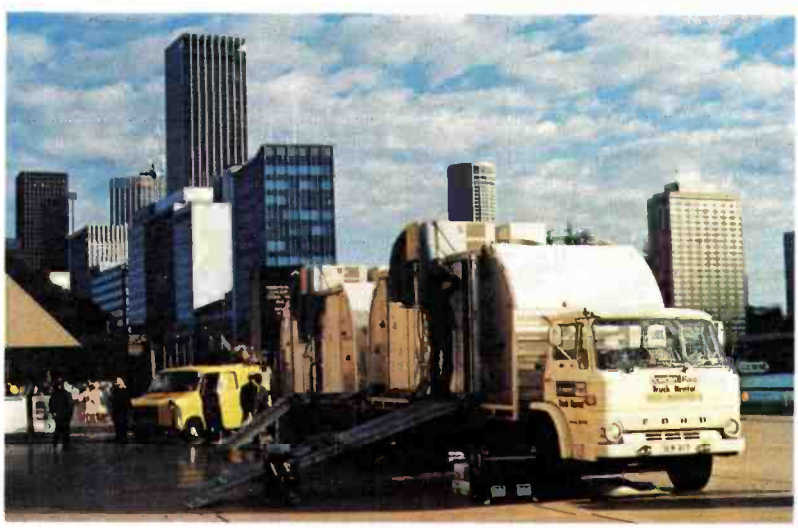
Computer print-out is used for scheduling installation and service calls.

34 "ON" service vehicles are on the road.

UNIQUE OUTSIDE BROADCAST SYSTEM

FOR WORLD-WIDE TV PRODUCTION

GOES ANYWHERE . . . SETS UP FAST



First test for the outside broadcast facility was in Australia, where it shuttled by land and air to several rallies around the continent. Here the system is loaded on a trailer at Sydney.

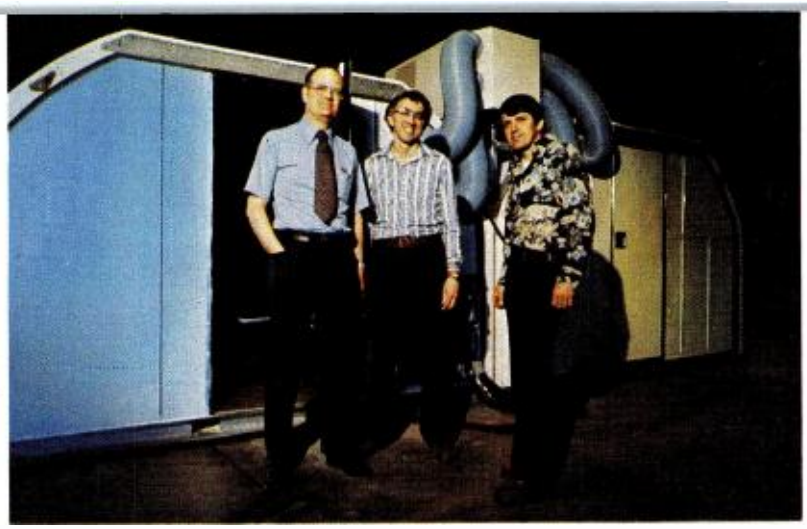
CUYAHOGA FALLS

"The difficult is done immediately; the impossible takes a little longer," is an expression that aptly suits the engineering staff of Rex Humbard ministries, Cuyahoga Falls, Ohio.

In a matter of just four months this dedicated team designed, fabricated and equipped a complete mobile television production center. Not a single, self-contained mobile van—but an Outside Broadcast unit designed to ship worldwide by air, land or sea and capable of being operational less than an hour after being set up on site.

The unique system, built around four standard air-shipment modules, includes six color cameras (three TKP-45; three TK-44); six quadruplex video tape recorders (three portable TPR-10; three TR-600A with AE-600 time code editing systems); 16-track audio and a comprehensive Master Control facility.

Rex Humbard has been producing a weekly television program for 25 years, the longest running syndicated series on air, and one of the most widely distributed. More than 500 stations around the world are carrying the program, which is dubbed in seven languages.



Among the prime movers in planning and constructing the Rex Humbard Ministries mobile TV production system were: Dave Ginaven, Director of Engineering (left); Steve McNeal Special Projects Supervisor, and Larry Bramlett, Manager of Building Maintenance.

For many years, the program was recorded at the Cathedral of Tomorrow, near Akron, Ohio. High production and video performance standards were established, so that the program tapes dubbed and distributed were superior in quality. With the extended travel schedule for Rex Humbard at international rallies, it became increasingly difficult to maintain the required quality level for on-location productions.

Varying standards made the rental of local television facilities hazardous. The rental systems were frequently not available, and if available were of questionable quality. Where 525 line NTSC recordings were made on 50 cycle power, hum bars in the picture were objectionable. When recording on other than NTSC standards, conversion was another problem—whether all of the tape should be converted to NTSC and then edited, or if it should be edited first, then converted.

All of these considerations pointed to the need for a mobile television production system which could ship by any available transportation; which could be set up and struck quickly, and which would yield high quality program tapes.

While many contributed to the project, Director of Engineering Dave Ginaven and Special Projects Supervisor Steve McNeal were chiefly responsible for the planning, design and packaging of the mobile television production unit. Director of Teleproductions, Jerry Patton and Ministry Producer/Director Bob Anderson handled design and acquisition of the lighting and scenic as well as design criteria for the overall system. It started while on a location rally in Switzerland, with a rash of logistics and operational problems hampering production. The ideas generated were discussed with other Rex Humbard Ministry staff members, and the concept took form.

Approval to proceed with the plan was obtained in mid-December of 1976. At this time no equipment had been ordered and no detailed plans or drawings existed—but it was anticipated that the new system would be operational during the Spring of 1977.

Requirements for the self-sufficient, highly mobile production center for world-wide operation were stringent and extensive:

1. Capable of quality video recording for program production in auditoriums or stadiums seating from 2,000 to more than 100,000 yet be able to record in extremely remote conditions.
2. Capable of working inside buildings or out-of-doors.
3. Shippable by land, water, or air.
4. Same day setup, record, and strike.
5. Multiple track Audio recording to accommodate foreign translations on-site.
6. Capability for complete Video/Audio post production edit at any remote location to allow an immediate satellite feed to the world.
7. Suitable lighting for Video recording.
8. Scenic properties to prevent distracting backgrounds.

A comprehensive complement of equipment, systems and facilities was developed to meet these requirements:

Cameras

Three Studio (TK-44) and three portable (TKP-45).

Recording/Editing

Six quadruplex video tape recorders:

- Three capable of 90 minute master and time code editing, allowing "A" and "B" roll post-production mixing (TR-600A/AE-600).
- Three portable 20-minute reel machines with dual purpose for complicated independent remote recording and isolated camera recording (TPR-10).

Audio Record/Playback

16 track audio recording to allow for separation of the spoken word from all other sound. This makes it possible to replace the English spoken word with other foreign translations in synchronization with the video picture. Separation of voices and other sounds also facilitates "recording studio" type remixing of the audio to provide a more uniform, pleasing sound.

Audio Playback and Recording Units: Audio mixing board for recording; Audio system for audience, and Audio system for stage (foldback).

Master Control Area With

1. Complete intercommunication system.
2. Complete video and audio monitoring.
3. Complete selectable patching and switching for entire system.
4. Time Code for entire system to allow for post production edit.

Lighting

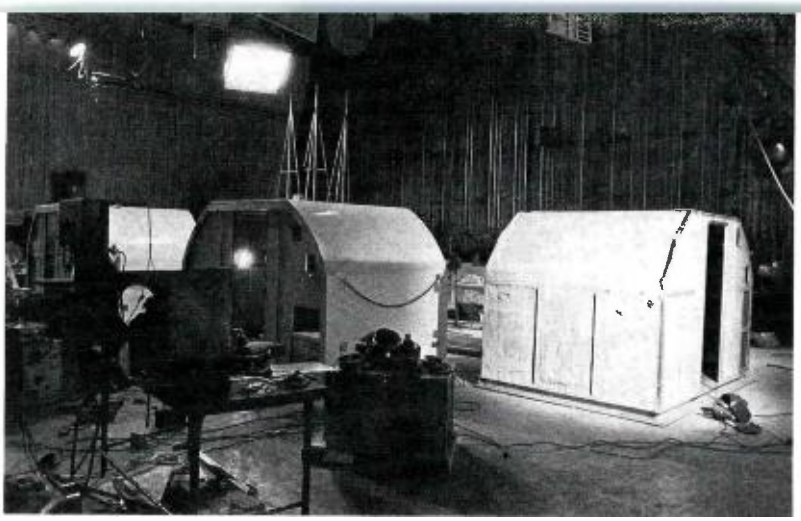
Portable, free-standing lighting towers and instruments to provide the ability for lighting effects on stage, and ample illumination on audience.

Staging

Scenic units and properties to provide reasonable background and setting for stage area. (Scenic design elements are covered in more detail further on.)

Support Equipment

Electrical power for entire system.
Air conditioning for areas enclosing sensitive electronic equipment.



Four standard air freight "igloos" provide the basic exterior shell for the RHM TV production system.

Packaging

While other outside broadcast facilities have the cameras, tape and audio facilities, the packaging of the Rex Humbard Ministries teleproduction system is unique, being designed for shipment by land, water or air.

Since air shipments are the most restrictive factor, it was determined that if the air shipping requirements for most common air cargo carriers was met, all other shipping methods could be handled.

The container selected is registered by most major air cargo carriers and can be accommodated by most types of overseas cargo aircrafts.

This air freight igloo is durable, rain proof, has a full cross section access for loading, can be securely locked, provides 440 cubic feet of internal space, and has a white fiberglass exterior for ease of maintenance and heat reflection.

The design of these units make it possible both to house and ship equipment as well as to become sophisticated operational rooms when set up for production.

The Brownline Division of Brooks and Perkins supplied four of their standard UDS-1 "A" size containers. From these exterior shells, the RHM video system was constructed. A whole new interior was fabricated, starting with extruded aluminum "I" beams for the base, to which the container pallet floor was secured. The "I"-beam structure permits the module to be handled by fork lift trucks.

A new interior framing for the pods was built of 1½" square aluminum extrusion. It was drilled and covered with aluminum sheeting which was pop-riveted to the frame. The outside of the sheeting was covered with polyeurathane foaming for insulation. Incredibly, only this specialized requirement was handled by an outside contractor. All other work was done by RHM personnel from engineering, production and maintenance—even machining and heliarc welding. It seemed that whenever a particular talent or skill was needed, someone on the staff was able to handle it, Dave Ginaven noted.

The aluminum sheeting inside the module was covered with anti-static, computer room carpeting for more insulation and sound deadening.

"These pods are seven by ten feet and about seven feet high, made of aluminum alloy with a fiberglass covering," explains Mr. McNeal. "We built false floors into them for our cables; then we built shelves and racks for equipment, with provision for elaborate air conditioning required because of the heat from the equipment.

"Once positioned on-site, the pods can be interconnected for power, air conditioning and control cabling, creating a complete television master control center in just half an hour."

Each of the four pods was customized to serve as a separate operating area:

Video Tape
Master Control
Video Control
Audio

Video Tape Module

This module is a complete video tape center, housing three TR-600A and three TPR-10 quad tape machines, and a ½-inch VTR. The three TR-600A's are installed with a separate custom monitor bridge which is built-in as a part of the interior structure for added rigidity. (In addition, the tapered configuration of the container would not accommodate the factory-supplied bridge.)

The three TPR-10's are mounted in a separate rack with sliding drawers for each access and operation. The frame stacking arrangement provides added flexibility, since the TPR's can be removed for separate production remotes. Soon to be installed in the TR-600A's is the AE-600 Editing System. One of the projected uses for the AE-600 is for building programs with matched edits to dissolves, thus eliminating the need for A-B rolls in many cases.

The TR-600A tape machine was selected because it was simpler, more reliable and fit nicely into the available space. In addition, the AE-600 provides a built-in time code editing capability without requiring any additional space. The TR-600 provides quality at an economical cost, and incorporates numerous useful features. The slanted transports and easy threading features are similar to those on the TR-70's which had been in operation for years. The use of standard, interchangeable headwheels in the RCA VTR's is another advantage cited by Mr. Ginaven. The world-wide back-up support from Tech Alert and ready parts availability were other plusses for RCA, he adds.

The Video Tape module houses six quad machines—three TR-600A and three TPR-10 Portables. The TR-600's are being equipped with AE-600 Time Code Editing Systems to facilitate on-location editing.

"Fisheye" shot of Master Control module shows space available for several operating personnel at front desk and rear table. (Below) Action photo with front desk positions manned.

Master Control

Surprisingly, the layout of this module provides room for up to six operating personnel. The Director, Technical Director and a Production Assistant usually man the front desk, while the Associate Director, a Production Assistant, and another crew member work from a table. The Technical Director at the production switcher "Takes" the camera shots selected by the Director. A second choice is made by the Associate Director from an "Iso-Switcher", permitting another selection of shots in post production.

On location, two of the TR-600's are used for Master Record. This double recording provides a back-up master, and leaves the third TR-600A and the three TPR-10's available for other "takes". These machines are assigned to the outputs of the 4-bus isolated switcher. The Associate Director controls which shots are recorded by these machines. Sometimes the iso-switcher is pre-set so the VTR's record given camera outputs continuously. The Iso-Switcher can only do straight "takes"; no dissolves or effects are available from this switcher as they are from the production switcher used for Master Record.

A Time Code Keyer in the system displays Time Code on one of the monitors in master control. These permit a Production Assistant to note good "takes" for later editing. In addition to the quad recordings, the ½ inch helical scan VTR is used for on-line recording with time code. These tapes are used for rough cut editing—making up "decision lists" for later use with on the computer editing system.

Video Control Module

The video control operator and the Lighting Director both work in this area which houses the control units for the three TKP-45 and TK-44 cameras. All six cameras are used for location productions.

The TKP-45's make good pictures, perform well and have useful features such as scene contrast compression which are ideal for field use. The mini-pack system is used for field recording, along with a TPR-10. Both shoulder and tripod mounts are used with the TKP-45's.

Audio Module

An Audio Engineer handles the 16-track audio recorder/mixer and ¼ inch Nagra portable audio production recorders in the audio module. For on-location rallies, 8 to 10 inputs are used, supplemented by background material played on the Nagras. This background is usually pre-recorded at the headquarters teleproduction center.

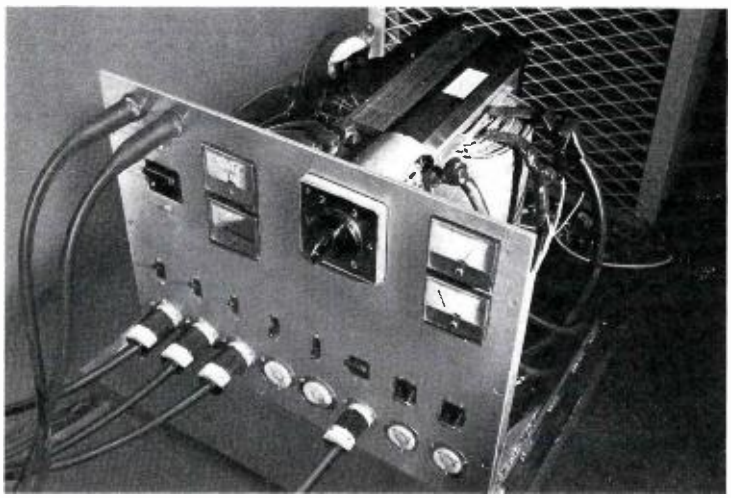
System Features

The entire system is designed for fast set-up and strike. Multi-coax cable connectors connect bundles of 16 cables and lock them securely in place. All connections terminate at racks, in BNC connectors. All components are accessible and equipments are fully patchable, so that individual modules can be removed and used separately.

This provides flexibility, since the TKP-45's and their mini-pack CCU's can be packed with the video tape module for limited separate productions. The TKP-45 cameras and TPR-10 portable quad

Video module includes control units for three TKP-45's and three TK-44 cameras.

Well-travelled TKP-45 cameras have already covered much of the globe, including Japan, Philippines, Australia and the Middle East, as well as North America.



Fast set-up and strike capability is basic to the system. All connections terminate in racks, and all components are readily accessible.

VTR's are used during the rally performance, and also for "beauty shots" of the locale and for guest interviews.

Two 3500W gasoline-powered generators are carried for use with the portable cameras and VTR's on remotes.

Mobile home type air conditioners are used for cooling. These mount on "T" frames between the modules. A shroud built on one end of the air conditioner accommodates the cool air and the exhausted hot air.

Two large generators are carried with the mobile unit: a 45 kW for technical operating equipment, and a 175 kW generator for lighting. The generators lock to the system sync generator (at 59.94 Hz), so that there are no "hum" bars in the picture. The loaded modules weigh about 7,000 pounds each.

Complex Program Production

The production and distribution procedures for the Rex Humbard weekly programs are probably as involved as any in television. For example, fifteen variations of the same program are made to fit different market situations and standards. Different openings are used and edits varied for specific needs. Versions are dubbed in English, Portugese, Spanish, French and Japanese. Versions are done in quad tape, helical scan and video cassette formats, and also in PAL-M and PAL-B as well as NTSC.

While the four-pod mobile television system in itself is a major production facility, the RHM headquarters teleproduction center carries another full complement of equipment for production; post-production, dubbing and distribution.

There are twelve quad tape machines in operation:

3 — TR-600A
4 — TR-70
2 — VR-1200B
3 — TR-60

The tape operation runs around the clock, with the VTR's averaging 40 hours a week. The four TR-70's, Mr. Ginaven notes, have logged more than 20,000 hours each, and the TR-60's about 10,000 hours. Headwheel life for all tape machines operated by RHM averaging about 1900 hours, according to Mike Snedden Maintenance Supervisor, and some have gone for 3,000 hours. Mr. Snedden notes that this is achieved with the standard penetration for recording.

Rex Humbard is noted for delivering quality tapes, and the VTR's are maintained to achieve interchangeability between machines, Mr. Snedden adds.

Editing Systems

In the main editing suite, a CMX-340 computer editing system is used with three TR-600 tape machines. One of

the TR-600's is equipped for switchable standard operation. This is used to record in PAL-M standard for tapes going to Brazil. The machine is equipped with an NTSC-to-PAL-M transcoder designed and built by Dave Ginaven.

Transferring from 525 line NTSC to 625 line PAL-M is a complex operation, Mr. Ginaven acknowledges. For this reason, edited NTSC material is supplied by RHM to Image Transforms and is returned as a PAL-B master. From this master, they can make dubs which are edited for various PAL-B countries.

A TCE-1 system is used with the TR-70C's for foreign language versions, with relays being used for adding mixed foreign audio on the tape.

Video Control and Telecine

Adjoining the editing bay is video control and telecine, which includes a TK-27 film island and CCU's for two studio TK-44's.

Helical Scan/Videocassette Duplicating

Another small room houses helical scan and videocassette VTR's for handling special dubbing requirements. One of the videocassette machines is on PAL-B standard.

A time code editor and time base corrector permits use of helical machines for editing and for dubbing up to quad.

Audio Recording Studio

Located in the basement is a complete audio recording studio with 16-track audio. The background music used at the rallies is pre-recorded here and is played back on location on Nagra recorders, providing the background music tracks that the Humbards sing against.

Studio

The RHM studio is massive and was once used extensively for in-house and commercial production work. Now, however, since the productions are done on location, the studio with its two TK-44 cameras is used for occasional special programs and for doing insert edits for post-production.

Small, Diversified Staff

System design, maintenance and updates are accomplished at RHM with a small, dedicated technical staff of just eleven. Their varied backgrounds in broadcasting and teleproduction, in designing studio and remote systems proved helpful in putting the new mobile system together.

The resources available to the technical group are also diversified and extensive. One such resource, for example, is a small machine shop, including a milling machine. Another in-house

SCENIC DESIGN became a "must" with the Rex Humbard Ministry because of the variety of background and stages where services were to be held.

Providing an adequate location for Rev. Humbard to speak from and environment for the family to sing in, suitable for televising, required carefully planned scenic design.

For example, the services are televised in both the traditional proscenium style theater and theater in the round.

Also, the scenic material would have to be air shipped.

The material had to be light weight: collapsible for shipping; designed for fast set-up and strike, and as durable as a tank. The design had to be an artistic suitable setting for the ministry, yet must be suitable for sitting on the stage of many theaters and coliseums in the world without extreme contrast to the architecture of the local building structure.

For the proscenium style theater a set design was completed with the assistance of Dick Sheehan of Los Angeles. This structure allows the flexibility to work on various size stages.

The set was constructed of hollow aluminum structure covered with wood panel riveted to the structure with perlite finish. The unit provided a 30′ x 16′ hard wall proscenium with a 2′ reveal. The total height of the unit is 20′. Double chiffon curtains on travelers are mounted at the proscenium line. Behind the proscenium is an 18′ cyclorama. A complete floor tile covering with 3′ square vinyl modular hexagonal risers provide arranged work areas for talent. Stage surface is covered with 3′ square vinyl tile.

A second scenic design utilized was adaptable for theater in the round. The set consists of free standing sunray splay units allowing varying color backgrounds with small "Bee" light inset for effects. Also utilized is floor covering and talent risers. On other occasions special sets were designed. In the Philippines, a 60′ x 20′ macrame hanging was designed. In Japan, a traditional teahouse look was fashioned into the set.

Lighting required the design of units capable of shipping by air, land, or sea, yet must have the availability for controlled area lighting on a stage area 80′ x 50′ and special effects and audience lighting.

The package was designed after consultation with Sundance Lighting of Los Angeles.

The unit utilizes the primary structure of genie super lifts. This hand crank telescoping lift allows the light structures to be hoisted 24′ into the air. These units can be climbed by a lighting technician for focusing without requiring a ladder. Light structures were developed which also provide their own shipping containers. Lamps are precabled to a central box providing quick set up. Only one cable was necessary to go to each unit. Five lighting trees provide all of the primary lighting which was supplemented by floor cyclorama strip lights. A custom designed computer lighting board and portable dimmer racks allows complete control of all areas.

A 175 kW generator accompanied the lighting package to supply the required electrical power.

This flexible, functional set was designed for use on the stage of many theatres and auditoriums around the world, to provide a tasteful setting without extreme contrast to the architecture of the building structure.

capability of RHM is designing and building printed circuit boards—either for special design needs or as replacement modules for system components no longer available from the suppliers.

A computer terminal from the main DEC-10 computer is also located in Engineering. The system's basic function is for business and mail operations, but a number of engineering programs are also stored and can be readily accessed, including complete equipment lists for all the video systems and subsystems operated by the RHM teleproduction group.

Four Months From Start To Finish

From a "cold start" in mid-December 1976, the RHM mobile TV production system was implemented on a crash basis. It had to be handled as a design-as-you-go project, with drawing being made as construction proceeded. Everything was detailed, however, so that when the system was completed, the support drawing and parts lists were ready. Vendor cooperation was outstanding, Mr. McNeal acknowledges. When the plan and deadlines were explained, the materials and equipment were made available to meet the requirements.

Inaugural In Australia

The completed system—modules and electronics— had to be ready by April 18 for shipment to Australia for a series of rallies in six cities there. It was set up and operating June 1 at Adelaide for the first rally. From there it travelled to Sydney, Hobart, Melbourne, Brisbane and Perth. It was trucked and air-lifted around the continent without a major hitch, and then sent by ship back to the U. S. The video "pod" concept passed its inaugural test with ease.

The next phase of the project will be with the purchase of a 42-foot flatbed trailer for hauling the four modules around the U. S. and Canada. The trailer will be modified to include equipment bays underneath between the wheel base for additional equipment storage.

A World-Wide Commitment

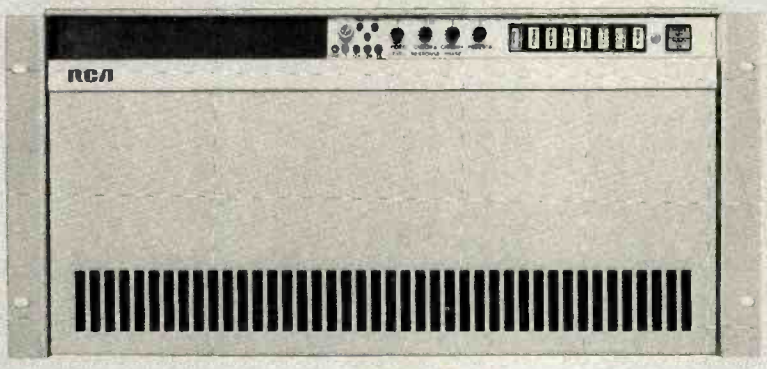
With a heavy equipment investment, utilization is critical. The RHM mobile TV production system will not be idle. It is already rolling on a series of rallies throughout North America. And, while an overseas schedule has not yet been set at BROADCAST NEWS press-time, the system is in "go" condition to handle its world-wide television production mission.

As happens with so many innovations, the frequently asked question now is "How did we ever manage without it?" □

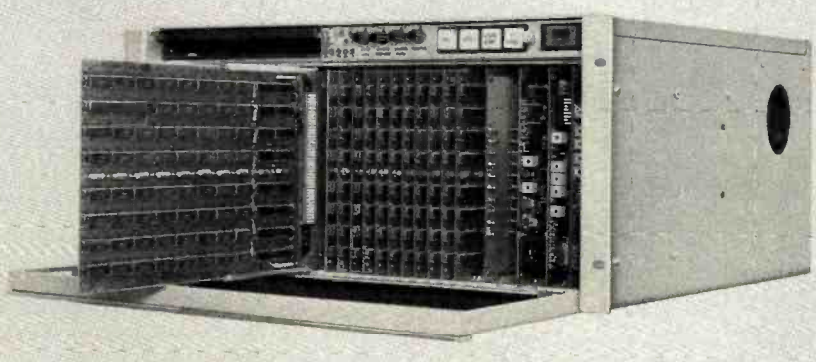
World-famous Sydney Opera House is the setting for this Rex Humbard rally. Varied environments for rallies made it necessary to design special lightweight, easily shippable sets.

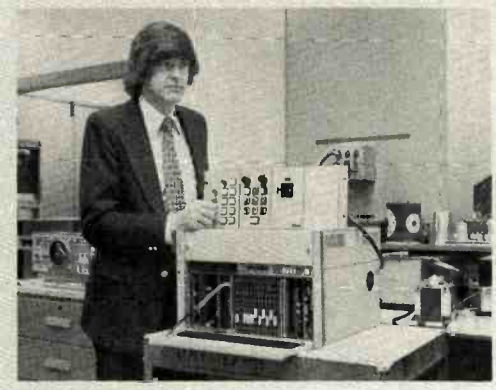
TV FRAME SYNCHRONIZER . . . Versatility by Design

R. S. Hopkins, Jr.
Leader, Control Equipment Engineering



Front and rear views of RCA's TFS-121 Synchronizer, showing compact configuration and accessibility of modules. Unit requires only 8¾ inches of height in a 19-inch rack.





R. S. Hopkins with prototype TFS-121 Synchronizer.

THE TV frame synchronizer is a comparative new comer to broadcasting. Aside from its primary function of synchronizing an input video signal to a reference timing signal, there are many other applications for such a device. Some of these have already been exploited with currently available equipment — including picture freeze, picture compression and time base correction. This article treats the frame synchronizer as a basic building block for special effects generation.

Television frame synchronizers such as the RCA Type TFS-121, while relatively new developments, have quickly established themselves as useful additions to TV station technical operations.

As is customary when a new type of equipment is introduced, there have been a number of articles published on the subject of synchronizers. These have covered the basic concept of the product and its operational aspects. Consequently, video engineers and production personnel are now acquainted with the system benefits of the synchronizer:

- — the elimination of genlock and its associated problems
- — the ability to smoothly integrate a variety of remote video sources into the local operation (allowing them to be mixed, keyed and wiped as if they were generated and timed with the local sync generator bus)
- — the elimination of problems caused by transmission path length changes such as doppler drift (with satellite feeds) and path length changes encountered when using microwave and telco feeds.

The key to synchronizer performance and versatility is its memory. This is particularly true when considering the special effects potential of the device. Following is a description of the basic operation of the RCA TFS-121 video frame synchronizer and the capabilities inherent in its design.

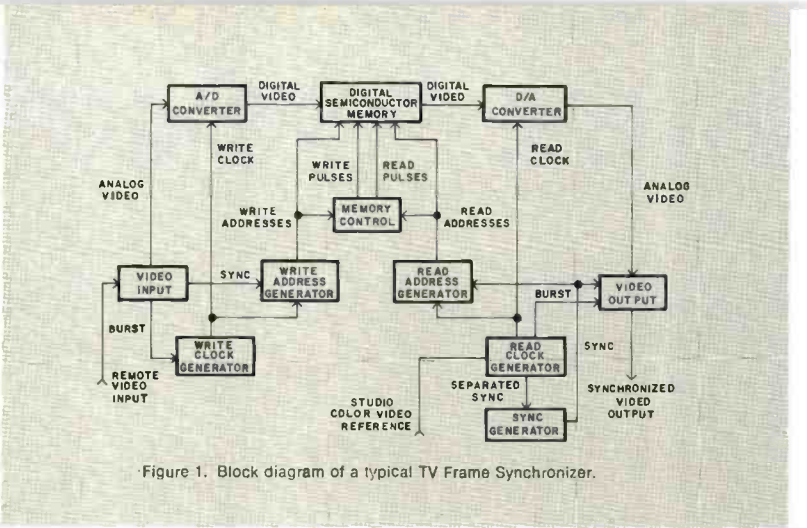


Figure 1. Block diagram of a typical TV Frame Synchronizer.

Synchronizer Block Diagram

Figure 1 is the typical block diagram of the RCA TFS-121 Synchronizer. Three video signals are shown—the Remote Video Input, a Studio Color Video Reference and a Synchronized Video Output. The remote Input and the Synchronized Output are identical except the output is timed precisely with the local reference rather than the input. The synchronizer has been described as a variable delay line[1] where the delay is precisely that which is necessary to phase the output horizontally and vertically (including subcarrier phase) with the reference. This is accomplished by writing the input video in a memory and, after the proper delay, reading the video out of the memory.

The remote video signal is received by an *Input Video Processor* whose primary functions are to clamp the analog video prior to being converted into a digital signal by the A/D Converter and to extract sync and burst from the video signal. The extracted burst is presented to the *Write Clock Generator* whose function is to provide a series of sampling pulses to the *A/D Converter* for digitizing the video signal. The extracted sync, after processing, is delivered to the *Write Address Generator* enabling that circuit to generate unique addresses for storage of the digital video in the memory.

The studio video reference is received by a *Read Clock Generator* whose function is to extract sync and burst from the reference video. The extracted sync is delivered to the *Sync Generator* which gen-locks to the reference video and delivers processed sync to the *Read Address Generator*. The *Read Address Generator* causes digital video to be read from the memory by producing the same sequence of addresses that was generated by the *Write Address Generator*. The *Read Clock Generator* uses the extracted burst to generate a series of re-sampling pulses which are delivered to the *D/A Converter* for purposes of converting the digital video signal back into an analog signal. The *Output Video Processor* accepts this analog video signal, inserts proper levels of sync and burst, and delivers the processed signal to the output terminals of the Synchronizer.

The *Memory Control* is responsible for looking at the write addresses and generating a write pulse at the proper time causing the digital video arriving from the A/D Converter to be stored in the memory at the specified address. The *Memory Control* is likewise responsible for looking at the read addresses and generating a read pulse at the proper time causing the digital video to be read from the memory at the specified address and then delivered to the D/A Converter.

Memory Operation

One frame of the video signal in the TFS-121 memory is composed of 393,216 picture elements, each of which is stored as a discrete number. Note that the number of picture elements is directly related to the frequency at which the incoming video is sampled and converted to digital numbers. The TFS-121, since it operates at four times the color subcarrier frequency (14.32 MHz) therefore divides the frame into 393,216 elements. Synchronizers which operate at lower frequencies divide the frame into fewer, more widely spaced elements and thus have lower resolution capability.

The discrete number refers to the brightness level. For example, the discrete value of 0 would be the blackest video encountered and the discrete value of 255 would be the whitest video encountered. All other numbers refer to some grey level. This is illustrated in Figure 2 with color bars. (Note: The precise correlation shown here between IRE Units and the stored value is intended only to illustrate the point. The relative numbers used in the TFS-121 are slightly different.) To be able to store these 256 different values requires 8 bits of memory for each and every picture element. The entire memory then requires 3,145,728 bits of storage. The addresses given by the *White Address Generator* specify the location in the memory into which each picture element will be placed. To facilitate understanding of the address scheme, assume the address generators count from 1 to 393,216 in one frame, and that the address of 1 occurs at the beginning of active video in the

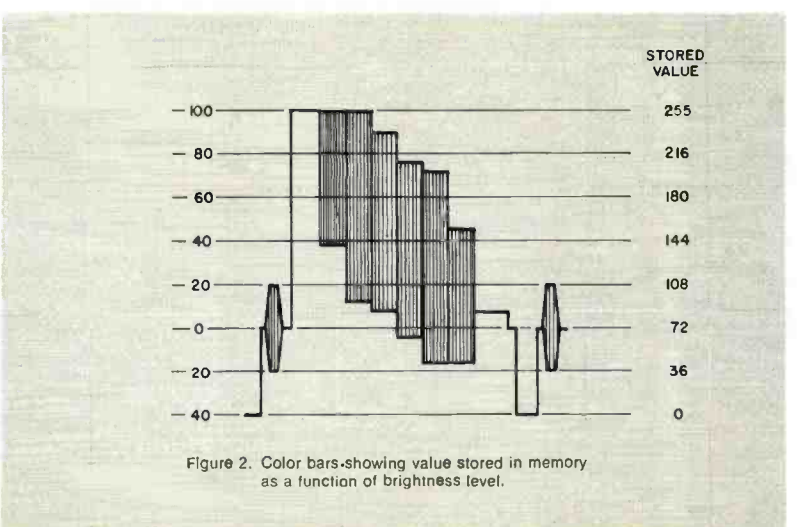


Figure 2. Color bars showing value stored in memory as a function of brightness level.

[1]R. J. Butler, "Operational Implementation of a Broadcast Television Frame Synchronizer", J. SMPTE, 84: 125-128, March, 1975.

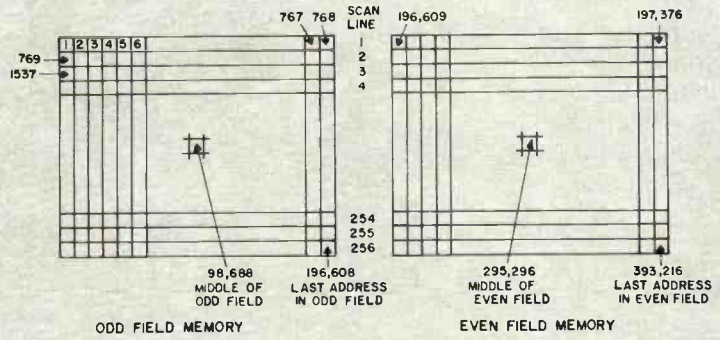


Figure 3. Correspondence between scanning raster and memory addresses for both fields. Each small box stores one picture element.

odd field. In this way, the memory is "scanned" by using digital IC counters in exactly the same way a picture monitor is scanned by an electron beam. Figure 3 represents the memory storage of both an odd field and an even field. This figure shows a one-to-one correspondence between the scanning of a raster and the 393,216 addresses in the memory. The numbers are the addresses generated by the address counter. As the input video scans the raster, it is also scanning the memory except a number value is assigned to the brightness level of the video and that number is stored in the memory just as a number value is stored in a digital computer. Synchronization can then occur, because the stored numbers can be read from the memory after the necessary delay time has elapsed. The *Read Address Generator* makes addresses for reading the digital video in precisely the same way the *Write Generator* made the storage addresses, except these addresses are referenced to the sync of the local reference input rather than the remote video.

Picture Freeze

Once this frame of storage is available, there are other things besides synchronizing that can be done. For example, to freeze a picture it is only necessary to terminate the storage of new video in the memory. This is done by eliminating the write pulses from *Memory Control* that were forcing the memory to store new video. At the same time, however, the read circuitry continues to generate read addresses and read pulses. As a result, the output video will be the stored video repeated over and over until storage of the input video resumes. This stored or "frozen" picture will not deteriorate with time because the semiconductor memory can hold the stored numbers as long as desired in the same way a computer can hold stored numbers.

There is one detail that should be mentioned. When continually reading the stored numbers from memory during a freeze, because of the field to field color subcarrier phase differences, it is necessary to use a chroma inverter to have proper color phase. Figure 4 illustrates the necessary modifications of the Synchronizer block diagram to accomplish Picture Freeze. A gate is used to interrupt the write pulses and at the same time turn on the Chroma Inverter during the fields designated by the *Read Address Generator*. The chroma inversion process can be accomplished either by analog means or digitally.

A similar application of a Frame-Storage Synchronizer is to "clean-up" any non-synchronous switches of the input video. The typical synchronizer will have circuitry which constantly monitors the input video. If the sync of the input video suffers a sudden unexpected change such as would occur if a "hot switch" were made between two, non-synchronous, incoming signals, the *Memory Control* write pulses can be eliminated just as they were for Picture Freeze. Once the input video circuits have been able to lock to the new input, the write pulses will resume storing the digital video in the memory at the next vertical interval. During this time interval, the read pulses will have continued to read the digital video that was held in the memory. As a result, there is a synchronous vertical interval switch at the output of the synchronizer even though there was a non-synchronous switch at the input of the synchronizer. By detecting whether the non-synchronous switch occurred during the storage of an odd or even field and forcing the read addresses to specify only the opposite field, there will be no visible tears in the output video. This feature, of course, requires that the synchronizer be a true *frame* (as opposed to a *field*) storage device. Then when one field is disrupted during the non-synchronous switch, the video which is read out of the memory is read from the last good, undisturbed field which was stored.

As a result of this ability to handle non-synchronous switches, the synchronizer can perform as a super dropout compensator. If the input video totally disappears, the write pulses will again be eliminated, causing the synchronizer to produce a frozen picture. When the input is re-established, the frozen picture will disappear and the live picture will continue. A situation like this occurred during the televising of the "Great American Celebration" from Baltimore when a microwave feed from San Diego was temporarily lost. Because a TFS-121 Synchronizer was used at the receiving end, there were no breakups in the picture even though the input was totally missing for a moment. Because sync and subcarrier are referenced to the studio and because they are properly established at the output of the synchronizer, the only effect of a loss of input is a frozen image seen at the synchronizer output.

Picture Compression

Picture compression is another special effect which can be done with a syn-

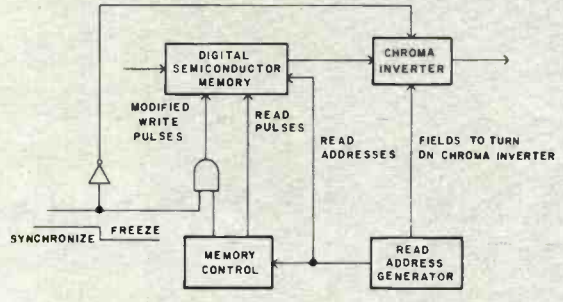


Figure 4. Modifications to synchronizer block diagram to add picture freeze.

chronizer. A simple way of explaining the technique of picture compression can be seen by again examining Figure 3. Suppose every other picture element produced by the *A/D Converter* during the first scan line of the odd field is literally thrown away and the remaining picture elements are placed next to one another in the memory. For example, the first picture element is placed in address 1, the second picture element is discarded, the third picture element is placed in address 2, the fourth picture element is discarded, the fifth picture element is placed in address 3, etc. Note that the first scan line of the input video will be located in the first half of the first line of the memory. Suppose then that the second scan line of the input video is completely discarded. The third scan line of the input video is then placed in the memory in a manner identical to that of the first scan line and in the memory locations that would normally be occupied by the second scan line. This procedure is followed throughout the entire field and as a result a smaller picture is stored in the upper half and the left half of the memory as shown in Figure 4. The picture elements in Figure 5A marked with an X are discarded and the remaining picture elements are stored as shown in Figure 5B. If this stored data is read from the memory by the normal method, the original picture will have been reduced to precisely one-quarter of its normal size.

The technique used in the TFS-121 for compression is far more complicated than the simple explanation given here. Rather than discarding picture elements, a digital filter is used to find average values which are then stored in the memory. The specific technique used results in high quality compressed pictures with no moire or missing portions of the picture.

Picture Positioning

Referring again to Figure 3, the relative ease of moving a picture around the TV raster, and even completely off the raster, can be seen. Normally, video of the odd field is stored with the top edge of the picture in addresses 1 through 768. Likewise the left edge is stored in addresses 1, 769, etc. In other words, the top left corner of the picture is stored at the top left corner of the memory. However, the top left corner of the picture could have been stored at the center of the memory. In this case the picture element normally stored in address 1 is stored in address 98,688, the center of the memory. The picture element normally stored in address 2 is stored in address 98,689, etc. This would cause the top left quarter of the picture to appear in the lower right quarter of the output video picture. In a similar manner the top left corner of the picture can be stored at any point in the memory. Or, the top left corner could be moved off the top of the raster, or off the left of the raster, or any combination. By using a conventional positioner to specify the desired location of the picture, the normal address given by the *Write Address Generator* can be modified in such a way that the picture can be moved around in the memory to any desired location. By generating a keying signal timed with the picture location and using this key as the external key input to a production switcher, any other synchronous picture can be inserted into the area vacated by the synchronizer picture.

In describing Picture Compression, the first picture element of the odd field was placed in address 1. By using the positioner this address can also be modified to cause the compressed picture to appear at any desired location on or off the raster. In this case the keying signal is timed with the picture location and size.

This effect is one which is possible only since the advent of synchronizers. Now, rather than wiping from one signal to another, the TFS-121 allows a full picture to be moved off-screen, "slid" if you will, in any direction, un-masking another picture that was hidden behind the original picture. In the same way, a picture can be moved from off-screen "over the top" of the original picture, and this new picture can be brought on-screen from any desired location.

Summary

Each of the effects described was accomplished by modifying the normal sequence of writing the digital video into the TFS-121 memory. For *Picture Freeze*, the writing of digital video was stopped. For *Picture Compression*, the digital video was averaged and some picture elements were deleted before writing data into the memory. For *Picture Positioning*, the write addresses were modified with a positioner. In each of these cases, reading data from the memory was not affected except for the use of a Chroma Inverter whenever data storage in the memory was stopped.

In the brief time that synchronizers have been with us, major advances have been made. The new generation synchronizers are one-tenth the size, one-tenth the weight, and consume one-quarter the power of the earliest models.

The synchronizer was originally made possible by accomplishments in digital integrated circuit technology. As that technology has advanced, it has made possible the great changes being made in synchronizers. And, as video engineers have become more familiar with these integrated circuits, they have been able to design a variety of effects that were not available with the earlier synchronizers.

The marriage of television and computer technology has produced today's digital video synchronizer—a product which is smaller, more economical, easier to operate, and far more versatile than its predecessors. ☐

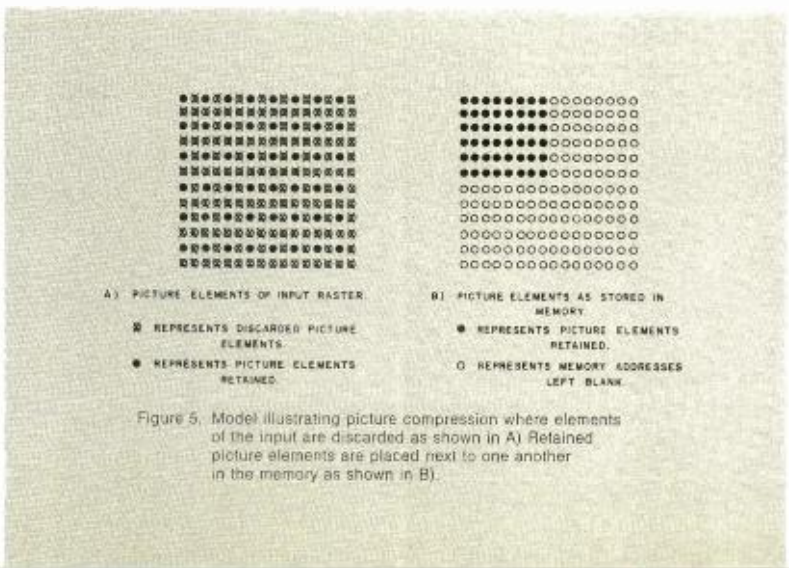


Figure 5. Model illustrating picture compression where elements of the input are discarded as shown in A) Retained picture elements are placed next to one another in the memory as shown in B).

DIGITAL FUNDAMENTALS FOR THE BROADCASTER

Part III Flip-Flops and Basic Applications

John W. Wentworth, *Manager, Broadcast Technical Training, RCA Broadcast Systems*

A. Introduction

In Parts I and II of this series, we have discussed basic logic gates and means for implementing them with several different types of electronic devices in integrated-circuit form. In this article, we shall discuss particularly important applications of logic elements in the latching circuits known as "flip-flops"—circuits which play fundamental roles in data registers and memories, in control units, and in computer systems.

B. Cross-Coupled Inverters as a Simple Latch

In the simplest possible terms, a flip-flop is the electronic equivalent of the mechanical toggle switch—it is a binary circuit capable of "remembering" or retaining either of two logic states until some external force is applied to change the state.

Perhaps the most basic type of flip-flop is that formed by cross-coupling a pair of inverters, as shown in Fig. 1. The circuit is bi-stable in the sense that either inverter can hold the other's output in the high logic state if it is once placed in this condition. The two circuits are coupled in a *positive* feedback loop that permits no stable operating point with both inverters conducting—any disturbance that causes one side to start conducting will lead to a rapid "flipping" action that will end with one side fully "on", the other side cut off.

There are relatively few applications for this simple type of flip-flop, however, because the output terminals and input terminals are the same and the only way the state of the flip-flop can be changed is by means of a very low-impedance driver capable of over-riding the output state of one inverter or the other. (This is a technique known as "jam-syncing".) Thus, a flip-flop of this simple type cannot be driven successfully by another logic element in the same basic family with a similar output stage.

One application that *is* very appropriate (and popular) for this flip-flop is the one illustrated in Fig. 1—the "de-bouncing" of switch contacts. The contacts of even high-quality mechanical switches tend to "bounce" a few times upon opening or closing, providing a few repetitive openings and closings lasting perhaps a couple of milliseconds. This bounce characteristic was unimportant in early digital systems using relays as logic elements, but becomes a very serious problem in modern computer systems where the electronic logic elements operate in time frames of microseconds or even nanoseconds—bouncing contacts may be falsely interpreted as a series of pulses when only a single edge is intended. Fortunately, switch contacts can serve as low-impedance driving points for a simple flip-flop, so the arrangement of Fig. 1 can provide output signals that are bounce-free. The first of several repetitive contact closings forces the flip-flop to a stable state which cannot be changed until the opposite contact on the switch is again closed.

Another important application for the most basic flip-flop is in semiconductor random-access memories—the individual storage cells in such memories usually consist of cross-coupled inverters (of relatively tiny dimensions), and the busses which write information into the cells are provided with drivers of sufficiently low impedance to accomplish the necessary jam-syncing.

C. The Set-Reset (S-R) Flip-Flop

A more versatile flip-flop that can be controlled by conventional logic elements is the set-reset (or S-R) flip-flop, shown in two different versions in Fig. 2. Such flip-flops are readily available in integrated-circuit packages, and are frequently shown on logic diagrams as rectangular blocks with S and R labels for the inputs (representing set and reset, respectively) and Q and $\overline{Q}$ labels

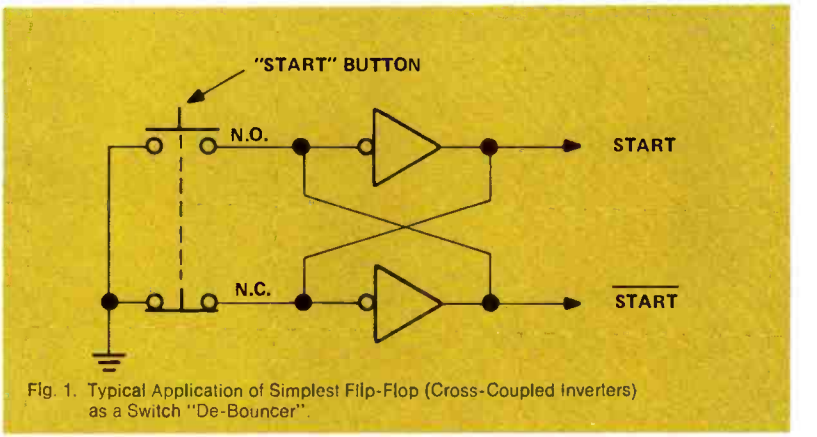


Fig. 1. Typical Application of Simplest Flip-Flop (Cross-Coupled Inverters) as a Switch "De-Bouncer".

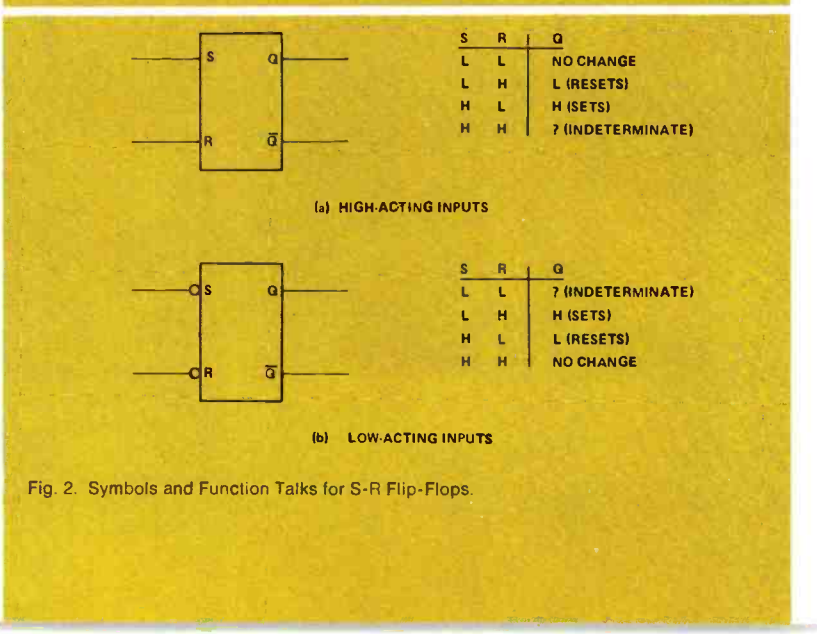


Fig. 2. Symbols and Function Talks for S-R Flip-Flops.

for the output. The Q labels don't really stand for anything, but, by definition, the Q terminal is the one which goes to the HIGH state when the flip-flop is *set*. (Q, of course, is always of the opposite logic state relative to Q.) S-R flip-flops are easily formed by cross-coupling either NOR or NAND gates, as illustrated by Figs. 3 and 4, and are frequently shown in this form on logic diagrams when they are, in fact, constructed by cross-coupling conventional gates.

Function tables for both high-acting and low-acting S-R flip-flops are shown in Fig. 2. In the case of the high-acting version, the application of a logic HIGH to the S terminal leads to a SET condition, while the similar application of a logic HIGH to the R terminal leads to a RESET condition. If a HIGH is applied to neither input terminal, the flip-flop simply remains in its present state. Simultaneous application of HIGH states to *both* input terminals leads to indeterminate behavior of the flip-flop; as a general rule, the S-R flip-flop is not suitable for applications which must contend with the simultaneous appearance of both SET and RESET signals. (Actually, there are some applications where simultaneous inputs are allowed (usually driving both output terminals to the same state), but the indeterminate condition is avoided by taking steps to *release* one input before the other.) The low-active S-R flip-flop behaves in a similar manner except that the active input states are LOW rather than HIGH.

The operating principle of the high-acting S-R flip-flop may be explained with the aid of Fig. 3. Such a flip-flop is made by cross-coupling a pair of NOR gates, and if one wishes to SET the flip-flop, this may be done by applying a momentary HIGH to the SET terminal (point 1). This HIGH state on one input of NOR gate A is sufficient to assure that the logic level at point 2 will be LOW. Point 3 is electrically the same as point 2, and if the flip-flop is being used in a legitimate application it must be assumed that the set trigger is being applied at a time when the RESET terminal (point 4) is in the LOW state. Since both inputs of NOR gate B are therefore low, its output (point 5) will be HIGH. This HIGH state is cross-coupled to the other input of gate A (point 6) and will maintain the LOW output condition at point 2 even if the HIGH applied to point 1 is of very brief duration. In other words, the cross-coupling between the two gates provides the latching action that holds the flip-flop in one state or the other. Because the circuit is symmetrical, it should be easy to see that a similar, but opposite, action would occur if a momentary high is applied to the RESET terminal at a time when the SET terminal is low. The only requirement for the duration of a SET or RESET pulse is that it be long enough to exceed the propagation delays through two gates to assure that the latching signal appears before the trigger signal is removed.

A low-acting S-R flip-flop is most commonly formed by cross-coupling a pair of NAND gates. The latching action can be most readily understood if these gates are drawn as low-active OR gates, as is done in Fig. 4. In this case, the flip-flop can be driven to the SET condition by the application of a momentary LOW pulse to point 1 at a time when point 4 is known to be LOW. This will cause points 2 and 3 to go HIGH, and since point 4 is already HIGH, points 5 and 6 will be in the LOW state. The LOW signal at point 6 is sufficient to hold the Q output terminal HIGH even after the original trigger at point 1 is removed.

S-R flip-flops are widely used as control elements in broadcast and teleproduction equipment. Many are used, for example, in the control logic for the RCA TCR-100 television cartridge recorder, and the control elements which define the operating modes for video tapes machines (such modes as RECORD, PLAY, FAST FORWARD or REWIND) are usually flip-flops of the S-R type.

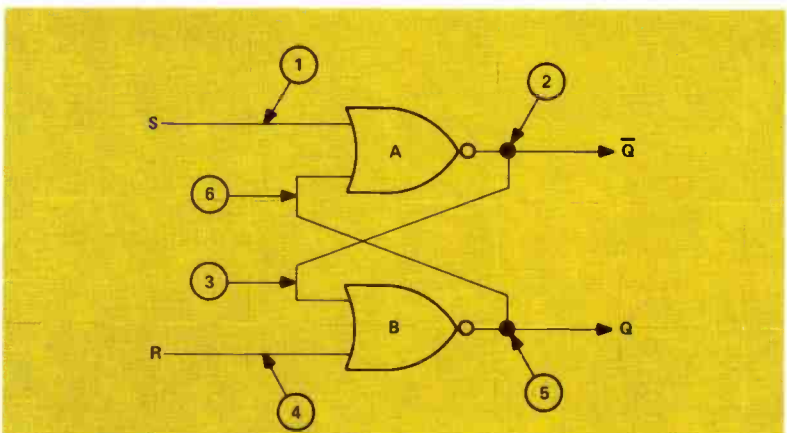


Fig. 3. Basic High-Acting S-R Flip-Flop from Cross-Coupled NOR Gates.

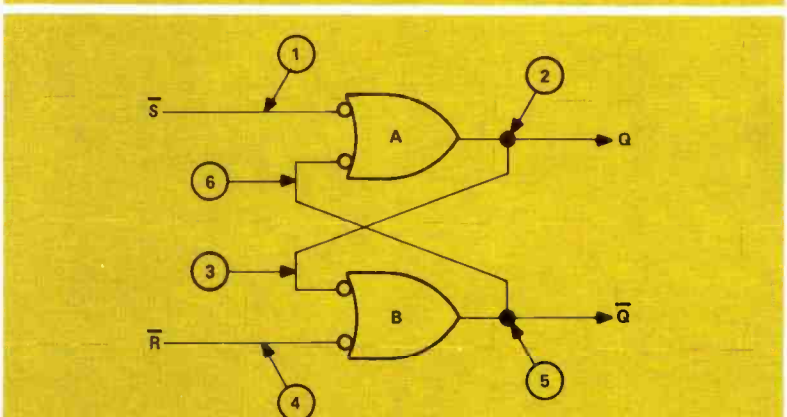


Fig. 4. Basic Low-Acting S-R Flip-Flop Made from Cross-Coupled NAND Gates (Drawn as Low-Active OR Gates).

D. The D-Type Flip-Flop

An important refinement of the basic S-R flip-flop yields the D-type (or Data-type) flip-flop shown in Fig. 5. The basic version of this flip-flop has two inputs, but they are now labeled D (for Data) and either C or CK (for Clock). (Because C is sometimes used to identify CLEAR terminals on flip-flops, we shall seek to avoid ambiguity in this article by using CK to identify CLOCK signals). The D flip-flop is usually provided as part of an integrated-circuit package and is represented by the simple symbol shown at (a) in Fig. 5, but its relationship to the more

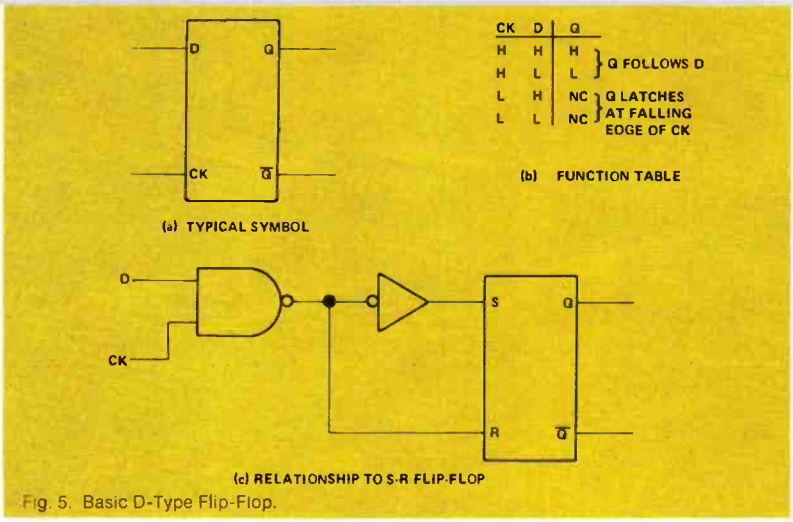


Fig. 5. Basic D-Type Flip-Flop.

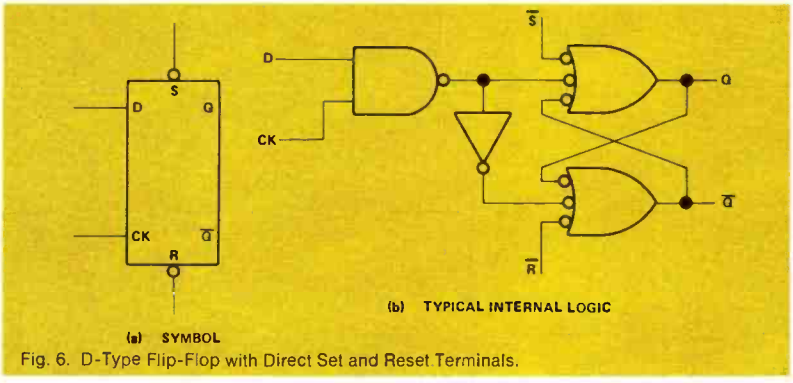


Fig. 6. D-Type Flip-Flop with Direct Set and Reset Terminals.

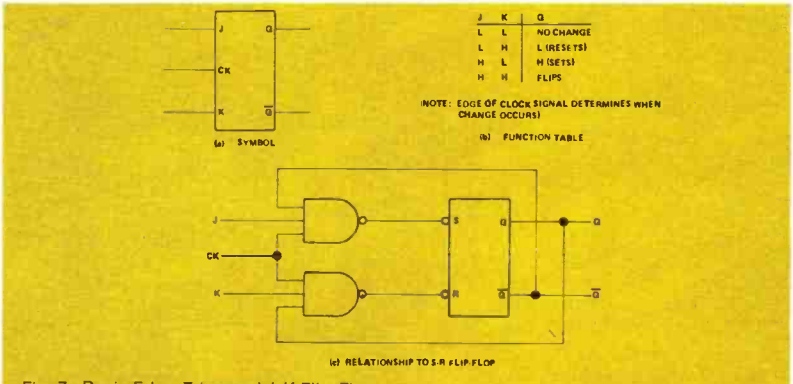


Fig. 7. Basic Edge-Triggered J-K Flip-Flop.

basic S-R flip-flop is shown at (c). The D input is actually connected to both the S and R terminals but through an inverter that assures that opposite level signals are always supplied to S and R. The D input is *gated* by the clock signal, so that it reaches the S-R flip-flop only when the clock signal is in the HIGH logic state. When the clock is HIGH, the state of the flip-flop is directly determined by the state of the D input, being SET when the input is HIGH and RESET when the input is LOW. When the clock input goes LOW, however, the state of the flip-flop as of the instant when the clock goes from high to low will be retained until the clock again goes HIGH.

A more advanced version of the D-type flip-flop with "direct set" and "direct reset" terminals is shown in Fig. 6. (Practical versions may have either high-acting or low-acting input terminals.) The direct SET and RESET inputs over-ride both the D and CLOCK inputs, and can be used to preset or clear the flip-flop by external control. (The S and R inputs follow the conventional S-R rule with respect to the need to avoid simultaneous operation.)

In later sections of this article, we shall discuss typical applications of D-type flip-flops in counters and registers.

E. The J-K Flip-Flop

Still greater versatility in the application of flip-flops is made possible by the J-K configuration shown in Fig. 7. The letters J and K refer to specialized SET and RESET input terminals which differ from those of ordinary S-R flip-flops in that they are gated by opposite output terminals—J is gated by the $\overline{Q}$ output, and K is gated by the Q output. An additional clock or trigger signal is also applied to both input gates. This gating arrangement permits the J-K flip-flop to do something predictable if both the J and K terminals (conventionally called the "steering" inputs) are in the HIGH state at the instant a clock pulse appears—the circuit will toggle or flip to its opposite state, since the clock pulse is internally directed to only one side or the other of the S-R stage. A 4-line function table is sufficient to explain the action of a J-K flip-flop if one recognizes that the function of the clock or trigger input is simply to determine *when* the inputs are sampled; the J and K inputs determine *what* happens to the state of the flip-flop. In cases where S and R input terminals are also shown in the symbol for a J-K flip-flop, it is safe to assume that these are direct-set and direct-reset terminals that over-ride the normal input conditions.

Because of the additional feedback connections between the output and input terminals (over and above the basic cross-connections within the S-R circuit at the heart of the flip-flop), a poorly-designed J-K flip-flop can be subject to an unwanted oscillation—if the output conditions change while the clock pulse is still present, the circuit will tend to flip back and forth rapidly between its two states. This problem can be avoided either by incorporating special arrangements to make the triggering circuit respond to clock-pulse *edges* only (rather than to static logic levels or to edges in the J-K signals) or by employing the master-slave principle illustrated in Fig. 8. In a master-slave circuit, two flip-flops operated by clock pulses of opposite polarity are connected in series in such a way that the output can change state only once for every complete clock cycle. In many such circuits, the master stage may respond to changes in the J and K inputs while the clock signal is in the high state, but the setting of the master is effectively "frozen" at the instant the clock goes low, and this stable state is transferred to the slave stage, which in turn drives the output terminals.

F. Binary Dividers and Counters

An important application for both D-type and J-K flip-flops is in binary frequency dividers and counters. As

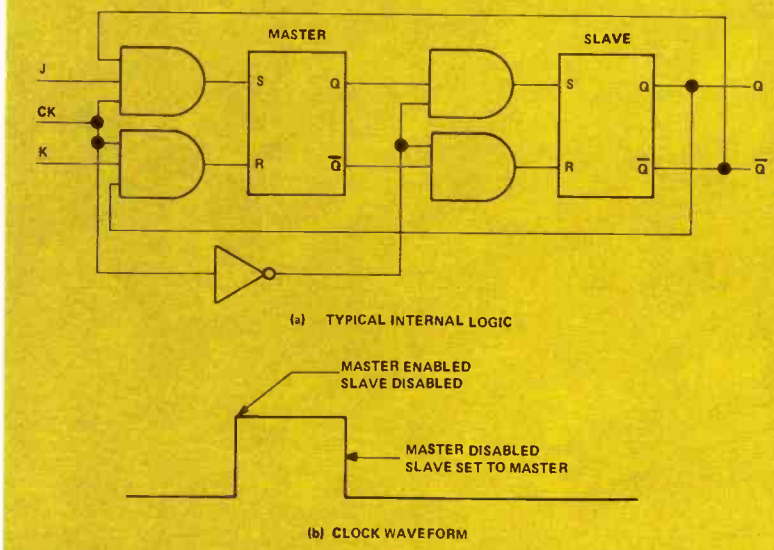


Fig. 8. Master-Slave Type of J-K Flip-Flop.

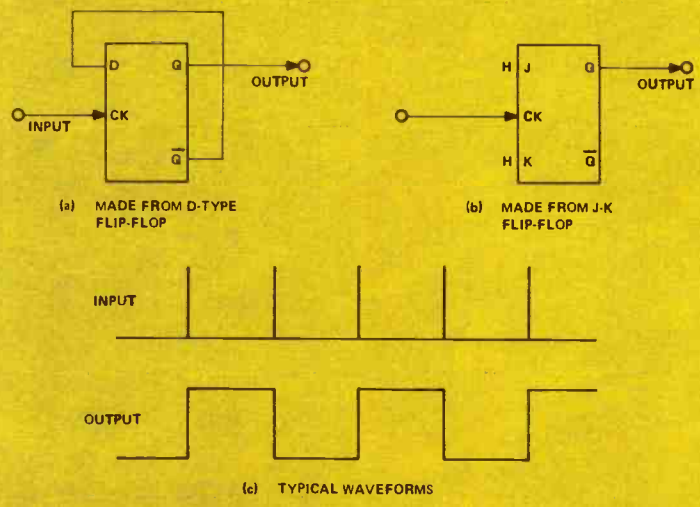


Fig. 9. Basic Binary Dividers on Single-Bit Counters.

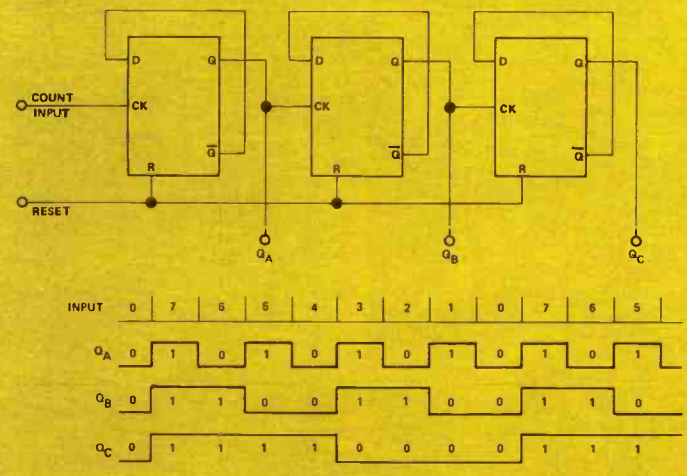


Fig. 10. 3-Bit Binary Down-Counter of Ripple-Through Type.

shown in Fig. 9 (a), a D-type flip-flop can be used as a counter if the $\overline{Q}$ output is connected to the D input. The arrival of each clock pulse will then cause the Q output terminal to go to the opposite logic state, and the output frequency will be one-half of the input frequency. (Caution: not every D-type flip-flop will work in this circuit because of the same oscillation hazard mentioned in connection with J-K flip-flops; the D-type circuit must employ either the master-slave principle or some technique to assure that triggering occurs only on the edges of clock pulses.) As an alternative to the D-type flip-flop in a binary divider application, a J-K flip-flop with both J and K inputs permanently HIGH may be employed, as shown in Fig. 9 (b). (A J-K flip-flop internally connected in this manner is sometimes designated a T or Toggle-type flip-flop.)

Groups of binary dividers may be interconnected to form multi-digit binary counters. If the Q terminal of each stage is coupled to the clock terminal of the following stage, the result is a down-counter as shown in Fig. 10. Output lines Q_A, Q_B and Q_C can be used to represent the 3 digits of a binary number, and direct-reset input terminals on the three stages can be connected to a common reset bus to force the number 000 to appear at the output. The first count pulse that appears after a reset condition forces Q_A to the HIGH state. The high-going edge in the signal from Q_A serves as a trigger for the second stage, and Q_B is also forced HIGH. The Q_B signal, in turn, clocks the third stage and forces Q_C to the HIGH state as well. This type of counter is sometimes called a "ripple through" counter because the precise instants of triggering the several stages are not the same (because of propagation delays)—in applications where these delays become troublesome, it is generally necessary to use more complex *synchronous* counters in which all stages are clocked simultaneously. The circuit of Fig. 10 is known as a down-counter because the effective number represented by the output signals jumps immediately from zero to the highest value that can be represented by the bits available (binary 111 or decimal 7 in the illustration), and then proceeds to count downward in numerical sequence until zero is reached once again. In the waveforms shown in Fig. 10, only stage A changed state at the second pulse because the *falling* edge in the Q_A signal is not of the proper polarity to trigger stage B. In

like manner, only the *rising* edges in the Q_B signal serve to trigger stage C. The frequencies of the three output signals are related to the input frequency by factors or 2, 4 and 8.

A familiar application of this type of counter in broadcast and teleproduction equipment is found in color bar generators—if signals Q_A, Q_B and Q_C are used to represent blue, red and green, respectively, the intervals identified in Fig. 10 as 7, 6, 5, 4, 3, 2, 1 and 0 will correspond to the familiar colors white, yellow, cyan, green, magenta, red, blue and black, respectively. In the color bar generator, the input signal which triggers the blue stage is derived from some type of start-stop oscillator which produces pulses of appropriate duration only during the active scanning portion of each television line.

If trigger signals for the successive stages of a multi-bit counter are derived from the Q terminals of the preceding stages (instead of the Q terminals), the result is a binary *up-counter*, as shown in Fig. 11. In this case, the first pulse after the reset condition takes only the first stage to its HIGH state, since the *falling* signal on the Q terminal is of the wrong polarity to trigger the second stage. Likewise, the third stage will ignore the high-to-low edges of the Q signal from the second stage, and will not enter the SET state until the fourth pulse after a reset condition. The net result is that the three output signals represent binary numbers whose decimal equivalents proceed in the conventional 0-1-2-3-4-5-6-7 sequence.

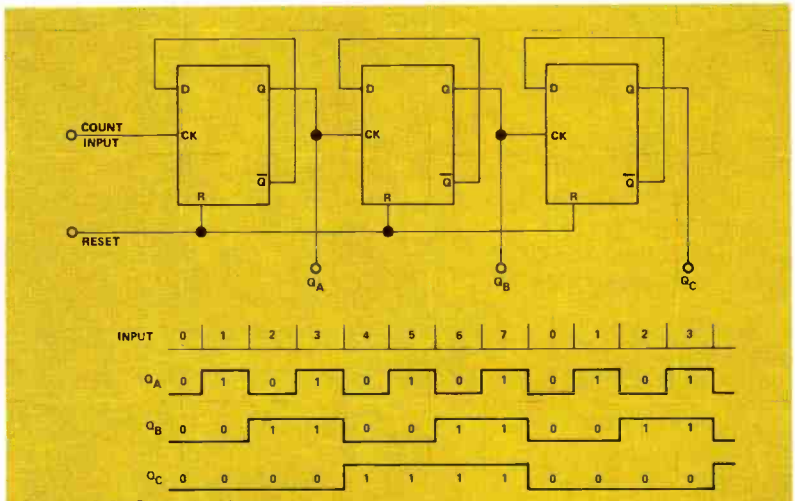


Fig. 11. 3-Bit Binary Up-Counter.

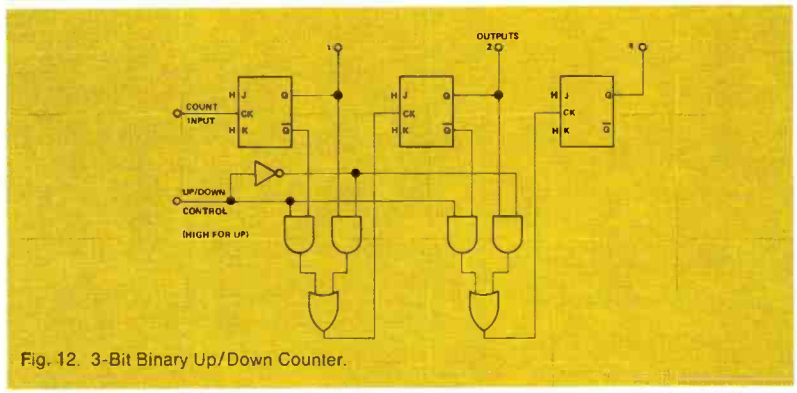


Fig. 12. 3-Bit Binary Up/Down Counter.

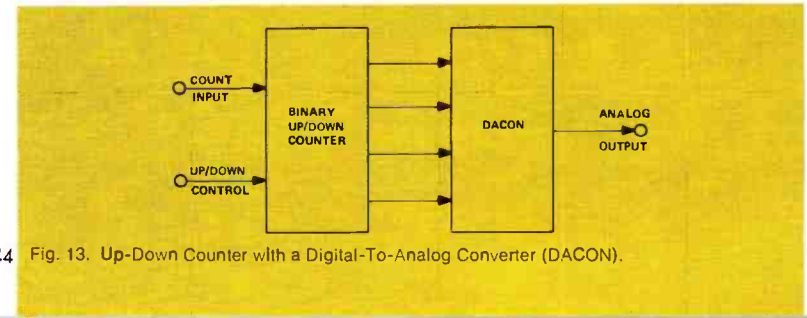


Fig. 13. Up-Down Counter with a Digital-To-Analog Converter (DACON).

G. Up-Down Counters and Digital-to-Analog Converters

The circuit shown in Fig. 12 employs a pair of *selector* circuits (as discussed in Part I of this series) to provide a choice of up-counting or down-counting action; the selectors determine whether the triggers for the second and third stages come from the Q or $\overline{Q}$ terminals of the preceding stages. (Note that the basic stages are of the J-K type rather than the D type.)

Up-down counters of this basic type can play several useful roles in teleproduction equipment. For example, the tape timer display in the RCA TR-600 video tape recorder uses an up-down counter coupled to a tape-driven tachometer to keep track of the flow of tape frames, counting *up* when the tape is moving forward and counting *down* when the tape is moving in a rewind mode. In the reel servo for the TCR-100 television cartridge recorder, an up-down counter is used in association with a tachometer on each supply reel to develop a binary number which represents how much tape has been removed from the supply reel. In the forward run mode, this binary number is used to control the torque applied to the takeup reel so that essentially constant tape tension can be maintained. In the rewind mode, the counter (now running downward) monitors the progress of the rewinding operation and makes possible the application of dynamic braking at an appropriate time a little before the "start of message" cue signal is encountered.

In many applications of binary counters, it is helpful to convert the binary numbers produced by the counter into analog voltages, using the general concept illustrated by Fig. 13. A counter can be effectively "frozen" at any given setting (by discontinuing the flow of input pulses), and this setting can be converted to a specific analog voltage through a *dacon* or digital-to-analog converter. This basic concept is at the heart of the automatic white level and automatic black level control circuits in many modern color television cameras (such as the RCA TK-45 and TK-46), and is also used in the time-base correction system for the TR-600 video tape recorder (where the timing errors between tape horizontal and reference horizontal sources are first converted to binary numbers by a counting process, then converted to analog voltages for control of electronically-variable delay lines).

The basic principle of a typical digital-

to-analog converter is shown in Fig. 14. The incoming digital signals are applied (through buffers, if necessary, depending upon the logic family employed) to a group of switching transistors. These switching transistors determine the amount of current drawn through the emitter of a common output transistor, which has a fixed bias of +5 volts on its base. The resistors in series with each of the switching transistors limit the currents to values which are proportional to the "weight" of each binary bit line. For example, if only the binary "1" line is HIGH at the input to its buffer, current I_T would be the same as current I_a, which would have a numerical value of approximately 5 volts divided by 4 kilohms, or 1.25 ma. (For simplicity, we shall ignore the slight drop across the emitter junction of the common transistor.) If the binary "2" line goes high, the current I_b drawn through the second transistor will have a value twice as great at I_a (or approximately 2.5 ma). Turning on the binary "4" line would permit I_c to assume a value of about 5 ma, and turning on the binary "8" line would permit I_d to assume a value of 10 ma. It should now be apparent that the total current I_T can assume any of 16 specific values (including zero) dependent on the logic states of the binary input lines, and this value will be proportional to the binary number represented by these lines. The analog current can be converted to an analog voltage by means of the 100-ohm resistor in the collector circuit of the output transistor. (An analog phase inverter may be needed if the *polarity* of the analog voltage is significant in a given application.) Higher resolution in the analog output voltage can be provided by increasing the number of binary lines in the digital portion of the system.

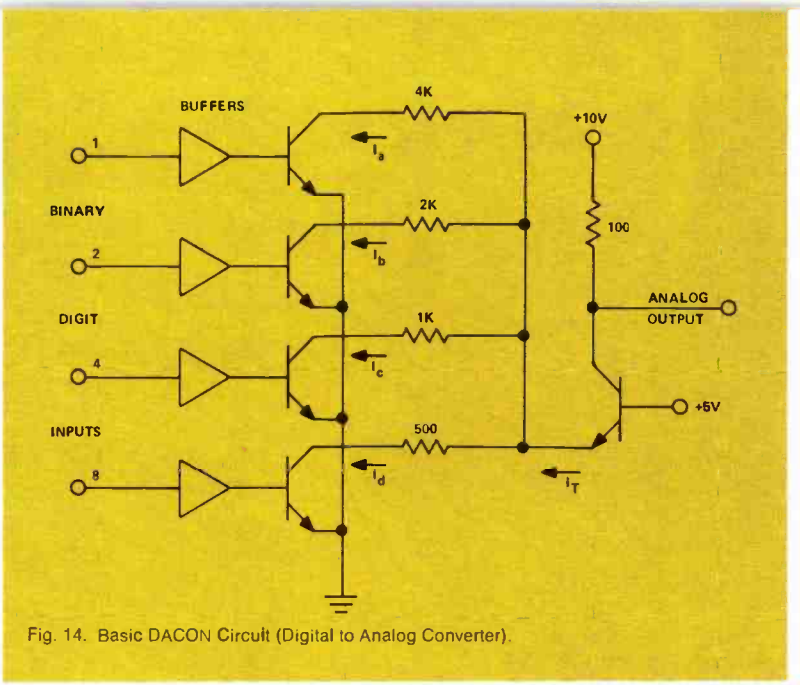


Fig. 14. Basic DACON Circuit (Digital to Analog Converter).

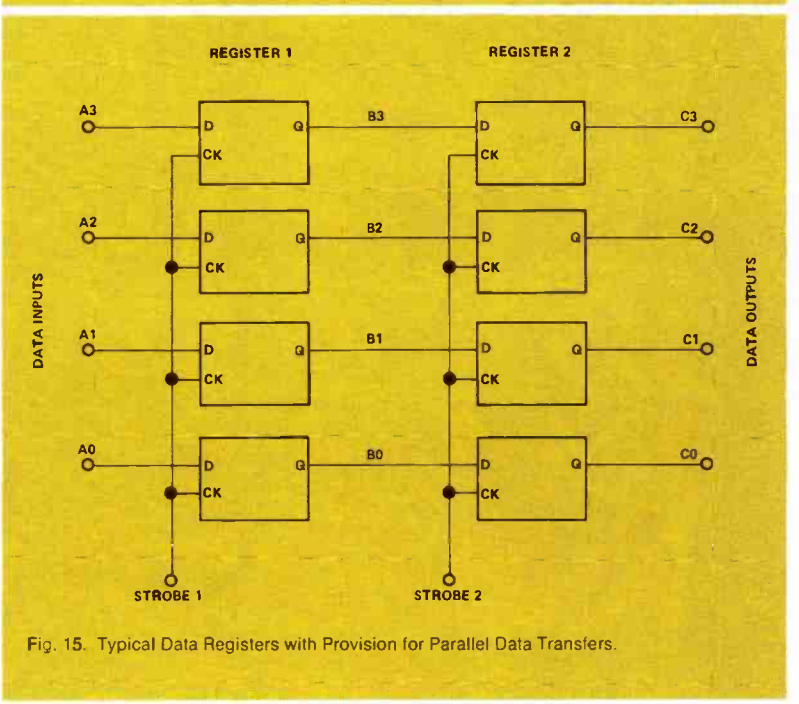


Fig. 15. Typical Data Registers with Provision for Parallel Data Transfers.

H. Registers

Flip-flops serve as the basic storage cells in *registers* used in many kinds of digital equipment for the temporary storage of both binary numbers and other types of binary-coded information (such as alphanumeric characters or instruction words for a computer). In principle, the electronic register is nothing more than an orderly group of flip-flops arranged for storing multiple binary digits. A typical arrangement of 4-bit registers with provision for transferring data between them is shown in Fig. 15. The clock inputs for the several D-type flip-flops in each register are connected to a common strobe line, which can be pulsed at the proper instant to "seize" a group of binary digits on the D inputs. An arrangement very similar to this is used in the time-base corrector of the TR-600 to store binary-encoded error information for nominally one horizontal period to compensate for delays experienced by the video signal in the dropout compensation system. In this application, Strobe 1 is used to latch the error information developed in a counter shortly after the measurement is complete (so that the counter can be reset in preparation for the next measurement interval), and Strobe 2 is timed so that the error information is fed out to the electronically-variable delay line (via a dacon) just in time to control the video which reaches the delay line through a separate path.

The registers in more complex digital equipment (such as microprocessors and related microcomputer systems) are usually interconnected through a *universal data bus*, using a concept similar to that of the "party line" in telephone systems. This concept is illustrated in Fig. 16, which shows a group of four registers with all inputs and outputs for a given bit position connected to the same bus. The output stages of the flip-flops used in such

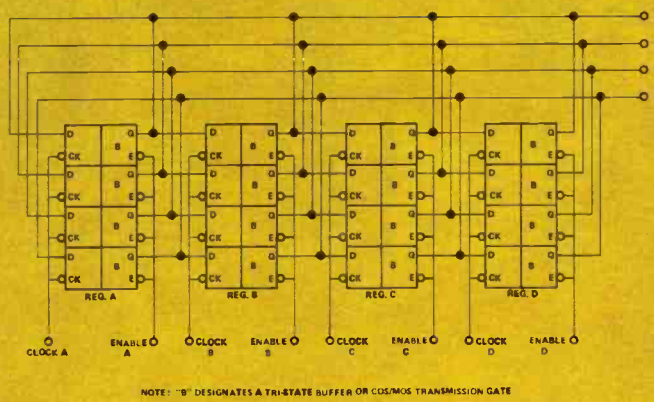


Fig. 16. Universal Data Bus ("Party Line") Arrangement for the Transfer of Data among Multiple Registers.

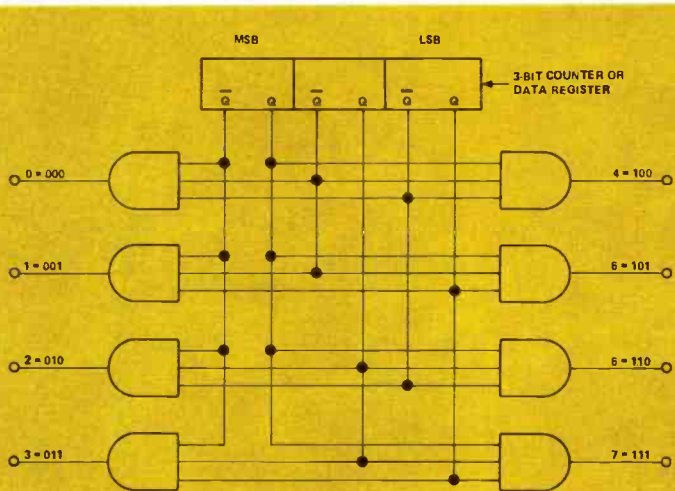


Fig. 17. Decoder for 3-Bit Words.

"party line" applications must be equipped with either tri-state buffers (in the TTL logic family) or transmission gates (in the COS/MOS family) so that there is never more than one register *controlling* the logic levels on the bus at any given time. As pointed out in Part II of this series, tri-state buffers and transmission gates provide alternative means of allowing output terminals to "float" in a high-impedance condition when the output is not deliberately set to either a LOW or HIGH state. If only one of the ENABLE lines is operated at a time in the arrangement of Fig. 16, there will be no ambiguity about the digital "word" transmitted on the universal bus. Any register which is to *receive* the information must have its clock line asserted at a time when the intended message is present on the universal data bus—simultaneous operation of two or more clock lines is acceptable, since the "loading" of the bus is not significantly affected by the clock lines.

I. Decoders

In many applications involving multi-digit binary "words", is is necessary to *decode* sets of bit lines to determine when specific numbers or other binary codes are present. For example, in multi-machine video tape editing systems, each machine is assigned an "address" in binary-coded form and must be able to recognize its own address so that it can be prepared for action at appropriate times. The basic principle involved in binary decoders is shown in Fig. 17, which shows a logic arrangement suitable for the full decoding of all eight code combinations provided by three binary digits. Three-input AND gates can be connected to the Q and $\bar{Q}$ terminals of three flip-flops storing the binary digits in such a way that only one AND gate will respond to each code combination. Note that the three flip-flops are arranged with the most-significant bit (MSB) on the left and the least-significant bit (LSB) on the right. If the flip-flops are configured as the three stages of a binary counter, the eight outputs shown in Fig. 17 form an effective *commutator*—each will be HIGH for one period in the divide-by-eight counting sequence. Full decoders for sets of three or four binary digits are readily available as integrated-circuit packages, and larger-scale decoders based on the same principle are incorporated in many semiconductor memory "chips" to accomplish decoding of binary address lines.

Combinations of counters and decoders may be used to accomplish counting operations involving numbers outside the conventional binary series (1, 2, 4, 8, 16, 32, etc.). To arrange a circuit to count by any arbitrary number (such as 23, for example), one can always set up a binary counter with sufficient bits to reach a higher number, then use a decoder to identify the desired count. When the decoder output appears, it can be applied to a direct-reset bus to force all counter stages back to the zero condition, thereby restarting the count cycle. (There are also other ways of achieving odd-number counts with flip-flops, but a full discussion of these techniques is beyond the scope of this introductory paper.)

J. Shift Registers

An interesting and significant variation of the basic register is the *shift register*, an arrangement in which a group of flip-flops are connected in series in such a way that binary digits can be transferred without change of logic state from one stage to the next. The flip-flops used in shift registers may be of the S-R, D or J-K types. Shift registers are occasionally used as *serial-access* memories (as contrasted to *random-access* memories), but their most common applications are in *serial-to-parallel* and *parallel-to-serial* conversions. A typical shift-register arrangements to accomplish serial-in, parallel-out (SIPO) conversions is shown in Fig. 18. Note that all stages are clocked simultaneously, but the data input for each stage is the Q output of the previous stage. A particular bit of data applied to the data input of the left-hand stage is moved one

stage at a time by successive clock pulses. When enough bits have been fed into the circuit to represent a complete binary "word" (4 bits in the case illustrated), an OUTPUT STROBE pulse can be applied to transmit that word on a parallel basis to an external 4-bit register or to some other destination. In some applications, gates A, B, C and D may be replaced by tri-state buffers or COS/MOS transmission gates. An optional serial output can be derived from the Q terminal of the final stage.

Another shift register in a typical parallel-in, serial-out (PISO) configuration is shown in Fig. 19. In this instance, the data inputs for each of the four stages are connected through digital selector circuits (discussed in detail in Part I of this series) to either the Q terminals of preceding stages or to the parallel input lines. The clock terminals are driven either by an INPUT STROBE signal (which must coincide with the presence of valid data on the parallel input lines) or by the SHIFT CLOCK pulses which cause the data to be transmitted one stage at a time down the register. Circuits of this general type are commonly used to operate teletypewriters connected to computer systems through single pairs of wires.

K. Ring Counters

As our final illustration in this introductory review of flip-flops and their applications, let us consider the *ring counter* shown in Fig. 20. The ring counter is a close relative of the shift register, formed by the simple expedient of connecting the output terminals back to the input terminals. In the example shown in Fig. 20, the flip-flops are of the J-K type, and the Q and Q terminals of each stage are directly connected to the J and K terminals, respectively, of the following stage. This arrangement assures that the arrival of each clock pulse will cause each stage to assume the previous setting of the stage immediately to its left. The extreme left-hand stage will, of course, assume the previous setting of the extreme right-hand stage. In many applications of ring counters, some type of INITIAL SET bus is provided to establish a known starting condition. (This is sometimes implemented in conjunction with a "power on reset" bus so that it happens automatically when power is first applied.) For the example shown in Fig. 20, the INITIAL SET bus has been arranged so that HIGH to the INITIAL SET input will cause Output A to go to the HIGH state and all other outputs to go to the LOW state. Clock pulses will then cause the HIGH state to be propagated around and around the closed register, providing a commutator-like action on the five output terminals. The *frequency* of the signal at each output terminal will be one-fifth that of the clock. □

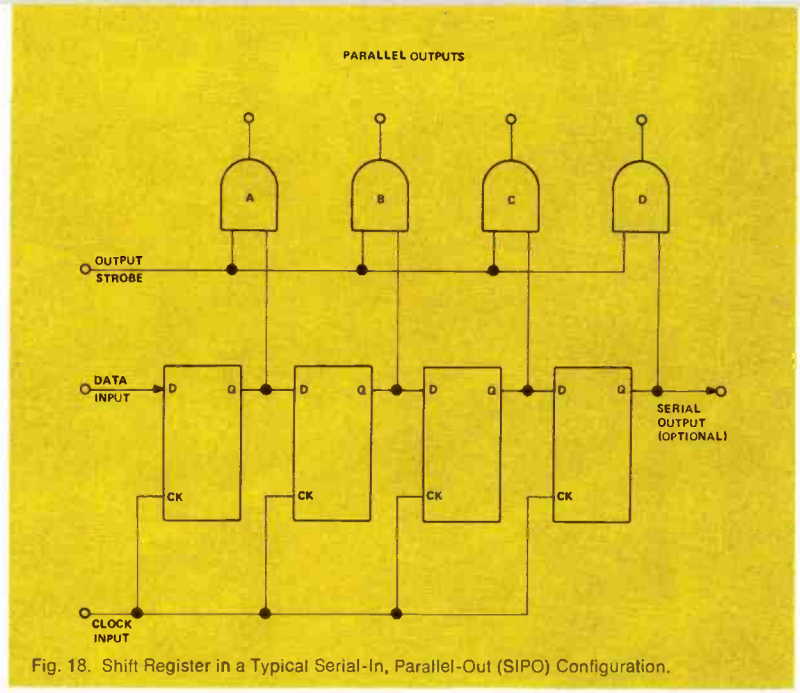


Fig. 18. Shift Register in a Typical Serial-In, Parallel-Out (SIPO) Configuration.

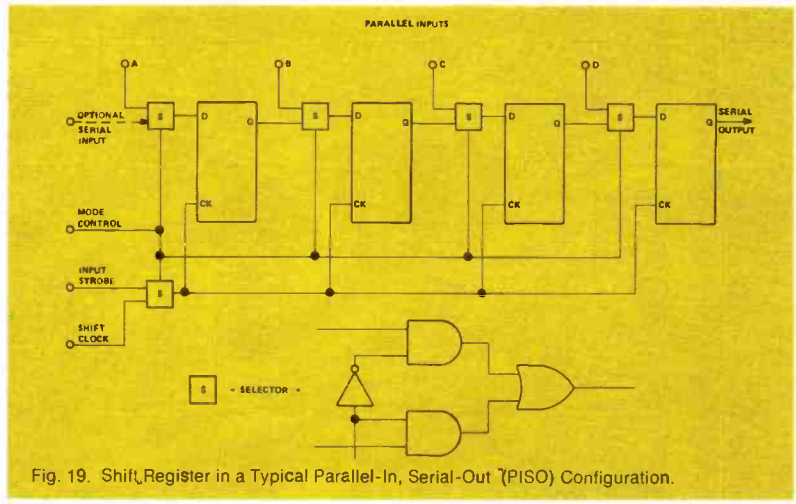


Fig. 19. Shift Register in a Typical Parallel-In, Serial-Out (PISO) Configuration.

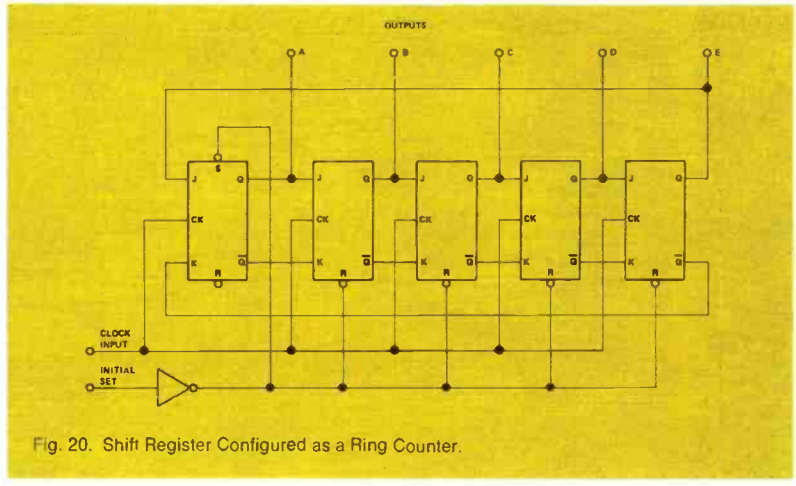


Fig. 20. Shift Register Configured as a Ring Counter.

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The video sampling is at four times subcarrier frequency, resulting in "superhighband" video performance which translates into excellent picture quality.

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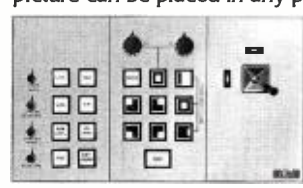
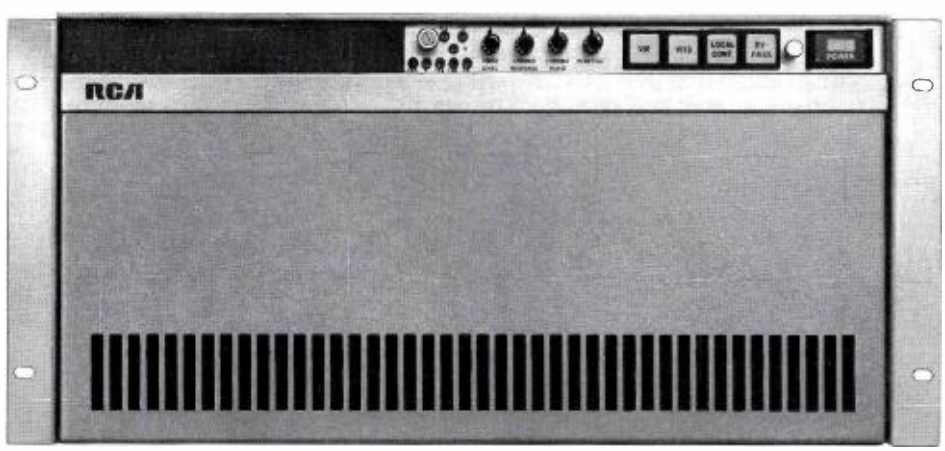
A production tool, too. Freeze frame and picture compression add new performance dimensions. With these options, the TFS-121 is far more than a synchronizer—it's a valuable production aid. Consider freeze frame. With it, you can present a still picture, up-date it at the push of a button, or create strobe-like effects such as "animation". Stop the action whenever you want, or at a rate you can vary.

Picture compression on the TFS-121 opens a whole new range of production possibilities. The full-size picture is reduced to ¼ size and can be positioned in any raster quadrant or in any desired pre-set position on the screen. With joystick control, the compressed picture can be placed in any part of the raster, or can be made to slide on and off anywhere. (The joystick control can also be used to move the full-size picture on and off the raster in any direction.)



How to be convinced. The TFS-121 Synchronizer is ready now. You can investigate the many benefits of this new RCA-developed product by contacting your RCA representative. The facts about the TFS-121 can be convincing.



RCA Broadcast Systems

TR-600A: first and only quad VTR with an editor's heart.

The new TR-600A is great VTR with a dramatic "first": AE-600, an integral on-line Time Code Editing option with built-in microprocessor control. The TR-600A with AE-600 is an editing system capable of operating one record and up to 8 playback TR-600A VTRs, plus three other sources.

More quad per dollar.

A great basic quad VTR is the best foundation for a good editor. The TR-600A has all-modular electronics. Includes desirable features that cost up to $20,000 to add to other VTRs. Offers a raft of options, including Super Highband/Pilot Tone for automatic picture correction. All housed in a cabinet that fits in 7 sq. ft. of van or studio floor. All at a surprisingly low price.

For the convincing story of the TR-600A, see your RCA Representative.

RCA

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